2

Installation, Wiring, and Specifications

In This Chapter. . . .

Safety Guidelines

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.

Safety Techniques

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.

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

Class 1, Division 2 Approval

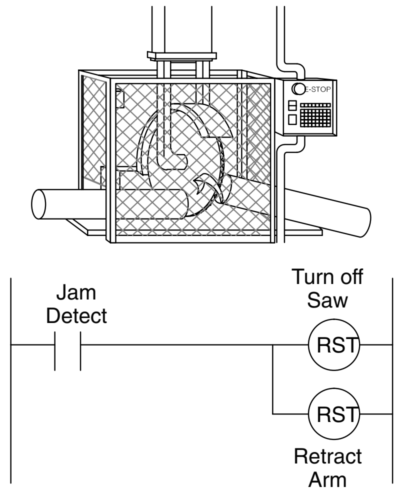
This equipment is suitable for use in Class 1, Division 2, Zone 2, groups A, B, C and D or non–hazardous locations only.

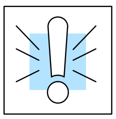
WARNING: Explosion Hazard:

- Substitution of components may impair suitability for Class 1, Division 2, Zone 2.
- Do not disconnect equipment unless power has been switched off or the area is known to be non–hazardous.

Orderly System Shutdown

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 are jammed or missing parts, empty bins, etc. that do not pose a risk of personal injury or equipment damage.





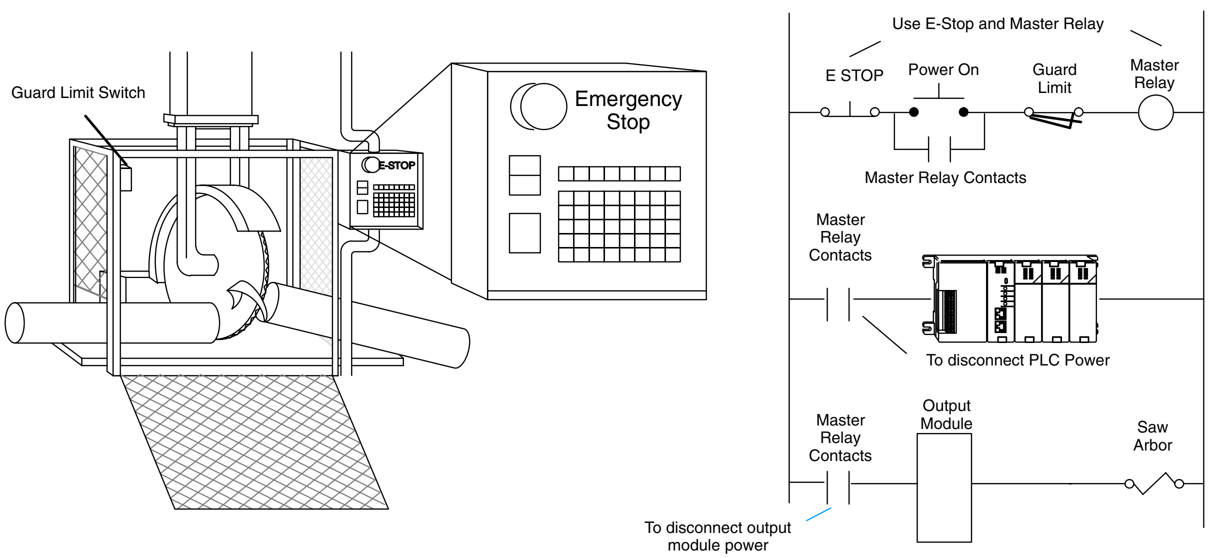
WARNING: The control program *must not* be the only form of protection for any problems that may result in a risk of personal injury or equipment damage.

System Power Disconnect

By using electromechanical devices, such as master control relays and/or limit switches, you can prevent accidental equipment startup. When installed properly, these devices will prevent *any* machine operations from occurring.

For example, if the machine has a jammed part, the PLC control program can turn off the saw blade and retract the arbor. However, since the operator must open the guard to remove the part, you must include a bypass switch to disconnect *all* system power any time the guard is opened.

The operator must also have a quick method of manually disconnecting *all* system power. This is accomplished with a mechanical device clearly labeled as an **Emergency Stop** switch.



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.

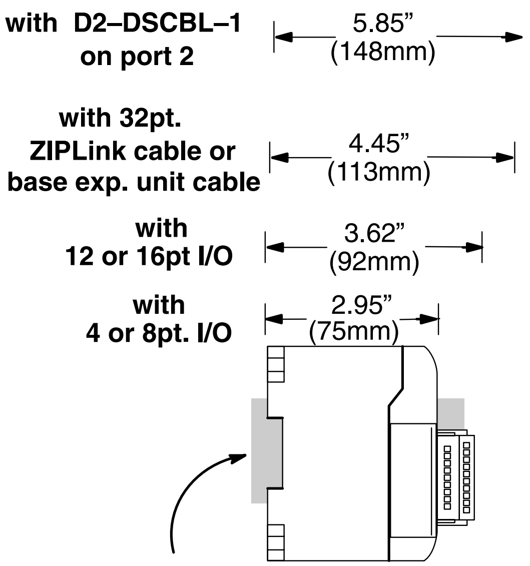
Mounting Guidelines

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

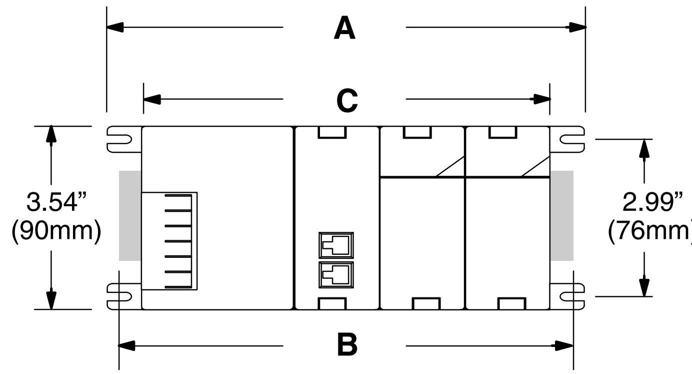
NOTE: If you are using other components in your system, refer to the appropriate manual to determine how those units can affect mounting dimensions.

Base Dimensions

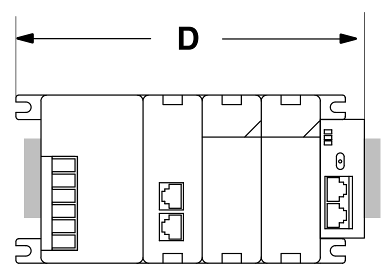
The following information shows the proper mounting dimensions. The height dimension is the same for all bases. The depth varies depending on your choice of I/O module. The length varies as the number of slots increase. Make sure you have followed the installation guidelines for proper spacing.



DIN Rail slot. Use rail conforming to DIN EN 50022.



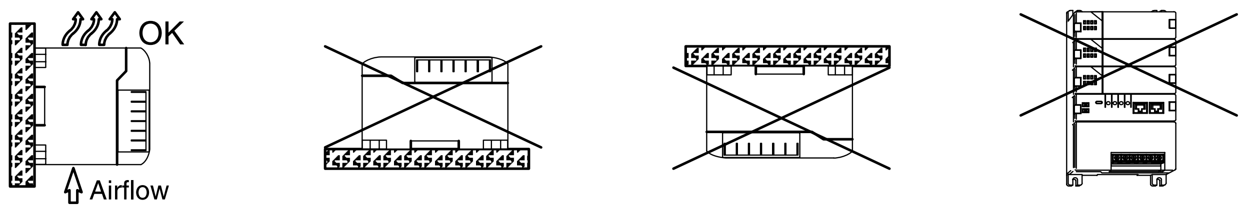
with D2–EM Expansion Unit



Base	A (Base Total Width)		B (Mounting Hole)		C (Component Width)		D (Width with Exp. Unit)	
	Inches	Millime-ters	Inches	Millimeters	Inches	Millimeters	Inches	Millimeters
3-slot	6.77”	172mm	6.41”	163mm	5.8”	148mm	7.24”	184mm
4-slot	7.99”	203mm	7.63”	194mm	7.04”	179mm	8.46”	215mm
6-slot	10.43”	265mm	10.07”	256mm	9.48”	241mm	10.90”	277mm
9-slot	14.09”	358mm	13.74”	349mm	13.14”	334mm	14.56”	370mm

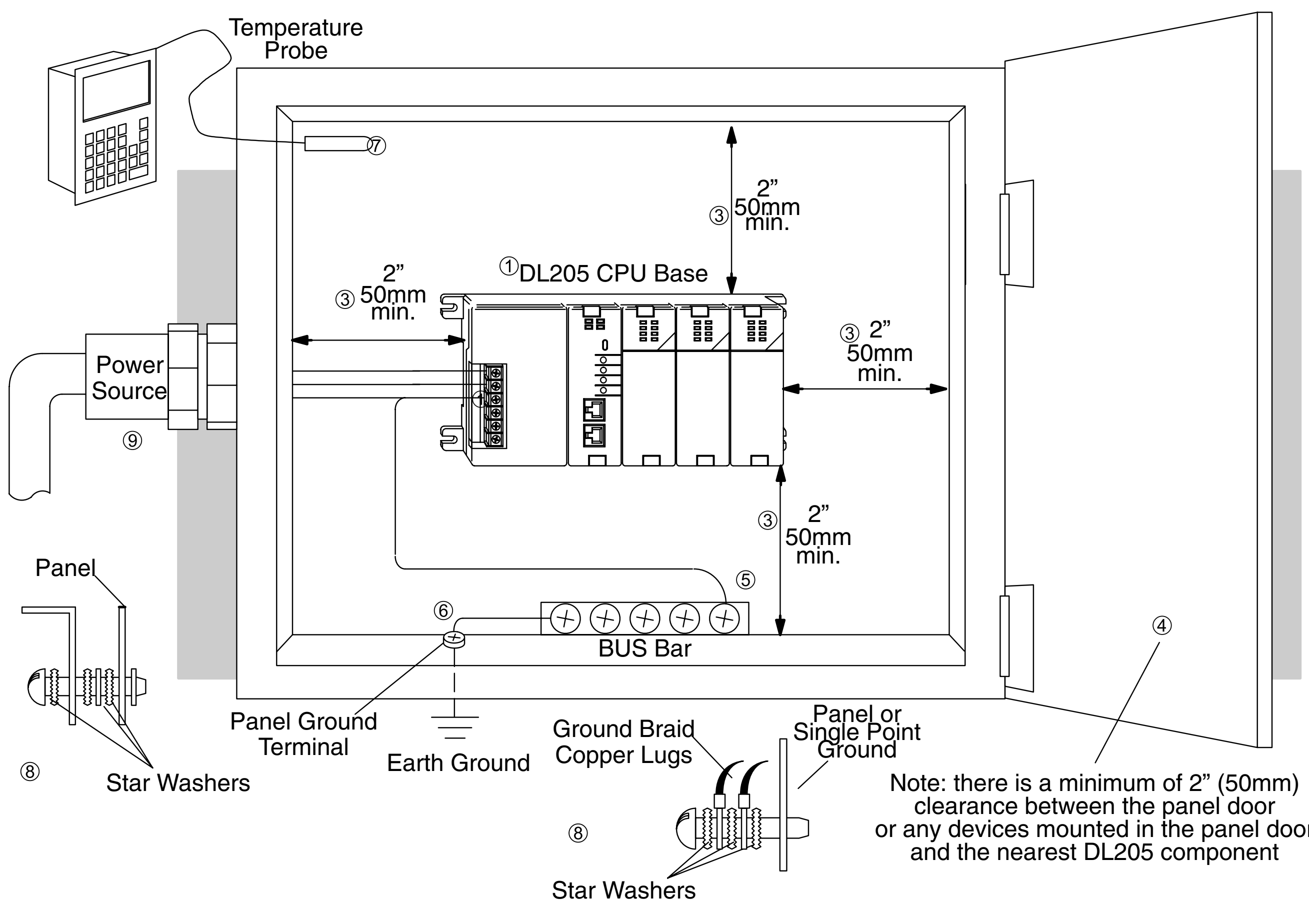
Panel Mounting and Layout

It is important to design your panel properly to help ensure the DL205 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. The diagrams below reference the items in the following list.



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 DL205 component.

Note: The cabinet configuration below is not suitable for EU installations. Refer to Appendix F European Union Directives.



5. The ground terminal on the DL205 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 DL205 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 DL205. 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 DL205 system, measures such as installing a cooling/heating source must be taken to get the ambient temperature within the DL205 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 DL205 system is designed to be powered by 110/220 VAC, 24 VDC, or 125 VDC normally available throughout an industrial environment. Electrical power in some areas where the PLCs are installed is not always stable and storms can cause power surges. Due to this, powerline filters are recommended for protecting the DL205 PLCs from power surges and EMI/RFI noise. The Automation Powerline Filter, for use with 120 VAC and 240 VAC, 1–5 Amps, is an exellent choice (can be located at www.automationdirect.com), however, you can use a filter of your choice. These units install easily between the power source and the PLC.

Enclosures

Your selection of a proper enclosure is important to ensure safe and proper operation of your DL205 system. Applications of DL205 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 DL205 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**	30% – 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.

Power

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

Specification	AC Powered Bases	24 VDC Powered Bases	125 VDC Powered Bases
Part Numbers	D2–03B–1, D2–04B–1, D2–06B–1, D2–09B–1	D2–03BDC1–1, D2–04BDC1–1, D2–06BDC1–1, D2–09BDC1–1	D2–06BDC2–1, D2–09BDC2–1
Input Voltage Range	100–240 VAC +10% –15%	10.2 – 28.8VDC (24VDC) with less than 10% ripple	104–240 VDC +10% –15%
Maximum Inrush Current	30 A	10A	20A
Maximum Power	80 VA	25W	30W
Voltage Withstand (dielectric)	1 minute @ 1500 VAC between primary, secondary, field ground, and run relay		
Insulation Resistance	> 10 MΩ at 500 VDC		
Auxiliary 24 VDC Output	20–28 VDC, less than 1V p-p 300mA max.	None	20–28 VDC, less than 1V p-p 300mA max.
Fusing (internal to base power supply)	non–replaceable 2A @ 250V slow blow fuse; external fusing recommended	non–replaceable 3.15A @ 250V slow blow fuse; external fusing recommended	non–replaceable 2A @ 250V slow blow fuse; external fusing recommended

Agency Approvals

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

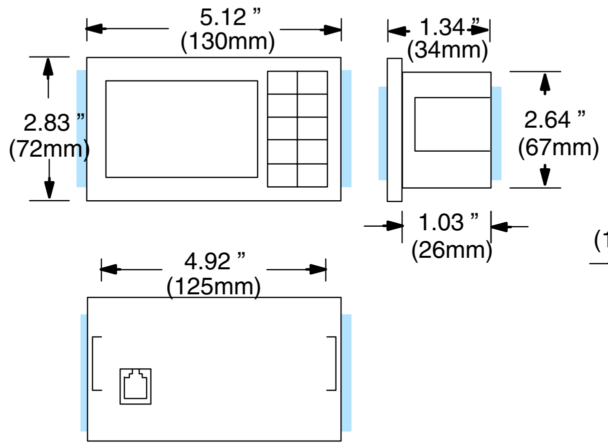
- UL (Underwriters' Laboratories, Inc.)
- CSA (Canadian Standards Association)
- FM (Factory Mutual Research Corporation)
- CUL (Canadian Underwriters' Laboratories, Inc.)

