Errata Sheet

This Errata Sheet contains corrections or changes made after the publication of this manual.

Product Family:	DL405	**Date**:	September 2018
Manual Number	D4-DCM-M		
Revision and Date	1st Edition, Rev. A; June 1998		

Changes to Page 7. Specifications

Operating Specifications

Revise the row 3 “Location of module” specification as follows:

Change “CPU base only, any slot except Slot 0 or CPU slot” to read “CPU base only, maximum 7”.

Changes to Page 16. Building the Communication Cable

Consideration 4: Cable Specifications

In the first paragraph, replace the sentence “A cable constructed equivalent to Belden 9855 will be sufficient” with the following:

“AutomationDirect L19772-1 (Belden 8102) or equivalent will be sufficient”.

Changes to Page 17. Building the Communication Cable (continued)

Multi-drop Termination Resistors

In the first paragraph, replace the last sentence: “For example, a typical 22 AWG solid conductor cable with 4.5 twists per foot has a typical impedance of about 120 ohms.” with the following:

“For example, AutomationDirect L19772-1 (Belden 8102) or equivalent has a nominal characteristic impedance of 100 ohms”.

Also on page 17, change two callouts in the upper Line-to-Line Termination drawing. Change the callouts saying “120 ohm Resistor” to “100 Ohms Resistor”

Change two callouts in the lower Line-to-Ground Termination drawing. Change the callouts saying “62 ohm Resistors” to “51 Ohms Resistors”

D4-DCM

Data Communications Module

Manual Number D4-DCM-M

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Manual Revisions

If you contact us in reference to this manual, be sure to include the revision number.

Title: DL405 Data Communications Module
Manual Number: D4-DCM-M

Issue	Date	Effective Pages	Description of Changes
Original	1/94	Cover/Copyright Contents Manual History Preface 1-1 - 1-26 A-1 - A-9	Original Issue
Rev. A	6/98	Entire Manual Manual Revisions Appendix A	Downsize to spiral Rev. A Added DL305/405 Cross Reference

Table of Contents

1

Introduction

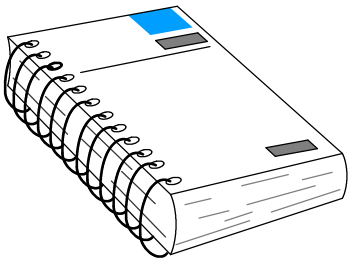
In This Section. . . .

- Overview
- DCM Hardware
- Applications
- Specifications
- Using the DCM – Five Steps

Overview

The Purpose of this Manual

This manual is designed to allow you to setup and install your DL405 Data Communications Module (DCM). This is the only manual you will need if you are using the DCM as an extra general purpose communication port for your DL405 PLC system. If you plan on using the DCM as a network master or slave on a ***Direct***NET network, we suggest that you read the ***Direct***NET manual first. The ***Direct***NET manual provides detailed descriptions of network configurations, protocol, and the PLC programs that are necessary to control communications with the DCMs.



If you plan on using a personal computer as the network master, it may be helpful to read the ***Direct***NET manual first. In either case, the ***Direct***NET manual can be useful because it provides detailed descriptions of network configurations, various cable connections, etc.

Supplemental Manuals

Depending on which products you have purchased, there may be other manuals that are necessary or helpful for your application. These are some suggested manuals:

User Manuals

- ***Direct***NET Network Guide part number DA-DNET-M
- ***Direct***Soft Programming Software part number DA-DSOFT-M

If you plan to use your D4-DCM to communicate with another PLC, you will need the appropriate user manual for the other PLC.

If you plan to use your D4-DCM module as an interface to HMI or PC Control software or to an Operator Interface panel, you will need to refer to the documentation for that product.

Who Should Read this Manual

If you need an additional communications port for your DL205 PLC and you understand the basics of installing and programming PLCs, this is the right manual for you. This manual gives you the information you need to set up an active port on the D4-DCM module.

Quality Technical Manuals and Technical Support

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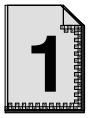
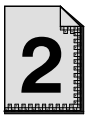
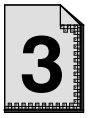
You can also find a variety of support solutions at our 24-hour per day **BBS** at:

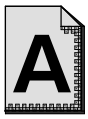
770-844-4209

If you find a problem with any of our products, services, or manuals, please fill out and return the 'Suggestions' card that came with this manual.

Steps The main contents of this manual are organized into five steps:

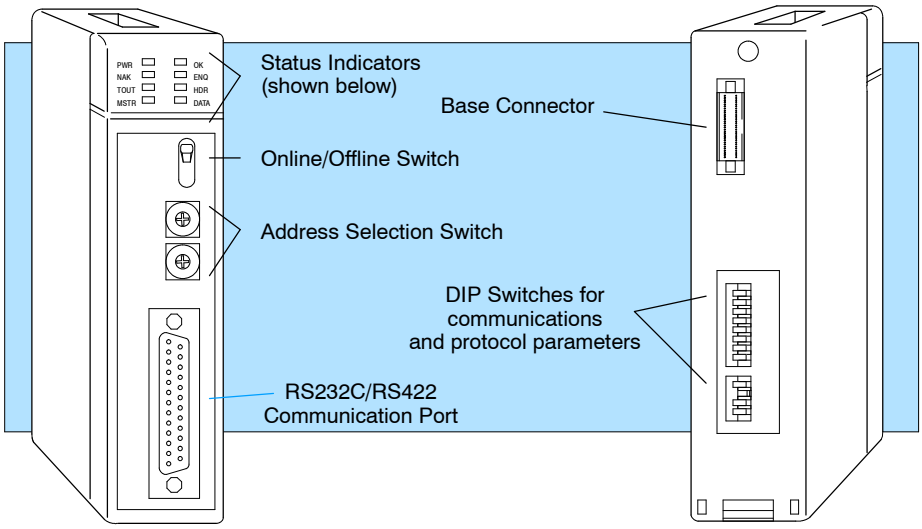
	**Introduction**	tells you about the Data Communication Module and its uses. It lists other manuals you may need and tells you how to get additional technical assistance, if necessary.
	**Build the Cable**	guides you through building the necessary communication cable, covering physical and electrical specifications.
	**Set the DCM Switches**	guides you through the setup of the rotary and DIP switches to select communication parameters and network addressing. It shows the proper method of inserting the module into the base.
	**Install the DCM and Start the Network**	tells you what to consider when laying out your network cable and how to terminate the individual conductors at the networked devices. It gives you specific cabling examples, showing pinouts for each device.
	**Verify and Troubleshoot**	introduces the use of the DCM's status indicator lights as a diagnostic tool. It gives you status indicator light patterns to help you identify problems that could be preventing communications.

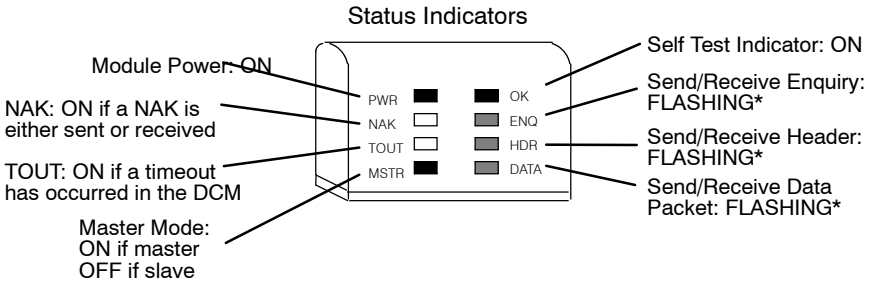
Appendix Additional reference information for the D4-DCM is available in this appendix:

	**RLL Communications Programs**	provides helpful examples of Ladder Logic programs for DCM communications.

DCM Hardware

The following diagram shows the major DCM components. The address selection switches and the communication dipswitches are of special importance.





DCM Uses

The DL405 Data Communications Module (DCM) is a general purpose communications interface for the DL405 family of Programmable Logic Controllers (PLCs). This module is primarily used for three reasons.

- As a network interface to a ***Direct***NET network
- As an extra general purpose communications port to connect a personal computer or operator interface
- As a network interface to a Modbus® network using the RTU protocol

The following pages provide an overview of these uses, along with the information you need to connect the DCM.

Applications

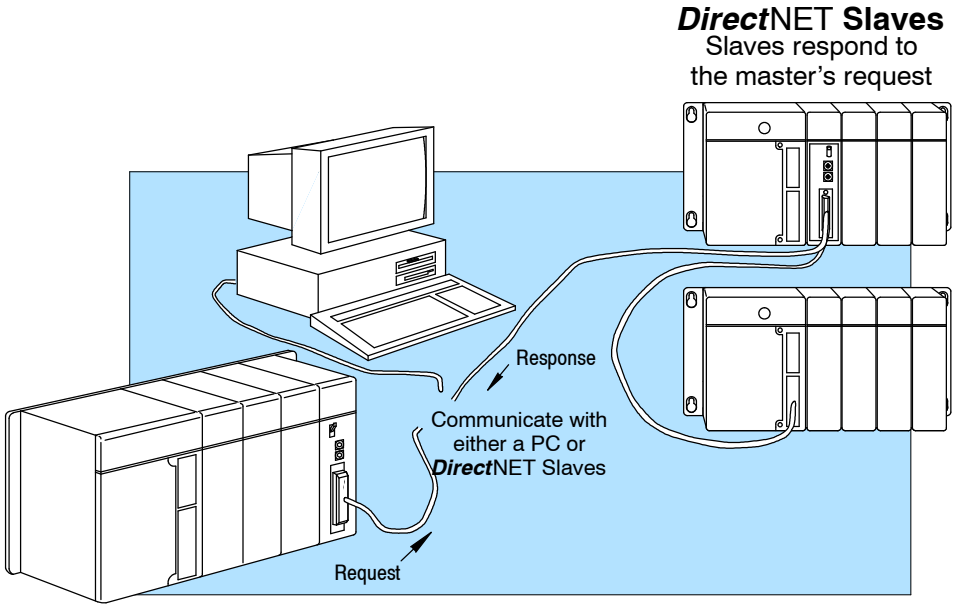
As a *Direct*NET Interface

The DCM can be used as a network interface for applications that require data to be shared between PLCs, or between PLCs and an intelligent device (such as a host computer). The DCM easily connects to ***Direct***NET. This network allows you to upload or download virtually any type of system data including Timer/Counter data, I/O information, and V-memory information.

Using a DCM as part of a PLC Network Master — The DCM can be used in a DL405 PLC station that is serving as a network master. (A master is the network station that initiates requests for data from other stations on the network). The DCM takes communication requests issued from the PLC program and automatically converts these requests into network commands that read data from or write data to another network station.

The PLC program is really very simple and only requires a few instructions. You do not have to be a PLC programming guru to use the network. Appendix A provides an overview of the instructions used. (If you want even more information, see the ***Direct***NET Manual).

Using a DCM as part of a PLC Network Slave — The DCM can also be used in a DL405 PLC station that is serving as a network slave station. In this case, the DCM "listens" to the network for any messages that contain the DCM's address. The DCM deciphers the network commands, carries out the request to read or write data, and sends confirmation and/or information to the master station.

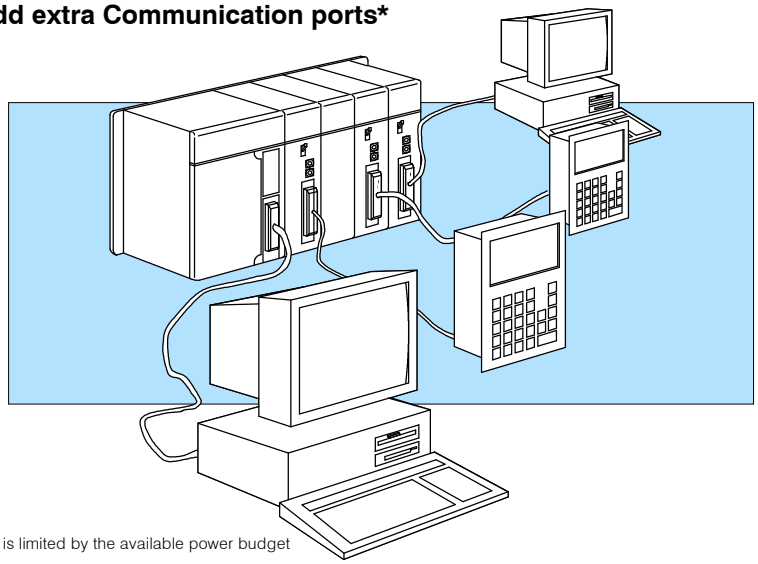


As an Extra Communication Port

As an extra communication port, the DCM has specifications similar to the bottom port on the DL405 PLCs. Plus, the DCM can communicate at higher baud rates. If you can connect a device to the bottom port on the DL405 PLC, then you can also connect the same device to the DCM. These devices can be a variety of things, such as operator interfaces or personal computers.

