

DL205 Installation and I/O Manual

Manual Number: D2-INST-M



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DL205 INSTALLATION AND I/O MANUAL



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Issue	Date	Description of Changes
1st Edition	10/98	Original edition
Rev. A	04/01	Added modules
Rev. B	06/02	Added surge suppression information and modules; updated Appendix A
2nd Edition	11/10	Converted to new word processor format, added power budget, added analog wiring and specs.
Rev. A	02/20	Converted to InDesign format with general updates

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INTRODUCTION



CHAPTER 1

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DL205 System I/O Components.....	1-5

Introduction

The Purpose of this Manual

Thank you for purchasing our DL205 family of products. This manual is written for the user of non-traditional CPU-slot controllers or I/O controllers who are also using AutomationDirect DL205 I/O products. This manual will show the user how to install and wire the equipment. It provides specifications for input and output modules. It also helps to understand how to interface these products to other devices in a control system.

Where to Begin

If you already understand PLCs please read Chapter 2, “Installation, Wiring, and Specifications”, and proceed on to other chapters as needed. Keep this manual handy for reference when you have questions. If you are a new DL205 customer, we suggest you read this manual completely to understand the wide variety of features in the DL205 family of products. We believe you will be pleasantly surprised with how much you can accomplish with our products.

Supplemental Manuals

If you have purchased operator interfaces or *DirectSOFT*, you will need to supplement this manual with the manuals that are written for these products.

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Conventions Used




When you see the “notepad” icon in the left-hand margin, the paragraph to its immediate right will be a special note. The word **NOTE** in boldface will mark the beginning of the text.



When you see the “exclamation mark” icon in the left-hand margin, the paragraph to its immediate right will be a warning. This information could prevent injury, loss of property, or even death (in extreme cases). The word **WARNING** in boldface will mark the beginning of the text.

Key Topics for Each Chapter

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

Getting Started	
 CHAPTER 1	
In This Chapter...	
General Information.....	1-2
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CPU-Slot Controllers

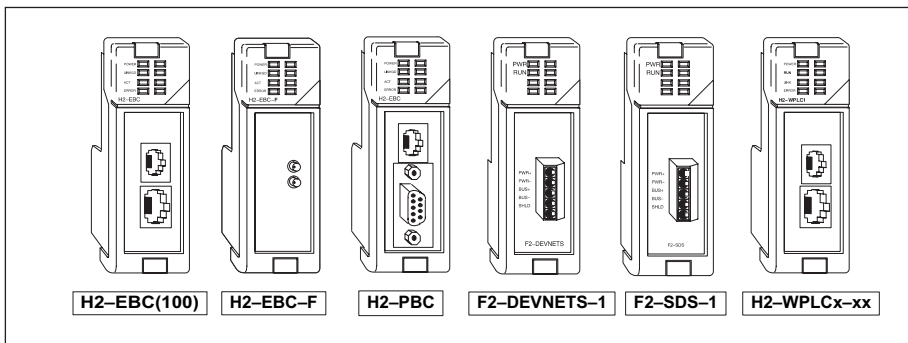
There are currently six “base controllers” or “I/O controllers” available for the DL205 hardware. Five of these are actually slave controllers and one is a stand-alone controller. These controllers allow the use of industry proven DL205 I/O for general purpose distributed applications.

The controller modules are plugged into the CPU slot of any size DL205 base. The slave controllers must be connected to a network master controller module or to a PC running PC-based control, HMI or SCADA software.

The four controllers currently available are:

- Ethernet Base Controller Module
 - H2-EBC(100)(-F)
- Profibus Slave Base Controller Module
 - H2-PBC
- DeviceNet™ Slave Module
 - F2-DEVNETS-1
- Smart Distributed System™ Slave Module
 - F2-SDS-1
- WinPLC
 - H2-WPLCx-xx

The WinPLC uses Windows CE, a real-time operating system combined with the advantages of open standard software such as OPC, ActiveX and other Microsoft communications tools. The WinPLC only supports certain DL205 modules (consult the WinPLC User Manual).



DL205 System I/O Components

Bases

Four base sizes are available: 3 slot, 4 slot, 6 slot and 9 slot. One slot is for the DL205 Controller/Slave module, the remaining slots are for I/O modules. All bases include a built-in power supply.

I/O Configuration

The number of I/O points that can be supported is CPU-slot controller dependent.

I/O Modules

The DL205 has some of the most powerful modules in the industry. A complete range of discrete modules which support 24VDC, 110/220 VAC and up to 10A relay outputs are offered. The analog modules provide 12 and 16 bit resolution and several selections of input and output signal ranges (including bipolar).

The F2-SDS-1 and F2-DEVNETS-1 do not support specialty modules. Specialty module H2-CTRIO is supported by the other slave controllers and the H2-WPLCx-xx controller.

INSTALLATION, WIRING AND SPECIFICATIONS



In This Chapter...

Safety Guidelines	2-1
Mounting Guidelines	2-4
Installing DL205 Bases	2-9
Installing Components in the Base	2-11
Base Wiring Guidelines	2-12

Safety Guidelines



NOTE: Products with CE marks perform their required functions safely and adhere to relevant standards as specified by CE directives, provided they are used according to their intended purpose and that the instructions in this manual are adhered to. The protection provided by the equipment may be impaired if this equipment is used in a manner not specified in this manual. A listing of our international affiliates is available on our Web site: <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 and/or damage equipment. Do not rely on the automation system alone to provide a safe operating environment. Sufficient emergency circuits should be provided to stop either partially or totally the operation of the PLC or the controlled machine or process. These circuits should be routed outside the PLC in the event of controller failure, so that independent and rapid shutdown are available. Devices, such as “mushroom” switches or end of travel limit switches, should operate motor starter, solenoids, or other devices without being processed by the PLC. These emergency circuits should be designed using simple logic with a minimum number of highly reliable electromechanical components. Every automation application is different, so there may be special requirements for your particular application. Make sure all national, state, and local government requirements are followed 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. Also, you should use the following techniques, which provide three levels of system control:

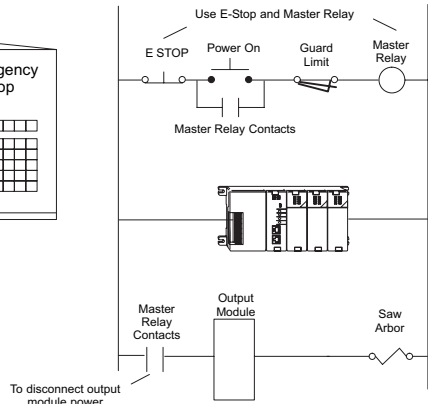
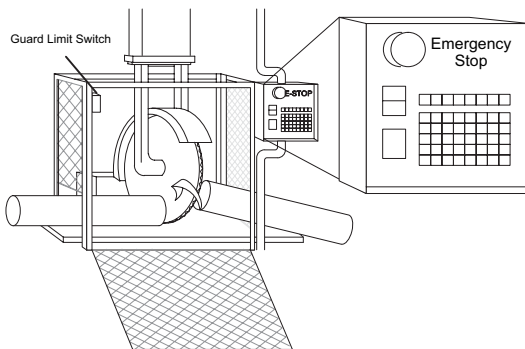
- Emergency stop switch for disconnecting system power
- Mechanical disconnect for output module power
- Orderly system shutdown sequence in the PLC control program

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.).



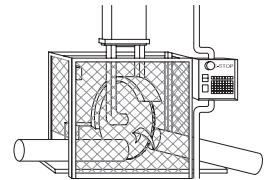
Emergency Power Disconnect

A properly rated emergency power disconnect should be used to power the PLC controlled system as a means 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.

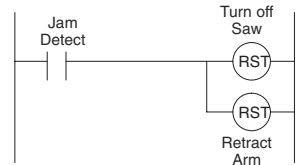
After an emergency shutdown or any other type of power interruption, there may be requirements that must be met before the PLC control program can be restarted. For example, there may be specific register values that must be established (or maintained from the state prior to the shutdown) before operations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

Orderly System Shutdown

Ideally, the first level of fault detection is the PLC control program, which can identify machine problems. Certain shutdown sequences should be performed. The types of problems are usually things such as jammed parts, 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.



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.



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

WARNING: All DL205 products used with connector accessories must use R/C (ECBT2) mating plugs. All mating plugs must have suitable ratings for the devices.

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.

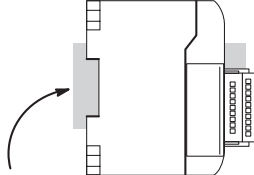
Mounting depths with:

D2-DSCBL-1 on port 2 5.85" (148mm)

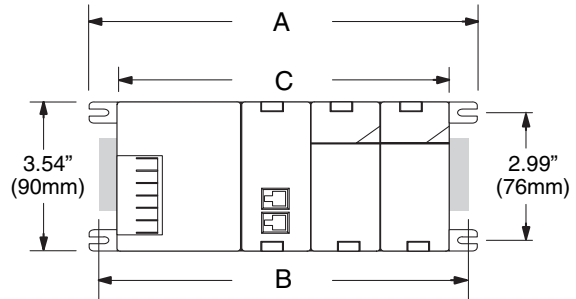
32pt. ZIPLink cable or base exp. unit cable 4.45" (113mm)

12 or 16pt I/O 3.62" (92mm)

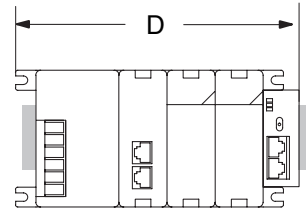
4 or 8pt. I/O 2.95" (75mm)



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



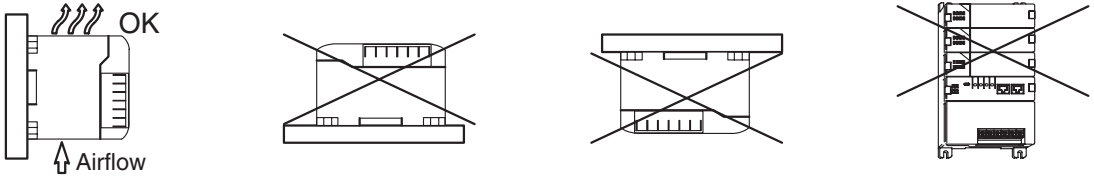
with D2-EM Expansion Unit



Base	A (Base Total Width)		B (Mounting Hole)		C (Component Width)		D (Width with Exp. Unit)	
	Inches	Millimeters	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

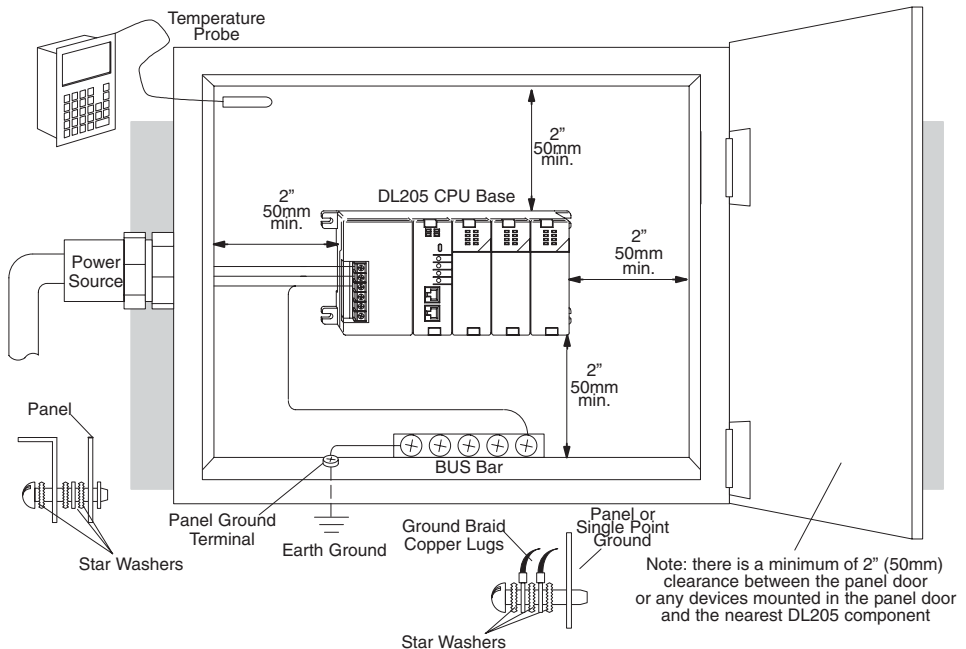
It is important to design your panel properly to help ensure the DL205 products operate within their environmental and electrical limits. The system installation should comply with all appropriate electrical codes and standards. It is important the system also conforms to the operating standards for 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 I 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 ensure 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, 24VDC, or 125VDC 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 120VAC and 240VAC, 1–5 Amps, is an excellent 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

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° to 70° 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%) 50/60 Hz	10.2 – 28.8 VDC (24VDC) with less than 10% ripple	104-240 VDC +10% -15%
Maximum Inrush Current	30A	10A	20A
Maximum Power	80VA	25W	30W
Voltage Withstand (dielectric)	1 minute @ 1500VAC between primary, secondary, and field ground		
Insulation Resistance	> 10 MΩ at 500VDC		
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	non-replaceable 3.15 A @ 250V slow blow fuse	non-replaceable 2A @ 250V slow blow fuse

* External fusing is not beneficial. The internal fuse does not protect the power supply from overload. It provides protection from fire in case the power supply fails, so if the internal fuse blows it means that the power supply has already failed.

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 flammability 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.*

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.)

24VDC Power Bases

Follow these additional installation guidelines when installing D2-03BDC1-1, D2-04BDC1-1, D2-06BDC1-1 and D2-09BDC1-1 bases:

- Install these bases in compliance with the enclosure, mounting, spacing, and segregation requirements of the ultimate application.
- These bases must be used within their marked ratings.
- These bases are intended to be installed within an enclosure rated at least IP54.
- provisions should be made to prevent the rated voltage being exceeded by transient disturbances of more than 40%.

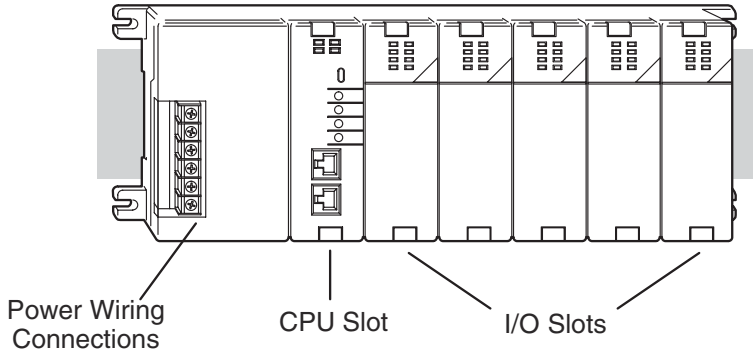
Installing DL205 Bases

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.

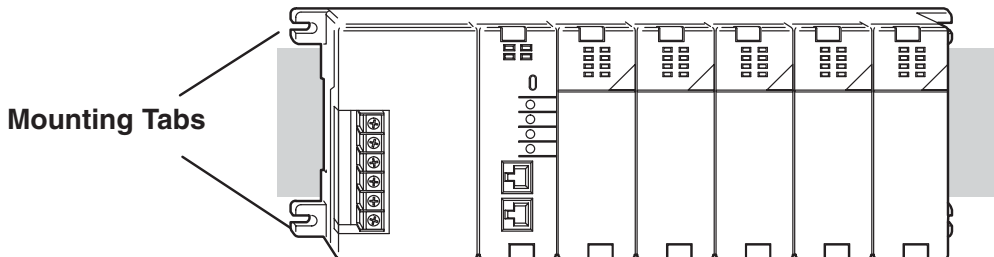
Your choice of base depends on three things:



- 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.

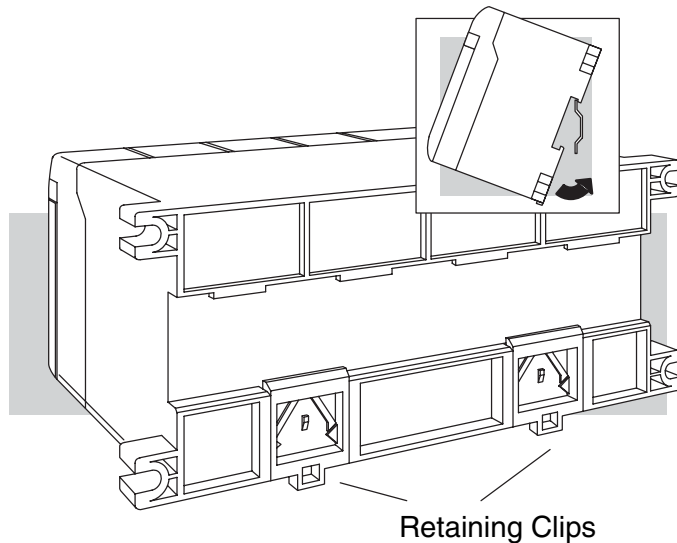
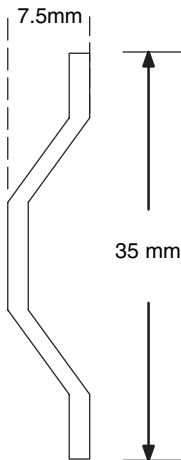
Using Mounting Rails

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.

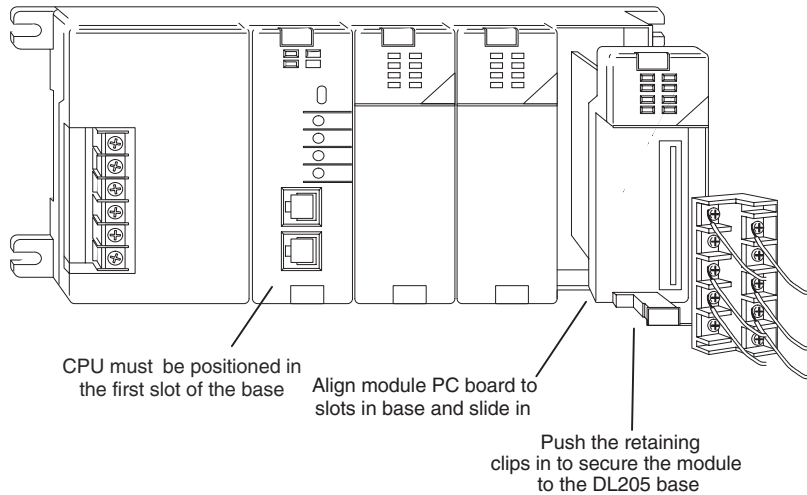
To remove the base, pull down on the retaining clips, lift up on the base slightly, and pull it away from the rail.

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.



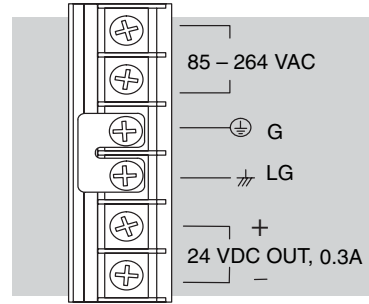
WARNING: Minimize the risk of electrical shock, personal injury, or equipment damage. Always disconnect the system power before installing or removing any system component.

Base Wiring Guidelines

Base Wiring

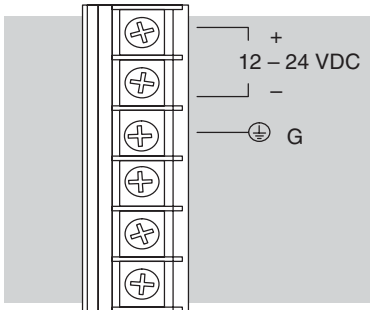
The diagrams show the terminal connections located on the power supply of the DL205 bases. The base terminals can accept up to 16 AWG. You may be able to use larger wiring depending on the type of wire used, but 16 AWG is the recommended size. Do not overtighten the connector screws; the recommended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

110/220 VAC Base Terminal Strip

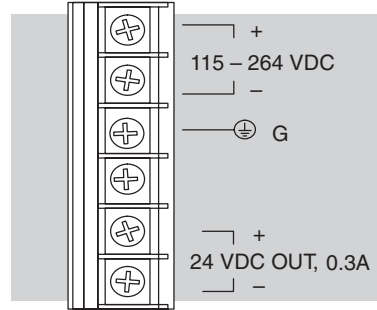


NOTE: You can connect either a 115 VAC or 220 VAC supply to the AC terminals. Special wiring or jumpers are not required as with some of the other **DirectLOGIC** products.

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 AND SPECIFICATIONS



In This Chapter...

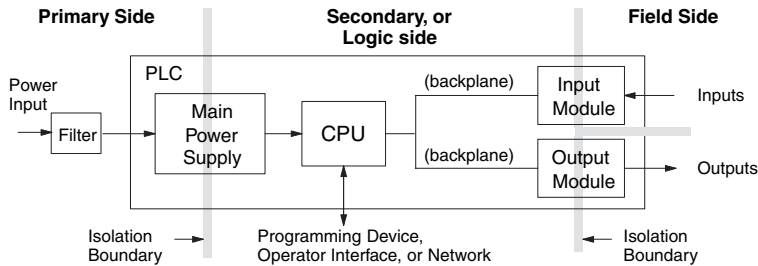
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I/O Wiring Strategies

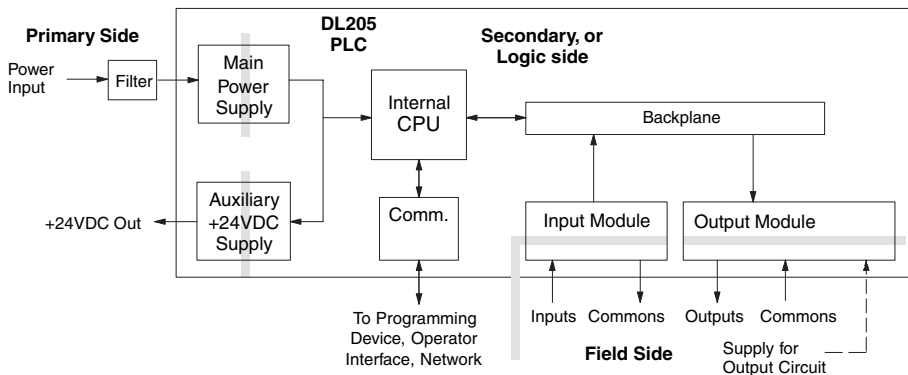
The DL205 PLC system is very flexible and will work in many different wiring configurations. By studying this section before actual installation, you can probably find the best wiring strategy for your application. This will help to lower system cost, wiring errors, and avoid safety problems.

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.



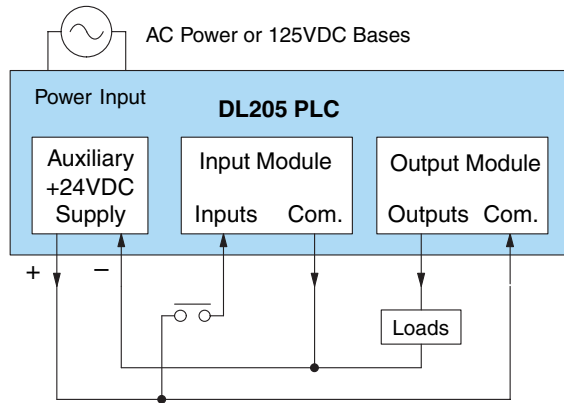
In addition to the basic circuits covered above, AC-powered and 125VDC bases include an auxiliary +24VDC power supply with its own isolation boundary. Since the supply output is isolated from the other three circuits, it can power input and/or output circuits!



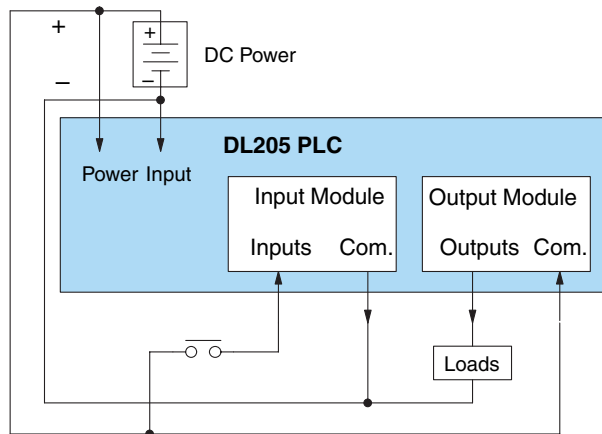
Powering I/O Circuits with the Auxiliary Supply

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.

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.



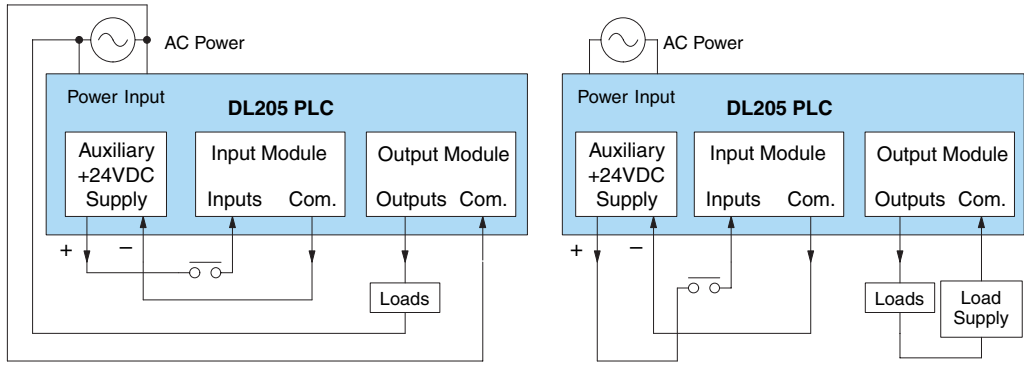
The 12/24VDC powered DL205 bases are designed for application environments in which low-voltage DC power is more readily available than AC. These include a wide range of battery-powered applications, such as remotely-located control, in vehicles, portable machines, etc. For this application type, all input devices and output loads typically use the same DC power source. Typical wiring for DC-powered applications is shown in the following diagram.



