2

Installation, Wiring, and Specifications

In This Chapter. . . .

10/2021 - 10 slot base D3-10B-1, D3-EXCBL expansion I/O cable, and Handheld Programmer D3-HP cable D3-HPCBL have been discontinued with not replacement. Consider BRX, Productivity, or CLICK PLC systems as upgrades.

Handheld Programmer D3-HP & D3-HPP have been retired as of 03/2021 & 01/2018 respectively. Please consider Productivity, BRX, or CLICK series PLC systems as upgrades.

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 usedaccording to their intended purpose and that the instructions in this manual areadhered to. The protection provided by the equipment may be impaired if thisequipment is used in a manner not specified in this manual. A listing of ourinternational affiliates is available on our web site: http://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 PLC 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.
- 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

The publications mentioned provide many ideas and requirements for system safety. At a minimum, you should follow these regulations. Using the techniques listed below will further help reduce the risk of safety problems.

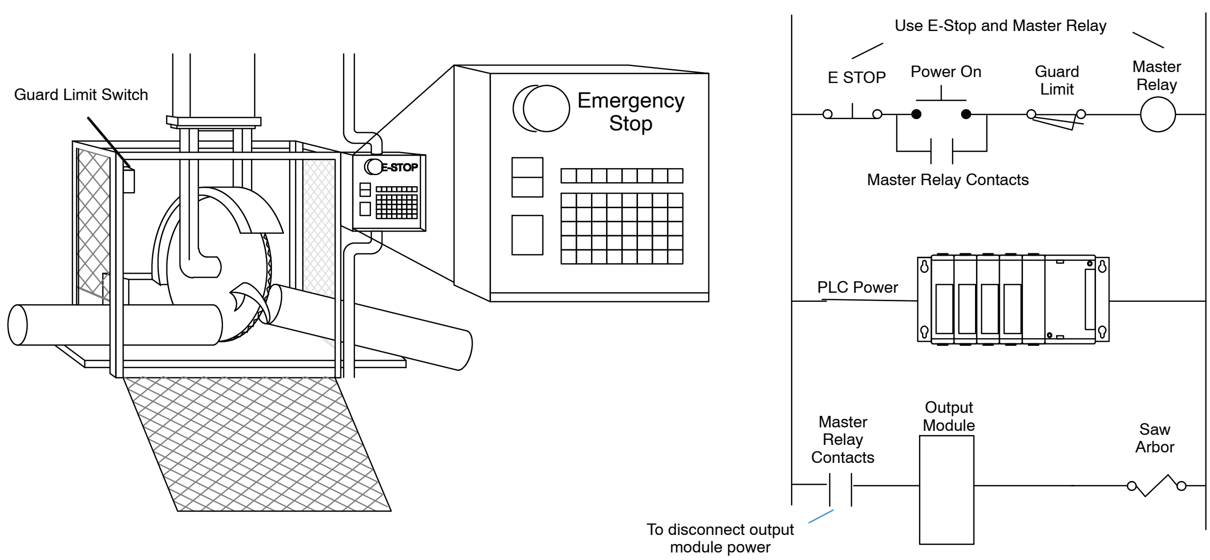
- Emergency stop switch for disconnecting system power.
- Mechanical disconnect for output module power.
- Orderly system shutdown sequence in the PLC control program.

Emergency Stops

It is recommended that emergency stop circuits be incorporated into the system for every machine controlled by a PLC. For maximum safety in a PLC system, these circuits must not be wired into the controller, but should be hardwired external to the PLC. The emergency stop switches should be easily accessed by the operator and are generally wired into a master control relay (MCR) or a safety control relay (SCR) that will remove power from the PLC 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 PLC continues to receive power and operate even though all its inputs and outputs are disabled.

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



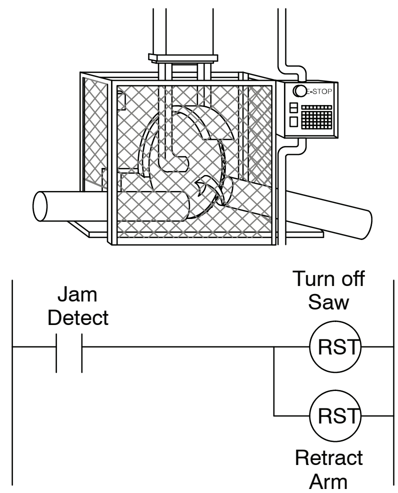
Emergency Power Disconnect

A properly rated emergency power disconnect should be used to power the PLC controlled system as ameans of removing the power from the entire control system. It may be necessary to install a capacitor across the disconnect to protect against a condition known as “outrush“. This condition occurs when the output triacs are turned off by powering off the disconnect, thus causing the energy stored in the inductive loads to seek the shortest distance to ground, which is often through the triacs.

After an emergency shutdown or any other type of power interruption, there may be requirements that must be met before the PLC control program can be restarted. For example, there may be specific register values that must be established (or maintained from the state prior to the shutdown) before operations can resume. In this case, you may want to use retentive memory locations, or include constants in the control program to ensure a known starting point.

Orderly System Shutdown

Ideally, the first level of protection can be provided with the PLC control program by identifying machine problems. Analyze your application and identify any shutdown sequences that must be performed. Typical problems such as jammed or missing parts, empty bins, etc., create a risk of personal injury or equipment damage.



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.

Class 1, Division 2 Approval

This equipment is suitable for use in Class 1, Division 2, groups A, B, C and D or non–hazardous locations only.

WARNING: Explosion Hazard! – Substitution of components may impair suitability for Class 1, Division 2.

WARNING: Explosion Hazard! – Do not disconnect equipment unless power has been switched off or area is known to be non–hazardous.

Mounting Guidelines

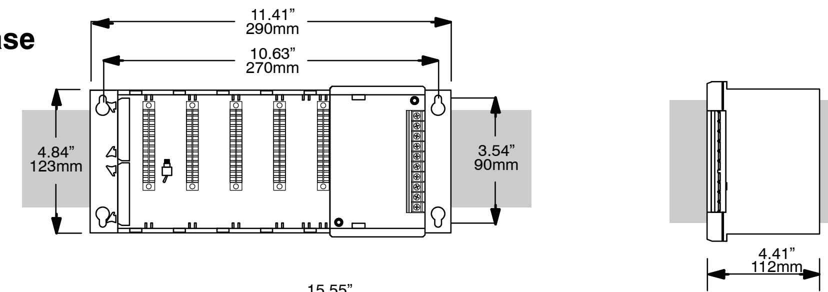
Before installing the PLC system you will need to know the dimensions for the components. The diagrams on the following pages provide the component dimensions to use in defining your enclosure specifications. Remember to leave room for potential expansion.

NOTE: If you are using other components in your system, refer to the appropriate manual to determine how those units can affect mounting dimensions.

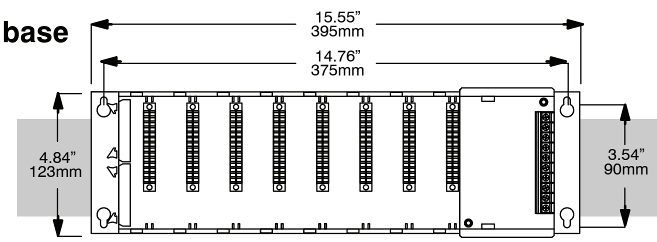
Base Dimensions

The following information shows the proper mounting dimensions. The height dimension is the same for all bases. The depth varies depending on your choice of I/O module. The length varies as the number of slots increase. Make sure you have followed the installation guidelines for proper spacing.

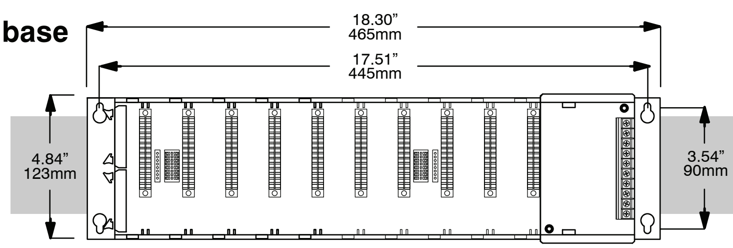
5 slot base



8 slot base



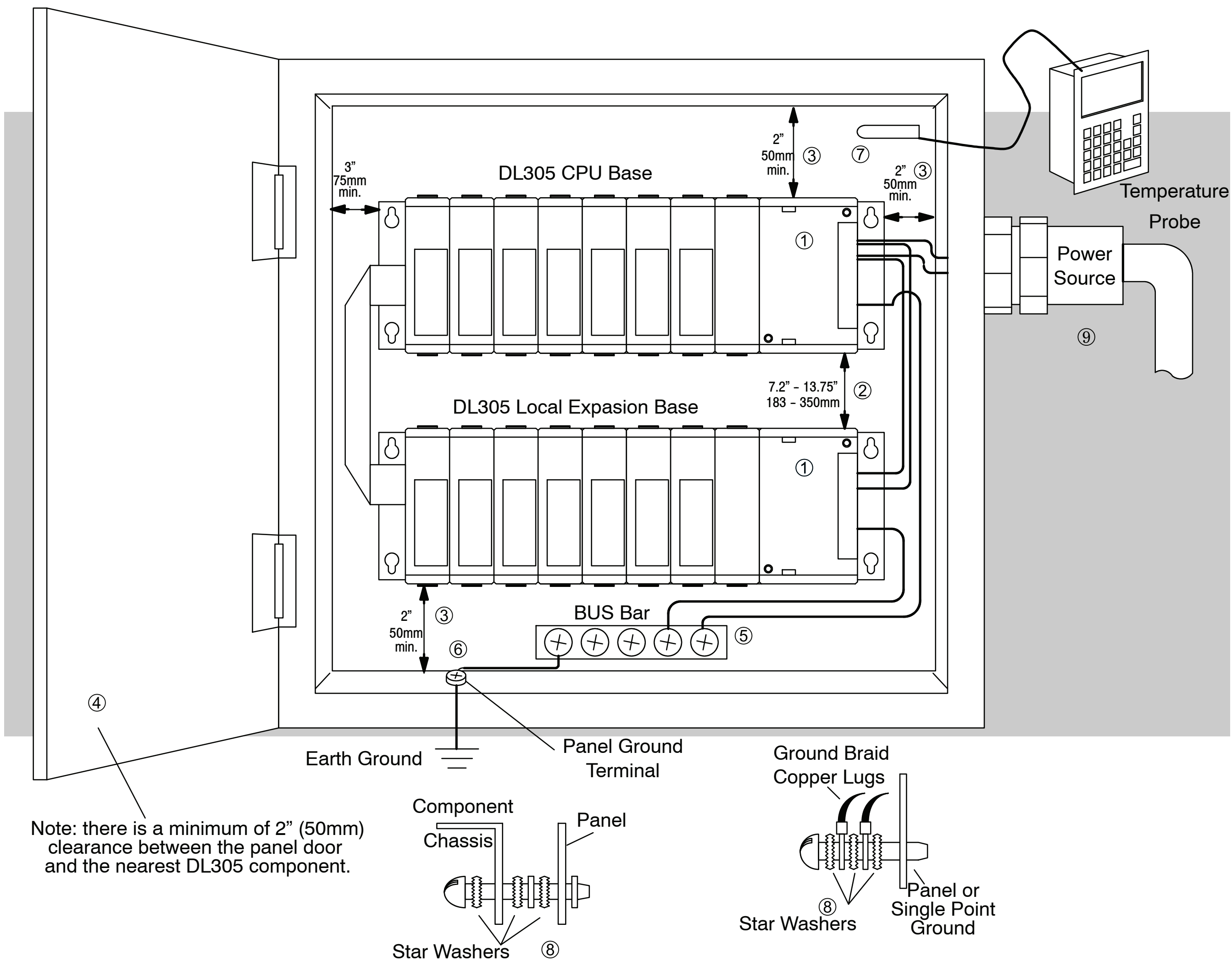
10 slot base



Panel Mounting and Layout

It is important to design your panel properly to help ensure the DL305 products operate within their environmental and electrical limits. The system installation should comply with all appropriate electrical codes and standards. It is important the system also conforms to the operating standards for the application to insure proper performance.

1. Mount the bases horizontally to provide proper ventilation.
2. If you place more than one base in a cabinet, there should be a minimum of 7.2" (183mm) between bases.
3. Provide a minimum clearance of 2" (50mm) between the base and all sides of the cabinet. There should also be at least 1.2" (30mm) of clearance between the base and any wiring ducts.
4. There must be a minimum of 2" (50mm) clearance between the panel door and the nearest DL305 component.



5. The ground terminal on the DL305 base must be connected to a single point ground. Use copper stranded wire to achieve a low impedance. Copper eye lugs should be crimped and soldered to the ends of the stranded wire to ensure good surface contact. Remove anodized finishes and use copper lugs and star washers at termination points. A general rule is to achieve a 0.1 ohm of DC resistance between the DL305 base and the single point ground.
6. There must be a single point ground (i.e. copper bus bar) for all devices in the panel requiring an earth ground return. The single point of ground must be connected to the panel ground termination.

   The panel ground termination must be connected to earth ground. For this connection you should use #12 AWG stranded copper wire as a minimum. Minimum wire sizes, color coding, and general safety practices should comply with appropriate electrical codes and standards for your region.

   A good common ground reference (Earth ground) is essential for proper operation of the DL305. There are several methods of providing an adequate common ground reference, including:
   a) Installing a ground rod as close to the panel as possible.
   b) Connection to incoming power system ground.
7. Properly evaluate any installations where the ambient temperature may approach the lower or upper limits of the specifications. Place a temperature probe in the panel, close the door and operate the system until the ambient temperature has stabilized. If the ambient temperature is not within the operating specification for the DL305 system, measures such as installing a cooling/heating source must be taken to get the ambient temperature within the DL305 operating specifications.
8. Device mounting bolts and ground braid termination bolts should be #10 copper bolts or equivalent. Tapped holes instead of nut-bolt arrangements should be used whenever possible. To assure good contact on termination areas impediments such as paint, coating or corrosion should be removed in the area of contact.
9. The DL305 system is designed to be powered by 110/220 VAC, or 24 VDC normally available throughout an industrial environment. Isolation transformers and noise suppression devices are not normally necessary, but may be helpful in eliminating/reducing suspect power problems.

Enclosures

Your selection of a proper enclosure is important to ensure safe and proper operation of your DL305 system. Applications of DL305 systems vary and may require additional features. The minimum considerations for enclosures include:

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

Environmental Specifications

The following table lists the environmental specifications that generally apply to the DL350 system (CPU, Bases, I/O Modules). The ranges that vary for the Handheld Programmer are noted at the bottom of this chart. I/O module operation may fluctuate depending on the ambient temperature and your application. Please refer to the appropriate I/O module specifications for the temperature derating curves applying to specific modules.

Specification	Rating
Storage temperature	-4° F to 158° F (-20° C to 70° C)
Ambient operating temperature*	32° F to 131° F (0° C to 55° C)
Ambient humidity**	5% - 95% relative humidity (non-condensing)
Vibration resistance	MIL STD 810C, Method 514.2
Shock resistance	MIL STD 810C, Method 516.2
Noise immunity	NEMA (ICS3-304)
Atmosphere	No corrosive gases

* Operating temperature for the Handheld Programmer and the DV-1000 is 32° to 122° F (0° to 50° C)
Storage temperature for the Handheld Programmer and the DV-1000 is -4° to 158° F (-20° to70° C).
**Equipment will operate below 30% humidity. However, static electricity problems occur much more frequently at lower humidity levels. Make sure you take adequate precautions when you touch the equipment. Consider using ground straps, anti-static floor coverings, etc. if you use the equipment in low humidity environments.

Agency Approvals

Some applications require agency approvals. Typical agency approvals which your application may require are:

- UL (Underwriters' Laboratories, Inc.)
- CSA (Canadian Standards Association)
- FM (Factory Mutual Research Corporation)
- CUL (Canadian Underwriters' Laboratories, Inc.)

Marine Use

American Bureau of Shipping (ABS) certification requires flame-retarding insulation as per 4-8-3/5.3.6(a). ABS will accept Navy low smoke cables, cable qualified to NEC "Plenum rated" (fire resistant level 4), or other similar flammablity resistant rated cables. Use cable specifications for your system that meet a recognized flame retardant standard (i.e. UL, IEEE, etc.), including evidence of cable test certification (i.e. tests certificate, UL file number, etc.).

NOTE: Wiring needs to be "low smoke" per the above paragraph. Teflon coated wire is also recommended.

Power The power source must be capable of supplying voltage and current complying with the base power supply specifications.

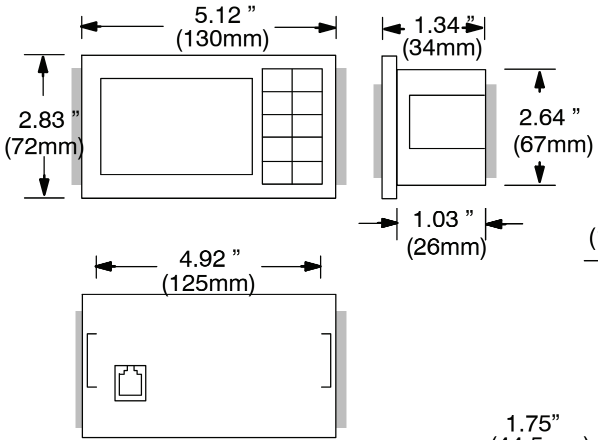
Specifications	D3-05B-1	D3-05BDC-1	D3-08B-1	D3-10B-1
Input Voltage Range	85-264 VAC 47-63Hz	20.5-30 VDC <10% ripple	85-264 VAC 47-63Hz	85-264 VAC 47-63Hz
Base Power Consumption	85 VA max	48 Watts	85 VA max	85 VA max
Inrush Current max.	30A	30A	30A	30A
Dielectric Strength	1500VAC for 1 minute between terminals of AC P/S, Run output, Common, 24VDC	1500VAC for 1 minute between 24VDC input terminals and Run output	1500VAC for 1 minute between terminals of AC P/S, Run output, Common, 24VDC	2000VAC for 1 minute between terminals of AC P/S, Run output, Common, 24VDC
Insulation Resistance	>10MΩ at 500VDC	>10MΩ at 500VDC	>10MΩ at 500VDC	>10MΩ at 500VDC
Power Supply Output (Voltage Ranges and Ripple)	(5VDC) 4.75-5.25V less than 0.25V p-p (9VDC) 8.0-10.0V less than 0.45 V p-p (24VDC) 20-28V less than 1.2V p-p	(5VDC) 4.75-5.25V less than 0.25V p-p (9VDC) 8.5-13.5V less than 0.45 V p-p (24VDC) 20-28V less than 1.2V p-p	(5VDC) 4.75-5.25V less than 0.25V p-p (9VDC) 8.0-10.0V less than 0.45 V p-p (24VDC) 20-28V less than 1.2V p-p	(5VDC) 4.75-5.25V less than 0.25V p-p (9VDC) 8.0-10.0V less than 0.45 V p-p (24VDC) 20-28V less than 1.2V p-p

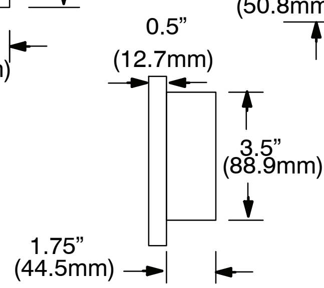
Component Dimensions

Before installing your PLC system you will need to know the dimensions for the components in your system. The diagrams on the following pages provide the component dimensions and should be used to define your enclosure specifications. Remember to leave room for potential expansion. Appendix E provides the weights for each component.

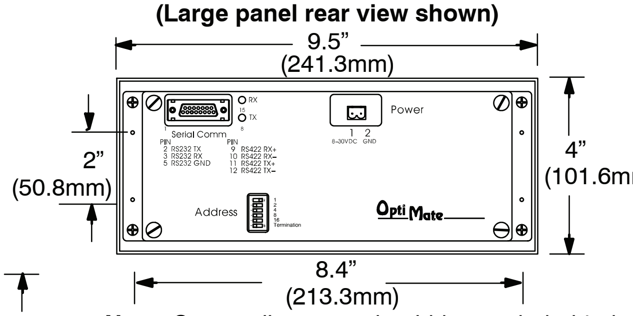
NOTE: If you are using other components in your system, make sure you refer to the appropriate manual to determine how those units can affect mounting dimensions.

***Direct*VIEW 1000**

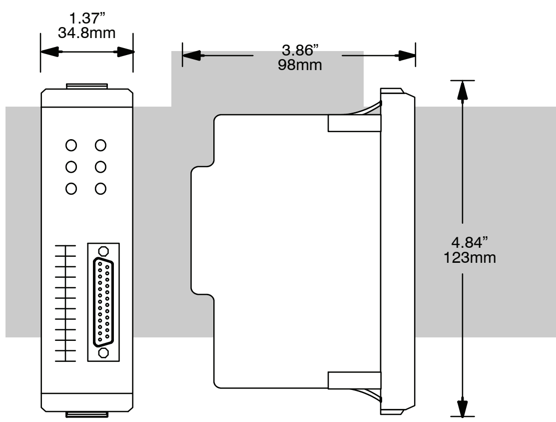




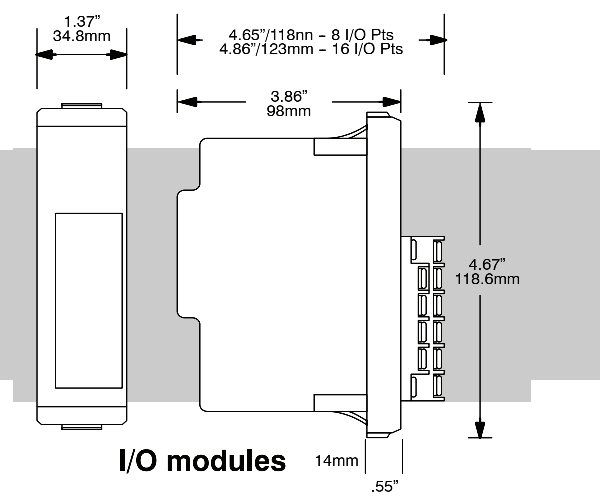
Optimation Units
(Large panel rear view shown)



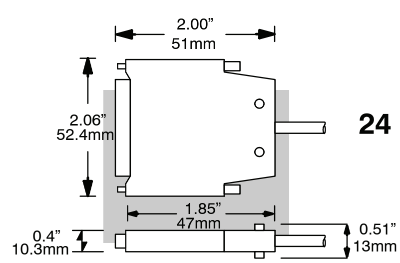
Note: Space allowance should be made behind the panel for the serial cable, and power connector. If you will be adding or removing panels for a multi-drop, then you may want to allow for hand room to reach the address switch on the back. We recommend 4 inches.