Since the DCM does not require any programming, you can simply set the DCM communication parameters, connect the appropriate RS232C or RS422 cables, and start transferring data.

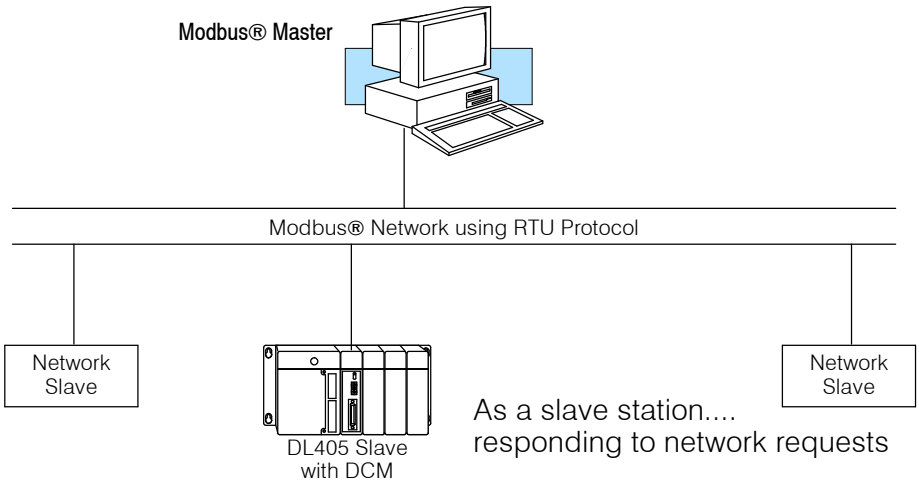
Quickly add extra Communication ports*



* Number of DCMs is limited by the available power budget

As a Modbus® Network Interface

The DCM can be used as a slave station interface to connect your DL405 system to the Modbus® network using the Modbus® RTU protocol. The host system must be capable of issuing the Modbus® commands to read or write the appropriate data. This manual does not describe the Modbus® protocol. You must reference the Gould Modbus® Protocol Reference Guide for details (P1-MBUS-300 Rev. B). There may be more recent editions of this manual, so check with your Modbus® supplier before ordering the documentation. (A cross reference for the Data Types is supplied later in this manual).



Specifications

Environmental Specifications

Operating Temperature	32° F to 140° F (0° to 60° C)
Storage Temperature	-4° F to 158° F (-20° to 80° C)
Operating Humidity	5 to 95% (non-condensing)
Air Composition	No corrosive gases permitted
Vibration	MIL STD 810C 514.2
Shock	MIL STD 810C 516.2
Voltage Isolation	1500 VAC, 1 minute duration
Insulation Resistance	10M ohms at 500 VDC
Noise	NEMA ICS3-304

Operating Specifications

Power Budget Requirement	500 ma @ 5 VDC
Maximum number of modules	limited only by power budget
Location of module	~~CPU base only~~ ~~any slot except Slot 0 or CPU slot~~
Interface	Serial RS232C / RS422 half-duplex, DTE, Asynchronous, 8 bits/character
Baud Rates	300 to 38.4K baud, switch selectable
Maximum Distance	RS232C - 49ft (15 meters) RS422 - 3300 feet (1000 meters)
Protocol	***Direct***NET[1] K-sequence (proprietary) MODBUS® RTU
Diagnostics	Automatic check of ROM/RAM, communications, switch settings, and LEDs

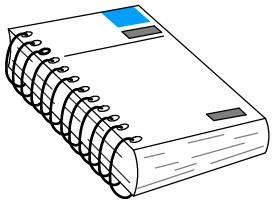
Change to:
"CPU base only, maximum 7"

Note 1: Also compatible with Hostlink and/or CCM2 protocols. These names were used by previous vendors of compatible Koyo designed products.

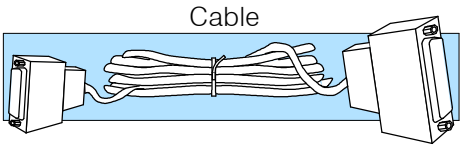
Using your DCM– Five Steps

Complete the following steps to connect the DCM.

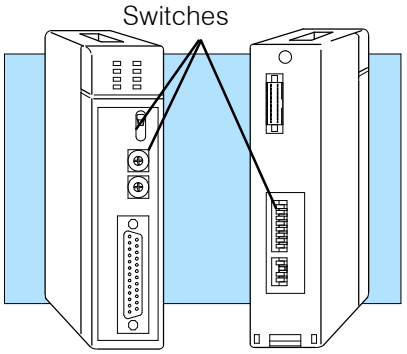
STEP 1. Familiarize yourself with the communications options of DCM in the Introduction.



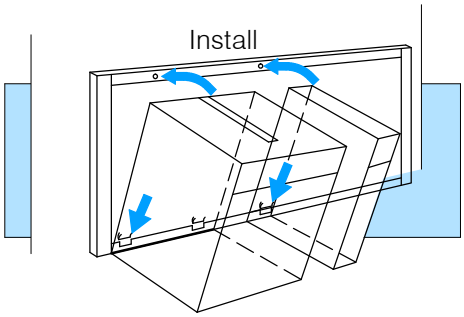
STEP 2. Build the communication cable that fits your needs.



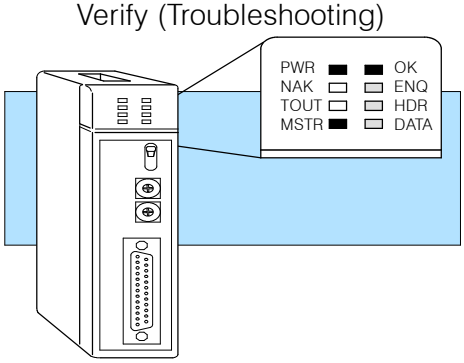
STEP 3. Set the DCM switches. (Baud rate, parity, etc).



STEP 4. Install the DCM.



STEP 5. Verify correct network operation.



Building the Communication Cable

There are several considerations that help determine the type of cable needed for your DCM application.

1. Will the DCM be physically connected in a point-to-point configuration or multi-drop configuration?
2. What electrical specification is best for your application? RS232C or RS422?
3. What is the cable schematic?
4. What are the relevant cable specifications?
5. What installation guidelines are necessary?
6. Do you just need a quick test cable?

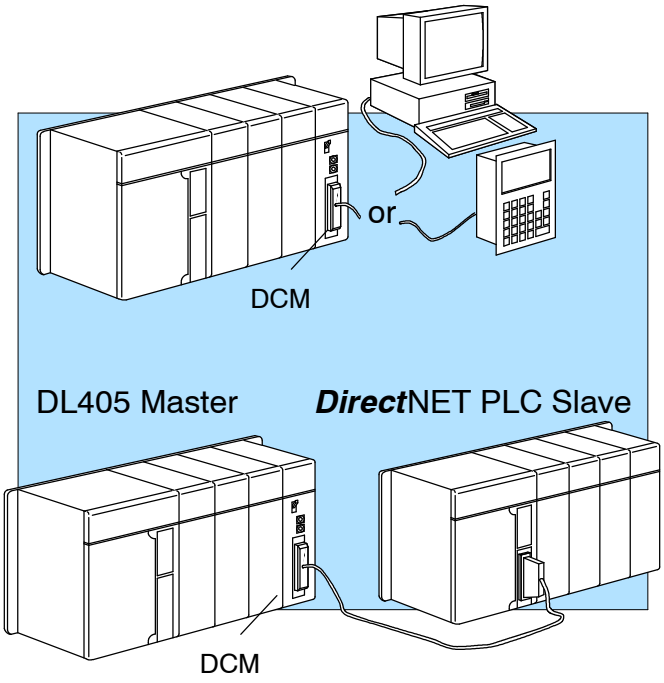
The next few pages discuss these considerations in detail. If you already know the type of cable needed, the cable schematics are included on pages 8 and 9.

Consideration 1: Physical Configuration

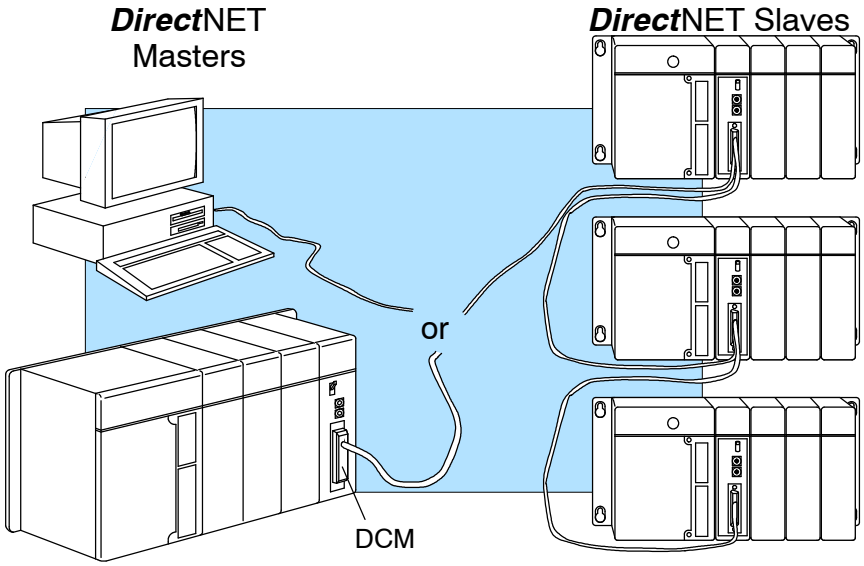
The DCM can be used in either a point-to-point or multi-drop configuration. A point-to-point connection only has two stations, a master and a slave. Use the point-to-point configuration to connect a personal computer, an operator interface, or an intelligent device to a single DCM. You must also use this configuration when you want to connect a ***Direct***NET master station to a single ***Direct***NET slave station.

Use the multi-drop configuration to connect one master to two or more slaves (90 slave maximum).

Point to Point



Multi-drop



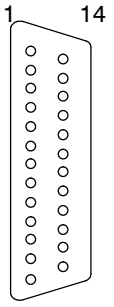
Consideration 2: Electrical Specification RS232C or RS422

The DCM can support RS232C or RS422 communication. Your application and configuration choice will help determine which electrical specification is best for you. If you are using multi-drop, you must use RS422. If you are using point-to-point, you may have a choice between RS232C and RS422.

You can use RS232C if the cable length is less than 50 feet and if the cable will not be subjected to induced electrical noise that is commonly found near welders, large motors, or other devices that create large magnetic fields.

You must use RS422 for all other applications. RS422 allows longer cable distances (up to 3300 feet) and provides higher noise immunity.

The following diagram shows the port pinouts for the DCM and the DL405 CPUs. These are the pinouts you'll need to be familiar with most often.



DL405 DCM Port Pinouts

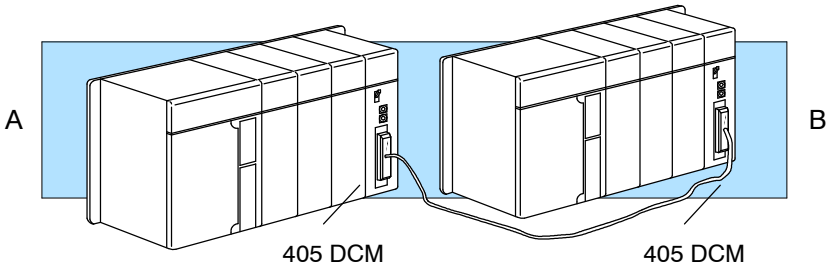
Pin	Signal Definition	Pin	Signal Definition
1	Not connected	14	RS422 data out +
2	RS232C data out	15	RS422 data out -
3	RS232C data in	16	RS422 data in -
4	RS232C RTS	17	RS422 data in +
5	RS232C CTS	18	Not connected
6	Internal Circuit 5V	19	Not connected
7	Internal Circuit 0V	20	Not connected
8	RS422 RTS +	21	Not connected
9	RS422 RTS -	22	RS422 data out +
10	RS422 RTS +	23	RS422 data out -
11	RS422 RTS -	24	RS422data in -
12	RS422 CTS +	25	RS422 data in +
13	RS422 CTS -		

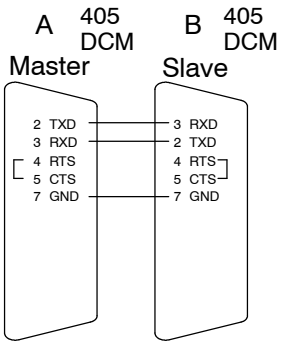
DL405 CPU Port Pinouts

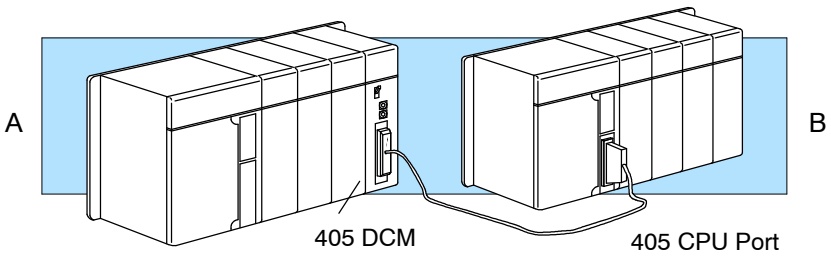
Pin	Signal Definition	Pin	Signal Definition
1	Not connected	14	RS422 data out +
2	RS232C data out	15	Not connected
3	RS232C data in	16	RS422 data out -
4	RS232C RTS	17	Not connected
5	RS232C CTS	18	RS422 RTS -
6	Not connected	19	RS422 RTS +
7	Signal ground	20	Not connected
8	Not connected	21	Not connected
9	RS422 data in +	22	Not connected
10	RS422 data in -	23	RS422 CTS -
11	RS422 CTS +	24	Not connected
12	Not connected	25	Not connected
13	Not connected		

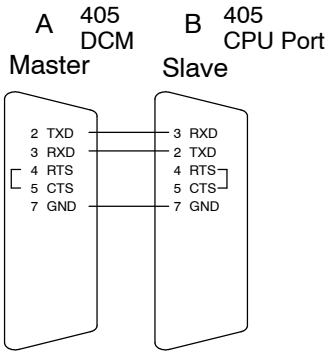
Consideration 3: Cable Schematics The following cable schematics are appropriate for most applications. You may have to combine some of these examples to design a cable that meets your exact application requirements.