Component Dimensions

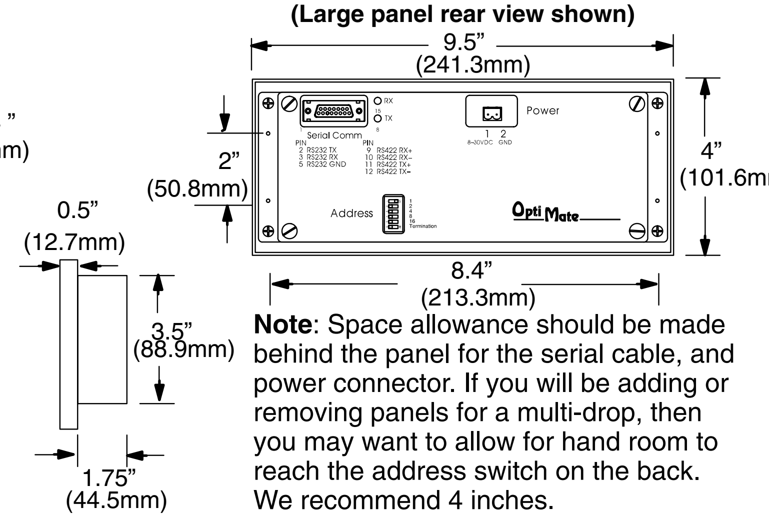
Before installing your PLC system you will need to know the dimensions for the components in your system. The diagrams on the following pages provide the component dimensions and should be used to define your enclosure specifications. Remember to leave room for potential expansion. Appendix E provides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

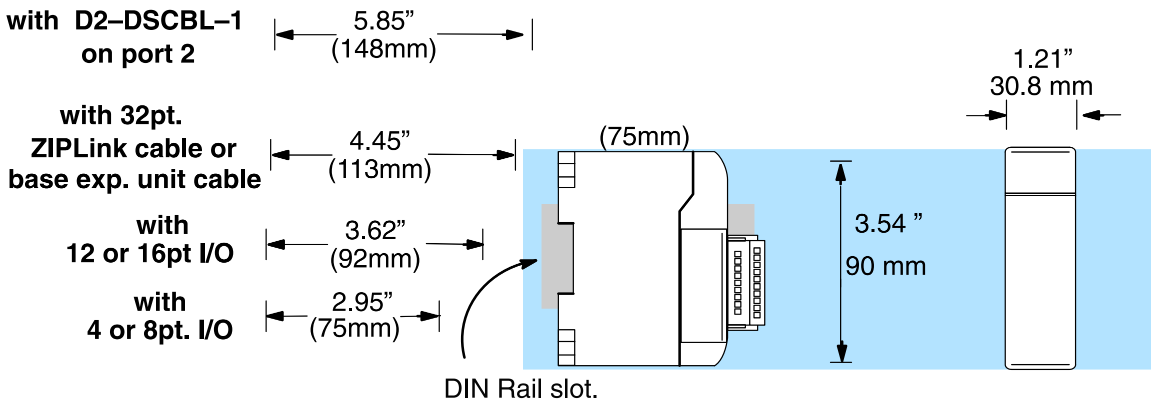


Optimation Units
(Large panel rear view shown)

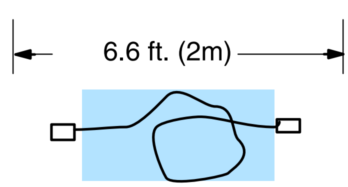


Note: Space allowance should be made behind the panel for the serial cable, and power connector. If you will be adding or removing panels for a multi-drop, then you may want to allow for hand room to reach the address switch on the back. We recommend 4 inches.

I/O modules in Base



Handheld programmer cable

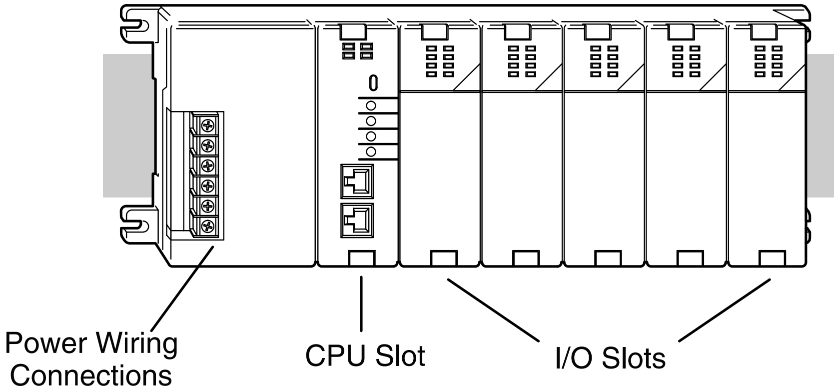


Installing DL205 Bases

Choosing the Base Type

The DL205 system offers four different sizes of bases and three different power supply options.

The following diagram shows an example of a 6-slot base.

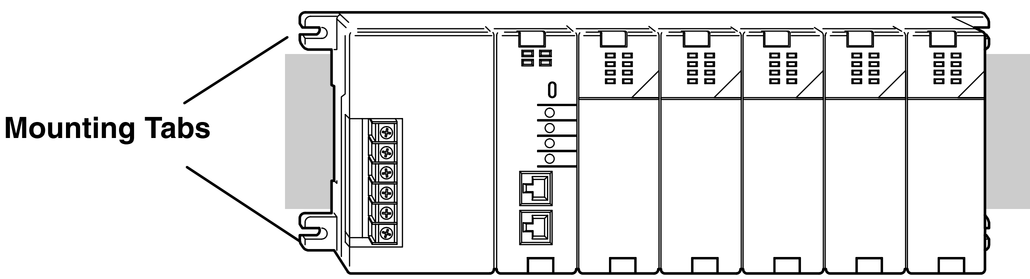


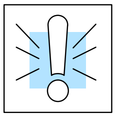
Your choice of base depends on three things.

- 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 DL205 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 tabs 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.

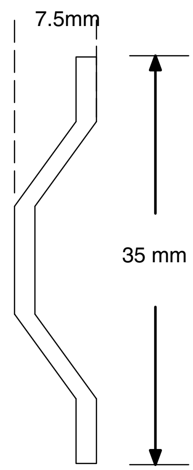
Using Mounting Rails

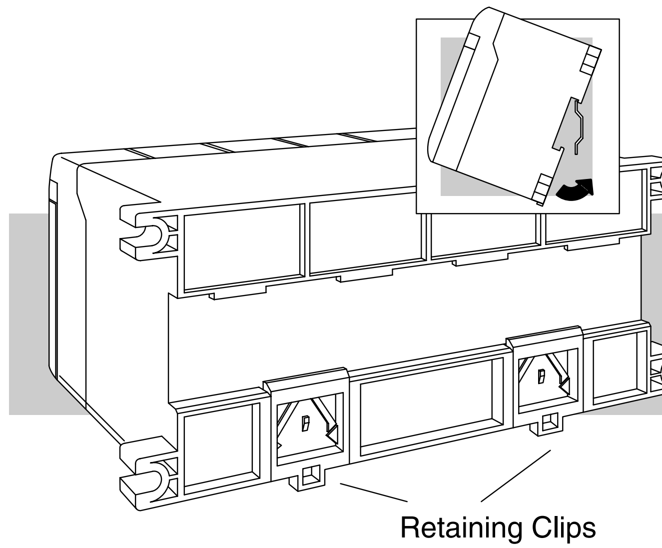
The DL205 bases can also be secured to the cabinet by using mounting rails. You should use rails that conform to DIN EN standard 50 022. Refer to our catalog for a complete line of DIN rail, DINnectors and DIN rail mounted apparatus. These rails are approximately 35mm high, with a depth of 7.5mm. If you mount the base on a rail, you should also consider using end brackets on each end of the rail. The end brackets help keep the base from sliding horizontally along the rail. This helps minimize the possibility of accidentally pulling the wiring loose.

If you examine the bottom of the base, you'll notice small retaining clips. To secure the base to a DIN rail, place the base onto the rail and gently push up on the retaining clips. The clips lock the base onto the rail.

To remove the base, pull down on the retaining clips, lift up on the base slightly, and pull it away from the rail.

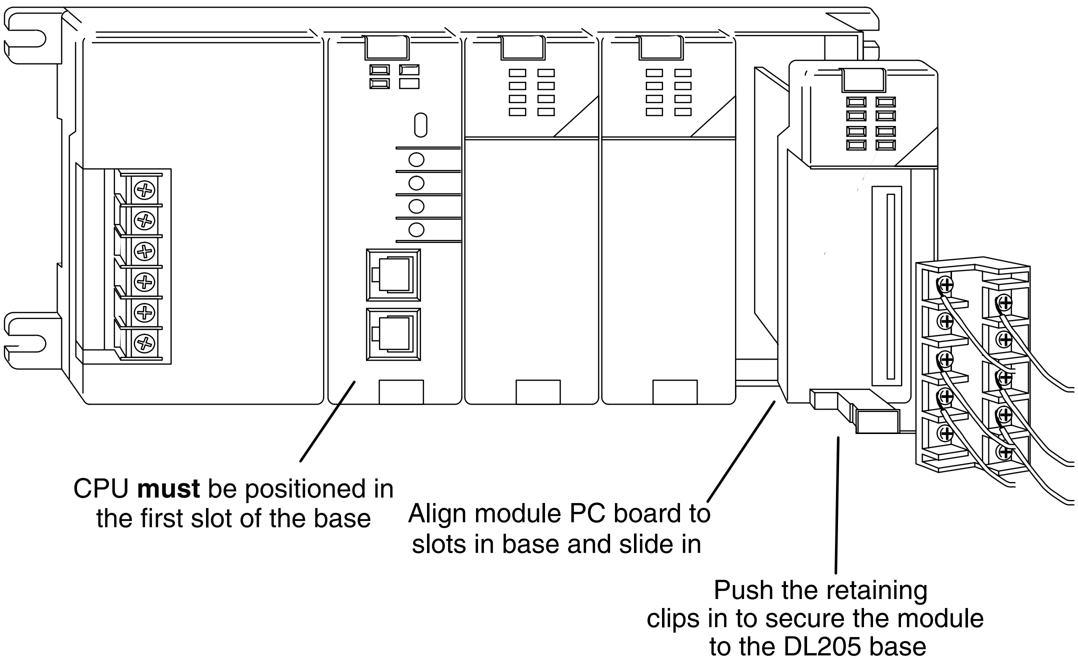
DIN Rail Dimensions





Installing Components in the Base

To insert components into the base: first slide the module retaining clips to the out position and 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 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.

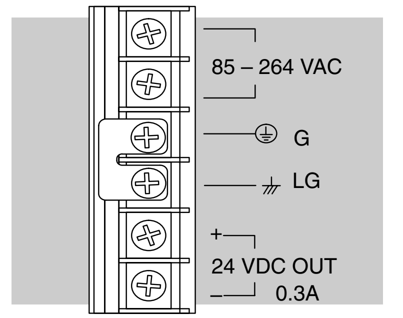
Base Wiring Guidelines

Base Wiring

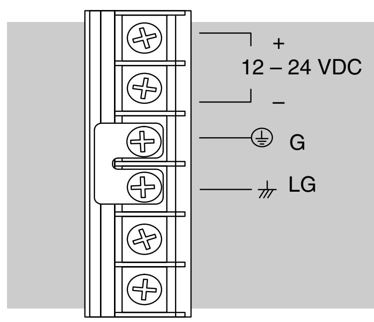
The diagrams show the terminal connections located on the power supply of the DL205 bases. The base terminals can accept up to 16 AWG. You may be able to use larger wiring depending on the type of wire used, but 16 AWG is the recommended size. Do not overtighten the connector screws; recommended torque value is 7.81 pound-inches (0.882 N•m).

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.

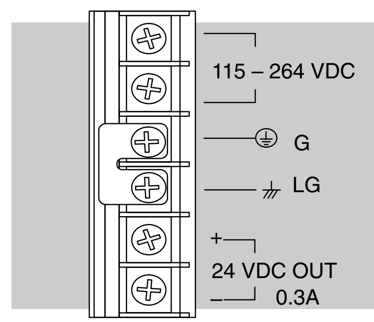
110/220 VAC Base Terminal Strip



12/24 VDC Base Terminal Strip



125 VDC Base Terminal Strip



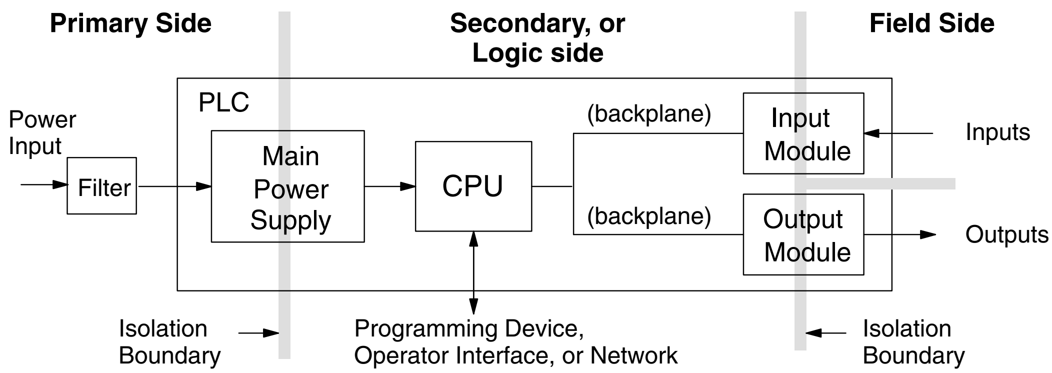
WARNING: Once the power wiring is connected, install the plastic protective cover. When the cover is removed there is a risk of electrical shock if you accidentally touch the wiring or wiring terminals.

I/O Wiring Strategies

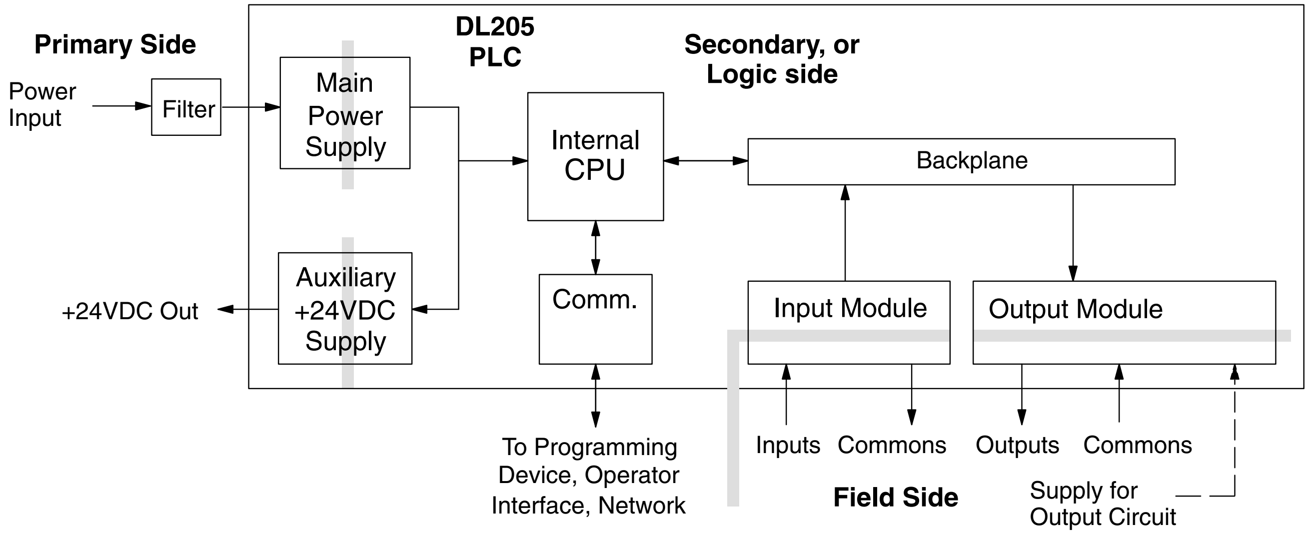
The DL205 PLC system is very flexible and will work in many different wiring configurations. By studying this section before actual installation, you can probably find the best wiring strategy for your application . This will help to lower system cost, wiring errors, and avoid safety problems.

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 powerline filter will provide isolation between the power source and the power supply. 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.*



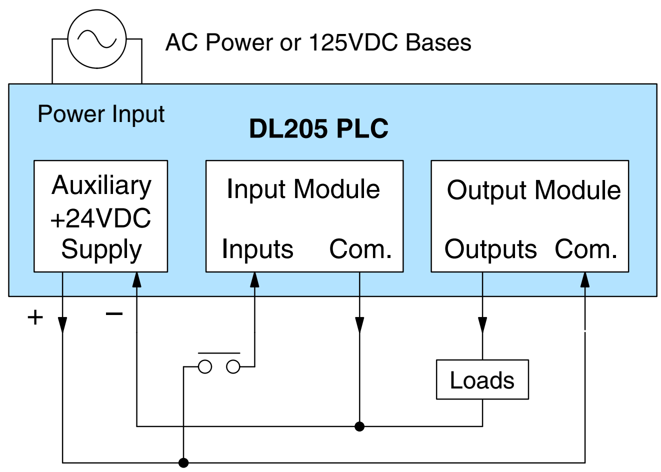
The next figure shows the physical layout of a DL205 PLC system, as viewed from the front. In addition to the basic circuits covered above, AC-powered and 125VDC bases include an auxiliary +24VDC power supply with its own isolation boundary. Since the supply output is isolated from the other three circuits, it can power input and/or output circuits!



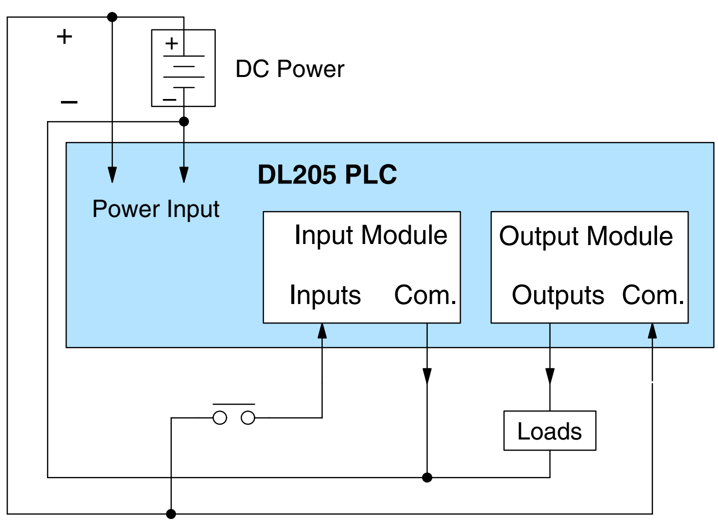
In some cases, using the built-in auxiliary +24VDC supply can result in a cost savings for your control system. It can power combined loads up to 300mA. Be careful not to exceed the current rating of the supply. If you are the system designer for your application, you may be able to select and design in field devices which can use the +24VDC auxiliary supply.

