BRX

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PLC HARDWARE USER MANUAL

Do-more DRIVEN



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BX-USER-M

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BRX Do-more! Platform



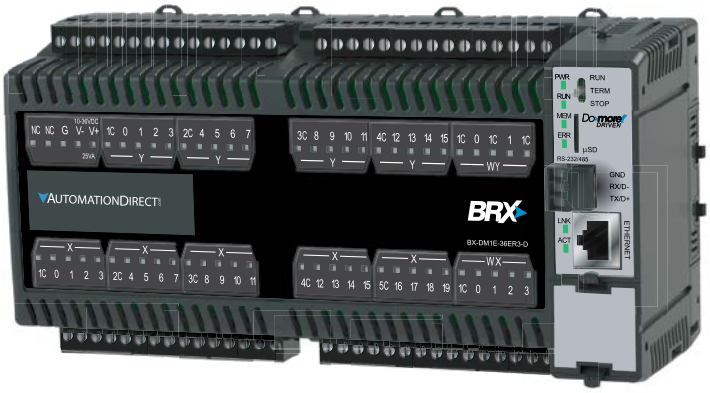
10-Point Unit



18-Point Unit



No Onboard I/O Unit



36-Point Unit

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Notes:

Do-more! BRX Hardware Manual

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Issue: 4th Edition, Rev. Q
Issue Date: 04/2025

Publication History		
Issue	**Date**	**Description of Changes**
1st Edition	02/2017	Original
1st Edition, Rev A	03/2017	Made minor corrections throughout the manual.
2nd Edition	09/2017	Added Analog I/O Expansion Modules. Updated BX-P-ECOMLT specifications. Made minor corrections throughout the manual.
3rd Edition	05/2018	Added Analog I/O Expansion Modules , Discrete I/O Expansion Modules and Remote I/O Controllers. Reformated manual page size. Made minor corrections throughout the manual.
3rd Edition, Rev A	10/2018	Corrected nominal input voltages. Updated EU Directives. Other minor corrections.
4th Edition	03/2019	Added HSIO and SERIO specialty modules. Expanded Motion Control, Serial and Ethernet Communications chapters Moved Do-more! Designer software chapter to separate Getting Started Guide. Corrected discrete I/O switching frequencies. Other minor corrections.
4th Edition, Rev A	06/2019	Added 16-pt and Combination Input/Output Analog I/O Expansion Modules. Other minor corrections.
4th Edition, Rev B	09/2019	Clarified need to test 'Data Not Valid' flag prior to reading to or writing from analog modules.
4th Edition, Rev C	03/2020	Added new analog expansion modules, serial expansion modules, padding module, and serial POMs. Error correction in Modbus registry tables.
4th Edition, Rev D	06/2020	Modified RS-232 wiring example on page 12-10.
4th Edition, Rev E	12/2020	Added new discrete and high-speed I/O expansion modules.
4th Edition, Rev F	02/2021	Clarified internal biasing for failsafe operation on RS-485 ports.
4th Edition, Rev G	09/2021	Clarified horizontal mounting clearances to adjacent wire ducts. BX-HSIO-4 input/output types changed to High Speed TTL Differential or Single Ended.
4th Edition, Rev H	11/2021	Updated BX-HSIO-4 to SureServo/SureStep wiring diagrams.
4th Edition, Rev I	12/2021	Added BX-HSIO-4 to Sourcing Input Device with Internal Power Supply wiring diagrams.
4th Edition, Rev J	04/2022	Clarified universal analog I/O modules require bipolar range selection for 16-bit resolution.
4th Edition, Rev K	12/2022	Replaced Type 1 fonts.
4th Edition, Rev L	02/2024	Updated BX-06RTD All Channel Update Rate.
4th Edition, Rev M	03/2024	Added BX-HSIO4 to Single-Ended Encoder wiring diagram.
4th Edition, Rev N	07/2024	Added EtherNet/IP Implicit messaging.
4th Edition, Rev O	10/2024	Clarified embedded web server security.
4th Edition, Rev P	01/2025	Replaced reference to part USB-RS232 with replacement part USB-RS232-1.
4th Edition, Rev Q	04/2025	Updated number of expansion modules allowed per MPU.

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Introduction: BRX Platform



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BRX Introduction

Purpose of this Manual

The hardware user manual provides information that will help you install, set up, program, troubleshoot, and maintain your BRX platform. The user manual also includes information that is critical to the safety of the personnel who will install and use the controller, and to the integrity of machinery, processes, and equipment controlled by the BRX Micro PLC Unit (MPU).

The manual also includes important information about power and signal wiring, mounting of the BRX MPU, and configuring the BRX MPU system.

About Getting Started

If you are familiar with programmable controllers in general, then following the simple steps in this manual may be all you require to start being productive using a BRX Do-more! MPU system. After you have completed the steps, your BRX MPU will be running the ladder logic project that you programmed.

Online Help Files and Other Documentation

BRX Do-more! Designer programming software is available as a download from our website. Please see the Do-more! Designer Software Getting Started Guide (DMD-GSG-M) for help on installation and usage of the software.

See http://support.automationdirect.com/products/domore.html.

The Do-more! Designer software includes researchable online help topics covering all aspects of the software, instruction set, module setup, and communications.

In addition, each BRX MPU, I/O expansion module and Pluggable Option Module (POM) module ships with an insert document containing technical data and installation instructions.

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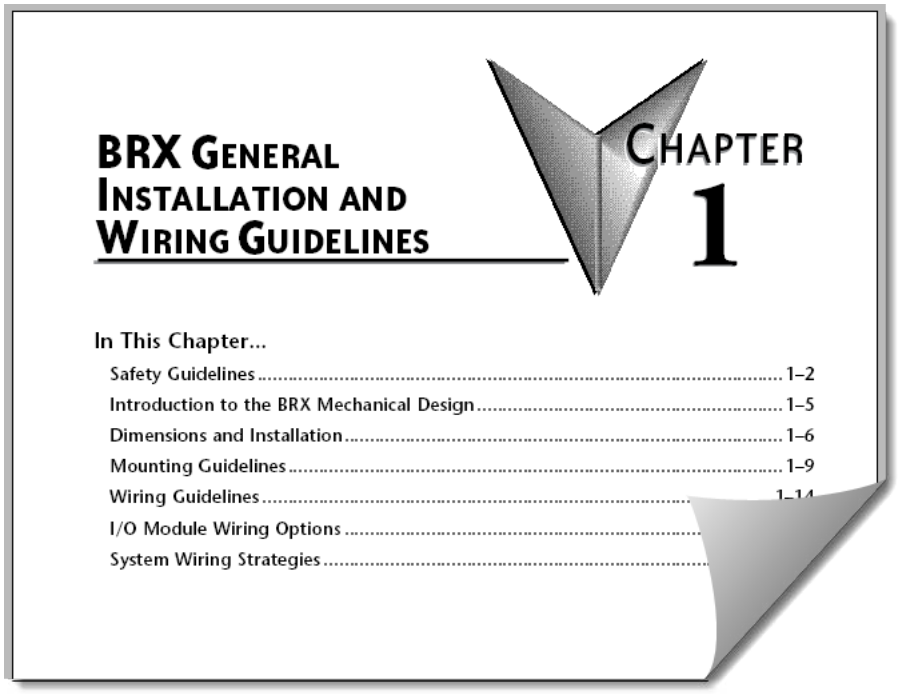
Conventions Used

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Key Topics for Each Chapter

The beginning of each chapter will list the key topics that can be found in that chapter.



BRX General Installation and Wiring Guidelines

Chapter 1

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Dimensions and Installation 1–6
Mounting Guidelines 1–9
Wiring Guidelines 1–14
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System Wiring Strategies .....

BRX Overview

The BRX platform is a very versatile modular Micro PLC system that combines powerful features in a compact, standalone footprint. The BRX platform is designed to be used as a standalone controller or can be expanded using a wide variety of expansion modules that easily snap onto the side of any BRX Micro PLC Unit (MPU) creating a sturdy and rugged PLC platform. The foundation of the platform consists of 4 unique MPU form factors that provide for a strong system design to fit your application requirements precisely while keeping the cost of the system to a minimum. Shown below are the four unique Micro PLC form factors.



BX ME
No Built-In I/O
Ethernet Port



BX 10
10 Discrete I/O
No Analog I/O
No Ethernet Port



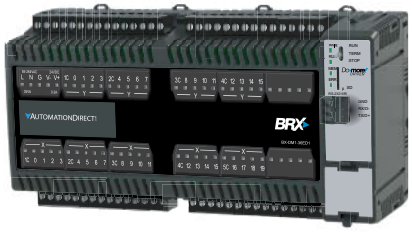
BX 10E
10 Discrete I/O
2 Analog I/O
Ethernet Port



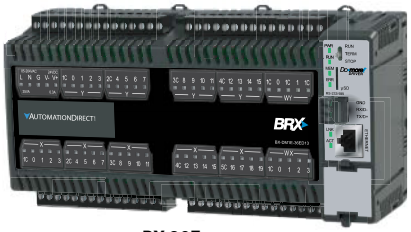
BX 18
18 Discrete I/O
No Analog I/O
No Ethernet Port



BX 18E
18 Discrete I/O
2 Analog I/O
Ethernet Port



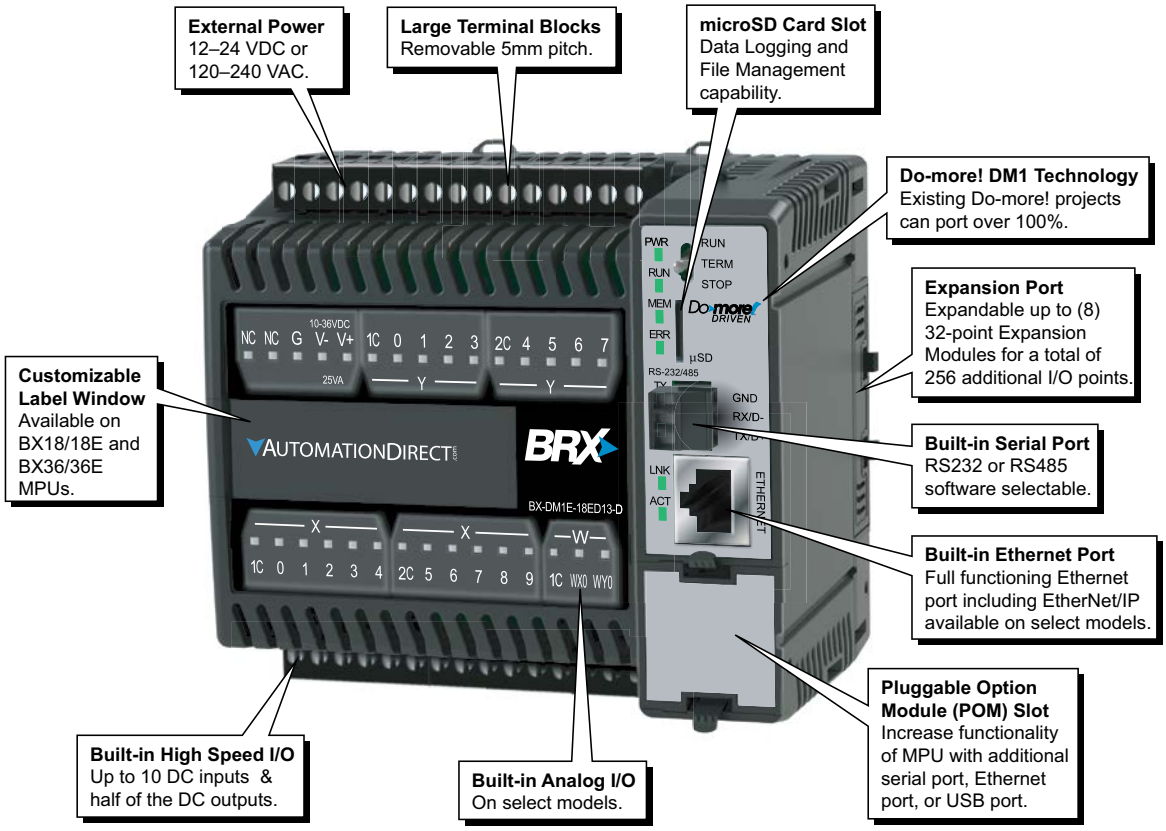
BX 36
36 Discrete I/O
No Analog I/O
No Ethernet Port



BX 36E
36 Discrete I/O
6 Analog I/O
Ethernet Port

BRX Platform

Below is a quick look at some of the standard features available on the BRX Platform.



The BRX platform allows you to choose from various communications ports. All BRX MPU models have a built-in RS232/485 (software-selectable) serial port. However, an RJ45 Ethernet port (10/100Mbps) is provided on select units. With support for EtherNet/IP, Modbus TCP, Modbus RTU, ASCII, K-sequence (DirectLOGIC users) and custom protocols, the BRX MPU platform provides supreme versatility for any application. In addition, all BRX MPUs have an extra plug-in slot that allows for additional user-selected communications port. These optional communications ports are called Pluggable Option Modules (POMs) and are available in 3-pin serial RS232, RJ12 serial RS232, 5-pin RS232, 5-pin RS422, 3-pin serial RS485, USB and Ethernet versions. Simply choose the extra port you want, plug it in and go.

BRX hardware is built to last and is engineered, assembled and supported right here in America; designed and fabricated by industrial automation veterans with hardware facilities in Tennessee and Florida. The compact modular architecture results in an outstanding controller package, with high performance, a small footprint, at a very low cost. The BRX platform is an extremely versatile modular system that you can customize to your specific controller needs. BRX has four distinct form factors, built-in high-speed I/O, motion control, an interchangeable communications port, on-board analog I/O, and many I/O expansion modules from which to choose. The BRX MPU platform allows you to build the ideal controller for your application that delivers the quality and reliability you expect at an unexpectedly lower cost.

FREE, fully-functional Do-more! Designer programming software was developed to be powerful, flexible and easy to use. The user-friendly, fill-in-the-blank software design makes complex operations like PID and motion control a cinch. It is available to download online whenever you choose, as often as you'd like. Take it for a spin or start your project immediately, there are never any licensing fees or service charges.

User Manual Layout

This BRX user manual is intended to be used as a reference manual for the BRX hardware. It is laid out into 3 sections as follows:

Installation, Wiring and Specifications

- Chapter 1: General Installation and Wiring Guidelines
- Chapter 2: BX ME Wiring
- Chapter 3: BX 10/10E Wiring
- Chapter 4: BX 18/18E Wiring
- Chapter 5: BX 36/36E Wiring
- Chapter 6: BRX Pluggable Option Module (POM)
- Chapter 7: BRX Digital I/O Expansion Modules
- Chapter 8: BRX Analog I/O Expansion Modules
- Chapter 9: BRX Motion Control, Communications & Specialty Expansion Modules

Programming and Software

- Chapter 10: BRX Do-more! CPU Specifications
- Chapter 11: BRX Do-more! Motion Control and High-speed I/O
- Chapter 12: BRX Do-more! Serial Communications
- Chapter 13: BRX Do-more! Ethernet Communications
- Chapter 14: BRX Remote I/O: BX-DMIO, BX-EBC100 & GS-EDRV100
- Chapter 15: BX-MBIO Modbus I/O Controller

Maintenance and Troubleshooting

- Appendix A: BRX Do-more! Maintenance and Troubleshooting
- Appendix B: EU Directives
- Appendix C: BRX MPU Power Budgeting
- Appendix D: Error Codes and System Locations
- Appendix E: NetEdit—Ethernet Setup Utility for HOST Automation Products
- Appendix F: Tips and Tricks
- Appendix G: Online Resources

General Installation and Wiring Guidelines



In This Chapter...

Safety Guidelines....1-2
Introduction to the BRX Mechanical Design....1-5
Dimensions and Installation....1-6
Mounting Guidelines....1-10
Wiring Guidelines....1-15
I/O Module Wiring Options....1-24
System Wiring Strategies....1-26

Safety Guidelines



NOTE: *Products with CE marks perform their required functions safely and adhere to relevant standards as specified by CE directives provided they are used according to their intended purpose and that the instructions in this manual are adhered to. The protection provided by the equipment may be impaired if this equipment is used in a manner not specified in this manual. A listing of our international affiliates is available on our Web site at https://www.AutomationDirect.com.*



WARNING: Providing a safe operating environment for personnel and equipment is your responsibility and should be your primary goal during system planning and installation. Automation systems can fail and may result in situations that can cause serious injury to personnel or damage to equipment. Do not rely on the automation system alone to provide a safe operating environment. You should use external electromechanical devices, such as relays or limit switches, that are independent of the MPU application to provide protection for any part of the system that may cause personal injury or damage. Every automation application is different, so there may be special requirements for your particular application. Make sure you follow all national, state, and local government requirements for the proper installation and use of your equipment.

Plan for Safety

The best way to provide a safe operating environment is to make personnel and equipment safety part of the planning process. You should examine every aspect of the system to determine which areas are critical to operator or machine safety. If you are not familiar with PLC system installation practices, or your company does not have established installation guidelines, you should obtain additional information from the following sources.

- NEMA — The National Electrical Manufacturers Association, located in Washington, D.C., publishes many different documents that discuss standards for industrial control systems. You can order these publications directly from NEMA. Some of these include:

  ICS 1, General Standards for Industrial Control and Systems
  ICS 3, Industrial Systems
  ICS 6, Enclosures for Industrial Control Systems

- NEC — The National Electrical Code provides regulations concerning the installation and use of various types of electrical equipment. Copies of the NEC Handbook can often be obtained from your local electrical equipment distributor or your local library.

- NFPA 70e — The National Fire Protection Associations document for electrical safety in workplaces. This can be obtained from the NFPA or other distributors and book stores.

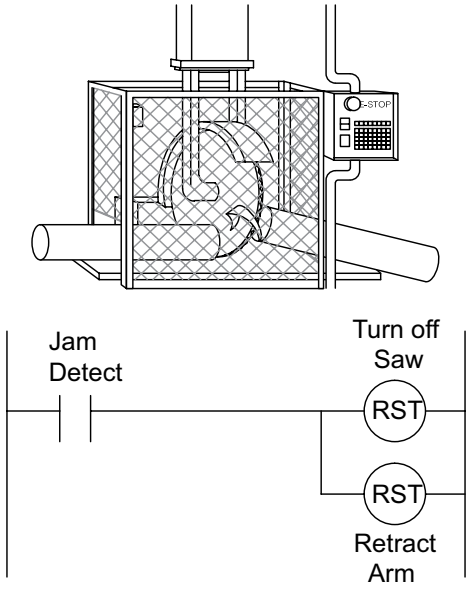
- Local and State Agencies — many local governments and state governments have additional requirements above and beyond those described in the NEC Handbook. Check with your local Electrical Inspector or Fire Marshall office for information.

Three Levels of Protection

WARNING: The control program must not be the only form of protection for any problems that may result in a risk of personal injury or equipment damage.

The publications mentioned provide many ideas and requirements for system safety. At a minimum, you should follow these regulations. Also, you should use the following techniques, which provide three levels of system control.

1. Orderly system shutdown sequence in the MPU control program.
2. Mechanical disconnect for output module power.
3. Emergency stop switch for disconnecting system power.



Orderly System Shutdown

The first level of fault detection is ideally the MPU control program in which you would identify any likely problems. Certain shutdown sequences should be performed. Some types of problems that are likely to occur are issues such as jammed parts or other process failures, that may not pose a risk of personal injury or equipment damage however, would need to be cleared prior to restarting the MPU control program.

System Power Disconnect

You should also use electromechanical devices, such as master control relays and/or limit switches, to prevent accidental equipment startup at an unexpected time. These safety devices should be installed in a manner that will prevent any machine operations from occurring where there maybe a possibility of injury to personnel or equipment.

For example, if the machine in the illustration above has a jammed part, the MPU control program can turn off the saw blade and retract the arbor. If the operator must open the guard to remove the part, you should also include a bypass switch that disconnects all system power any time the guard is opened.

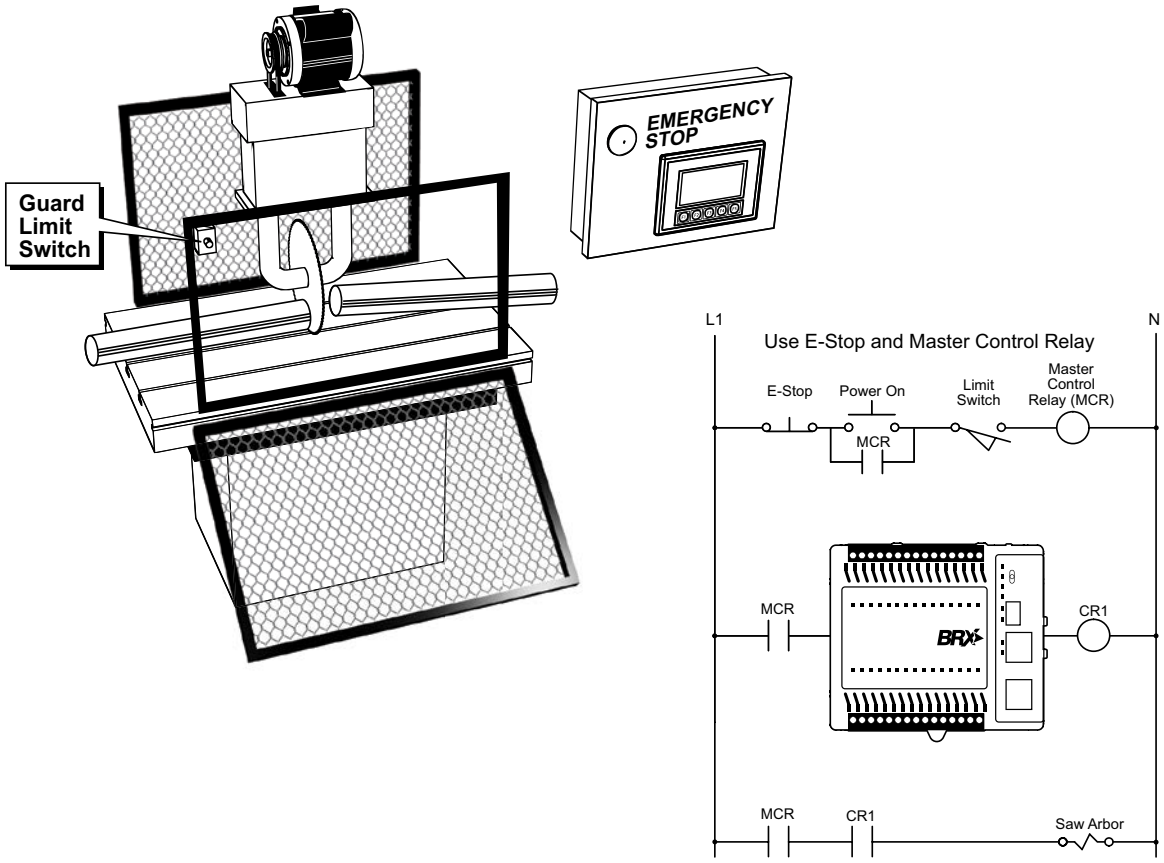
Emergency Stop Circuits

Emergency stop (E-Stop) circuits are a critical part of automation safety. For each machine controlled by an MPU, provide an E-Stop device that is hardwired external to the MPU and easily accessed by the machine operator.

E-stop devices are commonly hardwired through a master control relay (MCR) or a safety control relay (SCR) that will isolate power from the MPU I/O system in an emergency.

MCRs and SCRs provide a convenient means for removing power from the I/O system during an emergency situation. By de-energizing an MCR (or SCR) coil, power to the input (optional) and output devices is removed. This event occurs when any emergency stop switch opens. However, the MPU continues to receive power and operate even though all its inputs and outputs are disabled.

The MCR circuit could be extended by placing an MPU fault relay (closed during normal MPU operation) in series with any other emergency stop conditions. This would cause the MCR circuit to drop the MPU I/O power in case of an MPU failure (memory error, I/O communications error, etc.).

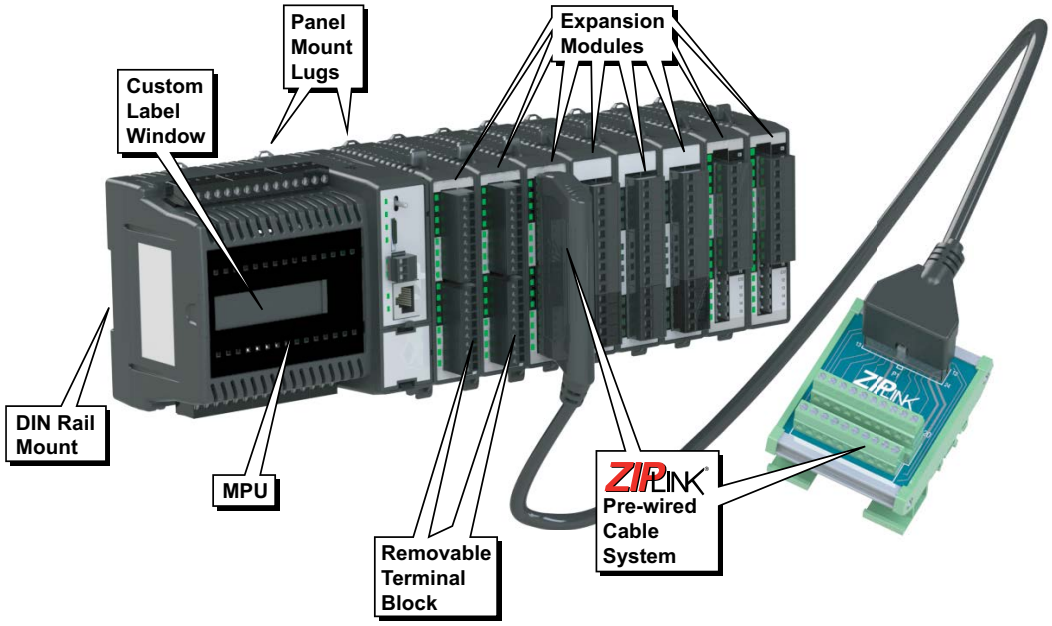


WARNING: For some applications, field device power may still be present on the terminal block even though the MPU is turned off. To minimize the risk of electrical shock, remove all field device power before you expose or remove MPU wiring.

Introduction to the BRX Mechanical Design

The BRX platform is designed to be used as a stand-alone controller or can be expanded. Using a combination of expansion modules, that simply snap on, you can create a sturdy and rugged PLC platform that can handle all your automation control applications.

Typical BRX Do-more! Platform System



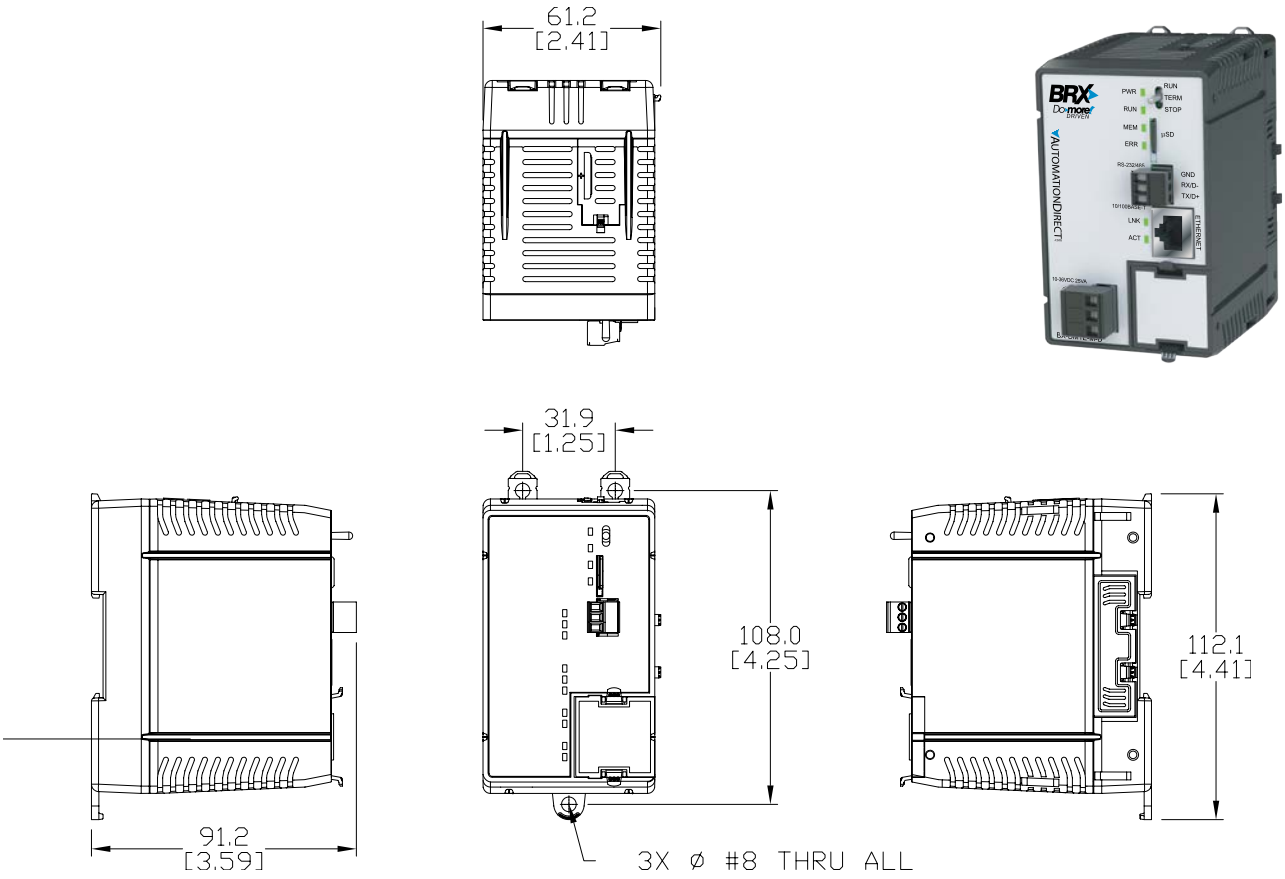
Dimensions and Installation

Before installing the BRX Micro PLC Unit (MPU) you will need to know the dimensions of the components considered. The diagrams on the following pages provide the nominal dimensions of each MPU series, Remote I/O and Expansion modules, which you can use when designing your enclosure. Remember to leave room for potential expansion to the right of the MPU or Remote I/O controller.

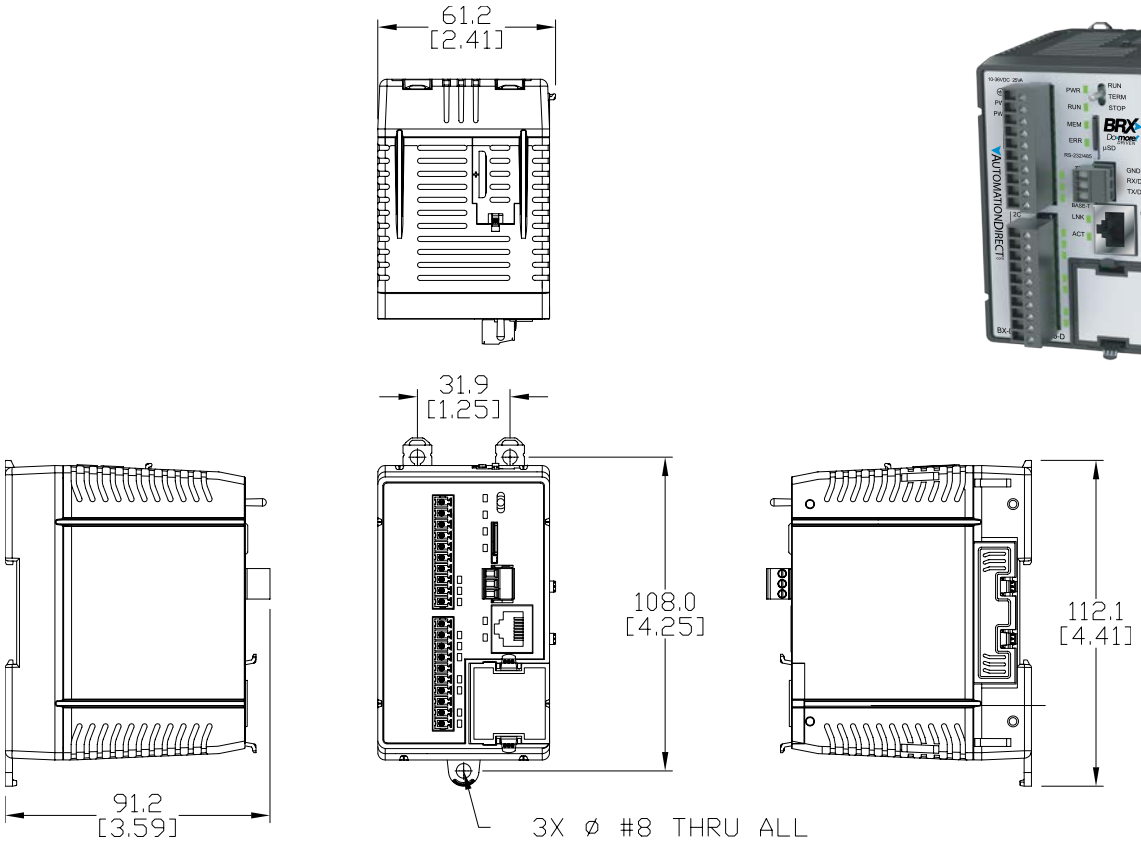
The height is the same for all components. The width varies depending on your choice of MPU and expansion modules. Allow adequate space to the right of MPU for mounting and dismounting additional Expansion modules. The BRX platform is designed to be mounted on standard 35mm DIN rail, or it can be surface mounted. Make sure you follow the installation guidelines for proper unit spacing.

NOTE: *Downloadable Dimensional drawings for MPUs, Remote I/O controllers and Expansion modules are available at AutomationDirect.com.*

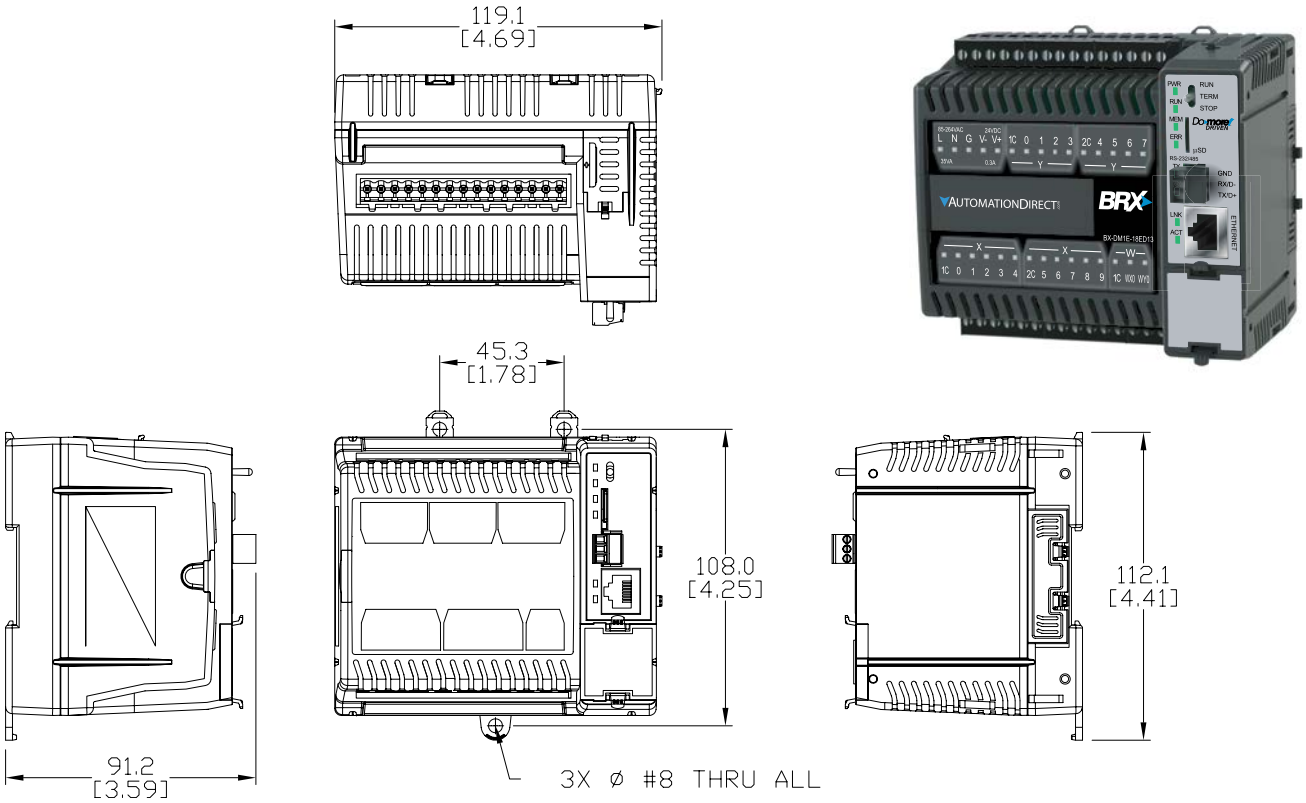
BX ME MPU Dimensions, mm[inch]



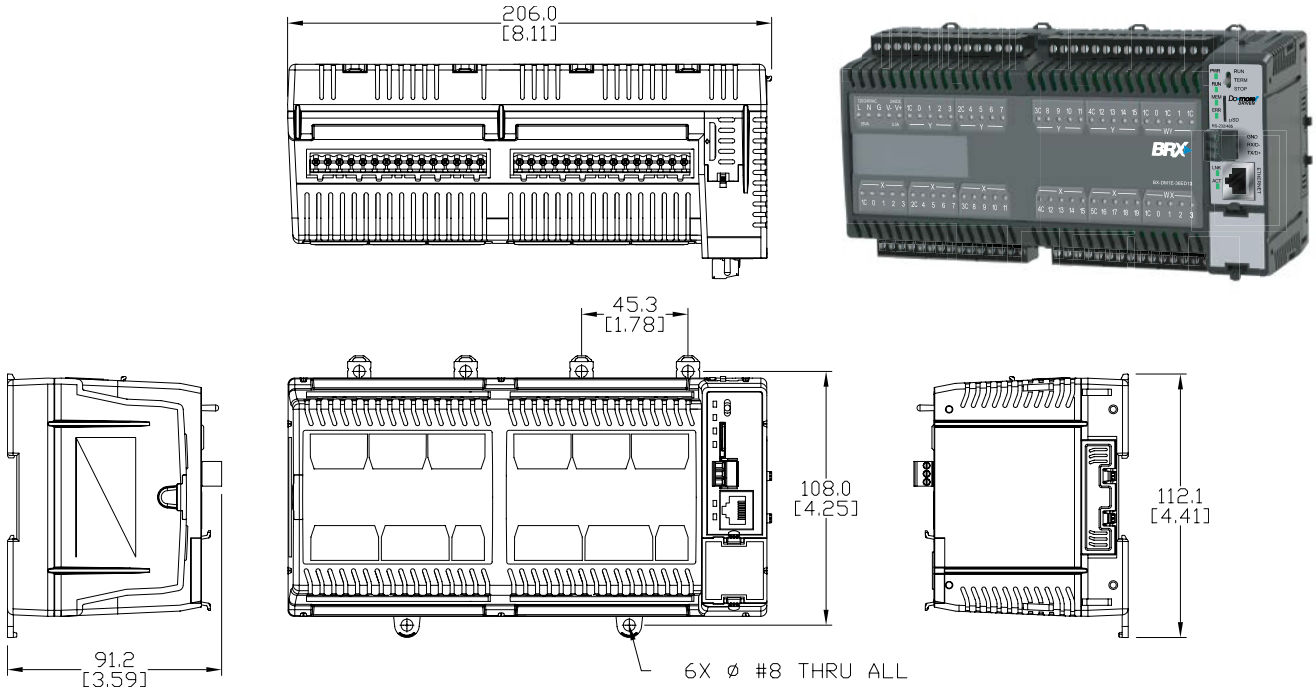
BX 10/10E MPU Dimensions, mm[inch]



BX 18/18E MPU Dimensions, mm[inch]

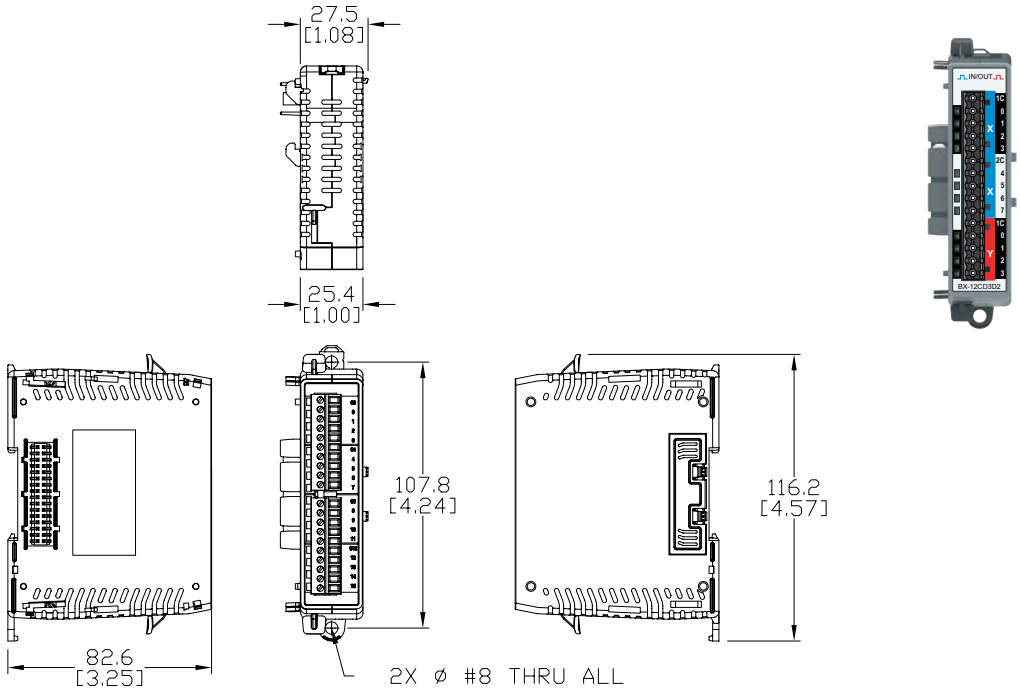


BX 36/36E Modules Dimensions, mm[inch]

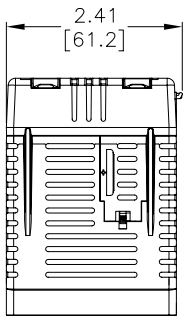


BRX Expansion Modules Dimensions, mm[inch]

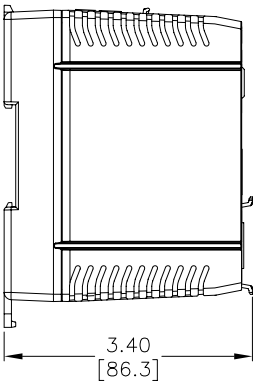
NOTE: *Allow a minimum of 45mm (1.75 in) to the right of MPU or Remote I/O chassis for mounting and dismounting Expansion modules.*

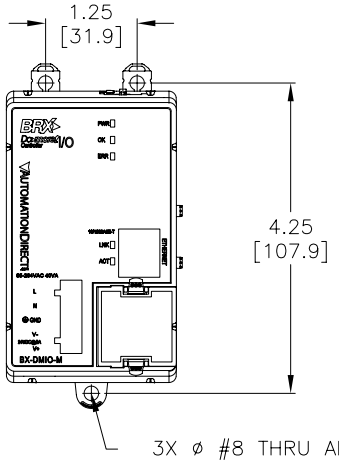


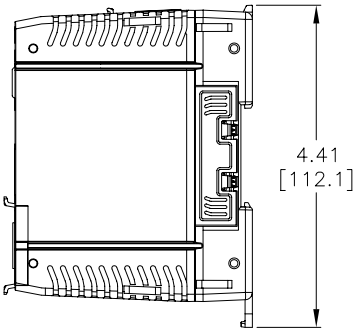
BX Remote I/O Controller Dimensions, mm[inch]











Mounting Guidelines

Enclosures

Your selection of a proper enclosure is important to ensure safe and proper operation of your BRX platform system. Applications for the BRX platform can vary and may require additional hardware considerations. The minimum considerations for enclosures include:

- Conformance to electrical standards
- Protection from the elements in an industrial environment
- Common ground reference
- Maintaining specified ambient temperature
- Access to the equipment
- Security or restricted access
- Sufficient space for proper installation and maintenance of the equipment

Mounting Position

Mount the BRX MPU horizontally, as shown in the illustration on the following page, to provide proper ventilation. Do not mount the BRX MPU vertically, upside down, or on a flat horizontal surface.

Mounting Clearances

Provide a minimum clearance of 2 inches (50mm) on all sides of the BRX MPU:

- Between the MPU and all sides of the enclosure.
- Between the MPU and enclosure door mounted operator panels and other door mounted items.
- Between the MPU and any wire duct.

Grounding

A good common ground reference (earth ground) is essential for proper operation of the BRX platform. One side of all control circuits, power circuits and the ground lead must be properly connected to earth ground by either installing a ground rod in close proximity to the enclosure or by connecting to the incoming power system ground. There must be a single-point ground (i.e. copper bus bar) for all devices in the enclosure that require an earth ground.



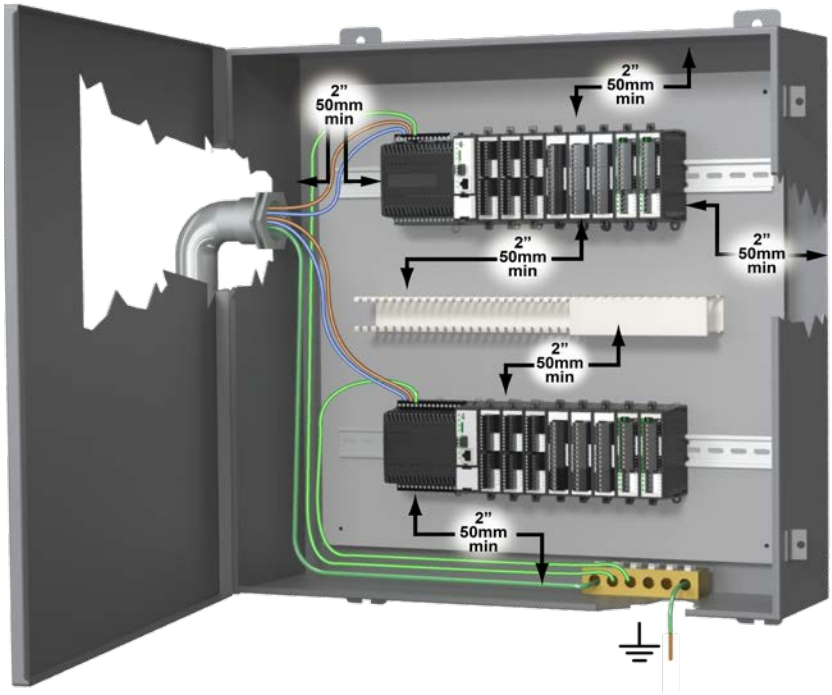
WARNING: The BRX System MUST have a proper earth ground. Do not operate the BRX MPU without proper earth grounding.

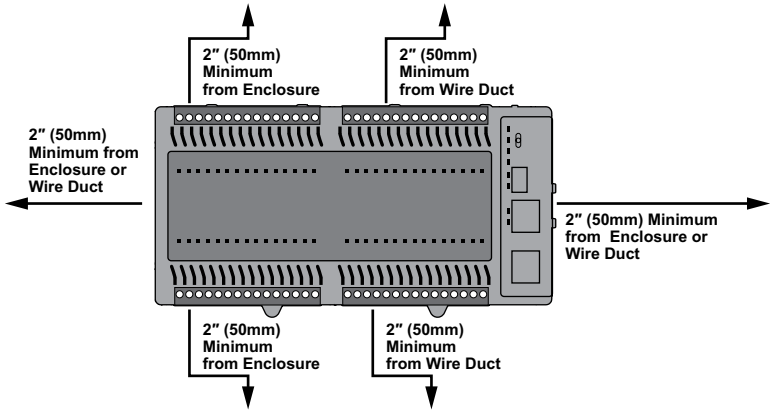
Temperature Considerations

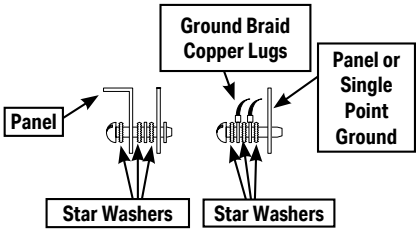
The BRX platform should be installed in an operating environment that complies with the equipment temperature specifications (Please review Chapter 11 for information about environmental specifications). If the enclosure temperature has the potential to fluctuate above or below the specifications, cooling or heating the enclosure should be considered.

Power Considerations

The BRX platform units have a wide range of DC or AC power supply options. Some require a 12–24 VDC power supply where others are capable of using 120–240 VAC power supply. The BRX platform requires the use of EMF/RFI line noise filters on the AC power supply to achieve CE certification. Please review the European Union (CE) material in Appendix B for more information.







NOTE: Removable terminal block kits and ***ZIP***Link wiring systems are sold separately. Detailed information is available in the BRX MPU Wiring chapters.

NOTE: Add 2" to mounting depth when using ***ZIP***Link cable.



In addition to the panel layout guidelines, other specifications can affect the installation of an MPU. Always consider the following:

- Environmental Specifications
- Power Requirements
- Agency Approvals
- Enclosure Selection and Component Dimensions

WARNING: Do not disconnect equipment unless power has been switched off or the area is known to be non–hazardous. Observe all Arc Flash safety precautions when working on electrical components.

Agency Approvals

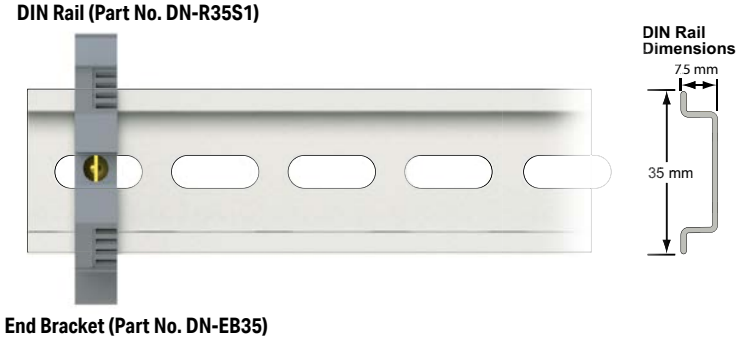
Some applications require agency approvals for particular components. The BRX platform agency approvals are listed below:

- UL (Underwriters' Laboratories, Inc.)
- CUL (Canadian Underwriters' Laboratories, Inc.)
- CE (European Economic Union)

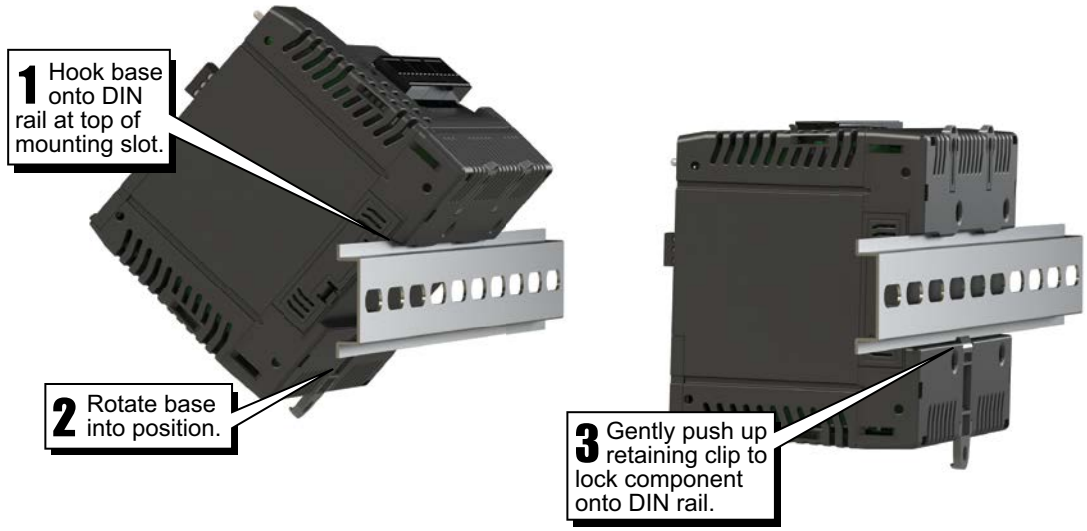
NOTE: *See the "EU Directives(CE)" in Appendix B in this manual for more information.*

Using DIN Rail Mounts

The BRX platform can be secured to the cabinet using DIN rails. Use DIN rail that conforms to DIN EN standard 50022. We offer a complete line of DIN rail and DIN rail mounted apparatus. These rails are approximately 35mm high, with a depth of 7.5 mm. If you mount the BRX MPU on a rail, you should also consider using end brackets on each side. The end brackets keep the BRX MPU from sliding horizontally along the rail. This minimizes the possibility of accidentally pulling connecting circuit wiring loose.

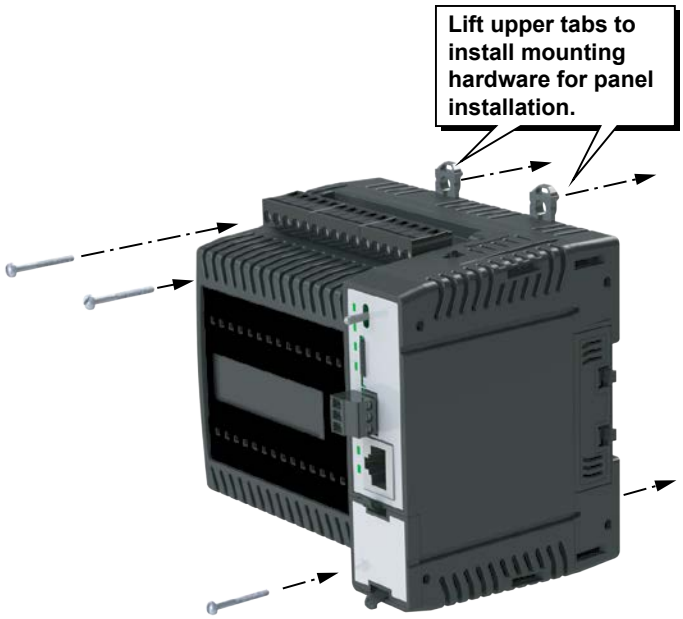


If you examine the bottom of the BRX MPU, you'll notice retaining clips. To secure to a DIN rail, hook the unit on to the DIN rail at the top of the mounting slot and gently press on the bottom of the unit until the unit snaps on to the DIN rail. The clips lock the BRX MPU onto the rail. To remove, pull down on the bottom retaining clips, slightly rotate the unit away from the DIN rail, lift the unit up off the DIN rail and pull it away from the rail.



Direct Panel Mount

The BRX MPU can be surface mounted directly to a panel. Along the back, top and bottom, of the BRX MPU you will find tabs with holes. Pull these out revealing mounting holes through which to screw down the BRX MPU to a panel, without the need for a DIN rail.



Installing the Expansion I/O Modules

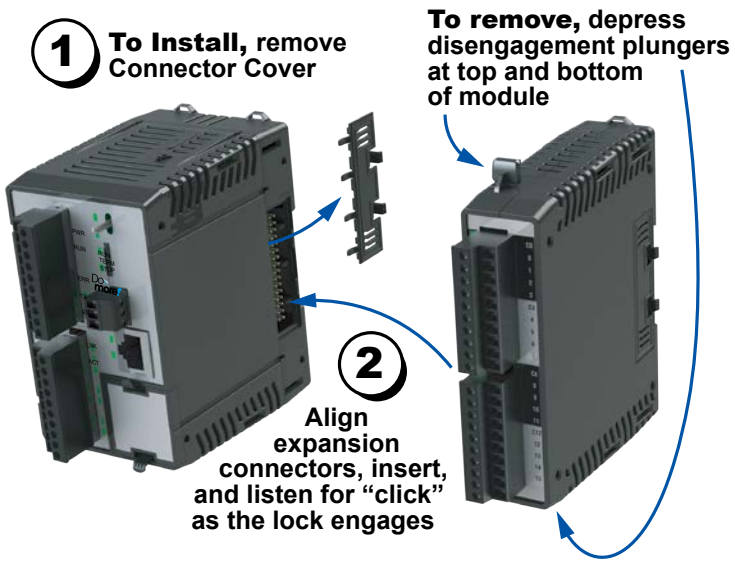
You can add additional I/O points to the BRX MPU by installing expansion I/O modules. Information on how many expansion modules are supported is found in the chapter associated with each of the BRX MPUs.

NOTE: *Allow a minimum of 45mm (1.75 in) to the right of MPU chassis or Expansion Modules for mounting and dismounting Expansion modules.*

Expansion modules are installed to the right of the BRX MPU. Before installing the module, be sure the expansion connector cover is removed.

When adding Expansion modules to a DIN rail mounted BRX MPU, the Expansion Module must be mounted to the rail first then connected to the BRX MPU. To install the expansion module on DIN rail, place the module onto the top of the rail and gently push the bottom down and in towards the rail. The spring loaded retaining clips will snap into the rail keeping the module on the rail. Slide the module to the left until it locks into the BRX MPU.

To install the expansion module to a panel mounted BRX MPU, align the expansion module connector with the MPU expansion slot and insert into the BRX MPU until it locks into place. Pull out the top and bottom screw mount tabs and screw the expansion module into the panel.



IMPORTANT!

Hot-Swapping Information
Note: This device cannot be Hot Swapped.

Wiring Guidelines

Power Wiring Connection

Connect the power source wiring for the BRX MPU as shown. Observe the precautions stated in this manual.

The power source for the BRX MPU's should be of good quality and sized appropriately so that the inrush when the PLC powers on does not cause a dip in the supplied voltage.

For DC-powered MPUs we recommend that the MPU be placed on a separate power supply. If this is not possible then care must be taken to reduce the CEMF component of coils and motors switching on and off by utilizing suppression techniques shown later in this chapter.

See the appropriate BRX MPU wiring chapter in this manual for technical specifications on wire size and screw torque recommendations on various terminal block connections available.



NOTE: *With external power supply off, terminal blocks may be removed for ease of wiring and then reinserted prior to applying power to the MPU.*

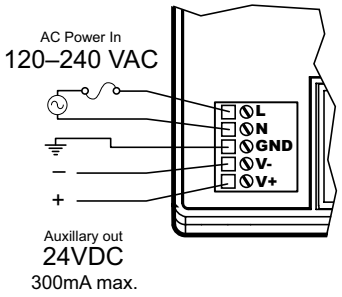
BX ME MPUs

Power Supply Connections

WARNING: Do not exceed the 24VDC auxiliary power supply load limit of 300mA.

WARNING: The BRX System MUST have a proper earth ground. Do not operate the BRX MPU without proper earth grounding.

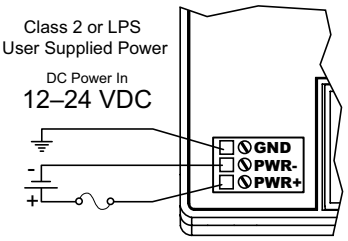
AC Powered Units	
Part Number	**External Power**
BX-DM1E-M	120–240 VAC





BX-DM1E-M
120–240 VAC

DC Powered Units	
Part Number	**External Power**
BX-DM1E-M-D	12–24 VDC





BX-DM1E-M-D
12–24 VDC

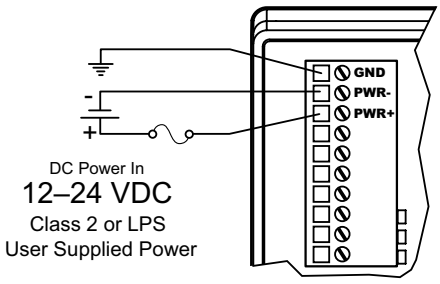
BRX 10/10E MPUs

Power Supply Connections

All BX 10/10E MPUs require 12–24 VDC external power supply. With power supply off, the terminal block may be removed for ease in wiring and then reinserted prior to applying power to the MPU. Follow the wiring termination diagram below for proper power supply connections.

DC Powered Units	
Part Number	**External Power**
BX 10 MPUs	12–24 VDC
BX-DM1-10ED1-D	
BX-DM1-10ED2-D	
BX-DM1-10ER-D	
BX-DM1-10AR-D	
BX 10E MPUs	
BX-DM1E-10ED13-D	
BX-DM1E-10ED23-D	
BX-DM1E-10ER3-D	
BX-DM1E-10AR3-D	





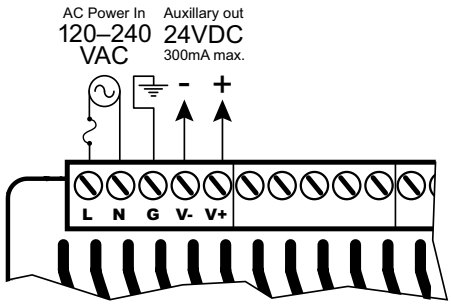
WARNING: The BRX System MUST have a proper earth ground. Do not operate the BRX MPU without proper earth grounding.

BX 18/18E MPUs

Power Supply Connections

AC Powered Units	
Part Number	**External Power**
BX 18 MPUs	120–240 VAC
BX-DM1-18ED1	
BX-DM1-18ED2	
BX-DM1-18ER	
BX-DM1-18AR	
BX 18E MPUs	
BX-DM1E-18ED13	
BX-DM1E-18ED23	
BX-DM1E-18ER3	
BX-DM1E-18AR3	





WARNING: Do not exceed the 24VDC auxiliary power supply load limit of 300mA.

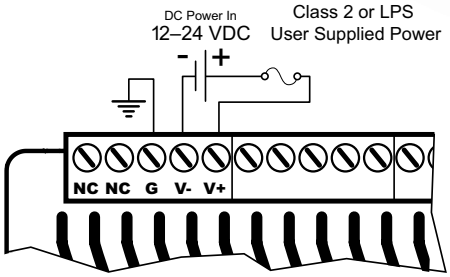
WARNING: The BRX System MUST have a proper earth ground. Do not operate the BRX MPU without proper earth grounding.

BRX 18/18E MPUs, Continued

Power Supply Connections

DC Powered Units	
Part Number	**External Power**
BX 18 MPUs	12–24 VDC
BX-DM1-18ED1-D	
BX-DM1-18ED2-D	
BX-DM1-18ER-D	
BX 18E MPUs	
BX-DM1E-18ED13-D	
BX-DM1E-18ED23-D	
BX-DM1E-18ER3-D	





WARNING: No External AC power supply needed on this unit. The two terminals marked "NC" are not used. These terminals are not internally connected. DO NOT CONNECT ANYTHING TO THESE TERMINALS!

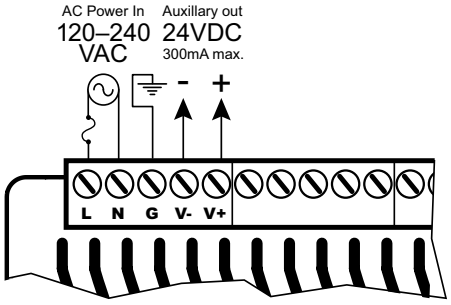
WARNING: The BRX System MUST have a proper earth ground. Do not operate the BRX MPU without proper earth grounding.

BX 36/36E MPUs

Power Supply Connections

AC Powered Units	
Part Number	**External Power**
BX 36 MPUs	120–240 VAC
BX-DM1-36ED1	
BX-DM1-36ED2	
BX-DM1-36ER	
BX-DM1-36AR	
BX 36E MPUs	
BX-DM1E-36ED13	
BX-DM1E-36ED23	
BX-DM1E-36ER3	
BX-DM1E-36AR3	





WARNING: Do not exceed the 24VDC auxiliary power supply load limit of 300mA.

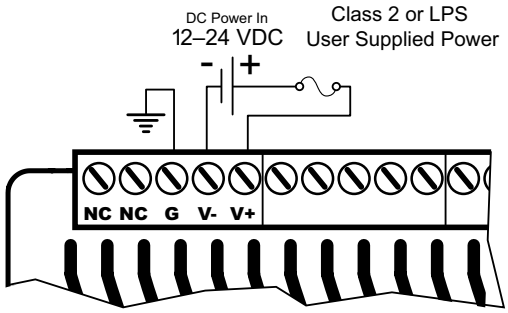
WARNING: The BRX System MUST have a proper earth ground. Do not operate the BRX MPU without proper earth grounding.

BRX 36/36E MPUs, Continued

Power Supply Connections

DC Powered Units	
Part Number	**External Power**
BX 36 MPUs	12–24 VDC
BX-DM1-36ED1-D	
BX-DM1-36ED2-D	
BX-DM1-36ER-D	
BX 36E MPUs	
BX-DM1E-36ED13-D	
BX-DM1E-36ED23-D	
BX-DM1E-36ER3-D	





WARNING: No External AC power supply needed on this unit. The two terminals marked "NC" are not used. These terminals are not internally connected. DO NOT CONNECT ANYTHING TO THESE TERMINALS!

WARNING: The BRX System MUST have a proper earth ground. Do not operate the BRX MPU without proper earth grounding.

Isolation

Electrical noise can enter the system through the power source for the MPU and I/O. Installing an isolation transformer for all AC sources can correct this problem.

DC power sources should be properly grounded, except for Class II power supplies which should never be bonded to ground. Switching DC power supplies commonly generate more noise than linear supplies. Typically switching type supplies work well for analog circuits, but for some circuits where noise can be a factor, linear type supplies may be needed.

Analog wiring should be placed in separate wire ways or wiring bundles. Keep AC and DC wiring separated. Never run analog signal or communications wiring in parallel or in close proximity to high voltage wiring.

Transformers, inductors, VFDs, DC drives, welders, static generators, ultrasonic devices, radio transmitters, receivers, wiring and antennas, along with similar types of devices, generate large amounts of RF interference. DC wiring, analog wiring and communications wiring should be kept as far away from these sorts of devices and their associated input and output wiring as possible.

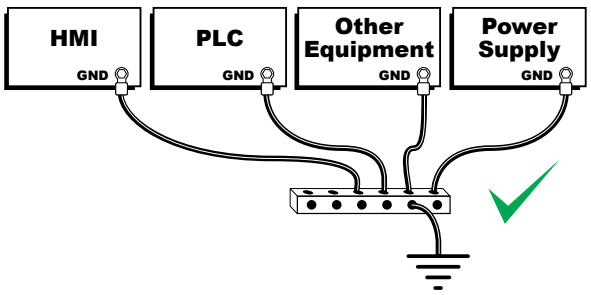
Devices that generate noise such as those listed above, along with coil driven devices such as relays, contactors, solenoids, etc., should be placed on a separate power supply from analog circuits. If this is not possible, then great care should be taken to properly suppress the transient voltage spikes from these devices turning on and off.

Grounding

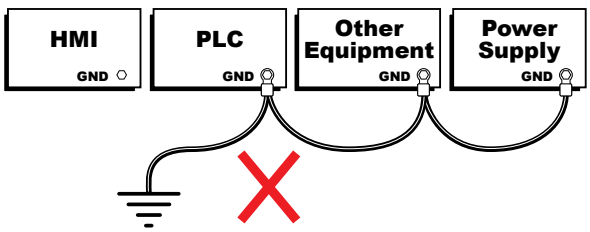
A good common ground reference (earth ground) is essential for proper operation of the BRX MPU. Most noise problems result from improper grounding of the system. A good earth ground can be the single most effective way to correct noise problems. If a ground is not available, install a ground rod as close to the system as possible.

Ensure all ground wires are single point grounds and are not daisy chained from one device to another. Ground metal enclosures around the system. Loose ground wires on your devices are more susceptible to noise than the other wires in your system. A loose wire is no more than a large antenna waiting to introduce noise into the system; therefore, you should tighten all connections in your system.

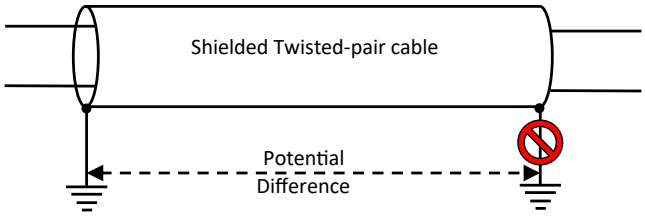
Proper Ground Connection



Improper Ground Connection



Cables with shields should be grounded on only one end of the shield. This prevents ground loops and allows for any radiated noise collected by the shield to properly drain to a single ground point.

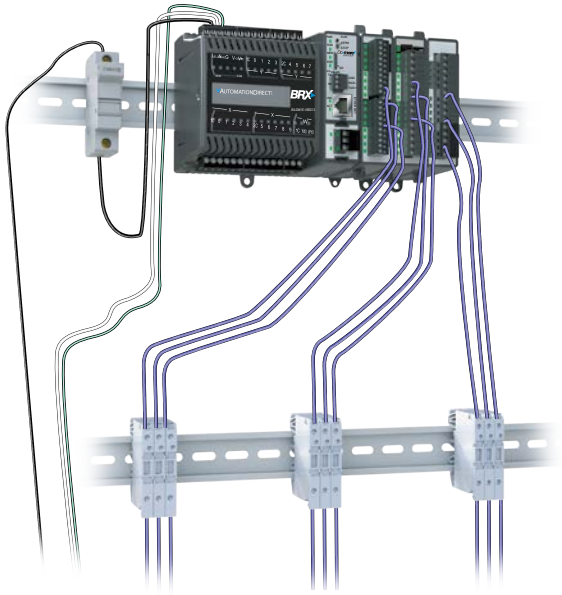


WARNING: The BRX System MUST have a proper earth ground. Do not operate the BRX MPU without proper earth grounding.

Fuse Protection

The BRX MPU and module I/O circuits do not have user serviceable internal fuses. In order to protect the MPU, we suggest you add external fuses to your I/O wiring. A fast-blow fuse with a lower current rating than the I/O bank common current rating can be wired to each common; or a fuse with a rating of slightly less than the maximum current per output point can be added to each output. Refer to the BRX MPU or module specifications for the model you are working with to find the maximum current per output point or per output common. Adding the external fuse does not guarantee the prevention of MPU or module damage, but it will provide added protection.

The image below shows a BRX platform MPU with Expansion Modules, where an external power supply is wired through a fused terminal block. Various other I/O is wired to DIN rail mounted fused terminal blocks.



I/O Module Wiring Options

There are two available methods for wiring BRX MPUs and expansion modules: hand wiring to the optional removable terminal blocks or using the ***ZIP***Link wiring system (recommended). Refer to the appropriate BRX chapter to review detailed information on the wiring options.



ZIPLink Wiring System



ZIPLink Pre-Wired Cable



ZIPLink Remote Feedthrough Terminal Block Module

Planning the I/O Wiring Routes

The following guidelines provide general information on how to wire the I/O connections to the BRX platform. For specific information on wiring a particular component of the BRX platform, refer to the wiring specifications in Chapters 2 through 5 for BRX MPUs and Chapter 7 for I/O expansion modules.

1. If using removable terminal blocks or ***ZIP***Link connector blocks, follow the wire size given for the connection method.
2. Always use a continuous length of wire from BRX MPU to I/O connections or junction panel terminations. Do not splice wires to attain a needed length.
3. Use the shortest run possible between devices.
4. Use conduit or wire trays for routing where possible.
5. Avoid running low voltage control or communication wiring near high voltage wiring.
6. Avoid confusion by separating input wiring runs from output wiring runs where possible.
7. To minimize voltage drops when wires must run long distances, consider using multiple wires for the return line.
8. Avoid running DC wiring in close proximity to AC wiring where possible.
9. Avoid creating sharp bends in wire runs; follow accepted Electrical Code standards.
10. Route communications wiring separately from control and power wiring.

Auxiliary DC Power Supply

On AC powered BRX MPUs an integral auxiliary isolated 24VDC power supply with its own isolation boundary is included. Since this is isolated it can be used to power input and/or output circuits.

In some cases using the built-in auxiliary 24VDC supply can result in a cost savings for your control system precluding the purchase of an addition external DC power source. It can power combined loads up to 300mA. Be careful not to exceed the current rating of the supply. As a system designer, you may be able to design or select field devices which can take advantage of the 24VDC auxiliary supply.



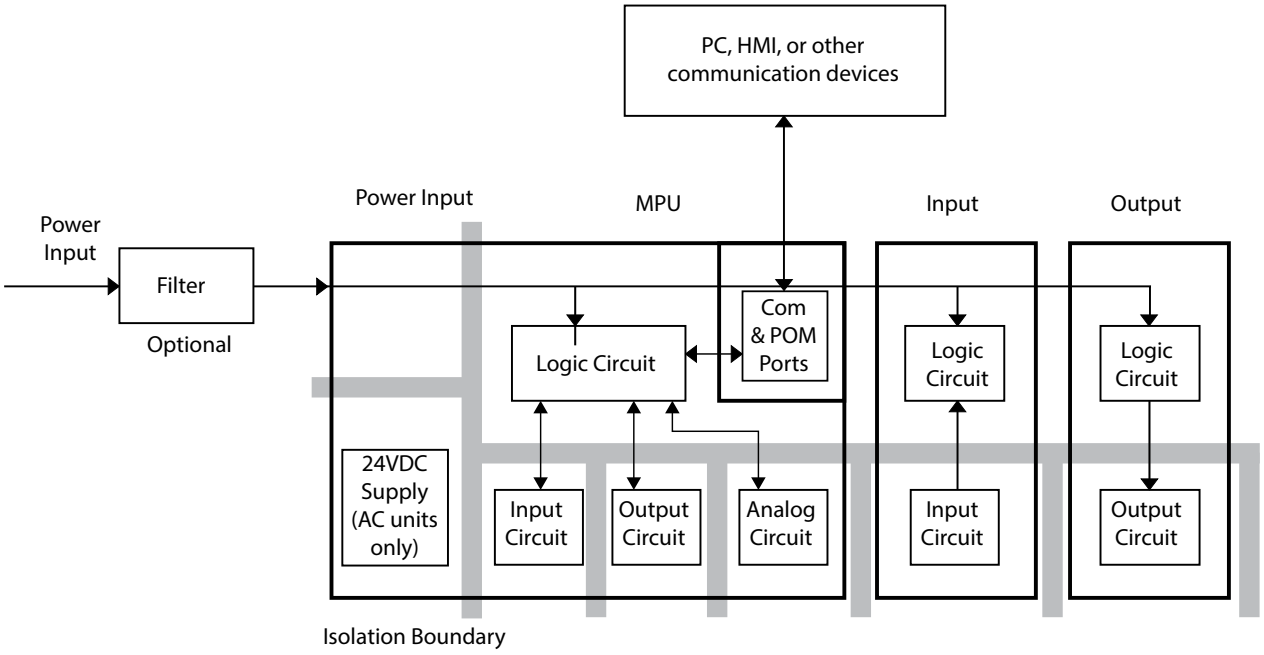
WARNING: Do not exceed the 24VDC auxiliary power supply load limit of 300mA.

System Wiring Strategies

The BRX platform is very flexible and will work in many different wiring configurations. By studying this section before actual installation, you can find the best wiring strategy for your application. This will help to lower system cost and wiring errors, while avoiding potential safety problems.

MPU Isolation Boundaries

MPU circuitry is divided into three main regions separated by isolation boundaries, shown in the drawing below. Electrical isolation provides safety, such that a fault in one area does not damage another. The transformer in the power supply provides magnetic isolation between the primary and secondary sides. Optical isolators provide isolation in Input and Output circuits. This isolates logic circuitry from the field side I/O. The discrete inputs are isolated from the discrete outputs because each is isolated from the logic side. Isolation boundaries protect the devices which are connected to the communication ports, such as PCs and HMIs, from power input faults or field wiring faults. When wiring a BRX MPU, it is extremely important to avoid making external connections that connect logic side circuits to any other.



Logical Representation of Isolation Boundaries

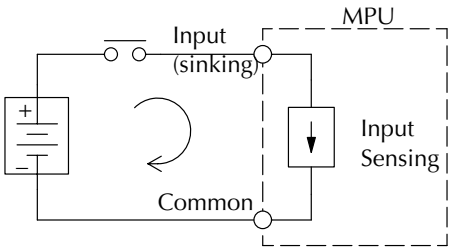
Sinking/Sourcing Concepts

Before wiring field devices to the BRX MPU I/O, it's necessary to have a basic understanding of "sinking" and "sourcing" concepts. Use of these terms occurs frequently in input or output circuit discussions. The purpose of this section is to explain the terms. The short definitions are as follows:

Sinking = Path to supply ground (–) or switching ground

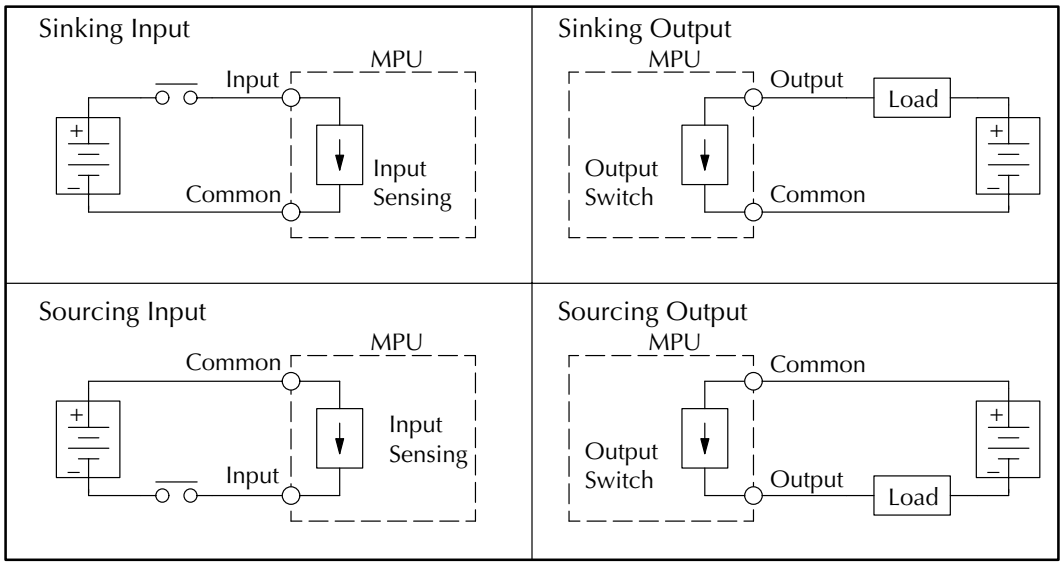
Sourcing = Path to supply source (+) or switching +V

These terms only apply to DC circuits, not AC circuits. Input and output points that are either sinking or sourcing can conduct current in only one direction. This means it is possible to wire the external supply and field device to the I/O point with current trying to flow in the wrong direction, in which case the circuit will not operate.



The diagram above shows a "sinking" MPU input. To properly connect the external supply, connect it so that the input provides a path to ground (–). Start at the MPU input terminal, follow through the input sensing circuit, exit at the common terminal, and connect the supply (–) to the common terminal.

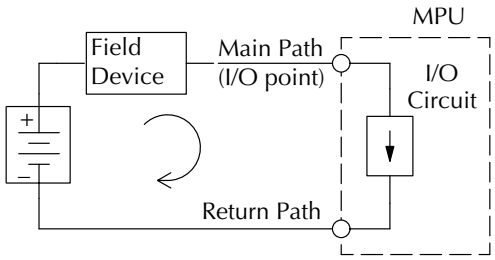
The switch between the supply (+) and the input completes the circuit. Current flows in the direction of the arrow when the switch is closed. By applying the circuit principle above to the four possible combinations of input/output sinking/sourcing types, we have the four circuits as shown below.



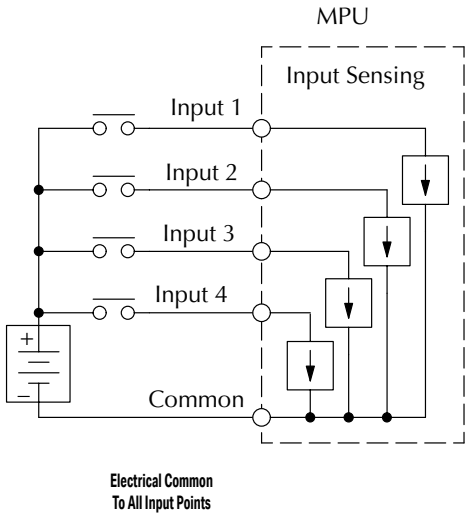
I/O "Common Terminal" Concepts

In order for a BRX MPU I/O circuit to operate, current must enter at one terminal and exit at another. This means at least two terminals are associated with every I/O point. In the figure below, the input or output terminal is the main path for the current. One additional terminal must provide the return path to the power supply.

If there was unlimited space then every I/O point could have two dedicated terminals as the figure below shows. Providing this level of flexibility is not practical or necessary for most applications.



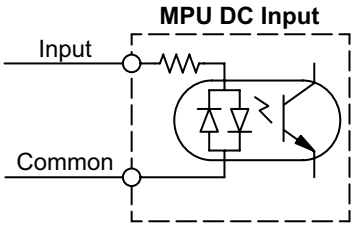
Most I/O point groups share the return path (common) among two or more I/O points. The figure below shows a group (or bank) of four input points which share a common return path. In this way, the four inputs require only five terminals instead of eight.



NOTE: *In the circuit above, the current in the common path is equal to the sum of the energized channels. This is especially important in output circuits, where larger gauge wire is sometimes needed for the commons.*

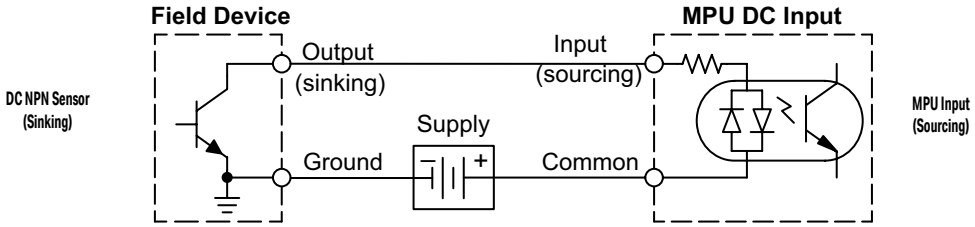
DC Input Wiring Methods

DC inputs can be wired as either sinking or sourcing inputs. The dual diodes (shown in this diagram) allow current to flow in either direction. Inputs grouped by a common point must be either all sinking or all sourcing. DC inputs typically operate in the range of 12–24 VDC.



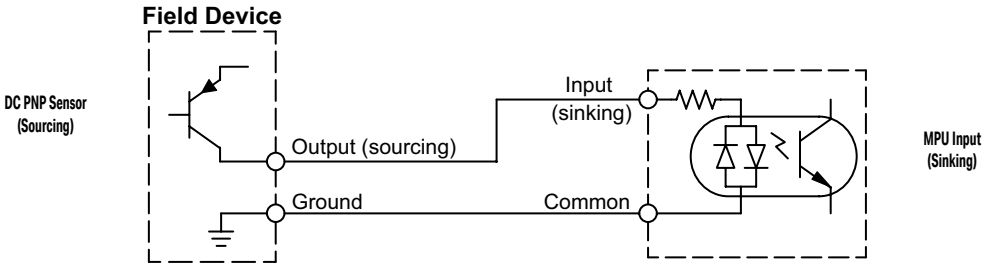
Sinking Input Sensor (NPN Type) to BRX MPU Sourcing Input

In the following example, a field device has an open-collector NPN transistor output. When energized, it sinks current to ground from the DC input point. The input current is sourced from the common terminal connected to power supply (+).



Sourcing Input Sensor (PNP Type) to BRX MPU Sinking Input

In the following example, a field device has an open-emitter PNP transistor output. When energized, it sources current to the input point, which sinks the current to ground. Since the field device loop is sourcing current, no additional power supply is required for the module.



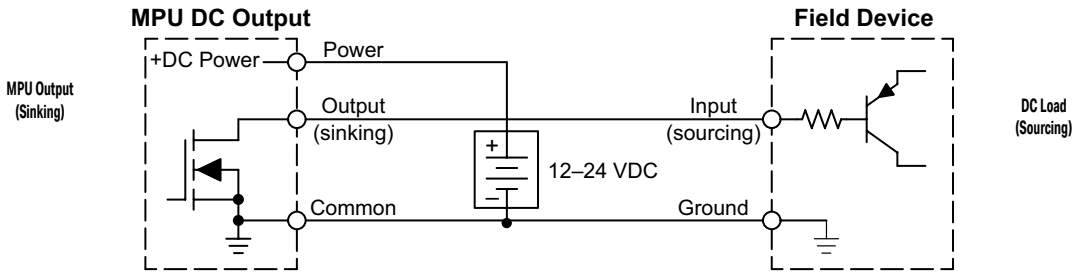
DC Output Wiring Methods

DC output circuits are wired as all current sinking or all current sourcing depending on which output module part number is used. DC outputs typically operate in the range of 12–24 VDC.

MPU Sinking Output to Sourcing Load Device

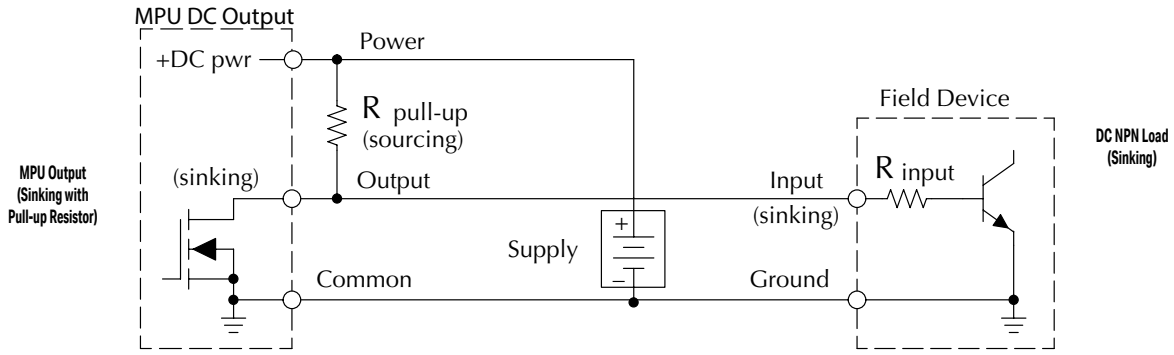
Many applications require connecting a MPU output point to a DC input on a field device load. This type of connection is made to carry a low-level DC signal.

In the following example, the MPU output point sinks current to ground (common) when energized. The output is connected to a field device load with a sourcing input.



MPUs DC Sinking Output to Sinking Load Device

In the example below, a sinking output point is connected to the sinking input of a field device load. In this case, both the MPU output and field device input are sinking type. Since the circuit must have one sourcing and one sinking device, we add sourcing capability to the MPU output by using a pull-up resistor. In the circuit below, we connect $R_{pull\text{-}up}$ from the output to the DC output circuit power input.



NOTE: *DO NOT attempt to drive a heavy load (>25mA) with this pull-up method.*

NOTE: *Using the pull-up resistor to implement a sourcing output has the effect of inverting the output point logic. In other words, the field device input is energized when the MPU output is OFF, from a ladder logic point-of-view. Your ladder program must take this into consideration and generate an inverted output. Or, you may choose to cancel the effect of the inversion elsewhere, such as in the field device.*

It is important to choose the correct value of $R_{pull\text{-}up}$. In order to do so, we need to know the nominal input current to the field device (I_{input}) when the input is energized. If this value is not known, it can be calculated as shown (a typical value is 15mA). Then use I_{input} and the voltage of the external supply to compute $R_{pull\text{-}up}$. Then calculate the power $P_{pull\text{-}up}$ (in watts), in order to size $R_{pull\text{-}up}$ properly.

$$I_{input} = \frac{V_{input\ \ (turn\text{–}on)}}{R_{input}}$$

$$R_{pull\text{-}up} = \frac{V_{supply} - 0.7}{I_{input}} - R_{input}$$

$$P_{pull\text{-}up} = \frac{V^2_{supply}}{R_{pull\text{-}up}}$$

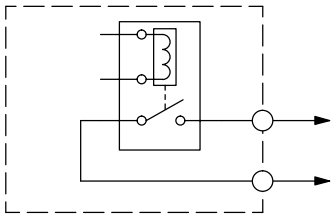
Relay Outputs - Wiring Methods

Relays are best for the following applications:

- Loads that require higher currents than the solid-state outputs can deliver
- Cost-sensitive applications
- Some output channels need isolation from other outputs (such as when some loads require different voltages than other loads)

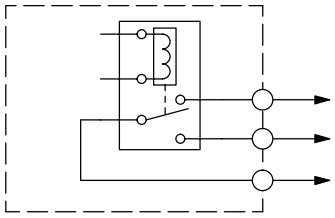
Relay outputs are available in two contact arrangements. Form A type, or SPST (single pole, single throw) type. They are normally open and are the simplest to use. The Form C, or SPDT (single pole, double throw) type has a center contact which moves and a stationary contact on either side. This provides a normally closed contact and a normally open contact.

Relay with Form A contacts



The relays in some relay output modules share common terminals, which connect to the wiper contact in each relay of the bank. Other relay modules have relays which are completely isolated from each other. In all cases, the module drives the relay coil when the corresponding output point is on.

Relay with Form C contacts



Some applications where relays would NOT be used:

- Loads that require currents under 10mA
- Loads which must be switched at high speed or heavy duty cycle.

Relay Outputs – Transient Suppression for Inductive Loads in a Control System

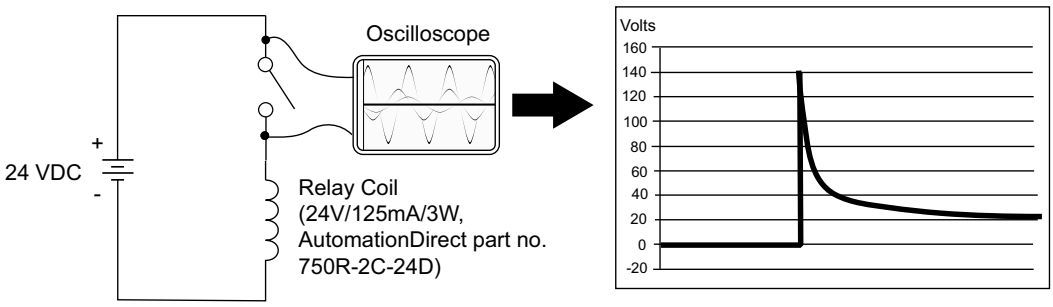
The following pages are intended to give a quick overview of the negative effects of transient voltages on a control system and provide some simple advice on how to effectively minimize them (Transient Voltage Suppression or TVS). The need for transient voltage suppression is often not apparent to the newcomers in the automation world. Many mysterious errors that can afflict an installation can be traced back to a lack of transient suppression.

What is a Transient Voltage and Why is it Bad?

Inductive loads (devices with a coil) generate transient voltages as they transition from being energized to being de-energized. If not suppressed, the transient can be many times greater than the voltage applied to the coil. These transient voltages can damage the BRX MPU outputs or other sensitive electronic devices connected to the circuit, and cause unreliable operation of adjacent electronics. Transients must be managed with suppressors (TVS) for longer component life while sustaining reliable operation of the control system.

Examples of coil driven devices include: Relays, Contactors, Solenoids, Motor starters, Motors, and Welders. This example shows a simple circuit with a small 24V/125mA/3W relay. As you can see, when the switch is opened, thereby de-energizing the coil, the transient voltage generated across the switch contacts peaks at 140V.

Example: Circuit with no Suppression



In the same circuit, replacing the relay with a larger 24V/290mA/7W relay will generate a transient voltage exceeding 800V (not shown). Transient voltages like this can cause many problems, including:

- Relay contacts driving the coil may experience arcing, which can pit the contacts and reduce the relay's lifespan.
- Solid state (transistor) outputs driving the coil can be damaged if the transient voltage exceeds the transistor's ratings. In extreme cases, complete failure of the output can occur the very first time a coil is de-energized.
- Input circuits, which might be connected to monitor the coil or the output driver, can also be damaged by the transient voltage.

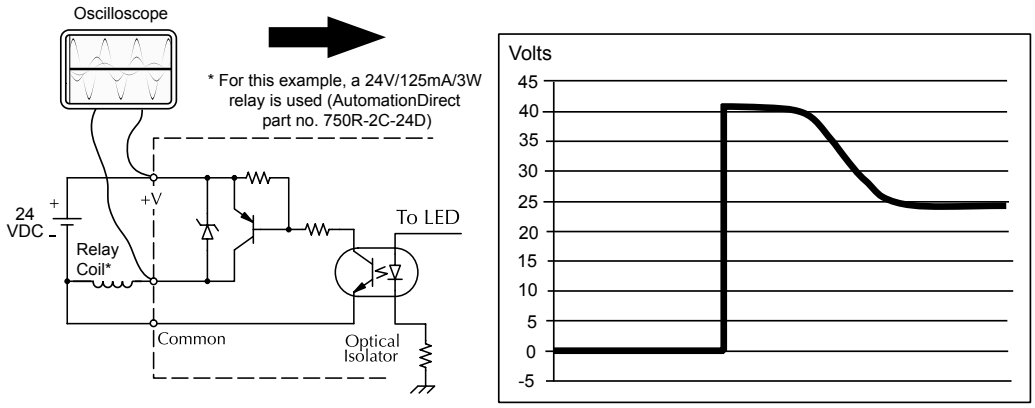
A very destructive side-effect of the arcing across relay contacts is the electromagnetic interference (EMI) it can cause. This occurs because the arcing causes a current surge, which releases RF energy. The entire length of wire between the relay contacts, the coil, and the power source carries the current surge and becomes an antenna that radiates the RF energy. It will readily couple into parallel wiring and may disrupt the MPU and other electronics in the area. This EMI can make an otherwise stable control system behave unpredictably at times.

MPU's Integrated Transient Suppressors

Although the BRX MPU outputs have integrated suppressors to protect against transients, they are not capable of handling them all. It is usually necessary to have some additional transient suppression for an inductive load.

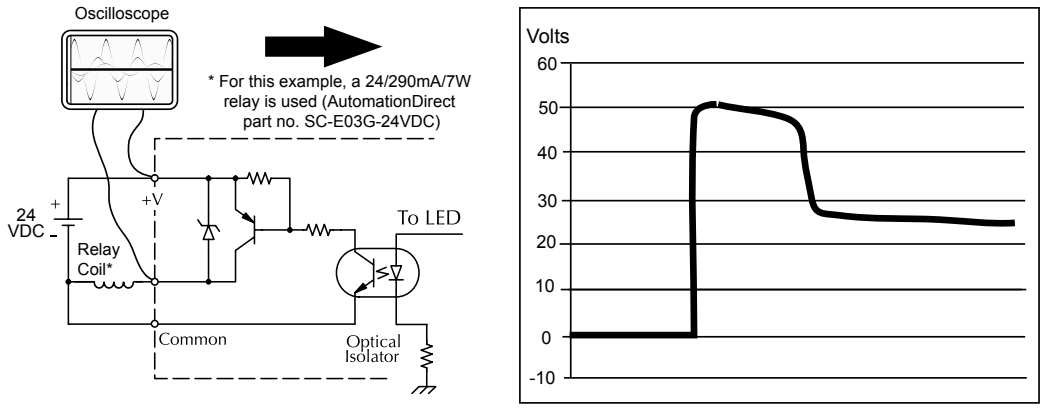
Here is another example using the same 24V/125mA/3W relay used earlier. This example measures the PNP transistor output of a typical MPU, which incorporates an integrated Zener diode for transient suppression. Instead of the 140V peak in the first example, the transient voltage here is limited to about 40V by the Zener diode. While the MPU will probably tolerate repeated transients in this range for some time, the 40V is still beyond the module's peak output voltage rating of 30V.

Example: Small Inductive Load with Only Integrated Suppression



The next example uses the same circuit as above, but with a larger 24V/290mA/7W relay, thereby creating a larger inductive load. As you can see, the transient voltage generated is much worse, peaking at over 50V, yet considerably below the 800V mentioned earlier. Driving an inductive load of this size(66% above rate voltage) without additional transient suppression is very likely to permanently damage the MPU output.

Example: Larger Inductive Load with Only Integrated Suppression

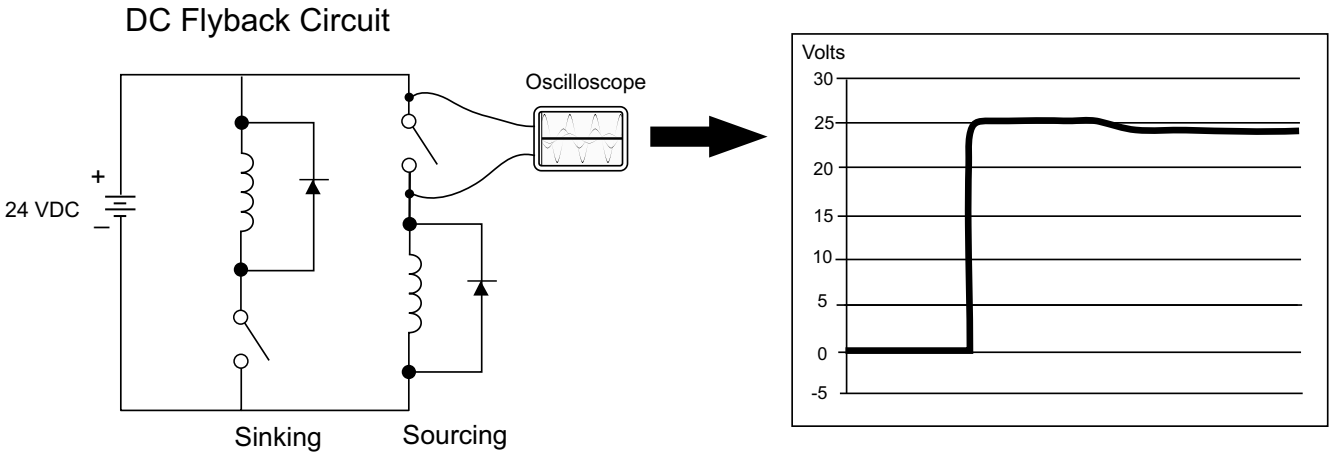


Additional transient suppression should be used in both these examples. If you are unable to measure the transients generated by the connected loads of your control system, using additional transient suppression on all inductive loads would be the safest practice.

Types of Additional Transient Protection

DC Coils:

The most effective protection against transients from a DC coil is a flyback diode. A flyback diode can reduce the transient to roughly 1V over the supply voltage, as shown in this example.



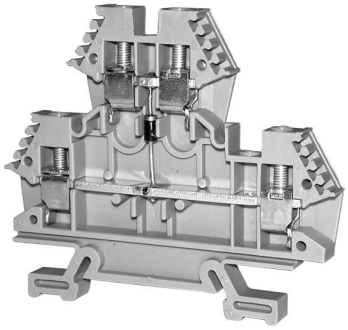
Many AutomationDirect socketed relays and motor starters have add-on flyback diodes that plug or screw into the base, such as the AD-ASMD-250 protection diode module and 784-4C-SKT-1 socket module shown below. If an add-on flyback diode is not available for your inductive load, an easy way to add one is to use AutomationDirect's DN-D10DR-A diode terminal block, a 600VDC power diode mounted in a slim DIN rail housing.



AD-ASMD-250
Protection Diode Module



784-4C-SKT-1
Relay Socket



DN-D10DR-A
Diode Terminal Block

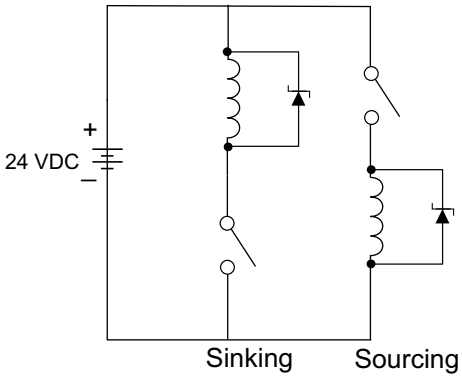
Two more common options for DC coils are Metal Oxide Varistors (MOV) or TVS diodes. These devices should be connected across the coil for best protection as shown below. The optimum voltage rating is the lowest rated voltage available for the suppressor that will NOT conduct at the supply voltage, while still allowing a safe margin.

AutomationDirect's ZL-TSD8-24 transorb module is a good choice for 24VDC circuits. It is a bank of 8 unidirectional 30V TVS diodes. Since it is unidirectional, be sure to observe the polarity during installation. MOVs or bidirectional TVS diodes would install at the same location, but have no polarity concerns.



ZL-TSD8-24
Transorb Module

DC MOV or TVS Diode Circuit



AC Coils:

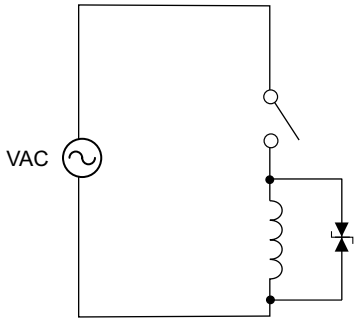
Two options for AC coils are MOVs or bi-directional TVS diodes. These devices are most effective at protecting the driver from a transient voltage when connected across the coil. The optimum voltage rating for the suppressor is the lowest rated voltage available that will NOT conduct at the supply voltage, while still allowing a safe margin.

AutomationDirect's ZL-TSD8-120 transorb module is a good choice for 120VAC circuits. It is a bank of eight bi-directional 180V TVS diodes.



ZL-TSD8-120
Transorb Module

AC MOV or Bi-Directional Diode Circuit



NOTE: *Manufacturers of devices with coils frequently offer MOV or TVS diode suppressors as an add-on option that mount conveniently across the coil. Before using them, carefully check the suppressor ratings. Just because the suppressor is made specifically for that part does not mean it will reduce the transient voltages to an acceptable level for your application.*

For example, a MOV or TVS diode rated for use on 24–48 VDC coils would need to have a high enough voltage rating to NOT conduct at 48V. That suppressor might typically start conducting at roughly 60VDC. If it were mounted across a 24V coil, transients of roughly 84V (if sinking output) or -60V (if sourcing output) could reach the MPU output. Many semiconductor MPU outputs cannot tolerate such levels.

Notes:

BX ME Wiring



In This Chapter...

BX ME Micro PLC Unit (MPU) Overview 2-2
BX-DM1E-M Wiring 2-4
BX-DM1E-M-D Wiring 2-6

BX ME Micro PLC Unit (MPU) Overview

The BX ME Micro PLC Unit (MPUs) includes two different versions. Both have the same appearance and basic features, the only difference being that one unit is externally powered with 12–24 VDC and the other unit is externally powered with 120–240 VAC.

The units have no built-in I/O points. This allows use as a standalone controller unit with no I/O or you can customize the I/O to meet the needs of your application by adding BRX Expansion Modules. All BX ME MPUs can expand their capacity with the addition of as many as eight (8) BRX Expansion Modules, allowing more flexibility while keeping control cost down.



BX-DM1E-M
120–240 VAC



BX-DM1E-M-D
12–24 VDC

General Specifications

- Support for 8 additional Expansion Modules (Expansion modules are discussed in Chapters 7, 8 and 9).
- No built-in discrete I/O points
- No built-in analog I/O points
- Serial port for RS232/485 communications
- RJ45 port for Ethernet communications
- microSD slot
- Pluggable Option Module (POM) for an additional communications port

Power Supply Connector

The power supply terminal block connectors are included with this MPU. The power supply connectors are a screw type, removable terminal block. Replacement connectors and specifications are listed in the tables that follow.

BX-DM1E-M AC Power Supply Connector Specifications			
Part Number	**BX-RTB05 (Included w/Unit)**	**BX-RTB05-1**	**BX-RTB05-2**
Connector Type	Screw Type-90 deg	Spring Clamp Type-180 deg	Screw Type-180 deg
Wire Exit	180 deg	180 deg	180 deg
Pitch	5.0 mm	5.0 mm	5.0 mm
Screw Size	M2.5	N/A	M2.5
Recommended Screw Torque	< 3.98 lb·in (0.45 N·m)	N/A	< 3.98 lb·in (0.45 N·m)
Screwdriver Blade Width	3.5 mm	3.5 mm	3.5 mm
Wire Gauge (Single wire)	28–12 AWG	28–14 AWG	28–14 AWG
Wire Gauge (Two wire)	28–16 AWG	28–16 AWG (Dual Wire Ferrule Required)	28–16 AWG (Dual Wire Ferrule Required)
Wire Strip Length	0.3 in (7.5 mm)	0.37 in (9.5 mm)	0.37 in (9.5 mm)
Equiv. Dinkle P/N	5ESDV-05P-BK	5ESDSR-05P-BK	5ESDSR-05P-BK



BX-RTB05



BX-RTB05-1



BX-RTB05-2

BX-DM1E-M-D DC Power Supply Connector Specifications			
Part Number	**BX-RTB03 (Included w/Unit)**	**BX-RTB03-1**	**BX-RTB03-2**
Connector Type	Screw Type-90 deg	Spring Clamp Type-180 deg	Screw Type-180 deg
Wire Exit	180 deg	180 deg	180 deg
Pitch	5.0 mm	5.0 mm	5.0 mm
Screw Size	M2.5	N/A	M2.5
Recommended Screw Torque	< 3.98 lb·in (0.45 N·m)	N/A	< 3.98 lb·in (0.45 N·m)
Screwdriver Blade Width	3.5 mm	3.5 mm	3.5 mm
Wire Gauge (Single wire)	28–12 AWG	28-14 AWG	28-12 AWG
Wire Gauge (Two wires)	28–16 AWG	28-16 AWG (Dual Wire Ferrule Required)	28-16 AWG
Wire Strip Length	0.3 in (7.5 mm)	0.37 in (9.5 mm)	0.3 in (7.5 mm)
Equiv. Dinkle P/N	5ESDV-03P-BK	5ESDSR-03P-BK	5ESDF-03P



BX-RTB03



BX-RTB03-1



BX-RTB03-2

BX-DM1E-M Wiring

- Serial port for RS232/485 communications
- RJ45 port for Ethernet communications
- microSD slot
- Pluggable Option Module (POM) for an additional communications port
- No built-in discrete I/O
- No built-in analog I/O
- Requires an external 120–240 VAC external power supply.
- Includes an integral 24VDC auxiliary output power supply.



BX-DM1E-M

NOTE: *Eight (8) Expansion Modules can be connected to add I/O capability.*

BX-DM1E-M Wiring, Continued

Power Supply Specifications

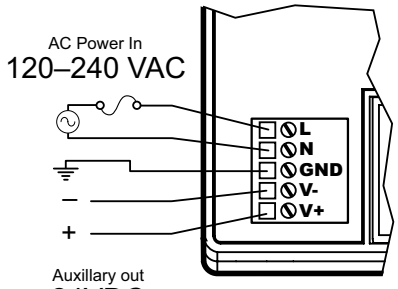
Power Supply Specifications	
Nominal Voltage Range	120–240 VAC
Input Voltage Range (Tolerance)	85–264 VAC
Rated Operating Frequency	47–63 Hz
Maximum Input Power	40VA
Cold Start Inrush Current	1.5 A, 2ms
Maximum Inrush Current (Hot Start)	1.5 A, 2ms
Internal Input Fuse Protection	Micro fuse 250V, 2A Non-replaceable
Acceptable External Power Drop Time	10ms
Under Input Voltage Lock-out	80VAC
Input Transient Protection	Input choke and line filter
Output Protection for Over Current, Over Voltage, and Over Temperature	Self resetting
Heat Dissipation	10.8 W Max
Isolated User 24VDC Output	24VDC @ 0.3 A max, <1V P-P Ripple, Integrated self-resetting short circuit protection
Voltage Withstand (dielectric)	1500VAC Power Inputs to Ground applied for 1 minute 1500VAC Ground to 24VDC Output applied for 1 minute
Insulation Resistance	>10MΩ @ 500VDC
Software Version Required	Do-more! Designer version 2.0 or later

Power Supply Connections

Pin	Connection
1	L
2	N
3	GND
4	V–
5	V+



Removable Connector Included
ADC Part # BX-RTB05



WARNING: Do not exceed the 24VDC auxiliary power supply load limit of 300mA.

WARNING: The BRX System MUST have a proper earth ground. Do not operate the BRX MPU without proper earth grounding.

BX-DM1E-M-D Wiring

- Serial port for RS232/485 communications
- RJ45 port for Ethernet communications
- microSD slot
- Pluggable Option Module (POM) for an additional communications port
- No built-in discrete I/O
- No built-in analog I/O
- Requires an external 12–24 VDC external power supply.
- No integral 24VDC auxiliary output power supply.



BX-DM1E-M-D

NOTE: *Eight (8) Expansion Modules can be connected to add I/O capability.*

BX-DM1E-M-D Wiring, Continued

Power Supply Specifications

Power Supply Specifications	
Nominal Voltage Range*	12–24 VDC
Input Voltage Range (Tolerance)*	10–36 VDC
Maximum Input Voltage Ripple	< ±10%
Maximum Input Power	30W
Cold Start Inrush Current	5A, 2ms
Maximum Inrush Current (Hot Start)	5A, 2ms
Internal Input Protection	Reverse polarity protection and undervoltage lockout via transistor circuit
Acceptable External Power Drop Time	10ms
Under Input Voltage Lock-out	<9VDC
Output Protection for Over Current, Over Voltage, and Over Temperature	Self resetting
Heat Dissipation	8.6 W Max
Isolated User 24VDC Output	None
Voltage Withstand (dielectric)	1500VAC power Inputs to ground applied for 1 minute
Insulation Resistance	>10MΩ @ 500VDC
Software Version Required	Do-more! Designer version 2.0 or later

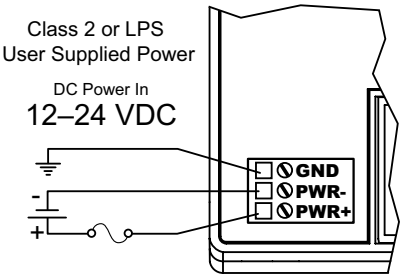
**** Class 2 or LPS Power Supply required.***

Power Supply Connections

Pin	Connection
1	GND
2	PWR –
3	PWR +



Removable Connector Included
ADC Part # BX-RTB03



WARNING: The BRX System MUST have a proper earth ground. Do not operate the BRX MPU without proper earth grounding.

Notes:

BX 10/10E Wiring

CHAPTER 3

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BX 10/10E Micro PLC Unit (MPU) Overview

The BX 10/10E Micro PLC Unit (MPU) includes eight different versions. All have the same appearance and basic features. All units have six (6) discrete input points, and four (4) discrete output points built-in. Units with DC inputs have six (6) selectable high-speed inputs and units with DC outputs have two (2) selectable high-speed outputs. All MPUs can expand their capacity with the BRX Expansion Modules to allow for more flexibility while keeping control cost down. BX 10E units have an Ethernet port as well as an additional one (1) analog input and one (1) analog output built-in that are current/voltage selectable within the software.

The units ship without wiring terminals. This allows you to select the terminal block type that best fits your application. There are several wiring options available, including screw terminal connectors, spring clamp terminal connectors and prewired ***ZIP***Link cable solutions.

BX 10/10E MPUs can be divided into two distinct groups, BX 10 and BX 10E. The BX 10 MPUs have no built-in analog I/O or Ethernet port. The BX 10E MPUs have the same features of the BX 10, plus built-in analog I/O and an Ethernet port.



BX 10E
Micro PLC Unit (MPU)
Built-in Analog and Ethernet



BX 10
Micro PLC Unit (MPU)
No Built-in Analog or Ethernet

BX 10 MPUs General Specifications



BX 10
Micro PLC Unit (MPU)
No Built-in Analog or Ethernet

- 10 discrete I/O points: 6 inputs, 4 outputs
- No built-in analog I/O points
- All units are externally powered by a nominal 12–24 VDC
- Models with DC inputs:
  - have 6 high speed inputs up to 250kHz
  - accept 12–24 nominal voltages AC or DC
  - can be wired as sinking or sourcing.
- Models with AC inputs can accept 120–240 nominal voltages
- Output types available are DC sinking, DC sourcing, and relay
- Models with DC outputs have 2 high speed outputs up to 250kHz

♥

The following table shows the available MPUs with the BX 10 feature set.

BX 10 MPUs

Part Number	External Power	Discrete Input	Discrete Output	Expansion Modules
BX-DM1-10ED1-D	12–24 VDC	6 High-Speed, Sinking or Sourcing	2 High-Speed 2 Standard DC Sinking	8, as long as the MPU power budget is not exceeded
BX-DM1-10ED2-D			2 High-Speed 2 Standard DC Sourcing	
BX-DM1-10ER-D			4 Form A Relay	
BX-DM1-10AR-D		6 Standard AC		

BX 10E MPUs General Specifications



BX 10E
Micro PLC Unit (MPU)
Built-in Analog and Ethernet

- 10 discrete I/O points: 6 in/4 out
- All units are externally powered by a nominal 12–24 VDC
- Models with DC inputs:
  - have 6 high speed inputs up to 250kHz
  - accept 12–24 nominal voltages AC or DC
  - can be wired as sinking or sourcing.
- Models with AC inputs can accept 120–240 nominal voltages
- All units have a built-in RJ-45 Ethernet port, 10/100 Mbps
- All units have 1 analog input and 1 analog output (current/voltage software selectable)
- Output types available are DC sinking, DC sourcing, and relay
- Models with DC outputs have 2 high speed outputs up to 250kHz
- Support for up to 8 additional Expansion Modules as long as the power budget is not exceeded.

The following table shows the available MPUs with the BX 10E feature set.

BX 10E MPUs

Part Number	External Power	Discrete Inputs	Discrete Output	Analog*		Expansion Modules
				Input	Output	
BX-DM1E-10ED13-D	12–24 VDC	6 High-Speed, Sinking or Sourcing	2 High-Speed 2 Standard DC Sinking	1 Current or Voltage	1 Current or Voltage	8, as long as the MPU power budget is not exceeded
BX-DM1E-10ED23-D			2 High-Speed 2 Standard DC Sourcing			
BX-DM1E-10ER3-D			4 Form A Relay			
BX-DM1E-10AR3-D		6 Standard AC				

** Analog can be current or voltage software selectable per channel.*

BX 10/10E Wiring Termination Selection

The BX 10/10E MPUs ship without wiring terminals. This allows you to select the terminal block type that best fits your application. There are several wiring options available, including removable screw terminal connectors, removable spring clamp terminal connectors and prewired ***ZIP***Link cable solutions.

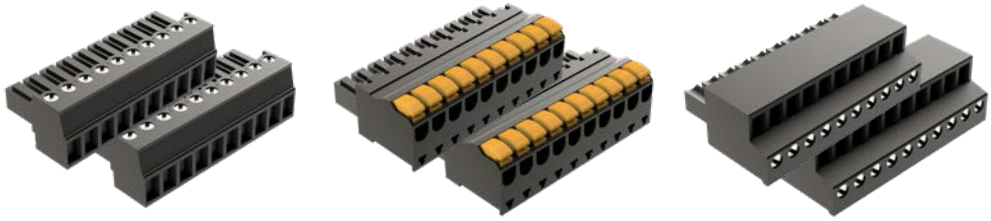
Terminal Block Connectors

The terminal block connectors are provided in kits and can be easily ordered as a single part number to receive all the terminal block connectors needed. Each kit for the BX 10/10E MPU comes with two (2) 10-pin, 3.8 mm terminal blocks. On the BX 10/10E MPUs the terminals are organized into groups consisting of 3 inputs with an isolated common and 2 outputs with an isolated common, e.g., Inputs X0-X2 are in a group with their common terminal.

The terminal block connector kit part numbers and connector specifications are listed in the table below.

Terminal Block Connector Specifications

Kit Part Number	BX-RTB10	BX-RTB10-1	BX-RTB10-2
Connector Type	Screw Type-90 degree	Spring Clamp Type-180 degree	Screw Type-180 degree
Wire Exit	180 degree	180 degree	180 degree
Pitch	3.81 mm	3.81 mm	3.81 mm
Screw Size	M2	N/A	M2
Recommended Screw Torque	<1.77 lb·in (0.2 N·m)	N/A	<1.77 lb·in (0.2 N·m)
Screwdriver Blade Width	2.5 mm	2.5 mm	2.5 mm
Wire Gauge (Single Wire)	28–16 AWG	28–18 AWG	30–16 AWG
Wire Gauge (Dual Wire)	28–16 AWG	30–20 AWG (Dual Wire Ferrule Required)	30–18 AWG
Wire Strip Length	0.24 in (6mm)	0.35 in (9mm)	0.26 in (6.5 mm)
Equiv. Dinkle part #	EC381V-10P-BK	ESC381V-10-BK	EC381F-10P-BK



BX-RTB10 BX-RTB10-1 BX-RTB10-2

NOTE: *For replacement terminal blocks, the appropriate part number in the table above should be ordered.*

*ZIP*Link Prewired Cable Solutions

*ZIP*Links eliminate the normally tedious process of wiring between devices by utilizing prewired cables and DIN rail mount connector modules. It's as simple as plugging in a cable connector at either end or terminating wires at only one end. Prewired cables keep installation clean and efficient, using less space at a fraction of the cost of standard terminal blocks. *ZIP*Link prewired cables can connect directly to a *ZIP*Link remote terminal block module or with the pigtail option they can allow for a convenient solution to wire the BRX platform to 3rd party devices. For the BX 10/10E MPUs, one cable and one feedthrough module is needed to connect to onboard wiring termination points. There are two feedthrough module options available, the ZL-RTB20 and the ZL-RTB20-1. The ZL-RTB20 is a standard feedthrough terminal module and the ZL-RTB20-1 is a compact feedthrough terminal block module and has a compact footprint which takes up less space in the control cabinet.

The *ZIP*Link system options for the BX 10/10E MPUs are listed in the table below.

BX 10/10E *ZIP*Link Selector

MPU Part Number	Component	Module Part No.	Cable Part No.*
BX-DM1-10ED1-D	Feedthrough	ZL-RTB20 (Standard) OR ZL-RTB20-1 (Compact)	ZL-BX-CBL20 ZL-BX-CBL20-1 ZL-BX-CBL20-2
BX-DM1-10ED2-D			
BX-DM1-10ER-D			
BX-DM1-10AR-D			
BX-DM1E-10ED13-D			
BX-DM1E-10ED23-D			
BX-DM1E-10ER3-D			
BX-DM1E-10AR3-D			

** Select the cable length: Blank = 0.5 m, -1 = 1.0 m, -2 = 2.0 m.*
Available pigtail cables: ZL-BX-CBL20-1P = 1.0 m, ZL-BX-CBL20-2P = 2.0 m.

*ZIP*Link Prewired Cables

Custom molded *ZIP*Link prewired cables allow for fast and easy connection of field wiring and remote I/O to the BRX platform. The prewired cables are available in 0.5 meter, 1 meter and 2 meter lengths. Pigtail cables are used to connect the BRX platform directly to third-party devices, lowering your wiring cost and time. The pigtail cables are available in 1 meter and 2 meter lengths.



ZL-BX-CBL20
***ZIP*Link Prewired Cable**



ZL-BX-CBL20-1P
***ZIP*Link Pigtail Cable**

*ZIP*Link Remote Feedthrough Modules

Feedthrough modules provide low-cost and compact field wiring screw termination solutions for quickly connecting with the BRX platform. There are 2 modules available for use with the BRX platform. The ZL-RTB20 and the ZL-RTB20-1. The ZL-RTB20 is a standard 2 row, 20-pin, DIN rail mountable feedthrough module. The ZL-RTB20-1 is a compact 3 row, 24-pin DIN rail mountable feedthrough module with a smaller footprint design.

The *ZIP*Link remote feedthrough module specifications are listed in the table below.

*ZIP*Link Module Specifications		
Part Number	**ZL-RTB20 (Maximum of 1 Needed)**	**ZL-RTB20-1 (Maximum of 1 Needed)**
Number of positions	20 screw terminals, 2 rows	24 screw terminals, 3 rows
Screwdriver Width	1/8 in (3.8 mm) maximum	
Screw Torque	4.4 lb·in (0.5 N·m)	



ZL-RTB20



ZL-RTB20-1

*ZIP*Link System Examples



BX 10E MPU with *ZIP*Link System pre-wired cable and feedthrough module.



BX 10E with *ZIP*Link Pigtail Cable ZL-BX-CBL20-1P

BX 10 Micro PLC Units (MPUs)

BX-DM1-10ED1-D Wiring

This MPU has 10 discrete I/O points. The connections are grouped as follows:

- Six (6) discrete inputs - sinking/sourcing; rated for 12–24 VAC/VDC. They are located along the front left of the unit; organized into groups of 4 terminals consisting of 3 inputs and an isolated common each.
- Four (4) discrete outputs - sinking; rated at 12–24 VDC. They are located along the front left of the unit. The outputs are organized into groups of 3 terminals consisting of 2 outputs and an isolated common each.

This MPU requires an external 12–24 VDC power supply. The DC power supply connection is located on the top left side of the unit. There is no 24VDC auxiliary output supply.

WARNING: No analog I/O is included on this unit. The three (3) terminals between the power supply and the inputs are not used. These terminals are not internally connected. DO NOT CONNECT ANYTHING TO THESE TERMINALS!



BX-DM1-10ED1-D

NOTE: *Eight (8) Expansion Modules can be connected to extend I/O capacity, as long as the MPU power budget is not exceeded.*

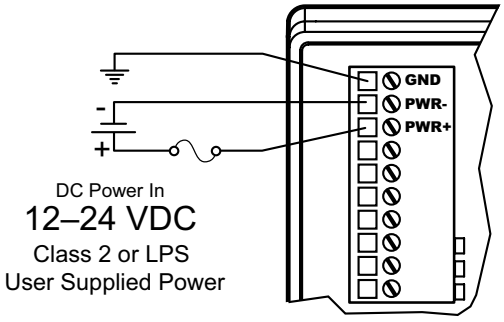
BX-DM1-10ED1-D Wiring, Continued

Power Supply Specifications

Power Supply Specifications	
Nominal Voltage Range*	12–24 VDC
Input Voltage Range (Tolerance)*	10–36 VDC
Maximum Input Voltage Ripple	< ±10%
Maximum Input Power	14W
Cold Start Inrush Current	5A, 2ms
Maximum Inrush Current (Hot Start)	5A, 2ms
Internal Input Protection	Reverse polarity protection and undervoltage lockout via transistor circuit
Acceptable External Power Drop Time	10ms
Under Input Voltage Lock-out	< 9VDC
Heat Dissipation	7.4 W Max
Isolated User 24VDC Output	None
Voltage Withstand (dielectric)	1500VAC power Inputs to ground applied for 1 minute
Insulation Resistance	>10MΩ @ 500VDC
Software Version Required	Do-more! Designer version 2.0 or later

** Class 2 or LPS Power Supply required.*

Power Supply Connections



WARNING: The BRX System MUST have a proper earth ground. Do not operate the BRX MPU without proper earth grounding.

BX-DM1-10ED1-D Wiring, Continued

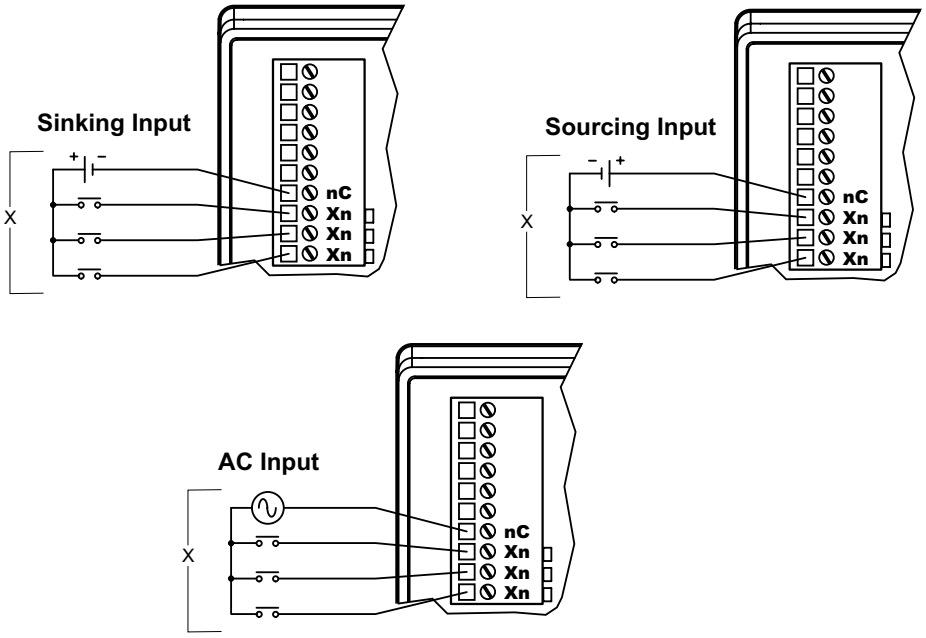
Discrete Input Specifications

Discrete Input Specifications			
Input Type		Sink/Source	
Total Inputs per Module		6	
Commons		2 (3 points/common) Isolated	
Nominal Voltage Range		12–24 VAC/VDC	
Input Voltage Range		9–30 VAC/VDC	
Maximum Voltage		30 VAC/VDC	
DC Frequency		0–250 kHz - High-speed	
Minimum Pulse Width		0.5 µs - High-speed	
AC Frequency		47–63 Hz[2]	
Input Impedance		3kΩ @ 24VDC	
Input Current (typical)		6mA @ 24 VAC/VDC	
Maximum Input Current		12mA @ 30 VAC/VDC	
ON Voltage Level		> 9.0 VAC/VDC	
OFF Voltage Level		< 2.0 VAC/VDC	
Maximum OFF Current		2.0 mA	
Status Indicators		Logic Side, Green	
Input Details			
Input Type		High-Speed DC	Standard[1]
Location		X0...X5	
OFF to ON Response	DC	< 2µs	
	AC	–	10ms[2]
ON to OFF Response	DC	< 2µs	
	AC	–	10ms[2]
Maximum Switching Frequency	DC	250kHz	
	AC	~ 30Hz	

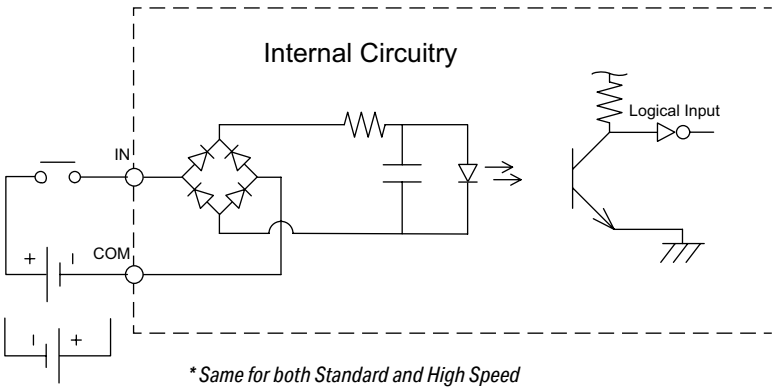
1. *All Inputs may be used as standard inputs or high speed inputs independently.*
2. *60Hz to 240Hz filter should be set in the software when using an AC line signal.*

BX-DM1-10ED1-D Wiring, Continued

Discrete Input Connection Options



Discrete Input Internal Circuitry *



** Same for both Standard and High Speed*

BX-DM1-10ED1-D Wiring, Continued

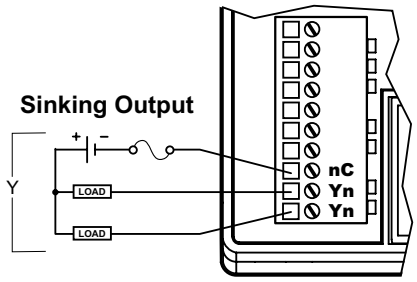
Discrete Output Specifications

Discrete Output Specifications		
Output Type	Sinking	
Total Outputs per Module	4	
Commons	2 (2 points/common) Isolated	
Maximum Current per Common	1A	
Nominal Voltage Range	12–24 VDC	
Operating Voltage Range	5–36 VDC	
Maximum Voltage	36VDC	
Minimum Output Current	0.1 mA @ 24VDC	
Maximum Output Current	0.5 A per output No derating over temperature range	
Maximum Inrush Current	5A for 50ms	
Maximum Leakage Current	10µA	
ON Voltage Drop	0.05 VDC	
Status Indicators	Logic Side, Green	
Output Details		
Output Type	High-Speed	Standard[1]
Location	Y0...Y1	Y2...Y3
OFF to ON Response	< 2µs	< 5ms
ON to OFF Response	< 2µs	< 2ms
Maximum Switching Frequency	1m cable - 250kHz 10m cable - 100kHz	~ 100Hz
Overcurrent, Short Circuit Protection and Short to Ground	Current limit by Common Group, self-resetting	N/A
Overcurrent Trip Level[2]	Between 4A and 8A	N/A
Fuse Type	User-supplied external fuse	

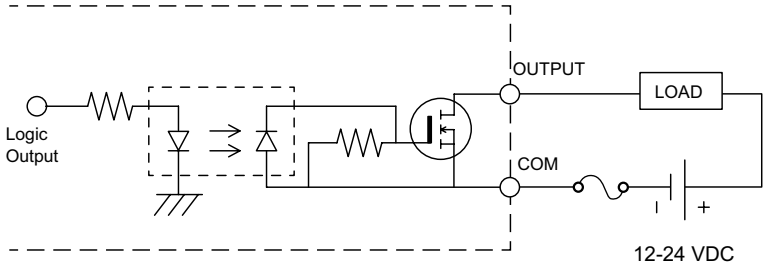
1. *All outputs may be used as standard outputs. Only the first 2 outputs (Y0...Y1) are capable of high-speed DC operation.*
2. *When the high-speed outputs are in an overcurrent situation, the Common terminal Red LED is on. The output LEDs will remain operational even though the output circuitry is turned off and no power is flowing. This condition is not reported to the CPU.*

BX-DM1-10ED1-D Wiring, Continued

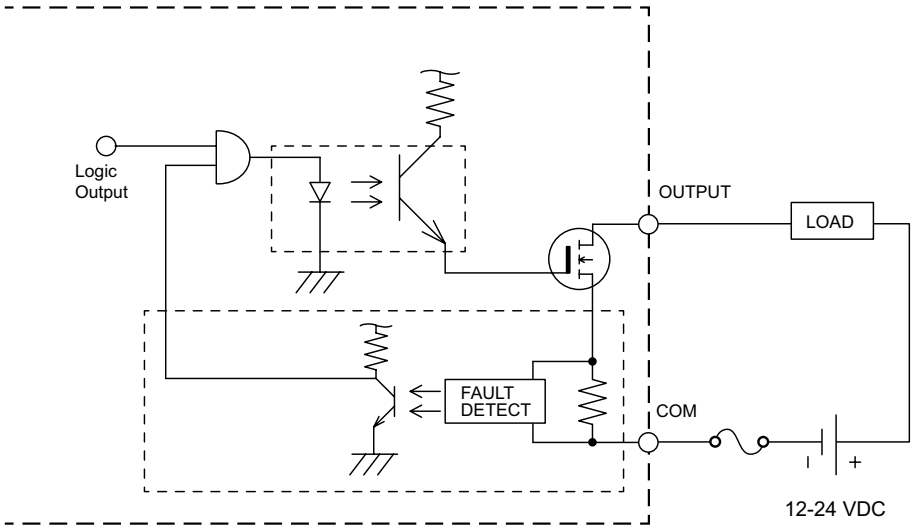
Discrete Output Connection Options



Discrete Standard Output Internal Circuitry



Discrete High-Speed Output Internal Circuitry



NOTE: *When the high speed outputs are in an overcurrent situation, the Common terminal Red LED is on. The output LEDs will remain operational even though the output circuitry is turned off and no power is flowing. This condition is not reported to the CPU.*

BX-DM1-10ED2-D Wiring

This MPU has 10 discrete I/O points. The connections are grouped as follows:

- Six (6) discrete inputs - sinking/sourcing; rated for 12–24 VAC/VDC. They are located along the front left of the unit; organized into groups of 4 terminals consisting of 3 inputs and an isolated common in each group.
- Four (4) discrete outputs - sourcing; rated at 12–24 VDC. They are located along the front left of the unit. The outputs are organized into groups of 3 terminals consisting of 2 outputs and an isolated common in each group.

This MPU requires an external 12–24 VDC power supply. The DC power supply connection is located on the top left side of the unit. There is no 24VDC auxiliary output supply.

WARNING: No analog I/O is included on this unit. The three (3) terminals between the power supply and the inputs are not used. These terminals are not internally connected. DO NOT CONNECT ANYTHING TO THESE TERMINALS!



BX-DM1-10ED2-D

NOTE: *Eight (8) Expansion Modules can be connected to extend I/O capacity, as long as the MPU power budget is not exceeded.*

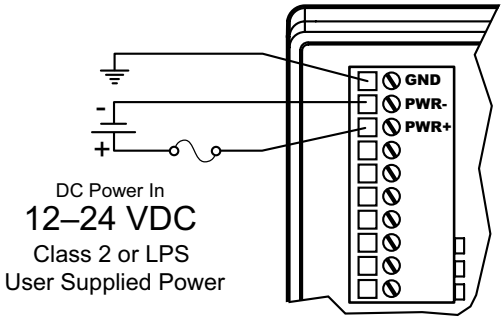
BX-DM1-10ED2-D Wiring, Continued

Power Supply Specifications

Power Supply Specifications	
Nominal Voltage Range*	12–24 VDC
Input Voltage Range (Tolerance)*	10–36 VDC
Maximum Input Voltage Ripple	< ±10%
Maximum Input Power	14W
Cold Start Inrush Current	5A, 2ms
Maximum Inrush Current (Hot Start)	5A, 2ms
Internal Input Protection	Reverse polarity protection and undervoltage lockout via transistor circuit
Acceptable External Power Drop Time	10ms
Under Input Voltage Lock-out	< 9VDC
Heat Dissipation	7.4 W Max
Isolated User 24VDC Output	None
Voltage Withstand (dielectric)	1500VAC power Inputs to ground applied for 1 minute
Insulation Resistance	>10MΩ @ 500VDC
Software Version Required	Do-more! Designer version 2.0 or later

** Class 2 or LPS Power Supply required.*

Power Supply Connections



WARNING: The BRX System MUST have a proper earth ground. Do not operate the BRX MPU without proper earth grounding.

BX-DM1-10ED2-D Wiring, Continued

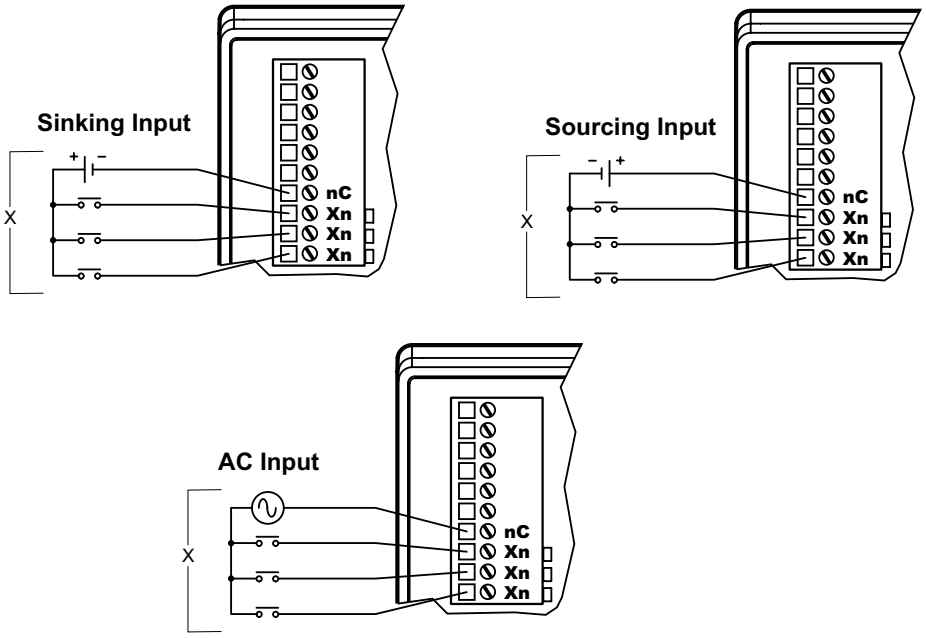
Discrete Input Specifications

Discrete Input Specifications			
Input Type		Sink/Source	
Total Inputs per Module		6	
Commons		2 (3 points/common) Isolated	
Nominal Voltage Range		12–24 VAC/VDC	
Input Voltage Range		9–30 VAC/VDC	
Maximum Voltage		30 VAC/VDC	
DC Frequency		0–250 kHz - High-speed	
Minimum Pulse Width		0.5 µs - High-speed	
AC Frequency		47–63 Hz[2]	
Input Impedance		3kΩ @ 24VDC	
Input Current (typical)		6mA @ 24 VAC/VDC	
Maximum Input Current		12mA @ 30 VAC/VDC	
ON Voltage Level		> 9.0 VAC/VDC	
OFF Voltage Level		< 2.0 VAC/VDC	
Maximum OFF Current		2.0 mA	
Status Indicators		Logic Side, Green	
Input Details			
Input Type		High-Speed DC	Standard[1]
Location		X0...X5	
OFF to ON Response	DC	< 2µs	
	AC	–	10ms[2]
ON to OFF Response	DC	< 2µs	
	AC	–	10ms[2]
Maximum Switching Frequency	DC	250kHz	
	AC	~ 30Hz	

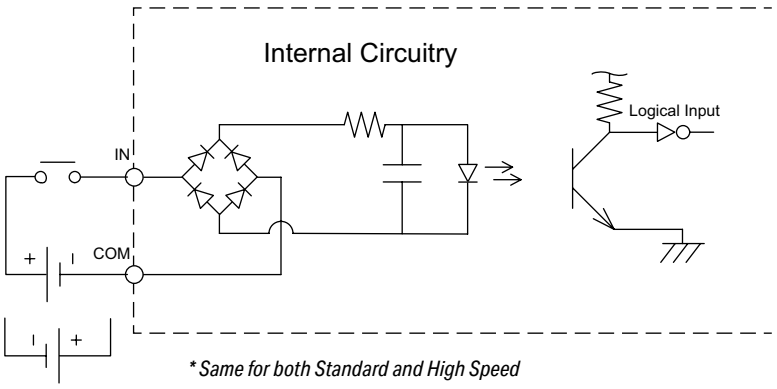
1. *All Inputs may be used as standard inputs or high speed inputs independently.*
2. *60Hz to 240Hz filter should be set in the software when using an AC line signal.*

BX-DM1-10ED2-D Wiring, Continued

Discrete Input Connection Options



Discrete Input Internal Circuitry *



** Same for both Standard and High Speed*

BX-DM1-10ED2-D Wiring, Continued

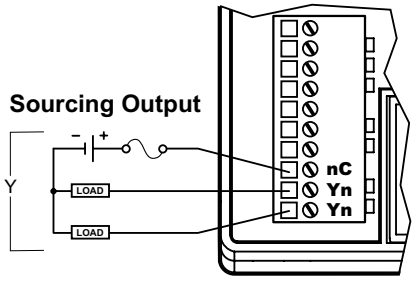
Discrete Output Specifications

Discrete Output Specifications		
Output Type	Sourcing	
Total Outputs per Module	4	
Commons	2 (2 points/common) Isolated	
Maximum Current per Common	1A	
Nominal Voltage Range	12–24 VDC	
Operating Voltage Range	5–36 VDC	
Maximum Voltage	36VDC	
Minimum Output Current	0.1 mA @ 24VDC	
Maximum Output Current	0.5 A per output No derating over temperature range	
Maximum Inrush Current	5A for 50ms	
Maximum Leakage Current	10µA	
ON Voltage Drop	0.05 VDC	
Status Indicators	Logic Side, Green	
Output Details		
Output Type	High-Speed	Standard[1]
Location	Y0...Y1	Y2...Y3
OFF to ON Response	< 2µs	< 5ms
ON to OFF Response	< 2µs	< 2ms
Maximum Switching Frequency	1m cable - 250kHz 10m cable - 100kHz	~ 100Hz
Overcurrent, Short Circuit Protection and Short to Ground	Current limit by Common Group, self-resetting	N/A
Overcurrent Trip Level[2]	Between 4A and 8A	N/A
Fuse Type	User-supplied external fuse	

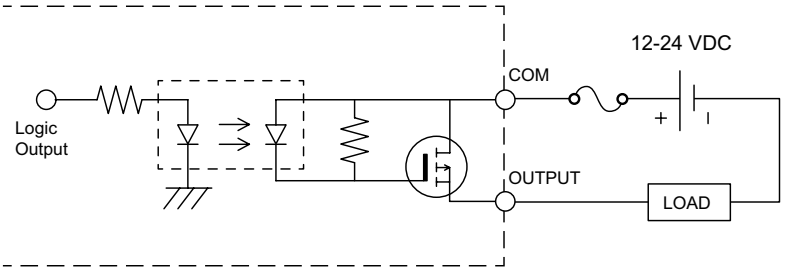
1. *All outputs may be used as standard outputs. Only the first 2 outputs (Y0...Y1) are capable of high-speed DC operation.*
2. *When the high-speed outputs are in an overcurrent situation, the Common terminal Red LED is on. The output LEDs will remain operational even though the output circuitry is turned off and no power is flowing. This condition is not reported to the CPU.*

BX-DM1-10ED2-D Wiring, Continued

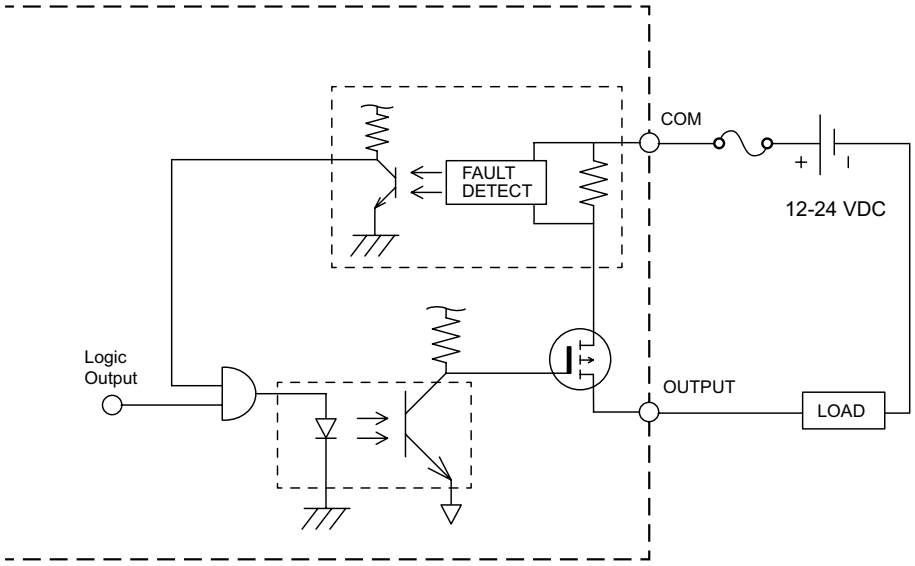
Discrete Output Connection Options



Discrete Standard Output Internal Circuitry



Discrete High-Speed Output Internal Circuitry



NOTE: *When the high speed outputs are in an overcurrent situation, the Common terminal Red LED is on. The output LEDs will remain operational even though the output circuitry is turned off and no power is flowing. This condition is not reported to the CPU.*

BX-DM1-10ER-D Wiring

This MPU has 10 discrete I/O points. The connections are grouped as follows:

- Six (6) discrete inputs - sinking/sourcing; rated for 12–24 VAC/VDC. They are located along the front left of the unit; organized into groups of 4 terminals consisting of 3 inputs and an isolated common in each group.
- Four (4) discrete outputs - Form A Relay (SPST); rated 12–48 VDC/ 24–240 VAC. They are located along the front left of the unit. The outputs are organized into groups of three terminals consisting of two outputs and an isolated common in each group.

This MPU requires an external 12–24 VDC power supply. The DC power supply connection is located on the top left side of the unit. There is no 24VDC auxiliary output supply.

WARNING: No analog I/O is included on this unit. The three (3) terminals between the power supply and the inputs are not used. These terminals are not internally connected. DO NOT CONNECT ANYTHING TO THESE TERMINALS!



BX-DM1-10ER-D

NOTE: *Eight (8) Expansion Modules can be connected to extend I/O capacity, as long as the MPU power budget is not exceeded.*

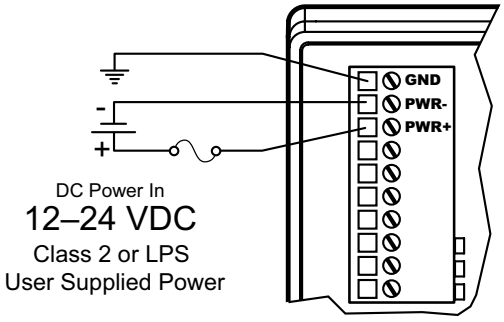
BX-DM1-10ER-D Wiring, Continued

Power Supply Specifications

Power Supply Specifications	
Nominal Voltage Range*	12–24 VDC
Input Voltage Range (Tolerance)*	10–36 VDC
Maximum Input Voltage Ripple	< ±10%
Maximum Input Power	14W
Cold Start Inrush Current	5A, 2ms
Maximum Inrush Current (Hot Start)	5A, 2ms
Internal Input Protection	Reverse polarity protection and undervoltage lockout via transistor circuit
Acceptable External Power Drop Time	10ms
Under Input Voltage Lock-out	< 9VDC
Heat Dissipation	8.9 W Max
Isolated User 24VDC Output	None
Voltage Withstand (dielectric)	1500VAC power Inputs to ground applied for 1 minute
Insulation Resistance	>10MΩ @ 500VDC
Software Version Required	Do-more! Designer version 2.0 or later

** Class 2 or LPS Power Supply required.*

Power Supply Connections



WARNING: The BRX System MUST have a proper earth ground. Do not operate the BRX MPU without proper earth grounding.

BX-DM1-10ER-D Wiring, Continued

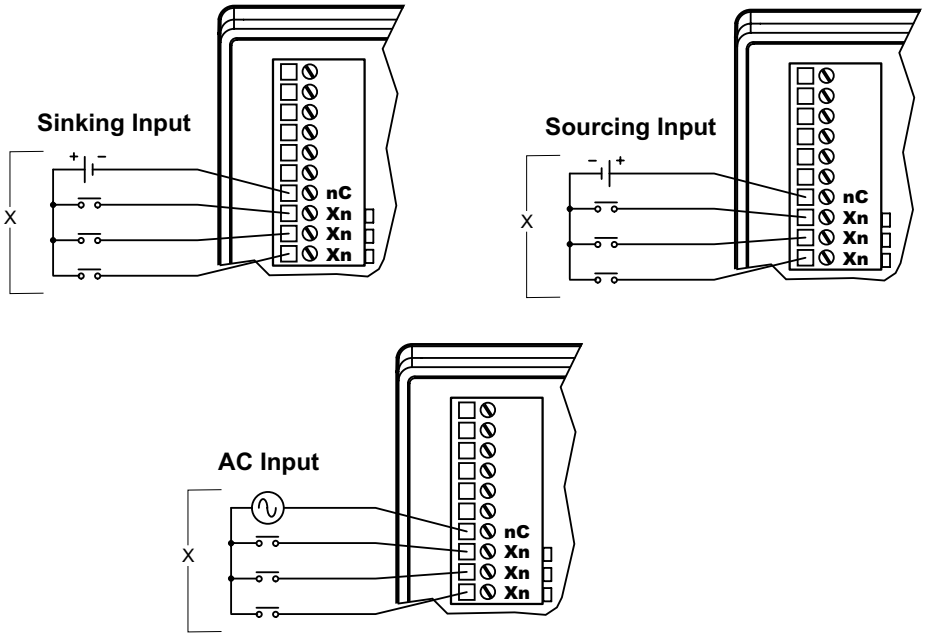
Discrete Input Specifications

Discrete Input Specifications			
Input Type		Sink/Source	
Total Inputs per Module		6	
Commons		2 (3 points/common) Isolated	
Nominal Voltage Range		12–24 VAC/VDC	
Input Voltage Range		9–30 VAC/VDC	
Maximum Voltage		30 VAC/VDC	
DC Frequency		0–250 kHz - High-speed	
Minimum Pulse Width		0.5 µs - High-speed	
AC Frequency		47–63 Hz[2]	
Input Impedance		3kΩ @ 24VDC	
Input Current (typical)		6mA @ 24 VAC/VDC	
Maximum Input Current		12mA @ 30 VAC/VDC	
ON Voltage Level		> 9.0 VAC/VDC	
OFF Voltage Level		< 2.0 VAC/VDC	
Maximum OFF Current		2.0 mA	
Status Indicators		Logic Side, Green	
Input Details			
Input Type		High-Speed DC	Standard[1]
Location		X0...X5	
OFF to ON Response	DC	< 2µs	
	AC	–	10ms[2]
ON to OFF Response	DC	< 2µs	
	AC	–	10ms[2]
Maximum Switching Frequency	DC	250kHz	
	AC	~ 30Hz	

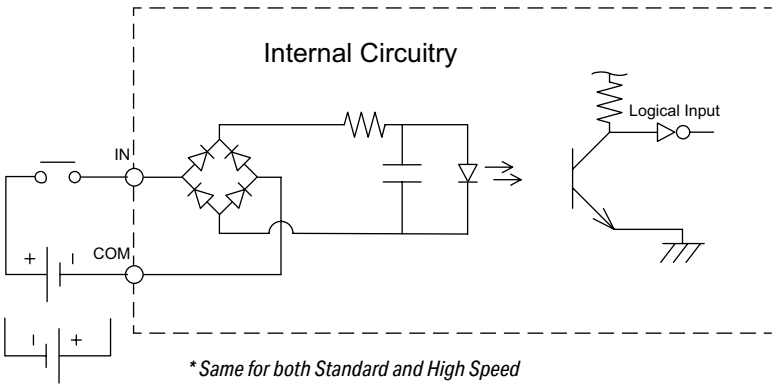
1. *All Inputs may be used as standard inputs or high speed inputs independently.*
2. *60Hz to 240Hz filter should be set in the software when using an AC line signal.*

BX-DM1-10ER-D Wiring, Continued

Discrete Input Connection Options



Discrete Input Internal Circuitry *



*Same for both Standard and High Speed

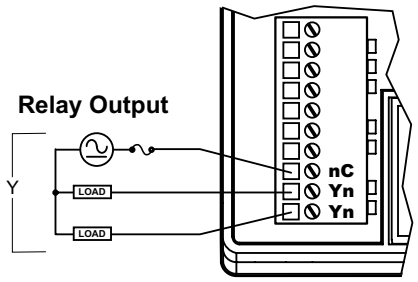
BX-DM1-10ER-D Wiring, Continued

Discrete Output Specifications

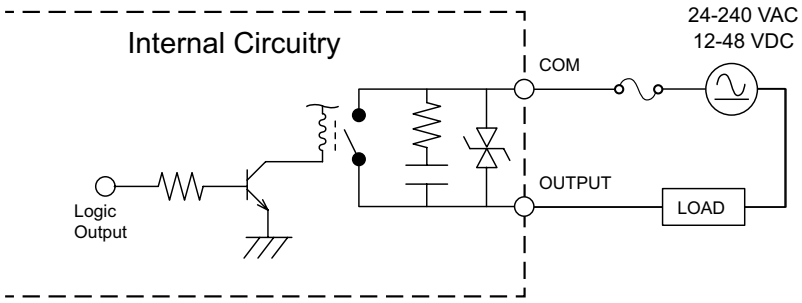
Discrete Output Specifications	
Output Type	Relay Form A (SPST)
Total Outputs per Module	4
Commons	2 (2 points/common) Isolated
Maximum Current per Common	4A
Nominal Voltage Range	12–48 VDC 24–240 VAC
Operating Voltage Range	5–60 VDC 5–264 VAC
Maximum Voltage	60VDC 264VAC
Minimum Output Current	0.1 mA @ 24VDC 0.1 mA @ 24VAC
Maximum Output Current	2A
Maximum Inrush Current	5A for 50ms
Maximum Leakage Current	1µA (DC), 300µA (AC) due to RC snubber circuit
ON Voltage Drop	0.2 V Max
Status Indicators	Logic Side, Green
Output Details	
Output Type	Standard
Location	Y0...Y3
ON-OFF Response	<10ms
OFF-ON Response	<10ms
Maximum Switching Frequency	10Hz
Relay Cycle Life Mechanical Endurance Electrical Endurance	 5 million operations 120,000 operations
Fuse Type	User-supplied external fuse

BX-DM1-10ER-D Wiring, Continued

Discrete Output Connection Options



Discrete Standard Output Internal Circuitry



BX-DM1-10AR-D Wiring

This MPU has 10 discrete I/O points. The connections are grouped as follows:

- Six (6) discrete inputs - AC rated for 120–240 VAC. They are located along the front left of the unit; organized into groups of 4 terminals consisting of 3 inputs and an isolated common in each group.
- Four (4) discrete outputs - Form A Relay (SPST); rated 12–48 VDC/ 24–240 VAC. They are located along the front left of the unit. The outputs are organized into groups of 3 terminals consisting of 2 outputs and an isolated common in each group.

This MPU requires an external 12–24 VDC power supply. The DC power supply connection is located on the top left side of the unit. There is no 24VDC auxiliary output supply.

WARNING: No analog I/O is included on this unit. The three (3) terminals between the power supply and the inputs are not used. These terminals are not internally connected. DO NOT CONNECT ANYTHING TO THESE TERMINALS!



BX-DM1-10AR-D

NOTE: *Eight (8) Expansion Modules can be connected to extend I/O capacity, as long as the MPU power budget is not exceeded.*

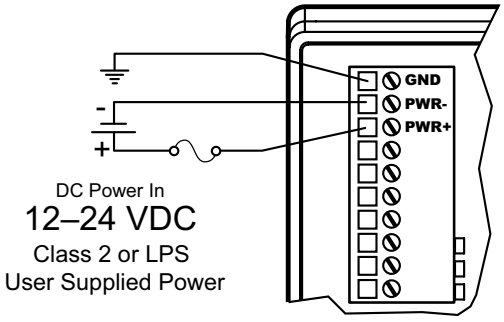
BX-DM1-10AR-D Wiring, Continued

Power Supply Specifications

Power Supply Specifications	
Nominal Voltage Range*	12–24 VDC
Input Voltage Range (Tolerance)*	10–36 VDC
Maximum Input Voltage Ripple	< ±10%
Maximum Input Power	14W
Cold Start Inrush Current	5A, 2ms
Maximum Inrush Current (Hot Start)	5A, 2ms
Internal Input Protection	Reverse polarity protection and undervoltage lockout via transistor circuit
Acceptable External Power Drop Time	10ms
Under Input Voltage Lock-out	< 9VDC
Heat Dissipation	8.7 W Max
Isolated User 24VDC Output	None
Voltage Withstand (dielectric)	1500VAC power Inputs to ground applied for 1 minute
Insulation Resistance	>10MΩ @ 500VDC
Software Version Required	Do-more! Designer version 2.0 or later

** Class 2 or LPS Power Supply required.*

Power Supply Connections



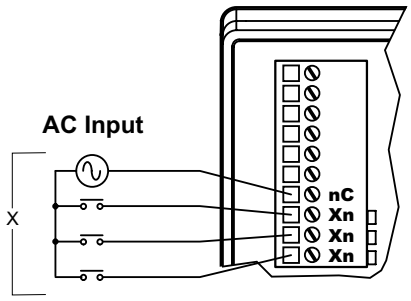
WARNING: The BRX System MUST have a proper earth ground. Do not operate the BRX MPU without proper earth grounding.

BX-DM1-10AR-D Wiring, Continued

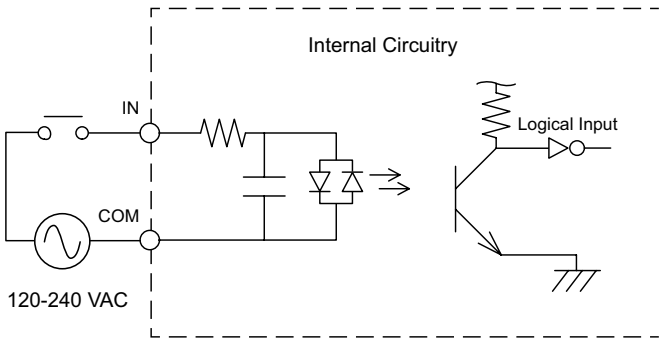
Discrete Input Specifications

Discrete Input Specifications	
Input Type	AC
Total Inputs per Module	6
Commons	2 (3 points/common) Isolated
Nominal Voltage Range	120–240 VAC
Input Voltage Range	85–264 VAC
Maximum Voltage	264VAC RMS
AC Frequency	47–63 Hz
Input Impedance	15kΩ
Input Current (typical)	9mA @ 120VAC, 13mA @ 220VAC
Maximum Input Current	14mA @ 120VAC, 20mA @ 220VAC
ON Voltage Level	> 85VAC
OFF Voltage Level	< 40VAC
Maximum OFF Current	2.5 mA
Status Indicators	Logic Side, Green
Input Details	
Input Type	Standard
Location	X0...X5
OFF - ON Response	10ms
ON - OFF Response	10ms
Maximum Switching Frequency	~ 30Hz

Discrete Input Connection Options



Discrete Input Internal Circuitry



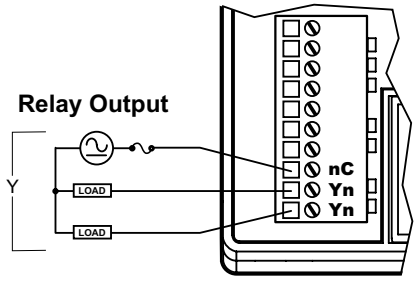
BX-DM1-10AR-D Wiring, Continued

Discrete Output Specifications

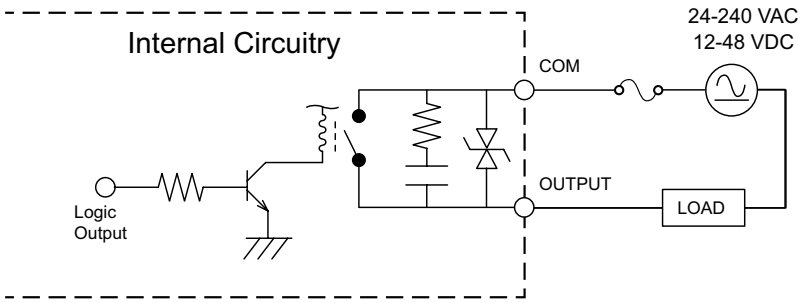
Discrete Output Specifications	
Output Type	Relay Form A (SPST)
Total Outputs per Module	4
Commons	2 (2 points/common) Isolated
Maximum Current per Common	4A
Nominal Voltage Range	12–48 VDC 24–240 VAC
Operating Voltage Range	5–60 VDC 5–264 VAC
Maximum Voltage	60VDC 264VAC
Minimum Output Current	0.1 mA @ 24VDC 0.1 mA @ 24VAC
Maximum Output Current	2A
Maximum Inrush Current	5A for 50ms
Maximum Leakage Current	1µA (DC), 300µA (AC) due to RC snubber circuit
ON Voltage Drop	0.2 V Max
Status Indicators	Logic Side, Green
Output Details	
Output Type	Standard
Location	Y0...Y3
ON-OFF Response	<10ms
OFF-ON Response	<10ms
Maximum Switching Frequency	10Hz
Relay Cycle Life Mechanical Endurance Electrical Endurance	 5 million operations 120,000 operations
Fuse Type	User-supplied external fuse

BX-DM1-10AR-D Wiring, Continued

Discrete Output Connection Options



Discrete Standard Output Internal Circuitry



BX 10E Micro PLC Units (MPUs)

BX-DM1E-10ED13-D Wiring

This MPU has 10 discrete I/O points. The connections are grouped as follows:

- Six (6) discrete inputs - sinking/sourcing; rated for 12–24 VAC/VDC. They are located along the front left of the unit; organized into groups of 4 terminals consisting of 3 inputs and an isolated common in each group.
- Four (4) discrete outputs - sinking; rated at 12–24 VDC. They are located along the front left of the unit. The outputs are organized into groups of 3 terminals consisting of 2 outputs and an isolated common in each group.
- One (1) analog input and one (1) analog output. The analog inputs and outputs are located along the front left side of the unit. The analog inputs and outputs are grouped together on 3 terminals consisting of 1 analog input, 1 analog output and a shared analog common.
  - current or voltage selectable through software
  - 16-bit resolution @ ±10V, ±20mA
  - current signal ranges of 4–20 mA, ±20 mA
  - voltage signal ranges of 0–5 VDC, 0–10 VDC, ±5VDC, ±10VDC

This MPU requires an external 12–24 VDC power supply. The DC power supply connection is located on the top left side of the unit. There is no 24VDC auxiliary output supply.



BX-DM1E-10ED13-D

NOTE: *Eight (8) Expansion Modules can be connected to extend I/O capacity, as long as the MPU power budget is not exceeded.*

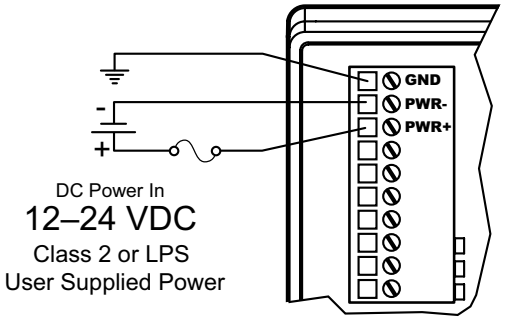
BX-DM1E-10ED13-D Wiring, Continued

Power Supply Specifications

Power Supply Specifications	
Nominal Voltage Range*	12–24 VDC
Input Voltage Range (Tolerance)*	10–36 VDC
Maximum Input Voltage Ripple	< ±10%
Maximum Input Power	14W
Cold Start Inrush Current	5A, 2ms
Maximum Inrush Current (Hot Start)	5A, 2ms
Internal Input Protection	Reverse polarity protection and undervoltage lockout via transistor circuit
Acceptable External Power Drop Time	10ms
Under Input Voltage Lock-out	< 9VDC
Heat Dissipation	8.7 W Max
Isolated User 24VDC Output	None
Voltage Withstand (dielectric)	1500VAC power Inputs to ground applied for 1 minute
Insulation Resistance	>10MΩ @ 500VDC
Software Version Required	Do-more! Designer version 2.0 or later

** Class 2 or LPS Power Supply required.*

Power Supply Connections



WARNING: The BRX System MUST have a proper earth ground. Do not operate the BRX MPU without proper earth grounding.

BX-DM1E-10ED13-D Wiring, Continued

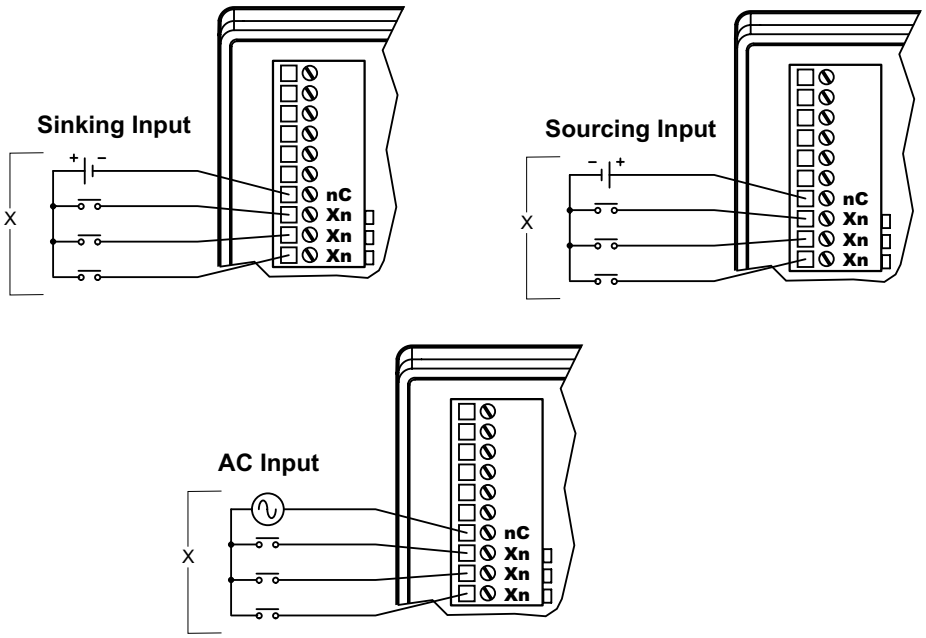
Discrete Input Specifications

Discrete Input Specifications			
Input Type		Sink/Source	
Total Inputs per Module		6	
Commons		2 (3 points/common) Isolated	
Nominal Voltage Range		12–24 VAC/VDC	
Input Voltage Range		9–30 VAC/VDC	
Maximum Voltage		30 VAC/VDC	
DC Frequency		0–250 kHz - High-speed	
Minimum Pulse Width		0.5 µs - High-speed	
AC Frequency		47–63 Hz[2]	
Input Impedance		3kΩ @ 24VDC	
Input Current (typical)		6mA @ 24 VAC/VDC	
Maximum Input Current		12mA @ 30 VAC/VDC	
ON Voltage Level		> 9.0 VAC/VDC	
OFF Voltage Level		< 2.0 VAC/VDC	
Maximum OFF Current		2.0 mA	
Status Indicators		Logic Side, Green	
Input Details			
Input Type		High-Speed DC	Standard[1]
Location		X0...X5	
OFF to ON Response	DC	< 2µs	
	AC	–	10ms[2]
ON to OFF Response	DC	< 2µs	
	AC	–	10ms[2]
Maximum Switching Frequency	DC	250kHz	
	AC	~ 30Hz	

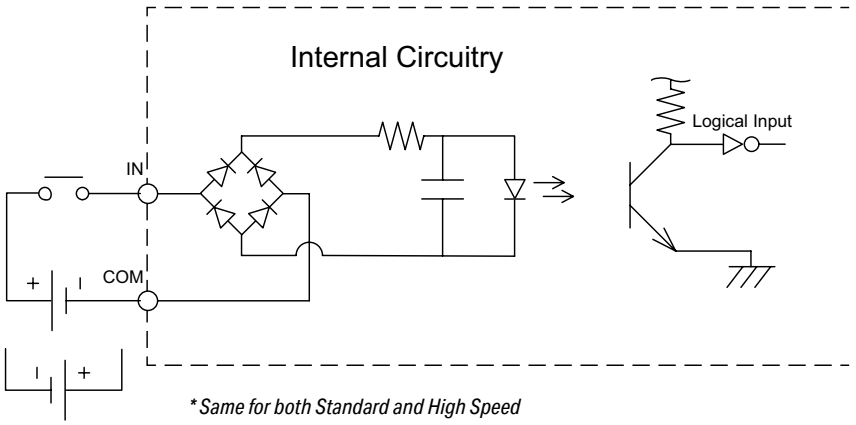
1. All Inputs may be used as standard inputs or high speed inputs independently.
2. 60Hz to 240Hz filter should be set in the software when using an AC line signal.

BX-DM1E-10ED13-D Wiring, Continued

Discrete Input Connection Options



Discrete Input Internal Circuitry *



BX-DM1E-10ED13-D Wiring, Continued

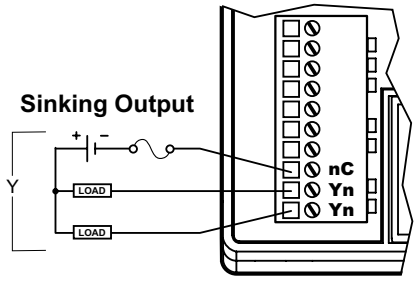
Discrete Output Specifications

Discrete Output Specifications		
Output Type	Sinking	
Total Outputs per Module	4	
Commons	2 (2 points/common) Isolated	
Maximum Current per Common	1A	
Nominal Voltage Range	12–24 VDC	
Operating Voltage Range	5–36 VDC	
Maximum Voltage	36VDC	
Minimum Output Current	0.1 mA @ 24VDC	
Maximum Output Current	0.5 A per output No derating over temperature range	
Maximum Inrush Current	5A for 50ms	
Maximum Leakage Current	10µA	
ON Voltage Drop	0.05 VDC	
Status Indicators	Logic Side, Green	
Output Details		
Output Type	High-Speed	Standard[1]
Location	Y0...Y1	Y2...Y3
OFF to ON Response	< 2µs	< 5ms
ON to OFF Response	< 2µs	< 2ms
Maximum Switching Frequency	1m cable - 250kHz 10m cable - 100kHz	~ 100Hz
Overcurrent, Short Circuit Protection and Short to Ground	Current limit by Common Group, self-resetting	N/A
Overcurrent Trip Level[2]	Between 4A and 8A	N/A
Fuse Type	User-supplied external fuse	

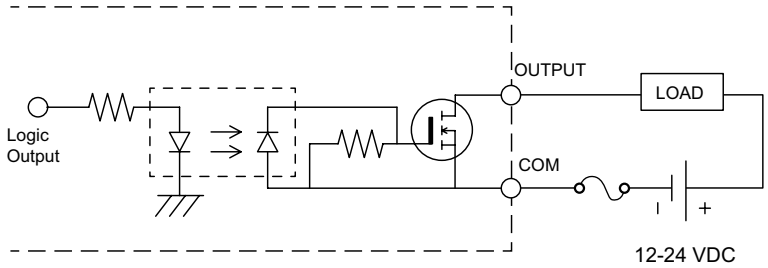
1. *All outputs may be used as standard outputs. Only the first 2 outputs (Y0...Y1) are capable of high-speed DC operation.*
2. *When the high-speed outputs are in an overcurrent situation, the Common terminal Red LED is on. The output LEDs will remain operational even though the output circuitry is turned off and no power is flowing. This condition is not reported to the CPU.*

BX-DM1E-10ED13-D Wiring, Continued

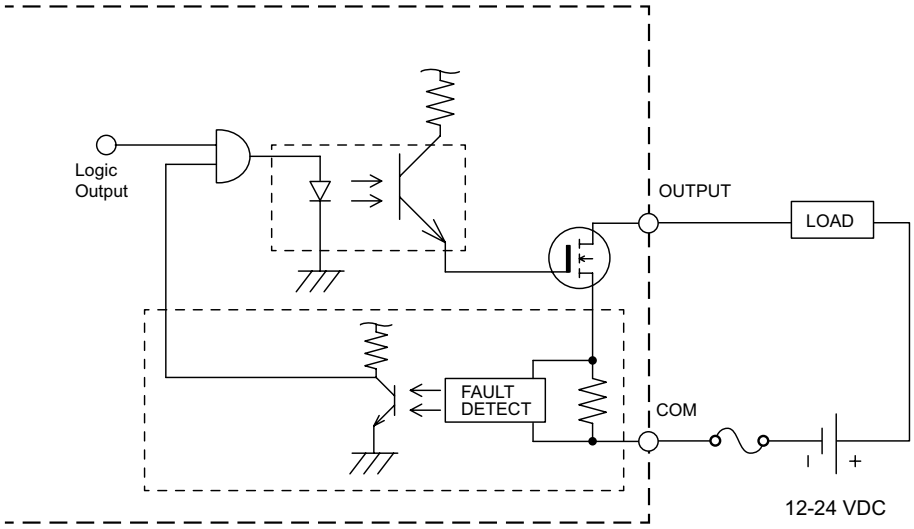
Discrete Output Connection Options



Discrete Standard Output Internal Circuitry



Discrete High-Speed Output Internal Circuitry



NOTE: *When the high speed outputs are in an overcurrent situation, the Common terminal Red LED is on. The output LEDs will remain operational even though the output circuitry is turned off and no power is flowing. This condition is not reported to the CPU.*

BX-DM1E-10ED13-D Wiring, Continued

Analog Input Specifications

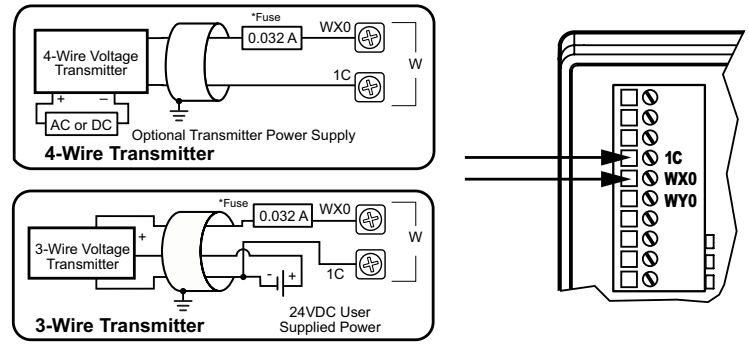
Analog Input Specifications	
Inputs per Module	1
Commons	1
Input Voltage Range *	Software Selectable ±10V, ±5V, 0–10 V, 0–5 V
Input Current Range *	Software Selectable ±20mA, 4–20 mA
Resolution ±10V, ±20mA ±5V 0–5 V 4–20 mA 0–10 V	 16 bits (0–65535 counts) 15 bits (0–32767 counts) 14 bits (0–16383 counts) ~15 bits (6553–32767 counts) 15 bits (0–32767 counts)
Input Impedance Voltage Modes	100kΩ
Absolute Maximum Input, Voltage Mode	±30V
Input Impedance Current Modes	249Ω
Absolute Maximum Input, Current Mode	±40mA sustained, ±100mA for < 5s
Conversion Time	1.2 ms
Input Stability	0.02% of Full Hardware Range = 13 Counts
Full Scale Calibration Error	0.05% of Full Hardware Range = 33 Counts
Offset Calibration Error	0.01% of Full Hardware Range = 7 Counts
Accuracy vs Temperature Error	0.05% of Full Hardware Range = 33 Counts
Maximum Linearity Error (End to End)	0.1% of Full Hardware Range = 66 Counts
Maximum Inaccuracy	0.2% of Full Hardware Range = 131 Counts
Fuse Type	User-supplied external fuse

** Software selectable per channel*

BX-DM1E-10ED13-D Wiring, Continued

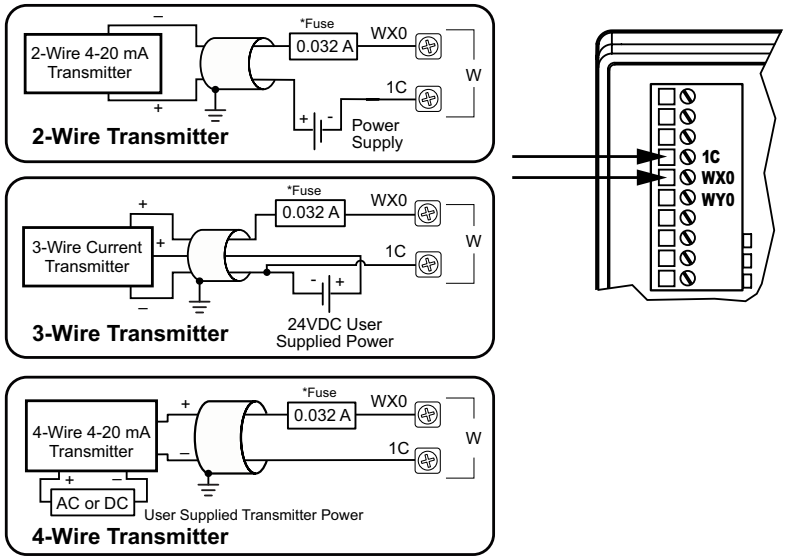
Analog Input Connections Options

Analog Voltage Input Circuits



NOTE: Shield should be connected only at one end, to ground at the source device.

Analog Current Sinking Input Circuits



NOTE: Shield should be connected only at one end, to ground at the source device.



NOTE: *An Edison S500-32-R 0.032A fast-acting fuse is recommended for all analog voltage inputs, analog outputs, and current loops.*

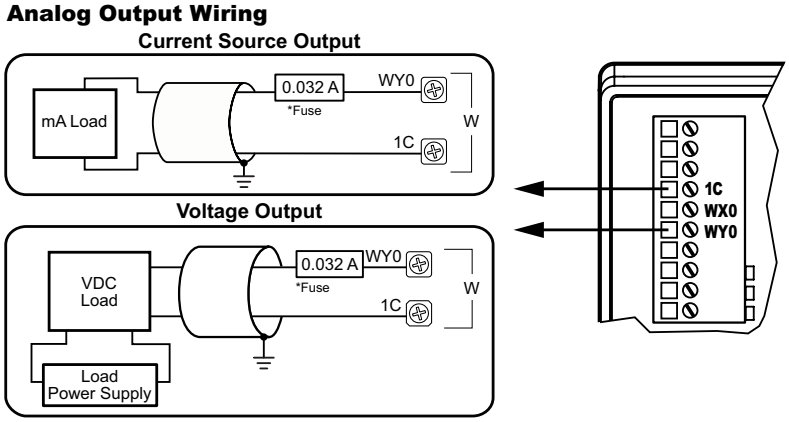
BX-DM1E-10ED13-D Wiring, Continued

Analog Output Specifications

Analog Output Specifications	
Outputs per Module	1
Commons	1
Output Voltage Range *	Software Selectable ±10V, ±5V, 0–10 V, 0–5 V
Output Current Range *	Software Selectable ±20mA, 4–20 mA
Resolution ±10V, ±20mA ±5V 0–5 V 4–20 mA 0–10 V	 16 bits (0–65535 counts) 15 bits (0–32767 counts) 14 bits (0–16383 counts) ~15 bits (6553–32767 counts) 15 bits (0–32767 counts)
Minimum Voltage Load Impedance	1kΩ
Maximum Current Load Impedance	500Ω
Maximum Rating	Continuous Short Circuit Protected
Settling Time	< 1ms
Output Stability	0.02% of Full Hardware Range = 13 Counts
Full Scale Calibration Error	0.05% of Full Hardware Range = 33 Counts
Offset Calibration Error	0.01% of Full Hardware Range = 7 Counts
Accuracy vs Temperature Error	0.05% of Full Hardware Range = 33 Counts
Maximum Linearity Error (End to End)	0.1% of Full Hardware Range = 66 Counts
Maximum Inaccuracy	0.2% of Full Hardware Range = 131 Counts
Fuse Type	User-supplied external fuse

** Software selectable per channel*

Analog Output Connections Options



NOTE: Shield should be connected only at one end, to ground at the source device.

NOTE: *An Edison S500-32-R 0.032A fast-acting fuse is recommended for all analog voltage inputs, analog outputs, and current loops.*

BX-DM1E-10ED23-D Wiring

This MPU has 10 discrete I/O points. The connections are grouped as follows:

- Six (6) discrete inputs - sinking/sourcing; rated for 12–24 VAC/VDC. They are located along the front left of the unit; organized into groups of 4 terminals consisting of 3 inputs and an isolated common in each group.
- Four (4) discrete outputs - sourcing; rated at 12–24 VDC. They are located along the front left of the unit. The outputs are organized into groups of 3 terminals consisting of 2 outputs and an isolated common in each group.
- One (1) analog input and one (1) analog output. The analog inputs and outputs are located along the front left side of the unit. The analog inputs and outputs are grouped together on 3 terminals consisting of 1 analog input, 1 analog output and a shared analog common.
  - current or voltage selectable through software
  - 16-bit resolution @ ±10V, ±20mA
  - current signal ranges of 4–20 mA, ±20 mA
  - voltage signal ranges of 0–5 VDC, 0–10 VDC, ±5VDC, ±10VDC

This MPU requires an external 12–24 VDC power supply. The DC power supply connection is located on the top left side of the unit. There is no 24VDC auxiliary output supply



BX-DM1E-10ED23-D

NOTE: *Eight (8) Expansion Modules can be connected to extend I/O capacity, as long as the MPU power budget is not exceeded.*

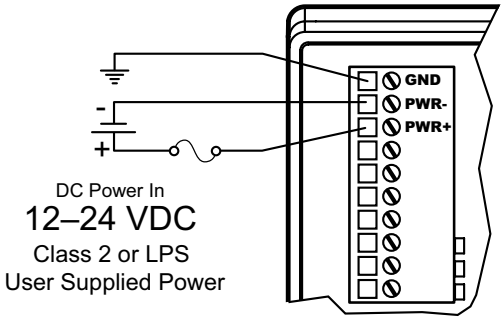
BX-DM1E-10ED23-D Wiring, Continued

Power Supply Specifications

Power Supply Specifications	
Nominal Voltage Range*	12–24 VDC
Input Voltage Range (Tolerance)*	10–36 VDC
Maximum Input Voltage Ripple	< ±10%
Maximum Input Power	14W
Cold Start Inrush Current	5A, 2ms
Maximum Inrush Current (Hot Start)	5A, 2ms
Internal Input Protection	Reverse polarity protection and undervoltage lockout via transistor circuit
Acceptable External Power Drop Time	10ms
Under Input Voltage Lock-out	< 9VDC
Heat Dissipation	8.7 W Max
Isolated User 24VDC Output	None
Voltage Withstand (dielectric)	1500VAC power Inputs to ground applied for 1 minute
Insulation Resistance	>10MΩ @ 500VDC
Software Version Required	Do-more! Designer version 2.0 or later

** Class 2 or LPS Power Supply required.*

Power Supply Connections



WARNING: The BRX System MUST have a proper earth ground. Do not operate the BRX MPU without proper earth grounding.

BX-DM1E-10ED23-D Wiring, Continued

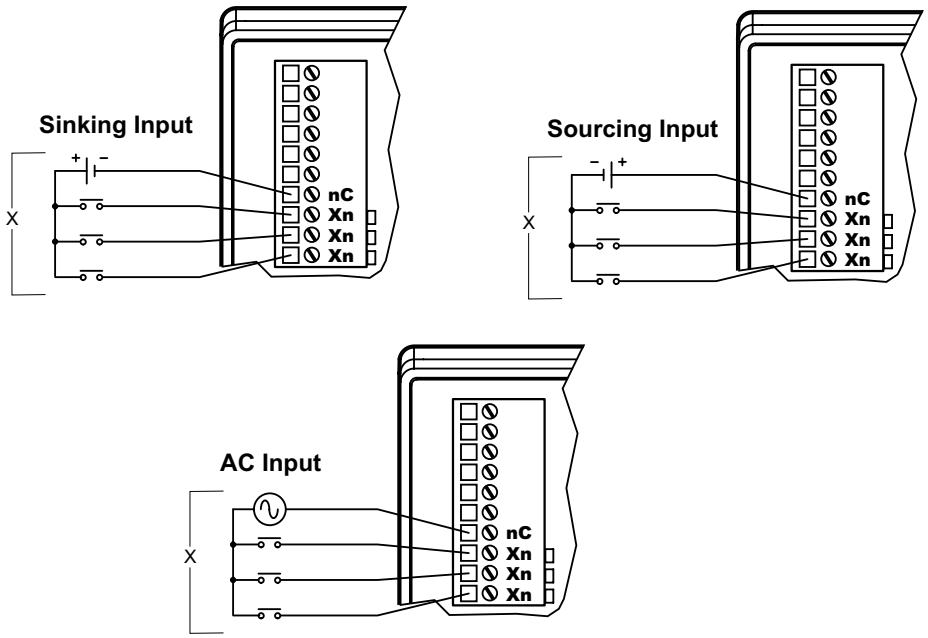
Discrete Input Specifications

Discrete Input Specifications			
Input Type		Sink/Source	
Total Inputs per Module		6	
Commons		2 (3 points/common) Isolated	
Nominal Voltage Range		12–24 VAC/VDC	
Input Voltage Range		9–30 VAC/VDC	
Maximum Voltage		30 VAC/VDC	
DC Frequency		0–250 kHz - High-speed	
Minimum Pulse Width		0.5 µs - High-speed	
AC Frequency		47–63 Hz[2]	
Input Impedance		3kΩ @ 24VDC	
Input Current (typical)		6mA @ 24 VAC/VDC	
Maximum Input Current		12mA @ 30 VAC/VDC	
ON Voltage Level		> 9.0 VAC/VDC	
OFF Voltage Level		< 2.0 VAC/VDC	
Maximum OFF Current		2.0 mA	
Status Indicators		Logic Side, Green	
Input Details			
Input Type		High-Speed DC	Standard[1]
Location		X0...X5	
OFF to ON Response	DC	< 2µs	
	AC	–	10ms[2]
ON to OFF Response	DC	< 2µs	
	AC	–	10ms[2]
Maximum Switching Frequency	DC	250kHz	
	AC	~ 30Hz	

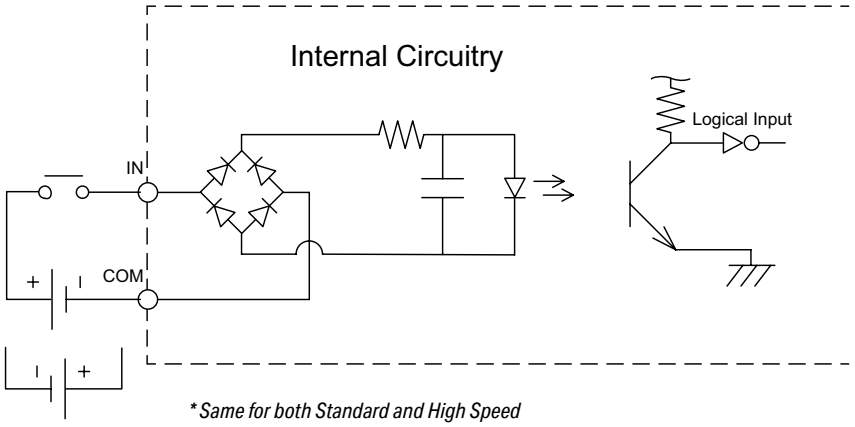
1. *All Inputs may be used as standard inputs or high speed inputs independently.*
2. *60Hz to 240Hz filter should be set in the software when using an AC line signal.*

BX-DM1E-10ED23-D Wiring, Continued

Discrete Input Connection Options



Discrete Input Internal Circuitry *



** Same for both Standard and High Speed*

12-24 VDC

BX-DM1E-10ED23-D Wiring, Continued

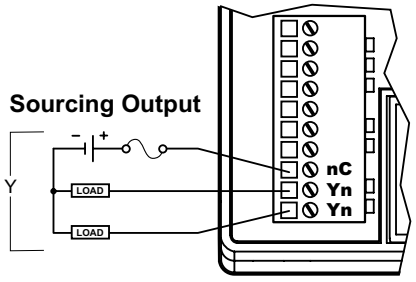
Discrete Output Specifications

Discrete Output Specifications		
Output Type	Sourcing	
Total Outputs per Module	4	
Commons	2 (2 points/common) Isolated	
Maximum Current per Common	1A	
Nominal Voltage Range	12–24 VDC	
Operating Voltage Range	5–36 VDC	
Maximum Voltage	36VDC	
Minimum Output Current	0.1 mA @ 24VDC	
Maximum Output Current	0.5 A per output No derating over temperature range	
Maximum Inrush Current	5A for 50ms	
Maximum Leakage Current	10µA	
ON Voltage Drop	0.05 VDC	
Status Indicators	Logic Side, Green	
Output Details		
Output Type	High-Speed	Standard[1]
Location	Y0...Y1	Y2...Y3
OFF to ON Response	< 2µs	< 5ms
ON to OFF Response	< 2µs	< 2ms
Maximum Switching Frequency	1m cable - 250kHz 10m cable - 100kHz	~ 100Hz
Overcurrent, Short Circuit Protection and Short to Ground	Current limit by Common Group, self-resetting	N/A
Overcurrent Trip Level[2]	Between 4A and 8A	N/A
Fuse Type	User-supplied external fuse	

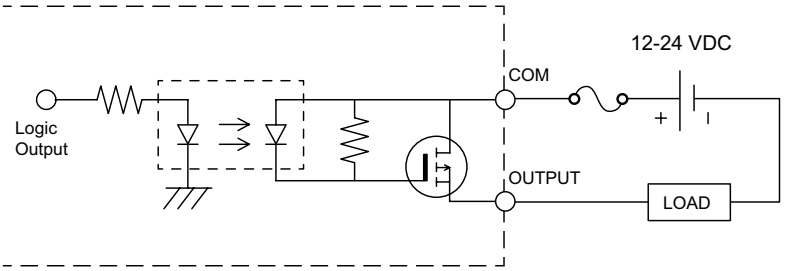
1. *All outputs may be used as standard outputs. Only the first 2 outputs (Y0...Y1) are capable of high-speed DC operation.*
2. *When the high-speed outputs are in an overcurrent situation, the Common terminal Red LED is on. The output LEDs will remain operational even though the output circuitry is turned off and no power is flowing. This condition is not reported to the CPU.*

BX-DM1E-10ED23-D Wiring, Continued

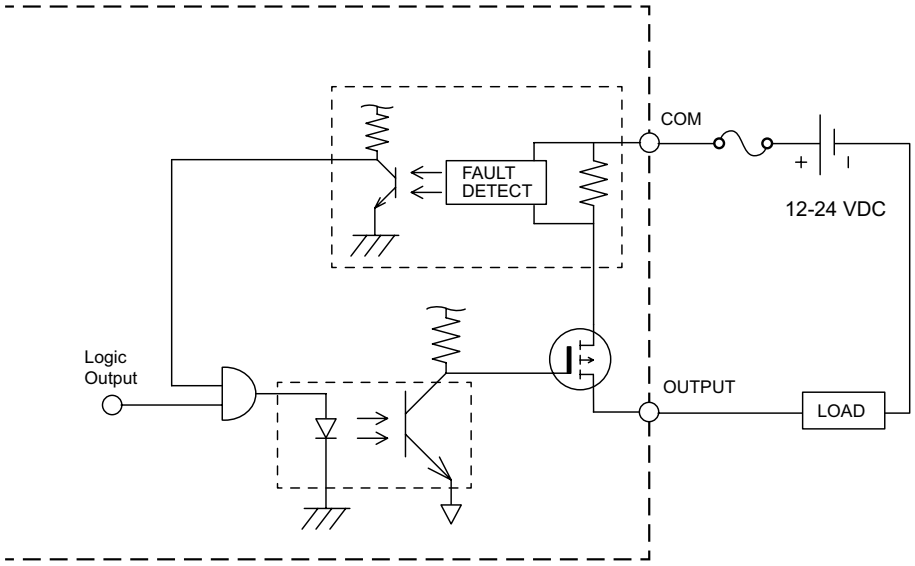
Discrete Output Connection Options



Discrete Standard Output Internal Circuitry



Discrete High-Speed Output Internal Circuitry



NOTE: *When the high speed outputs are in an overcurrent situation, the Common terminal Red LED is on. The output LEDs will remain operational even though the output circuitry is turned off and no power is flowing. This condition is not reported to the CPU.*

BX-DM1E-10ED23-D Wiring, Continued

Analog Input Specifications

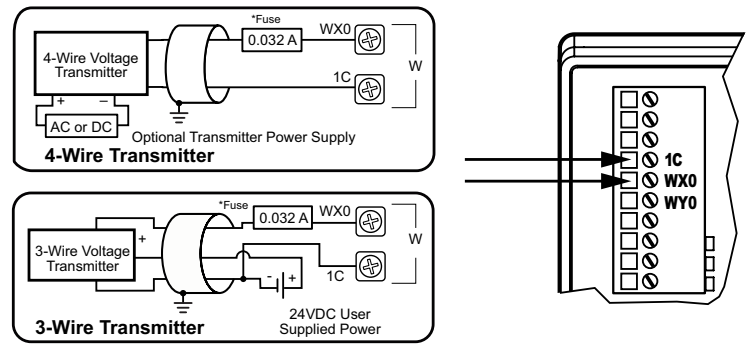
Analog Input Specifications	
Inputs per Module	1
Commons	1
Input Voltage Range *	Software Selectable ±10V, ±5V, 0–10 V, 0–5 V
Input Current Range *	Software Selectable ±20mA, 4–20 mA
Resolution ±10V, ±20mA ±5V 0–5 V 4–20 mA 0–10 V	 16 bits (0–65535 counts) 15 bits (0–32767 counts) 14 bits (0–16383 counts) ~15 bits (6553–32767 counts) 15 bits (0–32767 counts)
Input Impedance Voltage Modes	100kΩ
Absolute Maximum Input, Voltage Mode	±30V
Input Impedance Current Modes	249Ω
Absolute Maximum Input, Current Mode	±40mA sustained, ±100mA for < 5s
Conversion Time	1.2 ms
Input Stability	0.02% of Full Hardware Range = 13 Counts
Full Scale Calibration Error	0.05% of Full Hardware Range = 33 Counts
Offset Calibration Error	0.01% of Full Hardware Range = 7 Counts
Accuracy vs Temperature Error	0.05% of Full Hardware Range = 33 Counts
Maximum Linearity Error (End to End)	0.1% of Full Hardware Range = 66 Counts
Maximum Inaccuracy	0.2% of Full Hardware Range = 131 Counts
Fuse Type	User-supplied external fuse

** Software selectable per channel*

BX-DM1E-10ED23-D Wiring, Continued

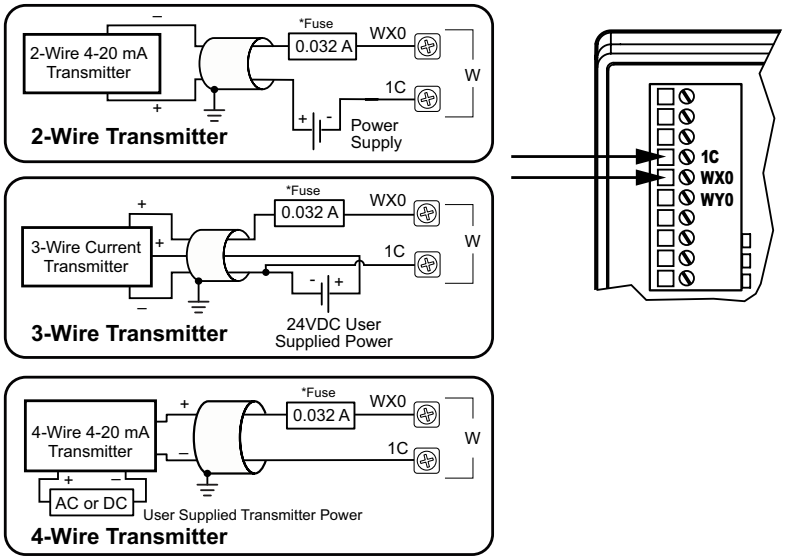
Analog Input Connections Options

Analog Voltage Input Circuits



NOTE: Shield should be connected only at one end, to ground at the source device.

Analog Current Sinking Input Circuits



NOTE: Shield should be connected only at one end, to ground at the source device.

NOTE: *An Edison S500-32-R 0.032A fast-acting fuse is recommended for all analog voltage inputs, analog outputs, and current loops.*

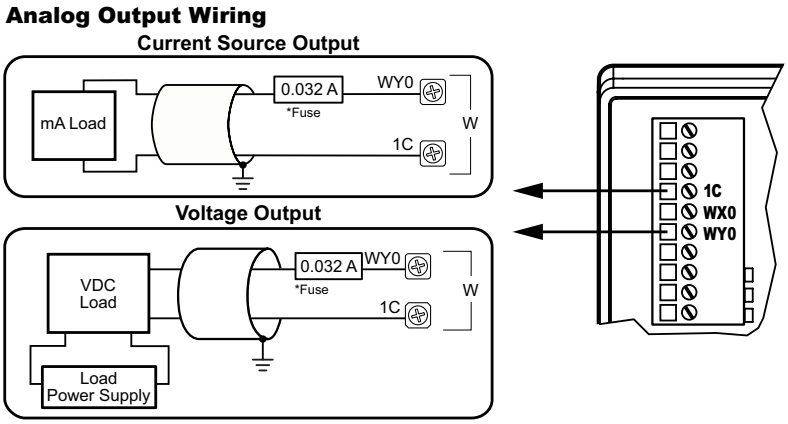
BX-DM1E-10ED23-D Wiring, Continued

Analog Output Specifications

Analog Output Specifications	
Outputs per Module	1
Commons	1
Output Voltage Range *	Software Selectable ±10V, ±5V, 0–10 V, 0–5 V
Output Current Range *	Software Selectable ±20mA, 4–20 mA
Resolution ±10V, ±20mA ±5V 0–5 V 4–20 mA 0–10 V	 16 bits (0–65535 counts) 15 bits (0–32767 counts) 14 bits (0–16383 counts) ~15 bits (6553–32767 counts) 15 bits (0–32767 counts)
Minimum Voltage Load Impedance	1kΩ
Maximum Current Load Impedance	500Ω
Maximum Rating	Continuous Short Circuit Protected
Settling Time	< 1ms
Output Stability	0.02% of Full Hardware Range = 13 Counts
Full Scale Calibration Error	0.05% of Full Hardware Range = 33 Counts
Offset Calibration Error	0.01% of Full Hardware Range = 7 Counts
Accuracy vs Temperature Error	0.05% of Full Hardware Range = 33 Counts
Maximum Linearity Error (End to End)	0.1% of Full Hardware Range = 66 Counts
Maximum Inaccuracy	0.2% of Full Hardware Range = 131 Counts
Fuse Type	User-supplied external fuse

** Software selectable per channel*

Analog Output Connections Options



NOTE: Shield should be connected only at one end, to ground at the source device.

NOTE: *An Edison S500-32-R 0.032A fast-acting fuse is recommended for all analog voltage inputs, analog outputs, and current loops.*

BX-DM1E-10ER3-D Wiring

This MPU has 10 discrete I/O points. The connections are grouped as follows:

- Six (6) discrete inputs - sinking/sourcing; rated for 12–24 VAC/VDC. They are located along the front left of the unit; organized into groups of 4 terminals consisting of 3 inputs and an isolated common in each group.
- Four (4) discrete outputs - Form A Relay (SPST); rated 12–48 VDC/ 24–240 VAC. They are located along the front left of the unit. The outputs are organized into groups of 3 terminals consisting of 2 outputs and an isolated common in each group.
- One (1) analog input and one (1) analog output. The analog inputs and outputs are located along the front left side of the unit. The analog inputs and outputs are grouped together on 3 terminals consisting of 1 analog input, 1 analog output and a shared analog common.
  - current or voltage selectable through software
  - 16-bit resolution @ ±10V, ±20mA
  - current signal ranges of 4–20 mA, ±20 mA
  - voltage signal ranges of 0–5 VDC, 0–10 VDC, ±5VDC, ±10VDC

This MPU requires an external 12–24 VDC power supply. The DC power supply connection is located on the top left side of the unit. There is no 24VDC auxiliary output supply.



BX-DM1E-10ER3-D

NOTE: *Eight (8) Expansion Modules can be connected to extend I/O capacity, as long as the MPU power budget is not exceeded.*

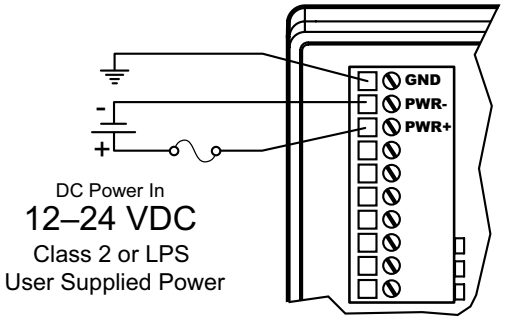
BX-DM1E-10ER3-D Wiring, Continued

Power Supply Specifications

Power Supply Specifications	
Nominal Voltage Range*	12–24 VDC
Input Voltage Range (Tolerance)*	10–36 VDC
Maximum Input Voltage Ripple	< ±10%
Maximum Input Power	14W
Cold Start Inrush Current	5A, 2ms
Maximum Inrush Current (Hot Start)	5A, 2ms
Internal Input Protection	Reverse polarity protection and undervoltage lockout via transistor circuit
Acceptable External Power Drop Time	10ms
Under Input Voltage Lock-out	< 9VDC
Heat Dissipation	10.3 W Max
Isolated User 24VDC Output	None
Voltage Withstand (dielectric)	1500VAC power Inputs to ground applied for 1 minute
Insulation Resistance	>10MΩ @ 500VDC
Software Version Required	Do-more! Designer version 2.0 or later

** Class 2 or LPS Power Supply required.*

Power Supply Connections



WARNING: The BRX System MUST have a proper earth ground. Do not operate the BRX MPU without proper earth grounding.

BX-DM1E-10ER3-D Wiring, Continued

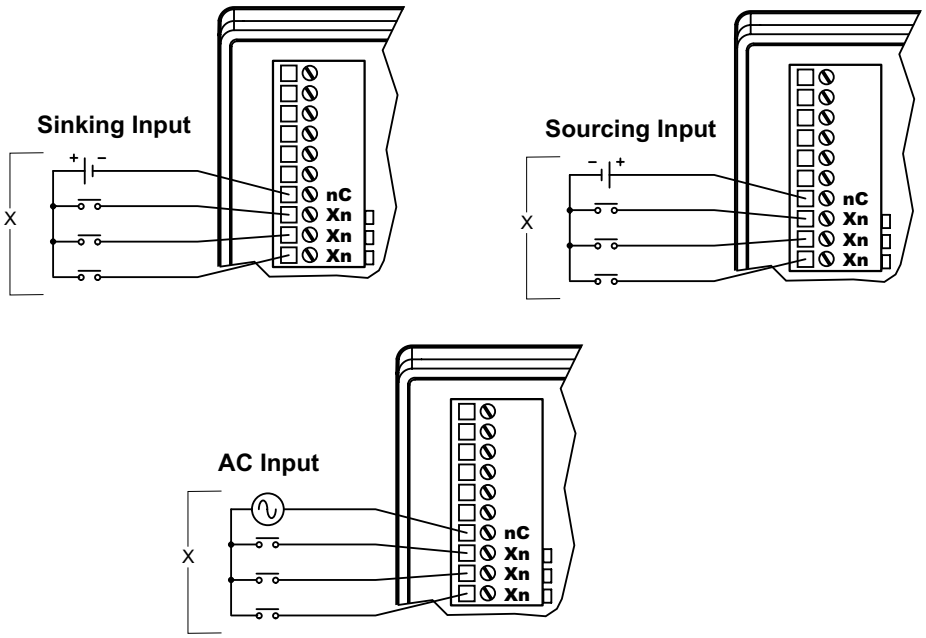
Discrete Input Specifications

Discrete Input Specifications			
Input Type		Sink/Source	
Total Inputs per Module		6	
Commons		2 (3 points/common) Isolated	
Nominal Voltage Range		12–24 VAC/VDC	
Input Voltage Range		9–30 VAC/VDC	
Maximum Voltage		30 VAC/VDC	
DC Frequency		0–250 kHz - High-speed	
Minimum Pulse Width		0.5 µs - High-speed	
AC Frequency		47–63 Hz[2]	
Input Impedance		3kΩ @ 24VDC	
Input Current (typical)		6mA @ 24 VAC/VDC	
Maximum Input Current		12mA @ 30 VAC/VDC	
ON Voltage Level		> 9.0 VAC/VDC	
OFF Voltage Level		< 2.0 VAC/VDC	
Maximum OFF Current		2.0 mA	
Status Indicators		Logic Side, Green	
Input Details			
Input Type		High-Speed DC	Standard[1]
Location		X0...X5	
OFF to ON Response	DC	< 2µs	
	AC	–	10ms[2]
ON to OFF Response	DC	< 2µs	
	AC	–	10ms[2]
Maximum Switching Frequency	DC	250kHz	
	AC	~ 30Hz	

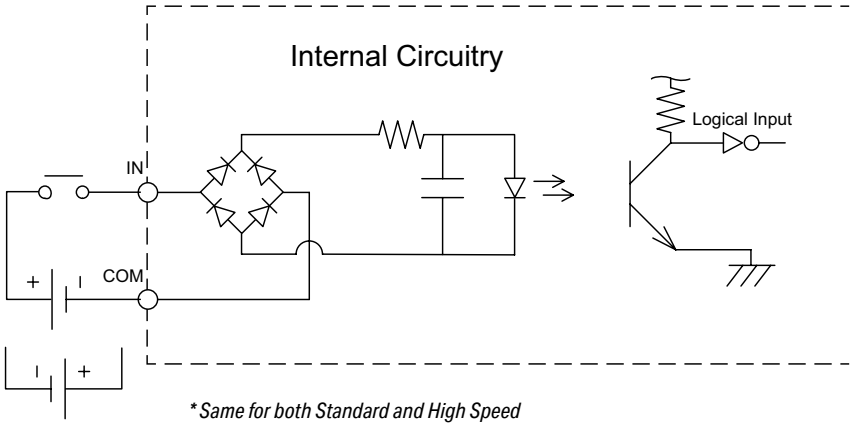
1. All Inputs may be used as standard inputs or high speed inputs independently.
2. 60Hz to 240Hz filter should be set in the software when using an AC line signal.

BX-DM1E-10ER3-D Wiring, Continued

Discrete Input Connection Options



Discrete Input Internal Circuitry *



12-24 VDC

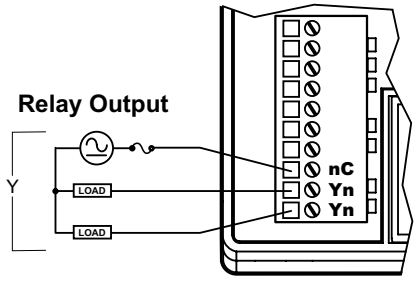
BX-DM1E-10ER3-D Wiring, Continued

Discrete Output Specifications

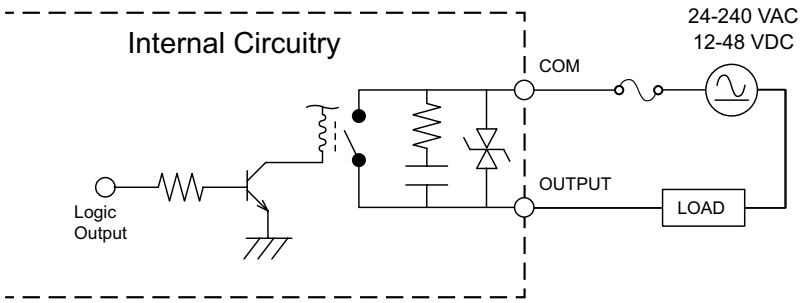
Discrete Output Specifications	
Output Type	Relay Form A (SPST)
Total Outputs per Module	4
Commons	2 (2 points/common) Isolated
Maximum Current per Common	4A
Nominal Voltage Range	12–48 VDC 24–240 VAC
Operating Voltage Range	5–60 VDC 5–264 VAC
Maximum Voltage	60VDC 264VAC
Minimum Output Current	0.1 mA @ 24VDC 0.1 mA @ 24VAC
Maximum Output Current	2A
Maximum Inrush Current	5A for 50ms
Maximum Leakage Current	1µA (DC), 300µA (AC) due to RC snubber circuit
ON Voltage Drop	0.2 V Max
Status Indicators	Logic Side, Green
Output Details	
Output Type	Standard
Location	Y0...Y3
ON-OFF Response	<10ms
OFF-ON Response	<10ms
Maximum Switching Frequency	10Hz
Relay Cycle Life Mechanical Endurance Electrical Endurance	 5 million operations 120,000 operations
Fuse Type	User-supplied external fuse

BX-DM1E-10ER3-D Wiring, Continued

Discrete Output Connection Options



Discrete Standard Output Internal Circuitry



BX-DM1E-10ER3-D Wiring, Continued

Analog Input Specifications

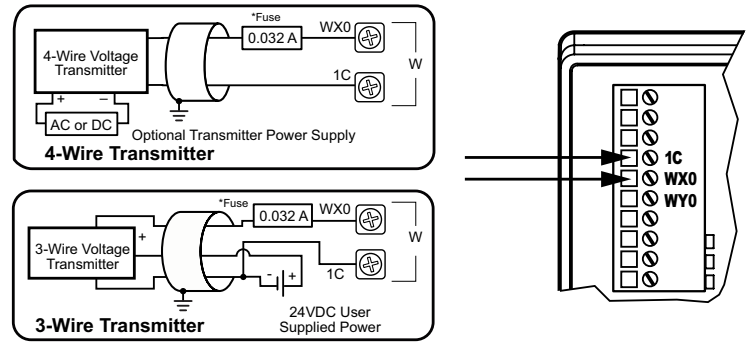
Analog Input Specifications	
Inputs per Module	1
Commons	1
Input Voltage Range *	Software Selectable ±10V, ±5V, 0–10 V, 0–5 V
Input Current Range *	Software Selectable ±20mA, 4–20 mA
Resolution ±10V, ±20mA ±5V 0–5 V 4–20 mA 0–10 V	 16 bits (0–65535 counts) 15 bits (0–32767 counts) 14 bits (0–16383 counts) ~15 bits (6553–32767 counts) 15 bits (0–32767 counts)
Input Impedance Voltage Modes	100kΩ
Absolute Maximum Input, Voltage Mode	±30V
Input Impedance Current Modes	249Ω
Absolute Maximum Input, Current Mode	±40mA sustained, ±100mA for < 5s
Conversion Time	1.2 ms
Input Stability	0.02% of Full Hardware Range = 13 Counts
Full Scale Calibration Error	0.05% of Full Hardware Range = 33 Counts
Offset Calibration Error	0.01% of Full Hardware Range = 7 Counts
Accuracy vs Temperature Error	0.05% of Full Hardware Range = 33 Counts
Maximum Linearity Error (End to End)	0.1% of Full Hardware Range = 66 Counts
Maximum Inaccuracy	0.2% of Full Hardware Range = 131 Counts
Fuse Type	User-supplied external fuse

** Software selectable per channel*

BX-DM1E-10ER3-D Wiring, Continued

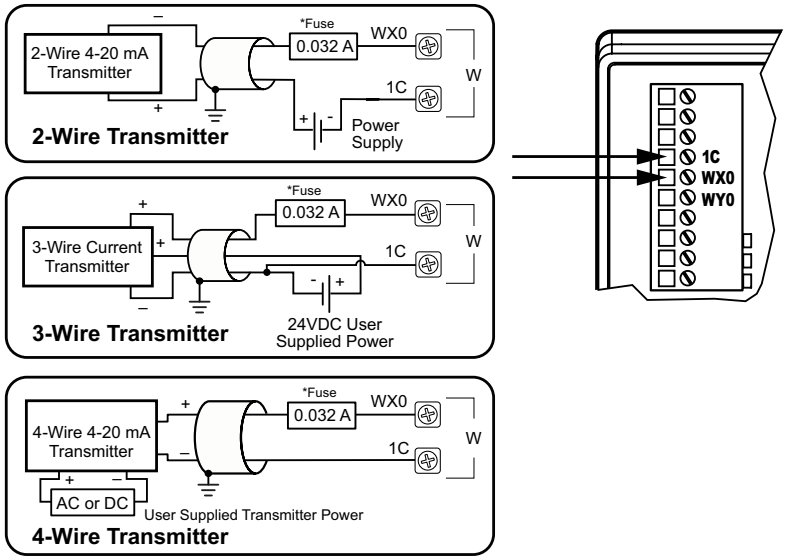
Analog Input Connections Options

Analog Voltage Input Circuits



NOTE: Shield should be connected only at one end, to ground at the source device.

Analog Current Sinking Input Circuits



NOTE: Shield should be connected only at one end, to ground at the source device.



NOTE: *An Edison S500-32-R 0.032A fast-acting fuse is recommended for all analog voltage inputs, analog outputs, and current loops.*

BX-DM1E-10ER3-D Wiring, Continued

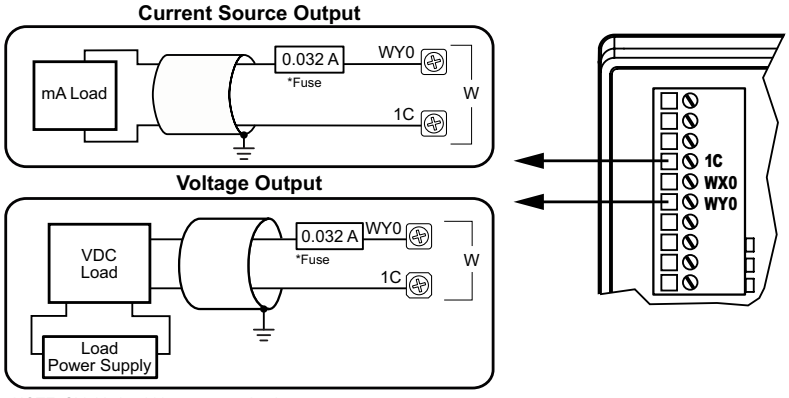
Analog Output Specifications

Analog Output Specifications	
Outputs per Module	1
Commons	1
Output Voltage Range *	Software Selectable ±10V, ±5V, 0–10 V, 0–5 V
Output Current Range *	Software Selectable ±20mA, 4–20 mA
Resolution ±10V, ±20mA ±5V 0–5 V 4–20 mA 0–10 V	 16 bits (0–65535 counts) 15 bits (0–32767 counts) 14 bits (0–16383 counts) ~15 bits (6553–32767 counts) 15 bits (0–32767 counts)
Minimum Voltage Load Impedance	1kΩ
Maximum Current Load Impedance	500Ω
Maximum Rating	Continuous Short Circuit Protected
Settling Time	< 1ms
Output Stability	0.02% of Full Hardware Range = 13 Counts
Full Scale Calibration Error	0.05% of Full Hardware Range = 33 Counts
Offset Calibration Error	0.01% of Full Hardware Range = 7 Counts
Accuracy vs Temperature Error	0.05% of Full Hardware Range = 33 Counts
Maximum Linearity Error (End to End)	0.1% of Full Hardware Range = 66 Counts
Maximum Inaccuracy	0.2% of Full Hardware Range = 131 Counts
Fuse Type	User-supplied external fuse

** Software selectable per channel*

Analog Output Connections Options

Analog Output Wiring



NOTE: Shield should be connected only at one end, to ground at the source device.

NOTE: *An Edison S500-32-R 0.032A fast-acting fuse is recommended for all analog voltage inputs, analog outputs, and current loops.*

BX-DM1E-10AR3-D Wiring

This MPU has 10 discrete I/O points. The connections are grouped as follows:

- Six (6) discrete inputs - AC rated for 120–240 VAC. They are located along the front left of the unit; organized into groups of 4 terminals consisting of 3 inputs and an isolated common in each group.
- Four (4) discrete outputs - Form A Relay (SPST); rated 12–48 VDC/ 24–240 VAC. They are located along the front left of the unit. The outputs are organized into groups of 3 terminals consisting of 2 outputs and an isolated common in each group.
- One (1) analog input and one (1) analog output. The analog inputs and outputs are located along the front left side of the unit. The analog inputs and outputs are grouped together on 3 terminals consisting of 1 analog input, 1 analog output and a shared analog common.
  - current or voltage selectable through software
  - 16-bit resolution @ ±10V, ±20mA
  - current signal ranges of 4–20 mA, ±20 mA
  - voltage signal ranges of 0–5 VDC, 0–10 VDC, ±5VDC, ±10VDC

This MPU requires an external 12–24 VDC power supply. The DC power supply connection is located on the top left side of the unit. There is no 24VDC auxiliary output supply



BX-DM1E-10AR3-D

.

NOTE: *Eight (8) Expansion Modules can be connected to extend I/O capacity, as long as the MPU power budget is not exceeded.*

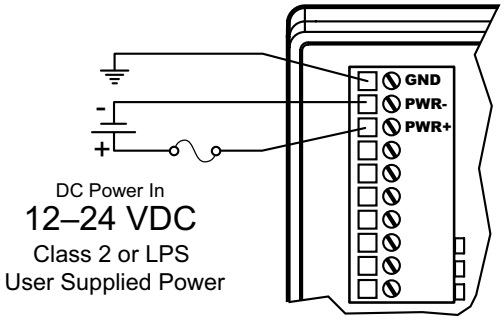
BX-DM1E-10AR3-D Wiring, Continued

Power Supply Specifications

Power Supply Specifications	
Nominal Voltage Range*	12–24 VDC
Input Voltage Range (Tolerance)*	10–36 VDC
Maximum Input Voltage Ripple	< ±10%
Maximum Input Power	14W
Cold Start Inrush Current	5A, 2ms
Maximum Inrush Current (Hot Start)	5A, 2ms
Internal Input Protection	Reverse polarity protection and undervoltage lockout via transistor circuit
Acceptable External Power Drop Time	10ms
Under Input Voltage Lock-out	< 9VDC
Heat Dissipation	10.1 W Max
Isolated User 24VDC Output	None
Voltage Withstand (dielectric)	1500VAC power Inputs to ground applied for 1 minute
Insulation Resistance	>10MΩ @ 500VDC
Software Version Required	Do-more! Designer version 2.0 or later

** Class 2 or LPS Power Supply required.*

Power Supply Connections



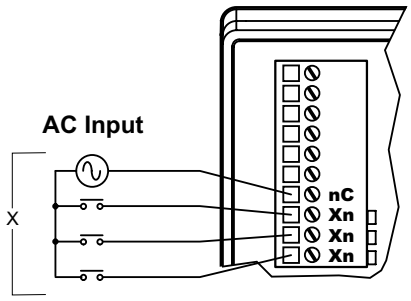
WARNING: The BRX System MUST have a proper earth ground. Do not operate the BRX MPU without proper earth grounding.

BX-DM1E-10AR3-D Wiring, Continued

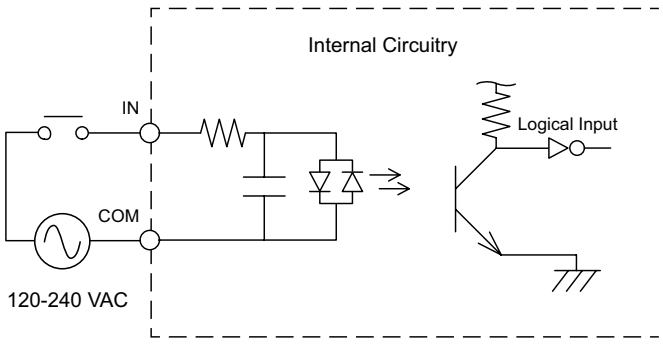
Discrete Input Specifications

Discrete Input Specifications	
Input Type	AC
Total Inputs per Module	6
Commons	2 (3 points/common) Isolated
Nominal Voltage Range	120–240 VAC
Input Voltage Range	85–264 VAC
Maximum Voltage	264VAC RMS
AC Frequency	47–63 Hz
Input Impedance	15kΩ
Input Current (typical)	9mA @ 120VAC, 13mA @ 220VAC
Maximum Input Current	14mA @ 120VAC, 20mA @ 220VAC
ON Voltage Level	> 85VAC
OFF Voltage Level	< 40VAC
Maximum OFF Current	2.5 mA
Status Indicators	Logic Side, Green
Input Details	
Input Type	Standard
Location	X0...X5
OFF - ON Response	10ms
ON - OFF Response	10ms
Maximum Switching Frequency	~ 30Hz

Discrete Input Connection Options



Discrete Input Internal Circuitry



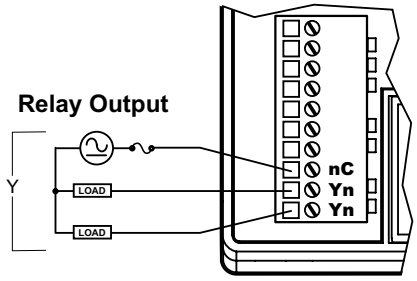
BX-DM1E-10AR3-D Wiring, Continued

Discrete Output Specifications

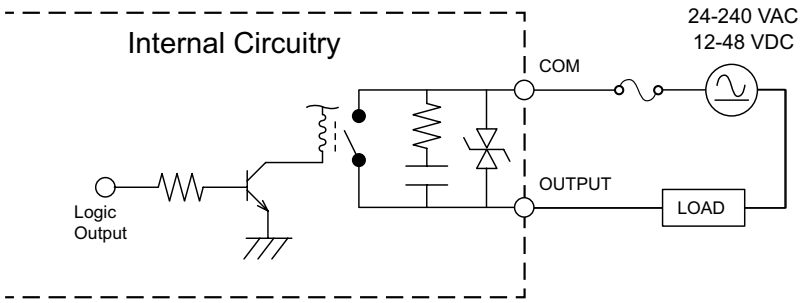
Discrete Output Specifications	
Output Type	Relay Form A (SPST)
Total Outputs per Module	4
Commons	2 (2 points/common) Isolated
Maximum Current per Common	4A
Nominal Voltage Range	12–48 VDC 24–240 VAC
Operating Voltage Range	5–60 VDC 5–264 VAC
Maximum Voltage	60VDC 264VAC
Minimum Output Current	0.1 mA @ 24VDC 0.1 mA @ 24VAC
Maximum Output Current	2A
Maximum Inrush Current	5A for 50ms
Maximum Leakage Current	1µA (DC), 300µA (AC) due to RC snubber circuit
ON Voltage Drop	0.2 V Max
Status Indicators	Logic Side, Green
Output Details	
Output Type	Standard
Location	Y0...Y3
ON-OFF Response	<10ms
OFF-ON Response	<10ms
Maximum Switching Frequency	10Hz
Relay Cycle Life Mechanical Endurance Electrical Endurance	 5 million operations 120,000 operations
Fuse Type	User-supplied external fuse

BX-DM1E-10AR3-D Wiring, Continued

Discrete Output Connection Options



Discrete Standard Output Internal Circuitry



BX-DM1E-10AR3-D Wiring, Continued

Analog Input Specifications

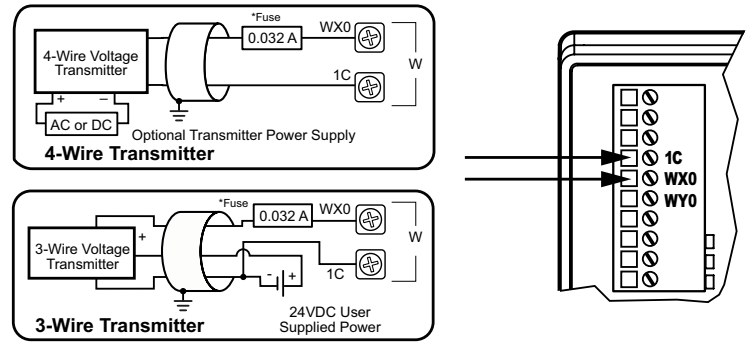
Analog Input Specifications	
Inputs per Module	1
Commons	1
Input Voltage Range *	Software Selectable ±10V, ±5V, 0–10 V, 0–5 V
Input Current Range *	Software Selectable ±20mA, 4–20 mA
Resolution ±10V, ±20mA ±5V 0–5 V 4–20 mA 0–10 V	 16 bits (0–65535 counts) 15 bits (0–32767 counts) 14 bits (0–16383 counts) ~15 bits (6553–32767 counts) 15 bits (0–32767 counts)
Input Impedance Voltage Modes	100kΩ
Absolute Maximum Input, Voltage Mode	±30V
Input Impedance Current Modes	249Ω
Absolute Maximum Input, Current Mode	±40mA sustained, ±100mA for < 5s
Conversion Time	1.2 ms
Input Stability	0.02% of Full Hardware Range = 13 Counts
Full Scale Calibration Error	0.05% of Full Hardware Range = 33 Counts
Offset Calibration Error	0.01% of Full Hardware Range = 7 Counts
Accuracy vs Temperature Error	0.05% of Full Hardware Range = 33 Counts
Maximum Linearity Error (End to End)	0.1% of Full Hardware Range = 66 Counts
Maximum Inaccuracy	0.2% of Full Hardware Range = 131 Counts
Fuse Type	User-supplied external fuse

** Software selectable per channel*

BX-DM1E-10DAR3-D Wiring, Continued

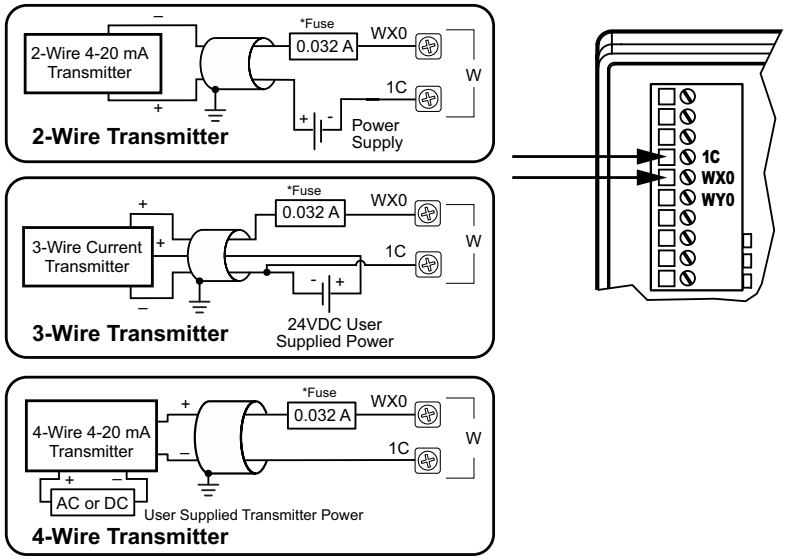
Analog Input Connections Options

Analog Voltage Input Circuits



NOTE: Shield should be connected only at one end, to ground at the source device.

Analog Current Sinking Input Circuits



NOTE: Shield should be connected only at one end, to ground at the source device.

NOTE: *An Edison S500-32-R 0.032A fast-acting fuse is recommended for all analog voltage inputs, analog outputs, and current loops.*

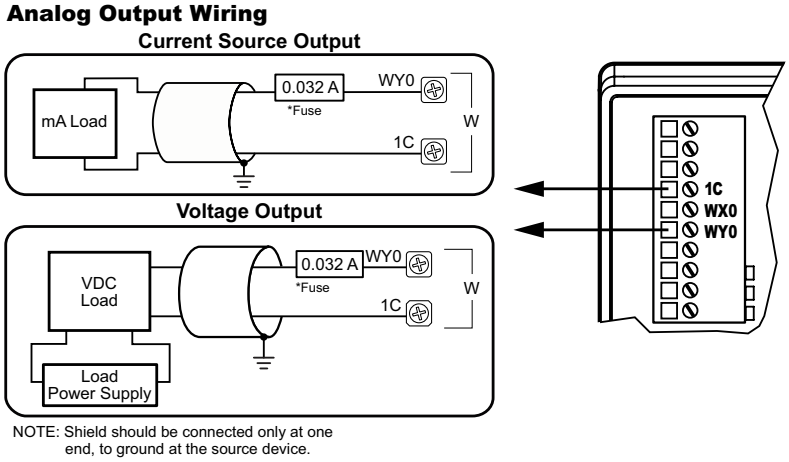
BX-DM1E-10AR3-D Wiring, Continued

Analog Output Specifications

Analog Output Specifications	
Outputs per Module	1
Commons	1
Output Voltage Range *	Software Selectable ±10V, ±5V, 0–10 V, 0–5 V
Output Current Range *	Software Selectable ±20mA, 4–20 mA
Resolution ±10V, ±20mA ±5V 0–5 V 4–20 mA 0–10 V	 16 bits (0–65535 counts) 15 bits (0–32767 counts) 14 bits (0–16383 counts) ~15 bits (6553–32767 counts) 15 bits (0–32767 counts)
Minimum Voltage Load Impedance	1kΩ
Maximum Current Load Impedance	500Ω
Maximum Rating	Continuous Short Circuit Protected
Settling Time	< 1ms
Output Stability	0.02% of Full Hardware Range = 13 Counts
Full Scale Calibration Error	0.05% of Full Hardware Range = 33 Counts
Offset Calibration Error	0.01% of Full Hardware Range = 7 Counts
Accuracy vs Temperature Error	0.05% of Full Hardware Range = 33 Counts
Maximum Linearity Error (End to End)	0.1% of Full Hardware Range = 66 Counts
Maximum Inaccuracy	0.2% of Full Hardware Range = 131 Counts
Fuse Type	User-supplied external fuse

** Software selectable per channel*

Analog Output Connections Options



NOTE: Shield should be connected only at one end, to ground at the source device.

NOTE: *An Edison S500-32-R 0.032A fast-acting fuse is recommended for all analog voltage inputs, analog outputs, and current loops.*

Notes:

BX 18/18E Wiring



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BX-DM1E-18ER3 Wiring 4-86
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BX 18/18E Micro PLC Units (MPUs) Overview

The BX 18/18E Micro PLC Unit (MPU) includes fourteen different versions having the same appearance and basic features. All units have 10 discrete input points and 8 discrete output points built-in. Units with DC inputs have 10 selectable high-speed inputs and units with DC outputs have 4 selectable high-speed outputs. All MPUs can expand their I/O capacity with the BRX Expansion Modules, allowing for more flexibility while keeping control cost down. BX 18E units additionally have an Ethernet port as well as 1 analog input and 1 analog output built-in that are current/voltage selectable within the software.

BX 18/18E MPUs are divided into two distinct groups, BX 18 and BX 18E. The BX 18 MPUs have no built-in analog I/O or Ethernet port. The BX 18E MPUs have all the features of the BX 18, plus built-in analog I/O and an Ethernet port.



BX 18 Micro PLC Unit (MPU) - No Built-in Analog or Ethernet



BX 18E Micro PLC Unit (MPU) with Built-in Analog and Ethernet Port

BX 18 MPUs General Specifications



BX 18 Micro PLC Unit (MPU)
No Built-in Analog or Ethernet

- 18 discrete I/O points: 10 input, 8 output
- No built-in analog I/O points
- Models with DC inputs:
  - have 10 high-speed inputs rated up to 250kHz
  - accept 12–24 nominal voltage, AC or DC
  - can be wired as sinking or sourcing
- Models with AC inputs can accept 120–240 nominal voltages
- Output types available are DC sinking, DC sourcing, and relay
- Models with DC outputs have 4 high-speed outputs rated up to 250kHz
- Support for up to 8 additional Expansion Modules as long as the power budget is not exceeded.

The following table shows the available BX 18 MPUs.

BX 18 MPUs				
Part Number	**External Power**	**Discrete Input**	**Discrete Output**	**Expansion Modules**
BX-DM1-18ED1	120–240 VAC	10 High-Speed, DC Sinking or Sourcing	4 High-Speed 4 Standard DC Sinking	8, as long as the MPU power budget is not exceeded
BX-DM1-18ED1-D	12–24 VDC			
BX-DM1-18ED2	120–240 VAC		4 High-Speed 4 Standard DC Sourcing	
BX-DM1-18ED2-D	12–24 VDC			
BX-DM1-18ER	120–240 VAC		8 Form A Relay	
BX-DM1-18ER-D	12–24 VDC			
BX-DM1-18AR	120–240 VAC	10 Standard AC		

BX 18E MPUs General Specifications



BX 18E Micro PLC Unit (MPU) with Built-in Analog and Ethernet Port

- 18 Discrete I/O points: 10 inputs, 8 outputs
- All units have 1 analog input and 1 analog output (current/voltage software selectable)
- All units have built-in Ethernet port, 10/100 Mbps
- Models with DC inputs:
  - have 10 high-speed inputs rated up to 250kHz
  - accept 12–24 nominal voltages, AC or DC
  - can be wired as sinking or sourcing
- Models with AC inputs can accept 120–240 nominal voltages
- Output types available are DC sinking, DC sourcing, and relay
- Models with DC outputs have 4 high-speed outputs rated up to 250kHz
- Support for 8 additional Expansion Modules

The following table shows the available BX 18E MPUs.

BX 18E MPUs

Part Number	External Power	Discrete Input	Discrete Output	Analog *		Expansion Modules
				Input	Output	
BX-DM1E-18ED13	120–240 VAC	10 High-Speed, DC Sinking or Sourcing	4 High-Speed 4 Standard DC sinking	1 Current or Voltage	1 Current or Voltage	8
BX-DM1E-18ED13-D	12–24 VDC					
BX-DM1E-18ED23	120–240 VAC		4 High-Speed 4 Standard DC sourcing			
BX-DM1E-18ED23-D	12–24 VDC					
BX-DM1E-18ER3	120–240 VAC		8 Form A relay			
BX-DM1E-18ER3-D	12–24 VDC					
BX-DM1E-18AR3	120–240 VAC	10 Standard AC				

Analog can be current or voltage software selectable per channel.

BX 18/18E MPU Wiring Termination Selection

The BX 18/18E MPUs ship without terminal blocks. This allows you to select the termination type that best suits your application. There are several wiring options available, including removable screw terminal connectors, removable spring clamp terminal connectors and pre-wired ***ZIP***Link cable solutions.

Terminal Block Connectors

The terminal block connectors are provided in kits and can be ordered as a single part number. Each kit contains all the terminal block connectors required: (3) 5-pin 5mm terminal blocks (BX-RTB05), (2) 6-pin 5mm terminal blocks (BX-RTB06), and (1) 3-pin 5mm terminal block (BX-RTB03).

The BX 18/18E MPUs terminals are configured into groups of 5 inputs and 4 outputs each with an isolated common, e.g., inputs X0–X4 are grouped with their common terminal. On the BX 18E MPU the analogs are grouped as 3 terminals consisting of 1 input, 1 output and a shared isolated analog common. The I/O termination groups are isolated such that a single group connector can be removed without affecting other groups of I/O or the external power source.

The terminal block connector kit part numbers and connector specifications are listed in the table below.

Terminal Block Connector Specifications

Kit Part Number	BX-RTB18	BX-RTB18-1
Connector Type	Screw Type-90 degree	Spring Clamp a Type-180 degree
Wire Exit	180 degree	180 degree
Pitch	5.0 mm	5.0 mm
Screw Size	M2.5	N/A
Recommended Screw Torque	< 3.98 lb·in (0.45 N·m)	N/A
Screwdriver Blade Width	3.5 mm	3.5 mm
Wire Gauge (Single Wire)	28–12 AWG	28–14 AWG
Wire Gauge (Dual Wire)	28–16 AWG	28–16 AWG (Dual wire ferrule required)
Wire Strip Length	0.3 in (7.5 mm)	0.37 in (9.5 mm)
Equiv. Dinkle P/N	5ESDV-0nP-BK*	5ESDSR-0nP-BK*

**** Replace n with: (3) 3-terminal, (5) 5-terminal or (6) for 6-terminal.***

BX-RTB18 Screw Terminal Block Kit

This terminal block kit has 90 degree screw terminal blocks. Wire is 180 degree pass through.



5-Pin



6-Pin



3-Pin

BX-RTB18-1 Spring Terminal Block Kit

This terminal block kit has Spring Clamp wire terminal blocks with 180 degree wire pass through.



5-Pin



6-Pin



3-Pin

Replacement terminal blocks can be ordered online at: www.AutomationDirect.com. Single replacement terminal blocks are listed in table below.

Replacement Terminal Blocks		
	BX-RTB18	BX-RTB18-1
3-pin	BX-RTB03	BX-RTB03-1
5-pin	BX-RTB05	BX-RTB05-1
6-pin	BX-RTB06	BX-RTB06-1

*ZIP*Link Prewired Cable Solutions

ZIPLinks eliminate the normally tedious process of wiring between devices by utilizing prewired cables and DIN rail mount connector modules. ***ZIP***Links are as simple as plugging in a cable connector at either end or terminating wires at only one end. Prewired cables keep installation clean and efficient, using less space at a fraction of the cost of standard terminal blocks. ***ZIP***Link prewired cables can connect directly to a ***ZIP***Link remote terminal block module or with the pigtail option, allowing for a convenient solution to wire the BRX platform to 3rd party devices. For the BX 18/18E MPUs, two (2) cables and two (2) ***ZIP***Link feedthrough modules are needed to connect all the wiring termination points.

There are two (2) feedthrough module options available, the ZL-RTB20 and the ZL-RTB20-1. The ZL-RTB20 is a standard feedthrough remote terminal module while the RTB20-1 is a feedthrough remote terminal block having a more compact footprint, requiring less space in the control cabinet.

The ***ZIP***Link system options for the BX 18/18E MPUs are listed in the table below.

BX 18/18E *ZIP*Link Selector					
Part Number	Module Type	Module Part No.	Max Qty Needed	Cable Part No.*	Max Qty Needed
BX-DM1-18ED1	Feedthrough	ZL-RTB20, (standard) -OR- ZL-RTB20-1 (compact)	2	ZL-BX-CBL15 ZL-BX-CBL15-1 ZL-BX-CBL15-2	2
BX-DM1-18ED1-D					
BX-DM1-18ED2					
BX-DM1-18ED2-D					
BX-DM1-18ER					
BX-DM1-18ER-D					
BX-DM1-18AR					
BX-DM1E-18ED13					
BX-DM1E-18ED13-D					
BX-DM1E-18ED23					
BX-DM1E-18ED23-D					
BX-DM1E-18ER3					
BX-DM1E-18ER3-D					
BX-DM1E-18AR3					

**** Select the cable length: Blank = 0.5 m, -1 = 1.0 m, -2 = 2.0 m.***
Available pigtail cables: ZL-BX-CBL15-1P = 1.0 m, ZL-BX-CBL15-2P = 2.0 m.

*ZIP*Link Prewired Cables

Custom molded ***ZIP***Link prewired cables allow for fast and easy connection of field wiring and remote I/O to the BRX platform. The prewired cables are available in 0.5 meter, 1 meter and 2 meter lengths. Pigtail cables are used to connect the BRX platform directly to third-party devices, lowering your wiring cost and time. The pigtail cables are available in 1 meter and 2 meter lengths.



ZL-BX-CBL20
***ZIP*Link Prewired Cable**



ZL-BX-CBL20-1P
***ZIP*Link Pigtail Cable**

*ZIP*Link Remote Feedthrough Modules

Feedthrough modules provide low-cost and compact field wiring screw termination solutions for quickly connecting with the BRX platform. There are 2 modules available for use with the BRX platform. The ZL-RTB20 and the ZL-RTB20-1. The ZL-RTB20 is a standard 2 row, 20-pin, DIN rail mountable feedthrough module. The ZL-RTB20-1 is a compact 3 row, 24-pin DIN rail mountable feedthrough module with a smaller footprint design.

The ***ZIP***Link remote feedthrough module specifications are listed in the table below.

***ZIP*Link Module Specifications**		
Part Number	**ZL-RTB20 (Maximum of 2 Needed)**	**ZL-RTB20-1 (Maximum of 2 Needed)**
Number of positions	20 screw terminals, 2 rows	24 screw terminals, 3 rows
Screwdriver Width	1/8 in (3.8 mm) maximum	
Screw Torque	4.4 lb·in (0.5 N·m)	



ZL-RTB20



ZL-RTB20-1

*ZIP*Link System Examples

BX 18 MPU with ***ZIP***Link pre-wired cables and ZL-RTB20 feedthrough modules.



BX 18 MPU with ***ZIP***Link pigtail cables installed.



BX 18 Micro PLC Units (MPUs)

BX-DM1-18ED1 Wiring

This MPU is made up of 18 discrete I/O points. The connections are grouped as follows:

- 10 discrete inputs - sinking/sourcing; rated for 12–24 VAC/VDC. They are located along the bottom of the unit; configured in two (2) groups of 6 terminals, each comprised of 5 inputs and an isolated common.
- 8 discrete outputs - sinking; rated at 12–24 VDC. They are located along the top of the unit starting to the right of the 24VDC auxiliary output terminals. The outputs are configured in two (2) groups of 5 terminals, each comprised of 4 outputs and an isolated common.

This MPU requires an external 120–240 VAC power supply. The AC power supply connection and the 24VDC auxiliary output supply terminals are located on the top left side of the unit.

WARNING: No analog I/O is included on this unit. The 3 terminals to the right of the inputs are not used. These terminals are not internally connected. DO NOT CONNECT ANYTHING TO THESE TERMINALS!



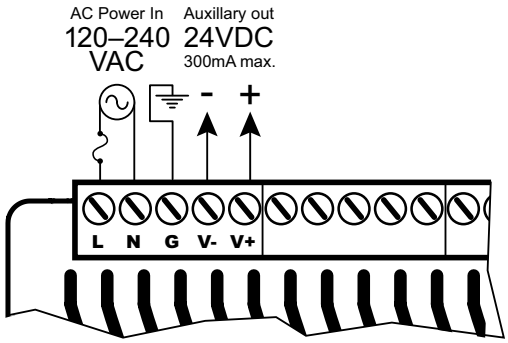
NOTE: *Eight (8) Expansion Modules can be connected to extend I/O capacity, as long as the MPU power budget is not exceeded.*

BX-DM1-18ED1 Wiring, Continued

Power Supply Specifications

Power Supply Specifications	
Nominal Voltage Range	120–240 VAC
Input Voltage Range (Tolerance)	85–264 VAC
Rated Operating Frequency	47–63 Hz
Maximum Input Power	40VA
Cold Start Inrush Current	1.5 A, 2ms
Maximum Inrush Current (Hot Start)	1.5 A, 2ms
Internal Input Fuse Protection	Micro fuse 250V, 2A Non-replaceable
Acceptable External Power Drop Time	10ms
Under Input Voltage Lock-out	80VAC
Input Transient Protection	Input choke and line filter
Heat Dissipation	16.1 W Max
Isolated User 24VDC Output	24VDC @ 0.3 A max, <1V P-P Ripple, Integrated self-resetting short circuit protection
Voltage Withstand (dielectric)	1500VAC Power Inputs to Ground applied for 1 minute 1500VAC Ground to 24VDC Output applied for 1 minute
Insulation Resistance	>10MΩ @ 500VDC
Software Version Required	Do-more! Designer version 2.0 or later

Power Supply Connections



WARNING: Do not exceed the 24VDC auxiliary power supply load limit of 300mA.

WARNING: The BRX System MUST have a proper earth ground. Do not operate the BRX MPU without proper earth grounding.

BX-DM1-18ED1 Wiring, Continued

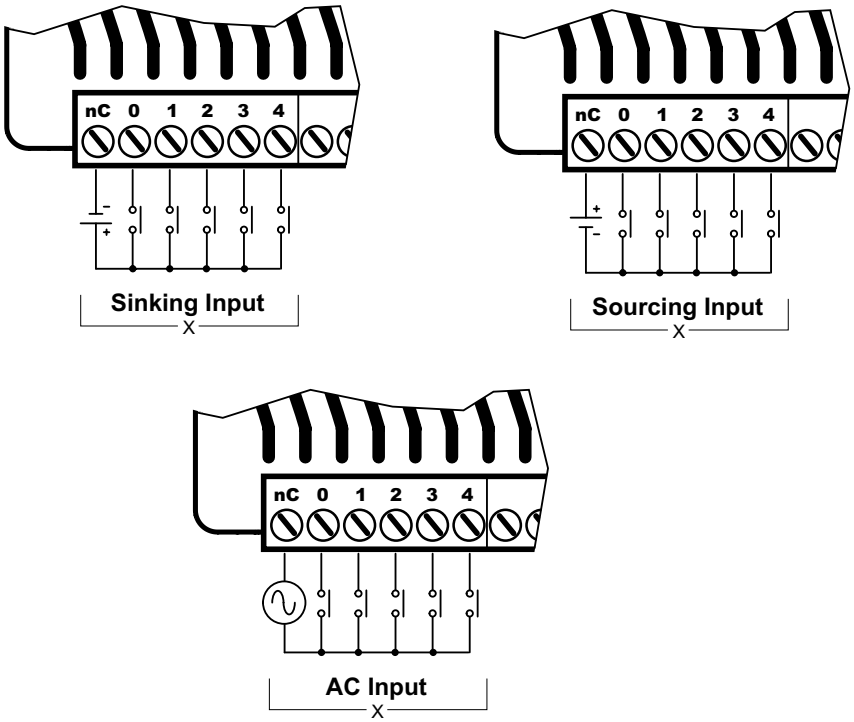
Discrete Input Specifications

Discrete Input Specifications			
Input Type		Sink/Source	
Total Inputs per Module		10	
Commons		2 (5 points/common) Isolated	
Nominal Voltage Range		12–24 VAC/VDC	
Input Voltage Range		9–30 VAC/VDC	
Maximum Voltage		30 VAC/VDC	
DC Frequency		0–250 kHz - High-speed	
Minimum Pulse Width		0.5 µs - High-speed	
AC Frequency		47–63 Hz[2]	
Input Impedance		3kΩ @ 24VDC	
Input Current (typical)		6mA @ 24 VAC/VDC	
Maximum Input Current		12mA @ 30 VAC/VDC	
ON Voltage Level		> 9.0 VAC/VDC	
OFF Voltage Level		< 2.0 VAC/VDC	
Maximum OFF Current		1.5 mA	
Status Indicators		Logic Side, Green	
Input Details			
Input Type		High-Speed DC	Standard[1]
Location		X0...X9	
OFF to ON Response	DC	< 2µs	
	AC	–	10ms[2]
ON to OFF Response	DC	< 2µs	
	AC	–	10ms[2]
Maximum Switching Frequency	DC	250kHz	
	AC	~ 30Hz	

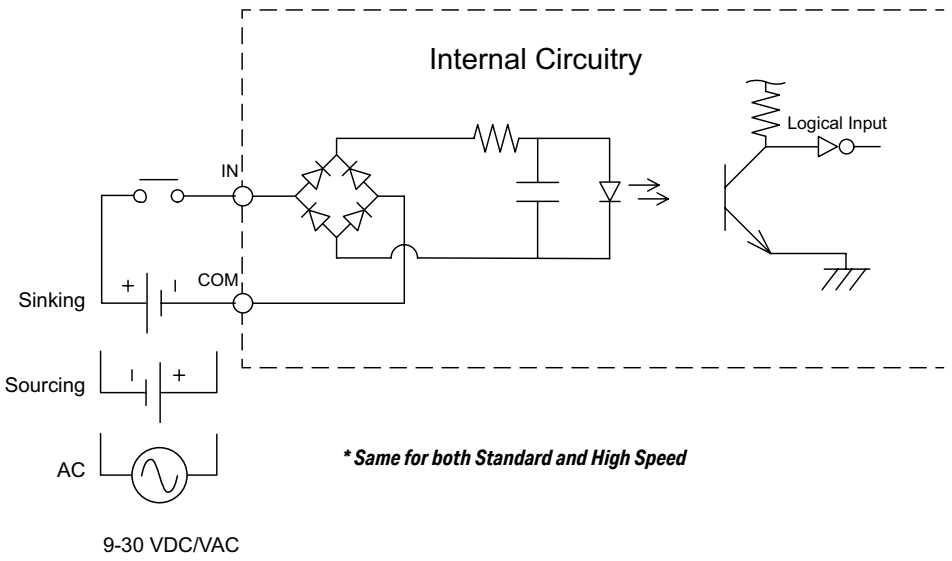
1. All Inputs may be used as standard inputs or high speed inputs independently.
2. 60Hz to 240Hz filter should be set in the software when using an AC line signal.

BX-DM1-18ED1 Wiring, Continued

Discrete Input Connection Options



Discrete Input Internal Circuitry *



BX-DM1-18ED1 Wiring, Continued

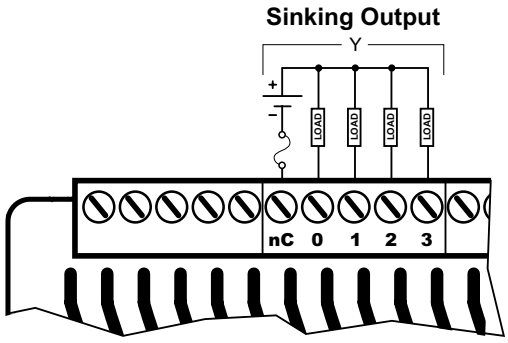
Discrete Output Specifications

Discrete Output Specifications		
Output Type	Sinking	
Total Outputs per Module	8	
Commons	2 (4 points/common) Isolated	
Maximum Current per Common	2A	
Nominal Voltage Range	12–24 VDC	
Operating Voltage Range	5–36 VDC	
Maximum Voltage	36VDC	
Minimum Output Current	0.1 mA @ 24VDC	
Maximum Output Current	0.5 A per output No derating over temperature range	
Maximum Inrush Current	5A for 50ms	
Maximum Leakage Current	10µA	
ON Voltage Drop	0.05 VDC	
Status Indicators	Logic Side, Green	
Output Details		
Output Type	High-Speed	Standard[1]
Location	Y0...Y3	Y4...Y7
OFF to ON Response	< 2µs	< 5ms
ON to OFF Response	< 2µs	< 2ms
Maximum Switching Frequency	1m cable - 250kHz 10m cable - 100kHz	~ 100Hz
Overcurrent, Short Circuit Protection and Short to Ground	Current limit by Common Group, self-resetting	N/A
Overcurrent Trip Level[2]	Between 4A and 8A	N/A
Fuse Type	User-supplied external fuse	

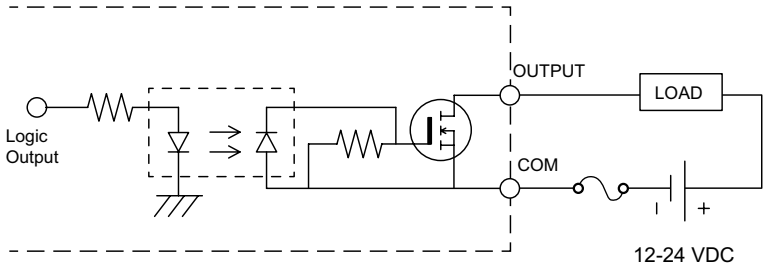
1. ***All outputs may be used as standard outputs. Only the first 4 outputs (Y0...Y3) are capable of high-speed DC operation.***
2. ***When the high-speed outputs are in an overcurrent situation, the Common terminal Red LED is on. The output LEDs will remain operational even though the output circuitry is turned off and no power is flowing. This condition is not reported to the CPU.***

BX-DM1-18ED1 Wiring, continued

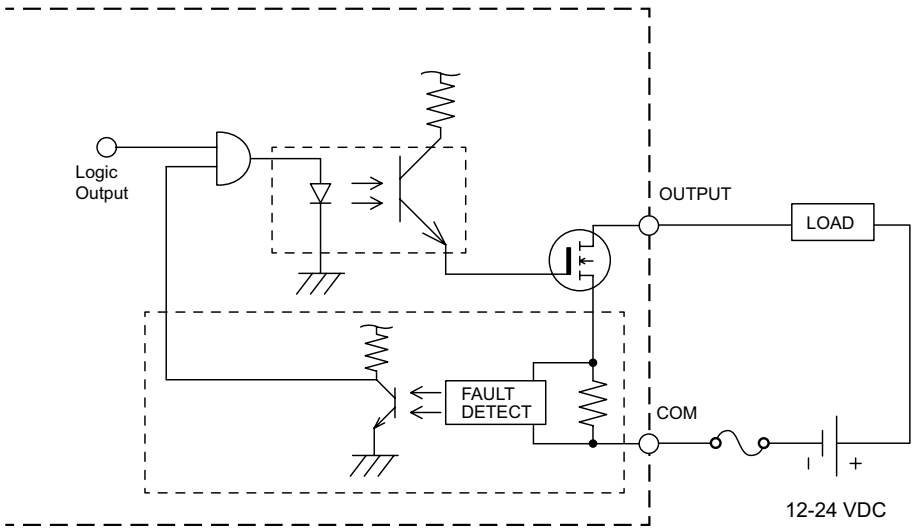
Discrete Output Connection Options



Discrete Standard Output Internal Circuitry



Discrete High-Speed Output Internal Circuitry



NOTE: *When the high speed outputs are in an overcurrent situation, the Common terminal Red LED is on. The output LEDs will remain operational even though the output circuitry is turned off and no power is flowing. This condition is not reported to the CPU.*

BX-DM1-18ED1-D Wiring

This MPU is made up of 18 discrete I/O points. The connections are grouped as follows:

- 10 discrete inputs - sinking/sourcing; rated for 12–24 VAC/VDC. They are located along the bottom of the unit; configured in two (2) groups of six (6) terminals, each comprised of five (5) inputs and an isolated common.
- 8 discrete outputs - sinking; rated at 12–24 VDC. They are located along the top of the unit starting to the right of the 24VDC external power supply terminals. The outputs are configured in two (2) groups of five (5) terminals, each comprised of four (4) outputs and an isolated common.

The MPU requires an external 12–24 VDC power supply. The DC power supply connection is located on the top left side of the unit. There is no 24VDC auxiliary output supply.

WARNING: No analog I/O is included on this unit. The 3 terminals to the right of the inputs are not used. These terminals are not internally connected. DO NOT CONNECT ANYTHING TO THESE TERMINALS!



BX-DM1-18ED1-D

NOTE: *Eight (8) Expansion Modules can be connected to extend I/O capacity, as long as the MPU power budget is not exceeded.*

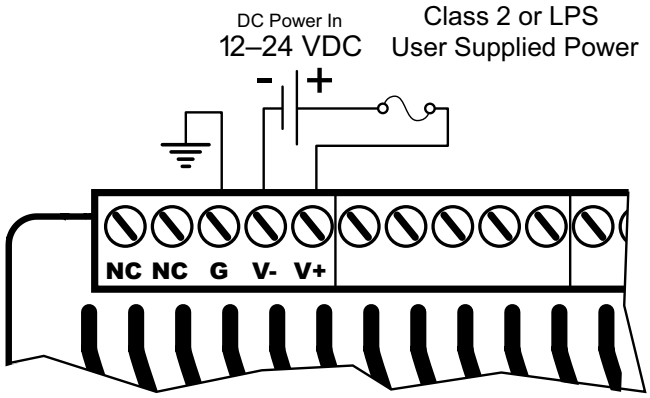
BX-DM1-18ED1-D Wiring, Continued

Power Supply Specifications

Power Supply Specifications	
Nominal Voltage Range*	12–24 VDC
Input Voltage Range (Tolerance)*	10–36 VDC
Maximum Input Voltage Ripple	< ±10%
Maximum Input Power	30W
Cold Start Inrush Current	5A, 2ms
Maximum Inrush Current (Hot Start)	5A, 2ms
Internal Input Protection	Reverse polarity protection and undervoltage lockout via transistor circuit
Acceptable External Power Drop Time	10ms
Under Input Voltage Lock-out	<9VDC
Heat Dissipation	13.9 W Max
Isolated User 24VDC Output	None
Voltage Withstand (dielectric)	1500VAC power Inputs to ground applied for 1 minute
Insulation Resistance	>10MΩ @ 500VDC
Software Version Required	Do-more! Designer version 2.0 or later

Class 2 or LPS Power Supply required.

Power Supply Connections



WARNING: No External AC power supply needed on this unit. The two terminals marked "NC" are not used. These terminals are not internally connected. DO NOT CONNECT ANYTHING TO THESE TERMINALS!

WARNING: The BRX System MUST have a proper earth ground. Do not operate the BRX MPU without proper earth grounding.

BX-DM1-18ED1-D Wiring, Continued

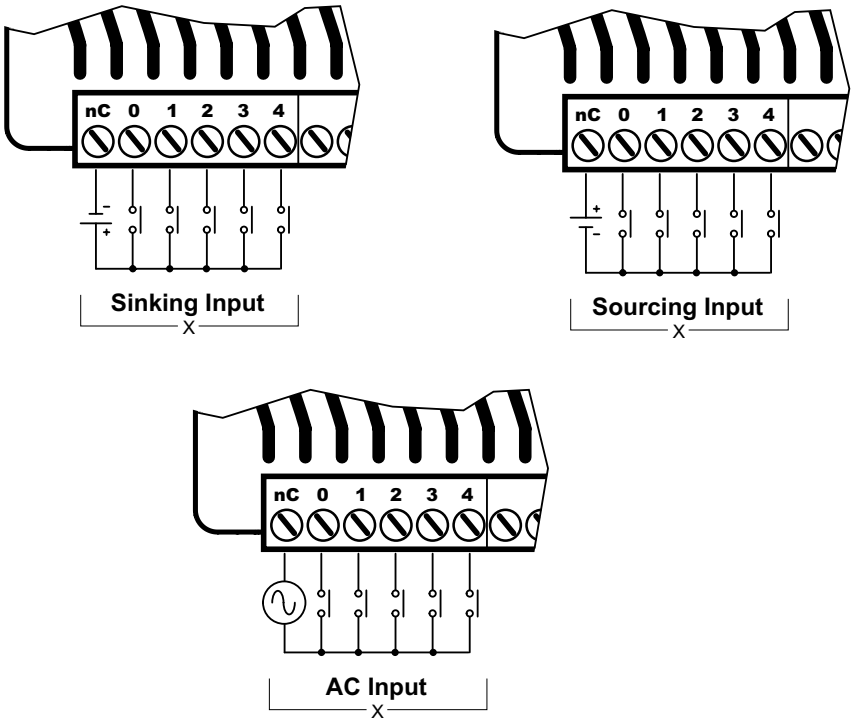
Discrete Input Specifications

Discrete Input Specifications			
Input Type		Sink/Source	
Total Inputs per Module		10	
Commons		2 (5 points/common) Isolated	
Nominal Voltage Range		12–24 VAC/VDC	
Input Voltage Range		9–30 VAC/VDC	
Maximum Voltage		30 VAC/VDC	
DC Frequency		0–250 kHz - High-speed	
Minimum Pulse Width		0.5 µs - High-speed	
AC Frequency		47–63 Hz[2]	
Input Impedance		3kΩ @ 24VDC	
Input Current (typical)		6mA @ 24 VAC/VDC	
Maximum Input Current		12mA @ 30 VAC/VDC	
ON Voltage Level		> 9.0 VAC/VDC	
OFF Voltage Level		< 2.0 VAC/VDC	
Maximum OFF Current		1.5 mA	
Status Indicators		Logic Side, Green	
Input Details			
Input Type		High-Speed DC	Standard[1]
Location		X0...X9	
OFF to ON Response	DC	< 2µs	
	AC	–	10ms[2]
ON to OFF Response	DC	< 2µs	
	AC	–	10ms[2]
Maximum Switching Frequency	DC	250kHz	
	AC	~ 30Hz	

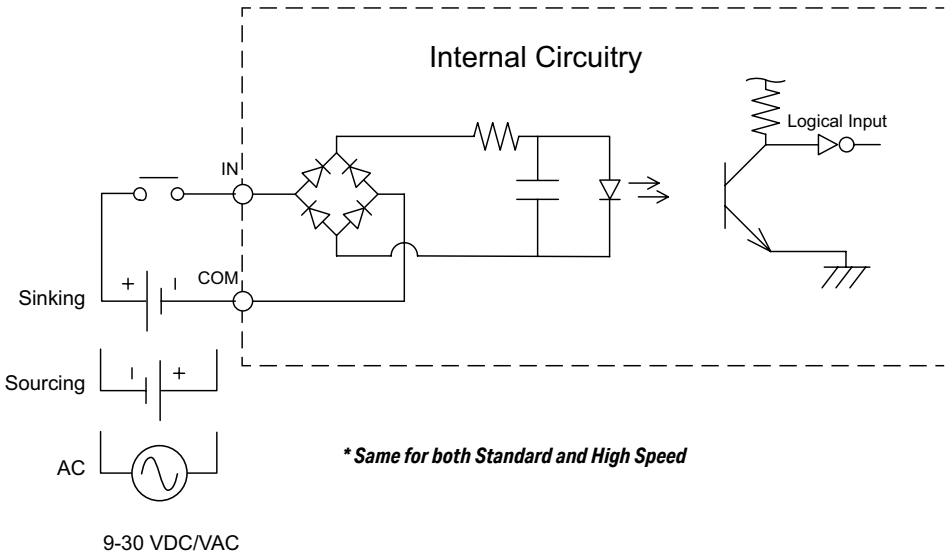
1. *All Inputs may be used as standard inputs or high speed inputs independently.*
2. *60Hz to 240Hz filter should be set in the software when using an AC line signal.*

BX-DM1-18ED1-D Wiring, Continued

Discrete Input Connection Options



Discrete Input Internal Circuitry *



BX-DM1-18ED1-D Wiring, Continued

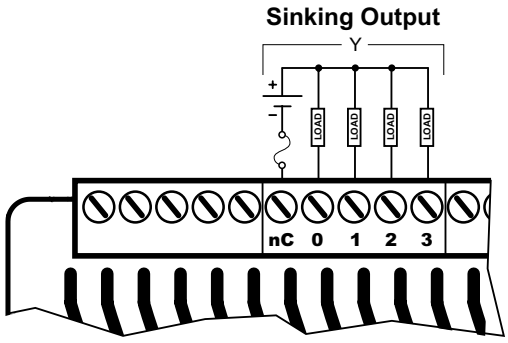
Discrete Output Specifications

Discrete Output Specifications		
Output Type	Sinking	
Total Outputs per Module	8	
Commons	2 (4 points/common) Isolated	
Maximum Current per Common	2A	
Nominal Voltage Range	12–24 VDC	
Operating Voltage Range	5–36 VDC	
Maximum Voltage	36VDC	
Minimum Output Current	0.1 mA @ 24VDC	
Maximum Output Current	0.5 A per output No derating over temperature range	
Maximum Inrush Current	5A for 50ms	
Maximum Leakage Current	10µA	
ON Voltage Drop	0.05 VDC	
Status Indicators	Logic Side, Green	
Output Details		
Output Type	High-Speed	Standard[1]
Location	Y0...Y3	Y4...Y7
OFF to ON Response	< 2µs	< 5ms
ON to OFF Response	< 2µs	< 2ms
Maximum Switching Frequency	1m cable - 250kHz 10m cable - 100kHz	~ 100Hz
Overcurrent, Short Circuit Protection and Short to Ground	Current limit by Common Group, self-resetting	N/A
Overcurrent Trip Level[2]	Between 4A and 8A	N/A
Fuse Type	User-supplied external fuse	

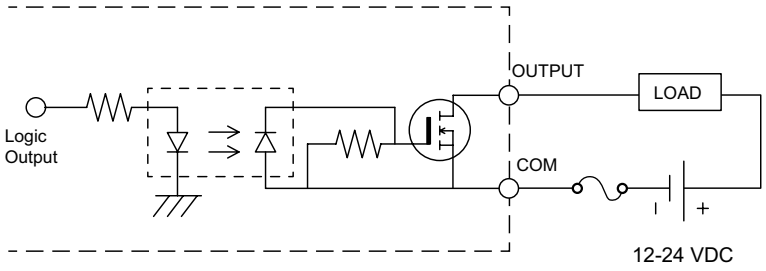
1. ***All outputs may be used as standard outputs. Only the first 4 outputs (Y0...Y3) are capable of high-speed DC operation.***
2. ***When the high-speed outputs are in an overcurrent situation, the Common terminal Red LED is on. The output LEDs will remain operational even though the output circuitry is turned off and no power is flowing. This condition is not reported to the CPU.***

BX-DM1-18ED1-D Wiring, Continued

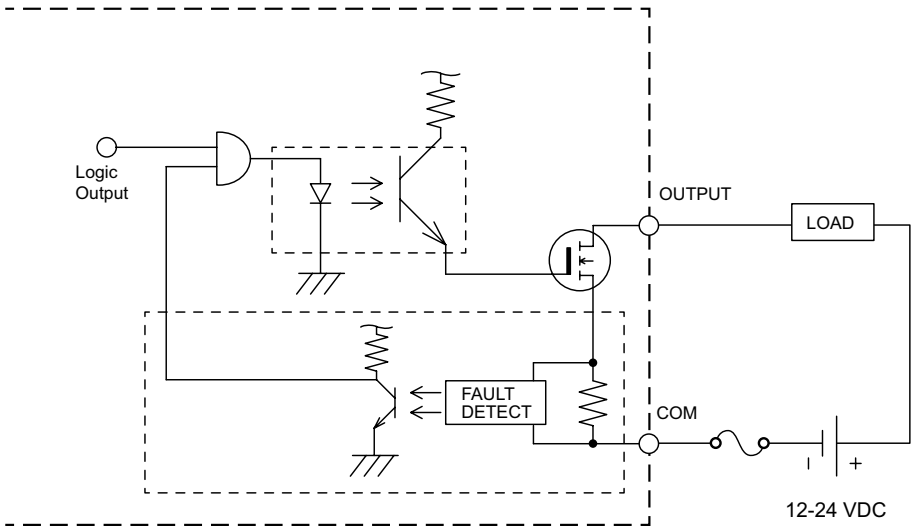
Discrete Output Connection Options



Discrete Standard Output Internal Circuitry



Discrete High-Speed Output Internal Circuitry



NOTE: *When the high speed outputs are in an overcurrent situation, the Common terminal Red LED is on. The output LEDs will remain operational even though the output circuitry is turned off and no power is flowing. This condition is not reported to the CPU.*

BX-DM1-18ED2 Wiring

This MPU is made up of 18 discrete I/O points. The connections are grouped as follows:

- 10 discrete inputs - sinking/sourcing; rated for 12–24 VAC/VDC. They are located along the bottom of the unit; configured in two (2) groups of 6 terminals, each comprised of 5 inputs and an isolated common.
- 8 discrete outputs - sourcing; rated at 12–24 VDC. They are located along the top of the unit starting to the right of the 24VDC auxiliary output terminals. The outputs are configured in two (2) groups of 5 terminals, each comprised of 4 outputs and an isolated common.

This MPU requires an external 120–240 VAC power supply. The AC power supply connection and the 24VDC auxiliary output supply terminals are located on the top left side of the unit.

WARNING: No analog I/O is included on this unit. The 3 terminals to the right of the inputs are not used. These terminals are not internally connected. DO NOT CONNECT ANYTHING TO THESE TERMINALS!



BX-DM1-18ED2

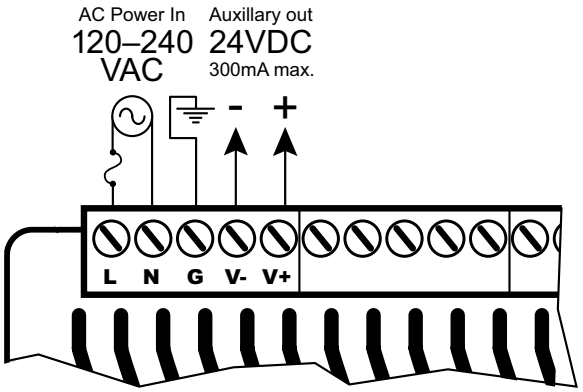
NOTE: *Eight (8) Expansion Modules can be connected to extend I/O capacity, as long as the MPU power budget is not exceeded.*

BX-DM1-18ED2 Wiring, Continued

Power Supply Specifications

Power Supply Specifications	
Nominal Voltage Range	120–240 VAC
Input Voltage Range (Tolerance)	85–264 VAC
Rated Operating Frequency	47–63 Hz
Maximum Input Power	40VA
Cold Start Inrush Current	1.5 A, 2ms
Maximum Inrush Current (Hot Start)	1.5 A, 2ms
Internal Input Fuse Protection	Micro fuse 250V, 2A Non-replaceable
Acceptable External Power Drop Time	10ms
Under Input Voltage Lock-out	80VAC
Input Transient Protection	Input choke and line filter
Heat Dissipation	16.1 W Max
Isolated User 24VDC Output	24VDC @ 0.3 A max, <1V P-P Ripple, Integrated self-resetting short circuit protection
Voltage Withstand (dielectric)	1500VAC Power Inputs to Ground applied for 1 minute 1500VAC Ground to 24VDC Output applied for 1 minute
Insulation Resistance	>10MΩ @ 500VDC
Software Version Required	Do-more! Designer version 2.0 or later

Power Supply Connections



WARNING: Do not exceed the 24VDC auxiliary power supply load limit of 300mA.

WARNING: The BRX System MUST have a proper earth ground. Do not operate the BRX MPU without proper earth grounding.

BX-DM1-18ED2 Wiring, Continued

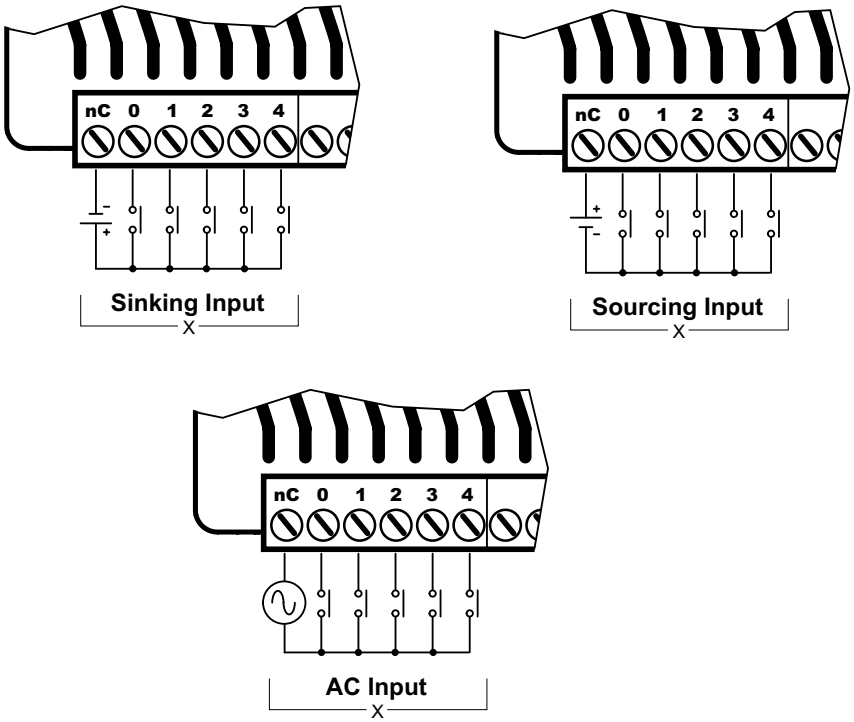
Discrete Input Specifications

Discrete Input Specifications			
Input Type		Sink/Source	
Total Inputs per Module		10	
Commons		2 (5 points/common) Isolated	
Nominal Voltage Range		12–24 VAC/VDC	
Input Voltage Range		9–30 VAC/VDC	
Maximum Voltage		30 VAC/VDC	
DC Frequency		0–250 kHz - High-speed	
Minimum Pulse Width		0.5 µs - High-speed	
AC Frequency		47–63 Hz[2]	
Input Impedance		3kΩ @ 24VDC	
Input Current (typical)		6mA @ 24 VAC/VDC	
Maximum Input Current		12mA @ 30 VAC/VDC	
ON Voltage Level		> 9.0 VAC/VDC	
OFF Voltage Level		< 2.0 VAC/VDC	
Maximum OFF Current		1.5 mA	
Status Indicators		Logic Side, Green	
Input Details			
Input Type		High-Speed DC	Standard[1]
Location		X0...X9	
OFF to ON Response	DC	< 2µs	
	AC	–	10ms[2]
ON to OFF Response	DC	< 2µs	
	AC	–	10ms[2]
Maximum Switching Frequency	DC	250kHz	
	AC	~ 30Hz	

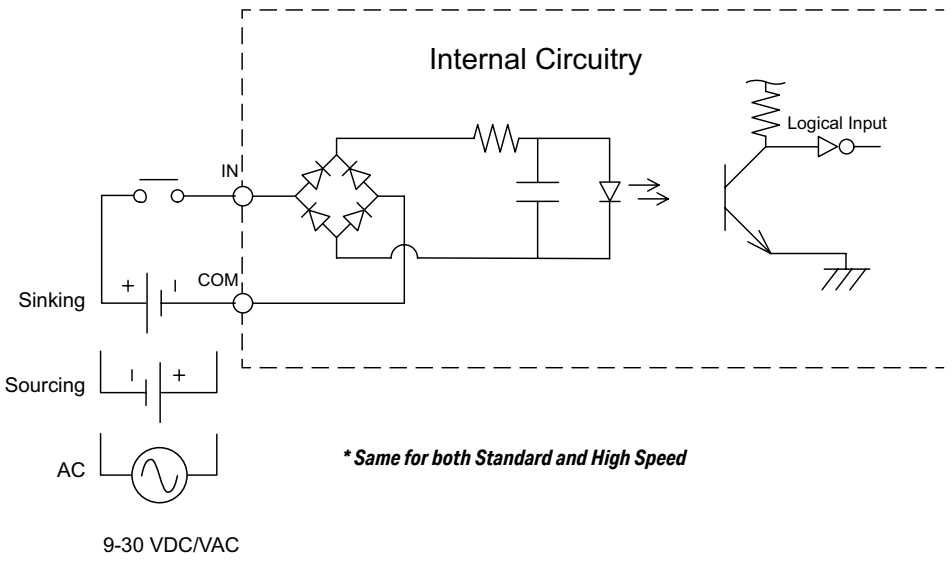
1. All Inputs may be used as standard inputs or high speed inputs independently.
2. 60Hz to 240Hz filter should be set in the software when using an AC line signal.

BX-DM1-18ED2 Wiring, Continued

Discrete Input Connection Options



Discrete Input Internal Circuitry *



BX-DM1-18ED2 Wiring, Continued

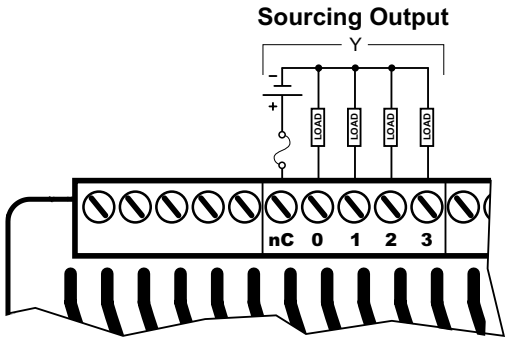
Discrete Output Specifications

Discrete Output Specifications		
Output Type	Sourcing	
Total Outputs per Module	8	
Commons	2 (4 points/common) Isolated	
Maximum Current per Common	2A	
Nominal Voltage Range	12–24 VDC	
Operating Voltage Range	5–36 VDC	
Maximum Voltage	36VDC	
Minimum Output Current	0.1 mA @ 24VDC	
Maximum Output Current	0.5 A per output No derating over temperature range	
Maximum Inrush Current	5A for 50ms	
Maximum Leakage Current	10µA	
ON Voltage Drop	0.05 VDC	
Status Indicators	Logic Side, Green	
Output Details		
Output Type	High-Speed	Standard[1]
Location	Y0...Y3	Y4...Y7
OFF to ON Response	< 2µs	< 5ms
ON to OFF Response	< 2µs	< 2ms
Maximum Switching Frequency	1m cable - 250kHz 10m cable - 100kHz	~ 100Hz
Overcurrent, Short Circuit Protection and Short to Ground	Current limit by Common Group, self-resetting	N/A
Overcurrent Trip Level[2]	Between 4A and 8A	N/A
Fuse Type	User-supplied external fuse	

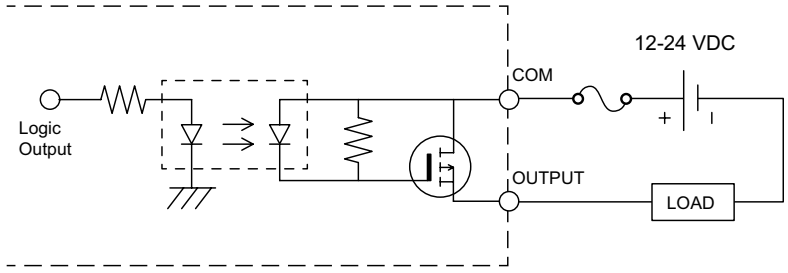
1. ***All outputs may be used as standard outputs. Only the first 4 outputs (Y0...Y3) are capable of high-speed DC operation.***
2. ***When the high-speed outputs are in an overcurrent situation, the Common terminal Red LED is on. The output LEDs will remain operational even though the output circuitry is turned off and no power is flowing. This condition is not reported to the CPU.***

BX-DM1-18ED2 Wiring, Continued

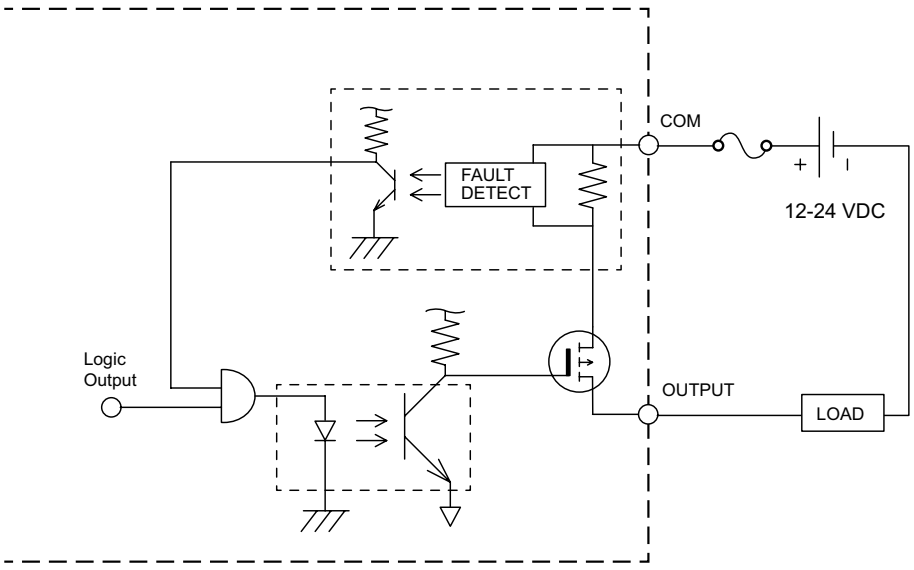
Discrete Output Connection Options



Discrete Standard Output Internal Circuitry



Discrete High-Speed Output Internal Circuitry



NOTE: *When the high speed outputs are in an overcurrent situation, the Common terminal Red LED is on. The output LEDs will remain operational even though the output circuitry is turned off and no power is flowing. This condition is not reported to the CPU.*

BX-DM1-18ED2-D Wiring

This MPU is made up of 18 discrete I/O points. The connections are grouped as follows:

- 10 discrete inputs - sinking/sourcing; rated for 12–24 VAC/VDC. They are located along the bottom of the unit; configured in two (2) groups of 6 terminals, each comprised of 5 inputs and an isolated common.
- 8 discrete outputs - sourcing; rated at 12–24 VDC. They are located along the top of the unit starting to the right of the 24VDC external power supply terminals. The outputs are configured in two (2) groups of 5 terminals, each comprised of 4 outputs and an isolated common..

This MPU requires an external 12–24 VDC power supply. The DC power supply connection is located on the top left side of the unit. There is no 24VDC auxiliary output supply.

WARNING: No analog I/O is included on this unit. The 3 terminals to the right of the inputs are not used. These terminals are not internally connected. DO NOT CONNECT ANYTHING TO THESE TERMINALS!



BX-DM1-18ED2-D

***NOTE:** Eight (8) Expansion Modules can be connected to extend I/O capacity, as long as the MPU power budget is not exceeded.*

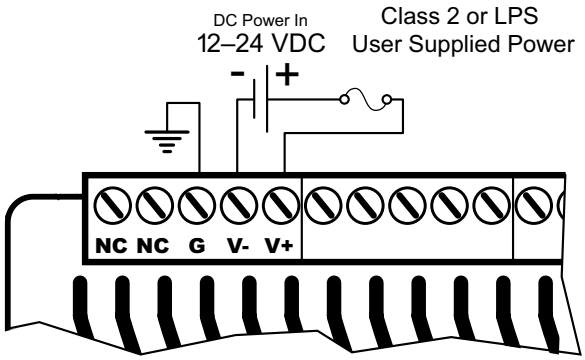
BX-DM1-18ED2-D, Continued

Power Supply Specifications

Power Supply Specifications	
Nominal Voltage Range*	12–24 VDC
Input Voltage Range (Tolerance)*	10–36 VDC
Maximum Input Voltage Ripple	< ±10%
Maximum Input Power	30W
Cold Start Inrush Current	5A, 2ms
Maximum Inrush Current (Hot Start)	5A, 2ms
Internal Input Protection	Reverse polarity protection and undervoltage lockout via transistor circuit
Acceptable External Power Drop Time	10ms
Under Input Voltage Lock-out	<9VDC
Heat Dissipation	13.9 W Max
Isolated User 24VDC Output	None
Voltage Withstand (dielectric)	1500VAC power Inputs to ground applied for 1 minute
Insulation Resistance	>10MΩ @ 500VDC
Software Version Required	Do-more! Designer version 2.0 or later

**** Class 2 or LPS Power Supply required.***

Power Supply Connections



WARNING: No External AC power supply needed on this unit. The two terminals marked "NC" are not used. These terminals are not internally connected. DO NOT CONNECT ANYTHING TO THESE TERMINALS!

WARNING: The BRX System MUST have a proper earth ground. Do not operate the BRX MPU without proper earth grounding.

BX-DM1-18ED2-D Wiring, Continued

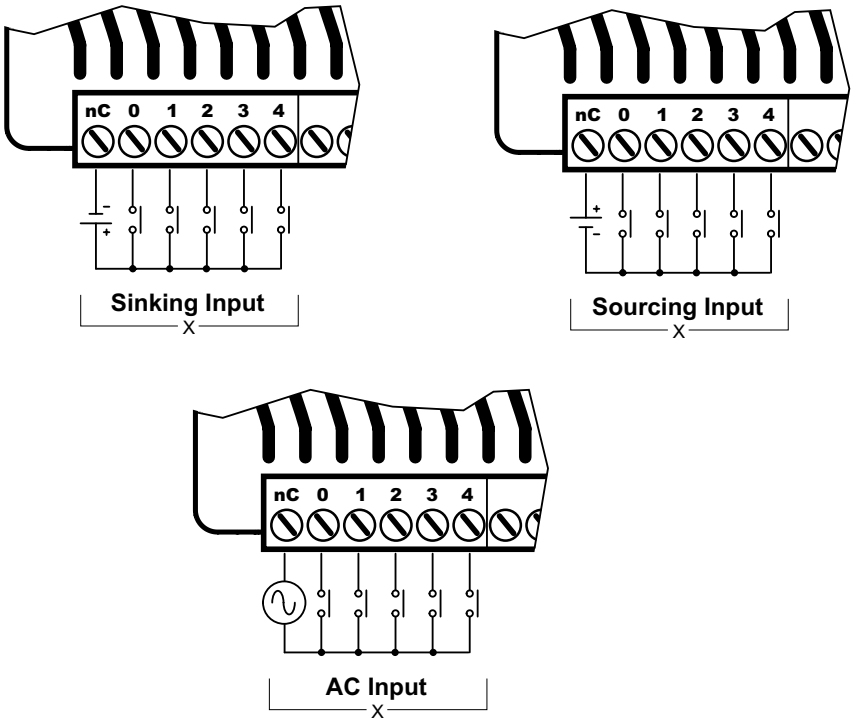
Discrete Input Specifications

Discrete Input Specifications			
Input Type		Sink/Source	
Total Inputs per Module		10	
Commons		2 (5 points/common) Isolated	
Nominal Voltage Range		12–24 VAC/VDC	
Input Voltage Range		9–30 VAC/VDC	
Maximum Voltage		30 VAC/VDC	
DC Frequency		0–250 kHz - High-speed	
Minimum Pulse Width		0.5 µs - High-speed	
AC Frequency		47–63 Hz[2]	
Input Impedance		3kΩ @ 24VDC	
Input Current (typical)		6mA @ 24 VAC/VDC	
Maximum Input Current		12mA @ 30 VAC/VDC	
ON Voltage Level		> 9.0 VAC/VDC	
OFF Voltage Level		< 2.0 VAC/VDC	
Maximum OFF Current		1.5 mA	
Status Indicators		Logic Side, Green	
Input Details			
Input Type		High-Speed DC	Standard[1]
Location		X0...X9	
OFF to ON Response	DC	< 2µs	
	AC	–	10ms[2]
ON to OFF Response	DC	< 2µs	
	AC	–	10ms[2]
Maximum Switching Frequency	DC	250kHz	
	AC	~ 30Hz	

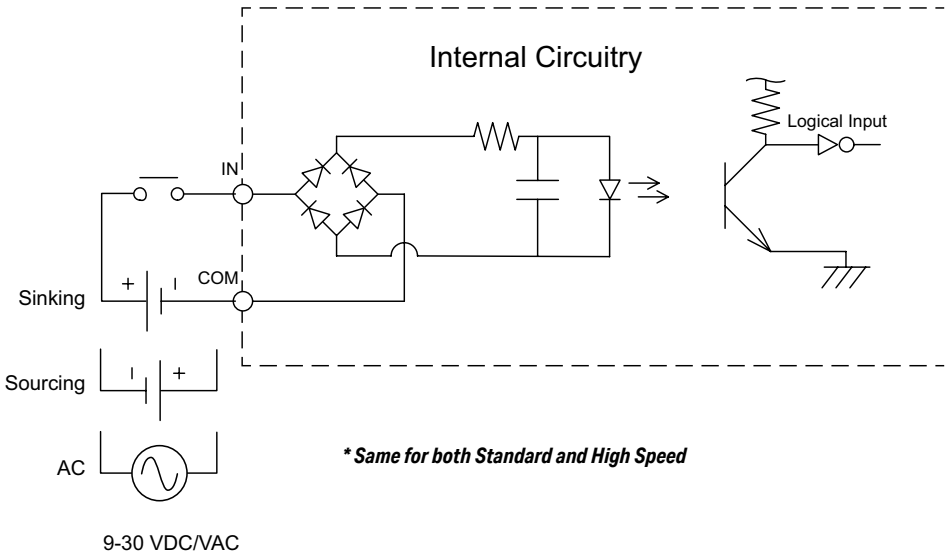
1. All Inputs may be used as standard inputs or high speed inputs independently.
2. 60Hz to 240Hz filter should be set in the software when using an AC line signal.

BX-DM1-18ED2-D Wiring, Continued

Discrete Input Connection Options



Discrete Input Internal Circuitry *



BX-DM1-18ED2-D Wiring, Continued

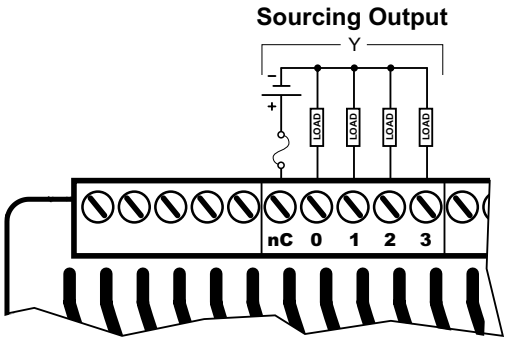
Discrete Output Specifications

Discrete Output Specifications		
Output Type	Sourcing	
Total Outputs per Module	8	
Commons	2 (4 points/common) Isolated	
Maximum Current per Common	2A	
Nominal Voltage Range	12–24 VDC	
Operating Voltage Range	5–36 VDC	
Maximum Voltage	36VDC	
Minimum Output Current	0.1 mA @ 24VDC	
Maximum Output Current	0.5 A per output No derating over temperature range	
Maximum Inrush Current	5A for 50ms	
Maximum Leakage Current	10µA	
ON Voltage Drop	0.05 VDC	
Status Indicators	Logic Side, Green	
Output Details		
Output Type	High-Speed	Standard[1]
Location	Y0...Y3	Y4...Y7
OFF to ON Response	< 2µs	< 5ms
ON to OFF Response	< 2µs	< 2ms
Maximum Switching Frequency	1m cable - 250kHz 10m cable - 100kHz	~ 100Hz
Overcurrent, Short Circuit Protection and Short to Ground	Current limit by Common Group, self-resetting	N/A
Overcurrent Trip Level[2]	Between 4A and 8A	N/A
Fuse Type	User-supplied external fuse	

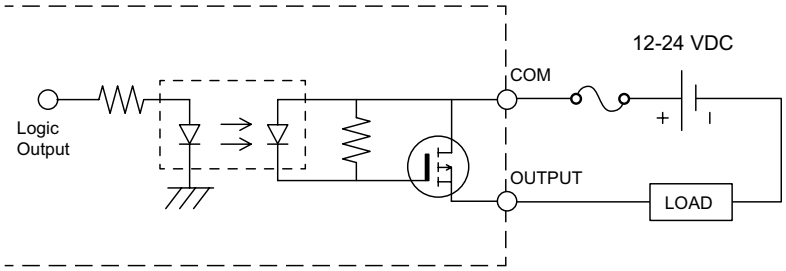
1. *All outputs may be used as standard outputs. Only the first 4 outputs (Y0...Y3) are capable of high-speed DC operation.*
2. *When the high-speed outputs are in an overcurrent situation, the Common terminal Red LED is on. The output LEDs will remain operational even though the output circuitry is turned off and no power is flowing. This condition is not reported to the CPU.*

BX-DM1-18ED2-D Wiring, Continued

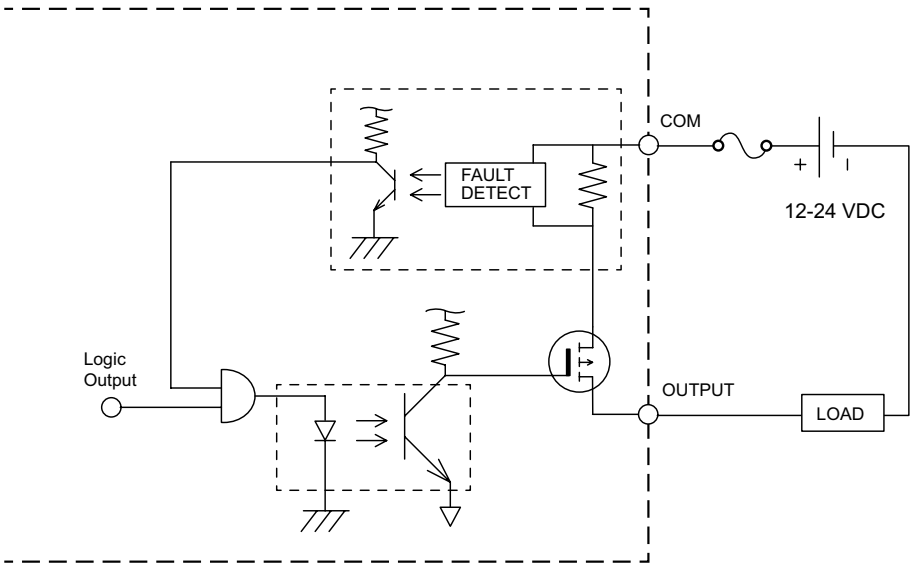
Discrete Output Connection Options



Discrete Standard Output Internal Circuitry



Discrete High-Speed Output Internal Circuitry



NOTE: *When the high speed outputs are in an overcurrent situation, the Common terminal Red LED is on. The output LEDs will remain operational even though the output circuitry is turned off and no power is flowing. This condition is not reported to the CPU.*

BX-DM1-18ER Wiring

This MPU is made up of 18 discrete I/O points. The connections are grouped as follows:

- 10 discrete inputs - sinking/sourcing; rated for 12–24 VAC/VDC. They are located along the bottom of the unit; configured in two (2) groups of 6 terminals, each comprised of 5 inputs and an isolated common.
- 8 discrete outputs - Form A Relay (SPST); rated 12–48 VDC/ 24–240 VAC. They are located along the top of the unit starting to the right of the 24VDC auxiliary output terminals. The outputs are configured in two (2) groups of 5 terminals, each comprised of 4 outputs and an isolated common.

This MPU requires an external 120–240 VAC power supply. The AC power supply connection and the 24VDC auxiliary output supply terminals are located on the top left side of the unit.

WARNING: No analog I/O is included on this unit. The 3 terminals to the right of the inputs are not used. These terminals are not internally connected. DO NOT CONNECT ANYTHING TO THESE TERMINALS!



BX-DM1-18ER

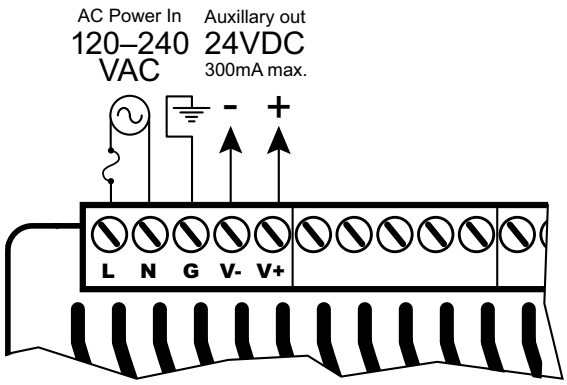
NOTE: *Eight (8) Expansion Modules can be connected to extend I/O capacity, as long as the MPU power budget is not exceeded.*

BX-DM1-18ER Wiring, Continued

Power Supply Specifications

Power Supply Specifications	
Nominal Voltage Range	120–240 VAC
Input Voltage Range (Tolerance)	85–264 VAC
Rated Operating Frequency	47–63 Hz
Maximum Input Power	40VA
Cold Start Inrush Current	1.5 A, 2ms
Maximum Inrush Current (Hot Start)	1.5 A, 2ms
Internal Input Fuse Protection	Micro fuse 250V, 2A Non-replaceable
Acceptable External Power Drop Time	10ms
Under Input Voltage Lock-out	80VAC
Input Transient Protection	Input choke and line filter
Heat Dissipation	19.3 W Max
Isolated User 24VDC Output	24VDC @ 0.3 A max, <1V P-P Ripple, Integrated self-resetting short circuit protection
Voltage Withstand (dielectric)	1500VAC Power Inputs to Ground applied for 1 minute 1500VAC Ground to 24VDC Output applied for 1 minute
Insulation Resistance	>10MΩ @ 500VDC
Software Version Required	Do-more! Designer version 2.0 or later

Power Supply Connections



WARNING: Do not exceed the 24VDC auxiliary power supply load limit of 300mA.

WARNING: The BRX System MUST have a proper earth ground. Do not operate the BRX MPU without proper earth grounding.

BX-DM1-18ER Wiring, Continued

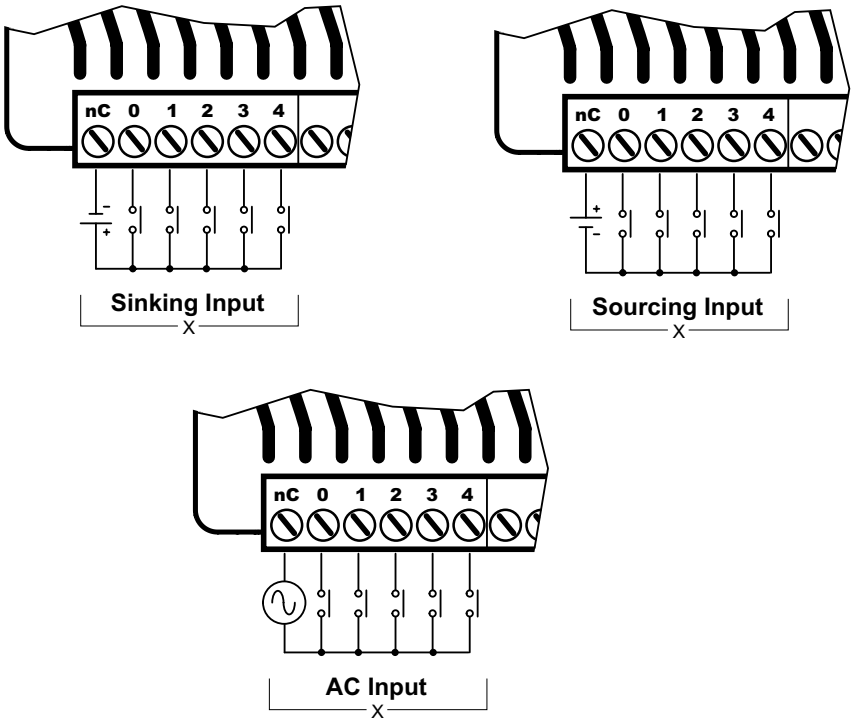
Discrete Input Specifications

Discrete Input Specifications			
Input Type		Sink/Source	
Total Inputs per Module		10	
Commons		2 (5 points/common) Isolated	
Nominal Voltage Range		12–24 VAC/VDC	
Input Voltage Range		9–30 VAC/VDC	
Maximum Voltage		30 VAC/VDC	
DC Frequency		0–250 kHz - High-speed	
Minimum Pulse Width		0.5 µs - High-speed	
AC Frequency		47–63 Hz[2]	
Input Impedance		3kΩ @ 24VDC	
Input Current (typical)		6mA @ 24 VAC/VDC	
Maximum Input Current		12mA @ 30 VAC/VDC	
ON Voltage Level		> 9.0 VAC/VDC	
OFF Voltage Level		< 2.0 VAC/VDC	
Maximum OFF Current		1.5 mA	
Status Indicators		Logic Side, Green	
Input Details			
Input Type		High-Speed DC	Standard[1]
Location		X0...X9	
OFF to ON Response	DC	< 2µs	
	AC	–	10ms[2]
ON to OFF Response	DC	< 2µs	
	AC	–	10ms[2]
Maximum Switching Frequency	DC	250kHz	
	AC	~ 30Hz	

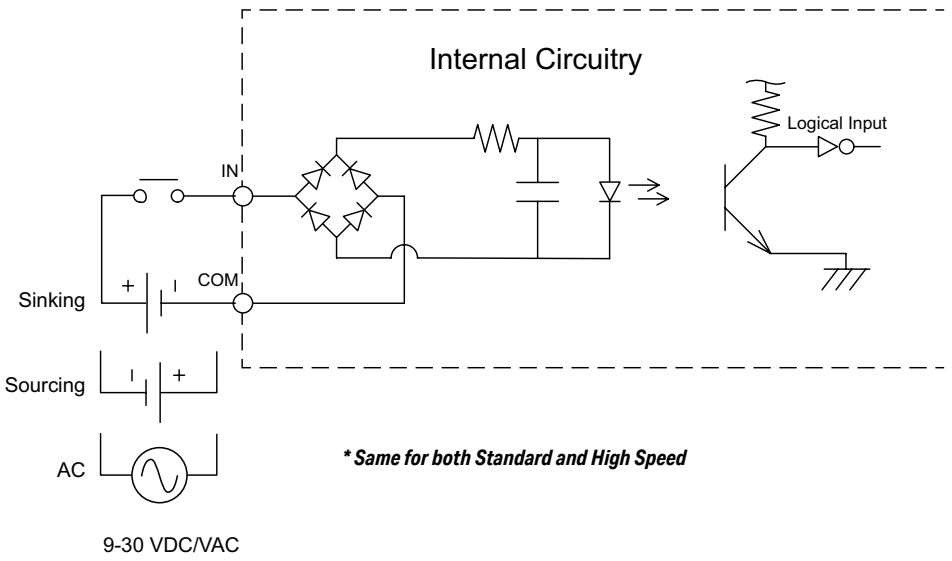
1. All Inputs may be used as standard inputs or high speed inputs independently.
2. 60Hz to 240Hz filter should be set in the software when using an AC line signal.

BX-DM1-18ER Wiring, Continued

Discrete Input Connection Options



Discrete Input Internal Circuitry *



** Same for both Standard and High Speed*

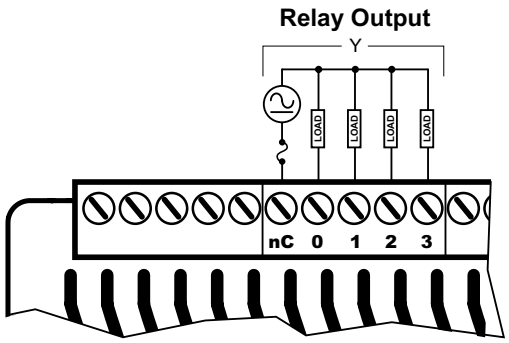
BX-DM1-18ER Wiring, Continued

Discrete Output Specifications

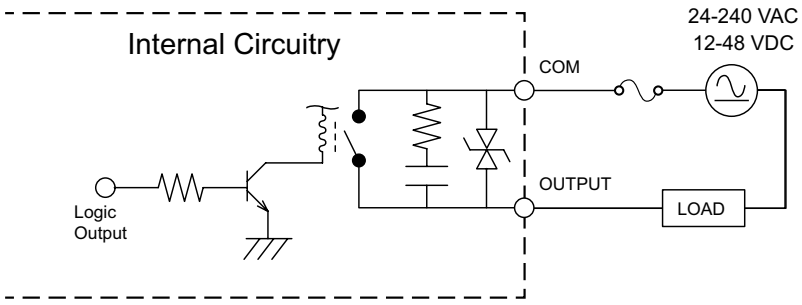
Discrete Output Specifications	
Output Type	Relay Form A (SPST)
Total Outputs per Module	8
Commons	2 (4 points/common) Isolated
Maximum Current per Common	8A
Nominal Voltage Range	12–48 VDC 24–240 VAC
Operating Voltage Range	5–60 VDC 5–264 VAC
Maximum Voltage	60VDC 264VAC
Minimum Output Current	0.1 mA @ 24VDC 0.1 mA @ 24VAC
Maximum Output Current	2A
Maximum Inrush Current	5A for 50ms
Maximum Leakage Current	1µA (DC), 300µA (AC) due to RC snubber circuit
ON Voltage Drop	0.2 V Max
Status Indicators	Logic Side, Green
Output Details	
Output Type	Standard
Location	Y0...Y7
ON-OFF Response	<10ms
OFF-ON Response	<10ms
Maximum Switching Frequency	10Hz
Relay Cycle Life Mechanical Endurance Electrical Endurance	 5 million operations 120,000 operations
Fuse Type	User-supplied external fuse

BX-DM1-18ER Wiring, Continued

Discrete Output Connection Options



Discrete Standard Output Internal Circuitry



BX-DM1-18ER-D Wiring

This MPU is made up of 18 discrete I/O points. The connections are grouped as follows:

- 10 discrete inputs - sinking/sourcing; rated for 12–24 VAC/VDC. They are located along the bottom of the unit; configured in two (2) groups of 6 terminals, each comprised of 5 inputs and an isolated common.
- 8 discrete outputs - Form A Relay (SPST); rated 12–48 VDC/ 24–240 VAC. They are located along the top of the unit starting to the right of the 24VDC external power supply terminals. The outputs are configured in two (2) groups of 5 terminals, each comprised of 4 outputs and an isolated common.

This MPU requires an external 12–24 VDC power supply. The DC power supply connection is located on the top left side of the unit. There is no 24VDC auxiliary output supply

WARNING: No analog I/O is included on this unit. The 3 terminals to the right of the inputs are not used. These terminals are not internally connected. DO NOT CONNECT ANYTHING TO THESE TERMINALS!



BX-DM1-18ER-D

NOTE: *Eight (8) Expansion Modules can be connected to extend I/O capacity, as long as the MPU power budget is not exceeded.*

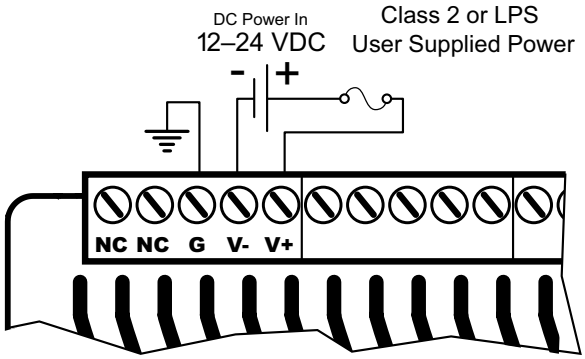
BX-DM1-18ER-D Wiring, Continued

Power Supply Specifications

Power Supply Specifications	
Nominal Voltage Range*	12–24 VDC
Input Voltage Range (Tolerance)*	10–36 VDC
Maximum Input Voltage Ripple	< ±10%
Maximum Input Power	30W
Cold Start Inrush Current	5A, 2ms
Maximum Inrush Current (Hot Start)	5A, 2ms
Internal Input Protection	Reverse polarity protection and undervoltage lockout via transistor circuit
Acceptable External Power Drop Time	10ms
Under Input Voltage Lock-out	<9VDC
Heat Dissipation	17.1 W Max
Isolated User 24VDC Output	None
Voltage Withstand (dielectric)	1500VAC power Inputs to ground applied for 1 minute
Insulation Resistance	>10MΩ @ 500VDC
Software Version Required	Do-more! Designer version 2.0 or later

**** Class 2 or LPS Power Supply required.***

Power Supply Connections



WARNING: No External AC power supply needed on this unit. The two terminals marked "NC" are not used. These terminals are not internally connected. DO NOT CONNECT ANYTHING TO THESE TERMINALS!

WARNING: The BRX System MUST have a proper earth ground. Do not operate the BRX MPU without proper earth grounding.

BX-DM1-18ER-D Wiring, Continued

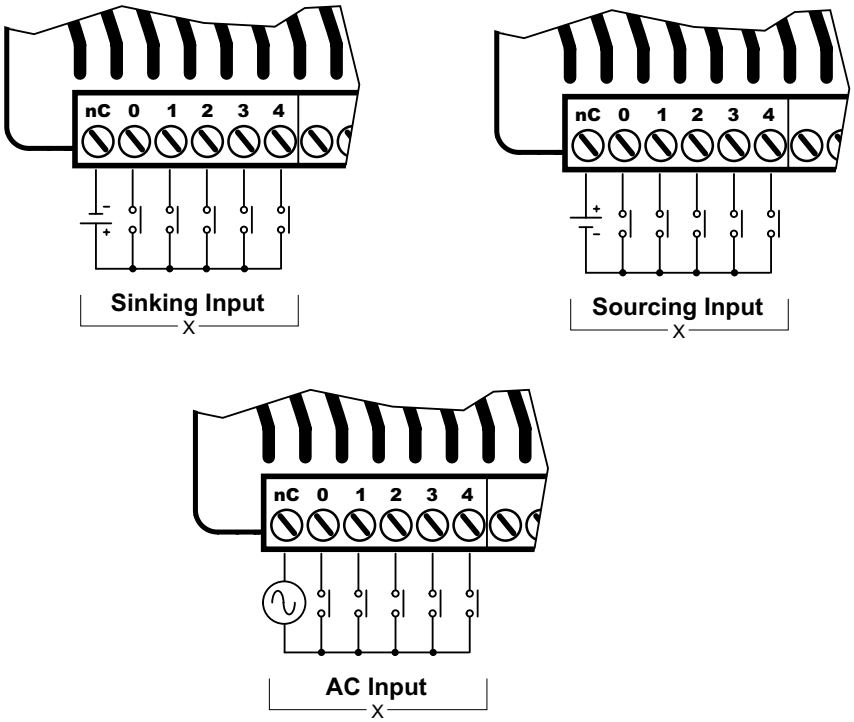
Discrete Input Specifications

Discrete Input Specifications			
Input Type		Sink/Source	
Total Inputs per Module		10	
Commons		2 (5 points/common) Isolated	
Nominal Voltage Range		12–24 VAC/VDC	
Input Voltage Range		9–30 VAC/VDC	
Maximum Voltage		30 VAC/VDC	
DC Frequency		0–250 kHz - High-speed	
Minimum Pulse Width		0.5 µs - High-speed	
AC Frequency		47–63 Hz[2]	
Input Impedance		3kΩ @ 24VDC	
Input Current (typical)		6mA @ 24 VAC/VDC	
Maximum Input Current		12mA @ 30 VAC/VDC	
ON Voltage Level		> 9.0 VAC/VDC	
OFF Voltage Level		< 2.0 VAC/VDC	
Maximum OFF Current		1.5 mA	
Status Indicators		Logic Side, Green	
Input Details			
Input Type		High-Speed DC	Standard[1]
Location		X0...X9	
OFF to ON Response	DC	< 2µs	
	AC	–	10ms[2]
ON to OFF Response	DC	< 2µs	
	AC	–	10ms[2]
Maximum Switching Frequency	DC	250kHz	
	AC	~ 30Hz	

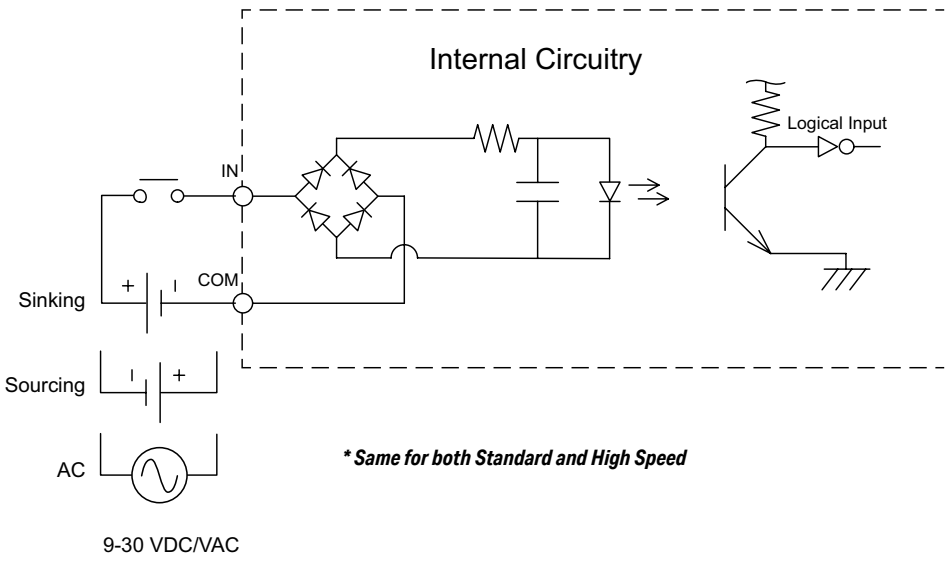
1. All Inputs may be used as standard inputs or high speed inputs independently.
2. 60Hz to 240Hz filter should be set in the software when using an AC line signal.

BX-DM1-18ER-D Wiring, Continued

Discrete Input Connection Options



Discrete Input Internal Circuitry *



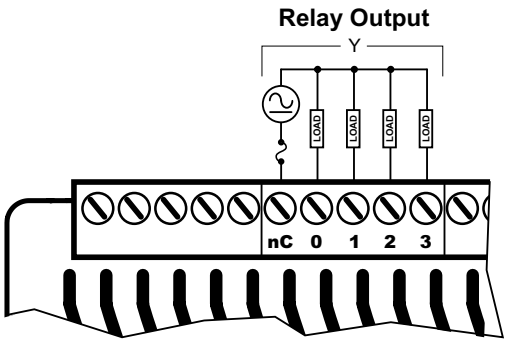
BX-DM1-18ER-D Wiring, Continued

Discrete Output Specifications

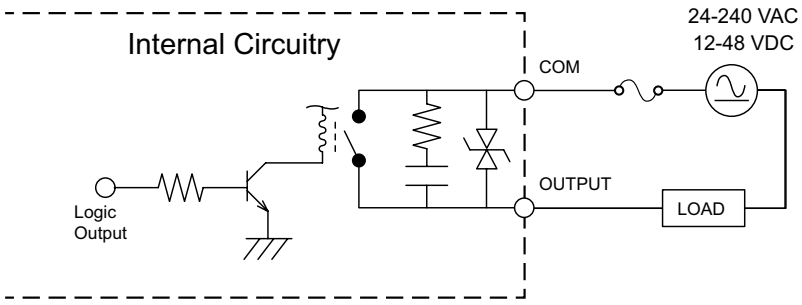
Discrete Output Specifications	
Output Type	Relay Form A (SPST)
Total Outputs per Module	8
Commons	2 (4 points/common) Isolated
Maximum Current per Common	8A
Nominal Voltage Range	12–48 VDC 24–240 VAC
Operating Voltage Range	5–60 VDC 5–264 VAC
Maximum Voltage	60VDC 264VAC
Minimum Output Current	0.1 mA @ 24VDC 0.1 mA @ 24VAC
Maximum Output Current	2A
Maximum Inrush Current	5A for 50ms
Maximum Leakage Current	1µA (DC), 300µA (AC) due to RC snubber circuit
ON Voltage Drop	0.2 V Max
Status Indicators	Logic Side, Green
Output Details	
Output Type	Standard
Location	Y0...Y7
ON-OFF Response	<10ms
OFF-ON Response	<10ms
Maximum Switching Frequency	10Hz
Relay Cycle Life Mechanical Endurance Electrical Endurance	 5 million operations 120,000 operations
Fuse Type	User-supplied external fuse

BX-DM1-18ER-D Wiring, Continued

Discrete Output Connection Options



Discrete Standard Output Internal Circuitry



BX-DM1-18AR Wiring

This MPU is made up of 18 discrete I/O points. The connections are grouped as follows:

- 10 discrete inputs - AC rated for 120–240 VAC. They are located along the bottom of the unit; configured in two (2) groups of 6 terminals, each comprised of 5 inputs and an isolated common.
- 8 discrete outputs - Form A Relay (SPST); rated 12–48 VDC/ 24–240 VAC. They are located along the top of the unit starting to the right of the 24VDC auxiliary output terminals. The outputs are configured in two (2) groups of 5 terminals, each comprised of 4 outputs and an isolated common.

This MPU requires an external 120–240 VAC power supply. The AC power supply connection and the 24VDC auxiliary output supply terminals are located on the top left side of the unit.

WARNING: No analog I/O is included on this unit. The 3 terminals to the right of the inputs are not used. These terminals are not internally connected. DO NOT CONNECT ANYTHING TO THESE TERMINALS!