DCM to DCM or PLC Slave (RS232C)

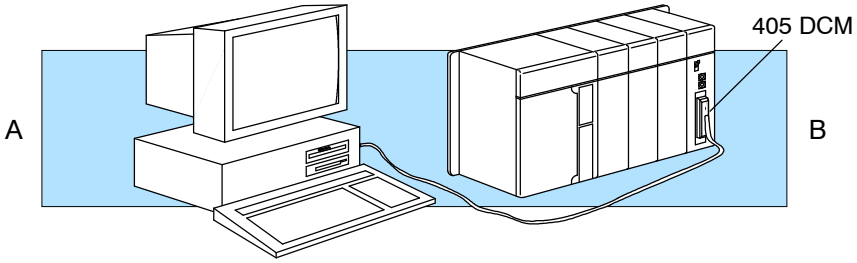


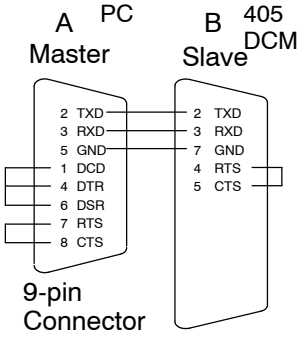


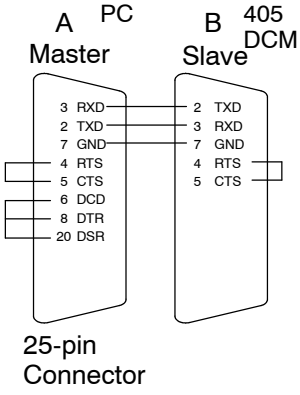




Personal Computer to DCM (RS232C)

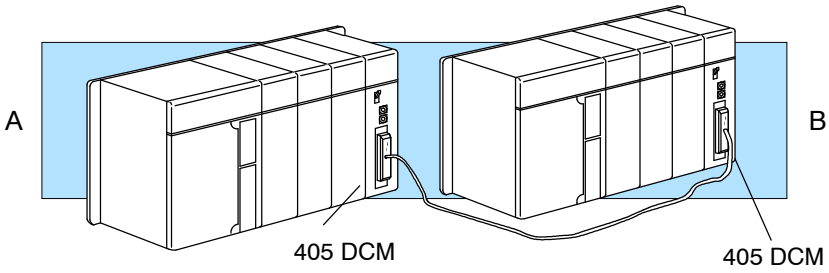


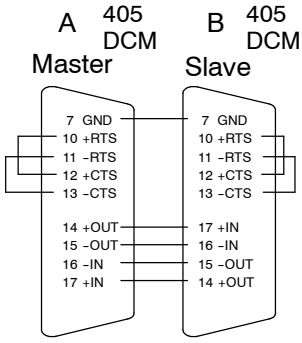


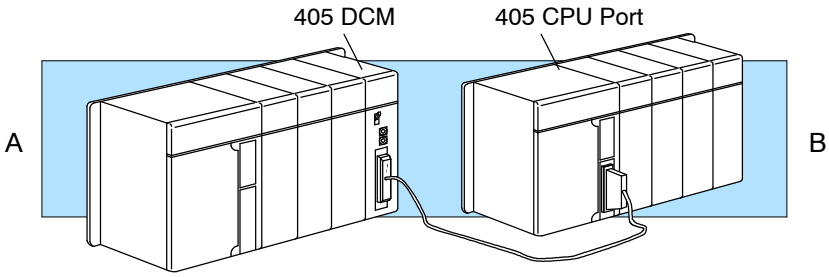


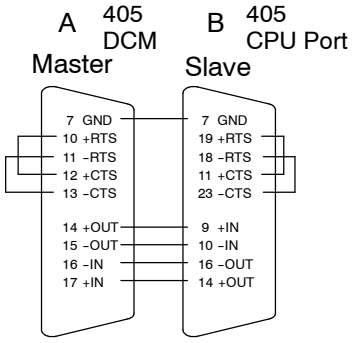
Pin labeling conforms to the IBM DTE and DCE standards.

DCM to DCM or PLC Slave (RS422)



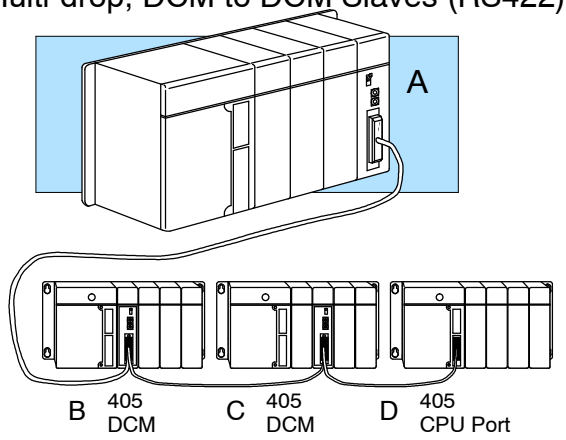


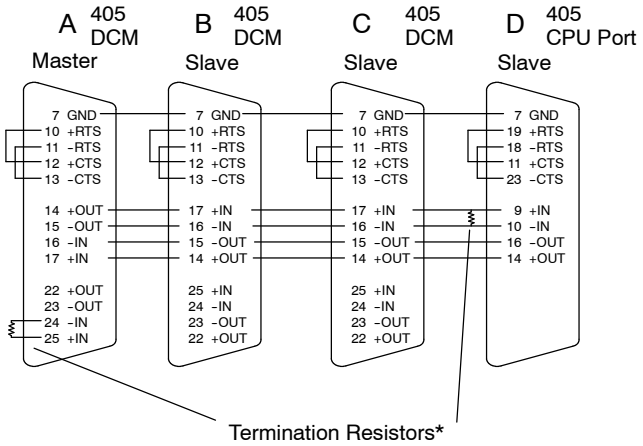




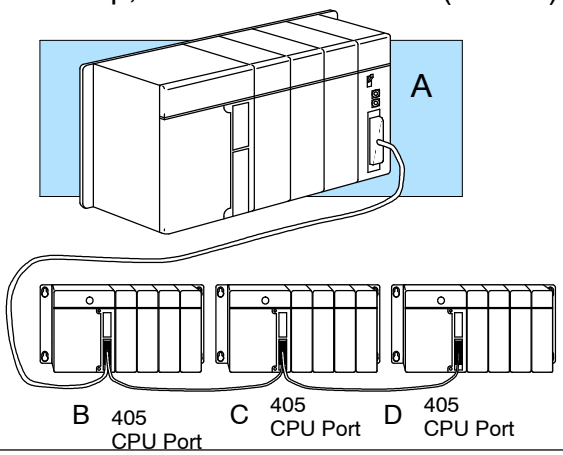
Pin labeling conforms to the IBM DTE and DCE standards.

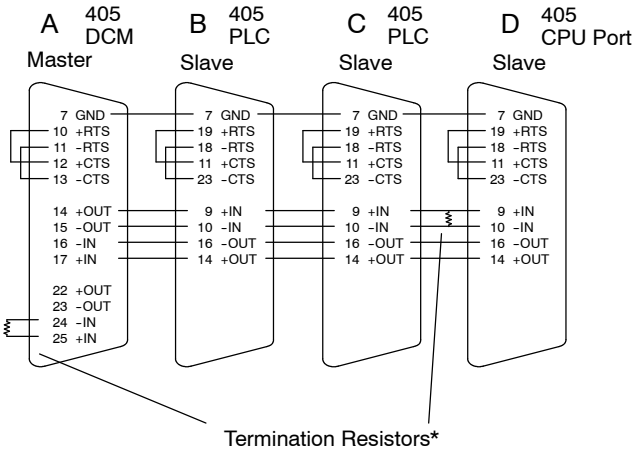
Multi-drop, DCM to DCM Slaves (RS422)



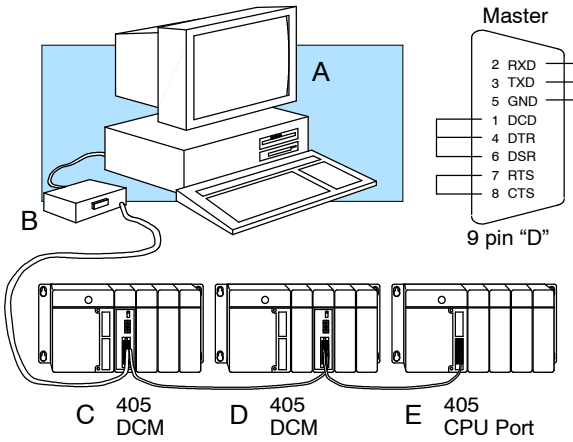


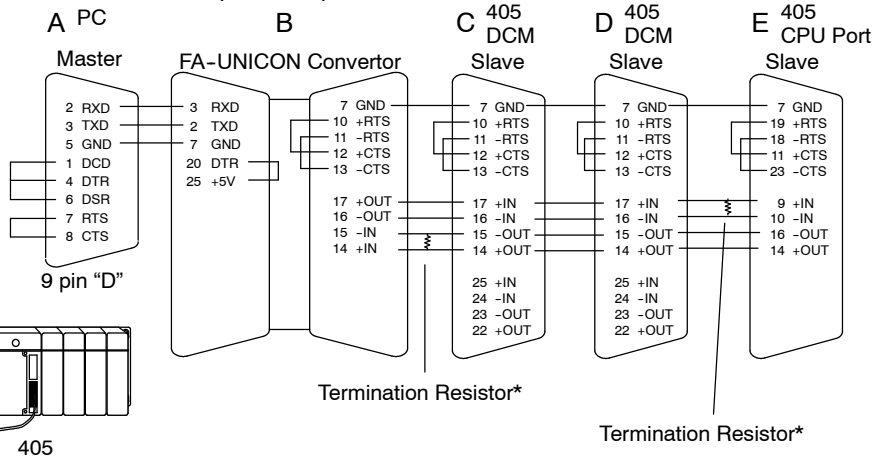
Multi-drop, DCM to PLC Slaves (RS422)





Multi-drop, 9-pin PC to DCM and PLC Slaves (RS422)

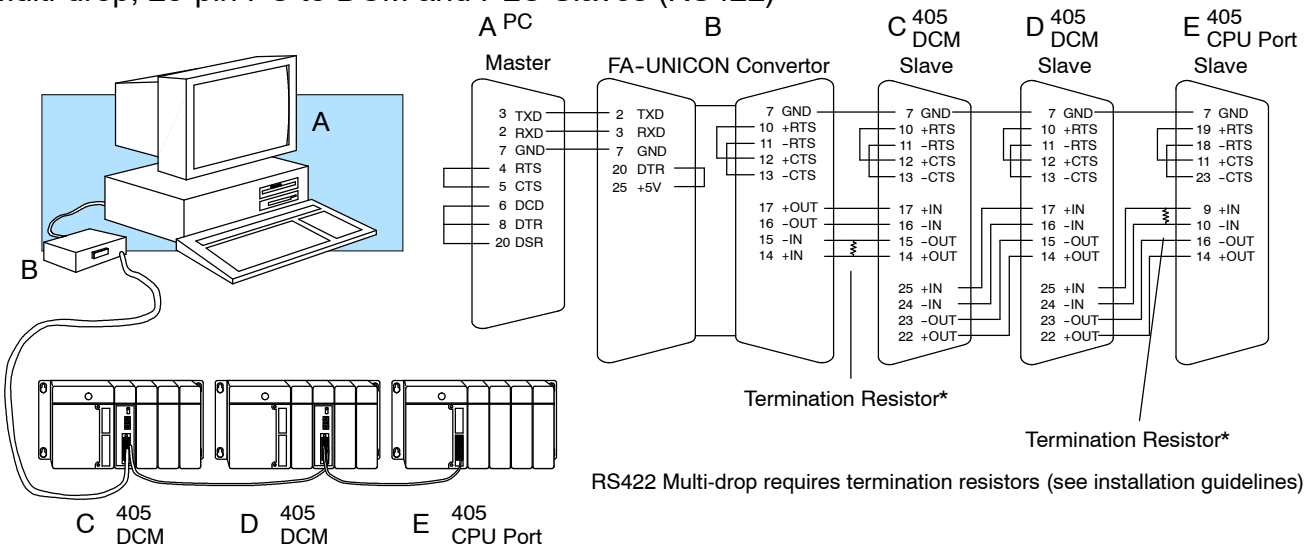




RS422 Multi-drop requires termination resistors (see installation guidelines)

Pin labeling conforms to the IBM DTE and DCE standards.