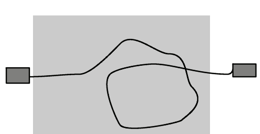
I/O module w/24 pin connector



I/O modules



24 pin connector



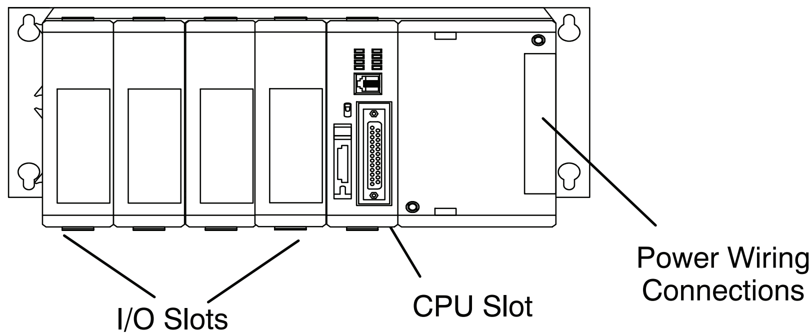
Handheld programmer cable

Installing DL305 Bases

Choosing the Base Type

The DL305 system offers three different sizes of bases and two different power supply options.

The following diagram shows an example of a 5-slot base.

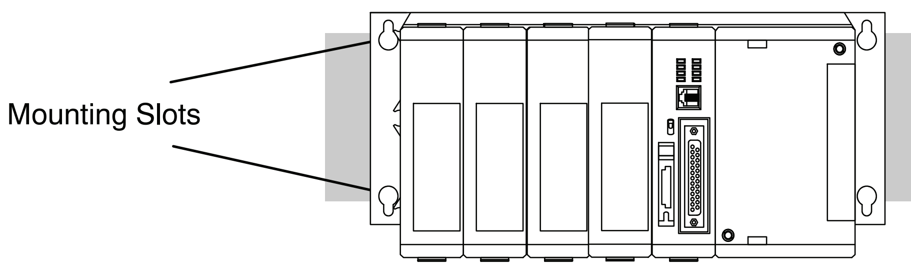


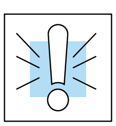
Your choice of base depends on three things.

- Number of I/O modules required
- Input power requirement (AC or DC power)
- Available power budget

Mounting the Base

All I/O configurations of the DL305 may use any of the base configurations. The bases are secured to the equipment panel or mounting location using four M4 screws in the corner mounting cut-outs of the base. The full mounting dimensions are given in the previous section on Mounting Guidelines.

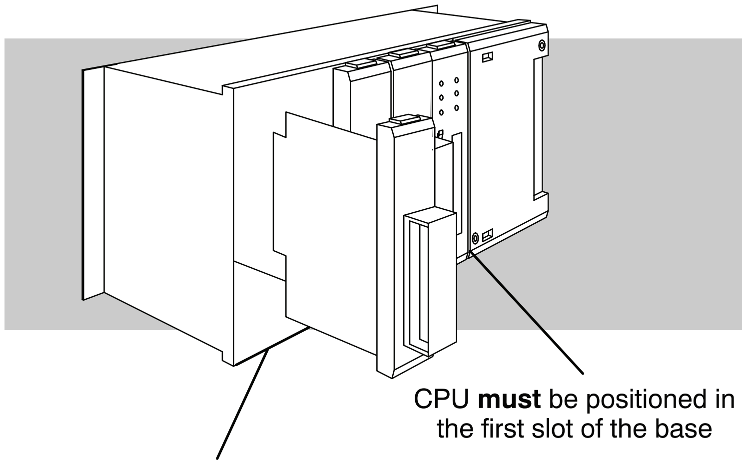


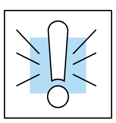


WARNING: To minimize the risk of electrical shock, personal injury, or equipment damage, always disconnect the system power before installing or removing any system component.

Installing Components in the Base

When inserting components into the base, align the PC board(s) of the module with the grooves on the top and bottom of the base. Push the module straight into the base until it is firmly seated in the backplane connector. Once the module is inserted into the base, push in the retaining clips (located at the top and bottom of the module) to firmly secure the module to the base.





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

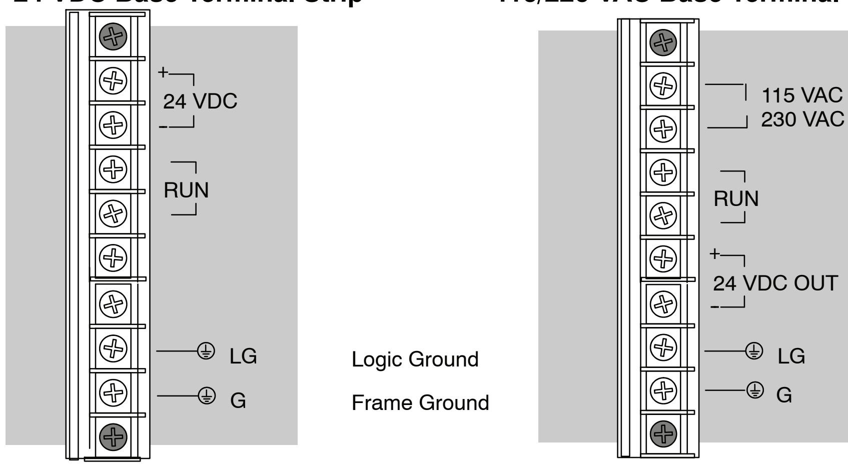
Base Wiring Guidelines

Base Wiring

The diagram shows the terminal connections located on the power supply of the DL305 xxxxx–1 bases. The base terminals can accept up to 16 AWG.

NOTE: You can connect either a 115 VAC or 220 VAC supply to the AC terminals. Special wiring or jumpers are not required as with some of the other ***Direct***LOGIC™ products.

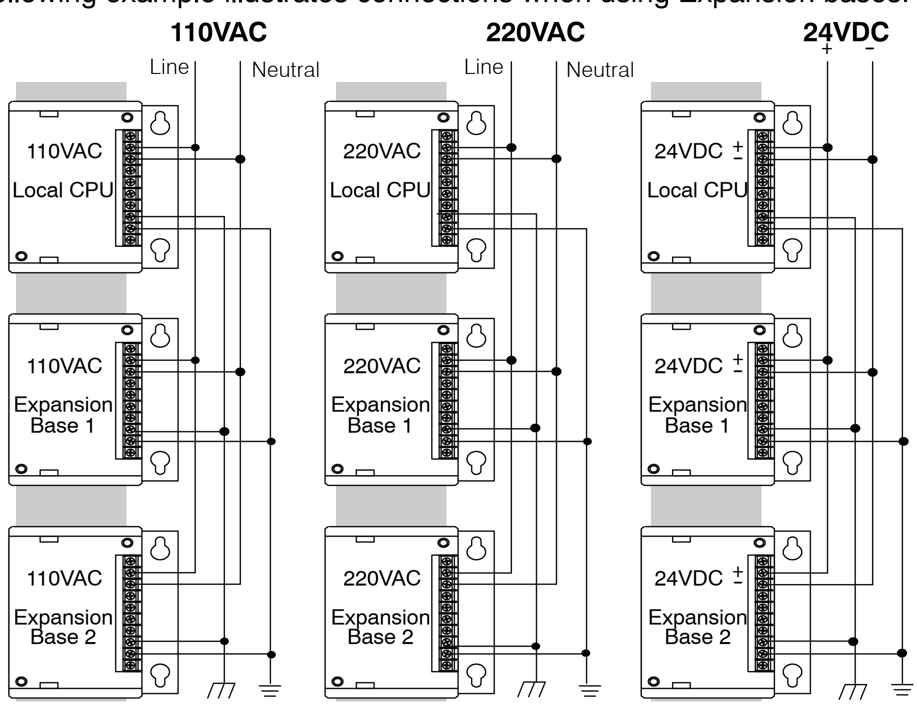
24 VDC Base Terminal Strip **110/220 VAC Base Terminal Strip**



WARNING: Once the power wiring is connected, install the plastic protective cover. When the cover is removed there is a risk of electrical shock if you accidentally touch the wiring or wiring terminals.

Expansion Base Wiring

The following example illustrates connections when using Expansion bases.

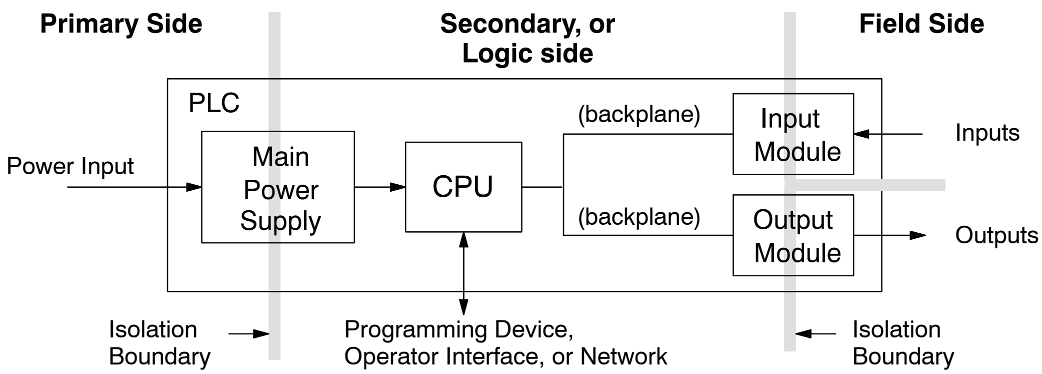


I/O Wiring Strategies

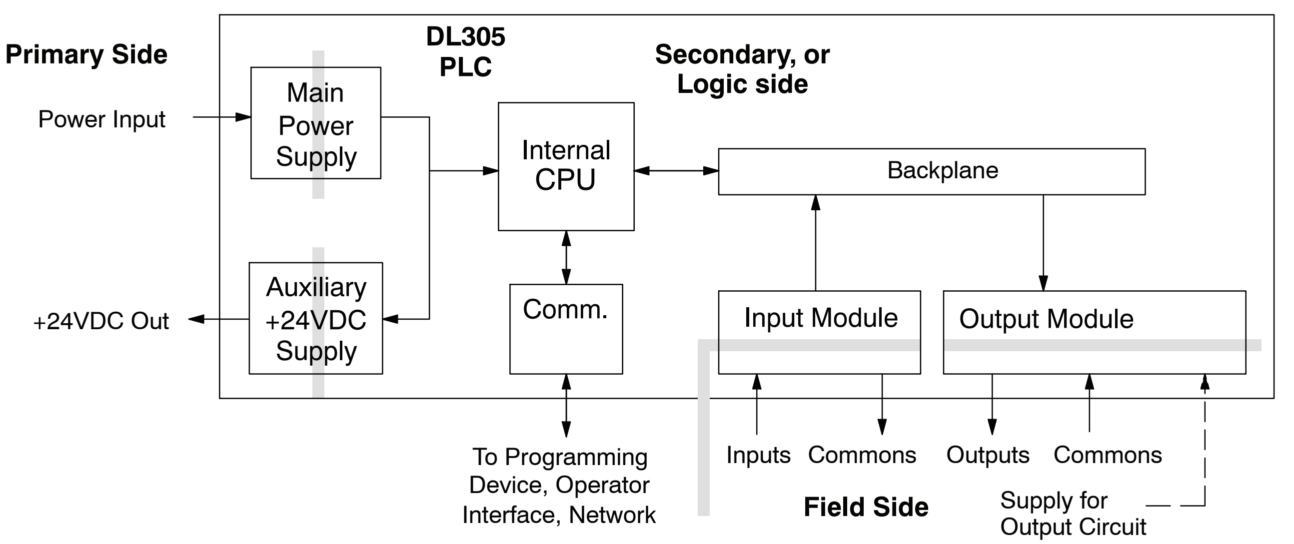
The DL305 PLC system is very flexible and will work in many different wiring configurations. By studying this section before actual installation, you can probably find the best wiring strategy for your application . This will help to lower system cost, wiring errors, and avoid safety problems.

PLC Isolation Boundaries

PLC circuitry is divided into three main regions separated by isolation boundaries, shown in the drawing below. Electrical isolation provides safety, so that a fault in one area does not damage another. A transformer in the power supply provides magnetic isolation between the primary and secondary sides. Opto-couplers provide optical isolation in Input and Output circuits. This isolates logic circuitry from the field side, where factory machinery connects. Note the discrete inputs are isolated from the discrete outputs, because each is isolated from the logic side. Isolation boundaries protect the operator interface (and the operator) from power input faults or field wiring faults. *When wiring a PLC, it is extremely important to avoid making external connections that connect logic side circuits to any other.*



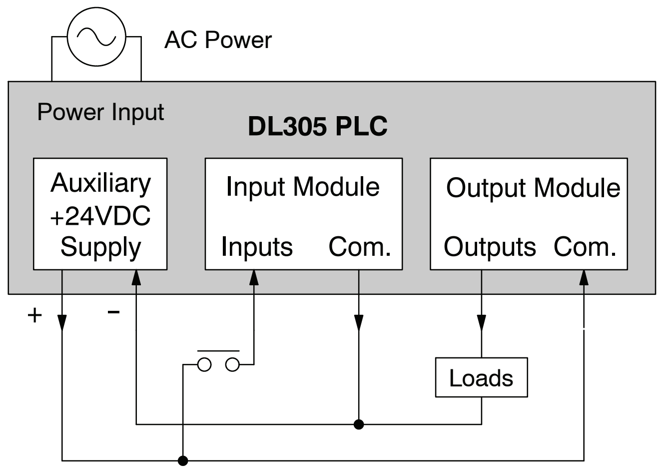
The next figure shows the physical layout of a DL305 PLC system, as viewed from the front. In addition to the basic circuits covered above, AC-powered bases include an auxiliary +24VDC power supply with its own isolation boundary. Since the supply output is isolated from the other three circuits, it can power input and/or output circuits!



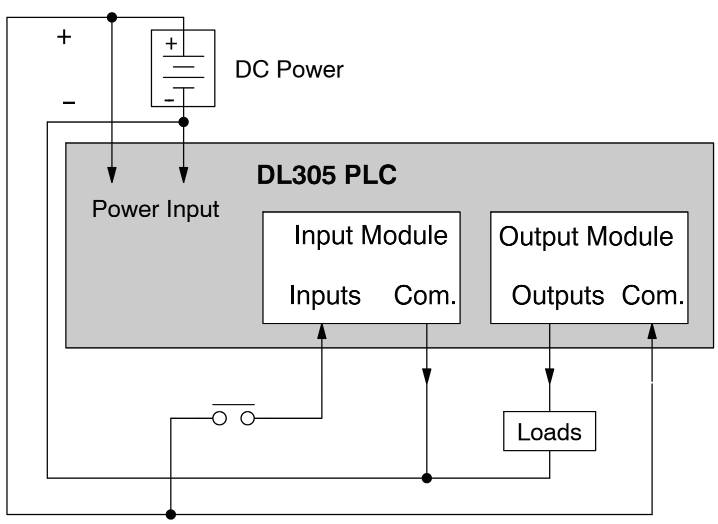
In some cases, using the built-in auxiliary +24VDC supply can result in a cost savings for your control system. It can power combined loads up to 100 mA. Be careful not to exceed the current rating of the supply. If you are the system designer for your application, you may be able to select and design in field devices which can use the +24VDC auxiliary supply.

Powering I/O Circuits with the Auxiliary Supply

All AC powered DL305 bases feature the internal auxiliary supply. If input devices AND output loads need +24VDC power, the auxiliary supply may be able to power both circuits as shown in the following diagram.



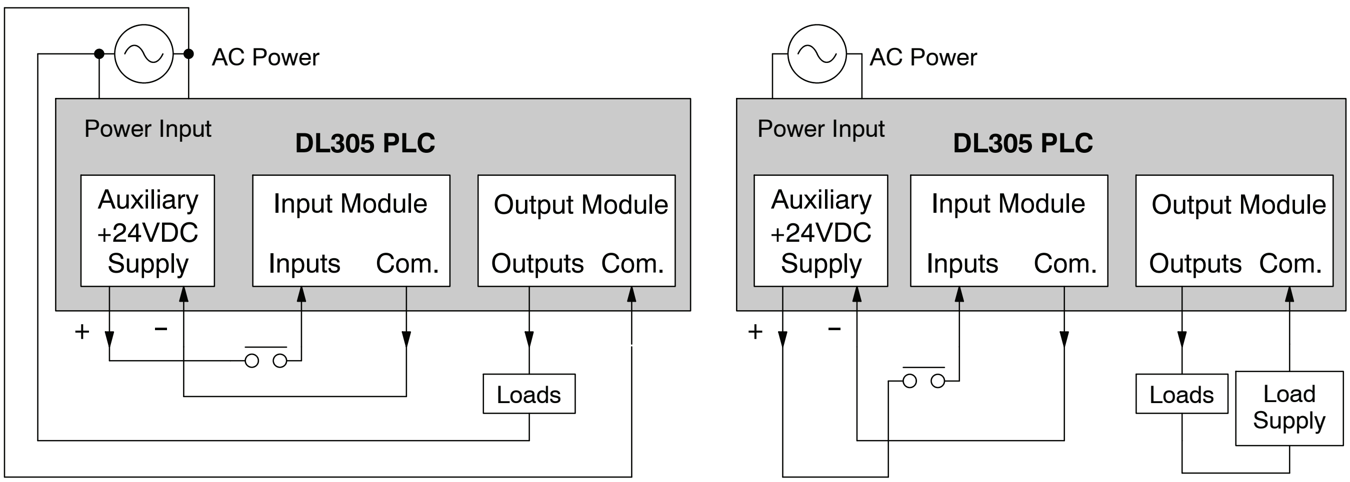
DC-powered DL305 bases are designed for application environments in which low-voltage DC power is more readily available than AC. These include a wide range of battery–powered applications, such as remotely-located control, in vehicles, portable machines, etc. For this application type, all input devices and output loads typically use the same DC power source. Typical wiring for DC-powered applications is shown in the following diagram.



Powering I/O Circuits Using Separate Supplies

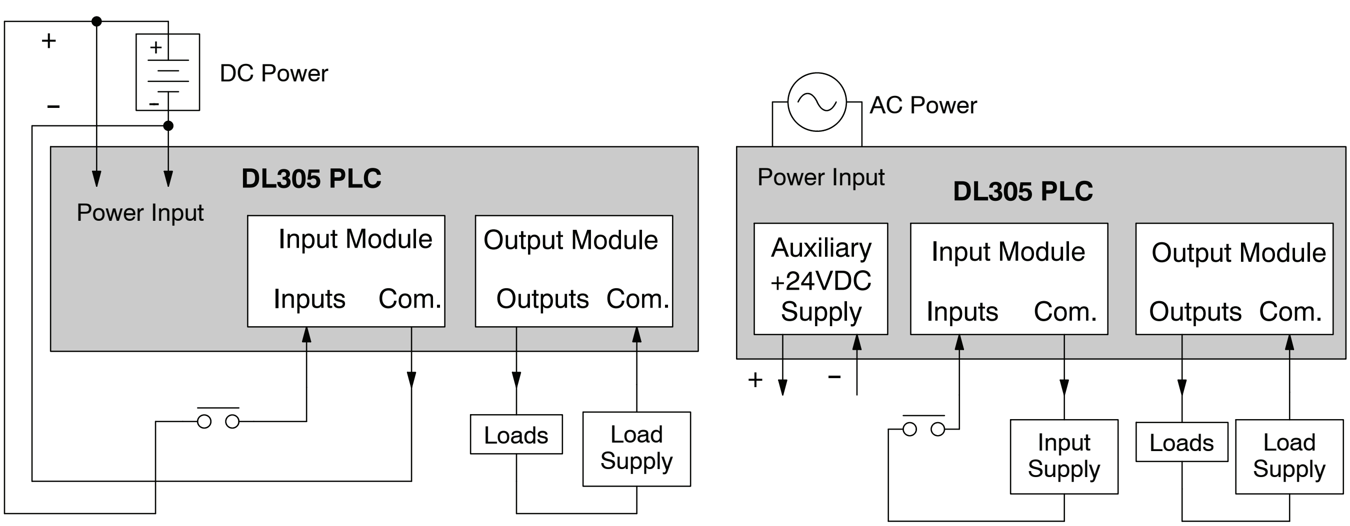
In most applications it will be necessary to power the input devices from one power source, and to power output loads from another source. Loads often require high-energy AC power, while input sensors use low-energy DC. If a machine operator is likely to come in close contact with input wiring, then safety reasons also require isolation from high-energy output circuits. It is most convenient if the loads can use the same power source as the PLC, and the input sensors can use the auxiliary supply, as shown to the left in the figure below.

If the loads cannot be powered from the PLC supply, then a separate supply must be used as shown to the right in the figure below.



Some applications will use the PLC external power source to also power the input circuit. This typically occurs on DC-powered PLCs, as shown in the drawing below to the left. The inputs share the PLC power source supply, while the outputs have their own separate supply.

A worst-case scenario, from a cost and complexity view-point, is an application which requires separate power sources for the PLC, input devices, and output loads. The example wiring diagram below on the right shows how this can work, but also the auxiliary supply output is an unused resource. You will want to avoid this situation if possible.



Sinking / Sourcing Concepts

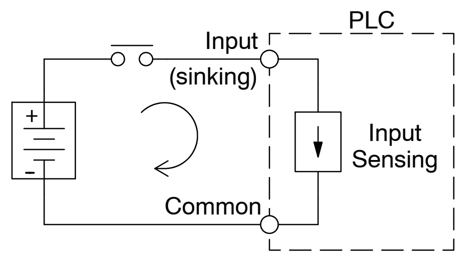
Before going further in the study of wiring strategies, you must have a solid understanding of "*sinking*" and "*sourcing*" concepts. Use of these terms occurs frequently in input or output circuit discussions. It is the goal of this section to make these concepts easy to understand, further ensuring your success in installation. First the following short definitions are provided, followed by practical applications.

Sinking = provides a path to supply **ground (–)**

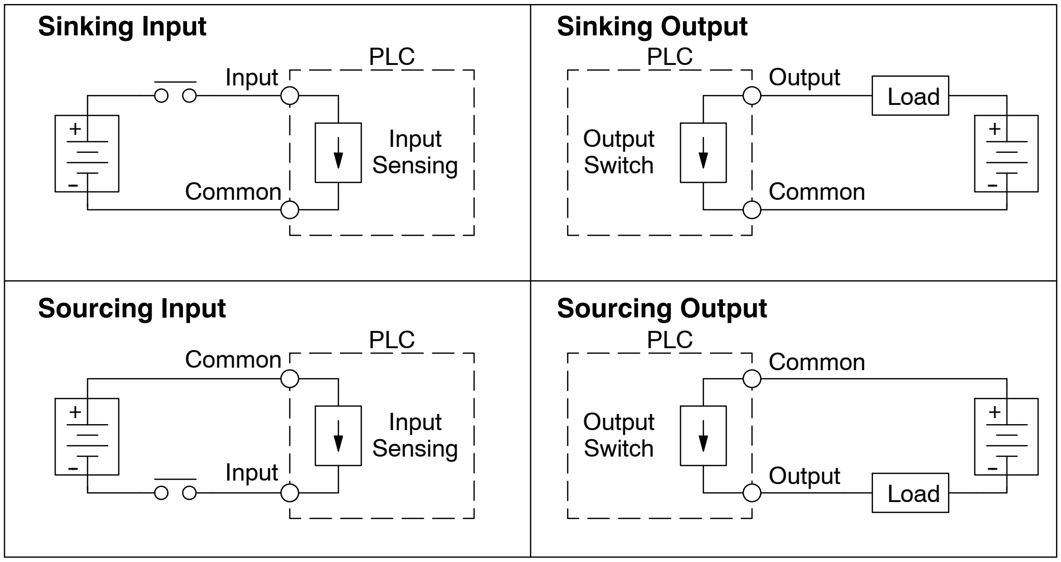
Sourcing = provides a path to supply **source (+)**

First you will notice these are only associated with DC circuits and not AC, because of the reference to (+) and (–) polarities. Therefore, *sinking and sourcing terminology only applies to DC input and output circuits.* Input and output points that are sinking or sourcing *only* can conduct current in only one direction. This means it is possible to connect the external supply and field device to the I/O point with current trying to flow in the wrong direction, and the circuit will not operate. However, you can successfully connect the supply and field device every time by understanding "sourcing" and "sinking".