Powering I/O Circuits with the Auxiliary Supply

All AC powered and 125VDC DL205 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.



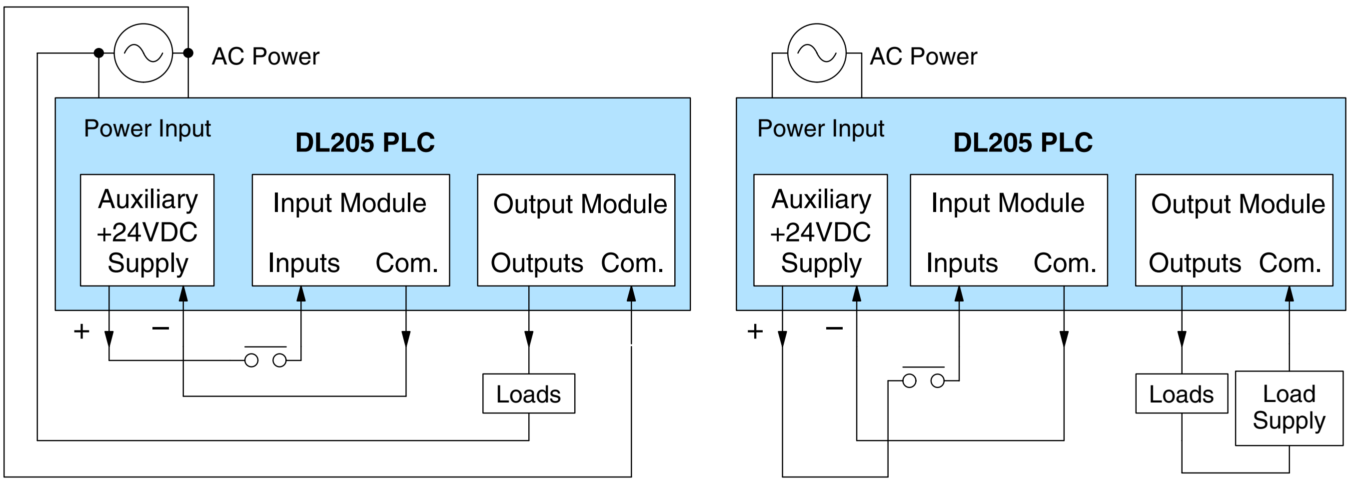
12/24VDC powered DL205 bases are designed for application environments in which low-voltage DC power is more readily available than AC. These include a wide range of battery–powered applications, such as remotely-located control, in vehicles, portable machines, etc. For this application type, all input 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

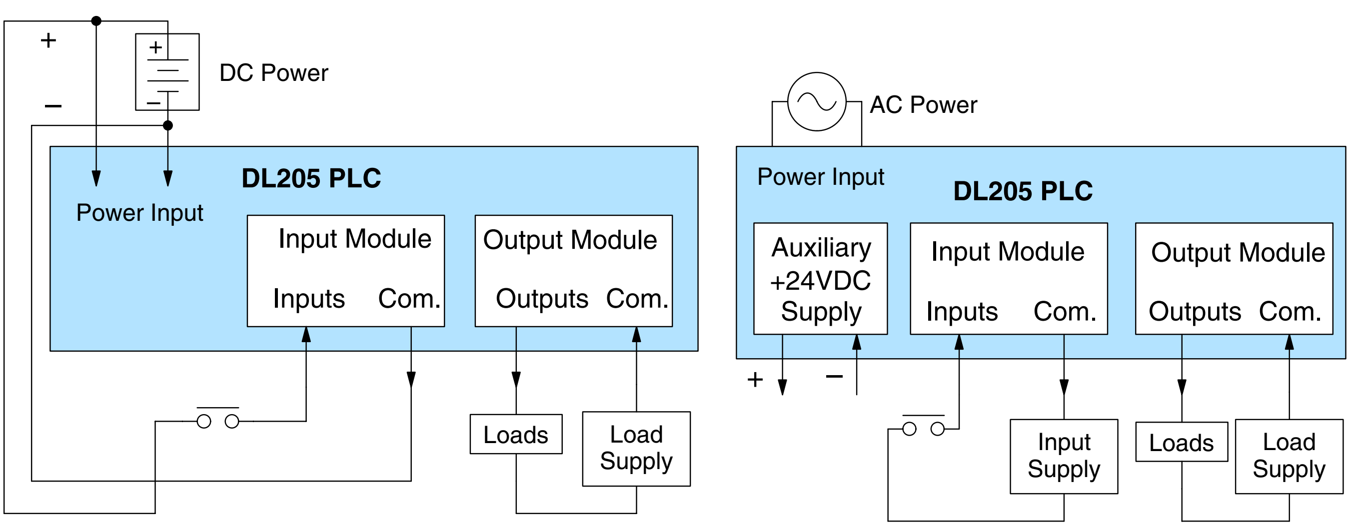
In most applications it will be necessary to power the input devices from one power source, and to power output loads from another source. Loads often require high-energy AC power, while input sensors use low-energy DC. If a machine operator is likely to come in close contact with input wiring, then 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

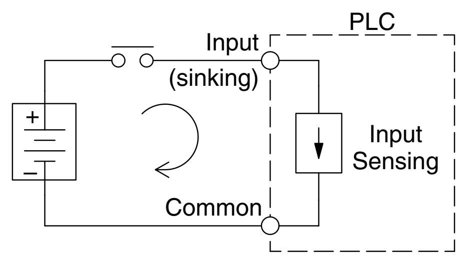
Before going further in the study of wiring strategies, you must have a solid understanding of "*sinking*" and "*sourcing*" concepts. Use of these terms occurs frequently in input or output circuit discussions. It is the goal of this section to make these concepts easy to understand, further ensuring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

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

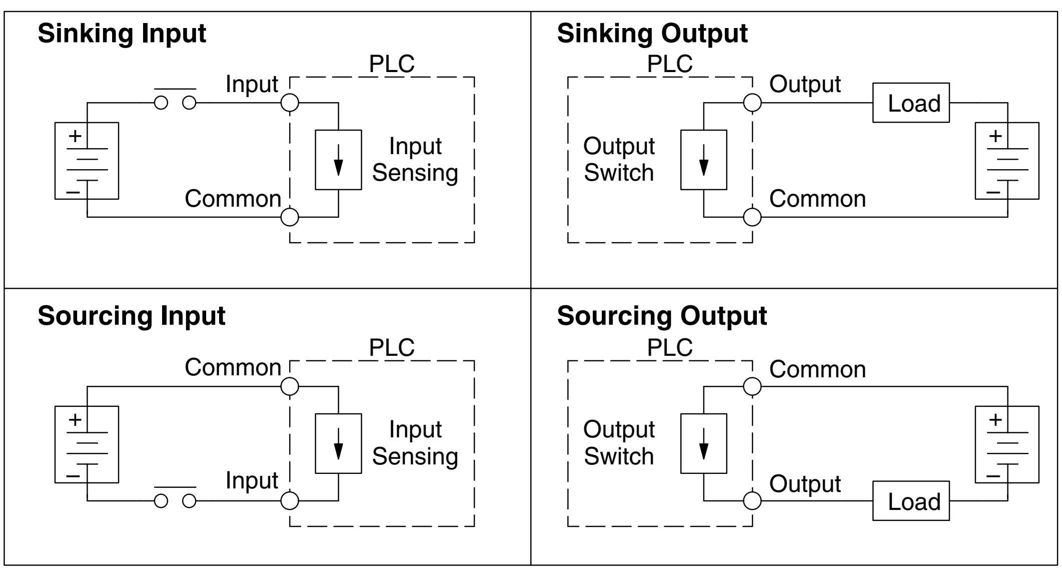
Sourcing = provides a path to supply **source (+)**

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.

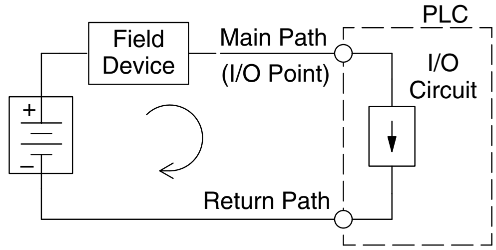


By applying the circuit principle above to the four possible combinations of input/output sinking/sourcing types as shown below. The I/O module specifications at the end of this chapter list the input or output type.

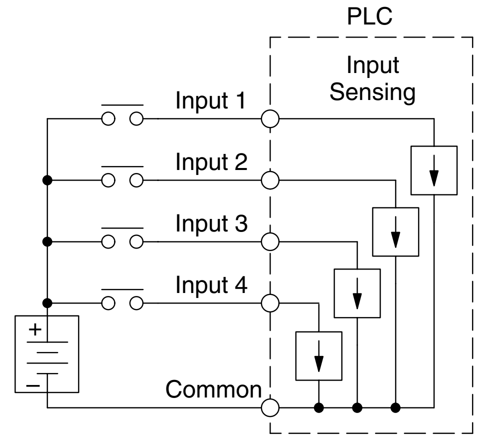


I/O "Common" Terminal Concepts

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.

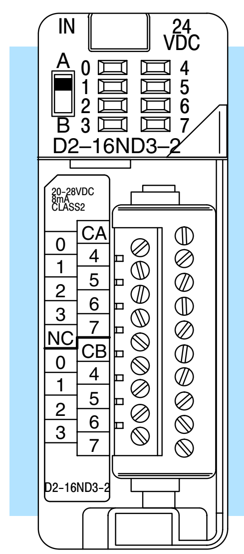


If there was unlimited space and budget for I/O terminals, every I/O point could have two dedicated terminals as the figure above shows. However, providing this level of flexibility is not practical or even necessary for most applications. So, most Input or Output points on PLCs are in groups which share 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.

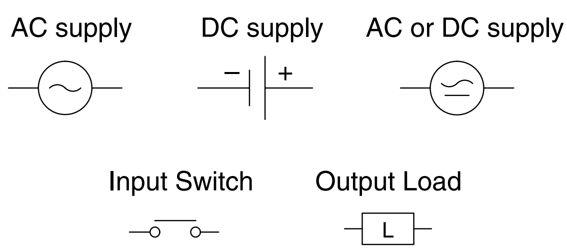


NOTE: In the circuit above, the current in the common path is 4 times any channel's input current when all inputs are energized. This is especially important in output circuits, where heavier gauge wire is sometimes necessary on commons.

Most DL205 input and output modules group their I/O points into banks that share a common return path. The best indication of I/O common grouping is on the wiring label, such as the one shown to the right. The miniature schematic shows two circuit banks with eight input points in each. The common terminal for each is labeled "CA" and "CB", respectively.



In the wiring label example, the positive terminal of a DC supply connects to the common terminals. Some symbols you will see on the wiring labels, and their meanings are:

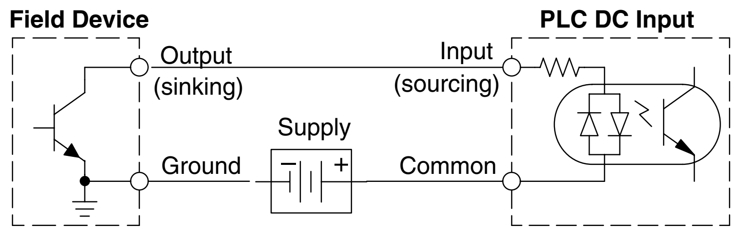


Connecting DC I/O to "Solid State" Field Devices

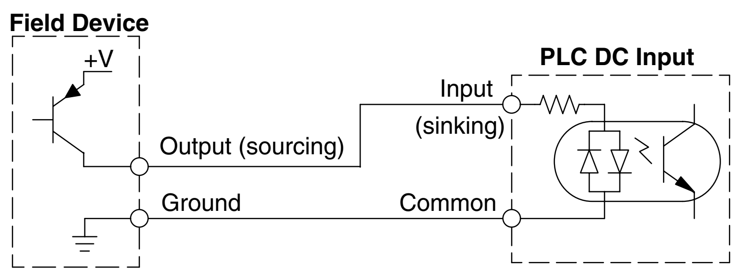
In the previous section on Sourcing and Sinking concepts, the DC I/O circuits were explained to sometimes only allow current to flow one way. This is also true for many of the field devices which have solid-state (transistor) interfaces. In other words, field devices can also be sourcing or sinking. *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 DL205 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.



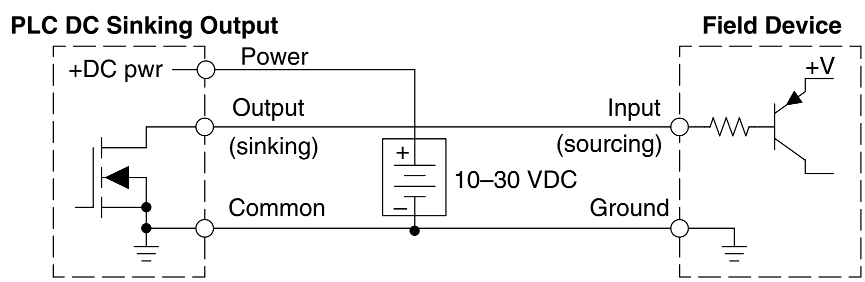
In the next circuit, a field device has an open-collector PNP transistor output. It sources current to the PLC input point, which sinks the current back to ground. Since the field device is sourcing current, no additional power supply is required.



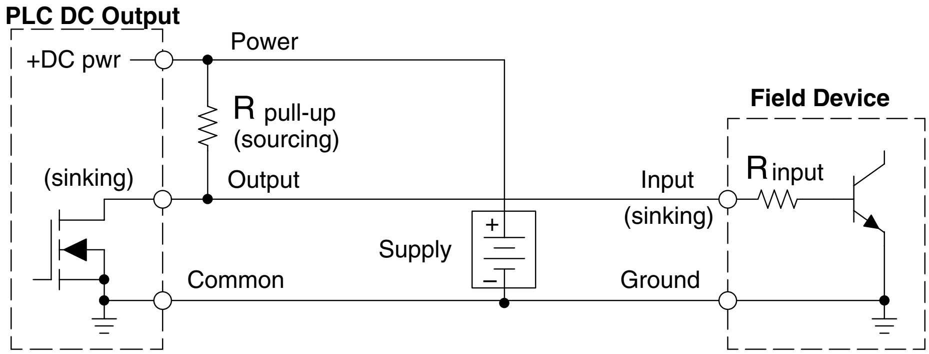
Solid State Output Loads

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 DL205 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 a little 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.



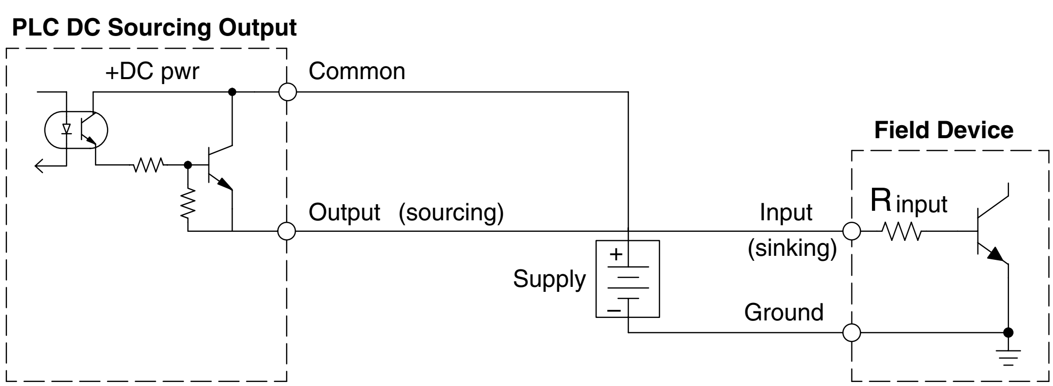
NOTE 1: DO NOT attempt to drive a heavy load (>25 mA) with this pull-up method
NOTE 2: Using the pull-up resistor to implement a sourcing output has the effect of inverting the output point logic. In other words, the field device input is energized when the PLC output is OFF, from a ladder logic point-of-view. 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.

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

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

Of course, the easiest way to drive a sinking input field device as shown below is to use a DC sourcing output module. The Darlington NPN stage will have about 1.5 V ON-state saturation, but this is not a problem with low-current solid-state loads.



Relay Output Guidelines

Several output modules in the DL205 I/O family feature relay outputs: D2–04TRS, D2–08TR, D2–12TR, D2–08CDR, F2–08TR and F2–08TRS. 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)

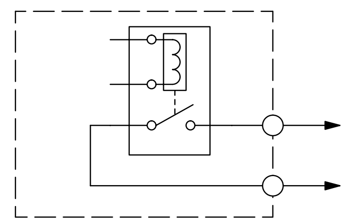
Some applications in which NOT to use relays:

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

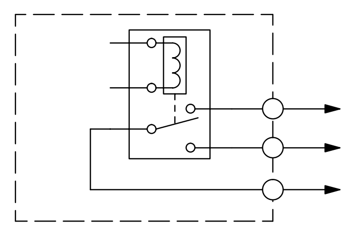
Relay outputs in the DL205 output modules are available in two contact arrangements, shown to the right. The Form A type, or SPST (single pole, single throw) type is normally open and is the simplest to use. The Form C type, or SPDT (single pole, double throw) type has a center contact which moves and 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.