Multi-drop, 25-pin PC to DCM and PLC Slaves (RS422)



RS422 Multi-drop requires termination resistors (see installation guidelines)

Pin labeling conforms to the IBM DTE and DCE standards.

Consideration 4: Cable Specifications

Although many types of cables may work for your application, we recommend you use a cable that is constructed to offer a high degree of noise immunity. A cable constructed equivalent to Belden 9855 will be sufficient. The following specifications are to be used as a guideline.

Structure	Shielded, twisted-pair (RS232C only uses two wires and a ground)
Conductor size	24 AWG or larger
Insulation	Polyethylene
Shield	Copper braid or aluminum foil
Impedance	100Ω @ 1MHz
Capacitance	60pf / meter or less

Replace with: "AutomationDirect L19772-1 (Belden 8120) or equivalent will be sufficient."

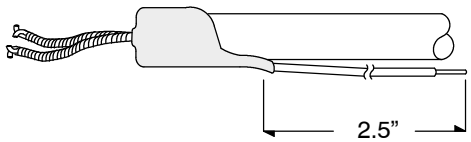
Consideration 5: Installation Guidelines

Your company may have guidelines for cable installation. If so, you must check those before you begin the installation. Here are some general things to consider.

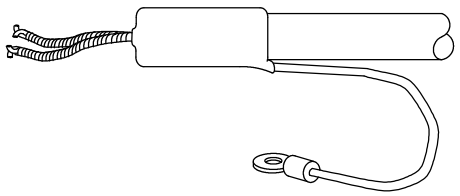
- Don't run cable next to larger motors, high current switches, or transformers. This may cause noise problems.
- Route the cable through an approved cable housing to minimize the risk of accidental cable damage. Check local and national codes to choose the correct method for your application.
- Consider redundant cabling if the application data is critical. This allows you to quickly reconnect all stations while the primary cable is being repaired.

Cable Shield Grounding — It is important to ground the cable shield to minimize the possibility of noise. The preferred method is to connect one end of the cable shield to the connector housing. If noise problems are still present and you have a good earth ground for the cabinet, you must connect one end of the shield to the cabinet earth ground. *Don't* ground both ends of the shield because this will create induced noise on the cable.

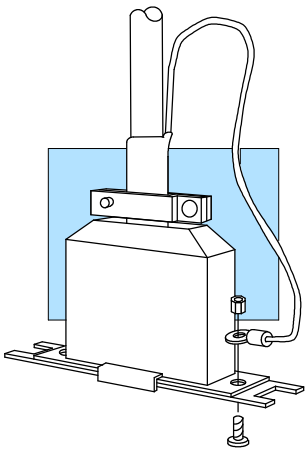
Step 1: Strip back about 2.5" of the shield.



Step 2: Crimp a ring connector onto the shield.



Step 3: Secure the shield to the connector shell.



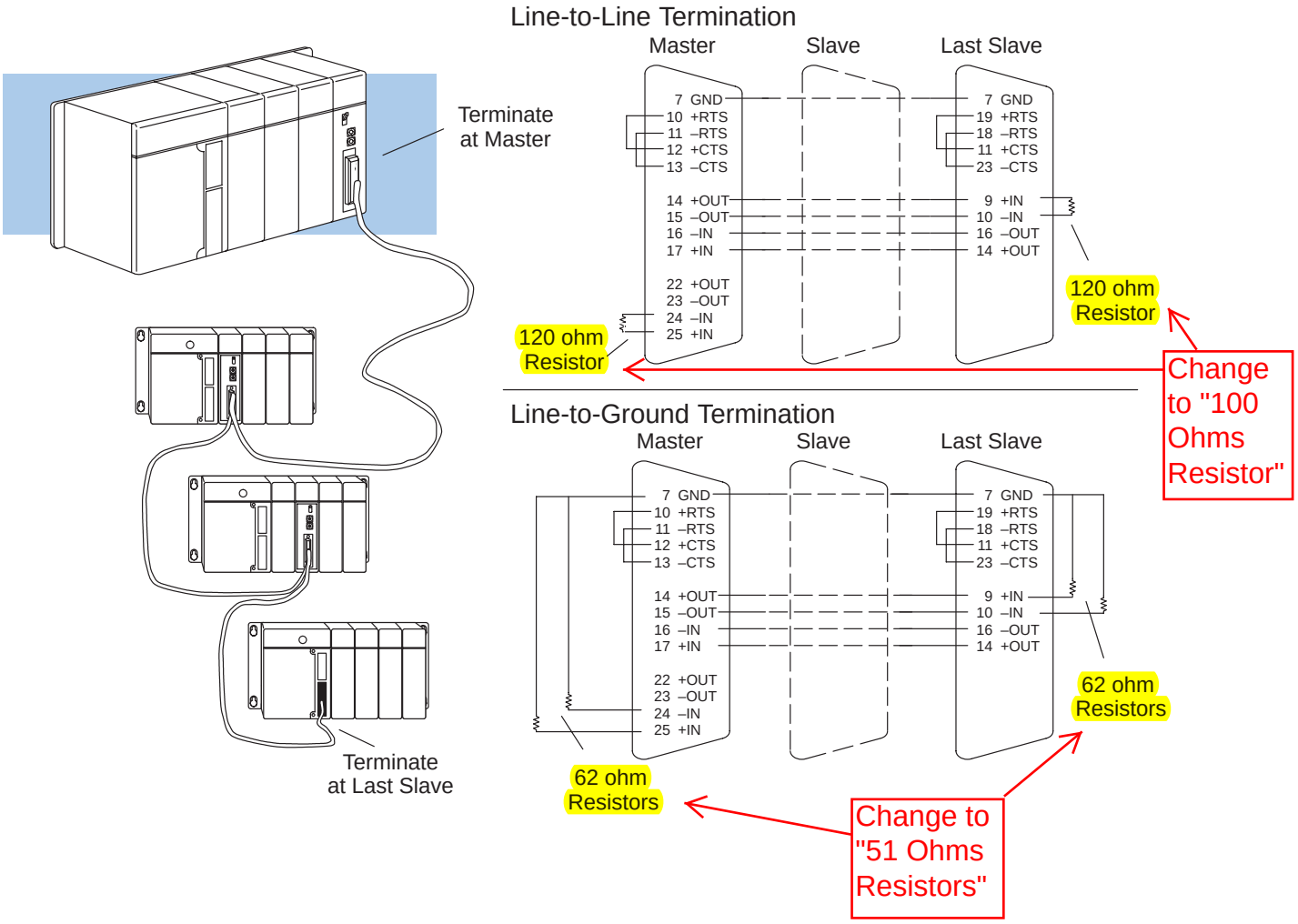
Multi-drop Termination Resistors — It is important you add termination resistors at each end of the RS422 line. This helps reduce data errors during data transmission. You must select resistors that match the cable impedance. For example, a typical 22 AWG solid conductor cable with 4.5 twists per foot has a typical impedance of about 120Ω.

There are two ways to actually connect the resistors.

Replace with: "For example, AutomationDirect L19772-1 (Belden 8102) or equivalent has a nominal characteristic impedance of 100 Ohms."

- Line-to-Line — this method balances the receive data lines (IN+ and IN–) and requires one resistor at each end of the line. (The cable diagrams we've provided show this method, but you can use either).
- Line-to-Ground — this method also balances the receive data lines, but common mode noise rejection is improved significantly. This method requires two resistors at each end of the line. Also, since there are two resistors, the sum total of both resistors must match the cable impedance.

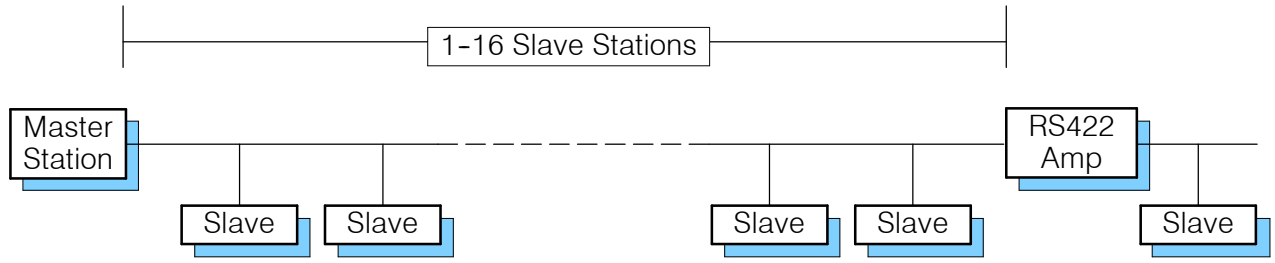
The following diagram illustrates the two options.



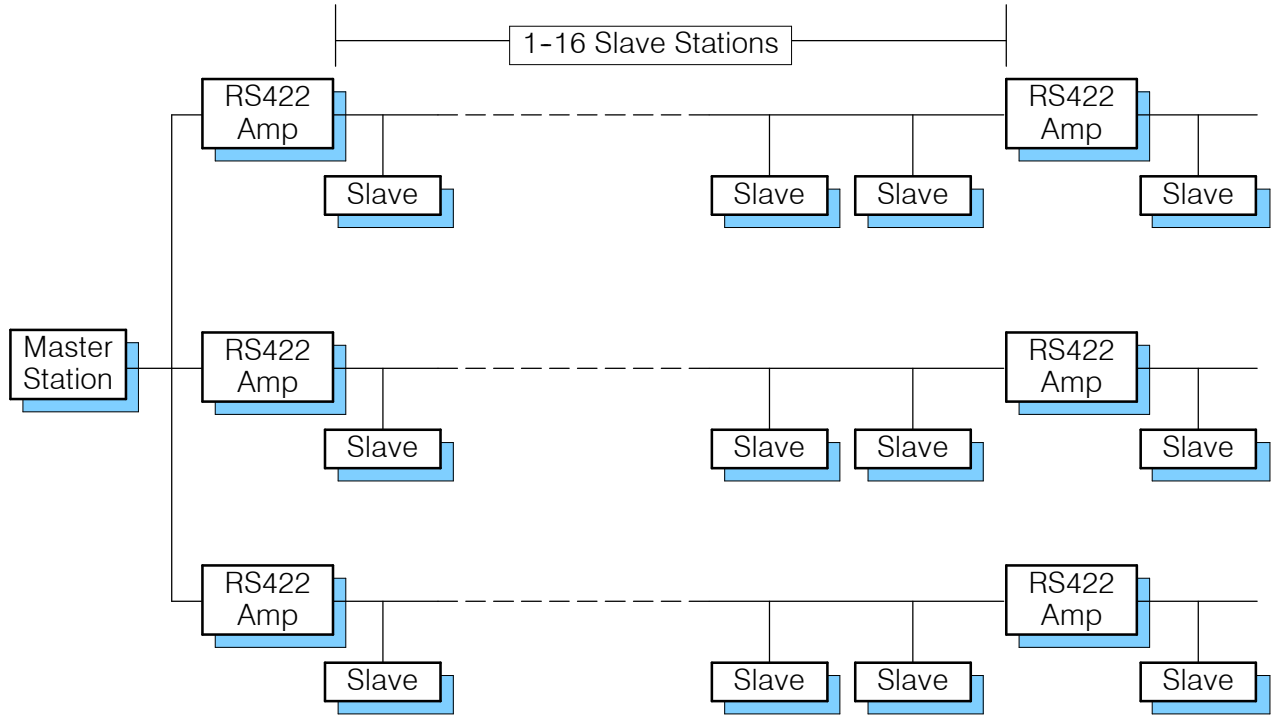
Pin labeling conforms to the IBM DTE and DCE standards.

Network Amplifiers — If you have more than 16 slave stations, you must use an RS422 amplifier to maintain the signal levels. The best amplifiers are regenerative, that is, they recover the signal and try to reduce any noise signals that are present. Some amplifiers are not regenerative and amplify the noise as well as the signal. (You can get amplifiers from several sources. The Black Box catalog is one of many good places to start). The following diagram shows some instances where an amplifier is necessary.