For example, the figure to the right depicts a "sinking" input. To properly connect the external supply, you will have to connect it so the input *provides a path to ground (–)*. Start at the PLC input terminal, follow through the input sensing circuit, exit at the common terminal, and connect the supply (–) to the common terminal. By adding the switch, between the supply (+) and the input, the circuit has been completed . Current flows in the direction of the arrow when the switch is closed.

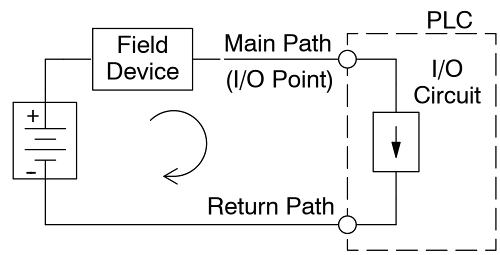


By applying the circuit principle above to the four possible combinations of input/output sinking/sourcing types as shown below. The I/O module specifications at the end of this chapter list the input or output type.

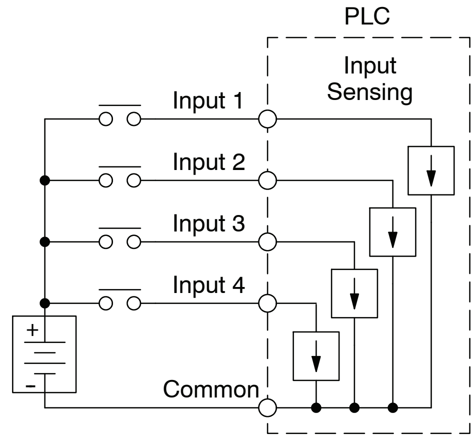


I/O "Common" Terminal Concepts

In order for a PLC I/O circuit to operate, current must enter at one terminal and exit at another. Therefore, at least two terminals are associated with every I/O point. In the figure to the right, 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 and budget for I/O terminals, every I/O point could have two dedicated terminals as the figure above shows. However, providing this level of flexibility is not practical or even necessary for most applications. Therefore, most Input or Output points on PLCs are in groups which share the return path (called *commons*). The figure to the right shows a group (or *bank*) of 4 input points which share a common return path. In this way, the four inputs require only five terminals instead of eight.



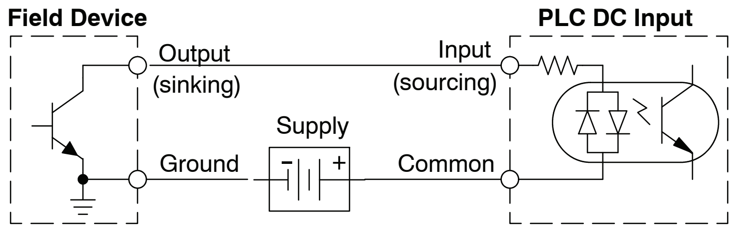
NOTE: In the circuit above, the current in the common path is 4 times any channel's input current when all inputs are energized. This is especially important in output circuits, where heavier gauge wire is sometimes necessary on commons.

Connecting DC I/O to "Solid State" Field Devices

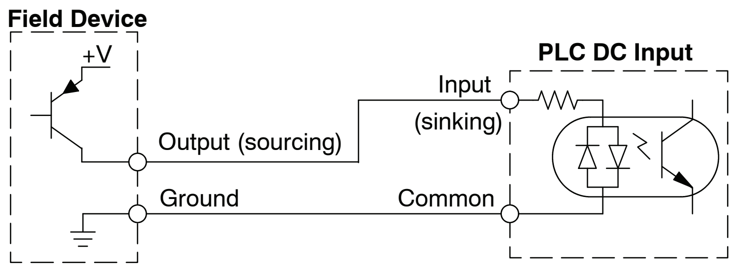
In the previous section on Sourcing and Sinking concepts, the DC I/O circuits were explained to sometimes will only allow current to flow one way. This is also true for many of the field devices which have solid-state (transistor) interfaces. In other words, field devices can also be sourcing or sinking. *When connecting two devices in a series DC circuit, one must be wired as sourcing and the other as sinking*.

Solid State Input Sensors

Several DL305 DC input modules are flexible because they detect current flow in either direction, so they can be wired as either sourcing or sinking. In the following circuit, a field device has an open-collector NPN transistor output. It sinks current from the PLC input point, which sources current. The power supply can be the +24 auxiliary supply or another supply (+12 VDC or +24VDC), as long as the input specifications are met.



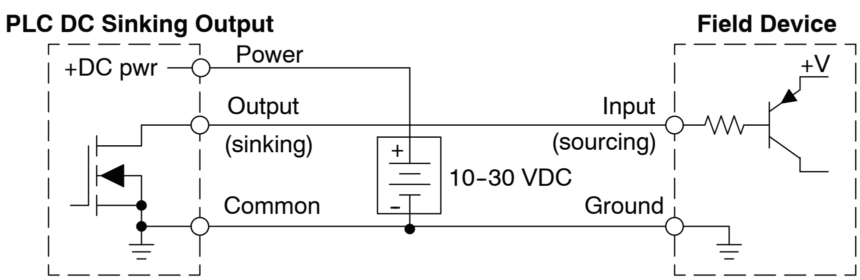
In the next circuit, a field device has an open-emitter PNP transistor output. It sources current to the PLC input point, which sinks the current back to ground. Since the field device is sourcing current, no additional power supply is required.



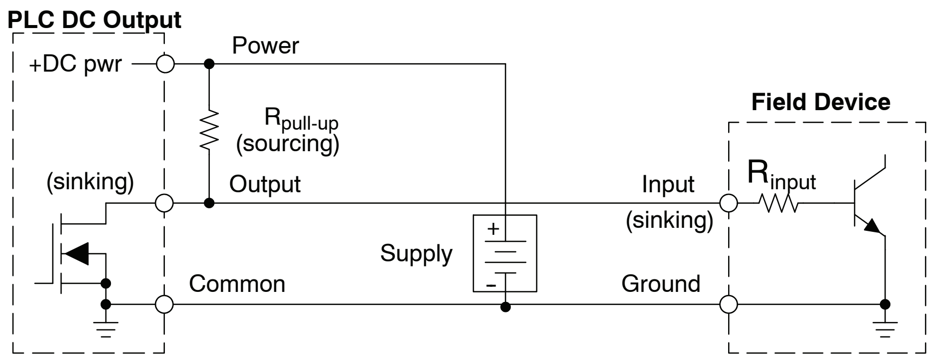
Solid State Output Loads

Sometimes an application requires connecting a PLC output point to a solid state input on a device. This type of connection is usually made to carry a low-level control signal, not to send DC power to an actuator.

Several of the DL305 DC output modules are the sinking type. This means that each DC output provides a path to ground when it is energized. In the following circuit, the PLC output point sinks current to the output common when energized. It is connected to a sourcing input of a field device input.



In the next example a PLC sinking DC output point is connected to the sinking input of a field device. This is tricky, because both the PLC output and field device input are sinking type. Since the circuit must have one sourcing and one sinking device, a sourcing capability needs to be added to the PLC output by using a pull-up resistor. In the circuit below, a $R_{pull\text{-}up}$ is connected from the output to the DC output circuit power input.



NOTE 1: DO NOT attempt to drive a heavy load (>25 mA) with this pull-up method
NOTE 2: 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 PLC output is OFF, from a ladder logic point-of-view. Your ladder program must comprehend this 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, you 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 15 mA). 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.

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

$$R_{pull\text{-}up} = \frac{V_{supply} - 0.7}{I_{input}} - R_{input} \qquad P_{pull\text{-}up} = \frac{V_{supply}^{\ 2}}{R_{pullup}}$$

Relay Output Guidelines

Four output modules in the DL305 I/O family feature relay outputs: D3-08TR, F3-08TRS-1, F3-08TRS-2, D3-16TR. 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)

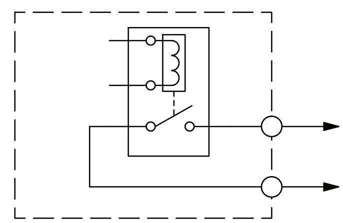
Some applications in which NOT to use relays:

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

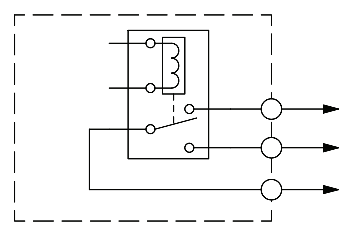
Relay outputs in the DL305 output modules are available in two contact arrangements, shown to the right. The Form A type, or SPST (single pole, single throw) type is normally open and is the simplest to use. The Form C type, or SPDT (single pole, double throw) type has a center contact which moves and a stationary contact on either side. This provides a normally closed contact and a normally open contact.

Some relay output module's relays 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 A contacts



Relay with Form C contacts



Surge Suppresion For Inductive Loads

Inductive load devices (devices with a coil) generate transient voltages when de-energized with a relay contact. When a relay contact is closed it "bounces", which energizes and de-energizes the coil until the "bouncing" stops. The transient voltages generated are much larger in amplitude than the supply voltage, especially with a DC supply voltage.

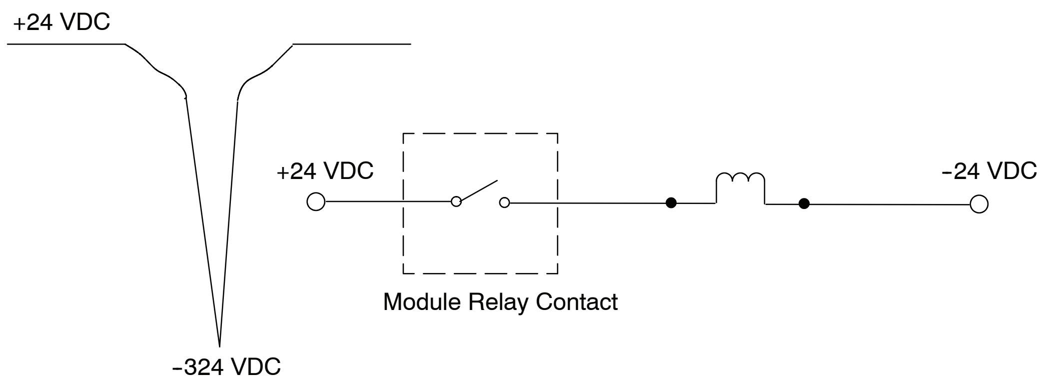
When switching a DC-supplied inductive load the full supply voltage is always present when the relay contact opens (or "bounces"). When switching an AC-supplied inductive load there is one chance in 60 (60 Hz) or 50 (50 Hz) that the relay contact will open (or "bounce") when the AC sine wave is zero crossing. If the voltage is not zero when the relay contact opens there is energy stored in the inductor that is released when the voltage to the inductor is suddenly removed. This release of energy is the cause of the transient voltages.

When inductive load devices (motors, motor starters, interposing relays, solenoids, valves, etc.) are controlled with relay contacts, it is recommended that a surge suppression device be connected directly across the coil of the field device. If the inductive device has plug-type connectors, the suppression device can be installed on the terminal block of the relay output.

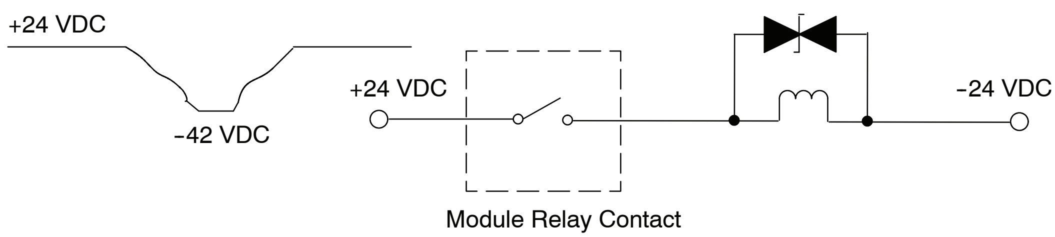
Transient Voltage Suppressors (TVS or transorb) provide the best surge and transient suppression of AC and DC powered coils, providing the fastest response with the smallest overshoot.

Metal Oxide Varistors (MOV) provide the next best surge and transient suppression of AC and DC powered coils.

For example, the waveform in the figure below shows the energy released when opening a contact switching a 24 VDC solenoid. Notice the large voltage spike.



This figure shows the same circuit with a transorb (TVS) across the coil. Notice that the voltage spike is significantly reduced.



Use the following table to help select a TVS or MOV suppressor for your application based on the inductive load voltage.

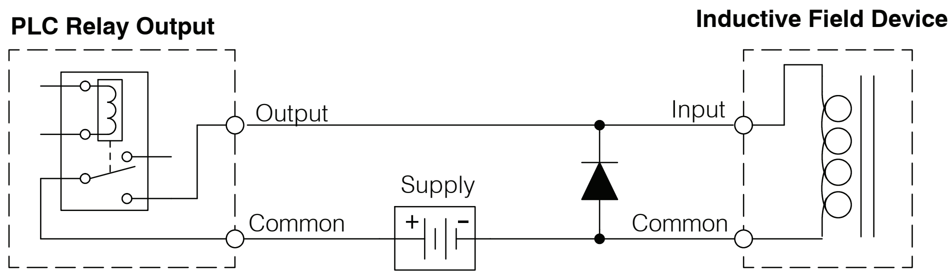
Vendor / Catalog	Type (TVS, MOV, Diode)	Inductive Load Voltage	Part Number
AutomationDirect Transient Voltage Suppressors, LiteOn Diodes; from DigiKey Catalog: Phone 1-800-344-4539	TVS TVS TVS Diode	110/120 VAC 24 VDC 220/240 VAC 12/24 VDC or VAC 12/24 VDC	ZL-TD8-120 ZL-TD8-24 P6K350CA Contact Digi-key Corp.
Digi-key www.didikey.com	MOV MOV	110/120 VAC 220/240 VAC	Contact Digi-key Corp.

Prolonging Relay Contact Life

Relay contacts wear according to the amount of relay switching, amount of spark created at the time of open or closure, and presence of airborne contaminants. There are some steps you can take to help prolong the life of relay contacts, such as switching the relay on or off only when it is necessary, and if possible, switching the load on or off at a time when it will draw the least current. Also, take measures to suppress inductive voltage spikes from inductive DC loads such as contactors and solenoids.

For inductive loads in DC circuits we recommend using a suppression diode as shown in the following diagram (DO NOT use this circuit with an AC power supply). When the load is energized the diode is reverse-biased (high impedance). When the load is turned off, energy stored in its coil is released in the form of a negative-going voltage spike. At this moment the diode is forward-biased (low impedance) and shunts the energy to ground. This protects the relay contacts from the high voltage arc that would occur just as the contacts are opening.

Place the diode as close to the inductive field device as possible. Use a diode with a peak inverse voltage rating (PIV) at least 100 PIV, 3A forward current or larger. Use a fast-recovery type (such as Schottky type). DO NOT use a small-signal diode such as 1N914, 1N941, etc. Be sure the diode is in the circuit correctly before operation. If installed backwards, it short-circuits the supply when the relay energizes.



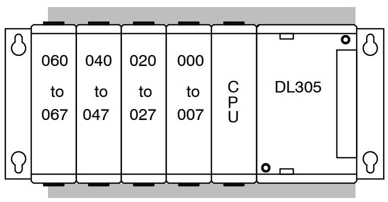
I/O Modules Position, Wiring, and Specification

Slot Numbering

The DL305 bases each provide different numbers of slots for use with the I/O modules. You may notice the bases refer to 5-slot, 8-slot, etc. One of the slots is dedicated to the CPU, so you always have one less I/O slot. For example, you have four I/O slots with a 5-slot base. The I/O slots are numbered 0 – 3. The CPU slot always contains a CPU and is not numbered.

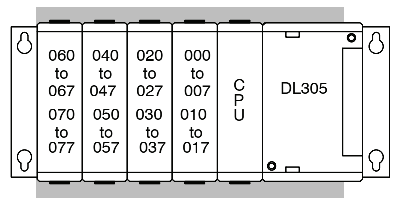
The examples below show the I/O numbering for a 5 slot local CPU base with 8 point I/O and a 5 slot local CPU base with 16 point I/O using the xxxxx-1 bases.

5 Slot Base Using 8 Point I/O Modules



Slot Number: 3—2—1—0

5 Slot Base Using 16 Point I/O Modules



Slot Number: 3—2—1—0

I/O Module Placement Rules

There are some limitations that determine where you can place certain types of modules. Some modules require certain locations and may limit the number or placement of other modules. If you have difficulty with some of the explanations, please look ahead to the illustrations in this chapter. They should clear up any gray areas in the explanation and you will probably find the configuration you intend to use in your installation.

In all of the configurations mentioned the number of slots from the CPU that are to be used can roll over into an expansion base if necessary. For example if a rule states a module must reside in one of the six slots adjacent to the CPU, and the system configuration is comprised of two 5 slot bases, slots 1 and 2 of the expansion base are valid locations.

The following table provides the general placement rules for the DL305 components.

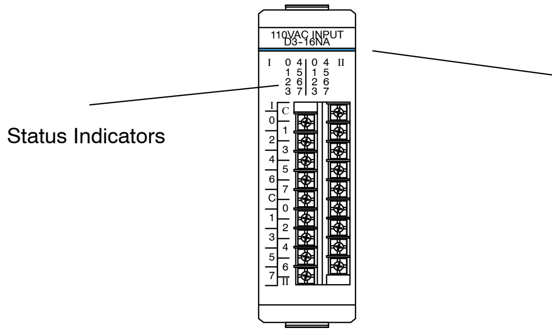
Module	Restriction
CPU	The CPU must reside in the first slot of the local CPU base. The first slot is the closest slot to the power supply.
16 Point I/O Modules	Any slot.
Analog Modules	Analog modules must reside in any valid 16 point I/O slot.
ASCII Basic Modules	ASCII Basic modules must reside in any valid 16 point I/O slot.
High Speed Counter	The D3-350 CPU does not support a high speed counter module.

Discrete Module Status Indicators

The discrete modules provide LED status indicators to show status of input points.

Color Coding of I/O Modules

The DL305 family of I/O modules have a color coding scheme to help you quickly identify if a module is either an input module, output module, or a specialty module. This is done through a color bar indicator located on the front of each module. The color scheme is listed below:



Module Type	Color Code
Discrete/Analog Output	Red
Discrete/Analog Input	Blue
Other	White

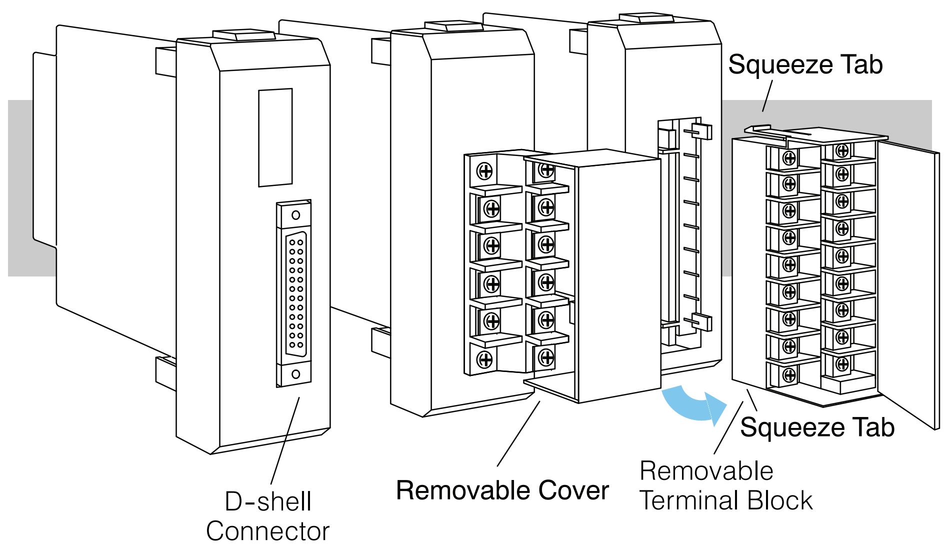
Wiring the Different Module Connectors

There are three types of module connectors for the DL305 I/O. Some modules have normal screw terminal connectors. Other modules have connectors with recessed screws. The recessed screws help minimize the risk of someone accidentally touching active wiring. The third type has a D-shell connector for special cable connections.

Both types of screw connectors can be easily removed. If you examine the connectors closely, you will notice there are squeeze tabs on the top and bottom. To remove the terminal block, press the squeeze tabs and pull the terminal block away from the module.

We also have DIN rail mounted terminal blocks, DINnectors (refer to our catalog for a complete listing of all available products). The DINnectors come with special pre-assembled cables with the I/O connectors installed and wired.

WARNING: For some modules, field device power may still be present on the terminal block even though the PLC system is turned off. To minimize the risk of electrical shock, check all field device power *before* you remove the connector.



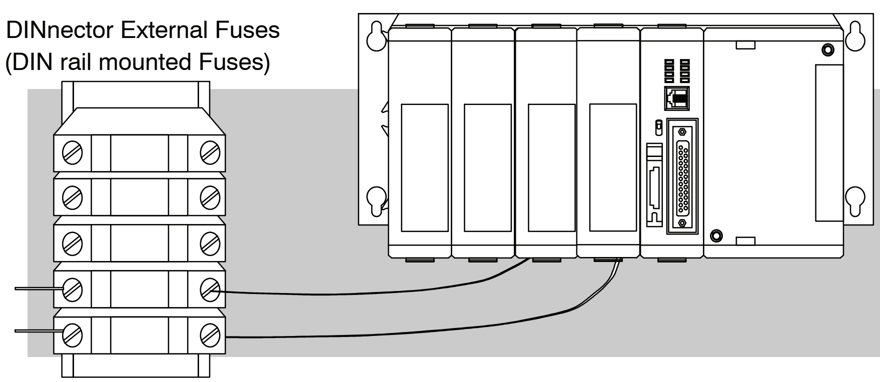
I/O Wiring Checklist

Use the following guidelines when wiring the I/O modules in your system.

1. There is a limit to the size of wire the modules can accept. The table below lists the maximum AWG for each module type. Smaller AWG is acceptable to use for each of the modules.