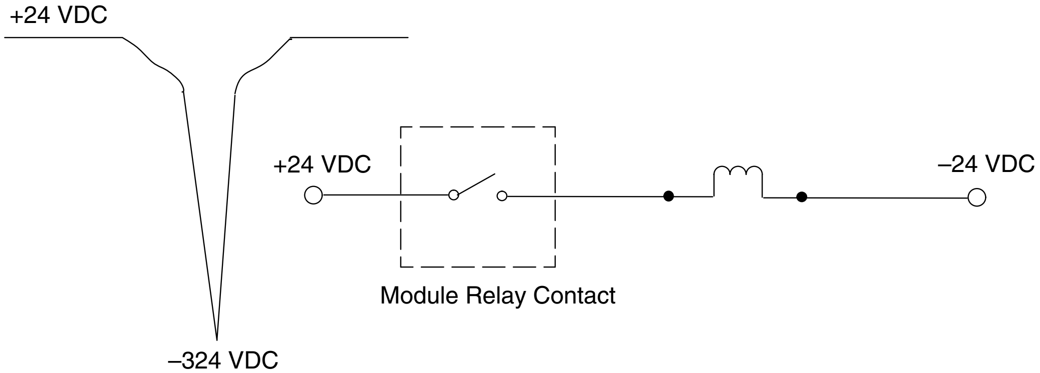
When switching a DC-supplied inductive load the full supply voltage is always present when the relay contact opens (or “bounces”). When switching an AC-supplied inductive load there is one chance in 60 (60 Hz) or 50 (50 Hz) that the relay contact will open (or “bounce”) when the AC sine wave is zero 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.

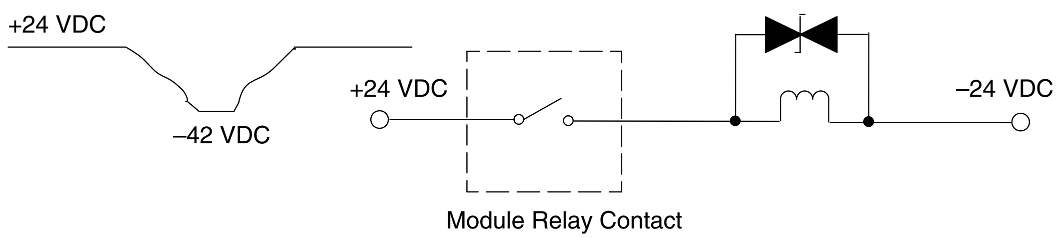
Transient Voltage Suppressors (TVS or transorb) provide the best surge and transient suppression of AC and DC powered coils, providing the fastest response with the smallest overshoot.

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.



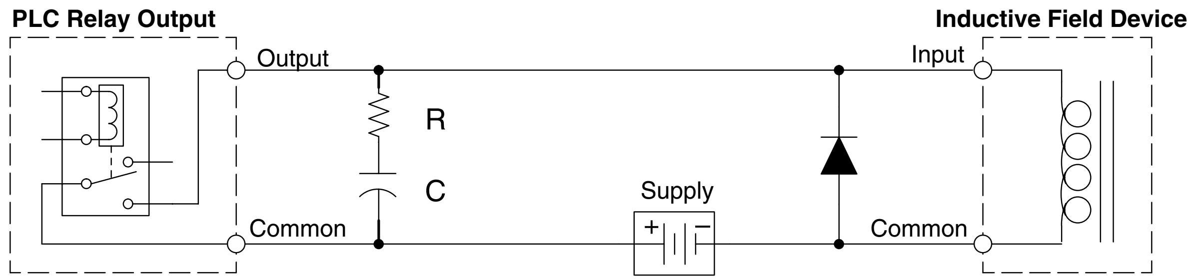
Use the following table to help select a TVS or MOV suppressor for your application based on the inductive load voltage.

Vendor / Catalog	Type (TVS, MOV, Diode)	Inductive Load Voltage	Part Number
AutomationDirect Transient Voltage Suppressors www.automationdirect.com	8–channel TVS 8–channel TVS	24 VDC 110 VAC	ZL–TD8–24 ZL–TD8–120
General Instrument Transient Voltage Suppressors and LiteOn Diodes; from DigiKey Catalog; Phone: 1-800-344-4539	TVS TVS TVS Diode	110/120 VAC 220/240 VAC 12/24 VDC or VAC 12/24 VDC or VAC	P6KE180CAGICT–ND P6KE350CA P6K30CAGICT–ND 1N4004CT–ND
Harris Metal Oxide Varistors; from Newark Catalog; Phone: 1-800-463-9275	MOV MOV	110/120 VAC 220/240 VAC	V150LA20C V250LA20C

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. However, there are some steps you can take to help prolong the life of relay contacts:

- Switch the relay on or off only when the application requires it.
- If you have the option, switch the load on or off at a time when it will draw the least current.
- Take measures to suppress inductive voltage spikes from inductive DC loads such as contactors and solenoids (circuit given below).



Adding external contact protection may extend relay life beyond the number of contact cycles listed in the specification tables for relay modules. High current inductive loads such as clutches, brakes, motors, direct-acting solenoid valves, and motor starters will benefit the most from external contact protection.

The RC network must be located close to the relay module output connector. To find the values for the RC snubber network, first determine the voltage across the contacts when open, and the current through them when closed. If the load supply is AC, then convert the current and voltage values to peak values:

Now you are ready to calculate values for R and C, according to the formulas:

$$C\ (\mu F) = \frac{I^2}{10} \qquad R\ (\Omega) = \frac{V}{10 \times I^{x}}, \text{ where } x = 1 + \frac{50}{V}$$

C minimum = 0.001 μF, the voltage rating of C must be $\geq$ V, non-polarized

R minimum = 0.5 Ω, 1/2 W, tolerance is $\pm$ 5%

For example, suppose a relay contact drives a load at 120VAC, 1/2 A. Since this example has an AC power source, first calculate the peak values:

$I_{peak} = I_{rms}$ x 1.414, = 0.5 x 1.414 = 0.707 Amperes

$V_{peak} = V_{rms}$ x 1.414 = 120 x 1.414 = 169.7 Volts

Now, finding the values of R and C,:

$$C\ (\mu F) = \frac{I^2}{10} = \frac{0.707^2}{10} = 0.05\ \mu F, \text{ voltage rating} \geq 170 \text{ Volts}$$

$$R\ (\Omega) = \frac{V}{10 \times I^x}, \text{ where } x = 1 + \frac{50}{V}$$

$$x = 1 + \frac{50}{169.7} = 1.29 \qquad R\ (\Omega) = \frac{169.7}{10 \times 0.707^{1.29}} = 26\ \Omega,\ 1/2\ W,\ \pm\ 5\%$$

If the contact is switching a DC inductive load, add a diode across the load as near to load coil as possible. 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 as the contacts are opening.

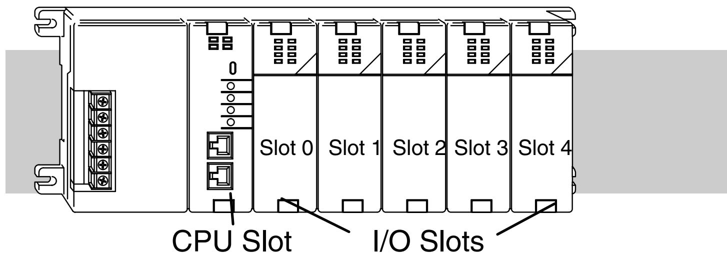
For best results, follow these guidelines in using a noise suppression diode:

- DO NOT use this circuit with an AC power supply.
- 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 DL205 bases each provide different numbers of slots for use with the I/O modules. You may notice the bases refer to 3-slot, 4-slot, etc. One of the slots is dedicated to the CPU, so you always have one less I/O slot. For example, you have five I/O slots with a 6-slot base. The I/O slots are numbered 0 – 4. The CPU slot always contains a PLC CPU or other CPU–slot controller and is not numbered.



Module Placement Restrictions

The following table lists the valid locations for all types of modules in a DL205 system.

Module/Unit	Local CPU Base	Local Expansion Base	Remote I/O Base
CPUs	CPU Slot Only		
DC Input Modules	✔	✔	✔
AC Input Modules	✔	✔	✔
DC Output Modules	✔	✔	✔
AC Output Modules	✔	✔	✔
Relay Output Modules	✔	✔	✔
Analog Input and Output Modules	✔	✔	✔
Local Expansion			
Base Expansion Module	✔	✔	
Base Controller Module		CPU Slot Only	
Serial Remote I/O			
Remote Master	✔		
Remote Slave Unit			CPU Slot Only
Ethernet Remote Master	✔		
CPU Interface			
Ethernet Base Controller	Slot 0 Only		Slot 0 Only*
WinPLC	Slot 0 Only		
DeviceNet	Slot 0 Only		
Profibus	Slot 0 Only		
SDS	Slot 0 Only		
Specialty Modules			
Counter Interface	Slot 0 Only		
Counter I/O	✔		✔*
Data Communications	✔		
Ethernet Communications	✔		
BASIC CoProcessor	✔		
Simulator	✔	✔	✔
Filler	✔	✔	✔

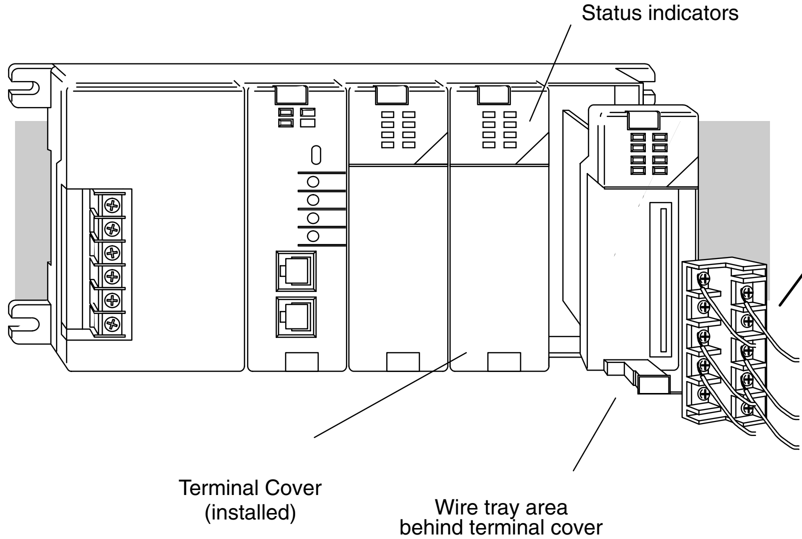
*When used with H2–ERM Ethernet Remote I/O system.

Special Placement Considerations for Analog Modules

In most cases, the analog modules can be placed in any slot. However, the placement can also depend on the type of CPU you are using and the other types of modules installed *to the left* of the analog modules. If you're using a DL230 CPU (or a DL240 CPU with firmware earlier than V1.4) you should check the DL205 Analog I/O Manual for any possible placement restrictions related to your particular module. You can order the DL205 Analog I/O Manual by ordering part number D2–ANLG–M.

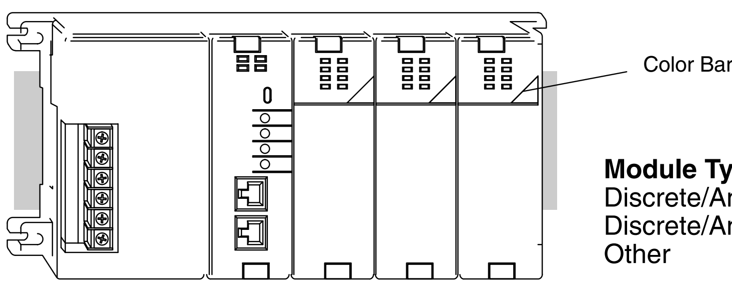
Discrete Input Module Status Indicators

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



Color Coding of I/O Modules

The DL205 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

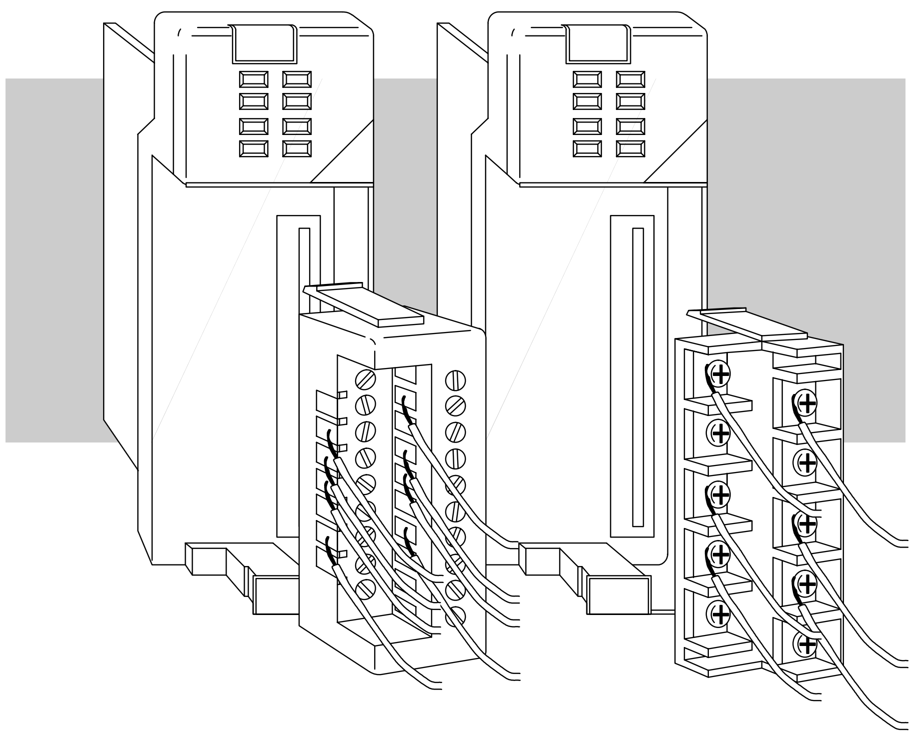
Wiring the Different Module Connectors

There are two types of module connectors for the DL205 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.

Both types of connectors can be easily removed. If you examine the connectors closely, you'll 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). ZIPLinks 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

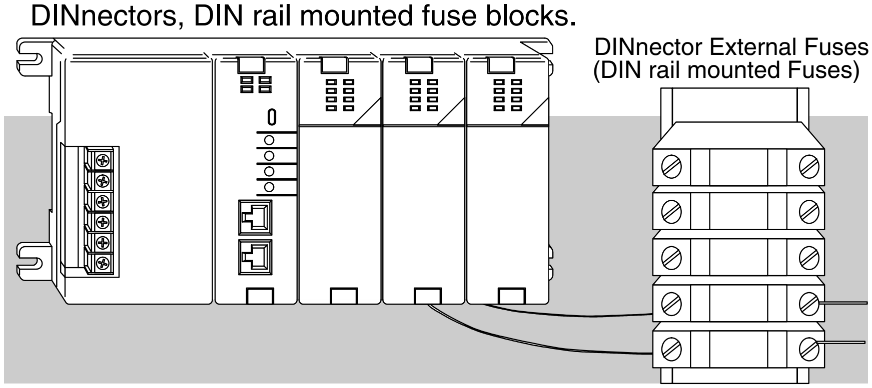
Use the following guidelines when wiring the I/O modules in your system.

1. There is a limit to the size of wire the modules can accept. The table below lists the **suggested** AWG for each module type. When making terminal connections, follow the suggested torque values.

Module type	Suggested AWG Range	Suggested Torque
4 point	16* – 24 AWG	7.81 lb-inch (0.882 N•m)
8 point	16* – 24 AWG	7.81 lb-inch (0.882 N•m)
12 point	16* – 24 AWG	2.65 lb-in (0.3 N•m)
16 point	16* – 24 AWG	2.65 lb-in (0.3 N•m)

***NOTE: 16 AWG Type TFFN or Type MTW is recommended.** Other types of 16 AWG may be acceptable, but it really depends on the thickness and stiffness of the wire insulation. **If the insulation is too thick or stiff and a majority of the module's I/O points are used, then the plastic terminal cover may not close properly or the connector may pull away from the module. This applies especially for high temperature thermoplastics such as THHN.**

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. Also, avoid running input wiring close to output wiring where possible.
6. To minimize voltage drops when wires must run a long distance , consider using multiple wires for the return line.
7. Avoid running DC wiring in close proximity to AC wiring where possible.
8. Avoid creating sharp bends in the wires.
9. 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 DL205 input modules and varies between different modules. The guidelines for using module power is explained in the power budget configuration section in Chapter 4–7.

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.