BX-DM1-18AR

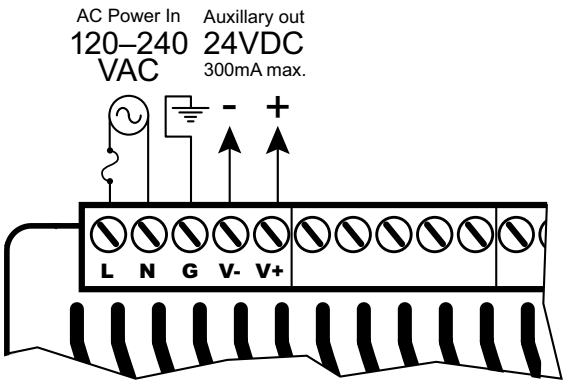
NOTE: *Eight (8) Expansion Modules can be connected to extend I/O capacity, as long as the MPU power budget is not exceeded.*

BX-DM1-18AR Wiring, Continued

Power Supply Specifications

Power Supply Specifications	
Nominal Voltage Range	120–240 VAC
Input Voltage Range (Tolerance)	85–264 VAC
Rated Operating Frequency	47–63 Hz
Maximum Input Power	40VA
Cold Start Inrush Current	1.5 A, 2ms
Maximum Inrush Current (Hot Start)	1.5 A, 2ms
Internal Input Fuse Protection	Micro fuse 250V, 2A Non-replaceable
Acceptable External Power Drop Time	10ms
Under Input Voltage Lock-out	80VAC
Input Transient Protection	Input choke and line filter
Heat Dissipation	18.9 W Max
Isolated User 24VDC Output	24VDC @ 0.3 A max, <1V P-P Ripple, Integrated self-resetting short circuit protection
Voltage Withstand (dielectric)	1500VAC Power Inputs to Ground applied for 1 minute 1500VAC Ground to 24VDC Output applied for 1 minute
Insulation Resistance	>10MΩ @ 500VDC
Software Version Required	Do-more! Designer version 2.0 or later

Power Supply Connections



WARNING: Do not exceed the 24VDC auxiliary power supply load limit of 300mA.

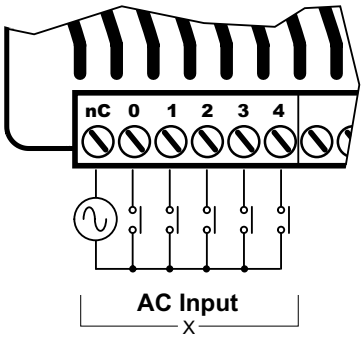
WARNING: The BRX System MUST have a proper earth ground. Do not operate the BRX MPU without proper earth grounding.

BX-DM1-18AR Wiring, Continued

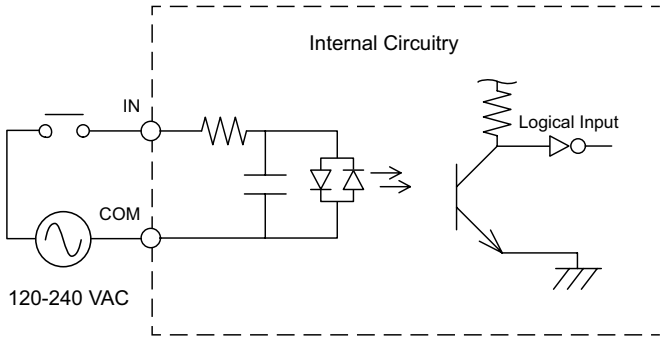
Discrete Input Specifications

Discrete Input Specifications	
Input Type	AC
Total Inputs per Module	10
Commons	2 (5 points/common) Isolated
Nominal Voltage Range	120–240 VAC
Input Voltage Range	85–264 VAC
Maximum Voltage	264VAC RMS
AC Frequency	47–63 Hz
Input Impedance	15kΩ
Input Current (typical)	9mA @ 120VAC, 13mA @ 220VAC
Maximum Input Current	14mA @ 120VAC, 20mA @ 220VAC
ON Voltage Level	> 85VAC
OFF Voltage Level	< 40VAC
Maximum OFF Current	2.5 mA
Status Indicators	Logic Side, Green
Input Details	
Input Type	Standard
Location	X0...X9
OFF - ON Response	10ms
ON - OFF Response	10ms
Maximum Switching Frequency	~ 30Hz

Discrete Input Connection Options



Discrete Input Internal Circuitry



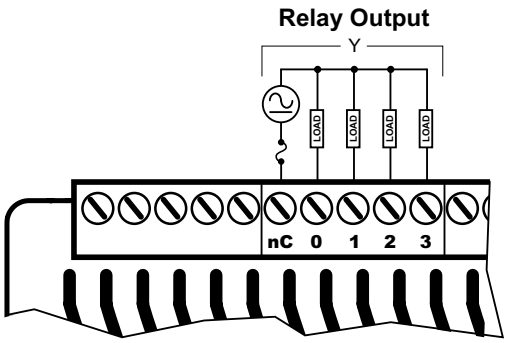
BX-DM1-18AR Wiring, Continued

Discrete Output Specifications

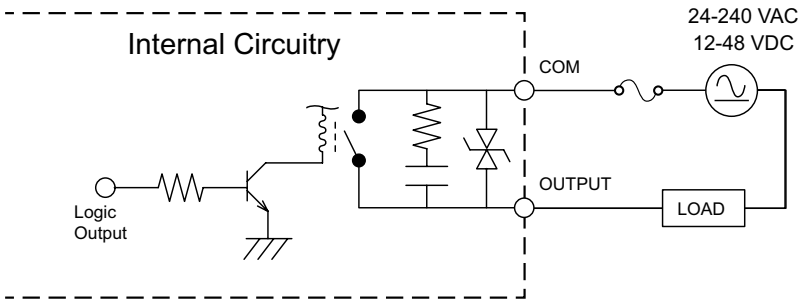
Discrete Output Specifications	
Output Type	Relay Form A (SPST)
Total Outputs per Module	8
Commons	2 (4 points/common) Isolated
Maximum Current per Common	8A
Nominal Voltage Range	12–48 VDC 24–240 VAC
Operating Voltage Range	5–60 VDC 5–264 VAC
Maximum Voltage	60VDC 264VAC
Minimum Output Current	0.1 mA @ 24VDC 0.1 mA @ 24VAC
Maximum Output Current	2A
Maximum Inrush Current	5A for 50ms
Maximum Leakage Current	1µA (DC), 300µA (AC) due to RC snubber circuit
ON Voltage Drop	0.2 V Max
Status Indicators	Logic Side, Green
Output Details	
Output Type	Standard
Location	Y0...Y7
ON-OFF Response	<10ms
OFF-ON Response	<10ms
Maximum Switching Frequency	10Hz
Relay Cycle Life Mechanical Endurance Electrical Endurance	 5 million operations 120,000 operations
Fuse Type	User-supplied external fuse

BX-DM1-18AR Wiring, Continued

Discrete Output Connection Options



Discrete Standard Output Internal Circuitry



BX 18E Micro PLC Units (MPUs)

BX-DM1E-18ED13 Wiring

This MPU is made up of 18 discrete I/O points. The connections are grouped as follows:

- 10 discrete inputs - sinking/sourcing; rated for 12–24 VAC/VDC. They are located along the bottom of the unit; configured in two (2) groups of 6 terminals, each comprised of 5 inputs and an isolated common.
- 8 discrete outputs - sinking; rated at 12–24 VDC. They are located along the top of the unit starting to the right of the 24VDC auxiliary output terminals. The outputs are configured in two (2) groups of 5 terminals, each comprised of 4 outputs and an isolated common.
- 1 analog input and 1 analog output. They are located along the bottom of the unit to the right of the discrete inputs. The analogs are a group of three (3) terminals, comprised of 1 input, 1 output and a shared isolated common. The analogs share these common features:
  - current or voltage selectable through software
  - 16-bit resolution @ ±20mA, ±10VDC
  - current signal ranges of 4–20 mA, ±20mA
  - voltage signal ranges of 0–5 VDC, 0–10 VDC, ±5VDC, ±10VDC.

This MPU requires an external 120–240 VAC power supply. The AC power supply connection and the 24VDC auxiliary output supply terminals are located on the top left side of the unit.



BX-DM1E-18ED13

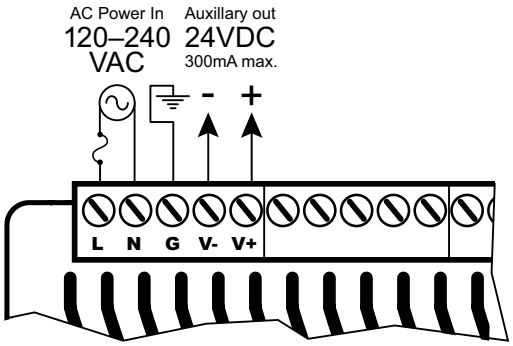
NOTE: *Eight (8) Expansion Modules can be connected to extend I/O capacity.*

BX-DM1E-18ED13 Wiring, Continued

Power Supply Specifications

Power Supply Specifications	
Nominal Voltage Range	120–240 VAC
Input Voltage Range (Tolerance)	85–264 VAC
Rated Operating Frequency	47–63 Hz
Maximum Input Power	40VA
Cold Start Inrush Current	1.5 A, 2ms
Maximum Inrush Current (Hot Start)	1.5 A, 2ms
Internal Input Fuse Protection	Micro fuse 250V, 2A Non-replaceable
Acceptable External Power Drop Time	10ms
Under Input Voltage Lock-out	80VAC
Input Transient Protection	Input choke and line filter
Heat Dissipation	17.6 W Max
Isolated User 24VDC Output	24VDC @ 0.3 A max, <1V P-P Ripple, Integrated self-resetting short circuit protection
Voltage Withstand (dielectric)	1500VAC Power Inputs to Ground applied for 1 minute 1500VAC Ground to 24VDC Output applied for 1 minute
Insulation Resistance	>10MΩ @ 500VDC
Software Version Required	Do-more! Designer version 2.0 or later

Power Supply Connections



WARNING: Do not exceed the 24VDC auxiliary power supply load limit of 300mA.

WARNING: The BRX System MUST have a proper earth ground. Do not operate the BRX MPU without proper earth grounding.

BX-DM1E-18ED13 Wiring, Continued

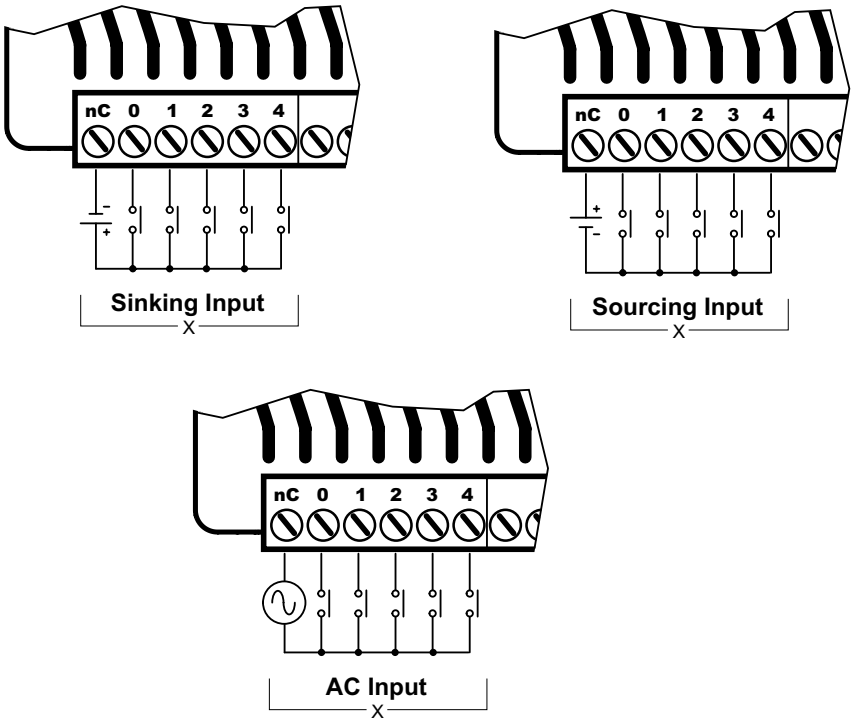
Discrete Input Specifications

Discrete Input Specifications			
Input Type		Sink/Source	
Total Inputs per Module		10	
Commons		2 (5 points/common) Isolated	
Nominal Voltage Range		12–24 VAC/VDC	
Input Voltage Range		9–30 VAC/VDC	
Maximum Voltage		30 VAC/VDC	
DC Frequency		0–250 kHz - High-speed	
Minimum Pulse Width		0.5 µs - High-speed	
AC Frequency		47–63 Hz[2]	
Input Impedance		3kΩ @ 24VDC	
Input Current (typical)		6mA @ 24 VAC/VDC	
Maximum Input Current		12mA @ 30 VAC/VDC	
ON Voltage Level		> 9.0 VAC/VDC	
OFF Voltage Level		< 2.0 VAC/VDC	
Maximum OFF Current		1.5 mA	
Status Indicators		Logic Side, Green	
Input Details			
Input Type		High-Speed DC	Standard[1]
Location		X0...X9	
OFF to ON Response	DC	< 2µs	
	AC	–	10ms[2]
ON to OFF Response	DC	< 2µs	
	AC	–	10ms[2]
Maximum Switching Frequency	DC	250kHz	
	AC	~ 30Hz	

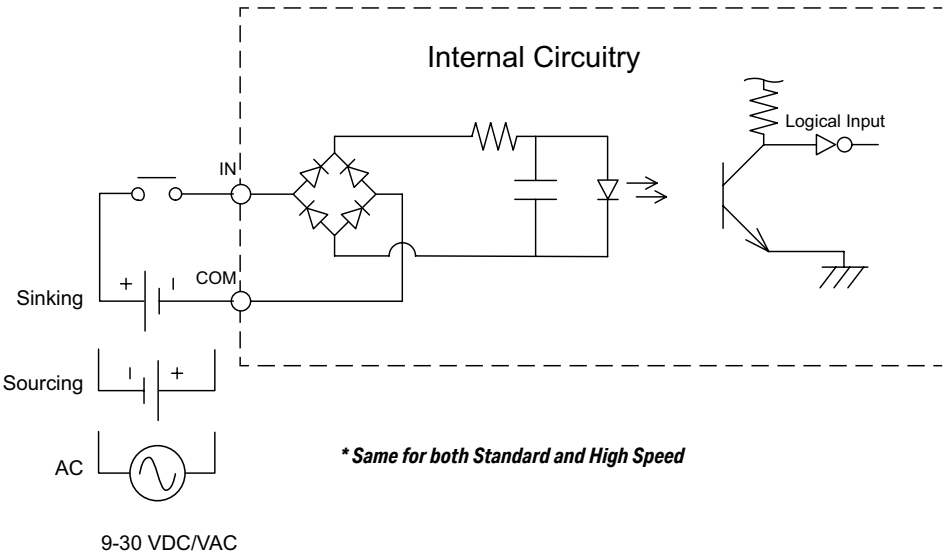
1. All Inputs may be used as standard inputs or high speed inputs independently.
2. 60Hz to 240Hz filter should be set in the software when using an AC line signal.

BX-DM1E-18ED13 Wiring, Continued

Discrete Input Connection Options



Discrete Input Internal Circuitry *



BX-DM1E-18ED13 Wiring, Continued

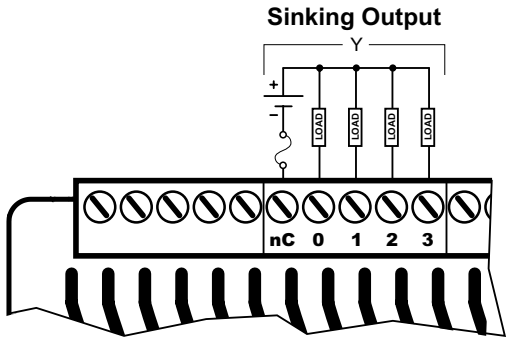
Discrete Output Specifications

Discrete Output Specifications		
Output Type	Sinking	
Total Outputs per Module	8	
Commons	2 (4 points/common) Isolated	
Maximum Current per Common	2A	
Nominal Voltage Range	12–24 VDC	
Operating Voltage Range	5–36 VDC	
Maximum Voltage	36VDC	
Minimum Output Current	0.1 mA @ 24VDC	
Maximum Output Current	0.5 A per output No derating over temperature range	
Maximum Inrush Current	5A for 50ms	
Maximum Leakage Current	10µA	
ON Voltage Drop	0.05 VDC	
Status Indicators	Logic Side, Green	
Output Details		
Output Type	High-Speed	Standard[1]
Location	Y0...Y3	Y4...Y7
OFF to ON Response	< 2µs	< 5ms
ON to OFF Response	< 2µs	< 2ms
Maximum Switching Frequency	1m cable - 250kHz 10m cable - 100kHz	~ 100Hz
Overcurrent, Short Circuit Protection and Short to Ground	Current limit by Common Group, self-resetting	N/A
Overcurrent Trip Level[2]	Between 4A and 8A	N/A
Fuse Type	User-supplied external fuse	

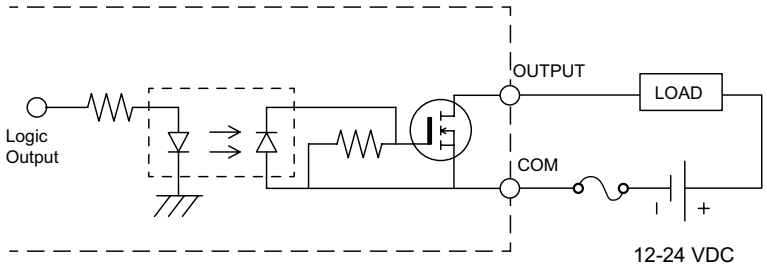
1. ***All outputs may be used as standard outputs. Only the first 4 outputs (Y0...Y3) are capable of high-speed DC operation.***
2. ***When the high-speed outputs are in an overcurrent situation, the Common terminal Red LED is on. The output LEDs will remain operational even though the output circuitry is turned off and no power is flowing. This condition is not reported to the CPU.***

BX-DM1E-18ED13 Wiring, continued

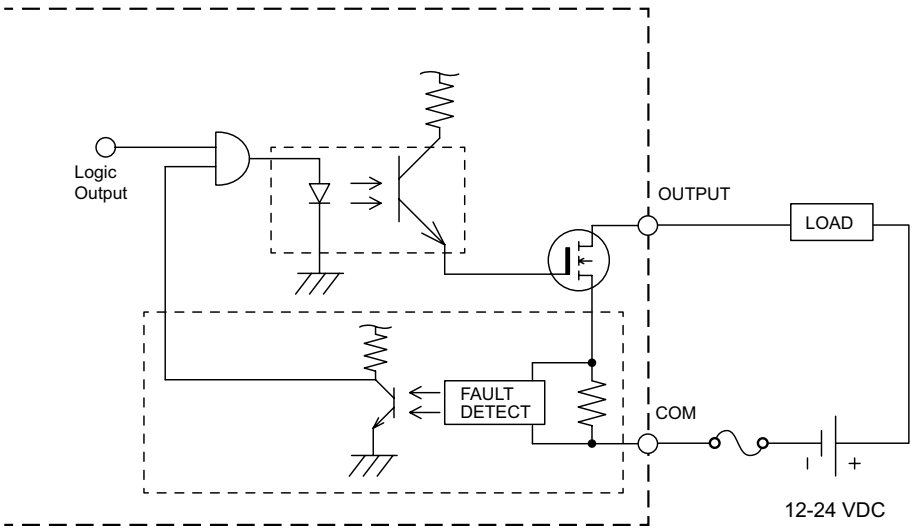
Discrete Output Connection Options



Discrete Standard Output Internal Circuitry



Discrete High-Speed Output Internal Circuitry



NOTE: *When the high speed outputs are in an overcurrent situation, the Common terminal Red LED is on. The output LEDs will remain operational even though the output circuitry is turned off and no power is flowing. This condition is not reported to the CPU.*

BX-DM1E-18ED13 Wiring, Continued

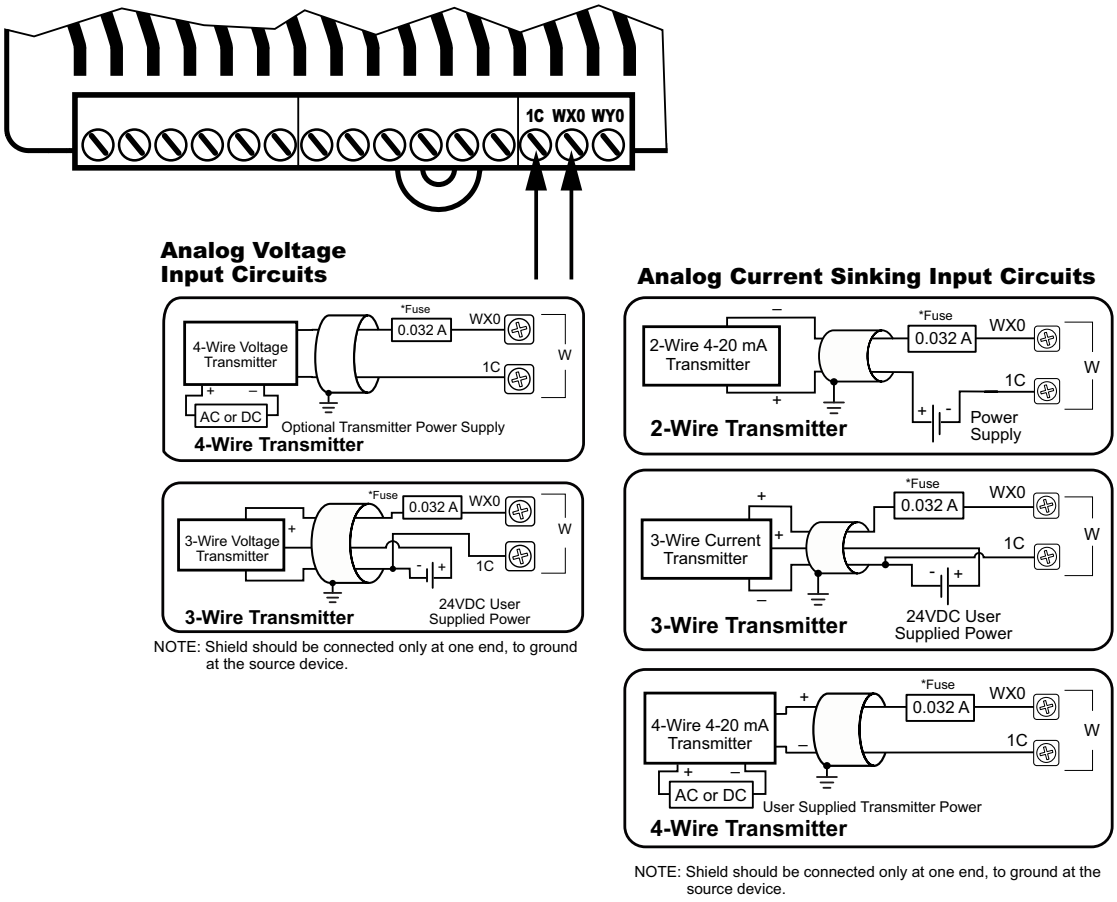
Analog Input Specifications

Analog Input Specifications	
Inputs per Module	1
Commons	1
Input Voltage Range *	Software Selectable ±10V, ±5V, 0–10 V, 0–5 V
Input Current Range *	Software Selectable ±20mA, 4–20 mA
Resolution ±10V, ±20mA ±5V 0–5 V 4–20 mA 0–10 V	 16 bits (0–65535 counts) 15 bits (0–32767 counts) 14 bits (0–16383 counts) ~15 bits (6553–32767 counts) 15 bits (0–32767 counts)
Input Impedance Voltage Modes	100kΩ
Absolute Maximum Input, Voltage Mode	±30V
Input Impedance Current Modes	249Ω
Absolute Maximum Input, Current Mode	±40mA sustained, ±100mA for < 5s
Conversion Time	1.2 ms
Input Stability	0.02% of Full Hardware Range = 13 Counts
Full Scale Calibration Error	0.05% of Full Hardware Range = 33 Counts
Offset Calibration Error	0.01% of Full Hardware Range = 7 Counts
Accuracy vs Temperature Error	0.05% of Full Hardware Range = 33 Counts
Maximum Linearity Error (End to End)	0.1% of Full Hardware Range = 66 Counts
Maximum Inaccuracy	0.2% of Full Hardware Range = 131 Counts
Fuse Type	User-supplied external fuse

**** Software selectable per channel***

BX-DM1E-18ED13 Wiring, Continued

Analog Input Connection Options



NOTE: *An Edison S500-32-R 0.032A fast-acting fuse is recommended for all analog voltage inputs, analog outputs, and current loops.*

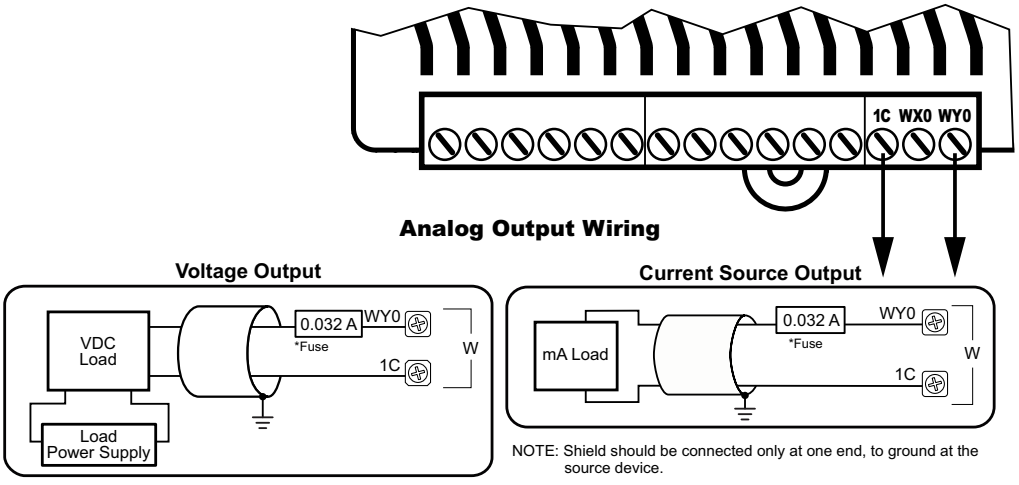
BX-DM1E-18ED13 Wiring, Continued

Analog Output Specifications

Analog Output Specifications	
Outputs per Module	1
Commons	1
Output Voltage Range *	Software Selectable ±10V, ±5V, 0–10 V, 0–5 V
Output Current Range *	Software Selectable ±20mA, 4–20 mA
Resolution ±10V, ±20mA ±5V 0–5 V 4–20 mA 0–10 V	 16 bits (0–65535 counts) 15 bits (0–32767 counts) 14 bits (0–16383 counts) ~15 bits (6553–32767 counts) 15 bits (0–32767 counts)
Minimum Voltage Load Impedance	1kΩ
Maximum Current Load Impedance	500Ω
Maximum Rating	Continuous Short Circuit Protected
Settling Time	< 1ms
Output Stability	0.02% of Full Hardware Range = 13 Counts
Full Scale Calibration Error	0.05% of Full Hardware Range = 33 Counts
Offset Calibration Error	0.01% of Full Hardware Range = 7 Counts
Accuracy vs Temperature Error	0.05% of Full Hardware Range = 33 Counts
Maximum Linearity Error (End to End)	0.1% of Full Hardware Range = 66 Counts
Maximum Inaccuracy	0.2% of Full Hardware Range = 131 Counts
Fuse Type	User-supplied external fuse

**** Software selectable per channel***

Analog Output Connection Options



NOTE: Shield should be connected only at one end, to ground at the source device.

NOTE: *An Edison S500-32-R 0.032A fast-acting fuse is recommended for all analog voltage inputs, analog outputs, and current loops.*

BX-DM1E-18ED13-D Wiring

This MPU is made up of 18 discrete I/O points. The connections are grouped as follows:

- 10 discrete inputs - sinking/sourcing; rated for 12–24 VAC/VDC. They are located along the bottom of the unit; configured in two (2) groups of six (6) terminals, each comprised of five (5) inputs and an isolated common.
- 8 discrete outputs - sinking; rated at 12–24 VDC. They are located along the top of the unit starting to the right of the 24VDC external power supply terminals. The outputs are configured in two (2) groups of five (5) terminals, each comprised of four (4) outputs and an isolated common.
- 1 analog input and 1 analog output. They are located along the bottom of the unit to the right of the discrete inputs. The analogs are a group of three (3) terminals, comprised of 1 input, 1 output and a shared isolated common. The analogs share these common features:
  - current or voltage selectable through software,
  - 16-bit resolution @ ±20 mA, ±10 VDC
  - current signal ranges of 4–20 mA, ±20 mA,
  - voltage signal ranges of 0–5 VDC, 0–10 VDC, ±5 VDC, ±10 VDC.

This MPU requires an external 12–24 VDC power supply. The DC power supply connection is located on the top left side of the unit. There is no 24VDC auxiliary output supply.



BX-DM1E-18ED13-D

NOTE: *Eight (8) Expansion Modules can be connected to extend I/O capacity.*

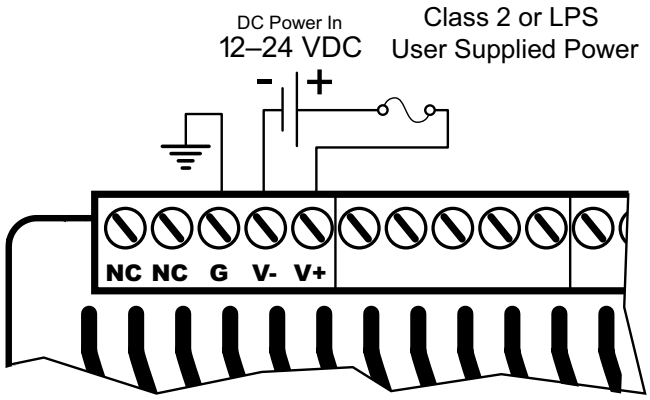
BX-DM1E-18ED13-D Wiring, Continued

Power Supply Specifications

Power Supply Specifications	
Nominal Voltage Range*	12–24 VDC
Input Voltage Range (Tolerance)*	10–36 VDC
Maximum Input Voltage Ripple	< ±10%
Maximum Input Power	30W
Cold Start Inrush Current	5A, 2ms
Maximum Inrush Current (Hot Start)	5A, 2ms
Internal Input Protection	Reverse polarity protection and undervoltage lockout via transistor circuit
Acceptable External Power Drop Time	10ms
Under Input Voltage Lock-out	<9VDC
Heat Dissipation	15.4 W Max
Isolated User 24VDC Output	None
Voltage Withstand (dielectric)	1500VAC power Inputs to ground applied for 1 minute
Insulation Resistance	>10MΩ @ 500VDC
Software Version Required	Do-more! Designer version 2.0 or later

**** Class 2 or LPS Power Supply required.***

Power Supply Connections



WARNING: No External AC power supply needed on this unit. The two terminals marked "NC" are not used. These terminals are not internally connected. DO NOT CONNECT ANYTHING TO THESE TERMINALS!

WARNING: The BRX System MUST have a proper earth ground. Do not operate the BRX MPU without proper earth grounding.

BX-DM1E-18ED13-D Wiring, Continued

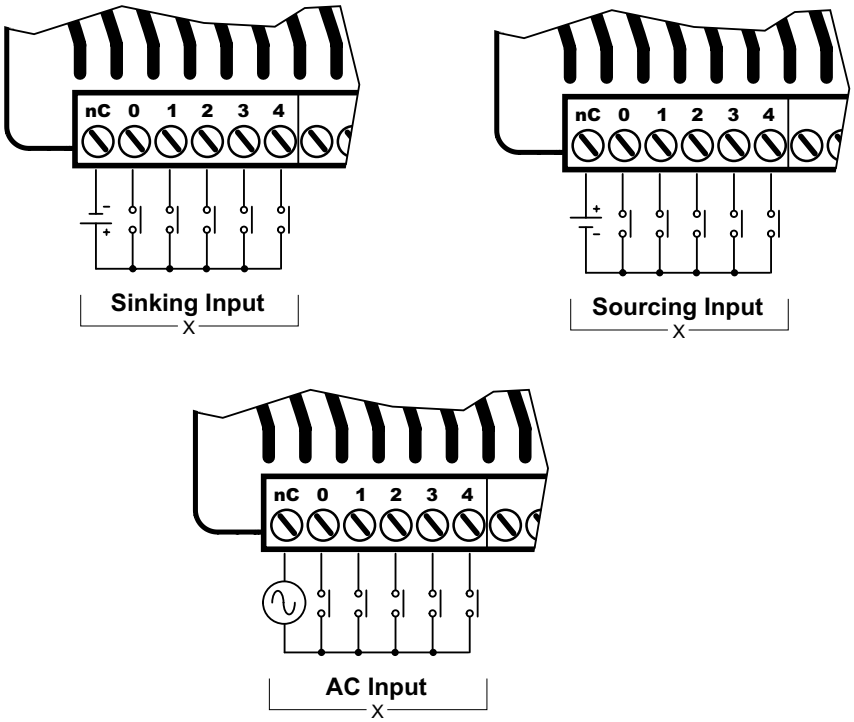
Discrete Input Specifications

Discrete Input Specifications			
Input Type		Sink/Source	
Total Inputs per Module		10	
Commons		2 (5 points/common) Isolated	
Nominal Voltage Range		12–24 VAC/VDC	
Input Voltage Range		9–30 VAC/VDC	
Maximum Voltage		30 VAC/VDC	
DC Frequency		0–250 kHz - High-speed	
Minimum Pulse Width		0.5 µs - High-speed	
AC Frequency		47–63 Hz[2]	
Input Impedance		3kΩ @ 24VDC	
Input Current (typical)		6mA @ 24 VAC/VDC	
Maximum Input Current		12mA @ 30 VAC/VDC	
ON Voltage Level		> 9.0 VAC/VDC	
OFF Voltage Level		< 2.0 VAC/VDC	
Maximum OFF Current		1.5 mA	
Status Indicators		Logic Side, Green	
Input Details			
Input Type		High-Speed DC	Standard[1]
Location		X0...X9	
OFF to ON Response	DC	< 2µs	
	AC	–	10ms[2]
ON to OFF Response	DC	< 2µs	
	AC	–	10ms[2]
Maximum Switching Frequency	DC	250kHz	
	AC	~ 30Hz	

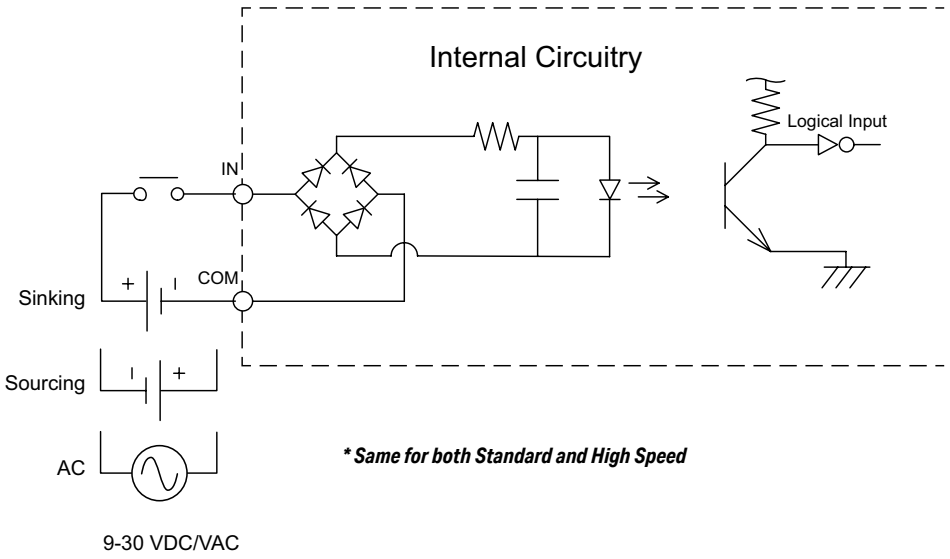
1. All Inputs may be used as standard inputs or high speed inputs independently.
2. 60Hz to 240Hz filter should be set in the software when using an AC line signal.

BX-DM1E-18ED13-D Wiring, Continued

Discrete Input Connection Options



Discrete Input Internal Circuitry *



BX-DM1E-18ED13-D Wiring, Continued

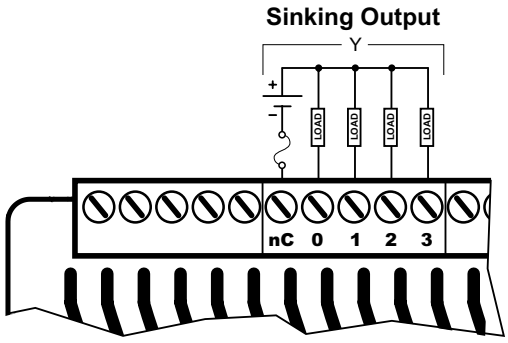
Discrete Output Specifications

Discrete Output Specifications		
Output Type	Sinking	
Total Outputs per Module	8	
Commons	2 (4 points/common) Isolated	
Maximum Current per Common	2A	
Nominal Voltage Range	12–24 VDC	
Operating Voltage Range	5–36 VDC	
Maximum Voltage	36VDC	
Minimum Output Current	0.1 mA @ 24VDC	
Maximum Output Current	0.5 A per output No derating over temperature range	
Maximum Inrush Current	5A for 50ms	
Maximum Leakage Current	10µA	
ON Voltage Drop	0.05 VDC	
Status Indicators	Logic Side, Green	
Output Details		
Output Type	High-Speed	Standard[1]
Location	Y0...Y3	Y4...Y7
OFF to ON Response	< 2µs	< 5ms
ON to OFF Response	< 2µs	< 2ms
Maximum Switching Frequency	1m cable - 250kHz 10m cable - 100kHz	~ 100Hz
Overcurrent, Short Circuit Protection and Short to Ground	Current limit by Common Group, self-resetting	N/A
Overcurrent Trip Level[2]	Between 4A and 8A	N/A
Fuse Type	User-supplied external fuse	

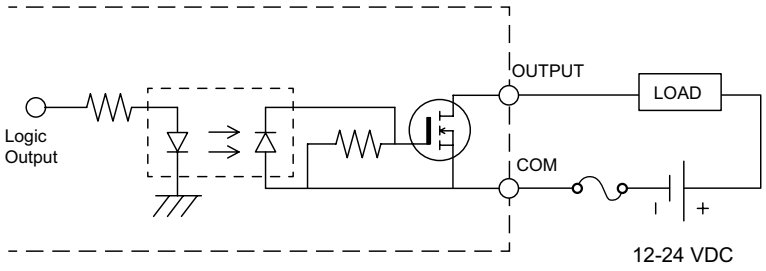
1. ***All outputs may be used as standard outputs. Only the first 4 outputs (Y0...Y3) are capable of high-speed DC operation.***
2. ***When the high-speed outputs are in an overcurrent situation, the Common terminal Red LED is on. The output LEDs will remain operational even though the output circuitry is turned off and no power is flowing. This condition is not reported to the CPU.***

BX-DM1E-18ED13-D Wiring, Continued

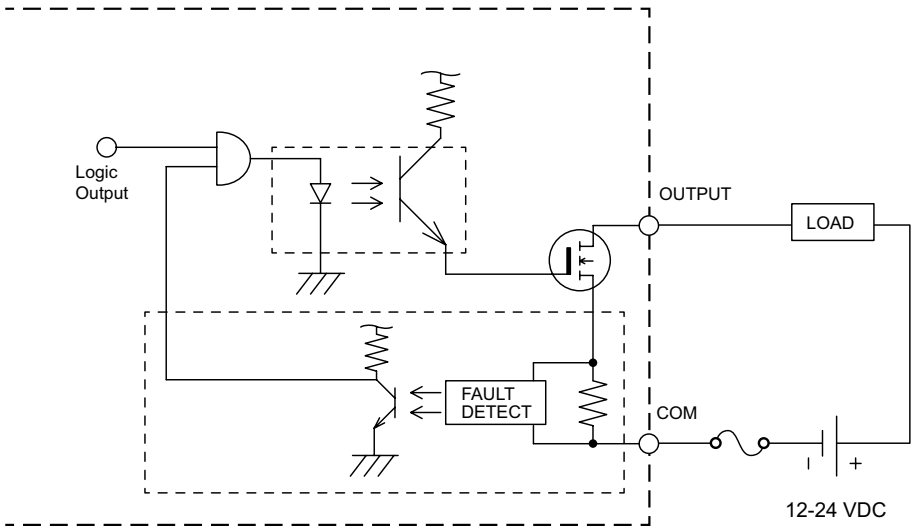
Discrete Output Connection Options



Discrete Standard Output Internal Circuitry



Discrete High-Speed Output Internal Circuitry



NOTE: *When the high speed outputs are in an overcurrent situation, the Common terminal Red LED is on. The output LEDs will remain operational even though the output circuitry is turned off and no power is flowing. This condition is not reported to the CPU.*

BX-DM1E-18ED13-D Wiring, Continued

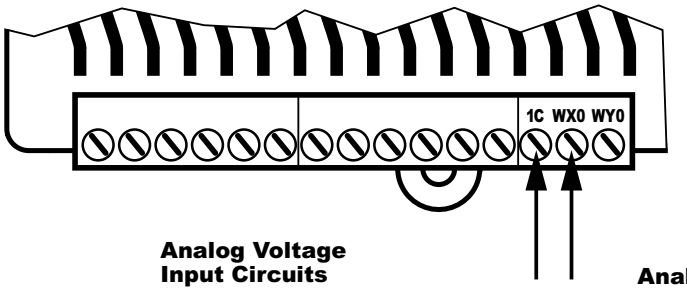
Analog Input Specifications

Analog Input Specifications	
Inputs per Module	1
Commons	1
Input Voltage Range *	Software Selectable ±10V, ±5V, 0–10 V, 0–5 V
Input Current Range *	Software Selectable ±20mA, 4–20 mA
Resolution ±10V, ±20mA ±5V 0–5 V 4–20 mA 0–10 V	 16 bits (0–65535 counts) 15 bits (0–32767 counts) 14 bits (0–16383 counts) ~15 bits (6553–32767 counts) 15 bits (0–32767 counts)
Input Impedance Voltage Modes	100kΩ
Absolute Maximum Input, Voltage Mode	±30V
Input Impedance Current Modes	249Ω
Absolute Maximum Input, Current Mode	±40mA sustained, ±100mA for < 5s
Conversion Time	1.2 ms
Input Stability	0.02% of Full Hardware Range = 13 Counts
Full Scale Calibration Error	0.05% of Full Hardware Range = 33 Counts
Offset Calibration Error	0.01% of Full Hardware Range = 7 Counts
Accuracy vs Temperature Error	0.05% of Full Hardware Range = 33 Counts
Maximum Linearity Error (End to End)	0.1% of Full Hardware Range = 66 Counts
Maximum Inaccuracy	0.2% of Full Hardware Range = 131 Counts
Fuse Type	User-supplied external fuse

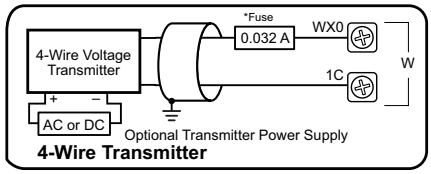
**** Software selectable per channel***

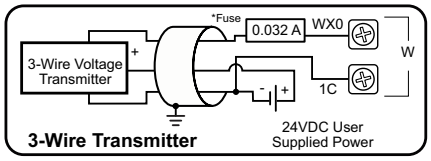
BX-DM1E-18ED13-D Wiring, Continued

Analog Input Connection Options



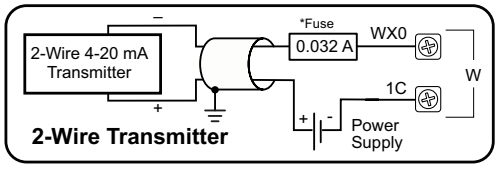
Analog Voltage Input Circuits

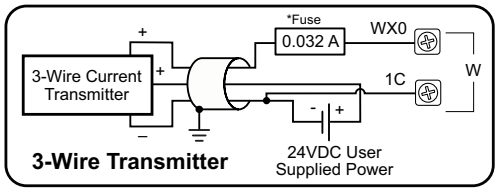


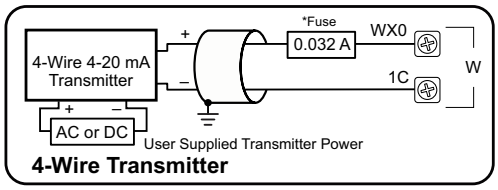


NOTE: Shield should be connected only at one end, to ground at the source device.

Analog Current Sinking Input Circuits







NOTE: Shield should be connected only at one end, to ground at the source device.



NOTE: *An Edison S500-32-R 0.032A fast-acting fuse is recommended for all analog voltage inputs, analog outputs, and current loops.*

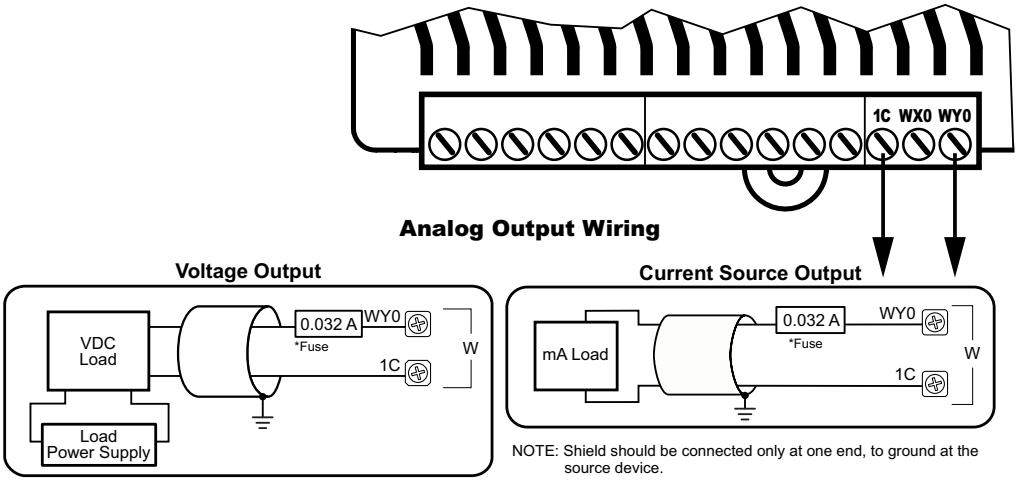
BX-DM1E-18ED13-D Wiring, Continued

Analog Output Specifications

Analog Output Specifications	
Outputs per Module	1
Commons	1
Output Voltage Range *	Software Selectable ±10V, ±5V, 0–10 V, 0–5 V
Output Current Range *	Software Selectable ±20mA, 4–20 mA
Resolution ±10V, ±20mA ±5V 0–5 V 4–20 mA 0–10 V	 16 bits (0–65535 counts) 15 bits (0–32767 counts) 14 bits (0–16383 counts) ~15 bits (6553–32767 counts) 15 bits (0–32767 counts)
Minimum Voltage Load Impedance	1kΩ
Maximum Current Load Impedance	500Ω
Maximum Rating	Continuous Short Circuit Protected
Settling Time	< 1ms
Output Stability	0.02% of Full Hardware Range = 13 Counts
Full Scale Calibration Error	0.05% of Full Hardware Range = 33 Counts
Offset Calibration Error	0.01% of Full Hardware Range = 7 Counts
Accuracy vs Temperature Error	0.05% of Full Hardware Range = 33 Counts
Maximum Linearity Error (End to End)	0.1% of Full Hardware Range = 66 Counts
Maximum Inaccuracy	0.2% of Full Hardware Range = 131 Counts
Fuse Type	User-supplied external fuse

**** Software selectable per channel***

Analog Output Connection Options



NOTE: Shield should be connected only at one end, to ground at the source device.

NOTE: *An Edison S500-32-R 0.032A fast-acting fuse is recommended for all analog voltage inputs, analog outputs, and current loops.*

BX-DM1E-18ED23 Wiring

This MPU is made up of 18 discrete I/O points. The connections are grouped as follows:

- 10 discrete inputs - sinking/sourcing; rated for 12–24 VAC/VDC. They are located along the bottom of the unit; configured in two (2) groups of 6 terminals, each comprised of 5 inputs and an isolated common.
- 8 discrete outputs - sourcing; rated at 12–24 VDC. They are located along the top of the unit starting to the right of the 24VDC auxiliary output terminals. The outputs are configured in two (2) groups of 5 terminals, each comprised of 4 outputs and an isolated common.
- 1 analog input and 1 analog output. They are located along the bottom of the unit to the right of the discrete inputs. The analogs are a group of three (3) terminals, comprised of 1 input, 1 output and a shared isolated common. The analogs share these common features:
  - current or voltage selectable through software,
  - 16-bit resolution @ ±20mA, ±10VDC
  - current signal ranges of 4–20 mA, ±20mA,
  - voltage signal ranges of 0–5 VDC, 0–10 VDC, ±5VDC, ±10VDC.

This MPU requires an external 120–240 VAC power supply. The AC power supply connection and the 24VDC auxiliary output supply terminals are located on the top left side of the unit.



BX-DM1E-18ED23

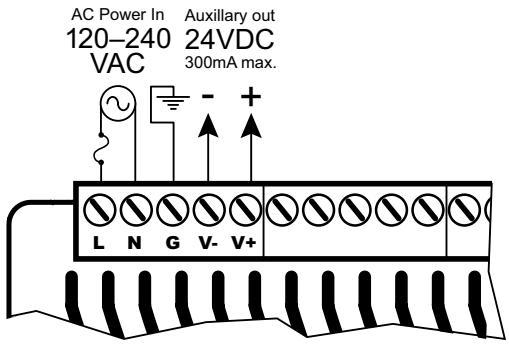
NOTE: *Eight (8) Expansion Modules can be connected to extend I/O capacity.*

BX-DM1E-18ED23 Wiring, Continued

Power Supply Specifications

Power Supply Specifications	
Nominal Voltage Range	120–240 VAC
Input Voltage Range (Tolerance)	85–264 VAC
Rated Operating Frequency	47–63 Hz
Maximum Input Power	40VA
Cold Start Inrush Current	1.5 A, 2ms
Maximum Inrush Current (Hot Start)	1.5 A, 2ms
Internal Input Fuse Protection	Micro fuse 250V, 2A Non-replaceable
Acceptable External Power Drop Time	10ms
Under Input Voltage Lock-out	80VAC
Input Transient Protection	Input choke and line filter
Heat Dissipation	17.6 W Max
Isolated User 24VDC Output	24VDC @ 0.3 A max, <1V P-P Ripple, Integrated self-resetting short circuit protection
Voltage Withstand (dielectric)	1500VAC Power Inputs to Ground applied for 1 minute 1500VAC Ground to 24VDC Output applied for 1 minute
Insulation Resistance	>10MΩ @ 500VDC
Software Version Required	Do-more! Designer version 2.0 or later

Power Supply Connections



WARNING: Do not exceed the 24VDC auxiliary power supply load limit of 300mA.

WARNING: The BRX System MUST have a proper earth ground. Do not operate the BRX MPU without proper earth grounding.

BX-DM1E-18ED23 Wiring, Continued

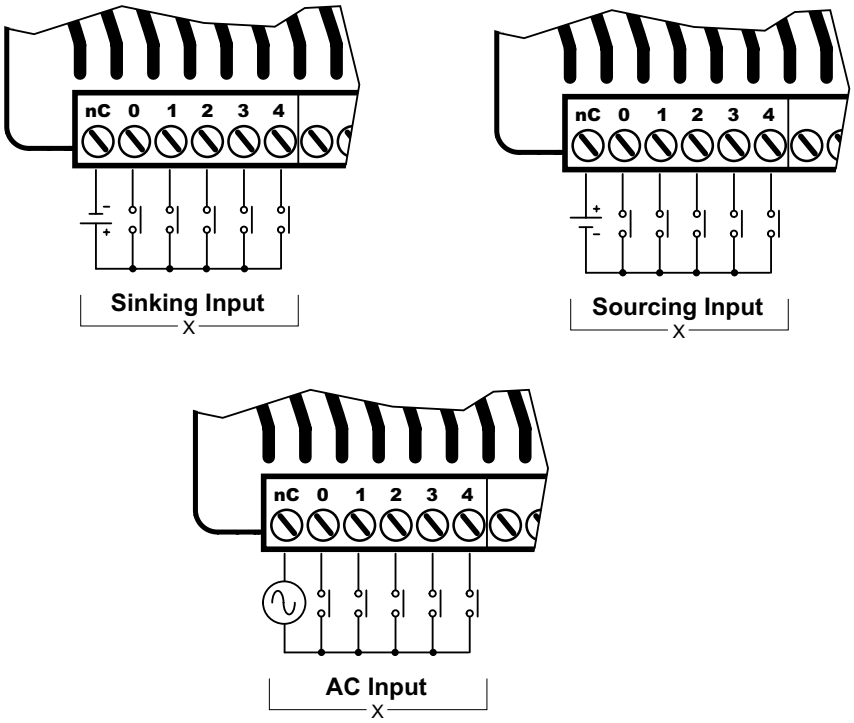
Discrete Input Specifications

Discrete Input Specifications			
Input Type		Sink/Source	
Total Inputs per Module		10	
Commons		2 (5 points/common) Isolated	
Nominal Voltage Range		12–24 VAC/VDC	
Input Voltage Range		9–30 VAC/VDC	
Maximum Voltage		30 VAC/VDC	
DC Frequency		0–250 kHz - High-speed	
Minimum Pulse Width		0.5 µs - High-speed	
AC Frequency		47–63 Hz[2]	
Input Impedance		3kΩ @ 24VDC	
Input Current (typical)		6mA @ 24 VAC/VDC	
Maximum Input Current		12mA @ 30 VAC/VDC	
ON Voltage Level		> 9.0 VAC/VDC	
OFF Voltage Level		< 2.0 VAC/VDC	
Maximum OFF Current		1.5 mA	
Status Indicators		Logic Side, Green	
Input Details			
Input Type		High-Speed DC	Standard[1]
Location		X0...X9	
OFF to ON Response	DC	< 2µs	
	AC	–	10ms[2]
ON to OFF Response	DC	< 2µs	
	AC	–	10ms[2]
Maximum Switching Frequency	DC	250kHz	
	AC	~ 30Hz	

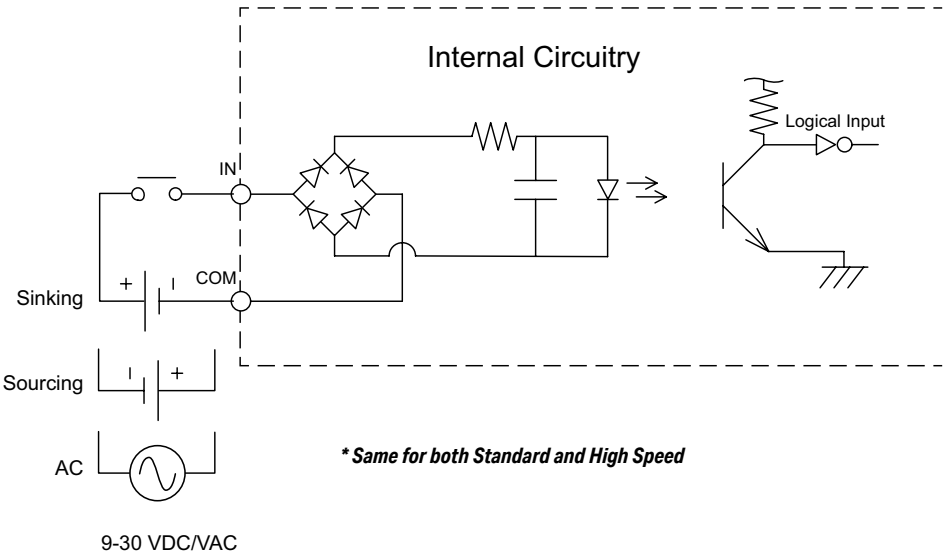
1. All Inputs may be used as standard inputs or high speed inputs independently.
2. 60Hz to 240Hz filter should be set in the software when using an AC line signal.

BX-DM1E-18ED23 Wiring, Continued

Discrete Input Connection Options



Discrete Input Internal Circuitry *



BX-DM1E-18ED23 Wiring, Continued

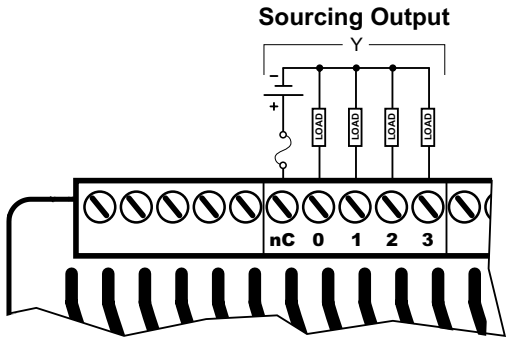
Discrete Output Specifications

Discrete Output Specifications		
Output Type	Sourcing	
Total Outputs per Module	8	
Commons	2 (4 points/common) Isolated	
Maximum Current per Common	2A	
Nominal Voltage Range	12–24 VDC	
Operating Voltage Range	5–36 VDC	
Maximum Voltage	36VDC	
Minimum Output Current	0.1 mA @ 24VDC	
Maximum Output Current	0.5 A per output No derating over temperature range	
Maximum Inrush Current	5A for 50ms	
Maximum Leakage Current	10µA	
ON Voltage Drop	0.05 VDC	
Status Indicators	Logic Side, Green	
Output Details		
Output Type	High-Speed	Standard[1]
Location	Y0...Y3	Y4...Y7
OFF to ON Response	< 2µs	< 5ms
ON to OFF Response	< 2µs	< 2ms
Maximum Switching Frequency	1m cable - 250kHz 10m cable - 100kHz	~ 100Hz
Overcurrent, Short Circuit Protection and Short to Ground	Current limit by Common Group, self-resetting	N/A
Overcurrent Trip Level[2]	Between 4A and 8A	N/A
Fuse Type	User-supplied external fuse	

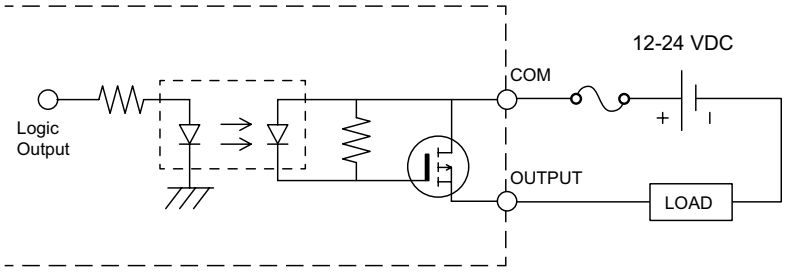
1. ***All outputs may be used as standard outputs. Only the first 4 outputs (Y0...Y3) are capable of high-speed DC operation.***
2. ***When the high-speed outputs are in an overcurrent situation, the Common terminal Red LED is on. The output LEDs will remain operational even though the output circuitry is turned off and no power is flowing. This condition is not reported to the CPU.***

BX-DM1E-18ED23 Wiring, Continued

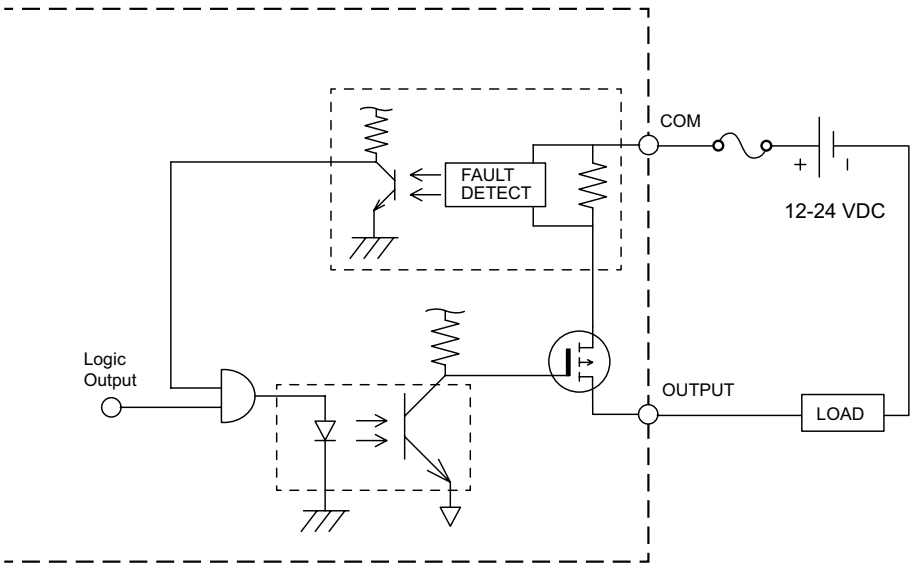
Discrete Output Connection Options



Discrete Standard Output Internal Circuitry



Discrete High-Speed Output Internal Circuitry



NOTE: *When the high speed outputs are in an overcurrent situation, the Common terminal Red LED is on. The output LEDs will remain operational even though the output circuitry is turned off and no power is flowing. This condition is not reported to the CPU.*

BX-DM1E-18ED23 Wiring, Continued

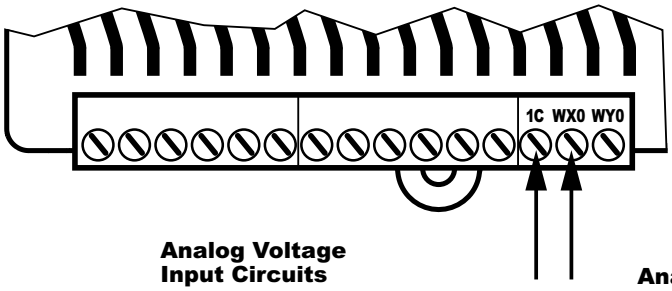
Analog Input Specifications

Analog Input Specifications	
Inputs per Module	1
Commons	1
Input Voltage Range *	Software Selectable ±10V, ±5V, 0–10 V, 0–5 V
Input Current Range *	Software Selectable ±20mA, 4–20 mA
Resolution ±10V, ±20mA ±5V 0–5 V 4–20 mA 0–10 V	 16 bits (0–65535 counts) 15 bits (0–32767 counts) 14 bits (0–16383 counts) ~15 bits (6553–32767 counts) 15 bits (0–32767 counts)
Input Impedance Voltage Modes	100kΩ
Absolute Maximum Input, Voltage Mode	±30V
Input Impedance Current Modes	249Ω
Absolute Maximum Input, Current Mode	±40mA sustained, ±100mA for < 5s
Conversion Time	1.2 ms
Input Stability	0.02% of Full Hardware Range = 13 Counts
Full Scale Calibration Error	0.05% of Full Hardware Range = 33 Counts
Offset Calibration Error	0.01% of Full Hardware Range = 7 Counts
Accuracy vs Temperature Error	0.05% of Full Hardware Range = 33 Counts
Maximum Linearity Error (End to End)	0.1% of Full Hardware Range = 66 Counts
Maximum Inaccuracy	0.2% of Full Hardware Range = 131 Counts
Fuse Type	User-supplied external fuse

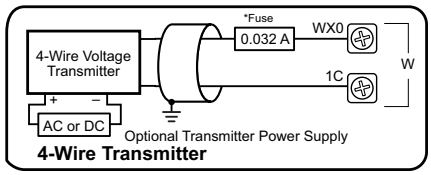
**** Software selectable per channel***

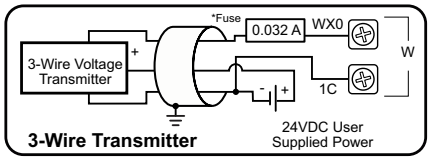
BX-DM1E-18ED23 Wiring, Continued

Analog Input Connection Options



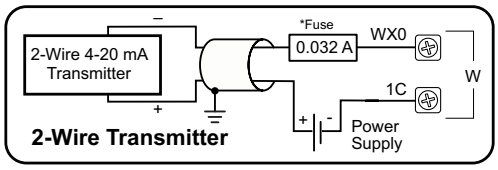
Analog Voltage Input Circuits

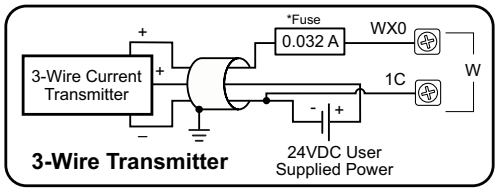


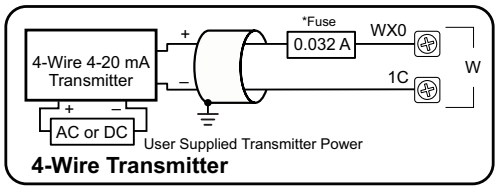


NOTE: Shield should be connected only at one end, to ground at the source device.

Analog Current Sinking Input Circuits







NOTE: Shield should be connected only at one end, to ground at the source device.

NOTE: *An Edison S500-32-R 0.032A fast-acting fuse is recommended for all analog voltage inputs, analog outputs, and current loops.*

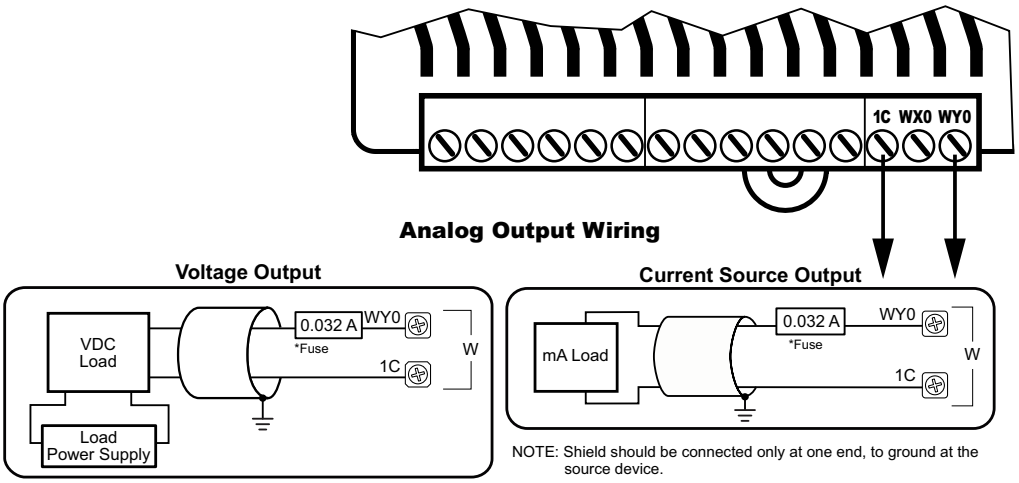
BX-DM1E-18ED23 Wiring, Continued

Analog Output Specifications

Analog Output Specifications	
Outputs per Module	1
Commons	1
Output Voltage Range *	Software Selectable ±10V, ±5V, 0–10 V, 0–5 V
Output Current Range *	Software Selectable ±20mA, 4–20 mA
Resolution ±10V, ±20mA ±5V 0–5 V 4–20 mA 0–10 V	 16 bits (0–65535 counts) 15 bits (0–32767 counts) 14 bits (0–16383 counts) ~15 bits (6553–32767 counts) 15 bits (0–32767 counts)
Minimum Voltage Load Impedance	1kΩ
Maximum Current Load Impedance	500Ω
Maximum Rating	Continuous Short Circuit Protected
Settling Time	< 1ms
Output Stability	0.02% of Full Hardware Range = 13 Counts
Full Scale Calibration Error	0.05% of Full Hardware Range = 33 Counts
Offset Calibration Error	0.01% of Full Hardware Range = 7 Counts
Accuracy vs Temperature Error	0.05% of Full Hardware Range = 33 Counts
Maximum Linearity Error (End to End)	0.1% of Full Hardware Range = 66 Counts
Maximum Inaccuracy	0.2% of Full Hardware Range = 131 Counts
Fuse Type	User-supplied external fuse

**** Software selectable per channel***

Analog Output Connection Options



NOTE: Shield should be connected only at one end, to ground at the source device.

NOTE: *An Edison S500-32-R 0.032A fast-acting fuse is recommended for all analog voltage inputs, analog outputs, and current loops.*

BX-DM1E-18ED23-D Wiring

This MPU is made up of 18 discrete I/O points. The connections are grouped as follows:

- 10 discrete inputs - sinking/sourcing; rated for 12–24 VAC/VDC. They are located along the bottom of the unit; configured in two (2) groups of 6 terminals, each comprised of 5 inputs and an isolated common.
- 8 discrete outputs - sourcing; rated at 12–24 VDC. They are located along the top of the unit starting to the right of the 24VDC external power supply terminals. The outputs are configured in two (2) groups of 5 terminals, each comprised of 4 outputs and an isolated common..
- 1 analog input and 1 analog output. They are located along the bottom of the unit to the right of the discrete inputs. The analogs are a group of three (3) terminals, comprised of 1 input, 1 output and a shared isolated common. The analog share these common features:
  - current or voltage selectable through software,
  - 16-bit resolution @ ±20mA, ±10VDC
  - current signal ranges of 4–20 mA, ±20mA,
  - voltage signal ranges of 0–5 VDC, 0–10 VDC, ±5VDC, ±10VDC.

This MPU requires an external 12–24 VDC power supply. The DC power supply connection is located on the top left side of the unit. There is no 24VDC auxiliary output supply.



BX-DM1E-18E23-D

NOTE: *Eight (8) Expansion Modules can be connected to extend I/O capacity.*

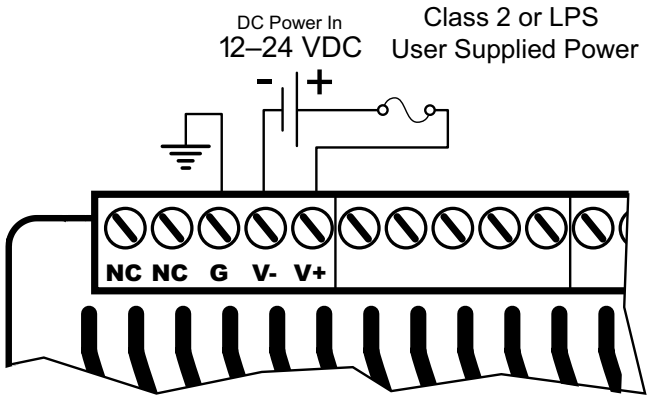
BX-DM1E-18ED23-D, Continued

Power Supply Specifications

Power Supply Specifications	
Nominal Voltage Range*	12–24 VDC
Input Voltage Range (Tolerance)*	10–36 VDC
Maximum Input Voltage Ripple	< ±10%
Maximum Input Power	30W
Cold Start Inrush Current	5A, 2ms
Maximum Inrush Current (Hot Start)	5A, 2ms
Internal Input Protection	Reverse polarity protection and undervoltage lockout via transistor circuit
Acceptable External Power Drop Time	10ms
Under Input Voltage Lock-out	<9VDC
Heat Dissipation	15.4 W Max
Isolated User 24VDC Output	None
Voltage Withstand (dielectric)	1500VAC power Inputs to ground applied for 1 minute
Insulation Resistance	>10MΩ @ 500VDC
Software Version Required	Do-more! Designer version 2.0 or later

**** Class 2 or LPS Power Supply required.***

Power Supply Connections



WARNING: No External AC power supply needed on this unit. The two terminals marked "NC" are not used. These terminals are not internally connected. DO NOT CONNECT ANYTHING TO THESE TERMINALS!

WARNING: The BRX System MUST have a proper earth ground. Do not operate the BRX MPU without proper earth grounding.

BX-DM1E-18ED23-D Wiring, Continued

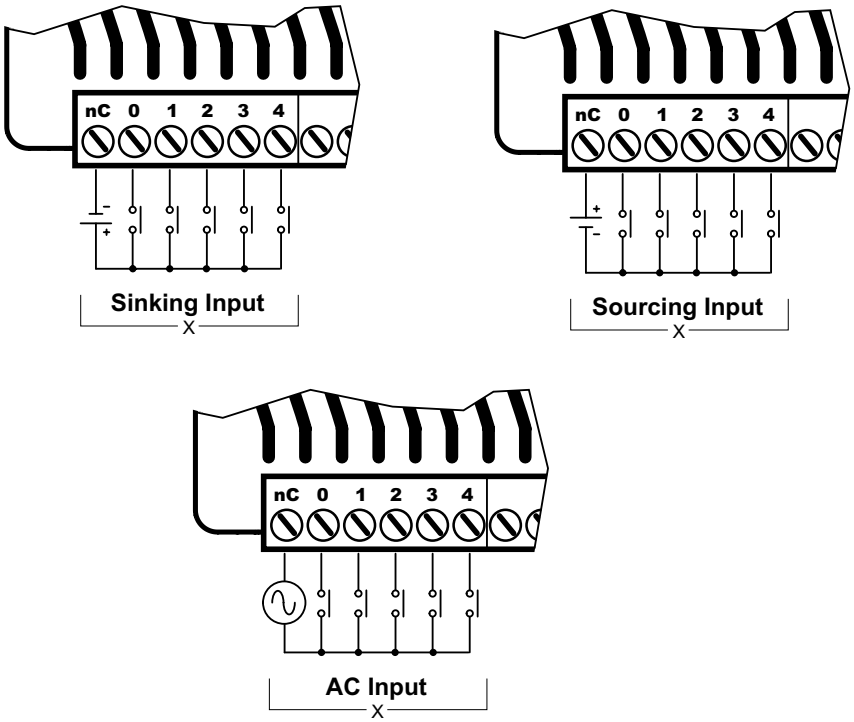
Discrete Input Specifications

Discrete Input Specifications			
Input Type		Sink/Source	
Total Inputs per Module		10	
Commons		2 (5 points/common) Isolated	
Nominal Voltage Range		12–24 VAC/VDC	
Input Voltage Range		9–30 VAC/VDC	
Maximum Voltage		30 VAC/VDC	
DC Frequency		0–250 kHz - High-speed	
Minimum Pulse Width		0.5 µs - High-speed	
AC Frequency		47–63 Hz[2]	
Input Impedance		3kΩ @ 24VDC	
Input Current (typical)		6mA @ 24 VAC/VDC	
Maximum Input Current		12mA @ 30 VAC/VDC	
ON Voltage Level		> 9.0 VAC/VDC	
OFF Voltage Level		< 2.0 VAC/VDC	
Maximum OFF Current		1.5 mA	
Status Indicators		Logic Side, Green	
Input Details			
Input Type		High-Speed DC	Standard[1]
Location		X0...X9	
OFF to ON Response	DC	< 2µs	
	AC	–	10ms[2]
ON to OFF Response	DC	< 2µs	
	AC	–	10ms[2]
Maximum Switching Frequency	DC	250kHz	
	AC	~ 30Hz	

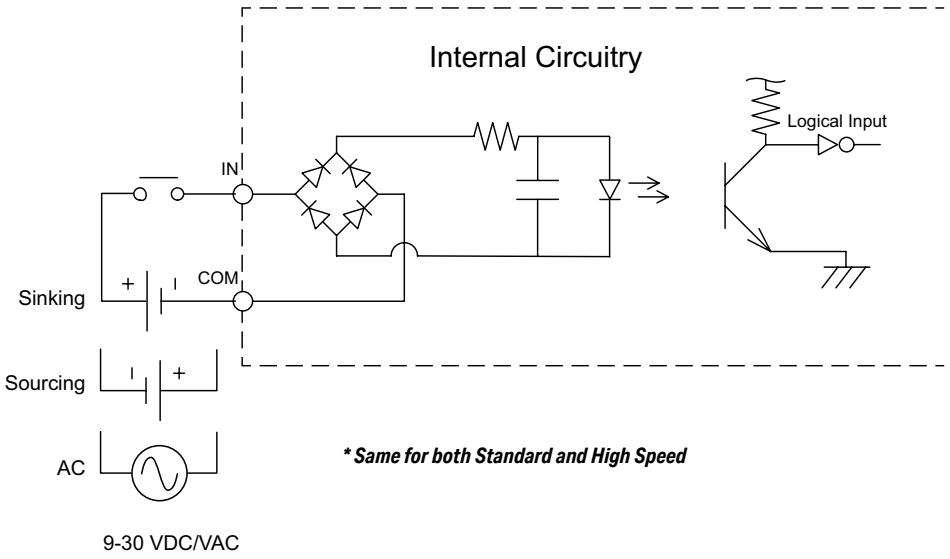
1. All Inputs may be used as standard inputs or high speed inputs independently.
2. 60Hz to 240Hz filter should be set in the software when using an AC line signal.

BX-DM1E-18ED23-D Wiring, Continued

Discrete Input Connection Options



Discrete Input Internal Circuitry *



BX-DM1E-18ED23-D Wiring, Continued

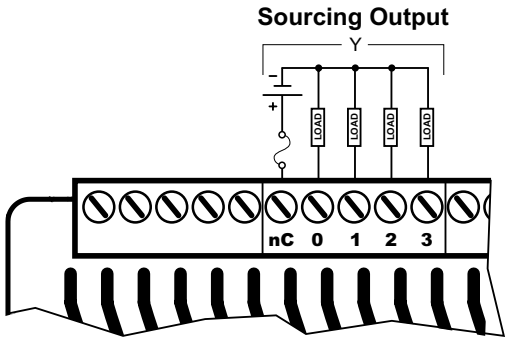
Discrete Output Specifications

Discrete Output Specifications		
Output Type	Sourcing	
Total Outputs per Module	8	
Commons	2 (4 points/common) Isolated	
Maximum Current per Common	2A	
Nominal Voltage Range	12–24 VDC	
Operating Voltage Range	5–36 VDC	
Maximum Voltage	36VDC	
Minimum Output Current	0.1 mA @ 24VDC	
Maximum Output Current	0.5 A per output No derating over temperature range	
Maximum Inrush Current	5A for 50ms	
Maximum Leakage Current	10µA	
ON Voltage Drop	0.05 VDC	
Status Indicators	Logic Side, Green	
Output Details		
Output Type	High-Speed	Standard[1]
Location	Y0...Y3	Y4...Y7
OFF to ON Response	< 2µs	< 5ms
ON to OFF Response	< 2µs	< 2ms
Maximum Switching Frequency	1m cable - 250kHz 10m cable - 100kHz	~ 100Hz
Overcurrent, Short Circuit Protection and Short to Ground	Current limit by Common Group, self-resetting	N/A
Overcurrent Trip Level[2]	Between 4A and 8A	N/A
Fuse Type	User-supplied external fuse	

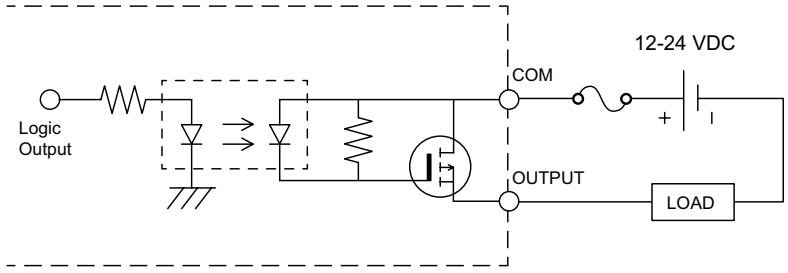
1. ***All outputs may be used as standard outputs. Only the first 4 outputs (Y0...Y3) are capable of high-speed DC operation.***
2. ***When the high-speed outputs are in an overcurrent situation, the Common terminal Red LED is on. The output LEDs will remain operational even though the output circuitry is turned off and no power is flowing. This condition is not reported to the CPU.***

BX-DM1E-18ED23-D Wiring, Continued

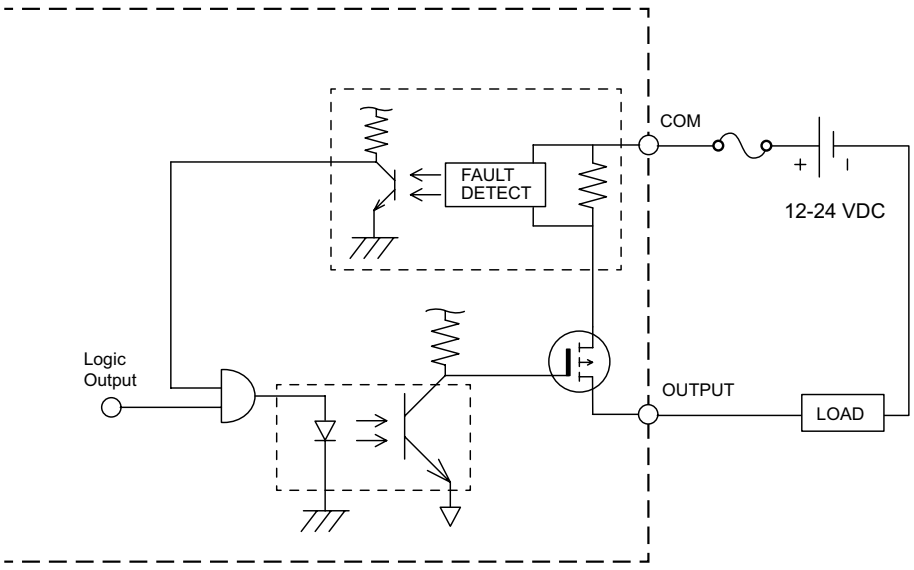
Discrete Output Connection Options



Discrete Standard Output Internal Circuitry



Discrete High-Speed Output Internal Circuitry



NOTE: *When the high speed outputs are in an overcurrent situation, the Common terminal Red LED is on. The output LEDs will remain operational even though the output circuitry is turned off and no power is flowing. This condition is not reported to the CPU.*

BX-DM1E-18ED23-D Wiring, Continued

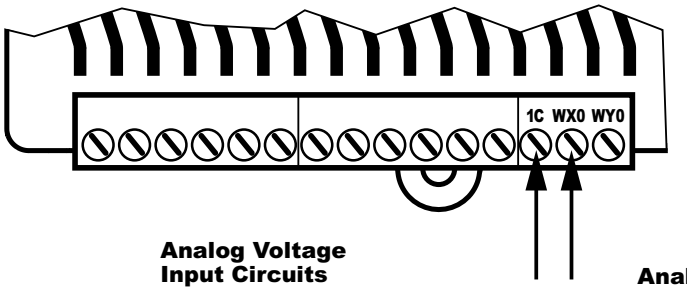
Analog Input Specifications

Analog Input Specifications	
Inputs per Module	1
Commons	1
Input Voltage Range *	Software Selectable ±10V, ±5V, 0–10 V, 0–5 V
Input Current Range *	Software Selectable ±20mA, 4–20 mA
Resolution ±10V, ±20mA ±5V 0–5 V 4–20 mA 0–10 V	 16 bits (0–65535 counts) 15 bits (0–32767 counts) 14 bits (0–16383 counts) ~15 bits (6553–32767 counts) 15 bits (0–32767 counts)
Input Impedance Voltage Modes	100kΩ
Absolute Maximum Input, Voltage Mode	±30V
Input Impedance Current Modes	249Ω
Absolute Maximum Input, Current Mode	±40mA sustained, ±100mA for < 5s
Conversion Time	1.2 ms
Input Stability	0.02% of Full Hardware Range = 13 Counts
Full Scale Calibration Error	0.05% of Full Hardware Range = 33 Counts
Offset Calibration Error	0.01% of Full Hardware Range = 7 Counts
Accuracy vs Temperature Error	0.05% of Full Hardware Range = 33 Counts
Maximum Linearity Error (End to End)	0.1% of Full Hardware Range = 66 Counts
Maximum Inaccuracy	0.2% of Full Hardware Range = 131 Counts
Fuse Type	User-supplied external fuse

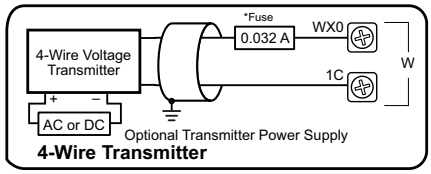
**** Software selectable per channel***

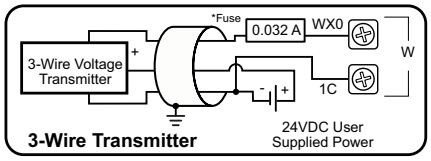
BX-DM1E-18ED23-D Wiring, Continued

Analog Input Connection Options



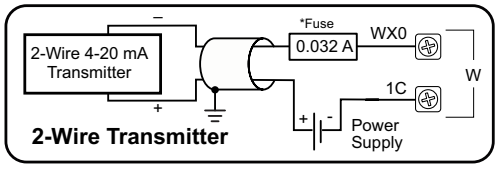
Analog Voltage Input Circuits

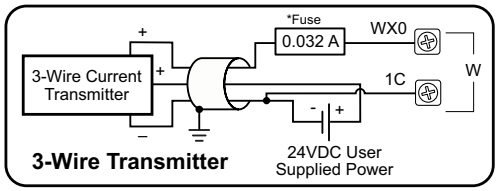


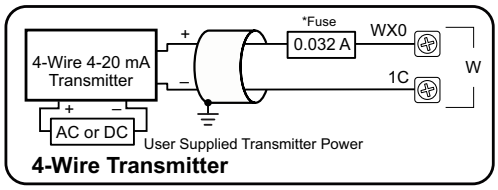


NOTE: Shield should be connected only at one end, to ground at the source device.

Analog Current Sinking Input Circuits







NOTE: Shield should be connected only at one end, to ground at the source device.



NOTE: *An Edison S500-32-R 0.032A fast-acting fuse is recommended for all analog voltage inputs, analog outputs, and current loops.*

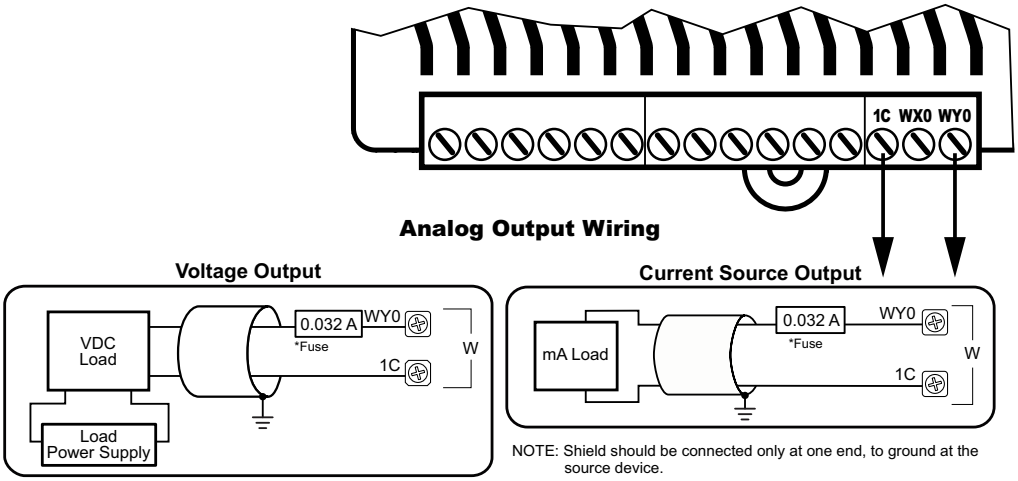
BX-DM1E-18ED23-D Wiring, Continued

Analog Output Specifications

Analog Output Specifications	
Outputs per Module	1
Commons	1
Output Voltage Range *	Software Selectable ±10V, ±5V, 0–10 V, 0–5 V
Output Current Range *	Software Selectable ±20mA, 4–20 mA
Resolution ±10V, ±20mA ±5V 0–5 V 4–20 mA 0–10 V	 16 bits (0–65535 counts) 15 bits (0–32767 counts) 14 bits (0–16383 counts) ~15 bits (6553–32767 counts) 15 bits (0–32767 counts)
Minimum Voltage Load Impedance	1kΩ
Maximum Current Load Impedance	500Ω
Maximum Rating	Continuous Short Circuit Protected
Settling Time	< 1ms
Output Stability	0.02% of Full Hardware Range = 13 Counts
Full Scale Calibration Error	0.05% of Full Hardware Range = 33 Counts
Offset Calibration Error	0.01% of Full Hardware Range = 7 Counts
Accuracy vs Temperature Error	0.05% of Full Hardware Range = 33 Counts
Maximum Linearity Error (End to End)	0.1% of Full Hardware Range = 66 Counts
Maximum Inaccuracy	0.2% of Full Hardware Range = 131 Counts
Fuse Type	User-supplied external fuse

**** Software selectable per channel***

Analog Output Connection Options



NOTE: Shield should be connected only at one end, to ground at the source device.

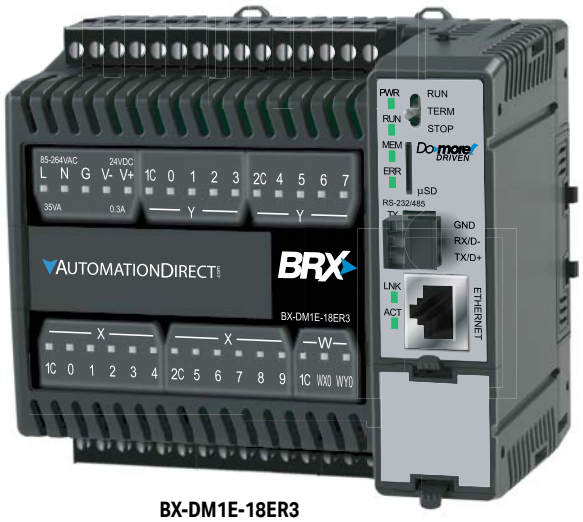
NOTE: *An Edison S500-32-R 0.032A fast-acting fuse is recommended for all analog voltage inputs, analog outputs, and current loops.*

BX-DM1E-18ER3 Wiring

This MPU is made up of 18 discrete I/O points. The connections are grouped as follows:

- 10 discrete inputs - sinking/sourcing; rated for 12–24 VAC/VDC. They are located along the bottom of the unit; configured in two (2) groups of 6 terminals, each comprised of 5 inputs and an isolated common.
- 8 discrete outputs - Form A Relay (SPST); rated 12–48 VDC/ 24–240 VAC. They are located along the top of the unit starting to the right of the 24VDC auxiliary output terminals. The outputs are configured in two (2) groups of 5 terminals, each comprised of 4 outputs and an isolated common.
- 1 analog input and 1 analog output. They are located along the bottom of the unit to the right of the discrete inputs. The analogs are a group of three (3) terminals, comprised of 1 input, 1 output and a shared isolated common. The analogs share these common features:
  - current or voltage selectable through software,
  - 16-bit resolution @ ±20mA, ±10VDC
  - current signal ranges of 4–20 mA, ±20mA,
  - voltage signal ranges of 0–5 VDC, 0–10 VDC, ±5 VDC, ±10VDC.

This MPU requires an external 120–240 VAC power supply. The AC power supply connection and the 24VDC auxiliary output supply terminals are located on the top left side of the unit.



BX-DM1E-18ER3

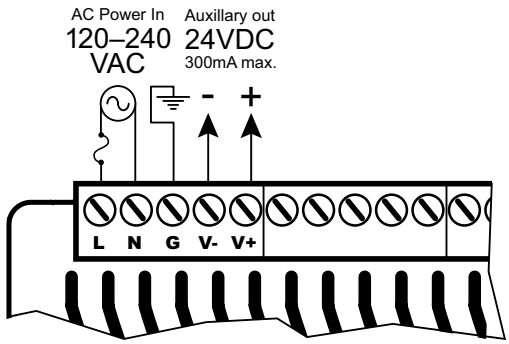
NOTE: *Eight (8) Expansion Modules can be connected to extend I/O capacity.*

BX-DM1E-18ER3 Wiring, Continued

Power Supply Specifications

Power Supply Specifications	
Nominal Voltage Range	120–240 VAC
Input Voltage Range (Tolerance)	85–264 VAC
Rated Operating Frequency	47–63 Hz
Maximum Input Power	40VA
Cold Start Inrush Current	1.5 A, 2ms
Maximum Inrush Current (Hot Start)	1.5 A, 2ms
Internal Input Fuse Protection	Micro fuse 250V, 2A Non-replaceable
Acceptable External Power Drop Time	10ms
Under Input Voltage Lock-out	80VAC
Input Transient Protection	Input choke and line filter
Heat Dissipation	21.1 W Max
Isolated User 24VDC Output	24VDC @ 0.3 A max, <1V P-P Ripple, Integrated self-resetting short circuit protection
Voltage Withstand (dielectric)	1500VAC Power Inputs to Ground applied for 1 minute 1500VAC Ground to 24VDC Output applied for 1 minute
Insulation Resistance	>10MΩ @ 500VDC
Software Version Required	Do-more! Designer version 2.0 or later

Power Supply Connections



WARNING: Do not exceed the 24VDC auxiliary power supply load limit of 300mA.

WARNING: The BRX System MUST have a proper earth ground. Do not operate the BRX MPU without proper earth grounding.

BX-DM1E-18ER3 Wiring, Continued

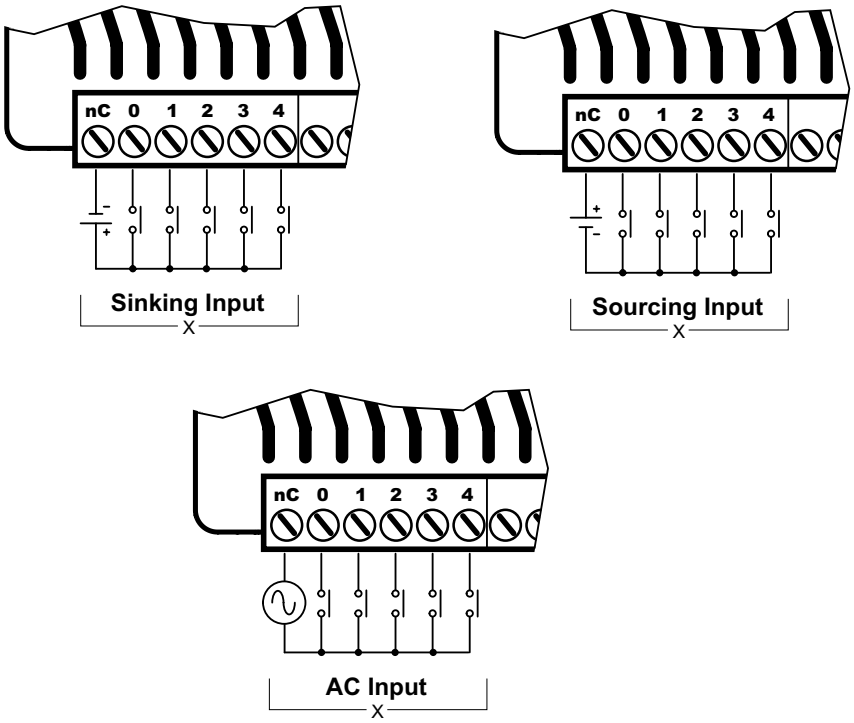
Discrete Input Specifications

Discrete Input Specifications			
Input Type		Sink/Source	
Total Inputs per Module		10	
Commons		2 (5 points/common) Isolated	
Nominal Voltage Range		12–24 VAC/VDC	
Input Voltage Range		9–30 VAC/VDC	
Maximum Voltage		30 VAC/VDC	
DC Frequency		0–250 kHz - High-speed	
Minimum Pulse Width		0.5 µs - High-speed	
AC Frequency		47–63 Hz[2]	
Input Impedance		3kΩ @ 24VDC	
Input Current (typical)		6mA @ 24 VAC/VDC	
Maximum Input Current		12mA @ 30 VAC/VDC	
ON Voltage Level		> 9.0 VAC/VDC	
OFF Voltage Level		< 2.0 VAC/VDC	
Maximum OFF Current		1.5 mA	
Status Indicators		Logic Side, Green	
Input Details			
Input Type		High-Speed DC	Standard[1]
Location		X0...X9	
OFF to ON Response	DC	< 2µs	
	AC	–	10ms[2]
ON to OFF Response	DC	< 2µs	
	AC	–	10ms[2]
Maximum Switching Frequency	DC	250kHz	
	AC	~ 30Hz	

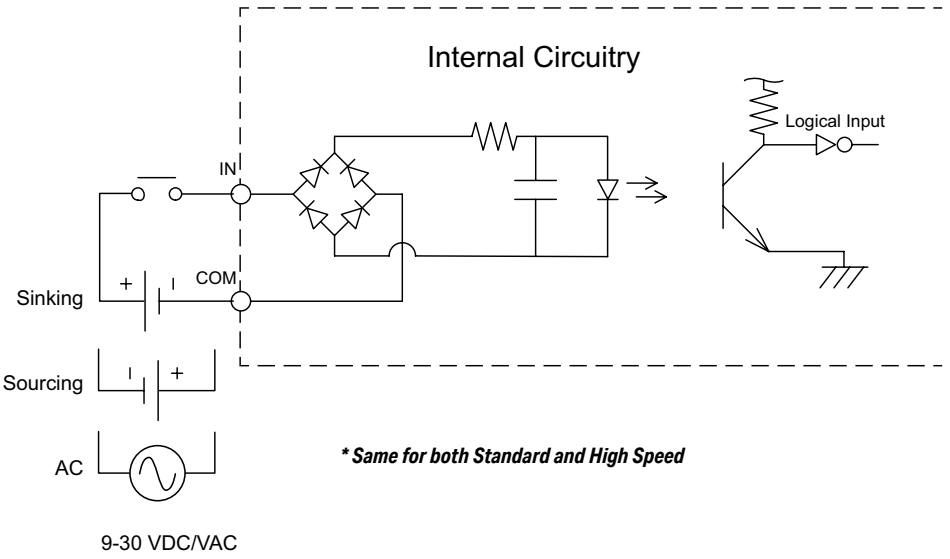
1. All Inputs may be used as standard inputs or high speed inputs independently.
2. 60Hz to 240Hz filter should be set in the software when using an AC line signal.

BX-DM1E-18ER3 Wiring, Continued

Discrete Input Connection Options



Discrete Input Internal Circuitry *



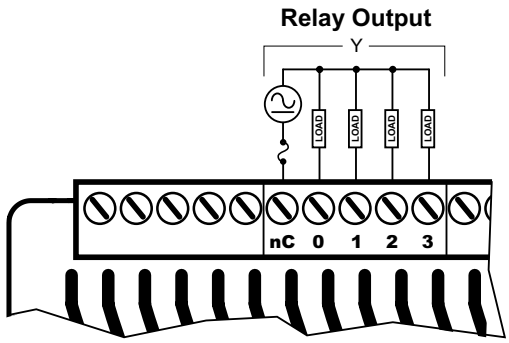
BX-DM1E-18ER3 Wiring, Continued

Discrete Output Specifications

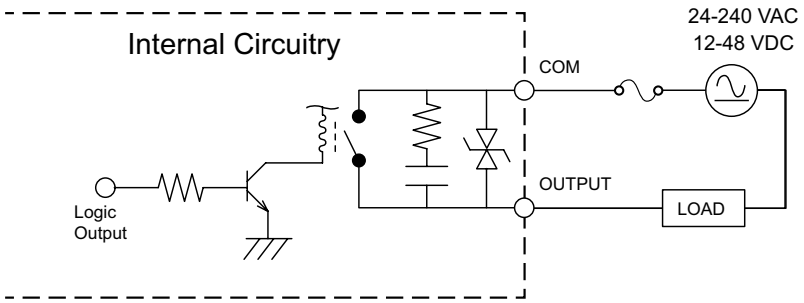
Discrete Output Specifications	
Output Type	Relay Form A (SPST)
Total Outputs per Module	8
Commons	2 (4 points/common) Isolated
Maximum Current per Common	8A
Nominal Voltage Range	12–48 VDC 24–240 VAC
Operating Voltage Range	5–60 VDC 5–264 VAC
Maximum Voltage	60VDC 264VAC
Minimum Output Current	0.1 mA @ 24VDC 0.1 mA @ 24VAC
Maximum Output Current	2A
Maximum Inrush Current	5A for 50ms
Maximum Leakage Current	1µA (DC), 300µA (AC) due to RC snubber circuit
ON Voltage Drop	0.2 V Max
Status Indicators	Logic Side, Green
Output Details	
Output Type	Standard
Location	Y0...Y7
ON-OFF Response	<10ms
OFF-ON Response	<10ms
Maximum Switching Frequency	10Hz
Relay Cycle Life Mechanical Endurance Electrical Endurance	 5 million operations 120,000 operations
Fuse Type	User-supplied external fuse

BX-DM1E-18ER3 Wiring, Continued

Discrete Output Connection Options



Discrete Standard Output Internal Circuitry



BX-DM1E-18ER3 Wiring, Continued

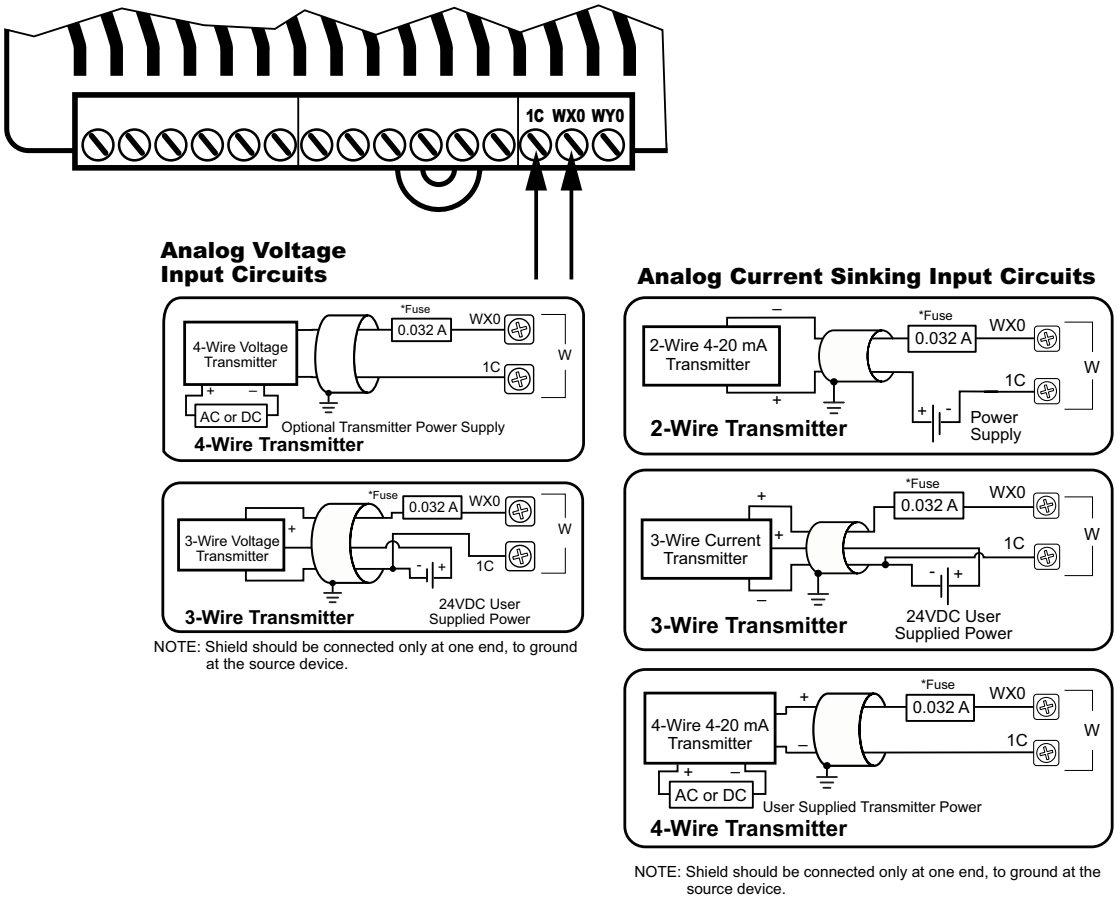
Analog Input Specifications

Analog Input Specifications	
Inputs per Module	1
Commons	1
Input Voltage Range *	Software Selectable ±10V, ±5V, 0–10 V, 0–5 V
Input Current Range *	Software Selectable ±20mA, 4–20 mA
Resolution ±10V, ±20mA ±5V 0–5 V 4–20 mA 0–10 V	 16 bits (0–65535 counts) 15 bits (0–32767 counts) 14 bits (0–16383 counts) ~15 bits (6553–32767 counts) 15 bits (0–32767 counts)
Input Impedance Voltage Modes	100kΩ
Absolute Maximum Input, Voltage Mode	±30V
Input Impedance Current Modes	249Ω
Absolute Maximum Input, Current Mode	±40mA sustained, ±100mA for < 5s
Conversion Time	1.2 ms
Input Stability	0.02% of Full Hardware Range = 13 Counts
Full Scale Calibration Error	0.05% of Full Hardware Range = 33 Counts
Offset Calibration Error	0.01% of Full Hardware Range = 7 Counts
Accuracy vs Temperature Error	0.05% of Full Hardware Range = 33 Counts
Maximum Linearity Error (End to End)	0.1% of Full Hardware Range = 66 Counts
Maximum Inaccuracy	0.2% of Full Hardware Range = 131 Counts
Fuse Type	User-supplied external fuse

**** Software selectable per channel***

BX-DM1E-18ER3 Wiring, Continued

Analog Input Connection Options



NOTE: Shield should be connected only at one end, to ground at the source device.

NOTE: Shield should be connected only at one end, to ground at the source device.



NOTE: *An Edison S500-32-R 0.032A fast-acting fuse is recommended for all analog voltage inputs, analog outputs, and current loops.*

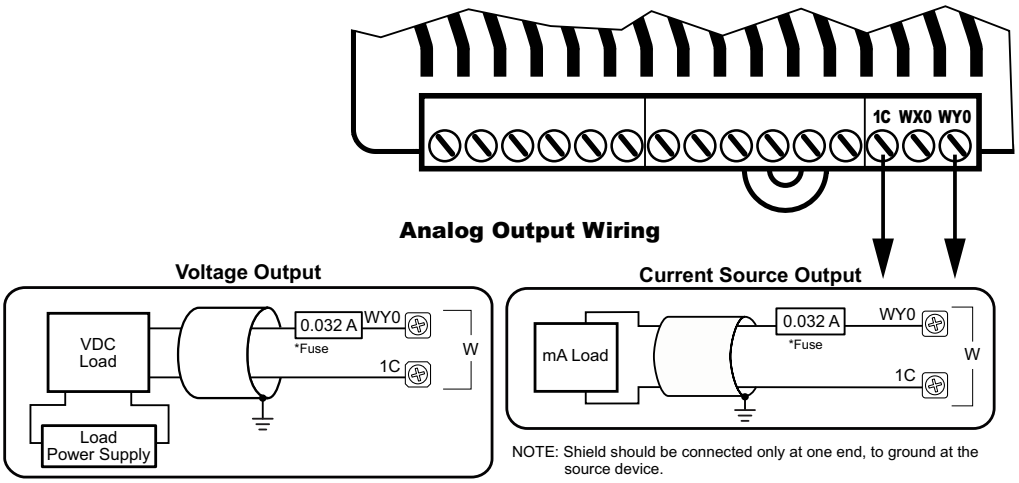
BX-DM1E-18ER3 Wiring, Continued

Analog Output Specifications

Analog Output Specifications	
Outputs per Module	1
Commons	1
Output Voltage Range *	Software Selectable ±10V, ±5V, 0–10 V, 0–5 V
Output Current Range *	Software Selectable ±20mA, 4–20 mA
Resolution ±10V, ±20mA ±5V 0–5 V 4–20 mA 0–10 V	 16 bits (0–65535 counts) 15 bits (0–32767 counts) 14 bits (0–16383 counts) ~15 bits (6553–32767 counts) 15 bits (0–32767 counts)
Minimum Voltage Load Impedance	1kΩ
Maximum Current Load Impedance	500Ω
Maximum Rating	Continuous Short Circuit Protected
Settling Time	< 1ms
Output Stability	0.02% of Full Hardware Range = 13 Counts
Full Scale Calibration Error	0.05% of Full Hardware Range = 33 Counts
Offset Calibration Error	0.01% of Full Hardware Range = 7 Counts
Accuracy vs Temperature Error	0.05% of Full Hardware Range = 33 Counts
Maximum Linearity Error (End to End)	0.1% of Full Hardware Range = 66 Counts
Maximum Inaccuracy	0.2% of Full Hardware Range = 131 Counts
Fuse Type	User-supplied external fuse

**** Software selectable per channel***

Analog Output Connection Options



NOTE: Shield should be connected only at one end, to ground at the source device.

NOTE: *An Edison S500-32-R 0.032A fast-acting fuse is recommended for all analog voltage inputs, analog outputs, and current loops.*

BX-DM1E-18ER3-D Wiring

This MPU is made up of 18 discrete I/O points. The connections are grouped as follows:

- 10 discrete inputs - sinking/sourcing; rated for 12–24 VAC/VDC. They are located along the bottom of the unit; configured in two (2) groups of 6 terminals, each comprised of 5 inputs and an isolated common.
- 8 discrete outputs - Form A Relay (SPST); rated 12–48 VDC/ 24–240 VAC. They are located along the top of the unit starting to the right of the 24VDC external power supply terminals. The outputs are configured in two (2) groups of 5 terminals, each comprised of 4 outputs and an isolated common.
- 1 analog input and 1 analog output. They are located along the bottom of the unit to the right of the discrete inputs. The analogs are a group of three (3) terminals, comprised of 1 input, 1 output and a shared isolated common. The analogs share these common features:
  - current or voltage selectable through software
  - 16-bit resolution @ ±20mA, ±10VDC
  - current signal ranges of 4–20 mA, ±20mA
  - voltage signal ranges of 0–5 VDC, 0–10 VDC, ±5VDC, ±10VDC

This MPU requires an external 12–24 VDC power supply. The DC power supply connection is located on the top left side of the unit. There is no 24VDC auxiliary output supply.



BX-DM1E-18ER3-D

NOTE: *Eight (8) Expansion Modules can be connected to extend I/O capacity.*

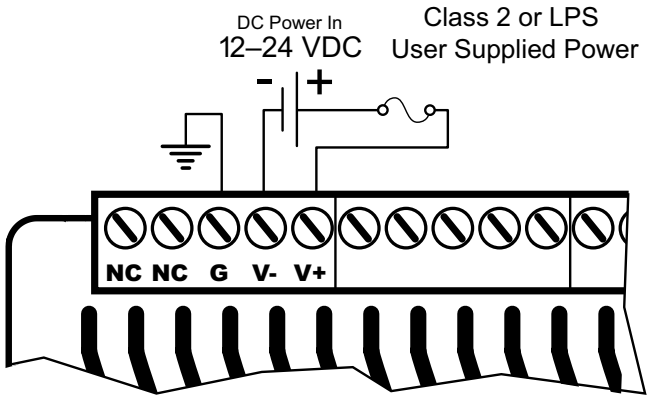
BX-DM1E-18ER3-D Wiring, Continued

Power Supply Specifications

Power Supply Specifications	
Nominal Voltage Range*	12–24 VDC
Input Voltage Range (Tolerance)*	10–36 VDC
Maximum Input Voltage Ripple	< ±10%
Maximum Input Power	30W
Cold Start Inrush Current	5A, 2ms
Maximum Inrush Current (Hot Start)	5A, 2ms
Internal Input Protection	Reverse polarity protection and undervoltage lockout via transistor circuit
Acceptable External Power Drop Time	10ms
Under Input Voltage Lock-out	<9VDC
Heat Dissipation	18.9 W Max
Isolated User 24VDC Output	None
Voltage Withstand (dielectric)	1500VAC power Inputs to ground applied for 1 minute
Insulation Resistance	>10MΩ @ 500VDC
Software Version Required	Do-more! Designer version 2.0 or later

**** Class 2 or LPS Power Supply required.***

Power Supply Connections



WARNING: No External AC power supply needed on this unit. The two terminals marked "NC" are not used. These terminals are not internally connected. DO NOT CONNECT ANYTHING TO THESE TERMINALS!

WARNING: The BRX System MUST have a proper earth ground. Do not operate the BRX MPU without proper earth grounding.

BX-DM1E-18ER3-D Wiring, Continued

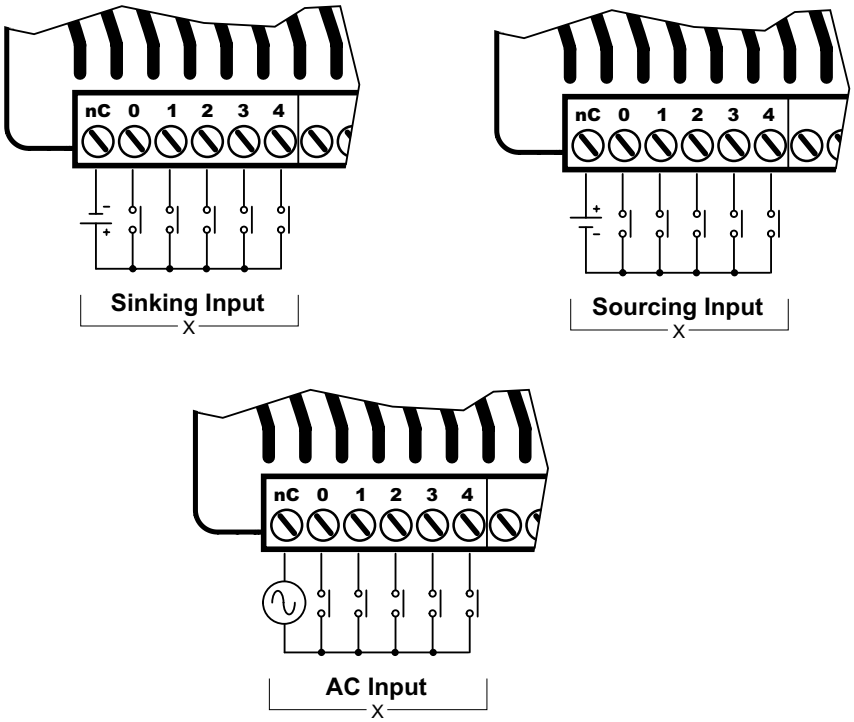
Discrete Input Specifications

Discrete Input Specifications			
Input Type		Sink/Source	
Total Inputs per Module		10	
Commons		2 (5 points/common) Isolated	
Nominal Voltage Range		12–24 VAC/VDC	
Input Voltage Range		9–30 VAC/VDC	
Maximum Voltage		30 VAC/VDC	
DC Frequency		0–250 kHz - High-speed	
Minimum Pulse Width		0.5 µs - High-speed	
AC Frequency		47–63 Hz[2]	
Input Impedance		3kΩ @ 24VDC	
Input Current (typical)		6mA @ 24 VAC/VDC	
Maximum Input Current		12mA @ 30 VAC/VDC	
ON Voltage Level		> 9.0 VAC/VDC	
OFF Voltage Level		< 2.0 VAC/VDC	
Maximum OFF Current		1.5 mA	
Status Indicators		Logic Side, Green	
Input Details			
Input Type		High-Speed DC	Standard[1]
Location		X0...X9	
OFF to ON Response	DC	< 2µs	
	AC	–	10ms[2]
ON to OFF Response	DC	< 2µs	
	AC	–	10ms[2]
Maximum Switching Frequency	DC	250kHz	
	AC	~ 30Hz	

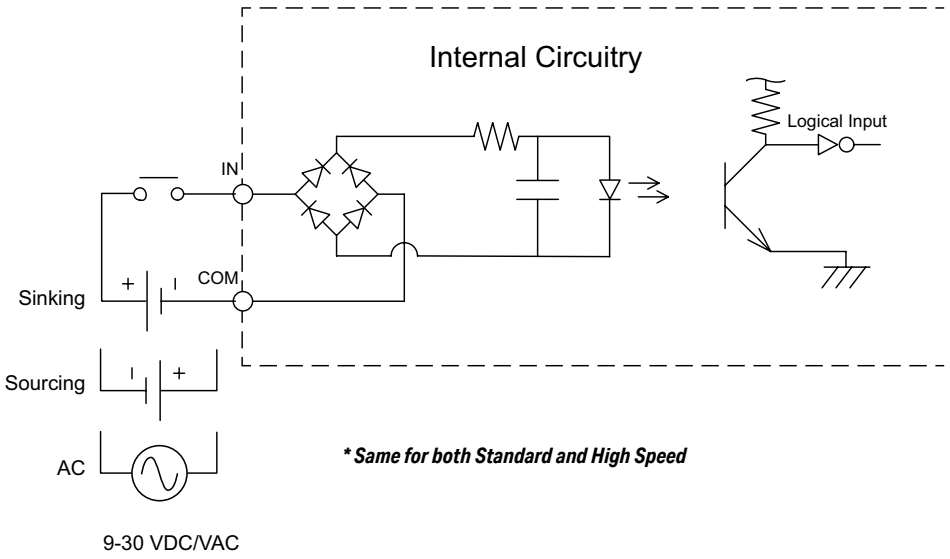
1. All Inputs may be used as standard inputs or high speed inputs independently.
2. 60Hz to 240Hz filter should be set in the software when using an AC line signal.

BX-DM1E-18ER3-D Wiring, Continued

Discrete Input Connection Options



Discrete Input Internal Circuitry *



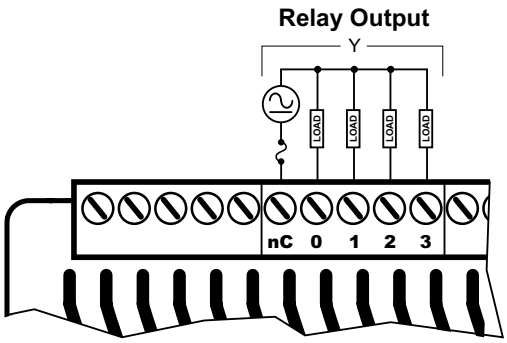
BX-DM1E-18ER3-D Wiring, Continued

Discrete Output Specifications

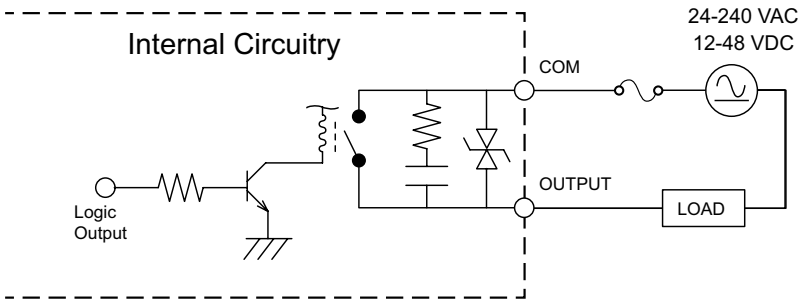
Discrete Output Specifications	
Output Type	Relay Form A (SPST)
Total Outputs per Module	8
Commons	2 (4 points/common) Isolated
Maximum Current per Common	8A
Nominal Voltage Range	12–48 VDC 24–240 VAC
Operating Voltage Range	5–60 VDC 5–264 VAC
Maximum Voltage	60VDC 264VAC
Minimum Output Current	0.1 mA @ 24VDC 0.1 mA @ 24VAC
Maximum Output Current	2A
Maximum Inrush Current	5A for 50ms
Maximum Leakage Current	1µA (DC), 300µA (AC) due to RC snubber circuit
ON Voltage Drop	0.2 V Max
Status Indicators	Logic Side, Green
Output Details	
Output Type	Standard
Location	Y0...Y7
ON-OFF Response	<10ms
OFF-ON Response	<10ms
Maximum Switching Frequency	10Hz
Relay Cycle Life Mechanical Endurance Electrical Endurance	 5 million operations 120,000 operations
Fuse Type	User-supplied external fuse

BX-DM1E-18ER3-D Wiring, Continued

Discrete Output Connection Options



Discrete Standard Output Internal Circuitry



BX-DM1E-18ER3-D Wiring, Continued

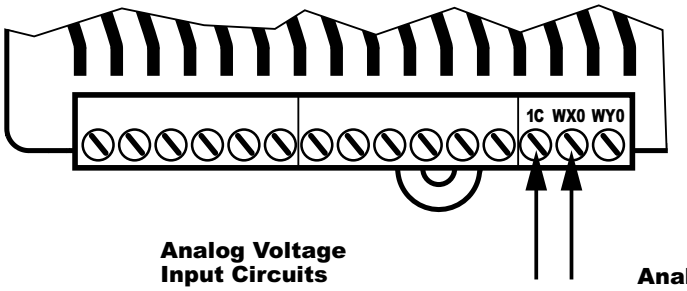
Analog Input Specifications

Analog Input Specifications	
Inputs per Module	1
Commons	1
Input Voltage Range *	Software Selectable ±10V, ±5V, 0–10 V, 0–5 V
Input Current Range *	Software Selectable ±20mA, 4–20 mA
Resolution ±10V, ±20mA ±5V 0–5 V 4–20 mA 0–10 V	 16 bits (0–65535 counts) 15 bits (0–32767 counts) 14 bits (0–16383 counts) ~15 bits (6553–32767 counts) 15 bits (0–32767 counts)
Input Impedance Voltage Modes	100kΩ
Absolute Maximum Input, Voltage Mode	±30V
Input Impedance Current Modes	249Ω
Absolute Maximum Input, Current Mode	±40mA sustained, ±100mA for < 5s
Conversion Time	1.2 ms
Input Stability	0.02% of Full Hardware Range = 13 Counts
Full Scale Calibration Error	0.05% of Full Hardware Range = 33 Counts
Offset Calibration Error	0.01% of Full Hardware Range = 7 Counts
Accuracy vs Temperature Error	0.05% of Full Hardware Range = 33 Counts
Maximum Linearity Error (End to End)	0.1% of Full Hardware Range = 66 Counts
Maximum Inaccuracy	0.2% of Full Hardware Range = 131 Counts
Fuse Type	User-supplied external fuse

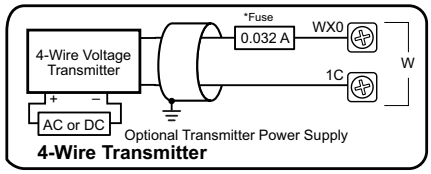
**** Software selectable per channel***

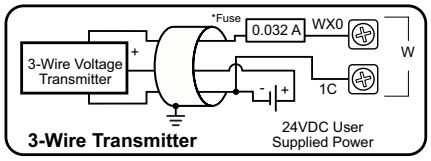
BX-DM1E-18ER3-D Wiring, Continued

Analog Input Connection Options



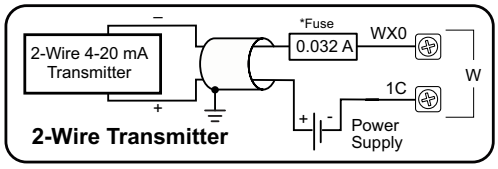
Analog Voltage Input Circuits

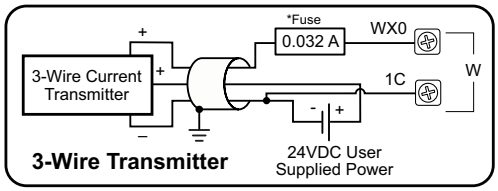


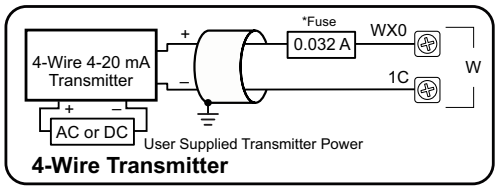


NOTE: Shield should be connected only at one end, to ground at the source device.

Analog Current Sinking Input Circuits







NOTE: Shield should be connected only at one end, to ground at the source device.



NOTE: *An Edison S500-32-R 0.032A fast-acting fuse is recommended for all analog voltage inputs, analog outputs, and current loops.*

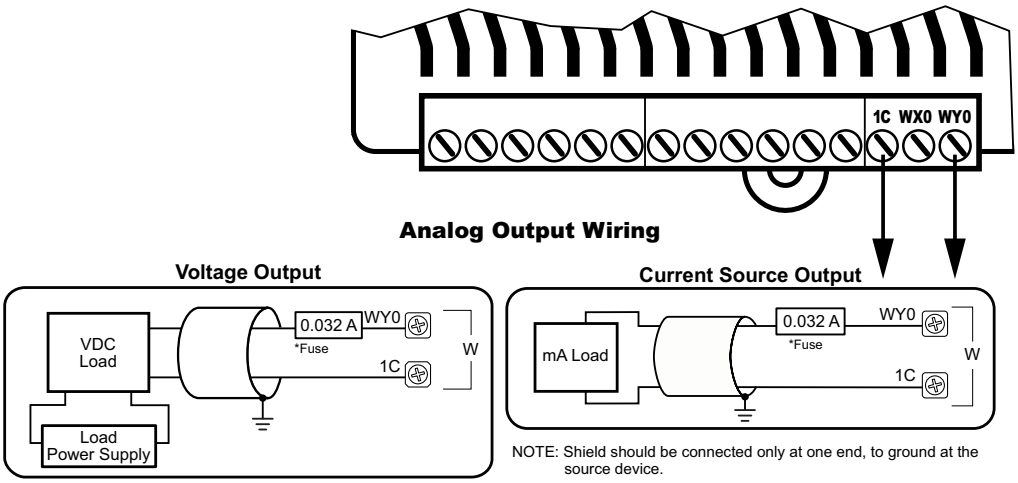
BX-DM1E-18ER3-D Wiring, Continued

Analog Output Specifications

Analog Output Specifications	
Outputs per Module	1
Commons	1
Output Voltage Range *	Software Selectable ±10V, ±5V, 0–10 V, 0–5 V
Output Current Range *	Software Selectable ±20mA, 4–20 mA
Resolution ±10V, ±20mA ±5V 0–5 V 4–20 mA 0–10 V	 16 bits (0–65535 counts) 15 bits (0–32767 counts) 14 bits (0–16383 counts) ~15 bits (6553–32767 counts) 15 bits (0–32767 counts)
Minimum Voltage Load Impedance	1kΩ
Maximum Current Load Impedance	500Ω
Maximum Rating	Continuous Short Circuit Protected
Settling Time	< 1ms
Output Stability	0.02% of Full Hardware Range = 13 Counts
Full Scale Calibration Error	0.05% of Full Hardware Range = 33 Counts
Offset Calibration Error	0.01% of Full Hardware Range = 7 Counts
Accuracy vs Temperature Error	0.05% of Full Hardware Range = 33 Counts
Maximum Linearity Error (End to End)	0.1% of Full Hardware Range = 66 Counts
Maximum Inaccuracy	0.2% of Full Hardware Range = 131 Counts
Fuse Type	User-supplied external fuse

**** Software selectable per channel***

Analog Output Connection Options



NOTE: *An Edison S500-32-R 0.032A fast-acting fuse is recommended for all analog voltage inputs, analog outputs, and current loops.*

BX-DM1E-18AR3 Wiring

This MPU is made up of 18 discrete I/O points. The connections are grouped as follows:

- 10 discrete inputs - AC rated for 120–240 VAC. They are located along the bottom of the unit; configured in two (2) groups of 6 terminals, each comprised of 5 inputs and an isolated common.
- 8 discrete outputs - Form A Relay (SPST); rated 12–48 VDC/ 24–240 VAC. They are located along the top of the unit starting to the right of the 24VDC auxiliary output terminals. The outputs are configured in two (2) groups of 5 terminals, each comprised of 4 outputs and an isolated common.
- 1 analog input and 1 analog output. They are located along the bottom of the unit to the right of the discrete inputs. The analogs are a group of three (3) terminals, comprised of 1 input, 1 output and a shared isolated common. The analogs share these common features:
  - current or voltage selectable through software,
  - 16-bit resolution @ ±20mA, ±10VDC
  - current signal ranges of 4–20 mA, ±20mA,
  - voltage signal ranges of 0–5 VDC, 0–10 VDC, ±5VDC, ±10 VDC.

This MPU requires an external 120–240 VAC power supply. The AC power supply connection and the 24VDC auxiliary output supply terminals are located on the top left side of the unit.



BX-DM1E-18AR3

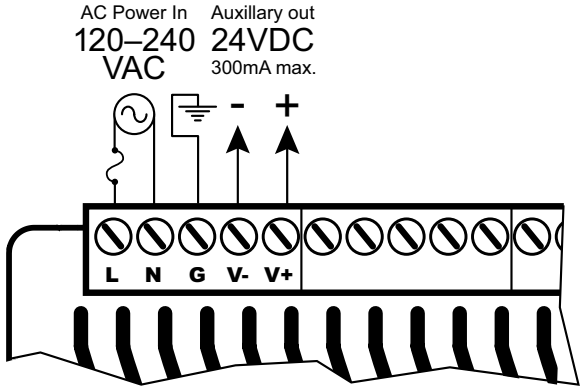
NOTE: *Eight (8) Expansion Modules can be connected to extend I/O capacity.*

BX-DM1E-18AR3 Wiring, Continued

Power Supply Specifications

Power Supply Specifications	
Nominal Voltage Range	120–240 VAC
Input Voltage Range (Tolerance)	85–264 VAC
Rated Operating Frequency	47–63 Hz
Maximum Input Power	40VA
Cold Start Inrush Current	1.5 A, 2ms
Maximum Inrush Current (Hot Start)	1.5 A, 2ms
Internal Input Fuse Protection	Micro fuse 250V, 2A Non-replaceable
Acceptable External Power Drop Time	10ms
Under Input Voltage Lock-out	80VAC
Input Transient Protection	Input choke and line filter
Heat Dissipation	20.7 W Max
Isolated User 24VDC Output	24VDC @ 0.3 A max, <1V P-P Ripple, Integrated self-resetting short circuit protection
Voltage Withstand (dielectric)	1500VAC Power Inputs to Ground applied for 1 minute 1500VAC Ground to 24VDC Output applied for 1 minute
Insulation Resistance	>10MΩ @ 500VDC
Software Version Required	Do-more! Designer version 2.0 or later

Power Supply Connections



WARNING: Do not exceed the 24VDC auxiliary power supply load limit of 300mA.

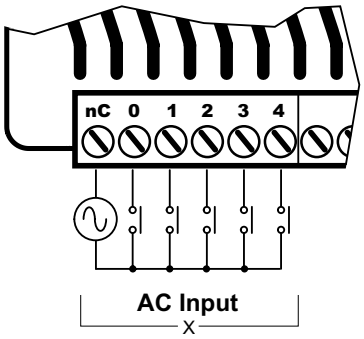
WARNING: The BRX System MUST have a proper earth ground. Do not operate the BRX MPU without proper earth grounding.

BX-DM1E-18AR3 Wiring, Continued

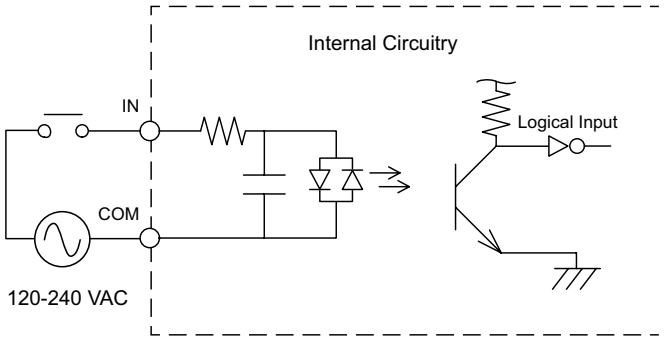
Discrete Input Specifications

Discrete Input Specifications	
Input Type	AC
Total Inputs per Module	10
Commons	2 (5 points/common) Isolated
Nominal Voltage Range	120–240 VAC
Input Voltage Range	85–264 VAC
Maximum Voltage	264VAC RMS
AC Frequency	47–63 Hz
Input Impedance	15kΩ
Input Current (typical)	9mA @ 120VAC, 13mA @ 220VAC
Maximum Input Current	14mA @ 120VAC, 20mA @ 220VAC
ON Voltage Level	> 85VAC
OFF Voltage Level	< 40VAC
Maximum OFF Current	2.5 mA
Status Indicators	Logic Side, Green
Input Details	
Input Type	Standard
Location	X0...X9
OFF - ON Response	10ms
ON - OFF Response	10ms
Maximum Switching Frequency	~ 30Hz

Discrete Input Connection Options



Discrete Input Internal Circuitry



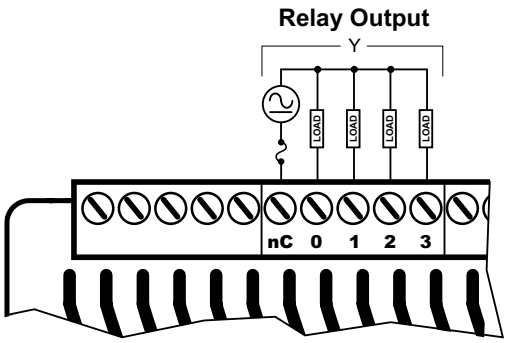
BX-DM1E-18AR3 Wiring, Continued

Discrete Output Specifications

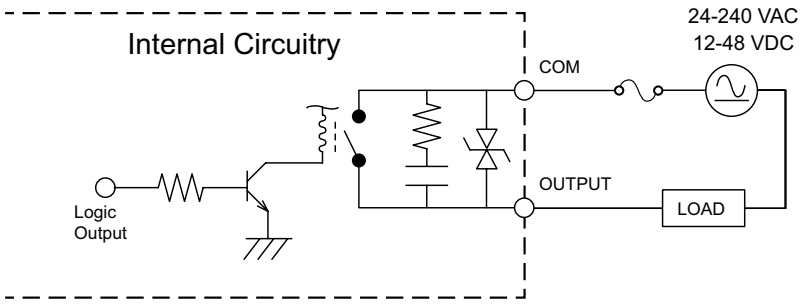
Discrete Output Specifications	
Output Type	Relay Form A (SPST)
Total Outputs per Module	8
Commons	2 (4 points/common) Isolated
Maximum Current per Common	8A
Nominal Voltage Range	12–48 VDC 24–240 VAC
Operating Voltage Range	5–60 VDC 5–264 VAC
Maximum Voltage	60VDC 264VAC
Minimum Output Current	0.1 mA @ 24VDC 0.1 mA @ 24VAC
Maximum Output Current	2A
Maximum Inrush Current	5A for 50ms
Maximum Leakage Current	1µA (DC), 300µA (AC) due to RC snubber circuit
ON Voltage Drop	0.2 V Max
Status Indicators	Logic Side, Green
Output Details	
Output Type	Standard
Location	Y0...Y7
ON-OFF Response	<10ms
OFF-ON Response	<10ms
Maximum Switching Frequency	10Hz
Relay Cycle Life Mechanical Endurance Electrical Endurance	 5 million operations 120,000 operations
Fuse Type	User-supplied external fuse

BX-DM1E-18AR3 Wiring, Continued

Discrete Output Connection Options



Discrete Standard Output Internal Circuitry



BX-DM1E-18AR3 Wiring, Continued

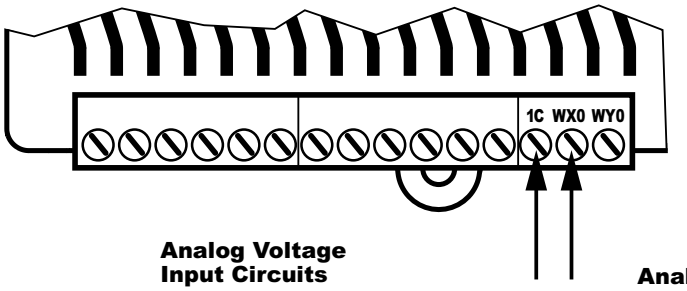
Analog Input Specifications

Analog Input Specifications	
Inputs per Module	1
Commons	1
Input Voltage Range *	Software Selectable ±10V, ±5V, 0–10 V, 0–5 V
Input Current Range *	Software Selectable ±20mA, 4–20 mA
Resolution ±10V, ±20mA ±5V 0–5 V 4–20 mA 0–10 V	 16 bits (0–65535 counts) 15 bits (0–32767 counts) 14 bits (0–16383 counts) ~15 bits (6553–32767 counts) 15 bits (0–32767 counts)
Input Impedance Voltage Modes	100kΩ
Absolute Maximum Input, Voltage Mode	±30V
Input Impedance Current Modes	249Ω
Absolute Maximum Input, Current Mode	±40mA sustained, ±100mA for < 5s
Conversion Time	1.2 ms
Input Stability	0.02% of Full Hardware Range = 13 Counts
Full Scale Calibration Error	0.05% of Full Hardware Range = 33 Counts
Offset Calibration Error	0.01% of Full Hardware Range = 7 Counts
Accuracy vs Temperature Error	0.05% of Full Hardware Range = 33 Counts
Maximum Linearity Error (End to End)	0.1% of Full Hardware Range = 66 Counts
Maximum Inaccuracy	0.2% of Full Hardware Range = 131 Counts
Fuse Type	User-supplied external fuse

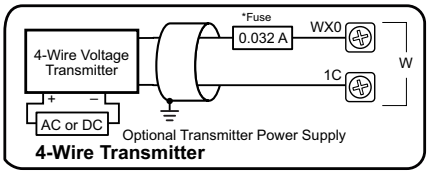
**** Software selectable per channel***

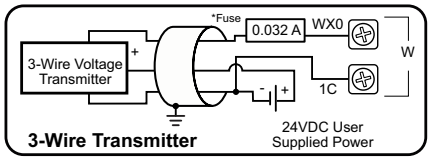
BX-DM1E-18AR3 Wiring, Continued

Analog Input Connection Options



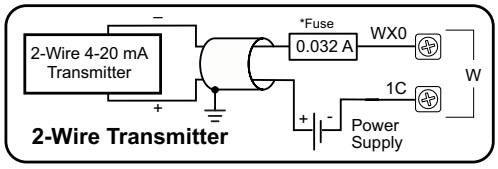
Analog Voltage Input Circuits

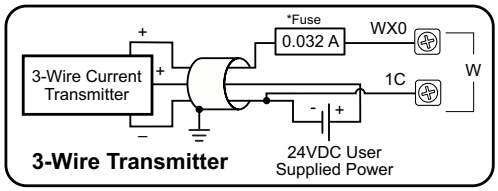


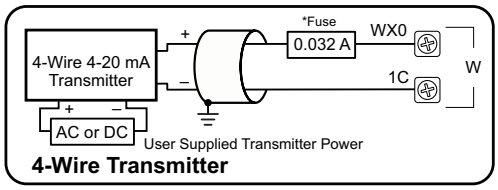


NOTE: Shield should be connected only at one end, to ground at the source device.

Analog Current Sinking Input Circuits







NOTE: Shield should be connected only at one end, to ground at the source device.



NOTE: *An Edison S500-32-R 0.032A fast-acting fuse is recommended for all analog voltage inputs, analog outputs, and current loops.*

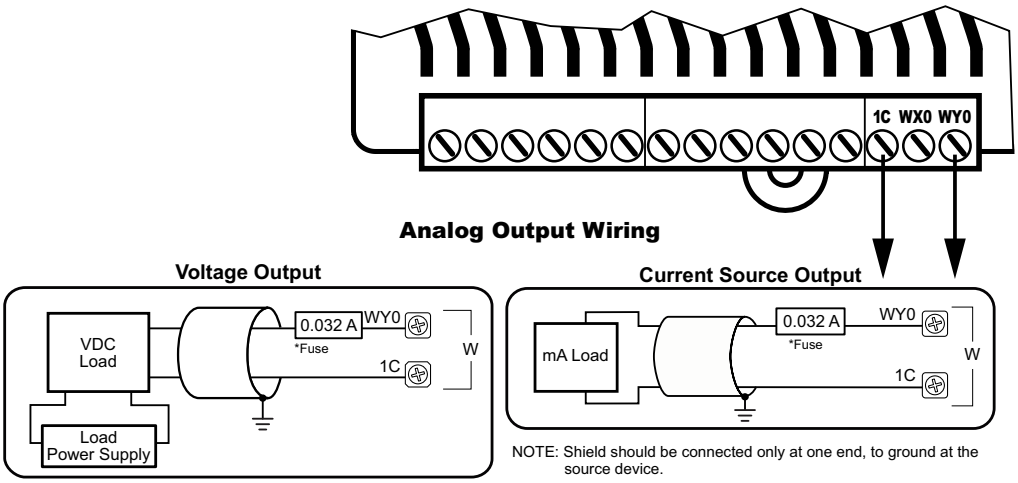
BX-DM1E-18AR3 Wiring, Continued

Analog Output Specifications

Analog Output Specifications	
Outputs per Module	1
Commons	1
Output Voltage Range *	Software Selectable ±10V, ±5V, 0–10 V, 0–5 V
Output Current Range *	Software Selectable ±20mA, 4–20 mA
Resolution ±10V, ±20mA ±5V 0–5 V 4–20 mA 0–10 V	 16 bits (0–65535 counts) 15 bits (0–32767 counts) 14 bits (0–16383 counts) ~15 bits (6553–32767 counts) 15 bits (0–32767 counts)
Minimum Voltage Load Impedance	1kΩ
Maximum Current Load Impedance	500Ω
Maximum Rating	Continuous Short Circuit Protected
Settling Time	< 1ms
Output Stability	0.02% of Full Hardware Range = 13 Counts
Full Scale Calibration Error	0.05% of Full Hardware Range = 33 Counts
Offset Calibration Error	0.01% of Full Hardware Range = 7 Counts
Accuracy vs Temperature Error	0.05% of Full Hardware Range = 33 Counts
Maximum Linearity Error (End to End)	0.1% of Full Hardware Range = 66 Counts
Maximum Inaccuracy	0.2% of Full Hardware Range = 131 Counts
Fuse Type	User-supplied external fuse

**** Software selectable per channel***

Analog Output Connection Options



NOTE: Shield should be connected only at one end, to ground at the source device.

NOTE: *An Edison S500-32-R 0.032A fast-acting fuse is recommended for all analog voltage inputs, analog outputs, and current loops.*

Notes:

BX 36/36E Wiring



In This Chapter...

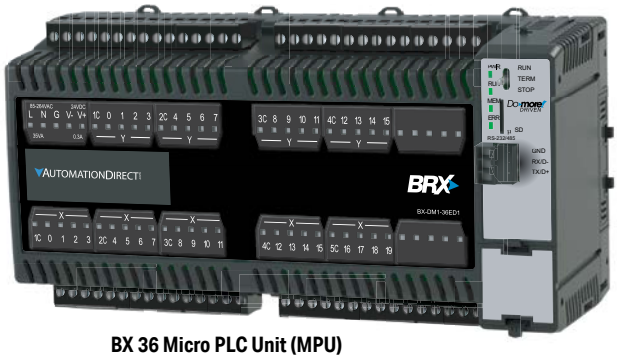
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BX 36/36E Micro PLC Units (MPUs) Overview

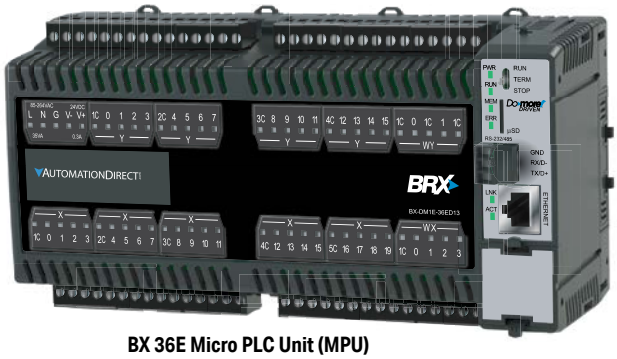
The BX 36/36E Micro PLC Unit (MPU) includes fourteen different versions. All have the same appearance and basic features. All units have 20 discrete input points and 16 discrete output points built-in. Units with DC inputs have 10 selectable high-speed inputs and units with DC outputs have 8 selectable high-speed outputs. All MPUs can expand their capacity with the BRX Expansion Modules to allow for more flexibility while keeping control cost down. BX 36E units have an Ethernet port as well as an additional 4 analog inputs and 2 analog outputs built-in that are current/voltage selectable within the software.

The units ship without wiring terminals. This allows you to select the termination type that best fits your application. There are several wiring options available, including screw terminal connectors, spring clamp terminal connectors and pre-wired ***ZIP***Link cable solutions.

BX 36/36E MPUs are divided into two distinct groups, BX 36 and BX 36E. The BX 36 MPUs have no built-in analog I/O or Ethernet port. The BX 36E MPUs have all the features of the BX 36, plus built-in analog I/O and an Ethernet port.

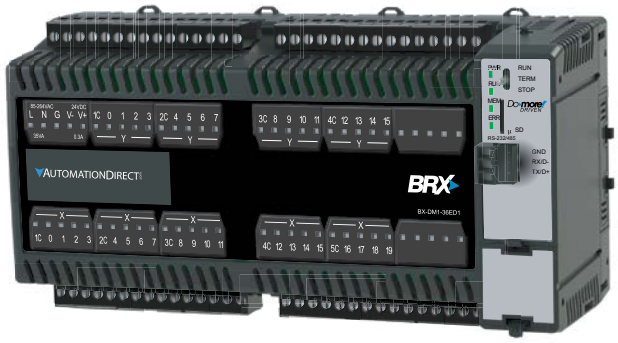


BX 36 Micro PLC Unit (MPU)
(No Built-in Analog or Ethernet Port)



BX 36E Micro PLC Unit (MPU)
(Built-in Analog and Ethernet Port)

BX 36 MPUs General Specifications



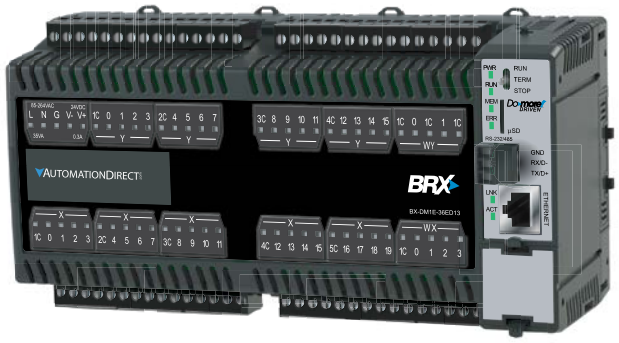
BX 36 Micro PLC Unit (MPU)
(No Built-in Analog or Ethernet port)

- 36 discrete I/O points: 20 input, 16 output
- No built-in analog I/O points
- Models with DC inputs:
  - have 10 high-speed inputs rated up to 250kHz
  - accept 12–24 nominal voltage, AC or DC
  - can be wired as sinking or sourcing
- Models with AC inputs can accept 120–240 nominal voltages
- Output types available are DC sinking, DC sourcing, and relay
- Models with DC outputs have 8 high-speed outputs rated up to 250kHz
- Support for up to 8 additional Expansion Modules as long as the power budget is not exceeded.

The following table shows the available BX 36 MPUs.

BX 36 MPUs				
Part Number	**External Power**	**Discrete Input**	**Discrete Output**	**Expansion Modules**
BX-DM1-36ED1	120–240 VAC	10 High-speed 10 Standard DC Sinking or Sourcing	8 High-speed 8 Standard DC Sinking	8, as long as the MPU power budget is not exceeded
BX-DM1-36ED1-D	12–24 VDC			
BX-DM1-36ED2	120–240 VAC		8 High-speed 8 Standard DC Sourcing	
BX-DM1-36ED2-D	12–24 VDC			
BX-DM1-36ER	120–240 VAC		16 Form A Relay	
BX-DM1-36ER-D	12–24 VDC			
BX-DM1-36AR	120–240 VAC	20 AC		

BX 36E MPUs General Specifications



BX 36E Micro PLC Unit (MPU)
(Built-in Analog and Ethernet Port)

- 36 Discrete I/O points: 20 inputs, 16 outputs
- All units have 4 analog input and 2 analog output (current/voltage software selectable)
- All units have built-in Ethernet port, 10/100 Mbps
- Models with DC inputs:
  - have 10 high-speed inputs rated up to 250kHz
  - accept 12–24 nominal voltages, AC or DC
  - can be wired as sinking or sourcing
- Models with AC inputs can accept 120–240 nominal voltages
- Output types available are DC sinking, DC sourcing, and relay
- Models with DC outputs have 8 high-speed outputs rated up to 250kHz
- Support for 8 additional Expansion Modules

The following table shows the available BX 36E MPUs.

BX 36E MPUs

Part Number	External Power	Discrete Inputs	Discrete Output	Analog *		Expansion Modules
				Input	Output	
BX-DM1E-36ED13	120–240 VAC	10 High-speed 10 Standard DC Sinking or Sourcing	8 High-Speed 8 Standard DC Sinking	4 Current or Voltage	2 Current or Voltage	8
BX-DM1E-36ED13-D	12–24 VDC					
BX-DM1E-36ED23	120–240 VAC		8 High-Speed 8 Standard DC Sourcing			
BX-DM1E-36ED23-D	12–24 VDC					
BX-DM1E-36ER3	120–240 VAC		16 Form A Relay			
BX-DM1E-36ER3-D	12–24 VDC					
BX-DM1E-36AR3	120–240 VAC	20 Standard AC				

Analog can be current or voltage software selectable per channel.

BX 36/36E MPU Wiring Termination Selection

The BX 36/36E MPUs ship without terminal blocks. This allows you to select the termination type that best suits your application. There are several removable terminal block options available, including screw terminals, spring clamp terminals, as well as pre-wired ***ZIP***Link module and cable solutions.

Terminal Block Connectors

The terminal block connectors are provided in kits and can be easily ordered as a single part number. Each kit contains the required number of terminal blocks: (12) 5-pin 5mm terminal blocks.

The BX 36/36E MPUs terminals are configured into groups consisting of 4 inputs and 4 outputs each with an isolated common, e.g., inputs X0–X3 are grouped with a common terminal. The groups are isolated such that a single 5-pin connector can be removed without affecting another group of I/O or the external power source.

The terminal block connector kit part numbers and connector specifications are listed in the table below.

Removable Terminal Block Connector Specifications

Kit Part Number	BX-RTB36	BX-RTB36-1
Connector Type	Screw Type-90 degree	Spring Clamp Type-180 degree
Wire Exit	180 degree	180 degree
Pitch	5.0 mm	5.0 mm
Screw Size	M2.5	N/A
Recommended Screw Torque	< 3.98 lb·in (0.45 N·m)	N/A
Screwdriver Blade Width	3.5 mm	3.5 mm
Wire Gauge (Single Wire)	28–12 AWG	28–14 AWG
Wire Gauge (Dual Wire)	28–16 AWG	28–16 AWG (Dual wire ferrule required)
Wire Strip Length	0.3 in (7.5 mm)	0.37 in (9.5 mm)
Equiv. Dinkle P/N	5ESDV-05P-BK	5ESDSR-05P-BK

BX-RTB36 Screw Terminal Block Kit

This terminal block kit has 12, 90 degree screw terminal blocks with 180 degree wire pass through.



5-Pin

BX-RTB36-1 Spring Terminal Block Kit

This terminal block kit has 12, Spring Clamp wire terminal blocks with 180 degree wire pass through.



5-Pin

Replacement terminal blocks can be ordered online at: www.AutomationDirect.com. Single replacement terminal blocks are listed in table below.

Replacement Terminal Blocks		
	BX-RTB36	BX-RTB36-1
5-pin	BX-RTB05	BX-RTB05-1

*ZIP*Link Prewired Cable Solutions

ZIPLinks eliminate the normally tedious process of wiring between devices by utilizing prewired cables and DIN rail mount connector modules. ***ZIP***Links are as simple as plugging in a cable connector at either end or terminating wires at only one end. Pre-wired cables keep installation clean and efficient, using less space at a fraction of the cost of standard terminal blocks. ***ZIP***Link pre-wired cables connect directly from the MPU to a ZIPlink remote terminal block module or with the pigtail cable option, that allows for a convenient solution to wire the BRX platform to third-party devices. For the BX 36/36E MPUs, four (4) cables and four (4) ***ZIP***Link feedthrough modules are needed to connect all the wiring termination points.

There are two (2) feedthrough module options available, the ZL-RTB20 and the ZL-RTB20-1. The ZL-RTB20 is a standard feedthrough remote terminal module while the ZL-RTB20-1 is a feedthrough remote terminal block having a more compact footprint, requiring less space in the control cabinet.

The table below lists the ***ZIP***Link system options for the BX 36/36E MPUs.

BX 36/36E *ZIP*Link Selector					
Part No.	Component Type	Module Part No.	Max Qty Needed	Cable Part No.*	Max Qty Needed
BX-DM1-36ED1	Feedthrough	ZL-RTB20 (Standard) -OR- ZL-RTB20-1 (Compact)	4	ZL-BX-CBL15 ZL-BX-CBL15-1 ZL-BX-CBL15-2	4
BX-DM1-36ED1-D					
BX-DM1-36ED2					
BX-DM1-36ED2-D					
BX-DM1-36ER					
BX-DM1-36ER-D					
BX-DM1-36AR					
BX-DM1E-36ED13					
BX-DM1E-36ED13-D					
BX-DM1E-36ED23					
BX-DM1E-36ED23-D					
BX-DM1E-36ER3					
BX-DM1E-36ER3-D					
BX-DM1E-36AR3					

**** Select the cable length: Blank = 0.5 m, -1 = 1.0 m, -2 = 2.0 m.***
Available pigtail cables: ZL-BX-CBL15-1P = 1.0 m, ZL-BX-CBL15-2P = 2.0 m.

*ZIP*Link Prewired Cables

Custom molded ***ZIP***Link prewired cables allow for fast and easy connection of field wiring and remote I/O to the BRX platform. The prewired cables are available in 0.5 meter, 1 meter and 2 meter lengths. Pigtail cables are used to connect the BRX platform directly to third-party devices, lowering your wiring cost and time. The pigtail cables are available in 1 meter and 2 meter lengths.



ZL-BX-CBL20
***ZIP*Link Prewired Cable**



ZL-BX-CBL20-1P
***ZIP*Link Pigtail Cable**

*ZIP*Link Remote Feedthrough Modules

Feedthrough modules provide low-cost and compact field wiring screw termination solutions for quickly connecting with the BRX platform. There are two (2) modules available for use with the BRX platform. The ZL-RTB20 and the ZL-RTB20-1. The ZL-RTB20 is a standard 2-row, 20-pin, DIN rail mountable feedthrough module. The ZL-RTB20-1 is a compact 3-row, 24-pin, DIN rail mountable feedthrough module with a smaller footprint design.

The ***ZIP***Link remote feedthrough module specifications are listed in the table below.

***ZIP*Link Module Specifications**		
Part Number	**ZL-RTB20 (Maximum of 4 Needed)**	**ZL-RTB20-1 (Maximum of 4 Needed)**
Number of positions	20 screw terminals, 2 rows	24 screw terminals, 3 rows
Screwdriver Width	1/8 in (3.8 mm) maximum	
Screw Torque	4.4 lb·in (0.5 N·m)	



ZL-RTB20



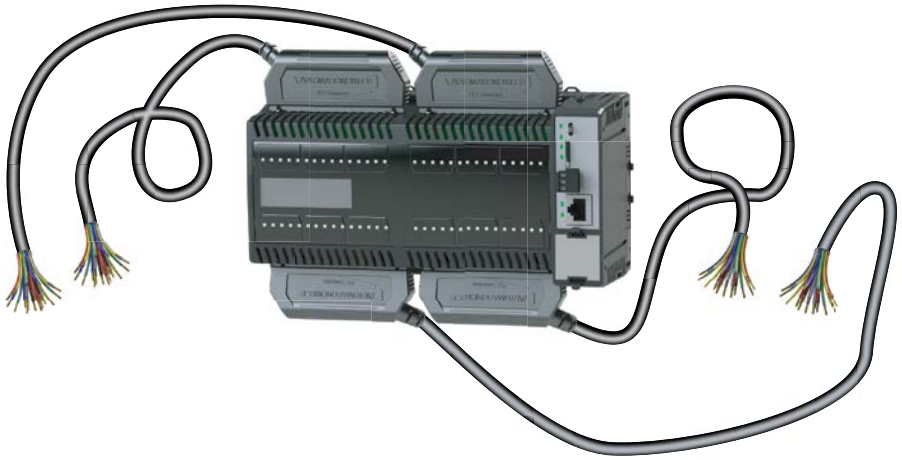
ZL-RTB20-1

*ZIP*Link System Examples

BX 36 MPU with ***ZIP***Link pre-wired cables and ZL-RTB20 feedthrough modules.



BX 36 MPU with ***ZIP***Link pigtail cables installed.



BX 36 Micro PLC Units (MPUs)

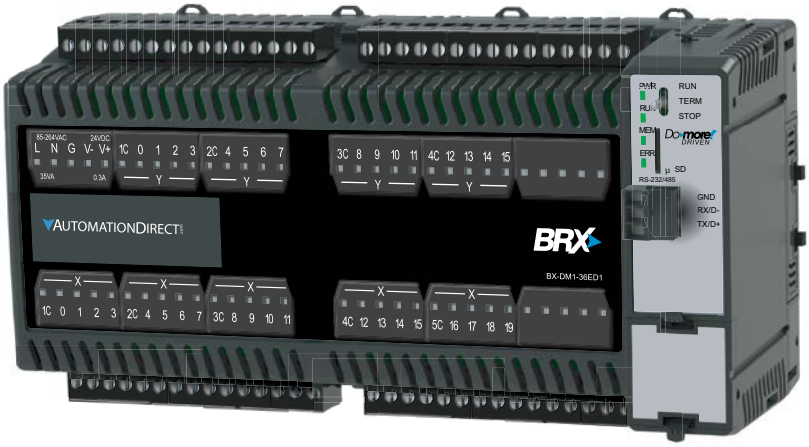
BX-DM1-36ED1 Wiring

This MPU is made up of 36 discrete I/O points. The connections are grouped as follows:

- 20 discrete inputs - sinking/sourcing; rated for 12–24 VAC/VDC. They are located along the bottom of the unit; configured in five (5) groups of 5 terminals, each comprised of 5 inputs and an isolated common.
- 16 discrete outputs - sinking; rated at 12–24 VDC. They are located along the top of the unit starting to the right of the 24VDC auxiliary output terminals. The outputs are configured in four (4) groups of 5 terminals, each comprised of 4 outputs and an isolated common.

This MPU requires an external 120–240 VAC power supply. The AC power supply connection and the 24VDC auxiliary output supply terminals are located on the top left side of the unit.

WARNING: No analog I/O is included on this unit. The 5 terminals to the right of the input and output rails are not used. These terminals are not internally connected. DO NOT CONNECT ANYTHING TO THESE TERMINALS!



BX-DM1-36ED1

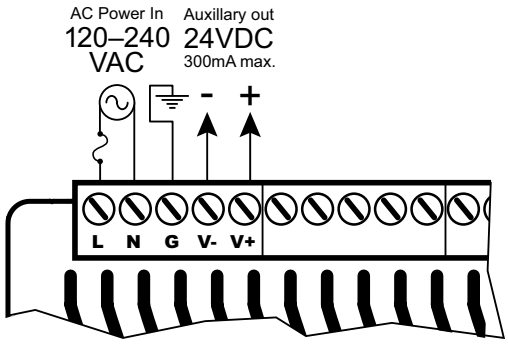
NOTE: *Four (4) Expansion Modules can be connected to extend I/O capacity.*

BX-DM1-36ED1 Wiring, Continued

Power Supply Specifications

Power Supply Specifications	
Nominal Voltage Range	120–240 VAC
Input Voltage Range (Tolerance)	85–264 VAC
Rated Operating Frequency	47–63 Hz
Maximum Input Power	40VA
Cold Start Inrush Current	1.5 A, 2ms
Maximum Inrush Current (Hot Start)	1.5 A, 2ms
Internal Input Fuse Protection	Micro fuse 250V, 2A Non-replaceable
Acceptable External Power Drop Time	10ms
Under Input Voltage Lock-out	80VAC
Input Transient Protection	Input choke and line filter
Heat Dissipation	21.7 W Max
Isolated User 24VDC Output	24VDC @ 0.3 A max, <1V P-P Ripple, Integrated self-resetting short circuit protection
Voltage Withstand (dielectric)	1500VAC Power Inputs to Ground applied for 1 minute 1500VAC Ground to 24VDC Output applied for 1 minute
Insulation Resistance	>10MΩ @ 500VDC
Software Version Required	Do-more! Designer version 2.0 or later

Power Supply Connections



WARNING: Do not exceed the 24VDC auxiliary power supply load limit of 300mA.

WARNING: The BRX System MUST have a proper earth ground. Do not operate the BRX MPU without proper earth grounding.

BX-DM1-36ED1 Wiring, Continued

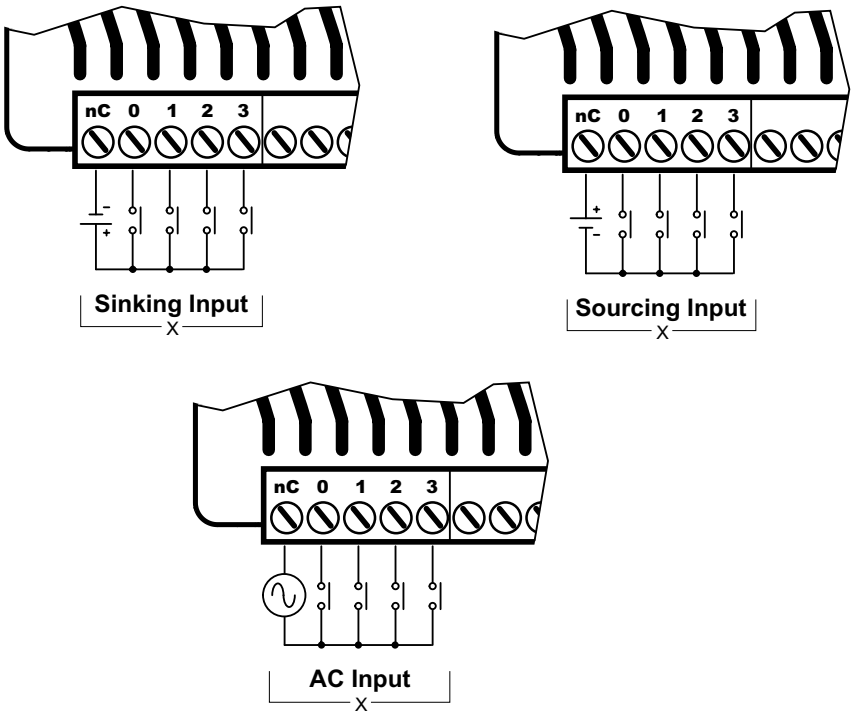
Discrete Input Specifications

Discrete Input Specifications			
Input Type		Sink/Source	
Total Inputs per Module		20	
Commons		5 (4 points/common) Isolated	
Nominal Voltage Range		12–24 VAC/VDC	
Input Voltage Range		9–30 VAC/VDC	
Maximum Voltage		30 VAC/VDC	
DC Frequency		0–250 kHz - High-speed	
Minimum Pulse Width		0.5 µs - High-speed	
AC Frequency		47–63 Hz[2]	
Input Impedance		3kΩ @ 24VDC	
Input Current (typical)		6mA @ 24 VAC/VDC	
Maximum Input Current		12mA @ 30 VAC/VDC	
ON Voltage Level		> 9.0 VAC/VDC	
OFF Voltage Level		< 2.0 VAC/VDC	
Maximum OFF Current		1.5 mA	
Status Indicators		Logic Side, Green	
Input Details			
Input Type		High-Speed DC	Standard[1]
Location		X0...X9	X10...X19
OFF to ON Response	DC	< 2µs	2ms
	AC	–	10ms[2]
ON to OFF Response	DC	< 2µs	2ms
	AC	–	10ms[2]
Maximum Switching Frequency	DC	250kHz	
	AC	~ 30Hz	

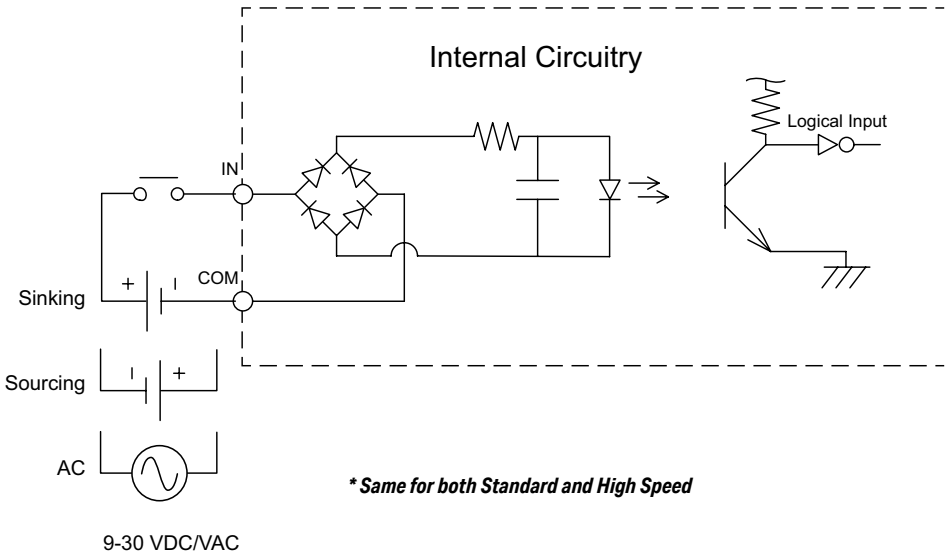
1. *All inputs may be used as standard inputs. Only the first 10 inputs (X0...X9) are capable of high-speed DC operation.*
2. *60Hz to 240Hz filter should be set in the software when using an AC line signal.*

BX-DM1-36ED1 Wiring, Continued

Discrete Input Connection Options



Discrete Input Internal Circuitry *



** Same for both Standard and High Speed*

BX-DM1-36ED1 Wiring, Continued

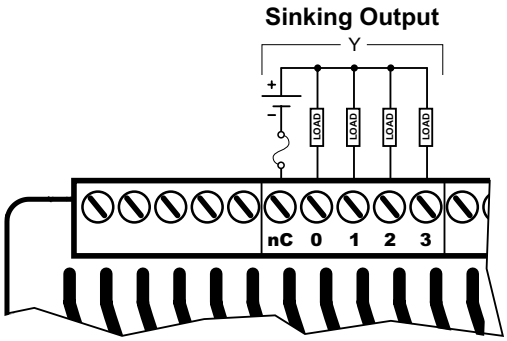
Discrete Output Specifications

Discrete Output Specifications		
Output Type	Sinking	
Total Outputs per Module	16	
Commons	4 (4 points/common) Isolated	
Maximum Current per Common	2A	
Nominal Voltage Range	12–24 VDC	
Operating Voltage Range	5–36 VDC	
Maximum Voltage	36VDC	
Minimum Output Current	0.1 mA @ 24VDC	
Maximum Output Current	0.5 A per output No derating over temperature range	
Maximum Inrush Current	5A for 50ms	
Maximum Leakage Current	10µA	
ON Voltage Drop	0.05 VDC	
Status Indicators	Logic Side, Green	
Output Details		
Output Type	High-Speed	Standard[1]
Location	Y0...Y7	Y8...Y15
OFF to ON Response	< 2µs	< 5ms
ON to OFF Response	< 2µs	< 2ms
Maximum Switching Frequency	1m cable - 250kHz 10m cable - 100kHz	~100Hz
Overcurrent, Short Circuit Protection and Short to Ground	Current limit by Common Group, self-resetting	N/A
Overcurrent Trip Level[2]	Between 4A and 8A	N/A
Fuse Type	User-supplied external fuse	

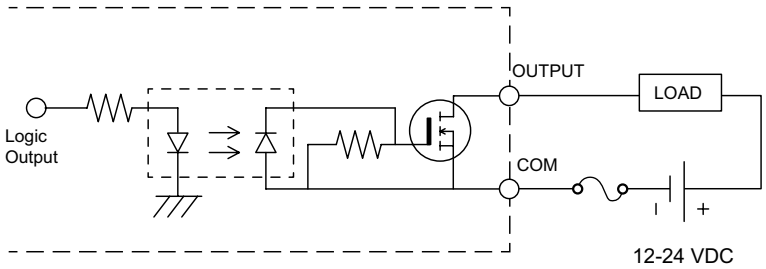
1. ***All outputs may be used as standard outputs. Only the first 8 outputs (Y0...Y7) are capable of high-speed DC operation.***
2. ***When the high-speed outputs are in an overcurrent situation, the Common terminal Red LED is on. The output LEDs will remain operational even though the output circuitry is turned off and no power is flowing. This condition is not reported to the CPU.***

BX-DM1-36ED1 Wiring, continued

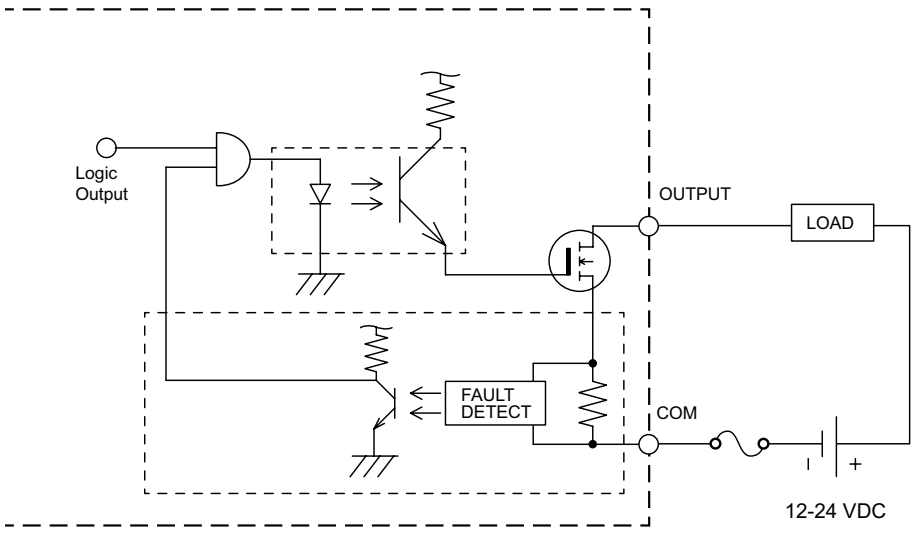
Discrete Output Connection Options



Discrete Standard Output Internal Circuitry



Discrete High-Speed Output Internal Circuitry



NOTE: *When the high speed outputs are in an overcurrent situation, the Common terminal Red LED is on. The output LEDs will remain operational even though the output circuitry is turned off and no power is flowing. This condition is not reported to the CPU.*

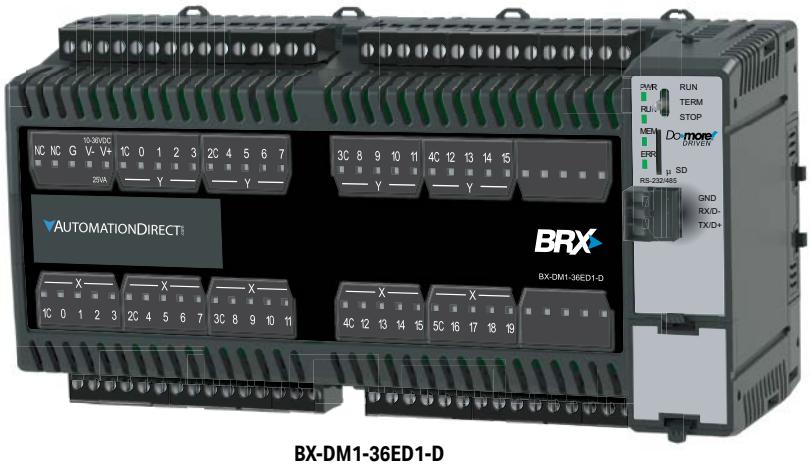
BX-DM1-36ED1-D Wiring

This MPU is made up of 36 discrete I/O points. The connections are grouped as follows:

- 20 discrete inputs - sinking/sourcing; rated for 12–24 VAC/VDC. They are located along the bottom of the unit; configured in five (5) groups of 5 terminals, each comprised of 4 inputs and an isolated common.
- 16 discrete outputs - sinking; rated at 12–24 VDC. They are located along the top of the unit starting to the right of the 24VDC external power supply terminals. The outputs are configured in four (4) groups of five (5) terminals, each comprised of four (4) outputs and an isolated common.

The MPU requires an external 12–24 VDC power supply. The DC power supply connection is located on the top left side of the unit. There is no 24VDC auxiliary output supply.

WARNING: No analog I/O is included on this unit. The 5 terminals to the right of the input and output rails are not used. These terminals are not internally connected. DO NOT CONNECT ANYTHING TO THESE TERMINALS!



BX-DM1-36ED1-D

NOTE: *Eight (8) Expansion Modules can be connected to extend I/O capacity, as long as the MPU power budget is not exceeded.*

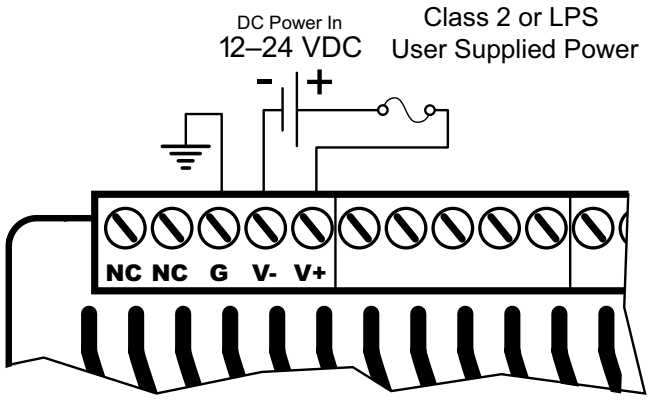
BX-DM1-36ED1-D Wiring, Continued

Power Supply Specifications

Power Supply Specifications	
Nominal Voltage Range*	12–24 VDC
Input Voltage Range (Tolerance)*	10–36 VDC
Maximum Input Voltage Ripple	< ±10%
Maximum Input Power	30W
Cold Start Inrush Current	5A, 2ms
Maximum Inrush Current (Hot Start)	5A, 2ms
Internal Input Protection	Reverse polarity protection and undervoltage lockout via transistor circuit
Acceptable External Power Drop Time	10ms
Under Input Voltage Lock-out	<9VDC
Heat Dissipation	19.5 W Max
Isolated User 24VDC Output	None
Voltage Withstand (dielectric)	1500VAC power Inputs to ground applied for 1 minute
Insulation Resistance	>10MΩ @ 500VDC
Software Version Required	Do-more! Designer version 2.0 or later

**** Class 2 or LPS Power Supply required.***

Power Supply Connections



WARNING: No External AC power supply needed on this unit. The two terminals marked "NC" are not used. These terminals are not internally connected. DO NOT CONNECT ANYTHING TO THESE TERMINALS!

WARNING: The BRX System MUST have a proper earth ground. Do not operate the BRX MPU without proper earth grounding.

BX-DM1-36ED1-D Wiring, Continued

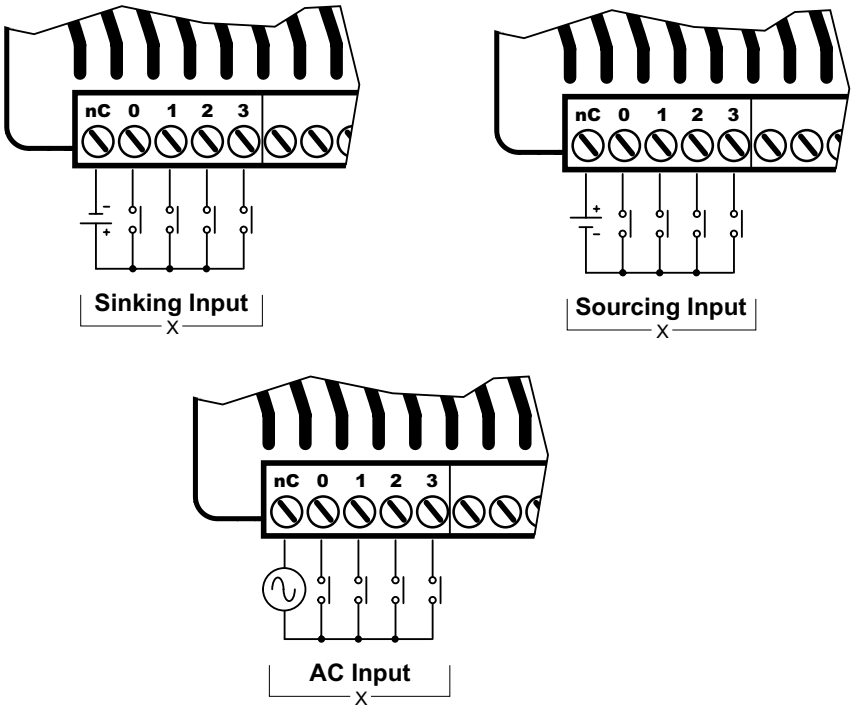
Discrete Input Specifications

Discrete Input Specifications			
Input Type		Sink/Source	
Total Inputs per Module		20	
Commons		5 (4 points/common) Isolated	
Nominal Voltage Range		12–24 VAC/VDC	
Input Voltage Range		9–30 VAC/VDC	
Maximum Voltage		30 VAC/VDC	
DC Frequency		0–250 kHz - High-speed	
Minimum Pulse Width		0.5 µs - High-speed	
AC Frequency		47–63 Hz[2]	
Input Impedance		3kΩ @ 24VDC	
Input Current (typical)		6mA @ 24 VAC/VDC	
Maximum Input Current		12mA @ 30 VAC/VDC	
ON Voltage Level		> 9.0 VAC/VDC	
OFF Voltage Level		< 2.0 VAC/VDC	
Maximum OFF Current		1.5 mA	
Status Indicators		Logic Side, Green	
Input Details			
Input Type		High-Speed DC	Standard[1]
Location		X0...X9	X10...X19
OFF to ON Response	DC	< 2µs	2ms
	AC	–	10ms[2]
ON to OFF Response	DC	< 2µs	2ms
	AC	–	10ms[2]
Maximum Switching Frequency	DC	250kHz	
	AC	~ 30Hz	

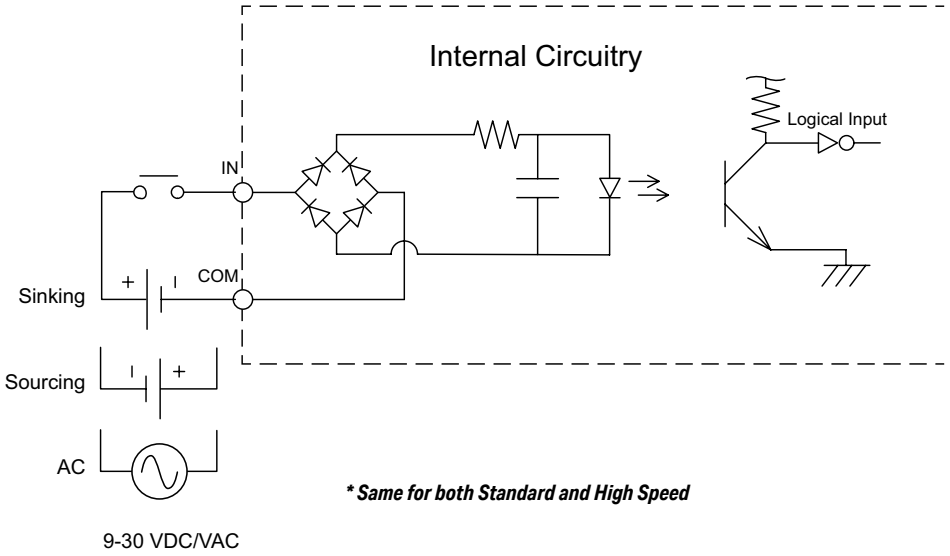
1. *All inputs may be used as standard inputs. Only the first 10 inputs (X0...X9) are capable of high-speed DC operation.*
2. *60Hz to 240Hz filter should be set in the software when using an AC line signal.*

BX-DM1-36ED1-D Wiring, Continued

Discrete Input Connection Options



Discrete Input Internal Circuitry *



** Same for both Standard and High Speed*

BX-DM1-36ED1-D Wiring, Continued

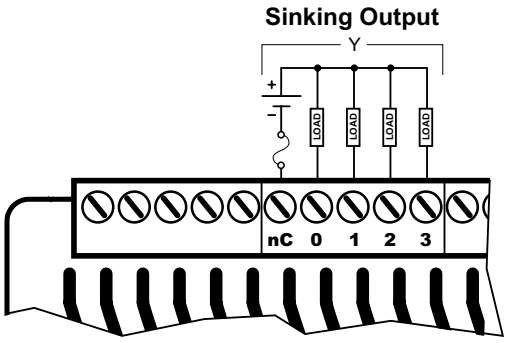
Discrete Output Specifications

Discrete Output Specifications		
Output Type	Sinking	
Total Outputs per Module	16	
Commons	4 (4 points/common) Isolated	
Maximum Current per Common	2A	
Nominal Voltage Range	12–24 VDC	
Operating Voltage Range	5–36 VDC	
Maximum Voltage	36VDC	
Minimum Output Current	0.1 mA @ 24VDC	
Maximum Output Current	0.5 A per output No derating over temperature range	
Maximum Inrush Current	5A for 50ms	
Maximum Leakage Current	10µA	
ON Voltage Drop	0.05 VDC	
Status Indicators	Logic Side, Green	
Output Details		
Output Type	High-Speed	Standard[1]
Location	Y0...Y7	Y8...Y15
OFF to ON Response	< 2µs	< 5ms
ON to OFF Response	< 2µs	< 2ms
Maximum Switching Frequency	1m cable - 250kHz 10m cable - 100kHz	~100Hz
Overcurrent, Short Circuit Protection and Short to Ground	Current limit by Common Group, self-resetting	N/A
Overcurrent Trip Level[2]	Between 4A and 8A	N/A
Fuse Type	User-supplied external fuse	

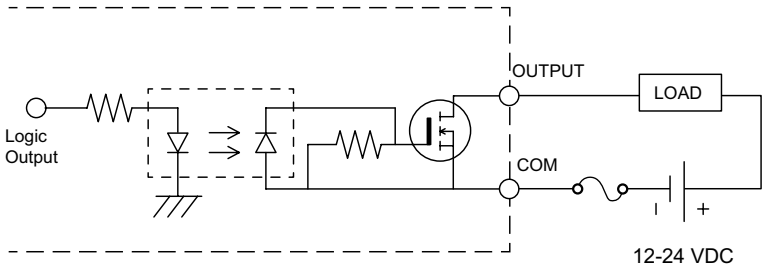
1. ***All outputs may be used as standard outputs. Only the first 8 outputs (Y0...Y7) are capable of high-speed DC operation.***
2. ***When the high-speed outputs are in an overcurrent situation, the Common terminal Red LED is on. The output LEDs will remain operational even though the output circuitry is turned off and no power is flowing. This condition is not reported to the CPU.***

BX-DM1-36ED1-D Wiring, Continued

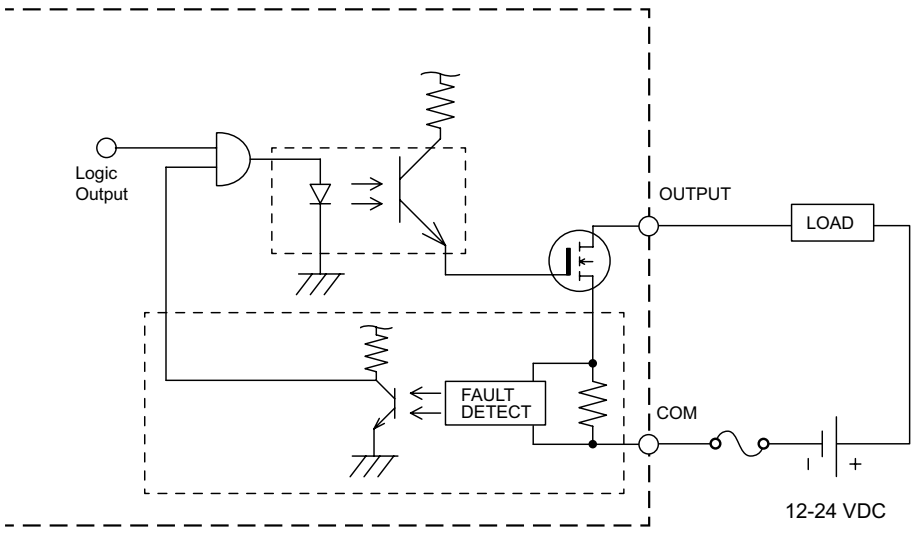
Discrete Output Connection Options



Discrete Standard Output Internal Circuitry



Discrete High-Speed Output Internal Circuitry



NOTE: *When the high speed outputs are in an overcurrent situation, the Common terminal Red LED is on. The output LEDs will remain operational even though the output circuitry is turned off and no power is flowing. This condition is not reported to the CPU.*

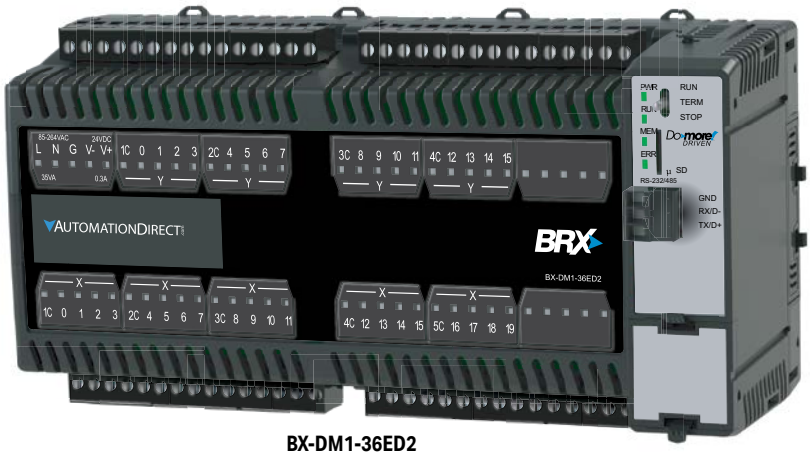
BX-DM1-36ED2 Wiring

This MPU is made up of 36 discrete I/O points. The connections are grouped as follows:

- 20 discrete inputs - sinking/sourcing; rated for 12–24 VAC/VDC. They are located along the bottom of the unit; configured in five (5) groups of 5 terminals, each comprised of 4 inputs and an isolated common.
- 16 discrete outputs - sourcing; rated at 12–24 VDC. They are located along the top of the unit starting to the right of the 24VDC auxiliary output terminals. The outputs are configured in four (4) groups of 5 terminals, each comprised of 4 outputs and an isolated common.

This MPU requires an external 120–240 VAC power supply. The AC power supply connection and the 24VDC auxiliary output supply terminals are located on the top left side of the unit.

WARNING: No analog I/O is included on this unit. The 5 terminals to the right of the input and output rails are not used. These terminals are not internally connected. DO NOT CONNECT ANYTHING TO THESE TERMINALS!



BX-DM1-36ED2

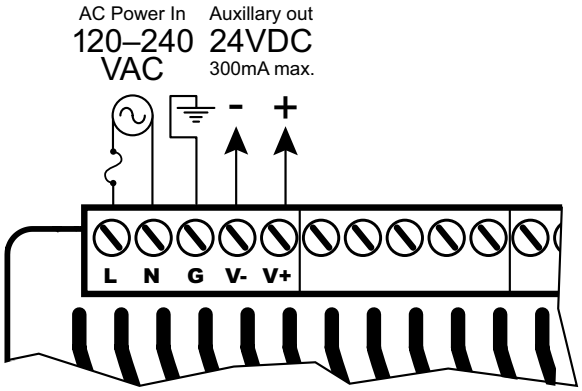
NOTE: *Eight (8) Expansion Modules can be connected to extend I/O capacity, as long as the MPU power budget is not exceeded.*

BX-DM1-36ED2 Wiring, Continued

Power Supply Specifications

Power Supply Specifications	
Nominal Voltage Range	120–240 VAC
Input Voltage Range (Tolerance)	85–264 VAC
Rated Operating Frequency	47–63 Hz
Maximum Input Power	40VA
Cold Start Inrush Current	1.5 A, 2ms
Maximum Inrush Current (Hot Start)	1.5 A, 2ms
Internal Input Fuse Protection	Micro fuse 250V, 2A Non-replaceable
Acceptable External Power Drop Time	10ms
Under Input Voltage Lock-out	80VAC
Input Transient Protection	Input choke and line filter
Heat Dissipation	21.7 W Max
Isolated User 24VDC Output	24VDC @ 0.3 A max, <1V P-P Ripple, Integrated self-resetting short circuit protection
Voltage Withstand (dielectric)	1500VAC Power Inputs to Ground applied for 1 minute 1500VAC Ground to 24VDC Output applied for 1 minute
Insulation Resistance	>10MΩ @ 500VDC
Software Version Required	Do-more! Designer version 2.0 or later

Power Supply Connections



WARNING: Do not exceed the 24VDC auxiliary power supply load limit of 300mA.

WARNING: The BRX System MUST have a proper earth ground. Do not operate the BRX MPU without proper earth grounding.

BX-DM1-36ED2 Wiring, Continued

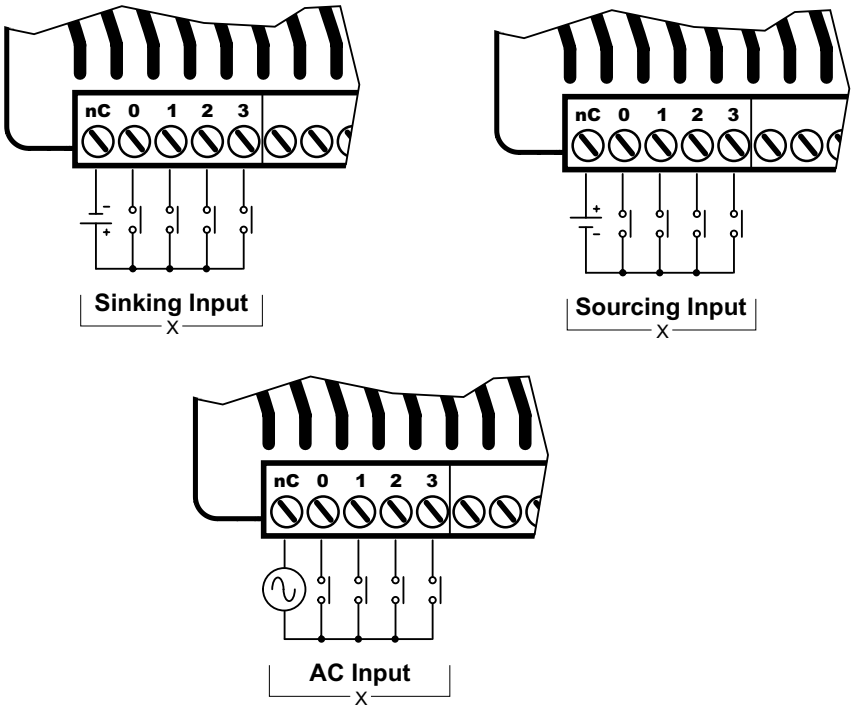
Discrete Input Specifications

Discrete Input Specifications			
Input Type		Sink/Source	
Total Inputs per Module		20	
Commons		5 (4 points/common) Isolated	
Nominal Voltage Range		12–24 VAC/VDC	
Input Voltage Range		9–30 VAC/VDC	
Maximum Voltage		30 VAC/VDC	
DC Frequency		0–250 kHz - High-speed	
Minimum Pulse Width		0.5 µs - High-speed	
AC Frequency		47–63 Hz[2]	
Input Impedance		3kΩ @ 24VDC	
Input Current (typical)		6mA @ 24 VAC/VDC	
Maximum Input Current		12mA @ 30 VAC/VDC	
ON Voltage Level		> 9.0 VAC/VDC	
OFF Voltage Level		< 2.0 VAC/VDC	
Maximum OFF Current		1.5 mA	
Status Indicators		Logic Side, Green	
Input Details			
Input Type		High-Speed DC	Standard[1]
Location		X0...X9	X10...X19
OFF to ON Response	DC	< 2µs	2ms
	AC	–	10ms[2]
ON to OFF Response	DC	< 2µs	2ms
	AC	–	10ms[2]
Maximum Switching Frequency	DC	250kHz	
	AC	~ 30Hz	

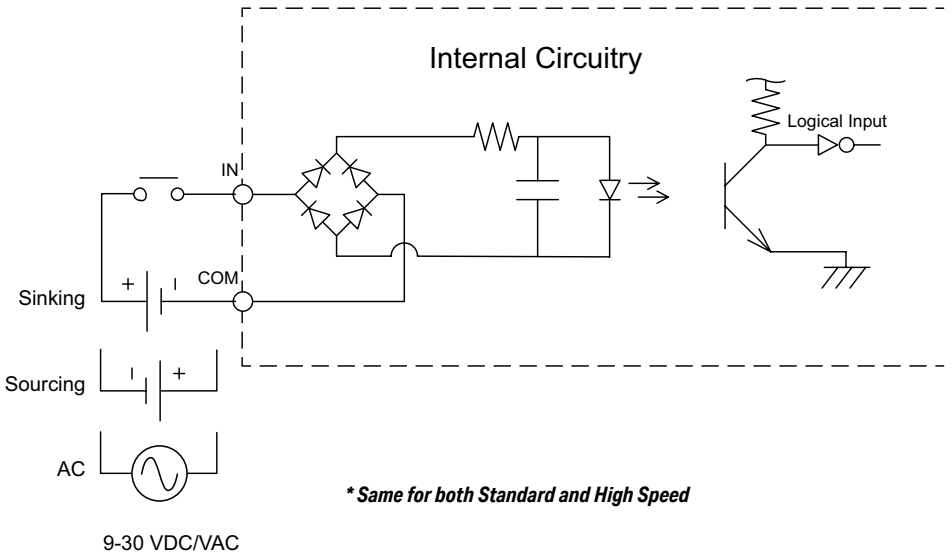
1. *All inputs may be used as standard inputs. Only the first 10 inputs (X0...X9) are capable of high-speed DC operation.*
2. *60Hz to 240Hz filter should be set in the software when using an AC line signal.*

BX-DM1-36ED2 Wiring, Continued

Discrete Input Connection Options



Discrete Input Internal Circuitry *



** Same for both Standard and High Speed*

BX-DM1-36ED2 Wiring, Continued

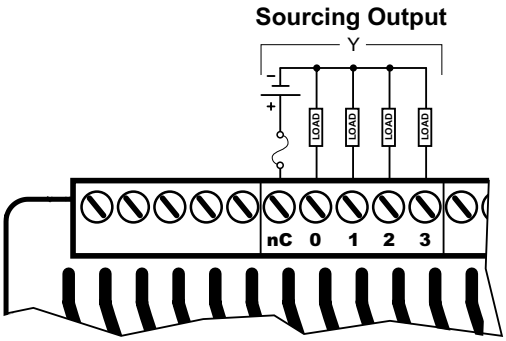
Discrete Output Specifications

Discrete Output Specifications		
Output Type	Sourcing	
Total Outputs per Module	16	
Commons	4 (4 points/common) Isolated	
Maximum Current per Common	2A	
Nominal Voltage Range	12–24 VDC	
Operating Voltage Range	5–36 VDC	
Maximum Voltage	36VDC	
Minimum Output Current	0.1 mA @ 24VDC	
Maximum Output Current	0.5 A per output No derating over temperature range	
Maximum Inrush Current	5A for 50ms	
Maximum Leakage Current	10µA	
ON Voltage Drop	0.05 VDC	
Status Indicators	Logic Side, Green	
Output Details		
Output Type	High-Speed	Standard[1]
Location	Y0...Y7	Y8...Y15
OFF to ON Response	< 2µs	< 5ms
ON to OFF Response	< 2µs	< 2ms
Maximum Switching Frequency	1m cable - 250kHz 10m cable - 100kHz	~100Hz
Overcurrent, Short Circuit Protection and Short to Ground	Current limit by Common Group, self-resetting	N/A
Overcurrent Trip Level[2]	Between 4A and 8A	N/A
Fuse Type	User-supplied external fuse	

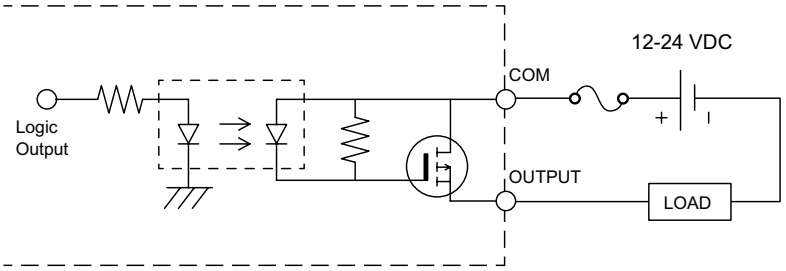
1. ***All outputs may be used as standard outputs. Only the first 8 outputs (Y0...Y7) are capable of high-speed DC operation.***
2. ***When the high-speed outputs are in an overcurrent situation, the Common terminal Red LED is on. The output LEDs will remain operational even though the output circuitry is turned off and no power is flowing. This condition is not reported to the CPU.***

BX-DM1-36ED2 Wiring, Continued

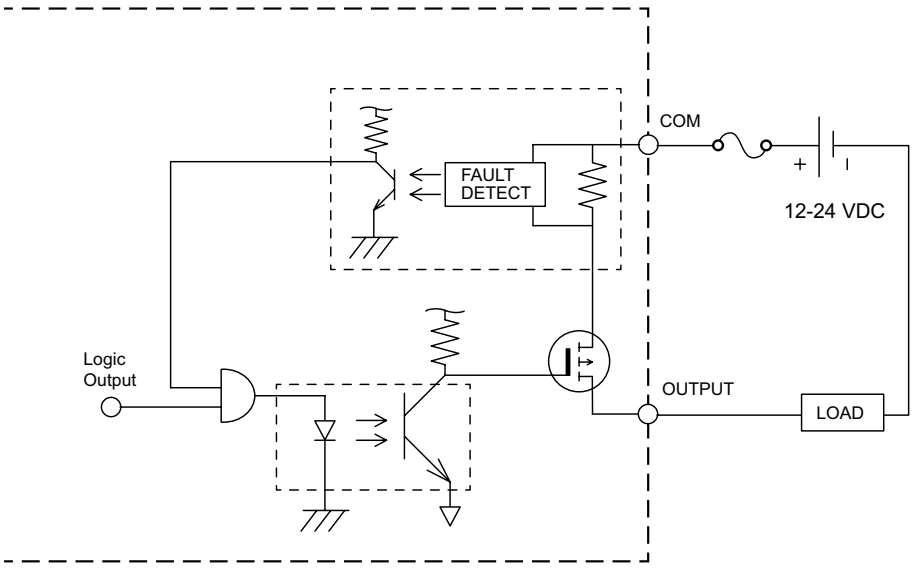
Discrete Output Connection Options



Discrete Standard Output Internal Circuitry



Discrete High-Speed Output Internal Circuitry



NOTE: *When the high speed outputs are in an overcurrent situation, the Common terminal Red LED is on. The output LEDs will remain operational even though the output circuitry is turned off and no power is flowing. This condition is not reported to the CPU.*

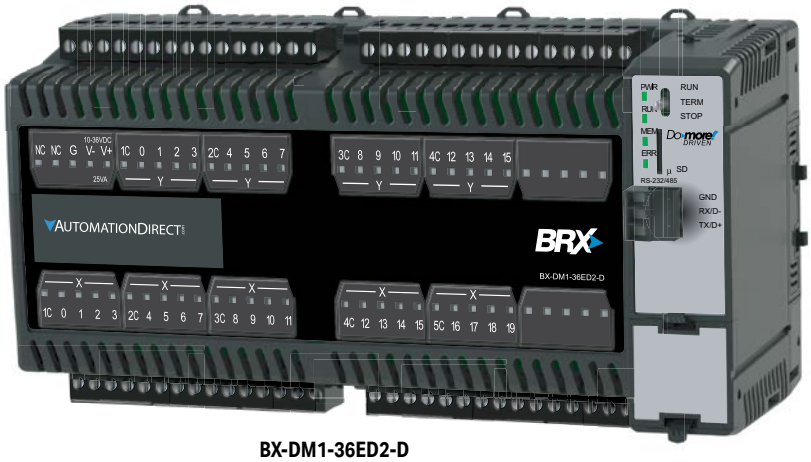
BX-DM1-36ED2-D Wiring

This MPU is made up of 36 discrete I/O points. The connections are grouped as follows:

- 20 discrete inputs - sinking/sourcing; rated for 12–24 VAC/VDC. They are located along the bottom of the unit; configured in five (5) groups of 5 terminals, each comprised of 4 inputs and an isolated common.
- 16 discrete outputs - sourcing; rated at 12–24 VDC. They are located along the top of the unit starting to the right of the 24VDC external power supply terminals. The outputs are configured in four (4) groups of 5 terminals, each comprised of 4 outputs and an isolated common.

This MPU requires an external 12–24 VDC power supply. The DC power supply connection is located on the top left side of the unit. There is no 24VDC auxiliary output supply.

WARNING: No analog I/O is included on this unit. The 5 terminals to the right of the input and output rails are not used. These terminals are not internally connected. DO NOT CONNECT ANYTHING TO THESE TERMINALS!



BX-DM1-36ED2-D

NOTE: *Eight (8) Expansion Modules can be connected to extend I/O capacity, as long as the MPU power budget is not exceeded.*

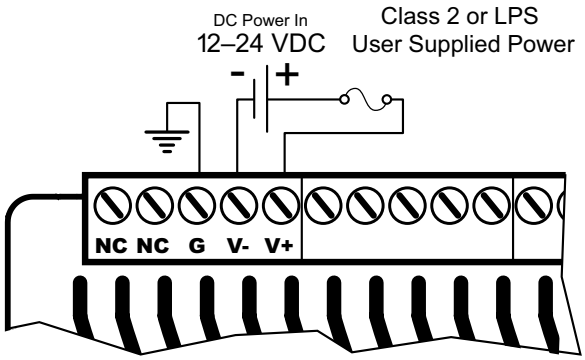
BX-DM1-36ED2-D, Continued

Power Supply Specifications

Power Supply Specifications	
Nominal Voltage Range*	12–24 VDC
Input Voltage Range (Tolerance)*	10–36 VDC
Maximum Input Voltage Ripple	< ±10%
Maximum Input Power	30W
Cold Start Inrush Current	5A, 2ms
Maximum Inrush Current (Hot Start)	5A, 2ms
Internal Input Protection	Reverse polarity protection and undervoltage lockout via transistor circuit
Acceptable External Power Drop Time	10ms
Under Input Voltage Lock-out	<9VDC
Heat Dissipation	19.5 W Max
Isolated User 24VDC Output	None
Voltage Withstand (dielectric)	1500VAC power Inputs to ground applied for 1 minute
Insulation Resistance	>10MΩ @ 500VDC
Software Version Required	Do-more! Designer version 2.0 or later

Class 2 or LPS Power Supply required.

Power Supply Connections



WARNING: No External AC power supply needed on this unit. The two terminals marked "NC" are not used. These terminals are not internally connected. DO NOT CONNECT ANYTHING TO THESE TERMINALS!

WARNING: The BRX System MUST have a proper earth ground. Do not operate the BRX MPU without proper earth grounding.

BX-DM1-36ED2-D Wiring, Continued

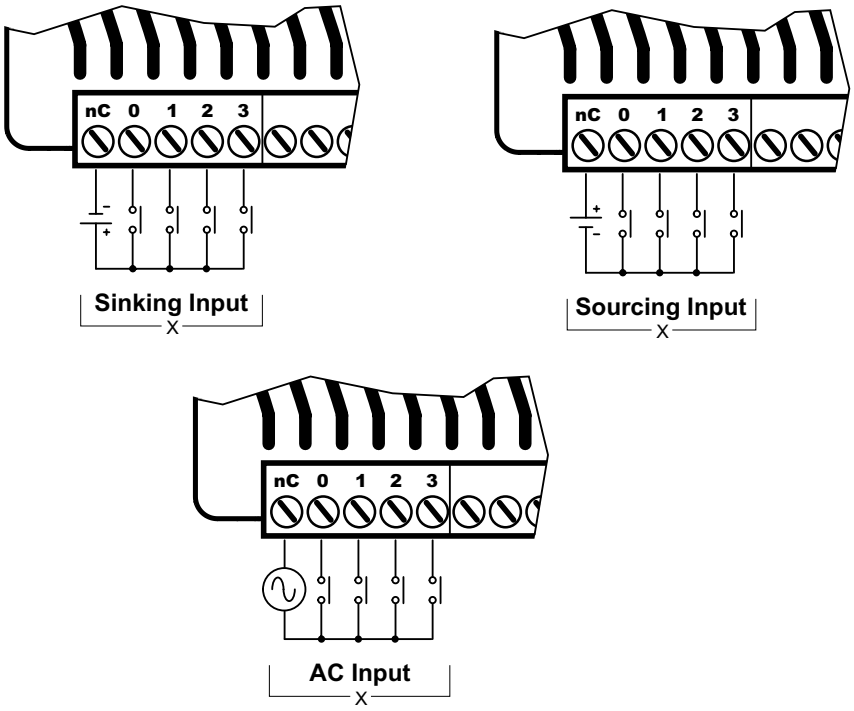
Discrete Input Specifications

Discrete Input Specifications			
Input Type		Sink/Source	
Total Inputs per Module		20	
Commons		5 (4 points/common) Isolated	
Nominal Voltage Range		12–24 VAC/VDC	
Input Voltage Range		9–30 VAC/VDC	
Maximum Voltage		30 VAC/VDC	
DC Frequency		0–250 kHz - High-speed	
Minimum Pulse Width		0.5 µs - High-speed	
AC Frequency		47–63 Hz[2]	
Input Impedance		3kΩ @ 24VDC	
Input Current (typical)		6mA @ 24 VAC/VDC	
Maximum Input Current		12mA @ 30 VAC/VDC	
ON Voltage Level		> 9.0 VAC/VDC	
OFF Voltage Level		< 2.0 VAC/VDC	
Maximum OFF Current		1.5 mA	
Status Indicators		Logic Side, Green	
Input Details			
Input Type		High-Speed DC	Standard[1]
Location		X0...X9	X10...X19
OFF to ON Response	DC	< 2µs	2ms
	AC	–	10ms[2]
ON to OFF Response	DC	< 2µs	2ms
	AC	–	10ms[2]
Maximum Switching Frequency	DC	250kHz	
	AC	~ 30Hz	

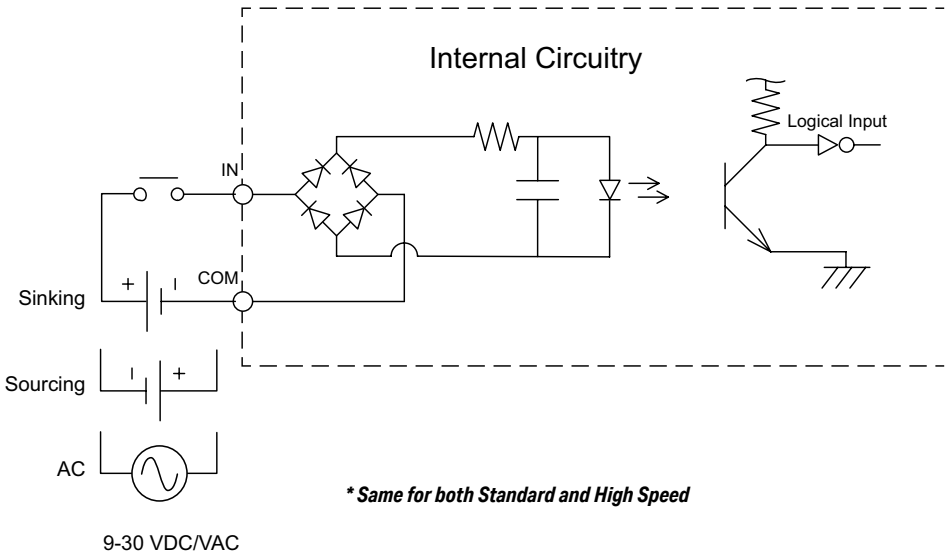
1. *All inputs may be used as standard inputs. Only the first 10 inputs (X0...X9) are capable of high-speed DC operation.*
2. *60Hz to 240Hz filter should be set in the software when using an AC line signal.*

BX-DM1-36ED2-D Wiring, Continued

Discrete Input Connection Options



Discrete Input Internal Circuitry *



** Same for both Standard and High Speed*

BX-DM1-36ED2-D Wiring, Continued

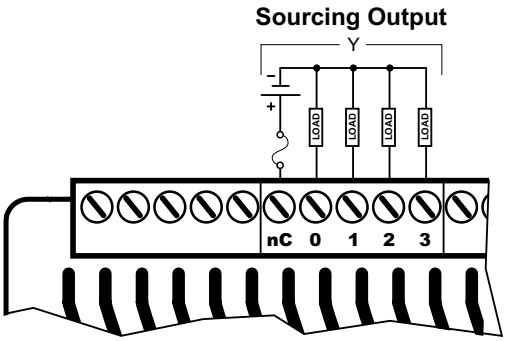
Discrete Output Specifications

Discrete Output Specifications		
Output Type	Sourcing	
Total Outputs per Module	16	
Commons	4 (4 points/common) Isolated	
Maximum Current per Common	2A	
Nominal Voltage Range	12–24 VDC	
Operating Voltage Range	5–36 VDC	
Maximum Voltage	36VDC	
Minimum Output Current	0.1 mA @ 24VDC	
Maximum Output Current	0.5 A per output No derating over temperature range	
Maximum Inrush Current	5A for 50ms	
Maximum Leakage Current	10µA	
ON Voltage Drop	0.05 VDC	
Status Indicators	Logic Side, Green	
Output Details		
Output Type	High-Speed	Standard[1]
Location	Y0...Y7	Y8...Y15
OFF to ON Response	< 2µs	< 5ms
ON to OFF Response	< 2µs	< 2ms
Maximum Switching Frequency	1m cable - 250kHz 10m cable - 100kHz	~100Hz
Overcurrent, Short Circuit Protection and Short to Ground	Current limit by Common Group, self-resetting	N/A
Overcurrent Trip Level[2]	Between 4A and 8A	N/A
Fuse Type	User-supplied external fuse	

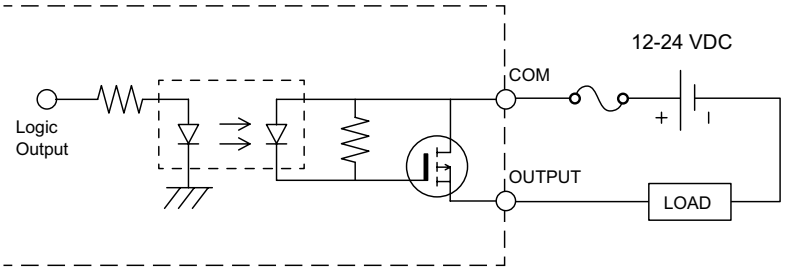
1. ***All outputs may be used as standard outputs. Only the first 8 outputs (Y0...Y7) are capable of high-speed DC operation.***
2. ***When the high-speed outputs are in an overcurrent situation, the Common terminal Red LED is on. The output LEDs will remain operational even though the output circuitry is turned off and no power is flowing. This condition is not reported to the CPU.***

BX-DM1-36ED2-D Wiring, Continued

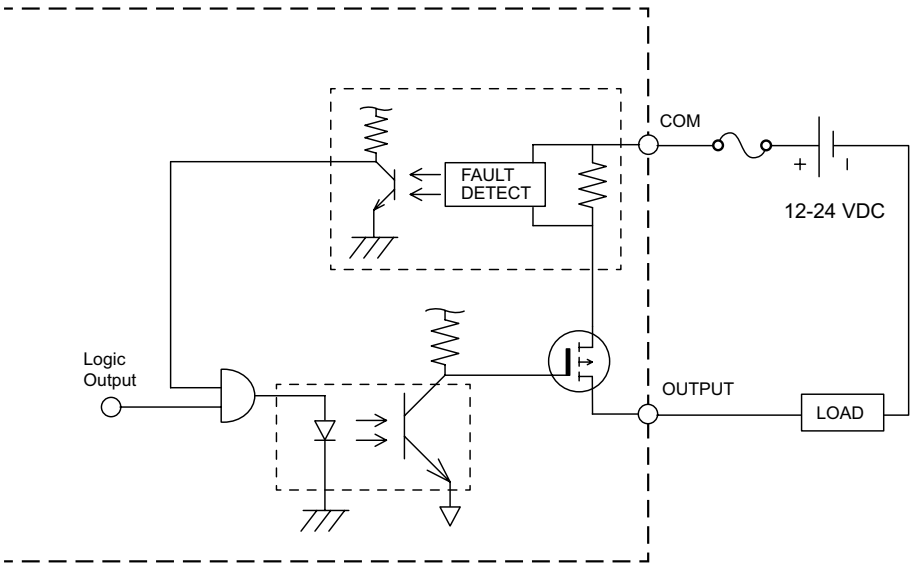
Discrete Output Connection Options



Discrete Standard Output Internal Circuitry



Discrete High-Speed Output Internal Circuitry



NOTE: *When the high speed outputs are in an overcurrent situation, the Common terminal Red LED is on. The output LEDs will remain operational even though the output circuitry is turned off and no power is flowing. This condition is not reported to the CPU.*

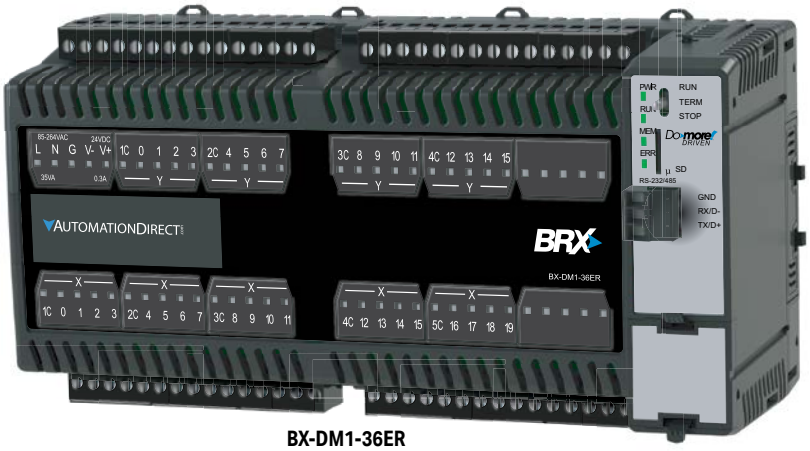
BX-DM1-36ER Wiring

This MPU is made up of 36 discrete I/O points. The connections are grouped as follows:

- 20 discrete inputs - sinking/sourcing; rated for 12–24 VAC/VDC. They are located along the bottom of the unit; configured in five (5) groups of 5 terminals, each comprised of 4 inputs and an isolated common.
- 16 discrete outputs - Form A Relay (SPST); rated 12–48 VDC/ 24–240 VAC. They are located along the top of the unit starting to the right of the 24VDC auxiliary output terminals. The outputs are configured in four (4) groups of 5 terminals, each comprised of 4 outputs and an isolated common.

This MPU requires an external 120–240 VAC power supply. The AC power supply connection and the 24VDC auxiliary output supply terminals are located on the top left side of the unit.

WARNING: No analog I/O is included on this unit. The 5 terminals to the right of the input and output rails are not used. These terminals are not internally connected. DO NOT CONNECT ANYTHING TO THESE TERMINALS!



BX-DM1-36ER

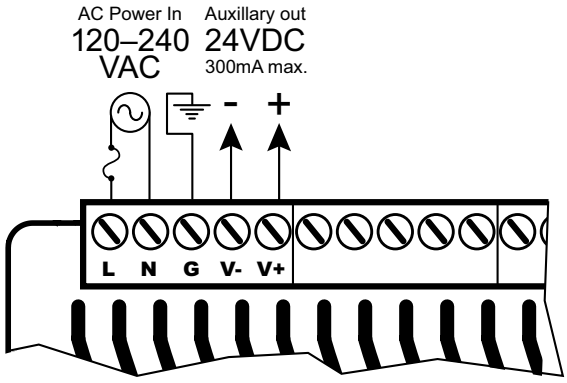
NOTE: *Eight (8) Expansion Modules can be connected to extend I/O capacity, as long as the MPU power budget is not exceeded.*

BX-DM1-36ER Wiring, Continued

Power Supply Specifications

Power Supply Specifications	
Nominal Voltage Range	120–240 VAC
Input Voltage Range (Tolerance)	85–264 VAC
Rated Operating Frequency	47–63 Hz
Maximum Input Power	40VA
Cold Start Inrush Current	1.5 A, 2ms
Maximum Inrush Current (Hot Start)	1.5 A, 2ms
Internal Input Fuse Protection	Micro fuse 250V, 2A Non-replaceable
Acceptable External Power Drop Time	10ms
Under Input Voltage Lock-out	80VAC
Input Transient Protection	Input choke and line filter
Heat Dissipation	24.9 W Max
Isolated User 24VDC Output	24VDC @ 0.3 A max, <1V P-P Ripple, Integrated self-resetting short circuit protection
Voltage Withstand (dielectric)	1500VAC Power Inputs to Ground applied for 1 minute 1500VAC Ground to 24VDC Output applied for 1 minute
Insulation Resistance	>10MΩ @ 500VDC
Software Version Required	Do-more! Designer version 2.0 or later

Power Supply Connections



WARNING: Do not exceed the 24VDC auxiliary power supply load limit of 300mA.

WARNING: The BRX System MUST have a proper earth ground. Do not operate the BRX MPU without proper earth grounding.

BX-DM1-36ER Wiring, Continued

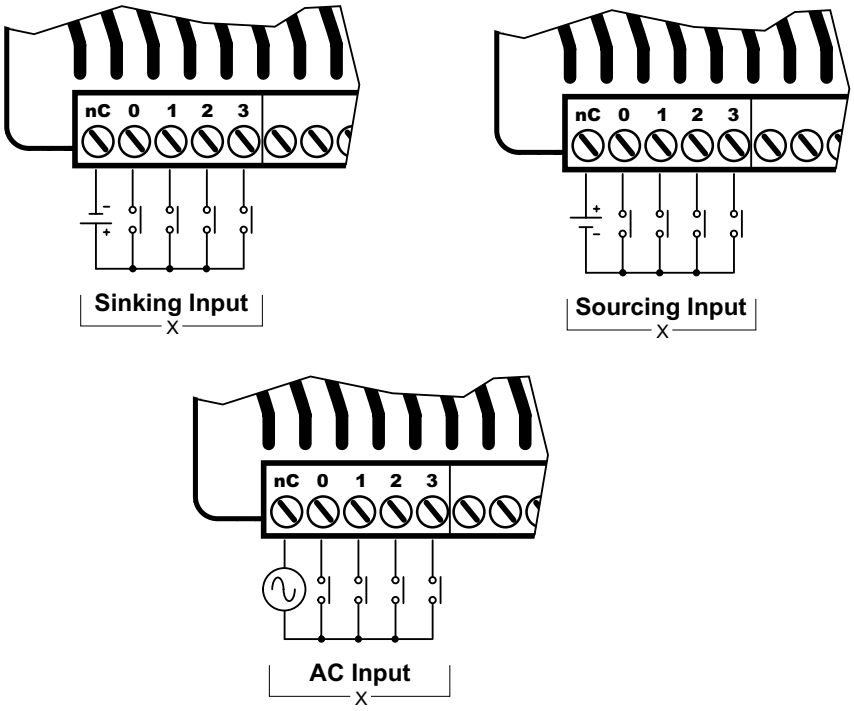
Discrete Input Specifications

Discrete Input Specifications			
Input Type		Sink/Source	
Total Inputs per Module		20	
Commons		5 (4 points/common) Isolated	
Nominal Voltage Range		12–24 VAC/VDC	
Input Voltage Range		9–30 VAC/VDC	
Maximum Voltage		30 VAC/VDC	
DC Frequency		0–250 kHz - High-speed	
Minimum Pulse Width		0.5 µs - High-speed	
AC Frequency		47–63 Hz[2]	
Input Impedance		3kΩ @ 24VDC	
Input Current (typical)		6mA @ 24 VAC/VDC	
Maximum Input Current		12mA @ 30 VAC/VDC	
ON Voltage Level		> 9.0 VAC/VDC	
OFF Voltage Level		< 2.0 VAC/VDC	
Maximum OFF Current		1.5 mA	
Status Indicators		Logic Side, Green	
Input Details			
Input Type		High-Speed DC	Standard[1]
Location		X0...X9	X10...X19
OFF to ON Response	DC	< 2µs	2ms
	AC	–	10ms[2]
ON to OFF Response	DC	< 2µs	2ms
	AC	–	10ms[2]
Maximum Switching Frequency	DC	250kHz	
	AC	~ 30Hz	

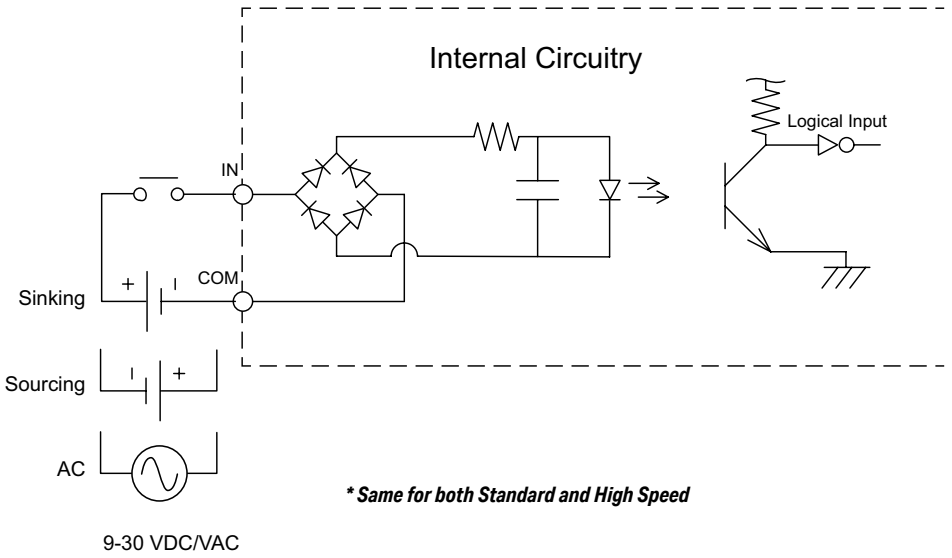
1. *All inputs may be used as standard inputs. Only the first 10 inputs (X0...X9) are capable of high-speed DC operation.*
2. *60Hz to 240Hz filter should be set in the software when using an AC line signal.*

BX-DM1-36ER Wiring, Continued

Discrete Input Connection Options



Discrete Input Internal Circuitry *



** Same for both Standard and High Speed*

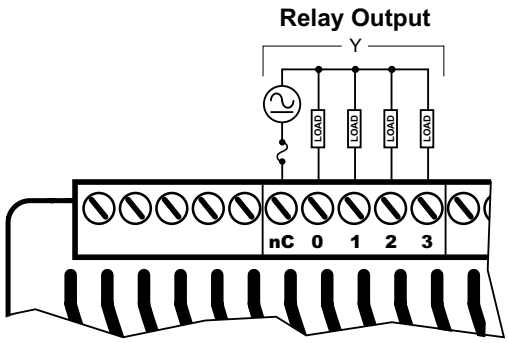
BX-DM1-36ER Wiring, Continued

Discrete Output Specifications

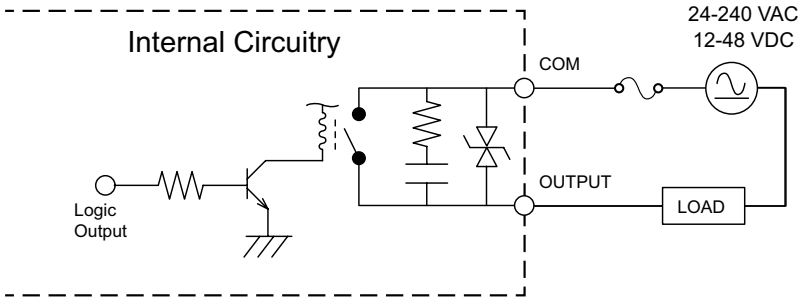
Discrete Output Specifications	
Output Type	Relay Form A (SPST)
Total Outputs per Module	16
Commons	4 (4 points/common) Isolated
Maximum Current per Common	8A
Nominal Voltage Range	12–48 VDC 24–240 VAC
Operating Voltage Range	5–60 VDC 5–264 VAC
Maximum Voltage	60VDC 264VAC
Minimum Output Current	0.1 mA @ 24VDC 0.1 mA @ 24VAC
Maximum Output Current	2A
Maximum Inrush Current	5A for 50ms
Maximum Leakage Current	1µA (DC), 300µA (AC) due to RC snubber circuit
ON Voltage Drop	0.2 V Max
Status Indicators	Logic Side, Green
Output Details	
Output Type	Standard
Location	Y0...Y15
ON-OFF Response	<10ms
OFF-ON Response	<10ms
Maximum Switching Frequency	10Hz
Relay Cycle Life Mechanical Endurance Electrical Endurance	 5 million operations 120,000 operations
Fuse Type	User-supplied external fuse

BX-DM1-36ER Wiring, Continued

Discrete Output Connection Options



Discrete Standard Output Internal Circuitry



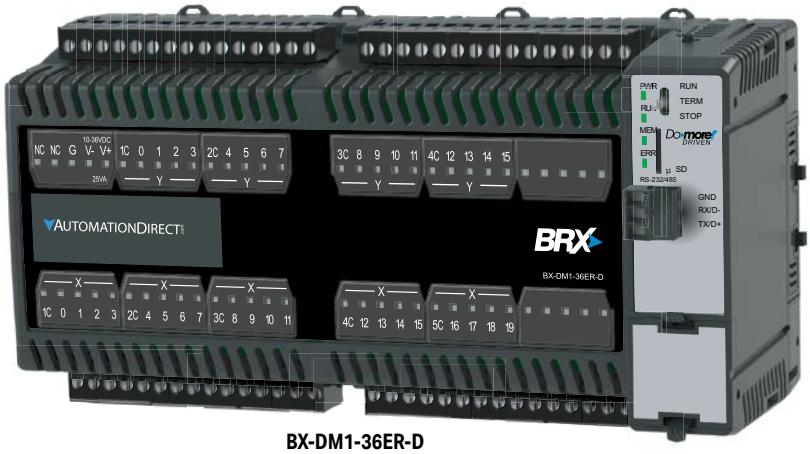
BX-DM1-36ER-D Wiring

This MPU is made up of 36 discrete I/O points. The connections are grouped as follows:

- 20 discrete inputs - sinking/sourcing; rated for 12–24 VAC/VDC. They are located along the bottom of the unit; configured in five (5) groups of 5 terminals, each comprised of 4 inputs and an isolated common.
- 16 discrete outputs - Form A Relay (SPST); rated 12–48 VDC/ 24–240 VAC. They are located along the top of the unit starting to the right of the 24VDC external power supply terminals. The outputs are configured in four (4) groups of 5 terminals, each comprised of 4 outputs and an isolated common.

This MPU requires an external 12–24 VDC power supply. The DC power supply connection is located on the top left side of the unit. There is no 24VDC auxiliary output supply

WARNING: No analog I/O is included on this unit. The 5 terminals to the right of the input and output rails are not used. These terminals are not internally connected. DO NOT CONNECT ANYTHING TO THESE TERMINALS!



BX-DM1-36ER-D

NOTE: *Eight (8) Expansion Modules can be connected to extend I/O capacity, as long as the MPU power budget is not exceeded.*

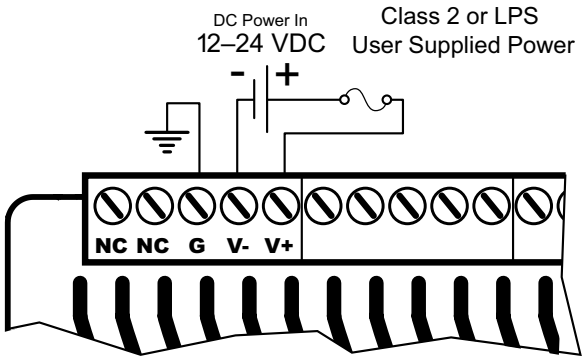
BX-DM1-36ER-D Wiring, Continued

Power Supply Specifications

Power Supply Specifications	
Nominal Voltage Range*	12–24 VDC
Input Voltage Range (Tolerance)*	10–36 VDC
Maximum Input Voltage Ripple	< ±10%
Maximum Input Power	30W
Cold Start Inrush Current	5A, 2ms
Maximum Inrush Current (Hot Start)	5A, 2ms
Internal Input Protection	Reverse polarity protection and undervoltage lockout via transistor circuit
Acceptable External Power Drop Time	10ms
Under Input Voltage Lock-out	<9VDC
Heat Dissipation	22.7 W Max
Isolated User 24VDC Output	None
Voltage Withstand (dielectric)	1500VAC power Inputs to ground applied for 1 minute
Insulation Resistance	>10MΩ @ 500VDC
Software Version Required	Do-more! Designer version 2.0 or later

**** Class 2 or LPS Power Supply required.***

Power Supply Connections



WARNING: No External AC power supply needed on this unit. The two terminals marked "NC" are not used. These terminals are not internally connected. DO NOT CONNECT ANYTHING TO THESE TERMINALS!

WARNING: The BRX System MUST have a proper earth ground. Do not operate the BRX MPU without proper earth grounding.

BX-DM1-36ER-D Wiring, Continued

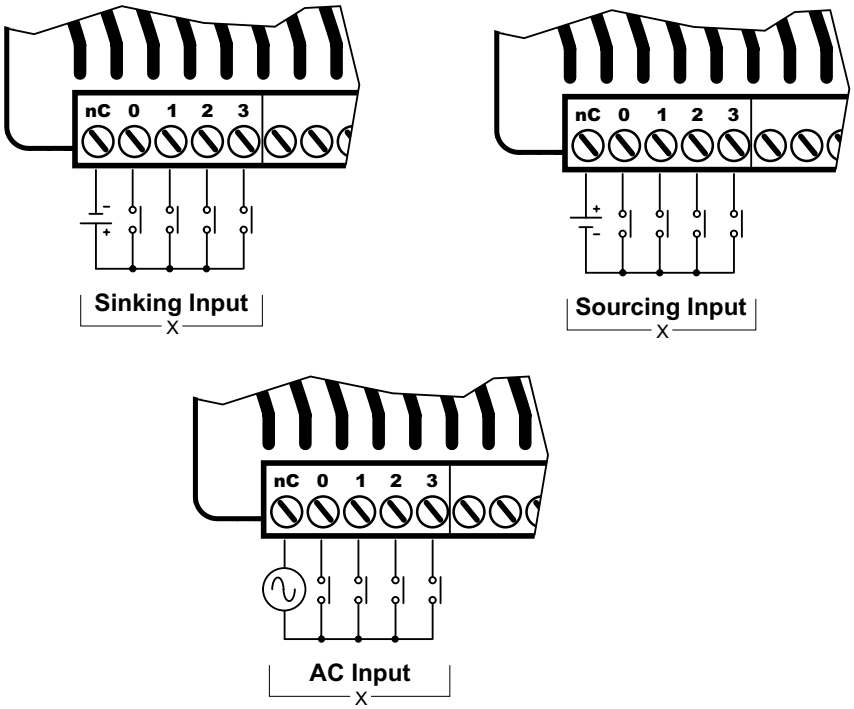
Discrete Input Specifications

Discrete Input Specifications			
Input Type		Sink/Source	
Total Inputs per Module		20	
Commons		5 (4 points/common) Isolated	
Nominal Voltage Range		12–24 VAC/VDC	
Input Voltage Range		9–30 VAC/VDC	
Maximum Voltage		30 VAC/VDC	
DC Frequency		0–250 kHz - High-speed	
Minimum Pulse Width		0.5 µs - High-speed	
AC Frequency		47–63 Hz[2]	
Input Impedance		3kΩ @ 24VDC	
Input Current (typical)		6mA @ 24 VAC/VDC	
Maximum Input Current		12mA @ 30 VAC/VDC	
ON Voltage Level		> 9.0 VAC/VDC	
OFF Voltage Level		< 2.0 VAC/VDC	
Maximum OFF Current		1.5 mA	
Status Indicators		Logic Side, Green	
Input Details			
Input Type		High-Speed DC	Standard[1]
Location		X0...X9	X10...X19
OFF to ON Response	DC	< 2µs	2ms
	AC	–	10ms[2]
ON to OFF Response	DC	< 2µs	2ms
	AC	–	10ms[2]
Maximum Switching Frequency	DC	250kHz	
	AC	~ 30Hz	

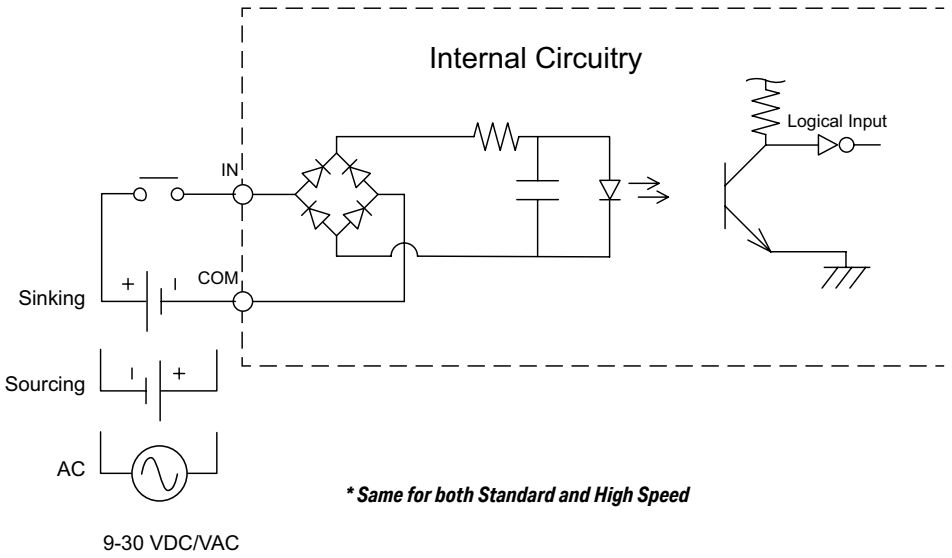
1. *All inputs may be used as standard inputs. Only the first 10 inputs (X0...X9) are capable of high-speed DC operation.*
2. *60Hz to 240Hz filter should be set in the software when using an AC line signal.*

BX-DM1-36ER-D Wiring, Continued

Discrete Input Connection Options



Discrete Input Internal Circuitry *



** Same for both Standard and High Speed*

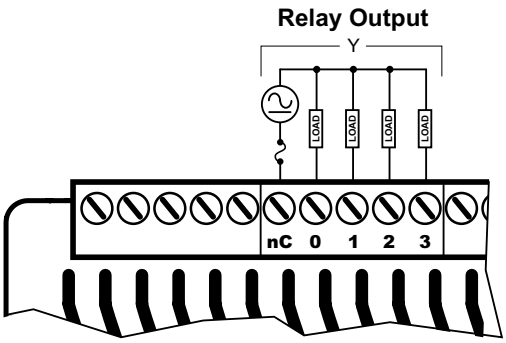
BX-DM1-36ER-D Wiring, Continued

Discrete Output Specifications

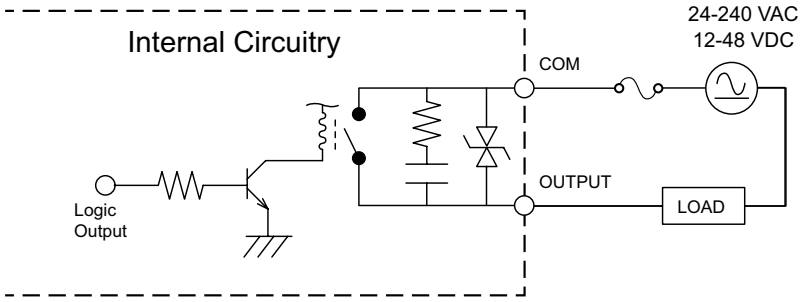
Discrete Output Specifications	
Output Type	Relay Form A (SPST)
Total Outputs per Module	16
Commons	4 (4 points/common) Isolated
Maximum Current per Common	8A
Nominal Voltage Range	12–48 VDC 24–240 VAC
Operating Voltage Range	5–60 VDC 5–264 VAC
Maximum Voltage	60VDC 264VAC
Minimum Output Current	0.1 mA @ 24VDC 0.1 mA @ 24VAC
Maximum Output Current	2A
Maximum Inrush Current	5A for 50ms
Maximum Leakage Current	1µA (DC), 300µA (AC) due to RC snubber circuit
ON Voltage Drop	0.2 V Max
Status Indicators	Logic Side, Green
Output Details	
Output Type	Standard
Location	Y0...Y15
ON-OFF Response	<10ms
OFF-ON Response	<10ms
Maximum Switching Frequency	10Hz
Relay Cycle Life Mechanical Endurance Electrical Endurance	 5 million operations 120,000 operations
Fuse Type	User-supplied external fuse

BX-DM1-36ER-D Wiring, Continued

Discrete Output Connection Options



Discrete Standard Output Internal Circuitry



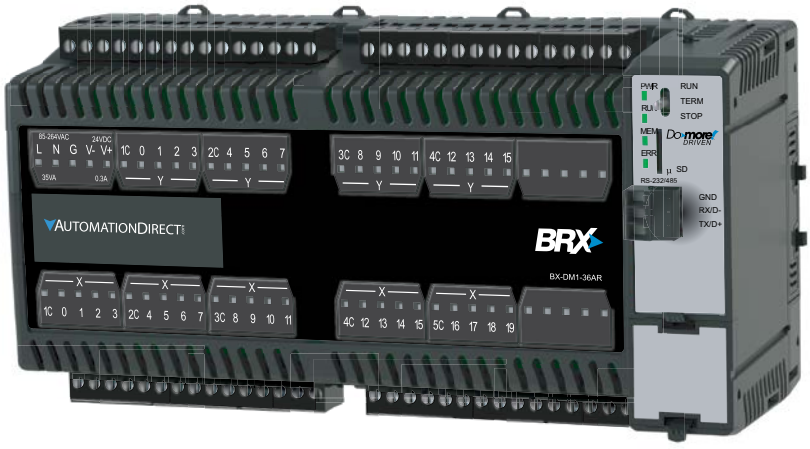
BX-DM1-36AR Wiring

This MPU is made up of 36 discrete I/O points. The connections are grouped as follows:

- 20 discrete inputs - AC rated for 120–240 VAC. They are located along the bottom of the unit; configured in five (5) groups of 5 terminals, each comprised of 4 inputs and an isolated common.
- 16 discrete outputs - Form A Relay (SPST); rated 12–48 VDC/ 24–240 VAC. They are located along the top of the unit starting to the right of the 24VDC auxiliary output terminals. The outputs are configured in four (4) groups of 5 terminals, each comprised of 4 outputs and an isolated common.

This MPU requires an external 120–240 VAC power supply. The AC power supply connection and the 24VDC auxiliary output supply terminals are located on the top left side of the unit.

WARNING: No analog I/O is included on this unit. The 5 terminals to the right of the input and output rails are not used. These terminals are not internally connected. DO NOT CONNECT ANYTHING TO THESE TERMINALS!



BX-DM1-36AR

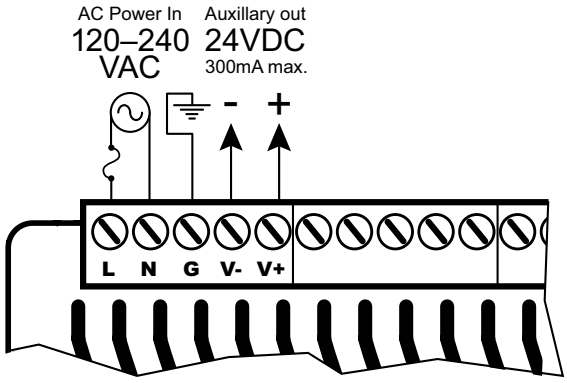
NOTE: *Eight (8) Expansion Modules can be connected to extend I/O capacity, as long as the MPU power budget is not exceeded.*

BX-DM1-36AR Wiring, Continued

Power Supply Specifications

Power Supply Specifications	
Nominal Voltage Range	120–240 VAC
Input Voltage Range (Tolerance)	85–264 VAC
Rated Operating Frequency	47–63 Hz
Maximum Input Power	40VA
Cold Start Inrush Current	1.5 A, 2ms
Maximum Inrush Current (Hot Start)	1.5 A, 2ms
Internal Input Fuse Protection	Micro fuse 250V, 2A Non-replaceable
Acceptable External Power Drop Time	10ms
Under Input Voltage Lock-out	80VAC
Input Transient Protection	Input choke and line filter
Heat Dissipation	24.1 W Max
Isolated User 24VDC Output	24VDC @ 0.3 A max, <1V P-P Ripple, Integrated self-resetting short circuit protection
Voltage Withstand (dielectric)	1500VAC Power Inputs to Ground applied for 1 minute 1500VAC Ground to 24VDC Output applied for 1 minute
Insulation Resistance	>10MΩ @ 500VDC
Software Version Required	Do-more! Designer version 2.0 or later

Power Supply Connections



WARNING: Do not exceed the 24VDC auxiliary power supply load limit of 300mA.

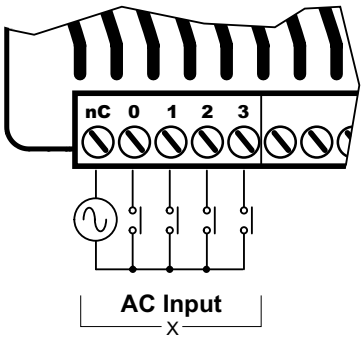
WARNING: The BRX System MUST have a proper earth ground. Do not operate the BRX MPU without proper earth grounding.

BX-DM1-36AR Wiring, Continued

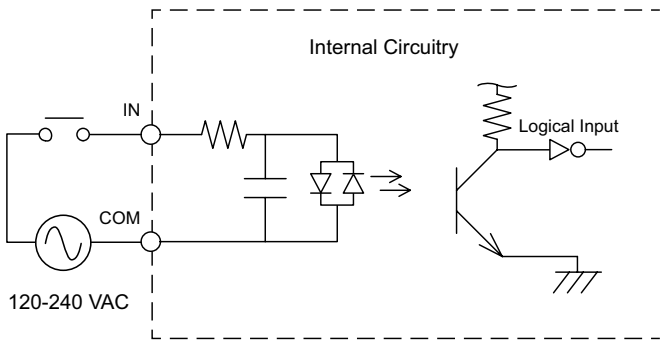
Discrete Input Specifications

Discrete Input Specifications	
Input Type	AC
Total Inputs per Module	20
Commons	5 (4 points/common) Isolated
Nominal Voltage Range	120–240 VAC
Input Voltage Range	85–264 VAC
Maximum Voltage	264VAC RMS
AC Frequency	47–63 Hz
Input Impedance	15kΩ
Input Current (typical)	9mA @ 120VAC, 13mA @ 220VAC
Maximum Input Current	14mA @ 120VAC, 20mA @ 220VAC
ON Voltage Level	> 85VAC
OFF Voltage Level	< 40VAC
Maximum OFF Current	2.5 mA
Status Indicators	Logic Side, Green
Input Details	
Input Type	Standard
Location	X0...X19
OFF - ON Response	10ms
ON - OFF Response	10ms
Maximum Switch Frequency	~ 30Hz

Discrete Input Connection Options



Discrete Input Internal Circuitry



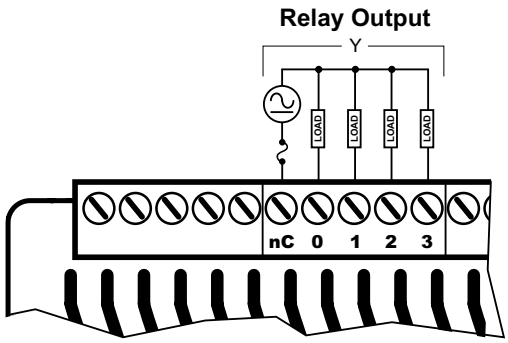
BX-DM1-36AR Wiring, Continued

Discrete Output Specifications

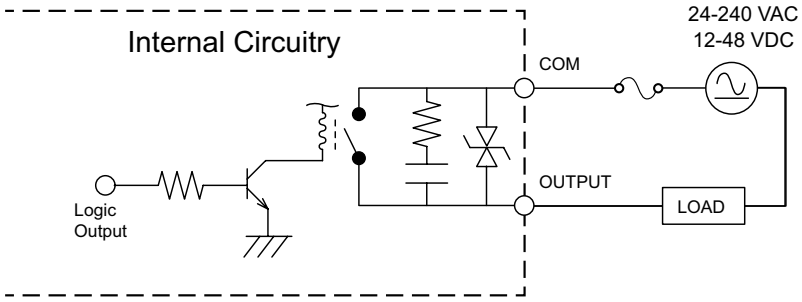
Discrete Output Specifications	
Output Type	Relay Form A (SPST)
Total Outputs per Module	16
Commons	4 (4 points/common) Isolated
Maximum Current per Common	8A
Nominal Voltage Range	12–48 VDC 24–240 VAC
Operating Voltage Range	5–60 VDC 5–264 VAC
Maximum Voltage	60VDC 264VAC
Minimum Output Current	0.1 mA @ 24VDC 0.1 mA @ 24VAC
Maximum Output Current	2A
Maximum Inrush Current	5A for 50ms
Maximum Leakage Current	1µA (DC), 300µA (AC) due to RC snubber circuit
ON Voltage Drop	0.2 V Max
Status Indicators	Logic Side, Green
Output Details	
Output Type	Standard
Location	Y0...Y15
ON-OFF Response	<10ms
OFF-ON Response	<10ms
Maximum Switching Frequency	10Hz
Relay Cycle Life Mechanical Endurance Electrical Endurance	 5 million operations 120,000 operations
Fuse Type	User-supplied external fuse

BX-DM1-36AR Wiring, Continued

Discrete Output Connection Options



Discrete Standard Output Internal Circuitry



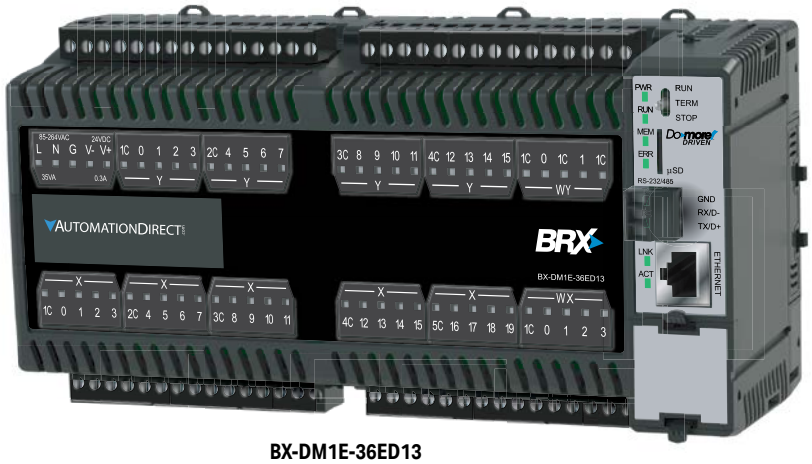
BX 36E Micro PLC Units (MPUs)

BX-DM1E-36ED13 Wiring

This MPU is made up of 36 discrete I/O points. The connections are grouped as follows:

- 20 discrete inputs - sinking/sourcing; rated for 12–24 VAC/VDC. They are located along the bottom of the unit; configured in five (5) groups of 5 terminals, each comprised of 4 inputs and an isolated common.
- 16 discrete outputs - sinking; rated at 12–24 VDC. They are located along the top of the unit starting to the right of the 24VDC auxiliary output terminals. The outputs are configured in four (4) groups of 5 terminals, each comprised of 4 outputs and an isolated common.
- 4 analog inputs and 2 analog outputs. The analog inputs are located along the bottom of the unit to the right of the discrete inputs. The analog inputs are grouped together on 5 terminals consisting of 4 input and a shared analog input common. The analog outputs are located along the top of the unit to the right of the discrete outputs. The analog outputs are grouped together on 5 terminals consisting of 2 outputs and 3 shared analog output common terminals. The analogs share these common features:
  - current or voltage selectable through software
  - 16-bit resolution @ ±20mA, ±10VDC
  - current signal ranges of 4–20 mA, ±20mA
  - voltage signal ranges of 0–5 VDC, 0–10 VDC, ±5VDC, ±10VDC.

This MPU requires an external 120–240 VAC power supply. The AC power supply connection and the 24VDC auxiliary output supply terminals are located on the top left side of the unit.



BX-DM1E-36ED13

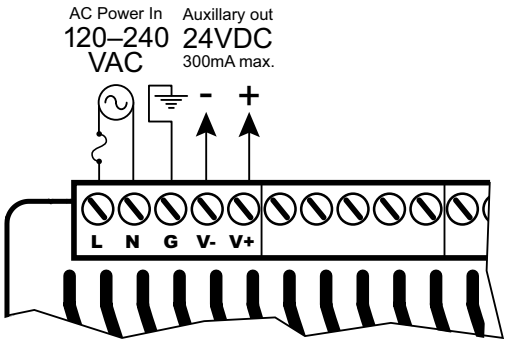
NOTE: *Eight (8) Expansion Modules can be connected to extend I/O capacity.*

BX-DM1E-36ED13 Wiring, Continued

Power Supply Specifications

Power Supply Specifications	
Nominal Voltage Range	120–240 VAC
Input Voltage Range (Tolerance)	85–264 VAC
Rated Operating Frequency	47–63 Hz
Maximum Input Power	40VA
Cold Start Inrush Current	1.5 A, 2ms
Maximum Inrush Current (Hot Start)	1.5 A, 2ms
Internal Input Fuse Protection	Micro fuse 250V, 2A Non-replaceable
Acceptable External Power Drop Time	10ms
Under Input Voltage Lock-out	80VAC
Input Transient Protection	Input choke and line filter
Heat Dissipation	24.4 W Max
Isolated User 24VDC Output	24VDC @ 0.3 A max, <1V P-P Ripple, Integrated self-resetting short circuit protection
Voltage Withstand (dielectric)	1500VAC Power Inputs to Ground applied for 1 minute 1500VAC Ground to 24VDC Output applied for 1 minute
Insulation Resistance	>10MΩ @ 500VDC
Software Version Required	Do-more! Designer version 2.0 or later

Power Supply Connections



WARNING: Do not exceed the 24VDC auxiliary power supply load limit of 300mA.

WARNING: The BRX System MUST have a proper earth ground. Do not operate the BRX MPU without proper earth grounding.

BX-DM1E-36ED13 Wiring, Continued

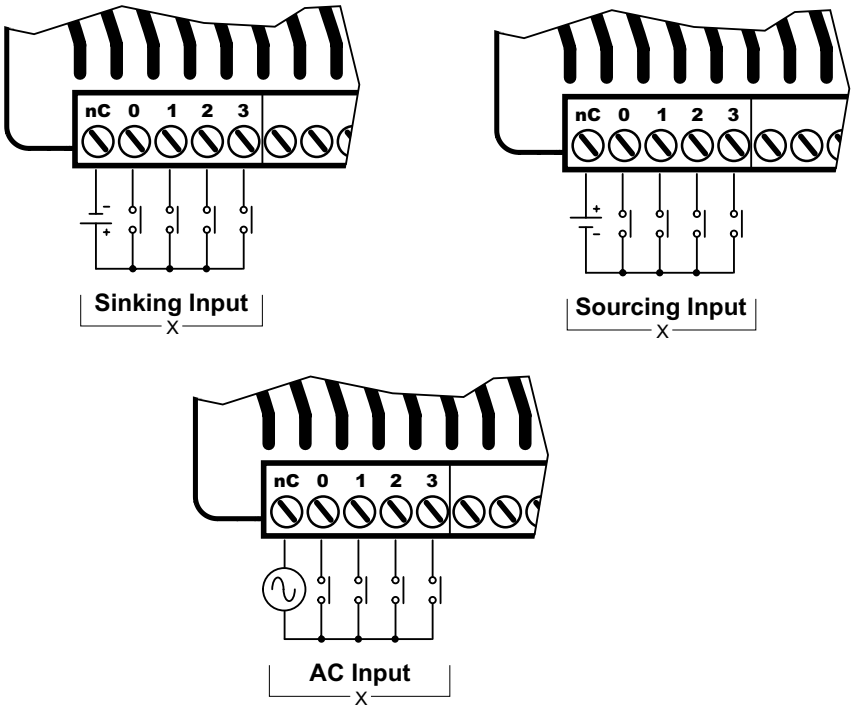
Discrete Input Specifications

Discrete Input Specifications			
Input Type		Sink/Source	
Total Inputs per Module		20	
Commons		5 (4 points/common) Isolated	
Nominal Voltage Range		12–24 VAC/VDC	
Input Voltage Range		9–30 VAC/VDC	
Maximum Voltage		30 VAC/VDC	
DC Frequency		0–250 kHz - High-speed	
Minimum Pulse Width		0.5 µs - High-speed	
AC Frequency		47–63 Hz[2]	
Input Impedance		3kΩ @ 24VDC	
Input Current (typical)		6mA @ 24 VAC/VDC	
Maximum Input Current		12mA @ 30 VAC/VDC	
ON Voltage Level		> 9.0 VAC/VDC	
OFF Voltage Level		< 2.0 VAC/VDC	
Maximum OFF Current		1.5 mA	
Status Indicators		Logic Side, Green	
Input Details			
Input Type		High-Speed DC	Standard[1]
Location		X0...X9	X10...X19
OFF to ON Response	DC	< 2µs	2ms
	AC	–	10ms[2]
ON to OFF Response	DC	< 2µs	2ms
	AC	–	10ms[2]
Maximum Switching Frequency	DC	250kHz	
	AC	~ 30Hz	

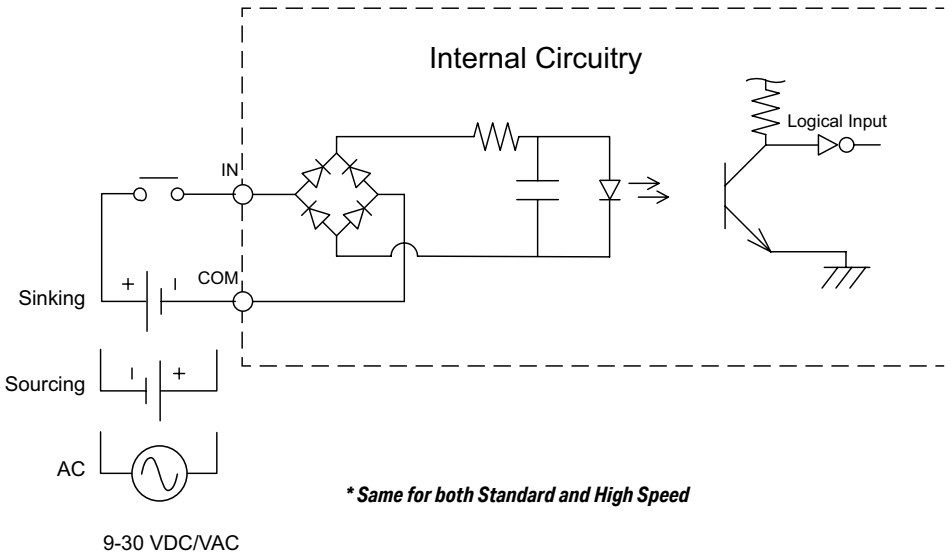
1. *All inputs may be used as standard inputs. Only the first 10 inputs (X0...X9) are capable of high-speed DC operation.*
2. *60Hz to 240Hz filter should be set in the software when using an AC line signal.*

BX-DM1E-36ED13 Wiring, Continued

Discrete Input Connection Options



Discrete Input Internal Circuitry *



** Same for both Standard and High Speed*

BX-DM1E-36ED13 Wiring, Continued

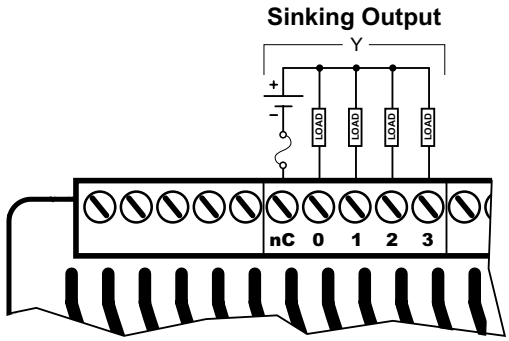
Discrete Output Specifications

Discrete Output Specifications		
Output Type	Sinking	
Total Outputs per Module	16	
Commons	4 (4 points/common) Isolated	
Maximum Current per Common	2A	
Nominal Voltage Range	12–24 VDC	
Operating Voltage Range	5–36 VDC	
Maximum Voltage	36VDC	
Minimum Output Current	0.1 mA @ 24VDC	
Maximum Output Current	0.5 A per output No derating over temperature range	
Maximum Inrush Current	5A for 50ms	
Maximum Leakage Current	10µA	
ON Voltage Drop	0.05 VDC	
Status Indicators	Logic Side, Green	
Output Details		
Output Type	High-Speed	Standard[1]
Location	Y0...Y7	Y8...Y15
OFF to ON Response	< 2µs	< 5ms
ON to OFF Response	< 2µs	< 2ms
Maximum Switching Frequency	1m cable - 250kHz 10m cable - 100kHz	~100Hz
Overcurrent, Short Circuit Protection and Short to Ground	Current limit by Common Group, self-resetting	N/A
Overcurrent Trip Level[2]	Between 4A and 8A	N/A
Fuse Type	User-supplied external fuse	

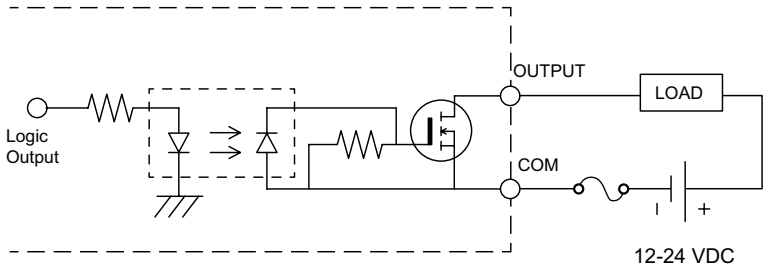
1. ***All outputs may be used as standard outputs. Only the first 8 outputs (Y0...Y7) are capable of high-speed DC operation.***
2. ***When the high-speed outputs are in an overcurrent situation, the Common terminal Red LED is on. The output LEDs will remain operational even though the output circuitry is turned off and no power is flowing. This condition is not reported to the CPU.***

BX-DM1E-36ED13 Wiring, continued

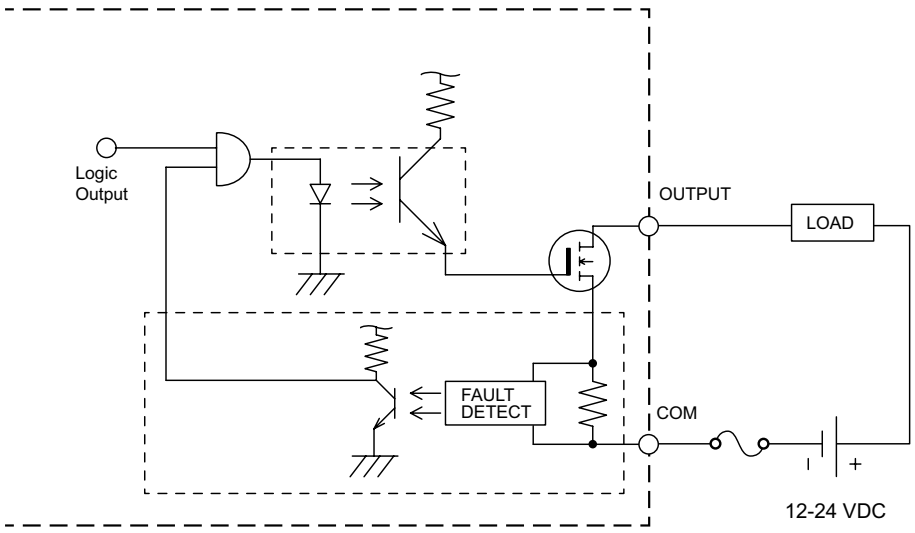
Discrete Output Connection Options



Discrete Standard Output Internal Circuitry



Discrete High-Speed Output Internal Circuitry



NOTE: *When the high speed outputs are in an overcurrent situation, the Common terminal Red LED is on. The output LEDs will remain operational even though the output circuitry is turned off and no power is flowing. This condition is not reported to the CPU.*

BX-DM1E-36ED13 Wiring, Continued

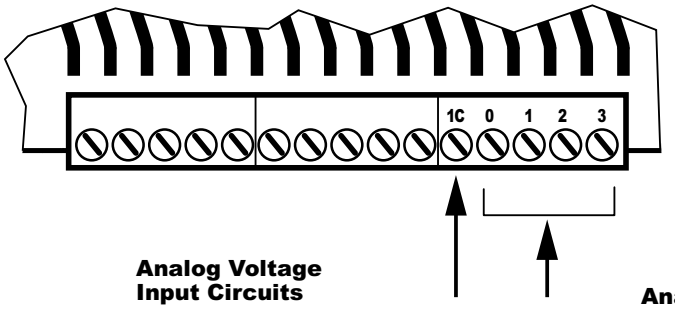
Analog Input Specifications

Analog Input Specifications	
Inputs per Module	4
Commons	1
Input Voltage Range *	Software Selectable ±10V, ±5V, 0–10 V, 0–5 V
Input Current Range *	Software Selectable ±20mA, 4–20 mA
Resolution ±10V, ±20mA ±5V 0–5 V 4–20 mA 0–10 V	 16 bits (0–65535 counts) 15 bits (0–32767 counts) 14 bits (0–16383 counts) ~15 bits (6553–32767 counts) 15 bits (0–32767 counts)
Input Impedance Voltage Modes	100kΩ
Absolute Maximum Input, Voltage Mode	±30V
Input Impedance Current Modes	249Ω
Absolute Maximum Input, Current Mode	±40mA sustained, ±100mA for < 5s
Conversion Time	1.2 ms
Input Stability	0.02% of Full Hardware Range = 13 Counts
Full Scale Calibration Error	0.05% of Full Hardware Range = 33 Counts
Offset Calibration Error	0.01% of Full Hardware Range = 7 Counts
Accuracy vs Temperature Error	0.05% of Full Hardware Range = 33 Counts
Maximum Linearity Error (End to End)	0.1% of Full Hardware Range = 66 Counts
Maximum Inaccuracy	0.2% of Full Hardware Range = 131 Counts
Fuse Type	User-supplied external fuse

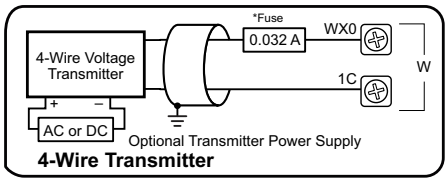
**** Software selectable per channel***

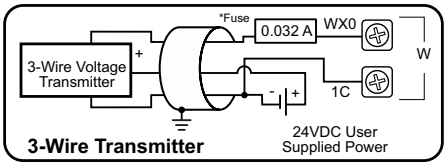
BX-DM1E-36ED13 Wiring, Continued

Analog Input Connection Options



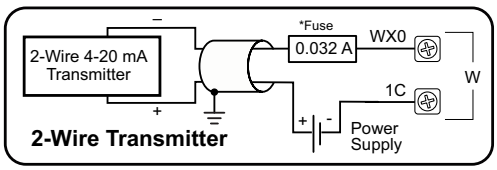
Analog Voltage Input Circuits

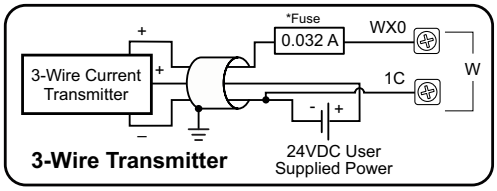


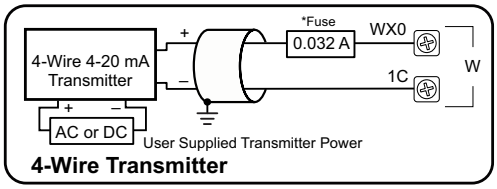


NOTE: Shield should be connected only at one end, to ground at the source device.

Analog Current Sinking Input Circuits







NOTE: Shield should be connected only at one end, to ground at the source device.

NOTE: *An Edison S500-32-R 0.032A fast-acting fuse is recommended for all analog voltage inputs, analog outputs, and current loops.*

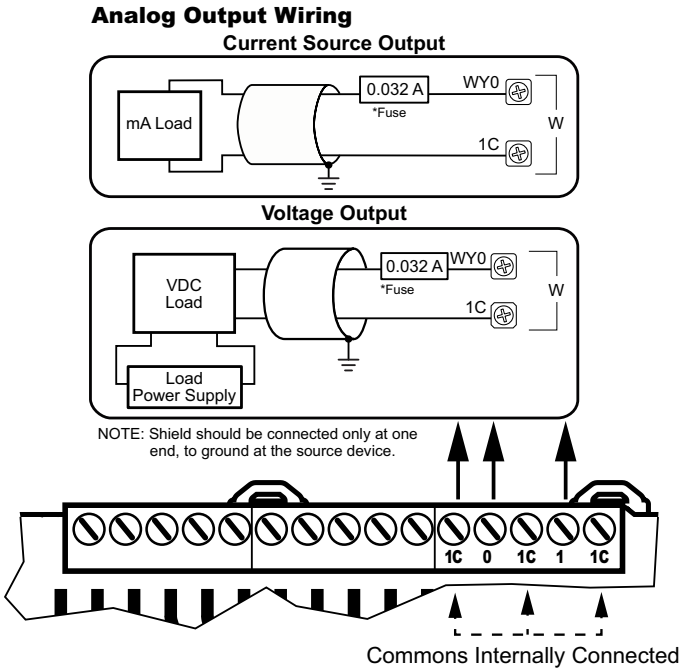
BX-DM1E-36ED13 Wiring, Continued

Analog Output Specifications

Analog Output Specifications	
Outputs per Module	2
Commons	3
Output Voltage Range *	Software Selectable ±10V, ±5V, 0–10 V, 0–5 V
Output Current Range *	Software Selectable ±20mA, 4–20 mA
Resolution ±10V, ±20mA ±5V 0–5 V 4–20 mA 0–10 V	 16 bits (0–65535 counts) 15 bits (0–32767 counts) 14 bits (0–16383 counts) ~15 bits (6553–32767 counts) 15 bits (0–32767 counts)
Minimum Voltage Load Impedance	1kΩ
Maximum Current Load Impedance	500Ω
Maximum Rating	Continuous Short Circuit Protected
Settling Time	< 1ms
Output Stability	0.02% of Full Hardware Range = 13 Counts
Full Scale Calibration Error	0.05% of Full Hardware Range = 33 Counts
Offset Calibration Error	0.01% of Full Hardware Range = 7 Counts
Accuracy vs Temperature Error	0.05% of Full Hardware Range = 33 Counts
Maximum Linearity Error (End to End)	0.1% of Full Hardware Range = 66 Counts
Maximum Inaccuracy	0.2% of Full Hardware Range = 131 Counts
Fuse Type	User-supplied external fuse

**** Software selectable per channel***

Analog Output Connection Options



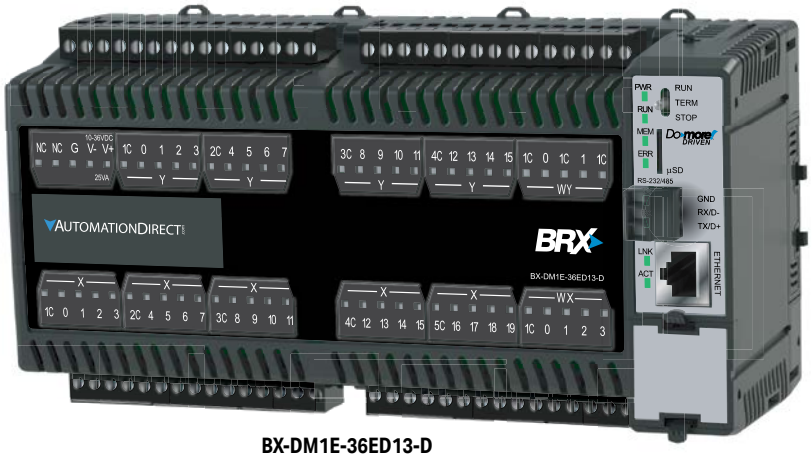
NOTE: *An Edison S500-32-R 0.032A fast-acting fuse is recommended for all analog voltage inputs, analog outputs, and current loops.*

BX-DM1E-36ED13-D Wiring

This MPU is made up of 36 discrete I/O points. The connections are grouped as follows:

- 20 discrete inputs - sinking/sourcing; rated for 12–24 VAC/VDC. They are located along the bottom of the unit; configured in five (5) groups of 5 terminals, each comprised of 4 inputs and an isolated common.
- 16 discrete outputs - sinking; rated at 12–24 VDC. They are located along the top of the unit starting to the right of the 24VDC external power supply terminals. The outputs are configured in four (4) groups of five (5) terminals, each comprised of four (4) outputs and an isolated common.
- 4 analog inputs and 2 analog outputs. The analog inputs are located along the bottom of the unit to the right of the discrete inputs. The analog inputs are grouped together on 5 terminals consisting of 4 input and a shared analog input common. The analog outputs are located along the top of the unit to the right of the discrete outputs. The analog outputs are grouped together on 5 terminals consisting of 2 outputs and 3 shared analog output common terminals. The analogs share these common features:
  - current or voltage selectable through software,
  - 16-bit resolution @ ±20 mA, ±10 VDC
  - current signal ranges of 4–20 mA, ±20 mA,
  - voltage signal ranges of 0–5 VDC, 0–10 VDC, ±5 VDC, ±10 VDC.

This MPU requires an external 12–24 VDC power supply. The DC power supply connection is located on the top left side of the unit. There is no 24VDC auxiliary output supply.



BX-DM1E-36ED13-D

NOTE: *Eight (8) Expansion Modules can be connected to extend I/O capacity.*

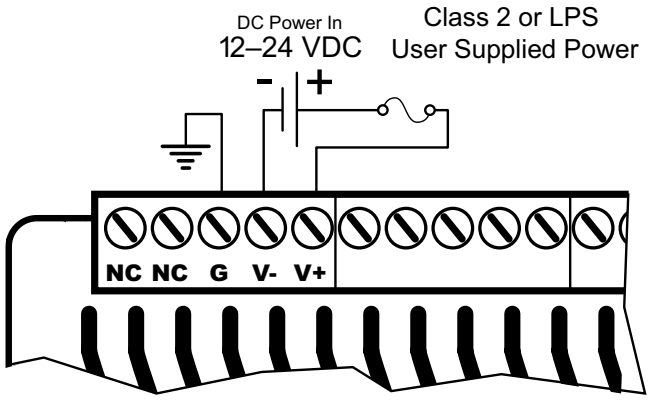
BX-DM1E-36ED13-D Wiring, Continued

Power Supply Specifications

Power Supply Specifications	
Nominal Voltage Range*	12–24 VDC
Input Voltage Range (Tolerance)*	10–36 VDC
Maximum Input Voltage Ripple	< ±10%
Maximum Input Power	30W
Cold Start Inrush Current	5A, 2ms
Maximum Inrush Current (Hot Start)	5A, 2ms
Internal Input Protection	Reverse polarity protection and undervoltage lockout via transistor circuit
Acceptable External Power Drop Time	10ms
Under Input Voltage Lock-out	<9VDC
Heat Dissipation	22.1 W Max
Isolated User 24VDC Output	None
Voltage Withstand (dielectric)	1500VAC power Inputs to ground applied for 1 minute
Insulation Resistance	>10MΩ @ 500VDC
Software Version Required	Do-more! Designer version 2.0 or later

**** Class 2 or LPS Power Supply required.***

Power Supply Connections



WARNING: No External AC power supply needed on this unit. The two terminals marked "NC" are not used. These terminals are not internally connected. DO NOT CONNECT ANYTHING TO THESE TERMINALS!

WARNING: The BRX System MUST have a proper earth ground. Do not operate the BRX MPU without proper earth grounding.

BX-DM1E-36ED13-D Wiring, Continued

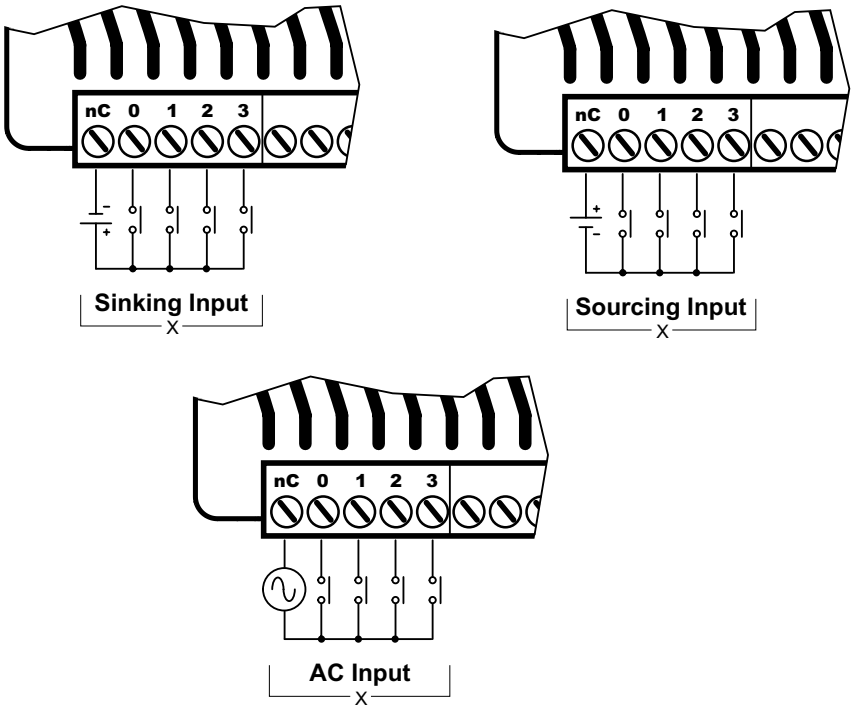
Discrete Input Specifications

Discrete Input Specifications			
Input Type		Sink/Source	
Total Inputs per Module		20	
Commons		5 (4 points/common) Isolated	
Nominal Voltage Range		12–24 VAC/VDC	
Input Voltage Range		9–30 VAC/VDC	
Maximum Voltage		30 VAC/VDC	
DC Frequency		0–250 kHz - High-speed	
Minimum Pulse Width		0.5 µs - High-speed	
AC Frequency		47–63 Hz[2]	
Input Impedance		3kΩ @ 24VDC	
Input Current (typical)		6mA @ 24 VAC/VDC	
Maximum Input Current		12mA @ 30 VAC/VDC	
ON Voltage Level		> 9.0 VAC/VDC	
OFF Voltage Level		< 2.0 VAC/VDC	
Maximum OFF Current		1.5 mA	
Status Indicators		Logic Side, Green	
Input Details			
Input Type		High-Speed DC	Standard[1]
Location		X0...X9	X10...X19
OFF to ON Response	DC	< 2µs	2ms
	AC	–	10ms[2]
ON to OFF Response	DC	< 2µs	2ms
	AC	–	10ms[2]
Maximum Switching Frequency	DC	250kHz	
	AC	~ 30Hz	

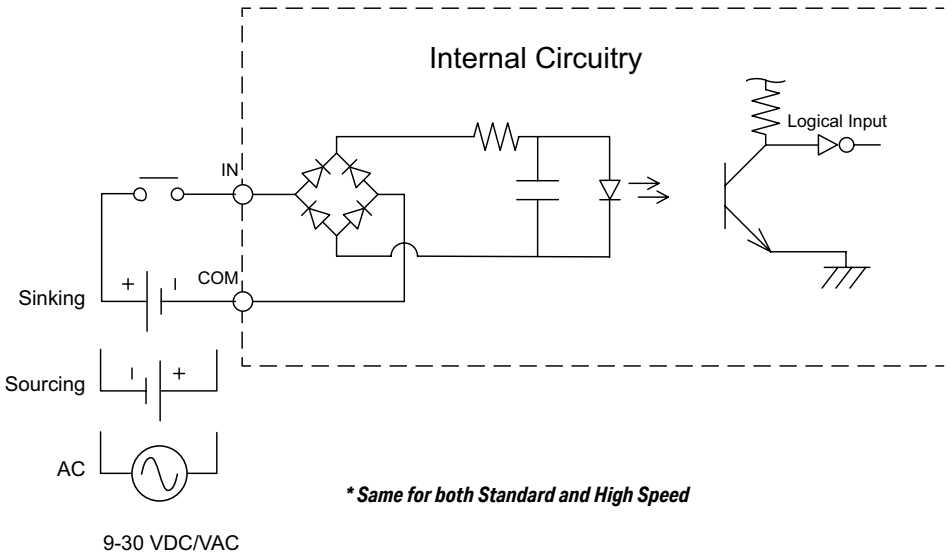
1. *All inputs may be used as standard inputs. Only the first 10 inputs (X0...X9) are capable of high-speed DC operation.*
2. *60Hz to 240Hz filter should be set in the software when using an AC line signal.*

BX-DM1E-36ED13-D Wiring, Continued

Discrete Input Connection Options



Discrete Input Internal Circuitry *



** Same for both Standard and High Speed*

BX-DM1E-36ED13-D Wiring, Continued

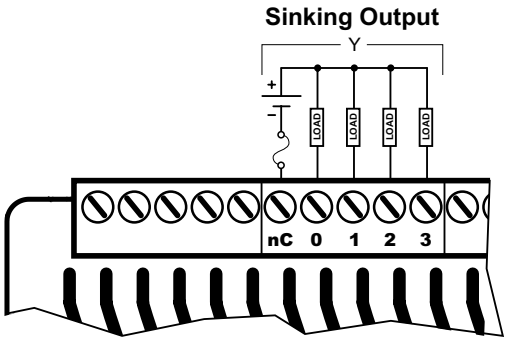
Discrete Output Specifications

Discrete Output Specifications		
Output Type	Sinking	
Total Outputs per Module	16	
Commons	4 (4 points/common) Isolated	
Maximum Current per Common	2A	
Nominal Voltage Range	12–24 VDC	
Operating Voltage Range	5–36 VDC	
Maximum Voltage	36VDC	
Minimum Output Current	0.1 mA @ 24VDC	
Maximum Output Current	0.5 A per output No derating over temperature range	
Maximum Inrush Current	5A for 50ms	
Maximum Leakage Current	10µA	
ON Voltage Drop	0.05 VDC	
Status Indicators	Logic Side, Green	
Output Details		
Output Type	High-Speed	Standard[1]
Location	Y0...Y7	Y8...Y15
OFF to ON Response	< 2µs	< 5ms
ON to OFF Response	< 2µs	< 2ms
Maximum Switching Frequency	1m cable - 250kHz 10m cable - 100kHz	~100Hz
Overcurrent, Short Circuit Protection and Short to Ground	Current limit by Common Group, self-resetting	N/A
Overcurrent Trip Level[2]	Between 4A and 8A	N/A
Fuse Type	User-supplied external fuse	

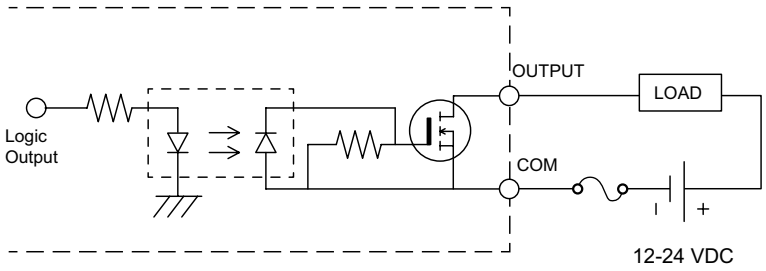
1. ***All outputs may be used as standard outputs. Only the first 8 outputs (Y0...Y7) are capable of high-speed DC operation.***
2. ***When the high-speed outputs are in an overcurrent situation, the Common terminal Red LED is on. The output LEDs will remain operational even though the output circuitry is turned off and no power is flowing. This condition is not reported to the CPU.***

BX-DM1E-36ED13-D Wiring, Continued

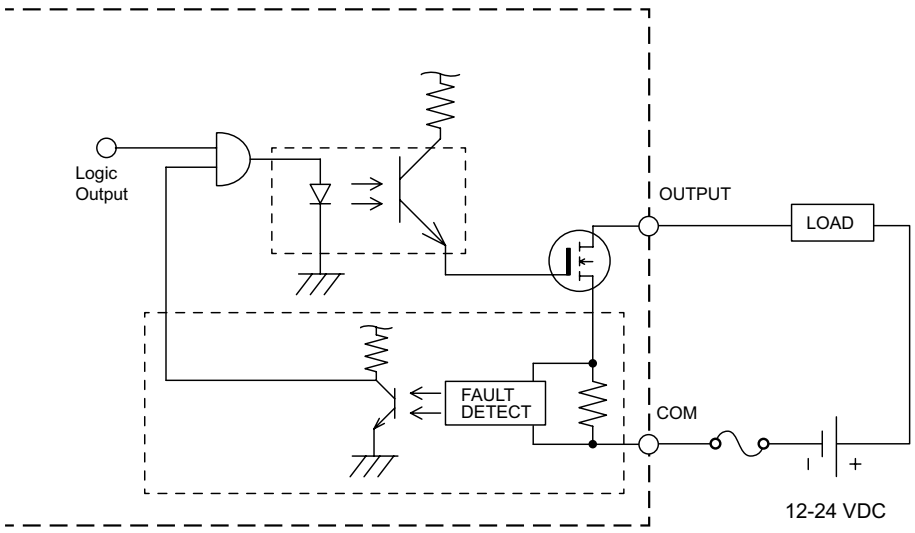
Discrete Output Connection Options



Discrete Standard Output Internal Circuitry



Discrete High-Speed Output Internal Circuitry



NOTE: *When the high speed outputs are in an overcurrent situation, the Common terminal Red LED is on. The output LEDs will remain operational even though the output circuitry is turned off and no power is flowing. This condition is not reported to the CPU.*

BX-DM1E-36ED13-D Wiring, Continued

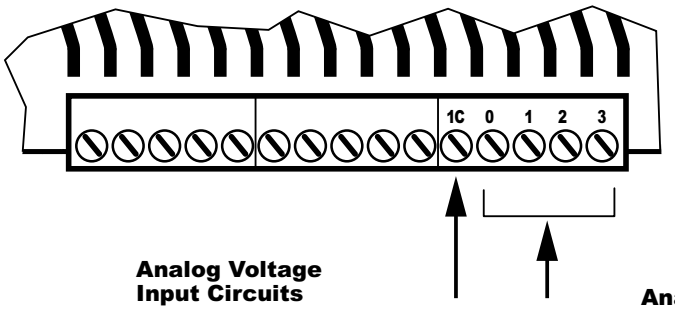
Analog Input Specifications

Analog Input Specifications	
Inputs per Module	4
Commons	1
Input Voltage Range *	Software Selectable ±10V, ±5V, 0–10 V, 0–5 V
Input Current Range *	Software Selectable ±20mA, 4–20 mA
Resolution ±10V, ±20mA ±5V 0–5 V 4–20 mA 0–10 V	 16 bits (0–65535 counts) 15 bits (0–32767 counts) 14 bits (0–16383 counts) ~15 bits (6553–32767 counts) 15 bits (0–32767 counts)
Input Impedance Voltage Modes	100kΩ
Absolute Maximum Input, Voltage Mode	±30V
Input Impedance Current Modes	249Ω
Absolute Maximum Input, Current Mode	±40mA sustained, ±100mA for < 5s
Conversion Time	1.2 ms
Input Stability	0.02% of Full Hardware Range = 13 Counts
Full Scale Calibration Error	0.05% of Full Hardware Range = 33 Counts
Offset Calibration Error	0.01% of Full Hardware Range = 7 Counts
Accuracy vs Temperature Error	0.05% of Full Hardware Range = 33 Counts
Maximum Linearity Error (End to End)	0.1% of Full Hardware Range = 66 Counts
Maximum Inaccuracy	0.2% of Full Hardware Range = 131 Counts
Fuse Type	User-supplied external fuse

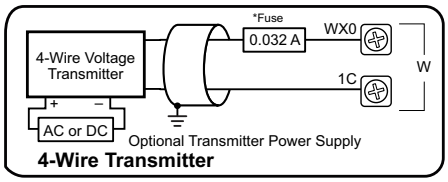
**** Software selectable per channel***

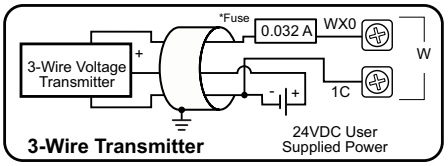
BX-DM1E-36ED13-D Wiring, Continued

Analog Input Connection Options



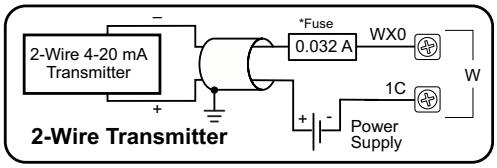
Analog Voltage Input Circuits

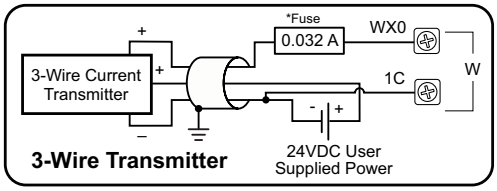


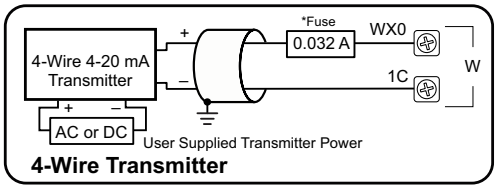


NOTE: Shield should be connected only at one end, to ground at the source device.

Analog Current Sinking Input Circuits







NOTE: Shield should be connected only at one end, to ground at the source device.



NOTE: *An Edison S500-32-R 0.032A fast-acting fuse is recommended for all analog voltage inputs, analog outputs, and current loops.*

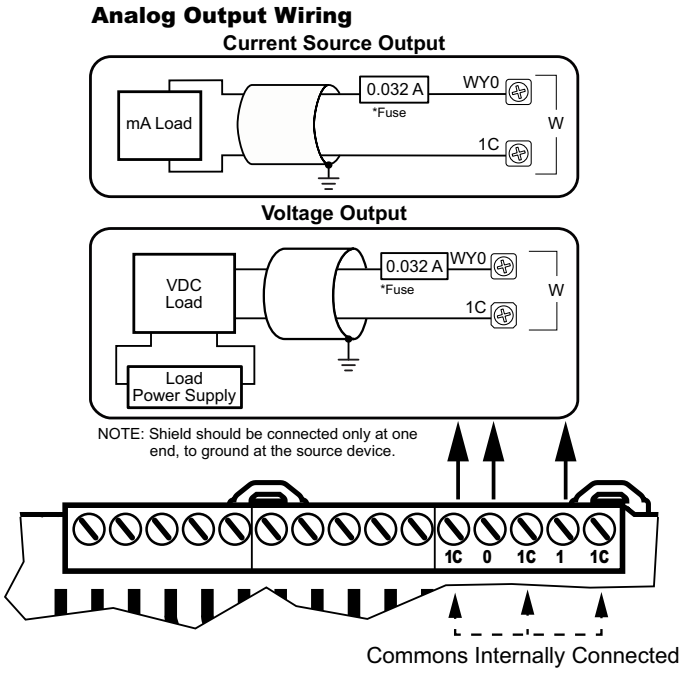
BX-DM1E-36ED13-D Wiring, Continued

Analog Output Specifications

Analog Output Specifications	
Outputs per Module	2
Commons	3
Output Voltage Range *	Software Selectable ±10V, ±5V, 0–10 V, 0–5 V
Output Current Range *	Software Selectable ±20mA, 4–20 mA
Resolution ±10V, ±20mA ±5V 0–5 V 4–20 mA 0–10 V	 16 bits (0–65535 counts) 15 bits (0–32767 counts) 14 bits (0–16383 counts) ~15 bits (6553–32767 counts) 15 bits (0–32767 counts)
Minimum Voltage Load Impedance	1kΩ
Maximum Current Load Impedance	500Ω
Maximum Rating	Continuous Short Circuit Protected
Settling Time	< 1ms
Output Stability	0.02% of Full Hardware Range = 13 Counts
Full Scale Calibration Error	0.05% of Full Hardware Range = 33 Counts
Offset Calibration Error	0.01% of Full Hardware Range = 7 Counts
Accuracy vs Temperature Error	0.05% of Full Hardware Range = 33 Counts
Maximum Linearity Error (End to End)	0.1% of Full Hardware Range = 66 Counts
Maximum Inaccuracy	0.2% of Full Hardware Range = 131 Counts
Fuse Type	User-supplied external fuse

**** Software selectable per channel***

Analog Output Connection Options



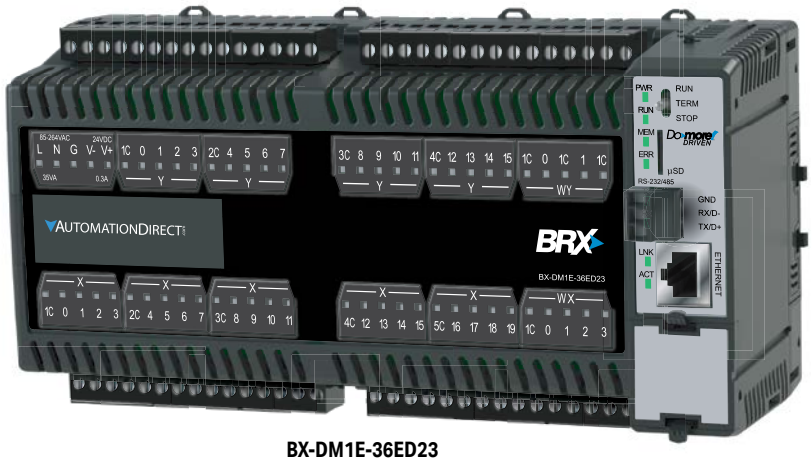
***NOTE:** An Edison S500-32-R 0.032A fast-acting fuse is recommended for all analog voltage inputs, analog outputs, and current loops.*

BX-DM1E-36ED23 Wiring

This MPU is made up of 36 discrete I/O points. The connections are grouped as follows:

- 20 discrete inputs - sinking/sourcing; rated for 12–24 VAC/VDC. They are located along the bottom of the unit; configured in five (5) groups of 5 terminals, each comprised of 4 inputs and an isolated common.
- 16 discrete outputs - sourcing; rated at 12–24 VDC. They are located along the top of the unit starting to the right of the 24VDC auxiliary output terminals. The outputs are configured in four (4) groups of 5 terminals, each comprised of 4 outputs and an isolated common.
- 4 analog inputs and 2 analog outputs. The analog inputs are located along the bottom of the unit to the right of the discrete inputs. The analog inputs are grouped together on 5 terminals consisting of 4 input and a shared analog input common. The analog outputs are located along the top of the unit to the right of the discrete outputs. The analog outputs are grouped together on 5 terminals consisting of 2 outputs and 3 shared analog output common terminals. The analogs share these common features:
  - current or voltage selectable through software,
  - 16-bit resolution @ ±20mA, ±10VDC
  - current signal ranges of 4–20 mA, ±20mA,
  - voltage signal ranges of 0–5 VDC, 0–10 VDC, ±5VDC, ±10VDC.

This MPU requires an external 120–240 VAC power supply. The AC power supply connection and the 24VDC auxiliary output supply terminals are located on the top left side of the unit.



BX-DM1E-36ED23

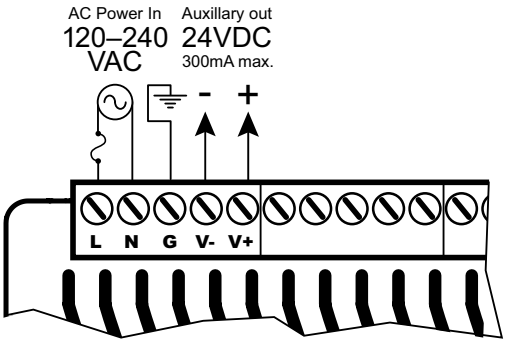
NOTE: *Eight (8) Expansion Modules can be connected to extend I/O capacity.*

BX-DM1E-36ED23 Wiring, Continued

Power Supply Specifications

Power Supply Specifications	
Nominal Voltage Range	120–240 VAC
Input Voltage Range (Tolerance)	85–264 VAC
Rated Operating Frequency	47–63 Hz
Maximum Input Power	40VA
Cold Start Inrush Current	1.5 A, 2ms
Maximum Inrush Current (Hot Start)	1.5 A, 2ms
Internal Input Fuse Protection	Micro fuse 250V, 2A Non-replaceable
Acceptable External Power Drop Time	10ms
Under Input Voltage Lock-out	80VAC
Input Transient Protection	Input choke and line filter
Heat Dissipation	24.4 W Max
Isolated User 24VDC Output	24VDC @ 0.3 A max, <1V P-P Ripple, Integrated self-resetting short circuit protection
Voltage Withstand (dielectric)	1500VAC Power Inputs to Ground applied for 1 minute 1500VAC Ground to 24VDC Output applied for 1 minute
Insulation Resistance	>10MΩ @ 500VDC
Software Version Required	Do-more! Designer version 2.0 or later

Power Supply Connections



WARNING: Do not exceed the 24VDC auxiliary power supply load limit of 300mA.

WARNING: The BRX System MUST have a proper earth ground. Do not operate the BRX MPU without proper earth grounding.

BX-DM1E-36ED23 Wiring, Continued

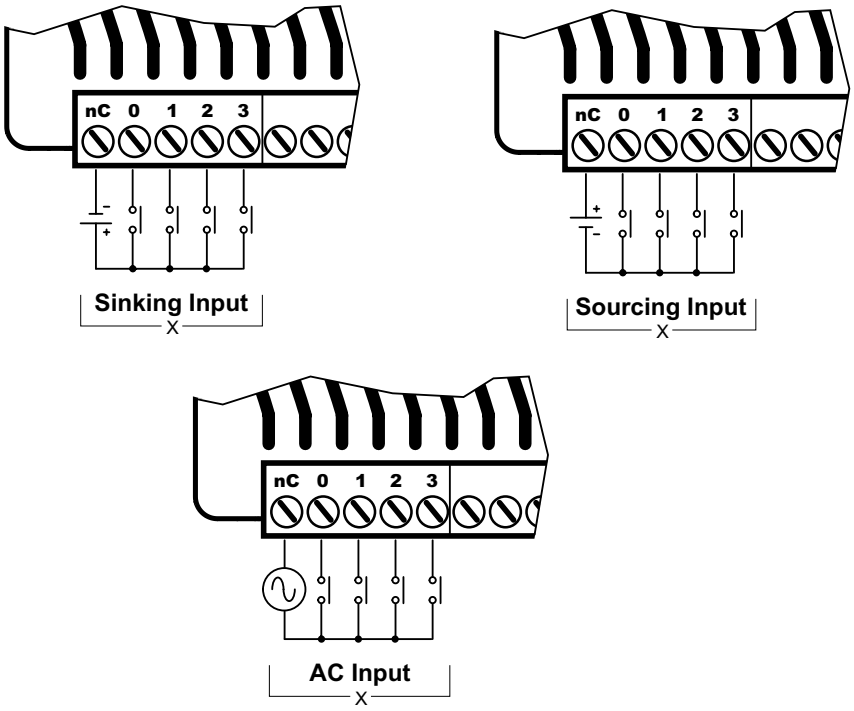
Discrete Input Specifications

Discrete Input Specifications			
Input Type		Sink/Source	
Total Inputs per Module		20	
Commons		5 (4 points/common) Isolated	
Nominal Voltage Range		12–24 VAC/VDC	
Input Voltage Range		9–30 VAC/VDC	
Maximum Voltage		30 VAC/VDC	
DC Frequency		0–250 kHz - High-speed	
Minimum Pulse Width		0.5 µs - High-speed	
AC Frequency		47–63 Hz[2]	
Input Impedance		3kΩ @ 24VDC	
Input Current (typical)		6mA @ 24 VAC/VDC	
Maximum Input Current		12mA @ 30 VAC/VDC	
ON Voltage Level		> 9.0 VAC/VDC	
OFF Voltage Level		< 2.0 VAC/VDC	
Maximum OFF Current		1.5 mA	
Status Indicators		Logic Side, Green	
Input Details			
Input Type		High-Speed DC	Standard[1]
Location		X0...X9	X10...X19
OFF to ON Response	DC	< 2µs	2ms
	AC	–	10ms[2]
ON to OFF Response	DC	< 2µs	2ms
	AC	–	10ms[2]
Maximum Switching Frequency	DC	250kHz	
	AC	~ 30Hz	

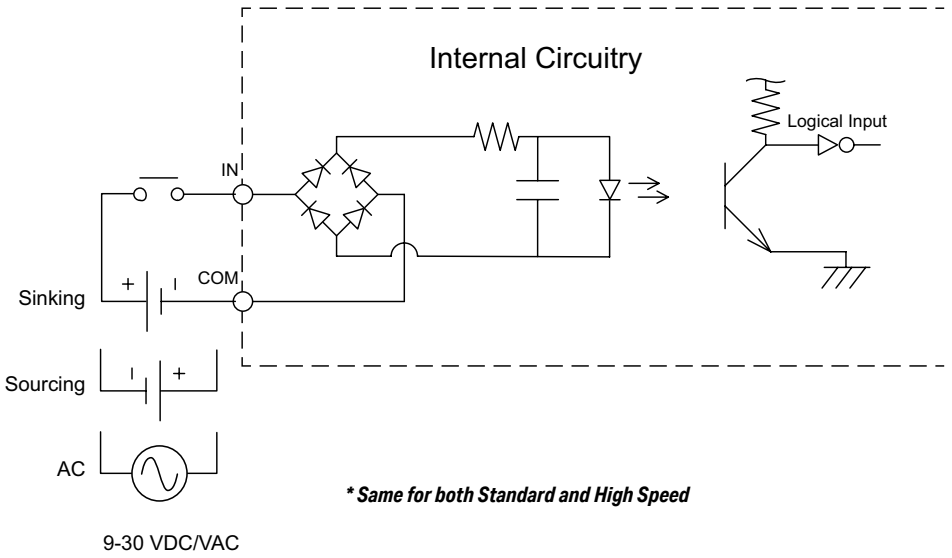
1. *All inputs may be used as standard inputs. Only the first 10 inputs (X0...X9) are capable of high-speed DC operation.*
2. *60Hz to 240Hz filter should be set in the software when using an AC line signal.*

BX-DM1E-36ED23 Wiring, Continued

Discrete Input Connection Options



Discrete Input Internal Circuitry *



** Same for both Standard and High Speed*

BX-DM1E-36ED23 Wiring, Continued

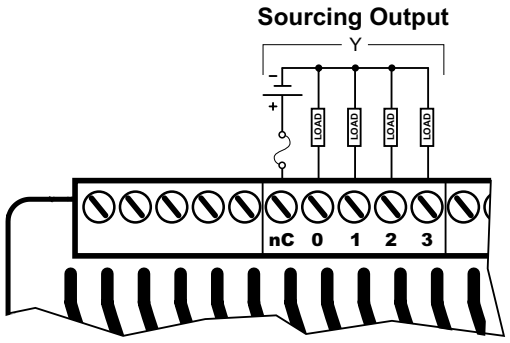
Discrete Output Specifications

Discrete Output Specifications		
Output Type	Sourcing	
Total Outputs per Module	16	
Commons	4 (4 points/common) Isolated	
Maximum Current per Common	2A	
Nominal Voltage Range	12–24 VDC	
Operating Voltage Range	5–36 VDC	
Maximum Voltage	36VDC	
Minimum Output Current	0.1 mA @ 24VDC	
Maximum Output Current	0.5 A per output No derating over temperature range	
Maximum Inrush Current	5A for 50ms	
Maximum Leakage Current	10µA	
ON Voltage Drop	0.05 VDC	
Status Indicators	Logic Side, Green	
Output Details		
Output Type	High-Speed	Standard[1]
Location	Y0...Y7	Y8...Y15
OFF to ON Response	< 2µs	< 5ms
ON to OFF Response	< 2µs	< 2ms
Maximum Switching Frequency	1m cable - 250kHz 10m cable - 100kHz	~100Hz
Overcurrent, Short Circuit Protection and Short to Ground	Current limit by Common Group, self-resetting	N/A
Overcurrent Trip Level[2]	Between 4A and 8A	N/A
Fuse Type	User-supplied external fuse	

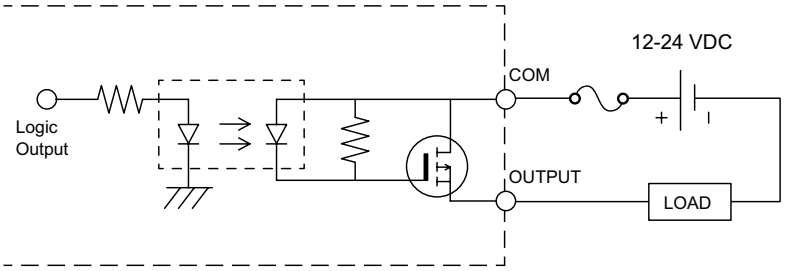
1. *All outputs may be used as standard outputs. Only the first 8 outputs (Y0...Y7) are capable of high-speed DC operation.*
2. *When the high-speed outputs are in an overcurrent situation, the Common terminal Red LED is on. The output LEDs will remain operational even though the output circuitry is turned off and no power is flowing. This condition is not reported to the CPU.*

BX-DM1E-36ED23 Wiring, Continued

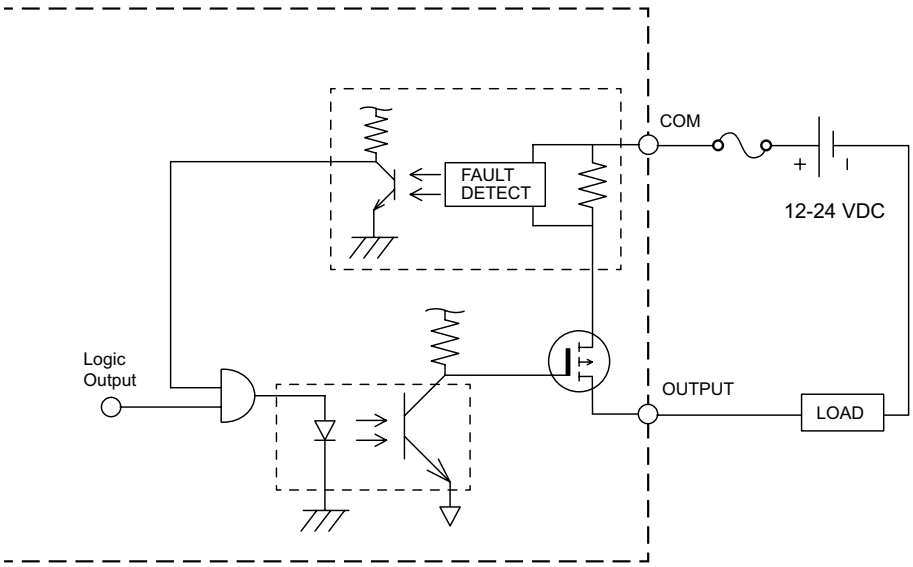
Discrete Output Connection Options



Discrete Standard Output Internal Circuitry



Discrete High-Speed Output Internal Circuitry



NOTE: *When the high speed outputs are in an overcurrent situation, the Common terminal Red LED is on. The output LEDs will remain operational even though the output circuitry is turned off and no power is flowing. This condition is not reported to the CPU.*

BX-DM1E-36ED23 Wiring, Continued

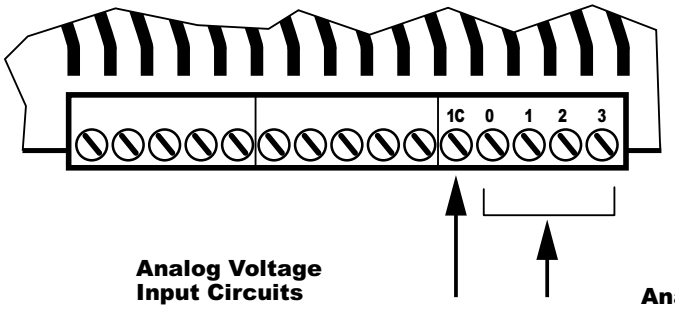
Analog Input Specifications

Analog Input Specifications	
Inputs per Module	4
Commons	1
Input Voltage Range *	Software Selectable ±10V, ±5V, 0–10 V, 0–5 V
Input Current Range *	Software Selectable ±20mA, 4–20 mA
Resolution ±10V, ±20mA ±5V 0–5 V 4–20 mA 0–10 V	 16 bits (0–65535 counts) 15 bits (0–32767 counts) 14 bits (0–16383 counts) ~15 bits (6553–32767 counts) 15 bits (0–32767 counts)
Input Impedance Voltage Modes	100kΩ
Absolute Maximum Input, Voltage Mode	±30V
Input Impedance Current Modes	249Ω
Absolute Maximum Input, Current Mode	±40mA sustained, ±100mA for < 5s
Conversion Time	1.2 ms
Input Stability	0.02% of Full Hardware Range = 13 Counts
Full Scale Calibration Error	0.05% of Full Hardware Range = 33 Counts
Offset Calibration Error	0.01% of Full Hardware Range = 7 Counts
Accuracy vs Temperature Error	0.05% of Full Hardware Range = 33 Counts
Maximum Linearity Error (End to End)	0.1% of Full Hardware Range = 66 Counts
Maximum Inaccuracy	0.2% of Full Hardware Range = 131 Counts
Fuse Type	User-supplied external fuse

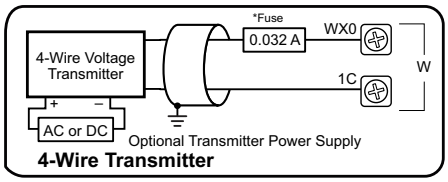
**** Software selectable per channel***

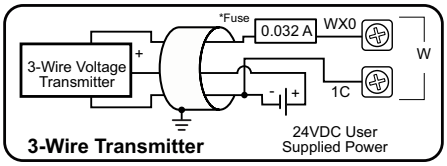
BX-DM1E-36ED23 Wiring, Continued

Analog Input Connection Options



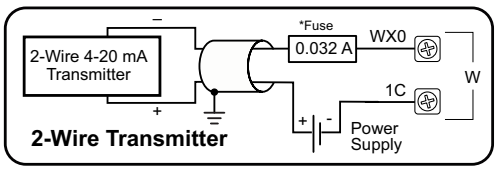
Analog Voltage Input Circuits

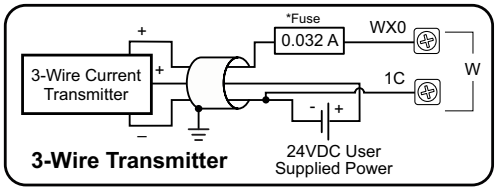


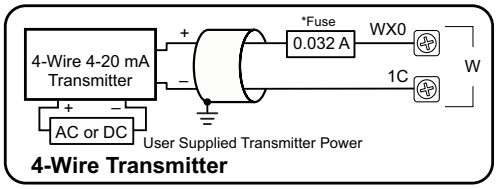


NOTE: Shield should be connected only at one end, to ground at the source device.

Analog Current Sinking Input Circuits







NOTE: Shield should be connected only at one end, to ground at the source device.

NOTE: *An Edison S500-32-R 0.032A fast-acting fuse is recommended for all analog voltage inputs, analog outputs, and current loops.*

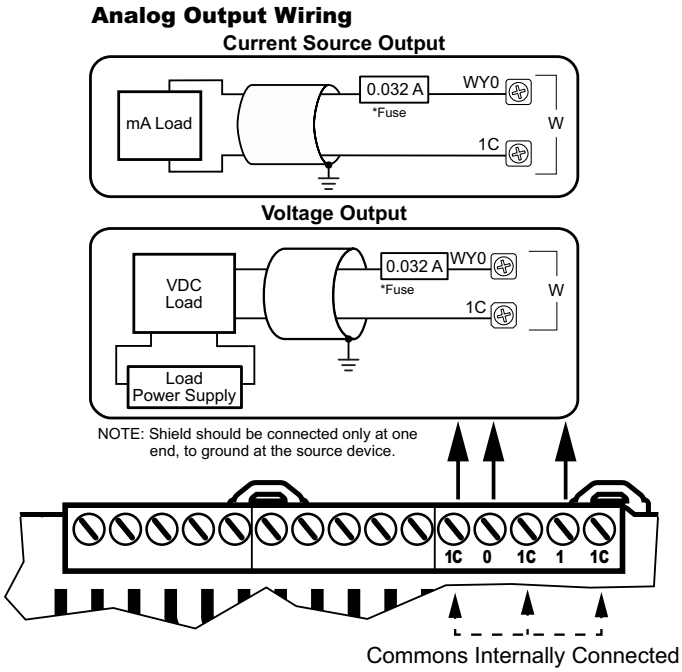
BX-DM1E-36ED23 Wiring, Continued

Analog Output Specifications

Analog Output Specifications	
Outputs per Module	2
Commons	3
Output Voltage Range *	Software Selectable ±10V, ±5V, 0–10 V, 0–5 V
Output Current Range *	Software Selectable ±20mA, 4–20 mA
Resolution ±10V, ±20mA ±5V 0–5 V 4–20 mA 0–10 V	 16 bits (0–65535 counts) 15 bits (0–32767 counts) 14 bits (0–16383 counts) ~15 bits (6553–32767 counts) 15 bits (0–32767 counts)
Minimum Voltage Load Impedance	1kΩ
Maximum Current Load Impedance	500Ω
Maximum Rating	Continuous Short Circuit Protected
Settling Time	< 1ms
Output Stability	0.02% of Full Hardware Range = 13 Counts
Full Scale Calibration Error	0.05% of Full Hardware Range = 33 Counts
Offset Calibration Error	0.01% of Full Hardware Range = 7 Counts
Accuracy vs Temperature Error	0.05% of Full Hardware Range = 33 Counts
Maximum Linearity Error (End to End)	0.1% of Full Hardware Range = 66 Counts
Maximum Inaccuracy	0.2% of Full Hardware Range = 131 Counts
Fuse Type	User-supplied external fuse

**** Software selectable per channel***

Analog Output Connection Options



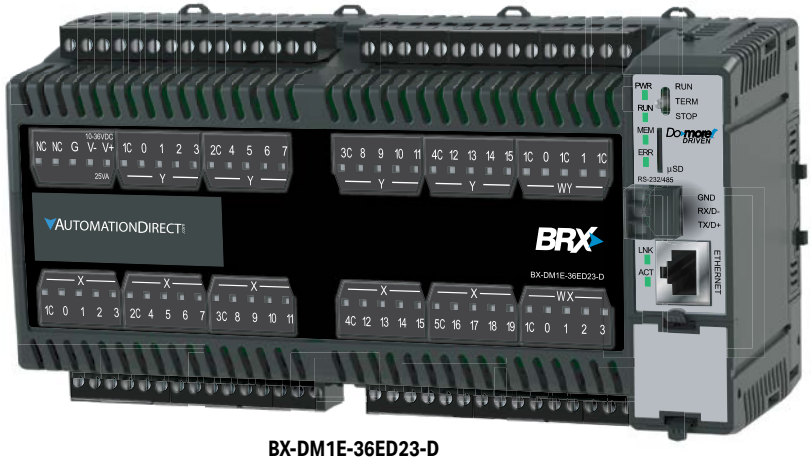
NOTE: *An Edison S500-32-R 0.032A fast-acting fuse is recommended for all analog voltage inputs, analog outputs, and current loops.*

BX-DM1E-36ED23-D Wiring

This MPU is made up of 36 discrete I/O points. The connections are grouped as follows:

- 20 discrete inputs - sinking/sourcing; rated for 12–24 VAC/VDC. They are located along the bottom of the unit; configured in five (5) groups of 5 terminals, each comprised of 4 inputs and an isolated common.
- 16 discrete outputs - sourcing; rated at 12–24 VDC. They are located along the top of the unit starting to the right of the 24VDC external power supply terminals. The outputs are configured in four (4) groups of 5 terminals, each comprised of 4 outputs and an isolated common.
- 4 analog inputs and 2 analog outputs. The analog inputs are located along the bottom of the unit to the right of the discrete inputs. The analog inputs are grouped together on 5 terminals consisting of 4 input and a shared analog input common. The analog outputs are located along the top of the unit to the right of the discrete outputs. The analog outputs are grouped together on 5 terminals consisting of 2 outputs and 3 shared analog output common terminals. The analog share these common features:
  - current or voltage selectable through software,
  - 16-bit resolution @ ±20mA, ±10VDC
  - current signal ranges of 4–20 mA, ±20mA,
  - voltage signal ranges of 0–5 VDC, 0–10 VDC, ±5VDC, ±10VDC.

This MPU requires an external 12–24 VDC power supply. The DC power supply connection is located on the top left side of the unit. There is no 24VDC auxiliary output supply.



BX-DM1E-36ED23-D

NOTE: *Eight (8) Expansion Modules can be connected to extend I/O capacity.*

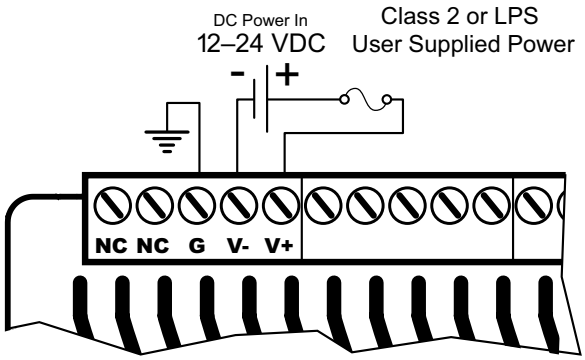
BX-DM1E-36ED23-D, Continued

Power Supply Specifications

Power Supply Specifications	
Nominal Voltage Range*	12–24 VDC
Input Voltage Range (Tolerance)*	10–36 VDC
Maximum Input Voltage Ripple	< ±10%
Maximum Input Power	30W
Cold Start Inrush Current	5A, 2ms
Maximum Inrush Current (Hot Start)	5A, 2ms
Internal Input Protection	Reverse polarity protection and undervoltage lockout via transistor circuit
Acceptable External Power Drop Time	10ms
Under Input Voltage Lock-out	<9VDC
Heat Dissipation	22.1 W Max
Isolated User 24VDC Output	None
Voltage Withstand (dielectric)	1500VAC power Inputs to ground applied for 1 minute
Insulation Resistance	>10MΩ @ 500VDC
Software Version Required	Do-more! Designer version 2.0 or later

**** Class 2 or LPS Power Supply required.***

Power Supply Connections



WARNING: No External AC power supply needed on this unit. The two terminals marked "NC" are not used. These terminals are not internally connected. DO NOT CONNECT ANYTHING TO THESE TERMINALS!