Serial Slave Connection



Parallel Slave Connection



Consideration 6: A Quick Test Cable

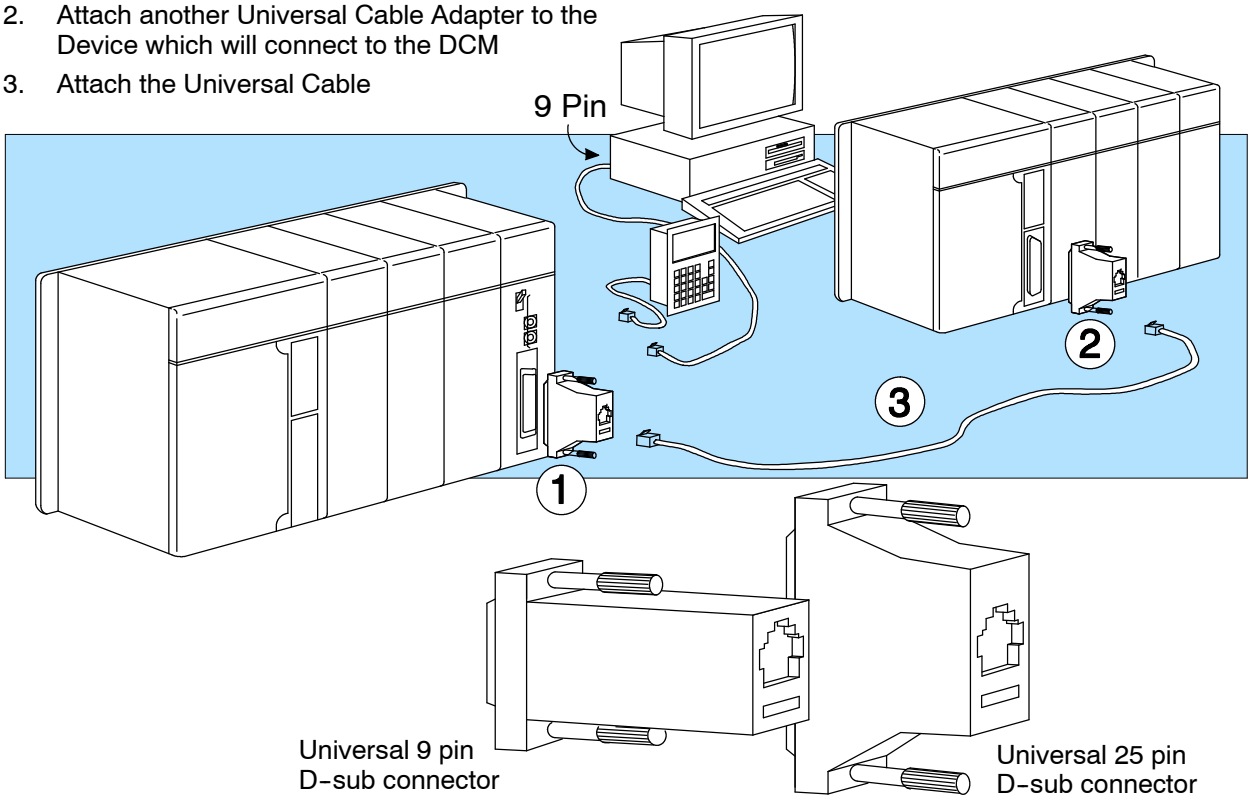
PLC***Direct***™ offers a Universal Cable Kit (part number FA-CABKIT). This cable kit allows you to connect various types of ***Direct***LOGIC™ products with an RS232C cable in a matter of minutes. (Check your DL405 Parts List for part number). The kit consists of cable (phone cable with male plugs already attached) and several specially wired connectors. The special connectors are a D-sub style with built-in female phone jacks. The kit includes a wide variety of the special connectors so you can use one kit to easily connect products from the different ***Direct***LOGIC™ family of products. To use the kit with the DCM, just follow these steps.

1. Plug the appropriate D-sub connector onto the DCM.
2. Plug the appropriate D-sub connector onto the other device you are connecting to the DCM.
3. Connect the cable to the two D-sub connectors.

WARNING: This cable is suitable for quick testing situations and must not be used in actual applications. This cable is not shielded and is highly susceptible to electrical noise. Electrical noise can cause unpredictable operation that may result in a risk of personal injury or damage to equipment. Use the cable specifications described earlier in this manual to select a cable suitable for actual applications.

Build A Test Cable In 30 Seconds

1. Attach Universal Cable Adapter to the DCM
2. Attach another Universal Cable Adapter to the Device which will connect to the DCM
3. Attach the Universal Cable



Setting the DCM Switches

The device(s) connected to the DCM will help you determine the appropriate switch settings.

Host Computer or Operator Interface Connection

If you're using a host computer or operator interface as the master station you must set the DCM to match the master station parameters. Check the documentation that came with your computer or operator interface to determine the available communication parameters.

You'll need to know the following things.

- Baud rate
- Parity settings
- Protocol

NOTE: Some operator interfaces should be connected to the DL405 programming port (top port) and cannot be used with the DCM. Make sure your operator interface uses one of the following protocols.

- ***Direct***NET (DL430, DL440, D4–DCM)
- Hostlink (TI™ or Simatic® TI425, -430, -435, U-01DM)
- Modbus® RTU

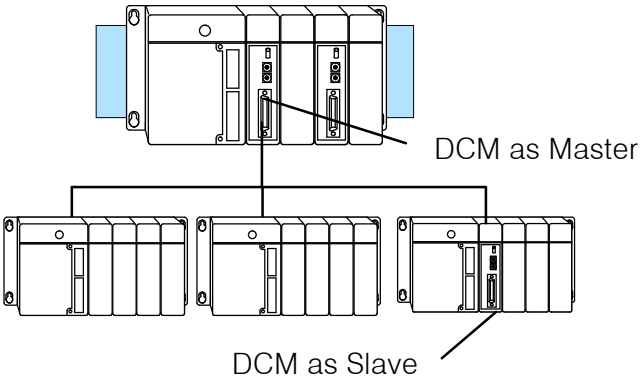
You may still be able to use an operator interface designed for the programming port with the DCM if:

- Your DCM has firmware release 1.4 or higher *and* your CPU has firmware releases 2.1 or higher.

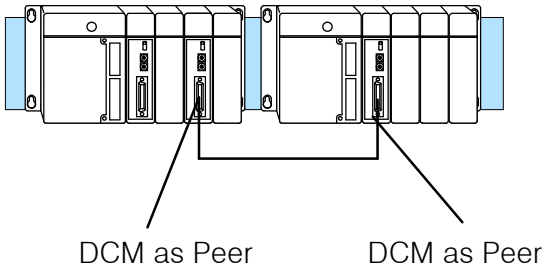
DirectNET Interface Connection

If you're using the DCM as a *Direct*NET interface, you'll need to know whether the DCM is being used in a master station, slave station, or peer station. Once you've determined how the DCM will be used, proceed with the dipswitch settings.

Master – Slave Network

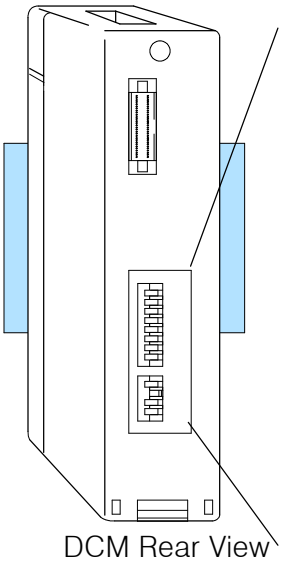


Peer as Master Network



DCM Switch Settings

There are two banks of switches located on the rear of the DCM that are used to set the communications and protocol parameters. The following diagram shows the locations and setting options.



Switch Positions

Time*	6	7	8
0	OFF	OFF	OFF
2	ON	OFF	OFF
5	OFF	ON	OFF
10	ON	ON	OFF
20	OFF	OFF	ON
50	ON	OFF	ON
100	OFF	ON	ON
500	ON	ON	ON

*Delay time in milliseconds

OFF ON

NO Parity
Set to OFF
Delay Time
Baud Rate
ODD Parity
Self Test
1 2 3 4 5 6 7 8
SW4

Switch Positions

Baud	1	2	3
300	ON	OFF	OFF
600	OFF	ON	OFF
1200	ON	ON	OFF
2400	OFF	OFF	ON
4800	ON	OFF	ON
9600	OFF	ON	ON
19200	ON	ON	ON
38400	OFF	OFF	OFF

Switch Positions

Protocol	1	2
DirectNET Slave	OFF	OFF
DirectNET Master	OFF	ON
DirectNET Peer	ON	OFF
Modbus® RTU	ON	ON

Network Protocol
COM Timeout Enable
Hexadecimal Mode
COM Timeout Disable
ASCII Mode
1 2 3 4
SW5

Baud Rate: Positions 1 – 3 on SW4 are used to set the baud rate for the DCM. There are eight baud rate selections available ranging from 300bps to 38.4Kbps. All stations must have the same baud rate before the communications will operate correctly. Usually, you will use the highest baud rate possible unless noise problems appear. If noise problems appear, try reducing the baud rates.

Parity: Position 4 on SW4 selects between the two parity options, odd or none. If you're using all DL405 equipment, you can use odd parity. Odd parity uses eleven bits total (1 start bit, 8 data bits, 1 stop bit, and 1 parity bit).

Some devices require no parity, which uses only 10 bits (1 start bit, 8 data bits, and 1 stop bit).

Self-Test: Position 5 on SW4 selects the factory self-test and must always be switched off. If the self-test is on, the module will not operate correctly.

Response Delay Time: Positions 6–8 on SW4 set the response delay time. This sets how long the DCM will wait before it responds to each component of a ***Direct***NET or Modbus® communication request. If you're using all DL405 equipment, a response delay is not required and you will set the time to 0.

The DCM may respond too quickly for some devices, such as telephone or radio modems. If you encounter this problem just choose a delay from 0 to 500 mS. Your device manual should suggest the proper settings.

Protocol Selection: Positions 1 and 2 on SW5 select the DCM protocol and the master or slave settings. The DCM can use two protocols, ***Direct***NET and Modbus® RTU protocol.

Computer or Operator Interface: If you're using the DCM to connect a computer or operator interface, check your documentation to see which protocol is being used. Since the DCM is always a slave station when it's connected to a computer or operator interface, you should select ***Direct***NET slave or Modbus® RTU slave.

DirectNET *Master / Slave:* In a ***Direct***NET master / slave network, one DCM should be set as a master and the rest should be set as slaves.

DirectNET *Peer as Master:* This is a variation of the master / slave protocol and should be selected when you only have two stations that can each initiate requests. Each station should have a DCM as the network interface.

Modbus® Slave: The DCM can also be a Modbus® slave (in the RTU or HEX mode). The DCM cannot be a Modbus® master station. If you're going to use Modbus®, make sure your software package supports the DL405 products. The following drivers should work correctly.

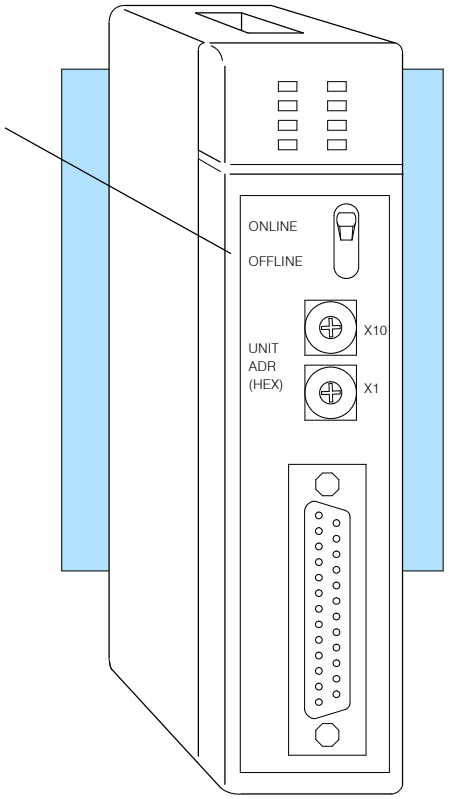
- DL405 (DL430, DL440, D4–DCM)
- Series 405™ (TI or Simatic TI425, -430, -435, U-01DM)

Communication Timeout: Position 3 on SW5 selects the communication timeout. Don't disable the timeout for normal use. Communication Timeout Disable is normally used *only* if you're developing your own ***Direct***NET programs. By disabling the timeout, you can send one ***Direct***NET component without any communication timeout problems. If you have this timeout disabled and a communication error does occur, you must restart communications by sending a retry or an End of Transmission (EOT) command. If you want to know more, see the ***Direct***NET manual for details.