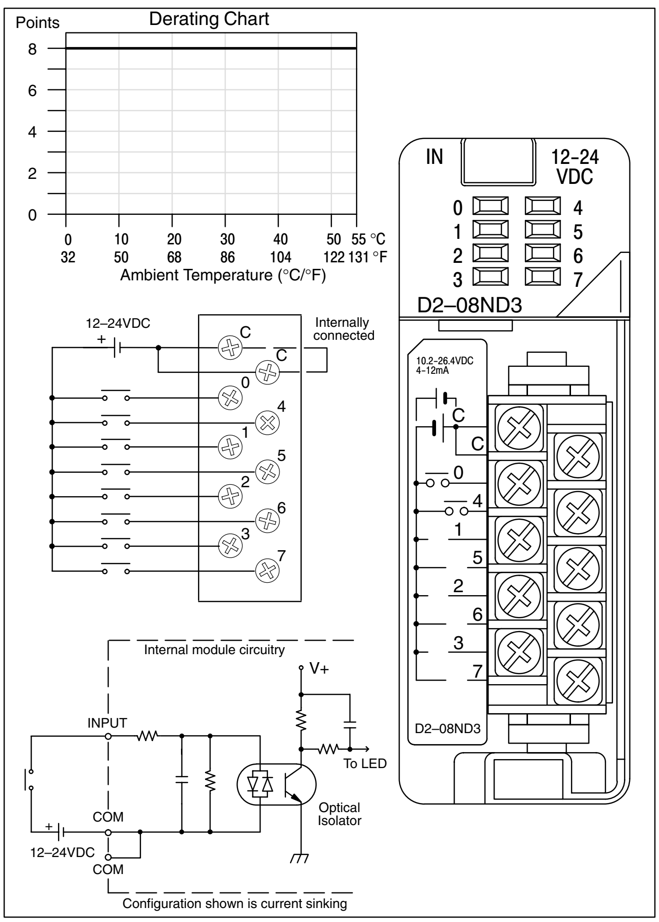
Status Indicators The LEDs that indicate the ON/OFF status of an input point. These LEDs are electrically located on either the logic side or the field device side of the input circuit.

Weight Indicates the weight of the module. See Appendix E for a list of the weights for the various DL205 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.

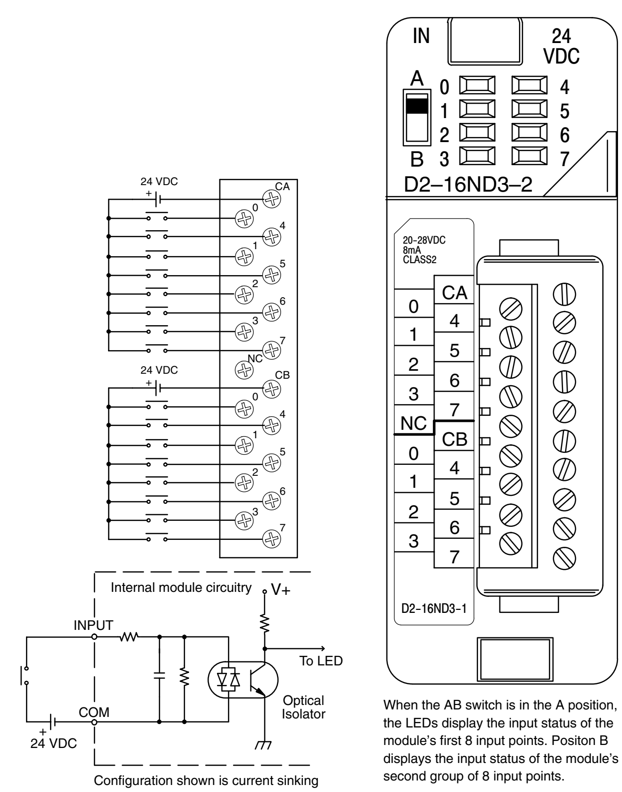
D2–08ND3 DC Input

Inputs per module	8 (sink/source)
Commons per module	1 (2 I/O terminal points)
Input voltage range	10.2–26.4 VDC
Peak voltage	26.4 VDC
AC frequency	n/a
ON voltage level	9.5 VDC minimum
OFF voltage level	3.5 VDC maximum
Input impedance	2.7 K
Input current	4.0 mA @ 12 VDC 8.5 mA @ 24 VDC
Minimum ON current	3.5 mA
Maximum OFF current	1.5 mA
Base power required	50 mA max
OFF to ON response	1 to 8 ms
ON to OFF response	1 to 8 ms
Terminal type	Removable
Status Indicator	Logic side
Weight	2.3 oz. (65 g)



D2–16ND3-2 DC Input

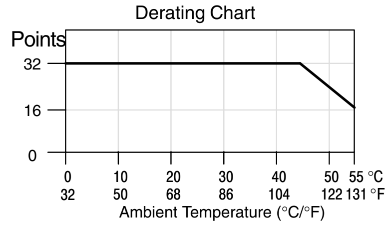
Inputs per module	16 (sink/source)
Commons per module	2 (isolated)
Input voltage range	20–28 VDC
Peak voltage	30 VDC (10 mA)
AC frequency	N/A
ON voltage level	19 VDC minimum
OFF voltage level	7 VDC maximum
Input impedance	3.9 K
Input current	6 mA @ 24 VDC
Minimum ON current	3.5 mA
Maximum OFF current	1.5 mA
Base power required	100 mA Max
OFF to ON response	3 to 9 ms
ON to OFF response	3 to 9 ms
Terminal type	Removable
Status Indicator	Logic side
Weight	2.3 oz. (65 g)

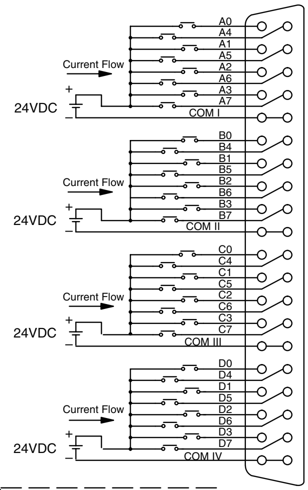


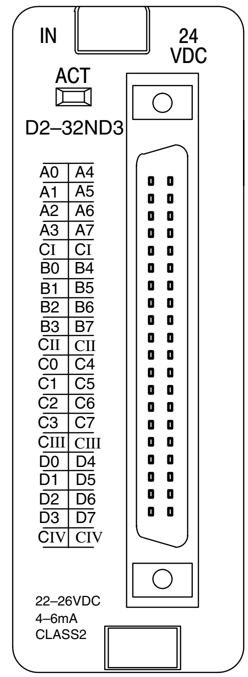
When the AB switch is in the A position, the LEDs display the input status of the module's first 8 input points. Positon B displays the input status of the module's second group of 8 input points.

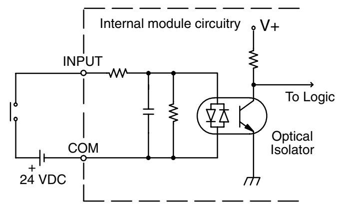
D2–32ND3 DC Input

Inputs per module	32 (sink/source)
Commons per module	4 (8 I/O terminal points)
Input voltage range	20–28 VDC
Peak voltage	30 VDC
AC frequency	n/a
ON voltage level	19 VDC minimum
OFF voltage level	7 VDC maximum
Input impedance	4.8 K
Input current	8.0 mA @ 24 VDC
Minimum ON current	3.5 mA
Maximum OFF current	1.5 mA
Base power required	25 mA max
OFF to ON response	3 to 9 ms
ON to OFF response	3 to 9 ms
Terminal type (removeable)	40-pin Connector or ZIPLink sold separately
Status Indicator	Module Activity LED
Weight	2.1 oz. (60 g)





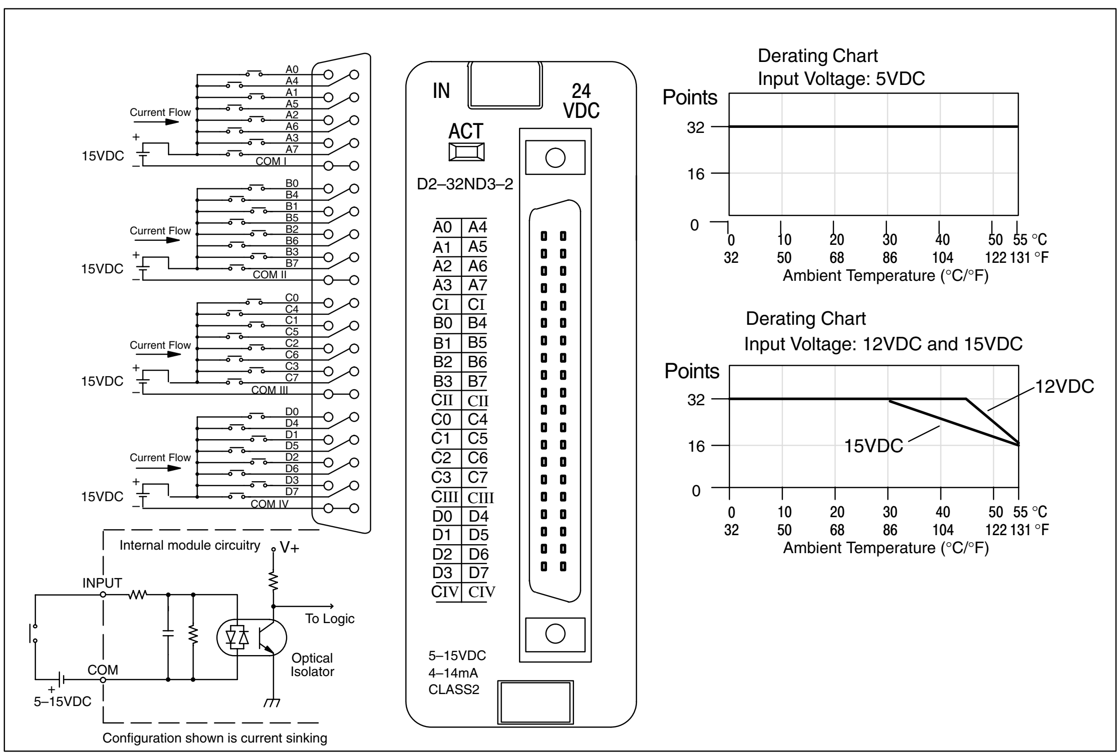




Configuration shown is current sinking

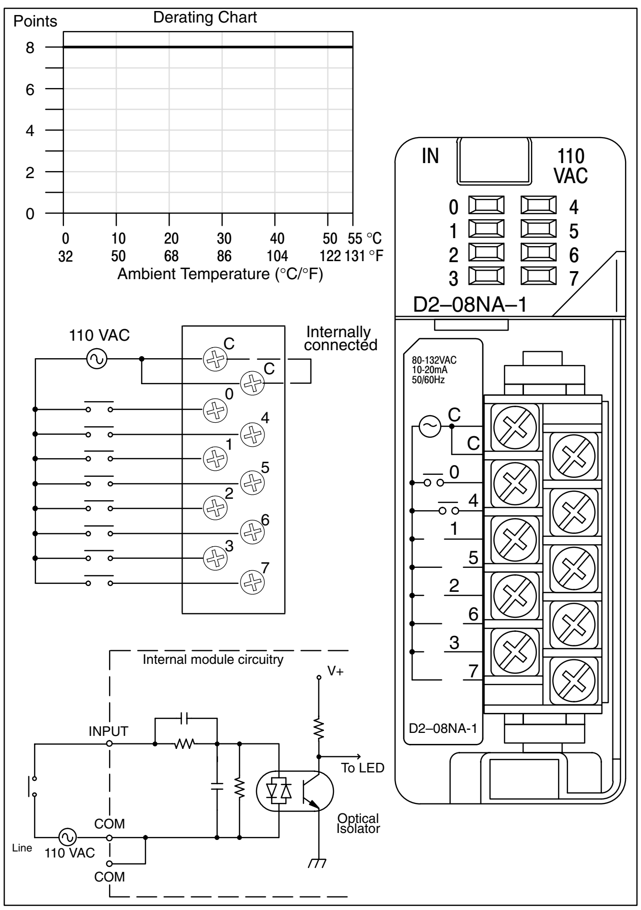
D2–32ND3–2 DC Input

Inputs per module	32 (sink/source)
Commons per module	4 (8 I/O terminal points)
Input voltage range	4.50 to 15.6VDC min to max
Peak voltage	16VDC
Input current	4mA @ 5VDC, 11mA @ 12VDC, 14mA @ 15VDC
Max input current	16mA @ 15.6VDC
Input impedance	1k ohms @ 5–15VDC
ON voltage level	4VDC
OFF voltage level	2VDC
Min ON current	3mA
Max OFF current	0.5mA
OFF to ON response	3 to 9ms
ON to OFF response	3 to 9ms
Status Indicators	Module activity LED
Terminal type (removeable)	40-pin Connector or ZIPLink sold separately
Base power required	5V/25mA max (all points on)
Weight	2.1oz (60g)



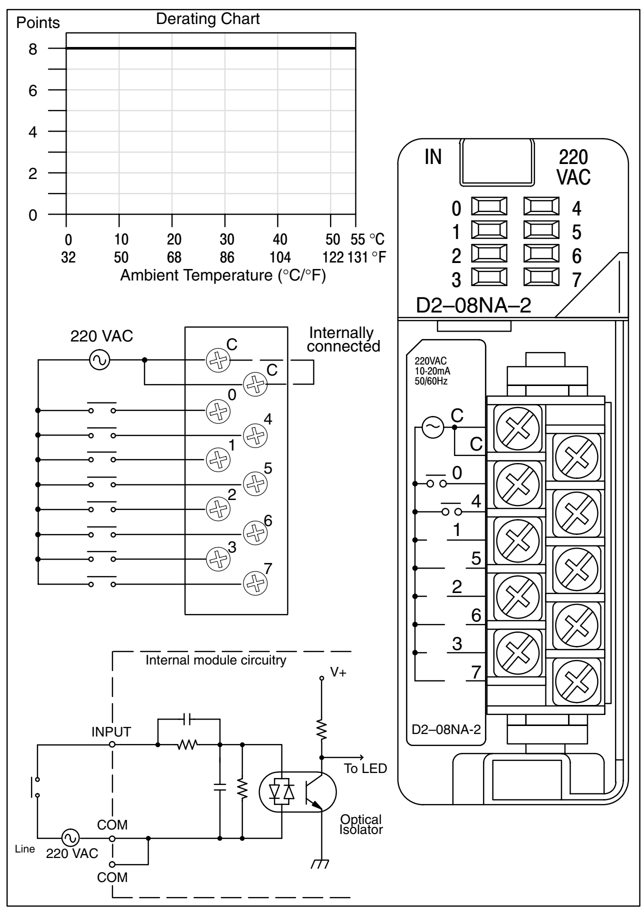
D2–08NA-1 AC Input

Inputs per module	8
Commons per module	1 (2 I/O terminal points)
Input voltage range	80–132 VAC
Peak voltage	132 VAC
AC frequency	47–63 Hz
ON voltage level	75 VAC minimum
OFF voltage level	20 VAC maximum
Input impedance	12K @ 60 Hz
Input current	13mA @ 100VAC, 60Hz 11mA @ 100VAC, 50Hz
Minimum ON current	5 mA
Maximum OFF current	2 mA
Base power required	50 mA Max
OFF to ON response	5 to 30 ms
ON to OFF response	10 to 50 ms
Terminal type	Removable
Status indicator	Logic side
Weight	2.5 oz. (70 g)



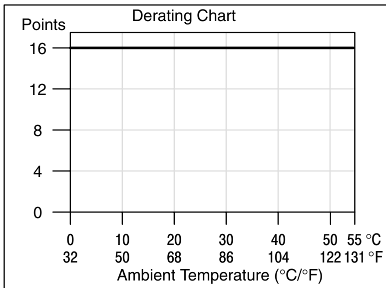
D2–08NA–2 AC Input

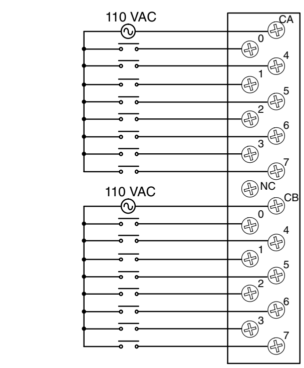
Inputs per module	8
Commons per module	2 (internally connected)
Input voltage range	170–265 VAC
Peak voltage	265 VAC
AC frequency	47–63 Hz
ON voltage level	150 VAC minimum
OFF voltage level	40 VAC maximum
Input impedance	18K @ 60 Hz
Input current	9mA @ 220VAC, 50Hz 11mA @ 265VAC, 60Hz 10mA @ 220VAC, 60Hz 12mA @ 265VAC, 60Hz
Minimum ON current	10 mA
Maximum OFF current	2 mA
Base power required	100 mA Max
OFF to ON response	5 to 30 ms
ON to OFF response	10 to 50 ms
Terminal type	Removable
Status indicator	Logic side
Weight	2.5 oz. (70 g)

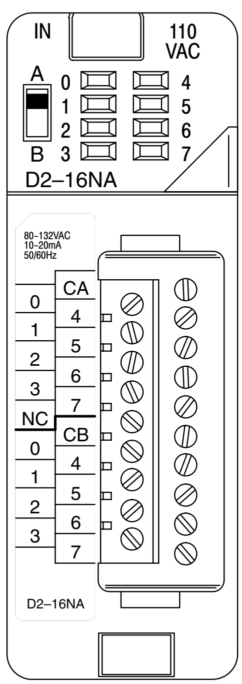


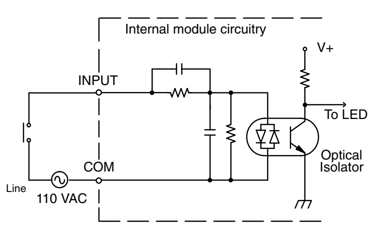
D2–16NA AC Input

Inputs per module	16
Commons per module	2 (isolated)
Input voltage range	80–132 VAC
Peak voltage	132 VAC
AC frequency	47–63 Hz
ON voltage level	70 VAC minimum
OFF voltage level	20 VAC maximum
Input impedance	12K @ 60 Hz
Input current	11mA @ 100VAC, 50Hz 13mA @ 100VAC, 60Hz 15mA @ 132VAC, 60Hz
Minimum ON current	5 mA
Maximum OFF current	2 mA
Base power required	100 mA Max
OFF to ON response	5 to 30 ms
ON to OFF response	10 to 50 ms
Terminal type	Removable
Status indicator	Logic side
Weight	2.4 oz. (68 g)





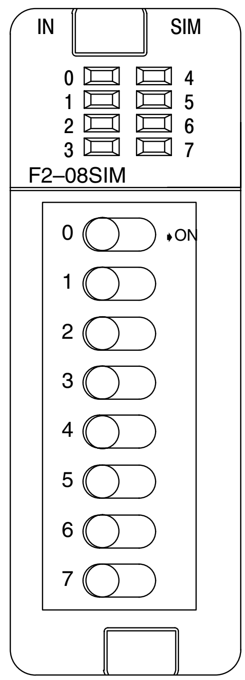




When the AB switch is in the A position, the LEDs display the input status of the module's first 8 input points. Positon B displays the input status of the module's second group of 8 input points.