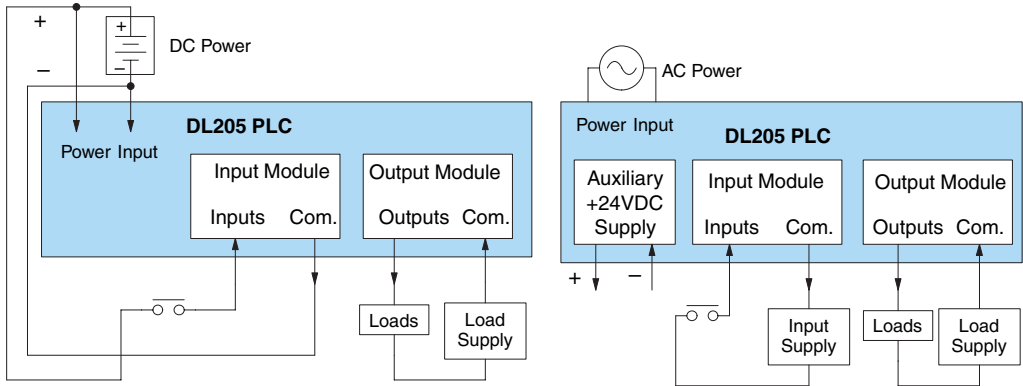
Powering I/O Circuits Using Separate Supplies

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 viewpoint, is an application which requires separate power sources for the PLC, input devices, and output loads. The wiring diagram example below on the right shows how this can work, but the auxiliary supply output is an unused resource. You will want to avoid this situation, if possible.



Sinking / Sourcing Concepts

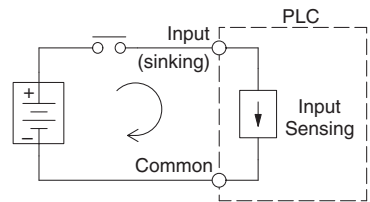
Before going further in the study of wiring strategies, you must have a solid understanding of “sinking” and “sourcing” concepts. Use of these terms occurs frequently in input or output circuit discussions. It is the goal of this section to make these concepts easy to understand, further ensuring your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

Sinking = provides a path to supply ground (-)

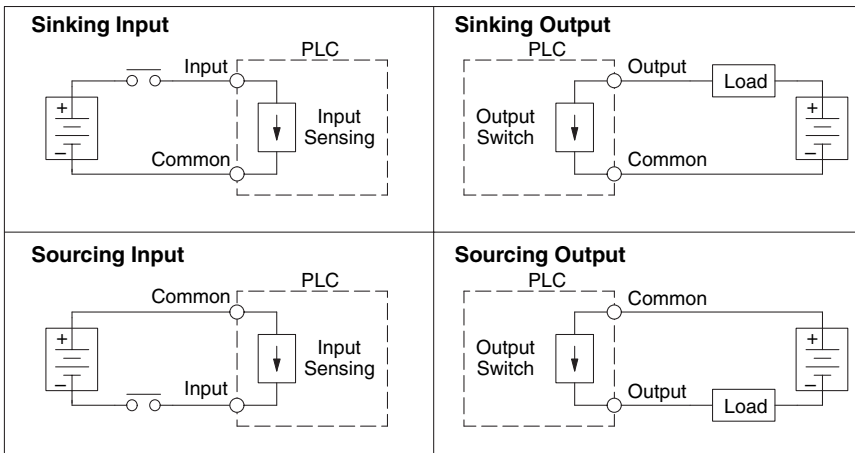
Sourcing = provides a path to supply source (+)

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 only 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.

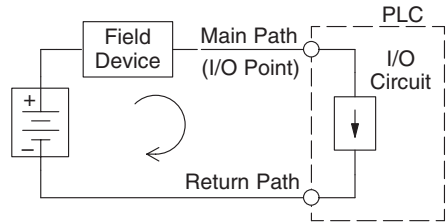


Apply the circuit principle above to the four possible combinations of input/output sinking/sourcing types as shown below. The I/O module specifications at the end of this chapter list the input or output type.

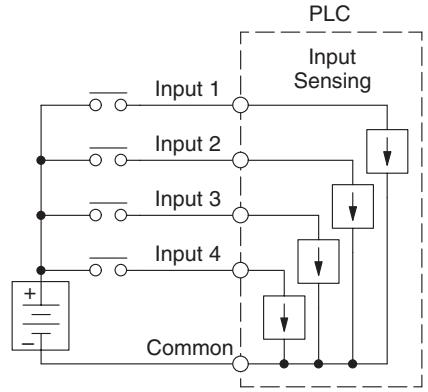


I/O “Common” Terminal Concepts

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.



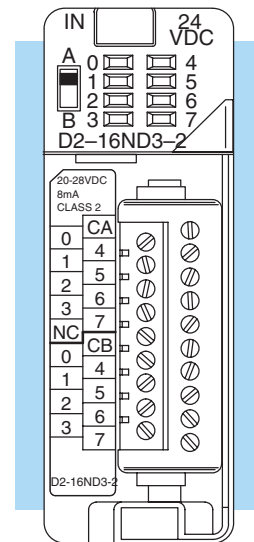
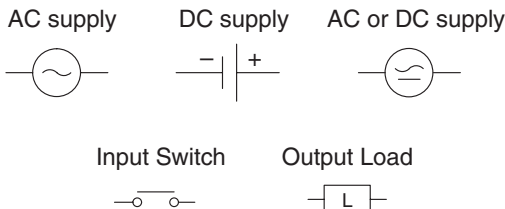
If there was unlimited space and budget for I/O terminals, every I/O point could have two dedicated terminals as the figure above shows. However, providing this level of flexibility is not practical or even necessary for most applications. So, most Input or Output points on PLCs are in groups which share the return path (called commons). The figure to the right shows a group (or bank) of four input points which share a common return path. In this way, the four inputs require only five terminals instead of eight.



NOTE: In the circuit above, the current in the common path is 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. There are 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:

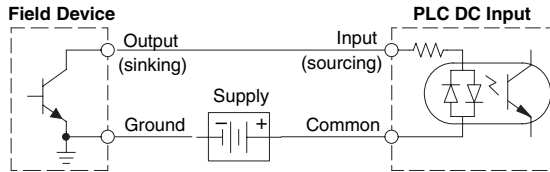


Connecting DC I/O to “Solid State” Field Devices

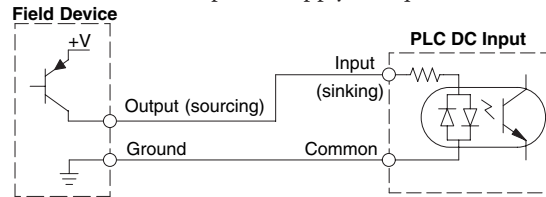
In the previous section on Sourcing and Sinking concepts, the DC I/O circuits were explained to sometimes only allow current to flow one way. This is also true for many of the field devices which have solid-state (transistor) interfaces. In other words, field devices can also be sourcing or sinking. *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 (+12VDC or +24VDC), as long as the input specifications are met.



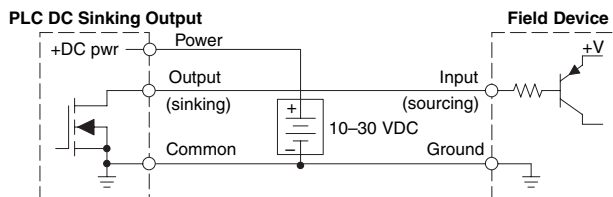
In the next circuit, a field device has an open-collector PNP transistor output. It sources current to the PLC input point, which sinks the current back to ground. Since the field device is sourcing current, no additional power supply is required.



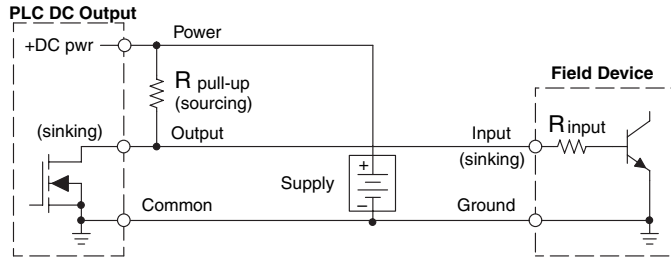
Solid State Output Loads

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, an $R_{\text{pull-up}}$ is connected from the output to the DC output circuit power input.



NOTE 1: DO NOT attempt to drive a heavy load (>25mA) 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.

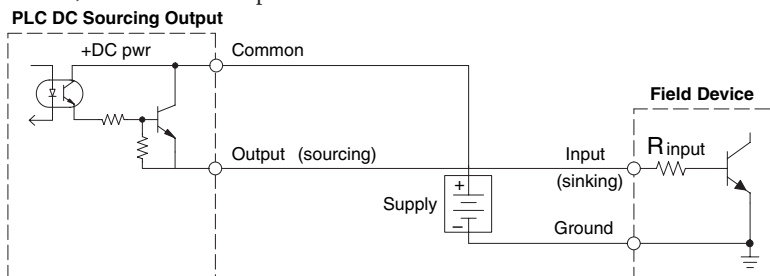
It is important to choose the correct value of $R_{\text{pull-up}}$. In order to do so, you need to know the nominal input current to the field device (I_{input}) when the input is energized. If this value is not known, it can be calculated as shown (a typical value is 15mA). Then use I_{input} and the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

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

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

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

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)

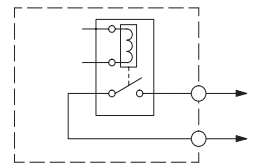
Some applications in which NOT to use relays:

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

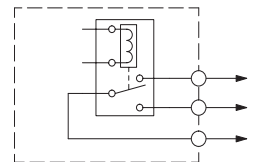
Relay outputs in the DL205 output modules are available in two contact arrangements, shown to the right. The Form A type, or SPST (single pole, single throw) type is normally open and is the simplest to use. The Form C type, or SPDT (single pole, double throw) type has a center contact which moves and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

Some relay output modules 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 Suppression For Inductive Loads



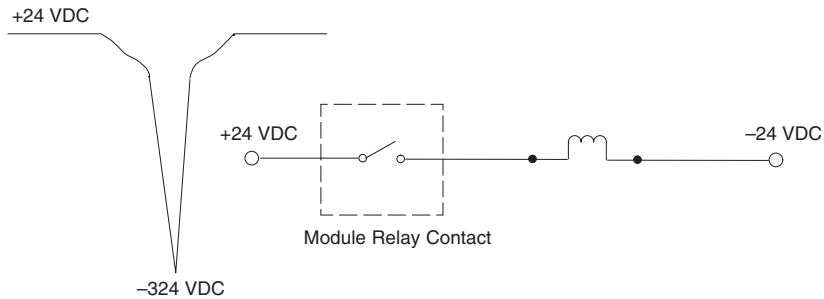
NOTE: For updated information on surge suppression for inductive loads, refer to Application Note AN-MISC-032 located on the Technical Support area of our website. The url is: <http://support.automationdirect.com/docs/an-misc-032.pdf>

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 are two (2) points when the voltage is zero (0) in one complete cycle of a sine wave; therefore, there are two (2) chances in 60 (60Hz) or 50 (50Hz) to stop the current flow at a zero crossover point. If current flow isn’t stopped, the relay contact will open (or “bounce”). 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.

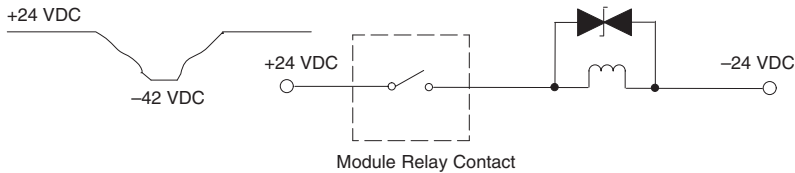
When inductive load devices (motors, motor starters, interposing relays, solenoids, valves, etc.) are controlled with relay contacts, it is recommended that a surge suppression device be connected directly across the coil of the field device. If the inductive device has plug-type connectors, the suppression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

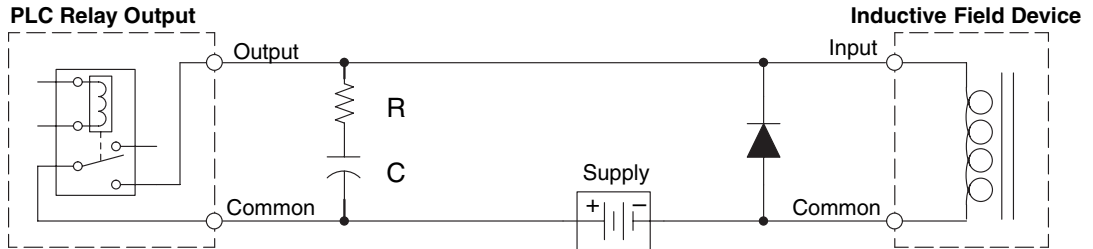
Use the following table to help select a TVS or MOV suppressor for your application based on the inductive load voltage.

Vendor / Catalog	Suppressor Types	Inductive Load Voltage	Part Number
AutomationDirect Transient Voltage Suppressors www.automationdirect.com	8-channel TVS	24 VDC	ZL-TD8-24
	8-channel TVS	110 VAC	ZL-TD8-120
General Instrument Transient Voltage Suppressors and LiteOn Diodes; from Digi-Key Catalog; www.digikey.com ; Phone: 1-800-344-4539	TVS, MOV TVS, MOV TVS Diode	110/120 VAC 220/240 VAC 12/24 VDC or VAC 12/24 VDC or VAC	Check Digi-Key Corp. catalog or website

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:

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

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:

$$I_{\text{peak}} = I_{\text{rms}} \times 1.414, = 0.5 \times 1.414 = 0.707 \text{ Amperes}$$

$$V_{\text{peak}} = V_{\text{rms}} \times 1.414 = 120 \times 1.414 = 169.7 \text{ Volts}$$

Now, find the values of R and C:

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

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

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

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.

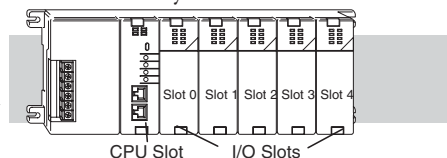
I/O Modules Position, Wiring, and Specification

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-slot controller, so you always have one less I/O slot. For example, there are 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 a 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	√	√	√

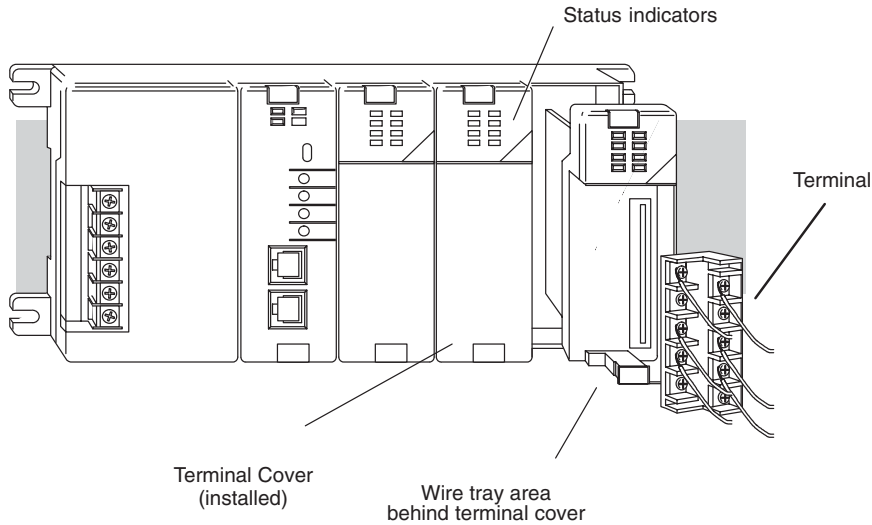
* When used with H2-ERM Ethernet Remote I/O system

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.

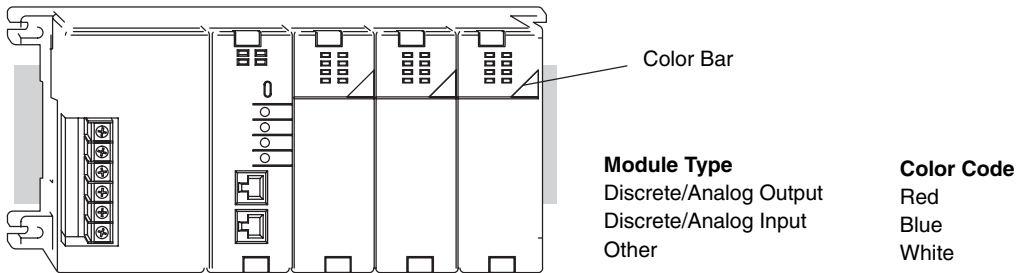
Discrete Input Module Status Indicators

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:



Wiring the Different Module Connectors

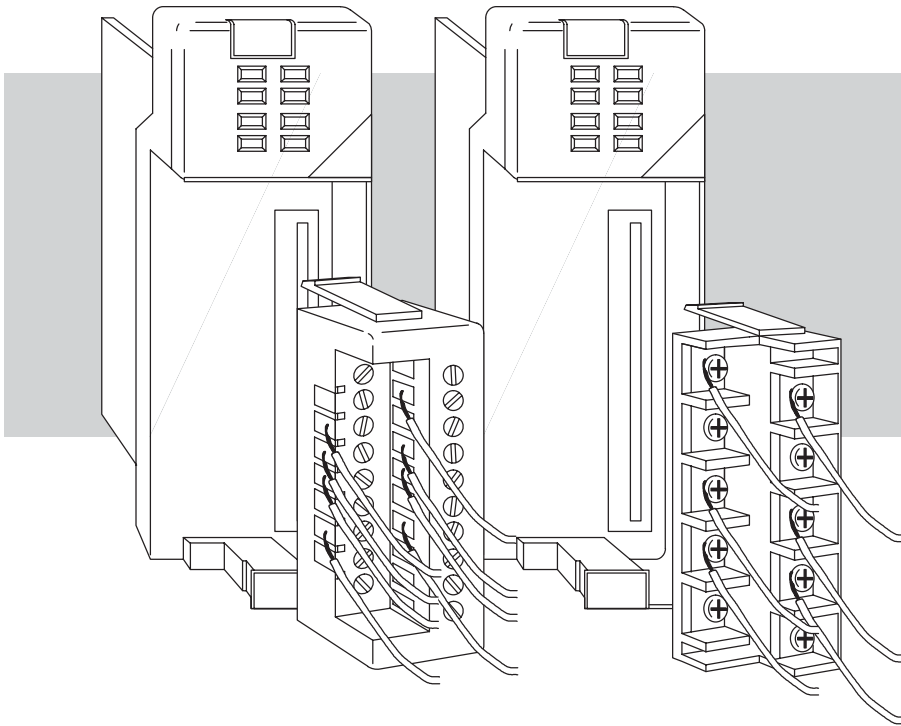
There are two types of module connectors for the DL205 I/O. Some modules have normal screw terminal connectors. Other modules have connectors with recessed screws. The recessed screws help minimize the risk of someone accidentally touching active wiring.

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.

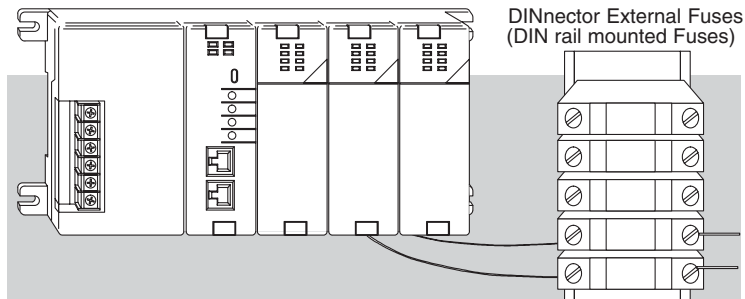
1. There is a limit to the size of wire the modules can accept. The table below lists the suggested AWG for each module type. When making terminal connections, follow the suggested torque values.

Terminal type	Suggested AWG Range	Suggested Torque
10-Terminal Fixed	14 – 24 AWG	3.5 lb-inch (0.4 N-m)
10-Terminal Removable	16* – 24 AWG	7.81 lb-inch (0.88 N-m)
20-Terminal Removable	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.

I/O Points Required for Each Module

Each type of module requires a certain number of I/O points. This is also true for some specialty modules, such as analog, counter interface, etc..

DC Input Modules	Number of I/O Pts. Required	Specialty Modules, etc.	Number of I/O Pts. Required
D2-08ND3	8 Input	H2-ECOM(-F)	None
D2-16ND3-2	16 Input	D2-DCM	None
D2-32ND3(-2)	32 Input	H2-ERM(-F)	None
AC Input Modules		H2-EBC(-F)	None
D2-08NA-1	8 Input	D2-RMSM	None
D2-08NA-2	8 Input	D2-RSSS	None
D2-16NA	16 Input	F2-CP128	None
DC Output Modules		H2-CTRIO	None
D2-04TD1	8 Output (Only the first four points are used)	D2-CTRINT	8 Input 8 Output
D2-08TD1	8 Output	F2-DEVNETS-1	None
D2-16TD1-2 (2-2)	16 Output	H2-PBC	None
D2-16TD1(2)P	16 Output	F2-SDS-1	None
D2-32TD1(-2)	32 Output	D2-08SIM	8 Input
AC Output Modules		D2-EM	None
D2-08TA	8 Output	D2-CM	None
F2-08TA	8 Output	H2-ECOM(100)	None
D2-12TA	16 Output (See note 1)		
Relay Output Modules			
D2-04TRS	8 Output (Only the first four points are used)		
D2-08TR	8 Output		
F2-08TRS	8 Output		
F2-08TR	8 Output		
D2-12TR	16 Output (See note 1)		
Combination Modules			
D2-08CDR	8 In, 8 Out (Only the first four points are used for each type)		
Analog Modules			
F2-04AD-1 & 1L	16 Input		
F2-04AD-2 & 2L	16 Input		
F2-08AD-1	16 Input		
F2-02DA-1 & 1L	16 Output		
F2-02DA-2 & 2L	16 Output		
F2-08DA-1	16 Output		
F2-08DA-2	16 Output		
F2-02DAS-1	32 Output		
F2-02DAS-2	32 Output		
F2-4AD2DA	16 Input & 16 Output		
F2-8AD4DA-1	32 Input & 32 Output		
F2-8AD4DA-2	32 Input & 32 Output		
F2-04RTD	32 Input		
F2-04THM	32 Input		



NOTE 1: -12pt. modules consume 16 points. The first 6 points are assigned, two are skipped, and then the next 6 points are assigned. For example, a D2-12TA installed in slot 0 would use Y0-Y5, and Y-10-Y15. Y6-Y7 and Y16-Y17 would be unused.

Calculating the Power Budget

Managing your Power Resource

When you determine the types and quantity of I/O modules you will be using in the DL205 system it is important to remember there is a limited amount of power available from the power supply. We have provided a chart to help you easily see the amount of power available with each base. The following chart will help you calculate the amount of power you need with your I/O selections. At the end of this section you will also find an example of power budgeting and a worksheet for your own calculations.

If the I/O you choose exceeds the maximum power available from the power supply, you may need to use local expansion bases or remote I/O bases.



WARNING: It is extremely important to calculate the power budget. If you exceed the power budget, the system may operate in an unpredictable manner which may result in a risk of personal injury or equipment damage.

Bases	5V Current Supplied	Auxiliary 24VDC Current Supplied
D2-03B-1	2600 mA	300 mA
D2-04B-1	2600 mA	300 mA
D2-06B-1	2600 mA	300 mA
D2-09B-1	2600 mA	300 mA
D2-03BDC1-1	2600 mA	None
D2-04BDC1-1	2600 mA	None
D2-06BDC1-1	2600 mA	None
D2-09BDC1-1	2600 mA	None
D2-06BDC2-1	2600 mA	300 mA
D2-09BDC2-1	2600 mA	300 mA

CPU Power Specifications

The following chart shows the amount of current available for the two voltages supplied from the DL205 base. Use these currents when calculating the power budget for your system. The Auxiliary 24V Power Source mentioned in the table is a connection at the base terminal strip allowing you to connect to devices or DL205 modules that require 24VDC.

Module Power Requirements

Use the power requirements shown on the next page to calculate the power budget for your system. If an External 24VDC power supply is required, the external 24VDC from the base power supply may be used as long as the power budget is not exceeded.

Power Consumed			Power Consumed		
Device	5V (mA)	24V Auxilliary (mA)	Device	5V (mA)	24V Auxilliary (mA)
CPUs			Combination Modules		
D2-230	120	0	D2-08CDR	200	0
D2-240	120	0	Specialty Modules		
D2-250-1	330	0	H2-PBC	530	0
D2-260/262	330	0	H2-ECOM	450	0
DC Input Modules			H2-ECOM100	300	0
D2-08ND3	50	0	H2-ECOM-F	640	0
D2-16ND3-2	100	0	H2-ERM	320	0
D2-32ND3(-2)	25	0	H2-ERM-F	450	0
AC Input Modules			H2-EBC	320	0
D2-08NA-1	50	0	H2-EBC-F	450	0
D2-08NA-2	100	0	H2-CTRIO	400	0
D2-16NA	100	0	D2-DCM	300	0
DC Output Modules			D2-RMSM	200	0
D2-04TD1	60	20	D2-RSSS	150	0
D2-08TD1(-2)	100	0	D2-CTRINT	50*	0
D2-16TD1-2	200	80	D2-08SIM	50	0
D2-16TD2-2	200	0	D2-CM	100	0
D2-32TD1(-2)	350	0	D2-EM	130	0
AC Output Modules			F2-CP128	235	0
D2-08TA	250	0	F2-DEVNETS-1	160	0
F2-08TA	250	0	F2-SDS-1	160	0
D2-12TA	350	0			
Relay Output Modules					
D2-04TRS	250	0			
D2-08TR	250	0			
F2-08TRS	670	0			
F2-08TR	670	0			
D2-12TR	450	0			
Analog Modules					
F2-04AD-1	50	80	F2-02DAS-1	100	50mA per channel
F2-04AD-1L	100	5mA @ 10-30V	F2-02DAS-2	100	60mA per channel
F2-04AD-2	110	5mA @ 10-30V	F2-4AD2DA	90	80mA**
F2-04AD-2L	60	90mA @ 12V**	F2-8AD4DA-1	35	100
F2-08AD-1	100	5mA @ 10-30V	F2-8AD4DA-2	35	80
F2-08AD-2	100	5mA @ 10-30V	F2-04RTD	90	0
F2-02DA-1	40	60**	F2-04THM	110	60
F2-02DA-1L	40	70mA @ 12V**			
F2-02DA-2	40	60			
F2-02DA-2L	40	70mA @ 12V**			
F2-08DA-1	30	50mA**			
F2-08DA-2	60	140			

*requires external 5VDC for outputs

**add an additional 20mA per loop

Power Budget Calculation Example

The following example shows how to calculate the power budget for the DL205 system.