Module type	Maximum AWG
8 point	12 AWG
16 point	16 AWG

2. Always use a continuous length of wire, do not combine wires to attain a needed length.
3. Use the shortest possible wire length.
4. Use wire trays for routing where possible.
5. Avoid running wires near high energy wiring.
6. Avoid running input wiring close to output wiring where possible.
7. To minimize voltage drops when wires must run a long distance , 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 the wires.
10. To reduce the risk of having a module with a blown fuse, we suggest you add external fuses to your I/O wiring. A fast blow fuse, with a lower current rating than the I/O module fuse can be added 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 our catalog for a complete line of DINnectors, DIN rail mounted fuse blocks.



NOTE: For modules which have soldered or non-replaceable fuses, we recommend you return your module to us and let us replace your blown fuse(s) since disassembling the module will void your warranty.

Glossary of Specification Terms

Inputs or Outputs Per Module	Indicates number of input or output points per module and designates current sinking, current sourcing, or either.
Commons Per Module	Number of commons per module and their electrical characteristics.
Input Voltage Range	The operating voltage range of the input circuit.
Output Voltage Range	The operating voltage range of the output circuit.
Peak Voltage	Maximum voltage allowed for the input circuit.
AC Frequency	AC modules are designed to operate within a specific frequency range.
ON Voltage Level	The voltage level at which the input point will turn ON.
OFF Voltage Level	The voltage level at which the input point will turn OFF.
Input Impedance	Input impedance can be used to calculate input current for a particular operating voltage.
Input Current	Typical operating current for an active (ON) input.
Minimum ON Current	The minimum current for the input circuit to operate reliably in the ON state.
Maximum OFF Current	The maximum current for the input circuit to operate reliably in the OFF state.
Minimum Load	The minimum load current for the output circuit to operate properly.
External DC Required	Some output modules require external power for the output circuitry.
ON Voltage Drop	Sometimes called “saturation voltage”, it is the voltage measured from an output point to its common terminal when the output is ON at max. load.
Maximum Leakage Current	The maximum current a connected maximum load will receive when the output point is OFF.
Maximum Inrush Current	The maximum current used by a load for a short duration upon an OFF to ON transition of a output point. It is greater than the normal ON state current and is characteristic of inductive loads in AC circuits.
Base Power Required	Power from the base power supply is used by the DL305 input modules and varies between different modules. The guidelines for using module power is explained in the power budget configuration section in Chapter 4–5.

OFF to ON Response The time the module requires to process an OFF to ON state transition.

ON to OFF Response The time the module requires to process an ON to OFF state transition.

Terminal Type Indicates whether the terminal type is a removable or non-removable connector or a terminal.

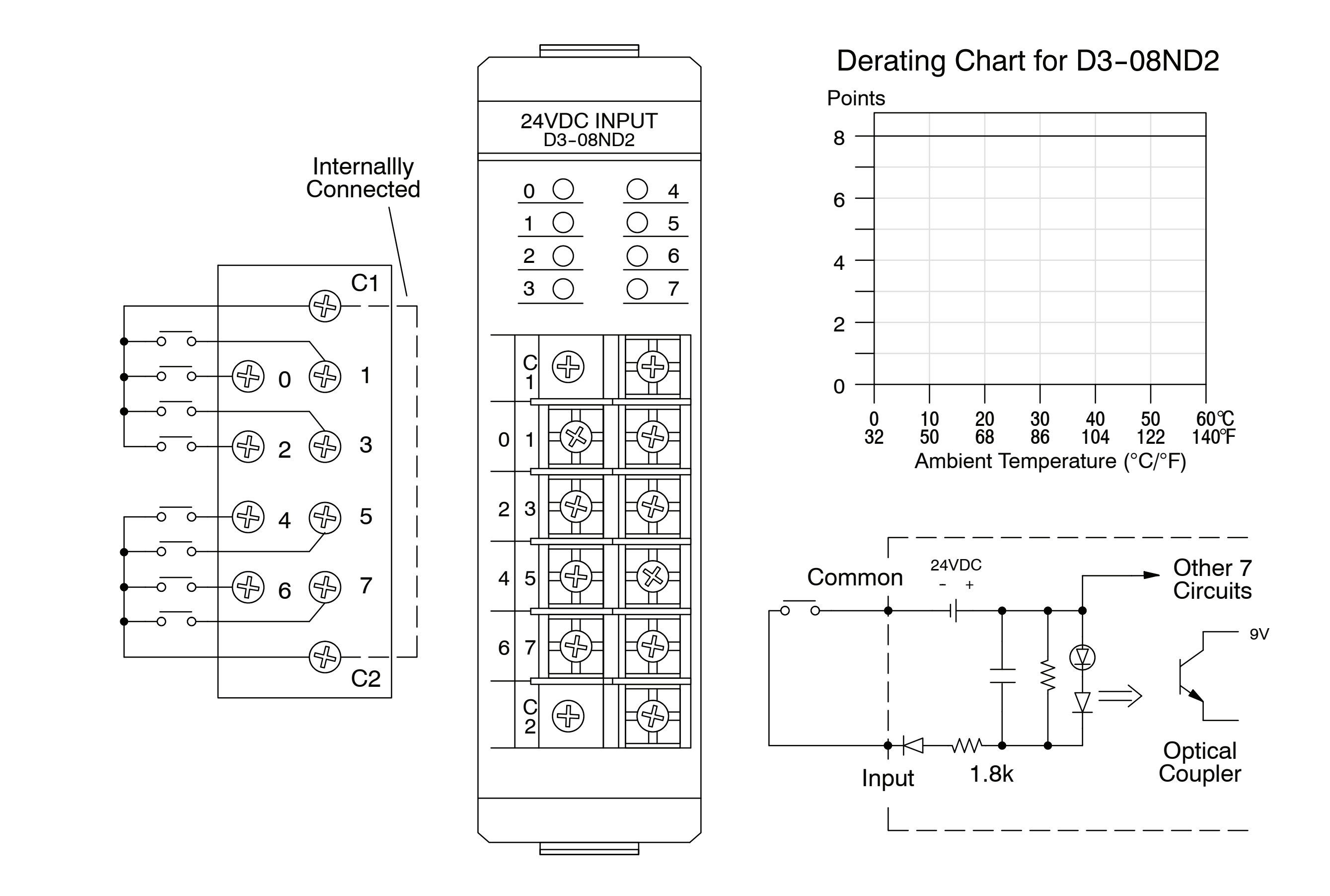
Status Indicators The LEDs that indicate the ON/OFF status of an input point. These LEDs are electrically located on either the logic side or the field device side of the input circuit.

Weight Indicates the weight of the module. See Appendix E for a list of the weights for the various DL305 components.

Fuses Protective device for an output circuit, which stops current flow when current exceeds the fuse rating. They may be replaceable or non-replaceable, or located externally or internally.

D3-08ND2, 24 VDC Input Module

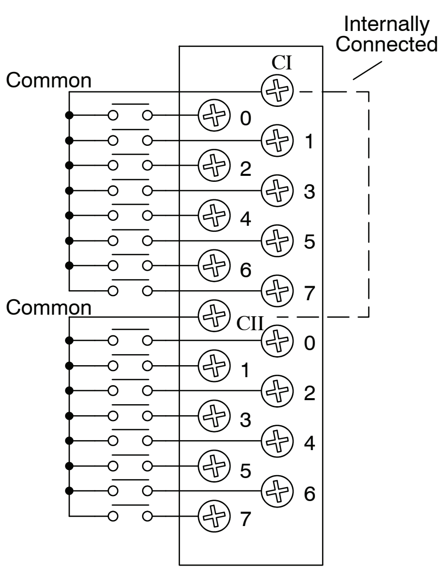
Inputs per module	8 (current sourcing)	Base power required	9V 10 mA Max 24V 14mA/ON pt. (112 mA Max)
Commons per module	2 (internally connected)		
Input voltage range	18-36VDC		
Input voltage	Internally supplied	OFF to ON response	4-15 ms
Peak voltage	40 VDC	ON to OFF response	4-15 ms
AC frequency	N/A	Terminal type	Non-removable
ON voltage level	< 3 V	Status indicators	Field side
OFF voltage level	>18 V	Weight	4.2 oz. (120 g)
Input impedance	1.8 K ohm		
Input current	12 mA Max		
Minimum ON current	7 mA		
Maximum OFF current	3 mA		

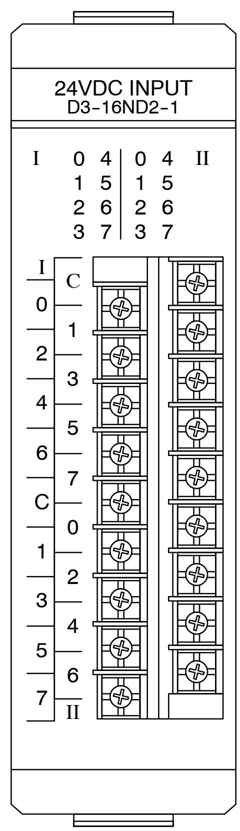


Installation, Wiring and Specifications

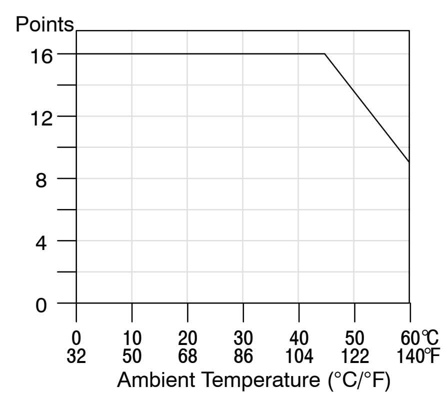
D3-16ND2-1, 24 VDC Input Module

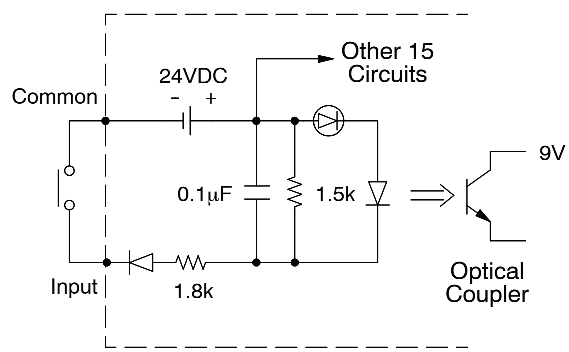
Inputs per module	16 (current sourcing)	Base power required	9V 25 mA Max 24V 14mA/ON pt. (224 mA Max)
Commons per module	2 (internally connected)		
Input voltage range	18-36VDC		
Input voltage	Internally supplied	OFF to ON response	3-15 ms
Peak voltage	36VDC	ON to OFF response	4-15 ms
AC frequency	N/A	Terminal type	Removable
ON voltage level	< 3V	Status indicators	Field side
OFF voltage level	>19 V	Weight	6.3 oz. (180 g)
Input impedance	1.8 K ohm		
Input current	20 mA Max		
Minimum ON current	5 mA		
Maximum OFF current	1 mA		





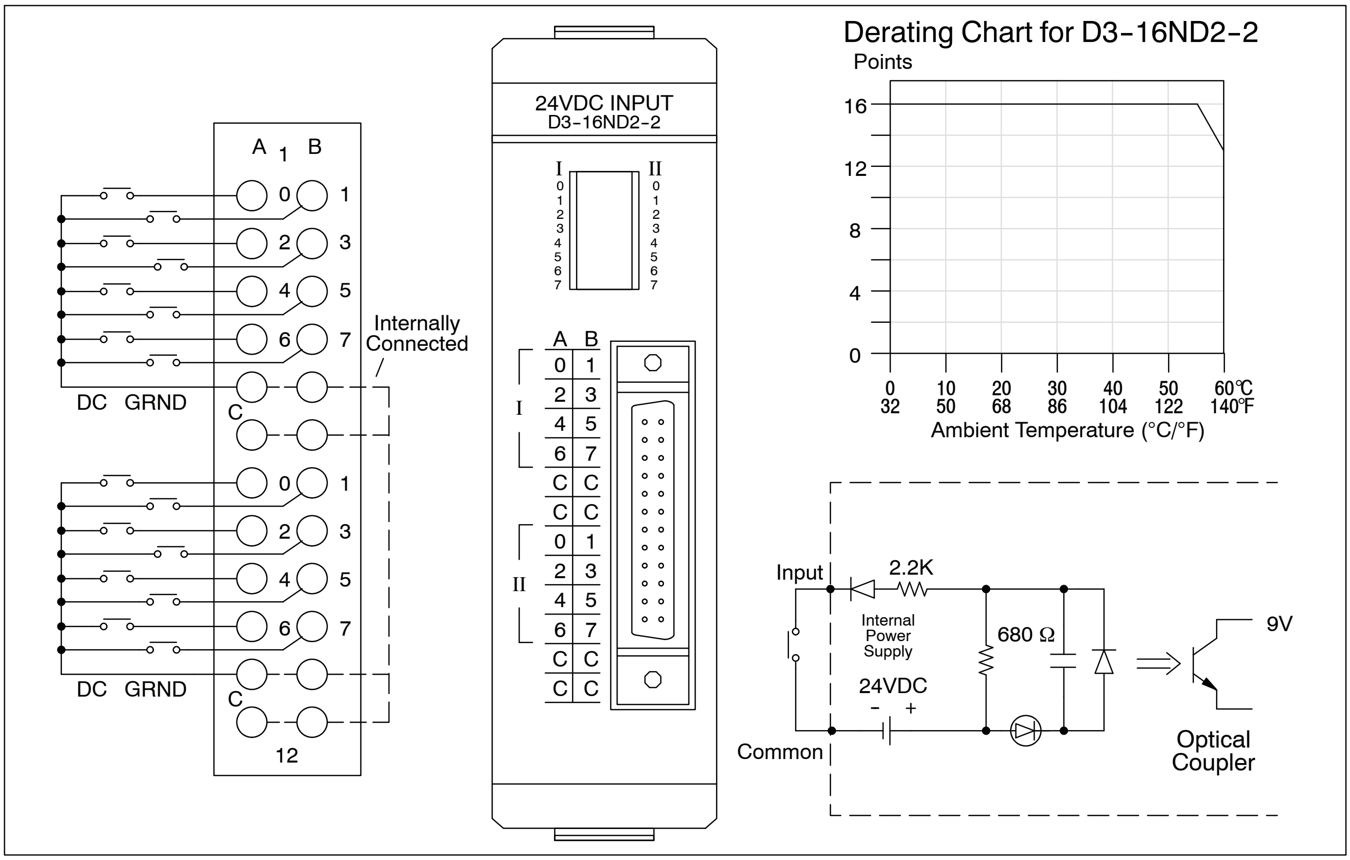
Derating Chart for D3-16ND2-1





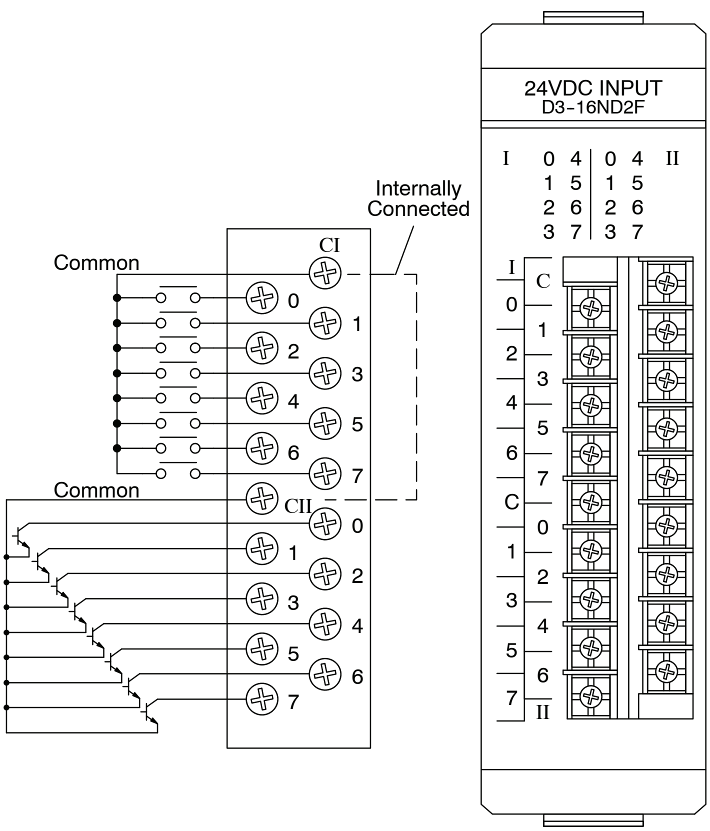
D3–16ND2–2, 24 VDC Input Module Module

Inputs per module	16 (current sourcing)	Base power required	9V 3mA+1.3mA/ON pt (24 mA Max) 24V 1mA+13mA/ON pt (209 mA Max)
Commons per module	8 internally connected		
Input voltage range	18–36 VDC		
Input voltage	Internally supplied		
Peak voltage	36 VDC	OFF to ON response	4–15 ms
AC frequency	N/A	ON to OFF response	4–15 ms
ON voltage level	< 3 V	Terminal type	24 Pin Removable connector
OFF voltage level	> 19 V		
Input impedance	2.2 K ohm	Status indicators	Field side
Input current	20 mA Max	Weight	5.3 oz. (150 g)
Minimum ON current	5 mA		
Maximum OFF current	2 mA		

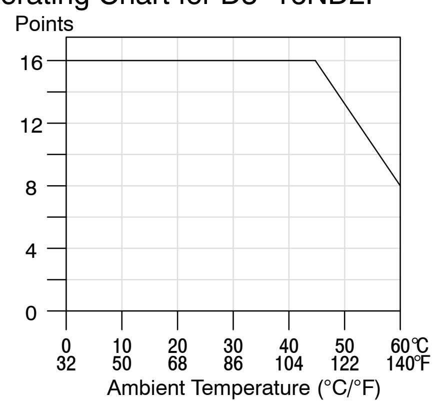


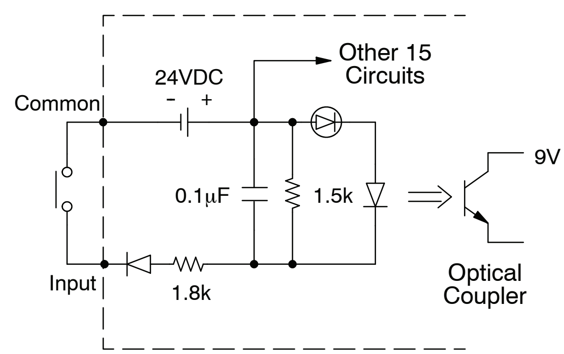
D3-16ND2F, 24 VDC Fast Response Input Module

Inputs per module	16 (current sourcing)	Base power required	9V 25 mA Max 24V 14 mA/ON pt. (224 mA Max)
Commons per module	2 (internally connected)		
Input voltage range	18-36VDC		
Input voltage	Internally supplied	OFF to ON response	0.8 ms
Peak voltage	36VDC	ON to OFF response	0.8 ms
AC frequency	N/A	Terminal type	Removable
ON voltage level	< 13V	Status indicators	Field side
OFF voltage level	>19 V	Weight	6.3 oz. (180 g)
Input impedance	1.8 K ohm		
Input current	20 mA Max		
Minimum ON current	5 mA		
Maximum OFF current	1 mA		



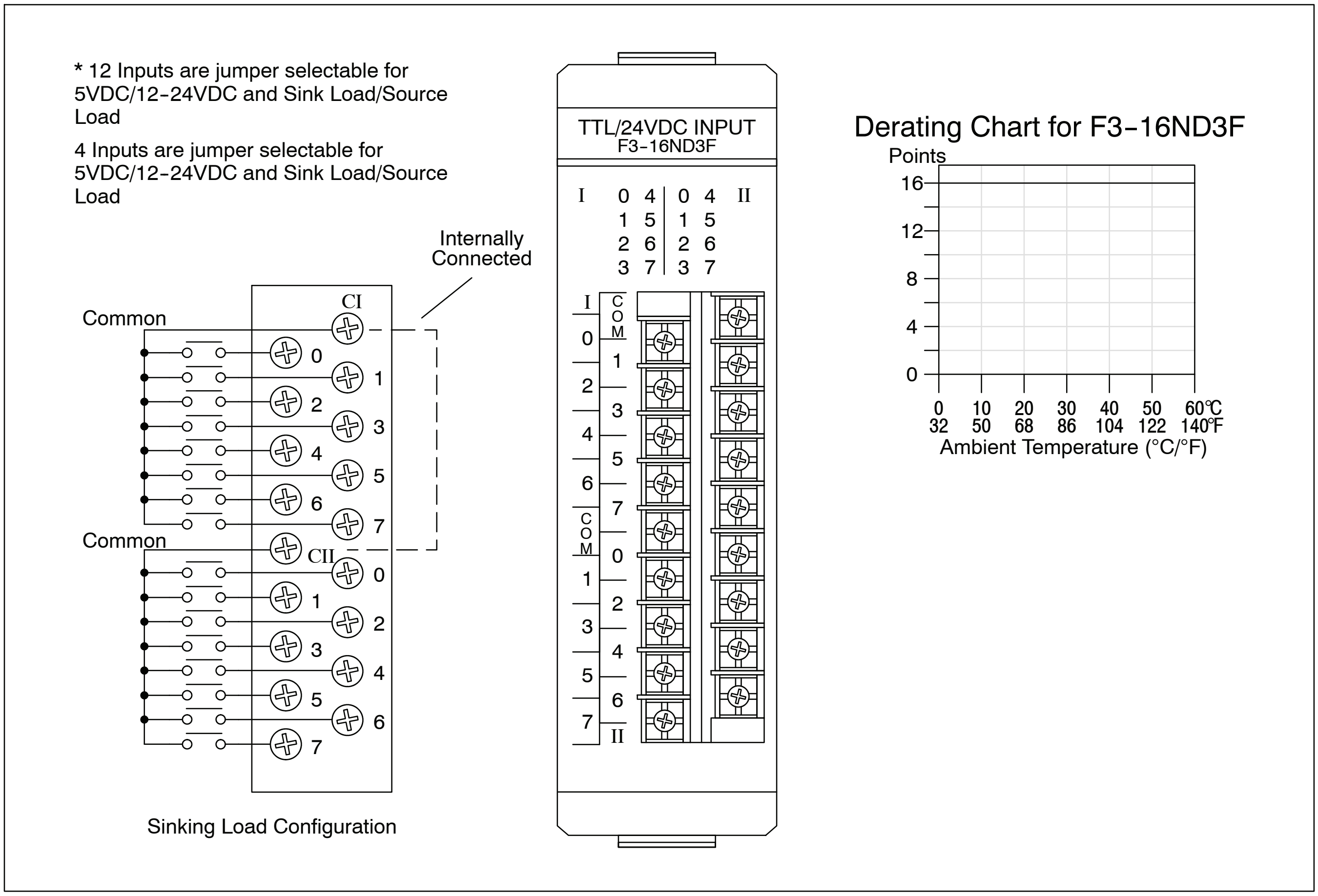
Derating Chart for D3-16ND2F

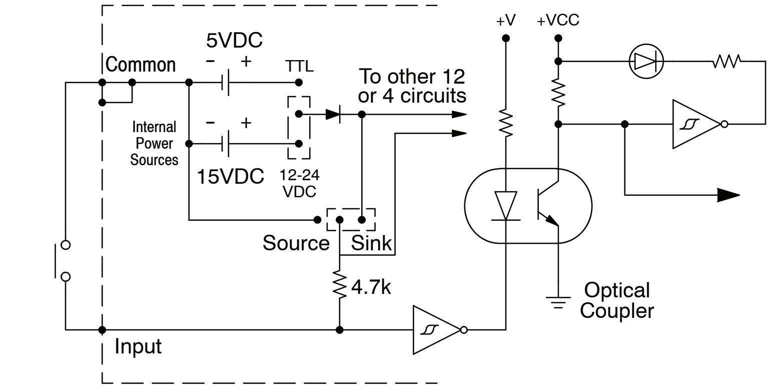




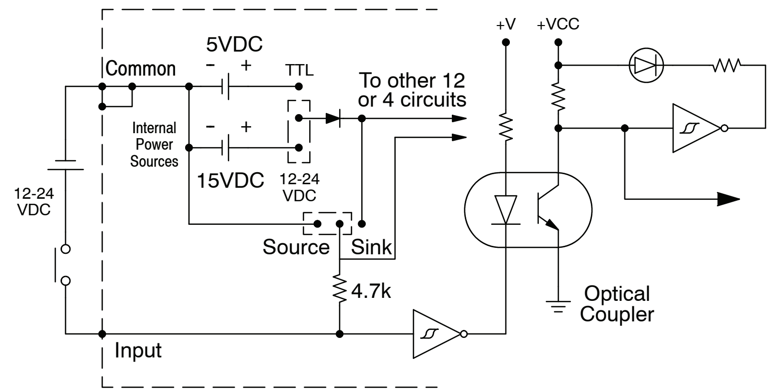
F3-16ND3F, TTL/24 VDC Fast Response Input Module

Inputs per module	16 sink/source (jumper selectable sink/ source)*	Base power required	9V 148 mA Max 24V 68 mA Max
		Input current	1 mA @ 5VDC 3 mA @ 12-24 DC
Commons per module	2 (non-isolated)	Input impedance	4.7K
Input voltage range	5 VDC TTL & CMOS, 12-24 VDC (jumper selectable)*	OFF to ON response	1 ms
		ON to OFF response	1 ms
Input voltage supplied	Internal (used with sinking loads) External (used with sourcing loads)	Maximum input rate	500 Hz
		Minimum ON current	0.4 mA @ 5VDC 0.9 mA @ 12-24VDC
Peak voltage	100 VDC (35 VDC Continuous)	Maximum OFF current	0.8 mA @ 5VDC 2.2 mA @ 12-24VDC
AC frequency	N/A	Terminal type	Removable
ON voltage level	0-1.5VDC @ 5VDC 0-4VDC @ 12-24VDC	Status indicators	Logic side
OFF voltage level	3.5-5VDC @ 5VDC 10-24VDC @12-24VDC	Weight	5.4 oz. (153 g)





Jumper selected for 12-24VDC, sinking load configuration



Jumper selected for sourcing load configuration. An external power supply must be used in this configuration.