ASCII / HEX Mode: Position 4 on SW5 selects between ASCII and HEX modes of data representation. If you want the fastest communication possible, use HEX mode. The difference is in the way the data is represented. The same data is twice as long in ASCII format, so if there's more data, it takes longer to transfer. If you have a device on the network that requires ASCII mode, then set the switch for ASCII mode, otherwise, use HEX mode.

Online / Offline Switch

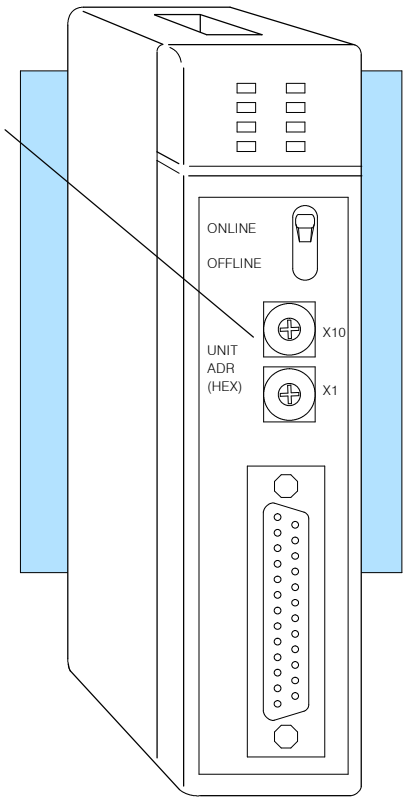
In the Offline position, this switch logically disconnects the DCM from the network (just as if you pulled the cable from the connector). Once this switch is moved to the Offline position, the DCM will not communicate with the network. If you move the switch to the Online position, the DCM will communicate with the network, but not until the master sends another request for communication. This does not operate like the reset switch on many personal computers.



Address Selection Switch

The DCM station address is set by the two rotary switches located on the front of the unit. Addresses are in hexadecimal format with valid addresses from 0 (only used for the master station) to hexadecimal 5A. The addresses do not have to be sequential, but each station must have a unique address.

The top rotary switch is used to set the most significant digit of the HEX address. The bottom switch is used to set the least significant digit of the HEX address. For example, to set a DCM address of HEX 10 (decimal 16), set the top rotary switch to 1 and the bottom rotary switch to 0. If you're using the DCM as a master, make sure you select address 0.



NOTE: The DCM address switch settings are only read at power up. If you've want to change the address and the DCM is already up and running, you'll have to cycle the system power to make the change.

Even though the DCM address is set in hexadecimal, it's a good idea to remember the decimal equivalent. This is because the communications program and the ***Direct***SOFT package use the decimal equivalent of the HEX address. It's easy to convert from hex to decimal.

HEX Format

0 1 2 3 4 5 6 7 8 9 A B C D E F

10 11 12 13 14 15

HEX 3C

3 x 16 = 48 + **C** = 12 = 60 decimal

Installing the DCM and Starting the Network

Install the DCM

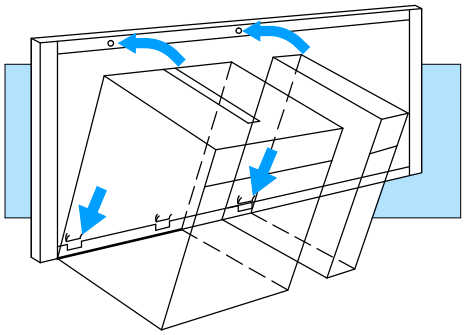
If you're using a DCM as the network interface in a PLC master station, make a note of the slot location. (This will be used in the RLL communications program. See Appendix A for details). If you're connecting the DCM to a host computer or operator interface master you can install the DCM in any slot of the slave station.

NOTE: The DCM *can not* be mounted in a base that does not contain a DL405 CPU. Also, the DCM requires 500 mA of +5V base power. Make sure you will not exceed the available base power budget by installing the DCM. See the DL405 User Manual for complete details on power budget calculations.

WARNING: To minimize the risk of electrical shock, personal injury, or equipment damage, always disconnect the system power before installing or removing any system component.

---

1. Notice the I/O module has a plastic tab at the bottom and a screw at the top.
2. With the module tilted slightly forward, hook the plastic tab on the module into the notch on the base.
3. Then gently push the top of the module back toward the base until it is firmly installed into the base.
4. Now tighten the screw at the top of the module to secure the module to the base.

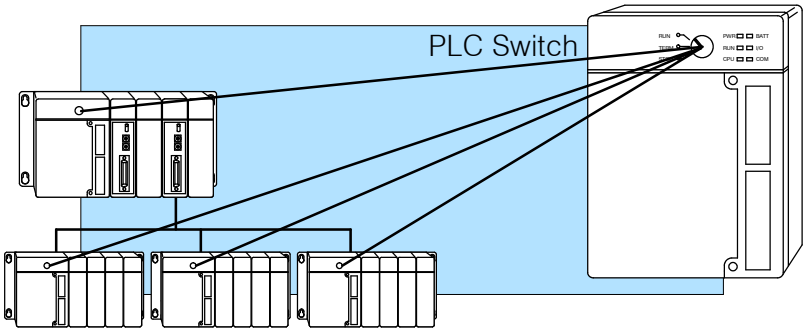


Connect the Cables

Make sure you have all the cables connected and that all the network devices have the same communication parameters (baud rate, parity, etc).

If you're using *Direct*NET...

The PLC master station must contain an RLL communications program . (See Appendix A for details on the RX and WX instructions). The master station CPU must be in Run mode in order to execute the communications program. The slave station CPUs do not absolutely have to be in Run mode because the DCM will still transfer the data. Whether you put the slave stations in Run mode depends on your application requirements.



If you're using an Operator Interface or Host Computer...

Connect the cables and follow the procedures outlined in the documentation that came with your host computer software or operator interface. You'll have to execute your host or operator interface program before the communications can begin. For example, if you're using ***Direct***SOFT, you can just specify the station address and start working!

If you're using Modbus®...

Follow the procedures outlined in your Modbus® Host software package to start the communications. The following table provides the types of operations allowed and a cross reference for the DL405 memory types.

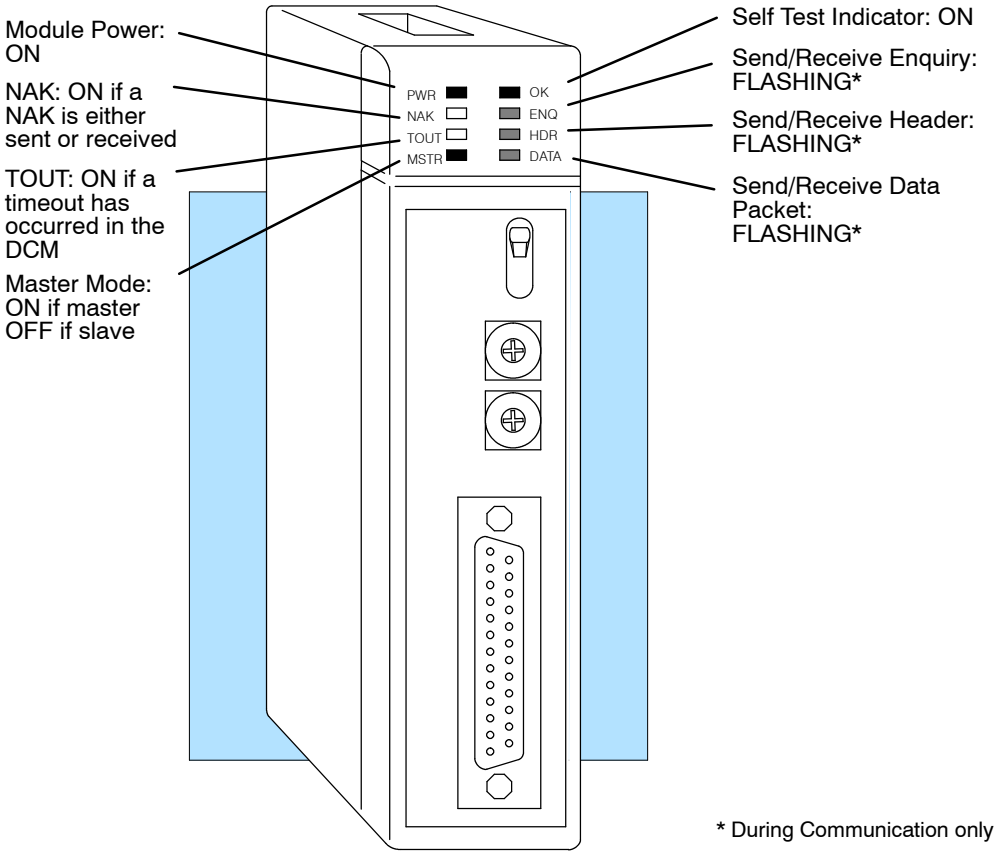
DL405 Memory Type	Range (Octal)	Operations Allowed	Modbus® Starting Reference (Hex)	Modbus® Function
V memory	0000–7777	Read Write	0000h 0000h	03 and 04 06
X (input)	000–477	Read	0800h	02
Y (output)	000–477	Read Write Write Multiple	0800h	01 05 15
C (control relay)	000–737	Read Write Write Multiple	0C00h	01 05 15
Timer (contact)	000–177	Read Write Write Multiple	1800h	01 05 15
Counter (contact)	000–177	Read Write Write Multiple	1900h	01 05 15
Stage (status bit)	000–577	Read Write Write Multiple	1400h	01 05 15
SP (special relay)	000–137 320–617	Read Read	0D00h 0DD0h	02 02

NOTE:

1. You cannot access V-memory addresses above V7777 (octal).
2. With Function 15, Write Multiple coils, you must write in 8 bit increments. This function is not supported with the number of coils less than 8.
3. Timer and counter current values are stored in V-memory areas V000–V177 and V1000–V1177 respectively. These values are stored in BCD format unlike the remainder of V memory which is stored in binary.

Verification and Troubleshooting

Check the DCM indicators to verify the DCM is operating correctly. The following diagram shows the proper indicator conditions.



* During Communication only

Troubleshooting Quick Steps

If the DCM does not seem to be working correctly, check the following items. These items represent the problems found most often.

1. Cable and connections. Incorrectly wired cables and loose connectors cause the majority of problems. Verify you've selected the proper cable configuration and check the cable making sure it is wired correctly.
2. Dipswitch settings. Make sure you've set the DCM to match the communication parameters required by the master station (DCM, operator interface or host computer).
3. Incorrect protocol. Make sure your operator interface or personal computer software can use the ***Direct***NET, Hostlink, CCM2, or MODBUS® RTU protocol.
4. Communications program. Check the communications program for errors. Consult the ***Direct***NET Manual or the manuals that came with your host computer software or operator interface for details.

NOTE: If you need more in depth troubleshooting, see the chart on the next page. It provides several different indicator patterns that may help identify your exact problem.

The following table provides additional troubleshooting details.

Indicator Status	Possible Cause	Corrective Action
PWR or OK off	PLC power is disconnected DCM is defective	Check the PLC source power. Replace the DCM.
MSTR off (and DCM is in a master station)	Switch setting is incorrect	Remove power from the PLC, remove the DCM and check positions 1 and 2 on SW5.
ENQ indicator does not come on when communications program is executed	The PLC master station is not in Run mode Online / Offline switch is in the Offline position Communications program is not correct	Place the PLC in Run mode. Set the switch to Online. Check the communications program. Verify the address, amount of data, and data type are correct. (See the ***Direct***NET manual for details on the programs).
ENQ stays on, but NAK, TOUT, or HDR indicators do not come on at all	Communication timeout is disabled RTS and CTS signals are not looped back on the master station end of the cable	Remove power from the PLC, remove the DCM, and check position 3 on SW5. Remove master station connector, ensure RTS and CTS are connected according to the cable diagram.
ENQ comes on and TOUT indicator flashes	RLL communications program is not correct Modes are different Communication cable	Check the communications program. Verify the address is correct. (The address is set in hex, but the RLL uses BCD). Set baud rate, parity, and mode (HEX/ASCII) to match the master station. Verify the cable is wired according to the cable pinouts.
ENQ indicator comes on and NAK indicator flashes (slave responds, but the data is incorrect)	Modes are different Communication cable	Set baud rate, parity, and mode (HEX/ASCII) to match the master station. Make sure the + and – connections are correct (RS422). Check pin 7 (GND) if you're using RS232C.
ENQ and HDR indicators come on and the NAK indicator flashes	Communications program is not correct Modes are different	Check the amount of data being transferred. You must use the correct byte boundaries for the data type being used. Set baud rate, parity, and mode (HEX/ASCII) to match the master station.
DATA indicator is on, but the NAK indicator comes on intermittently	Electrical noise	Make sure the system has good earth grounds. Only one end of the cable shield should be grounded. If you're using RS232C, try using RS422.

Appendix A
RLL Communications Programs

Why do you need a communications program?