Base # 0	Module Type	5 VDC (mA)	Auxiliary Power Source 24VDC Output (mA)
Available Base Power	D2-09B-1	2600	300
CPU Slot	D2-260	+ 330	
Slot 0	D2-16ND3-2	+ 100	+ 0
Slot 1	D2-16NA	+ 100	+ 0
Slot 2	D2-16NA	+ 100	+ 0
Slot 3	F2-04AD-1	+ 50	+ 80
Slot 4	F2-02DA-1	+ 40	+ 60
Slot 5	D2-08TA	+ 250	+ 0
Slot 6	D2-08TD1	+ 100	+ 0
Slot 7	D2-08TR	+ 250	+ 0
Other			
Handheld Programmer	D2-HPP	+ 200	+ 0
Total Power Required		1520	140
Remaining Power Available		2600-1520 = 1080	300 - 140 = 160

1. Use the power budget table to fill in the power requirements for all the system components. First, enter the amount of power supplied by the base. Next, list the requirements for the CPU, any I/O modules, and any other devices, such as the Handheld Programmer, C-more HMI or the DV-1000 operator interface. Remember, even though the Handheld or the DV-1000 are not installed in the base, they still obtain their power from the system. Also, make sure you obtain any external power requirements, such as the 24VDC power required by the analog modules.
2. Add the current columns starting with CPU slot and put the total in the row labeled "Total power required"
3. Subtract the row labeled "Total power required" from the row labeled "Available Base Power". Place the difference in the row labeled "Remaining Power Available".
4. If "Total Power Required" is greater than the power available from the base, the power budget will be exceeded. It will be unsafe to use this configuration and you will need to restructure your I/O configuration.



WARNING: It is extremely important to calculate the power budget. If you exceed the power budget, the system may operate in an unpredictable manner which may result in a risk of personal injury or equipment damage.

Power Budget Calculation Worksheet

This blank chart is provided for you to copy and use in your power budget calculations.

Base # 0	Module Type	5VDC (mA)	Auxiliary Power Source 24VDC Output (mA)
Available Base Power			
CPU Slot			
Slot 0			
Slot 1			
Slot 2			
Slot 3			
Slot 4			
Slot 5			
Slot 6			
Slot 7			
Other			
Total Power Required			
Remaining Power Available			

1. Use the power budget table to fill in the power requirements for all the system components. This includes the CPU, any I/O modules, and any other devices, such as the Handheld Programmer, C-more HMI or the DV-1000 operator interface. Also, make sure you obtain any external power requirements, such as the 24VDC power required by the analog modules.
2. Add the current columns starting with CPU slot and put the total in the row labeled “Total power required”.
3. Subtract the row labeled “Total power required” from the row labeled “Available Base Power”. Place the difference in the row labeled “Remaining Power Available”.
4. If “Total Power Required” is greater than the power available from the base, the power budget will be exceeded. It will be unsafe to use this configuration and you will need to restructure your I/O configuration.



WARNING: It is extremely important to calculate the power budget. If you exceed the power budget, the system may operate in an unpredictable manner which may result in a risk of personal injury or equipment damage.

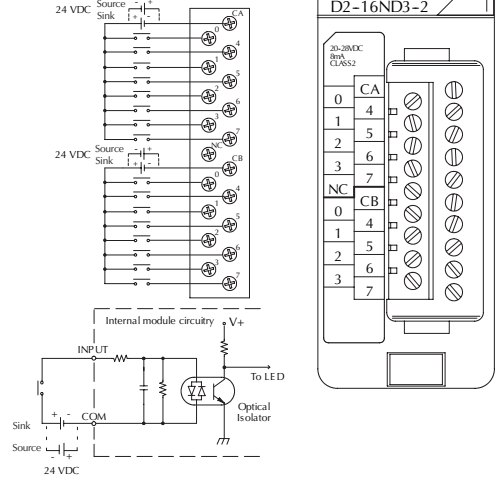
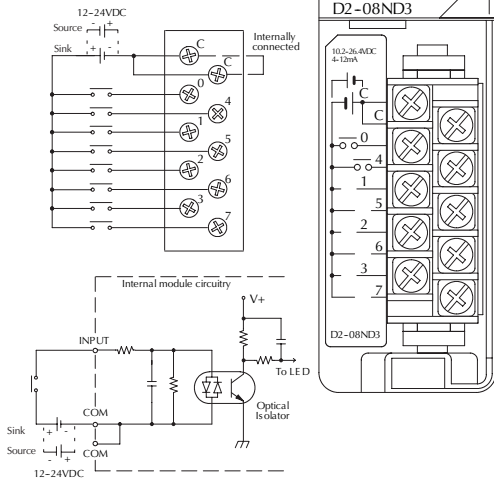
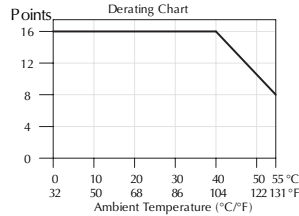
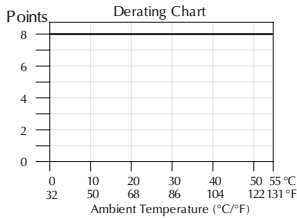
DL205 Digital Input Modules

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
ON Voltage Level	9.5 VDC minimum
OFF Voltage Level	3.5 VDC maximum
AC Frequency	N/A
Input Impedance	2.7 kΩ
Input Current	4.0 mA @ 12VDC 8.5 mA @ 24VDC
Minimum ON Current	3.5 mA
Maximum OFF Current	1.5 mA
Base Power Required 5VDC	50mA
OFF to ON Response	1 to 8 ms
ON to OFF Response	1 to 8 ms
Terminal Type (included)	Removable, D2-8IOCON
Status Indicator	Logic side
Weight	2.3 oz. (65g)

D2-16ND3-2, DC Input

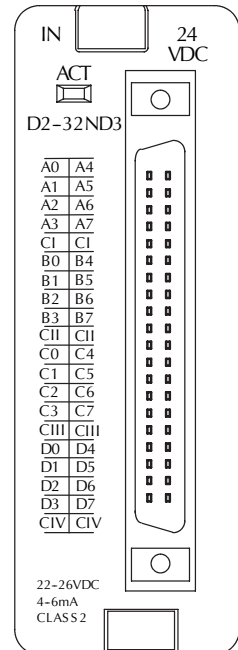
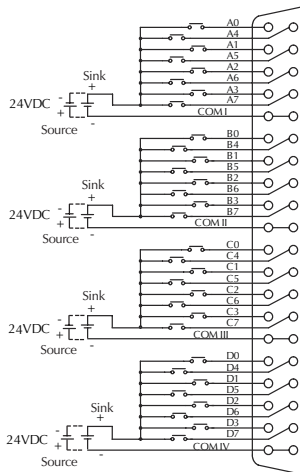
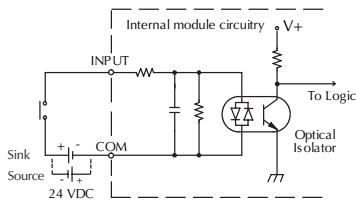
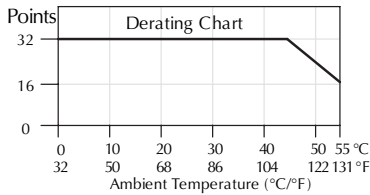
Inputs per Module	16 (sink/source)
Commons per Module	2 isolated (8 I/O terminal points/com)
Input Voltage Range	20-28 VDC
Peak Voltage	30VDC (10mA)
ON Voltage Level	19VDC minimum
OFF Voltage Level	7VDC maximum
AC Frequency	N/A
Input Impedance	3.9 kΩ
Input Current	6mA @ 24VDC
Minimum ON Current	3.5 mA
Maximum OFF Current	1.5 mA
Base Power Required 5VDC	100mA
OFF to ON Response	3 to 9 ms
ON to OFF Response	3 to 9 ms
Terminal Type (included)	Removable, D2-16IOCON
Status Indicator	Logic side
Weight	2.3 oz. (65g)



D2-32ND3, DC Input

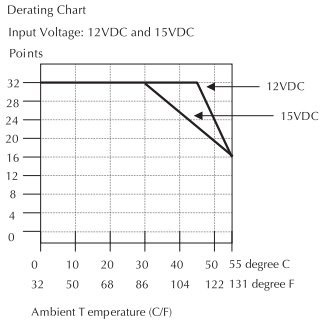
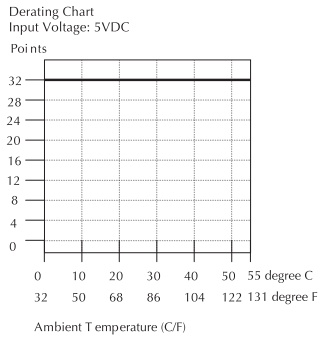
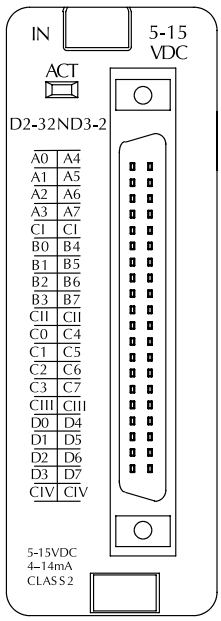
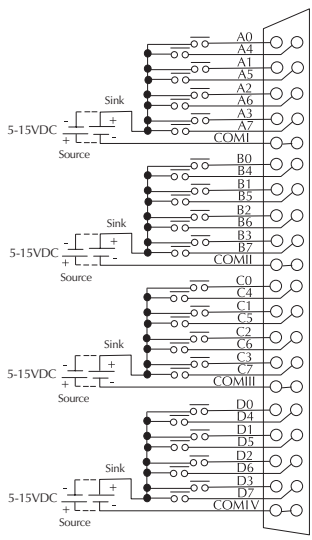
Inputs per Module	32 (sink/source)
Commons per Module	4 isolated (8 I/O terminal points / com)
Input Voltage Range	20-28 VDC
Peak Voltage	30VDC
ON Voltage Level	19VDC minimum
OFF Voltage Level	7VDC maximum
AC Frequency	N/A
Input Impedance	4.8 kΩ
Input Current	8.0 mA @ 24 VDC
Minimum ON Current	3.5 mA
Maximum OFF Current	1.5 mA
Base Power Required 5VDC	25mA
OFF to ON Response	3 to 9 ms
ON to OFF Response	3 to 9 ms
Terminal Type (not included)	Removable 40-pin Connector ¹
Status Indicator	Module Activity LED
Weight	2.1 oz. (60g)

¹ Connector sold separately. See Terminal Blocks and Wiring for wiring options.



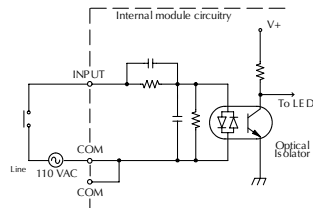
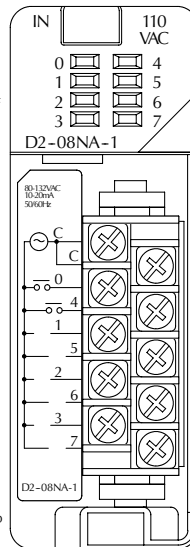
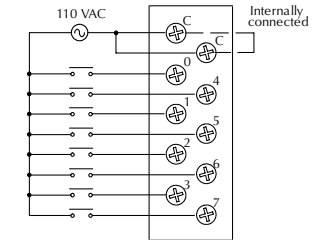
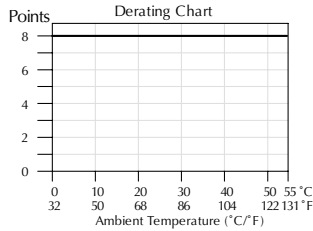
D2-32ND3-2, DC Input

Inputs per Module	32 (Sink/Source)
Commons per Module	4 isolated (8 I/O terminal points / com)
Input Voltage Range	4.50 to 15.6 VDC min. to max.
Peak Voltage	16VDC
ON Voltage Level	4VDC minimum
OFF Voltage Level	2VDC maximum
AC Frequency	N/A
Input Impedance	1.0 kΩ @ 5-15 VDC
Input Current	4mA @ 5VDC 11mA @ 12VDC 14mA @ 15VDC
Maximum Input Current	16mA @ 15.6 VDC
Minimum ON Current	3mA
Maximum OFF Current	0.5 mA
Base Power Required 5VDC	25mA
OFF to ON Response	3 to 9 ms
ON to OFF Response	3 to 9 ms
Terminal Type (not included)	Removable 40-pin connector ¹
Status Indicator	Module activity LED
Weight	2.1 oz (60g)
¹ Connector sold separately. See Terminal Blocks and Wiring for wiring options.	



D2-08NA-1, AC Input

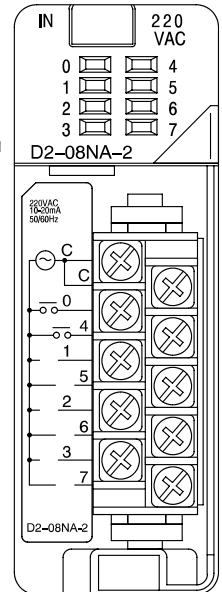
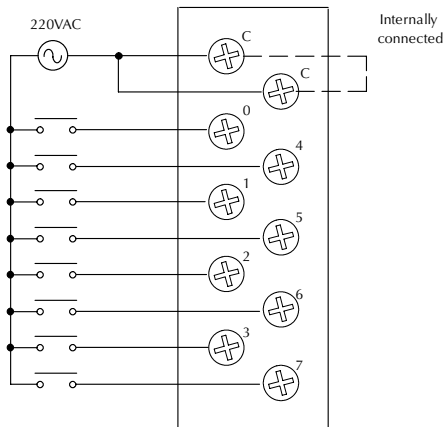
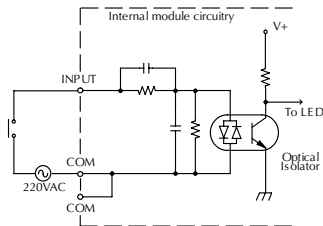
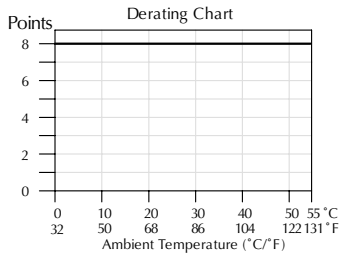
Inputs per Module	8
Commons per Module	1 (2 I/O terminal points)
Input Voltage Range	80-132 VAC
Peak Voltage	132VAC
ON Voltage Level	75VAC minimum
OFF Voltage Level	20VAC maximum
AC Frequency	47-63 Hz
Input Impedance	12k Ω @ 60Hz
Input Current	13mA @ 100VAC, 60Hz 11mA @ 100VAC, 50Hz
Minimum ON Current	5mA
Maximum OFF Current	2mA
Base Power Required 5VDC	50mA
OFF to ON Response	5 to 30 ms
ON to OFF Response	10 to 50 ms
Terminal Type (included)	Removable; D2-8IOCON
Status Indicator	Logic side
Weight	2.5 oz. (70g)



D2-08NA-2, AC Input

Inputs per Module	8
Commons per Module	1 (2 I/O terminal points)
Input Voltage Range	170-265 VAC
Peak Voltage	265VAC
ON Voltage Level	150VAC minimum
OFF Voltage Level	40VAC maximum
AC Frequency	47-63 Hz
Input Impedance	18k Ω @ 60Hz
Input Current	9mA @ 220VAC, 50Hz 11mA @ 265VAC, 50Hz 10mA @ 220VAC, 60Hz 12mA @ 265VAC, 60Hz
Minimum ON Current	10mA
Maximum OFF Current	2mA
Base Power Required 5VDC	100mA
OFF to ON Response	5 to 30ms
ON to OFF Response	10 to 50ms
Terminal Type (included)	Removably; D2-8IOCON
Status Indicator	Logic side
Weight	2.5 oz. (70g)

Operating Temperature	32°F to 131°F (0° to 55°C)
Storage Temperature	-4°F to 158°F (-20°C to 70°C)
Humidity	35% to 95% (non-condensing)
Atmosphere	No corrosive gases permitted
Vibration	MIL STD 810C 514.2
Shock	MIL STD 810C 516.2
Insulation Withstand Voltage	1500VAC 1 minute (COM-GND)
	10M \approx @ 500VDC
Noise Immunity	NEMA 1500V 1 minute SANKI 1000V 1 minute
RFI	150MHz, 430MHz

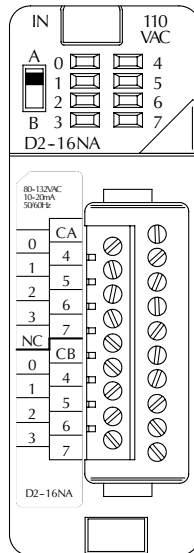
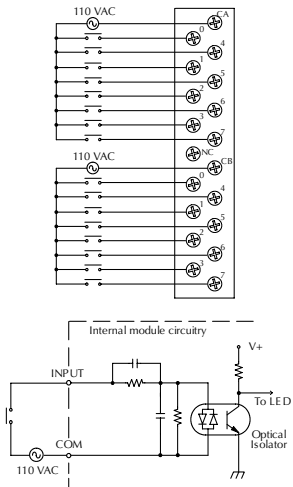
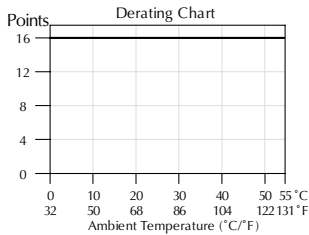
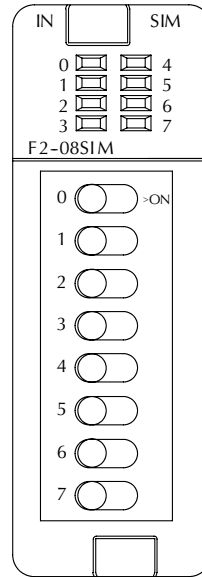


D2-16NA, AC Input

Inputs per Module	16
Commons per Module	2 (isolated)
Input Voltage Range	80-132 VAC
Peak Voltage	132VAC
ON Voltage Level	70VAC minimum
OFF Voltage Level	20VAC maximum
AC Frequency	47-63 Hz
Input Impedance	12kΩ @ 60Hz
Input Current	11mA @ 100VAC, 50Hz
	13mA @ 100VAC, 60Hz
	15mA @ 132VAC, 60Hz
Minimum ON Current	5mA
Maximum OFF Current	2mA
Base Power Required 5VDC	100mA
OFF to ON Response	5 to 30 ms
ON to OFF Response	10 to 50 ms
Terminal Type (included)	Removable; D2-16IOCON
Status Indicator	Logic side
Weight	2.4 oz. (68g)

F2-08SIM, Input Simulator

Inputs per Module	8
Base Power Required 5VDC	50mA
Terminal Type	None
Status Indicator	Switch side
Weight	2.65 oz. (75g)

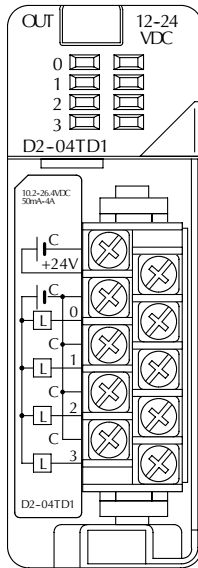
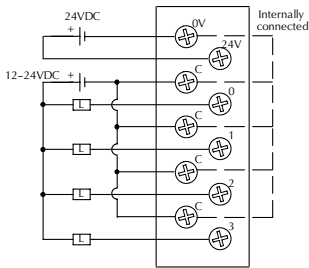
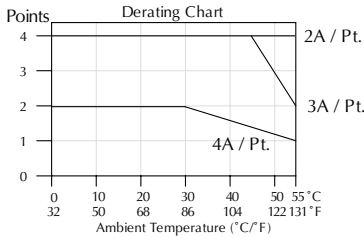


DL205 Digital Output Modules

D2-04TD1, DC Output

Outputs per Module	4 (current sinking)
Output Points Consumed	8 points (only first 4 pts. used)
Commons per Module	1 (4 I/O terminal points)
Output Type	NMOS FET (open drain)
Operating Voltage	10.2-26.4 VDC
Peak Voltage	40VDC
ON Voltage Drop	0.72 VDC maximum
AC Frequency	N/A
Max Load Current (resistive)	4A/point 8A/common
Max Leakage Current	0.1 mA @ 40VDC
Max Inrush Current	6A for 100ms, 15A for 10ms
Minimum Load Current	50mA

External DC Required	24VDC @ 20mA max.
Base Power Required 5VDC	60mA
OFF to ON Response	1ms
ON to OFF Response	1ms
Terminal Type (included)	Removable; D2-8IOCON
Status Indicator	Logic side
Weight	2.8 oz. (80g)
Fuses	4 (1 per point) (6.3 A slow blow, non-replaceable)



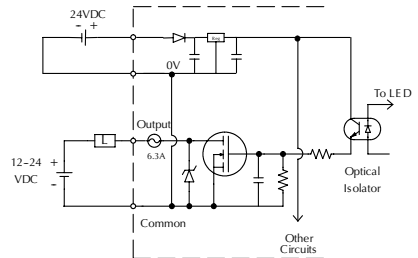
Inductive Load
Maximum Number of Switching Cycles per Minute

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 3.0 A or greater cannot be used.

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

Find the load current you expect to use and the duration that the output 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 100 ms 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. In this example, (60 x 0.1)/60 = 0.1, or 10% duty cycle.

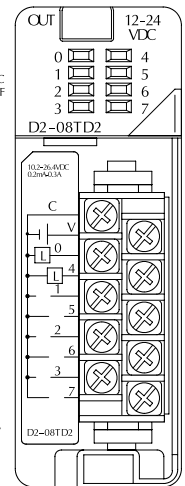
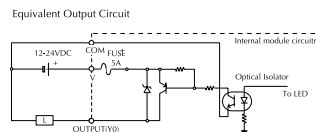
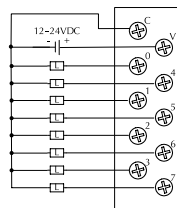
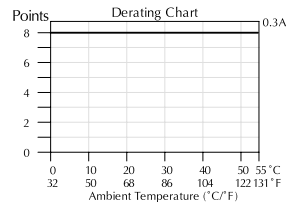
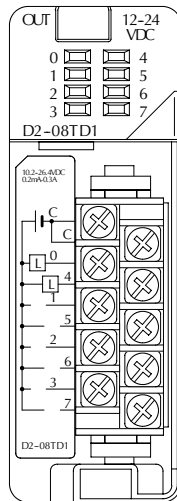
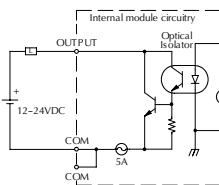
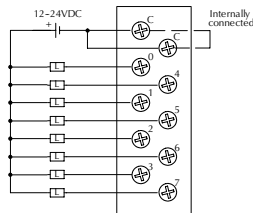
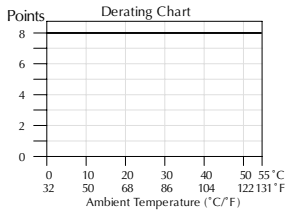


D2-08TD1, DC Output

Outputs per Module	8 (current sinking)
Commons per Module	1 (2 I/O terminal points)
Output Type	NPN open collector
Operating Voltage	10.2-26.4 VDC
Peak Voltage	40VDC
ON Voltage Drop	1.5 VDC maximum
AC Frequency	N/A
Minimum Load Current	0.5 mA
Max Load Current	0.3 A/point; 2.4 A/common
Max Leakage Current	0.1 mA @ 40VDC
Max Inrush Current	1A for 10ms
Base Power Required 5VDC	100mA
OFF to ON Response	1 ms
ON to OFF Response	1 ms
Terminal Type (included)	Removable; D2-8IOCON
Status Indicator	Logic side
Weight	2.3 oz. (65g)
Fuses	1 per common 5A fast blow, non-replaceable

D2-08TD2, DC Output

Outputs per Module	8 (current sourcing)
Commons per Module	1
Output Type	PNP open collector
Operating Voltage	12 to 24 VDC
Output Voltage	10.8 to 26.4 VDC
Peak Voltage	40VDC
ON Voltage Drop	1.5 VDC
AC Frequency	N/A
Minimum Load Current	N/A
Max Load Current	0.3 A per point; 2.4 A per common
Max Leakage Current	1.0 mA @ 40VDC
Max Inrush Current	1A for 10ms
Base Power Required 5VDC	100mA
OFF to ON Response	1ms
ON to OFF Response	1ms
Terminal Type (included)	Removable; D2-8IOCON
Status Indicator	Logic side
Weight	2.1 oz. (60g)
Fuses	1 per common 5A fast blow, non-replaceable

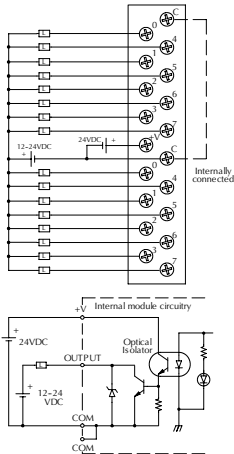
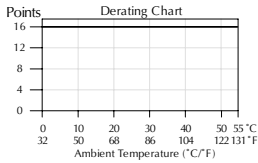


D2-16TD1-2, DC Output

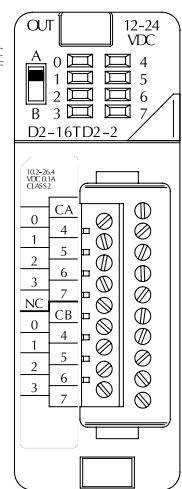
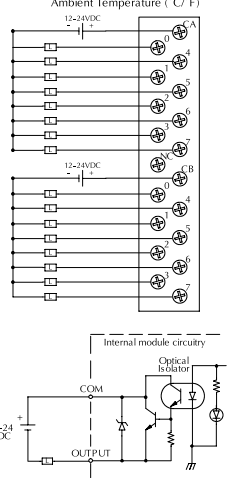
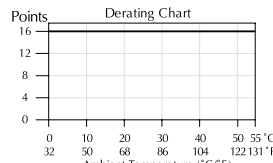
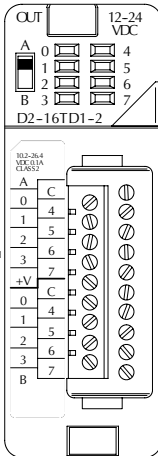
Outputs per Module	16 (current sinking)
Commons per Module	1 (2 I/O terminal points)
Output Type	NPN open collector
External DC required	24VDC \pm 4V @ 80mA max
Operating Voltage	10.2-26.4 VDC
Peak Voltage	30VDC
ON Voltage Drop	0.5 VDC maximum
AC Frequency	N/A
Minimum Load Current	0.2 mA
Max Load Current	0.1A/point 1.6 A/common
Max Leakage Current	0.1 mA @ 30VDC
Max Inrush Current	150mA for 10ms
Base Power Required 5VDC	200mA
OFF to ON Response	0.5 ms
ON to OFF Response	0.5 ms
Terminal Type (included)	Removable; D2-16IOCON
Status Indicator	Logic side
Weight	2.3 oz. (65g)
Fuses	None

D2-16TD2-2, DC Output

Outputs per Module	16 (current sourcing)
Commons per Module	2
Output Type	NPN open collector
Operating Voltage	10.2-26.4 VDC
Peak Voltage	30 VDC
ON Voltage Drop	1.0 VDC maximum
AC Frequency	N/A
Minimum Load Current	0.2 mA
Max Load Current	0.1A/point 1.6A/module
Max Leakage Current	0.1 mA @ 30 VDC
Max Inrush Current	150 mA for 10 ms
Base Power Required 5VDC	200 mA
OFF to ON Response	0.5 ms
ON to OFF Response	0.5 ms
Terminal Type (included)	Removable; D2-16IOCON
Status Indicator	Logic side
Weight	2.8 oz. (80g)
Fuses	None



* Can also be used with 5VDC supply



F2-16TD1(2)P, DC Output With Fault Protection



NOTE: Not supported in D2-230, D2-240 and D2-250 CPUs.