F2–08SIM Input Simulator

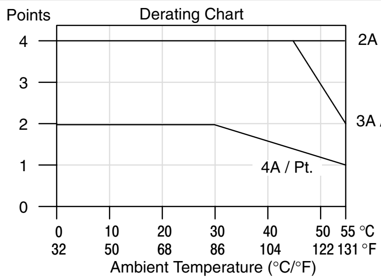
Inputs per module	8
Base power required	50 mA Max
Terminal type	None
Status indicator	Switch side
Weight	2.65 oz. (75 g)

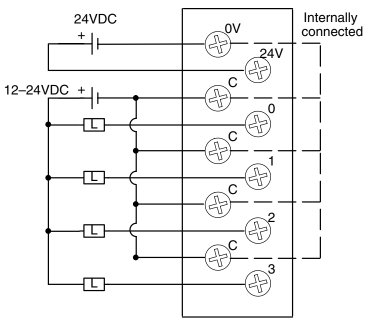


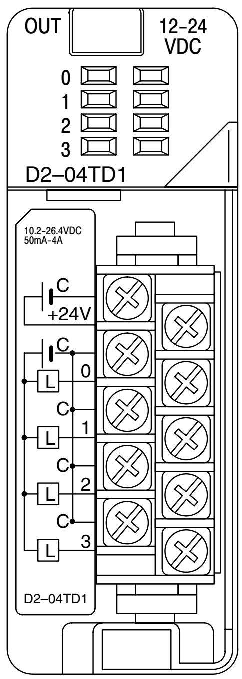
D2–04TD1 DC Output

Outputs per module	4 (current sinking)
Output Points Consumed	8 points (only 1st 4 pts. used)
Commons per module	1 (4 I/O terminal points)
Operating voltage	10.2–26.4 VDC
Output type	NMOS FET (open drain)
Peak voltage	40 VDC
AC frequency	n/a
ON voltage drop	0.72 VDC maximum
Max load current (resistive)	4A / point 8A / common
Max leakage current	0.1mA @ 40 VDC

Max inrush current	6A for 100ms, 15A for 10 ms
Minimum load	50mA
Base power required 5v	60mA Max
OFF to ON response	1 ms
ON to OFF response	1 ms
Terminal type	Removable
Status indicators	Logic Side
Weight	2.8 oz. (80 g)
Fuses	4 (1 per point) 6.3A slow blow (non–replaceable)







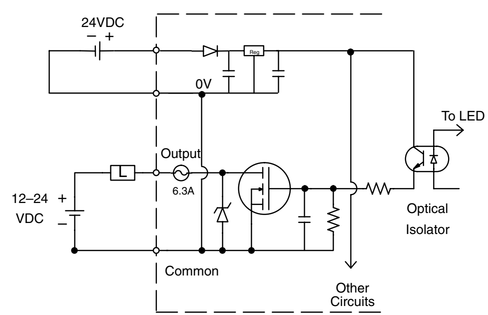
Inductive Load
Maximum Number of Switching Cycles per Minute

Load Current	Duration of output in ON state 7ms	40ms	100ms
0.1A	8000	1400	600
0.5A	1600	300	120
1.0A	800	140	60
1.5A	540	90	35
2.0A	400	70	–
3.0A	270	–	–
4.0A	200	–	–

At 40ms duration, loads of 3.0A or greater cannot be used.

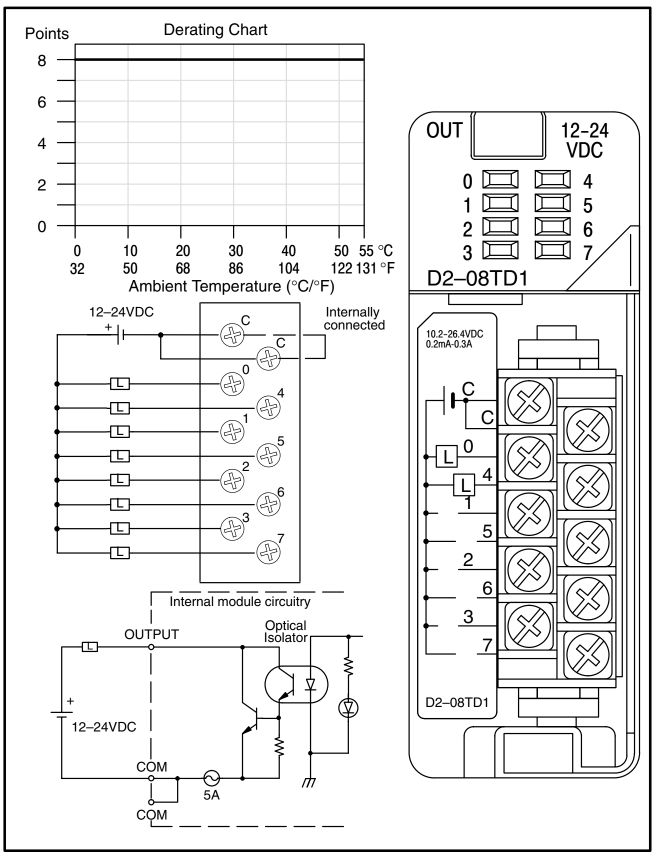
At 100ms duration, loads of 2.0A or greater cannot be used.

Here's how to use the table. Find the load current you expect to use and the duration that the ouput is ON. The number at the intersection of the row and column represents the switching cycles per minute. For example, a 1A inductive load that is on for 100ms can be switched on and off a maximum of 60 times per minute. To convert this to duty cycle percentage use: (Duration x cycles) / 60. Our example would be (60x.1) / 60 = .1 (10% duty cycle).



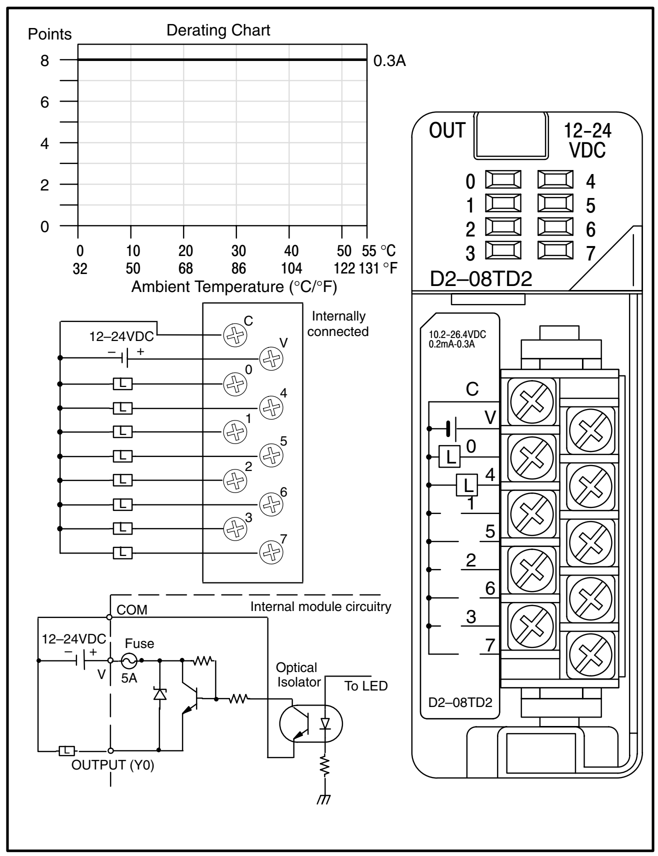
D2–08TD1 DC Output

Outputs per module	8 (current sinking)
Commons per module	1 (2 I/O terminal points)
Operating voltage	10.2–26.4 VDC
Output type	NPN open collector
Peak voltage	40 VDC
AC frequency	n/a
ON voltage drop	1.5 VDC maximum
Max load current	0.3A / point 2.4A / common
Max leakage current	0.1mA @ 40 VDC
Max inrush current	1A for 10 ms
Minimum load	0.5mA
Base power required 5v	100mA Max
OFF to ON response	1 ms
ON to OFF response	1 ms
Terminal type	Removable
Status indicators	Logic Side
Weight	2.3 oz. (65 g)
Fuses	1 per common 5A fast blow (non–replaceable)



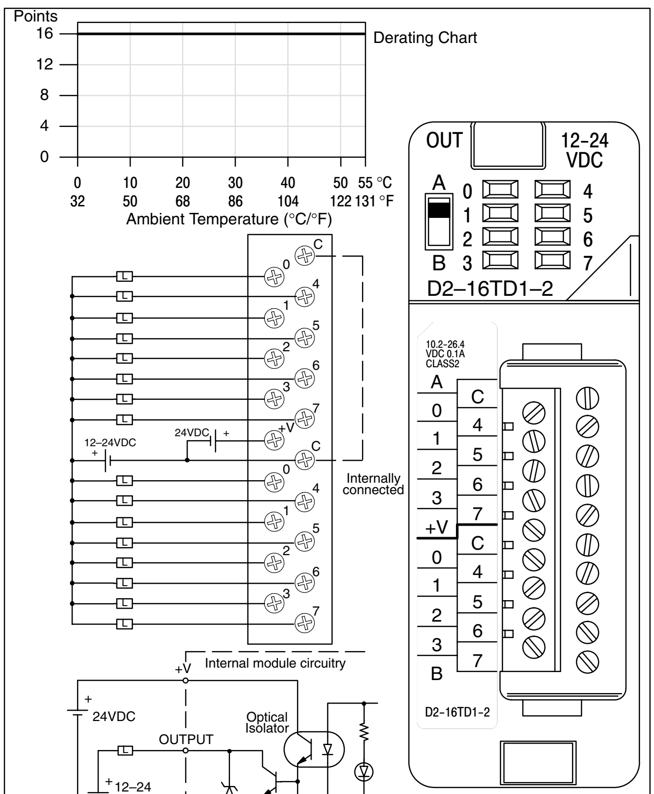
D2–08TD2 DC Output

Outputs per module	8 (current sourcing)
Commons per module	1
Output voltage	10.8–26.4VDC
Operating voltage range	12–24VDC
Peak voltage	40VDC
AC frequency	n/a
ON voltage drop	1.5 VDC
Max output current	0.3A / point, 2.4A / common
Max leakage current	1mA @ 40VDC
Max inrush current	1A for 10ms
OFF to ON response	1ms
ON to OFF response	1ms
Terminal type	Removable
Status indicators	Logic Side
Weight	2.3 oz. (65 g)
Fuse	5A/250V fast blow (non–replaceable)
Base power required	5V/100mA max



D2–16TD1–2 DC Output

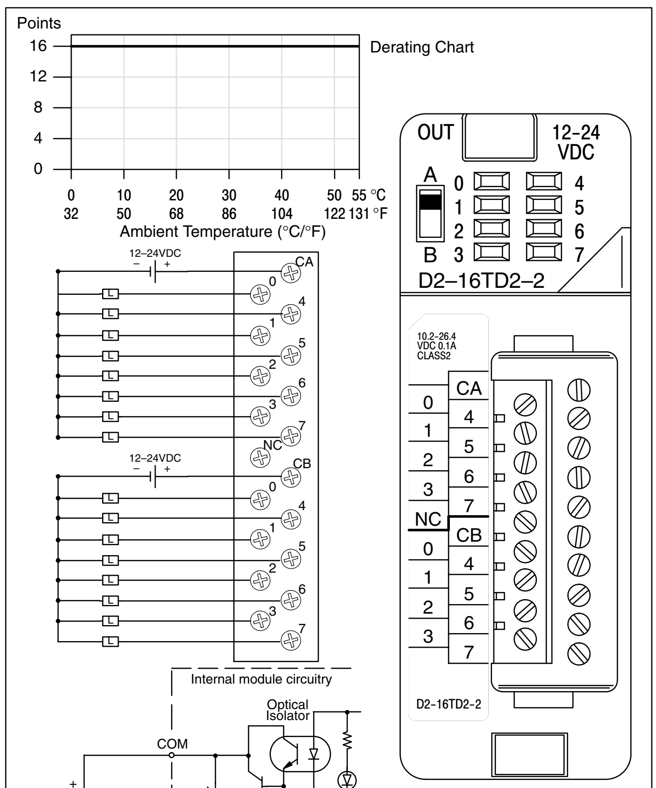
Outputs per module	16 (current sinking)
Commons per module	1 (2 I/O terminal points)
Operating voltage	10.2–26.4 VDC
Output type	NPN open collector
Peak voltage	30 VDC
AC frequency	N/A
ON voltage drop	0.5 VDC maximum
Max load current	0.1A / point 1.6A / common
Max leakage current	0.1mA @ 30 VDC
Max inrush current	150mA for 10 ms
Minimum load	0.2mA
Base power required	200mA Max
OFF to ON response	0.5 ms
ON to OFF response	0.5 ms
Terminal type	Removable
Status indicators	Logic Side
Weight	2.3 oz. (65 g)
Fuses	none
External DC required	24VDC ±4V @ 80mA max



When the AB switch is in the A position, the LEDs display the output status of the module's first 8 output points. Positon B displays the output status of the second group of 8 output points.

D2–16TD2–2 DC Output

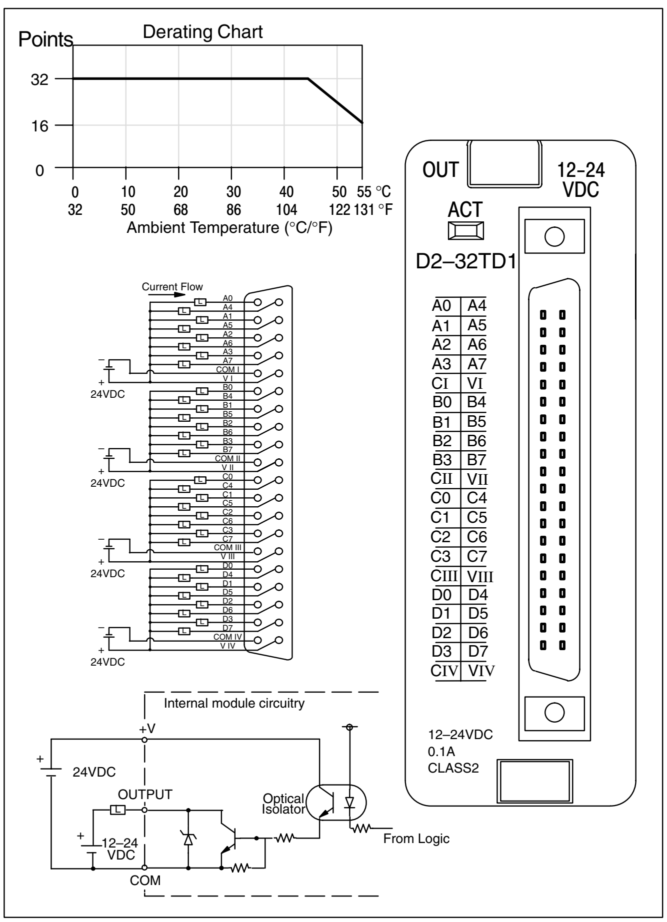
Outputs per module	16 (current sourcing)
Commons per module	2
Operating voltage	10.2–26.4 VDC
Output type	NPN open collector
Peak voltage	30 VDC
AC frequency	N/A
ON voltage drop	1.0 VDC maximum
Max load current	0.1A / point 1.6A / common
Max leakage current	0.1mA @ 30 VDC
Max inrush current	150 mA for 10 ms
Minimum load	0.2mA
Base power required	200mA Max
OFF to ON response	0.5 ms
ON to OFF response	0.5 ms
Terminal type	Removable
Status indicators	Logic Side
Weight	2.8 oz. (80 g)
Fuses	none



When the AB switch is in the A position, the LEDs display the output status of the module's first 8 output points Positon B displays the output status of the module's second group of 8 output points.