WARNING: The BRX System MUST have a proper earth ground. Do not operate the BRX MPU without proper earth grounding.

BX-DM1E-36ED23-D Wiring, Continued

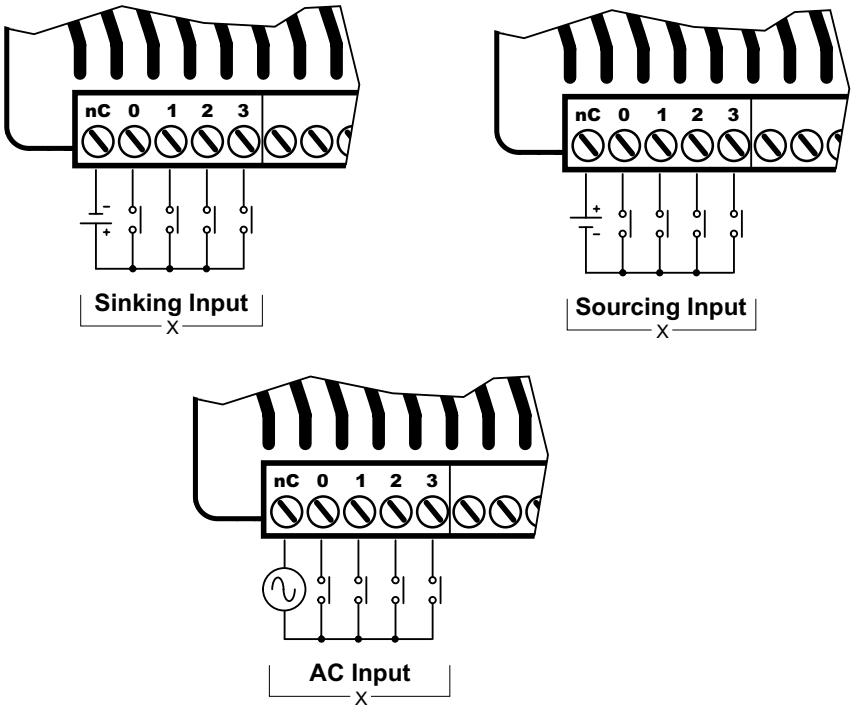
Discrete Input Specifications

Discrete Input Specifications			
Input Type		Sink/Source	
Total Inputs per Module		20	
Commons		5 (4 points/common) Isolated	
Nominal Voltage Range		12–24 VAC/VDC	
Input Voltage Range		9–30 VAC/VDC	
Maximum Voltage		30 VAC/VDC	
DC Frequency		0–250 kHz - High-speed	
Minimum Pulse Width		0.5 µs - High-speed	
AC Frequency		47–63 Hz[2]	
Input Impedance		3kΩ @ 24VDC	
Input Current (typical)		6mA @ 24 VAC/VDC	
Maximum Input Current		12mA @ 30 VAC/VDC	
ON Voltage Level		> 9.0 VAC/VDC	
OFF Voltage Level		< 2.0 VAC/VDC	
Maximum OFF Current		1.5 mA	
Status Indicators		Logic Side, Green	
Input Details			
Input Type		High-Speed DC	Standard[1]
Location		X0...X9	X10...X19
OFF to ON Response	DC	< 2µs	2ms
	AC	–	10ms[2]
ON to OFF Response	DC	< 2µs	2ms
	AC	–	10ms[2]
Maximum Switching Frequency	DC	250kHz	
	AC	~ 30Hz	

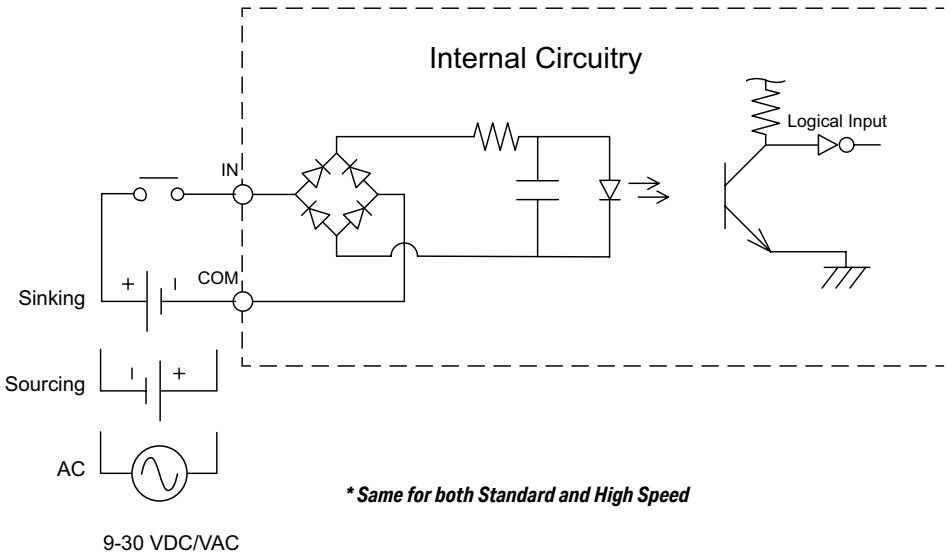
1. *All inputs may be used as standard inputs. Only the first 10 inputs (X0...X9) are capable of high-speed DC operation.*
2. *60Hz to 240Hz filter should be set in the software when using an AC line signal.*

BX-DM1E-36ED23-D Wiring, Continued

Discrete Input Connection Options



Discrete Input Internal Circuitry *



** Same for both Standard and High Speed*

BX-DM1E-36ED23-D Wiring, Continued

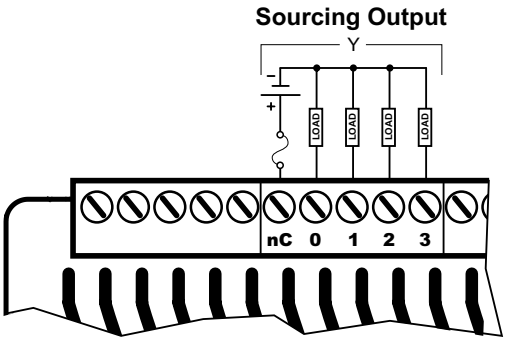
Discrete Output Specifications

Discrete Output Specifications		
Output Type	Sourcing	
Total Outputs per Module	16	
Commons	4 (4 points/common) Isolated	
Maximum Current per Common	2A	
Nominal Voltage Range	12–24 VDC	
Operating Voltage Range	5–36 VDC	
Maximum Voltage	36VDC	
Minimum Output Current	0.1 mA @ 24VDC	
Maximum Output Current	0.5 A per output No derating over temperature range	
Maximum Inrush Current	5A for 50ms	
Maximum Leakage Current	10µA	
ON Voltage Drop	0.05 VDC	
Status Indicators	Logic Side, Green	
Output Details		
Output Type	High-Speed	Standard[1]
Location	Y0...Y7	Y8...Y15
OFF to ON Response	< 2µs	< 5ms
ON to OFF Response	< 2µs	< 2ms
Maximum Switching Frequency	1m cable - 250kHz 10m cable - 100kHz	~100Hz
Overcurrent, Short Circuit Protection and Short to Ground	Current limit by Common Group, self-resetting	N/A
Overcurrent Trip Level[2]	Between 4A and 8A	N/A
Fuse Type	User-supplied external fuse	

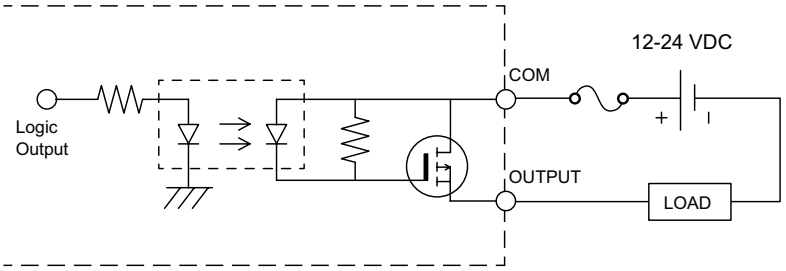
1. ***All outputs may be used as standard outputs. Only the first 8 outputs (Y0...Y7) are capable of high-speed DC operation.***
2. ***When the high-speed outputs are in an overcurrent situation, the Common terminal Red LED is on. The output LEDs will remain operational even though the output circuitry is turned off and no power is flowing. This condition is not reported to the CPU.***

BX-DM1E-36ED23-D Wiring, Continued

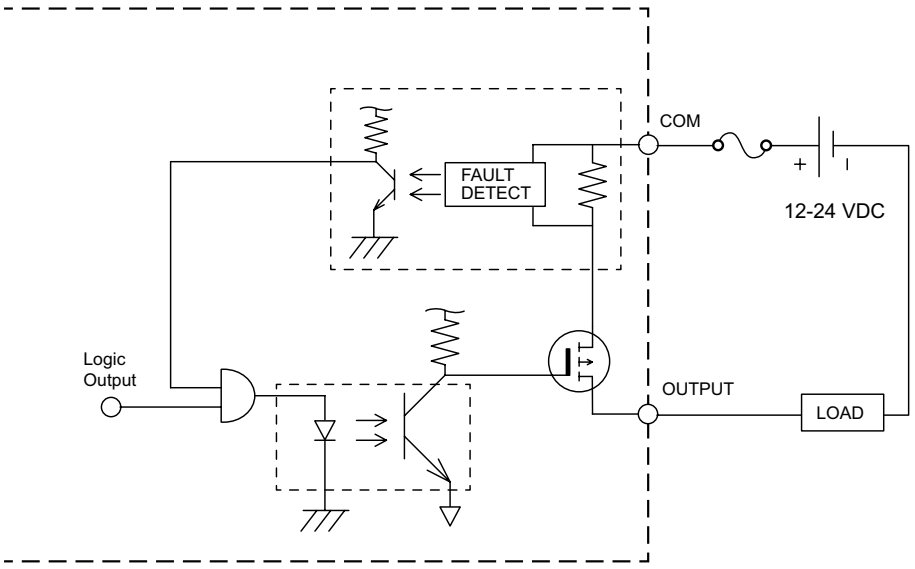
Discrete Output Connection Options



Discrete Standard Output Internal Circuitry



Discrete High-Speed Output Internal Circuitry



NOTE: *When the high speed outputs are in an overcurrent situation, the Common terminal Red LED is on. The output LEDs will remain operational even though the output circuitry is turned off and no power is flowing. This condition is not reported to the CPU.*

BX-DM1E-36ED23-D Wiring, Continued

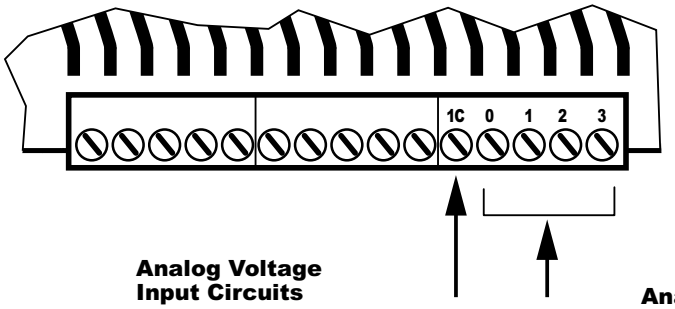
Analog Input Specifications

Analog Input Specifications	
Inputs per Module	4
Commons	1
Input Voltage Range *	Software Selectable ±10V, ±5V, 0–10 V, 0–5 V
Input Current Range *	Software Selectable ±20mA, 4–20 mA
Resolution ±10V, ±20mA ±5V 0–5 V 4–20 mA 0–10 V	 16 bits (0–65535 counts) 15 bits (0–32767 counts) 14 bits (0–16383 counts) ~15 bits (6553–32767 counts) 15 bits (0–32767 counts)
Input Impedance Voltage Modes	100kΩ
Absolute Maximum Input, Voltage Mode	±30V
Input Impedance Current Modes	249Ω
Absolute Maximum Input, Current Mode	±40mA sustained, ±100mA for < 5s
Conversion Time	1.2 ms
Input Stability	0.02% of Full Hardware Range = 13 Counts
Full Scale Calibration Error	0.05% of Full Hardware Range = 33 Counts
Offset Calibration Error	0.01% of Full Hardware Range = 7 Counts
Accuracy vs Temperature Error	0.05% of Full Hardware Range = 33 Counts
Maximum Linearity Error (End to End)	0.1% of Full Hardware Range = 66 Counts
Maximum Inaccuracy	0.2% of Full Hardware Range = 131 Counts
Fuse Type	User-supplied external fuse

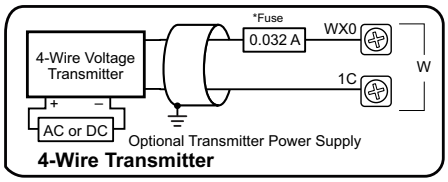
**** Software selectable per channel***

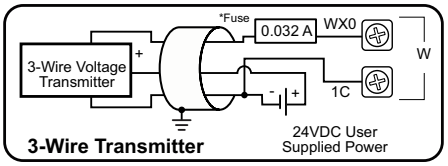
BX-DM1E-36ED23-D Wiring, Continued

Analog Input Connection Options



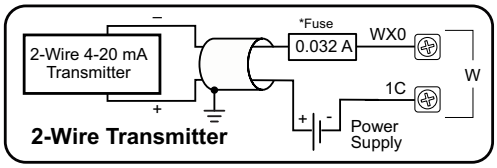
Analog Voltage Input Circuits

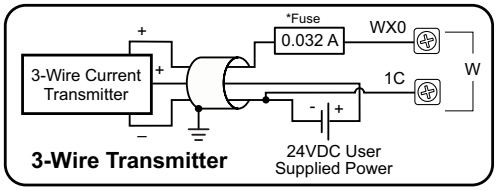


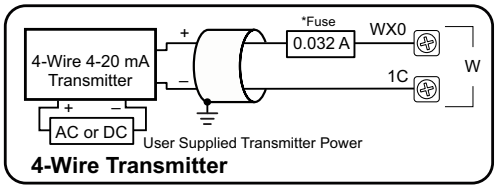


NOTE: Shield should be connected only at one end, to ground at the source device.

Analog Current Sinking Input Circuits







NOTE: Shield should be connected only at one end, to ground at the source device.



NOTE: *An Edison S500-32-R 0.032A fast-acting fuse is recommended for all analog voltage inputs, analog outputs, and current loops.*

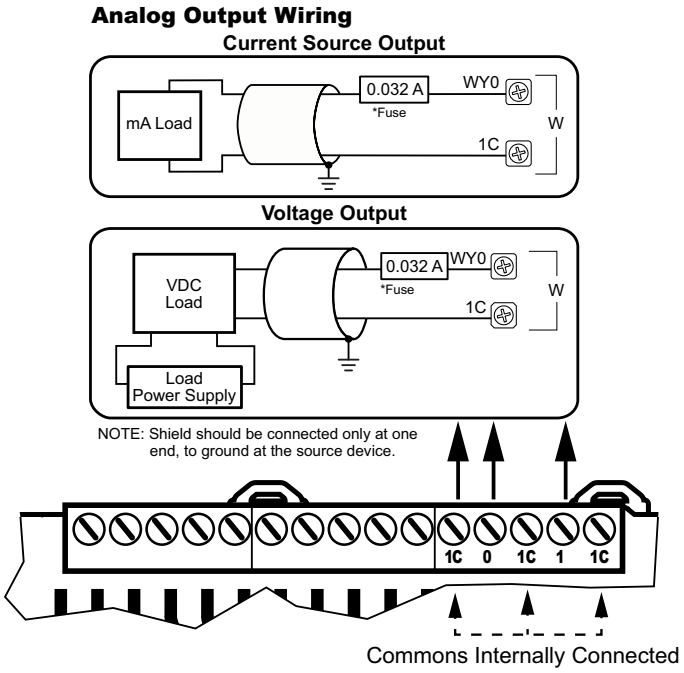
BX-DM1E-36ED23-D Wiring, Continued

Analog Output Specifications

Analog Output Specifications	
Outputs per Module	2
Commons	3
Output Voltage Range *	Software Selectable ±10V, ±5V, 0–10 V, 0–5 V
Output Current Range *	Software Selectable ±20mA, 4–20 mA
Resolution ±10V, ±20mA ±5V 0–5 V 4–20 mA 0–10 V	 16 bits (0–65535 counts) 15 bits (0–32767 counts) 14 bits (0–16383 counts) ~15 bits (6553–32767 counts) 15 bits (0–32767 counts)
Minimum Voltage Load Impedance	1kΩ
Maximum Current Load Impedance	500Ω
Maximum Rating	Continuous Short Circuit Protected
Settling Time	< 1ms
Output Stability	0.02% of Full Hardware Range = 13 Counts
Full Scale Calibration Error	0.05% of Full Hardware Range = 33 Counts
Offset Calibration Error	0.01% of Full Hardware Range = 7 Counts
Accuracy vs Temperature Error	0.05% of Full Hardware Range = 33 Counts
Maximum Linearity Error (End to End)	0.1% of Full Hardware Range = 66 Counts
Maximum Inaccuracy	0.2% of Full Hardware Range = 131 Counts
Fuse Type	User-supplied external fuse

**** Software selectable per channel***

Analog Output Connection Options



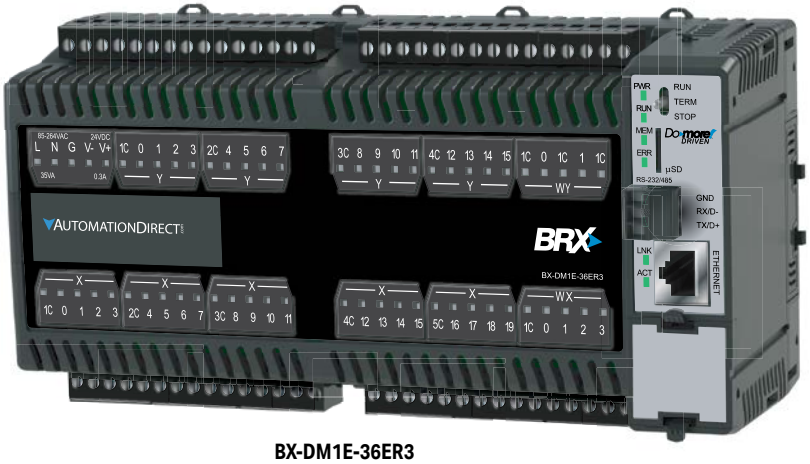
***NOTE:** An Edison S500-32-R 0.032A fast-acting fuse is recommended for all analog voltage inputs, analog outputs, and current loops.*

BX-DM1E-36ER3 Wiring

This MPU is made up of 36 discrete I/O points. The connections are grouped as follows:

- 20 discrete inputs - sinking/sourcing; rated for 12–24 VAC/VDC. They are located along the bottom of the unit; configured in five (5) groups of 5 terminals, each comprised of 4 inputs and an isolated common.
- 16 discrete outputs - Form A Relay (SPST); rated 12–48 VDC/ 24–240 VAC. They are located along the top of the unit starting to the right of the 24VDC auxiliary output terminals. The outputs are configured in four (4) groups of 5 terminals, each comprised of 4 outputs and an isolated common.
- 4 analog inputs and 2 analog outputs. The analog inputs are located along the bottom of the unit to the right of the discrete inputs. The analog inputs are grouped together on 5 terminals consisting of 4 input and a shared analog input common. The analog outputs are located along the top of the unit to the right of the discrete outputs. The analog outputs are grouped together on 5 terminals consisting of 2 outputs and 3 shared analog output common terminals. The analogs share these common features:
  - current or voltage selectable through software,
  - 16-bit resolution @ ±20mA, ±10VDC
  - current signal ranges of 4–20 mA, ±20mA,
  - voltage signal ranges of 0–5 VDC, 0–10 VDC, ±5 VDC, ±10VDC.

This MPU requires an external 120–240 VAC power supply. The AC power supply connection and the 24VDC auxiliary output supply terminals are located on the top left side of the unit.



BX-DM1E-36ER3

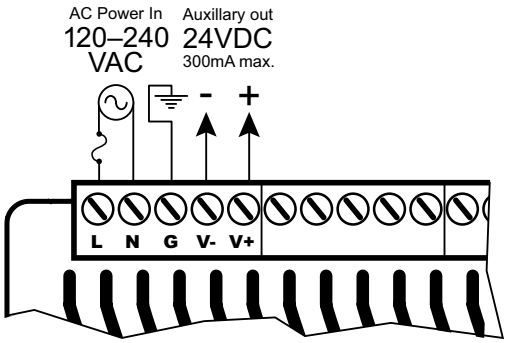
NOTE: *Eight (8) Expansion Modules can be connected to extend I/O capacity.*

BX-DM1E-36ER3 Wiring, Continued

Power Supply Specifications

Power Supply Specifications	
Nominal Voltage Range	120–240 VAC
Input Voltage Range (Tolerance)	85–264 VAC
Rated Operating Frequency	47–63 Hz
Maximum Input Power	40VA
Cold Start Inrush Current	1.5 A, 2ms
Maximum Inrush Current (Hot Start)	1.5 A, 2ms
Internal Input Fuse Protection	Micro fuse 250V, 2A Non-replaceable
Acceptable External Power Drop Time	10ms
Under Input Voltage Lock-out	80VAC
Input Transient Protection	Input choke and line filter
Heat Dissipation	27.6 W Max
Isolated User 24VDC Output	24VDC @ 0.3 A max, <1V P-P Ripple, Integrated self-resetting short circuit protection
Voltage Withstand (dielectric)	1500VAC Power Inputs to Ground applied for 1 minute 1500VAC Ground to 24VDC Output applied for 1 minute
Insulation Resistance	>10MΩ @ 500VDC
Software Version Required	Do-more! Designer version 2.0 or later

Power Supply Connections



WARNING: Do not exceed the 24VDC auxiliary power supply load limit of 300mA.

WARNING: The BRX System MUST have a proper earth ground. Do not operate the BRX MPU without proper earth grounding.

BX-DM1E-36ER3 Wiring, Continued

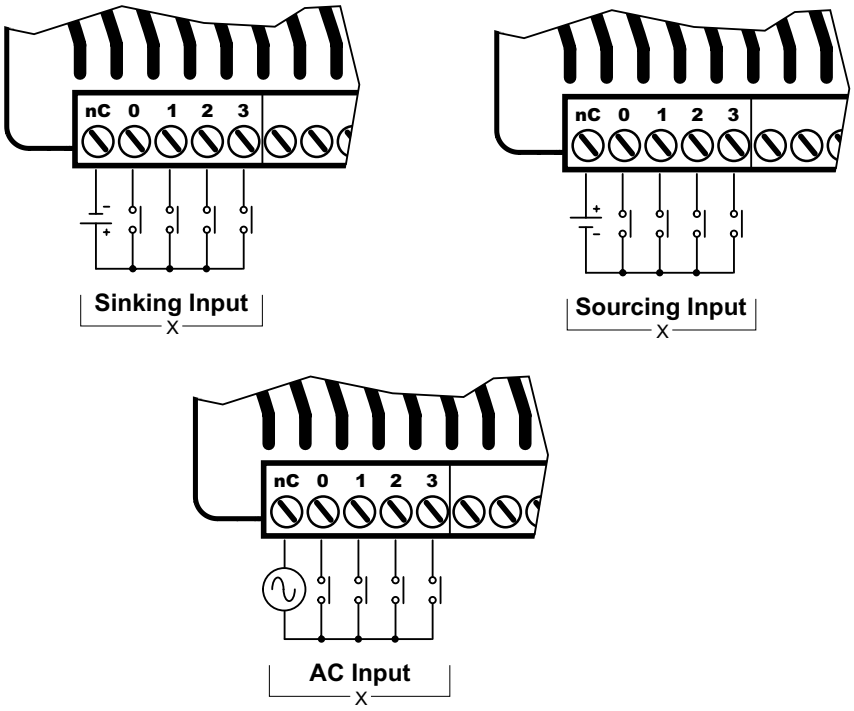
Discrete Input Specifications

Discrete Input Specifications			
Input Type		Sink/Source	
Total Inputs per Module		20	
Commons		5 (4 points/common) Isolated	
Nominal Voltage Range		12–24 VAC/VDC	
Input Voltage Range		9–30 VAC/VDC	
Maximum Voltage		30 VAC/VDC	
DC Frequency		0–250 kHz - High-speed	
Minimum Pulse Width		0.5 µs - High-speed	
AC Frequency		47–63 Hz[2]	
Input Impedance		3kΩ @ 24VDC	
Input Current (typical)		6mA @ 24 VAC/VDC	
Maximum Input Current		12mA @ 30 VAC/VDC	
ON Voltage Level		> 9.0 VAC/VDC	
OFF Voltage Level		< 2.0 VAC/VDC	
Maximum OFF Current		1.5 mA	
Status Indicators		Logic Side, Green	
Input Details			
Input Type		High-Speed DC	Standard[1]
Location		X0...X9	X10...X19
OFF to ON Response	DC	< 2µs	2ms
	AC	–	10ms[2]
ON to OFF Response	DC	< 2µs	2ms
	AC	–	10ms[2]
Maximum Switching Frequency	DC	250kHz	
	AC	~ 30Hz	

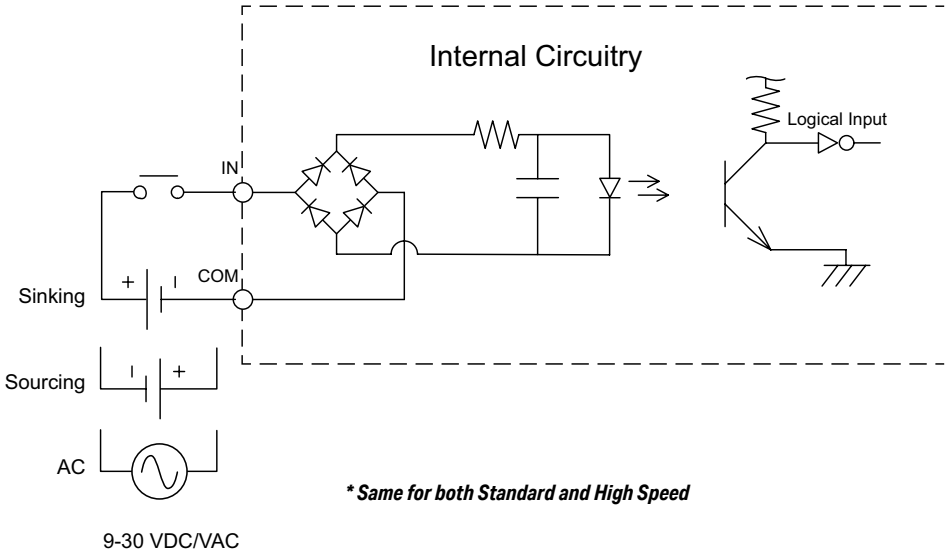
1. *All inputs may be used as standard inputs. Only the first 10 inputs (X0...X9) are capable of high-speed DC operation.*
2. *60Hz to 240Hz filter should be set in the software when using an AC line signal.*

BX-DM1E-36ER3 Wiring, Continued

Discrete Input Connection Options



Discrete Input Internal Circuitry *



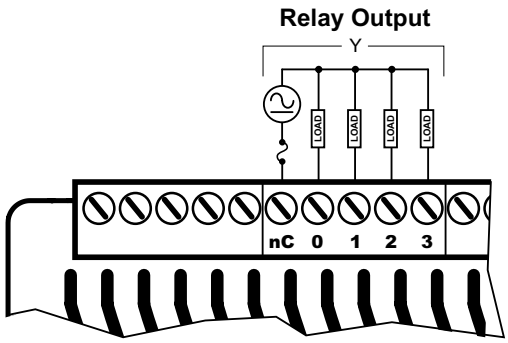
BX-DM1E-36ER3 Wiring, Continued

Discrete Output Specifications

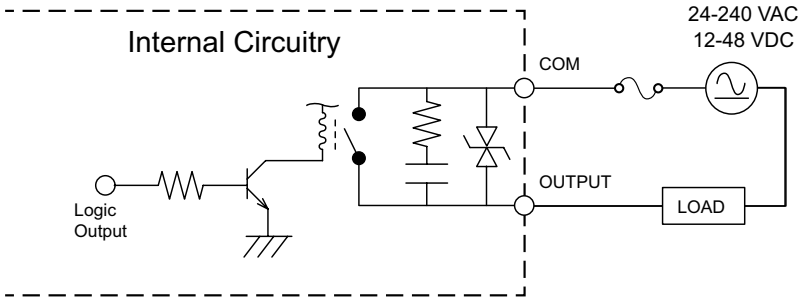
Discrete Output Specifications	
Output Type	Relay Form A (SPST)
Total Outputs per Module	16
Commons	4 (4 points/common) Isolated
Maximum Current per Common	8A
Nominal Voltage Range	12–48 VDC 24–240 VAC
Operating Voltage Range	5–60 VDC 5–264 VAC
Maximum Voltage	60VDC 264VAC
Minimum Output Current	0.1 mA @ 24VDC 0.1 mA @ 24VAC
Maximum Output Current	2A
Maximum Inrush Current	5A for 50ms
Maximum Leakage Current	1µA (DC), 300µA (AC) due to RC snubber circuit
ON Voltage Drop	0.2 V Max
Status Indicators	Logic Side, Green
Output Details	
Output Type	Standard
Location	Y0...Y15
ON-OFF Response	<10ms
OFF-ON Response	<10ms
Maximum Switching Frequency	10Hz
Relay Cycle Life Mechanical Endurance Electrical Endurance	 5 million operations 120,000 operations
Fuse Type	User-supplied external fuse

BX-DM1E-36ER3 Wiring, Continued

Discrete Output Connection Options



Discrete Standard Output Internal Circuitry



BX-DM1E-36ER3 Wiring, Continued

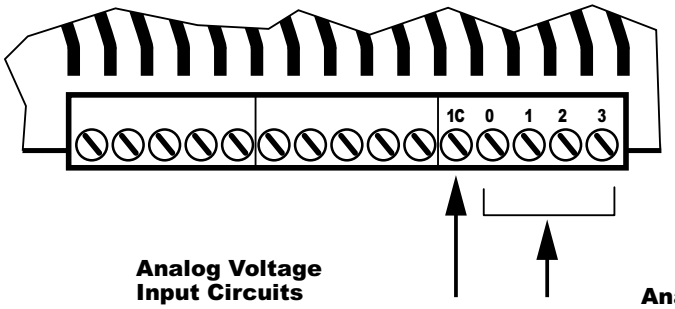
Analog Input Specifications

Analog Input Specifications	
Inputs per Module	4
Commons	1
Input Voltage Range *	Software Selectable ±10V, ±5V, 0–10 V, 0–5 V
Input Current Range *	Software Selectable ±20mA, 4–20 mA
Resolution ±10V, ±20mA ±5V 0–5 V 4–20 mA 0–10 V	 16 bits (0–65535 counts) 15 bits (0–32767 counts) 14 bits (0–16383 counts) ~15 bits (6553–32767 counts) 15 bits (0–32767 counts)
Input Impedance Voltage Modes	100kΩ
Absolute Maximum Input, Voltage Mode	±30V
Input Impedance Current Modes	249Ω
Absolute Maximum Input, Current Mode	±40mA sustained, ±100mA for < 5s
Conversion Time	1.2 ms
Input Stability	0.02% of Full Hardware Range = 13 Counts
Full Scale Calibration Error	0.05% of Full Hardware Range = 33 Counts
Offset Calibration Error	0.01% of Full Hardware Range = 7 Counts
Accuracy vs Temperature Error	0.05% of Full Hardware Range = 33 Counts
Maximum Linearity Error (End to End)	0.1% of Full Hardware Range = 66 Counts
Maximum Inaccuracy	0.2% of Full Hardware Range = 131 Counts
Fuse Type	User-supplied external fuse

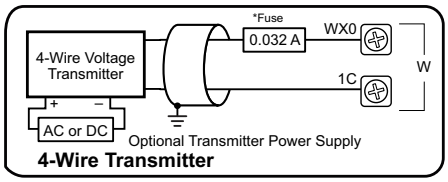
**** Software selectable per channel***

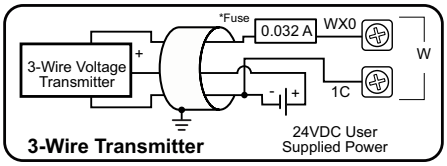
BX-DM1E-36ER3 Wiring, Continued

Analog Input Connection Options



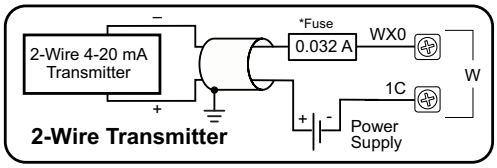
Analog Voltage Input Circuits

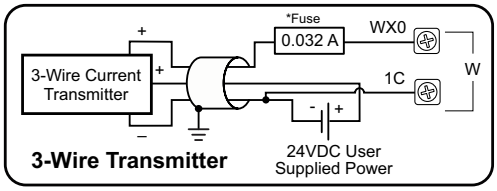


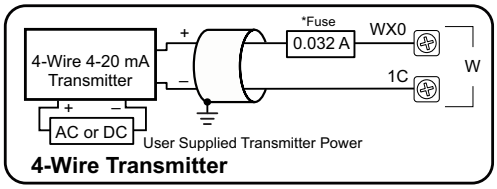


NOTE: Shield should be connected only at one end, to ground at the source device.

Analog Current Sinking Input Circuits







NOTE: Shield should be connected only at one end, to ground at the source device.

NOTE: *An Edison S500-32-R 0.032A fast-acting fuse is recommended for all analog voltage inputs, analog outputs, and current loops.*

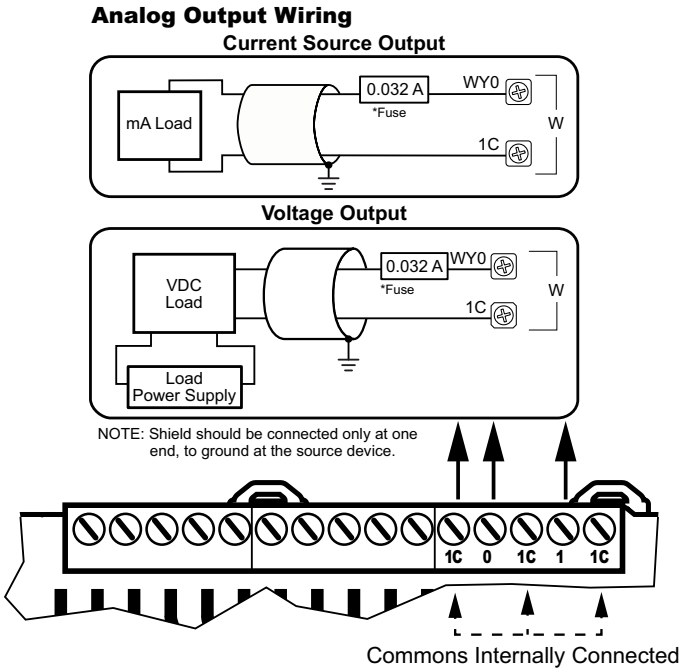
BX-DM1E-36ER3 Wiring, Continued

Analog Output Specifications

Analog Output Specifications	
Outputs per Module	2
Commons	3
Output Voltage Range *	Software Selectable ±10V, ±5V, 0–10 V, 0–5 V
Output Current Range *	Software Selectable ±20mA, 4–20 mA
Resolution ±10V, ±20mA ±5V 0–5 V 4–20 mA 0–10 V	 16 bits (0–65535 counts) 15 bits (0–32767 counts) 14 bits (0–16383 counts) ~15 bits (6553–32767 counts) 15 bits (0–32767 counts)
Minimum Voltage Load Impedance	1kΩ
Maximum Current Load Impedance	500Ω
Maximum Rating	Continuous Short Circuit Protected
Settling Time	< 1ms
Output Stability	0.02% of Full Hardware Range = 13 Counts
Full Scale Calibration Error	0.05% of Full Hardware Range = 33 Counts
Offset Calibration Error	0.01% of Full Hardware Range = 7 Counts
Accuracy vs Temperature Error	0.05% of Full Hardware Range = 33 Counts
Maximum Linearity Error (End to End)	0.1% of Full Hardware Range = 66 Counts
Maximum Inaccuracy	0.2% of Full Hardware Range = 131 Counts
Fuse Type	User-supplied external fuse

**** Software selectable per channel***

Analog Output Connection Options



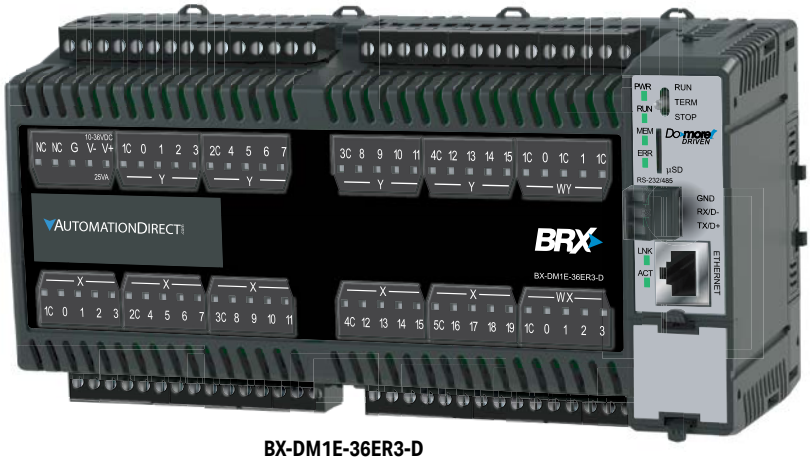
NOTE: *An Edison S500-32-R 0.032A fast-acting fuse is recommended for all analog voltage inputs, analog outputs, and current loops.*

BX-DM1E-36ER3-D Wiring

This MPU is made up of 36 discrete I/O points. The connections are grouped as follows:

- 20 discrete inputs - sinking/sourcing; rated for 12–24 VAC/VDC. They are located along the bottom of the unit; configured in five (5) groups of 5 terminals, each comprised of 4 inputs and an isolated common.
- 16 discrete outputs - Form A Relay (SPST); rated 12–48 VDC/ 24–240 VAC. They are located along the top of the unit starting to the right of the 24VDC external power supply terminals. The outputs are configured in four (4) groups of 5 terminals, each comprised of 4 outputs and an isolated common.
- 4 analog inputs and 2 analog outputs. The analog inputs are located along the bottom of the unit to the right of the discrete inputs. The analog inputs are grouped together on 5 terminals consisting of 4 input and a shared analog input common. The analog outputs are located along the top of the unit to the right of the discrete outputs. The analog outputs are grouped together on 5 terminals consisting of 2 outputs and 3 shared analog output common terminals. The analogs share these common features:
  - current or voltage selectable through software
  - 16-bit resolution @ ±20mA, ±10VDC
  - current signal ranges of 4–20 mA, ±20mA
  - voltage signal ranges of 0–5 VDC, 0–10 VDC, ±5VDC, ±10VDC

This MPU requires an external 12–24 VDC power supply. The DC power supply connection is located on the top left side of the unit. There is no 24VDC auxiliary output supply.



BX-DM1E-36ER3-D

NOTE: *Eight (8) Expansion Modules can be connected to extend I/O capacity.*

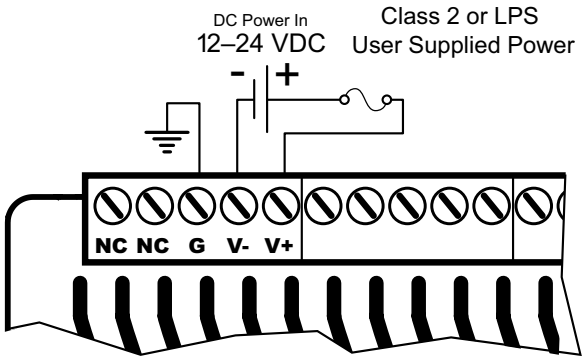
BX-DM1E-36ER3-D Wiring, Continued

Power Supply Specifications

Power Supply Specifications	
Nominal Voltage Range*	12–24 VDC
Input Voltage Range (Tolerance)*	10–36 VDC
Maximum Input Voltage Ripple	< ±10%
Maximum Input Power	30W
Cold Start Inrush Current	5A, 2ms
Maximum Inrush Current (Hot Start)	5A, 2ms
Internal Input Protection	Reverse polarity protection and undervoltage lockout via transistor circuit
Acceptable External Power Drop Time	10ms
Under Input Voltage Lock-out	<9VDC
Heat Dissipation	25.4 W Max
Isolated User 24VDC Output	None
Voltage Withstand (dielectric)	1500VAC power Inputs to ground applied for 1 minute
Insulation Resistance	>10MΩ @ 500VDC
Software Version Required	Do-more! Designer version 2.0 or later

**** Class 2 or LPS Power Supply required.***

Power Supply Connections



WARNING: No External AC power supply needed on this unit. The two terminals marked "NC" are not used. These terminals are not internally connected. DO NOT CONNECT ANYTHING TO THESE TERMINALS!

WARNING: The BRX System MUST have a proper earth ground. Do not operate the BRX MPU without proper earth grounding.

BX-DM1E-36ER3-D Wiring, Continued

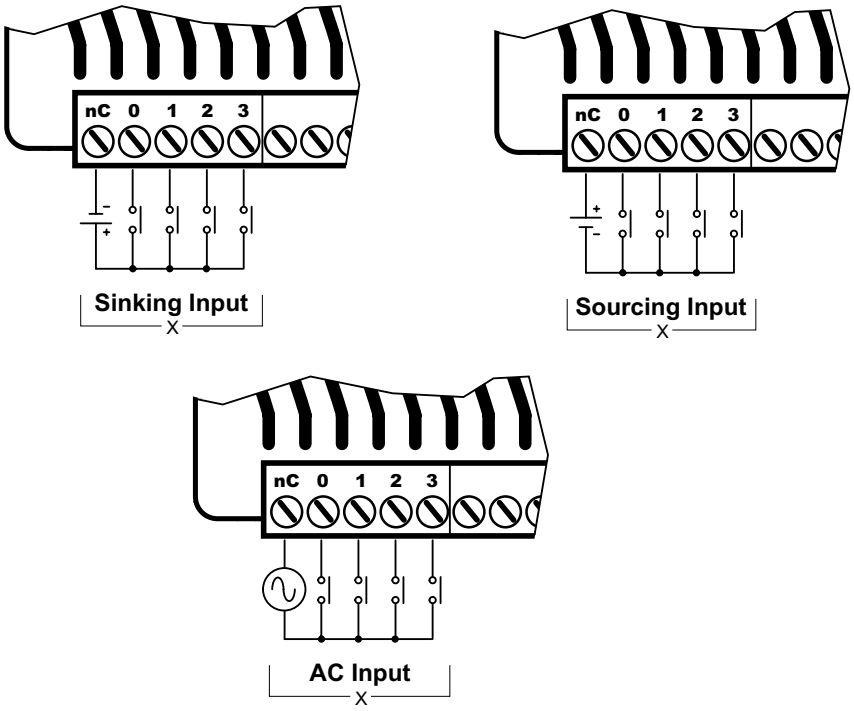
Discrete Input Specifications

Discrete Input Specifications			
Input Type		Sink/Source	
Total Inputs per Module		20	
Commons		5 (4 points/common) Isolated	
Nominal Voltage Range		12–24 VAC/VDC	
Input Voltage Range		9–30 VAC/VDC	
Maximum Voltage		30 VAC/VDC	
DC Frequency		0–250 kHz - High-speed	
Minimum Pulse Width		0.5 µs - High-speed	
AC Frequency		47–63 Hz[2]	
Input Impedance		3kΩ @ 24VDC	
Input Current (typical)		6mA @ 24 VAC/VDC	
Maximum Input Current		12mA @ 30 VAC/VDC	
ON Voltage Level		> 9.0 VAC/VDC	
OFF Voltage Level		< 2.0 VAC/VDC	
Maximum OFF Current		1.5 mA	
Status Indicators		Logic Side, Green	
Input Details			
Input Type		High-Speed DC	Standard[1]
Location		X0...X9	X10...X19
OFF to ON Response	DC	< 2µs	2ms
	AC	–	10ms[2]
ON to OFF Response	DC	< 2µs	2ms
	AC	–	10ms[2]
Maximum Switching Frequency	DC	250kHz	
	AC	~ 30Hz	

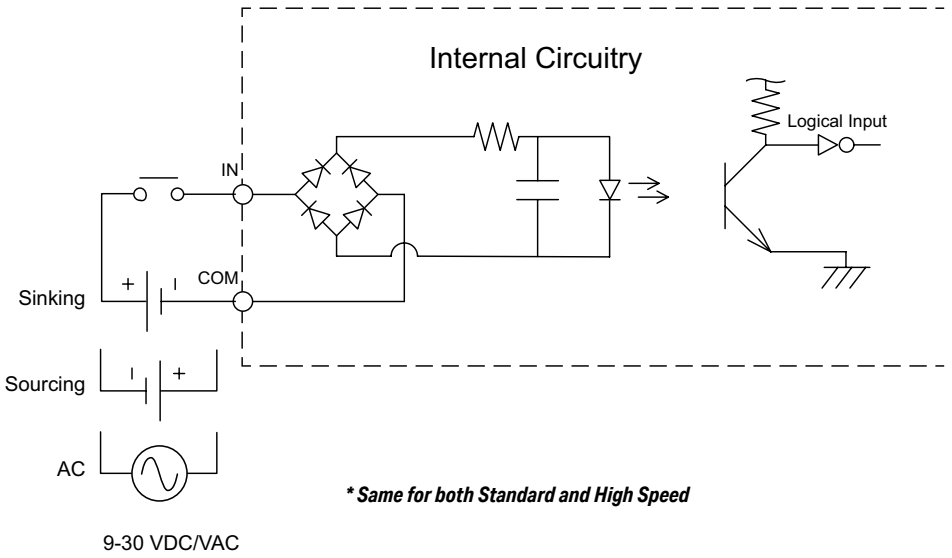
1. *All inputs may be used as standard inputs. Only the first 10 inputs (X0...X9) are capable of high-speed DC operation.*
2. *60Hz to 240Hz filter should be set in the software when using an AC line signal.*

BX-DM1E-36ER3-D Wiring, Continued

Discrete Input Connection Options



Discrete Input Internal Circuitry *



** Same for both Standard and High Speed*

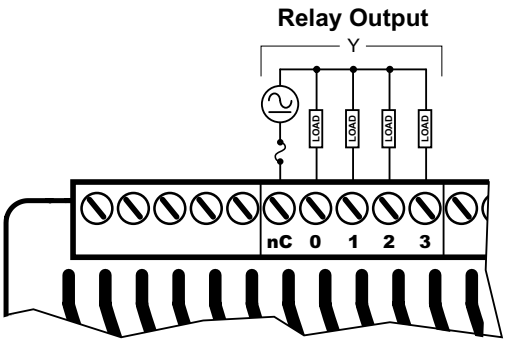
BX-DM1E-36ER3-D Wiring, Continued

Discrete Output Specifications

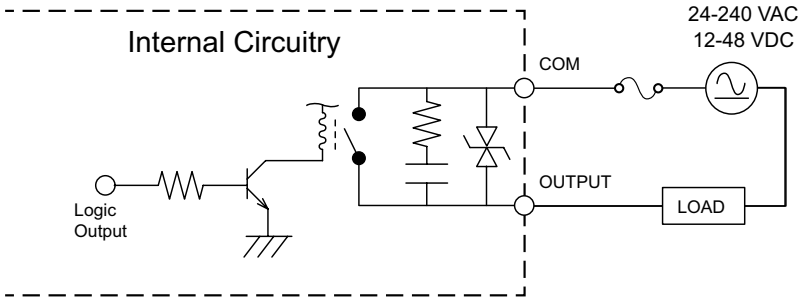
Discrete Output Specifications	
Output Type	Relay Form A (SPST)
Total Outputs per Module	16
Commons	4 (4 points/common) Isolated
Maximum Current per Common	8A
Nominal Voltage Range	12–48 VDC 24–240 VAC
Operating Voltage Range	5–60 VDC 5–264 VAC
Maximum Voltage	60VDC 264VAC
Minimum Output Current	0.1 mA @ 24VDC 0.1 mA @ 24VAC
Maximum Output Current	2A
Maximum Inrush Current	5A for 50ms
Maximum Leakage Current	1µA (DC), 300µA (AC) due to RC snubber circuit
ON Voltage Drop	0.2 V Max
Status Indicators	Logic Side, Green
Output Details	
Output Type	Standard
Location	Y0...Y15
ON-OFF Response	<10ms
OFF-ON Response	<10ms
Maximum Switching Frequency	10Hz
Relay Cycle Life Mechanical Endurance Electrical Endurance	 5 million operations 120,000 operations
Fuse Type	User-supplied external fuse

BX-DM1E-36ER3-D Wiring, Continued

Discrete Output Connection Options



Discrete Standard Output Internal Circuitry



BX-DM1E-36ER3-D Wiring, Continued

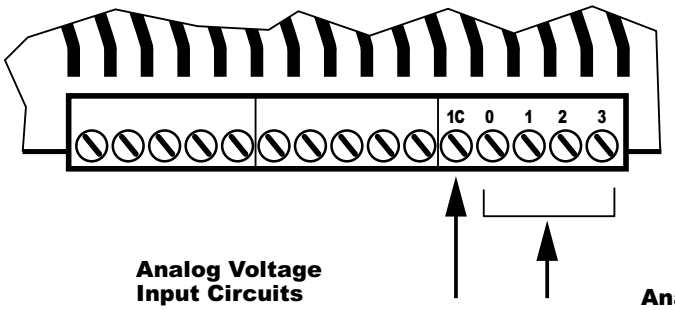
Analog Input Specifications

Analog Input Specifications	
Inputs per Module	4
Commons	1
Input Voltage Range *	Software Selectable ±10V, ±5V, 0–10 V, 0–5 V
Input Current Range *	Software Selectable ±20mA, 4–20 mA
Resolution ±10V, ±20mA ±5V 0–5 V 4–20 mA 0–10 V	 16 bits (0–65535 counts) 15 bits (0–32767 counts) 14 bits (0–16383 counts) ~15 bits (6553–32767 counts) 15 bits (0–32767 counts)
Input Impedance Voltage Modes	100kΩ
Absolute Maximum Input, Voltage Mode	±30V
Input Impedance Current Modes	249Ω
Absolute Maximum Input, Current Mode	±40mA sustained, ±100mA for < 5s
Conversion Time	1.2 ms
Input Stability	0.02% of Full Hardware Range = 13 Counts
Full Scale Calibration Error	0.05% of Full Hardware Range = 33 Counts
Offset Calibration Error	0.01% of Full Hardware Range = 7 Counts
Accuracy vs Temperature Error	0.05% of Full Hardware Range = 33 Counts
Maximum Linearity Error (End to End)	0.1% of Full Hardware Range = 66 Counts
Maximum Inaccuracy	0.2% of Full Hardware Range = 131 Counts
Fuse Type	User-supplied external fuse

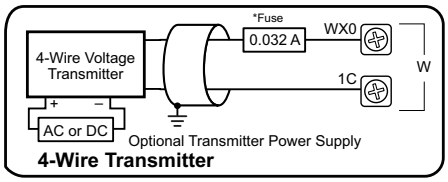
**** Software selectable per channel***

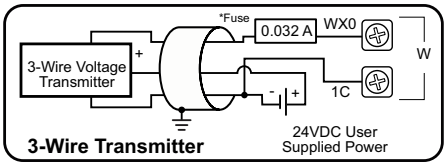
BX-DM1E-36ER3-D Wiring, Continued

Analog Input Connection Options



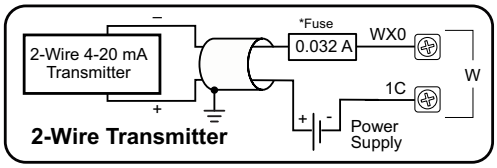
Analog Voltage Input Circuits

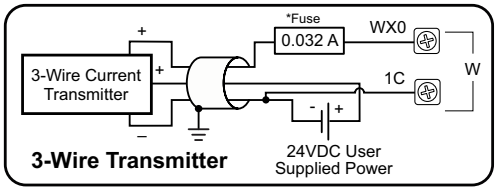


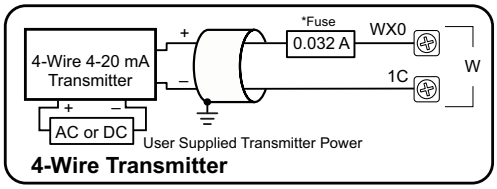


NOTE: Shield should be connected only at one end, to ground at the source device.

Analog Current Sinking Input Circuits







NOTE: Shield should be connected only at one end, to ground at the source device.



NOTE: *An Edison S500-32-R 0.032A fast-acting fuse is recommended for all analog voltage inputs, analog outputs, and current loops.*

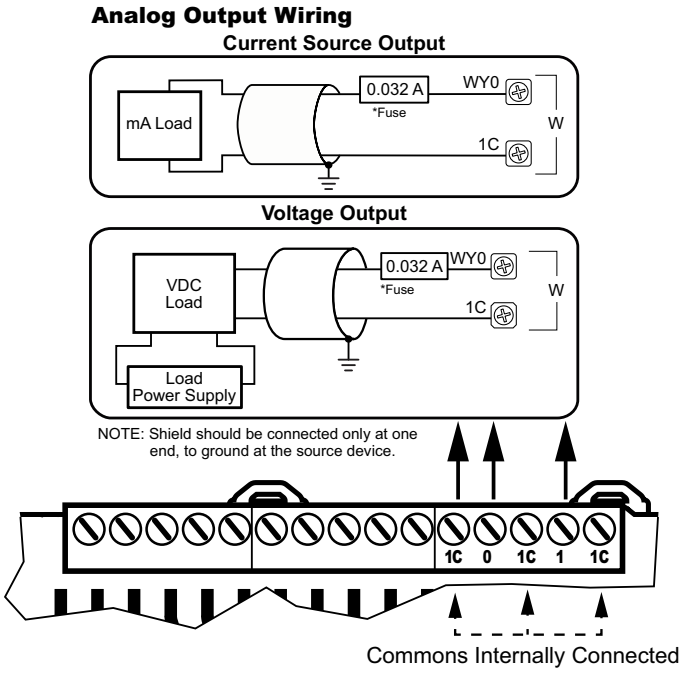
BX-DM1E-36ER3-D Wiring, Continued

Analog Output Specifications

Analog Output Specifications	
Outputs per Module	2
Commons	3
Output Voltage Range *	Software Selectable ±10V, ±5V, 0–10 V, 0–5 V
Output Current Range *	Software Selectable ±20mA, 4–20 mA
Resolution ±10V, ±20mA ±5V 0–5 V 4–20 mA 0–10 V	 16 bits (0–65535 counts) 15 bits (0–32767 counts) 14 bits (0–16383 counts) ~15 bits (6553–32767 counts) 15 bits (0–32767 counts)
Minimum Voltage Load Impedance	1kΩ
Maximum Current Load Impedance	500Ω
Maximum Rating	Continuous Short Circuit Protected
Settling Time	< 1ms
Output Stability	0.02% of Full Hardware Range = 13 Counts
Full Scale Calibration Error	0.05% of Full Hardware Range = 33 Counts
Offset Calibration Error	0.01% of Full Hardware Range = 7 Counts
Accuracy vs Temperature Error	0.05% of Full Hardware Range = 33 Counts
Maximum Linearity Error (End to End)	0.1% of Full Hardware Range = 66 Counts
Maximum Inaccuracy	0.2% of Full Hardware Range = 131 Counts
Fuse Type	User-supplied external fuse

**** Software selectable per channel***

Analog Output Connection Options



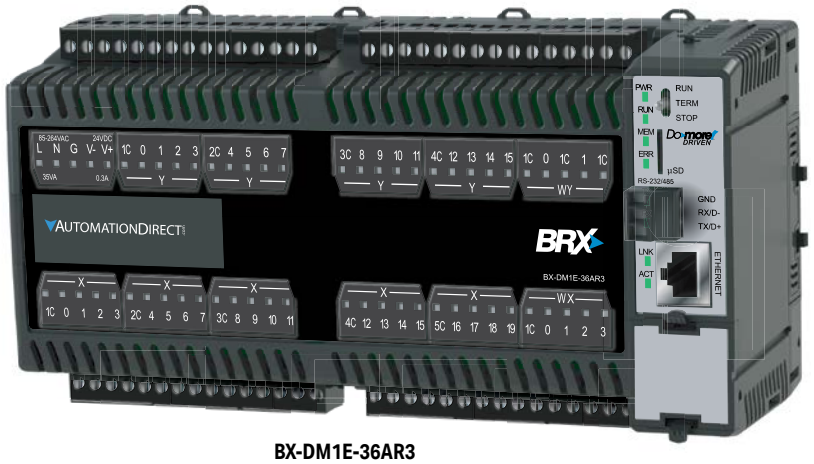
NOTE: *An Edison S500-32-R 0.032A fast-acting fuse is recommended for all analog voltage inputs, analog outputs, and current loops.*

BX-DM1E-36AR3 Wiring

This MPU is made up of 36 discrete I/O points. The connections are grouped as follows:

- 20 discrete inputs - AC rated for 120–240 VAC. They are located along the bottom of the unit; configured in five (5) groups of 5 terminals, each comprised of 4 inputs and an isolated common.
- 16 discrete outputs - Form A Relay (SPST); rated 12–48 VDC/ 24–240 VAC. They are located along the top of the unit starting to the right of the 24VDC auxiliary output terminals. The outputs are configured in four (4) groups of 5 terminals, each comprised of 4 outputs and an isolated common.
- 4 analog inputs and 2 analog outputs. The analog inputs are located along the bottom of the unit to the right of the discrete inputs. The analog inputs are grouped together on 5 terminals consisting of 4 input and a shared analog input common. The analog outputs are located along the top of the unit to the right of the discrete outputs. The analog outputs are grouped together on 5 terminals consisting of 2 outputs and 3 shared analog output common terminals. The analogs share these common features:
  - current or voltage selectable through software,
  - 16-bit resolution @ ±20mA, ±10VDC
  - current signal ranges of 4–20 mA, ±20mA,
  - voltage signal ranges of 0–5 VDC, 0–10 VDC, ±5VDC, ±10 VDC.

This MPU requires an external 120–240 VAC power supply. The AC power supply connection and the 24VDC auxiliary output supply terminals are located on the top left side of the unit.



BX-DM1E-36AR3

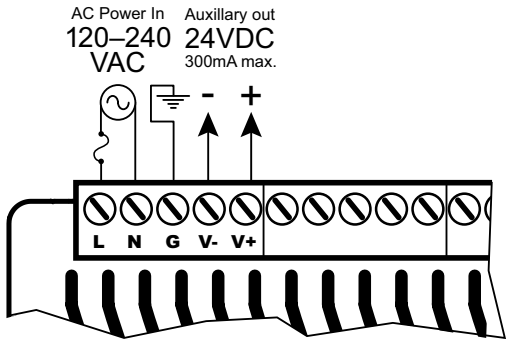
NOTE: *Eight (8) Expansion Modules can be connected to extend I/O capacity.*

BX-DM1E-36AR3 Wiring, Continued

Power Supply Specifications

Power Supply Specifications	
Nominal Voltage Range	120–240 VAC
Input Voltage Range (Tolerance)	85–264 VAC
Rated Operating Frequency	47–63 Hz
Maximum Input Power	40VA
Cold Start Inrush Current	1.5 A, 2ms
Maximum Inrush Current (Hot Start)	1.5 A, 2ms
Internal Input Fuse Protection	Micro fuse 250V, 2A Non-replaceable
Acceptable External Power Drop Time	10ms
Under Input Voltage Lock-out	80VAC
Input Transient Protection	Input choke and line filter
Heat Dissipation	26.8 W Max
Isolated User 24VDC Output	24VDC @ 0.3 A max, <1V P-P Ripple, Integrated self-resetting short circuit protection
Voltage Withstand (dielectric)	1500VAC Power Inputs to Ground applied for 1 minute 1500VAC Ground to 24VDC Output applied for 1 minute
Insulation Resistance	>10MΩ @ 500VDC
Software Version Required	Do-more! Designer version 2.0 or later

Power Supply Connections



WARNING: Do not exceed the 24VDC auxiliary power supply load limit of 300mA.

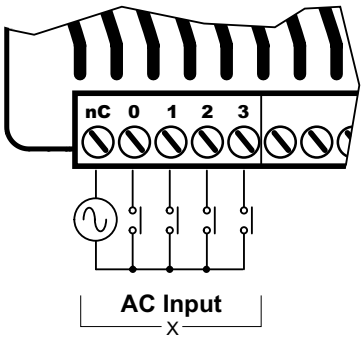
WARNING: The BRX System MUST have a proper earth ground. Do not operate the BRX MPU without proper earth grounding.

BX-DM1E-36AR3 Wiring, Continued

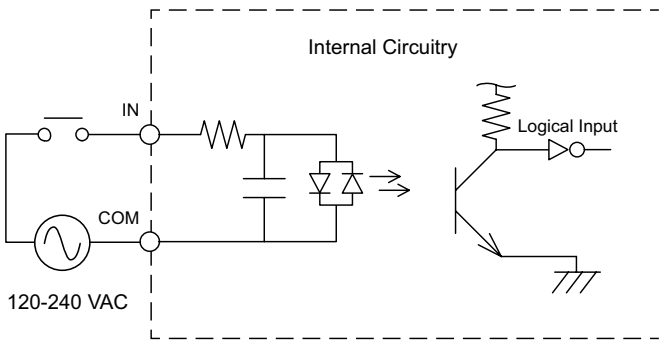
Discrete Input Specifications

Discrete Input Specifications	
Input Type	AC
Total Inputs per Module	20
Commons	5 (4 points/common) Isolated
Nominal Voltage Range	120–240 VAC
Input Voltage Range	85–264 VAC
Maximum Voltage	264VAC RMS
AC Frequency	47–63 Hz
Input Impedance	15kΩ
Input Current (typical)	9mA @ 120VAC, 13mA @ 220VAC
Maximum Input Current	14mA @ 120VAC, 20mA @ 220VAC
ON Voltage Level	> 85VAC
OFF Voltage Level	< 40VAC
Maximum OFF Current	2.5 mA
Status Indicators	Logic Side, Green
Input Details	
Input Type	Standard
Location	X0...X19
OFF - ON Response	10ms
ON - OFF Response	10ms
Maximum Switching Frequency	~ 30Hz

Discrete Input Connection Options



Discrete Input Internal Circuitry



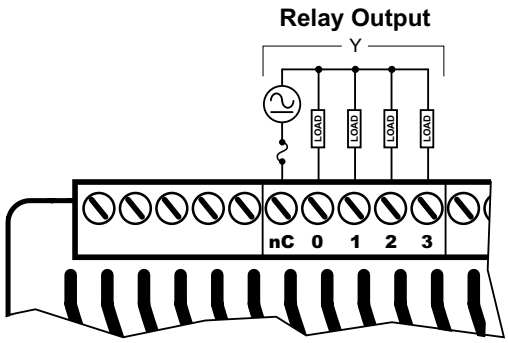
BX-DM1E-36AR3 Wiring, Continued

Discrete Output Specifications

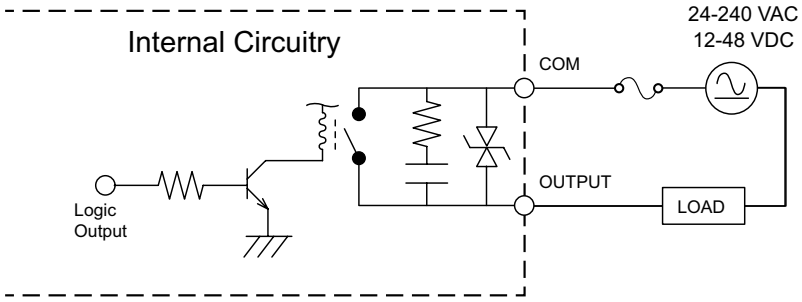
Discrete Output Specifications	
Output Type	Relay Form A (SPST)
Total Outputs per Module	16
Commons	4 (4 points/common) Isolated
Maximum Current per Common	8A
Nominal Voltage Range	12–48 VDC 24–240 VAC
Operating Voltage Range	5–60 VDC 5–264 VAC
Maximum Voltage	60VDC 264VAC
Minimum Output Current	0.1 mA @ 24VDC 0.1 mA @ 24VAC
Maximum Output Current	2A
Maximum Inrush Current	5A for 50ms
Maximum Leakage Current	1µA (DC), 300µA (AC) due to RC snubber circuit
ON Voltage Drop	0.2 V Max
Status Indicators	Logic Side, Green
Output Details	
Output Type	Standard
Location	Y0...Y15
ON-OFF Response	<10ms
OFF-ON Response	<10ms
Maximum Switching Frequency	10Hz
Relay Cycle Life Mechanical Endurance Electrical Endurance	 5 million operations 120,000 operations
Fuse Type	User-supplied external fuse

BX-DM1E-36AR3 Wiring, Continued

Discrete Output Connection Options



Discrete Standard Output Internal Circuitry



BX-DM1E-36AR3 Wiring, Continued

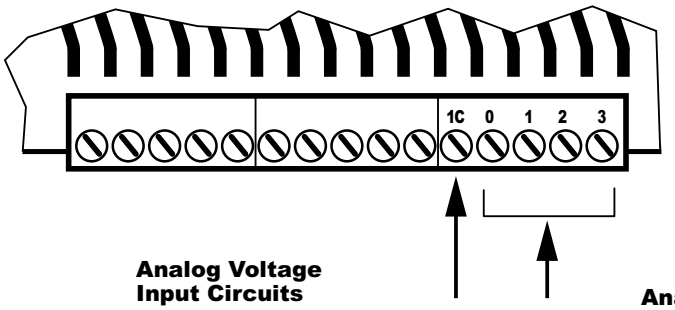
Analog Input Specifications

Analog Input Specifications	
Inputs per Module	4
Commons	1
Input Voltage Range *	Software Selectable ±10V, ±5V, 0–10 V, 0–5 V
Input Current Range *	Software Selectable ±20mA, 4–20 mA
Resolution ±10V, ±20mA ±5V 0–5 V 4–20 mA 0–10 V	 16 bits (0–65535 counts) 15 bits (0–32767 counts) 14 bits (0–16383 counts) ~15 bits (6553–32767 counts) 15 bits (0–32767 counts)
Input Impedance Voltage Modes	100kΩ
Absolute Maximum Input, Voltage Mode	±30V
Input Impedance Current Modes	249Ω
Absolute Maximum Input, Current Mode	±40mA sustained, ±100mA for < 5s
Conversion Time	1.2 ms
Input Stability	0.02% of Full Hardware Range = 13 Counts
Full Scale Calibration Error	0.05% of Full Hardware Range = 33 Counts
Offset Calibration Error	0.01% of Full Hardware Range = 7 Counts
Accuracy vs Temperature Error	0.05% of Full Hardware Range = 33 Counts
Maximum Linearity Error (End to End)	0.1% of Full Hardware Range = 66 Counts
Maximum Inaccuracy	0.2% of Full Hardware Range = 131 Counts
Fuse Type	User-supplied external fuse

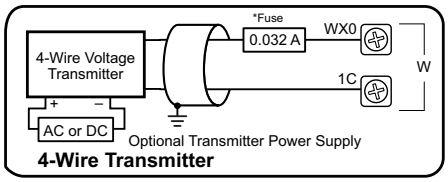
**** Software selectable per channel***

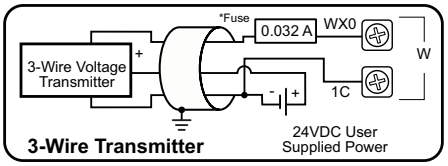
BX-DM1E-36AR3 Wiring, Continued

Analog Input Connection Options



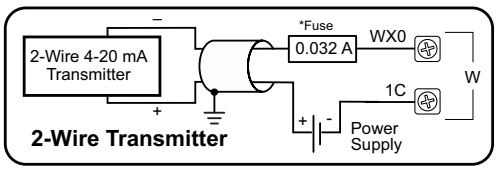
Analog Voltage Input Circuits

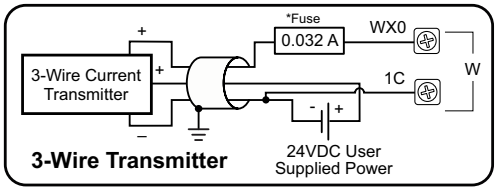


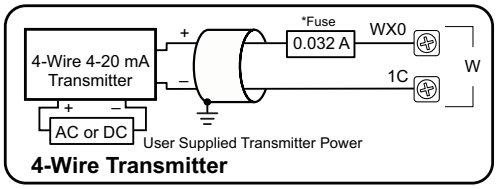


NOTE: Shield should be connected only at one end, to ground at the source device.

Analog Current Sinking Input Circuits







NOTE: Shield should be connected only at one end, to ground at the source device.

NOTE: *An Edison S500-32-R 0.032A fast-acting fuse is recommended for all analog voltage inputs, analog outputs, and current loops.*

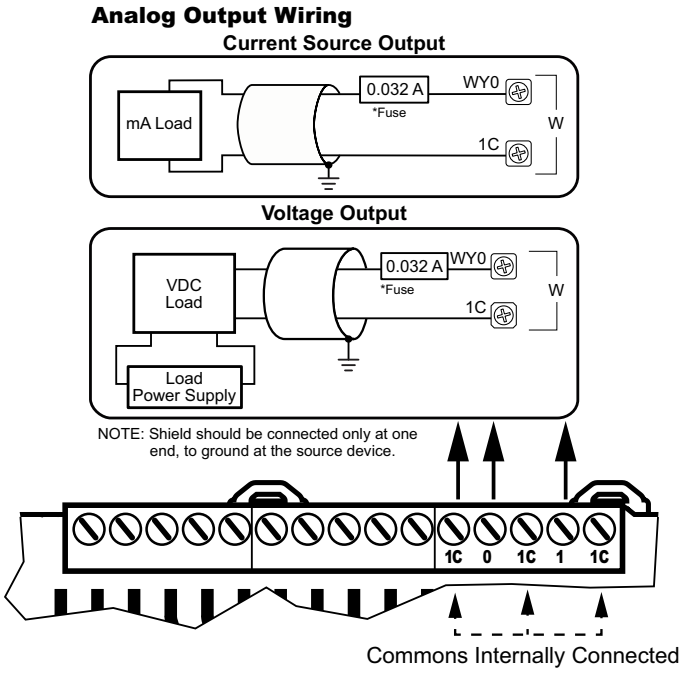
BX-DM1E-36AR3 Wiring, Continued

Analog Output Specifications

Analog Output Specifications	
Outputs per Module	2
Commons	3
Output Voltage Range *	Software Selectable ±10V, ±5V, 0–10 V, 0–5 V
Output Current Range *	Software Selectable ±20mA, 4–20 mA
Resolution ±10V, ±20mA ±5V 0–5 V 4–20 mA 0–10 V	 16 bits (0–65535 counts) 15 bits (0–32767 counts) 14 bits (0–16383 counts) ~15 bits (6553–32767 counts) 15 bits (0–32767 counts)
Minimum Voltage Load Impedance	1kΩ
Maximum Current Load Impedance	500Ω
Maximum Rating	Continuous Short Circuit Protected
Settling Time	< 1ms
Output Stability	0.02% of Full Hardware Range = 13 Counts
Full Scale Calibration Error	0.05% of Full Hardware Range = 33 Counts
Offset Calibration Error	0.01% of Full Hardware Range = 7 Counts
Accuracy vs Temperature Error	0.05% of Full Hardware Range = 33 Counts
Maximum Linearity Error (End to End)	0.1% of Full Hardware Range = 66 Counts
Maximum Inaccuracy	0.2% of Full Hardware Range = 131 Counts
Fuse Type	User-supplied external fuse

**** Software selectable per channel***

Analog Output Connection Options



NOTE: *An Edison S500-32-R 0.032A fast-acting fuse is recommended for all analog voltage inputs, analog outputs, and current loops.*

Notes:

BRX Pluggable Option Module (POM)



In This Chapter...

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Overview

BRX Do-more! MPUs have a slot available for the addition of a single BRX Pluggable Option Module (POM). The POM slot can be used to add a serial port, Ethernet port, USB port or any other POM modules that are available.

POM modules are hot swappable; this allows you to interchange different communication options while the system is running. For example you can configure the system to use the RJ45 Ethernet port POM to talk with a C-more panel. Then you can hot swap to the USB POM for programming. When you are done programming you can hot swap back to the Ethernet POM without needing to power cycle or reconfigure the system.

General Specifications

General specifications common to the POM modules are listed in the table below.

General Specifications	
Operating Temperature	0° to 60°C (32° to 140°F)
Storage Temperature	-20° to 85°C (-4° to 185°F)
Humidity	5 to 95% (non-condensing)
Environmental Air	No corrosive gases permitted
Vibration	IEC60068-2-6 (Test Fc)
Shock	IEC60068-2-27 (Test Ea)
Enclosure Type	Open equipment
Agency Approvals	UL 61010-2 - UL File # E185989 Canada and USA CE Compliant E185989*
Noise Immunity	NEMA ICS3-304
EU Directive	See the "EU Directive" in Appendix B or topic DMD0331 in the Do-more! Designer software Help file.
Weight	7g (0.25 oz)

**** Meets EMC and Safety requirements. See the D.O.C. for details.***



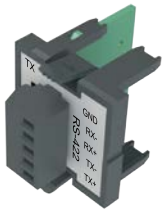
BX-P-SER2-TERM
RS-232 Port



BX-P-SER2-TERMFC
RS-232 Port
w/Flow Control



BX-P-SER4-TERM
RS-485 Port



BX-P-SER422-TERM
RS-422 Port



BX-P-SER2-RJ12
RS-232 Port (RJ12)



BX-P-ECOMLT
Ethernet Port
(Any CPU)



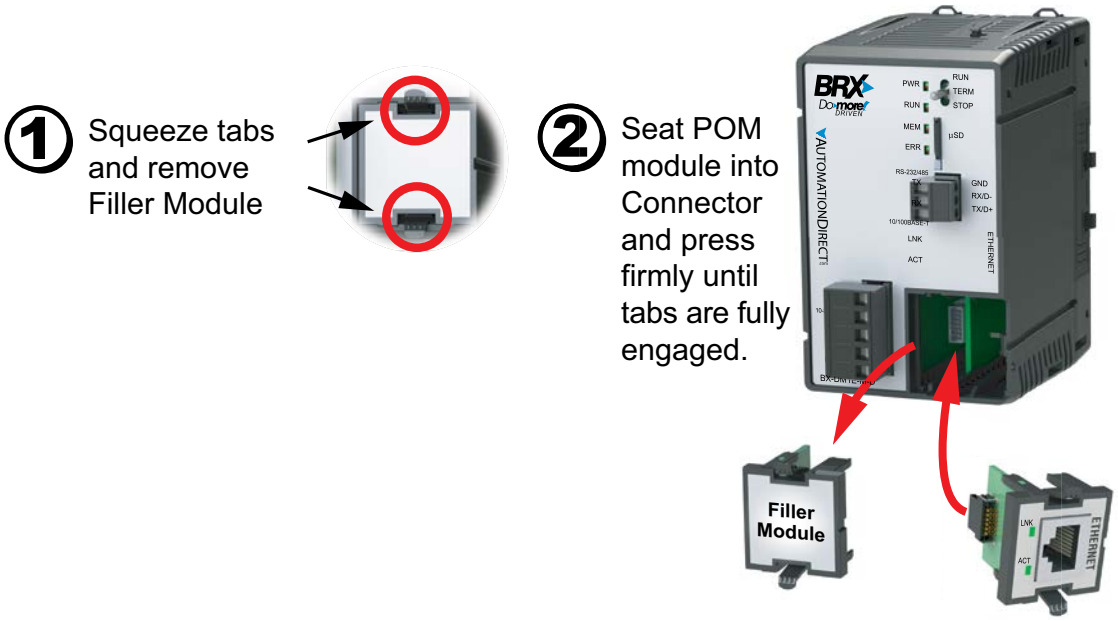
BX-P-ECOMEX
Ethernet Port
(DM1E CPU Only)



BX-P-USB-B
USB Type B Port

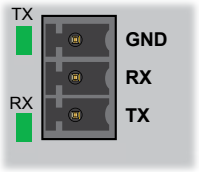
Module Installation

The blank filler plate can be removed by squeezing in on the top and bottom tabs and pulling the module forward, away from the unit. To install the POM, orient the module so that the connector on the rear is on the left side, align the locking tabs on the top and bottom of the module, and gently guide the module into the opening until you hear it click, locking the module into place.



BX-P-SER2-TERM

This RS-232 POM can be connected to the Do-more! Designer programming software, Modbus RTU master or slave devices, DirectLogic PLCs via K-Sequence protocol, as well as devices that send or receive non-sequenced ASCII strings or characters.



Pinout	RS232
1	GND
2	RX
3	TX



Removable Connector Included

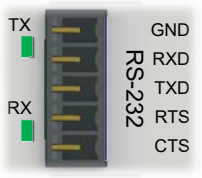
BX-P-SER2-TERM Specifications	
Description	Non-isolated Serial port that can communicate via RS-232. Includes ESD protection and built-in surge protection.
Supported Protocols	Do-more!™ Protocol (Slave) (Default) Modbus RTU (Master & Slave) K-Sequence (Slave) ASCII (In & Out)
Data Rates	1200, 2400, 4800, 9600, 19200, 38400, 57600, and 115200 Baud
Default Settings	115200bps, No Parity, 8 Data Bits, 1 Stop Bit, Station #1
Port Status LED	Green LED is illuminated when active for TXD and RXD
Port Type	Removable 3-pin terminal strip 3.5 mm pitch
RS-232 TX	RS-232 Transmit output
RS-232 RX	RS-232 Receive input
RS-232 GND	Logic ground
RS-232 Maximum Output Load (TXD/RTS)	3kΩ, 1000pf
RS-232 Minimum Output Voltage Swing	±5V
RS-232 Output Short Circuit Protection	±15mA
Cable Requirements	RS-232 use P/N L19772-XXX from automationdirect.com
Maximum Distance	6 meters (20 foot) recommended maximum
Replacement Connector	ADC Part # BX-RTB03S
Hot Swappable	Yes
Software Version Required	Do-more! Designer version 2.0 or later

BX-RTB03S Connector Specifications	
Part Number	BX-RTB03S
Connector Type	Screw type
Wire Exit	180 degree
Pitch	3.5 mm
Screw Size	M2
Recommended Screw Torque	<1.77 lb·in (0.2 N·m)
Screwdriver Blade Width	2.5 mm
Wire Gauge (Single Wire)	28–16 AWG
Wire Gauge (Two Wires)	28–16 AWG
Wire Strip Length	0.24 in (6mm)
Equiv. Dinkle part #	EC350V-03P-BK

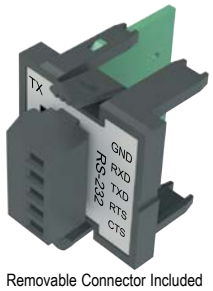

Removable Connector Included

BX-P-SER2-TERMFC

This RS-232 POM can be connected to the Do-more! Designer programming software, Modbus RTU master devices, DirectLogic PLCs via K-Sequence protocol, as well as devices that send or receive non-sequenced ASCII strings or characters.



Pinout	RS232
1	GND
2	RXD
3	TXD
4	RTS
5	CTS



Removable Connector Included

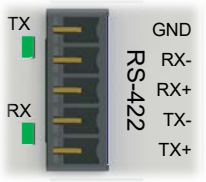
BX-P-SER2-TERMFC Specifications	
Description	Non-isolated Serial port that can communicate via RS-232. Includes ESD protection and built-in surge protection.
Supported Protocols	Do-more!™ Protocol (Slave) (Default) Modbus RTU (Master & Slave) K-Sequence (Slave) ASCII (In & Out)
Data Rates	1200, 2400, 4800, 9600, 19200, 38400, 57600, and 115200 Baud
Default Settings	115200bps, No Parity, 8 Data Bits, 1 Stop Bit
Port Status LED	Green LED is illuminated when active for TXD and RXD
Port Type	Removable 5-pin terminal strip 3.5 mm pitch
RS-232 TX	RS-232 Transmit output
RS-232 RX	RS-232 Receive input
RS-232 GND	Logic ground
RS-232 CTS	RS-232 Clear to Send input
RS-232 RTS	RS-232 Request to Send input
RS-232 Maximum Output Load (TXD/RTS)	3kΩ, 1000pf
RS-232 Minimum Output Voltage Swing	±5V
RS-232 Output Short Circuit Protection	±15mA
Cable Requirements	RS-232 use P/N L19853-XXX from automationdirect.com
Maximum Distance	6 meters (20 foot) recommended maximum
Replacement Connector	ADC Part # BX-RTB05S
Hot Swappable	Yes
Software Version Required	Do-more! Designer version 2.7 or later

BX-RTB05S Connector Specifications	
Part Number	BX-RTB05S
Connector Type	Screw type
Wire Exit	180 degree
Pitch	3.5 mm
Screw Size	M2
Recommended Screw Torque	<1.77 lb·in (0.2 N·m)
Screwdriver Blade Width	2.5 mm
Wire Gauge (Single Wire)	28–16 AWG
Wire Gauge (Two Wires)	28–16 AWG
Wire Strip Length	0.24 in (6mm)
Equiv. Dinkle part #	EC350V-05P-BK


Removable Connector Included

BX-P-SER422-TERM

The RS-422 POM can be connected to the Do-more! Designer programming software, Modbus RTU master devices, DirectLogic PLCs via K-Sequence protocol, as well as devices that send or receive non-sequenced ASCII strings or characters.



Pinout	RS422
1	GND
2	RX-
3	RX+
4	TX-
5	TX+



Removable Connector Included

BX-P-SER422-TERM Specifications	
Description	Non-isolated Serial port that can communicate via RS-422. Includes ESD protection and built-in surge protection.
Supported Protocols	Do-more!™ Protocol (Slave) (Default) Modbus RTU (Master & Slave) K-Sequence (Slave) ASCII (In & Out)
Data Rates	1200, 2400, 4800, 9600, 19200, 38400, 57600, and 115200 Baud
Default Settings	115200bps, No Parity, 8 Data Bits, 1 Stop Bit, Station #1
Port Status LED	Green LED is illuminated when active for TXD and RXD
Port Type	Removable 5-pin terminal strip 3.5 mm pitch
Station Addresses	1–247
TX-/RX-	RS-422 Transceiver low
TX+/RX+	RS-422 Transceiver high
GND	Logic ground
Input Impedance	96kΩ
Maximum Load	50 transceivers, 19kΩ each, 120Ω termination
Output Short Circuit Protection	±250mA, thermal shutdown protection
Minimum Differential Output Voltage	2.0 VDC with 54Ω load
Maximum Common Mode Voltage	-7.5 to 12.5 VDC
Fail Safe Inputs	Logic high input state if inputs are unconnected
Electrostatic Discharge Protection	±15kV human body, ±6kV contact discharge per IEC61000-4-2
Cable Requirements	RS-422 use P/N L19853-XXX from automationdirect.com
Maximum Distance	1000 meters (3280 feet) recommended maximum
Replacement Connector	ADC Part # BX-RTB05S
Hot Swappable	Yes
Software Version Required	Do-more! Designer version 2.7 or later

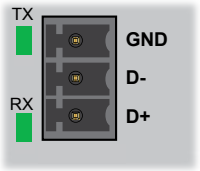
BX-RTB05S Connector Specifications	
Part Number	BX-RTB05S
Connector Type	Screw type
Wire Exit	180 degree
Pitch	3.5 mm
Screw Size	M2
Recommended Screw Torque	<1.77 lb·in (0.2 N·m)
Screwdriver Blade Width	2.5 mm
Wire Gauge (Single Wire)	28–16 AWG
Wire Gauge (Two Wires)	28–16 AWG
Wire Strip Length	0.24 in (6mm)
Equiv. Dinkle part #	EC350V-05P-BK



Removable Connector Included

BX-P-SER4-TERM

The RS-485 POM can be connected to the Do-more! Designer programming software, Modbus RTU master or slave devices, DirectLogic PLCs via K-Sequence protocol, as well as devices that send or receive non-sequenced ASCII strings or characters.



Pinout	RS485
1	GND
2	D-
3	D+



Removable Connector Included

BX-P-SER4-TERM Specifications	
Description	Non-isolated Serial port that can communicate via RS-485. Includes ESD protection and built-in surge protection. Includes internal biasing to be a true failsafe receiver while maintaining EIA/TIA-485 compatibility.
Supported Protocols	Do-more!™ Protocol (Slave) (Default) Modbus RTU (Master & Slave) K-Sequence (Slave) ASCII (In & Out)
Data Rates	1200, 2400, 4800, 9600, 19200, 38400, 57600, and 115200 baud
Default Settings	115200bps, No Parity, 8 Data Bits, 1 Stop Bit, Station #1, Termination resistor OFF
Port Status LED	Green LED is illuminated when active for TXD and RXD
Port Type	Removable 3-pin terminal strip, 3.5 mm pitch
RS-485 Station Addresses	1–247
RS-485 D+	RS-485 transceiver high
RS-485 D-	RS-485 transceiver low
RS-485 GND	Logic ground
RS-485 Input Impedance	19kΩ
RS-485 Maximum Load	50 transceivers, 19kΩ each, DIP switch selectable 120Ω termination resistor
RS-485 Output Short Circuit Protection	±250mA, thermal shut-down protection
RS-485 Electrostatic Discharge Protection	±8kV per IEC1000-4-2
RS-485 Electrical Fast Transient Protection	±2kV per IEC1000-4-4
RS-485 Minimum Differential Output Voltage	1.5 V with 60Ω load
RS-485 Fail Safe Inputs	Logic high input state if inputs are unconnected
RS-485 Maximum Common Mode Voltage	-7.5 V to 12.5 V
Cable Requirements	RS-485 use P/N L19954-XXX from automationdirect.com
Maximum Distance	1000 meters (3280 feet)
Replacement Connector	ADC Part # BX-RTB03S
Hot Swappable	Yes
Software Version Required	Do-more! Designer version 2.0 or later

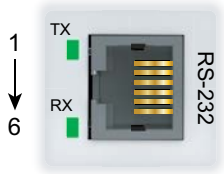
BX-RTB03S Connector Specifications	
Part Number	BX-RTB03S
Connector Type	Screw type
Wire Exit	180 degree
Pitch	3.5 mm
Screw Size	M2
Recommended Screw Torque	<1.77 lb·in (0.2 N·m)
Screwdriver Blade Width	2.5 mm
Wire Gauge (Single Wire)	28–16 AWG
Wire Gauge (Two Wires)	28–16 AWG
Wire Strip Length	0.24 in (6mm)
Equiv. Dinkle part #	EC350V-03P-BK


Removable Connector Included

BX-P-SER2-RJ12

The RS-232 RJ12 POM can be connected to the Do-more! Designer programming software, Modbus RTU master or slave devices, DirectLogic PLCs via K-Sequence protocol, as well as devices that send or receive non-sequenced ASCII strings or characters.





6-pin RJ12 Female Modular Connector

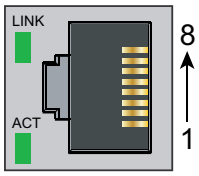
Pin #	Signal	
1	0V	Power (-) connection (GND)
2	5V	Power (+) connection (220mA max)
3	RXD	Receive Data (RS-232)
4	TXD	Transmit Data (RS-232)
5	RTS	Request to Send (RS-232)
6	CTS	Clear to Send (RS-232)

BX-P-SER2-RJ12 Specifications	
Description	Non-isolated Serial port that can communicate via RS-232. Includes ESD protection and built-in surge protection.
Supported Protocols	Do-more!™ Protocol (Slave) (Default) Modbus RTU (Master & Slave) K-Sequence (Slave) ASCII (In & Out)
Data Rates	1200, 2400, 4800, 9600, 19200, 38400, 57600, and 115200 Baud
Default Settings	115200bps, No Parity, 8 Data Bits, 1 Stop Bit, Station #1
Port Status LED	Green LED is illuminated when active for TXD and RXD
Port Type	RJ12 - 6P6C
RS-232 Maximum Output Load (TXD/RTS)	3kΩ, 1000pf
RS-232 Minimum Output Voltage Swing	±5V
RS-232 Output Short Circuit Protection	±15mA
Cable Requirements	Recommend AutomationDirect.com cable D2-DSCBL (with USB-RS232-1) or EA-MG-PGM-CBL
Maximum Distance	6 meters (20 feet), maximum recommended distance
Replacement Connector	N/A
Hot Swappable	Yes
Software Version Required	Do-more! Designer version 2.0 or later

BX-P-ECOMLT

The Ethernet LT POM can be connected to the Do-more! Designer programming software or HMI's that support the Do-more!, Modbus, or K-sequence protocol. This POM functions only as a server device.





Pin #	Signal
1	TXD+ Transmit Data
2	TXD- Transmit Data
3	RXD+ Receive Data
4	N/C
5	N/C
6	RXD- Receive Data
7	N/C
8	N/C

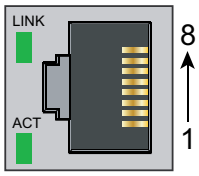
BX-P-ECOMLT Specifications	
Description	Standard transformer isolated Ethernet port with built-in surge protection.
Transfer Rate	1 Mbps throughput max
Port Status LED[1]	LINK LED is solid when network link is established. ACT LED flashes when port is active.
Supported Protocols	Do-more! Protocol (Server) Modbus (Server) K-sequence (Server) Programming/Monitoring
Cable Recommendation	C5E-STxxx-xx from AutomationDirect.com
Maximum Distance	100 meters (328 feet)
Port Type	RJ45, Category 5, Auto Crossover
Ethernet Port Numbers: Do-more! Slave Protocol Modbus TCP Slave K-sequence Slave Programming/Monitoring	 28784, UDP 502, TCP 28784, UDP 28784, UDP
Hot Swappable	Yes
Software Version Required	Do-more! Designer version 2.0 or later

1. Link LED will Blink when no cable is attached, showing that the POM has a connection to the CPU and is waiting for a working link.

BX-P-ECOMEX

The Ethernet EX POM provides a general-purpose Ethernet interface that can be connected to devices using a wide range of protocols, as shown in the table below.





Pin #	Signal
1	TXD+ Transmit Data
2	TXD- Transmit Data
3	RXD+ Receive Data
4	N/C
5	N/C
6	RXD- Receive Data
7	N/C
8	N/C

NOTE: *The BX-P-ECOMEX POM can be installed in the DM1E CPUs only. It must be configured via Do-more! Designer software, and* ***must be on a different subnet than the built-in Ethernet port****.*

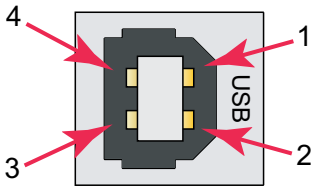
BX-P-ECOMEX Specifications			
Description	Standard transformer isolated Ethernet port with built-in surge protection.		
Transfer Rate	10/100 Mbps		
Port Status LED*	LINK LED is solid when network link is established. ACT LED flashes when port is active.		
Supported Protocols	SMTP(Email) FTP (Client) Do-more! Ethernet I/O MQTT / MQTTS HTTP / HTTPS Embedded Web Server: HTTP (Unsecure) EtherNet/IP: Explicit/Implicit Messaging, Scanner/Adapter SNTP (Time Server) TCP/IP (Raw Packet) Modbus TCP/IP (Client & Server) DHCP		
Cable Recommendation	C5E-STxxx-xx from AutomationDirect.com		
Maximum Distance	100 meters (328 feet)		
Port Type	RJ45, Category 5, Auto Crossover		
Ethernet Port Numbers:	Peerlink Do-more! Protocol (Client, Server) Modbus TCP (Client, Server) HOST Ethernet Protocol (Client, Server) EtherNet/IP: Explicit/Implicit Messaging Scanner/Adapter SMTP (Email) Ethernet Remote I/O HTTP, HTTPS Embedded Web Server: HTTP (Unsecure) MQTT, MQTTS SNTP (Time Server) TCP Raw Packet UDP Raw Packet FTP (Client)	28784 28784 502 28784 44818 25 28784 80, 443 80 1883, 8883 123 User defined User defined 20, 21	UDP UDP TCP UDP TCP TCP UDP TCP TCP TCP TCP TCP UDP TCP
Hot Swappable	Yes		
Software Version Required	Do-more! Designer version 2.8 or later (version 2.10 or later required for EtherNet/IP Implicit Messaging)		

**** Link LED will Blink when no cable is attached, showing that the POM has a connection to the CPU and is waiting for a working link.***

BX-P-USB-B

The USB POM can only be connected to the Do-more! Designer programming software. This POM functions only as a programming interface.





Pin #	Signal
1	+5VDC
2	-Data
3	+Data
4	GND

BX-P-USB-B Specifications	
Description	USB Type B Port that can be utilized for programming.
USB Specification Version	USB 2.0
Port Status LED	LED flashes when port is active
Cable Recommendation	USB-CBL-ABxx from AutomationDirect.com
Hot Swappable	Yes
Software Version Required	Do-more! Designer version 2.0 or later

BRX Digital I/O Expansion Modules



In This Chapter...

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BX-08CD3R Combination DC Input/Relay Output 7-32
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BX-16CF3F2 Combination DC Input/DC Sourcing Output 7-40

Overview

One key feature of the BRX platform is its ability to expand its capability to fit your application solution. One of the ways the BRX platform can do this is by using expansion modules that conveniently "Snap-on" to the side of any BRX MPU. Once the expansion module has snapped in place it is automatically added to the project and instantly adds additional I/O and features to the MPU with little to no additional setup required.



NOTE: *To learn more about adding expansion units to the project, go to "Installing the Expansion I/O Modules" in Chapter 1.*

The digital expansion modules give you the ability to add additional discrete I/O as needed and are identified as an input module, output module or combination input/output module. On the front panel of the digital I/O expansion modules a color scheme and a symbol are used to denote the module type.

Most modules are available in 5, 8, 12, 16 or 32 point variations consisting of sink/source DC inputs/outputs, AC inputs/outputs, relay outputs and combination modules.

The modules ship without wiring terminal blocks. This allows you to select the termination style that best fits your application. There are several wiring options available, including screw terminal connectors, spring clamp terminal connectors and pre-wired ***ZIP***Link cable solutions.

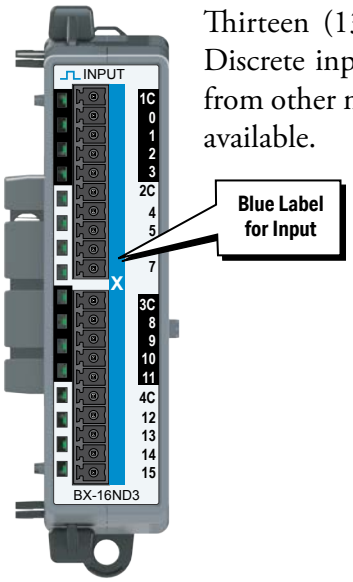
More detailed information about the digital expansion modules along with specifications and wiring diagrams follow in this chapter.



NOTE: *When using relay expansion modules, adding 32 or more relay points requires you to perform a power budget calculation. See Appendix C for more information.*

Module Types

Discrete Input Modules

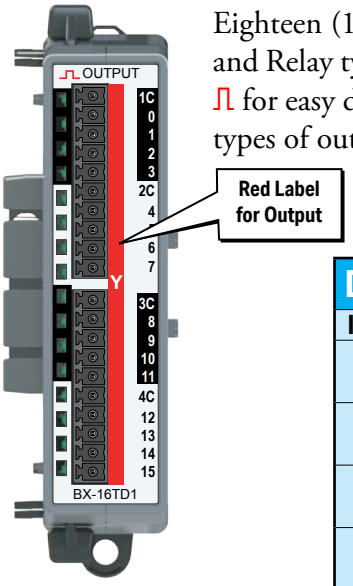


Thirteen (13) discrete input modules are available in various DC and AC voltage ranges. Discrete input module faceplates have a blue terminal bar and symbol ⎍ for easy distinction from other module types. Listed in the table below are the five different types of input modules available.

Discrete Input Modules

Identifier	Type	8-Point	12-Point	16-Point	32-Point
NF3	3–5 VDC Sink/Source	BX-08NF3	N/A	BX-16NF3	N/A
ND3	12–24 VDC Sink/Source	BX-08ND3	BX-12ND3	BX-16ND3	BX-32ND3
NB	24VAC	BX-08NB	BX-12NB	BX-16NB	N/A
NA	120VAC	BX-08NA	BX-12NA	BX-16NA	N/A
SIM	Simulator	BX-08SIM	N/A	N/A	N/A

Discrete Output Modules



Eighteen (18) discrete output modules are available in DC sinking, DC sourcing, AC voltage and Relay type outputs. Discrete output module faceplates have a red terminal bar and symbol ⎍ for easy distinction from other module types. Listed in the table below are the five different types of output modules available.

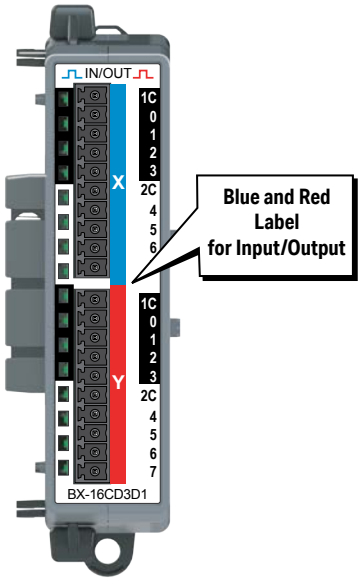
Discrete Output Modules

Identifier	Type	5-Point	8-Point	12-Point	16-Point	32-Point
TD1	12–24 VDC Sinking	N/A	BX-08TD1	BX-12TD1	BX-16TD1	BX-32TD1
TD2	12–24 VDC Sourcing	N/A	BX-08TD2	BX-12TD2	BX-16TD2	BX-32TD2
TF2	3–5 VDC Sourcing	N/A	N/A	N/A	BX-16TF2	N/A
TR	Relay Form A (SPST)	N/A	BX-08TR	BX-12TR	BX-16TR	N/A
TRZ	Relay Form A (SPST), no surge suppression	N/A	BX-08TRZ	N/A	BX-16TRZ	N/A
TRS	Relay Form C (SPDT)	BX-05TRS, BX-05TRS-1	N/A	N/A	N/A	N/A
TA	120–240 VAC Triac	N/A	BX-08TA	BX-12TA	N/A	N/A

Module Types, Continued

Discrete Combo Input/Output Modules

Six (6) discrete input/output combo modules are available with DC sink/source inputs and sink/source/relay outputs. The Input/Output faceplate terminal bar is in blue and red, with both the blue ⎍ and red ⎍ symbols to make it easy to distinguish between inputs and outputs and from other module types.



Discrete Combo Input/Output Type						
Identifier	**Identifier**	**Input Type**	**Output Type**	**8-Point**	**12-Point**	**16-Point**
CD3	D1	12–24 VDC Sink/Source	12–24 VDC Sinking	N/A	BX-12CD3D1	BX-16CD3D1
	D2		12–24 VDC Sourcing		BX-12CD3D2	BX-16CD3D2
	R		Relay Form A (SPST)	BX-08CD3R	N/A	N/A
CF3	F2	3–5 VDC Sink/Source	3–5 VDC Sourcing	N/A	N/A	BX-16CF3F2

Wiring Termination Options

The BRX digital expansion modules ship without wiring terminals blocks. This allows you to select the termination style that best fits your application. There are several wiring options available, including removable screw terminal connectors, removable spring clamp terminal connectors and pre-wired ***ZIP***Link cable solutions.

Terminal Block Connectors

The terminal block connectors are provided in kits of multiple connectors that are easily ordered as a single part number. There are 2 different types of kits to choose from; one kit for the five, eight and 12-point discrete modules and one kit for the 16-point discrete modules. The five, eight and 12-point module kit includes (3) 5-pin 5mm connectors. The 8-point modules will use only 2 of the 5-pin connectors, one (1) will not be used. The 5 and 12-point modules will use all three connectors. The 16-point module kits include (2) 10-pin 3.81 mm connectors.

NOTE: *32-point modules are not compatible with terminal block connectors and require* ***ZIP****Link cables.*

Terminal block kit part numbers and connector specifications are listed in the following tables.

Terminal Block Connectors, 5-Point, 8-Point & 12-Point Discrete Modules



BX-RTB08 Kit



BX-RTB08-1 Kit



BX-RTB08-2 Kit

Terminal Block Specifications 5, 8 & 12-point Type			
Kit Part Number	**BX-RTB08**	**BX-RTB08-1**	**BX-RTB08-2**
Connector Type	Screw Type - 90 degree	Spring Clamp Type - 180 degree	Screw Type - 180 degree
Wire Exit	180 degree	180 degree	180 degree
Pitch	5.0 mm	5.0 mm	5.0 mm
Screw Size	M2.5	N/A	M2.5
Screw Torque Recommended	< 3.98 lb·in (0.45 N·m)	N/A	< 3.98 lb·in (0.45 N·m)
Screwdriver Blade Width	3.5 mm	3.5 mm	3.5 mm
Wire Gauge (Single Wire)	28–12 AWG	28–14 AWG	28–12 AWG
Wire Gauge (Dual Wire)	28–16 AWG	28–16 AWG (Dual Wire Ferrule Required)	28–16 AWG
Wire Strip Length	0.3 in (7.5 mm)	0.37 in (9.5 mm)	0.3 in (7.5 mm)
Equiv. Dinkle P/N	5ESDV-05P-BK	5ESDSR-05P-BK	5ESDF-05P-BK

Terminal Block Connectors, 16-Point Discrete Modules



BX-RTB10 Kit



BX-RTB10-1 Kit



BX-RTB10-2 Kit

Terminal Block Specifications 16-point			
Part Number	**BX-RTB10**	**BX-RTB10-1**	**BX-RTB10-2**
Connector Type	Screw Type 90 degree	Spring Clamp Type 180 degree	Screw Type 180 degree
Wire Exit	180 degree	180 degree	180 degree
Pitch	3.81 mm	3.81 mm	3.81 mm
Screw Size	M2	N/A	M2
Screw Torque Recommended	<1.77 lb·in (0.2 N·m)	N/A	<1.77 lb·in (0.2 N·m)
Screwdriver Blade Width	2.5 mm	2.5 mm	2.5 mm
Wire Gauge (Single Wire)	28–16 AWG	26–18 AWG	30–16 AWG
Wire Gauge (Dual Wire)	28–18 AWG	30–20 AWG (Dual Wire Ferrule Required)	30–18 AWG
Wire Strip Length	0.24 in (6mm)	0.35 in (9mm)	0.26 in (6.5 mm)
Equiv. Dinkle P/N	EC381V-10P-BK	ESC381V-10-BK	EC381F-10P-BK

*ZIP*Link Wiring System

BRX digital expansion modules can be quickly connected to convenient ***ZIP***Link remote terminal blocks for ease of wiring remote I/O devices. Your ***ZIP***Link selection is dependent on the number of expansion module terminal points. The following tables list the connector options.

8-Point BRX Digital Expansion Module *ZIP*Link Selector					
Expansion Module Part No.	**ZIPLink Module**	**ZIPLink Module Part No.**	**Qty Needed**	**ZIPLink Cable Part No.***	**Qty Needed**
BX-08ND3	Feedthrough	ZL-RTB20, (standard) -OR- ZL-RTB20-1 (compact)	1	ZL-BXEM-CBL10 ZL-BXEM-CBL10-1 ZL-BXEM-CBL10-2	1
BX-08NF3					
BX-08NA					
BX-08NB					
BX-08TD1					
BX-08TD2					
BX-08TR					
BX-08TRZ					
BX-08TA					
BX-08CD3R					

**** Select the cable length: Blank = 0.5 m, -1 = 1.0 m, -2 = 2.0 m.***
Available pigtail cables: ZL-BXEM-CBL10-1P = 1.0 m, ZL-BXEM-CBL10-2P = 2.0 m.

12 & 5-Point BRX Digital Expansion Module *ZIP*Link Selector

Expansion Module Part No.	ZIPLink Module	ZIPLink Module Part No.	Qty Needed	ZIPLink Cable Part No.*	Qty Needed
BX-12ND3	Feedthrough	ZL-RTB20 (standard) -OR- ZL-RTB20-1 (compact)	1	ZL-BXEM-CBL15 ZL-BXEM-CBL15-1 ZL-BXEM-CBL15-2	1
BX-12NA					
BX-12NB					
BX-12TD1					
BX-12TD2					
BX-12TR					
BX-05TRS					
BX-12TA					
BX-12CD3D1					
BX-12CD3D2					

Select the cable length: Blank = 0.5 m, -1 = 1.0 m, -2 = 2.0 m.
Available pigtail cables: ZL-BXEM-CBL15-1P = 1.0 m, ZL-BXEM-CBL15-2P = 2.0 m.

16-Point BRX Digital Expansion Module *ZIP*Link Selector

Expansion Module Part No.	ZIPLink Module	ZIPLink Module Part No.	Qty Needed	ZIPLink Cable Part No.*	Qty Needed
BX-16ND3	Sensor	ZL-LTB16-24-1	1	ZL-BXEM-CBL20 ZL-BXEM-CBL20-1 ZL-BXEM-CBL20-2	1
	Feedthrough	ZL-RTB20 (standard) -OR- ZL-RTB20-1 (compact)	1		
BX-16NF3	Feedthrough				
BX-16NA	Feedthrough				
BX-16NB					
BX-16TD1	Feedthrough				
	Relay (Sourcing)	ZL-RRL16-24-1 ZL-RRL16W-24-1 ZL-RRL16F-24-1 ZL-RRL16HDF-24-1	1		
BX-16TD2	Relay (Sinking)	ZL-RRL16-24-2 ZL-RRL16W-24-2 ZL-RRL16F-24-2 ZL-RRL16HDF-24-2	1		
	Feedthrough	ZL-RTB20 (standard) -OR- ZL-RTB20-1 (compact)	1		
BX-16TF2	Feedthrough				
BX-16TR					
BX-16TRZ					
BX-16CD3D1					
BX-16CD3D2					
BX-16CF3F2					

Select the cable length: Blank = 0.5 m, -1 = 1.0 m, -2 = 2.0 m.
Available pigtail cables: ZL-BXEM-CBL20-1P = 1.0 m, ZL-BXEM-CBL20-2P = 2.0 m.

32-Point BRX Digital Expansion Module *ZIP*Link Selector

Expansion Module Part No.	ZIPLink Module	ZIPLink Module Part No.	Qty Needed	ZIPLink Cable Part No.*	Qty Needed
BX-32ND3	Sensor	ZL-LTB32-24-1	1	ZL-D24-CBL40 ZL-D24-CBL40-1 ZL-D24-CBL40-2	1
	Feedthrough	ZL-RTB40 (standard) -OR- ZL-RTB40-1 (compact)	1		
BX-32TD1	Feedthrough				
BX-32TD2					

Select the cable length: Blank = 0.5 m, -1 = 1.0 m, -2 = 2.0 m.
Available pigtail cables: ZL-D24-CBL20-1P = 1.0 m, ZL-D24-CBL20-2P = 2.0 m.
Suffix -X indicates 45° cable connector angle. Non -X indicates 180° cable connector angle.

General Specifications

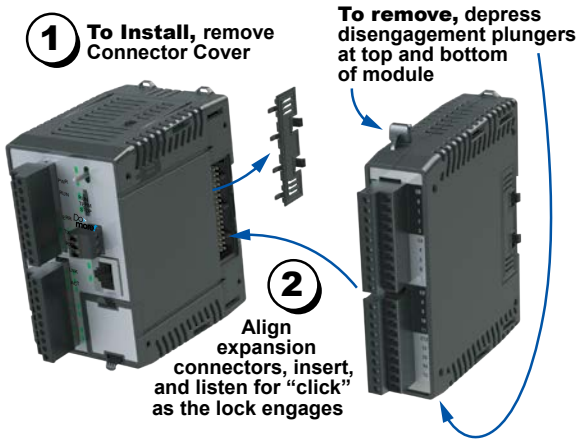
All BRX digital expansion modules have the same general specifications listed in the table below.

General Specifications	
Operating Temperature	0° to 60°C (32° to 140°F)
Storage Temperature	-20° to 85°C (-4° to 185°F)
Humidity	5 to 95% (non-condensing)
Environmental Air	No corrosive gases permitted
Vibration	IEC60068-2–6 (Test Fc)
Shock	IEC60068-2-27 (Test Ea)
Enclosure Type	Open Equipment
Noise Immunity	NEMA ICS3-304
EU Directive	See the "EU Directive" topic in the Help File
Agency Approvals	UL 61010-2 - UL File # E185989 Canada and USA CE Compliant EN61131-2

Module Installation

WARNING: Do not apply field power until the following steps are completed. The BRX expansion modules are NOT hot swappable.

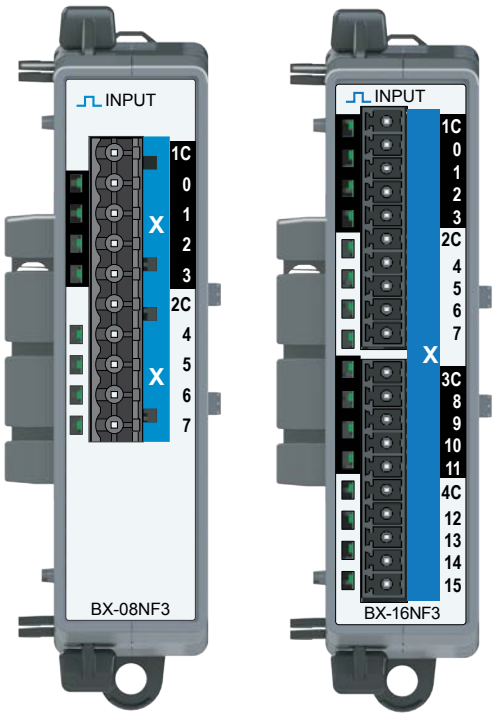
To install an expansion module, remove the connector cover on the right side of the MPU or expansion module to which the new module is to be connected. Align the expansion connectors, insert the module until you hear a "click", indicating the module expansion connectors have engaged.



To remove an expansion module locate the two disengagement levers. One is located at the top of the of the expansion module and a second one at the bottom of the expansion module. Firmly drawing the top and bottom disengagement levers forward at the same time will release the locking mechanism and disengage the unit from the system.

NOTE: *Allow a minimum of 45mm (1.75 in) to the right of MPU chassis or any subsequent expansion modules for mounting and dismounting of the modules.*

BX-xxNF3 Sinking/Sourcing 3–5 VDC Input



BX-08NF3

Input Module
8-pt, 3–5 VDC
Sink/Source

Terminal Blocks or *ZIP*Link Cable Sold Separately

BX-16NF3

Input Module
16-pt, 3–5 VDC
Sink/Source

Terminal Blocks or *ZIP*Link Cable Sold Separately

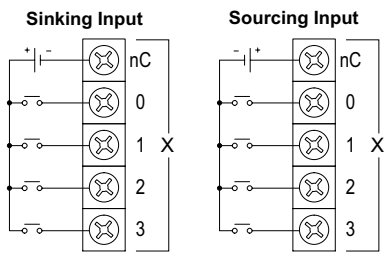
We recommend using prewired *ZIP*Link cables and connection modules. If you wish to hand-wire your module, a removable terminal block is available. See Wiring Termination Selection in this chapter for all options.

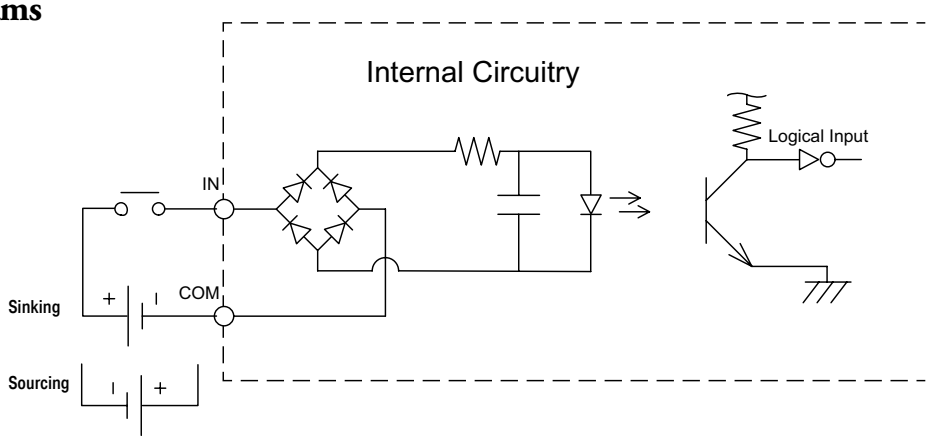
Discrete Input Specifications		
	BX-08NF3	**BX-16NF3**
Input Type	Sink/Source	
Inputs per Module	8	16
Commons	2 (4 points/common) Isolated	4 (4 points/common) Isolated
Nominal Voltage Range	3–5 VDC	
Input Voltage Range	2–6 VDC	
Maximum Voltage	6VDC	
Input Impedance	870Ω @ 5VDC	
Input Current (typical)	6mA @ 5VDC	
Maximum Input Current	8mA @ 6VDC	
Heat Dissipation	0.6 W Max	1.1 W Max
ON Voltage Level	> 2.0 VDC	
OFF Voltage Level	< 0.8 VDC	
Minimum ON Current	1.2 mA (2V required-guarantee ON state)	
Maximum OFF Current	0.5 mA	
OFF-ON Response	2ms	
ON-OFF Response	2ms	
Status Indicators	Logic Side, Green	
Software Version Required	Do-more! Designer version 2.0 or later	Do-more! Designer version 2.8 or later

IMPORTANT!

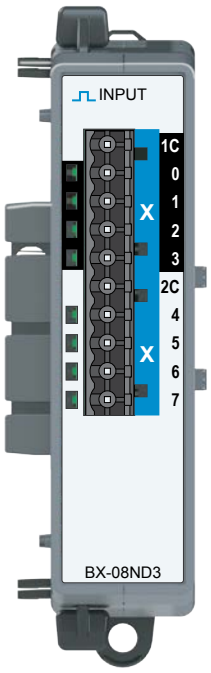
Hot-Swapping Information
Note: This device cannot be Hot Swapped.

Discrete Input Wiring Diagrams





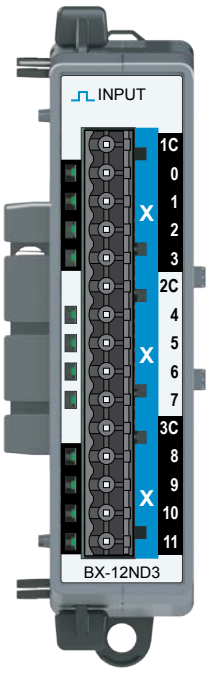
BX-xxND3 Sinking/Sourcing 12–24 VDC Input



BX-08ND3

Input Module
8-pt, 12–24 VDC
Sink/Source

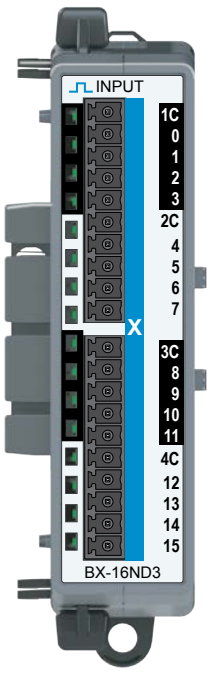
Terminal Blocks or *ZIP*Link Cable Sold Separately



BX-12ND3

Input Module
12-pt, 12–24 VDC
Sink/Source

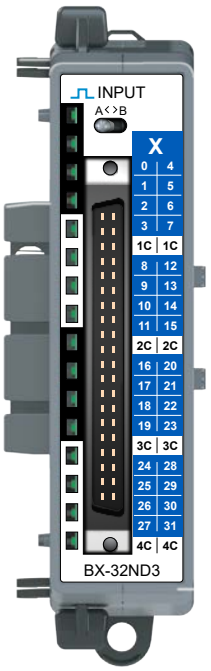
Terminal Blocks or *ZIP*Link Cable Sold Separately



BX-16ND3

Input Module
16-pt, 12–24 VDC
Sink/Source

Terminal Blocks or *ZIP*Link Cable Sold Separately



BX-32ND3

Input Module
32-pt, 12–24 VDC
Sink/Source

***ZIP*Link Cable Sold Separately**

We recommend using prewired *ZIP*Link cables and connection modules. See Wiring Termination Selection in this chapter for all options.

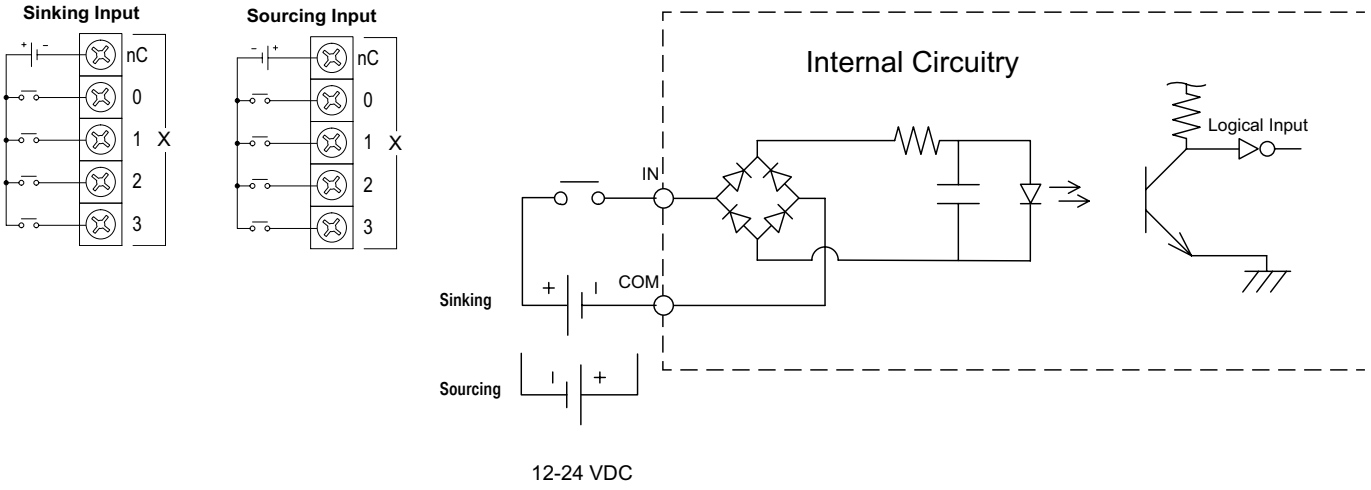
IMPORTANT!

Hot-Swapping Information
Note: This device cannot be Hot Swapped.

BX-xxND3 Sinking/Sourcing 12–24 VDC Input, continued

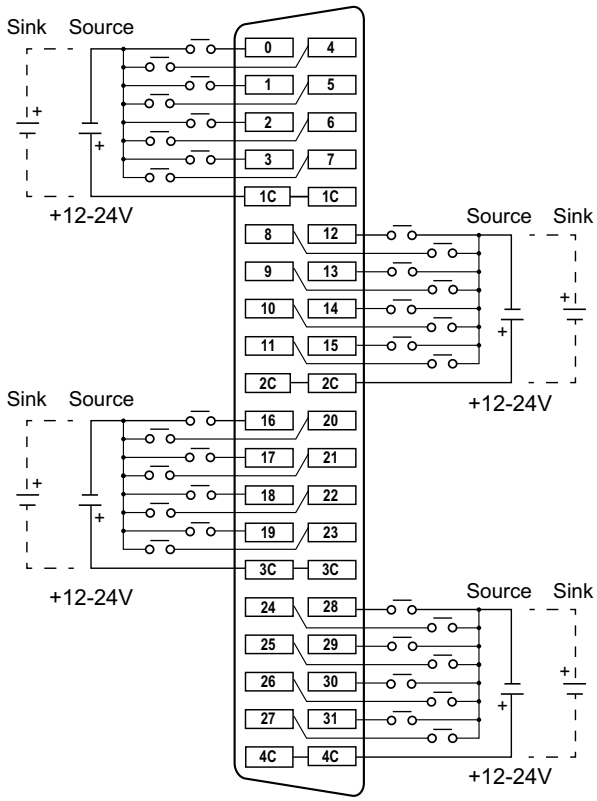
Discrete Input Specifications				
	BX-08ND3	BX-12ND3	BX-16ND3	BX-32ND3
Input Type	Sink/Source			
Inputs per Module	8	12	16	32
Commons (Isolated)	2	3	4	4
Points per Common	4	4	4	8
Nominal Voltage Range	12–24 VDC			
Input Voltage Range	9–30 VDC			
Maximum Voltage	30VDC			
Input Impedance	3kΩ @ 24VDC			8kΩ @ 24VDC
Input Current (typical)	8mA @ 24VDC			3mA @ 24VDC
Maximum Input Current	12mA @ 30VDC			6mA @ 30VDC
Heat Dissipation	3.1 W Max	4.7 W Max	6.1 W Max	6.2 W Max
ON Voltage Level	> 9.0 VDC			> 9.0 VDC
OFF Voltage Level	< 2.0 VDC			< 2.0 VDC
Minimum ON Current	5.0 mA (9V required to guarantee ON state)			3.0 mA (9V required to guarantee ON state)
Maximum OFF Current	2.0 mA			1.5 mA
OFF-ON Response	2ms			
ON-OFF Response	2ms			
Status Indicators	Logic Side, Green (32-point module has 16 LEDs for half of inputs, switchable via A/B switch)			
Software Version Required	Do-more! Designer version 2.0 or later			Do-more! Designer version 2.3 or later

Discrete Input Wiring Diagrams for 8, 12 and 16-point modules

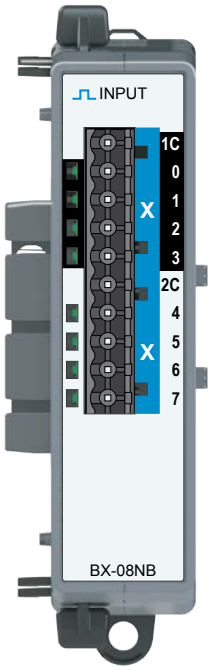


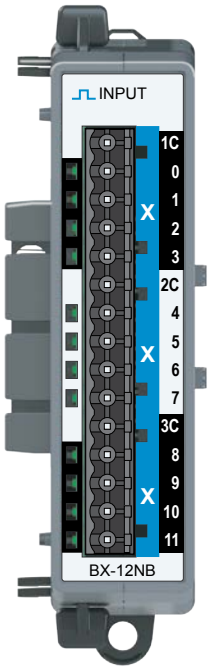
BX-xxND3 Sinking/Sourcing 12–24 VDC Input, continued

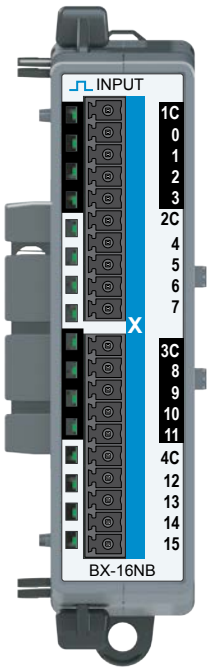
Discrete Input Wiring Diagrams, 32-point module



BX-xxNB 12–24 VAC Input







BX-08NB
Input Module
8-pt, 12–24 VAC

BX-12NB
Input Module
12-pt, 12–24 VAC

BX-16NB
Input Module
16-pt, 12–24 VAC

Terminal Blocks or *ZIP*Link Cables Sold Separately

We recommend using prewired ***ZIP***Link cables and connection modules.
If you wish to hand-wire your module, a removable terminal block is available. See Wiring Termination Selection in this chapter for all options.

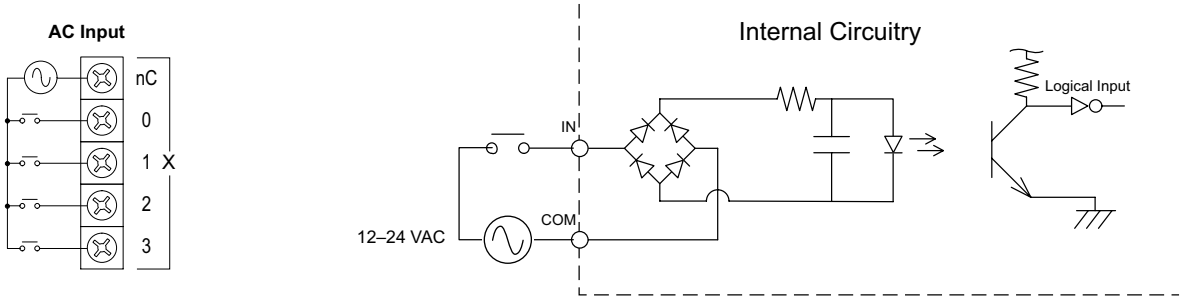
IMPORTANT!

Hot-Swapping Information
Note: This device cannot be Hot Swapped.

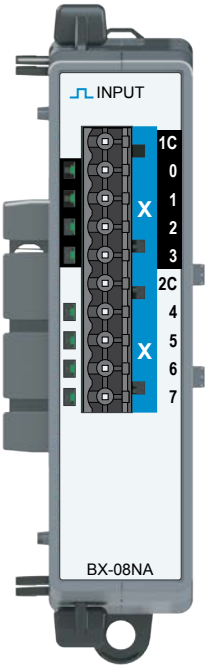
BX-xxNB 12–24 VAC Input, continued

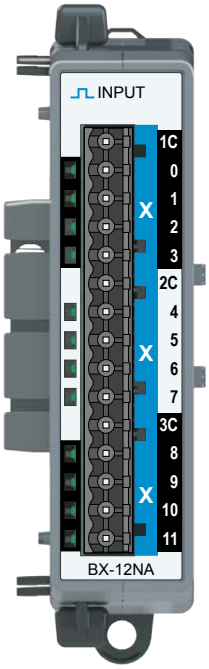
Discrete Input Specifications			
	BX-08NB	**BX-12NB**	**BX-16NB**
Input Type	AC		
Inputs per Module	8	12	16
Commons	2 (4pts / common) Isolated	3 (4pts / common) Isolated	4 (4pts / common) Isolated
Nominal Voltage Range	12–24 VAC		
Input Voltage Range	9–30 VAC		
Maximum Voltage	30VAC RMS		
AC Frequency	47–63 Hz		
Input Impedance	3kΩ @ 24VAC		
Input Current (typical)	8mA @ 24VAC		
Maximum Input Current	12mA @ 30VAC		
Heat Dissipation	3.1 W Max	4.7 W Max	6.1 W Max
ON Voltage Level	> 9.0 VAC		
OFF Voltage Level	< 2.0 VAC		
Minimum ON Current	5.0 mA (9V required-guarantee ON state)		
Maximum OFF Current	2.0 mA		
OFF-ON Response	10ms		
ON-OFF Response	10ms		
Status Indicators	Logic Side, Green		
Software Version Required	Do-more! Designer version 2.0 or later		

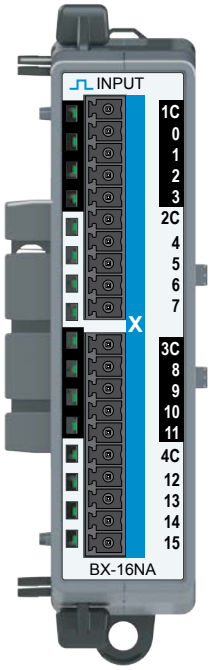
Discrete Input Wiring Diagram



BX-xxNA 120–240 VAC Input







BX-08NA
Input Module
8-pt, 120–240 VAC

BX-12NA
Input Module
12-pt, 120–240 VAC

BX-16NA
Input Module
16-pt, 120–240 VAC

Terminal Blocks or *ZIP*Link Cables Sold Separately

We recommend using prewired ***ZIP***Link cables and connection modules.
If you wish to hand-wire your module, a removable terminal block is available. See Wiring Termination Selection in this chapter for all options.

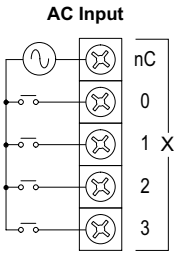
IMPORTANT!

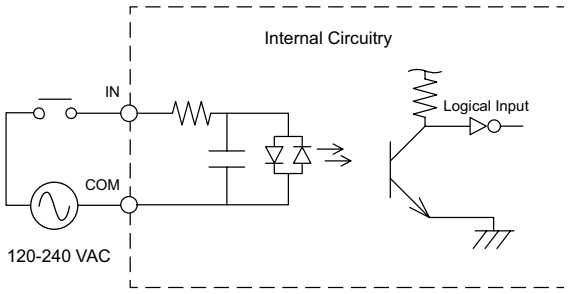
Hot-Swapping Information
Note: This device cannot be Hot Swapped.

BX-xxNA 120–240 VAC Input, continued

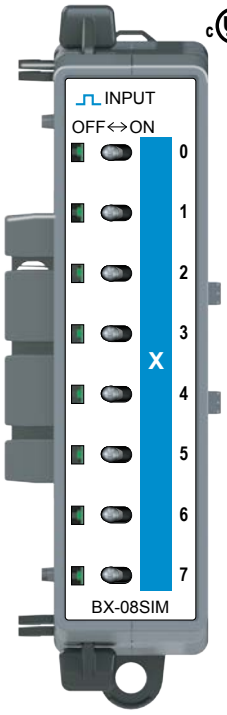
Discrete Input Specifications			
	BX-08NA	BX-12NA	BX-16NA
Input Type	AC		
Inputs per Module	8	12	16
Commons	2 (4pts / common) Isolated	3 (4pts / common) Isolated	4 (4pts / common) Isolated
Nominal Voltage Range	120–240 VAC		
Input Voltage Range	85–264 VAC		
Maximum Voltage	264VAC RMS		
AC Frequency	47–63 Hz		
Input Impedance	15kΩ		
Input Current (typical)	9mA @ 120VAC, 13mA @ 220VAC		
Maximum Input Current	14mA @ 120VAC, 20mA @ 220VAC		
Heat Dissipation	2.8 W Max	4.2 W Max	5.5 W Max
ON Voltage Level	> 85VAC		
OFF Voltage Level	< 40VAC		
Maximum OFF Current	2.5 mA		
OFF-ON Response	10ms		
ON-OFF Response	10ms		
Status Indicators	Logic Side, Green		
Software Version Required	Do-more! Designer version 2.0 or later		

Discrete Input Wiring Diagram





BX-08SIM Simulator Input

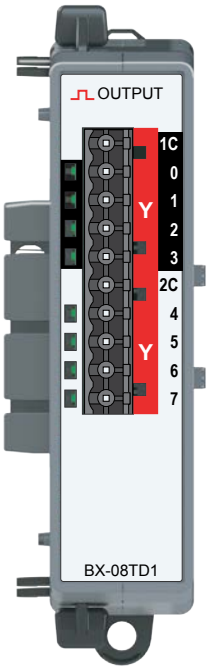


Discrete Input Specifications	
Input Type	Simulator
Inputs per Module	8
Heat Dissipation	0.2 W Max
Status Indicators	Logic Side, Green
Software Version Required	Do-more! Designer version 2.3 or later

IMPORTANT!

Hot-Swapping Information
Note: This device cannot be Hot Swapped.

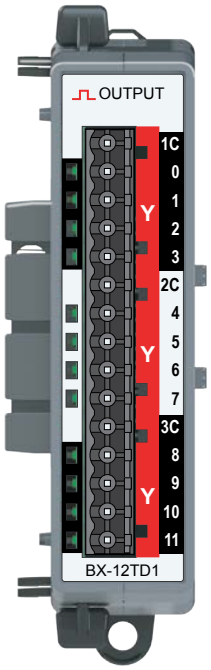
BX-xxTD1 Sinking 12–24 VDC Output



BX-08TD1

Output Module
8-pt, 12–24 VDC
Sinking

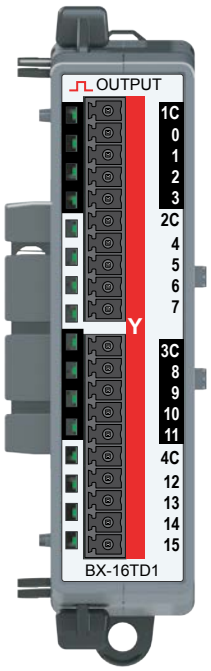
Terminal Blocks or *ZIP*Link Cable Sold Separately



BX-12TD1

Output Module
12-pt, 12–24 VDC
Sinking

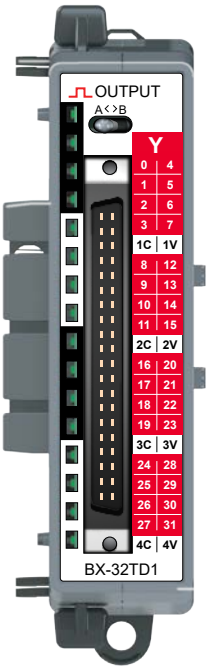
Terminal Blocks or *ZIP*Link Cable Sold Separately



BX-16TD1

Output Module
16-pt, 12–24 VDC
Sinking

Terminal Blocks or *ZIP*Link Cable Sold Separately



BX-32TD1

Output Module
32-pt, 12–24 VDC
Sinking

***ZIP*Link Cable Sold Separately**

We recommend using prewired ***ZIP*Link** cables and connection modules.
See Wiring Termination Selection in this chapter for all options.



IMPORTANT!

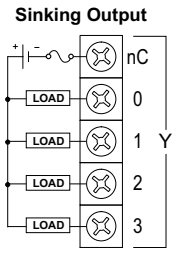


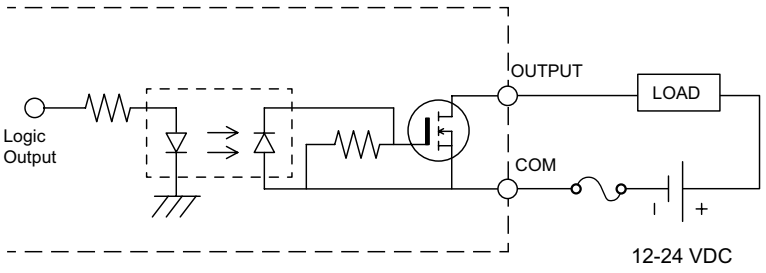
Hot-Swapping Information
Note: This device cannot be Hot Swapped.

BX-xxTD1 Sinking 12–24 VDC Output, continued

Discrete Output Specifications				
	BX-08TD1	BX-12TD1	BX-16TD1	BX-32TD1
Output Type	Sinking			
Outputs per Module	8	12	16	32
Commons (Isolated)	2	3	4	4
Points per Common	4	4	4	8
Maximum Current per Common	2A			
Nominal Voltage Range	12–24 VDC			
Operating Voltage Range	5–36 VDC			
Maximum Voltage	36VDC			
Minimum Output Current	0.1 mA @ 24VDC			
Maximum Output (Load) Current	0.5 A per output, no derating over temperature range			
Maximum Inrush Current	5A for 50ms			
Maximum Leakage Current	10µA			
Heat Dissipation	1.0 W Max	1.4 W Max	1.6 W Max	3.2 W Max
ON Voltage Drop	0.05 VDC			
OFF-ON Response	< 5ms			
ON-OFF Response	< 2ms			
Maximum Switching Frequency	143Hz			
Overcurrent Protection	N/A			
Fuse Type	User-supplied external fuse			
Status Indicators	Logic Side, Green (32-point module has 16 LEDs for half of outputs, selectable via A/B switch)			
Software Version Required	Do-more! Designer version 2.0 or later			Do-more! Designer version 2.3 or later

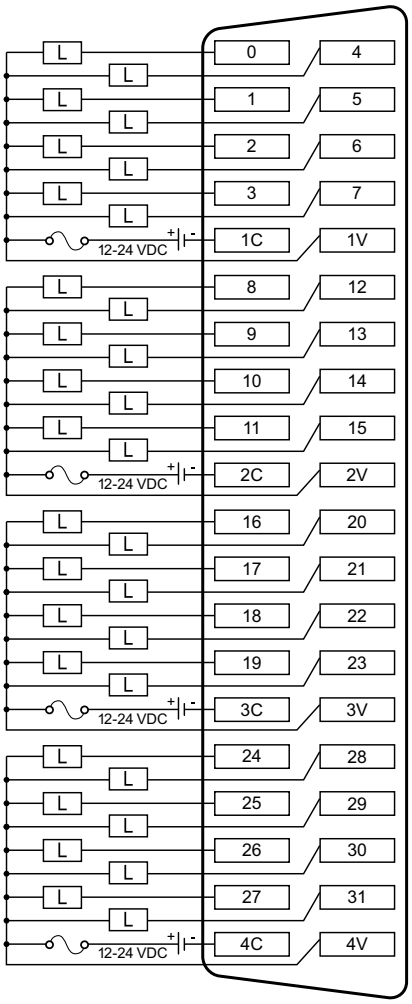
Discrete Output Wiring Diagram for 8, 12 and 16-point modules



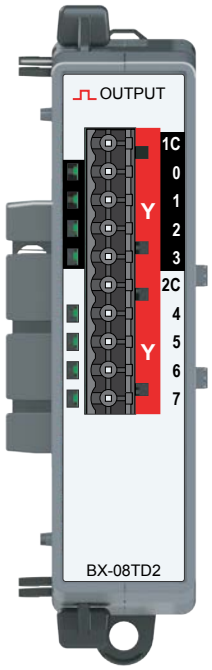


BX-xxTD1 Sinking 12–24 VDC Output, continued

Discrete Output Wiring Diagrams, 32-point module



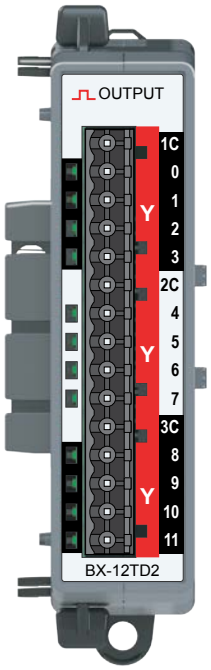
BX-xxTD2 Sourcing 12–24 VDC Output



BX-08TD2

Output Module
8-pt, 12–24 VDC
Sourcing

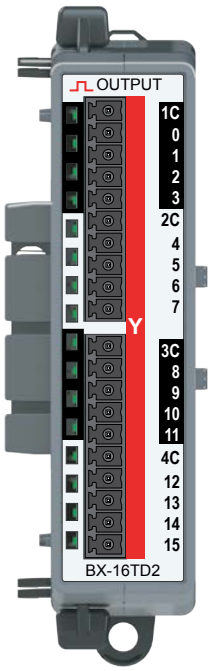
Terminal Blocks or *ZIP*Link Cable Sold Separately



BX-12TD2

Output Module
12-pt, 12–24 VDC
Sourcing

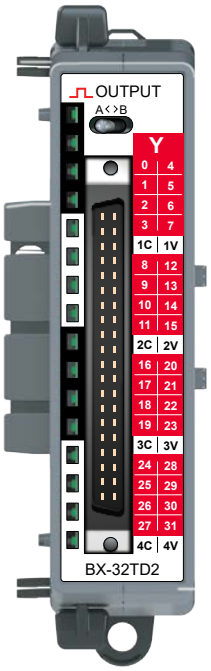
Terminal Blocks or *ZIP*Link Cable Sold Separately



BX-16TD2

Output Module
16-pt, 12–24 VDC
Sourcing

Terminal Blocks or *ZIP*Link Cable Sold Separately



BX-32TD2

Output Module
32-pt, 12–24 VDC
Sourcing

***ZIP*Link Cable Sold Separately**

We recommend using prewired *ZIP*Link cables and connection modules.
See Wiring Termination Selection in this chapter for all options.

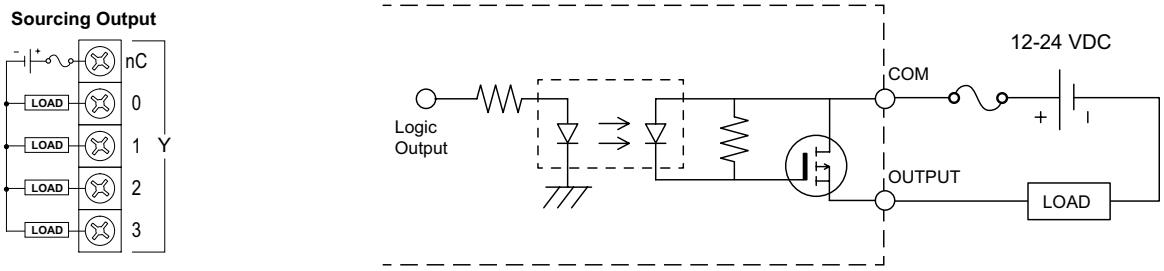
IMPORTANT!

Hot-Swapping Information
Note: This device cannot be Hot Swapped.

BX-xxTD2 Sourcing 12–24 VDC Output, continued

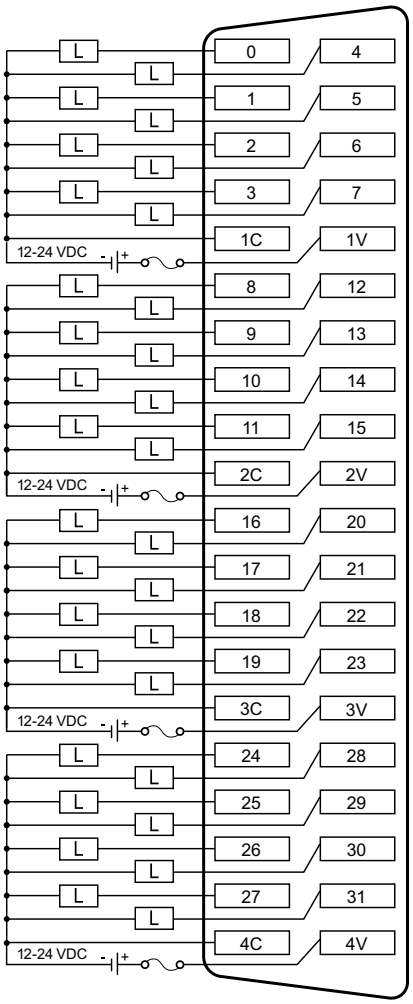
Discrete Output Specifications				
	BX-08TD2	BX-12TD2	BX-16TD2	BX-32TD2
Output Type	Sourcing			
Outputs per Module	8	12	16	32
Commons (Isolated)	2	3	4	4
Points per Common	4	4	4	8
Maximum Current per Common	2A			
Nominal Voltage Range	12–24 VDC			
Operating Voltage Range	5–36 VDC			
Maximum Voltage	36VDC			
Minimum Output Current	0.1 mA @ 24VDC			
Maximum Output (Load) Current	0.5 A per output, no derating over temperature range			
Maximum Inrush Current	5A for 50ms			
Maximum Leakage Current	10µA			
Heat Dissipation	1.0 W Max	1.4 W Max	1.6 W Max	3.2 W Max
ON Voltage Drop	0.05 VDC			
OFF-ON Response	< 5ms			
ON-OFF Response	< 2ms			
Maximum Switching Frequency	143Hz			
Overcurrent Protection	N/A			
Fuse Type	User-supplied external fuse			
Status Indicators	Logic Side, Green (32-point module has 16 LEDs for half of outputs, selectable via A/B switch)			
Software Version Required	Do-more! Designer version 2.0 or later			Do-more! Designer version 2.3 or later

Discrete Output Wiring Diagram for 8, 12 and 16-point modules

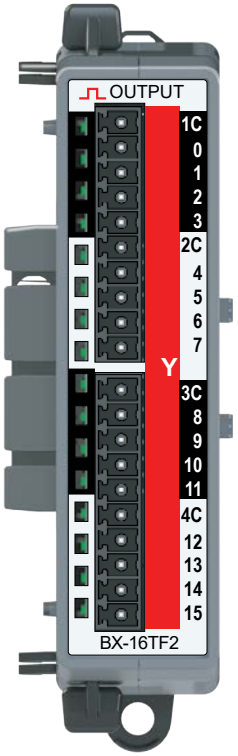


BX-xxTD2 Sourcing 12–24 VDC Output, continued

Discrete Output Wiring Diagrams, 32-point module



BX-16TF2 Sourcing 3–5 VDC Output



Terminal Blocks or *ZIP*Link Cables Sold Separately

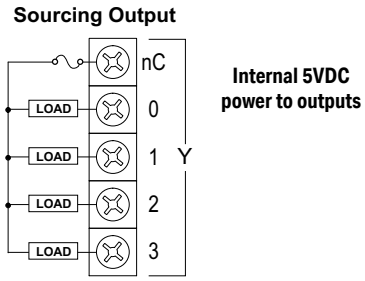
We recommend using prewired ***ZIP***Link cables and connection modules.
If you wish to hand-wire your module, a removable terminal block is available. See Wiring Termination Selection in this chapter for all options.

Discrete Output Specifications	
Output Type	Sourcing
Outputs per Module	16
Commons	4
Maximum Current per Common	96mA
Power Supply	Internal +5VDC
Peak Voltage	5.5 VDC
Minimum Output Current	0 µA
Maximum Output Current	24mA per output, no derating over temperature range
Maximum Leakage Current	10µA
Heat Dissipation	1.2 W Max
ON Voltage Drop	0.05 VDC
ON-OFF Response	<2ms
OFF-ON Response	<5ms
Fuses, Overcurrent Protection	N/A
Backplane Power Consumption	0.9 W
Status Indicators	Logic Side, Green
Software Version Required	Do-more! Designer version 2.8 or later

IMPORTANT!

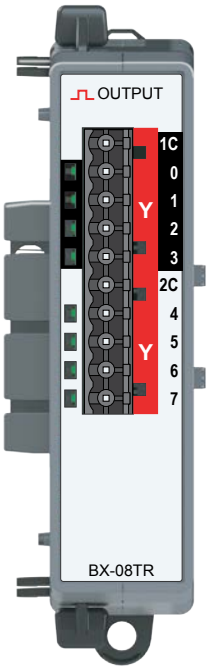
Hot-Swapping Information
Note: This device cannot be Hot Swapped.

Discrete Output Wiring Diagram



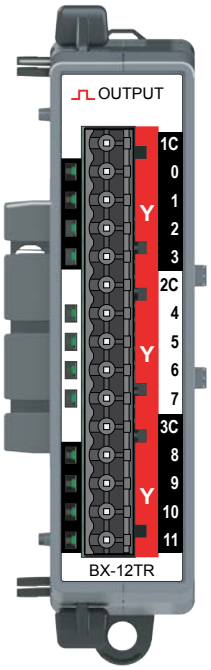
Internal 5VDC power to outputs

BX-xxTR Relay Output



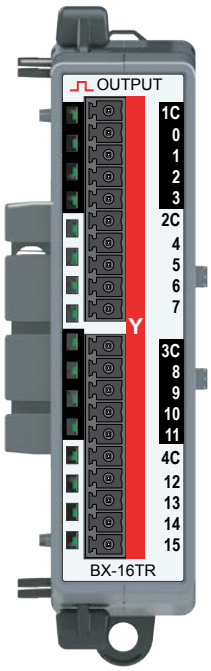
BX-08TR

Output Module 8-pt,
Relay Form A (SPST)



BX-12TR

Output Module 12-pt,
Relay Form A (SPST)



BX-16TR

Output Module 16-pt,
Relay Form A (SPST)

Terminal Blocks or *ZIP*Link Cables Sold Separately

We recommend using prewired ***ZIP***Link cables and connection modules.
If you wish to hand-wire your module, a removable terminal block is available. See Wiring Termination Selection in this chapter for all options.

IMPORTANT!

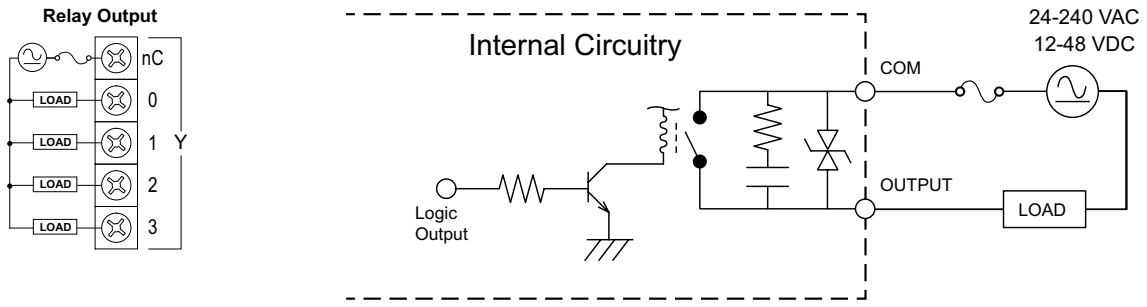
Hot-Swapping Information
Note: This device cannot be Hot Swapped.

NOTE: *When using relay expansion modules, adding 32 or more relay points requires you to perform a power budget calculation. See Appendix C for more information.*

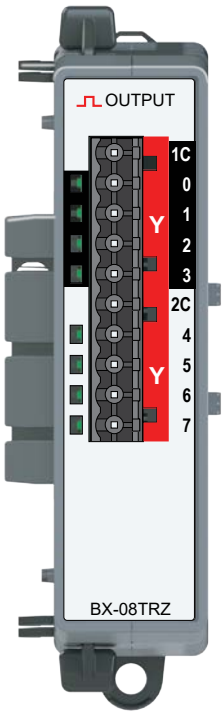
BX-xxTR Relay Output, continued

Discrete Output Specifications			
	BX-08TR	**BX-08TR**	**BX-16TR**
Output Type	Relay, Form A (SPST)		
Outputs per Module	8	12	16
Commons	2 (4pts / common) Isolated	3 (4pts / common) Isolated	4 (4pts / common) Isolated
Surge Suppression	Yes		
Maximum Current per Common	8A		
Nominal Voltage Range	12–48 VDC 24–240 VAC		
Operating Voltage Range	5–60 VDC 5–264 VAC		
Maximum Voltage	60VDC, 264VAC		
Minimum Output Current	0.1 mA @ 24V AC/DC		
Maximum Output Current	2A		
Maximum Inrush Current	5A for 50ms		
Maximum Leakage Current	1µA (DC), 300µA (AC) due to RC snubber circuit		
Heat Dissipation	4.9 W Max	7.3 W Max	9.8 W Max
ON Voltage Drop	> 0.2 Vmax		
Fuse Type	User-supplied external fuse		
Maximum Switching Frequency	10Hz		
Relay Cycle Life Mechanical Endurance Electrical Endurance	 5 Million Operations 120,000 Operations		
Status Indicators	Logic Side, Green		
Software Version Required	Do-more! Designer version 2.0 or later		

Relay Output Wiring Diagram



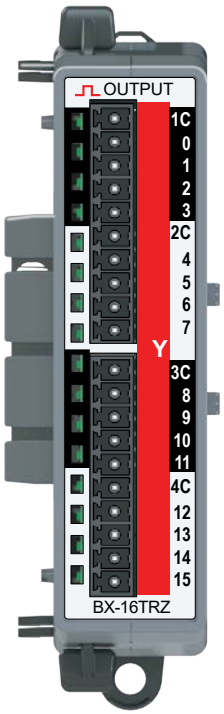
BX-xxTRZ Relay Output



BX-08TRZ

Output Module 8-pt,
Relay Form A (SPST)
No surge suppression

Terminal Blocks or *ZIP*Link Cable Sold Separately



BX-16TRZ

Output Module 16-pt,
Relay Form A (SPST)
No surge suppression

Terminal Blocks or *ZIP*Link Cable Sold Separately

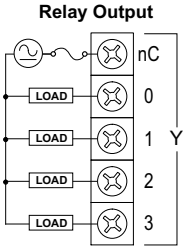
We recommend using prewired *ZIP*Link cables and connection modules.
If you wish to hand-wire your module, a removable terminal block is available. See Wiring Termination Selection in this chapter for all options.

Discrete Output Specifications		
	BX-08TRZ	**BX-16TRZ**
Output Type	Relay, Form A (SPST)	
Outputs per Module	8	16
Commons	2 (4pts / common) Isolated	4 (4pts / common) Isolated
Surge Suppression	No	
Maximum Current per Common	8A	
Nominal Voltage Range	5–48 VDC, 24–240 VAC	
Operating Voltage Range	5–60 VDC, 18–264 VAC	
Maximum Voltage	60VDC, 264VAC	
Minimum Output Current	0.1 mA @ 24VDC	
Maximum Output Current	2A	
Maximum Inrush Current	5A for 50ms	
Maximum Leakage Current	1nA	
Heat Dissipation	4.9 W Max	9.8 W Max
Backplane Power Consumption	1.7 W	3.4 W
ON Voltage Drop	0.2 Vmax	
Relay Cycle Life Mechanical Endurance Electrical Endurance	 5 Million Operations 120,000 Operations	
Status Indicators	Logic Side, Green	
Software Version Required	Do-more! Designer version 2.8 or later	

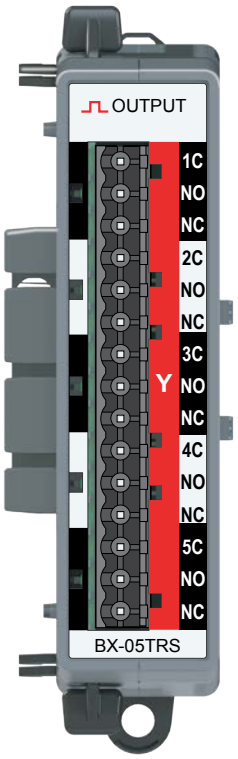
IMPORTANT!

Hot-Swapping Information
Note: This device cannot be Hot Swapped.

Relay Output Wiring Diagram



BX-05TRS Relay Output



Terminal Blocks or *ZIP*Link Cables Sold Separately

We recommend using prewired ***ZIP***Link cables and connection modules.
If you wish to hand-wire your module, a removable terminal block is available. See Wiring Termination Selection in this chapter for all options.

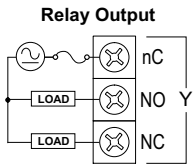
Discrete Output Specifications	
Output Type	Relay, Form C (SPDT)
Outputs per Module	5
Commons	5 Isolated
Maximum Current per Common	2A
Nominal Voltage Range	12–48 VDC 24–240 VAC
Operating Voltage Range	5–60 VDC 5–264 VAC
Maximum Voltage	60VDC, 264VAC
Minimum Output Current	0.1 mA @ 24V AC/DC
Maximum Output Current	2A
Maximum Inrush Current	5A for 50ms
Maximum Leakage Current	1µA (DC), 300µA (AC) due to RC snubber circuit
Heat Dissipation	3.8 W Max
ON Voltage Drop	> 0.2 Vmax
ON-OFF Response	<10ms
OFF-ON Response	<10ms
Fuse Type	User-supplied external fuse
Maximum Switching Frequency	10Hz
Relay Cycle Life Mechanical Endurance Electrical Endurance	 10 Million Operations 50,000 Operations
Status Indicators	Logic Side, Green
Software Version Required	Do-more! Designer version 2.0 or later

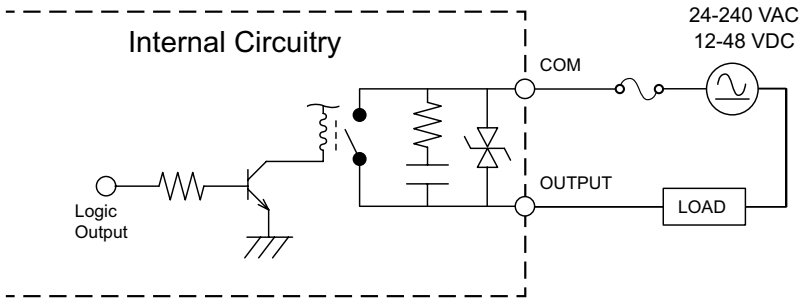
IMPORTANT!

Hot-Swapping Information
Note: This device cannot be Hot Swapped.

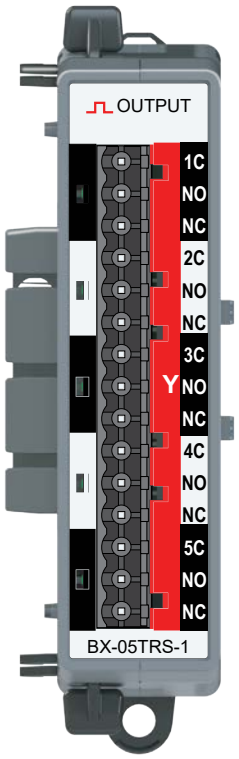
NOTE: *When using relay expansion modules, adding 32 or more relay points requires you to perform a power budget calculation. See Appendix C for more information.*

Relay Output Wiring Diagram





BX-05TRS-1 Relay Output



Terminal Blocks Sold Separately

Discrete Output Specifications	
Output Type	Relay, Form C (SPDT)
Outputs per Module	5
Commons	5 Isolated
Maximum Current per Common	8A
Nominal Voltage Range	5–48 VDC, 24–240 VAC
Operating Voltage Range	5–120 VDC, 18–264 VAC
Peak Voltage	120VDC, 264VAC
Minimum Output Current	0.1 mA @ 24VDC
Maximum Output Current @30VDC Resistive Load @50VDC Resistive Load @120VDC Resistive Load @120VAC Resistive Load @240VAC Resistive Load @120VAC Inductive 0.4 Power Factor @240VAC Inductive 0.4 Power Factor	 8A 3A 0.5 A 8A 5A 5A 2A
Maximum Inrush Current	15A for 50ms
Maximum Leakage Current	10µA
Heat Dissipation	308W Max
Backplane Power Consumption	1.8 W Max
ON Voltage Drop	0.2 Vmax
ON-OFF Response	<10ms
OFF-ON Response	<10ms
Fuse Type	N/A
Maximum Switching Frequency	10Hz
Relay Cycle Life Mechanical Endurance Electrical Endurance	 5 Million Operations 120,000 Operations
Status Indicators	Logic Side, Green
Software Version Required	Do-more! Designer version 2.8 or later

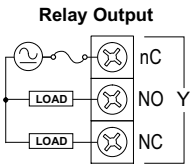
***NOTE:** This device does not support ZIPLink Wiring Systems.*

IMPORTANT!

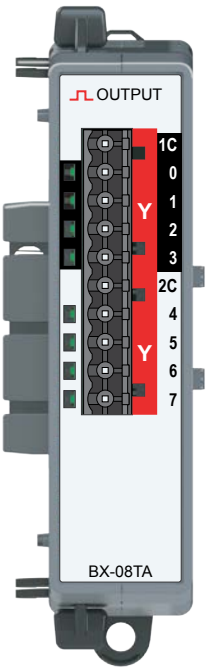
Hot-Swapping Information
Note: This device cannot be Hot Swapped.

***NOTE:** When using relay expansion modules, adding 32 or more relay points requires you to perform a power budget calculation. See Appendix C for more information.*

Relay Output Wiring Diagram

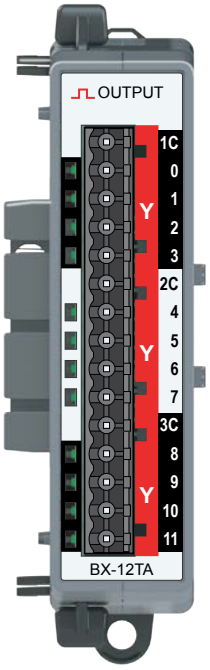


BX-xxTA 120–240 VAC Output



BX-08TA

Output Module
8-pt, 120–240 VAC



BX-12TA

Output Module
12-pt, 120–240 VAC

Terminal Blocks or *ZIP*Link Cables Sold Separately

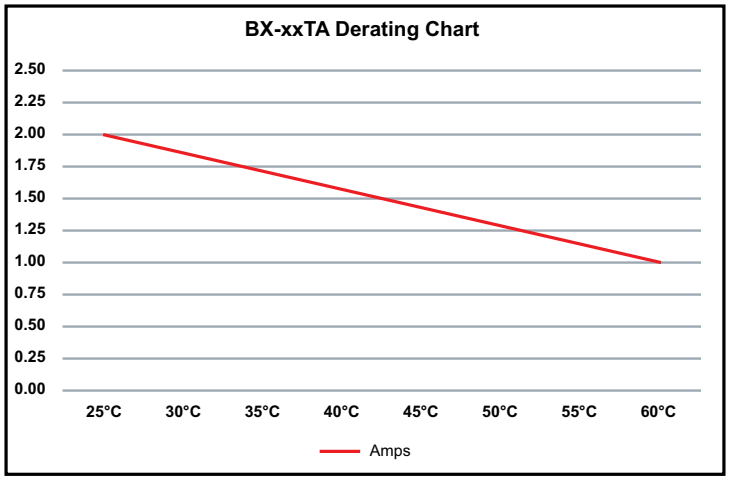
We recommend using prewired ***ZIP***Link cables and connection modules.
If you wish to hand-wire your module, a removable terminal block is available. See Wiring Termination Selection in this chapter for all options.

IMPORTANT!

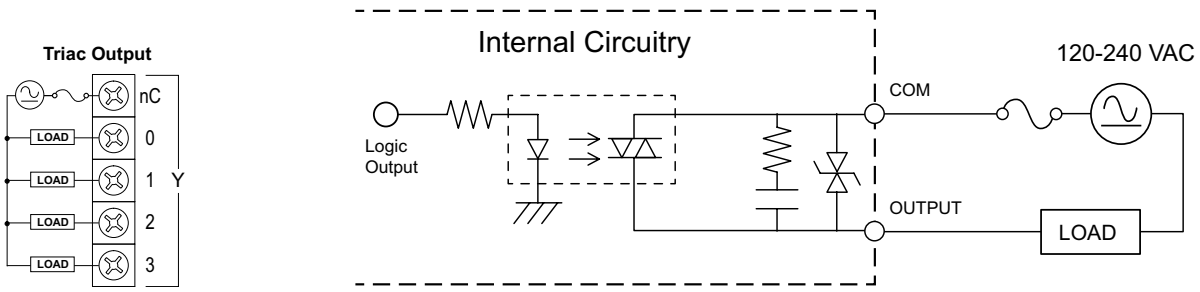
Hot-Swapping Information
Note: This device cannot be Hot Swapped.

BX-xxTA 120–240 VAC Output, continued

Discrete Output Specifications		
	BX-08TA	BX-12TA
Output Type	Triac	
Outputs per Module	8	12
Commons	2 (4 points/common) Isolated	3 (4 points/common) Isolated
Maximum Current per Common	2A	
Nominal Voltage Range	120–240 VAC	
Operating Voltage Range	5–258 VAC	
Maximum Voltage	258VAC	
Maximum Output Current	0.5 A across temp range	
Current Derating	Linear by Common: 2A @ 25°C - 1A @ 60°C	
Maximum Inrush Current	5A for 50ms	
Maximum Leakage Current	1µA	
Heat Dissipation	4.8 W Max	7.1 W Max
ON Voltage Drop	2.5 Vmax	
ON-OFF Response	<10ms	
OFF-ON Response	<10ms	
Fuse Type	User-supplied external fuse	
Status Indicators	Logic Side, Green	
Software Version Required	Do-more! Designer version 2.0 or later	

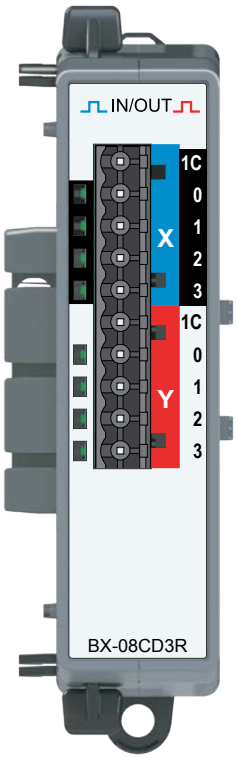


Triac Output Wiring Diagram



BX-08CD3R Combination DC Input/Relay Output

The BX-08CD3R Combination DC Input/Relay Output Expansion Module provides a total of eight (8) points; four (4) 12–24 VDC sink/source inputs and four (4) Form A (SPST) relay outputs.



Terminal Blocks or *ZIP*Link Cables Sold Separately

We recommend using prewired ***ZIP***Link cables and connection modules.
If you wish to hand-wire your module, a removable terminal block is available. See Wiring Termination Selection in this chapter for all options.

IMPORTANT!

Hot-Swapping Information
Note: This device cannot be Hot Swapped.

Module Specifications

Heat Dissipation	4.1 W Max
Status Indicators	Logic Side, Green
Software Version Required	Do-more! Designer version 2.0 or later

Discrete Input Specifications

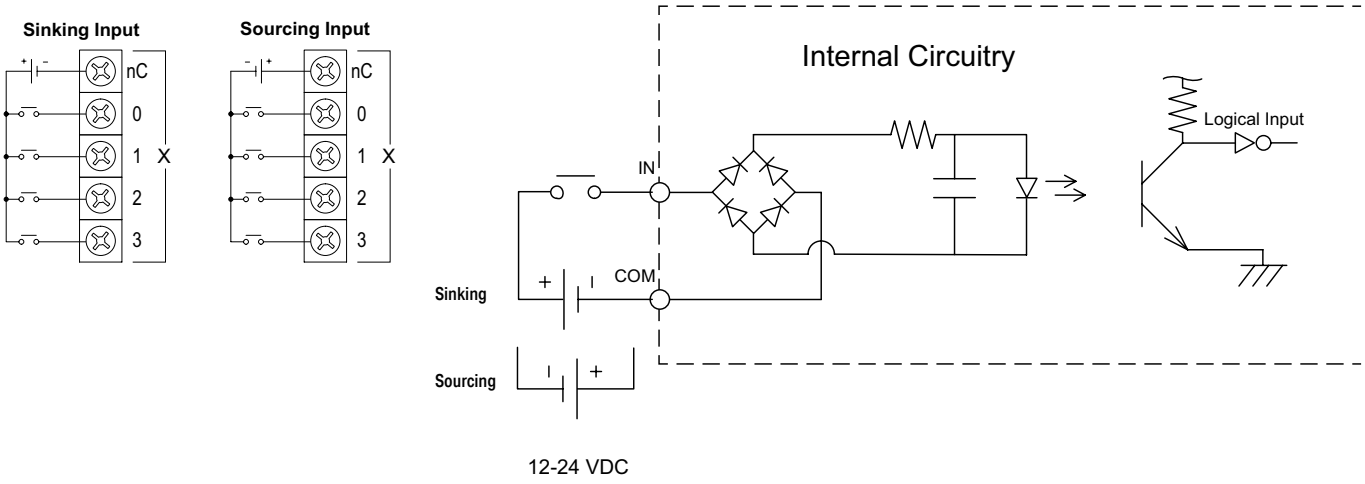
Input Type	Sink/Source
Inputs per Module	4
Nominal Voltage Range	12–24 VDC
Input Voltage Range	9–30 VDC
Maximum Voltage	30VDC
Commons	1 (4 points/common)
Input Current (typical)	8mA @ 24VDC
Maximum Input Current	12mA @ 30VDC
Input Impedance	3kΩ @ 24VDC
ON Voltage Level	> 9.0 VDC
OFF Voltage Level	< 2.0 VDC
Minimum ON Current	5.0 mA (9V required-guarantee ON state)
Maximum OFF Current	2.0 mA
OFF-ON Response	2ms
ON-OFF Response	2ms

Discrete Output Specifications

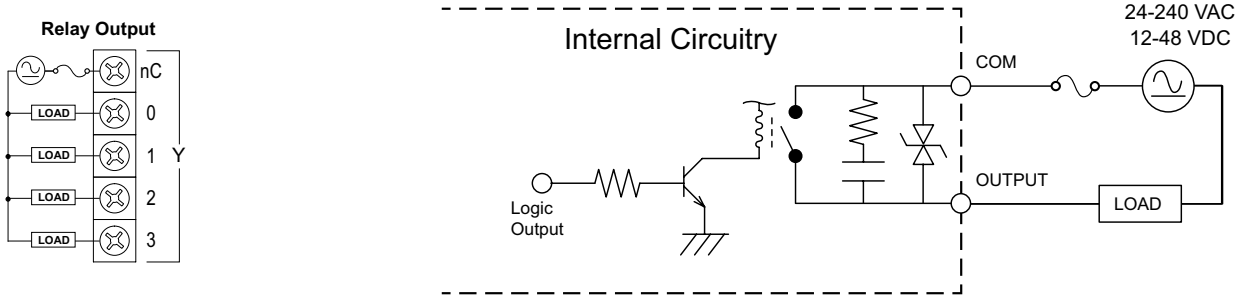
Output Type	Relay, Form A (SPST)
Outputs per Module	4
Commons	1 (4 points/common)
Maximum Current per Common	8A
Nominal Voltage Range	12–48 VDC 24–240 VAC
Operating Voltage Range	5–60 VDC 5–264 VAC
Maximum Voltage	60VDC, 264VAC
Minimum Output Current	0.1 mA @24VDC
Maximum Output Current	2A
Maximum Inrush Current	5A for 50ms
Maximum Leakage Current	1µA
ON Voltage Drop	0.2 Vmax
ON-OFF Response	<10ms
OFF-ON Response	<10ms
Fuse Type	User-supplied external fuse
Maximum Switching Frequency	10Hz
Relay Cycle Life Mechanical Endurance Electrical Endurance	 5 Million Operations 120,000 Operations

BX-08CD3R Combination DC Input/Relay Output, continued

Discrete Input Wiring Diagrams

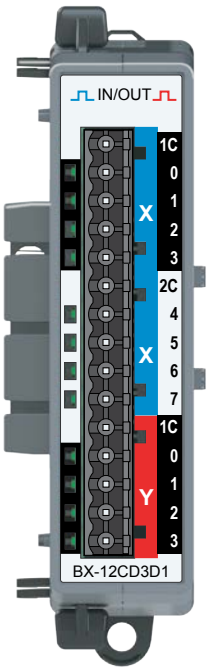


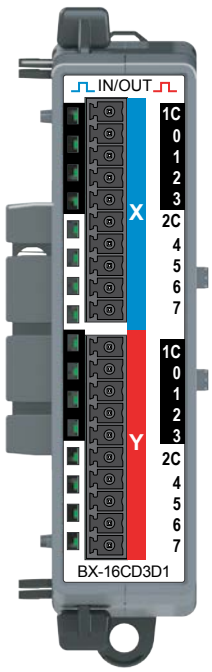
Relay Output Wiring Diagrams



BX-xxCD3D1 Combination DC Input/Sinking DC Output

The BX-xxCD3D1 Combination DC Input/Sourcing Output Expansion Modules provides a total of twelve (12) or sixteen (16) points; eight (8) 12–24 VDC sink/source inputs and either four (4) or eight (8) 12-24 VDC sinking outputs.





Terminal Blocks or *ZIP*Link Cables Sold Separately

BX-12CD3D1

Combination Discrete Module
Input: 8-pt, 12–24 VDC, Sink/Source,
Output: 4-pt, 12–24 VDC, Sinking

BX-16CD3D1

Combination Discrete Module
Input: 8-pt, 12–24 VDC, Sink/Source,
Output: 8-pt, 12–24 VDC, Sinking

We recommend using prewired *ZIP*Link cables and connection modules.
If you wish to hand-wire your module, a removable terminal block is available. See Wiring Termination Selection in this chapter for all options.

IMPORTANT!

Hot-Swapping Information
Note: This device cannot be Hot Swapped.

BX-xxCD3D1 Combination DC Input/Sinking DC Output, continued

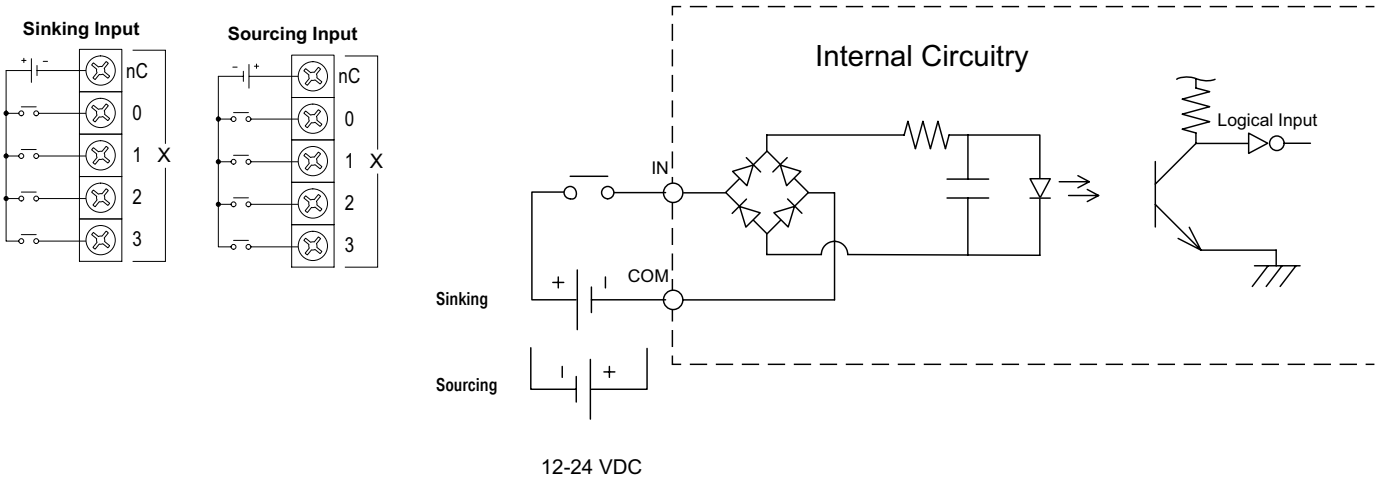
Module Specifications		
	BX-12CD3D1	BX-16CD3D1
Heat Dissipation	3.5 W Max	3.9 W Max
Status Indicators	Logic Side, Green	
Software Version Required	Do-more! Designer version 2.0 or later	

Discrete Input Specifications		
	BX-12CD3D1	BX-16CD3D1
Input Type	Sink/Source	
Inputs per Module	8	
Commons	2 (4 points/common) Isolated	
Nominal Voltage Range	12–24 VDC	
Input Voltage Range	9–30 VDC	
Maximum Voltage	30VDC	
Input Impedance	3kΩ @ 24VDC	
Input Current (typical)	8mA @ 24VDC	
Maximum Input Current	12mA @ 30VDC	
ON Voltage Level	> 9.0 VDC	
OFF Voltage Level	< 2.0 VDC	
Minimum ON Current	5.0 mA (9V required-guarantee ON state)	
Maximum OFF Current	2.0 mA	
OFF-ON Response	2ms	
ON-OFF Response	2ms	

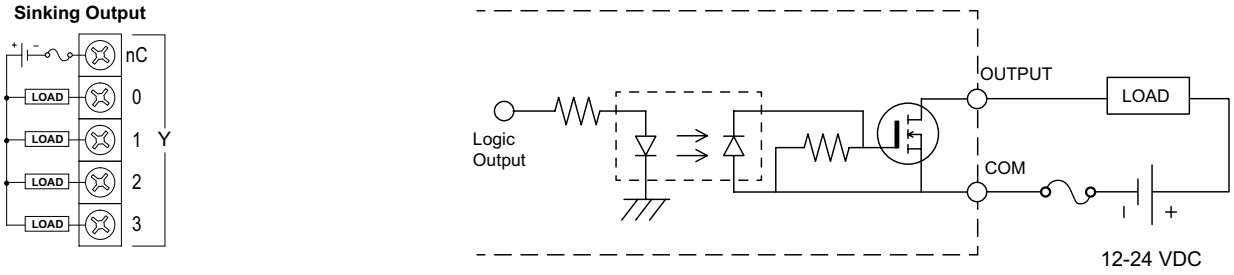
Discrete Output Specifications		
	BX-12CD3D1	BX-16CD3D1
Output Type	Sinking	
Outputs per Module	4	8
Commons	1 (4 points/common)	2 (4 points/common) Isolated
Maximum Current per Common	2A	
Nominal Voltage Range	12–24 VDC	
Operating Voltage Range	5–36 VDC	
Maximum Voltage	36VDC	
Minimum Output Current	0.1 mA @ 24VDC	
Maximum Output Current	0.5 A per output, no derating over temperature range	
Maximum Inrush Current	5A for 50ms	
Maximum Leakage Current	10µA	
ON Voltage Drop	0.05 VDC	
Fuse Type	User-supplied external fuse	
OFF-ON Response	< 5ms	
ON-OFF Response	< 2ms	

BX-xxCD3D1 Combination DC Input/DC Sinking Output, continued

Discrete Input Wiring Diagrams

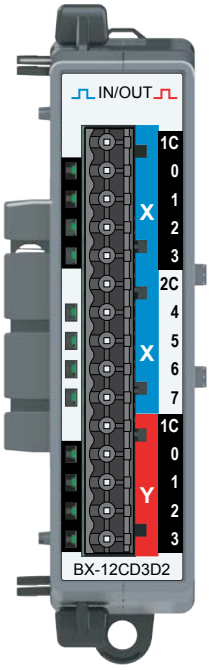


Discrete Output Wiring Diagrams



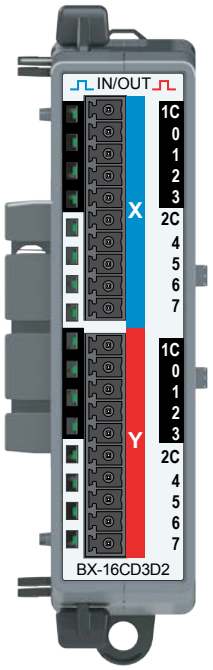
BX-xxCD3D2 Combination DC Input/Sourcing DC Output

The BX-xxCD3D2 Combination Input/Output Expansion Modules provides a total of twelve (12) or sixteen (16) points; eight (8) 12–24 VDC sink/source inputs and either four (4) or eight (8) 12-24 VDC sourcing outputs.



BX-12CD3D2

Combination Discrete Module
Input: 8-pt, 12–24 VDC, Sink/Source
Output: 4-pt, 12–24 VDC, Sourcing



Terminal Blocks or *ZIP*Link Cables Sold Separately

BX-16CD3D2

Combination Discrete Module
Input: 8-pt, 12–24 VDC, Sink/Source,
Output: 8-pt, 12–24 VDC, Sourcing

We recommend using prewired *ZIP*Link cables and connection modules.
If you wish to hand-wire your module, a removable terminal block is available. See Wiring Termination Selection in this chapter for all options.

IMPORTANT!

Hot-Swapping Information
Note: This device cannot be Hot Swapped.

BX-xxCD3D2 Combination DC Input/Sourcing DC Output, continued

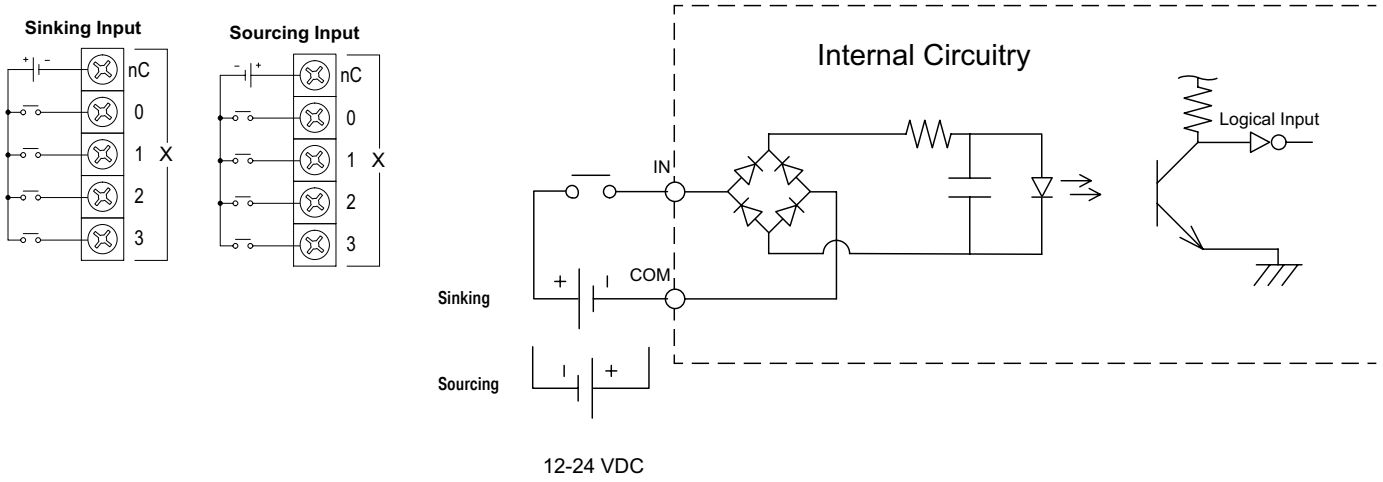
Module Specifications		
	BX-12CD3D2	BX-16CD3D2
Heat Dissipation	3.5 W Max	3.9 W Max
Status Indicators	Logic Side, Green	
Software Version Required	Do-more! Designer version 2.0 or later	

Discrete Input Specifications		
	BX-12CD3D2	BX-16CD3D2
Input Type	Sink/Source	
Inputs per Module	8	
Commons	2 (4 points/common) Isolated	
Nominal Voltage Range	12–24 VDC	
Input Voltage Range	9–30 VDC	
Maximum Voltage	30VDC	
Input Impedance	3kΩ @ 24VDC	
Input Current (typical)	8mA @ 24VDC	
Maximum Input Current	12mA @ 30VDC	
ON Voltage Level	> 9.0 VDC	
OFF Voltage Level	< 2.0 VDC	
Minimum ON Current	5.0 mA (9V required-guarantee ON state)	
Maximum OFF Current	2.0 mA	
OFF-ON Response	2ms	
ON-OFF Response	2ms	

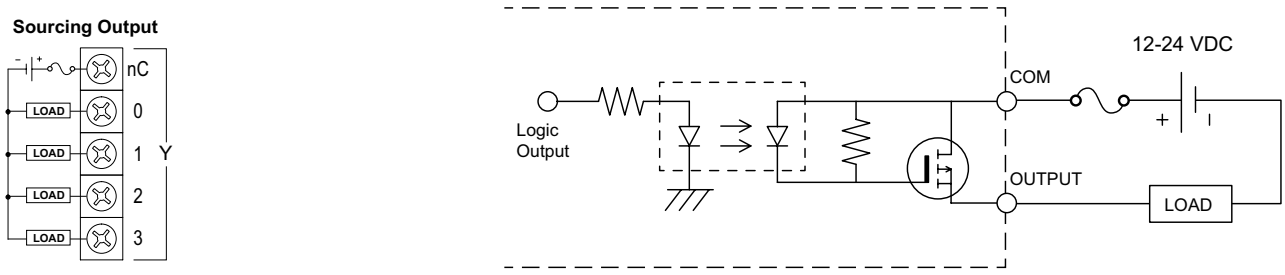
Discrete Output Specifications		
	BX-12CD3D2	BX-16CD3D2
Output Type	Sourcing	
Outputs per Module	4	8
Commons	1 (4 points/common)	2 (4 points/common) Isolated
Maximum Current per Common	2A	
Nominal Voltage Range	12–24 VDC	
Operating Voltage Range	5–36 VDC	
Maximum Voltage	36VDC	
Minimum Output Current	0.1 mA @ 24VDC	
Maximum Output Current	0.5 A per output, no derating over temperature range	
Maximum Inrush Current	5A for 50ms	
Maximum Leakage Current	10µA	
ON Voltage Drop	0.05 VDC	
Fuse Type	User-supplied external fuse	
OFF-ON Response	< 5ms	
ON-OFF Response	< 2ms	

BX-xxCD3D2 Combination DC Input/DC Sourcing Output, continued

Discrete Input Wiring Diagrams

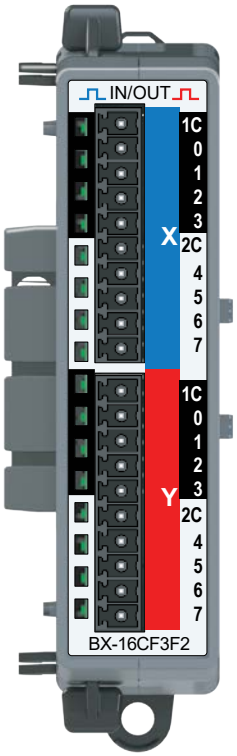


Discrete Output Wiring Diagrams



BX-16CF3F2 Combination DC Input/DC Sourcing Output

The BX-16CF3F2 Combination DC Input/DC Sourcing Output Expansion Module provides a total of sixteen (16) points; eight (8) 3–5 VDC sink/source inputs and eight (8) 3–5 VDC sourcing outputs.



Terminal Blocks or *ZIP*Link Cables Sold Separately

We recommend using prewired ***ZIP***Link cables and connection modules.
If you wish to hand-wire your module, a removable terminal block is available. See Wiring Termination Selection in this chapter for all options.

IMPORTANT!

Hot-Swapping Information
Note: This device cannot be Hot Swapped.

Module Specifications

Heat Dissipation	1.5 W Max
Backplane Power Consumption	1.0 W Max
Status Indicators	Logic Side, Green
Software Version Required	Do-more! Designer version 2.8 or later

Discrete Input Specifications

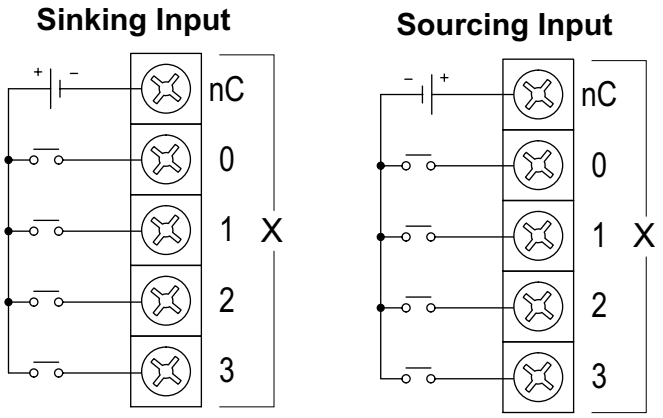
Input Type	Sink/Source
Inputs per Module	8
Nominal Voltage Range	3–5 VDC
Input Voltage Range	2–6 VDC
Maximum Voltage	6VDC
Commons	2 (4 points/common)
Input Impedance	870Ω @ 5VDC
Input Current (typical)	6mA @ 5VDC
Maximum Input Current	8mA @ 6VDC
ON Voltage Level	> 2.0 VDC
OFF Voltage Level	< 0.8 VDC
Minimum ON Current	1.2 mA (2.0 V required to guarantee ON state)
Maximum OFF Current	0.5 mA
OFF-ON Response	2ms
ON-OFF Response	2ms

Discrete Output Specifications

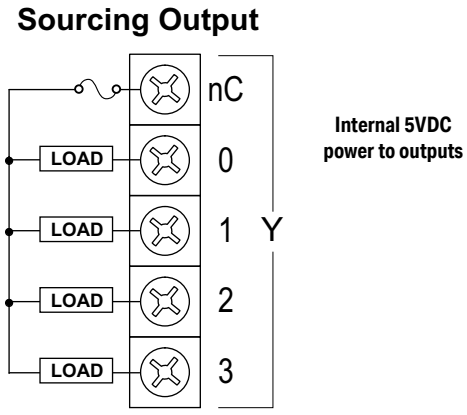
Output Type	Sourcing
Outputs per Module	8
Commons	2 (4 points/common)
Maximum Current per Common	96mA
Power Supply	Internal +5VDC
Peak Voltage	5.5 VDC
Minimum Output Current	0µA
Maximum Output Current	24mA per output, no derating over temperature range
Maximum Leakage Current	10µA
ON Voltage Drop	0.05 VDC
Fuse Type	N/A
OFF-ON Response	< 5ms
ON-OFF Response	< 2ms

BX-16CF3F2 Combination DC Input/DC Sourcing Output, continued

Discrete Input Wiring Diagrams



Discrete Output Wiring Diagrams



BRX Analog I/O Expansion Modules



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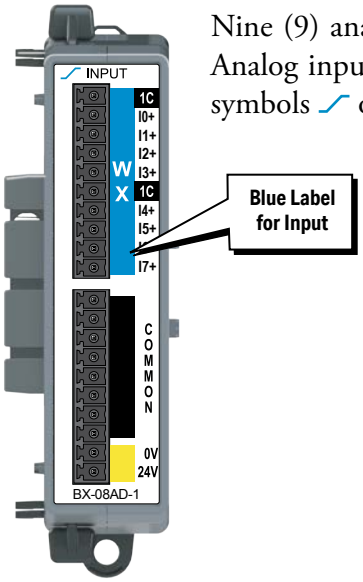
Overview

One valuable feature of the BRX platform is its ability to easily expand its capabilities to fit your application solution. One of the ways the BRX platform can do this is by using expansion modules that conveniently "snap-on" to the side of any BRX MPU.

The analog expansion modules give you the ability to add analog I/O as needed and are identified as an input module, output module, temperature input module, or combination input/output module. On the front panel of the analog I/O expansion modules, a color scheme and a symbol are used to denote the module type. Analog modules are available with current inputs/outputs, unipolar or bipolar voltage inputs/outputs, and thermocouple, resistance temperature detector (RTD) and thermistor inputs.

Module Types

Analog Input Modules

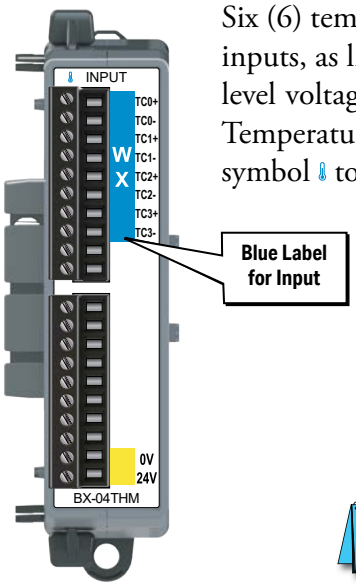


Nine (9) analog input modules are available, with current or voltage inputs, as listed below. Analog input module faceplates have a blue terminal bar to distinguish them as inputs, with symbols ⟋ or ◢ to signify current or voltage, respectively.

Analog Input Modules

Identifier	Input Type	Resolution	4-Point	8-Point	16-Point
ADM-1	Current Sink 0–20mA, 4–20mA	14-bit	BX-04ADM-1	-	-
AD-1	Current Sink 0–20mA, 4–20mA	16-bit	BX-04AD-1	BX-08AD-1	BX-16AD-1
AD-2B	Voltage ±10VDC, ±5VDC, 0–5VDC, 0–10VDC	16-bit	BX-04AD-2B	BX-08AD-2B	BX-16AD-2B
AD-3	Current Sink 0–20mA, 4–20mA Voltage ±10VDC, ±5VDC, 0–5VDC, 0–10VDC	16-bit	BX-04AD-3	BX-08AD-3	-

Temperature Input Module



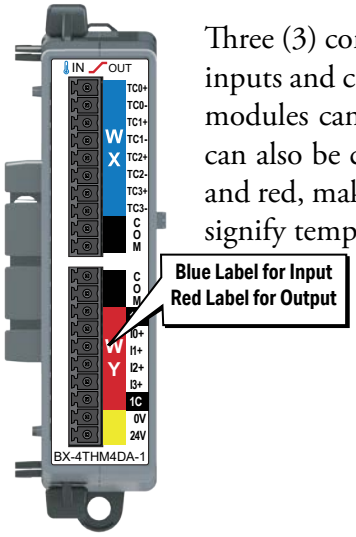
Six (6) temperature input modules are available, with thermocouple, RTD, and/or thermistor inputs, as listed below. The thermocouple input modules can also be configured for millivolt-level voltage inputs, and the RTD input module can also be configured for resistance input. Temperature module faceplates have a blue terminal bar to distinguish them as inputs, with symbol 🌡 to signify temperature.

Temperature Input Modules

Identifier	Input Type	4-Point	6-Point	8-Point
THM	Thermocouple	BX-04THM	-	BX-08THM
RTD	Resistance Temperature Detector (RTD)	-	BX-06RTD	-
NTC	Thermistor	-	-	BX-08NTC
UT	Universal Temperature (Thermocouple, RTD, Thermistor)	BX-04UT	BX-08UT	-

NOTE: *Temperature Input Modules do not support* ***ZIP****Link Wiring Systems.*

Temperature Input/Analog Output Combination Modules



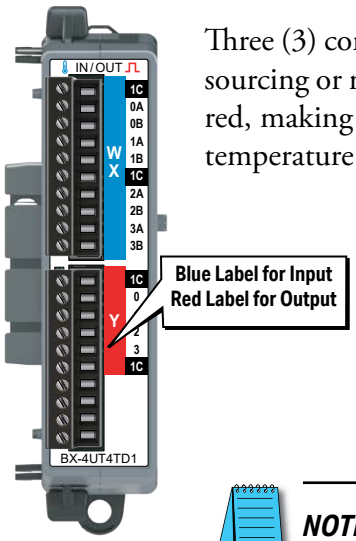
Three (3) combination modules are available with thermocouple, RTD or universal temperature inputs and current sourcing or current/voltage outputs, as listed below. The thermocouple input modules can also be configured for millivolt-level voltage inputs, and the RTD input module can also be configured for resistance input. The Input/Output faceplate terminal bar is in blue and red, making it easy to distinguish between inputs and outputs, and the 🌡, ⟋ and ⎯ symbols signify temperature, current and universal analog, respectively.

Temperature Input/Analog Output Combination Modules

Identifier	Input Type	Output Type	# Inputs	# Outputs	Part #
xRTDxDA-1	Resistance Temperature Detector (RTD)	Current Source 0–20mA, 4–20mA	4	4	BX-4RTD4DA-1
xTHMxDA-1	Thermocouple	Current Source 0–20mA, 4–20mA	4	4	BX-4THM4DA-1
xUTxDA-3	Universal Temperature (Thermocouple, RTD, Thermistor)	Current Source 0–20mA, 4–20mA Voltage ±10VDC, ±5VDC, 0–5VDC, 0–10VDC	4	4	BX-4UT4DA-3

NOTE: *Combination Modules with temperature inputs do not support* ***ZIP****Link Wiring Systems.*

Temperature Input/Discrete Output Combination Modules



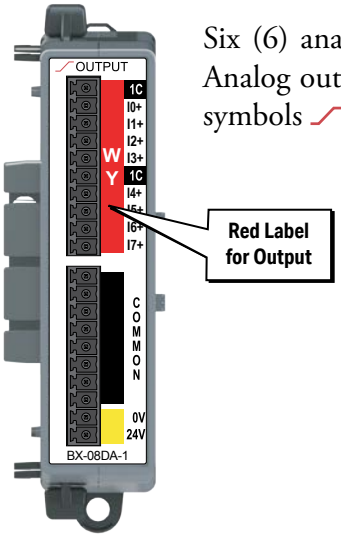
Three (3) combination modules are available with universal temperature inputs and DC sinking, sourcing or relay outputs, as listed below. The Input/Output faceplate terminal bar is in blue and red, making it easy to distinguish between inputs and outputs, and the 🌡 and ⎍ symbols signify temperature and discrete signals, respectively.

Temperature Input/Discrete Output Combination Modules

Identifier	Input Type	Output Type	# Inputs	# Outputs	Part #
xUTxTD1	Universal Temperature (Thermocouple, RTD, Thermistor)	12–24 VDC Sinking	4	4	BX-4UT4TD1
xUTxTD2		12–24 VDC Sourcing	4	4	BX-4UT4TD2
xUTxTR		Relay Form A (SPST)	4	4	BX-4UT4TR

NOTE: *Combination Modules with temperature inputs do not support* ***ZIP****Link Wiring Systems.*

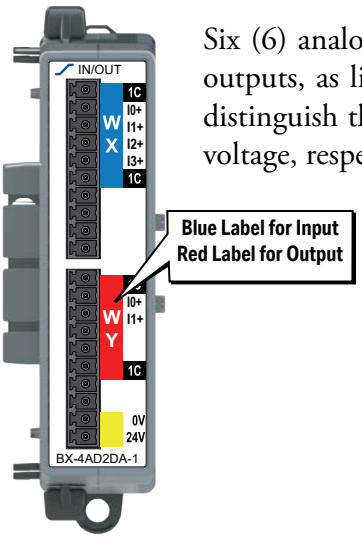
Analog Output Modules



Six (6) analog output modules are available, in current and voltage outputs, as listed below. Analog output module faceplates have a red terminal bar to distinguish them as outputs, with symbols ⟋, ◢ or ⎯ to signify current, voltage or universal analog signals, respectively.

Analog Output Modules			
Identifier	**Type**	**4-Point**	**8-Point**
DA-1	Current Source 0–20mA, 4–20mA	BX-04DA-1	BX-08DA-1
DA-2B	Voltage ±10VDC, ±5VDC, 0–5VDC, 0–10VDC	BX-04DA-2B	BX-08DA-2B
DA-3	Current Source 0–20mA, 4–20mA Voltage ±10VDC, ±5VDC, 0–5VDC, 0–10VDC	BX-04DA-3	BX-08DA-3

Analog Combo Input/Output Modules



Six (6) analog input/output combo modules are available, with current or voltage inputs and outputs, as listed below. Analog combo module faceplates have red and blue terminal bars to distinguish the input and output sections, respectively. Symbols ⟋ and ◢ signify current and voltage, respectively, and are colored blue for inputs and red for outputs.

Analog Combination Input/Output Modules					
Identifier	**Input Type**	**Output Type**	**# Inputs**	**# Outputs**	**Part #**
xADxDA-1	Current Sink 0–20mA, 4–20mA	Current Source 0–20mA, 4–20mA	2	2	BX-2AD2DA-1
			4	2	BX-4AD2DA-1
xADxDA-2B	Voltage ±10VDC, ±5VDC, 0–5VDC, 0–10VDC	Voltage ±10VDC, ±5VDC, 0–5VDC, 0–10VDC	2	2	BX-2AD2DA-2B
			4	2	BX-4AD2DA-2B
xADxDA-3	Current Source 0–20mA, 4–20mA Voltage ±10VDC, ±5VDC, 0–5VDC, 0–10VDC	Current Source 0–20mA, 4–20mA Voltage ±10VDC, ±5VDC, 0–5VDC, 0–10VDC	2	2	BX-2AD2DA-3
			4	4	BX-4AD4DA-3

Wiring Termination Options

The BRX analog expansion modules ship without wiring terminal blocks. This enables you to select the termination style that best fits your application. Several wiring options are available, including removable screw terminal connectors, removable spring clamp terminal connectors and pre-wired ***ZIP***Link cable solutions. The BRX temperature input modules include the BX-RTB10 kit. The BX-RTB10-1 or BX-RTB10-2 can also be used and can be purchased separately.

Terminal Block Connectors

The terminal block connectors are provided in kits of multiple connectors that are easily ordered as a single part number. BX-RTB10 kits include (2) 10-pin 3.81-mm connectors. The 5-wire terminal blocks are available as single units (BX-RTB05) or as kits of three connectors (BX-RTB08).

Terminal block kit part numbers and connector specifications are listed in the table below.



BX-RTB10 Kit



BX-RTB10-1 Kit



BX-RTB10-2 Kit

10-Wire Terminal Block Specifications

Part Number	BX-RTB10	BX-RTB10-1	BX-RTB10-2
Connector Type	Screw Type 90°	Spring Clamp Type 180°	Screw Type 180°
Wire Exit	180°	180°	180°
Pitch	3.81 mm	3.81 mm	3.81 mm
Screw Size	M2	N/A	M2
Screw Torque Recommended	<1.77 lb·in (0.2 N·m)	N/A	<1.77 lb·in (0.2 N·m)
Screwdriver Blade Width	2.5 mm	2.5 mm	2.5 mm
Wire Gauge (Single Wire)	28–16 AWG	26–18 AWG	30–16 AWG
Wire Gauge (Dual Wire)	28–18 AWG	30–20 AWG (Dual Wire Ferrule Required)	30–18 AWG
Wire Strip Length	0.24 in (6mm)	0.35 in (9mm)	0.26 in (6.5 mm)
Equiv. Dinkle P/N	EC381V-10P-BK	ESC381V-10-BK	EC381F-10P-BK

NOTE: *BX-RTB10 terminal blocks are included with Temperature Input modules.*



BX-RTB08 Kit



BX-RTB08-1 Kit



BX-RTB08-2 Kit

5-Wire Terminal Block Specifications

Part Number Single Block Set of 3 Blocks	BX-RTB05 BX-RTB08	BX-RTB05-1 BX-RTB08-1	BX-RTB05-2 BX-RTB08-2
Connector Type	Screw Type 90°	Spring Clamp Type 180°	Screw Type 180°
Wire Exit	180°	180°	180°
Pitch	5.0 mm	5.0 mm	5.0 mm
Screw Size	M2.5	N/A	M2.5
Screw Torque Recommended	<3.98 lb·in (0.45 N·m)	N/A	<3.98 lb·in (0.45 N·m)
Screwdriver Blade Width	3.5 mm	3.5 mm	3.5 mm
Wire Gauge (Single Wire)	28–12 AWG	26–14 AWG	28–12 AWG
Wire Gauge (Dual Wire)	28–16 AWG	28–16 AWG (Dual Wire Ferrule Required)	28–16 AWG
Wire Strip Length	0.3 in (7.5 mm)	0.37 in (9.5 mm)	0.3 in (7.5 mm)
Equiv. Dinkle P/N	5ESDV-05P-BK	5ESDSR-05P-BK	5ESDF-05P-BK

Wiring Termination Options, continued



BX-RTB03



BX-RTB03-1



BX-RTB03-2

3-Wire Terminal Block Specifications			
Part Number	**BX-RTB03**	**BX-RTB03-1**	**BX-RTB03-2**
Connector Type	Screw Type 90°	Spring Clamp Type 180°	Screw Type 180°
Wire Exit	180°	180°	180°
Pitch	5.0 mm	5.0 mm	5.0 mm
Screw Size	M2.5	N/A	M2.5
Screw Torque Recommended	<3.98 lb·in (0.45 N·m)	N/A	<3.98 lb·in (0.45 N·m)
Screwdriver Blade Width	3.5 mm	3.5 mm	3.5 mm
Wire Gauge (Single Wire)	28–12 AWG	26–14 AWG	28–12 AWG
Wire Gauge (Dual Wire)	28–16 AWG	28–16 AWG (Dual Wire Ferrule Required)	28–16 AWG
Wire Strip Length	0.3 in (7.5 mm)	0.37 in (9.5 mm)	0.3 in (7.5 mm)
Equiv. Dinkle P/N	5ESDV-03P-BK	5ESDSR-03P-BK	5ESDF-03P

*ZIP*Link Wiring System

BRX analog expansion modules can be quickly connected to convenient ***ZIP***Link remote terminal blocks for ease of wiring remote I/O devices. The table below lists the connector options. The ***ZIP***Link wiring system is not available for use with BRX modules with temperature input.

BRX Analog Expansion Module *ZIP*Link Selector

Expansion Module Part No.	ZIPLink Module	ZIPLink Module Part No.	Qty Needed	ZIPLink Cable Part No.*	Qty Needed
BX-04ADM-1	Feedthrough	ZL-RTB20 (standard) OR ZL-RTB20-1 (compact)	1	ZL-BXEM-CBL20 ZL-BXEM-CBL20-1 ZL-BXEM-CBL20-2	1
BX-04AD-1					
BX-04AD-2B					
BX-08AD-1					
BX-08AD-2B					
BX-16AD-1					
BX-16AD-2B					
BX-04DA-1					
BX-04DA-2B					
BX-08DA-1					
BX-08DA-2B					
BX-2AD2DA-1					
BX-4AD2DA-1					
BX-2AD2DA-2B					
BX-4AD2DA-2B					
BX-08AD-3				ZL-BXEM-CBL10 ZL-BXEM-CBL10-1 ZL-BXEM-CBL10-2	1
BX-08DA-3					
BX-4AD4DA-3					
BX-4AD4DA-3					
BX-04THM	Temperature Input modules are not supported by the *ZIP*Link wiring system.				
BX-08THM					
BX-06RTD					
BX-08NTC					
BX-04UT					
BX-08UT					
BX-4THM4DA-1					
BX-4RTD4DA-1					
BX-4UT4DA-3					
BX-4UT4TD1					
BX-4UT4TD2					
BX-4UT4TR					

**** Select the cable length: Blank = 0.5 m, -1 = 1.0 m, -2 = 2.0 m.***
Available pigtail cables: ZL-BXEM-CBLxx-1P = 1.0 m, ZL-BXEM-CBLxx-2P = 2.0 m.



General Specifications

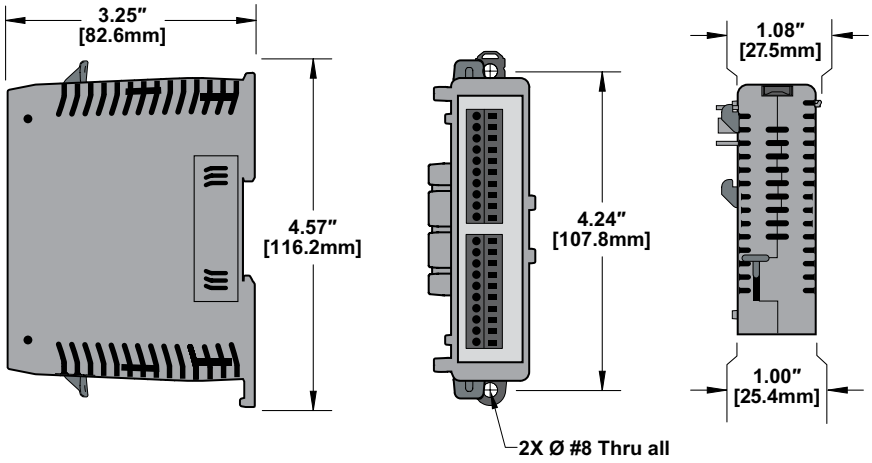
All BRX analog expansion modules and temperature input modules have the same general specifications listed in the tables below.

General Specifications	
Storage Temperature	−20° to 70°C (−4° to 158°F)
Humidity	5 to 95% (non-condensing)
Environmental Air	No corrosive gases permitted
Vibration	IEC60068-2-6 (Test Fc)
Shock	IEC60068-2-27 (Test Ea)
Enclosure Type	Open Equipment
Noise Immunity	NEMA ICS3-304
EU Directive	See the “EU Directive” topic in the BRX Help File.

Operating Temperature Range		
Operating Temperature	0° to 45°C (32° to 113°F)	0° to 60°C (32° to 140°F)
Module	**Module Revision***	
BX-08AD-1	Rev A (Prior to May 2018)	Rev B (After May 2018)
BX-08AD-2B		
BX-04THM		
BX-08DA-1		
BX-08DA-2B	Rev B (Prior to May 2018)	Rev C (After May 2018)
All other Analog and Temperature Expansion Module part numbers	N/A	Rev A (After May 2018)

**** Module Revision can be found in the last letter (last or second-to-last character) of the module serial number.***

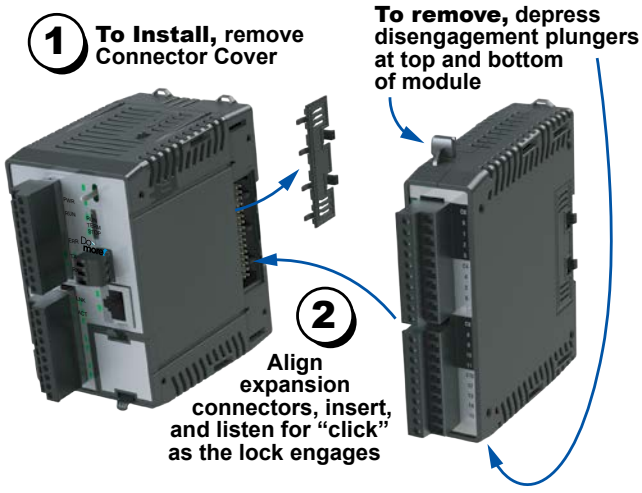
Dimensional Information



Module Installation

WARNING: Do not apply field power until the following steps are completed. The BRX expansion modules are NOT hot swappable.

To install an expansion module, remove the connector cover on the right side of the MPU or expansion module to which the new module is to be connected. Align the expansion connectors and insert the module until you hear a "click," indicating the module expansion connectors have engaged.



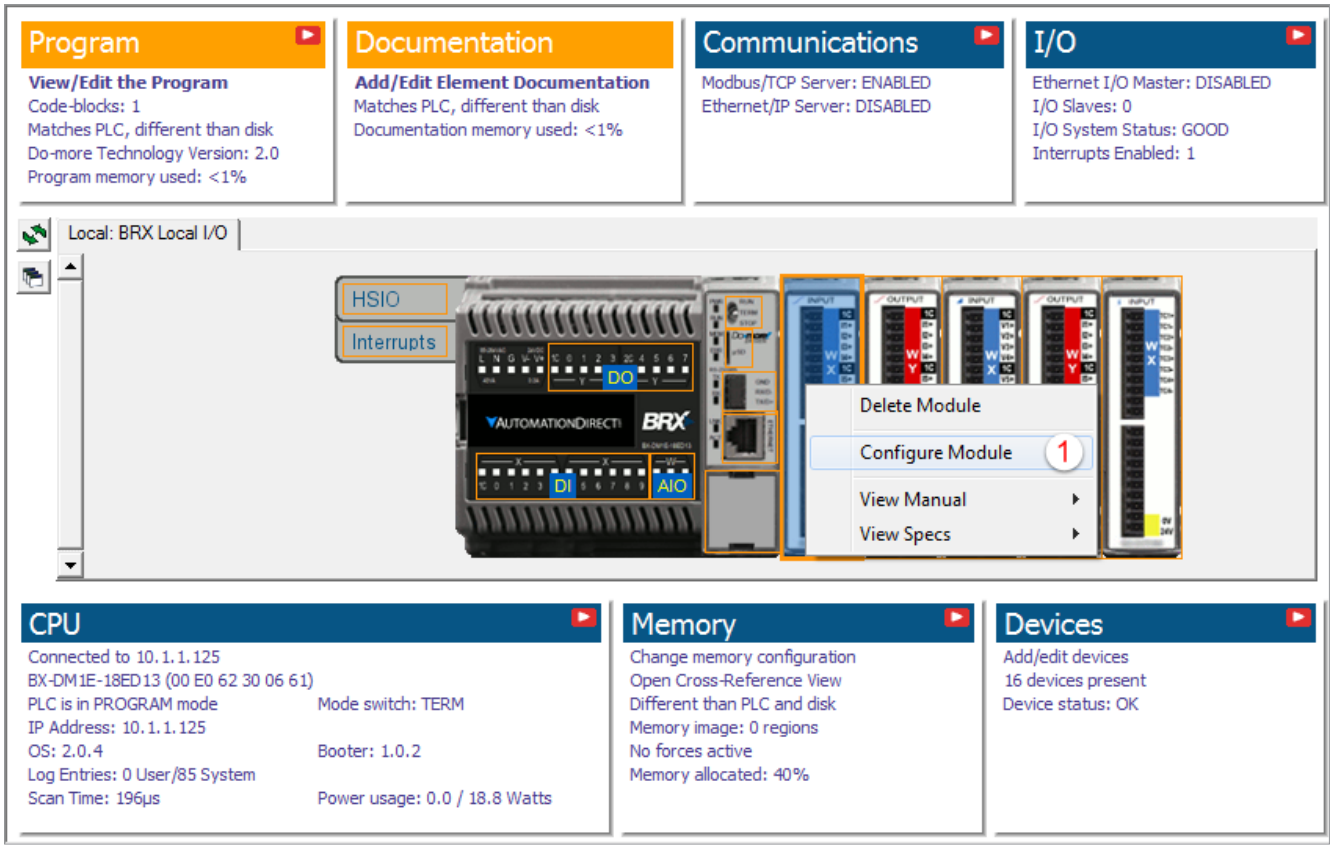
To remove an expansion module, locate the two disengagement plungers. One is located at the top of the of the expansion module and a second one at the bottom of the expansion module. Depressing both plungers at the same time will release the locking mechanism and disengage the unit from the system.

NOTE: *Allow a minimum of 45mm (1.75 in) to the right of the MPU chassis or any subsequent expansion modules for mounting and dismounting of the modules.*

Module Configuration

Once the expansion module has snapped in place and is added to the project, it instantly adds additional I/O and features to the MPU with minimal additional setup required.

To configure a newly attached module, load the Do-more! Designer software and connect to the BRX MPU, as discussed in the Do-more! Designer Software Getting Started Guide (DMD-GSG-M) which can be found at http://support.automationdirect.com/products/domore.html. A graphical representation of the BRX unit with its attached modules is displayed in the Dashboard of the software.



To access the module configuration dialogs, left-click or right-click on the module in the Dashboard and select (1) **Configure Module**. The configuration dialogs for each module are discussed in the corresponding section of this chapter.

Analog Tips and Troubleshooting

This subsection presents common tips on selection and installation of analog hardware, as well as basic troubleshooting techniques, to maximize the performance of your analog input/output circuits.

General Tips for Analog Circuits

When selecting and installing analog devices a few things should be considered:

- Current devices are much more tolerant of noise than voltage devices.
- Current devices can handle much longer runs of wire without signal loss.
- Shielded twisted pair wire should always be used. Analog signals are typically low power, and the better your isolation the less noise you will have degrading the signal.
- If the analog signal is from a thermocouple, the appropriate thermocouple extension wire and terminal blocks must be used if needed to extend wire lengths.
- Use the shortest wiring route whenever possible.
- Do not run analog signal wiring in the same conduit or wire way as AC wiring.
- Do not run analog signal wiring next to large motors, high current switches, or transformers.
- Route the wiring through an approved cable housing to minimize the risk of accidental damage.
- Shields should be connected only at one end, to ground at the source device. Connecting both ends of a shield will create a ground loop, which can increase the noise in a circuit.



- Bonding of the DC negative to ground should be considered, with the exception of Class II power supplies which should never be bonded to ground. This can help with reducing noise induced into analog circuits. Please note that consideration should be given to all devices that will utilize the power supply to ensure that bonding of the negative will not cause damage or interference.
- AC power should be checked from neutral to ground. This voltage should be less than 0.1 VAC.

NOTE: *Your company may have guidelines for wiring and cable installation. If so, you should check those before you begin the installation.*

NOTE: *Check local and national codes to choose the correct method for your application.*

Reducing Electrical Noise

Electrical noise is one of the most difficult problems to diagnose. It can enter the system from a wide range of conducted or radiated sources.

Conducted noise is when the electrical interference is introduced into the system by way of an attached wire, panel connection, etc. It may enter through an I/O point, a power supply connection, the communication ground connection, or the chassis ground connection.

Radiated noise is when electrical interference is introduced into the system without a direct electrical connection, such as via radio waves.

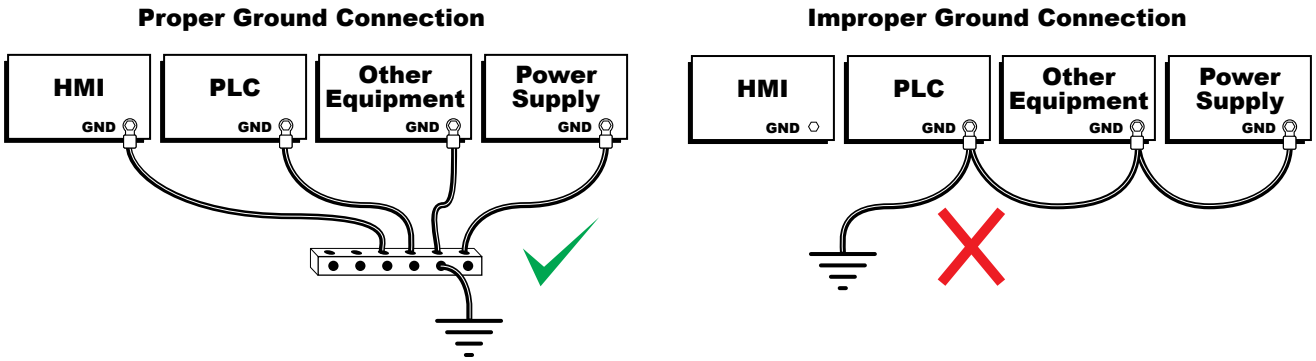
It may be difficult to determine how electrical noise is entering the system, but the corrective actions for either type of noise problem are similar.

While electrical noise cannot be eliminated completely, it can be reduced to a level that will not affect system function. Proper grounding of components and signal wiring along with proper isolation of voltages can minimize noise in the system.

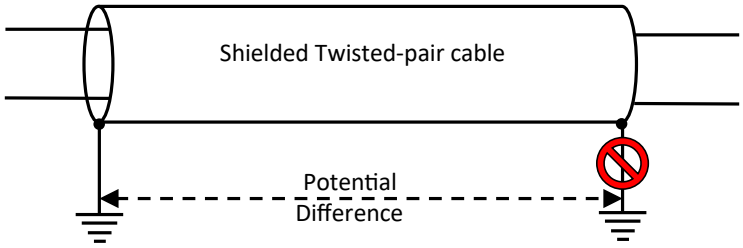
Grounding

Most noise problems result from improper grounding of the system. A good earth ground can be the single most effective way to correct noise problems. If a ground is not available, install a ground rod as close to the system as possible.

Ensure all ground wires are single point grounds and are not daisy chained from one device to another. Ground metal enclosures around the system. Loose ground wires on your devices are more susceptible to noise than the other wires in your system. A loose wire is no more than a large antenna waiting to introduce noise into the system; therefore, you should tighten all connections in your system. Review Chapter 1, "General Installation and Wiring Guidelines," if you have questions regarding how to ground your system.



Cables with shields should be grounded on only one end of the shield. This prevents ground loops and allows for any radiated noise collected by the shield to properly drain to a single ground point.



Isolation

Electrical noise can enter the system through the power source for the MPU and I/O. Installing an isolation transformer for all AC sources can correct this problem.

DC power sources should be properly grounded, except for Class II power supplies, which should never be bonded to ground. Switching DC power supplies commonly generate more noise than linear supplies. Typically, switching type supplies work well for analog circuits, but for some circuits where noise can be a factor, linear type supplies may be needed.

Analog wiring should be placed in separate wire ways or wiring bundles. Keep AC and DC wiring separated. Never run analog signal or communications wiring in parallel or in close proximity to high voltage wiring.

Transformers, inductors, VFDs, DC drives, welders, static generators, ultrasonic devices, radio transmitters, receivers, wiring and antennas, along with similar types of devices, generate large amounts of RF interference. DC wiring, analog wiring and communications wiring should be kept as far away from these sorts of devices and their associated input and output wiring as possible.

Devices that generate noise such as those listed above, along with coil-driven devices such as relays, contactors, solenoids, etc., should be placed on a separate power supply from analog circuits. If this is not possible, then great care should be taken to properly suppress the transient voltage spikes from these devices turning on and off. See Chapter 1, "BRX General Installation and Wiring Guidelines" for more information on this subject.

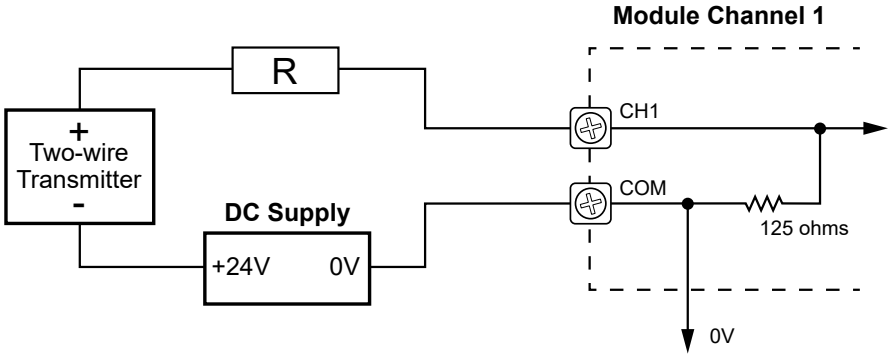
Current Module Tips and Troubleshooting

- Use shielded twisted pair wire. Suggested ADC cables are PLTC3-18-xS-xxxx or PLTC3-18-xSS-xxxx
- Analog circuits follow Ohm's Law. As such, it is important to follow the specifications for impedance in the circuit. If you allow the impedance values to go outside of the specification, damage to the module will occur.
- If your transmitter requires a load resistance higher than 125Ω, you may need to add a resistor in series with the module. Consider the following example for a transmitter being operated from a 24VDC supply with a recommended load resistance of 750 ohms. Since the module has a 125-ohm resistance, you need to add a resistor. Make sure not to exceed the transmitter's maximum load impedance.

R = Tr – Mr
R = 750 – 125
R ≥ 625*

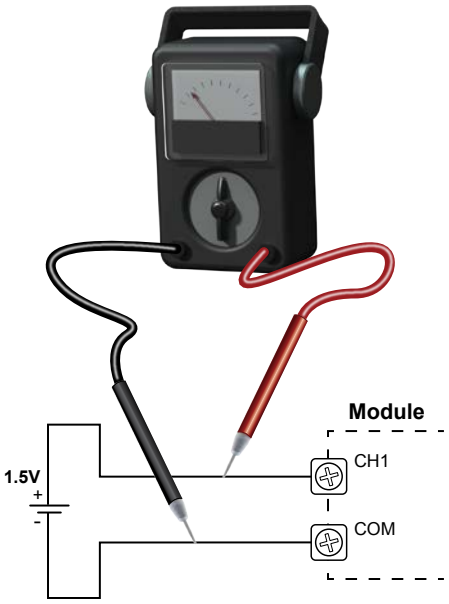
R = Resistor to add
Tr = Termination Requirement
Mr = Module resistance (Internal 125 ohms)

* Do not exceed the transmitter's maximum load impedance.



- If you suspect an I/O error, several things could be causing the problem:
  - A blown fuse.
  - A loose terminal block.
  - The 24VDC supply has failed or 24VDC has not been supplied to the I/O common.
  - The I/O point has failed.
- The DC power supply that powers the module should be checked for the negative side to ground voltage being under 0.1 V for both AC and DC. If this voltage is floating, it can cause errors and/or damage to the circuit.

- To test a current input module, use a 1.5 V battery wired across the positive and negative terminals of the channel to check for current. When applied across a current analog input point, a reading of approximately 30% of the full scale value should result.

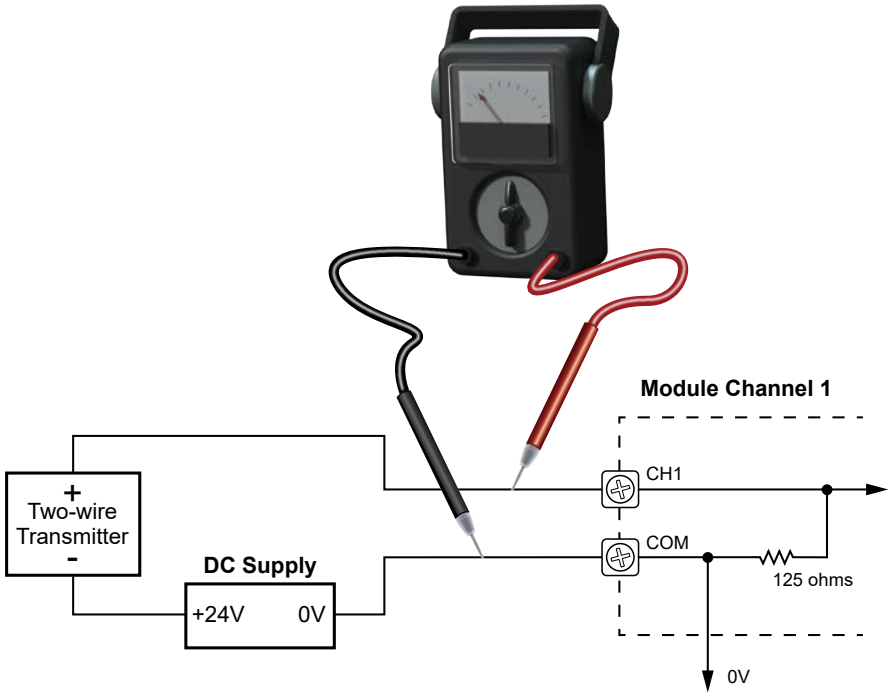


  0–20mA is 0–5VDC across the input resistor

  1.5V/5V=0.3

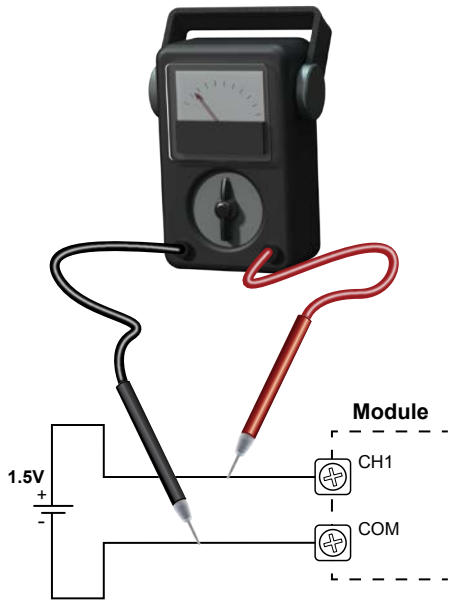
  0.3*65535 = ~19660 counts or 0.3*32767=~9830 counts

- Most current input modules read voltage across a shunt resistor. It may be easier to test for proper current by measuring the voltage across that shunt resistor and applying Ohm's Law (Voltage/125Ω = Current).



Voltage Module Tips and Troubleshooting

- Use shielded twisted pair wire. Suggested ADC cables are PLTC3-18-xS-xxxx or PLTC3-18-xSS-xxxx.
- Jumper the positive and negative terminals together on unused voltage input channels.
- Analog circuits follow Ohm's Law. As such, it is important to follow the specifications for impedance in the circuit. If you allow the impedance values to go outside of the specification, damage to the module will occur.
- If you suspect an I/O error, several things could be causing the problem:
  - A blown fuse.
  - A loose terminal block.
  - The 24VDC supply has failed or 24VDC has not been supplied to the I/O common.
  - The I/O point has failed.
- The DC power supply that powers the module should be checked for the negative side to ground voltage being under 0.1 V for both AC and DC. If this voltage is floating, it can cause errors and/or damage to the circuit.
- To test the voltage input module, use a 1.5 V battery wired across the positive and negative terminals of the input channel to check for voltage. When applied across a voltage analog input point, a reading of approximately 1.5 V should result.



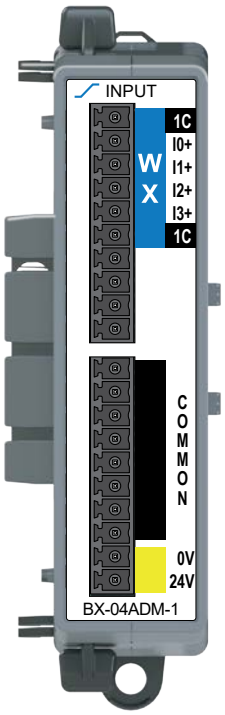
Thermocouple Module Tips and Troubleshooting

- Use shielded thermocouple extension wire of the same type as the thermocouple.
- Do not use terminal blocks that are not designed for thermocouple extension wire.
- Thermocouple wires that have simply been twisted to form a junction will inherently be less accurate than factory-made thermocouples. The use of twist junction thermocouples is not recommended.
- Jumper each of the channel +/- connections together on the module with a short piece of copper wire. This will cause the module to return the measured terminal block temperature for that channel. Does it read the correct ambient temperature of the thermocouple module? If so, there probably isn't anything wrong with the module. This temperature will be several degrees higher than the ambient air temperature of the enclosure.
- With a thermocouple simulator, you have to disable the burnout detection for the module using the module setup in the Do-more! Designer software and download the program to the PLC. This will disable the burnout circuitry, which will cause incorrect readings if left enabled. Even then, it is likely that the module will not read exactly what the simulator is putting out due to the wire differences and the terminal block on the module causing some cold junction error.
- It is possible that the module may be damaged from exceeding the common mode voltage spec, which is 5 Volts. The voltage needs to be measured between each channel on both plus and minus terminals of the module on both AC and DC scales and make sure that it is under 5 Volts maximum. Preferably, the voltage should be less than 0.1V.
- AC power should be checked from neutral to ground. This voltage should be less than 0.1 VAC.
- With grounded thermocouples, take precautions to prevent having a voltage potential between thermocouple tips. A voltage of 1V or greater between tips will skew measurements. For grounded thermocouples, the equipment and thermocouples must be bonded with large-gauge braided wire to the same ground as the PLC.
- The DC power supply that powers the module should be checked for the negative side to ground voltage being under 0.1V for both AC and DC. If this voltage is floating, it can cause errors and/or damage to the circuit.

RTD and Thermistor Troubleshooting

- The easiest way to troubleshoot an RTD or thermistor is with an ohmmeter. If the RTD or thermistor reads open (infinity) or very high resistance, then the RTD or thermistor is bad and should be replaced.
- Intermittent readings can sometimes be caused by a broken RTD or thermistor where the element has cracked but is not fully broken. As it heats up, the crack widens and causes incorrect readings. In this case, the RTD or thermistor should be replaced as well.

BX-04ADM-1 Analog Current Sinking Input



BX-04ADM-1
Analog Input
Expansion Module
4-ch, 0-20mA/4-20mA,
14-bit

Terminal Blocks or *ZIP*Link Cables Sold Separately

We recommend using prewired ***ZIP***Link cables and connection modules. If you wish to hand-wire your module, a removable terminal block is available. See Wiring Termination Selection in this chapter for all options.

Analog Current Sinking Input Specifications	
Inputs per Module	4
Commons	1
Module Signal Input Range	0–20mA, 4–20mA (Default)
Signal Resolution	14-bit
Resolution Value of LSB	See Data Range Specifications table
Input Impedance	125Ω±0.1%, 1/10th watt
All Channel Update Rate	45ms (4 channels)
Over Current Circuit Detection Time	< 1second
Maximum Continuous Overload	±28mA
Sample Duration Time	5µs per channel
Hardware Filter Characteristics	Low Pass 1st order, −3dB @ 144Hz
Conversion Method	Successive approximation
Linearity Error (end to end)	±0.09% of range
Input Stability and Repeatability	±0.035% of range (after 10 min. warmup)
Full Scale Calibration Error	±0.1% of range
Offset Calibration Error	±0.1% of range
Accuracy vs. Temperature	±35PPM / °C maximum
Maximum Inaccuracy	0.1% of range (incl. Temperature Drift)
Maximum Crosstalk	−96dB, 1 LSB
Channel to Backplane Isolation	1800VAC applied for one second
Channel to Channel Isolation	None
Loop Fusing (External)	Fast-acting 0.032A recommended
Backplane Power Consumption	0.1 W
External DC Power Required	Class 2 or LPS power supply 24VDC (±20%) 25mA
Heat Dissipation	0.8 W
Weight	98g (3.5 oz)
Agency Approvals	UL 61010-1 and UL 61010-2-201 File E139594, Canada and USA CE (EN 61131-2 EMC, EN 61010-1 and EN 61010-2-201 Safety)
Software Version Required (Do-more! Designer Programming Software)	2.3 or later

IMPORTANT!

Hot-Swapping Information
Note: This device cannot be Hot Swapped.

BX-04ADM-1 Analog Current Sinking Input, continued

Data Range Specifications			
Selection	**Description**	**Raw Counts**	**µA Per Count**
0–20mA	unipolar 0–20mA	0–16383	1.22
4–20mA	unipolar 4–20mA	0–16383	0.977

The module reserves the first 24 bits of unused contiguous space in the X register, aligned to an 8-bit word boundary, for status reporting. Error flags for this module are laid out within its status register space as described in the table below.

Error Flag Specifications								
	MSB							**LSB**
1st Byte of unused X Registers								
Module Status	-	-	-	-	-	Data Not Valid	Missing 24VDC	Self Test Failed
2nd Byte of unused X Registers								
Channel Open(Broken Transmitter)*	-	-	-	-	Channel 4	Channel 3	Channel 2	Channel 1
3rd Byte of unused X Registers								
Unused	-	-	-	-	-	-	-	-

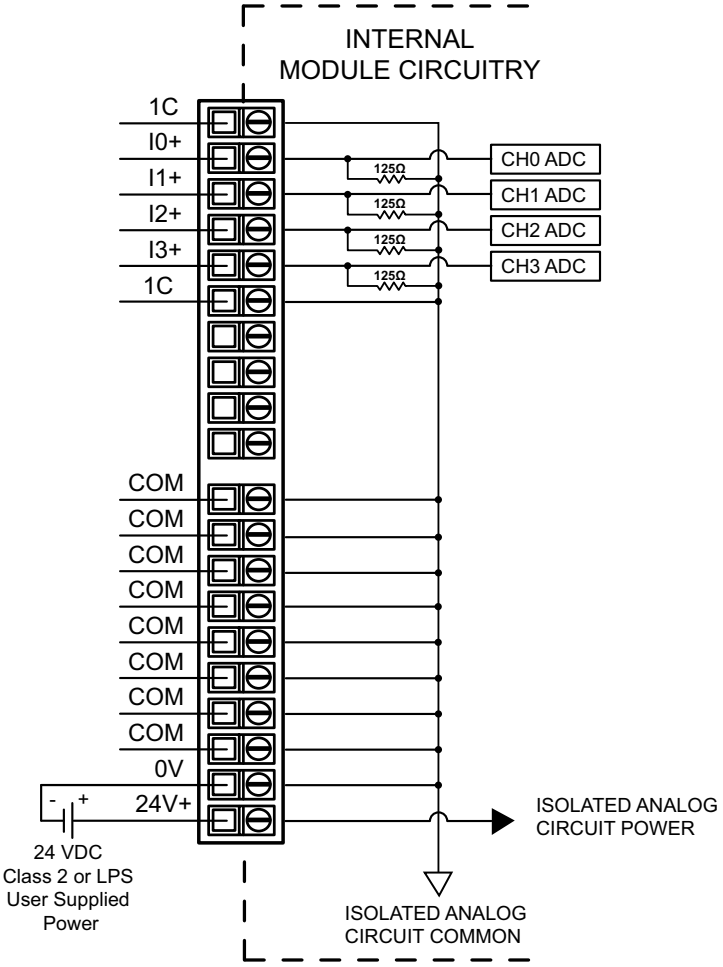
**** 4–20mA mode only. Broken Transmitter bits will turn on below ~3.75 mA.***



***NOTE:** The Data Not Valid flag should always be tested and confirmed to be in the "Off" state in your PLC program before reading from the analog module.*

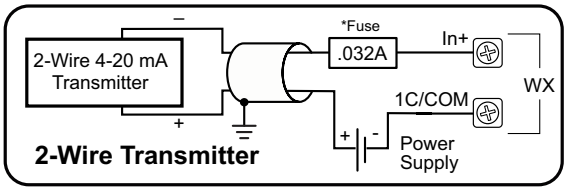
BX-04ADM-1 Analog Current Sinking Input, continued

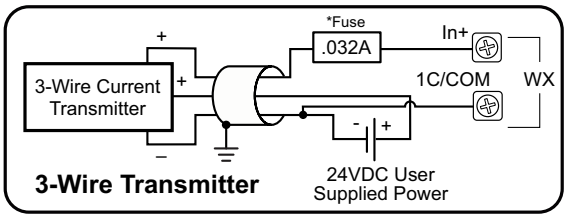
Analog Current Input Wiring

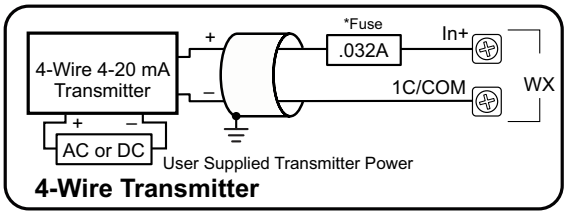


Analog Current Sinking Input Circuits

*An Edison S500-32-R 0.032A fast-acting fuse is recommended for all analog voltage inputs, analog outputs, and current loops.





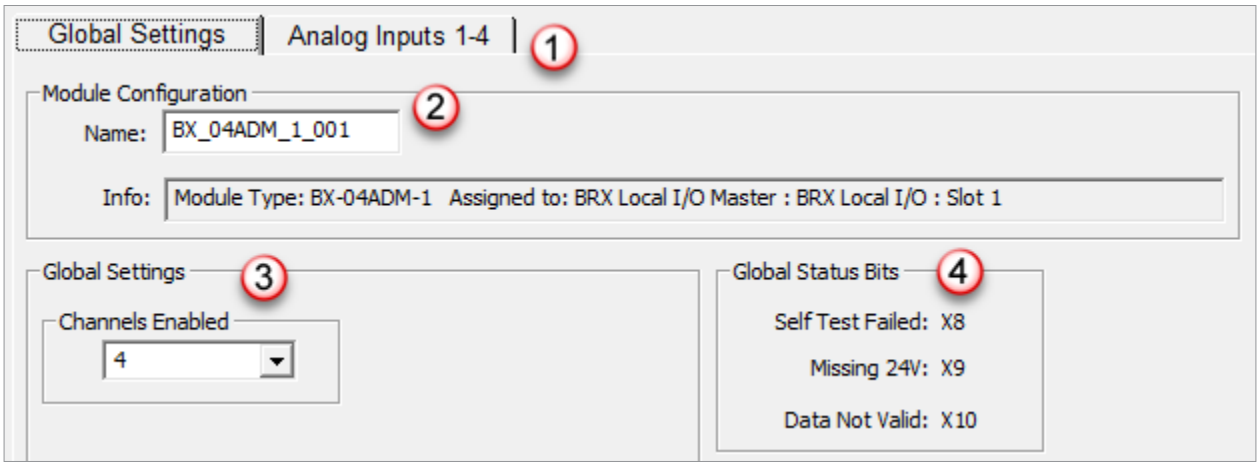


NOTE: Shield should be connected only at one end, to ground at the source device.

BX-04ADM-1 Analog Current Sinking Input, continued

Software Setup

After the module is installed, open the Do-more! Designer programming software, connect to the BRX MPU and open the **Configure Module** dialog as described at the beginning of this chapter.



1. The module options are divided into subsets across multiple tabs. Click the appropriate tab to edit the configuration.
2. *Module Configuration*

   Name – Each module comes with a default name. This may be changed by the user to better identify the module, if desired.

   Info – This is the system description of the module. It is static and may not be changed.
3. *Global Settings*

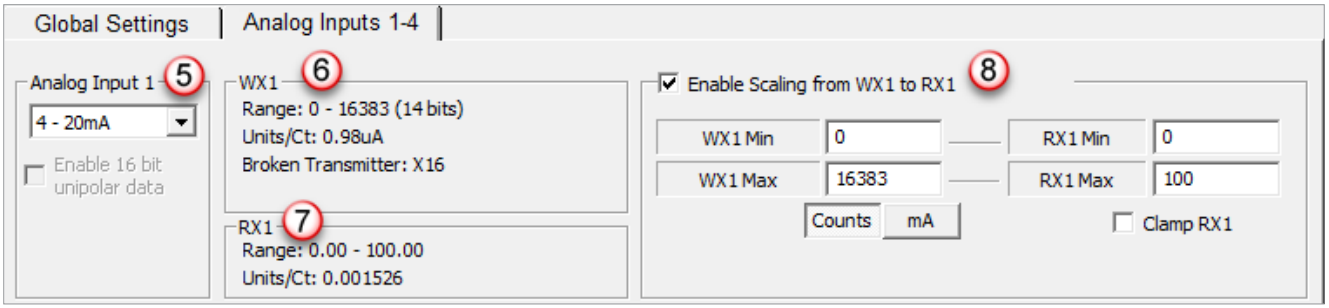
   Channels Enabled – Select how many channels will be used. The default is all channels. Selecting fewer channels may increase the update frequency. See the module specifications for details.
4. *Global Status Bits*

   Self Test Failed – This bit will be On if the module has failed its internal self-test. In this case, the module is likely bad and should be replaced.

   Missing 24V – This bit will be On if the external 24VDC power is missing. Check the 24VDC power connection on the module terminal block.

   Data Not Valid – This bit will be On if the module does not have the latest configuration parameters or the module has not been configured at all. Reload the program into the CPU and power cycle.

BX-04ADM-1 Analog Current Sinking Input, continued



5. ***Analog Input x***

   These settings are for each channel of the analog module.

   Drop-down menu - Select the range of the analog input here.

   The ***Enable 16 bit unipolar data*** option does not apply to this 14-bit module, and is grayed out.

6. ***WXx***

   Range – The number of Raw counts for the selected channel on the module.

   Units/Ct – The amount of current that will equal 1 raw count.

   Broken Transmitter – The input register that, when On, will indicate that the loop is broken.

7. ***RXx***

   Range – The engineering units to which the raw counts are scaled.

   Units/Ct – The number of raw counts that will equal 1 scaled engineering unit.

8. ***Enable Scaling from WXx to RXx***

   WXx Min – The minimum value of the raw counts to scale.

   WXx Max – The maximum value of the raw counts to scale.

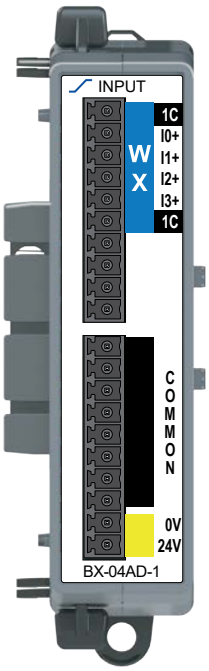
   RXx Min – The minimum value of the engineering units for scaling.

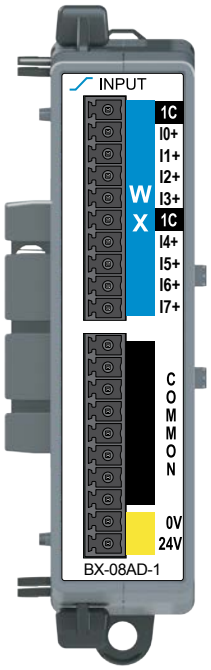
   RXx Max – The maximum value of the engineering units for scaling.

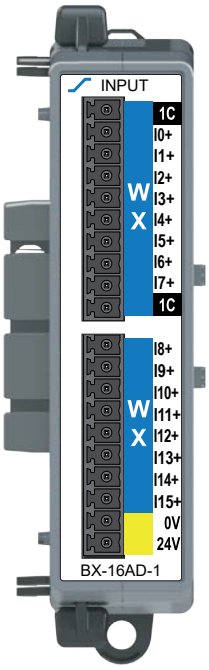
   Counts/mA – Use these buttons to change the raw scaling to counts or milliamps.

   Clamp RXx – If this box is checked, RXx will clamp at the minimum and maximum scaled values.

BX-xxAD-1 Analog Current Sinking Input







Terminal Blocks or *ZIP*Link Cables Sold Separately

BX-04AD-1

Analog Input
Expansion Module
4-ch, 0-20mA/4-20mA,
16-bit

BX-08AD-1

Analog Input
Expansion Module
8-ch, 0-20mA/4-20mA,
16-bit

BX-16AD-1

Analog Input
Expansion Module
16-ch, 0-20mA/4-20mA,
16-bit

We recommend using prewired *ZIP*Link cables and connection modules.
If you wish to hand-wire your module, a removable terminal block is available. See Wiring Termination Selection in this chapter for all options.

IMPORTANT!

Hot-Swapping Information
Note: This device cannot be Hot Swapped.

BX-xxAD-1 Analog Current Sinking Input, continued

Analog Current Sinking Input Specifications			
	BX-04AD-1	BX-08AD-1	BX-16AD-1
Inputs per Module	4	8	16
Commons	1		
Module Signal Input Range	0–20mA, 4–20mA (Default)		
Signal Resolution	16-bit, 15-bit (Default)		
Resolution Value of LSB	See Data Range Specifications table		
Input Impedance	125Ω±0.1%, 1/10th watt		256Ω±0.1%, 1/10th watt
All Channel Update Rate	45ms		80ms
Over Current Circuit Detection Time	< 1second		NA
Maximum Continuous Overload	±28mA		
Sample Duration Time	5µs per channel		100µs per channel
Hardware Filter Characteristics	Low Pass 1st order, −3dB @ 144Hz		Low Pass 2nd order, -3dB @ 15KHz
Conversion Method	Successive approximation		
Linearity Error (end to end)	±0.09% of range		
Input Stability and Repeatability (after 10 min. warmup)	±0.035% of range		±0.05% of range
Full Scale Calibration Error	±0.1% of range		
Offset Calibration Error	±0.1% of range		
Accuracy vs. Temperature	±25PPM/ºC maximum		
Maximum Inaccuracy	0.1% of range (incl. Temperature Drift)		
Maximum Crosstalk	−96dB, 1 LSB		−90dB, 1 LSB
Channel to Backplane Isolation	1800VAC applied for one second		
Channel to Channel Isolation	None		
Loop Fusing (External)	Fast-acting 0.032A recommended		
Backplane Power Consumption	0.1 W		0.3 W
External DC Power Required	Class 2 or LPS power supply 24VDC (±20%)		
	25mA		75mA
Heat Dissipation	0.8 W	2.5 W	2W
Weight	98g (3.5 oz)		110g (3.9 oz)
Agency Approvals	UL 61010-1 and UL 61010-2-201 File E139594, Canada and USA CE (EN 61131-2 EMC, EN 61010-1 and EN 61010-2-201 Safety)		
Software Version Required (Do-more! Designer Programming Software)	2.3 or later	2.1 or later	2.6 or later

BX-xxAD-1 Analog Current Sinking Input, continued

Data Range Specifications							
Selection	Description	Enable 16 bit Unchecked (15 bit Resolution, Default)			Enable 16 bit Checked (16 bit Resolution)		
		Raw Counts	Casting*	µA Per Count	Raw Counts	Casting*	µA Per Count
0–20mA	unipolar 0–20mA	0–32767	–	0.61	0–65535	WXn:U	0.31
4–20mA	unipolar 4–20mA	0–32767	–	0.49	0–65535	WXn:U	0.24

For more information on Casting, refer to Help topic DMD0309 in the Do-more! Designer Software.

The module reserves the first 24 bits of unused contiguous space in the X register, aligned to an 8-bit word boundary, for status reporting. Error flags for this module are laid out within its status register space as described in the table below.

Error Flag Specifications								
	MSB							LSB
1st Byte of unused X Registers								
Module Status	-	-	-	-	-	Data Not Valid	Missing 24VDC	Self Test Failed
2nd Byte of unused X Registers								
Channel Open (Broken Transmitter)*	Channel 8	Channel 7	Channel 6	Channel 5	Channel 4	Channel 3	Channel 2	Channel 1
3rd Byte of unused X Registers								
Channel Open (Broken Transmitter)***	Channel 16	Channel 15	Channel 14	Channel 13	Channel 12	Channel 11	Channel 10	Channel 9

4–20mA mode only. Broken Transmitter bits will turn on below ~3.75 mA.

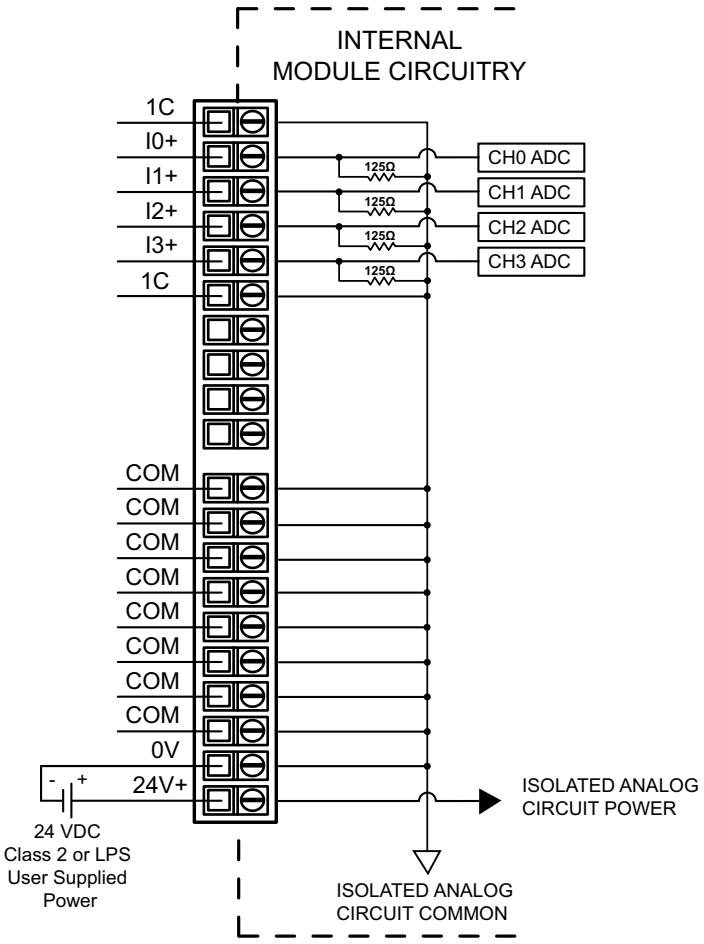
****BX-16AD-1 only.***

***NOTE:** The Data Not Valid flag should always be tested and confirmed to be in the "Off" state in your PLC program before reading from the analog module.*

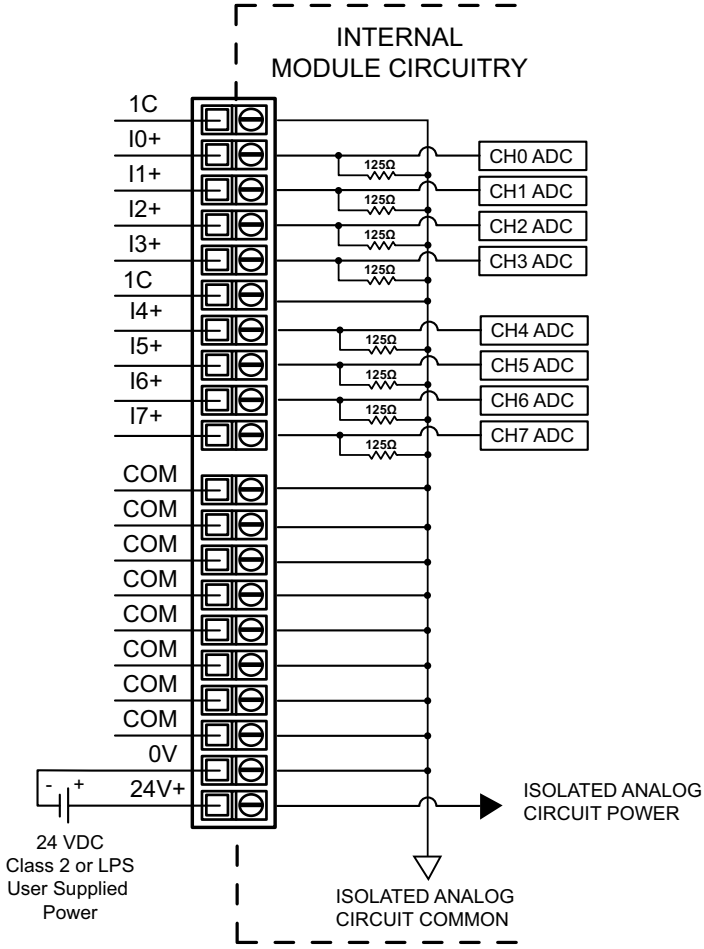
BX-xxAD-1 Analog Current Sinking Input, continued

Analog Current Input Wiring

BX-04AD-1



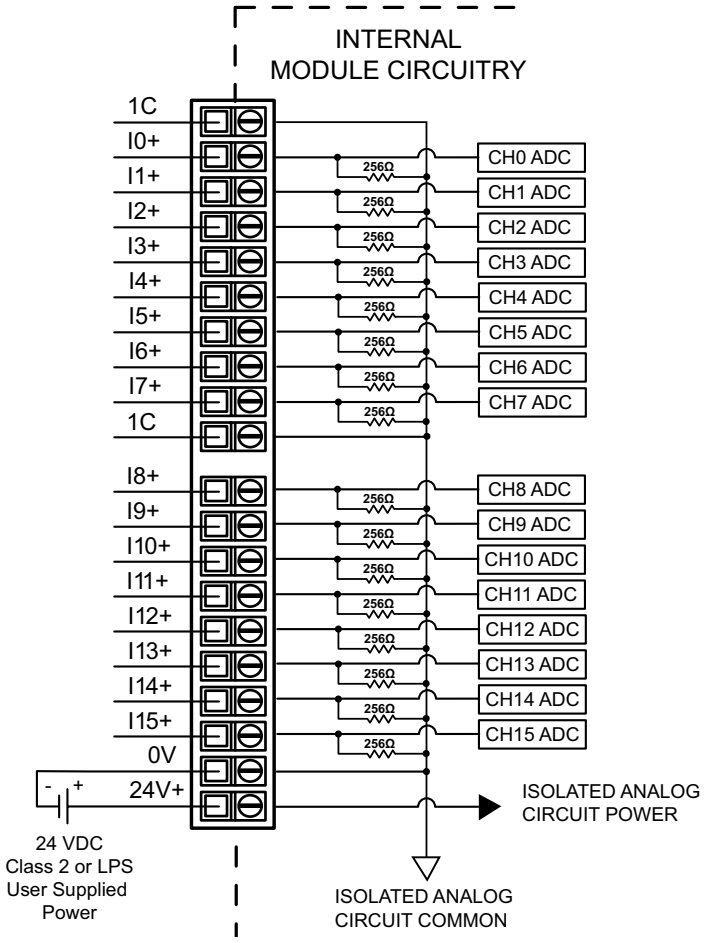
BX-08AD-1



BX-xxAD-1 Analog Current Sinking Input, continued

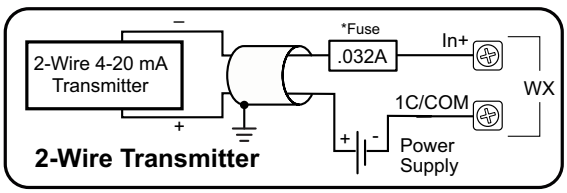
Analog Current Input Wiring, continued

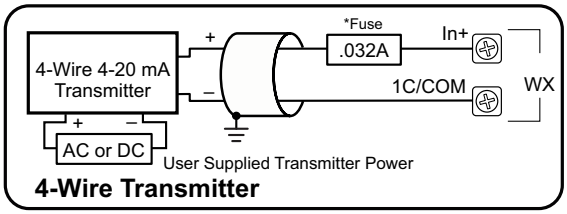
BX-16AD-1

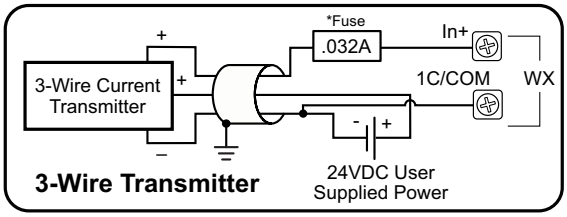


Analog Current Sinking Input Circuits

*An Edison S500-32-R 0.032A fast-acting fuse is recommended for all analog voltage inputs, analog outputs, and current loops.





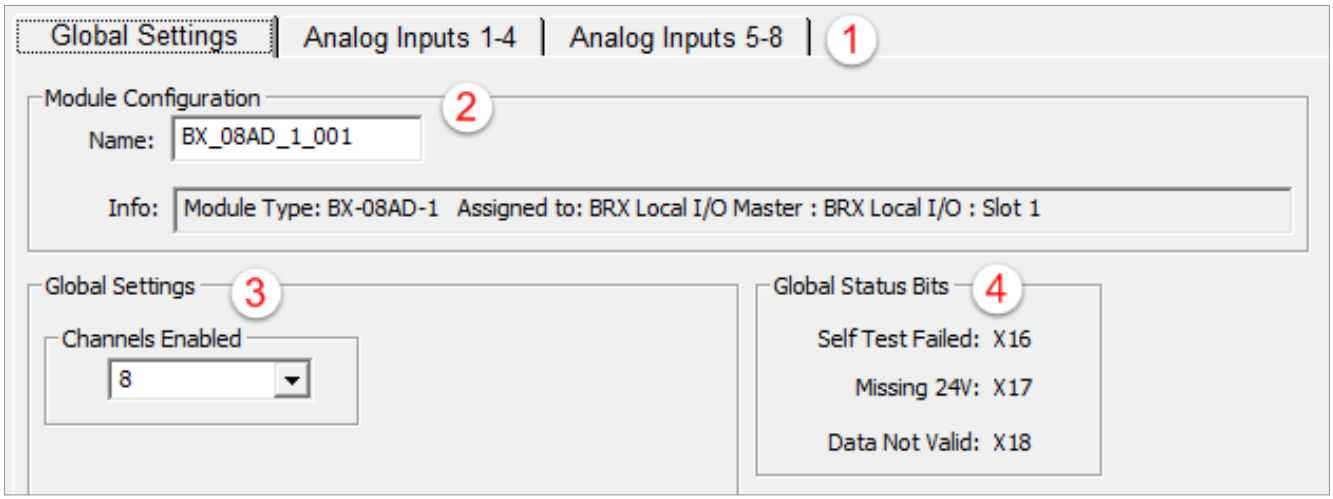


NOTE: Shield should be connected only at one end, to ground at the source device.

BX-xxAD-1 Analog Current Sinking Input, continued

Software Setup

After the module is installed, open the Do-more! Designer programming software, connect to the BRX MPU and open the **Configure Module** dialog as described at the beginning of this chapter.



1. The module options are divided into subsets across multiple tabs. Click the appropriate tab to edit the configuration.
2. *Module Configuration*

   Name – Each module comes with a default name. This may be changed by the user to better identify the module if desired.

   Info – This is the system description of the module. It is static and may not be changed.
3. *Global Settings*

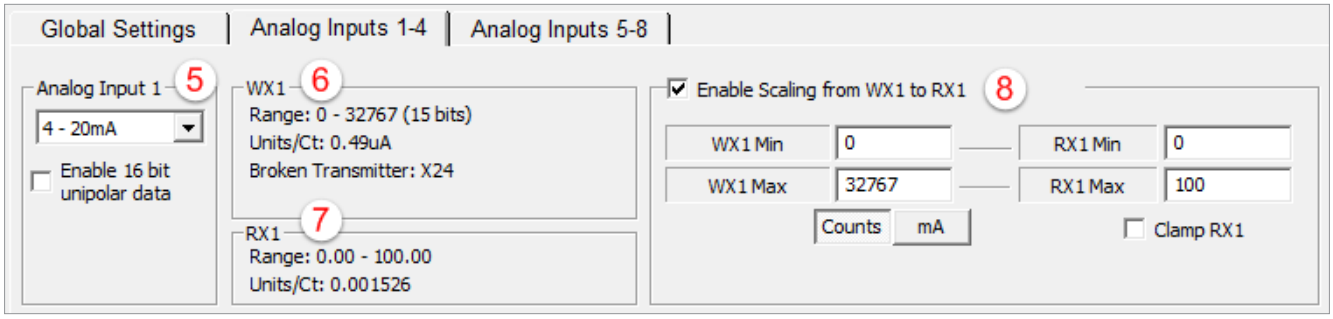
   Channels Enabled – Select how many channels will be used. The default is all channels. Selecting fewer channels may increase the update frequency. See the module specifications for details.
4. *Global Status Bits*

   Self Test Failed – This bit will be On if the module has failed its internal self-test. In this case, the module is likely bad and should be replaced.

   Missing 24V – This bit will be On if the external 24VDC power is missing. Check the 24VDC power connection on the module terminal block.

   Data Not Valid – This bit will be On if the module does not have the latest configuration parameters or the module has not been configured at all. Reload the program into the CPU and power cycle.

BX-xxAD-1 Analog Current Sinking Input, continued



5. ***Analog Input x***

   These settings are for each channel of the analog module.

   Drop-down menu - Select the range of the analog input here.

   Enable 16 bit unipolar data – Check this box to change the raw count range from a signed decimal bipolar data format to an unsigned decimal data format. This may require that Casting be used in the program in order to properly access the data. Refer to the chart of Data Range Specifications earlier in this chapter to see if the registers must be accessed with Casting.

6. ***WXx***

   Range – The number of Raw counts for the selected channel on the module

   Units/Ct – The amount of current that will equal 1 raw count.

   Broken Transmitter – The input register that, when On, will indicate that the loop is broken.

7. ***RXx***

   Range – The engineering units to which the raw counts are scaled.

   Units/Ct – The number of raw counts that will equal 1 scaled engineering unit.

8. ***Enable Scaling from WXx to RXx***

   WXx Min – The minimum value of the raw counts to scale.

   WXx Max – The maximum value of the raw counts to scale.

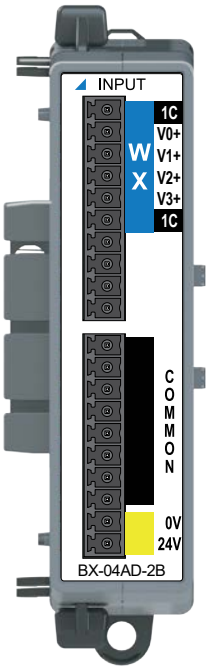
   RXx Min – The minimum value of the engineering units for scaling.

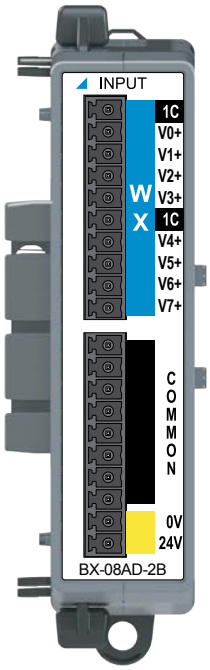
   RXx Max – The maximum value of the engineering units for scaling.

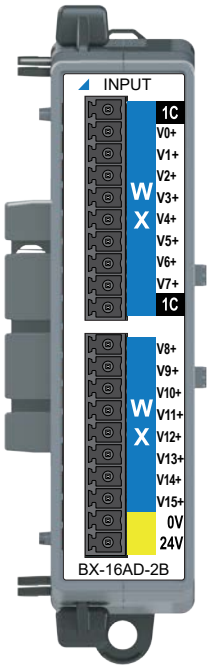
   Counts/mA – Use these buttons to change the raw scaling to counts or milliamps.

   Clamp RXx – If this box is checked, RXx will clamp at the minimum and maximum scaled values.

BX-xxAD-2B Analog Voltage Input







Terminal Blocks or *ZIP*Link Cables Sold Separately

BX-04AD-2B

Analog Input
Expansion Module
4-ch, ±10 VDC, ±5 VDC,
0–5 VDC, 0–10 VDC,
16-bit

BX-08AD-2B

Analog Input
Expansion Module
8-ch, ±10 VDC, ±5 VDC,
0–5 VDC, 0–10 VDC,
16-bit

BX-16AD-2B

Analog Input
Expansion Module
16-ch, ±10 VDC, ±5 VDC,
0–5 VDC, 0–10 VDC,
16-bit

We recommend using prewired ***ZIP***Link cables and connection modules.
If you wish to hand-wire your module, a removable terminal block is available. See Wiring Termination Selection in this chapter for all options.

IMPORTANT!

Hot-Swapping Information
Note: This device cannot be Hot Swapped.

BX-xxAD-2B Analog Voltage Input, continued

Analog Voltage Input Specifications			
	BX-04AD-2B	**BX-08AD-2B**	**BX-16AD-2B**
Inputs per Module	4	8	16
Commons	1		
Module Signal Input Range	±10 VDC, ±5 VDC, 0–5 VDC, 0–10 VDC (Default)		
Signal Resolution	16-bit, 15-bit (Default)		
Resolution Value of LSB	See Data Range Specifications table		
Input Impedance	>10MΩ		>1MΩ
All Channel Update Rate	45ms		100ms
Sample Duration Time	5µs per channel		100µs per channel
Hardware Filter Characteristics	Low Pass 2nd order, −3dB @ 15kHz		
Conversion Method	Successive approximation		
Accuracy vs. Temperature	±25PPM/°C maximum		
Maximum Inaccuracy	0.15% of full range (over temp)		
Linearity Error (end to end)	±0.03%		±0.09%
Input Stability and Repeatability	±0.06% of range (after 10 min. warmup)		
Full Scale Calibration Error	±0.08% of range		±0.1% of range
Offset Calibration Error	±0.08% of range		±0.1% of range
Maximum Crosstalk	−96dB, 1 LSB		−90dB, 1 LSB
Channel to Backplane Isolation	1800VAC applied for one second		
Channel to Channel Isolation	None		
Loop Fusing (External)	Fast-acting 0.032A recommended		
Backplane Power Consumption	0.1 W		0.3 W
External DC Power Required	Class 2 or LPS power supply 24VDC (±20%)		
	25mA		75mA
Heat Dissipation	0.8 W		1W
Weight	98g (3.5 oz)		110g (3.9 oz)
Agency Approvals	UL 61010-1 and UL 61010-2-201 File E139594, Canada and USA CE (EN 61131-2 EMC, EN 61010-1 and EN 61010-2-201 Safety)		
Software Version Required (Do-more! Designer Programming Software)	2.3 or later	2.1 or later	2.6 or later

BX-xxAD-2B Analog Voltage Input, continued

Data Range Specifications							
Selection	Description	Enable 16 bit Unchecked (15 bit Resolution, Default)[1]			Enable 16 bit Checked (16 bit Resolution)		
		Raw Counts	Casting[2]	µV Per Count	Raw Counts	Casting[2]	µV Per Count
0–10V	unipolar 10VDC	0–32767	-	305	0–65535	WXn:U	152
0–5V	unipolar 5VDC	0–32767	-	152	0–65535	WXn:U	76
±10V	bipolar 10VDC	-	-	-	−32768 to 32767	-	305
±5V	bipolar 5VDC	-	-	-	−32768 to 32767	-	152

1. Bipolar ranges default to 16-bit resolution.

2. For more information on Casting, refer to Help topic DMD0309 in the Do-more! Designer Software.

The module reserves the first 24 bits of unused contiguous space in the X register, aligned to an 8-bit word boundary, for status reporting. Error flags for this module are laid out within its status register space as described in the table below.

Error Flag Specifications								
	MSB							LSB
1st Byte of unused X Registers								
Module Status	-	-	-	-	-	Data Not Valid	Missing 24VDC	Self Test Failed
2nd Byte of unused X Registers								
Channel Out of Range	Channel 8	Channel 7	Channel 6	Channel 5	Channel 4	Channel 3	Channel 2	Channel 1
3rd Byte of unused X Registers								
Channel Out of Range*	Channel 16	Channel 15	Channel 14	Channel 13	Channel 12	Channel 11	Channel 10	Channel 9

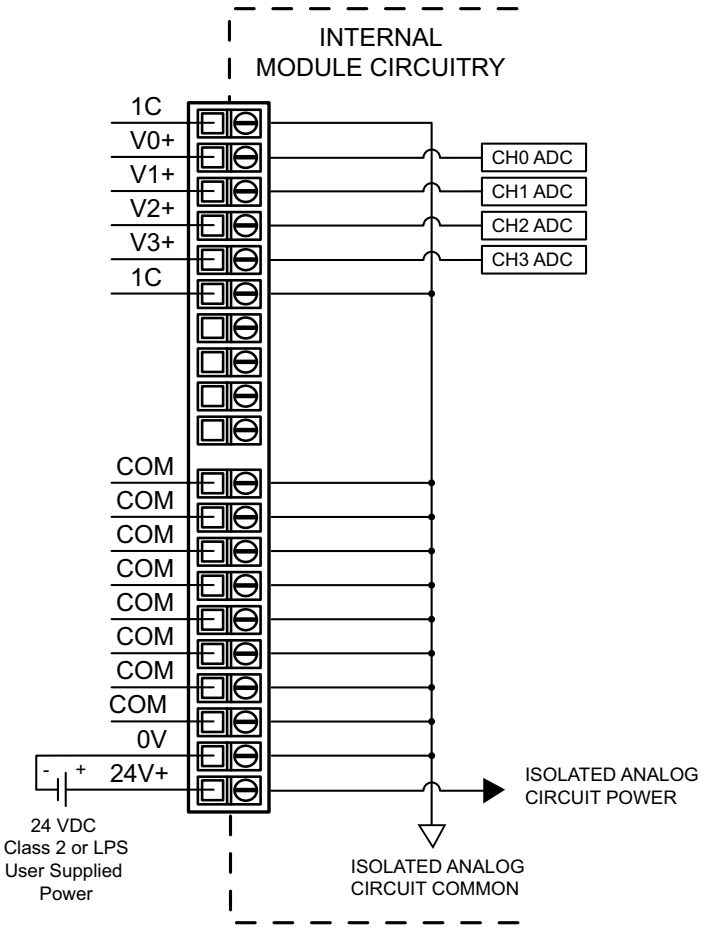
** BX-16AD-2B only.*

NOTE: *The Data Not Valid flag should always be tested and confirmed to be in the "Off" state in your PLC program before reading from the analog module.*

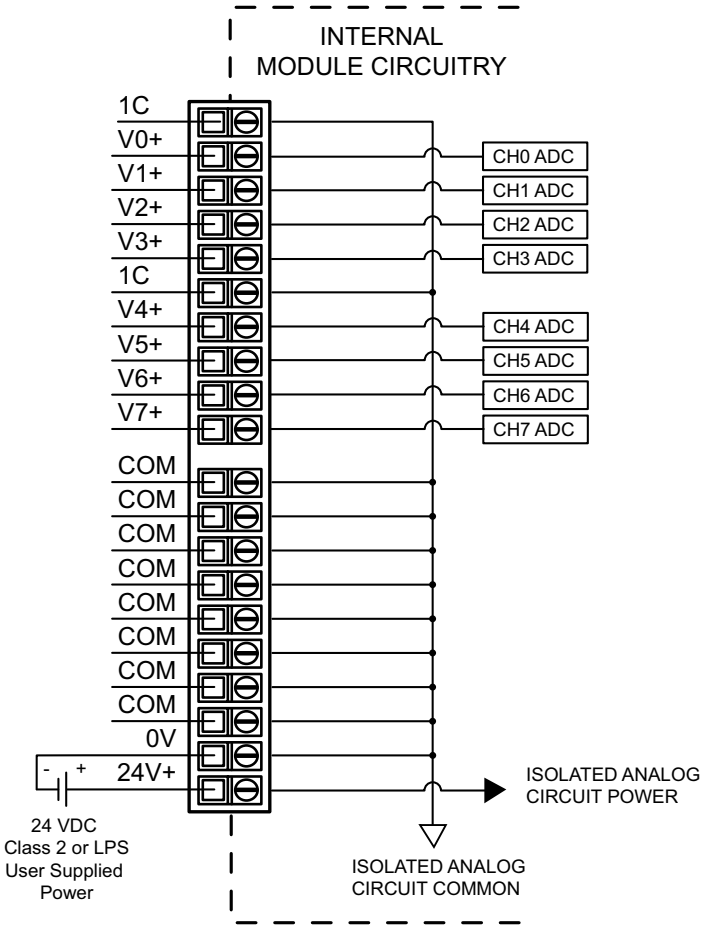
BX-xxAD-2B Analog Voltage Input, continued

Analog Voltage Input Wiring

BX-04AD-2B



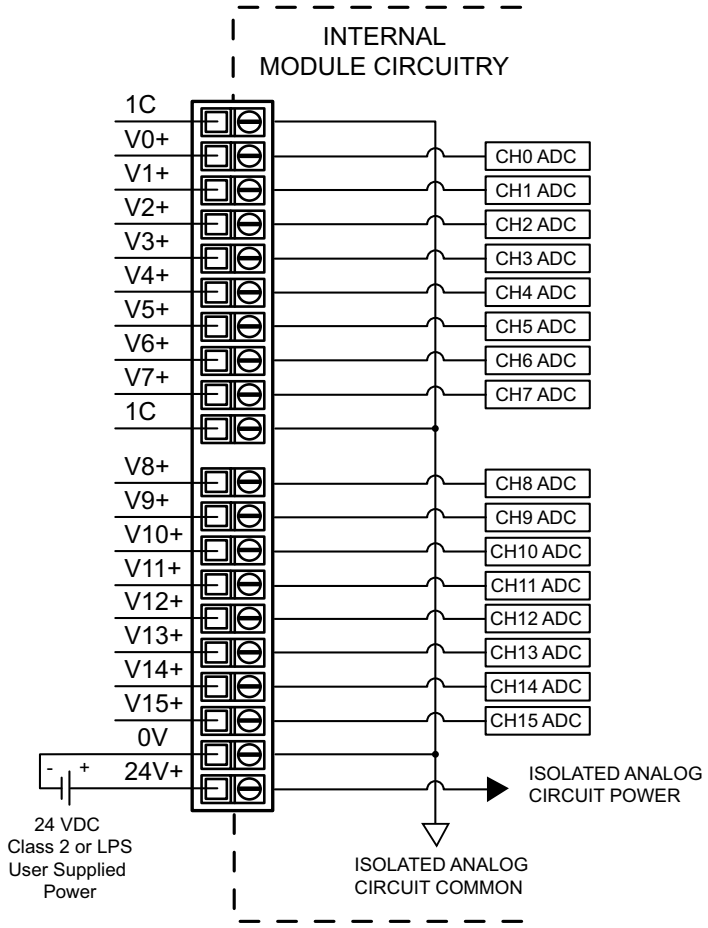
BX-08AD-2B



BX-xxAD-2B Analog Voltage Input, continued

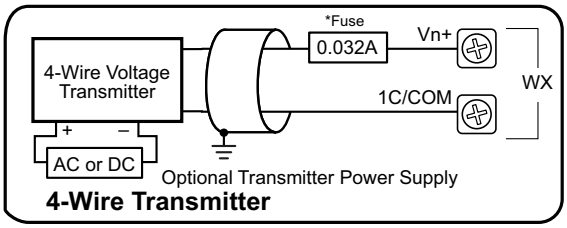
Analog Voltage Input Wiring, continued

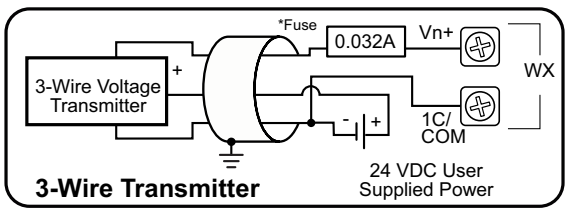
BX-16AD-2B



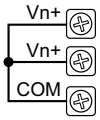
Analog Voltage Input Circuits

*An Edison S500-32-R 0.032A fast-acting fuse is recommended for all analog voltage inputs, analog outputs, and current loops.





NOTE: For maximum accuracy, jumper unused inputs to common.

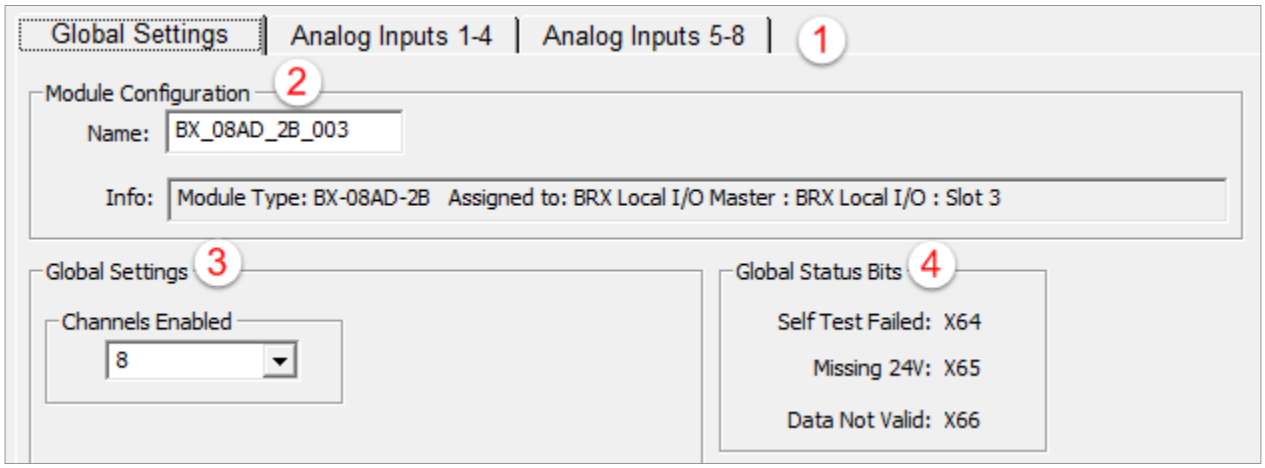


NOTE: Shield should be connected only at one end, to ground at the source device.

BX-xxAD-2B Analog Voltage Input, continued

Software Setup

After the module is installed, open the Do-more! Designer programming software, connect to the BRX MPU and open the Configure Module dialog as described at the beginning of this chapter.



1. The module options are divided into subsets across multiple tabs. Click the appropriate tab to edit the configuration.
2. *Module Configuration*

   Name – Each module comes with a default name. This may be changed by the user to better identify the module if desired.

   Info – This is the system description of the module. This is static and may not be changed.
3. *Global Settings*

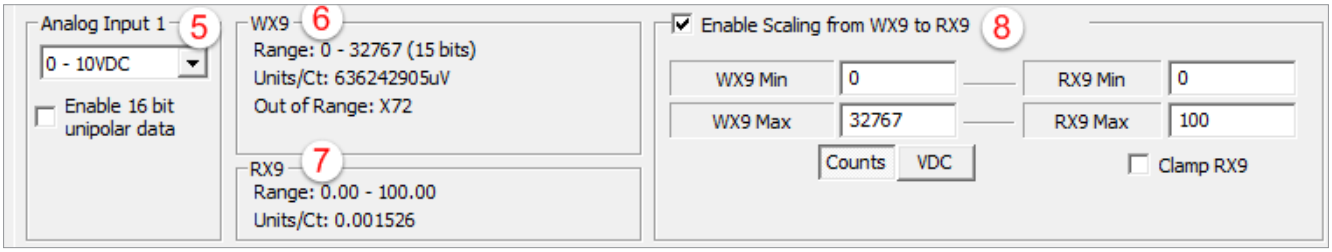
   Channels Enabled – Select how many channels will be used. The default is all channels. Selecting fewer channels may increase the update frequency. See the module specifications for details.
4. *Global Status Bits*

   Self Test Failed – This bit will be On if the module has failed its internal self-test. In this case, the module is likely bad and should be replaced.

   Missing 24V – This bit will be On if the external 24VDC power is missing. Check the 24VDC power connection on the module terminal block.

   Data Not Valid – This bit will be On if the module does not have the latest configuration parameters or the module has not been configured at all. Reload the program into the CPU and power cycle.

BX-xxAD-2B Analog Voltage Input, continued



5. *Analog Input x*

   These settings are for each channel of the analog module.

   Drop-down menu - Select the range of the analog input here.

   Enable 16 bit unipolar data – Check this box to change the raw count range from a signed decimal bipolar data format to an unsigned decimal data format. This may require that Casting be used in the program in order to properly access the data. Refer to the chart of Data Range Specifications earlier in this chapter to see if the registers must be accessed with Casting.

6. *WXx*

   Range – The number of Raw counts for the selected channel on the module.

   Units/Ct – The amount of voltage that will equal 1 raw count.

   Out of Range – The input register that, when On, will indicate that the voltage is outside of the selected range.

7. *RXx*

   Range – The engineering units to which the raw counts are scaled.

   Units/Ct – The number of raw counts that will equal 1 scaled engineering unit.

8. *Enable Scaling from WXx to RXx*

   WXx Min – The minimum value of the raw counts to scale.

   WXx Max – The maximum value of the raw counts to scale.

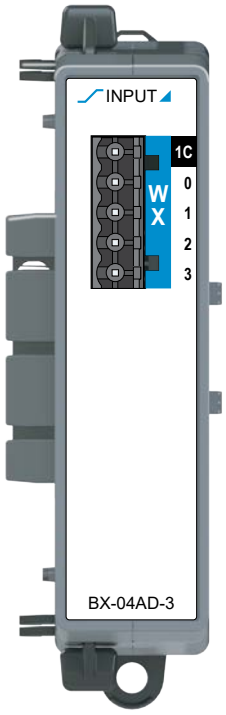
   RXx Min – The minimum value of the engineering units for scaling.

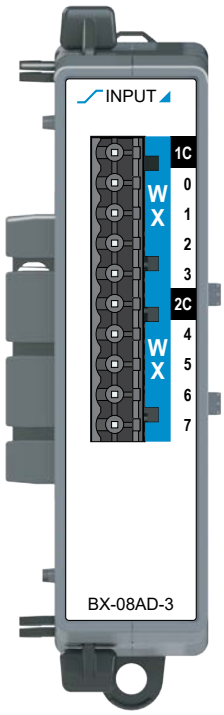
   RXx Max – The maximum value of the engineering units for scaling.

   Counts/VDC – Use these buttons to change the raw scaling to counts or volts.

   Clamp RXx – If this box is checked, RXx will clamp at the minimum and maximum scaled values.

BX-xxAD-3 Universal Analog Input





BX-04AD-3
Analog Input
Expansion Module
4-ch, ±20mA or ±10V,
16-bit*

BX-08AD-3
Analog Input
Expansion Module
8-ch, ±20mA or ±10V,
16-bit*

Terminal Blocks or *ZIP*Link Cables Sold Separately

We recommend using prewired ***ZIP***Link cables and connection modules. If you wish to hand-wire your module, a removable terminal block is available. See Wiring Termination Selection in this chapter for all options.

IMPORTANT!

Hot-Swapping Information

Note: This device cannot be Hot Swapped.

Universal Current/Voltage Sinking Input Specifications			
		BX-04AD-3	BX-08AD-3
Inputs per Module		4	8
Commons		1	2
Module Signal Input Range		0–20mA, 4–20mA, ±10 VDC, ±5 VDC, 0–5 VDC (Default), 0–10 VDC	
Signal Resolution		16-bit at ±10V or ±20mA*	
Resolution Value of LSB		See Data Range Specifications table	
Input Impedance	Current Input	249Ω±0.1%, 1/10th watt	
	Voltage Input	100kΩ	
All Channel Update Rate		1.2 ms	
Over Current Circuit Detection Time		< 1second	
Maximum Continuous Overload		±40mA current mode, ±20V voltage mode	
Sample Duration Time		1.2 ms	
Hardware Filter Characteristics		Active Low Pass, −3dB @ 1kHz	
Conversion Method		Delta Sigma	
Linearity Error (end to end)		±0.1% of HW Full Scale (65 counts)	
Input Stability and Repeatability (after 10 min. warmup)		±0.02% of HW Full Scale (13 counts)	
Full Scale Calibration Error		±0.1% of HW Full Scale (65 counts)	
Offset Calibration Error		±0.05% of HW Full Scale (32 counts)	
Accuracy vs. Temperature		±25PPM / °C maximum	
Maximum Inaccuracy		±0.2% of HW Full Scale (130 counts)	
Maximum Crosstalk		1 count	
Channel to Backplane Isolation		1500VAC applied for one second, 1C to 2C	
Channel to Channel Isolation		None	
Loop Fusing (External)		Fast-acting 0.032A recommended	
Backplane Power Consumption		1.5 W	2.5 W
Heat Dissipation		2.25 W	3.25 W
Weight		98g [3.5 oz]	
Agency Approvals		UL 61010-2 File E185989, Canada and USA	
Software Version Required (Do-more! Designer Programming Software)		2.7 or later	

**** 16-bit resolution is only available when a bipolar input range is selected.***

BX-xxAD-3 Universal Analog Input, continued

Data Range Specifications				
Selection	**Description**	**Raw Counts**	**Casting[1]**	**Per Count**
−20–20mA	bipolar −20–20mA	−32768 to 32767	-	0.61 µA
4–20mA	unipolar 4–20mA	6553–32767	-	0.61 µA
0–10V	unipolar 10VDC	0–32767	-	305 µV
0–5V	unipolar 5VDC	0–32767	-	305 µV
±10V	bipolar 10VDC	−32768 to 32767	-	305 µV
±5V	bipolar 5VDC	−32768 to 32767	-	305 µV

1. For more information on Casting, refer to Help topic DMD0309 in the Do-more! Designer Software.

The module reserves the first 8 bits of unused contiguous space in the X register, aligned to an 8-bit word boundary, for status reporting. Error flags for this module are laid out within its status register space as described in the table below.

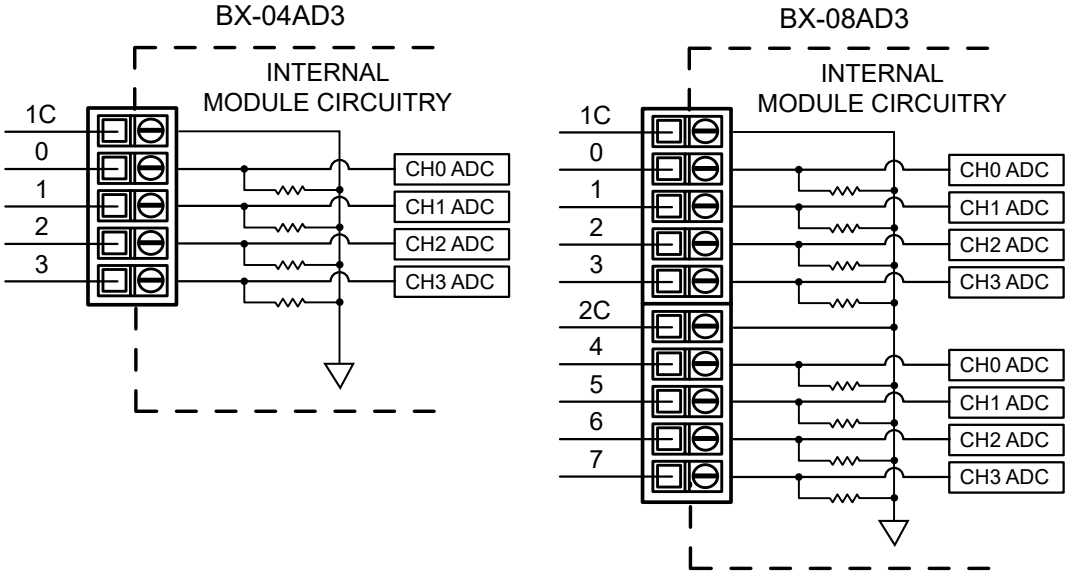
Error Flag Specifications								
	MSB							**LSB**
1st Byte of unused X Registers								
Out of Range	Channel 8	Channel 7	Channel 6	Channel 5	Channel 4	Channel 3	Channel 2	Channel 1

Channel Bit Error Flag is set when a channel's input signal meets the conditions in the table below.

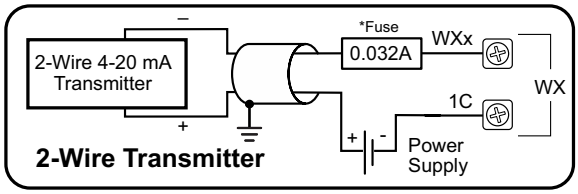
Channel Bit Error Conditions	
Selected Data Range	**Error Condition**
−20–20mA	< −20.0 mA or > 20.0 mA
4–20mA	< 2.0 mA (i.e., Broken Transmitter, no upper error condition for 4–20mA)
0–10V	< −0.05 V or > 10.0 V
0–5V	< −0.05 V or > 5.05 V
±10V	< −10.0 V or > 10.0 V
±5V	< −5.05 V or > 5.05 V

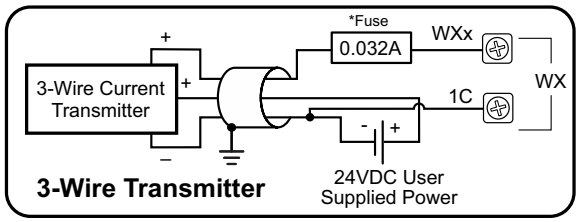
BX-xxAD-3 Universal Analog Input, continued

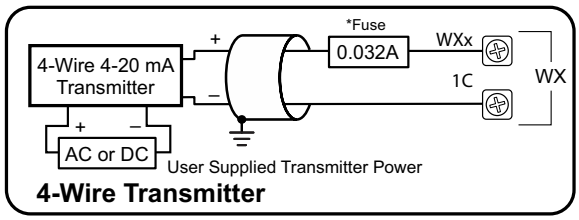
Analog Current/Voltage Input Wiring



Analog Current Sinking Input Circuits

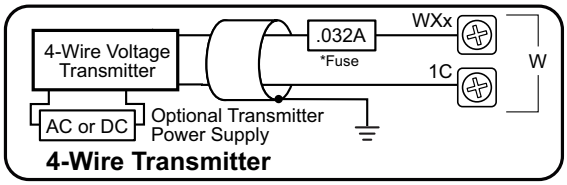


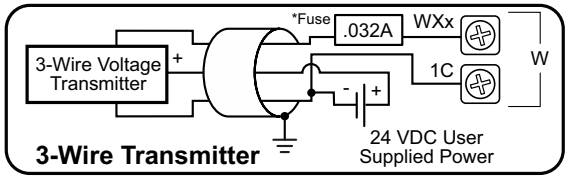




*NOTE: An Edison S500-32-R 0.032A fast-acting fuse is recommended for all analog voltage inputs, analog outputs, and current loops.

Analog Voltage Input Circuits



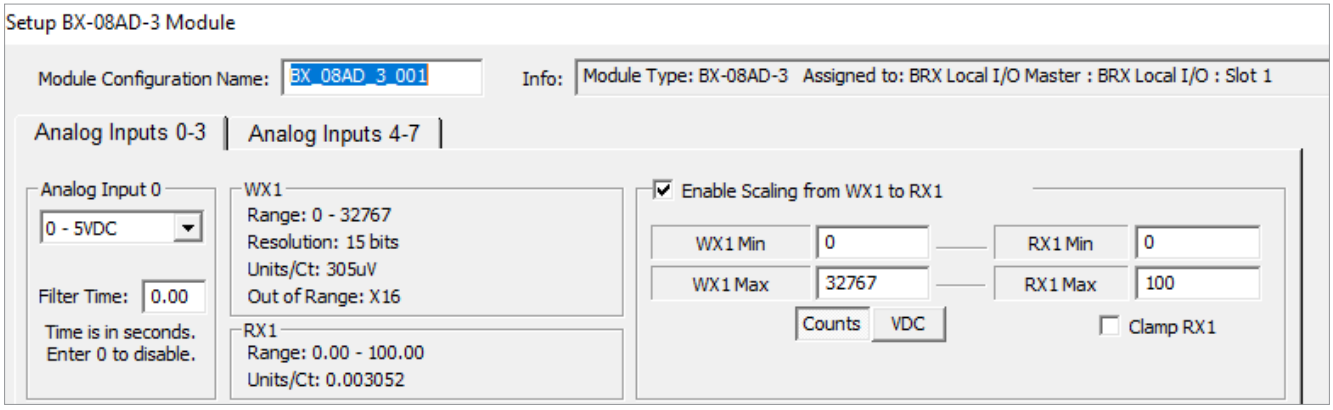


NOTE: Shield should be connected only at one end, to ground at the source device.

BX-xxAD-3 Universal Analog Input, continued

Software Setup

After the module is installed, open the Do-more! Designer programming software, connect to the BRX MPU and open the Configure Module dialog as described at the beginning of this chapter.



The module options are divided into subsets across multiple tabs. Click the appropriate tab to edit the configuration.

1. *Analog Input x*

   These settings are for each channel of the analog module.

   Drop-down menu – Select the range of the analog input here.

   Filter Time – Time to average the Analog signal in seconds.

2. *WXx*

   Range – The number of Raw counts for the selected channel on the module.

   Units/Ct – The amount of voltage that will equal 1 raw count.

   Out of Range – The input register that, when On, will indicate that the voltage is outside of the selected range.

3. *RXx*

   Range – The engineering units to which the raw counts are scaled.

   Units/Ct – The number of raw counts that will equal 1 scaled engineering unit.

4. *Enable Scaling from WXx to RXx*

   WXx Min – The minimum value of the raw counts to scale.

   WXx Max – The maximum value of the raw counts to scale.

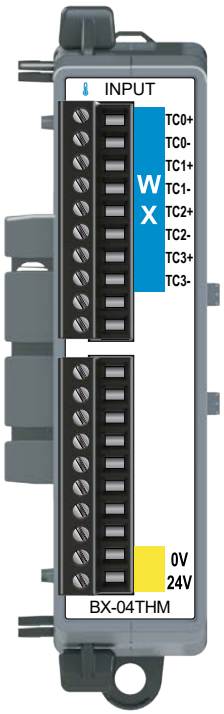
   RXx Min – The minimum value of the engineering units for scaling.

   RXx Max – The maximum value of the engineering units for scaling.

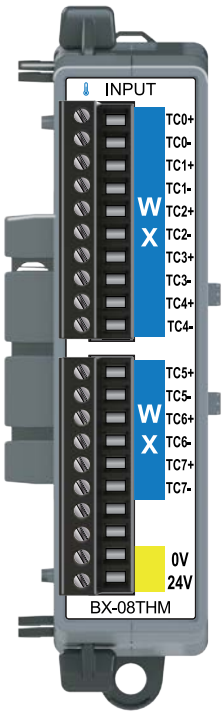
   Counts/VDC – Use these buttons to change the raw scaling to counts or volts.

   Clamp RXx – If this box is checked, RXx will clamp at the minimum and maximum scaled values.

BX-xxTHM Thermocouple Input



BX-04THM
Temperature Input
Expansion Module
4-pt Thermocouple
Temperature Input



BX-08THM
Temperature Input
Expansion Module
8-pt Thermocouple
Temperature Input

BX-RTB10 Terminal Blocks Included. The BX-RTB10-1 or BX-RTB10-2 can also be used and can be purchased separately.

***NOTE:** This device does not support ZIPLink Wiring Systems.*

IMPORTANT!

Hot-Swapping Information

Note: This device cannot be Hot Swapped.

Thermocouple Input Specifications

	BX-04THM	BX-08THM
Input Channels	4 Differential	8 Differential
Commons	0	
Input Impedance	Rev. B2 or lower: >5MΩ Rev. B3 or higher: >1MΩ	Rev. A1: >5MΩ Rev. A2 or higher: >1MΩ
Resolution	16-bit, 0.1°(C or F) See Data Range Specifications table	
Thermocouple Input Ranges	Type J: −190° to 760°C (−310° to 1400°F) (Default) Type E: −210° to 1000°C (−346° to 1832°F) Type K: −150° to 1372°C (−238° to 2502°F) Type R: 65° to 1768°C (149° to 3214°F) Type S: 65° to 1768°C (149° to 3214°F) Type T: −230° to 400°C (−382° to 752°F) Type B: 529° to 1820°C (984° to 3308°F) Type N: −70° to 1300°C (−94° to 2372°F) Type C: 65° to 2320°C (149° to 4208°F)	
Cold Junction Compensation	Automatic	
Thermocouple Linearization	Automatic	
Accuracy vs. Temperature	±50PPM per °C (maximum)	
Maximum Inaccuracy–Temperature	±3°C maximum (excluding thermocouple error) (including temperature drift)	
Linear Voltage Input Ranges	0–39mV ±39mV ±78mV 0–156mV ±156mV 0–1.25 V	
Maximum Inaccuracy–Voltage	0.06% @ 25°C, 0.10% @ 0–60°C	
All Channel Update Rate	2.16 s	
Sample Duration Time	270ms	
Open Circuit Detection Time	Within 2s	
Maximum Ratings	Fault protected inputs to ±50V	
Common Mode Range	0.6 V (@ 16-bit Resolution)	
Common Mode Rejection	100dB @ DC and 130dB @ 60Hz	
Conversion Method	Sigma-Delta	
Backplane Power Consumption	0.1 W	
External DC Power Required	Class 2 or LPS power supply 24VDC (±20%) 25mA	
Heat Dissipation	0.8 W	
Weight	98g (3.5 oz)	
Agency Approvals	UL 61010-1 and UL 61010-2-201 File E139594, Canada and USA CE (EN 61131-2 EMC, EN 61010-1 and EN 61010-2-201 Safety)	
Software Version Required (Do-more! Designer Programming Software)	2.1 or later	2.3 or later

BX-xxTHM Thermocouple Input, continued

Data Range Specifications							
Selection	Description	Enable 16 bit Unchecked (15 bit Resolution, Default)[1]			Enable 16 bit Checked (16 bit Resolution)		
		Raw Counts	Casting[2]	µV Per Count	Raw Counts[3]	Casting[2]	µV Per Count
Type J	Type J	-	-		°C: −1900 to 7600 °F: −3100 to 14000	-	-
Type E	Type E	-	-		°C: −2100 to 10000 °F: −3460 to 18320	-	-
Type K	Type K	-	-		°C: −1500 to 13720 °F: −2380 to 25020	-	-
Type R	Type R	-	-		°C: 650 to 17680 °F: 1490 to 32140	-	-
Type S	Type S	-	-		°C: 650 to 17680 °F: 1490 to 32140	-	-
Type T	Type T	-	-		°C: −2300 to 4000 °F: −380 to 7520	-	-
Type B	Type B	-	-		°C: 5290 to 18200 °F: 9840 to 33080	- WXn:U	-
Type N	Type N	-	-		°C: −700 to 13000 °F: −940 to 23720	-	-
Type C	Type C	-	-		°C: 650 to 23200 °F: 1490 to 42080	- WXn:U	-
0–39 mVDC	Unipolar 39 mVDC	0–32767	-	1.2	0–65535	WXn:U	0.6
−39–39 mVDC	Bipolar 39 mVDC	-	-		−32768 to 32767	-	1.2
−78–78 mVDC	Bipolar 78 mVDC	-	-		−32768 to 32767	-	2.4
0–156 mVDC	Unipolar 156 mVDC	0–32767	-	4.8	0–65535	WXn:U	2.4
−156–156 mVDC	Bipolar 156 mVDC	-	-		−32768 to 32767	-	4.8
0–1.25 VDC	Unipolar 1.25 VDC	0–32767	-	38.1	0–65535	WXn:U	19.1

1. Thermocouple and bipolar ranges default to 16-bit resolution.
2. For more information on Casting, refer to Help topic DMD0309 in the Do-more! Designer Software.
3. Temperatures have one implied decimal place (e.g., raw count of -1900 is -190.0°).

The module reserves the first 24 bits of unused contiguous space in the X register, aligned to an 8-bit word boundary, for status reporting. Error flags for this module are laid out within its status register space as described in the table below.

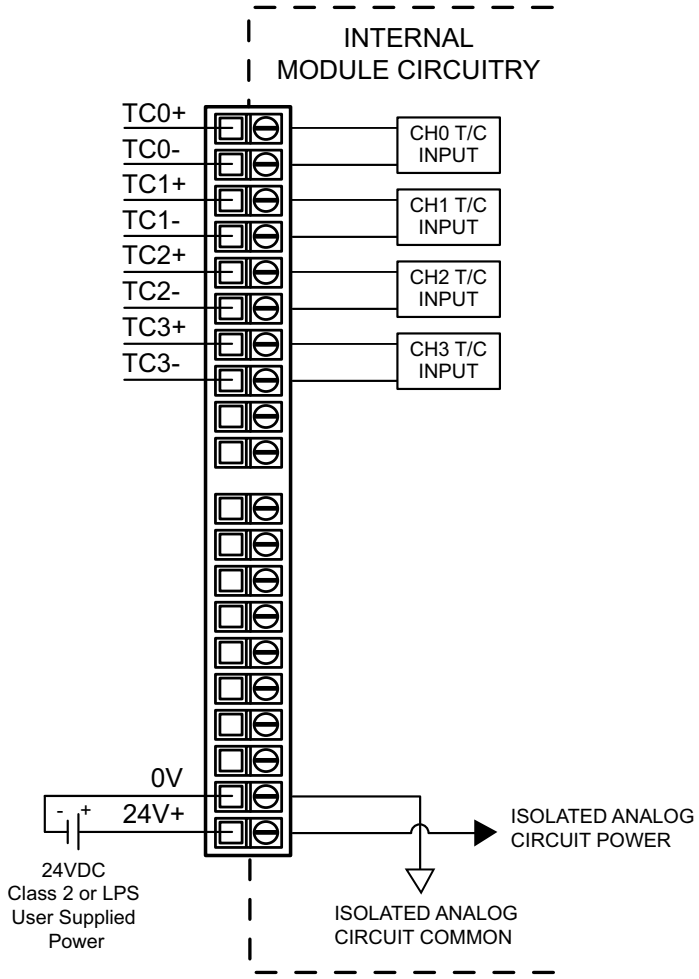
Error Flag Specifications								
	MSB							LSB
1st Byte of unused X Registers								
Module Status	-	-	-	-	-	Data Not Valid	Missing 24VDC	Self Test Failed
2nd Byte of unused X Registers								
Channel Out of Range	Channel 8	Channel 7	Channel 6	Channel 5	Channel 4	Channel 3	Channel 2	Channel 1
3rd Byte of unused X Registers								
Burn Out	Channel 8	Channel 7	Channel 6	Channel 5	Channel 4	Channel 3	Channel 2	Channel 1

NOTE: *The Data Not Valid flag should always be tested and confirmed to be in the "Off" state in your PLC program before reading from the analog module.*

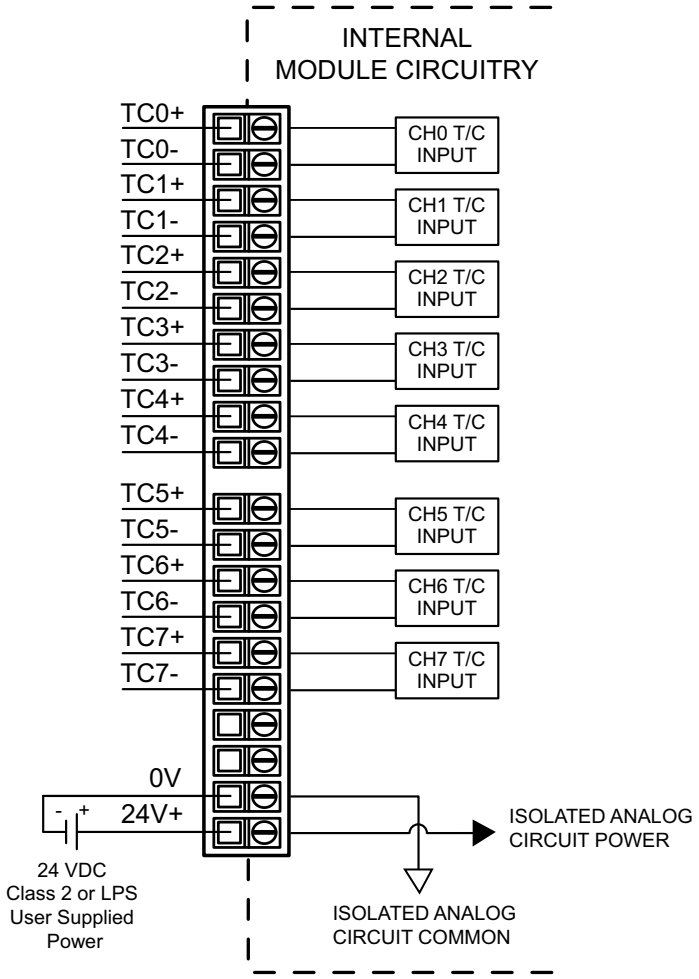
BX-xxTHM Thermocouple Input, continued

Analog Thermocouple/Voltage Input Wiring

BX-04THM

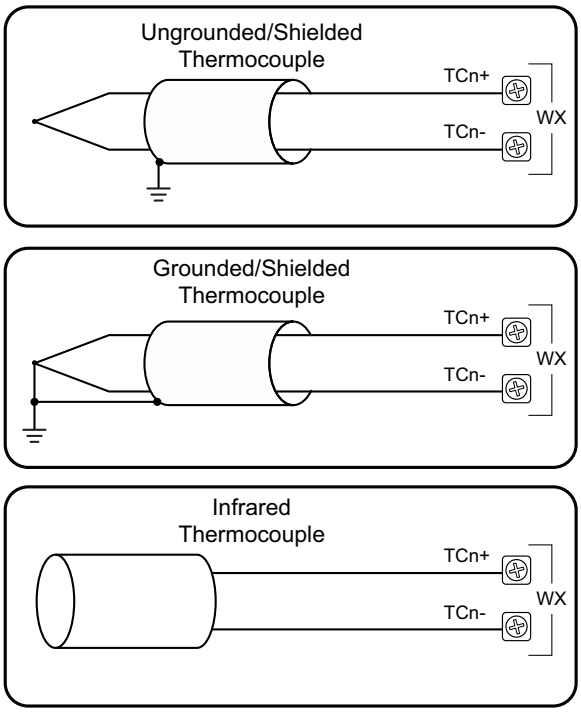


BX-08THM



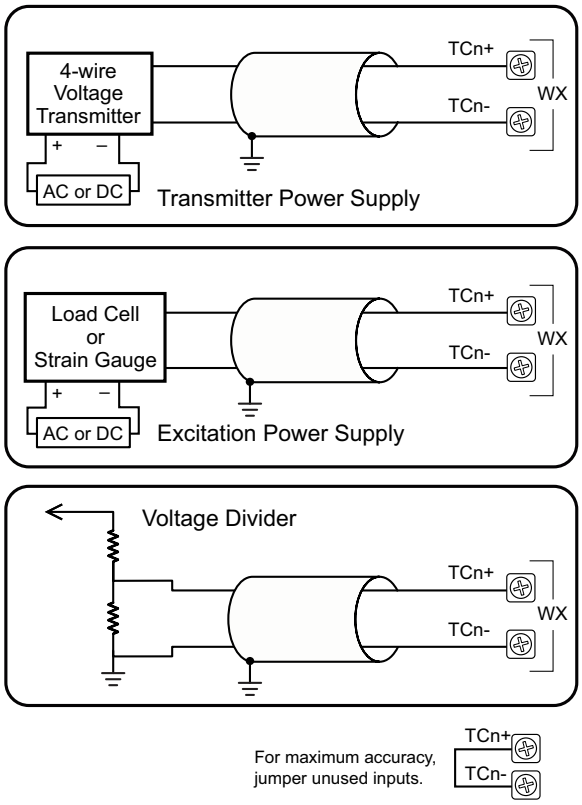
BX-xxTHM Thermocouple Input, continued

Thermocouple Input Circuits



NOTE: Thermocouple extension wire and proper thermocouple terminal blocks must be used to extend thermocouples. AutomationDirect thermocouple wire is recommended.

Analog Voltage Input Circuits



For maximum accuracy, jumper unused inputs.

NOTE: Shield should be connected only at one end, to ground at the source device.

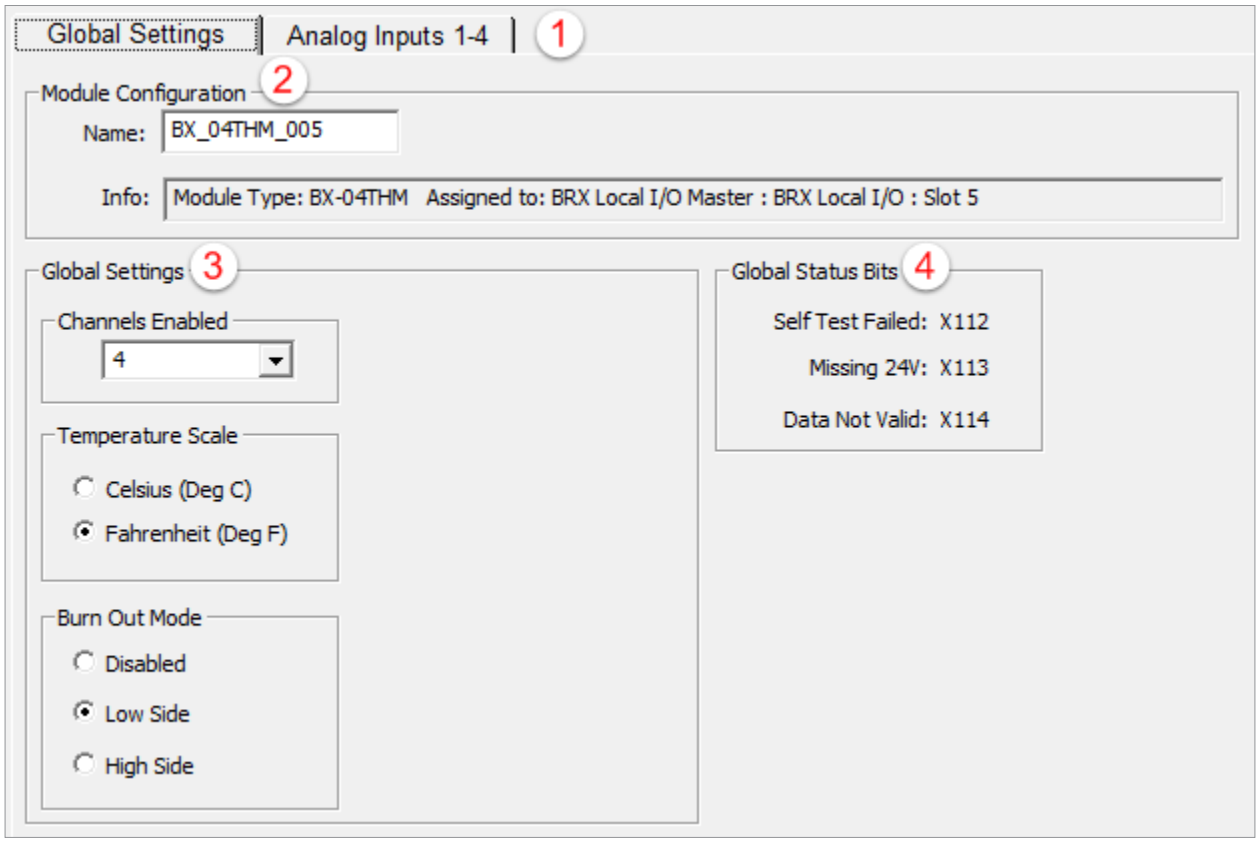


NOTE: *With grounded thermocouples, take precautions to prevent having a voltage potential between thermocouple tips. A voltage of 1.25 V or greater between tips will skew measurements.*

BX-xxTHM Thermocouple Input, continued

Software Setup

After the module is installed, open the Do-more! Designer programming software, connect to the BRX MPU and open the **Configure Module** dialog as described at the beginning of this chapter.



1. The module options are divided into subsets across multiple tabs. Click the appropriate tab to edit the configuration.
2. *Module Configuration*

   Name – Each module comes with a default name. This may be changed by the user to better identify the module if desired.

   Info – This is the system description of the module. This is static and may not be changed.
3. *Global Settings*

   Channels Enabled – Select how many channels will be used. The default is all channels. Selecting fewer channels may increase the update frequency. See the module specifications for details.

   Temperature Scale – Select either Celcius or Fahrenheit.

   Burn Out Mode – Select if the Input register should read Low or High on burn out or if burn out detection should be disabled. Note: Burn Out Mode must be set to Disabled in order to use a Thermocouple Calibrator.

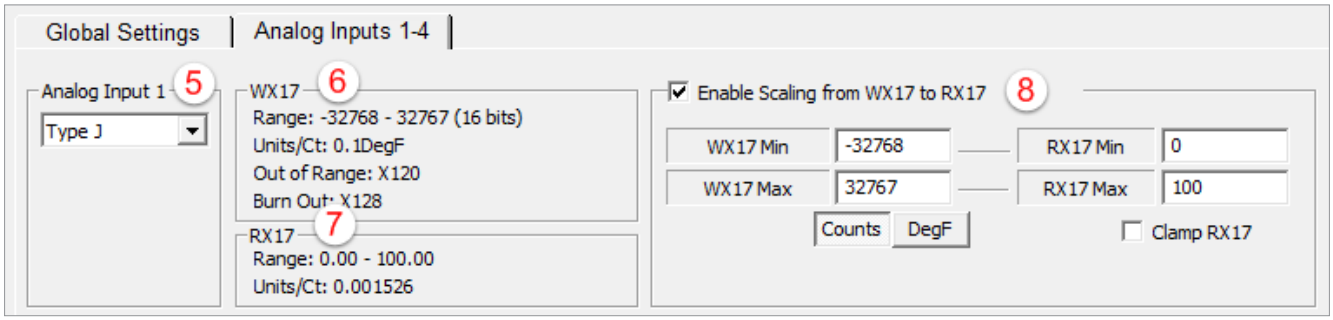
BX-xxTHM Thermocouple Input, continued

4. *Global Status Bits*

   Self Test Failed – This bit will be On if the module has failed its internal self-test. In this case, the module is likely bad and should be replaced.

   Missing 24V – This bit will be on if the external 24VDC power is missing. Check the 24VDC power connection on the module terminal block.

   Data Not Valid – This bit will be on if the module does not have the latest configuration parameters or the module has not been configured at all. Reload the program into the CPU and power cycle.