The DC power to sense the state of the inputs when jumpers are installed for sinking type signals is provided by the rack power supply. Sinking type inputs are turned ON by switching the input circuit to common. Source type input signals assume the ON state until the input device provides the voltage to turn the input OFF.

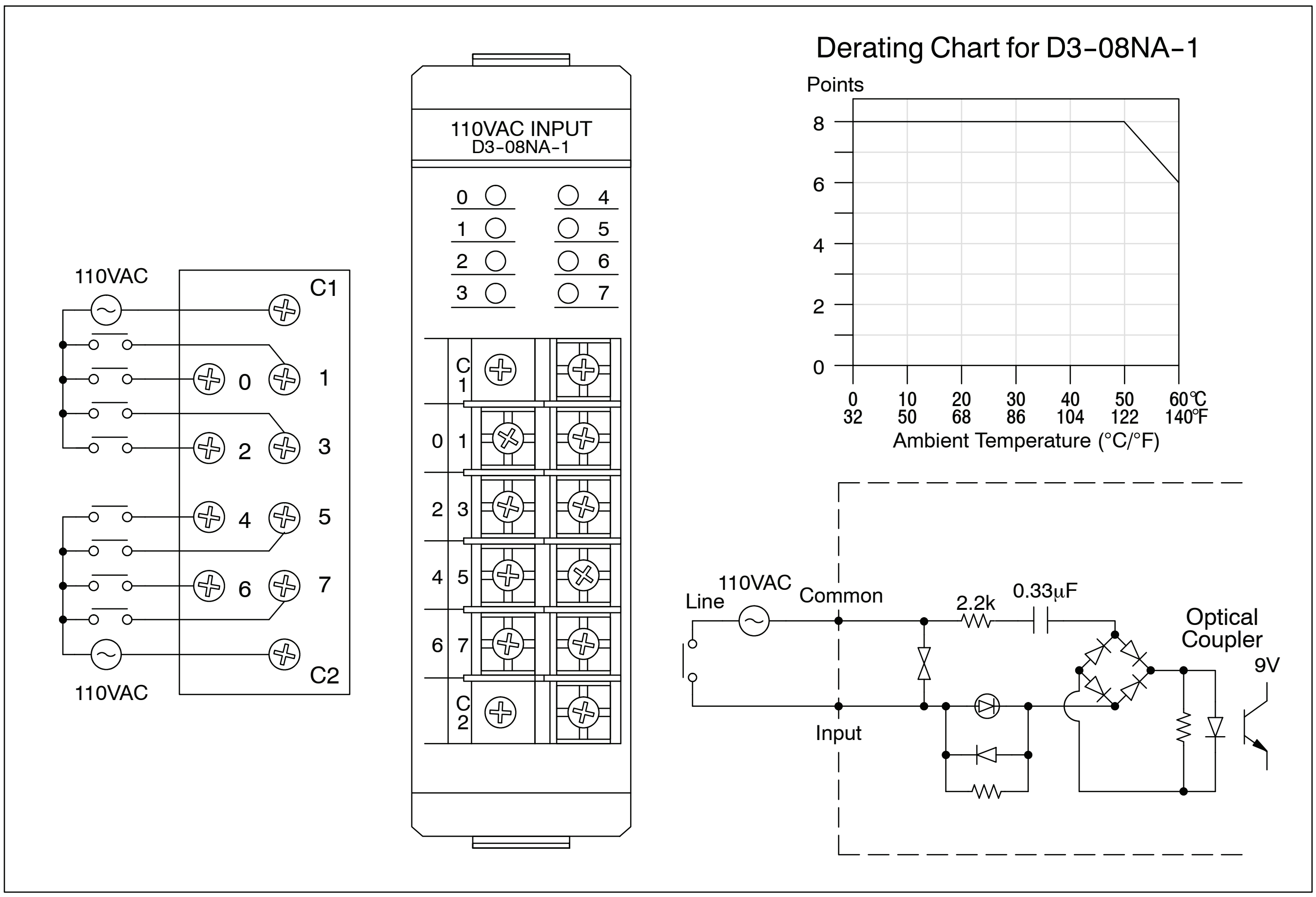
Selection of Operating Mode

The mode of operation, either 5VDC or 12-24VDC sink or source, for each group of circuits is determined by the position of jumper plugs on pins located on the edge of the circuit board. There are four sets of pins (3 pins in each set), with two sets for each group of inputs. The first two sets of pins are used to configure the first 12 inputs (eg. 0 to 7 and 100 to 103) and are labeled 12 CIRCUITS. Above the first set of pins are the labels 12/24V and 5V. Above the second set of pins are the labels SINK and SRC (source). To select an operating mode for the first 12 circuits, place a jumper on the two pins nearest the appropriate labels. For example, to select 24VDC Sink input operation for the first 12 inputs, place a jumper on the two pins labeled 12/24V and on the two pins labeled SINK. The last two sets of pins are used to configure the last 4 inputs (eg. 104 to 107) and are labeled 4 CIRCUITS. The operating mode selected for the last group of 4 inputs can be different than the mode chosen for the first group of 12 inputs. Correct module operation requires each set of three pins have a jumper installed (four jumpers total).

NOTE: When a group of inputs are used with TTL logic, select the SINK operating mode for that group. “Standard” TTL can sink several milliamps but can source less than 1 mA.

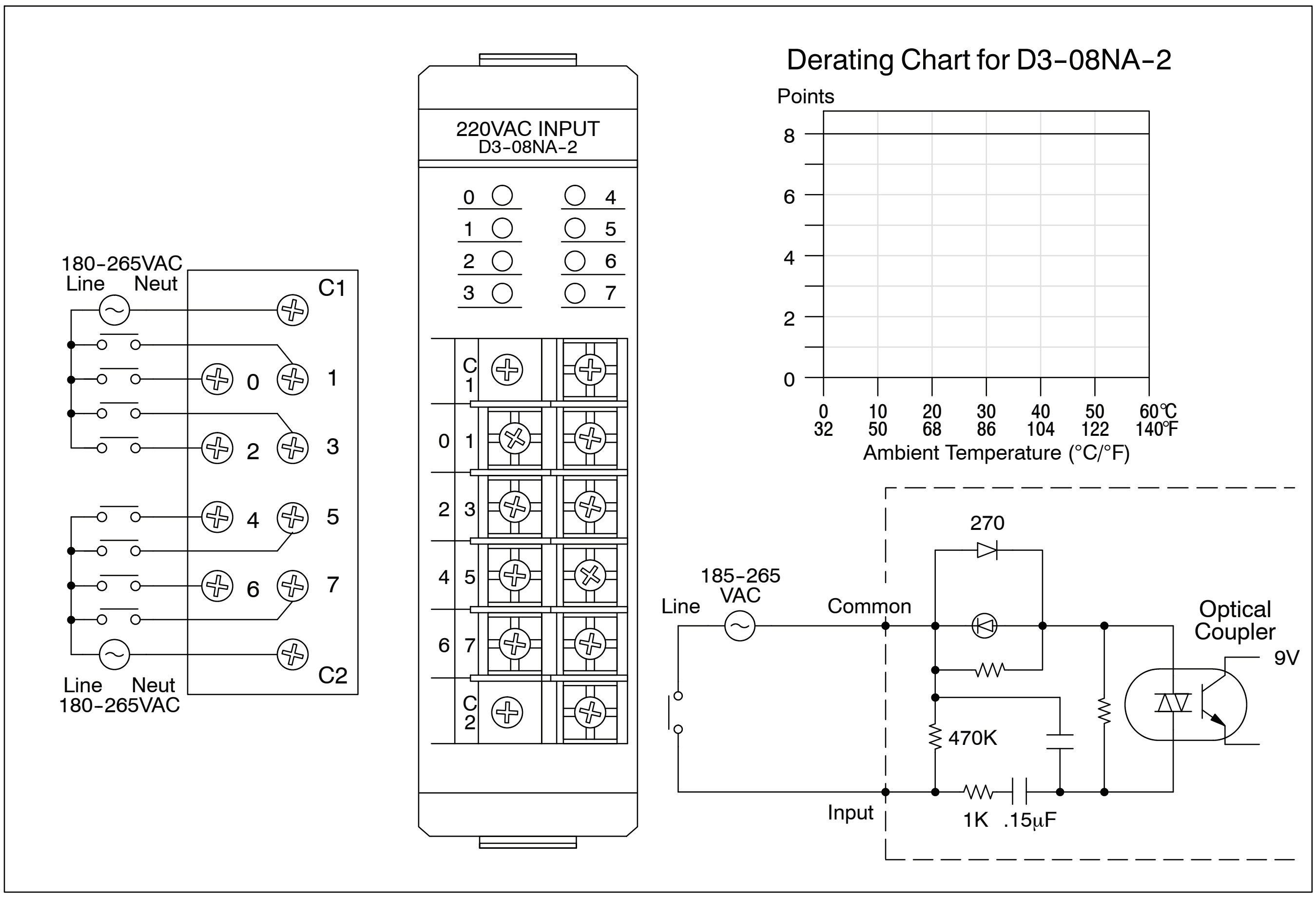
D3-08NA-1, 110 VAC Input Module

Inputs per module	8	Minimum ON current	8 mA
Commons per module	2 (isolated)	Maximum OFF current	2 mA
Input voltage range	85-132VAC	Base power required	9V 10 mA Max 24V N/A
Input voltage supply	External		
Peak voltage	132VAC	OFF to ON response	10-30 ms
AC frequency	47-63 Hz	ON to OFF response	10-60 ms
ON voltage level	>80 VAC	Terminal type	Non-removable
OFF voltage level	<20 VAC	Status indicators	Field side
Input impedance	10 K ohm	Weight	5 oz. (140 g)
Input current	15 mA @ 50 Hz 18 mA @ 60 Hz		



D3-08NA-2, 220 VAC Input Module

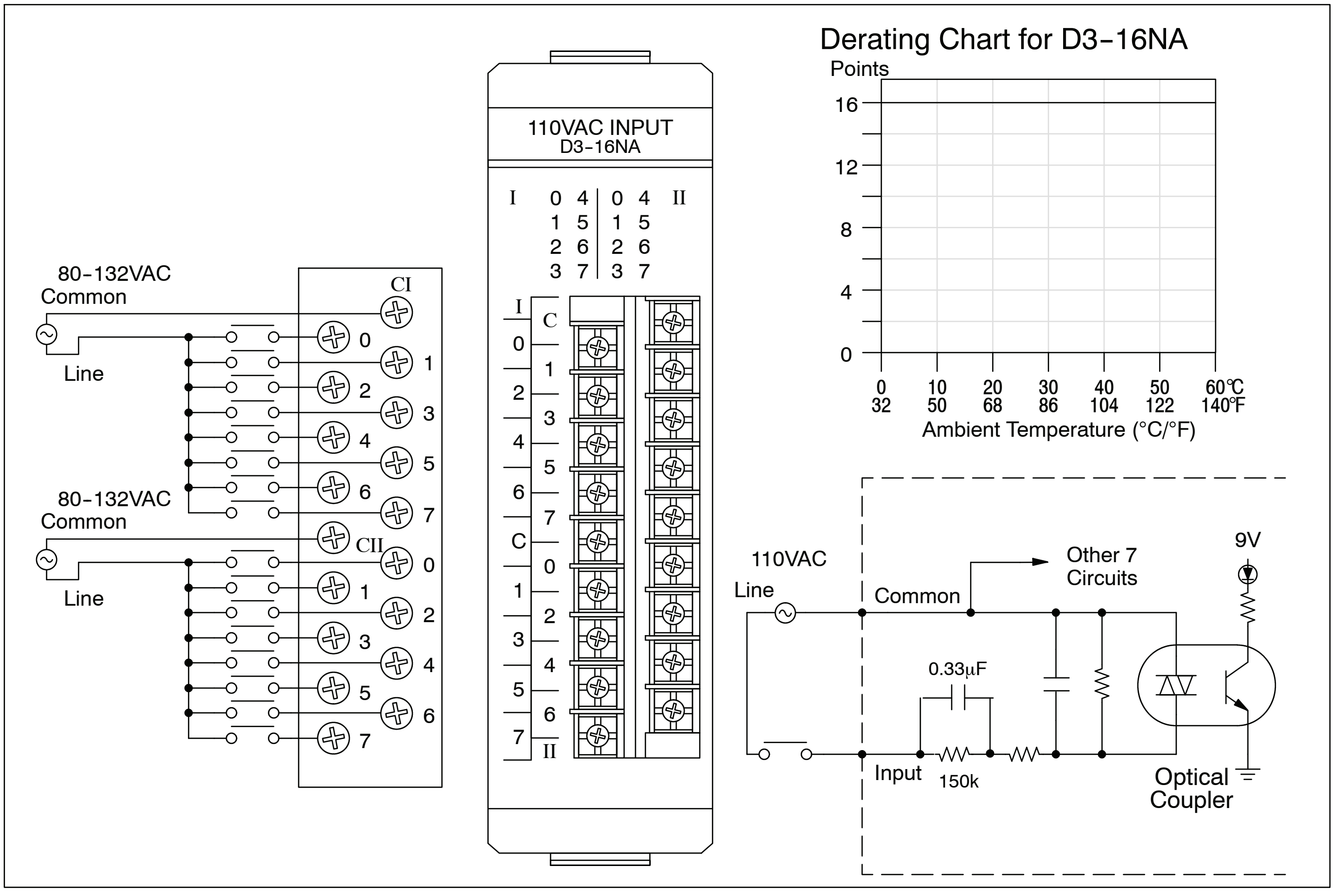
Inputs per module	8	Minimum ON current	10 mA
Commons per module	2 (isolated)	Maximum OFF current	2 mA
Input voltage range	180-265VAC	Base power required	9V 10 mA max 24V N/A
Input voltage supply	External		
Peak voltage	265 VAC	OFF to ON response	5-50 ms
AC frequency	50-60Hz	ON to OFF response	5-60 ms
ON voltage level	>180 VAC	Terminal type	Non-removable
OFF voltage level	< 40 VAC	Status indicators	Field side
Input impedance	18 K ohm	Weight	5 oz. (140 g)
Input current	13 mA @ 50 Hz 18 mA @ 60 Hz		



D3–16NA, 110 VAC Input Module

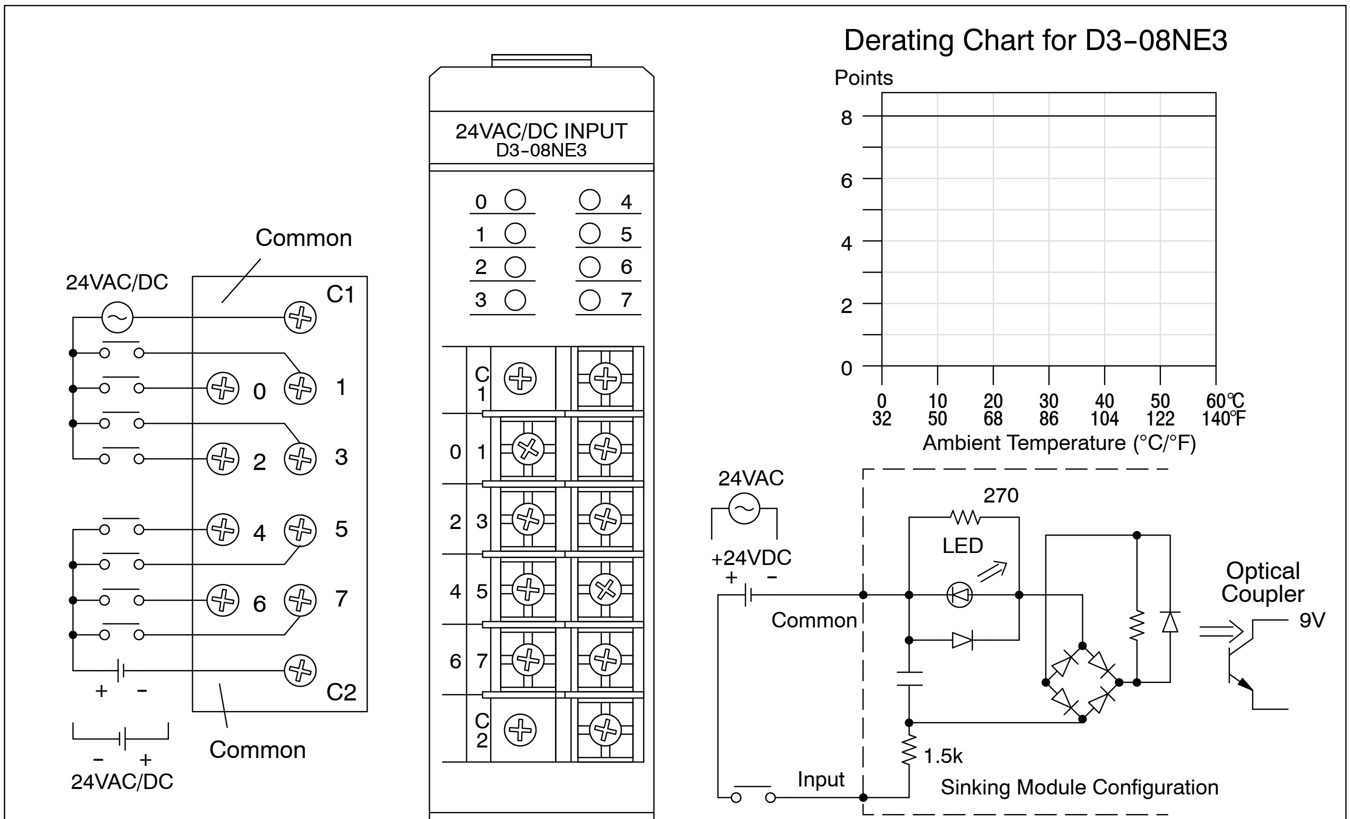
Inputs per module	16	Minimum ON current	8 mA
Commons per module	2 (isolated)	Maximum OFF current	1.5 mA
Input voltage range	80–132VAC	Base power required*	9V 6.25 mA Max/ON pt. 100mA max
Input voltage supply	External		
Peak voltage	132VAC	OFF to ON response	5–50 ms
AC frequency	50–60 Hz	ON to OFF response	5–60 ms
ON voltage level	>80 VAC	Terminal type	Removable
OFF voltage level	<15 VAC	Status indicators	Logic side
Input impedance	8 K ohm	Weight	6.4 oz. (180 g)
Input current	16 mA @ 50 Hz 25 mA @ 60 Hz		

* 9V typical values are 4 mA/ON pt., 64 mA total



D3-08NE3, 24 VAC/DC Input Module

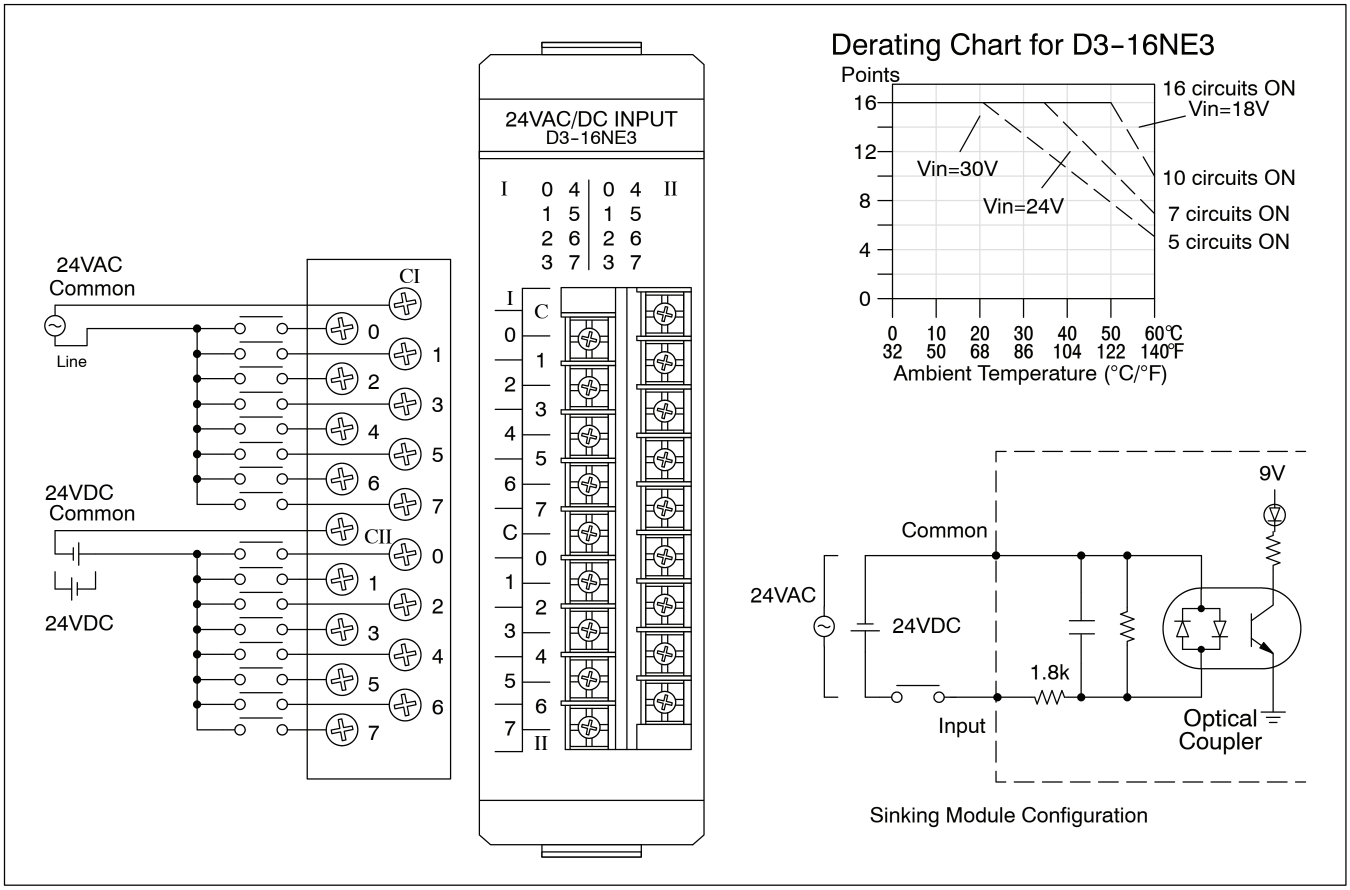
Inputs per module	8 (sink/source)	Base power required	9V 10 mA max 24V N/A
Commons per module	2 (isolated)		
Input voltage range	20-28 VAC/VDC	OFF to ON response	AC: 5-50 ms DC: 6-30 ms
Input voltage	External		
Peak voltage	28 VAC/VDC	ON to OFF response	AC/DC: 5-60 ms
AC frequency	47-63 Hz	Terminal type	Non-removable
ON voltage level	>20 V	Status indicators	Field side
OFF voltage level	<6V	Weight	4.2 oz. (120 g)
Input impedance	1.5 K ohm		
Input current	19 mA Max		
Minimum ON current	10 mA		
Maximum OFF current	2 mA		



NOTE: This module can be wired in a sourcing configuration and it will be operational except there will be no module LED indication for each input.