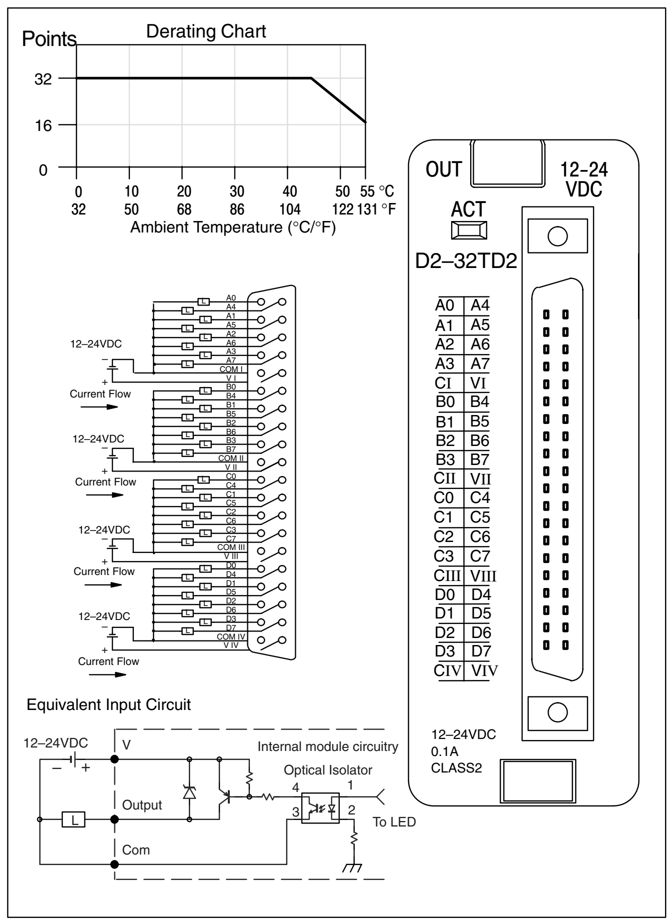
D2–32TD1 DC Output

Outputs per module	32 (current sinking)
Commons per module	4 (8 I/O terminal points)
Operating voltage	12–24 VDC
Output type	NPN open collector
Peak voltage	30 VDC
AC frequency	N/A
ON voltage drop	0.5 VDC maximum
Max load current	0.1A / point
Max leakage current	0.1mA @ 30 VDC
Max inrush current	150 mA for 10 ms
Minimum load	0.2mA
Base power required	350mA Max
OFF to ON response	0.5 ms
ON to OFF response	0.5 ms
Terminal type (removeable)	40-pin connector or ZIPLink sold separately
Status indicators	Module Activity
Weight	2.1 oz. (60 g)
Fuses	none



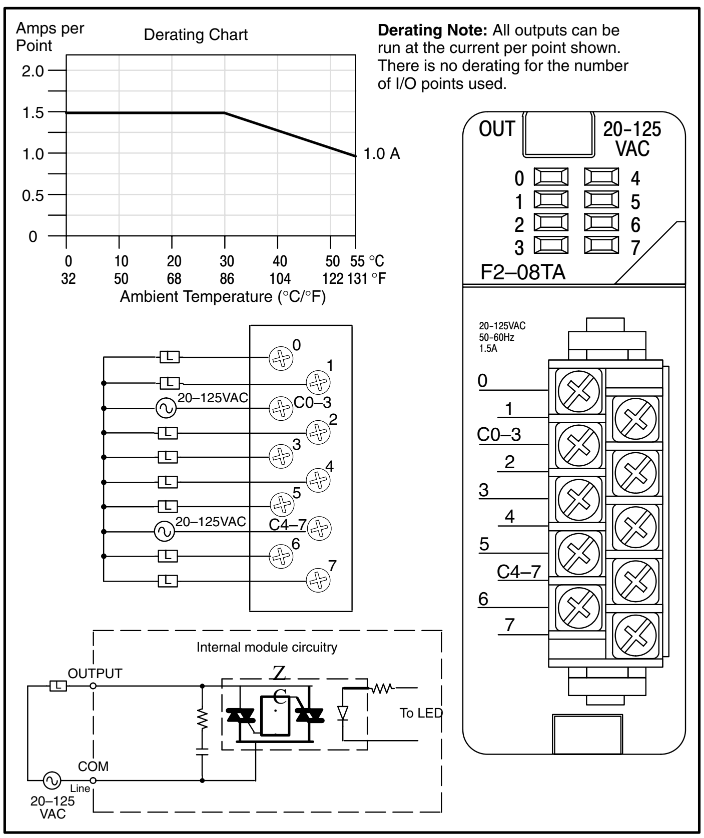
D2–32TD2 DC Output

Outputs per module	32 (current sourcing)
Commons per module	4, 8 points / common (isolated)
Operating voltage	12 to 24VDC
Peak voltage	30VDC
Max load current	0.1A / point, 0.8A / common
Min load	0.2mA
Max leakage current	0.1mA @ 30VDC
ON voltage drop	0.5 VDC @ 0.1A
Max inrush current	150mA @ 10ms
OFF to ON response	0.5ms
ON to OFF response	0.5ms
Status indicators	Module activity: green LED I/O Status: none
Terminal type (removeable)	40-pin connector or ZIPLink sold separately
Weight	2.1oz. (60g)
Fuses	none
Base power required	5V/350mA max (all points on)



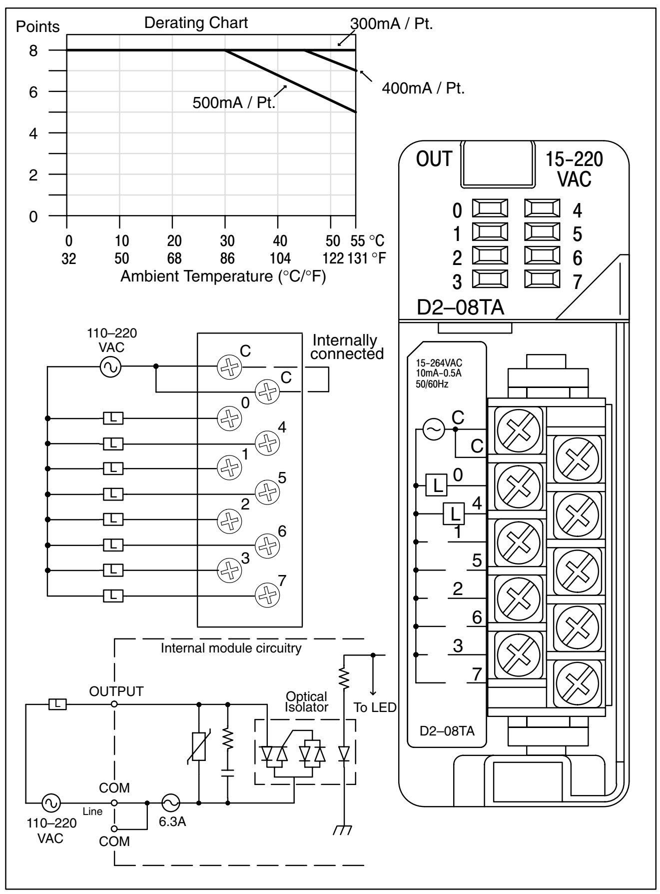
F2–08TA AC Output

Outputs per module	8
Output Points Consumed	10
Commons per module	2 (isolated)
Operating voltage	24–140 VAC
Output type	SSR (Triac with Zero Crossover)
Peak voltage	140 VAC
AC frequency	47 to 63 Hz
ON voltage drop	1.6 Vrms @ 1.5A
Max load current	1.5A / point @ 30°C, 1.0A / point @ 60°C 4.0A / common; 8A/module @ 60°C
Max leakage current	0.7mA(rms)
Peak one cycle surge current	15A
Minimum load	10mA
Base power required	250mA max
OFF to ON response	0.5mS– 1/2 cycle
ON to OFF response	0.5mS– 1/2 cycle
Terminal type	Removable
Status indicators	Logic side
Weight	3.5 oz.
Fuses	N/A



D2–08TA AC Output

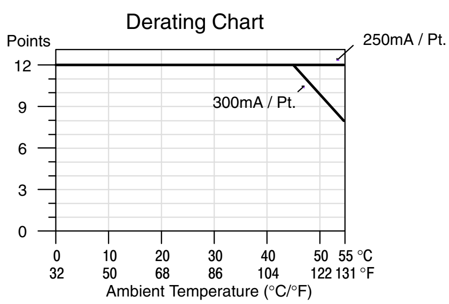
Outputs per module	8
Commons per module	1 (2 I/O terminal points)
Operating voltage	15–264 VAC
Output type	SSR (Triac)
Peak voltage	264 VAC
AC frequency	47 to 63 Hz
ON voltage drop	< l.5 VAC (> 0.1A) < 3.0 VAC (< 0.1A)
Max load current	0.5A / point 4A / common
Max leakage current	4mA (264VAC, 60Hz) 1.2mA (100VAC, 60Hz) 0.9mA (100VAC,50Hz)
Max inrush current	10A for 10 ms
Minimum load	10 mA
Base power required	20 mA / ON pt. 250 mA max
OFF to ON response	1 ms
ON to OFF response	1 ms +1/2 cycle
Terminal type	Removable
Status indicators	Logic Side
Weight	2.8 oz. (80 g)
Fuses	1 per common, 6.3A slow blow



D2–12TA AC Output

Outputs per module	12
Output Points Consumed	16 (4 unused, see chart below)
Commons per module	2 (isolated)
Operating voltage	15–132 VAC
Output type	SSR (Triac)
Peak voltage	132 VAC
AC frequency	47 to 63 Hz
ON voltage drop	< l.5 VAC (> 50mA) < 4.0 VAC (< 50mA)
Max load current	0.3A / point, 1.8A / common

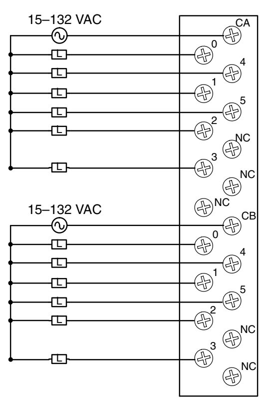
Max leakage current	2mA (132VAC, 60Hz)
Max inrush current	10A for 10 ms
Minimum load	10 mA
Base power required	350 mA Max
OFF to ON response	1 ms
ON to OFF response	1 ms +1/2 cycle
Terminal type	Removable
Status indicators	Logic Side
Weight	3.8 oz. (110 g)
Fuses	(2) 1 per common 3.15A slow blow, replaceable Order D2–FUSE–1 (5 per pack)

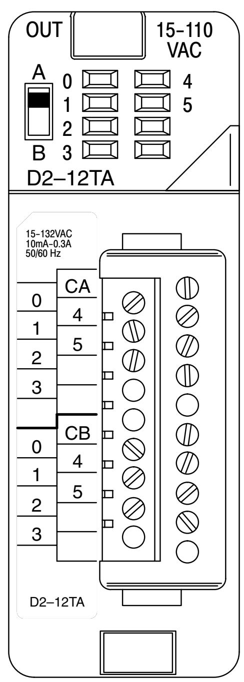


Addresses Used

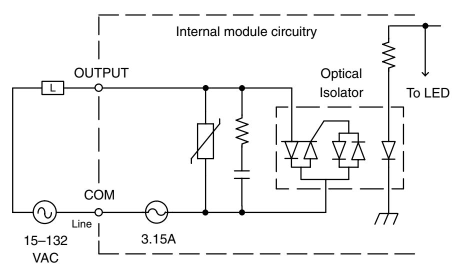
Points	Used?	Points	Used?
Yn+0	Yes	Yn+10	Yes
Yn+1	Yes	Yn+11	Yes
Yn+2	Yes	Yn+12	Yes
Yn+3	Yes	Yn+13	Yes
Yn+4	Yes	Yn+14	Yes
Yn+5	Yes	Yn+15	Yes
Yn+6	No	Yn+16	No
Yn+7	No	Yn+17	No

n is the starting address





When the AB switch is in the A position, the LEDs display the output status of the module's first 6 output points. Positon B displays the output status of the module's second group of 6 output points.



D2–04TRS Relay Output

Outputs per module	4
Commons per module	4 (isolated)
Output Points Consumed	8 (only 1st 4pts. are used)
Operating voltage	5–30VDC / 5–240VAC
Output type	Relay, form A (SPST)
Peak voltage	30VDC, 264VAC
AC frequency	47–63 Hz
ON voltage drop	0.72 VDC maximum
Max load current (resistive)	4A / point 8A / module (resistive)
Max leakage current	0.1mA @ 264VAC

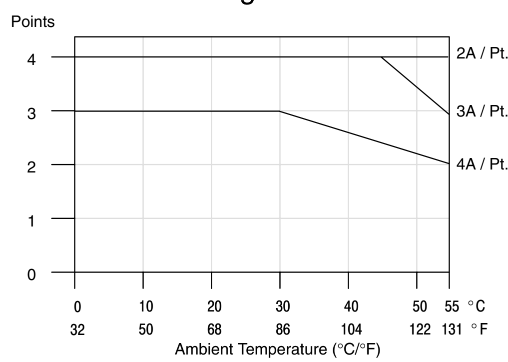
Max inrush current	5A for < 10ms
Minimum load	10mA
Base power required 5v	250mA Max
OFF to ON response	10 ms
ON to OFF response	10 ms
Terminal type	Removable
Status indicators	Logic Side
Weight	2.8 oz. (80 g)
Fuses	1 per point 6.3A slow blow, replaceable Order D2–FUSE–3 (5 per pack)

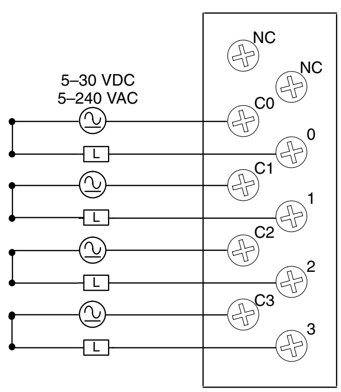
Typical Relay Life (Operations)

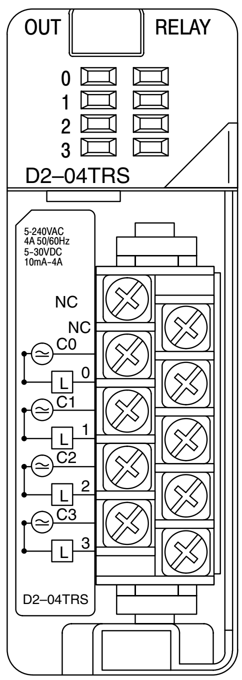
Voltage & Type of Load	Load Current 1A	2A	3A	4A
24 VDC Resistive	500K	200K	100K	50K
24 VDC Solenoid	100K	40K	–	–
110 VAC Resistive	500K	250K	150K	100K
110 VAC Solenoid	200K	100K	50K	–
220 VAC Resistive	350K	150K	100K	50K
220 VAC Solenoid	100K	50K	–	–

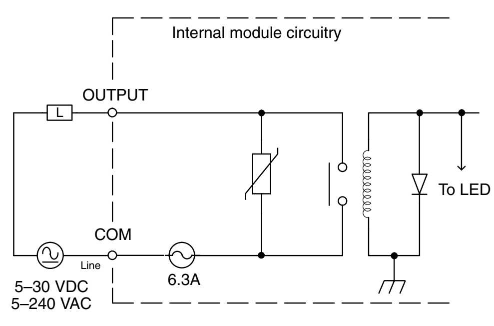
At 24 VDC, solenoid (inductive) loads over 2A cannot be used.
At 110 VAC, solenoid (inductive) loads over 3A cannot be used.
At 220 VAC, solenoid (inductive) loads over 2A cannot be used.