These modules detect the following fault status and turn the related X bit(s) on.

1. Missing external 24VDC for the module
2. Open load¹
3. Over temperature (the output is shut down)
4. Over load current (the output is shut down)

Fault Status	X bit Fault Status Indication
Missing external 24VDC	All 16 X bits are on.
Open load ¹	Only the X bit assigned to the faulted output is on
Over temperature	
Over load current	

When these modules are installed, 16 X bits are automatically assigned as the fault status indicator. Each X bit indicates the fault status of each output.

In this example, X10-X27 are assigned as the fault status indicator.

X10: Fault status indicator for Y0

X11: Fault status indicator for Y1



X26: Fault status indicator for Y16

X27: Fault status indicator for Y17

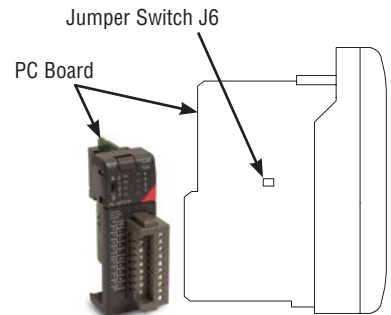
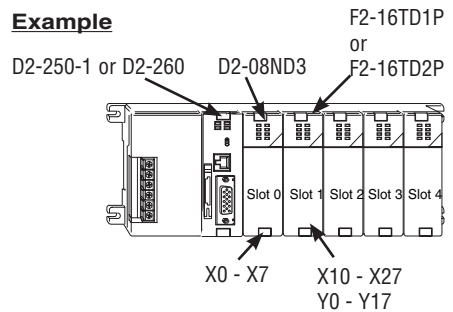
The fault status indicators (X bits) can be reset by performing the indicated operations in the following table:

Fault Status	Operation
Missing external 24VDC	Apply external 24VDC
Open load ¹	Connect the load.
Over temperature	Turn the output (Y bit) off or power cycle the PLC
Over load current	Turn the output (Y bit) off or power cycle the PLC



NOTE 1: Open load detection can be disabled by removing the jumper switch J6 on the module PC board.

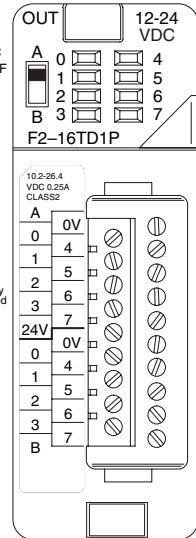
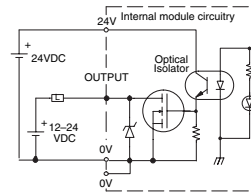
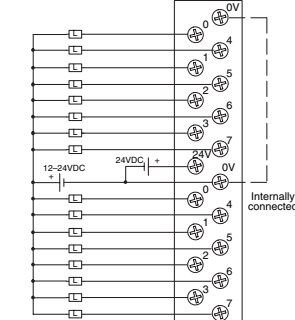
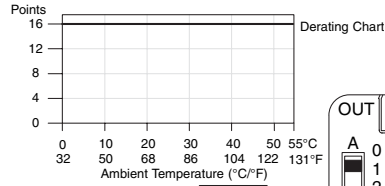
Example



Continued on next two pages.

F2-16TD1P, DC Output With Fault Protection

Inputs per module	16 (status indication)
Outputs per module	16 (current sinking)
Commons per module	1 (2 I/O terminal points)
Output type	NMOS FET (open drain)
Operating voltage	10.2 -26.4 VDC, external
Peak voltage	40VDC
AC frequency	N/A
ON voltage drop	0.7 V (output current 0.5 A)
Overcurrent trip	0.6 A min., 1.2 A max.
Maximum load current	0.25 A continuous, 0.5 A peak
Maximum OFF current	Jumper J6 installed: 200 μ A; J6 removed: 30 μ A
Base power required 5V	70mA
OFF to ON response	0.5 ms
ON to OFF response	0.5 ms
Terminal type	Removable (D2-16IOCON)
Status indicators	Logic Side
Weight	2.0 oz. (25g)
Fuses	None
External DC required	24VDC \pm 10% @ 50mA
External DC overvoltage shutdown	27V, outputs are restored when voltage is within limits



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



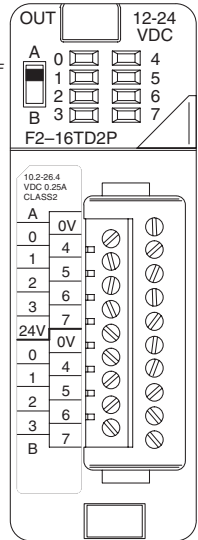
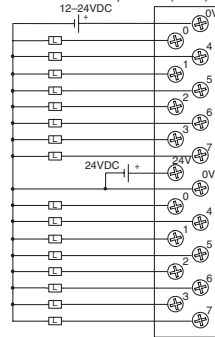
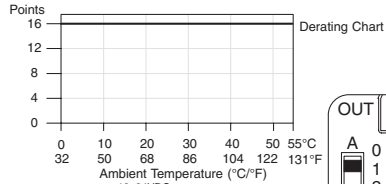
NOTE 1: Not supported in D2-230, D2-240 and D2-250 CPUs.

NOTE 2: Supporting Firmware: D2-250-1 must be V4.80 or later
D2-260 must be V2.60 or later

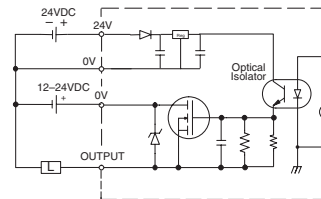
NOTE 3: This module does not currently support Think & Do 8.0. It does not support Think & Do Live! or Studio.

F2-16TD2P, DC Output with Fault Protection

Inputs per module	16 (status indication)
Outputs per module	16 (current sourcing)
Commons per module	1
Output type	NMOS FET (open source)
Operating voltage	10.2 -26.4 VDC, external
Peak voltage	40 VDC
AC frequency	N/A
ON voltage drop	0.7 V (output current 0.5 A)
Overcurrent trip	0.6 A min., 1.2 A max.
Maximum load current	0.25 A continuous, 0.5 A peak
Maximum OFF current	Jumper J6 installed: 200 μ A; J6 removed: 30 μ A
Base power required 5V	70mA
OFF to ON response	0.5 ms
ON to OFF response	0.5 ms
Terminal type	Removable (D2-16IOCON)
Status indicators	Logic Side
Weight	2.0 oz. (25g)
Fuses	None
External DC required	24 VDC +/-10% @ 50 mA
External DC overvoltage shutdown	27 V, outputs are restored when voltage is within limits



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



NOTE 1: Not supported in D2-230, D2-240 and D2-250 CPUs.

NOTE 2: Supporting Firmware: D2-250-1 must be V4.80 or later

D2-260 must be V2.60 or later

NOTE 3: This module does not currently support Think & Do 8.0. It does not support Think & Do Live! or Studio.

D2-32TD1, DC Output

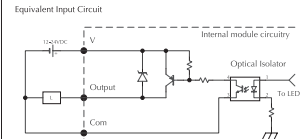
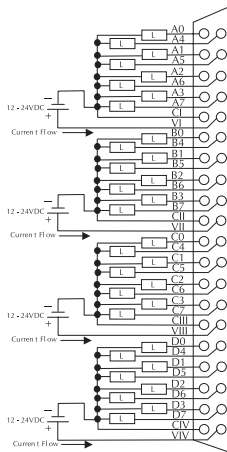
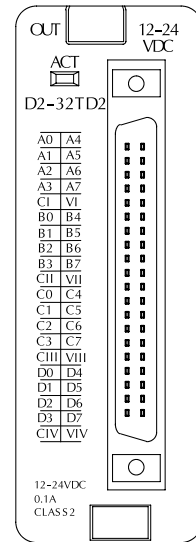
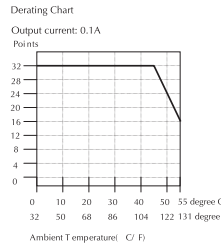
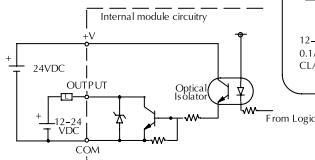
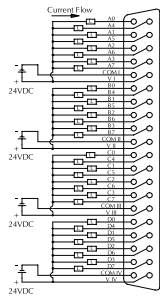
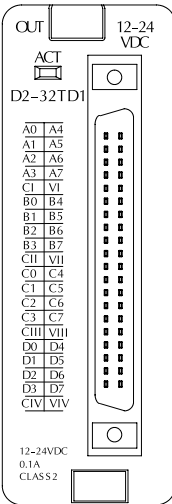
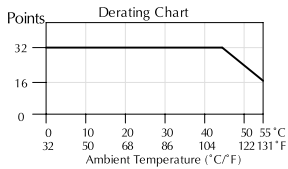
Outputs per Module	32 (current sinking)
Commons per Module	4 (8 I/O terminal points)
Output Type	NPN open collector
Operating Voltage	12-24 VDC
Peak Voltage	30VDC
ON Voltage Drop	0.5 VDC maximum
Minimum Load Current	0.2 mA
Max Load Current	0.1 A/point; 3.2 A per module
Max Leakage Current	0.1 mA @ 30VDC
Max Inrush Current	150mA for 10ms
Base Power Required 5VDC	350mA
OFF to ON Response	0.5 ms
ON to OFF Response	0.5 ms
Terminal Type (not included)	Removable 40-pin connector ¹
Status Indicator	Module activity (no I/O status indicators)
Weight	2.1 oz. (60g)
Fuses	None
External DC Power Required	20-28 VDC max. 120mA (all points on)

¹ Connector sold separately.
See Terminal Blocks and Wiring for wiring options.

D2-32TD2, DC Output

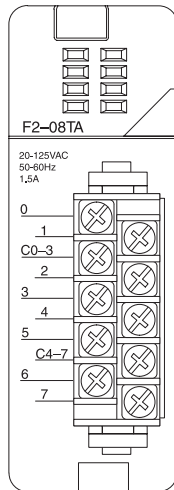
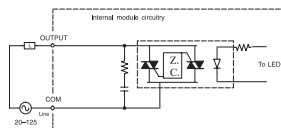
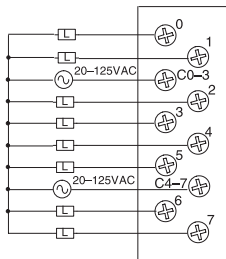
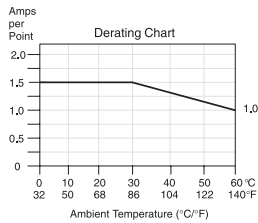
Outputs per Module	32 (current sourcing)
Commons per Module	4 (8 I/O terminal points)
Output Type	Transistor
Operating Voltage	12 to 24 VDC
Peak Voltage	30VDC
ON Voltage Drop	0.5 VDC @ 0.1 A
Minimum Load Current	0.2 mA
Max Load Current	0.1A/point; 0.8A/common
Max Leakage Current	0.1 mA @ 30VDC
Max Inrush Current	150mA @ 10ms
Base Power Required 5VDC	350 mA
OFF to ON Response	0.5 ms
ON to OFF Response	0.5 ms
Terminal Type (not included)	Removable 40-pin connector ¹
Status Indicator	Module activity (no I/O status indicators)
Weight	2.1 oz (60g)
Fuses	None

¹ Connector sold separately.
See Terminal Blocks and Wiring for wiring options.



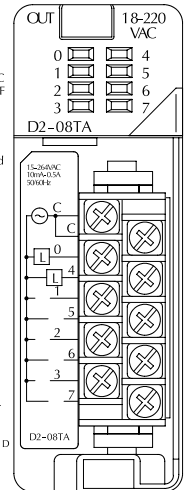
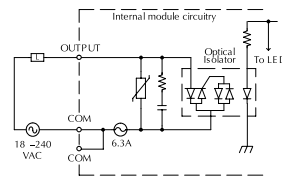
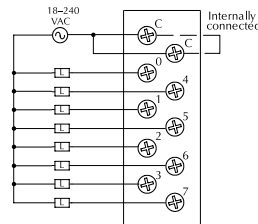
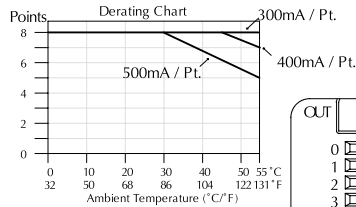
F2-08TA, AC Output

Outputs per Module	8
Commons per Module	2 (Isolated)
Output Type	SSR (Triac with zero crossover)
Operating Voltage	24-140 VAC
Peak Voltage	140VAC
ON Voltage Drop	1.6 V(rms) @ 1.5 A
AC Frequency	47 to 63 Hz
Minimum Load Current	50mA
Max Load Current	1.5 A / pt @ 30°C 1.0 A / pt @ 60°C 4.0 A / common; 8.0 A / module @ 60°C
Max Leakage Current	0.7 mA (rms)
Peak One Cycle Surge Current	15A
Base Power Required 5VDC	250mA
OFF to ON Response	0.5 ms - 1/2 cycle
ON to OFF Response	0.5 ms - 1/2 cycle
Terminal Type (included)	Removable; D2-8IOCON
Status Indicator	Logic side
Weight	3.5 oz.
Fuses	None



D2-08TA, AC Output

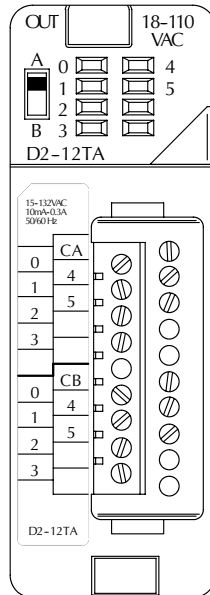
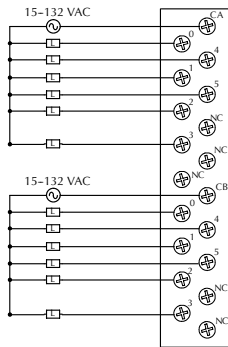
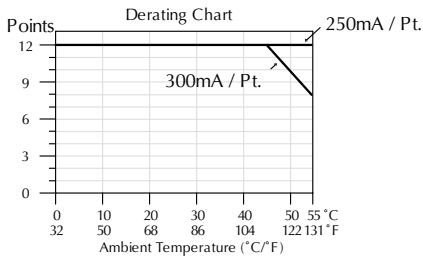
Outputs per Module	8
Commons per Module	1 (2 I/O terminal points)
Output Type	SSR (Triac)
Operating Voltage	15-264 VAC
Peak Voltage	264VAC
ON Voltage Drop	< 1.5 VAC (>0.1A) < 3.0 VAC (<0.1A)
AC Frequency	47 to 63 Hz
Minimum Load Current	10mA
Max Load Current	0.5 A/point; 4A/common 4mA (264VAC, 60Hz) 1.2 mA (100VAC, 60Hz) 0.9 mA (100VAC, 50Hz)
Max Inrush Current	10A for 10ms
Base Power Required 5VDC	250mA
OFF to ON Response	1ms
ON to OFF Response	1ms + 1/2 cycle
Terminal Type (included)	Removable; D2-8IOCON
Status Indicator	Logic side
Weight	2.8 oz. (80g)
Fuses	1 per common, 6.3 A slow blow, non-replaceable



D2-12TA, AC Output

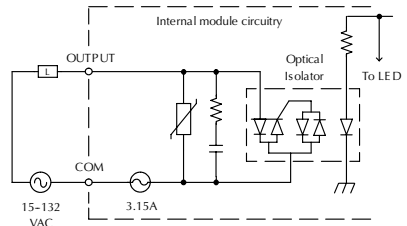
Outputs per Module	12
Outputs Points Consumed	16 (four unused, see chart below)
Commons per Module	2 (isolated)
Output Type	SSR (Triac)
Operating Voltage	15-132 VAC
Peak Voltage	132 VAC
ON Voltage Drop	< 1.5VAC (>50mA) < 4.0VAC (<50mA)
AC Frequency	47 to 63 Hz
Minimum Load Current	10mA
Max Load Current	0.3 A/point; 1.8A/common

Max Leakage Current	2mA (132VAC, 60Hz)
Max Inrush Current	10A for 10ms
Base Power Required 5VDC	350mA
OFF to ON Response	1ms
ON to OFF Response	1ms + 1/2 cycle
Terminal Type (included)	Removable; D2-16IOCON
Status Indicator	Logic side
Weight	2.8 oz. (80g)
Fuses	(2) 1 per common 3.15 A 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



D2-04TRS, Relay Output

Outputs per Module	4
Outputs Points Consumed	8 (only 1st 4pts. are used)
Commons per Module	4 (isolated)
Output Type	Relay, form A (SPST)
Operating Voltage	5-30 VDC / 5-240 VAC
Peak Voltage	30VDC, 264VAC
ON Voltage Drop	0.72 VDC maximum
AC Frequency	47 to 63 Hz
Minimum Load Current	10mA
Max Load Current (resistive)	4A/point; 8A/module (resistive)

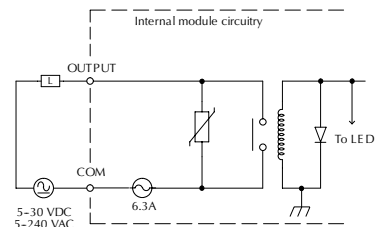
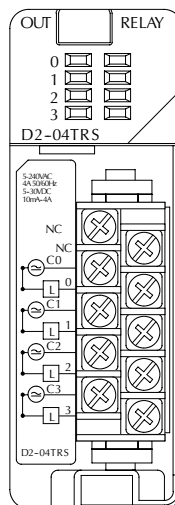
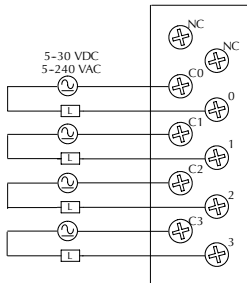
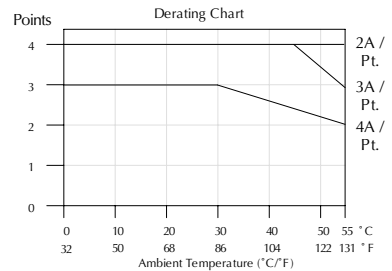
Max Leakage Current	0.1 mA @ 264VAC
Max Inrush Current	5A for < 10ms
Base Power Required 5VDC	250mA
OFF to ON Response	10ms
ON to OFF Response	10ms
Terminal Type (included)	Removable; D2-8IOCON
Status Indicator	Logic side
Weight	2.8 oz. (80g)
Fuses	1 per point 6.3 A slow blow, replaceable Order D2-FUSE-3 (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 100 VAC, solenoid (inductive) loads over 3A cannot be used.

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

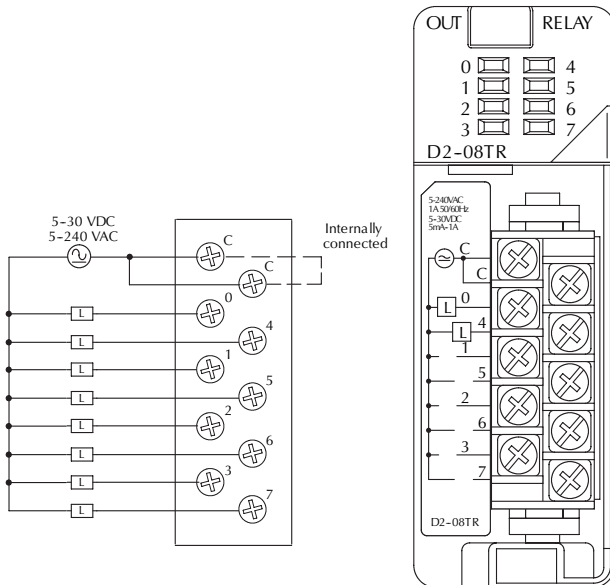
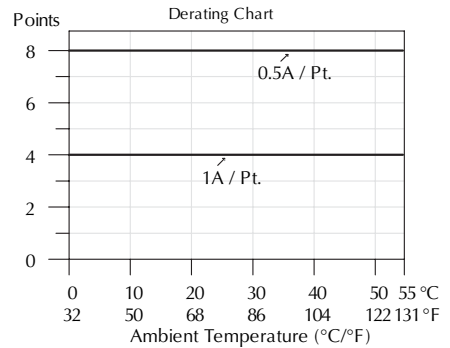


D2-08TR, Relay Output

Outputs per Module	8
Outputs Points Consumed	8
Commons per Module	1 (2 I/O terminals)
Output Type	Relay, form A (SPST)
Operating Voltage	5-30 VDC; 5-240 VAC
Peak Voltage	30VDC, 264VAC
ON Voltage Drop	N/A
AC Frequency	47 to 60 Hz
Minimum Load Current	5mA @ 5VDC
Max Load Current (resistive)	1A/point; 4A/common

Max Leakage Current	0.1 mA @ 265VAC
Max Inrush Current	Output: 3A for 10ms Common: 10A for 10ms
Base Power Required 5VDC	250mA
OFF to ON Response	12ms
ON to OFF Response	10ms
Terminal Type (included)	Removable; D2-8IOCON
Status Indicator	Logic side
Weight	3.9 oz. (110g)
Fuses	One 6.3 A slow blow, replaceable Order D2-FUSE-3 (5 per pack)

Typical Relay Life (Operations)		
24 VDC Resistive	1A	500k
24 VDC Solenoid	1A	100k
110 VDC Resistive	1A	500k
110 VDC Solenoid	1A	200k
220 VAC Resistive	1A	350k
220 VAC Solenoid	1A	100k

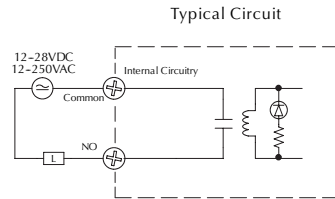
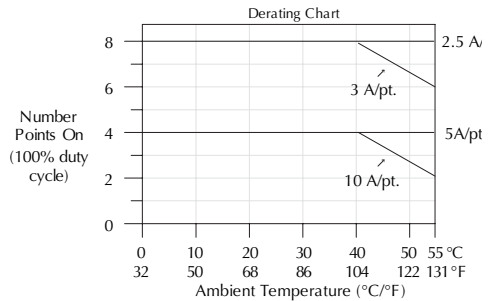
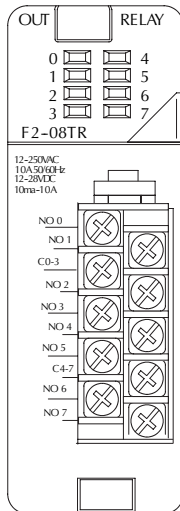
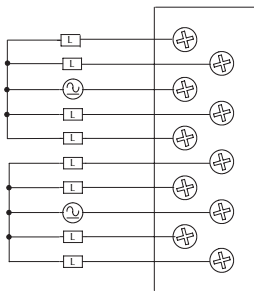


F2-08TR, Relay Output

Outputs per Module	8
Outputs Points Consumed	8
Commons per Module	2 (isolated), 4-pt. per common
Output Type	8, Form A (SPST normally open)
Operating Voltage	7A @ 12-28 VDC, 12-250 VAC; 0.5 A @ 120VDC
Peak Voltage	150VDC, 265 VAC
ON Voltage Drop	N/A
AC Frequency	47 to 63Hz
Minimum Load Current	10mA @ 12VDC
Max Load Current (resistive)	10A/point ³ (subject to derating) Max of 10A/common
Max Leakage Current	N/A
Max Inrush Current	12A
Base Power Required 5VDC	670mA
OFF to ON Response	15ms (typical)
ON to OFF Response	5ms (typical)
Terminal Type (included)	Removable; D2-8IOCON
Status Indicator	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 VDC Resistive	-	600k	300k
110 VDC Solenoid	-	500k	200k
220 VAC Resistive	-	300k	150k
220 VAC Solenoid	-	250k	100k

1) Contact life may be extended beyond those values shown with the use of arc suppression techniques described in the DL205 User Manual. Since these modules have no leakage current, they do not have built-in snubber. For example, if you place a diode across a 24 VDC 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.
3) Normally closed contacts have 1/2 the current handling capability of the normally open contacts.