The Master Initiates Requests

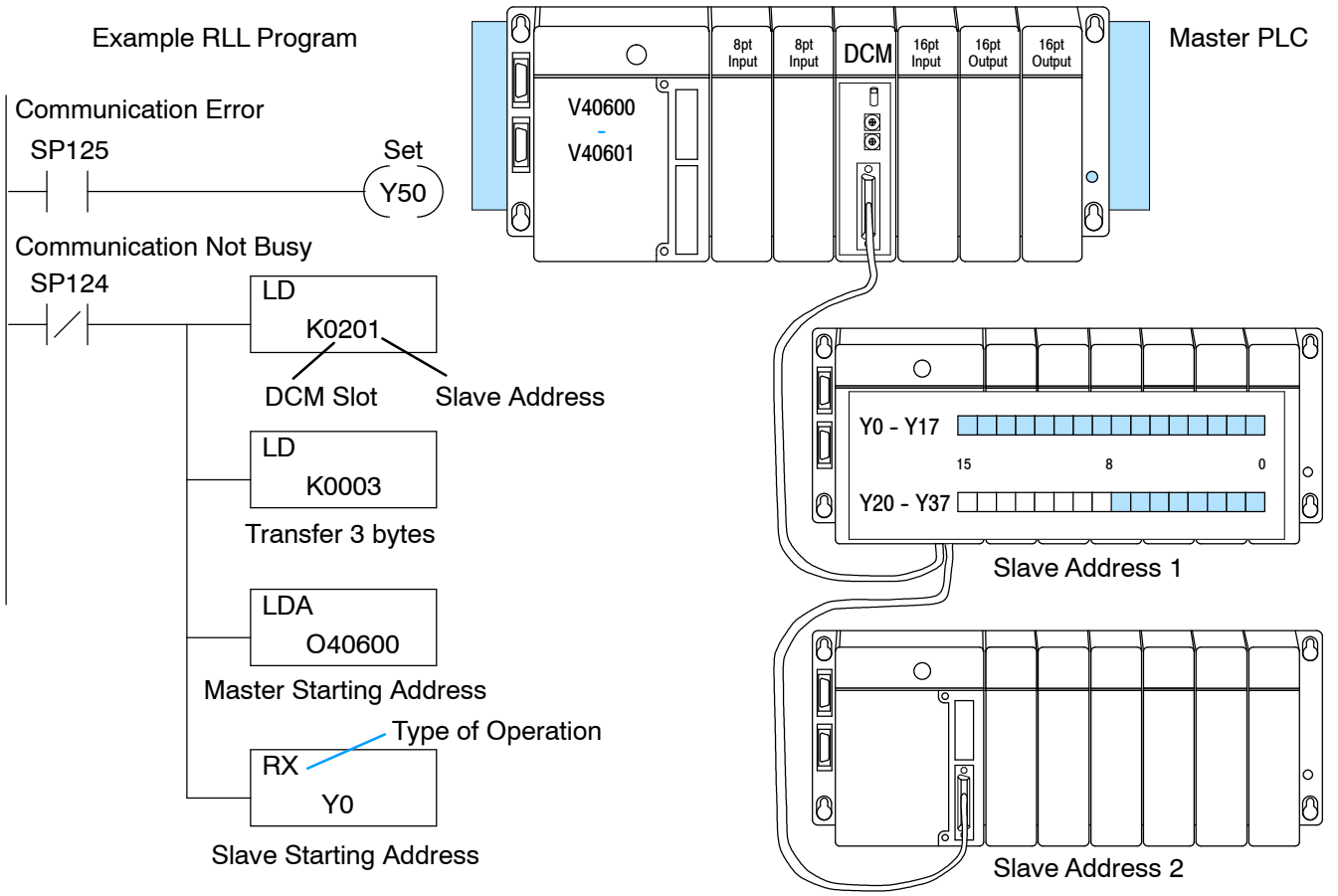
Since ***Direct***NET is a master / slave network, the master station must initiate requests for network data transfers. If you're using a PLC as the master station, you use simple RLL instructions to initiate the requests.

Why Ladder Logic?

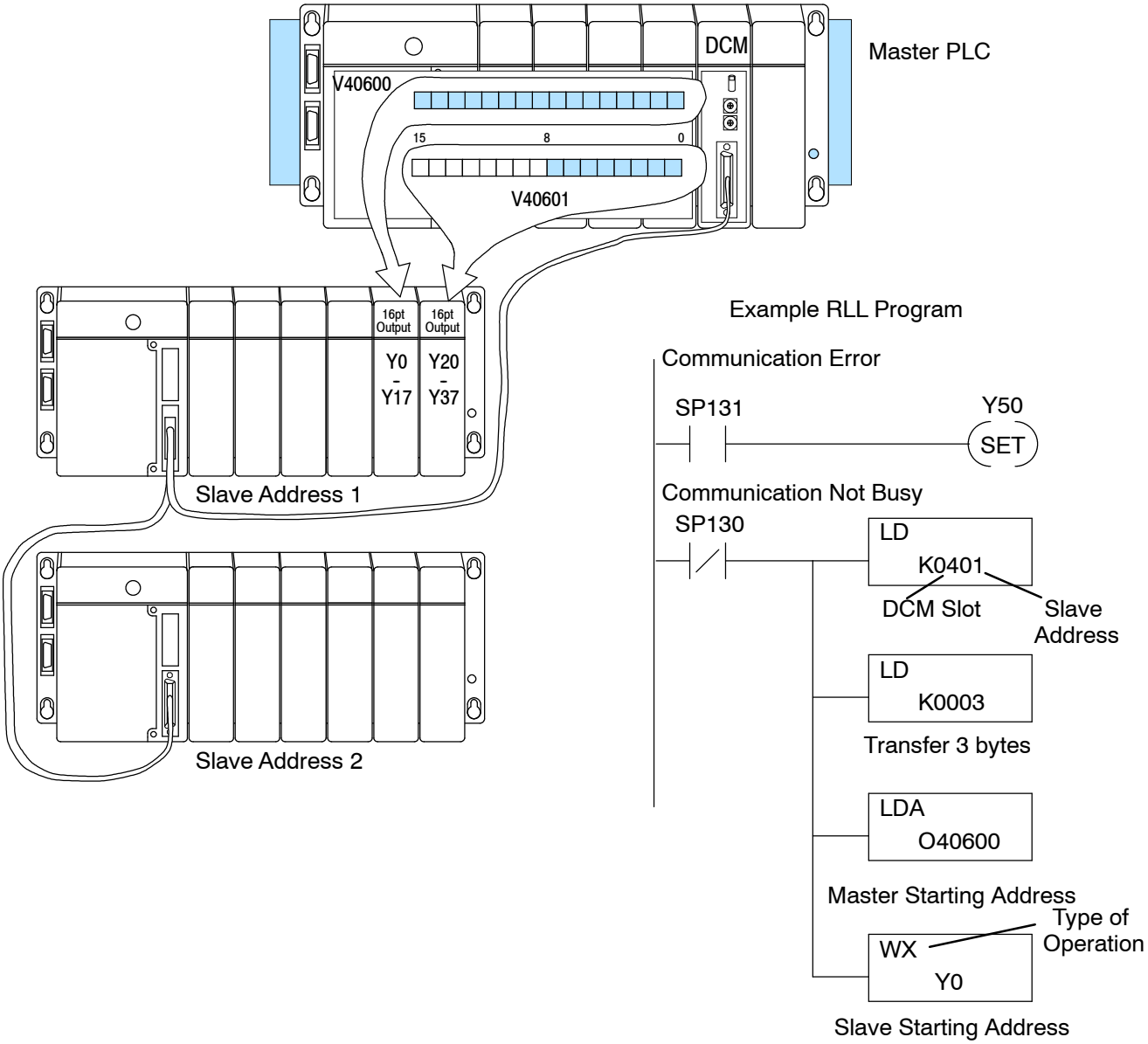
Since the DCM network interface does not contain a program, you have to use the PLC to issue the commands to tell the DCM where to read or write data. The DCM gets information from the PLC and then converts the information into the appropriate ***Direct***NET commands. The RLL instructions identify the following items.

1. Slot location of the DCM master and the slave station address. (LD instruction)
2. Amount of data (in bytes) you want to transfer. (LD instruction)
3. Area of memory to be used by the master. (LDA instruction)
4. Area of memory to be used by the slave, and whether it is a read or write operation. (RX or WX instruction)
5. Interlocks for communication timing and multiple RX and WX routines.

This example reads 3 bytes of data from Slave Address #1,(starting at Y0), into the Master PLC starting at V40600 (Control Relays).



This example writes 3 bytes of data from the Master Station (starting at V40600) to Y0 - Y27 in Slave Station #1.



The following paragraphs explain each operation and provide some helpful hints to make your programs simple and easy to follow.

Identifying the master and slave

Location of Master and Slave

The first Load (LD) instruction identifies the slot location of the DCM master and the address of the slave station. (Remember, the slot numbers start at 0.)

The constant (K) portion of the instruction actually contains two pieces (bytes) of information. The first two digits specify the DCM master location and the second two digits specify the slave station address.

It is necessary to specify both the master slot location and slave address because you can have more than one DCM master in the base and you can have up to 90 slave stations for each master.

NOTE: The LD instruction K value is entered in decimal, but the DCM master and slave addresses are in HEX. You have to convert the HEX addresses to their decimal equivalent for this instruction. It's easy to convert from HEX to decimal.

Valid Slot Range: 0–7

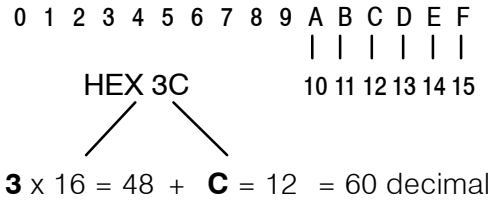
Valid Slave Address: 1–90

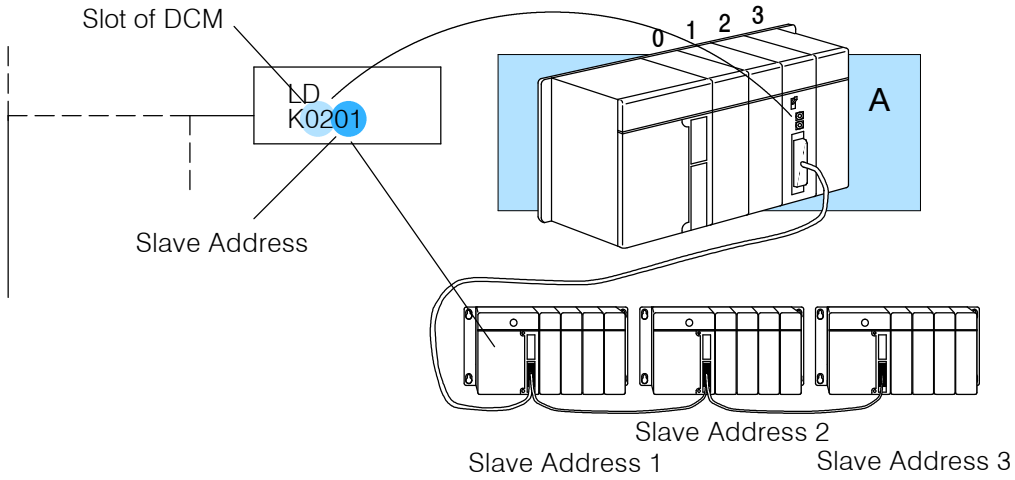
Example:

Master Slot: 2 HEX, 2 decimal

Slave Address: 1 HEX, 1 decimal

HEX Format



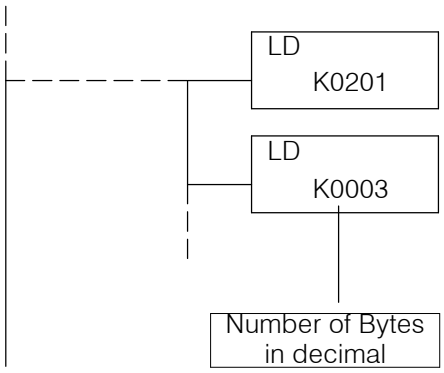


Specifying the amount of data

Number of Bytes to Transfer

The second LD instruction indicates the amount of data (in bytes) that needs to be transferred. You have to specify the amount of data in complete bytes. For example, Y0 – Y27 would be three bytes of data.

The different PLC families do not always use the same types of memory or the same byte boundaries. For example, the DL305 does not use a separate data type for input and output points.



Example:

3 bytes of data to be transferred

The number of bytes specified also depends on the type of data you want to obtain. For example, the DL405 Input points can be accessed by V-memory locations or as X input locations. However, if you only want X0 – X27, you'll have to use the X input data type because the V-memory locations can only be accessed in 2-byte increments. The following table shows the byte ranges for the various types of ***Direct***LOGIC™ products.