5. *Analog Input x*

   These settings are for each channel of the analog module.

   Drop-down menu - Select the range of the analog input here.

6. *WXx*

   Range – The number of Raw counts for the selected channel on the module.

   Units/Ct – The amount of temperature or voltage that will equal 1 raw count.

   Out of Range – The input register that, when On, will indicate that the input is outside of the range selected.

   Burn Out – If burn out is enabled, this register will be On when the loop is broken.

7. *RXx*

   Range – The engineering units to which the raw counts are scaled.

   Units/Ct – The number of raw counts that will equal 1 scaled engineering unit.

8. *Enable Scaling from WXx to RXx*

   WXx Min – The minimum value of the raw counts to scale.

   WXx Max – The maximum value of the raw counts to scale.

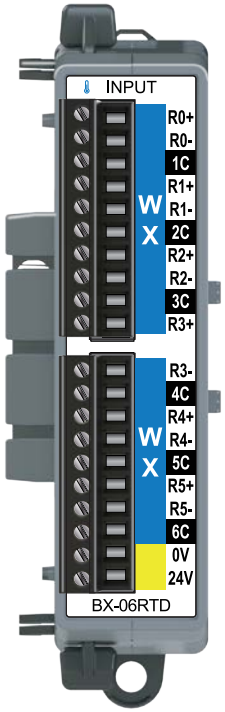
   RXx Min – The minimum value of the engineering units for scaling.

   RXx Max – The maximum value of the engineering units for scaling.

   Counts/DegF – Use these buttons to change the raw scaling to counts or degrees (C or F).

   Clamp RXx – If this box is checked, RXx will clamp at the minimum and maximum scaled values.

BX-06RTD Resistance Temperature Detector Input



BX-06RTD
Temperature Input
Expansion Module
6-pt RTD
Temperature Input

BX-RTB10 Terminal Blocks Included. The BX-RTB10-1 or BX-RTB10-2 can also be used and can be purchased separately.

***NOTE:** This device does not support ZIPLink Wiring Systems.*

IMPORTANT!

Hot-Swapping Information

Note: This device cannot be Hot Swapped.

RTD Input Specifications	
Input Channels	6 Differential
Commons	6
Resolution	16-bit, 0.1°(C or F) (up to 100Hz filter) See Data Range Specifications table
Input Ranges (RTD Types)	Pt100: −200° to 850°C (−328° to 1562°F) (Default) Pt1000: −200° to 595°C (−328° to 1103°F) JPt100: −100° to 450°C (−148° to 842°F) 10Ω Cu: −200° to 260°C (−328° to 500°F) ±3°C 25Ω Cu: −200° to 260°C (−328° to 500°F) ±3°C 120Ω Ni: −80° to 260°C (−112° to 500°F)
Resistance Input Ranges	0 to 10,000 Ω 0 to 6,250 Ω 0 to 3,125 Ω 0 to 1,562.5 Ω 0 to 781.2 Ω 0 to 390.6 Ω 0 to 195.3 Ω
Excitation Current	210µA
RTD Linearization	Automatic
Accuracy vs. Temperature	±10 ppm per °C (maximum)
Full Scale Calibration	±1°C
Offset Calibration Error	±1°C, ±3°C for 10Ω/25Ω Cu.
Maximum Inaccuracy	±1°C, ±3°C for 10Ω/25Ω Cu. maximum (excluding RTD error) (including temperature drift)
Warmup Time	2 minutes for ±0.2% repeatability
All Channel Update Rate	210ms + 170ms x (number of active channels) @470Hz 210ms + 750ms x (number of active channels) @16.7Hz
Filter Characteristics	Digital filter cutoff frequencies: 16.7 Hz, 470Hz
Sample Duration Time	Dependent on digital filter settings: 120ms@16.7 Hz, 4ms@470Hz
Open Circuit Detection Time	Positive full-scale reading within 2s
Maximum Ratings	Fault protected inputs to ±50V
Max. Common Mode Voltage	5VDC
Common Mode Rejection	90dB @ DC and 100dB @ 50/60Hz
Conversion Method	Sigma-Delta
Backplane Power Consumption	0.1 W
External DC Power Required	Class 2 or LPS power supply 24VDC (±20%) 25mA
Heat Dissipation	0.8 W
Weight	96g (3.4 oz)
Agency Approvals	UL 61010-1 and UL 61010-2-201 File E139594, Canada and USA CE (EN 61131-2 EMC, EN 61010-1 and EN 61010-2-201 Safety)
Software Version Required (Do-more! Designer Programming Software)	2.3 or later

BX-06RTD Resistance Temperature Detector Input, continued

Data Range Specifications		
Selection	**Description**	**Raw Counts[1]**
Pt100	Pt100 Platinum RTD	°C: −2000 to 8500 °F: −3280 to 15620
Pt1000	Pt1000 Platinum RTD	°C: −2000 to 5950 °F: −3280 to 11030
JPt100	JPt100 Platinum RTD	°C: −1000 to 4500 °F: −1480 to 8420
10Ω Cu	10Ω Copper RTD	°C: −2000 to 2600 °F: −3280 to 5000
25Ω Cu	25Ω Copper RTD	°C: −2000 to 2600 °F: −3280 to 5000
120Ω Ni	120Ω Nickel RTD	°C: −800 to 2600 °F: −1120 to 5000
0–10,000 Ω		0–10000
0–6,250 Ω		0–6250
0–3,125 Ω		0–3125
0–1,562.5 Ω		0–15625 [2]
0–781.2 Ω		0–7812 [2]
0–390.6 Ω		0–3906 [2]
0–195.3 Ω		0–1953 [2]

1. *Temperatures have one implied decimal place (e.g., raw count of -1900 is -190.0°).*
2. *Certain resistance ranges have one implied decimal place (e.g., raw count of 7812 is 781.2 Ω).*

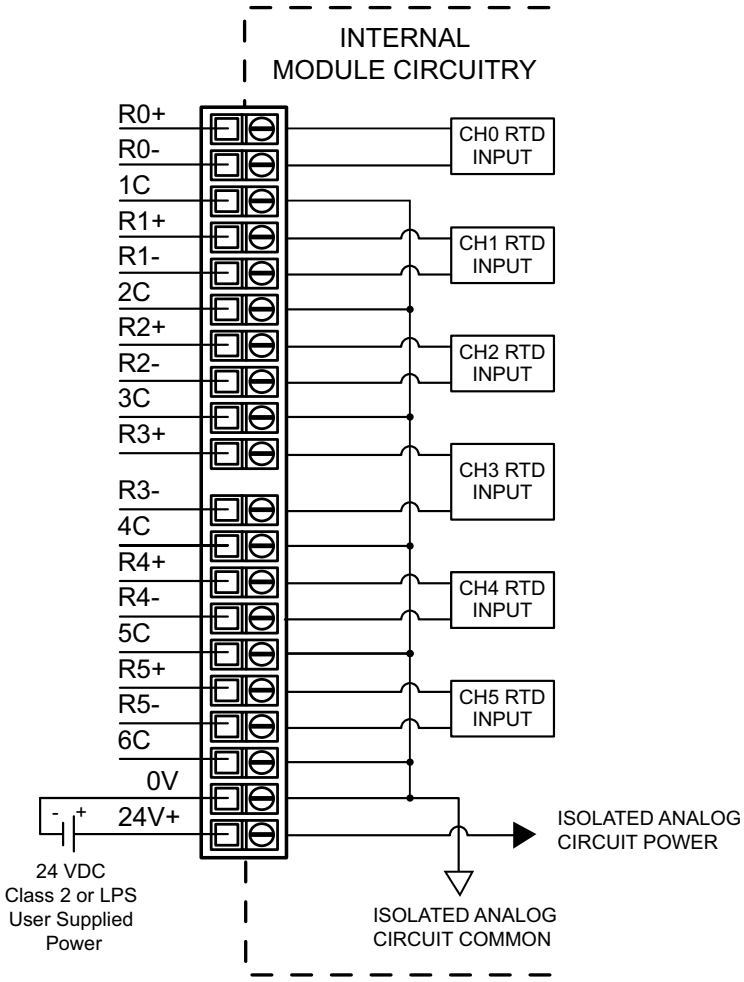
The module reserves the first 24 bits of unused contiguous space in the X register, aligned to an 8-bit word boundary, for status reporting. Error flags for this module are laid out within its status register space as described in the table below.

Error Flag Specifications								
	MSB							**LSB**
1st Byte of unused X Registers								
Module Status	-	-	-	-	-	Data Not Valid	Missing 24VDC	Self Test Failed
2nd Byte of unused X Registers								
Channel Out of Range	-	-	Channel 6	Channel 5	Channel 4	Channel 3	Channel 2	Channel 1
3rd Byte of unused X Registers								
Burn Out	-	-	Channel 6	Channel 5	Channel 4	Channel 3	Channel 2	Channel 1

NOTE: *The Data Not Valid flag should always be tested and confirmed to be in the "Off" state in your PLC program before reading from the analog module.*

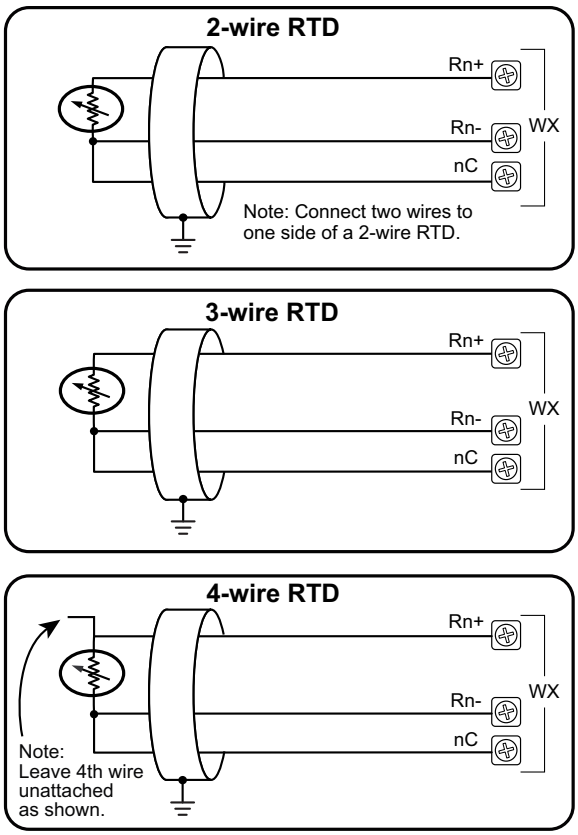
BX-06RTD Resistance Temperature Detector Input, continued

Analog RTD/Resistance Input Wiring

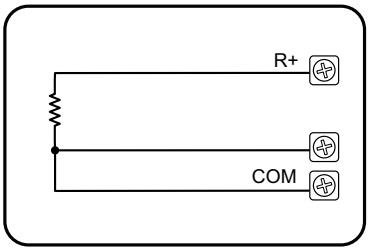


BX-06RTD Resistance Temperature Detector Input, continued

RTD Input Circuits

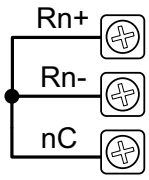


Resistance Input



Notes for maximum accuracy:

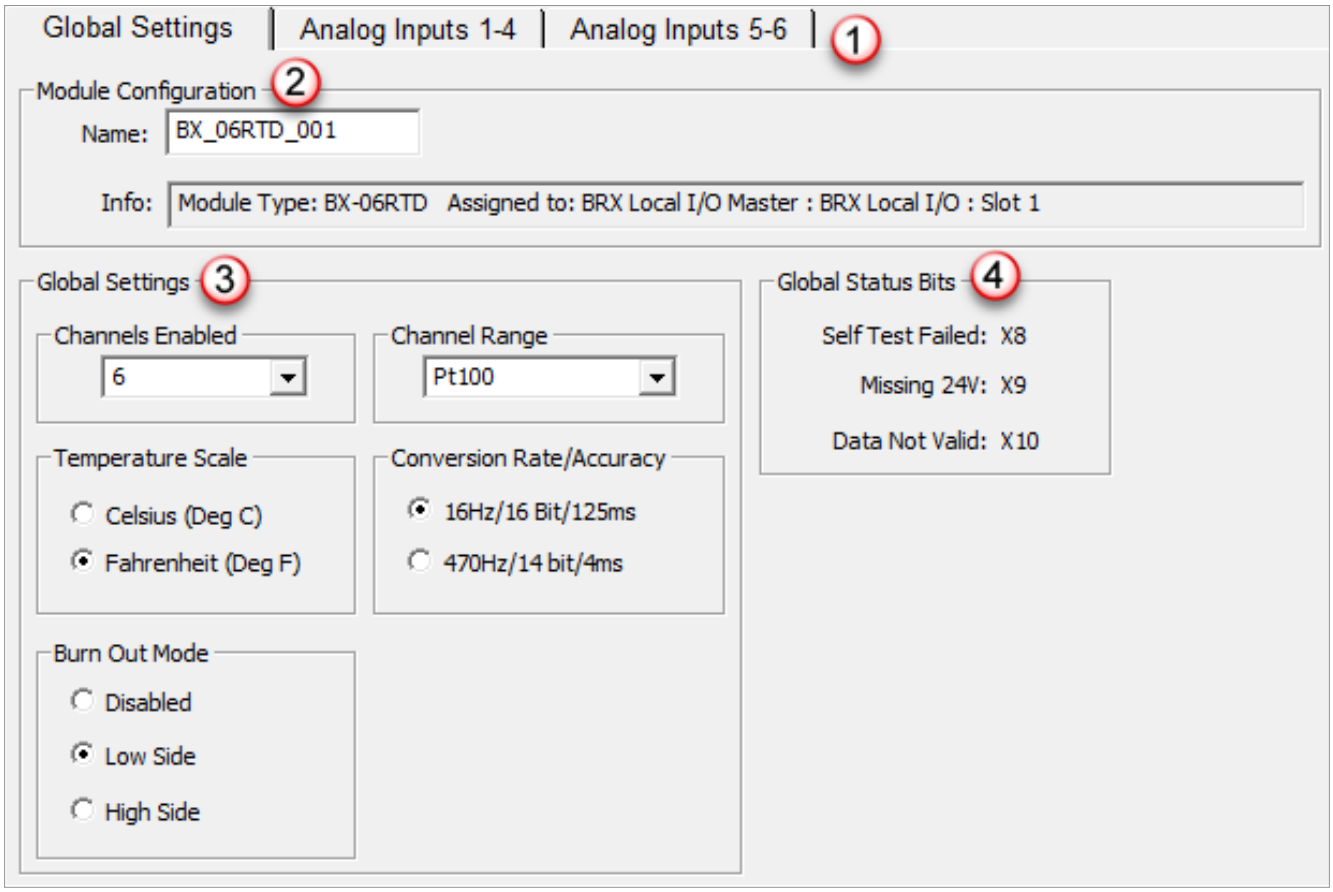
1. For 2-wire RTD, attach a third wire to module common.
2. R+, R-, and COM wires to an RTD must be equal length and type. Refer to RTD manufacturer's recommendations.
3. Do not use cable shield as sensing wire.
4. When applicable, connect shield to RTD common only, otherwise connect to module common only. Do not connect shield to both ends.
5. Jumper unused inputs to common.



BX-06RTD Resistance Temperature Detector Input, continued

Software Setup

After the module is installed, open the Do-more! Designer programming software version 2.3 or later, connect to the BRX MPU and open the **Configure Module** dialog as described at the beginning of this chapter.



1. The module options are divided into subsets across multiple tabs. Click the appropriate tab to edit the configuration.
2. *Module Configuration*

   Name – Each module comes with a default name. This may be changed by the user to better identify the module, if desired.

   Info – This is the system description of the module. This is static and may not be changed.
3. *Global Settings*

   Channels Enabled – Select how many channels will be used. The default is all channels. Selecting fewer channels may increase the update frequency. See the module specifications for details.

   Temperature Scale – Select either Celcius or Fahrenheit.

   Burn Out Mode – Select if the Input register should read Low or High on burn out or if burn out detection should be disabled.

   Channel Range – Select the RTD type or resistance range to measure. Note this setting affects all channels in the module.

   Conversion Rate/Accuracy – Select the desired sample conversion rate and accuracy.

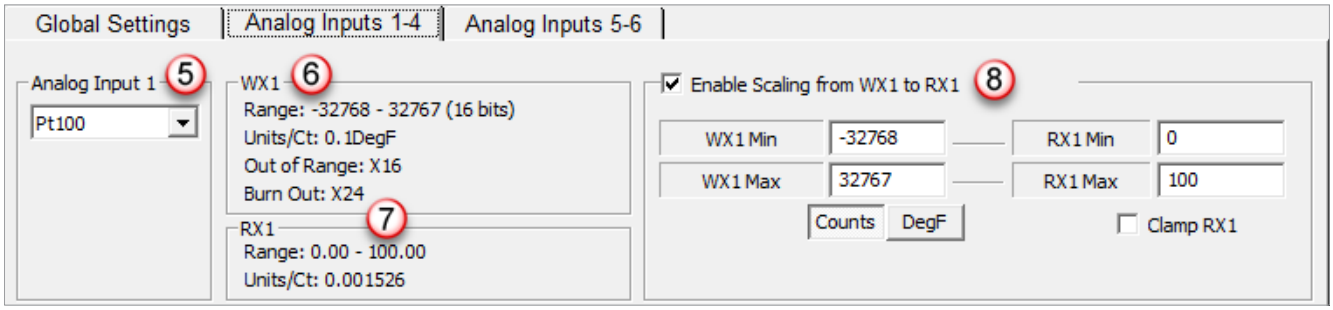
BX-06RTD Resistance Temperature Detector Input, continued

4. *Global Status Bits*

   Self Test Failed – This bit will be On if the module has failed its internal self-test. In this case, the module is likely bad and should be replaced.

   Missing 24V – This bit will be on if the external 24VDC power is missing. Check the 24VDC power connection on the module terminal block.

   Data Not Valid – This bit will be on if the module does not have the latest configuration parameters or the module has not been configured at all. Reload the program into the CPU and power cycle.



5. *Analog Input x*

   Input type for this module is a per-module setting. The settings are shown here for information only.

6. *WXx*

   Range – The number of Raw counts for the selected channel on the module.

   Units/Ct – The amount of temperature or voltage that will equal 1 raw count.

   Out of Range – The input register that, when On, will indicate that the input is outside of the range selected.

   Burn Out – If burn out is enabled, this register will be On when the loop is broken.

7. *RXx*

   Range – The engineering units to which the raw counts are scaled.

   Units/Ct – The number of raw counts that will equal 1 scaled engineering unit.

8. *Enable Scaling from WXx to RXx*

   WXx Min – The minimum value of the raw counts to scale.

   WXx Max – The maximum value of the raw counts to scale.

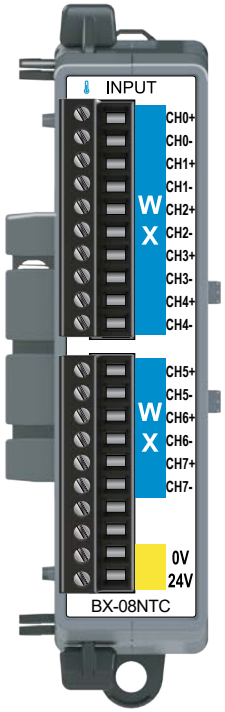
   RXx Min – The minimum value of the engineering units for scaling.

   RXx Max – The maximum value of the engineering units for scaling.

   Counts/DegF – Use these buttons to change the raw scaling to counts or degrees (C or F).

   Clamp RXx – If this box is checked, RXx will clamp at the minimum and maximum scaled values.

BX-08NTC Thermistor Input



BX-08NTC
Temperature Input
Expansion Module
8-pt Thermistor
Temperature Input

BX-RTB10 Terminal Blocks Included. The BX-RTB10-1 or BX-RTB10-2 can also be used and can be purchased separately.

***NOTE:** This device does not support ZIPLink Wiring Systems.*

Thermistor Input Specifications	
Input Channels	8 Single-ended
Commons	0
Resolution	16-bit, ±0.1°C or °F (up to 100Hz filter) See Data Range Specifications table
Thermistor Input Ranges	2252: −40° to 150°C (−40° to 302°F) 10K-AN Type 3: −40° to 150°C (−40° to 302°F) 10K-CP Type 2: −40° to 150°C (−40° to 302°F) 5K: −40° to 150°C (−40° to 302°F) 3K: −40° to 150°C (−40° to 302°F) 1.8K: −40° to 150°C (−40° to 302°F)
Thermistor Linearization	Automatic
Excitation Current (all ranges)	10µA to 210µA autoscaling
Accuracy vs. Temperature	±10PPM per °C (maximum)
Full Scale Calibration	±1°C
Offset Calibration Error	±1°C
Linearity Error (end to end)	Nonlinear
Maximum Inaccuracy	1°C @ 16.7 Hz, 2.5°C @ 470Hz
Warm-up Time	30 minutes for ±1°C Repeatability
Sample Duration	120ms @ 16.7 Hz, 4ms @ 470Hz
All Channel Update Rate	2.2 s @ 16.7 Hz
Open Circuit Detection Time	Within 2s @ 16.7 Hz
Common Mode Rejection	100dB @ DC and 100dB @ 60Hz
Absolute Maximum Ratings	Fault protected inputs to ±50V
Conversion Method	Sigma-Delta
Backplane Power Consumption	0.1 W
External DC Power Required	Class 2 or LPS power supply 24VDC (±20%) 25mA
Heat Dissipation	0.8 W
Weight	98g (3.5 oz)
Agency Approvals	UL 61010-1 and UL 61010-2-201 File E139594, Canada and USA CE (EN 61131-2 EMC, EN 61010-1 and EN 61010-2-201 Safety)
Software Version Required (Do-more! Designer Programming Software)	2.3 or later

IMPORTANT!

Hot-Swapping Information
Note: This device cannot be Hot Swapped.

BX-08NTC Thermistor Input, continued

Data Range Specifications		
Selection	**Description**	**Raw Counts[1]**
2252	2252Ω thermistor	°C: −400 to 1500 °F: −400 to 3020
10K-AN Type 3	10kΩ Type 3 (AN) thermistor	
10K-CP Type 2	10kΩ Type 2 (CP) thermistor	
5K	5kΩ thermistor	
3K	3kΩ thermistor	
1.8K	1.8 kΩ thermistor	

1. Temperatures have one implied decimal place (e.g., raw count of -400 is -40.0°).

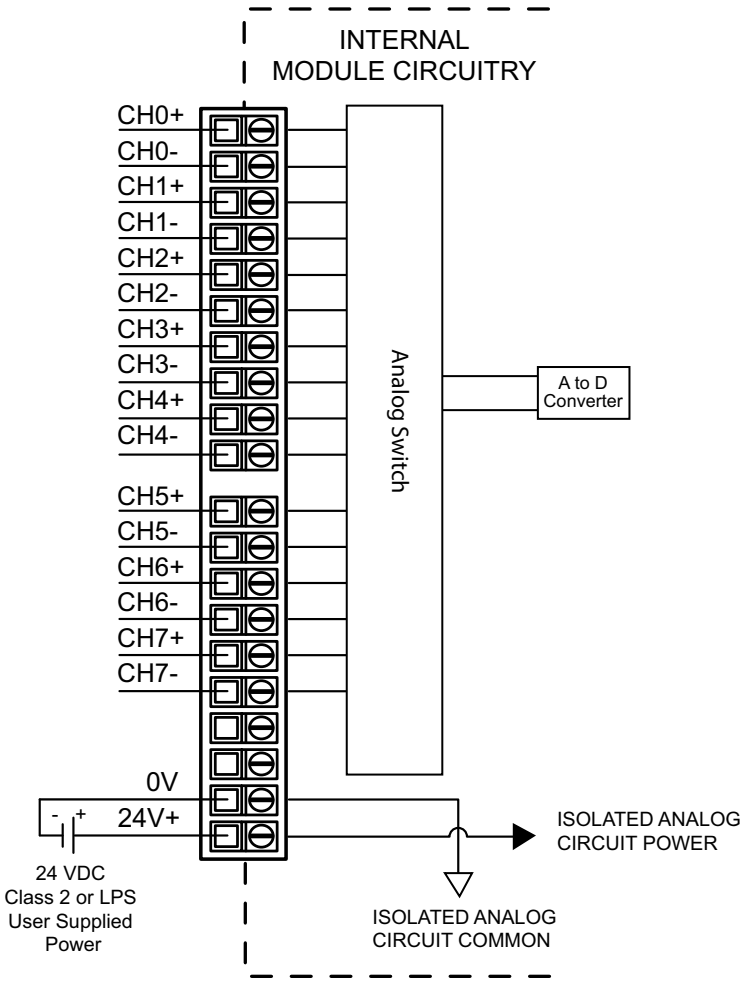
The module reserves the first 24 bits of unused contiguous space in the X register, aligned to an 8-bit word boundary, for status reporting. Error flags for this module are laid out within its status register space as described in the table below.

Error Flag Specifications								
	MSB							**LSB**
1st Byte of unused X Registers								
Module Status	-	-	-	-	-	Data Not Valid	Missing 24VDC	Self Test Failed
2nd Byte of unused X Registers								
Channel Out of Range	Channel 8	Channel 7	Channel 6	Channel 5	Channel 4	Channel 3	Channel 2	Channel 1
3rd Byte of unused X Registers								
Burn Out	Channel 8	Channel 7	Channel 6	Channel 5	Channel 4	Channel 3	Channel 2	Channel 1

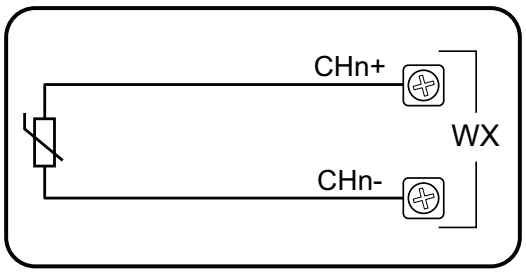
NOTE: *The Data Not Valid flag should always be tested and confirmed to be in the "Off" state in your PLC program before reading from the analog module.*

BX-08NTC Thermistor Input, continued

Analog Thermistor Input Wiring



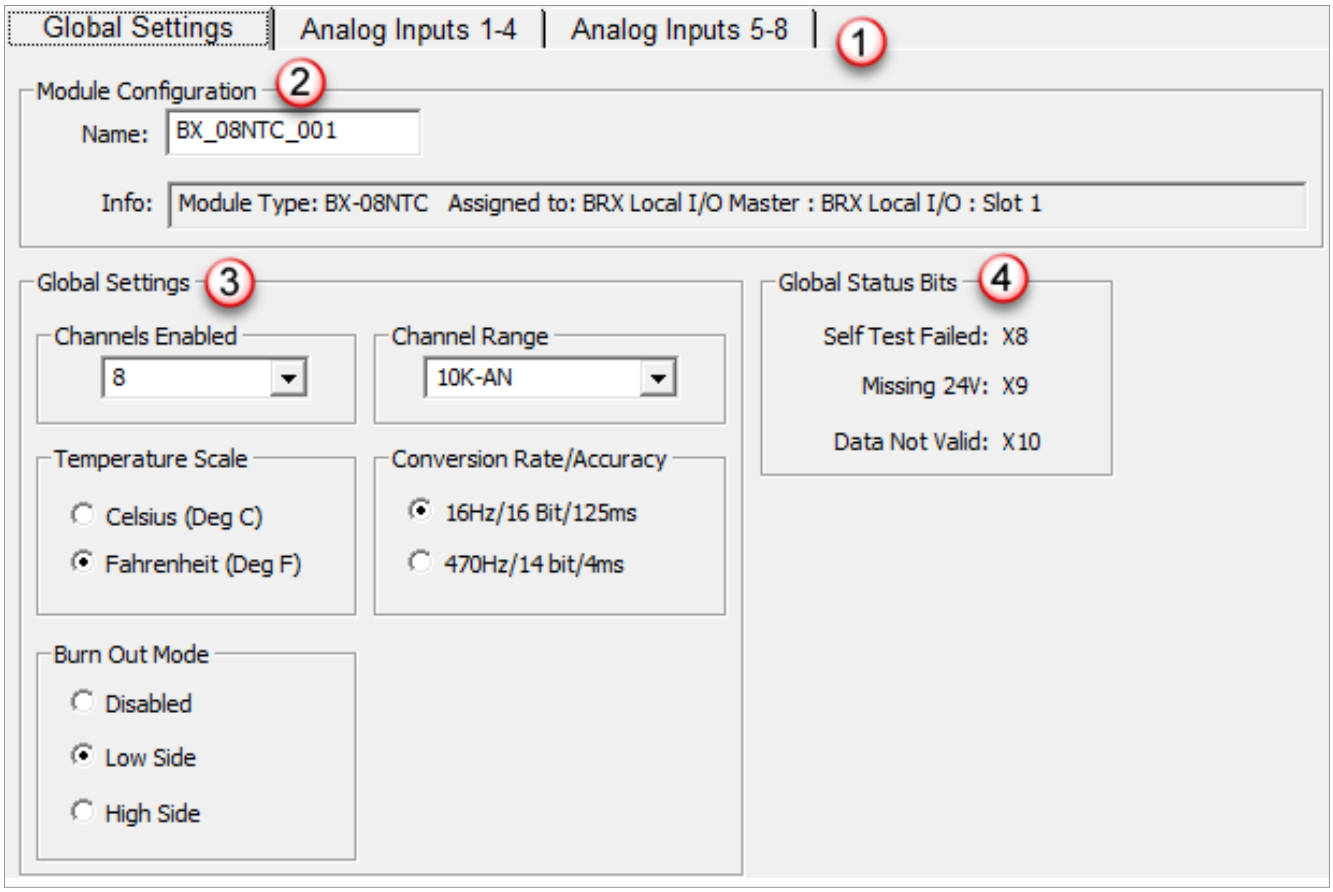
Thermistor Input



BX-08NTC Thermistor Input, continued

Software Setup

After the module is installed, open the Do-more! Designer programming software version 2.3 or later, connect to the BRX MPU and open the **Configure Module** dialog as described at the beginning of this chapter.



1. The module options are divided into subsets across multiple tabs. Click the appropriate tab to edit the configuration.
2. *Module Configuration*

   Name – Each module comes with a default name. This may be changed by the user to better identify the module if desired.

   Info – This is the system description of the module. This is static and may not be changed.
3. *Global Settings*

   Channels Enabled – Select how many channels will be used. The default is all channels. Selecting fewer channels may increase the update frequency. See the module specifications for details.

   Temperature Scale – Select either Celcius or Fahrenheit.

   Burn Out Mode – Select if the Input register should read Low or High on burn out or if burn out detection should be disabled.

   Channel Range – Select the RTD type or resistance range to measure. Note this setting affects all channels in the module.

   Conversion Rate/Accuracy – Select the desired sample conversion rate and accuracy.

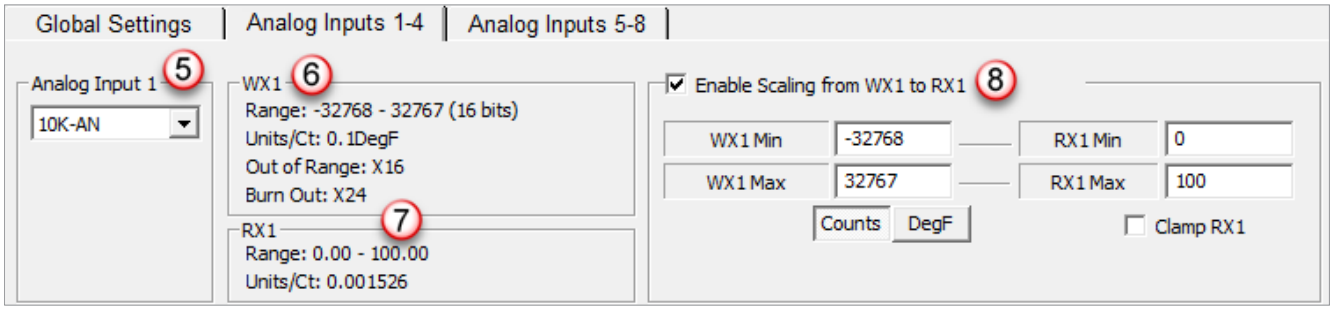
BX-08NTC Thermistor Input, continued

4. *Global Status Bits*

   Self Test Failed – This bit will be On if the module has failed its internal self-test. In this case, the module is likely bad and should be replaced.

   Missing 24V – This bit will be on if the external 24VDC power is missing. Check the 24VDC power connection on the module terminal block.

   Data Not Valid – This bit will be on if the module does not have the latest configuration parameters or the module has not been configured at all. Reload the program into the CPU and power cycle.



5. *Analog Input x*

   Input type for this module is a per-module setting. The settings are shown here for information only.

6. *WXx*

   Range – The number of Raw counts for the selected channel on the module.

   Units/Ct – The amount of temperature change that will equal 1 raw count.

   Out of Range – The input register that, when On, will indicate that the input is outside of the range selected.

   Burn Out – If burn out is enabled, this register will be On when the loop is broken.

7. *RXx*

   Range – The engineering units to which the raw counts are scaled.

   Units/Ct – The number of raw counts that will equal 1 scaled engineering unit.

8. *Enable Scaling from WXx to RXx*

   WXx Min – The minimum value of the raw counts to scale.

   WXx Max – The maximum value of the raw counts to scale.

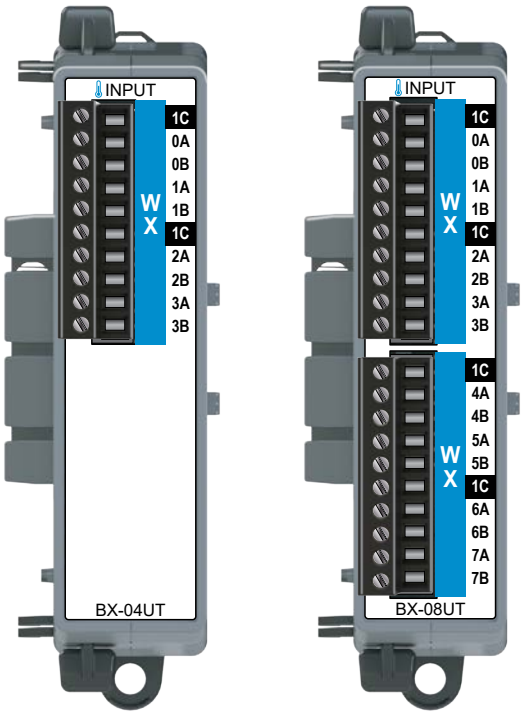
   RXx Min – The minimum value of the engineering units for scaling.

   RXx Max – The maximum value of the engineering units for scaling.

   Counts/DegF – Use these buttons to change the raw scaling to counts or degrees (C or F).

   Clamp RXx – If this box is checked, RXx will clamp at the minimum and maximum scaled values.

BX-xxUT Universal Temperature Input



BX-04UT
Temperature Input
Expansion Module
4-pt Universal
Temperature Input

BX-08UT
Temperature Input
Expansion Module
8-pt Universal
Temperature Input

BX-RTB10 Terminal Blocks Included.
The BX-RTB10-1 or BX-RTB10-2 can also be used and can be purchased separately.

***NOTE:** This device does not support ZIPLink Wiring Systems.*

IMPORTANT!

Hot-Swapping Information
Note: This device cannot be Hot Swapped.

Universal Temperature Input Specifications

	BX-04UT	BX-08UT
Input Channels	4 Differential	8 Differential
Commons	1	
Input Impedance	>5MΩ	
Resolution	24-bit, 0.1°(C or F) See Data Range Spec. table	
All Channel Update Rate (Max with noted inputs enabled)	1s (4 thermocouples) 700ms (4RTD/NTX/mV)	2s (8 thermocouples) 1.4s (4RTD/NTX/mV)
Sample Duration Time	175ms	
Open Circuit Detection Time	Within 5s	
Maximum Ratings	-0.3 V to +5.3 V, <15mA	
Common Mode Range	-0.3 V to +5.3 V	
Common Mode Rejection	100dB@DC, 130dB@60Hz	
Conversion Method	Sigma-Delta, 24-bit	
Backplane Power Consumption	1.5 W	
Heat Dissipation	1.5 W	
Weight	98g (3.5 oz)	
Agency Approvals	UL 61010-2 File E185989, Canada and USA	
Software Version Required	Do-more! Designer 2.7 or later	
Thermocouple Parameters		
Thermocouple Input Ranges	Type J: −210° to 1200°C (−346° to 2192°F) Type K: −265° to 1372°C (−445° to 2502°F) Type E: −265° to 1000°C (−445° to 1832°F) Type N: −265° to 1300°C (−445° to 2372°F) Type R: −50° to 1768°C (−58° to 3214°F) Type S: −50° to 1768°C (−58° to 3214°F) Type B: 40° to 1820°C (104° to 3308°F) Type T: −265° to 400°C (−445° to 752°F)	
Linear Voltage Input Ranges	−31.25 to 31.25 mVDC −31.25 to 125mVDC −31.25 to 62.5 mVDC 0 to 1.0 VDC	
Cold Junction Compensation	Automatic	
Thermocouple Linearization	Automatic	
Max. Inaccuracy–Thermocouple	±(0.2°C + 3% of °C reading)	
Maximum Inaccuracy–Voltage	±250µV	
RTD/Thermistor Parameters		
RTD Input Ranges (RTD Types)	10, 50, 100, 200, 500, 1000Ω Pt Platinum RTD 0.00385 European Curve: −200° to 850°C (−328° to 1562°F) 120Ω Ni N120 Nickel RTD 0.00672 Curve: −80° to 260°C (−112° to 500°F)	
Thermistor Input Ranges	2.252 kΩ @ 25°C: −40° to 150°C (−40° to 302°F) 3 kΩ @ 25°C: −40° to 150°C (−40° to 302°F) 5 kΩ @ 25°C: −40° to 150°C (−40° to 302°F) 10k-AN Type 3 @ 25°C: −40° to 150°C (−40° to 302°F) 30 kΩ @ 25°C: −40° to 150°C (−40° to 302°F)	
RTD Excitation Current	RTD 10, 100, 120, 200: 1mA RTD 500: 500µA RTD 1000: 250µA	
Thermistor Excitation Current	NTC 2.252k, NTC 3k: 10µA NTC 5k, NTC 10k: 5µA NTC 30k: 1µA	
Thermistor Linearization	Automatic	
Maximum Inaccuracy	±0.2°C	

BX-xxUT Universal Temperature Input, continued

Data Range Specifications			
Thermocouple Selection	**Temperature Range**	**Resolution**	
		WXn	**RXn**
Type J	−210 to 1200 °C −346 to 2192 °F	Degrees x10 (One Implied Decimal)[1]	24-Bit Floating[1]
Type K	−265 to 1372 °C −445 to 2502 °F		
Type E	−265 to 1000 °C −445 to 1832 °F		
Type R	−50 to 1768 °C −58 to 3214 °F		
Type S	−50 to 1768 °C −58 to 3214 °F		
Type B	40 to 1820 °C 104 to 3308 °F [3]		
Type T	−265 to 400 °C −445 to 752 °F		
Voltage Selection	**Voltage Range**	**WXn[2]**	**RXn**
−31.25 to 31.25 mVDC	Bipolar 31.25 mVDC	0.95 µV per count (−32768 to 32767)	User Scaled
−31.25 to 62.5 mVDC	Bipolar 62.5 mVDC	1.9 µV per count (−16384 to 32767)	
−31.25 to 125 mVDC	Bipolar 125 mVDC	3.8 µV per count (−8192 to 32767)	
0 to 1.0 VDC	Unipolar 1.0 VDC	30.5 µV per count (0 to 32767)	
RTD Selection	**Temperature Range**	**WXn**	**RXn**
10, 50, 100, 200, 500, 1000Ω Pt Platinum RTD 0.00385 European Curve	−200 to 850 °C −328 to 1562 °F	Degrees x10 (One Implied Decimal)[1]	24-Bit Floating[1]
120Ω Ni N120 Nickel RTD 0.00672 Curve	−80 to 260 °C −112 to 500 °F		
Thermistor Selection	**Temperature Range**	**WXn**	**RXn**
Thermistor 2.252 kΩ @25°C	−40 to 150 °C −40 to 302 °F	Degrees x10 (One Implied Decimal)[1]	24-Bit Floating[1]
Thermistor 3kΩ @25°C			
Thermistor 5kΩ @25°C			
Thermistor 10k-AN Type 3 @25°C			
Thermistor 30kΩ @25°C			

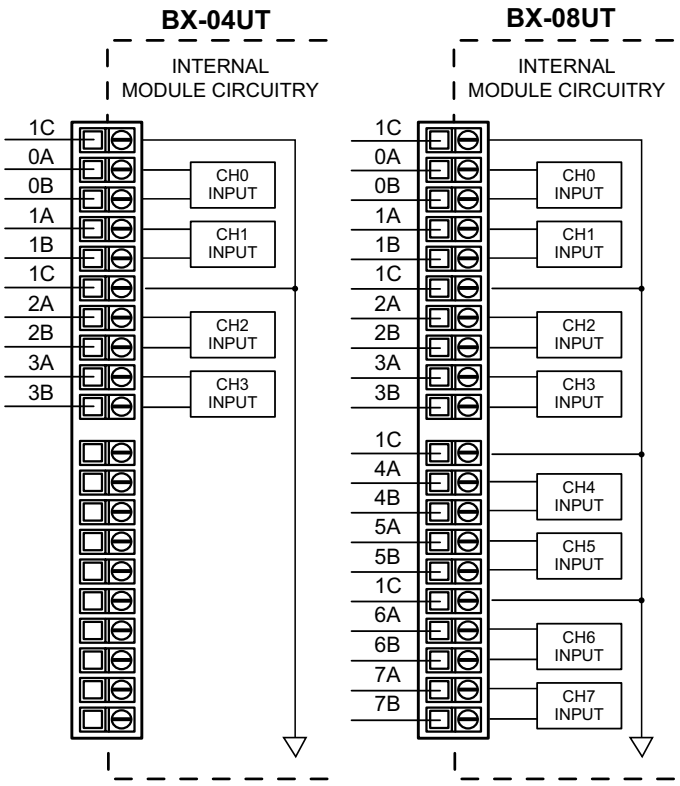
1. Temperatures reported in rounded integer to WXn and as scaled floating point 24bits resolution to RXn.
2. Raw Counts = −32768 to 32767.
3. Max value displayed in WXn is 32767. RXn will display the full range of 3308.0.

The module reserves the first 16 bits of unused contiguous space in the X register, aligned to an 8-bit word boundary, for status reporting. Error flags for this module are laid out within its status register space as described in the table below.

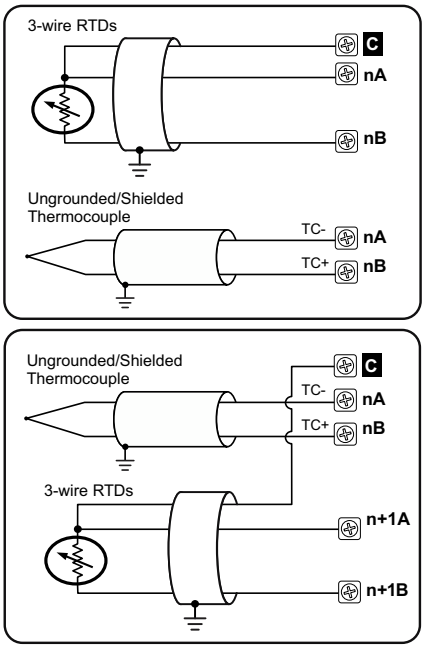
Error Flag Specifications								
	MSB							**LSB**
1st Byte of unused X Registers								
Module Status	Channel 4 Burnout	Channel 4 Out of Range	Channel 3 Burnout	Channel 3 Out of Range	Channel 2 Burnout	Channel 2 Out of Range	Channel 1 Burnout	Channel 1 Out of Range
2nd Byte of unused X Registers								
Module Status	Channel 8 Burnout	Channel 8 Out of Range	Channel 7 Burnout	Channel 7 Out of Range	Channel 6 Burnout	Channel 6 Out of Range	Channel 5 Burnout	Channel 5 Out of Range

BX-xxUT Universal Temperature Input, continued

Analog Thermocouple/Voltage Input Wiring

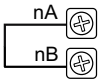


Mixed Resistive and Thermocouple Sensors



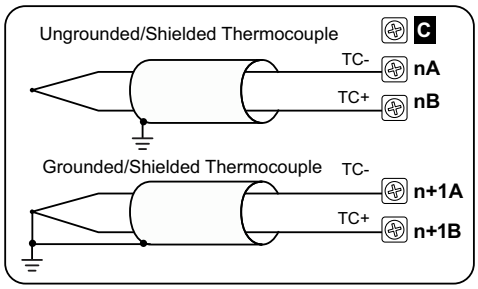
Notes for maximum accuracy:

1. All wires to an RTD must be equal length and type. Refer to RTD manufacturer's recommendations.
2. Do not use cable shield as sensing wire.
3. When applicable, connect shield to RTD common only, otherwise connect to module common only. Do not connect shield to both ends.
4. Jumper unused inputs.

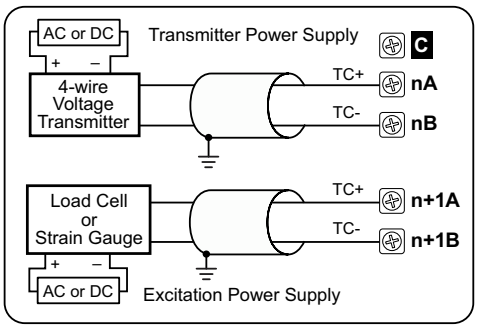


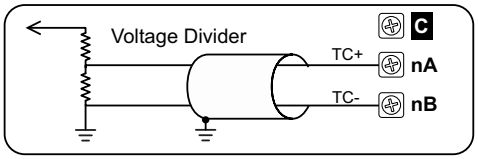
BX-xxUT Universal Temperature Input, continued

Thermocouple and Voltage Sensors



NOTE: Thermocouple extension wire and proper thermocouple terminal blocks must be used to extend thermocouples. AutomationDirect thermocouple wire is recommended.



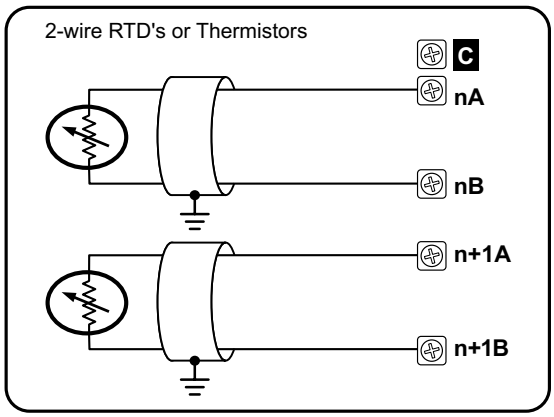


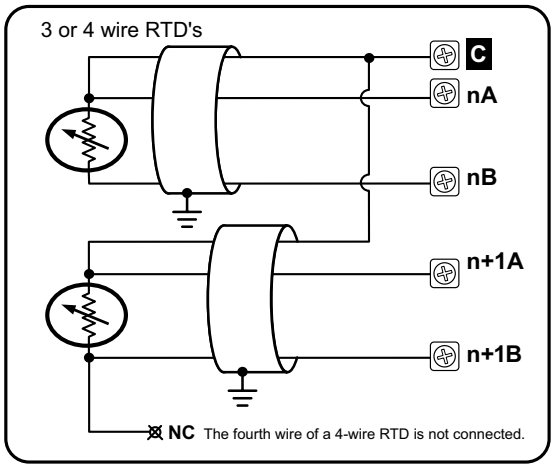
NOTE: Shield should be connected only at one end, to ground at the source device.

For maximum accuracy: Jumper unused inputs.



Resistive and Thermistor Sensors



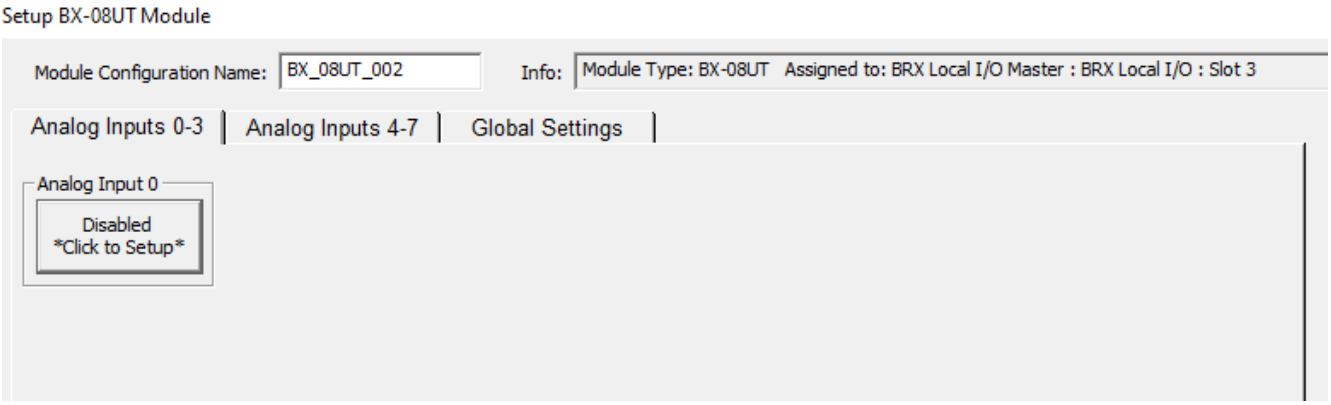


***NOTE:** With grounded thermocouples, take precautions to prevent having a voltage potential between thermocouple tips. A voltage of 1.25 V or greater between tips will skew measurements.*

BX-xxUT Universal Temperature Input, continued

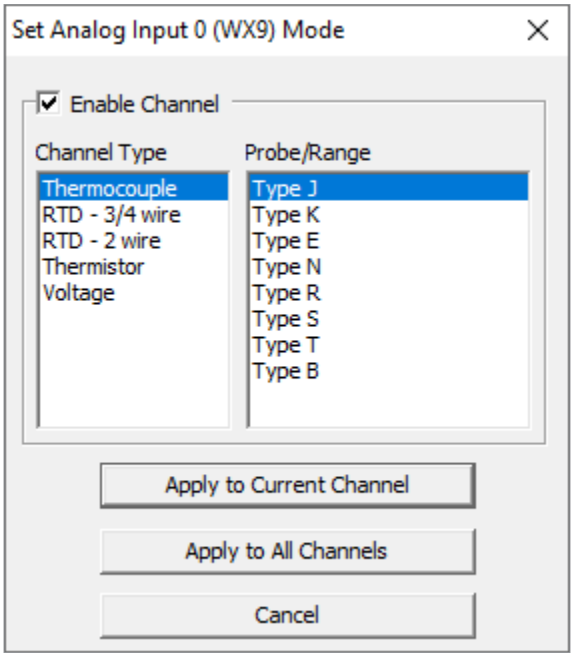
Software Setup

After the module is installed, open the Do-more! Designer programming software, connect to the BRX MPU and open the **Configure Module** dialog as described at the beginning of this chapter.



1. *Analog Input x*

   Button – Click the button to set up the channel.



2. Set *Analog Input x*

   Enable Channel – Check the box to enable this channel.

   Channel Type – Select the type of device for this channel. This can be different for each channel.

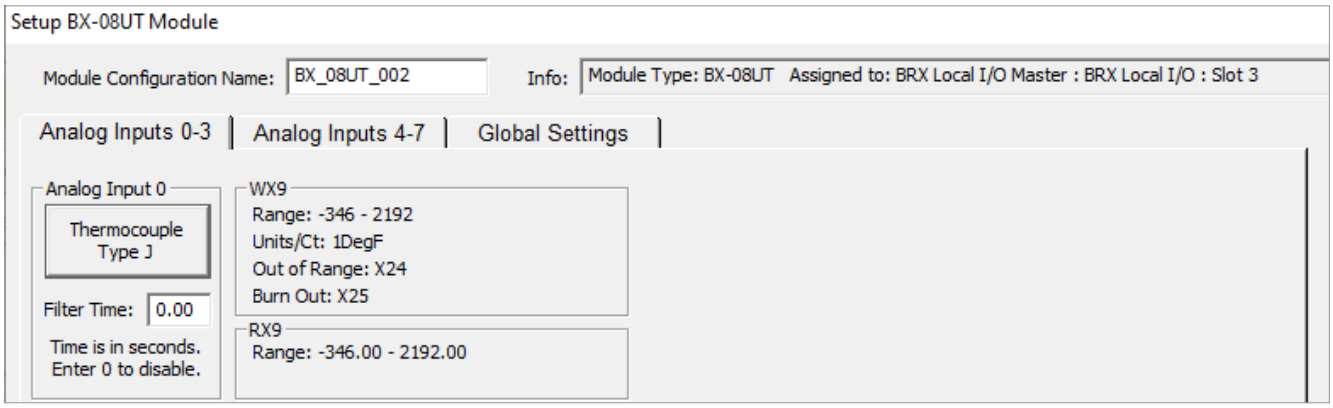
   Probe/Range – Select the style of device for this channel.

   Apply to Current Channel – Apply these settings to just this one channel.

   Apply to All Channels – Apply these settings to every channel on the card.

   Cancel – Make no changes and leave this dialog.

BX-xxUT Universal Temperature Input, continued



3. *WXx*

   Range – The temperature in whole degrees for the selected channel on the module.

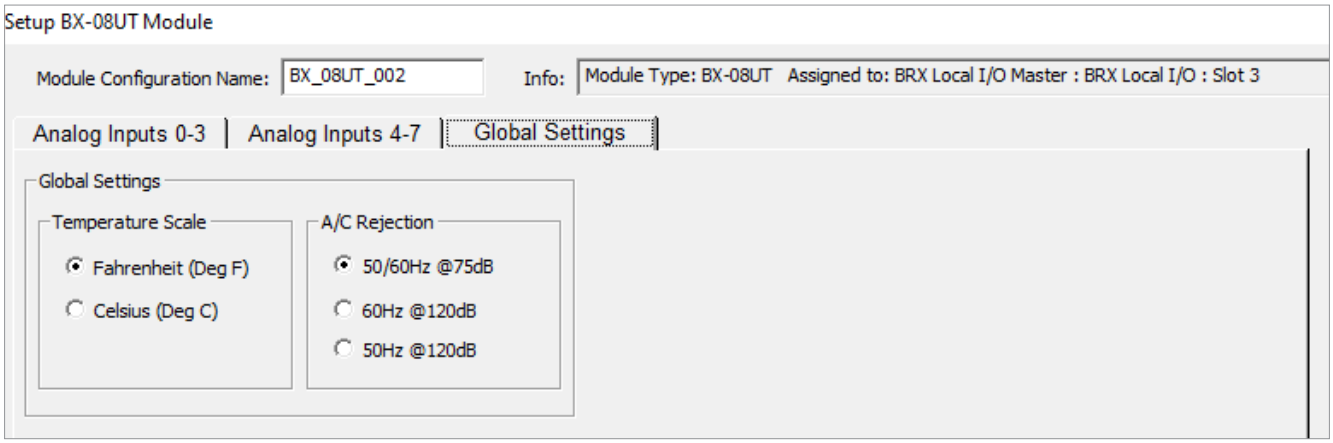
   Units/Ct – The amount of temperature change that will equal 1 raw count.

   Out of Range – The input register that, when On, will indicate that the input is outside of the range selected.

   Burn Out – If burn out is enabled, this register will be On when the loop is broken.

4. *RXx*

   Range – The floating point value of the channel temperature.



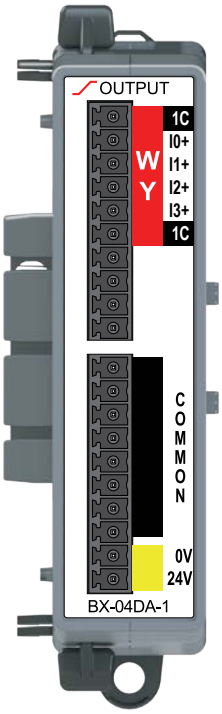
5. *Temperature Scale*

   Select Fahrenheit or Celsius.

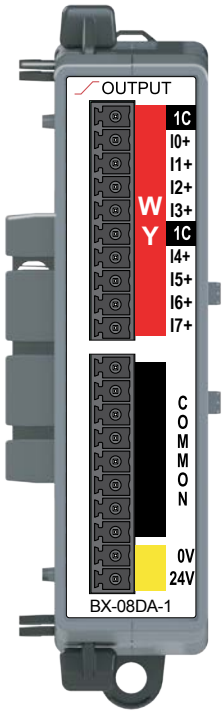
6. *A/C Rejection*

   The rejection range for the common mode rejection. This is typically set to the AC line frequency at the installation.

BX-xxDA-1 Analog Current Source Output



BX-04DA-1
Analog Output
Expansion Module
4-ch, 0-20mA/4-20mA,
16-bit



BX-08DA-1
Analog Output
Expansion Module
8-ch, 0-20mA/4-20mA,
16-bit

Terminal Blocks or *ZIP*Link Cables Sold Separately

We recommend using prewired ***ZIP***Link cables and connection modules.
If you wish to hand-wire your module, a removable terminal block is available. See Wiring Termination Selection in this chapter for all options.

Analog Current Source Output Specifications		
	BX-04DA-1	**BX-08DA-1**
Outputs per Module	4	8
Commons	1	
Module Signal Output Range	0–20mA, 4–20mA (Default)	
Signal Resolution	16-bit, 15-bit (Default)	
Resolution Value of LSB	See Data Range Specifications table	
Output Type	Current Sourcing up to 22mA	
Output Value in Fault Mode	~0mA	
Maximum Load Impedance	700Ω	
Maximum Capacitive Load	1000pF	
Allowed Load Type	Grounded	
Maximum Continuous Overload	30mA	
All Channel Update Rate	1.5 ms per enabled channel	
Maximum Inaccuracy	±0.1% of range	±0.05% of range
Maximum Full Scale Calibration Error	±0.05% of range	
Maximum Offset Calibration Error	±0.05% of range	
Conversion Method	Successive approximation	
Accuracy vs. Temperature	±25PPM / °C maximum	
Maximum Crosstalk	+10µV	
Linearity Error (end to end)	±0.08% of range	±0.06% of range
Output Stability and Repeatability	±0.02% of full range after 10 minute warmup (typical)	
Output Ripple	±0.01% of range/mA	
Output Settling Time	200µs	
Channel to Backplane Isolation	1800VAC applied for one second	
Channel to Channel Isolation	None	
Loop Fusing (External)	Fast-acting 0.032A recommended	
Backplane Power Consumption	0.1 W	
External DC Power Required	Class 2 or LPS power supply 24VDC (±20%)	
	175mA	250mA
Heat Dissipation	5.1 W	8.1 W
Weight	98g (3.5 oz)	
Agency Approvals	UL 61010-1 and UL 61010-2-201 File E139594, Canada and USA CE (EN 61131-2 EMC, EN 61010-1 and EN 61010-2-201 Safety)	
Software Version Required (Do-more! Designer Programming Software)	2.3 or later	2.1 or later

IMPORTANT!

Hot-Swapping Information
Note: This device cannot be Hot Swapped.

BX-xxDA-1 Analog Current Source Output, continued

Data Range Specifications							
Selection	Description	Enable 16 bit Unchecked (15 bit Resolution, Default)			Enable 16 bit Checked (16 bit Resolution)		
		Raw Counts	Casting*	µA Per Count	Raw Counts	Casting*	µA Per Count
0–20mA	unipolar 0–20mA	0–32767	-	0.61	0–65535	WYn:U	0.31
4–20mA	unipolar 4–20mA	0–32767	-	0.49	0–65535	WYn:U	0.24

For more information on Casting, refer to Help topic DMD0309 in the Do-more! Designer Software.

The module reserves the first 24 bits of unused contiguous space in the X register, aligned to an 8-bit word boundary, for status reporting. Error flags for this module are laid out within its status register space as described in the table below.

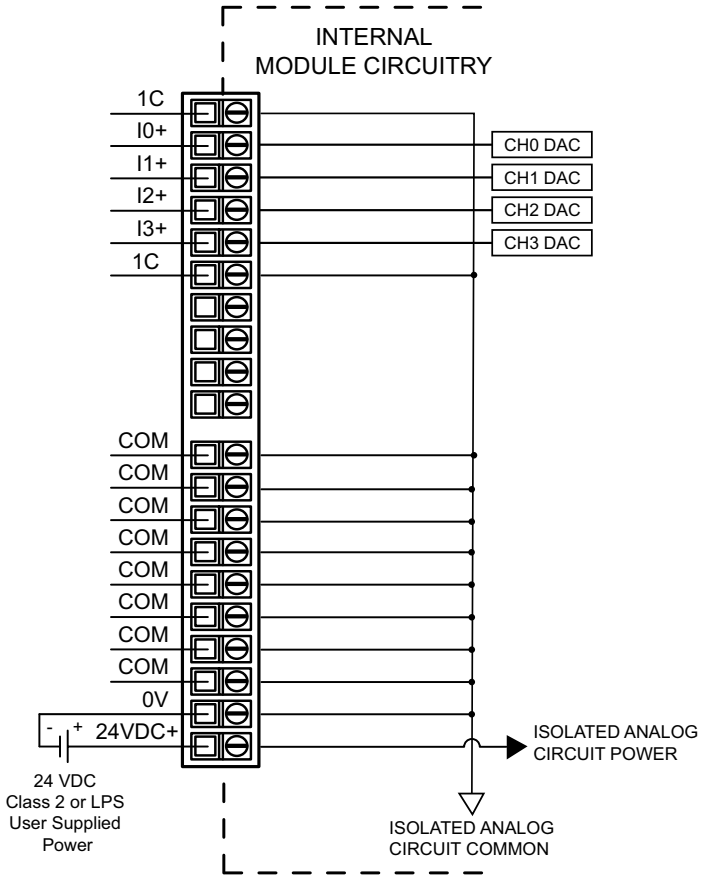
Error Flag Specifications								
	MSB							LSB
1st Byte of unused X Registers								
Module Status	-	-	-	-	-	Data Not Valid	Missing 24VDC	Self Test Failed
2nd Byte of unused X Registers								
Unused	-	-	-	-	-	-	-	-
3rd Byte of unused X Registers								
Unused	-	-	-	-	-	-	-	-

NOTE: *The Data Not Valid flag should always be tested and confirmed to be in the "Off" state in your PLC program before writing to the analog module.*

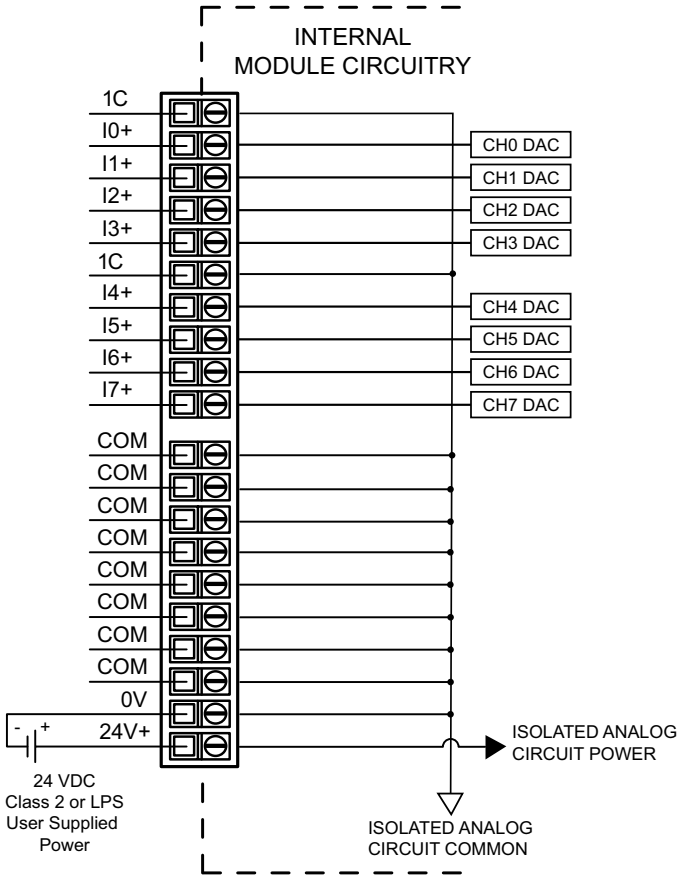
BX-xxDA-1 Analog Current Source Output, continued

Analog Current Output Wiring

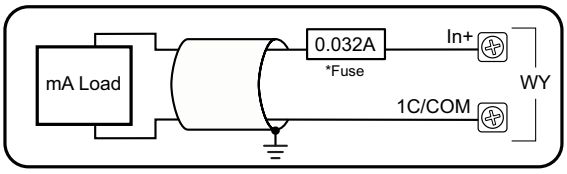
BX-04DA-1



BX-08DA-1



Analog Current Source Output



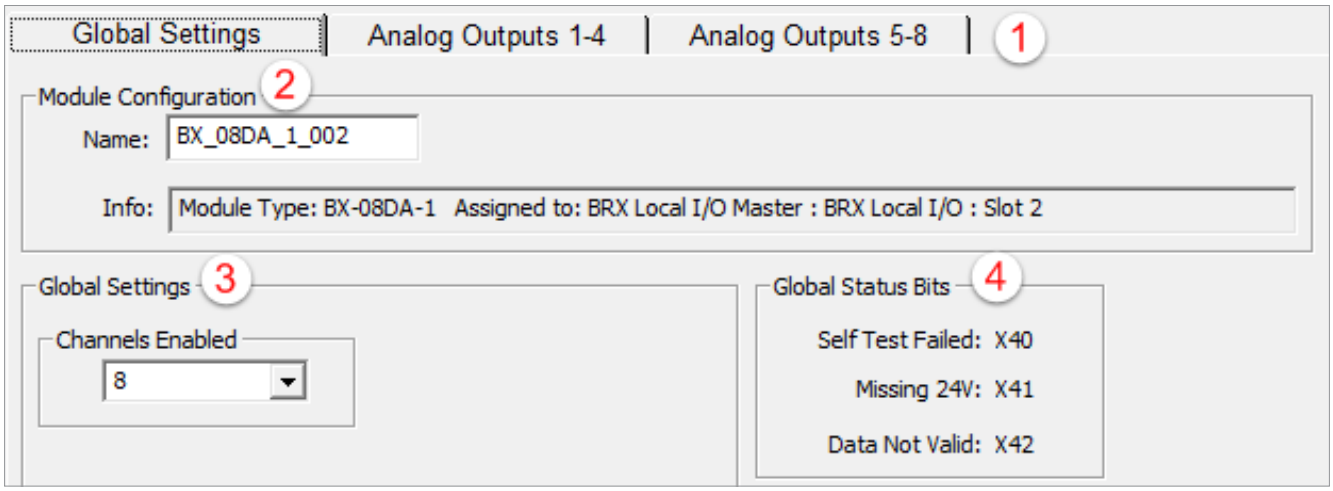
*An Edison S500-32-R 0.032A fast-acting fuse is recommended for all analog voltage inputs, analog outputs, and current loops.

NOTE: Shield should be connected only at one end, to ground at the source device.

BX-xxDA-1 Analog Current Source Output, continued

Software Setup

After the module is installed, open the Do-more! Designer programming software, connect to the BRX MPU and open the **Configure Module** dialog as described at the beginning of this chapter.



1. The module options are divided into subsets across multiple tabs. Click the appropriate tab to edit the configuration.
2. *Module Configuration*

   Name – Each module comes with a default name. This may be changed by the user to better identify the module if desired.

   Info – This is the system description of the module. It is static and may not be changed.
3. *Global Settings*

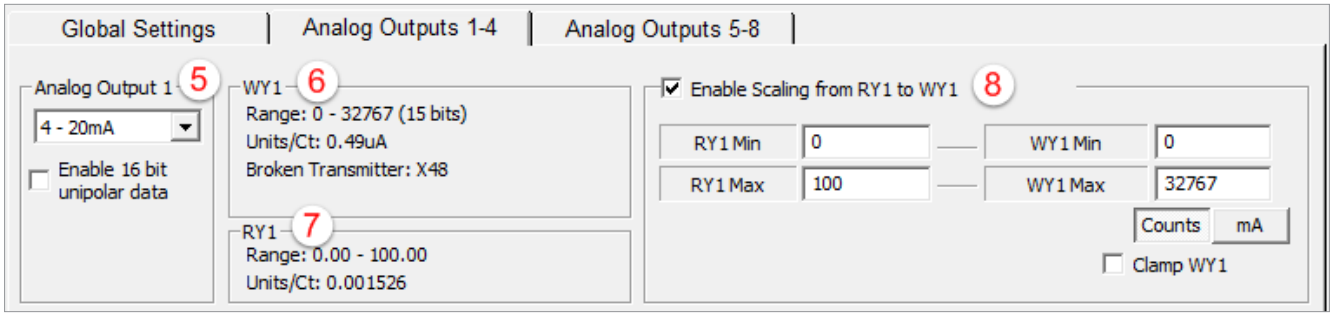
   Channels Enabled – Select how many channels will be used. The default is all channels. Selecting fewer channels may increase the update frequency. See the module specifications for details.
4. *Global Status Bits*

   Self Test Failed – This bit will be On if the module has failed its internal self-test. In this case, the module is likely bad and should be replaced.

   Missing 24V – This bit will be On if the external 24VDC power is missing. Check the 24VDC power connection on the module terminal block.

   Data Not Valid – This bit will be On if the module does not have the latest configuration parameters or the module has not been configured at all. Reload the program into the CPU and power cycle.

BX-xxDA-1 Analog Current Source Output, continued



5. *Analog Output x*

   These settings are for each channel of the analog module.

   Drop-down menu - Select the range of the analog input here.

   Enable 16 bit unipolar data – Check this box to change the raw count range from a signed decimal bipolar data format to an unsigned decimal data format. This may require that Casting be used in the program in order to properly access the data. Refer to the chart of Data Range Specifications earlier in this chapter to see if the registers must be accessed with Casting.

6. *WXx*

   Range – The number of Raw counts for the selected channel on the module.

   Units/Ct – The amount of current that will equal 1 raw count.

   Broken Transmitter – The input register that, when On, will indicate that the loop is broken.

7. *RXx*

   Range – The engineering units to which the raw counts are scaled.

   Units/Ct – The number of raw counts that will equal 1 scaled engineering unit.

8. *Enable Scaling from WYx to RYx*

   RYx Min – The minimum value of the engineering units for scaling.

   RYx Max – The maximum value of the engineering units for scaling.

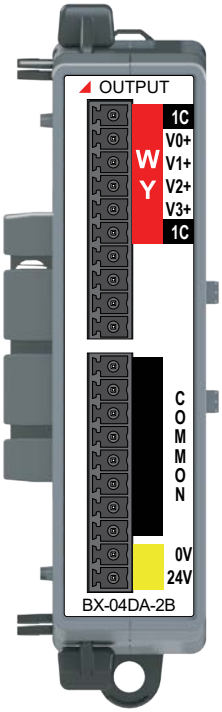
   WYx Min – The minimum value of the raw counts to scale.

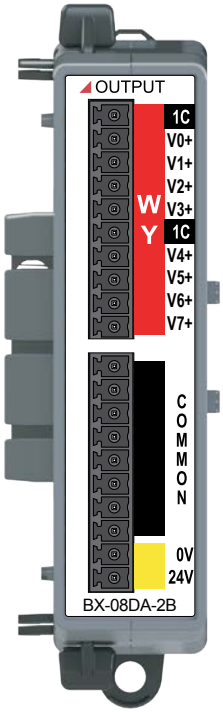
   WYx Max – The maximum value of the raw counts to scale.

   Counts/mA – Use these buttons to change the raw scaling to counts or milliamps.

   Clamp WYx – If this box is checked, WYx will clamp at the minimum and maximum scaled values.

BX-xxDA-2B Analog Voltage Output





BX-04DA-2B
Analog Output
Expansion Module
4-ch, ±10 VDC, ±5 VDC,
0–5 VDC, 0–10 VDC,
16-bit

BX-08DA-2B
Analog Output
Expansion Module
8-ch, ±10 VDC, ±5 VDC,
0–5 VDC, 0–10 VDC,
16-bit

Terminal Blocks or *ZIP*Link Cables Sold Separately

We recommend using prewired ***ZIP***Link cables and connection modules.
If you wish to hand-wire your module, a removable terminal block is available. See Wiring Termination Selection in this chapter for all options.

Analog Voltage Output Specifications

	BX-04DA-2B	BX-08DA-2B
Outputs per Module	4	8
Commons	1	
Module Signal Output Range	±10 VDC, ±5 VDC, 0–5 VDC, 0–10 VDC (Default)	
Signal Resolution	16-bit, 15-bit (Default)	
Resolution Value of LSB	See Data Range Specifications table	
Output Type	Voltage outputs sourcing/sinking at 10mA (example 10V @ 1kΩ load).	
Output Value in Fault Mode	Voltage outputs 0V (Unipolar or Bipolar)	
Minimum Load Impedance	1kΩ	
Maximum Capacitive Load	1000pF	
Allowed Load Type	Grounded	
Maximum Continuous Overload	15mA	
All Channel Update Rate	3ms	
Maximum Inaccuracy	0.2% of range	
Maximum Full Scale Calibration Error	±0.08% of range	
Maximum Offset Calibration Error	±0.04% of range	
Accuracy vs. Temperature	±25PPM/°C maximum	
Maximum Crosstalk	+3µV	
Linearity Error (end to end)	±0.01% of range	
Output Stability and Repeatability	±0.02% of full range after 10 min. warmup (typical)	
Output Ripple	150 µV/mA	
Output Settling Time	200µs	
Channel to Backplane Isolation	1800VAC applied for one second	
Channel to Channel Isolation	None	
Loop Fusing (External)	Fast-acting 0.032A recommended	
Backplane Power Consumption	0.1 W	
External DC Power Required	Class 2 or LPS power supply 24VDC (±20%) 100mA	
Heat Dissipation	2.9 W	3.1 W
Weight	104g (3.7 oz)	
Agency Approvals	UL 61010-1 and UL 61010-2-201 File E139594, Canada and USA CE (EN 61131-2 EMC, EN 61010-1 and EN 61010-2-201 Safety)	
Software Version Required (Do-more! Designer Programming Software)	2.3 or later	2.1 or later

IMPORTANT!

Hot-Swapping Information
Note: This device cannot be Hot Swapped.

BX-xxDA-2B Analog Voltage Output, continued

Data Range Specifications							
Selection	Description	Enable 16 bit Unchecked (15 bit Resolution, Default)[1]			Enable 16 bit Checked (16 bit Resolution)		
		Raw Counts	Casting[2]	µV Per Count	Raw Counts	Casting[2]	µV Per Count
0–10V	unipolar 10VDC	0–32767	-	305	0–65535	WYn:U	152
0–5V	unipolar 5VDC	0–32767	-	152	0–65535	WYn:U	76
±10V	bipolar 10VDC	-	-		–32768 to 32767	-	305
±5V	bipolar 5VDC	-	-		–32768 to 32767	-	152

1. Bipolar ranges default to 16-bit resolution.

2. For more information on Casting, refer to Help topic DMD0309 in the Do-more! Designer Software.

The module reserves the first 24 bits of unused contiguous space in the X register, aligned to an 8-bit word boundary, for status reporting. Error flags for this module are laid out within its status register space as described in the table below.

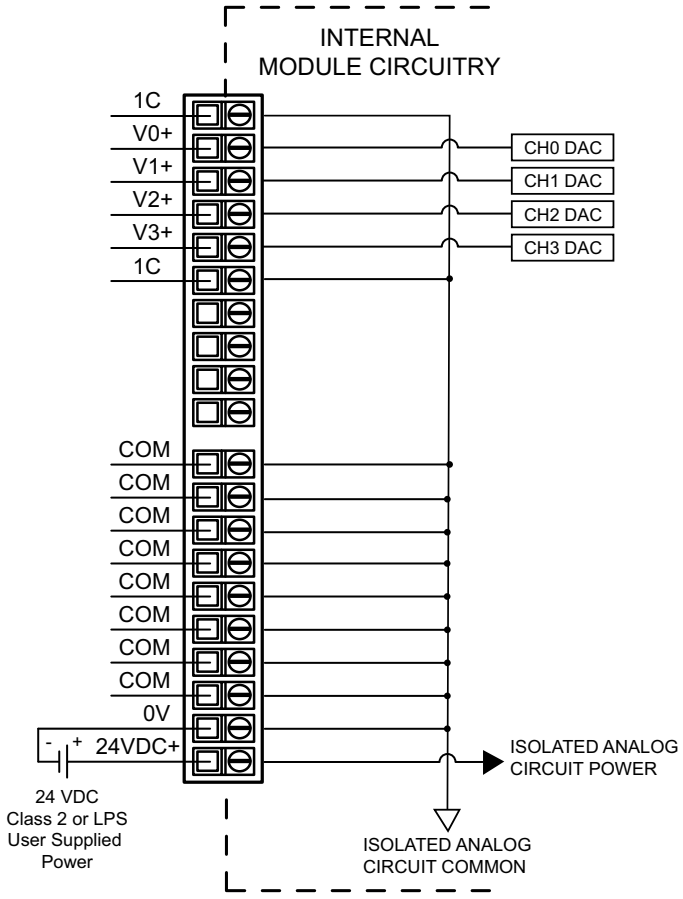
Error Flag Specifications								
	MSB							LSB
1st Byte of unused X Registers								
Module Status	-	-	-	-	-	Data Not Valid	Missing 24VDC	Self Test Failed
2nd Byte of unused X Registers								
Unused	-	-	-	-	-	-	-	-
3rd Byte of unused X Registers								
Unused	-	-	-	-	-	-	-	-

NOTE: *The Data Not Valid flag should always be tested and confirmed to be in the "Off" state in your PLC program before writing to the analog module.*

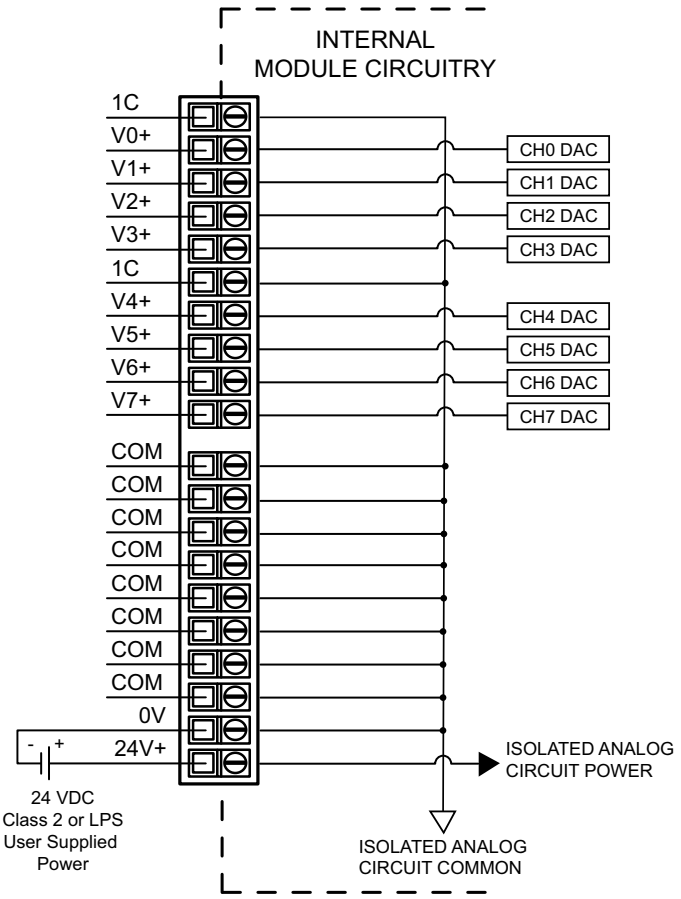
BX-xxDA-2B Analog Voltage Output, continued

Analog Voltage Output Wiring

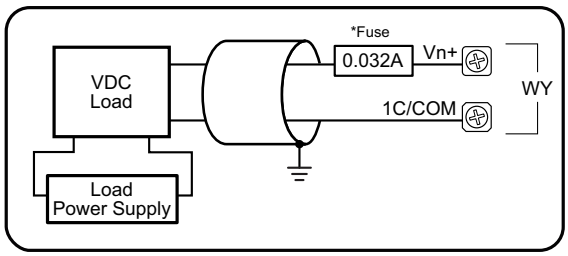
BX-04DA-2B



BX-08DA-2B



Analog Voltage Output Circuit



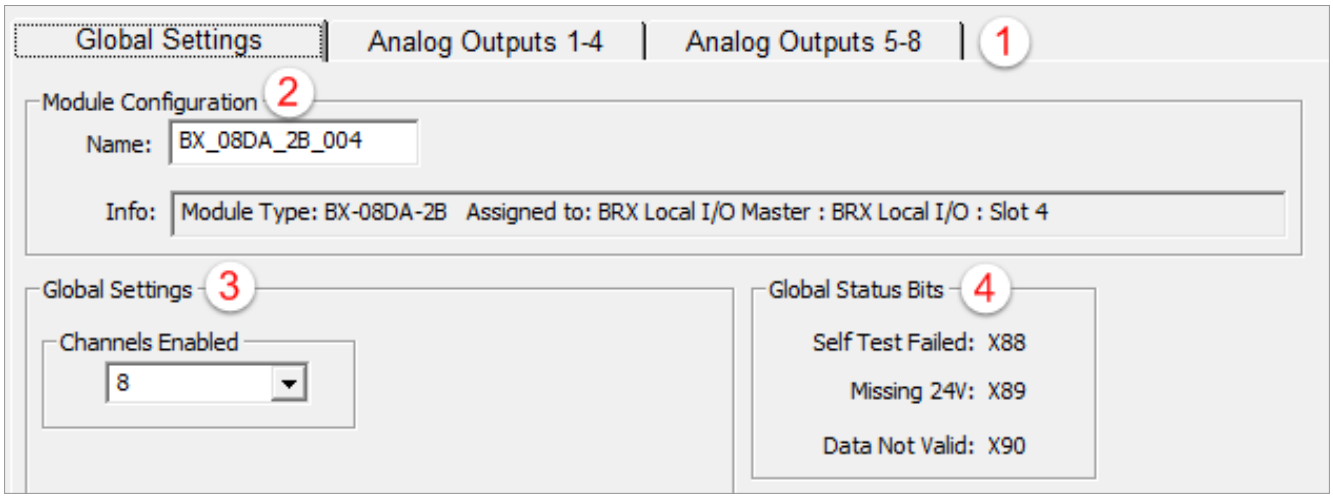
*An Edison S500-32-R 0.032A fast-acting fuse is recommended for all analog voltage inputs, analog outputs, and current loops.

NOTE: Shield should be connected only at one end, to ground at the source device.

BX-xxDA-2B Analog Voltage Output, continued

Software Setup

After the module is installed, open the Do-more! Designer programming software, connect to the BRX MPU and open the **Configure Module** dialog as described at the beginning of this chapter.



1. The module options are divided into subsets across multiple tabs. Click the appropriate tab to edit the configuration.
2. *Module Configuration*

   Name – Each module comes with a default name. This may be changed by the user to better identify the module if desired.

   Info – This is the system description of the module. It is static and may not be changed.
3. *Global Settings*

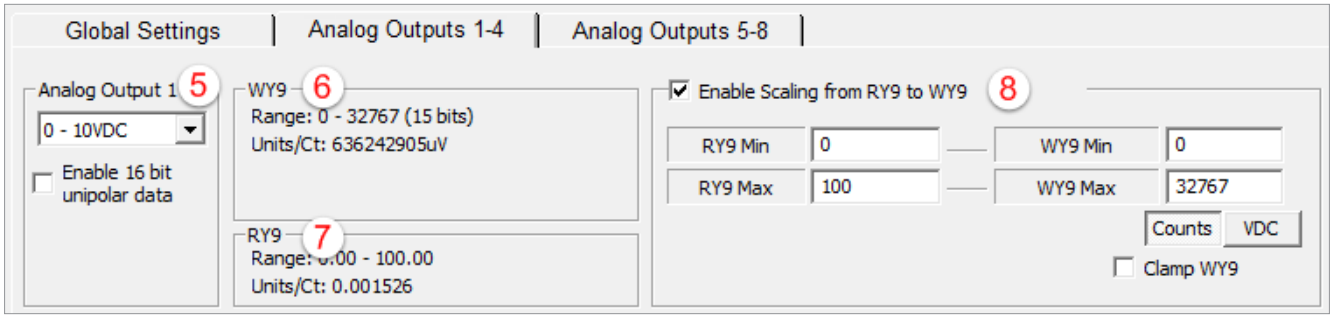
   Channels Enabled – Select how many channels will be used. The default is all channels. Selecting fewer channels may increase the update frequency. See the module specifications for details.
4. *Global Status Bits*

   Self Test Failed – This bit will be On if the module has failed its internal self-test. In this case, the module is likely bad and should be replaced.

   Missing 24V – This bit will be On if the external 24VDC power is missing. Check the 24VDC power connection on the module terminal block.

   Data Not Valid – This bit will be On if the module does not have the latest configuration parameters or the module has not been configured at all. Reload the program into the CPU and power cycle.

BX-xxDA-2B Analog Voltage Output, continued



5. *Analog Output x*

   These settings are for each channel of the analog module.

   Drop-down menu - Select the range of the analog input here.

   Enable 16 bit unipolar data – Check this box to change the raw count range from a signed decimal bipolar data format to an unsigned decimal data format. This may require that Casting be used in the program in order to properly access the data. Refer to the chart of Data Range Specifications earlier in this chapter to see if the registers must be accessed with Casting.

6. *WXx*

   Range – The number of Raw counts for the selected channel on the module.

   Units/Ct – The amount of current that will equal 1 raw count.

7. *RXx*

   Range – The engineering units to which the raw counts are scaled.

   Units/Ct – The number of raw counts that will equal 1 scaled engineering unit.

8. *Enable Scaling from WYx to RYx*

   RYx Min – The minimum value of the engineering units for scaling.

   RYx Max – The maximum value of the engineering units for scaling.

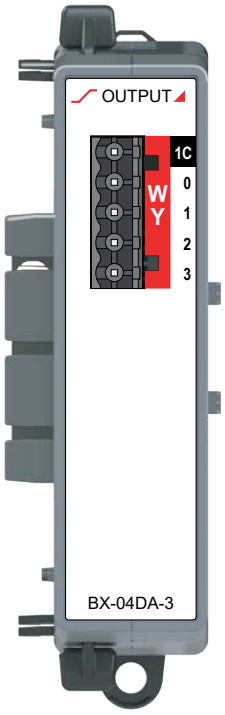
   WYx Min – The minimum value of the raw counts to scale.

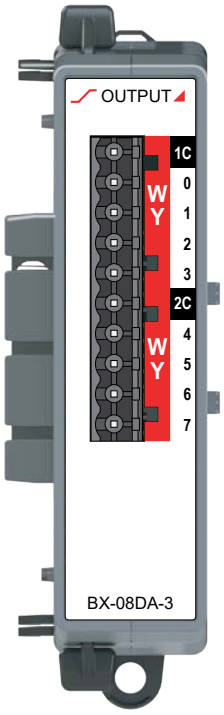
   WYx Max – The maximum value of the raw counts to scale.

   Counts/VDC – Use these buttons to change the raw scaling to counts or milliamps.

   Clamp WYx – If this box is checked, WYx will clamp at the minimum and maximum scaled values.

BX-xxDA-3 Universal Analog Output





BX-04DA-3
Analog Output
Expansion Module
4-ch, 0-20mA/4-20mA,
±10 VDC, ±5 VDC,
0–5 VDC, 0–10 VDC,
16-bit*

BX-08DA-3
Analog Output
Expansion Module
8-ch, 0-20mA/4-20mA,
±10 VDC, ±5 VDC,
0–5 VDC, 0–10 VDC,
16-bit*

Terminal Blocks or *ZIP*Link Cables Sold Separately

We recommend using prewired ***ZIP***Link cables and connection modules. If you wish to hand-wire your module, a removable terminal block is available. See Wiring Termination Selection in this chapter for all options.

IMPORTANT!

Hot-Swapping Information

Note: This device cannot be Hot Swapped.

Analog Universal Current/Voltage Output Specifications

	BX-04DA-3	BX-08DA-3
Outputs per Module	4	8
Commons	1	2
Module Signal Output Range	0–20mA, 4–20mA, ±20mA, ±10 VDC, ±5 VDC, 0–5 VDC (Default), 0–10 VDC	
Signal Resolution	16-bit at ±10V or ±20mA*	
Resolution Value of LSB	See Data Range Specifications table	
Output Type	Current Sinking/Sourcing up to 5V Voltage outputs sourcing/sinking at 10mA (example 10V @ 1kΩ load).	
Output Value in Fault Mode	Current outputs ~0mA Voltage outputs 0V (Unipolar or Bipolar)	
Minimum Voltage Load Impedance	1kΩ	
Maximum Current Load Impedance	250Ω	
Allowed Load Type	Grounded	
Maximum Continuous Overload	Indefinitely	
All Channel Update Rate	1.0 ms	
Maximum Inaccuracy	±0.1% of HW full scale (65 counts)	
Maximum Full Scale Calibration Error	±0.1% of HW full scale (65 counts)	
Conversion Method	Amplified Divide-by-2 Resistor String	
Linearity Error (end to end)	±0.1% of HW full scale (65 counts)	
Output Stability and Repeatability	±0.02% of HW full scale (12 counts) after 10 min. warmup (typical)	
Output Settling Time	10µs	
Channel to Backplane Isolation	1500VAC applied for one second, 1C to 2C	
Channel to Channel Isolation	None	
Loop Fusing (External)	Fast-acting 0.032A recommended	
Backplane Power Consumption (Max)	2.4 W	5 W
Heat Dissipation	2.25 W	5.5 W
Weight	98g (3.5 oz)	
Agency Approvals	UL 61010-2 File E185989, Canada and USA	
Software Version Required (Do-more! Designer Programming Software)	2.7 or later	

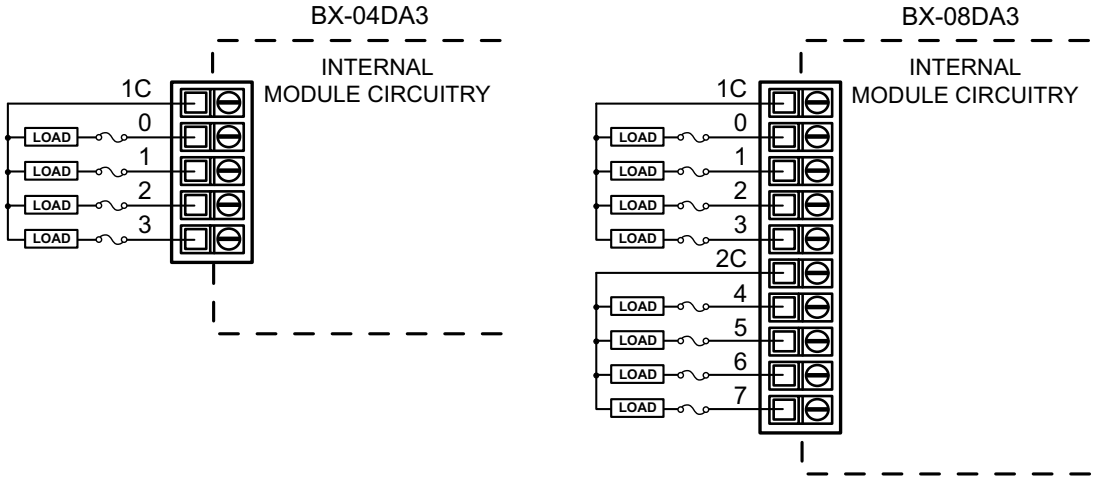
**** 16-bit resolution is only available when a bipolar output range is selected.***

BX-xxDA-3 Universal Analog Output, continued

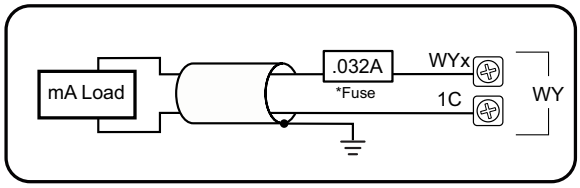
Data Range Specifications				
Selection	**Description**	**Raw Counts**	**Casting[1]**	**Per Count**
−20–20mA	bipolar −20 to 20mA	−32768 to 32767	-	0.61 µA
4–20mA	unipolar 4–20mA	6553–32767	-	0.61 µA
0–10V	unipolar 10VDC	0–32767	-	305µV
0–5V	unipolar 5VDC	0–32767	-	153µV
±10V	bipolar 10VDC	−32768 to 32767	-	305µV
±5V	bipolar 5VDC	−32768 to 32767	-	153µV

1. For more information on Casting, refer to Help topic DMD0309 in the Do-more! Designer Software.

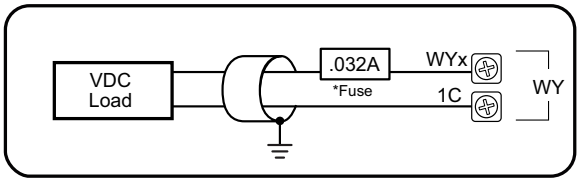
Analog Current/Voltage Output Wiring



Analog Current Source Output Circuit



Analog Voltage Output Circuit



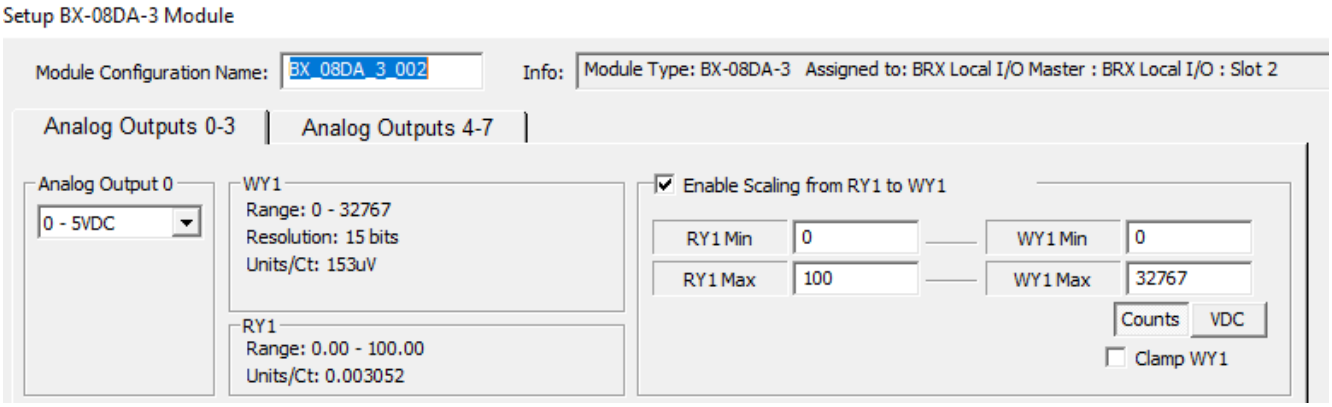
NOTE: Shield should be connected only at one end, to ground at the source device.

*An Edison S500-32-R 0.032A fast-acting fuse is recommended for all analog voltage inputs, analog outputs, and current loops.

BX-xxDA-3 Universal Analog Output, continued

Software Setup

After the module is installed, open the Do-more! Designer programming software, connect to the BRX MPU and open the **Configure Module** dialog as described at the beginning of this chapter.



1. ***Analog Output x***

   These settings are for each channel of the analog module.

   Drop-down menu - Select the range of the analog input here.

2. ***WXx***

   Range – The number of Raw counts for the selected channel on the module.

   Units/Ct – The amount of current that will equal 1 raw count.

3. ***RXx***

   Range – The engineering units to which the raw counts are scaled.

   Units/Ct – The number of raw counts that will equal 1 scaled engineering unit.

4. ***Enable Scaling from WYx to RYx***

   RYx Min – The minimum value of the engineering units for scaling.

   RYx Max – The maximum value of the engineering units for scaling.

   WYx Min – The minimum value of the raw counts to scale.

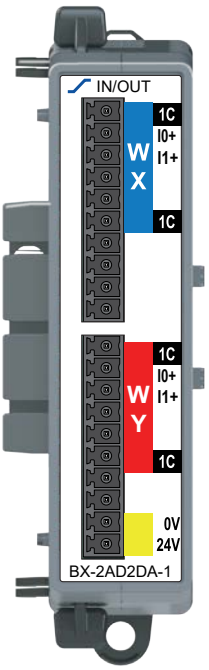
   WYx Max – The maximum value of the raw counts to scale.

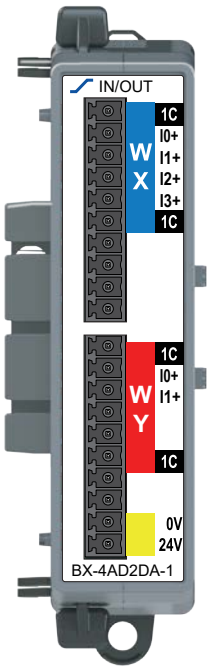
   Counts/VDC – Use these buttons to change the raw scaling to counts or milliamps.

   Clamp WYx – If this box is checked, WYx will clamp at the minimum and maximum scaled values.

BX-xADxDA-1 Combination Analog Current Input/Output

The BX-xADxDA-1 Combination Analog Current Input/Output Expansion Modules provide two (2) or four (4) points current sinking inputs and two (2) current sourcing outputs.





Terminal Blocks or *ZIP*Link Cables Sold Separately

BX-2AD2DA-1

Combination Analog Module
Input: 2-pt, 0–20mA/4–20mA, Sinking
Output: 2-pt, 0–20mA/4–20mA, Sourcing

BX-4AD2DA-1

Combination Analog Module
Input: 4-pt, 0–20mA/4–20mA, Sinking
Output: 2-pt, 0–20mA/4–20mA, Sourcing

We recommend using prewired *ZIP*Link cables and connection modules.
If you wish to hand-wire your module, a removable terminal block is available. See Wiring Termination Selection in this chapter for all options.

IMPORTANT!

Hot-Swapping Information
Note: This device cannot be Hot Swapped.

BX-xADxDA-1 Combination Analog Current Input/Output, continued

Analog Current Sinking Input Specifications		
	BX-2AD2DA-1	BX-4AD2DA-1
Inputs per Module	2	4
Commons	1	
Module Signal Input Range	0–20mA, 4–20mA (Default)	
Signal Resolution	16-bit, 15-bit (Default)	
Resolution Value of LSB	See Data Range Specifications table	
Input Impedance	256Ω±0.1%, 1/10th watt	
All Channel Update Rate	30ms	45ms
Maximum Continuous Overload	±28mA	
Sample Duration Time	100µs per channel	
Hardware Filter Characteristics	Low Pass 2nd order, −3dB @ 15kHz	
Conversion Method	Successive Approximation	
Linearity Error (end to end)	±0.09% of range	
Input Stability and Repeatability	±0.05% of range (after 10 min. warmup)	
Full Scale Calibration Error	±0.1% of range	
Offset Calibration Error	±0.1% of range	
Accuracy vs. Temperature	±25PPM/ºC maximum	
Maximum Inaccuracy	0.1% of range (incl. Temperature Drift)	
Maximum Crosstalk	−90dB, 1 LSB	
Channel to Backplane Isolation	1800VAC applied for one second	
Channel to Channel Isolation	None	

Analog Current Source Output Specifications		
	BX-2AD2DA-1	BX-4AD2DA-1
Outputs per Module	2	2
Commons	1	
Module Signal Output Range	0–20mA, 4–20mA (Default)	
Signal Resolution	16-bit, 15-bit (Default)	
Resolution Value of LSB	See Data Range Specifications table	
Output Type	Current Sourcing up to 20mA	
Output Value in Fault Mode	0mA in 0–20mA mode, 4mA in 4–20mA mode	
Maximum Load Impedance	700Ω	
Maximum Capacitive Load	1000pF	
Allowed Load Type	Grounded	
Maximum Continuous Overload	30mA	
All Channel Update Rate	2.5 ms per enabled channel	
Maximum Inaccuracy	±0.1% of range	
Maximum Full Scale Calibration Error	±0.08% of range	
Maximum Offset Calibration Error	±0.08% of range	
Conversion Method	Successive Approximation	
Accuracy vs. Temperature	±25PPM/ºC maximum	
Maximum Crosstalk	+10µV	
Linearity Error (end to end)	±0.08% of range	
Output Stability and Repeatability	±0.03% of full range after 10 minute warmup (typical)	
Output Ripple	±0.03% of range/mA	
Output Settling Time	350µs	
Channel to Backplane Isolation	1800VAC applied for one second	
Channel to Channel Isolation	None	

BX-xADxDA-1 Combination Analog Current Input/Output, continued

Module General Specifications		
	BX-2AD2DA-1	BX-4AD2DA-1
Weight	110g (3.9 oz)	
Heat Dissipation	3.75 W Max	
Backplane Power Consumption	0.3 W	
External DC Power Required	Class 2 or LPS power supply 24VDC (±20%) 100mA	
Loop Fusing (External)	Fast-acting 0.032A recommended	
Agency Approvals	UL 61010-1 and UL 61010-2-201 File E139594, Canada and USA CE (EN 61131-2 EMC, EN 61010-1 and EN 61010-2-201 Safety)	
Software Version Required	Do-more! Designer version 2.6 or later	

Data Range Specifications							
Selection	Description	Enable 16 bit Unchecked (15 bit Resolution, Default)			Enable 16 bit Checked (16 bit Resolution)		
		Raw Counts	Casting*	µA Per Count	Raw Counts	Casting*	µA Per Count
0–20mA	unipolar 0–20mA	0–32767	-	0.61	0–65535	WYn:U	0.31
4–20mA	unipolar 4–20mA	0–32767	-	0.49	0–65535	WYn:U	0.24

For more information on Casting, refer to Help topic DMD0309 in the Do-more! Designer Software.

The module reserves the first 24 bits of unused contiguous space in the X register, aligned to an 8-bit word boundary, for status reporting. Error flags for this module are laid out within its status register space as described in the table below.

Error Flag Specifications								
	MSB							LSB
1st Byte of unused X Registers								
Module Status	-	-	-	-	Data Not Valid (Out)	Data Not Valid (In)	Missing 24VDC	Self Test Failed
2nd Byte of unused X Registers								
Channel Open (Broken Transmitter)*	-	-	-	-	Channel 4	Channel 3	Channel 2	Channel 1
3rd Byte of unused X Registers								
Unused	-	-	-	-	-	-	-	-

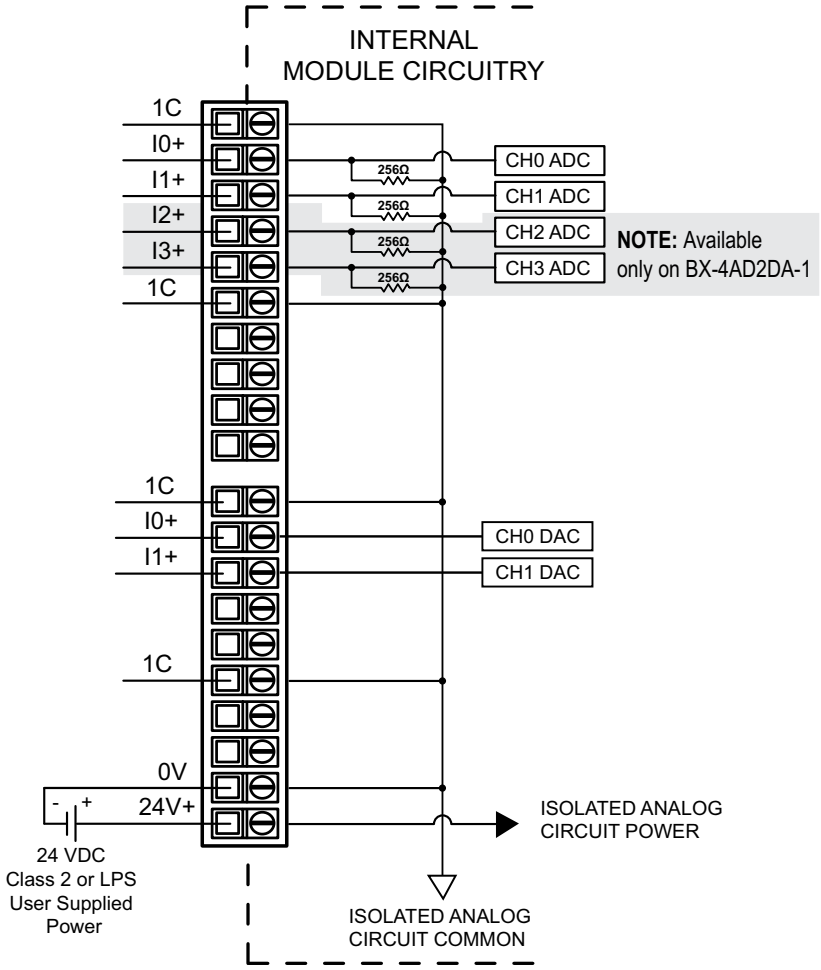
Input channels. 4–20mA mode only. Broken Transmitter bits will turn on below ~3.75 mA.



***NOTE:** The Data Not Valid flag should always be tested and confirmed to be in the "Off" state in your PLC program before reading from or writing to the analog module.*

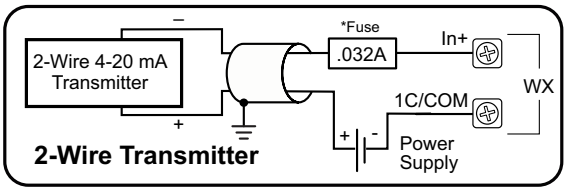
BX-xADxDA-1 Combination Analog Current Input/Output, continued

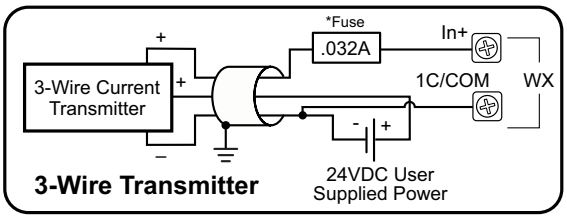
Analog Current Input/Output Wiring

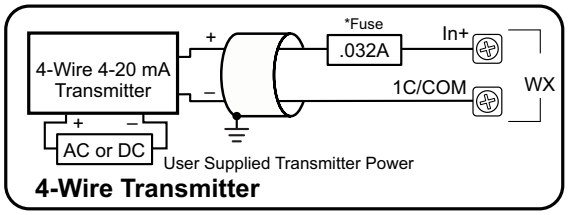


Analog Current Sinking Input Circuits

*An Edison S500-32-R 0.032A fast-acting fuse is recommended for all analog voltage inputs, analog outputs, and current loops.

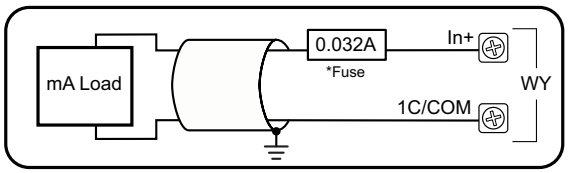






NOTE: Shield should be connected only at one end, to ground at the source device.

Analog Current Source Output

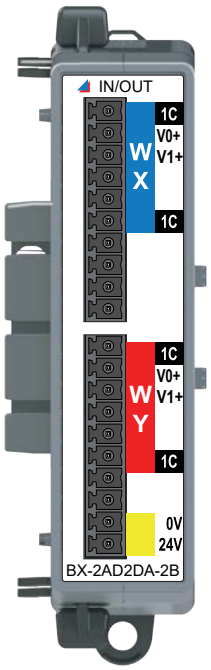


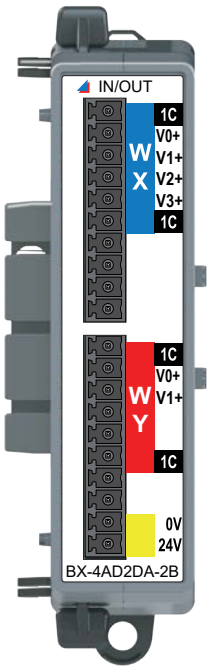
*An Edison S500-32-R 0.032A fast-acting fuse is recommended for all analog voltage inputs, analog outputs, and current loops.

NOTE: Shield should be connected only at one end, to ground at the source device.

BX-xADxDA-2B Combination Analog Voltage Input/Output

The BX-xADxDA-2B Combination Analog Voltage Input/Output Expansion Modules provide two (2) or four (4) points voltage inputs and two (2) voltage outputs.





Terminal Blocks or *ZIP*Link Cables Sold Separately

BX-2AD2DA-2B

Combination Analog Module
2 Channels In, 2 Channels Out
±10 VDC, ±5 VDC, 0–5 VDC, 0–10 VDC

BX-4AD2DA-2B

Combination Analog Module
4 Channels In, 2 Channels Out
±10 VDC, ±5 VDC, 0–5 VDC, 0–10 VDC

We recommend using prewired *ZIP*Link cables and connection modules.
If you wish to hand-wire your module, a removable terminal block is available. See Wiring Termination Selection in this chapter for all options.

IMPORTANT!

Hot-Swapping Information
Note: This device cannot be Hot Swapped.

BX-xADxDA-2B Combination Analog Voltage Input/Output, continued

Analog Voltage Input Specifications		
	BX-2AD2DA-2B	BX-4AD2DA-2B
Inputs per Module	2	4
Commons	1	
Module Signal Input Range	±10 VDC, ±5 VDC, 0–5 VDC, 0–10 VDC (Default)	
Signal Resolution	16-bit, 15 bit (Default)	
Resolution Value of LSB	See Data Range Specifications table	
Input Impedance	>1MΩ	
All Channel Update Rate	30ms	45ms
Maximum Continuous Overload	15mA	
Sample Duration Time	100µs per channel	
Hardware Filter Characteristics	Low Pass 2nd order, −3dB @ 15kHz	
Conversion Method	Successive Approximation	
Accuracy vs. Temperature	±25PPM/°C maximum	
Maximum Inaccuracy	0.15% of full range (over temp)	
Linearity Error (end to end)	±0.09% of range	
Input Stability and Repeatability	±0.06% of range (after 10 min. warmup)	
Full Scale Calibration Error	±0.1% of range	
Offset Calibration Error	±0.1% of range	
Maximum Crosstalk	−90dB, 1 LSB	
Channel to Backplane Isolation	1800VAC applied for one second	
Channel to Channel Isolation	None	

Analog Voltage Output Specifications		
	BX-2AD2DA-2B	BX-4AD2DA-2B
Outputs per Module	2	2
Commons	1	
Module Signal Output Range	±10 VDC, ±5 VDC, 0–5 VDC, 0–10 VDC (Default)	
Signal Resolution	16-bit, 15-bit (Default)	
Resolution Value of LSB	See Data Range Specifications table	
Output Type	Voltage outputs sourcing/sinking at 10mA	
Output Value in Fault Mode	Voltage outputs 0V (unipolar or bipolar)	
Maximum Load Impedance	1kΩ	
Maximum Capacitive Load	1000pF	
Allowed Load Type	Grounded	
Maximum Continuous Overload	15mA	
All Channel Update Rate	2.5 ms per enabled channel	
Maximum Inaccuracy	±0.2% of range	
Maximum Full Scale Calibration Error	±0.08% of range	
Maximum Offset Calibration Error	±0.04% of range	
Conversion Method	Successive Approximation	
Accuracy vs. Temperature	±25PPM/ºC maximum	
Maximum Crosstalk	+3µV	
Linearity Error (end to end)	±0.04% of range	
Output Stability and Repeatability	±0.03% of full range after 10 minute warmup (typical)	
Output Ripple	150µV/mA	
Output Settling Time	200µs	
Channel to Backplane Isolation	1800VAC applied for one second	
Channel to Channel Isolation	None	

BX-xADxDA-2B Combination Analog Voltage Input/Output, continued

Module General Specifications		
	BX-2AD2DA-2B	BX-4AD2DA-2B
Weight	98g (3.4 oz)	
Heat Dissipation	0.3 W Max	
Backplane Power Consumption	0.1 W	0.3 W
External DC Power Required	Class 2 or LPS power supply 24VDC (±20%) 50mA	
Loop Fusing (External)	Fast-acting 0.032A recommended	
Agency Approvals	UL 61010-1 and UL 61010-2-201 File E139594, Canada and USA CE (EN 61131-2 EMC, EN 61010-1 and EN 61010-2-201 Safety)	
Software Version Required	Do-more! Designer version 2.6 or later	

Data Range Specifications							
Selection	Description	Enable 16 bit Unchecked (15 bit Resolution, Default)[1]			Enable 16 bit Checked (16 bit Resolution)		
		Raw Counts	Casting[2]	µV Per Count	Raw Counts	Casting[2]	µV Per Count
0–10V	unipolar 10VDC	0–32767	-	305	0–65535	WYn:U	152
0–5V	unipolar 5VDC	0–32767	-	152	0–65535	WYn:U	76
±10V	bipolar 10VDC	-	-		−32768 to 32767	-	305
±5V	bipolar 5VDC	-	-		−32768 to 32767	-	152

1. Bipolar ranges default to 16-bit resolution.

2. For more information on Casting, refer to Help topic DMD0309 in the Do-more! Designer Software.

The module reserves the first 24 bits of unused contiguous space in the X register, aligned to an 8-bit word boundary, for status reporting. Error flags for this module are laid out within its status register space as described in the table below.

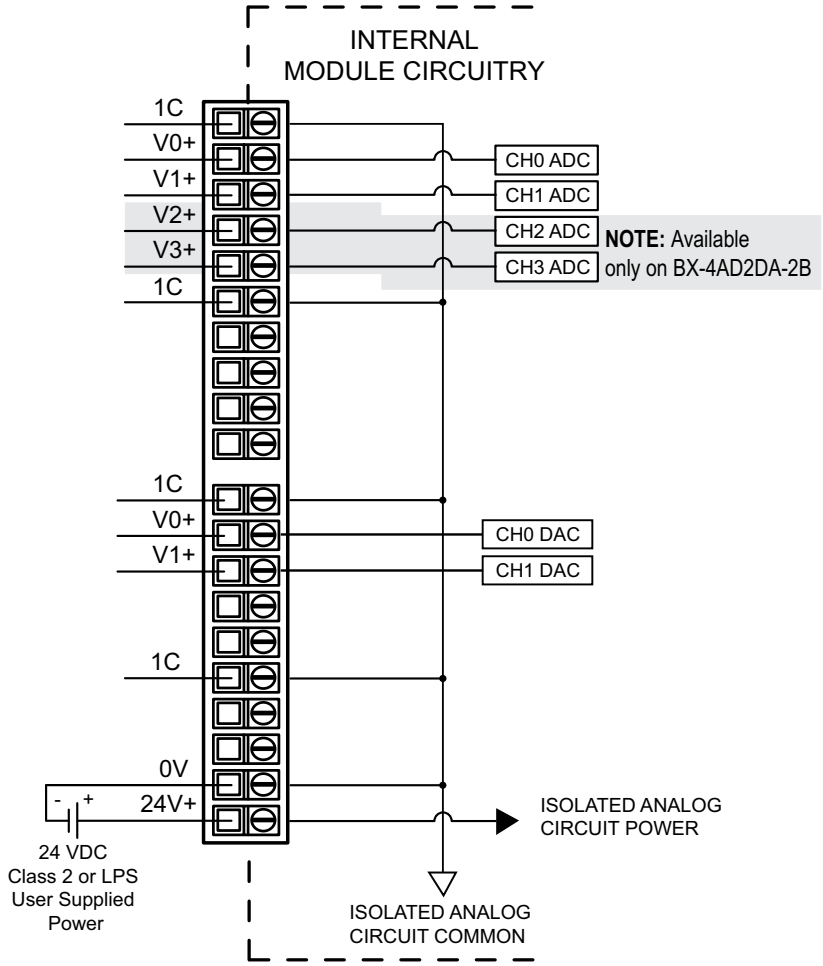
Error Flag Specifications								
	MSB							LSB
1st Byte of unused X Registers								
Module Status	-	-	-	-	Data Not Valid (Out)	Data Not Valid (In)	Missing 24VDC	Self Test Failed
2nd Byte of unused X Registers								
Channel Out of Range*	-	-	-	-	Channel 4	Channel 3	Channel 2	Channel 1
3rd Byte of unused X Registers								
Unused	-	-	-	-	-	-	-	-

**** Input channels.***

NOTE: *The Data Not Valid flag should always be tested and confirmed to be in the "Off" state in your PLC program before reading from or writing to the analog module.*

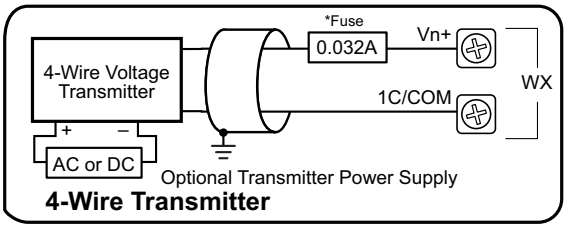
BX-xADxDA-2B Combination Analog Voltage Input/Output, continued

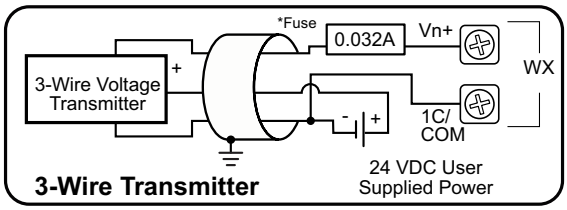
Analog Voltage Input/Output Wiring



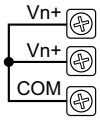
Analog Voltage Input Circuits

*An Edison S500-32-R 0.032A fast-acting fuse is recommended for all analog voltage inputs, analog outputs, and current loops.



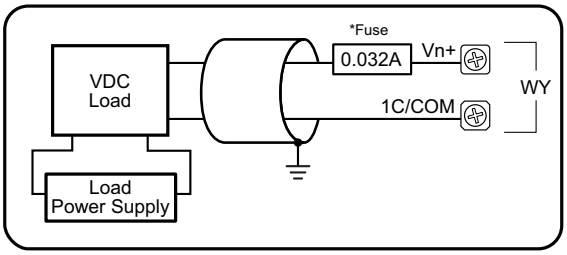


NOTE: For maximum accuracy, jumper unused inputs to common.



NOTE: Shield should be connected only at one end, to ground at the source device.

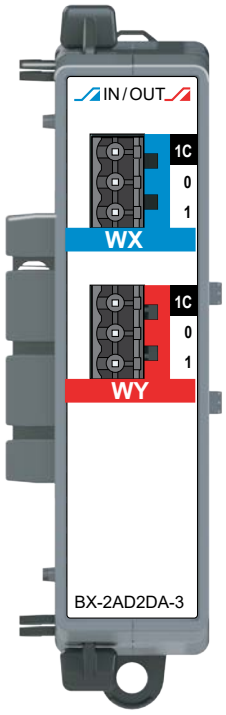
Analog Voltage Output Circuit

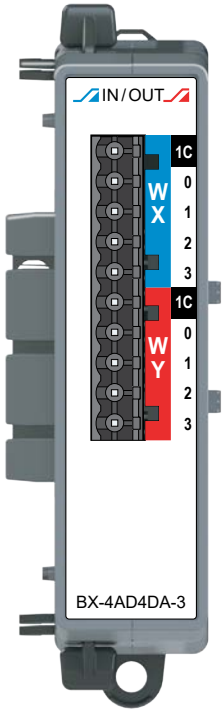


*An Edison S500-32-R 0.032A fast-acting fuse is recommended for all analog voltage inputs, analog outputs, and current loops.

NOTE: Shield should be connected only at one end, to ground at the source device.

BX-xADxDA-3 Universal Combination Analog Input/Output





BX-2AD2DA-3

Combination Analog Module
2 Channels In, 2 Channels Out
0–20mA/4–20mA, Sink/Source
±10 VDC, ±5 VDC,
0–5 VDC, 0–10 VDC

BX-4AD4DA-3

Combination Analog Module
4 Channels In, 4 Channels Out
0–20mA/4–20mA, Sink/Source
±10 VDC, ±5 VDC,
0–5 VDC, 0–10 VDC

Terminal Blocks or *ZIP*Link Cables Sold Separately



We recommend using prewired ***ZIP***Link cables and connection modules. If you wish to hand-wire your module, a removable terminal block is available. See Wiring Termination Selection in this chapter for all options.

IMPORTANT!



Hot-Swapping Information
Note: This device cannot be Hot Swapped.

Analog Universal Current/Voltage Input Specifications

	BX-2AD2DA-3	BX-4AD4DA-3
Inputs per Module	2	4
Commons	1	
Module Signal Input Range	0–20mA, 4–20mA, ±20mA ±10 VDC, ±5 VDC, 0–5 VDC (Default), 0–10 VDC	
Signal Resolution	16-bit at ±10V or ±20mA*	
Resolution Value of LSB	See Data Range Specifications table	
Input Impedance	Current Input: 249Ω Voltage Input: 100kΩ	
All Channel Update Rate	1.2 ms	
Over Current Circuit Detection Time	< 1second	
Maximum Continuous Overload	±40mA current mode, ±20V voltage mode	
Sample Duration Time	1.2 ms	
Hardware Filter Characteristics	Active Low Pass, −3dB @ 1kHz	
Conversion Method	Delta Sigma	
Linearity Error (end to end)	±0.1% of HW full scale (65 counts)	
Input Stability and Repeatability (after 10 min. warmup)	±0.02% of HW full scale (13 counts)	
Full Scale Calibration Error	±0.1% of HW full scale (65 counts)	
Offset Calibration Error	±0.05% of HW full scale (32 counts)	
Accuracy vs. Temperature	±25PPM / °C maximum	
Maximum Inaccuracy	±0.2% of HW full scale (130 counts)	
Maximum Crosstalk	1 count	
Channel to Backplane Isolation	1800VAC applied for one second	
Channel to Channel Isolation	None	
Loop Fusing (External)	Fast-acting 0.032A recommended	

**** 16-bit resolution is only available when a bipolar input range is selected.***

BX-xADxDA-3 Universal Combination Analog Input/Output, continued

Analog Universal Current/Voltage Output Specifications		
	BX-2AD2DA-3	BX-4AD4DA-3
Outputs per Module	2	4
Commons	1	
Module Signal Output Range	0–20mA, 4–20mA, ±20mA ±10VDC, ±5VDC, 0–5VDC (Default), 0–10VDC	
Signal Resolution	16-bit at ±10V or ±20mA*	
Resolution Value of LSB	See Data Range Specifications table	
Output Type	Current Sinking/Sourcing up to 5V Voltage outputs Sinking/Sourcing at 10mA (example 10V @ 1kΩ load).	
Output Value in Fault Mode	Current outputs ~0mA Voltage outputs 0V (Unipolar or Bipolar)	
Minimum Load Impedance	1kΩ	
Maximum Current Load Impedance	500Ω	
Allowed Load Type	Grounded	
Maximum Continuous Overload	Indefinitely	
All Channel Update Rate	1.0 ms	
Maximum Inaccuracy	±0.1% of HW full scale (65 counts)	
Maximum Full Scale Calibration Error	±0.1% of HW full scale (65 counts)	
Conversion Method	Amplified Divide-by-2 Resistor String	
Linearity Error (end to end)	±0.1% of HW full scale (65 counts)	
Output Stability and Repeatability	±0.02% of HW full scale (12 counts) after 10 min. warmup	
Output Settling Time	10µs	
Channel to Backplane Isolation	1800VAC applied for one second	
Channel to Channel Isolation	None	
Loop Fusing (External)	Fast-acting 0.032A recommended	

**** 16-bit resolution is only available when a bipolar output range is selected.***

Analog Universal Current/Voltage General Specifications		
	BX-2AD2DA-3	BX-4AD4DA-3
Backplane Power Consumption	2.5 W	3.75 W
Heat Dissipation	2.5 W	4.0 W
Weight	98g [3.5 oz]	
Agency Approvals	UL 61010-2 File E185989, Canada and USA	
Software Version Required (Do-more! Designer Programming Software)	2.7 or later	

BX-xADxDA-3 Universal Combination Analog Input/Output, continued

Data Range Specifications				
Selection	**Description**	**Raw Counts**	**Casting[1]**	**Per Count**
−20–20mA	bipolar −20 to 20mA	−32768 to 32767	-	0.61 µA
4–20mA	unipolar 4–20mA	6553 to 32767	-	0.61 µA
0–10V	unipolar 10VDC	0–32767	-	305 µV
0–5V	unipolar 5VDC	0–32767	-	153 µV
±10V	bipolar 10VDC	−32768 to 32767	-	305 µV
±5V	bipolar 5VDC	−32768 to 32767	-	153 µV

1. For more information on Casting, refer to Help topic DMD0309 in the Do-more! Designer Software.

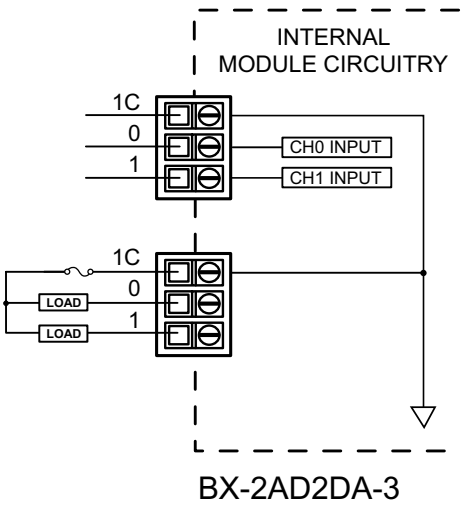
The module reserves the first 8 bits of unused contiguous space in the X register, aligned to an 8-bit word boundary, for status reporting. Error flags for this module are laid out within its status register space as described in the table below.

Error Flag Specifications								
	MSB							**LSB**
1st Byte of unused X Registers								
Out of Range	-	-	-	-	Input Channel 4	Input Channel 3	Input Channel 2	Input Channel 1

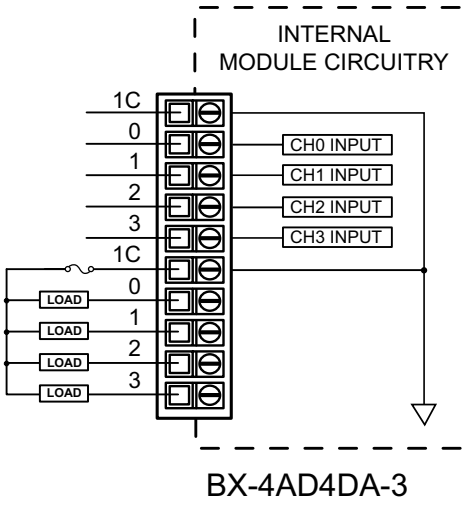
Channel Bit Error Flag is set when a channel's input signal meets the conditions in the table below.

Channel Bit Error Conditions	
Selected Data Range	**Error Condition**
−20–20mA	< −20.0 mA or > 20.0 mA
4–20mA	< 2.0 mA (i.e., Broken Transmitter, no upper error condition for 4–20mA)
0–10V	< −0.05 V or > 10.0 V
0–5V	< −0.05 V or > 5.05 V
±10V	< −10.0 V or > 10.0 V
±5V	< −5.05 V or > 5.05 V

Analog Input/Output Wiring



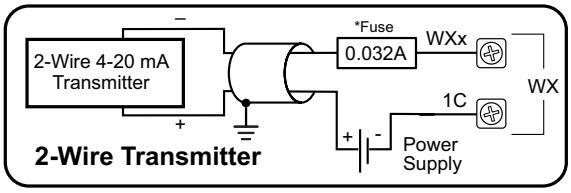
BX-2AD2DA-3

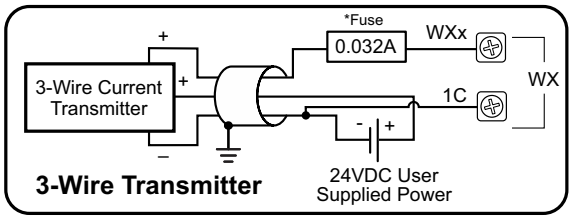


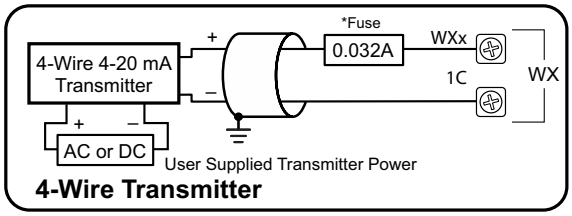
BX-4AD4DA-3

BX-xADxDA-3 Universal Combination Analog Input/Output, continued

Analog Current Sinking Input Circuits

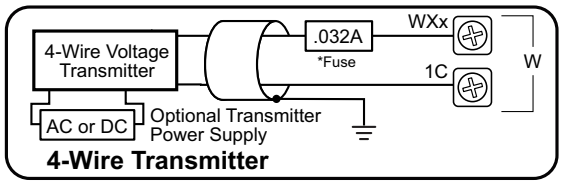


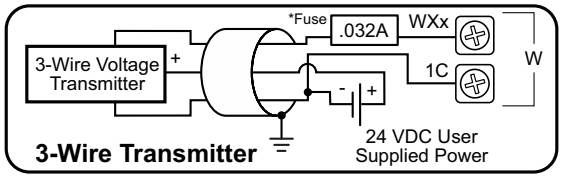




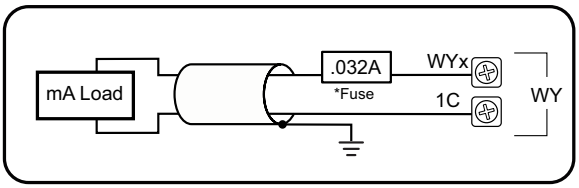
*NOTE: An Edison S500-32-R 0.032A fast-acting fuse is recommended for all analog voltage inputs, analog outputs, and current loops.

Analog Voltage Input Circuits

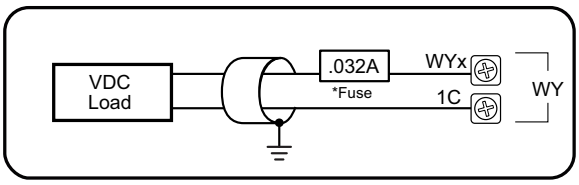




Analog Current Source Output Circuit



Analog Voltage Output Circuit



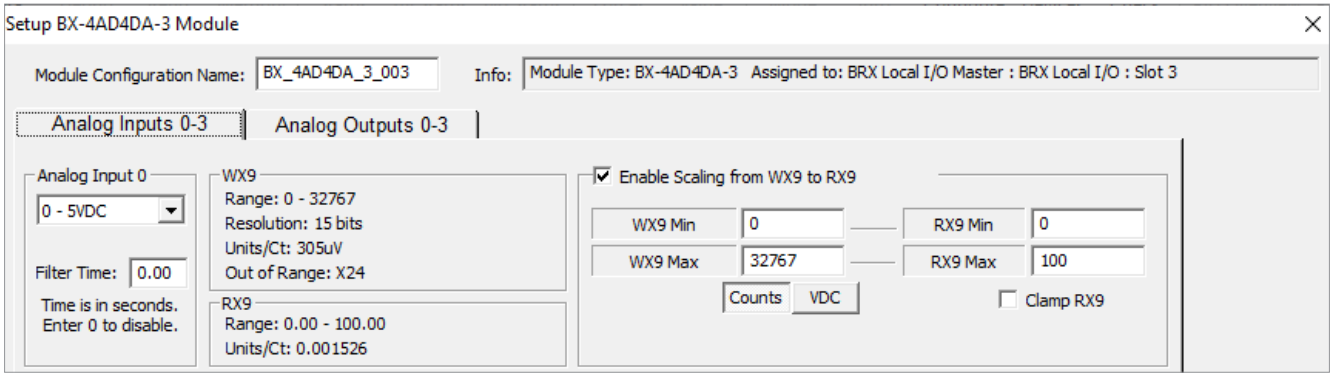
NOTE: Shield should be connected only at one end, to ground at the source device.

*An Edison S500-32-R 0.032A fast-acting fuse is recommended for all analog voltage inputs, analog outputs, and current loops.

BX-xADxDA-3 Universal Combination Analog Input/Output, continued

Software Setup

After the module is installed, open the Do-more! Designer programming software, connect to the BRX MPU and open the Configure Module dialog as described at the beginning of this chapter.



The module options are divided into subsets across multiple tabs. Click the appropriate tab to edit the configuration.

1. ***Analog Input x***

   These settings are for each channel of the analog module.

   Drop-down menu – Select the range of the analog input here.

   Filter Time – Time to average the Analog signal in seconds.

2. ***WXx***

   Range – The number of Raw counts for the selected channel on the module.

   Units/Ct – The amount of voltage that will equal 1 raw count.

   Out of Range – The input register that, when On, will indicate that the voltage is outside of the selected range.

3. ***RXx***

   Range – The engineering units to which the raw counts are scaled.

   Units/Ct – The number of raw counts that will equal 1 scaled engineering unit.

4. ***Enable Scaling from WXx to RXx***

   WXx Min – The minimum value of the raw counts to scale.

   WXx Max – The maximum value of the raw counts to scale.

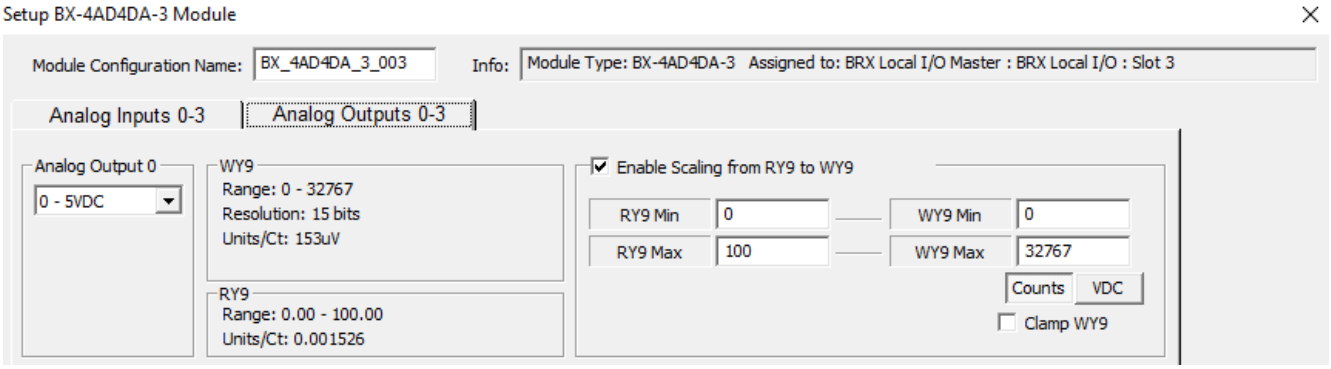
   RXx Min – The minimum value of the engineering units for scaling.

   RXx Max – The maximum value of the engineering units for scaling.

   Counts/VDC – Use these buttons to change the raw scaling to counts or volts.

   Clamp RXx – If this box is checked, RXx will clamp at the minimum and maximum scaled values.

BX-xADxDA-3 Universal Combination Analog Input/Output, continued



1. ***Analog Output x***

   These settings are for each channel of the analog module.

   Drop-down menu - Select the range of the analog input here.

2. ***WXx***

   Range – The number of Raw counts for the selected channel on the module.

   Units/Ct – The amount of current that will equal 1 raw count.

3. ***RXx***

   Range – The engineering units to which the raw counts are scaled.

   Units/Ct – The number of raw counts that will equal 1 scaled engineering unit.

4. ***Enable Scaling from WYx to RYx***

   RYx Min – The minimum value of the engineering units for scaling.

   RYx Max – The maximum value of the engineering units for scaling.

   WYx Min – The minimum value of the raw counts to scale.

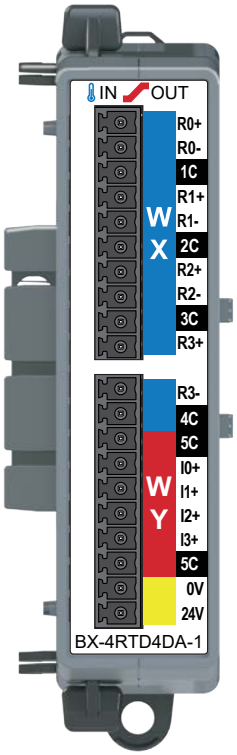
   WYx Max – The maximum value of the raw counts to scale.

   Counts/VDC – Use these buttons to change the raw scaling to counts or milliamps.

   Clamp WYx – If this box is checked, WYx will clamp at the minimum and maximum scaled values.

BX-4RTD4DA-1 Combination RTD Input/Current Output

The 4RTD4DA-1 Combination RTD Input/Current Output Expansion Module provides four (4) resistance temperature detector inputs and four (4) current sourcing outputs.



BX-4RTD4DA-1

RTD Temperature Input/
Analog Output Expansion Module
4-pt RTD Temperature Input
4-pt Universal Analog Output

BX-RTB10 Terminal Blocks Included. The BX-RTB10-1 or BX-RTB10-2 can also be used and can be purchased separately.

RTD Input Specifications	
Input Channels	4 Differential
Commons	4
Resolution	16-bit, 0.1°(C or F) See Data Range Specifications table
Input Ranges (RTD Types)	Pt100: −200° to 850°C (−328° to 1562°F) (Default) Pt1000: −200° to 595°C (−328° to 1103°F) JPt100: −100° to 450°C (−148° to 842°F) 10Ω Cu: −200° to 260°C (−328° to 500°F) ±3°C 25Ω Cu: −200° to 260°C (−328° to 500°F) ±3°C 120Ω Ni: −80° to 260°C (−112° to 500°F)
Resistance Input Ranges	0 – 10,000 Ω 0 – 6,250 Ω 0 – 3,125 Ω 0 – 1,562.5 Ω 0 – 781.2 Ω 0 – 390.6 Ω 0 – 195.3 Ω
Excitation Current	210µA
RTD Linearization	Automatic
Accuracy vs. Temperature	±10 ppm per °C (maximum)
Full Scale Calibration	±1°C
Offset Calibration Error	±1°C (±3°C for 10Ω/25Ω Cu)
Maximum Inaccuracy	±1°C (±3°C for 10Ω/25Ω Cu maximum) (excluding RTD error) (including temperature drift)
Warmup Time	2 minutes for ±0.2% repeatability
All Channel Update Rate	Single channel sample duration times the number of enabled channels
Filter Characteristics	Digital filter cutoff frequencies: 16Hz, 470Hz
Sample Duration Time	Dependent on digital filter settings: 125ms@16Hz, 4ms@470Hz
Open Circuit Detection Time	Positive full-scale reading within 2s
Maximum Ratings	Fault protected inputs to ±50V
Max. Common Mode Voltage	4VDC
Common Mode Rejection	−90dB @ DC, −150dB @ 50/60Hz
Conversion Method	Sigma-Delta

***NOTE:** This device does not support ZIPLink Wiring Systems.*

IMPORTANT!

Hot-Swapping Information
Note: This device cannot be Hot Swapped.

BX-4RTD4DA-1 Combination RTD Input/Current Output, continued

Analog Current Source Output Specifications	
Outputs per Module	4
Commons	1
Module Signal Output Range	0–20mA, 4–20mA (Default)
Signal Resolution	16-bit, 15-bit (Default)
Resolution Value of LSB	See Data Range Specifications table
Output Type	Current Sourcing up to 20mA
Output Value in Fault Mode	0mA in 0–20mA mode, 4mA in 4–20mA mode
Maximum Load Impedance	700Ω
Maximum Capacitive Load	1000pF
Allowed Load Type	Grounded
Maximum Continuous Overload	30mA
All Channel Update Rate	2.5 ms per enabled channel
Maximum Inaccuracy	±0.1% of range
Maximum Full Scale Calibration Error	±0.08% of range
Maximum Offset Calibration Error	±0.08% of range
Conversion Method	Successive approximation
Accuracy vs. Temperature	±25PPM/ºC maximum
Maximum Crosstalk	+10µV
Linearity Error (end to end)	±0.08% of range
Output Stability and Repeatability	±0.03% of full range after 10 minute warmup (typical)
Output Ripple	±0.03% of range/mA
Output Settling Time	320µs
Channel to Backplane Isolation	1800VAC applied for one second
Channel to Channel Isolation	None
Loop Fusing (External)	Fast-acting 0.032A recommended

Module General Specifications	
Weight	110g (3.9 oz)
Heat Dissipation	3W Max
Backplane Power Consumption	0.1 W
External DC Power Required	Class 2 or LPS power supply 24VDC (±20%) 125mA
Agency Approvals	UL 61010-1 and UL 61010-2-201 File E139594, Canada and USA CE (EN 61131-2 EMC, EN 61010-1 and EN 61010-2-201 Safety)
Software Version Required	Do-more! Designer version 2.6 or later

BX-4RTD4DA-1 Combination RTD Input/Current Output, continued

Data Range Specifications		
Selection	**Description**	**Raw Counts[1]**
Pt100	Pt100 Platinum RTD	°C: −2000 to 8500 °F: −3280 to 15620
Pt1000	Pt1000 Platinum RTD	°C: −2000 to 5950 °F: −3280 to 11030
JPt100	JPt100 Platinum RTD	°C: −1000 to 4500 °F: −1480 to 8420
10Ω Cu	10Ω Copper RTD	°C: −2000 to 2600 °F: −3280 to 5000
25Ω Cu	25Ω Copper RTD	°C: −2000 to 2600 °F: −3280 to 5000
120Ω Ni	120Ω Nickel RTD	°C: −800 to 2600 °F: −1120 to 5000
0–10,000 Ω		0–10000
0–6,250 Ω		0–6250
0–3,125 Ω		0–3125
0–1,562.5 Ω		0–15625 [2]
0–781.2 Ω		0–7812 [2]
0–390.6 Ω		0–3906 [2]
0–195.3 Ω		0–1953 [2]

1. *Temperatures have one implied decimal place (e.g., raw count of -1900 is -190.0°).*
2. *Certain resistance ranges have one implied decimal place (e.g., raw count of 7812 is 781.2 Ω).*

The module reserves the first 24 bits of unused contiguous space in the X register, aligned to an 8-bit word boundary, for status reporting. Error flags for this module are laid out within its status register space as described in the table below.

Error Flag Specifications								
	MSB							**LSB**
1st Byte of unused X Registers								
Module Status	-	-	-	-	-	Data Not Valid	Missing 24VDC	Self Test Failed
2nd Byte of unused X Registers								
Channel Out of Range*	-	-	-	-	Channel 4	Channel 3	Channel 2	Channel 1
3rd Byte of unused X Registers								
Burn Out**	-	-	-	-	Channel 4	Channel 3	Channel 2	Channel 1

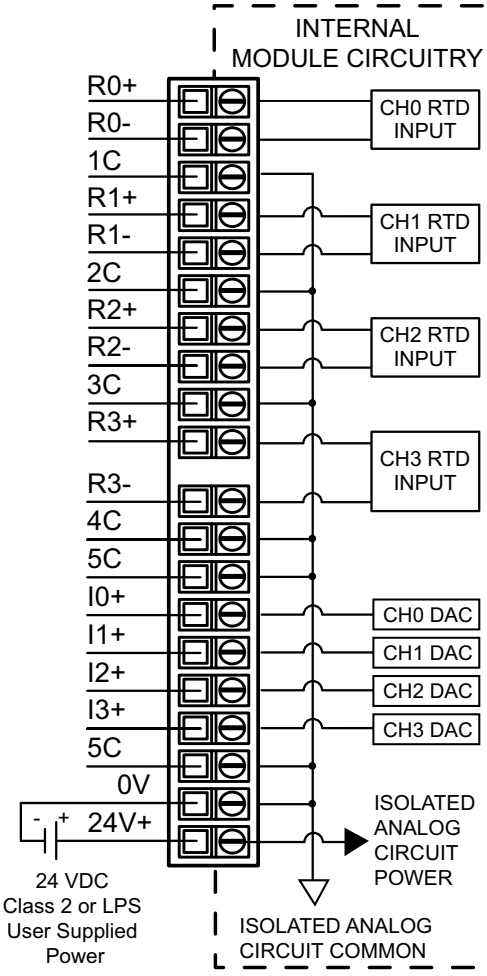
** Input channels.*
*** Output channels.*



NOTE: *The Data Not Valid flag should always be tested and confirmed to be in the "Off" state in your PLC program before reading from or writing to the analog module.*

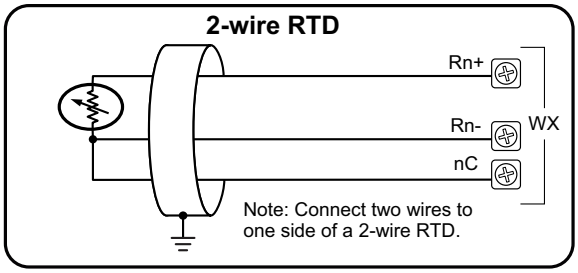
BBX-4RTD4DA-1 Combination RTD Input/Current Output, continued

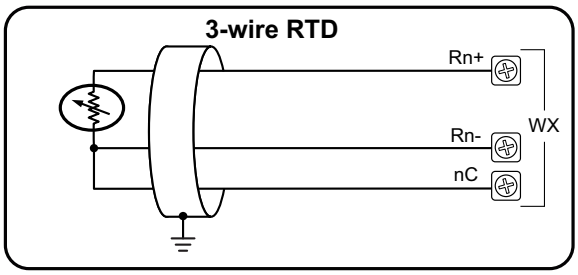
Analog RTD/Resistance Input and Current Output Wiring

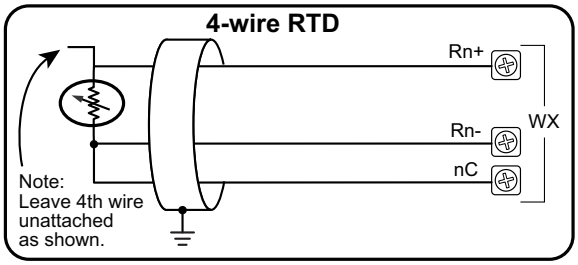


BX-4RTD4DA-1 Combination RTD Input/Current Output, continued

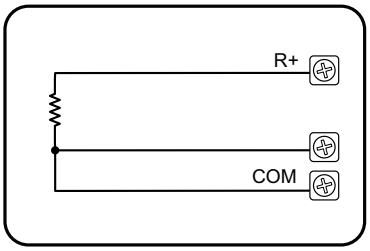
RTD Input Circuits





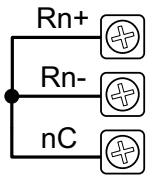


Resistance Input

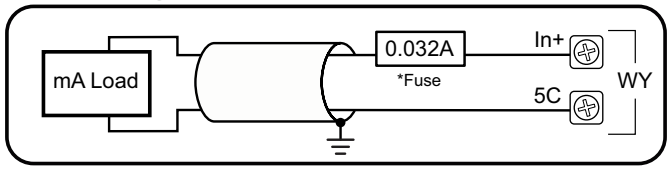


Notes for maximum accuracy:

1. For 2-wire RTD, attach a third wire to module common.
2. R+, R-, and COM wires to an RTD must be equal length and type. Refer to RTD manufacturer's recommendations.
3. Do not use cable shield as sensing wire.
4. When applicable, connect shield to RTD common only, otherwise connect to module common only. Do not connect shield to both ends.
5. Jumper unused inputs to common.



Analog Current Source Output

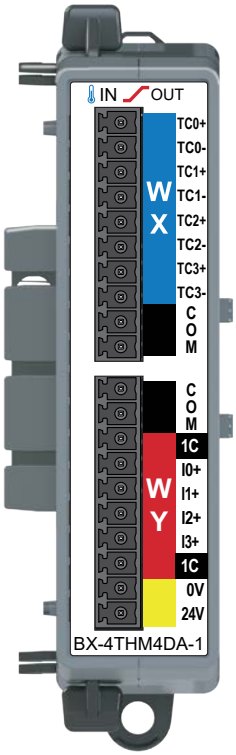


*An Edison S500-32-R 0.032A fast-acting fuse is recommended for all analog voltage inputs, analog outputs, and current loops.

NOTE: Shield should be connected only at one end, to ground at the source device.

BX-4THM4DA-1 Combination Thermocouple Input/Current Output

The 4THM4DA-1 Combination Thermocouple Input/Current Output Expansion Module provides four (4) thermocouple inputs and four (4) current sourcing outputs.



BX-4THM4DA-1

Thermocouple Temperature Input/
Analog Output Expansion Module
4-pt Thermocouple Temperature Input
4-pt Universal Analog Output

BX-RTB10 Terminal Blocks Included. The BX-RTB10-1 or BX-RTB10-2 can also be used and can be purchased separately.

Thermocouple Input Specifications	
Input Channels	4 Differential
Commons	NA
Input Impedance	>1MΩ
Resolution	16-bit, 0.1°(C or F) See Data Range Specifications table
Thermocouple Input Ranges	Type J: −190° to 760°C (−310° to 1400°F) (Default) Type E: −210° to 1000°C (−346° to 1832°F) Type K: −150° to 1372°C (−238° to 2502°F) Type R: 65° to 1768°C (149° to 3214°F) Type S: 65° to 1768°C (149° to 3214°F) Type T: −230° to 400°C (−382° to 752°F) Type B: 529° to 1820°C (984° to 3308°F) Type N: −70° to 1300°C (−94° to 2372°F) Type C: 65° to 2320°C (149° to 4208°F)
Cold Junction Compensation	Automatic
Thermocouple Linearization	Automatic
Accuracy vs. Temperature	±50PPM per °C (maximum)
Maximum Inaccuracy–Temperature	±3°C maximum (excluding thermocouple error) (including temperature drift)
Linear Voltage Input Ranges	0–39mV ±39mV ±78mV 0–156mV ±156mV 0–1.25 V
Maximum Inaccuracy–Voltage	0.06% @ 25°C, 0.10% @ 0–60°C
All Channel Update Rate	1.6 s
Sample Duration Time	270ms
Open Circuit Detection Time	Within 2–10s
Maximum Ratings	Fault protected inputs to ±50V
Common Mode Range	0.6 V (@ 16-bit Resolution)
Common Mode Rejection	100dB @ DC and 130dB @ 60Hz
Conversion Method	Sigma-Delta

***NOTE:** This device does not support ZIPLink Wiring Systems.*

IMPORTANT!

Hot-Swapping Information
Note: This device cannot be Hot Swapped.

BX-4THM4DA-1 Combo Thermocouple Input/Current Output, continued

Analog Current Source Output Specifications	
Outputs per Module	4
Commons	1
Module Signal Output Range	0–20mA, 4–20mA (Default)
Signal Resolution	16-bit, 15-bit (Default)
Resolution Value of LSB	See Data Range Specifications table
Output Type	Current Sourcing up to 20mA
Output Value in Fault Mode	0mA in 0–20mA mode, 4mA in 4–20mA mode
Maximum Load Impedance	700Ω
Maximum Capacitive Load	1000pF
Allowed Load Type	Grounded
Maximum Continuous Overload	30mA
All Channel Update Rate	2.5 ms per enabled channel
Maximum Inaccuracy	±0.1% of range
Maximum Full Scale Calibration Error	±0.08% of range
Maximum Offset Calibration Error	±0.08% of range
Conversion Method	Successive approximation
Accuracy vs. Temperature	±25PPM/ºC maximum
Maximum Crosstalk	+10µV
Linearity Error (end to end)	±0.08% of range
Output Stability and Repeatability	±0.03% of full range after 10 minute warmup (typical)
Output Ripple	±0.03% of range/mA
Output Settling Time	320µs
Channel to Backplane Isolation	1800VAC applied for one second
Channel to Channel Isolation	None
Loop Fusing (External)	Fast-acting 0.032A recommended

Module General Specifications	
Weight	110g (3.9 oz)
Heat Dissipation	3.75 W Max
Backplane Power Consumption	0.3 W
External DC Power Required	Class 2 or LPS power supply 24VDC (±20%) 125mA
Agency Approvals	UL 61010-1 and UL 61010-2-201 File E139594, Canada and USA CE (EN 61131-2 EMC, EN 61010-1 and EN 61010-2-201 Safety)
Software Version Required	Do-more! Designer version 2.6 or later

BX-4THM4DA-1 Combo Thermocouple Input/Current Output, continued

Data Range Specifications							
Selection	Description	Enable 16 bit Unchecked (15 bit Resolution, Default)[1]			Enable 16 bit Checked (16 bit Resolution)		
		Raw Counts	Casting[2]	µV Per Count	Raw Counts[3]	Casting[2]	µV Per Count
Type J	Type J	-	-		°C: −1900 to 7600 °F: −3100 to 14000	-	-
Type E	Type E	-	-		°C: −2100 to 10000 °F: −3460 to 18320	-	-
Type K	Type K	-	-		°C: −1500 to 13720 °F: −2380 to 25020	-	-
Type R	Type R	-	-		°C: 650 to 17680 °F: 1490 to 32140	-	-
Type S	Type S	-	-		°C: 650 to 17680 °F: 1490 to 32140	-	-
Type T	Type T	-	-		°C: −2300 to 4000 °F: −380 to 7520	-	-
Type B	Type B	-	-		°C: 5290 to 18200 °F: 9840 to 33080	- WXn:U	-
Type N	Type N	-	-		°C: −700 to 13000 °F: −940 to 23720	-	-
Type C	Type C	-	-		°C: 650 to 23200 °F: 1490 to 42080	- WXn:U	-
0–39 mVDC	Unipolar 39 mVDC	0–32767	-	1.2	0–65535	WXn:U	0.6
−39–39 mVDC	Bipolar 39 mVDC	-	-		−32768 to 32767	-	1.2
−78–78 mVDC	Bipolar 78 mVDC	-	-		−32768 to 32767	-	2.4
0–156 mVDC	Unipolar 156 mVDC	0–32767	-	4.8	0–65535	WXn:U	2.4
−156–156 mVDC	Bipolar 156 mVDC	-	-		−32768 to 32767	-	4.8
0–1.25 VDC	Unipolar 1.25 VDC	0–32767	-	38.1	0–65535	WXn:U	19.1

1. Thermocouple and bipolar ranges default to 16-bit resolution.
2. For more information on Casting, refer to Help topic DMD0309 in the Do-more! Designer Software.
3. Temperatures have one implied decimal place (e.g., raw count of -1900 is -190.0°).

The module reserves the first 24 bits of unused contiguous space in the X register, aligned to an 8-bit word boundary, for status reporting. Error flags for this module are laid out within its status register space as described in the table below.

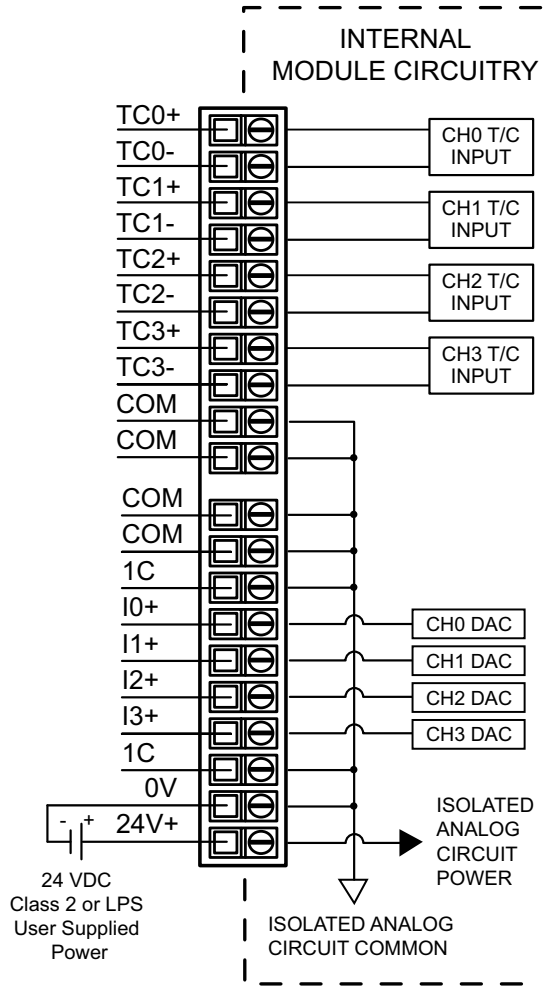
Error Flag Specifications								
	MSB							LSB
1st Byte of unused X Registers								
Module Status	-	-	-	-	Data Not Valid (Out)	Data Not Valid (In)	Missing 24VDC	Self Test Failed
2nd Byte of unused X Registers								
Channel Out of Range*	-	-	-	-	Channel 4	Channel 3	Channel 2	Channel 1
3rd Byte of unused X Registers								
Burn Out**	-	-	-	-	Channel 4	Channel 3	Channel 2	Channel 1

**** Input channels.***
***** Output channels.***

NOTE: *The Data Not Valid flag should always be tested and confirmed to be in the "Off" state in your PLC program before reading from or writing to the analog module.*

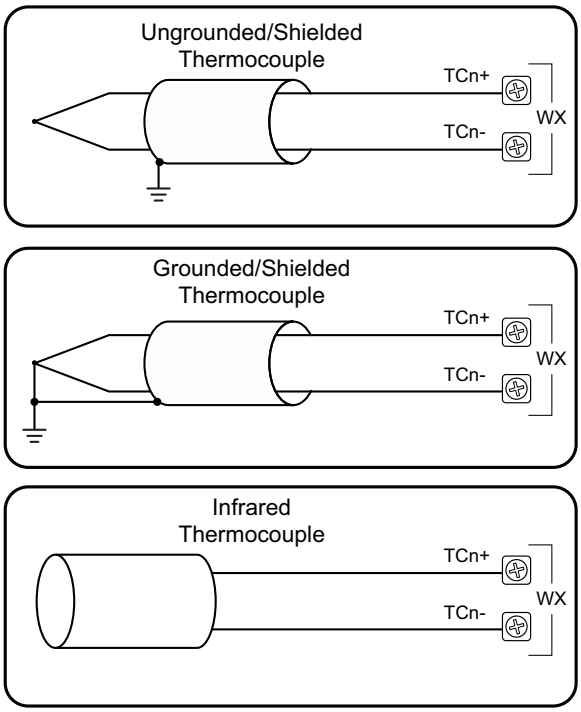
BX-4THM4DA-1 Combo Thermocouple Input/Current Output, continued

Analog Thermocouple/Voltage Input and Current Output Wiring



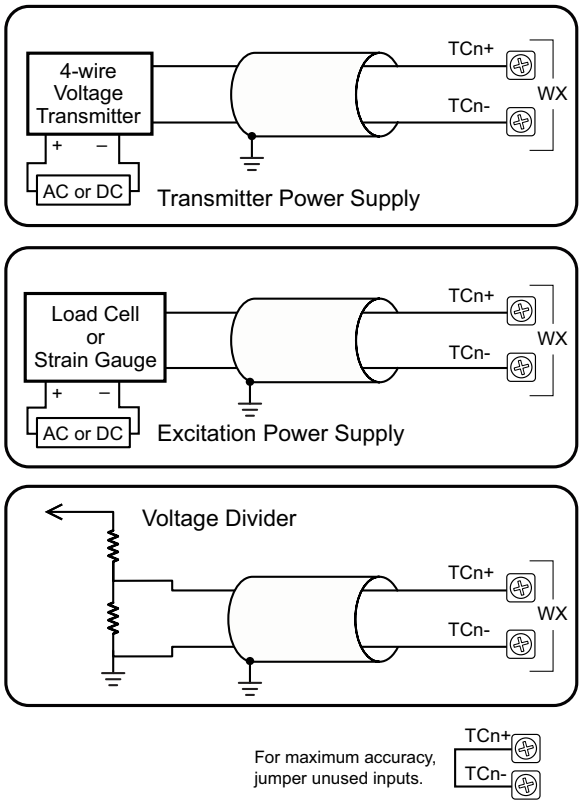
BX-4THM4DA-1 Combo Thermocouple Input/Current Output, continued

Thermocouple Input Circuits



NOTE: Thermocouple extension wire and proper thermocouple terminal blocks must be used to extend thermocouples. AutomationDirect thermocouple wire is recommended.

Analog Voltage Input Circuits



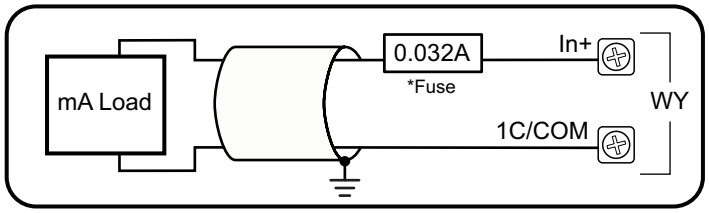
For maximum accuracy, jumper unused inputs.

NOTE: Shield should be connected only at one end, to ground at the source device.



NOTE: *With grounded thermocouples, take precautions to prevent having a voltage potential between thermocouple tips. A voltage of 1.25 V or greater between tips will skew measurements.*

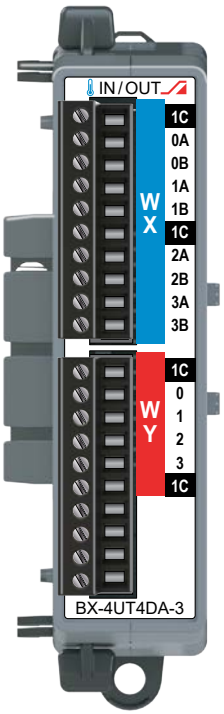
Analog Current Source Output



*An Edison S500-32-R 0.032A fast-acting fuse is recommended for all analog voltage inputs, analog outputs, and current loops.

NOTE: Shield should be connected only at one end, to ground at the source device.

BX-4UT4DA-3 Universal Temperature Input/Analog Output



BX-4UT4DA-3

Universal Temperature Input/
Analog Output Expansion Module
4-pt Universal Temperature Input
4-pt Universal Analog Output

BX-RTB10 Terminal Blocks Included.
The BX-RTB10-1 or BX-RTB10-2 can also be used and can be purchased separately.

NOTE: *This device does not support ZIPLink Wiring Systems.*

IMPORTANT!

Hot-Swapping Information
Note: This device cannot be Hot Swapped.

Universal Temperature Input Specifications	
Input Channels	4 Differential
Commons	1
Input Impedance	>5MΩ
Resolution	24-bit, 0.1°(C or F) See Data Range Specifications table
All Channel Update Rate	1s max (4 thermocouples enabled) 700ms max (4RTD/NTX/mV enabled)
Sample Duration Time	175ms
Open Circuit Detection Time	Within 5s
Maximum Ratings	-0.3 V to +5.3 V, <15mA
Common Mode Range	-0.3 V to +5.3 V
Common Mode Rejection	100dB@DC, 130dB@60Hz
Conversion Method	Sigma-Delta, 24-bit
Thermocouple Parameters	
Thermocouple Input Ranges	Type J: −210° to 1200°C (−346° to 2192°F) Type K: −265° to 1372°C (−445° to 2502°F) Type E: −265° to 1000°C (−445° to 1832°F) Type N: −265° to 1300°C (−445° to 2372°F) Type R: −50° to 1768°C (−58° to 3214°F) Type S: −50° to 1768°C (−58° to 3214°F) Type B: 40° to 1820°C (104° to 3308°F) Type T: −265° to 400°C (−445° to 752°F)
Linear Voltage Input Ranges	−31.25 to 31.25 mVDC −31.25 to 125mVDC −31.25 to 62.5 mVDC 0 to 1.0 VDC
Cold Junction Compensation	Automatic
Thermocouple Linearization	Automatic
Maximum Inaccuracy–Thermocouple	±(0.2°C + 3% of °C reading)
Maximum Inaccuracy–Voltage	±250µV
RTD/Thermistor Parameters	
Input Ranges (RTD Types)	10, 50, 100, 200, 500, 1000Ω Pt Platinum RTD 0.00385 European Curve: −200° to 850°C (−328° to 1562°F) 120Ω Ni N120 Nickel RTD 0.00672 Curve: −80° to 260°C (−112° to 500°F)
Thermistor Input Ranges	2.252 kΩ @ 25°C: −40° to 150°C (−40° to 302°F) 3 kΩ @ 25°C: −40° to 150°C (−40° to 302°F) 5 kΩ @ 25°C: −40° to 150°C (−40° to 302°F) 10k-AN Type 3 @ 25°C: −40° to 150°C (−40° to 302°F) 30 kΩ @ 25°C: −40° to 150°C (−40° to 302°F)
RTD Excitation Current	RTD 10, 100, 120, 200: 1mA RTD 500: 500µA RTD 1000: 250µA
Thermistor Excitation Current	NTC 2.252k, NTC 3k: 10µA NTC 5k, NTC 10k: 5µA NTC 30k: 1µA
RTD/Thermistor Linearization	Automatic
Maximum Inaccuracy	±0.2°C

BX-4UT4DA-3 Universal Temp Input/Analog Output, continued

Analog Universal Current/Voltage Sinking Output Specifications	
	BX-4UT4DA-3
Outputs per Module	4
Commons	1
Module Signal Output Range	0–20mA, 4–20mA, ±20mA, ±10 VDC, ±5 VDC, 0–5 VDC (Default), 0–10 VDC
Signal Resolution	16-bit at ±10V or ±20mA
Resolution Value of LSB	See Data Range Specifications table
Output Type	Current Sinking/Sourcing up to 5V Voltage outputs sourcing/sinking at 10mA (example 10V @ 1kΩ load).
Output Value in Fault Mode	Current outputs ~0mA Voltage outputs 0V (Unipolar or Bipolar)
Minimum Voltage Load Impedance	1kΩ
Maximum Current Load Impedance	250Ω
Allowed Load Type	Grounded
Maximum Continuous Overload	Indefinitely
All Channel Update Rate	1.0 ms
Maximum Inaccuracy	±0.1% of HW full scale (65 counts)
Maximum Full Scale Calibration Error	±0.1% of HW full scale (65 counts)
Conversion Method	Amplified Divide-by-2 Resistor String
Linearity Error (end to end)	±0.1% of HW full scale (65 counts)
Output Stability and Repeatability	±0.02% of full range (12 counts) after 10 min. warmup (typical)
Output Settling Time	10µs
Channel to Backplane Isolation	1800VAC applied for one second
Channel to Channel Isolation	None
Loop Fusing (External)	Fast-acting 0.032A recommended

Module General Specifications	
Weight	98g (3.5 oz)
Heat Dissipation	2.5 W
Backplane Power Consumption	2.65 W
Agency Approvals	UL 61010-2 File E185989, Canada and USA
Software Version Required	Do-more! Designer 2.7 or later

BX-4UT4DA-3 Universal Temp Input/Analog Output, continued

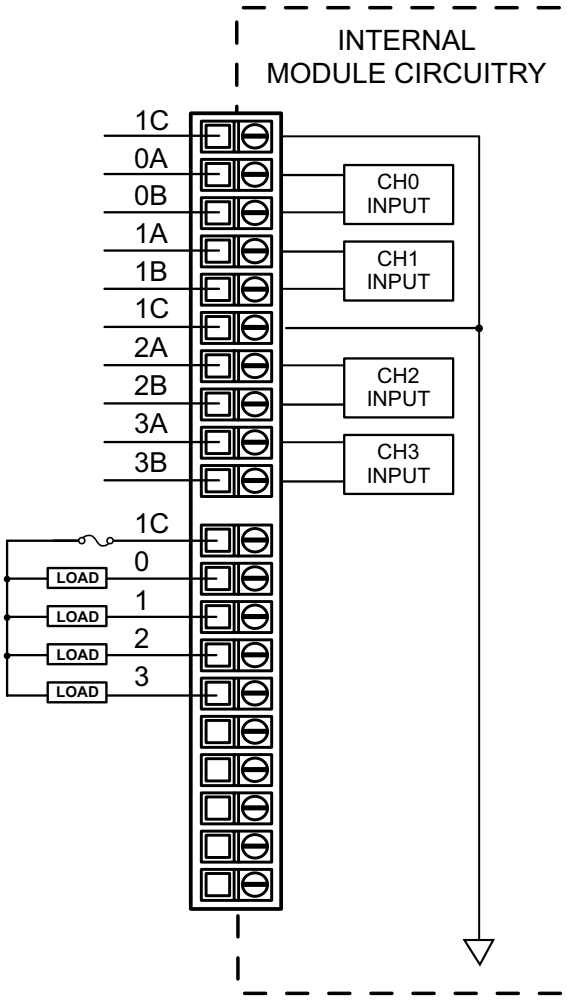
Data Range Specifications			
Thermocouple Selection	**Temperature Range**	**Resolution**	
		WXn	**RXn**
Type J	−210 to 1200 °C −346 to 2192 °F	Degrees x10 (One Implied Decimal)[1]	24-Bit Floating[1]
Type K	−265 to 1372 °C −445 to 2502 °F		
Type E	−265 to 1000 °C −445 to 1832 °F		
Type R	−50 to 1768 °C −58 to 3214 °F		
Type S	−50 to 1768 °C −58 to 3214 °F		
Type B	40 to 1820 °C 104 to 3308 °F [3]		
Type T	−265 to 400 °C −445 to 752 °F		
Voltage Selection	**Voltage Range**	**WXn[2]**	**RXn**
−31.25 to 31.25 mVDC	Bipolar 31.25 mVDC	0.95 µV per count (−32768 to 32767)	User Scaled
−31.25 to 62.5 mVDC	Bipolar 62.5 mVDC	1.9 µV per count (−16384 to 32767)	
−31.25 to 125 mVDC	Bipolar 125 mVDC	3.8 µV per count (−8192 to 32767)	
0 to 1.0 VDC	Unipolar 1.0 VDC	30.5 µV per count (0 to 32767)	
RTD Selection	**Temperature Range**	**WXn**	**RXn**
10, 50, 100, 200, 500, 1000Ω Pt Platinum RTD 0.00385 European Curve	−200 to 850 °C −328 to 1562 °F	Degrees x10 (One Implied Decimal)[1]	24-Bit Floating[1]
120Ω Ni N120 Nickel RTD 0.00672 Curve	−80 to 260 °C −112 to 500 °F		
Thermistor Selection	**Temperature Range**	**WXn**	**RXn**
Thermistor 2.252 kΩ @25°C	−40 to 150 °C −40 to 302 °F	Degrees x10 (One Implied Decimal)[1]	24-Bit Floating[1]
Thermistor 3kΩ @25°C			
Thermistor 5kΩ @25°C			
Thermistor 10k-AN Type 3 @25°C			
Thermistor 30kΩ @25°C			

1. Temperatures reported in rounded integer to WXn and as scaled floating point 24bits resolution to RXn.
2. Raw Counts = −32768 to 32767.
3. Max value displayed in WXn is 32767. RXn will display the full range of 3308.0.

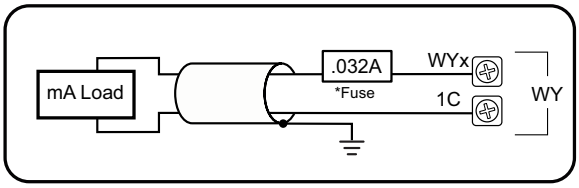
The module reserves the first 8 bits of unused contiguous space in the X register, aligned to an 8-bit word boundary, for status reporting. Error flags for this module are laid out within its status register space as described in the table below.

Error Flag Specifications								
	MSB							**LSB**
1st Byte of unused X Registers								
Module Status	Channel 4 Burnout	Channel 4 Out of Range	Channel 3 Burnout	Channel 3 Out of Range	Channel 2 Burnout	Channel 2 Out of Range	Channel 1 Burnout	Channel 1 Out of Range

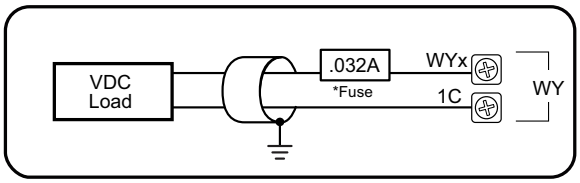
BX-4UT4DA-3 Universal Temp Input/Analog Output, continued



Analog Current Source Output Circuit



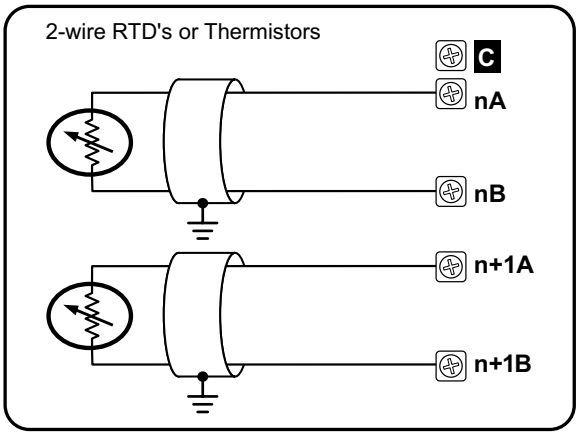
Analog Voltage Output Circuit

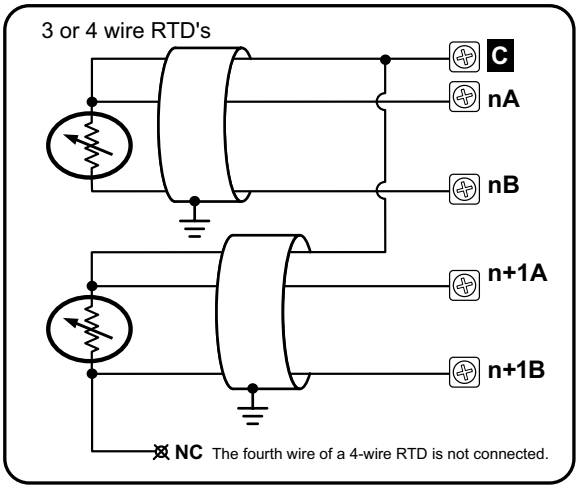


NOTE: Shield should be connected only at one end, to ground at the source device.

*An Edison S500-32-R 0.032A fast-acting fuse is recommended for all analog voltage inputs, analog outputs, and current loops.

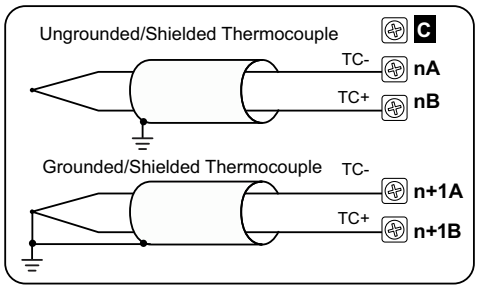
Resistive and Thermistor Sensors



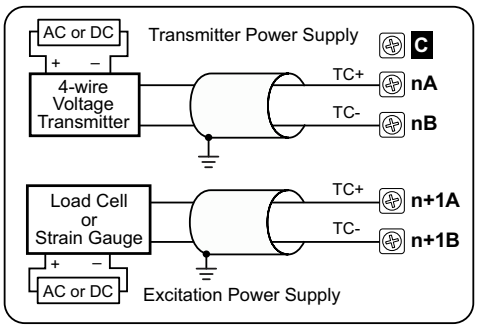


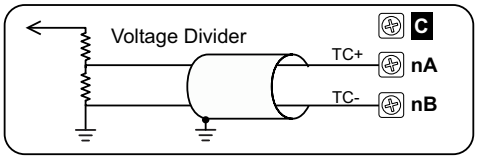
BX-4UT4DA-3 Universal Temp Input/Analog Output, continued

Thermocouple and Voltage Sensors



NOTE: Thermocouple extension wire and proper thermocouple terminal blocks must be used to extend thermocouples. AutomationDirect thermocouple wire is recommended.



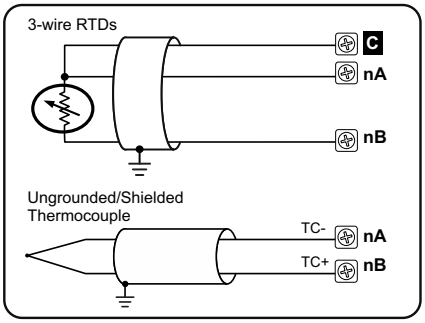


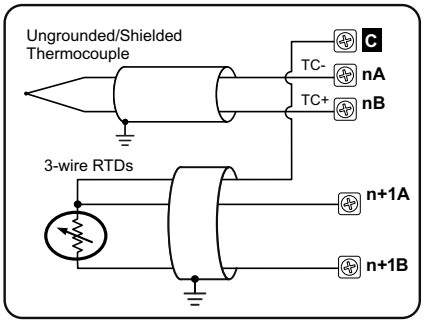
NOTE: Shield should be connected only at one end, to ground at the source device.

For maximum accuracy: Jumper unused inputs.



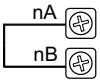
Mixed Resistive and Thermocouple Sensors





Notes for maximum accuracy:

1. All wires to an RTD must be equal length and type. Refer to RTD manufacturer's recommendations.
2. Do not use cable shield as sensing wire.
3. When applicable, connect shield to RTD common only, otherwise connect to module common only. Do not connect shield to both ends.
4. Jumper unused inputs.

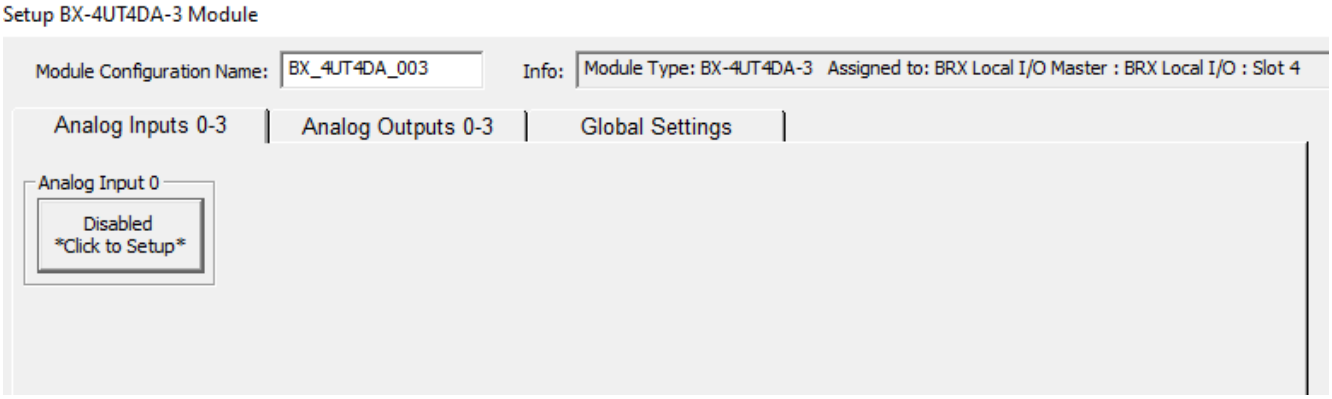


***NOTE:** With grounded thermocouples, take precautions to prevent having a voltage potential between thermocouple tips. A voltage of 1.25 V or greater between tips will skew measurements.*

BX-4UT4DA-3 Universal Temp Input/Analog Output, continued

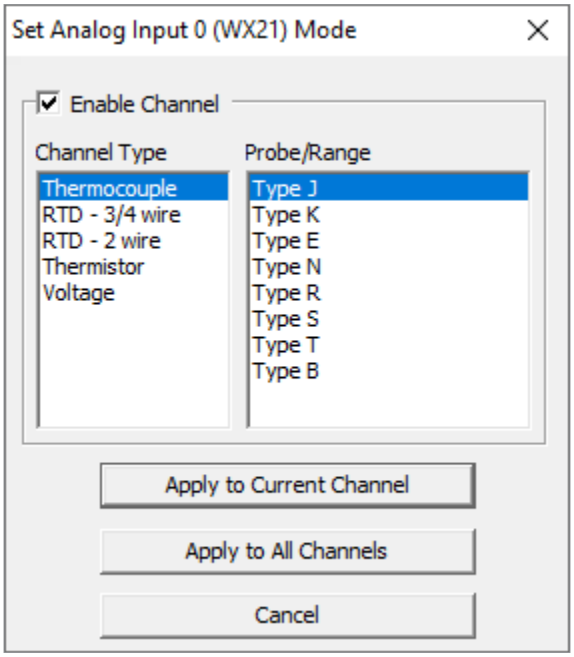
Software Setup

After the module is installed, open the Do-more! Designer programming software, connect to the BRX MPU and open the **Configure Module** dialog as described at the beginning of this chapter.



1. ***Analog Input x***

   Button – Click the button to set up the channel.



2. Set ***Analog Input x***

   Enable Channel – Check the box to enable this channel.

   Channel Type – Select the type of device for this channel. This can be different for each channel.

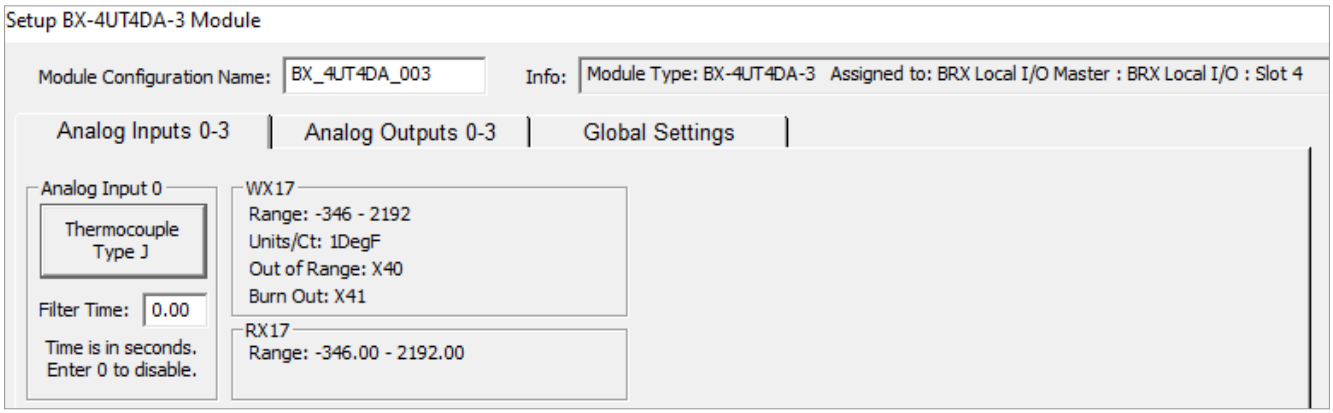
   Probe/Range – Select the style of device for this channel.

   Apply to Current Channel – Apply these settings to just this one channel.

   Apply to All Channels – Apply these settings to every channel on the card.

   Cancel – Make no changes and leave this dialog.

BX-4UT4DA-3 Universal Temp Input/Analog Output, continued



3. *WXx*

   Range – The temperature in whole degrees for the selected channel on the module.

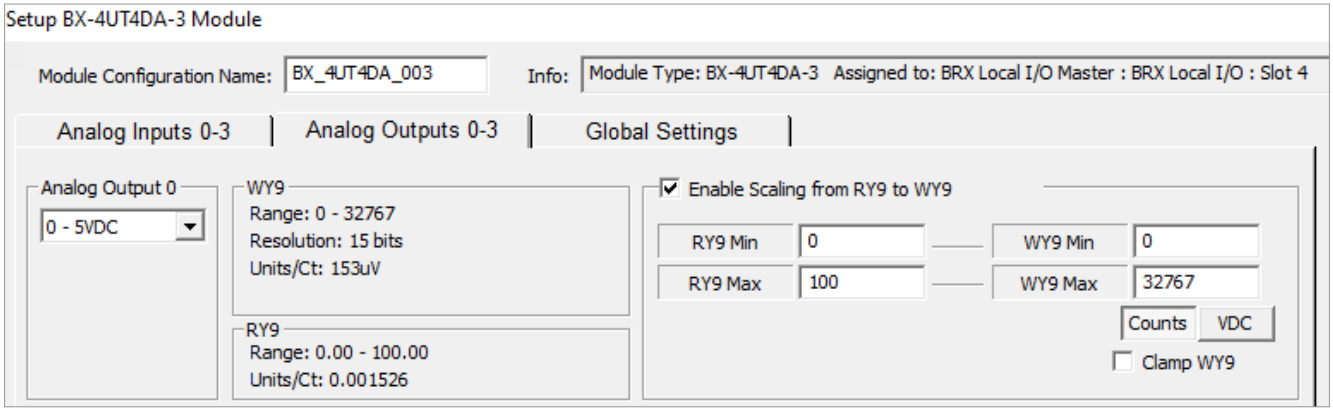
   Units/Ct – The amount of temperature change that will equal 1 raw count.

   Out of Range – The input register that, when On, will indicate that the input is outside of the range selected.

   Burn Out – If burn out is enabled, this register will be On when the loop is broken.

4. *RXx*

   Range – The floating point value of the channel temperature.



5. *Analog Output x*

   These settings are for each channel of the analog module.

   Drop-down menu - Select the range of the analog input here.

6. *WXx*

   Range – The number of Raw counts for the selected channel on the module.

   Units/Ct – The amount of current that will equal 1 raw count.

7. *RXx*

   Range – The engineering units to which the raw counts are scaled.

   Units/Ct – The number of raw counts that will equal 1 scaled engineering unit.

BX-4UT4DA-3 Universal Temp Input/Analog Output, continued

8. *Enable Scaling from WYx to RYx*

   RYx Min – The minimum value of the engineering units for scaling.

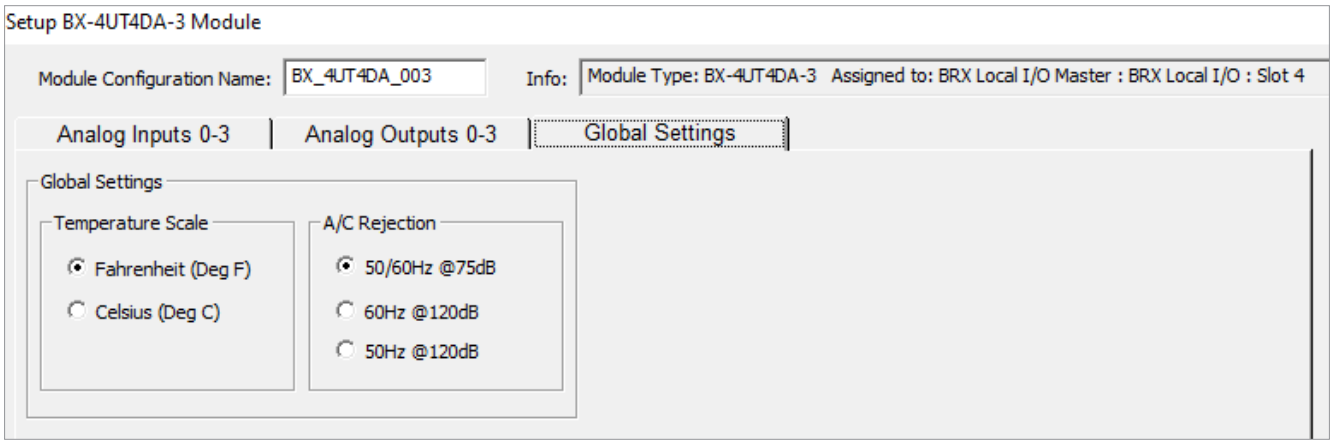
   RYx Max – The maximum value of the engineering units for scaling.

   WYx Min – The minimum value of the raw counts to scale.

   WYx Max – The maximum value of the raw counts to scale.

   Counts/VDC – Use these buttons to change the raw scaling to counts or milliamps.

   Clamp WYx – If this box is checked, WYx will clamp at the minimum and maximum scaled values.



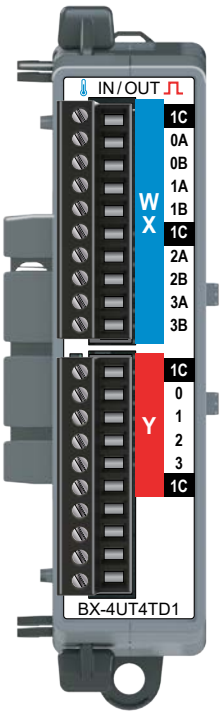
9. *Temperature Scale*

   Select Fahrenheit or Celsius.

10. *A/C Rejection*

    The rejection range for the common mode rejection. This is typically set to the AC line frequency at the installation.

BX-4UT4TD1 Universal Temperature Input/ DC Sinking Output



BX-4UT4TD1

Universal Temperature Input/
DC Sinking Output Expansion Module
4-pt Universal Temperature Input
4-pt DC Sinking Output

BX-RTB10 Terminal Blocks Included.
The BX-RTB10-1 or BX-RTB10-2 can also be used and can be purchased separately.

NOTE: *This device does not support ZIPLink Wiring Systems.*

IMPORTANT!

Hot-Swapping Information
Note: This device cannot be Hot Swapped.

Universal Temperature Input Specifications	
	BX-4UT4TD1
Input Channels	4 Differential
Commons	1
Input Impedance	>5MΩ
Resolution	24-bit, 0.1°(C or F) See Data Range Specifications table
All Channel Update Rate	1s max (4 thermocouples enabled) 700ms max (4RTD/NTX/mV enabled)
Sample Duration Time	175ms
Open Circuit Detection Time	Within 5s
Maximum Ratings	-0.3 V to +5.3 V, <15mA
Common Mode Range	-0.3 V to +5.3 V
Common Mode Rejection	100dB@DC, 130dB@60Hz
Conversion Method	Sigma-Delta, 24-bit
Thermocouple Parameters	
Thermocouple Input Ranges	Type J: −210° to 1200°C (−346° to 2192°F) Type K: −265° to 1372°C (−445° to 2502°F) Type E: −265° to 1000°C (−445° to 1832°F) Type N: −265° to 1300°C (−445° to 2372°F) Type R: −50° to 1768°C (−58° to 3214°F) Type S: −50° to 1768°C (−58° to 3214°F) Type B: 40° to 1820°C (104° to 3308°F) Type T: −265° to 400°C (−445° to 752°F)
Linear Voltage Input Ranges	−31.25 to 31.25 mVDC −31.25 to 125mVDC −31.25 to 62.5 mVDC 0 to 1.0 VDC
Cold Junction Compensation	Automatic
Thermocouple Linearization	Automatic
Maximum Inaccuracy–Thermocouple	±(0.2°C + 3% of °C reading)
Maximum Inaccuracy–Voltage	±250µV
RTD/Thermistor Parameters	
Input Ranges (RTD Types)	10, 50, 100, 200, 500, 1000Ω Pt Platinum RTD 0.00385 European Curve: −200° to 850°C (−328° to 1562°F) 120Ω Ni N120 Nickel RTD 0.00672 Curve: −80° to 260°C (−112° to 500°F)
Thermistor Input Ranges	2.252 kΩ @ 25°C: −40° to 150°C (−40° to 302°F) 3 kΩ @ 25°C: −40° to 150°C (−40° to 302°F) 5 kΩ @ 25°C: −40° to 150°C (−40° to 302°F) 10k-AN Type 3 @ 25°C: −40° to 150°C (−40° to 302°F) 30 kΩ @ 25°C: −40° to 150°C (−40° to 302°F)
Thermistor Excitation Current	NTC 2.252k, NTC 3k: 10µA NTC 5k, NTC 10k: 5µA NTC 30k: 1µA
RTD Excitation Current	RTD 10, 100, 120, 200: 1mA RTD 500: 500µA RTD 1000: 250µA
RTD/Thermistor Linearization	Automatic
Maximum Inaccuracy	±0.2°C

BX-4UT4TD1 Universal Temperature Input/ DC Sinking Output, continued

Voltage Sinking Output Specifications	
	BX-4UT4TD1
Outputs per Module	4
Commons	1
Output Type	Sinking
Maximum Current per Common	2A
Nominal Voltage	12–24VDC
Operating Voltage Range	5–36VDC
Peak Voltage	36VDC
Minimum Output Current	0.1 mA @ 24VDC
Maximum Output Current	0.5 A per output, no derating over temperature range
Maximum Inrush Current	5A for 50ms
Maximum Leakage Current	10µA
ON Voltage Drop	0.05 VDC
Fuses, Overcurrent Protection	N/A
OFF-ON Response	<5ms
ON-OFF Response	<2ms
Status Indicators	Logic Side, Green

Module General Specifications	
Weight	98g (3.5 oz)
Heat Dissipation	2.5 W
Backplane Power Consumption	2.5 W
Agency Approvals	UL 61010-2 File E185989, Canada and USA
Software Version Required	Do-more! Designer 2.7 or later

BX-4UT4TD1 Universal Temperature Input/ DC Sinking Output, continued

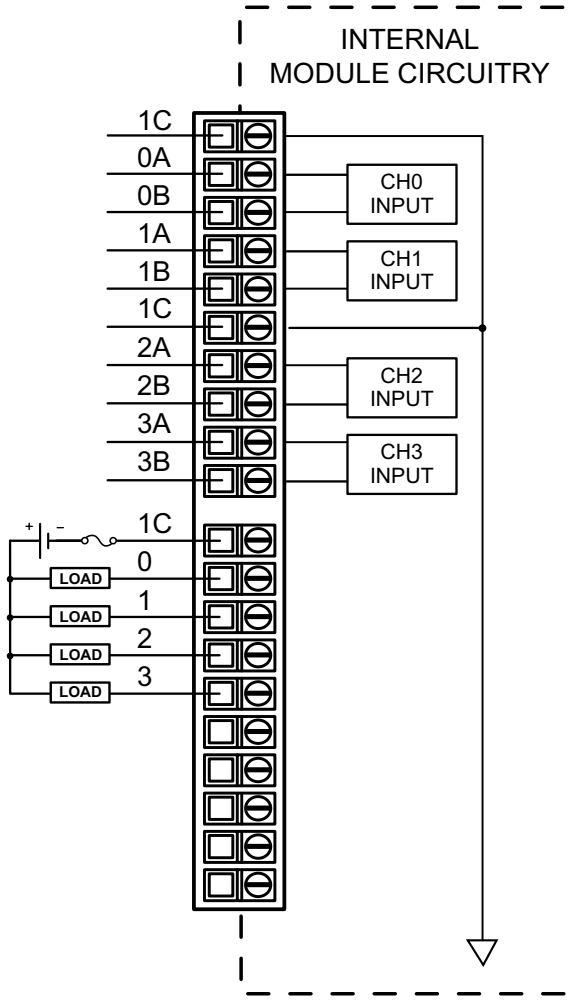
Data Range Specifications			
Thermocouple Selection	**Temperature Range**	**Resolution**	
		WXn	**RXn**
Type J	−210 to 1200 °C −346 to 2192 °F	Degrees x10 (One Implied Decimal)[1]	24-Bit Floating[1]
Type K	−265 to 1372 °C −445 to 2502 °F		
Type E	−265 to 1000 °C −445 to 1832 °F		
Type R	−50 to 1768 °C −58 to 3214 °F		
Type S	−50 to 1768 °C −58 to 3214 °F		
Type B	40 to 1820 °C 104 to 3308 °F [3]		
Type T	−265 to 400 °C −445 to 752 °F		
Voltage Selection	**Voltage Range**	**WXn[2]**	**RXn**
−31.25 to 31.25 mVDC	Bipolar 31.25 mVDC	0.95 µV per count (−32768 to 32767)	User Scaled
−31.25 to 62.5 mVDC	Bipolar 62.5 mVDC	1.9 µV per count (−16384 to 32767)	
−31.25 to 125 mVDC	Bipolar 125 mVDC	3.8 µV per count (−8192 to 32767)	
0 to 1.0 VDC	Unipolar 1.0 VDC	30.5 µV per count (0 to 32767)	
RTD Selection	**Temperature Range**	**WXn**	**RXn**
10, 50, 100, 200, 500, 1000Ω Pt Platinum RTD 0.00385 European Curve	−200 to 850 °C −328 to 1562 °F	Degrees x10 (One Implied Decimal)[1]	24-Bit Floating[1]
120Ω Ni N120 Nickel RTD 0.00672 Curve	−80 to 260 °C −112 to 500 °F		
Thermistor Selection	**Temperature Range**	**WXn**	**RXn**
Thermistor 2.252 kΩ @25°C	−40 to 150 °C −40 to 302 °F	Degrees x10 (One Implied Decimal)[1]	24-Bit Floating[1]
Thermistor 3kΩ @25°C			
Thermistor 5kΩ @25°C			
Thermistor 10k-AN Type 3 @25°C			
Thermistor 30kΩ @25°C			

1. Temperatures reported in rounded integer to WXn and as scaled floating point 24bits resolution to RXn.
2. Raw Counts = −32768 to 32767.
3. Max value displayed in WXn is 32767. RXn will display the full range of 3308.0.

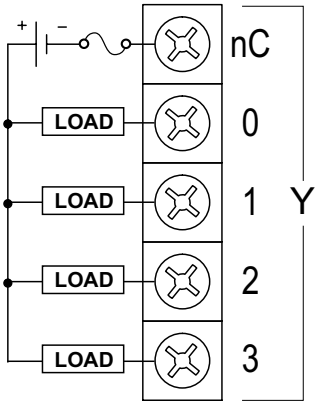
The module reserves the first 8 bits of unused contiguous space in the X register, aligned to an 8-bit word boundary, for status reporting. Error flags for this module are laid out within its status register space as described in the table below.

Error Flag Specifications								
	MSB							**LSB**
1st Byte of unused X Registers								
Module Status	Channel 4 Burnout	Channel 4 Out of Range	Channel 3 Burnout	Channel 3 Out of Range	Channel 2 Burnout	Channel 2 Out of Range	Channel 1 Burnout	Channel 1 Out of Range

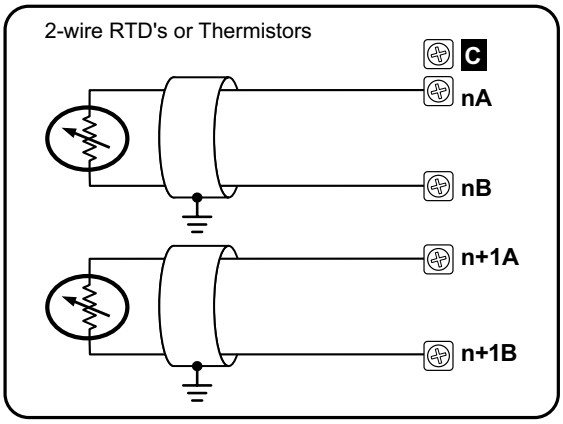
BX-4UT4TD1 Universal Temperature Input/ DC Sinking Output, continued

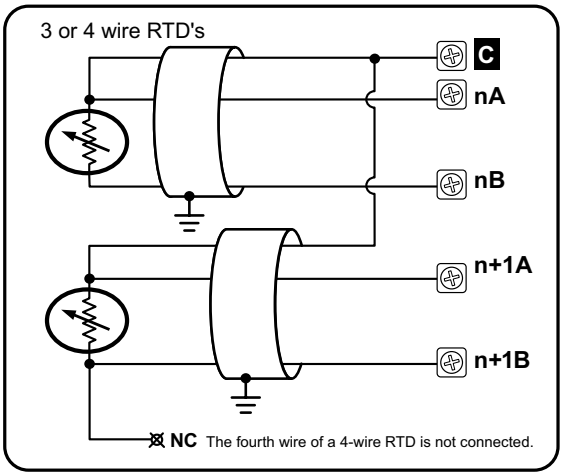


Sinking Output



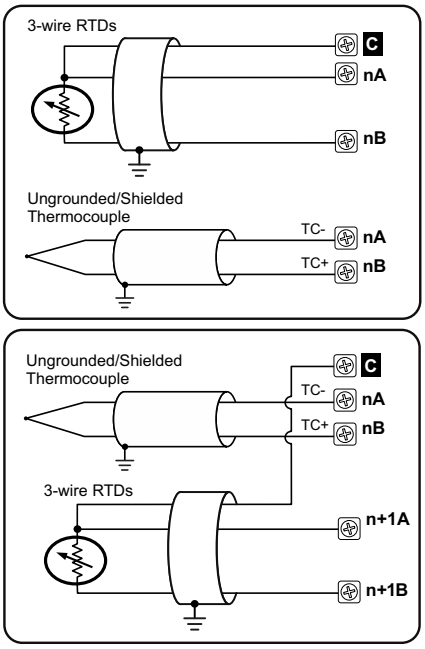
Resistive and Thermistor Sensors





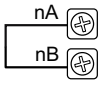
BX-4UT4TD1 Universal Temperature Input/ DC Sinking Output, continued

Mixed Resistive and Thermocouple Sensors

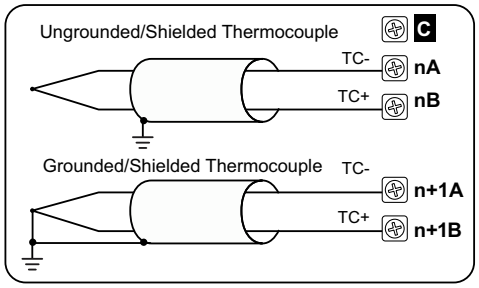


Notes for maximum accuracy:

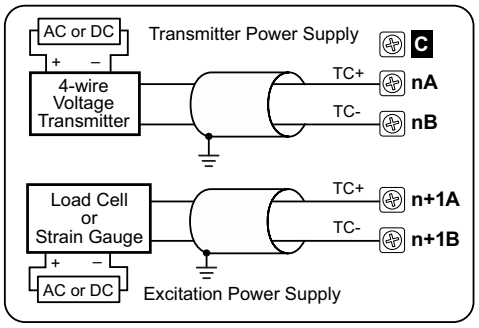
1. All wires to an RTD must be equal length and type. Refer to RTD manufacturer's recommendations.
2. Do not use cable shield as sensing wire.
3. When applicable, connect shield to RTD common only, otherwise connect to module common only. Do not connect shield to both ends.
4. Jumper unused inputs.

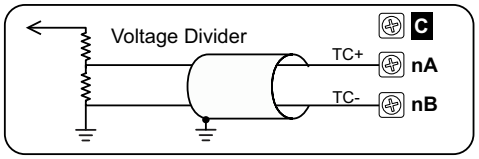


Thermocouple and Voltage Sensors



NOTE: Thermocouple extension wire and proper thermocouple terminal blocks must be used to extend thermocouples. AutomationDirect thermocouple wire is recommended.





NOTE: Shield should be connected only at one end, to ground at the source device.

For maximum accuracy: Jumper unused inputs.

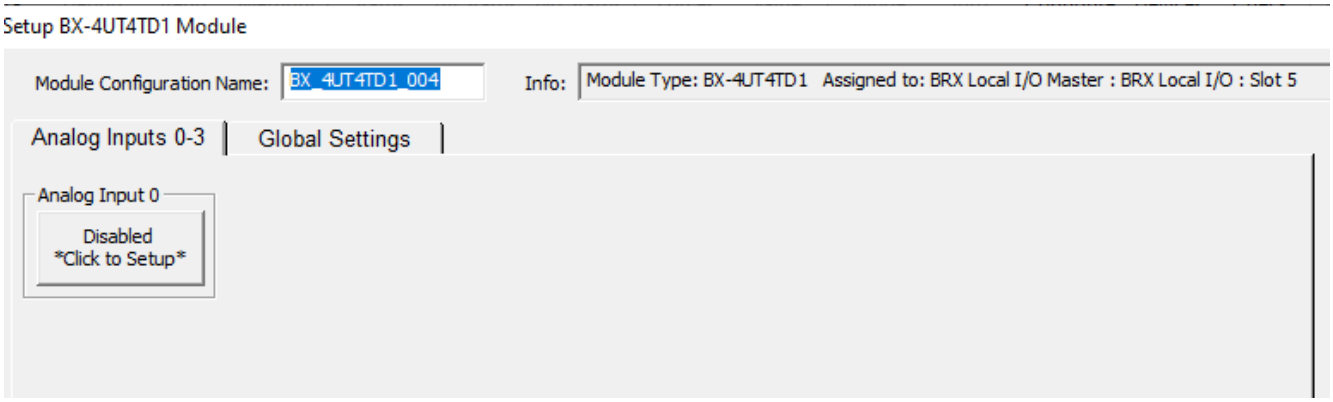


NOTE: *With grounded thermocouples, take precautions to prevent having a voltage potential between thermocouple tips. A voltage of 1.25 V or greater between tips will skew measurements.*

BX-4UT4TD1 Universal Temperature Input/ DC Sinking Output, continued

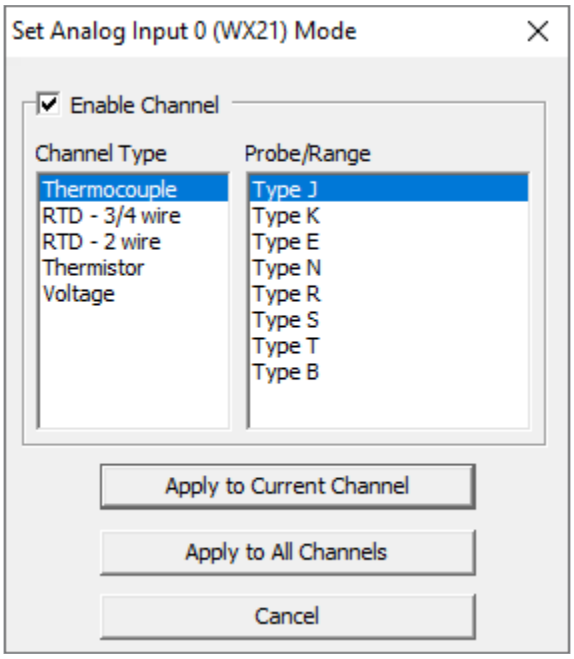
Software Setup

After the module is installed, open the Do-more! Designer programming software, connect to the BRX MPU and open the **Configure Module** dialog as described at the beginning of this chapter.



1. *Analog Input x*

   Button – Click the button to set up the channel.



2. Set *Analog Input x*

   Enable Channel – Check the box to enable this channel.

   Channel Type – Select the type of device for this channel. This can be different for each channel.

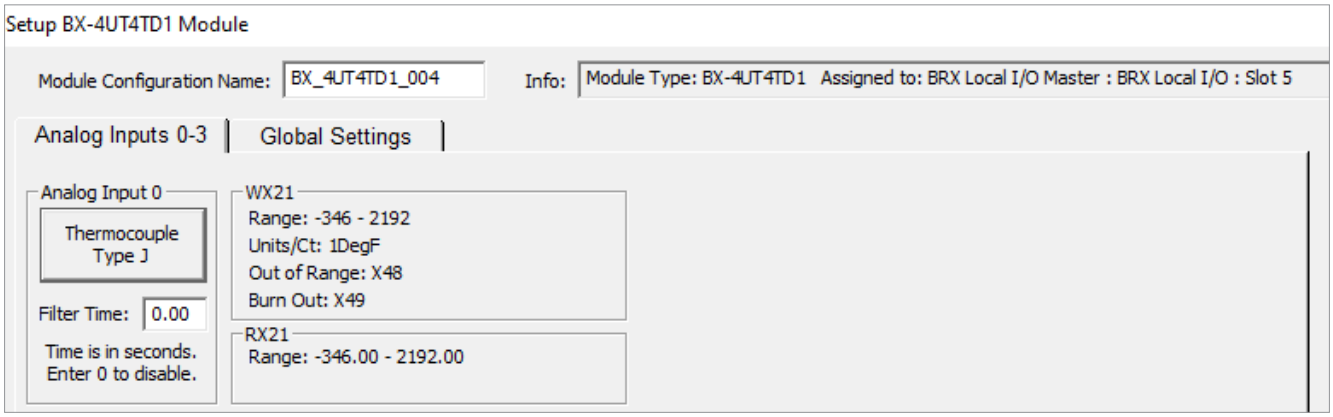
   Probe/Range – Select the style of device for this channel.

   Apply to Current Channel – Apply these settings to just this one channel.

   Apply to All Channels – Apply these settings to every channel on the card.

Cancel – Make no changes and leave this dialog.

BX-4UT4TD1 Universal Temperature Input/ DC Sinking Output, continued



3. *WXx*

   Range – The temperature in whole degrees for the selected channel on the module.

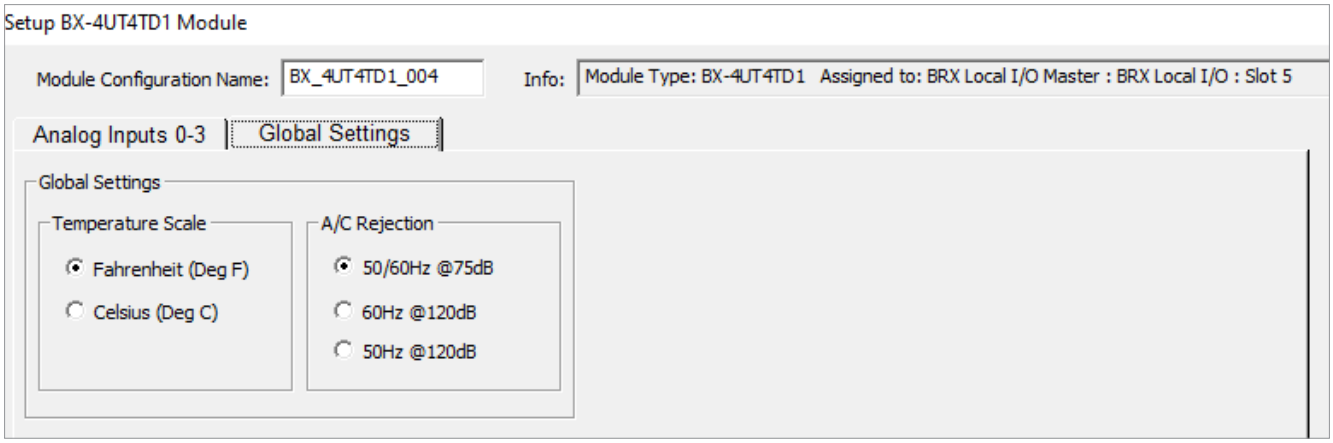
   Units/Ct – The amount of temperature change that will equal 1 raw count.

   Out of Range – The input register that, when On, will indicate that the input is outside of the range selected.

   Burn Out – If burn out is enabled, this register will be On when the loop is broken.

4. *RXx*

   Range – The floating point value of the channel temperature.



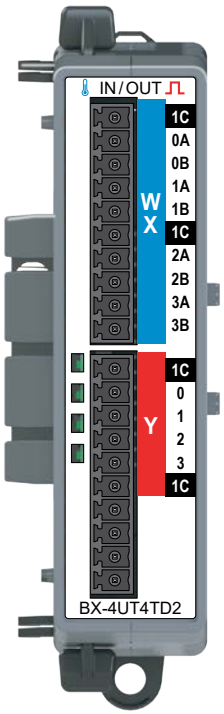
5. *Temperature Scale*

   Select Fahrenheit or Celsius.

6. *A/C Rejection*

   The rejection range for the common mode rejection. This is typically set to the AC line frequency at the installation.

BX-4UT4TD2 Universal Temperature Input/ DC Sourcing Output



BX-4UT4TD2

Universal Temperature Input/
DC Sourcing Output Expansion Module
4-pt Universal Temperature Input
4-pt DC Sourcing Output

BX-RTB10 Terminal Blocks Included.
The BX-RTB10-1 or BX-RTB10-2 can also be used and can be purchased separately.

NOTE: *This device does not support ZIPLink Wiring Systems.*

IMPORTANT!

Hot-Swapping Information
Note: This device cannot be Hot Swapped.

Universal Temperature Input Specifications

	BX-4UT4TD2
Input Channels	4 Differential
Commons	1
Input Impedance	>5MΩ
Resolution	24-bit, 0.1°(C or F) See Data Range Specifications table
All Channel Update Rate	1s max (4 thermocouples enabled) 700ms max (4RTD/NTX/mV enabled)
Sample Duration Time	175ms
Open Circuit Detection Time	Within 5s
Maximum Ratings	-0.3 V to +5.3 V, <15mA
Common Mode Range	-0.3 V to +5.3 V
Common Mode Rejection	100dB@DC, 130dB@60Hz
Conversion Method	Sigma-Delta, 24-bit
Thermocouple Parameters	
Thermocouple Input Ranges	Type J: −210° to 1200°C (−346° to 2192°F) Type K: −265° to 1372°C (−445° to 2502°F) Type E: −265° to 1000°C (−445° to 1832°F) Type N: −265° to 1300°C (−445° to 2372°F) Type R: −50° to 1768°C (−58° to 3214°F) Type S: −50° to 1768°C (−58° to 3214°F) Type B: 40° to 1820°C (104° to 3308°F) Type T: −265° to 400°C (−445° to 752°F)
Linear Voltage Input Ranges	−31.25 to 31.25 mVDC −31.25 to 125mVDC −31.25 to 62.5 mVDC 0 to 1.0 VDC
Cold Junction Compensation	Automatic
Thermocouple Linearization	Automatic
Maximum Inaccuracy–Thermocouple	±(0.2°C + 3% of °C reading)
Maximum Inaccuracy–Voltage	±250µV
RTD/Thermistor Parameters	
Input Ranges (RTD Types)	10, 50, 100, 200, 500, 1000Ω Pt Platinum RTD 0.00385 European Curve: −200° to 850°C (−328° to 1562°F) 120Ω Ni N120 Nickel RTD 0.00672 Curve: −80° to 260°C (−112° to 500°F)
Thermistor Input Ranges	2.252 kΩ @ 25°C: −40° to 150°C (−40° to 302°F) 3 kΩ @ 25°C: −40° to 150°C (−40° to 302°F) 5 kΩ @ 25°C: −40° to 150°C (−40° to 302°F) 10k-AN Type 3 @ 25°C: −40° to 150°C (−40° to 302°F) 30 kΩ @ 25°C: −40° to 150°C (−40° to 302°F)
Thermistor Excitation Current	NTC 2.252k, NTC 3k: 10µA NTC 5k, NTC 10k: 5µA NTC 30k: 1µA
RTD Excitation Current	RTD 10, 100, 120, 200: 1mA RTD 500: 500µA RTD 1000: 250µA
RTD/Thermistor Linearization	Automatic
Maximum Inaccuracy	±0.2°C

BX-4UT4TD2 Universal Temperature Input/ DC Sourcing Output, continued

Voltage Sourcing Output Specifications	
	BX-4UT4TD2
Outputs per Module	4
Commons	1
Output Type	Sourcing
Maximum Current per Common	2A
Nominal Voltage	12–24VDC
Operating Voltage Range	5–36VDC
Peak Voltage	36VDC
Minimum Output Current	0.1 mA @ 24VDC
Maximum Output Current	0.5 A per output, no derating over temperature range
Maximum Inrush Current	5A for 50ms
Maximum Leakage Current	10µA
ON Voltage Drop	0.05 VDC
Fuses, Overcurrent Protection	N/A
OFF-ON Response	<5ms
ON-OFF Response	<2ms
Status Indicators	Logic Side, Green

Module General Specifications	
Weight	98g (3.5 oz)
Heat Dissipation	2.3 W
Backplane Power Consumption	2.5 W
Agency Approvals	UL 61010-2 File E185989, Canada and USA
Software Version Required	Do-more! Designer 2.7 or later

BX-4UT4TD2 Universal Temperature Input/ DC Sourcing Output, continued

Data Range Specifications

Thermocouple Selection	Temperature Range	Resolution	
		WXn	RXn
Type J	−210 to 1200 °C −346 to 2192 °F	Degrees x10 (One Implied Decimal)[1]	24-Bit Floating[1]
Type K	−265 to 1372 °C −445 to 2502 °F		
Type E	−265 to 1000 °C −445 to 1832 °F		
Type R	−50 to 1768 °C −58 to 3214 °F		
Type S	−50 to 1768 °C −58 to 3214 °F		
Type B	40 to 1820 °C 104 to 3308 °F [3]		
Type T	−265 to 400 °C −445 to 752 °F		
Voltage Selection	**Voltage Range**	**WXn[2]**	**RXn**
−31.25 to 31.25 mVDC	Bipolar 31.25 mVDC	0.95 µV per count (−32768 to 32767)	User Scaled
−31.25 to 62.5 mVDC	Bipolar 62.5 mVDC	1.9 µV per count (−16384 to 32767)	
−31.25 to 125 mVDC	Bipolar 125 mVDC	3.8 µV per count (−8192 to 32767)	
0 to 1.0 VDC	Unipolar 1.0 VDC	30.5 µV per count (0 to 32767)	
RTD Selection	**Temperature Range**	**WXn**	**RXn**
10, 50, 100, 200, 500, 1000Ω Pt Platinum RTD 0.00385 European Curve	−200 to 850 °C −328 to 1562 °F	Degrees x10 (One Implied Decimal)[1]	24-Bit Floating[1]
120Ω Ni N120 Nickel RTD 0.00672 Curve	−80 to 260 °C −112 to 500 °F		
Thermistor Selection	**Temperature Range**	**WXn**	**RXn**
Thermistor 2.252 kΩ @25°C	−40 to 150 °C −40 to 302 °F	Degrees x10 (One Implied Decimal)[1]	24-Bit Floating[1]
Thermistor 3kΩ @25°C			
Thermistor 5kΩ @25°C			
Thermistor 10k-AN Type 3 @25°C			
Thermistor 30kΩ @25°C			

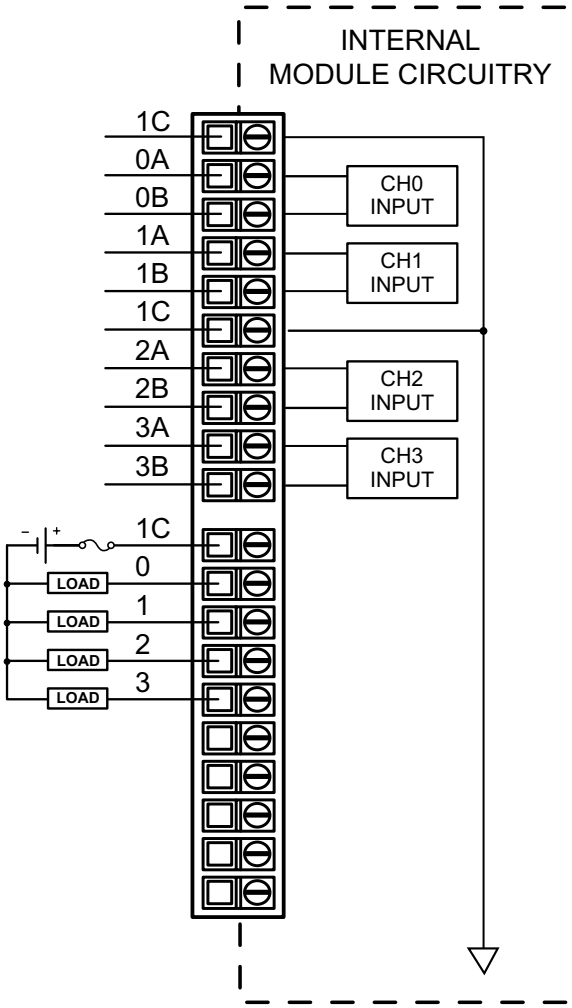
1. Temperatures reported in rounded integer to WXn and as scaled floating point 24bits resolution to RXn.
2. Raw Counts = −32768 to 32767.
3. Max value displayed in WXn is 32767. RXn will display the full range of 3308.0.

The module reserves the first 8 bits of unused contiguous space in the X register, aligned to an 8-bit word boundary, for status reporting. Error flags for this module are laid out within its status register space as described in the table below.

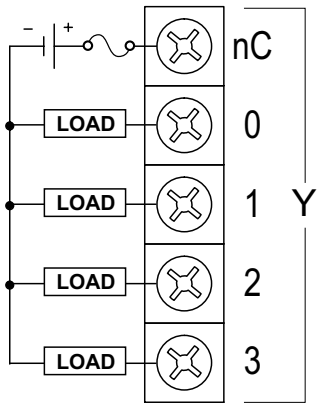
Error Flag Specifications

	MSB							LSB
1st Byte of unused X Registers								
Module Status	Channel 4 Burnout	Channel 4 Out of Range	Channel 3 Burnout	Channel 3 Out of Range	Channel 2 Burnout	Channel 2 Out of Range	Channel 1 Burnout	Channel 1 Out of Range

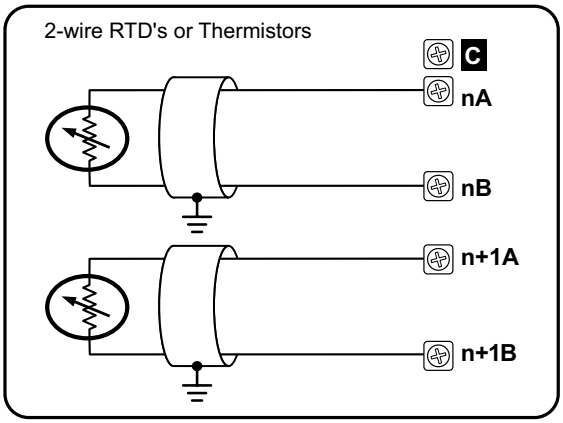
BX-4UT4TD2 Universal Temperature Input/ DC Sourcing Output, continued

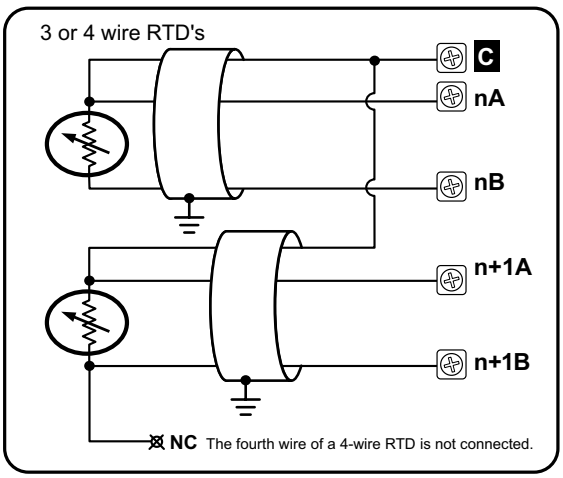


Sourcing Output



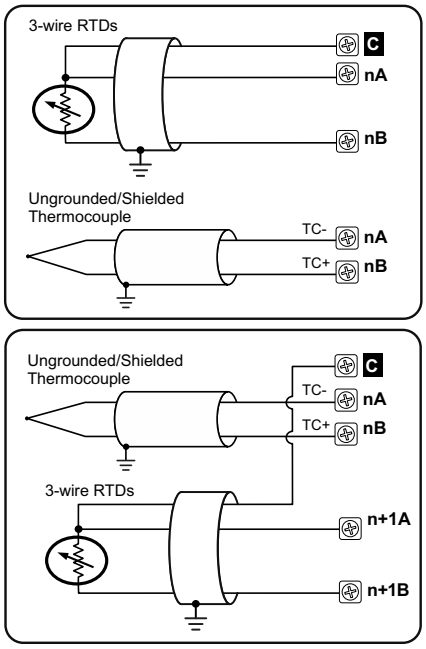
Resistive and Thermistor Sensors





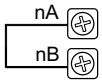
BX-4UT4TD2 Universal Temperature Input/ DC Sourcing Output, continued

Mixed Resistive and Thermocouple Sensors

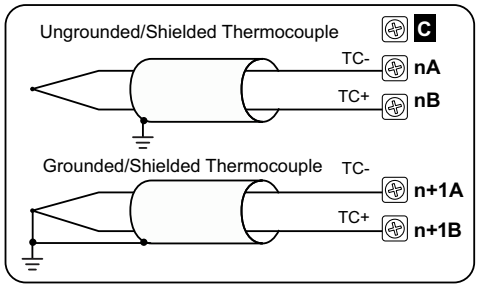


Notes for maximum accuracy:

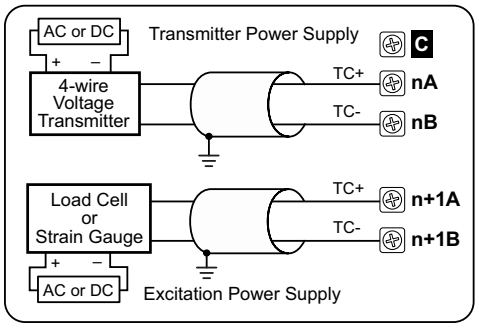
1. All wires to an RTD must be equal length and type. Refer to RTD manufacturer's recommendations.
2. Do not use cable shield as sensing wire.
3. When applicable, connect shield to RTD common only, otherwise connect to module common only. Do not connect shield to both ends.
4. Jumper unused inputs.

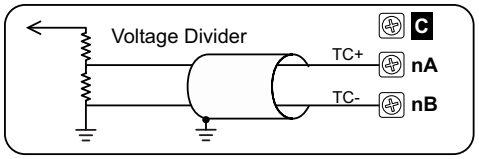


Thermocouple and Voltage Sensors



NOTE: Thermocouple extension wire and proper thermocouple terminal blocks must be used to extend thermocouples. AutomationDirect thermocouple wire is recommended.





NOTE: Shield should be connected only at one end, to ground at the source device.

For maximum accuracy: Jumper unused inputs.

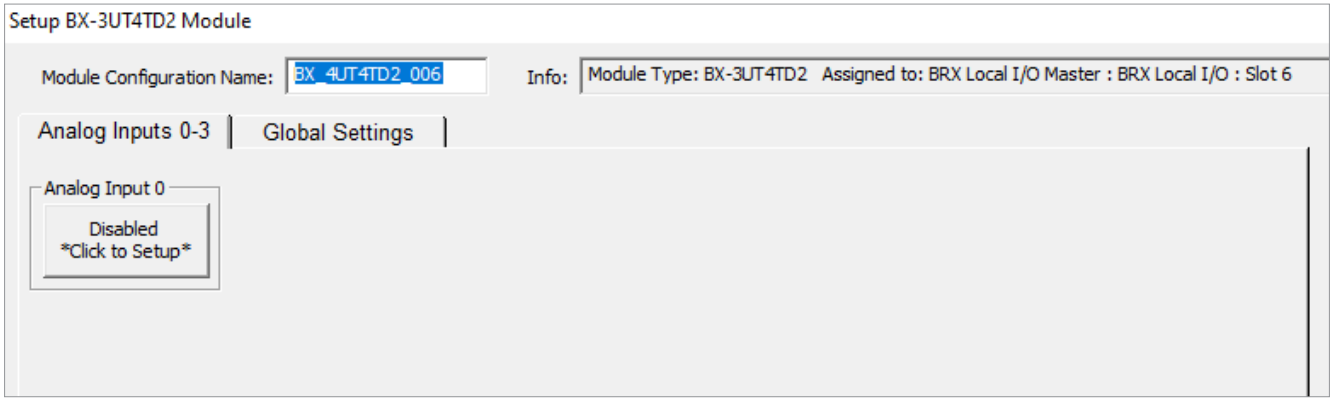


NOTE: *With grounded thermocouples, take precautions to prevent having a voltage potential between thermocouple tips. A voltage of 1.25 V or greater between tips will skew measurements.*

BX-4UT4TD2 Universal Temperature Input/ DC Sourcing Output, continued

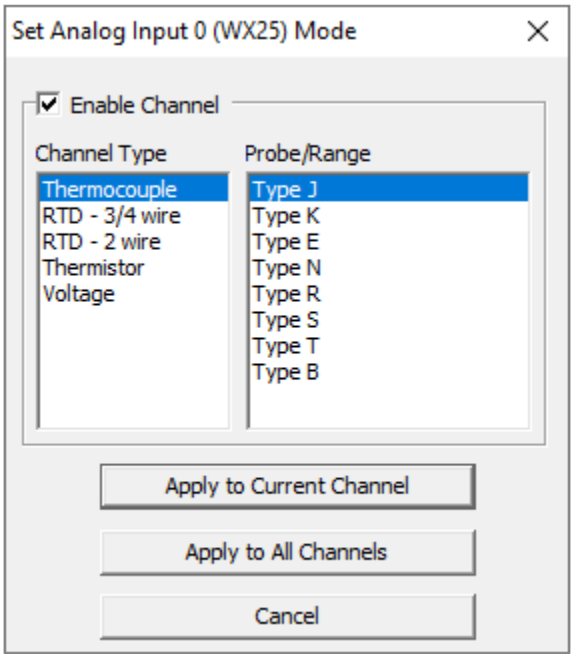
Software Setup

After the module is installed, open the Do-more! Designer programming software, connect to the BRX MPU and open the **Configure Module** dialog as described at the beginning of this chapter.



1. ***Analog Input x***

   Button – Click the button to set up the channel.



2. Set ***Analog Input x***

   Enable Channel – Check the box to enable this channel.

   Channel Type – Select the type of device for this channel. This can be different for each channel.

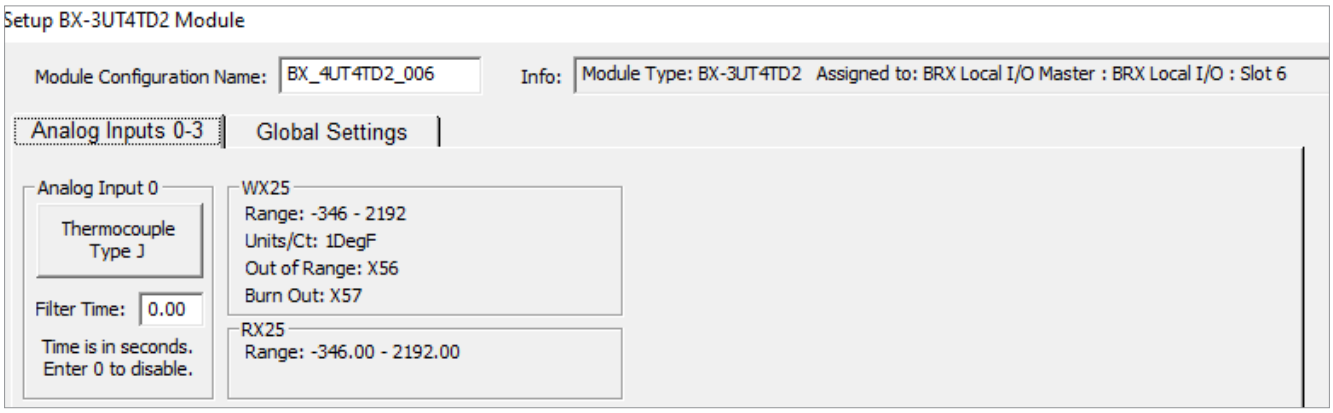
   Probe/Range – Select the style of device for this channel.

   Apply to Current Channel – Apply these settings to just this one channel.

   Apply to All Channels – Apply these settings to every channel on the card.

   Cancel – Make no changes and leave this dialog.

BX-4UT4TD2 Universal Temperature Input/ DC Sourcing Output, continued



3. *WXx*

   Range – The temperature in whole degrees for the selected channel on the module.

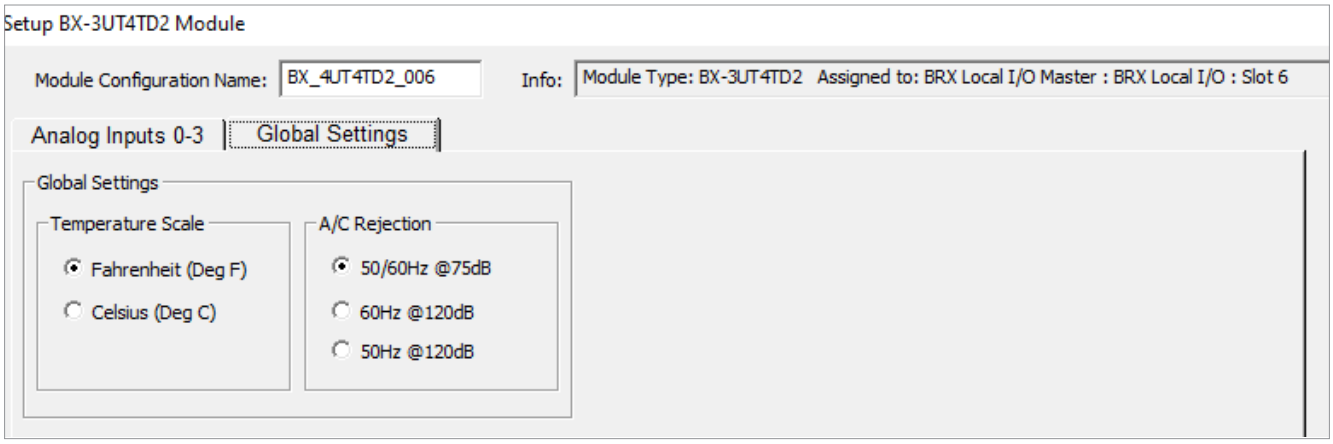
   Units/Ct – The amount of temperature change that will equal 1 raw count.

   Out of Range – The input register that, when On, will indicate that the input is outside of the range selected.

   Burn Out – If burn out is enabled, this register will be On when the loop is broken.

4. *RXx*

   Range – The floating point value of the channel temperature.



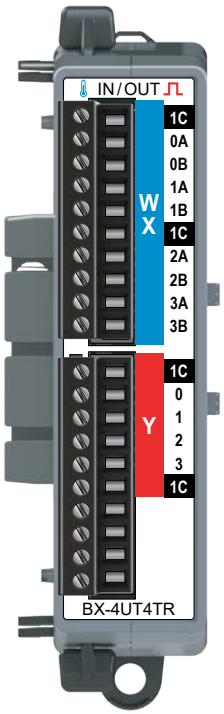
5. *Temperature Scale*

   Select Fahrenheit or Celsius.

6. *A/C Rejection*

   The rejection range for the common mode rejection. This is typically set to the AC line frequency at the installation.

BX-4UT4TR Universal Temperature Input/ Relay Output



BX-4UT4TR

Universal Temperature Input/
Relay Output Expansion Module
4-pt Universal Temperature Input
4-pt Relay Form A (SPST) Output

BX-RTB10 Terminal Blocks Included.
The BX-RTB10-1 or BX-RTB10-2 can also be used and can be purchased separately.

NOTE: *This device does not support ZIPLink Wiring Systems.*

IMPORTANT!

Hot-Swapping Information
Note: This device cannot be Hot Swapped.

Universal Temperature Input Specifications	
	BX-4UT4TR
Input Channels	4 Differential
Commons	1
Input Impedance	>5MΩ
Resolution	24-bit, 0.1°(C or F) See Data Range Specifications table
All Channel Update Rate	1s max (4 thermocouples enabled) 700ms max (4RTD/NTX/mV enabled)
Sample Duration Time	175ms
Open Circuit Detection Time	Within 5s
Maximum Ratings	-0.3 V to +5.3 V, <15mA
Common Mode Range	-0.3 V to +5.3 V
Common Mode Rejection	100dB@DC, 130dB@60Hz
Conversion Method	Sigma-Delta, 24-bit
Thermocouple Parameters	
Thermocouple Input Ranges	Type J: −210° to 1200°C (−346° to 2192°F) Type K: −265° to 1372°C (−445° to 2502°F) Type E: −265° to 1000°C (−445° to 1832°F) Type N: −265° to 1300°C (−445° to 2372°F) Type R: −50° to 1768°C (−58° to 3214°F) Type S: −50° to 1768°C (−58° to 3214°F) Type B: 40° to 1820°C (104° to 3308°F) Type T: −265° to 400°C (−445° to 752°F)
Linear Voltage Input Ranges	−31.25 to 31.25 mVDC −31.25 to 125mVDC −31.25 to 62.5 mVDC 0 to 1.0 VDC
Cold Junction Compensation	Automatic
Thermocouple Linearization	Automatic
Maximum Inaccuracy–Thermocouple	±(0.2°C + 3% of °C reading)
Maximum Inaccuracy–Voltage	±250µV
RTD/Thermistor Parameters	
Input Ranges (RTD Types)	10, 50, 100, 200, 500, 1000Ω Pt Platinum RTD 0.00385 European Curve: −200° to 850°C (−328° to 1562°F) 120Ω Ni N120 Nickel RTD 0.00672 Curve: −80° to 260°C (−112° to 500°F)
Thermistor Input Ranges	2.252 kΩ @ 25°C: −40° to 150°C (−40° to 302°F) 3 kΩ @ 25°C: −40° to 150°C (−40° to 302°F) 5 kΩ @ 25°C: −40° to 150°C (−40° to 302°F) 10k-AN Type 3 @ 25°C: −40° to 150°C (−40° to 302°F) 30 kΩ @ 25°C: −40° to 150°C (−40° to 302°F)
Thermistor Excitation Current	NTC 2.252k, NTC 3k: 10µA NTC 5k, NTC 10k: 5µA NTC 30k: 1µA
RTD Excitation Current	RTD 10, 100, 120, 200: 1mA RTD 500: 500µA RTD 1000: 250µA
RTD/Thermistor Linearization	Automatic
Maximum Inaccuracy	±0.2°C

BX-4UT4TR Universal Temperature Input/ Relay Output, continued

Voltage Relay Output Specifications	
	BX-4UT4TR
Outputs per Module	4
Commons	1
Maximum Current per Common	8A
Nominal Voltage	5–48VDC, 24–240VAC
Operating Voltage Range	5–60VDC, 18–264VAC
Peak Voltage	60VDC, 264VAC
Minimum Output Current	0.1 mA @ 24VDC
Maximum Output Current	2A
Maximum Inrush Current	5A for 50ms
Maximum Leakage Current	1µA
ON Voltage Drop	0.2 V maximum
Fuses, Overcurrent Protection	N/A
OFF-ON Response	<10ms
ON-OFF Response	<10ms
Relay Cycle Life Mechanical Endurance Electrical Endurance	 5 Million Operations 120,000 Operations
Status Indicators	Logic Side, Green

Module General Specifications	
Weight	98g (3.5 oz)
Heat Dissipation	3.6 W
Backplane Power Consumption	2.5 W
Agency Approvals	UL 61010-2 File E185989, Canada and USA
Software Version Required	Do-more! Designer 2.7 or later

BX-4UT4TR Universal Temperature Input/ Relay Output, continued

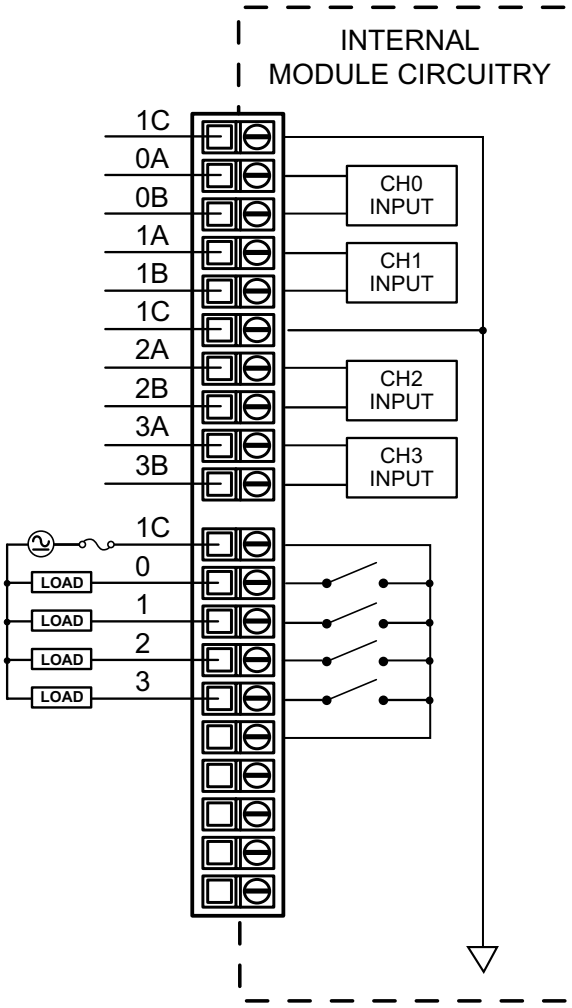
Data Range Specifications			
Thermocouple Selection	**Temperature Range**	**Resolution**	
		WXn	**RXn**
Type J	−210 to 1200 °C −346 to 2192 °F	Degrees x10 (One Implied Decimal)[1]	24-Bit Floating[1]
Type K	−265 to 1372 °C −445 to 2502 °F		
Type E	−265 to 1000 °C −445 to 1832 °F		
Type R	−50 to 1768 °C −58 to 3214 °F		
Type S	−50 to 1768 °C −58 to 3214 °F		
Type B	40 to 1820 °C 104 to 3308 °F [3]		
Type T	−265 to 400 °C −445 to 752 °F		
Voltage Selection	**Voltage Range**	**WXn[2]**	**RXn**
−31.25 to 31.25 mVDC	Bipolar 31.25 mVDC	0.95 µV per count (−32768 to 32767)	User Scaled
−31.25 to 62.5 mVDC	Bipolar 62.5 mVDC	1.9 µV per count (−16384 to 32767)	
−31.25 to 125 mVDC	Bipolar 125 mVDC	3.8 µV per count (−8192 to 32767)	
0 to 1.0 VDC	Unipolar 1.0 VDC	30.5 µV per count (0 to 32767)	
RTD Selection	**Temperature Range**	**WXn**	**RXn**
10, 50, 100, 200, 500, 1000Ω Pt Platinum RTD 0.00385 European Curve	−200 to 850 °C −328 to 1562 °F	Degrees x10 (One Implied Decimal)[1]	24-Bit Floating[1]
120Ω Ni N120 Nickel RTD 0.00672 Curve	−80 to 260 °C −112 to 500 °F		
Thermistor Selection	**Temperature Range**	**WXn**	**RXn**
Thermistor 2.252 kΩ @25°C	−40 to 150 °C −40 to 302 °F	Degrees x10 (One Implied Decimal)[1]	24-Bit Floating[1]
Thermistor 3kΩ @25°C			
Thermistor 5kΩ @25°C			
Thermistor 10k-AN Type 3 @25°C			
Thermistor 30kΩ @25°C			

1. Temperatures reported in rounded integer to WXn and as scaled floating point 24bits resolution to RXn.
2. Raw Counts = −32768 to 32767.
3. Max value displayed in WXn is 32767. RXn will display the full range of 3308.0.

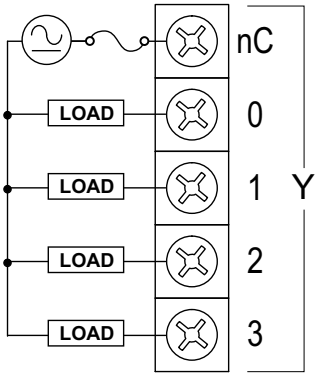
The module reserves the first 8 bits of unused contiguous space in the X register, aligned to an 8-bit word boundary, for status reporting. Error flags for this module are laid out within its status register space as described in the table below.

Error Flag Specifications								
	MSB							**LSB**
1st Byte of unused X Registers								
Module Status	Channel 4 Burnout	Channel 4 Out of Range	Channel 3 Burnout	Channel 3 Out of Range	Channel 2 Burnout	Channel 2 Out of Range	Channel 1 Burnout	Channel 1 Out of Range

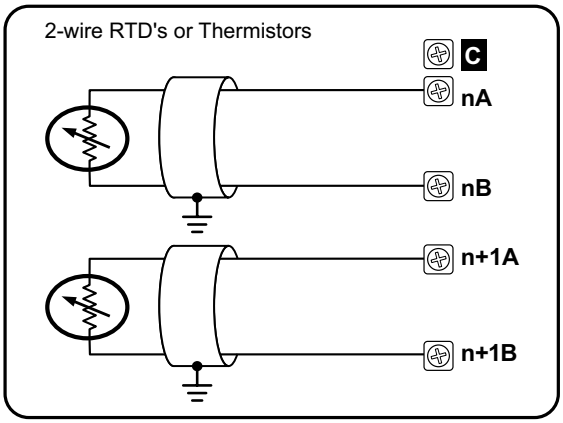
BX-4UT4TR Universal Temperature Input/ Relay Output, continued

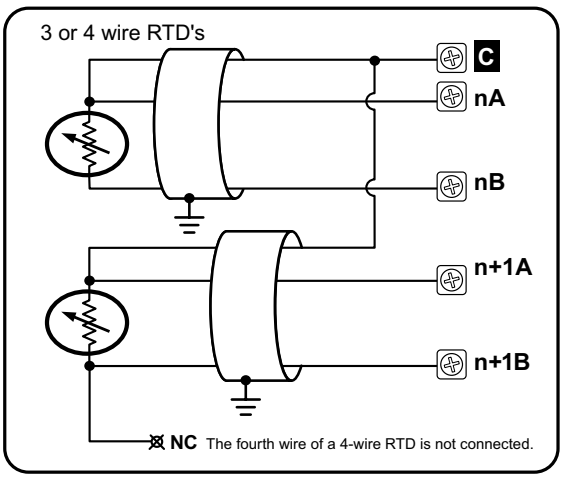


Relay Output



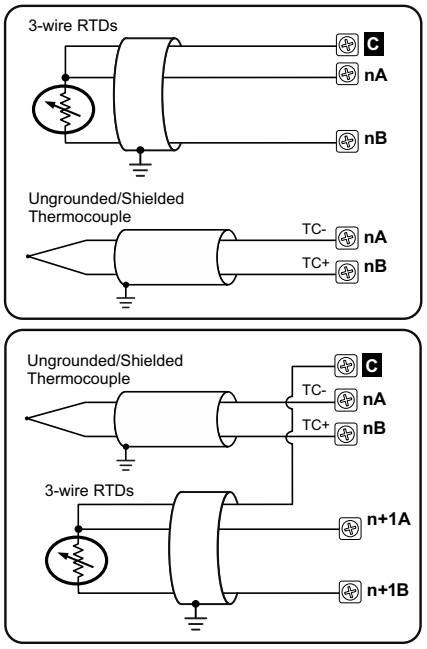
Resistive and Thermistor Sensors





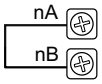
BX-4UT4TR Universal Temperature Input/ Relay Output, continued

Mixed Resistive and Thermocouple Sensors

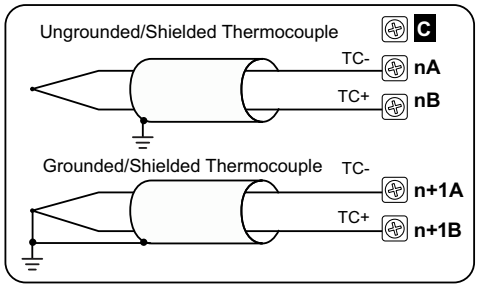


Notes for maximum accuracy:

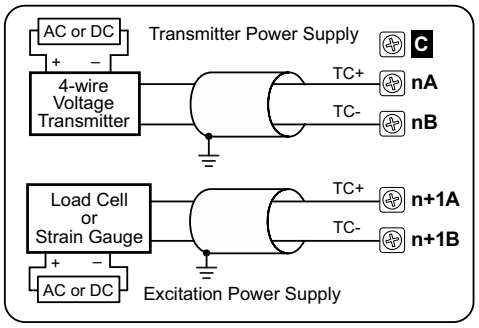
1. All wires to an RTD must be equal length and type. Refer to RTD manufacturer's recommendations.
2. Do not use cable shield as sensing wire.
3. When applicable, connect shield to RTD common only, otherwise connect to module common only. Do not connect shield to both ends.
4. Jumper unused inputs.

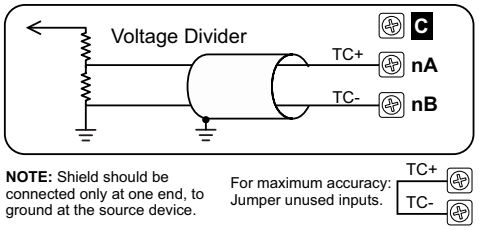


Thermocouple and Voltage Sensors



NOTE: Thermocouple extension wire and proper thermocouple terminal blocks must be used to extend thermocouples. AutomationDirect thermocouple wire is recommended.





NOTE: Shield should be connected only at one end, to ground at the source device.

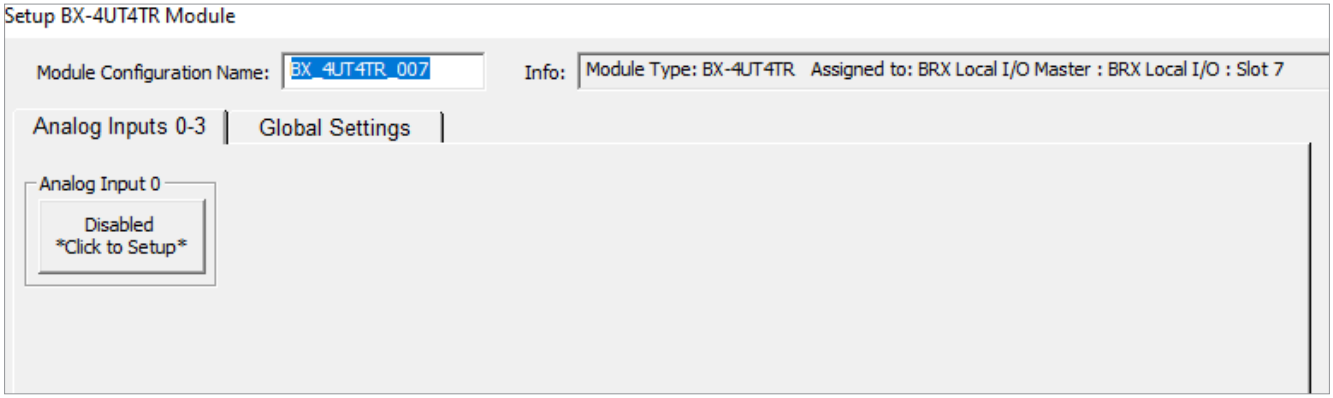
For maximum accuracy: Jumper unused inputs.

NOTE: *With grounded thermocouples, take precautions to prevent having a voltage potential between thermocouple tips. A voltage of 1.25 V or greater between tips will skew measurements.*

BX-4UT4TR Universal Temperature Input/ Relay Output, continued

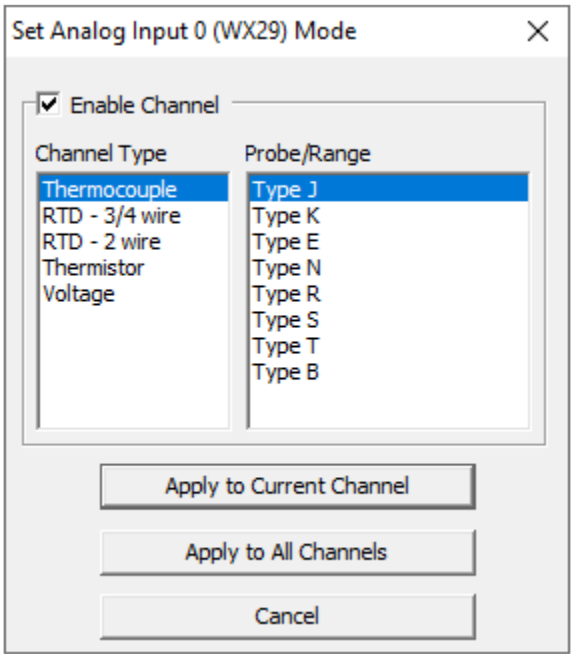
Software Setup

After the module is installed, open the Do-more! Designer programming software, connect to the BRX MPU and open the **Configure Module** dialog as described at the beginning of this chapter.



1. *Analog Input x*

   Button – Click the button to set up the channel.



2. Set *Analog Input x*

   Enable Channel – Check the box to enable this channel.

   Channel Type – Select the type of device for this channel. This can be different for each channel.

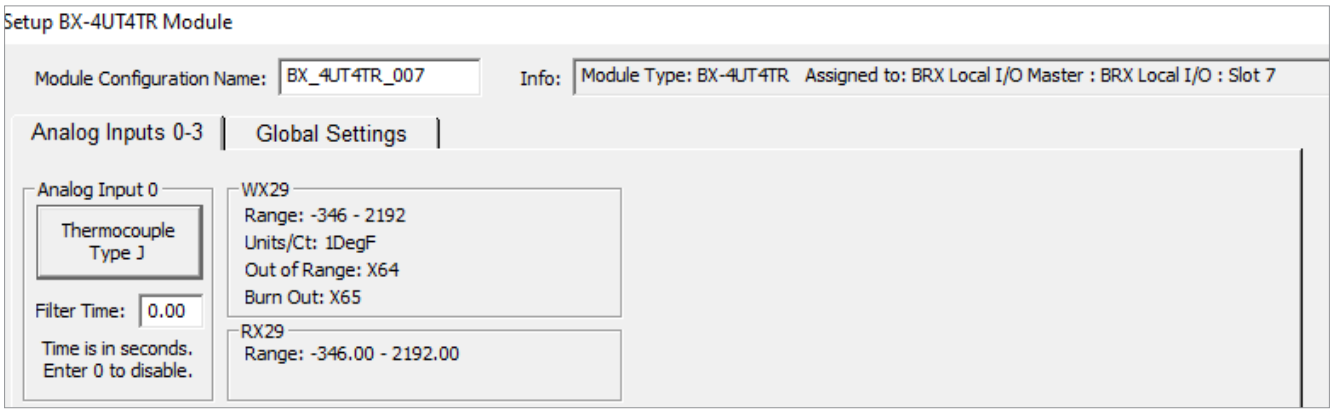
   Probe/Range – Select the style of device for this channel.

   Apply to Current Channel – Apply these settings to just this one channel.

   Apply to All Channels – Apply these settings to every channel on the card.

   Cancel – Make no changes and leave this dialog.

BX-4UT4TR Universal Temperature Input/ Relay Output, continued



3. *WXx*

   Range – The temperature in whole degrees for the selected channel on the module.

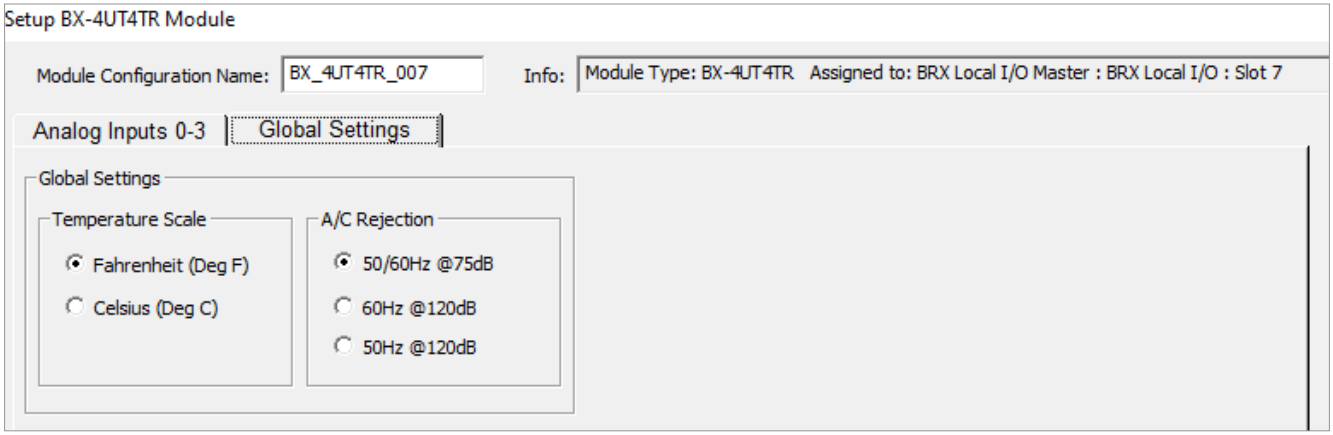
   Units/Ct – The amount of temperature change that will equal 1 raw count.

   Out of Range – The input register that, when On, will indicate that the input is outside of the range selected.

   Burn Out – If burn out is enabled, this register will be On when the loop is broken.

4. *RXx*

   Range – The floating point value of the channel temperature.



5. *Temperature Scale*

   Select Fahrenheit or Celsius.

6. *A/C Rejection*

   The rejection range for the common mode rejection. This is typically set to the AC line frequency at the installation.

BRX Motion Control, Communications & Specialty Modules



In This Chapter...

Overview 9-2
Module Types 9-2
Wiring Termination Options 9-4
General Specifications 9-6
Dimensional Information 9-6
Module Installation 9-7
Module Configuration 9-8
BX-HSIO1 and BX-HSIO2 High Speed Input/Output Modules 9-9
BX-HSIO4 High Speed Input/Output Module 9-11
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BX-SERIO Serial Communications Module 9-17
BX-SERIO-2 Serial Communications Module 9-20
BX-SERIO-4 Serial Communications Module 9-23
BX-APAD Active Filling Module 9-26

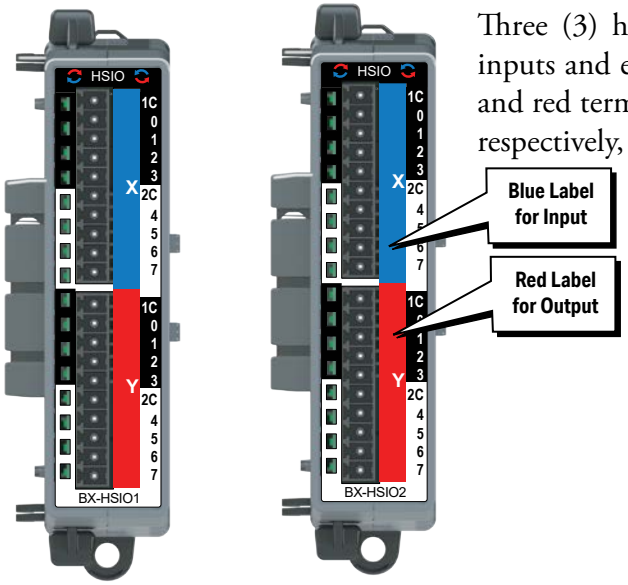
Overview

One key feature of the BRX platform is its ability to easily expand its capability to fit your application solution. One of the ways the BRX platform can do this is by using expansion modules that conveniently "snap-on" to the side of any BRX MPU.

The motion control, communications and specialty expansion modules currently include high-speed I/O modules, serial communications modules and an active padding module.

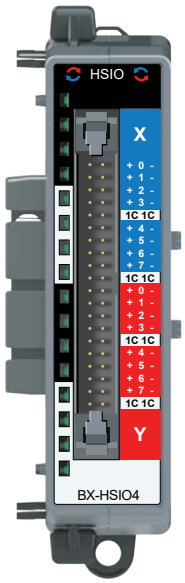
Module Types

High-Speed Input/Output Modules



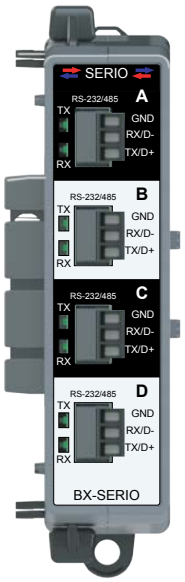
Three (3) high-speed input/output modules are available, with eight inputs and eight outputs. High-speed I/O module faceplates have blue and red terminal bar sections to distinguish input and output terminals, respectively, and have the symbol to signify high-speed I/O.

The table below shows the high-speed I/O modules and their input/output types.



High-Speed Input/Output Module			
Identifier	**HSIO1**	**HSIO2**	**HSIO4**
Input Type	12–24 VDC Sink/Source	12–24 VDC Sink/Source	2.5–5 VDC Sink/Source
Number of Inputs	8	8	8
Output Type	12–24 VDC Sinking	12–24 VDC Sourcing	5VDC Differential
Number of Outputs	8	8	8
Max Frequency	250kHz	250kHz	2MHz

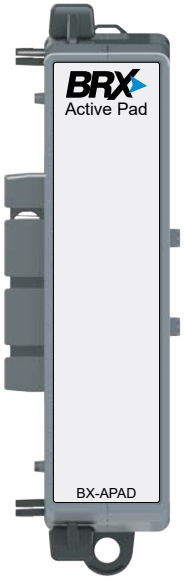
Serial Communications Modules



Three (3) serial communications modules are available, with four serial ports. Serial communications module faceplates have black and white terminal sections to distinguish serial terminals, and have the ⇄ symbol to signify serial I/O. The table below shows the serial I/O module and its port types.

Serial Input/Output Module			
Identifier	**SERIO**	**SERIO-2**	**SERIO-4**
Port Type	RS-232 / RS-485	RS-232 with Flow Control	RS-422
Number of Ports	4	4	4

Active Padding Module



One (1) active padding module is available. This module emulates other BRX modules in the I/O configuration of a BRX system. It is configured in software to emulate the address space of a specific BRX module. The padding module can be used to reserve address space so that addressing in subsequent modules does not change if a module is removed.

Wiring Termination Options

The BRX high-speed input/output expansion modules ship without wiring terminal blocks. This allows you to select the termination style that best fits your application. There are several wiring options available, including screw type terminal connectors with either 90° or 180° (straight) termination angle, and a 180° (straight) spring clamp type connector. The BX-HSIO1 and HX-HSIO2 high-speed I/O modules are not compatible with the ***ZIP***Link Wiring System. The BX-HSIO4 high-speed I/O module **requires** the ***ZIP***Link Wiring System.

NOTE: *The BX-HSIO4 high-speed I/O module requires the ZIPLink Wiring System.*

The BRX serial communications expansion modules ship with four (4) removable screw terminal connectors. Replacement terminal connectors are available.

Terminal Block Connectors

The terminal block connectors for the high-speed I/O modules include (2) 10-pin 3.81-mm connectors in kits as a single part number. Replacement terminal block connectors for the serial communications module are sold individually.

Terminal block kit part numbers and connector specifications are listed in the following table.

Terminal Block Specifications

Module	BX-HSIO1/BX-HSIO2			BX-SERIO	BX-SERIO-2	BX-SERIO-4
Part Number	BX-RTB10	BX-RTB10-1	BX-RTB10-2	BX-RTB03S	BX-RTB05S	
Connector Type	Screw Type 90 degree	Spring Clamp Type 180 degree	Screw Type 180 degree	Screw Type 90 degree	Screw Type 90 degree	
Wire Exit	180 degree	180 degree	180 degree	180 degree	180 degree	
Pitch	3.81 mm	3.81 mm	3.81 mm	3.5 mm	3.5 mm	
Screw Size	M2	N/A	M2	M2	M2	
Screw Torque Recommended	<1.77 lb·in (0.2 N·m)	N/A	<1.77 lb·in (0.2 N·m)	<1.77 lb·in (0.2 N·m)	<1.77 lb·in (0.2 N·m)	
Screwdriver Blade Width	2.5 mm	2.5 mm	2.5 mm	2.5 mm	2.5 mm	
Wire Gauge (Single Wire)	28–16 AWG	26–18 AWG	30–16 AWG	28–16 AWG	28–16 AWG	
Wire Gauge (Dual Wire)	28–18 AWG	30–20 AWG (Dual Wire Ferrule Required)	30–18 AWG	28–16 AWG	28–16 AWG	
Wire Strip Length	0.24 in (6mm)	0.35 in (9mm)	0.26 in (6.5 mm)	0.24 in (6mm)	0.24 in (6mm)	
Equiv. Dinkle P/N	EC381V-10P-BK	ESC381V-10-BK	EC381F-10P-BK	EC350V-03P-BK	EC350V-05P-BK	


BX-RTB10 Kit


BX-RTB10-1 Kit


BX-RTB10-2 Kit


BX-RTB03S Kit


BX-RTB05S Kit

NOTE: *Four (4) BX-RTB03S terminal blocks are included with BX-SERIO expansion module.*
Four (4) BX-RTB05S terminal blocks are included with BX-SERIO-2 and BX-SERIO-4 expansion modules.

*ZIP*Link Wiring System

BRX digital expansion modules can be quickly connected to convenient ***ZIP***Link remote terminal blocks for ease of wiring remote I/O devices. Your ***ZIP***Link selection is dependent on the number of expansion module terminal points. The following tables list the connector options.

16-Point BRX High Speed I/O Expansion Module *ZIP*Link Selector

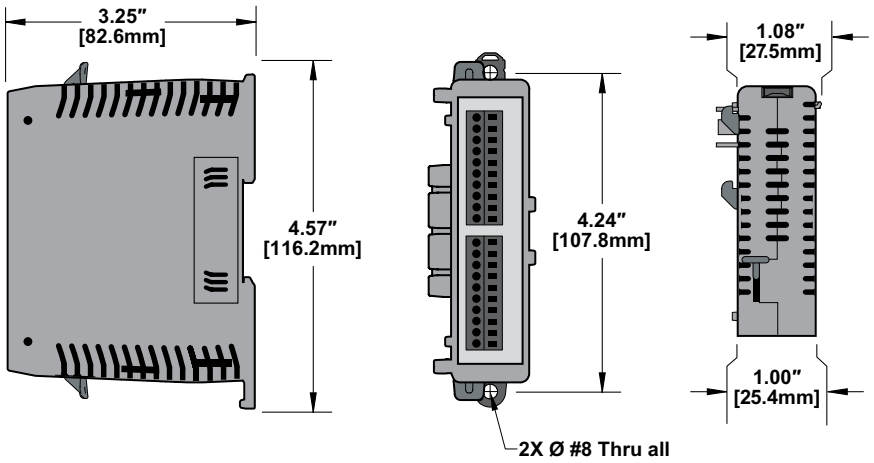
Expansion Module Part No.	ZIPLink Module	ZIPLink Module Part No.	Qty Needed	ZIPLink Cable Part No.	Qty Needed
BX-HSIO4	Feedthrough	ZL-RTB40 (standard) -OR- ZL-RTB40-1 (compact)	1	ZL-BX-CBL40-S ZL-BX-CBL40-1S	1

General Specifications

All BRX motion control and communications expansion modules have the same general specifications listed in the table below.

General Specifications	
Operating Temperature	0° to 60°C (32° to 140°F)
Storage Temperature	−20° to 85°C (−4° to 185°F)
Humidity	5 to 95% (non-condensing)
Environmental Air	No corrosive gases permitted
Vibration	IEC60068-2-6 (Test Fc)
Shock	IEC60068-2-27 (Test Ea)
Enclosure Type	Open Equipment
Noise Immunity	NEMA ICS3-304
EU Directive	See the “EU Directive” topic in the BRX Help File.

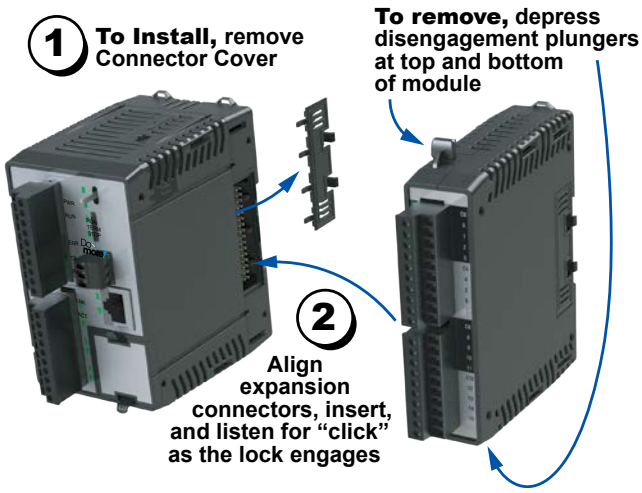
Dimensional Information



Module Installation

WARNING: Do not apply field power until the following steps are completed. The BRX expansion modules are NOT hot swappable.

To install an expansion module, remove the connector cover on the right side of the MPU or expansion module the new module is to be connected to. Align the expansion connectors, insert the module until you hear a "click", indicating the module expansion connectors have engaged.



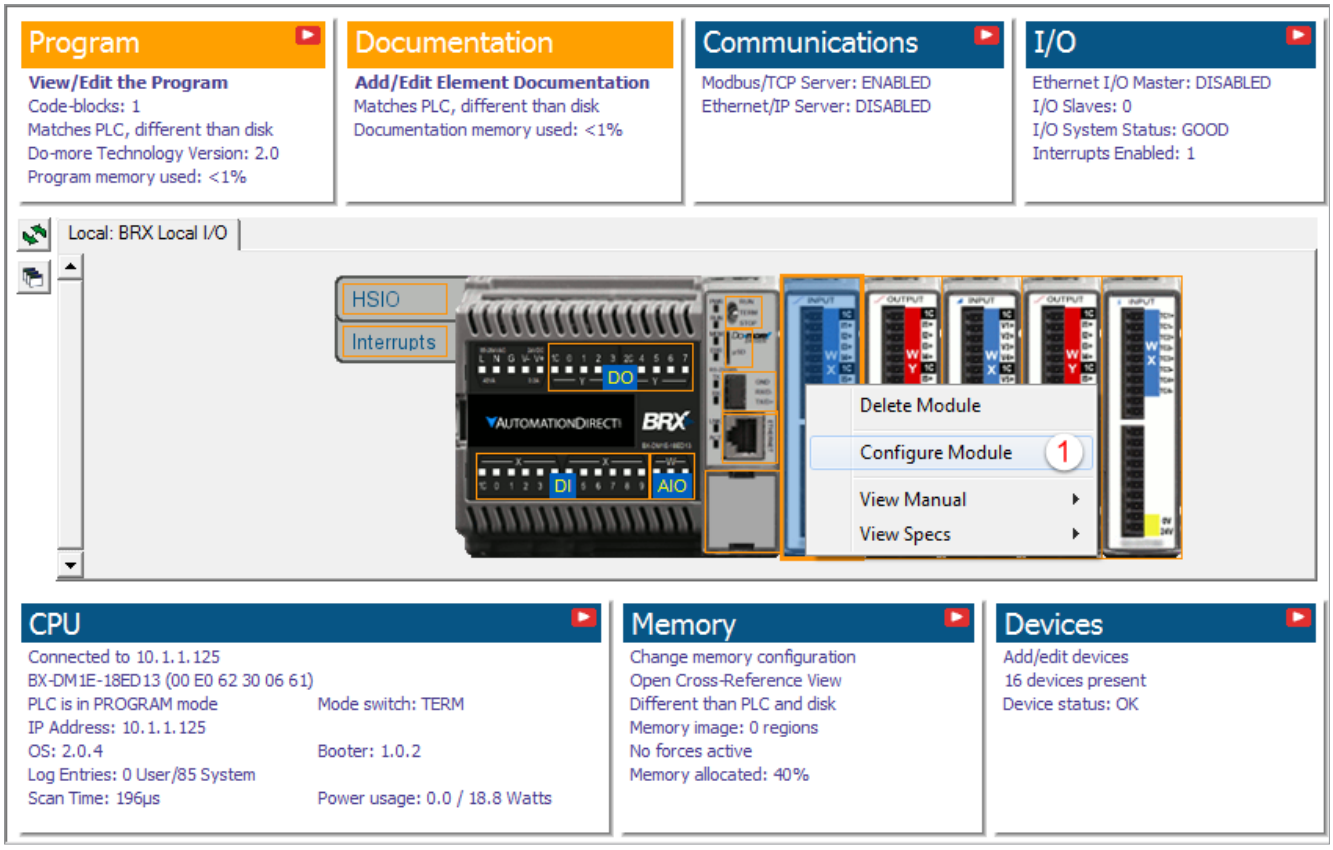
To remove an expansion module locate the two disengagement plungers. One is located at the top of the of the expansion module and a second one at the bottom of the expansion module. Depressing both plungers at the same time will release the locking mechanism and disengage the unit from the system.

NOTE: *Allow a minimum of 45mm (1.75 in) to the right of MPU chassis or any subsequent expansion modules for mounting and dismounting of the modules.*

Module Configuration

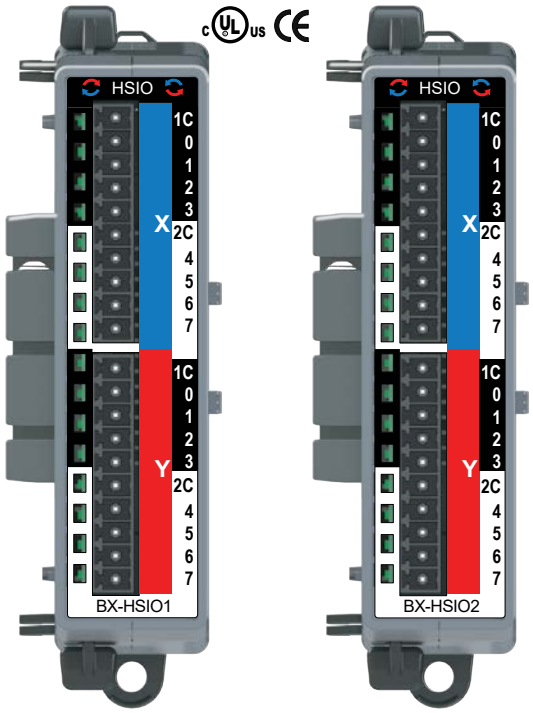
Once the expansion module has snapped in place and is added to the project, it instantly adds additional I/O and features to the MPU with minimal additional setup required.

To configure a newly attached module, load the Do-more! Designer software and connect to the BRX MPU, as discussed in the Do-more! Designer Software Getting Started Guide (DMD-GSG-M) which can be found at http://support.automationdirect.com/products/domore.html. A graphical representation of the BRX unit with its attached modules is displayed in the Dashboard of the software.



To access the module configuration dialogs, left-click or right-click on the module in the Dashboard and select (1) **Configure Module**. The configuration dialogs for each module are discussed in the corresponding section of this chapter.

BX-HSIO1 and BX-HSIO2 High Speed Input/Output Modules



Terminal Blocks Sold Separately

NOTE: This device does not support ZIPLink Wiring Systems.

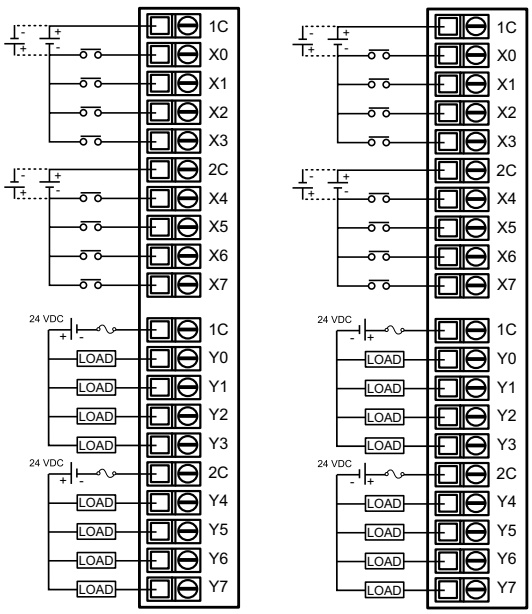
NOTE: Cannot be used in Remote I/O Bases.

IMPORTANT!

Hot-Swapping Information

NOTE: This device cannot be Hot Swapped.

High Speed Input/Output Wiring



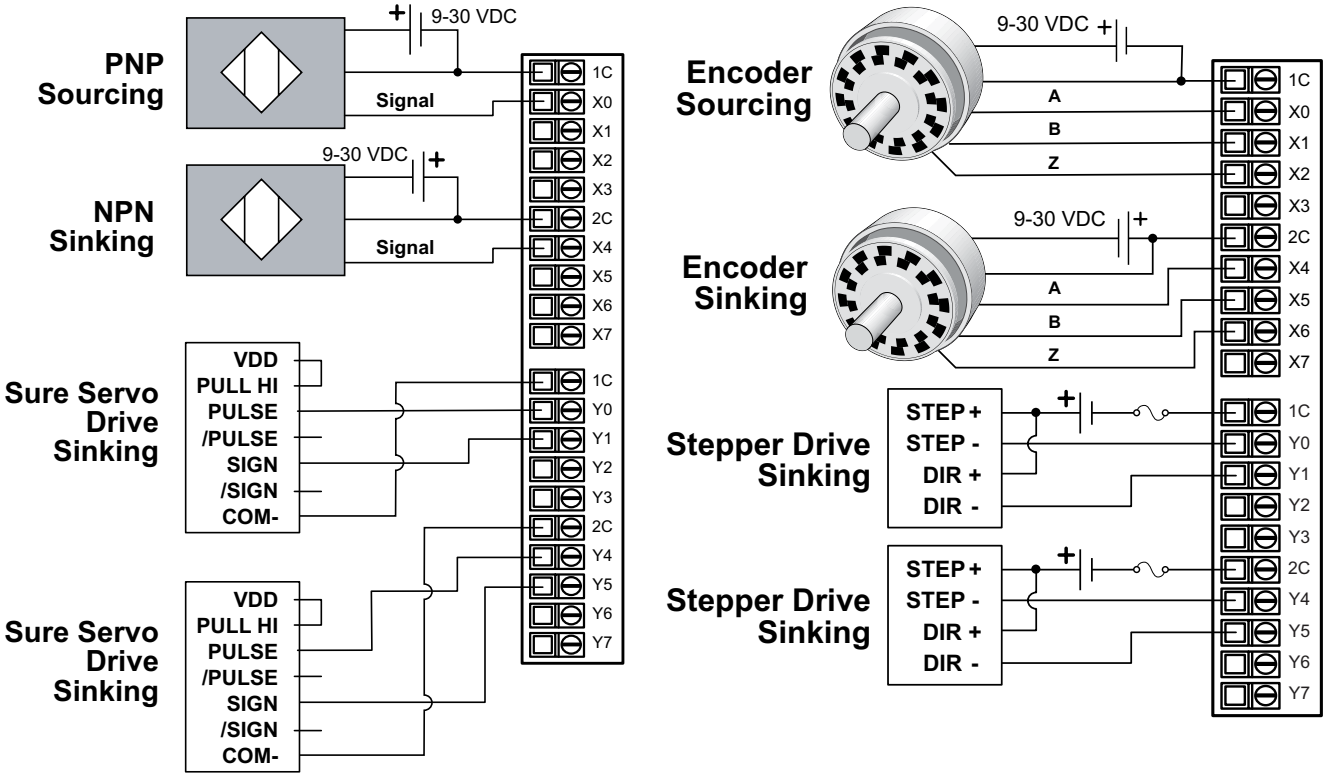
High Speed Input/Output Specifications

Specification	BX-HSIO1	BX-HSIO2
High Speed Input Specifications		
Type	Sink/Source	
Total Input Points per Module	8	
Commons	2 (4 points/common) Isolated	
Nominal Voltage Range*	12–24 VDC	
Input Voltage Range*	9–30 VDC	
Maximum Voltage	30VDC	
DC Frequency	0–250 kHz	
Minimum Pulse Width	0.5 µs	
Input Impedance	3kΩ @ 24VDC	
Input Current (typical)	4mA @ 24VDC	
Maximum Input Current	8mA @ 30VDC	
ON Voltage Level	> 9.0 VDC	
OFF Voltage Level	< 2.0 VDC	
Minimum ON Current	3.0 mA (9V req'd to guarantee ON state)	
Maximum OFF Current	1.5 mA	
Status Indicators	Logic Side, Green	
OFF to ON Response	< 2µs	
ON to OFF Response	< 2µs	
High Speed Output Specifications		
Type	Sinking	Sourcing
Total Output Points per Module	8	
Commons	2 (4 points/common) Isolated	
Maximum Current per Common	2A	
Nominal Voltage Range*	12–24 VDC	
Operating Voltage Range*	5–36 VDC	
Maximum Voltage	36VDC	
Minimum Output Current	0.1 mA @ 24VDC	
Maximum Load Current	0.5 A per Output, No derating over temperature range	
Maximum Inrush Current	5A for 50ms	
Maximum Leakage Current	10µA	
ON Voltage Drop	0.5 VDC	
Status Indicators	Logic Side, Green	
OFF to ON Response	< 2µs	
ON to OFF Response	< 2µs	
Maximum Switching Frequency	250kHz (1m cable), 100kHz (10m cable)	
Overcurrent, Short Circuit Protection and Short to Ground	Protected by common group of 4 outputs. If tripped, Common terminal Red LED will be ON, others OFF. Self-Resetting.	
Overcurrent Trip Level	4A minimum, 8A maximum	
Fuse Type	User-supplied external fuse	
General		
Backplane Power Consumption	2.2 W	
Heat Dissipation	5.7 W	
Weight	85g (3oz)	
Agency Approvals	UL 61010-2-201 File #E185989 Canada and USA, CE (Immunity: EN61131-2: 2007)	
Software Version Required	Do-more! Designer v2.5 or later	

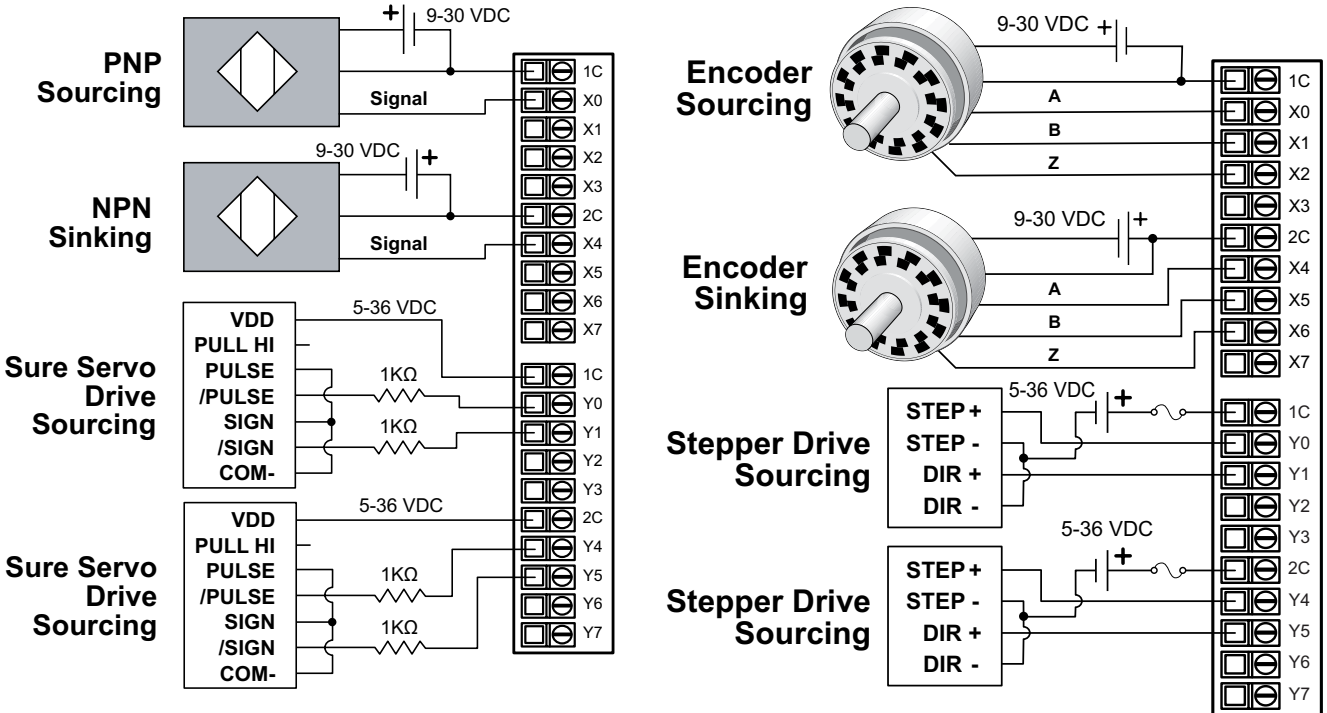
**** Class 2 or LPS Power Supply required.***

BX-HSIO1 and BX-HSIO2 High Speed I/O Modules, continued

BX-HSIO1 High Speed Input/Output Wiring



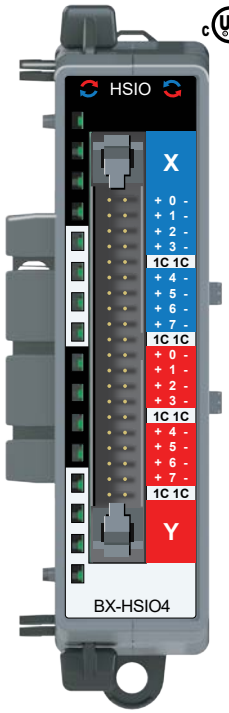
BX-HSIO2 High Speed Input/Output Wiring



Note: VDD = 24VDC – 1KΩ resistor is needed for servo to handle this voltage. The 1KΩ resistors are not needed if a 5VDC source is used.

NOTE: *Stepper power supplies should be separated from other components. Never place a stepper drive on the same power supply as the PLC or it's I/O.*

BX-HSIO4 High Speed Input/Output Module



*NOTE: This device **requires** ZIPLink Wiring Systems.*

NOTE: Cannot be used in Remote I/O Bases.

IMPORTANT!

Hot-Swapping Information

NOTE: This device cannot be Hot Swapped.

High Speed Input/Output Specifications	
High Speed Input Specifications	
Type	High Speed TTL Differential or Single Ended
Total Input Points per Module	8
Commons	1
Nominal Voltage Range	5VDC
Input Voltage Range	-5.5 to 5.5 VDC
Maximum Voltage	5.5 VDC
DC Frequency	0–2 MHz
Minimum Pulse Width	125ns
Input Impedance	694Ω @ 5VDC
Input Current (typical)	±7mA @ 5VDC
Maximum Input Current	10mA @ 5.5 VDC
ON Voltage Level	> +2.5 VDC differential
OFF Voltage Level	< +1.0 VDC differential
Hysteresis	50mV typical
Status Indicators	Logic Side, Green
OFF to ON Response	<125ns
ON to OFF Response	<125ns
High Speed Output Specifications	
Type	High Speed TTL Differential or Single Ended
Total Output Points per Module	8
Commons	1
Maximum Current per Common	160mA
Power Supply	Internal +5VDC
Maximum Voltage	5.5 VDC
Minimum Output Current	1µA
Maximum Load Current	20mA per Output
Maximum Leakage Current	±20µA
Differential Output Voltage	>3.0 VDC
Status Indicators	Logic Side, Green
OFF to ON Response	<125ns
ON to OFF Response	<125ns
Maximum Switching Frequency	2MHz
Overcurrent, Short Circuit Protection and Short to Ground	Protected
Overcurrent Trip Level	150mA maximum
Fuse Type	User-supplied external fuse
General	
Backplane Power Consumption	2.6 W
Heat Dissipation	3.0 W
Weight	85g (3oz)
Agency Approvals	UL 61010-2-201 File #E185989 Canada and USA, CE (Immunity: EN61131-2: 2007)
Software Version Required	Do-more! Designer v2.8 or later

BX-HSIO4 High Speed I/O Module, continued

BX-HSIO4 High Speed Input/Output Wiring

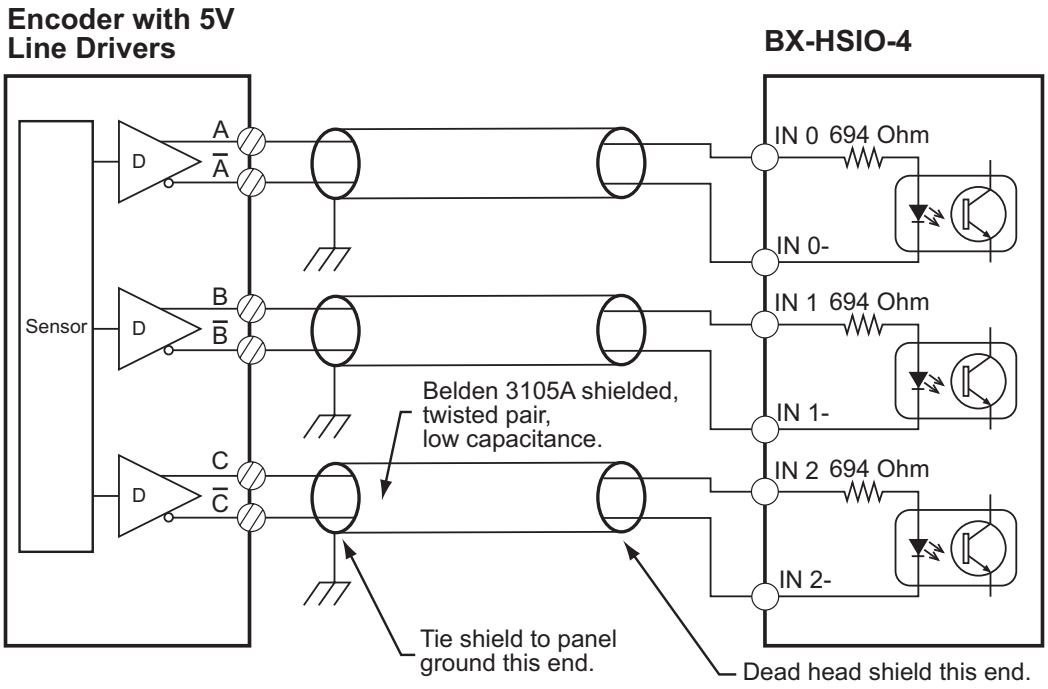
*ZIP*Link Terminal Block Wiring Connections for BX-HSIO4

Wiring Connections for ZL-RTB40 Terminal Block																						
MODULE	LABELS																					LEVEL
BX-HSIO4	IN 0-	IN 1-	IN 2-	IN 3-	COM	IN 4-	IN 5-	IN 6-	IN 7-	COM	OUT 0-	OUT 1-	OUT 2-	OUT 3-	COM	OUT 4-	OUT 5-	OUT 6-	OUT 7-	COM	UPPER
	IN 0+	IN 1+	IN 2+	IN 3+	COM	IN 4+	IN 5+	IN 6+	IN 7+	COM	OUT 0+	OUT 1+	OUT 2+	OUT 3+	COM	OUT 4+	OUT 5+	OUT 6+	OUT 7+	COM	LOWER
TERMINAL BLOCK LABEL SHEET FOR ZIPLINK CABLE ZL-BX-CBL40-xS																						

Wiring Connections for ZL-RTB40-1 Terminal Block																	
MODULE	LABELS																LEVEL
BX-HSIO4	COM		COM		COM		COM		COM		COM		COM		COM		UPPER
	IN 0-	IN 1-	IN 2-	IN 3-	IN 4-	IN 5-	IN 6-	IN 7-	OUT 0-	OUT 1-	OUT 2-	OUT 3-	OUT 4-	OUT 5-	OUT 6-	OUT 7-	MIDDLE
	IN 0+	IN 1+	IN 2+	IN 3+	IN 4+	IN 5+	IN 6+	IN 7+	OUT 0+	OUT 1+	OUT 2+	OUT 3+	OUT 4+	OUT 5+	OUT 6+	OUT 7+	LOWER
TERMINAL BLOCK LABEL SHEET FOR ZIPLINK CABLE ZL-BX-CBL40-xS																	

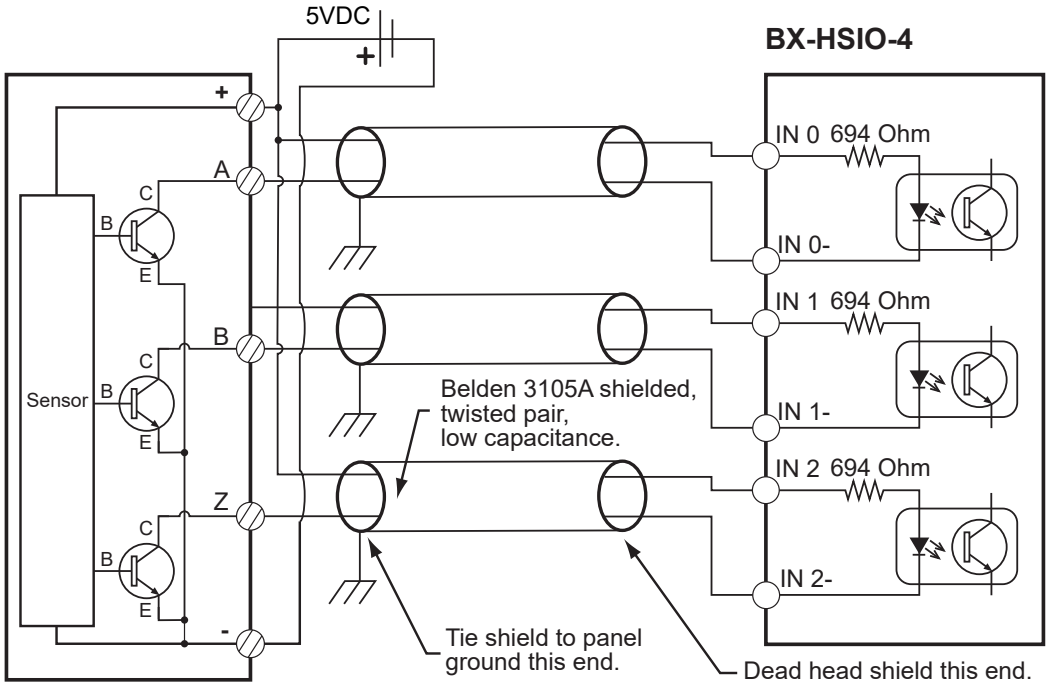
Differential 5V Encoder Input to BX-HSIO4

To prevent damage to 5V inputs,
do not exceed 6.8V or 30 mA on inputs

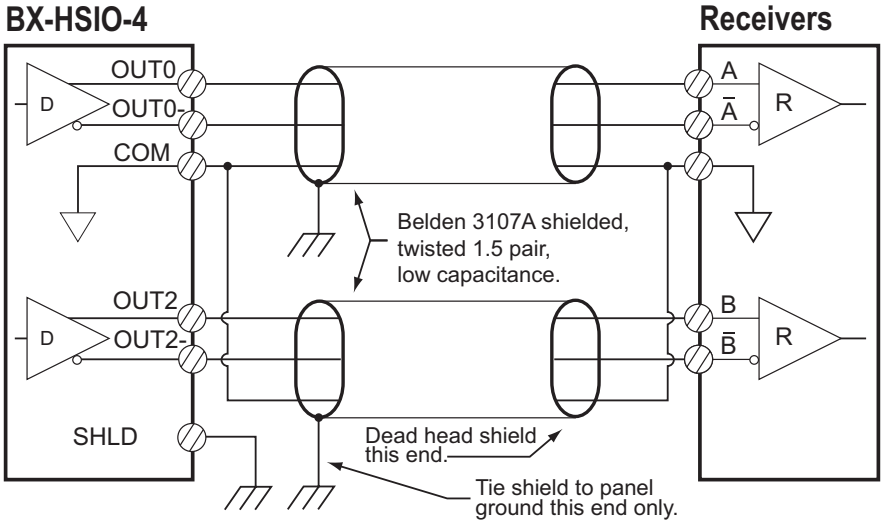


BX-HSIO4 High Speed I/O Module, continued

Single-Ended 5V Encoder Input to BX-HSIO4

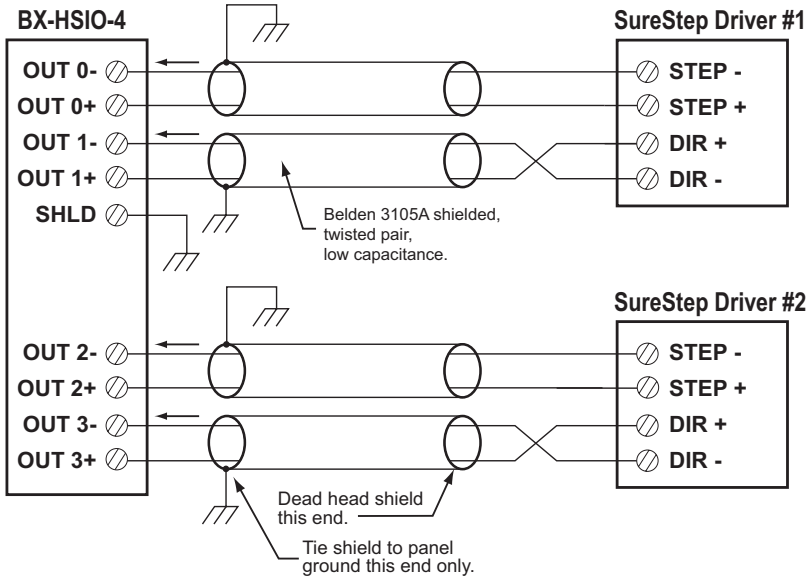


Line Driver Pulse Output from BX-HSIO4

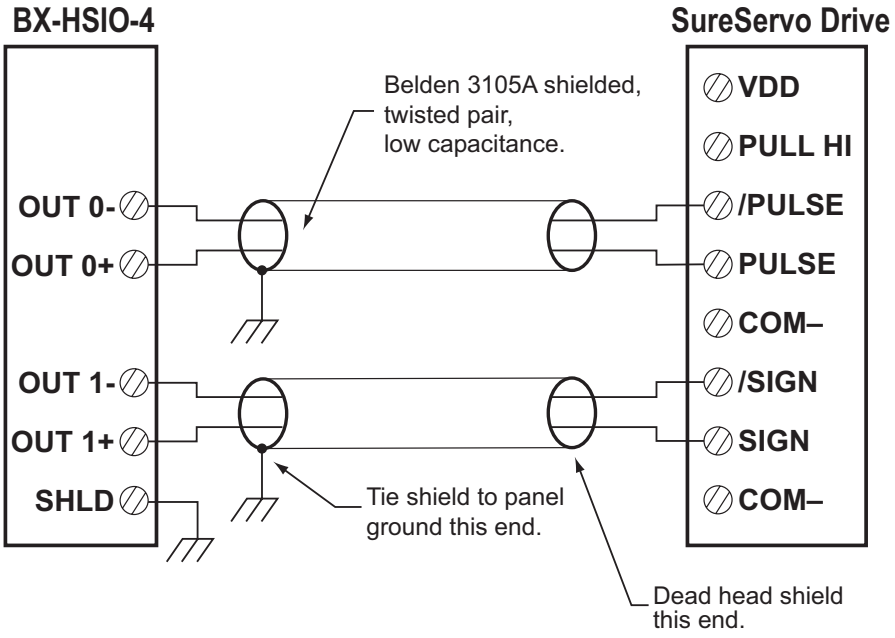


BX-HSIO4 High Speed I/O Module, continued

BX-HSIO-4 to SureStep

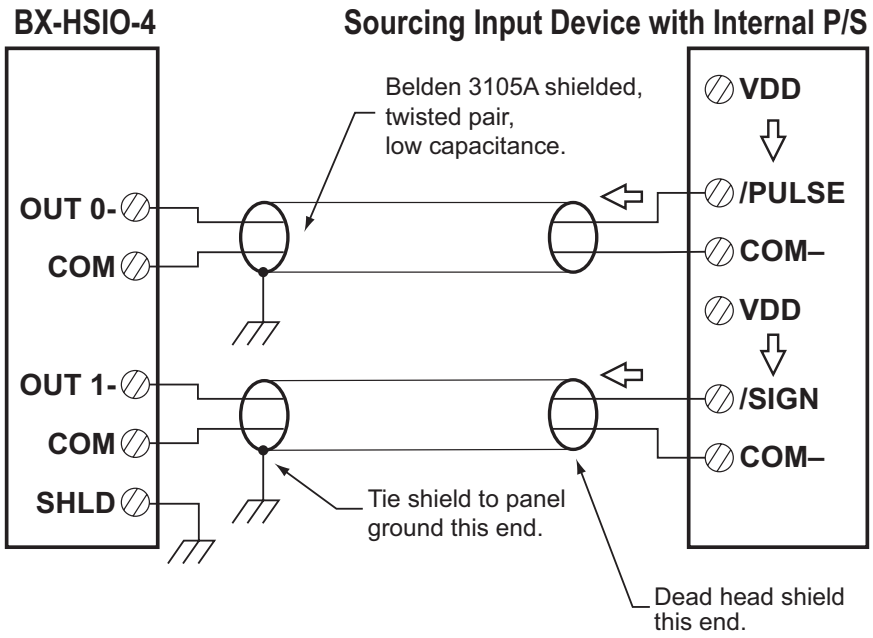


BX-HSIO-4 to SureServo



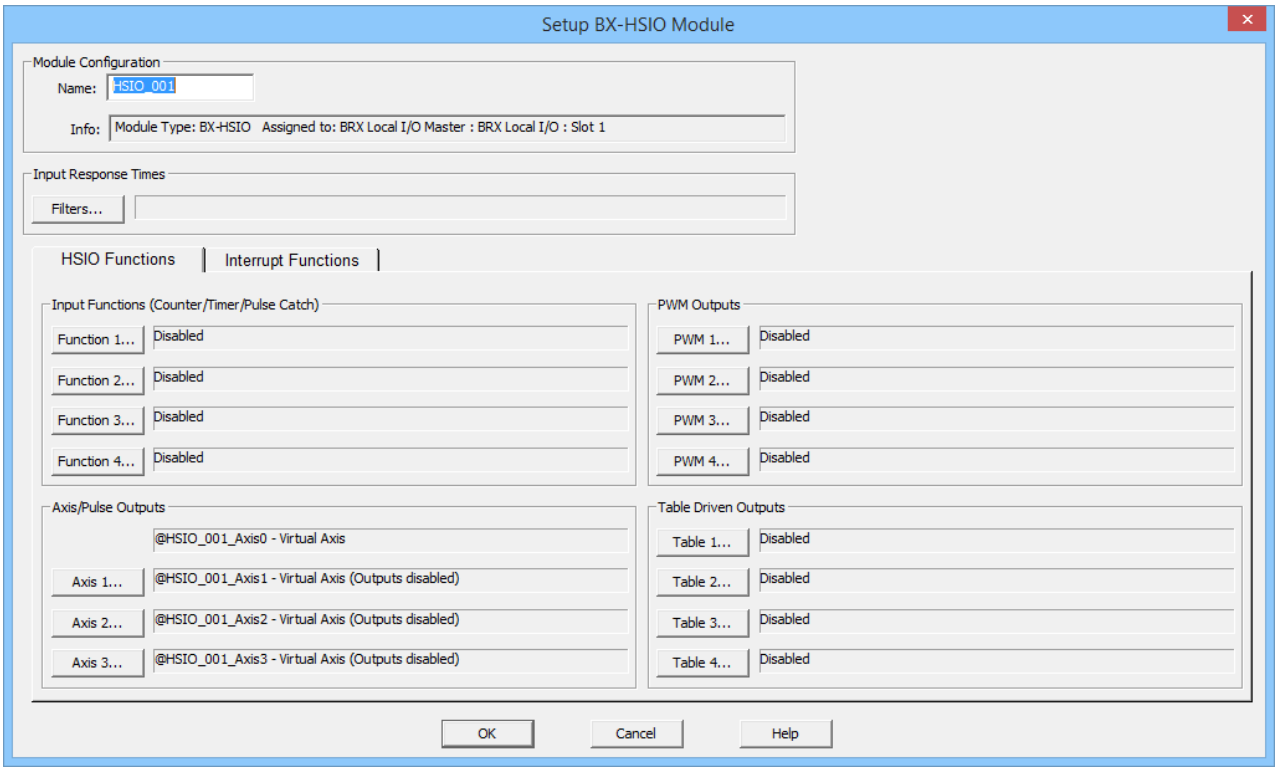
BX-HSIO4 High Speed I/O Module, continued

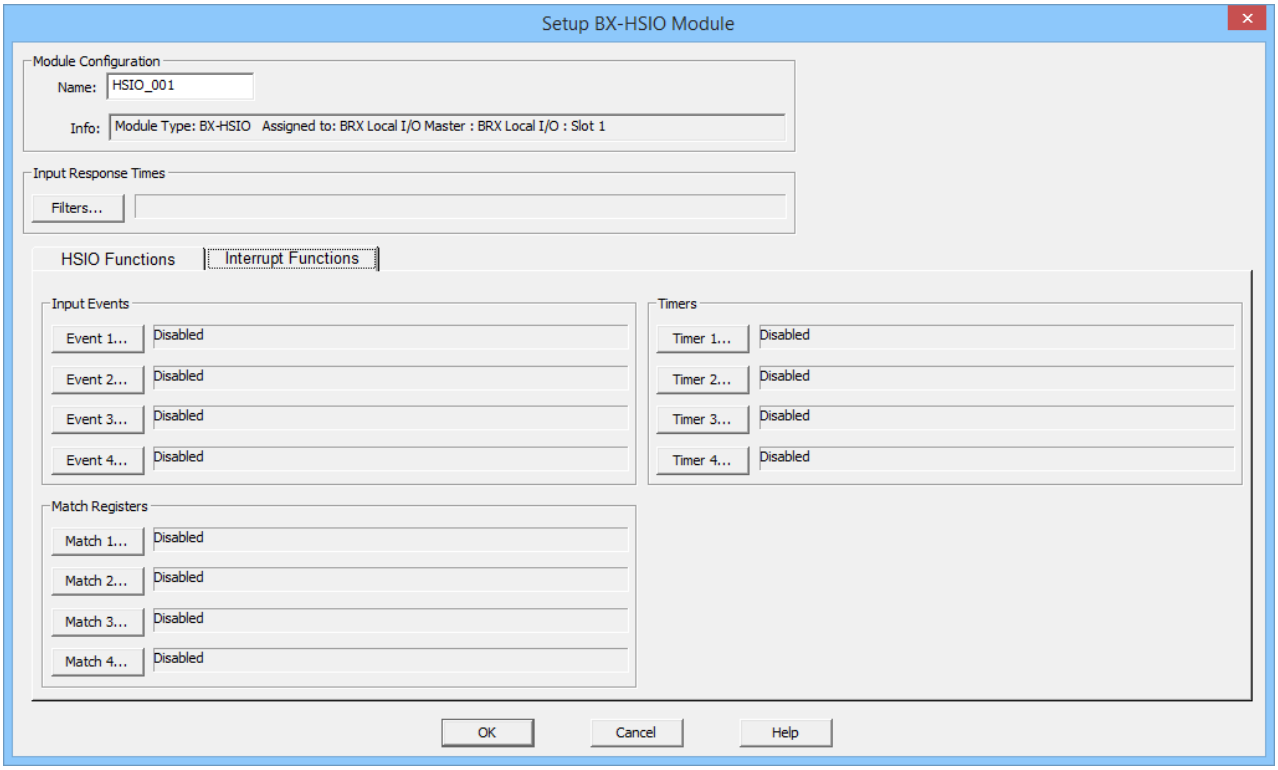
BX-HSIO-4 to Sourcing Input Device with Internal Power Supply



BX-HSIOx High Speed I/O Modules Setup

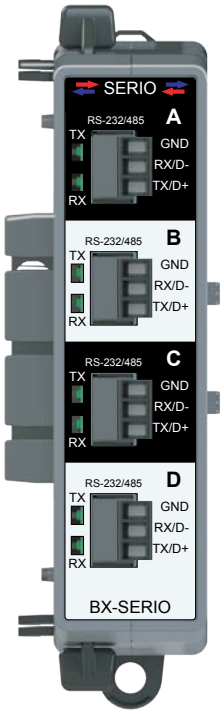
The *Setup BX-HSIO Module* page for the BX-HSIOx expansion I/O modules will be displayed when the user right-clicks or left-clicks on one of the high-speed expansion modules. Input/Output and Interrupt functions are separated into the *HSIO Functions* and *Interrupt Functions* tabs, respectively.





Please see Chapter 11 in this user manual for detailed information on how to setup the I/O for use with the high-speed functions, to review various wiring examples, to review detailed programming examples and to learn more about the available high-speed instructions.

BX-SERIO Serial Communications Module



Four (4) Terminal Blocks Included (Part Number BX-RTB03S)

IMPORTANT!

Hot-Swapping Information

NOTE: This device cannot be Hot Swapped.

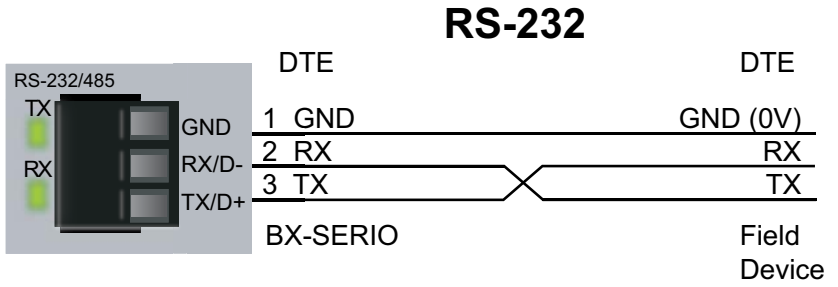
NOTE: Cannot be used in Remote I/O Bases.

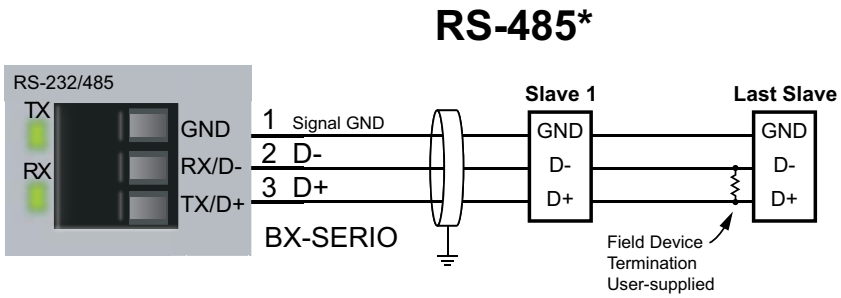
Serial Communications Module Specifications		
Number of Ports	Four RS-232/RS-485 Serial Ports	
Description	Isolated serial port that can communicate via RS-232 or RS-485 (software selectable). Includes ESD protection and built-in surge protection. Includes internal biasing to be a true failsafe receiver while maintaining EIA/TIA-485 compatibility.	
Supported Protocols	Do-more!™ Protocol (Slave)(Default), Modbus RTU (Master/Slave), K-Sequence (Slave), ASCII (In/Out), DMX512 (Master/Slave)	
Data Rates	1200, 2400, 4800, 9600, 19200, 38400, 57600, and 115200 Baud	
Default Settings	RS-232, 115200bps, No Parity, 8 Data Bits, 1 Stop Bit, Station #1, Termination resistor OFF	
Port Status LED	Green LED illuminated when active (TX and RX)	
Port Type	Removable 3-pin terminal strip 3.5 mm pitch	
	RS-232	RS-485
Station Addresses	N/A	1–247
RX/D-	Receive input (RX)	Transceiver low (D-)
TX/D+	Transmit output (TX)	Transceiver high (D+)
GND	Port Ground	
Input Impedance	5kΩ	19kΩ
Terminating Resistor	N/A	120Ω, software selectable
Maximum Load	3kΩ, 1000pf	50 transceivers, 19kΩ each, 120Ω termination
Output Short Circuit Protection	±15mA	±250mA, thermal shutdown protection
Electrostatic Discharge Protection	±1.5 kV per JESD22-C101	±7kV per IEC 61000-4-2
Electrical Fast Transient Protection	±2kV per IEC 61000-4-4	
Min. Output Voltage	±5V with 3kΩ load	Differential: 1.5 V with 60Ω load
Fail Safe Inputs	N/A	Logic high input state if inputs are unconnected
Maximum Common Mode Voltage	500 Vrms to Logic Ground	
Cable Requirements	ADC# L19772-XXX	ADC# L19954-XXX
Maximum Cable Distance	30m [100ft]; 6m [20ft] rec'd max.	1000m [3280ft]
Backplane Power Consumption	1.2 W	
Heat Dissipation	1.2 W	
Weight	85g (3oz)	
Agency Approvals	UL 61010-2-201 File #E185989 Canada and USA, CE (Immunity: EN61131-2: 2007)	
Software Version	Do-more! Designer v2.5 or later	
Replacement Connector	ADC Part # BX-RTB03S	

BX-SERIO Serial Communications Module, continued

Field Wiring

Field Wiring Information

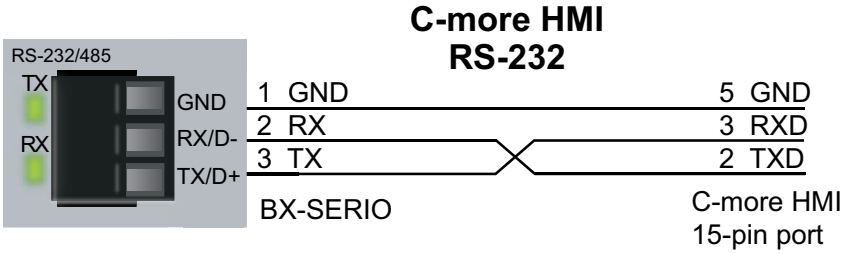


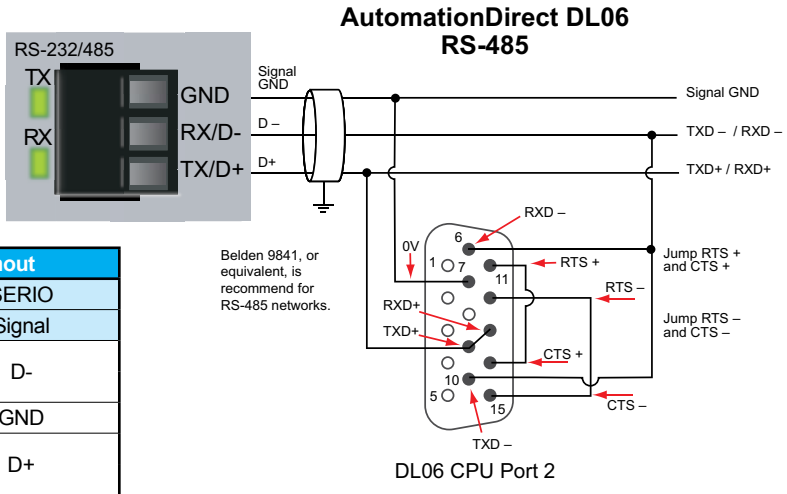


***NOTE:** Termination resistor is built-in and software selectable.

ADC # L19827-xxx or equivalent is recommended for RS-485 networks.