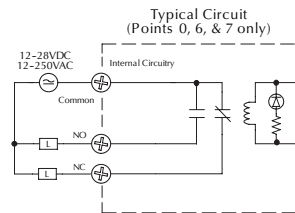
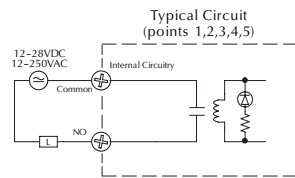
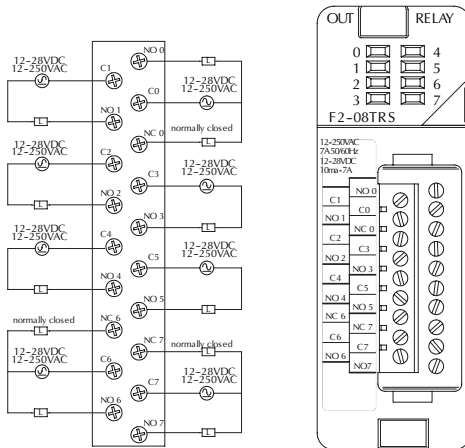
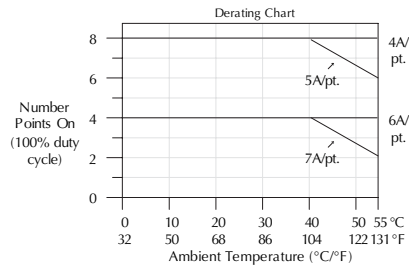


F2-08TRS, Relay Output

Outputs per Module	8
Outputs Points Consumed	8
Commons per Module	8 (isolated)
Output Type	3, Form C (SPDT) 5, Form A (SPST normally open)
Operating Voltage	7A @ 12-28 VDC, 12-250 VAC 0.5A @ 120VDC
Peak Voltage	150VDC, 265VAC
ON Voltage Drop	N/A
AC Frequency	47 to 63 Hz
Minimum Load Current	10mA @ 12VDC
Max Load Current (resistive)	7A/point ³ (subject to derating)
Max Leakage Current	N/A
Max Inrush Current	12A
Base Power Required 5VDC	670mA
OFF to ON Response	15ms (typical)
ON to OFF Response	5ms (typical)
Terminal Type (included)	Removable; D2-16IOCON
Status Indicator	Logic side
Weight	5.5oz. (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 VDC Resistive	-	600k	300k
110 VDC Solenoid	-	500k	200k
220 VAC Resistive	-	300k	150k
220 VAC Solenoid	-	250k	100k

1) Contact life may be extended beyond those values shown with the use of arc suppression techniques described in the DL205 User Manual. Since these modules have no leakage current, they do not have 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 120VDC 0.5 A resistive load, contact life cycle is 200k cycles.
3) Normally closed contacts have 1/2 the current handling capability of the normally open contacts.



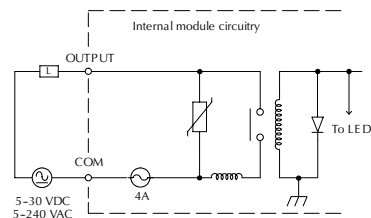
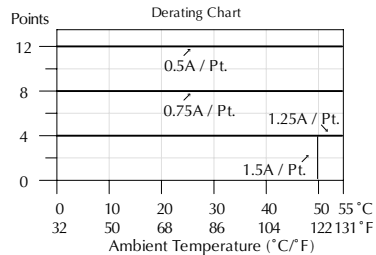
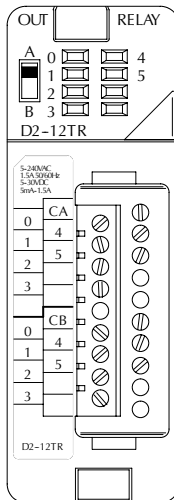
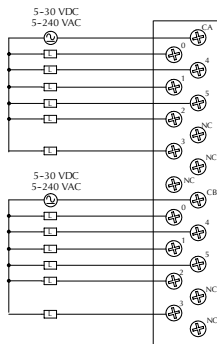
D2-12TR, Relay Output

Outputs per Module	12
Outputs Points Consumed	16 (four unused, see chart below)
Commons per Module	2 (6-pts. per common)
Output Type	Relay, form A (SPST)
Operating Voltage	5-30 VDC; 5-240 VAC
Peak Voltage	30VDC; 264VAC
ON Voltage Drop	N/A
AC Frequency	47 to 60 Hz
Minimum Load Current	5mA @ 5VDC
Max Load Current (resistive)	1.5 A/point; Max of 3A/common
Max Leakage Current	0.1 mA @ 265VAC
Max Inrush Current	Output: 3A for 10ms Common: 10A for 10 ms
Base Power Required 5VDC	450mA
OFF to ON Response	10ms
ON to OFF Response	10ms
Terminal Type (included)	Removable; D2-16IOCON
Status Indicator	Logic side
Weight	4.6 oz. (130g)
Fuses	(2) 4A slow blow, replaceable Order D2-FUSE-4 (5 per pack)

Typical Relay Life (Operations)		
24 VDC Resistive	1A	500k
24 VDC Solenoid	1A	100k
110 VDC Resistive	1A	500k
110 VDC Solenoid	1A	200k
220 VAC Resistive	1A	350k
220 VAC Solenoid	1A	100k

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

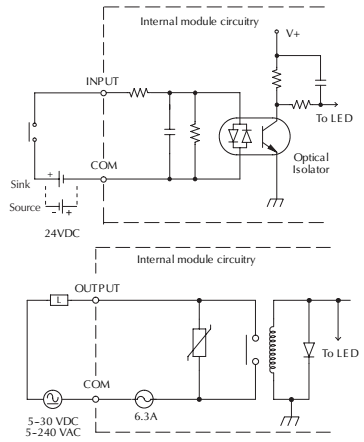
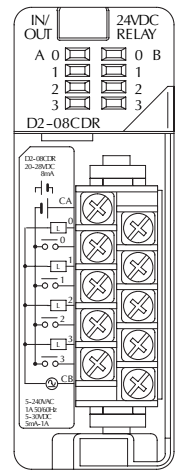
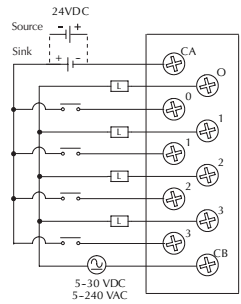
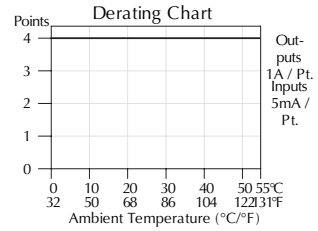


D2-08CDR, 4 pt. DC Input / 4pt. Relay Output

General Specifications	
Base Power Required 5VDC	200mA
Terminal Type (included)	Removable; D2-8IOCON
Status Indicator	Logic side
Weight	3.5 oz. (100g)
Input Specifications	
Inputs per Module	4 (sink/source)
Input Points Consumed	8 (only first 4-pt. are used)
Commons per Module	1
Input Voltage Range	20-28 VDC
Peak Voltage	30VDC
ON Voltage Level	19VDC minimum
OFF Voltage Level	7VDC maximum
AC Frequency	N/A
Input Impedance	4.7 kΩ
Input Current	5mA @ 24VDC
Maximum Current	8mA @ 30VDC
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
Fuses (input circuits)	None

Output Specifications	
Outputs per Module	4
Outputs Points Consumed	8 (only first 4-pt. are used)
Commons per Module	1
Output Type	Relay, form A (SPST)
Operating Voltage	5-30 VDC; 5-240 VAC
Peak Voltage	30VDC; 264VAC
ON Voltage Drop	N/A
AC Frequency	47 to 63 Hz
Minimum Load Current	5mA @ 5VDC
Max Load Current (resistive)	1A/point ; 4A/module
Max Leakage Current	0.1 mA @ 264VAC
Max Inrush Current	3A for < 100ms 10A for < 10ms (common)
OFF to ON Response	12ms
ON to OFF Response	10ms
Fuses (output circuits)	1 (6.3A slow blow, replaceable); Order D2-FUSE-3 (5 per pack)

Typical Relay Life (Operations)		
24 VDC Resistive	1A	500k
24 VDC Solenoid	1A	100k
110 VDC Resistive	1A	500k
110 VDC Solenoid	1A	200k
220 VAC Resistive	1A	350k
220 VAC Solenoid	1A	100k



NOTES:

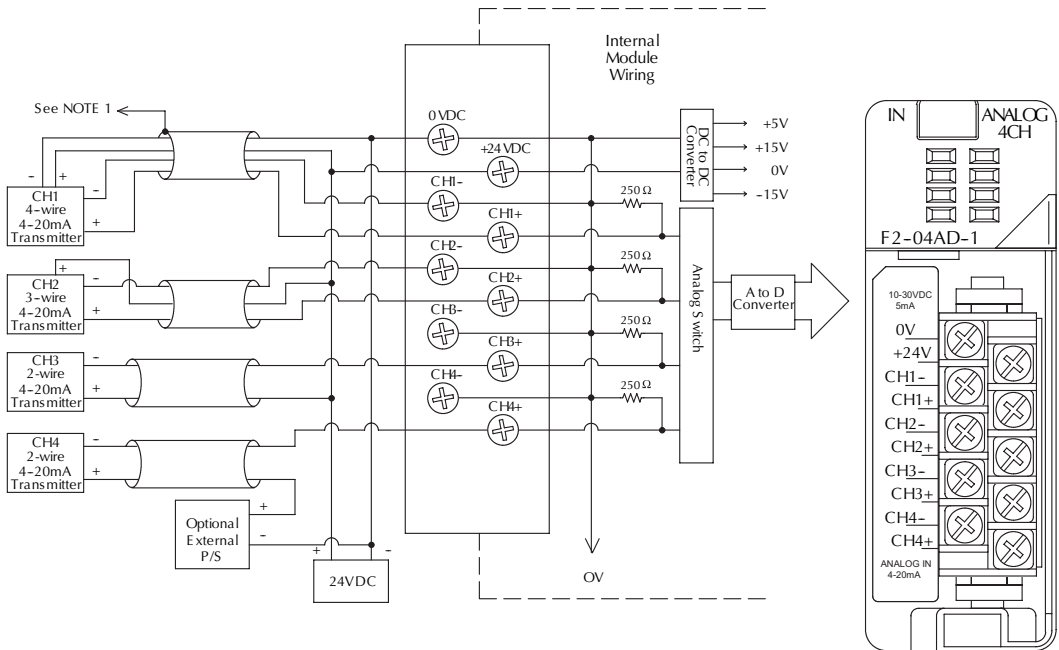
DL205 Analog Input Modules

F2-04AD-1 4-Channel 4-20mA Analog Input Module

This module can be powered by either a 12VDC or 24VDC power supply, and is a direct replacement for F2-04AD-1L modules.	
Number of Channels	4, single ended (1 common)
Input Ranges	4 to 20 mA current
Resolution	12-bit (1 in 4096)
Active Low-pass Filtering	-3 dB at 120 Hz, 2 poles (-12 dB per octave)
Input Impedance	250Ω ±0.1%, 1/2W current input
Absolute Maximum Ratings	-40mA to +40mA, current input
Converter Type	Successive approximation
Conversion Time (PLC Update Rate)	1 channel per scan maximum (D230 CPU); 4 channels per scan maximum (D2-240, D2-250(-1), D2-260, and D2-262 CPUs)
Linearity Error (End to End)	±1 count (0.025% of full scale) maximum
Input Stability	±1 count
Full Scale Calibration Error (offset error not included)	±12 counts max., @ 20 mA current input
Offset Calibration Error	±7 counts max., @ 4mA current input
Step Response	4.9 ms to 95% of F.S. change
Maximum Inaccuracy	±.5% @ 77°F (25°C) ±.65% 32° to 140°F (0° to 60°C)
Accuracy vs. Temperature	±50 ppm/°C maximum full scale (including max. offset change)
Recommended Fuse	0.032 A, Series 217 fast-acting, current inputs
Digital Input Points Required	16 (X) input points (12 binary data bits, 2 channel ID bits, 2 diagnostic bits)
Base Power Required 5 VDC	100mA
External Power Supply	5mA maximum, +10 to +30 VDC
Operating Temperature	32° to 140°F (0° to 60°C)
Storage Temperature	-4° to 158°F (-20° to 70°C)
Relative Humidity	5 to 95% (non-condensing)
Environmental Air	No corrosive gases permitted
Shock & Vibration	MIL STD 810C 514.2
Noise Immunity	NEMA ICS3-304
Terminal Type (included)	Removable; D2-8IOCON

One count in the specification table is equal to one least significant bit of the analog data value (1 in 4096).

F2-04AD-1 4-Channel 4-20mA Analog Input



Note 1: Shields should be grounded at the signal source

More than one external power supply can be used provided all the power supply commons are connected. A Series 217, 0.032A, fast-acting fuse is recommended for 4-20 mA current loops. If the power supply common of an external power supply is not connected to 0VDC on the module, then the output of the external transmitter must be isolated. To avoid "ground loop" errors, recommended 4-20 mA transmitter types are:

2 or 3 wire: Isolation between input signal and power supply.

4 wire: Isolation between input signal, power supply, and 4-20 mA output

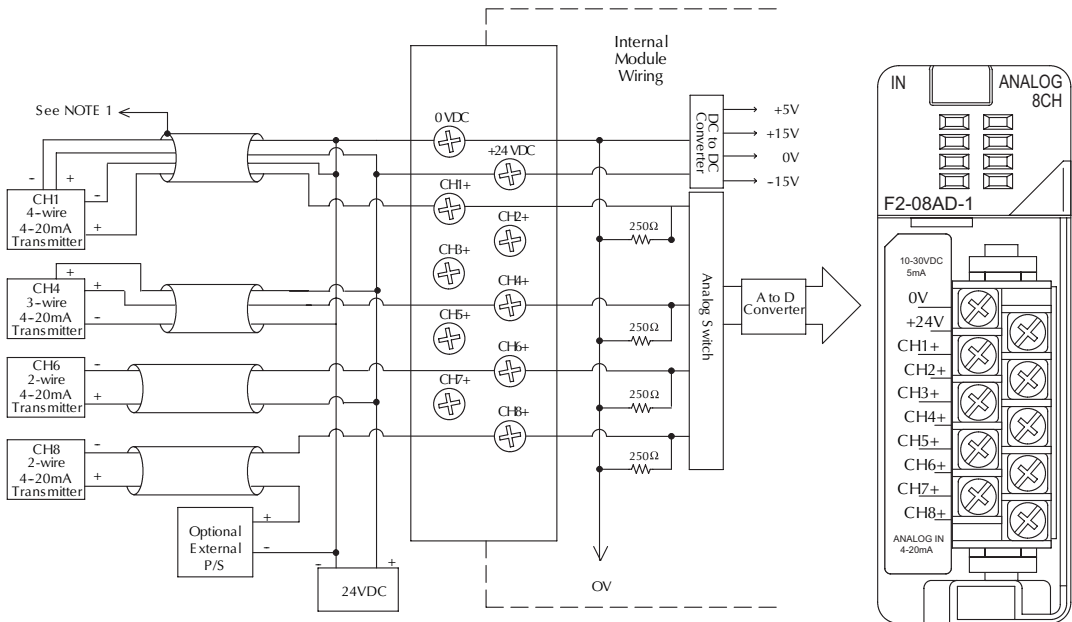
F2-08AD-1 8-Channel 4-20mA Analog Input Module

Number of Channels	8, single ended (1 common)
Input Ranges	4 to 20 mA current
Resolution	12-bit (1 in 4096)
Low-pass Filtering	-3dB at 200Hz, (-6dB per octave)
Input Impedance	250Ω ±0.1%, 1/2W current input
Absolute Maximum Ratings	-45mA to +45mA
Converter Type	Successive approximation
Conversion Time (PLC Update Rate)	(D2-230 CPU) 1 channel per scan maximum (D2-240, D2-250(-1), D2-260, and D2-262 CPUs) 8 channels per scan maximum
Linearity Error (End to End)	±1 count (0.025% of full scale) maximum
Input Stability	±1 count
Full Scale Calibration Error (offset error not included)	±5 counts max., @ 20mA current input
Offset Calibration Error	±2 counts max., @ 4mA current input
Step Response	1 ms to 95% of F.S. change

Maximum Inaccuracy	±.1% @ 77°F (25°C) ±.25% 32° to 140°F (0° to 60°C)
Accuracy vs. Temperature	±50 ppm/°C maximum full scale (including max. offset change of two counts)
Recommended Fuse	0.032 A, Series 217 fast-acting, current inputs
Digital Input Points Required	16 (X) input points (12 binary data bits, 3 channel ID bits, 1 broken transmitter bit)
Base Power Required 5VDC	100mA
External Power Supply	5mA maximum, +10 to +30 VDC
Operating Temperature	32° to 140°F (0° to 60°C)
Storage Temperature	-4° to 158°F (-20° to 70°C)
Relative Humidity	5 to 95% (non-condensing)
Environmental Air	No corrosive gases permitted
Shock & Vibration	MIL STD 810C 514.2
Noise Immunity	NEMA ICS3-304
Terminal Type (included)	Removable; D2-8IOCON

One count in the specification table is equal to one least significant bit of the analog data value (1 in 4096).

F2-08AD-1 8-Channel 4-20mA Analog Input



Note 1: Shields should be grounded at the signal source.

More than one external power supply can be used provided all the power supply commons are connected. A Series 217, 0.032A, fast-acting fuse is recommended for 4-20 mA current loops. If the power supply common of an external power supply is not connected to 0 VDC on the module, then the output of the external transmitter must be isolated. To avoid "ground loop" errors, recommended 4-20 mA transmitter types are:

2 or 3 wire: Isolation between input signal and power supply.

4 wire: Isolation between input signal, power supply, and 4-20 mA output

F2-04AD-2 4-Channel Voltage Analog Input Module

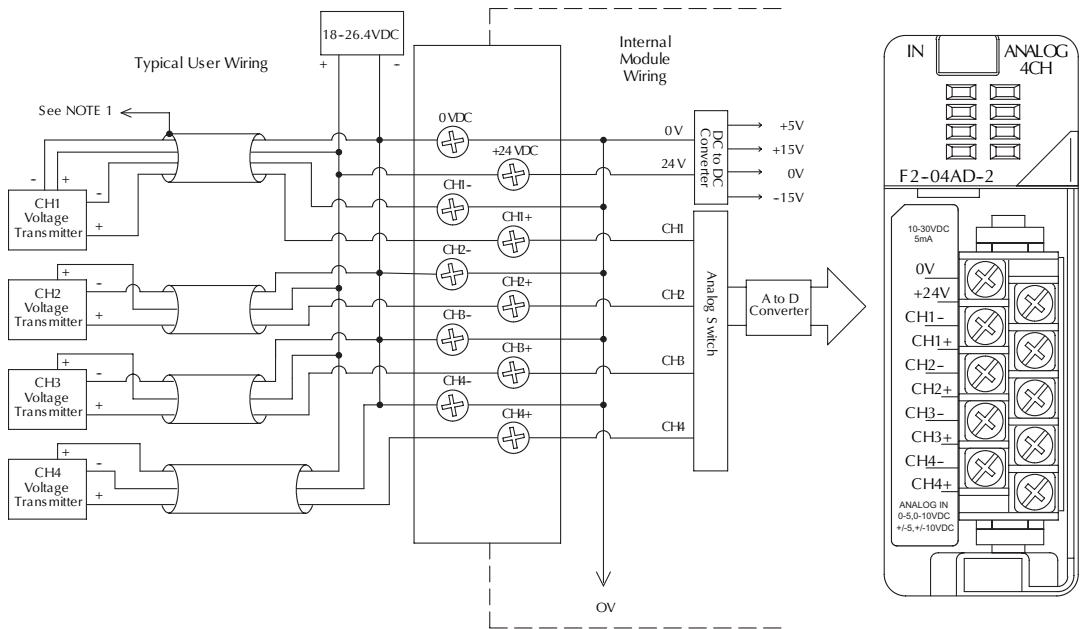
This module can be powered by either a 12VDC or 24VDC power supply, and is a direct replacement for F2-04AD-2L modules.

Number of Channels	4, single ended (1 common)
Input Ranges	0 to 5V, 0 to 10 V, $\pm 5V$, $\pm 10 V$
Resolution	12-bit (1 in 4096)
Active Low-pass Filtering	-3 dB at 80 Hz, 2 poles (-12 dB per octave)
Input Impedance	$>20M\Omega$
Absolute Maximum Ratings	-75 to +75 VDC
Converter Type	Successive approximation
Conversion Time (PLC Update Rate)	1 channel per scan maximum (D2-230 CPU) 4 channels per scan maximum (D2-240, D2-250(-1) and D2-260 CPUs)
Linearity Error (End to End)	± 1 count (0.025% of full scale) maximum ± 2 counts maximum (bi-polar)
Input Stability	± 1 count
Full Scale Calibration Error (offset error not included)	± 3 counts maximum
Offset Calibration Error	± 1 count maximum (0V input)
Step Response	8.2 ms to 95% of F.S change

Maximum Inaccuracy	$\pm 1\%$ @ 77°F (25°C) $\pm 3\%$ 32° to 140°F (0° to 60°C)
Accuracy vs. Temperature	± 50 ppm/°C full scale calibration change (including maximum offset change)
Digital Input Points Required	16(x) input points (12 binary data bits, 2 channel ID bits)
Base Power Required 5VDC	110mA
External Power Supply	5mA maximum, +10 to +30 VDC
Operating Temperature	32° to 140°F (0 to 60°C)
Storage Temperature	-4° to 158°F (-20° to 70°C)
Relative Humidity	5 to 95% (non-condensing)
Environmental Air	No corrosive gases permitted
Shock & Vibration	MIL STD 810C 514.2
Noise Immunity	NEMA ICS3-304
Terminal Type (included)	Removable; D2-8IOCON

One count in the specification table is equal to one least significant bit of the analog data value (1 in 4096).

F2-04AD-2 4-Channel Voltage Analog Input



Note 1: Shields should be grounded at the signal source.

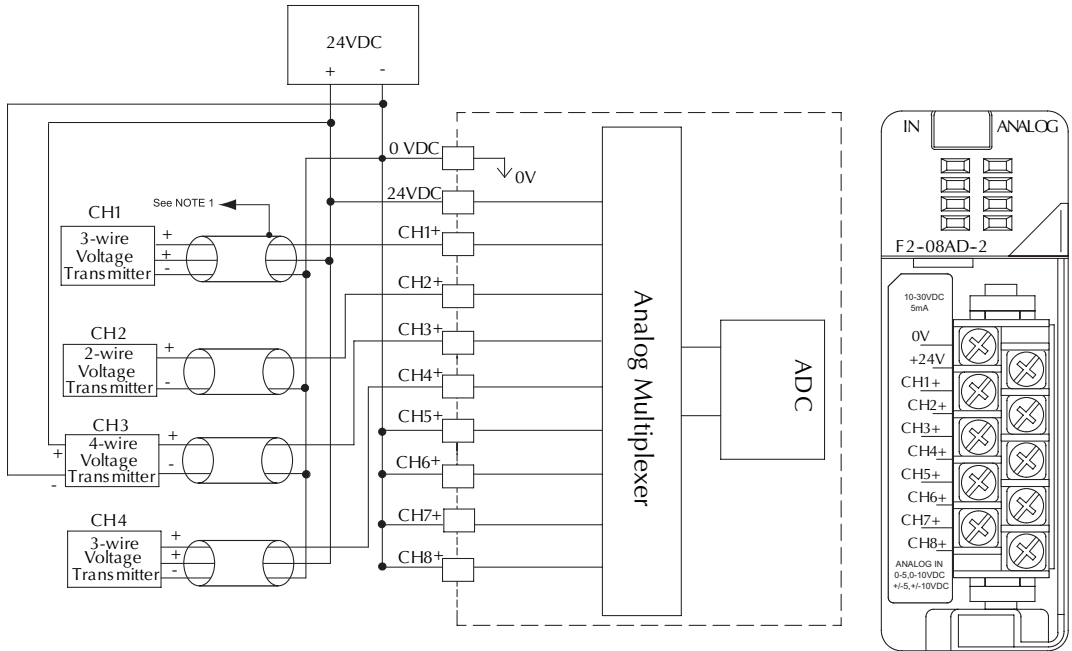
F2-08AD-2 8-Channel Voltage Analog Input Module

Number of Channels	8, single ended (1 common)
Input Ranges	0 to 5V, 0 to 10 V, $\pm 5V$, ± 10 VDC
Resolution	12 bit (1 in 4095) uni-polar 13 bit (-4095 to 4095) bi-polar
Active Low-pass Filtering	-3dB at 200 Hz, (-6dB per octave)
Input Impedance	>20M Ω
Absolute Maximum Ratings	-75 to +75 VDC
Converter Type	Successive approximation
Conversion Time (PLC Update Rate)	1 channel per scan maximum (D2-230 CPU) 8 channels per scan maximum (D2-240, D2-250(-1) and D2-260 CPUs)
Linearity Error (End to End)	± 1 count (0.025% of full scale) maximum
Input Stability	± 1 count
Full Scale Calibration Error (offset error not included)	± 3 counts maximum
Offset Calibration Error	± 1 count maximum (0V input)
Step Response	1ms to 95% of F.S. change

Maximum Inaccuracy	$\pm 1.1\%$ @ 77°F (25°C) $\pm 3\%$ 32° to 140°F (0° to 60°C)
Accuracy vs. Temperature	± 50 ppm/°C maximum full scale (including max. offset change of 2 counts)
Digital Input Points Required	16 (X) input points, (12 binary data bits, 3 channel ID bits, 1 sign bit, 1 diagnostic bit)
Base Power Required 5VDC	100mA
External Power Supply	5mA maximum, +10 to +30 VDC
Operating Temperature	32° to 140°F (0° to 60°C)
Storage Temperature	-4° to 158°F (-20° to 70°C)
Relative Humidity	5 to 95% (non-condensing)
Environmental Air	No corrosive gases permitted
Shock & Vibration	MIL STD 810C 514.2
Noise Immunity	NEMA ICS3-304
Terminal Type (included)	Removable; D2-8IOCON

One count in the specification table is equal to one least significant bit of the analog data value (1 in 4096). Includes circuitry to automatically detect broken or open transmitters.