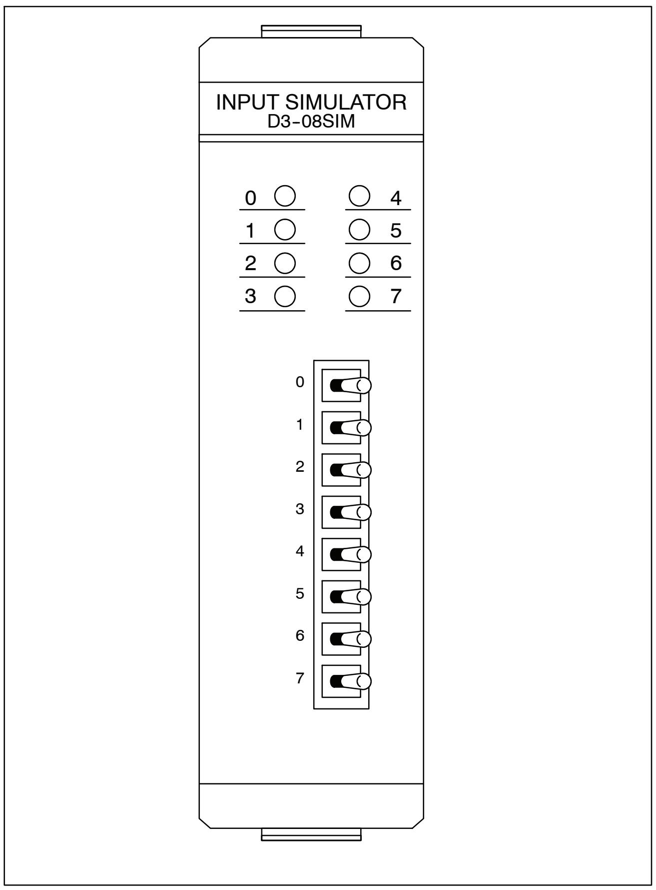
D3-16NE3, 24 VAC/DC Input Module

Inputs per module	16 (sink/source)	Base power required	9V 2.5 mA.+4.5mA/ ON pt.(130 mA max) 24V N/A
Commons per module	2 (isolated)		
Input voltage range	14-30VAC/VDC		
Input voltage supplied	External	OFF to ON response	AC 5-30 ms DC 5-25 ms
Peak voltage	30 VAC/VDC		
AC frequency	47-63 Hz	ON to OFF response	AC 5-30 ms DC 5-25 ms
ON voltage level	>14 V		
OFF voltage level	<3 V	Terminal type	Removable
Input impedance	1.8 K ohm	Status indicators	Logic side
Input current	16 mA Max	Weight	6 oz. (170 g)
Minimum ON current	7 mA		
Maximum OFF current	2 mA		



D3-08SIM, Input Simulator

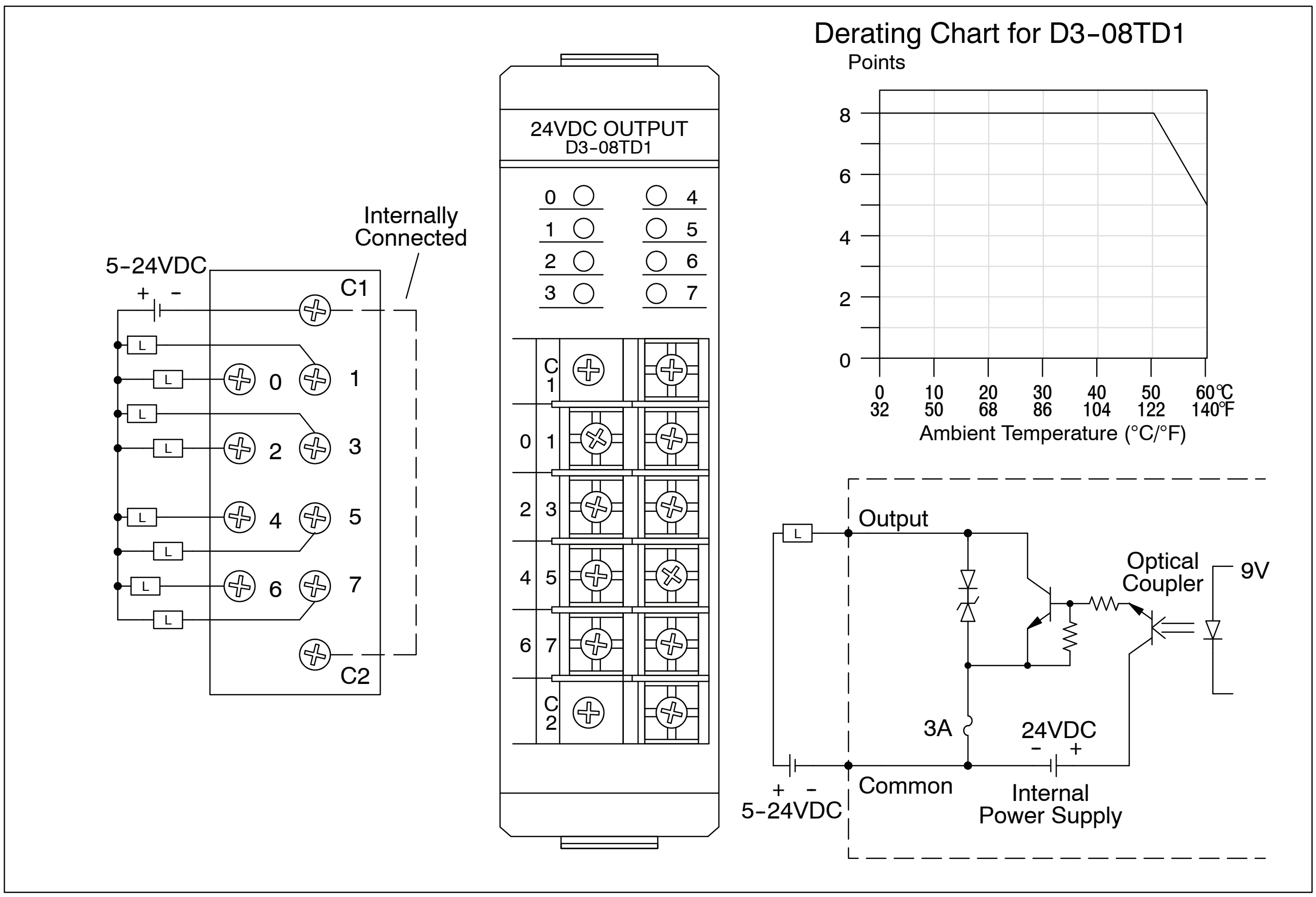
Inputs per module	8
Base Power required	10mA @ 9VDC 112mA max @ 24VDC
OFF to ON response	4-15 ms
ON to OFF response	4-15 ms
Terminal type	None
Status indicators	Switch side
Weight	3.0 oz. (85 g)



D3-08TD1, 24 VDC Output Module

Outputs per module	8 (current sinking)
Commons per module	2(internally connected)
Operating voltage	5-24VDC
Output type	NPN (open collector)
Peak voltage	45VDC
AC frequency	N/A
ON voltage drop	0.8V @ 0.5A
Max current	0.5A / point 1.8 / common
Max leakage current	0.1 mA @ 40VDC
Max inrush current	3A / 20ms 1A / 100ms

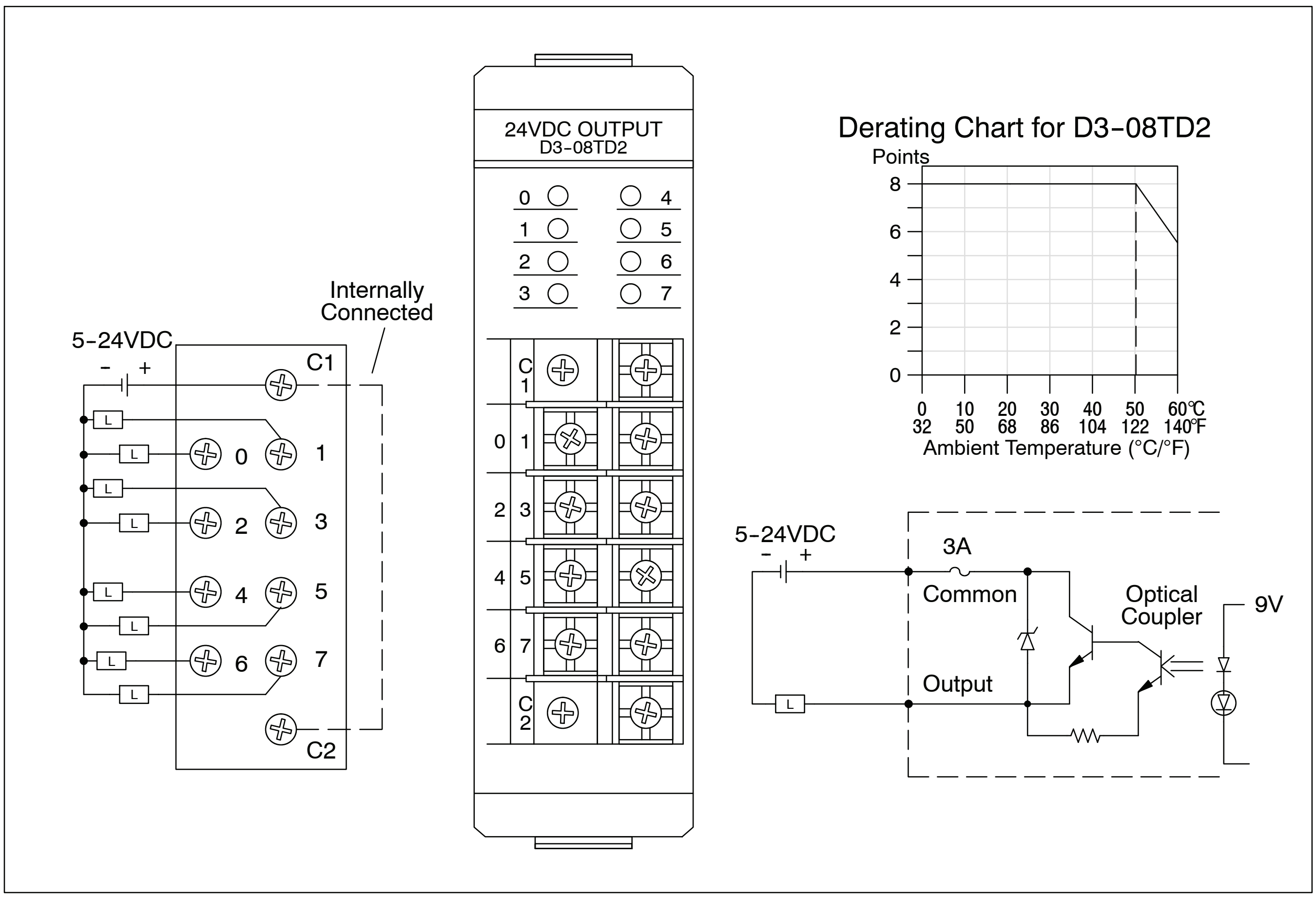
Minimum load	1 mA
Base power required	9V 20 mA Max 24V 3mA/pt. (24mA Max)
OFF to ON response	0.1 ms
ON to OFF response	0.1 ms
Terminal type	Non-removable
Status indicators	Logic Side
Weight	4.2 oz. (120 g)
Fuses	(2) One 3A per common Non-replaceable



D3-08TD2, 24 VDC Output Module

Outputs per module	8 (current sourcing)
Commons per module	2 (internally connected)
Operating voltage	5-24VDC
Output type	NPN Transistor (emitter follower)
Peak voltage	40VDC
AC frequency	N/A
ON voltage drop	1V @ 0.5A
Max current	0.5A / point 1.8A/ common
Max leakage current	0.1 mA @ 24VDC
Max inrush current	3A / 20ms 1A / 100ms

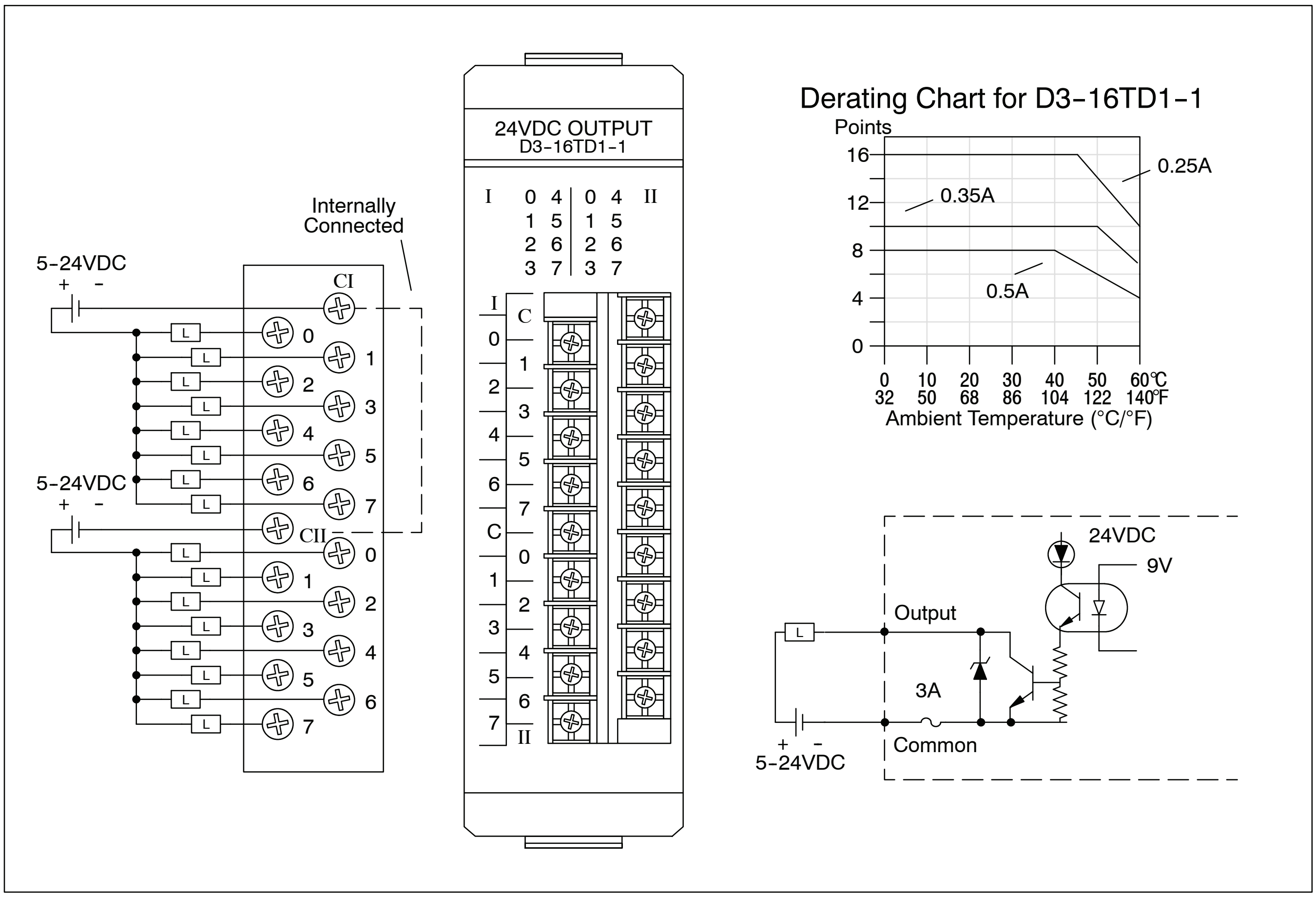
Minimum load	1 mA
Base power required	9V 30 mA Max 24V N/A
OFF to ON response	0.1 ms
ON to OFF response	0.1 ms
Terminal type	Non-removable
Status indicators	Logic Side
Weight	4.2 oz. (120 g)
Fuses	(2) One 3A per common Non-replaceable



D3–16TD1–1, 24 VDC Output Module

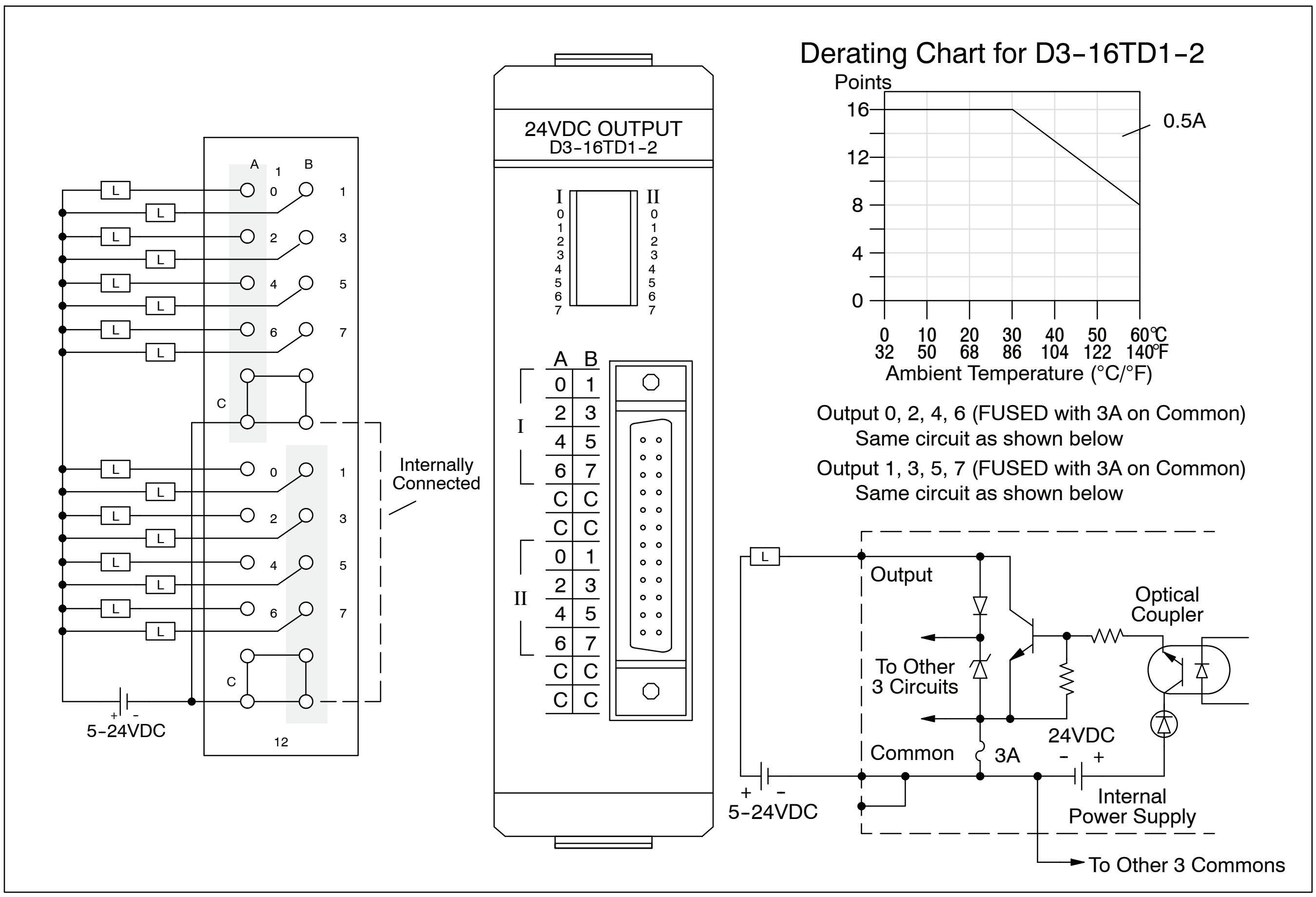
Outputs per module	16 (current sinking)
Commons per module	2 (internally connected)
Operating voltage	5–24VDC
Output type	NPN transistor (open collector)
Peak voltage	45VDC
AC frequency	N/A
ON voltage drop	2V @ 0.5A
Max current	0.5A/ point 2A/ common
Max leakage current	0.1mA @ 40VDC
Max inrush current	3A / 20 ms 1A / 100 ms