DL 205 / 405 Memory	Bits per unit	Bytes
V memory	16	2
T / C current value	16	2
Inputs (X, GX, SP)	8	1
Outputs (Y, C, Stage, T/C bits)	8	1
Scratch Pad Memory	8	1
Diagnostic Status	8	1

DL305 Memory	Bits per unit	Number of bytes
Data registers	8	1
T / C accumulator	16	2
I/O, internal relays, shift register bits, T/C bits, stage bits	1	1
Scratch Pad Memory	8	2
Diagnostic Status (5 word R/W)	16	10

Designating the master station memory area

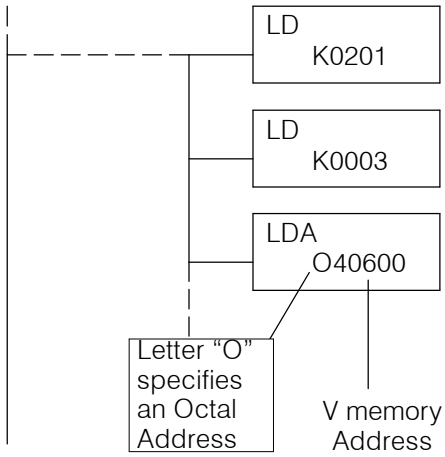
Memory Area of Master

The Load Address (LDA) instruction specifies the V memory area of the master that will be used. This is the starting address. Additional sequential locations may be used, depending on the number of bytes that are being transferred. Since all DL405 data is mapped into V memory, you can easily access the data you need.

If you are reading information from the slave station, this is the destination area, or, the area where the master will store the information.

If you are writing information to the slave station, this is the source area, or, the area where the master will obtain the information that will be transferred to the slave.

NOTE: Since V memory words are always 16 bits, you may not always use the whole word. For example, if you only specify 3 bytes and you are reading Y outputs from the slave, you will only get 24 bits of data. In this case, only the 8 least significant bits of the last word location will be modified. The remaining 8 bits are not affected.



Example:

V memory location 40600 will be the starting point of the data transfer area for the master. The following locations will be used to store the data.

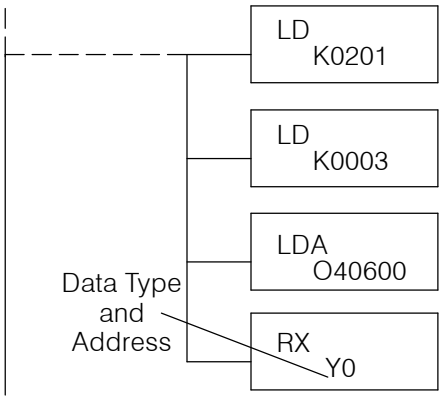
Identifying the slave station memory area

Memory Area of Slave to Read or Write

The Read Network (RX) or Write Network (WX) is the last instruction in the routine. Use the RX if you want to read data from the slave, or use the WX instruction if you want to write data to the slave.

You have to specify the data type and the starting address (in octal) for the slave. (Remember, you have to specify a data type that will work correctly with the number of bytes specified.)

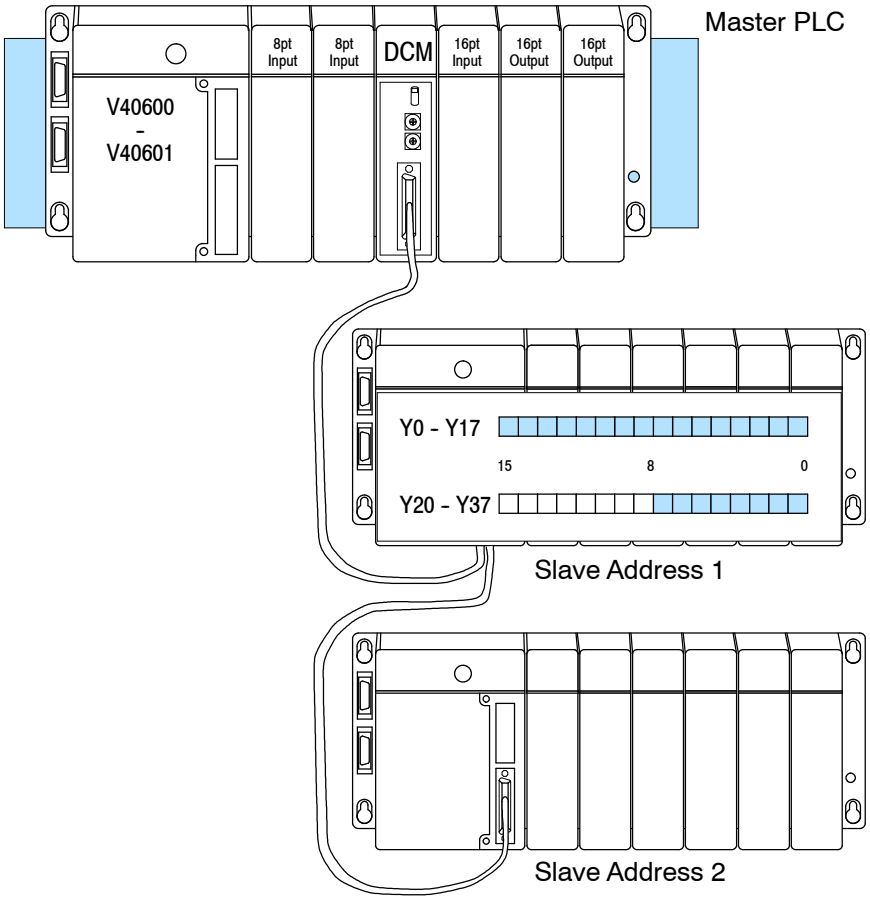
If you use the RX instruction, the data will be read from the slave starting at the address specified. If you use the WX instruction, the data will be written to the slave starting at the address specified.



Example:

Read from slave starting at Y0.

NOTE: If you are using an RLL communications program to transfer data to or from a DL305 slave station, the data type is slightly different. For example, the DL305 I/O points are accessed with the GY data type. The ***Direct***NET manual provides a listing of memory types and cross references for the DL305 family.



Controlling the communications

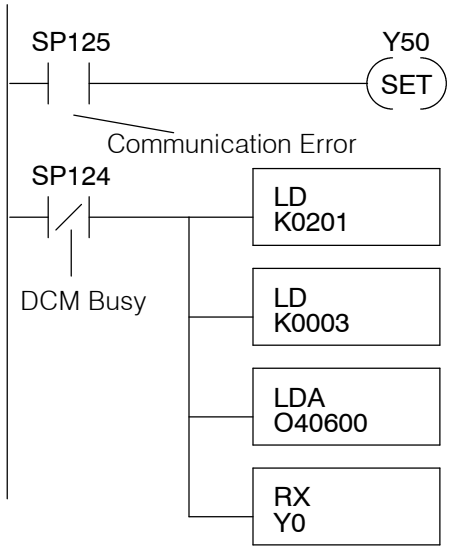
Communications Special Relays

When you execute communication with a DCM, chances are good the communication may take longer than the actual PLC scan. If the DCM is busy, you should not initiate another request until it is finished. Fortunately, there's an easy solution for this.

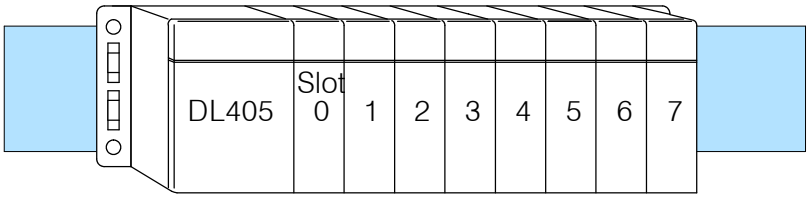
There are two SPs for each slot in the CPU base which are used only with the DCM. For example, slot 0 has SP120 and SP121. SP120 is the DCM Busy relay and, when turned on, indicates the DCM is busy. SP121 indicates there is a communication error for slot 0.

You should always use the DCM Busy SP in your RLL programs to ensure the DCM is ready.

The communication error SP is optional, but it's a good way to monitor the communication status in the RLL program. If you use the communication error SP, make sure you place it at the beginning of your communication routines. This is because the communication error relay is always reset (turned off) whenever an RX or WX instruction is executed.



Special Purpose Communication Relays								
Communication Busy	SP120	SP122	SP124	SP126	SP130	SP132	SP134	SP136
Communication Error	SP121	SP123	SP125	SP127	SP131	SP133	SP135	SP137
I/O Slot Location	0	1	2	3	4	5	6	7



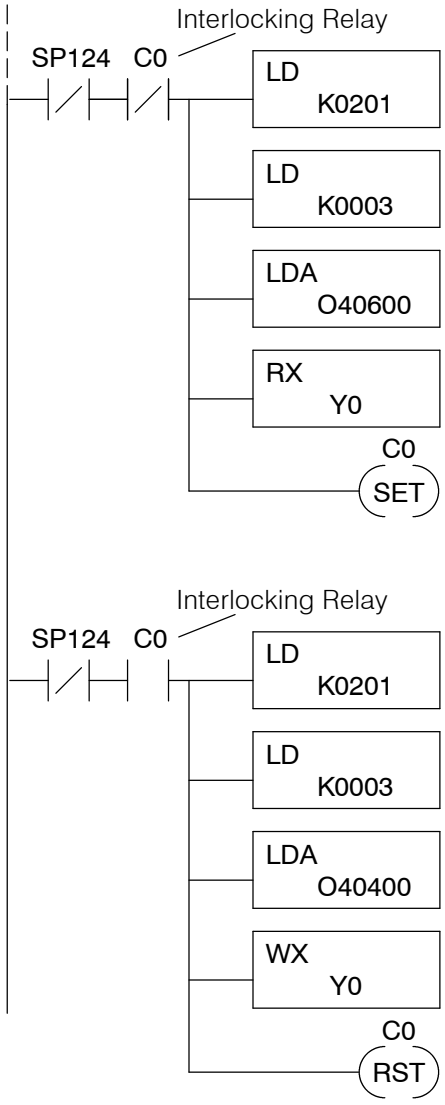
Multiple Read and Write Interlocks

If you're using multiple reads and writes in the RLL program, you have to interlock the routines to make sure all the routines are executed. If you don't use the interlocks, then the CPU will only execute the first routine. This is because the DCM can only handle one routine at a time.

In the example, once the RX instruction is executed, C0 is set. When the DCM has finished the communication task, the second routine is executed and C0 is reset.

If you're using RLL*PLUS*, you can just put each routine in a separate program stage to ensure proper execution. In most all cases, RLL*PLUS* is a much more efficient way to create automation program.

The ***Direct***NET manual provides a master / slave example with both RLL and RLL*PLUS* program descriptions.



DL305 / 405 Cross Reference

If you are using a DL405 Master, you will have to make some slight changes in the way you request certain types of data. For example, the DL405 uses V-memory references instead of Register references. This section shows the cross references.

NOTE: Not all DL305 devices offer the same memory ranges. Check your DL305 User Manual to determine the ranges for your particular model.

Data Type 31: Register Access

To get to ... TMR / CTR Accumulator in a DL305	Use Reference ... in a DL405	To get to ... Register Data in a DL305	Use Reference ... in a DL405
R600	V000	R401, 400*	V100
R601	V001	R403, 402	V101
— — —	— — —	— — —	— — —
R624	V024	R777, 776	V237
R677	V077		
Two bytes of DL305 register data are returned with one DL405 V memory location.			

Data Type 33: I/O Point Access

Non RLL*PLUS* CPUs			
To get to ... I/O Points, CRs, & Shift Registers in a DL305	**Use Reference ... in a DL405**	**To get to ... TMR / CNT Status Bit in a DL305**	**Use Reference ... in a DL405**
IO 000	GY000	600	GY600
IO 001	GY001	601	GY601
— — —	— — —	— — —	— — —
IO 157	GY157	677	GY677
CR160	GY160		
— — —	— — —		
CR 377	GY377		
IO 700	GY700		
IO 701	GY701		
— — —	— — —		
IO 1067	GY1067		
SR 400	GY400		
SR 401	GY401		
— — —	— — —		
SR 577	GY577		

RLL*PLUS* CPUs					
To get to ... I/O Points, CRs, & Shift Registers in a DL305	**Use Ref. ... in a DL405**	**To get to ... Stage Status Bit in a DL305**	**Use Ref. ... in a DL405**	**To get to ... TMR / CNT Status Bit in a DL305**	**Use Ref. ... in a DL405**
IO 000	GY000	000	GY200	600	GY600
IO 001	GY001	001	GY201	601	GY601
— — —	— — —	— — —	— — —	— — —	— — —
CR160	GY160	177	GY377	677	GY677
— — —	— — —				
CR 277	GY277				
IO 700	GY700				
IO 701	GY701				
IO 1067	GY1067				
SR 200	GY400				
SR 201	GY 401				
— — —	— — —				
SR 277	GY477				