Derating Chart









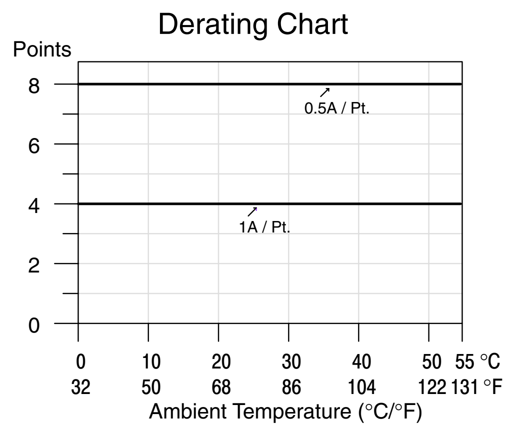
D2–08TR Relay Output

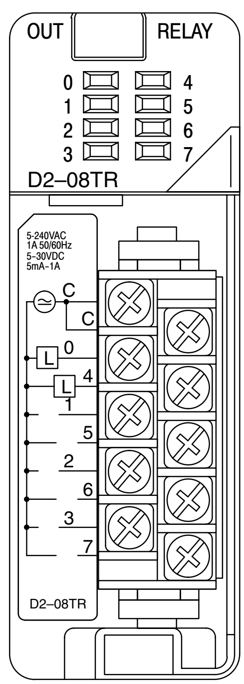
Outputs per module	8
Commons per module	1 (2 I/O terminal points)
Operating voltage	5–30VDC / 5–240VAC
Output type	Relay, form A (SPST)
Peak voltage	30VDC / 264VAC
AC frequency	47 to 60 Hz
ON voltage drop	N/A
Max current (resistive)	1A / point 4A / common
Max leakage current	0.1mA @ 265 VAC
Max inrush current	Output: 3A for 10 ms Common: 10A for 10ms

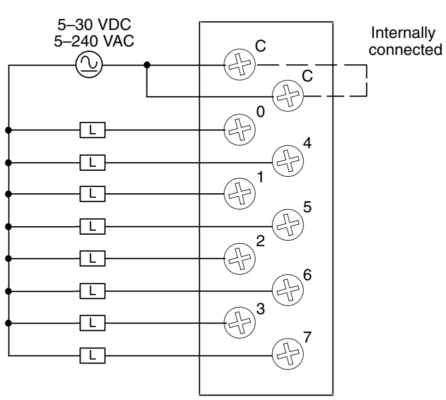
Minimum load	5mA @ 5VDC
Base power required	250mA max
OFF to ON response	12 ms
ON to OFF response	10 ms
Terminal type	Removable
Status indicators	Logic Side
Weight	3.9 oz. (110 g)
Fuses	1 6.3A slow blow, replaceable Order D2–FUSE–3 (5 per pack)

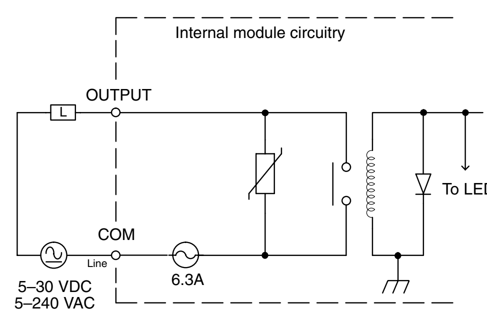
Typical Relay Life (Operations)

Voltage / Load		Current	Closures
24VDC	Resistive	1A	500K
24VDC	Solenoid	1A	100K
110VAC	Resistive	1A	500K
110VAC	Solenoid	1A	200K
220VAC	Resistive	1A	350K
220VAC	Solenoid	1A	100K









F2–08TR Relay Output

Outputs per module	8
Commons per module	2 (isolated)
Output Points Consumed	8
Operating voltage	12–28VDC, 12–250VAC, 10A 120VDC, 0.5A
Output type	8 Form A (SPST normally open)
Peak voltage	150VDC, 265VAC
AC frequency	47–63 Hz
ON voltage drop	N/A
Max load current (resistive)	10A/common (subject to derating)

Max leakage current	N/A
Max inrush current	12A
Minimum load	10mA @ 12VDC
Base power required 5v	670mA Max
OFF to ON response	15 ms (typical)
ON to OFF response	5 ms (typical)
Terminal type	Removable
Status indicators	Logic Side
Weight	5.5 oz. (156g)
Fuses	None

Typical Relay Life[1] (Operations) at Room Temperature

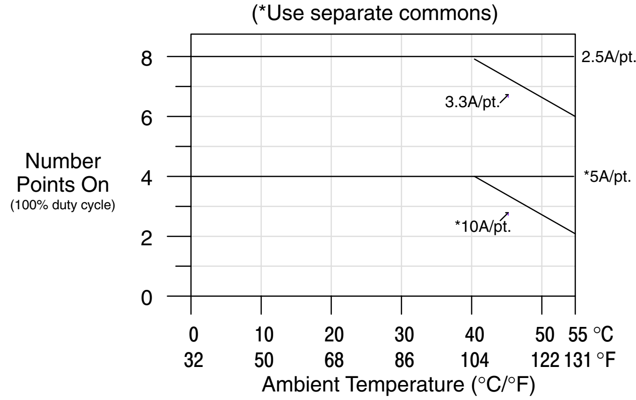
Voltage & Type of Load[2]	Load Current 50mA	5A	7A
24 VDC Resistive	10M	600K	300K
24 VDC Solenoid	–	150K	75K
110 VAC Resistive	–	600K	300K
110 VAC Solenoid	–	500K	200K
220 VAC Resistive	–	300K	150K
220 VAC Solenoid	–	250K	100K

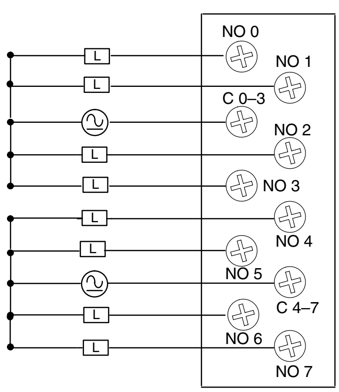
1 Contact life may be extended beyond those values shown by the use of arc suppression techniques described in the 205 User Manual. Since these modules have no leakage current, they do not have a built in snubber. For example, if you place a diode across a 24VDC inductive load, you can significantly increase the life of the relay.

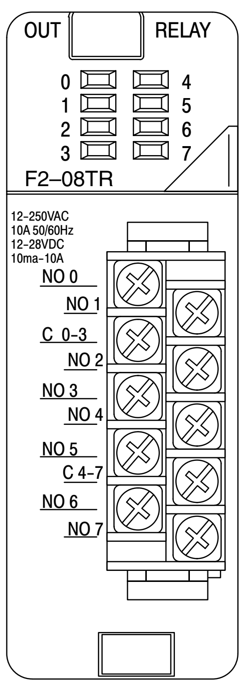
2 At 120 VDC 0.5A resistive load, contact life cycle is 200K cycles.

Derating Chart

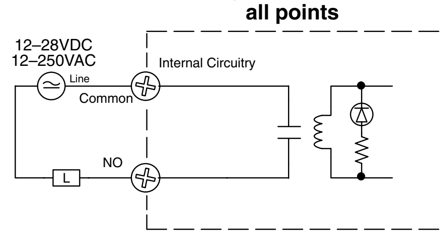
(*Use separate commons)







Typical Circuit all points



F2–08TRS Relay Output

Outputs per module	8
Commons per module	8 (isolated)
Output Points Consumed	8
Operating voltage	12–28VDC, 12–250VAC, 7A 120VDC, 0.5A
Output type	3, Form C (SPDT) 5, Form A (SPST normally open)
Peak voltage	150VDC, 265VAC
AC frequency	47–63 Hz
ON voltage drop	N/A
Max load current (resistive)	7A/point3 (subject to derating)

Max leakage current	N/A
Max inrush current	12A
Minimum load	10mA @ 12VDC
Base power required 5v	670mA Max
OFF to ON response	15 ms (typical)
ON to OFF response	5 ms (typical)
Terminal type	Removable
Status indicators	Logic Side
Weight	5.5 oz. (156g)
Fuses	None

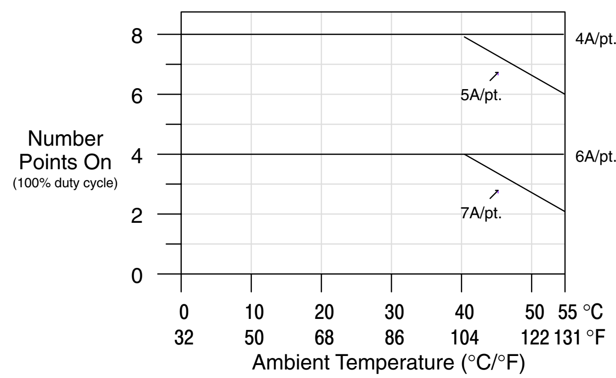
Typical Relay Life[1] (Operations) at Room Temperature

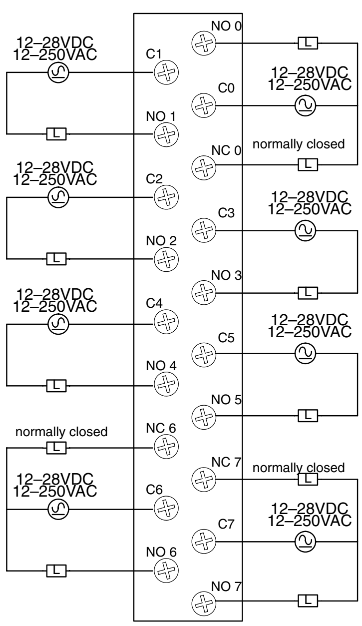
Voltage & Type of Load[2]	Load Current[3] 50mA	5A	7A
24 VDC Resistive	10M	600K	300K
24 VDC Solenoid	–	150K	75K
110 VAC Resistive	–	600K	300K
110 VAC Solenoid	–	500K	200K
220 VAC Resistive	–	300K	150K
220 VAC Solenoid	–	250K	100K

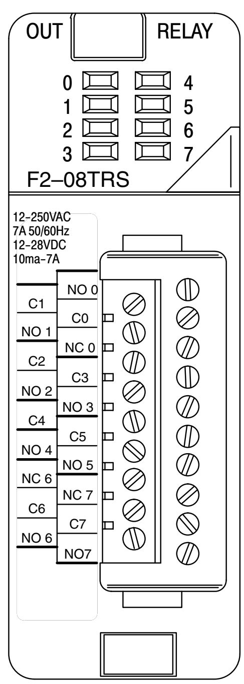
1 At 120 VDC 0.5A resistive load, contact life cycle is 200K cycles.

2 Normally closed contacts have 1/2 the current handling capability of the normally open contacts.

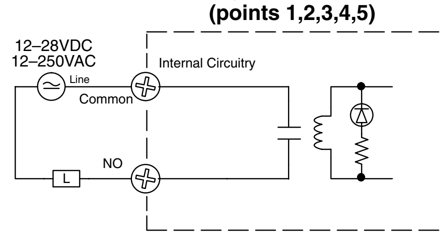
Derating Chart



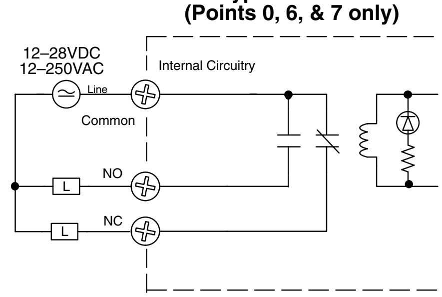




Typical Circuit (points 1,2,3,4,5)



Typical Circuit (Points 0, 6, & 7 only)



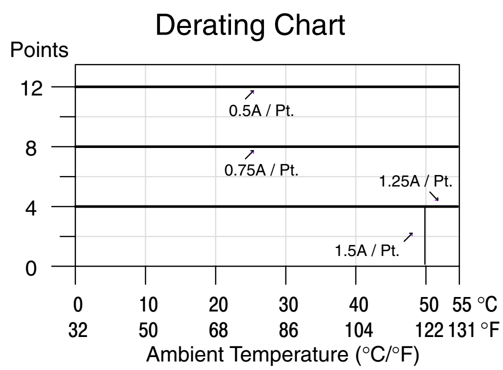
D2–12TR Relay Output

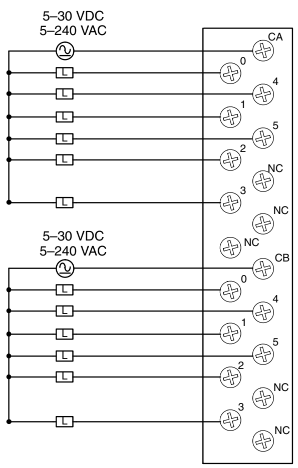
Outputs per module	12
Outputs Consumed	16 (4 unused, see chart below)
Commons per module	2 (6pts. per common)
Operating voltage	5–30VDC / 5–240VAC
Output type	Relay, form A (SPST)
Peak voltage	30VDC / 264VAC
AC frequency	47 to 60 Hz
ON voltage drop	N/A
Max current (resistive)	1.5A / point 3A / common
Max leakage current	0.1mA @ 265 VAC

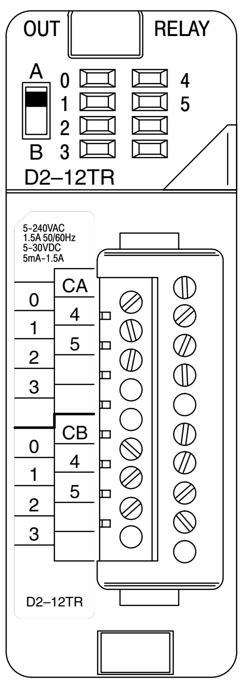
Max inrush current	Output: 3A for 10 ms Common: 10A for 10ms
Minimum load	5mA @ 5VDC
Base power required	450mA max
OFF to ON response	10 ms
ON to OFF response	10 ms
Terminal type	Removable
Status indicators	Logic Side
Weight	4.6 oz. (130 g)
Fuses	2 4A slow blow, replaceable Order D2–FUSE–4 (5 per pack)

Typical Relay Life (Operations)

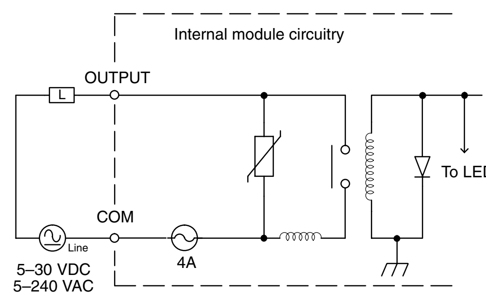
Voltage / Load		Current	Closures
24VDC	Resistive	1A	500K
24VDC	Solenoid	1A	100K
110VAC	Resistive	1A	500K
110VAC	Solenoid	1A	200K
220VAC	Resistive	1A	350K
220VAC	Solenoid	1A	100K







When the AB switch is in the A position, the LEDs display the output status of the module's first 8 output points. Positon B displays the output status of the module's second group of 8 output points.



Addresses Used

Points	Used?	Points	Used?
Yn+0	Yes	Yn+10	Yes
Yn+1	Yes	Yn+11	Yes
Yn+2	Yes	Yn+12	Yes
Yn+3	Yes	Yn+13	Yes
Yn+4	Yes	Yn+14	Yes
Yn+5	Yes	Yn+15	Yes
Yn+6	No	Yn+16	No
Yn+7	No	Yn+17	No

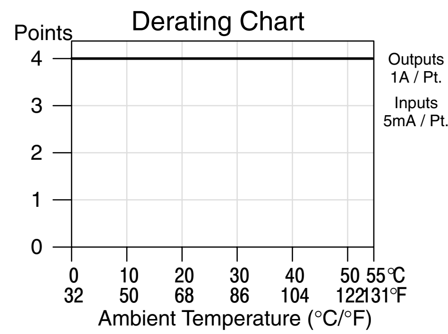
n is the starting address

D2–08CDR 4 pt. DC Input / 4pt. Relay Output

Input Specifications	
Inputs per module	4 (sink/source)
Input Points Consumed	8 (only 1st 4pts. are used)
Input Commons per module	1
Input voltage range	20 – 28 VDC
Peak voltage	30 VDC
AC frequency	n/a
ON voltage level	19 VDC minimum
OFF voltage level	7 VDC maximum
Input impedance	4.7 K
Input current	5 mA @ 24 VDC
Maximum Current	8 mA @ 30 VDC
Minimum ON current	4.5 mA
Maximum OFF current	1.5 mA
OFF to ON response	1 to 10 ms
ON to OFF response	1 to 10 ms
Fuse (input circuits)	None

General Specifications	
Base power required	200 mA max
Terminal type	Removable
Status Indicators	Logic side
Weight	3.5 oz. (100 g)

Output Specifications	
Outputs per module	4
Output Points Consumed	8 (only 1st 4pts. are used)
Output Commons per module	1
Operating voltage	5–30VDC / 5–240VAC
Output type	Relay, form A (SPST)
Peak voltage	30VDC, 264VAC
AC frequency	47–63 Hz
Max load current (resistive)	1A / point 4A / module (resistive)
Max leakage current	0.1mA @ 264VAC
Max inrush current	3A for <100 ms 10A for < 10 ms (common)
Minimum load	5 mA @ 5 VDC
OFF to ON response	12 ms
ON to OFF response	10 ms
Fuse (output circuits)	1 (6.3A slow blow, replaceable) Order D2–FUSE–3 (5 per pack)



Typical Relay Life (Operations)

Voltage / Load		Current	Closures
24VDC	Resistive	1A	500K
24VDC	Solenoid	1A	100K
110VAC	Resistive	1A	500K
110VAC	Solenoid	1A	200K
220VAC	Resistive	1A	350K
220VAC	Solenoid	1A	100K