Minimum load	1 mA
Base power required	9V (40 mA Max) 3mA+2.3mA/ON pt. 24V 6 mA/ON pt. (96 mA Max)
OFF to ON response	0.1 ms
ON to OFF response	0.1 ms
Terminal type	Removable
Status indicators	Logic Side
Weight	5.6 oz. (160 g)
Fuses	(2) One 3A per common Non-replaceable



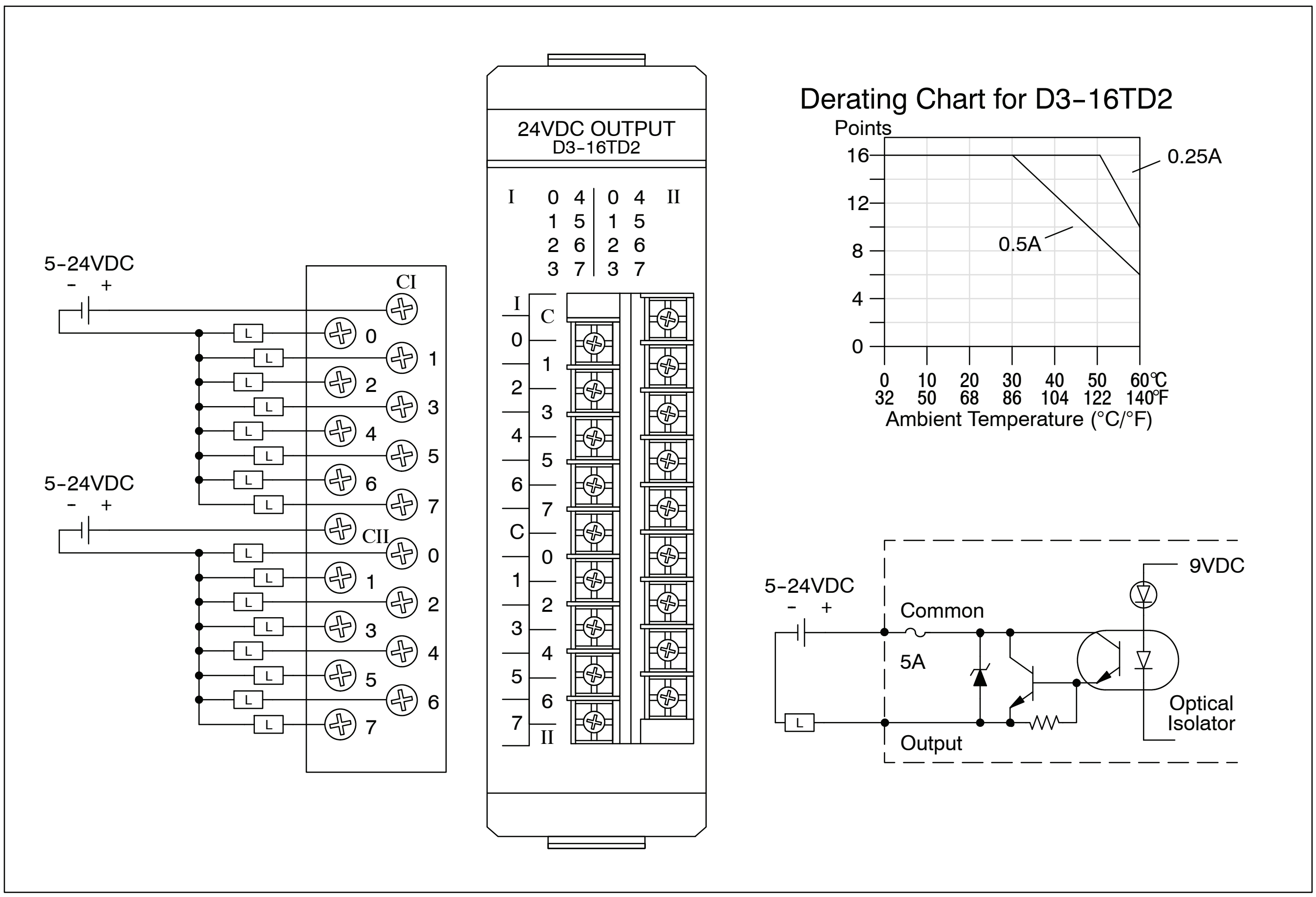
D3–16TD1–2, 24 VDC Output Module

Outputs per module	16 (current sinking)	Minimum load	1 mA
Commons per module	4 (internally connected)	Base power required	9V (40mA Max) 3mA+2.3mA/ON pt. 24V 6mA/ON pt. (96mA Max)
Operating voltage	5–24VDC	OFF to ON response	0.1 ms
Output type	NPN transistor (open collector)	ON to OFF response	0.1 ms
Peak voltage	45VDC	Terminal type	Removable connector
AC frequency	N/A	Status indicators	Logic Side
ON voltage drop	2.0V @ 0.5A	Weight	5.6 oz. (160 g)
Max current	0.5A / point 1.8A common	Fuses	(4) One 3A per common Non–replaceable
Max leakage current	0.3 mA @ 40VDC		
Max inrush current	3A / 20ms 1A / 100ms		



D3-16TD2, 24 VDC Output Module

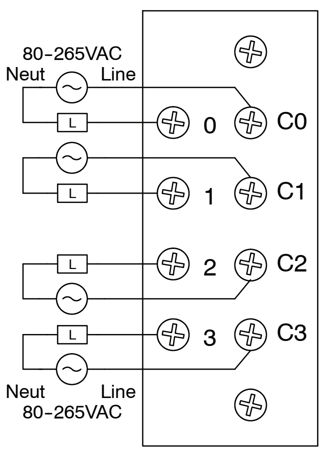
Outputs per module	16 (current sourcing)	Minimum load	1 mA
Commons per module	2 (isolated)	Base power required	9V 7.5 mA/ON pt. (180 mA Max) 24V N/A
Operating voltage	5-24VDC		
Output type	NPN transistor (emitter follower)	OFF to ON response	0.1 ms
Peak voltage	40VDC	ON to OFF response	1 ms
AC frequency	N/A	Terminal type	Removable
ON voltage drop	1.5V @ 0.5A	Status indicators	Logic Side
Max current	0.5A / point 3A common	Weight	7.1 oz. (210 g)
Max leakage current	0.01 mA @ 40VDC	Fuses	(2) One 5A per common Non-replaceable
Max inrush current	3A / 20ms 1A / 100ms		

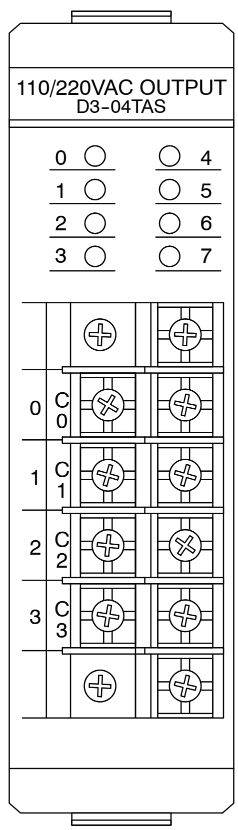


D3-04TAS, 110-220 VAC Output Module

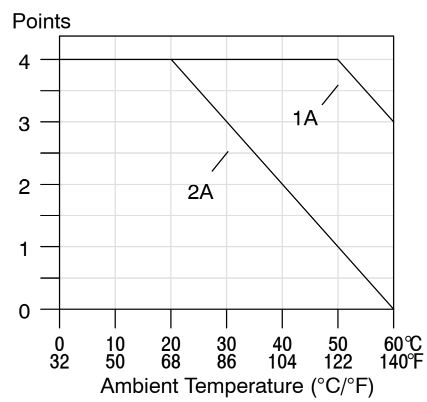
Outputs per module	4
Commons per module	4 (isolated)
Operating voltage	80-265VAC
Output type	Triac
Peak voltage	265 VAC
AC frequency	47-63 Hz
ON voltage drop	1.5 VAC @ 2A
Max current	2A / point 2A / common
Max leakage current	7 mA @ 220VAC 3.5 mA @ 110VAC
Max inrush current	20A for 16 ms 10A for 100 ms

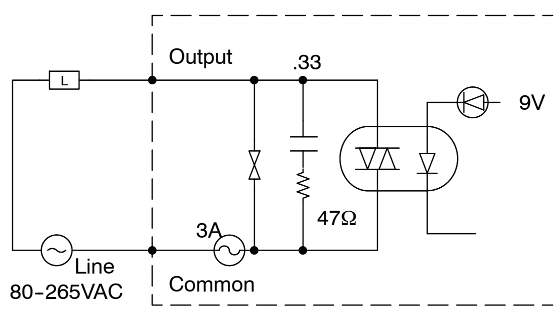
Minimum load	10 mA
Base power required	9V 12 mA Max 24V N/A
OFF to ON response	1 ms Max
ON to OFF response	10 ms Max
Terminal type	Non-removable
Status indicators	Logic Side
Weight	6.4 oz. (180 g)
Fuses	(4) One 3A per common User replaceable





Derating Chart for D3-04TAS



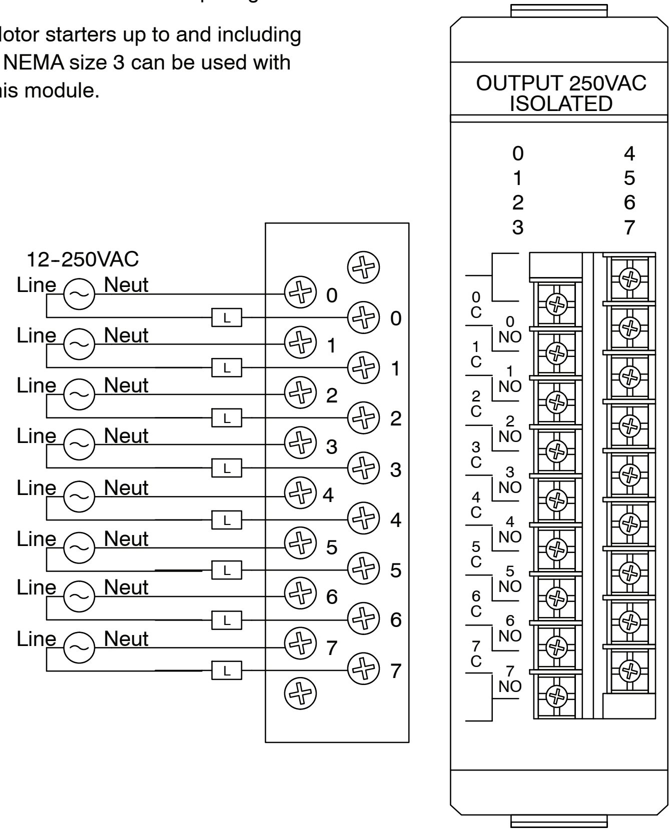


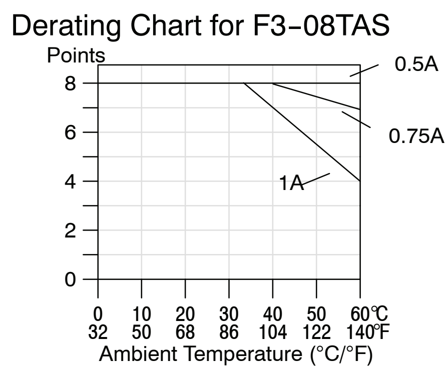
F3-08TAS, 250 VAC Isolated Output Module

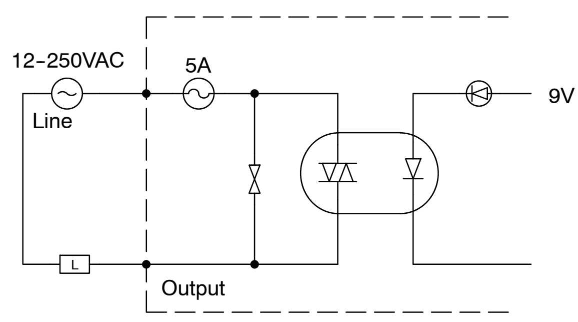
Outputs per module	8 (500V point-to-point isolation)	Base power required	9V 10mA / ON pt. 80mA Max. 24V N/A
Commons per module	8 (isolated)		
Operating voltage	12-125 VAC 125-250 VAC requires external fuses	OFF to ON response	8 ms Max
		ON to OFF response	8 ms Max
Output type	SSR Array (TRIAC)	Terminal type	Removable
Peak voltage	400 VAC	Status indicators	Logic Side
AC frequency	47 - 440 Hz	Weight	6.3 oz. (178g)
ON voltage drop	1 VAC @ 1A	Fuses BK/PCE-5 Bussman (One spare fuse included)	(8) fast blow One 5A (125V fast blow) per each circuit User replaceable
Max current	1A / point		
Max leakage current	10 µA @ 240 VAC		
Max inrush current*	20A for 16 ms 3A for 100 ms		
Minimum load	0.5 mA		

*Fuse blows at 30 Amp surge

Motor starters up to and including a NEMA size 3 can be used with this module.



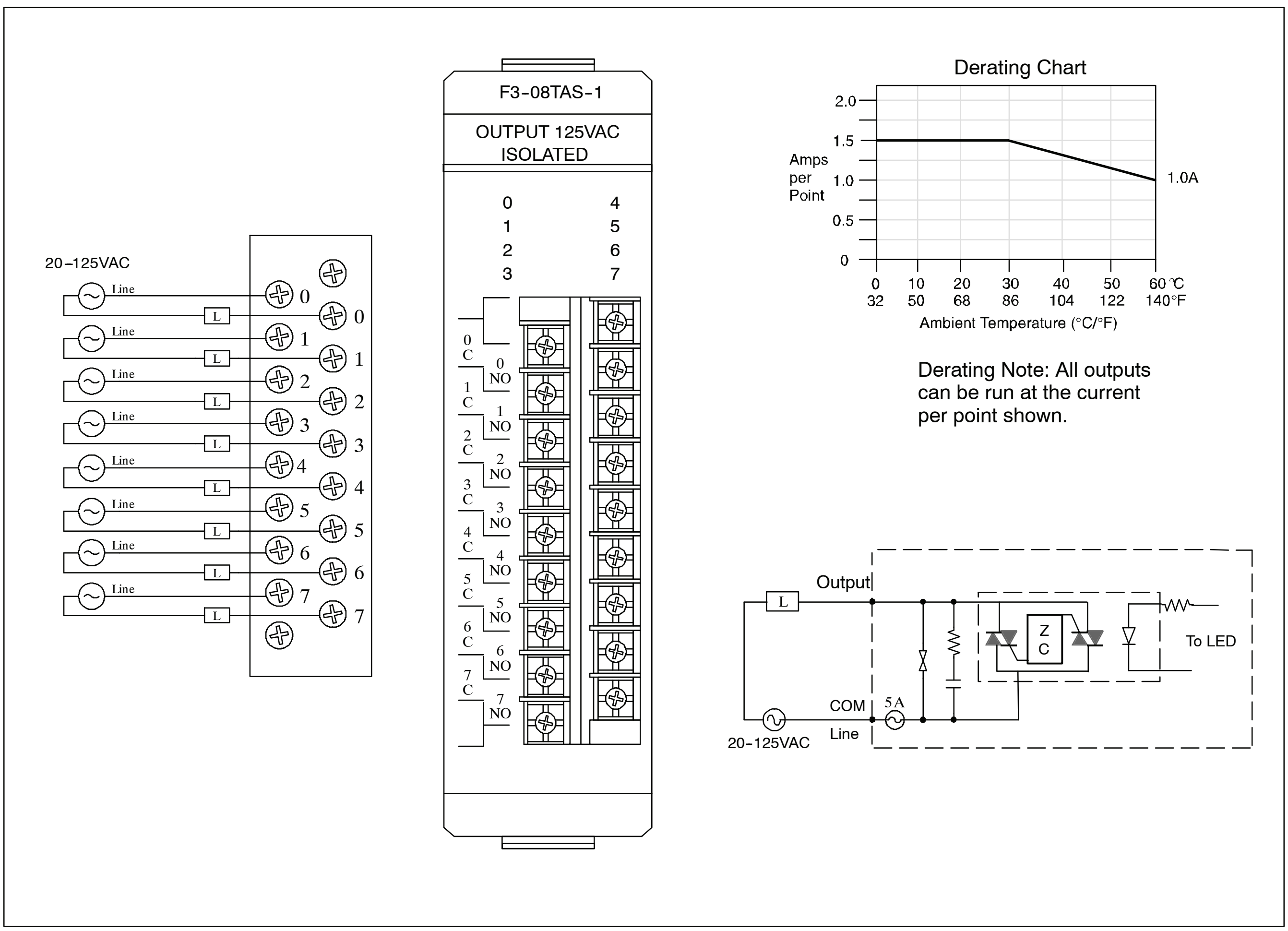




F3-08TAS-1, 125 VAC Isolated Output Module

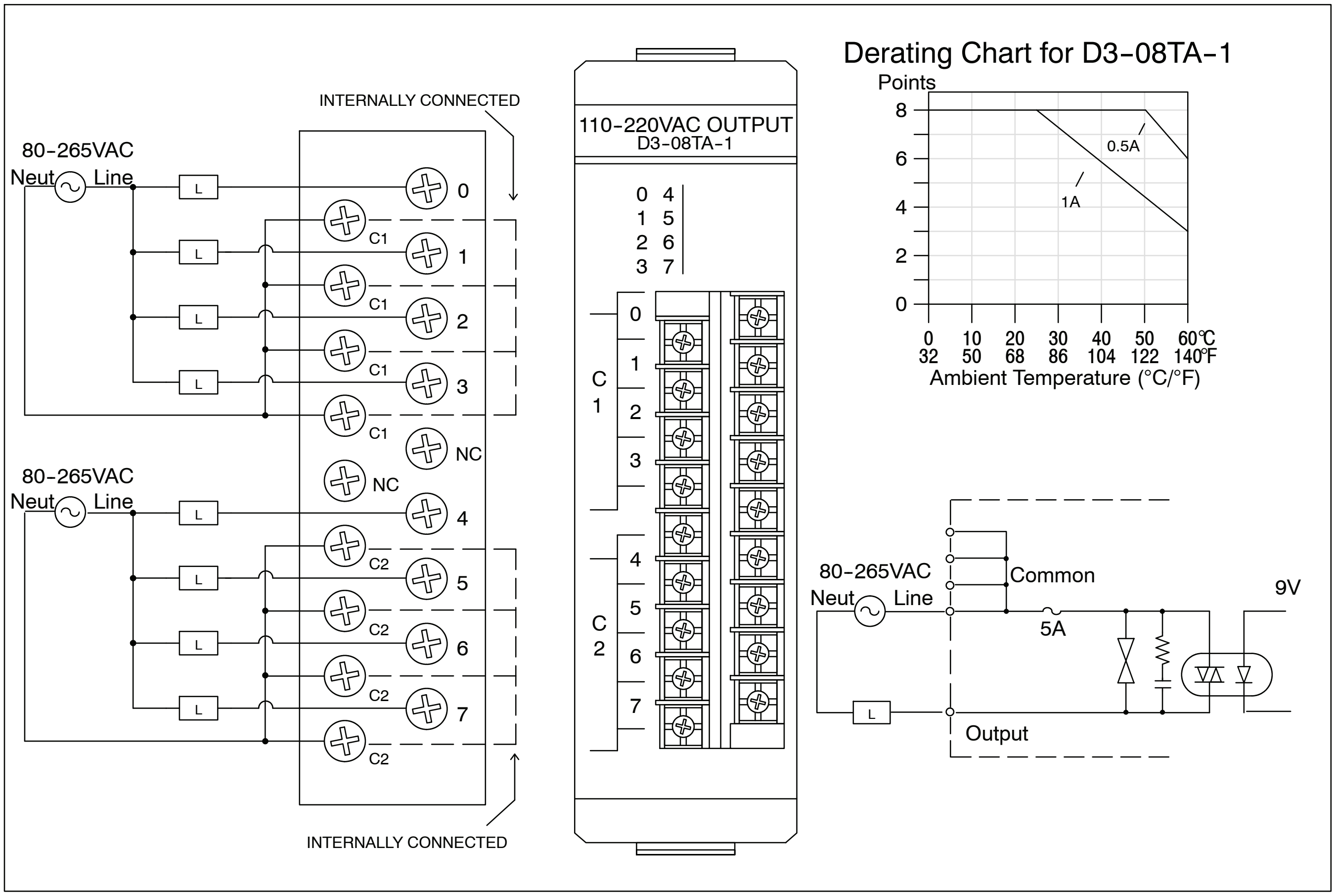
Outputs per module	8 (1500V point-to-point isolation)
Commons per module	8 (isolated)
Operating voltage	20-125VAC
Output type	SSR (TRIAC with zero cross-over)
Peak voltage	140VAC
AC frequency	47 - 63 Hz
ON voltage drop	1.6V(rms) @ 1.5A
Max current	1.5A/point
Max leakage current	0.7mA (rms)
Max inrush current*	15A for 20 ms 8A for 100 ms
Minimum load	50mA

Base power required	9V 25mA/ON pt. (200mA Max), 24V N/A
OFF to ON response	1 ms Max
ON to OFF response	9 ms Max
Terminal type	Removable
Status indicators	Logic Side
Weight	6.3 oz. (177g)
Fuses	8 (1 per common) 5A, 125V fast blow Order D3-FUSE-4 (5 per pack)



D3-08TA-1, 110-220 VAC Output Module

Outputs per module	8	Minimum load	25 mA
Commons per module	2 (isolated)	Base power required	9V 20mA/ON pt. (160 mA Max) 24V N/A
Operating voltage	80-265VAC		
Output type	Triac		
Peak voltage	265VAC	OFF to ON response	1 ms Max
AC frequency	47-63 Hz	ON to OFF response	8.33 ms Max
ON voltage drop	1.5 VAC @ 1A	Terminal type	Removable
Max current	1A / point 3A / common	Status indicators	Logic Side
		Weight	7.4 oz. (210 g)
Max leakage current	1.2 mA @ 220VAC 0.52 mA @ 110VAC	Fuses	(2) One 5A per common Non-replaceable
Max inrush current	10A for 16 ms 5A for 100 ms		