Example Wiring Connections

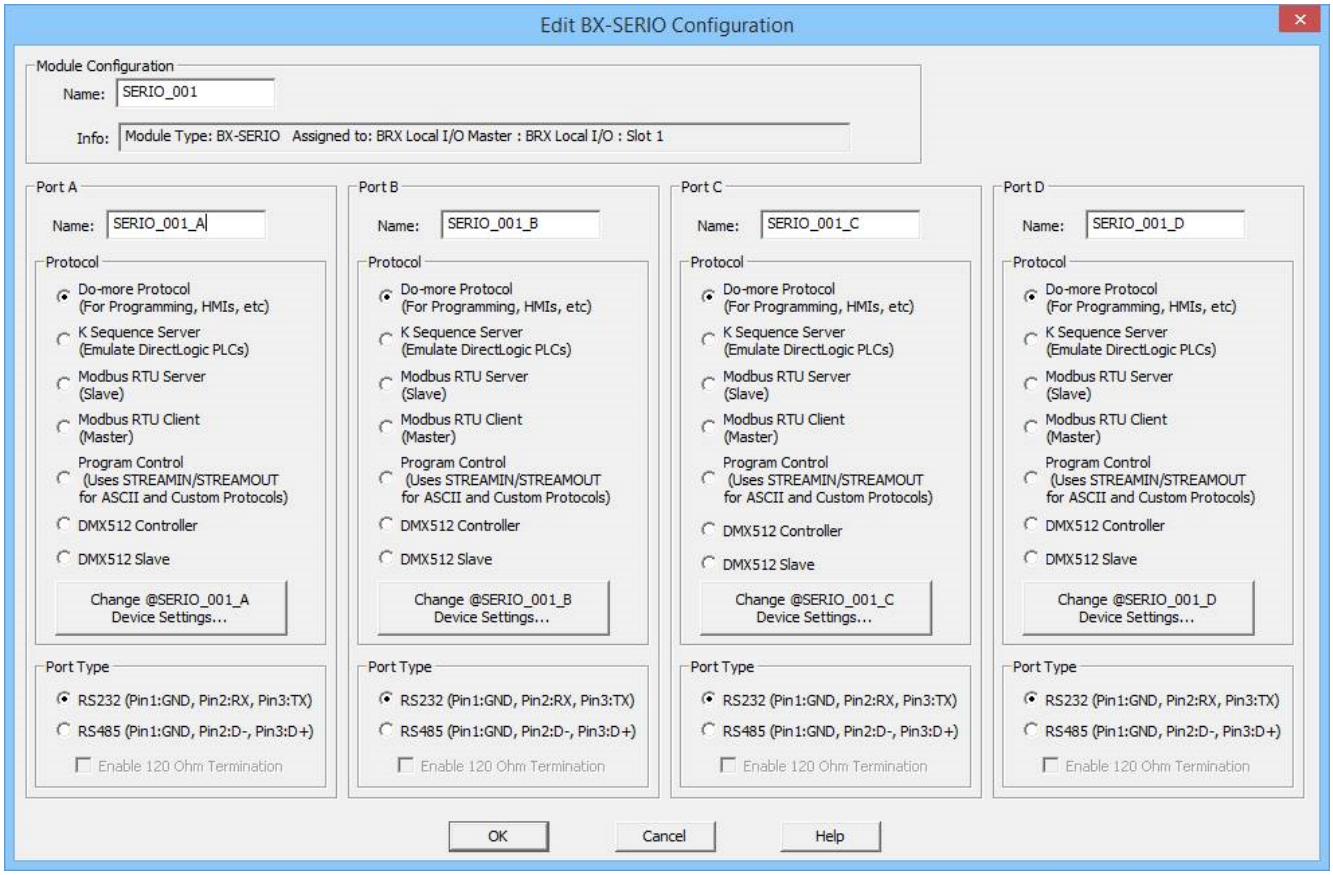




DL06 to BX-SERIO RS-485 Pinout		
DL06		SERIO
Pin	Signal	Signal
6	RXD-	D-
10	TXD-	
7	0V	GND
9	TXD+	D+
13	RXD+	
11/14	RTS+/CTS+	(jumper together)
12/15	RTS-/ CTS-	(jumper together)

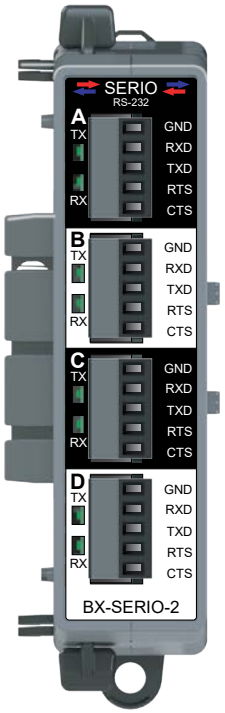
BX-SERIO Serial Communications Module, continued

The ***Setup BX-SERIO Module*** page for the BX-SERIO expansion I/O module will be displayed when the user right-clicks or left-clicks on one of the serial communications expansion modules.



Please see Chapter 12 in this user manual for detailed information on the serial communications capabilities of the BRX platform.

BX-SERIO-2 Serial Communications Module



Four (4) Terminal Blocks Included (Part Number BX-RTB05S)

Serial Communications Module Specifications

Number of Ports	Four RS-232 Serial Ports
Description	Isolated serial port that can communicate via RS-232. Includes ESD protection and built-in surge protection.
Supported Protocols	Do-more! Protocol (Default) Modbus RTU (Master & Slave) K-Sequence (Slave) ASCII (In & Out)
Data Rates	1200, 2400, 4800, 9600, 19200, 38400, 57600, and 115200 Baud
Default Settings	RS-232, 115200bps, No Parity, 8 Data Bits, 1 Stop Bit, Station #1
Port Statu	D and RXD)
Port Type	itch
RXD	
TXD	RS-232 Transmit output
GND	Logic Ground
CTS	RS-232 Clear to Send input
RTS	RS-232 Request to Send input
Maximum Output Load (TXD/RTS)	3kΩ, 1000pf
Minimum Output Voltage Swing	±5VDC
Output Short Circuit Protection	±15mA
Cable Requirements	ADC# L19853-XXX
Maximum Cable Distance	15m [50ft]; RS-232 has a 6m [20ft] recommended max.
Backplane Power Consumption	2.0 W
Heat Dissipation	2.0 W
Weight	85g (3oz)
Agency Approvals	UL 61010-2 File E185989, Canada and USA, CE Compliant EN61131-2
Software Version	Do-more! Designer v2.7 or later
Replacement Connector	ADC Part # BX-RTB05S

NOTE: Cannot be configured in Remote I/O Bases.

IMPORTANT!

Hot-Swapping Information

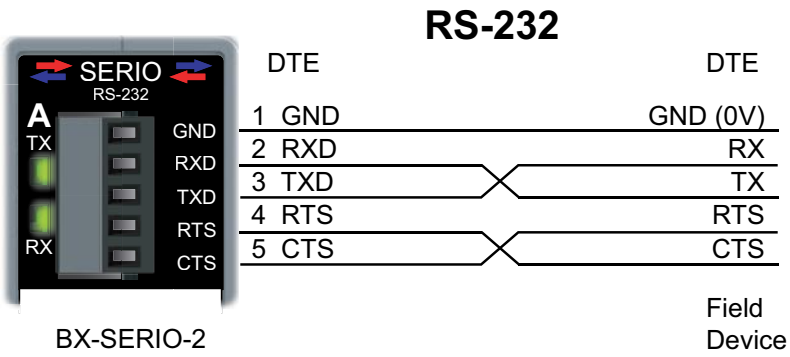
NOTE: This device cannot be Hot Swapped.

NOTE: Cannot be used in Remote I/O Bases.

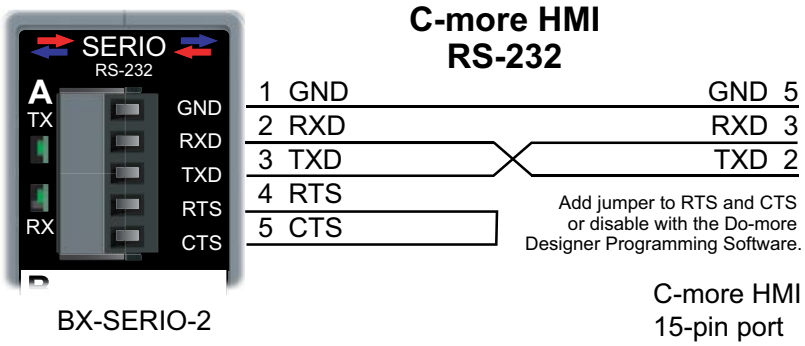
BX-SERIO-2 Serial Communications Module, continued

Field Wiring

Field Wiring Information

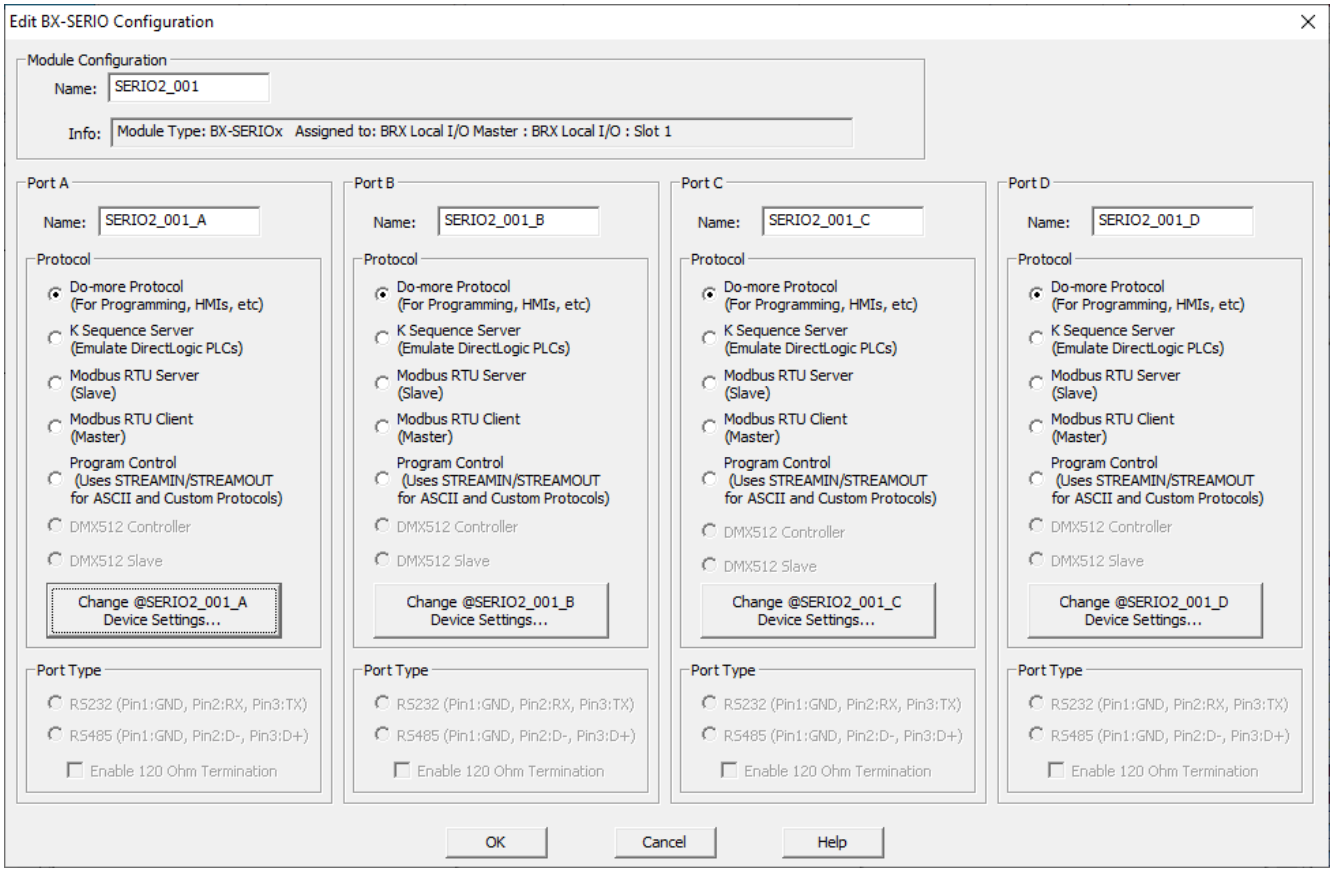


Example Wiring Connections



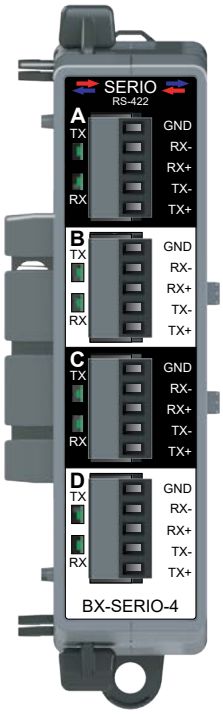
BX-SERIO-2 Serial Communications Module Configuration, continued

The *Setup BX-SERIO Module* page for the BX-SERIO-2 expansion I/O module will be displayed when the user right-clicks or left-clicks on one of the serial communications expansion modules.



Please see Chapter 12 in this user manual for detailed information on the serial communications capabilities of the BRX platform.

BX-SERIO-4 Serial Communications Module



Four (4) Terminal Blocks Included (Part Number BX-RTB05S)

Serial Communications Module Specifications	
Number of Ports	Four RS-422 Serial Ports
Description	Isolated serial port that can communicate via RS-422. Includes ESD protection and built-in surge protection.
Supported Protocols	Do-more! Protocol (Default) Modbus RTU (Master & Slave) K-Sequence (Slave) ASCII (In & Out)
Data Rates	1200, 2400, 4800, 9600, 19200, 38400, 57600, and 115200 Baud
Default Settings	RS-422, 115200bps, No Parity, 8 Data Bits, 1 Stop Bit, Station #1
Port Status LED	Green LED illuminated when active (TX and RX)
Port Type	Removable 5-pin terminal strip 3.5 mm pitch
Station Addresses	1–247
TX-/RX-	RS-422 transceiver low
TX+/RX+	RS-422 transceiver high
GND	Logic Ground
Input Impedance	96kΩ
Maximum Load	1 transceiver, 19kΩ each, 120Ω termination
Output Short Circuit Protection	±250mA, thermal shutdown protection
Minimum Differential Output Voltage	2.0 VDC with 54Ω load
Maximum Common Mode Voltage	-7.5 to 12.5 VDC
Fail Safe Inputs	Logic high input state if inputs are unconnected
Electrostatic Discharge Protection	±15kV per IEC61000-4-2
Cable Requirements	ADC Part# L19853-XXX
Maximum Cable Distance	1000m [3280ft]
Backplane Power Consumption	1.2 W
Heat Dissipation	1.2 W
Weight	85g (3oz)
Agency Approvals	UL 61010-2 File E185989, Canada and USA, CE Compliant EN61131-2
Software Version	Do-more! Designer v2.7 or later
Replacement Connector	ADC Part# BX-RTB05S

IMPORTANT!

Hot-Swapping Information
NOTE: This device cannot be Hot Swapped.

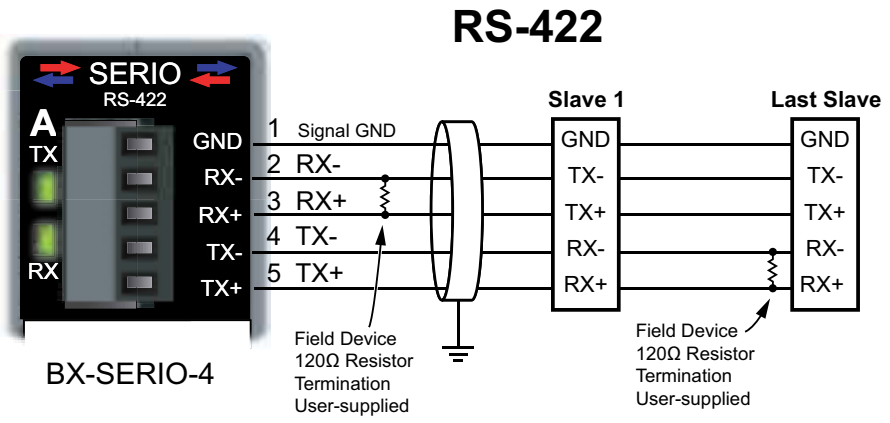
NOTE: Cannot be used in Remote I/O Bases.

NOTE: The BX-SERIO-4 supports point to point wiring only. Multi-Drop wiring is not supported.

BX-SERIO-4 Serial Communications Module, continued

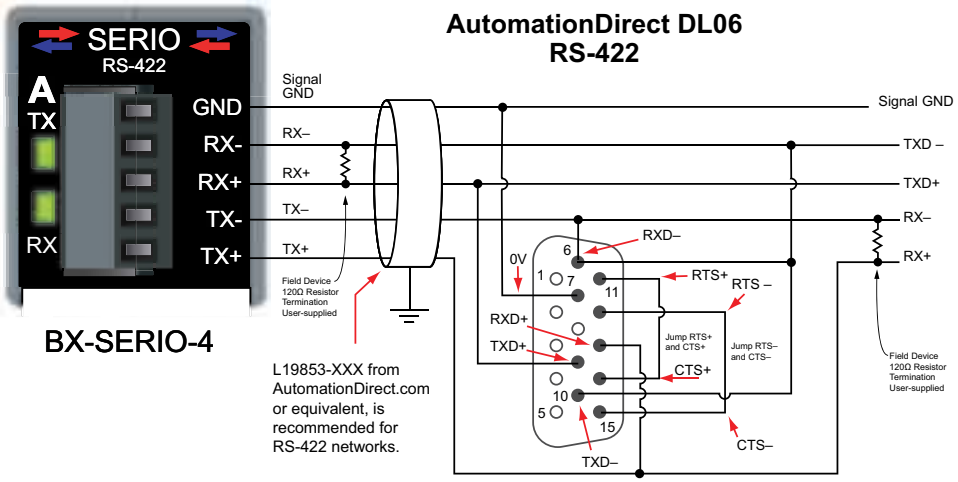
Field Wiring

Field Wiring Information



ADC # L19853-XXX or equivalent is recommend for RS-422 networks.

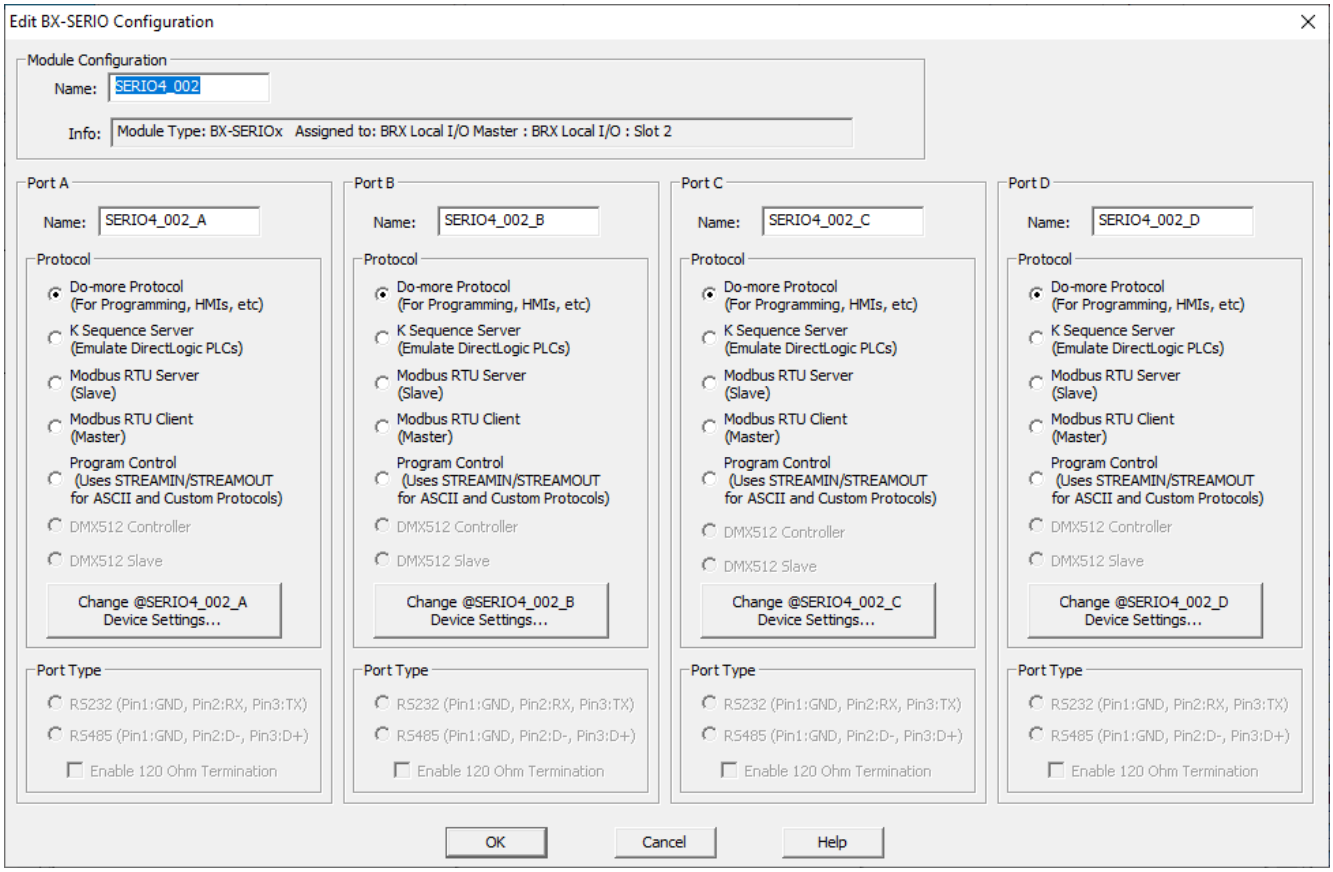
Example Wiring Connections



DL06 CPU Port 2

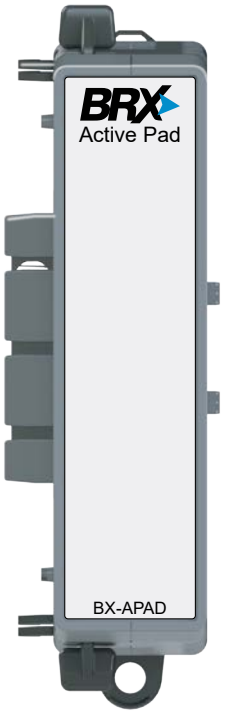
BX-SERIO-4 Serial Communications Module Configuration, continued

The *Setup BX-SERIO Module* page for the BX-SERIO-4 expansion I/O module will be displayed when the user right-clicks or left-clicks on one of the serial communications expansion modules.



Please see Chapter 12 in this user manual for detailed information on the serial communications capabilities of the BRX platform.

BX-APAD Active Filling Module



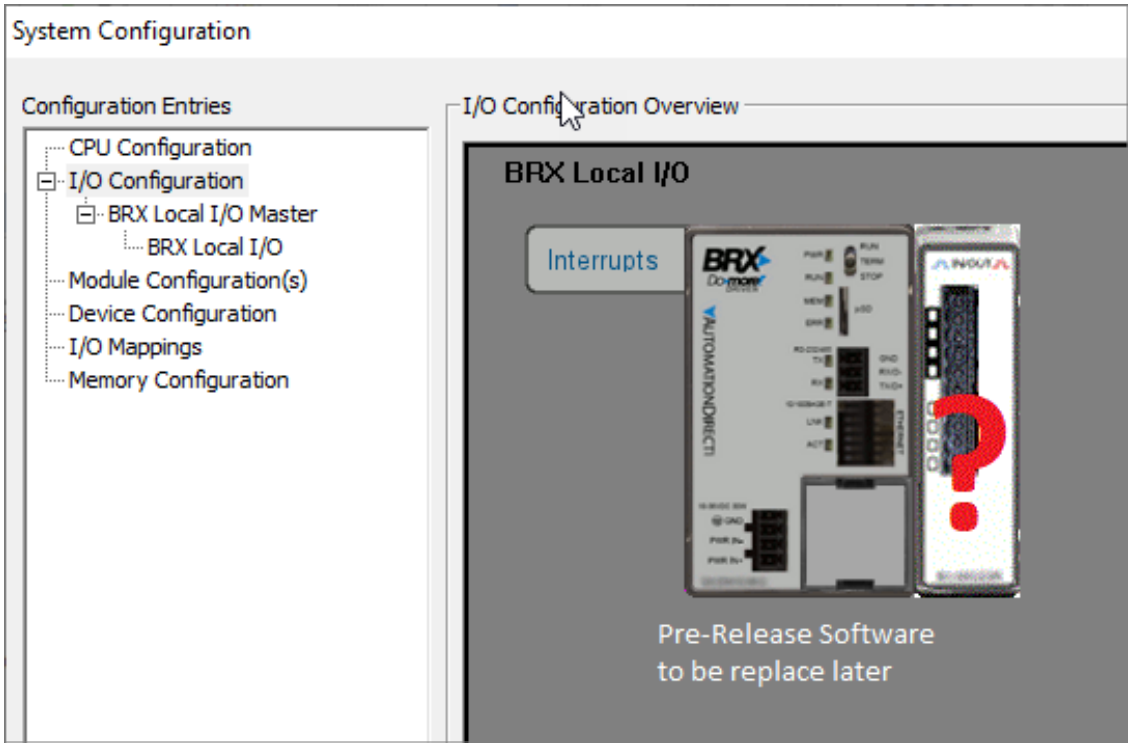
Active Filling Module Specifications	
Description	BRX active padding module, allows emulation of BRX modules in I/O configuration.
Backplane Power Consumption	0 W
Heat Dissipation	0 W
Weight	85g (3oz)
Agency Approvals	UL 61010-2 File E185989, Canada and USA, CE Compliant EN61131-2
Software Version	Do-more! Designer v2.7 or later

IMPORTANT!

Hot-Swapping Information
NOTE: This device cannot be Hot Swapped.

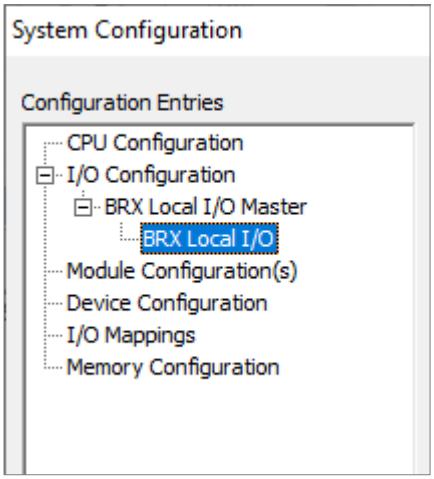
BX-APAD Active Filling Module, continued

This module emulates other BRX modules in the I/O configuration of a BRX system. It is configured in software to emulate the address space of a specific BRX module. The padding module can be used to reserve address space so that addressing in subsequent modules does not change if a module is removed. It also allows Intelligent module configurations and data structures to be emulated. The BRX processor will auto-discover the BX-APAD, like other modules as shown below.

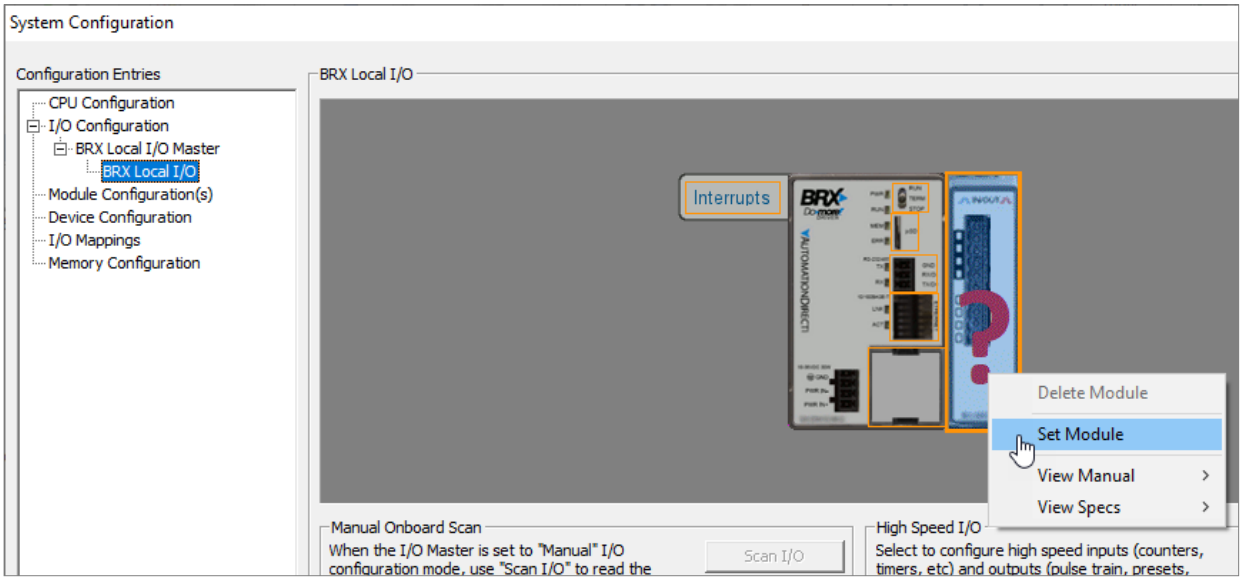


However, the user can specify which module they would like BX-APAD to emulate. To select module emulation type:

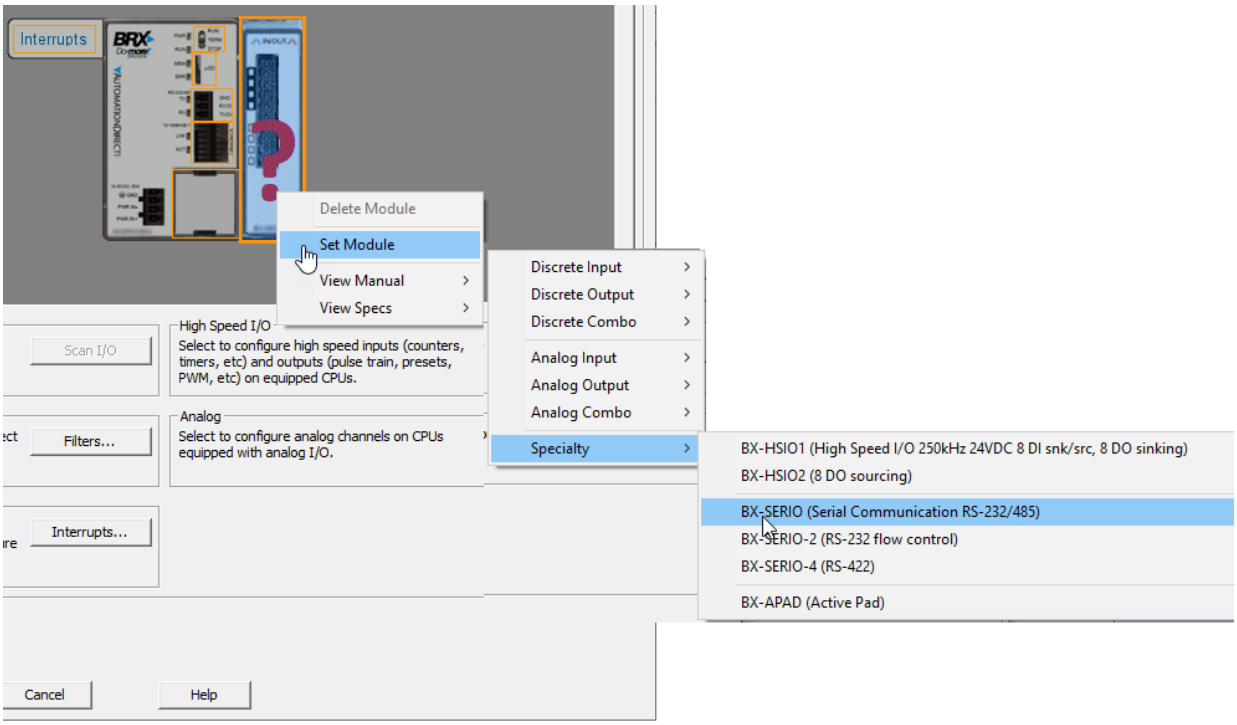
1. Select I/O Configuration>BRX Local I/O Master>BRX Local I/O.



2. Right-Click on the BRX-APAD module and select “Set Module”.



3. Select the I/O Module to emulate.



The Do-more! Designer programming software reserves physical I/O, device status attributes and configuration services.

The user can determine when the actual module is present versus the BRX-APAD by using the Get Hardware Information (HWINFO) instruction. The Get Hardware Information (HWINFO) instruction is used to retrieve hardware-specific information from an I/O module. This instruction allows a Do-more! MPU to confirm at runtime that an I/O module is present, or missing; or confirm that a module in a slot has the required I/O count, etc.



Ladder 1

In the example above, Ladder 1 is configured to read the Module ID of the I/O card installed in slot 0 of the BRX Local I/O. The instruction returns an integer value of 38668 (0x0000970C hex). This is the Module ID of the BX-APAD. A user can find all Module IDs under the Help topic: "Module ID".

Use Case 1

It is not uncommon for a machine builder to sell a machine in multiple configurations. In order to reduce engineering and cost, they use the same cabinet layout and PLC program. Options are added by adding additional physical inputs and output and having a software switch to enable or disable the options. For example, consider the continuous sealing machine below.



Continuous Sealing Machine



Continuous Sealing Machine with Nitrogen Flushing

The image on the left is the base model of a Continuous Sealing Machine, but the machine is also sold with a Nitrogen Flushing option as shown in the image on the right.

In a traditional rack-based PLC the machine builder may have left empty slots to accommodate the addition of additional I/O. Since BRX has a Stackable I/O configuration, adding additional I/O may require a physical change to the panel layout. The BRX-APAD will allow the machine builder to reserve the physical space in the cabinet for optional upgrades or future additions.

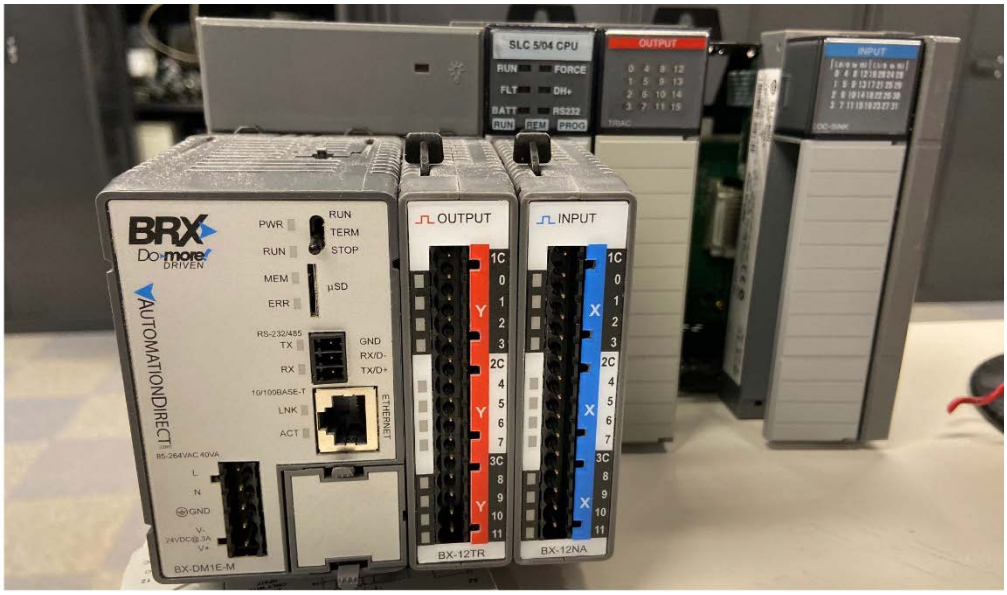
Use Case 2

Similarly, a machine builder may offer a machine in a base configuration plus multiple available options. In this case, the programming can be standardized by using BX-APAD modules to reserve address space for unused options.

Since the BX-APAD reserves address space as if it were another selected module, but can be identified by the Get Hardware Information instruction, a builder can design the system so that optional programming can be automatically enabled if the appropriate module is installed, but the addressing of all other modules remains unchanged if an optional module is not present.

Use Case 3

Another use case is when retrofitting a legacy PLC system with a BRX Control System. Most legacy PLCs had fixed rack sizes; these racks could have open slots between I/O modules. The wiring of these modules has already been established and wiring to a new PLC is either not possible or time consuming. For example, if the new and old module locations are significantly different the retrofit may require additional engineering. This is especially true if the older rack I/O had many open slots between I/O modules.



Even if the first I/O modules are aligned, it is most likely that the wires for the input modules wouldn't reach. BX-APAD can be used to emulate a empty slot in a fixed rack, which allows the module location to align. This will reduce the overall effort of the retrofit.

BRX Do-more! CPU Specifications



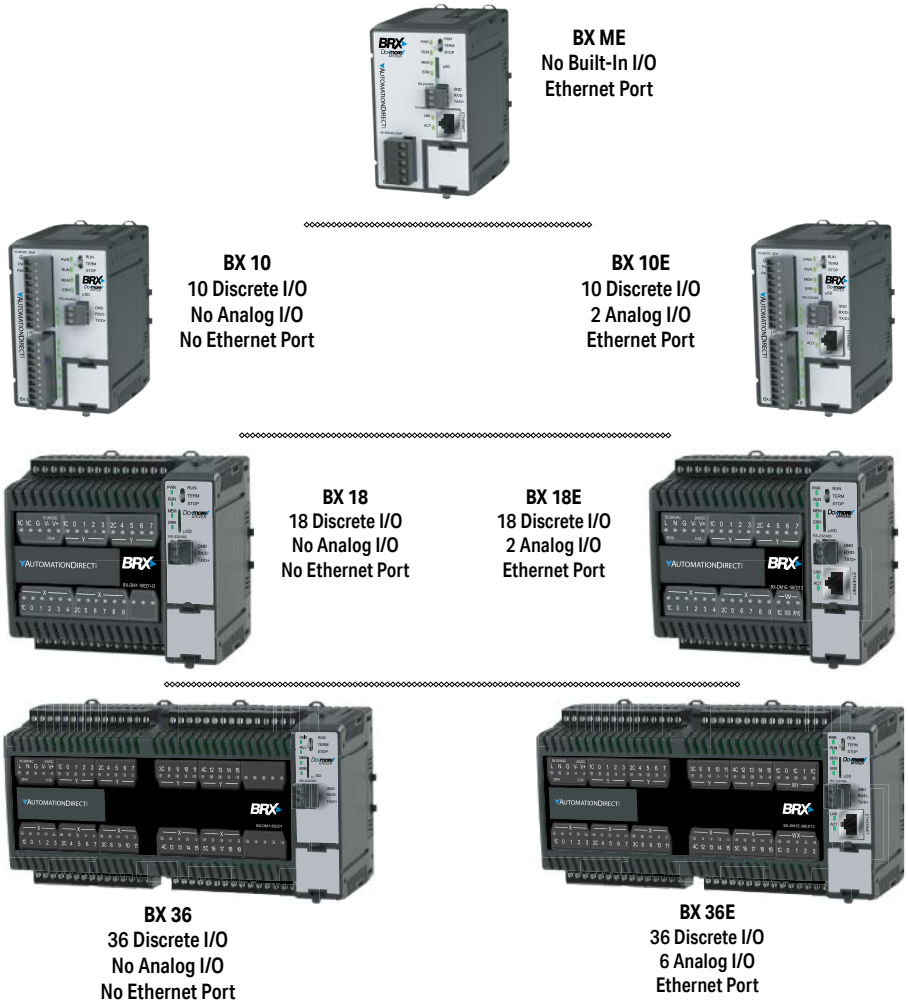
In This Chapter...

The BRX Platform 10-2
Do-more! Designer Software 10-3
BRX Do-more! CPU Common Specifications 10-3
CPU Status Indicators 10-6
Mode Switch Functions 10-7
DIP Switch Specifications 10-7
Battery Replacement 10-10
microSD Slot 10-11
Customizing the Logo Window 10-12
Replacing Access Covers 10-13
RS-232/485 Port Specifications 10-14
Ethernet Port Specifications 10-16
POM Slot 10-16

The BRX Platform

The BRX Platform is a very versatile modular Micro PLC system that combines powerful features in a compact standalone footprint. One of the many features that the BRX platform has is the ability to utilize the Do-more! DM1 Technology. This allows the BRX platform to leverage the power of the Do-more! DM1 technology resulting in shorter development time and cost. For example you are able to take an existing Do-more! project that was created using the proven H2-DM1(E) or T1H-DM1(E) CPUs and port the program right into the BRX-DM1(E) CPUs.

The foundation of the platform consists of 4 unique Micro PLC unit (MPU) form factors that incorporates the Do-more! DM1 technology. Shown below are the four unique Micro PLC form factors.



BX ME
No Built-In I/O
Ethernet Port

BX 10
10 Discrete I/O
No Analog I/O
No Ethernet Port

BX 10E
10 Discrete I/O
2 Analog I/O
Ethernet Port

BX 18
18 Discrete I/O
No Analog I/O
No Ethernet Port

BX 18E
18 Discrete I/O
2 Analog I/O
Ethernet Port

BX 36
36 Discrete I/O
No Analog I/O
No Ethernet Port

BX 36E
36 Discrete I/O
6 Analog I/O
Ethernet Port

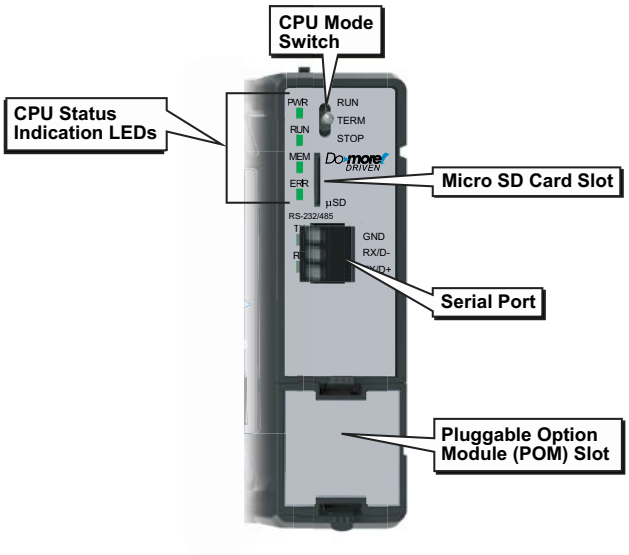
Do-more! Designer Software

The BRX platform uses the Do-more! Designer programming software, which is available as a download from our website. Please see the Do-more! Designer Software Getting Started Guide (DMD-GSG-M) for help on installation and usage of the software.

See http://support.automationdirect.com/products/domore.html.

BRX Do-more! CPU Common Specifications

The BRX Do-more! CPUs have standard built-in features such as CPU status indication, a CPU mode selection switch, microSD card slot and a CPU Pluggable Option Module (POM) slot.



General Specifications	
Operating Temperature	0° to 60°C (32° to 140°F)
Storage Temperature	-20° to 85°C (-4° to 185°F)
Humidity	5 to 95% (non-condensing)
Environmental Air	No corrosive gases permitted
Vibration	IEC60068-2-6 (Test Fc)
Shock	IEC60068-2-27 (Test Ea)
Enclosure Type	Open Equipment
Noise Immunity	NEMA ICS3-304
EU Directive	See the "EU Directive" in Appendix B or topic DMD0331 in the Help File.
Agency Approvals*	UL 61010-2 - UL File # E185989 Canada and USA CE Compliant EN61131-2

Meets EMC and Safety requirements. See the Declaration of Conformity for details.

MPU Specifications	
Scan Time	50µs 1K Boolean
Serial Port	RS-232/485, 3-Pin, Software configurable
Pluggable Option Module	RS-232, RS-485, Ethernet 10/100, USB 2.0 Type B
Data Logging	microSD card slot (32G max)
Expansion Modules[1]	8 expansion modules
Expansion Module Density	5 ,8, 12, 16 or 32 points/module
Expansion I/O Limits	128 I/O points
Remote Ethernet Slaves	16 slave units
Remote Ethernet Slave Discrete	4096 maximum
Remote Ethernet Slave Analog	4096 maximum
Real Time Clock Accuracy	±2.6 sec per day typical at 25°C ±8s per day max at 60°C
Programming Software[3]	Do-more! Designer – Ver. 2.0 or later
Programming Cable Options[2]	BX-PGM-CBL
Custom Label Window Size	0.75 in x 2.25 in (19mm x 57.2 mm) (18 & 36 point units only)

1. ***Always check the power budget to insure that the system can handle all of the expansion IO. Please review Appendix C for power budget information.***
2. ***Can be programmed from any available Serial, Ethernet or USB communications port. Optional programming cable assembly BX-PGM-CBL, includes the BX-USB-P USB POM module and a USB cable which allows programming from the CPU POM option slot.***
3. ***Some expansion modules may have different requirements.***

BRX Do-more! Specifications		
Feature	**BX-DM1-XXX**	**BX-DM1E-XXX**
User Data Memory Type	Battery Backed RAM, user configurable	
Program Memory	256KB with backup	
Retentive Memory	256KB	
System Configuration	128KB	
Documentation	1MB	
Total Memory	1.8 MB	
Ladder Memory (instruction words)	65,536	
V-Memory (words)	Configurable up to 65536 (4096 default)	
Non-volatile V Memory (words)	Configurable up to 65536 (4096 default)	
D-memory (DWORDs)	Configurable up to 65536 (4096 default)	
Non-volatile D-Memory (DWORDs)	Configurable up to 65536 (4096 default)	
R-memory (REAL DWORDs)	Configurable up to 65536 (4096 default)	
Non-volatile R-Memory (REAL DWORDs)	Configurable up to 65536 (4096 default)	
Stage Programming	Yes	
Number of Stages	128 per program code-block; number of code-blocks configurable to memory limit	
Handheld Programmer	No	
Built-In Communications Ports	RS-232/485	RS-232/485 Ethernet (10/100 Base-T)
Pluggable Option Module Slot (POM)	1	
Program Memory	Flash ROM	
Total I/O points available	X, Y, each configurable up to 65536 (2048 default); WX, WY (analog in/out) each configurable up to 65536 (256 default)	

Table continued on next page

BRX Do-more! Specifications (continued)		
Feature	**BX-DM1-XXX**	**BX-DM1E-XXX**
Number of Instructions Available	>170	>190
Control Relays	Configurable up to 65536 (2048 default)	
Special Relays (system defined)	1024	
Special Registers (system defined)	512	
Timers	Configurable up to 65536 (256 default)	
Counters	Configurable up to 65536 (256 default)	
System Date/Time Structures	8	
User Date/Time Structures	Configurable up to 65536 (32 default)	
Ascii String/Byte Buffer Structures	Configurable up to memory limit (192 default)	
MODBUS Client Memory	Configurable up to memory limit, default 1024 input bits, 1024 coil bits, 2048 input registers, 2048 holding registers	
DL Classic Client Memory	Up to memory limit, default 512 X, 512 Y, 512 C, 2048 V	
Immediate I/O	Yes	
Interrupt Input (hardware / timed)	Yes	
Subroutines	Program, Task, Subroutine Code-blocks, up to memory limit	
Drum Timers	Yes, up to memory limit	
Table Instructions	Yes	
Loops	FOR/NEXT, WHILE/WEND, REPEAT/UNTIL loops	
Math	>60 operators and functions: Integer, Floating Point, Trigonometric, Statistical, Logical, Bitwise, Timing	
ASCII	Yes, IN/OUT, Serial, Ethernet TCP and UDP; 11 output script commands	
PID Loop Control, Built-in	Yes, configurable to memory limit (over 2,000)	
microSD Slot	Several instructions are available to perform data logging and file management interaction on the microSD card.	
Time of Day Clock/Calendar	Yes	
Run Time Edits	Yes	
Supports True Force	Yes	
Internal Diagnostics	Yes	
Password Security	Multi-user, credentialed, session-based security	
System Error Log	Yes	
User Error Log	Yes	
Battery Backup	Yes (Battery included)	

CPU Status Indicators

CPU Status Indicators		
Indicator	**Status**	**Description**
PWR	OFF	Base power OFF
	Green	Base power ON
	Yellow	Low battery
RUN	OFF	CPU is in STOP mode
	Green	CPU is in RUN mode
	Yellow	Forces are Active
MEM	OFF	No ROM activity, No SD card
	Yellow	ROM activity (Flash or SD card)
	Green	SD Card installed and mounted*
	Red	SD Card installed and not mounted*
ERR	OFF	CPU is functioning normally
	Red	CPU Fatal Hardware Error or Software Watchdog Error



**** A microSD card will become "mounted" to the MPU once the MPU recognizes the microSD card and renders it accessible for use.***

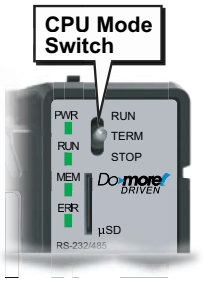
In addition to the individual definition of each LED, there are times when the controller will use combinations of the LED ON/OFF states and colors to convey status information. The following list describes the possible LED combinations:

- ERR LED is blinking RED for (15 seconds) - Do-more! Designer can blink the ERR LED for 15 seconds to verify that a communication link is targeting the correct controller.
- All four (4) of the LEDs are ON and the color of each LED is GREEN - indicates the operating system has started running.
- All four (4) of the LEDs are cycling through RED, GREEN and YELLOW, in a serial 'chase' pattern - indicates the operating system is initializing.
- The four (4) LEDs are cycling through RED and GREEN, in a 'bouncing ball' pattern, this indicates the controller is running only the boot loader and is NOT going to load and run the operating system. The most likely cause is having DIP switch #1 in the ON position.
- All eight (8) of the LEDs are ON and the color of each LED is RED - indicates the hardware watchdog timer has expired because the controller's operating system has stopped running.
- All four (4) of the LEDs are ON and the color of each LED is YELLOW - indicates the PLC has failed to start the OS. To recover from this condition, you can try turning DIP switch #0 ON and updating firmware. If this does not work, the PLC will need to be returned to the manufacturer for recovery.

Mode Switch Functions

The mode switch on the BRX Do-more! CPU allows the user to externally select the different modes of operation. There are three modes available: RUN, TERM and STOP.

CPU Mode Switch Functions	
Position	**Function**
RUN	CPU is forced into RUN mode if no errors are encountered.
TERM	Allows changing modes (RUN and PROGRAM) using the Do-more! Designer software.
STOP	CPU is forced into STOP mode



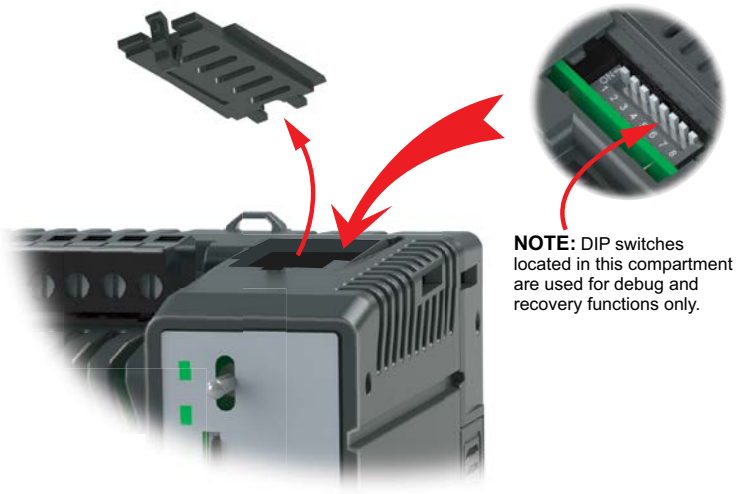
The CPU mode can also be changed through the programming software if the mode switch is placed in the TERM position. In this position, the CPU can be changed remotely between the Run and Program modes. For more information on changing CPU modes through the software, see the *Step 9: Write Project to the BRX MPU* section of Chapter 10 "BRX Do-more! Designer Getting Started".

When power is applied to the system, the controller will go through its power-up sequence. Then it will either, stay in Program mode if the mode switch is in the STOP position, or attempt to go to Run mode if the mode switch is in the RUN position. If the mode switch is in the TERM position, the CPU will return to the last operational mode before power was lost. For example, if the CPU was in Run mode when power was lost, when power is restored and the mode switch is in the TERM position, the CPU will attempt to return to Run mode.

DIP Switch Specifications

The BRX Do-more! CPU has a block of DIP switches, located on the top of the chassis, that are used to perform various debug and reset operations. The DIP switch settings are only read when the system is first powered up. The default position for all of the DIP switches is OFF.

WARNING: CPU must be powered down prior to changing DIP switch settings!



The following table describes the position and function associated with each DIP switch. BRX Do-more! CPUs make use of combinations of DIP switch settings and the Mode switch on the front of the controller to perform two reset functions. These reset functions can only be performed when the CPU is in the Boot Loader portion of the power-up sequence.

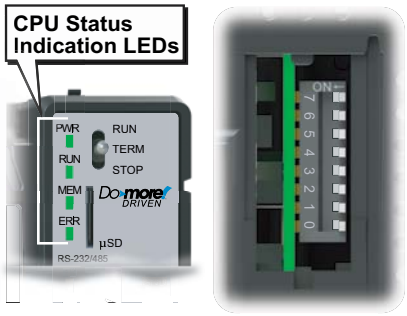
DIP Switch Settings		
DIP#	**Switch Position**	**Function**
7	ON	Reset the TCP/IP Network Settings to factory default values - Must be used with DIP #1
6	ON	Reserved
5	ON	Reserved
4	ON	Force the Serial port into RS-232 mode with default settings (Programming mode for recovery purposes).
3	ON	Disable ability to update the firmware and/or gate array.
2	ON	Disable the hardware watchdog timer - the hardware watchdog is always enabled, but this switch allows the user to override the ability of the Force Watchdog Error (WATCHDOG) and Debug mode to generate a Watchdog condition.
1	ON	Do not load an Operating System, stay in the Boot Loader.
0	ON	Load the oldest copy of the operating system.



DIP Switch Functions

The following sequence describes the steps necessary to perform one of the reset operations. This combination of DIP switch settings and mode switch manipulation is purposely complex to prevent these reset operations from being accidentally executed.

Clear Only the Network Settings



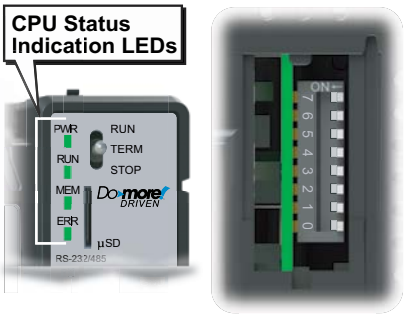
This reset function will clear ONLY the Network settings, which consists of the Module ID, Module Name, Module Description, IP Address, Subnet Mask and Gateway Address.

1. Begin by powering down the MPU.
2. Record the current DIP switch positions (so they can be set back to their original position after the manual reset is finished).
3. Set ONLY DIP #1 and #7 to ON position to perform the Clear Only the Network Settings operation. Ensure all other DIP switches are in OFF position.
4. Set the CPU mode switch to TERM (the center location) and power up the CPU.
5. At this point the top 4 LEDs (CPU, Run, Mem and Err) should be blinking the 'stay in the boot loader sequence', that is, they should be blinking in sequence, from top to bottom then back to the top, alternating between red and green.
6. Move the CPU mode switch to RUN (to the top).
7. Move the CPU mode switch to TERM (to the center).
8. Move the CPU mode switch to RUN (to the top).
9. Move the CPU mode switch to TERM (to the center).
10. Move the CPU mode switch to STOP (to the bottom).
11. Move the CPU mode switch to TERM (to the center) - the top 4 LEDs should now be ON.

***NOTE:** If you want to terminate the reset at this point you can do so by moving the CPU mode switch to RUN instead of STOP or power down the MPU.*

12. Move the CPU mode switch to STOP (to the bottom) - the bottom 4 LEDs should now be ON.
13. Move the CPU mode switch to TERM (to the center) - the top 4 LEDs begin flashing the power up sequence, and the ROM led should briefly be ON indicating that the data in the ROM is being rewritten. The LEDs will then begin flashing the 'staying in boot loader' sequence indicating the reset is complete.
14. Power down the MPU.
15. Return the DIP switches to their original positions.
16. Set the CPU mode switch to TERM (in the center location).

Reset to Factory Defaults



1. This reset function will clear everything from the CPU, including the Network Settings as described previously, and the System Configuration, Memory Configuration, all control logic, all Documentation, and all of the User Accounts and Passwords.
2. Begin by powering down the MPU.
3. Record the location of the DIP switches (so they can be set back to their original position after the manual reset is finished).
4. Next, set all eight of the DIP switches ON to perform a Reset to Factory Defaults.
5. Set the CPU mode switch to TERM (the center location) and power up the MPU.
6. At this point the top 4 LEDs (CPU, Run, Mem and Err) should be blinking the 'stay in the boot loader sequence', that is, they should be blinking in sequence, from top to bottom then back to the top, alternating between red and green.
7. Move the CPU mode switch to RUN (to the top).
8. Move the CPU mode switch to TERM (to the center).
9. Move the CPU mode switch to RUN (to the top).
10. Move the CPU mode switch to TERM (to the center).
11. Move the CPU mode switch to STOP (to the bottom).
12. Move the CPU mode switch to TERM (to the center) - the top 4 LEDs should now be ON (GREEN).

***NOTE:** If you want to terminate the reset at this point you can do so by moving the CPU mode switch to RUN instead of STOP or power down the MPU.*

13. Move the CPU mode switch to STOP (to the bottom) - the Serial and/or Ethernet LEDs should now be ON (GREEN).
14. Move the CPU mode switch to TERM (to the center) - the top 4 LEDs begin flashing the power up sequence, and the ROM led should briefly be ON indicating that the data in the ROM is being rewritten. The LEDs will then begin flashing the 'staying in boot loader' sequence indicating the reset is complete.
15. Power down the MPU.
16. Return the DIP switches to their original positions.
17. Set the CPU mode switch to TERM (in the center location).

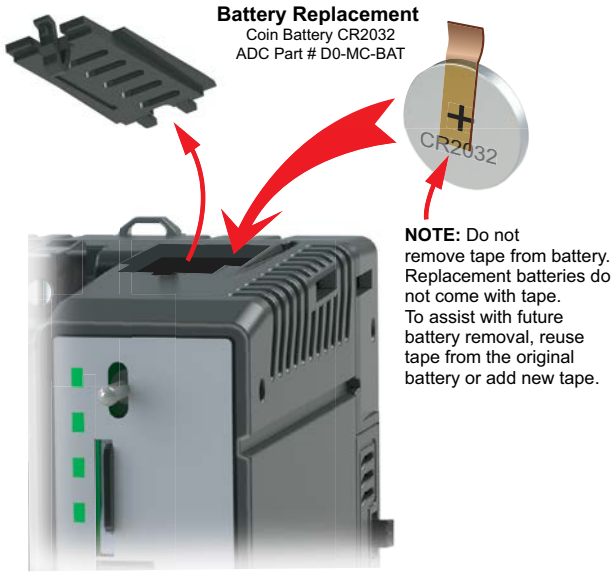
Battery Replacement

All BRX MPUs have an onboard battery that maintains the contents of the retentive memory any time the power to the controller is lost. The battery has an expected lifespan of three years; after which the battery will need to be replaced. The battery is a standard CR2032, coin cell battery (AutomationDirect P/N: D0-MC-BAT).

When the controller detects that the battery voltage is too low, and needs to be replaced, the PWR LED will be YELLOW instead of its normal GREEN color. When Do-more! Designer is online with the controller, the system-defined location $BatteryLow will be ON as well.

NOTE: *Retentive memory is not saved automatically when a Do-more! Designer project is saved to disk. Use the Memory Image Manager to create and manage retentive memory data images. Detailed information can be found in Do-more! Designer software help topic DMD0282. It is good practice to make backups of your projects and memory images to recover from unexpected circumstances.*

1. Power down the MPU.
2. Remove the battery from it's holder located on top of the MPU. Take note of how the battery is aligned in the holder. The battery is removed by pulling on the tape attached to the battery to begin sliding it out of the holder, then grasp the top edge to complete the removal of the battery.



NOTE: *The MPU has an onboard capacitor that will maintain the retentive memory contents while the battery is being replaced. The capacitor has a two-hour runtime, which should be more than enough to replace the battery.*

Insert the new battery into the holder, making sure the alignment is correct.

Power up the MPU.

Verify that the PWR LED is now GREEN instead of YELLOW and the system-defined location $BatteryLow will be OFF.

microSD Slot

The BRX Do-more! CPU has data logging and file management instructions that allow a microSD card to be used for data logging and other file storage capabilities. The microSD card must be formatted to FAT32 and a maximum size of 32GB can be used. All card speeds are currently supported.



***NOTE:** Card not included with unit. Optional 16G microSD card available (AutomationDirect P/N MICSD-16G).*

microSD Specifications				
Port Name	**microSD**			
Description	Standard microSD socket for data logging or file storage.			
Maximum Card Capacity	32GB			
Transfer Rate (ADATA microSDHC Class 4 memory card)	Mbps	Minimum	Typical	Maximum
	Read	14.3	14.4	14.6
	Write	4.8	4.9	5.1
Port Status LED	Green LED is illuminated when card is inserted/detected.			
Optional microSD Card	ADC Part# MICSD-16G			

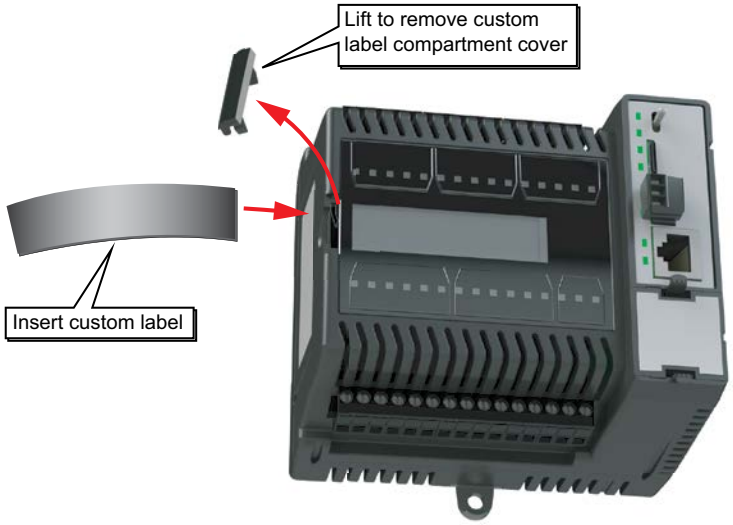


Pin	SD
1	DAT2
2	CD/DAT3
3	CMD
4	VDD
5	CLK
6	VSS
7	DAT0
8	DAT1

Customizing the Logo Window

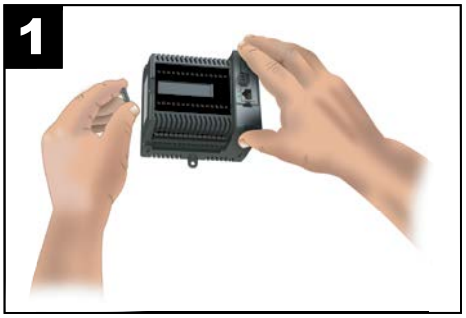
NOTE: *The Logo Window feature is only available on the BX 18/18E and BX 36/36E units.*

A custom label may be placed in the logo window. The logo window can accommodate label sizes up to 2 1/4" x 3/4".

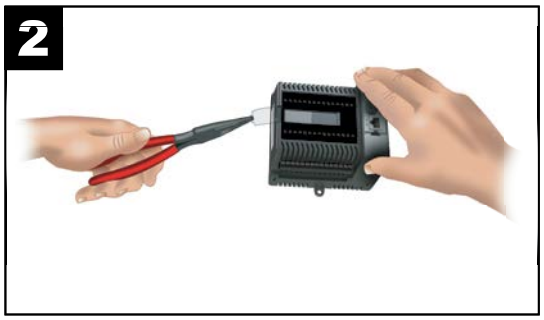


Follow the steps below to add a custom logo/label:

1. Remove the small gray clip at the left edge of the clear plastic window by pulling upward, away from the unit.

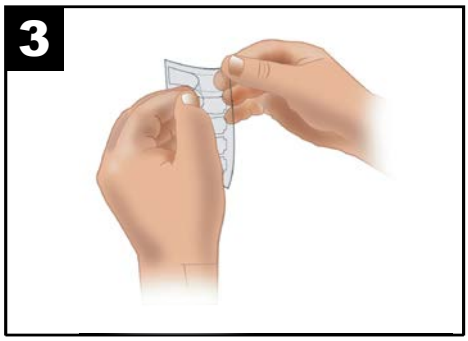


2. If a label has been previously installed you will need to remove the existing label. Needlenose pliers are helpful to grasp the exposed edge of the label

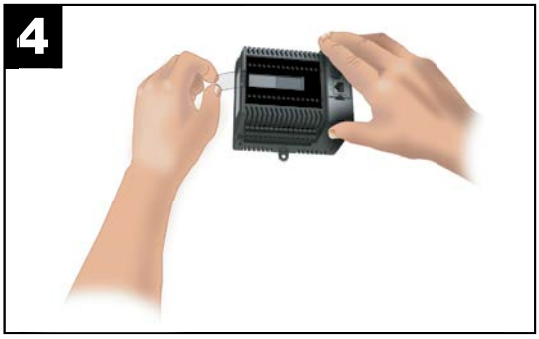


NOTE: *Labels do not come with the BRX unit. They must be purchased separately. The part number for the label sheet is BX-LBL-1.*

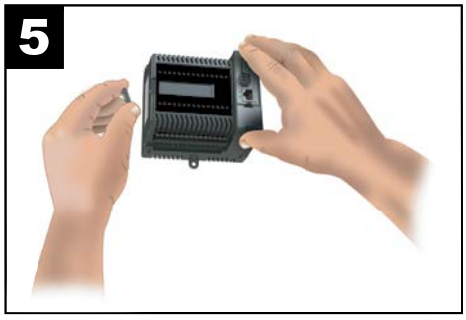
3. Remove a plastic label tab from the sheet (Part #BX-LBL-1) and attach a label that you have printed. Avery label models 8987, 6870, 8986 or 8257 may be used.



4. Slide the plastic tab with attached label into the label slot.



5. Reinstall the small gray plastic clip.



The custom logo window can be used to display a company's logo, or a system identification tag, identifying the BRX MPU location and function within your system.

Replacing Access Covers

Replacements for lost or damaged access coveres are available in the BRX Access Cover Kit (PN# BX-ACC-1). The kit is for use with all BRX PLCs, and includes (1) battery cover, (1) expansion slot cover, (1) blank POM slot insert and (1) custom label slot cover.

RS-232/485 Port Specifications

The RS-232/485 port utilizes a removable three-pin screw terminal block and is located on the front of the CPU. This port is software selectable to communicate as RS-232 or as RS-485. In the RS-485 mode you can also enable a 120 ohm termination resistor if needed.



The RS-232/485 port can be connected to the Do-more! Designer programming software, Modbus RTU master or slave devices, DirectLogic PLCs via K-Sequence protocol, as well as devices that output non-sequenced ASCII strings or characters.

Built-in RS-232 Specifications	
Port Name	RS-232/RS-485
Description *	Non-isolated Serial port that can communicate via RS-232 or RS-485 (software selectable). Includes ESD protection and built-in surge protection.
Supported Protocols	Do-more!™ Protocol (Slave) (Default) Modbus RTU (Master & Slave) K-Sequence (Slave) ASCII (In & Out)
Data Rates	1200, 2400, 4800, 9600, 19200, 38400, 57600, and 115200 Baud
Default Settings	RS-232, 115200bps, No Parity, 8 Data Bits, 1 Stop Bit, Station #1, Termination resistor OFF
Port Status LED	Green LED is illuminated when active for TXD and RXD
Port Type	Removable 3-pin terminal strip 3.5 mm pitch
RS-232 TXD	RS-232 Transmit output
RS-232 RXD	RS-232 Receive input
RS-232 GND	Logic ground
RS-232 Maximum Output Load (TXD/RTS)	3kΩ, 1000pf
RS-232 Minimum Output Voltage Swing	±5V
RS-232 Output Short Circuit Protection	±15mA
Cable Requirements	RS-232 use P/N L19772-XXX from AutomationDirect.com
Maximum Distance	30 meters (100 feet); 6 meters (20 foot) recommended maximum
Replacement Connector	ADC Part # BX-RTB03S

When using RS-485 a termination resistor is available and is software selectable.

Built-in RS-485 Specifications	
Port Name	RS-232/RS-485
Description *	Non-isolated Serial port that can communicate via RS-232 or RS-485 (software selectable). Includes ESD protection and built-in surge protection. Includes internal biasing to be a true failsafe receiver while maintaining EIA/TIA-485 compatibility.
Supported Protocols	Do-more!™ Protocol (Slave) (Default) Modbus RTU (Master & Slave) K-Sequence (Slave) ASCII (In & Out)
Data Rates	1200, 2400, 4800, 9600, 19200, 38400, 57600, and 115200 Baud
Default Settings	RS-232, 115200bps, No Parity, 8 Data Bits, 1 Stop Bit, Station #1, Termination resistor OFF
Port Status LED	Green LED is illuminated when active for TXD and RXD
Port Type	Removable 3-pin terminal strip 3.5 mm pitch
RS-485 Station Addresses	1–247
TXD-/RXD-	RS-485 transceiver low
TXD+/RXD+	RS-485 transceiver high
RS-485 GND	Logic ground
RS-485 Input Impedance	19kΩ
RS-485 Maximum Load	50 transceivers, 19kΩ each, 120Ω termination
RS-485 Output Short Circuit Protection	±250mA, thermal shut-down protection
RS-485 Electrostatic Discharge Protection	±8kV per IEC1000-4-2
RS-485 Electrical Fast Transient Protection	±2kV per IEC1000-4-4
RS-485 Minimum Differential Output Voltage	1.5 V with 60Ω load
RS-485 Fail Safe Inputs	Logic high input state if inputs are unconnected
RS-485 Maximum Common Mode Voltage	-7.5 V to 12.5 V
Cable Requirements	RS-485 use P/N L19954-XXX from AutomationDirect.com
Maximum Distance	1000 meters (3280 feet)
Replacement Connector	ADC Part # BX-RTB03S

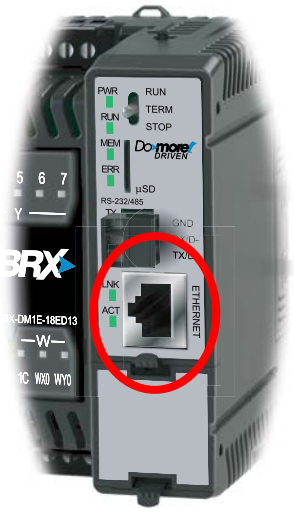
**** When using RS-485 a termination resistor is available and is software selectable.***

Ethernet Port Specifications

NOTE: *This section applies only to the units with the Built-in Ethernet port. These models include all BRX CPUs with the DM1E technology which includes BX ME, BX 10E, BX 18E and BX 36E.*

The Ethernet port utilizes a standard RJ-45 connector and is located on the front of the CPU just below the serial port. This port uses the 10/100BASE-T standard and has built-in auto-crossover capability allowing the use of any standard patch cable or crossover cable.

Ethernet Port Specifications	
Port Name	ETHERNET
Ethernet Port Type	RJ45, Category 5, 10/100 BASE-T, Auto Crossover
Description	Standard transformer isolated Ethernet port with built-in surge protection
Transfer Rate	10 Mbps (Orange LED) and 100 Mbps (Green LED)
Port Status LED	LED is solid when network LINK is established. LED flashes when port is active (ACT).
Supported Protocols	Do-more! Protocol Ethernet Remote I/O Modbus TCP (Client, Server) EtherNet/IP: Explicit Messaging Scanner/Adapter Implicit Messaging Scanner/Adapter HOST ECOM (DirectLogic) Peerlink Embedded Web Server, HTTP (Unsecure) SMTP (Email) SNTP (Time Server) TCP/IP UDP/IP (Raw packet)
Cable Recommendation	C5E-STxxx-xx from AutomationDirect.com
Ethernet Port Numbers	
Modbus TCP	502, TCP (Configurable)
EtherNet I/P	44818, UDP (Configurable)
HOST ECOM	28784, UDP (Configurable)
Do-more! Protocol	28784, UDP (Configurable)



POM Slot

The POM slot allows for an additional communication port, as an Ethernet, USB or serial protocol. See Chapter 6: BRX Pluggable Option Module (POM) for port options.

BRX Do-more! Motion Control and High-speed I/O



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Overview

The purpose of this chapter is to help the user understand the capabilities and flexibility of motion control, using high-speed inputs and outputs (HSIO) supported by the BRX MPU built-in I/O and the BX-HSIO1/ BX-HSIO2/BX-HSIO4 (referred as BX-HSIO in this chapter for simplification) expansion modules. This section will show the user the steps needed to setup the I/O for use with the high-speed functions, provide various wiring examples, detailed programming examples and explain the available high-speed instructions.

On the BRX MPU built-in I/O, all DC Inputs and Outputs (standard and high-speed) can be selected for use in an HSIO application. However, the standard I/O will work at a lower response time (approximately 120Hz for standard inputs and 110Hz for standard outputs). This flexibility frees up the high-speed inputs and outputs. For example, in a BRX 18/18E MPU, when setting up a pulse train output (PTO) as step/ direction control to a stepper motor, it is possible to select a high-speed output for the step signal and a standard output for the direction signal. By doing this, a high-speed output is made available that can be used for another high-speed output function, such as PWM. On the BX-HSIO expansion modules, the eight high-speed DC Inputs and eight high-speed DC Outputs available to the module can be selected for use in a HSIO application. It is not possible to select I/O points outside the BX-HSIO expansion module.

The high-speed inputs are very flexible to meet your application needs. They can work with an input DC frequency of up to 250kHz (2MHz for BX-HSIO4), as a high-speed counter as well as for simple Edge timers. High-speed counter values can be used as accurate position feedback and engineered values for rate and position. The high-speed inputs additionally can be triggers for Interrupt Service Routines (ISRs). The ISRs can be used to run logic based on events that are too fast for standard input triggers and normal PLC logic scan times.



NOTE: *Interrupts configured in the BX-HSIO expansion modules may have a latency of up to 50µs.*

The high-speed outputs are also very adaptable to your application needs. They can be switched as fast as 250kHz for BX-HSIO1 and BX-HSIO2, and up to 2MHz for BX-HSIO4. They also can be used for position and velocity motion control moves as well as provide a programmable Pulse Width Modulation (PWM) output. The high-speed outputs facilitate accurate position and velocity moves including homing, jogging, trapezoid and S-curve moves. Instructions include simple position and velocity moves, to more complicated electronic camming and gearing, providing additional ways to handle follower type moves. In addition to the frequency adjustment, the duty cycle can also be adjusted on the PWM output, allowing for more accurate control of the PWM output signal.

Overview, continued

The following tables show the BRX platform high-speed input (HSI) specifications.

HSI Specifications						
Item	**10/10E**	**18/18E**	**36/36E**	**BX-HSIO1**	**BX-HSIO2**	**BX-HSIO4**
Input Type	Sink/Source					High Speed TTL Differential or Single Ended
Total Inputs [1]	6	10	20 [2]	8	8	8
High-Speed Inputs	6	10	10	8	8	8
Location	X0–X5	X0–X9	X0–X9	Slot dependent		
Frequency	0 to 250kHz					0 to 2MHz
Minimum Pulse width	0.5 µs					125ns
Off to On Response	< 2µs					125ns
On to Off Response	< 2µs					125ns

1. *Refer to the specific wiring chapter for the discrete input specs of the specific model you are using.*
2. *BRX MPU standard inputs may be used with high-speed functions, but at lower response frequencies of approximately 120Hz.*

High-speed Input Function										
	Functions Available			**Inputs Required[1]**	**User Selected Options**					
	MPU	**BX-HSIO1 BX-HSIO2**	**BX-HSIO4**		**Reset Input**	**Capture**	**Inhibit**	**Rotary**	**Position Scaling[2]**	**Rate Scaling[2]**
Up Counter	Up to 3	Up to 4	Up to 4	1	1 Input is used	1 Input is used	1 Input is used	N/A	(optional)	
Down Counter				1					(optional)	
Quad Counter				2				(optional)		
Bidirectional Counter				2						
Up/Down Counter				2						
Edge Timer				1				N/A	N/A	(optional)
Edge Timer (Duration)				1						
Dual Edge Timer				2						
Pulse Catch				1	N/A	N/A	N/A			N/A
External Interrupt Triggers										
Event Trigger	4	4	4	Available inputs	N/A					
Timer Trigger	4	4	4	N/A						
Match Register	4	4	4							
Input Filters	Able to filter all inputs									

1. *BRX MPU standard inputs may be used with high-speed functions, but at lower response frequencies of approximately 120Hz.*
2. *Only one scaling option can be used at any given time. If Position scaling is used, Rate scaling is not available, and vice versa.*

Table Driven Inputs						
	Functions Available			**Inputs Required**	**Outputs Required[1]**	**Instructions**
	MPU	**BX-HSIO1 BX-HSIO2**	**BX-HSIO4**			
Preset Table	Up to 4	Up to 4	Up to 4	Reference to (one) Axis Position or (one) High-Speed Counter/ Timer Accumulator	1	TDOPRESET
Programmable Limit Switch				Reference to (one) Axis Position or (one) High-Speed Counter/ Timer Accumulator	1	TDOPLS

1. *BRX MPU standard outputs may be used with high-speed functions, but at lower response frequencies of approximately 110Hz. Use of relay outputs is not recommended.*

Overview, continued

The following tables show the BRX platform high-speed output (HSO) specifications.

HSO Specifications						
Item	**10/10E**	**18/18E**	**36/36E**	**BX-HSIO1**	**BX-HSIO2**	**BX-HSIO4**
Output Type	Sink or Source [2]			Sink	Source	High Speed TTL Differential or Single Ended
Total Outputs[1,2]	4	8	16 [2]	8	8	8
High-Speed Outputs	2	4	8	8	8	8
Location	Y0–Y1	Y0–Y3	Y0–Y7	Slot dependent		
Off to On Response	< 2µs					125ns
On to Off Response	< 2µs					125ns
Max Switching Frequency	1m cable; 250kHz 10m cable; 100kHz					2MHz

1. *Refer to the specific wiring chapter for the discrete output specs of the specific model you are using.*
2. *BRX MPU standard outputs may be used with high-speed functions, but at lower response frequencies of approximately 110Hz.*

High-speed Output Function					
	Functions Available[2]			**Outputs Required[1]**	**Profile/Instruction**
	MPU	**BX-HSIO1 BX-HSIO2**	**BX-HSIO4**		
Axis/Pulse Output	Up to 4 (1 virtual and 3 axis)	Up to 4 (1 virtual and 3 axis)	Up to 4 (1 virtual and 3 axis)		
Virtual Axis	Up to 4	Up to 4	Up to 4	N/A	Trapezoid, Velocity, Electronic Camming, Electronic Gearing, Following, Homing
Step/Direction	Up to 3	Up to 3	Up to 3	2	
CW/CCW					
Quadrature					
Pulse Width Modulation (PWM)	Up to 3	Up to 4	Up to 4	1	N/A

1. *BRX MPU standard outputs may be used with high-speed functions, but at lower response frequencies of approximately 110Hz. Use of relay outputs is not recommended.*
2. *This is the total number of functions. On the BRX MPU, a combination of high-speed outputs and standard outputs may be used UP TO this total.*

Unsuitable Applications

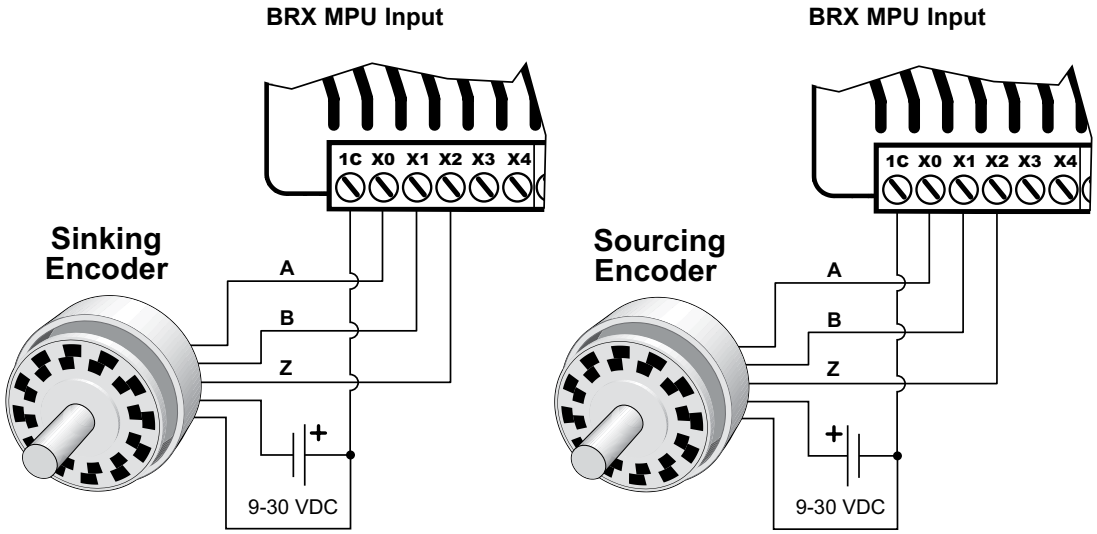
There are situations where HSIO is not an appropriate control choice:

- Mechanical contacts used as counter or encoder inputs: Reliable readings are not possible using mechanical contacts. The bounce of mechanical contacts will cause the High-speed input to see more edges than intended.
- Direct connection to TTL, line driver or differential encoders, other than with the BX-HSIO4: A BX-HSIO1 or BX-HSIO2 high-speed input cannot accept these low voltage inputs directly. (Consider using a BX-HSIO4, or using the FC-ISO-C signal conditioner to be able to input these signal types to these modules.)
- Absolute encoders are not suitable for use with the high speed inputs of the BRX.

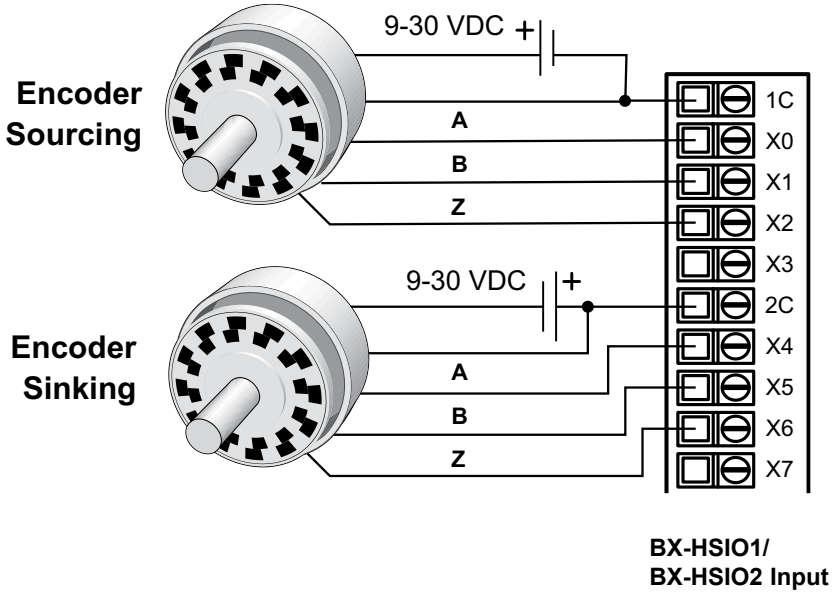
BRX Wiring Examples: High-Speed Inputs

Quadrature Encoder Input

BRX MPU Wiring



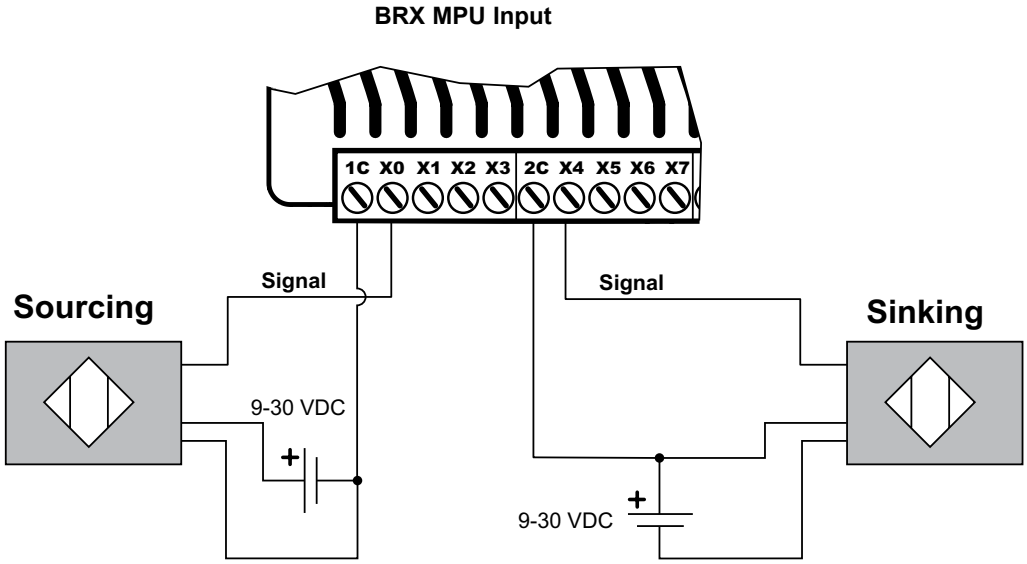
BX-HSIO1/BX-HSIO2 Wiring



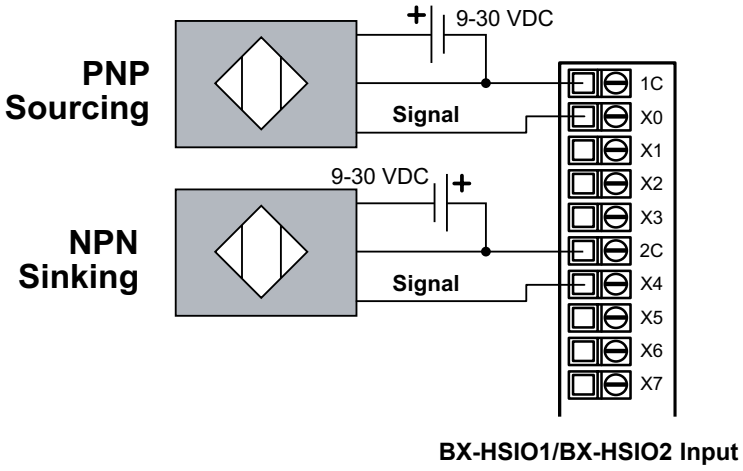
BRX Wiring Examples: High-Speed Inputs, continued

NPN/PNP Input Example

BRX MPU Wiring

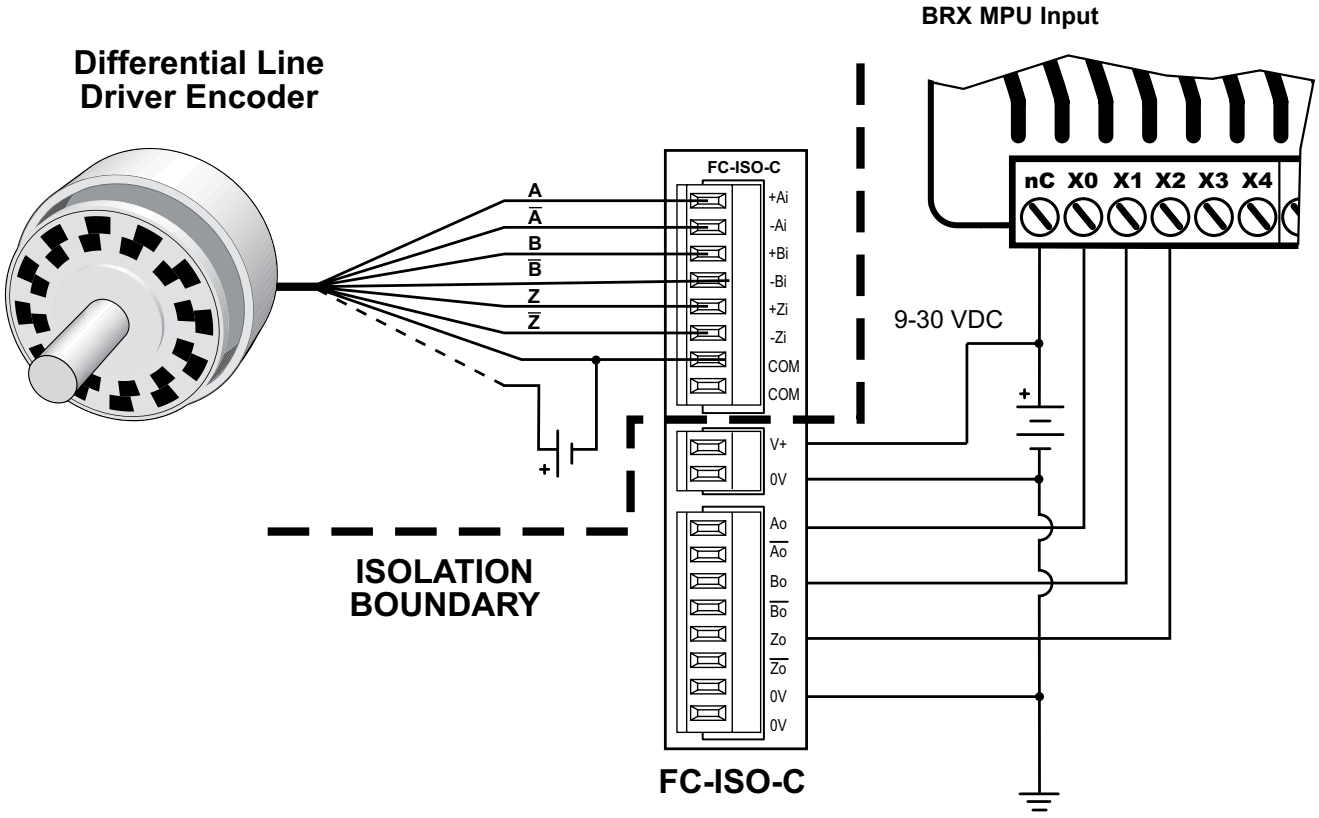


BX-HSIO1/BX-HSIO2 Wiring

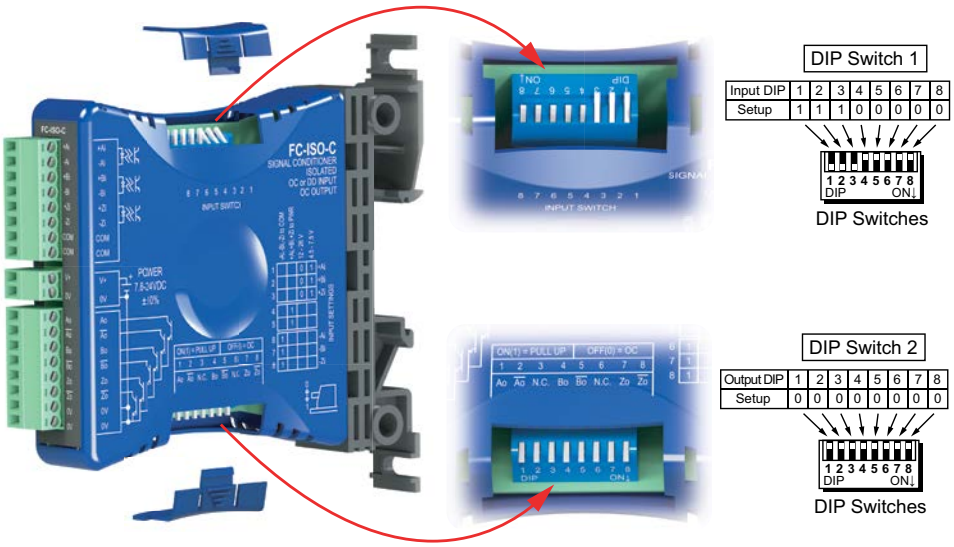


BRX Wiring Examples: High-Speed Inputs, continued

Differential Line Driver Encoder Input to BRX MPU

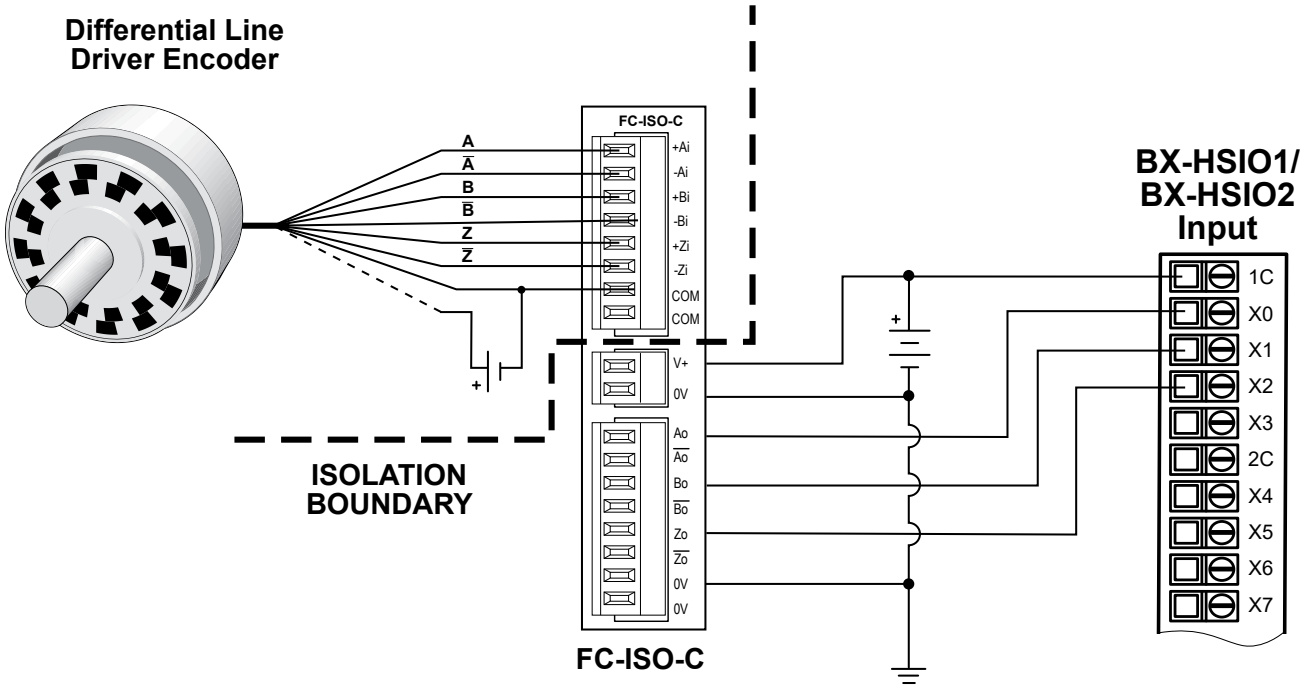


FC-ISO-C Dipswitch Settings

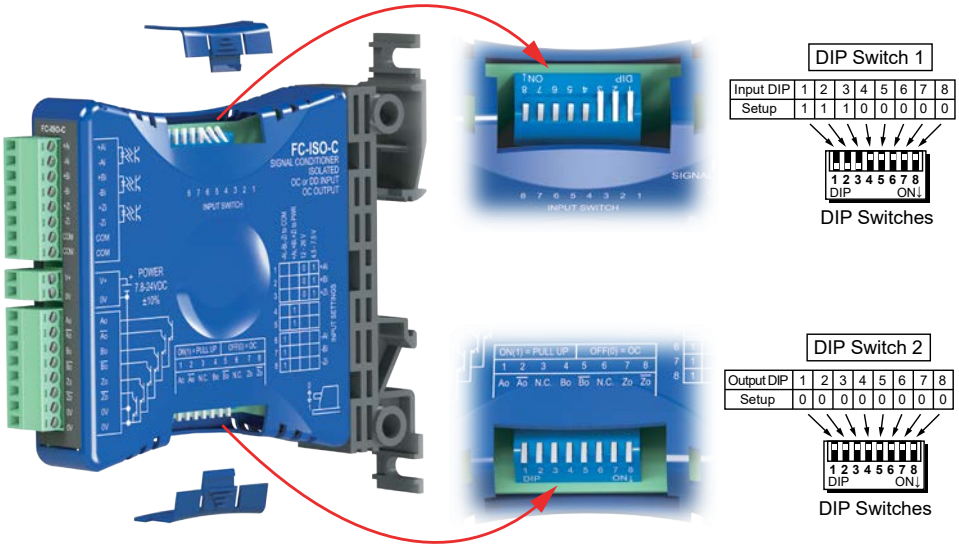


BRX Wiring Examples: High-Speed Inputs, continued

Differential Line Driver Encoder Input to BX-HSIO1/BX-HSIO2



FC-ISO-C Dipswitch Settings



BRX Wiring Examples: High-Speed Inputs, continued

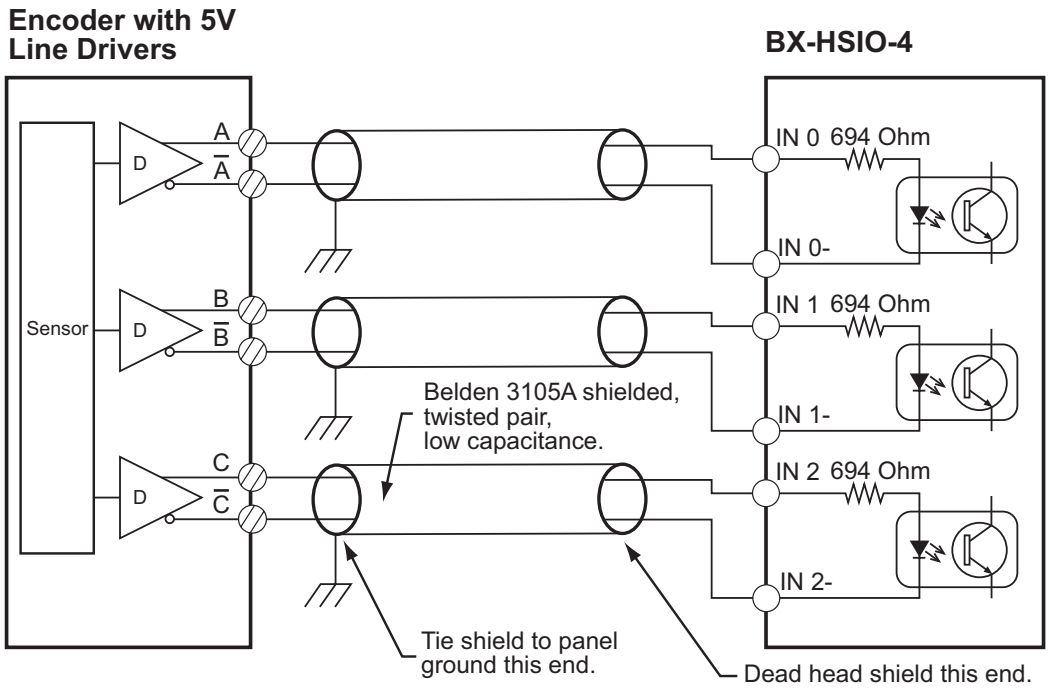
*ZIP*Link Terminal Block Wiring Connections for BX-HSIO4

Wiring Connections for ZL-RTB40 Terminal Block																					
MODULE	LABELS																				LEVEL
BX-HSIO4	IN 0-	IN 1-	IN 2-	IN 3-	COM	IN 4-	IN 5-	IN 6-	IN 7-	COM	OUT 0-	OUT 1-	OUT 2-	OUT 3-	COM	OUT 4-	OUT 5-	OUT 6-	OUT 7-	COM	UPPER
	IN 0+	IN 1+	IN 2+	IN 3+	COM	IN 4+	IN 5+	IN 6+	IN 7+	COM	OUT 0+	OUT 1+	OUT 2+	OUT 3+	COM	OUT 4+	OUT 5+	OUT 6+	OUT 7+	COM	LOWER
TERMINAL BLOCK LABEL SHEET FOR ZIPLINK CABLE ZL-BX-CBL-40-xS																					

Wiring Connections for ZL-RTB40-1 Terminal Block																	
MODULE	LABELS																LEVEL
BX-HSIO4	COM		COM		COM		COM		COM		COM		COM		COM		UPPER
	IN 0-	IN 1-	IN 2-	IN 3-	IN 4-	IN 5-	IN 6-	IN 7-	OUT 0-	OUT 1-	OUT 2-	OUT 3-	OUT 4-	OUT 5-	OUT 6-	OUT 7-	MIDDLE
	IN 0+	IN 1+	IN 2+	IN 3+	IN 4+	IN 5+	IN 6+	IN 7+	OUT 0+	OUT 1+	OUT 2+	OUT 3+	OUT 4+	OUT 5+	OUT 6+	OUT 7+	LOWER
TERMINAL BLOCK LABEL SHEET FOR ZIPLINK CABLE ZL-BX-CBL-40-xS																	

Differential 5V Encoder Input to BX-HSIO4

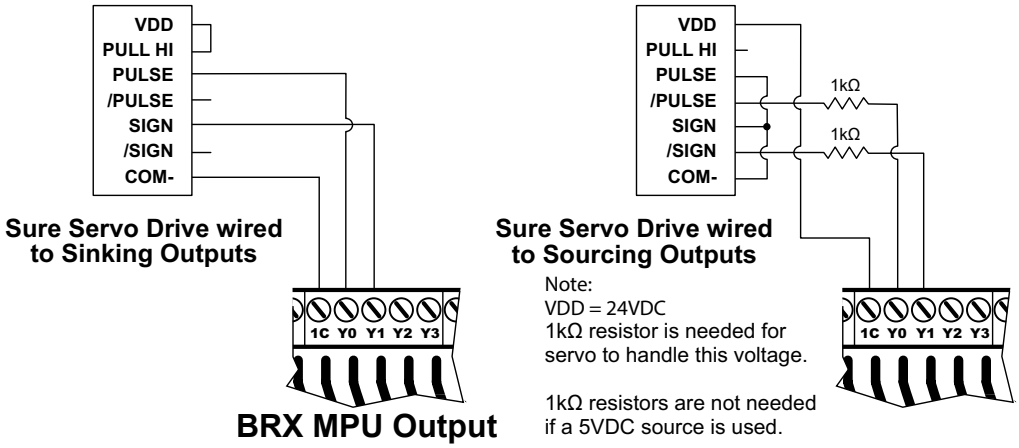
To prevent damage to 5V inputs,
do not exceed 6.8V or 30 mA on inputs



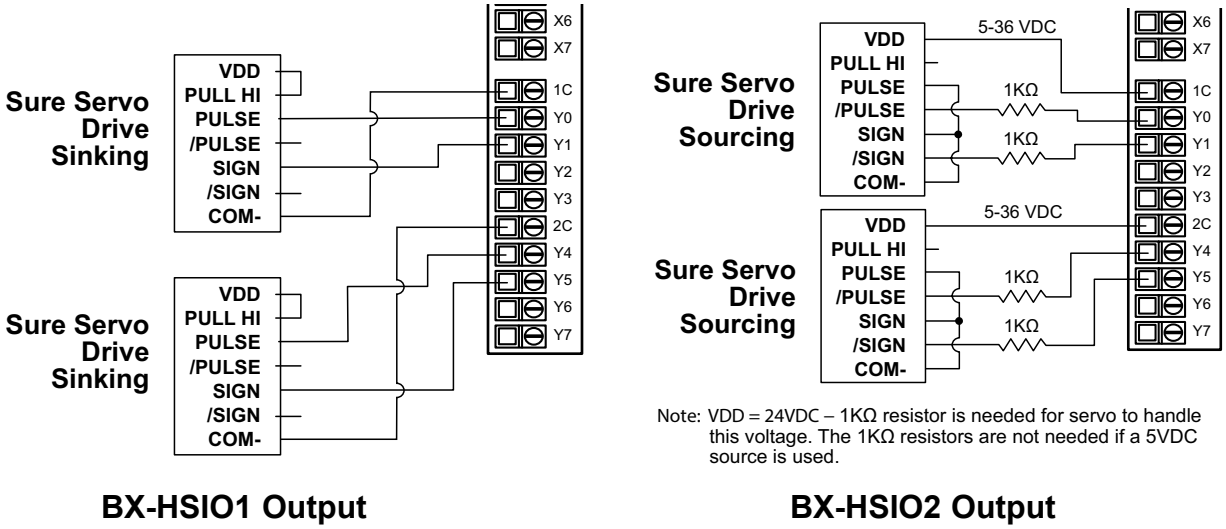
BRX Wiring Examples: High-speed Outputs

SureServo Driver Wiring Example

BRX MPU Wiring



BX-HSIO1/BX-HSIO2 Wiring



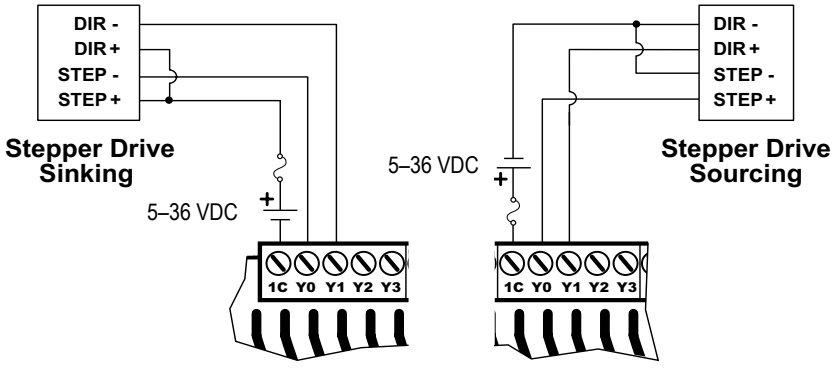


NOTE: *Customer must consult SureServo documentation for specific details on the servo drive.*

BRX Wiring Examples: High-Speed Outputs, continued

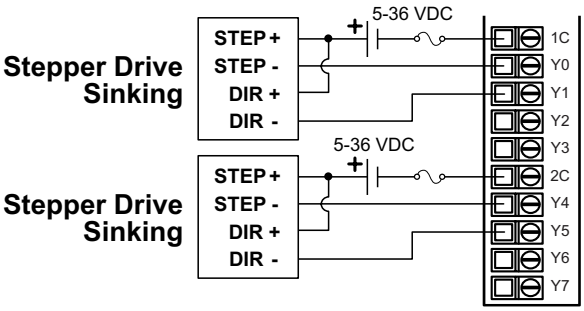
Stepper Drive Wiring Example

BRX MPU Wiring

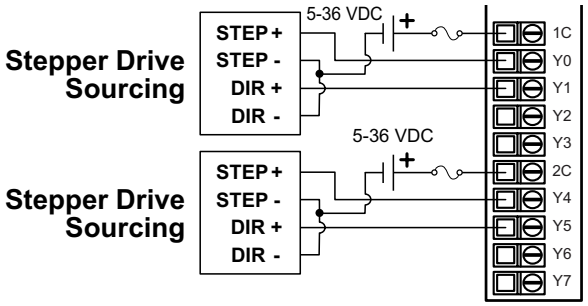


BRX MPU Output

BX-HSIO1/BX-HSIO2 Wiring



BX-HSIO1 Output

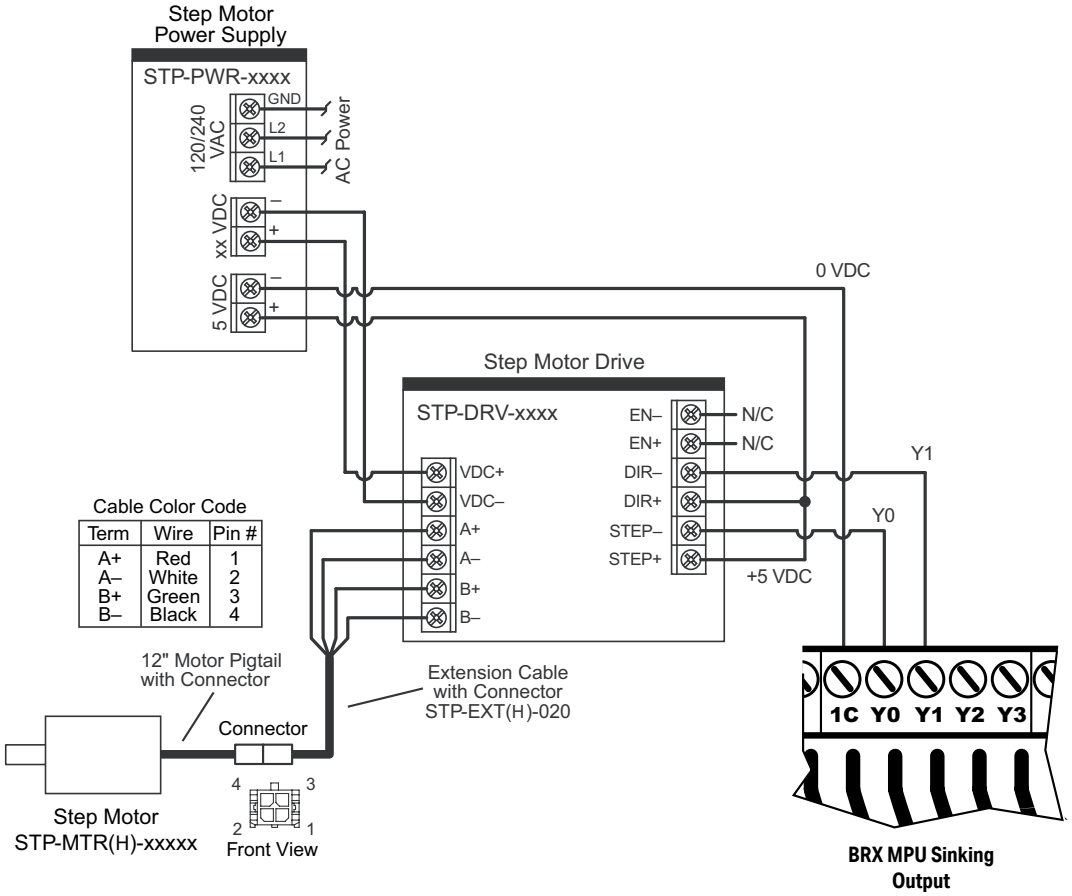


BX-HSIO2 Output

BRX Wiring Examples: High-Speed Outputs, continued

BRX MPU with Sinking Outputs to Stepper/Servo Drive Input

Detailed output wiring example between a BRX MPU and the SureStep Stepping System components.

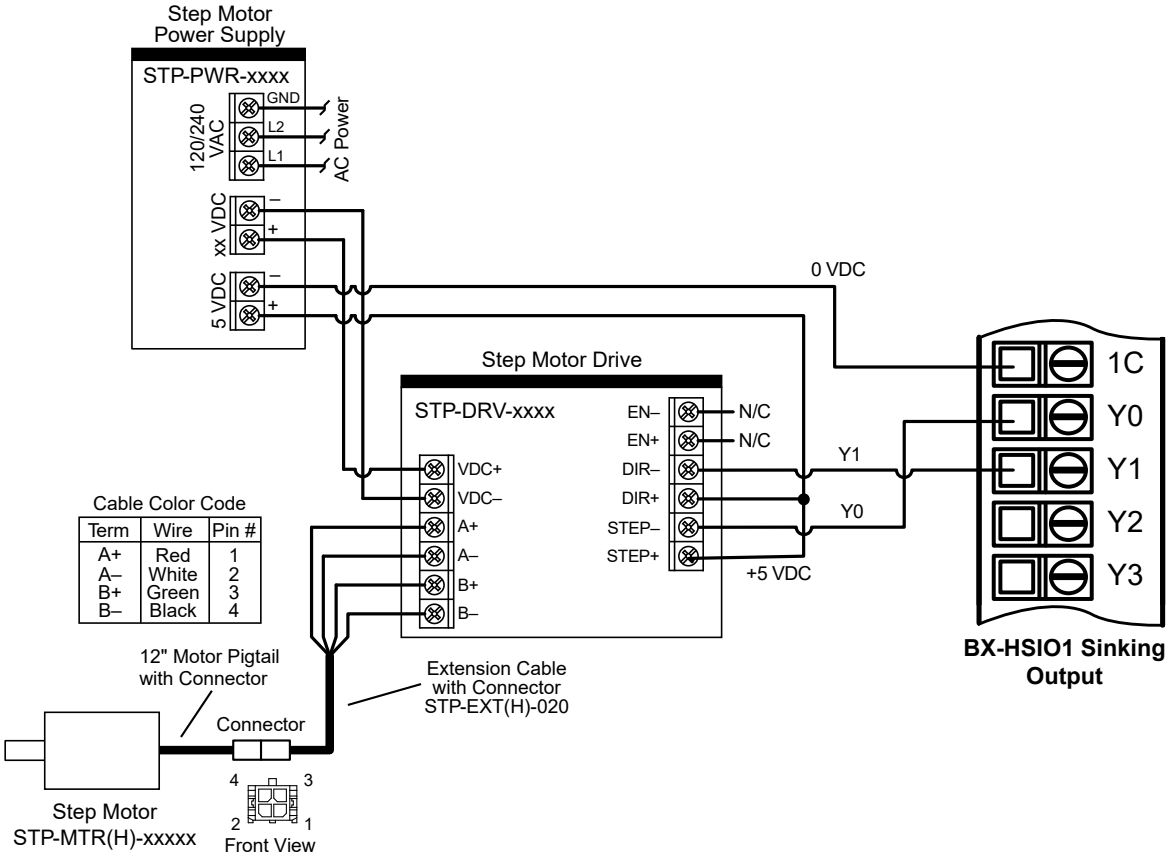


Wiring Diagram for a BRX MPU Using the SureStep Stepping System Components.

BRX Wiring Examples: High-Speed Outputs, continued

BX-HSIO1 with Sinking Outputs to Stepper/Servo Drive Input

Detailed output wiring example between a BX-HSIO1 and the SureStep Stepping System components.

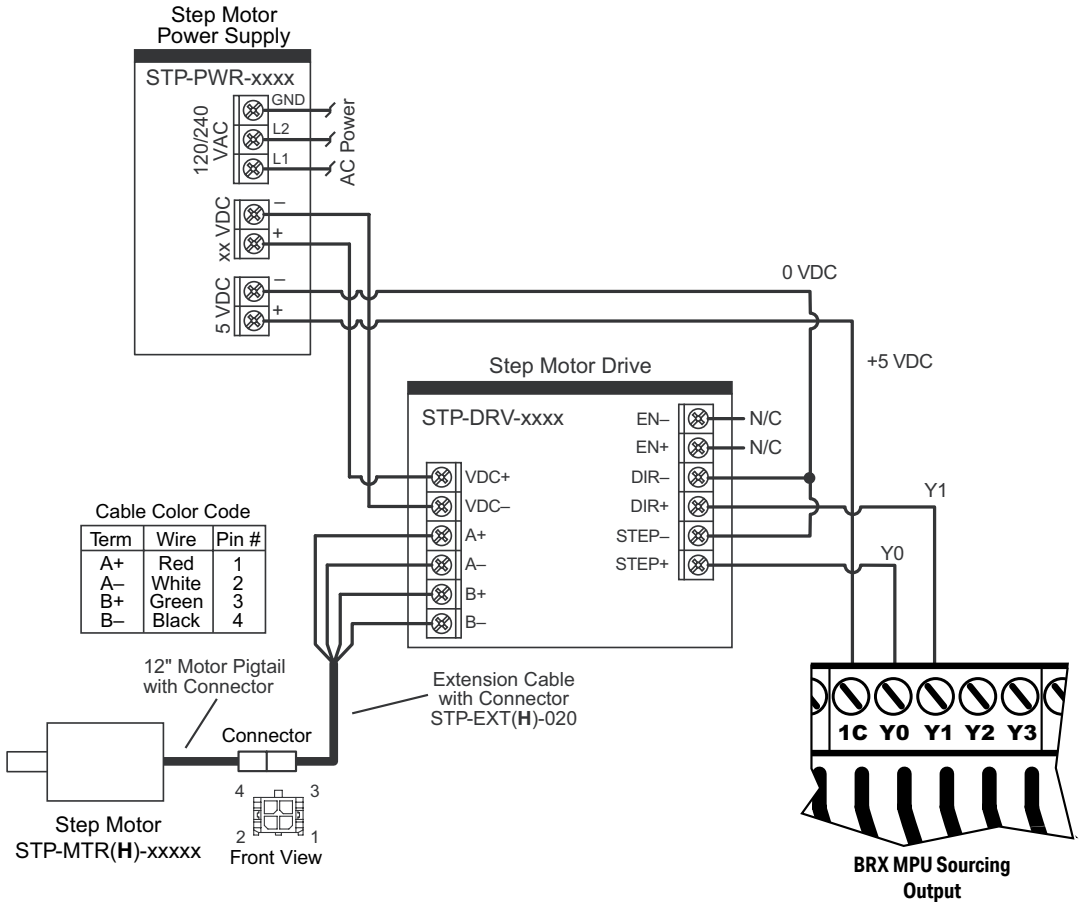


Wiring Diagram for a BX-HSIO1 Using the SureStep Stepping System Components.

BRX Wiring Examples: High-Speed Outputs, continued

BRX MPU with Sourcing Outputs to Stepper/Servo Drive Input

Detailed output wiring example between a BRX MPU and the SureStep Stepping System components.

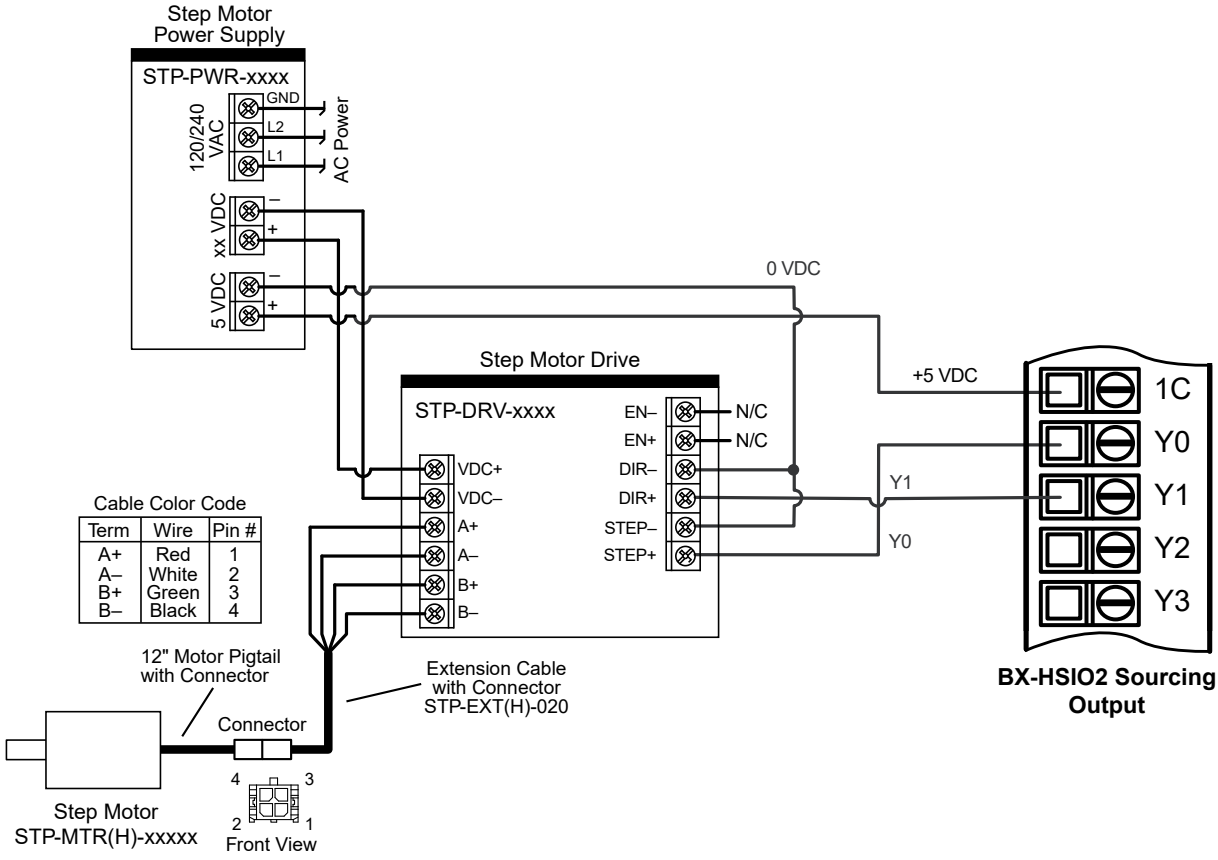


Wiring Diagram for a BRX MPU Using SureStep Stepping System Components.

BRX Wiring Examples: High-Speed Outputs, continued

BX-HSIO2 with Sourcing Outputs to Stepper/Servo Drive Input

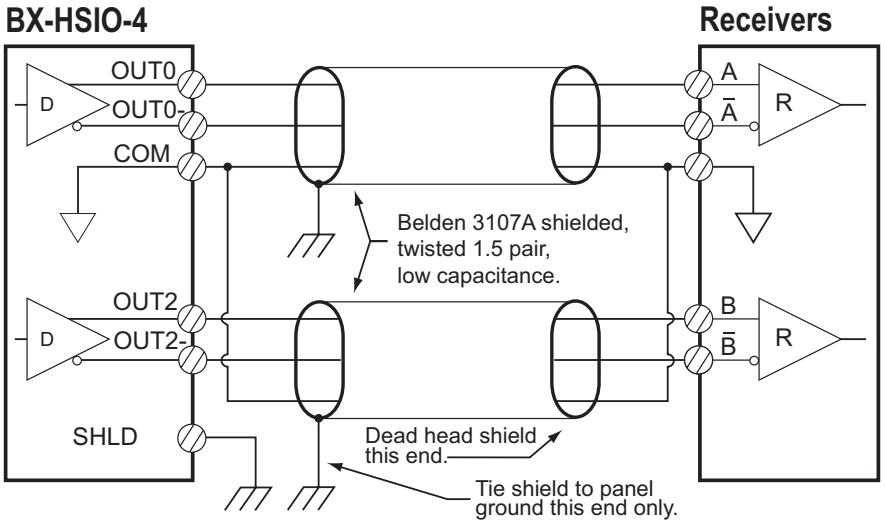
Detailed output wiring example between a BX-HSIO2 and the SureStep Stepping System components.



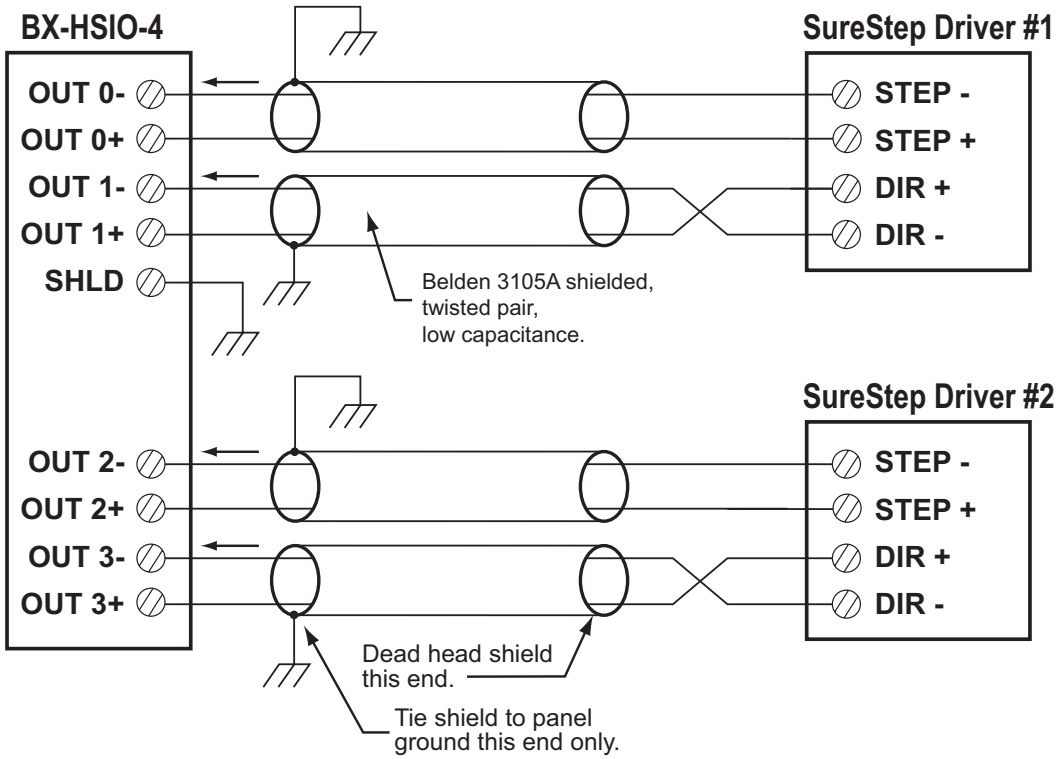
Wiring Diagram for a BX-HSIO2 Using SureStep Stepping System Components.

BRX Wiring Examples: High-Speed Outputs, continued

Line Driver Pulse Output from BX-HSIO4

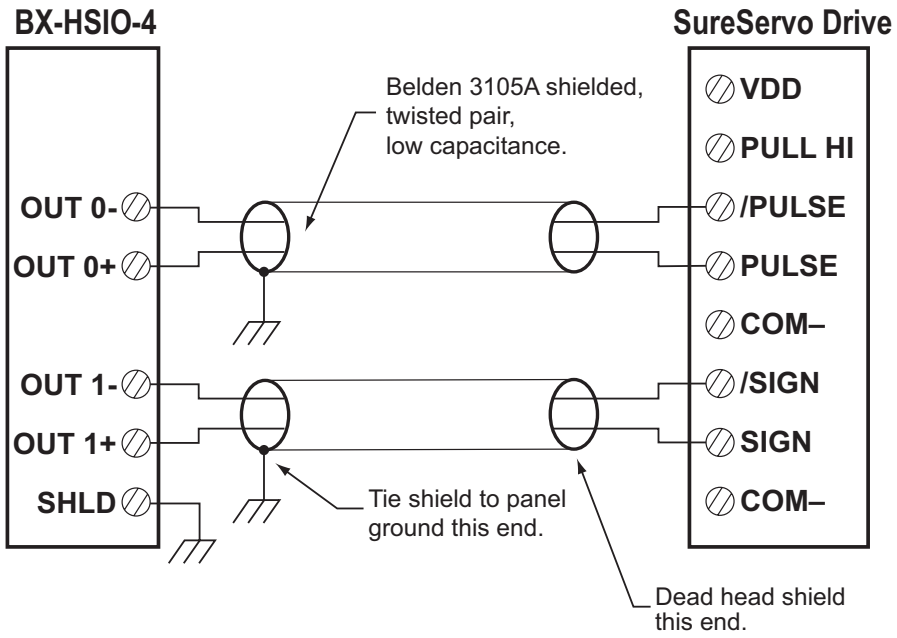


BX-HSIO-4 to SureStep

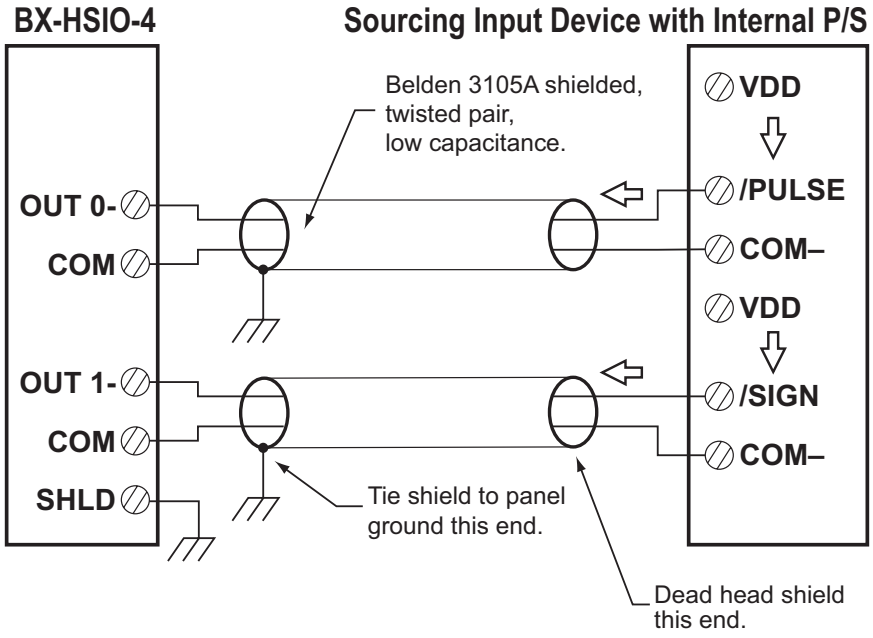


BRX Wiring Examples: High-Speed Outputs, continued

BX-HSIO-4 to SureServo



BX-HSIO-4 to Sourcing Input Device with Internal Power Supply



Available High-Speed Input and Output Features

The following High-Speed input and output features are available on the BRX Do-more! MPUs and the BX-HSIO specialty modules. Reference the specific numbered topic listed below for directions on configuring that feature.

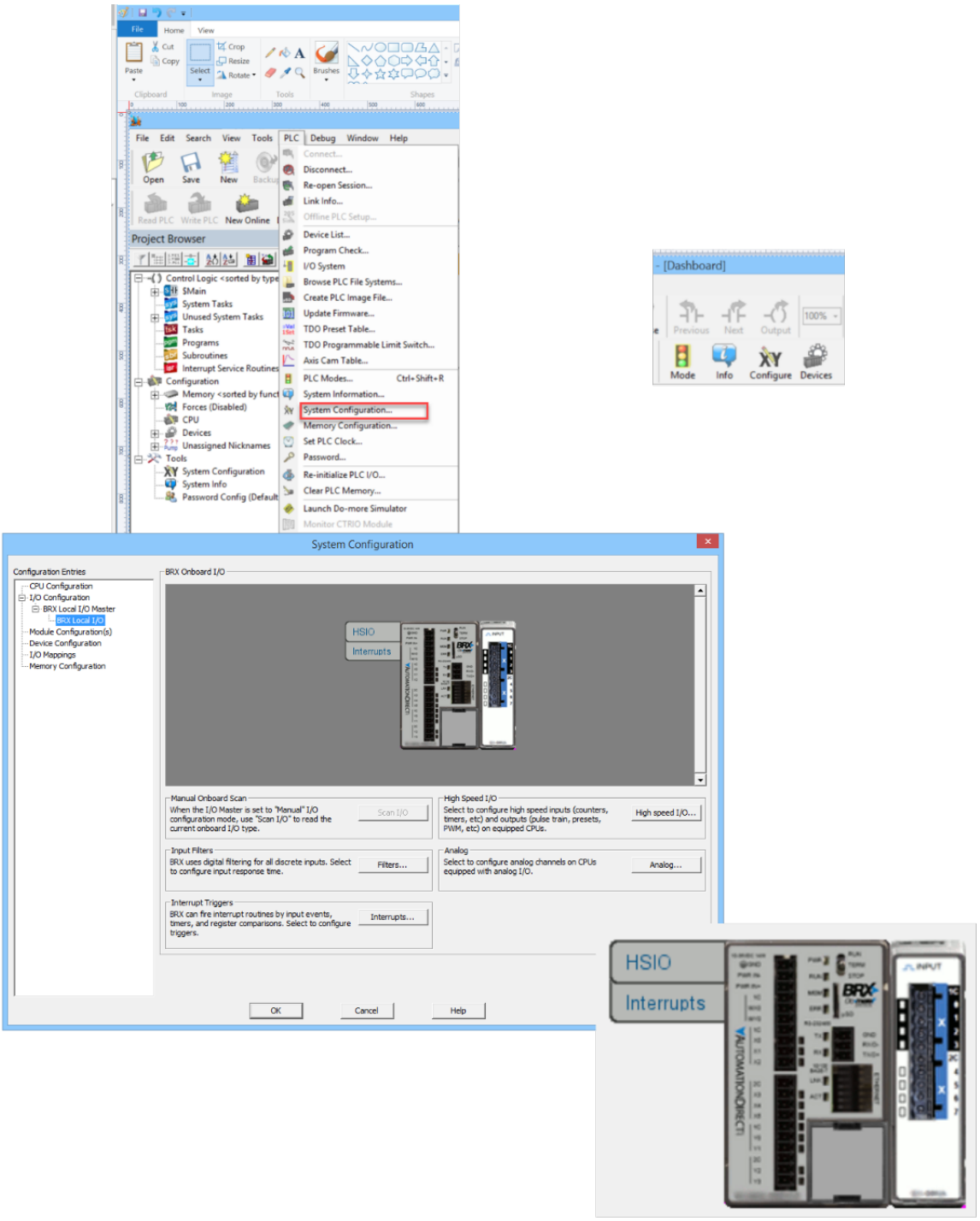
1. Input Filters
2. Interrupt Setup (BRX MPUs Only)
    a. Setup Input Interrupts
    b. Setup Timer Interrupts
    c. Setup Match Register Interrupts
    d. Interrupt Instructions
3. High-Speed Counting, Timing and Pulse Catch
    a. Counters
    b. Timers
        i. Interval Scaling
    c. Pulse Catch
4. Table Driven Outputs
    a. Preset Tables
    b. Programmable Limit Switch (PLS)
5. Outputs
    a. Axis/Pulse Outputs
    b. PWM (Pulse Width Modulation)

Access Setup High Speed I/O page

BRX MPU

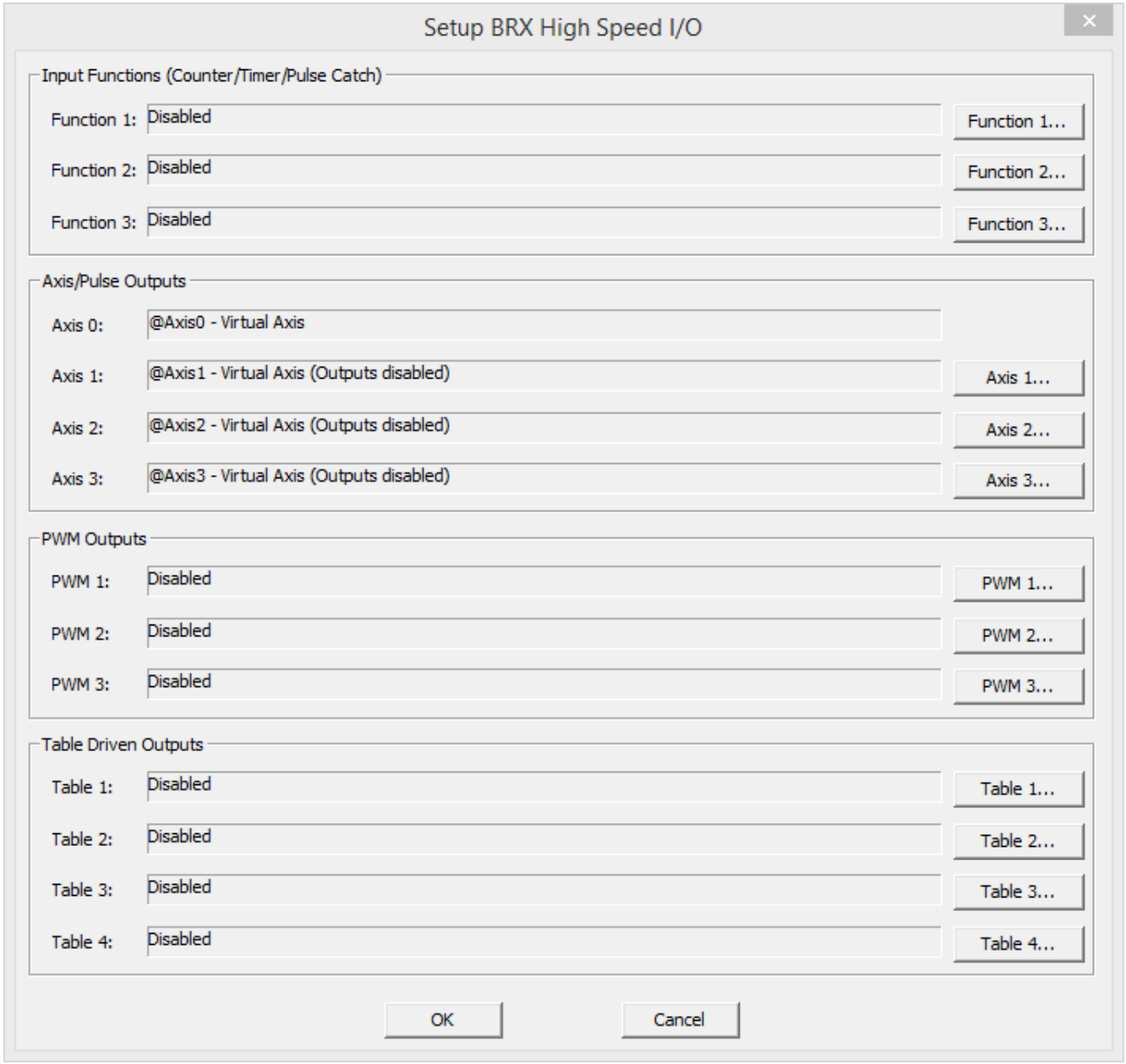
For High-Speed input and output setup:

- Go to Do-more! Designer (a) menu – PLC > System Configuration. In the ***System Configuration*** window or click on the (b) **Configure** icon, select (c) **BRX Local I/O** option under the ***Configuration Entries*** panel. Click on the (d) **High Speed I/O** button.
- From the system dashboard you can click (e) **HSIO** on the left side of the PLC image.



Access Setup High Speed I/O page, continued

The *Setup BRX High Speed I/O* page for the MPU built-in I/O comes up.

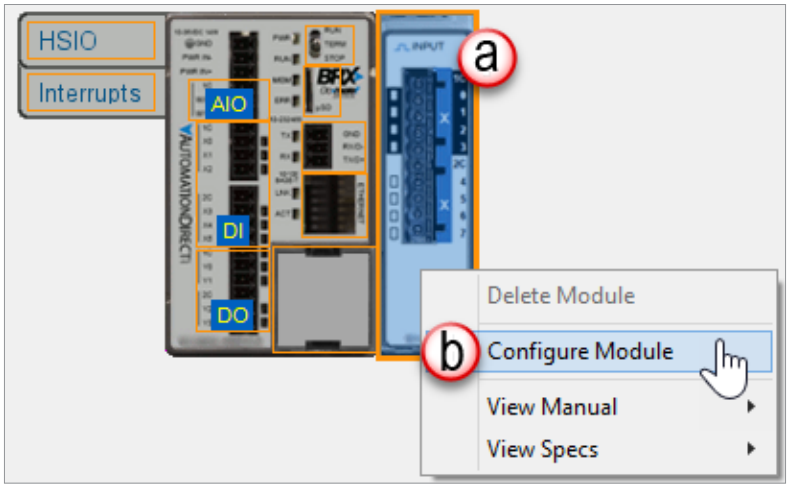


Access Setup High Speed I/O page, continued

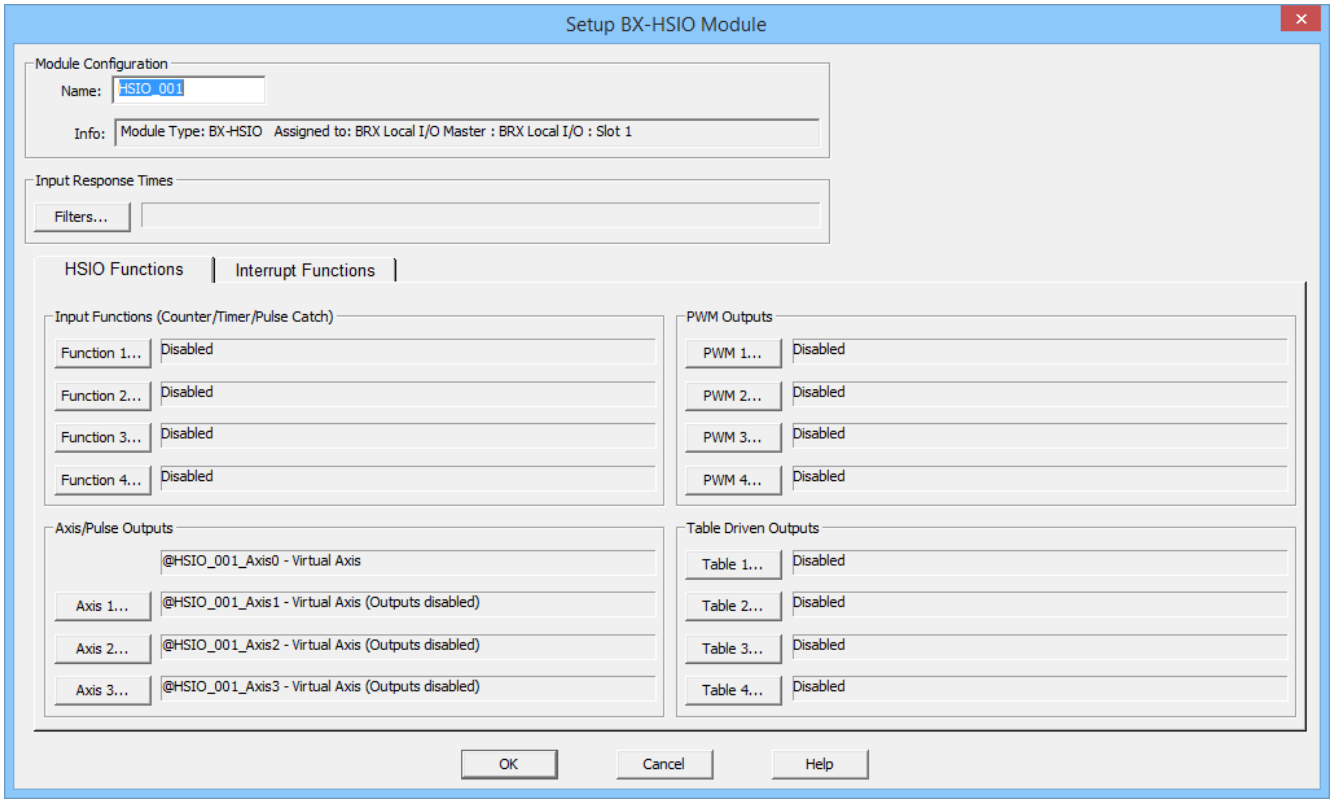
BX-HSIO1/BX-HSIO2/BX-HSIO4

For High-Speed input and output setup:

- From the system dashboard left or right-click on the (a) BX-HSIO expansion module and click on the (b) **Configure Module** link.



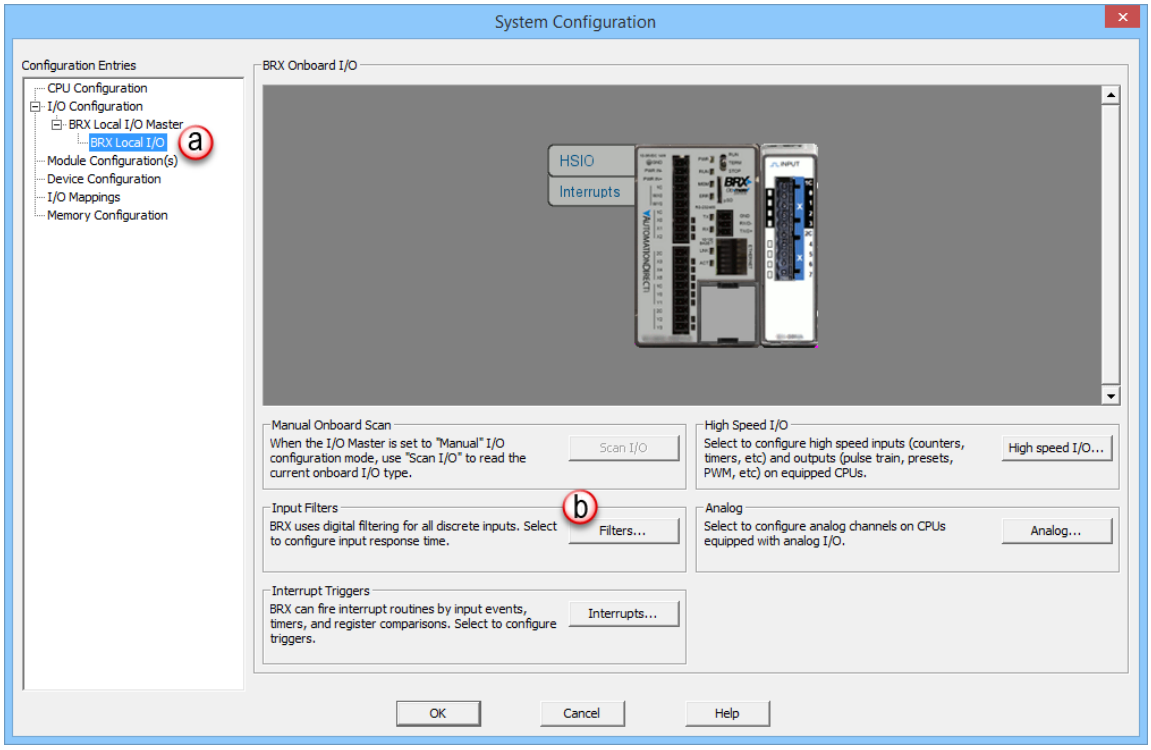
The *Setup BX-HSIO Module* page for the BX-HSIO expansion module I/O comes up.



1. Input Filters

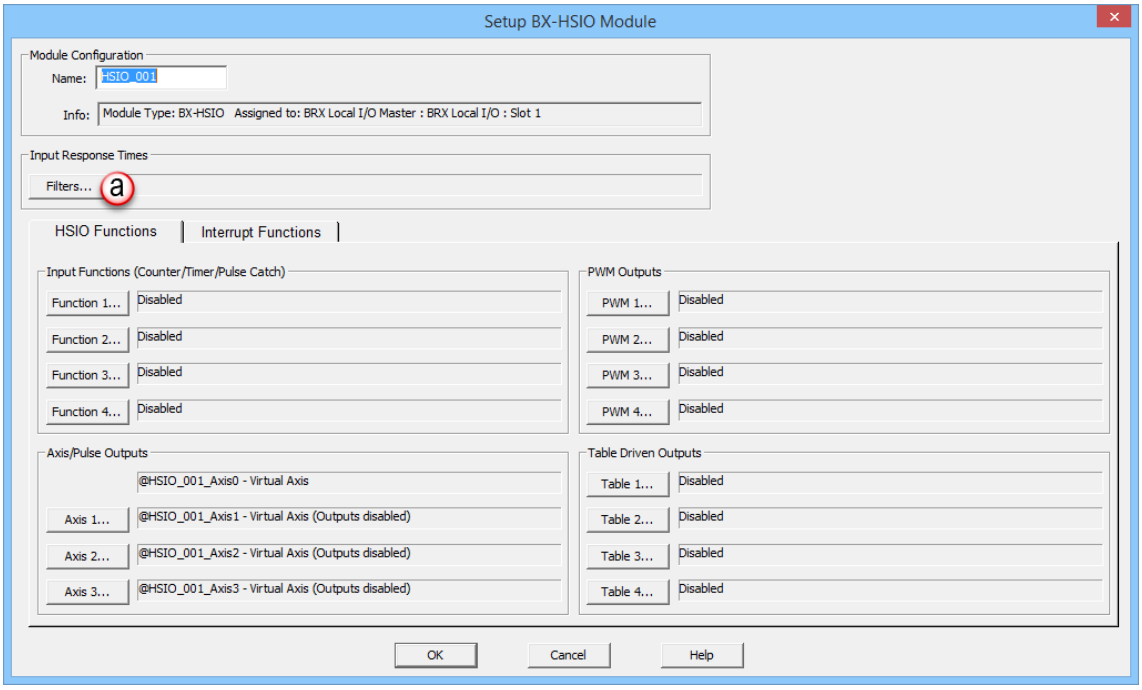
BRX MPU

In the ***System Configuration*** window, select (a) the ***BRX Local I/O*** option under the ***Configuration Entries*** panel. The on-board discrete inputs on all of the BRX hardware platforms can be configured to use (b) input filters.



BX-HSIO1/BX-HSIO2/BX-HSIO4

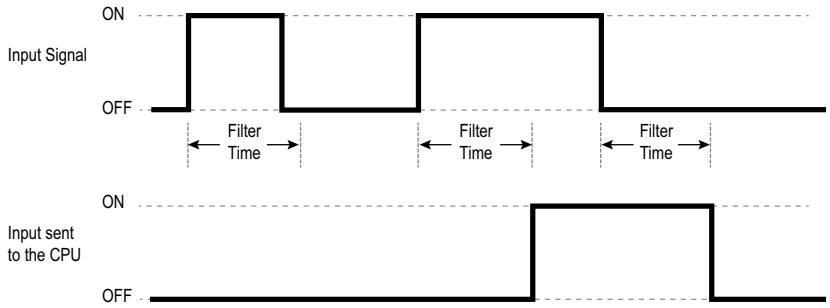
In the ***Setup BX-HSIO*** window, select (a) the **Filters** button. The on-board discrete inputs on the BX-HSIO1 and BX-HSIO2 can be configured to use input filtering.



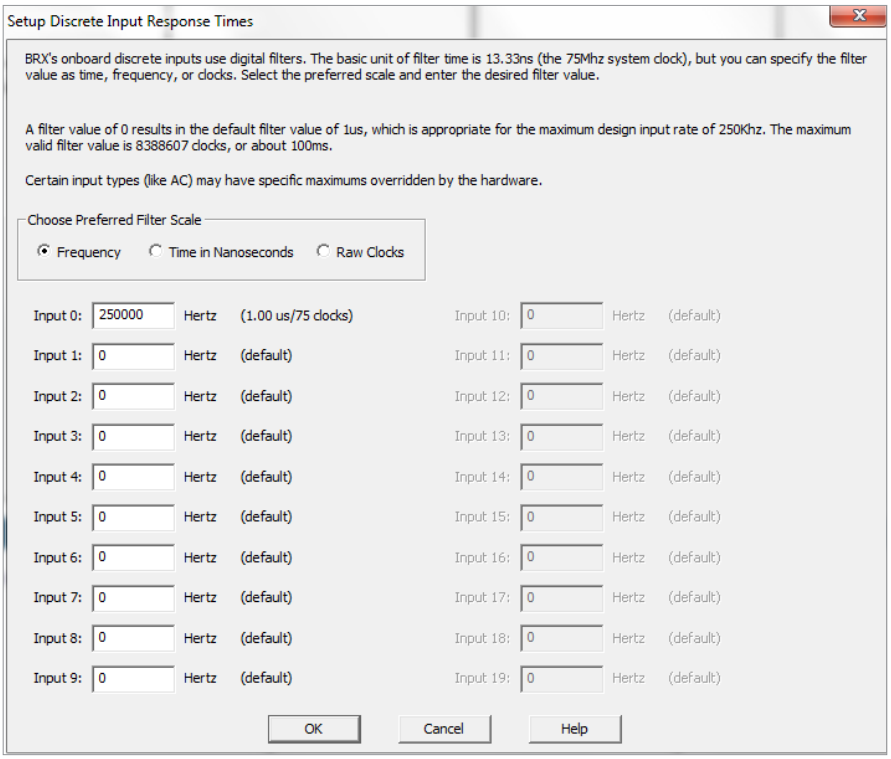
1. Input Filters, continued

Filter Setup

Filters are typically used on inputs that are operating in electrically noisy environments to remove "false positives". This is accomplished by requiring the input signal remain above the input hardware threshold level longer than the filter time so the CPU will see that input as ON. Once ON, it must be OFF for more than the filter time before the CPU will see that input as OFF.



Clicking on **Filters** opens the ***Setup Discrete Input Response Times*** dialog box (below).



Choose Preferred Filter Scale – Sets format for all of the Inputs values entered in the form.

NOTE: *Be sure to select the Filter Scale before entering values in fields. If you change the Preferred Filter Scale after entering values then any values that are not valid in that scale will be set to 0.*

1. Input Filters, continued

The Filter Scale can be specified in the following formats:

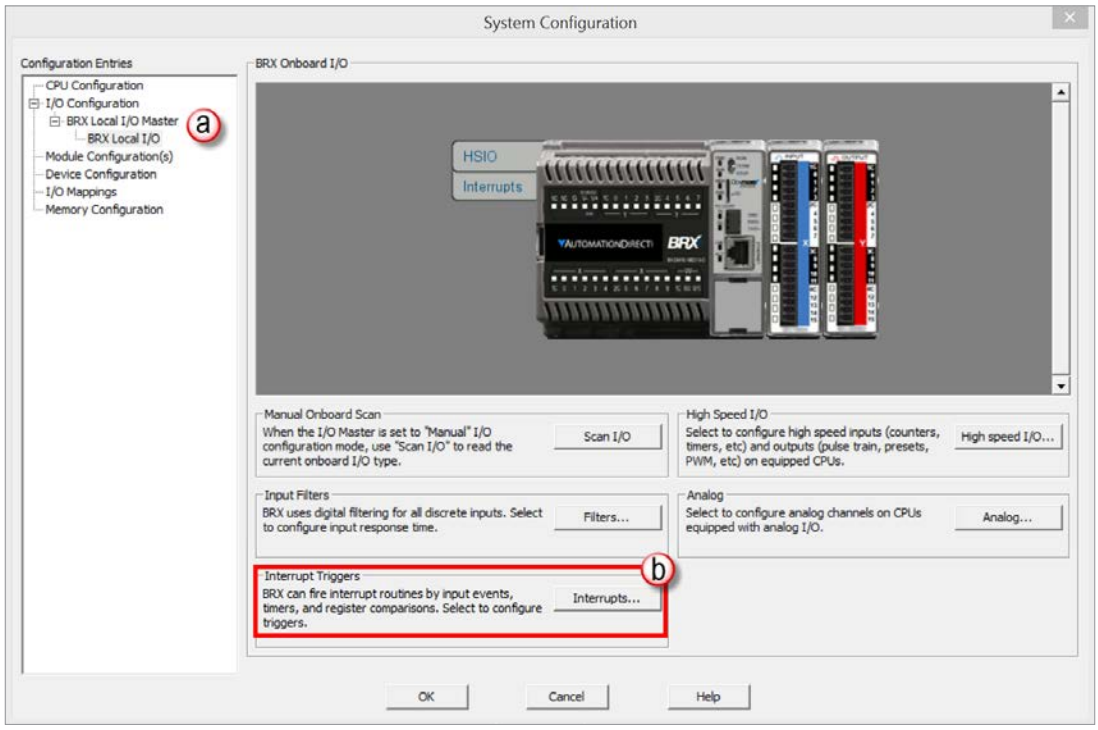
- For BX-HSIO1 and BXHSIO2:
  - A frequency in the range of 0–250000 Hz.
  - A time value in milliseconds in the range of 0–112, microseconds in the range of 0–111848, or nanoseconds in the range of 0–111848093.
  - The number of 13.33 nanosecond clocks in the range of 0–8388607.
- For BX-HSIO4:
  - A frequency in the range of 0–2000000 Hz.
  - A time value in milliseconds in the range of 0–112, microseconds in the range of 0–111848, or nanoseconds in the range of 0–111848093.
  - The number of 13.33 nanosecond clocks in the range of 0–8388607.

An input filter value of 0 will use the default filter value of 1 microsecond. Selecting one format to specify the filter value will automatically show the filter value in the other two formats.

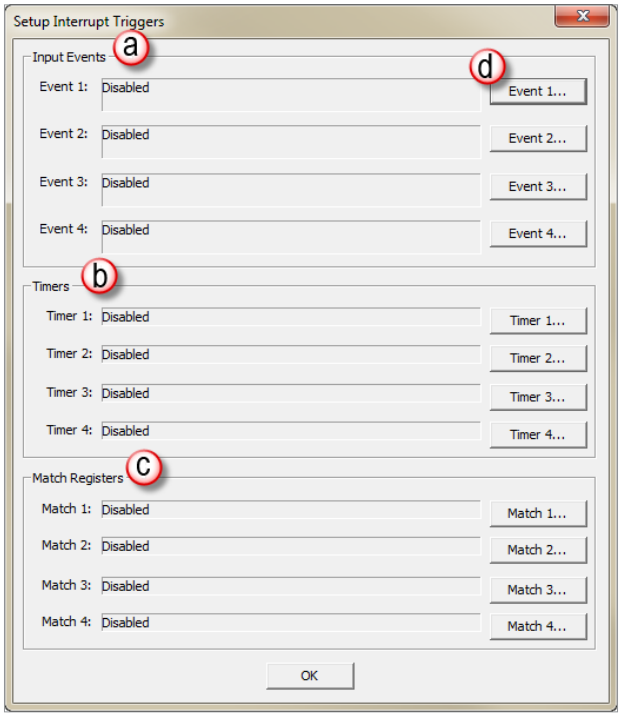
2. Interrupt Setup

BRX MPU

In the ***System Configuration*** window, select (a) the ***BRX Local I/O*** option under the ***Configuration Entries*** panel.



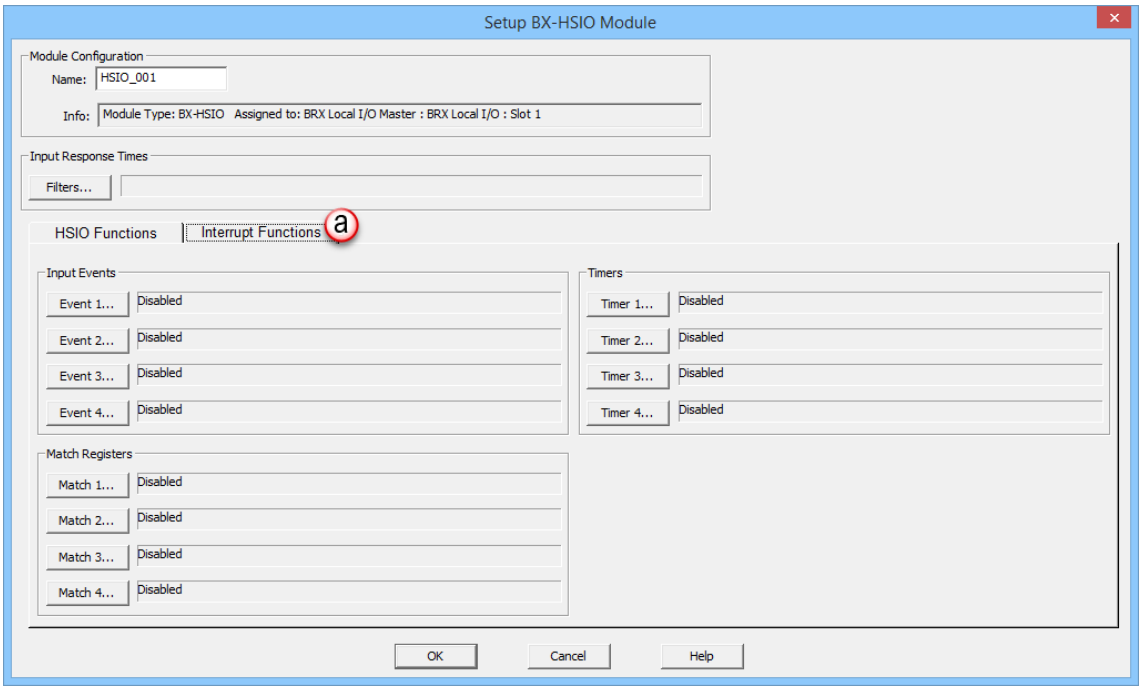
Clicking on (b) **Interrupts** opens the ***Setup Interrupt Triggers*** dialog box (below).



2. Interrupt Setup, continued

BX-HSIO1/BX-HSIO2/BX-HSIO4

From the system dashboard, left or right-click on the BX-HSIO expansion module and click on the **Configure Module** link. In the *Setup BX-HSIO* window, select (a) the **Interrupt Functions** tab.



A PLC normally reads inputs at the top of the scan and writes outputs at the bottom of the scan. The ladder logic is solved after the inputs are read and after the ladder is solved the outputs are written. Because the PLC can change the amount of work it does from scan to scan, the PLC scan time will also change accordingly, which will directly affect how frequently inputs will be read and outputs will be written. Interrupts are a method of triggering an action or code segment immediately after the qualifying condition(s) becomes true, regardless of variations in the PLC scan time. In the BRX PLC, this can be accomplished by using hardware (a) ***Input Events***, (b) ***Timers*** or (c) ***Match Registers***, (matching a register count). There are 12 Interrupt triggers available: 4 Input Interrupts, 4 Timer Interrupts and 4 Match Register Interrupts.

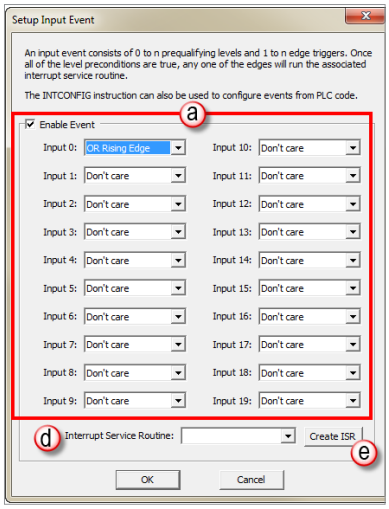
Click on (d) **Event 1** to bring up the ***Setup Input Event*** dialog box.

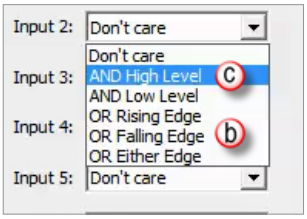
2a. Setup Input Interrupts

Input Interrupts can be used to respond to transitions of discrete inputs that occur during a PLC scan. Input Interrupts can be triggered in several different ways:

- Any (a) of the on-board discrete inputs
- Single Input (b, dropdown menu at right) OR Rising Edge, OR Falling Edge or OR Either
- Combinations of Inputs (c, dropdown menu at right) AND High Level or AND Low Level

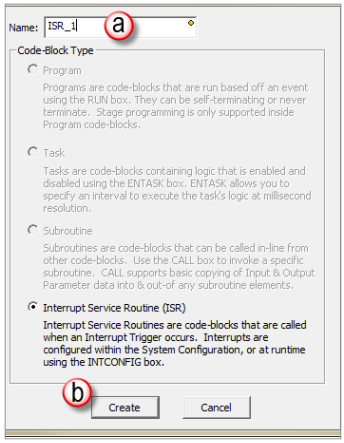
Next, choose to assign the input event to (d) an existing ***Interrupt Service Routine (ISR)*** or (e) create a new ISR.





Dropdown Menu Interrupt Selections

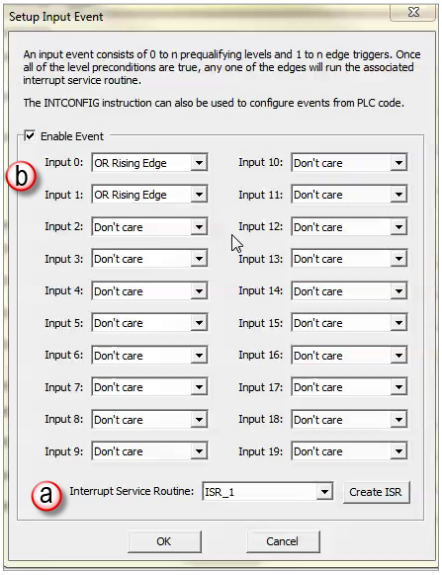
For this exercise we will click on "Create ISR" (e, above). Enter a name (a, below) for the ISR and click the Create button (b, below).



2a. Setup Input Interrupts, continued

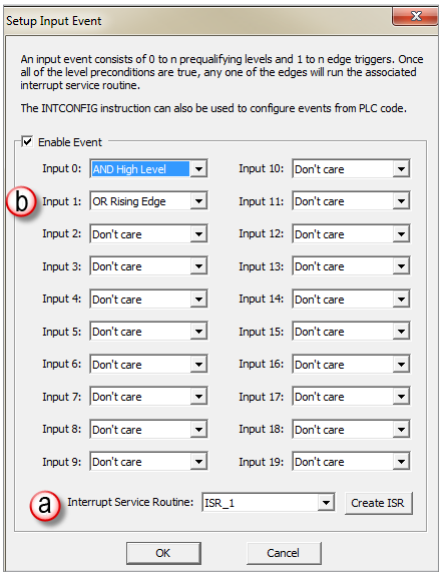
Input Interrupt Example 1

In the configuration below (a) of **ISR_1**, if (b) EITHER **Input 0** or **Input 1** goes from false to true, the Interrupt Service Routine **ISR_1** will run.



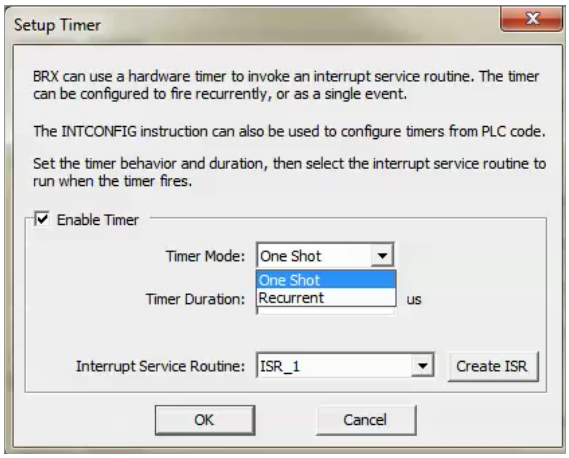
Input Interrupt Example 2

In the configuration below of (a) **ISR_1**, **Input 0** must be true and when (b) **Input 1** goes from false to true, the Interrupt Service Routine **ISR_1** will run.

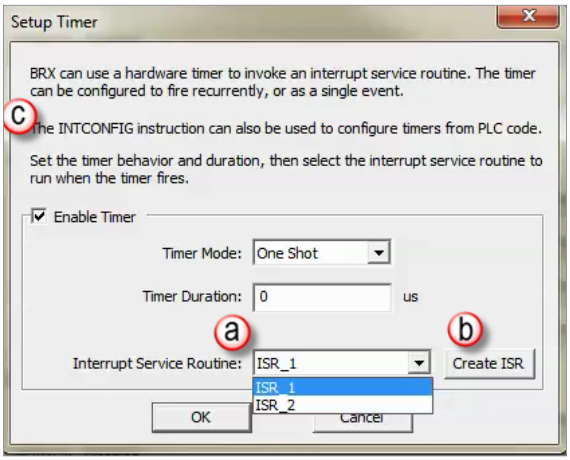


2b. Setup Timer Interrupts

Timer Interrupts use a hardware timer to run an Interrupt Service Routine in situations where you need an action to occur at regular intervals that are not affected by variations in the PLC scan time. This can be a situation that require actions to occur at exact repeating intervals (Recurrent), or actions that occur after a precise amount of delay time (One Shot).



Timer Interrupts are fairly simple to setup. There are two modes: One Shot or Recurrent. The Timer Duration is in microseconds resolution. As with the Input Interrupt setup, an existing (a) ISR can be specified or a new one can be created from this dialog by clicking on (b) **Create ISR** button.



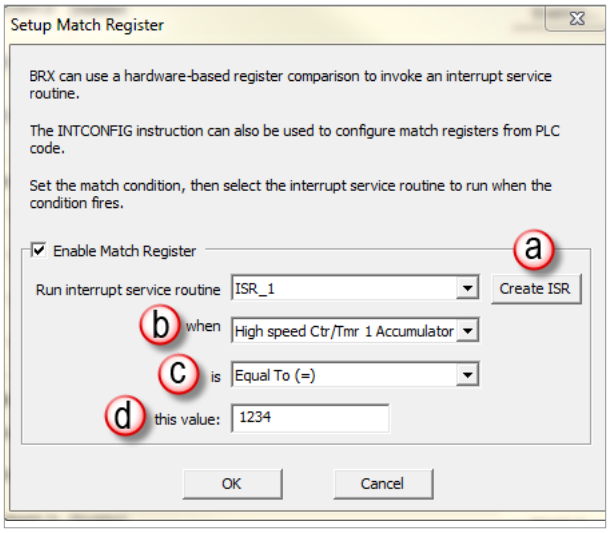
One Shot – The ISR will run only once at the time period specified after putting the PLC into Run. In order for this Interrupt to run again, the PLC will need to transition from Stop/Program to Run or you can use the (c) INTCONFIG instruction in ladder logic to trigger it again. The INTCONFIG instruction is very useful and will be discussed in more detail later.

Recurrent – the ISR will run continuously at the time period specified after putting the PLC in Run mode or it can be controlled (turned on or off) by using the INTCONFIG instruction.



NOTE: *The Timer Interrupt will be triggered when the PLC goes from Stop/Program mode to Run mode. To stop this from taking place, you can use the ISRname.Inhibit bit to disable the ISR from triggering when the PLC first goes into Run mode.*

2c. Setup Match Register



The Match Register function allows you to compare one of the hardware based registers to a value. When that condition is met, the specified Interrupt Service Routine will run. As with the other Interrupt functions, you can pick from a previously created ISR or you can create one from this dialog (a).

(b) **...when** – specifies which of the High-Speed input or output locations to use in the comparison. Choose from the following:

- High-Speed Ctr / Tmr 1 Accumulator
- High-Speed Ctr / Tmr 2 Accumulator
- High-Speed Ctr / Tmr 3 Accumulator
- Pulse Output 1 Position
- Pulse Output 2 Position
- Pulse Output 3 Position

(c) **...is** – specifies the math operator to use when performing the comparison. Choose from the following:

- Equal To
- Not Equal To
- Greater Than
- Greater Than or Equal To
- Less Than
- Less Than or Equal To

(d) **...this value** - specifies the 32-bit signed decimal constant value to compare to the register contents. This can be any constant value between -2147483648 and 2147483647.

The specified ISR will run once when the operand condition is met. For example: In the case of greater than, the ISR will run when the high-speed counter/timer or pulse output position is above the set point. It will not run again until the value has gone below the set point and then back above it again. The same is true for not equal to - the ISR will run the very first time after going into run mode if the high-speed counter/timer or pulse output position is not equal to the set point. It will not run again until the high-speed counter/timer or pulse output position becomes equal to the set point and then moves off of that value.

2d. Interrupt instructions

There are four Interrupt instructions:

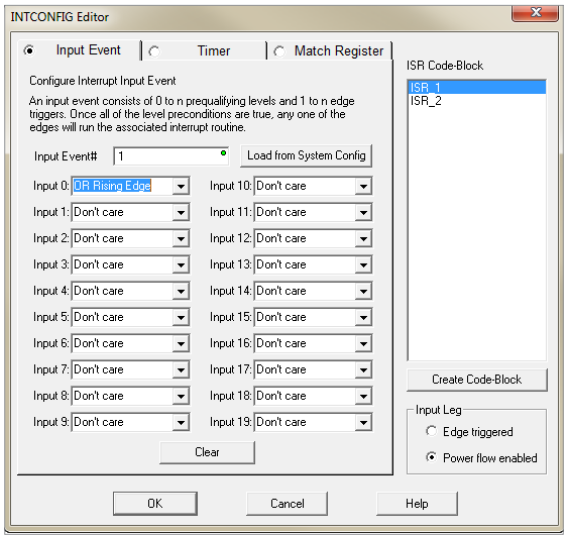
- INTCONFIG (Configure Interrupt)
- INTDECONFIG (Deconfigure Interrupt)
- INTSUSPEND (Suspend Interrupts)
- INTRESUME (Resume Interrupts)

NOTE: *If you are doing ISRs, you should use one or more of the Immediate Output instructions:*
OUTI (Out Immediate)
SETI (Set Immediate)
RSTI (Reset Immediate).
These will help get a faster response from a Y in the ISRs.

A brief explanation of the use of these instructions will be given here. For full details on these instructions, refer to the help file.

For each instruction, there is an ***Input Leg*** action selection: **Power flow enabled** or **Edge triggered**. A **Power flow enabled** will lock the instruction on. So if an INTCONFIG instruction was configured as **Power flow enabled**, the rung became true and an INTDECONFIG instruction was enabled, the Interrupts would still occur. Choosing **Edge triggered** will invoke the action once and other instructions may change the current behavior.

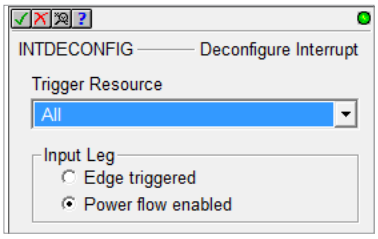
NOTE: *If an Interrupt Trigger was created using the Interrupt Triggers setup in System Configuration, be aware that these instructions DO NOT change that configuration. The Interrupt Trigger configuration will return each time the BRX CPU transitions from PROGRAM to RUN mode.*



2d. Interrupt instructions, continued

INTCONFIG

The INTCONFIG instruction performs the same Interrupt setup located within the System Configuration. The instruction allows you to dynamically change the setup in applications where this may be required. One example is to calculate a Match Register value in Ladder Logic using the MATH instruction to D100, then use D100 in an INTCONFIG. If the INTDECONFIG instruction is used to disable Interrupts, this instruction is required to re-enable them.

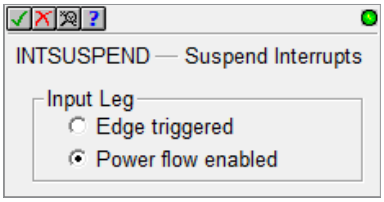


INTDECONFIG

This instruction disables the Interrupt(s) selected. Individual Interrupts may be selected as well as choosing to disable all of them. To re-enable Interrupts, the PLC must transition from Program to Run or the INTCONFIG instruction must be used. To temporarily disable Interrupts, use the INTSUSPEND instruction.

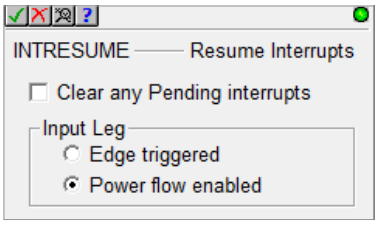
INTSUSPEND

The INTSUSPEND instruction temporarily suspends the interrupts and does not allow the ISRs to run. To enable the interrupts to function again, use the INTRESUME instruction. When interrupts are suspended using the INTSUSPEND instruction and one or more triggers take place, only one iteration of the interrupt will be available to be triggered after it is no longer suspended.



INTRESUME

The INTRESUME instruction resumes the normal processing of suspended interrupts. When the INTRESUME instruction is enabled, if one or more than one trigger took place while suspended, only one will be triggered when it resumes.



Clear any Pending interrupts: When enabled, it resets the trigger that took place while suspended. For example, if one or more triggers take place while suspended and the Clear any Pending Interrupts was not enabled, when interrupts are resumed, it will immediately execute the interrupt routine one time. If, however, the Clear any Pending Interrupts was enabled, any trigger that took place while suspended would be reset and when interrupts resume, it would start the normal processing of the interrupts.

2d. Interrupt instructions, continued

Interrupt Service Routines

Only a brief explanation will be given of the ***Interrupt Service Routine***. This topic is defined in the help file as well.

When an ***Interrupt Service Routine*** (ISR) is created, a structure is created. The members of the structure are as follows:

- **.ExecutionTime** – Time, in microseconds, it took to run the ISR the last time it ran.
- **.HasRun** – Should be on if the ISR has run at least once since the last Program to Run transition.
- **.Inhibit** – Enabling this bit will prevent the ISR from running. The actions do NOT get queued when this bit is enabled and the hardware interrupt becomes true for this ISR.
- **.Latency** – Time in microseconds elapsed between when the hardware Interrupt occurred and when the ISR execution began.
- **.RunCounter** – Indicates how many times the ISR has run since the past Program to Run transition.

These structure members may be helpful in troubleshooting the process when using Interrupts.

3. High-Speed Counting, Timing and Pulse Catch

a. Counters

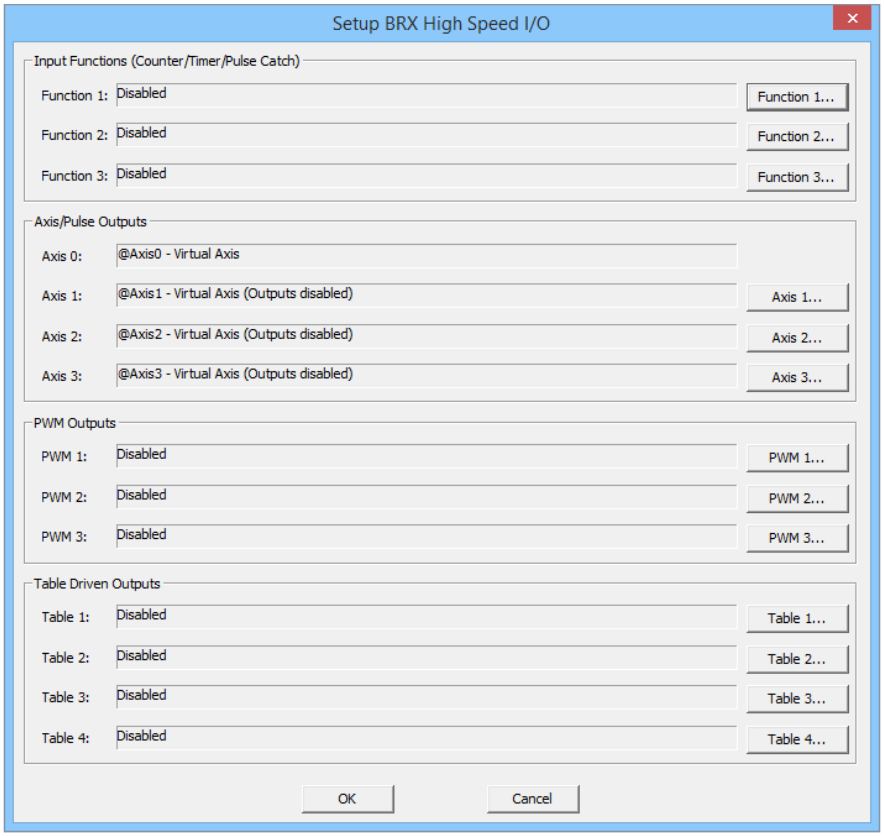
b. Timers

c. Pulse Catch

d. Table Driven Outputs

BRX MPU

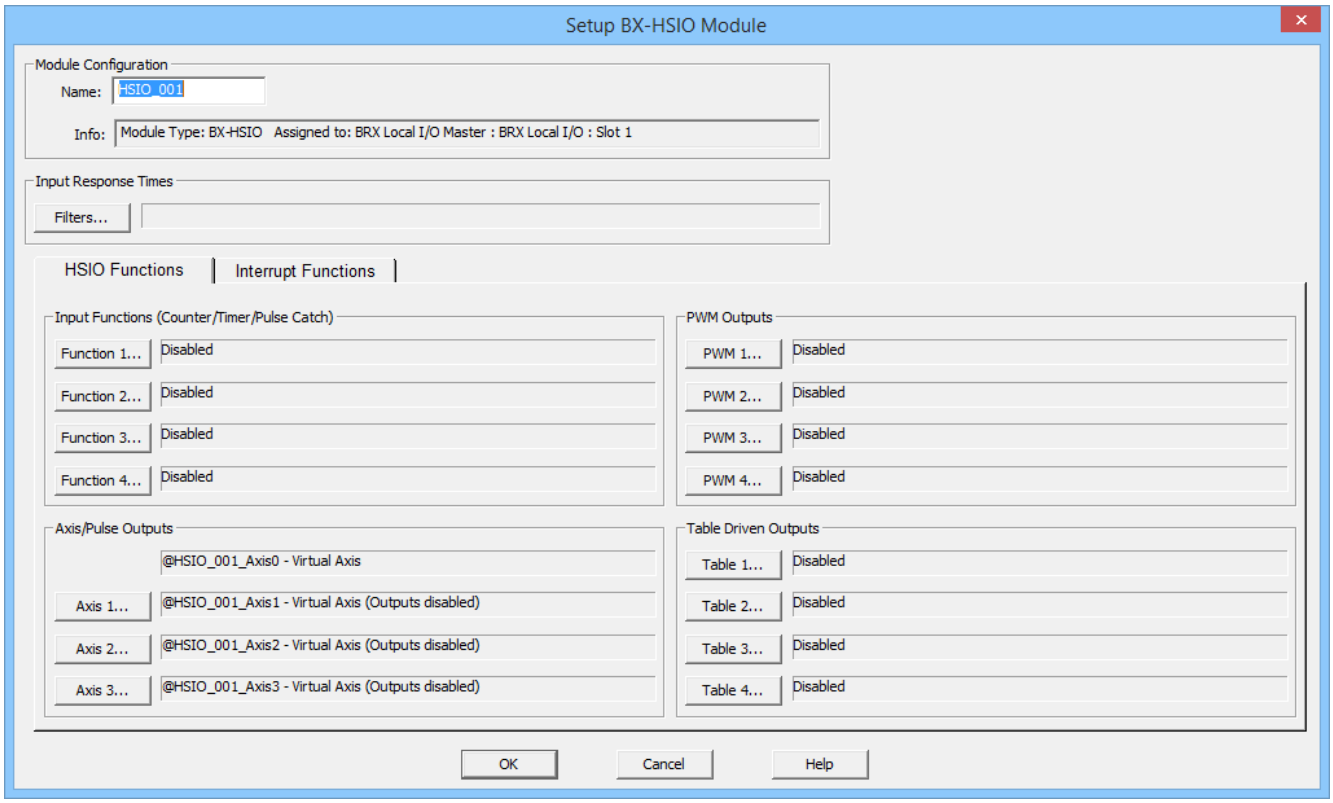
There are three functions that can be configured as a counter, timer and/or pulse catch. To open the configuration window, click one of the **Function** buttons



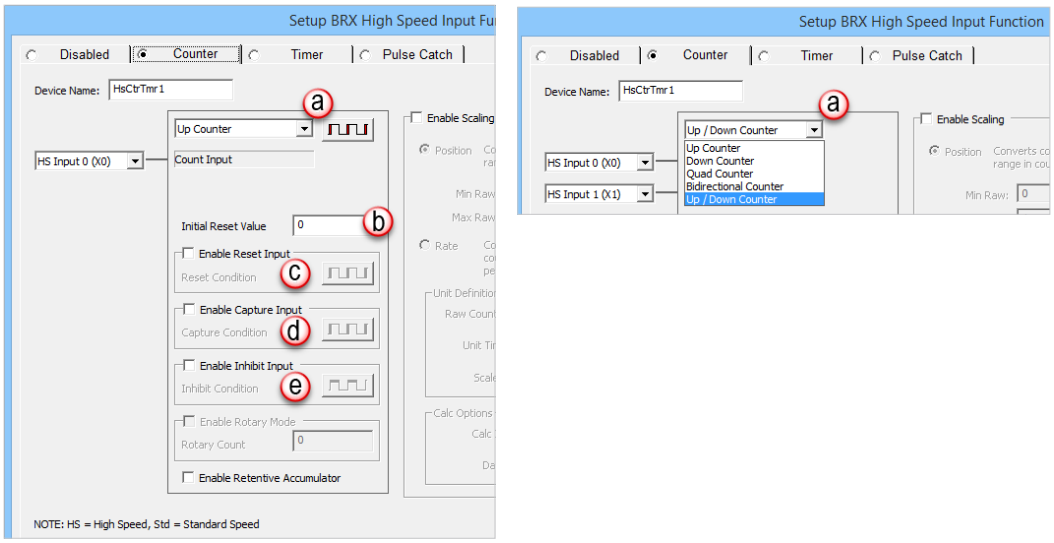
3. High-Speed Counting, Timing and Pulse Catch, continued

BX-HSIO1/BX-HSIO2/BX-HSIO4

There are four functions that can be configured as a counter, timer and/or pulse catch. To open the configuration window, click one of the **Function** buttons



3a. Counters



A structure is created when this function is used. The name of the structure is configurable in the **Device Name** field. For the description of this function we will use the default name ***HsCtrTmr1***.

(a) The BRX PLC allows for either 3 High-Speed Counters or 3 High-Speed Timers. Counters may be used in 5 different configurations with different options for the "Edge" to count:

Up Counter (Rising Edge, Trailing Edge or Both): Uses a single input and increments the count in the ***$HsCtrTmr1.Acc*** register.

Down Counter (Rising Edge, Trailing Edge or Both): Uses a single input and decrements the count in the ***$HsCtrTmr1.Acc*** register.

Quad Counter (1X, 2X or 4X): Uses 2 inputs and counts in both positive and negative directions based upon which of the inputs is 'leading'.

Bidirectional Counter: Uses 2 inputs. The first input is the count input. The second input determines whether the count is incrementing (when input is low) or decrementing (when input is high).

Up/Down Counter: Uses 2 inputs. The first input increments the count. The second input decrements the count.

(b) **Initial Reset Value**: The ***$HsCtrTmr1.Acc*** register will be loaded with the value configured in this field when a reset of the Counter occurs.

(c) **Reset Input**: Optionally, specify one High-Speed discrete input that will stop the current count operation. When this condition is met, the ***$HsCtrTmr1.Acc*** register will be loaded with the value specified in the (b) ***Initial Reset Value*** field. The Input can be configured to indicate a true condition when the Rising Edge occurs, the Falling Edge, High Level or Low Level. In addition to this hardware reset input, there is a software reset available that is performed through the structure fields named ***$HsCtrTmr1.EdgeReset*** or the ***$HsCtrTmr1.LevelReset***. Any time the hardware level reset input is ON or the software level reset structure field is ON, the structure field ***$DeviceName.AtResetValue*** will be ON.

(d) **Enable Capture Input**: Optionally, specify one High-Speed discrete input that will capture the current count value when the specified input signal changes states. When this condition is met AND when the structure member ***$HsCtrTmr1.EnableCapture*** is true, the current value that is in the ***$HsCtrTmr1.Acc*** register will be loaded into the ***$HsCtrTmr1.CapturedValue*** register. When this occurs, the structure member ***$HsCtrTmr1.CountCaptured*** will be true. To capture again, the

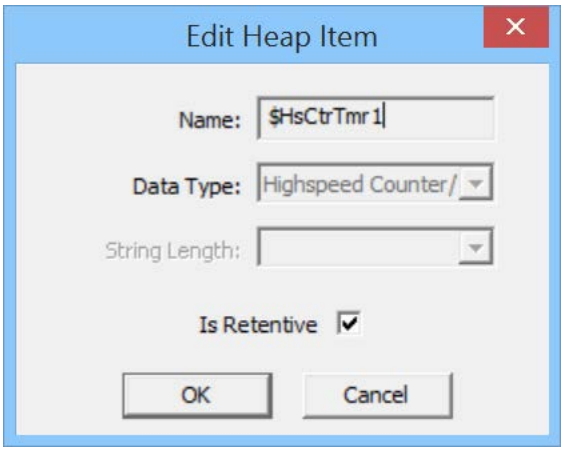
3a. Counters, continued

$HsCtrTmr1.EnableCapture bit must be turned OFF and back ON. This input can be configured to indicate a true condition on Rising Edge or Falling Edge.

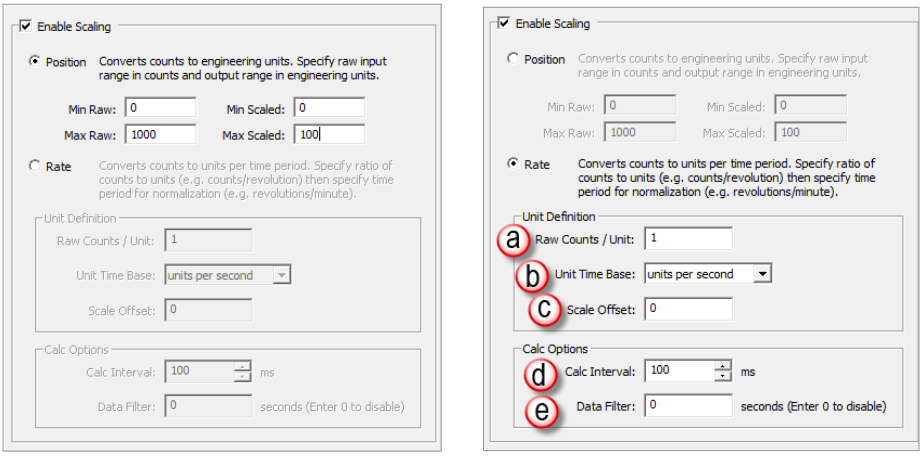
(e) **Inhibit Input**: Optionally, specify one High-Speed discrete input that will cause the counter to stop counting input pulses. When the Inhibit Input is ON, the value in the ***$HsCtrTmr1.Acc*** register will be maintained, and any new pulses are not counted. When the Inhibit Input is no longer active, new pulses will be counted. The Input can be configured to indicate a true condition on High Level or Low Level.

(f) **Rotary Mode**: This mode is available only for Quad, Bi-Directional and Up/Down Counters. Input pulses that originate from a rotary source are expected to generate count values that wrap at a certain count value. One positive pulse at the maximum value will wrap the Current Count value to 0. One negative pulse at 0 will wrap the Current Count to the maximum value. The ***Rotary Count*** specifies the total number of counts in the rotary range. The range of count values will be from 0 to (Rotary Count – 1).

(g) **Enable Retentive Accumulator**: Optionally, make the current count value in the accumulator retentive, meaning that it will retains its current value through a loss of system power. **For this option to work correctly the high-speed counter's associated structure also must be marked as retentive in the Memory Configuration as shown below:**



Counter Scaling



3a. Counters, continued

Position

Converts "raw" pulse count values to "engineering units" of distance using linear interpolation. Enter the **Min Raw**, **Max Raw**, **Min Scaled** and **Max Scaled** values and the scaling function will derive a distance or position value. That result will be placed in the ***$HsCtrTmr1*** structure member ***$HsCtrTmr1.ScaledValue***.

Rate

Converts "raw" pulse count values to "engineering units" by sampling the accumulated count value over a period. Rate scaling of a pulse train is preferred over Interval Scaling of the time between pulses for frequencies over 5kHz. Because this form of scaling renders a velocity, the result of the scaling operation will be some distance unit (e.g. inches, feet, revolutions, etc.) per some time unit (seconds, minutes, hours). The scaled value will be placed in the structure member ***$HsCtrTmr1.ScaledValue***.



NOTE: *The raw value is used for Match Register functionality. However, the Preset Command table and PLS table can use the scaled value.*

Rate scaling is a measurement of distance over time. The following parameters are used in calculating the ***.ScaledValue***:

(a) **Raw Counts / Unit**: The raw count value that would comprise 1 scaled unit value. So for calculated RPMs of an encoder, this might be the Pulses Per Revolution of the encoder.

(b) **Unit Time Base**: A time base for the scaled unit value. In the example of calculating RPMs, this value would be units per minute.

(c) **Scale Offset**: Simply a value added to the resulting ***.ScaledValue***.

(d) **Calc Interval**: Specifies how often (in milliseconds) the rate calculation is performed. The higher the value, the lower the impact on performance to the system. The calculation should be performed no faster than the process requires. If the application generates very slow pulse signals, consider using the Interval Scaling, discussed later in this chapter.

(e) **Data Filter**: Entering a value into this field will apply a time constant filter to a rolling average resulting in a 'smoother' value.

Rate Scale Example

An RPM (revolutions per minute) value is needed for a motor that has an 800-ppr (pulses per revolution) encoder that is wired to the High-Speed I/O inputs on a BRX MPU.

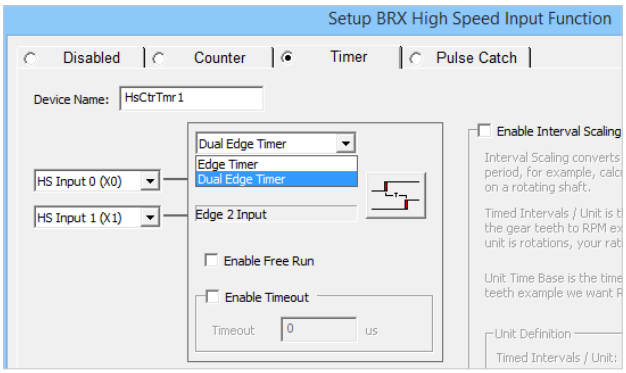
The encoder yields 800 pulses in 1 revolution. If it makes 1 revolution in 1 minute, that would yield 800 pulses in 1 minute's time. If the BRX MPU sees 800 pulses in the time span of 1 minute, that would be 1 RPM. The **Raw Counts / Unit** is equal to 800 (meaning 800 pulses per minute = 1 RPM).

Since the desired unit is RPM (revolutions per minute) a **Unit Time Base** of **Minutes** is selected.

Scale Offset is zero because when there are no pulses being generated we want the value to be 0 RPM.

3b. Timers

There are 2 types (a) of High-Speed Timers for the BRX PLC: **Edge Timer** (1 Input) and **Dual Edge Timer** (2 Inputs). Edge timers measure the amount of time between pulses. Using an edge timer instead of pulse counting for pulse rates below 5kHz is a better option when the desired result is a scaled value representing a speed or a rate.



Edge Timer: With the Edge Timer, measurements can be taken in 4 possible ways:

- From rising edge of one pulse to the rising edge of the next pulse
- From rising edge to falling edge of the same pulse
- From falling edge of one pulse to the rising edge of the next pulse
- From falling edge of one pulse to the falling edge of the next pulse

Dual Edge Timer: With the Dual Edge Timer, measurements can be taken in 4 possible ways:

- From the rising edge of input 1 to the rising edge of the subsequent pulse of Input 2
- From the rising edge of input 1 to the falling edge of the subsequent pulse of Input 2
- From the falling edge of input 1 to the rising edge of the subsequent pulse of Input 2
- From the falling edge of input 1 to the falling edge of the subsequent pulse of Input 2

When a High-Speed Timer is configured, a structure is created. To use the timer, the ***$HsCtrTmr1.EnableTimer*** bit must be enabled. The BRX PLC will then look for the first pulse. When the first pulse is read, the timer begins. The current time value (in microseconds) can be seen in the ***$HsCtrTmr1.Acc*** register. When the second pulse has been read, the time value is moved into the ***$HsCtrTmr1.LastTime*** register and the timer stops. To run again, disable the ***$HsCtrTmr1.EnableTimer*** bit and re-enable. There are 2 other bits to indicate the state that the timer is in. The ***$HsCtrTmr1.TimerStarted*** indicates that the timer is active. The ***$HsCtrTmr1.TimerComplete*** bit indicates that the timer has completed.

Enable Free Run: When the (b) **Enable Free Run** checkbox is selected, the edge timer automatically re-arms itself after each timing measurement. This results in a continuous (moving average) measurement. With this mode selected, the ***$HsCtrTmr1.EnableTimer*** bit only needs to be enabled.

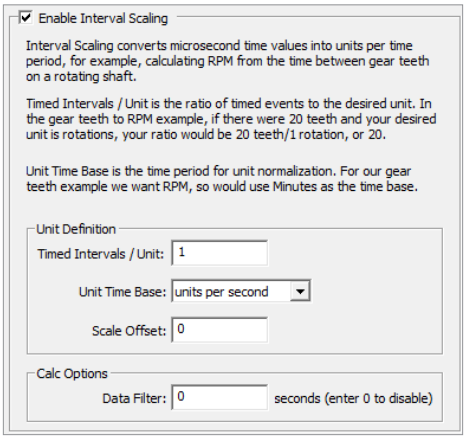
NOTE: *The timer will 'free run' and will not stop in between pulses. The BRX PLC is just grabbing snapshots of the configured pulse timing.*

3b. Timers, continued

Enable Timeout: This (c) feature gives an indication that the first edge has been received but the second edge has not been received within the time specified. When this takes place, the structure member ***$HsCtrTmr1.Timeout*** is set ON. The timeout value is entered in microseconds. When the timeout occurs, it will not successfully complete the timer even though the second edge may eventually arrive. The ***$HsCtrTmr1.EnableTimer*** bit must be disabled and re-enabled.

Interval Scaling

Interval scaling uses the time between input pulses to calculate the frequency of the input pulses. It then normalizes that frequency to a desired time base. Interval scaling is typically used for units of speed, flow, velocity, etc., and is preferred over Rate Scaling for input pulse frequencies lower than 5kHz. Because this form of scaling renders a velocity, the result of the scaling operation will be some distance unit (e.g. inches, feet, revolutions, etc.) per some time unit (seconds, minutes, hours).



The Interval Scaling operation requires the following three parameters:

Timed Intervals / Unit: the number of pulses over a certain period, for example, the number of teeth on a gear, or the number of index marks on a belt.

Unit Time Base: the time unit you want the interval normalized to, either units per Second, Minute or Hour.

Scale Offset: a fixed value to add to each frequency calculation.

You can optionally enable a **Data Filter** that will perform a rolling average of the **Interval Scaled** values over the time (in seconds) specified for the **Data Filter**. A value of 0 disables the use of the **Data Filter**.

Interval Scale Example #1

A value for the RPM (revolutions per minute) is needed for a motor whose encoder is wired to the High-Speed I/O Inputs on a BRX CPU. The encoder produces 800 pulses per revolution.

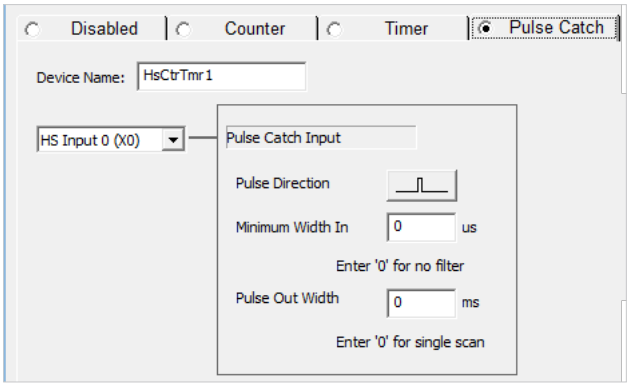
The encoder yields 800 pulses in 1 revolution. Each time it makes 1 revolution in 1 minute, that would yield 800 pulses in 1 minute's time. If the input sees 800 pulses in the time span of 1 minute, that would be 1 RPM. The **Time Intervals / Unit** is equal to 800 (meaning 800 pulses per minute = 1 RPM).

Since the desired unit is RPM (revolutions per minute) a **Unit Time Base** of **Minutes** is selected.

Scale Offset is zero because when there are no pulses being generated we want the value to be 0 RPM.

3c. Pulse Catch

The BRX high-speed ***Pulse Catch*** will generate an output that can be seen by the PLC scan in response to input pulses that are too fast to reliably be seen otherwise. The output can be ON for one PLC scan or ON for a fixed number of milliseconds. Once the ***Pulse Catch*** has been configured its operation is completely automatic. The associated structure member ***$HsCtrTmr1.PulseCatchOut*** will come ON each time a qualifying ***Pulse Catch*** event is processed.



Device Name: is the name given to this high-speed I/O counter, timer or pulse catch function. This name will also be used as the name of the structure you will use to interact with this function in the ladder logic project.

Pulse Catch Input: selects which of the on-board inputs to use.

Note: You can select any of the on-board discrete inputs. Verify which inputs are high-speed for the MPU model you are using.

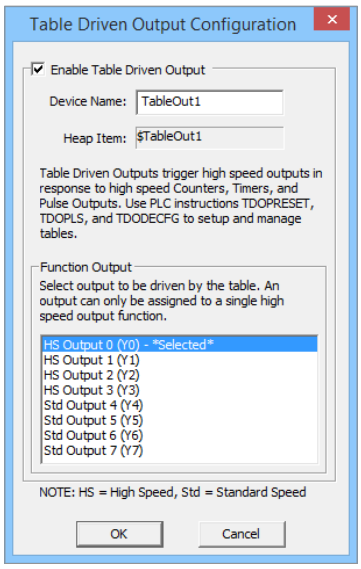
Pulse Direction button: specifies whether to monitor the input for positive pulses or negative pulses. Clicking the button cycles through the possible selections.

Minimum Width In: specifies the minimum pulse width (in microseconds) that will be considered a valid input to generate a Pulse Catch event.

Pulse Out Width: specifies how long the generated output, structure member ***$HsCtrTmr1.PulseCatchOut***, will be ON each time a Pulse Catch event is generated. A value of 0 means the output will be ON for one complete PLC scan. Any other positive value means the output will be ON for that number of milliseconds. The structure member ***$HsCtrTmr1.OutputTime*** contains the amount of time remaining for the output to be ON.

3d. Table Driven Outputs

Table Driven Outputs are a method to control outputs at high speed based upon set points from a high-speed counter, timer or axis position. Typically, controlling outputs from a set point in ladder would incur 'jitter' delays from one scan to the next. When controlling outputs at High-Speed, the ladder scan variation may produce undesired changes in response from one scan to the next. Using table driven outputs will eliminate this ladder scan variation.



There are 2 methods of controlling table driven outputs: Preset Tables or Programmable Limit Switch (PLS). The *TDOPRESET* instruction is used for Preset Tables and the *TDOPLS* instruction is used for PLS.

Preset Tables

Preset Tables will always run in the order the steps appear in the table, from first to last. This means that it must always be known whether the count will increment or decrement and at what point it will do this. These steps compare the current count value of the specified Master Register to the Preset Count in the Step, and when the count values match, the step's action is performed on the selected discrete output and the next step in the table becomes the active step. If unexpected direction changes in count may occur, the Programmable Limit Switch function may be a better choice for that application.

As mentioned above, the table will always run steps from first (top of table) to last (bottom of table). To restart the table from the top, the **Reset Table & Acc** function should be used as one of the steps in the table.

There are 6 Preset functions to choose from in the table:

Set: This function will turn the Table Driven Output ON. A Reset must be used to turn the output OFF.

Reset: This function will turn the Table Driven Output OFF.

Pulse ON: This function will turn the Table Driven Output ON for the specified "Pulse Time" (in microseconds). At the end of the specified Pulse Time, the output will turn OFF.

Pulse OFF: If the output is ON, this function will turn the Table Driven Output OFF for the specified "Pulse Time" (in microseconds). At the end of the specified Pulse Time, the output will return to ON.

Toggle: This function will set the Table Driven Output to the opposite state from what it is currently at. If the output was ON, this function will turn it OFF. If the output was OFF, this function will turn it ON.

3d. Table Driven Outputs, continued

Reset Table & Acc: Performs a reset of the Master Register which sets its current count value to the Initial Reset Value specified in the Timer/Counter Function setup, and sets the current step in the Preset Table to Step 0.

When a Preset Table is configured, a structure becomes available for use in control and monitoring. The members of the structure are as follows:

.EnableOutput (Bit): This Bit is automatically set ON when the Preset Table is first loaded, and automatically turned OFF when the Table Driven Output is deconfigured. The ladder logic program can manually turn this Bit OFF to stop the table from writing it's state data to the Table Driven Output without having to use the TDODECFG instruction. While this bit is ON, the Preset Table updates the Table Driven Output.

.OutputState (Bit, Read Only): This bit is ON when the Table Driven Output is ON.

.StepNumber (Signed Byte): The zero-based step number from the table that is currently active. A step number of -1 indicates the Preset Table is either in Level Reset or is unconfigured.

.InputValOffset (Signed DWord): The current count value from the Master Register can be adjusted by a fixed amount before the comparison in the step is performed by entering that offset value here.

.ResetEdge (Bit): Turn this Bit ON to reset the Preset Table to Step 0, the PLC will automatically turn this bit back off.

.ResetLevel (Bit): Turn this Bit ON to reset the Preset Table to Step 0. Leaving the Bit ON will hold the Table in Reset until this Bit is turned OFF.

For more information on using the TDOPRESET instruction and the Preset Table function, reference the help file.

Programmable Limit Switch (PLS)

Unlike the Preset Table, the PLS (Programmable Limit Switch) will act upon the output whenever the High-Speed I/O Source Master Register is within the configured entry points no matter the direction it may have entered the range specified. The table contains a series of start and stop positions like the cams on a shaft. These cam positions are compared to the current count value of the specified Master Register. When the count value falls between any of the positions in the table the discrete output is turned ON or OFF as specified in the table.

The entry requires specifying the low range (**ON when Greater Than or Equal to**) and high range (**and Less Than**) fields. The **On when Greater than or equal to** field must always be a lower value than the **and Less Than** field.

Multiple entries can be configured to control the output at different ranges but they cannot overlap each other. The PLS can control the output so that its default state is ON and the entries configured will turn the output OFF within those ranges. The same structure that is used for the Preset Table is used for the PLS Table with a few minor changes in behavior. The explanations are given below:

.EnableOutput (Bit): This Bit is automatically set ON when the PLS Table is first loaded, and automatically turned OFF when the Table Driven Output is deconfigured. The ladder logic program can manually turn this Bit OFF to stop the table from writing its state data to the Table Driven Output without having to use a TDODECFG instruction. If this Bit is ON the PLS Table will update the Table Driven Output.

.OutputState (Bit, Read Only): This bit is true when the Table Driven Output being controlled by the PLS is currently true.

3d. Table Driven Outputs, continued

.StepNumber (Signed Byte): The zero-based step number from the table that is currently active. A step number of -1 indicates the PLS Table is between ON positions or is unconfigured.

.InputValOffset (Signed DWord): The current count value from the Master Register can be adjusted by a fixed amount before the comparison in the step is performed by entering that offset value here.

.ResetEdge and ***.ResetLevel***: Not used with the PLS function.

For more information on using the TDOPLS and PLS function, reference the Help file.

Deconfigure Table Driven Output

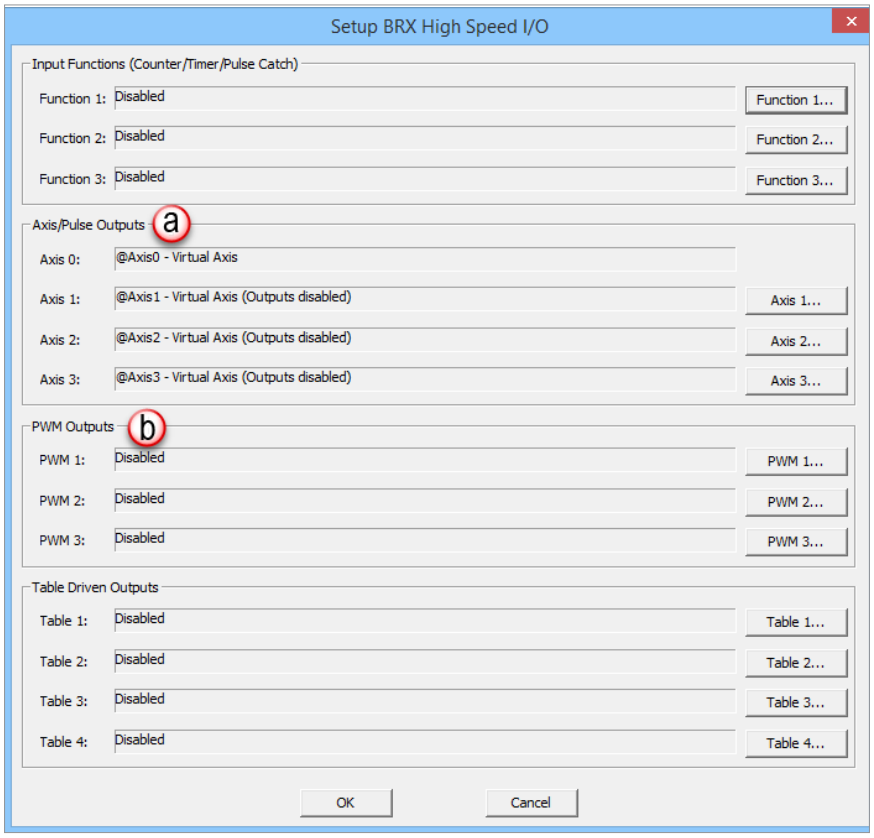
Once a TDOPLS (Programmable Limit Switch on Table Drive Output) or TDOPreset (Run Preset Table on Table Drive Output) has been enabled for a Table-Driven Output, it will continue to control that output even if the input logic is no longer ON. Use the ***Deconfigure Table Driven Output*** (TDODECFG) instruction to stop the Preset table or PLS table from controlling the Table-Driven Output.

4. Outputs

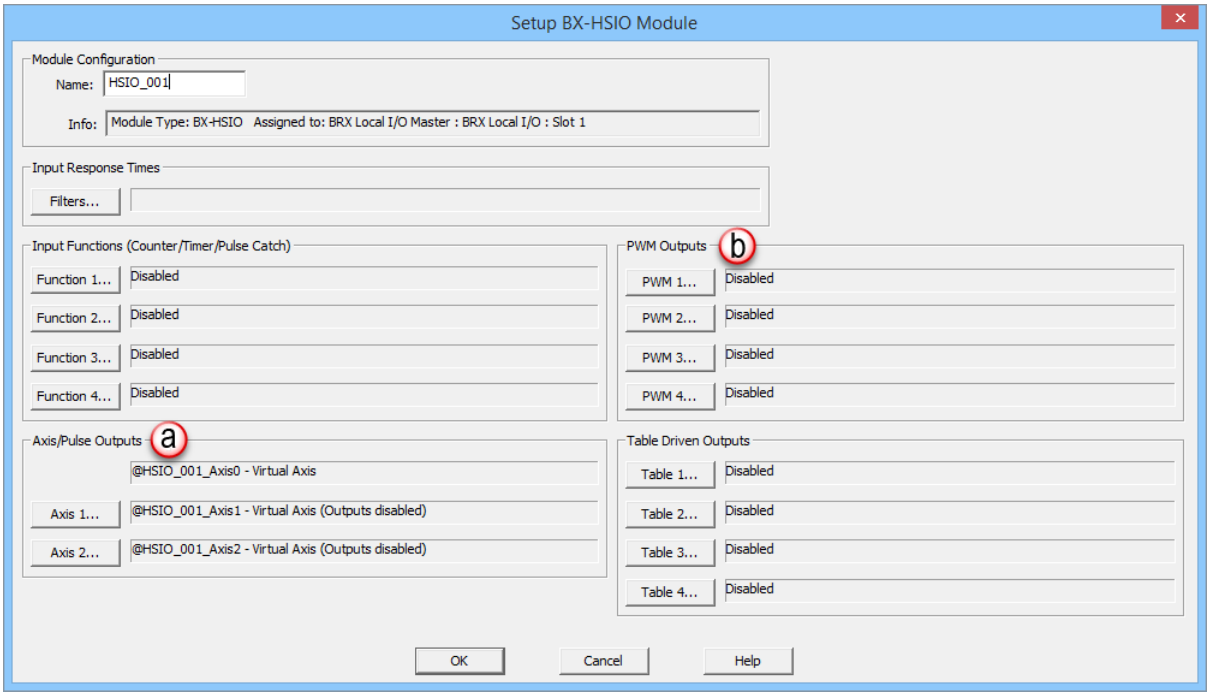
(a) Axis/Pulse Outputs

(b) Pulse Width Modulation (PWM) Outputs

BRX MPU



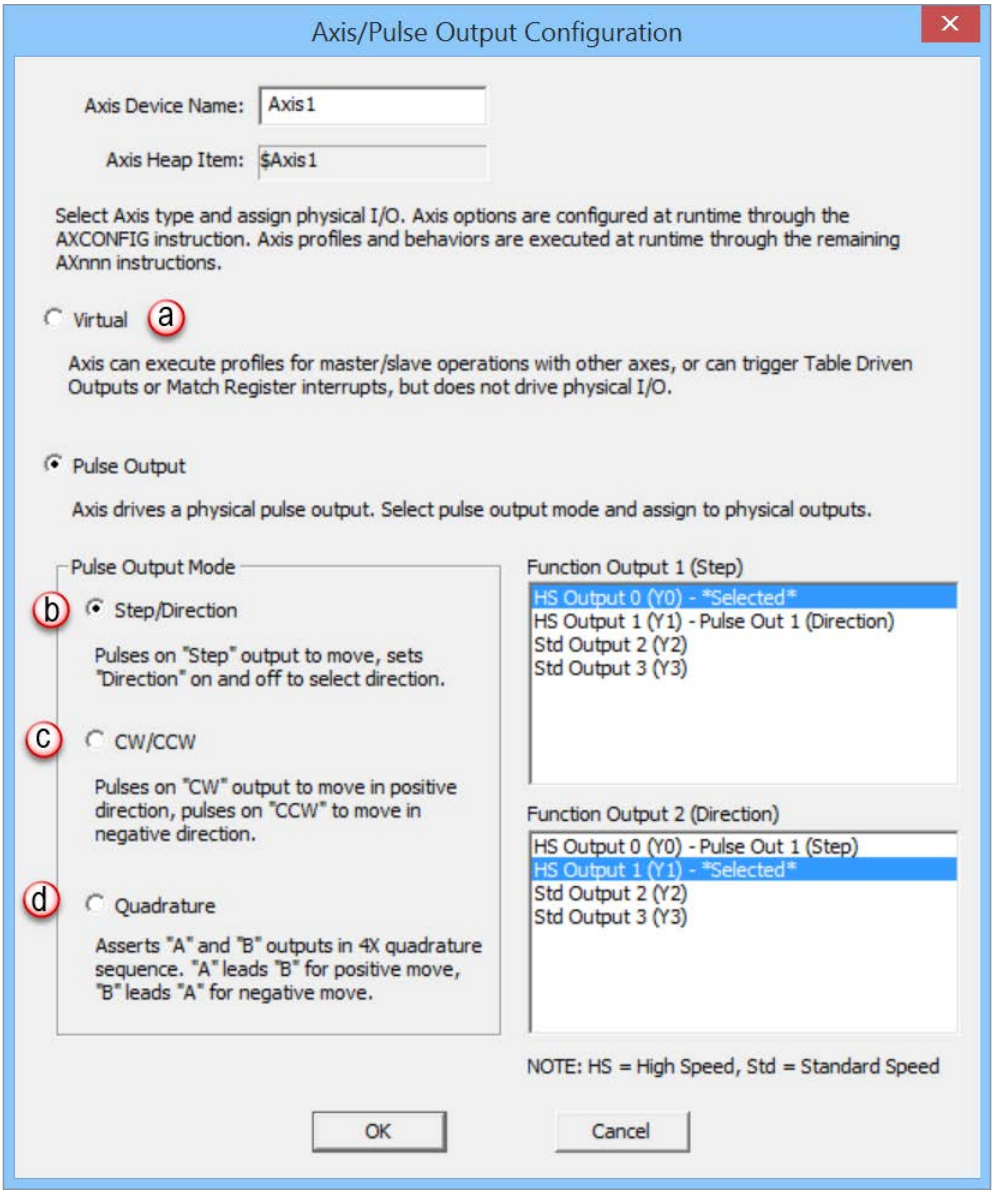
BX-HSIO1/BX-HSIO2



4a. Axis/Pulse Outputs

The Axis/Pulse Output Configuration window allows you to specify the type of pulse train (mode) to output as well as the physical output points to use for this Axis. The software will indicate and warn if there are conflicts specified for the output points selected in this or other axis configurations.

There are four Pulse Output Modes:



1. **Virtual** (a): Axis can execute profiles for master/slave operations with other axes, or can trigger Table Driven Outputs or Match Register interrupts, but does not drive physical I/O.

***NOTE:** A **Virtual** axis will not generate pulses to physical outputs of the PLC. Convenient for testing.*

2. **Step/Direction** (b): The output specified for **Function Output 1** will pulse at the speed and/or amount (Position) specified. The output specified for **Function Output 2** will be low for a positive position value move or high for a negative position value move.

4a. Axis/Pulse Outputs, continued

3. **CW/CCW** (c): The output specified for **Function Output 1** will pulse at the speed and/or amount (Position) specified when the Position value is positive. The output specified for **Function Output 2** will pulse at the speed and/or amount (Position) specified when the Position value is negative.
4. **Quadrature** (d): In Quadrature mode, both outputs specified will pulse at the speed and/or amount (Position) specified in 4X fashion (both leading and trailing edges are considered a pulse). If the position value specified is a positive value, the output specified for **Function Output 1** will lead. If the position value specified is a negative value, the output specified for **Function Output 2** will lead.

When an Axis is created, a structure is available for use in control and monitoring. Each member takes the form of ***$Axisn.member***, where "***n***" is the Axis number (0 to 3) and "***member***" is the element word or bit referenced. Each member and an explanation of that structure are listed below.

.TargetVelocity (Signed DWord, Read/Write): When using an AXVEL instruction, this is the target Velocity (When using an AXPOSTRAP or AXPOSSCRV instruction, the velocity configured in the AXCONFIG instruction is the velocity that is used).

.CurRateOfChg (Signed DWord, Read Only): This is the current velocity the Axis is using during the ramp.

.TargetPosition (Signed DWord, Read Only): This is the target position that has been configured successfully by an AXPOSTRAP or AXPOSSCRV instruction.

.CurrentVelocity (Signed DWord, Read Only): This is velocity at which the axis is currently running.

.CurrentPosition (Signed DWord, Read Only): This is the pulse count where the Axis is currently located.

.FollowingError (Signed DWord, Read Only): When an Axis is configured to use encoder feedback as the Axis position, the FollowingError is the difference between the output pulse count (TargetPosition) and the encoder input value (CurrentPosition). This value is always reported in pulse counts, not in encoder count values.

.MstSlvCoordError (Signed DWord, Read Only): This error is the difference between the position of the Master Axis and the projected location of the Slave Axis when using the AXGEAR, AXFOLLOW and AXCAM instruction.

.Suspend (Bit, Read/Write): When this Bit transitions from OFF to ON, the Axis will decelerate to a Stop. A Bit transition from ON to OFF will resume the axis motion, accelerating back to the target velocity.

.MasterEnable (Bit, Read/Write): This Bit gets enabled automatically after the AXCONFIG has completed successfully. If the bit transitions from ON to OFF, the Axis will decelerate to a stop using the Axis' Fault Deceleration Rate.

.EnableOutput (Bit, Read/Write): This Bit is automatically set ON when the Axis is properly configured. If the bit transitions from ON to OFF the Axis will immediately stop sending output pulses to the high-speed output. If the Axis is moving it WILL NOT decelerate.

.Configured (Bit, Read Only): This bit is ON when the axis has been successfully configured by the AXCONFIG instruction.

.Active (Bit, Read Only): This bit is ON when the axis is enabled and in any mode other than idle.

.AtVelocity (Bit, Read Only): This bit is ON when the axis is generating the pulses at the frequency specified by an AXPOSTRAP or AXPOSSCRV, an AXVEL or other axis instructions (TargetVelocity = CurrentVelocity).

.AtPosition (Bit, Read Only): This bit is true when the position specified by an AXPOSTRAP or AXPOSSCRV has been achieved (TargetPosition = CurrentPosition).

4a. Axis/Pulse Outputs, continued

.***ScriptBusy*** (Bit, Read Only): This Bit will be ON when an AXSCRIPT command is waiting on the Axis engine to complete an asynchronous function, like a Wait for Discrete Limit, Wait For Bit to be ON, etc.

.***Fault*** (Bit, Read Only): Will be ON when either Fault Limit for an Axis is ON, or when the Axis' MasterEnable has been manually turned OFF. A Reset Axis Limit Fault (AXRSTFAULT) or an Axis Configuration (AXCONFIG) instruction must be executed to clear the Fault in the Axis before the Axis will operate again.

.***Mode*** (Unsigned Byte, Read Only): This byte indicates the current execution mode of the Axis.

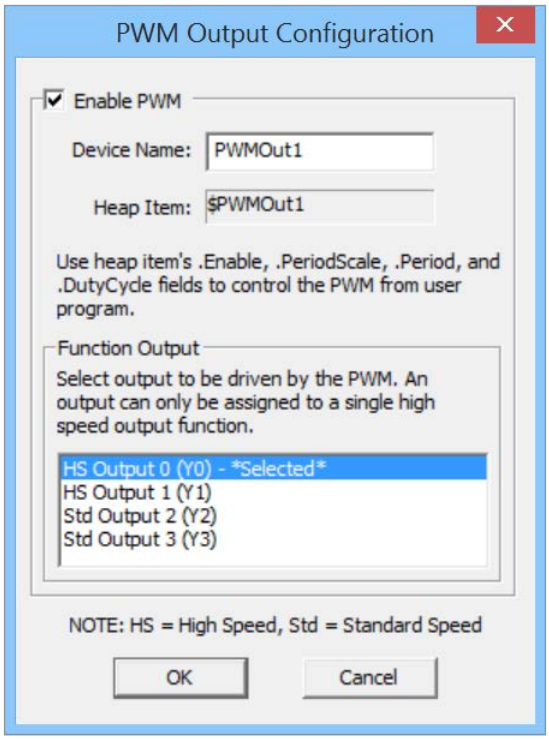
.***ScriptStep*** (Unsigned Byte, Read Only): This byte indicates which step of an AXSCRIPT instruction is currently being executed. This value is a 1-based number in the range of 1 to 254. A step number of "-1" means Done.

.***Timer*** (Signed DWord): If an AXSCRIPT instruction has a Start Timer command, this field will contain the time remaining (in milliseconds) as it times down.

.***Counter*** (Signed DWord): If an AXSCRIPT instruction contains a For/Next loop, this field will contain the current loop count as it counts down.

4b. PWM (Pulse Width Modulation)

The PWM function has no associated instructions. In the ***PWM Output Configuration***, specify the output to control. Once this function has been configured, a structure is created. The function is used by manipulating the members of that structure. The structure members are defined below:



.EnableOutput (Bit): Set this bit ON to generate output pulses, set the bit OFF to stop generating output pulses.

.PeriodScale (Bit): This specifies the time base for the output pulses. OFF = Microseconds (♥s), ON = Milliseconds (ms).

.Period (Unsigned Word): Specifies the amount of time (in microseconds or milliseconds) for one complete pulse. This can be any positive constant value from 0–65535.

NOTE: *Remember, this value is NOT a frequency specified in Hz; this is the duration (milliseconds or microseconds) of one pulse. Because Frequency and Period are reciprocals of each other, the following formulas can be used to convert a value specified in Hz to a Period value in milliseconds or microseconds:*

*Converting Hz to millisecond period = (1/ Hz) * 1000. For example: 60Hz = (1 / 60) * 1000 = 17 milliseconds.*

*Converting Hz to microsecond period = (1/ Hz) * 1000000. For example: 60Hz = (1 / 60) * 1000000 = 16667 microseconds.*

.DutyCycle (Real): The DutyCycle determines the percentage of time that the output is high versus low. 10% Duty Cycle would mean that the output is high for 10% of the Period (or cycle) and low for 90% of the Period. This can be any Real value between 0.0 and 100.0.

BRX High-Speed Examples

This section includes brief descriptions of how to implement some common motion control solutions. The information provided should give the user a good understanding of what basic steps are required to implement the desired function. Later in the chapter, we will present detailed examples that will guide you step by step, on how to read a quadrature encoder value and how to generate a trapezoid profile using High-Speed outputs.

Get Position Using an Encoder

To read the position of an encoder, follow these basic steps in the Do-more! Designer software:

1. From the Dashboard page –
   a. For MPUs: Select ***High-Speed I/O (HSIO)***.
   b. For BX-HSIO: Left-click or right-click on the BX-HSIO module. Click the ***Configure module*** link.
2. Counter/Timer/Pulse Catch Functions – Select ***Function 1***.
3. Select ***Counter*** – Configure the counter for Quad Counter and select ***X0*** and ***X1*** as your inputs.
4. Optional – Setup scaling or enable rotary mode.
5. Download the configuration to the BRX CPU and set it to RUN.
6. While connected with the CPU, verify that the encoder counts are appearing in a ***DataView*** window. Use the address ***$HsCtrTmr1.acc*** to monitor the accumulated encoder pulses.

Get Rate Using an Encoder

To read the rate of an encoder, follow these basic steps in the Do-more! Designer software:

1. From the Dashboard page –
   a. For MPUs: Select ***High-Speed I/O (HSIO)***.
   b. For BX-HSIO: Left-click or right-click on the BX-HSIO module. Click the ***Configure module*** link.
2. Counter/Timer/Pulse Catch Functions – Select ***Function 1***.
3. Select ***Counter*** – Configure the counter for Quad Counter and select ***X0*** and ***X1*** as your inputs.
4. Enable Scaling – Select ***Rate***.
5. Enter the conversion parameters.
6. Download the configuration and verify the CPU is in RUN mode.
7. While connected with the CPU, verify the encoder rate values are appearing in a ***DataView*** window. Use the address ***$HsCtrTmr1.scaledvalue*** to monitor the rate value.

Measure Timing Between Pulse Edges

To measure the time between edges of a pulse, follow these basic steps in the Do-more! Designer software:

1. From the Dashboard page –
   a. For MPUs: Select ***High-Speed I/O (HSIO)***.
   b. For BX-HSIO: Left-click or right-click on the BX-HSIO module. Click the ***Configure module*** link.
2. Counter/Timer/Pulse Catch Functions – Select ***Function 2***.

BRX High-Speed Examples, continued

3. Select ***Timer*** – Keep the default device name, ***@HsCtrTmr2***. Select ***Edge Timer*** function. For this test, use one of the encoder inputs, i.e. ***X0***. Select appropriate options (Free-run is suggested for testing since it does not require any ladder programming to function).
4. Optionally, setup scaling if needed.
5. Download the configuration and verify the CPU is in RUN mode.
6. While connected with the CPU, verify that the pulse measurements are showing up in a ***DataView*** window. Use the address ***$HsCtrTmr2.LastTime*** to monitor the previous amount of time between pulses.

Pulse Catch

To generate an output that can be seen by the PLC scan in response to a high-speed input that is too fast, follow these basic steps in the Do-more! Designer software:

1. From the Dashboard page –
   a. For MPUs: Select ***High-Speed I/O (HSIO)***.
   b. For BX-HSIO: Left-click or right-click on the BX-HSIO module. Click the ***Configure module*** link.
2. Counter/Timer/Pulse Catch Functions – Select ***Function 3***.
3. Select ***Pulse Catch*** – Keep the default name, ***@HsCtrTmr3***.
4. Select the ***Pulse Direction***.
5. Enter the ***Minimum Width In*** value in microseconds.
6. Enter the ***Pulse Out Width*** value in milliseconds. This will be how long the ***.PulseCatchOut*** structure field will remain on.
7. While connected with the CPU, verify that the pulse measurements are showing up in a ***DataView*** window. Use the address ***$HsCtrTmr3.PulseCatchOut*** to monitor the previous amount of time between pulses.

Table Driven Output using a Preset Table

Control a high-speed output based upon a high-speed counter, timer or axis position.

1. Configure a High-Speed input to read encoder values. See section on "Get Position using an Encoder".
2. From the Dashboard page –
   a. For MPUs: Select ***High-Speed I/O (HSIO)***.
   b. For BX-HSIO: Left-click or right-click on the BX-HSIO module. Click the ***Configure module*** link.
3. Table Driven Output – Select ***Table 1***.
4. Table Driven Output Configuration – Enable ***Table Driven Output***.
   a. This is used to trigger High-Speed outputs in response to High-Speed counters, timers and pulse outputs.
   b. Use ladder instructions TDOPRESET, TDOPLS and TDODECFG to setup and manage tables.
5. Select output ***Y3***.
6. Download changes to the CPU.
7. Add a rung with the instruction TDOPRESET and a rung with the instruction TDODECFG.
8. Once the TDOPRESET is running, it takes over the discrete output assigned to ***Table1***.
9. To release the discrete output from being controlled by ***Table1***, use TDODECFG.

BRX High-Speed Examples, continued

Pulse Train Output – Move to a Specific Position

The following steps will explain what is needed for the BRX CPU to prompt a stepper motor, for example, to move an absolute number of steps:

1. From the Dashboard page –
   a. For MPUs: Select ***High-Speed I/O (HSIO)***.
   b. For BX-HSIO: Left-click or right-click on the BX-HSIO module. Click the ***Configure module*** link.
2. Axis/Pulse Outputs – Select ***Axis 1***.
3. Axis 1 Configuration – Keep the default Device name, ***@Axis1***. Select ***Pulse Output***. Select the Output Type required by your controller. For this example, we are using Step/Direction with a SureStep stepper drive. Select ***Y0*** for Step and ***Y1*** for Direction.
4. Download the configuration to the CPU.
5. AXCONFIG ladder rung – Configure the AXCONFIG instruction for Device ***@AXIS1***. Use the defaults for all the fields. The move instructions use the Accel/Decel and Min/Max frequencies configured in this instruction.
6. AXPOSTRAP ladder rung – Configure the AXPOSTRAP for Device ***@Axis1***. For Move Type, select Single Move and Power Flow Enabled. For Target Type, select Relative and for Position Value use the default of 1000. For Linear vs Rotary, select Linear.
7. Download program and verify the CPU is in RUN mode.
8. Trigger the AXCONFIG ladder rung – When the AXCONFIG instruction is triggered, the ***MasterEnable*** and the ***EnableOutput*** heap items will be ON. The success bit will be ON.
9. Turn on the AXPOSTRAP ladder rung – Every time the rung is powered on and left on, the instruction will send out a pulse train that matches the target position value. The ***CurrentPosition*** will increase from 0 to 1000 the first time the rung is turned on. The target position will display 1000. ***AtPosition*** turns on when the target position is reached. If you turn the rung off and back on, the ***CurrentPosition*** will increase from 1000 to 2000.
10. A detailed example using the AXPOSTRAP will be provided later in this chapter. For detailed information of the instructions, review the Do-more! Designer Help topics.

Pulse Train Output – To Home an Output

The following steps will explain what is needed for the BRX CPU to prompt a stepper motor, for example, to find a Home position:

1. From the Dashboard page –
   a. For MPUs: Select ***High-Speed I/O (HSIO)***.
   b. For BX-HSIO: Left-click or right-click on the BX-HSIO module. Click the ***Configure module*** link.
2. Axis/Pulse Outputs – Select Axis 1.
3. Axis 1 Configuration – Keep the default Device name, ***@Axis1***. Select ***Pulse Output***. Select the Output Type required by your controller. For this example, we are using ***Step/Direction*** with a SureStep stepper drive. Select ***Y0*** for Step and ***Y1*** for Direction.
4. Download the configuration to the CPU.
5. AXCONFIG ladder rung – Configure the AXCONFIG instruction for Device ***@AXIS1***. Use the defaults for all the fields. The move instructions use the ***Accel/Decel*** and ***Min/Max*** frequencies configured in this instruction.

BRX High-Speed Examples, continued

6. AXHOME ladder rung – Configure the AXHOME for Device ***@Axis1***. For this example, we use ***X2*** as our ***Discrete Input Limit 1***. Enter a value for ***Homing Velocity***. Select the Discrete input and event type. Select the ***Homing Termination***. For this example, we will use Decelerate to 0 after reaching input limit 1 and zero out the position value when Home is reached. Edge-triggered is selected for the input leg.
7. Download program and verify the CPU is in RUN mode.
8. Trigger the AXCONFIG ladder rung – When the AXCONFIG instruction is triggered, the MasterEnable and the ***EnableOutput*** heap items will be ON. The AXCONFIG success bit will be ON.
9. Trigger the AXHOME ladder rung – Turning on the input to the AXHOME rung, will trigger the HOME move. The input does not have to remain on for the HOME move to continue when the edge-triggered input is selected. Pulse outputs will be generated while the discrete input limit 1 is not reached. Once the discrete input limit 1 is reached, the pulse output will decelerate to 0, as configured for this example. During the HOME move, the ***CurrentPosition*** will increase. Once the HOME position is reached, the ***CurrentPosition*** is reset to 0.

Output Pulse Width Modulated (PWM) Pulses

To generate PWM outputs, follow these basic steps:

1. From the Dashboard page –
   a. For MPUs: Select ***High-Speed I/O (HSIO)***.
   b. For BX-HSIO: Left-click or right-click on the BX-HSIO module. Click the ***Configure module*** link.
2. PWM Outputs – Select ***PWM 1***.
3. PWM 1 Configuration – Enable PWM. Keep the default Device name, ***@PWMOut1***. Select output Y2, for example.
4. Download the program (no ladder instructions need to be added for this test) and verify the CPU is in Run.
5. Use ***Data View*** to control the PWM 1 output. Use heap items ***.EnableOutput***, ***.PeriodScale***, ***.Period*** and ***.DutyCycle***.
6. ***$PWMOut1.DutyCycle*** – Specifies the percentage of one period where the output is ON, during the remaining portion the output will be OFF. This can be any Real value between 0.0 and 100.0.
7. ***$PWMOut1.PeriodScale*** – Selects the time base for the output pulses, OFF = microseconds (♥s), ON = milliseconds (ms).
8. ***$PWMOut1.Period*** – Specifies the amount of time (in microseconds or milliseconds) for one complete pulse. This can be any positive constant value from 0–65535.

NOTE: *Remember, this value is NOT a frequency specified in Hz, this is the duration (milliseconds or microseconds) of one pulse. Because Frequency and Period are reciprocals of each other, the following formulas can be used to convert a value specified in Hz to a Period value in milliseconds or microseconds:*

*Converting Hz to millisecond period = (1/ Hz) * 1000. For example: 60Hz = (1 / 60) * 1000 = 17 milliseconds.*

*Converting Hz to microsecond period = (1/ Hz) * 1000000. For example: 60Hz = (1 / 60) * 1000000 = 16667 microseconds.*

9. ***$PWMOut1.EnableOutput*** - Set this ON to generate output pulses, set OFF to stop generating output pulses.

Detailed Example: Configure and Test a Quadrature Input

This example walks through the steps required to get the counts from a quadrature encoder. Phase A of the encoder is wired to input X0 and Phase B of the encoder is wired to input X1.

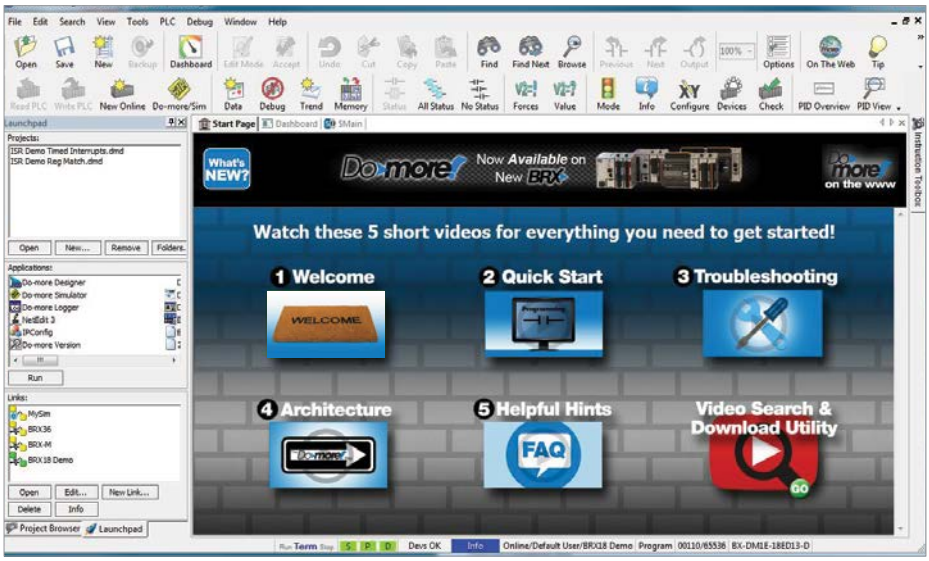
The Basic Steps

1. Wire the encoder and connect Do-more! Designer to the BRX CPU.
2. Configure a High-Speed Input as a quadrature counter.
3. Download the program changes to the CPU and place the CPU in Run.
4. Use DataView and Trend View to verify the encoder values are being read correctly by the BRX CPU.

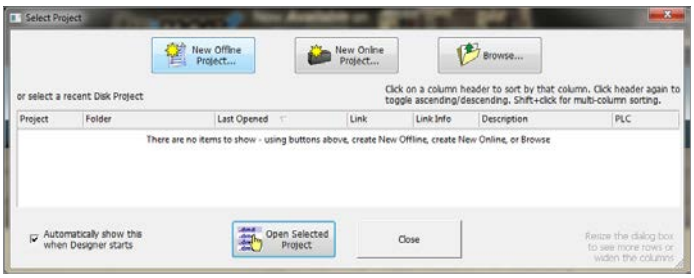
Equipment Used

BRX MPU with DC inputs. A quadrature encoder (open collector or totem pole) properly powered and connected to inputs X0 and X1 of the BRX.

Launch Do-more! Designer. By default, the Tip of the Day will pop up. Close it.

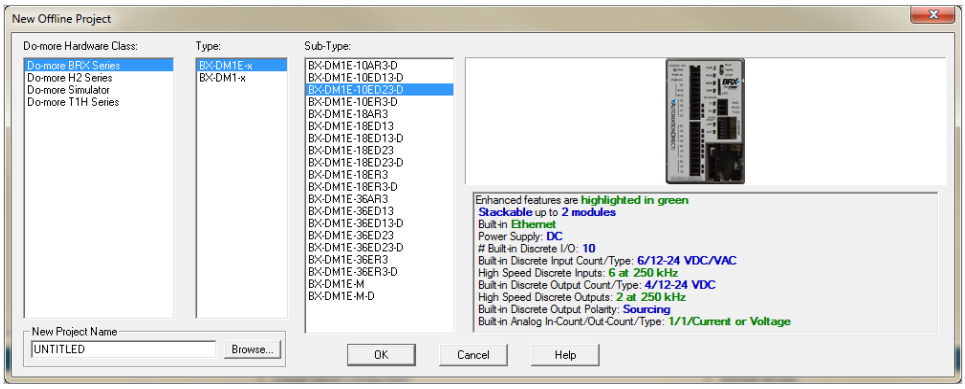


The *Select Project* window will be displayed next. Select **New Offline Project**. Launch the Do-more! Designer Software.

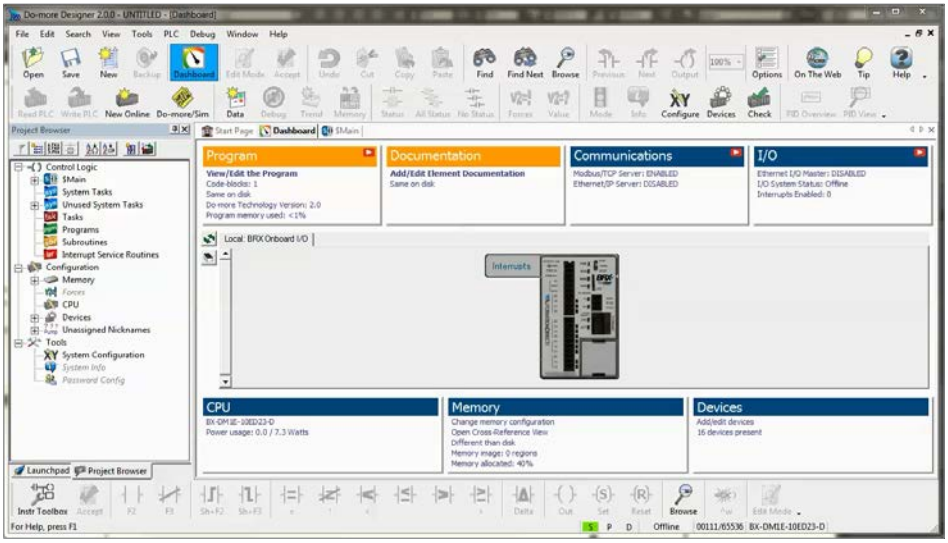


Detailed Example: Configure and Test a Quadrature Input, continued

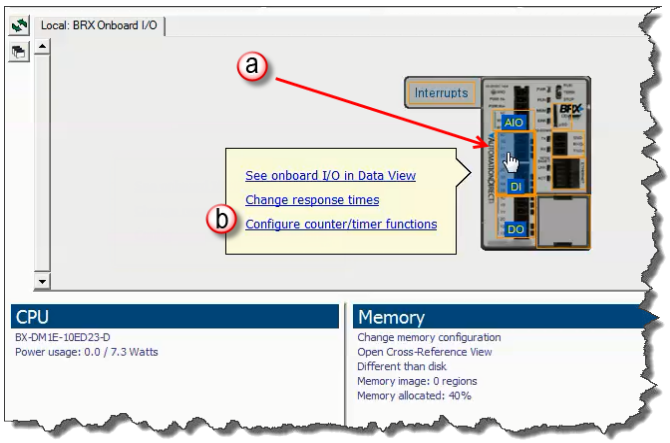
In the *New Offline Project* window select the BRX MPU model you are working with. Rename the project as Quad Encoder in the **New Project Name** field (bottom left). Press the **OK** button to accept the selections.



The Dashboard page is displayed and the screen will look as follows:

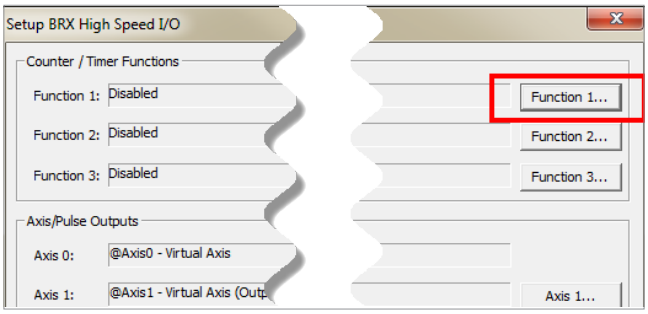


Mouse over the BRX MPU in the Dashboard BRX Onboard I/O view, orange blocks will appear around the various built-in MPU features. Select the inputs orange block (a). Select **Configure counter/timer functions** (b) to access the Setup BRX High-speed I/O page.

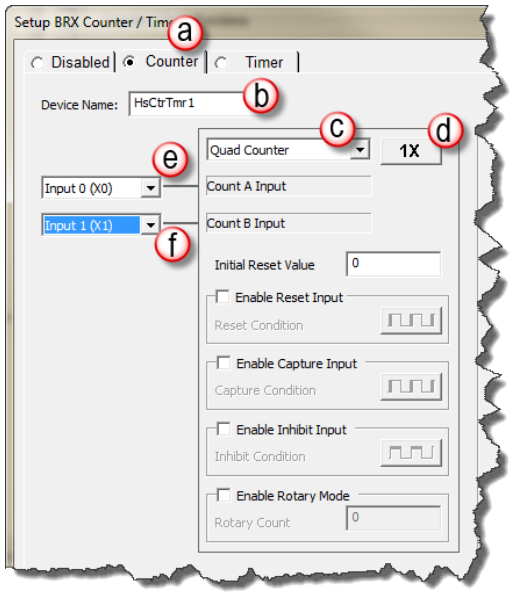


Detailed Example: Configure and Test a Quadrature Input, continued

From the Setup BRX High-speed I/O page, select **Function 1** under the *Counter/Timer Functions* section.



Selecting (a) **Counter** from the *Setup BRX Counter/Timer* dialog box. The dialog box will fill in with counter parameters. For this example, we will keep the default (b) **Device Name** of *HsCtrTmr1*. Select (c) **Quad Counter** from the dropdown menu, leaving it at (d) 1X counting resolution and select input (e) X0 (Phase A) and input (f) X1 (Phase B).



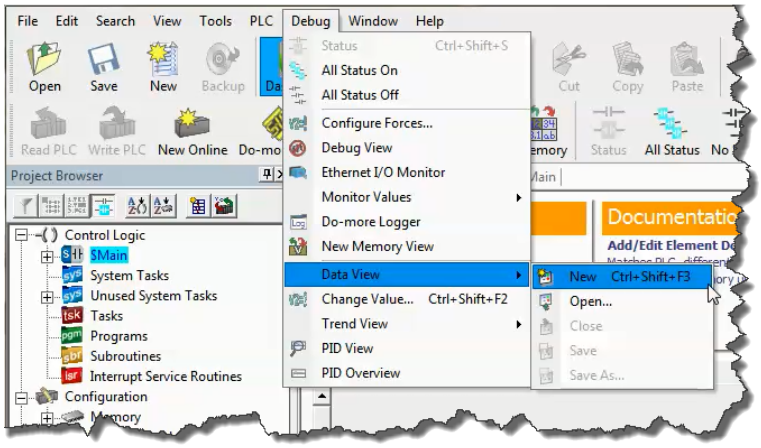
Click OK to return to the Dashboard screen. **Write** the changes to the PLC and verify you are in **Run** mode.

At this point, we have configured inputs X0 and X1 for quadrature counter high-speed inputs. No ladder is needed to monitor the counts from the encoder.

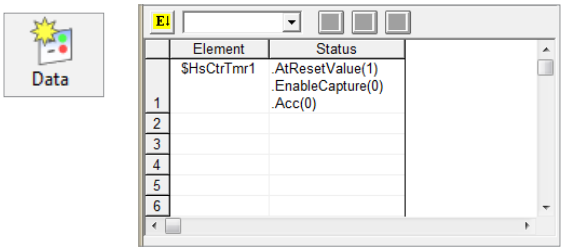
Detailed Example: Configure and Test a Quadrature Input, continued

Displaying Encoder Values via Data View

Create a New *Data View* window. From the menu select **Debug** -> **Data View** and **New**.



Alternately, you can use the *Data* icon on the toolbar to open a new *Data View* window.

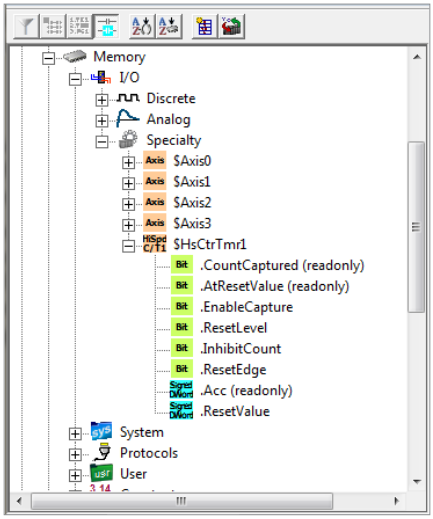


The *Data1* window is displayed. Start by typing *$HsCtrTmr1* on row 1 under the *Element* column. Make this *Data1* window wider by placing the mouse on the right edge of the window, left clicking and dragging to the right.

You can see under *Status* the Heap items *.AtResetValue*, *.EnableCapture*, and *.Acc*. The value in parenthesis is the current value. As you turn your encoder, the value for *.Acc* will change. If you move the encoder in the clockwise direction the values will increase. When the encoder moves in the counter-clockwise direction, the value decreases. (The reverse may be true depending on the wiring of the encoder phase A and phase B).

Detailed Example: Configure and Test a Quadrature Input, continued

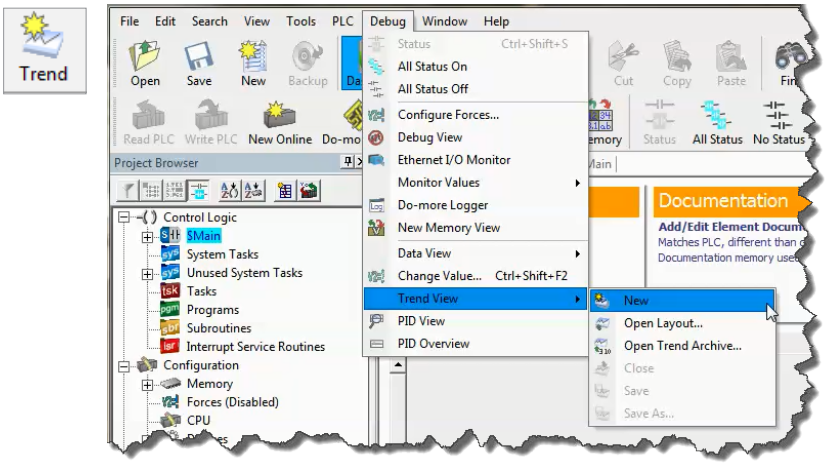
It is possible to view one Heap item per Data View row. The available Heap items for the *$HsCtrTmr1* can be found under the **Project Browser** -> **Configuration** -> **Memory** -> **I/O** -> **Specialty** -> *$HsCtrTmr1* as shown below.



Displaying Encoder values using Trend View

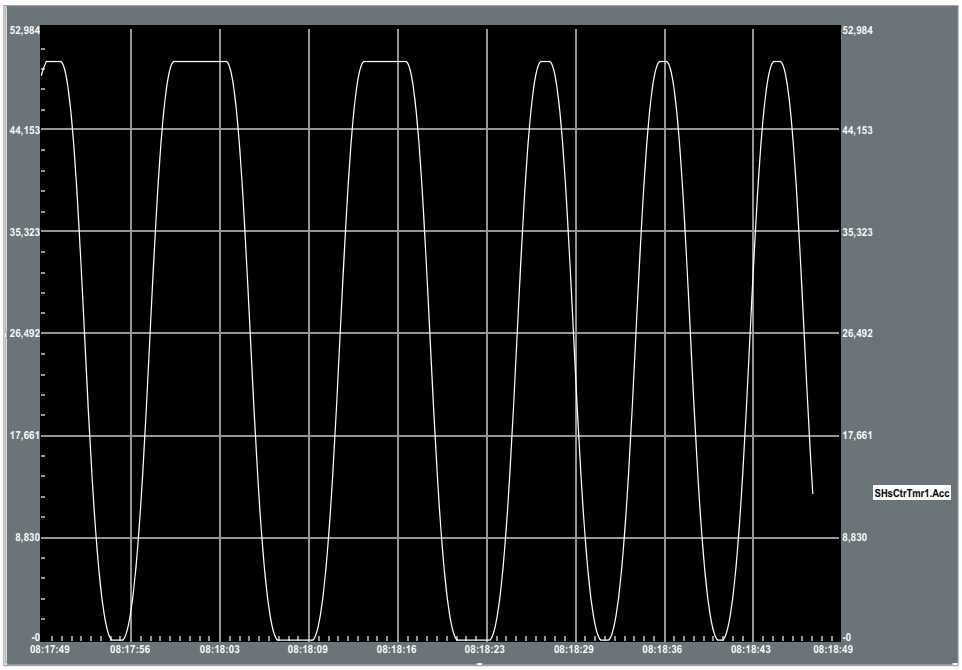
Trend View is a very powerful utility, one that can be used to troubleshoot the control system. We highly recommend you use this tool to the fullest.

Create a new *Trend View* from the *Debug Menu* or the *Trend* icon on the toolbar, as shown below.



Detailed Example: Configure and Test a Quadrature Input, continued

In *Trend View*, using a single pane, add the accumulated value of the high-speed counter, *$HsCtrTmr1.Acc*. As the encoder is turned, you can see the accumulated value changing on the *Trend View* pane.



Detailed Example: Configure and Test a High-Speed Pulse Output with a Trapezoid Profile

This example walks through the steps required to use a BRX MPU to generate a pulsed output with a trapezoid profile using the built-in high-speed outputs.

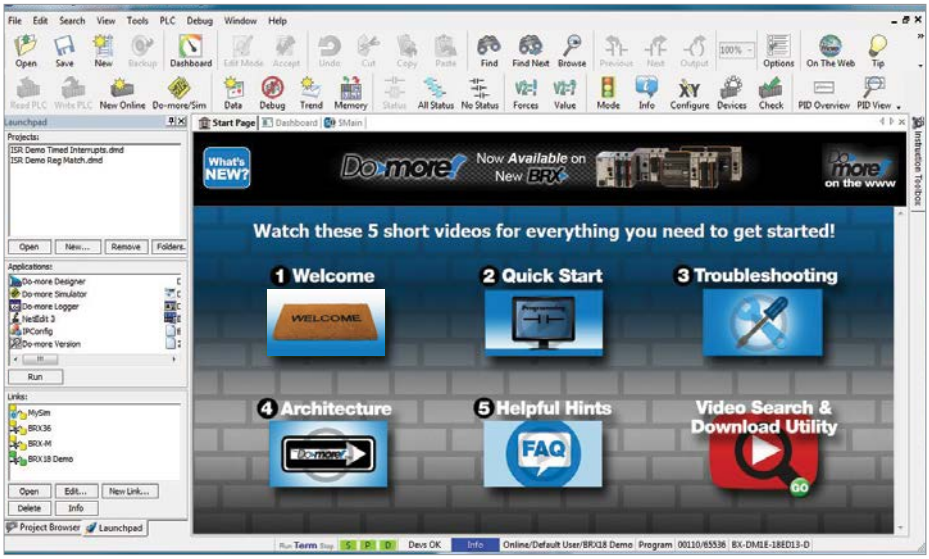
The Basic Steps

1. Gather and wire up the hardware (not covered here).
2. Launch the Do-more! Designer software and connect to a BRX MPU with DC sinking or sourcing outputs.
3. Configure Axis 1 to use Y0 for Step and Y1 for Direction.
4. Write the necessary ladder program to generate the trapezoid profile.
5. Download and run the program.
6. Show how Data View and Trend View can be used to monitor and control the profile.

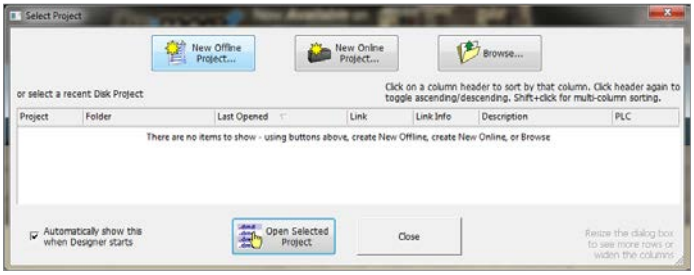
Equipment Needed

A BRX MPU with DC sinking or sourcing outputs, i.e. BX-DM1E-10ED23-D. A stepper drive and motor properly powered and wired to the BRX MPU outputs. Alternately, the output activity can be monitored in Data View or in Trend View, encase a stepper or similar hardware is not available.

Launch the Do-more! Designer Software. By default, the Tip of the Day will pop up. Close it.

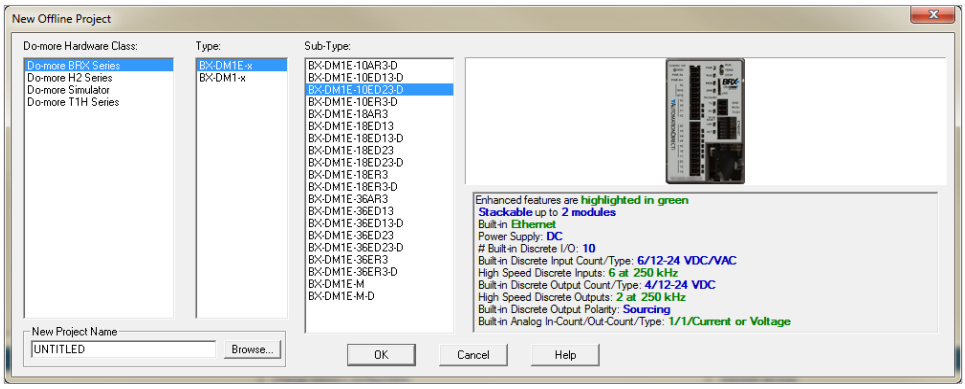


The *Select Project* window will be displayed next. Select **New Offline Project**.

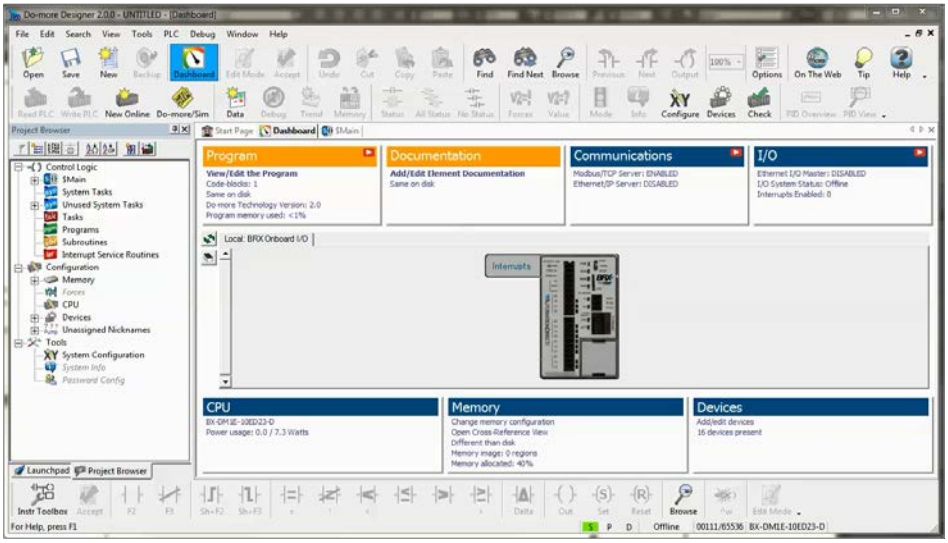


Detailed Example: Configure and Test a High-Speed Pulse Output, continued

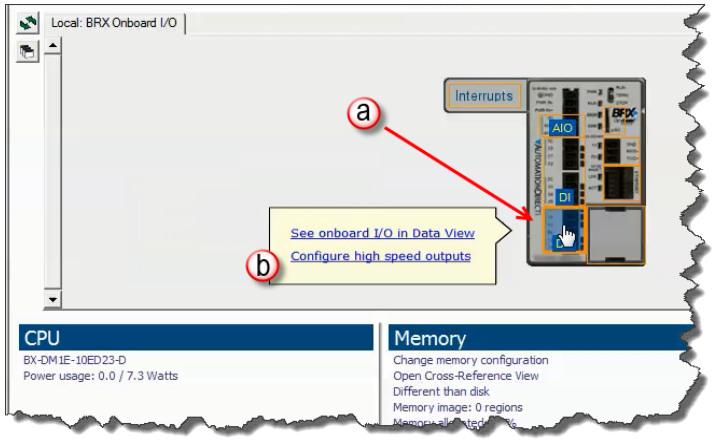
In the ***New Offline Project*** windows select the BRX MPU model you are working with. Rename the project as Trapezoid, in the ***New Project Name*** field. Press the **OK** button to accept the selections.



The Dashboard page is displayed and the screen will look as follows:

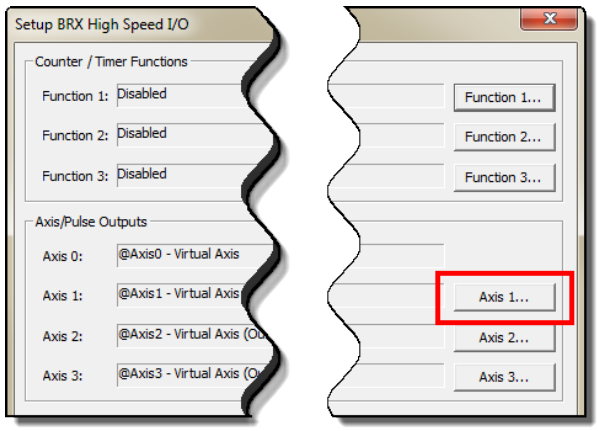


Mouse over the BRX MPU in the ***Local BRX Onboard I/O*** view. Select (a) the outputs orange block. Select **Configure high-speed outputs** (b) to access the ***Setup BRX High-speed I/O*** page.



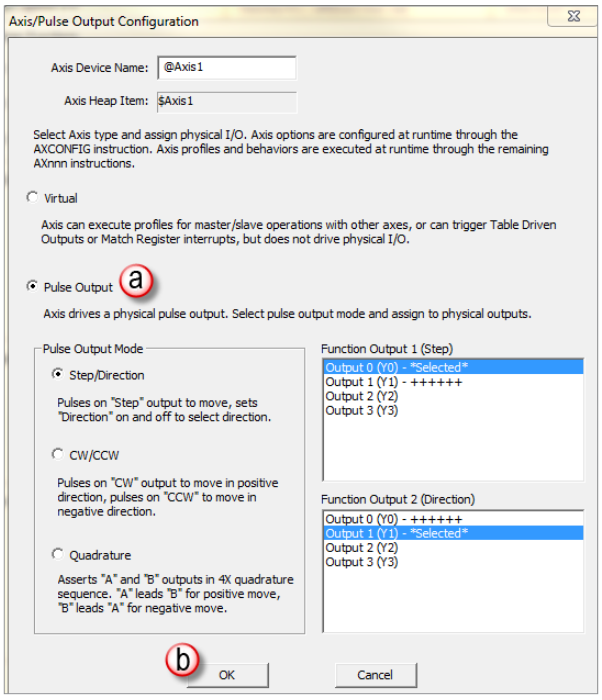
Detailed Example: Configure and Test a High-Speed Pulse Output, continued

From the *Setup BRX High-speed I/O* page, select **Axis 1** under the *Axis/Pulse Outputs* section.



The *Axis/Pulse Output Configuration* window comes up. Select (a) **Pulse Output**. Use the default device name, *$Axis 1*. For this exercise, select Pulse Output, Step/Direction, Y0 for Step and Y1 for Direction, as shown below.

Press (b) **OK** to return to the *Setup BRX High-Speed I/O* window. Press **OK** again to return to the *Dashboard* screen. Save the project at this time.

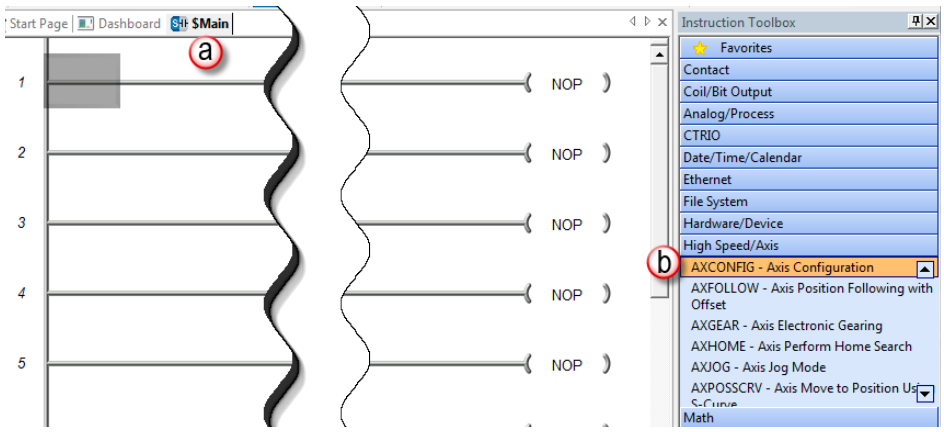


At this point, we have configured outputs Y0 and Y1 for Step and Direction high-speed outputs. Next, we will write the necessary ladder to generate a trapezoid profile with the configured high-speed outputs.

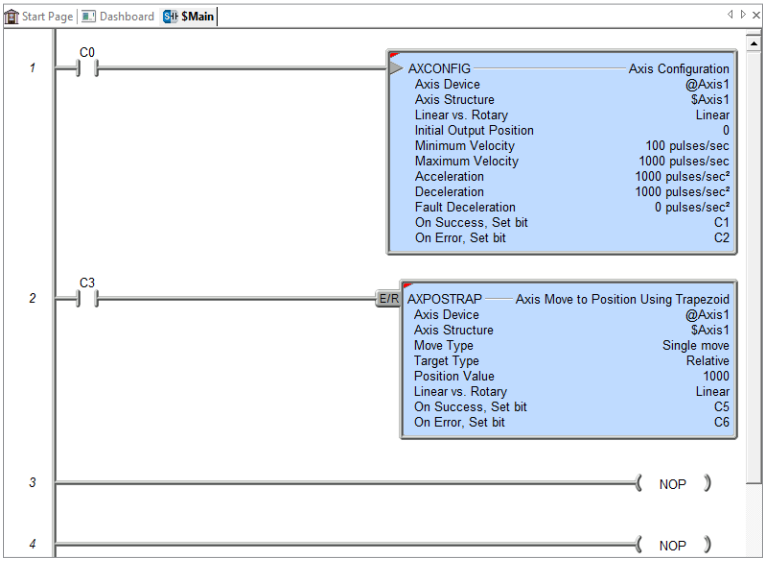
Detailed Example: Configure and Test a High-Speed Pulse Output, continued

Ladder Program for Trapezoid Profile

Start by opening the **$Main** code block (a), as shown below.

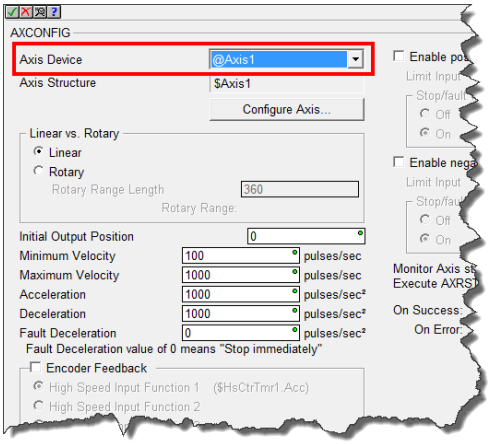


We will add two rungs to the ladder diagram by selecting two instructions from the ***Instruction Toolbox*** in the (b) ***High-Speed/Axis*** section. The ladder will look like the one shown below. On rung 1 we will place the AXCONFIG instruction and on rung 2 we will place the AXPOSTRAP instruction. The following page discusses setting the instruction parameters when placing these instructions.

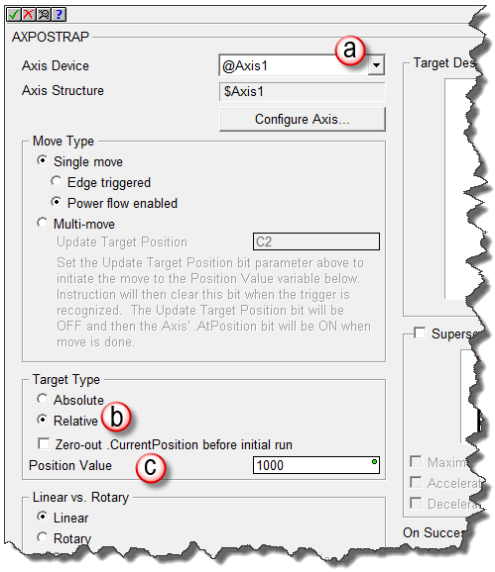


Detailed Example: Configure and Test a High-Speed Pulse Output, continued

With the cursor on rung 1, Select AXCONFIG from the tool palette. AXCONFIG is needed to setup the runtime parameters for an Axis. An Axis has no default values and must be configured before it can be used. For this example, we will configure the AXCONFIG with the values as shown in the dialog box on the right. Since we have configured Axis 1 for Step/Direction, change the AXCONFIG Axis Device field to ***@Axis1***. For the purpose of our example, leave all other fields at their default values.



Move cursor to rung 2 and select AXPOSTRAP from the tool palette. AXPOSTRAP is used to move an Axis from its current position to a specified target position using the configured parameters to generate a trapezoid move profile.



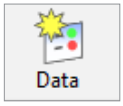
For the purpose of this example, change the (a) ***Axis Device*** to ***@Axis1*** and change the (b) ***Target Type*** to ***Relative***, leaving the other parameters at their default values. You can change the (c) ***Position Value*** if your setup requires additional steps to approximate the trapezoid move. When you use the ***Relative*** target type, the profile will move the number of steps indicated by the (c) ***Position Value*** each time the AXPOSTRAP instruction is triggered.

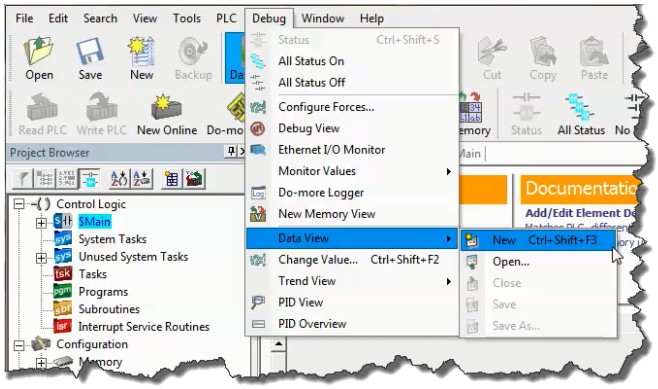
Write the program to the BRX CPU and verify it is in **RUN** mode.

Detailed Example: Configure and Test a High-Speed Pulse Output, continued

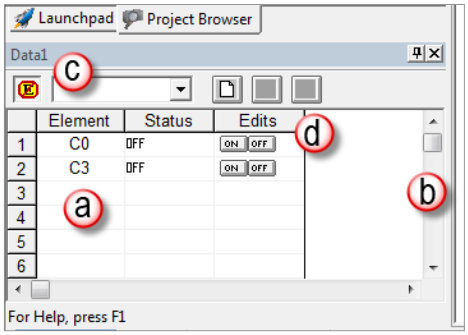
Displaying and controlling the trapezoid profile move using Data View

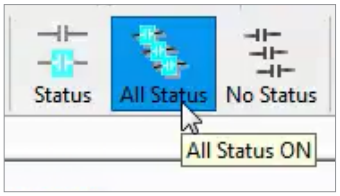
From the menu select a new *Data View* under the **Debug** -> **Data View** menu. Alternately, you can use the **Data** icon (shown on right) on the toolbar ribbon to open a new *Data View* window.





The *Data1* window is displayed. Start by typing C0 on row 1 and C3 on row 2, under the (a) ***Element*** column. Make the *Data1* window wider by placing the mouse on the right edge of the window (b), left clicking and dragging to the right. Select (c) the yellow **E** icon in order to display (d) the ***Edits*** column. Be sure **All Status On** (toolbar ribbon) is selected.





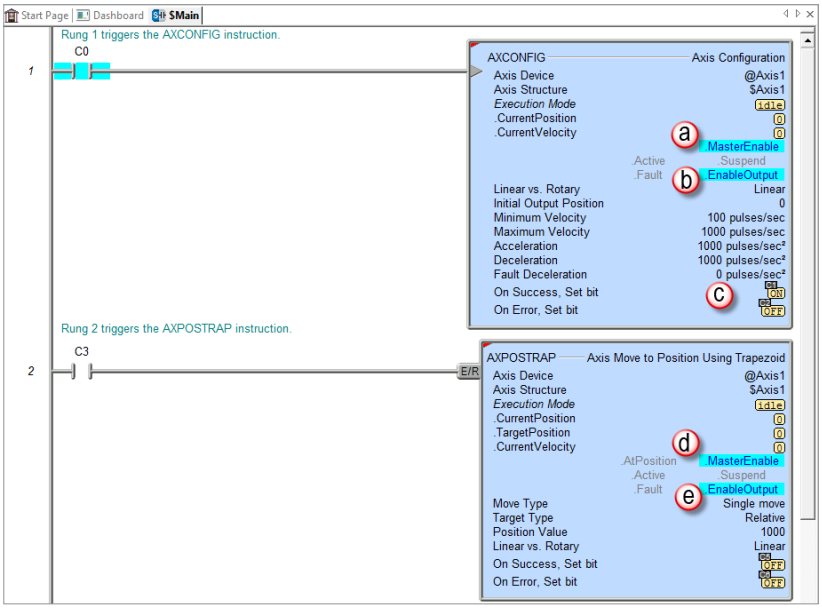
Under the ***Edits*** column (d), you will see **ON** and **OFF** buttons adjacent to C0 and C3. We will use these to trigger our two rungs of instructions. In Data View, to configure *$Axis1* parameters, double-left click the **ON** button for C0 element.



NOTE: *The first time you use this feature, the program will ask you to confirm the writes. If you prefer check the box so that it will not ask you again.*

Detailed Example: Configure and Test a High-Speed Pulse Output, continued

After triggering C0, the ladder will display the following status as shown below.



In the AXCONFIG instruction, we see (a) ***.MasterEnable*** and (b) ***.EnableOutput*** are highlighted in blue and C1 is set to ON. These indicate that ***$Axis1*** is configured and ready to be used.

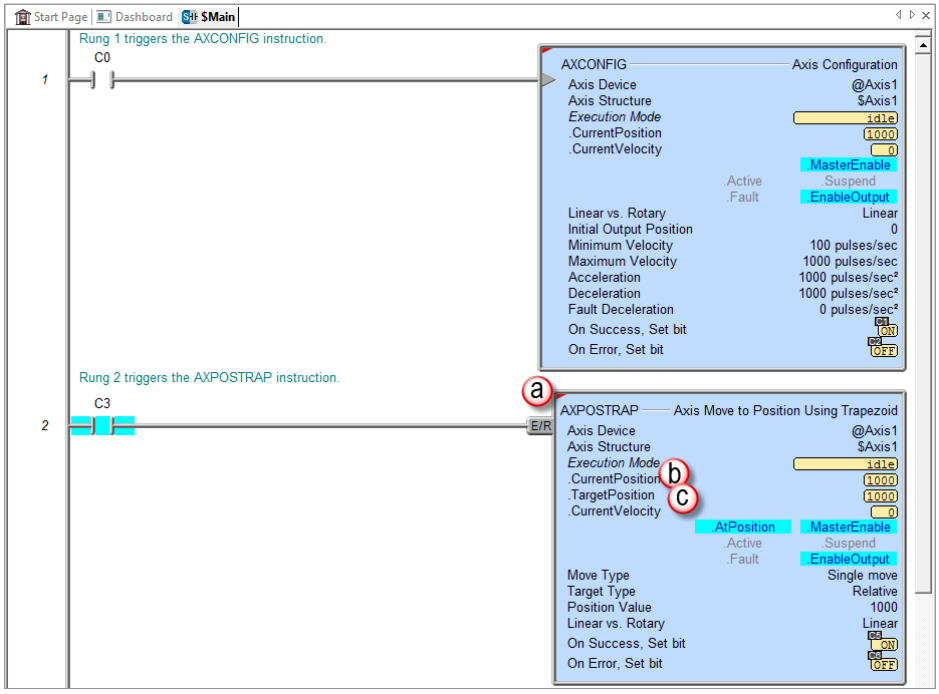
The AXPOSTRAP instruction in Rung 2 shows ***$Axis1*** parameters have been configured (d) (***.MasterEnable*** is highlighted) and it is ready to start sending pulses (e) (***.EnableOutput*** is highlighted).

C0 can be turned off once the On Success bit (c), of the AXCONFIG turns on.

We are now ready to initiate our trapezoid move.

Detailed Example: Configure and Test a High-Speed Pulse Output, continued

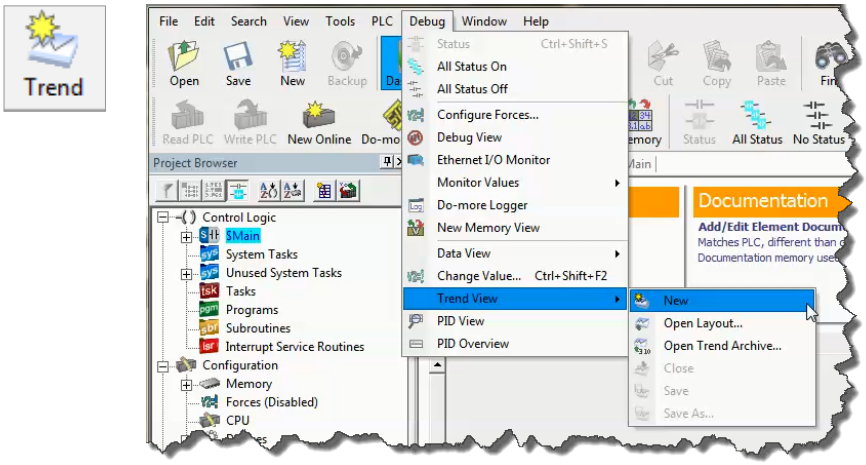
Double-left click on the C3 ON button in Data View. The trapezoid move will begin. Status indicators on (a) the AXPOSTRAP instruction will provide feedback about the move. The following graphic shows its status after the move is complete. Notice (b) the Current Position is now 1000 and the (c) Target Position is 1000. The field device should have moved 1000 steps.



Displaying $Axis1 Current and Target values using Trend View

As mentioned before, Trend View is a very powerful utility, one that can be used to troubleshoot the control system.

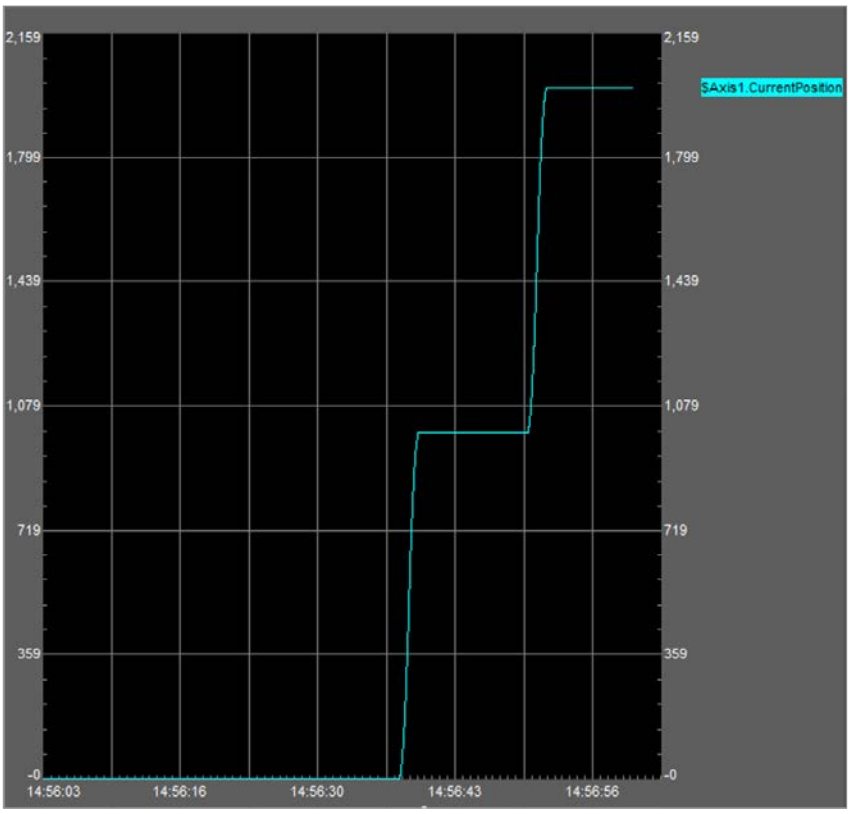
Open **Trend View** from the **Debug Menu** or the **Trend** icon on the toolbar, as shown below.



In Trend View, using a single pane, add ***$Axis1.CurrentPosition*** to a pane.

Every time the AXPOSTRAP instruction is triggered, 1000 pulses are generated. In the Trend View snapshot that follows, we can see the instruction was triggered twice. It started at 0 counts and reached 1000 counts the first trigger. On the second trigger, it started at 1000 and reached 2000 counts.

Detailed Example: Configure and Test a High-Speed Pulse Output, continued



There are many settings available that allow the user to meet application needs. Please review the Do-more! Designer High-speed Instruction Help topics for detailed information.

BRX High-speed Instructions

In this section we will give an overview of the high-speed instructions available to the BRX Do-more! CPU. They will be presented in this section as in the Instruction Toolbox, in alphabetical order.

1. AXCAM – Axis Electronic Camming
2. AXCONFIG – Axis Configuration
3. AXFOLLOW – Axis Position Following with Offset
4. AXGEAR – Axis Electronic Gearing
5. AXHOME – Axis Perform Home Search
6. AXJOG – Axis Jog Mode
7. AXPOSSCRV – Axis Move to Position Using S-Curve
8. AXPOSTRAP – Axis Move to Position Using Trapezoid
9. AXRSTFAULT – Reset Axis Limit Fault
10. AXSCRIPT – Run a Sequence of Axis Commands
11. AXSETPROP – Set Axis Properties
12. AXVEL – Axis Set Velocity Mode
13. TDODECFG – Deconfigure Table Driven Output
14. TDOPLS – Load Programmable Limit Switch Table for Table Driven Output
15. TDOPRESET – Load Preset Table for Table Driven Output

An expanded discussion of each of these instructions can be found in the Do-more! Designer online Help files under the High-Speed/Axis topic.

Before Using the BRX High-Speed I/O Instructions

Remember the following before using the BRX high-speed i/o instructions.

1. Each of the instructions covered in this section will require one or more of the following to be setup prior to being able to use the instruction:

   – Slave Axis Device or Axis Device - specifies which axis to use as the slave axis. This can be any axes available to the MPU or to a BX-HSIO expansion module.

   – Master Register - selects the axis position or high-speed counter/timer accumulated value that provides the position source value. This value can come from any axes or high/speed counter/timer available to the MPU or to a BX-HSIO expansion module.

   – Table Driven Output Device - specifies which discrete output to use. This can be any of the outputs available to the MPU or available in the BX-HSIO expansion module.

   – AXCONFIG – this instruction configures parameters associated with a specific Axis. The Axis minimum and maximum Velocity, the Axis Acceleration and Decelaration are some of the configurable parameters that will affect how an Axis behaves. (See the AXCONFIG instruction later in this section for detailed information)

   Note: There can be more than one AXCONFIG instruction configured for the same Axis, however, the parameters associated with the last AXCONFIG run for an Axis will be used.

2. The Axis, the High-speed Counters/Timers and the Table Driven Outputs are configured in the MPUs ***Setup BRX High-speed I/O*** dialog or the BX-HSIO ***Setup BX-HSIO Module*** dialog. Please review the information under the "Access Setup High Speed I/O Page" section earlier in this chapter. It explains the different paths to opening these setup dialog page.

   Please review the section "Available High-Speed Input and Output Features" earlier in this chapter, which explains in detail how to configure the Axis/Pulse Outputs, the Counter/Timers, and the Table Driven Outputs.

   For example, from the MPUs ***Setup BRX High-speed I/O*** dialog or the BX-HSIO ***Setup BX-HSIO Module*** dialog:

   – Click the **Axis 1…** button to select the axis type: Virtual, Step/Direction, CW/CCW, Quadrature. Here you select the discrete output points to be used by an axis that generates physical pulses.

   – Click the **Function1…** button to configure a Counter or a Timer input function. Here you select the discrete input point(s) to be used by the input function.

   – Click the **Table1…** button to enable a Table Driven Output. Here you select the discrete output point to be used by the Table Driven Output function.

3. For instructions that require the use of an Axis, be sure to add at least one AXCONFIG instruction for the Axis used. Please see the detailed information on the AXCONFIG instruction later in this chapter.

AXCAM

The **Axis Electronic Camming** (AXCAM) instruction is used to establish a master/slave connection for an axis so that its movement is synchronized to another axis or to a high-speed counter/timer. The slave axis position is derived from the master position. Any time the master axis moves to a new position the slave axis will also move to a corresponding position as directed by the Cam Table.

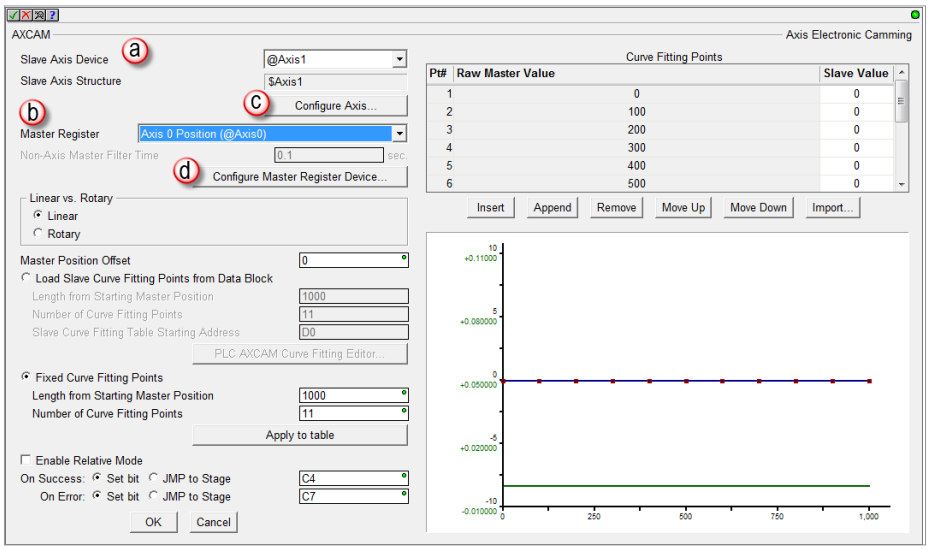
This instruction requires the following:

- Axis configured to be used as the slave Axis.
- One of the following to be used as the Master Register:
  - Position value from a configured master axis.
  - Accumulated value from a configured high speed counter/timer function.
- AXCONFIG instruction configured for each axis associated with the instruction.

The (a) ***Slave Axis Device*** specifies which axis to use as the slave axis and the (b) ***Master Register*** selects the axis position or high-speed counter/timer accumulated value that provides the position source value. These can be any of the axis or high-speed counter/timers available to the MPU or available to a BX-HSIO expansion module.

The Axis and high-speed counters/timers are configured in the MPUs ***Setup BRX High-speed I/O*** dialog or the BX-HSIO ***Setup BX-HSIO Module*** dialog. Please see detailed information on these under the "Available High-Speed Input and Output Features" earlier in this chapter. These dialog boxes can be opened directly from the AXCAM instruction by clicking on the (c) **Configure Axis...** button and (d) **Configure Master Register Device...** button. These allow the user to:

- configure an axis or a counter/timer function for use with the instruction.
- verify or edit the physical I/O selected for an already configured axis or counter/timer function.



AXCAM, continued

Points and segments:

A Cam Table describes a motion profile that clearly assigns a slave position for each master position of a specific master position range.

Cam tables are entered as a series of up to 64 segments. All of the segments are the same size in that they are equal divisions of the total span of the Master Axis travel.

A segment describes the distance traveled and the position of the axis. It is equal to the difference between the previous and current positions. Each segment is executed over a defined distance traveled for the Master Axis. When executing these segments, the profiling software in the controller will fit a smooth curve to the data with an updated velocity profile every millisecond.

Curve Fitting

The Cubic Interpolation method fits a cubic trajectory between each pair (segment) of cam table entries.

All segment transitions are curved, even for a linear progression between the segments. The only exception is on the last 2 table segments. The last 2 segments will be a linear progression unless **Rotary** mode has been selected. In **Rotary** mode, there will be curves on the last position of the table to the first position of the table.

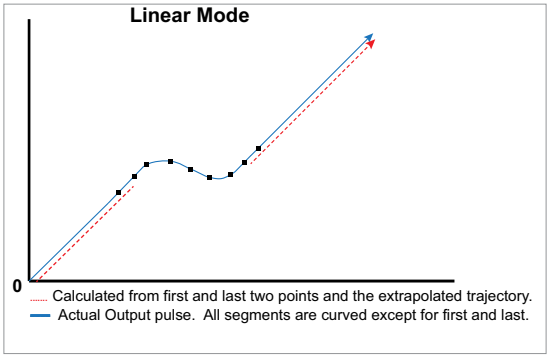
Master Register: This is the Axis, High-Speed Counter or Timer that provides the position source value. This can be any of the Axes or High-Speed Counter/Timers.

Non-Axis Master Filter Time: This parameter is only enabled if the Master Register is a High-Speed Counter/Timer. This value is the Filter Time Constant which specifies how often (in Seconds) the Slave's position is calculated. This can be any constant value or any numeric location.

Configure Master Register Device: This button will open the BRX High-Speed Input or Axis/Pulse Output dialog in the System Configuration.

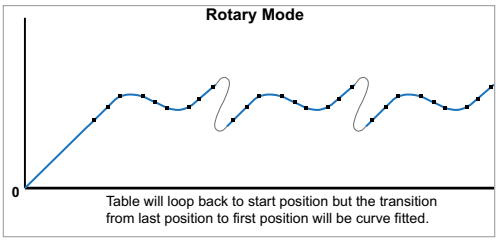
Linear vs. Rotary: This setting selects the behavior that will occur when the end of the table has been reached.

- Linear: The first two and the last two table positions are used to calculate a linear trajectory (from 0 at the start of the table) and the CPU will continue to output pulses until the instruction is terminated.



AXCAM, continued

- **Rotary**: This selection will 'loop' the table to start at the beginning. The modulus of the Master Register is used as the table Master Value.



Master Position Offset: A pulse count value that is added to the Master Axis position before the associated Slave position value is calculated. This can be any constant value or any numeric location. If this value is a numeric location the value is read from that location only when the instruction is first enabled.

Load Slave Curve Fitting Points from Data Block: The data for the curve is located in PLC memory.

- **Length from Starting Master Position**: The total number of pulse counts the Master will move.
- **Number of Curve Fitting Points**: The number of segments to divide the Length from Master Position into. There must be at least 3 curve fitting points in the table with a maximum of 64.
- **Slave Curve Fitting Table Starting Address**: The beginning address in PLC memory where the curve data is stored.

Fixed Curve Fitting Points: The data for the curve is in the instruction table.

- **Length from Starting Master Position**: The total number of pulse counts the Master will move.
- **Number of Curve Fitting Points**: The number of segments to divide the **Length from Master Position** into. There must be at least 3 curve fitting points in the table with a maximum of 64.

Enable Relative Mode: If selected, the function is enabled. The Slave Axis' current position is stored internally and that position becomes the new 0 for the Slave Axis. As the Master Axis moves, the Slave position values are now relative to this stored position.

On Success:

- **Set Bit**: The bit will become FALSE when the instruction is enabled and will remain FALSE until the enable leg goes back OFF. Once the enable leg turns OFF, if the instruction's device/parameters were valid, this bit will turn ON once the .CurrentVelocity reaches 0.
- **JMP to Stage**: Similarly, the JMP will not occur until after the instruction is enabled, then disabled, and all the instruction device/parameters were valid and the .CurrentVelocity reaches 0.

On Error:

- **Set Bit**: The bit will become FALSE when the instruction is enabled and will become TRUE if there was a problem with the parameters configured in the instruction, with the devices specified or if the AXCAM move was interrupted before completion.
- **JMP to Stage**: If there was a problem with the parameters configured in the instruction, with the devices specified or the AXCAM move was interrupted before completion, the PLC will jump to that stage.

AXCAM, continued

Example AXCAM

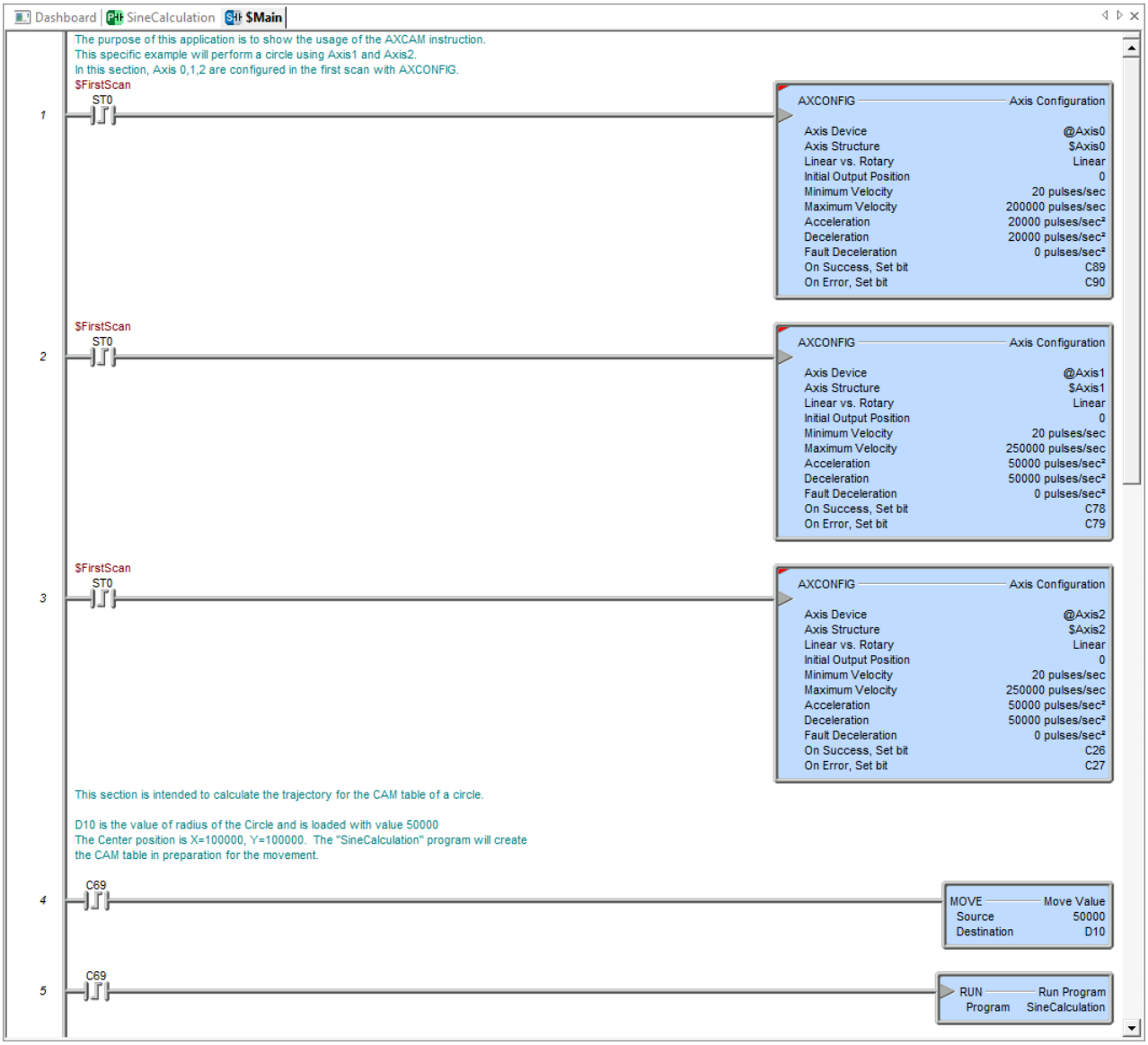
In this example we will demonstrate the use of the AXCAM instruction in conjunction with the AXCONFIG instruction to create a circular path output using multiple axes.

The radius of the circle (50000) is loaded into D10. The center position is: X=100000, Y=100000. The path followed is defined in the program **SineCalculation**.

Axes 0,1 & 2 are defined with the AXCONFIG instruction. The AXCAM instruction creates the movement of the Axes to define the path traveled. From the $Main program, a program called **SineCalculation** is called to perform the necessary math calculations to create a circular path output. The **SineCalculation** is called for each segment in the camming table (61 segments).

The following pages show the ladder program that defines this operation.

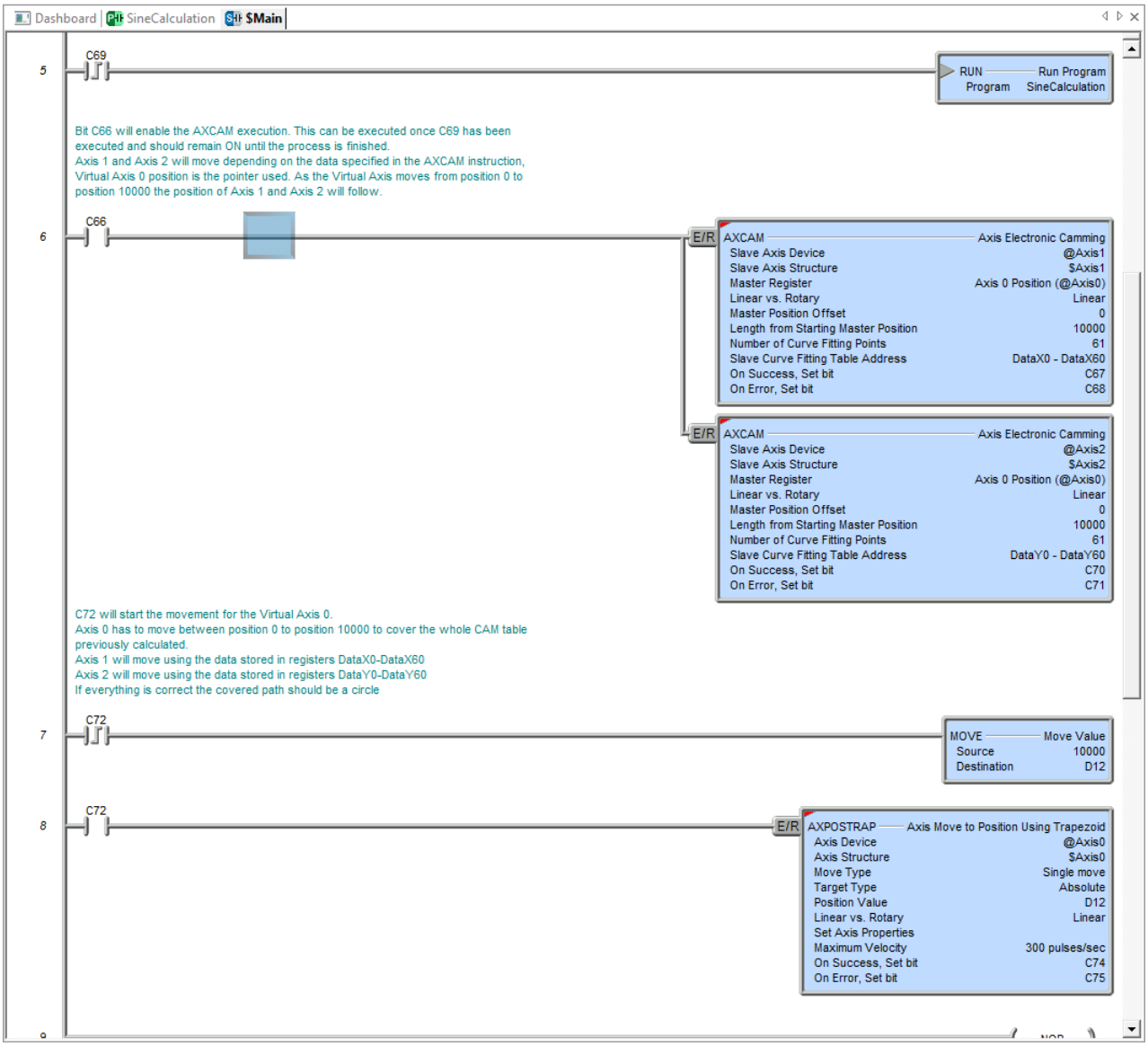
Here is the $Main program:



(Ladder continued on next page.)

AXCAM, continued

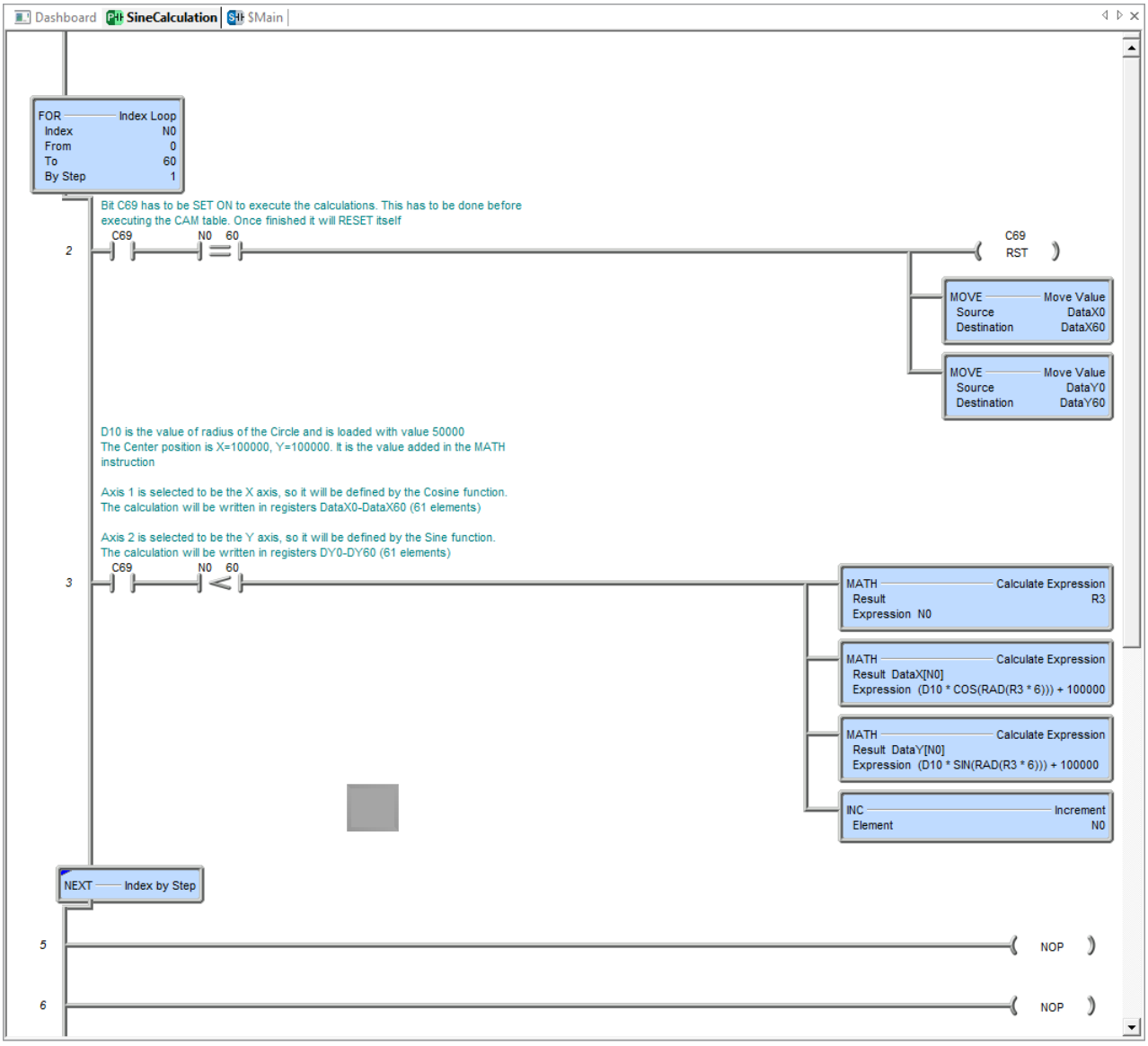
$Main program continued:



AXCAM, continued

Program: SineCalculation

Here is the SineCalculation program that is called from the $Main program.



AXCONFIG

The **Axis Configuration** (AXCONFIG) instruction configures the parameters for a specific Axis so that it may be used for all of the other AXIS commands. Pulse Outputs for a given AXIS cannot be commanded until the AXCONFIG instruction has been run successfully. When the AXCONFIG instruction has been successfully created and initiated, the ***.MasterEnable*** structure member for that AXIS will become true and the AXIS may be commanded by other Axis instructions.

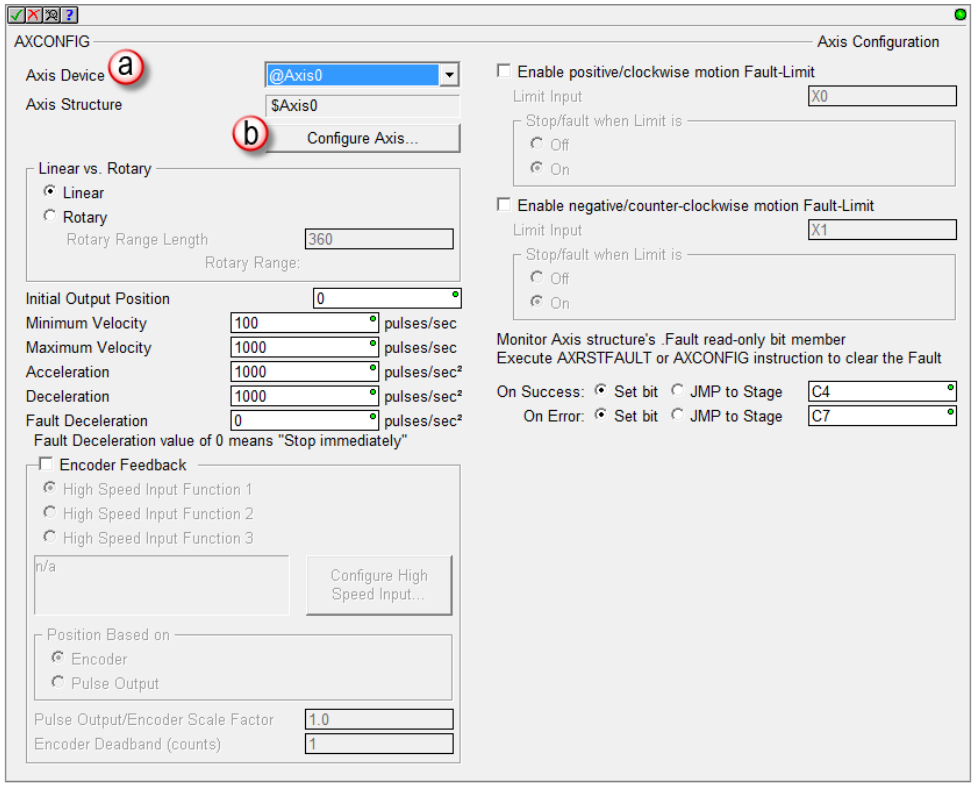
NOTE: *There can be more than one AXCONFIG instruction configured for the same Axis, however, the parameters associated with the last AXCONFIG run for an Axis will be used.*

This instruction requires an Axis configured to be used as the slave Axis.

The (a) ***Axis Device*** specifies which Axis the parameters will be applied to. This can be any axis available to the MPU or available to a BX-HSIO expansion module.

The Axis is configured in the MPUs ***Setup BRX High-speed I/O*** dialog or the BX-HSIO ***Setup BX-HSIO Module*** dialog. Please see detailed information on these under the "Available High-Speed Input and Output Features" earlier in this chapter. This dialog box can be opened directly from the AXCONFIG instruction by clicking on the (b) **Configure Axis…** button. These allow the user to:

- configure an axis for use with the instruction.
- verify or edit the physical I/O selected for an already configured axis.



NOTE: *Axis0 is a 'virtual axis' and will not generate pulses to physical outputs of the PLC. Axis0 can be used for generating pulse output profile register values to be used for Table Driven Outputs (TDOPRESET or TDOPLS) or as the master for other axes in following-type applications (AXCAM, AXFOLLOW or AXGEAR). Axis0 is also good to use for testing.*

AXCONFIG, continued

Linear vs Rotary: This setting selects the behavior that will occur when the end of the table has been reached.

- **Linear**: Linear actuators move forward or backward on a fixed linear path. The movement of linear actuators are defined in linear units such as inches or millimeters. Since linear actuators only move in two directions on a fixed path, linear actuators are defined as finite, meaning they have a set distance that they can travel in either direction before they must stop.
- **Rotary**: Rotary actuators produce rotary motion, meaning that the actuator revolves on a circular path. Movement from this type of actuator is defined in rotary units, typically degrees. A rotary table doesn't have a fixed distance it can travel; it can keep spinning in the same direction indefinitely. The count for a rotary input is kept within a defined range (***Rotary Range Length***). Once the count has exceeded the high limit of the specified ***Rotary Range Length***, it will reset to 0. If the Axis position is decreasing (negative velocity value), when it falls below 0, it will go to the high value specified in the ***Rotary Range Length***.

Initial Output Position: The current count will be set to this value when the Axis is first enabled and any time the Axis is reset. This can be any constant value or any numeric location.

Minimum Velocity (pulses/sec): The slowest frequency of output pulses that will be generated when the output is enabled. This can be any positive constant from 10 to 250000 or any numeric location with a value in that range.

Maximum Velocity (pulses/sec): The fastest frequency of output pulses that will be generated when the output is enabled. This can be any positive constant from 10 to 250000 or any numeric location with a value in that range.

Acceleration Rate (pulses/sec^2): The rate at which the pulses will be generated when the axis is ramping up from a slower pulse rate to a higher pulse rate. This can be any positive constant or any numeric location with a value in that range.

Deceleration Rate (pulses/sec^2): The rate at which the pulses will be generated when the axis is ramping down from a faster pulse rate to a slower pulse rate. This can be any positive constant or any numeric location with a value in that range.

Fault Deceleration Rate (pulses/sec^2): Any time a Fault Limit is reached or the Axis .MasterEnable is turned OFF, the Axis will decelerate to 0 at this specified rate. A value of 0 will cause the Axis to immediately stop moving. This can be any positive constant or any numeric location with a value in that range.

Encoder Feedback: Enable this option if an incremental encoder is being used to provide the speed reference feedback. The Axis structure contains a ***.FollowingError*** that indicates the difference in the commanded position and the encoder feedback. This can indicate a stalled motor, mechanical slippage or other problem in the application.

- **High-speed Input Function 1/High-speed Input Function 2/High-speed Input Function 3**: Choose one of these options for the encoder feedback. The High-speed Counters must be setup in the ***Setup BRX Counter/Timer*** section of the ***BRX Onboard I/O>High-speed I/O*** section in the System Configuration. Click on the **Configure High-speed Input** button to access this directly.
- **Position Based on**:
  - **Encoder**: This option will place the specified High-speed Input Function into the ***.CurrentPosition*** member of the Axis configured in this instruction. The difference in the specified High-speed Input Function and the actual pulse output count of the Axis configured in this instruction will be indicated in the ***.FollowingError***.

AXCONFIG, continued

  - **Pulse Output**: This option will indicate the actual pulse output count of the Axis configured in this instruction into the ***.CurrentPosition*** member and the ***.FollowingError*** will indicate the difference between ***.CurrentPosition*** and the High-speed Input Function that has been specified.

- **Pulse Output/Encoder Scale**: If the motor and the encoder have different pulse-per-revolution values, enter the scale value required to bring them into alignment.
- **Encoder Deadband** (counts): Having some deadband value around the encoder current position can prevent the pulse output from generating alternating small pulses trying to get the input value to an exact number. This value is applied both above and below the encoder value. For example: A value of 2 will be a deadband of 2 above and 2 below for a span of 4 counts.

Enable Positive/Clockwise Motion Fault-Limit: Enable this option to use a physical input that will cause the Axis to Fault (Stop) if the input becomes true or false (based on the setting below) when moving in the Clockwise or Positive direction. This is typically used as an over-travel limit switch.

If a Fault-Limit is tripped, use the Axis Reset Fault (AXRSTFLT) instruction or re-trigger the Axis Config (AXCONFIG) instruction to clear the fault. Any attempt to move in the same direction that caused the fault will immediately generate another fault condition. Movement of the Axis in the opposite direction is permitted.

  - **Limit Input**: This needs to be one of the onboard X discrete input elements. This is where the over travel limit switch would be wired to.
  - **Stop/fault when Limit is**: Choose OFF to cause the Axis to fault (stop) when the specified input goes from True to False. Choose ON to cause the Axis to fault (stop) when the specified input goes from False to True.

Enable Negative/Counter-Clockwise Motion Fault-Limit: Enable this option to use a physical input that will cause the Axis to Fault (Stop) if the input becomes true or false (based on the setting below) when moving in the Counter-Clockwise or Negative direction. This is typically used as an over-travel limit switch.

If a Fault-Limit is tripped, use the Axis Reset Fault (AXRSTFLT) instruction or re-trigger the Axis Config (AXCONFIG) instruction to clear the fault. Any attempt to move in the same direction that caused the fault will immediately generate another fault condition. Movement of the Axis in the opposite direction is permitted.

  - **Limit Input**: This needs to be one of the onboard "X" discrete input elements. This is where the over travel limit switch would be wired to.
  - **Stop/fault when Limit is**: Choose OFF to cause the Axis to fault (stop) when the specified input goes from True to False. Choose ON to cause the Axis to fault (stop) when the specified input goes from False to True.

On Success:

- **Set Bit**: The bit will become FALSE when the instruction is enabled and will become TRUE if the parameters configured in the instruction and proper devices were specified.
- **JMP to Stage**: If the parameters configured in the instruction and proper devices were specified, the PLC will jump to that stage.

On Error:

- **Set Bit**: The bit will become FALSE when the instruction is enabled and will become TRUE if there was a problem with the parameters configured in the instruction or with the devices specified.
- **JMP to Stage**: If there was a problem with the parameters configured in the instruction or with the devices specified, the PLC will jump to that stage.

AXFOLLOW

The **Axis Position Following with Offset** (AXFOLLOW) instruction is used to establish a Master/Follower connection for an Axis so that the Follower's movement is synchronized to the Master's movement. The Master can be another Axis or a High-Speed Counter/Timer.

Because the Follower Axis will need the ability to overtake the Master Axis during a Goto Relative Offset operation, ensure that the Maximum Velocity and Acceleration parameters of the Master and Follower Axes have been configured with enough capacity to allow this. The Follower Axis can be made more responsive by configuring it with higher Maximum Velocity or a faster Acceleration or both.

If the instruction is enabled with the Goto Offset Signal OFF, the Axis will behave in a Velocity-following manner. As soon as the Goto Offset Signal turns ON, the Axis will now behave in a Position-following manner and will remain so until the instruction is terminated. If the instruction is enabled with the Goto Offset Signal ON, the Axis will behave in a Position-following manner until the instruction is terminated.

To help keep track of the Axes movement relative to each other, any time the Axis is in Position Following mode the Follower Axis associated structure member, ***.MstSlvCoordError***, will contain the difference (in pulse counts) between the Master Axis position and the Follower Axis' position.

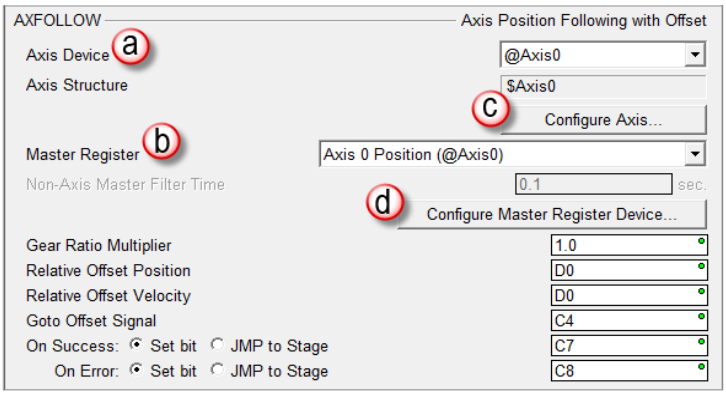
This instruction requires the following:

- Axis configured to be used as the slave Axis.
- One of the following to be used as the Master Register:
  - Position value from a configured master axis.
  - Accumulated value from a configured high speed counter/timer function.
- AXCONFIG instruction configured for each axis associated with the instruction.