F2-08AD-2 8-Channel Voltage Analog Input



Note 1: Shields should be grounded at the signal source.

Note 2: Connect all external power supply commons.

Note 3: Connect unused channels (CH5+, CH6+, CH7+, CH8+ in this example) to 0VDC.

DL205 RTD and Thermocouple Modules

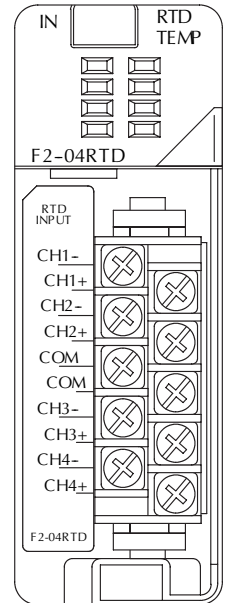
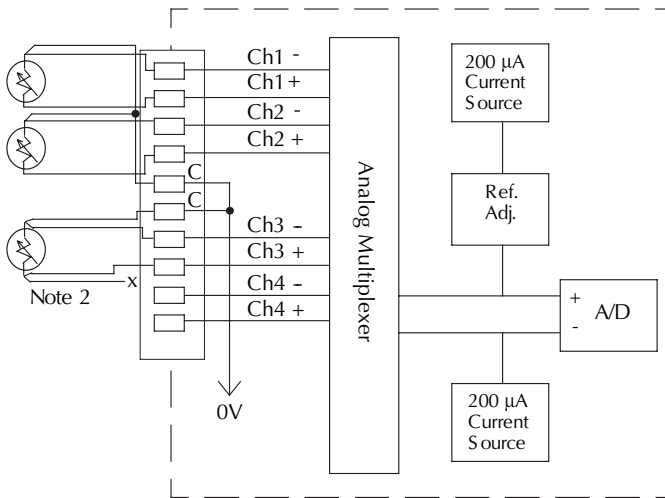
F2-04RTD 4-Channel RTD Input Module

Number of Channels	4
Input Ranges	Type Pt100: -200.0/850.0°C, -328/1562°F Type Pt1000: -200.0/595.0°C, -328/1103°F Type jPt100: -38.0/450.0°C, -36/842°F Type CU-10/25z: -200.0/260.0°C, -328/500°F
Resolution	16 bit (1 in 65535)
Display Resolution	±0.1°C, ±0.1°F (±3276.7)
RTD Excitation Current	200µA
Input Type	Differential
Notch Filter	>100 db notches at 50/60 Hz -3db=13.1Hz
Maximum Setting Time	100ms (full-scale step input)
Common Mode Range	0-5 VDC
Absolute Maximum Ratings	Fault protected inputs to ±50 VDC
Sampling Rate	160 ms per channel

Converter Type	Charge Balancing
Linearity Error	±.05°C maximum, ±.01°C typical
Maximum Inaccuracy	±1°C
PLC Update Rate	4 channel/scan max., 240/250(-1)/D2-260CPUs 1 channel per scan max., 230 CPU
Digital Input Points Required	32 input points (16 binary data bits, 2 channel ID bits, 4 fault bits)
Base Power Required 5VDC	90mA
Operating Temperature	32° to 140°F (0° to 60°C)
Storage Temperature	-4° to 158°F (-20° to 70°C)
Temperature Drift	None (self-calibrating)
Relative Humidity	5 to 95% (non-condensing)
Environmental Air	No corrosive gases permitted
Shock & Vibration	MIL STD 810C 514.2
Noise Immunity	NEMA ICS3-304
Terminal Type (included)	Removable; D2-8IOCON

F2-04RTD 4-Channel RTD Input

Note 1



Notes:

1. The three wires connecting the RTD to the module must be the same type and length. Do not use the shield or drain wire for the third connection.
2. If an RTD sensor has four wires, the plus sense wire should be left unconnected as shown.
3. This module is not compatible with the ZIPLink wiring systems.

F2-04THM 4-Channel Thermocouple Input Module

Number of Channels	4, differential
Common Mode Range	±5VDC
Common Mode Rejection	90dB min. @ DC, 150dB min. @ 50/60 Hz.
Input Impedance	1 MΩ
Absolute Maximum Ratings	Fault-protected inputs to ±50VDC
Accuracy vs. Temperature	±5 ppm/°C maximum full scale calibration (including maximum offset change)
PLC Update Rate	4 channels per scan max. D2-240/250(-1)/D2-260 CPU, H2-EBC(-F); 1 chan. per scan max. D2-230 CPU
Digital Input Points Required	32 (X) input points (16 binary data bits, 2 channel ID bits, 4 diagnostic bits)
External Power Supply	60mA maximum, 18 to 26.4 VDC
Base Power Required 5VDC	110mA
Operating Temperature	32° to 140°F (0° to 60°C)
Storage Temperature	-4° to 158°F (-20° to 70°C)
Relative Humidity	5 to 95% (non-condensing)
Environmental Air	No corrosive gases permitted
Shock & Vibration	MIL STD 810C 514.2
Noise Immunity	NEMA ICS3-304
Terminal Type (included)	Non-removable

CPU Firmware Required	
CPU	Firmware Required
D2-230	V1.06
D2-240	V2.5
D2-250	V1.06
D2-250-1, D2-260	All firmware versions work

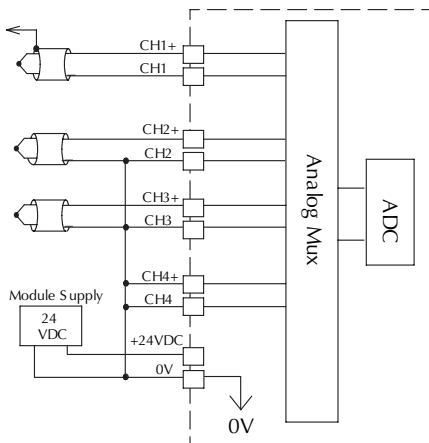
Notes:

- 1: Terminate shields at the respective signal source.
- 2: Connect unused channels to a common terminal (0V, CH4+, CH4).
- 3: When using 0-156 mV and 5V ranges, connect (-) or (0) volts terminal to 0V to ensure common mode range acceptance.
4. This module is not compatible with the ZIPLink wiring system.

F2-04THM 4-Channel Thermocouple Input

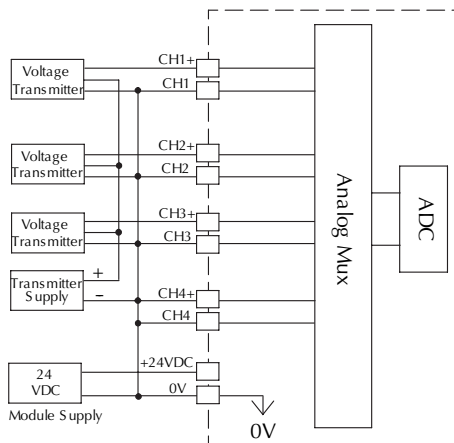
Input Ranges	Type J	-190 to 760°C	-310 to 1400°F
	Type E	-210 to 1000°C	-346 to 1832°F
	Type K	-150 to 1372°C	-238 to 2502°F
	Type R	65 to 1768°C	149 to 3214°F
	Type S	65 to 1768°C	149 to 3214°F
	Type T	-230 to 400°C	-382 to 752°F
	Type B	529 to 1820°C	984 to 3308°F
	Type N	-70 to 1300°C	-94 to 2372°F
	Type C	65 to 2320°C	149 to 4208°F
Display Resolution	±0.1°C or ±0.1°F		
Cold Junction Compensation	Automatic		
Conversion Time	100ms per channel		
Warm-Up Time	30 minutes typically ± 1°C repeatability		
Linearity Error (End to End)	±.05°C maximum, ±.01°C typical		
Maximum Inaccuracy	±3°C (excluding thermocouple error)		
Voltage Input Specifications			
Voltage Ranges	0-5V, ±5V, 0-156.25 mV, ±156.25 mVDC		
Resolution	16 bit (1 in 65535)		
Full Scale Calibration Error (Offset Error Included)	±13 counts typical ±33 maximum		
Offset Calibration Error	±1 count maximum, @ 0V input		
Linearity Error (End to End)	±1 count maximum		
Maximum Inaccuracy	±.02% @ 25°C (77°F)		

Thermocouple input wiring diagram

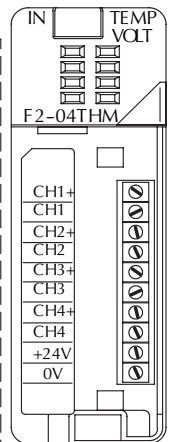


See Notes 1 and 2

Voltage input wiring diagram



See Notes 2 and 3



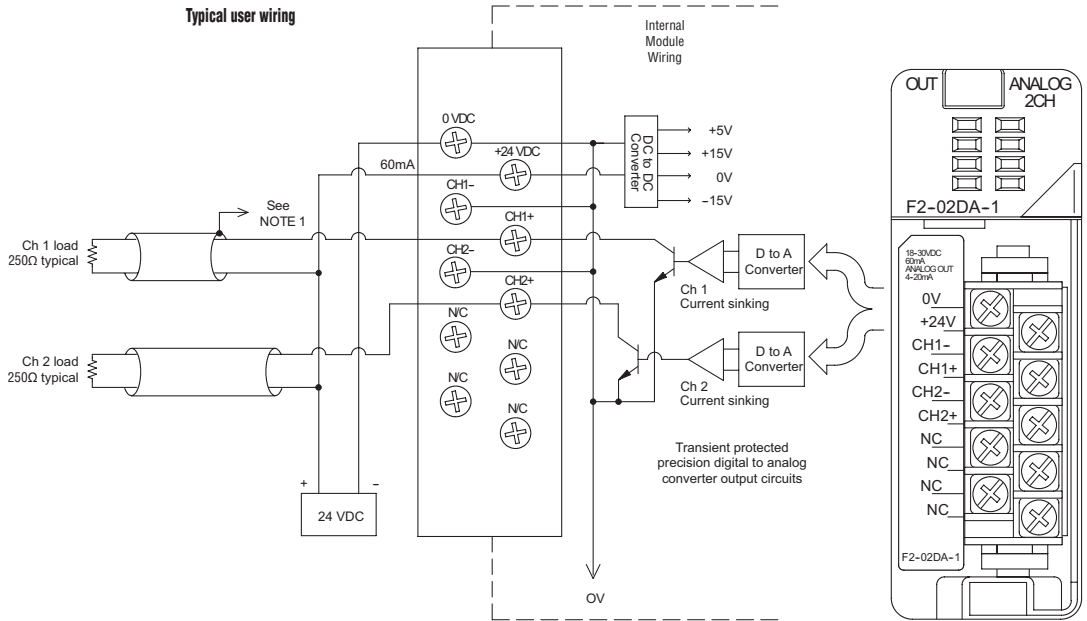
DL205 Analog Output Modules

F2-02DA-1 2-Channel 4-20mA Analog Output Module

This module requires a 24VDC user power supply for operation. See the F2-02DA-1L on the next page if you want to use a 12VDC supply. All other specifications are the same.	
Number of Channels	2
Output Ranges	4 to 20 mA
Resolution	12 bit (1 in 4096)
Output Type	Single ended, one common
Digital Output Points Required	16 (Y) output points (12 binary data bits, 2 channel ID bits)
Maximum Loop Supply	30VDC
Peak Output Voltage	40VDC (clamped by transient voltage suppressor)
Load Impedance	0 Ω minimum
Maximum Load/Power Supply	620 Ω /18 V, 910 Ω /24 V, 1200 Ω /30V
PLC Update Rate	1 channel per scan maximum D2-230 CPU 2 channels per scan maximum (D2-240, D2-250(-1) and D2-260 CPUs)
Linearity Error (end to end)	± 1 count ($\pm 0.025\%$ of full scale) maximum
Conversion Settling Time	100 μ s maximum (full scale change)
Full Scale Calibration Error (offset error included)	± 5 counts max., 20mA @77°F (25°C)
Offset Calibration Error	± 3 counts max., 4mA @ 77°F (25°C)
Accuracy vs. Temperature	± 50 ppm/°C full scale calibration change (including maximum offset change of 2 counts)
Maximum Inaccuracy	0.1% @ 77°F (25°C) 0.3% @ 32° to 140°F (0° to 60°C)
Base Power Required 5VDC	40mA
External Power Supply	18 to 30 VDC, 60mA. (add 20 mA for each current loop used)
Operating Temperature	32° to 140°F (0° to 60°C)
Storage Temperature	-4 to 158°F (-20 to 70°C)
Relative Humidity	5% to 95% (non-condensing)
Environmental Air	No corrosive gases permitted
Shock & Vibration	MIL STD 810C 514.2
Noise Immunity	NEMA ICS3-304
Terminal Type (included)	Removable; D2-8IOCON

One count in the specification table is equal to one least significant bit of the analog data value (1 in 4096).

F2-02DA-1 2-Channel 4-20mA Analog Output



NOTE 1: Shields should be connected to the 0V of the module or the 0V of the R/S.

NOTE 2: Unused current outputs should remain open (no connections) for minimum power consumption.

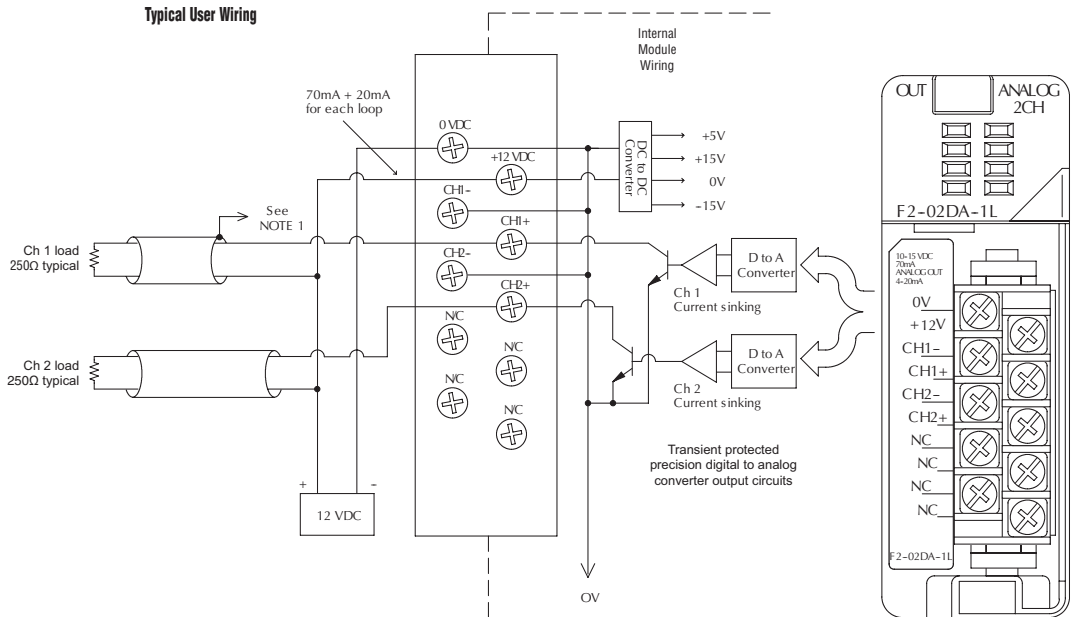
F2-02DA-1L 2-Channel 4-20mA Analog Output Module

This module requires a 12 VDC user power supply for operation. See the F2-02DA-1 on the previous page if you want to use a 24 VDC supply. All other specifications are the same.	
Number of Channels	2
Output Ranges	4 to 20 mA
Resolution	12 bit (1 in 4096)
Output Type	Single ended, 1 common
Digital Output Points Required	16(Y) output points (12 binary data bits, 2 channel ID bits)
Maximum Loop Supply	30VDC
Peak Output Voltage	40VDC (clamped by transient voltage suppressor)
Load Impedance	0Ω minimum
Maximum Load/Power Supply	620Ω/18V, 910Ω/24V, 1200Ω/30V
PLC Update Rate	1 channel per scan maximum (D2-230 CPU) 2 channels per scan maximum (D2-240, D2-250(-1) and D2-260 CPUs)
Linearity Error (end to end)	±1 count (0.025% of full scale) maximum
Conversion Settling Time	100 μs maximum (full scale change)
Full Scale Calibration Error (offset error included)	±5 counts max., 20 mA @ 77°F (25°C)
Offset Calibration Error	±3 counts max., 4mA @ 77°F (25°C)

Accuracy vs. Temperature	±50 ppm/°C full scale calibration change (including maximum offset change of 2 counts)
Maximum Inaccuracy	+0.1% @ 77°F (25°C) ±0.3% @ 32 to 140°F (0 to 60°C)
Base Power Required 5VDC	40mA
External Power Supply	10 to 15 VDC, 70 mA (add 20 mA for each current loop used)
Operating Temperature	32° to 140°F (0° to 60°C)
Storage Temperature	-4° to 158°F (-20° to 70°C)
Relative Humidity	5 to 95% (non-condensing)
Environmental Air	No corrosive gases permitted
Shock & Vibration	MIL STD 810C 514.2
Noise Immunity	NEMA ICS3-304
Terminal Type (included)	Removable; D2-8IOCON

One count in the specification table is equal to one least significant bit of the analog data value (1 in 4096).

F2-02DA-1L 2-Channel 4-20mA Analog Output



NOTE 1: Shields should be connected to the 0V of the module or the 0V of the P/S.

NOTE 2: Unused current outputs should remain open (no connections) for minimum power consumption.

Maximum user load is dependent upon loop power supply.

Loop power supply	Load range (ohm)
15 VDC	0 to 450
12 VDC	0 to 300
10 VDC	0 to 200

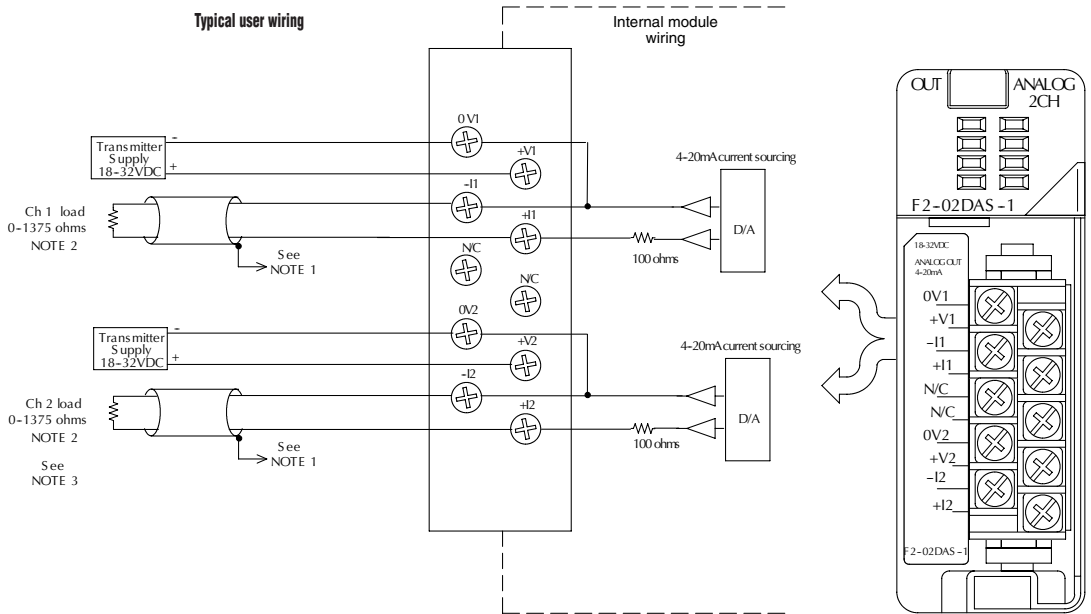
F2-02DAS-1 2-Channel Isolated 4-20mA Analog Output Module

Number of Channels	2, isolated
Output Ranges	4 to 20 mA
Resolution	16 bit (1 in 65536)
Output Type	Current sourcing
Digital Output Points Required	32 (Y) output points (16 binary data bits, 2 channel ID bits, 1 output enable bit)
Isolation Voltage	±750 V continuous, channel to channel, channel to logic
Base Power Required 5VDC	100mA
Loop Supply	18-32 VDC
External Power Supply	18-32 VDC @ 50 mA per channel
Output Loop Compliance	Vin - 2.5V
Load Impedance	0-1375 Ω (@ 32 V)
Maximum Load/ Power Supply	375 Ω/12 V, 975 Ω/24 V, 1375 Ω/32 V
PLC Update Rate	1 channel per scan maximum (D2-230 CPU) 2 channels per scan maximum (D2-240, D2-250(-1) and D2-260 CPUs)
Conversion Settling Time	3ms to 0.1% of full scale

Linearity Error (end to end)	±10 count (±0.015% of full scale) maximum
Gain Calibration Error	±32 counts (±0.05%)
Offset Calibration Error	±13 counts (±0.02%)
Output Drift	50 ppm/°C
Maximum Inaccuracy	0.07% @ 25°C (77°F) 0.18% 0 to 60°C (32° to 140°F)
Operating Temperature	0° to 60°C (32° to 140°F)
Storage Temperature	-20° to 70°C (-4° to 158°F)
Relative Humidity	5 to 95% (non-condensing)
Environmental air	No corrosive gases permitted
Shock & Vibration	MIL STD 810C 514.2
Noise Immunity	NEMA ICS3-304
Terminal Type (included)	Removable; D2-8IOCON

One count in the specification table is equal to one least significant bit of the analog data value (1 in 65536).

F2-02DAS-1 2-Channel Isolated 4-20mA Analog Output



NOTE 1: Shields should be connected to the 0V terminal of the module.

NOTE 2: Load must be within compliance voltage.

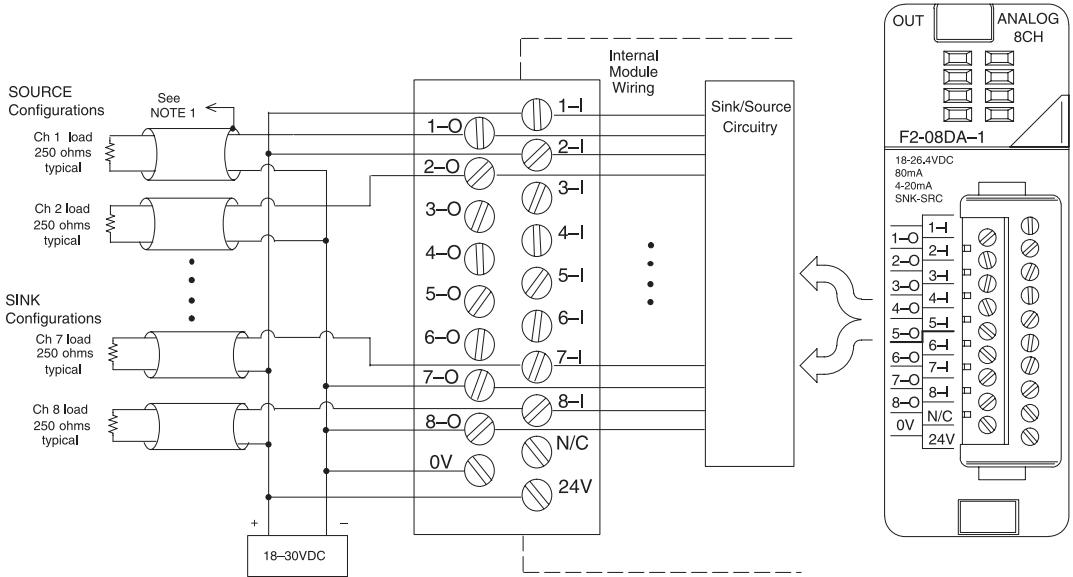
NOTE 3: For non-isolated outputs, connect all 0V's together (0V1...0V2) and connect all +V's together (+V1...+V2).