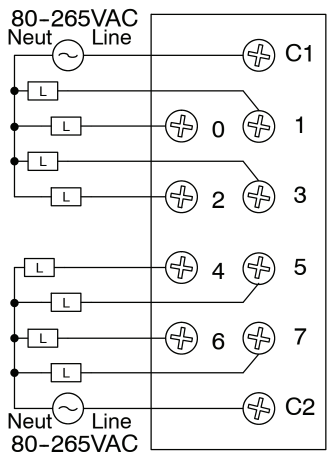


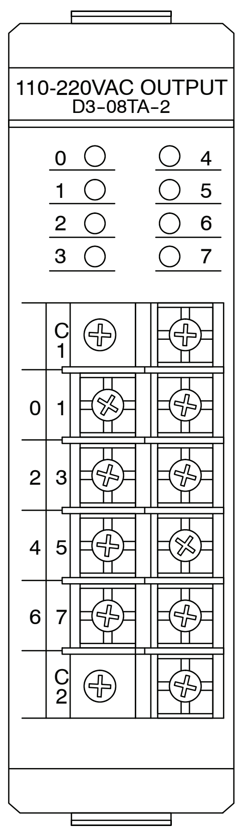
 D3-08TA-2 Discontinued 09/2022

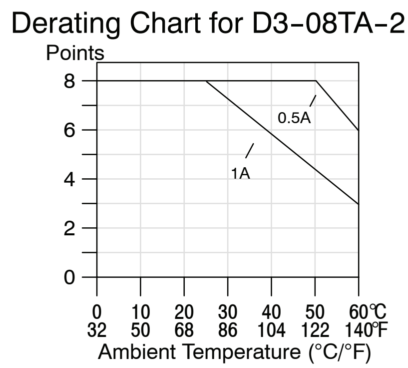
D3-08TA-2, 110-220 VAC Output Module

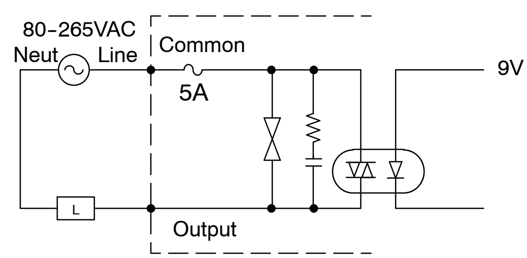
Outputs per module	8
Commons per module	2 (isolated)
Operating voltage	80-265VAC
Output type	Triac
Peak voltage	265VAC
AC frequency	47-63 Hz
ON voltage drop	1.5 VAC @ 1A
Max current	1A / point 3A / common
Max leakage current	1.2 mA @ 220VAC 0.52 mA @ 110VAC
Max inrush current	10A for 16 ms 5A for 100 ms
Minimum load	25 mA

Base power required	9V 20mA/ON pt. (160 mA Max) 24V N/A
OFF to ON response	1 ms Max
ON to OFF response	8.33 ms Max
Terminal type	Non-removable
Status indicators	Logic Side
Weight	6.4 oz. (180 g)
Fuses	(2) One 5A per common Non-replaceable



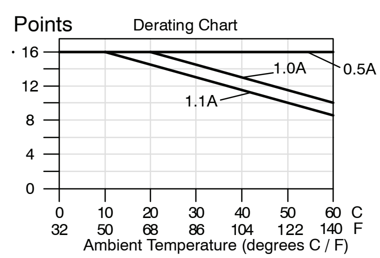






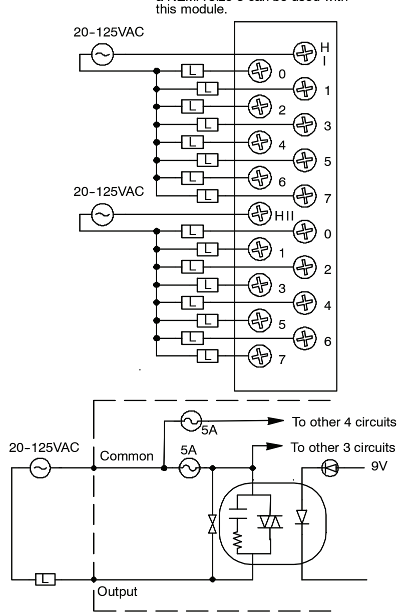
F3–16TA–2, 20–125 VAC Output Module

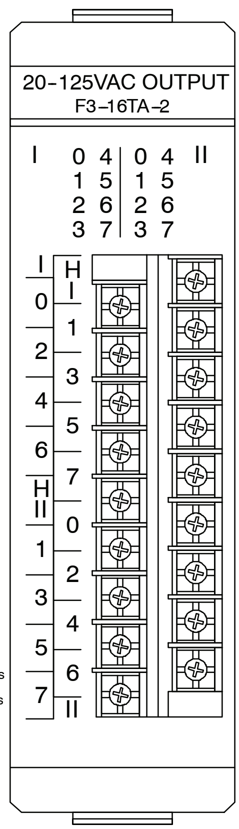
Outputs per module	16	Minimum load	50mA
Commons per module	2 (isolated)	Base power required	9V 14mA / ON pt. 250mA Max. 24V N/A
Operating voltage	20–125VAC	OFF to ON response	8ms Max
		ON to OFF response	8ms Max
Output type	SSR Array (TRIAC)	Terminal type	Removable
Peak voltage	140VAC	Status indicators	Logic Side
AC frequency	47 – 63Hz	Weight	7.7oz. (218g)
ON voltage drop	1.1VAC @ 1.1A	Fuses	4 (One 5A 125V fast blow per each group of four outputs) Order D3–FUSE–4 (5 per pack)
Max current	1.1A / point		
Max leakage current	0.7mA @ 125VAC		
Max inrush current*	15A for 20 ms 8A for 100 ms		



*Fuse blows at 20 Amp surge

Motor starters up to and including a NEMA size 3 can be used with this module.



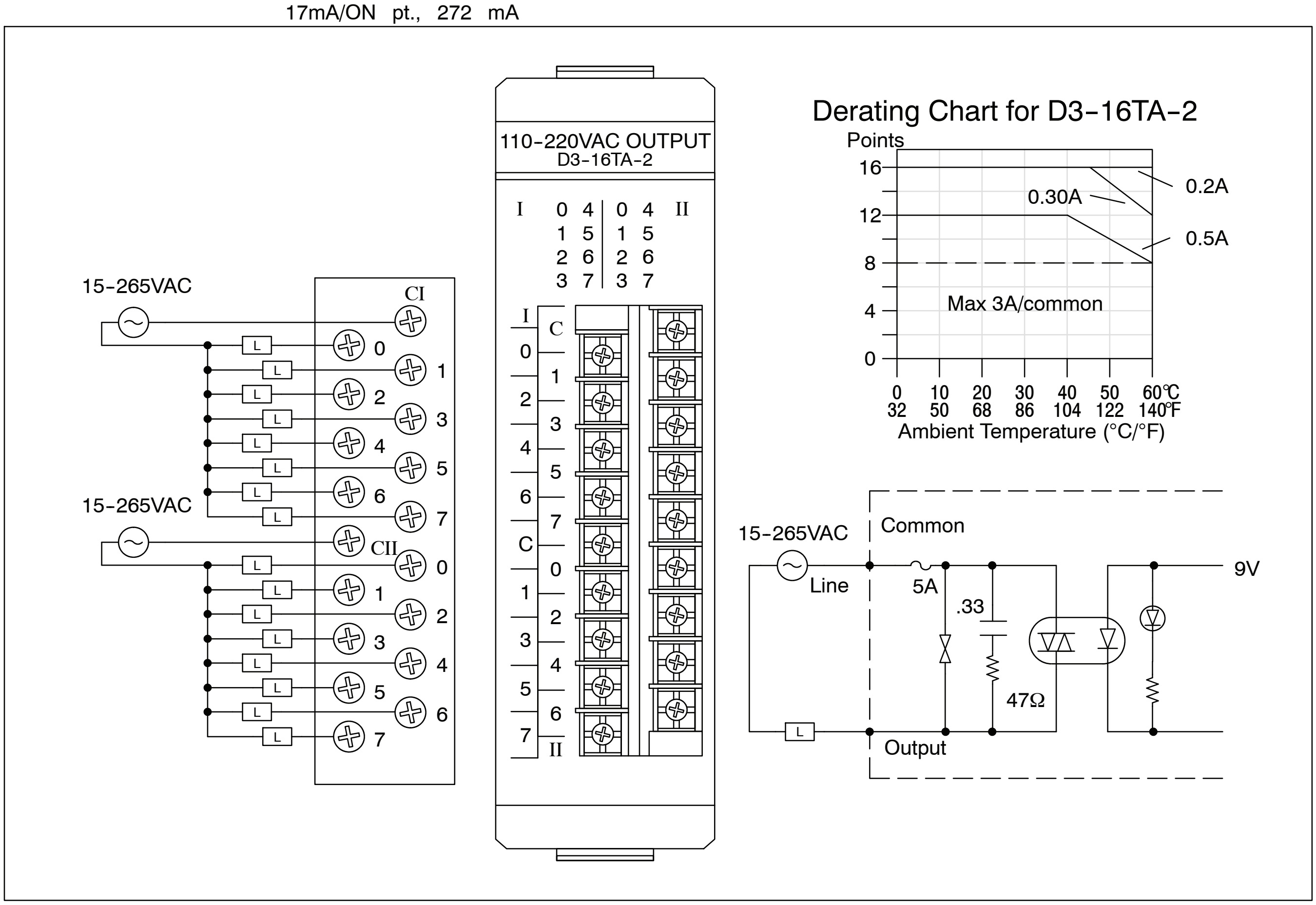


D3-16TA-2, 15-220 VAC Output Module

Outputs per module	16
Commons per module	2 (isolated)
Operating voltage	15-265 VAC
Output type	Triac
Peak voltage	265 VAC
AC frequency	47-63 Hz
ON voltage drop	1.5 VAC @ 0.5A
Max current	0.5A / point 3A / common 6A / per module
Max leakage current	4 mA @ 265 VAC
Max inrush current	10A for 10 ms 5A for 100 ms

Minimum load	10 mA @ 15VAC
Base power required *	9V 25mA Max/ON pt. 400 mA Max 24V N/A
OFF to ON response	1 ms Max
ON to OFF response	9 ms Max
Terminal type	Removable
Status indicators	Logic Side
Weight	7.2 0z. (210 g)
Fuses	(2) One 5A per common Non-replaceable

* 9V typical values 17mA/ON pt., 272 mA total

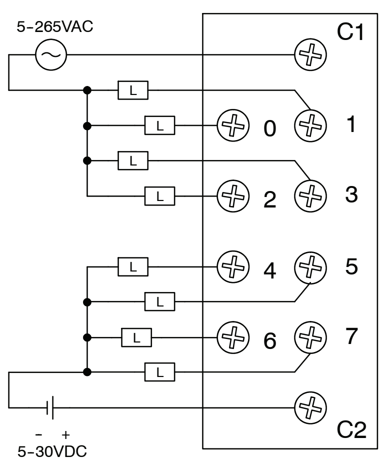


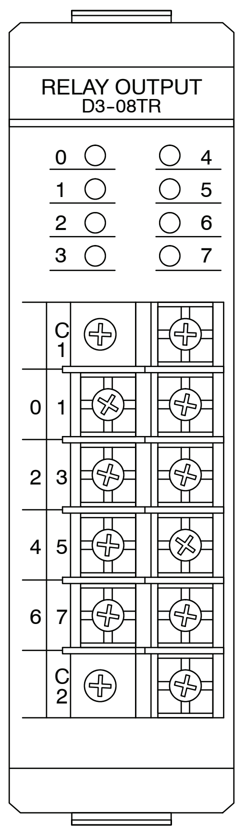
D3–08TR, Relay Output Module

Outputs per module	8	Minimum load	5 mA @ 5v
Commons per module	2 (isolated)	Base power required	9V 45 mA/ON pt. (360 mA Max) 24V N/A
Operating voltage	5–265VAC 5–30VDC		
Output type	Form A (SPST)	OFF to ON response	5 ms
Peak voltage	265VAC / 30VDC	ON to OFF response	5 ms
AC frequency	47–63 Hz	Terminal type	Non-removable
ON voltage drop	N/A	Status indicators	Logic Side
Max current	4A / point AC 5A / point DC 6A / common	Weight	7 oz. (200 g)
		Fuses	(2) One 10A per common User replaceable
Max leakage current	1 mA @ 220VAC		
Max inrush current	5A		

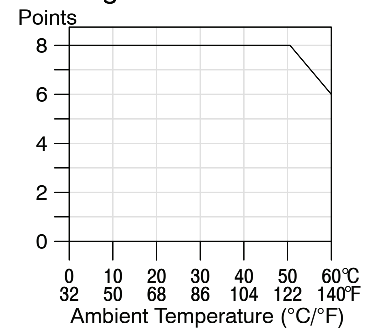
Typical Relay Life (Operations)

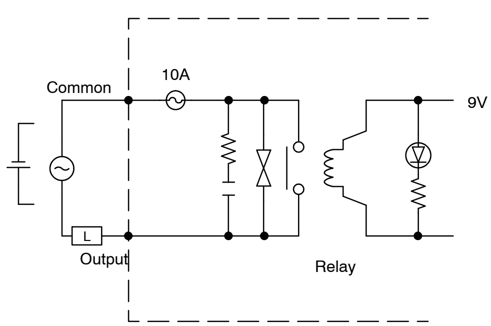
Voltage	Resistive	Solenoid	Closures
220VAC	4A	0.5A	100k
220VAC		0.05A	800k
110VAC	4A	0.5A	100k
110VAC		0.1A	650k
24VDC	5A	0.5A	100k





Derating Chart for D3–08TR



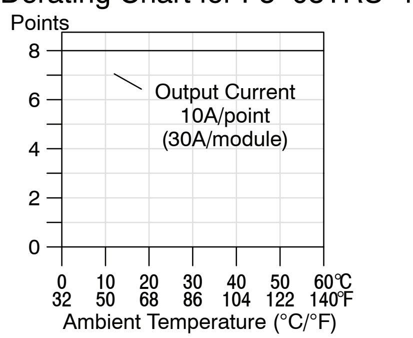


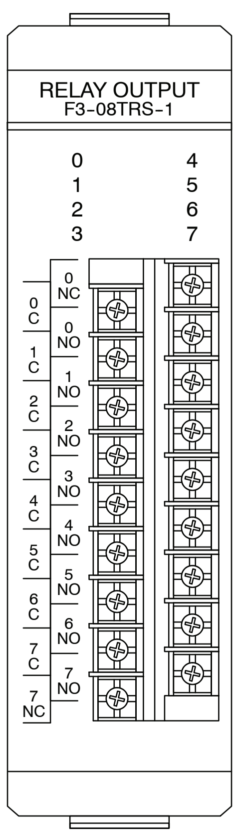
F3-08TRS-1, Relay Output Module

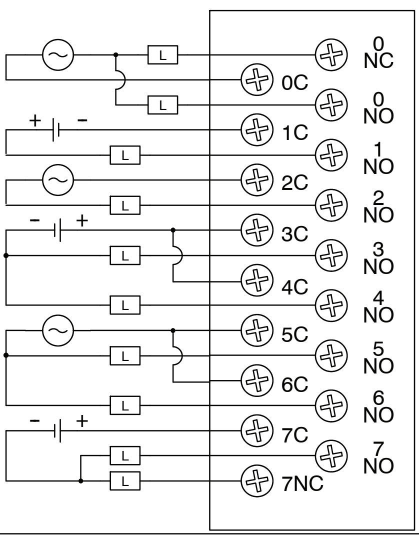
Outputs per module	8	Max leakage current	N/A
Commons per module	8 (isolated)	Max inrush current	10A Inductive
Operating voltage*	12-125 VAC 125-250 VAC requires external fuses 12-30 VDC	Minimum load	100 mA @12VDC
		Base power required	9V 37mA / ON pt. (296 mA Max) 24V N/A
Output type	6 Form A (SPST) 2 Form C (SPDT)	OFF to ON response	13 ms Max
		ON to OFF response	9 ms Max
Peak voltage	265 VAC / 120 VDC	Terminal type	Removable
AC frequency	47-63 Hz	Status indicators	Logic Side
ON voltage drop	N/A	Weight	8.9 oz. (252 g)
Max current (resistive)	10A / point AC/DC 30A / module AC/DC	Fuses	(8) One 10A (125V) per common Non-replaceable

NOTE: Contact life may be lengthened beyond those values shown by the use of an appropriate arc suppression. This technique is discussed earlier in this chapter.

Derating Chart for F3-08TRS-1

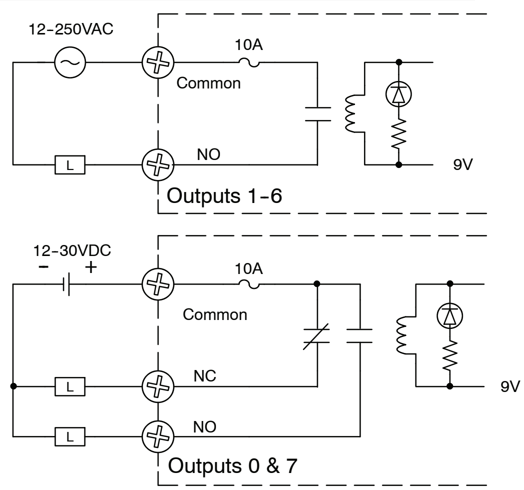






Typical Relay Life (Operations)

Maximum Resistive or Inductive Inrush Load Current	Operating Voltage		
	28VDC	120VAC	240VAC
1/4HP		25K	
10.0A	50K	50K	
5.0A	200K	100K	
3.0A	325K	125K	50K
.05A	>50M		



*Maximum DC voltage rating is 120 VDC at .5 Amp, 30,000 cycles typical

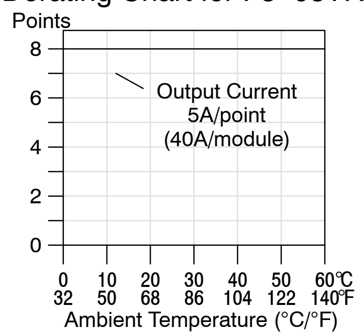
Motor starters up to and including a NEMA size 4 can be used with this module.

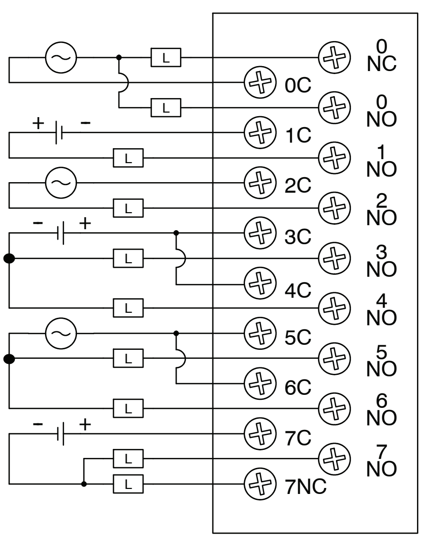
F3–08TRS–2, Relay Output Module

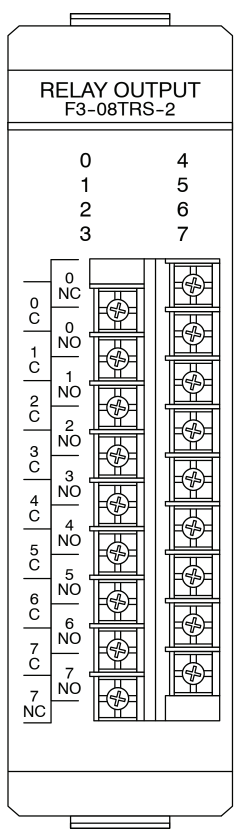
Outputs per module	8	Max leakage current	N/A
Commons per module	8 (isolated)	Max inrush current	10A Inductive
Operating voltage*	12–125 VAC 12–30 VDC	Minimum load	100 mA @12VDC
		Base power required	9V 37mA / ON pt. (296 mA Max) 24V N/A
Output type	6 Form A (SPST) 2 Form C (SPDT)	OFF to ON response	13 ms Max
		ON to OFF response	9 ms Max
Peak voltage	265 VAC / 120 VDC	Terminal type	Removable
AC frequency	47–63 Hz	Status indicators	Logic Side
ON voltage drop	N/A	Weight	9 oz. (255 g)
Max current (resistive)	5A / point AC/DC 40A / module AC/DC	Fuses 19379–K–10A Wickman	(8) One 5A (125V) per common User replaceable

NOTE: Contact life may be lengthened beyond those values shown by the use of an appropriate arc suppression. This technique is discussed earlier in this chapter.

Derating Chart for F3–08TRS–2



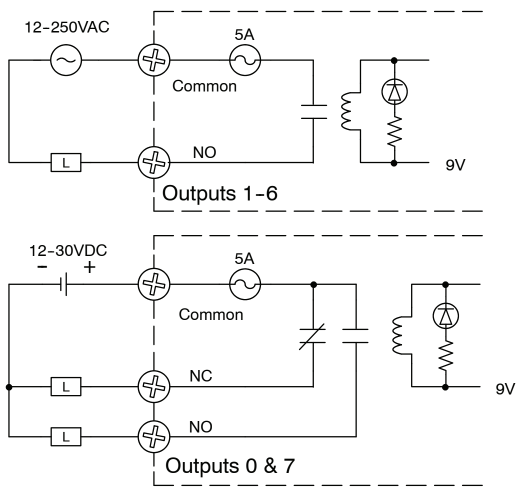




Typical Relay Life (Operations)

Maximum Resistive or Inductive Inrush Load Current	Operating Voltage		
	28VDC	120VAC	240VAC
5.0A 3.0A .05A	200K 325K >50M	100K 125K	50K

Expected mechanical relay life is 100 million operations.



*Maximum DC voltage rating is 120 VDC at .5 Amp, 30,000 cycles typical

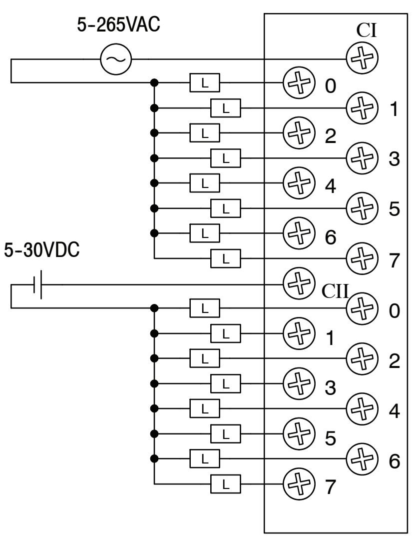
Motor starters up to and including a NEMA size 3 can be used with this module.

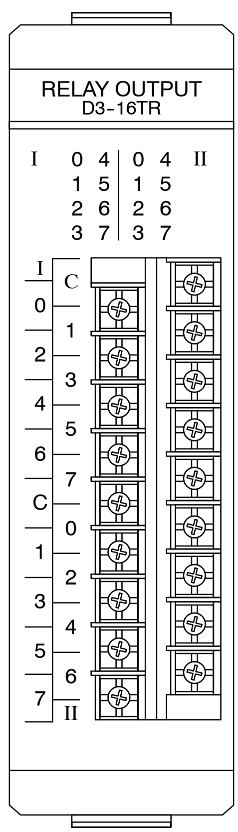
D3-16TR, Relay Output Module

Outputs per module	16	Minimum load	5 mA @ 5v
Commons per module	2 (isolated)	Base power required	9V 30 mA/ON pt. (480 mA Max) 24V N/A
Operating voltage	5-265 VAC 5-30 VDC		
Output type	16 Form A (SPST)	OFF to ON response	12 ms
Peak voltage	265 VAC / 30 VDC	ON to OFF response	12 ms
AC frequency	47-63 Hz	Terminal type	Removable
ON voltage drop	N/A	Status indicators	Logic Side
Max current	2A / point AC/DC (resistive) 8A / common AC/DC	Weight	8.5 oz. (248g)
		Fuses	None
Max leakage current	0.1mA @ 220 VAC		
Max inrush current	2A		

Typical Relay Life (Operations)

Voltage	Resistive	Solenoid	Closures
220VAC	2A	0.25A	100k
220VAC		0.03A	800k
110VAC	2A	0.25A	100k
110VAC		0.05A	650k
24VDC	2A	0.25A	100k





Derating Chart for D3-16TR