The (a) ***Slave Axis Device*** specifies which axis to use as the slave axis and the (b) ***Master Register*** selects the axis position or high-speed counter/timer accumulated value that provides the position source value. These can be any of the axis or high-speed counter/timers available to the MPU or available to a BX-HSIO expansion module.

The Axis and high-speed counters/timers are configured in the MPUs ***Setup BRX High-speed I/O*** dialog or the BX-HSIO ***Setup BX-HSIO Module*** dialog. Please see detailed information on these under the "Available High-Speed Input and Output Features" earlier in this chapter. These dialog boxes can be opened directly from the AXFOLLOW instruction by clicking on the (c) **Configure Axis...** button and (d) **Configure Master Register Device...** button. These allow the user to:

- configure an axis or a counter/timer function for use with the instruction.
- verify or edit the physical I/O selected for an already configured axis or counter/timer function.



AXFOLLOW, continued

NOTE: *Axis0 is a 'virtual axis' and will not generate pulses to physical outputs of the PLC. Axis0 can be used for generating pulse output profile register values to be used for Table Driven Outputs (TDOPRESET or TDOPLS) or as the master for other axes in following-type applications (AXCAM, AXFOLLOW or AXGEAR). Axis0 is also good to use for testing.*

Master Register: This is the Axis, High-Speed Counter or Timer that provides the position source value. This can be any of the Axes or High-Speed Counter/Timers.

Non-Axis Master Filter Time: This parameter is only enabled if the Master Register is a High-Speed Counter/Timer. This value is the Filter Time Constant which specifies how often (in Seconds) the Slave's position is calculated. This can be any constant value or any numeric location.

Configure Master Register Device: This button will open the BRX High-Speed Input or Axis/Pulse Output dialog in the System Configuration.

Gear Ratio Multiplier: A multiplier that will be applied when the Follower's position is calculated. This can be any constant value or any numeric location. Unlike the similar parameter in the Electronic Gearing (AXGEAR) instruction, this value cannot be adjusted while the instruction is enabled.

Relative Offset Position: The Follower's position value will be adjusted by this pulse count value each time the Goto Offset Signal turns ON. This can be any constant value or any numeric location.

Relative Offset Velocity: The additional velocity the Follower Axis will use when moving to the Relative Offset Position. This value specifies how much faster (in pulses/second) the Follower Axis can move than the Master Axis when attempting to move to the Relative Offset Position. This value can be any constant between 0 and 250,000 or any numeric location containing a value in that range.

Goto Offset Signal: Each time this Bit transitions from OFF to ON, the Follower Axis will attempt to move to the Relative Offset Position using the Relative Offset Velocity. If the Relative Offset Position is reached the instruction will turn this Bit OFF. This can be any Bit memory address.

NOTE: *If the Bit assigned to the Goto Offset Signal stays ON, it indicates the Follower Axis does not have the capacity to overtake the Master Axis. Make the Follower Axis more responsive by configuring it with higher Maximum Velocity or a faster Acceleration, or both.*

On Success:

- **Set Bit**: The bit will become FALSE when the instruction is enabled and will remain FALSE until the enable leg goes back OFF. Once the enable leg turns OFF, if the instruction's device/parameters were valid, this bit will turn ON once the .CurrentVelocity reaches 0.
- **JMP to Stage**: Similarly, the JMP will not occur until after the instruction is enabled, then disabled, and all the instruction's device/parameters were valid and the .CurrentVelocity reaches 0.

On Error:

- **Set Bit**: The bit will become FALSE when the instruction is enabled and will become TRUE if there was a problem with the parameters configured in the instruction, with the devices specified or if the AXFOLLOW move was interrupted before completion.
- **JMP to Stage**: If there was a problem with the parameters configured in the instruction, with the devices specified or the AXFOLLOW move was interrupted before completion, the PLC will jump to that stage.

AXFOLLOW, continued

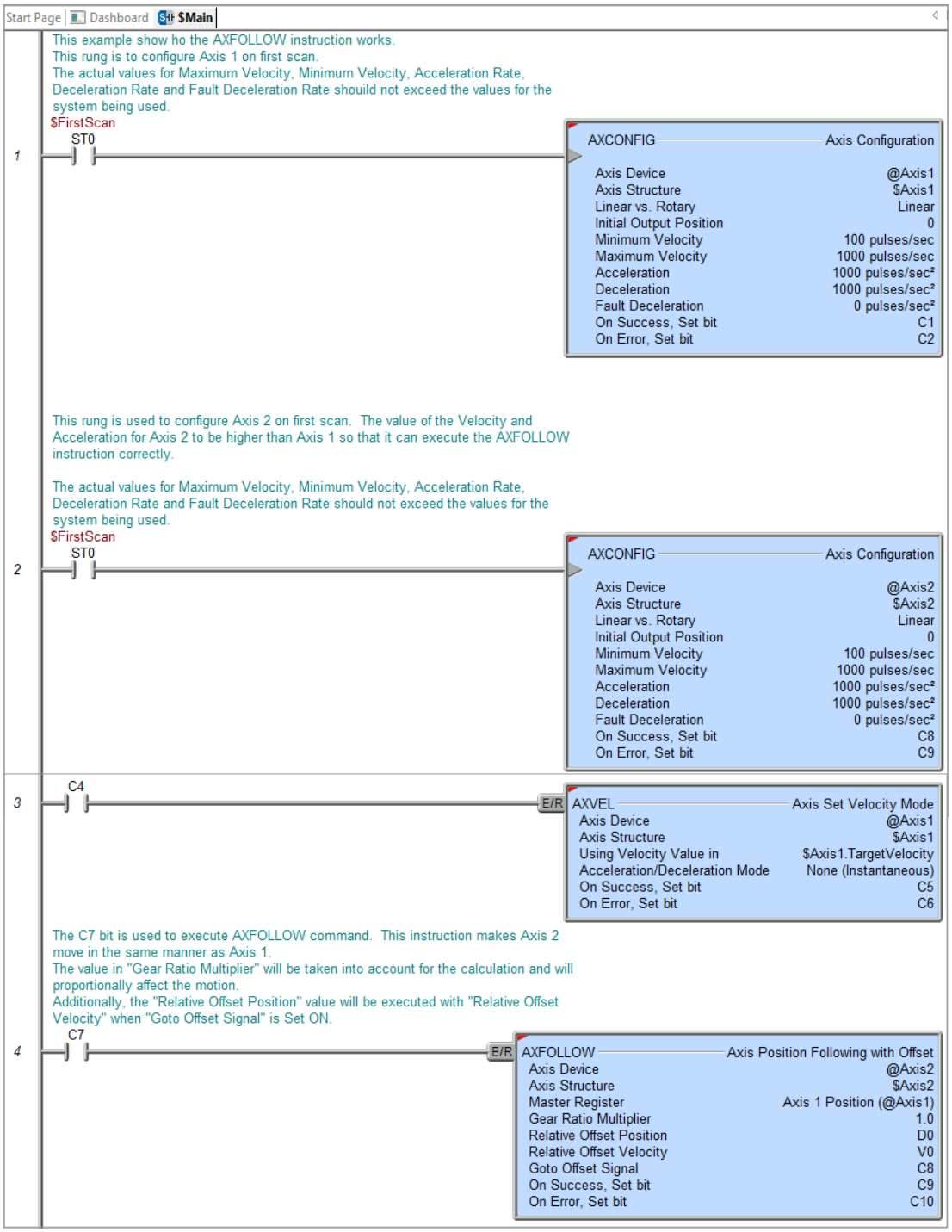
Example AXFOLLOW ladder.

Rung 1: configures Axis 1 parameters

Rung 2: configures Axis 2 parameters

Rung 3: uses the AXVEL instruction to set the velocity structure

Rung 4: sets the AXFOLLOW instruction that will describe the motion of both axes



AXGEAR

The **Axis Electronic Gearing** (AXGEAR) instruction is used to create a type of Master/Slave connection that will synchronize the movement of one axis relative to another axis or a High-Speed Counter/Timer.

AXGEAR always behaves in a Position-Following mode. The Slave axis position is derived from the Master position so that any time the position of the Master Axis changes, the position of the Slave Axis will move to a position that has been modified by the user-supplied gear ratio. When the move to position operation is enabled, the AXGEAR instruction will use the current values of the Gear Ratio, the Axis Maximum Velocity, Accel, Decel and the Master's Target Position to calculate the move profile. Any changes to the Gear Ratio and Target Position will result in a trajectory change of the AXGEAR Axis.

To help keep track of the Axes movement relative to each other, any time the Axis is in Electronic Gearing mode the Slave Axis associated structure member, ***.MstSlvCoordError***, will contain the difference (in pulse counts) between the Master Axis position and the Slave Axis position.

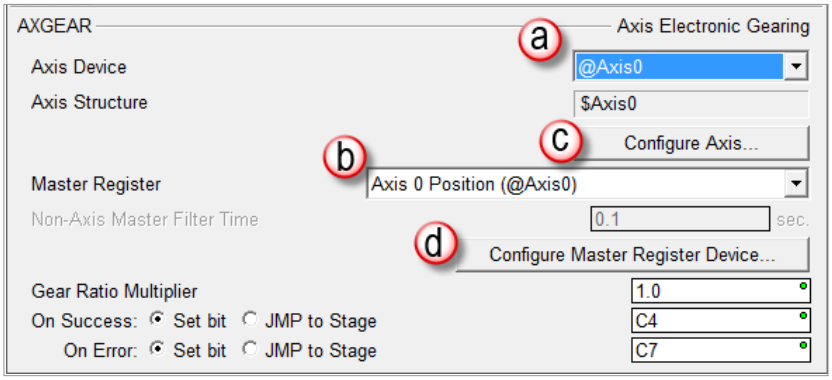
This instruction requires the following:

- Axis configured to be used as the slave Axis.
- One of the following to be used as the Master Register:
  - Position value from a configured master axis.
  - Accumulated value from a configured high speed counter/timer function.
- AXCONFIG instruction configured for each axis associated with the instruction.

The (a) ***Slave Axis Device*** specifies which axis to use as the slave axis and the (b) ***Master Register*** selects the axis position or high-speed counter/timer accumulated value that provides the position source value. These can be any of the axis or high-speed counter/timers available to the MPU or available to a BX-HSIO expansion module.

The Axis and high-speed counters/timers are configured in the MPUs ***Setup BRX High-speed I/O*** dialog or the BX-HSIO ***Setup BX-HSIO Module*** dialog. Please see detailed information on these under the "Available High-Speed Input and Output Features" earlier in this chapter. These dialog boxes can be opened directly from the AXGEAR instruction by clicking on the (c) **Configure Axis...** button and (d) **Configure Master Register Device...** button. These allow the user to:

- configure an axis or a counter/timer function for use with the instruction.
- verify or edit the physical I/O selected for an already configured axis or counter/timer function.



NOTE: *Axis0 is a 'virtual axis' and will not generate pulses to physical outputs of the PLC. Axis0 can be used for generating pulse output profile register values to be used for Table Driven Outputs (TDOPRESET or TDOPLS) or as the master for other axes in following-type applications (AXCAM, AXFOLLOW or AXGEAR). Axis0 is also good to use for testing.*

AXGEAR, continued

Master Register: This is the Axis, High-Speed Counter or Timer that the Slave Axis will be electronically geared to. This can be any of the Axes or High-Speed Counter/Timers.

Non-Axis Master Filter Time: This parameter is only enabled if the Master Register is a High-Speed Counter/Timer. This value is the Filter Time Constant which specifies how often (in Seconds) the Slave's position is calculated. This can be any constant value or any numeric location.

Configure Master Register Device: This button will open the BRX High-Speed Input or Axis/Pulse Output dialog in the System Configuration.

Gear Ratio Multiplier: A multiplier that will be applied each time the Slave's position is calculated. A value of 0 will cause the Slave Axis to stop. This can be any constant value or any numeric location.

On Success:

- **Set Bit**: The bit will become FALSE when the instruction is enabled and will remain FALSE until the enable leg goes back OFF. Once the enable leg turns OFF, if the instruction's device/parameters were valid, this bit will turn ON once the .CurrentVelocity reaches 0.
- **JMP to Stage**: Similarly, the JMP will not occur until after the instruction is enabled, then disabled, and all the instruction's device/parameters were valid and the .CurrentVelocity reaches 0.

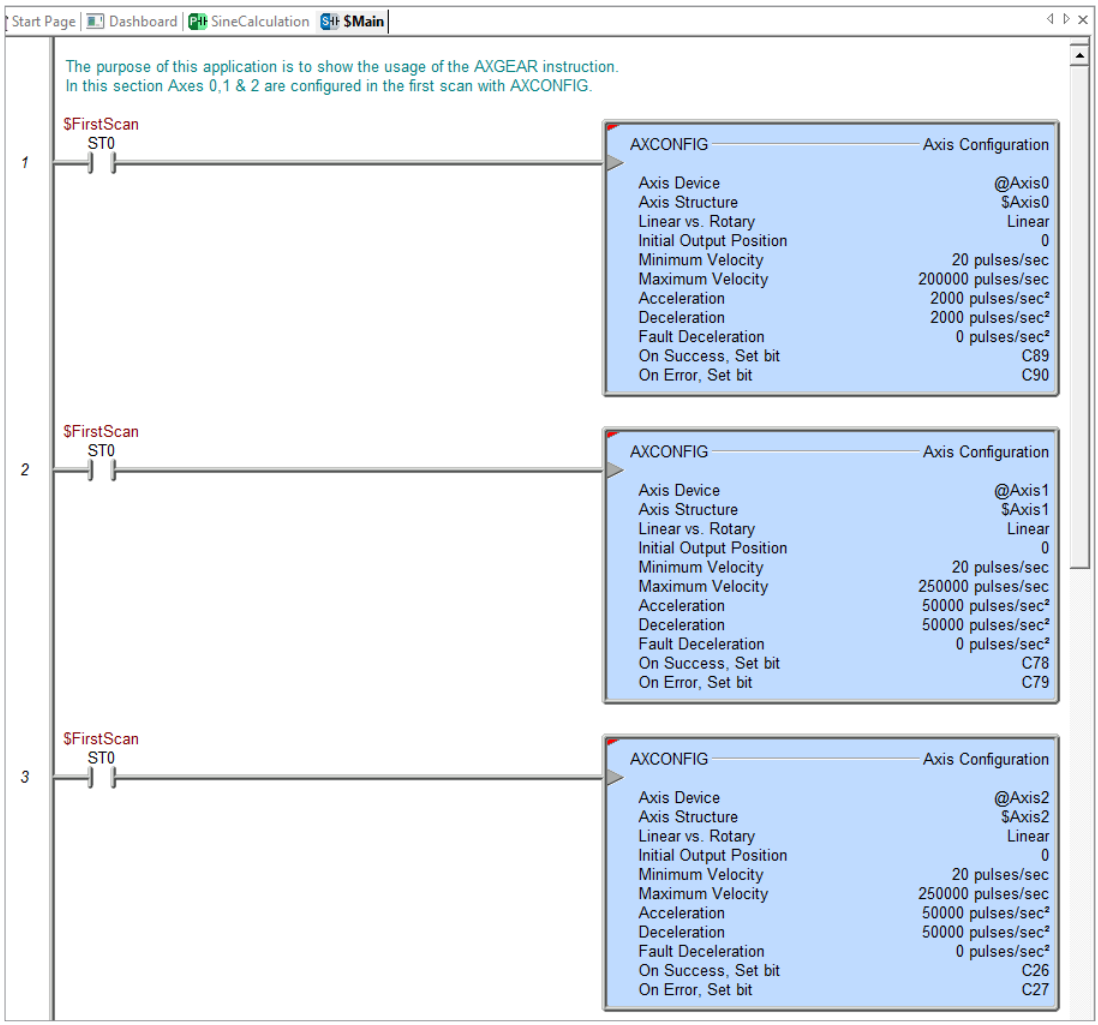
On Error:

- **Set Bit**: The bit will become FALSE when the instruction is enabled and will become TRUE if there was a problem with the parameters configured in the instruction, with the devices specified or if the AXGEAR move was interrupted before completion.
- **JMP to Stage**: If there was a problem with the parameters configured in the instruction, with the devices specified or the AXGEAR move was interrupted before completion, the PLC will jump to that stage.

Example AXGEAR ladder.

This example demonstrates the usage of the AXGEAR instruction. Axes 0, 1& 2 are configured in the first scan with AXCONFIG.

AXGEAR, continued

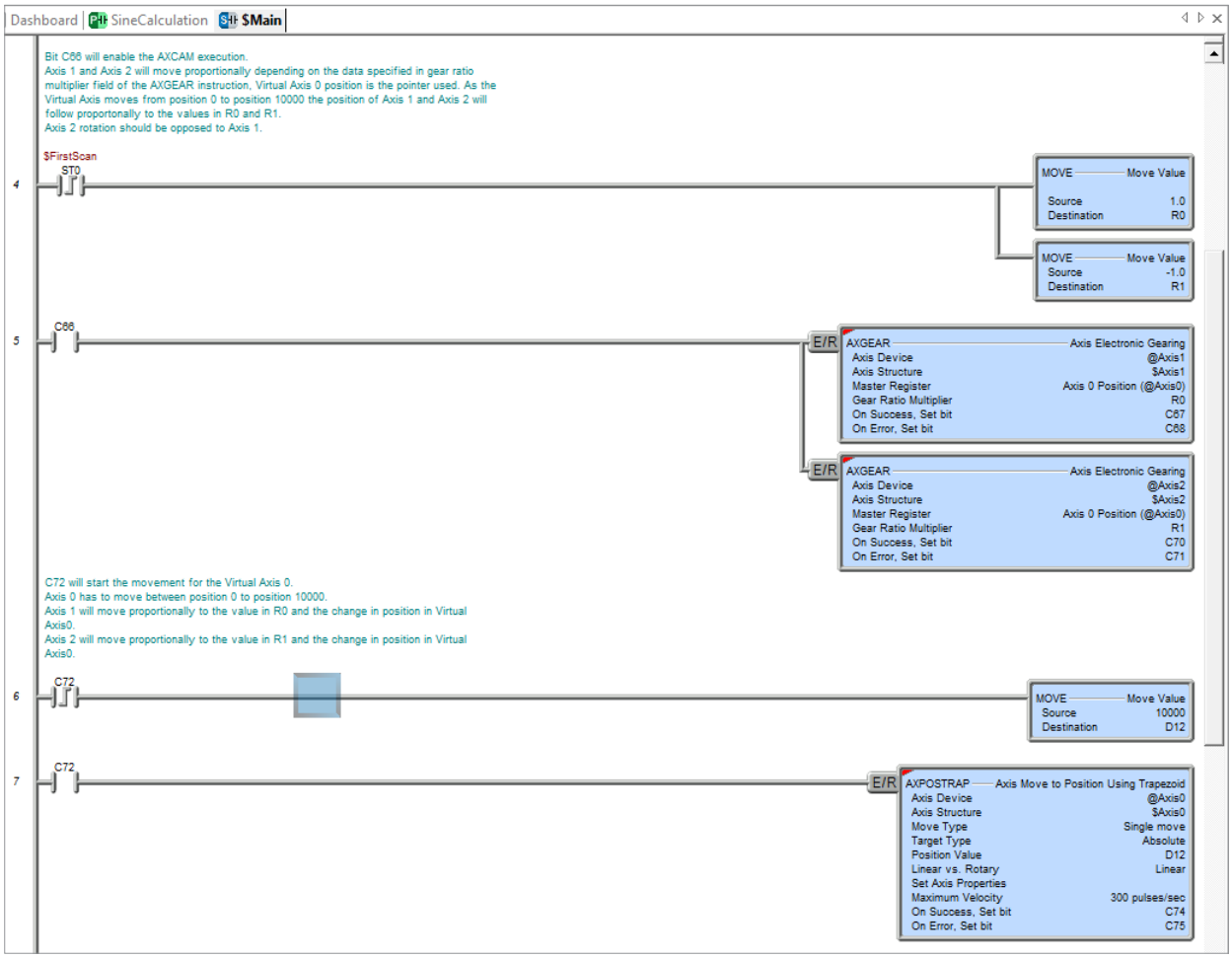


(Ladder continued on next page.)

AXGEAR, continued

In this section when C66 goes high AXGEAR is executed. Axis 1 and Axis 2 will move proportionally depending on the data specified in gear ratio multiplier field of the AXGEAR instruction. Virtual Axis 0 position is the pointer used. As the Virtual Aixs 0 moves from position 0 to position 10000 the position of Axis 1 and Axis 2 will follow proportionally to the values in R0 and R1. Axis 2 rotation should be opposed to Axis 1.

(Ladder continued from previous page.)



AXHOME

The **Axis Perform Home Search** (AXHOME) instruction is used to perform the necessary steps to move the specified Axis to a known starting position.

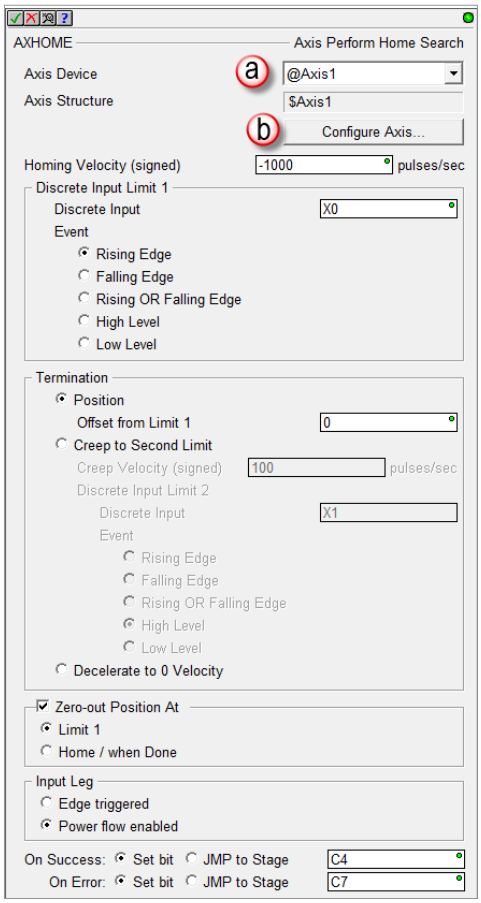
This instruction requires the following:

- Axis configured to be used as the slave Axis.
- AXCONFIG instruction configured for each axis associated with the instruction.

The (a) ***Axis Device*** specifies which axis to use as the slave axis. This can be any axis available to the MPU or available to a BX-HSIO expansion module.

The Axis is configured in the MPUs ***Setup BRX High-speed I/O*** dialog or the BX-HSIO ***Setup BX-HSIO Module*** dialog. Please see detailed information on these under the "Available High-Speed Input and Output Features" earlier in this chapter. These dialog boxes can be opened directly from the AXHOME instruction by clicking on the (b) **Configure Axis...** button. This allows the user to:

- configure an axis for use with the instruction.
- verify or edit the physical I/O selected for an already configured axis.



NOTE: *Axis0 is a 'virtual axis' and will not generate pulses to physical outputs of the PLC. Axis0 can be used for generating pulse output profile register values to be used for Table Driven Outputs (TDOPRESET or TDOPLS) or as the master for other axes in following-type applications (AXCAM, AXFOLLOW or AXGEAR). Axis0 is also good to use for testing.*

AXHOME, continued

Homing Velocity (Signed): The maximum velocity the Axis will ramp up to when moving toward Discrete Input Limit 1. The Axis will ramp up and down using the Axis current Acceleration and Deceleration settings. This can be any constant value from -250000 to -10, 0, and 10 to 250000 or any numeric location containing a value in that range. The sign of the value will indicate the direction of travel. Positive numbers will move the Axis clockwise, negative numbers will move the Axis counter-clockwise.

Discrete Input Limit 1: The Home Search operation requires at least one discrete input.

- Discrete Input: The discrete input where the **Home** limit switch is connected. This must be one of the on-board discrete inputs.
- Event: Selects which of the following conditions will indicate the **Home** switch has been reached:

Rising Edge	
Falling Edge	
Rising OR Falling Edge	
High Level	
Low Level	

Termination: Specifies what action to take after reaching the Home switch (Input Limit 1)

- **Position**: Use the Axis current positioning configuration to move the Axis to an absolute pulse count relative to the position of Discrete Input Limit 1.
- **Offset from Limit 1**: When Discrete Input Limit 1 is reached, the Axis marks the position of the switch and will then move the Axis toward the specified Position.
- **Creep to Second Position**: Move the Axis to a second discrete Input Limit switch.
  - Creep Velocity (Signed): The maximum frequency the Axis will ramp up to when moving toward Discrete Input Limit 2. The Axis will ramp up and down using the Axis current Acceleration and Deceleration settings. This can be any consta nt value between -250000 to -10, 0, and 10 to 250000 or any numeric location containing a value in that range. The sign of the value will indicate the direction of travel: positive numbers will move the Axis clockwise, negative numbers will move the Axis counter-clockwise.
  - Discrete Input Limit 2: Use a discrete input for Limit 2. This could be a second discrete input or the same input as Discrete Input Limit 1.

    Discrete Input: The discrete input where the Discrete Input Limit 2 switch is connected. This must be one of the on-board discrete inputs.

    Event: Selects which of the following conditions will indicate the Home switch has been reached:

Rising Edge	
Falling Edge	
Rising OR Falling Edge	
High Level	
Low Level	

  - Decelerate to 0 Velocity: The Axis will decelerate from the Homing Velocity to 0.

AXHOME, continued

Zero Position At: Enable this option to have the Axis set its Current Position to 0 after the following step of the Home Search operation:

- Limit 1: Set the Current Position to 0 when the Discrete Input Limit 1 switch is reached. Any additional movement of the Axis during the Termination phase will be reflected in the Axis Current Position value.
- Home/When Done: Set the Current Position to 0 when all phases of the Home Search operation is complete.

Input Leg: Specifies how the instruction will be enabled to run:

- Edge Triggered: Each time the input logic transitions from OFF to ON this instruction will run to completion. This selection does not allow the Home Search operation to be interrupted once it has started except by manually turning OFF the .MasterEnable for the Axis, which will put the Axis into a fault condition that must be cleared before the Axis will be permitted to move. Use the AXRSTFAULT (Reset Axis Limit Fault) instruction to clear an Axis Fault.
- Power Flow Enabled: When the Input logic transitions from OFF to ON the instruction will begin to execute and will continue executing as long as the input logic remains ON. This selection allows the Home Search operation to be interrupted by turning the input logic OFF. This is an error condition but it does not put the Axis into a Fault condition.

On Success:

- **Set Bit**: The bit will become FALSE when the instruction is enabled and will become TRUE if the parameters configured in the instruction and proper devices were specified and the Home operation completes uninterrupted.
- **JMP to Stage**: If the parameters configured in the instruction and proper devices were specified, the PLC will jump to that stage once the Home operation completes.

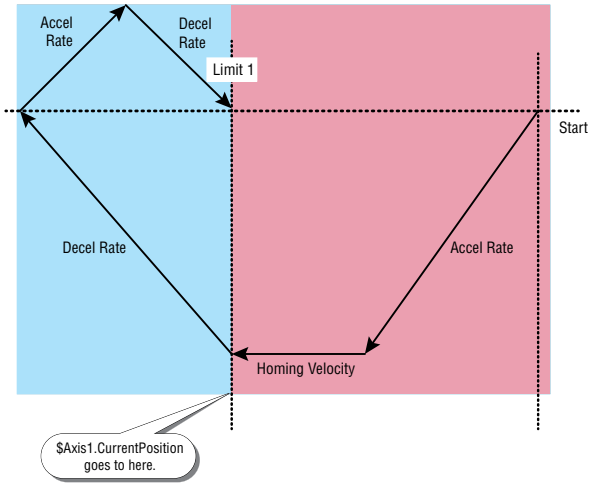
On Error:

- **Set Bit**: The bit will become FALSE when the instruction is enabled and will become TRUE if there was a problem with the parameters configured in the instruction, with the devices specified or if the Home operation was interrupted before completion.
- **JMP to Stage**: If there was a problem with the parameters configured in the instruction, with the devices specified or the Home operation was interrupted before completion, the PLC will jump to that stage.

Examples of various AXHOME configurations are considered on the following pages.

AXHOME, continued

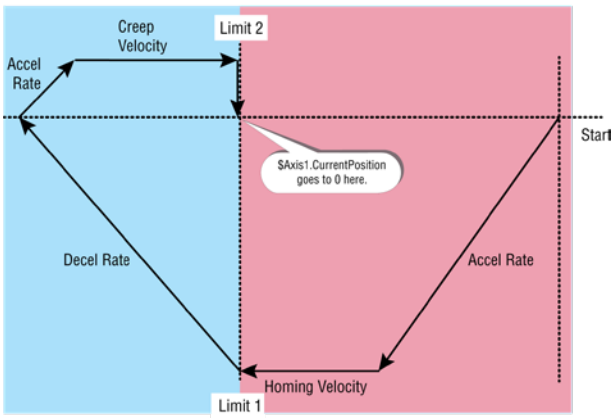
Example 1: Termination at Position of Limit 1

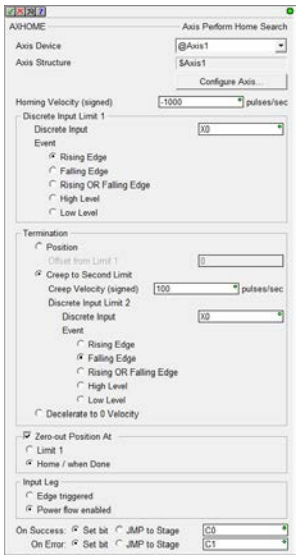




The Axis decelerates, changes direction and goes back to ***$Axis.CurrentPosition*** = 0 (Not looking at Limit 1 anymore).

Example 2: Termination Using Creep to Limit 2.

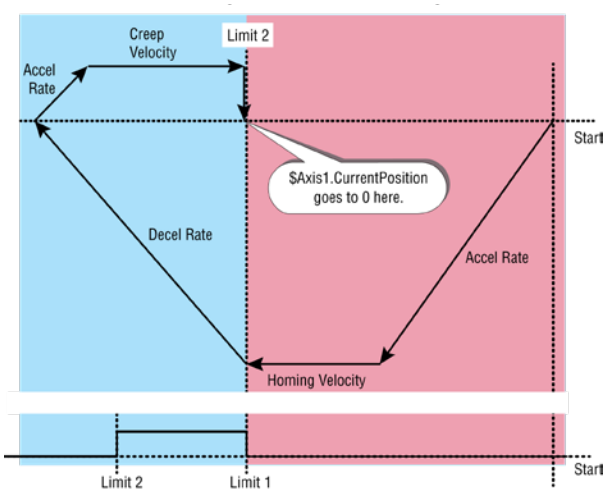


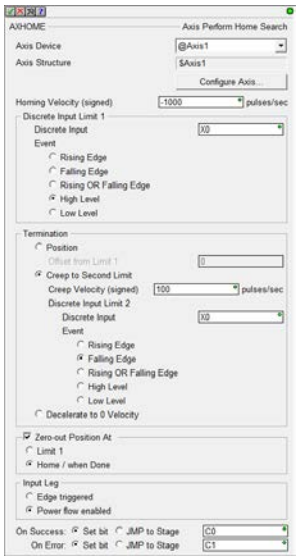


The Axis decelerates, changes direction and goes back to the falling edge of Limit 2 and the ***$Axis.CurrentPosition*** goes to 0 Take note that Limit 2 is the same physical switch in this situation. It could be a different one if it would make better sense for the application.

AXHOME, continued

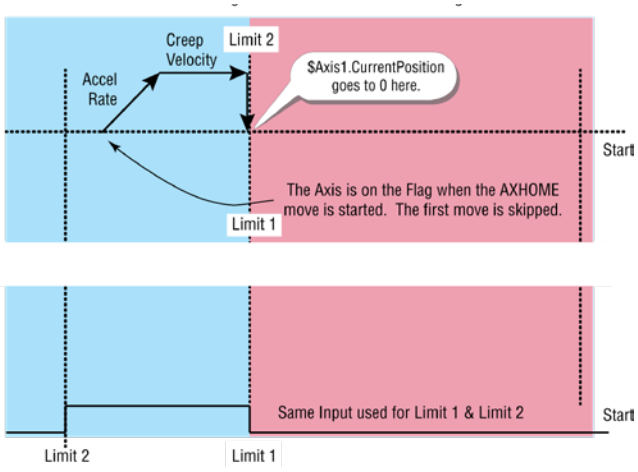
Example 3: Using Level and Edge Limits, Sharing the Same Input.

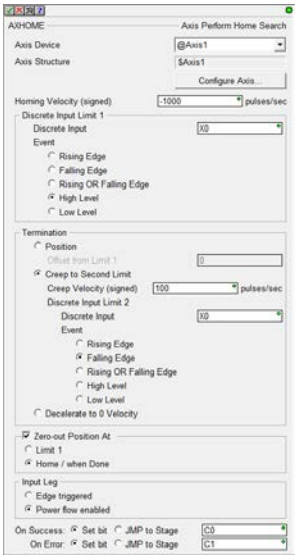




The Axis decelerates, changes direction and goes back to the Falling Edge of Limit 2 and the ***$Axis.CurrentPosition*** goes to 0. Take note that Limit 2 is the same physical switch in this situation. It could be a different one if it would make better sense for the application.

Example 4: Using Level and Edge Limits, Sharing the Same Input.

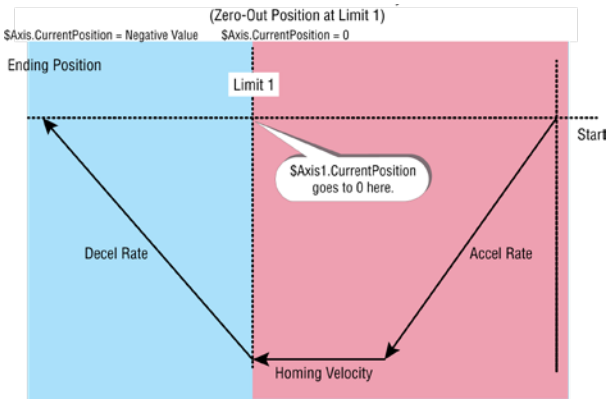




This is the same setup as the prior example but the Input for limit 1 on ON at the time of enabling the AXHOME instruction. The first movement does not occur in this case and the Axis creeps back to the Falling Edge of the switch.

AXHOME, continued

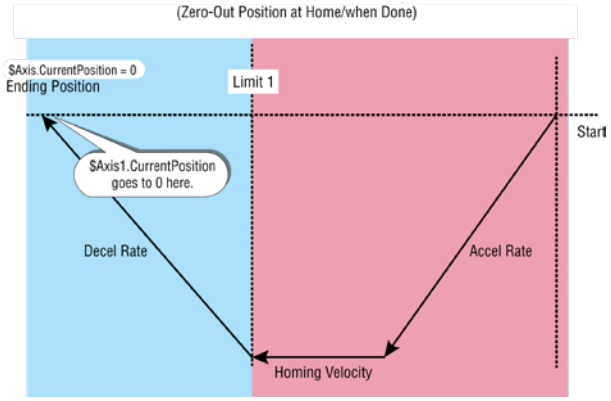
Example 5: Termination Decelerate to 0 Velocity.





In this case, when the AXHOME operation is complete, the ***$Axis1.CurrentPosition*** will contain a negative value.

Example 6: Termination Decelerate to 0 Velocity.





In this case, when the AXHOME operation is complete, the ***$Axis1.CurrentPosition*** will go to a 0 value.

AXJOG

The **Axis Jog** (AXJOG) instruction sets an Axis into a mode where its position can be manually adjusted by moving the Axis in the forward or reverse direction. Jogging is a simple velocity move that uses the Acceleration and Deceleration parameters specified in the Axis Configuration to ramp up to and ramp down from the Target Velocity specified in the AXJOG instruction or the Maximum Velocity specified in the Axis Configuration, whichever is lower.

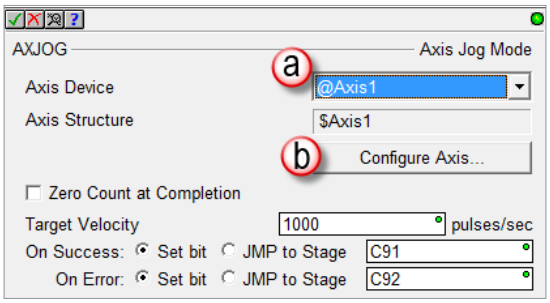
This instruction requires the following:

- Axis configured to be used as the slave Axis.
- AXCONFIG instruction configured for each axis associated with the instruction.

The (a) ***Axis Device*** specifies which axis to use as the slave axis. This can be any axis available to the MPU or available to a BX-HSIO expansion module.

The Axis is configured in the MPUs ***Setup BRX High-speed I/O*** dialog or the BX-HSIO ***Setup BX-HSIO Module*** dialog. Please see detailed information on these under the "Available High-Speed Input and Output Features" earlier in this chapter. These dialog boxes can be opened directly from the AXJOG instruction by clicking on the (b) **Configure Axis...** button. This allows the user to:

- configure an axis for use with the instruction.
- verify or edit the physical I/O selected for an already configured axis.



NOTE: *Axis0 is a 'virtual axis' and will not generate pulses to physical outputs of the PLC. Axis0 can be used for generating pulse output profile register values to be used for Table Driven Outputs (TDOPRESET or TDOPLS) or as the master for other axes in following-type applications (AXCAM, AXFOLLOW or AXGEAR). Axis0 is also good to use for testing.*

Zero Count at Completion: When this option is enabled the Current Position of the Axis will be set to 0 when the Enable/Reset input transitions from ON to OFF. If this option is not enabled, the Axis will retain the contents of the Current Position after the Jog is complete.

Target Velocity: Specifies the speed that the Axis will output pulses when the Enable Leg of the AXJOG is ON and either the Forward or Reverse Leg is ON. If this value is higher than the Maximum Velocity specified in the Axis Configuration, the Axis Configuration value will be used. Forward and Reverse moves will use the Axis Configuration's Acceleration and Deceleration values when ramping up to and ramping down from the Maximum Velocity allowed.

AXJOG, continued

On Success:

- **Set Bit**: The bit will become FALSE when the instruction is enabled and will remain FALSE until the enable leg goes back OFF. Once the enable leg turns OFF, if the instruction's device/parameters were valid, this bit will turn ON once the .CurrentVelocity reaches 0.
- **JMP to Stage**: Similarly, the JMP will not occur until after the instruction is enabled, then disabled, and all the instruction's device/parameters were valid and the .CurrentVelocity reaches 0.

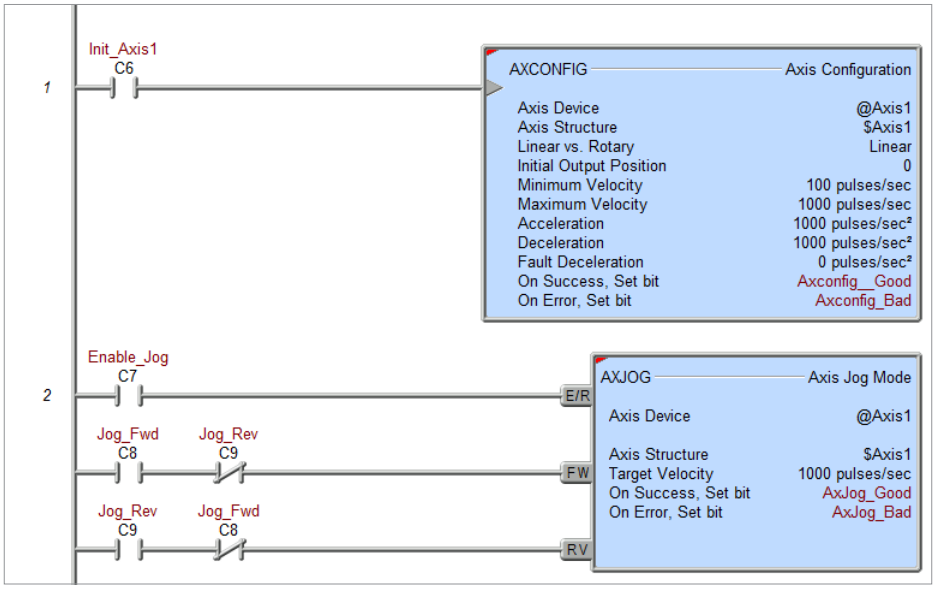
On Error:

- **Set Bit**: The bit will become FALSE when the instruction is enabled and will become TRUE when proper instruction parameters are NOT properly entered or the instruction IS NOT completed successfully. The specified bit is enabled with a SET operation, not an OUT operation. The On Error bit will remain ON even if the instruction input logic goes OFF.
- **JMP to Stage**: when proper instruction parameters are NOT properly entered or the instruction IS NOT completed successfully, the PLC will jump to that stage.



NOTE: *Because this instruction puts the Axis into an operational mode (as opposed to performing a single operation), On Success is defined as getting the Axis into Jog mode with no errors. This means that the On Success indication will turn ON after the Enable/Reset input logic transitions from ON to OFF and the Axis' Current Velocity is at 0. When these conditions are met the Axis' Mode is "Idle". You should wait until the On Success indication turns ON before attempting to execute any other Axis instruction.*

Example Ladder Logic:



AXPOSSCRV

The **Axis Move to Position Using S-Curve** (AXPOSSCRV) instruction is used to move an Axis from its current position to a specified target position using the Axis configured parameters and the specified Jerk parameter which will yield an S-curve velocity profile.

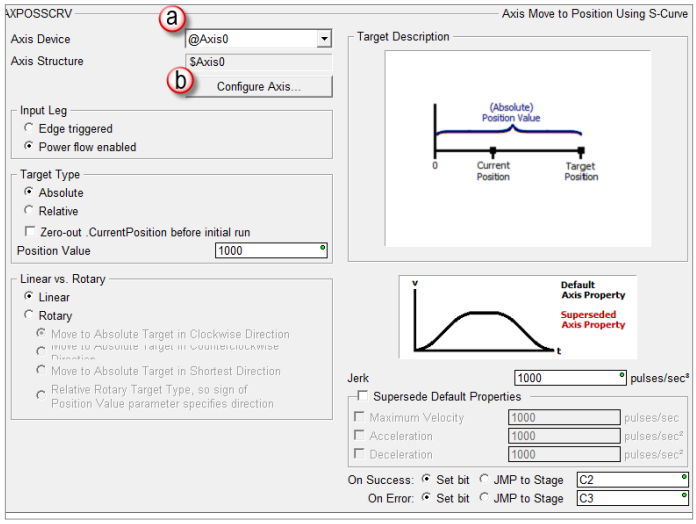
This instruction requires the following:

- Axis configured to be used as the slave Axis.
- AXCONFIG instruction configured for each axis associated with the instruction.

The (a) ***Axis Device*** specifies which axis to use as the slave axis. This can be any axis available to the MPU or available to a BX-HSIO expansion module.

The Axis is configured in the MPUs ***Setup BRX High-speed I/O*** dialog or the BX-HSIO ***Setup BX-HSIO Module*** dialog. Please see detailed information on these under the "Available High-Speed Input and Output Features" earlier in this chapter. These dialog boxes can be opened directly from the AXPOSSCRV instruction by clicking on the (b) **Configure Axis...** button. This allows the user to:

- configure an axis for use with the instruction.
- verify or edit the physical I/O selected for an already configured axis.



NOTE: *Axis0 is a 'virtual axis' and will not generate pulses to physical outputs of the PLC. Axis0 can be used for generating pulse output profile register values to be used for Table Driven Outputs (TDOPRESET or TDOPLS) or as the master for other axes in following-type applications (AXCAM, AXFOLLOW or AXGEAR). Axis0 is also good to use for testing.*

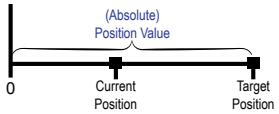
AXPOSSCRV, continued

Input Leg

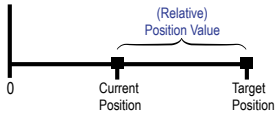
- **Edge Triggered**: The move to position operation will be performed each time the input transitions from OFF to ON. Once a move to position operation is in progress it can only be stopped by manually setting the axis .MasterEnable member to OFF, which will put the axis into a Fault state.
- **Power flow Enabled**: The move to position operation will begin when the input transitions from OFF to ON and will continue to completion as long as the input remains ON. This selection has the benefit of being able to interrupt a move to position operation by setting the input state to OFF and NOT putting the Axis into a Fault state.

Target Type

- **Absolute**: Absolute moves are measured from the axis zero position. When an axis is initialized, its current position is set to 0. An absolute move to 10000 will generate 10000 pulses to move the axis forward 10000 pulses. A subsequent absolute move to -10000 will generate 20000 pulses to move the axis backward past 0 to the -10000 position. If you execute an absolute move with a Position Value that is the same as the Axis Current Position the axis will not move as the absolute position is already reached.



- **Relative**: Relative moves are measured from the Axis' current position. When an axis is initialized, its current position is set to 0. A relative move to 10000 will generate 10000 pulses to move the axis forward 10000 pulses. A subsequent relative move of -10000 will generate 10000 pulses to move the axis backward to that 0 position.



- **Zero-out Current Position Before Initial Move**: Enable this option to have the axis set its Current Position value to 0 before any move operation.



- **Position Value**: The target position (pulse count) to move the axis to. This can be any constant value, or any numeric location with a value in that range.

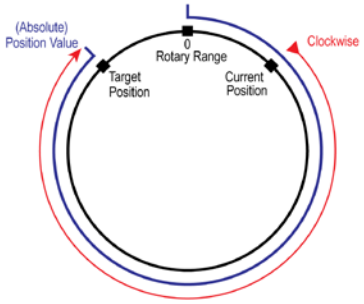
AXPOSSCRV, continued

Linear vs. Rotary

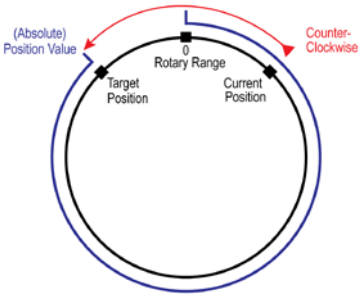
- **Linear**: The series of pulses will produce forward or backwards motion along a fixed linear path. If the Target Position value is a higher value than the Current Position value, the resulting move will be in the positive (increasing) direction. If the Target Position value is a lower value than the Current Position, the resulting move will be in the negative (decreasing) direction.

- **Rotary**: The series of pulses will produce Clockwise or CounterClockwise motion along a fixed circular path either as an absolute position value or relative position as noted in the discussion below.

  Move to Absolute Target in Clockwise Direction: Taking into account the Rotary Range specified in the AXCONFIG and the Target Position Value, the PLC will always generate pulses in an increasing (positive) direction. So if the Target Position value is lower than the Current Position, the PLC will 'roll over' in the clockwise direction to achieve the position. If the Target Position Value specified exceeds the Rotary Range, the Axis will move to the modulus result. For example: If the Rotary Range is 0–359 (360 degrees) and a Target Position Value of 500 was specified, the Axis will output 140 pulses.

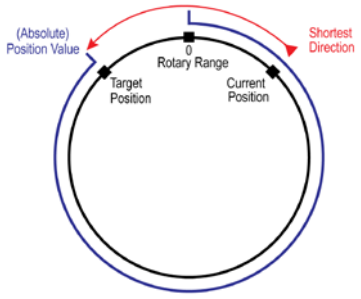


  Move to Absolute Target in Counterclockwise Direction: Taking into account the Rotary Range specified in the AXCONFIG and the Target Position Value, the PLC will always generate pulses in a decreasing (negative) direction. So if the Target Position value is higher than the Current Position value, the PLC will 'roll over' in the Counter clockwise direction to achieve the position. If the Target Position Value specified exceeds the Rotary Range, the Axis will move to the modulus result. For example: If the Rotary Range is 0–359 (360 degrees) and a Target Position Value of 500 was specified, the Axis will output 220 pulses.

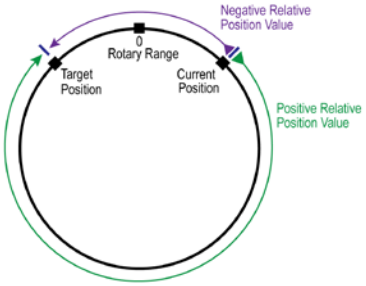


AXPOSSCRV, continued

Move to Absolute Target in Shortest Direction: Taking into account the Rotary Range specified in the AXCONFIG and the Target Position Value, the PLC will calculate the shortest distance between the Target Position Value and the Current Position value and go in either Clockwise or Counter Clockwise direction to achieve the target. If the Target Position Value specified exceeds the Rotary Range, the Axis will move to the modulus result. For example: If the Rotary Range is 0–359 (360 degrees) and a Target Position Value of 500 was specified, the Axis will output 140 pulses.



Relative Rotary Target Type, so sign of Position Value parameter specifies direction: A positive Position Value will move the Axis in a Clockwise direction and a negative Position Value will move the Axis in a Counter Clockwise direction. If the Target Position Value specified exceeds the Rotary Range, the Axis will move to the modulus result. For example: If the Rotary Range is 0–359 (360 degrees) and a Target Position Value of 500 was specified, the Axis will output 140 pulses.



Jerk: The Jerk term specifies how quickly the Axis is allowed to achieve maximum Acceleration and Deceleration on its way to reaching maximum Velocity. This value is specified in pulses/sec3.

Supersede Default Properties: These parameters allow this AXPOSSCRV instruction to override the values specified in the AXCONFIG instruction. They only temporarily change the values in the AXCONFIG for this movement. To permanently change the parameters in the AXCONFIG, use the Set Axis Properties (AXSETPROP) instruction.

- **Maximum Velocity** (pulses/sec): The fastest frequency of output pulses that will be generated during the move to position operation. This can be any positive constant from 10 to 250000, or any numeric location with a value in that range.
- **Acceleration Rate** (pulses/sec^2): The rate at which the pulses will be generated when the axis is ramping up from a slower pulse rate to a higher pulse rate. This can be any positive constant or any numeric location with a value in that range.
- **Deceleration Rate** (pulses/sec^2): The rate at which the pulses will be generated when the axis is ramping down from a higher pulse rate to a slower pulse rate. This can be any positive constant or any numeric location with a value in that range.

AXPOSSCRV, continued

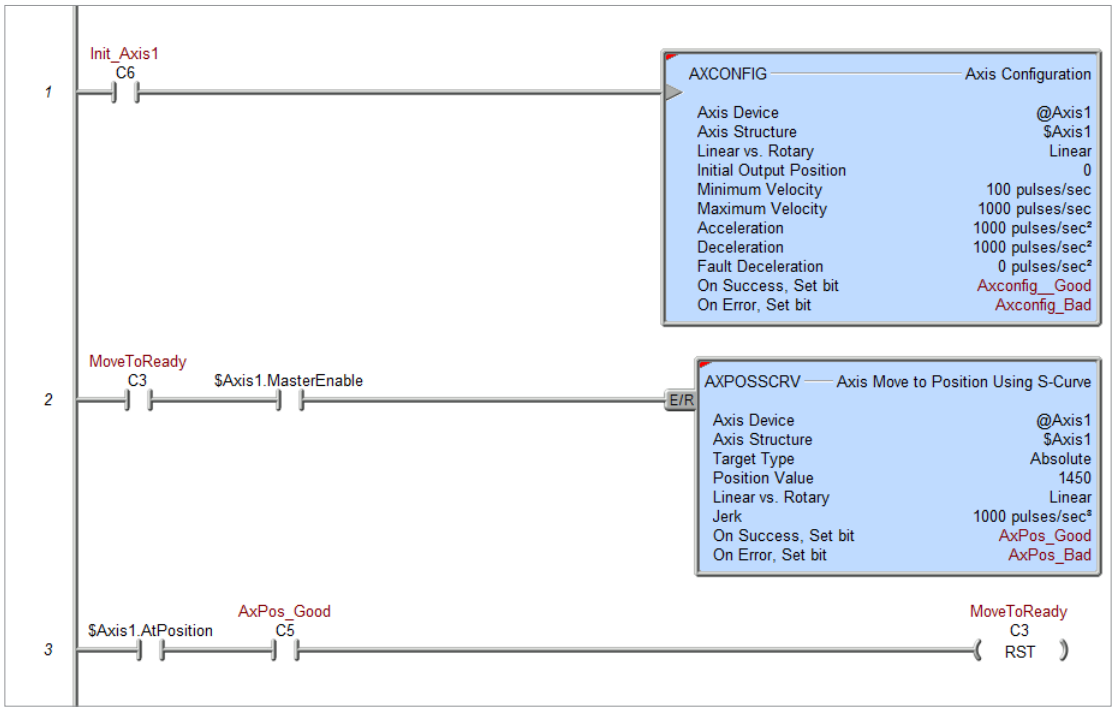
On Success:

- **Set Bit**: The bit will become FALSE when the instruction is enabled and will become TRUE when instruction parameters are properly entered and the instruction completes successfully. The specified bit is enabled with a SET operation, not an OUT operation. The On Success bit will remain ON even if the instruction input logic goes OFF.
- **JMP to Stage**: When instruction parameters are properly entered and the instruction completes successfully, the PLC will jump to that stage.

On Error:

- **Set Bit**: The bit will become FALSE when the instruction is enabled and will become TRUE when proper instruction parameters are NOT properly entered or the instruction IS NOT completed successfully. The specified bit is enabled with a SET operation, not an OUT operation. The On Error bit will remain ON even if the instruction input logic goes OFF
- **JMP to Stage**: When proper instruction parameters are NOT properly entered or the instruction IS NOT completed successfully, the PLC will jump to that stage.

Example Usage:



AXPOSTRAP

The **Axis Move to Position Using Trapezoid** (AXPOSTRAP) instruction is used to move an Axis from its current position to a specified target position using the Axis' configured parameters which will yield a trapezoid velocity profile (linear acceleration and deceleration).

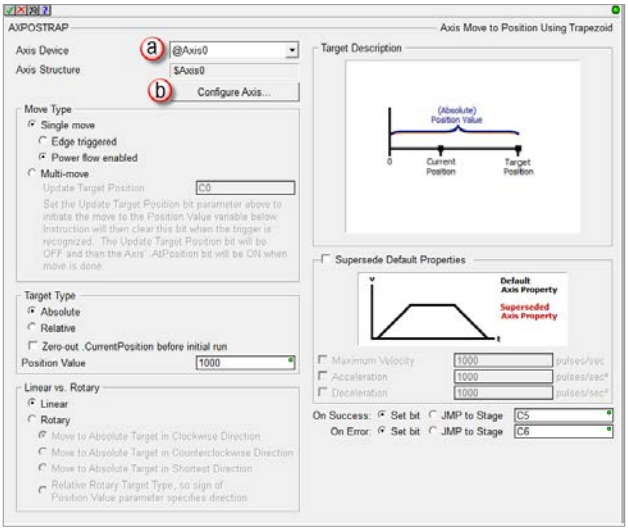
This instruction requires the following:

- Axis configured to be used as the slave Axis.
- AXCONFIG instruction configured for each axis associated with the instruction.

The (a) ***Axis Device*** specifies which axis to use as the slave axis. This can be any axis available to the MPU or available to a BX-HSIO expansion module.

The Axis is configured in the MPUs ***Setup BRX High-speed I/O*** dialog or the BX-HSIO ***Setup BX-HSIO Module*** dialog. Please see detailed information on these under the "Available High-Speed Input and Output Features" earlier in this chapter. These dialog boxes can be opened directly from the AXPOSTRAP instruction by clicking on the (b) **Configure Axis...** button. This allows the user to:

- configure an axis for use with the instruction.
- verify or edit the physical I/O selected for an already configured axis.



NOTE: *Axis0 is a 'virtual axis' and will not generate pulses to physical outputs of the PLC. Axis0 can be used for generating pulse output profile register values to be used for Table Driven Outputs (TDOPRESET or TDOPLS) or as the master for other axes in following-type applications (AXCAM, AXFOLLOW or AXGEAR). Axis0 is also good to use for testing.*

Move Type

- **Single move**: The axis will perform 1 move to the specified position.

  Edge Triggered: The move to position operation will be performed each time the input transitions from OFF to ON. Once a move to position operation is in progress it can only be stopped by manually setting the axis .MasterEnable member to OFF, which will put the axis into a Fault state.

  Power flow Enabled: The move to position operation will begin when the input transitions from OFF to ON and will continue to completion as long as the input remains ON. This selection has the

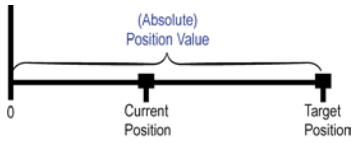
AXPOSTRAP, continued

benefit of being able to interrupt a move to position operation by setting the input state to OFF and NOT putting the axis into a Fault state.

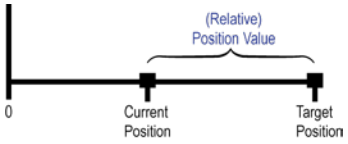
- **Multi-move**: The axis can perform multiple moves by changing the "Position Value" register and triggering the "Update Target Position" bit.
- **Trigger Target Position**: Specify an internal bit for this field. Changing this bit from OFF to ON will result in the PLC changing its Target Position (without stopping) to the value loaded into the ***Position Value*** register. The PLC will automatically turn the ***Update Target Position*** bit back OFF after changing its target position. The ***.AtPosition*** bit member of the Axis structure can be monitored to ensure completion.

Target Type

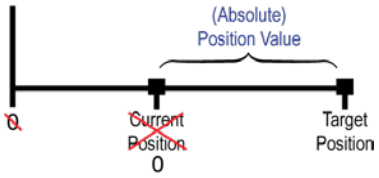
- **Absolute**: Absolute moves are measured from the axis zero position. When an axis is initialized, its current position is set to 0. An absolute move to 10000 will generate 10000 pulses to move the Axis forward 10000 pulses. A subsequent absolute move to -10000 will generate 20000 pulses to move the Axis backward past 0 to the -10000 position. If you execute an absolute move with a Position Value that is the same as the axis Current Position the axis will not move as the absolute position is already reached.



- **Relative**: Relative moves are measured from the axis current position. When an axis is initialized, its current position is set to 0. A relative move to 10000 will generate 10000 pulses to move the axis forward 10000 pulses. A subsequent relative move of -10000 will generate 10000 pulses to move the Axis backward to that 0 position.



- **Zero Current Position Before Initial Move**: Enable this option to have the Axis set its Current Position value to 0 before any move operation.



Single Move: Current Position is set to 0 before the move to position operation begins.

Multi-Move: Current Position is set to 0 before the first move to position but does not happen on subsequent OFF to ON transitions of the Trigger Target Position.

- **Position Value**: The target position (pulse count) to move the Axis to. This can be any constant value, or any numeric location with a value in that range.

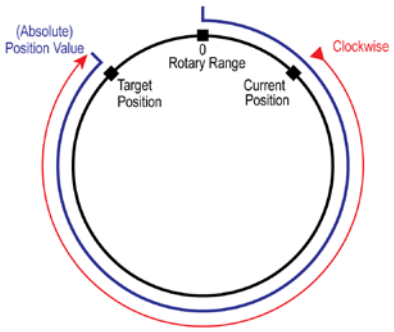
AXPOSTRAP, continued

Linear vs. Rotary:

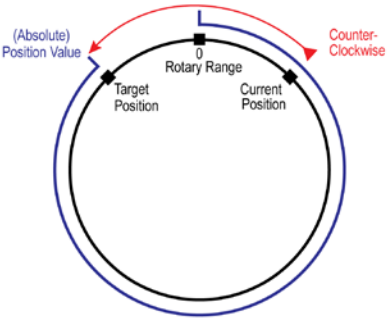
- **Linear**: The series of pulses will produce forward or backwards motion along a fixed linear path. If the Target Position value is a higher value than the Current Position value, the resulting move will be in the positive (increasing) direction. If the Target Position value is a lower value than the Current Position, the resulting move will be in the negative (decreasing) direction.

- **Rotary**

  Move to Absolute Target in Clockwise Direction: Taking into account the Rotary Range specified in the AXCONFIG and the Target Position Value, the PLC will always generate pulses in an increasing (positive) direction. So if the Target Position value is lower than the Current Position, the PLC will 'roll over' in the clockwise direction to achieve the position. If the Target Position Value specified exceeds the Rotary Range, the Axis will move to the modulus result. For example: If the Rotary Range is 0–359 (360 degrees) and a Target Position Value of 500 was specified, the Axis will output 140 pulses.

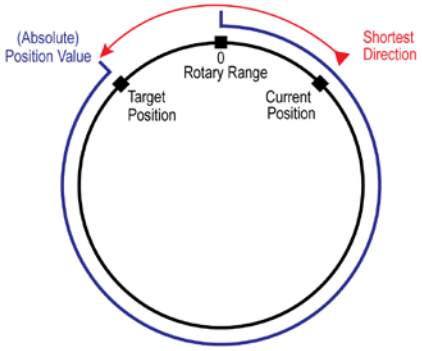


  Move to Absolute Target in Counterclockwise Direction: Taking into account the Rotary Range specified in the AXCONFIG and the Target Position Value, the PLC will always generate pulses in a decreasing (negative) direction. So if the Target Position value is higher than the Current Position value, the PLC will 'roll over' in the Counter clockwise direction to achieve the position. If the Target Position Value specified exceeds the Rotary Range, the Axis will move to the modulus result. For example: If the Rotary Range is 0–359 (360 degrees) and a Target Position Value of 500 was specified, the Axis will output 220 pulses.

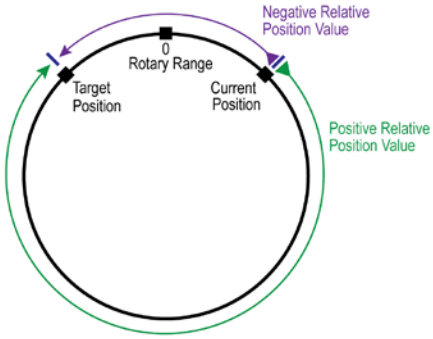


AXPOSTRAP, continued

Move to Absolute Target in Shortest Direction: Taking into account the Rotary Range specified in the AXCONFIG and the Target Position Value, the PLC will calculate the shortest distance between the Target Position Value and the Current Position value and go in either Clockwise or Counter Clockwise direction to achieve the target. If the Target Position Value specified exceeds the Rotary Range, the Axis will move to the modulus result. For example: If the Rotary Range is 0–359 (360 degrees) and a Target Position Value of 500 was specified, the Axis will output 140 pulses.



Relative Rotary Target Type, so sign of Position Value parameter specifies direction: A positive Position Value will move the Axis in a Clockwise direction and a negative Position Value will move the Axis in a Counter Clockwise direction. If the Target Position Value specified exceeds the Rotary Range, the Axis will move to the modulus result. For example: If the Rotary Range is 0–359 (360 degrees) and a Target Position Value of 500 was specified, the Axis will output 140 pulses.



Supersede Default Properties

Selecting these parameters allows the AXPOSTRAP instruction to override the values specified in the AXCONFIG instruction. They only temporarily change the values in the AXCONFIG for this movement. To permanently change the parameters in the AXCONFIG, use the Set Axis Properties (AXSETPROP) instruction.

- **Maximum Velocity** (pulses/sec): The fastest frequency of output pulses that will be generated during the move to position operation. This can be any positive constant from 10 to 250000, or any numeric location with a value in that range.
- **Acceleration Rate** (pulses/sec^2): The rate at which the pulses will be generated when the axis is ramping up from a slower pulse rate to a higher pulse rate. This can be any positive constant or any numeric location with a value in that range.

AXPOSTRAP, continued

- **Deceleration Rate** (pulses/sec^2): The rate at which the pulses will be generated when the axis is ramping down from a higher pulse rate to a slower pulse rate. This can be any positive constant or any numeric location with a value in that range.

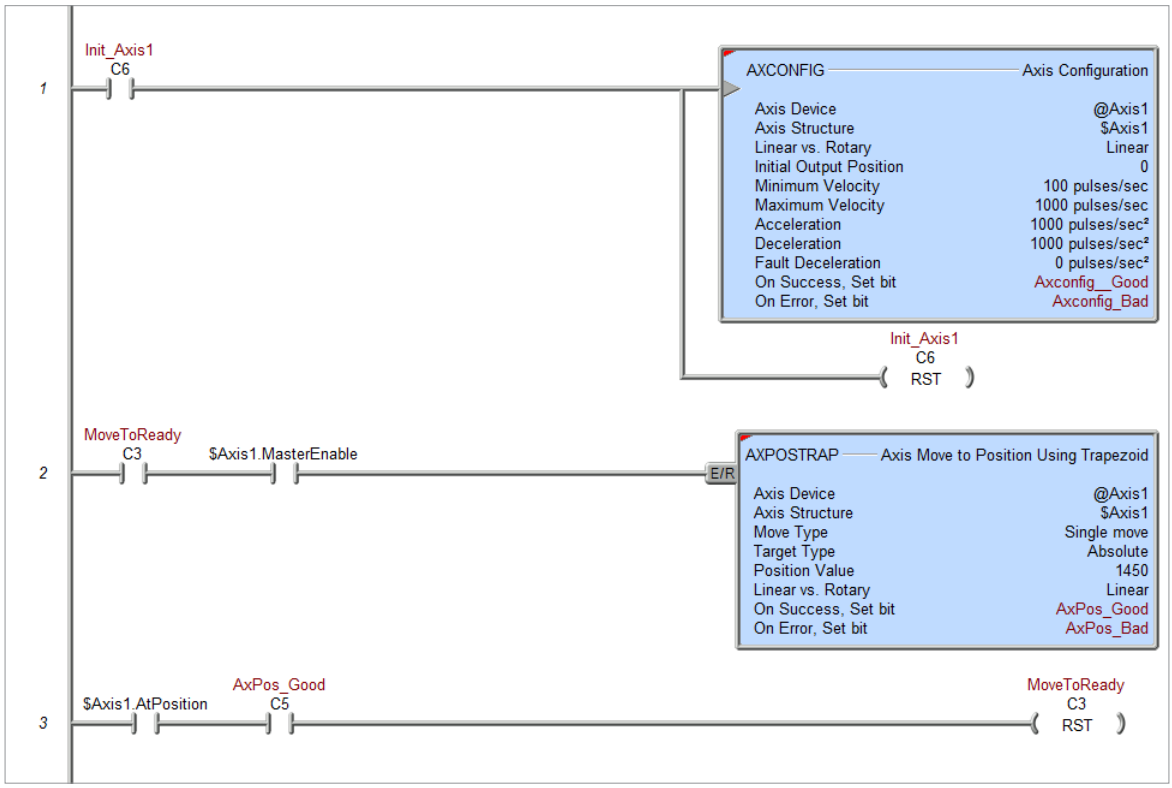
On Success:

- **Set Bit**: The bit will become FALSE when the instruction is enabled and will become TRUE when instruction parameters are properly entered and the instruction completes successfully. The specified bit is enabled with a SET operation, not an OUT operation. The On Success bit will remain ON even if the instruction input logic goes OFF.
- **JMP to Stage**: When instruction parameters are properly entered and the instruction completes successfully, the PLC will jump to that stage.

On Error:

- **Set Bit**: The bit will become FALSE when the instruction is enabled and will become TRUE when proper instruction parameters are NOT properly entered or the instruction IS NOT completed successfully. The specified bit is enabled with a SET operation, not an OUT operation. The On Error bit will remain ON even if the instruction input logic goes OFF.
- **JMP to Stage**: When proper instruction parameters are NOT properly entered or the instruction IS NOT completed successfully, the PLC will jump to that stage.

Example Usage:



AXRSTFAULT

The **Reset Axis Limit Fault** (AXRSTFAULT) instruction is used to clear the fault in an axis that has either reached one of the configured Fault Limits while it was moving or has had its ***.MasterEnable*** manually reset.

After the instruction has cleared the fault state in an axis fault, any attempt to move the Axis in the same direction that caused the fault will immediately generate another fault condition. Movement of the axis in the opposite direction that caused the fault is permitted.

Triggering the AXCONFIG (Axis Configuration) instruction will also reset an Axis that is in a fault state.

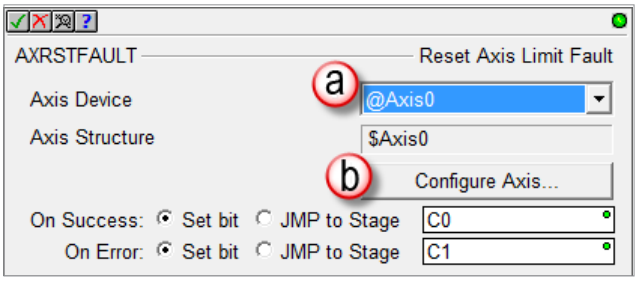
This instruction requires the following:

- Axis configured to be used as the slave Axis.
- AXCONFIG instruction configured for each axis associated with the instruction.

The (a) ***Axis Device*** specifies which axis to use as the slave axis. This can be any axis available to the MPU or available to a BX-HSIO expansion module.

The Axis is configured in the MPUs ***Setup BRX High-speed I/O*** dialog or the BX-HSIO ***Setup BX-HSIO Module*** dialog. Please see detailed information on these under the "Available High-Speed Input and Output Features" earlier in this chapter. These dialog boxes can be opened directly from the AXRSTFAULT instruction by clicking on the (b) **Configure Axis...** button. This allows the user to:

- configure an axis for use with the instruction.
- verify or edit the physical I/O selected for an already configured axis.



NOTE: *Axis0 is a 'virtual axis' and will not generate pulses to physical outputs of the PLC. Axis0 can be used for generating pulse output profile register values to be used for Table Driven Outputs (TDOPRESET or TDOPLS) or as the master for other axes in following-type applications (AXCAM, AXFOLLOW or AXGEAR). Axis0 is also good to use for testing.*

On Success:

- **Set Bit**: The bit will become FALSE when the instruction is enabled and will become TRUE when instruction parameters are properly entered and the instruction completes successfully. The specified bit is enabled with a SET operation, not an OUT operation. The On Success bit will remain ON even if the instruction input logic goes OFF.
- **JMP to Stage**: When instruction parameters are properly entered and the instruction completes successfully, the PLC will jump to that stage.

On Error:

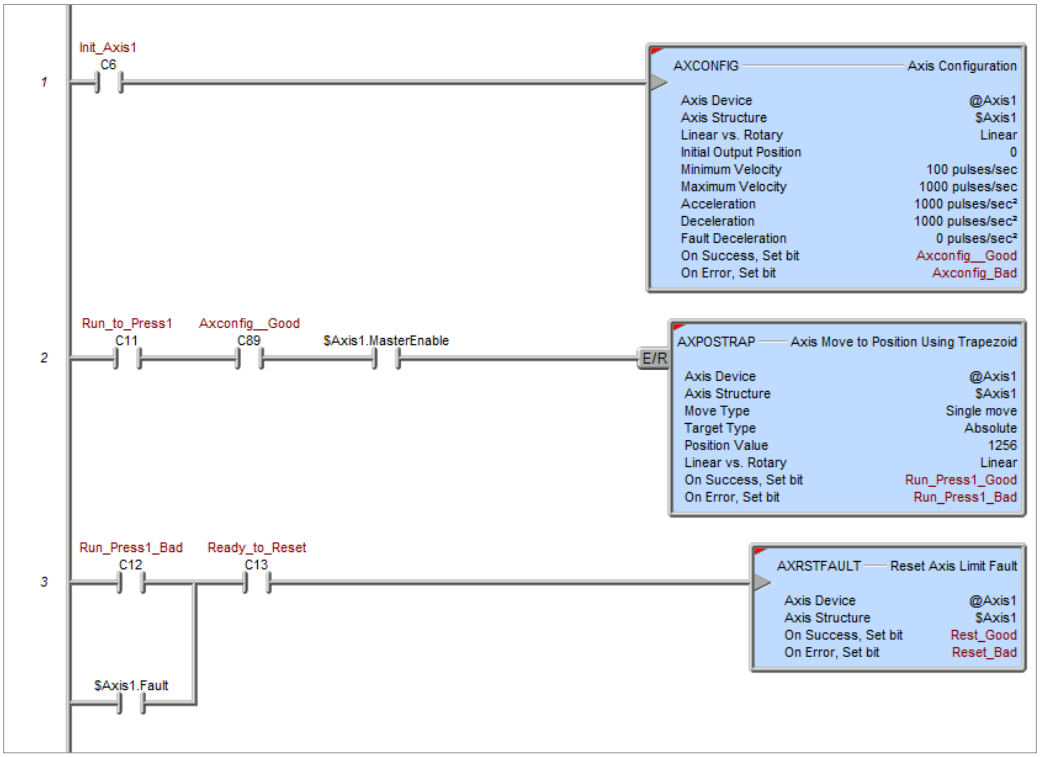
- **Set Bit**: The bit will become FALSE when the instruction is enabled and will become TRUE when proper instruction parameters are NOT properly entered or the instruction IS NOT completed

AXRSTFAULT, continued

successfully. The specified bit is enabled with a SET operation, not an OUT operation. The On Error bit will remain ON even if the instruction input logic goes OFF.

- **JMP to Stage**: When proper instruction parameters are NOT properly entered or the instruction IS NOT completed successfully, the PLC will jump to that stage.

Example Usage



AXSCRIPT

The **Run a Sequence of Axis Commands** (AXSCRIPT) instruction is used to process a series of commands that can control an Axis, change PLC memory items, and interact with the ladder logic. This series of commands allow for Axis movements that cannot be done with the existing Axis instructions. You should only be using the AXSCRIPT instruction if the other Axis instructions don't give you the control that you need over that Axis. Although some of the Axis-control commands have similar sounding names to the existing Axis instructions, ***they do not work exactly the same***.

Unlike the other Axis instructions which will leave the Axis in Idle mode when the instruction ends, the AXSCRIPT will leave the Axis in the last state that it was put into by the commands in the instruction when it ends. This can be used to your advantage by allowing you to "chain" AXSCRIPT instructions together. And because the other Axis instructions can start from any velocity / position, you can use an AXSCRIPT to start a move then finish the move with any of the other Axis instructions, which will end with the Axis in Idle mode.

If the parameters for any of the commands use a PLC memory location instead of a constant value, the instruction will use the value in those parameter locations when it gets to the step that contains them.

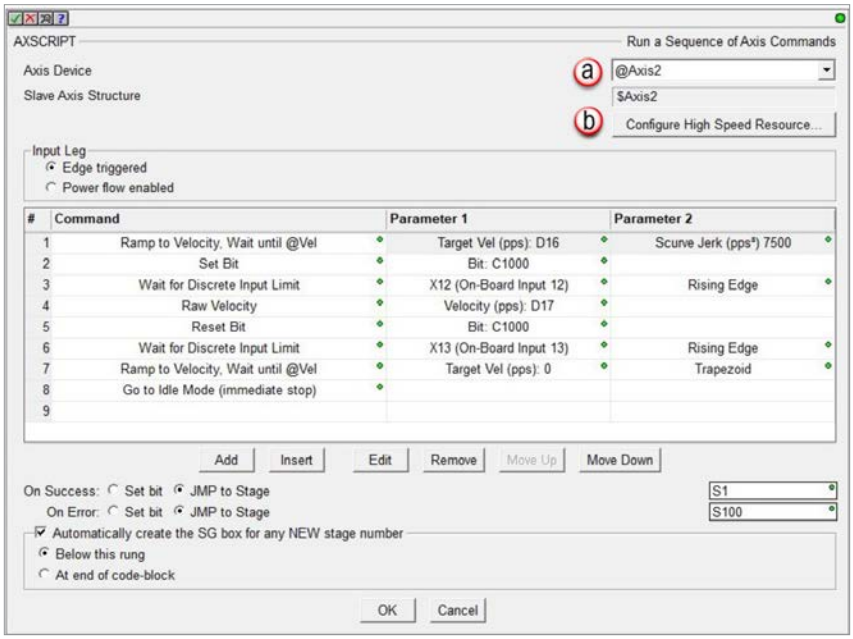
This instruction requires the following:

- Axis configured to be used as the slave Axis.
- AXCONFIG instruction configured for each axis associated with the instruction.

The (a) ***Axis Device*** specifies which axis to use as the slave axis. This can be any axis available to the MPU or available to a BX-HSIO expansion module.

The Axis is configured in the MPUs ***Setup BRX High-speed I/O*** dialog or the BX-HSIO ***Setup BX-HSIO Module*** dialog. Please see detailed information on these under the "Available High-Speed Input and Output Features" earlier in this chapter. These dialog boxes can be opened directly from the AXSCRIPT instruction by clicking on the (b) **Configure High Speed Resource...** button. This allows the user to:

- configure an axis for use with the instruction.
- verify or edit the physical I/O selected for an already configured axis.



NOTE: *Axis0 is a 'virtual axis' and will not generate pulses to physical outputs of the PLC. Axis0 can be used for generating pulse output profile register values to be used for Table Driven Outputs (TDOPRESET or TDOPLS) or as the master for other axes in following-type applications (AXCAM, AXFOLLOW or AXGEAR). Axis0 is also good to use for testing.*

AXSCRIPT, continued

Input Leg

- **Edge Triggered**: The AXSCRIPT will be performed each time the input transitions from OFF to ON. Once an AXSCRIPT operation is in progress it can only be stopped by manually setting the Axis' ***.MasterEnable*** structure member to OFF, which will put the Axis into a Fault state.
- **Power flow Enabled**: The AXSCRIPT will begin when the input transitions from OFF to ON and will continue to completion as long as the input remains ON. This selection has the benefit of being able to interrupt an AXSCRIPT operation by setting the input state to OFF and NOT putting the Axis into a Fault state.

The instruction's commands are listed in the order they will be executed. Each AXSCRIPT instruction can contain up to 50 commands.

- **Command**: is the Axis command or PLC command to execute. Refer to the Available Commands section below for details on the individual commands and their required parameters.
- **Parameter 1**: is the parameter required by the command.
- **Parameter 2**: is the optional 2nd parameter for any command that requires it.

The buttons below the table provide functions that are used to organize the rows in the table:

- **Add**: opens the row editor sub-dialog so that a new entry can be added to the end of the table.
- **Insert**: inserts an empty row before the currently selected row
- **Edit**: opens the currently selected row in the row editor sub-dialog
- **Remove**: deletes the currently selected row
- **Move Up / Move Down**: moves the currently selected row up one row or down one row respectively.

On Success:

- **Set Bit**: The bit will become FALSE when the instruction is enabled and will become TRUE when instruction parameters are properly entered and the instruction completes successfully. The specified bit is enabled with a SET operation, not an OUT operation. The On Success bit will remain ON even if the instruction input logic goes OFF.
- **JMP to Stage**: When instruction parameters are properly entered and the instruction completes successfully, the PLC will jump to that stage.

On Error:

- **Set Bit**: The bit will become FALSE when the instruction is enabled and will become TRUE when proper instruction parameters are NOT properly entered or the instruction IS NOT completed successfully. The specified bit is enabled with a SET operation, not an OUT operation. The On Error bit will remain ON even if the instruction input logic goes OFF.
- **JMP to Stage**: When proper instruction parameters are NOT properly entered or the instruction IS NOT completed successfully, the PLC will jump to that stage.

Available Commands:

The commands available for use in the AXSCRIPT instruction are listed in the following functional groups: Velocity, Position, Rotary, Follower, Events, Ladder Operations, and Misc.

AXSCRIPT, continued

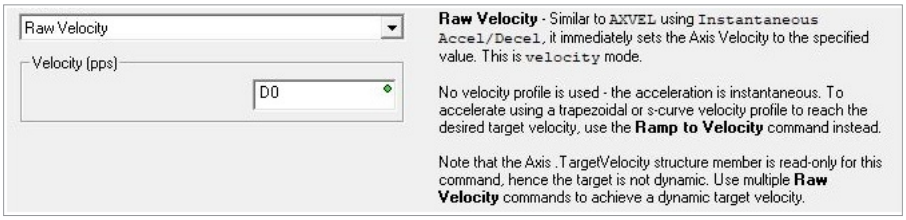
These commands are entered in the table through the row editor that prompts for the command to execute and any parameters required by that command. And remember, if the parameters for any of the commands use a PLC memory location instead of a constant value, the instruction will use the value in the parameter location when it processes the step that contains the parameter reference.

After selecting the command and entering the parameters, use the buttons at the bottom of the dialog as follows:

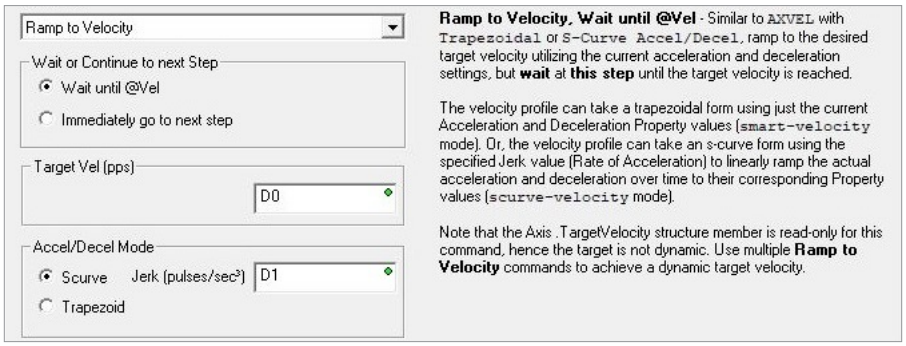
- **Save**: will commit any changes that were made to the command and close the row editor.
- **Save / Next**: will commit any changes that were made to the command and create a new command entry for the next row in the table.
- **Save / Insert**: will commit any changes that were made to the command and create a new command entry for the previous row in the table.
- **Cancel**: will close the row editor without saving any changes that have been made.

Velocity commands are very similar to the Axis Set Velocity Mode (AXVEL) instruction:

The **Raw Velocity** command immediately sets the Axis' velocity to the specified Velocity value and immediately moves to the next step in the table.



The **Ramp to Velocity** command sets the Axis' Target Velocity to the specified Velocity value, and the Axis will begin to ramp toward that new Target Value using either an S-Curve (with Jerk) or Trapezoid profile as selected. If **Wait Until @Vel** is selected, the table will remain at this step until the Axis reaches the Target Velocity. If **Immediately go to next step** is selected, the table will immediately move to the next step without waiting on the Axis to reach the Target Velocity.



The **Go to Idle Mode (immediate stop)** command will instruct the Axis to immediately go to IDLE mode which takes the Axis out of the current execution mode. ***If the Axis is moving it will immediately stop; it will NOT ramp to a stop.*** To avoid potential machine damage, you should probably use a **Ramp to Velocity of 0** command (to bring the Axis to a controlled stop) before using the **Go to Idle Mode** command.

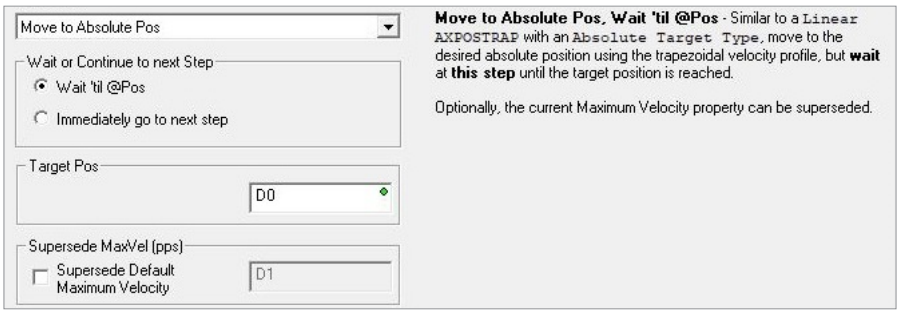
AXSCRIPT, continued

NOTE: *Unlike the other Axis instructions which will leave the Axis in Idle mode, the AXSCRIPT will leave the Axis in the last state that it was put into by the commands in the instruction. Unless you have a purpose for leaving the Axis in a state where it is potentially moving (not idle) when this instruction finishes, we recommend that you make sure the Axis is not moving when the AXSCRIPT instruction completes by adding a Go to Idle Mode command as the last step in the table.*

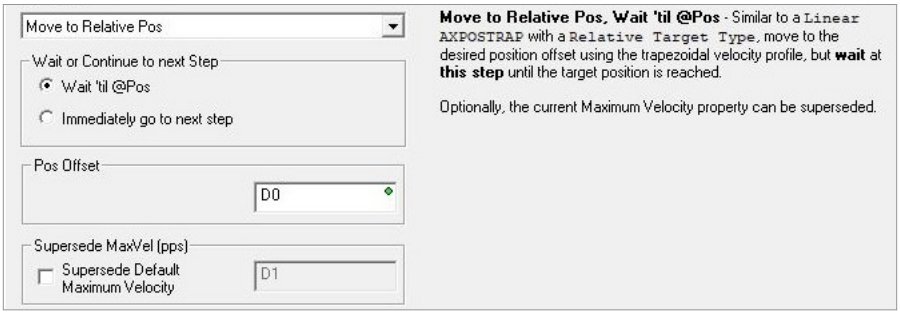


Position commands approximate the Axis Move to Position Using Trapezoid (AXPOSTRAP) and Axis Move to Position Using S-Curve (AXPOSSCRV) instructions when making **Linear position** moves.

The **Move to Absolute Pos w/Trap** command will use a Trapezoid profile to move the Axis to the specified absolute Target Position, optionally using a different Maximum Velocity. If **Wait 'til @Pos** is selected, the table will remain at this step until the Axis reaches the Target Position. If **Immediately go to next step** is selected, the table will immediately move to the next step without waiting on the Axis to reach the Target Position.



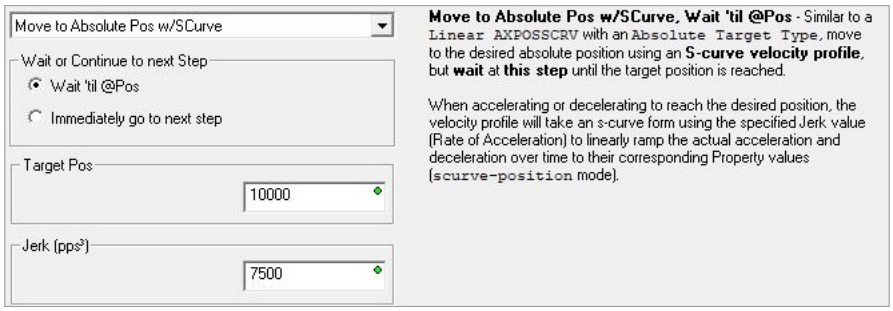
The **Move to Relative Pos w/Trap** command will use a Trapezoid profile to move the Axis to the specified relative Position Offset, optionally using a different Maximum Velocity. If **Wait 'til @Pos** is selected, the table will remain at this step until the Axis reaches the Position Offset. If **Immediately go to next step** is selected, the table will immediately move to the next step without waiting on the Axis to reach the Position Offset.



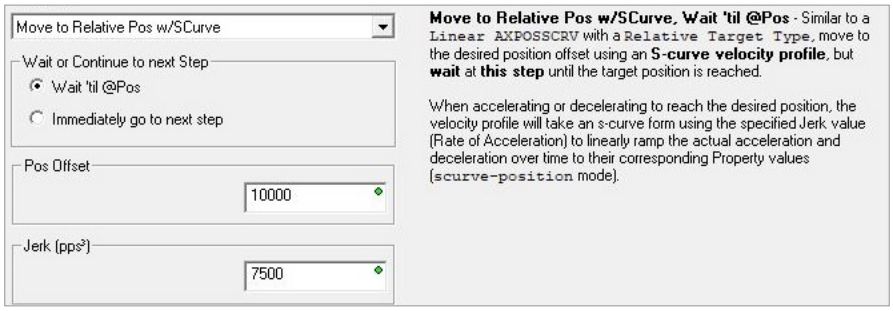
The **Move to Absolute Pos w/ SCurve** command will use an S-Curve profile to move the Axis to the specified absolute Target Position, optionally using a different Maximum Velocity. If **Wait 'til @Pos** is selected, the table

AXSCRIPT, continued

will remain at this step until the Axis reaches the Target Position. If **Immediately go to next step** is selected, the table will immediately move to the next step without waiting on the Axis to reach the Target Position.

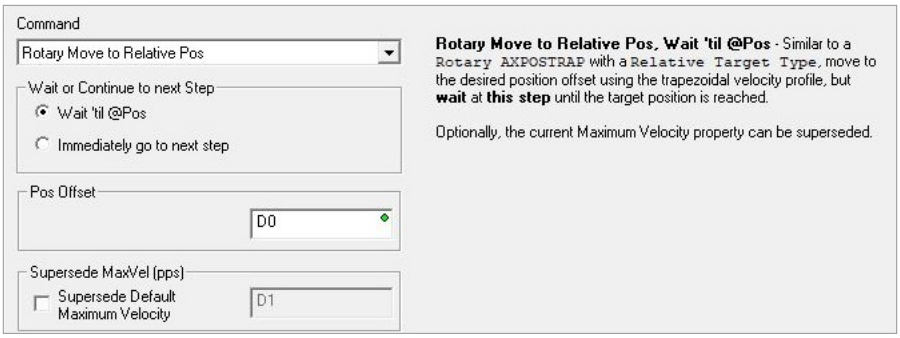


The **Move to Relative Pos w/ SCurve** command will use an S-Curve profile to move the Axis to the specified relative Position Offset, optionally using a different Maximum Velocity. If **Wait 'til @Pos** is selected, the table will remain at this step until the Axis reaches the Position Offset. If **Immediately go to next step** is selected, the table will immediately move to the next step without waiting on the Axis to reach the Position Offset.



Rotary commands approximate the Axis Move to Position Using Trapezoid (AXPOSTRAP) instruction when making Rotary position moves.

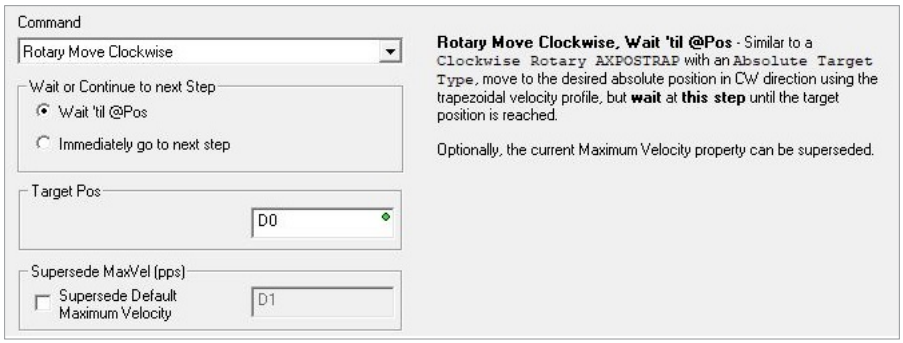
The **Rotary Move to Relative Pos** command will use a Trapezoid profile to move the Axis to the specified relative Position Offset, optionally using a different Maximum Velocity. If **Wait 'til @Pos** is selected, the table will remain at this step until the Axis reaches the Position Offset. If **Immediately go to next step** is selected, the table will immediately move to the next step without waiting on the Axis to reach the Position Offset.



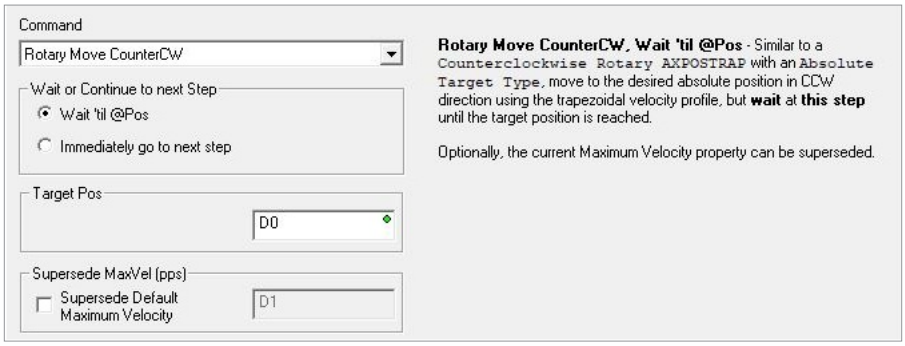
The **Rotary Move Clockwise** command will use a Trapezoid profile to move the Axis in the clockwise direction to the to the specified Target Position, optionally using a different Maximum Velocity. If **Wait 'til @Pos** is selected, the table will remain at this step until the Axis reaches the Target Position. If **Immediately**

AXSCRIPT, continued

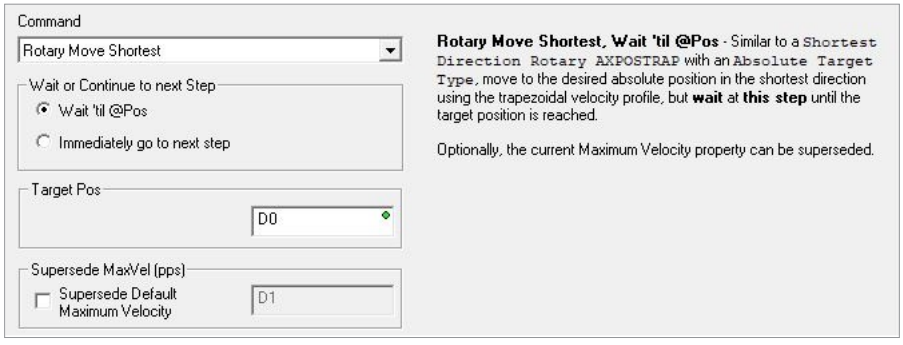
go to next step is selected, the table will immediately move to the next step without waiting on the Axis to reach the Target Position.



The **Rotary Move Counter-Clockwise** command will use a Trapezoid profile to move the Axis in the counter-clockwise direction to the to the specified Target Position, optionally using a different Maximum Velocity. If **Wait 'til @Pos** is selected, the table will remain at this step until the Axis reaches the Target Position. If **Immediately go to next step** is selected, the table will immediately move to the next step without waiting on the Axis to reach the Target Position.



The **Rotary Move Shortest** command will use a Trapezoid profile to move the Axis in the direction that will reach the specified Target Position in the shortest distance, optionally using a different Maximum Velocity. If **Wait 'til @Pos** is selected, the table will remain at this step until the Axis reaches the Target Position. If **Immediately go to next step** is selected, the table will immediately move to the next step without waiting on the Axis to reach the Target Position.



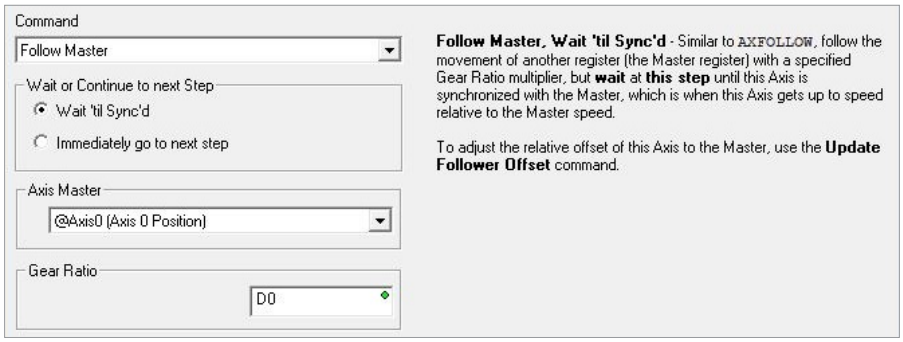
Follower commands approximate the Axis Position Following with Offset (AXFOLLOW) instruction:

The **Follow Master** command will establish a Master / Follower connection for the Axis so that the Follower's movements are synchronized to the Master's movement, using the specified Gear Ratio. The Master can be another Axis or a High-Speed Counter / Timer. ***Because the Follower Axis will need the ability to overtake the***

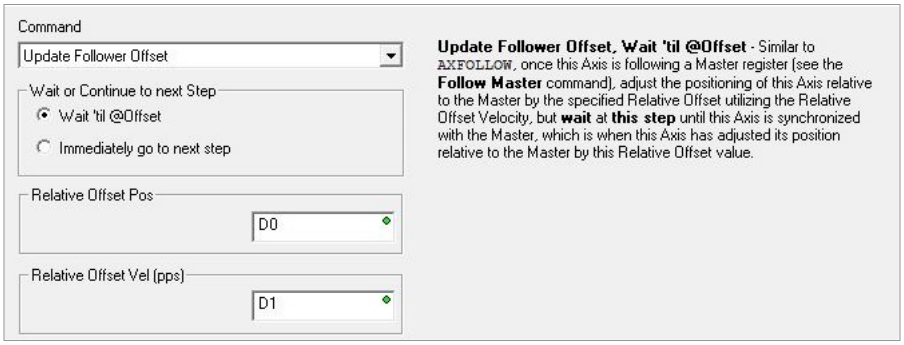
AXSCRIPT, continued

Master Axis, make sure the Maximum Velocity and Acceleration parameters of the Master and Follower Axes have been configured with enough capacity to allow this. The Follower Axis can be made more responsive by configuring it with higher Maximum Velocity or a faster Acceleration, or both.

If **Wait 'til Sync'd** is selected, the table will remain at this step until the velocity of the following Axis (including the Gear Ratio) matches the velocity of the master Axis. If **Immediately go to next step** is selected, the table will immediately move to the next step without waiting for the velocities to match.

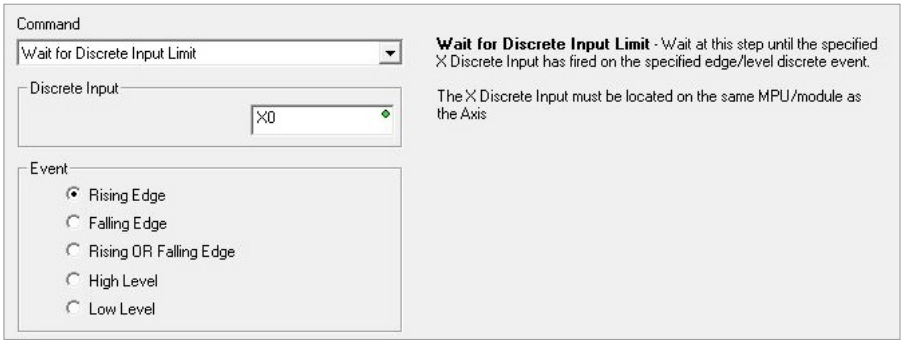


The **Update Follower Offset** command causes the Follower Axis to attempt to move to the Relative Offset Position using the Relative Offset Velocity. ***Because the Follower Axis will need the ability to overtake the Master Axis during this operation, make sure the Maximum Velocity and Acceleration parameters of the Master and Follower Axes have been configured with enough capacity to allow this.*** The Follower Axis can be made more responsive by configuring it with higher Maximum Velocity or a faster Acceleration, or both.



Event commands will wait at the current step on an input event from the Axis.

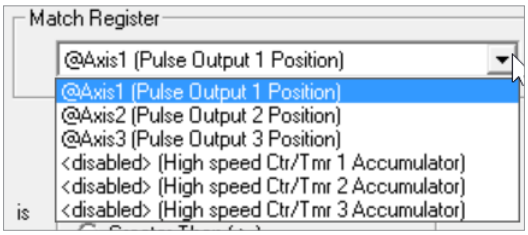
The **Wait For Discrete Input Limit** command will wait at this step in the table until the selected event occurs on the specified discrete input. The discrete input must be a local I/O point if the Axis is using local discrete outputs, or a discrete input point on the same BX-HSIO module that the Axis is configured to use.



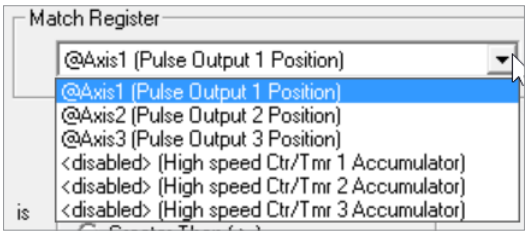
AXSCRIPT, continued

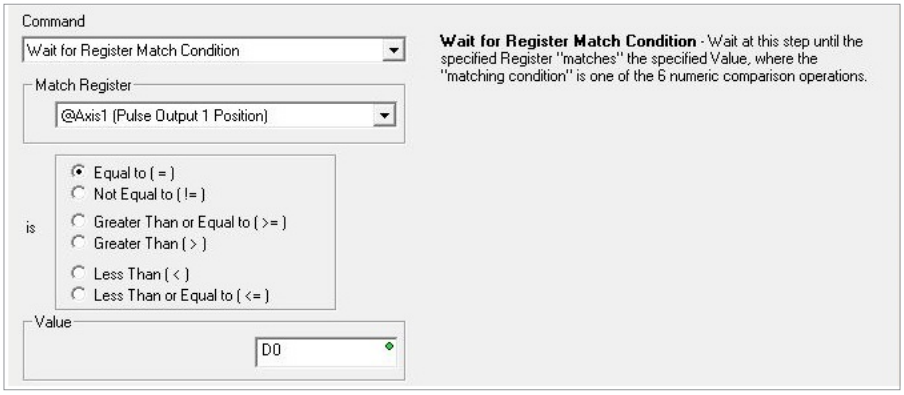
The **Wait For Register Match Condition** command will wait at this step in the table until the specified Register "matches" the specified Value, where the "matching condition" is one of the 6 numeric comparison operations. The choices available for the Match Register will depend on the Axis Device selected for the AXSCRIPT instruction.

If the Axis Device is a local Axis the Match Register can be:



If the Axis Device is a BX-HSIO Axis the Match Register can be:





The **Wait Until At Velocity** command will wait at this step in the table until the Axis has reached its target velocity (*.CurrentVelocity* = *.TargetVelocity*).



The **Wait Until At Position** command will wait at this step in the table until the Axis has reached its target position (*.CurrentPosition* = *.TargetPosition*).



The **Wait Until Stopped** command will wait at this step in the table until the Axis has stopped moving. (*.CurrentVelocity* = 0).



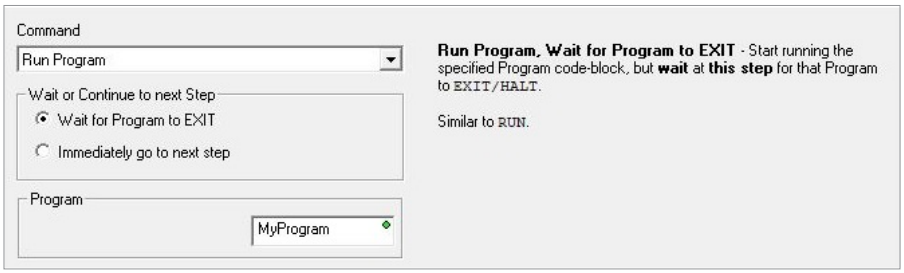
Ladder Operation commands perform actions that interact with elements in the ladder logic program.

AXSCRIPT, continued

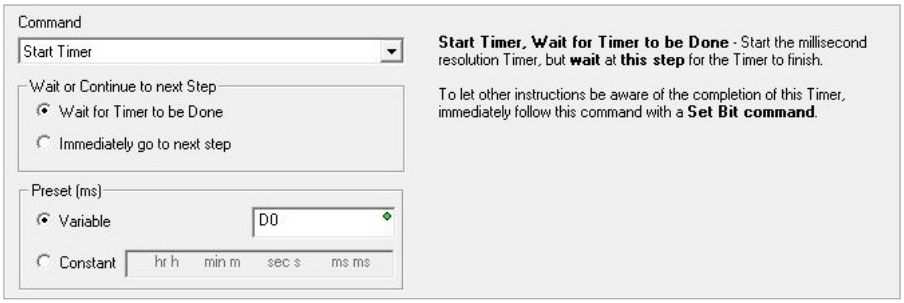
The **Set Stage** command will enable a Stage in the same Program that contains the AXSCRIPT instruction. This cannot be a Stage in a different Program code-block. If **Wait for Stage to Complete** is selected, the table will remain at this step until the specified Stage is disabled. If **Immediately go to next step** is selected, the table will immediately move to the next step without waiting on the Stage to be disabled.



The **Run Program** command will run the specified Program code-block. If **Wait for Program to Exit** is selected, the table will remain at this step until the specified Program's .Done bit comes ON. If **Immediately go to next step** is selected, the table will immediately move to the next step without waiting on the Program to end.



The **Start Timer** command will start running an internal Timer using the specified Preset value. ***This is NOT a Timer in the ladder logic; it is a Timer that is internal to the AXSCRIPT instruction.*** If **Wait for Timer to be Done** is selected, the table will remain at this step until the specified Timer has timed out. If **Immediately go to next step** is selected, the table will immediately move to the next step without waiting on the Timer to complete.

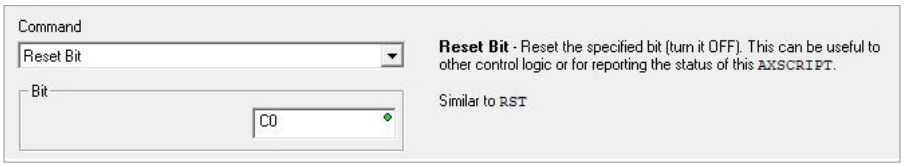


The **Set Bit** command will turn ON the specified bit location in the same way a Set Coil (SET) instruction does.

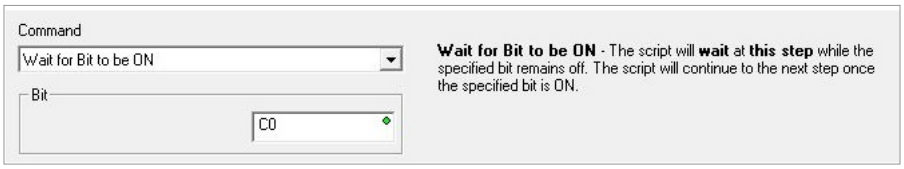


AXSCRIPT, continued

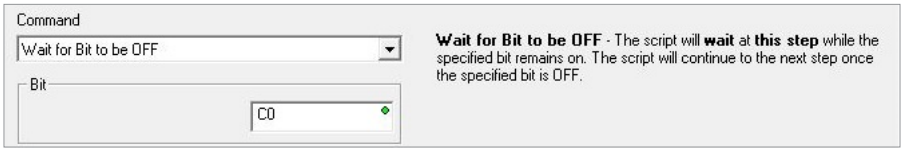
The **Reset Bit** command will turn OFF the specified bit location in the same way a Reset Coil (RST) instruction does.



The **Wait for Bit to be ON** command will wait at this step in the table until the specified Bit location turns ON. This does NOT wait for an OFF to ON transition of the specified Bit; if the Bit is ON when the table gets to this step, the condition will be met, and the table will not wait at this step.



The **Wait for Bit to be OFF** command will wait at this step in the table until the specified Bit location turns OFF. This does NOT wait for an ON to OFF transition of the specified Bit; if the Bit is OFF when the table gets to this step, the condition will be met and the table will not wait at this step.



The **Wait for Timer to be Done** command will wait at this step for the AXSCRIPT's internal Timer to complete. ***This is NOT a Timer in the ladder logic; it is a Timer that is internal to the AXSCRIPT instruction.*** This is only useful if the table contains a previously executed "Start Timer / immediately go to next step" command.



Miscellaneous commands

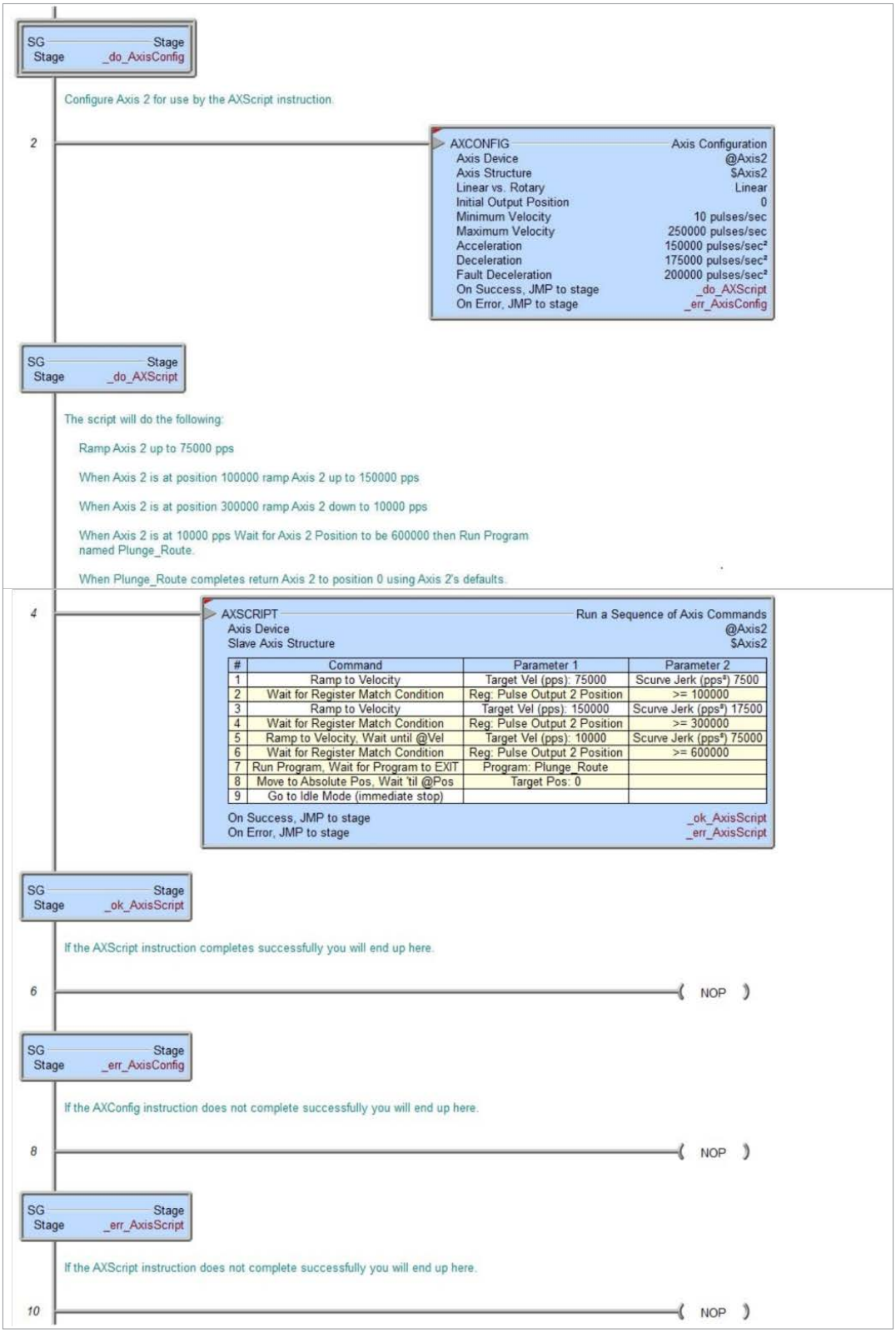
The **Set Axis Property** command will change the selected Axis parameter without having to re-run an Axis Configuration (AXCONFIG) instruction. Changes made to the Axis by this command will affect all subsequent instructions that reference this Axis, but they will not affect any Axis instructions that are currently running.



AXSCRIPT, continued

Example Usages:

The following example performs a **Blended Move**, where an Axis arrives at a target position at a velocity that is ***NOT 0***. In this case, the use of the AXPOSTRAP instruction will not work for this application because the Axis arrives at the target position at a velocity of 0.



AXSETPROP

The **Set Axis Properties** (AXSETPROP) instruction is used to make runtime changes to the configured parameters of an Axis.

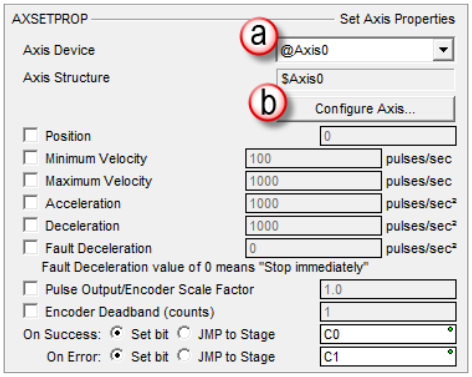
This instruction requires the following:

- Axis configured to be used as the slave Axis.
- AXCONFIG instruction configured for each axis associated with the instruction.

The (a) ***Axis Device*** specifies which axis to use as the slave axis. This can be any axis available to the MPU or available to a BX-HSIO expansion module.

The Axis is configured in the MPUs ***Setup BRX High-speed I/O*** dialog or the BX-HSIO ***Setup BX-HSIO Module*** dialog. Please see detailed information on these under the "Available High-Speed Input and Output Features" earlier in this chapter. These dialog boxes can be opened directly from the AXSETPROP instruction by clicking on the (b) **Configure Axis...** button. This allows the user to:

- configure an axis for use with the instruction.
- verify or edit the physical I/O selected for an already configured axis.



NOTE: *Axis0 is a 'virtual axis' and will not generate pulses to physical outputs of the PLC. Axis0 can be used for generating pulse output profile register values to be used for Table Driven Outputs (TDOPRESET or TDOPLS) or as the master for other axes in following-type applications (AXCAM, AXFOLLOW or AXGEAR). Axis0 is also good to use for testing.*

Position: The current count will be set to this value when this instruction is enabled. This can be any constant value or any numeric location.

Minimum Velocity (pulses/sec): The slowest frequency of output pulses that will be generated when the output is enabled. This can be any positive constant from 10 to 250000 or any numeric location with a value in that range.

Maximum Velocity (pulses per second): The fastest frequency of output pulses that will be generated when the output is enabled. This can be any positive constant from 10 to 250000 or any numeric location with a value in that range.

Acceleration Rate (pulses/sec^2): The rate at which the pulses will be generated when the axis is ramping up from a slower pulse rate to a higher pulse rate. This can be any positive constant or any numeric location with a value in that range.

Deceleration Rate (pulses/sec^2): The rate at which the pulses will be generated when the axis is ramping down from a faster pulse rate to a slower pulse rate. This can be any positive constant or any numeric location with a value in that range.

AXSETPROP, continued

Fault Deceleration Rate (pulses/sec^2): Any time a Fault Limit is reached or the Axis .MasterEnable is turned OFF, the axis will decelerate to a velocity of 0 pulses/sec at this specified rate. A value of 0 will cause the Axis to immediately stop moving. This can be any positive constant or any numeric location with a value in that range.

Pulse Output/Encoder Scale: If the motor and the encoder have different pulse-per-revolution values, enter the scale value required to bring them into alignment.

Encoder Deadband (counts): Having some deadband value around the encoder current position can prevent the pulse output from generating alternating small pulses trying to get the input value to an exact number. This value is applied both above and below the encoder value. For example: A value of 2 will be a deadband of 2 above and 2 below for a span of 4 counts.

On Success:

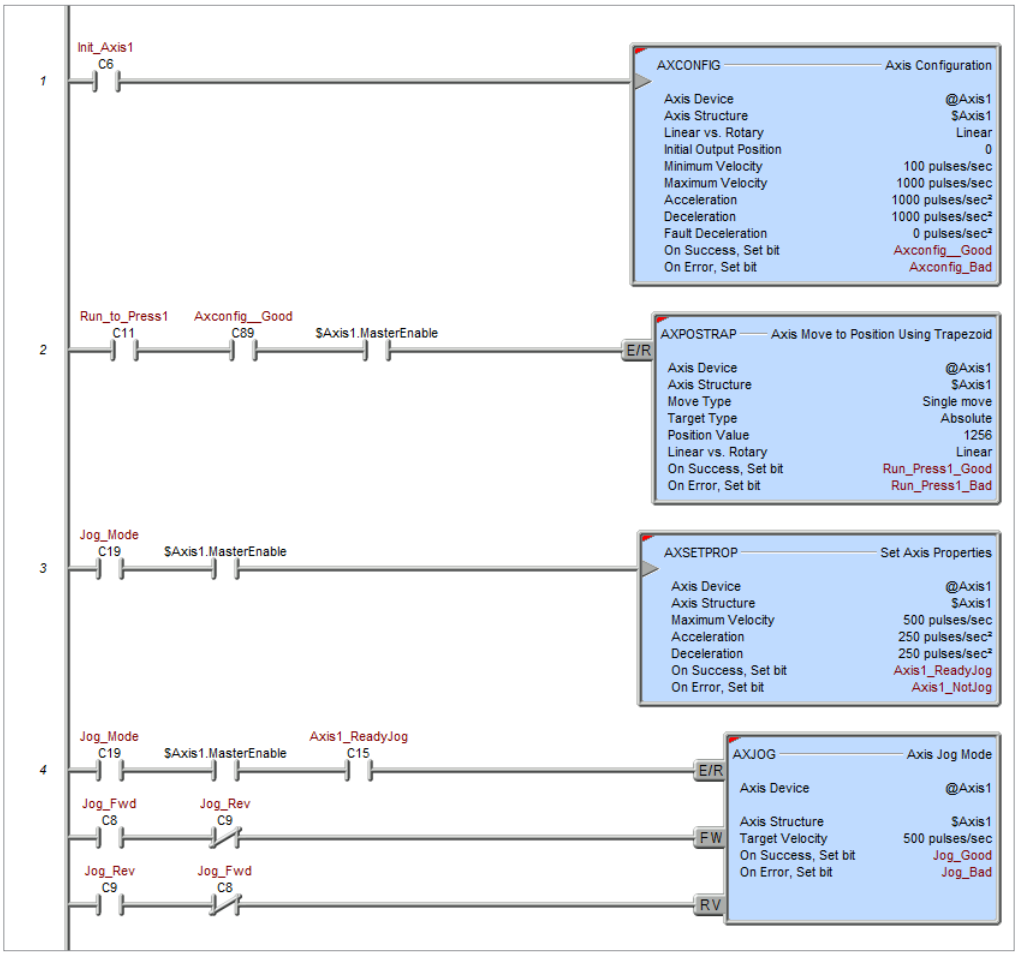
- **Set Bit**: The bit will become FALSE when the instruction is enabled and will become TRUE when instruction parameters are properly entered and the instruction completes successfully. The specified bit is enabled with a SET operation, not an OUT operation. The On Success bit will remain ON even if the instruction input logic goes OFF.
- **JMP to Stage**: When instruction parameters are properly entered and the instruction completes successfully, the PLC will jump to that stage.

On Error:

- **Set Bit**: The bit will become FALSE when the instruction is enabled and will become TRUE when proper instruction parameters are NOT properly entered or the instruction IS NOT completed successfully. The specified bit is enabled with a SET operation, not an OUT operation. The On Error bit will remain ON even if the instruction input logic goes OFF.
- **JMP to Stage**: When proper instruction parameters are NOT properly entered or the instruction IS NOT completed successfully, the PLC will jump to that stage.

AXSETPROP, continued

Example Usage



AXVEL

The **Axis Set Velocity Mode** (AXVEL) instruction is used to put an axis into an operation mode where its movement is controlled by velocity rather than position.

The ladder logic input to this instruction is an Enable/Reset, which means that when the Input logic turns ON the axis will ramp to the axis structure's ***.TargetVelocity*** value, and when the Input logic turns OFF the axis will ramp down to a velocity of 0 and the instruction will end.

While the instruction is enabled, changing the axis associated structure member ***.TargetVelocity*** will dynamically change the output pulse frequency and will follow the specified Acceleration/Deceleration Mode of the instruction to achieve the speed change.

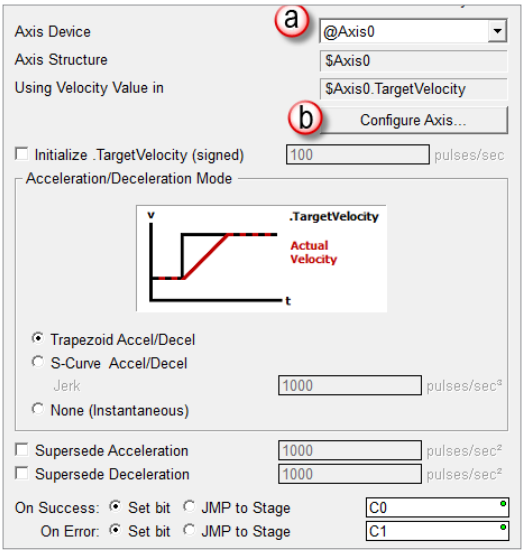
This instruction requires the following:

- Axis configured to be used as the slave Axis.
- AXCONFIG instruction configured for each axis associated with the instruction.

The (a) ***Axis Device*** specifies which axis to use as the slave axis. This can be any axis available to the MPU or available to a BX-HSIO expansion module.

The Axis is configured in the MPUs ***Setup BRX High-speed I/O*** dialog or the BX-HSIO ***Setup BX-HSIO Module*** dialog. Please see detailed information on these under the "Available High-Speed Input and Output Features" earlier in this chapter. These dialog boxes can be opened directly from the AXVEL instruction by clicking on the (b) **Configure Axis...** button. This allows the user to:

- configure an axis for use with the instruction.
- verify or edit the physical I/O selected for an already configured axis.



NOTE: *Axis0 is a 'virtual axis' and will not generate pulses to physical outputs of the PLC. Axis0 can be used for generating pulse output profile register values to be used for Table Driven Outputs (TDOPRESET or TDOPLS) or as the master for other axes in following-type applications (AXCAM, AXFOLLOW or AXGEAR). Axis0 is also good to use for testing.*

AXVEL, continued

Using Velocity Value in: This field indicates the proper axis structure member to use for the desired Velocity.

Initialize .TargetVelocity (signed): Enable this option to set the velocity of the axis when this instruction is enabled. A non-zero value will cause the axis to begin moving at the specified velocity as soon as this instruction is enabled. This value can be any constant between -250000 to -10, 0, and 10 to 250000 or any numeric location containing a value in that range. The sign of the value will indicate the direction of travel: positive numbers will cause the axis to move clockwise, negative numbers will cause the axis to move counter-clockwise. Any value that is below the axis **Configured Minimum Velocity** will result in the **Axis Minimum Velocity** being used.

Acceleration/Deceleration Mode: Specifies what level of Acceleration / Deceleration to use when the axis is changing to a new Target Velocity. The graphic will change with the selection to display what the velocity curve will look like for that selection.

- **Trapezoid Accel / Decel**: The axis will ramp from the Current Velocity to the new Target Velocity value using the axis currently configured Acceleration and Deceleration values which results in a trapezoid velocity path.
- **S-Curve Accel / Decel**: The axis will ramp from the Current Velocity to the new Target Velocity value using the axis currently configured Acceleration and Deceleration values in addition to the following Jerk parameter which results in an s-curve velocity path.
- **Apply Jerk to Accel / Decel** (pulses / sec^3): This selection is only available for S-Curve Accel / Decel. Whereas the Acceleration and Deceleration values specify how quickly the Axis is allowed to reach maximum velocity, the Jerk parameter specifies how quickly the Axis is allowed to achieve maximum Acceleration and Deceleration. This can be any positive constant greater than 0 or any numeric location with a value in that range.
- **None (Instantaneous)**: The axis will immediately begin moving at the specified Target Velocity value; there is no ramp up or ramp down to the new velocity.

Supersede Acceleration Rate (pulses/sec^2): When the axis is ramping up from a slower velocity to a higher velocity use the specified rate instead of the axis configured acceleration rate. This can be any positive constant or any numeric location with a value in that range.

Supersede Deceleration Rate (pulses/sec^2): When the axis is ramping down from a faster velocity to a slower velocity use the specified rate instead of the axis configured deceleration rate. This can be any positive constant or any numeric location with a value in that range.

AXVEL, continued

On Success:

- **Set Bit**: The bit will become FALSE when the instruction is enabled and will remain FALSE until the enable leg goes back OFF. Once the enable leg turns OFF, if the instruction device/parameters were valid, this bit will turn ON once the .CurrentVelocity reaches 0.
- **JMP to Stage**: Similarly, the JMP will not occur until after the instruction is enabled, then disabled, and all the instruction device/parameters were valid and the .CurrentVelocity reaches 0.

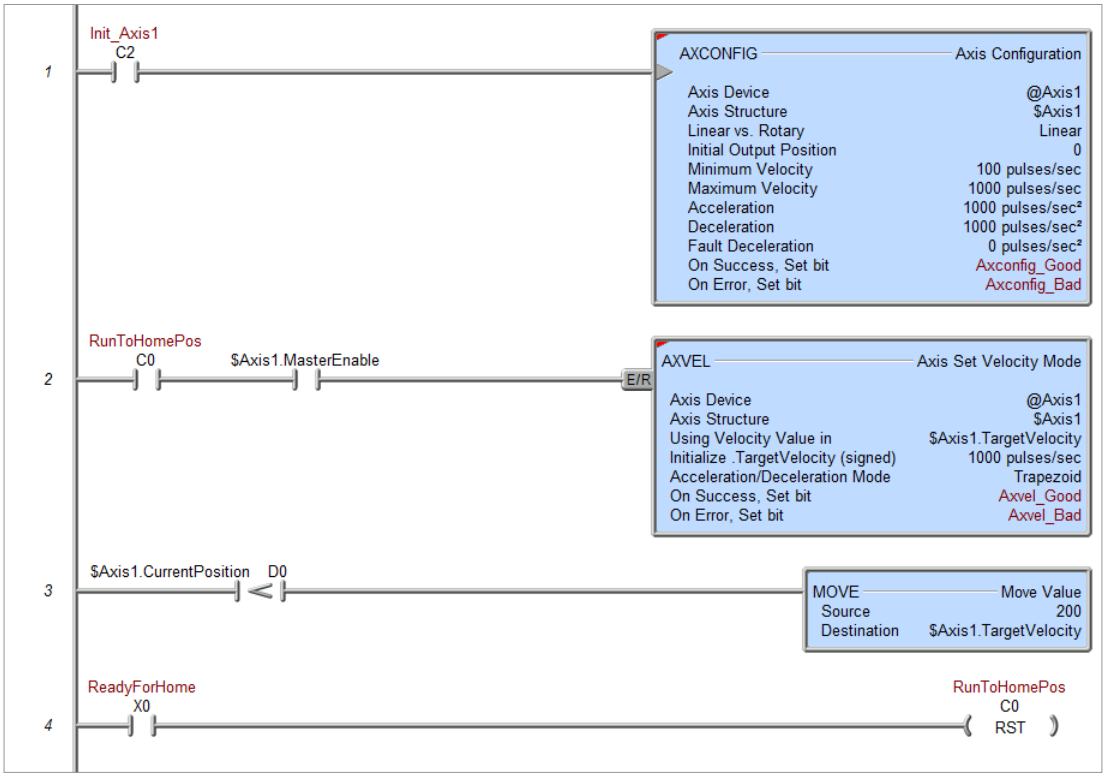
On Error:

- **Set Bit**: The bit will become FALSE when the instruction is enabled and will become TRUE when proper instruction parameters are NOT properly entered or the instruction IS NOT completed successfully. The specified bit is enabled with a SET operation, not an OUT operation. The On Error bit will remain ON even if the instruction input logic goes OFF.
- **JMP to Stage**: When proper instruction parameters are NOT properly entered or the instruction IS NOT completed successfully, the PLC will jump to that stage.



NOTE: *Because this instruction puts the Axis into an operational mode (as opposed to performing a single operation), On Success is defined as getting the Axis into Jog mode with no errors. This means that the On Success indication will turn ON after the Enable/Reset input logic transitions from ON to OFF and the Axis' Current Velocity is at 0. When these conditions are met the Axis' Mode is "Idle". You should wait until the On Success indication turns ON before attempting to execute any other Axis instruction.*

Example Usage



TDODECFG

Once a TDOPLS-Load Programmable Limit Switch Table for Table Driven Output or TDOPRESET-Load Preset Table for Table Driven Output has been enabled it will continue to control that output even if the input logic is no longer ON. Use the **Deconfigure Table Driven Output** (TDODECFG) instruction to stop the Preset Table or PLS table from controlling the Table Driven Output.

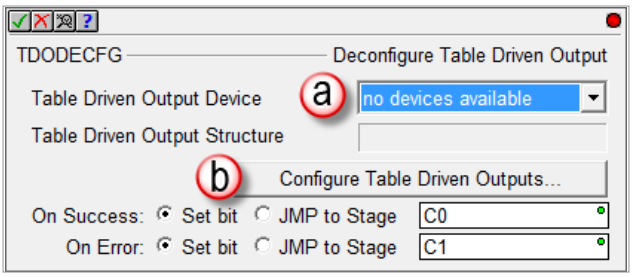
This instruction is useful for situations when the application may require changing control of the Table Driven Output from one instruction, such as a TDOPRESET, to another.

This instruction requires that a Table Driven Output be configured.

The (a) ***Table Driven Output Device*** specifies which discrete output will be used by the instruction. This can be any discrete output available to the MPU or available to a BX-HSIO expansion module.

The Table Driven Output is configured in the MPUs ***Setup BRX High-speed I/O*** dialog or the BX-HSIO ***Setup BX-HSIO Module*** dialog. Please see detailed information on these under the "Available High-Speed Input and Output Features" earlier in this chapter. These dialog boxes can be opened directly from the TDODECFG instruction by clicking on the (b) **Configure Axis...** button. This allows the user to:

- configure a Table Driven Output for use with the instruction.
- verify or edit the physical I/O selected for an already configured Table Driven Output function.



On Success:

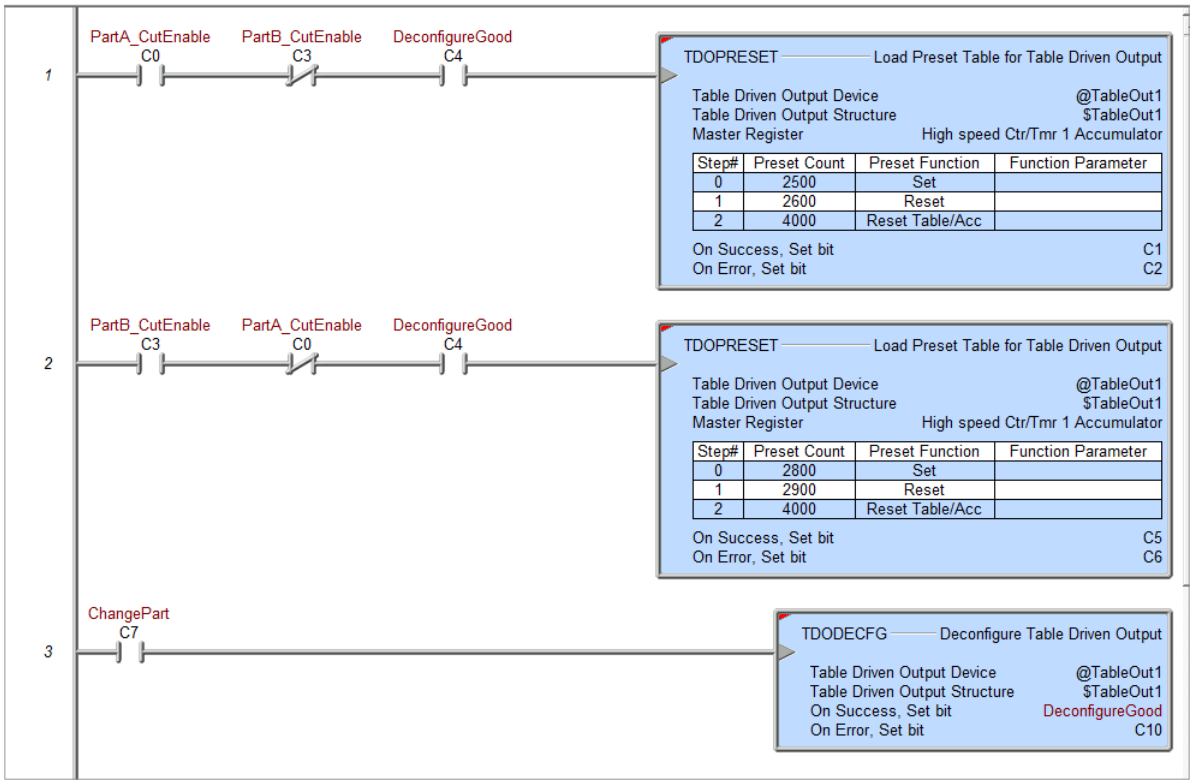
- **Set Bit**: The bit will become FALSE when the instruction is enabled and will become TRUE when instruction parameters are properly entered and the instruction completes successfully. The specified bit is enabled with a SET operation, not an OUT operation. The On Success bit will remain ON even if the instruction input logic goes OFF.
- **JMP to Stage**: When instruction parameters are properly entered and the instruction completes successfully, the PLC will jump to that stage.

On Error:

- **Set Bit**: The bit will become FALSE when the instruction is enabled and will become TRUE when proper instruction parameters are NOT properly entered or the instruction IS NOT completed successfully. The specified bit is enabled with a SET operation, not an OUT operation. The On Error bit will remain ON even if the instruction input logic goes OFF.
- **JMP to Stage**: When proper instruction parameters are NOT properly entered or the instruction IS NOT completed successfully, the PLC will jump to that stage.

TDODECFG, continued

Example Usage



TDOPLS

A **Load Programmable Limit Switch Table for Table Driven Output** (TDOPLS) contains a table with a series of start and stop positions similar to the cams on a shaft. These cam positions are compared to the current count value of the specified Master Register, which can be a High-speed Counter, Timer or AXIS Current position value. When the count value falls between any of the positions in the table, the discrete output that is specified is turned ON or OFF according to the table configuration. Each table can have up to 64 cam positions. Each PLS table compares the count value of one Master Register counter and can drive one High-speed I/O discrete output.

Once a PLS table has been enabled for a Table Driven Output it will continue to control that output even if the input logic is no longer ON. Use the De-configure Table Driven Output (TDODECFG) instruction to stop the PLS table from controlling the discrete output associated with the selected Table Driven Output.

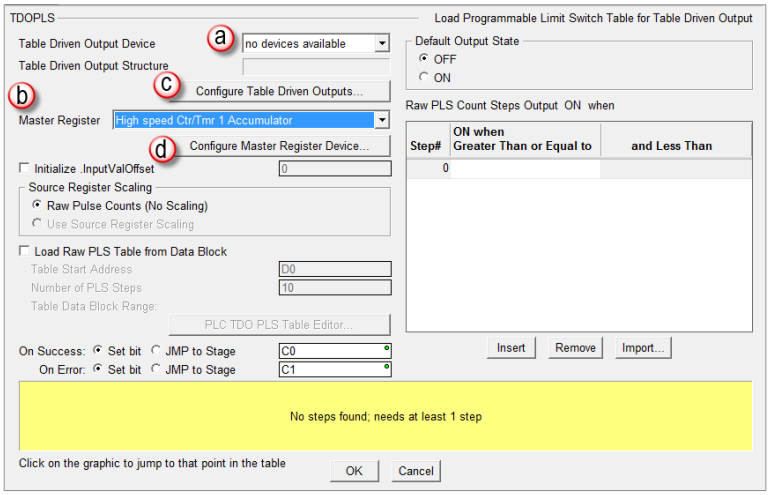
This instruction requires the following:

- Table Driven Output configured to be used by the instruction.
- One of the following to be used as the Master Register:
  - Position value from a configured master axis.
  - Accumulated value from a configured high speed counter/timer function.

The (a) ***Table Driven Output Device*** specifies which discrete output will be used by the instruction and the (b) ***Master Register*** selects the axis position or high-speed counter/timer accumulated value that provides the position source value. These can be any discrete output or high-speed counter/timer available to the MPU or available to a BX-HSIO expansion module.

The Table Driven Output and the high-speed counter/timer functions are configured in the MPUs ***Setup BRX High-speed I/O*** dialog or the BX-HSIO ***Setup BX-HSIO Module*** dialog. Please see detailed information on these under the "Available High-Speed Input and Output Features" earlier in this chapter. These dialog boxes can be opened directly from the TDOPLS instruction by clicking on the (c) **Configure Axis...** Button and (d) **Configure Master Register Device...** button. These allow the user to:

- configure a table function or a counter/timer function for use with the instruction.
- verify or edit the physical I/O selected for an already configured axis or counter/timer function.



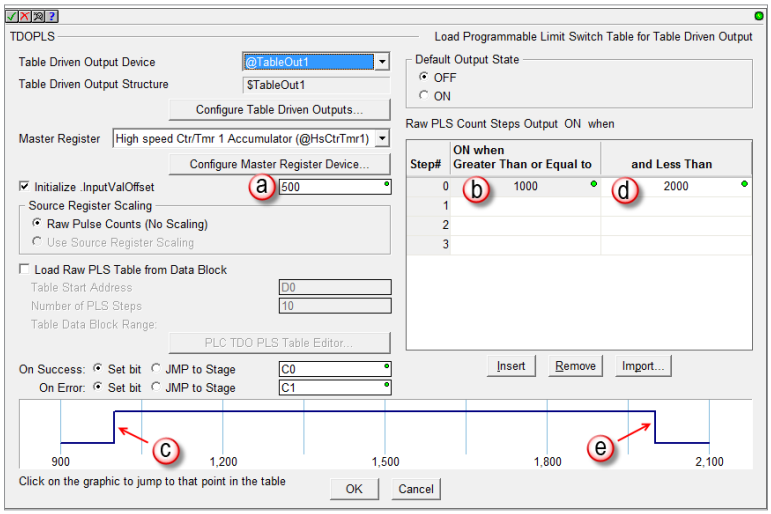
TDOPLS, continued

Initialize .InputValOffset: ***.InputValOffset*** is used to adjust the current count value from the Master Register. The "calculated master register" value will be used for subsequent comparisons.

For example:

- A table is processed, expecting no deviation (delta value) in the position. If there is a deviation (an amount of error), this delta value can be written (by means of the ladder) to ***.InputValOffset*** in order for the system to behave as if there is no deviation.
- Write a fixed value into the ***.InputValOffset*** field in the instruction to take care of equipment changes, i.e. change an encoder with one with different pulses per revolution.

When the Master Register is configured as Linear or Rotary device, a positive value in the ***.InputValOffset*** field (a) means that the entries will act at a lower value than shown. A negative value means that the entries will act at a higher value than shown. For example: An offset of 500 is configured in the ***.InputValOffset*** field (a). The first entry (b, c) is configured to turn ON the output at 1000 and (d, e) turn OFF at 2000. When the table runs, the ***.OutputState*** will actually turn ON at a value of 500 and turn OFF at 1500. If the ***.InputValOffset*** was configured for -500, the first ***.OutputState*** would have turned ON at a value of 1500 and OFF at 2500.



NOTE: *When the Master Register is configured as a Rotary device, the user must make sure the calculated range stays within the device's configured Rotary Range.*

TDOPLS will stop triggering the table ***.OutputState*** in two situations:

- A positive ***.InputValOffset*** value is greater than or equal to the configured "and Less Than" value.
- A negative ***.InputValOffset*** value has a magnitude greater than or equal to the configured "ON when Greater Than or Equal to" configured value.

The effect of ***.InputValOffset*** is illustrated by the following examples:

TDOPLS *.InputValOffset* Behavior

Rotary Range: 0–200

ON when Greater Than or Equal to: 100 and Less Than: 110

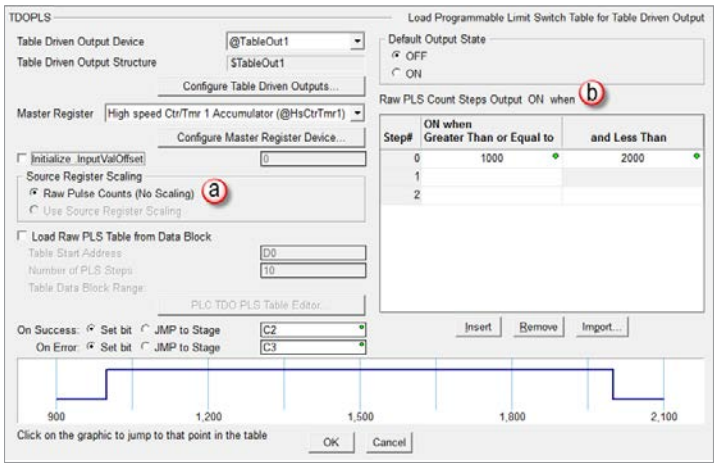
.InputValOffset	-100	-99	-90	-50	0	50	90	99	105	110
Table .OutputState is ON	Stopped	199	190	150	100	50	10	1	0	Stopped
Table .OutputState is OFF		0	0	160	110	60	20	11	5	

TDOPLS, continued

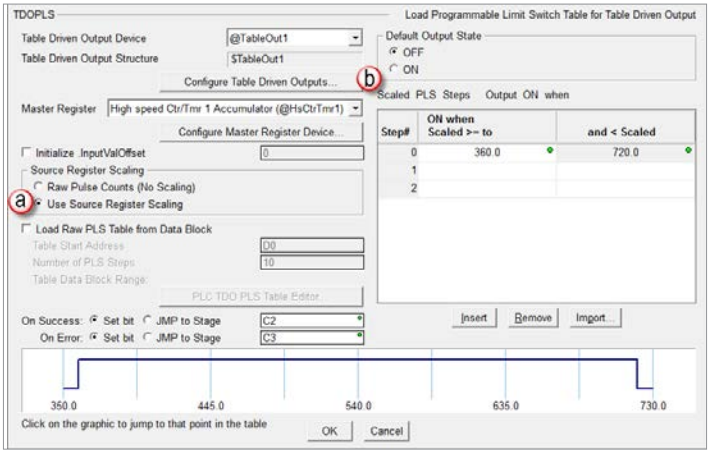
NOTE: *if the Master Register is an Axis' position, and the application is using either a servo controller or stepper controller with micro-stepping or smoothing, be aware that both controller types have a conversion time that will introduce some delay between the Axis' output position and the actual shaft position of the motor. The* ***.InputValOffset*** *can be used to compensate for the conversion time by adding the number of pulses that would occur during the conversion time to the current count of the Master Register. Multiplying the servo or stepper controller's conversion time by the current velocity will yield the number of pulses that would occur during that amount of time. Using this pulse count value in the* ***.InputValOffset*** *field will delay the comparison in the Steps by the same amount as the conversion time of the motor controller. Doing this will more closely sync the Table Driven Output's state to the actual shaft position of the motor.*

Source Register Scaling: The TDOPLS instruction can use the raw count value from the specified Master Register or, if scaling was enabled in the High-speed I/O setup, the scaled value to do its comparisons.

- **Raw Pulse Counts** (No Scaling): Select this option to enter the Preset Count values in the Table as raw count values. The image below shows (a) Raw Pulse Counts (No Scaling selected, indicating the Master Register scaling was not enabled. The (b) table entry shows that the values entered are based on raw counts.

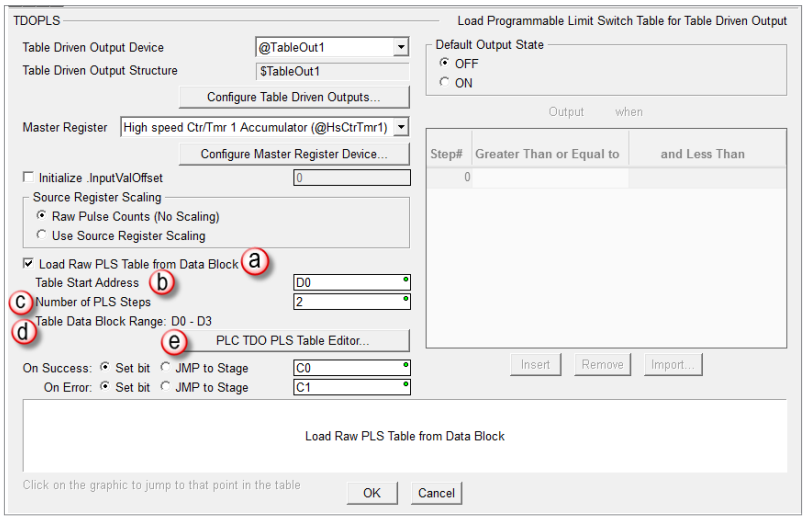


- **Use Source Register Scaling**: If the Master Register has been configured to scale the current count value you can use the scaled values in the table by selecting this option and entering values that are scaled the same as the Master Register. The image below shows (a) Use Source Register Scaling selected, indicating the Master Register scaling was enabled. The (b) table entry shows that the entries are based on the scaled values.



TDOPLS, continued

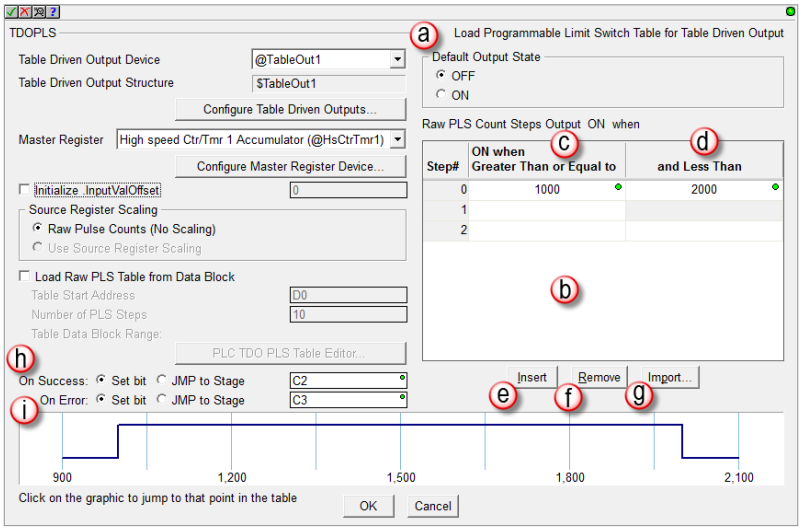
Load Raw PLS Table from Data Block (a): When enabled, the values used by the PLS Table come from the values stored in the specified memory range. This allows for more dynamic control of the PLS function.



- **Table Start Address** (b): The beginning address in PLC memory where the PLS table data is stored.
- **Number of PLS Steps** (c): The number of steps in the PLS table that are stored in PLC memory. A PLS Table can have up to 64 steps.
- **Table Data Block Range** (d): Using the two values above, this shows the range of PLC memory that will be used as the PLS data table. With a starting address of D0 and a total of 2 steps, the memory range is D0 to D3.

***NOTE:** The PLC TDO PLS Table Editor button is available only when the Do-more! Designer software is connected and Online with the BRX CPU.*

- **PLC TDO PLS Table Editor** button (e): Click this to open the ***PLS Table Editor***. The editor allows you to edit the data values in the specified Data Block. The data configuration options on this dialog (Default Output State, value for "Greater Than or Equal", value for "Less Than") are the same as the main dialog. Detailed information of the PLC TDO PLS Table Editor dialog screen is discussed later in this section.



TDOPLS, continued

Default Output State (a): The Default Output state determines the starting state of the Output when the PLS instruction is enabled and the state that the Output is in when the count is NOT within the Entry comparisons. If the Default Output State is OFF, the Output will be ON when the count is within the Entry comparison values. If the Default Output State is ON, the Output will be OFF when the count is within the Entry comparison values.

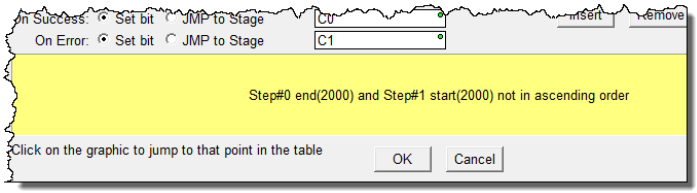
Raw (or Scaled) PLS Count Steps Output ON when (b): A table of entries that determines the Output state when the TDOPLS is running.

- The entries in the table (b) can be constants or variables. If variables are used, the instruction must be disabled and re-enabled after the variable value has been changed. The values in the entry table cannot be overlapping.
- The values must be increasing with the Entry numbers. In other words, the values in (c) **And Less Than** must be larger than the value in (d) **Greater Than or Equal to**.

  Output On/Off when Greater Than or Equal to: The value that represents the lower edge of the cam position. This can be any value between -2,147,483,648 and 2,147,483,647.

  And Less Than: The value that represents the upper edge of the cam position. This can be any value between -2,147,483,648 and 2,147,483,647.

If invalid entry values are used when specifying constant values, the Do-more! Designer programming software will indicate an error (below) and not allow the instruction configuration to be completed.



If variables are used and invalid entry values are specified, the ***On Error*** state will become true (***Set Bit*** or ***JMP to Stage***).

If the Scaling was configured for the Master Register counter and the Use Source Register Scaling option was specified, the entry values will be the scaled values and no conversion will be necessary.

Insert (e): Add an empty Step above the currently highlighted Step in the table.

Remove (f): Delete the currently highlighted Step from the table.

Import (g): Import the contents of the PLS Table from a CSV file. The format of the import file is two numbers per line, separated by a comma or whitespace, all numbers must be in ascending order, and a maximum of 64 lines. Please review CSV file formatting information later in this TDOPLS instruction section, under the section explaining the PLC TDO PLS Table Editor dialog.

On Success (h):

- **Set Bit**: The bit will become FALSE when the instruction is enabled and will become TRUE when instruction parameters are properly entered and the instruction completes successfully. The specified bit is enabled with a SET operation, not an OUT operation. The On Success bit will remain ON even if the instruction input logic goes OFF.
- **JMP to Stage**: If the parameters configured in the instruction and proper devices were specified, the PLC will jump to that stage.

TDOPLS, continued

On Error (i):

- **Set Bit**: The bit will become FALSE when the instruction is enabled and will become TRUE if there was a problem with the parameters configured in the instruction or with the devices specified.
- **JMP to Stage**: If there was a problem with the parameters configured in the instruction or with the devices specified, the PLC will jump to that stage.

PLC TDO PLS Table Editor: Allows you to edit the data values in the specified Data Block. The data configuration options on this dialog (Default Output State, value for "Greater Than or Equal", value for "Less Than") are the same as the main dialog.

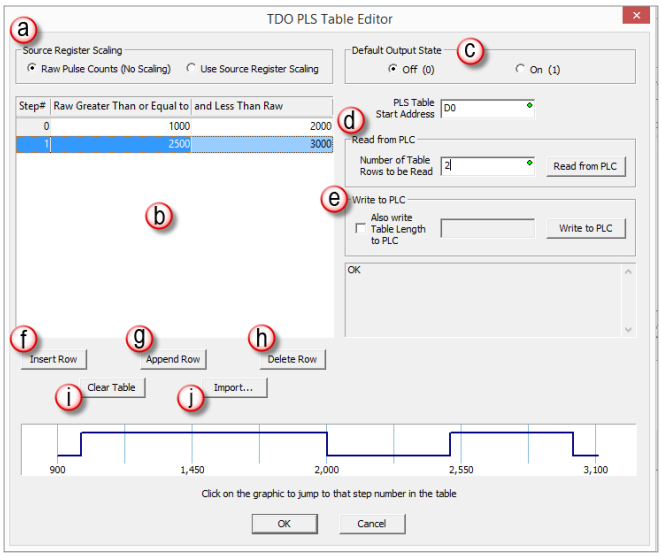
NOTE: *Initial values for Default Output State, PLS Table Start Address, and Number of PLS Entries come from the main instruction editor. If these values are changed while editing the table data with this dialog those values will be updated on the main instruction editor when this dialog is closed.*

NOTE: *If the PLC TDO PLS Table Editor dialog is opened when the Number of PLS Entries is a variable (memory address), the value in that location is read and the data in that number of rows will be read from the PLC to prefill the table. The Also Write Table Length to PLC selection will be enabled and that variable location will be prefilled here so that when the table data is written back to the PLC this location will be updated as well.*

NOTE: *A graph of the current PLS Table configuration is displayed at the bottom of the editor which shows each of the entries. Clicking on the graph will place the cursor on the table entry that contains that location. If incorrect data values are entered, i.e. overlapping data, a message will be displayed instead of the graph.*

- **PLC TDO PLS Table Editor Dialog**:

  Source Register Scaling (a): Same as the main dialog. The TDOPLS instruction can use the raw count value from the specified Master Register or, if scaling was enabled in the High-speed I/O setup, it can use the scaled value to do its comparisons.



  PLS Data Entry (b): Same as main dialog. Entries must be unique within the Table, the lower and upper positions of a step cannot overlap the other cam positions. The data has to be incremental.

  – **Output On/Off when Greater Than or Equal to**: The value that represents the lower edge of the cam position. This can be any value between -2,147,483,648 and 2,147,483,647.

  – **And Less Than**: The value that represents the upper edge of the cam position. This can be any value between -2,147,483,648 and 2,147,483,647.

TDOPLS, continued

Default Output State (c): Same as main dialog. Specifies the state of the first entry in the table.

– **OFF** (default): The output is OFF to start with. The first entry in the table will be a point which the output turns ON and subsequent entries will flip between OFF / ON / OFF / etc.

– **ON**: The output is ON to start with. The first entry in the table will be a point which the output turns OFF and subsequent entries will flip between ON / OFF / ON / etc.

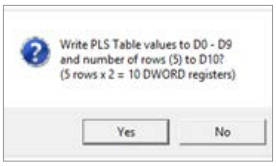
Read from PLC button (d): Overwrite the contents of the table with values from the PLC memory location specified in the Load Raw PLS Table from Data Block section.

– Confirmation is requested before reading the PLC data. In this example the starting data block is D0, D10 holds a value of 5, which indicates 10 DWords will be read:



Write to PLC (e): Overwrite the contents of PLC memory at the location specified in the Load Raw PLS Table from Data Block section with the current contents of the table.

– Confirmation is requested before writing data to the PLC. In this example, there are 5 rows of data. A 5 is written o D10 and the 10 DWords of data is written to D0 to D9.



Insert Row button (f): (**Insert** button in main dialog) add an empty Step above the currently highlighted Step in the table.

Append Row (g): Add a new row after the current last step in the table.

Delete Row button (h): (**Remove** button in main dialog) delete the currently highlighted Step from the table.

Clear Table button (i): Will display a confirmation dialog explaining it will delete all rows and the table will end up with a single row with values of 0 for the **Greater Than or Equal to** and 0 for **and Less Than**.

Import button (j): (Import button in main dialog) Import the contents of the PLS Table from a CSV file. The format of the import file is two numbers per line, separated by a comma or whitespace, all numbers must be in ascending order, and a maximum of 64 lines.

NOTE: *Any available text editor or an Excel worksheet can be used to create a CSV file. Just save the file as a .CSV file type.*

	A	B	C	D
1	1000	1200	// Step 1	
2	2000	2300	//Step 2	
3	3000	3400	//Step 3	

TDOPLS, continued

Example of how data should be formatted in the CSV file:

a. Two integer values per row separated by comma (surrounded by any amount of white space) or just white space.

b. You can also have empty rows.

c. You can also use a line comment starting with two forward slashes: // This is a comment

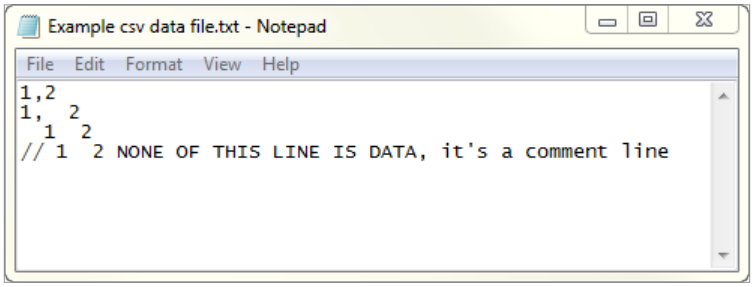
Example on how to format the data per line in the CSV file:

a. Simple comma separated values 1 and 2. (See line one below.)

b. Some white space before and/or after the comma is OK (see line two below).

c. Whitespace before, between, and after is OK also (i.e. comma is optional, see line three below).

d. Comment line (no data allowed). (see line four below.)



TDOPRESET

A **Load Preset Table for Table Driven Output** (TDOPRESET) instruction contains a series of steps that are processed in the order they appear in the table. These steps compare the current count value of the specified Master Register, which can be a High-speed Counter, Timer or AXIS Current position value, to the Preset Count in the Step, and when the count values match, the step action is performed on the selected discrete output and the next step in the table becomes the active step. Each Preset Table can have up to 64 steps. Each Preset Table compares the count value of one Master Register counter and can drive one High-speed I/O discrete output.

Once a Preset table has been enabled for a Table Driven Output, it will continue to control that output even if the input logic is no longer ON. Use the Deconfigure Table Driven Output (TDODECFG) instruction to stop the Preset table from controlling the Table Driven Output.

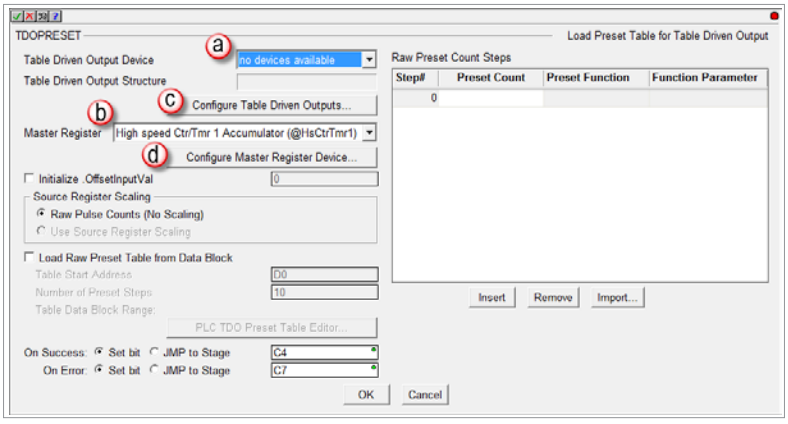
This instruction requires the following:

- Table Driven Output configured to be used by the instruction.
- One of the following to be used as the Master Register:
  - Position value from a configured master axis.
  - Accumulated value from a configured high speed counter/timer function.

The (a) ***Table Driven Output Device*** specifies which discrete output will be used by the instruction and the (b) ***Master Register*** selects the axis position or high-speed counter/timer accumulated value that provides the position source value. These can be any discrete output or high-speed counter/timer available to the MPU or available to a BX-HSIO expansion module.

The Table Driven Output and the high-speed counter/timer functions are configured in the MPUs ***Setup BRX High-speed I/O*** dialog or the BX-HSIO ***Setup BX-HSIO Module*** dialog. Please see detailed information on these under the "Available High-Speed Input and Output Features" earlier in this chapter. These dialog boxes can be opened directly from the TDOPRESET instruction by clicking on the (c) **Configure Axis...** Button and (d) **Configure Master Register Device...** button. These allow the user to:

- configure a table function or a counter/timer function for use with the instruction.
- verify or edit the physical I/O selected for an already configured axis or counter/timer function.



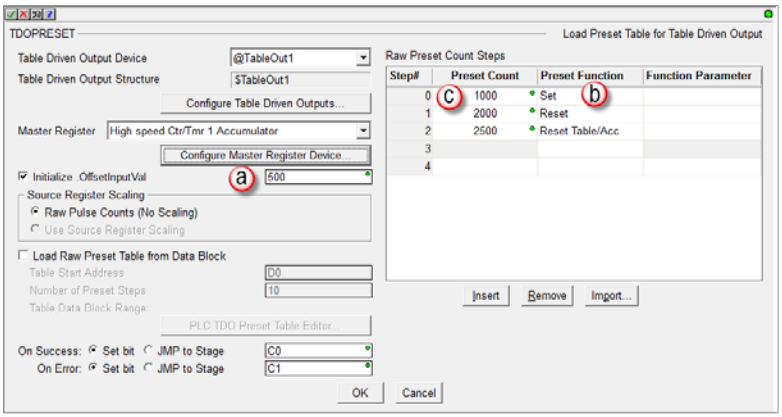
TDOPRESET, continued

Initialize .InputValOffset: ***.InputValOffset*** is used to adjust the current count value from the Master Register. The "calculated master register" value will be used for subsequent comparisons.

For example:

- A table is processed, expecting no deviation (delta value) in the position. If there is a deviation (an amount of error), this delta value can be written (by means of the ladder) to ***.InputValOffset*** in order for the system to behave as if there is no deviation.
- Write a fixed value into the ***.InputValOffset*** field in the instruction to take care of equipment changes, i.e. change an encoder with one with different pulses per revolution.

When the Master Register is configured as Linear or Rotary device, a positive value in this field means that the entries will act at a lower value than shown. A negative value means that the entries will act at a higher value than shown. For example: An offset of (a) 500 is configured in the ***.InputValOffset*** field. The first entry is configured to (b) SET the output at (c) 1000. When the table runs, the ***.OutputState*** will actually SET at a value of 500. If the ***.InputValOffset*** was configured for -500, the first ***.OutputState*** would have SET at a value of 1500.



NOTE: *When the Master Register is configured as a Rotary device, the user must make sure the calculated range (Master Register value - .InputValOffset + 1) stays within the device's configured Rotary Range.*

TDOPRESET will stop triggering the table ***.OutputState*** when the Master Register is configured as a Rotary device, and either:

- A positive ***.InputValOffset*** value is at least 1 count greater than the configured "SET" value.
- A negative ***.InputValOffset*** value has a magnitude greater than or equal to the configured "SET" value.

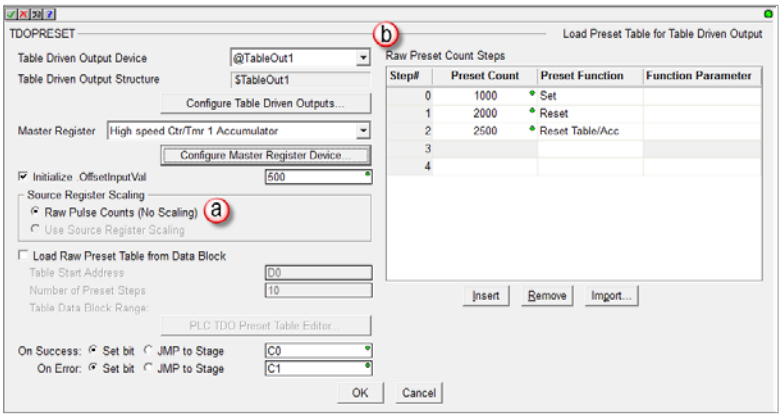
The effect of ***.InputValOffset*** is illustrated by the following examples:

TDOPRESET *.InputValOffset* Behavior										
Rotary Range: 0–200										
SET at: 100 RESET at: 110										
.InputValOffset	-100	-99	-90	-50	0	50	90	99	100	101
Table .OutputState is SET	Stopped	199	190	150	100	50	10	1	0	Stopped
Table .OutputState is RESET		0	0	160	110	60	20	11	10	

TDOPRESET, continued

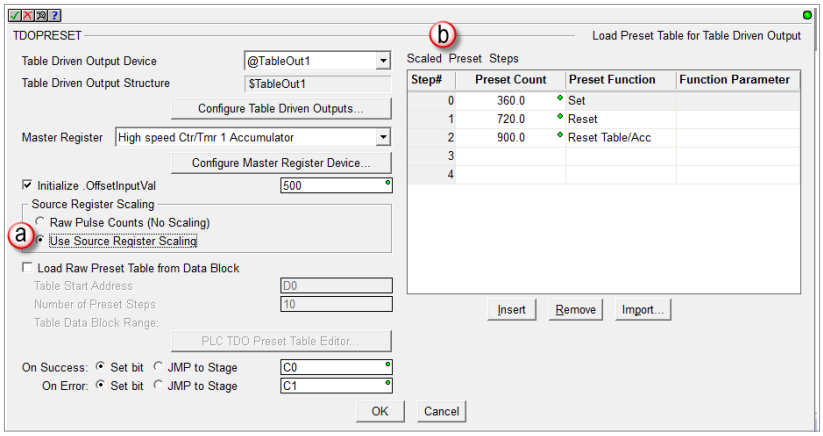
NOTE: *if the Master Register is an Axis' position, and the application is using either a servo controller or stepper controller with micro-stepping or smoothing, be aware that both controller types have a conversion time that will introduce some delay between the Axis' output position and the actual shaft position of the motor. The* ***.InputValOffset*** *can be used to compensate for the conversion time by adding the number of pulses that would occur during the conversion time to the current count of the Master Register. Multiplying the servo or stepper controller's conversion time by the current velocity will yield the number of pulses that would occur during that amount of time. Using this pulse count value in the* ***.InputValOffset*** *field will delay the comparison in the Steps by the same amount as the conversion time of the motor controller. Doing this will more closely sync the Table Driven Output's state to the actual shaft position of the motor.*

Source Register Scaling: The TDOPRESET instruction can use the raw count value from the specified Master Register or, if scaling was enabled in the High-speed I/O setup, the scaled value to do its comparisons.



- **Raw Pulse Counts (No Scaling)** (a): Select this option to enter the Preset Count values in the Table as raw count values. The image above shows (a) **Raw Pulse Counts (No Scaling)** selected, indicating the Master Register scaling was not enabled. The (b) **Raw Preset Count Steps** table entry shows that the values entered are based on raw counts.

- **Use Source Register Scaling**: If the Master Register has been configured to scale the current count value you can use the scaled values in the table by selecting this option and entering values that are scaled the same as the Master Register. The image below shows (a) Use Source Register Scaling selected, indicating the Master Register scaling was enabled. The (b) Scaled Preset Steps table entry shows that the entries are based on the scaled values.



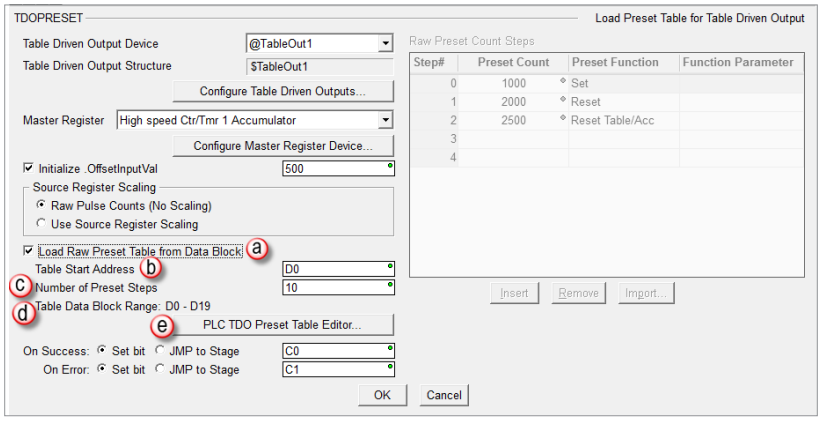
TDOPRESET, continued

Load Raw Preset Table from Data Block (a): When enabled, the values used by the Preset Table come from the values stored in the specified memory range. This allows for a more dynamic control of the Preset function.

- **Table Start Address** (b): The beginning address in PLC memory where the Preset table data is stored. This must be a block of Signed DWords.
- **Number of Preset Steps** (c): The number of steps in the Preset table that are stored in PLC memory. A Preset Table can have up to 64 steps.
- **Table Data Block Range** (d): Using the two values above, this shows the range of PLC memory that will be used as the Preset data table. With a starting address of D0 and a total of 10 steps, the memory range is D0 to D19. Data formatting will be discussed in the PLC TDO Preset Table Editor section found later in this section.

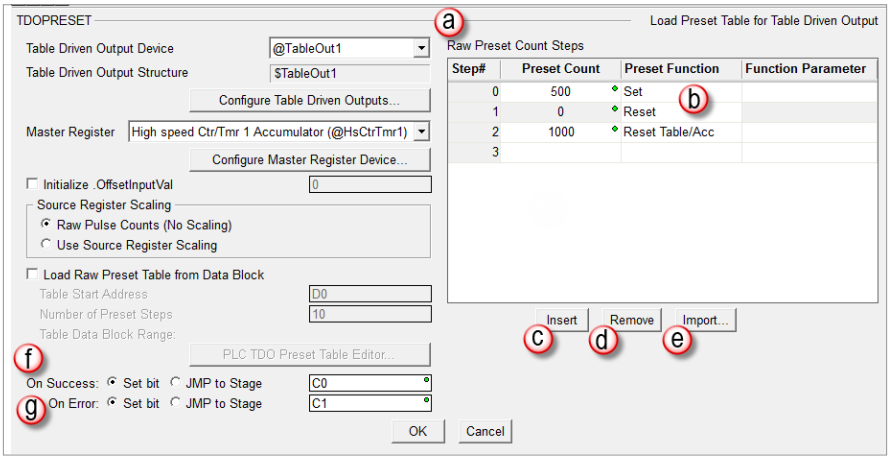
NOTE: *The PLC TDO Preset Table Editor button is available only when the Do-more! Designer software is connected and Online with the BRX CPU.*

- **PLC TDO Preset Table Editor** button (e): Click to open the PLC TDO Preset Table Editor which allows you to edit the data values in the specified Data Block. The data configuration options on this dialog (Preset Count, Preset Function, Function Parameter) are the same as the main dialog. Detailed information of the PLC TDO Preset Table Editor dialog screen is discussed later in this section.



TDOPRESET, continued

Raw (or Scaled) Preset Count Entries Output xx when: This is the table of entries for **Raw (or Scaled) Preset Count Steps** (a): This is the list of steps that determines the Table Driven Output state when the TDOPRESET is running.



- **Preset count**: The pulse count values in the table can be constants or variables. If variables are used, the instruction must be disabled and re-enabled after the variable value has been changed. This can be any value in the range of -2,147,483,648 and 2,147,483,647.
- **Preset Function** (b): Select the action to perform on the Table Driven Output when the Step is triggered.
  1. **Set**: Turns ON the Table Driven Output.
  2. **Reset**: Turns OFF the Table Driven Output.
  3. **Reset Table/Acc**: Performs a reset of the Master Register which sets its current count value to the Initial Reset Value specified in the Timer/Counter Function setup, and sets the current step in the Preset Table to Step 0.
  4. **Pulse On**: Turns ON the Table Driven Output for the amount of time specified in the Function Parameter, which is the duration of the output pulse in microseconds (1 to 16,777,215).
  5. **Pulse Off**: Turns OFF the Table Driven Output for the amount of time specified in the Function Parameter, which is the duration of the output pulse in microseconds (1 to 16,777,215).
  6. **Toggle**: Inverts the state of the Table Driven Output. If the Table Driven Output is currently ON, it is turned OFF, or it is turned ON if it is currently turned OFF.
- Several things to consider when using this instruction:
  1. Unlike the TDOPLS instruction, the values in the entry table do not have to be increasing with the Entry numbers. The table runs step by step in order of entry. Therefore, if the value in a higher entry is lower than a previous entry, the current count value must be decreasing in order for the step to be completed. For example, if Step 0 is configured as Set at 500 and Step 1 is configured as Reset at 0, the Output will be Set ON when the current counts reach 500 or more and the Output will be Reset to OFF when the current counts decrease to 0 or less.
  2. In order for the table to run continuously, the final entry function must be to (X) Reset Count. After the step with the Reset Count function is complete, the table will start over at Step 0. When the TDOPRESET instruction is disabled and re-enabled, it will start over at Step 0.

TDOPRESET, continued

3. If the Scaling was configured for the Master Register counter and the "Use Source Register Scaling" option was specified, the Step values will be entered as scaled values and no conversion will be necessary.

- **Insert** button (c): add an empty Step above the currently highlighted Step in the table.
- **Remove** button (d): delete the currently highlighted Step from the table.
- **Import** button (e): Import the contents of the Preset table from a CSV file. The format of the import file is two or three numbers per line, separated by a comma or whitespace, and a maximum of 64 lines. Please review the CSV file formatting information later in this TDOPRESET instruction section, under the section explaining the PLC TDO Preset Table Editor dialog.

On Success (f):

- **Set Bit**: The bit will become FALSE when the instruction is enabled and will become TRUE when instruction parameters are properly entered and the instruction completes successfully. The specified bit is enabled with a SET operation, not an OUT operation. The On Success bit will remain ON even if the instruction input logic goes OFF.
- **JMP to Stage**: When instruction parameters are properly entered and the instruction completes successfully, the PLC will jump to that stage.

On Error (g):

- **Set Bit**: The bit will become FALSE when the instruction is enabled and will become when proper instruction parameters are NOT properly entered or the instruction IS NOT completed successfully. The specified bit is enabled with a SET operation, not an OUT operation. The On Error bit will remain ON even if the instruction input logic goes OFF.
- **JMP to Stage**: When proper instruction parameters are NOT properly entered or the instruction IS NOT completed successfully, the PLC will jump to that stage.



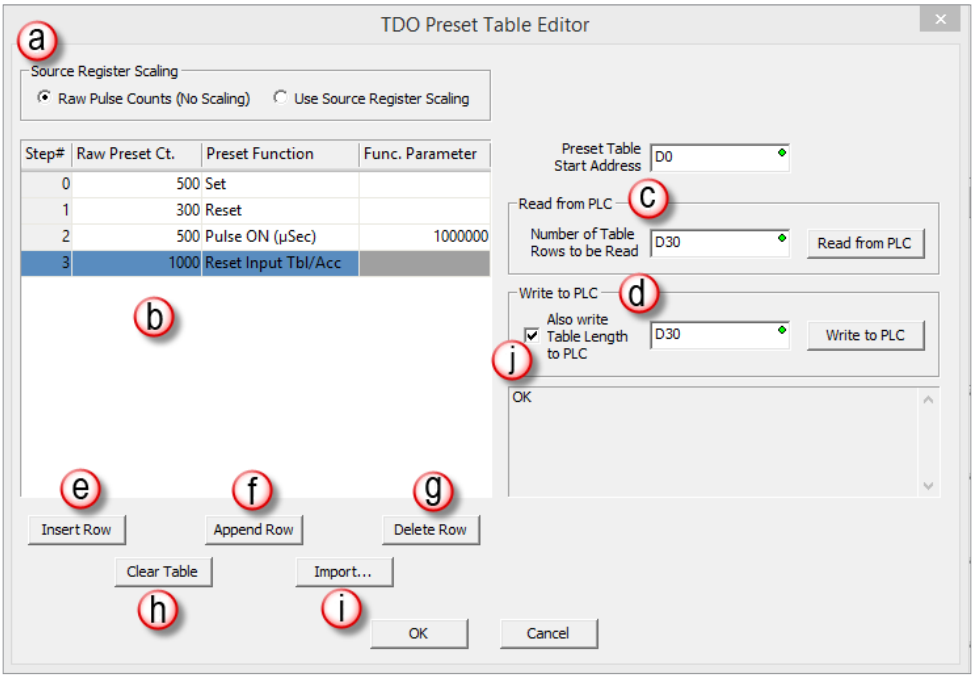
NOTE: *Initial values for Preset Table Start Address, and Number of Table Rows to be Read (or Number of Preset Steps) come from the main instruction editor. If these values are changed while editing the table data with this dialog, those values will be updated on the main instruction editor when this dialog is closed.*



NOTE: *If the Number of Preset Steps is a variable (memory address), the value in that location is read and the data in that number of rows will be read from the PLC to prefill the table. The Also Write Table Length to PLC selection will be enabled and that variable location will be prefilled here so that when the table data is written back to the PLC this location will be updated as well.*

TDOPRESET, continued

PLC TDO Preset Table Editor



Source Register Scaling (a): Same as the main dialog. The TDOPRESET instruction can use the raw count value from the specified Master Register or, if scaling was enabled in the High-speed I/O setup, it can use the scaled value to do its comparisons.

Raw (or Scaled) Preset Count Steps (b): Same as main dialog. This is the list of steps that determines the Table Driven Output state when the TDOPRESET is running.

1. **Preset Count**: The PLC TDO Preset Table Editor is reading a block of D memory, it is editing the values that go into that block. The Preset Count in the PLC TDO Preset Table Editor can only be contant values. This value can be in the range of -2,147,483,648 and 2,147,483,647.
2. **Preset Functions**: Select the action to perform on the Table Driven Output when the Step is triggered.
   a. **Set**: Turns ON the Table Driven Output.
   b. **Reset**: Turns OFF the Table Driven Output.
   c. **Reset Table/Acc**: Performs a reset of the Master Register which sets its current count value to the Initial Reset Value specified in the Timer/Counter Function setup, and sets the current step in the Preset Table to Step 0.
   d. **Pulse On**: Turns ON the Table Driven Output for the amount of time specified in the Function Parameter, which is the duration of the output pulse in microseconds (1 to 16,777,215).
   e. **Pulse Off**: Turns OFF the Table Driven Output for the amount of time specified in the Function Parameter, which is the duration of the output pulse in microseconds (1 to 16,777,215).
   f. **Toggle**: Inverts the state of the Table Driven Output. If the Table Driven Output is currently ON, it is turned OFF, or it is turned ON if it is currently turned OFF.
3. **Read from PLC** button (c): Overwrite the contents of the table with values from the PLC memory location specified in the Load Raw Preset Table from Data Block section.

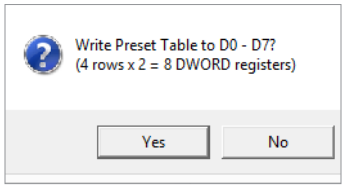
TDOPRESET, continued

Confirmation is requested before reading the PLC data. In this example the starting data block is D0, D30 is the memory address that stores the Number of Preset Steps. This has a value of 4. Eight DWords will be read from the PLC starting at D0:

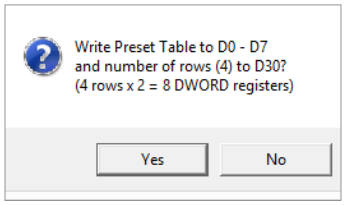


4. **Write to PLC** (d): overwrite the contents of PLC memory at the location specified in the Load Raw Preset Table from Data Block section with the current contents of the table.

   Confirmation is requested before writing data to the PLC. The four rows of data are stored in D0 to D7.



   Confirmation request before writing data to the PLC with the **Also write Table Length to PLC** enabled. In this example, there are 4 rows of data. A 4 is written to D30 and the 8 DWords of data is written to D0 to D7.



5. **Format of the Preset Data Read from PLC or Written to the PLC memory addresses**: When using the PLC TDO Preset Table Editor, the data values in the specified memory locations must be formatted properly. Improperly formatted data will generate a warning message. The following example shows a range of D0 to D7, which corresponds to a starting Preset Data Table address of D0 and 4 steps. Each step is comprised of two DWords. Each Preset table entry consists of 2 signed DWord locations:

   a. The first DWord location corresponds to the Preset Count where the specified command will take place. This can be any value between -2,147,483,648 and 2,147,483,647.

   b. The second DWord location contains the Function Code for the command to be performed and the additional data required by a command code.

      i. The upper BYTE (Byte 0) contains one of the following values to indicate the action:

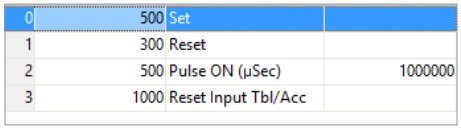
         0: Set
         1: Reset
         2: Pulse ON
         3: Pulse OFF
         4: Toggle
         5: Reset Table & Acc

TDOPRESET, continued

ii. When using the Pulse ON or Pulse OFF command, the lower 3 BYTEs of the second DWord location will contain the amount of time (in microseconds) the pulse will be ON or OFF respectively.

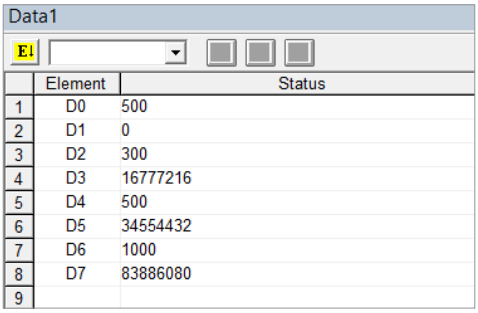
c. Example: This shows the Preset Table filled in with the desired values:

Line 1 Step 0: Preset Count of 500. Set = Code 0.
Line 2 Step 1: Preset Count of 300. Reset = Code 1.
Line 3 Step 2: Preset Count of 500. Pulse ON = Code 2. Function Parameter of 1,000,000.
Line 4 Step 3: Preset Count of 1000. Reset Table/Acc = Code 5.



0	500	Set	
1	300	Reset	
2	500	Pulse ON (µSec)	1000000
3	1000	Reset Input Tbl/Acc	

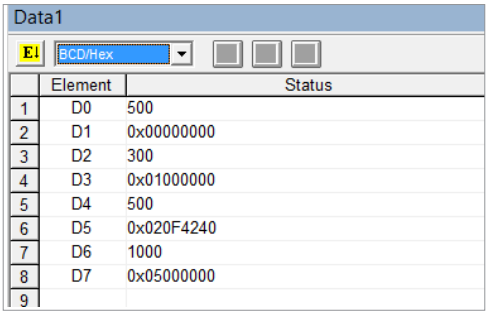
i. The following Data View shows the Native values for the Data Block range of D0 to D7 associated with our example:



Data1

	Element	Status
1	D0	500
2	D1	0
3	D2	300
4	D3	16777216
5	D4	500
6	D5	34554432
7	D6	1000
8	D7	83886080
9		

ii. The following Data View shows the second DWord of each step in BCD/HEX data type:



Data1 (BCD/Hex)

	Element	Status
1	D0	500
2	D1	0x00000000
3	D2	300
4	D3	0x01000000
5	D4	500
6	D5	0x020F4240
7	D6	1000
8	D7	0x05000000
9		

D1 corresponds to SET (code 0) of Step 0.

D3 corresponds to RESET (code 1) of Step 1.

D5 corresponds to Pulse ON (code 2) of Step 2.

D7 corresponds to Reset Table/Acc (code 5) of Step 3.

iii. The upper Byte represents the Function Code. The lower three Bytes represent the Function Parameter value. 0Xuullllll.

For Step 0, function code 0 (Set) is uu = 00.

For Step 1, function code 1 (Reset) is uu = 01.

For Step 2, function code 2 (Pulse ON) is uu = 02. Pulse ON has a function parameter of time in microseconds, which is llllll = 0F4240. Converting Hex 0F4240 to Decimal is 1,000,000.

TDOPRESET, continued

For Step 3, function code 5 (Reset Table/Acc) is uu = 05.

iv. If, for example, we want to change the Pulse ON to last 2,500,000 microseconds, D5 would have a BCD/HEX value = 0X022625A0.

6. **Insert Row** button (e): (Insert button in main dialog) add an empty Step above the currently highlighted Step in the table.
7. **Append Row** (f): Add a new row after the current last step in the table.
8. **Delete Row** button (g): (Remove button in main dialog) delete the currently highlighted Step from the table.
9. **Clear Table** button (h): Will display a confirmation dialog explaining it will delete all rows and the table will end up with a single row to Set at a Preset Value of 0.
10. **Import** button (i): (Import button in main dialog) Import the contents of the PLS Table from a CSV file. The format of the import file is two or three numbers per line, separated by a comma or whitespace, with a maximum of 64 lines.

Below is an example of how data should be formatted in the CSV file.

	A	B	C	D
1	1000	0		//Set ON @ 1000
2	2000	1		// Set OFF @ 2000
3	3000	2	1000000	//Pulse ON @ 3000 for 1,000,000 microseconds
4	4000	0		// Set ON @ 4000
5	5000	3	1500000	//Pulse OFF @ 5000 for 1,500,000 microseconds
6	6000	4		//Toggle @6000
7	7000	5		//Reset Count & Table @ 7000

Column A holds the Preset Count. This can be any value between -2,147,483,648 and 2,147,483,647

Column B holds the Preset Function code. The following table shows the available function codes.

Preset Function Codes		
0	SET	No function parameter needed
1	RESET	No function parameter needed
2	PULSE ON	Requires function parameter. Time in microseconds: 1 to 16,777,215
3	PULSE OFF	Requires function parameter. Time in microseconds: 1 to 16,777,215
4	TOGGLE	No function parameter needed
5	RESET TABLE & COUNT	No function parameter needed

Column C holds the Function Parameter, which is the amount of time (in microseconds) the pulse will be ON or OFF. This is required for the PULSE ON and PULSE OFF function codes.

Column D holds the comments, which is indicated by the "//" before the text.

BRX Do-more!
Serial Communications



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Overview

The purpose of this chapter is to help the user gain an understanding of the serial communications capabilities of the BRX platform. The BRX platform features the Do-more! DM1 technology which has a very robust communications system allowing the programmer to accomplish many tasks that can prove difficult with other PLCs. Every BRX MPU has a built-in RS232/485 (software-selectable) serial port. Pluggable Option Modules (POM) and Expansion modules are also available that will add additional RS-232 and RS-485 port configurations.

The BRX platform provides a wide variety of serial protocols to choose from and is capable of serial communications to a wide variety of field devices such as HMIs, SCADA systems, PLCs, barcode readers and scales, to name a few.

The available protocols are:

- Modbus RTU protocol: one of the most popular and widely used protocols in the industrial automation community.
- Do-more! protocol: can access the entire BRX memory structure and can utilize a security account to protect the data. Some HMIs and SCADA software such as C-more and C-more Micro, can take advantage of this enhanced security while keeping data transmission integrity intact.
- K-sequence protocol: is typically used to communicate with DirectLOGIC PLC systems.
- ASCII: although technically not a protocol, it is supported to communicate with devices such as scales, barcode readers and other simple devices.
- DMX512 protocol: stage lighting control protocol allows the BRX platform to easily send and receive commands to most DMX512 devices and controllers.
- Custom protocol: if there is a need for a protocol that is not available, and the user has a thorough working knowledge of the protocol, it is possible for a user to use the available raw commands to write a custom protocol the DM1 technology can execute.

The following sections of this chapter as well as the software help file will be of significant use to you when connecting and communicating with the various protocols needed for these types of devices.

General Concepts

As a security feature, when communicating with Modbus RTU or K-sequence the controller does not allow external devices that communicate with the controller to have direct access to the controller's internal memory and I/O. These protocols will be serviced through reserved memory blocks designated for that protocol. This is setup to allow the programmer to pass data externally when using third party devices while maintaining a secure environment. This is discussed in more detail in each protocol section later in this chapter.

Terminology

During the course of this chapter we will use terminology and phrases that are specific to a Protocol or Physical Medium the user should understand. By way of explanation we have included some common terms and definitions in this section. Definitions and explanations of specific parameters particular to each Protocol will be discussed later in this chapter.

Physical Medium – Wires, radios, cellular service, or satellite link. The physical method (hardware) on which the data is being transmitted or received. The physical medium contains no data information. Examples of a physical medium are: RS-232, RS-485 and Ethernet 10/100 Base T.

Protocol – A Protocol is the specification for the formatting of the data (bits, bytes and words) being transmitted through the physical medium. Examples of some common industry protocols are: Modbus RTU and K-Sequence.

One way to think of the Physical Medium and the Protocol is to liken them to placing a phone call. The phone call is being placed over wires, cellular service or even perhaps a satellite link. This is the physical medium. Now if the call was to China, you would say "Hello" in English. If the person on the other end understands English, they will respond with "Hello". If the person on the other end only understands Mandarin Chinese they might respond "Ni Hao". If you do not understand Chinese, you will be confused as to what they are saying. This is the same for a Protocol. If your PLC uses Modbus RTU and you try to talk to a PLC that only understands K-Sequence, then you will not be able to communicate with it. The Protocols must match in order to communicate.

Client (Master) – A Client is a Master device that requests data from a Server (Slave) device. The Client (Master) device initiates communications with a Server (Slave) device.

Server (Slave) – A Server is a Slave device that responds to a request from a Client (Master) device. The Server (Slave) device listens/replies to requests made by a Client (Master).

Field Device – A device external to the BRX MPU.



NOTE: *Software dialog windows and other documentation may interchangeably use the terms Client/Server or Master/Slave when referring to requesting/responding devices in Ethernet or Serial communications. In this chapter, with regards to Serial communications, we will use the term Client to refer to a requesting device and Server to refer to a responding device.*

Troubleshooting Serial Communications

Troubleshooting communications can seem frustrating to the novice because you cannot see what is happening in real time. However, most communications troubleshooting is fairly straight forward if you take the right steps. Below are some recommendations for how to go about troubleshooting when a device does not communicate.

1. Make sure the baud rate, parity, stop bits, end bits, RTS/CTS control and other parameters match both the sending and receiving devices. With RS-485 make sure each device has a unique ID number.
2. Make sure the wiring is the right choice for the communications standard that you are using. Having the right wire with the right impedance and capacitance characteristics is very important. Using the wrong type wire will nearly certainly cause the link to fail or at the very least be very noisy and troublesome.
3. Make sure that the wiring pinouts are correct between the devices. For RS-232, RX and TX must be swapped for DTE devices. Ground must be used for RS-232. For RS-485, Plus should go to Plus and Minus to Minus.
4. RS-232 is a ground referenced signal. This means that having a good common ground connection between the devices is extremely important. If the devices are not at the same ground potential, they will not communicate properly and can even cause damage to the connected devices. Both devices should be grounded at the same potential source.
5. RS-232 is a one to one wiring standard. It cannot be multi-dropped without special adapters. For multi-drop (slave) arrangements, RS-485 is the preferred method.
6. For RS-485 links one of the most common issues is that the plus and minus wires simply need to be swapped. These may be labeled differently depending on the manufacturer, but the principle is the same. RS-485 usually has a ground wire, but it is not quite as important as with RS-232 since RS-485 is a differential signal that is not ground referenced.
7. Termination resistors may be required to prevent data reflections from the ends of the cable. These resistors should match the cable impedance as closely as possible. For shorter runs of a few feet of cable, the resistors may cause issues and it should be tested to see if they are needed or not.
8. Make sure that the protocols match between the sending and receiving devices.
9. If available RX and TX lights should be flashing or steady if data is being transferred. If only one light is on or if no lights are on, then it is likely not working.
10. The last tip is to start simple. Start with a simple program that uses a single read instruction to a single address that holds a known, non-zero value. Once you get this working, start to expand the capabilities. Don't start off your troubleshooting journey with a full program of reads and writes using radios and long wire distances. Keep it simple. Start small and grow.

Communications Design

The BRX platform features the Do-more! DM1 technology which has a very robust communications system allowing the programmer to accomplish many tasks that can prove difficult with other PLC's. The DM1 technology manages the asynchronous actions of communications in the background without taking a huge hit on the PLC scan time.

Sequencing Communications

The easy way

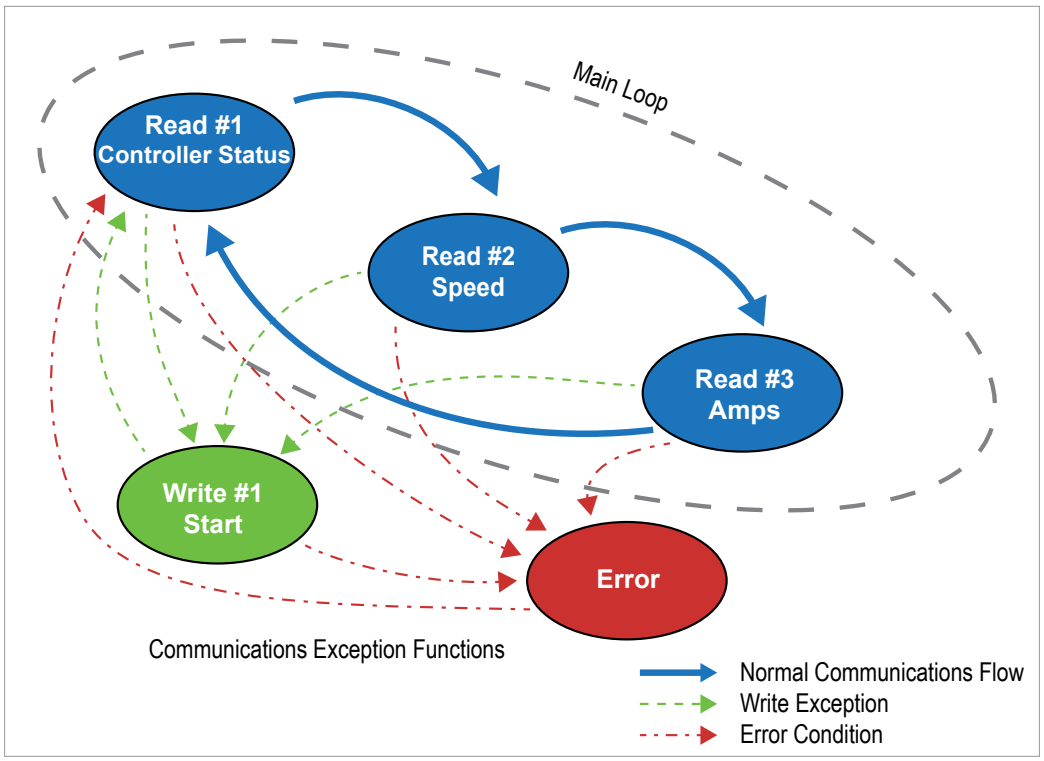
In many PLC's the programmer must manage the communications sequencing. This can be frustrating and time consuming to get the communications working correctly especially when you have multiple requests to handle. The DM1 technology eliminates this frustration and will simply manage each Comm request in the order that the program initiates a request. You no longer must write code to sequence and manage each request. For some applications this is enough to do what the programmer needs to accomplish.

More advanced sequencing – State Machines

State machines have been used to sequence communication sequences for a very long time. The reason for this is that communications by definition consists of always being in a particular state and transitioning to a different state based on some action. This is all that there is to state machine programming; do an action and wait for something to happen, then move to a different action.

Do-more! supports state machine programming. This is accomplished by the use of Stages. Stage programming has been around a long time and Do-more! PLC's take full advantage of Stage programming. For more information on Stage Programming see Do-more! Designer Help topic DMD0502.

For our example on State Machine programming using Stages consider talking to a variable speed motor controller. What is there that you will be doing? By drawing out the conditions, you can see that there are definite states that the communications to the motor controller will be going through.



Sequencing Communications, continued

In this example we can see that we have three reads from the device and one write condition. We can also see that we need an error handling routine. That's all there is to it. It looks fairly simple when we draw it out in this manner. The beauty of drawing a State Machine out with a flow chart is that it transitions in nearly the exact same manner to ladder logic.

Main loop:

Read #1 – Read the Controller status word. This might consist of whether the drive is running, jogging, in error, etc.

Read #2 – Read the Controller speed. How fast is it running?

Read #3 – Read the amp draw. Is it within limits?

Main loop end

Things that happen occasionally:

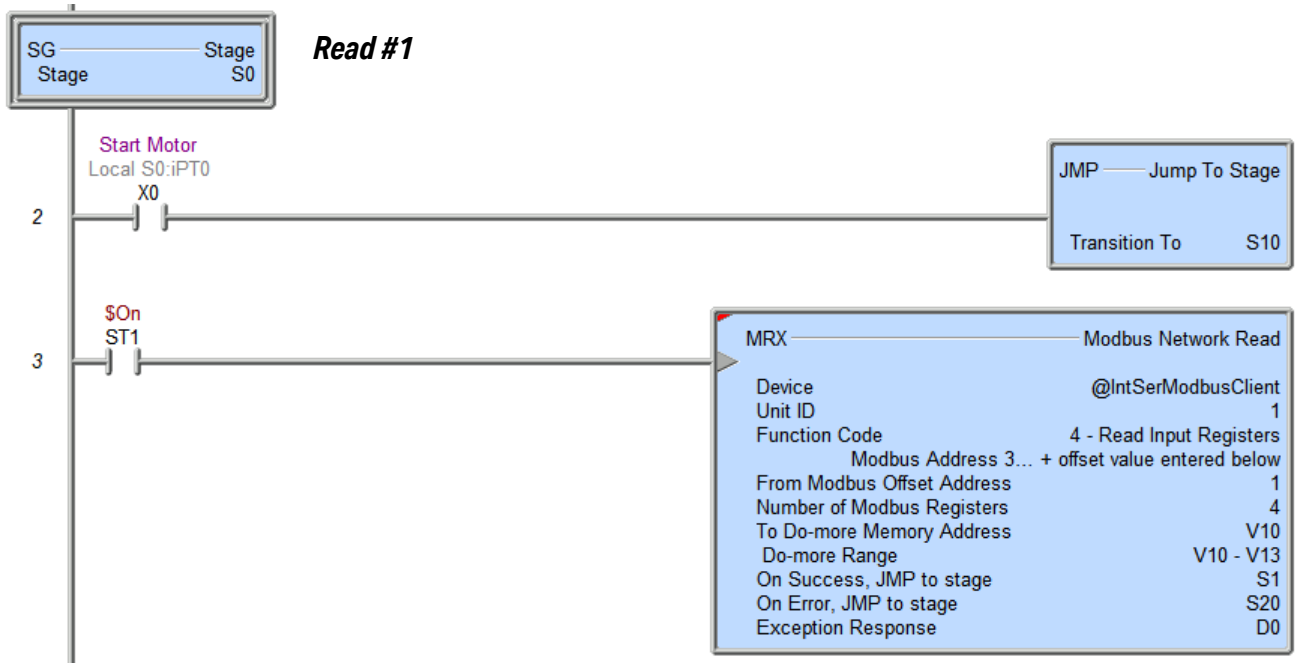
Write #1 – Start the Controller running.

Error – Something bad happened to the communications. What do we need to do to flag this as a problem?

An implementation of this State Machine in ladder logic is shown below. Since the Do-more! Communication instructions have built in transitioning between Stages based on Success or Error, this eliminates a lot of programming. To accomplish the diagram the only manual transitioning that needs to occur is for the Write to start the motor controller.

While this example is somewhat incomplete in that it does not have provisions for stopping the drive or other potential needs, it does serve to show how State Programming can help to make transitioning between communications states relatively easy in the Do-more! Controller.

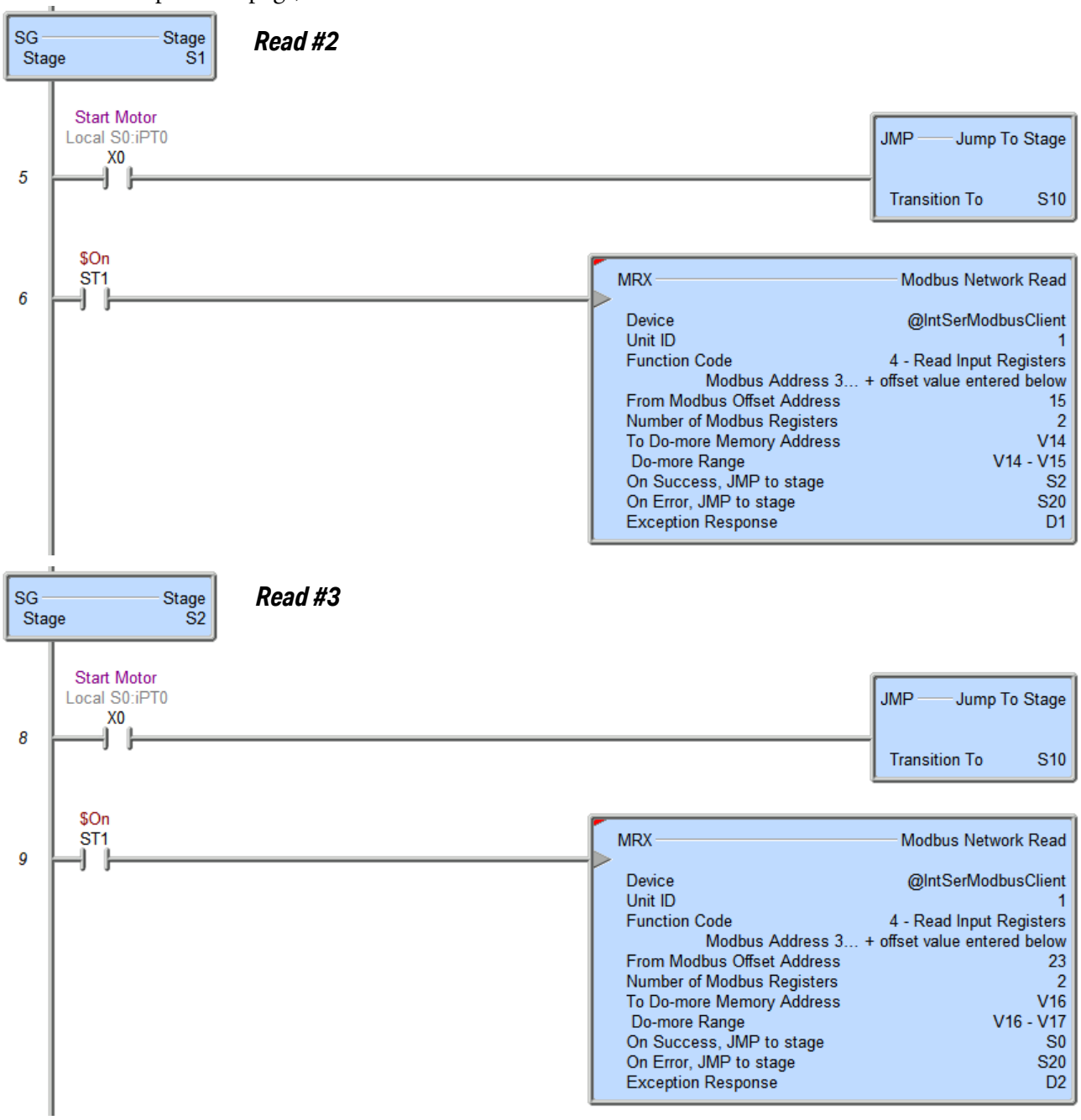
Main loop:



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Sequencing Communications, continued

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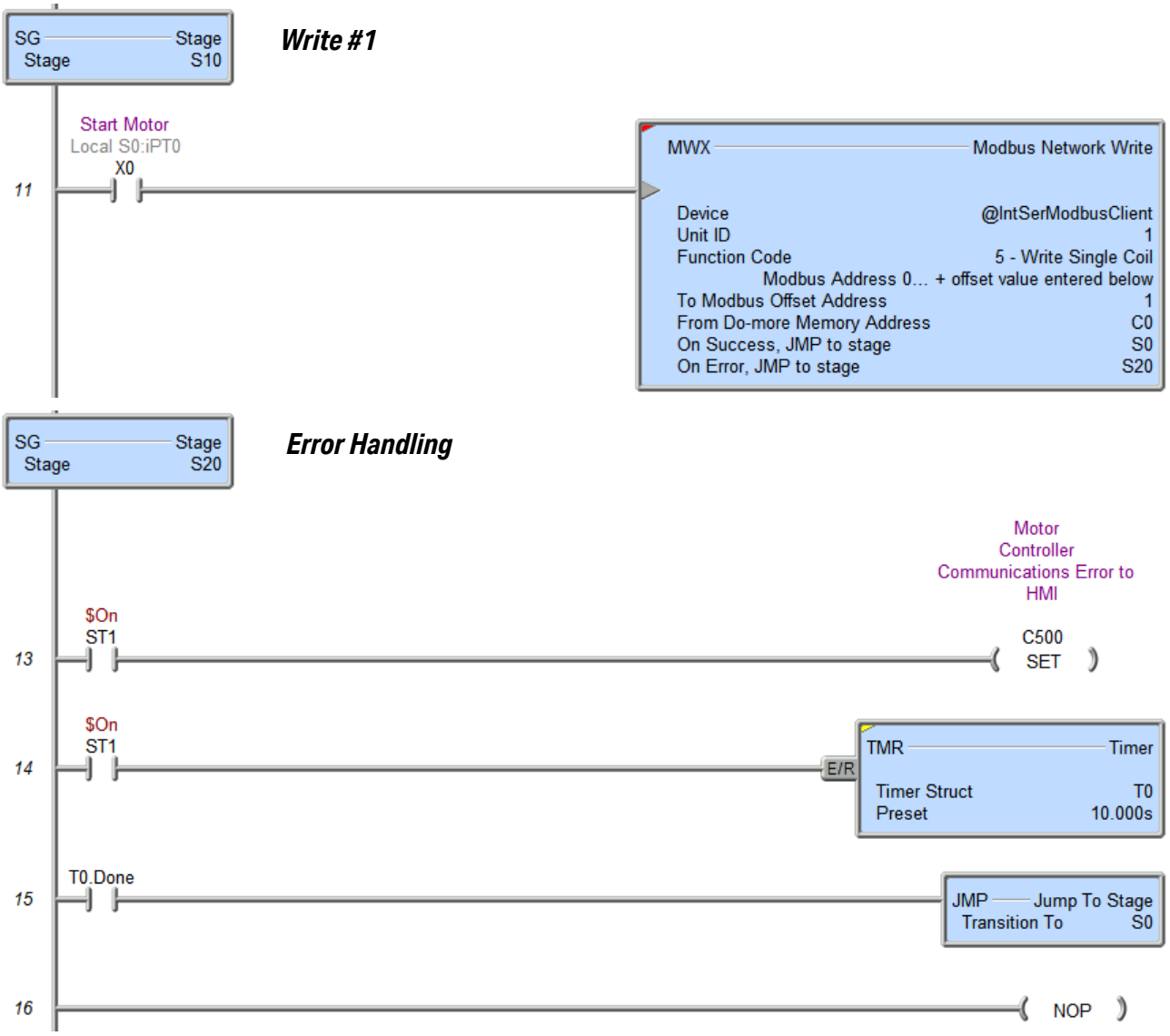
Main loop end

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Sequencing Communications, continued

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Things that happen occasionally:



USB Communications

The POM slot USB port is useful for programming and monitoring the BRX Do-more! MPU. It is compatible with Desktop PCs and Laptops utilizing USB 2.0 or higher, communicating through USB Type A to USB Type B cable. It does not support connections to other USB devices such as printers.

The POM slot USB port relies on drivers included with Windows, so there are no drivers to download. It truly is plug and play.

Serial Communications

There are multiple options when doing serial communications with a BRX PLC. The MPU has a built in serial port that can do RS-232 and RS-485 communications. The BRX POM modules have several options from which you can pick the style of serial port that you might want. The BRX serial expansion modules have 4 serial ports that can do RS-232, RS-422 or RS-485 communications. If you need more ports, just add more modules.

See the table below for a matrix of what protocols are supported by the different communications options.

Supported Communications Protocols

Protocol	Onboard	Serial POMs	BX-SERIO	BX-SERIO-2	BX-SERIO-4
Do-more Protocol (Slave)	X	X	X	X	X
Modbus RTU (Slave)	X	X	X	X	X
Modbus RTU (Master)	X	X	X	X	X
K-Sequence (Slave)	X	X	X	X	X
ASCII	X	X	X	X	X
DMX512 (Controller)			X		
DMX512 (Slave)			X		

General Serial Specifications

RS-232

RS-232 is a single point wiring standard that can be used to connect external devices to the PLC.



Pinout	RS-232
1	GND
2	RX
3	TX

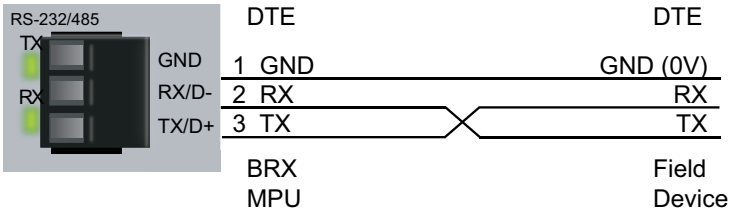
General RS-232 Specifications	
Data Rates	1200, 2400, 4800, 9600, 19200, 38400, 57600, and 115200
Default Settings	RS-232, 115200 bps, No Parity, 8 Data Bits, 1 Stop Bit, Station #1
Port Status LED	Green LED is illuminated when active for TXD and RXD
Port Type	3-pin terminal strip 3.5mm pitch
RS-232 TXD	RS-232 Transmit output
RS-232 RXD	RS-232 Receive input
RS-232 GND	Logic ground
RS-232 Maximum Output Load (TXD/RTS)	3kΩ, 1000 pf
RS-232 Minimum Output Voltage Swing	±5VDC
RS-232 Output Short Circuit Protection	±15mA
Maximum Distance	6 meters (20 foot) recommended maximum

The manner in which external devices are wired to the BRX serial port depend on whether the device is considered to be Data Terminal Equipment (DTE) or Data Communications Equipment (DCE). The BRX serial port is considered a DTE device. Most Modbus or ASCII devices being connected to the BRX serial port will also be considered a DTE device and will need to swap TX and RX (as shown below), but you should always consult the documentation of that device to verify.

If a device such as a Modem, which is a DCE device, is placed between the BRX serial port and another Modbus or ASCII device it will most likely require connecting the signals straight across (TX to TX and RX to RX). Again, this can differ from manufacturer to manufacturer so always consult the documentation before wiring the devices together.

RS-232 is a ground referenced signal and as such it is susceptible to noise and ground differentials which may make it unsuitable for use in some circumstances.

The wiring for RS-232 is shown below. Please note that there are no connections for RTS (Ready To Send), CTS (Clear To Send) or for port powered devices (+5VDC).

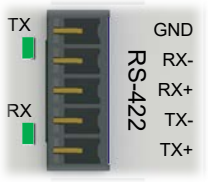


NOTE: *Recommended distance between RS-232 devices is less than 6 meters (20 feet) in industrial environments. For longer distances, please consider using RS-485 or Ethernet.*

General Serial Specifications, continued

RS-422

RS-422 is a multi-point wiring standard that can be used to connect external devices to the PLC.



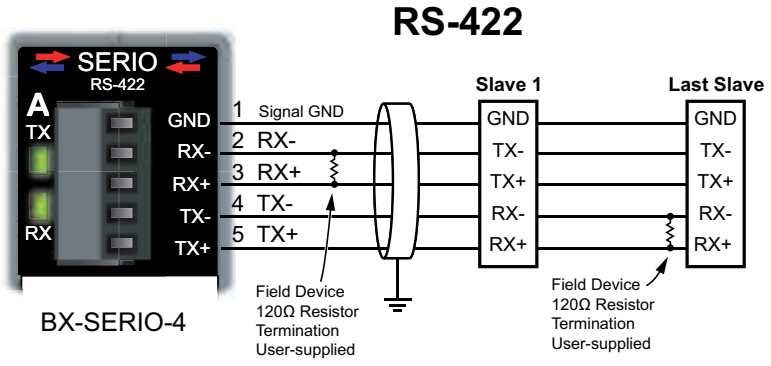
Pinout	RS-422
1	GND
2	RX-
3	RX+
4	TX-
5	TX+

General RS-422 Specifications	
Data Rates	1200, 2400, 4800, 9600, 19200, 38400, 57600, and 115200
Default Settings	RS-422, 115200 bps, No Parity, 8 Data Bits, 1 Stop Bit, Station #1
Port Status LED	Green LED is illuminated when active for TXD and RXD
Port Type	5-pin terminal strip 3.5mm pitch
RS-422 Station Addresses	1-247
RS-422 TXD-/RXD-	RS-422 transceiver low
RS-422 TXD+/RXD+	RS-422 transceiver high
RS-422 GND	Logic ground
RS-422 Input Impedance	96kΩ
RS-422 Maximum Load	50 transceivers, 19kΩ each, 120Ω termination
RS-422 Output Short Circuit Protection	±250mA, thermal shut-down protection
RS-422 Minimum Differential Output Voltage	2.0 VDC with 54Ω load
RS-422 Maximum Common Mode Voltage	-7.5-12.5 VDC
RS-422 Fail Safe Inputs	Logic high input state if inputs are unconnected
RS-422 Electrostatic Discharge Protection	±15KV human body, ±6KV contact discharge per IEC1000-4-2
Maximum Distance	1000 meters (3280 feet)

The RS-422 port is useful for connecting multiple receivers to one transmitter on one network and/or connecting devices to the BRX serial port at much longer distances than RS-232. The RS-422 standard supports distances of up to 1000 meters. The RS-422 serial port can support up to 50 devices, depending on the load of each device (assuming a 19kΩ load for each device).

RS-422 utilizes a differential signal which makes it much more immune to noise and grounding issues than RS-232 and is therefore a much better choice when available for communications.

The wiring for RS-422 is shown below.



General Serial Specifications, continued

RS-485

RS-485 is a multi-point wiring standard that can be used to connect external devices to the BRX serial port.



Pinout	RS-485
1	GND
2	D-
3	D+

General RS-485 Specifications	
Data Rates	1200, 2400, 4800, 9600, 19200, 38400, 57600, and 115200
Default Settings	RS-232, 115200 bps, No Parity, 8 Data Bits, 1 Stop Bit, Station #1
Port Status LED	Green LED is illuminated when active for TXD and RXD
Port Type	3-pin terminal strip 3.5mm pitch
RS-485 Station Addresses	1-247
RS-485 TXD-/RXD-	RS-485 transceiver low
RS-485 GND	Logic ground
RS-485 Input Impedance	19kΩ
RS-485 Maximum Load	50 transceivers, 19kΩ each, 120Ω termination
RS-485 Output Short Circuit Protection	±250mA, thermal shut-down protection
RS-485 Minimum Differential Output Voltage	1.5 VDC with 60Ω load
RS-485 Maximum Common Mode Voltage	-7.5-12.5 VDC
RS-485 Fail Safe Inputs	Logic high input state if inputs are unconnected
RS-485 Electrostatic Discharge Protection	±8KV per IEC1000-4-2
RS-485 Electrical Fast Transient Protection	±2KV per IEC1000-4-4
Maximum Distance	1000 meters (3280 feet)

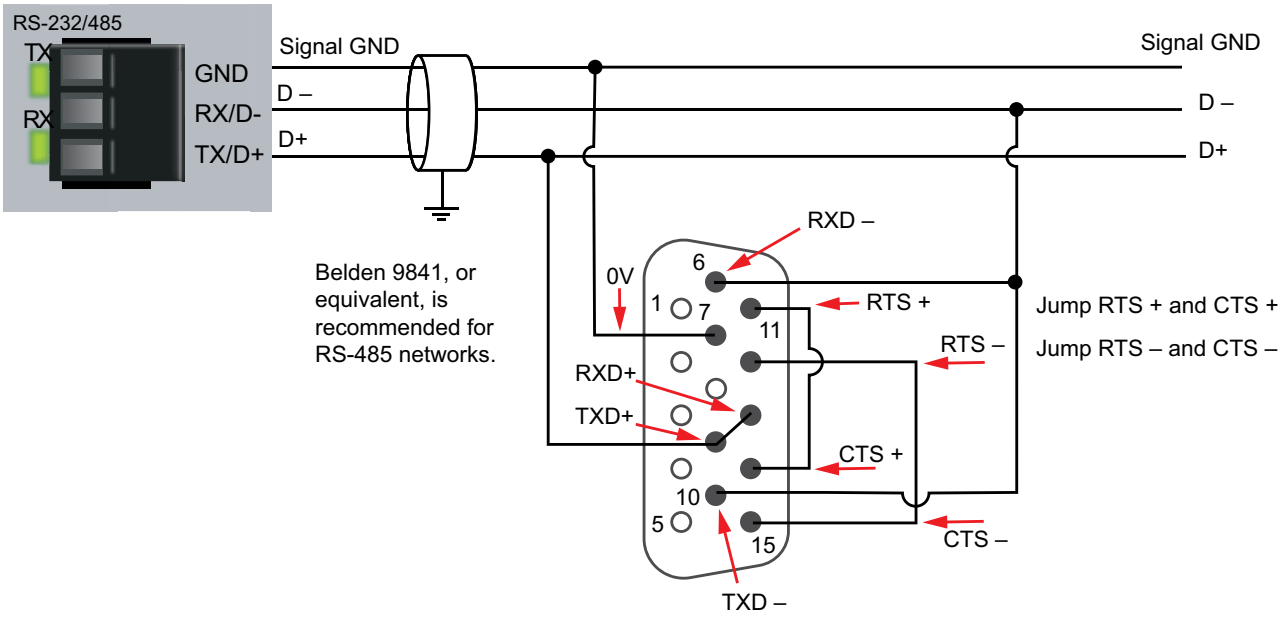
The RS-485 port is useful for connecting multiple devices on one network and/or connecting devices to the BRX serial port at much longer distances than RS-232. The RS-485 standard supports distances of up to 1000 meters without requiring a repeater. The distance can be increased by placing an RS-485 repeater on the network, if necessary. The BRX serial port in the RS-485 mode can support up to 50 devices, depending on the load of each device (assuming a 19kΩ load for each device).

RS-485 utilizes a differential signal which makes it much more immune to noise and grounding issues than RS-232 and is therefore a much better choice when available for communications.

This port only supports RS-485, 2-wire connections. For 4-wire RS-485 or RS-422, a converter, such as an FA-ISOCON must be used.

General Serial Specifications, continued

The wiring for RS-485 is shown below.



MPU Built-in Serial Port Specifications

The RS-232/485 port is a removable three-pin screw terminal block located on the front of the MPU. The port is software selectable to communicate as RS-232 or as RS-485. In the RS-485 mode you can also enable a 120 Ohm termination resistor if needed.



The RS-232/485 port can be connected to the Do-more! Designer programming software, Modbus RTU master or slave devices, C-more HMIs via K-Sequence protocol, as well as devices that send or receive non-sequenced ASCII strings or characters.

Built-in Serial Port Specifications	
Port Name	RS-232/RS-485 Serial Port
Description	Non-isolated serial port that can communicate via RS-232 or RS-485 (software selectable). Includes ESD protection and built-in surge protection. Includes internal biasing to be a true failsafe receiver while maintaining EIA/TIA-485 compatibility.
Supported Protocols	Do-more! Protocol (Default) Modbus RTU (Master & Slave) K-Sequence (Slave) ASCII (In & Out)
Cable Requirements	RS-232 use L19772-XXX from AutomationDirect.com RS-485 use L19827-XXX from AutomationDirect.com
Replacement Connector	ADC Part # BX-RTB03S

POM Specifications

BX-P-SER2-TERM

This RS-232 POM can be connected to the Do-more! Designer programming software, Modbus RTU master devices, C-more HMIs via K-Sequence protocol, as well as devices that send or receive non-sequenced ASCII strings or characters.



Removable Connector Included

BX-P-SER2-TERM Specifications	
Description	Non-isolated Serial port that can communicate via RS-232. Includes ESD protection and built-in surge protection.
Supported Protocols	Do-more! Protocol (Default) Modbus RTU (Master & Slave) K-Sequence (Slave) ASCII (In & Out)
Cable Requirements	RS-232 use L19772-XXX from AutomationDirect.com
Replacement Connector	ADC Part # BX-RTB03S

BX-P-SER2-TERMFC

This RS-232 POM can be connected to the Do-more! Designer programming software, Modbus RTU master devices, C-more HMIs via K-Sequence protocol, as well as devices that send or receive non-sequenced ASCII strings or characters.



Removable Connector Included

BX-P-SER2-TERMFC Specifications	
Description	Non-isolated Serial port that can communicate via RS-232. Includes ESD protection and built-in surge protection.
Supported Protocols	Do-more! Protocol (Default) Modbus RTU (Master & Slave) K-Sequence (Slave) ASCII (In & Out)
Cable Requirements	RS-232 use L19853-XXX from AutomationDirect.com
Replacement Connector	ADC Part # BX-RTB05S

BX-P-SER422-TERM

The RS-422 POM can be connected to the Do-more! Designer programming software, Modbus RTU master devices, DirectLogic PLCs via K-Sequence protocol, as well as devices that send or receive non-sequenced ASCII strings or characters.



Removable Connector Included

BX-P-SER422-TERM Specifications	
Description	Non-isolated Serial port that can communicate via RS-422. Includes ESD protection and built-in surge protection.
Supported Protocols	Do-more! Protocol (Default) Modbus RTU (Master & Slave) K-Sequence (Slave) ASCII (In & Out)
Cable Requirements	RS-422 use L19853-XXX from AutomationDirect.com
Replacement Connector	ADC Part # BX-RTB05S

POM Specifications, continued

BX-P-SER4-TERM



Removable Connector Included

The RS-485 POM can be connected to the Do-more! Designer programming software, Modbus RTU master devices, C-more HMIs via K-Sequence protocol, as well as devices that send or receive non-sequenced ASCII strings or characters.

BX-P-SER4-TERM Specifications	
Port Name	RS-232/RS-485 Serial Port
Description	Non-isolated Serial port that can communicate via RS-485. Includes ESD protection and built-in surge protection. Includes internal biasing to be a true failsafe receiver while maintaining EIA/TIA-485 compatibility.
Supported Protocols	Do-more! Protocol (Default) Modbus RTU (Slave) K-Sequence (Slave) ASCII (In & Out)
Cable Requirements	RS-485 use L19827-XXX from AutomationDirect.com
Replacement Connector	ADC Part # BX-RTB03S

BX-P-SER2-RJ12



The RS-232 RJ12 POM can be connected to the Do-more! Designer programming software, Modbus RTU master devices, C-more HMIs via K-Sequence protocol, as well as devices that send or receive non-sequenced ASCII strings or characters.

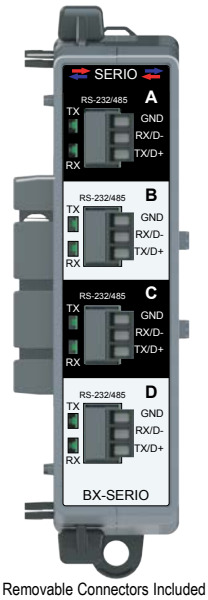
BX-P-SER2-RJ12 Specifications	
Port Name	RS-232 Serial Port
Description	Non-isolated Serial port that can communicate via RS-232. Includes ESD protection and built-in surge protection.
Supported Protocols	Do-more! Protocol (Default) Modbus RTU (Slave) K-Sequence (Slave) ASCII (In & Out)
Cable Requirements	RS-232 use L19772-XXX from AutomationDirect.com

Serial Expansion Modules Specifications

BX-SERIO Expansion Module Specifications

The BX-SERIO expansion module adds four additional serial ports to any BRX system. Up to 8 modules can be added to an MPU depending on the MPU model.

BX-SERIO Expansion Module Port Specifications	
Port Name	RS-232/RS-485 Serial Port
Description	Isolated serial port that can communicate via RS-232 or RS-485 (software selectable). Includes ESD protection and built-in surge protection. Includes internal biasing to be a true failsafe receiver while maintaining EIA/TIA-485 compatibility.
Supported Protocols	Do-more! Protocol (Default) Modbus RTU (Master & Slave) K-Sequence (Slave) ASCII (In & Out) DMX512 (Master & Slave)
Cable Requirements	RS-232 use L19772-XXX from AutomationDirect.com RS-485 use L19827-XXX from AutomationDirect.com
Replacement Connector	ADC Part # BX-RTB03S (4 required)

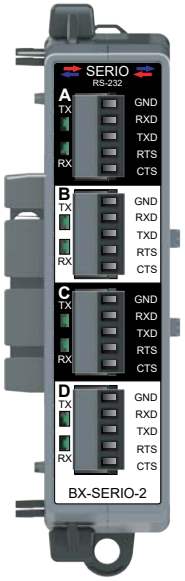


4 Removable Connectors Included

BX-SERIO-2 Expansion Module Specifications

The BX-SERIO-2 expansion module adds four additional serial ports to any BRX system. Up to 8 modules can be added to an MPU depending on the MPU model.

BX-SERIO-2 Expansion Module Port Specifications	
Port Name	RS-232 Serial Port
Description	Isolated serial port that can communicate via RS-232 Includes ESD protection and built-in surge protection.
Supported Protocols	Do-more! Protocol (Default) Modbus RTU (Master & Slave) K-Sequence (Slave) ASCII (In & Out)
Cable Requirements	Use L19853-XXX from AutomationDirect.com
Replacement Connector	ADC Part # BX-RTB05S (4 required)

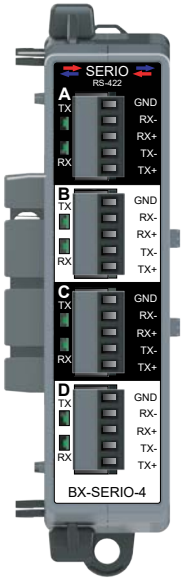


4 Removable Connectors Included

BX-SERIO-4 Expansion Module Specifications

The BX-SERIO-4 expansion module adds four additional serial ports to any BRX system. Up to 8 modules can be added to an MPU depending on the MPU model.

BX-SERIO-4 Expansion Module Port Specifications	
Port Name	RS-422 Serial Port
Description	Isolated serial port that can communicate via RS-422 Includes ESD protection and built-in surge protection.
Supported Protocols	Do-more! Protocol (Default) Modbus RTU (Master & Slave) K-Sequence (Slave) ASCII (In & Out)
Cable Requirements	Use L19853-XXX from AutomationDirect.com
Replacement Connector	ADC Part # BX-RTB05S (4 required)



4 Removable Connectors Included

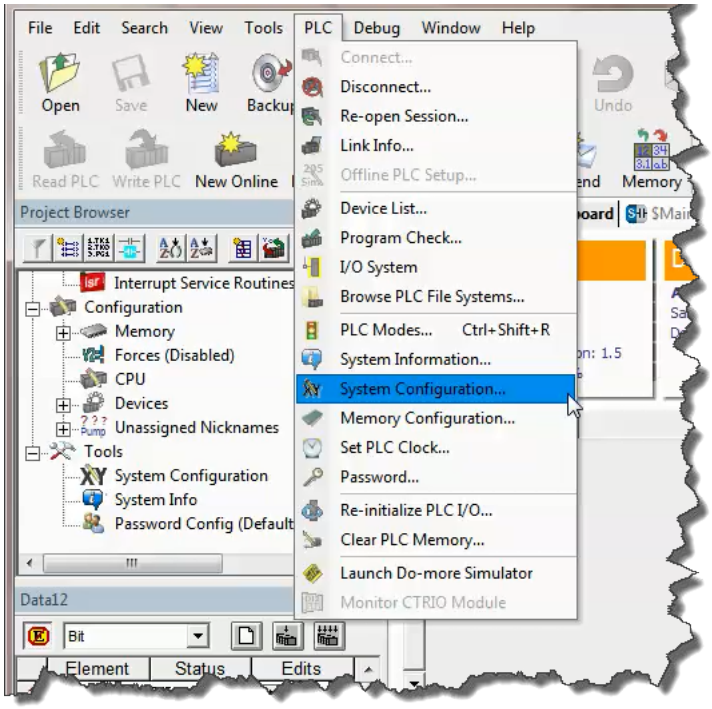
Serial Port Setup and Programming

Serial Port Settings

Setting up your serial port is straightforward. Follow the simple steps below.

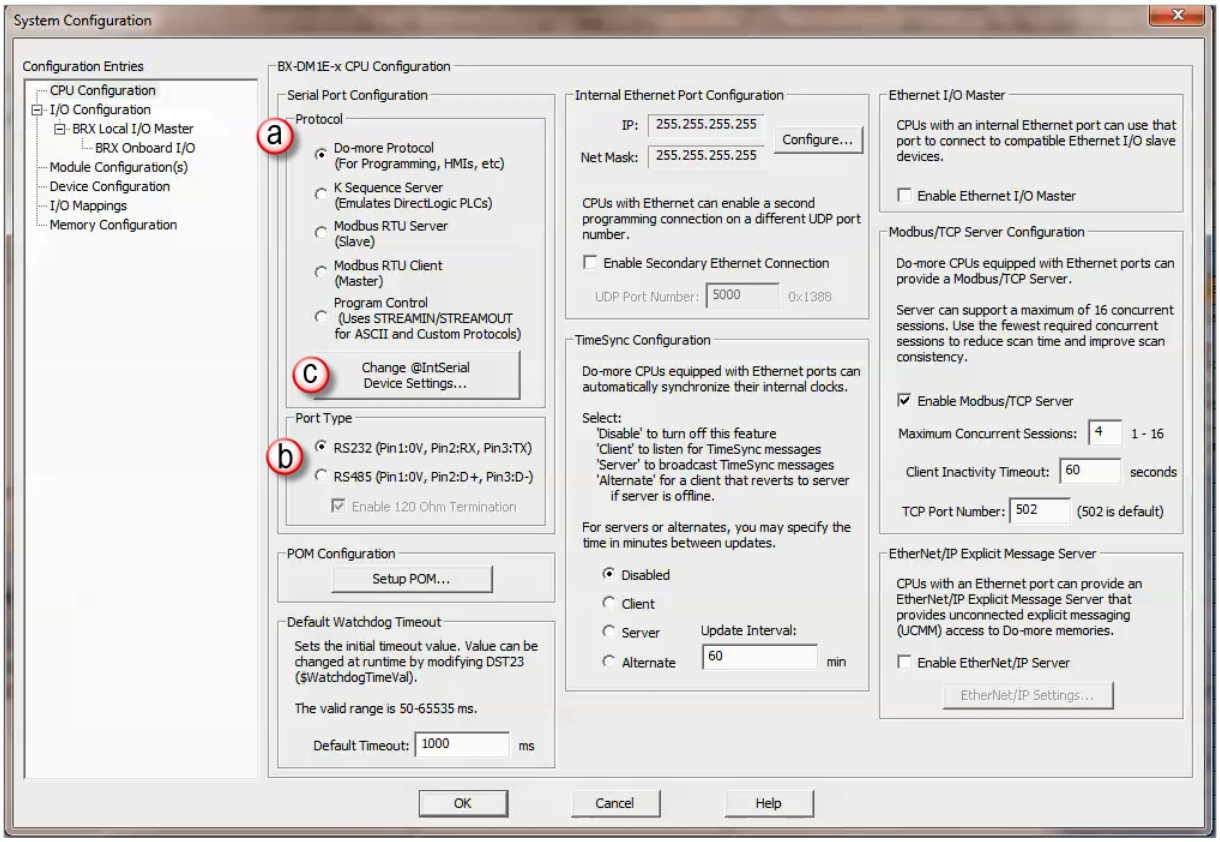
1. You must know what physical medium your connecting device uses.
2. Establish which protocol your device supports.
3. Wire the physical medium using the wiring diagrams for either RS-232 or RS-485 on the previous pages.
4. Select supported protocol from the configuration list in the Do-more! Designer software.
5. Select baud rate, data bits, stop bits and parity for your device.
6. Set the baud, data bits, stop bits and parity to match your device and Do-more! Designer software.
7. If your device is a Client (Master) device such as an HMI, then your setup is completed.
8. If your device is a Server (Slave) device and the BRX Do-more! MPU will be requesting data from it, then some ladder logic must be written. Please refer to the specific section for your chosen protocol. The Do-more! Designer software help file is also a good resource for setting up communications.

To set up your serial communications port in Do-more! Designer, from the PLC drop-down menu at the top of the screen, select **System Configuration**.



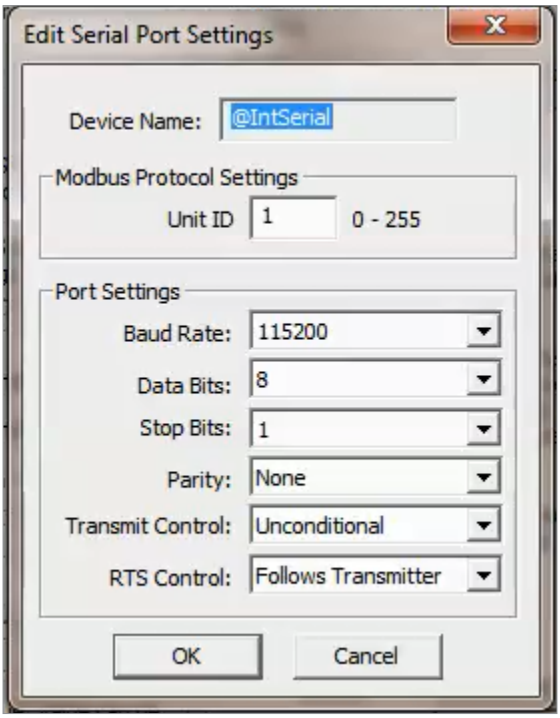
The *System Configuration* dialog will appear. Within this dialog box you can (a) pick the **Protocol** and (b) **Port Type**, whether the port should be used for RS-232 or RS-485.

Serial Port Settings, continued



Once you have selected the desired Protocol and Port Type, click (c) the button labeled **Change @IntSerial Device Settings**.

The ***Edit Serial Port Settings*** dialog (below) will appear. Here you will configure the serial port settings to match any additional device(s) settings. These settings must match exactly in order for the devices to communicate properly.



Serial Port Settings, continued

Unit ID – This is the Modbus protocol identification number when the BRX Do-more! MPU functions as a server (slave) device. For RS-232 this value should always be set to 1. For RS-485, this value will depend on how many other devices are present on the network and how they are to be numbered.

Baud Rate – The rate at which the data is transmitted. The higher the number the faster the data will be transmitted. Choosing a lower value can help with issues when the data is not being received reliably.

Available Baud Rate choices: 115200, 57600, 38400, 19200, 9600, 4800, 2400, 1200

Data Bits – The number of bits in each character.

Available choices: 7 or 8.

Stop Bits – The number of bits sent to denote the end of each character.

Available choices: 1 or 2.

Parity – The method of error detection used during transmission.

Available choices: None, Odd, Even

Transmit Control – Designates when data will be transmitted.

Delayed 5ms, delayed 50ms, delayed 250ms, delayed 500ms – After data reaches the output buffer, the RTS line (internal) will be asserted, and the transmitting of the data will be delayed by the selected number of milliseconds.

RTS Control – There are four settings for RTS Control. Follow Transmitter is the recommended option.

Follows Transmitter puts the RTS line under the control of the transmitter.

Manual allows programmatic control of the RTS line through the structure member IntSerial.RTS.

Off forces the RTS line to always be OFF.

On forces the RTS line to always be ON.

The following options are available when Modbus RTU Client (Master) is selected:

Timeout – how many milliseconds should the instruction wait for the remote Modbus RTU Server (Slave) to respond; this can be any constant from 0 to 32767.

Retries – how many times should the instruction retry the communication with the remote Modbus RTU Server (Slave); this can be any constant from 0 to 255.

Inter-packet Delay – the amount of time (in microseconds) the Modbus/RTU Client (Master) will place between packets as they are sent; this can be any be any constant value between 0 and 65535.

Serial Protocols

The BRX Do-more! MPU supports several Protocol choices for communicating to external devices. In this section we will go over the choices and describe each choice.

Supported Communications Protocols					
Protocol	**Onboard**	**Serial POMs**	**BX-SERIO**	**BX-SERIO-2**	**BX-SERIO-4**
Do-more Protocol (Slave)	X	X	X	X	X
Modbus RTU (Slave)	X	X	X	X	X
Modbus RTU (Master)	X		X	X	X
K-Sequence (Slave)	X	X	X	X	X
ASCII	X	X	X	X	X
DMX512 (Controller)			X		
DMX512 (Slave)			X		

Do-more! Protocol

The Do-more! protocol is a proprietary protocol that is used exclusively by the Do-more! family of controllers. This is a very feature rich and secure protocol that is used to communicate between the Do-more! Designer software and Do-more! controllers. It can also be used to communicate between multiple Do-more! controllers or to other devices such as the C-more HMI and some SCADA systems that support the Do-more! Protocol.

Modbus RTU

Modbus RTU is a protocol overseen by Modbus.org. This is an open standard, meaning that anyone can utilize it freely.

Modbus RTU can be utilized as either a client or server configuration. When using RS-485, Modbus RTU supports a single Client (Master) device communicating to multiple Server (Slave) devices. When using RS-232, Modbus RTU supports a single Client (Master) device communicating to a single Server (Slave) device.

Modbus RTU Server (Slave)

As a Modbus RTU Server, the BRX MPU is functioning as a listening/replying device. When an external Client device requests data from the BRX MPU, the MPU will reply with the appropriate data.

All Modbus data is stored in four sets of registers in the BRX MPU. This memory area is blocked off specifically for Modbus communications. You must place data in these registers in order for a Modbus device to be able to access it.

Modbus		
Register Type	**Register Name**	**Range**
Holding Coil	MC	00000–01023
Input Coil	MI	10000–11023
Holding Register	MHR	40000–42047
Input Register	MIR	30000–31047



NOTE: *Ranges can be expanded in the Memory Configuration section of the Do-more! Designer software as needed.*

Modbus RTU Server (Slave), continued

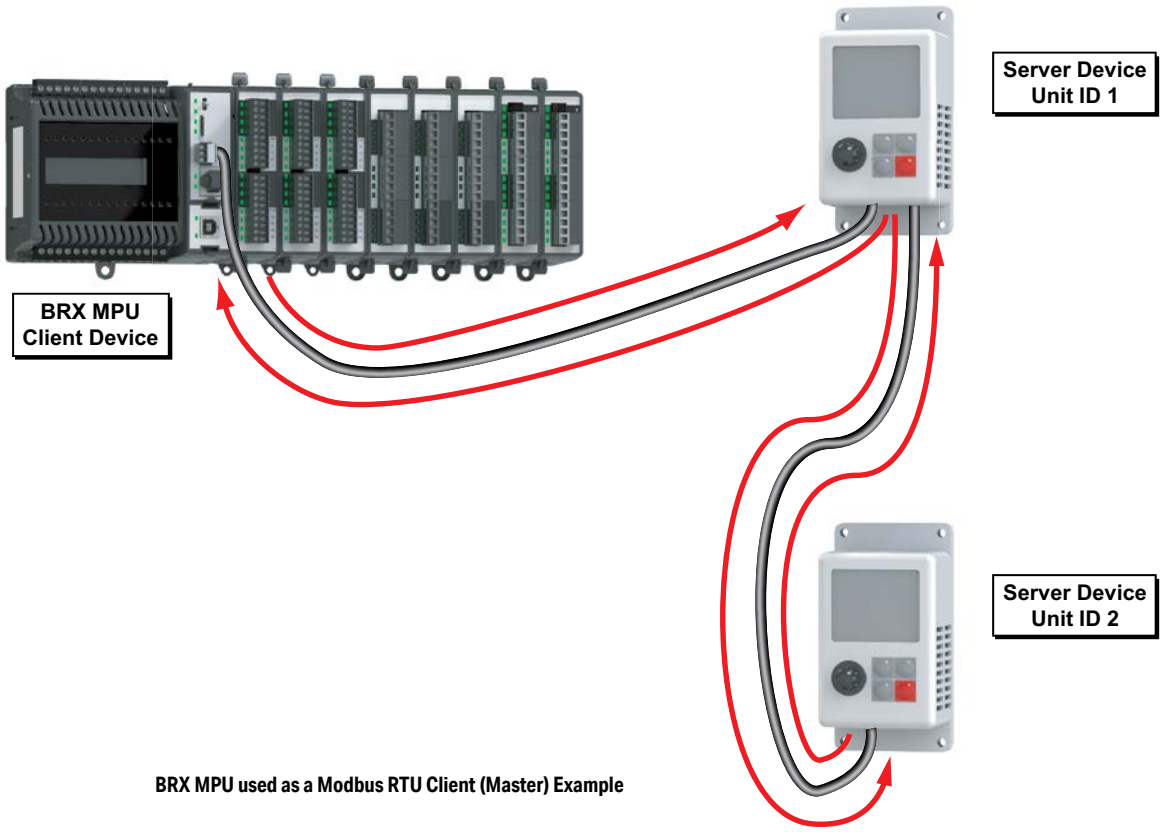
The Modbus data area is loosely data typed and casting or other instructions such as PUBLISH and SUBSCRIBE can be utilized to convert data in this area to the correct data type required. Please reference the Help file on casting, PUBLISH and SUBSCRIBE.

The Modbus RTU Server (Slave) supports the following function codes:

Modbus	
Function Code	**Description**
1	Read coil
2	Read discrete inputs
3	Read holding registers
4	Read input registers
5	Write single coil
6	Write single registers
7	Read exception status
15	Write multiple coils
16	Write multiple registers
22	Mask write registers

Modbus RTU Client (Master)

As a Modbus RTU Client, the BRX MPU is requesting data from a Modbus RTU Server device. In order for this to work, you need to know quite a few things about your Server device such as the function codes that it supports, the data registers that are accessible and possibly the Unit ID or Slave Address.

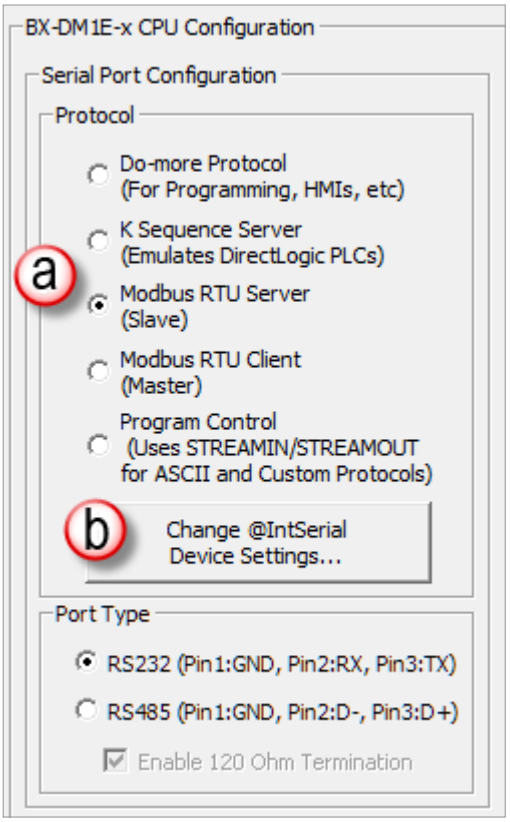


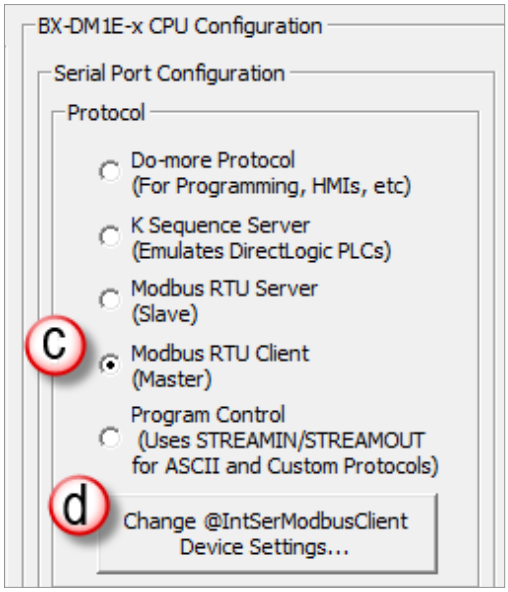
BRX MPU used as a Modbus RTU Client (Master) Example

NOTE: *Only one Modbus RTU Client (Master) can be on a network.*

Modbus RTU Client (Master), continued

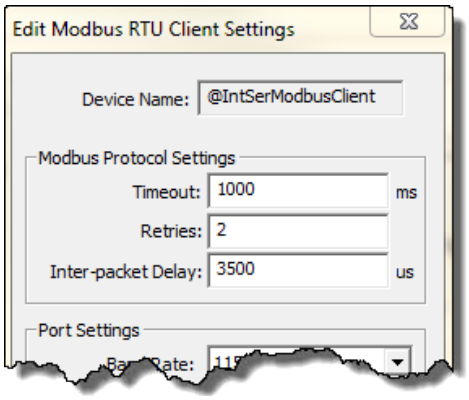
Opening the *System Configuration* dialog box you will find the **Serial Port Configuration** section where you can select the required protocol. Setting the serial port as (a) Modbus RTU Server, select (b) to create a the device @IntSerialDevice. This device will handle all of the communications with the external Modbus Servers through a BRX serial port.





As a Modbus RTU Client, you do not have to sequence the MRX read and MWX write instructions. You can just drop them into your program and they will work in a round robin manner. However, sequencing the instructions will give you better control and allow you to build complex communication patterns to optimally communicate with your devices.

Selecting (c) **Modbus RTU Client (Master)** creates the device @IntSerModbusClient. Clicking on (d) brings up the *Edit Modbus RTU Client Settings* dialog box (below). Here you can configure Modbus Protocol Settings.



Modbus RTU Client (Master), continued

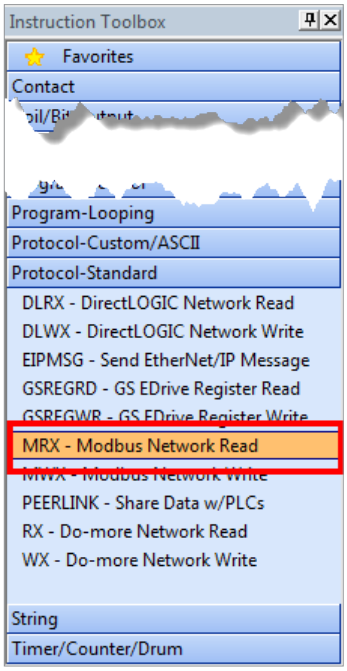
Timeout – Time in milliseconds that the instruction waits for the remote Modbus RTU Server to respond, this can be any constant from 0 to 32767.

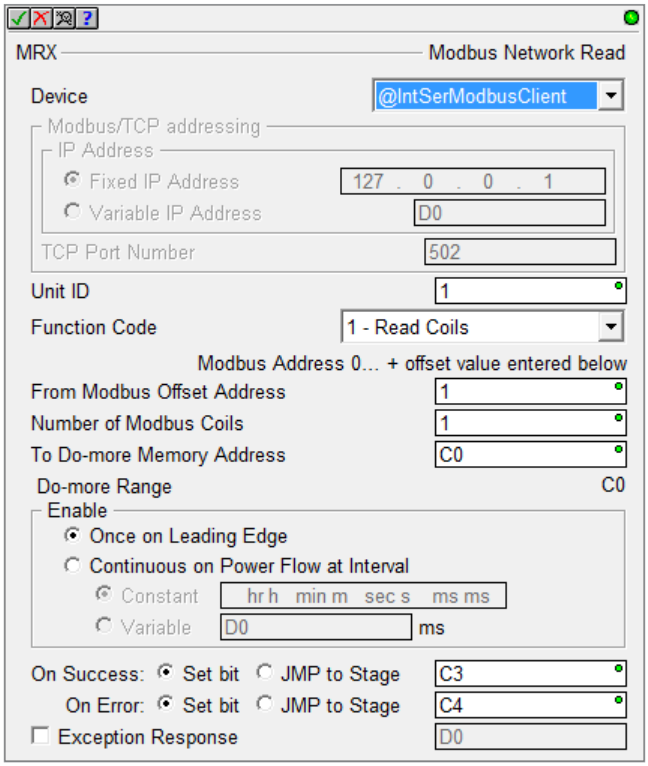
Retries – The number of retries of the instruction to communicate with the remote Modbus RTU Server, this can be any constant from 0 to 255.

Inter-packet Delay – Time, in microseconds, that the Modbus RTU Client will place between packets as they are sent, this can be any be any constant value between 0 and 65535.

MRX Instruction

The MRX instruction, found in the Instruction Tool Box under the Protocol-Standard tab (below), is used to read from a Modbus RTU Server. (For more detailed information please refer to the Do-more! Designer Help files.)





Device – The device associated with the physical port that you want to communicate from. @IntSerModbusClient is the name of the device associated with the built in serial port when set as a Modbus Client (Master).

Unit ID – The ID number of the Server device that the BRX MPU will talk to. Typically this is 1 for RS-232. For RS-485, this number could change depending on which device number you are talking to on the network.

Function Code – Select from the drop-down list one of the following Modbus function codes to use:

1 - Read Coils

2 - Read Discrete Inputs

3 - Read Holding Registers

4 - Read Input Registers

7 - Read Exception Status

MRX Instruction, continued

Modbus Address 0... + offset value entered below:

From Modbus Offset Address – The address in the Modbus Server that you will be reading from. This address may be offset by a value of +1 depending on how the manufacturer followed the Modbus standard..

Number of Modbus Coils/ Registers – Based on the Function Code selected, this selection specifies how many consecutive elements to read. For example, if using function code 3, read holding registers, with an offset of 1, and you request 2 consecutive registers, you will read the value in Modbus addresses 400001 and 400002.

To Do-more! Memory Address – Specifies the beginning address of a range of bits or numeric locations in the MPU where the data that is read will be stored. This data type (bit or register) must match the type expected by the Function Code.

Do-more Range – This is the ending register where the data will be stored at, calculated by taking the To Do-more Memory address and adding the Number of Modbus Coils/Registers value to it.

Enable – Designates how this instruction will operate. Select from one of the following:

Once on Leading Edge – Select this option to have this instruction run to completion exactly one time. Typically, this instruction will take more than one controller scan to complete. Configured this way the instruction is Edge Triggered.

Continuous on Power Flow at Interval – Select this option to have this instruction run as long as the instruction has power flow. After the instruction has initially run, if the instruction still has power flow, the instruction will remain enabled and will wait the specified amount of time before running again. The following options select how much time (in milliseconds) to wait between successive runs. A value of zero milliseconds (0ms) means the instruction will re-run immediately.

On Success – When the instruction completes successfully this action will be performed.

Set Bit – Enable this selection then specify any writable bit location.

JMP to Stage – Enable this selection then specify any Stage number from S0 to S127 in the current Program code-block.

On Error – When the instruction does not complete successfully this action will be performed.

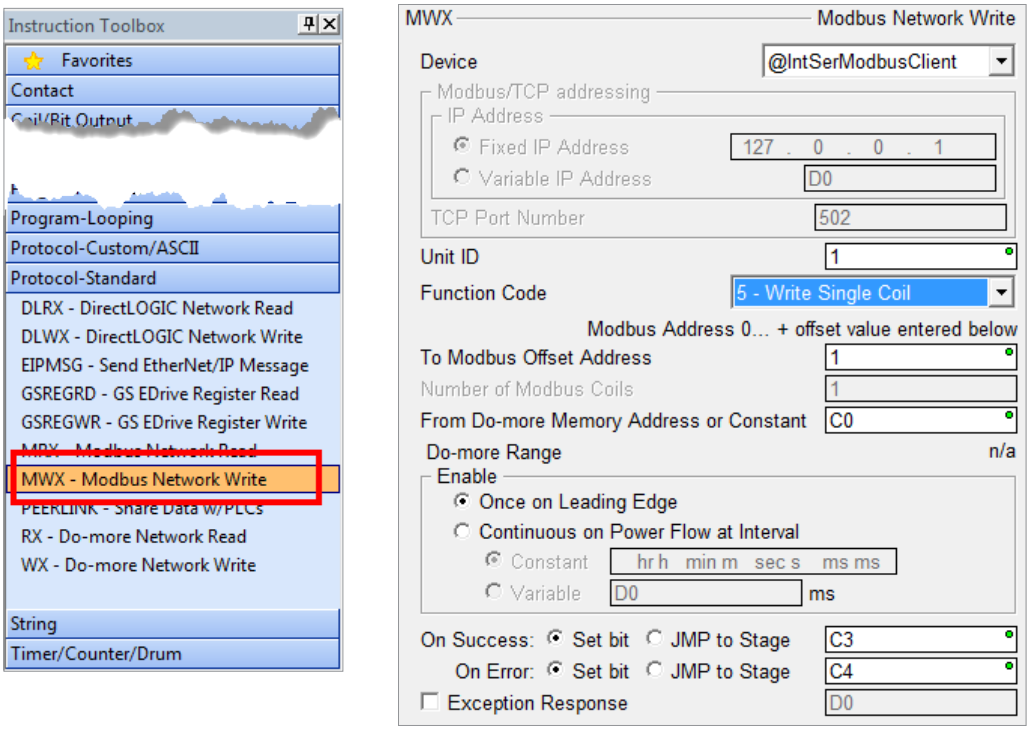
Set Bit – Enable this selection then specify any writable bit location.

JMP to Stage – Enable this selection then specify any Stage number from S0 to S127 in the current Program code-block.

Exception Response – For errors where the message was received properly by the Server device, this will contain a value to indicate why the Server rejected the message. This can aid in troubleshooting the issue.

MWX Instruction

The MWX instruction, found in the Instruction Tool Box under Protocol - Standard (right and below), is used to write to a Modbus RTU Server. (For specific information please refer to the Do-more! Designer help files.)



Device – The device associated with the physical port that you want to communicate from. @IntSerModbusClient is the name of the device associated with the built in serial port when set as a Modbus Client (Master).

Unit ID – The ID number of the Server device the BRX MPU is talking to. Typically this is 1 unless there are multiple devices on the network.

Function Code – Select from the drop-down list one of the following Modbus function codes to use:

5 - Write Single Coil

6 - Write Single Register

15 - Write Multiple Coils

16 - Write Multiple Registers

Modbus Address 0... + offset value entered below:

To Modbus Offset Address – The starting register to which you will be writing data. This address may be offset by a value of +1 depending on how the manufacturer followed the Modbus standard.

Number of Modbus Coils/ Registers – This selection specifies how many consecutive elements to write from the Modbus Offset Address. For example, if using function code 6,write a single register, with an offset of 1, it would write a value to Modbus address 400001.

From Do-more Memory Address – specifies the beginning address of a range of bits or numeric locations in the MPU to where the data will be written. This data type (bit or register) must match the type expected by the Function Code.

MWX Instruction, continued

Do-more Range – This is the ending register from where the data will be written, calculated by taking the From Do-more! Memory address and adding the Number of Modbus Coils/Registers value to it.

Enable – Designates how this instruction will operate. Select from one of the following:

Once on Leading Edge - Select this option to have this instruction run to completion exactly one time. Typically, this instruction will take more than one controller scan to complete. Configured this way the instruction is Edge Triggered.

Continuous on Power Flow at Interval - Select this option to have this instruction run as long as the instruction has power flow. After the instruction has initially run, if the instruction still has power flow, the instruction will remain enabled and will wait the specified amount of time before running again. The following options select how much time (in milliseconds) to wait between successive runs. A value of 0ms means the instruction will re-run immediately.

On Success – When the instruction completes successfully this action will be performed.

Set Bit – Enable this selection then specify any writable bit location.

JMP to Stage – Enable this selection then specify any Stage number from S0 to S127 in the current Program code-block.

On Error – When the instruction does not complete successfully this action will be performed.

Set Bit – Enable this selection then specify any writable bit location.

JMP to Stage – Enable this selection then specify any Stage number from S0 to S127 in the current Program code-block.

Exception Response – For errors where the message was received properly by the Server device, this will contain a value to indicate why the Server rejected the message. This can aid in troubleshooting the error issue.

K-Sequence Server (Slave)

The BRX Do-more! MPU can serve as a K-Sequence server to communicate to legacy devices that utilize the K-Sequence protocol such as C-more HMI, SCADA systems, etc.

All K-Sequence data is stored in four sets of registers in the BRX Do-more! MPU. The memory area is blocked off specifically for K-Sequence communications. You must place data in these registers in order for a K-Sequence Client device to be able to access it.

The K-Sequence data area is loosely data typed. Instructions such as Publish and Subscribe can be utilized to convert data in this area to the proper data type needed as well. Please see the Help file for more information on Casting, PUBLISH and SUBSCRIB (Help topics DMD0309, DMD0073 and DMD0074, respectively).

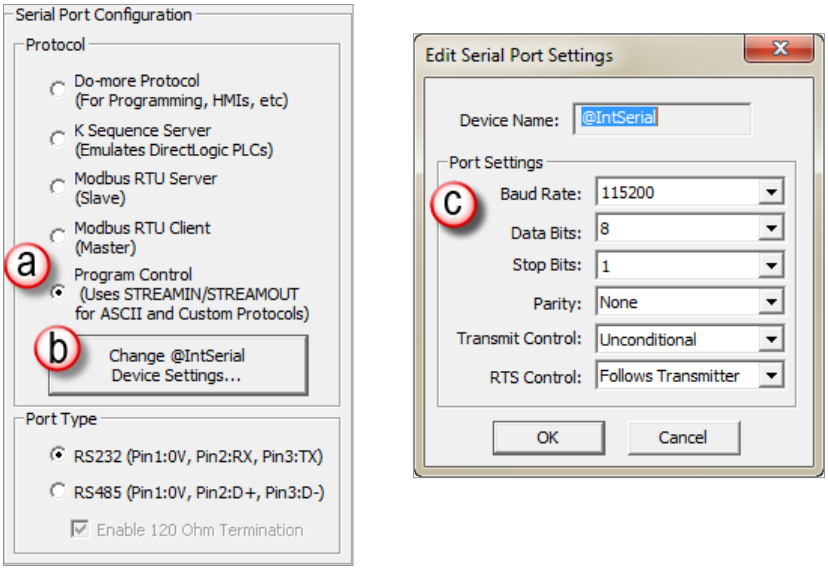
K-Sequence		
Register Type	**Register Name**	**Range**
Input Register	DLX	0–777
Output Register	DLY	0–777
Internal Coil Register	DLC	0–777
Internal Word Register	DLV	0–3777



NOTE: *Ranges can be expanded in the Memory Configuration section of the Do-more! Designer software as needed.*

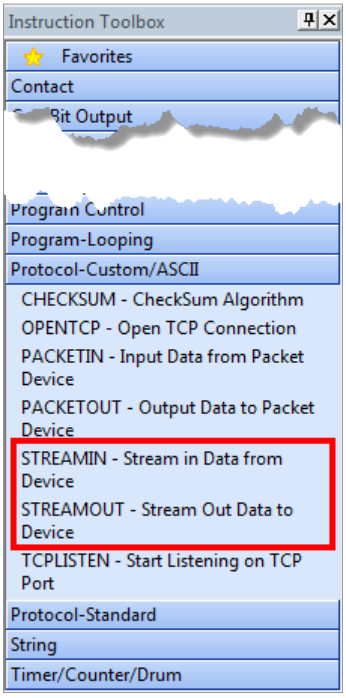
ASCII

The BRX Do-more! MPU can communicate with devices that utilize a non-sequenced or a custom protocol. When using ASCII messaging it is important to know how the external device communicates. This will require knowledge of how the external device expects to send and receive the data. Most ASCII devices have specification guidelines in the user manual that explain the methods needed to facilitate communications. Having this reference handy can be invaluable, saving time while programming instead of struggling with getting the communications working.



Utilizing ASCII as a messaging medium requires that the serial port (a) be set to Program Control. To configure the port settings select (b) the Change @IntSerial Device Settings button. This will bring up the (c) Edit Serial Port Settings dialog. The communications settings here need to match those of the device you are communicating with.

Once set, the STREAMIN and STREAMOUT instructions can be utilized.

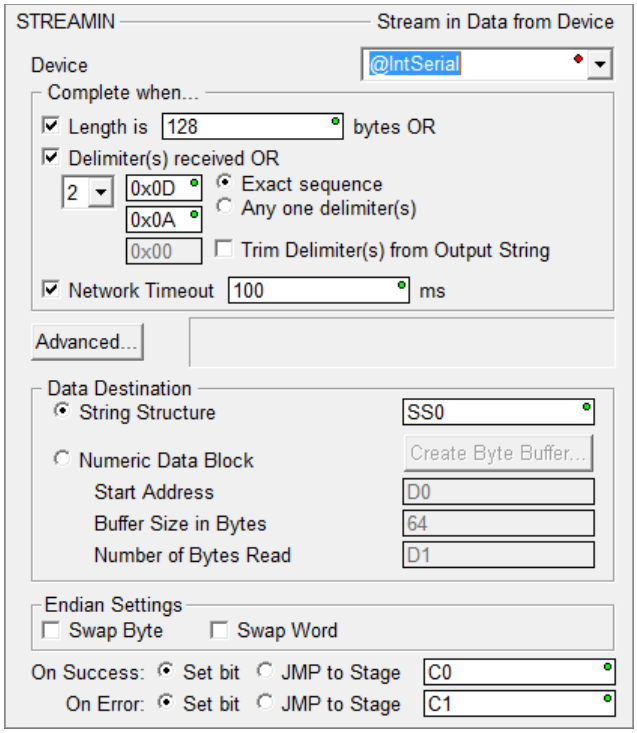


ASCII, continued

One beneficial feature of the BRX Do-more! MPU is that the serial ports are buffered so that bi-directional data transfer is possible without needing the external device to pause between sending and receiving.

ASCII: STREAMIN Instruction

The STREAMIN instruction is found in the ***Instruction Tool Box*** under the ***Protocol-Custom/ASCII*** tab.



Device – The device name associated with the physical port to which you want to communicate. *@IntSerial* is the name of the device associated with the built in serial port for ASCII control.

Complete when...

Length is...bytes OR – Specifies the number of characters received that will signal the completion of the instruction. The OR is used if Delimiter(s) received OR is selected.

Delimiter(s) received OR – Message characters that once received will signal the completion of the instruction. The OR implements:

Exact sequence – The specified characters must be received in the order specified

Any one delimiter(s) – Receipt of any of the specified characters will signal completion.

Trim Delimiter(s) from Output String – Removes the delimiter characters from the Data Destination.

Network Timeout – The maximum amount of time that the instruction waits for completion.

Advanced – When selected a text box opens on the right. Allows the backspace character to remove characters from the received string before being placed into the Data Destination.

Data Destination

String Structure – The String memory location for the incoming data to be stored.

Numeric Data Block

Start Address – The offset into the Byte Buffer Data Block to store the incoming data.

ASCII: STREAMIN Instruction, continued

Create Byte Buffer – Creates a data block of bytes to store the incoming data.

Buffer Size in Bytes – The maximum number of bytes that will be placed in the Byte Buffer Data Block.

Number of Bytes Read – Stores the number of bytes that were read into the Byte Buffer Data Block.

Endian Settings

Swap Byte – Swaps the bytes in each word of incoming data.

Swap Word – Swaps the words in each Double Word of incoming data.

On Success – When the instruction completes successfully this action will be performed.

Set Bit – Enable this selection then specify any writable bit location.

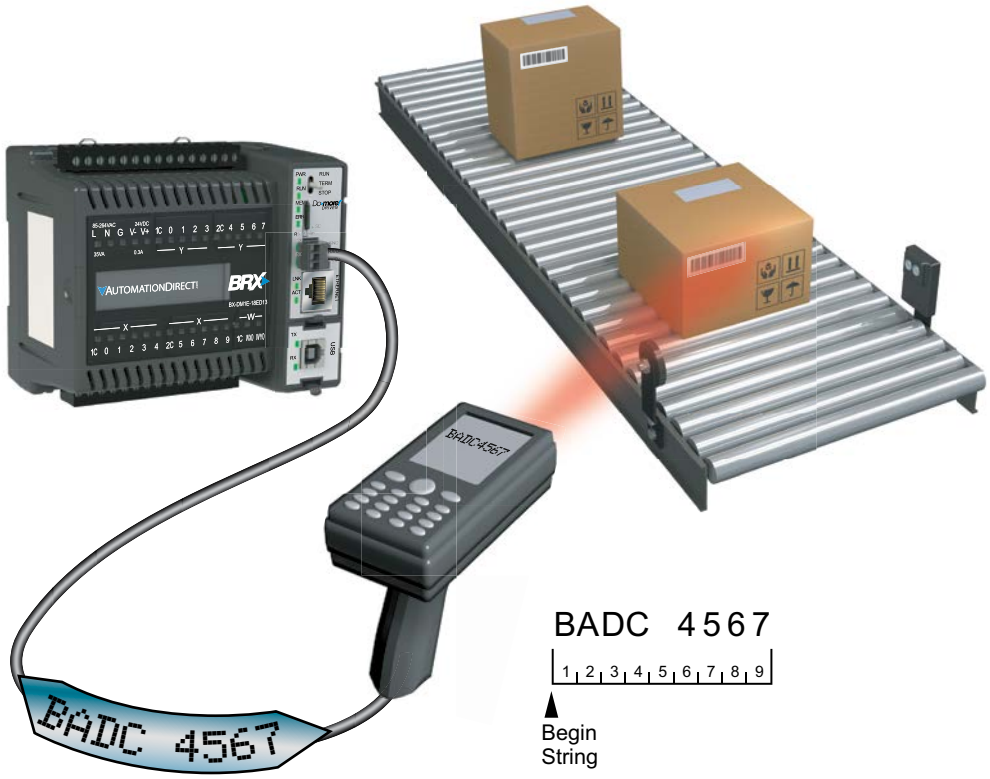
JMP to Stage – Enable this selection then specify any Stage number from S0 to S127 in the current Program code-block.

On Error – When the instruction does not complete successfully this action will be performed.

Set Bit – Enable this selection then specify any writable bit location.

JMP to Stage – Enable this selection then specify any Stage number from S0 to S127 in the current Program code-block.

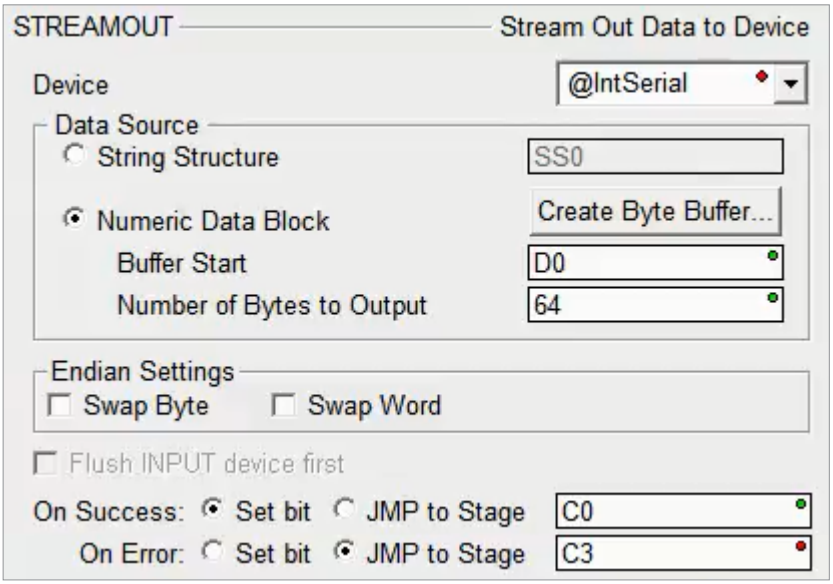
A barcode reader is an example of using STREAMIN and ASCII messaging. The string "BADC 4567" represented by the barcode is transmitted to the MPU as ASCII text with the use of the STREAMIN instruction.



NOTE: *Using @IntSerial.InQueue > 0 is the best way to trigger the STREAMIN function.*

ASCII: STREAMOUT Instruction

The STREAMOUT instruction is found in the Instruction Tool Box under the Protocol-Custom/ASCII tab.



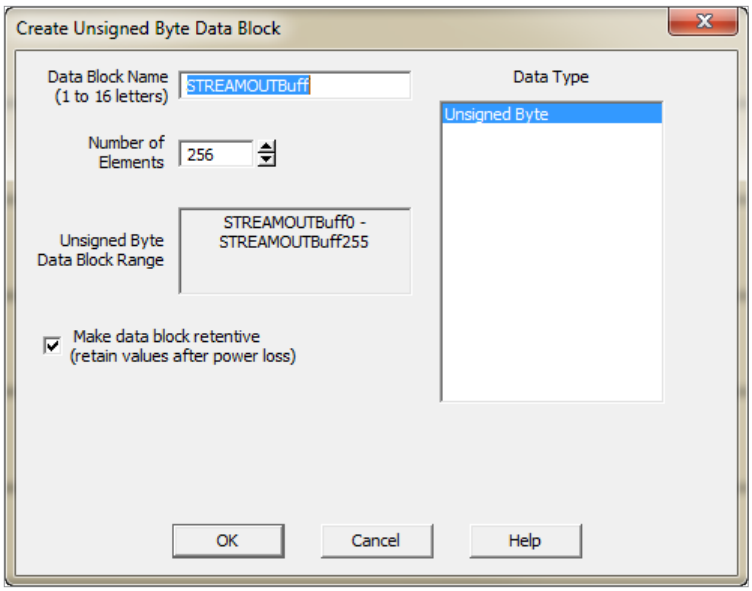
Device – The device associated with the physical port from which you want to communicate. ***@IntSerial*** is the name of the device associated with the built in serial port for ASCII control.

Data Source

String Structure – The String memory location that contains the data to be transmitted.

Numeric Data Block

– **Create Byte Buffer** – Only available when **Numeric Data Block** is selected. Clicking this button opens *Create Unsigned Byte Data Block* box (below). Here you will name and create a data block of bytes to store the data to be transmitted.



– **Buffer Start** – The offset into the Byte Buffer Data Block for the data to be transmitted.

– **Number of Bytes to Output** – The number of bytes that will be transmitted.

ASCII: STREAMOUT Instruction, continued

Endian Settings

Swap Byte – Swaps the bytes in each word of data.

Swap Word – Swaps the words in each Double Word of data.

Flush INPUT device first – Clears the input buffer to ready it for a return response.

On Success – When the instruction completes successfully this action will be performed.

Set Bit – Enable this selection then specify any writable bit location.

JMP to Stage – Enable this selection then specify any Stage number from S0 to S127 in the current Program code-block.

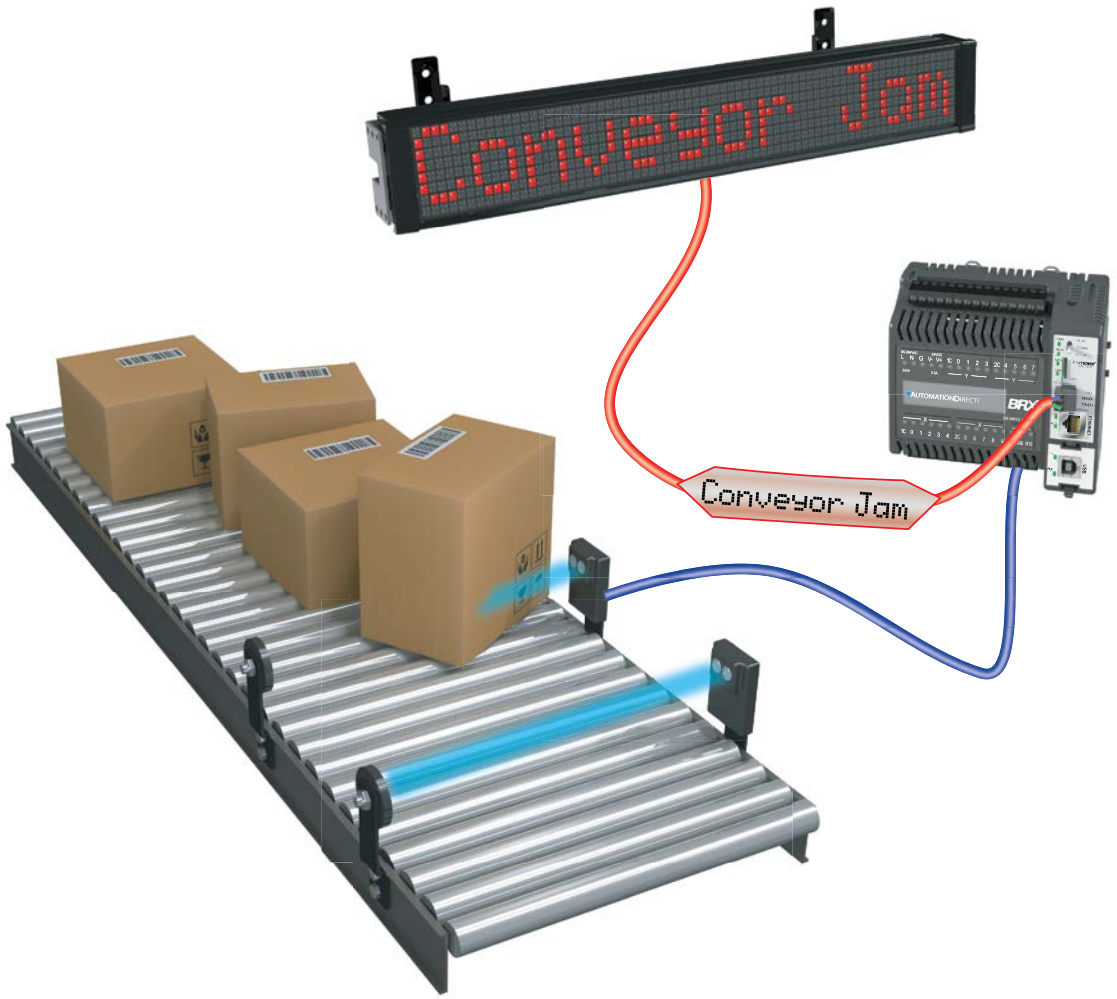
On Error – When the instruction does not complete successfully this action will be performed.

Set Bit – Enable this selection then specify any writable bit location.

JMP to Stage – Enable this selection then specify any Stage number from S0 to S127 in the current Program code-block.

Use of the STREAMOUT instruction and ASCII messaging to display text from the BRX PLC

A sensor on the conveyor triggers a conveyor jam event in the program. The string "Conveyor Jam" is transmitted as ASCII text with the use of the STREAMOUT instruction.



DMX512 (Master & Slave)

DMX512 is commonly used to control stage lighting, dimmers and special effects devices such as fog machines and intelligent lights. DMX can also be used to control non-theatrical interior and architectural lighting as well as electronic billboards.

A DMX512 network is called a "DMX universe." Each communications port on a DMX512 controller can control a single universe.

The physical layer of DMX12 is based on the RS-485 standard. It is unidirectional. It does not include automatic error checking and correction, and so is not an appropriate control for hazardous applications such as pyrotechnics or movement of theatrical rigging.

A DMX512 controller transmits data at 250 kbit/s; one start bit, eight data bits (LSB first), two stop bits and no parity. There are up to 512 bytes of data sent with each transmission. Data transmissions occur approximately 40 times a second. There is no reply from slave units that data was received and no checking for data integrity.

A DMX512 network employs a multi-drop bus topology with nodes strung together in a daisy chain. Each slave device has an IN connector and usually a THRU connector as well.

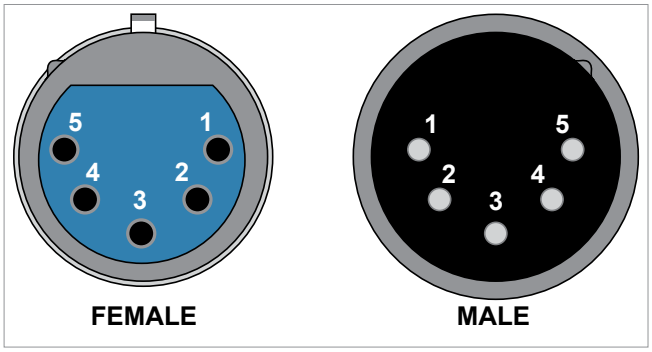
Wiring

Standard DMX512 requires twisted-pair, shielded, low-capacitance data cable designed for RS-485. The DMX512 signal lines require a single termination resistor to be fitted at the physical end of the signal cable. The maximum recommended length of a DMX512 run of cable is 1000 feet.

DMX512 typically uses XLR-5 or RJ-45 connectors, though non-compliant connectors such as XLR-3 are also commonly encountered.

XLR-5 pinout

1. Signal Common
2. Data 1- (Primary Data Link)
3. Data 1+ (Primary Data Link)
4. Data 2- (Optional Secondary Data Link)
5. Data 2+ (Optional Secondary Data Link)



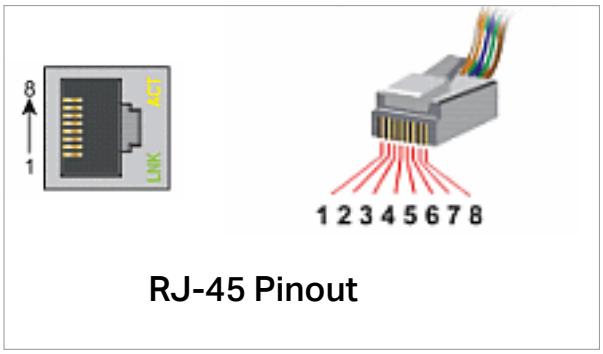
XLR-5 Pinout

DMX512 (Master & Slave), continued

RJ-45 pinout

1. Data 1+
2. Data 1-
3. Data 2+
4. Not Assigned
5. Not Assigned
6. Data 2-
7. Signal Common (0 V) for Data 1
8. Signal Common (0 V) for Data 2

The pinout matches the wiring used by Category 5 (Cat5) twisted pair patch cables.



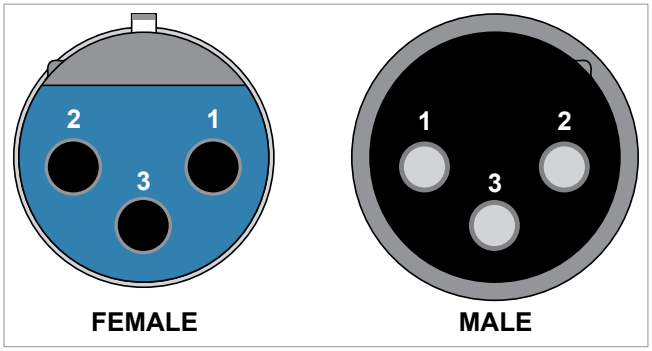
RJ-45 Pinout

XLR-3 pinout (common non-compliant connector)

The most commonly encountered pinout is shown.

1. Ground
2. Data 1+
3. Data 1-

Depending on manufacturer, Pin 2 and Pin 3 may be swapped. Check the device wiring diagram.



XLR-3 Pinout

DMX data

Data for the DMX512 protocol for both master and slave is stored in a structure that is created when the protocol is selected in the serial port setup. If you do not change the name of the serial port, it will default to DMXA to DMXD for serial port 1 to 4 respectively. To access the data, you would use DMXx0 to DMXx511, where x equals A, B, C or D assuming that you did not change the serial port name from default. The values for the data range are between 0 and 255.

Notes:

BRX Do-more!
Ethernet Communications



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Overview

The purpose of this chapter is to help the user gain an understanding of the Ethernet communications capabilities of the BRX MPU. The BRX platform features the Do-more! DM1 technology which has a very robust communications system allowing the programmer to accomplish many tasks that can prove difficult with other PLCs. Many BRX MPUs have a built-in Ethernet port. A Pluggable Option Modules (POM) is also available that will add an additional Ethernet port.

The BRX platform provides a wide variety of Ethernet protocols to choose from and is capable of Ethernet communications to a wide variety of field devices.

The available protocols are:

- Peerlink – This is possibly the easiest of all of the protocols to implement. Consisting of multiple shared areas of memory, you place values into these memory locations and set the instruction to share them with other Do-more! PLCs.
- Do-more! Protocol (Client, Server) – The Do-more! protocol is a proprietary protocol that is used exclusively by the Do-more! family of controllers. This is a very feature rich and secure protocol for communication between Do-more! controllers.
- Modbus TCP (Client, Server) – Modbus TCP is one of the most widely used protocols for PLCs and other industrial devices. This protocol is overseen by Modbus.org. This protocol is an open standard meaning that anyone can utilize it freely. Modbus TCP can be utilized in either a client or server configuration. It supports Clients and Servers in a Peer to Peer fashion.
- HOST Ethernet (ECOM) Protocol (Client, Server) – The BRX Do-more! MPU can serve as a HOST Ethernet protocol client and server to communicate to legacy devices that utilize the HOST Ethernet protocol such as DirectLogic PLCs, C-more HMI, SCADA systems, etc.
- EtherNet/IP: Explicit and Implicit Messaging, Scanner and Adapter – EtherNet/IP is one of the fastest growing Ethernet protocols available today. It is overseen by ODVA.org. Used by a wide variety of PLCs and industrial devices, it has several variants. Explicit messaging is supported by all Ethernet-capable Do-more! Controllers. Implicit messaging is supported for all Ethernet-capable BRX MPUs (not supported by H2 and T1H series Do-More! devices). Both scanner and adapter configurations of Explicit and Implicit messaging are supported.
- SMTP (Email) – All Do-more! CPUs (H2 series, T1H series, and BRX) support unsecure SMTP email services. In addition, the BRX Do-more! CPUs with built-in Ethernet ports support secure SMTP email services that use SSL or TLS encryption.
- Ethernet Remote IO Master – All Do-more! CPUs support the use of remote expansion bases to expand the IO count of the controller. More information on this can be found in Chapter 14 – BRX Remote I/O: BX-DMIO, BX-EBC100 & GS-EDRV100.
- HTTP – BRX MPUs support Hypertext Transfer Protocol (HTTP). The following 5 HTTP commands are supported: GET, HEAD, POST, PUT and DELETE. SSL and TLS encryption are also supported.♥
- MQTT – MQTT was designed as a machine to machine/Interconnected Internet of Things (IIOT) protocol. It is extremely lightweight and useful where bandwidth is at a premium. BRX Do-more! MPUs support both Publish and Subscribe mechanisms to an external broker. BRX Do-more! MPUs cannot be a Broker.

Overview, continued

- SNTP (Time Server) – All Do-more! CPUs support syncing with a time server to synchronize the time. This server can be either local or an Internet based server such as time.nist.gov.
- TCP/IP (Raw packet) – The Do-more! CPUs can connect via raw commands and send and receive packets via TCP/IP. This is useful for creating or replicating a protocol that is not currently supported by the processor. To do this, you will need to have knowledge of the protocol that you wish to use.
- UDP/IP (Raw packet) - The Do-more! CPUs can connect via raw commands and send and receive packets via UDP/IP. This is useful for creating or replicating a protocol that is not currently supported by the processor. To do this, you will need to have knowledge of the protocol that you wish to use.
- DNS Lookup – Do-more! CPUs support looking up URLs via DNS if a DNS server is available. This can be useful for translating URLs to IP addresses that may change frequently such as email server addresses.
- Ping – Ping is a useful IMCP utility that can check to see if an IP address is online and available. This is frequently used with DNS lookup before sending an email to check if the current IP address of an email server is valid.

In addition to this chapter, the software help file is a valuable resource when connecting and communicating with the various protocols needed for these types of devices.

General Concepts

The BRX Do-more! MPU has tightly coupled security features incorporated into it to protect your installation. See the manual section for each protocol and also the Do-more! Designer software help file for more information on password protection and Protocol Specific Memory.

Multiple user accounts are supported and logged when accessed. When programming, session based communication with unique IDs is utilized to prevent unauthorized access.

The Do-more! Protocol can access the full memory structure and is capable of utilizing a security account to protect the data. Some HMIs and SCADA software such as C-more, C-more Micro and Point of View, can utilize the Do-more! Protocol for enhanced security while accessing the full memory area.

Protocol Specific memory areas are blocked out of the User Memory when using Modbus TCP or HOST Ethernet. These memory areas are only accessible externally by using the specific protocol that corresponds to the type of memory being accessed. They are usable by the programmer to pass data externally when using third party devices. This is discussed in more detail in each Protocol section later in this chapter.

Terminology

During the course of this chapter we will use terminology and phrases that are specific to a Protocol or Physical Medium the user should understand. By way of explanation we have included some common terms and definitions in this section. Definitions and explanations of specific parameters particular to each Protocol will be discussed later in this chapter.

Physical Medium – Wires, radios, cellular service, or satellite link. The physical method (hardware) on which the data is being transmitted or received. The physical medium contains no data information. Examples of a physical medium are: RS-232, RS-485 and Ethernet 10/100 Base T.

Protocol – A Protocol is the specification for the formatting of the data (bits, bytes and words) being transmitted through the physical medium. Examples of some common industry protocols are: Modbus TCP and EtherNet/IP.

One way to think of the Physical Medium and the Protocol is to liken them to placing a phone call. The phone call is being placed over wires, cellular service or even perhaps a satellite link. This is the physical medium. Now if the call was to China, you would say "Hello" in English. If the person on the other end understands English, they will respond with "Hello". If the person on the other end only understands Mandarin Chinese they might respond "Ni Hao". If you do not understand Chinese, you will be confused as to what they are saying. This is the same for a Protocol. If your PLC uses Modbus TCP and you try to talk to a PLC that only understands EtherNet/IP, then you will not be able to communicate with it. The Protocols must match in order to communicate.

Client (Master, Scanner) – A Client is a Master device that requests data from a Server (Slave) device. The Client (Master) device initiates communications with a Server (Slave) device. In the EtherNet/IP protocol, the term Scanner is used to indicate this device.

Server (Slave, Adapter) – A Server is a Slave device that responds to a request from a Client (Master) device. The Server (Slave) device listens/replies to requests made by a Client (Master). In the EtherNet/IP protocol, the term Adapter is used to indicate this device.

UDP – User Datagram Protocol (UDP) is part of the Transport Layer of the Internet Protocol Suite. The Transport Layer is Layer 4 in the Open Systems Interconnection (OSI) reference model. UDP is a simple connectionless transport mechanism for Ethernet packets. Checksums are used for data integrity, however it has no error correction or guarantee of delivery. It is considerably faster than TCP/IP due to these factors. It is widely used when data is time sensitive because dropped packets may be preferable to retries and delays.

TCP – TCP or TCP/IP is part of the Transport Layer of the Internet Protocol Suite. The Transport Layer is Layer 4 in the OSI reference model. TCP is defined as a reliable, ordered and an error checked delivery method. TCP/IP is most often used when the data integrity is more important than raw speed.

Field Device – A device external to the BRX MPU.



NOTE: *Software dialog windows and other documentation may interchangeably use the terms Client/Server or Master/Slave when referring to requesting/responding devices in Ethernet or Serial communications. In this chapter, with regards to Ethernet communications, we will use the term Client to refer to a requesting device and Server to refer to a responding device.*

IP Addressing and Subnets

IP Addresses (used in conjunction with the Subnet Mask and Default Gateway address) are used for network routing. This allows for easy and logical separation of networks. It is outside of the scope of this user manual to explain how IP Addresses and Subnet masks are configured for actual usage. There are many books, documents and tools (Subnet calculators) on the Internet that provide this information. Each facility and network will incorporate their own rules and guidelines for how their networks are to be configured.

We suggest that users maintain their IP addressing and Subnets according to common networking practices by using private network addressing when at all possible. Examples of private addressing IP ranges can be found in the table below.

IP Addressing and Subnets

IP Address Range	Typical Subnet	Classful Description
192.168.0.0–192.168.255.255	255.255.0.0	Class C Network
172.16.0.0–172.31.255.255	255.240.0.0	Class B Network
10.0.0.0–10.255.255.255	255.0.0.0	Class A Network



NOTE: *Notice that the IP range of 169.254.0.1 – 169.254.255.254 is not listed above. This range is reserved for APIPA addressing and is not recommended for use with most networks.*

Connecting to the Internet

We recommend that users of PLCs, HMI products and SCADA systems perform your own network security analysis to determine the proper level of security required for you application. However, the Department of Homeland Security's National Cybersecurity and Communications Integration Center (NCCIC) and Industrial Control Systems Cyber Emergency Response Team (ICS-CERT) has provided direction related to network security and safety under an approach described as "Defense in Depth", which is published at https://www.us-cert.gov/sites/default/files/recommended_practices/NCCIC_ICS-CERT_Defense_in_Depth_2016_S508C.pdf.

This comprehensive security strategy involves physical protection methods, as well as process and policy methods. This approach creates multiple layers and levels of security for industrial automation systems. Such safeguards include the location of control system networks behind firewalls, their isolation from business networks, the use of intrusion detection systems, and the use of secure methods for remote access such as Virtual Private Networks (VPNs). Further, users should minimize network exposure for all control system devices and such control systems and these systems should not directly face the internet. Following these procedures should significantly reduce your risks both from external sources as well as internal sources, and provide a more secure system.

It is the user's responsibility to protect such systems, just as you would protect your computer and business systems. AutomationDirect recommends using one or more of these resources in putting together a secure system:

- ICS-CERT's Control Systems recommended practices at the following web address: https://ics-cert.us-cert.gov/Recommended-Practices
- Special Publication 800-82 of the National Institute of Standards and Technology – Guide to Industrial Control Systems (ICS) Security https://csrc.nist.gov/publications/detail/sp/800-82/rev-2/final

Connecting to the Internet, continued

- ISA99, Industrial Automation and Control Systems Security
  http://www.isa.org/MSTemplate.cfm?MicrositeID=988&CommitteeID=6821 (please note this is a summary and these standards have to be purchased from ISA)

The above set of resources provides a comprehensive approach to securing a control system network and reducing risk and exposure from security breaches.

Given the nature of any system that accesses the internet, it is incumbent upon each user to assess the needs and requirements of their application, and take steps to mitigate the particular security risks inherent in their control system.

Troubleshooting Ethernet Communications

Troubleshooting communications can seem frustrating to the novice because you cannot see what is happening in real time. However, most communications troubleshooting is straightforward if you take the right steps. Below are some recommendations for troubleshooting when a device does not communicate.

1. Communications is not instantaneous. This is a common misconception with Ethernet because Ethernet communications tends to be fast. It does take time for transactions to complete.
2. Ethernet has a capacity. This goes hand in hand with #1. Ethernet communications does have limits on capacity. It is not a "set everything at max" medium. Poll times may need to be adjusted to give everything some "breathing room".
3. IP addresses and subnets must match. Ethernet communications will fail if the IP addressing, subnets and/or gateways are not set properly.
4. Managed switches and routers will not always pass every Ethernet packet. Most block broadcast transmissions by default. This can cause issues depending on what you are trying to do.
5. Ethernet communications over the Internet can be extremely slow due to latency. This needs to be taken into account when trying to do long distance communications.
6. Cellular modems can cause issues with Ethernet communications due to overall slowness, latency and a technique called packet bursting. Packet bursting (or Frame bursting) is where the cell modem and/or the cell tower stores multiple Ethernet packets and then pushes them out all at once without regard for the proper waiting period. While this is allowed by wireless standards, wired devices connected to a wireless modem or router can have issues with this technique.
7. Ethernet is inherently good at handling noise. This does not mean that Ethernet is immune to noise issues from VFDs, welders, coils, contactors, etc. This is especially true when the Ethernet switch is powered by the same power supply as other noise producing industrial devices. For best immunity, put the Ethernet switch on its own power supply.
8. Ethernet switches, hubs, routers, etc. can have a single or sometimes multiple bad ports that may be causing issues. This is a rare occurrence, but it is possible. Try a different device and see if it helps the issue.
9. Ethernet cables can cause issues as well. Try a different cable.
10. If you are using wireless Ethernet and having issues, try using the devices in a wired configuration to see if the issue is with the wireless device or if it is a configuration issue.
11. Ethernet devices can suffer from timeouts due to latency. Try extending the timeout period to see if that is the issue. Ping is a useful command to use from your PC as well as the PLC to see the potential

Troubleshooting Ethernet Communications, continued

latency of a connection. A rule of thumb for setting timeouts is to start with the maximum ping time multiplied by at least 150%. So, if you have a ping time of 250ms, you should use at least 375ms as your timeout. Note that this is a starting point for adjusting the timeout and not a hard number that will work for every situation.

Ethernet Traffic Congestion

While several protocols can be enabled on the BRX Do-more! CPU Ethernet port, it should be noted that Ethernet can handle a finite amount of traffic. The amount of traffic load on the Ethernet port should be considered and polling times for Clients adjusted accordingly to allow ample time for the BRX Do-more! CPU to respond to and create requests for other devices.



NOTE: *Care should be taken when adding a BRX Do-more! MPU to an existing network as some protocols can create a significant traffic load.*

Communications Design

The BRX platform features the Do-more! DM1 technology which has a very robust communications system allowing the programmer to accomplish many tasks that can prove difficult with other PLCs. The DM1 technology manages the asynchronous actions of communications in the background without taking a huge hit on the PLC scan time.

Managing Communications Devices

When you make a connection with an Ethernet protocol as a Client (Master) in a Do-more! Processor, you will have created a "Device" for that connection. Each Client Device has its own timeout settings. To take full advantage of this feature, it is advisable to create a Client Device for each Server (Slave) that you will be talking to. This allows for other Ethernet communications to continue uninterrupted if one of the Servers (Slaves) falls offline. See Help topic DMD0248 in the Do-more! Designer Software for more information on creating additional Client Devices.

Modbus/TCP can benefit from using multiple Devices to manage connections because the TCP connection must be shut down and restarted for each Client (Slave) that it talks to. Think of each Device as a telephone. If I have one, I must call, talk, and hang up for each target. If I have four phones, I can call each target individually and keep all lines open. Devices work the same way. By having multiples, you can achieve faster turn around times in your communications.

Port Numbers

When doing TCP and UDP/IP communications, there is a Source Port number and Destination Port number for every message. The Client device must be aware of the Destination Port Number(s) the Server device is expecting to see, while the Server device must listen for this Destination Port number. After the Server device has received the message with the Destination Port Number on which it is listening, it will formulate the return message (if the applications require this) with the Source Port Number from the message sent as its Destination Port Number.

It is important to understand a little about the Port numbering concept because many Ethernet devices, such as routers with firewalls, will block messages with Destination Port numbers that are not configured for that device. Listed below are the default Port Numbers used in the BRX Do-more! platform. Some of the Port Numbers are configurable, allowing more flexibility when going through many different router applications.

Default Port Numbers

Ethernet	Port Numbers	TCP or UDP	Configurable
Peerlink	28784	UDP	No
Do-more! Protocol (Client, Server)	28784	UDP	Yes*
Modbus TCP (Client, Server)	502	TCP	Yes
HOST Ethernet Protocol (Client, Server)	28784	UDP	No
EtherNet/IP: Explicit/Implicit Messaging Scanner/Adapter	44818	TCP	Yes
SMTP (Email)	25	TCP	Yes
Ethernet Remote I/O	28784	UDP	No
HTTP	80, 443	TCP	Yes
MQTT	1883	TCP	No
SNTP (Time Server)	123	TCP	No
TCP Raw Packet	User defined	TCP	Yes
UDP Raw Packet	User defined	UDP	Yes

** Secondary Ethernet Connection can be enabled for the built-in Ethernet port of a BRX MPU. By default it has a UDP Port Number of 5000. It can be configured to any decimal number between 5000 and 65535, except for 28784.*

Sequencing Communications

The easy way

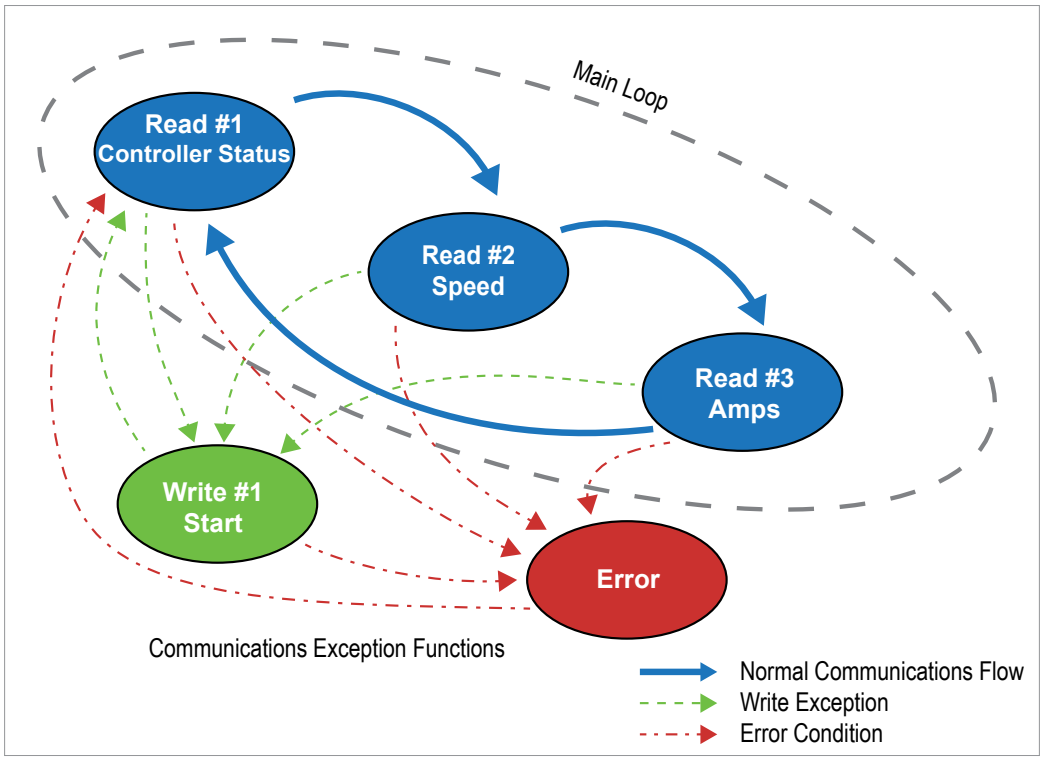
In many PLCs the programmer must manage the communications sequencing. This can be frustrating and time consuming to get the communications working correctly especially when you have multiple requests to handle. The DM1 technology eliminates this frustration and will simply manage each Comm request in the order that the program initiates a request. You no longer must write code to sequence and manage each request. For some applications this is enough to do what the programmer needs to accomplish.

More advanced sequencing – State Machines

State machines have been used to sequence communication sequences for a very long time. The reason for this is that communications by definition consists of always being in a particular state and transitioning to a different state based on some action. This is all that there is to state machine programming; do an action and wait for something to happen, then move to a different action.

Do-more! supports state machine programming. This is accomplished by the use of Stages. Stage programming has been around a long time and Do-more! PLCs take full advantage of Stage programming. For more information on Stage Programming see Do-more! Designer Help topic DMD0502.

For an example on State Machine programming using Stages, consider talking to a variable speed motor controller. What are the conditions to talk to the motor controller? By drawing out the conditions, you can see that there are definite conditions or states that the communications to the motor controller will be going through.



In this example we can see that we have three reads from the device and one write condition. We can also see that we need an error handling condition. The beauty of drawing the state machine conditions out in a flow chart format is that it allows you to easily see and translate the conditions to Ladder Logic code.

Sequencing Communications, continued

Main loop:

Read #1 – Read the Controller status word. This might consist of whether the drive is running, jogging, in error, etc.

Read #2 – Read the Controller speed. How fast is it running?

Read #3 – Read the amp draw. Is it within limits?

Main loop end

Things that happen occasionally:

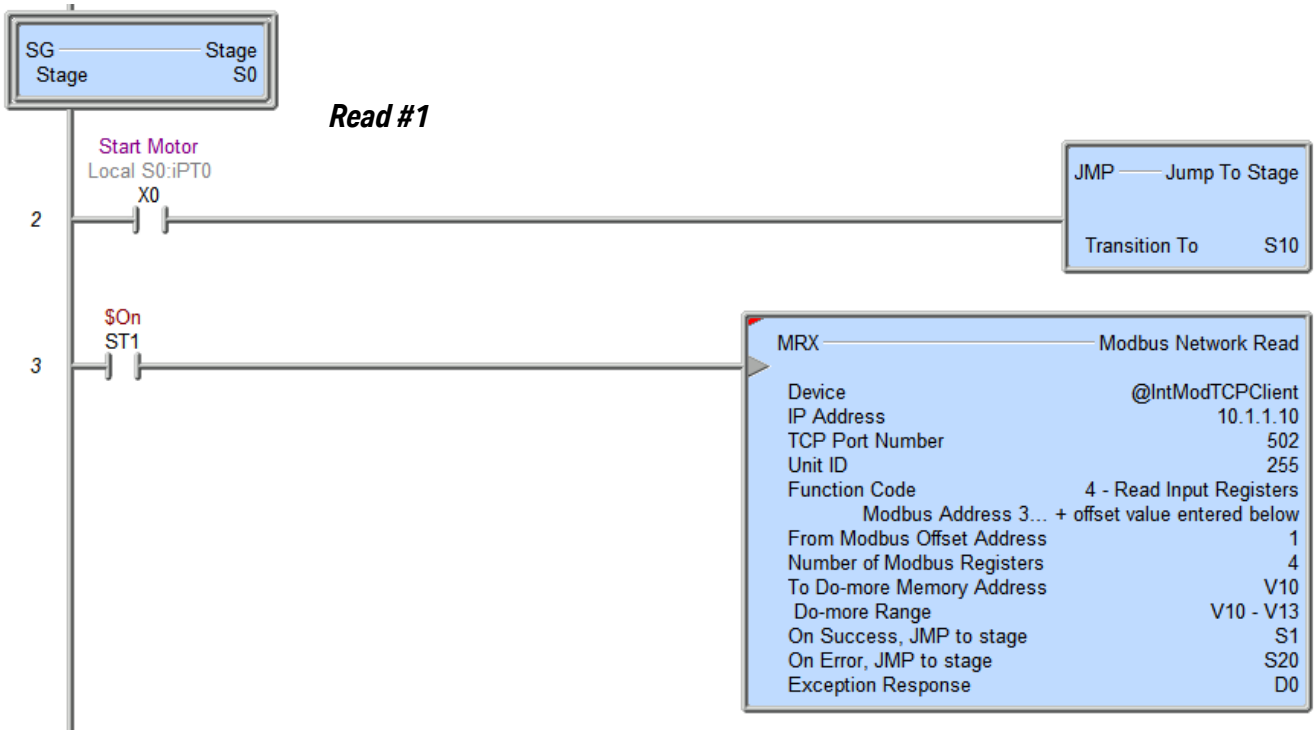
Write #1 – Start the Controller running.

Error – Something bad happened to the communications. What do we need to do to flag this as a problem?

An implementation of this State Machine in ladder logic is shown below. Since the Do-more! Communication instructions have built in transitioning between Stages based on Success or Error, this eliminates a lot of programming. To accomplish the diagram the only manual transitioning that needs to occur is for the Write to start the motor controller.

While this example is somewhat incomplete in that it does not have provisions for stopping the drive or other potential needs, it does serve to show how State Programming can help to make transitioning between communications states relatively easy in the Do-more! Controller.

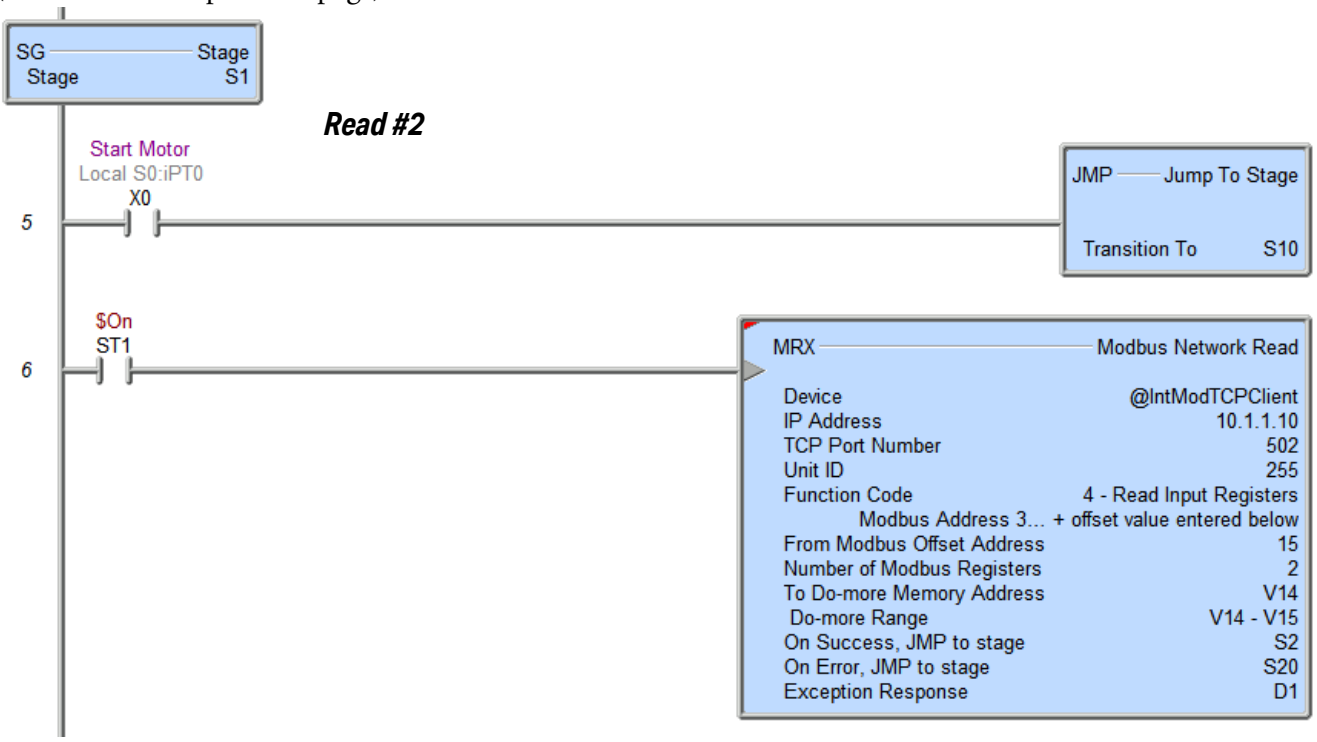
Main loop:

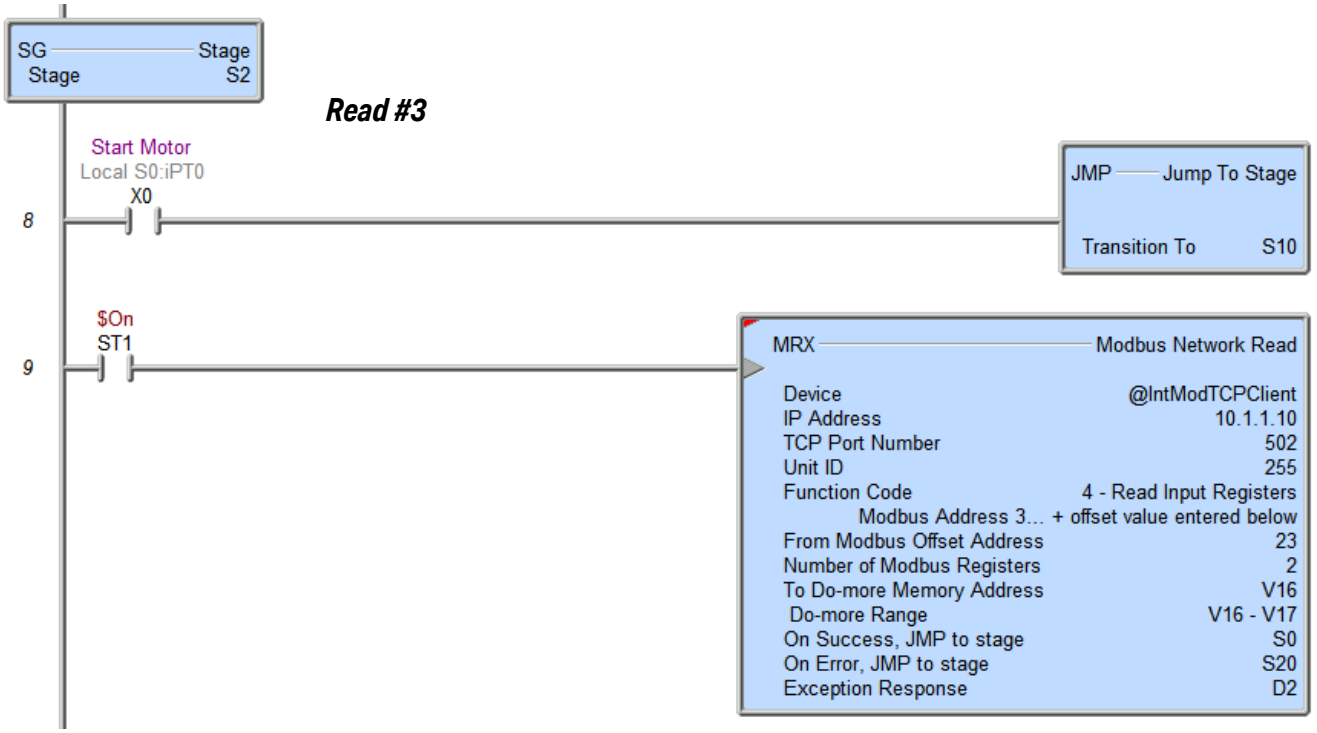


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Sequencing Communications, continued

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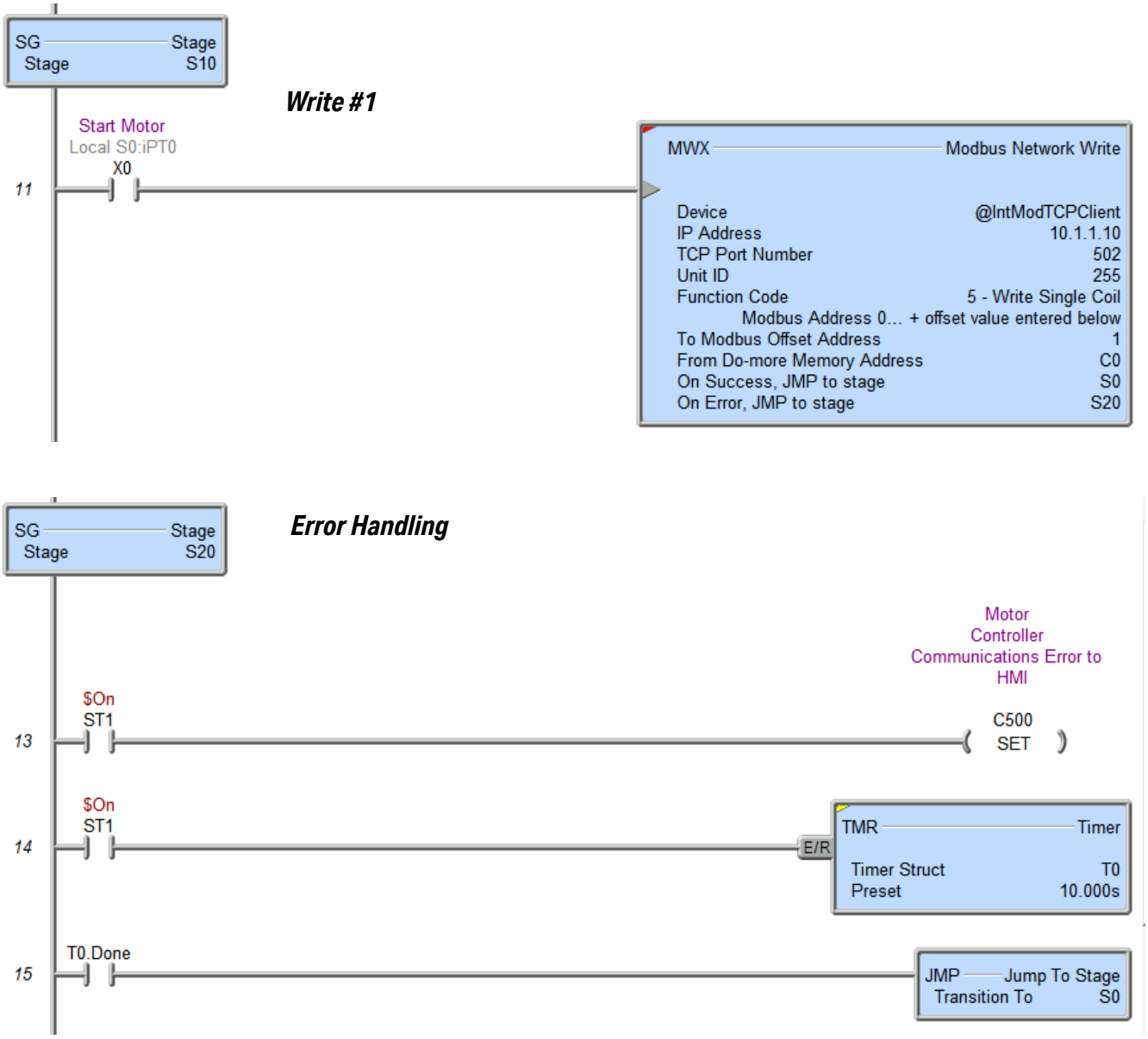
Main loop end

(continued on next page)

Sequencing Communications, continued

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Things that happen occasionally:



Ethernet

There are multiple options when doing Ethernet communications with a BRX PLC. Some MPUs have a built in Ethernet port. The BRX POM modules also have an Ethernet option.

See the table below for a matrix of what protocols are supported by the different communications options.

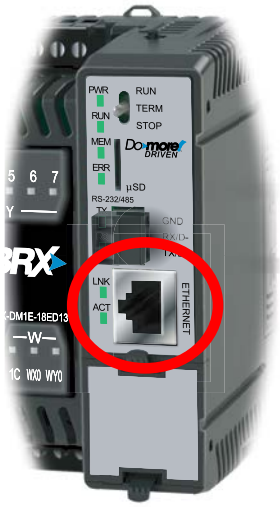
Supported Ethernet Communications Protocols

Protocol	Onboard	Ethernet POM BX-P-ECOMLT	Ethernet POM BX-P-ECOMEX
Peerlink	X		X
Do-more Protocol (Slave)	X	X	X
Modbus TCP (Client)	X		X
Modbus TCP (Server)	X	X	X
HOST Ethernet (Client)	X		X
HOST Ethernet (Server)	X	X	X
EtherNet/IP Explicit/Implicit Scanner	X	X	X
EtherNet/IP Explicit/Implicit Adapter	X	X	X
SMTP (Email)	X		X
Ethernet Remote I/O (Master)	X		X
HTTP	X		X
Embedded Web Server: HTTP (Unsecure)	X		X
MQTT	X		X
SNTP (Time Server)	X		X
TCP/IP Raw Packet	X		X
UDP/IP Raw Packet	X		X
DNS Lookup	X		X
Ping	X		X

MPU Built-in Ethernet Port

The RJ-45 Ethernet port connector is located on the CPU faceplate. Rated at 10/100 Mbps, it accepts standard CAT5e cable and has built-in auto-crossover capability.