F2-08DA-1 8-Channel 4-20mA Analog Output Module

Number of Channels	8, single-ended
Output Ranges	4 to 20 mA
Resolution	12 bit (1 in 4096)
Output Type	Current sinking or current sourcing
Digital Output Points Required	16 (Y) output points (12 binary data bits, 3 channel ID bits, 1 output enable bit)
Base Power Required 5VDC	30mA
Maximum Loop Voltage	30VDC
External Power Supply	18 to 30 VDC, 50 mA., class 2 (add 20 mA for each current loop used)
Source Load	0-400 Ω @ 18-30 VDC
Sink Load	0-600 Ω /18V, 0-900 Ω /24 V, 0-1200 Ω /30 V
Total Load (sink + source)	600 Ω /18 V, 900 Ω /24 V, 1200 Ω /30 V
PLC Update Rate	1 channel per scan maximum (D2-230 CPU) 8 channels per scan maximum (D2-240, D2-250(-1) and D2-260 CPUs)
Conversion Settling Time	400 μ s maximum (full scale change)

Linearity Error (end to end)	± 2 count ($\pm 0.050\%$ of full scale) maximum
Full Scale Calibration Error	± 12 counts max. sinking @ any load ± 12 counts max. sourcing @ 125 Ω load ± 18 counts max. sourcing @ 250 Ω load ± 26 counts max. sourcing @ 400 Ω load
Offset Calibration Error	± 9 counts max. sinking @ any load ± 9 counts max. sourcing @ 125 Ω load ± 11 counts max. sourcing @ 250 Ω load ± 13 counts max. sourcing @ 400 Ω load
Maximum Full Scale Inaccuracy @ 60°C	0.5% sinking (any load) sinking & sourcing @ 125 Ω load 0.64% sourcing @ 250 Ω load 0.83% sourcing @ 400 Ω load
Maximum Full Scale Inaccuracy @ 25°C (Includes all errors and temp drift)	0.3% sinking (any load) sinking & sourcing @ 125 Ω load 0.44% sourcing @ 250 Ω load 0.63% sourcing @ 400 Ω load
Operating Temperature	32° to 140°F (0° to 60°C)
Storage Temperature	-4 to 158°F (-20 to 70°C)
Relative Humidity	5% to 95% (non-condensing)
Environmental air	No corrosive gases permitted
Shock & Vibration	MIL STD 810C 514.2
Noise Immunity	NEMA ICS3-304
Terminal Type (included)	Removable; D2-16IOCON

F2-08DA-1 8-Channel 4-20mA Analog Output



NOTE 1: Shields should be connected to the 0V of the module.

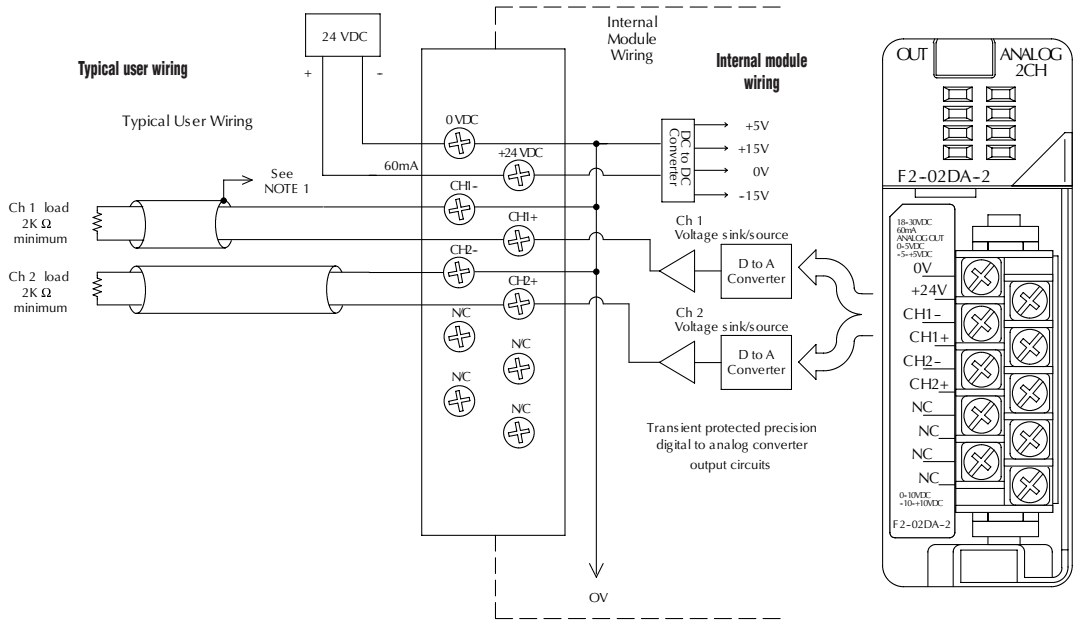
F2-02DA-2 2-Channel Voltage Analog Output Module

This module requires a 24VDC user power supply for operation. See the F2-02DA-2L on the next page if you want to use a 12VDC supply. All other specifications are the same.	
Number of Channels	2
Output Ranges	0 to 5V, 0 to 10 V, $\pm 5V$, $\pm 10 V$
Resolution	12 bit (1 in 4096)
Output Type	Single ended, 1 common
Digital Output Points Required	16 (Y) output points (12 binary data bits, 2 channel ID bits)
Peak Output Voltage	15VDC (clamped by transient voltage suppressor)
Load Impedance	2000 Ω minimum
Load Capacitance	0.01 μF maximum
PLC Update Rate	1 channel per scan maximum D2-230 CPU 2 channels per scan maximum (D2-240, D2-250(-1) and D2-260 CPUs)
Linearity Error (end to end)	± 1 count (0.025% of full scale) maximum
Conversion Settling Time	5 μs maximum (full scale change)
Full Scale Calibration Error (offset error included)	± 12 counts max. unipolar @ 77°F (25°C) ± 16 counts max. bipolar @ 77°F (25°C)
Offset Calibration Error	± 3 counts max., unipolar @ 77°F (25°C) ± 8 counts max., bipolar @ 77°F (25°C)

Accuracy vs. Temperature	± 50 ppm/°C full scale calibration change (including maximum offset change of 2 counts)
Maximum Inaccuracy	+0.3% unipolar ranges @ 77°F (25°C) $\pm 0.45\%$ unipolar ranges >77°F (25°C) $\pm 0.4\%$ bipolar ranges @77°F (25°C) $\pm 0.55\%$ bipolar ranges >77°F (25°C)
Base Power Required 5VDC	40mA
External Power Supply	18 to 30 VDC, 60mA (outputs fully loaded)
Operating Temperature	32° to 140°F (0° to 60°C)
Storage Temperature	-4° to 158°F (-20° to 70°C)
Relative Humidity	5 to 95% (non-condensing)
Environmental Air	No corrosive gases permitted
Shock & Vibration	MIL STD 810C 514.2
Noise Immunity	NEMA ICS3-304
Terminal Type (included)	Removable; D2-8IOCON

One count in the specification table is equal to one least significant bit of the analog data value (1 in 4096).

F2-02DA-2 2-Channel Voltage Analog Output



NOTE 1: Shields should be connected to the 0V of the module or the 0V of the R/S.

NOTE 2: Unused voltage outputs should remain open (no connections) for minimum power consumption.

F2-02DA-2L 2-Channel Voltage Analog Output Module

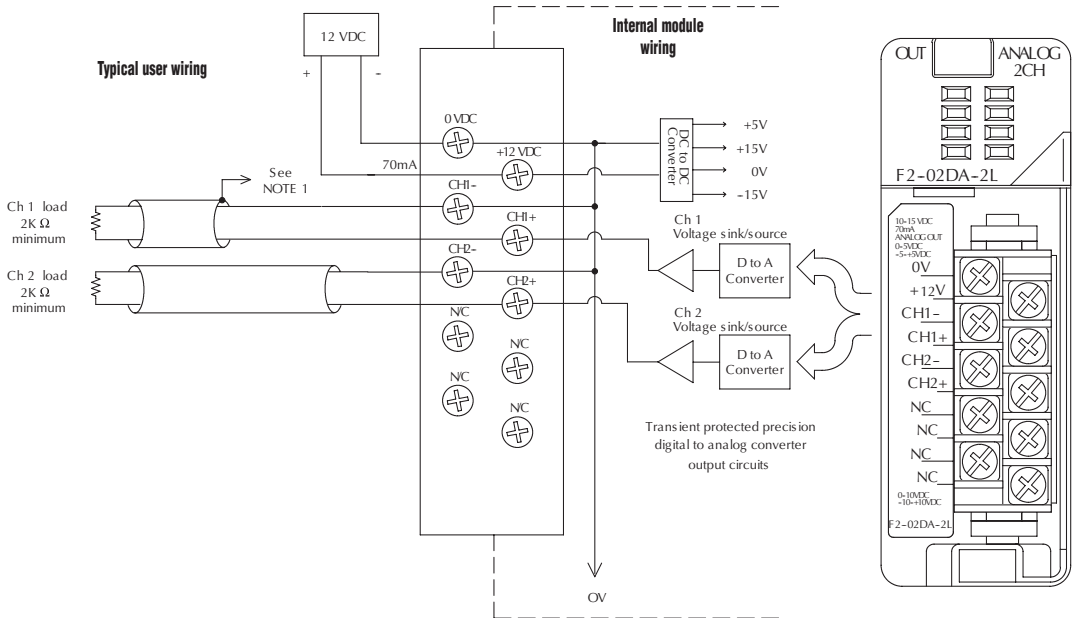
This module requires a 12 VDC user power supply for operation. See the F2-02DA-2 on the previous page if you want to use a 24 VDC supply. All other specifications are the same.

Number of Channels	2
Output Ranges	0 to 5V, 0 to 10 V, $\pm 5V$, $\pm 10 V$
Resolution	12-bit (1 in 4096)
Output Type	Single ended, 1 common
Digital Output Points Required	16 (Y) output points (12 binary data bits, 2 channel ID bits)
Peak Output Voltage	15VDC (clamped by transient voltage suppressor)
Load Impedance	2000 Ω minimum
Load Capacitance	.01 μF maximum
PLC Update Rate	1 channel per scan maximum (D2-230 CPU) 2 channels per scan maximum (D2-240, D2-250(-1), D2-260, and D2-262 CPUs)
Linearity Error (end to end)	± 1 count (0.025% of full scale) maximum
Conversion Settling Time	5 μs maximum (full scale change)
Full Scale Calibration Error (offset error included)	± 12 counts max. unipolar @ 77°F (25°C) ± 16 counts max. bipolar @ 77°F (25°C)
Offset Calibration Error	± 3 counts max., unipolar @ 77°F (25°C) ± 8 counts max., bipolar @ 77°F (25°C)

Accuracy vs. Temperature	± 50 ppm/°C full scale calibration change (including maximum offset change of 2 counts)
Maximum Inaccuracy	+0.3% unipolar ranges @ 77°F (25°C) $\pm 0.45\%$ unipolar ranges >77°F (25°C) $\pm 0.4\%$ bipolar ranges @77°F (25°C) $\pm 0.55\%$ bipolar ranges >77°F (25°C)
Base Power Required 5VDC	40mA
External Power Supply	10 to 15 VDC, 70 mA (outputs fully loaded)
Operating Temperature	32° to 140°F (0° to 60°C)
Storage Temperature	-4° to 158°F (-20° to 70°C)
Relative Humidity	5 to 95% (non-condensing)
Environmental Air	No corrosive gases permitted
Shock & Vibration	MIL STD 810C 514.2
Noise Immunity	NEMA ICS3-304
Terminal Type (included)	Removable; D2-8IOCON

One count in the specification table is equal to one least significant bit of the analog data value (1 in 4096).

F2-02DA-2L 2-Channel Voltage Analog Output



NOTE 1: Shields should be connected to the 0V of the module or the 0V of the P/S.

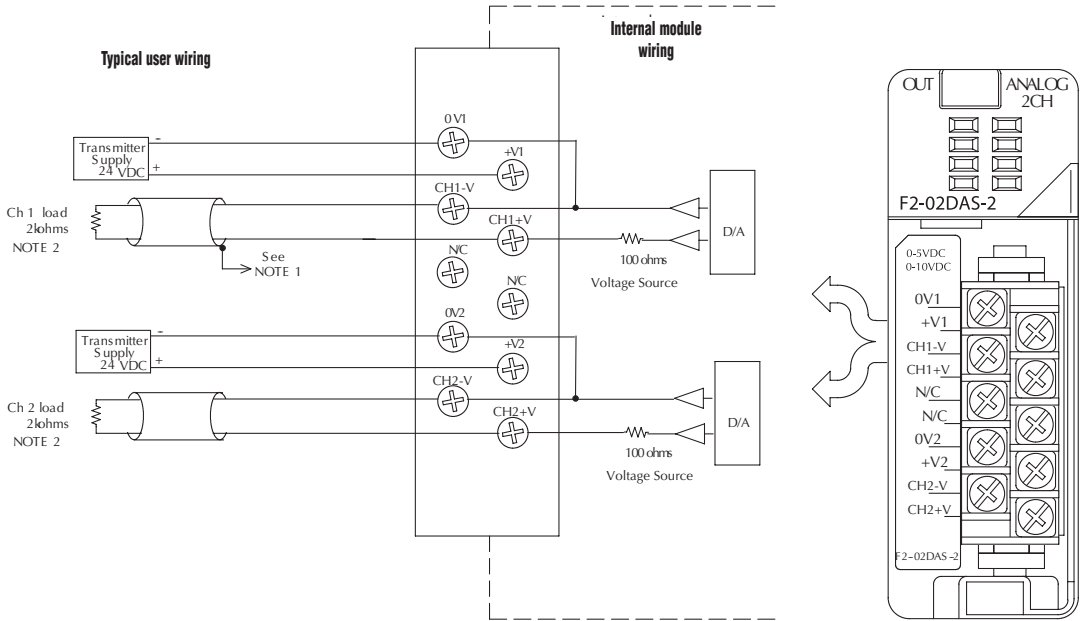
NOTE 2: Unused voltage outputs should remain open (no connections) for minimum power consumption.

F2-02DAS-2 2-Channel 0-5 V, 0-10 V Isolated Analog Output Module

Number of Channels	2, isolated
Output Ranges	0-5 V, 0-10 V
Resolution	16 bit (1 in 65536)
Output Type	Sourced through external loop supply
Digital Output Points Required	32 (Y) output points (16 binary data bits, 2 channel ID bits)
Isolation Voltage	±750V continuous, channel to channel, channel to logic
Base Power Required 5VDC	60mA
External Power Supply	21.6-26.4 VDC @ 60 mA per channel
Load Impedance	2k Ω min
PLC Update Rate	1 channel per scan maximum (D2-230 CPU) 2 channels per scan maximum (D2-240, D2-250(-1), D2-260, and D2-262 CPUs)
Conversion Settling Time	3ms to 0.1% of full scale

Linearity Error (end to end)	±10 count (±0.015% of full scale) maximum
Gain Calibration Error	±32 counts (±0.05%)
Offset Calibration Error	±13 counts (±0.02%)
Output Drift	50 ppm/°C
Maximum Inaccuracy	0.07% @ 25°C (77°F) 0.18% 0 to 60°C (32° to 140°F)
Operating Temperature	0° to 60°C (32° to 140°F)
Storage Temperature	-20° to 70°C (-4° to 158°F)
Relative Humidity	5 to 95% (non-condensing)
Environmental air	No corrosive gases permitted
Shock & Vibration	MIL STD 810C 514.2
Noise Immunity	NEMA ICS3-304
Terminal Type (included)	Removable; D2-8IOCON

F2-02DAS-2 2-Channel 0-5V, 0-10V Isolated Analog Output



NOTE 1: Shields should be connected to the 0V of the module or the 0V of the P/S.
NOTE 2: Unused voltage outputs should remain open (no connections) for minimum power consumption.

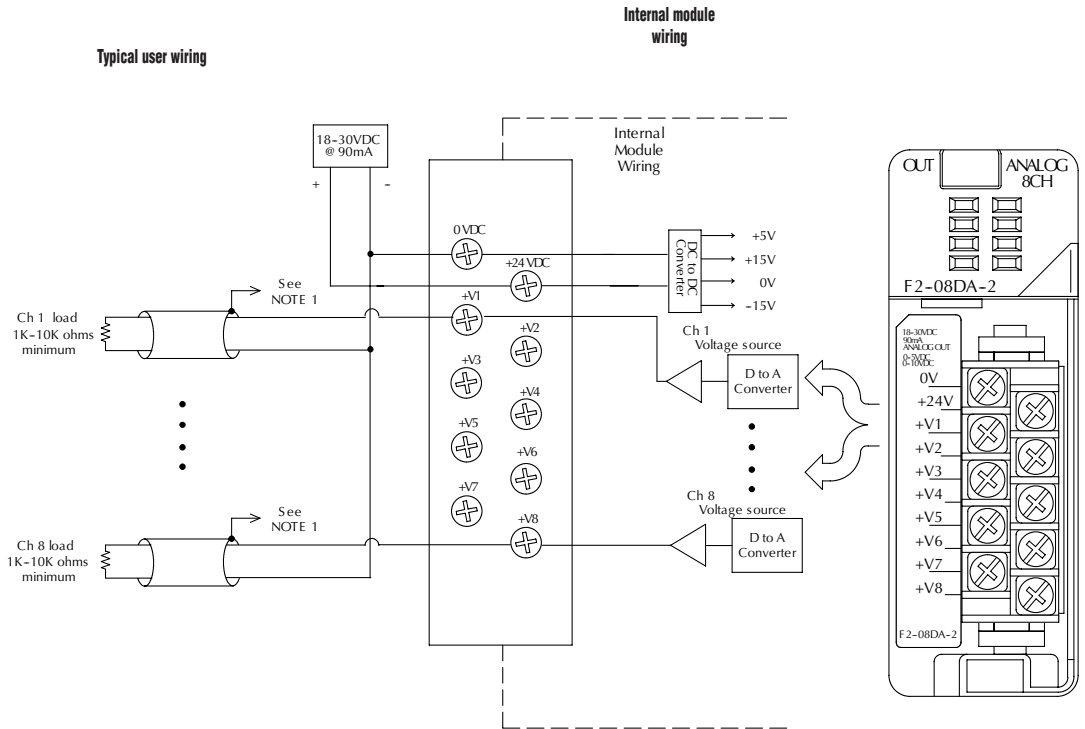
F2-08DA-2 8-Channel Voltage Analog Output Module

Number of Channels	8, single-ended, 1 common
Output Ranges	0 to 5V, 0 to 10V
Resolution	12 bit (1 in 4096)
Output Type	Voltage sourcing
Digital Output Points Required	16 (Y) output points (12 binary data bits, 3 channel ID bits, 1 output enable bit)
Base Power Required 5VDC	60mA
External Power Supply	21.6-26.4 VDC, 140 mA (outputs fully loaded)
Peak Output Voltage	15 VDC (clamped by transient voltage suppressor)
Load Impedance	1-10 k Ω
Load Capacitance	0.01 μ F maximum
PLC Update Rate	1 channel per scan maximum (D2-230 CPU) 8 channels per scan maximum (D2-240, D2-250(-1) and D2-260 CPUs)
Conversion Settling Time	400 μ s maximum (full scale change) 4.5 ms to 9ms for digital out to analog out

Linearity Error (end to end)	± 1 count ($\pm 0.025\%$ of full scale) maximum
Full Scale Calibration Error	± 12 counts max. unipolar @ 25°C (77°F)
Offset Calibration Error	± 3 counts max., unipolar @ 25°C (77°F)
Accuracy vs. Temperature	± 57 ppm/°C full scale calibration change (including maximum offset change of 2 counts)
Maximum Inaccuracy	$\pm 0.3\%$ @ 25°C (77°F) $\pm 0.45\%$ @ 0-60°C (32-140°F)
Operating Temperature	0° to 60°C (32° to 140°F)
Storage Temperature	-20° to 70°C (-4° to 158°F)
Relative Humidity	5 to 95% (non-condensing)
Environmental air	No corrosive gases permitted
Shock & Vibration	MIL STD 810C 514.2
Noise Immunity	NEMA ICS3-304
Terminal Type (included)	Removable; D2-8IOCON

One count in the specification table is equal to one least significant bit of the analog data value (1 in 4096).

F2-08DA-2 8-Channel Voltage Analog Output



NOTE 1: Shields should be connected to the 0V of the module.

DL205 Combination Analog I/O Modules

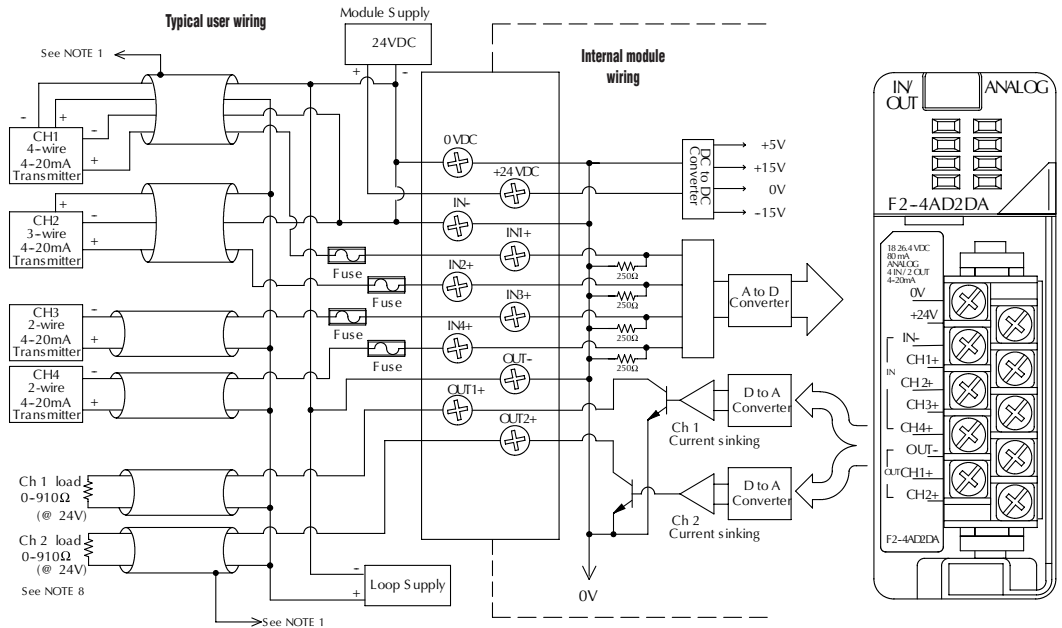
F2-04AD2DA 4-Channel Analog Input / 2-Channel Analog Output Module

Number of Input Channels	4, single-ended (1 common)
Number of Output Channels	2, single-ended (1 common)
Ranges	4 to 20 mA current (current sinking)
Resolution	12 bit (1 in 4096)
Peak Withstanding Voltage	75VDC, current outputs
Max. Continuous Overload	-40 to +40 mA, each current output
Input Impedance	250 Ω , \pm 0.1%, 1/2 W, 25 ppm/ $^{\circ}$ C current input resistance
External Load Resistance	0 Ω minimum, current outputs
Maximum Loop Supply	30VDC
Recommended Fuse	0.032 A, series 217 fast-acting, current inputs
Maximum Load/Power Supply	910 Ω /24V, current outputs 620 Ω /18V, 1200 Ω /30V
Active Low-pass Filter	-3 dB @ 20 Hz, 2 poles (-12 dB per octave)
Linearity Error (best fit)	\pm 1 count (\pm 0.025% of full scale) maximum
Output Settling Time	100 μ s maximum (full scale change)

Accuracy vs. Temperature	\pm 50 ppm/ $^{\circ}$ C full scale calibration change (including maximum offset change)
Maximum Inaccuracy	\pm 0.1% @ 77 $^{\circ}$ F (25 $^{\circ}$ C) \pm 0.3% @ 32 to 140 $^{\circ}$ F (0 to 60 $^{\circ}$ C)
Digital Input and Output Points Required	16 (X) input points (12 binary data bits, 2 channel ID bits, 2 diagnostic bits) 16 (Y) output points (12 binary data bits, 2 channel enable bits)
PLC Update Rate	4 channels per scan maximum: (D2-240, D2-250(-1) and D2-260 CPUs) 2 output channels per scan maximum: (D2-240, D2-250(-1) and D2-260 CPUs) 1 input and 1 output channel per scan maximum: (D2-230 CPU)
Base Power Required 5VDC	90mA
External Power Supply Requirement	18-26.4 VDC @ 80mA 20mA per loop
Operating Temperature	32 $^{\circ}$ to 140 $^{\circ}$ F (0 $^{\circ}$ to 60 $^{\circ}$ C)
Storage Temperature	-4 $^{\circ}$ to 158 $^{\circ}$ F (-20 $^{\circ}$ to 70 $^{\circ}$ C)
Relative Humidity	5 to 95% (non-condensing)
Environmental Air	No corrosive gases permitted
Shock & Vibration	MIL STD 810C 514.2
Noise Immunity	NEMA ICS3-304
Terminal Type (included)	Removable; D2-8IOCON

One count in the specification table is equal to one least significant bit of the analog data value (1 in 4096).

F2-04AD2DA 4-Channel Analog Input / 2-Channel Analog Output Module



Note 1: Shields should be connected at their respective signal source.

Note 2: Unused channel should remain open for minimum power consumption.

Note 3: More than one external power supply can be used provided the power supply commons are connected.

Note 4: A Series 217, 0.032A fast-acting fuse is recommended for 4-20 mA current input loops.

Note 5: If the power supply common of an external power supply is not connected to 0 VDC on the module, then the output of the external transmitter must be isolated. To avoid "ground loop" errors, recommended 4-20 mA transmitter types are:
 2 or 3 wire: isolation between Input signal and power supply
 4 wire: Isolation between input signal, power supply, and 4-20 mA output.

Note 6: If an analog channel is connected backwards, then erroneous data values will be returned for that channel.

Note 7: To avoid small errors due to terminal block losses, connect 0 VDC, IN-, and OUT- on the terminal block as shown. The module's internal connection alone of these nodes is not sufficient to permit module performance up to the accuracy specifications.

Note 8: Choose an output transducer resistance according to the maximum load/power listed in the Output Specifications.