Ethernet Port Specifications	
Port Name	ETHERNET
Ethernet Port Type	RJ45, CAT5e, 10/100 BASE-T, Auto Crossover
Description	Standard transformer isolated Ethernet port with built-in surge protection
Transfer Rate	10 Mbps and 100 Mbps (Green LED)
Port Status LED	LED is solid when network LINK is established. LED flashes when port is active (ACT).
Supported Protocols	Peerlink Do-more! Protocol (Client, Server) Modbus TCP (Client, Server) HOST Ethernet Protocol (Client, Server) EtherNet/IP: Explicit Messaging Scanner/Adapter Implicit Messaging Scanner/Adapter SMTP (Email) HTTP Embedded Web Server: HTTP (Unsecure) MQTT SNTP (Time Server) TCP/IP (Raw packet), UDP/IP (Raw packet)
Cable Recommendation	C5E-STxxx-xx from AutomationDirect.com
Ethernet Port Numbers	
Modbus TCP	502 (configurable), TCP
EtherNet I/P	44818 (configurable), TCP
Embedded Web Server	80, TCP (unsecure)
HOST Ethernet Protocol	28784, UDP
Do-more! Protocol	28784, UDP



Ethernet POMs

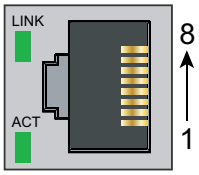
The Ethernet LT POM and EX POM can be connected to the Do-more! Designer programming software or HMI's that support the Do-more!, Modbus, or K-sequence protocol. The LT POM functions only as a server device.



BX-P-ECOMLT



BX-P-ECOMEX



Pin #	Signal
1	TXD+ Transmit Data
2	TXD- Transmit Data
3	RXD+ Receive Data
4	N/C
5	N/C
6	RXD- Receive Data
7	N/C
8	N/C

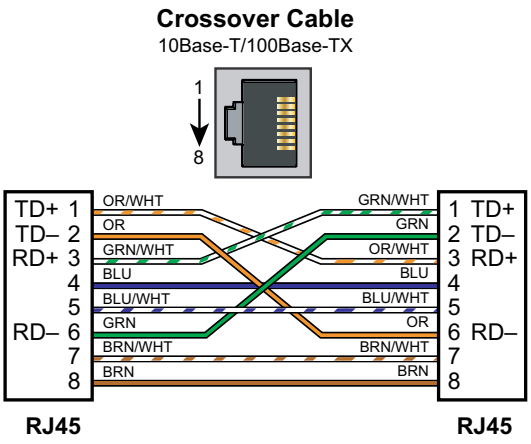
BX-P-ECOMLT and BX-P-ECOMEX Specifications

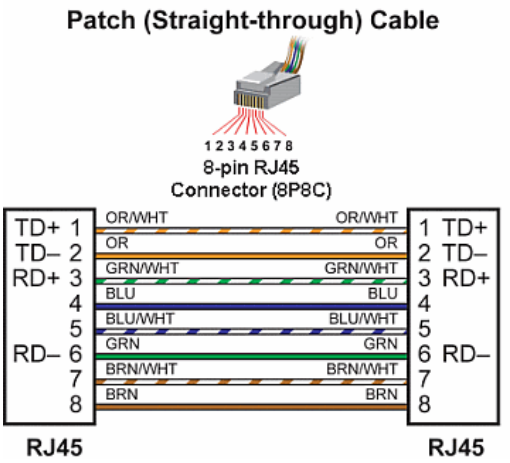
	BX-P-ECOMLT	BX-P-ECOMEX
Description	Standard transformer isolated Ethernet port with built-in surge protection.	
Compatibility	Any BRX MPU	Only BRX MPUs with a built-in Ethernet port
Transfer Rate	1 Mbps throughput max	10/100 Mbps
Port Status LED*	LINK LED is solid when network link is established. ACT LED flashes when port is active.	
Supported Protocols and Port Numbers:		
Peerlink	–	28784, UDP
Do-more! Protocol (Client)	–	28784, UDP
Do-more! Protocol (Server)	28784, UDP	28784, UDP
Modbus TCP (Client)	–	502, TCP
Modbus TCP (Server)	502, TCP	502, TCP
K-sequence (Server)	28784, UDP	
Programming/Monitoring	28784, UDP	
HOST Ethernet Protocol (Client, Server)	–	28784, UDP
EtherNet/IP: Explicit/Implicit Messaging Scanner/Adapter	–	44818, TCP
SMTP (Email)	–	25, TCP
Ethernet Remote I/O	–	28784, UDP
HTTP, HTTPS	–	80, 443, TCP
Embedded Web Server (Unsecure)	–	80, TCP
MQTT, MQTTS	–	1883, 8883, TCP
SNTP (Time Server)	–	123, TCP
TCP Raw Packet	–	User defined, TCP
UDP Raw Packet	–	User defined, UDP
FTP (Client)	–	20, 21, TCP
DHCP	–	67, 68, UDP
Cable Recommendation	C5E-STxxx-xx from AutomationDirect.com	
Maximum Distance	100 meters (328 feet)	
Port Type	RJ45, Category 5, Auto Crossover	
Hot Swappable	Yes	
Software Version Required	Do-more! Designer version 2.0 or later	Do-more! Designer version 2.8 or later (version 2.10 or later required for EtherNet/IP Implicit Messaging)

1. Link LED will Blink when no cable is attached, showing that the POM has a connection to the CPU and is waiting for a working link.

Wiring

The Ethernet port on the BRX Do-more! CPU's utilizes standard networking cables and devices. Category 5e cabling is preferred. Cables can be either patch (straight through) or crossover as the BRX Do-more! CPU Ethernet port has Auto MDI detection.





Ethernet Port Setup

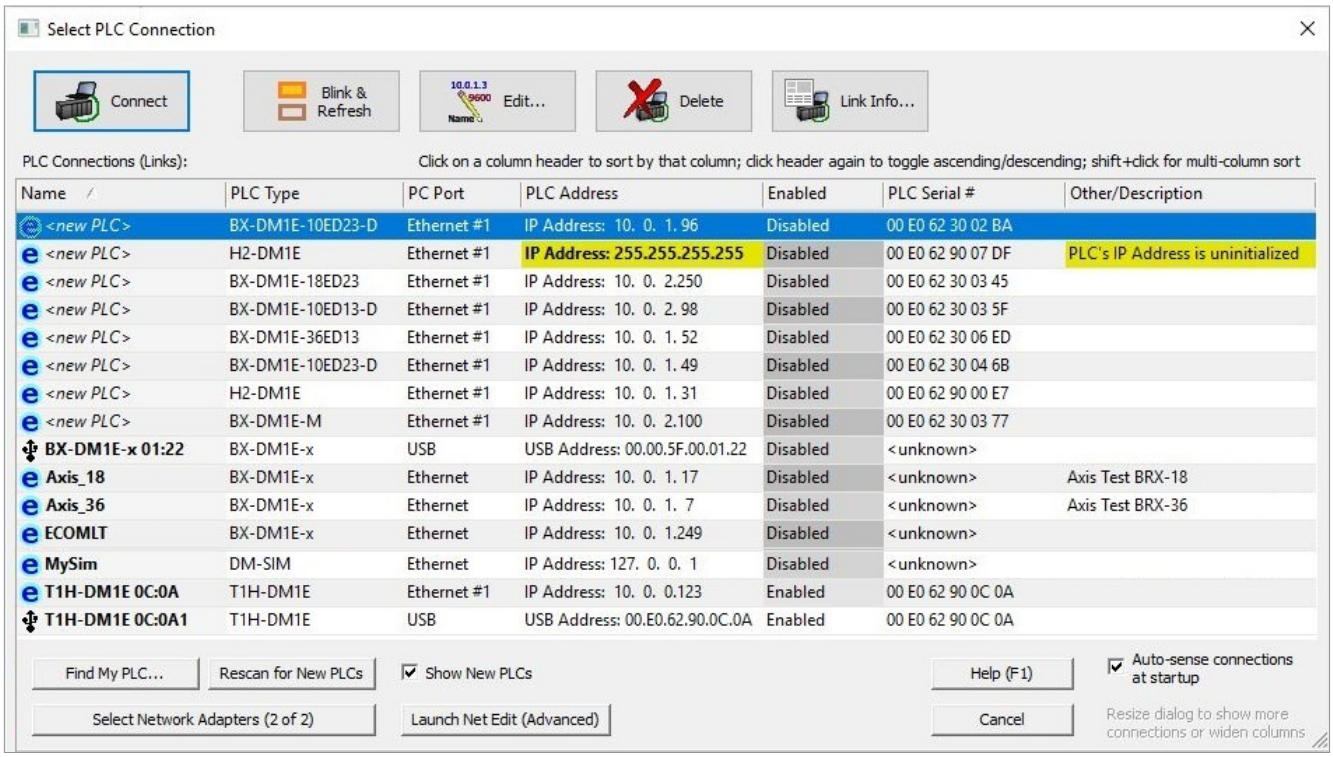
The Ethernet port can be set up when you connect to the BRX MPU for the first time with the Do-more! Designer Software. Alternatively, the Ethernet port of a BRX MPU can be set up using the NetEdit utility. More information on this utility can be found in Appendix E.

Select PLC Connection

The ***Select PLC Connection*** dialog provides the tools that are necessary to create connections to new PLCs over the Ethernet, serial and USB ports on the PC running Do-more! Designer, and to manage those connections later as needed. The buttons along the top are operations that can be performed on the connection that is currently highlighted in the center section. The center section is a list of the currently defined connections and any PLC that can be detected that are not yet used in a connection. The selections along the bottom are used to help locate PLCs that should be in the center list but are currently not there.

When this utility is first opened, it will scan all of the network adapters, serial ports and USB ports for PLCs that are currently accessible. If the PLC is used in an existing connection its current state will be shown in the PLC Connections table. If a PLC is not currently used in a connection, it will be marked as a <new PLC> in the table.

Ethernet Port Setup, continued

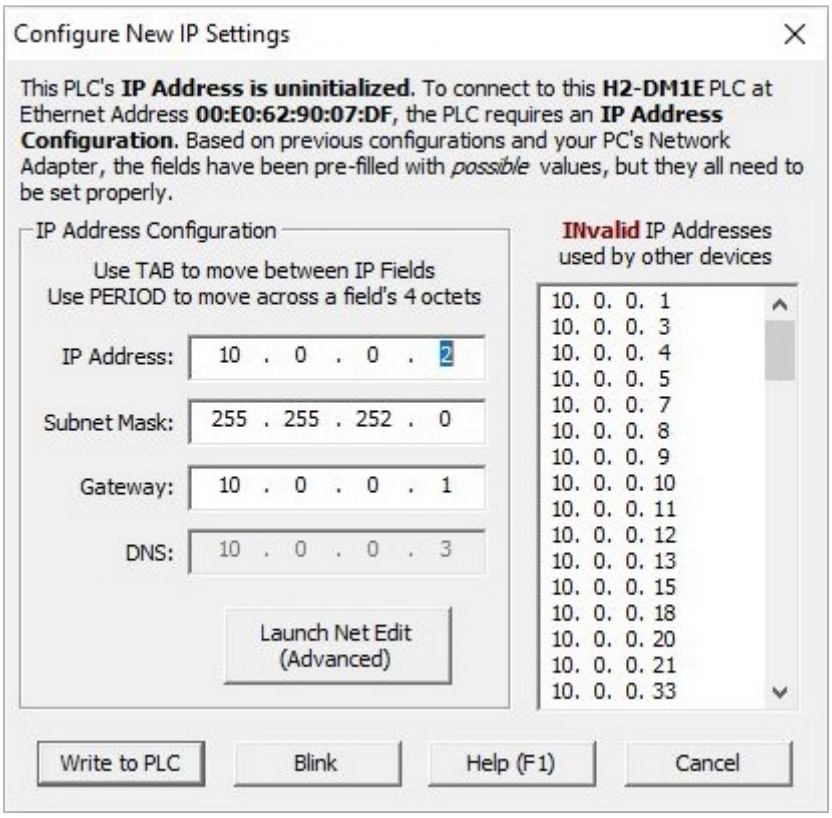


Clicking the **Connect** button will cause Do-more! Designer to attempt to connect with the currently highlighted PLC from the list. Depending on the current state of the PLC there could be one of several things happen:

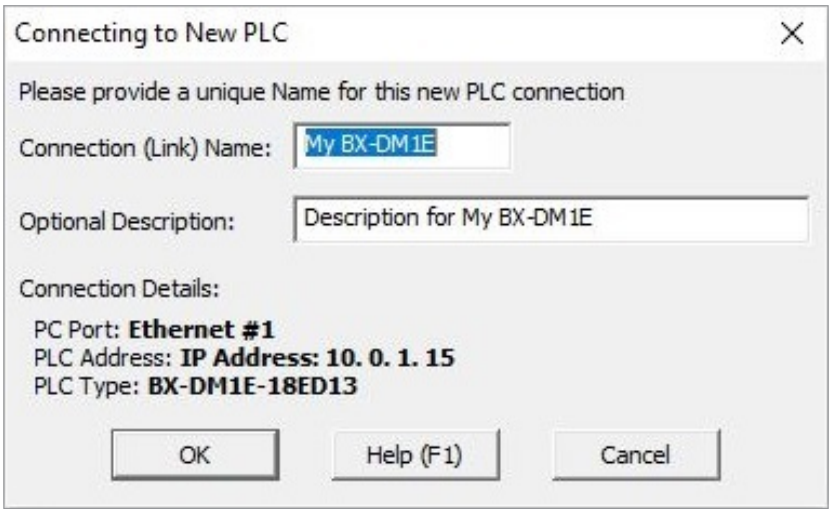
If the PLC's IP Address has not been configured the ***Configure New IP Settings*** dialog will be displayed. Before an Ethernet connection can be made, the PLC's Ethernet port must have its IP Address information configured with values that allow it to operate on the same network and the PC attempting to connect to it. To that end, when a PLC is selected that does not have its IP Address configuration setup the ***Configure New IP Settings*** dialog will be displayed.

When this dialog is first opened, it will examine the Ethernet settings of the NIC where the PLC was found and prefill the Subnet Mask, Gateway, and DNS fields with the same values as the NIC where it was found. It will then search for an unused IP Address on the same network as the NIC and prefill that field with a unique address. It will also generate a list of the IP Addresses on that network that are already in use by another device.

Ethernet Port Setup, continued

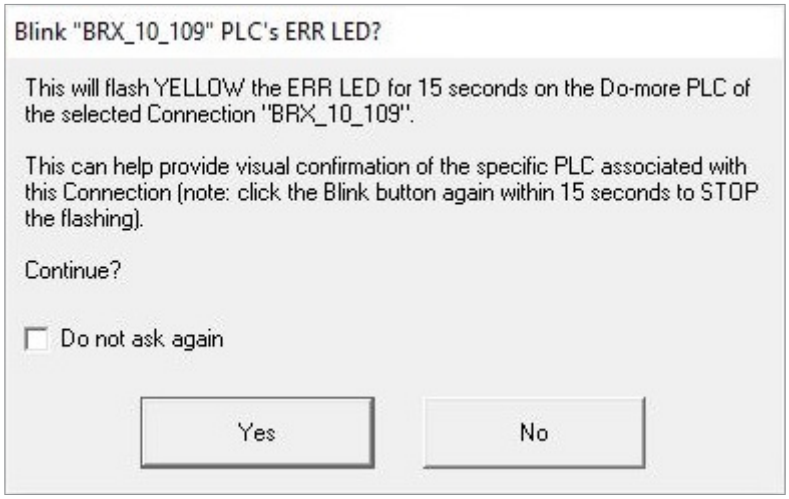


If the PLC's IP Address has been configured but the PLC is not already used in a connection the ***Connect to New PLC*** dialog will be displayed. Each connection must have a unique name, and each can have an optional description.



Ethernet Port Setup, continued

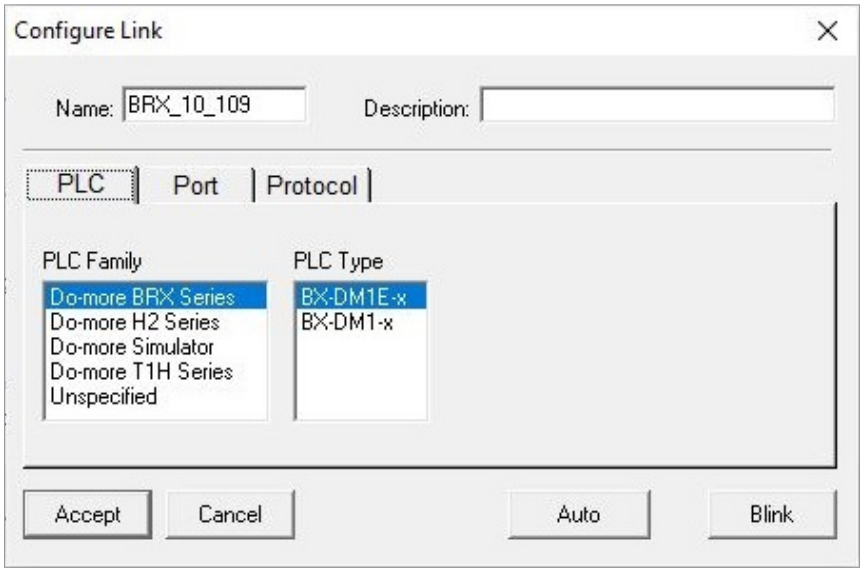
Blink and **Refresh** cause the selected PLC to blink its ERR LED for 15 seconds. This is useful for visually confirming that the connection you have selected from the list is the actual PLC you think it is. Enabling the **Do Not Ask Again** option will bypass this confirmation dialog in the future. It will also reread the information that was read from the PLC when the Select PLC Connection dialog was first launched.



If the attempt to get the PLC to blink is not successful, you will see a message similar to the following and the Enabled state will be set to "Bad Comm".

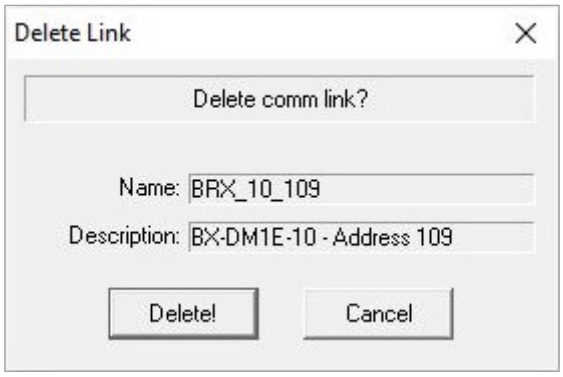


Clicking the **Edit** button will open the highlighted connection in the ***Configure Link*** dialog where the communication parameters of the link used in the connection can be changed.

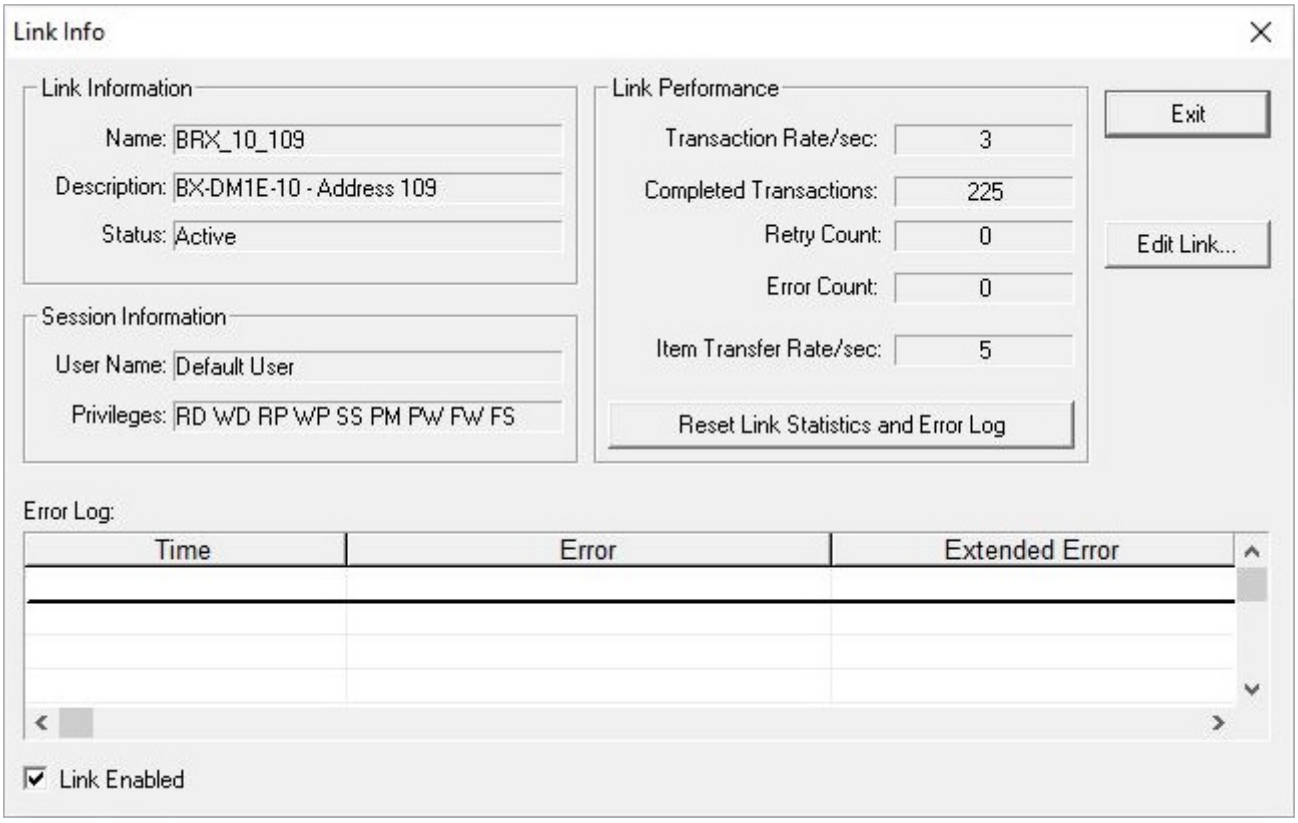


Ethernet Port Setup, continued

Clicking the **Delete** button will remove the highlighted connection from the list.



Clicking **Link Info** will open the Link Info dialog for the highlighted connection where the operational statistics of the connection can be seen, and any errors that have occurred while that connection has been in use are logged.



The *PLC Connections* list in the center of the dialog contains entries for all of the existing connections, and entries for any Do-more! compatible devices found on all of the Ethernet networks connected to the PC. The list can be sorted by any column in the table; click on the column header to sort by that column.



The **Name** column will have the either the Connection Name for existing connections, or <new PLC> for PLCs that have detected on the Ethernet, Serial, and USB ports of the PC, but are not used in an existing connection.

Ethernet Port Setup, continued

The **PLC Type** column will contain the Full PLC Part Number if communication to this PLC was successful, or the base model number stored in the connection if PLC is offline.

The **PC Port** column shows which port on the PC the connection is using, either Ethernet #1, Ethernet #2, etc., (if the PLC is online), Ethernet (if the PLC is offline), COM1, COM2, etc. (if serial), or USB.

The **PLC Address** column contains the address of the PLC that is used in the connection:

If the PC Port is Ethernet then the address is the user-assigned IP Address of the PLC. Note: if the IP Address is the factory-assigned 255.255.255.255.255, this means the PLC's IP Address is uninitialized. The IP Address configuration will have to be assigned by the user before this PLC can be used in a connection.

If the PC Port is USB the address is the factory-assigned address of the USB port of the CPU.

If the PC Port is a Serial port the address is simply the name of the serial port, e.g. COM1.

The **Enabled** column shows the state of the connection:

Enabled means the PLC used in the connection is online.

Disabled means the PLC used in the connection is offline.

Bad Comm means an attempt to contact the PLC using the current settings in the connection failed.

The **PLC Serial Number** column shows the factory-configured serial number of the CPU:

A 12 digit MAC address is shown if the connection is through an Ethernet port on the CPU, through an Ethernet POM (BX-P-ECOMLT), or through an ECOM100 module (H2-ECOM100).

A 12 digit serial number is shown if the connection is through a USB port on the CPU, or a USB POM (BX-P-USB-B).

<unknown > means the serial number couldn't be read using the current settings in the connection.

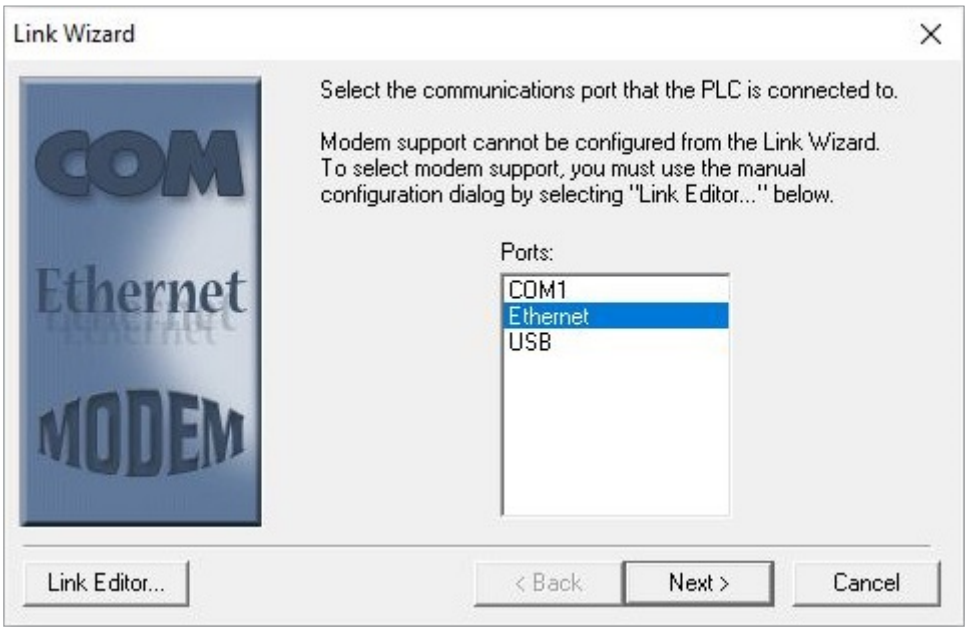
The **Other / Description** column shows the description field from the link that's used by the connection and any additional information about the connection status.

The selections along the bottom are used to help locate PLCs that should be in the center list but are currently not there.



Clicking the **Find My PLC...** button will open the initial dialog of the Link Wizard which will step you through the process of manually locating a new PLC on the Ethernet port, the serial port, or the USB port and creating a link for that PLC that can be used in a new connection.

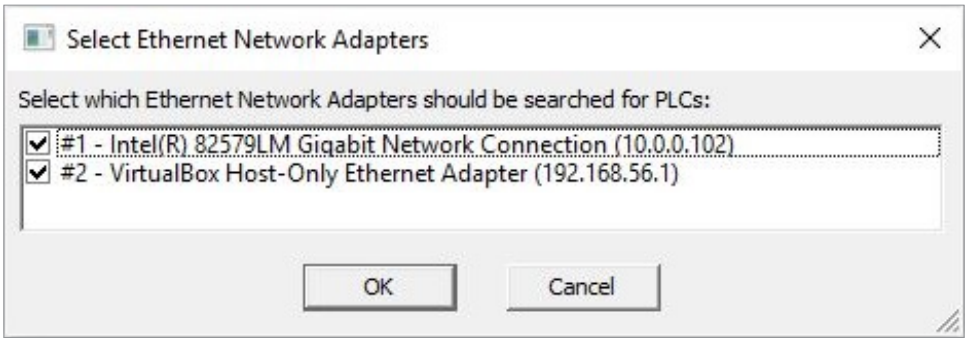
Ethernet Port Setup, continued



Clicking the **Rescan For New PLCs** button will rerun the network scan that was run when you initially ran the Select PLC Connection utility.

If the **Show New PLCs** option is enabled, PLCs that are not used in an existing connection will be shown in the table as <new PLCs>. If this option is disabled, only PLCs that are already used in a connection will be shown.

Clicking the **Select Network Adapters** button will open a dialog where all of the network adapters (NICs) in the PC will be listed. By default, the Select PLC Connection dialog will search for accessible PLCs on all of the NICs in the PC. You can disable any (or all) of the network adapters in the list which will prevent them from being used in future network operations.



Clicking the **Launch NetEdit (Advanced)** button will open NetEdit as a separate utility.

Having the **Auto-sense Connections at Startup** option enabled will cause this utility to step through each of the existing connections in an attempt to communicate with the PLC defined in the connection. Doing this work when the utility is first opened is what fills in the information about the PLC's state in the table. Stepping through all of the existing connection does take some time, so disabling this option will make the utility start up faster, but at the expense of having up-to-date state information for the connections.

Ethernet Protocols

The BRX Do-more! MPU has several Ethernet Protocol choices for communicating to external devices. In this section we will discuss each choice.

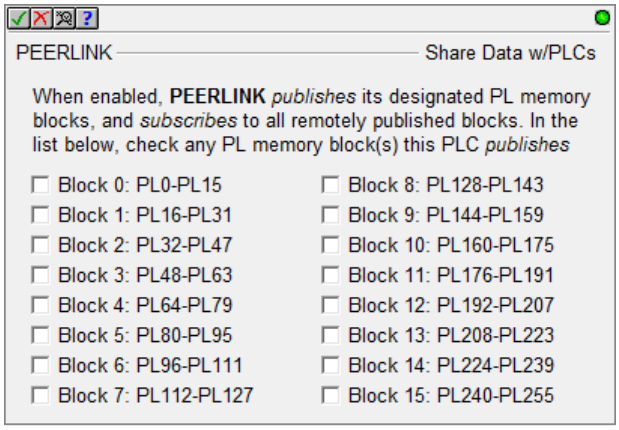
Supported Ethernet Communications Protocols			
Ethernet	**Port Numbers**	**TCP or UDP**	**Configurable**
Peerlink	28784	UDP	No
Do-more! Protocol (Client, Server)	28784	UDP	Yes*
Modbus TCP (Client, Server)	502	TCP	Yes
HOST Ethernet Protocol (Client, Server)	28784	UDP	No
EtherNet/IP: Explicit/Implicit Messaging Scanner/Adapter	44818	TCP	Yes
SMTP (Email)	25	TCP	Yes
Ethernet Remote I/O	28784	UDP	No
HTTP	80, 443	TCP	Yes
MQTT	1883	TCP	No
SNTP (Time Server)	123	TCP	No
TCP Raw Packet	User defined	TCP	Yes
UDP Raw Packet	User defined	UDP	Yes

Secondary Ethernet Connection can be enabled for the built-in Ethernet port of a BRX MPU. By default it has a UDP Port Number of 5000. It can be configured to any decimal number between 5000 and 65535, except for 28784.

PEERLINK Instruction

The PEERLINK instruction allows easy data sharing across any PLC that is running Do-more! technology.

To set this instruction up, place your data into the appropriate PL (PEERLINK) registers that you wish this PLC to share to other Do-more! PLCs. Then check the box that corresponds to that memory area.



When this instruction is enabled, it will then automatically broadcast this information to all other Do-more! PLCs that are listening with a PEERLINK instruction.

To listen for broadcasts from other Do-more! PLCs, all you have to do is place the instruction in your ladder code. If this PLC is not sharing data, do not check any boxes. Incoming data will automatically be placed into the same register area that the broadcasting PLC has checked.

PEERLINK Instruction, continued

Using PUBLISH and SUBSCRIBE instructions can help to get data into and out of the PL memory area as the PL memory area is untyped data. See the Do-more! Designer help file for more information on PEERLINK, PUBLISH and SUBSCRIBE instructions.

NOTE: *Keep in mind that multiple Do-more! PLCs cannot broadcast to the same memory area. This will cause an error.*

Do-more! Protocol

The Do-more! protocol is a proprietary protocol that is used exclusively by the Do-more! family of controllers. This is a very feature rich and secure protocol for communication with the Do-more! Designer software and between Do-more! controllers. It can also be used to communicate between multiple Do-more! controllers or between some brands of HMI's, such as C-more, to a Do-more! controller. Some SCADA systems such as Point of View also support the Do-more! Protocol.

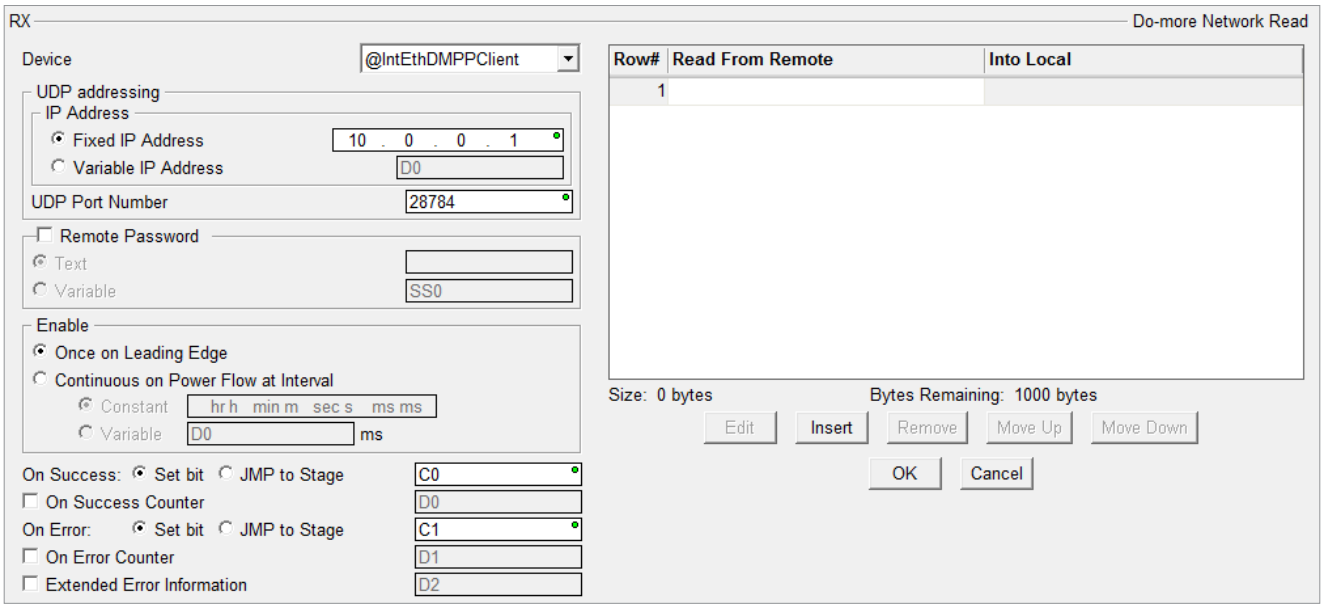
RX Instruction

The Do-more! Network Read (RX) instruction uses the Do-more! proprietary protocol to read incoming data on the on-board Ethernet port from another Ethernet-equipped Do-more! CPU. RX uses UDP (not TCP) protocol to communicate with the remote Do-more! CPU.

Each RX instruction can contain up to 50 individual read requests for a total of up to 1000 bytes of data. The RX instruction can read from all of the built-in memory blocks, all of the built-in structures, and any user-created memory blocks from the remote PLC. RX does NOT support reading a Heap Item from a remote Do-more! CPU.

In contrast to DirectLOGIC (DLRX / DLWX) and Modbus TCP (MRX / MWX) network communication which only has access to the protocol-specific memory blocks in the remote CPUs, Do-more! RX has direct access to nearly all the memory in the remote Do-more! CPU, including direct access to the CPU I/O memory.

The RX instruction establishes a session with the remote Do-more! CPU. The session is established using one of the User Accounts on the remote Do-more! CPU. It is through that User Account (System Security) that any access restrictions on what can be accessed can be enforced. By default it will use the Default User account (no password required).



Do-more! Protocol, continued

IP Address – The IP Address of the Do-more! CPU to read the data from. This can be either a Fixed (static) IP Address or a Variable (dynamic) value.

Fixed IP Address – The TCP Address assigned to the Do-more! CPU. IP addresses are canonically represented in dot-decimal notation, consisting of four decimal numbers, each ranging from 0 to 255, separated by dots.

Variable IP Address – The IP Address resides in the specified memory location. This can be any readable DWord numeric location.

UDP Port Number – The port number of the Do-more! CPU to read the data from. The default value of 28784 (0x7070) is typically the correct number for Do-more! protocol. It is possible to use a different UDP Port Number if the Enable Secondary Ethernet Connection is turned on under the CPU Configuration settings. This secondary UDP Port Number defaults to 5000. This UDP Port Number can be any decimal value between 5000 and 65535, except for 28784 (the port number used by Do-more! Designer)..

Remote Password – The RX instruction requires that a communication session be established with the remote Do-more! CPU before the data read operations can be processed. Depending on how the remote system is configured, this may require the user to enter the password for the User Account to allow the session to be established. If no remote password is selected, the connection will be established using the Default User account.

Enable – Designates how this instruction is enabled. Select from one of the following:

Once on Leading Edge – Select this option to have this instruction run to completion exactly one time. Typically, this will take more than one controller scan. Configured this way the Do-more! Network Read (RX) instruction is Edge Triggered.

Continuous on Power Flow at Interval – Select this option to have this instruction run as long as the instruction has power flow. After the Do-more! Network Read (RX) has initially run, if the instruction still has power flow, the instruction will remain enabled and will wait the specified amount of time before running again. The following options select how much time (in milliseconds) to wait between successive runs.

- **Constant** – specifies the interval time in Hours / Minutes / Seconds / Milliseconds.
- **Variable** – This can be any readable numeric location that contains a value between 0 and 2,147,483,647 which represents the number of milliseconds to wait before running again. A value of 0 ms means this instruction will be set to run on the next scan.

On Success – Selects which of the following actions to perform if the Network Read operation is successful:

Set Bit – Enable this selection then specify any writable bit location.

JMP to Stage – Enable this selection then specify any Stage number from S0 to S127 in the current Program code block.

On Success Counter – Enable this option and select a DWord location to store the total number of times the RX completed successfully. This can be any DWord location.

Do-more! Protocol, continued

On Error – Selects which of the following actions to perform if the Network Read operation is unsuccessful:

Set Bit – Enable this selection then specify writable bit location.

JMP to Stage – Enable this selection then specify any Stage number from S0 to S127 in the current Program code block.

On Error Counter – Enable this option and select a DWord location to store the total number of times the RX failed to complete. This can be any DWord location.

Extended Error Information – Enable this selection then enter a memory location to store any error codes returned for this instruction. This can be any writable numeric location. The list following is of the Extended error responses and their meaning:

-1 = Protocol Error occurred. The value in LastProtoError (DST38) contains the protocol error code as follows:

2 (0x02) = Out Of Sessions: the remote PLC currently has 32 concurrent connections and cannot accept any more.

3 (0x03) = Illegal Operation: the User Account for the password in the instruction does not have Write Data privilege.

4 (0x04) = Invalid Session: an error occurred with the session to the remote PLC, for example the remote PLC lost power during the session.

6 (0x06) = Invalid Argument: the write requests are not formed properly (you should never see this).

14 (0x0E) = Invalid Password: the password in the instruction does not match any User Account in the remote PLC,

20 (0x14) = Bad DMPP Request: one or more of the write requests cannot be processed, most likely the request is for a location that is out of range on the remote PLC or the memory block doesn't exist on the remote PLC. The Extended Error location will contain the entry number of the write request that is causing the error.

0 = No Extended Error

1 – 50 = row number of the bad read request if the Last Protocol Error Code was 20 (0x14).

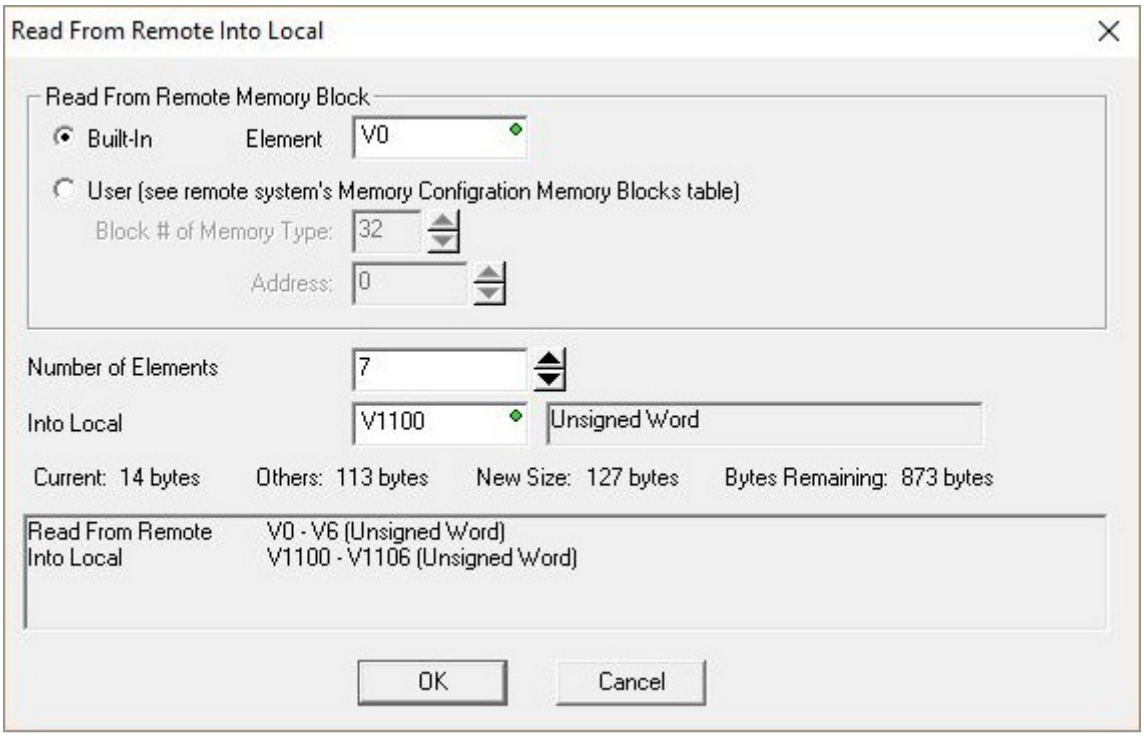
Insert – Select Insert to open Read From Remote Into Local setup dialog box (See page following).

Read From Remote Into Local

Be aware that because the local PLC does not have access to the memory configuration of the remote system, there is no guarantee that a read request that is correctly formed on the local PLC will work when the remote system tries to execute it. For example, you could request data from a memory location that is valid locally

Do-more! Protocol, continued

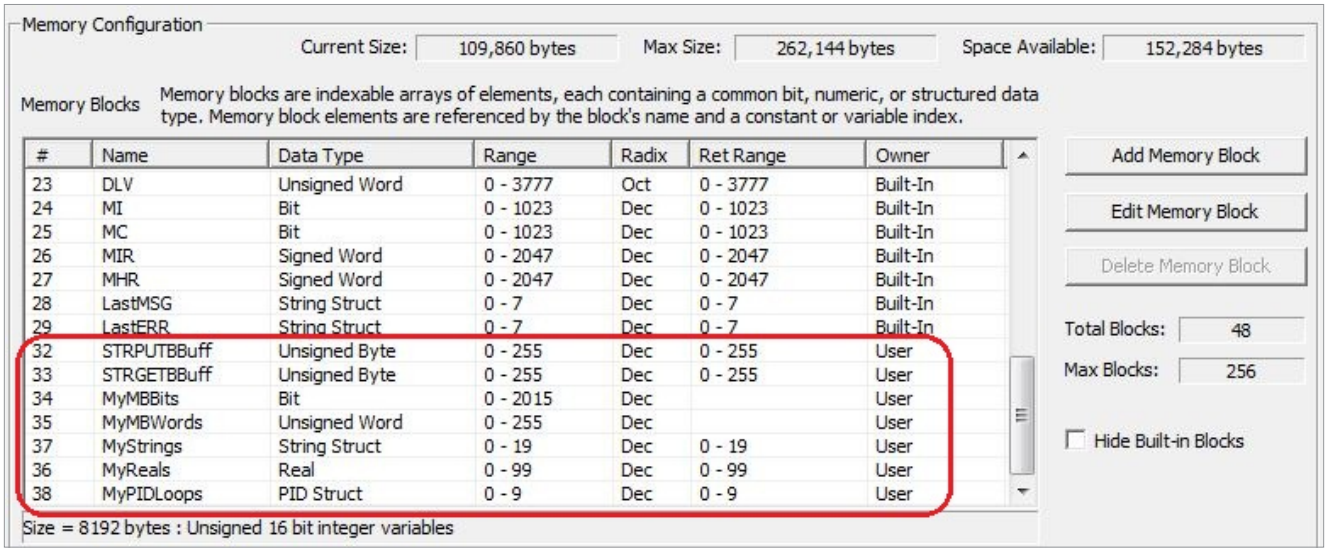
(D4000–D4095) but the range of D memory locations may have been adjusted in the remote PLC to stop at D3000.



Read From Remote into Local selects the first location in the remote PLC to begin reading data.

Select **Built-In** to read from one of the built-in memory blocks in the remote PLC. You will need to enter the first element in the memory block in the Element field.

Select **User** to read from a memory block that was manually created (not built-in). You will need to enter the Block Number assigned to the user memory block in the remote PLC and the offset of the first element in the memory block in the Address field. When User Blocks are created they are assigned a number starting at 32. You can see the number that is assigned to a user memory block in the Memory Configuration page of the System Configuration as shown below:



Do-more! Protocol, continued

Number of Elements is the number of consecutive elements in the memory block to read.

Into Local selects the beginning location in the local PLC to store the data from the read operation. This location must be the same data type and have the same element size as the specified Read From Remote into Local data location. For example you can read from WY (Signed Word) into N (Signed Word) but you cannot read from WY (Signed Word) into V (Unsigned Word).

The remaining fields are to help you maintain the size limitations of the instruction. These fields validate immediately as you make changes in the editor. Current is the number of bytes in the read request currently being edited, Others is the number of bytes in the read requests already in this instruction, **New Size** is the total number of bytes of all the read requests in this instruction (including the one currently being edited), and **Bytes Remaining** is the number of bytes of the 1000 byte limit remaining for read requests in this instruction.

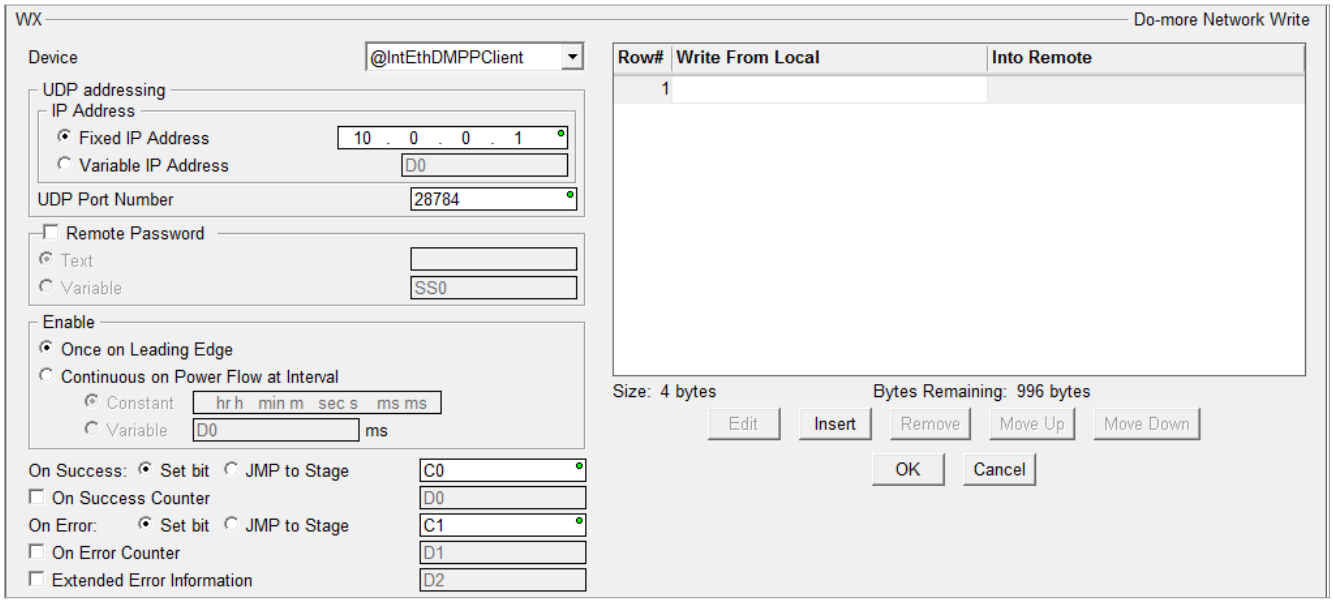
WX Instruction

The Do-more! Network Write (WX) instruction uses the Do-more! proprietary protocol to write data over the on-board Ethernet port to another Ethernet-equipped Do-more! CPU. WX uses UDP (not TCP) protocol to communicate with the remote Do-more! CPU.

Each WX instruction can contain up to 50 individual write requests for a total of up to 1000 bytes of data. The WX instruction can write to all of the built-in memory blocks, all of the built-in structures, and any user-created memory blocks in the remote PLC. WX does NOT support writing to a Heap Item in the remote Do-more! CPU.

In contrast to DirectLOGIC (DLRX / DLWX) and Modbus/TCP (MRX / MWX) network communication which only has access to the protocol-specific memory blocks in the remote CPUs, Do-more! WX has direct access to nearly all of the memory in the remote Do-more! CPU – including direct access to the PLC's I/O memory.

The WX instruction establishes a session with the remote Do-more! CPU. The session is established using one of the User Accounts on the remote Do-more! CPU. It is through that User Account (System Security) that any access restrictions on what can be accessed can be enforced. By default it will use the Default User account (no password required).



Do-more! Protocol, continued

IP Address – The IP Address of the Do-more! CPU to write the data to. This can be either a Fixed (static) IP Address or a Variable (dynamic) value.

Fixed IP Address – The TCP Address assigned to the Do-more! CPU. IP addresses are canonically represented in dot-decimal notation, consisting of four decimal numbers, each ranging from 0 to 255, separated by dots.

Variable IP Address – The IP Address resides in the specified memory location. This can be any readable DWord numeric location.

UDP Port Number – The port number of the Do-more! CPU to write the data to. The default value of 28784 (0x7070) is typically the correct number for Do-more! protocol. It is possible to use a different UDP Port Number if the Enable Secondary Ethernet Connection is turned on under the CPU Configuration settings. This secondary UDP Port Number defaults to 5000. This UDP Port Number can be any decimal value between 5000 and 65535, except for 28784 (the port number used by Do-more! Designer).

Remote Password – The WX instruction requires that a communication session be established with the remote Do-more! CPU before the data write operations can be processed. Depending on how the remote system is configured, this may require the user to enter the password for the User Account to allow the session to be established. If no remote password is selected, the connection will be established using the Default User account.

Enable – Designates how this instruction is enabled. Select from one of the following:

Once on Leading Edge – Select this option to have this instruction run to completion exactly one time. Typically, this will take more than one controller scan. Configured this way the Do-more! Network Write (WX) instruction is Edge Triggered.

Continuous on Power Flow at Interval – select this option to have this instruction run as long as the instruction has power flow. After the Do-more! Network Write (WX) has initially run, if the instruction still has power flow, the instruction will remain enabled and will wait the specified amount of time before running again. The following options select the time (in milliseconds) delay between successive runs.

Constant - specifies the interval time in Hours / Minutes / Seconds / Milliseconds.

Variable - This can be any readable numeric location that contains a value between 0 and 2,147,483,647 which represents the number of milliseconds to wait before running again. A value of 0 ms means this instruction will be set to run on the next scan.

On Success – Selects which of the following actions to perform if the Network Write operation is successful:

Set Bit – Enable this selection then specify any writable bit location.

JMP to Stage – Enable this selection then specify any Stage number from S0 to S127 in the current Program code block.

On Success Counter – Enable this option and select a DWord location to store the total number of times the WX completed successfully. This can be any DWord location.

On Error – Selects which of the following actions to perform if the Network Write operation is unsuccessful:

Set Bit – Enable this selection then specify writable bit location.

Do-more! Protocol, continued

JMP to Stage – Enable this selection then specify any Stage number from S0 to S127 in the current Program code block.

On Error Counter – Enable this option and select a DWord location to store the total number of times the RX failed to complete. This can be and DWord location.

Extended Error Information – Enable this selection then enter a memory location to store any error codes returned for this instruction. This can be any writable numeric location. The following lists the Extended error responses and their meaning:

-1 = Protocol Error occurred. The value in LastProtoError (DST38) contains the protocol error code as follows:

2 (0x02) = Out Of Sessions: the remote PLC currently has 32 concurrent connections and cannot accept any more.

3 (0x03) = Illegal Operation: the User Account for the password in the instruction does not have Write Data privilege.

4 (0x04) = Invalid Session: an error occurred with the session to the remote PLC, for example the remote PLC lost power during the session.

6 (0x06) = Invalid Argument: the write requests are not formed properly (you should never see this).

14 (0x0E) = Invalid Password: the password in the instruction does not match any User Account in the remote PLC.

20 (0x14) = Bad DMPP Request: one or more of the write requests cannot be processed, most likely the request is for a location that is out of range on the remote PLC or the memory block doesn't exist on the remote PLC. The Extended Error location will contain the entry number of the write request that is causing the error.

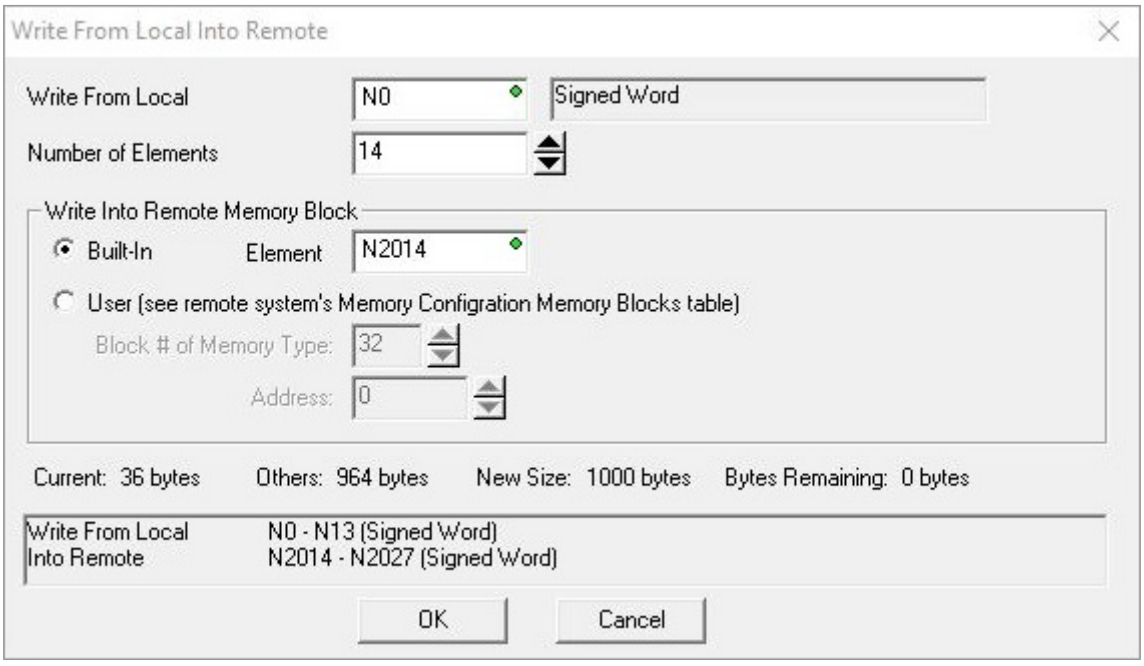
0 = No Extended Error

1 – 50 = Row number of the bad read request if the Last Protocol Error Code was 20 (0x14).

Insert – Select Insert to open Write From Local Into Remote dialog box.

Write From Local Into Remote

Write From Local into Remote selects the first location of the source data in the Local PLC to write to the remote PLC.



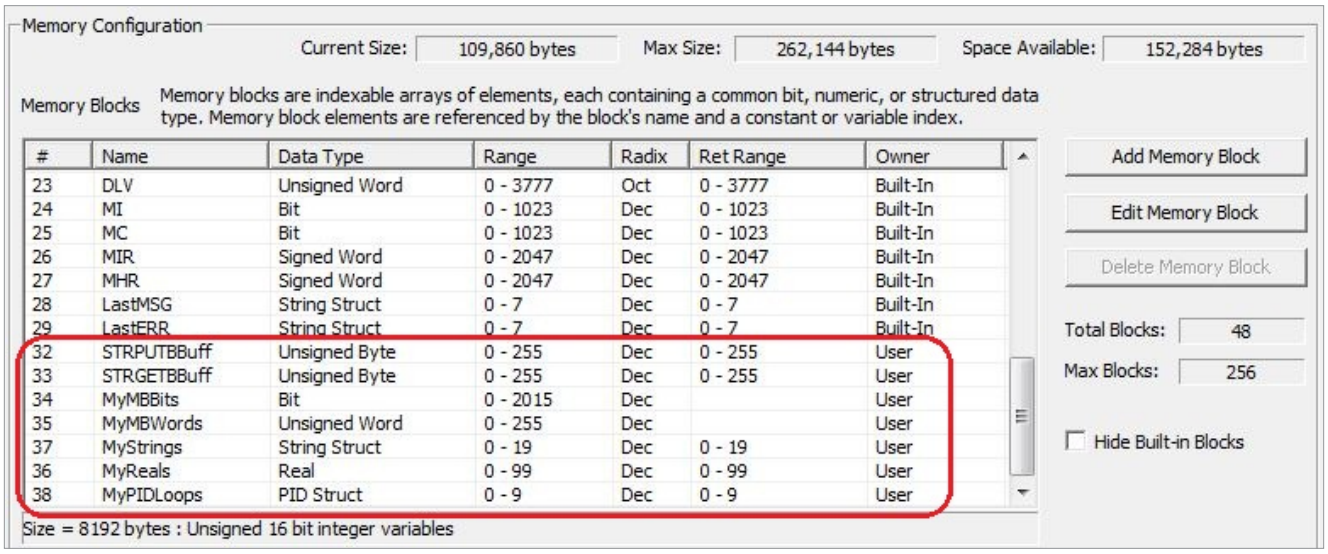
Do-more! Protocol, continued

Number of Elements is the number of consecutive elements in the memory block to write.

Write Into Remote Memory Block selects the beginning location in the remote PLC to store the data from the write operation. This location must be the same data type and have the same element size as the specified Write From Local data location. For example you can write from WY (Signed Word) into N (Signed Word) but you cannot write from WY (Signed Word) into V (Unsigned Word).

Select **Built-In** to write into one of the built-in memory blocks in the remote PLC. You will need to enter the first element in the memory block in the Element field.

Select **User** to write into a memory block that was manually created (not built-in). You will need to enter the Block Number assigned to the user memory block in the remote PLC and the offset of the first element in the memory block in the Address field. When User Blocks are created they are assigned a number starting at 32. You can see the number that is assigned to a user memory block in the Memory Configuration page of the System Configuration as shown below:



The remaining fields are to help you maintain the size limitations of the instruction. These fields validate immediately as you make changes in the editor. **Current** is the number of bytes in the write request currently being edited, **Others** is the number of bytes in the write requests already in this instruction, **New Size** is the total number of bytes of all the write requests in this instruction (including the one currently being edited), and **Bytes Remaining** is the number of bytes of the 1000 byte limit remaining for write requests in this instruction.

Modbus TCP

Modbus TCP is a protocol overseen by Modbus.org. This standard is an open standard meaning that anyone can utilize it freely.

Modbus TCP can be utilized as either a client or server configuration. It supports Clients and Servers in a Peer to Peer fashion.

Modbus TCP Server (Slave)

As a Modbus TCP Server, the BRX Do-more! MPU is functioning as a listening/replying device. The external Client device will request data registers from the BRX Do-more! and the BRX Do-more! will reply with the appropriate data.

All Modbus Client data is stored in four sets of registers in the BRX Do-more!. This memory area is blocked off specifically for Modbus communications. You must place data in these registers in order for a Modbus Client device to be able to access it.

Modbus Data Registers		
Register Type	**Register Name**	**Range**
Coil	MC	00000–01023
Discrete Input	MI	10000–11023
Holding Register	MHR	40000–42047
Input Register	MIR	30000–32047

The Modbus data area is loosely data typed and casting or other instructions such as PUBLISH and SUBSCRIBE can be utilized to convert data in this area to the proper data type needed as well. Please see the help file for more information on casting, PUBLISH and SUBSCRIBE.



NOTE: *Ranges can be expanded in the Memory Configuration section of the Do-more! Designer software as needed.*

The Modbus TCP Server (Slave) supports the following function codes:

Modbus	
Function Code	**Description**
1	Read coil
2	Read discrete inputs
3	Read holding registers
4	Read input registers
5	Write single coil
6	Write single registers
7	Read exception status
15	Write multiple coils
16	Write multiple registers
22	Mask write registers

Modbus TCP, continued

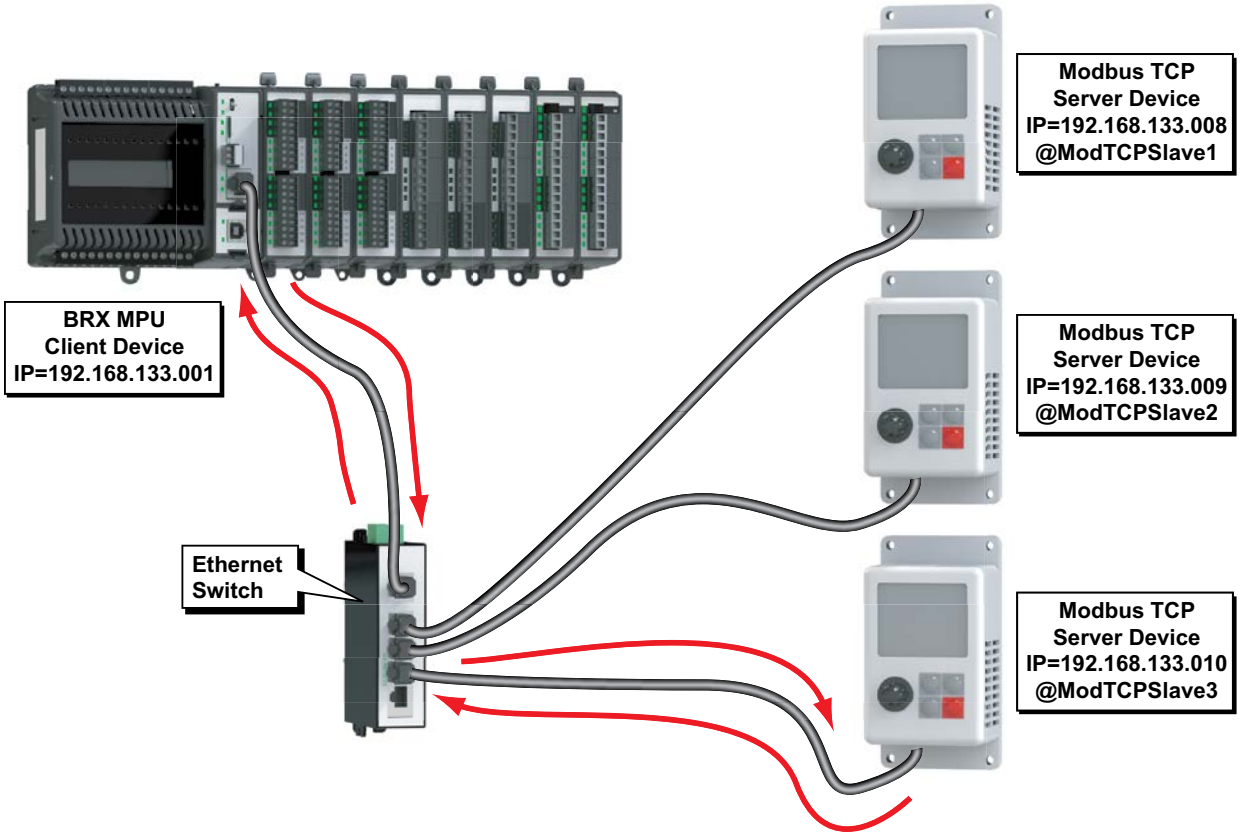
Modbus TCP Client (Master)

As a Modbus TCP Client, the BRX Do-more! MPU is requesting data from a Modbus TCP Server device.

In order for this to work, you need to know quite a few things about your Server device such as the function codes that it supports, the data registers that are accessible and possibly the Unit ID or Slave Address.

In order to utilize the BRX Do-more! as a Modbus TCP Client you will need to create a Modbus TCP Client Device. This device will handle all of the communications with the external Modbus TCP servers by using the Ethernet port on the front of the BRX MPU.

NOTE: *The default @IntMODTCPClient device is created automatically. You can choose to use this device, however we strongly recommend that you make a new Device for each Modbus TCP server that you will be communicating with. This will allow simultaneous communications to flow uninterrupted if one of the Modbus TCP servers goes offline.*



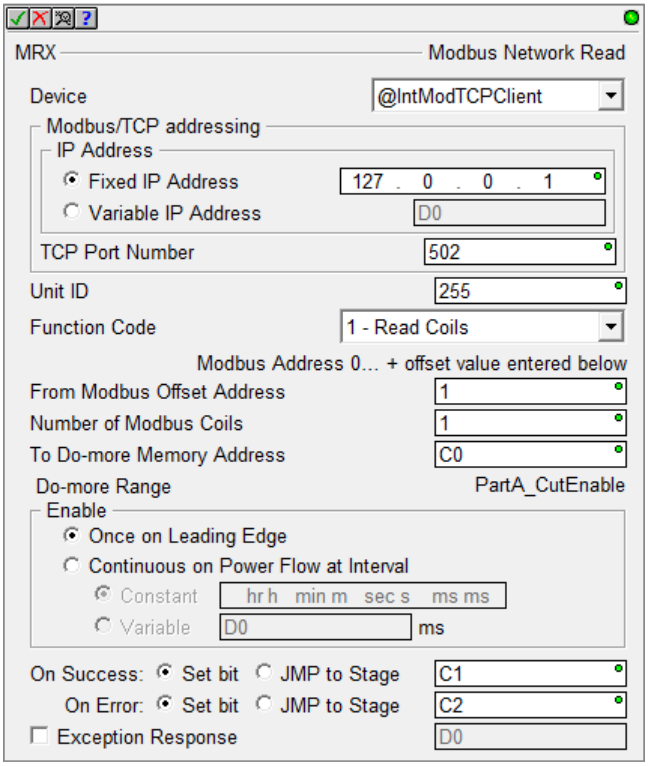
As a Modbus TCP Client, you do not have to sequence the MRX read and MRX write instructions. If you are so inclined, you can just drop them into your program and they will work in a round robin manner. However, sequencing the instructions will give you better control and allow you to build complex communication patterns to optimally communicate with your devices.

The communications instructions in Do-more! Designer have Success and Error built into the instructions so that you can either set a bit or move to a Stage if you are doing state style programming. There are examples of using Stage (state) programming in the software help file to show how you could use this to implement a complex communications routine.

Modbus TCP, continued

MRX Instruction

The MRX instruction is used to read from a Modbus TCP Server. Following is a brief description of the MRX instruction parameters. For more detailed information please refer to the Do-more! Designer help files.



Device – The device associated with the physical port that you want to communicate from. @IntModTCPClient is the name of the device associated with the built in Ethernet port when set as a Modbus TCP Client. We strongly recommend that you make a new Device for each Modbus TCP server that you will be communicating with. This will allow simultaneous communications to flow uninterrupted if one of the Modbus TCP servers goes offline.

IP Address – The IP Address of the Modbus TCP Server to read the data from. This can be either a Fixed (static) IP Address or a Variable (dynamic) value.

Fixed IP Address – The TCP Address assigned to the Modbus TCP Server. IP addresses are canonically represented in dot-decimal notation, consisting of four decimal numbers, each ranging from 0 to 255, separated by dots.

Variable IP Address – The IP Address resides in the specified memory location. This can be any readable DWord numeric location.

TCP Port Number – This should normally be set to 502 unless the end device has had the default port number changed.

Unit ID – The ID number of the Server device. Typically this is 255 unless you are talking to a Modbus Serial Gateway style of device.

Modbus TCP, continued

Function Code – selects which of the following Modbus function codes to use:

1 - Read Coils

2 - Read Discrete Inputs

3 - Read Holding Registers

4 - Read Input Registers

7 - Read Exception Status

From Modbus Offset Address – The address in the Modbus Server that you will be reading from. This address may be offset by a value of +1 depending on how the manufacturer followed the Modbus standard.

Number of Modbus Coils/ Registers – Based on the Function Code selected, this selection specifies how many consecutive elements to read.

To Do-more Memory Address – Specifies the beginning address of a range of bits or numeric locations in the CPU where the data that is read will be stored. This data type (bit or register) must match the type expected by the Function Code.

Do-more Range – This is the ending register where the data will be stored at, calculated by taking the To Do-more Memory address and adding the Number of Modbus Coils/Registers value to it.

Enable – Designates how this instruction will operate. Select from one of the following:

Once on Leading Edge - Select this option to have this instruction run to completion exactly one time. Typically, this instruction will take more than one controller scan to complete. Configured this way the instruction is Edge Triggered.

Continuous on Power Flow at Interval - Select this option to have this instruction run as long as the instruction has power flow. After the instruction has initially run, if the instruction still has power flow, the instruction will remain enabled and will wait the specified amount of time before running again. The following options select how much time (in milliseconds) to wait between successive runs. A value of 0ms means the instruction will re-run immediately.

On Success – When the instruction completes successfully this action will be performed.

Set Bit – Enable this selection then specify any writable bit location.

JMP to Stage – Enable this selection then specify any Stage number from S0 to S127 in the current Program code block.

On Error – When the instruction does not complete successfully this action will be performed.

Set Bit – Enable this selection then specify any writable bit location.

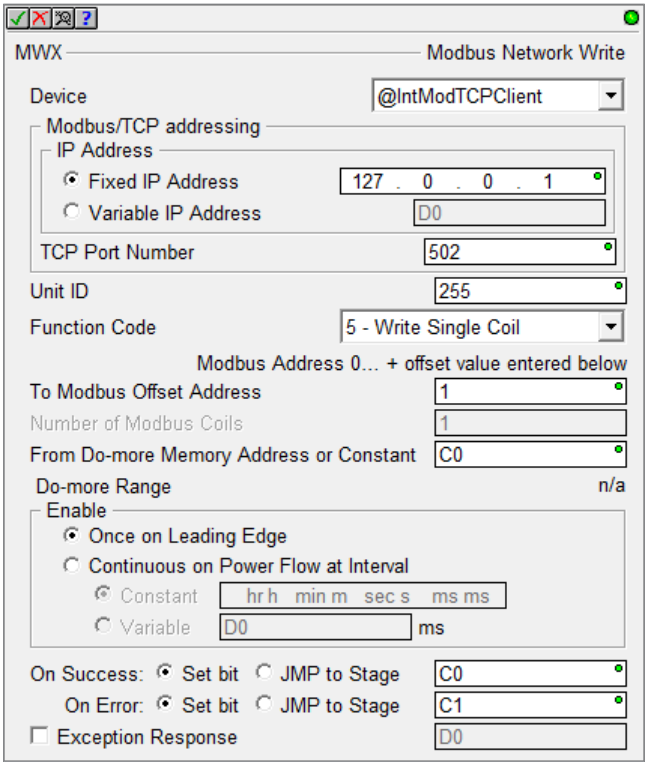
JMP to Stage – Enable this selection then specify any Stage number from S0 to S127 in the current Program code block.

Exception Response – For errors where the message was received properly by the Server device, this will contain a value to indicate why the Server rejected the message. This can aid in troubleshooting the issue with the message.

Modbus TCP, continued

MWX Instruction

The MWX instruction is used to write to a Modbus TCP Server (Slave). For specific information please refer to the Do-more! Designer help files.



Device – The device associated with the physical port that you want to communicate from. @IntModTCPClient is the name of the device associated with the built in Ethernet port when set as a Modbus TCP Client. We strongly recommend that you make a new Device for each Modbus TCP Server that you will be communicating with. This will allow simultaneous communications to flow uninterrupted if one of the Modbus TCP servers goes offline.

IP Address – The IP Address of the Modbus TCP Server to read the data from. This can be either a Fixed (static) IP Address or a Variable (dynamic) value.

Fixed IP Address – The TCP Address assigned to the Modbus TCP Server. IP addresses are canonically represented in dot-decimal notation, consisting of four decimal numbers, each ranging from 0 to 255, separated by dots.

Variable IP Address – The IP Address resides in the specified memory location. This can be any readable DWord numeric location.

TCP Port Number – This should normally be set to 502 unless the end device has had the default port number changed.

Unit ID – The ID number of the Modbus TCP Server device. Typically this is 255 unless you are talking to a Modbus Serial Gateway style of device.

Modbus TCP, continued

Function Code – Selects which of the following Modbus function codes to use:

5 - Write Single Coil

6 - Write Single Register

15 - Write Multiple Coils

16 - Write Multiple Registers

To Modbus Offset Address – The starting register that you will be writing to. This address may be offset by a value of +1 depending on how the manufacturer followed the Modbus standard.

Number of Modbus Coils/ Registers – This selection specifies how many consecutive elements to write from the Modbus Offset Address.

From Do-more Memory Address – Specifies the beginning address of a range of bits or numeric locations in the CPU where the data that will be written from. This data type (bit or register) must match the type expected by the Function Code.

Do-more Range – This is the ending register where the data will be written from, calculated by taking the To Do-more Memory address and adding the Number of Modbus Coils/Registers value to it.

Enable – Designates how this instruction will operate. Select from one of the following:

Once on Leading Edge – Select this option to have this instruction run to completion exactly one time. Typically, this instruction will take more than one controller scan to complete. Configured this way the instruction is Edge Triggered.

Continuous on Power Flow at Interval – Select this option to have this instruction run as long as the instruction has power flow. After the instruction has initially run, if the instruction still has Power Flow, the instruction will remain enabled and will wait the specified amount of time before running again. The following options select how much time (milliseconds) to wait between successive runs. A value of 0ms means the instruction will re-run immediately.

On Success – When the instruction completes successfully this action will be performed.

Set Bit – Enable this selection then specify any writable bit location.

JMP to Stage – Enable this selection then specify any Stage number from S0 to S127 in the current Program code block.

On Error – When the instruction does not complete successfully this action will be performed.

Set Bit – Enable this selection then specify any writable bit location.

JMP to Stage – Enable this selection then specify any Stage number from S0 to S127 in the current Program code block.

Exception Response – For errors where the message was received properly by the Server device, this will contain a value to indicate why the Server rejected the message. This can aid in troubleshooting the issue with the message.

HOST Ethernet Protocol (Client, Server)

The BRX Do-more! MPU can serve as a HOST Ethernet Protocol Client and Server to communicate to legacy devices that utilize the HOST Ethernet protocol such as DirectLogic PLCs, C-more HMI, SCADA systems, etc.

All data is stored in four sets of registers in the BRX Do-more!. This memory area is blocked off specifically for HOST Ethernet Protocol communications. You must place data in these registers so that a HOST Ethernet Protocol Client device will be able to access it.

HOST Data Registers		
DirectLogic Type	**Do-more! Block Name**	**Default Octal Range**
Discrete Input (X)	DLX	0–777
Discrete Output (Y)	DLY	0–777
Control Relay (C)	DLC	0–777
16-Bit Data (V)	DLV	0–3777

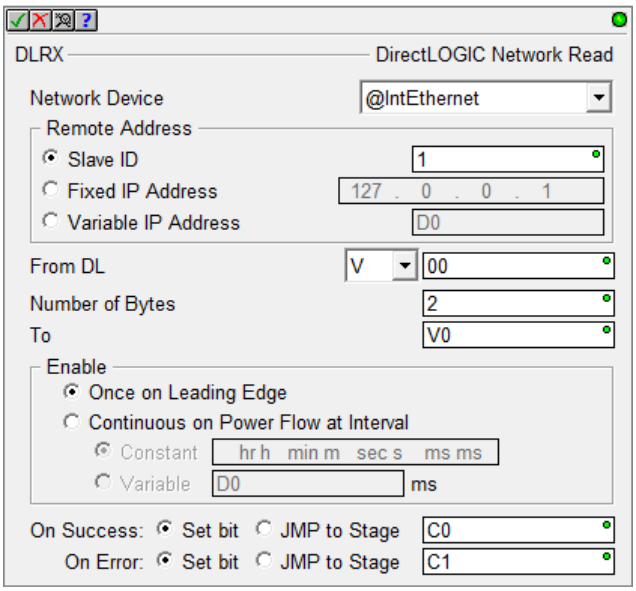
The HOST Ethernet Protocol data area is loosely data typed and casting or other instructions such as PUBLISH and SUBSCRIBE can be utilized to convert data in this area to the proper data type needed as well. Please see the help file for more information on casting, PUBLISH and SUBSCRIBE.

NOTE: *Ranges can be expanded in the Memory Configuration section of the Do-more! Designer software as needed.*

DirectLogic Client (Master)

The BRX Do-more! MPU can be a HOST Ethernet Protocol Client to communicate to legacy devices that utilize the HOST Ethernet protocol such as DirectLogic PLCs.

DLRX



HOST Ethernet Protocol (Client, Server), continued

Network Device – The device associated with the physical port that you want to communicate from. @IntEthernet is the name of the device associated with the built in Ethernet port.

Remote Address – specifies which of the following addressing modes to use:

Slave ID - Selects the Slave ID (Module ID) of the remote DirectLOGIC server. The Slave ID can be any constant value in the range of 1 to 90, or any readable numeric location that contains a value in that range. If Slave ID is selected, a TCP/IP broadcast is used to perform the network read operation. This means that both the Do-more! controller and the remote ECOM module must be in the same Broadcast Domain.

Fixed IP Address – Specifies the IP Address assigned to the remote server ECOM module. IP addresses are canonically represented in dot-decimal notation, consisting of four decimal numbers, each ranging from 0 to 255, separated by dots.

Variable IP Address – The IP Address resides in a memory location in the PLC, allowing the IP Address to be changed at runtime. This can be any readable DWord numeric location. Each octet of the IP Address is stored in one byte of the Variable Address location.

From DL - Designates the data type and the address of the data to read from the DirectLOGIC controller.

V-Memory – Locations in a DirectLOGIC controller are unsigned 16-bit values. Each V-Memory location is 2 bytes in length, so reading V-Memory requires the length be in 2-byte increments. The memory address value must begin on a byte boundary. Single Bit locations in the DirectLOGIC controllers cannot be read individually, you must read the byte that contains the desired bit.

Number of Bytes – Designates the number of elements of the selected type to read.
X, Y, C, S, T, CT, GX, GY, SP – Bit locations must be read in 1-byte increments.

Enable – designates how this instruction will operate. Select from one of the following:

Once on Leading Edge - select this option to have this instruction run to completion exactly one time. Typically, this instruction will take more than one controller scan to complete. Configured this way the instruction is Edge Triggered.

Continuous on Power Flow at Interval - Select this option to have this instruction run as long as the instruction has power flow. After the instruction has initially run, if the instruction still has power flow, the instruction will remain enabled and will wait the specified amount of time before running again. The following options select how much time (in milliseconds) to wait between successive runs. A value of 0ms means the instruction will re-run immediately.

On Success – When the instruction completes successfully this action will be performed.

Set Bit – Enable this selection then specify any writable bit location.

JMP to Stage – Enable this selection then specify any Stage number from S0 to S127 in the current Program code block.

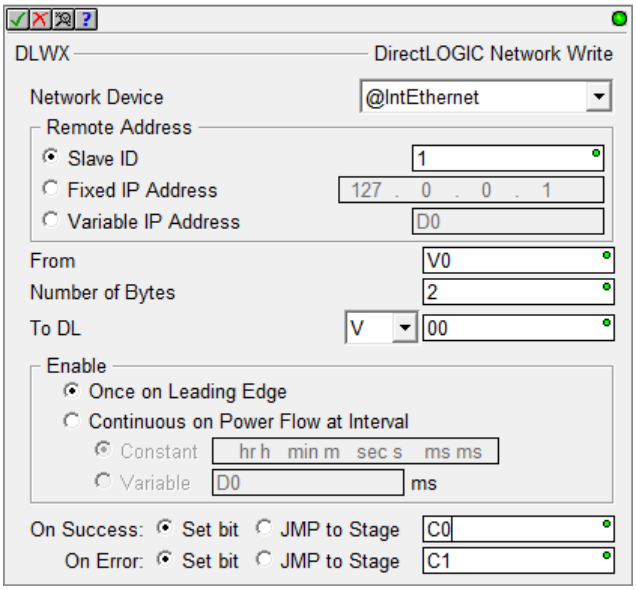
On Error – When the instruction does not complete successfully this action will be performed.

Set Bit – Enable this selection then specify any writable bit location.

JMP to Stage – Enable this selection then specify any Stage number from S0 to S127 in the current Program code block.

HOST Ethernet Protocol (Client, Server), continued

DLWX



Network Device – The device associated with the physical port that you want to communicate from. @IntEthernet is the name of the device associated with the built in Ethernet port.

Remote Address - Specifies which of the following addressing modes to use:

Slave ID – Selects the Slave ID (Module ID) of the remote DirectLOGIC server. This can be any constant value in the range of 1 to 90, or any readable numeric location that contains a value in that range. If Slave ID is selected, the a TCP/IP broadcast is used to perform the network write operation, this means that both the Do-more! controller and the remote ECOM module must be in the same Broadcast Domain.

Fixed IP Address – Specifies the IP Address assigned to the remote server ECOM module. IP addresses are canonically represented in dot-decimal notation, consisting of four decimal numbers, each ranging from 0 to 255, separated by dots.

Variable IP Address – The IP Address resides in a memory location in the PLC. This allows the IP Address to be changed at runtime. This can be any readable DWord numeric location. Each octet of the IP Address is stored in one byte of the Variable Address location.

From – Specifies the beginning memory address in the Do-more! controller of the data to send to the remote server. This value can be any readable numeric location.

To DL – Designates the data type and the address of the data to Write to the DirectLOGIC controller.

V-Memory locations in a DirectLOGIC controller are unsigned 16-bit values. Each V-Memory location is 2 bytes in length, so reading V-Memory requires the length be in 2-Byte increments. The memory address value must begin on a Byte boundary. Single Bit locations in the DirectLOGIC controllers cannot be written individually, you must write the Byte that contains the desired Bit.

Number of Bytes – Designates the number of elements of the selected type to read.
X, Y, C, S, T, CT, GX, GY, SP – Bit locations must be read in 1-Byte increments.

HOST Ethernet Protocol (Client, Server), continued

Enable – designates how this instruction will operate. Select from one of the following:

Once on Leading Edge – Select this option to have this instruction run to completion exactly one time. Typically, this instruction will take more than one controller scan to complete. Configured this way the instruction is Edge Triggered.

Continuous on Power Flow at Interval – Select this option to have this instruction run as long as the instruction has power flow. After the instruction has initially run, if the instruction still has Power Flow, the instruction will remain enabled and will wait the specified amount of time before running again. The following options select how much time (in milliseconds) to wait between successive runs. A value of 0ms means the instruction will re-run immediately.

On Success – When the instruction completes successfully this action will be performed.

Set Bit – Enable this selection then specify any writable bit location.

JMP to Stage – Enable this selection then specify any Stage number from S0 to S127 in the current Program code block.

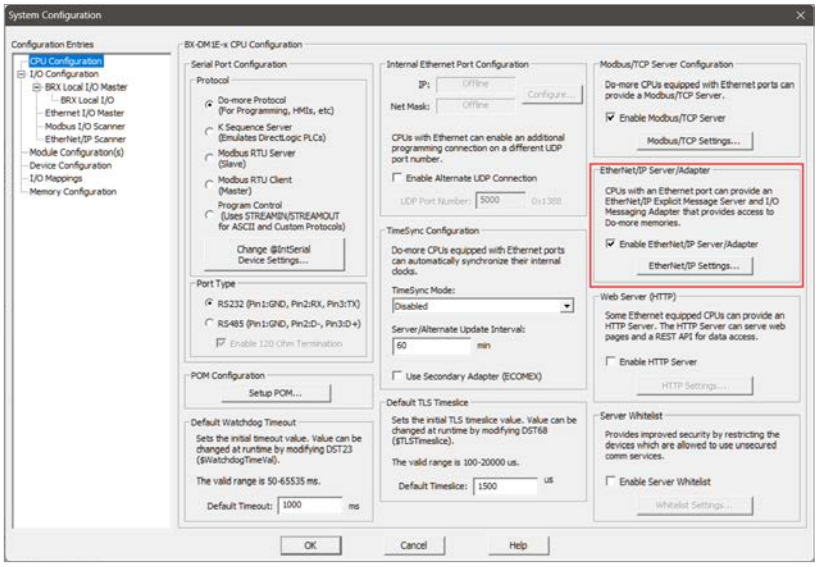
On Error – When the instruction does not complete successfully this action will be performed.

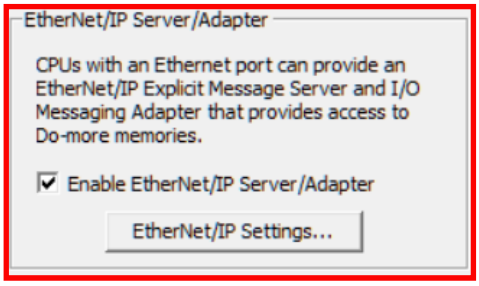
Set Bit – Enable this selection then specify any writable bit location.

JMP to Stage – Enable this selection then specify any Stage number from S0 to S127 in the current Program code block.

EtherNet/IP: Explicit/Implicit Messaging Adapter

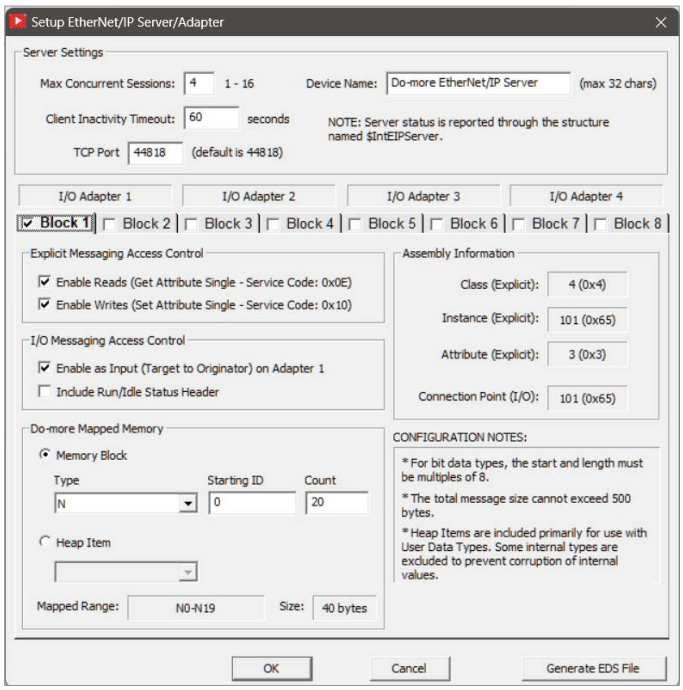
The EtherNet/IP Explicit/Implicit Message Adapter must be enabled in the System Configuration dialog box.





Once this is enabled, you must click the EtherNet/IP Settings button to set the data blocks that will be served to outside EtherNet/IP scanners.

EtherNet/IP: Explicit/Implicit Messaging Adapter, continued



Maximum Concurrent Sessions – Specifies how many simultaneous connections from Explicit Message Clients and / or Implicit Scanners the EtherNet/IP Server /Adapter device driver can handle. Establishing an EtherNet/IP session requires processing time which will inevitably impact the scan time. If there are more EtherNet/IP Clients requesting connections than there are concurrent sessions available, part of this processing includes shutting down the oldest session so that a new session can be opened. The need to forcibly close sessions so that new ones can be opened can be minimized by setting this value to the maximum number of individual EtherNet/IP Clients that will be connecting to this PLC at any given time. This can be any constant value between 1 and 16.

Client Inactivity Timeout – Specifies how much time (in seconds) to wait before closing the connection for a EtherNet/IP Client that has stopped communicating. This can be any constant value between 0 and 65535.

TCP Port Number (44818 is default) – Designates the TCP port number on which the EtherNet/IP Explicit Message Adapter will accept connections. The default value of 44818 is the industry standard and will rarely need to be changed. However, this can be any constant value between 0 and 65535.

Device Name – Up to 32 characters that will be returned in requests for the Identity Class.

NOTE: *Runtime status of the EtherNet/IP adapter is accessed through the built-in structure $IntEIPServer which has the following members:*

.ActiveSessions (read-only) – The number of concurrent open connections to EtherNet/IP scanners.
.LastError – Last error reported to an EtherNet/IP scanner.
.Errors – Total number of errors returned to all EtherNet/IP scanners.
.Transactions – Total number or completed scanner requests to EtherNet/IP scanner.

EtherNet/IP: Explicit/Implicit Messaging Adapter, continued

Select the quantity of Data Blocks (up to 8 data blocks - Block 1 to Block 8) that will be made available to EtherNet/IP scanners. You can specify how many data blocks will be used and then configure each of the blocks in the sections below.

Explicit Messaging Access Control – Specify explicit messaging external access ability.

Enable Reads (Get Single Attribute – Service Code: 0x0E) – Allows EtherNet/IP scanners to read from this data block using Get Single Attribute.

Enable Writes (Set Single Attribute – Service Code: 0x10) – Allows EtherNet/IP scanners to write to this data block using Set Single Attribute.

I/O Messaging Access Control – Specify implicit messaging external access ability.

Enable as Input (Target to Originator) on Adapter x – Allows read access to this block by Implicit Scanners.

Include Run/Idle Status Header – When enabled, 4 additional bytes are added to the message to contain the Run / Idle status information.

Do-more Mapped Memory – Specifies the location in a data block in the Do-more! PLC memory, or a heap item, that will be accessed when requests with this Class/Instance/Attribute are received.

Memory Block – Select if this Block's data resides in one of the predefined Numeric or Bit memory blocks.

Type – Select the memory block to use from the drop-down list of available numeric memory blocks.

Starting ID – Specify the first element in the memory block to use.

Count – The number of successive Elements in the Do-more! memory block to use. The maximum total size on an EtherNet/IP request is 500 bytes, so the maximum number of elements per block will depend on the size of the individual elements. Refer to the chart below:

Element Count

Element Type	Maximum Number of This Type per Data Block
Bit	4000
Byte	500
Word	250
DWord	125
Real	125

Mapped Range – Displays the currently selected range of Elements.

Size – Displays the size of the selected Element range in Bytes.

Heap Item – if this Block's data resides in a Heap Item. The primary use of this selection is with User Data Types. Select one of the existing Heap Items from the drop-down list of available Heap Items.

Assembly Instance – Displays the Path (class / instance / attribute) of the data block being configured.

Class (Explicit) – The Class of all the data blocks is fixed at 0x04 (assembly class).

EtherNet/IP: Explicit/Implicit Messaging Adapter, continued

Instance (Explicit) – Each of the 8 blocks is assigned a unique Instance as shown in this table.

Instance Blocks	
Block Number	**Instance ID**
1	101 (0x65)
2	102 (0x66)
3	103 (0x67)
4	104 (0x68)
5	105 (0x69)
6	106 (0x6A)
7	107 (0x6B)
8	108 (0x6C)

Attribute (Explicit) – The Attribute of each of these data blocks is fixed at 0x03.

Connection Point (Implicit) – Shows the unique Connection Point values that will be used by an Implicit Scanner to access a Block or other I/O.

Instance Blocks	
Block Number	**Instance ID**
1	101 (0x65)
2	102 (0x66)
3	103 (0x67)
4	104 (0x68)
5	105 (0x69)
6	106 (0x6A)
7	107 (0x6B)
8	108 (0x6C)
Input Only Hearbeat	238 (0xEE)

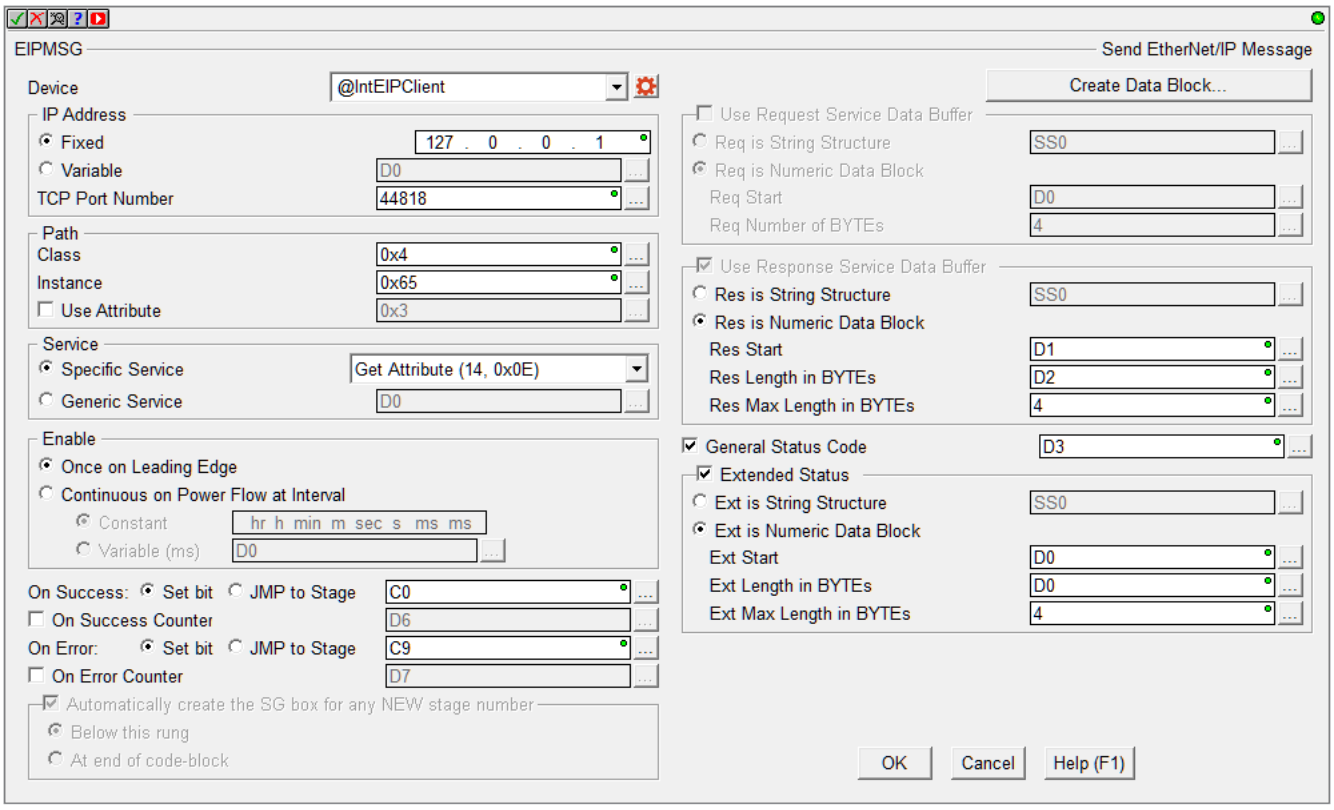
CONFIGURATION NOTES: – This area contains information pertinent to the configuration selections being made.

Generate EDS File – Export the configuration as an Electronic Data Sheet (EDS) file.

EtherNet/IP: Explicit Messaging Scanner

EIPMSG Instruction – The Send EtherNet/IP Message instruction implements an Explicit Unconnected EtherNet/IP Scanner using the on-board Ethernet port of a Do-more! CPU. An explicit message scanner initiates request/response oriented communications with EtherNet/IP adapters. Message rates and latency requirements should not be too demanding. Examples of other explicit message adapters you can talk to are barcode scanners, scales, drives, or other intelligent devices.

EtherNet/IP: Explicit Messaging Scanner, continued



Device – Designates which of the pre-configured EtherNet/IP Scanner devices to use when sending the message. Part of the configuration for a device is assigning a name to the device. It is that name which will show up in the Device selection drop-down menu. The Timeout, Retries and Inactivity Timeout settings for the device are configured by clicking the gear icon to the right of the device name field. A new device can be created by selecting create device in the Device selection drop-down menu. For more information on configuring devices go to the Help file.

NOTE: *If you will be communicating to more than one EtherNet/IP servers (servers with different IP addresses), we recommend that a separate EtherNet/IP Explicit Message client device be created for each of the EtherNet/IP servers. Doing this will minimized the TCP overhead required to manage connections to multiple EtherNet/IP servers.*

IP Address – The IP Address of the EtherNet/IP Adapter to send the message to. This can be either a Fixed (static) IP Address or a Variable (dynamic) value as described below:

Fixed Address – The TCP/IP Address assigned to the EtherNet/IP Server. IP addresses are canonically represented in dot-decimal notation, consisting of four decimal numbers, each ranging from 0 to 255, separated by dots.

NOTE: *Invoking the Element Browser (F9) for this field will bring up the IP Address Lookup utility that can find the IP Address for a given name.*

Variable IP Address – The IP Address resides in the specified memory location. This can be any readable DWord numeric location.

EtherNet/IP: Explicit Messaging Scanner, continued

TCP Port Number – The port number of the EtherNet/IP Server to send the message to. The default value of 44818 is typically the correct port number for EtherNet/IP protocol. This can be any constant value between 0 and 65535, or any readable numeric location containing a value in that range.

Path – Specifies the parameters for the request. The specific values needed for the fields will be provided by the manufacturer of the EtherNet/IP server that you are talking to.

Class – The Class ID value (defined by the EtherNet/IP Server). This can be any positive integer value or any readable numeric location.

Instance – The Instance ID value (defined by the EtherNet/IP Server). This can be any positive integer value or any readable numeric location.

Use Attribute – Enable this option to specify the Attribute value (defined by the EtherNet/IP Server). This can be any positive integer value or any readable numeric location.

Service - Specifies the operation to perform on the set of objects. Choose from the following list of predefined Services, or select Generic and enter the Service number.

Specific Service – Select one of the predefined Service Requests below:

Get Single Attribute (14, 0x0E) - request a single attribute

Set Single Attribute (16, 0x10) - write a single attribute

Get All Attributes (1, 0x01) - request all of the attributes

Set All Attributes (2, 0x02) - write to all of the attributes

Generic Service – Specify a Service that is NOT one of the predefined Service Requests. This can be any constant integer value or readable memory location.

Create Data Block – If an appropriate data block does not already exist, or if you want to create an additional data block for use in this instruction, then click this button to open a dialog where you can create a new data block of the required type.

Use Request Service Data Buffer – This selection will be automatically enabled when any Set Attribute service is selected and automatically disabled when any Get Attribute service is selected. This buffer can be enabled any time the Generic Service is selected.

Req is String Structure – Select this option if the data for the Set Attribute service or any Generic service is contained in a String, then enter the String element to use. This can be any of the system-defined Short Strings, or system-defined Long Strings, or any of the user-defined Strings. The maximum length of the String to send is 500 bytes.

Req is Numeric Data Block – Select this option if the data for the Set Attribute service or any Generic service is contained in a numeric memory block. The maximum size of the data block that can be sent in a single service request 500 bytes (250 Words, 125 DWords, 125 Reals).

Req Start – Specify the first element of the memory block that is the data for the Set Attribute or Generic service.

Req Number of Bytes - The number of consecutive BYTEs of data for the Set Attribute or Generic service (Words = 2 Bytes, DWord = 4 Bytes, Real = 4 Bytes).

Use Response Service Data Buffer – This selection will be automatically enabled when any Get Attribute service or any Generic service is selected and automatically disabled when any Set Attribute service is selected. This buffer can be enabled any time the Generic Service is selected.

EtherNet/IP: Explicit Messaging Scanner, continued

Res is String Structure – Select this option to store the data from the Get Attribute service or any Generic service in a String, then enter the String element to use. This can be any of the system-defined Short Strings, or system-defined Long Strings, or any of the user-defined Strings. The maximum length of the String that could potentially be received is 500 bytes, so make sure the String can handle the maximum response for the desired service.

Res is Numeric Data Block – Select this option to store the data from the Get service or any Generic service in a numeric memory block. The maximum size of the data block that can be read in a single service request 500 bytes (250 Words, 125 DWords, 125 Reals).

Res Start – Specify the first element in the numeric data block to store the data that was returned by the Get Attribute or Generic service. This can be any writable numeric location.

Res Length in BYTEs – Specify a memory location to store the actual number of Bytes of data that was returned by the Get Attribute or Generic service. This can be any writable numeric location.

Res Max Length in BYTEs – Specify the maximum number of BYTEs of the returned data to retain to store in the data block. This can be any positive integer constant between 1 and 500 or any readable numeric location.



NOTE: *The byte length value should be a multiple of the number of BYTEs in a single element in the numeric memory block. For example, if the memory block consists of DWords or Reals, this value should be a multiple of 4, as there are 4 BYTEs per DWord or Real.*

General Status Code – enable this option to store the value returned from the EtherNet/IP Adapter in response to processing the Service Request; enter the numeric location to store the value. This can be any writable numeric location. This value could indicate success or be an error code. Consult the documentation for the EtherNet/IP Adapter for information on how to interpret General Status Code values.

Extended Status – Enable this option to store any extended status value returned from the EtherNet/IP Adapter in response to processing the Service Request.

Ext is String Structure – Select this option to store the extended status information in a String, then enter the destination String element. This can be any of the system-defined Short Strings, or system-defined Long Strings, or any of the user-defined Strings.

Ext is Numeric Data Block – Select this option to store the Extended Status data in a numeric data block.

Ext Start – Specify the first element in the numeric data block to store the Extended Status data. This can be any writable numeric location.

Ext Length in BYTEs – Specify a memory location to store the actual number of Bytes of Extended Status data. This can be any writable numeric location.

Ext Max Length in BYTEs – Specify the maximum number of BYTEs of Extended Status data to store in the data block. This can be any positive integer constant between 1 and 500, or any readable numeric location.



NOTE: *The byte length value should be a multiple of the number of BYTEs in a single element in the numeric memory block. For example, if the memory block consists of DWords or Reals, this value should be a multiple of 4, as there are 4 BYTEs per DWord or Real.*

Enable – Designates how this instruction will operate. Select from one of the following:

EtherNet/IP: Explicit Messaging Scanner, continued

Once on Leading Edge - Select this option to have this instruction run to completion exactly one time. Typically, this instruction will take more than one controller scan to complete. Configured this way the instruction is Edge Triggered.

Continuous on Power Flow at Interval – Select this option to have this instruction run as long as the instruction has power flow. After the instruction has initially run, if the instruction still has power flow, the instruction will remain enabled and will wait the specified amount of time before running again. The following options select how much time (in milliseconds) to wait between successive runs. A value of zero milliseconds (0ms) means the instruction will re-run immediately.

On Success – When the instruction completes successfully this action will be performed.

Set Bit – Enable this selection then specify writable bit location.

JMP to Stage – Enable this selection then specify any Stage number from S0 to S127 in the current Program code block.

On Success Counter – Enable this option and select a DWord location to store the total number of times the RX completed successfully. This can be any DWord location.

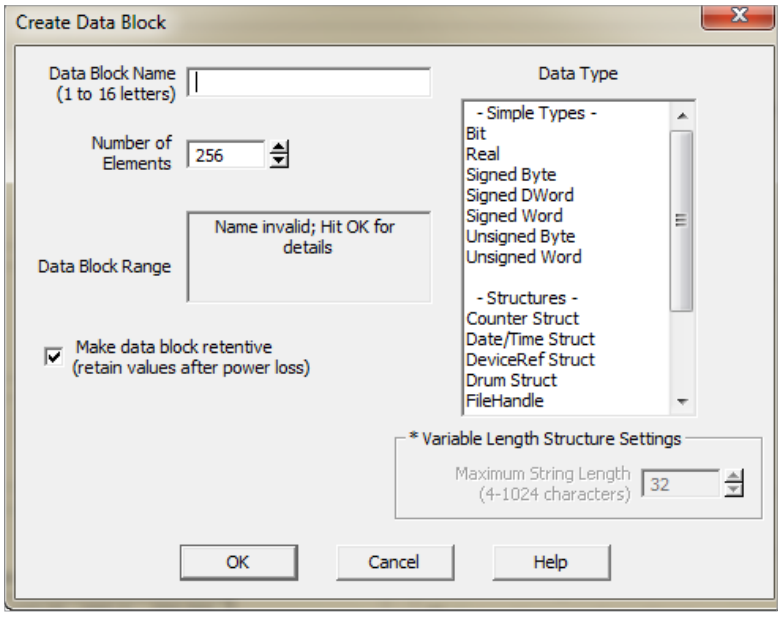
On Error – When the instruction does not complete successfully this action will be performed.

Set Bit – Enable this selection then specify writable bit location.

JMP to Stage – Enable this selection then specify any Stage number from S0 to S127 in the current Program code block.

On Error Counter – Enable this option and select a DWord location to store the total number of times the RX failed to complete. This can be any DWord location.

Create Data Block – If an appropriate data block does not already exist, or if you want to create an additional data block for use in this instruction, then click this button to open a dialog where you can create a new data block of the required type.



Data Block Name (1 to 16 letters) – Block names must be unique, and consist of 1 to 16 characters (A-Z, a-z; no numbers, no spaces).

EtherNet/IP: Explicit Messaging Scanner, continued

Number of Elements – Specifies the number of bytes in the data block. The data blocks must be created on a DWord (4-byte) boundary. The maximum number of Bytes that can be received from a single packet is 1024.

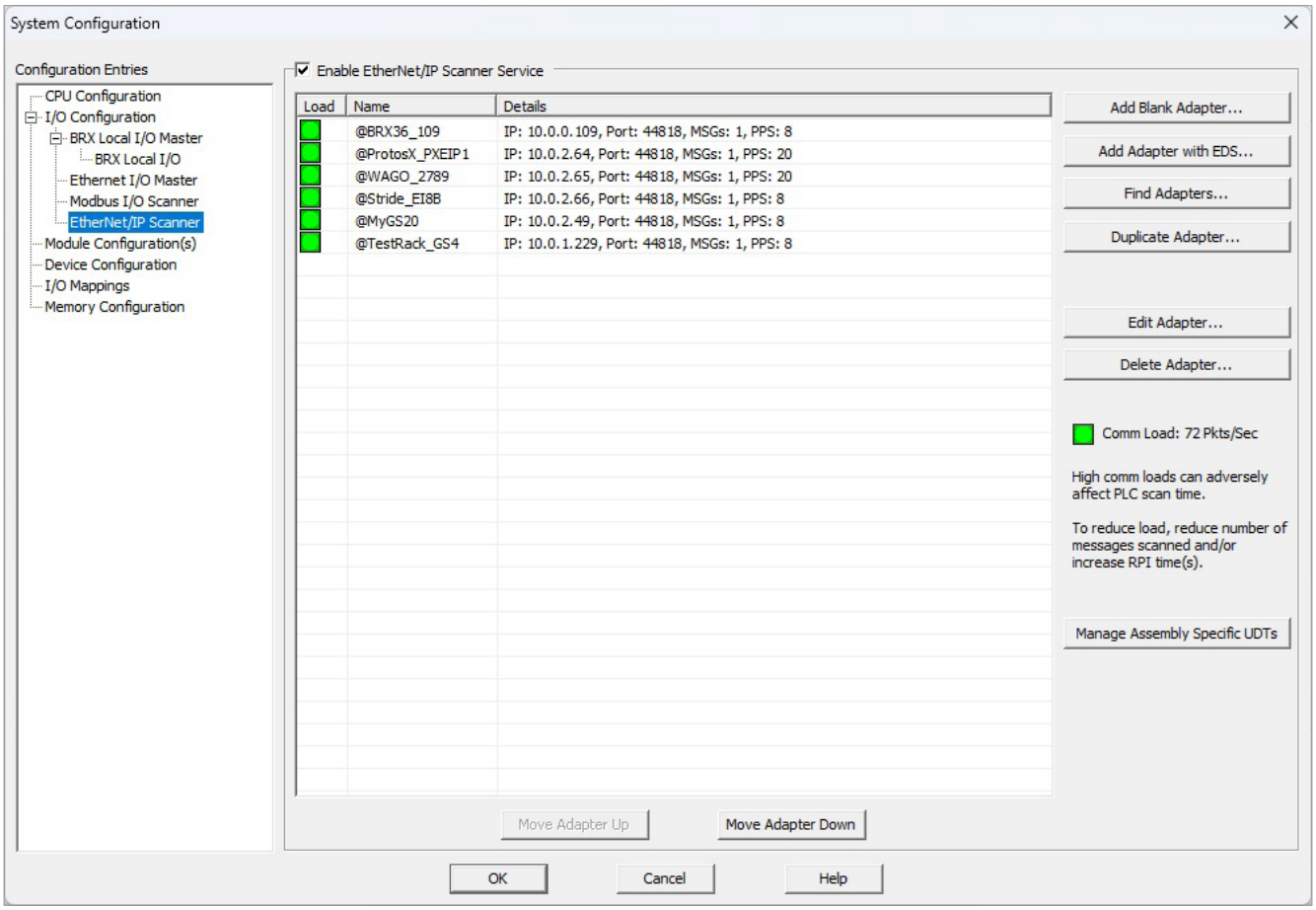
Data Block Range – Displays the first and last element of the block that will be created based on the current entries for Data Block Name and Number of Elements.

Data Type – The data block will consist of Unsigned Bytes.

Make Data Block Retentive (retain values after power loss) – A data block marked as retentive will hold its state through a power cycle or a Program-to-Run mode transition. The status of memory NOT marked as retentive will be cleared at power up and during a Program-to-Run mode transition.

EtherNet/IP: Implicit Messaging Scanner

Ethernet-equipped BRX CPUs can configure their on-board Ethernet or a BX-P-ECOMEX POM to operate as an EtherNet/IP Scanner to create I/O Messaging, also called Implicit, connections with up to 32 connections to Adapters. Each of the connections can have from 1 to 8 Messages. The EtherNet/IP Implicit Messaging Scanner must be enabled in the System Configuration dialog box.



Load – column shows each adapter connection's contribution to the cumulative Comm Load. The Comm Load indicator provides a visual cue to the cumulative level of network traffic that is being generated by all of the EtherNet/IP Scanner devices currently configured. As the Comm Load increases from green to yellow to red, the impact on other processes in the CPU will increase as well. For example, the scan time will go up and the responsiveness of the Ethernet port to other connections (Do-more Designer, Ethernet Remote I/O, etc.) will go down. The Comm Load can be lowered by reducing the number of messages being generated by the current Adapter connections, or by increasing the RPI Time (requested packet interval) of the Messages in those connections.

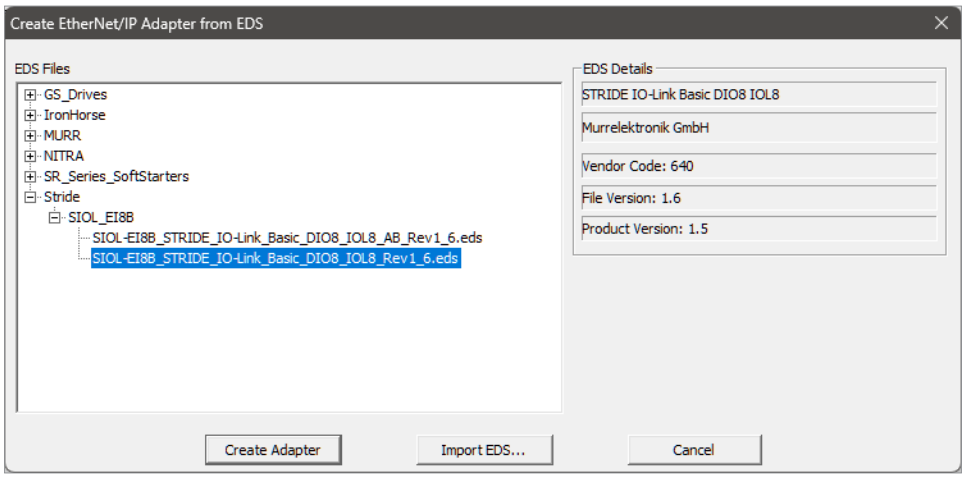
Name – column shows the user-assigned name for the connection to the Adapter.

Details – column displays a short summary of the most important details of the connection, this is, the IP address of the Adapter and the Port used, the number of Messages configured, and the packet rate for this connection.

Add Blank Adapter – will open the Adapter Settings editor with all of the fields set to their default values so that a connection to a new Adapter can be created.

EtherNet/IP: Implicit Messaging Scanner, continued

Add Adapter with EDS – will open the Adapter Settings editor and prompt for the EDS file to use, so that a connection to a new Adapter can be created. Select a device from the profile repository, or choose **Import EDS** to load a third party EDS file and add it to the repository.



Details from the highlighted EDS file will be displayed in the EDS Details pane on the right. Clicking **Create Adapter** will make a new Adapter using the information from the highlighted or imported EDS file.

Find Adapters – will open a dialog where all of the EtherNet/IP devices currently available on the network can be seen, and one of them selected as a new Adapter.

Duplicate Adapter – will make an exact copy of the currently highlighted connection and open that new connection in the Adapter Settings editor. This can be quite handy when there are connections to multiple adapters with similar messaging; you need only change the Device Name, IP Address, and local storage for the data as required.

Edit Adapter – will open the currently highlighted entry in the EtherNet/IP Adapter Settings editor.

Delete Adapter – will remove the currently highlighted Adapter connection from the current configuration.

Manage Assembly Specific UDTs – create and manage EDS Assembly-Specific User Data Types and map the Assembly's named parameters to your named structure fields.

Move Device Up & **Moved Device Down** buttons – reposition the currently highlighted Adapter connection one row toward the top or toward the bottom of the list, respectively.

EtherNet/IP: Implicit Messaging Scanner, continued

Structure Fields

Each time a new connection to an Adapter is created, an associated data structure will be automatically created using the same as the Adapter. The fields of this structure can be used to monitor the health of the connection.

$<EIP Adapter name>

Each Implicit Adapter structure contains the following fields:

.EnableScanner is a Bit that indicates the current State of the Adapter; ON means the Adapter is enabled / OFF means disabled.

.TCPConnected is a Bit that indicates that the Implicit Adapter is connected.

.Error is a Bit that will be ON if the TCP connection is not functional (typically due to a Timeout).

.RunIdle is a Bit that reflects the Run/Idle state from the T -> O (Input) header.

.EnableMSG1 through **.EnableMSG8** will be ON if that MSG has been enabled for this Adapter. Turning this Bit OFF will prevent this MSG from being processed.

.EnableMSG is a Byte that contains a Bit for each of the 8 possible MSGs for this Adapter; the Bit location within the Byte will ON if the MSG is enabled. Turning a Bit OFF will prevent the corresponding MSG from being processed.

.MSGStatus is a Byte that contains a Bit for each of the possible 8 MSGs; the Bit location within the Byte will be ON if here is a Status code being reported for the corresponding MSG.

.MSGError is a Byte that contains a Bit for each of the possible 8 MSGs; the Bit location within the Byte will be ON if there is an error being reported for the corresponding MSG.

.GenStatusCode is an Unsigned Byte that contains the last General Status Code value reported to the Scanner from this Adapter.

.ExtStatusCode is an Unsigned Word that contains the last Extended Status Code value reported to the Scanner from this Adapter.

.ExtStatusInfo1 is an Unsigned Word that contains the last Extended Status Info 1 value reported to the Scanner from this Adapter.

.ExtStatusInfo2 is an Unsigned Word that contains the last Extended Status Info 2 value reported to the Scanner from this Adapter.

.XferCount is an Unsigned Word that contains running count of the successful T -> O (Input) and O -> T (Output) data transfers

.ErrorCount is an Unsigned Word that contains a running count of the unsuccessful T -> O (Input) and O -> T (Output) data transfers

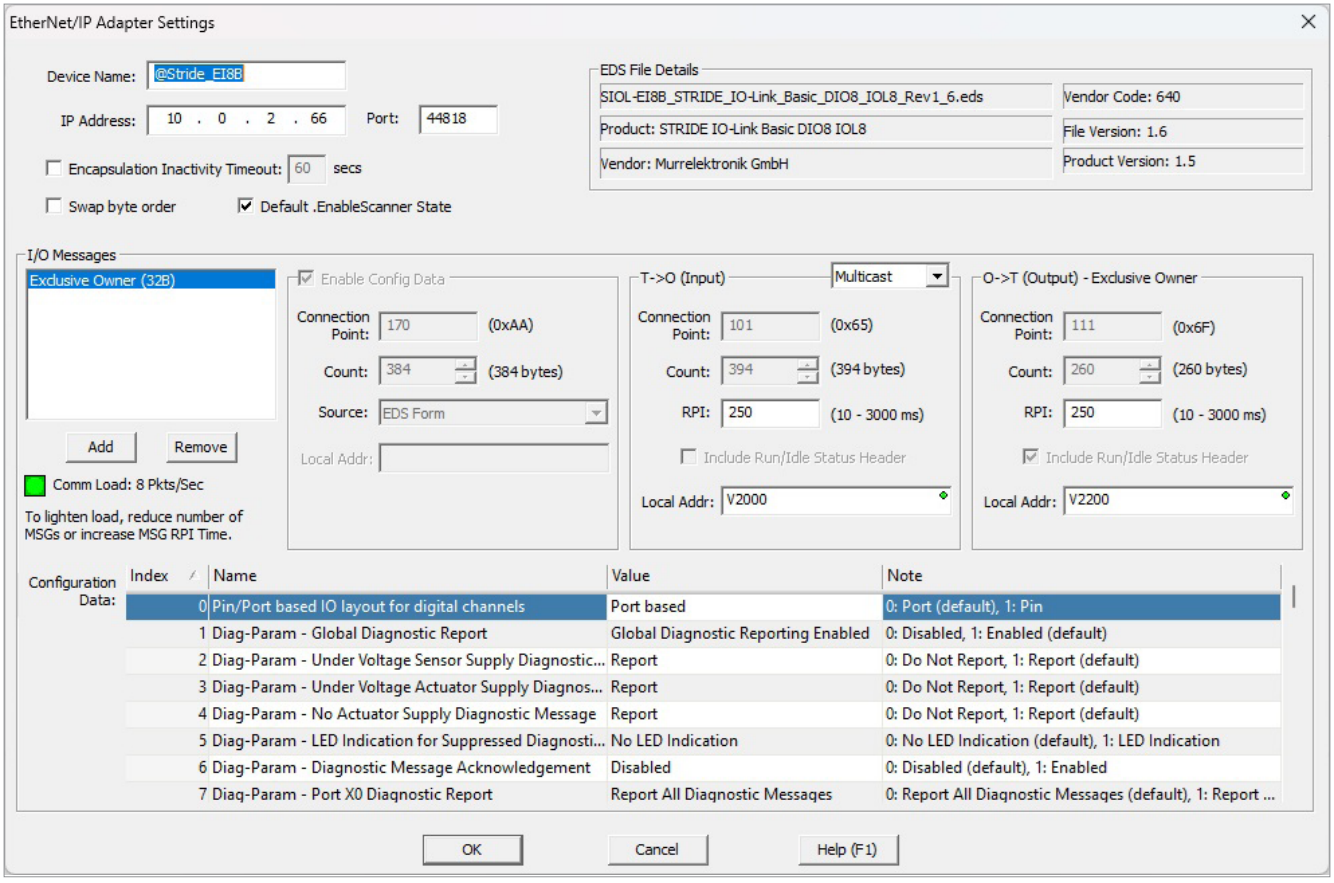
.VendorID is a read-only Unsigned Word that contains the Vendor ID read from the Adapter, or from the EDS file (if applicable).

.AdapterName (.MaxLen = 32) is a String of up to 32 characters that contains the name of the Adapter read from the EDS file (if applicable).

EtherNet/IP: Implicit Messaging Scanner, continued

EtherNet/IP Adapter Settings

The EtherNet/IP Adapter Settings editor is used to create a connection to an I/O Messaging (Implicit) Adapter and then configure the Messages for that Adapter.



Device Name is the user-assigned name for the Adapter. This is also the name of the structure that is automatically created for each Adapter.

IP Address is the TCP/IP address of the Adapter.

Port is the IP port number for the connection to use. The default value of 44818 is the traditional port number for I/O Messaging (Implicit) connections.

Enable **Encapsulation Inactivity Timeout** to have the Scanner close the session for this Adapter the specified number of seconds of inactivity.

Enable **Swap Byte Order** to have the Scanner swap the bytes in the outgoing data packet before the packet is sent.

Each time the CPU powers up, or a change is made that requires an update to the System Configuration, the Scanner will use the **Default .EnableScanner State** to determine whether the connection to the specified Adapter will be enabled.

The **EDS File Details** group shows information on the current EDS file.

The **I/O Messages** group contains the parameters that define the optional **Config Data**, **T->O (Input)** and **O->T (Output)** blocks for each I/O Message.

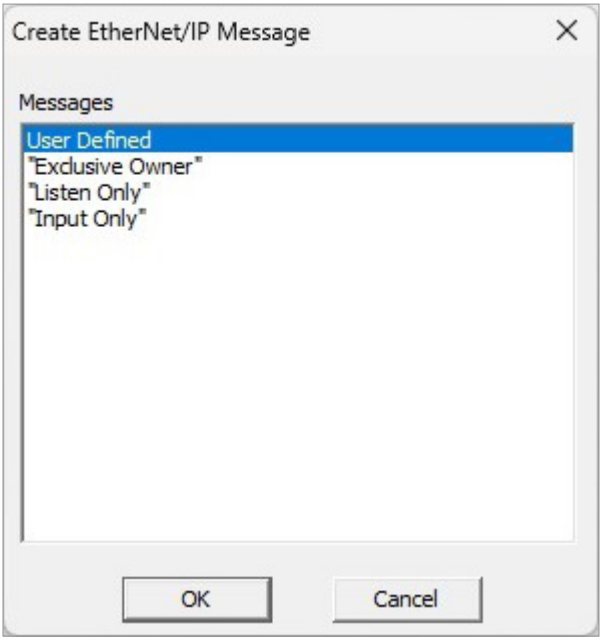
An **O->T (Output) Byte Count value greater than 0** is referred to as an **Exclusive Owner** connection, which is a Class 0 or 1 connection to an Output connection point that allows the Scanner to send

EtherNet/IP: Implicit Messaging Scanner, continued

Output Data to the Target (O->T). The Target can send Input Data to the Scanner (T->O). The Target can only accept one connection to the specified Output connection point. If the Input Data length in this connection is zero, then a 'heartbeat' connection point is used.

A **T->O Byte Count value of 0** could be an **Input-Only** connection or a **Listen-Only** connection. Both are Class 0 or 1 connections to an Input connection point that allows the Target to send Input Data to the Scanner (T->O). The Scanner sends no Output Data to the Target, but rather maintains the connection using a 'heartbeat' connection. The **Listen-Only** connection is dependent upon the existence of some other non-Listen-Only connection (Exclusive Owner or Input-Only) for its own existence. If the Exclusive Owner / Input-Only connection closes, the Listen-Only connection will also close or timeout. A Target can only open a Listen-Only connection while there is an existing Exclusive Owner or Input-Only connection.

The **Add** button will create a new Message. If the Adapter was created from an EDS file, the following dialog will open displaying the Assembly Instances and Connection Points defined in the EDS file.



The **Remove** button will delete the highlighted Messages.

Comm Load provides a visual cue to the level of network traffic that will be generated by the currently defined Messages. The Comm Load can be lowered by reducing the number of Messages or by increasing the RPI Time (requested packet interval) of the Message.

Enable the **Config Data** group if the Message includes Configuration Data. If an EDS file was used to create the Adapter, and the EDS file has a Connection Point for the Config Data, that connection information will be used to populate the following fields:

Assembly Instance / Connection Point is the Connection Point parameter for the desired configuration data block of the Adapter. This value is specific for the Adapter and is determined from the manufacturer's documentation of that device when not using its EDS file. This can be any constant value or any readable numeric location.

Count specifies how many contiguous bytes of memory are required to store the Config Data.

Data Source selects the data type of the Config Data. If an EDS file was used to create the Message, the default will be **EDS Form**. Otherwise, select **Local Address** and specify the memory location in

EtherNet/IP: Implicit Messaging Scanner, continued

the CPU where the Config Data will be stored, or select the appropriate format for the config data. Options include **Signed Byte Array**, **Unsigned Byte Array**, **Hex Byte Array**, **Signed Word Array** (2 bytes per value), **Unsigned Word Array** (2 bytes per value) and **Hex Word Array** (2 bytes per value)

T->O (Input) group defines the data being written from the BRX CPU back to the EtherNet/IP Scanner.

Select **Multicast** or **Unicast**. Some adapters can be configured to Multicast their input data on the network or Unicast their input data back only to the Scanner (originator). Some devices only support multicasting of input data. In situations where the Adapter supports both, and there are multiple devices consuming this data, then it is more efficient to use Multicast.

Assembly Instance / Connection Point is the Connection Point parameter for the desired input data block of the Adapter. This value is specific for the Adapter and is determined from the manufacturer's documentation of that device when not using its EDS file. This can be any constant value or any readable numeric location.

Byte Count is the number of contiguous bytes of data to read from this connection point. This can be any positive integer value or any readable numeric location.

RPI Time is the Requested Packet Interval (in ms) for this connection. The RPI value determines how often the input data will be sent back to the Scanner from the Adapter. The smaller the value configured in this field, the more resource intensive it will be for both the Scanner and the Adapter. This can be any positive integer value between 10 and 1,000,000 milliseconds, or any readable numeric location containing a value in that range.

If **Include Status Header** is enabled, 4 additional bytes are added to the message to contain the Run / Idle status information.

Local Address selects the memory location in the CPU where the source data is stored.

O->T (Output) group defines the data being written from the EtherNet/IP Scanner to the BRX CPU.

Assembly Instance / Connection Point is the Connection Point parameter for the desired output data block of the Adapter. This value is specific for the Adapter and is determined from the manufacturer's documentation of that device when not using its EDS file. This can be any constant value or any readable numeric location.

Byte Count is the number of data bytes in this message.

RPI Time is the Requested Packet Interval (in ms) for this connection. The RPI value determines how often the output data will be sent from the CPU to the Adapter. The smaller the value configured in this field, the more resource intensive it will be for both devices. This can be any positive integer value between 10 and 1,000,000 milliseconds, or any readable numeric location containing a value in that range.

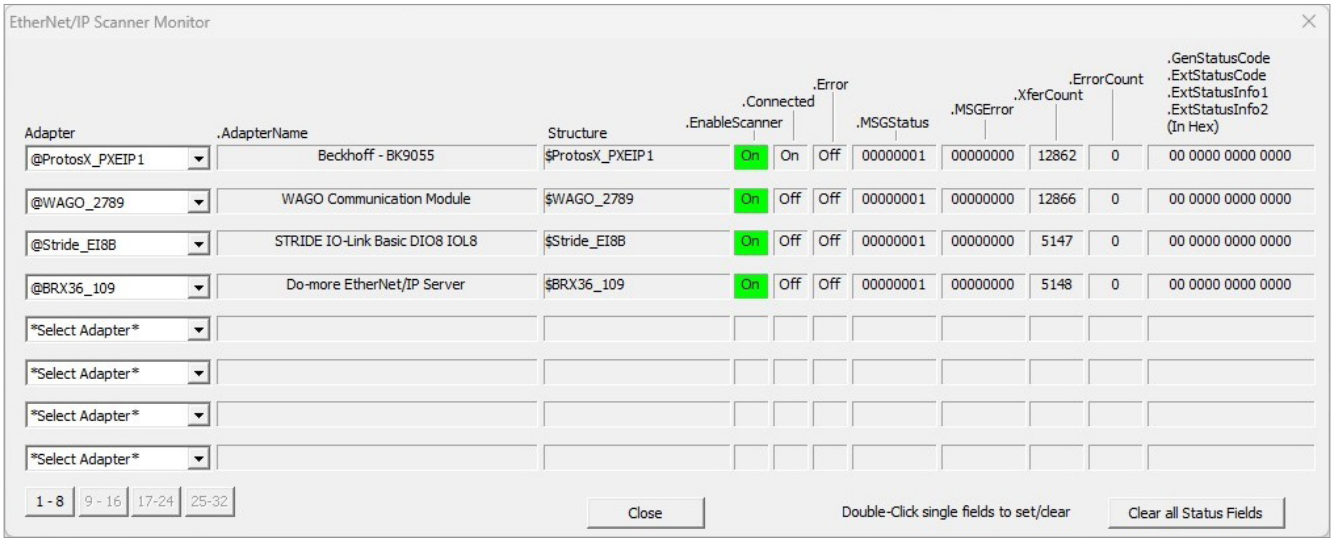
If **Include Status Header** is enabled, 4 additional bytes are added to the message to contain the Run / Idle status information.

Local Address selects the memory location in the CPU where the data will be stored.

EtherNet/IP: Implicit Messaging Scanner, continued

EtherNet/IP Scanner Monitor

After the EtherNet/IP Scanner is configured and running, the EtherNet/IP Scanner Monitor can be used to display the "health" of the currently configured network of EtherNet/IP Adapters. This utility can be opened through by selecting the **Debug** > **EtherNet/IP Scanner Monitor** menu selection.



The monitor can show the status of 8 of the possible 32 Adapters on each of 4 pages. When the monitor is first opened, the first 8 configured Adapters (1 thru 8) will automatically be selected. If there are more than 8 Adapters configured, the remaining Adapters will be automatically selected on one the next three pages. The 4 buttons in the lower left corner of the dialog will select the current page of Adapters (1 - 8), (9 - 16), (17-24), and (25 - 32). Double-click on any field of any Adapter to Enable or Disable the I/O cycles of individual Adapters, or Clear/Reset errors/metrics

Adapter selects from the list of configured Adapters.

.AdapterName displays the name of the selected Adapter.

Structure displays the name of the selected Adapter's associated structure whose fields are used for status and runtime control:

.EnableScanner showa the current state (ON / OFF) of the Adapter's connection to the Scanner. Double-clicking the field will toggle that Bit to the opposite state.

.TCPConnected shows the current state (ON / OFF) of the TCP/IP connection. Double-clicking the field will toggle that Bit to the opposite state.

.Error is the last error received from comm operations performed by the Scanner. Double-clicking on that field will clear the error.

.MSGStatus is the last error received from comm operations performed by the Scanner. Double-clicking on that field will clear the error.

.MSGError is the last error received from comm operations performed by the Scanner. Double-clicking on that field will clear the error.

.GenStatusCode, **.ExtStatusCode**, **.ExtStatusInfo1** and **.ExtStatusInfo2** values are displayed as a group in the final column. When an error occurs, the values in the column will show these code value in Hex; hovering the cursor over that field will generate a popup with an explanation of the status codes.

EtherNet/IP: Implicit Messaging Scanner, continued

.XferCount and **.ErrorCount** show the current values for those numeric fields. Double-clicking on either field will reset the field's value to 0.

Clicking the **Clear All Status Fields** button will reset the **.XferCount** and **.ErrorCount** fields to 0, and clear the **.MSGError** field for all of the Adapters on the current page (it does NOT clear these values for Adapters on other pages).

The majority of the values that are shown in the **.GenStatusCode**, **.ExtStatusCode**, **.ExtStatusInfo1**, and **.ExtStatusInfo2** are NOT manufacturer specific, they are part of the CIP specification. There are very specific codes for specific conditions and specific names that are associated with these codes.

Also be aware that not all Status and Exception code values will be generated by the Adapter; some of these codes will be generated by the Scanner itself.

One notable exception is Extended Status code in the range of 0x0320 through 0x07FF are reserved for Vendors; you will need to contact the adapter manufacturer for details for values within this range.

Error Codes

EIP Level Errors

Error Code	Extended Error Info	Description
1 (0x01)	None	**Invalid Command** is returned for any command that is not recognized, and from RegisterSession if the session is already been registered.
3 (0x03)	None	**Invalid Request** is returned for any request that is not recognized.
100 (0x64)	None	**Invalid Session** is returned if session hasn't been opened or if the session handle is wrong.
101 (0x65)	None	**Invalid Length** is returned if the request length is wrong or longer than can be handled.
105 (0x69)	None	**Invalid Revision** is returned from RegisterSession if the requested version is not 1.

CIP Level Errors

General Status	Extended Status	Name	Description
0x01	0x0100	Connection In Use or Duplicate Forward_Open	A connection is already established from the target device sending a Forward Open request or the target device has sent multiple forward open request. This could be caused by poor network traffic. Check the cabling, switches and connections.
0x01	0x0103	Transport Class and Trigger Combination Not Supported	The Transport class and trigger combination is not supported. The BRX CPU only supports Class 1 and Class 3 transports and triggers: Change of State and Cyclic.
0x01	0x0106	Ownership Conflict	An existing exclusive owner has already configured a connection to this Connection Point. Check to see if other Scanner devices are connected to this adapter or verify that Multicast is supported by adapter device if Multicast is selected for Forward Open. This could be caused by poor network traffic. Check the cabling, switches and connections.
0x01	0x0107	Target Connection Not Found	This occurs if a device sends a Forward Close on a connection and the device can't find this connection. This could occur if one of these devices has powered down or if the connection timed out on a bad connection. This could be caused by poor network traffic. Check the cabling, switches and connections.
0x01	0x0108	Invalid Network Connection Parameter	This error occurs when one of the parameters specified in the Forward Open message is not supported such as Connection Point, Connection type, Connection priority, redundant owner or exclusive owner.
0x01	0x0109	Invalid Connection Size	This error occurs when the target device doesn't support the requested connection size. Check the documentation of the manufacturer's device to verify the correct Connection size required by the device.

Table continued on next page

EtherNet/IP: Implicit Messaging Scanner, continued

CIP Level Errors

General Status	Extended Status	Name	Description
0x01	0x0110	Target for Connection Not Configured	This error occurs when a message is received with a connection number that does not exist in the target device. This could occur if the target device has powered down or if the connection timed out. This could be caused by poor network traffic. Check the cabling, switches and connections.
0x01	0x0111	RPI Not Supported	This error occurs if the Originator is specifying an RPI that is not supported. The BRX CPU will accept a minimum value of 10ms on a CIP Forward Open request. However, the CPU will produce at the specified rate up to the scan time of the installed project. The CPU cannot product any faster than the scan time of the running project.
0x01	0x0112	RPI Value(s) Not Acceptable	This error is returned when the RPI value(s) in the Forward Open request is outside the range required by the application in the target device or the target is producing at a different interval. The target shall include information with acceptable RPIs. For this error, the extended status size is 6 16-bit words and is formatted as follows:

Data Type	Value	Explanation of Field
UINT	0x112	Extended Status Code
USINT	<variable>	Acceptable Originator to Target RPI (see below) type, values: 0 - The RPI specified in the Forward Open was acceptable (the Originator to Target RPI value is ignored.) 1 - unspecified (used to suggest an alternate RPI, e.g. default) 2 - minimum acceptable RPI (used when RPI was too fast for range) 3 - maximum acceptable RPI (used when RPI was too slow for the range) 4 - required RPI to correct mismatch (used when data already being produced at a different interval) 5 - 255- reserved
UDINT	<variable>	Value of Originator to Target RPI that is within the acceptable range for the application. This field is defined the same as the RPI parameter in the Forward Open request.
UDINT	<variable>	Value of Originator to Target RPI that is within the acceptable range for the application. This field is defined the same as the RPI parameter in the Forward Open request.

The value of the Originator to Target and Target to Originator type shall not both be 0.

0x01	0x0113	Out of Connections	The maximum number of EtherNet/IP connections supported by the target device has been reached.
0x01	0x0114	Vendor ID or Product Code Mismatch	The compatibility bit was set in the Forward Open message but the Vendor ID or Product Code did not match.
0x01	0x0115	Device Type Mismatch	The compatibility bit was set in the Forward Open message but the Device Type did not match.
0x01	0x0116	Revision Mismatch	The compatibility bit was set in the Forward Open message but the major and minor revision numbers were not a valid revision.

Table continued on next page

EtherNet/IP: Implicit Messaging Scanner, continued

CIP Level Errors			
General Status	**Extended Status**	**Name**	**Description**
0x01	0x0117	Invalid Produced or Consumed Application Path	This error is returned from the Target device when the Connection Point parameters specified for the O->T (Output) or T->O (Input) connection is incorrect or not supported.
0x01	0x0118	Invalid or Inconsistent Configuration Application Path	This error is returned from the Target device when the Connection Point parameter specified for the Configuration data is incorrect or not supported.
0x01	0x0119	Non-Listen Only Connection Not Opened	This error code is returned from the target device when an attempt is made by a Scanner to establish a Listen Only connection type to the target, which has no non-Listen Only connections with the same T->O application path already established.
0x01	0x011A	Target Object Out of Connections	The maximum number of connections supported by this instance of the object has been exceeded.
0x01	0x011B	The Production Inhibit Time is Greater than the RPI	The Target to Originator RPI is smaller than the Target to Originator Production Inhibit Time. Consult the manufacturer's documentation as to the minimum rate that data can be produced and adjust the RPI to greater than this value.
0x01	0x011C	Transport Class Not Supported	The Transport Class requested in the Forward Open is not supported. Only Class 1 and Class 3 classes are supported in the BRX CPU.
0x01	0x011D	T->O Production Trigger Not Supported	The Production Trigger requested in the Forward Open is not supported by the target device. The BRX CPU, as an EtherNet/IP Adapter, will accept Forward Open requests for Class 1 connections that specify Cyclic or Change of State Production Triggers. The Application object is supported for Class 3 connections.
0x01	0x011E	Direction Not Supported	The Direction requested in the Forward Open is not supported.
0x01	0x011F	Invalid Originator to Target Network Connection FixVar	This error is returned from the target device when the Originator to Target fixed / variable flag specified in the Forward Open is not supported.
0x01	0x0120	Invalid Target to Originator Network Connection FixVar	This error is returned from the target device when the Target to Originator fixed / variable flag specified in the Forward Open is not supported.
0x01	0x0121	Invalid Originator to Target Network Connection Priority	The Originator to Target Network Connection Priority specified in the Forward Open is not supported. Low, High, Scheduled, and Urgent are all supported by the BRX CPU.
0x01	0x0122	Invalid Target to Originator Network Connection Priority	The Target to Originator Network Connection Priority specified in the Forward Open is not supported. Low, High, Scheduled, and Urgent are all supported by the BRX CPU.
0x01	0x0123	Invalid Originator to Target Network Connection Type	The Originator to Target Network Connection Type specified in the Forward Open is not supported. Only Unicast is supported for O->T (Output) data in the BRX CPU.
0x01	0x0124	Invalid Target to Originator Network Connection Type	The Target to Originator Network Connection Type specified in the Forward Open is not supported. Multicast and Unicast is supported in the BRX CPU. Although many devices will support both Multicast and Unicast in the T->O direction, some devices will require Multicast while others will require Unicast. If this error is encountered, attempt the other method.
0x01	0x0125	Invalid Originator to Target Network Connection Redundant_Owner	The Originator to Target Network Connection Redundant Owner flag specified in the Forward Open is not supported.
0x01	0x0126	Invalid Configuration Size	This error is returned when the Configuration data sent in the Forward Open does not match the size specified or is not supported by the Adapter. The Target device may return an additional Unsigned Integer 16 value that specifies the maximum size allowed for this data. An array can be defined for this field in order to view the extended error code attributes.

Table continued on next page

EtherNet/IP: Implicit Messaging Scanner, continued

CIP Level Errors			
General Status	**Extended Status**	**Name**	**Description**
0x01	0x0127	Invalid Originator to Target Network Connection Size	This extended status code is returned by the target device when the O->T connection size specified in the Forward Open does not match the O->T connection size of the target device. Target devices that return this extended status shall return an additional UINT that specifies the maximum connection size (in bytes) supported by the target device. Note: The connection size is defined as sum of the data block size, the 32-bit Run / Idle header (if included), and a 2-byte sequence count. Note: As an Adapter, the Productivity Series CPU requires the Run / Idle header to be included in the O->T connection. Note: If the Scanner device does not have the option to specify the Run / Idle header in the O->T connection, the Scanner must increase the requested data block size by 4 bytes. The first 4 bytes within the O->T payload should replace the required Run / Idle header and actual Output Data needs to be offset by 4 bytes.
0x01	0x0128	Invalid Target to Originator Network Connection Size	This extended status code is returned by the target device when the T->O connection size specified in the Forward Open does not match the T->O connection size of the target device. Target devices that return this extended status shall return an additional UINT that specifies the maximum connection size (in bytes) supported by the target device. Note: The connection size is defined as sum of the data block size, the 32-bit Run / Idle header (if included), and a 2-byte sequence count. Note: As an Adapter, the BRX CPU does not include a Run / Idle header in the T->O connection.
0x01	0x0129	Invalid Configuration Application Path	The Configuration path specified in the Forward Open does not correspond to a valid Configuration path within the target device. This error could also be returned if the Configuration path is required by the target device, but not provided in the Forward Open. The BRX CPU, as an Adapter, does not require a Configuration path to be specified. However, if a Configuration path is specified in the Forward Open, the size must be set to zero.
0x01	0x012A	Invalid Consuming Application Path	This error is returned by the target device when the Consuming path (Originator to Target) specified in the Forward Open does not correspond to a valid Consuming path (Originator to Target) within the target device. This error could also be returned if the Consuming path is required by the target device, but not provided in the Forward Open.
0x01	0x012B	Invalid Producing Application Path	This error is returned by the target device when the Producing path (Target to Originator) specified in the Forward Open does not correspond to a valid Producing path (Target to Originator) within the target device. This error could also be returned if the Producing path is required by the target device, but not provided in the Forward Open.
0x01	0x012C	Configuration Symbol Does Not Exist	The Originator attempted to connect to a configuration tag name that is not supported in the Target.
0x01	0x012D	Consuming Symbol Does Not Exist	The Originator attempted to connect to a consuming tag name that is not supported in the Target.
0x01	0x012E	Producing Symbol Does Not Exist	The Originator attempted to connect to a producing tag name that is not supported in the Target.
0x01	0x012F	Inconsistent Application Path Combination	The combination of Configuration, Consuming and Producing application paths specified are inconsistent.
0x01	0x0130	Inconsistent Consume Data Format	Information in the data segment not consistent with the format of the data in the consumed data.
0x01	0x0131	Inconsistent Produce Data Format	Inconsistent Produce data format.
0x01	0x0132	Null Forward_Open Function Not Supported	The target device does not support the function requested in the NULL Forward Open request. The requested function may be 'ping device', 'configure a device's application', or 'reconfigure a target device's application.'

Table continued on next page

EtherNet/IP: Implicit Messaging Scanner, continued

CIP Level Errors			
General Status	**Extended Status**	**Name**	**Description**
0x01	0x0133	Connection Timeout Multiplier Not Acceptable	The Connection Timeout Multiplier specified in the Forward Open produces a timeout value that is too large for the target device to support. The timeout value is a result of the specified RPI value multiplied by the Connection Timeout Multiplier value. Consult the manufacturer's device documentation for appropriate RPI values or Connection Timeout values.
0x01	0x0203	Connection Timed Out	This extended status code shall occur when a connection has timed-out.
0x01	0x0204	Unconnected Request Timed Out	A client device may return an Unconnected Request Timeout error when the allotted time to process the request is insufficient or the client device receives no reply to the request within the time specified by the Time_tick / Time-out_ ticks parameter. A target device may return an Unconnected Request Timeout error when the allotted time to process the request is insufficient.
0x01	0x0205	Parameter Error in Unconnected Request Service	This extended status code shall occur when a CIP router does not support the Connection Tick Time and Connection time-out combination used in the client request.
0x01	0x0206	Message Too Large for Unconnected_Send Service	This extended status occurs when the Unconnected Send message is too large to send out on the network.
0x01	0x0207	Unconnected Acknowledge Without Reply	This error occurs if an Acknowledge was received but no data response occurred. Verify that the message that was sent is supported by the Target device using the device manufacturer's documentation.
0x01	0x0301	No Buffer Memory Available	This error occurs if the Connection memory buffer in the target device is full. Correct this by reducing the frequency of the messages being sent to the device and/or reducing the number of connections to the device. Consult the manufacturer's documentation for other means of correcting this.
0x01	0x0302	Network Bandwidth Not Available for Data	This error occurs if the Producer device cannot support the specified RPI rate when the connection has been configured with schedule priority. Reduce the RPI rate or consult the manufacturer's documentation for other means to correct this.
0x01	0x0303	No Consumed Connection ID Filter Available	This error occurs if a Consumer device doesn't have an available consumed_ connection_id filter.
0x01	0x0304	Not Configured to Send Scheduled Priority Data	This error occurs if a device has been configured for a scheduled priority message and it cannot send the data at the scheduled time slot.
0x01	0x0305	Schedule Signature Mismatch	This error occurs if the schedule priority information does not match between the Target and the Originator.
0x01	0x0306	Schedule Signature Validation Not Possible	This error occurs when the schedule priority information sent to the device is not validated.
0x01	0x0311	Port Not Available	This error occurs when a port number specified in a port segment is not available. Consult the documentation of the device to verify the correct port number.
0x01	0x0312	Link Address Not Valid	The Link address specified in the port segment is not correct. Consult the documentation of the device to verify the correct port number.
0x01	0x0315	Invalid Segment in Connection Path	This extended status code is the result of a device being unable to decode the connection path.
0x01	0x0316	Forward_Close Service Connection Path Mismatch	This error occurs when the Connection path in the Forward Close message does not match the Connection Path configured in the connection. Contact Tech Support if this error persists.
0x01	0x0317	Scheduling Not Specified	This error can occur if the Schedule network segment or value is invalid.
0x01	0x0318	Link Address to Self Invalid	If the Link address points back to the originator device, this error will occur.
0x01	0x0319	Secondary Resources Unavailable	This occurs in a redundant system when the secondary connection request is unable to duplicate the primary connection request.
0x01	0x031A	Rack Connection Already Established	The connection to a module is refused because part or all of the data requested is already part of an existing rack connection.
0x01	0x031B	Module Connection Already Established	The connection to a rack is refused because part or all of the data requested is already part of an existing module connection.
0x01	0x031C	Miscellaneous	This error is returned when there is no other applicable code for the error condition.

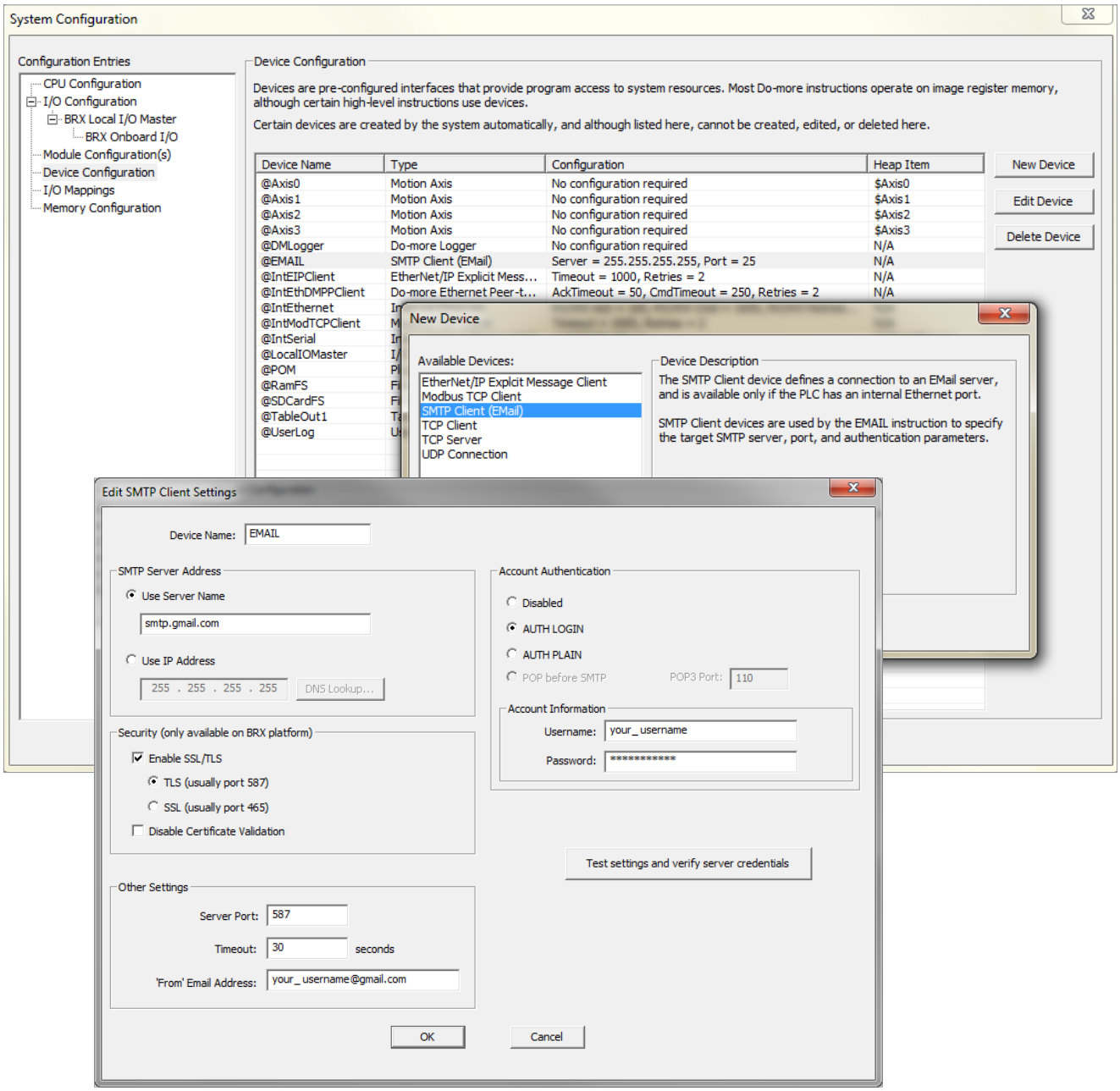
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EtherNet/IP: Implicit Messaging Scanner, continued

CIP Level Errors			
General Status	**Extended Status**	**Name**	**Description**
0x01	0x031D	Redundant Connection Mismatch	This error occurs when these parameters don't match when establishing a redundant owner connection: O -> T RPI, O -> T Connection Parameters, T -> O RPI, T -> O Connection Parameters and Transport Type and Trigger.
0x01	0x031E	No More User Configurable Link Consumer Resources Available in the Producing Module	This error is returned from the Target device when no more available Consumer connections available for a Producer.
0x01	0x031F	No User Configurable Link Consumer Resources Configured in the Producing Module	This error is returned from the Target device when no Consumer connections have been configured for a Producer connection.
0x01	0x0800	Network Link Offline	The Link path is invalid or not available.
0x01	0x0810	No Target Application Data Available	This error is returned from the Target device when the application has no valid data to produce.
0x01	0x0811	No Originator Application Data Available	This error is returned from the Originator device when the application has no valid data to produce.
0x01	0x0812	Node Address Has Changed Since the Network Was Scheduled	This specifies that the router has changed node addresses since the value configured in the original connection.
0x01	0x0813	Not Configured for Off-Subnet Multicast	The producer has been requested to support a Multicast connection for a consumer on a different subnet and does not support this functionality.
0x01	0x0814	Invalid Produce / Consume Data Format	Information in the data segment not consistent with the format of the data in the consumed or produced data. Errors 0x0130 and 0x0131 are typically used for this situation in most devices now.
0x02	N/A	Resources Unavailable for Unconnected_Send	The Target device does not have the resources to process the Unconnected Send request.
0x04	N/A	Path Segment Error In Unconnected_Send	The path segment identifier or the segment syntax was not understood by the target device.
0x05	N/A	Path Destination Error In Unconnected_Send	The Class, Instance or Attribute value specified in the Unconnected Explicit Message request is incorrect or not supported in the Target device. Check the manufacturer's documentation for the correct codes to use.
0x09	<Index to Element>	Error in Data Segment	This error code is returned when an error is encountered in the Data segment portion of a Forward Open message. The Extended Status value is the offset in the Data segment where the error was encountered.
0x0C	<Optional>	Object State Error	This error is returned from the Target device when the current state of the Object requested does not allow it to be returned. The current state can be specified in the Optional Extended Error status field.
0x10	<Optional>	Device State Error	This error is returned from the Target device when the current state of the Device requested does not allow it to be returned. The current state can be specified in the Optional Extended Error status field. Check your configured connections points for other Client devices using this same connection.
0x13	N/A	Not Enough Data	Not enough data was supplied in the service request specified.
0x15	N/A	Too Much Data	Too much data was supplied in the service request specified.

SMTP – EMAIL

The Edit SMTP Client Settings dialog is used to configure an SMTP connection from the Do-more! controller to an SMTP server in order for the controller to send Email. The information that is required to configure an SMTP connection is always going to be specific to the installation. It is up to the programmer to locate the required information.



Device Name is the name given to the SMTP Client that will be referenced in Send Email (EMAIL) instructions. Device Names can consists of 1 to 16 alphanumeric characters and must follow Nickname.

SMTP, continued



NOTE: *The Email instruction in Do-more! Technology v2.2 and later can perform a DNS name resolution internally. That is, they can use the DNS protocol to resolve a name of an SMTP server to its IP address when the Email instruction is executed. This also means the SMTP Client can be configured to establish encrypted connections to Email servers and optionally require trust certificate validation. The Email instruction in Do-more! Technology versions previous to v2.2 do not have this internal DNS capability. This means the SMTP Client in those previous versions must contain the IP address of the SMTP server, not the name of the SMTP server.*

SMTP Server Address selects how the connection to the SMTP server will be established.

Select **Use Server Name** to enter a text string that will be resolved when the EMail instruction is executed. This selection is required if a TLS or SSL encryption to a secure Email server is selected. The CPU will use the DNS server in the Ethernet Settings configuration to resolve the server name entered.

Select **Use IP Address** to enter the static IP address of the SMTP server. Clicking the **DNS Loopkup** button will open the IP Address Lookup utility in Do-more Designer that can search for the IP Address assigned to a given SMTP Server name. This requires a functional connection to a DNS Server. Enter the URL for the SMTP server then click the **Lookup** button. If the operation is successful click the **Select** button to use the IP address that was found.



NOTE: *In Do-more! Technology versions previous to v2.2, the IP Address of the SMTP Server can be resolved at runtime by using additional ladder logic instructions, specifically the Name to IP Address (DNSLOOKUP) instruction can be used to find the IP Address associated with a Server's name, then the Write Device Register (DEVWRITE) instruction can be used to set the SMTP Client Device to use the IP Address that was found. Refer to the example program in the Send Email (EMAIL) instruction to see how this is done.*

Security (only available on BRX platform) options are used when establishing an encrypted connection to a secure SMTP server instead of a plain-text connection to an unsecured port 25 server.

Enable SSL / TLS uses an encrypted connection to the SMTP Server. Disabling this option will set the Server Port number to 25.

- **TLS (usually port 587)** will establish an encrypted connection to the SMTP Server Address using STARTTLS protocol.
- **SSL (usually port 465)** will establish an encrypted connection to the SMTP Server Address using SSL protocol.

Disable Certificate Validation – If this option is NOT selected, when Do-more! Designer creates the SMTP Client, it will retrieve the security certificate for the specified SMTP server from the PC running Do-more! Designer, and will attach that certificate to the SMTP Client device when it is downloaded to the CPU. Each time an EMail instruction uses the SMTP Client device, the certificate is validated as part of establishing the encrypted connection. Checking the **Disable Certificate Validation** option will prevent the SMTP Client device from attempting to validate the certificate as part of establishing the encrypted connection.

Server Port – the IP Port number to use when creating the connection to the SMTP server:

- 25 is the standard Server Port number used by plain-text (unencrypted) SMTP servers.
- 587 is the standard Server Port number for encrypted connections using STARTTLS protocol.
- 465 is the standard Server Port number used for encrypted connections using SSL protocol.

The Server Port number can be read at runtime with the Read Device Register (DEVREAD) instruction, and changed at runtime through the Write Device Register (DEVWRITE) instruction.

SMTP, continued

Timeout – the amount of time (in seconds) the SMTP Client will attempt to connect to the specified SMTP server before reporting an error. The default value of 30 seconds should be sufficient in most instances. Be aware that it is quite normal for communications with SMTP servers to take several seconds of time - especially so when using SLS / TLS encryption. Setting this value too low will only cause needless problems.

From Email Address – specifies the Email address that all Emails using this SMTP Client will use in the 'From' field. Email addresses must be in the form of X@Y.Z. SMTP servers typically require that the 'From' address be configured as a recipient address on that SMTP server before they will accept Emails from that address.

Authentication – used if the SMTP server requires authentication before it will accept an Email from the Do-more! CPU. Select one of the following methods:

- **Disabled**: if the SMTP server does not require authentication.
- **AUTH LOGIN**: authenticate by logging into the SMTP Server with the Username and Password specified below.
- **AUTH PLAIN**: authenticate by logging into the SMTP Server with the Username and Password specified below.
- **POP before SMTP**: an older authentication method that attempts to get Email before attempting to send an Email, the premise being that if an Email client can log in and read Email the Client must be legitimate.
- **Pop3 Port**: the default port number of 110 is the standard IP port number for POP3 requests and should not need to be change. The Pop3 Port number can be examined at runtime with the Read Device Register (DEVREAD) instruction, and changed at runtime through the Write Device Register (DEVWRITE) instruction.

Account Information – These authentication methods require a UserID and Password. For 'AUTH LOGIN' and 'AUTH PLAIN', the account information is for the SMTP account. For the 'POP before SMTP' method, the account information is for the POP3 account.

Username – 1 to 64 characters

Password – 1 to 63 characters

Clicking the **Test settings and verify server credentials** button will attempt to establish a connection to the specified SMTP Server using the options and parameters that have been selected. This step is required if the SMTP Client will use Certificate Validation.

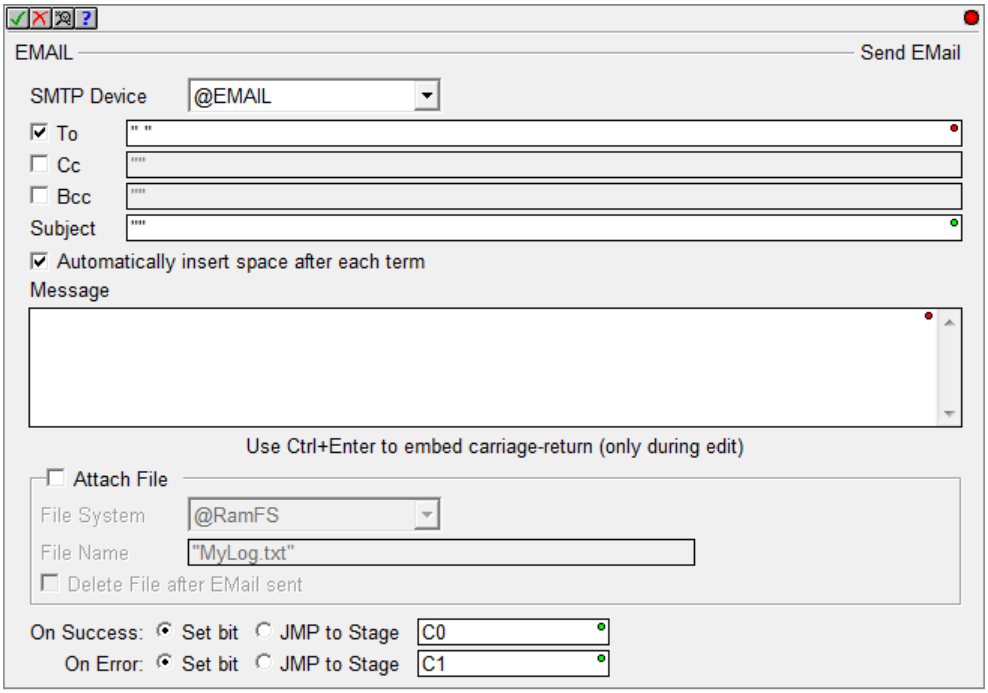


NOTE: *This verification work is done by Do-more! Designer - not the PLC - but it will mimic the work the PLC will do when it attempts to send Email using this SMTP Client. The Help text for the Send Email (EMAIL) instruction has a section detailing how to use Do-More! Logger to debug SMTP connection issues from the PLC's perspective.*

SMTP, continued

EMAIL (Send Email instrcuction)

The Send Email (EMAIL) instruction is used to send an Email message. This instruction is only valid for Do-more! controllers that have an on-board Ethernet port. The message portion of the Email can be any combination of text and data elements from the controller. An Email can also send an attachment which can be any file on any of the built-in file systems.



SMTP Device – Designates the SMTP Client device to use to send the Email. An SMTP Client device must be configured before the Send Email instruction can be added to a program.

To – One or more primary audience Email addresses separated by semicolons. This can be a string literal (text in double quotes), or any String element.

Cc (optional) – One or more Courtesy Copy (or Carbon Copy) Email addresses separated by semicolons. This can be a string literal (text in double quotes), or any String element.

Bcc (optional) – One or more Blind Carbon Copy Email addresses separated by semicolons. This can be a string literal (text in double quotes), or any String element.

Subject – The Total number of characters in Subject line is limited to 1024 characters. This can be a string literal (text in double quotes), or any readable String element.

Automatically insert space after each term – Will insert a space between the terms when the instruction is processed. This is most useful when the Message Field contains only a list of elements that would otherwise require a manually entered space character to separate the items.

Message – Text box in which to place the body of the Email message. There can be up to 1023 characters of data in a Message field. This data can consist of any combination of the following:

- String Literal (text in double quotes).
- Control characters.
- Any readable String element.
- Controller data elements (V0, D0, T0.Acc, etc.).
- Data formatting functions (FmtInt, FmtReal, etc.).
- String selection function (Lookup).

SMTP, continued

For a complete description of the available data options provided by the scripting language for use in the Text Field, see the Help file.

Attach File – Enable this option to send an existing file from one of the file Systems in the Do-more! CPU along with the Message text.

File System – Specifies which of the available file systems contains the file.

@RamFS – The 1 MB file system in the Do-more! CPU's system RAM. All Do-more! CPUs will have this file system available.

@SDCardFS – On PLC systems that have the microSD card slot, this selection is the file system on the removable media in that slot.

File Name – The full path (including any directories) of the file on the specified file system. This can be text enclosed in double quotes, or any system or user-defined string. The File Name allows a maximum length of 255 characters including spaces and non-alphanumeric characters, excluding the following characters which have special meaning to the file system * ? " : < >. The File Name is not case sensitive.

Delete File After Email Sent – Enable this option to delete the specified file AFTER the Email has been successfully sent to the specified SMTP Server.

On Success – When the instruction completes successfully this action will be performed.

Set Bit – Enable this selection then specify writable bit location.

JMP to Stage – Enable this selection then specify any Stage number from S0 to S127 in the current Program code block.

On Error – When the instruction does not complete successfully this action will be performed

Set Bit – Enable this selection then specify writable bit location.

JMP to Stage – Enable this selection then specify any Stage number from S0 to S127 in the current Program code block.

Testing the Send Email Instruction:

When the SMTP Client device was created, the Verify SMTP Server Configuration utility was available to test the SMTP Client configuration from within Do-more! Designer. But that doesn't guarantee the configuration will work once it's downloaded to the PLC if the PLC will be deployed on a different network, or if at some point in the future the stored configuration no longer matches the SMTP Server being targeted. The CPU has two System Strings that automatically receive error and status information while the CPU is in RUN mode. The contents of these two system strings can be viewed on the System Status tab of the System Info dialog, or by adding MSG and ERR to a Data View:

The system string MSG receives status information any time an instruction sets an error code.

The system string ERR will display an associated text message that explains what the error code means.

SMTP, continued

Do-more! Logger

By far, the most useful tool for debugging problems with getting Email to function properly from the PLC's perspective is Do-more! Logger. Setting the system status bit $EnableMsgDump (ST36) ON will cause the Send Email instruction to automatically echo the SMTP traffic between the Do-more! CPU and the SMTP Server to the Do-more! Logger. Do-more! Logger will capture and display this SMTP conversation which allows to programmer to see what changes need to be made to correct any errors.

Send a Text Message via Email

Another option to test the SMTP Client is to send an Email to one of the cellphone carriers email-to-text services so that a text message is generated and sent to the specified cell phone number instead of an email. The web site http://www.emailtextmessages.com/ contains a list of email addresses that can be used to send text messages to phones. This is the most simple way of sending text messages from the Do-more! CPU to a cell phone. These email addresses essentially act as a direct link to a carrier's SMS gateway. For example, for Verizon customers use TenDigitPhoneNumber@vtext.com as the Send To address.

The SMTP Protocol Primer

A typical example of sending a message via SMTP to two mailboxes (alice and theboss) located in the same mail domain (example.com or localhost.com) is reproduced in the following session exchange. In this example, the conversation parts are prefixed with S: and C:, for server and client, respectively; these labels are not part of the exchange.

S: 220 smtp.example.com ESMTP Postfix

C: HELO relay.example.org

S: 250 Hello relay.example.org, I am glad to meet you

C: MAIL FROM:<bob@example.org>

S: 250 Ok

C: RCPT TO:<alice@example.com>

S: 250 Ok

C: RCPT TO:<theboss@example.com>

S: 250 Ok

C: DATA

S: 354 End data with <CR><LF>.<CR><LF>

C: From: "Bob Example" <bob@example.org>

C: To: "Alice Example" <alice@example.com>

C: Cc: theboss@example.com

C: Date: Tue, 15 January 2008 16:02:43 -0500

C: Subject: Test message

C:

SMTP, continued

C: Hello Alice.

C: This is a test message with 5 header fields and 4 lines in the message body.

C: Your friend,

C: Bob

C: .

S: 250 Ok: queued as 12345

C: QUIT

S: 221 Bye

{The server closes the connection}

After the SMTP client establishes a reliable communications channel to the SMTP server, the session is opened with a greeting by the server, usually containing its fully qualified domain name (FQDN).

The client initiates its conversation by responding with a HELO command identifying itself in the command's parameter with its FQDN (or an address literal if none is available).

The client notifies the receiver of the originating email address of the message in a MAIL FROM command. In this example, the email message is sent to two mailboxes on the same SMTP server: one for each recipient listed in the To and Cc header fields. The corresponding SMTP command is RCPT TO. Each successful reception and execution of a command is acknowledged by the server with a result code and response message 250 Ok.

The transmission of the body of the mail message is initiated with a DATA command after which it is transmitted verbatim line by line and is terminated with an end-of-data sequence. This sequence consists of a new-line (<CR><LF>), a single full stop (period), followed by another new-line. Since a message body can contain a line with just a period as part of the text, the client sends two periods every time a line starts with a period; correspondingly, the server replaces every sequence of two periods at the beginning of a line with a single one. Such escaping method is called dot-stuffing.

The server's positive reply to the end-of-data, as exemplified, implies that the server has taken the responsibility of delivering the message. A message can be doubled if there is a communication failure at this time, e.g. due to a power shortage: Until the sender has received that 250 reply, it must assume the message was not delivered. On the other hand, after the receiver has decided to accept the message, it must assume the message has been delivered to it. Thus, during this time span, both agents have active copies of the message that they will try to deliver. The probability that a communication failure occurs exactly at this step is directly proportional to the amount of filtering that the server performs on the message body, most often for anti-spam purposes.

The QUIT command ends the session. If the email has other recipients located elsewhere, the client would QUIT and connect to an appropriate SMTP server for subsequent recipients after the current destination had been queued. The information that the client sends in the HELO and MAIL FROM commands are added as additional header fields to the message by the receiving server. It adds a Received and Return-Path header field, respectively.

The server responds with a 221 reply then closes the communication channel.

SMTP, continued

SMTP Server Response Codes

SMTP Server Response Codes		
Response Code	**Meaning**	**How to Solve / What To Do**
101	The SMTP server is unable to connect.	Try to change the server's name (maybe it was spelled incorrectly) or the connection port.
111	Connection refused or inability to open an SMTP stream.	This error normally refers to a connection issue with the remote SMTP server, depending on firewalls or misspelled domains. Double-check all the configurations and in case ask your provider.
211	System status message or help reply.	It comes with more information about the server.
214	A response to the HELP command.	It contains information about your particular server, normally pointing to a FAQ page.
220	The server is ready.	It's just a welcome message. Just read it and be happy that everything is working (so far).
221	The server is closing its transmission channel. It can come with side messages like "Goodbye" or "Closing connection".	The mailing session is going to end, which simply means that all messages have been processed.
250	Its typical side message is "Requested mail action okay completed": meaning that the server has transmitted a message.	No error; everything has worked and your email has been delivered.
251	"User not local will forward": the recipient's account is not on the present server, so it will be relayed to another.	It's a normal transfer action.
252	The server cannot verify the user, but it will try to deliver the message anyway.	The recipient's email account is valid, but not verifiable. Normally the server relays the message to another one that will be able to check it.
354	The side message can be very cryptic ("Start mail input end <CR><LF>.<CR><LF>"). It's the typical response to the DATA command.	The server has received the "From" and "To" details of the email, and is ready to get the body message.
420	"Timeout connection problem": there have been issues during the message transfer.	This error message is produced only by GroupWise servers. Either your email has been blocked by the recipient's firewall, or there's a hardware problem.
421	The service is unavailable due to a connection problem: it may refer to an exceeded limit of simultaneous connections, or a more general temporary problem.	The server (yours or the recipient's) is not available at the moment, so the dispatch will be tried again later.
422	The recipient's mailbox has exceeded its storage limit.	Create some free room in the destination mailbox.
431	Not enough space on the disk, or an "out of memory" condition due to a file overload.	This error may depend on too many messages sent to a particular domain. You should try again sending smaller sets of emails instead of one big mail-out.
432	Typical side-message: "The recipient's Exchange Server incoming mail queue has been stopped".	A Microsoft Exchange Server's SMTP error code
441	The recipient's server is not responding.	There's an issue with the user's incoming server.
442	The connection was dropped during the transmission.	A typical network connection problem.
446	The maximum hop count was exceeded for the message: an internal loop has occurred.	Ask your SMTP provider to verify what has happened.
447	Your outgoing message timed out because of issues concerning the incoming server.	This happens generally when you exceeded your server's limit of number of recipients for a message. Try to send it again segmenting the list in different parts.
449	A routing error.	Like error 432, it's related only to Microsoft Exchange.

Table continued on next page

SMTP, continued

SMTP Server Response Codes (continued)		
Response Code	**Meaning**	**How to Solve / What To Do**
450	"Requested action not taken – The user's mailbox is unavailable". The mailbox has been corrupted or placed on an offline server, or your email hasn't been accepted for IP problems or blacklisting.	The server will retry to mail the message again, after some time.
451	"Requested action aborted – Local error in processing". Your ISP's server or the server that got a first relay from yours has encountered a connection problem.	It's normally a transient error due to a message overload, but it can refer also to a rejection due to a remote anti-spam filter.
452	Too many emails sent or too many recipients: more in general, a server storage limit exceeded.	Again, the typical cause is a message overload. Usually the next try will succeed: in case of problems on your server it will come with a side-message like "Out of memory".
471	An error of your mail server, often due to an issue of the local anti-spam filter.	Contact your SMTP service provider to fix the situation.
500	A syntax error: the server couldn't recognize the command.	It may be caused by a bad interaction of the server with your firewall or anti-virus. Read carefully their instructions to solve it.
501	Another syntax error, not in the command but in its parameters or arguments.	In the majority of the times it's due to an invalid email address, but it can also be associated with connection problems (and again, an issue concerning your anti-virus settings).
502	The command is not implemented.	The command has not been activated yet on your own server.
503	The server has encountered a bad sequence of commands, or it requires an authentication.	In case of "bad sequence", the server has pulled off its commands in a wrong order, usually because of a broken connection. If an authentication is needed, you should enter your username and password.
504	A command parameter is not implemented.	Like error 501, is a syntax problem.
510	Bad email address.	One of the addresses in your To, Cc or Bcc line doesn't exist. Check again your recipients' accounts and correct any possible misspelling.
511	Bad email address.	One of the addresses in your To, Cc or Bcc line doesn't exist. Check again your recipients' accounts and correct any possible misspelling.
512	A DNS error: the host server for the recipient's domain name cannot be found.	Check again all your recipients' addresses: there will likely be an error in a domain name (like mail@domain.coom instead of mail@domain.com).

Ethernet Remote IO Master

Do-more! PLCs can utilize Remote I/O in several ways. This is covered in Chapter 14 of this manual.

HTTP

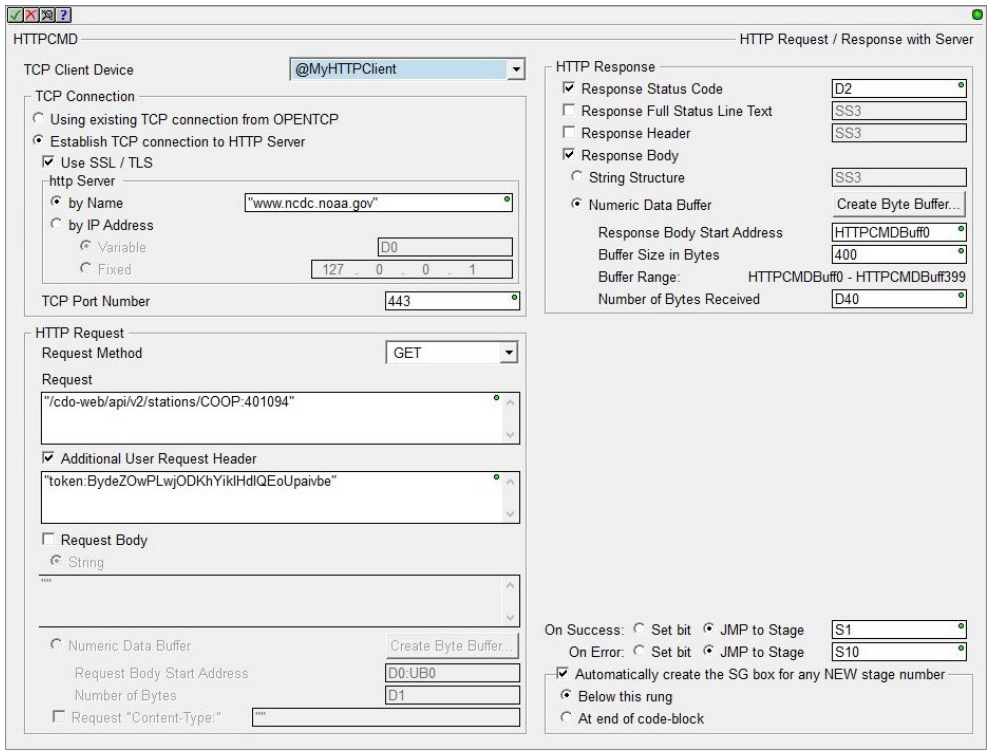
The Hypertext Transfer Protocol (HTTP) works as a request-response protocol between a network client and server. A client submits an HTTP request to the server; then the server returns a response to the client. The response contains both status information about the request itself, and the requested content if applicable.

HTTPCMD – Execute HTTP Command



NOTE: *This instruction can only be used with a BRX MPU!*

The Execute HTTP Command (HTTPCMD) instruction implements the following 5 HTTP commands: GET which is used to request data from a specified resource. HEAD which is almost identical to GET, but without returning data in the Response Body, POST and PUT which are used to send data to a server to create or update a resource, and DELETE which removes the specified resource.



The *TCP Connection* group contains selections that establish the required network connection to an HTTP server:

Use Existing TCP Connection from OPENTCP allows this instruction to use a TCP connection that has already been established by an Open TCP Connection (OPENTCP) instruction. If this option is selected the TCP connection will NOT be closed when this instruction is completed.

Establish TCP Connection to HTTP Server will establish a new TCP connection to an HTTP server. Once the instruction has completed execution it will close the TCP connection. The connection will be established using the following credentials.

Enable the **Use SSL / TLS** option if the HTTP server requires an encrypted connection.

HTTP, continued

http / https Server selects how the connection to the HTTP Server will be established:

By Name is the name of the HTTP server that will receive the request. This can be text that is already stored in a system-defined String, or a user-defined String, or enter the text within double quotes in the space below. The Name is not case-sensitive.

By IP Address will use the IP Address of the server. This can be either the traditional dotted-decimal form for a static IP address or a DWord numeric location containing the IP Address if it needs to be set at runtime.

TCP Port Number specifies the port number the connection will use. The default value of 80 is typical for HTTP traffic to unencrypted servers. The value 443 is typically used for HTTPS traffic using (SSL / TLS) encryption. This can be any constant between 1 and 65534, or any Numeric memory location containing a value in that range.

The *HTTP Request* group contain the selections that build up the command that will be sent to the HTTP server.

Request Method selects which HTTP function to send:

GET is used to request data from a specified resource. The query string (name / value pairs) is sent in the URL of a GET request. The requested data will be returned in the Response Body.

HEAD is almost identical to GET, but without returning any data in the Response Body. For example, if "GET /users" returns a list of users, then "HEAD /users" will make the same request but will not return the list of users. HEAD requests are useful for checking what a GET request will return before actually making a GET request.

POST is used to send data to a server to create or update a resource. The data sent to the server with POST is stored in the Request body of the HTTP request.

PUT is also used to send data to a server to create or update a resource. The difference between POST and PUT is calling the same PUT request multiple times will always produce the same result. In contrast, calling a POST request repeatedly have side effects of creating the same resource multiple times.

DELETE method deletes the specified resource.

The **Request**, often called the query-string, is a string of information that the server can use as parameters. The Request is usually one or more name and value pairs; for example, term=bluebird. Name and value pairs are separated from each other by an ampersand (&); for example, term=bluebird&source=browser-search. Components in the Request are case-sensitive. This can be text that is already stored in a system-defined String, or a user-defined String, or enter the text within double quotes in the space below.

Enable the optional **Additional User Request Header** selection to include any additional header fields in the request. Request Headers define the operating parameters of an HTTP transaction. They allow the client to pass additional information to the server with the request. A Request header consists of its case-insensitive name followed by a colon ':', then by its value (without line breaks). Leading white space before the value is ignored. Request Headers can be text that is already stored in a system-defined String, or a user-defined String, or enter the text within double quotes in the space below.



NOTE: *If there is only one user request header entry you do not have to enter the terminating <CR><LF>, the editor will do that for you. If you have multiple user request headers you will need to place the required <CR><LF> termination characters after each header. You can use the Print to String (STRPRINT) instruction to build up the list of headers and store it in a String then reference that String here.*

HTTP, continued

Enable the optional **Request Body** selection to send data bytes immediately following the headers. This is where the data sent to the server with POST or PUT methods is stored.

Select **String** if the text is already stored in a system-defined String, or a user-defined String, or enter the text within double quotes in the box below.

Select **Numeric Data Buffer** to place the Response Body in a numeric data block (a byte buffer).

Click **Create Byte Buffer** to create a new data block of bytes to store the JSON record. You will need to specify the **Data Block Name** (1 to 16 letters) names must be unique and consist of 1 to 16 characters (A-Z, a-z; no numbers, no spaces). The default name is **HTTPCCMDBuff**, but it can be changed. You will also specify **Number of Elements** is the number of bytes (maximum of 65000) in the data block. The data blocks must be created on a DWord (4-byte) boundary. And specify whether to **Make Data Block Retentive** (retain values after power loss) will have the data block hold its state through a power cycle or a Program-to-Run mode transition. Memory NOT marked as retentive will be cleared at power up and during a Program-to-Run mode transition.

Request Body Start Address is the beginning offset into the data block where the Request Body data begins.

Number of Bytes is maximum number of bytes to allocate for use by the Request. This can be any constant value from 1 to the maximum size of the Byte buffer.

The **Buffer Range** shows the range of bytes in the buffer that will be used as defined by the Request Body Start Address and by the Number of Bytes.



NOTE: *When using a Numeric Data Buffer to store the text for the Request Body, use the Memory View with ASCII format to see the contents of the Numeric Data Buffer in human-readable text form.*

Enable the optional **Request "Content-Type"** to include the Content-Type header with the user-supplied type and sub-type. This can be text that is already stored in a system-defined String, or a user-defined String, or enter the text within double quotes. Two of the more common Content-Types are:

application which represents application data or binary data. For instance, Content-Type: application/json; charset=utf-8 designates the content to be in the JavaScript Object Notation (JSON) format, encoded with UTF-8 character encoding.

text indicates that the content is plain text and no special software is required to read the contents. The subtype represents more specific details about the content, which can be used by the client for special processing. For instance, Content-Type: text/html indicates that the body content is text in HTML format.

The *HTTP Response* group contains selections that will handle the data that is returned from the HTTP Request. All of the HTTP Response selections are optional.

The **Response Status Code** is a numeric value returned from the server. This can be any writable numeric location. The most common Response Codes are :

200 - (OK) the request has succeeded. The information returned with the response is dependent on the method used in the request.

204 - (No Content) the server has fulfilled the request but does not need to return an entity-body, and might want to return updated meta-information.

304 - (Not Modified) if the client has performed a conditional GET request and access is allowed, but the document has not been modified, the server SHOULD respond with this status code.

HTTP, continued

400 - (Bad Request) the request could not be understood by the server due to malformed syntax.

401 - (Unauthorized) the request requires user authentication.

403 - (Forbidden) the server understood the request, but is refusing to fulfill it. Authorization will not help.

404 - (Not Found) the server has not found anything matching the Request.

409 - (Conflict) the request could not be completed due to a conflict with the current state of the resource.

500 - (Internal Server Error) the server encountered an unexpected condition which prevented it from fulfilling the request.

The **Response Full Status Line Text** contains the status message text that corresponds to the Response Status Code.

The **Response Header** is used to give a more detailed context of the response.

Enable the optional **Response Body** selection to store the body of the response data.

Select **String Structure** if the text is already stored in a system-defined String, or a user-defined String, or enter the text within double quotes in the box to the right.

Select **Numeric Data Block Containing Text** if the Response Body has been stored in a numeric data block (a byte buffer).

Click **Create Byte Buffer** to create a new data block of bytes to store the JSON record. You will need to specify the **Data Block Name** (1 to 16 letters) names must be unique and consist of 1 to 16 characters (A-Z, a-z; no numbers, no spaces). The default name is **HTTPCCMDBuff**, but it can be changed. You will also specify **Number of Elements** is the number of bytes (maximum of 65000) in the data block. The data blocks must be created on a DWord (4-byte) boundary. And specify whether to **Make Data Block Retentive** (retain values after power loss) will have the data block hold its state through a power cycle or a Program-to-Run mode transition. Memory NOT marked as retentive will be cleared at power up and during a Program-to-Run mode transition.

Response Body Start Address is the beginning offset into the data block where the Response Body data begins. The Buffer Range shows the range of bytes in the buffer that will be used by the Response.

Buffer Size in Bytes is maximum number of bytes to allocate for use by the Response.

Buffer Range shows the range of bytes in the buffer that will be used as defined by the Response Body Start Address and by the Buffer Size in Bytes.

Number of Bytes Received is the number of bytes of the Response Body that were stored in the byte buffer.



NOTE: *When using a Numeric Data Buffer to store the text for the Request Body, use the Memory View with ASCII format to see the contents of the Numeric Data Buffer in human-readable text form.*

The **On Success** and **On Error** parameters specify what action to perform when this instruction completes. You do not have to use the same type of selection for both **On Success** and **On Error**.

If the **Set Bit** selection is used for either **On Success** or **On Error**, the specified BIT location will be SET OFF when the instruction is first enabled and will remain OFF until the instruction completes. Once complete, the appropriate Success or Error bit location will be set ON. The specified Bit location is enabled with a SET (Latch) operation (not an OUT operation) meaning that it will remain ON even if this instruction's input logic goes OFF.

HTTP, continued

If the **JMP to Stage** selection is used for either **On Success** or **On Error** the target Stage must be in the same Program code block as this instruction; you cannot specify a target Stage that exists in a different Program code block. When the operation finishes, the target Stage will be enabled the same way as it would with a standalone Jump to Stage (JMP) instruction. The **JMP to Stage** option will only be selectable if this instruction is placed in a Program code block.

On Success selects which of the following actions to perform if the operation is successful:

Set Bit – enable this selection then specify any writable bit location.

JMP to Stage – enable this selection then specify any Stage number from S0 to S127 in the current Program code block.

On Error selects which of the following actions to perform if the operation is unsuccessful:

Set Bit – enable this selection then specify writable bit location.

JMP to Stage – enable this selection then specify any Stage number from S0 to S127 in the current Program code block.

Automatically create the SG box for any NEW stage number – if either the On Success or On Error selections are set to JMP to Stage, this option will be enabled which will automatically create any target stage that does not already exist.

Below this rung – the new target stage will be created on a new rung following this instruction.

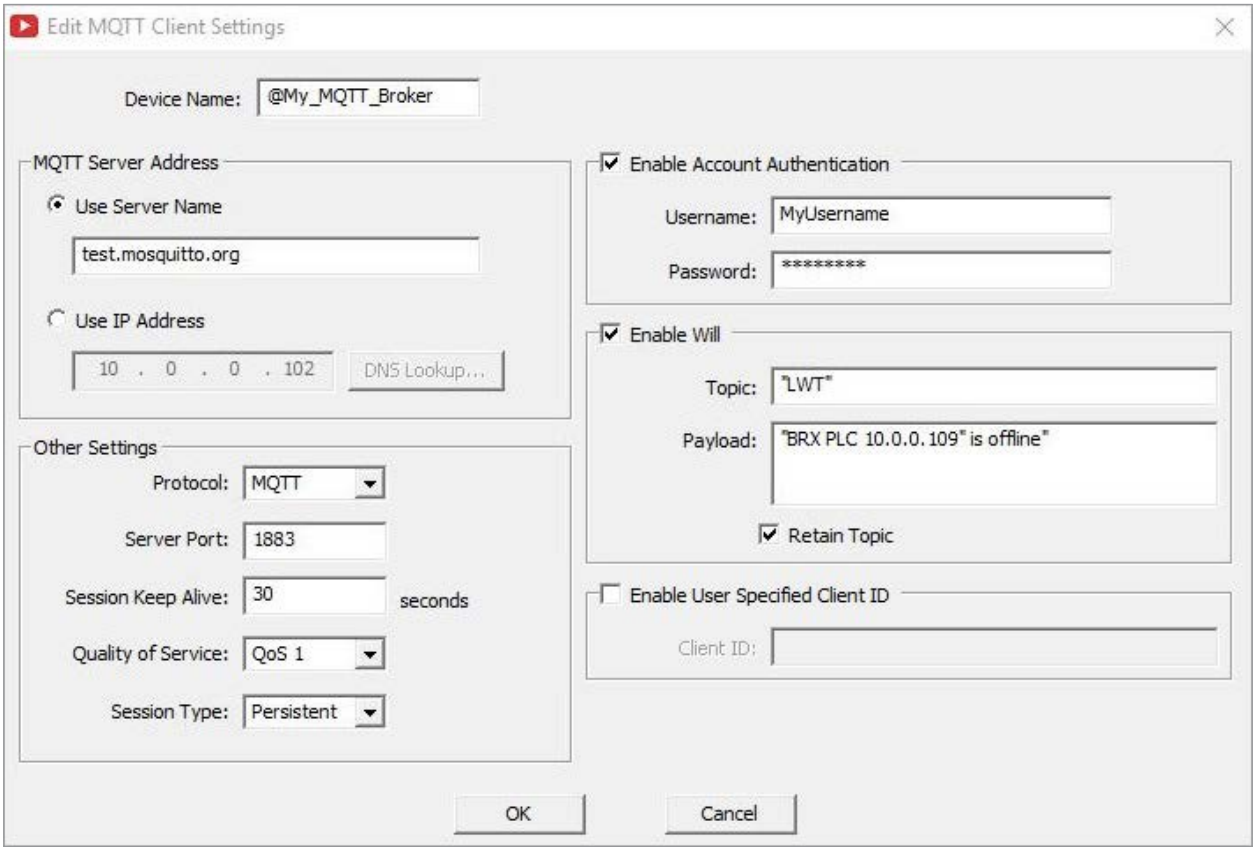
At end of code block – the new target stage will be created as the last rung of this Program.

MQTT

MQTT Client (IoT) Device

BRX PLCs with on-board Ethernet ports can connect to one or more MQTT Brokers, and once connected, these PLCs can publish messages to the Brokers and subscribe to messages from the Brokers. The parameters required to create a connection to a Broker is managed by an MQTT Client (IoT) device.

There is no limit to the number of MQTTPUB instructions that can use a single MQTT Client device, but each MQTT Client device can only provide a subscription space for 100 active topics spread across a maximum of 10 MQTTSUB instructions (for example, 2 enabled instruction with 50 Topics each, or 10 enabled instructions with 10 Topics each). To subscribe to more than 100 Topics, create multiple MQTT Client devices to the same MQTT Broker.



Device Name is the name given to the MQTT Client device that will be referenced in IoT Publish MQTT Topics (MQTTPUB) and IoT Subscribe to MQTT Topics (MQTTSUB) instructions. Device Names can consists of 1 to 16 alphanumeric characters and must follow Nickname Rules.

MQTT Server Address selects how the connection to the MQTT Broker will be established.

Select **Use Server Name** to enter a text string that will be resolved when the MQTTPUB or MQTTSUB instruction is executed.

Select **Use IP Address** to enter the static IP address of the MQTT Broker. Clicking the **DNS Lookup** button will open the IP Address Lookup utility in Do-more! Designer that can search for the IP Address assigned to a given MQTT Broker. This requires a functional connection to a DNS Server. Enter the URL for the SMTP server then click the Lookup button. If the operation is successful click the Select button to use the IP address that was found.

MQTT, continued

Other Settings

Protocol selects whether to use MQTT (unsecured, plain text) or MQTTS (secured, SSL/TLS encryption).

Note: using SSL / TLS encryption is a very CPU intensive operation because of the math involved. Because the CPU must keep the PLC's scan time in check, the SSL encoding is processed as a time-slicing event, meaning that only a portion of each scan time is used to work on the encryption; this prevents the scan time from exceeding the watchdog timer. Processing the encryption can take several seconds depending on the number of security certificates that must be processed and the amount of data being transferred.

The amount of time the CPU allots to processing TLS transactions on each scan is called the TLS Timeslice. This value can be changed on the CPU page of the System Configuration. Increasing this value can allow the TLS process to complete sooner, but at the cost of increasing the PLC's scan time. The **Default TLS Timeslice** value will be used by the TLS encryption engine each time the PLC powers up and goes into RUN mode. RUN-mode changes to this value can be made by changing the value in **$TLSTimeslice (DST68)**.

Server Port is the IP Port number to use when creating the connection to the MQTT Broker:

1883 is the standard Port number used in connections to unencrypted MQTT Brokers.

This Server Port number can be read at runtime with the Read Device Register (DEVREAD) instruction and changed at runtime through the Write Device Register (DEVWRITE) instruction.

Session Keep Alive assures that the connection is still open and both Broker and client are connected to one another. This interval is the longest possible period of time which Broker and client can endure without sending a message. The client specifies a time interval in seconds and communicates it to the Broker when it establishes the connection. The BRX CPU will send a PING to the broker at 75% of this value if there is no Publish or Subscribe activity to the Broker to keep the session active. The default value of 30 seconds should be sufficient in most instances; the maximum time is 65535 seconds.

Quality of Service is an agreement between sender and receiver of a message regarding the guarantee of delivering a message. BRX CPUs support 2 levels of QoS:

0 (at most once) is the fastest method but it is also the most unreliable transfer mode because the BRX CPU does not wait for the message to be acknowledged by the Broker. With this QoS level the message will be delivered only one time, but possibly not at all, but there is no possibility of duplicate messages.

1 (at least once) means the BRX CPU sends a message and waits for an acknowledgment (PUBACK). This guarantees that the message will be delivered at least once, but it also means that it may be delivered more than once.

Session Type selects whether or not the server will store data for a broker.

Clean means that if the connection between the client and broker is interrupted the client will need to re-subscribe to topics when it reconnects.

Persistent means all information that is relevant for the client is saved by the broker so that if the connection is interrupted the client need only to reconnect to the broker and all of the topic subscriptions are still present and any messages that arrived while the connection was broken are queued by the broker and will be delivered after the connection is remade.

MQTT, continued

Enable Account Authentication is used if the MQTT Broker requires authentication before it will accept messages.

Username – 1 to 128 characters.

Password – 0 to 19 characters. (Password can be empty.)

Last Will and Testament

MQTT is often used on unreliable networks. The Last Will and Testament (LWT) feature is used in MQTT to notify other clients about an ungracefully disconnected client. Each client can specify its Last Will message (a normal MQTT message with Topic, Payload, and , Retain flag) when connecting to a Broker. The Broker will store the message until it detects that the client has disconnected ungracefully. If the client disconnect abruptly, the Broker sends the message to all clients that are subscribed to the Topic which was specified in the Last Will message. The stored Last Will message will be discarded if a client disconnects gracefully.

According to the MQTT 3.1.1 specification the Broker will distribute the LWT of a client in the following cases:

- An I/O error or network failure is detected by the Broker.
- The client fails to communicate within the Keep Alive time.
- The client closes the network connection without sending a DISCONNECT packet first.
- The Broker closes the network connection because of a protocol error.

Enable Will to specify a Topic and a Payload that will be published as the Last Will and Testament for this MQTT Broker Device specify the following:

Topic is a simple UTF-8 string, consisting of one or more levels, which are separated by a forward slash (aka the topic level separator). A Topic is case-sensitive. Each Topic must have at least 1 character to be valid and it can contain spaces. A leading forward slash is not recommended. Published Topics cannot start with $. Wildcards (+ or #) are not supported. The Topic can be entered as a String literal (text within double quotes) up to 128 characters, or a user-defined String or a system-defined String element of up to 128 characters.

Payload – It's completely up to the client if it wants to send binary data or textual data. The only requirement is that the data be stored in a String element. Use the Print to String (STRPRINT) instruction with it's collection of String Functions to generate a text Payload. Use the Put Bytes into a String (STRPUTB) instruction to generate a Payload consisting of raw bytes of data.

The **Retain Topic** flag determines if the message will be saved by the Broker even after sending it to all current subscribers. This effectively makes the message for the Topic a "last known good value".

Enable User Specified Client ID to supersede the automatically generated Client ID with one provided by the user. The Client ID is a 64 byte string that uniquely identifies each MQTT client. Each identifier must be unique to only one connected client at a time, and must contain only characters valid in a queue manager name. Within these constraints, you are able to use any identification string. The MQTT Client Device automatically generates a Client ID using the MAC address of the BRX CPU's Ethernet port that is used during the connection process unless superceded by this setting.

Client ID contains the text to use as the Client ID

MQTT, continued

MQTTPUB - IoT Publish MQTT Topics



NOTE: *This instruction can only be used with a BRX MPU or the Do-more! Simulator.*

The IoT Publish MQTT Topics (MQTTPUB) instruction is used to publish messages from a BRX MPU to an MQTT Broker. Each published message must contain a Topic, which will be used by the Broker to forward the message to interested clients, and a Payload which contains the actual data to transmit. When a client publishes a message to a MQTT Broker, the Broker will determine which other clients have subscribed to that Topic and then send the appropriate message to those clients. The client who publishes the message is only concerned about delivering the message to the Broker. From there on it is the responsibility of the Broker to deliver the message to all subscribers. The publishing client doesn't get any feedback that says subscribers have received the message.

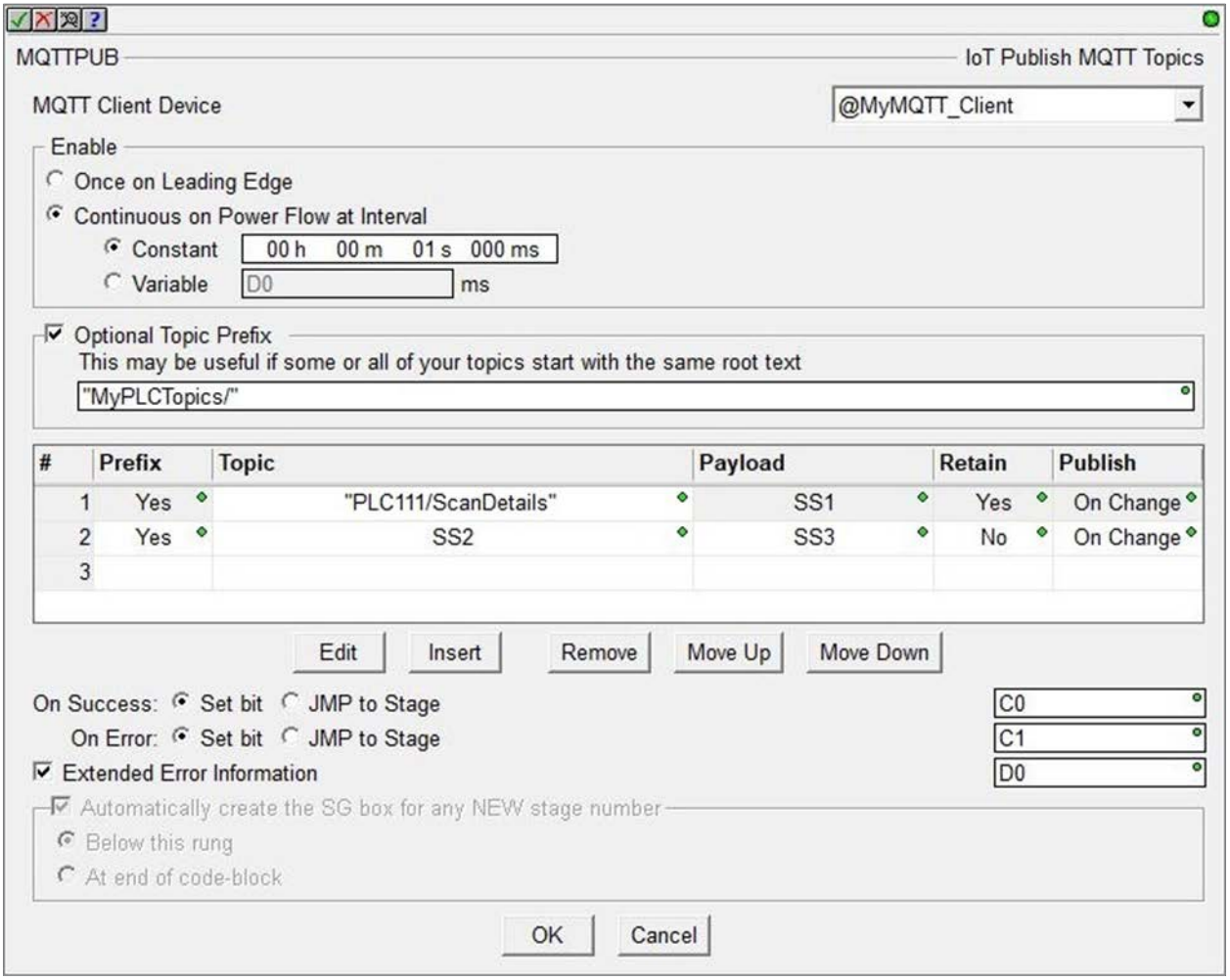
Quality of Service

Quality of Service (QoS) is a major feature of MQTT in that it makes communication in unreliable networks much easier because the protocol handles retransmission and guarantees the delivery of the message regardless of the unreliability of the underlying transport. The QoS level is an agreement between sender and receiver of a message regarding the guarantee of delivering a message.

There are 3 QoS levels in MQTT: At most once (0), At least once (1), and Exactly once (2). **The MQTTPUB instruction publishes all messages with a QoS of 0 (at most once).** The client sends a message but does not wait for an acknowledgment from the Broker.

And remember that in a MQTT system there are always two different parts of delivering a message: publishing client to Broker then Broker to subscribing client(s). The QoS level for publishing client to Broker is set when the client connects to the Broker. When the Broker transfers a message to a subscribing client it uses the QoS of the subscription made by the client.

MQTT, continued



MQTT Client Device selects which of the preconfigured MQTT Client devices this instruction will connect to.

Click **create device** to open the Add Device dialog of the System Configuration where a new MQTT Client device can be created.

Enable selects how often the Topics in this instruction will be published. Choose one of the following:

Select the **Once on Leading Edge** option to have this instruction make exactly one attempt to publish each of the Topics in the instruction.

Select the **Continuous on Power Flow at Interval** option to have this instruction attempt to publish each of the Topics in the instruction when the instruction is first enabled, then as long as this instruction remains enabled, each time the specified time interval is reached, the list of Topics is reprocessed. Refer to the Publish Interval Setting below which determines if a Topic is published only if it has changed, or published every time the list is processed.

The following options select how much time (in milliseconds) to wait between successive runs. A value of 0ms means the instruction will re-run immediately. Be aware of setting an interval value that is very low because many Brokers will protect themselves against overloading by rejecting or ignoring messages.

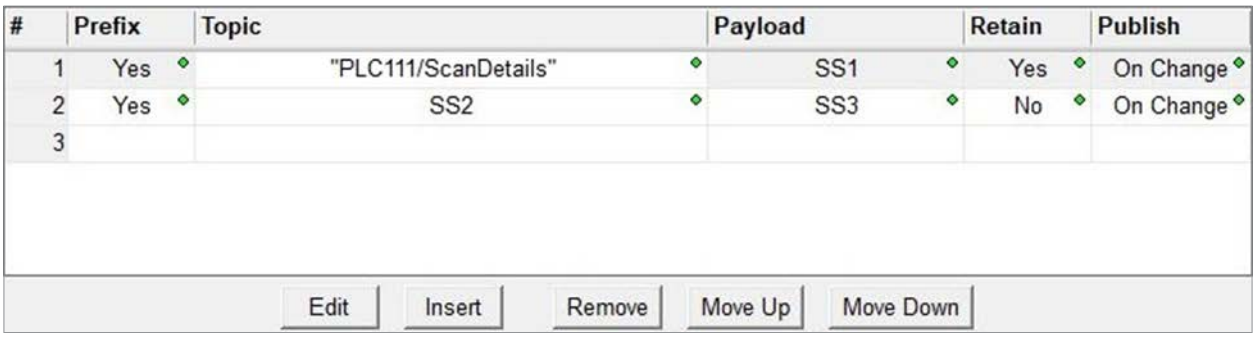
Constant means the interval time is a fixed value specified as Hours / Minutes / Seconds / Milliseconds.

MQTT, continued

Variable means this can be any writable numeric location that contains a value between 0 and 2,147,483,647.

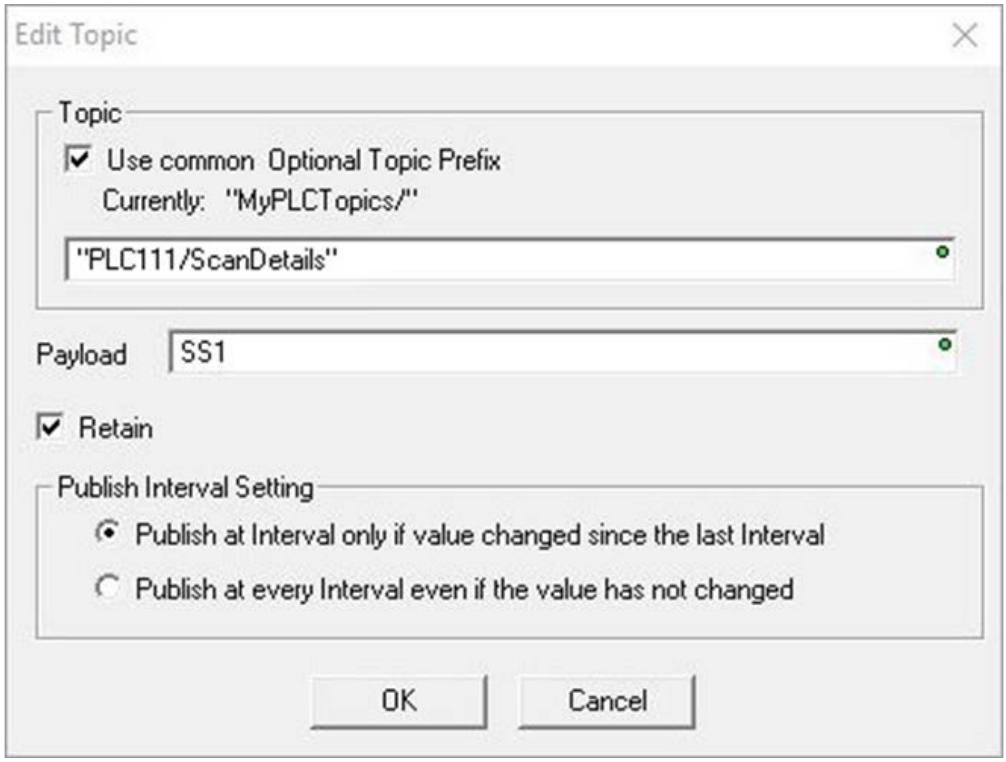
The next section contains a list of up to 50 Topics that get published to the selected MQTT Broker.

Enabling the **Optional Topic Prefix** allows Topics to use repeated text. If there are multiple Topics that begin with the same text, you can put the repeated text in this Optional Topic Prefix and then select that optional text when the Topic is created and added to the list. This can be any string literal (text enclosed with double quotes) of any user-defined or system-defined String. Remember, Topics are case sensitive.



The buttons below the list are functions which manage the rows in the instruction: **Edit** opens the editor for the currently selected row, **Insert** adds an empty row before the currently selected row and opens the editor for this new row, **Remove** deletes the currently selected row from the table, and **Move Up / Move Down** shifts the currently selected row up one or down one row respectively in the table.

Clicking the **Edit** (on an existing Topic) or **Insert** button will open a sub-editor where the contents of the message are managed. The **Topic** group specifies the Topic to publish:



MQTT, continued

If an **Optional Topic Prefix** was created on the main dialog, you can enable the **Use Common Optional Topic Prefix** to prepend the prefix text to the Topic text to construct the full name of the Topic.

The **Topic** itself is a simple UTF-8 string, consisting of one or more levels, which are separated by a forward slash (aka the topic level separator). A Topic is case-sensitive. Each Topic must have at least 1 character to be valid and it can contain spaces. A leading forward slash is not recommended. Published Topics cannot start with $. MQTTPUB does not support Wildcards (+ or #) in Topics. The Topic can be entered as a String literal (text within double quotes) up to 128 characters, or a user-defined String or a system-defined String element.

The **Payload** is the data to be published to the Broker. MQTT protocol itself is data-agnostic, meaning the format of the data totally depends on the how the Payload will be used by the subscribing clients. It's completely up to the publishing client if it wants to send binary data or textual data. The only requirement for the instruction is that the data be a String literal (text within double quotes) up to 128 characters, or stored in a String element. Use the Print to String (STRPRINT) instruction with its collection of String Functions to embed PLC data into ASCII text Payload. Use the Put Bytes into a String (STRPUTB) instruction to generate a Payload consisting of raw bytes of data.

The **Retain** flag determines if the message will be saved by the Broker even after sending it to all current subscribers. This effectively makes the message for the Topic a "last known good value". Normally if a publisher publishes a message to a Topic, and no one is currently subscribed to that Topic, the message is simply discarded by the Broker. However, the publisher can tell the Broker to keep the last message for that Topic by setting the Retain flag. New clients that subscribe to a Topic that is Retained will receive the "last known good value" for that Topic as soon as they subscribe. Without retained messages, any new subscribers would have to wait for the status to change before it received a message. Only one message is Retained per Topic. The next message published on that Topic replaces the last Retained message for that Topic.

To **Delete a retained message** send another Retained message with an empty Payload (a zero-byte String, for example "") to the same Topic where the previous Retained message is stored. The Broker deletes the Retained message meaning new subscribers will no longer get a "last known good value" message for that Topic.

Publish Interval Setting is only available if the **Enable** selection is set to Continuous on Power Flow at Interval. The selection determines whether or not the Topic will be published each time the MQTTPUB executes regardless of whether the Topic or the Payload changed since the last interval:

Publish at interval only if value changed since the last interval means each time the MQTTPUB instruction processes the entry list the Topic and Payload will be published only if either the Topic or the Payload have changed since the last time the list was processed.

Publish at every interval even if value has not changed means each time the MQTTPUB instruction processes the entry list the Topic and Payload will be published, even if neither the Topic or Payload have changed since the last time the list was processed.

Depending on the **Enable** selection, this instruction will run to completion exactly one time, or run to completion multiple times as long as the instruction is enabled. Each time the execution of this instruction completes it is deemed a Success if at least one of the Topics in the list was successfully published. If none of the Topics were successfully published the instruction is deemed to be in Error. The **On Success** and **On Error** parameters specify what action to perform when this instruction completes. You do not have to use the same type of selection for both **On Success** and **On Error**.

MQTT, continued

If the **Set Bit** selection is used for either **On Success** or **On Error**, the specified BIT location will be SET OFF when the instruction is first enabled and will remain OFF until the instruction completes. Once complete, the appropriate Success or Error bit location will be set ON. The specified Bit location is enabled with a SET (Latch) operation (not an OUT operation) meaning that it will remain ON even if this instruction's input logic goes OFF.

If the **JMP to Stage** selection is used for either **On Success** or **On Error** the target Stage must be in the same Program code block as this instruction; you cannot specify a target Stage that exists in a different Program code block. When the operation finishes, the target Stage will be enabled the same way as it would with a standalone Jump to Stage (JMP) instruction. The **JMP to Stage** option will only be selectable if this instruction is placed in a Program code block.

On Success selects which of the following actions to perform if the operation is successful:

Set Bit – enable this selection then specify any writable bit location.

JMP to Stage – enable this selection then specify any Stage number from S0 to S127 in the current Program code block.

On Error selects which of the following actions to perform if the operation is unsuccessful:

Set Bit – enable this selection then specify writable bit location.

JMP to Stage – enable this selection then specify any Stage number from S0 to S127 in the current Program code block.

The **Extended Error Information** is a DWord location that contains a combination value. Using the :SD cast here provides a good method for easily separating the high / low values. For example, V100:SD would place the high word in V101 and the low Word in V100).

The high Word is the entry number of the first Topic that failed. There may have been multiple failures, but only the entry number of the first failure will be listed in the Return Code. That error must be corrected before failures for any later entry numbers will be shown.

The low Word contains the error code itself from the following table:

MQTT Error Codes

Value in Low Word	Error	Description
0	No Error	
57	Unexpected MQTT Response	The response from the MQTT Broker was not properly formed.
58	MQTT Broker Rejected	The MQTT Broker refused the Topic; could be a bad username or password, or a security violation on the Broker itself.
59	Out of Resources (MQTTSUB only)	There are more than 10 MQTTSUB instructions using the same MQTT Client device, or there are more than 100 Topics using the same MQTT Client device.
60	Invalid Topic	This typically means the Topic is empty.
61	Duplicate Topic	The Topic is already subscribed to in a different MQTTSUB instruction.

The last error code reported by the MQTT Broker will be in **$LastProtoError** (DST38).

Automatically create the SG box for any NEW stage number – if either the On Success or On Error selections are set to JMP to Stage, this option will be enabled which will automatically create any target stage that does not already exist.

Below this rung – the new target stage will be created on a new rung following this instruction.

At end of code block – the new target stage will be created as the last rung of this Program.

MQTT, continued

Do-more Logger

Another tool that is useful for debugging problems with getting MQTTPUB to function properly from the PLC's perspective is Do-more! Logger. Setting the system status bit **$EnableMsgDump** (ST36) ON will cause the MQTTPUB instruction to automatically echo the MQTT communication traffic between the Do-more! CPU and the MQTT Broker to the Do-more! Logger. Do-more! Logger will capture and display this conversation which allows to programmer to see what changes need to be made to correct any errors.

So between the High Word (:W1) of the Extended Error Information value telling you which entry number failed, and the Low Word of the Extended Error Information value telling you why that entry failed, and the value in **$LastProtoError** (DST38) giving you the MQTT Broker's error value, and Do-more! Logger displaying the communication traffic, you should be able to resolve any fault conditions.

MQTTSUB - IoT Subscribe to MQTT Topics



NOTE: *This instruction can only be used with a BRX MPU or the Do-more! Simulator.*

The IoT Subscribe to MQTT Topics (MQTTSUB) instruction is used to subscribe to Topics in an MQTT Broker. An MQTTSUB instruction can contain up to 50 subscriptions for a Broker. After a client successfully subscribes to one or more Topics, as long as the instruction remains enabled, it will receive every published message matching the Topic of the subscription.

When the MQTTSUB instruction is disabled it will automatically attempt to unsubscribe from any Topics to which it is currently subscribed.

Quality of Service

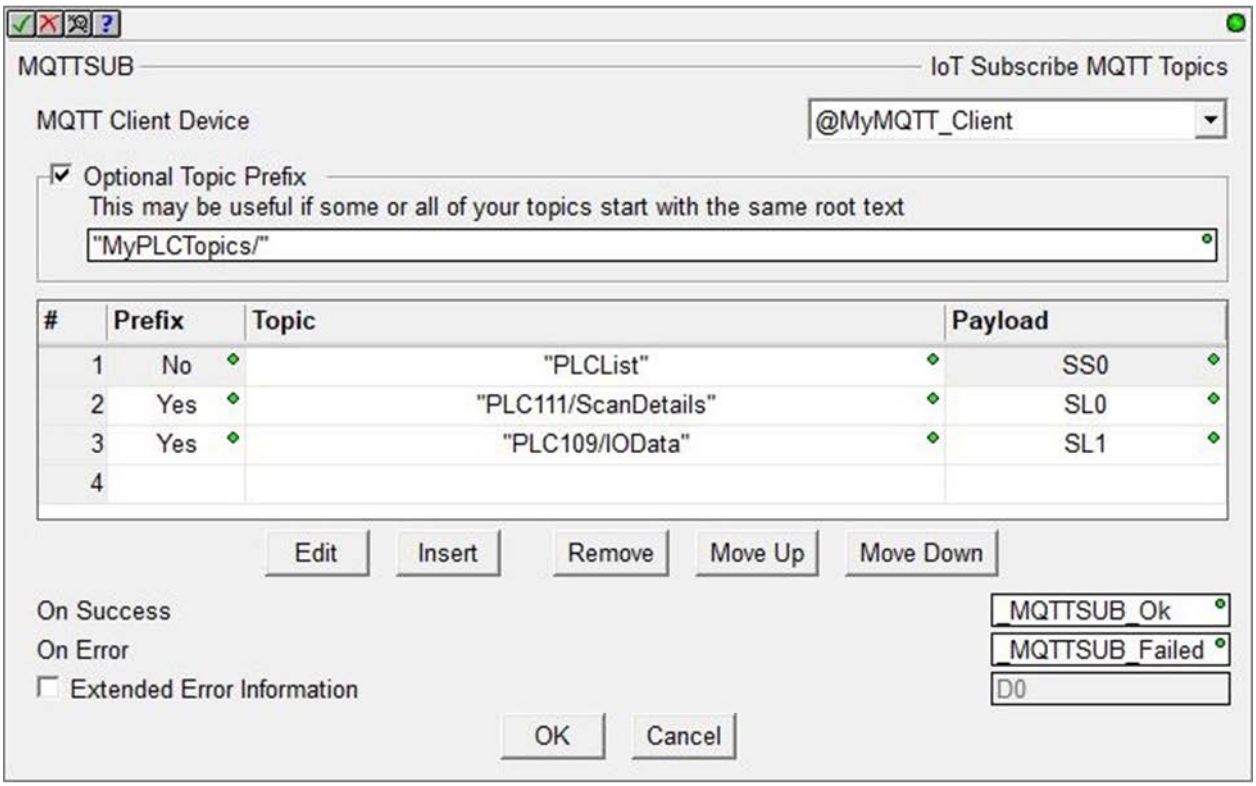
Quality of Service (QoS) is a major feature of MQTT in that it makes communication in unreliable networks much easier because the protocol handles retransmission and guarantees the delivery of the message regardless of the unreliability of the underlying transport. The QoS level is an agreement between sender and receiver of a message regarding the guarantee of delivering a message.

There are 3 QoS levels in MQTT: At most once (0), At least once (1), and Exactly once (2). **The MQTTSUB instruction subscribes to all messages with a QoS of 0 (at most once)**, which means that a subscription message from the Broker will be delivered only once; the Broker will not continue retrying the transmission until it gets an acknowledgment message from the receiver.



NOTE: *Although RUN-mode edits are allowed on existing MQTTSUB instructions, doing so will likely cause a "Duplicate MQTTSUB topic ..." warning message as the PLC works through resubscribing the Topics in the message list. The re-subscribes work properly after the RUN-mode edit; this is just a warning caused by a temporary situation. You can clear this warning message on the System Status tab of the System Information utility.*

MQTT, continued



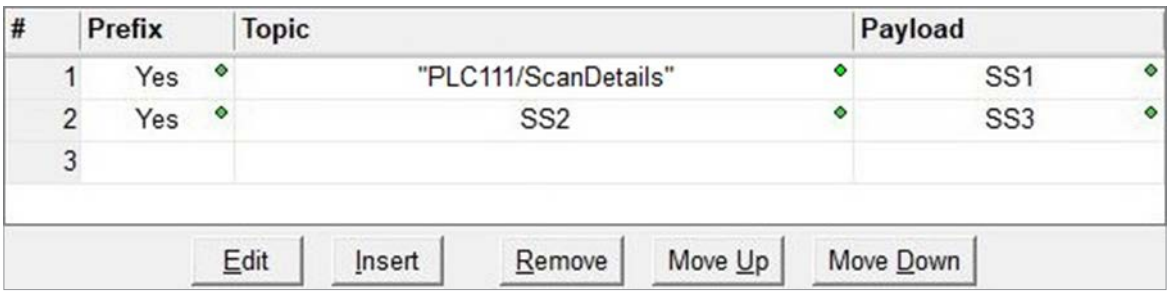
MQTT Client Device selects which of the preconfigured MQTT Client devices this instruction will connect to.

Click **create device** to open the Add Device dialog of the System Configuration where a new MQTT Client device can be created.

NOTE: *Each MQTT Client device can only provide a subscription space for 100 concurrent topics spread across a maximum of 10 active MQTTSUB instructions; for example, 2 enabled instructions with 50 Topics each, or 10 enabled instructions with 10 Topics each. To subscribe to more than 100 Topics, create multiple MQTT Client devices to the same MQTT Broker.*

The next section contains a list of up to 50 Topics that get subscribed to from the selected MQTT Broker.

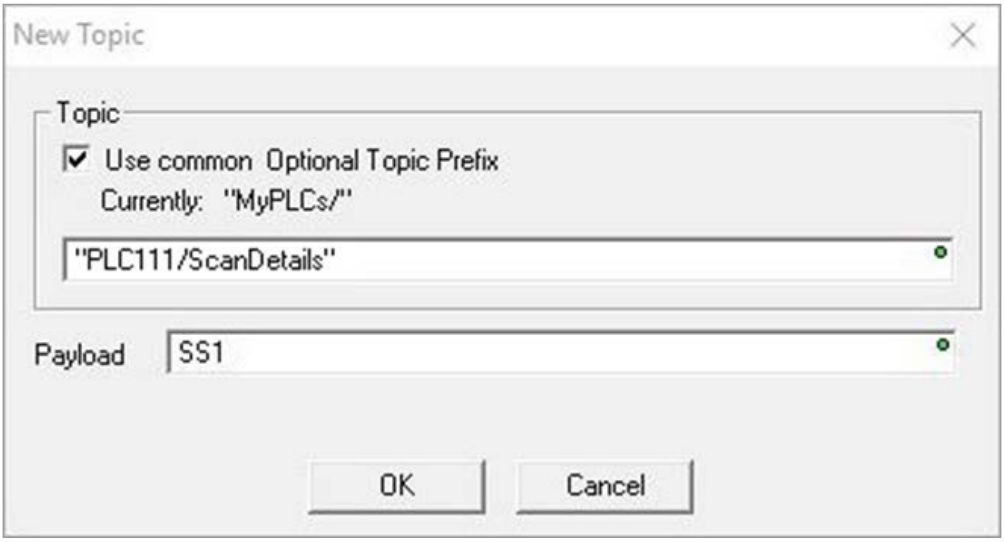
Enabling the **Optional Topic Prefix** allows Topics to use repeated text. If there are multiple Topics that begin with the same text, you can put the repeated text in this Optional Topic Prefix and then select that optional text when the Topic is created and added to the list. This can be any string literal (text enclosed with double quotes) of any user-defined or system-defined String. Remember, Topics are case sensitive.



MQTT, continued

The buttons below the list are functions which manage the rows in the instruction: **Edit** opens the editor for the currently selected row, **Insert** adds an empty row before the currently selected row and opens the editor for this new row, **Remove** deletes the currently selected row from the table, and **Move Up / Move Down** shifts the currently selected row up one or down one row respectively in the table.

Clicking the **Edit** (on an existing Topic) or **Insert** button will open a sub-editor where the contents of the message are managed. The **Topic** group specifies the Topic to which to subscribe:



If an **Optional Topic Prefix** was created on the main dialog, you can enable the **Use Common Optional Topic Prefix** to prepend the prefix text to the Topic text to construct the full name of the Topic.

The **Topic** itself is a simple UTF-8 string, consisting of one or more levels, which are separated by a forward slash (aka the topic level separator). A Topic is case-sensitive. Each Topic must have at least 1 character to be valid and it can contain spaces. A leading forward slash is not recommended. Published Topics cannot start with $. MQTTSUB does not support Wildcards (+ or #) in Topics. The Topic can be entered as a String literal (text within double quotes) up to 128 characters, or a user-defined String or a system-defined String element.

The **Payload** is the memory location in the PLC where the data from the subscribed Topic will be stored. MQTT protocol itself is data-agnostic, meaning the format of the data totally depends on the how the data was published to the Broker. It's completely up to the publisher if it wants to send binary data or textual data. The only requirement for the instruction is that the data be stored in a String element. Use the Convert String to Integer (STR2INT) or Convert String to Real (STR2REAL) instructions to convert the contents of the Strings to numbers if needed. Use the Get Bytes Out of a String (STRGETB) instruction to extract raw bytes of data into a byte buffer.



NOTE: *The maximum length of the Topic (including the Optional Topic Prefix if selected) plus the Payload is 1024 characters.*

When this instruction is first enabled the On Success and On Error indicators will be turned OFF. Then the instruction will process each subscribe entry in the list. The On Success will be turned ON if at least one of the Topics in the instruction was successfully subscribed to. If none of the Topics were successfully subscribed the On Error will be turned ON.

MQTT, continued

When this instruction is disabled, it will process each entry in the list of Topics and attempt to unsubscribe each of them. The On Success will be turned ON if at least one of the Topics in the instruction was successfully unsubscribed. If none of the Topics were successfully unsubscribed the On Error will be turned ON.

On Success – select any writable bit location.

On Error – select any writable bit location.

The **Extended Error Information** is a DWord location that contains a combination value. Using the :SD cast here provides a good method for easily separating the high / low values. For example, V100:SD would place the high word in V101 and the low Word in V100).

The high Word is the entry number of the first Topic that failed. There may have been multiple failures, but only the entry number of the first failure will be listed in the Return Code. That error must be corrected before failures for any later entry numbers will be shown.

The low Word contains the error code itself from the following table:

MQTT Error Codes

Value in Low Word	Error	Description
0	No Error	
57	Unexpected MQTT Response	The response from the MQTT Broker was not properly formed.
58	MQTT Broker Rejected	The MQTT Broker refused the Topic; could be a bad username or password, or a security violation on the Broker itself.
59	Out of Resources (MQTTSUB only)	There are more than 10 MQTTSUB instructions using the same MQTT Client device, or there are more than 100 Topics using the same MQTT Client device.
60	Invalid Topic	This typically means the Topic is empty.
61	Duplicate Topic	The Topic is already subscribed to in a different MQTTSUB instruction.

The last error code reported by the MQTT Broker will be in **$LastProtoError** (DST38).

Do-more Logger

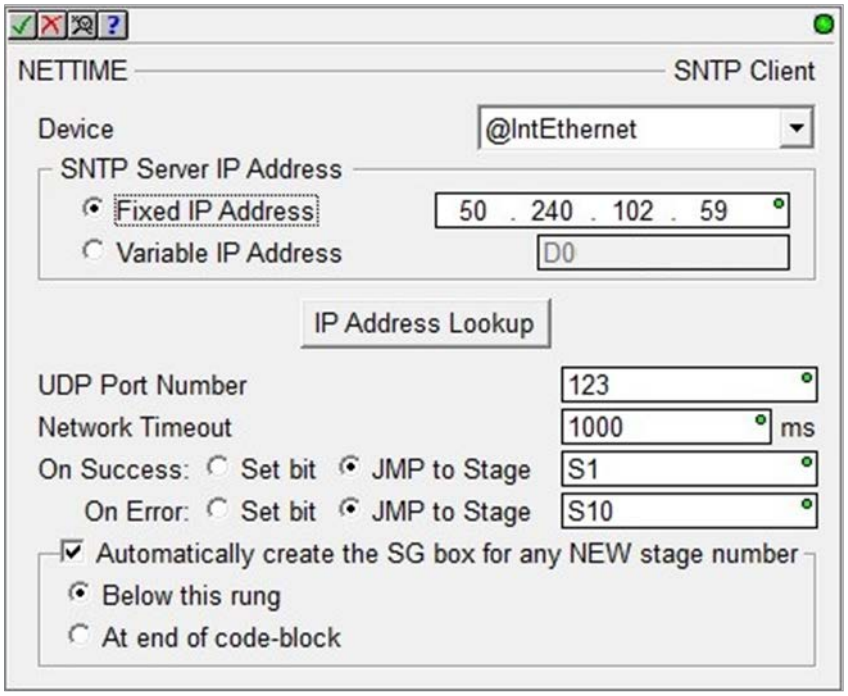
Another tool that is useful tool for debugging problems with getting MQTTSUB to function properly from the PLC's perspective is Do-more! Logger. Setting the system status bit **$EnableMsgDump** (ST36) ON will cause the MQTTSUB instruction to automatically echo the MQTT communication traffic between the Do-more! CPU and the MQTT Broker to the Do-more! Logger. Do-more! Logger will capture and display this conversation which allows to programmer to see what changes need to be made to correct any errors.

So between the High Word (:W1) of the Extended Error Information value telling you which entry number failed, and the Low Word of the Extended Error Information value telling you why that entry failed, and the value in **$LastProtoError** (DST38) giving you the MQTT Broker's error value, and Do-more! Logger displaying the communication traffic, you should be able to resolve any fault conditions.

NETTIME (SNTP Client)

The SNTP Client (NETTIME) instruction is used to retrieve clock and calendar information from a Time Server using the Simple Network Time Protocol (SNTP). This instruction can use either an NTP Server or an SNTP Server as the time server. After the date and time have been successfully read from the time server, the retrieved values will be used to recalculate the local time ($Now) and set the PC's real-time clock to this calculated value. This instruction can be used in conjunction with TimeSync operation to synchronize the real-time clocks in multiple Do-more! PLCs with the date and time of a master PLC.

The local time ($Now) is calculated by applying a local Time Zone offset value ($TimeZone, DST384), and optionally adjusting for Daylight Saving Time ($SummerTime, ST768) to the value retrieved via the NETTIME instruction.



***NOTE:** Use the F9 key to open the Default Element Selection Tool (the Element Picker or the Element Browser) or use the Down-Arrow key (Auto-Complete) on any parameter field to see a complete list of the memory locations that are valid for that parameter of the instruction.*

Parameters:

Device selects which of the Ethernet Devices to use. For more information on configuring devices go to the Device Configuration Section under System Configuration.

@IntEthernet will use the on-board Ethernet port on the Do-more! CPU.

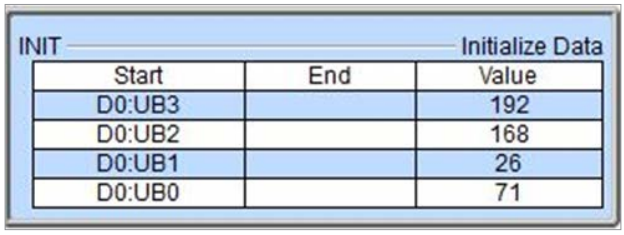
'No devices available' indicates that there are no Devices that can execute this instruction, i.e. the CPU does not have an on-board Ethernet port.

SNTP Server IP Address is the TCP/IP Address of the SNTP server to contact for the clock and calendar information. The default SNTP Server IP Address of 12.69.41.165 is an SNTP server (ntp2.hosteng.com) at Host Engineering. While it is reasonable to use the default time server for testing purposes, be aware that the uptime of the default time server can not be guaranteed. It is recommended that you install your own time server or select a publicly available time server for long-term use.

NETTIME (SNTP Client), continued

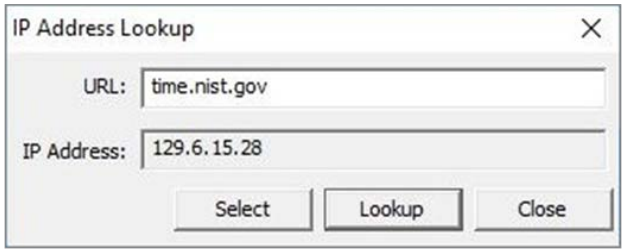
Fixed Address: select this option to enter the static TCP/IP address assigned to the SNTP server. IP addresses are canonically represented in dot-decimal notation, consisting of four decimal numbers, each ranging from 0 to 255, separated by dots. Invoking the Element Browser (F9) for this field will bring up the IP Address Lookup utility that can find the IP address for a given SNTP Server name.

Variable IP Address: select this option if the IP address resides in a numeric memory location in the CPU. This can be any readable DWord numeric location. This allows the IP address to be changed at runtime. Each octet of the IP address is stored in one byte of the Variable Address location. In the example below the Initialize Data instruction will use the :UB operator to place the 4 octet values of IP address 192.168.26.71 into the 4 Bytes of the DWord location D0 in the proper order.



The 'IP Address' format selection in a Data View can be used to see the IP address stored in the DWord location in the traditional dot-decimal notation (000.000.000.000).

Clicking the **IP Address Lookup** button will open a dialog where the name of an SNTP server can be entered and Do-more! Designer will attempt to find the TCP/IP address assigned to that name using the Domain Name System protocol (DNS).



The server name needs to consist only of the server name, not a fully qualified URL. For example, the Name field should contain only the text "time.nist.gov", not "https://time.nist.gov".

UDP Port Number is the UDP/IP port number the SNTP Server uses to communicate. The SNTP protocol uses UDP Port Number 123 by default. This value can be any constant in the range of 1 to 65535, or any readable numeric location containing a value in that range.

Network Timeout specifies the maximum amount of time in milliseconds to allow the instruction to wait before signaling a completion. This value can be any constant in the range of 1 to 65535.

The **On Success** and **On Error** parameters specify what action to perform when this instruction completes. You do not have to use the same type of selection for both On Success and On Error.

If the **Set Bit** selection is used for either **On Success** or **On Error**, the specified BIT location will be SET OFF when the instruction is first enabled and will remain OFF until the instruction completes. Once complete, the appropriate Success or Error bit location will be set ON. The specified Bit location is enabled with a SET (Latch) operation meaning that it will remain ON even if the input logic for the instruction goes OFF.

NETTIME (SNTP Client), continued

If the **JMP to Stage** selection is used for either **On Success** or **On Error** the target Stage must be in the same Program code block as this instruction; you cannot specify a target Stage that exists in a different Program code block. When the operation finishes, the target Stage will be enabled the same way as a standalone Jump to Stage (JMP) instruction would do it. The JMP to Stage option will only be available if this instruction is placed in a Program code block.

On Success - selects which of the following actions to perform if the operation is successful:

SET Bit - enable this selection then specify any writable bit location.

JMP to Stage - enable this selection then specify any Stage number from S0 to S127 in the current Program code block.

On Error - selects which of the following actions to perform if the Close Device operation is unsuccessful:

SET Bit - enable this selection then specify writable bit location.

JMP to Stage - enable this selection then specify any Stage number from S0 to S127 in the current Program code block.

Automatically create the SG box for any NEW stage number - if either the **On Success** or **On Error** selections are set to **JMP to Stage**, this option will be enabled which will automatically create any target stage that does not already exist.

Below this rung - the new target stage will be created on a new rung following this instruction.

At end of code block - the new target stage will be created as the last rung of this Program.

TCP/IP Raw Data

Do-more! PLCs can be used to create custom protocols for various types of devices. For devices that utilize TCP/IP based protocols, this section of the manual will give you direction on how to get started. You will need to have a thorough understanding of the protocol that you are attempting to write. Showing how to fully implement a protocol is beyond the scope of this manual.

Basic steps to implement a Server (Slave) protocol:

1. Create a TCP/IP Server Raw socket device. Enter the correct port number that your Server is transmitting on. See Do-more! Designer help topic DMD0248.
2. Put a TCPLISTEN command into $MAIN that will start the Program to handle the communications with your TCP Server. See Do-more! Designer help topic DMD0072.
3. In the Program block above, put the appropriate STREAMIN and STREAMOUT instructions for communications. See Do-more! Designer help topics DMD0303 and DMD0304.

Basic steps to implement a Client (Master) protocol:

1. Create a TCP/IP Client Raw socket device.
2. When $YourTCPClientNameHere.TCPConnected is true, execute an OPENTCP command. See Do-more! Designer help topic DMD0069.
3. Execute a STREAMOUT command with your data. See Do-more! Designer help topic DMD0304.

UDP/IP Raw Data

Do-more! PLCs can be used to create custom protocols for various types of devices. For devices that utilize UDP/IP based protocols, this section of the manual will give you direction on how to get started. You will need to have a thorough understanding of the protocol that you are attempting to write. Showing how to fully implement a protocol is beyond the scope of this manual.

Basic steps to implement an UDP/IP protocol:

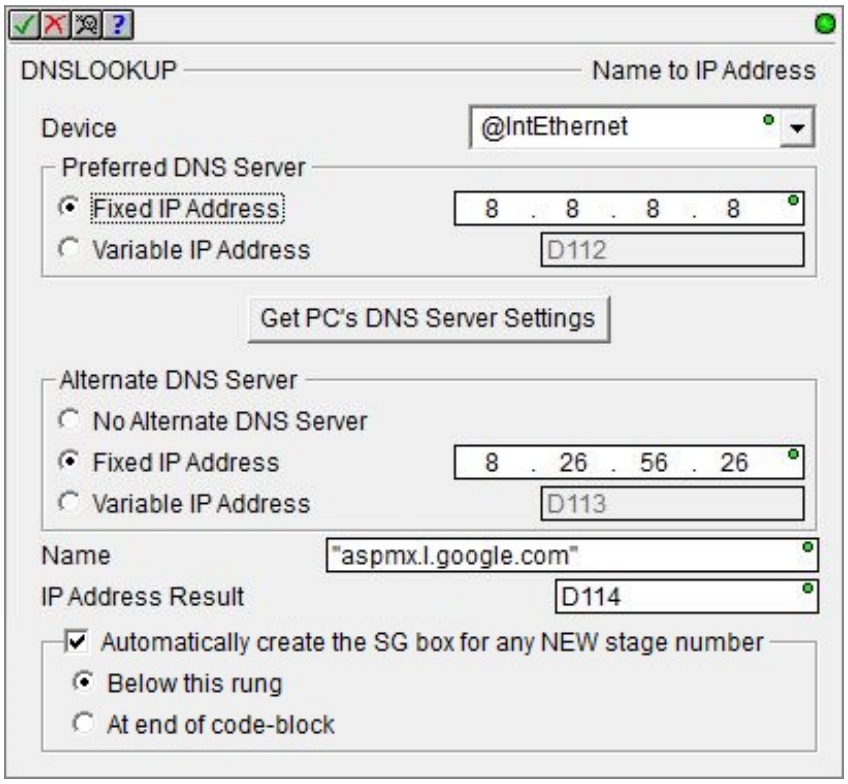
1. Create an UDP/IP Raw socket device. Enter the correct port number that your Server is transmitting or listening on. See Do-more! Designer help topic DMD0248.
2. When $YourUDPClientNameHere.PacketAvailable is true, execute a PACKETIN command. See Do-more! Designer help topic DMD0301.
3. When you want to send data to the server, execute a PACKETOUT. See Do-more! Designer help topics DMD0302.

DNS Lookup – Name to IP Address

The Name to IP Address (DNSLOOKUP) instruction is used to find the IP Address assigned to the named device using the Domain Name System protocol (DNS). This instruction uses the on-board Ethernet port and requires that the TCP/IP network be setup so the CPU has a functional connection to a DNS Server.

The Name needs to consist only of the server name, not a fully qualified URL. For example, the Name field should contain only the text “mail.google.com”, not “https://mail.google.com”. The timeout value (including retries) for the DNS Lookup operation is fixed in the DNS client at 126 seconds.

If the DNS Lookup operation is successful, the IP address will be stored in a DWord location. Use the “IP Address” format in a Data View to see the returned IP Address in the traditional dot-decimal notation (000.000.000.000).



DNS Lookup, continued

NOTE: *Use the F9 key to open the Default Element Selection Tool (the Element Picker or the Element Browser) or use the Down-Arrow key (Auto-Complete) on any parameter field to see a complete list of the memory locations that are valid for that parameter of the instruction.*

Parameters:

Device selects which of the Ethernet Devices to use. Currently this instruction can only use @IntEthernet which is the on-board Ethernet port on the Do-more! CPU. If the only entry in the list is no devices available this indicates that there are no Devices that can execute this instruction, most likely cause is the CPU does not have an on-board Ethernet port.

Preferred DNS Server: the TCP/IP Address of the first DNS server to contact for resolving the Name to an IP Address. The default value is 8.8.8.8 (decimal 34744072) which is Google's public DNS Server.

Fixed Address: the IP Address assigned to the DNS Server. IP addresses are canonically represented in dot-decimal notation, consisting of four decimal numbers, each ranging from 0 to 255, separated by dots.

Variable IP Address: the IP Address resides in a memory location in the CPU. This allows the IP Address to be changed at runtime. This can be any readable DWord numeric location. Each octet of the IP Address is stored in one byte of the Variable Address location. In the example below the Initialize Data instruction will use the :UB operator to place the 4 octet values of IP Address 192.168.26.71 into the 4 Bytes of the DWord location D0 in the proper order.

INIT — Initialize Data

Start	End	Value
D0:UB3		192
D0:UB2		168
D0:UB1		26
D0:UB0		71

The 'IP Address' format selection in a Data View can be used to see the IP address stored in the DWord location in the traditional dot-decimal notation (000.000.000.000).

Click the **Get PC's DNS Server Settings** button to retrieve the Preferred DNS Server and the Alternate DNS Server IP Addresses from the network configuration of the PC running Do-more! Designer and use those IP Addresses in this instruction.

Alternate DNS Server: the TCP/IP Address of an alternate DNS server to contact if the preferred DNS server cannot resolve the Name to an IP Address. The default value is the Secondary DNS Server IP address from the network setup on the computer that is running Do-more! Designer.

No Alternate DNS Server: select this option to only use the Preferred DNS Server to resolve the Name.

Fixed Address: the IP Address assigned to the Alternate DNS Server. IP addresses are canonically represented in dot-decimal notation, consisting of four decimal numbers, each ranging from 0 to 255, separated by dots.

Variable IP Address: the IP Address resides in a memory location in the CPU. This allows the IP Address to be changed at runtime. This can be any readable DWord numeric location. Each octet of the IP Address is stored in one byte of the Variable Address location. In the example below

DNS Lookup, continued

the Initialize Data instruction will use the :UB operator to place the 4 octet values of IP Address 192.168.26.71 into the 4 Bytes of the DWord location D0 in the proper order.

INIT — Initialize Data

Start	End	Value
D0:UB3		192
D0:UB2		168
D0:UB1		26
D0:UB0		71

The 'IP Address' format selection in a Data View can be used to see the IP Address stored in the DWord location in the traditional dot-decimal notation (000.000.000.000).

Name: specifies the name to resolve to an IP Address. This can be a string literal (text within double quotes), or any system-defined Short Strings, or system-defined Long Strings, or user-defined Strings. The Name is not a fully qualified URL like "https://mail.google.com"; use only the "mail.google.com".

IP Address Result: designates a location to store the IP Address if a DNS server can successfully resolve the Name. This can be any writable numeric location.

The **On Success** and **On Error** parameters specify what action to perform when this instruction completes. You do not have to use the same type of selection for both On Success and On Error.

If the **Set Bit** selection is used for either **On Success** or **On Error**, the specified BIT location will be SET OFF when the instruction is first enabled and will remain OFF until the instruction completes. Once complete, the appropriate Success or Error bit location will be set ON. The specified Bit location is enabled with a SET (Latch) operation meaning that it will remain ON even if the input logic for the instruction goes OFF.

If the **JMP to Stage** selection is used for either **On Success** or **On Error** the target Stage must be in the same Program code block as this instruction; you cannot specify a target Stage that exists in a different Program code block. When the operation finishes, the target Stage will be enabled the same way as a standalone Jump to Stage (JMP) instruction would do it. The JMP to Stage option will only be available if this instruction is placed in a Program code block.

On Success - selects which of the following actions to perform if the operation is successful:

SET Bit - enable this selection then specify any writable bit location.

JMP to Stage - enable this selection then specify any Stage number from S0 to S127 in the current Program code block.

On Error - selects which of the following actions to perform if the Close Device operation is unsuccessful:

SET Bit - enable this selection then specify writable bit location.

JMP to Stage - enable this selection then specify any Stage number from S0 to S127 in the current Program code block.

Automatically create the SG box for any NEW stage number - if either the **On Success** or **On Error** selections are set to **JMP to Stage**, this option will be enabled which will automatically create any target stage that does not already exist.

Below this rung - the new target stage will be created on a new rung following this instruction.

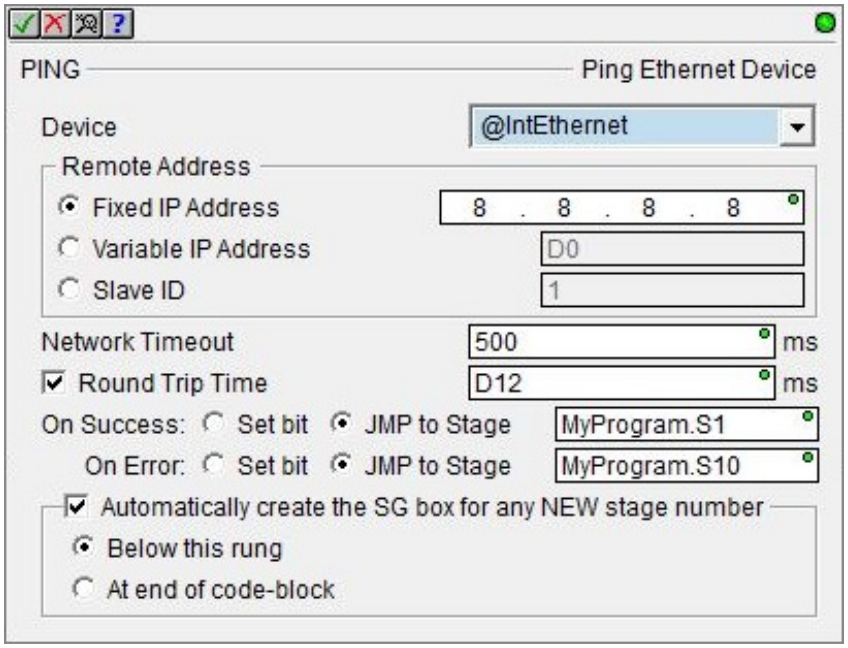
At end of code block - the new target stage will be created as the last rung of this Program.

Ping – Ping Ethernet Device

The Ping Ethernet Device (PING) instruction uses the Internet Control Message protocol (ICMP) to determine if the device with the specified IP Address is available on the network, and optionally to report the amount of time required to get a response from that device.

The amount of time required to complete the PING operation can optionally be stored in a numeric location. The round trip time begins accumulating when the PING packet is actually sent and ends with either a response from the remote device or a timeout. If the PING operation is successful, the Round Trip Time will be total amount of time (in milliseconds) that elapsed after the PING packet was sent and the response packet was received. If the PING operation failed, the Round Trip Time will be the total mount of time (in milliseconds) that elapsed while waiting for the timeout to occur.

NOTE: *Care must be taken to NOT run this instruction at an uncontrolled pace. If this happens the network hardware could perceive it as a Ping Flood (where ICMP packets are sent as fast as possible without waiting for replies). This could lead to a DENIAL-OF-SERVICE for legitimate PING operations.*



NOTE: *Use the F9 key to open the Default Element Selection Tool (the Element Picker or the Element Browser) or use the Down-Arrow key (Auto-Complete) on any parameter field to see a complete list of the memory locations that are valid for that parameter of the instruction.*

Parameters:

Device selects which of the Ethernet Devices to use. Currently this instruction can only use @IntEthernet which is the on-board Ethernet port on the Do-more! CPU. If the only entry in the list is no devices available this indicates that there are no Devices that can execute this instruction, most likely cause is the CPU does not have an on-board Ethernet port.

Remote Address: the TCP/IP Address of the remote network device to attempt to locate.

Fixed Address: the IP Address assigned to the DNS Server. IP addresses are canonically represented in dot-decimal notation, consisting of four decimal numbers, each ranging from 0 to 255, separated by dots.

Ping, continued

Variable IP Address: the IP Address resides in a memory location in the CPU. This allows the IP Address to be changed at runtime. This can be any readable DWord numeric location. Each octet of the IP Address is stored in one byte of the Variable Address location. In the example below the Initialize Data instruction will use the :UB operator to place the 4 octet values of IP Address 192.168.26.71 into the 4 Bytes of the DWord location D0 in the proper order.

INIT — Initialize Data

Start	End	Value
D0:UB3		192
D0:UB2		168
D0:UB1		26
D0:UB0		71

The 'IP Address' format selection in a Data View can be used to see the IP address stored in the DWord location in the traditional dot-decimal notation (000.000.000.000).

Network Timeout: specifies the amount of time (in milliseconds) to wait on a response from the network device. This can be any constant value between 1 and 65535, or any readable numeric location containing a value in that range.

Round Trip Time (optional): if enabled, designates a location to store the total amount of time (in milliseconds) that elapsed during the Ping operation. This can be any writable numeric location.

The **On Success** and **On Error** parameters specify what action to perform when this instruction completes. You do not have to use the same type of selection for both On Success and On Error.

If the **Set Bit** selection is used for either **On Success** or **On Error**, the specified BIT location will be SET OFF when the instruction is first enabled and will remain OFF until the instruction completes. Once complete, the appropriate Success or Error bit location will be set ON. The specified Bit location is enabled with a SET (Latch) operation meaning that it will remain ON even if the input logic for the instruction goes OFF.

If the **JMP to Stage** selection is used for either **On Success** or **On Error** the target Stage must be in the same Program code block as this instruction; you cannot specify a target Stage that exists in a different Program code block. When the operation finishes, the target Stage will be enabled the same way as a standalone Jump to Stage (JMP) instruction would do it. The JMP to Stage option will only be available if this instruction is placed in a Program code block.

On Success - selects which of the following actions to perform if the operation is successful:

SET Bit - enable this selection then specify any writable bit location.

JMP to Stage - enable this selection then specify any Stage number from S0 to S127 in the current Program code block.

On Error - selects which of the following actions to perform if the Close Device operation is unsuccessful:

SET Bit - enable this selection then specify writable bit location.

JMP to Stage - enable this selection then specify any Stage number from S0 to S127 in the current Program code block.

Automatically create the SG box for any NEW stage number - if either the **On Success** or **On Error** selections are set to **JMP to Stage**, this option will be enabled which will automatically create any target stage that does not already exist.

Below this rung - the new target stage will be created on a new rung following this instruction.

At end of code block - the new target stage will be created as the last rung of this Program.

BRX Remote I/O: BX-DMIO, BX-EBC100 & GS-EDRV100



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What it is

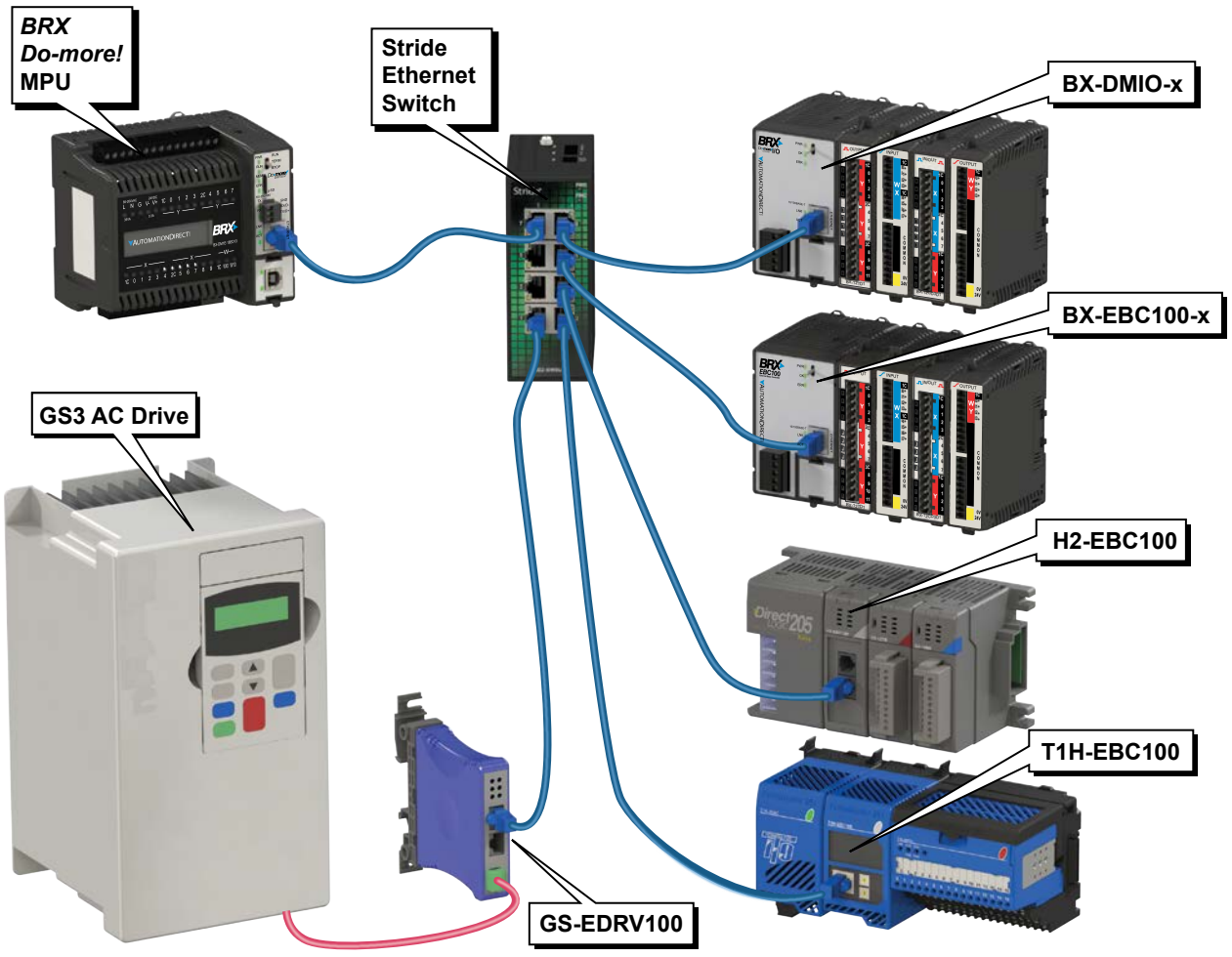
The BX-DMIO Modules are low-cost remote I/O controller modules that provide, through an Ethernet connection, a remote I/O drop to any PLC utilizing the Do-more! technology.

The BX-EBC100 Modules are remote I/O controller modules that provide, through an Ethernet connection, a remote I/O drop to any PLC utilizing the Do-more! technology or can be used with the DirectLOGIC PLC family using an Ethernet Remote Master (ERM100).

Comparison Chart

	BX-DMIO	BX-EBC100
Lowest Cost	Yes	No
Supported Protocols	Do-more! Ethernet Remote I/O	Do-more! Ethernet Remote I/O Host Ethernet Remote I/O Modbus TCP
Can Be Used With	BX-DM1E MPUs H2-DM1E CPUs T1H-DM1E CPUs Up to 16 slaves can be used by the Masters listed above.	BX-DM1E MPUs H2-DM1E CPUs T1H-DM1E CPUs H2-ERM100s H4-ERM100s Up to 16 slaves can be used by the Masters listed above.

In this chapter we will be focusing on using DMIO and EBC100 along with GS-EDRV100 to provide a complete remote I/O solution for a Do-more! technology based PLC.



BX-DMIO & BX-EBC100 I/O Controllers

General Specifications

- RJ45 port for Ethernet communications
- No support for Pluggable Option Module (POM)
- Supports up to 8 addtional Expansion Modules
- No built-in discrete or analog I/O
- AC and DC powered units available

BX-DMIO Controllers			
Part Number	**External Power**	**Expansion Modules**	**Can be Used With**
BX-DMIO-M	120–240 VAC	8	BX-DM1E MPUs H2-DM1E CPUs T1H-DM1E CPUs
BX-DMIO-M-D	12–24 VDC	8	



BX-DMIO-M
Do-more! I/O Controller

BX-EBC100 Controllers			
Part Number	**External Power**	**Expansion Modules**	**Can be Used With**
BX-EBC100-M	120–240 VAC	8	BX-DM1E MPUs H2-DM1E CPUs T1H-DM1E CPUs H2-ERM100s H4-ERM100s
BX-EBC100-M-D	12–24 VDC	8	



BX-EBC100-M
Ethernet Base Controller

General Specifications, continued

General Specifications				
Part Number	**BX-DMIO-M**	**BX-DMIO-M-D**	**BX-EBC100-M**	**BX-EBC100-M-D**
Operating Temperature	0° to 60°C (32° to 140°F)			
Storage Temperature	-20° to 85°C (-4° to 185°F)			
Humidity	5 to 95% (non-condensing)			
Environmental Air	No corrosive gases permitted			
Vibration	IEC60068-2-6 (Test Fc)			
Shock	IEC60068-2-27 (Test Ea)			
Enclosure Type	Open Equipment			
Agency Approvals	UL61010-2 - UL File # E185989 Canada and USA CE Compliant EN61131-2			
Noise Immunity	NEMA ICS3-304			
EU Directive	See the "EU Directive" topic in the Help File			
Heat Dissipation	10.8 W Max	8.6 W Max	10.8 W Max	8.6 W Max
Weight	198g (7oz)	170g (6oz)	198g (7oz)	170g (6oz)
Software Version	Do-more! Designer 2.3 or later			

NOTE: *Eight (8) Expansion Modules can be connected to add I/O capability. Only Discrete and Analog Expansion Modules are supported.*

NOTE: *For specifications for H2-EBC100, T1H-EBC100 or GS-EDRV100 please refer to the appropriate manual on the AutomationDirect.com website under Manuals/Docs.*

Power Supply Connector

The power supply terminal block connectors are included with the BX-EBC100 and BX-DMIO. The power supply connectors are a screw type, removable terminal block. Replacement connectors and specifications are listed in the tables that follow.

AC Power Supply Connector Specifications (-M models)			
Part Number	**BX-RTB05 (Included w/Unit)**	**BX-RTB05-1**	**BX-RTB05-2**
Connector Type	Screw Type-90 deg	Spring Clamp Type-180 deg	Screw Type-180 deg
Wire Exit	180 deg	180 deg	180 deg
Pitch	5.0 mm	5.0 mm	5.0 mm
Screw Size	M2.5	N/A	M2.5
Recommended Screw Torque	< 3.98 lb·in (0.45 N·m)	N/A	< 3.98 lb·in (0.45 N·m)
Screwdriver Blade Width	3.5 mm	3.5 mm	3.5 mm
Wire Gauge (Single wire)	28–12 AWG	28–14 AWG	28–14 AWG
Wire Gauge (Two wire)	28–16 AWG	28–16 AWG (Dual Wire Ferrule Required)	28–16 AWG (Dual Wire Ferrule Required)
Wire Strip Length	0.3 in (7.5 mm)	0.37 in (9.5 mm)	0.37 in (9.5 mm)
Equiv. Dinkle P/N	5ESDV-05P-BK	5ESDSR-05P-BK	5ESDF-05P-BK



BX-RTB05



BX-RTB05-1



BX-RTB05-2

DC Power Supply Connector Specifications (-M-D models)			
Part Number	**BX-RTB03 (Included w/Unit)**	**BX-RTB03-1**	**BX-RTB03-2**
Connector Type	Screw Type-90 deg	Spring Clamp Type-180 deg	Screw Type-180 deg
Wire Exit	180 deg	180 deg	180 deg
Pitch	5.0 mm	5.0 mm	5.0 mm
Screw Size	M2.5	N/A	M2.5
Recommended Screw Torque	< 3.98 lb·in (0.45 N·m)	N/A	< 3.98 lb·in (0.45 N·m)
Screwdriver Blade Width	3.5 mm	3.5 mm	3.5 mm
Wire Gauge (Single wire)	28–12 AWG	28-14 AWG	28-12 AWG
Wire Gauge (Two wires)	28–16 AWG	28-16 AWG (Dual Wire Ferrule Required)	28-16 AWG
Wire Strip Length	0.3 in (7.5 mm)	0.37 in (9.5 mm)	0.3 in (7.5 mm)
Equiv. Dinkle P/N	5ESDV-03P-BK	5ESDSR-03P-BK	5ESDF-03P



BX-RTB03



BX-RTB03-1



BX-RTB03-2

AC Power Wiring (BX-DMIO-M & BX-EBC100-M)

Power Supply Specifications

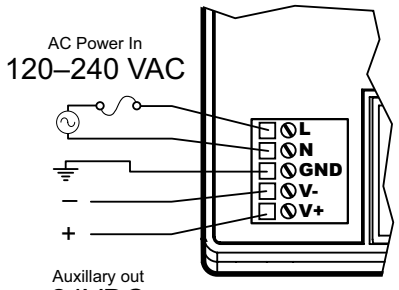
Power Supply Specifications	
Nominal Voltage Range	120–240 VAC
Input Voltage Range (Tolerance)	85–264 VAC
Rated Operating Frequency	47–63 Hz
Maximum Input Power	40VA
Cold Start Inrush Current	1.5 A, 2ms
Maximum Inrush Current (Hot Start)	1.5 A, 2ms
Internal Input Fuse Protection	Micro fuse 250V, 2A Non-replaceable
Acceptable External Power Drop Time	10ms
Under Input Voltage Lock-out	80VAC
Input Transient Protection	Input choke and line filter
Output Protection for Over Current, Over Voltage, and Over Temperature	Self resetting
Auxiliary 24VDC Output	24VDC @ 0.3 A max, <1V P-P Ripple, Integrated self-resetting short circuit protection, Isolated
Voltage Withstand (dielectric)	1500VAC Power Inputs to Ground applied for 1 minute 1500VAC Ground to 24VDC Output applied for 1 minute
Insulation Resistance	>10MΩ @ 500VDC

Power Supply Connections

Pin	Connection
1	L
2	N
3	GND
4	V–
5	V+



Removable Connector Included
ADC Part # BX-RTB05



WARNING: Do not exceed the 24VDC auxiliary power supply load limit of 300mA.

WARNING: The BRX System MUST have a proper earth ground. Do not operate the BRX MPU without proper earth grounding.

DC Power Wiring (BX-DMIO-M-D & BX-EBC100-M-D)

Power Supply Specifications

Power Supply Specifications	
Nominal Voltage Range*	12–24 VDC
Input Voltage Range (Tolerance)*	10–36 VDC
Maximum Input Voltage Ripple	< ±10%
Maximum Input Power	30W
Cold Start Inrush Current	5A, 2ms
Maximum Inrush Current (Hot Start)	5A, 2ms
Internal Input Protection	Reverse polarity protection and undervoltage lockout via transistor circuit
Acceptable External Power Drop Time	10ms
Under Input Voltage Lock-out	<9VDC
Output Protection for Over Current, Over Voltage, and Over Temperature	Self resetting
Auxiliary 24VDC Output	None
Voltage Withstand (dielectric)	1500VAC power Inputs to ground applied for 1 minute
Insulation Resistance	>10MΩ @ 500VDC

**** Class 2 or LPS Power Supply required.***

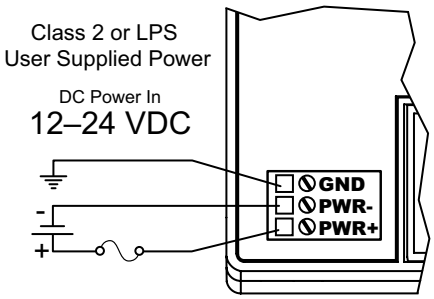
Power Supply Connections

Pin	Connection
1	GND
2	PWR –
3	PWR +





Removable Connector Included
ADC Part # BX-RTB03



WARNING: The BRX System MUST have a proper earth ground. Do not operate the BRX MPU without proper earth grounding.

Ethernet Communications

The RJ-45 Ethernet port connector is located on the CPU faceplate. Rated at 10/100 Mbps, it accepts standard CAT5e cable and has built-in auto-crossover capability; no crossover cable is required.

Ethernet Specifications		
	BX-DMIO-M (-D)	**BX-EBC100-M (-D)**
Port Type	Ethernet	
Description	Standard transformer-isolated Ethernet port with built-in surge protection.	
Transfer Rate	10Mbps and 100Mbps	
Port Status LED	LINK LED is solid GREEN when network LINK is established. ACT LED flashes GREEN when port is active.	
Supported Protocols (Server)	Do-more! Ethernet Remote I/O Embedded Web Server: HTTP (Unsecure)	Do-more! Ethernet Remote I/O HOST Ethernet Remote I/O Modbus TCP Embedded Web Server: HTTP (Unsecure)
Cable Recommendation	C5E-STxxx-xx from AutomationDirect.com	
Port Type	RJ45, Category 5, 10/100 BASE-T, Auto Crossover	
Ethernet Port Numbers: Do-more! Ethernet Expansion I/O (Server) HOST Ethernet Remote I/O (Server) Modbus TCP (Server) Embedded Web Server: HTTP (Unsecure)	 28784, UDP - - -	 28784, UDP 28784, UDP 502, TCP 80, TCP

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DIP Switch Specifications

The BX-DMIO and BX-EBC100 Remote I/O controllers have a block of DIP switches, located on the top of the chassis, that are used to setup the Module ID, write protect the module and disable the Web configuration page. The DIP switch settings are read when the system is powered up. The default position for all DIP switches is OFF.

WARNING: The BX-DMIO and BX-EBC100 Remote I/O controllers must be powered down prior to changing DIP switch settings.



NOTE: DIP switches located in this compartment are used for controller configuration.

DIP Switch Specifications, continued

The following table describes the position and function associated with each DIP switch.

DIP Switch Settings		
DIP#	**Switch Position**	**Function**
7	ON	Reserved
6	ON	Reset the module to factory default
5	ON	Write protect the module. No writes to flash memory are allowed. Disable Web configuration page.
4	ON	Station number: DIP Switch 0–4: Supports addresses 1 to 31. All DIP Switch OFF: Station number from flash. Enter via Netedit 3 or Web configuration page. Supports addresses 1 to 247.
3	ON	
2	ON	
1	ON	
0	ON	



DIP Switch position is read when power is applied to the module. Power down the module before changing DIP switch settings.

DIP switches 0 to 4: Use to set a Module ID (0x00 up to 0x1F).

DIP Switch 5: When ON, it will write protect the module. It will not be possible to update the network settings, update the firmware or the booter version. It also disables access to the Web configuration page.

DIP Switch 6: When ON, the module is reset to factory defaults.

Status Indicators

Status Indicators		
Indicator	**Status**	**Description**
PWR	OFF	Base Power is OFF
	GREEN	Base Power is Good
OK	GREEN	Controller is Functioning Normally
	GREEN (Blinking)	Reset Mode (Booter without OS)
	YELLOW	Analog Module Mismatch
	OFF	Controller HW Error or Power is OFF
ERR	OFF	Controller is Functioning Normally
	RED	Controller HW Error or Communications Watchdog Timeout
	RED (Blinking)	Reset Mode (Booter without OS)
LNK	OFF	No Ethernet Link
	GREEN	Ethernet Link is Good
ACT	OFF	No Ethernet Activity
	GREEN (Blinking)	Ethernet Activity

Supported Modules

List of modules supported by BX-DMIO & BX-EBC100 and corresponding number of I/O points

Module	Number of Points	
	In	Out
Discrete Input		
BX-08NF3	8	
BX-08ND3	8	
BX-08NB	8	
BX-08NA	8	
BX-08SIM	8	
BX-12ND3	12	
BX-12NB	12	
BX-12NA	12	
BX-16NF3	16	
BX-16ND3	16	
BX-16NB	16	
BX-16NA	16	
BX-32ND3	32	
Discrete Output		
BX-05TRS		5
BX-05TRS-1		5
BX-08TD1		8
BX-08TD2		8
BX-08TR		8
BX-08TRZ		8
BX-08TA		8
BX-12TD1		12
BX-12TD2		12
BX-12TR		12
BX-12TA		12
BX-16TD1		16
BX-16TD2		16
BX-16TF2		16
BX-16TR		16
BX-16TRZ		16
BX-32TD1		32
BX-32TD2		32

Module	Number of Points	
	In	Out
Discrete Input/Output		
BX-08CD3R	4	4
BX-12CD3D1	8	4
BX-12CD3D2	8	4
BX-16CD3D1	8	8
BX-16CD3D2	8	8
BX-16CF3F2	8	8
Temperature		
BX-04THM	4	
BX-08THM	8	
BX-06RTD	6	
BX-08NTC	8	
BX-04UT	4	
BX-08UT	8	
Temperature Input/Analog Output		
BX-4RTD4DA-1	4	4
BX-4THM4DA-1	4	4
BX-4UT4DA-3	4	4
Temperature Input/Discrete Output		
BX-4UT4TD1	4	4
BX-4UT4TD2	4	4
BX-4UT4TR	4	4

Module	Number of Points	
	In	Out
Analog Input		
BX-04ADM-1	4	
BX-04AD-1	4	
BX-08AD-1	8	
BX-16AD-1	16	
BX-04AD-2B	4	
BX-08AD-2B	8	
BX-16AD-2B	16	
BX-04AD-3	4	
BX-08AD-3	8	
Analog Output		
BX-04DA-1		4
BX-08DA-1		8
BX-04DA-2B		4
BX-08DA-2B		8
BX-04DA-3		4
BX-08DA-3		8
Analog Input/Output		
BX-2AD2DA-1	2	2
BX-4AD2DA-1	4	2
BX-2AD2DA-2B	2	2
BX-4AD2DA-2B	4	2
BX-2AD2DA-3	2	2
BX-4AD4DA-3	4	4

List of modules NOT supported by BX-DMIO & BX-EBC100

BX-HSIO1	BX-SERIO	BX-SERIO-4
BX-HSIO2	BX-SERIO-2	BX-APAD
BX-HSIO4		

Configuration

Configuration of a Do-more! Remote I/O network is fairly straightforward.

1. Hook up power and Ethernet cables to the PLC and all remote I/O drops.
2. Use the NetEdit3 utility to give the PLC and all remote I/O drops an IP address.
3. Use Do-more! Designer software to add the remote I/O drops to the PLC program.
4. Write your program.

Wiring and IP address selection

See Appendix E for information on Ethernet wiring and how to use NetEdit3 for IP address selection. Using the NetEdit3 tool is the easiest way to set IP addresses for use with a Remote I/O network.

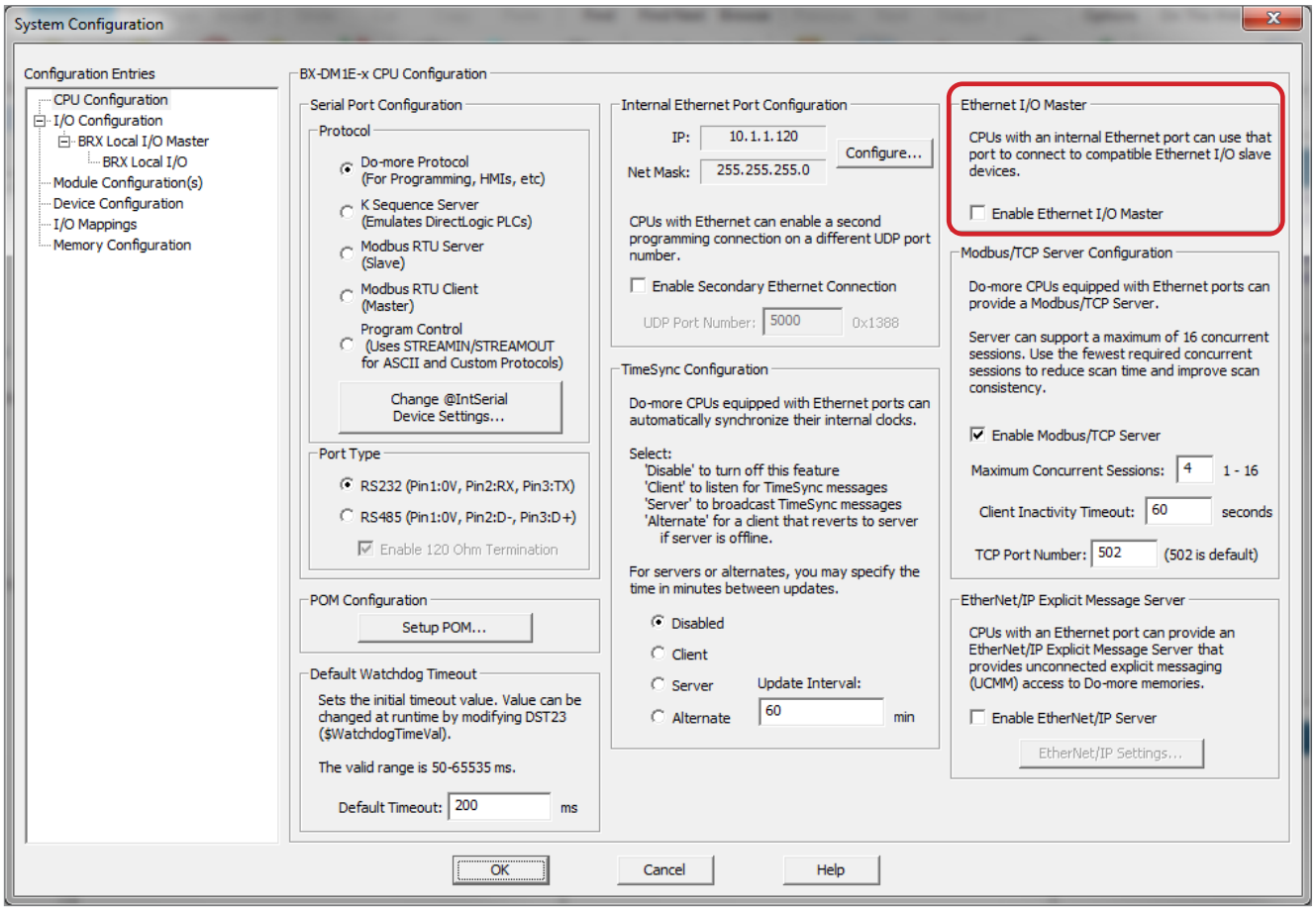
NOTE: *We recommend that all Remote I/O networks be placed on isolated networks if at all possible.*

System Configuration

CPU Configuration

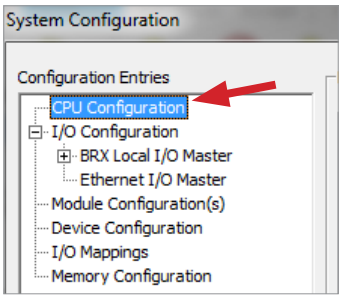
The first step to setting up a Do-more! Ethernet I/O Master is to enable it in the System Configuration.

You will find this under the CPU Configuration section of the System Configuration Dialog or by left clicking the Ethernet Port in the Dashboard and picking “Enable Ethernet I/O Master”.

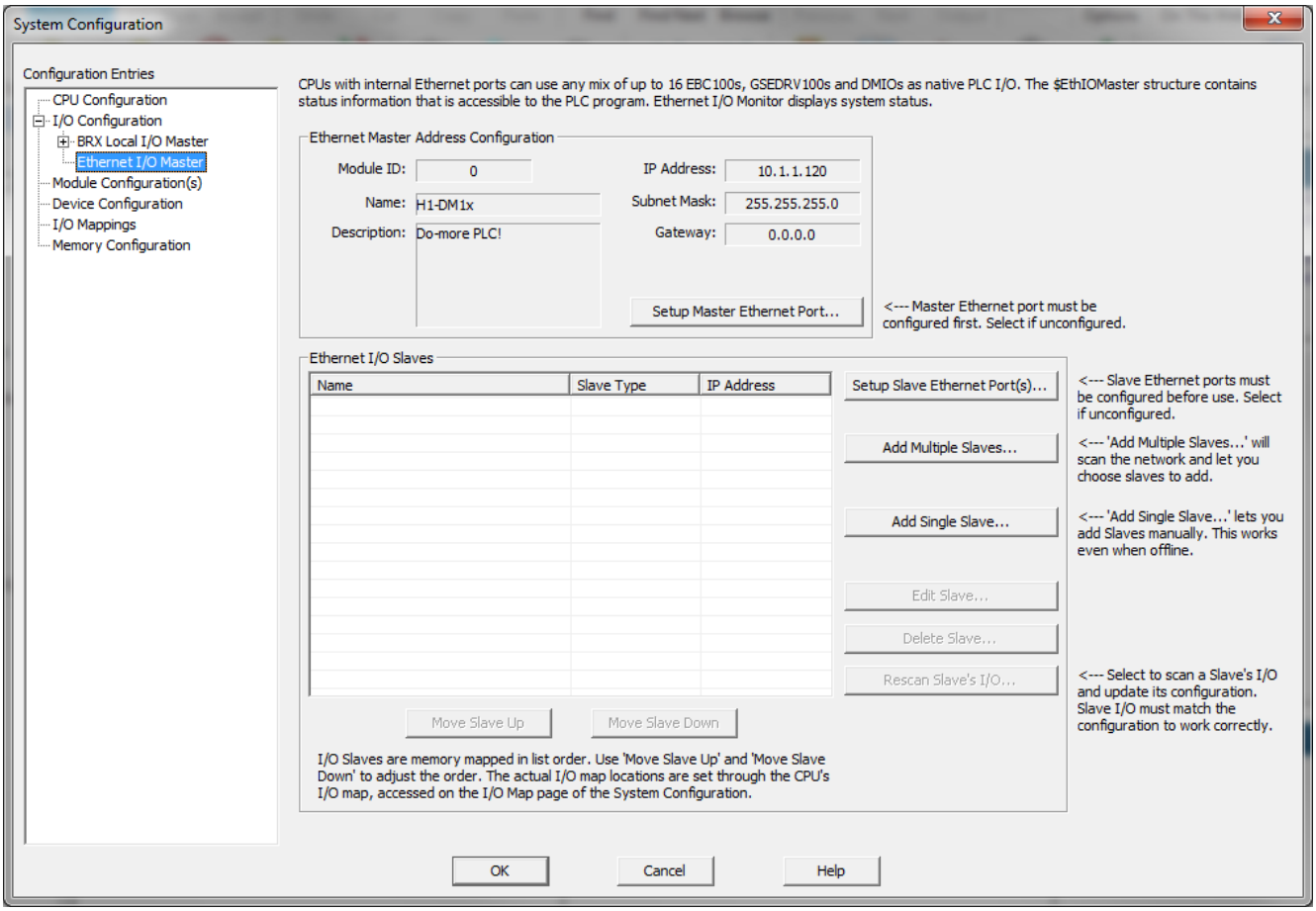


CPU Configuration, continued

Once the Ethernet I/O Master is enabled, you will notice that you now have a new entry under the I/O Configuration.



Clicking on the new Ethernet I/O Master entry will pop up this dialog.



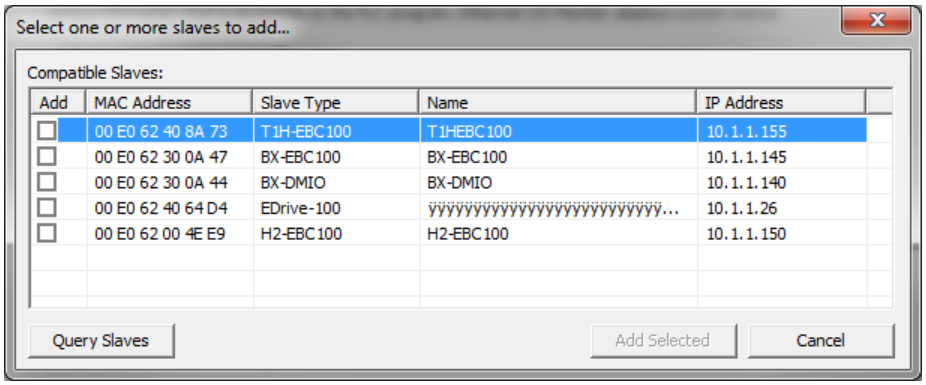
You are now ready to begin adding your slave devices to the Ethernet I/O Master.

If you have not setup IP addresses for your slave devices, now is the time to do so using the "Setup Slave Ethernet Port(s)" button.

If you have IP addresses assigned to your slave devices, select either "Add Multiple Slaves" or "Add a Single Slave".

CPU Configuration, continued

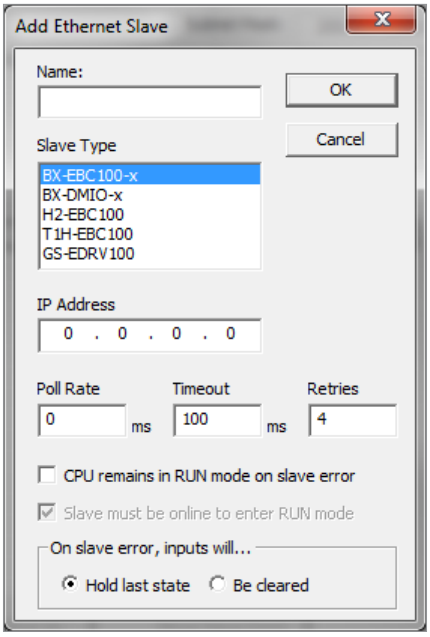
Add multiple Slaves will bring up the following dialog.



Assuming that your PC is on the same network as your slaves, you should see the slaves listed as above.

Pick the slaves that you wish to be attached to the Ethernet I/O Master by checking the box in the "Add" column and press "Add Selected".

To add a single slave, you must know the IP address.



The first three items uniquely identify the Slave on the network, and describe the communication requirements.

Name specifies the name of the slave (any combination of alphanumeric and punctuation characters up to 255 characters), the **Slave Type** selects the type of device from the list (BX-DMIO-x, BX-EBC100-x, H2-EBC100, T1H-EBC100, or GS-EDRV100), and the **IP Address** specifies the TCP/IP address of the slave device.

CPU Configuration, continued

The next three items describe the communication requirements. All of the Slaves have an Ethernet Watchdog Timer that gets set when the Ethernet I/O Master initializes the Slave. The value of this timer is computed from the **Poll Rate**, **Timeout** and **Retries** settings for the Slave using the following formula:

Ethernet Watchdog Timer = Poll Rate + (Timeout * (Retries +1))

If the Ethernet communication between the Ethernet I/O Master and this Slave is ever interrupted longer than the timer value the Slave will turn OFF all of the discrete outputs and set all of the analog output values to 0.

Poll Rate specifies the frequency (in milliseconds) at which the Ethernet I/O Master will read and write to the I/O modules in this slave device. This can be any value between 0 and 32767. The default value of 0 means as "often as possible".

Timeout specifies the amount of time (in milliseconds) the Ethernet I/O Master will wait on a response from a read or write operation before it retries that operation. This can be any value between 25 and 32767.

Retries specifies the number of times the Ethernet I/O Master will retry a read or write operation before it cancels that operation and returns an error. This can be any value between 25 and 32767.

The last three options specify what actions the Ethernet I/O Master will take when it encounters an error from this I/O Slave:

CPU remains in RUN mode on slave error selects what action to take if the CPU is in RUN mode and this I/O Slave reports an error:

If **checked** the CPU will remain in RUN mode.

If **unchecked (default)** the CPU will drop into PROGRAM mode.

The **Slave must be online to enter RUN mode** specifies whether or not the CPU can go to RUN mode based on whether or not this I/O Slave is present on the network.

If **checked (default)** the CPU can only go to RUN mode if this I/O Slave is present on the network.

If **unchecked** the CPU can go to RUN mode even if this I/O Slave is NOT present on the network.

On slave error, inputs will ... selects what action to take with the current image register data for the discrete and analog input modules in this I/O Slave if an error is reported:

If **Hold last state (default)** is selected the image register data for all of the discrete inputs and all of the analog inputs will retain the last values that were received.

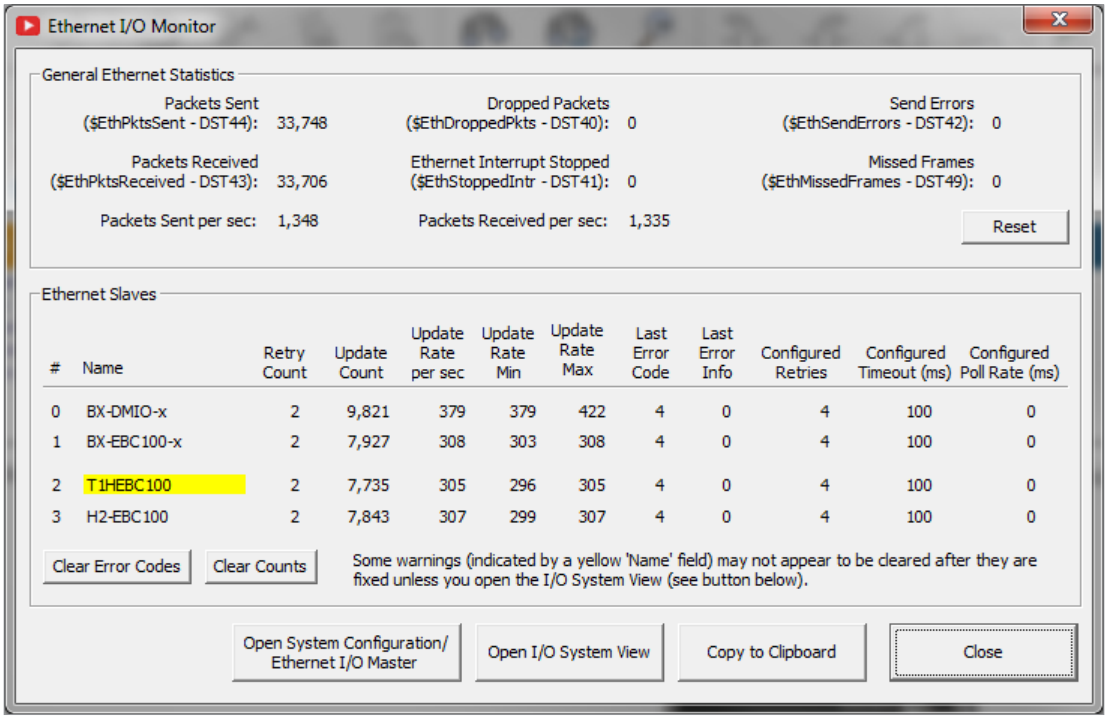
If **Be cleared** is selected the image register data for all discrete inputs will set to OFF, and the image register data for analog inputs will be set to 0.

The last steps are to save the configuration and download the program to the PLC.

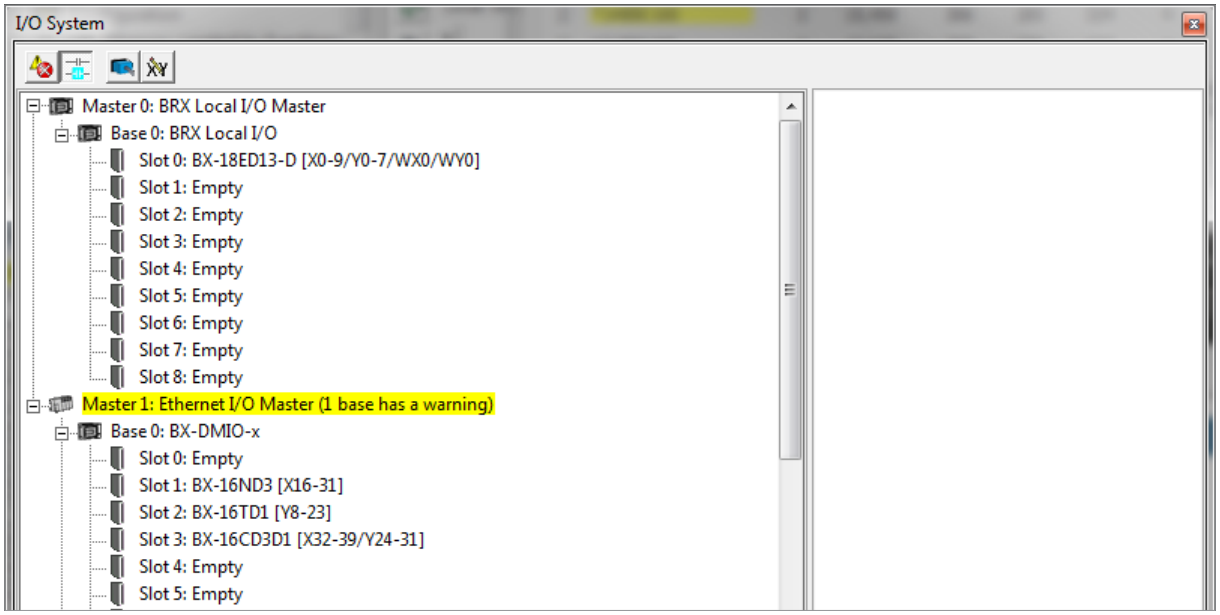
Error Reporting:

The **Ethernet I/O Master** can manage any mix of up to 16 Ethernet I/O Slaves. The $EthIOMaster contains member fields that report the configuration status for each of the Slaves and report errors and warnings for each slot that contains an I/O module. The Ethernet I/O Master classifies Errors as any condition that will prevent the CPU from going to RUN mode; Warnings are conditions that allow the CPU to go RUN mode but an I/O module is reporting an issue that may require user intervention to resolve.

The Ethernet I/O Monitor is another utility that shows the current "health" of the Ethernet I/O Master and its configured Ethernet I/O Slaves.

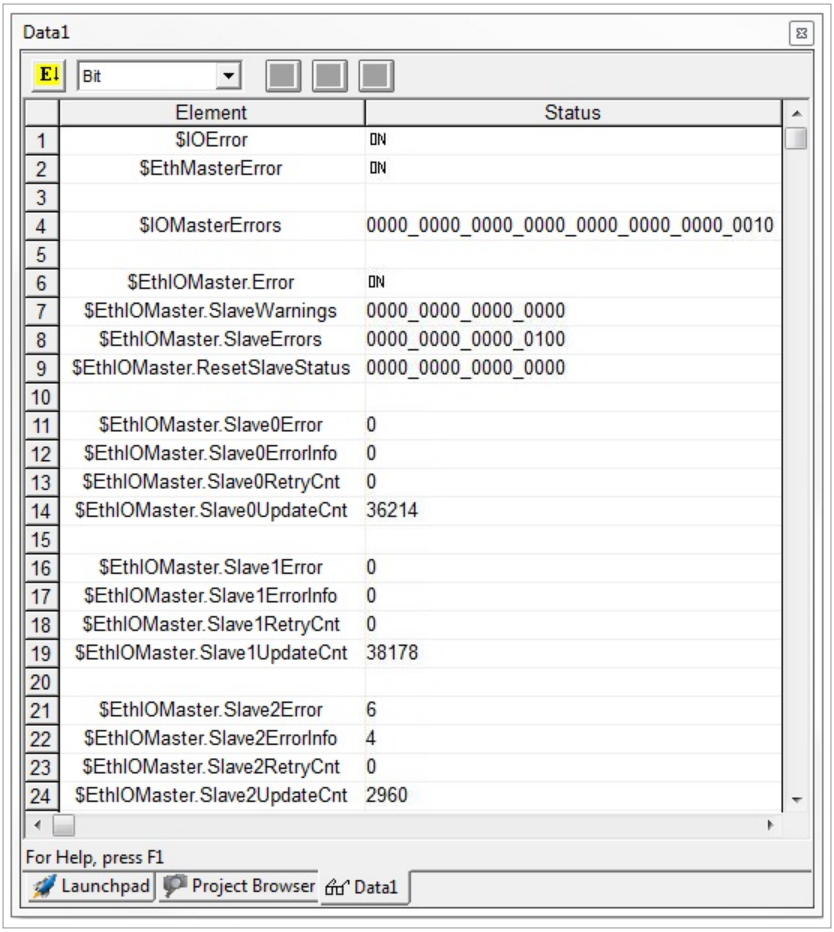


The I/O System View will display all of the current Error and Warning information for all of the I/O modules in all of the Ethernet I/O Slaves.



Error Reporting, continued

The Do-more! CPU has several built-in Bit and Word locations that can be utilized at runtime to detect Errors and Warnings in the Ethernet I/O subsystem. Refer to the following Data View to see the progression of error reporting that can be utilized in the ladder logic project:



	Element	Status
1	$IOError	ON
2	$EthMasterError	ON
3		
4	$IOMasterErrors	0000_0000_0000_0000_0000_0000_0000_0010
5		
6	$EthIOMaster.Error	ON
7	$EthIOMaster.SlaveWarnings	0000_0000_0000_0000
8	$EthIOMaster.SlaveErrors	0000_0000_0000_0100
9	$EthIOMaster.ResetSlaveStatus	0000_0000_0000_0000
10		
11	$EthIOMaster.Slave0Error	0
12	$EthIOMaster.Slave0ErrorInfo	0
13	$EthIOMaster.Slave0RetryCnt	0
14	$EthIOMaster.Slave0UpdateCnt	36214
15		
16	$EthIOMaster.Slave1Error	0
17	$EthIOMaster.Slave1ErrorInfo	0
18	$EthIOMaster.Slave1RetryCnt	0
19	$EthIOMaster.Slave1UpdateCnt	38178
20		
21	$EthIOMaster.Slave2Error	6
22	$EthIOMaster.Slave2ErrorInfo	4
23	$EthIOMaster.Slave2RetryCnt	0
24	$EthIOMaster.Slave2UpdateCnt	2960

In this example, you can see that there is an I/O Error (***$IOError*** is ON).

The I/O Master that is reporting the error is Ethernet I/O Master (bit 1 of ***IOMasterErrors*** is ON).

The Ethernet I/O Slave that is causing the Error (Slave #2) is indicated in the ***$EthIOMaster.SlaveErrors*** structure member. With the .SlaveErrors structure member viewed in a Binary form, each Bit represents one of the 16 possible I/O Slaves, the lowest order Bit being Slave 0, the highest order Bit being Slave 15.

For each of the 16 potential I/O Slaves, there are two structure members that contain an error code that explains the problem and the slot number of the I/O module that is involved. The structure members are named ***.Slave0Error*** & ***.Slave0ErrorInfo*** through ***.Slave15Error*** & ***.Slave15ErrorInfo***. In the example above, Slave #2 is reporting an error code 6 (I/O Mismatch) in Slot #4.

Error Reporting, continued

The following table lists the range of potential Error codes that can appear in the ***.Slave0Error*** through ***.Slave15Error*** fields:

Ethernet I/O Slave Error Codes		
Error Code	**Error**	**Description**
1	MODULE NOT RESPONDING	One or more of the I/O modules in the stored configuration is not detected in the base. Only applicable when the I/O Slave is a T1H-EBC100.
2	BASE CHANGED	A new I/O module is detected in the base that is not in the stored configuration. Only applicable when the I/O Slave is a T1H-EBC100.
3	SIGNATURE ERROR	The stored Link Monitor value does not match the Link Monitor value being returned by the I/O Slave—this can happen if the I/O Slave was power-cycled, or if the Slave's Link Monitor was reconfigured by a different master.
4	TIMEOUT	The I/O Slave did not respond within the allotted amount of time (Timeout x Retrys).
5	DEVICE MISMATCH	The I/O Slave that responded to a request was not the type of device (BX-DMIO, BX-EBC100, H2-EBC100, T1H-EBC100, or GS-EDRV100) that was expected. This can happen if the IP Address specified for the slave has been reassigned to a different type of slave.
6	I/O MISMATCH	I/O count of a module detected does not match the I/O count stored in the configuration. The corresponding .SlaveXErrorInfo member contains the slot number of the I/O module reporting the error.
7	MODULE CONFIG ERROR	An I/O module that requires a Module configuration did not have its configuration data correctly downloaded. The corresponding .SlaveXErrorInfo member contains the slot number of the I/O module reporting the error.

Clearing Ethernet I/O Slave Errors and Warnings

If any of the Ethernet I/O Slaves reports an I/O Warning, like a "broken transmitter" or "drive tripped" the remote slave will retain that warning until it is manually cleared. It does this to make sure that all of error and warning conditions that occur at any slave—specifically any intermittent ones—will be reported to the Ethernet I/O Master. So, after the problem that is causing the Error or Warning condition is resolved, there are two methods available to manually clear the retained status data from the Ethernet I/O system:

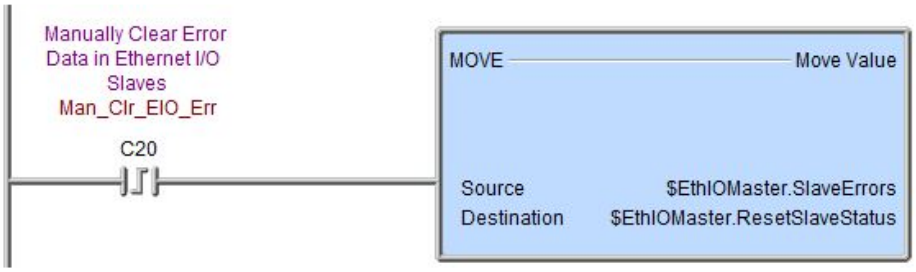
Using Do-more! Designer: opening the I/O System View will reset the Error and Warning information in each slave device when it polls each slave device for its Error and Warning data.

Runtime in Ladder Logic: in Do-more! version 2.0 and later, the ***$EthIOMaster*** structure has a 16-Bit field named ***.ResetSlaveStatus***. Each slave device is mapped to a bit in that 16-Bit register as follows: Bit 0 = Slave 0, Bit 1 = Slave 1, ... Bit 15 = Slave 15. Setting a Bit to a value of 1 will cause the Ethernet I/O Master to clear the retained Error and Warning data in the corresponding slave device and then set that Bit back to 0.

The preferred method for doing this at runtime is to perform a one-time copy of the contents of ***$EthIOMaster.SlaveErrors*** to ***$EthIOMaster.ResetSlaveStatus***.

This will cause the Ethernet I/O Master to issue the reset command to each slave device that is currently showing an error. Each slave device that no longer has any error or warning data will leave its corresponding bit in ***$EthIOMaster.SlaveErrors*** at 0. Any slave device that still has Error or Warning data will have its corresponding bit in ***$EthIOMaster.SlaveErrors*** set back to 1.

Clearing Ethernet I/O Slave Errors and Warnings, continued



Ethernet I/O Master Startup and Shutdown Sequences

Once the Ethernet Master I/O configuration has been set the Do-more! CPU will perform the following sequences depending on the starting condition. Again, it is important to understand that the CPU places the same importance on the Ethernet Master I/O that it does on the Local I/O Master. The Ethernet I/O Master configuration must remain consistent for the CPU to operate normally.

Power ON Initialization Sequence is executed each time the CPU is powered ON.

- Query Network to make sure the currently configured Slaves are present on the network.
  - If all Slaves are present, each Slave is then queried to make sure that the I/O modules that are currently found in each Slave match the I/O modules that are in the stored configuration.
    - If all of the I/O modules match the current configuration, the Ethernet I/O Master will download the module configuration for all of the I/O modules that have one, for example, the CTRIO module.

      The ERR LED (BX-DM1E, H2-DM1E) or STAT LED (T1H-DM1E) will be rapidly blinking RED while the module configurations are being downloaded.

      - If all of the module configurations are downloaded successfully the initialization process is complete.

        A unique value (called the Link Monitor) is written to each Ethernet I/O Slave. This unique Link Monitor value is included as part of each data packet between the Ethernet I/O Master and its Ethernet I/O Slaves. This allows the Ethernet I/O Master to verify that each response packet is from one of its own Ethernet I/O Slaves, and each Ethernet I/O Slave can know that each data packet it receives is from its own Ethernet I/O Master.

        At this point the Ethernet I/O Master will begin normal updates for the I/O modules in all of its Ethernet I/O Slaves as described in the section below.

      - If any of the Module configurations fail to download, the CPU will NOT go into RUN mode until the problem is resolved.

        The ERR LED (BX-DM1E, H2-DM1E) or STAT LED (T1H-DM1E) will be solid RED.

        The system Bit ***$IOError (ST152)*** - "One or more I/O Master are reporting a problem with a module" will be ON. The error message can be seen on the System Status tab of the System Info utility.

        The corresponding Bit for each Slave that is reporting a module error will be ON in the system structure member ***$EthIOMaster.SlaveError***.

Ethernet I/O Master Startup and Shutdown Sequences, continued

The appropriate structure member (***$EthIOMaster.Slave0ErrorInfo*** - ***$EthIOMaster.Slave7ErrorInfo***) will contain the number of the first slot that has an I/O module that failed to download its Module configuration.

– If one or more of the I/O modules is different than what is in the configuration (this could be a module that is missing or a module that is a different type), the CPU will NOT go into RUN mode until the problem is resolved.

The ERR LED (BX-DM1E, H2-DM1E) or STAT LED (T1H-DM1E) will be solid RED.

The system Bit ***$IOError (ST152)*** - "One or more Ethernet I/O Masters are reporting a problem with a module" will be ON. The error message can be seen on the System Status tab of the System Info utility.

The corresponding Bit for each Ethernet I/O Slave that is reporting a module error will be ON in the system structure member ***$EthIOMaster.SlaveError***.

The appropriate structure member (***$EthIOMaster.Slave0ErrorInfo*** - ***$EthIOMaster.Slave7ErrorInfo***) will contain the number of the first slot that has an I/O module that is different than the configuration.

– If one or more of the Ethernet I/O Slave devices (that are configured as required to be present on the network) are NOT present on the network, the CPU will NOT go into RUN mode until the problems is resolved.

The ERR LED (BX-DM1E, H2-DM1E) or STAT LED (T1H-DM1E) will be solid RED.

The system Bit ***$IOError (ST152)*** - "One or more Ethernet I/O Masters are reporting a problem with a module" will be ON.

The system Bit ***$EthMasterError (ST153)*** - "The Ethernet I/O Master is reporting an error, most likely a slave is offline" will be ON. These error messages can be seen on the System Status tab of the System Info utility.

The corresponding Bit for each Ethernet I/O Slave that is NOT present will be ON in the system structure member ***$EthIOMaster.SlaveErrors***.

The Ethernet I/O Master will continue to query the network for missing Ethernet I/O Slaves at 10 second intervals. If one of the missing Ethernet I/O Slaves appears on the network, it will be initialized as described above.

After all of the missing Ethernet I/O Slaves are located the remainder of the initialization process will run, if that process completes successfully the ERR LED (BX-DM1E, H2-DM1E) or STAT LED (T1H-DM1E) will go OFF and the CPU can then be manually put into to RUN mode.

PROGRAM mode to RUN mode Sequence is executed each time the CPU transitions from PROGRAM mode to RUN mode. The process is very similar to the power-on sequence but there are a couple of notable exceptions that are described below. The resolution to any problems is the same as described in the power-on sequence.

- Query Network to make sure the currently configured Ethernet I/O Slaves are still present on the network.

Ethernet I/O Master Startup and Shutdown Sequences, continued

- If all Ethernet I/O Slaves are present, each one is then queried to make sure that the I/O modules that are currently found match the I/O modules that are in the stored configuration.
  - If all of the I/O modules match the stored configuration the Ethernet I/O Master will initialize the image register locations with the Module configuration data for any that require it, for example: the Terminator I/O analog output modules, and the F2-8AD4DA-x modules. The Module configurations for all I/O modules are NOT downloaded again, only image register locations that need to be initialized with Module configuration data get processed.
    - After all of the initialization is complete the Ethernet I/O Master will begin normal updates for the I/O modules in its Ethernet I/O Slaves as described in the next subsection.
  - If one or more of the I/O modules is different than what is in the configuration (this could be a module that is missing or a module that is a different type), the CPU will NOT go into RUN mode until the problems is resolved.

- If one or more of the configured Ethernet I/O Slaves are NOT present on the network, the CPU will NOT go into RUN mode until the problems is resolved.

RUN mode to PROGRAM mode is executed each time the CPU transitions from RUN mode to PROGRAM mode.

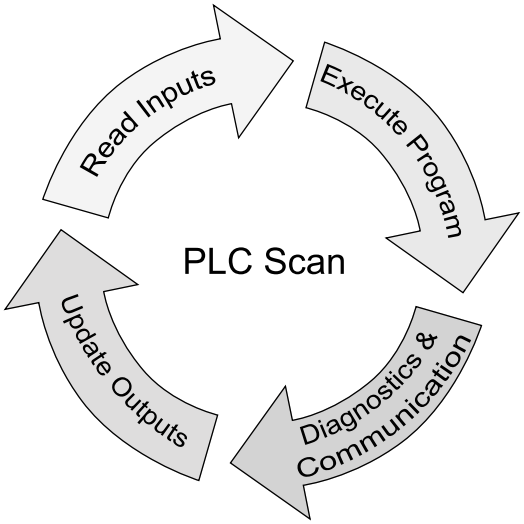
- All of the discrete outputs are turned OFF and a value of 0 is written to all of the channels of the analog output modules.

Ethernet Master I/O Update Cycle

Once it has been enabled and its Ethernet I/O Slaves configured, the CPU allows the Ethernet I/O Master to run during the Diagnostics and Communication slice of each scan. Each time the Ethernet I/O Master function is allowed to run it will update all of the configured Ethernet I/O Slaves.

When the CPU is in **PROGRAM mode**, only status data from the input modules in each Ethernet I/O Slave is read. That data is then used to update the Do-more's local copy in the image register. Any I/O modules that have structures instead of I/O, the structures will be read and the image register will be updated with that data. This allows both the input modules from Ethernet I/O Slaves and input modules in the local base to continue to update in PROGRAM mode.

When the CPU is in **RUN mode**, data for each output module is sent to the appropriate Ethernet I/O Slave, and for I/O modules that have structures instead of I/O, the I/O modules will be updated with data from their structures. The status data from the input modules in each Ethernet I/O Slave is read. Any I/O modules that have structures instead of I/O, the structures will be read and the image register will be updated with that data. The data from the input modules is then used to update the Do-more's local copy in the image register.

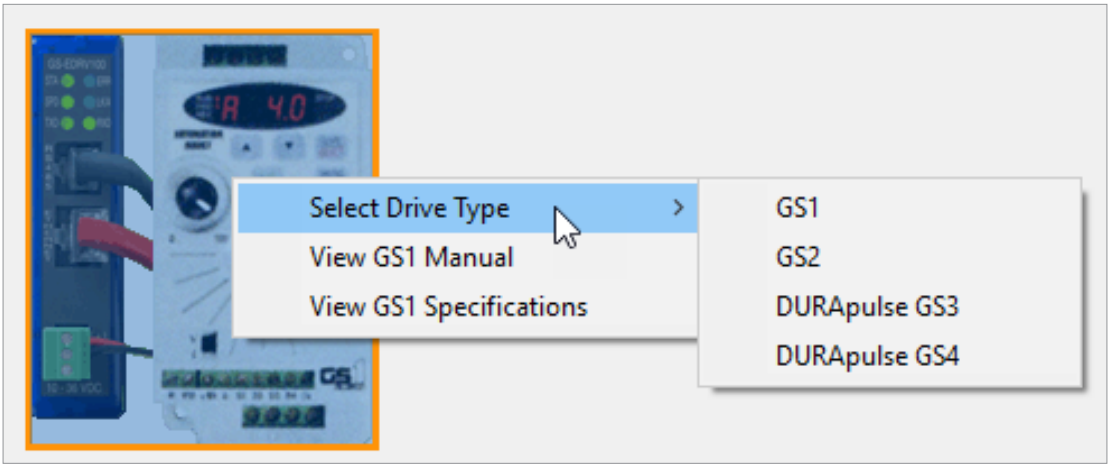


GS-EDRV100

The GS-EDRV100 is an Ethernet remote I/O slave device that allows an easy and convenient way to add an AutomationDirect GS1, GS2, GS3 or GS4 AC variable frequency drive to a Do-more! Ethernet Remote I/O or Host Ethernet Remote I/O network. This allows any Do-more! PLC (with a built-in Ethernet port), DL205 PLC or DL405 PLC (using the ERM100) to control any GS series drive as an Ethernet remote I/O drop.

GS-EDRV100 Setup

The process for adding a GS-EDRV100 is the same as adding any other remote I/O device. The only difference is that once you have the device added, you must go to the device in the I/O configuration section of the System Configuration and tell it which drive type you have (GS1, GS2, DURAPulse GS3 or DURAPulse GS4).



GS-EDRV100 Setup, continued

Once the drive is configured, you will have access to two instructions as well as a group of structure members. The structure members are as follows:

GSEDRV100 Structure Members			
Member	**Read/ Write[1]**	**Type[2]**	**Meaning**
$GS1_000.RunCommand	W	UW	Set value to 0 to STOP, set value 1 to RUN (P9.27)
$GS1_000.Direction	W	B	Set ON for FORWARD, turn this Bit OFF for REVERSE (P9.28)
$GS1_000.RS485SpeedRef	W	B	Set the motor speed (P9.26)
$GS1_000.OutputCurrent	R	UW	Shows the present Output Current
$GS1_000.OutputFrequency	R	UW	Shows the present Output Frequency
$GS1_000.StatusMonitor1	R	UW	Shows the present Status Monitor 1 (h2100) value
$GS1_000.StatusMonitor2	R	UW	Shows the present Status Monitor 2 (h2101) value
$GS1_000.ResetCommFault	W	B	Set ON to RESET FAULT, turn the Bit OFF for no action
$GS1_000.ExtCommFault	R	B	ON if the AC Drive's Serial Comm Fault bit (P9.29) is ON
$GS1_000.IntCommFault	R	B	ON if the GS-EDRV100's Serial cable to the GS Drive is disconnected or not functioning
$GS1_000.BlockParm1	W	UW	Block Transfer Parameter 1 - User defined write value (P9.11)
$GS1_000.BlockParm2	W	UW	Block Transfer Parameter 2 - User defined write value (P9.12)
$GS1_000.BlockParm3	W	UW	Block Transfer Parameter 3 - User defined write value (P9.13)
$GS1_000.BlockParm4	W	UW	Block Transfer Parameter 4 - User defined write value (P9.14)
$GS1_000.BlockParm5	W	UW	Block Transfer Parameter 5 - User defined write value (P9.15)
$GS1_000.BlockParm6	R	UW	Block Transfer Parameter 6 - User defined write value (P9.16)
$GS1_000.BlockParm7	R	UW	Block Transfer Parameter 7 - User defined write value (P9.17)
$GS1_000.BlockParm8	R	UW	Block Transfer Parameter 8 - User defined write value (P9.18)
$GS1_000.BlockParm9	R	UW	Block Transfer Parameter 9 - User defined write value (P9.19)
$GS1_000.BlockParm10	R	UW	Block Transfer Parameter 10 - User defined write value (P9.20)
$GS1_000.BlockParm11	R	UW	Block Transfer Parameter 11 - User defined write value (P9.21)
$GS1_000.BlockParm12	R	UW	Block Transfer Parameter 12 - User defined write value (P9.22)
$GS1_000.BlockParm13	R	UW	Block Transfer Parameter 13 - User defined write value (P9.23)
$GS1_000.BlockParm14	R	UW	Block Transfer Parameter 14 - User defined write value (P9.24)
$GS1_000.BlockParm15	R	UW	Block Transfer Parameter 15 - User defined write value (P9.25)

1. *R = Read Only, W = Read/Write*
2. *B = Boolean (Bit), UW = Unsigned 16-bit Integer*



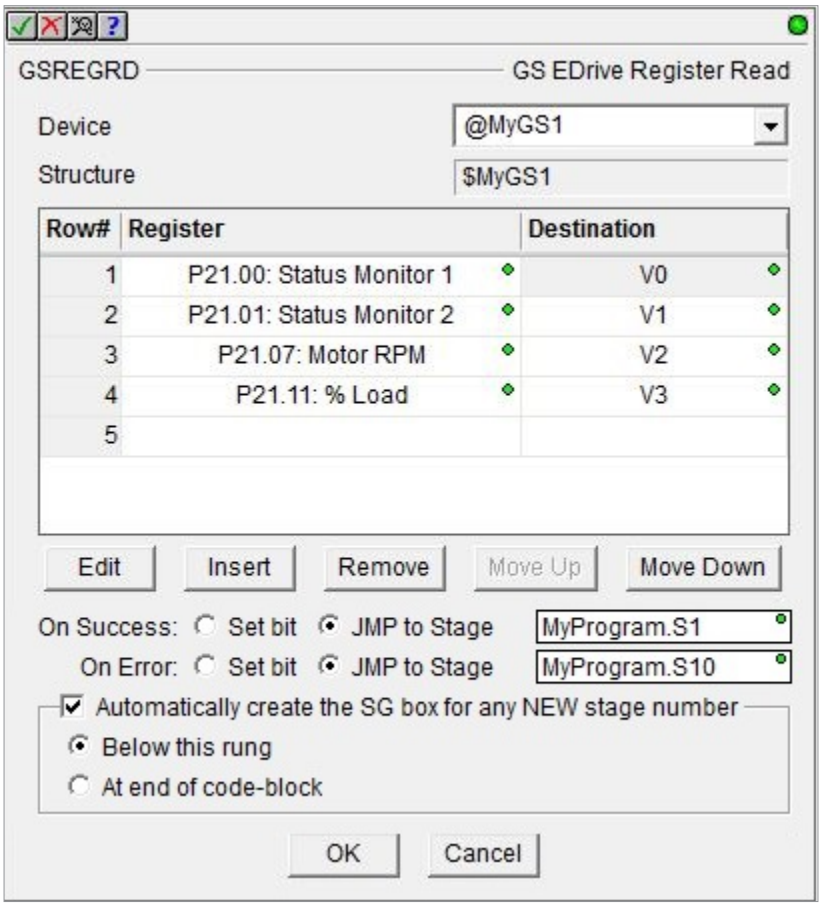
NOTE: *GS4 drive users. The GS4 drives support up to Block Transfer #16. The Do-more! Designer heap-item structure supports up to Block Transfer #15. If the additional block transfer is needed, use the GSREGWR instruction, which allows the writing of all 16 Block Transfers at once (instead of using Do-more!'s heap-item structure). To read the value associated with Block Transfer #16, use the GSREGRD instruction.*

GSREGRD – GS EDrive Register Read

The GS EDrive Register Read (GSREGRD) instruction is used to perform a series of read operations from parameter values in a GS Series AC Drive which is connected to a GS-EDRV100. The instruction can contain up to 50 individual READ operations which are performed in the order that they are listed in the instruction. If all of the listed READ operations were completed successfully the On Success selection will be executed. Processing of the listed READ operations will stop after the first failure and the On Error condition will be executed.

GSREGRD – GS EDrive Register Read, continued

This instruction can only be performed by the Ethernet I/O Master through a GS-EDRV100 which is connected to the GS Drive's serial port. When the Ethernet I/O Master is connected to a GS-EDRV100, it automatically reads a fixed set of parameters from the drive and places the data in the member fields of a GS Drive structure. This instruction is used to read values to parameter locations that are NOT already being read by that process. Parameter locations that are already being read from the GS Drive structure will still be displayed in the row editor with the name of the GS Drive structure, but they cannot be selected for use in this instruction.



Parameters:



NOTE: *Use the **F9** key to open the Default Element Selection Tool (the Element Picker or the Element Browser) or use the **Down-Arrow** key (Auto-Complete) on any parameter field to see a complete list of the memory locations that are valid for that parameter of the instruction.*

Device - selects which of the configured GS-EDRV100 devices to use.

Create module - indicates that there are no GS-EDRV100 devices configured to perform this instruction. Selecting this option will open the Module Configuration section of the System Configuration utility where a GS-EDRV100 device can be created.

Structure - displays the name of the system-created structure for the selected GS-EDRV100.

The center section displays the table of individual write operations that will be performed each time this instruction is executed. The buttons below the table are used to manage the rows in the table:

Edit - opens the row editor to change the currently selected row.