F2-08AD4DA-1 8-Channel Analog Current Input / 4-Channel Analog Current Output Module

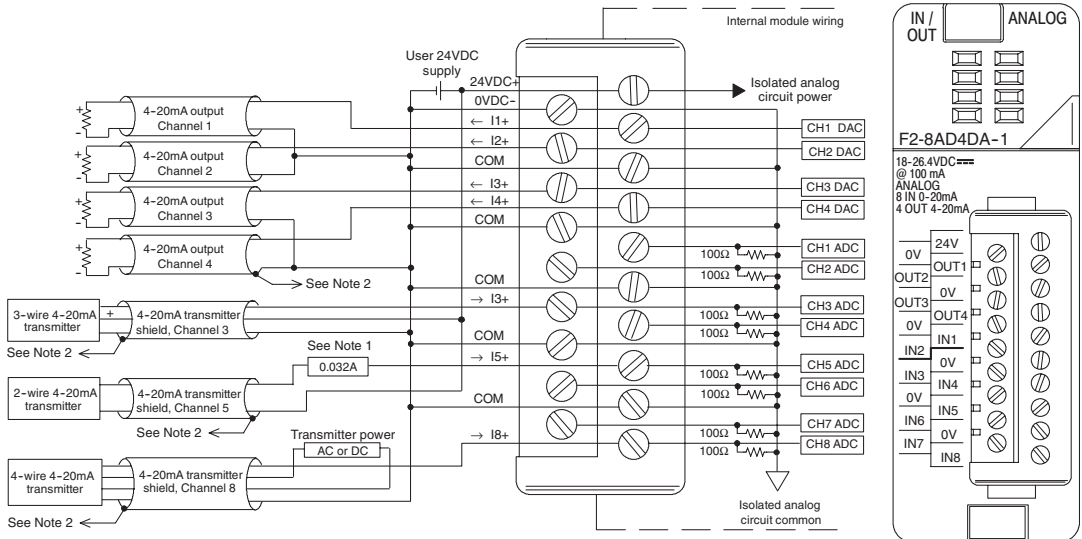
NOT SUPPORTED BY D2-230 AND D2-240 CPUs.

Input Channels per Module	8, single ended (one common)
Input Range	0 to 20 mA
Resolution	12, 14, 16-bit selectable
External DC Power Required	100mA @ 18-26.4 VDC
Max. Continuous Overload	±45mA
Input Impedance	100 Ω 0.1% 1/4W
Filter Characteristics	Active low pass, -3dB @ 80 Hz
Conversion Time	12-bit = 1.5 ms per channel 14-bit = 6 ms per channel 16-bit = 25 ms per channel
Conversion Method	Over sampling successive approximation
Accuracy vs. Temperature	±25 ppm / °C Max.
Maximum Inaccuracy	0.1% of range
Linearity Error (End to End)	12-bit = ±2 count max. (±0.06% of range) 14-bit = ±10 count max. (±0.06% of range) 16-bit = ±20 count max. (±0.06% of range) Monotonic with no missing codes
Full Scale Calibration Error (not including offset error)	±0.07% of range max.
Offset Calibration Error	±0.03% of range max.
Rec. Fuse (external)	0.032 A, Littelfuse Series 217 fast-acting
Base Power Required 5VDC	35mA

Output Channels per Module	4
Output Range	4 to 20 mA
Resolution	16-bit, 0.244 mA/bit
Output Type	Current sourcing at 20 mA max.
Load Impedance	0-750 Ω
Max. Inaccuracy	0.25% of range
Max. Full Scale Calibration Error (not incl. offset error)	±0.075% of range max.
Max. Offset Calibration Error	±0.1% of range max.
Accuracy vs. Temperature	±25 ppm/°C max. full scale calibration change (± 0.0025% of range / °C)
Max. Crosstalk at DC, 50/60Hz	-70 dB, 1 LSB

F2-08AD4DA-1 8-Channel Analog Current Input / 4-Channel Analog Current Output

Linearity Error (End to End)	±1 count max. (±0.025% of full scale) Monotonic with no missing codes
Output Stability and Repeatability	±1 LSB after 10 min. warm-up typical
Output Ripple	0.005% of full scale
Output Settling Time	0.5 ms max., 5µs min. (full scale change)
Max. Continuous Overload	Outputs open circuit protected
Type of Output Protection	Electronically current limited to 20mA or less
Output Signal at Power-up and Power-down	4mA
Terminal Type (included)	Removable; D2-16IOCON



Note 1: A Littelfuse Series 217, 0.032A fast-acting fuse is recommended for all 4-20mA current loop inputs.

Note 2: Connect shields to the 0V of the module; do not connect both ends of shield.

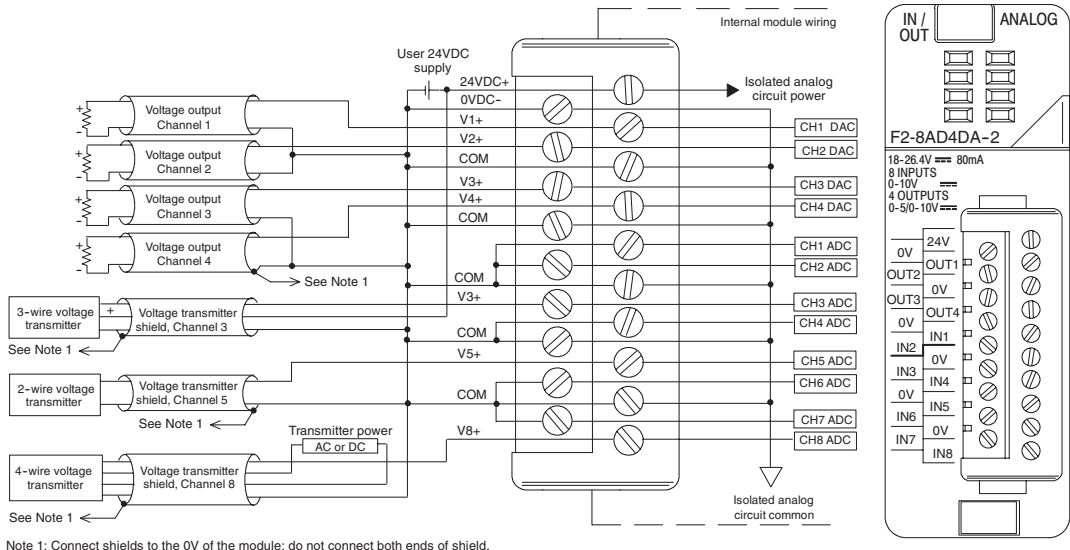
F2-08AD4DA-2 8-Channel Analog Voltage Input / 4-Channel Analog Voltage Output Module

Input Channels per Module	8, single ended (one common)
Input Range	0 to 10 V
Resolution	12, 14, 16-bit selectable
External DC Power Required	80mA @ 18-26.4 VDC
Max. Continuous Overload	±100 V
Input Impedance	>10MΩ
Filter Characteristics	Active low pass, -3 dB @ 80Hz
Conversion Time	12-bit = 1.5 ms per channel 14-bit = 6 ms per channel 16-bit = 25 ms per channel
Conversion Method	Over sampling successive approximation
Accuracy vs. Temperature	±50 ppm / °C Max.
Maximum Inaccuracy	0.1% of range
Linearity Error (End to End)	12-bit = ±1 count max. (±0.025% of range) 14-bit = ±4 count max. (±0.025% of range) 16-bit = ±16 count max. (±0.025% of range) Monotonic with no missing codes
Full Scale Calibration Error (not including offset error)	±0.075% of range max.
Offset Calibration Error	±0.025% of range max.
Base Power Required 5VDC	35mA

Output Channels per Module	4
Output Range	0–5 V, 0–10 V
Resolution	0 to 5 V at 15-bit, 0 to 10 V at 16-bit, 152µV/bit
Output Type	Voltage sourcing/sinking at 10mA max.
Load Impedance	>1000 Ω
Max. Inaccuracy	0.15% of range
Max. Full Scale Calibration Error (not incl. offset error)	±0.075% of range max.
Max. Offset Calibration Error	±0.025% of range max.
Accuracy vs. Temperature	±50 ppm/ °C max. full scale calibration change (± 0.005% of range / °C)
Max. Crosstalk @ DC, 50/60Hz	-70 dB, 1 LSB

F2-08AD4DA-2 8-Channel Analog Voltage Input / 4-Channel Analog Voltage Output

Linearity Error (End to End)	±1 count max. (±0.025% of full scale) Monotonic with no missing codes
Output Stability and Repeatability	±1 LSB after 10 min. warm-up typical
Output Ripple	0.005% of full scale
Output Settling Time	0.5 ms max., 5µs min. (full scale change)
Max. Continuous Overload	Outputs current limited to 15mA typical
Type of Output Protection	1VDC peak output voltage (clamped by transient voltage suppressor)
Output Signal at Power-up and Power-down	0V
Terminal Type (included)	Removable; D2-16IOCON



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.

Fuses

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

EUROPEAN UNION DIRECTIVES (CE)



In This Appendix...

European Union (EU) Directives	A-2
Basic EMC Installation Guidelines	A-4

European Union (EU) Directives



NOTE: *The information contained in this section is intended as a guideline and is based on our interpretation of the various standards and requirements. Since the actual standards are issued by other parties, and in some cases governmental agencies, the requirements can change over time without advance warning or notice. Changes or additions to the standards can possibly invalidate any part of the information provided in this section.*

This area of certification and approval is absolutely vital to anyone who wants to do business in Europe. One of the key tasks that faced the EU member countries and the European Economic Area (EEA) was the requirement to bring several similar yet distinct standards together into one common standard for all members. The primary purpose of a single standard was to make it easier to sell and transport goods between the various countries and to maintain a safe working and living environment. The Directives that resulted from this merging of standards are now legal requirements for doing business in Europe. Products that meet these Directives are required to have a CE mark to signify compliance.

Member Countries

As of January 1, 2007, the members of the EU are Austria, Belgium, Bulgaria, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, and United Kingdom. Iceland, Liechtenstein, and Norway together with the EU members make up the European Economic Area (EEA) and all are covered by the Directives.

Applicable Directives

There are several Directives that apply to our products. Directives may be amended, or added, as required.

- **Electromagnetic Compatibility Directive (EMC)** — this Directive attempts to ensure that devices, equipment, and systems have the ability to function satisfactorily in an electromagnetic environment without introducing intolerable electromagnetic disturbance to anything in that environment.
- **Machinery Safety Directive** — this Directive covers the safety aspects of the equipment, installation, etc. There are several areas involved, including testing standards covering both electrical noise immunity and noise generation.
- **Low Voltage Directive** — this Directive is also safety related and covers electrical equipment that has voltage ranges of 50–1000VAC and/or 75–1500VDC.
- **Battery Directive** — this Directive covers the production, recycling, and disposal of batteries.

Compliance

Certain standards within each Directive already require mandatory compliance. The EMC Directive, which has gained the most attention, became mandatory as of January 1, 1996. The Low Voltage Directive became mandatory as of January 1, 1997.

Ultimately, we are all responsible for our various pieces of the puzzle. As manufacturers, we must test our products and document any test results and/or installation procedures that are necessary to comply with the Directives. As a machine builder, you are responsible for

installing the products in a manner which will ensure compliance is maintained. You are also responsible for testing any combinations of products that may (or may not) comply with the Directives when used together. The end user of the products must comply with any Directives that may cover maintenance, disposal, etc. of equipment or various components. *Although we strive to provide the best assistance available, it is impossible for us to test all possible configurations of our products with respect to any specific Directive. Because of this, it is ultimately your responsibility to ensure that your machinery (as a whole) complies with these Directives and to keep up with applicable Directives and/or practices that are required for compliance.*

As of January 1, 1999, the DL05, DL06, DL205, DL305, and DL405 PLC systems manufactured by Koyo Electronics Industries, FACTS Engineering or HOST Engineering, when properly installed and used, conform to the Electromagnetic Compatibility (EMC), Low Voltage Directive, and Machinery Directive requirements of the following standards.

- **EMC Directive Standards Relevant to PLCs**

- EN50081-1 Generic emission standard for residential, commercial, and light industry

- EN50081-2 Generic emission standard for industrial environment.

- EN50082-1 Generic immunity standard for residential, commercial, and light industry

- EN50082-2 Generic immunity standard for industrial environment.

- **Low Voltage Directive Standards Applicable to PLCs**

- EN61010-1 Safety requirements for electrical equipment for measurement, control, and laboratory use.

- **Product Specific Standard for PLCs**

- EN61131-2 Programmable controllers, equipment requirements and tests. This standard replaces the above generic standards for immunity and safety. However, the generic emissions standards must still be used in conjunction with the following standards:

- EN 61000-3-2 Harmonics

- EN 61000-3-2 Fluctuations

- **Warning on Electrostatic Discharge (ESD)**

- We recommend that all personnel take necessary precautions to avoid the risk of transferring static charges to inside the control cabinet, and clear warnings and instructions should be provided on the cabinet exterior. Such precautions may include, the use of earth straps, similar devices or the powering off of the equipment inside the enclosure before the door is opened.

- **Warning on Radio Interference (RFI)**

- This is a class A product. In a domestic environment this product may cause radio interference in which case the user may be required to take adequate measures.

General Safety

- External switches, circuit breaker or external fusing, are required for these devices.
- The switch or circuit breaker should be mounted near the PLC equipment.

AutomationDirect is currently in the process of changing their testing procedures from the generic standards to the product specific standards.

Special Installation Manual

The installation requirements to comply with the requirements of the Machinery Directive, EMC Directive and Low Voltage Directive are slightly more complex than the normal installation requirements found in the United States. To help with this, we have published a special manual which you can order:

- DA-EU-M – EU Installation Manual that covers special installation requirements to meet the EU Directive requirements. Order this manual to obtain the most up-to-date information.

Other Sources of Information

Although the EMC Directive gets the most attention, other basic Directives, such as the Machinery Directive and the Low Voltage Directive, also place restrictions on the control panel builder. Because of these additional requirements it is recommended that the following publications be purchased and used as guidelines:

- BSI publication TH 42073: February 1996 – covers the safety and electrical aspects of the Machinery Directive
- EN 60204-1:1992 – General electrical requirements for machinery, including Low Voltage and EMC considerations
- IEC 1000-5-2: EMC earth grounding and cabling requirements
- IEC 1000-5-1: EMC general considerations

It may be possible for you to obtain this information locally; however, the official source of applicable Directives and related standards is:

The Office for Official Publications of the European Communities L-2985 Luxembourg; quickest contact is via the World Wide Web at http://publications.europa.eu/index_en.htm

Other sources are:

British Standards Institution – Sales Department
Linford Wood
Milton Keynes
MK14 6LE

United Kingdom; the quickest contact is via the World Wide Web at <http://www.bsi.org.uk>
A commercial provider of Standards at www.ih.com

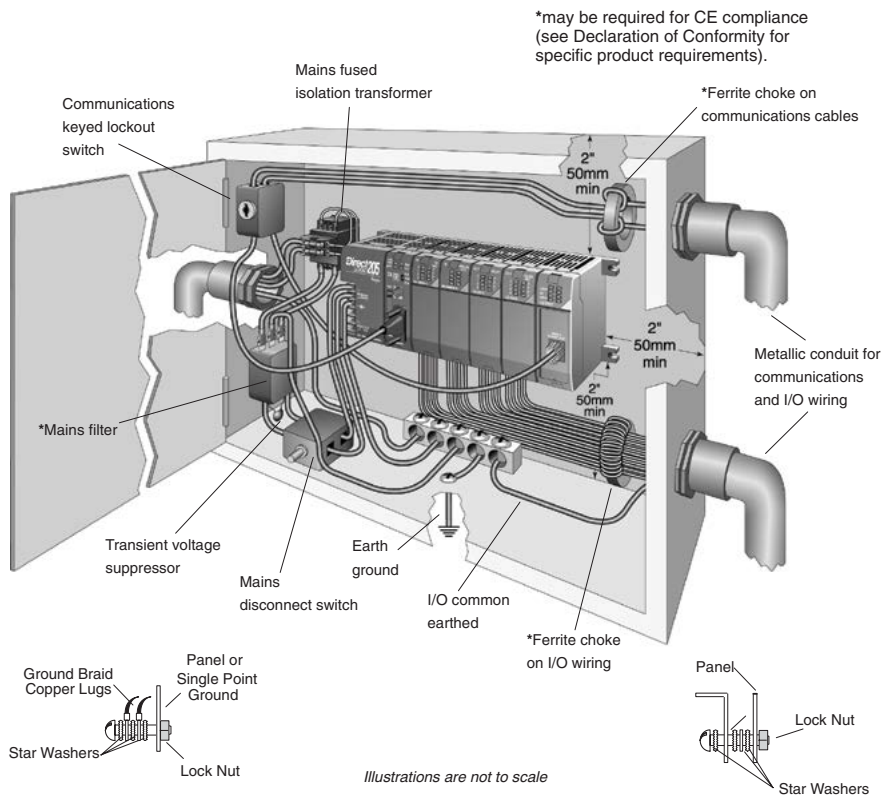
Basic EMC Installation Guidelines

Enclosures

The simplest way to meet the safety requirements of the Machinery and Low Voltage Directives is to house all control equipment in an industry standard lockable steel enclosure. This normally has an added benefit because it will also help ensure that the EMC characteristics are well within the requirements of the EMC Directive. Although the RF emissions from the PLC equipment, when measured in the open air, are well below the EMC Directive limits, certain configurations can increase emission levels. Holes in the enclosure, for the passage of cables or to mount operator interfaces, will often increase emissions.

AC Mains Filters

The DL205 AC powered base power supplies require extra mains filtering to comply with the EMC Directive on conducted RF emissions. All PLC equipment has been tested with filters from Schaffner, which reduce emissions levels if the filters are properly grounded (earth ground). A filter with a current rating suitable to supply all PLC power supplies and AC input modules should be selected. We suggest the FN2010 for DL205 systems.



Illustrations are not to scale



NOTE: Very few mains filters can reduce problem emissions to negligible levels. In some cases, filters may increase conducted emissions if not properly matched to the problem emissions.

Suppression and Fusing

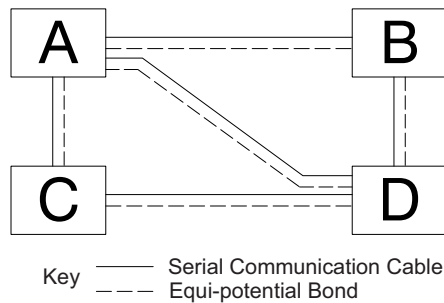
In order to comply with the fire risk requirements of the Low Voltage and Machinery Directive electrical standards (EN 61010-1 and EN 60204-1), by limiting the power into “unlimited” mains circuits with power leads reversed, it is necessary to fuse both AC and DC supply inputs. You should also install a transient voltage suppressor across the power input connections of the PLC. Choose a suppressor such as a metal oxide varistor, with a rating of 275VAC working voltage for 230V nominal supplies (150VAC working voltage for 115V supplies) and high energy capacity (e.g., 140 joules).

Transient suppressors must be protected by fuses and the capacity of the transient suppressor must be greater than the blow characteristics of the fuses or circuit breakers to avoid a fire risk. A recommended AC supply input arrangement for Koyo PLCs is to use twin 3 amp TT fused terminals with fuse blown indication, such as DINnectors DN-F10L terminals, or twin circuit breakers, wired to a Schaffner FN2010 filter or equivalent, with high energy transient suppressor soldered directly across the output terminals of the filter. PLC system inputs should also be protected from voltage impulses by deriving their power from the same fused, filtered, and surge-suppressed supply.

Internal Enclosure Grounding

A heavy-duty star earth terminal block should be provided in every cubicle for the connection of all earth ground straps, protective earth ground connections, mains filter earth ground wires, and mechanical assembly earth ground connections. This should be installed to comply with safety and EMC requirements, local standards, and the requirements found in IEC 1000-5-2. The Machinery Directive also requires that the common terminals of PLC input modules, and common supply side of loads driven from PLC output modules should be connected to the protective earth ground terminal.

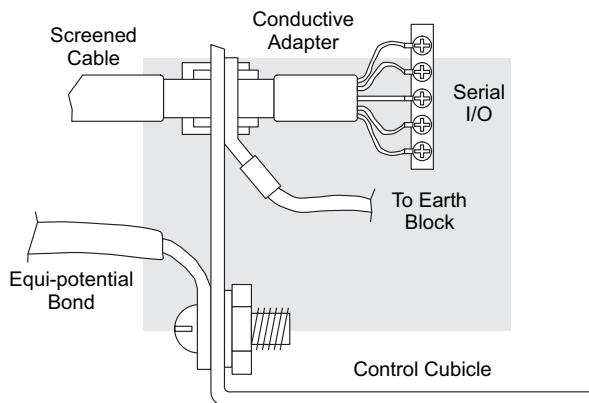
Equipotential Grounding



Adequate site earth grounding must be provided for equipment containing modern electronic circuitry. The use of isolated earth electrodes for electronic systems is forbidden in some countries. Make sure you check any requirements for your particular destination. IEC 1000-5-2 covers equipotential bonding of earth grids adequately, but special attention should be given to apparatus and control cubicles that contain I/O devices, remote I/O racks, or have inter-system communications with the primary PLC system enclosure. An equipotential bond wire must be provided alongside all serial communications cables, and to any separate items of the plant which contain I/O devices connected to the PLC. The diagram shows an example of four physical locations connected by a communications cable.

Communications and Shielded Cables

Good quality 24 AWG minimum twisted-pair shielded cables, with overall foil and braid shields are recommended for analog cabling and communications cabling outside of the PLC enclosure. To date it has been a common practice to only provide an earth ground for one end of the cable shield in order to minimize the risk of noise caused by earth ground loop currents between apparatus. The procedure of only grounding one end, which primarily originated as a result of trying to reduce hum in audio systems, is no longer applicable to the complex industrial environment. Shielded cables are also efficient emitters of RF noise from the PLC system, and can interact in a parasitic manner in networks and between multiple sources of interference.



The recommendation is to use shielded cables as electrostatic “pipes” between apparatus and systems, and to run heavy gauge equi-potential bond wires alongside all shielded cables. When a shielded cable runs through the metallic wall of an enclosure or machine, it is recommended in IEC 1000–5–2 that the shield should be connected over its full perimeter to the wall, preferably using a conducting adapter, and not via a pigtail wire connection to an earth ground bolt. Shields must be connected to every enclosure wall or machine cover that they pass through.

Analog and RS232 Cables

Providing an earth ground for both ends of the shield for analog circuits provides the perfect electrical environment for the twisted pair cable as the loop consists of signal and return, in a perfectly balanced circuit arrangement, with connection to the common of the input circuitry made at the module terminals. RS232 cables are handled in the same way.

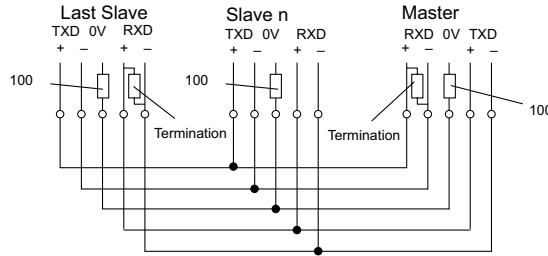
Multidrop Cables

RS422 twin twisted pair, and RS485 single twisted pair cables also require a 0V link, which has often been provided in the past by the cable shield. It is now recommended that you use triple twisted pair cabling for RS422 links, and twin twisted pair cable for RS485 links. This is because the extra pair can be used as the 0V inter-system link. With loop DC power supplies earth grounded in both systems, earth loops are created in this manner via the inter-system 0V link. The installation guides encourage earth loops, which are maintained at a low impedance by using heavy equipotential bond wires. To account for non-European installations using single-end earth grounds, and sites with far

from ideal earth ground characteristics, we recommend the addition of 100 ohm resistors at each 0V link connection in network and communications cables.

Shielded Cables within Enclosures

When you run cables between PLC items within an enclosure which also contains susceptible electronic equipment from other manufacturers, remember that these cables may be a source of RF emissions. There are ways to minimize this risk. Standard data cables connecting PLCs and/or operator interfaces should be routed well away from other equipment and their associated cabling. You can make special serial cables where the cable shield is connected to the enclosure's earth ground at both ends, the same way as external cables are connected.



Analog Modules and RF Interference

All Automationdirect products are tested to withstand field strength levels up to 10V/m, which is the maximum required by the relevant EU standards. While all products pass this test, analog modules will typically exhibit deviations of their readings. This is quite normal; however, systems designers should be aware of this and plan accordingly.

When assembling a control system using analog modules, these issues must be adhered to and should be integrated into the system design. This is the responsibility of the system builder/commissioner.

Network Isolation

For safety reasons, it is a specific requirement of the Machinery Directive that a keyswitch that isolates any network input signal during maintenance must be provided, so that remote commands cannot be received that could result in the operation of the machinery. The FA-ISOCON does not have a keyswitch! Use a keylock and switch on your enclosure, which, when open, removes power from the FA-ISOCON. To avoid the introduction of noise into the system, any keyswitch assembly should be housed in its own earth grounded steel box and the integrity of the shielded cable must be maintained.

Again, for further information on EU directives we recommend that you get a copy of our EU Installation Manual (DA-EU-M). Also, if you are connected to the World Wide Web, you can check the EU Commission's official site at: http://ec.europa.eu/index_en.htm.

DC Powered Versions

Due to slightly higher emissions radiated by the DC powered versions of the DL205, and the differing emissions performance for different DC supply voltages, the following stipulations must be met:

- The PLC must be housed within a metallic enclosure with a minimum amount of orifices.
- I/O and communications cabling exiting the cabinet must be contained within metallic conduit/trunking.

Items Specific to the DL205

- The rating between all circuits in this product are rated as **basic insulation only**, as appropriate for single fault conditions.
- There is no isolation offered between the PLC and the analog inputs of this product.
- It is the responsibility of the system designer to earth one side of all control and power circuits, and to earth the braid of screened cables.
- This equipment must be properly installed while adhering to the guidelines of the installation manual DA-EU-M (available for download at AutomationDirect Technical Support Manuals), and the installation standards IEC 1000-5-1, IEC 1000-5-2 and IEC 1131-4.
- It is a requirement that all PLC equipment must be housed in a protective steel enclosure, which limits access to operators by a lock and power breaker. If access is required by operators or untrained personnel, the equipment must be installed inside an internal cover or secondary enclosure. A warning label must be used on the front door of the installation cabinet as follows:
Warning: Exposed terminals and hazardous voltages inside.
- It should be noted that the safety requirements of the machinery directive standard EN60204-1 state that all equipment power circuits must be wired through isolation transformers or isolating power supplies, and that one side of all AC or DC control circuits must be earthed.
- Both power input connections to the PLC must be separately fused using 3 amp T-type anti-surge fuses, and a transient suppressor fitted to limit supply overvoltages.
- The user is made aware by notice in the documentation that, if the equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.