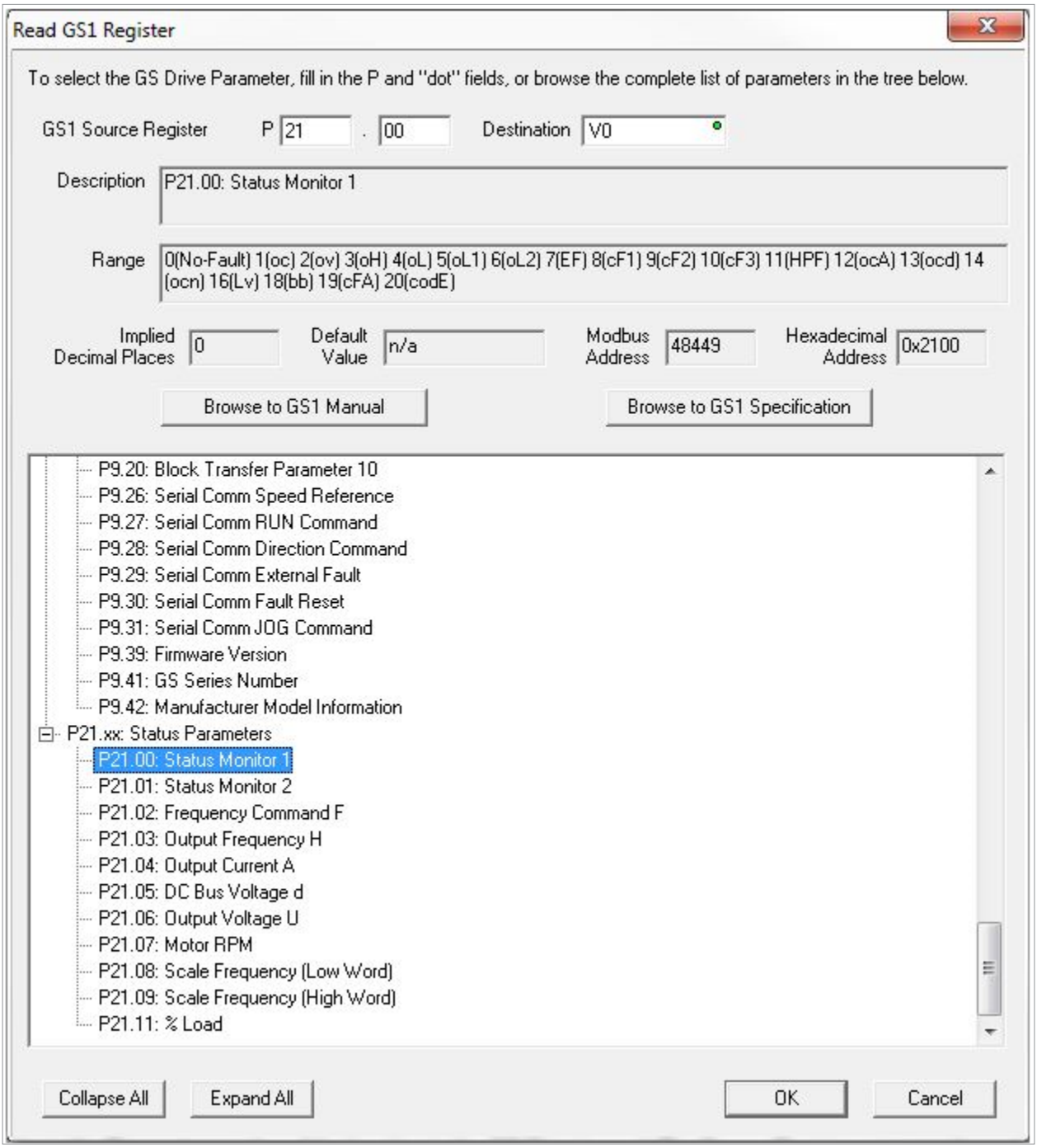
GSREGRD – GS EDrive Register Read, continued

Insert - inserts an empty row before the currently selected row and opens the row editor .

Remove - removes the currently selected row.

Move Up / Move Down - moves the currently selected row up one row or down one row in the table respectively.

The row editor is used to add a new entry to the table, or modify an existing entry in the table. To open the row editor, double-click on the row, or highlight a row then click the **Edit** or **Insert** button.



Source Register - this is the Parameter number of the location in the GS Drive to read. The Source Register can be selected by entering the P XX.yy values in the two locations in the upper section, or by selecting one of the entries from the tree-control in the lower section.

GSREGRD – GS EDrive Register Read, continued

Destination - specifies the location to store the value read from the GS Drive.

The **Description**, **Range**, **Implied Decimal Places**, **Default Value**, **Modbus Address**, and **Hexadecimal Addresss** fields will display the appropriate information as the Source Register data is changed.

The **Browse to GSx Manual** and **Browse to GSx Specification** buttons will open the default web browser, which will then open a page on Automationdirect's web site that contains links to the User Manual or the Specification page for the type of GS Drive configured. These two options require a functional connection to the Internet and a PDF viewer.

The **Collapse All** button will collapse the Parameter Range lists so that only the Parameter Ranges are shown.

The **Expand All** button will fully expand all of the Parameter Ranges lists so that each selection in each Range is shown.

The **On Success** and **On Error** parameters specify what action to perform when this instruction completes. You do not have to use the same type of selection for both **On Success** and **On Error**.

If the **Set Bit** selection is used for either **On Success** or **On Error**, the specified BIT location will be SET OFF when the instruction is first enabled and will remain OFF until the instruction completes. Once complete, the appropriate Success or Error bit location will be set ON. The specified Bit location is enabled with a SET (Latch) operation meaning that it will remain ON even if the input logic for the instruction goes OFF.

If the **JMP to Stage** selection is used for either **On Success** or **On Error** the target Stage must be in the same Program code-block as this instruction. You cannot specify a target Stage that exists in a different Program code-block. When the operation finishes, the target Stage will be enabled the same way that a standalone Jump to Stage (JMP) instruction would do it. The JMP to Stage option will only be available if this instruction is placed in a Program code-block.

On Success - selects which of the following actions to perform if the operation is successful:

SET Bit - enable this selection then specify any writable bit location.

JMP to Stage - enable this selection then specify any Stage number from S0 to S127 in the current Program code-block.

On Error - selects which of the following actions to perform if the Close Device operation is unsuccessful:

SET Bit - enable this selection then specify any writable bit location.

JMP to Stage - enable this selection then specify any Stage number from S0 to S127 in the current Program code-block.

Automatically create the SG box for any NEW stage number - if either the On Success or On Error selections are set to JMP to Stage, this option will be enabled which will automatically create any target stage that does not already exist.

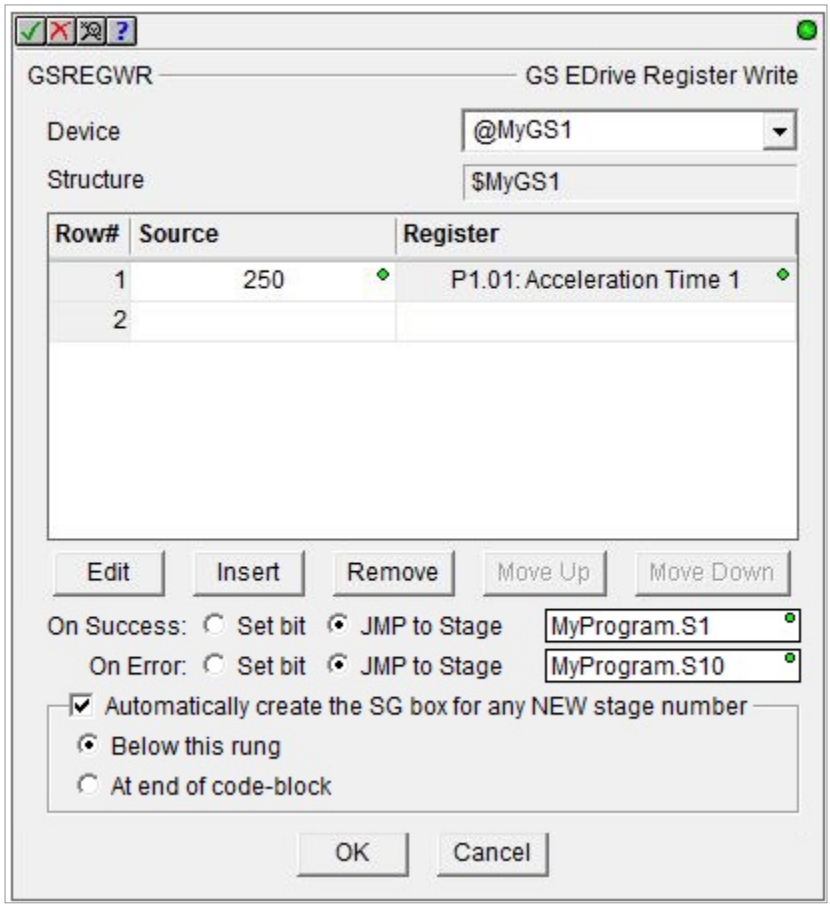
Below this rung - the new target stage will be created on a new rung following this instruction.

At end of code-block - the new target stage will be created as the last rung of this Program.

GSREGWR – GS EDrive Register Write

The GS EDrive Register Write (GSREGWR) instruction is used to perform a series of write operations to parameter values in a GS Series AC Drive which is connected to a GS-EDRV100. The instruction can contain up to 50 individual WRITE operations which are performed in the order that they are listed in the instruction. If all of the listed WRITE operations were completed successfully, the On Success selection will be executed. Processing of the listed WRITE operations will stop after the first failure and the On Error condition will be executed.

This instruction can only be performed by the Ethernet I/O Master through a GS-EDRV100 which is connected to the GS Drive's serial port. When the Ethernet I/O Master is connected to a GS-EDRV100, it automatically writes a fixed set of parameters from the member fields of a GS Drive structure. This instruction is used to write values to parameter locations that are NOT already being written by that process. Parameter locations that are already being written from the GS Drive structure will still be displayed in the row editor with the name of the GS Drive structure, but they cannot be selected for use in this instruction.



Parameters:

NOTE: *Use the **F9** key to open the Default Element Selection Tool (the Element Picker or the Element Browser) or use the **Down-Arrow** key (Auto-Complete) on any parameter field to see a complete list of the memory locations that are valid for that parameter of the instruction.*

Device - selects which of the configured GS-EDRV100 device to use.

GSREGWR – GS EDrive Register Write, continued

Create module - indicates that there are no GS-EDRV100 devices configured to perform this instruction, selecting this option will open the Module Configuration section of the System Configuration utility where a GS-EDRV100 device can be created.

Structure - displays the name of the system-created structure for the selected GS-EDRV100.

The center section displays the table of individual write operations that will be performed each time this instruction is executed. The buttons below the table are used to manage the rows in the table:

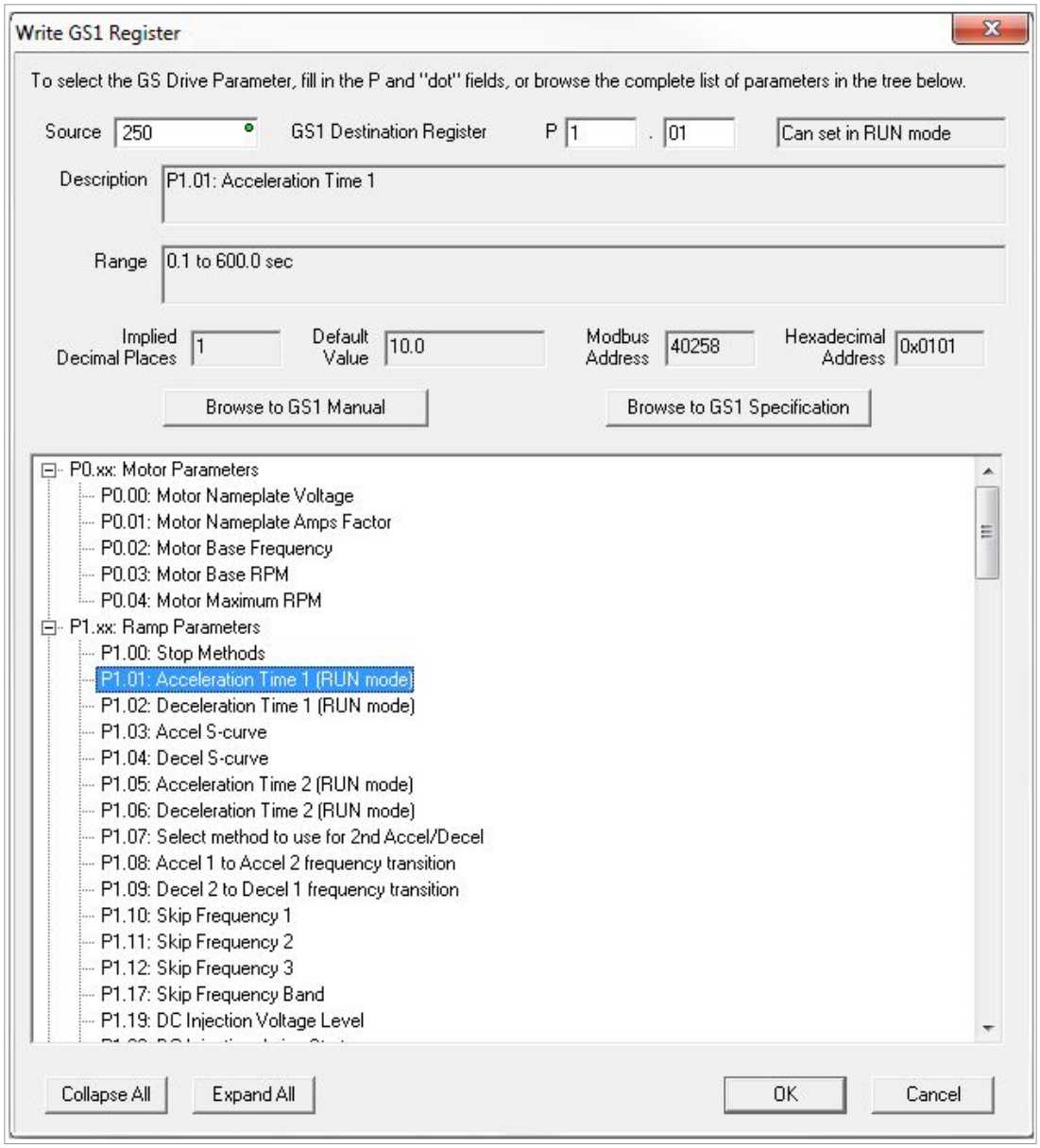
Edit - opens the row editor to change the currently selected row.

Insert - inserts an empty row before the currently selected row and opens the row editor.

Remove - removes the currently selected row.

Move Up / Move Down - moves the currently selected row up one row or down one row in the table respectively.

The row editor is used to add a new entry to the table, or modify an existing entry in the table. To open the row editor, double-click on the row, or highlight a row then click the Edit or Insert button.



GSREGWR – GS EDrive Register Write, continued

Source - specifies the location or constant value that contains the value to write to the GS Drive.

Destination Register - this is the Parameter number of the location in the GS Drive to which the Destination value will be written. The Destination Register can be selected by entering the P XX.yy values in the two location in the upper section, or by selecting one of the entries from the tree-control in the lower section.

The **Description**, **Range**, **Implied Decimal Places**, **Default Value**, **Modbus Address**, and **Hexadecimal Address** fields will display the appropriate information as the Source Register data is changed.

The **Browse to GSx Manual** and **Browse to GSx Specification** buttons will open the default web browser, which will then open a page on Automationdirect's web site that contains links to the User Manual or the Specification page for the type of GS Drive configured. These two options require a functional connection to the Internet and a PDF viewer.

The **Collapse All** button will collapse the Parameter Range lists so that only the Parameter Ranges are shown.

The **Expand All** button will fully expand all of the Parameter Ranges lists so that each selection in each Range is shown.

If all of the listed WRITE operations were completed successfully the On Success selection will be executed. Processing of the listed WRITE operations will stop after the first failure and the On Error condition will be executed.

The **On Success** and **On Error** parameters specify what action to perform when this instruction completes. You do not have to use the same type of selection for both **On Success** and **On Error**.

If the **Set Bit** selection is used for either **On Success** or **On Error**, the specified BIT location will be SET OFF when the instruction is first enabled and will remain OFF until the instruction completes. Once complete, the appropriate Success or Error bit location will be set ON. The specified Bit location is enabled with a SET (Latch) operation meaning that it will remain ON even if the input logic for the instruction goes OFF.

If the **JMP to Stage** selection is used for either **On Success** or **On Error** the target Stage must be in the same Program code-block as this instruction. You cannot specify a target Stage that exists in a different Program code-block. When the operation finishes, the target Stage will be enabled the same way that a standalone Jump to Stage (JMP) instruction would do it. The JMP to Stage option will only be available if this instruction is placed in a Program code-block.

On Success - selects which of the following actions to perform if the operation is successful:

SET Bit - enable this selection then specify any writable bit location.

JMP to Stage - enable this selection then specify any Stage number from S0 to S127 in the current Program code-block.

On Error - selects which of the following actions to perform if the Close Device operation is unsuccessful:

SET Bit - enable this selection then specify any writable bit location.

JMP to Stage - enable this selection then specify any Stage number from S0 to S127 in the current Program code-block.

Automatically create the SG box for any NEW stage number - if either the On Success or On Error selections are set to JMP to Stage, this option will be enabled which will automatically create any target stage that does not already exist.

Below this rung - the new target stage will be created on a new rung following this instruction.

At end of code-block - the new target stage will be created as the last rung of this Program.

BX-MBIO Modbus I/O Controller



In This Chapter...

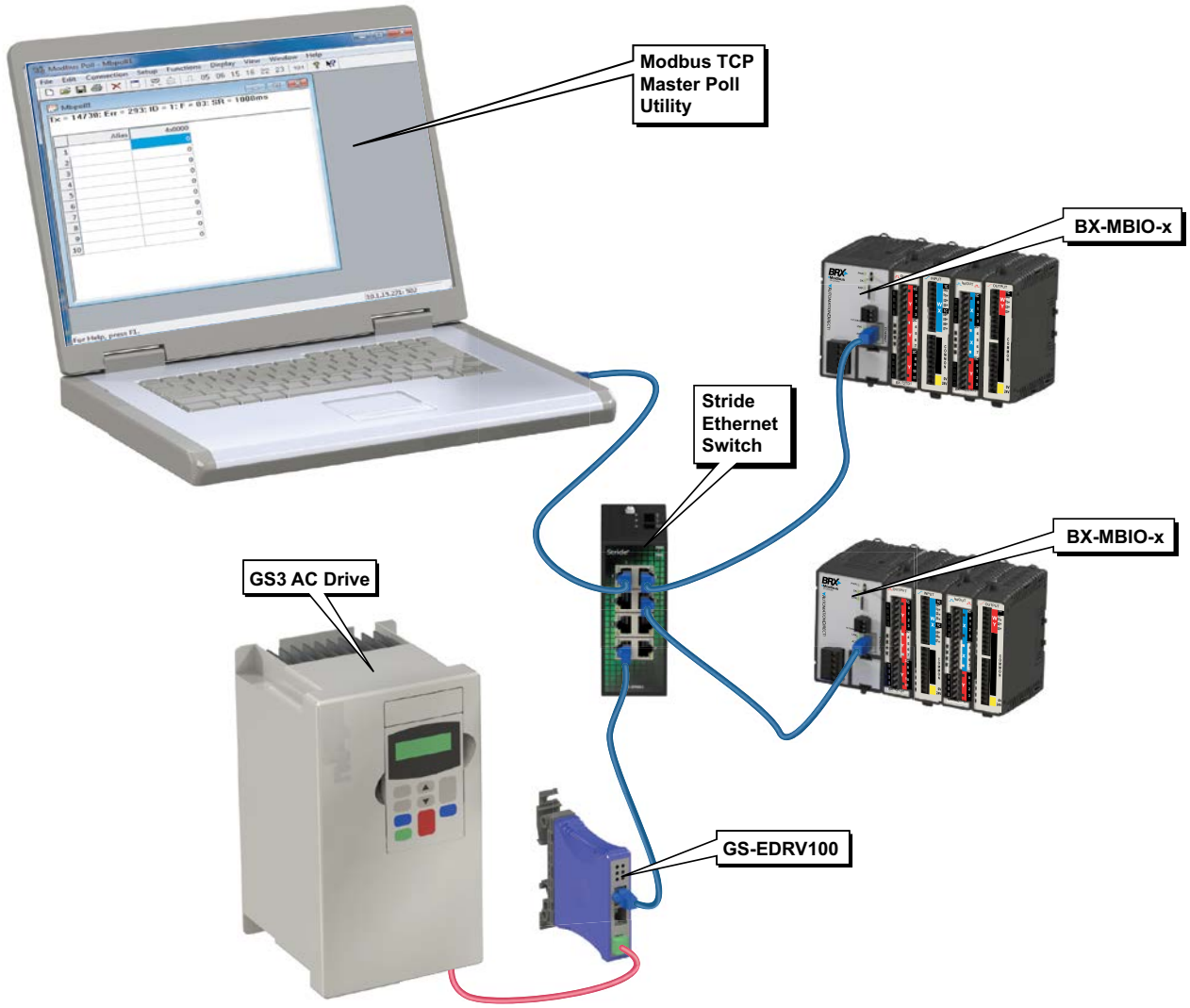
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Overview

The BX-MBIO Modules are remote I/O controller modules that provides a remote I/O drop using the Modbus protocol for communications. They are Modbus RTU slave devices and Modbus TCP servers. They function as listening/replying devices and can connect with any mastering (client) device that communicates using the Modbus protocol.

Modbus RTU is supported over an RS-485 serial connection. Modbus TCP is supported over an Ethernet connection. Any Modbus RTU master and Modbus TCP client that adheres to the Modbus.Org standards, and support the function codes listed in this chapter, can communicate with the BX-MBIO.

The units have no built-in I/O points. The user can customize the I/O to meet the needs of their application by adding as many as eight (8) BRX Expansion Modules, allowing more flexibility while keeping control costs down.



BX-MBIO I/O Controllers

General Specifications

- RJ45 Ethernet port for communications via Modbus TCP
- RS485 serial port for communications via Modbus RTU
- No support for Pluggable Option Module (POM)
- Supports up to 8 additional Expansion Modules
- No built-in discrete or analog I/O
- AC and DC powered units available
- AC powered units include an integral 24VDC auxiliary output power supply
- Power connector and serial port connector included



BX-MBIO-M
Modbus I/O Controller



BX-MBIO-M-D
Modbus I/O Controller

BX-MBIO Controllers			
Part Number	**External Power**	**Expansion Modules**	**Can be Used With**
BX-MBIO-M	120–240 VAC	8	Modbus RTU Modbus TCP
BX-MBIO-M-D	12–24 VDC	8	

General Specifications, continued

General Specifications		
Part Number	**BX-MBIO-M**	**BXC-MBIO-M-D**
Operating Temperature	0° to 60°C (32° to 140°F)	
Storage Temperature	-20° to 85°C (-4° to 185°F)	
Humidity	5 to 95% (non-condensing)	
Environmental Air	No corrosive gases permitted	
Vibration	IEC60068-2-6 (Test Fc)	
Shock	IEC60068-2-27 (Test Ea)	
Enclosure Type	Open Equipment	
Agency Approvals	UL61010-2 - UL File # E185989 Canada and USA CE Compliant EN61131-2	
Noise Immunity	NEMA ICS3-304	
EU Directive	See the "EU Directive" topic in the Help File	
Heat Dissipation	10.8 W Max	8.6 W Max
Weight	198g (7oz)	170g (6oz)
Software Version	NetEdit Version 3.15 or later	

NOTE: *Eight (8) Expansion Modules can be connected to add I/O capability. Only Discrete and Analog Expansion Modules are supported.*

NOTE: *If you are a Do-more! user and are looking to add additional remote I/O you should consider the BX-DMIO or the BX-EBC100 for a lower cost and easier installation and startup. (See Chapter 14 for more detail.) The BX-MBIO Controllers are designed for systems that use Modbus Clients as remote I/O drops.*

Serial Port Connector

BX-MBIO Serial Port Connector Specifications	
Part Number	**BX-RTB03S**
Connector Type	Screw Type-90° (included with unit)
Wire Exit	180 deg
Pitch	3.5 mm
Screw Size	M2
Recommended Screw Torque	< 1.77 lb·in (0.2 N·m)
Screwdriver Blade Width	2.5 mm
Wire Gauge (Single wire)	28-16 AWG
Wire Gauge (Two wires)	28-16 AWG
Wire Strip Length	0.24 in (6mm)
Equiv. Dinkle P/N	EC350V-03P-BK



BX-RTB03S

Power Supply Connector

The power supply terminal block connector is included with each controller. The power supply connector is a screw type, removable terminal block. Replacement connectors and specifications are listed in the tables that follow.

BX-MBIO-M AC Power Supply Connector Specifications			
Part Number	**BX-RTB05 (Included w/Unit)**	**BX-RTB05-1**	**BX-RTB05-2**
Connector Type	Screw Type-90 deg	Spring Clamp Type-180 deg	Screw Type-180 deg
Wire Exit	180 deg	180 deg	180 deg
Pitch	5.0 mm	5.0 mm	5.0 mm
Screw Size	M2.5	N/A	M2.5
Recommended Screw Torque	< 3.98 lb·in (0.45 N·m)	N/A	< 3.98 lb·in (0.45 N·m)
Screwdriver Blade Width	3.5 mm	3.5 mm	3.5 mm
Wire Gauge (Single wire)	28–12 AWG	28–14 AWG	28–14 AWG
Wire Gauge (Two wire)	28–16 AWG	28–16 AWG (Dual Wire Ferrule Required)	28–16 AWG (Dual Wire Ferrule Required)
Wire Strip Length	0.3 in (7.5 mm)	0.37 in (9.5 mm)	0.37 in (9.5 mm)
Equiv. Dinkle P/N	5ESDV-05P-BK	5ESDSR-05P-BK	5ESDF-05P-BK



BX-RTB05



BX-RTB05-1



BX-RTB05-2

BX-MBIO-M-D DC Power Supply Connector Specifications			
Part Number	**BX-RTB03 (Included w/Unit)**	**BX-RTB03-1**	**BX-RTB03-2**
Connector Type	Screw Type-90 deg	Spring Clamp Type-180 deg	Screw Type-180 deg
Wire Exit	180 deg	180 deg	180 deg
Pitch	5.0 mm	5.0 mm	5.0 mm
Screw Size	M2.5	N/A	M2.5
Recommended Screw Torque	< 3.98 lb·in (0.45 N·m)	N/A	< 3.98 lb·in (0.45 N·m)
Screwdriver Blade Width	3.5 mm	3.5 mm	3.5 mm
Wire Gauge (Single wire)	28–12 AWG	28-14 AWG	28-12 AWG
Wire Gauge (Two wires)	28–16 AWG	28-16 AWG (Dual Wire Ferrule Required)	28-16 AWG
Wire Strip Length	0.3 in (7.5 mm)	0.37 in (9.5 mm)	0.3 in (7.5 mm)
Equiv. Dinkle P/N	5ESDV-03P-BK	5ESDSR-03P-BK	5ESDF-03P



BX-RTB03



BX-RTB03-1



BX-RTB03-2

Power Supply Specifications for BX-MBIO-M

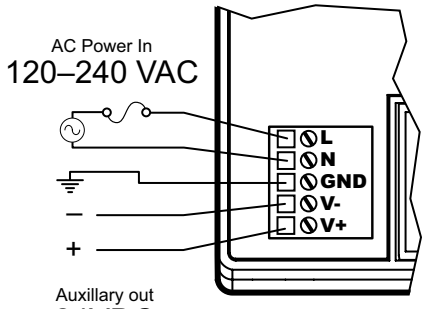
BX-MBIO-M Power Supply Specifications	
Nominal Voltage Range	120–240 VAC
Input Voltage Range (Tolerance)	85–264 VAC
Rated Operating Frequency	47–63 Hz
Maximum Input Power	40VA
Cold Start Inrush Current	1.5 A, 2ms
Maximum Inrush Current (Hot Start)	1.5 A, 2ms
Internal Input Fuse Protection	Micro fuse 250V, 2A Non-replaceable
Acceptable External Power Drop Time	10ms
Under Input Voltage Lock-out	80VAC
Input Transient Protection	Input choke and line filter
Output Protection for Over Current, Over Voltage, and Over Temperature	Self resetting
Auxiliary 24VDC Output	24VDC @ 0.3 A max, <1V P-P Ripple, Integrated self-resetting short circuit protection, Isolated
Voltage Withstand (dielectric)	1500VAC Power Inputs to Ground applied for 1 minute 1500VAC Ground to 24VDC Output applied for 1 minute
Insulation Resistance	>10MΩ @ 500VDC

Power Supply Connections

Pin	Connection
1	L
2	N
3	GND
4	V–
5	V+



Removable Connector Included
ADC Part # BX-RTB05



WARNING: Do not exceed the 24VDC auxiliary power supply load limit of 300mA.

WARNING: The BRX System MUST have a proper earth ground. Do not operate the BRX MPU without proper earth grounding.

Power Supply Specifications for BX-MBIO-M-D

BX-MBIO-M-D Power Supply Specifications	
Nominal Voltage Range*	12–24 VDC
Input Voltage Range (Tolerance)*	10–36 VDC
Maximum Input Voltage Ripple	< ±10%
Maximum Input Power	30W
Cold Start Inrush Current	5A, 2ms
Maximum Inrush Current (Hot Start)	5A, 2ms
Internal Input Protection	Reverse polarity protection and undervoltage lockout via transistor circuit
Acceptable External Power Drop Time	10ms
Under Input Voltage Lock-out	<9VDC
Output Protection for Over Current, Over Voltage, and Over Temperature	Self resetting
Auxiliary 24VDC Output	None
Voltage Withstand (dielectric)	1500VAC power Inputs to ground applied for 1 minute
Insulation Resistance	>10MΩ @ 500VDC

**** Class 2 or LPS Power Supply required.***

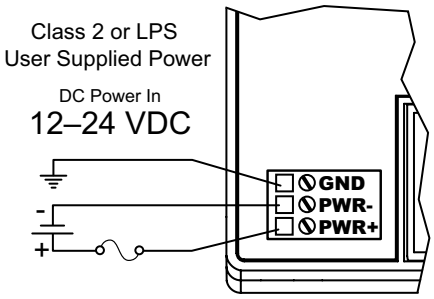
Power Supply Connections

Pin	Connection
1	GND
2	PWR –
3	PWR +





Removable Connector Included
ADC Part # BX-RTB03



WARNING: The BRX System MUST have a proper earth ground. Do not operate the BRX MPU without proper earth grounding.

Configuration

The BX-MBIO controller can be configured as a serial Modbus RTU slave or as a Ethernet Modbus TCP server.

As a Modbus RTU serial slave you can simply use the dip switches and set the module ID. Using the default settings no other setup is needed. Any changes to the configuration of the controller is done through the Ethernet port using the NetEdit 3 utility to get access to the web configuration page of the controller. See Appendix E if needed on how to use the NetEdit 3 utility to gain this access.

Default settings:

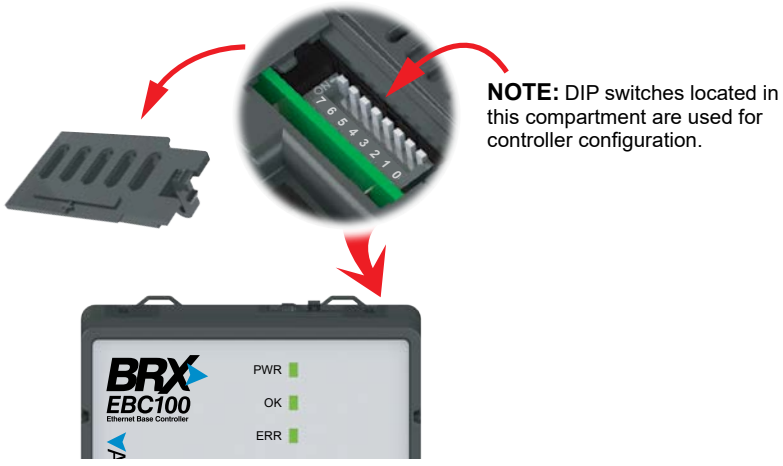
- The serial port - 115,200 baud, 8 data bits, parity None, 1 stop bit
- The attached expansion modules - see the expansion module specifications for the default settings for each module.

As a Modbus TCP Ethernet server the NetEdit 3 utility will be needed to set the Ethernet settings and to gain access to the web configuration page. See appendix E if needed on how to use the NetEdit 3 Utility to gain this access.

DIP Switch Specifications

The BX-MBIO Modbus I/O controller has a block of DIP switches, located on the top of the chassis, that are used to setup the serial port station number, write protect the module and disable the Web configuration page. The DIP switch settings are read when the system is powered up. The default position for all DIP switches is OFF.

WARNING: The BX-MBIO Modbus I/O controller must be powered down prior to changing DIP switch settings.



The following table describes the position and function associated with each DIP switch.

DIP Switch Settings		
DIP#	**Switch Position**	**Function**
7	ON	Reserved
6	ON	Reset the module to factory default
5	ON	Write protect the module. No writes to flash memory are allowed. Disable Web configuration page.
4	ON	Station number: DIP Switch 0–4: Supports addresses 1 to 31. All DIP Switch OFF: Station number from flash. Enter via Netedit 3 or Web configuration page. Supports addresses 1 to 247.
3	ON	
2	ON	
1	ON	
0	ON	



DIP Switch position is read when power is applied to the module. Power down the module before changing DIP switch settings.

DIP switches 0 to 4: Use to set a fixed serial port station number, from 1 to 31. If all five switches are left in the OFF position, the station number will be read from the module flash. The user can use the utility NetEdit 3 or, if enabled, the user can use the Web configuration page to set the RS-485 station number, from 1 to 247.

DIP Switch 5: When ON, it will write protect the module. It will not be possible to update the network settings, update the firmware or the booter version. It also disables access to the Web configuration page.

DIP Switch 6: When ON, the module is reset to factory defaults.

Status Indicators

BX-MBIO Status Indicators		
Indicator	**Status**	**Description**
PWR	OFF	Base Power is OFF
	GREEN	Base Power is Good
OK	GREEN	Controller is Functioning Normally
	GREEN (Blinking)	Reset Mode (Booter without OS)
	YELLOW	Analog Module Mismatch
	OFF	Controller HW Error or Power is OFF
ERR	OFF	Controller is Functioning Normally
	RED	Controller HW Error or Communications Watchdog Timeout
	RED (Blinking)	Reset Mode (Booter without OS)
TX	OFF	No Transmit Activity
	GREEN (Blinking)	Data is being Transmitted
RX	OFF	No Receive Activity
	GREEN (Blinking)	Data is being Received
LNK	OFF	No Ethernet Link
	GREEN	Ethernet Link is Good
ACT	OFF	No Ethernet Activity
	GREEN (Blinking)	Ethernet Activity

Modbus Protocol Function Codes Supported by BX-MBIO

Modbus Protocol Function Codes		
Function Type	Modbus Function Code	
	(Decimal)	(Hex)
Read Coil Status	01	01
Read Input Status	02	02
Read Holding Registers	03	03
Read Input Registers	04	04
Force Single Coil	05	05
Preset Single Register	06	06
Force Multiple Coils	15	0F
Force Multiple Registers	16	10
Mask Write Register	22	16



NOTE: *Please visit Modbus.org to get information on the latest revision of the Modbus Protocol Specifications.*

Function 01 (0x01) Read Coils

This function code is used to read the status of a block (1 to 2000) of contiguous coils (bits) in a remote device. Depending on the type of Modbus slave, coils can be used as internal bits or physical discrete outputs.

Modbus data type identifier: 0xxxxx

Modbus address range: 000001 to 065536

Example: Coil 17 is referred to as 000017

Function 02 (0x02) Read Discrete Inputs

This function code is used to read the status of a block (1 to 2000) of contiguous discrete inputs (bits) in a remote device.

Modbus data type identifier: 1xxxxx

Modbus address range: 100001 to 165536

Example: Discrete input 31 is referred to as 1000031

Function 03 (0x03) Read Holding Registers

This function code is used to read the contents of a block (1 to 125) of contiguous holding registers in a remote device. Holding registers are 16 bit words. Depending on the Modbus slave, Holding Registers may be used to address Analog Outputs or used as general purpose registers to store values in the program.

Modbus data type identifier: 4xxxxx

Modbus address range: 400001 to 465536

Example: Holding Register 2035 is referred to as 402035

Modbus Protocol Function Codes Supported by BX-MBIO, continued

Function 04 (0x04) Read Input Registers

This function code is used to read the contents of a block (1 to 125) of contiguous input registers in a remote device. Input Registers are 16 bit words. Depending on the Modbus slave, they may be used to address Analog Inputs or read-only values.

Modbus data type identifier: 3xxxxx

Modbus address range: 300001 to 365536

Example: Input Register 1027 is referred to as 301027

Function 05 (0x05) Write Single Coil

This function code is used to write a single output to either ON or OFF in a remote device. Depending on the type of Modbus slave, coils can be used as internal bits or physical discrete outputs.

Modbus data type identifier: 0xxxxx

Modbus address range: 000001 to 065536

Example: Coil 17 is referred to as 000017

Function 06 (0x06) Write Single Register

This function code is used to write a single holding register in a remote device. Holding registers are 16-bit words. Depending on the Modbus slave, Holding Registers may be used to address Analog Outputs or used as general purpose registers to store values in the program.

Modbus data type identifier: 4xxxxx

Modbus address range: 400001 to 465536

Example: Holding Register 2035 is referred to as 402035

Function 15 (0x0F) Write Multiple Coils

This function code is used to force each coil in a sequence (1 to 1968) of coils (bits) to either ON or OFF in a remote device. Depending on the type of Modbus slave, coils can be used as internal bits or physical discrete outputs.

Modbus data type identifier: 0xxxxx

Modbus address range: 000001 to 065536

Example: Coil 64 is referred to as 000064

Function 16 (0x10) Write Multiple Registers

This function code is used to write a block (1 to 123 registers) of contiguous Holding Registers in a remote device. Holding registers are 16 bit words. Depending on the Modbus slave, Holding

Registers may be used to address Analog Outputs or used as general purpose registers to store values in the program.

Modbus Protocol Function Codes Supported by BX-MBIO, continued

Modbus data type identifier: 4xxxxx

Modbus address range: 400001 to 465536

Example: Holding Register 2035 is referred to as 402035

Function 22 (0x16) Mask Write Register

This function code is used to modify the contents of a specified holding register using a combination of an AND mask, an OR mask, and the register's current contents. The function can be used to set or clear individual bits in the register.

The request specifies the holding register to be written, the data to be used as the AND mask, and the data to be used as the OR mask.

The function's algorithm is:

Result = (Current Contents AND And_Mask) OR (Or_Mask AND (NOT And_Mask))

For example:

Mask Write Register Example		
	Hex	Binary
Current Contents	12	0001 0010
And_Mask =	F2	1111 0010
Or_Mask =	0D	0000 1101
(NOT And_Mask) =	17	0001 0111
Result =	17	0001 0111

Note:

- If the Or_Mask value is zero, the result is simply the logical ANDing of the current contents and And_Mask. If the And_Mask value is zero, the result is equal to the Or_Mask value.
- The contents of the register can be read with the Read Holding Registers function (function code 03). They could, however, be changed subsequently as the controller scans its user logic program.

Modbus data type identifier: 4xxxxx

Modbus address range: 400001 to 465536

Example: Holding Register 2035 is referred to as 402035

Modbus Protocol Exception Responses

Except for a broadcast message, when a client (master) device sends a request to a server (slave) device it expects a normal response. One of four possible events can occur from the client's (master) query:

- If the server (slave) device receives the query without a communication error, and can handle the query normally, it returns a normal response.
- If the server (slave) does not receive the query due to a communication error, no response is returned. The client (master) will eventually process a timeout condition for the request. (Timeout is fixed at 800ms. Once the first character arrives, the controller waits 800ms for the entire request to arrive.)
- If the server (slave) receives the query, but detects a communication error (parity, LRC, CRC, ...), no response is returned. The client (master) will eventually process a timeout condition for the request. (Timeout is fixed at 800ms. Once the first character arrives, the controller waits 800ms for the entire request to arrive.)
- If the server receives the query without a communication error, but cannot handle it (for example, if the request is to read a non–existent coil or register), the server (slave) will return an Exception Response informing the client (master) of the nature of the error. This Exception Response value from the server (slave) can optionally be stored in a memory location. The BX-MBIO uses a 1-byte Exception Code on an exception response.

Modbus Protocol Exception Responses, continued

List of Modbus Exception Response Codes		
Code	**Name**	**Meaning**
01	Illegal Function	The function code received in the query is not an allowable action for the server (or slave). This may be because the function code is only applicable to newer devices, and was not implemented in the unit selected. It could also indicate that the server (or slave) is in the wrong state to process a request of this type, for example because it is unconfigured and is being asked to return register values.
02	Illegal Data Address	The function code received in the query is not an allowable action for the server (or slave). This may be because the function code is only applicable to newer devices, and was not implemented in the unit selected. It could also indicate that the server (or slave) is in the wrong state to process a request of this type, for example because it is unconfigured and is being asked to return register values.
03	Illegal Data Value	A value contained in the query data field is not an allowable value for server (or slave). This indicates a fault in the structure of the remainder of a complex request, such as that the implied length is incorrect. It specifically does NOT mean that a data item submitted for storage in a register has a value outside the expectation of the application program, since the Modbus protocol is unaware of the significance of any particular value of any particular register.
04	Slave Device Failure	An unrecoverable error occurred while the server (or slave) was attempting to perform the requested action.
05	Acknowledge	Specialized use in conjunction with programming commands. The server (or slave) has accepted the request and is processing it, but a long duration of time will be required to do so. This response is returned to prevent a timeout error from occurring in the client (or master). The client (or master) can next issue a Poll Program Complete message to determine if processing is completed.
06	Slave Device Busy	Specialized use in conjunction with programming commands. The server (or slave) is engaged in processing a long duration program command. The client (or master) should retransmit the message later when the server (or slave) is free.
08	Memory Parity Error	Specialized use in conjunction with function codes 20 and 21 and reference type 6, to indicate that the extended file area failed to pass a consistency check. The server (or slave) attempted to read record file, but detected a parity error in the memory. The client (or master) can retry the request, but service may be required on the server (or slave) device.
0A	Gateway Path Unavailable	Specialized use in conjunction with gateways, indicates that the gateway was unable to allocate an internal communication path from the input port to the output port for processing the request. Usually means that the gateway is misconfigured or overloaded.
0B	Gateway Target Device Failed to Respond	Specialized use in conjunction with gateways, indicates that no response was obtained from the target device. Usually means that the device is not present on the network.

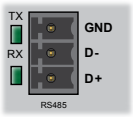
Modbus RTU, Serial Communications



RS-485 is a multi-point wiring standard that can be used to connect external devices to the PLC. The RS-485 port has a removable three-pin screw terminal block located on the front of the CPU. The serial port has a software-selectable 120Ω termination resistor available if needed.

RS-485 Specifications	
Port Type	RS-485
Description	Non-isolated serial port that can communicate via RS-485. Includes ESD protection and built-in surge protection. 120Ω Termination resistor is available (software selectable). Includes internal biasing to be a true failsafe receiver while maintaining EIA/TIA-485 compatibility.
Supported Protocols	Modbus RTU (Slave)
Data Rates	1200, 2400, 4800, 9600, 19200, 38400, 57600, and 115200
Timeout	Fixed at 800ms. Once the first character arrives, the controller waits 800ms for the entire request to arrive.
Default Settings	RS-485, 115200 bps, No Parity, 8 Data Bits, 1 Stop Bit, Station #1
Port Type	3-pin terminal strip 3.5mm pitch
RS-485 Station Addresses	1-247
Cable Requirements	RS-485 use L19954-XXX from AutomationDirect.com
Replacement Connector	ADC Part # BX-RTB03S





Pinout	RS-485
1	GND
2	D-
3	D+

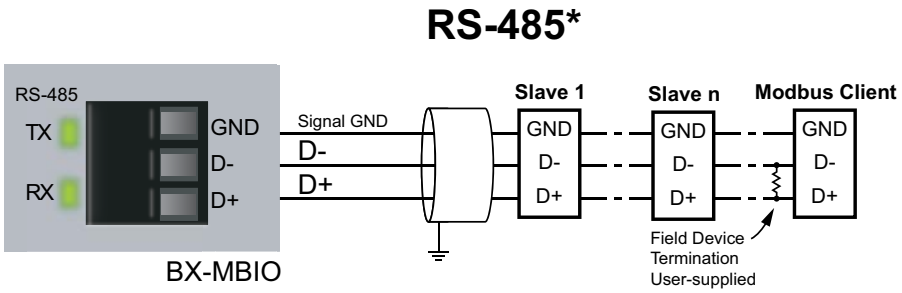
Removable connector included (ADC Part# BX-RTB03S)

The RS-485 standard supports distances of up to 1000 meters without requiring a repeater. The distance can be increased by placing an RS-485 repeater on the network, if necessary.

RS-485 utilizes a differential signal which makes it much more immune to noise and grounding issues than RS-232 and is therefore a much better choice when available for communications. This port only supports RS-485, 2-wire connections. Please note that there are no connections for RTS (Ready To Send), CTS (Clear To Send) or for port powered devices (+5VDC).

Modbus RTU, Serial Communications, continued

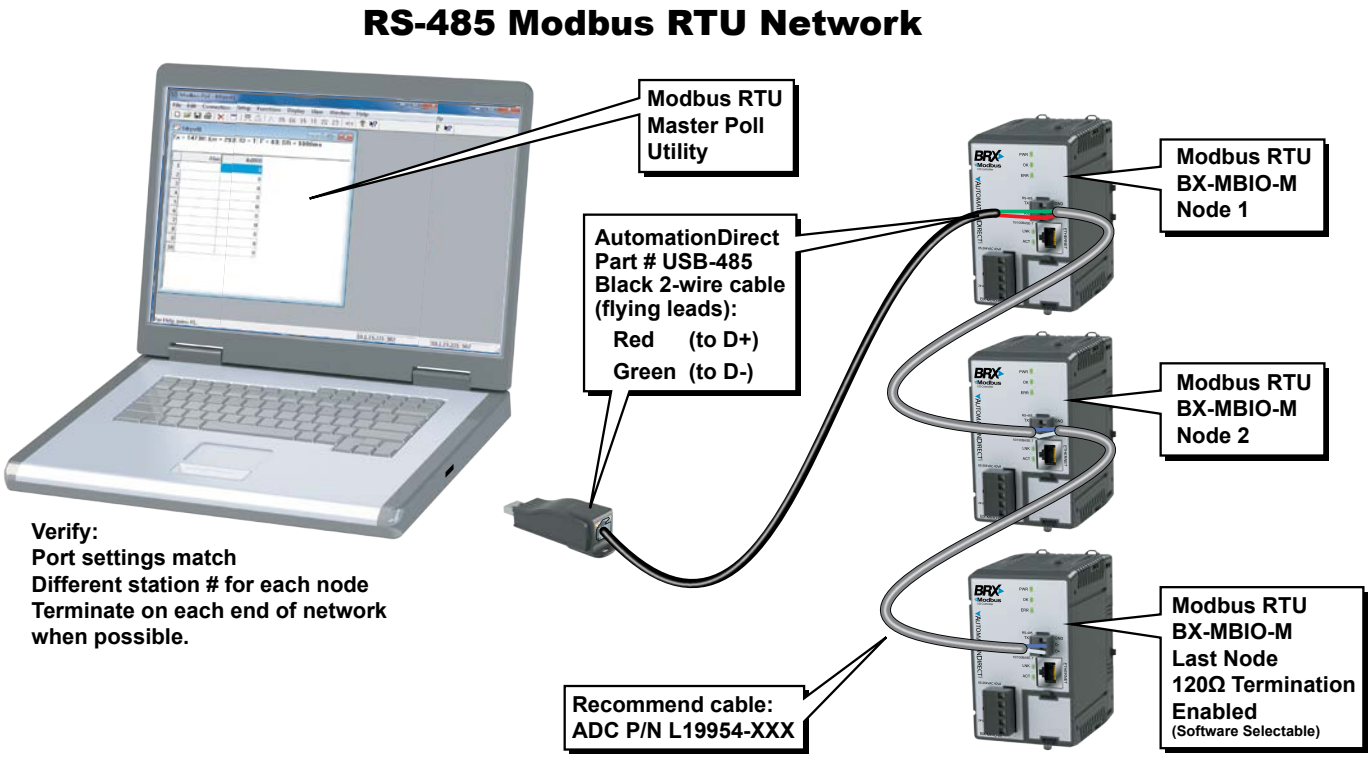
Field Wiring information:



***NOTE:** Termination resistor is built-in and software selectable.
ADC # L19954-xxx or equivalent is recommend for RS-485 networks.

RS-485 example wiring diagrams

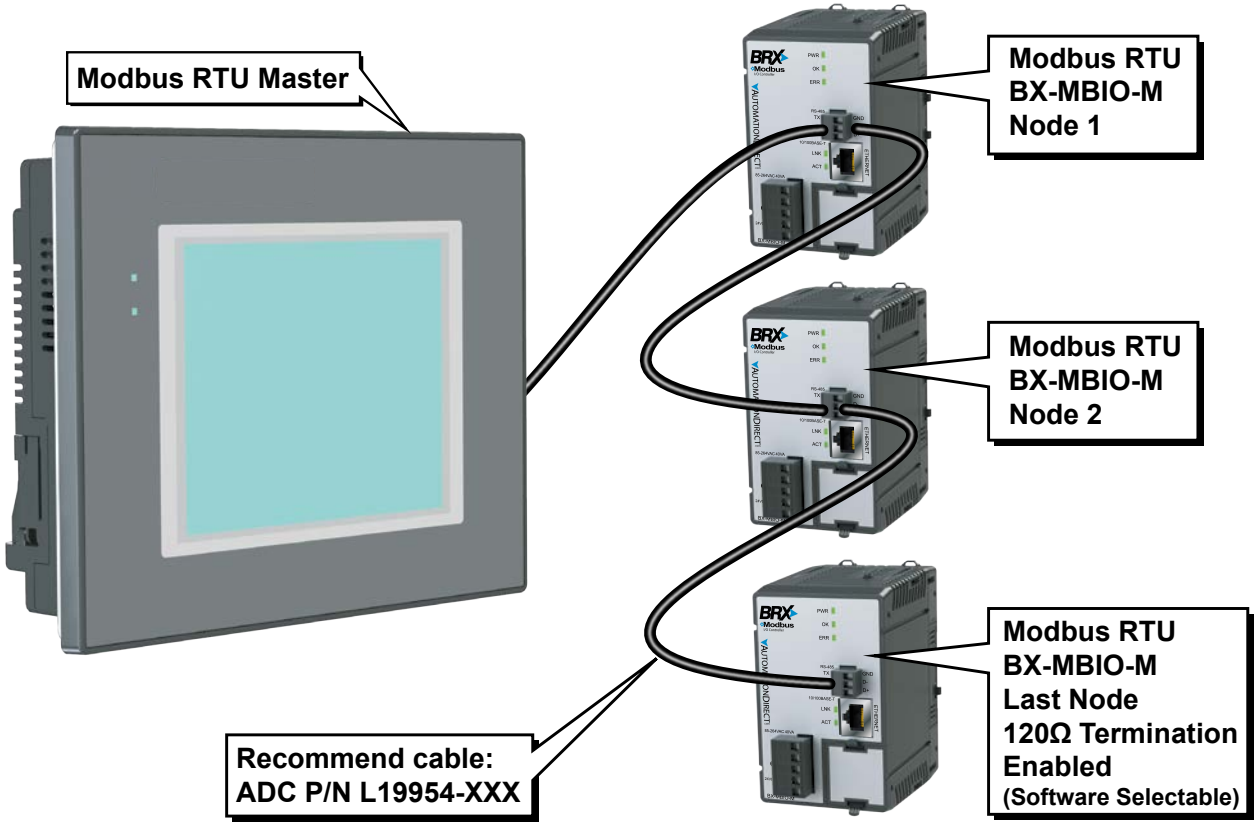
Example Wiring BX-MBIO to PC via RS-485, using Modbus Poll Software as Modbus RTU Master



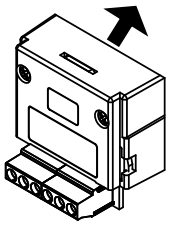
Modbus RTU, Serial Communications, continued

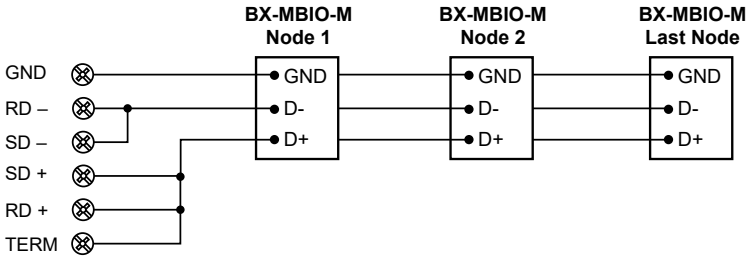
Example Wiring BX-MBIO to C-more HMI via RS-485

RS-485 C-more RTU Network

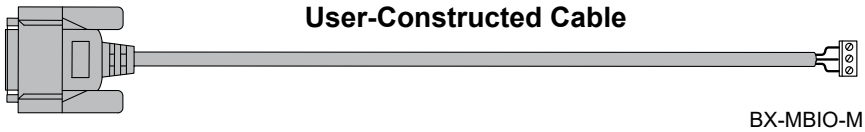


EA-COMCON-3 (-3A)
Terminal Block Adapter
plugs into ***C-more*** 15-pin
PLC Serial Comm. Port





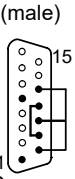
User-Constructed Cable



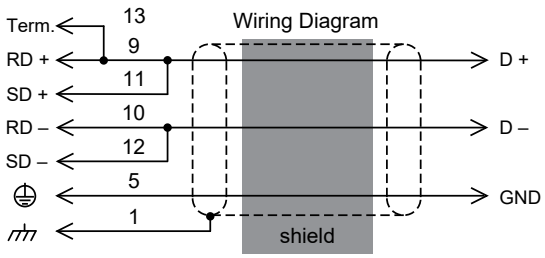
BX-MBIO-M (-D)

15-pin
D-sub
(male)

8 = do not use
7 = do not use
6 = do not use
5 = Logic GND
4 = do not use
3 = do not use
2 = do not use
1 = Frame GND



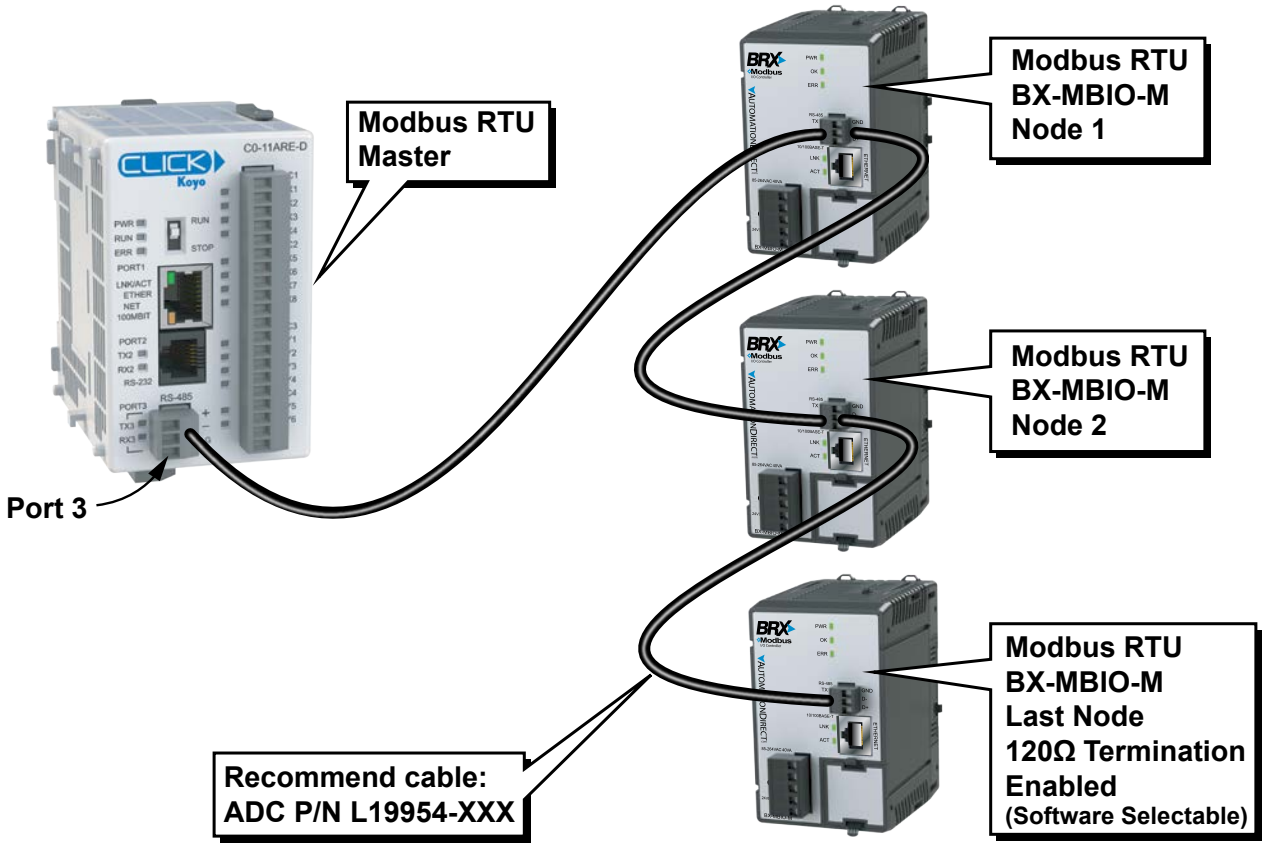
15 = do not use
14 = do not use
13 = Termination
12 = SD– (RS485)
11 = SD+ (RS485)
10 = RD– (RS485)
9 = RD+ (RS485)

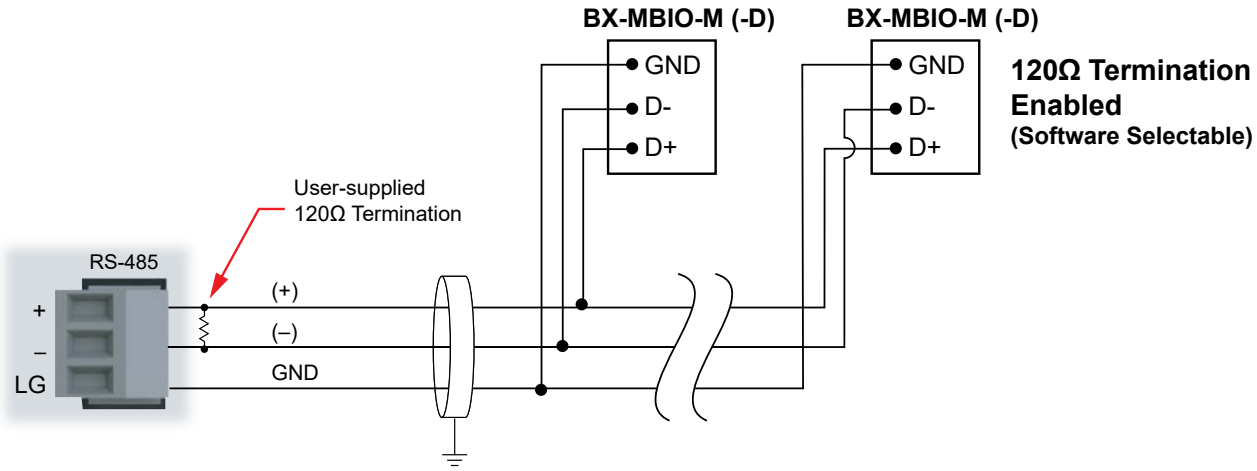


Modbus RTU, Serial Communications, continued

Example Wiring BX-MBIO to Click PLC via RS-485

RS-485 Click to BX-MBIO

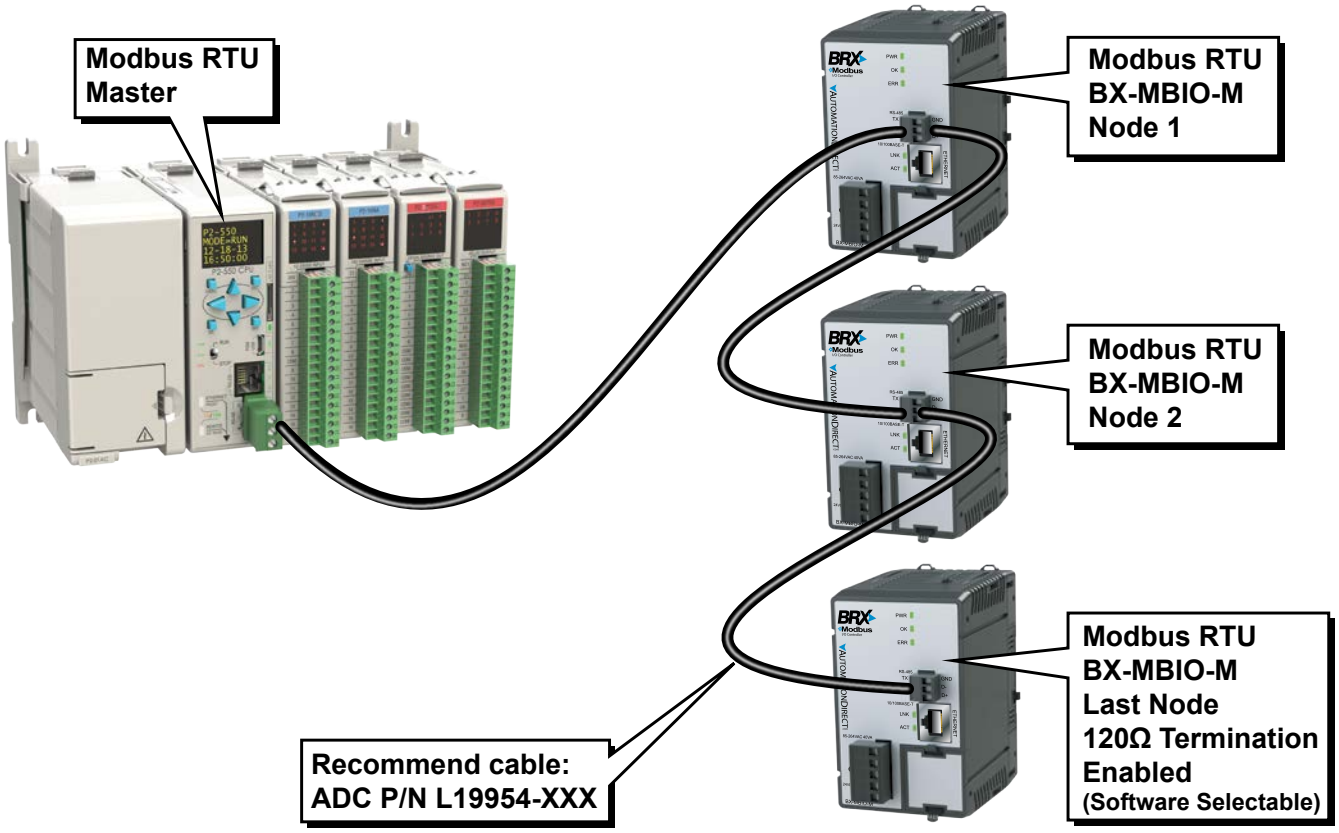


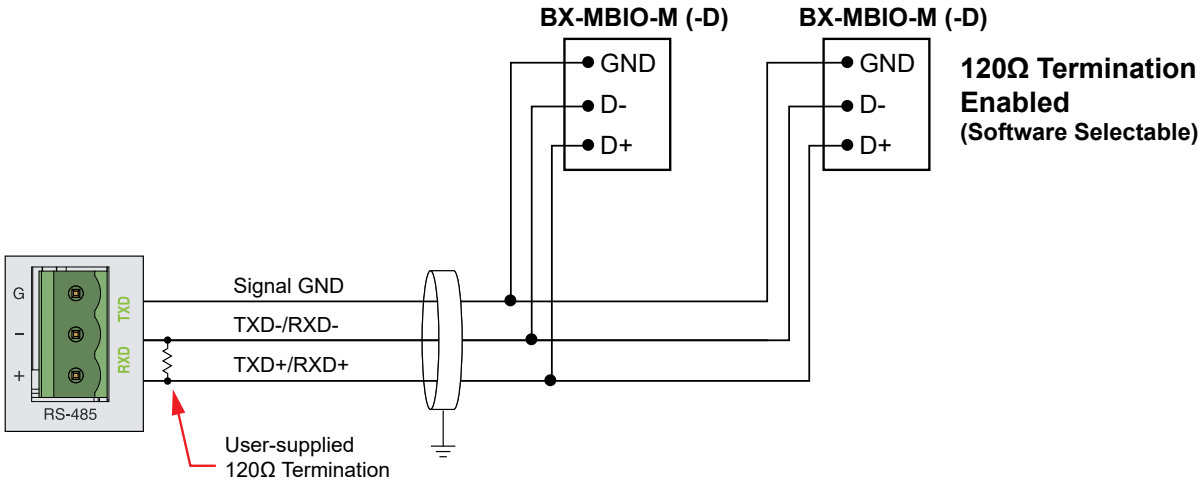


Modbus RTU, Serial Communications, continued

Example Wiring BX-MBIO to Productivity PLC via RS-485

RS-485 Productivity to BX-MBIO





Modbus TCP, Ethernet Communications

The RJ-45 Ethernet port connector is located on the CPU faceplate. Rated at 10/100 Mbps, it accepts standard CAT5e cable and has built-in auto-crossover capability.

Ethernet Specifications	
Port Type	Ethernet
Description	Standard transformer-isolated Ethernet port with built-in surge protection.
Transfer Rate	10Mbps and 100Mbps
Port Status LED	LINK LED is solid when network LINK is established. ACT LED flashes when port is active.
Timeout	Fixed at 800ms. Once the first character arrives, the controller waits 800ms for the entire request to arrive.
Supported Protocols	Modbus TCP (Server)
Cable Recommendation	C5E-STxxx-xx from AutomationDirect.com
Port Type	RJ45, Category 5, 10/100 BASE-T, Auto Crossover
Ethernet Port Numbers: Modbus TCP (Server)	502, TCP

BX-MBIO Configuration

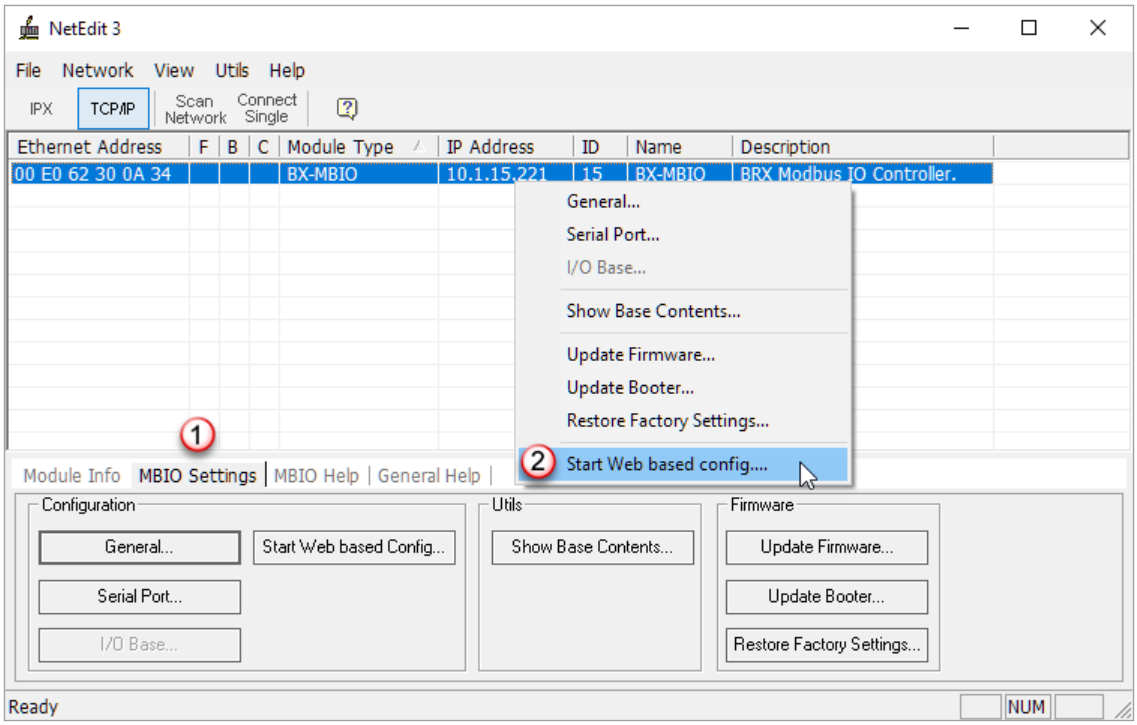
To perform the initial configuration of the BX-MBIO, use the NetEdit 3 utility. Please refer to Appendix E of this manual for information on how the free NetEdit 3 utility is used to manage all aspects of HOST Ethernet-enabled devices. This includes the configuration of the network settings, updating the firmware in the devices, and setting up any runtime configuration options that are available to the HOST device.

Once the BX-MBIO has been assigned an IP address and subnet by using NetEdit 3, it is possible to use the Web Configuration Page to perform additional configurations.

The Web Configuration Page can be accessed via NetEdit 3 or via a browser. This configuration page uses an embedded web server on port 80 (unsecure).

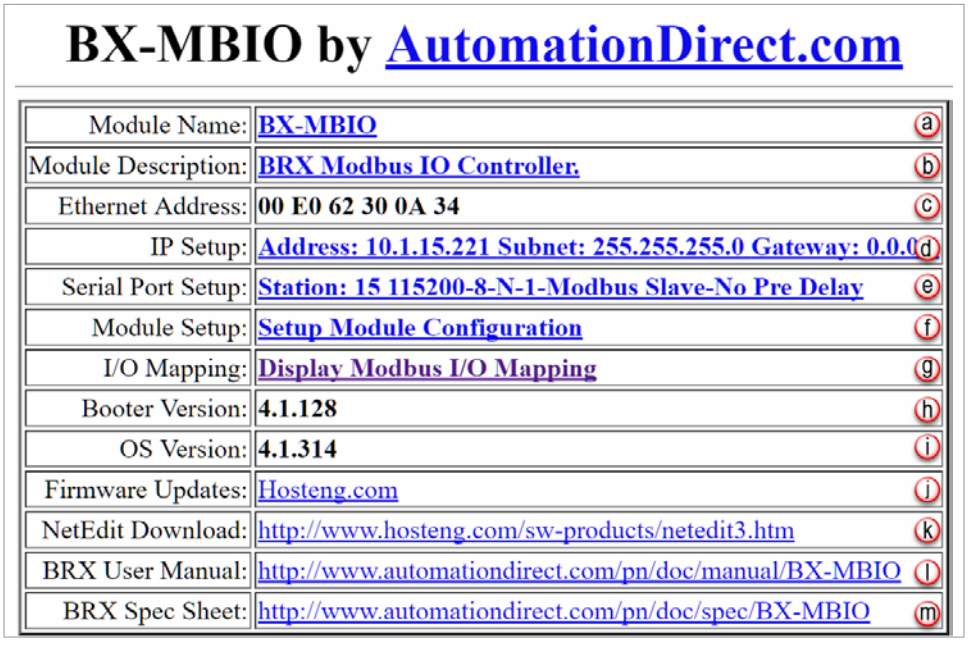
BX-MBIO Configuration, continued

If using NetEdit 3, select BX-MBIO from the list of available HOST Ethernet devices. You can select the "Start Web based Config" from the (1) MBIO Settings tab or from the (2) drop down list you get when you right click on the BX-MBIO row.



If using a web browser, enter the IP address of the BX-MBIO you want to configure in the URL address field of the web browser.

After selecting "Start Web based Config…" in NetEdit 3 or accessing the IP address of the BX-MBIO via a browser page, the following web page will open in your default Web Browser:



BX-MBIO by AutomationDirect.com

Module Name:	BX-MBIO	a
Module Description:	BRX Modbus IO Controller.	b
Ethernet Address:	00 E0 62 30 0A 34	c
IP Setup:	Address: 10.1.15.221 Subnet: 255.255.255.0 Gateway: 0.0.0	d
Serial Port Setup:	Station: 15 115200-8-N-1-Modbus Slave-No Pre Delay	e
Module Setup:	Setup Module Configuration	f
I/O Mapping:	Display Modbus I/O Mapping	g
Booter Version:	4.1.128	h
OS Version:	4.1.314	i
Firmware Updates:	Hosteng.com	j
NetEdit Download:	http://www.hosteng.com/sw-products/netedit3.htm	k
BRX User Manual:	http://www.automationdirect.com/pn/doc/manual/BX-MBIO	l
BRX Spec Sheet:	http://www.automationdirect.com/pn/doc/spec/BX-MBIO	m

BX-MBIO Configuration, continued

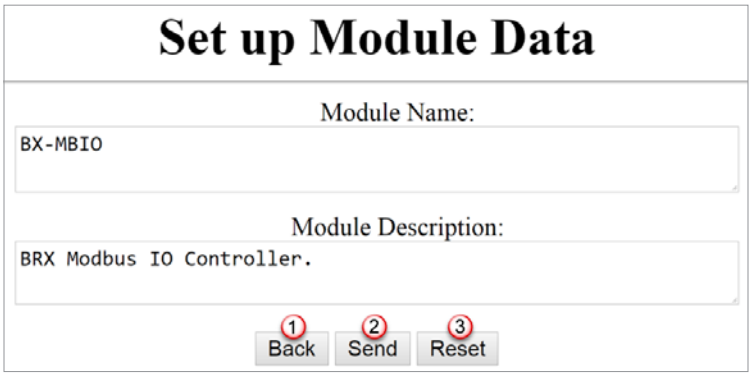
(a) Module Name

The user is able to change the name of the module, making it meaningful to the location or the process. Select the (a) link to change the name. The Module Name can be 255 characters long.

(b) Module Description

The user is able to change the description of the module, allowing the addition of pertinent information to the process. Select the (b) link to edit the module description. The Module Description can be 255 characters long.

Selecting the link to change the (a) Module Name or the (b) Module Description, brings up this page:



(1) Back button, returns you to the main setup page of the Web configuration page.

(2) Send button, writes the modified information to the BX-MBIO.

(3) Reset button, changes any edits back to default.

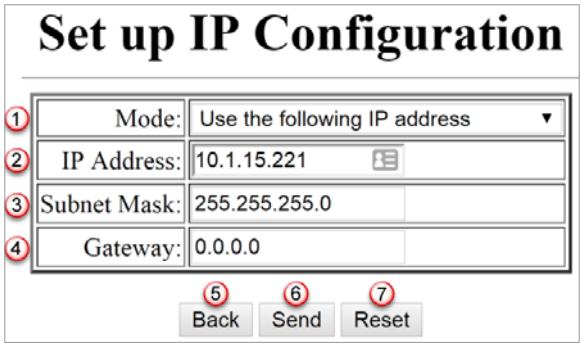
To complete editing the Module Name or Description, select the (2) Send button. Once it is complete, a dialog box will confirm "Module Data setup complete."

(c) Ethernet Address

This field displays the MAC address of the BX-MBIO. This is a static field.

(d) IP Setup

The user is able to change the IP address, the subnet and the gateway of the module. Access the setup page by selecting the (d) link. This brings up the Set up IP Configuration page:



BX-MBIO Configuration, continued

(1) Mode: gives you two options from a drop-down menu:

(i) Obtain an IP address automatically. Use only if DHCP server is available.

(ii) Use the following IP address

(3) IP Address: Enter the BX-MBIO network IP address. This should be in the same family as that of the Modbus client.

(4) Subnet Mask: Enter the Subnet Mask associated with the network to which the BX-MBIO is added.

(5) Gateway: Enter the IP address of the network gateway.

(6) Back button, returns you to the main setup page of the Web configuration page.

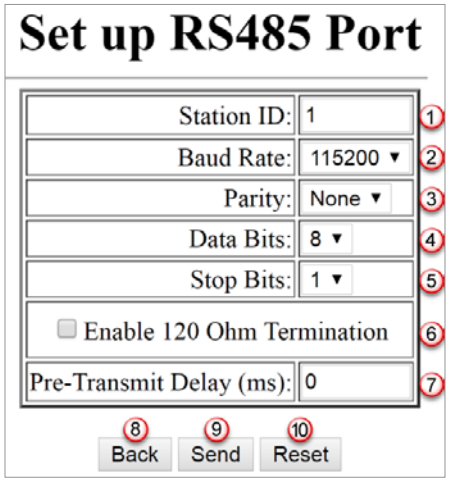
(7) Send button, writes the modified information to the BX-MBIO.

(8) Reset button, changes any edits back to default.

To complete editing the Set up IP Configuration, select the (6) Send button. Once it is complete, a dialog box will confirm "Set up IP Configuration complete."

(e) Serial Port Setup

Selecting the serial port setup link brings up the Set up RS485 Port page:



(1) Station ID: Enter a valid station number, 1-247. Each device on the network must have a unique station ID.

(2) Baud Rate: The rate at which the data is transmitted. The higher the number the faster the data will be transmitted. Choosing a lower value can help with issues when the data is not being received reliably. Available Baud Rate choices: 115200, 57600, 38400, 19200, 9600, 4800, 2400, 1200. This must match the baud rate of the Modbus RTU master.

(3) Parity: The method of error detection used during transmission. Available choices: Even, Odd, None.

(4) Data Bits: The number of bits in each character. Available choices: 7 or 8.

(5) Stop Bits: The number of bits sent to denote the end of each character. Available choices: 1 or 2.

BX-MBIO Configuration, continued

(6) Enable 120-ohm Termination: When enabled, a 120-ohm termination resistor is added to the BX-MBIO RS-485 circuit. Use only at the beginning and end of the RS-485 network.

(7) Pre-Transmit Delay (ms): Enter a time from 0 to 500ms. This allows the user to adjust the response rate based on what master is talking to it. For example, a radio may require a delay before they are ready to "receive" a packet of information.

(8) Back button, returns you to the main setup page of the Web configuration page.

(9) Send button, writes the modified information to the BX-MBIO.

(10) Reset button, changes any edits back to default.

(11) To complete editing the Serial Port Setup, select the (9) Send button. Once it is complete, a dialog box will confirm "Serial Port Setup complete."

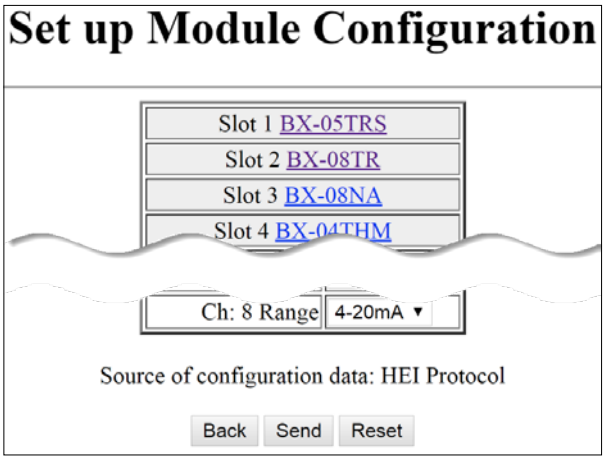
(f) Module Setup

The user is able to view which expansion modules are in each slot. If Analog I/O modules are installed, the user will be able to change the module configuration. Access the setup page by selecting the (f) link. This brings up the Set up Module Configuration page. In general, the page will display a list of slot numbers and the module part number installed in that slot. Configuration fields will be available for the slot with an installed Analog I/O module.

Each displayed module part number is a hyperlink to the product insert for that module on www.AutomationDirect.com.

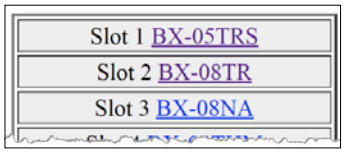
One example configuration used to illustrate the module setup interface comprises the following:

Slot 1: BX-05TRS
Slot 2: BX-08TR
Slot 3: BX-08NA
Slot 4: BX-04THM
Slot 5: BX-08AD-2B
Slot 6: BX-08DA-2B
Slot 7: BX-08AD-1
Slot 8: BX-08DA-1



We will step through the Set up Module Configuration page for this example slot-by-slot.

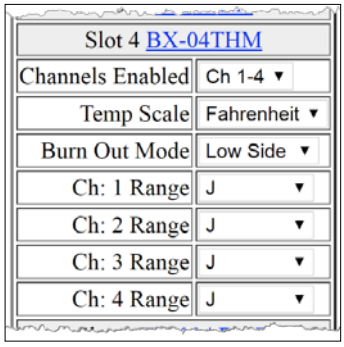
Slots 1–3 (Discrete I/O modules):



In this example we have three discrete I/O modules installed. There is nothing to configure for these discrete I/O modules. All Discrete I/O expansion modules available to the BRX series work in a similar manner.

BX-MBIO Configuration, continued

Slot 4 (BX-04THM):



The BX-04THM analog temperature module is installed in slot 4 in this example. The BX-04THM module has the following configuration options:

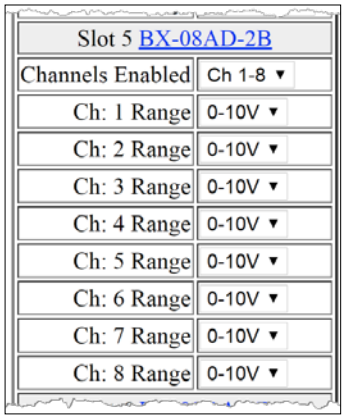
(i) Channels Enabled: (1–4)

(ii) Temp Scale: Celsius or Fahrenheit.

(iii) Burn Out Mode: Select if the Input register should read a Low or High value on burn out or if burn out detection should be disabled. Note: Burn Out Mode must be set to Disabled in order to use a Thermocouple Calibrator.

(iv) Input Range for Channels 1 to 4: These are the settings for each channel of the analog temperature module. Available choices are: J, K, E, R, S, T, B, N, C, 0-39mV, +/-39mV, +/-78mV, 0-156mV, +/-156mV, 0-1.25V.

Slot 5 (BX-08AD-2B):

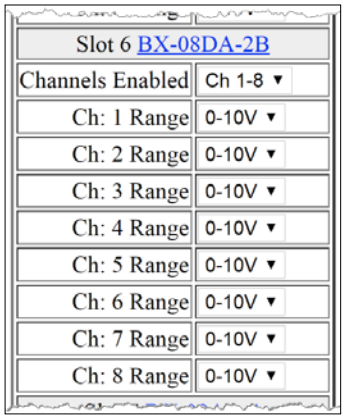


The BX-08AD-2B is installed in slot 5 in this example. The BX-08AD-2B module has the following configuration options:

(i) Channels Enabled: (1–8)

(ii) Range for Input Channels 1 to 8: There is a configuration field for each channel. Available choices are: 0-5V, 0-10V, +/-5V, +/-10V.

Slot 6 (BX-08DA-2B):



The BX-08DA-2B is installed in slot 6 of this example. The BX-08DA-2B module has the following configuration options:

(i) Channels Enabled: (1–8)

(ii) Range for Output Channels 1 to 8: There is a configuration field for each channel. Available choices are: 0–5V, 0–10V, ±5V, ±10V.

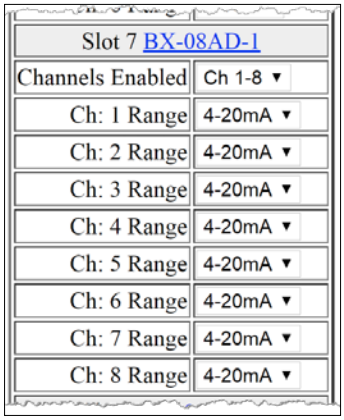
BX-MBIO Configuration, continued

Slot 7 (BX-08AD-1):

The BX-08AD-1 is installed in slot 7 of this example. The BX-08AD-1 module has the following configuration options:

(i) Channels Enabled: (1–8)

(ii) Range for Input Channels 1 to 8: There is a configuration field for each channel. Available choices are: 0–20mA, 4–20mA.

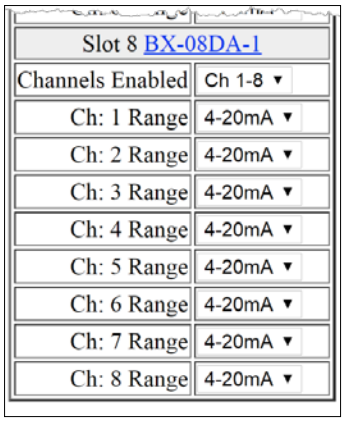


Slot 8 (BX-08DA-1):

The BX-08DA-1 is installed in slot 8 of the sample drop. The BX-08DA-1 module has the following configuration options:

(i) Channels Enabled: (1–8)

(ii) Range for Output Channels 1 to 8: There is a configuration field for each channel. Available choices are: 0–20mA, 4–20mA.



The Back button returns you to the main setup page of the Web configuration page, the Send button writes the modified information to the BX-MBIO, and the Reset button changes any edits back to default.

To complete editing the Setup Module Configuration, select the Send button. The BX-MBIO will be rebooted in order to use the new configuration. A warning and confirmation message box will be displayed:



If you press the OK button, the new configuration will be written to the BX-MBIO.

WARNING: Output states are not retained when a new configuration is written to the BX-MBIO. Only authorized persons should write a configuration.

Once the write is complete, a dialog box will confirm "Setup complete."

BX-MBIO Configuration, continued

(g) I/O Mapping

The Modbus I/O Mapping page is viewable by selecting the (g) link. This page displays the Modbus I/O addressing associated with each slot plus error and device information.

Based on the example set of installed modules listed previously, the following Modbus I/O Mapping table is displayed.

Modbus I/O Mapping

Description	Inputs Offset: 100000	Coils Offset: 0	Input Regs Offset: 300000	Holding Regs Offset: 400000
Slot 1 BX-05TRS				
5 Bit Outputs		1 - 8		402001 - 402001 LO
Slot 2 BX-08TR				
8 Bit Outputs		9 - 16		402001 HI - 402001
Slot 3 BX-08NA				
8 Bit Inputs	100001 - 100008		302001 - 302001 LO	411625 - 411625 LO
Slot 4 BX-04THM				
24 Bit Inputs	100009 - 100032		302001 HI - 302002	411625 HI - 411626
4 Word Inputs			300001 - 300004	412252 - 412255
Slot 5 BX-08AD-2B				
24 Bit Inputs	100033 - 100056		302003 - 302004 LO	411627 - 411628 LO
8 Word Inputs			300005 - 300012	412256 - 412263
Slot 6 BX-08DA-2B				
24 Bit Inputs	100057 - 100080		302004 HI - 302005	411628 HI - 411629
8 Word Outputs				400001 - 400008
Slot 7 BX-08AD-1				
24 Bit Inputs	100081 - 100104		302006 - 302007 LO	411630 - 411631 LO
8 Word Inputs			300013 - 300020	412264 - 412271
Slot 8 BX-08DA-1				
24 Bit Inputs	100105 - 100128		302007 HI - 302008	411631 HI - 411632
8 Word Outputs				400009 - 400016
Error Information (write 0 to clear):				
Module Error				410001
Bit Per Slot Error				410002
Device Information:				
Firmware Version			307001 - 307006	419251 - 419256
Millisecond Tick			307007 - 307008	419257 - 419258
MAC Address			307016 - 307018	419266 - 419268
DIP Switches			307022	419272
IP Addressing			307036 - 307041	419286 - 419291
Additional Mapping Information				

Back

Description column:

Displays the slot number, the module installed in that slot and the Input/Output bits and/or words used by the module. The module part number is a link to the module insert.

BX-MBIO Configuration, continued

Inputs column:

Displays the discrete input addressing. The offset is 100000. If a module has discrete input addresses associated with it, the Modbus discrete input address range is shown. For example, in slot 3, the BX-08NA module is mapped to 8 discrete input addresses, 100001 – 100008.

Coils column:

Displays the discrete output addressing. The offset is 0. If a module has discrete output addresses associated with it, the Modbus discrete output range is shown. For example, in slot 1, the BX-05TRS module is mapped to 5 discrete output addresses. However, the addressing is mapped in byte ranges, which means the module takes up 8 bits, 1 – 8. For this module, BX-05TRS, the user will use the first 5 bits of the addressed range, 1-5.

Input Regs column:

Displays the input register addressing. The offset is 300000. If a module has input registers associated with it, the Modbus input register range is shown. Input registers are typically used to store analog input values. Input registers are typically read only registers. For example, in slot 4, the BX-04THM module is mapped to 24 discrete input bits and 4 input words. These 4 words are mapped to 4 input registers, 300001 – 300004, one word for each input channel. In this case, data read from channel 1 of the BX-04THM is stored in Modbus input register 300001.

Discrete inputs are also mapped to input registers. For example BX-08NA, an 8-point input module, mapped to 302001 LO. This is the lower 8 bits of the 16-bit word 302001.

Analog and Temperature modules have 24 discrete inputs used as error status flags. These are also mapped to input registers. For example, BX-04THM has 24 discrete input bits mapped to 302001 HI to 302002 input registers. This is the top 8 bits of 302001 and 16 bits of 302002.

Refer to Chapter 8, "BRX Analog I/O Expansion Modules," for information on the function of the 24 bits associated with Analog I/O and Temperature modules.

Holding Regs column:

Displays the holding register addressing. The offset is 400000. If a module has holding registers associated with it, the Modbus holding register range is shown. Holding registers are typically used to store analog output values or to store variable data used by the system. Holding registers are typically read/write registers. For example, in slot 6, the BX-08DA-2B module is mapped to 24 discrete input bits and 8 output words. These 8 words are mapped to 8 holding registers, 400001 – 400008, one word for each output channel. In this case, data written to channel 1 of the BX-08DA-2B is stored in Modbus holding register 400001.

Discrete inputs are also mapped to holding registers. For example BX-08NA, an 8-point input module, mapped to 411625 LO. This is the lower 8 bits of the 16-bit word 411625.

Analog and Temperature modules have 24 discrete inputs used as error status flags. These are also mapped to holding registers. For example, BX-04THM has 24 discrete input bits mapped to 411625 HI to 411626 holding registers. This is the top 8 bits of 411625 and 16 bits of 411626.

Refer to Chapter 8, "BRX Analog I/O Expansion Modules," for information on the function of the 24 bits associated with Analog I/O and Temperature modules.

BX-MBIO Configuration, continued

Extra information available in the Modbus I/O mapping table:

Addressing of available error information is mapped to holding registers. Module Error and Bit Per Slot Error can be read from holding registers 410001 and 410002, for this setup. To clear an error, write a value of 0 to the corresponding holding register.

BX-MBIO Diagnostic Information (write 0 to clear):		
Data	**Input Registers**	**Holding Registers**
Module Error		410001
Bit Per Slot Error		410002
Reserved*		410003 – 410006
Link Monitor Timeout		410007

* This section is for use by the MBIO operating system. Do not write to this area.

Device Information is comprised of a block of 40 words. A Modbus client (master) can read the entire block or a specific portion.

BX-MBIO Device Information		
Data	**Input Registers**	**Holding Registers**
Firmware Version	307001 – 307006	419251 – 419256
Millisecond Tick	307007 – 307008	419257 – 419258
Reserved*	307009 – 307015	419259 – 419265
MAC Address	307016 – 307018	419266 – 419268
Reserved*	307019 – 307022	419269 – 419271
DIP Switches	307022	419272
Reserved*	307023 – 307035	419273 – 419285
IP Addressing	307036 – 307041	419286 – 419291

* This section is for use by the MBIO operating system. Do not write to this area.

The Device Information displays items from those available in the table above. These are as follows:

(1) Firmware Version: six words hold information on the Firmware and Booter version of the BX-MBIO, mapped to input registers 307001-307006 and to holding registers 419251-419256.

BX-MBIO Firmware and Booter versions: Firmware: 4.1.299 Booter: 4.1.128				
Modbus Input Register	**Modbus Holding Register**	**MAC address value viewed as Signed Decimal**		
307001	419251	4	Hold the Firmware version	least significant word
307002	419252	1		
307003	419253	299		most significant word
307004	419254	4	Hold the Booter version	least significant word
307005	419255	1		
307006	419256	128		most significant word

BX-MBIO Configuration, continued

(2) Millisecond Tick: Two words hold information on the Millisecond Tick clock of the BX-MBIO, which could be used to indicate communications is active with the BX-MBIO, mapped to input registers 307007-307008 and to holding registers 419257-419258.

BX-MBIO Millisecond Tick			
Modbus Input Register	**Modbus Holding Register**	**MAC address value viewed as HEX**	
307007	419257	0xE000	least significant word
307008	419258	0x3062	most significant word

(3) MAC Address: Three words hold information on the MAC address of the BX-MBIO, mapped to input registers 307016-307018 and to holding registers 41 9266-419268.

BX-MBIO MAC address: 00:E0:62:30:0A:34			
Modbus Input Register	**Modbus Holding Register**	**MAC address value viewed as HEX**	
307016	419266	0xE000	least significant word
307017	419267	0x3062	
307018	419268	0x340A	most significant word

(4) DIP Switches: One word holds information about the position of the DIP Switches of the BX-MBIO, which provides the status of the DIP switch position, mapped to input register 307022 and holding register 419272.

BX-MBIO DIP Switch: Example with DIP Switches 0 to 3 ON, serial port Station # 15			
Modbus Input Register	**Modbus Holding Register**	**DIP Switch value viewed as Unsigned Decimal**	**DIP Switch value viewed in Binary**
307022	419272	15	0000 0000 0000 1111
			msb ----------lsb

(5) IP Addressing: Six words hold information about the IP address, the Gateway address, and the Subnet mask of the BX-MBIO, mapped to input registers 307036-307041 and to holding registers 419286-419291.

BX-MBIO IP and Subnet address: IP: 10.1.15.221 Gateway: 192.168.2.1 Subnet: 255.255.255.0					
Modbus Input Register	**Modbus Holding Register**	**MAC address value viewed in HEX**			
307036	419286	0x010A	where: 01 = 1, 0A = 10	IP Address	least significant word
307037	419287	0xDD0F	where: DD = 221, 0F = 15		most significant word
307038	419288	0xA8C0	where: A8 = 168, C0 = 192	Gateway address	least significant word
307039	419289	0x0102	where: 01 = 1, 02 = 2		most significant word
307040	419290	0xFFFF	where: FF = 255, FF = 255	Subnet mask	least significant word
307041	419291	0x00FF	where: 00 = 0, FF = 255		most significant word

BX-MBIO Configuration, continued

(h) Booter Version

This field displays the current booter version of the BX-MBIO controller. This is a fixed field. It is necessary to use the NetEdit 3 utility to update the booter.

(i) OS Version

This field displays the current OS version of the BX-MBIO controller. This is a fixed field. It is necessary to use the NetEdit 3 utility to update the OS.

(j) Firmware Updates

This field contains a link to the firmware download location on the HOST Engineering website: Hosteng.com (http://www.hosteng.com/hw-products/firmware.htm).

(k) NetEdit Download

This field contains a link to the NetEdit 3 utility download page: http://www.hosteng.com/sw-products/netedit3.htm.

(l) BRX User Manual

This field contains a link to the BRX user manual web page: http://www.automationdirect.com/pn/doc/manual/BX-MBIO.

(m) BRX Spec Sheet

This field contains a link to the BX-MBIO-M insert page: http://www.automationdirect.com/pn/doc/spec/BX-MBIO.

List of modules supported by BX-MBIO

Module	Number of Points		Address Offset	Bytes Used	Function Codes	Example Addressing: Module Installed in Slot 1
	In	Out				
Discrete IO						
BX-08NF3	8		1–8	1	02	100001–100008
BX-08ND3	8		1–8	1	02	100001–100008
BX-08NB	8		1–8	1	02	100001–100008
BX-08NA	8		1–8	1	02	100001–100008
BX-08SIM	8		1–8	1	02	100001–100008
BX-12ND3	12		1–12[1]	2	02	100001–100016[1]
BX-12NB	12		1–12[1]	2	02	100001–100016[1]
BX-12NA	12		1–12[1]	2	02	100001–100016[1]
BX-16NF3	16		1–16	2	02	100001–100016
BX-16ND3	16		1–16	2	02	100001–100016
BX-16NB	16		1–16	2	02	100001–100016
BX-16NA	16		1–16	2	02	100001–100016
BX-32ND3	32		1–16, 17–32	4	02	100001–100016 100017–100032
BX-05TRS		5	1–5[2]	1	01, 05, 15	000001–000008[2]
BX-05TRS-1		5	1–5[2]	1	01, 05, 15	000001–000008[2]
BX-08TD1		8	1–8	1	01, 05, 15	000001–000008
BX-08TD2		8	1–8	1	01, 05, 15	000001–000008
BX-08TR		8	1–8	1	01, 05, 15	000001–000008

Table continued on next page

BX-MBIO Configuration, continued

List of modules supported by BX-MBIO (continued)

Module	Number of Points		Address Offset	Bytes Used	Function Codes	Example Addressing: Module Installed in Slot 1
	In	Out				
BX-08TRZ		8	1–8	1	01, 05, 15	000001–000008
BX-08TA		8	1–8	1	01, 05, 15	000001–000008
BX-12TD1		12	1–12[1]	2	01, 05, 15	000001–000016[1]
BX-12TD2		12	1–12[1]	2	01, 05, 15	000001–000016[1]
BX-12TR		12	1–12[1]	2	01, 05, 15	000001–000016[1]
BX-12TA		12	1–12[1]	2	01, 05, 15	000001–000016[1]
BX-16TD1		16	1–16	2	01, 05, 15	000001–000016
BX-16TD2		16	1–16	2	01, 05, 15	000001–000016
BX-16TF2		16	1–16	2	01, 05, 15	000001–000016
BX-16TR		16	1–16	2	01, 05, 15	000001–000016
BX-16TRZ		16	1–16	2	01, 05, 15	000001–000016
BX-32TD1		32	1–16, 17–32	4	01, 05, 15	100001–100016 100017–100032
BX-32TD2		32	1–16, 17–32	4	01, 05, 15	100001–100016 100017–100032
BX-08CD3R	4	4	Input: 1–4[3] Output: 1–4[3]	1 1	02 01, 05, 15	100001–100008[3] 000001–000008[3]
BX-12CD3D1	8	4	Input: 1–8 Output: 1–4[3]	1 1	02 01, 05, 15	100001–100008 000001–000008[3]
BX-12CD3D2	8	4	Input: 1–8 Output: 1–4[3]	1 1	02 01, 05, 15	100001–100008 000001–000008[3]
BX-16CD3D1	8	8	Input: 1–8 Output: 1–8	1 1	02 01, 05, 15	100001–100008 000001–000008
BX-16CD3D2	8	8	Input: 1–8 Output: 1–8	1 1	02 01, 05, 15	100001–100008 000001–000008
BX-12CF3F2	8	8	Input: 1–8 Output: 1–8	1 1	02 01, 05, 15	100001–100008 000001–000008
Analog IO						
BX-04ADM-1	4		Data Words: 1–4 Status Flags[4]: 1–24	2 (per word) 3	04 02	300001–300004 100001–100024
BX-04AD-1	4		Data Words: 1–4 Status Flags[4]: 1–24	2 (per word) 3	04 02	300001–300004 100001–100024
BX-08AD-1	8		Data Words: 1–8 Status Flags[4]: 1–24	2 (per word) 3	04 02	300001–300008 100001–100024
BX-16AD-1	16		Data Words: 1–16 Status Flags[4]: 1–24	2 (per word) 3	04 02	300001–300016 100001–100024
BX-04AD-2B	4		Data Words: 1–4 Status Flags[4]: 1–24	2 (per word) 3	04 02	300001–300004 100001–100024
BX-08AD-2B	8		Data Words: 1–8 Status Flags[4]: 1–24	2 (per word) 3	04 02	300001–300008 100001–100024
BX-16AD-2B	16		Data Words: 1–16 Status Flags[4]: 1–24	2 (per word) 3	04 02	300001–300016 100001–100024
BX-04AD-3	4		Data Words: 1–4 Status Flags: 1–8	2 (per word) 1	04 02	300001–300004 100001–100008
BX-08AD-3	8		Data Words: 1–8 Status Flags: 1–8	2 (per word) 1	04 02	300001–300008 100001–100008
BX-04DA-1		4	Data Words: 1–4 Status Flags[4]: 1–24	2 (per word) 3	03, 06, 16 02	400001–400004 100001–100024

Table continued on next page

BX-MBIO Configuration, continued

List of modules supported by BX-MBIO (continued)

Module	Number of Points		Address Offset	Bytes Used	Function Codes	Example Addressing: Module Installed in Slot 1
	In	Out				
BX-08DA-1		8	Data Words: 1–8 Status Flags[4]: 1–24	2 (per word) 3	03, 06, 16 02	400001–400008 100001–100024
BX-04DA-2B		4	Data Words: 1–4 Status Flags[4]: 1–24	2 (per word) 3	03, 06, 16 02	400001–400004 100001–100024
BX-08DA-2B		8	Data Words: 1–8 Status Flags[4]: 1–24	2 (per word) 3	03, 06, 16 02	400001–400008 100001–100024
BX-04DA-3		4	Data Words: 1–4 Status Flags: 1–8	2 (per word) 1	03, 06, 16 02	400001–400004 100001–100008
BX-08DA-3		8	Data Words: 1–8 Status Flags: 1–8	2 (per word) 1	03, 06, 16 02	400001–400008 100001–100008
BX-2AD2DA-1	2	2	Input Data Words: 1–2 Output Data Words: 1–2 Status Flags[4]: 1–24	2 (per word) 2 (per word) 3	04 03, 06, 16 02	300001–300002 400001–400002 100001–100024
BX-4AD2DA-1	4	2	Input Data Words: 1–4 Output Data Words: 1–2 Status Flags[4]: 1–24	2 (per word) 2 (per word) 3	04 03, 06, 16 02	300001–300004 400001–400002 100001–100024
BX-2AD2DA-2B	2	2	Input Data Words: 1–2 Output Data Words: 1–2 Status Flags[4]: 1–24	2 (per word) 2 (per word) 3	04 03, 06, 16 02	300001–300002 400001–400002 100001–100024
BX-4AD2DA-2B	4	2	Input Data Words: 1–4 Output Data Words: 1–2 Status Flags[4]: 1–24	2 (per word) 2 (per word) 3	04 03, 06, 16 02	300001–300004 400001–400002 100001–100024
BX-2AD2DA-3	2	2	Input Data Words: 1–2 Output Data Words: 1–2 Status Flags: 1–8	2 (per word) 2 (per word) 1	04 03, 06, 16 02	300001–300002 400001–400002 100001–100008
BX-4AD4DA-3	4	4	Input Data Words: 1–4 Output Data Words: 1–4 Status Flags: 1–8	2 (per word) 2 (per word) 1	04 03, 06, 16 02	300001–300004 400001–400002 100001–100008
Temperature						
BX-04THM	4		Data Words: 1–4 Status Flags (Bits)[4]: 1–24	2 (per word) 3	04 02	300001–300004 100001–100024
BX-08THM	8		Data Words: 1–8 Status Flags (Bits)[4]: 1–24	2 (per word) 3	04 02	300001–300008 100001–100024
BX-06RTD	6		Data Words: 1–6 Status Flags (Bits)[4]: 1–24	2 (per word) 3	04 02	300001–300006 100001–100024
BX-04UT	4		Data Words: 1–4 Status Flags (Bits): 1–16	2 (per word) 2	04 02	300001–300004 100001–100016
BX-08UT	8		Data Words: 1–8 Status Flags (Bits): 1–16	2 (per word) 2	04 02	300001–300008 100001–100016
BX-08NTC	8		Data Words: 1–8 Status Flags (Bits)[4]: 1–24	2 (per word) 3	04 02	300001–300008 100001–100024

Table continued on next page

BX-MBIO Configuration, continued

List of modules supported by BX-MBIO (continued)

Module	Number of Points		Address Offset	Bytes Used	Function Codes	Example Addressing: Module Installed in Slot 1
	In	Out				
BX-4RTD4DA-1	4	4	Input Data Words: 1–4 Output Data Words: 1–4 Status Flags (Bits)[4]: 1–24	2 (per word) 2 (per word) 3	04 03, 06, 16 02	300001–300004 400001–400002 100001–100024
BX-4THM4DA-1	4	4	Input Data Words: 1–4 Output Data Words: 1–4 Status Flags (Bits)[4]: 1–24	2 (per word) 2 (per word) 3	04 03, 06, 16 02	300001–300004 400001–400002 100001–100024
BX-4UT4DA-3	4	4	Input Data Words: 1–4 Output Data Words: 1–4 Status Flags: 1–8	2 (per word) 2 (per word) 1	04 03, 06, 16 02	300001–300004 400001–400002 100001–100008
BX-4UT4TD1	4	4	Input Data Words: 1–4 Output Data Words: 1–4 Status Flags: 1–8	2 (per word) 2 (per word) 1	04 03, 06, 16 02	300001–300004 400001–400002 100001–100008
BX-4UT4TD2	4	4	Input Data Words: 1–4 Output Data Words: 1–4 Status Flags: 1–8	2 (per word) 2 (per word) 1	04 03, 06, 16 02	300001–300004 400001–400002 100001–100008
BX-4UT4TR	4	4	Input Data Words: 1–4 Output Data Words: 1–4 Status Flags: 1–8	2 (per word) 2 (per word) 1	04 03, 06, 16 02	300001–300004 400001–400002 100001–100008

1. *The 12-point modules use 12 addressing bits, but they are mapped to 16 bits (two bytes). Addressing follows a Byte boundary.*
2. *The 5-point module uses 5 addressing bits, mapped to 8 bits (one byte). Addressing follows a Byte boundary.*
3. *The 8- and 12-point combo modules with four input or four output points use 4 addressing bits, but are mapped to 8 bits (one byte). Addressing follows a Byte boundary.*
4. *Module uses 24 bits as Status Flags. These are mapped to 24 addressing bits (3 bytes). Addressing follows a Byte boundary.*

Troubleshooting with Modbus Poll

Detailed Example: Using the Modbus Poll Utility to Verify Communications With BX-MBIO

This example explains how to use the Modbus client utility, Modbus Poll, to establish communications with a BX-MBIO Modbus server (slave) and read and write information related to the discrete and analog I/O modules connected to the BX-MBIO.

For this test, the following hardware will be used:

- Slot 0: BX-MBIO-M
- Slot 1: BX-05TRS
- Slot 2: BX-08TR
- Slot 3: BX-08NA
- Slot 4: BX-04THM
- Slot 5: BX-08AD-2B
- Slot 6: BX-08DA-2B
- Slot 7: BX-08AD-1
- Slot 8: BX-08DA-1

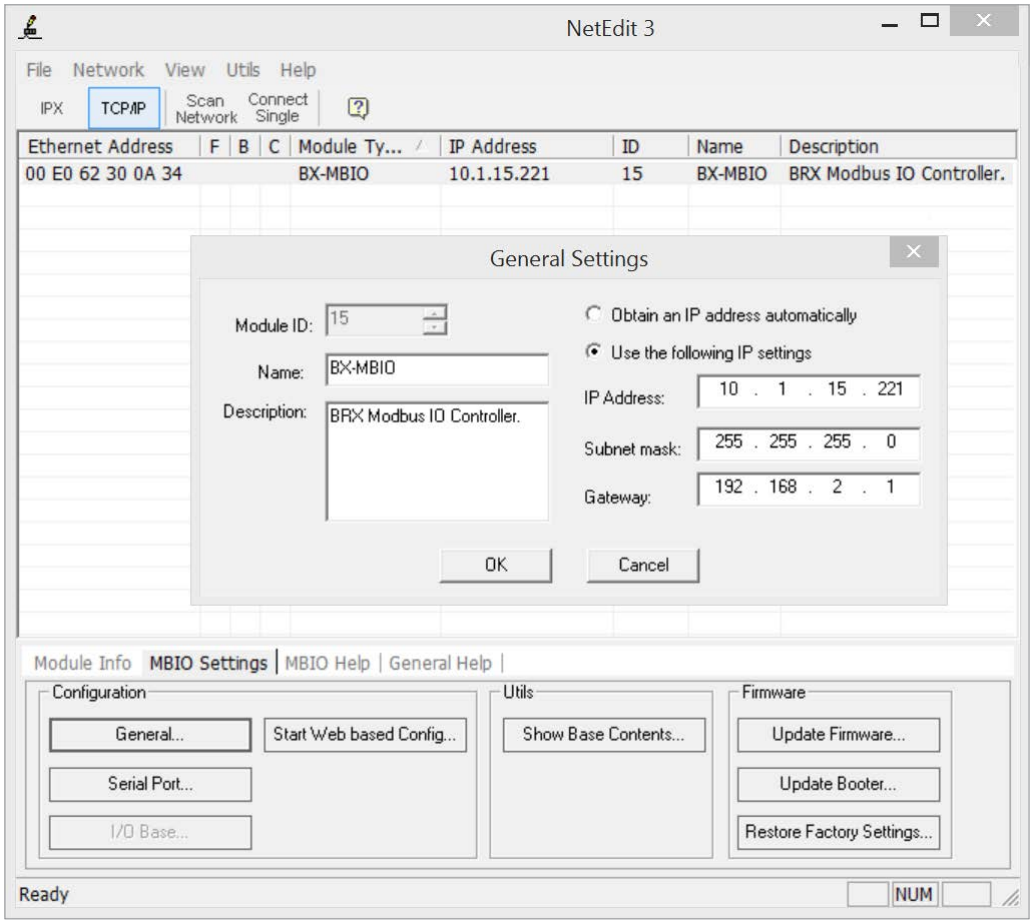
Troubleshooting with Modbus Poll, continued

Start by wiring the modules to provide live data for the test:

1. Wire the BX-08TR to the BX-08NA. When an output point is turned on, the corresponding input will turn on.
2. Wire the BX-08AD-2B to the BX-08DA-2B and wire the BX-08AD-1 to the BX-08DA-1. When a value is written to an analog output channel, the corresponding input channel should read a value that is approximately the same as the output value. For example, if a value of 32750 is written to BX-08DA-1, we would expect the BX-08AD-1 to read a value of 32750 or very close to it. Note that the values may not be identical due to the nature of analog I/O.

Connect the BX-MBIO to the same network switch as the PC running the Modbus Poll utility. It is also possible to connect a PC Ethernet port directly to the BX-MBIO. Apply power to the unit.

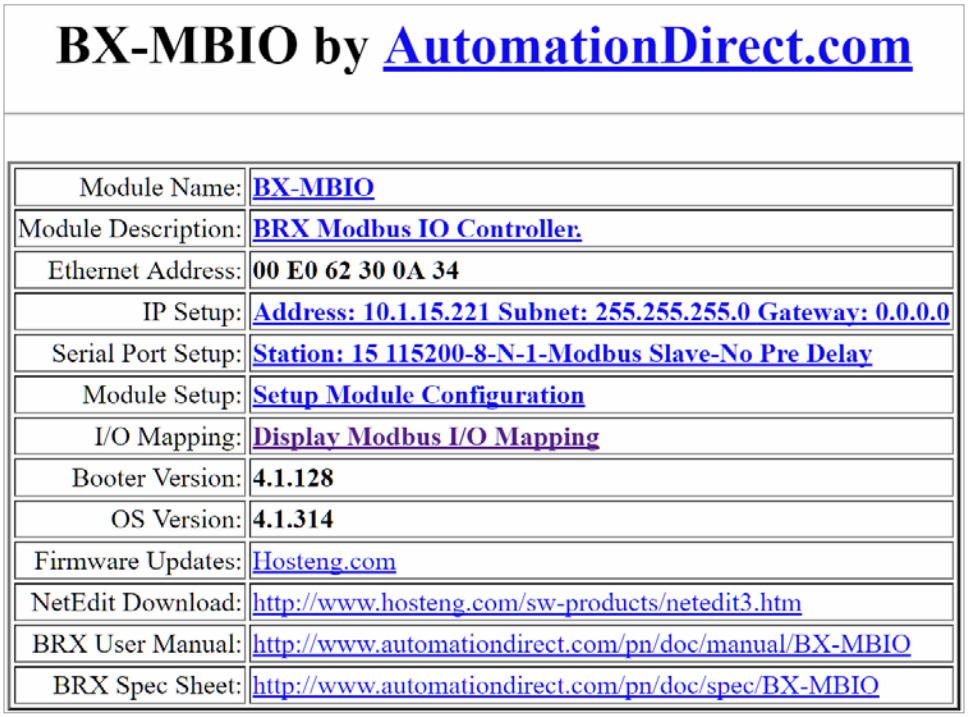
Open the NetEdit 3 utility and select the BX-MBIO on the list. Under the MBIO Settings table, click on the General button to configure the IP address and the subnet mask:



From the example above, the test BX-MBIO is configured with IP address of 10.1.15.221 and a subnet mask of 255.255.255.0. If needed, a Gateway address can be configured here.

Troubleshooting with Modbus Poll, continued

Using NetEdit 3, select the Start Web based Config button to open the Web based configuration page, as shown below:



BX-MBIO by AutomationDirect.com

Module Name:	BX-MBIO
Module Description:	BRX Modbus IO Controller.
Ethernet Address:	00 E0 62 30 0A 34
IP Setup:	Address: 10.1.15.221 Subnet: 255.255.255.0 Gateway: 0.0.0.0
Serial Port Setup:	Station: 15 115200-8-N-1-Modbus Slave-No Pre Delay
Module Setup:	Setup Module Configuration
I/O Mapping:	Display Modbus I/O Mapping
Booter Version:	4.1.128
OS Version:	4.1.314
Firmware Updates:	Hosteng.com
NetEdit Download:	http://www.hosteng.com/sw-products/netedit3.htm
BRX User Manual:	http://www.automationdirect.com/pn/doc/manual/BX-MBIO
BRX Spec Sheet:	http://www.automationdirect.com/pn/doc/spec/BX-MBIO

Open the Module setup by clicking on the Setup Module Configuration link. This page displays each of the modules connected to the BX-MBIO, as explained on page 15-24. Edit the configuration of the analog modules to meet your test requirements.

For this test:

1. Slots 1 to 3 are discrete I/O and do not need to be configured.
2. Slot 4, BX-08THM: Enabled 4 channels, all for type J thermocouple.
3. Slot 5, BX-08AD-2B: Enabled 8 channels, all for 0–10 VDC.
4. Slot 6, BX-08DA-2B: Enabled 8 channels, all for 0–10 VDC.
5. Slot 7, BX-08AD-1: Enabled 8 channels, all for 4–20 mA.
6. Slot 8, BX-08DA-1: Enabled 8 channels, all for 4–20 mA.

Once edits are made, click on the Send button to write the new configuration to the flash memory.

At this point, we have a BX-MBIO that is powered up and available on the network with a proper IP address. The discrete and analog I/O modules are properly installed and the analog I/O have been configured.

Troubleshooting with Modbus Poll, continued

From the main BX-MBIO Web configuration page select the Display Modbus I/O Mapping link. The following chart shows the Modbus mapping for each module.

Modbus I/O Mapping

Description	Inputs Offset: 100000	Coils Offset: 0	Input Regs Offset: 300000	Holding Regs Offset: 400000
Slot 1 BX-05TRS				
5 Bit Outputs		1 - 8		402001 - 402001 LO
Slot 2 BX-08TR				
8 Bit Outputs		9 - 16		402001 HI - 402001
Slot 3 BX-08NA				
8 Bit Inputs	100001 - 100008		302001 - 302001 LO	411625 - 411625 LO
Slot 4 BX-04THM				
24 Bit Inputs	100009 - 100032		302001 HI - 302002	411625 HI - 411626
4 Word Inputs			300001 - 300004	412252 - 412255
Slot 5 BX-08AD-2B				
24 Bit Inputs	100033 - 100056		302003 - 302004 LO	411627 - 411628 LO
8 Word Inputs			300005 - 300012	412256 - 412263
Slot 6 BX-08DA-2B				
24 Bit Inputs	100057 - 100080		302004 HI - 302005	411628 HI - 411629
8 Word Outputs				400001 - 400008
Slot 7 BX-08AD-1				
24 Bit Inputs	100081 - 100104		302006 - 302007 LO	411630 - 411631 LO
8 Word Inputs			300013 - 300020	412264 - 412271
Slot 8 BX-08DA-1				
24 Bit Inputs	100105 - 100128		302007 HI - 302008	411631 HI - 411632
8 Word Outputs				400009 - 400016
Error Information (write 0 to clear):				
Module Error				410001
Bit Per Slot Error				410002
Device Information:				
Firmware Version			307001 - 307006	419251 - 419256
Millisecond Tick			307007 - 307008	419257 - 419258
MAC Address			307016 - 307018	419266 - 419268
DIP Switches			307022	419272
IP Addressing			307036 - 307041	419286 - 419291
Additional Mapping Information				

Back

We will use the mapping in Modbus Poll to read/write data.

For this test we will use the following addresses:

Slot 1: BX-05TRS. Modbus coils 1–8.

Slot 2: BX-08TR. Modbus coils 9–16.

Slot 3: BX-08NA. Modbus discrete inputs 100001–100008.

When Coil 9 is turned on, discrete input 100001 will come on.

Troubleshooting with Modbus Poll, continued

Slot 4: BX-04THM.

Modbus Input Registers 300001–300004. If a type J thermocouple is wired to channel 1 to read room temperature, the reading will be read in Input Register 300001. There are 24 status flag bits associated with this module mapped to discrete inputs 100009–1000032. The table below shows the addressing for the status flags.

Error Flag Specifications								
	MSB							**LSB**
1st Byte of status flags						*100011*	*100010*	*100009*
Module Status	-	-	-	-	-	Data Not Valid	Missing 24VDC	Self Test Failed
2nd Byte of status flags					*100020*	*100019*	*100018*	*100017*
Channel Out of Range	-	-	-	-	Channel 4	Channel 3	Channel 2	Channel 1
3rd Byte of status flags					*100028*	*100027*	*100026*	*100025*
Channel Open (Burn Out)	-	-	-	-	Channel 4	Channel 3	Channel 2	Channel 1

Slot 5:

BX-08AD-2B. Modbus Input Registers 300005–300012. If a transducer is wired to channel 1, the value is read in Input Register 300005. There are 24 status flag bits associated with this module, mapped to discrete inputs 100033–100056. The table below shows the addressing for the status flags.

Error Flag Specifications								
	MSB							**LSB**
1st Byte of status flags						*100035*	*100034*	*100033*
Module Status	-	-	-	-	-	Data Not Valid	Missing 24VDC	Self Test Failed
2nd Byte of status flags								
	100048	*100047*	*100046*	*100045*	*100044*	*100043*	*100042*	*100041*
Channel Out of Range	Channel 8	Channel 7	Channel 6	Channel 5	Channel 4	Channel 3	Channel 2	Channel 1
3rd Byte of status flags								
Unused	-	-	-	-	-	-	-	-

Slot 6:

BX-08DA-2B. Modbus Holding Registers 400001–400008. If channel 1 is used to drive the speed reference of a VFD, the value is written to Holding Register 400001. There are 24 status flag bits associated with this module, mapped to discrete inputs 100057–100080. The table below shows the addressing for the status flags.

Error Flag Specifications								
	MSB							**LSB**
1st Byte of status flags						*100059*	*100058*	*100057*
Module Status	-	-	-	-	-	Data Not Valid	Missing 24VDC	Self Test Failed
2nd Byte of status flags								
Unused	-	-	-	-	-	-	-	-
3rd Byte of status flags								
Unused	-	-	-	-	-	-	-	-

Troubleshooting with Modbus Poll, continued

Slot 7:

BX-08AD-1. Modbus Input Registers 300013–300020. If a transducer is wired to channel 1, the value is read in Input Register 300013. There are 24 status flag bits associated with this module, mapped to discrete inputs 100081–100104. The table below shows the addressing for the status flags.

Error Flag Specifications								
	MSB							**LSB**
1st Byte of status flags						*100083*	*100082*	*100081*
Module Status	-	-	-	-	-	Data Not Valid	Missing 24VDC	Self Test Failed
2nd Byte of status flags								
	100096	*100095*	*100094*	*100093*	*100092*	*100091*	*100090*	*100089*
Channel Open (Broken Transmitter)	Channel 8	Channel 7	Channel 6	Channel 5	Channel 4	Channel 3	Channel 2	Channel 1
3rd Byte of status flags								
Unused	-	-	-	-	-	-	-	-

Slot 8:

BX-08DA-1. Modbus Holding Registers 400009-400016. If channel 1 is used to drive the speed reference of a VFD, the value is written to Holding Register 400009. There are 24 status flag bits associated with this module, mapped to discrete inputs 100105-100128. The table below shows the addressing for the status flags.

Error Flag Specifications								
	MSB							**LSB**
1st Byte of status flags						*100107*	*100106*	*100105*
Module Status	-	-	-	-	-	Data Not Valid	Missing 24VDC	Self Test Failed
2nd Byte of status flags								
Unused	-	-	-	-	-	-	-	-
3rd Byte of status flags								
Unused	-	-	-	-	-	-	-	-

Ready to connect with the Modbus Poll

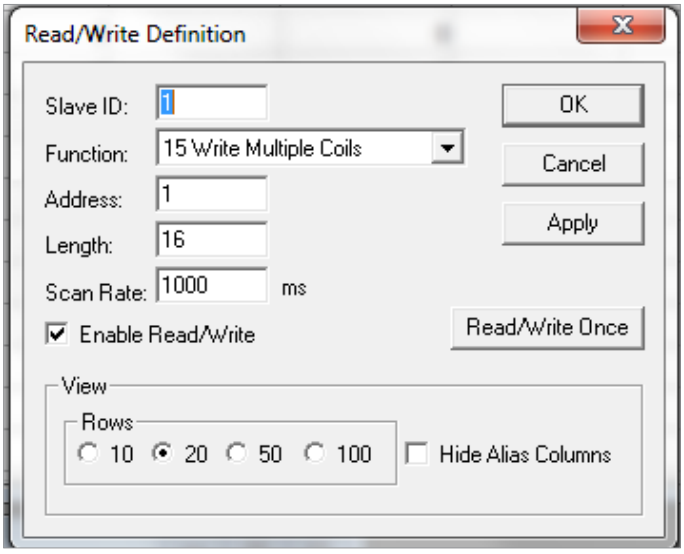
We have all the information we need to connect with our target BX-MBIO, as summarized below:

1. IP Address of BX-MBIO: 10.1.15.221
2. Coil addresses: 000001–000016. This covers the two relay output modules.
3. Discrete inputs: 100001–100128. This covers the discrete input addresses and the set of 24 status flags for each of the 5 analog I/O and temperature modules.
4. Input Registers: 300001–300020. This covers the analog and temperature input modules.
5. Holding Registers: 400001–400016. This covers the analog output modules.

With Modbus Poll running, we will start by setting up the read and write blocks for each group of addressing.

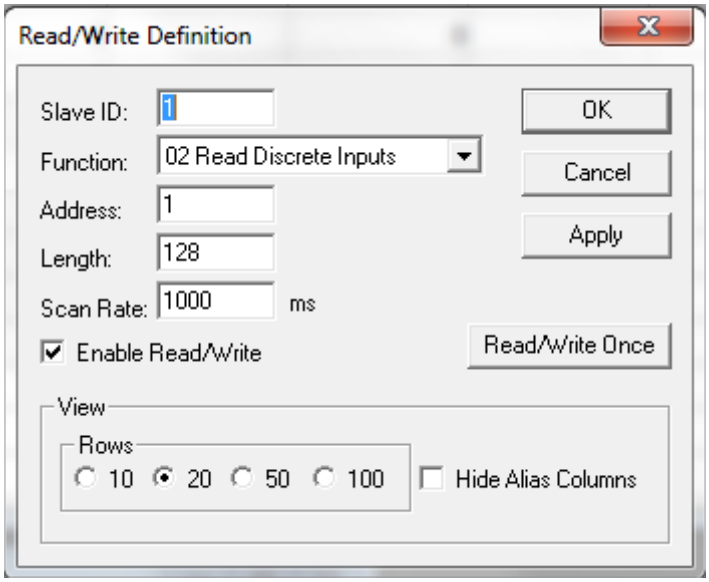
Troubleshooting with Modbus Poll, continued

For coils related to BX-05TRS and BX-08TR, use the Mbpoll1 window. Write to coils 1 to 16:



1. From the Display menu, select PLC Address (Base 1).
2. From the Setup menu, select Read/Write Definition.
   a. Slave ID = 1, change to match BX-MBIO module ID.
   b. Function = 15 Write Multiple Coils
   c. Address = 1
   d. Length = 16
   e. Scan rate = 1000ms (user preference)
   f. View rows = 20 (user preference)

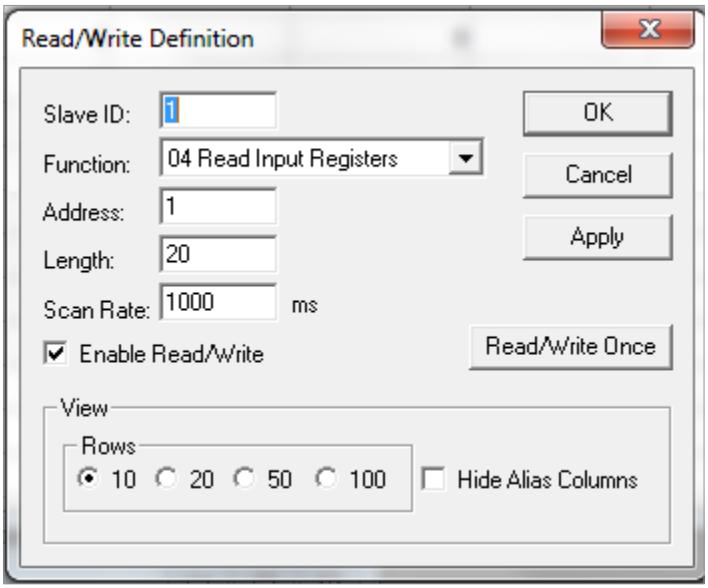
For discrete inputs related to the BX-08NA and the four groups of 24 status flags related to the analog and temperature modules, use the Mbpoll2 window. Read from discrete inputs 100001 to 100128.



Troubleshooting with Modbus Poll, continued

1. From the Display menu, select PLC Address (Base 1).
2. From the Setup menu, select Read/Write Definition.
   a. Slave ID = 1, change to match BX-MBIO module ID.
   b. Function = 02 Read Discrete Inputs
   c. Address = 1
   d. Length = 128
   e. Scan rate = 1000ms (user preference)
   f. View rows = 20 (user preference)

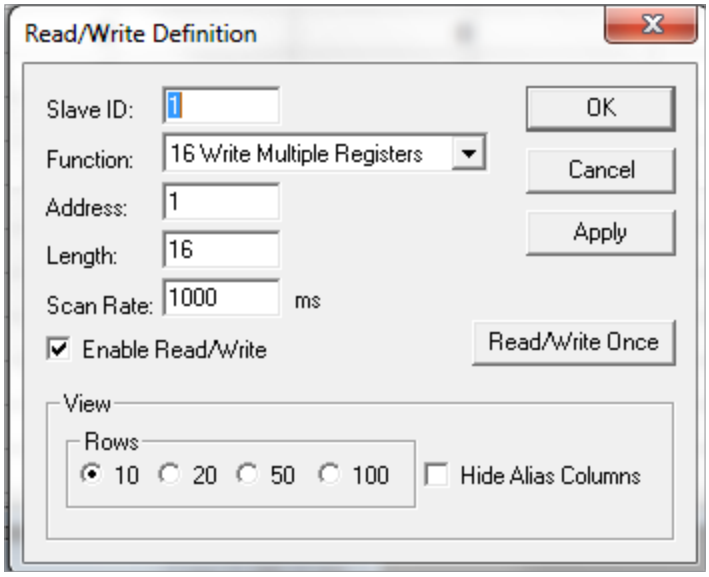
For input registers related to the BX-04THM, BX-08AD-2B and BX-08AD-1 modules, use the Mbpoll3 window. Read from input registers 300001 to 300020.



1. From the Display menu, select PLC Address (Base 1).
2. From the Setup menu, select Read/Write Definition.
   a. Slave ID = 1, change to match BX-MBIO module ID.
   b. Function = 04 Read Input Registers
   c. Address = 1
   d. Length = 20
   e. Scan rate = 1000ms (user preference)
   f. View rows = 10 (user preference)

Troubleshooting with Modbus Poll, continued

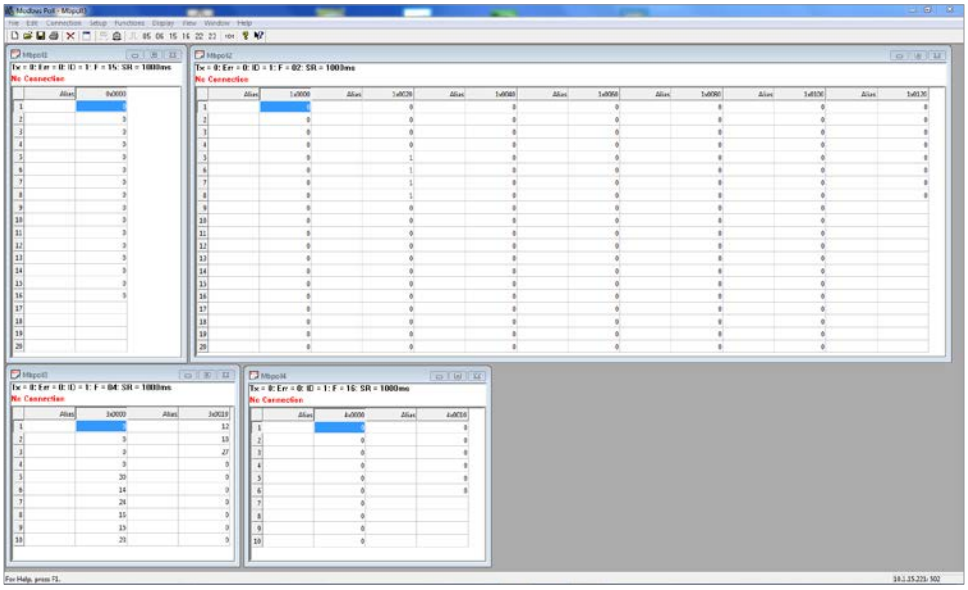
For holding registers related to the BX-08DA-2B and BX-08DA-1 modules, use the Mbpoll4 window. Read from holding registers 400001 to 400016.



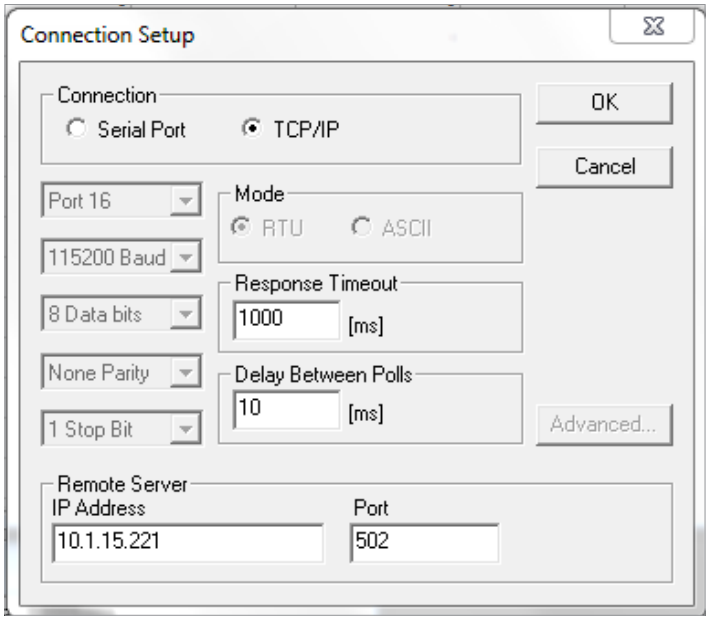
1. From the Display menu, select PLC Address (Base 1).
2. From the Setup menu, select Read/Write Definition.
   a. Slave ID = 1, change to match BX-MBIO module ID.
   b. Function = 16 Write Multiple Registers
   c. Address = 1
   d. Length = 16
   e. Scan rate = 1000ms (user preference)
   f. View rows = 10 (user preference)

Troubleshooting with Modbus Poll, continued

Once each addressing group is configured, the Modbus Poll screen should look as follows (user must re-size windows):



From the Connect menu, select Connect, to establish a connection with the BX-MBIO.



To setup the connection:

1. Connection = select TCP/IP.
2. Response timeout = 1000ms
3. Delay Between Polls = 10ms
4. IP Address = 10.1.15.221, the IP address of BX-MBIO
5. Port = 502

Troubleshooting with Modbus Poll, continued

Let's Get Some Values

Now that everything is wired, configured and mapped in Modbus Poll, we can write an output and see the corresponding input turn on. We will write an output from BX-08TR and that should turn on an input on the BX-08NA. We will then write a value to the analog output modules, BX-08DA-2B and BX-08DA-1 and we will see the input channel on the BX-08AD-2B and BX-08AD-1 display a value in the range of the output value.

Discrete I/O: BX-08TR to BX-08NA

- Coil 000009 turns on input 100001
- Coil 000010 turns on input 100002
- Coil 000011 turns on input 100003
- Coil 000012 turns on input 100004
- Coil 000013 turns on input 100005
- Coil 000014 turns on input 100006
- Coil 000015 turns on input 100007
- Coil 000016 turns on input 100008

Temperature input: BX-04THM wired to thermocouple

- Channel 1 data read to 300001
- Channel 2 data read to 300002
- Channel 3 data read to 300003
- Channel 4 data read to 300004

Analog I/O, voltage: BX-08DA-2B to BX-08AD-2B

- Output driven by 400001 wired to input value in 300005
- Output driven by 400002 wired to input value in 300006
- Output driven by 400003 wired to input value in 300007
- Output driven by 400004 wired to input value in 300008
- Output driven by 400005 wired to input value in 300009
- Output driven by 400006 wired to input value in 300010
- Output driven by 400007 wired to input value in 300011
- Output driven by 400008 wired to input value in 300012

Analog I/O, current: BX-08DA-1 to BX-08AD-1

- Output driven by 400009 wired to input value in 300013
- Output driven by 400010 wired to input value in 300014
- Output driven by 400011 wired to input value in 300015
- Output driven by 400012 wired to input value in 300016
- Output driven by 400013 wired to input value in 300017
- Output driven by 400014 wired to input value in 300018
- Output driven by 400015 wired to input value in 300019
- Output driven by 400016 wired to input value in 300020

Additional BX-EBC100 and BX-MBIO Modbus Mapping Information

Modbus Mapping for I/O

BX-EBC100 and BX-MBIO Discrete Input and Output Modbus Mapping				
Modbus Data Type (Bit)	**Memory Type**	**Address Range Bit (Input/Hold Registers)**	**Words (Bytes/Bits)**	**Access**
Coil	Discrete Output	000001 – 000512 (402001 – 402032)	32 (64/512)	R/W
Input	Discrete Inputs	100001 – 100512 (302001 – 302032) (411625 – 411656)"	32 (64/512)	R

BX-EBC100 and BX-MBIO Analog Input and Output Modbus Mapping				
Modbus Data Type (Word)	**Memory Type**	**Address Range Input/Hold Registers**	**Words (Bytes)**	**Access**
Input Register	Analog Input Register	300001 – 300128 (412251 – 412378)	128 (256)	R
Holding Register	Analog Output Register	400001 – 400128	128 (256)	R/W

System Memory Modbus Mapping

BX-EBC100 and BX-MBIO System Memory Modbus Mapping					
	Input Registers	**Holding Registers**	**Words (Bytes)**	**Description**	**Access**
Version Data	307001 307002 307003 307004 307005 307006	419251 419252 419253 419254 419255 419256	6 (12)	1 - OS Major Version 2 - OS Minor Version 3 - OS Build Version 4 - Booter Major Version 5 - Booter Minor Version 6 - Booter Build Version	R
MS Tick Data	307007 – 307008	419257 – 419258	2 (4)	Millisecond Tick Data Registers	R
Reserved*	307009 – 307010		2 (4)	Used by the System	
Device Data	307011 307012 307013 307014 307015 307016 – 307018 307019 307020 307021 307022 307023 307024 – 307027 307028 307029 307030 307031 307032 307033 307034 307035 307036 – 307041 307042 – 307100	419261 419262 419263 419264 419265 419266 – 419268 419269 419270 419271 419272 419273 419274 – 419277 419278 419279 419280 419281 419282 419283 419284 419285 419286 – 419291 419292 – 419350	90 (180)	1 - Version of Device 2 - Family 3 - Processor 4 - Module Type 5 - Status Code (6-8) - Ethernet Address 9 - RAM Size 10 - Flash Size 11 - Batt Switch 12 - DIP Settings 13 - Media Type (14-17) - Reserved* 18 - Model Number 19 - Ethernet Speed 20 - Reserved* 21 - IO -tal Byte Count 22 - Bit Input Byte Count 23 - Bit Output Byte Count 24 - Non-bit Input Byte Count 25 - Non-bit Output Byte Count (26-31) - IP Configuration (32-90) Reserved*	R

Table continued on next page

Additional BX-EBC100 & BX-MBIO Modbus Mapping Info, continued

BX-EBC100 and BX-MBIO System Memory Modbus Mapping (continued)					
	Input Registers	**Holding Registers**	**Words (Bytes)**	**Description**	**Access**
Module IDs	307101 – 307109	419351 – 419359	9 (18)	I/O module ID numbers per slot location. Address 307102 (419352) is for the first expansion I/O module, Slot 1.	R
Module Information	307201 – 307204 Slot 1 307205 307206 307207 307208 307209 – 307236	419451 – 419454 Slot 1 419455 419456 419457 419458 419459 – 419486	36 (72)	(4 words per slot) Slot 0 words; Reserved* Slot 1 words: 1 - Bit Input Count 2 - Bit Output Count 3 - Non-bit Input Count 4 - Non-bit Output Count Words for Slot 2 to Slot 8	R
I/O Module Status	307401 – 307420 Slot 1 307421 307422 307423 – 307440 307441 – 307580 307581 – 307600	419651 – 419670 Slot 1 419671 419672 419673 – 419690 419691 – 419830 419831 – 419850	200 (400)	(20 words per slot) Slot 0 words; Reserved* Slot 1 words: 1 - Flags with bits indicating presence of an Error Bit 0: If set, indicates that Error Value is non-zero 2 - Error Code - refer to Error Codes Table. 3 - 20: Reserved* Words for Slot 2 to Slot 8 Reserved*	R
Reserved*		404001 – 408096	4096 (8192)	Used by system	
Dynamic Data		410001 410002 – 410006 410007 410008 – 410020	20 (40)	Words per BX-EBC100 1 - Refer to Error Codes Table. Bits 0 to 11: Error code. Bit 12: Module error exists. May be triggered by: 1. Internal Error 2. Too much I/O to fit into the internal buffer Bits 13 to 15: Reserved for system use. Example of error E126: 410001 = 4222 = 107E (hex), Where 126 = 7E (hex), plus 4096 when bit 12 is on. 2–6 - Reserved* 7 - Link Monitor Timeout (EBC communication watchdog timer) - 0 to disable; range 0 - 10000ms. 8-20 - Reserved*	R W
Reserved*		410021 – 410276	256 (512)	Used by system	
Reserved*		411125 – 411188	64 (128)	Used by system	
Reserved*		419259 – 419260	2 (4)	Used by system	
Reserved*		460001 – 460200	200 (400)	Used by system	

Reserved - used by system. User should not write to these addresses.

Additional BX-EBC100 & BX-MBIO Modbus Mapping Info, continued

Error Codes

BX-EBC100 and BX-MBIO Error Codes		
Error Code	**Description**	**Additional Information**
E000	No Error	
E013	This is a buffer overflow condition	This error indicates an internal buffer overflow condition that should be reported.
E119	Data not valid.	This error indicates that more I/O was found in the system than the firmware can handle. Can also be an internal error that should be reported.
E126	Module is write protected.	This Error can show up if the module is activeliy being used by a Do-more! PLC. Also, this error may be the result of DIP switch 5 being on which write-protects the module. Several functions are not available while the module is being used from a Do-more! PLC.
E165	Module configuration is incorrect.	This Error indicates that the I/O configuration has changed from what has been stored for things such as analog config data. Moving configured analog modules around in the base will cause this error. The configuration will need to be re-written to fix this.

Notes:

BRX Do-more! Maintenance and Troubleshooting



In This Appendix...

Hardware Maintenance A-2
Diagnostics A-3
CPU Indicators A-5
PWR Indicator A-6
RUN Indicator A-7
ERR Indicator A-7
Communications Problems A-7
I/O Troubleshooting A-8
Noise Troubleshooting A-10

Hardware Maintenance

Standard Maintenance

The BRX Platform is a low maintenance system requiring only a few periodic checks to help reduce the risks of problems. Routine maintenance checks should be made regarding two key items.

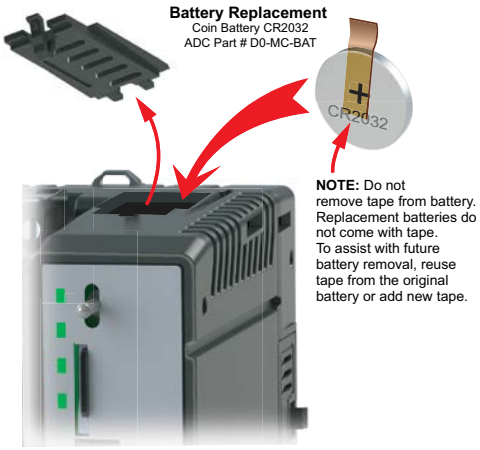
- Air quality (cabinet temperature, airflow, etc.)
- CPU battery

Air Quality Maintenance

The quality of the air your system is exposed to can affect system performance. If you have placed your system in an enclosure, check to see that the ambient temperature is not exceeding the operating specifications. If there are filters in the enclosure, clean or replace them as necessary to ensure adequate airflow. A good rule of thumb is to check your system environment every one to two months. Make sure the BRX Platform is operating within the system operating specifications.

CPU Battery Replacement

A battery is included with the CPU. When installed, the time and date along with retentive memory values will be retained. The battery is not needed for program backup. It is recommended that the battery be replaced annually.



Battery (Optional)	
D0-MC-BAT	Coin type, 3.0 V Lithium battery, 190mAh, battery number CR2032

NOTE: *Proper orientation of battery is with the "+" symbol facing left when viewed from front of MPU.*

Diagnostics

Diagnostics

Your BRX MPU performs many predefined diagnostic routines with every CPU scan. The diagnostics have been designed to detect various types of failures for the CPU and I/O modules. There are two primary error classes, critical and non-critical.

Critical Errors

Critical errors are errors the CPU has detected that present a risk of the system not functioning safely or properly. If the CPU is in Run Mode when the critical error occurs, the CPU will switch to Stop Mode (Remember, in Stop Mode all outputs are turned off). If the critical error is detected while the CPU is in Stop Mode, the CPU will not enter Run Mode until the error has been corrected. Here are some examples of critical errors:

- Power supply failure
- Parity error or CPU malfunction
- I/O configuration errors
- Certain programming errors.

Non-Critical Errors

Non-critical errors are flagged by the CPU as requiring attention. They can neither cause the CPU to change from Run Mode to Stop Mode, nor do they prevent the CPU from entering Run Mode. There are system memory addresses that the application program references to detect if a non-critical error has occurred. The application program can be used to take the system to an orderly shutdown or to switch the CPU to Stop Mode if necessary.

Some examples of non-fatal errors are:

- Backup battery voltage low
- Certain programming errors

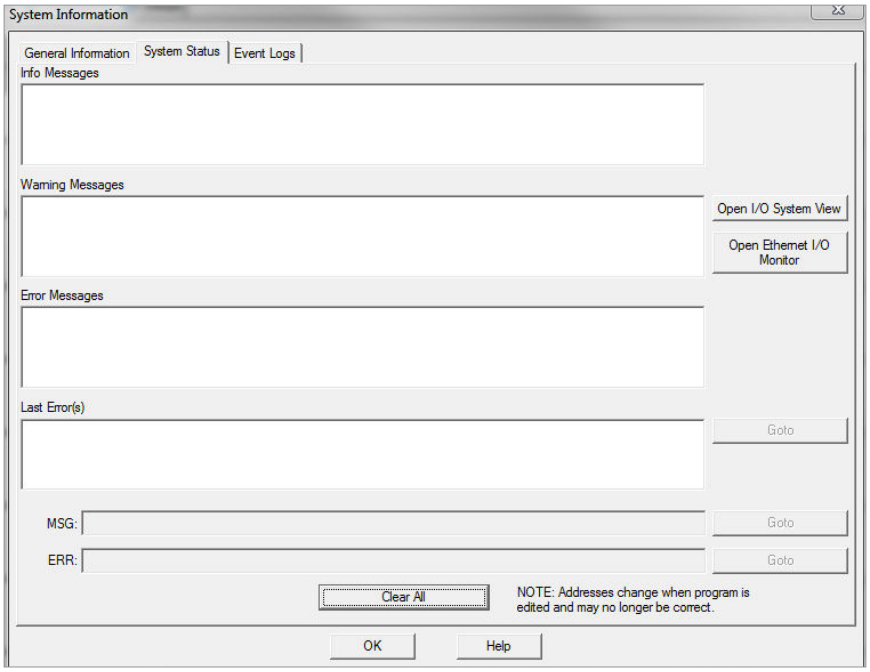


NOTE: *Please refer to Appendix D for the error code list.*

Finding Diagnostic Information

The CPU automatically logs critical and non-critical error codes. Logged errors can be found in the following places marked with a time and date stamp:

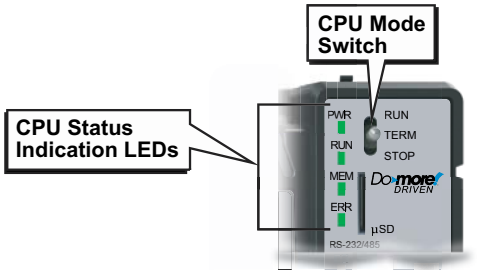
- Under the PLC menu item, select System Information and then pick the System Status tab. All errors and messages are shown here.
- Also check the Event Log tab for further system status.



NOTE: *Please refer to Appendix D for the error code list.*

CPU Indicators

The BRX MPU has indicators on the faceplate to help diagnose problems with the system. The table below gives a quick reference of potential problems associated with each status indicator. The pages following the table contain a detailed analysis of each of these problems.



CPU Status Indicators		
Indicator	**Status**	**Description**
PWR	OFF	Base power OFF
	Green	Base power ON
	Yellow	Low battery
RUN	OFF	CPU is in STOP (Program) mode
	Green	CPU is in RUN mode
	Yellow	Forces are active
MEM	OFF	No ROM activity, No SD card
	Green	SD Card installed and mounted*
	Yellow	ROM activity (Flash or SD card)
	Red	microSD Card installed and not mounted*
ERR	OFF	CPU is functioning normally
	Red	CPU fatal hardware error or software watchdog error

**** A microSD card will become "mounted" once the MPU recognizes the microSD card and renders it accessible for use.***



CPU Mode Switch	
Position	**Description**
RUN	Puts the CPU into RUN mode - assuming there are no issues that prevent it from happening, like errors in the project currently loaded in the CPU, or a problem with the hardware.
TERM	Allows the Do-more! Designer programming software to set the CPU's mode using the "Set PLC Mode" utility.
STOP	Puts the CPU into Stop (Program) mode which stops running the currently loaded project.

PWR Indicator

There are three general reasons for the CPU power status LED (PWR) to be OFF:

1. Power to the MPU is incorrect or is not applied.
2. MPU power supply is faulty.
3. Other component(s) have the power supply shut down.

Incorrect MPU Power

If the voltage to the power supply is not correct, the MPU may not operate properly or may not operate at all. Use the following guidelines to correct the problem.



WARNING: To minimize the risk of electrical shock, always disconnect the system power before inspecting the physical wiring.

1. First, disconnect the system power and check all incoming wiring for loose connections.
2. If you are using a separate termination panel, check those connections to make sure the wiring is connected to the proper location.
3. If the connections are acceptable, reconnect the system power and measure the voltage at the power supply connection terminal block to ensure it is within specification. If the voltage is not correct, shut down the system and correct the problem.
4. If all wiring is connected correctly and the incoming power is within the specifications required, the MPU should be replaced.

Faulty MPU

There is no simple test for a faulty MPU other than substituting a known good one to see if this corrects the problem. If you have experienced major power surges, it is possible the MPU has been damaged. If you suspect this is the cause, a line conditioner should be installed on the incoming line. This will keep damaging voltage spikes from reaching the MPU.

External Device or Module Causes the Power Supply to Shutdown

Module:

If the Power LED is not lit, remove all modules including a POM module (if present) from the BRX Platform and reapply power. If the Power LED is still unlit, then the BRX unit has sustained damage and will need to be replaced.

External Device:

External influence from a communications port.

Test as follows:

1. Turn off power to the BRX Platform.
2. Disconnect all external devices (i.e., communication cables) from the BRX Platform.
3. Reapply power.
4. If power supply operates normally then check for a shorted device or shorted cable.

RUN Indicator

If the CPU will not enter the Run mode (the RUN indicator is off), the problem is usually in the application program, unless the CPU has a critical error. If a critical error has occurred, the ERR LED should be on. You can use Do-more! Designer Software to determine the cause of the error.

When the RUN LED is yellow it indicates the CPU has one or more memory locations with Forced values.

ERR Indicator

If the ERR indicator is OFF, it means the CPU is functioning normally. If the ERR indicator is ON, the CPU has experienced one or more of the following conditions:

- A Fatal Hardware Error.
- A Software Watchdog Error has occurred.
- An I/O module has been removed while the CPU is in RUN mode.
- An I/O module in an Ethernet I/O Slave drop is not present.

If rebooting the BRX Platform clears the error, you should monitor the system and determine what caused the problem. You will find this problem is sometimes caused by high frequency electrical noise introduced into the MPU from an outside source. Check your system grounding and install electrical noise filters if the grounding is suspected. If power cycling the system does not reset the error, or if the problem returns, you should replace the MPU.

The ERR indicator can be made to BLINK from the Edit Link dialog in order to help identify the CPU. This is helpful where you may have multiple MPUs in a cabinet.

Communications Problems

If you cannot establish communications with the MPU, check these items:

- The cable is disconnected.
- The cable has a broken wire or has been wired incorrectly.
- The cable is improperly terminated or grounded.
- The device connected is not operating at the correct baud rate.
- The device connected to the port is sending data incorrectly.
- A grounding difference exists between the two devices.
- Electrical noise is causing intermittent errors.
- If it is determined that a built-in CPU communications port is bad, the MPU should be replaced. If it is a POM communications port, just replace the POM port.

I/O Troubleshooting

Things to Check

If you suspect an I/O error, there are several things that could be causing the problem:

- A blown fuse
- A loose terminal block
- The 24VDC supply has failed or 24VDC has not been supplied to the I/O common.
- The I/O point has failed.

Error Codes

Also, in the Do-more! Designer software, you can go to the PLC menu item, select System Information and then pick the System Status tab.

All errors and messages are shown here. Also check the Event Log for further information on system status such as rebooting.

Some Quick Steps

When troubleshooting the BRX Platform I/O there are a few facts you should be aware of which may assist you in quickly correcting an I/O problem:

- The CPU cannot detect shorted or open output points. If you suspect one or more points on an output module to be faulty, you should measure the voltage drop from the common to the suspect point. Remember, when using a Digital Volt Meter, leakage current from an output device, such as a triac or a transistor, must be considered. A point which is off may appear to be ON if no load is connected to the point.
- The I/O point status indicators on the modules are logic side indicators. This means the LED which indicates the ON or OFF status reflects the status of the point in respect to the CPU. For an output module, the status indicators could be operating normally, while the actual output device (transistor, Triac etc.) could be damaged. With an input module, if the indicator LED is ON, the input circuitry should be operating properly. To verify proper functionality, check to see that the LED goes off when the input signal is removed.
- Leakage current can be a problem when connecting field devices to I/O points. False input signals can be generated when the leakage current of an output device is great enough to turn on the connected input device. To correct this, install a resistor in parallel with the input or output of the circuit. The value of this resistor will depend on the amount of leakage current and the voltage applied but usually a 10kΩ to 20kΩ resistor will work. Verify that the wattage rating of the resistor is correct for your application.
- The easiest method to determine if an I/O point has failed is to replace the MPU or the expansion module if you have a spare. However, if you suspect another device to have caused the failure in the MPU or the expansion module, that device may cause the same failure in the replacement as well. As a point of caution, you may want to check devices or power supplies connected to the failed MPU or expansion module before replacing it with a spare.

Testing Output Points

Output points can be set ON or OFF using the force function to override a point even while the program is running. However, this is not a recommended method to test the output points.



NOTE: *RUN LED will turn Yellow when one or more outputs are forced.*



WARNING: Depending on your application, forcing I/O points may cause unpredictable machine operation that can result in a risk of personal injury or equipment damage. Make sure you have taken all appropriate safety precautions prior to testing any I/O points.

If you want to do an I/O check independent of the application program, follow the procedure in the table below:

I/O Check Procedure

Step	Action
1.	Use Do-more! Designer software to communicate on-line to the CPU.
2.	Change to Program Mode.
3.	Go to the first rung of $Main. All System Tasks should be disabled by following Step 4 as well.
4.	Insert a rung with an “END” statement. (This will cause program execution to occur only at address 0 and prevent the application program from turning the I/O points on or off).
5.	Change to Run Mode.
6.	Use the programming device to set (turn) on or off the points you wish to test.
7.	When you finish testing I/O points delete the “END” statement at the first rung.

Noise Troubleshooting

Electrical Noise Problems

Noise is one of the most difficult problems to diagnose. Electrical noise, whether conducted or radiated, can enter a system in many different ways. It may be difficult to determine how the noise is entering the system but the corrective actions for either type of noise problem are similar.

Conducted noise is when the electrical interference is introduced into the system by way of an attached wire, panel connection, etc. It may enter through an I/O point, a power supply connection, the communication ground connection, or the chassis ground connection.

Radiated noise is when electrical interference is introduced into the system without a direct electrical connection such as radio waves.

Reducing Electrical Noise

While electrical noise cannot be eliminated completely, it can be reduced to a level that will not affect system function. Proper grounding of components and signal wiring along with proper isolation of voltages can minimize noise in the system.

1. Grounding:

   Most noise problems result from improper grounding of the system. A good earth ground can be the single most effective way to correct noise problems. If a ground is not available, install a ground rod as close to the system as possible.

   Ensure all ground wires are single point grounds and are not daisy chained from one device to another. Ground metal enclosures around the system. A loose wire is no more than a large antenna waiting to introduce noise into the system; therefore, you should tighten all connections in your system. Loose ground wires are more susceptible to noise than the other wires in your system. Review Chapter 1, "General Installation and Wiring Guidelines", if you have questions regarding how to ground your system.

2. Isolation:

   Electrical noise can enter the system through the power source for the MPU and I/O. Installing an isolation transformer for all AC sources can correct this problem.

   DC power sources should be properly grounded, except for Class II power supplies. Switching DC power supplies commonly generate more noise than linear supplies.

   Place input and output wiring in separate wireways or wiring bundles. Keep AC and DC wiring separated as well. Never run I/O wiring parallel or close proximity to high voltage wiring.

EU Directives (CE)



In This Appendix...

European Union (EU) Directives B-2
Basic EMC Installation Guidelines B-5

European Union (EU) Directives



NOTE: *The information contained in this section is intended as a guideline and is based on our interpretation of the various standards and requirements. Since the actual standards are issued by other parties, and in some cases governmental agencies, the requirements can change over time without advance warning or notice. Changes or additions to the standards can possibly invalidate any part of the information provided in this section.*

This area of certification and approval is absolutely vital to anyone who wants to do business in Europe. One of the key tasks that faced the EU member countries and the European Economic Area (EEA) was the requirement to bring several similar yet distinct standards together into one common standard for all members. The primary purpose of a single standard was to make it easier to sell and transport goods between the various countries and to maintain a safe working and living environment. The Directives that resulted from this merging of standards are now legal requirements for doing business in Europe. Products that meet these Directives are required to have a CE mark to signify compliance.

Member Countries

As of January 1, 2015, the members of the EU are Austria, Belgium, Bulgaria, Croatia, Republic of Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, and United Kingdom. Iceland, Liechtenstein, and Norway together with the EU members make up the European Economic Area (EEA) and all are covered by the Directives.

Applicable Directives

There are several Directives that apply to our products. Directives may be amended, or added, as required.

- **Electromagnetic Compatibility (EMC) Directive** — this Directive attempts to ensure that devices, equipment, and systems have the ability to function satisfactorily in an electromagnetic environment without introducing intolerable electromagnetic disturbance to anything in that environment.
- **Machinery Safety Directive** — this Directive covers the safety aspects of the equipment, installation, etc. There are several areas involved, including testing standards covering both electrical noise immunity and noise generation.
- **Low Voltage Directive (LVD)** — this Directive is also safety related and covers electrical equipment that has voltage ranges of 50–1000VAC and/or 75–1500VDC.
- **Battery Directive** — this Directive covers the production, recycling, and disposal of batteries.

Compliance



NOTE: *As of July 22, 2017 ROHS has been added as an additional requirement for CE Compliance per Directive 2011/65/EU. All products bearing the CE mark must be ROHS compliant.*

Certain standards within each Directive already require mandatory compliance. The EMC Directive, which has gained the most attention, became mandatory as of January 1, 1996. The Low Voltage Directive became mandatory as of January 1, 1997.

Ultimately, we are all responsible for our various pieces of the puzzle. As manufacturers, we must test our products and document any test results and/or installation procedures that are necessary to comply with the Directives. As an end user, you are responsible for installing the products applying "good engineering practices" and in a manner which will ensure compliance is maintained. You are also responsible for testing

any combinations of products that may (or may not) comply with the Directives when used together. The end user of the products must comply with any Directives that may cover maintenance, disposal, etc. of equipment or various components. *Although we strive to provide the best assistance available, it is impossible for us to test all possible configurations of our products with respect to any specific Directive. Because of this, it is ultimately your responsibility to ensure that your machinery (as a whole) complies with these Directives and to keep up with applicable Directives and/or practices that are required for compliance.*

This then is the product specific standard for CPUs and covers the low voltage and EMC directives as required for European CE certification. This standard has many tests together with test procedures and limits, but also references the below standards for some tests.

IEC 60068	IEC 60417	IEC 60664	IEC 60695	IEC 60707	IEC 60947	IEC 60950	IEC 61000	IEC 61010
-2-1:1990 Part 2 Test A	All Parts	-1:1992 Part 1	-2-1 (all sheets) Part 2	:1999	-5-1:1997 Part 5-1	-1:2001 Part 1	-4-2:1995 Part 4-2	-1:2001 Part 1
-2-2:1974 Part 2 Test B		-3:1992			-7-1:2002 Part 7-1		-4-3:2002 Part 4-3	
-2-6:1995 Part 2: Test Fc							-4-4:1995	
-2-6:1995 Part 2: Test Fc		CISPR 11:1999					-4-5:1995 Part 4-5	
-2-14:1984 Part 2 Test N		CISPR 16-1:1999 Part 1					-4-6:1996 Part 4-6	
-2-27:1987 Part 2 Test Ea		CISPR 16-2:1999 Part 2					-4-8:1993 Part 4-8	
-2-30:1980 Part 2 Test Db							-4-12:1995 Part 4-12	
-2-31:1969 Part 2 Test Ec								
-2-32:1975 Part 2 Test Ed								

For undated references, the latest edition of the referenced document (including any amendments) applies.

The BRX system, manufactured by HOST Engineering, when properly installed and used, conforms to the Electromagnetic Compatibility (EMC), Low Voltage Directive, and Machinery Directive requirements of the following standards:

- **Product Specific Standard for Programmable Controllers**

  EN61131–2:2003 Programmable controllers, equipment requirements and tests.

- **Warning on Electrostatic Discharge (ESD)**

  We recommend that all personnel take necessary precautions to avoid the risk of transferring static charges within the control cabinet and provide clear warnings and instructions on the cabinet exterior. Such precautions may include the use of earth straps, grounding mats and similar static-control devices, or the powering off of the equipment inside the enclosure before the door is opened.

- **Warning on Radio Interference (RFI)**

  This is a class A product. In a domestic environment this product may cause radio interference in which case the user may be required to take adequate preventative measures.

General Safety

- External switches, circuit breaker or external fusing are required for these devices.
- The switch or circuit breaker should be mounted near the programmable controller equipment.

Other Sources of Information

Although the EMC Directive gets the most attention, other basic Directives such as the Machinery Directive and the Low Voltage Directive, also place restrictions on the control panel builder. Because of these additional requirements it is recommended that the following publications be purchased and used as guidelines:

- BSI publication BS TH 42073: November 2000 – covers the safety and electrical aspects of the Machinery Directive
- EN 60204–1:2006 – Safety of Machinery; General electrical requirements for machinery, including Low Voltage and EMC considerations
- IEC 61000–5–2: EMC earthing and cabling requirements
- IEC 61000–5–1: EMC general considerations

It may be possible for you to obtain this information locally; however, the official source of applicable Directives and related standards is:

Publications Office
2, rue Mercier
2985 Luxembourg
LUXEMBOURG

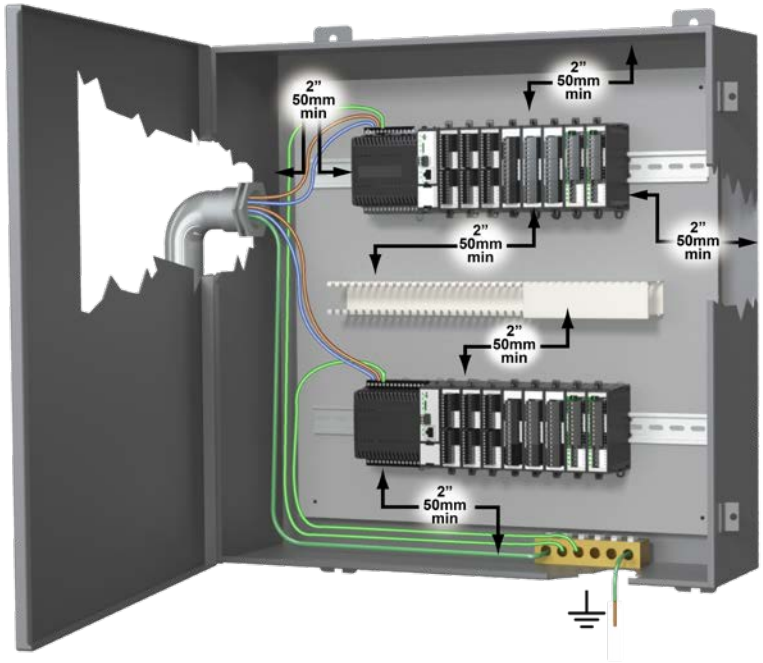
Quickest contact is via the web at:
http://ec.europa.eu/growth/single-market/european-standards/harmonised-standards.

The 'Blue Guide' on the implementation of EU product rules 2016
http://ec.europa.eu/DocsRoom/documents/18027/

Basic EMC Installation Guidelines

Enclosures

The simplest way to meet the safety requirements of the Machinery and Low Voltage Directives is to house all control equipment in an industry standard lockable steel enclosure. This normally has an added benefit because it will also help to reduce EMC emissions. Although the RF emissions from the programmable controller equipment, when measured in the open air, are well below the EMC Directive limits, certain configurations can increase emission levels. Holes in the enclosure, for the passage of cables or to mount operator interfaces, can increase emissions.



Mains Filters

All AC powered BRX units must be wired through an in line mains filter of type Schaffner FN 2010-1-06, or similar design. The equipment must be properly installed while adhering to the guidelines of the BRX user guide, the BRX installation manual and the installation standards IEC 1000-5-1, IEC 1000-5-2 and IEC 1131-4. It is a requirement that all PLC equipment be housed in a protective steel enclosure, which limits access to operators by a lock and power breaker and that all cables which exit the enclosure, do so through metallic conduit. If access is required by operators or untrained personnel, the PLC equipment must be installed inside an internal cover or secondary enclosure. It should be noted that the safety requirements of the machinery directive standard EN60204-1 state that all PLC power circuits must be wired through isolation transformers or isolating power supplies, and that one side of all AC or DC control circuits must be earthed. Both power input connections to the PLC equipment must be separately fused using 3 amp T-type anti-surge fuses, and a transient suppressor fitted to limit supply over voltages.

Suppression and Fusing

In order to comply with the fire risk requirements of the Low Voltage and Machinery Directive standards EN 61010–1 and EN 60204–1, it is necessary to fuse both sides of the power inputs (on both AC and DC units).

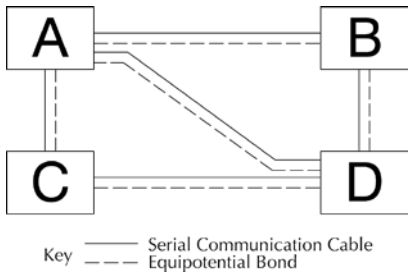
Transient suppressors must be protected by fuses and the capacity of the transient suppressor must be greater than the blow characteristics of the fuses or circuit breakers to avoid a fire risk. A recommended AC supply input arrangement for the BRX is to use twin 3 amp TT fused terminals with fuse blown indication, such as DINnectors DN–F10L terminals, or twin circuit breakers.

Internal Enclosure Grounding

A heavy-duty star earth terminal block should be provided in every cubicle for the connection of all earth ground straps, protective earth ground connections, mains filter earth ground wires, and mechanical assembly earth ground connections. This should be installed to comply with safety and EMC requirements, local standards, and the requirements found in IEC 61000–5–2. The Machinery Directive also requires that the common terminals of the programmable controller input modules, and common supply side of loads driven from programmable controller output modules should be connected to the protective earth ground terminal.

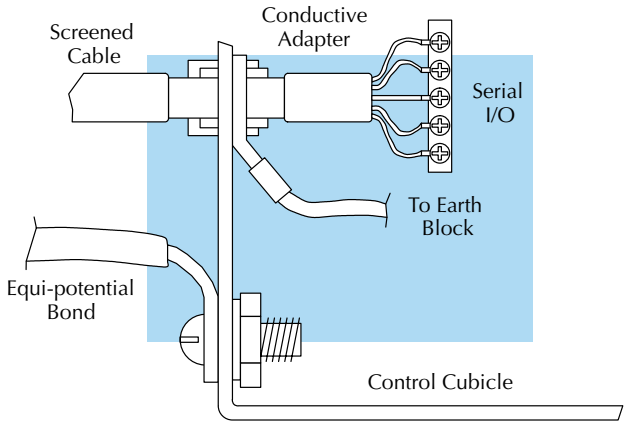
Equipotential Grounding

Adequate site earth grounding must be provided for equipment containing modern electronic circuitry. The use of isolated earth electrodes for electronic systems is forbidden in some countries. Make sure you check any requirements for your particular destination. IEC 61000–5–2 covers equipotential bonding of earth grids adequately, but special attention should be given to apparatus and control cubicles that contain I/O devices, remote I/O racks, or have inter-system communications with the primary CPU system enclosure.



An equipotential bond wire must be provided alongside all serial communications cables, and to any separate items of the plant which contain I/O devices connected to the programmable controller. The diagram above shows an example of four physical locations connected by a communications cable.

Communications and Shielded Cables



Good quality 24AWG minimum twisted-pair shielded cables, with overall foil and braid shields are recommended for analog cabling and communications cabling outside of the programmable controller enclosure. To date it has been a common practice to only provide an earth ground for one end of the cable shield in order to minimize the risk of noise caused by earth ground loop currents between apparatus. The procedure of only grounding one end, which primarily originated as a result of trying to reduce hum in audio systems, is no longer applicable to the complex industrial environment. Shielded cables are also efficient emitters of RF noise from the CPU system, and can interact in a parasitic manner in networks and between multiple sources of interference.

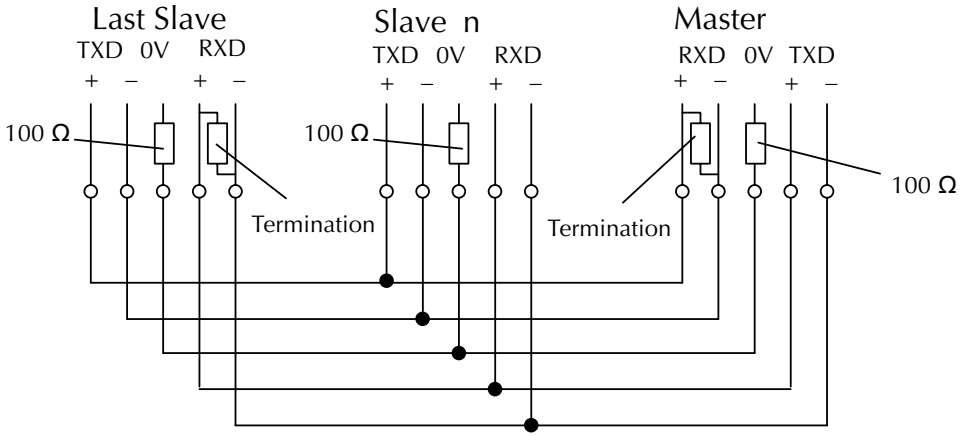
The recommendation is to use shielded cables as electrostatic "pipes" between apparatus and systems, and to run heavy gauge equipotential bond wires alongside all shielded cables. When a shielded cable runs through the metallic wall of an enclosure or machine, it is recommended in IEC 61000–5–2 that the shield should be connected over its full perimeter to the wall, preferably using a conducting adapter, and not via a pigtail wire connection to an earth ground bolt. Shields must be connected to every enclosure wall or machine cover that they pass through.

Analog and RS232 Cables

Providing an earth ground for both ends of the shield for analog circuits provides the perfect electrical environment for the twisted pair cable as the loop consists of signal and return, in a perfectly balanced circuit arrangement, with connection to the common of the input circuitry made at the module terminals. RS232 cables are handled in the same way.

Multi-drop Cables

RS422 twin twisted pair, and RS485 single twisted pair cables also require a 0V link, which has often been provided in the past by the cable shield. It is now recommended that you use triple twisted pair cabling for RS422 links, and twin twisted pair cable for RS485 links. This is because the extra pair can be used as the 0V inter-system link. With loop DC power supplies earth grounded in both systems, earth loops are created in this manner via the inter-system 0v link. The installation guides encourage earth loops, which are maintained at a low impedance by using heavy equipotential bond wires. To account for non–European installations using single-end earth grounds, and sites with far from ideal earth ground characteristics, we recommend the addition of 100 ohm 1/8 watt resistors at each 0V link connection in network and communications cables.



Shielded Cables Within Enclosures

When you run cables between programmable controller items within an enclosure which also contains susceptible electronic equipment from other manufacturers, remember that these cables may be a source of RF emissions. There are ways to minimize this risk. Standard data cables connecting CPUs and/or operator interfaces should be routed well away from other equipment and their associated cabling. You can make special serial cables where the cable shield is connected to the enclosure's earth ground at both ends, the same way as external cables are connected.

Analog I/O and RF Interference

The readings from all analog I/O will be affected by the use of devices that exhibit high field strengths, such as mobile phones and motor drives.

All AutomationDirect products are tested to withstand field strength levels up to 10V/m, which is the maximum required by the relevant EU standards. While all products pass this test, analog I/O will typically exhibit deviations of their readings. This is quite normal, however, systems designers should be aware of this and plan accordingly.

When assembling a control system using analog I/O, these issues must be adhered to and should be integrated into the system design. This is the responsibility of the system builder/commissioner.

Network Isolation

For safety reasons, it is a specific requirement of the Machinery Directive that a keyed switch must be provided that isolates any network input signal during maintenance, so that remote commands cannot be received that could result in the operation of the machinery. To avoid the introduction of noise into the system, any keyed switch assembly should be housed in its own earth grounded steel box and the integrity of the shielded cable must be maintained.

Again, for further information on EU directives we recommend you check the EU Commission's official web site at:

http://ec.europa.eu/growth/single-market/european-standards/harmonised-standards.

It is good Engineering practice to install toroid inductors on the I/O wiring and the communications cables such as listed in the table below.

Toroid Inductors

Manufacturer	Mfg. Part Number	Outside Diameter	Inside Diameter	Length
RS Online	2606795	17.5 mm	9.5 mm	28.5 mm
Fair-Rite	2643665702	17.45 mm	9.5 mm	28.6 mm
Wurth Elektronick	7427009	17.5 mm	9.5 mm	28.5 mm

Items Specific to BRX

- The rating between all circuits in this product are rated as basic insulation only, as appropriate for single fault conditions.
- It is the responsibility of the system designer to earth one side of all control and power circuits, and to earth the braid of screened cables.
- This equipment must be properly installed while adhering to the installation standards IEC 61000–5–1, IEC 61000–5–2 and IEC 61131–4.
- It is a requirement that all CPU equipment must be housed in a protective steel enclosure, which limits access to operators by a lock and power breaker. If access is required by operators or untrained personnel, the equipment must be installed inside an internal cover or secondary enclosure.
- It should be noted that the safety requirements of the machinery directive standard EN60204–1 state that all equipment power circuits must be wired through isolation transformers or isolating power supplies, and that one side of all AC or DC control circuits must be earthed.
- Both power input connections to the programmable controller must be separately fused using three (3) amp T-type anti–surge fuses, and a transient suppressor fitted to limit supply over-voltages.
- If the equipment is used in a manner not specified by the manufacturer the protection provided by the equipment may be impaired.

Notes:

BRX MPU Power Budgeting



In This Appendix...

BRX MPU Power Budget C-2
Power Budget Form C-2
Power Budget Worksheet C-3
BRX MPU Available Expansion Power C-3
BRX I/O Controller Available Expansion Power C-4
BRX MPU POM Power Consumed C-5
BRX MPU Expansion Module Power Consumed C-5
Power Budget Examples C-8

BRX MPU Power Budget

The BRX MPU will automatically calculate the power budget, online or offline, taking into account the added expansion modules. However, since there is a limited amount of power available to supply the expansion modules, the power budget should be taken into account when designing a BRX system, to be sure that the system will perform as expected.

A general rule of thumb is that when there are 32 or more points of relay expansion modules in a system, a power budget calculation must be performed to ensure that there is enough available power to accommodate all expected modules.

On the following pages you will find a worksheet and power budget tables to help you determine your system total power budget requirement. If the calculations exceeds the total available power, you may need to consider using an additional MPU or using a Remote I/O solution to satisfy the system requirements.

Examples are also included to help show how the calculations should be performed.



NOTE: *The Power Budget calculation applies only to backplane power supplied by the MPU or Remote I/O controller. Some expansion modules also require external power supplied directly to the module, which is not included in this calculation.*



WARNING: It is extremely important to calculate the power budget. If you exceed the power budget, the system may operate in an unpredictable manner which may result in a risk of personal injury or equipment damage.

Power Budget Form

1. Find the Watts available for the BRX MPU that you will be using. Put this value in line 1 - MPU section of the worksheet.
2. If you are using a POM (Pluggable Option Module), find the watts consumed and put this value in line 2 - POM section of the worksheet.
3. For each Expansion Module that you will be using, find the watts consumed and put this value in the appropriate slot that the module will reside in, lines 3 through 10.
4. Add the values located in the POM Watts and Slot 1 through 8, lines 2 through 10. Write the value of this sum in line 11 - Total Watts Consumed.
5. Subtract line 11 - Total Watts Consumed from line 1 - MPU Watts Available. Write this value in line 12 - Watts Remaining.
6. If the value in line 12 - Watts Remaining is a negative number, your system is consuming more Watts than the MPU is capable of providing. This system would be unsafe as designed. You will need to reconsider your design. If the remaining wattage is zero or more than zero, the system design is good.

Power Budget Worksheet

Power Budget Worksheet			
Line	**Item**	**Part #**	**Watts**
1	MPU		
2	POM		
3	Slot 1		
4	Slot 2		
5	Slot 3		
6	Slot 4		
7	Slot 5		
8	Slot 6		
9	Slot 7		
10	Slot 8		
11	Total Watts Consumed (Add lines 2 thru 10)		
12	Watts Remaining (Line 1 – line 11)		

WARNING: It is extremely important to calculate the power budget. If you exceed the power budget, the system may operate in an unpredictable manner which may result in a risk of personal injury or equipment damage.

BRX MPU Available Expansion Power

The following tables show the available power for each of the BRX MPUs. Use the wattages shown as the total available power when calculating the power budget.

MPU Total Power Available			
Model	**# Built-in Inputs**	**# Built-in Outputs**	**Total Available Power (W)**
BX-DM1E-M	0	0	21.3
BX-DM1E-M-D	0	0	21.3
BX 10			
BX-DM1-10ED1-D	6	4	8.5
BX-DM1-10ED2-D	6	4	8.5
BX-DM1-10ER-D	6	4	8.3
BX-DM1-10AR-D	6	4	8.3
BX 10E			
BX-DM1E-10ED13-D	6	4	7.3
BX-DM1E-10ED23-D	6	4	7.3
BX-DM1E-10ER3-D	6	4	7.0
BX-DM1E-10AR3-D	6	4	7.0
BX 18			
BX-DM1-18ED1	10	8	20.2
BX-DM1-18ED2	10	8	20.2
BX-DM1-18ER	10	8	19.6
BX-DM1-18AR	10	8	19.6
BX-DM1-18ED1-D	10	8	20.2
BX-DM1-18ED2-D	10	8	20.2
BX-DM1-18ER-D	10	8	19.6

Table continued on next page

MPU Total Power Available (continued)			
Model	**# Built-in Inputs**	**# Built-in Outputs**	**Total Available Power (W)**
BX 18E			
BX-DM1E-18ED13	10	8	18.8
BX-DM1E-18ED23	10	8	18.8
BX-DM1E-18ER3	10	8	17.9
BX-DM1E-18AR3	10	8	17.9
BX-DM1E-18ED13-D	10	8	18.8
BX-DM1E-18ED23-D	10	8	18.8
BX-DM1E-18ER3-D	10	8	17.9
BX 36			
BX-DM1-36ED1	20	16	18.7
BX-DM1-36ED2	20	16	18.7
BX-DM1-36ER	20	16	17.6
BX-DM1-36AR	20	16	17.6
BX-DM1-36ED1-D	20	16	18.7
BX-DM1-36ED2-D	20	16	18.7
BX-DM1-36ER-D	20	16	17.6
BX 36E			
BX-DM1E-36ED13	20	16	16.4
BX-DM1E-36ED23	20	16	16.4
BX-DM1E-36ER3	20	16	15.3
BX-DM1E-36AR3	20	16	15.3
BX-DM1E-36ED13-D	20	16	16.5
BX-DM1E-36ED23-D	20	16	16.5
BX-DM1E-36ER3-D	20	16	15.3

BRX I/O Controller Available Expansion Power

The following table shows the available power for each of the BRX I/O controllers. Use the wattages shown as the total available power when calculating the power budget.

I/O Controller Total Power Available			
Model	**# Built-in Inputs**	**# Built-in Outputs**	**Total Available Power (W)**
BX-EBC100			
BX-EBC100-M	NA	NA	21.3
BX-EBC100-M-D	NA	NA	21.3
BX-DMIO			
BX-DMIO-M	NA	NA	21.3
BX-DMIO-M-D	NA	NA	21.3
BX-MBIO			
BX-MBIO-M	NA	NA	21.3
BX-MBIO-M-D	NA	NA	21.3

BRX MPU POM Power Consumed

The following chart shows the power consumed by each of the BRX POMs. Use the wattages shown as the amount to be subtracted from the total available wattage when calculating the power budget.

POM Power Consumption	
Model	**Consumption (W)**
BX-P-SER2-RJ12	0.2
BX-P-SER2-TERM	0.2
BX-P-SER2-TERMFC	0.2
BX-P-SER422-TERM	0.2
BX-P-SER4-TERM	0.2
BX-P-USB-B	0.1
BX-P-ECOMLT	0.4
BX-P-ECOMEX	0.2

BRX MPU Expansion Module Power Consumed

The following tables show the power consumed by each of the BRX Expansion Modules. Use the wattages shown as the total amount to be subtracted from the available wattage when calculating the power budget.

BRX Discrete Input Expansion Modules

BRX Discrete Input Expansion Modules Power Consumption			
Model	**Inputs/Module**	**Outputs/ Module**	**Consumption (W)**
BX-08NA	8	0	0.2
BX-08NB	8	0	0.2
BX-08ND3	8	0	0.2
BX-08NF3	8	0	0.2
BX-08SIM	8	0	0.2
BX-12NA	12	0	0.3
BX-12NB	12	0	0.3
BX-12ND3	12	0	0.3
BX-16NA	16	0	0.3
BX-16NB	16	0	0.3
BX-16ND3	16	0	0.3
BX-16NF3	16	0	0.3
BX-32ND3	32	0	0.4

BRX Discrete Output Expansion Modules

BRX Discrete Output Expansion Modules Power Consumption			
Model	**Inputs/ Module**	**Outputs/ Module**	**Consumption (W)**
BX-05TRS	0	5	1.8
BX-05TRS-1	0	5	1.8
BX-08TA	0	8	0.4
BX-08TD1	0	8	0.4
BX-08TD2	0	8	0.4
BX-08TR	0	8	1.7
BX-08TRZ	0	8	1.7

Table continued on next page

Discrete Output Modules Power Consumption (continued)			
Model	**Inputs/ Module**	**Outputs/ Module**	**Consumption (W)**
BX-12TA	0	12	0.5
BX-12TD1	0	12	0.5
BX-12TD2	0	12	0.5
BX-12TR	0	12	2.5
BX-16TD1	0	16	0.5
BX-16TD2	0	16	0.5
BX-16TF2	0	16	0.9
BX-16TR	0	16	3.4
BX-16TRZ	0	16	3.4
BX-32TD1	0	32	1.0
BX-32TD2	0	32	1.0

BRX Discrete Input/Output Combination Expansion Modules

BRX Discrete Combination Expansion Modules Power Consumption			
Model	**Inputs/Module**	**Outputs/Module**	**Consumption (W)**
BX-08CD3R	4	4	1.0
BX-12CD3D1	8	4	0.3
BX-12CD3D2	8	4	0.3
BX-16CD3D1	8	8	0.4
BX-16CD3D2	8	8	0.4
BX-16CF3F2	8	8	1.0

BRX Analog Input/Output and Temperature Expansion Modules

BRX Analog Expansion Modules Power Consumption				
Type	**Model**	**Inputs/Module**	**Outputs/Module**	**Consumption (W)**
In	BX-04AD-1	4	0	0.1
In	BX-04ADM-1	4	0	0.1
In	BX-08AD-1	8	0	0.1
In	BX-16AD-1	16	0	0.3
In	BX-04AD-2B	4	0	0.1
In	BX-08AD-2B	8	0	0.1
In	BX-16AD-2B	16	0	0.3
In	BX-04AD-3	4	0	1.5
In	BX-08AD-3	8	0	2.5
In	BX-04THM	4	0	0.1
In	BX-08THM	8	0	0.1
In	BX-06RTD	6	0	0.1
In	BX-08NTC	8	0	0.1
In	BX-04UT	4	0	1.5
In	BX-08UT	8	0	1.5
Out	BX-04DA-1	0	4	0.1
Out	BX-08DA-1	0	8	0.1
Out	BX-04DA-2B	0	4	0.1
Out	BX-08DA-2B	0	8	0.1

Table continued on next page

BRX Analog Expansion Modules Power Consumption (continued)				
Type	**Model**	**Inputs/Module**	**Outputs/Module**	**Consumption (W)**
Out	BX-04DA-3	0	4	2.4
Out	BX-08DA-3	0	8	5.5
Combo	BX-02AD2DA-1	2	2	0.3
Combo	BX-04AD2DA-1	4	2	0.3
Combo	BX-02AD2DA-2B	2	2	0.1
Combo	BX-04AD2DA-2B	4	2	0.3
Combo	BX-02AD2DA-3	2	2	2.5
Combo	BX-04AD4DA-3	4	4	3.75
Combo	BX-4RTD4DA-1	4	4	0.1
Combo	BX-4THM4DA-1	4	4	0.3
Combo	BX-4UT4DA-3	4	4	2.65
Combo	BX-4UT4TD1	4	4	2.5
Combo	BX-4UT4TD2	4	4	2.5
Combo	BX-4UT4TR	4	4	2.5

BRX Specialty Modules

BRX Motion Control and Communications Modules Power Consumption			
Model	**Inputs/Module**	**Outputs/Module**	**Consumption (W)**
BX-HSIO1	8	8	2.2 W
BX-HSIO2	8	8	2.2 W
BX-HSIO4	8	8	2.6 W
BX-SERIO	4 serial ports		1.2 W
BX-SERIO-2	4 serial ports		2.0 W
BX-SERIO-4	4 serial ports		1.2 W
BX-APAD	Filler module, no I/O		0 W

Power Budget Examples

Example 1

Power Budget Worksheet			
Line	**Item**	**Part #**	**Watts**
1	MPU	BX-DM1-18ED1	20.20
2	POM		
3	Slot 1	BX-08ND3	0.20
4	Slot 2	BX-16ND3	0.30
5	Slot 3	BX-16TR	3.40
6	Slot 4	BX-16TR	3.40
7	Slot 5		
8	Slot 6		
9	Slot 7		
10	Slot 8		
11	Total Watts Consumed (Add lines 2 thru 10)		7.30
12	Watts Remaining (Line 1 – line 11)		12.90

This example shows that the selected configuration is within the power budget. This is a sound configuration and will work as designed.

WARNING: It is extremely important to calculate the power budget. If you exceed the power budget, the system may operate in an unpredictable manner which may result in a risk of personal injury or equipment damage.

Example 2

Power Budget Worksheet			
Line	**Item**	**Part #**	**Watts**
1	MPU	BX-DM1E-36ER3	15.30
2	POM	BX-P-ECOMLT	0.40
3	Slot 1	BX-08NA	0.20
4	Slot 2	BX-16ND3	0.30
5	Slot 3	BX-16ND3	0.30
6	Slot 4	BX-16TD1	0.50
7	Slot 5	BX-16TD1	0.50
8	Slot 6	BX-16TR	3.40
9	Slot 7	BX-05TRS	1.80
10	Slot 8	BX-05TRS	1.80
11	Total Watts Consumed (Add lines 2 thru 10)		9.20
12	Watts Remaining (Line 1 – line 11)		6.10

This example shows that the selected configuration is within the power budget. This is a sound configuration and will work as designed.

WARNING: It is extremely important to calculate the power budget. If you exceed the power budget, the system may operate in an unpredictable manner which may result in a risk of personal injury or equipment damage.

Example 3

Power Budget Worksheet			
Line	**Item**	**Part #**	**Watts**
1	MPU	BX-DM1E-36ER3	15.30
2	POM	BX-P-SER2-TERM	0.20
3	Slot 1	BX-16NA	0.30
4	Slot 2	BX-16NA	0.30
5	Slot 3	BX-16NA	0.30
6	Slot 4	BX-16TR	3.40
7	Slot 5	BX-16TR	3.40
8	Slot 6	BX-16TR	3.40
9	Slot 7	BX-16TR	3.40
10	Slot 8	BX-16TR	3.40
11	Total Watts Consumed (Add lines 2 thru 10)		18.10
12	Watts Remaining (Line 1 − line 11)		-2.80

This example shows that the selected configuration will exceed the power budget. This is an unsafe configuration and will not work as designed. One way to correct this is to add Remote I/O to this system for additional I/O capability.



WARNING: It is extremely important to calculate the power budget. If you exceed the power budget, the system may operate in an unpredictable manner which may result in a risk of personal injury or equipment damage.

Error Codes and System Locations



In This Appendix...

Do-more! Designer Errors and System Locations D-2
Memory Locations with System-Assigned Nicknames D-4

Do-more! Designer Errors and System Locations

Errors in Do-more! Designer are typically found in the Output Window. To get to the Output Window, Go to Windows -> Output Window and a new pane will open. Typically the Output window will open automatically when an error is found when accepting rungs or when downloading to the PLC.

For errors that are not program check errors, there may be an error reporting field in the Device Structure that can provide information on the error and what it means. For these sorts of errors, the best place to find more information is in the Software Help file for the operation that you are attempting.

System memory locations can also help with finding errors. There is a chart later in this appendix for reference. For more information see Do-more! Designer help topic DMD0323.

Program Check Rules

Class	Number	Description
Message	M090	Disconnected Module is being downloaded as part of the System Configuration.
Error	E091	Support for feature added in Do-more! Technology Version, but this PLC is currently running older Do-more! Technology Version
Warning	W092	Support for feature added in Do-more! Technology Version, but this PLC is currently running older Do-more! Technology Version
Warning	W101	Rung is missing input logic, power flow state will be based on previous rung's power flow state
Error	E102	Multiple instructions exist; only one is allowed
Error	E103	Do-more! Technology Version in CPU does not support the new instruction; remove the instruction or upgrade firmware
Error	E121	Instruction validation error
Message	M122	Program contains Unassigned Nicknames
Error	E123	Program contains Unassigned Nicknames
Error	E124	Disconnected Module Device used by instruction
Warning	W125	DirectLOGIC Stub instruction needs attention before downloading to PLC
Error	E126	DirectLOGIC Stub instruction needs attention before downloading to PLC
Error	E128	Array reference found within differential/delta contact inside a loop
Warning	W129	Writing to Raw Analog Output WY or to Scaled Analog Input RX when that analog channel has a pre-defined scale in the System Configuration
Warning	W130	Writing to High Speed Y that is bound to High Speed Output Function (instruction has no effect)
Warning	W131	Accessing a 16 bit unipolar analog without the Unsigned cast :U
Warning	W201	<Primary-instruction> <element> in <secondary-instruction> does not exist
Warning	W202	<Resource-parameter> in instruction used multiple times
Error	E203	<Resource-parameter> in instruction used multiple times
Message	M204	Code-block exists without any invocation-instruction to execute it
Warning	W221	OUT <element> coil duplicated multiple times
Message	M222	OUT <element> coil duplicated multiple times
Message	M240	Common Modbus/TCP Client Device used for multiple Servers
Error	E301	Duplicate LABEL at address
Error	E302	GOTO missing corresponding LABEL
Error	E303	Cannot GOTO a LABEL in a different Stage
Message	M304	LABEL missing corresponding GOTO
Error	E305	Cannot GOTO a LABEL in a different code-block
Error	E311	End-of-loop instruction is missing start-of-loop or is paired with incorrect start-of-loop instruction
Error	E312	Start-of-loop missing corresponding end-of-loop

Table continued on next page

Program Check Rules (continued)		
Class	**Number**	**Description**
Error	E313	Instruction not allowed within a loop
Message	M314	Instruction found within loop
Message	M315	Clocked/edged instruction used within loop
Error	E316	Cannot GOTO a LABEL into or out of a loop
Warning	W317	Asynchronous instruction found within loop
Error	E318	Instruction must exist within a loop
Message	M331	Asynchronous instruction used in code-block with yielding instructions
Warning	W401	SUSPEND not recommended within its own code-block (no easy way to un-SUSPEND self)
Warning	W402	Found <code-block-invoking-instruction> within its own code-block
Warning	W403	Using HALT on a code-block that utilizes fully-asynchronous instruction(s)
Error	E411	Instruction can only exist in $Main code-block
Error	E412	<Instruction> found in <non-program> code-block; can only exist in a PROGRAM code-block
Error	E413	Instruction not permitted in $Main code-block
Error	E421	Stage bit cannot be modified by logic in a different PROGRAM code-block
Error	E422	Instruction cannot be in a Stage
Error	E423	Instruction must be within a Stage
Warning	W424	Using retentive element in coil within a non-retentive stage
Warning	W451	Time-based instruction used in edge-enabled task
Warning	W452	Time-based instruction used in a continuously-enabled task with a non-zero interval
Warning	W453	Fully-asynchronous instruction used in edge-enabled task
Warning	W454	Fully-asynchronous instruction used in a continuously-enabled task with a non-zero interval
Message	M455	Partial-asynchronous instruction used in edge-enabled task
Message	M456	Partial-asynchronous instruction used in a continuously-enabled task with a non-zero interval
Message	M457	Clocked/edged instruction used in edge-enabled task
Message	M458	Clocked/edged instruction used in a continuously-enabled task with a non-zero interval
Warning	W459	Edge-Enabled ENTASK instructions exist with Interval-Enabled ENTASK instructions
Warning	W460	Other continuous / interval ENTASK instructions exist
Warning	W461	Full OFF-to-ON Transition Input Leg counting instruction used in edge-enabled task
Error	E501	Subroutine missing unconditional RET at end of code-block
Message	M521	High Speed Discrete Output set within non-Immediate instruction in Interrupt-Service-Routine
Message	M522	Immediate I/O instruction inside NON-Interrupt-Service-Routine
Error	E701	Do-more! Technology Version in CPU only supports Edge-Triggered Input-Leg (not Power-Flow-Enabled) in instruction; modify instruction or upgrade firmware
Error	E702	Do-more! Technology Version in CPU does not support ONLY Swap Bytes or ONLY Swap Words on DWord sized memory in PUBLISH/SUBSCRIB instruction; modify instruction, or upgrade firmware
Error	E703	Do-more! Technology Version in CPU does not support clearing bit-sized elements in MEMCLEAR instruction; modify instruction, use RSTR, or upgrade firmware
Error	E704	Do-more! Technology Version in CPU does not support variable Modbus parameter in MRX/MWX instruction; use only constant, or upgrade firmware
Error	E705	Do-more! Technology Version in CPU does not support variable parameter in NETTIME instruction; use only a constant value, or upgrade firmware
Error	E706	Do-more! Technology Version in CPU does not support a variable networking parameter in DLRX/DLWX instruction; use only constant, or upgrade firmware
Error	E707	Do-more! Technology Version in CPU does not support "ipaddr" format in "FmtInt()" print script command in instruction; modify instruction or upgrade firmware
Warning	W708	Do-more! Technology Version in CPU does not support register in DEVREAD/DEVWRITE instruction; modify instruction or upgrade firmware
Error	E890	CTRIO's file system does not contain a file at file number compatible with the instruction

Memory Locations with System-Assigned Nicknames

The Do-more! CPUs are pre-configured with several bit and numeric locations that have system-assigned Nicknames. Some of these locations are outputs that report Status information, some of them are inputs used to provide configuration selections to the CPU, and some of them are input & output locations. This list can be found in Help topic DMD0208.

Bit Locations with System-Assigned Nicknames

Bit Location	Nickname	Type	Description
ST0	$FirstScan	Status	Will be ON for the duration of the first CPU scan after a STOP mode -to- RUN mode transition.
ST1	$On	Status	Always ON.
ST2	$Off	Status	Always OFF.
ST3	$1Minute	Status	While the CPU is in RUN mode this bit location will be set ON once a minute with a 50% duty cycle, that is, it will be ON for 30 seconds then OFF for 30 seconds.
ST4	$1Second	Status	While the CPU is in RUN mode this bit location will be set ON once a second with a 50% duty cycle, that is, it will be ON for 1/2 second then OFF for 1/2 second.
ST5	$100ms	Status	While the CPU is in RUN mode this bit location will be set ON once every 100ms with a 50% duty cycle, that is, it will be ON for 50 milliseconds then OFF for 50 milliseconds.
ST6	$50ms	Status	While the CPU is in RUN mode this bit location will be set ON once every 50ms with a 50% duty cycle, that is, it will be ON for 25 milliseconds then OFF for 25 milliseconds.
ST7	$ScanToggle	Status	Will be ON for alternate scans.
ST8	$LastScan	Status	Will be ON for the duration of the last CPU scan before a RUN mode -to- STOP mode transition.
ST10	$HasErrors	Status	Will be ON any time the CPU is reporting any runtime errors.
ST11	$HasWarnings	Status	Will be ON any time the CPU is reporting any runtime warnings.
ST12	$HasInfo	Status	Will be ON any time the CPU is reporting any runtime informational messages.
ST13	$WatchdogReboot	Status	Will be ON after a Hardware Watchdog Reboot has occurred.
ST14	$ModuleFailed	Status	Will be ON when any installed module fails validation, which generally means that its module ID doesn't match the module ID discovered at power up.

Table continued on next page

Bit Locations with System-Assigned Nicknames (continued)			
Bit Location	**Nickname**	**Type**	**Description**
ST15	$PgmModeRestart	Configuration	Will be ON after a Program mode -to- Run mode transition (because of a Do-more! Designer mode change operation or because the front panel mode switch was used). Non-retentive memory has been cleared, retentive memory has not been changed, but the state information of all Programs (including their Stage bits) and Tasks have been reset even if the Program or Task has been configured as retentive. Will be OFF in Run mode after a power-up, or a restart after a Watchdog Timer event, or after a REBOOT instruction is executed. Non-retentive memory has been cleared, retentive memory has been preserved. The state information for Programs and Tasks marked as retentive has been preserved, those NOT marked as retentive has been cleared. By default, user created Programs are Tasks are non-retentive, but they can be made retentive if required through the Code-block Configuration dialog. All System (built-in) Programs and Tasks are retentive and that cannot be changed. The one exception is that all Stages in $Main will be disabled and the Initial Stage will be enabled if the CPU powers up in Run mode, or on a Program -to-Run transition. Note: the Difference Between Two Date / Times (DTDIFF) instruction with SDT1 ($SysShutdown) and SDT2 ($SysStartup) can be used to determine how long a CPU has NOT been in Run mode. The result of this calculation can be used to help decide what (if anything) needs to be manually reset based on the amount of time the PLC was not in control of the machine or process.
ST16	$TermRunMode	Status	Will be ON if the CPU is in RUN mode and the switch is in TERM position. Will be OFF if the CPU is in STOP (PGM) mode and the switch is in TERM position, or if the if the mode switch is NOT in TERM position (regardless of the CPU mode).
ST17	$SerFifoOverflow	Configuration	Will be ON if the input buffer for the on-board serial port contains 1023 bytes of data.
ST18	$RetErrOnBadReq	Configuration	Will be ON if there is a bad array reference in a Data View.
ST21	$InhPgmUpdate	Configuration	Set to ON to prevent program from being updated.
ST23	$TimeSynced	Status	Will be ON if the TimeSync operation is successful.
ST24	$HwWatchdogMode	Configuration	Specifies the action to take in the event of a Hardware Watchdog Timeout.
ST25	$DisableHwWdog	Configuration	Set ON to disable the Hardware Watchdog Timer.
ST33	$EnableDebug	Configuration	Set ON by the Debug View to put the CPU in debug mode.
ST34	$EnablePowerFlow	Configuration	Reserved.
ST35	$EnableNScan	Configuration	Set ON by the Debug View to put the CPU into N-Scan Mode.
ST36	$EnableMsgDump	Configuration	Set ON to send all ERR and MSG values to Do-more! Logger, see the Send Email (EMAIL) Instruction.
ST37	$DisableSwWdog	Configuration	Set ON to disable the software watchdog timer.
ST128	$WatchdogTimeout	Status	Will be ON when a software watchdog occurs.
ST129	$IndexError	Status	Will be ON when an array reference is out of range.
ST131	$InvalidInstr	Status	Will be ON if an invalid instruction was downloaded to the CPU. User generally should never see this.
Table continued on next page			

Bit Locations with System-Assigned Nicknames (continued)			
Bit Location	**Nickname**	**Type**	**Description**
ST132	$OutOfRange	Status	Will be ON when a parameter that isn't an index error, or an overflow, or a divide-by-zero is out of range. The Status tab of System Info will also display "A comm client attempted to read a data address that was out of range. Zero data was returned." in the ERR field. Two common examples (assume the normal range of C is C0–C2047): If V0 = 9999, then trying to reference C[V0] = C9999 would fail because 9999 is outside the range of configured C locations. If an external communication client creates a tag that references C9999. Again, 9999 is outside the range of configured C locations. To correct this, the external communication client should import the memory configuration from the Do-more! Designer project so that the only the correct ranges are available for its tags.
ST133	$Overflow	Status	Will be ON when certain math operators (POW, INC, DEC, etc.) overflow their calculation.
ST134	$InstIOChanged	Status	Do-more! CPUs keep a copy of the last known good I/O Configuration data stored in their battery-backed memory. While the system is powered down, if an I/O module is removed, or an I/O module is added, or an existing I/O module is moved to a different slot, or an existing I/O module is replaced with a different one, the collection of I/O modules will not match the collection that is in the battery-backed memory when the system is powered back on. Will be ON at power-up any time the collection of installed I/O modules has changed from the last time the PLC was powered on.
ST135	$IOConfigError	Status	Will be ON when there is an error in the manual I/O configuration.
ST136	$IOMapError	Status	Will be ON when there is an error in the manual I/O map.
ST137	$LoopTuning	Status	Will be ON while a PID loop is being Auto-tuned.
ST138	$MathStackOverflw	Status	Will be ON when a math operation has caused a stack overflow.
ST139	$FileSystemError	Status	Reserved.
ST140	$BufferOverflow	Status	Will be ON if the result of a string operation is larger than the string element can hold.
ST141	$DivideByZero	Status	Will be ON when a math operation has a divide by zero operation.
ST142	$DriverLoadError	Status	Will be ON if any device driver failed to load.
ST143	$DriverError	Status	Will be ON if any device is reporting a runtime error, use the Device List to see the specific device in error.
ST144	$SystemStopped	Status	Will be ON when a Switch to Program Mode (STOP) instruction has executed and put the CPU in Stop mode.
ST145	$QueuesFlushed	Status	Will be ON when Ethernet queues were forcibly cleared, possibly due to an open Ethernet device which isn't being serviced.
ST146	$CommStackOverrn	Status	Will be ON when the Ethernet stack was unable to allocate a packet buffer for an incoming packet.
ST147	$InstrTerminated	Status	Will be ON when a Device instruction was terminated before normal completion.
ST148	$CriticalIOError	Status	Will be ON when one or more modules failed to verify for longer than the verify filter time, and the system is in a permanent I/O shutdown. Power cycle or Re-Initialize I/O required to return to RUN mode.
ST149	$BatteryLow	Status	Will be ON if the battery voltage is below the minimum threshold, see the help section on Battery Backup for more information.
ST150	$LoginLockedOut	Status	Will be ON when PLC isn't accepting session passwords due to excessive password failures. See the help topic for Failed Login Attempts.

Table continued on next page

Bit Locations with System-Assigned Nicknames (continued)			
Bit Location	**Nickname**	**Type**	**Description**
ST151	$IndexRealigned	Status	Will be ON if the CPU adjusted a misaligned array index. Occurs when incorrectly indexing memory cast to a larger size...as in X[V0]:B, where V0 isn't 0, 8, 16, etc.
ST152	$IOError	Status	Will be ON an I/O Master is in a warning state, this can go from ON to OFF as module issues arise and are resolved.
ST153	$EthMasterError	Status	Will be ON when the Ethernet I/O Master detects an error with one of its Ethernet I/O Slaves - most likely an Ethernet I/O Slave is offline.
ST154	$EthSlaveOffline	Status	Will be ON when the Ethernet I/O Master detects one of its Ethernet I/O Slaves that is marked as Not Required to Go TO Run Mode is offline.
ST192	$PgmSwitchActive	Status	Will be ON when system is swapping program buffers during run mode program update.
ST193	$CurPgmBuffer	Status	Indicates active program buffer. Toggles when new program is downloaded.
ST194	$SysConfigUpdate	Status	Will be ON when system is updating system configuration.
ST200	$PgmROMUpdate	Status	Will be ON when system is writing program to ROM.
ST201	$SysCfgROMUpdate	Status	Will be ON when system is writing system configuration to ROM.
ST202	$DocROMUpdate	Status	Will be ON when system is writing project documentation to ROM.
ST203	$SysSetROMUpdate	Status	Will be ON when system is writing system setup to ROM.
ST204	$UserROMUpdate	Status	Will be ON when system is writing to user ROM
All bit locations starting at ST768 are retentive; they will hold their value through a power cycle.			
ST768	$SummerTime	Configuration	Set this bit ON to add one hour to $LocalTime calculation to account for Daylight Savings Time.

Numeric Locations with System-Assigned Nicknames			
Numeric Location	**Nickname**	**Type**	**Description**
DST0	$ScanCounter	Status	Contains the number of scans since the last STOP mode to RUN mode transition.
DST1	$ScanTime	Status	Contains a filtered average of the $ElapsedTicks.
DST2	$MinScanTime	Status	Contains the length of time (in microseconds) of the shortest scan since the last STOP mode to RUN mode transition.
DST3	$MaxScanTime	Status	Contains the length of time (in microseconds) of the longest scan since the last STOP mode to RUN mode transition.
DST4	$ElapsedTicks	Status	Contains the number of microseconds for the last scan.
DST5	$Errors	Status	Compilation of bit flags from (ST128 ... ST159) which are considered to be errors. Currently contains the following: WATCHDOGTIMEOUT MEMORYERROR IOCONFIGERROR IOMAPERROR MATHSTACKOVERFLOW STOPPED COMM_STACK_OVERRUN PERMIOFAILURE
Table continued on next page			

Numeric Locations w/System-Assigned Nicknames (continued)

Numeric Location	Nickname	Type	Description
DST6	$Warnings	Status	Compilation of bit flags from (ST128...159) which are considered to be warnings. Currently contains the following: INDEXERROR OUTOFRANGE INVALIDINSTRUCTION OVERFLOW FILESYSERROR BUFFEROVERFLOW DIVIDEBYZERO DRIVERLOADERROR DRIVERERROR QUEUES_FLUSHED BATTERYLOW
DST7	$Info	Status	Compilation of bit flags from (ST128...159) which are considered to be info. Currently contains the following: INSTALLEDIOCHANGED, LOOPTUNING, and LOGINLOCKEDOUT
DST8	$InvalidInstrAddr	Status	Contains address of invalid instruction on failed program validation: -1 = no invalid instruction address
DST10	$PLCMode	Status	Contains a value that reflects the current operational mode of the PLC: 2 = STOP mode 3 = RUN mode.
DST11	$PLCStatus	Status	Contains the PSTAT_XXX bits from ST192-223.
DST12	$FirmwareRev	Status	The revision number of the CPU's firmware in the form MMmmbbbb.
DST13	$DmRev	Status	The revision number of the CPU's Do-more! library in the form MMmmbbbb.
DST14	$HardwareRev	Status	The revision number of the CPU's PWB n the form 0000MMaa.
DST15	$BooterRev	Status	The revision number of the CPU's boot loader in the form MMmmbbbb.
DST16	$FPGARev	Status	The revision number of the CPU's FPGA code in the form MMMMmmmm.
DST17	$NodeNumber	Status	The Node Number assigned to the PLC.
DST18	$IPAddress	Status	The IP Address assigned to the PLC. Use the IP Address format of the Data View to see the value in the traditional dotted-decimal form.
DST19	$NetMask	Status	The Subnet Mask assigned to the PLC. Use the IP Address format of the Data View to see the value in the traditional dotted-decimal form.
DST20	$Gateway	Status	The Gateway IP Address assigned to the PLC. Use the IP Address format of the Data View to see the value in the traditional dotted-decimal form.
DST21	$UTC	Status	Contains the current UTC value (the number of seconds that have elapsed since Jan, 1 1970).
DST22	$LocalTime	Status	The current time calculated from the UTC value after adjustments for Time Zone and Daylight Savings.
DST23	$WatchdogTimeVal	Status	Contains the maximum number of milliseconds to allow for a single scan.
DST24	$DefaultBlockVer	Status	Used by C-More panels to enforce protocol compatibility.
DST25	$DefaultHeapVer	Status	Used by C-More panels to enforce protocol compatibility.
DST26	$IOVerifyTimeout	Status	Contains the minimum amount of time for a module to fail verification before a permanent IO failure shutdown.
DST27	$IOVerifyLastTO	Status	Contains the amount of time accrued during the last failure verification.
DST28	$IOMasterErrors	Status	Contains one bit per I/O Master, that bit will be ON if that I/O Master is reporting a Module Error, can go from ON to OFF as module errors arise and are resolved.
DST29	$PLCType	Status	Values that indicate the PLC type: 0: Unknown 1: DM-SIM (Do-more! Simulator) 2: H2-DM1 (DirectLOGIC 205 Series) 3: H2-DM1E (DirectLOGIC 205 Series with on-board Ethernet) 4: T1H-DM1 (Terminator I/O Series) 5: T1H-DM1E (Terminator I/O Series with on-board Ethernet) 6: BRX-DM1 (BRX series) 7: BRX-DM1E (BRX Series with on-board Ethernet) see DST53 for BRX Series PLC Sub-types

Table continued on next page

Numeric Locations w/System-Assigned Nicknames (continued)			
Numeric Location	**Nickname**	**Type**	**Description**
The following 8 locations serve as a 4 x 2 stack that contains the last 4 error codes and the address of the instruction that reported that error. To locate the instruction that reported the error, Open Search -> Goto -> Goto Address or Rung Number (or press Ctrl+G), then enter the value in the associated LastErrorAddr location in the Address / Rung Number field and make sure to select Absolute Address then click OK. This will move the edit cursor to the code-block that contains the rung that has the instruction that reported the error code.			
DST30	$LastError1	Status	Contains the code of the most recently reported error.
DST31	$LastErrorAddr1	Status	Contains the address of the most recently reported error.
DST32	$LastError2	Status	Contains the code of the 2nd most recently reported error.
DST33	$LastErrorAddr2	Status	Contains the address of the 2nd most recently reported error.
DST34	$LastError3	Status	Contains the code of the 3rd most recently reported error.
DST35	$LastErrorAddr3	Status	Contains the address of the 3rd most recently reported error.
DST36	$LastError4	Status	Contains the code of the 4th most recently reported error.
DST37	$LastErrorAddr4	Status	Contains the address of the 4th most recently reported error.
			The following is a list of the possible error codes that appear in the $LastError locations (DST30, DST32, DST34, DST36). -2 - UNKNOWN ERROR ---------- An unexpected error occurred. This can be an attempted operation on a POM that is not installed or a POM that does not support that operation. -1 - RESERVED ---------- Reserved. 00 - NO_ERROR ---------- No error. 10 - TIMEOUT ---------- Operation timed out. 11 - RXWX_NAK ---------- The target device NAKed a DLRX or DLWX request. 12 - UNKNOWN_RESPONSE --------- Unknown response. 13 - MODULE_NOT_INSTALLED ----- An Attempt was made to access an I/O module that isn't installed. 14 - MODULE_ACCESS_FAILED ----- Unable to access I/O module. 15 - DEVICE_ALREADY_OPEN ------ An attempt was made to open a Device that is already open. 16 - DEVICE_NOT_OPEN ---------- An attempt was made to use a Device that hasn't been opened. 17 - INVALID_DATA ---------- Invalid data in response. 18 - EXCEPTION_RESPONSE ------- Exception response from MRX or MWX request. 19 - INVALID_CRC ---------- Invalid CRC in MRX or MWX request. 20 - CONNECTION_FAILED -------- Couldn't open TCP connection with specified device. 21 - UNEXPECTED_SMTP_RESP ----- Unexpected response from SMTP server. 22 - POP3_ERROR_RESP ---------- Error response from POP3 server. 23 - MODULE_ERROR_RESP -------- I/O module returned and error response. 24 - MODULE_TIMEOUT ---------- Timed out while waiting for an I/O module to respond. 25 - ILLEGAL OPERATION -------- An operation was attempted that is illegal in the current mode or configuration. 26 - DEVICE_NOT_CONNECTED ----- An attempt was made to use a Device that is not connected. 27 - INDEXERROR ---------- Array index was out of bounds. 28 - DIVEDEBYZERO ---------- Divide by Zero. 29 - OUTOFRANGE ---------- Parameter out of range. 30 - OVERFLOW ---------- Numeric value overflow. 31 - WATHCDOGTIMEOUT ---------- Watchdog timeout. 32 - STOPPED ---------- PLC Stopped. 33 - BUFFEROVERFLOW ---------- Result of an attempted string operation was longer than the target string and was truncated. 34 - INSTRUCTION_TERMINATED --- Multi-scan device instruction was forcibly terminated before completion. 35 - EIPMSG_RESP_TOO_LONG ----- Received a response that exceeded the maximum length. ***Cell continued on next page***
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Numeric Locations w/System-Assigned Nicknames (continued)			
Numeric Location	**Nickname**	**Type**	**Description**
			Cell continued from previous page 36 - EIPMSG_ERROR_RESPONSE ---- Received an error response from adapter. 37 - DMPP_ERROR_RESPONSE ------ An error was returned to a peer to peer request in an RX or WX instruction. 38 - FILESYS_ERROR ---------- File system returned an error. 39 - FILESYS_NOMEDIA ---------- File operation failed because there is no media card installed or the media card didn't mount properly. 40 - FILESYS_NODIRSTART ------- The file system's .StartFolderScan structure member must be set to start a scan with FILEQUERY instruction. 41 - AXIS_UNCONFIGURED -------- Axis unconfigured. Must be configured with AXCONFIG prior to use. 42 - AXIS_INVALID_MODE -------- Requested an unsupported Axis mode. 43 - AXIS_UNKNOWN_ERROR ------- Axis controller received unknown command. 44 - AXIS_COMMAND_PENDING ----- Attempted to send command to axis controller with a command pending. 45 - AXIS_INVALID_PARM -------- Axis command contained an invalid parameter. 46 - AXIS_ESTOP --------------- Attempted operation on an Axis that is disabled through the .MasterEnable structure member. 47 - AXIS_DISABLED ------------ Axis instruction was terminated prior to normal completion. 48 - AXIS_SCRIPT_BUSY --------- Attempted new script operation while script is running. 49 - AXIS_LINROT_MISMATCH ----- Linear / Rotary mismatch between current Axis configuration and request. 50 - AXIS_FAULT --------------- Axis has faulted. 51 - TABLE_INVALID_PARM ------- Invalid parameter in table driven output function.
DST38	$LastProtoError	Status	Contains the error response value from last protocol-based instruction (RX, WX, MRX, MWX, EIPMSG, DLRX, DLWX, etc.).
DST39	$InhibitErrors	Configuration	Specifies which errors should not result in fatal shutdown of the CPU.
DST40	$EthDroppedPckts	Status	Contains the number of Ethernet packets that have been lost since the last power-cycle.
DST41	$EthStoppedIntr	Status	Contains the number of times the Ethernet interrupt was shut off due to excessive network traffic.
DST42	$EthSendErrors	Status	Contains the number of Ethernet send errors that have occurred since the last power-cycle.
DST43	$EthPktsReceived	Status	Contains the total number of Ethernet packets that have been received since the last power-cycle
DST44	$EthPktsSent	Status	Contains the total number of Ethernet packets that have been sent since the last power-cycle.
DST45	$TuneDeadBand	Configuration	Deadband value used the by the PID Autotune process.
DST46	$TuneSampleTime	Configuration	Sample time value used the by the PID Autotune process.
DST47	$TuneMinPVChange	Configuration	The Minimum PV Change value used the by the PID Autotune process.
DST48	$TuneOutputBump	Configuration	The Output bump value used the by the PID Autotune process.
DST49	$EthMissedFrames	Status	Contains the total number of packets since the last power-cycle that the Ethernet hardware did not process because the packets were incorrectly formed.
DST50	$Installed POM	Status	255 - No POM installed 0 - Unknown POM installed 1 - BX-P-USB-B ------- (USB POM with USB-B connector) 2 - BX-P-ECOMLT ------ (Ethernet POM with RJ-45 connector) 3 - BX-P-SER2-TERM --- (Serial RS-232 with 3-pin header) 4 - BX-P-SER4-TERM --- (Serial RS-485 with 3-pin header) 5 - BX-P-SER2-RJ12 --- (Serial RS-232 with RJ-12 connector)
Table continued on next page			

Numeric Locations w/System-Assigned Nicknames (continued)			
Numeric Location	**Nickname**	**Type**	**Description**
DST51	$FatalTermCode	Status	When a fatal error occurs, the ERR LED will be on and this register will contain a value that explains what caused the fatal error. 0 : No Fatal Error Code 1 : any of the following conditions: watchdog timeout, memory error, I/O Error - configuration or mapping - typically happens if the I/O layout changed, Ethernet I/O Master detected an error (usually a missing slave or the I/O layout in a slave has changed). 2 : An I/O module in the local base is not responding to backplane requests 3 : An Ethernet I/O Slave that is marked as required is not responding. 4 : An instruction that was downloaded to the PLC is not valid for the firmware version in the CPU. This will typically only happen if the firmware is downgraded without clearing the Program section of the PLC first. 5 : A Force Watchdog Error (WATCHDOG) instruction was executed. 6: An error occurred in the program, typically an issue in the MATH stack (overflow / underflow). 7 : The limit on the number of local expansion modules that are allowed in the BRX system has been exceeded.
DST52	$ActiveSessions	Status	The number of active communications sessions using Do-more! protocol - DmDesigner, HMI (if it's using DM driver), RX/WX connections to other DM CPUs, or any 3rd party device that's using DM protocol. This is for all ports, ethernet or serial or usb. Maximum of 32 sessions
DST53	$PLCSubType (for BRX)	Status	For the BRX Series PLCs these are the valid Sub-types: 128: BX-DM1E-M 129: BX-DM1E-M-D 144: BX-DM1-10ED1-D 145: BX-DM1-10ED2-D 146: BX-DM1-10ER-D 147: BX-DM1-10AR-D 148: BX-DM1E-10ED13-D 149: BX-DM1E-10ED23-D 150: BX-DM1E-10ER3-D 151: BX-DM1E-10AR3-D 4256: BX-DM1-18ED1 4257: BX-DM1-18ED2 4258: BX-DM1-18ER 4259: BX-DM1-18ED1-D 4260: BX-DM1-18ED2-D 4261: BX-DM1-18ER-D 4514: BX-DM1-18AR 4768: BX-DM1E-18ED13 4769: BX-DM1E-18ED23 4770: BX-DM1E-18ER3 4771: BX-DM1E-18ED13-D 4772: BX-DM1E-18ED23-D 4773: BX-DM1E-18ER3-D 5026: BX-DM1E-18AR3 8368: BX-DM1-36ED1 8369: BX-DM1-36ED2 8370: BX-DM1-36ER 8371: BX-DM1-36ED1-D 8372: BX-DM1-36ED2-D 8373: BX-DM1-36ER-D 8626: BX-DM1-36AR 8886: BX-DM1E-36ED13 8887: BX-DM1E-36ED23 ***Cell continued on next page***
Table continued on next page			

Numeric Locations w/System-Assigned Nicknames (continued)

Numeric Location	Nickname	Type	Description
			Cell continued from previous page 8888: BX-DM1E-36ER3 8889: BX-DM1E-36ED13-D 8890: BX-DM1E-36ED23-D 8891: BX-DM1E-36ER3-D 9144: BX-DM1E-36AR3
			The BX-P-ECOMLT POM requires functional IP Addressing information to operate on an Ethernet network. Because the ECOMLT can be hot-swapped into an operating BRX CPU, you have the option of specifying where the IP Addressing for the ECOMLT resides: • Use the IP Addressing information that was statically assigned by NetEdit. In this mode the ECOMLT operates like a traditional ECOM. • Any ECOMLT that is installed will temporarily use the IP Addressing information that has been provided in the System Configuration. If the ECOMLT already has a statically assigned IP address that information will not be used. This will allow any external network connection - like Do-more! Designer - to operate with any ECOMLT that is installed in this BRX PLC, because the BRX CPU will assign the IP address. • Overwrite the existing IP Addressing information in ROM of the ECOMLT with the values from DST55, DST56, and DST57, then use the newly written values.
DST54	$POMIpSetupSrc	Configuration	Specifies the source for the TCP/IP configuration for the ECOMLT POM (value in the least significant byte): 0: uses the IP Address information in the BX-P-ECOMLT POM; also stores a copy of that information in the DST55, DST56, and DST57. 1: ignore values from DST55, DST56, DST57; do not write values from DST55, DST56, and DST57 to the ECOMLT. 2: ignores any existing IP addressing information in the ECOMLT and uses the values currently stored in DST55, DST56, and DST57. 3: overwrite the IP Addressing information in ROM of the ECOMLT with the values from DST55, DST56, and DST57. DST54 will change to 0 after the ROM update is complete. The steps to manually change from the default mode of 0 in DST54 to using a given IP configuration are as follows: • Write a value of 1 to DST54 to get the ECOMLT to ignore values from the ECOMLT. • After delaying for a few milliseconds (in case the ECOMLT was already is in the process of writing the values) write the new IP Addressing information to DST55, DST56, and DST57. • Then write a value of 2 to DST54 to instruct the ECOMLT to update it's ROM with the new values. • DST54 will return to a value of 0 when the process is complete. 4 - 254: Reserved. 255: ECOMLT reporting an error in high Word of DST54
DST55	$POMIpAddress	Configuration	The IP Address of the BX-P-ECOMLT POM that is installed.
DST56	$POMIpNetmask	Configuration	The Netmask of the BX-P-ECOMLT POM that is installed.
DST57	$POMIpGateway	Configuration	The Gateway Address of the BX-P-ECOMLT POM that is installed.
DST58	$ProgramChecksum		A 32-bit value that is the checksum of the current program data.
DST384	$TimeZone (signed integer in minutes)	Configuration	Contains the number of minutes to apply to the UTC value for the current location of the PLC.
DST385	$WatchdogReboots	Status	The number of hardware and / or software watchdog reboots that have occurred since the last power-cycle. Each time the CPU watchdog fires it will increment the value. When this value reaches 10 it will drop the PLC into Program mode on the next restart. This is to prevent the CPU from getting stuck in an unrecoverable crash loop.
DST386	$FailedLoginCnt	Status	The number of login attempts that have failed.

Table continued on next page

Numeric Locations w/System-Assigned Nicknames (continued)			
Numeric Location	**Nickname**	**Type**	**Description**
DST387	$ProductID	Configuration	An 8-digit Hex value that is used by **Generate DMLoader Image** and **DMLoader** to validate the target CPU before downloading the contents of the image file.
DST388	$ProductVersion	Configuration	An 8-digit Hex value (MMmmBBBB - where MM is the major version, mm is minor version and BBBB is the build number) that is used by **Generate DMLoader Image** and **DMLoader** to validate the target CPU before downloading the contents of the image file.
DST410	$ModeChngFailed	Status	If an attempt to transition between PLC modes is successful this register will contain 0. If an attempt to transition between PLC modes fails, this location will contain one of the following failure codes: 100 - low level hardware initialization failed 101 - one or more modules failed to verify for longer than the verify filter time, and the system is in a permanent I/O shutdown. Power cycle or Re-Initialize I/O required to return to RUN mode 102 - there is an error in the manual I/O map 103 - there is an error in the manual I/O configuration 104 - the attempt to initialize the local I/O failed 105 - one or more Ethernet I/O Slaves is offline 106 - the Ethernet I/O Master failed to initialize 107 - an invalid instruction was downloaded to the CPU

Notes:

NetEdit—Ethernet Setup Utility for HOST Automation Products



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Basic Ethernet wiring and setup

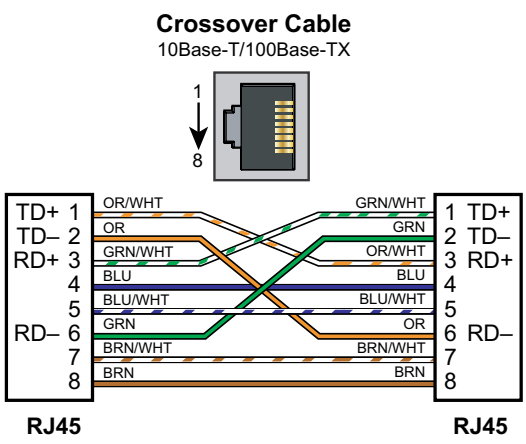
This appendix is intended to provide information on Ethernet network wiring and the use of the NetEdit 3 utility to configure and update HOST Engineering Ethernet-enabled modules:

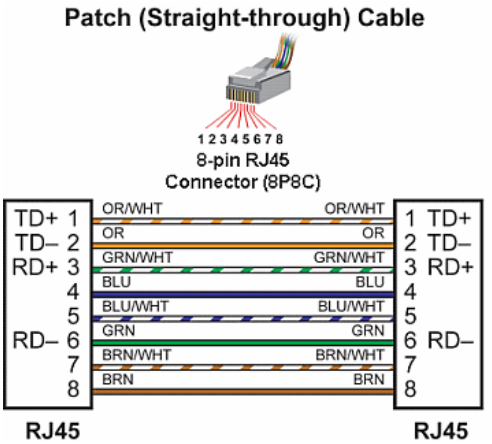
- BRX series: BX-DM1E MPUs, BX-EBC100-M (-D), BX-DMIO-M (-D), BX-MBIO-M (-D), BX-ECOMLT
- DL05/06 series: H0-PSCM, H0-ECOM100
- DL205 series: H2-EBC100, H2-ECOM100, H2-ERM100
- DL405 series: H4-EBC, H4-ECOM100, H4-ERM100
- Terminator series: T1H-EBC100, T1H-PBC
- Additional: GS-EDRV100, MB-Gateway

NOTE: *For specific information on a device, please refer to the appropriate manual on the AutomationDirect.com website under Manuals/Docs.*

Network Wiring

The Ethernet port on the HOST Ethernet-based modules utilizes standard networking cables and devices. Category 5e cabling is preferred. Cables can be either patch (straight through) or crossover, as follows.





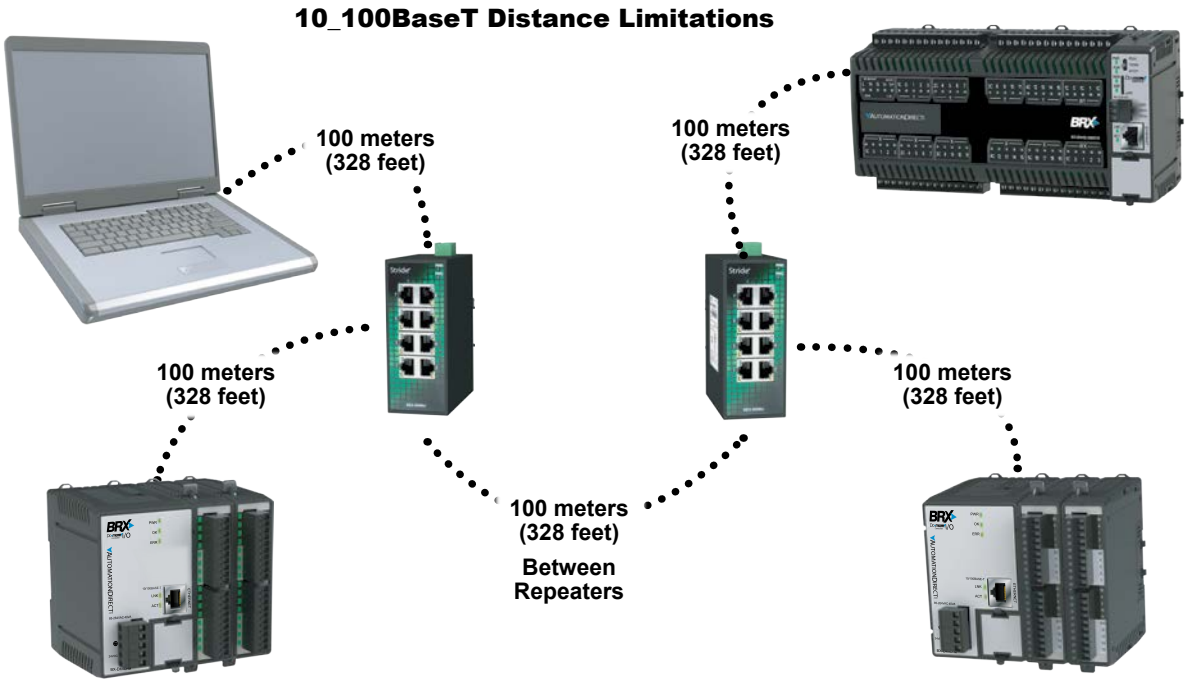
A patch or crossover cable can be connected to an Ethernet port that supports automatic MDIX detection. The port detects the type of cable that is connected (straight through or crossover) and configures the port connection to match it. The following HOST Engineering devices support automatic MDIX detection:

- BRX series: BX-DM1E MPUs, BX-EBC100-M (-D), BX-DMIO-M (-D), BX-MBIO-M (-D), BX-ECOMLT
- DL05/06 series: H0-ECOM100
- DL205 series: H2-EBC100, H2-ECOM100, H2-ERM100
- DL405 series: H4-ECOM100, H4-ERM100
- Terminator series: T1H-EBC100, T1H-PBC
- Additional: GS-EDRV100, MB-Gateway

The H4-EBC module does not support automatic MDIX detection. A crossover cable is required to connect a PC directly to this module. A patch cable is normally used between a network switch and this module.

Maximum Cable Length

The maximum distance per 10/100BaseT cable segment is 100 meters (328 feet). A repeater will extend the distance. A repeater can be an Ethernet unmanaged or managed switch, an Ethernet router or an Ethernet media converter (RJ45 10/100 to multi-mode SC/ST 100FX fiber). Each cable segment attached to a repeater can be 100 meters (328 feet) long.



IP Addressing and Subnets

IP Addresses (used in conjunction with the Subnet Mask and Default Gateway address) are used for network routing. This allows for easy and logical separation of networks. It is outside of the scope of this user manual to explain how IP addresses and subnet masks are configured for actual usage. There are many books, documents and tools (subnet calculators) on the Internet that provide this information. Each facility and network will incorporate their own rules and guidelines for how their networks are to be configured.

We suggest that users maintain their IP addressing and subnets according to common networking practices by using private network addressing when at all possible. Examples of private addressing IP ranges can be found in the table below.

IP Addressing and Subnets

IP Address Range	Typical Subnet	Classful Description
192.168.0.0–192.168.255.255	255.255.0.0	Class C Network
172.16.0.0–172.31.255.255	255.240.0.0	Class B Network
10.0.0.0–10.255.255.255	255.0.0.0	Class A Network

NOTE: *Notice that the IP range of 169.254.0.1–169.254.255.254 is not listed above. This range is reserved for APIPA addressing and is not recommended for use with most networks.*

NetEdit 3 Software

NetEdit 3 is the free utility used to manage all aspects of HOST Engineering Ethernet-enabled devices. This includes configuring the network settings (Module ID or IP address), updating the firmware in the devices, performing diagnostic and troubleshooting tasks and setting up any runtime configuration options that are available. The use of an Excel-style grid allows the list of devices to be sorted by any column. The built-in Export feature will save the current device list to a CSV file.

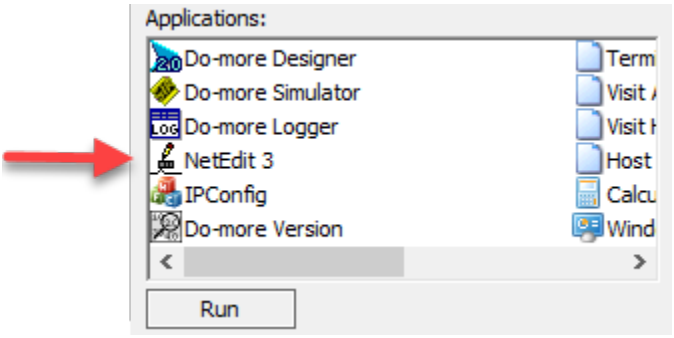
Installing NetEdit 3

NetEdit 3 is installed with Do-more! Designer and with DirectSOFT6 programming software packages. This utility is also available as a standalone download. The download link is: http://www.hosteng.com/SW-Products/Netedit3.zip. This is a compressed file. Extract the file and run the SetupNE3.exe file to install the utility.

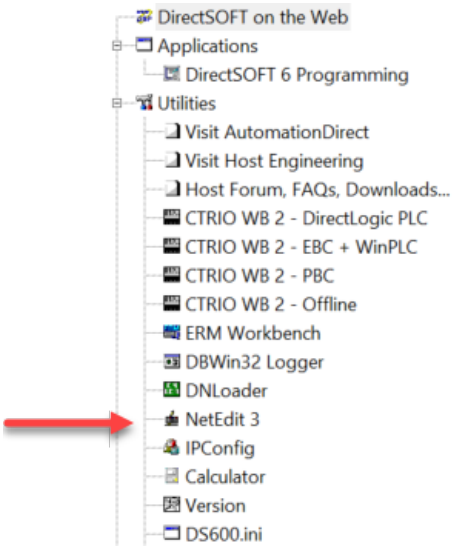
Launching NetEdit 3

It is possible to launch NetEdit 3 in several ways:

- From the Do-more! Designer programming software, under the Applications window, select NetEdit 3:



- From the DirectSOFT6 programming software, under the DSLaunch Utilities menu, select NetEdit 3:

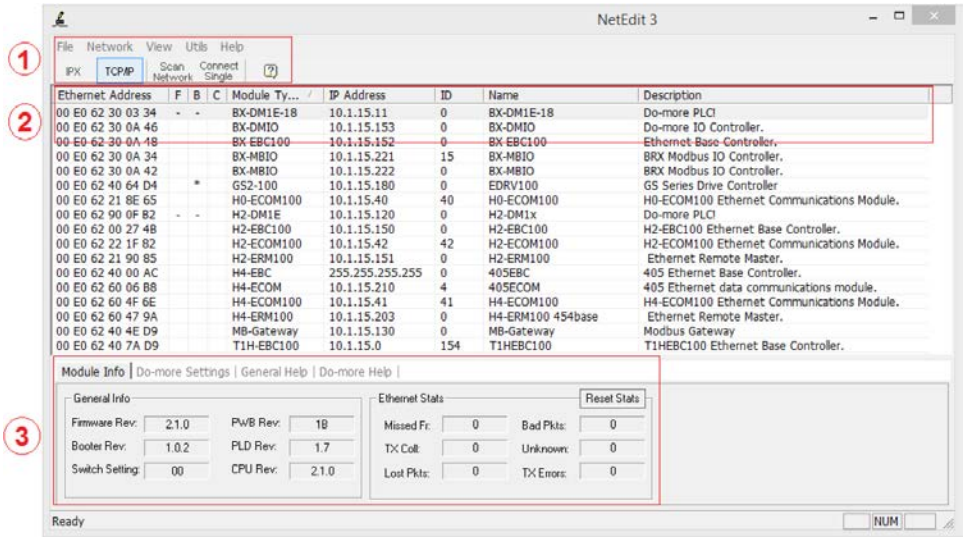


- Stand-alone: On Windows 7 or later, Search for NetEdit 3 or select the app from the programs list under AutomationDirect Tools > NetEdit 3.

The NetEdit 3 Screen

Starting NetEdit 3 brings up the screen below. All NetEdit 3 functions are accessed from this screen. The screen is divided into the following three sections, each of which is discussed later in this section:

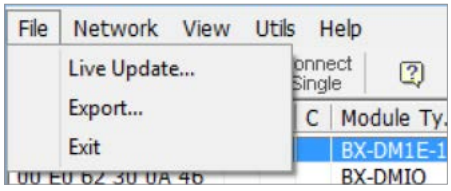
1. Menu section: Allows update of NetEdit 3 and select the network card (NIC) to be used.
2. Information available for each device: the main body of the screen provides addressing and identification for each device.
3. Information and Settings for each device: Provides hardware information and allows you to configure the devices to fit your application. The Settings section is broken up into three major parts: Configuration, Utils and Firmware. Available settings vary depending on the device selected from the list, as discussed later in this section.



Using NetEdit 3

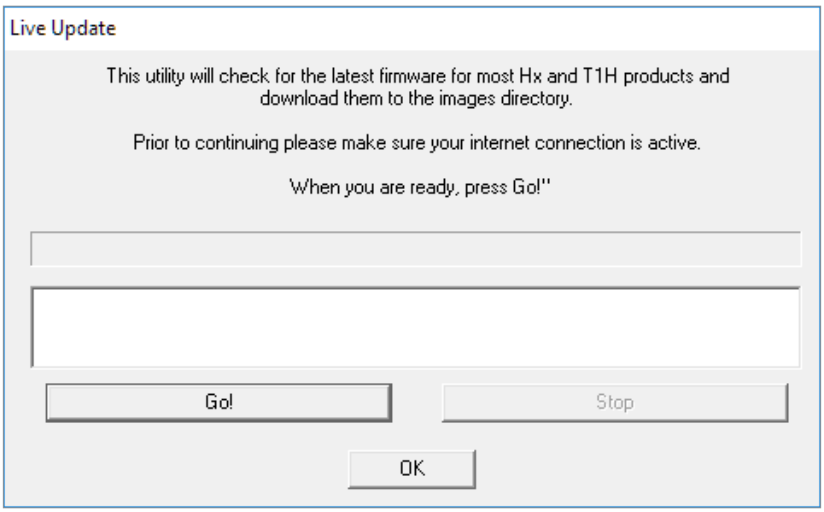
This section steps through the features and uses of NetEdit3, including individual segments of the NetEdit 3 screen and their corresponding functions.

File Menu



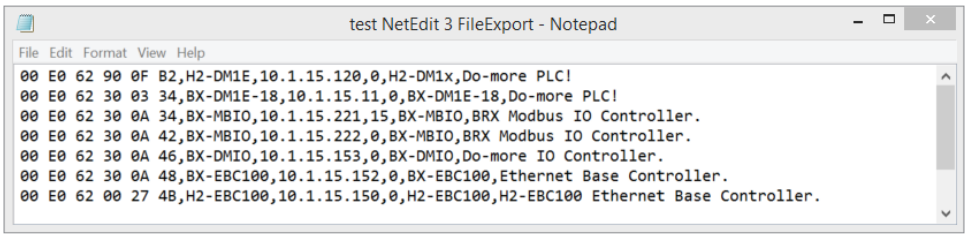
Using NetEdit 3, continued

FileMenu: Live Update



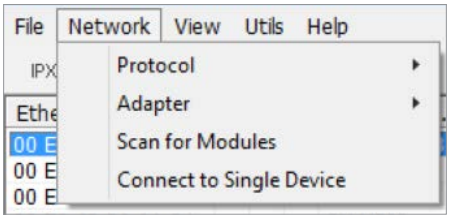
The Live Update option will retrieve the latest firmware and boot loader files from the Host Engineering web site and place them in the NetEdit 3 Images folder that was created during the install of NetEdit 3. The feature requires that you have a functional Internet connection. If the Images folder does not exist on your PC, it will be created as part of the retrieval process. When you click the Go! Button on the Live Update window, NetEdit 3 will compare the version information of the files on the Host Engineering web site against the files you have locally on your PC, and it will download any newer files. Once this process is complete, NetEdit 3 will rescan the devices on your network and refresh the "F" and "B" columns next to the listed devices.

FileMenu: Export



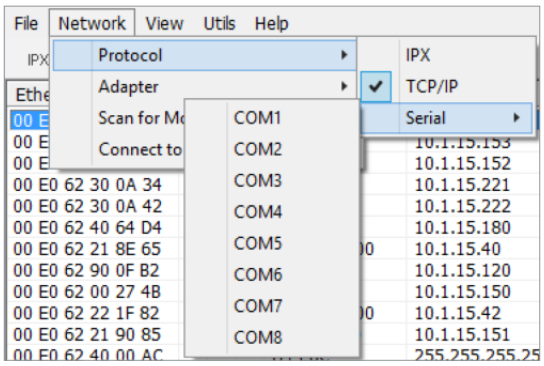
Use the Export function to save a copy of the modules listed in the NetEdit 3 screen. The CSV file stores the Ethernet address, module type, IP address, module ID, name and description. Clicking on the Export button brings up a Windows Save As dialog, allowing the user to enter the file name and folder in which to store the CSV file.

Network Menu



Using NetEdit 3, continued

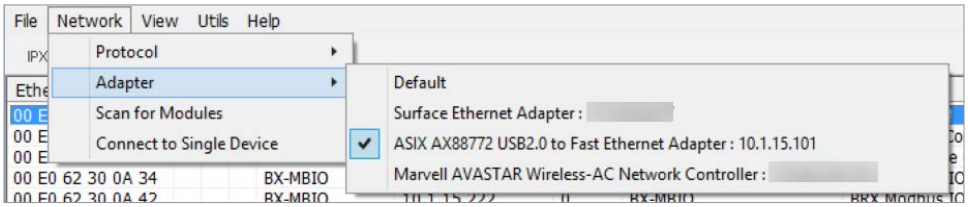
Network Menu: Protocol



The user can select the protocol NetEdit 3 will use to communicate with the field device. It is possible to select IPX, TCP/IP or Serial, as shown in the image to the right.

The Serial protocol allows the user to select the communications port on the PC to be used in updating the firmware on a H0/H2/T1H-PBC module.

Network Menu: Adapter



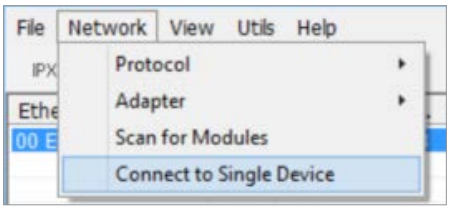
The Adapter feature allows the user to select the network interface card (NIC) used to connect to the network of HOST Ethernet-enabled devices. This is useful if there is more than one NIC. The user does not have to change Windows settings in order to connect to a network other than the Windows default network.

Network Menu: Scan for Modules

Clicking on the Scan for Modules button causes NetEdit 3 to transmit a broadcast to the network. All HOST Ethernet-enabled devices on the network respond to the query and NetEdit 3 fills the list. The list contains the Ethernet address, Firmware/Booter/Conflict status, Module Type, IP address, module ID, Name and Description for each module.

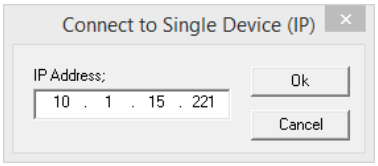
Network Menu: Connect to Single Device

The Connect to Single Device feature allows you to filter the list and view only the specified device.

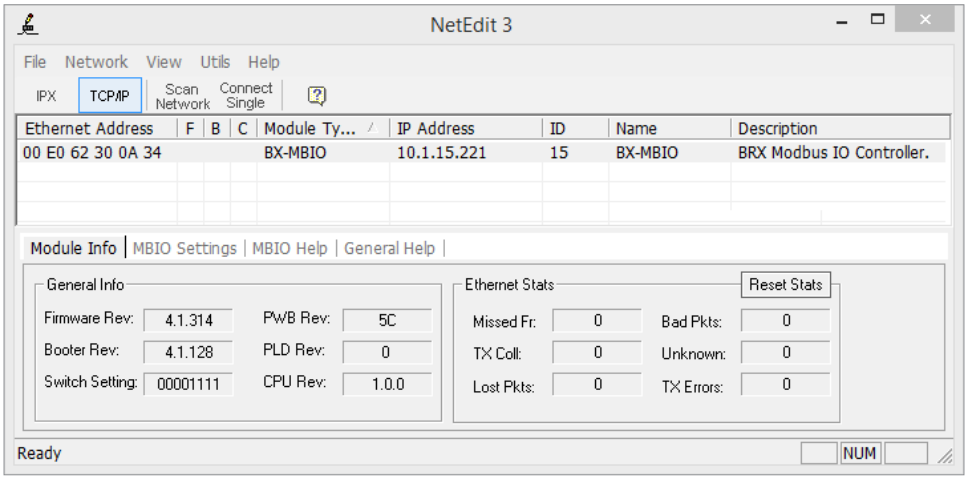


Using NetEdit 3, continued

Selecting this option brings up a window where the user enters the specific IP address of the device they want to get information about.

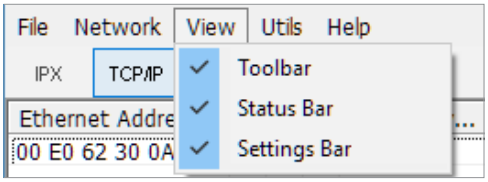


For example, when 10.1.15.221 is entered in the "Connect to Single Device" window, the list is cleared and only the requested device is displayed, as shown below:



View Menu

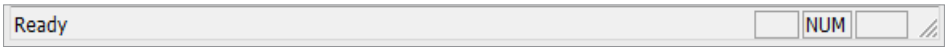
The View menu allows the user to select the features to be displayed in the NetEdit 3 screen.



The Toolbar displays/hides the following:

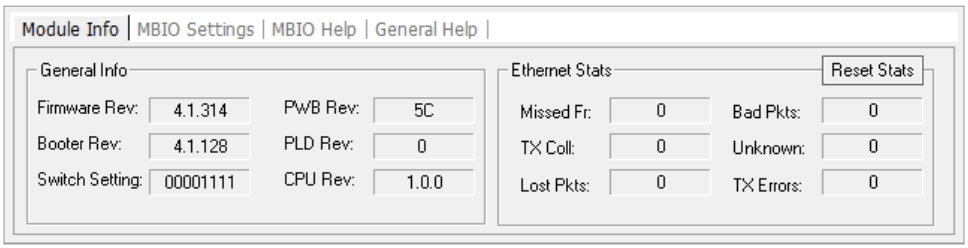


The Status Bar displays/hides the bottom portion of the screen:

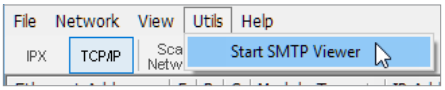


Using NetEdit 3, continued

The Settings Bar displays/hides the Settings box:

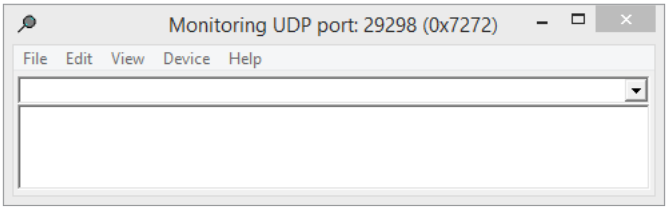


Utils Menu: Start SMTP Viewer



NOTE: *Do not use SMTP Viewer for Do-more! PLCs. SMTP Viewer is only helpful for DirectLOGIC and DirectSOFT projects. Do-more! uses the DmLogger and ST36 $EnableMsgDump for EMAIL SMTP protocol debugging.*

Selecting to Start SMTP Viewer feature displays the following window.

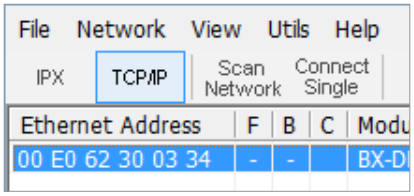


This utility helps troubleshoot Email transmission issues by allowing you to look at the SMTP protocol traffic between an ECOM100 module and an SMTP Server.

For more information, review HOST ECOM FAQ0105 (http://www.hosteng.com/FAQFiles/ECOM.htm#FAQ0105) on ECOM100 Send EMAIL Theory of Operation and this utility.

Ethernet Communications Protocol

In the upper left corner of the NetEdit3 screen, you will find buttons labeled IPX and TCP/IP. The HOST Ethernet-enabled modules understand these protocols. Both protocols are permanently resident in the firmware of the module.



When you click on one of these buttons, you are selecting the protocol you want your PC to use to communicate with the module. You are not telling the module which protocol to use, because it is using both protocols all the time.

Using NetEdit 3, continued

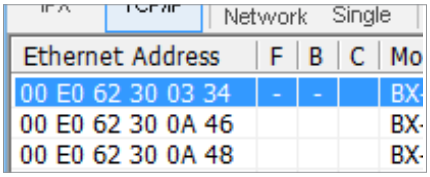
Note: IPX is a Novell standard which is no longer supported by Windows since the release of the Vista OS.

UDP/IP is a popular protocol supported by the TCP/IP suite of protocols in your PC. The figure to the right shows the Protocol selection buttons in the upper left corner of the NetEdit 3 screen. The choice you make here tells your PC which protocol to send to the HOST module to link NetEdit 3 to the module.

Some PC-based control software products may support only one of these protocols. Read the documentation for your software to be sure the protocol you select is supported.

Ethernet Address

The upper left section of the NetEdit 3 screen displays the Ethernet MAC Address of HOST modules currently on the network.



If modules are added or removed from the network, click on the Scan Network button to update the list. Notice that the MAC Address is the factory-assigned address that is on the permanent label on the module. Select a specific module here by clicking on the MAC Address or by using the arrow keys. The selected module is highlighted.

F/B/C Columns

The F, B, and C columns are provided to signify potential issues with devices on the network.

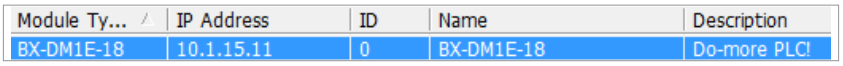
The "F" column will display an asterisk beside any device whose firmware is older than its firmware file in your Images folder. This column will display a hyphen for devices that cannot have firmware updated with NetEdit 3, such as a BRX MPU.

The "B" column will display an asterisk beside any device whose boot loader is older than its boot loader file in your Images folder. This column will display a hyphen for devices that cannot have firmware updated with NetEdit 3, such as a BRX MPU.

The "C" column will display an asterisk beside any device that has a configuration conflict with another device on the network. Duplicate module IDs (that are non-zero) and duplicate IP Addresses (that are not 255.255.255.255) will report as conflicts.

Ethernet Address	F	B	C	Module Ty...
00 E0 62 30 03 34	-	-		BX-DM1E-18
00 E0 62 30 0A 42				BX-MBIO
00 E0 62 40 64 D4		*		GS2-100
00 E0 62 21 8E 65				H0-ECOM100
00 E0 62 90 0F B2	-	-		H2-DM1E
00 E0 62 00 27 4B				H2-EBC100

Module Type, IP Address, ID, Name and Description



Module Ty...	IP Address	ID	Name	Description
BX-DM1E-18	10.1.15.11	0	BX-DM1E-18	Do-more PLC!

The upper mid-section of the NetEdit 3 screen displays the Module Type, IP Address, module ID, Name and Description of the modules currently on the network.

Default Values

The following table shows the default value for a new module or for a module that has been Restored to Factory Settings.

Default values for new modules or after reset to factory default

	IP Address of 0.0.0.0	IP address of 255.255.255.255	ID of 0	Name	Description
BX-DM1E	N	Y	Y	BX-DM1E-xx	Do-more! PLC!
BX-DMIO	Y	N	Y	BX-DMIO	Do-more! IO Controller.
BX-EBC100	Y	N	Y	BX-EBC100	Ethernet Base Controller.
BX-MBIO*	Y	N	Y	BX-MBIO	BRX Modbus IO Controller.
GS-EDRV100	Y	N	Y	T1HEBC100	T1HEBC100 Ethernet Base Controller.
H0-ECOM100	Y	N	Y	H0-ECOM100	H0-ECOM100 Ethernet Communication Module.
H2-DM1E	N	Y	Y	H2-DM1x	Do-more! PLC!
H2-EBC100	Y	N	Y	H2-EBC100	H2-EBC100 Ethernet Base Controller.
H2-ECOM100	Y	N	Y	H2-ECOM100	H2-ECOM100 Ethernet Communication Module.
H2-ERM100	Y	N	Y	H2-ERM100	Ethernet Remote Master.
H4-EBC	N	Y	Y	405EBC	405 Ethernet Base Controller.
H4-ECOM100	Y	N	Y	H4-ECOM100	H4-ECOM100 Ethernet Communications Module.
H4-ERM100	Y	N	Y	H4-ERM100	Ethernet Remote Master.
MB-GATEWAY	Y	N	Y	MB-Gateway	Modbus Gateway
T1H-EBC100	Y	N	Y	T1HEBC100	T1HEBC100 Ethernet Base Controller.
T1H-DM1E	N	Y	Y	T1HEBC100	T1HEBC100 Ethernet Base Controller.

**** The BX-MBIO requires a valid IP address to be setup before you are able to access the web configuration page.***

Access to the configuration settings of a device is done through the bottom portion of the NetEdit 3 screen or by right clicking on the device listed in the NetEdit 3 screen.

Settings Available per Device

The following table shows the available tabs and settings available to each device:

Tabs and Settings Available to Each Device

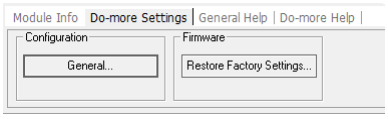
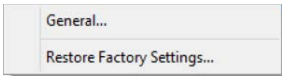
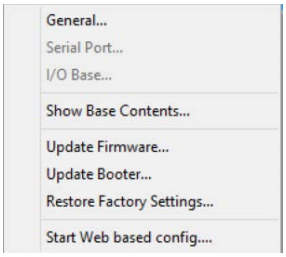
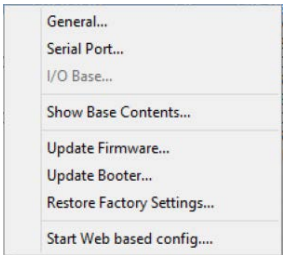
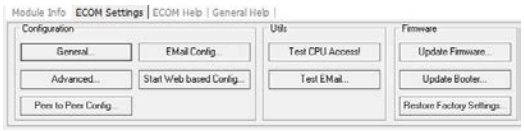
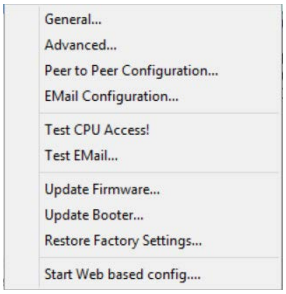
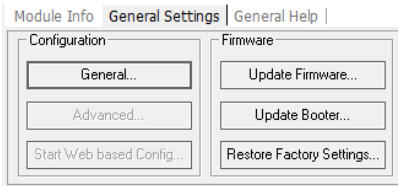
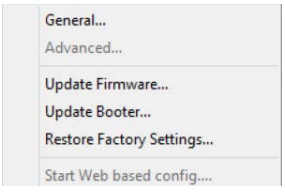
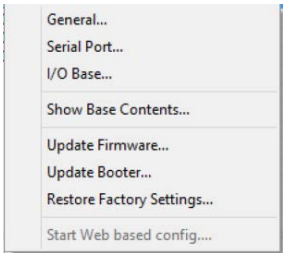
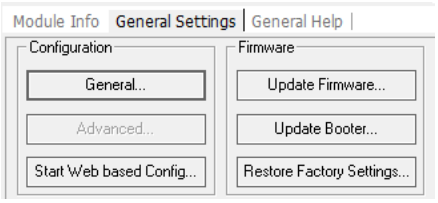
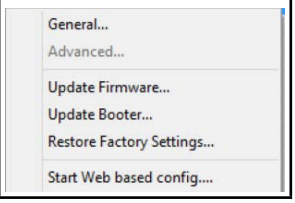
Device	Module Info Tab	Module Settings (Right-click Selection)
BX-DM1E BX-DMIO BX-EBC100 BX-MBIO GS-EDRV100 H0-ECOM100 H2-DM1E H2-EBC100 H2-ECOM100 H2-ERM100 H4-EBC H4-ECOM100 H4-ERM100 MB-GATEWAY T1H-EBC100 T1H-DM1E		
BX-DM1E H2-DM1E T1H-DM1E		
BX-DMIO BX-EBC100		
BX-MBIO H2-EBC100 T1H-EBC100		
H0-ECOM100 H2-ECOM100 H4-ECOM100		
H2-ERM100 H4-ERM100		

Table continued on next page

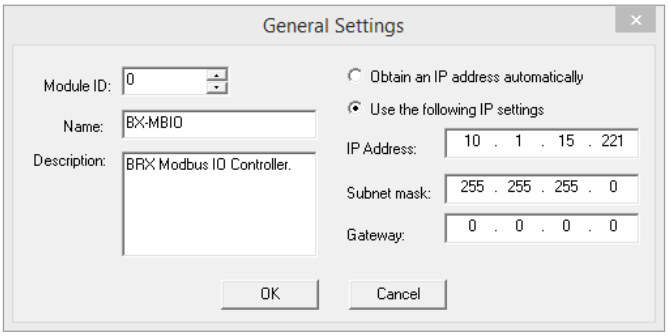
Settings Available per Device, continued

Tabs and Settings Available to Each Device (continued)		
Device	**Module Info Tab**	**Module Settings (Right-click Selection)**
H4-EBC		
GS-EDRV100 MB-GATEWAY		

The following table provides a list of HOST devices and their available configuration options. Each option will be described in general terms. Please visit the user manual for the device when detailed information is required.

Configuration Options Available per HOST Ethernet-enabled Device													
	Configuration							**Utils**			**Firmware**		
	General	Serial Port	I/O Base	Advanced	Peer to Peer Config.	Email Config.	Start Web-based Config	Test CPU Access!	Test Email	Show Base Contents	Update Firmware	Update Booter	Restore Factory Settings
BX-DM1E	Y	--	--	--	--	--	--	--	--	--	--	--	Y
BX-DMIO	Y	--	--	--	--	--	Y	--	--	Y	Y	Y	Y
BX-EBC100	Y	--	--	--	--	--	Y	--	--	Y	Y	Y	Y
BX-MBIO	Y	Y	--	--	--	--	Y	--	--	Y	Y	Y	Y
GS-EDRV100	Y	--	--	--	--	--	Y	--	--	--	Y	Y	Y
H0-ECOM100	Y	--	--	Y	Y	Y	Y	Y	Y	--	Y	Y	Y
H2-DM1E	Y	--	--	--	--	--	--	--	--	--	--	--	Y
H2-EBC100	Y	Y	--	--	--	--	Y	--	--	Y	Y	Y	Y
H2-ECOM100	Y	--	--	Y	Y	Y	Y	Y	Y	--	Y	Y	Y
H2-ERM100	Y	--	--	--	--	--	--	--	--	--	Y	Y	Y
H4-EBC	Y	Y	Y	--	--	--	--	--	--	Y	Y	Y	Y
H4-ECOM100	Y	--	--	Y	Y	Y	Y	Y	Y	--	Y	Y	Y
H4-ERM100	Y	--	--	--	--	--	--	--	--	--	Y	Y	Y
MB-GATEWAY	Y	--	--	--	--	--	Y	--	--	--	Y	Y	Y
T1H-EBC100	Y	Y	--	--	--	--	Y	--	--	Y	Y	Y	Y
T1H-DM1E	Y	--	--	--	--	--	--	--	--	--	--	--	Y

Configuration: General Settings



The General Settings box allows the user to assign a Module ID, give the module a name and description and to set the IP, Subnet Mask, and Gateway addresses for the module.

Module ID

Module IDs are optional for most devices. Module IDs must be unique for each device, but, they don't have to be in sequence. The module DIP switches associated with the Module ID, must be set to zero to allow NetEdit 3 to set a Module ID. Do not use address zero (0) when used for communications.

The Name field and Description field are optional and can be used by the user for identification purposes.

IP Address

It is recommended that all Ethernet devices have an IP address. An IP Address is assigned to a device if your network will be using the TCP/IP or Modbus TCP (not available in all devices) protocols. If you have a separate dedicated network for your device, you may be able to use the Module ID identifier (IPX protocol) for communications instead of an IP address.

Some HOST Ethernet-enabled devices are configured at the factory to look for a DHCP (Dynamic Host Configuration Protocol) server at power up. DHCP provides a way to allocate an IP address, a DNS domain or a gateway IP address dynamically to devices on the local area network. A system or network administrator configures a DHCP server with a range of IP addresses that can be assigned to DHCP enabled clients (e.g. H2-EBC100). Not all HOST Ethernet-enabled devices support DHCP.

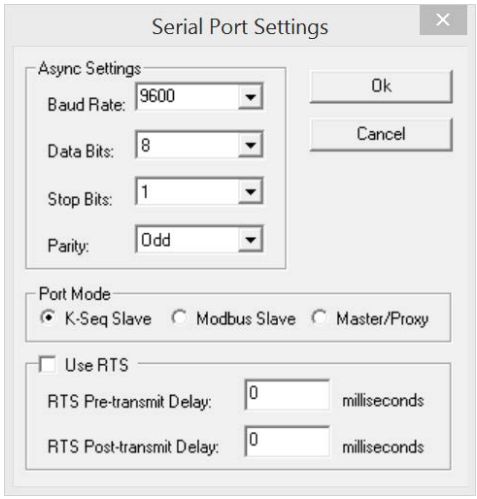
NOTE: It is not recommended to use DHCP to assign IP addresses for your permanent installation. The user should assign a static IP address to each device. It is extremely important not to have duplicate IP addresses on the network.

To set an IP Address, select **Use the following IP settings**. Use the IP Address assigned to the EBC module by your network administrator. If you change the IP Address, do not use the number "0" or "255" in any field. Doing so will cause communication problems. The valid settings are 1 through 254. The module ships from the factory with an IP Address of 0.0.0.0 or 255.255.255.255. This is not a usable IP Address for communications. The IP address must be updated before it is used.

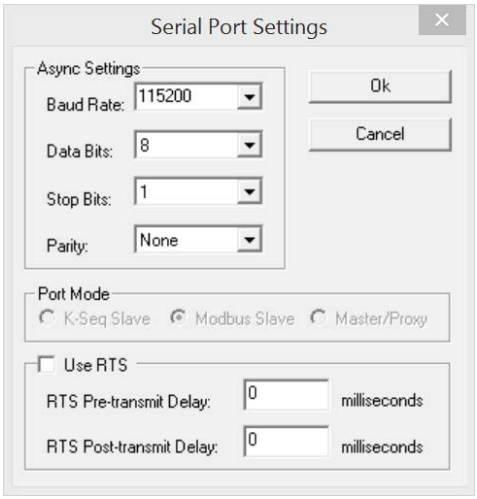
Once the IP address, the Subnet mask and the Gateway (optional) are entered, click on the OK button to write the updated settings to the flash memory on the device.

Configuration: Serial Port Settings

Hx-EBC100: RS-232 Serial Port settings



BX-MBIO: RS-485 Serial Port settings



On the Serial Port Settings window, make any necessary changes to the serial communication parameters. Be sure these parameters match the parameters of the serial device with which you are communicating.

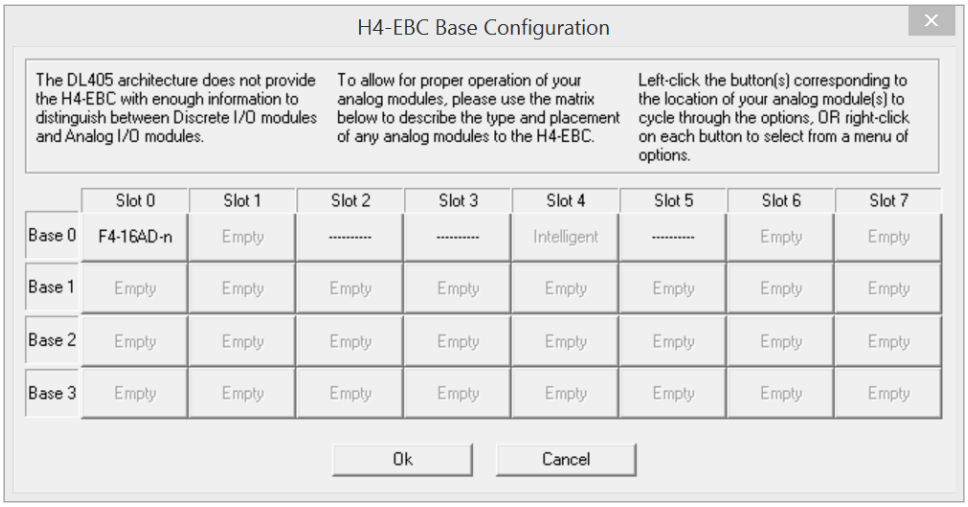
The serial port on the HX-EBC100s was intended to be used as a single RS-232 device. The station address is fixed at 1.

The serial port on the BX-MBIO is a Modbus RTU slave device, wired for RS-485. The user can select a station address in the range of 1 to 247.

NOTE: *Some PC-based Control software packages may automatically overwrite settings selected here. Refer to the documentation for your PC-based Control software.*

Once changes to the parameters are complete, click on the OK button to write the updated settings to the flash memory on the device.

Configuration: I/O Base settings



The I/O base settings box applies to the H4-EBC and the DL405 I/O. Because the H4-EBC does not receive enough information from the installed modules, the user must distinguish between Discrete I/O and Analog I/O modules.

The default symbol "----------" appears on the configuration screen where a discrete or analog module is present. For discrete modules, you do not have to change anything. The H4-EBC recognizes and self-configures for the discrete modules.

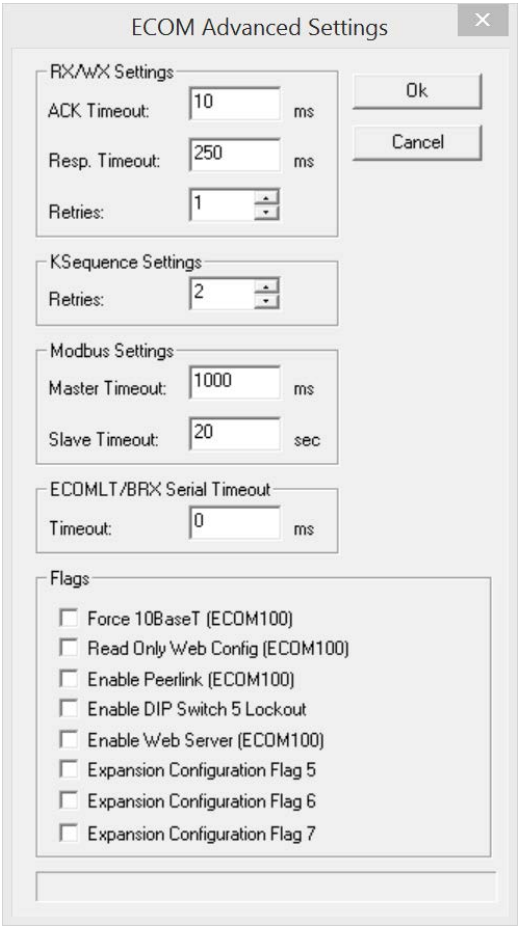
If you are using analog modules, you must let the H4-EBC know which module is installed in the slot. Click on the slot location where the analog module is located. Continue clicking on the same slot location until the part number of the installed analog module is displayed. In the example above, the user selected the F4-16AD-n, because there is a F4-16AD-1 installed in that slot.

If you are using a H4-HSC, High Speed Counter module, the word "Intelligent" will be displayed in gray in the slot it is installed in. In the example above, slot 4 displays the word "Intelligent" because there is a H4-HSC installed in that slot. This H4-HSC is configured automatically. No action is required.

If the H4-CTRIO module is used, the slot it is installed in appears as "Empty" in gray. The user must use the CTRIO Workbench utility to configure the H4-CTRIO module. Reference the HX-CTRIO-M user manual for more information.

Once the correct part numbers appear for each of your analog modules, click the OK button to save the configuration into the H4-EBC flash memory.

Configuration: Advanced settings



The advanced settings box is available to the H0-ECOM100, the H2-ECOM100 and the H4-ECOM100.

The RX/WX Settings affect PLC to PLC communications.

- ACK Timeout – the time the initiating ECOM will wait for the target ECOM over the network to reply with an ACK (acknowledgement) telegram, indicating the target ECOM received the read or write request.
- Resp. Timeout – the time the initiating ECOM will wait (after successfully receiving an ACK) for the target ECOM over the network to reply with the telegram containing the data requested in the read or write.
- Retries –this is the number of times the ECOM will retry transmissions over the network for ECOM to ECOM (Peer to Peer) communications. The number of times the initiating ECOM will resend the original request to the target ECOM over the network if he received no ACK, nor response.

KSequence Settings

- Retries – the number of times the ECOM will resend the original response to the PLC across the backplane.

Modbus Settings

- Master timeout – the time the ECOM will wait (if it is the master/client in a Modbus TCP network) for any of his Modbus TCP slaves/servers over the network to reply to the FC (function code) it just sent.
- Slave Timeout – the time the ECOM will wait (if it is the slave/server in a Modbus TCP network) for the Modbus TCP master/client to make contact again before it closes the TCP connection.

ECOMLT/BRX Serial Timeout

- Timeout –sets the maximum time for the BRX MPU to respond to the ECOMLT POM.

  Note: Under normal circumstances, the default value is fine. This field should not be used by the user unless recommended by technical support.

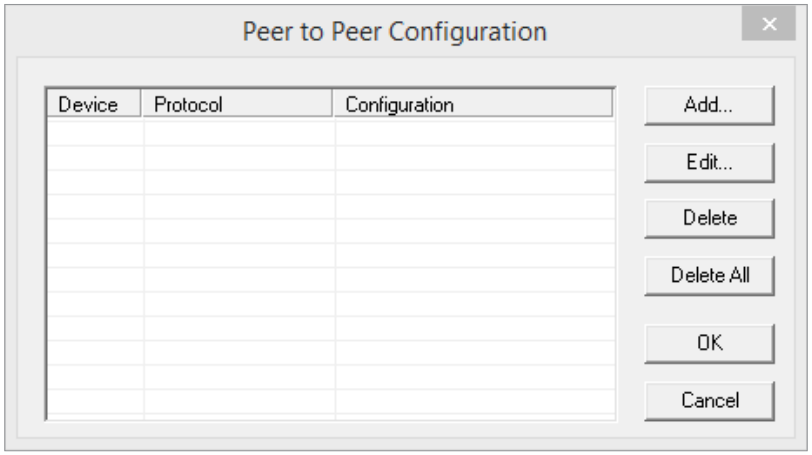
Flags

- Force 10BaseT (ECOM100) - this selection forces the ECOM100 to communicate at 10 Mbps. Normally, the ECOM100 auto-negotiates with the Ethernet switch it is connected to and picks to communicate at the fastest speed it can (100 Mbps). This selection has no meaning for ECOMs since they cannot communicate at anything faster than 10 Mbps.
- Read Only Web Config (ECOM100) - this selection makes it impossible to modify any of the ECOM100's settings via the HTML (web server) configuration with an Internet browser. This selection has no meaning for ECOMs since they cannot be configured via HTML.

Configuration: Advanced settings, continued

- Enable Peerlink (ECOM100) - this selection enables the ECOM100 to function as a PEERLINK device on a Do-more! PEERLINK network. This selection has no meaning for ECOMs since they cannot be used on a PEERLINK network.
- Enable DIP Switch 5 Lockout - this selection enables DIP switch 5 on the ECOM100 to be able to be used to write-protect the ECOM100's flash memory. Thus, the firmware, network configuration, node configuration, peer-to-peer configuration and the SMTP (Email) configuration become read-only. Normally DIP switch 5 is used as part of the ECOM100's Module ID number. If you are currently using DIP switch 5 to set the Module ID to a value greater than 32 and you want to use DIP switch 5 as a lockout, then you will have to set all the Module ID dipswitches to OFF (for a Module ID value of zero) and then use NetEdit 3 to set the Module ID to what it was before.
- Enable Web Server (ECOM100) - this selection enables the HTML (web server) configuration. By default, this interface is now disabled to protect the ECOM100's configuration from unauthorized access.
- Expansion Configuration Flag 5 – No function.
- Expansion Configuration Flag 6 - No function.
- Expansion Configuration Flag 7 - No function.

Configuration: Peer to Peer configuration



This function allows you to configure the client H0/H2/H4-ECOM(100) module to use an IP protocol packet to perform the RX/WX instruction, as opposed to a broadcast packet to locate the slave ECOM or MODBUS TCP server.

When to use Peer to Peer: the following are reasons or conditions of when to configure the H0/H2/H4-ECOM(100) for peer to peer communications with a TCP/IP server device:

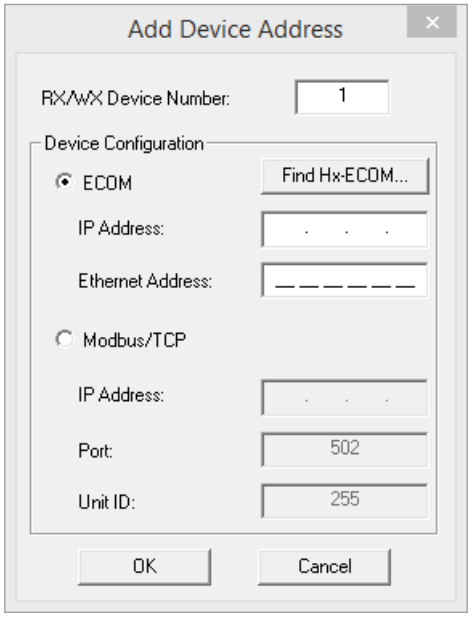
- To eliminate network broadcast traffic when the ECOM(100) is a client executing RX/WX network instructions.
- When an ECOM(100) is an "ECOM protocol client" and needs to access other server ECOMs through a router.
- When an ECOM100 needs to serve as MODBUS TCP client

Any previous configuration will be listed when the Peer to Peer Configuration box is displayed.

Configuration: Peer to Peer configuration, continued

The RX and WX ladder logic instructions used by the PLC allow you to specify a Node (Device) Number as the slave identifier in the range of 1-87. The Peer to Peer Configuration information is stored in the ECOM(100) module's flash memory. This basically associates a Device Number (that is used by the RX/WX instructions) with a server's IP address.

Clicking on the Add button in the Peer to Peer Configuration window will display the Add Device Address window shown below.



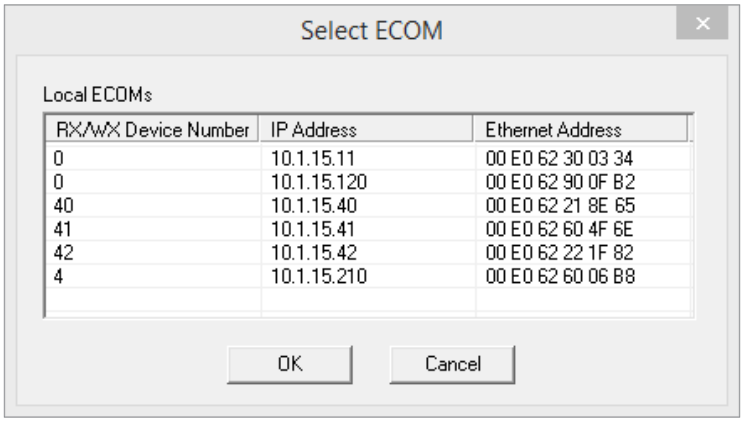
Enter the necessary server's network information (i.e. Device Number, server's IP address and protocol). You can manually enter the information or you can click on the Find Hx-ECOM button to display all local ECOMs currently on the network.

MODBUS TCP device's network information will have to be entered manually.

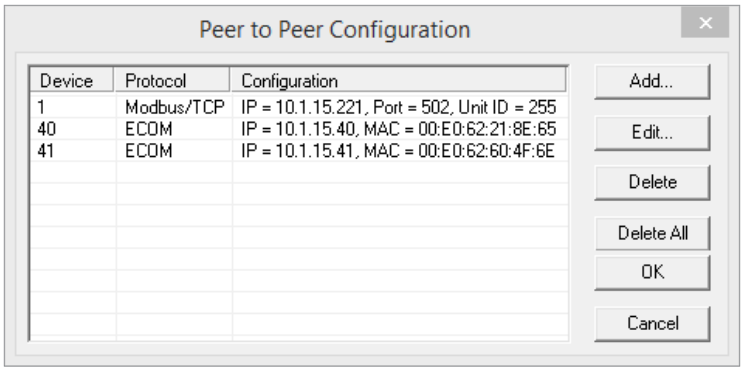
Clicking the OK button adds the Device Configuration to the main peer to peer configuration screen. Be certain not to duplicate Device Numbers.

Clicking on the Find Hx-ECOM button in the Add Device Address window will display the Select ECOM window shown below. Highlight the server ECOM that you intend to communicate with peer to peer via the client ECOM(100) module. Then click the OK button. This will add the ECOM's Device Configuration information to the previous Add Device Address window.

Configuration: Peer to Peer configuration, continued



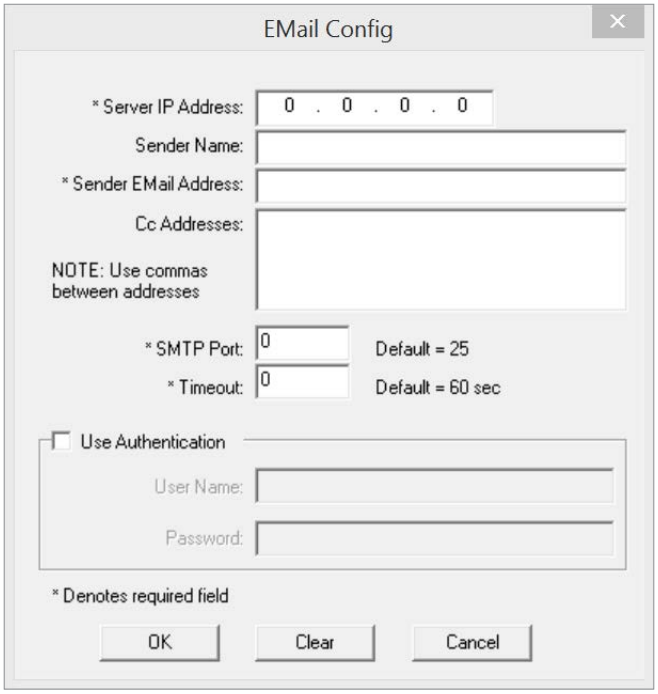
Once the module's network information is in the Add Device Address window (previous page), click the OK button to add the information to the main Peer to Peer Configuration window. Repeat the steps to add other ECOMs or Modbus TCP devices to the configuration.



Clicking the OK button on the main screen window writes the module(s) network information to the ECOM(100)'s flash memory.

Configuration: Email configuration

NOTE: *Do not use EMail Configuration for Do-more! PLCs. Use Do-more! Designer to configure EMail for a Do-more! PLC. This EMail Configuration is only useful for DirectLOGIC and DirectSOFT projects.*



Some of the EMail Setup parameters are required, and some are optional. Below is a description each parameter:

- Server IP Address (REQUIRED) - must be a valid IP address of an SMTP Server accessible from the ECOM100. This implies that the ECOM100's IP Address and Subnet Mask (both part of the normal IP configuration) must be valid also.
- Sender Name (optional) – a human readable name which will be the "From" field on all recipients of any EMail from the ECOM100.
- Sender EMail Address (REQUIRED) – almost all SMTP servers require this to be a valid EMail account on the SMTP server.
- Cc Addresses (optional) – a comma separated list of EMail addresses. Due to the limitation of the backplane data length, the EMail instruction from ladder can only generate 128 bytes of data for all fields in the ECEMAIL instruction, including the To: Subject: and Body: fields. One way to maximize the Subject: and Body: fields from the ladder program is to enter a common "predefined" list of Email addresses to be Carbon Copied (Cc:) on every sent EMail. Since this list will already be in the ECOM100, the user will not need to have a list of Email addresses in the EMAIL instruction's To: field, thus maximizing the data bytes for the Subject: and Body: fields of the ECEMAIL instruction.
- SMTP Port (REQUIRED) – By default, most SMTP Servers use TCP/IP Port number 25. It can be changed here, if necessary.
- Timeout) (REQUIRED) – The default value is 60 seconds. Since the PLC program is running asynchronously to the processing of all EMails by the SMTP server, a timeout needs to be provided in order to allow for the possibility that the Server could be down, or the Ethernet cable could be disconnected, or the Server is being bombarded with other requests, or other issues. This will allow

Configuration: Email configuration, continued

the ECOM100 to report a timeout error back to the ladder program if it was unable to complete the operation. Note that this is the time it takes to do the complete transaction, so the user may need to increase it if they have a lot of recipients (in the To: and Cc: fields) because the total amount of time taken is directly proportional to the number of recipients. A good guess for a timeout value is twice the wait of a "long" EMail message with "a lot" of recipients, when the server is busy processing other Email transactions or other services. For some SMTP Servers, this could be 5 minutes (300 seconds).

- Use Authentication – allows the user to enter a username and password to be used by the SMTP server to verify that the incoming Email is from a trusted source.

See HOST ECOM FAQ0105 (http://www.hosteng.com/FAQFiles/ECOM.htm#FAQ0105) for more information on ECOM100 Send EMAIL Theory of Operation and this utility.

Configuration: Start Web based Config

Several HOST Ethernet-enabled devices have a web configuration page. From the web server page, it is possible to access the same setting options that are available through NetEdit 3. This configuration page uses an embedded web server on port 80 (unsecure).

Before the web configuration page can be accessed, the device must be appropriately added to the network. The IP address, the subnet mask and the Gateway address (optional) must be configured via NetEdit 3.

The following table presents web the configuration page for each device supporting web configuration.

Web Configuration Pages for Supported Devices

Device	Web-based Configuration Page
BX-DMIO	**BX-DMIO by AutomationDirect.com** Module ID: 0 (0x0) Module Name: BX-DMIO Module Description: Do-more IO Controller. Ethernet Address: 00 E0 62 30 0A 46 IP Setup: Address: 10.1.15.153 Subnet: 255.255.255.0 Gateway: 0.0.0.0 Module Setup: Setup Module Configuration Booter Version: 4.1.128 OS Version: 4.1.299 Firmware Updates: Hosteng.com NetEdit Download: http://www.hosteng.com/sw-products/netedit3.htm BRX User Manual: http://www.automationdirect.com/pn/doc/manual/BX-DMIO BRX Spec Sheet: http://www.automationdirect.com/pn/doc/spec/BX-DMIO
BX-EBC100	**BX-EBC100 by AutomationDirect.com** Module ID: 0 (0x0) Module Name: BX-EBC100 Module Description: Ethernet Base Controller. Ethernet Address: 00 E0 62 30 0A 48 IP Setup: Address: 10.1.15.152 Subnet: 255.255.255.0 Gateway: 0.0.0.0 Module Setup: Setup Module Configuration I/O Mapping: Display Modbus I/O Mapping Booter Version: 4.1.128 OS Version: 4.1.299 Firmware Updates: Hosteng.com NetEdit Download: http://www.hosteng.com/sw-products/netedit3.htm BRX User Manual: http://www.automationdirect.com/pn/doc/manual/BX-EBC100 BRX Spec Sheet: http://www.automationdirect.com/pn/doc/spec/BX-EBC100

Table continued on next page

Configuration: Start Web based Config, continued

Web Configuration Pages for Supported Devices (continued)

Device	Web-based Configuration Page
BX-MBIO	**BX-MBIO by AutomationDirect.com** Module Name: BX-MBIO Module Description: BRX Modbus IO Controller. Ethernet Address: 00 E0 62 30 0A 34 IP Setup: Address: 10.1.15.221 Subnet: 255.255.255.0 Gateway: 0.0.0.0 Serial Port Setup: Station: 15 115200-8-N-1-Modbus Slave-No Pre Delay Module Setup: Setup Module Configuration I/O Mapping: Display Modbus I/O Mapping Booter Version: 4.1.128 OS Version: 4.1.314 Firmware Updates: Hosteng.com NetEdit Download: http://www.hosteng.com/sw-products/netedit3.htm BRX User Manual: http://www.automationdirect.com/pn/doc/manual/BX-MBIO BRX Spec Sheet: http://www.automationdirect.com/pn/doc/spec/BX-MBIO
GS-EDRV100	**GS2-100 by AutomationDirect.com** Module ID: 0 (0x0) Module Name: EDRV100 Module Description: GS Series Drive Controller Ethernet Address: 00 E0 62 40 64 D4 IP Setup: Address: 10.1.15.180 Subnet: 255.255.255.0 Gateway: 0.0.0.0 Booter Version: 5.0.76 OS Version: 5.0.258 Comm Link: 19200-8-ODD-1-RTU P0 Monitoring parms P1 Ramps parms P2 Volts/Hertz parms P3 Digital parms P4 Analog parms P5 Presets parms P6 Protection parms P7 PID parms P8 Display parms P9 Comm parms P10 Encoder Feedback parms Firmware Updates: Hosteng.com
H2-ECOM100	**H0-ECOM100 by Automation Direct.com** Module ID: 0 (0x0) Module Name: H0-ECOM100 Module Description: H0-ECOM100 Ethernet Communications Module. Ethernet Address: 00 E0 62 21 7B 59 IP Setup: Address: 10.1.15.40 Subnet: 255.255.255.0 Gateway: 0.0.0.0 Booter Version: 4.0.165 OS Version: 4.0.348 EMail Working Setup: Server Address: 0.0.0.0 / Sender Name: -- undefined -- / Sender Address: -- undefined -- / Cc: -- undefined -- / Port: 25 / Timeout: 60 seconds EMail Setup: Server Address: 0.0.0.0 / Sender Name: -- undefined -- / Sender Address: -- undefined -- / Cc: -- undefined -- / Port: 0 / Timeout: 0 seconds EMail Test: Send Test EMail Peer to Peer: [1-7] [8-15] [16-23] [24-31] [32-39] [40-47] [48-55] [56-63] [64-71] [72-79] [80-87] Advanced: ECOM Advanced Settings Peerlink: Peerlink Settings CPU Rev: 1.1.1 PWB/PLD Rev: 4C / 1A Firmware Updates: Hosteng.com

Table continued on next page

Configuration: Start Web based Config, continued

Web Configuration Pages for Supported Devices (continued)

Device	Web-based Configuration Page
H2-EBC100	**H2-EBC100 by Automation Direct.com** Module ID: 0 (0x0) Module Name: H2-EBC100 Module Description: H2-EBC100 Ethernet Base Controller. Ethernet Address: 00 E0 62 00 27 4B IP Setup: Address: 10.1.15.150 Subnet: 255.255.255.0 Gateway: 0.0.0.0 Booter Version: 4.0.165 OS Version: 4.0.605 Serial Port Setup: 9600-8-O-1-KSeq Slave Mode-No RTS CPU Rev: 1.0.3 PWB/PLD Rev: 2A / 1A Firmware Updates: Hosteng.com
H2-ECOM100	**H2-ECOM100 by Automation Direct.com** Module ID: 42 (0x2A) Module Name: H2-ECOM100 Module Description: H2-ECOM100 Ethernet Communications Module. Ethernet Address: 00 E0 62 22 1F 82 IP Setup: Address: 10.1.15.42 Subnet: 255.255.255.0 Gateway: 0.0.0.0 Booter Version: 4.0.165 OS Version: 4.0.914 Peer to Peer: [1-7] [8-15] [16-23] [24-31] [32-39] [40-47] [48-55] [56-63] [64-71] [72-79] [80-87] CPU Rev: 1.1.1 PWB/PLD Rev: 5A / 1B Firmware Updates: Hosteng.com
H4-ECOM100	**H4-ECOM100 by Automation Direct.com** Module ID: 41 (0x29) Module Name: H4-ECOM100 Module Description: H4-ECOM100 Ethernet Communications Module. Ethernet Address: 00 E0 62 60 4F 6E IP Setup: Address: 10.1.15.41 Subnet: 255.255.255.0 Gateway: 0.0.0.0 Booter Version: 4.0.165 OS Version: 4.0.2132 EMail Working Setup: Server Address: 0.0.0.0 Sender Name: -- undefined -- Sender Address: -- undefined -- Cc: -- undefined -- Port: 25 Timeout: 60 seconds EMail Setup: Server Address: 0.0.0.0 Sender Name: -- undefined -- Sender Address: -- undefined -- Cc: -- undefined -- Port: 0 Timeout: 0 seconds EMail Test: Send Test EMail Peer to Peer: [1-7] [8-15] [16-23] [24-31] [32-39] [40-47] [48-55] [56-63] [64-71] [72-79] [80-87] Advanced: ECOM Advanced Settings Peerlink: Peerlink Settings CPU Rev: 1.0.2 PWB/PLD Rev: 4A / 1A Firmware Updates: Hosteng.com

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Configuration: Start Web based Config, continued

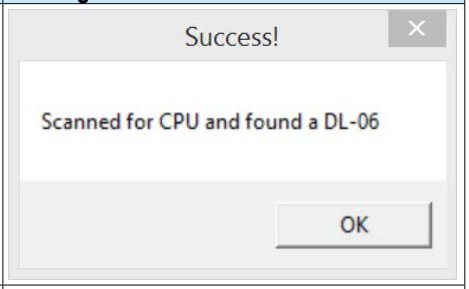
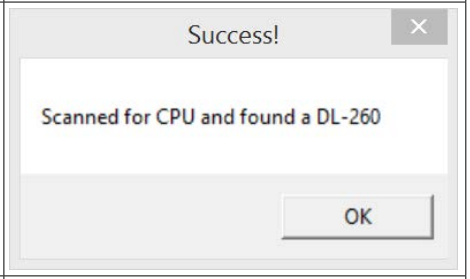
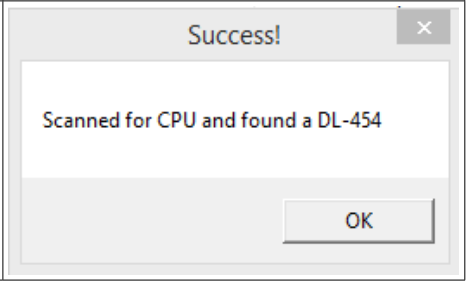
Web Configuration Pages for Supported Devices (continued)

Device	Web-based Configuration Page
MB-GATEWAY	**MB-Gateway by AutomationDirect.com** Gateway Modbus ID: 0 (0x0) Module Name: MB-Gateway Module Description: Modbus Gateway Ethernet Address: 00 E0 62 40 4E D9 IP Setup: Address: 10.1.15.130 Subnet: 255.255.255.0 Gateway: 0.0.0.0 Booter Version: 5.0.53 OS Version: 1.0.601 Serial Port Configuration: 19200-8-ODD-1-RTU Slave Timeout/Retries: Timeout=1000 Retries=2 Automatic Reads: Reading from: none Show Status: Monitor Status Information Firmware Updates: Hosteng.com
T1H-EBC100	**T1H-EBC100 by Automation Direct.com** Module ID: 154 (0x9A) Module Name: T1HEBC100 Module Description: T1HEBC100 Ethernet Base Controller. Ethernet Address: 00 E0 62 40 7A D9 IP Setup: Address: 10.1.15.0 Subnet: 255.255.255.0 Gateway: 0.0.0.0 Booter Version: 4.0.165 OS Version: 4.0.1432 Serial Port Setup: 9600-8-O-1-KSeq Slave Mode-No RTS CPU Rev: 1.1.5 PWB/PLD Rev: 7A / 1A Firmware Updates: Hosteng.com

Utils: Test CPU Access!

The Test CPU Access option is available to the H0/H2/H4-ECOM100. When the button is pressed and everything is working correctly, a Success window will be shown:

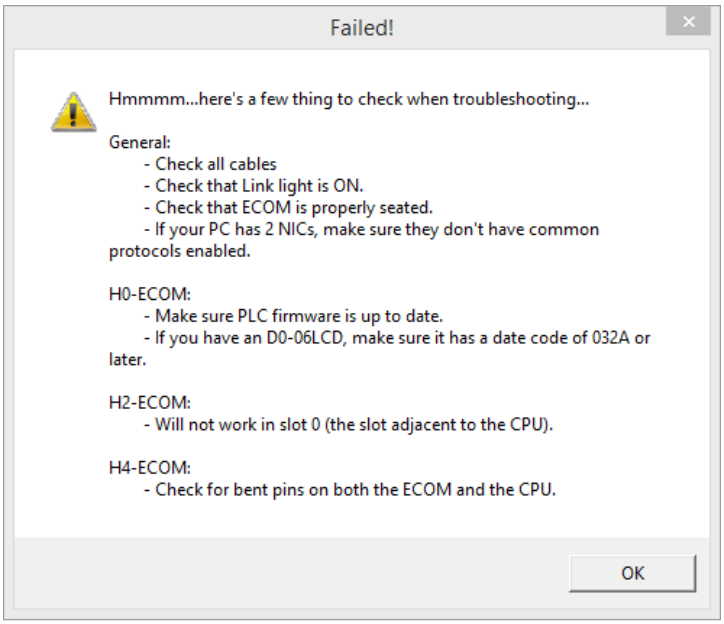
CPU Access Success Messages

Device	Message
For a H0-ECOM100 installed in a DL06 base:	
For a H2-ECOM100 installed on a DL260 base:	
For a H4-ECOM100 installed on a DL454 base:	

The ECOM has two distinct “sides”, the network side, which contains the network configuration settings, and the backplane side, which the ECOM uses to communicate with the PLC CPU. It is possible that only one side could be operating correctly, while the other side is not. The Test CPU Access function will test the connection from your PC to the ECOM module through the network side, across the backplane to the PLC CPU and back to your PC.

Utils: Test CPU Access, continued

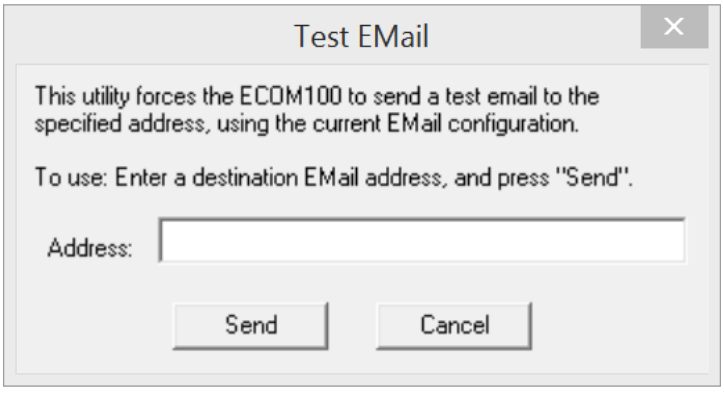
If the Test CPU Access fails, the following window is displayed. This windows provides some troubleshooting suggestions.



Utils: Test EMail

The Test EMail option is available to the H0/H2/H4-ECOM100. When the button is pressed it forces the ECOM100 to send a test email to the address specified by the user, using the current Email configuration.

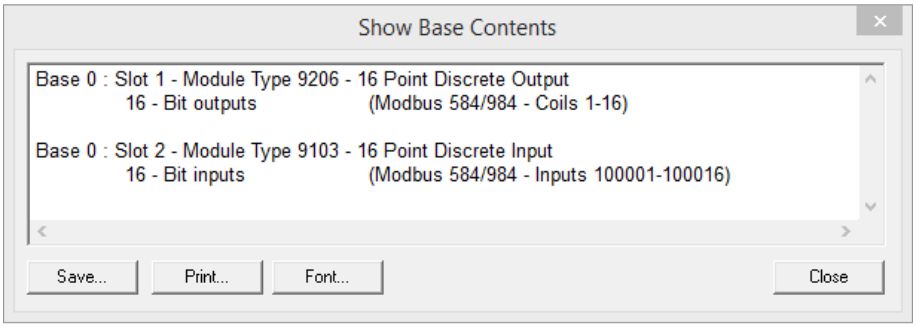
When the button is pressed the following window is shown. The user enters the EMail address to which the test message will be sent.



When the Send button is pressed, the ECOM100 will send the EMail. Note that the EMail is sent from the ECOM100 directly, not from the PC running NetEdit 3 or running the web server configuration page.

Utils: Show Base Contents

The "show base contents" menu option is available to the BX-DMIO, BX-MBIO, and BX/H0/H2/H4-EBC100. As an example, consider the window that comes up for a BX-EBC100 controller:



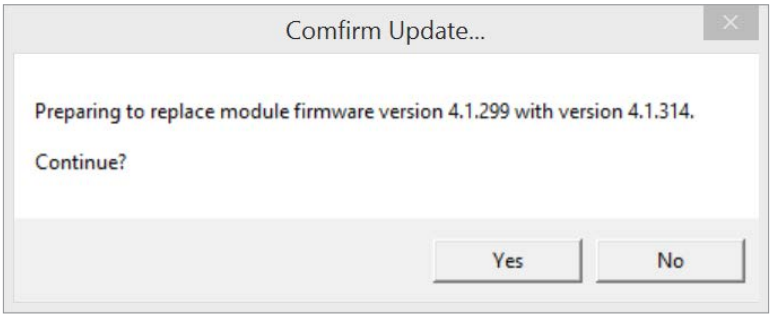
This function queries the DMIO/EBC100/MBIO for a list of the I/O modules it has in its base. The Module Type and the Modbus 584/984 addressing (available for the EBC100/MBIO) will be listed as well. This helps confirm that the DMIO/EBC100/MBIO can recognize all the I/O modules connected to the controller, an important troubleshooting tool. The information on the Show Base Contents window can be saved as a text (*.txt) file or printed for reference or future use. The Font button allows you to change the way text is displayed in the window.

Firmware: Update Firmware, Update Booter and Restore Factory Settings

The functions in the Firmware box are used to update the selected module's firmware and booter versions. The Restore Factory Settings option resets the selected module's IP address, Module ID (if not set by DIP switches), Name and Description to factory defaults.

Clicking on either of the Update buttons opens the appropriate folder within the Images folder, which is created during the install of NetEdit 3. The Images folder is located in the same folder as NetEdit3.exe. Each module folder contains the module's firmware and boot loader files.

Before the update takes place, a confirmation window is displayed, allowing the user to initiate the update. For example, the following window is displayed when attempting to update the firmware in a BX-EBC100:



Clicking on the Yes button continues with the update.

As discussed earlier in this appendix, the user should periodically check for new firmware and booter versions by using the "Live Update" feature in NetEdit 3 or the "Check For Updates" feature in the Do-more! Designer programming software. Once the latest updates have been downloaded, use the F/B/C columns to determine if any device requires an update.

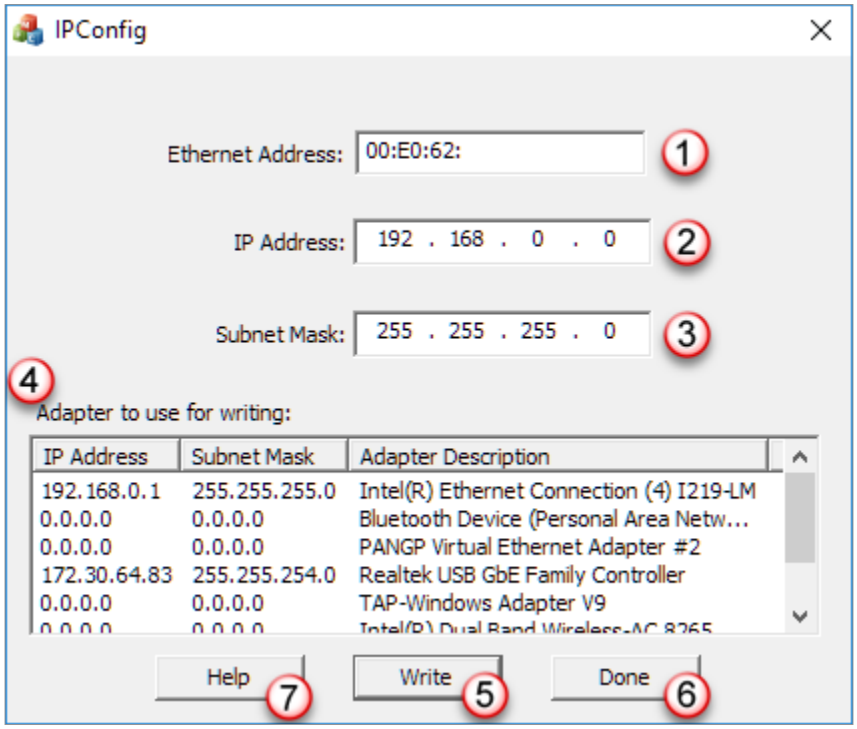
When NetEdit Does Not Work

When NetEdit does not "see" a Host Engineering Ethernet device

The IPConfig Tool was created to help recover Host Engineering Ethernet devices (e.g. ECOM100, EBC100, etc.) when:

- the devices have disappeared off the TCP/IP network and have become invisible to NetEdit.
- the IPX protocol is not available.

The IPConfig Tool does this by using a directed IP broadcast to the MAC address (since the IP settings are obviously unknown or incorrect).



1. ETHERNET ADDRESS: Enter the last 3 bytes of the Ethernet address (MAC address) of the Host Engineering Ethernet device you wish to recover. This address is printed on the label of the device itself. For convenience, the field will contain the first 3 bytes of the MAC address of all Host Engineering Ethernet devices (00:E0:62).
2. IP ADDRESS: Enter the IP address you wish for the device to have. By default, this will contain bytes based on what it discovered about your PC's IP address and subnet settings, but all fields are editable.
3. SUBNET MASK: Enter the subnet mask you wish for the device to have. By default, this will contain the same subnet mask as your PC.
4. ADAPTER TO USE FOR WRITING: Select the Ethernet adapter you wish to use for performing the write. As you click on different adapters, if they have different subnet mask definitions, then the SUBNET MASK field will change accordingly.

When NetEdit Does Not Work, continued

5. WRITE button: Pressing this button will write the IP Address and Subnet Mask to the device that has the entered Ethernet Address.
6. DONE button: Pressing this button will close the application.
7. HELP button: Pressing this button will open a Notepad window with the information found in this section.

How to use the IPConfig Tool

1. Run the IPConfig Tool from one of the following locations:
   a. Double-click on IPConfig under Do-more! Designer Launchpad Applications windows.
   b. Double-click on IPConfig under DSLaunch Utilities section.
   c. Double-click on IPConfig102.EXE file from Windows Explorer (under the HAPTOOLS folder).
2. At the bottom, select the adapter you wish to use for performing the write. This will help set the Subnet Mask field to a proper default value.
3. Enter the Ethernet (MAC) address of the device you wish to attempt to recover in the Ethernet Address field.
4. Enter the IP address you wish the device to have in the IP Address field. Make sure you choose one that is on the PC's subnet.
5. In most cases there is no need to set the Subnet Mask field because it will have the correct subnet based on the adapter you picked in Step 2.
6. Press the <Write> button.
   a. If it completes with no errors you will get a message saying, "Cool! Found device!" Goto Step 7.
   b. If it can't find the device you will get a message saying, "Sorry! Unable to find device!" Check the Ethernet Address for typos and try again.
7. Press the <Done> button to close the application.
8. Try NetEdit again and see if your device shows up.

Tips & Tricks



In This Appendix...

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Tips & Tricks

C-more tag import

To easily get your tags from a Do-more! Designer Project into a C-more HMI, in Do-more! Designer go to File –> Export -> Element Documentation. Pick C-more Do-more! Driver Format WITH Structure Fields.

If you want C-more to reference elements that are used in your ladder program but do NOT have nicknames, you can either assign them nicknames, or you can check the "Also export USED elements which do not have a nickname" in the Export Element Documentation dialog box.

Pointers, Indexing and Arrays

In order to utilize a memory element as an array, it must be a Memory Block. Heap Items are singeltons and cannot be utilized as an array. To see what elements can be used as an array or to create a custom item, go to System Configuration -> Memory Configuration -> Memory blocks tab.

Addressing a Memory Block as an array is simple. Place brackets [ ] after the Memory Block name and use a V memory element such as V0 as the index. IE D[V0], N[V5], UDT[V0], etc.

A handy trick for knowing how large the array is without hardcoding values is to use the DATAINFO instruction.

Bit of Word, Data type conversion and Casting

Getting bits out of a word in Do-more! Designer is done with a method called Casting. More information on Casting can be found in Do-more! Designer Help Topic DMD0309.

The basics of Casting a memory element are to use a ":" and an identifier or for Bit of Word, a number. IE D0:1 is bit 1 of memory element D0. All Bits start at zero.

To simplify Casting, you can use the Cast Builder. When on a field that supports a memory element, press the F9 key. Type your Source Element in the appropriate field and then in the bottom right corner, press the "Show Cast Builder" button. Click the appropriate radio buttons and then press "Select". It is that easy to cast a memory element.

Other methods for doing memory type conversion is by using the ladder commands PUBLISH and SUBSCRIBE. These will allow you to convert large areas of memory at once which is useful when you are talking to a Modbus or DirectLogic device that utilizes untyped memory.

Formatting Date and Time on an HMI with String Scripting

If you want your date and time to look nice on your HMI, put the data into a string using STRPRINT and the string scripting language. See Do-more! Designer Help Topic DMD0168 for a list of all string scripting commands.

MATH, Logical Operations & statistical functions

The Do-more! MATH instruction is a very powerful feature. Do-more! Designer Help Topic DMD0085 covers the lists of functions that are available.

In addition to doing Arithmetic and Trigonometry, it can also do Logical and Bitwise operations. A few minutes perusing this help topic can save you a lot of time.

The most common issue when doing Math with a Do-more! processor is knowing that you must promote the equation to Real (Floating Point) if you are using integers with a Real result. If the equation is integers, but you wish to have a result that is a Real number you must use TOREAL() or add a decimal point to one of the numbers; IE 2.0. See Help topic DMD0085 for more information on promoting numbers to Real format.

Simulation and PID Simulation

Do-more! Designer software comes with a separate Do-more! simulator application that runs the same Do-more! control engine that is in the Do-more! CPUs. You can connect/disconnect and upload/download to the simulator as you would with a Do-more! CPU. There is even a Run/Term/Stop mode switch and LED indicators for power, Run and communication activity. This is a great tool to test your code before you ever load it into your system.

The Simulator also has the ability to do simple PID simulation to learn how PID works!

See Do-more! Designer Help Topic DMD0234 for more information.

Symbolic Constants

Do-more! Designer supports the use of Symbolic Constants. A Symbolic Constant is where you assign a nickname to a hard coded value. IE Sunday = 0, Monday = 1, Tuesday = 3, etc. Do-more! Designer Help topic DMD0276 has more information on symbolic constants.

To assign a Symbolic Constant, go to Tools -> Documentation Editor and then press the "Symb" in the toolbar of the Documentation Editor tab. This can help make your program much easier to read and navigate.

You can add a nickname to a memory location that has a cast. For example you have a double word signed number in D100 nicknamed "Dancer" for your dancer position. If you wanted to know that it was a negative, you could use D100:31 which is the sign bit for D100. If you were to nickname D100:31 "Dancer_Neg" you could use this nickname throughout your program and it would always refer to D100:31.

Start Page replacement

You can attach documents to your project to replace the content of the Start Page on a project-by-project basis. This can be a PDF, Excel spreadsheet, .JPG, etc. A good example of this is the PID1.dmd example project found in the Examples folder in Do-more! Designer.

Moving Communications links to another PC

You can move your communications links from one PC to another by copying the DmDComm.RST file that is located in the Do-more\Designerx_x\Bin\ folder.

Troubleshooting email with DMLogger

In your Do-more! Designer ladder project, turn $EnableMsgDump bit ON & start Do-more! Logger from Applications window in the Launchpad to troubleshoot email. This will send the server messages to your PC so that you can see exactly where it is getting stuck at.

The DMLogger utility can also be useful for troubleshooting by placing STREAMOUT instructions in your ladder code to send messages to the utility to let you know what is happening at various times.

Importing Program segments

Use the #import mechanism in your Import Program text file so you can modularly create projects from different source files. So MyProject.TXT could contain just 4 lines:

#include "SysConfigXYZZY.txt"

#include "MachineControl.txt"

#include "Library\NonLinearControlLibrary.txt"

#include "Library\CalendarLibrary.txt"

Keyboard Shortcuts

The following table lists the keystrokes (also known as Hot Keys or Accelerator Keys) available in the various views of Do-more! Designer that can greatly enhance the usability of each view.

Keyboard Shortcuts	
Shortcut	**Action**
Ladder View	
!	Edit Not-Equal-To Contact
<	Edit Less-Than Contact
=	Edit Equal-To Contact
>	Edit Great-Than-Or-Equal-To Contact
Ctrl+A	Select All
Ctrl+C	Copy into Clipboard
Ctrl+E	Toggle Edit Mode
Ctrl+F	Open Find Dialog
Ctrl+Shft+F	Find Next
Ctrl+K	Open Rung Comment Editor
Ctrl+P	Print Current View
Ctrl+R	Open Replace dialog
Ctrl+V	Paste Clipboard into View
Ctrl+W	Connect Wire to Output
Ctrl+X	Cut into Clipboard
Ctrl+Z	Open Edit History
Backspace	Delete Instruction to Left then move Edit cursor to Left
Ctrl+Comma	Goto Previous Instruction
Ctrl+Delete	Cut into Clipboard
Delete	Delete
Ctrl+Down Arrow	Draw Wire Down
Ctrl+Shft+Down Arrow	Delete Wire Down
Ctrl+End	Goto Last Rung in Code Block
Ctrl+Shft+End	Add from Current Location to End to Selection
Shft+End	Add Next Rung to Selection
Enter	Insert Row After Block Cursor, or Before Block Cursor if in First Column
F12	Goto Element's Output Reference
Ctrl+F2	Edit Positive Differential Powerflow Modifier
Shft+F2	Edit Positive Differential Contact
Table continued on next page	

Keyboard Shortcuts (continued)	
Class	**Description**
F2	Edit Normally Open Contact
Ctrl+F3	Edit Negative Differential Powerflow Modifier
Shft+F3	Edit Negative Differential Contact
F3	Edit Normally Closed Contact
F4	Open Contact Instruction Browser
F5	Open Coil Instruction Browser
F7	Open Box Instruction Browser
F8	Accept Modified Rungs
Ctrl+Home	Goto First Rung in Code-Block
Ctrl+Shft+Home	Add from Current Location to Beginning to Selection
Shft+Home	Add Previous Rung to Selection
Ctrl+Insert	Copy into Clipboard
Shft+Insert	Paste Clipboard into View
Insert	Open Insert Rung, Row, Column dialog
Ctrl+Left	Draw Wire to Left
Ctrl+Shft+Left	Delete Wire to Left
Ctrl-Minus	Goto Element's Previous Reference
Ctrl+Shft+Minus	Zoom Out
Ctrl+Page Down	Goto Next Modified Rung
Page Down	Goto Next Rung
Ctrl+Page Up	Goto Previous Modified Rung
Page Up	Goto Previous Rung
Ctrl+Period	Goto Next Instruction
Ctrl+Plus	Goto Element's Previous Reference
Ctrl+Shft+Plus	Zoom In
Ctrl+Right	Draw Wire to Right
Ctrl+Shft+Right	Delete Wire to Right
Ctrl+Up	Draw Wire Up
Ctrl+Shft+Up	Delete Wire Up
Main Programming Window	
Ctrl+D	Open Documentation Editor
Ctrl+L	Open Ladder View
Ctrl+Shft+L	Restore Default Window Layout
Ctrl+N	Create New Project
Ctrl+O	Open Project
Ctrl+Shft+R	Open Set PLC Mode dialog
Ctrl+S	Save Project to Disk
Ctrl+Shft+S	Toggle View's Status On/Off
Ctrl+T	Edit Title Page
Ctrl+Y	Open Cross Reference View
F1	Launch Contextual Help
Ctrl+Shft+F2	Open Change Value dialog
Ctrl+ShftF3	New Data View
Ctrl+F9	Read Project from PLC
Shft+F9	Write Project to PLC
F9	Open Element Selection Tool

Table continued on next page

Keyboard Shortcuts (continued)	
Class	**Description**
Data View	
Ctrl+Shft+A	Sort Elements Ascending
Ctrl+C	Copy into Clipboard
Ctrl+ShftD	Sort Elements Descending
Ctrl+V	Copy Clipboard into View
Ctrl+X	Cut into Clipboard
Ctrl+Delete	Cut into Clipboard
Delete	Delete
Ctrl+Enter	Insert Element with Next ID
Ctrl+Shft+Enter	Structure Field: Insert Element with Next Field Structure: Insert Structure Fields
Ctrl+F2	Modify Element or Edit Cell
F2	Modify Element or Edit Cell
Shft+F6	Move to Format Selections
F6	Move to Format Selections
Shft+F9	Write Value to PLC
Ctrl+Insert	Copy into Clipboard
Shft+Insert	Paste Clipboard into View
Insert	Insert Row
Project Browser	
Ctrl+C	Copy into Clipboard
Ctrl+V	Copy Clipboard into View
Ctrl+X	Cut into Clipboard
Ctrl+Delete	Cut into Clipboard
Delete	Delete
Ctrl+Insert	Copy into Clipboard
Shft+Insert	Paste Clipboard into View
Insert	Open Create New Code-Block dialog
Rung Comment Editor	
Ctrl+A	Select All
Ctrl+F	Goto Comment for Rung
Ctrl+G	Goto Comment for Rung
Ctrl+End	Goto Last Rung in Code Block
Ctrl+Home	Goto First Rung in Code-Block
Ctrl+Page Down	Go 5 Rungs Forward
Ctrl+Page Up	Go 5 Rungs Back
Cross Reference View	
Ctrl+F	Open Find Dialog
Ctrl+Shft+F	Find Next
Ctrl+P	Print Current View
Trend View	
F2	Open Add / Remove Elements dialog
Element Documentation Editor	
Ctrl+C	Copy into Clipboard
Ctrl+F	Open Find Dialog

Table continued on next page

Keyboard Shortcuts (continued)	
Class	**Description**
Ctrl+Shft+F	Find Next
Ctrl+P	Print Current View
Ctrl+V	Copy Clipboard into View
Ctrl+X	Cut into Clipboard
Ctrl+Delete	Cut into Clipboard
Delete	Delete
Ctrl+Insert	Copy into Clipboard
Shft+Insert	Paste Clipboard into View
Change Value Dialog	
Ctrl+F9	Read Value from PLC
Shft+F9	Write Value to PLC
Print Preview	
Page Down	Next Page
Page Up	Previous Page

Notes:

Online Resources



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Online Resources

AutomationDirect Technical Support

http://support.automationdirect.com/techcontact.html

AutomationDirect BRX & Do-more! Videos

https://www.automationdirect.com/do-more/brx/Support/index

Interconnecting Automation Online BRX Training

http://www.interconnectingautomation.com/onlinecourses/course/index.php?categoryid=17

AutomationDirect Forum

https://forum.automationdirect.com/

Do-more! Designer Software

http://support.automationdirect.com/products/domore.html

BRX Manuals and Inserts

https://cdn.automationdirect.com/static/manuals/index.html#domore

BRX 2D CAD drawings

http://ftp.automationdirect.com/support/drawings/brx.zip

NOTE: 3D Drawings can be found by browsing to the Product on the AutomationDirect website and selecting the STEP file download link.

HOST Engineering Main Website

https://www.hosteng.com/

HOST Engineering BRX FAQ's

https://www.hosteng.com/FAQFiles/Do-more.htm

HOST Engineering Forum

http://forum.hosteng.com/

HOST Engineering Do-more! Designer Revision History

https://www.hosteng.com/SW-Products/Domore%20Designer/DmDesigner.htm

HOST Engineering BRX Firmware Revision History

https://www.hosteng.com/HW-Products/DM1/BX-DM1_RevHistory.htm

HOST Engineering Do-more! Training Slides

https://www.hosteng.com/FAQFiles/TechSlides/TechTrainingSlides01.html

HOST Engineering BRX Specific Training Slides

https://www.hosteng.com/FAQFiles/BRXTraining/BRXTechTrainingSlides.html

Notes: