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DL350 PLC User Manual

Manual Number: D3–350–M

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Manual Revisions

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

Title: DL350 PLC User Manual
Manual Number: D3-350-M

Issue	Date	Description of Changes
Original	8/97	Original Issue
Rev A	6/98	Minor corrections
Rev B	5/99	Automationdirect.com
Rev C	8/02	Replaced F3-16TA-1 with F3-16TA-2
2nd Edition	3/10	Updated entire manual

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1

Getting Started

In This Chapter. . . .

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— DL305 System Components
— Programming Methods
— ***Direct***LOGIC™ Part Numbering System
— Quick Start for PLC Validation and Programming
— Steps to Designing a Successful System

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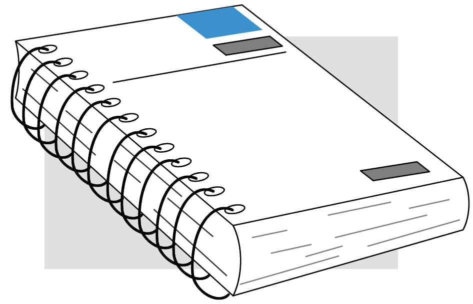
Introduction

The Purpose of this Manual

Thank you for purchasing our DL305 family of products. This manual shows you how to install, program, and maintain the equipment. It also helps you understand how to interface them to other devices in a control system.



This manual contains important information for personnel who will install DL305 PLCs, DL350 CPU and components, and for the PLC programmer. If you understand PLC systems, our manuals will provide all the information you need to start and keep your system up and running.

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 DL305 customer, we suggest you read this manual completely to understand the wide variety of features in the DL305 family of products. We believe you will be pleasantly surprised with how much you can accomplish with **Automation*Direct***™ products.

Supplemental Manuals

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

Technical Support

We realize that even though we strive to be the best, we may have arranged our information in such a way you cannot find what you are looking for. First, check these resources for help in locating the information:

- **Table of Contents** – chapter and section listing of contents, in the front of this manual
- **Appendices** – reference material for key topics, near the end of this manual
- **Index** – alphabetical listing of key words, at the end of this manual

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- **Internet** – Our Web address is **http://www.automationdirect.com**

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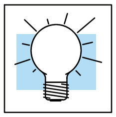
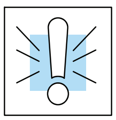


When you see the "light bulb" icon in the left–hand margin, the paragraph to its immediate right will give you a **special tip**.
The word **TIP:** in boldface will mark the beginning of the text.

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.



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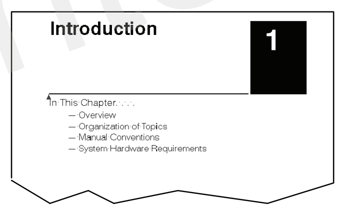
The word **WARNING:** and text will be in **boldface**.

Key Topics for Each Chapter

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



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DL305 System Components

The DL305 family is a versatile product line that provides a wide variety of features in an extremely compact package. The CPUs are small, but offer many instructions normally only found in larger, more expensive systems. The modular design also offers more flexibility in the fast moving industry of control systems. The following is a summary of the major DL305 system components.

CPUs

There are three feature enhanced CPUs in this product line, the DL330, DL340, and the DL350. This manual covers the DL350 CPU ***only***. The DL330 and DL340 CPUs are covered in detail in the DL305C User Manual. The DL350 CPU includes built-in communication ports, a large amount of program memory, a substantial instruction set and advanced diagnostics. It also features drum timers, floating–point math, and built in PID loops with automatic tuning.

Bases

Three base sizes are available: 5 slot, 8 slot, and 10 slot. One slot is for the CPU, the remaining slots are for I/O modules. All bases include a built-in power supply. Currently there are two versions of the bases. The xxxxx–1 bases were designed to compliment the DL350 CPU. Any of the three CPUs will work in either type of base and the bases can be mixed in a system. When the DL350 CPU is used in an old base, or if it is in a system of mixed bases, it will act similar to the DL340 CPU in addressing and I/O configuration (See Appendix F).

I/O Configuration

The DL350 CPU can support up to 368 I/O points with the bases currently available. These points can be assigned as input or output points. The DL305 system can also be expanded by adding remote I/O. The DL350 also provides a built–in master for remote I/O networks. The I/O configuration is explained in Chapter 4, System Design and Configuration.

I/O Modules

The DL305 has some of the most powerful modules in the industry. A complete range of discrete modules which support 24 VDC, 110/220 VAC and up to 10A relay outputs are offered. The analog modules provide 12 bit resolution and several selections of input and output signal ranges (including bipolar).

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Programming Methods

There are two programming methods available to the DL350 CPU, RLL (Relay Ladder Logic) and RLL^{PLUS} (Stage Programming). Both the ***Direct***SOFT™ programming package and the handheld programmer support RLL and Stage.

***Direct*SOFT Programming for Windows™**

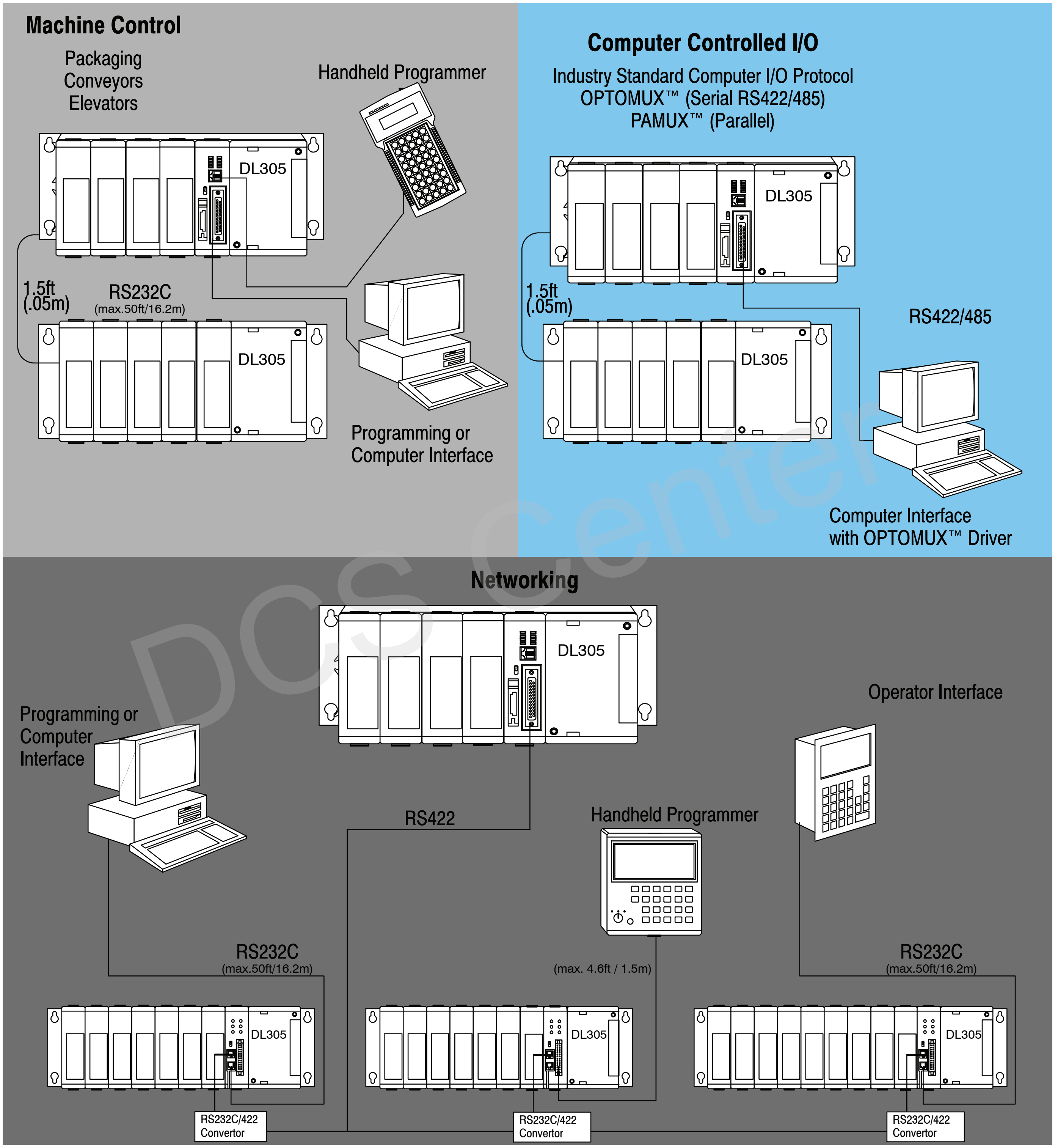
The DL305 can be programmed with one of the most advanced programming packages in the industry ––***Direct***SOFT. ***Direct***SOFT is a Windows-based software package that supports many Windows-features you are already know, such as cut and paste between applications, point and click editing, viewing and editing multiple application programs at the same time, etc. ***Direct***SOFT universally supports the ***Direct***LOGIC™ CPU families. This means you can use the *same* ***Direct***SOFT package to program DL105, DL205, DL305, DL405 or any new CPUs we may add to our product line. There is a separate manual that discusses the ***Direct***SOFT programming software.

Handheld Programmer

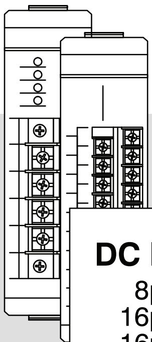
The DL350 CPU has a built-in programming port for use with the DL205 handheld programmer (D2–HPP). The handheld programmer can be used to create, modify and debug your application program. A separate manual that discusses the Handheld Programmer is available.

DL305 System Diagrams

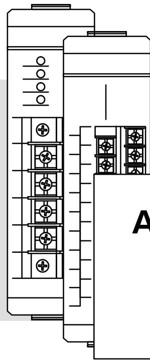
The diagram below shows the major components and configurations of the DL305 system. The next two pages show specific components for building your system.



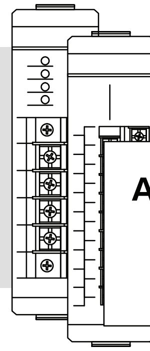
***Direct*LOGIC**



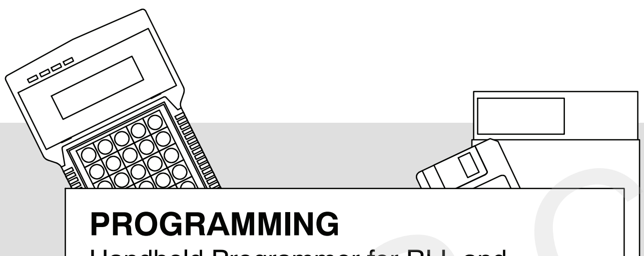
DC INPUT
8pt 24 VDC
16pt 24 VDC
16pt 5-24 VDC
16pt 12-24 VDC



AC INPUT
8pt 110 VAC
16pt 110 VAC
8pt 220 VAC

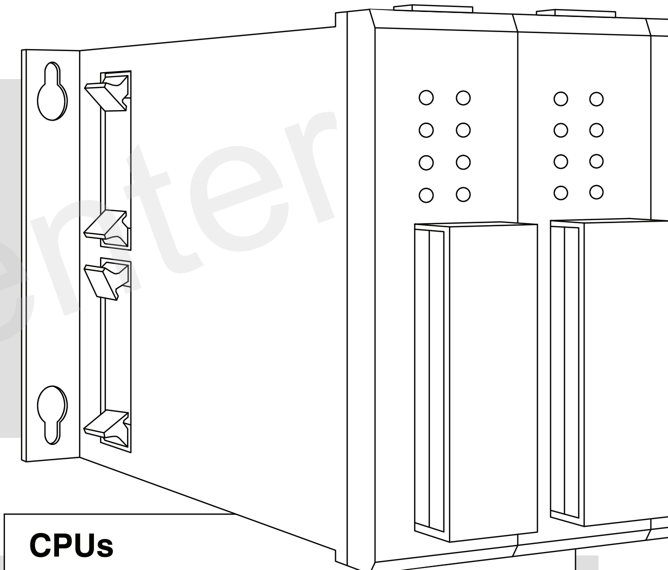


AC/DC INPUT
8pt 24 VAC/DC
16pt 24 VAC/DC



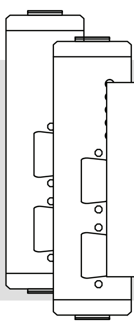
PROGRAMMING
Handheld Programmer for RLL and RLL*PLUS*

***Direct*SOFT Programming for Windows™**



CPUs
DL350
7.6K Built in Flash memory and 2 Built-in Ports

BASES
5 Slot Base w/Expansion Capability, 110/220 VAC P/S
5 Slot Base w/Expansion Capability, 24 VDC Supply
8 Slot Base w/Expansion Capability, 110/220 VAC P/S
10 Slot Base w/Expansion Capability, 110/220 VAC P/S



ASCII BASIC Modules
RS232C / RS422 / RS485
Built-in Radio Modem
Built-in Telephone Modem
Program Memory 64K/128K

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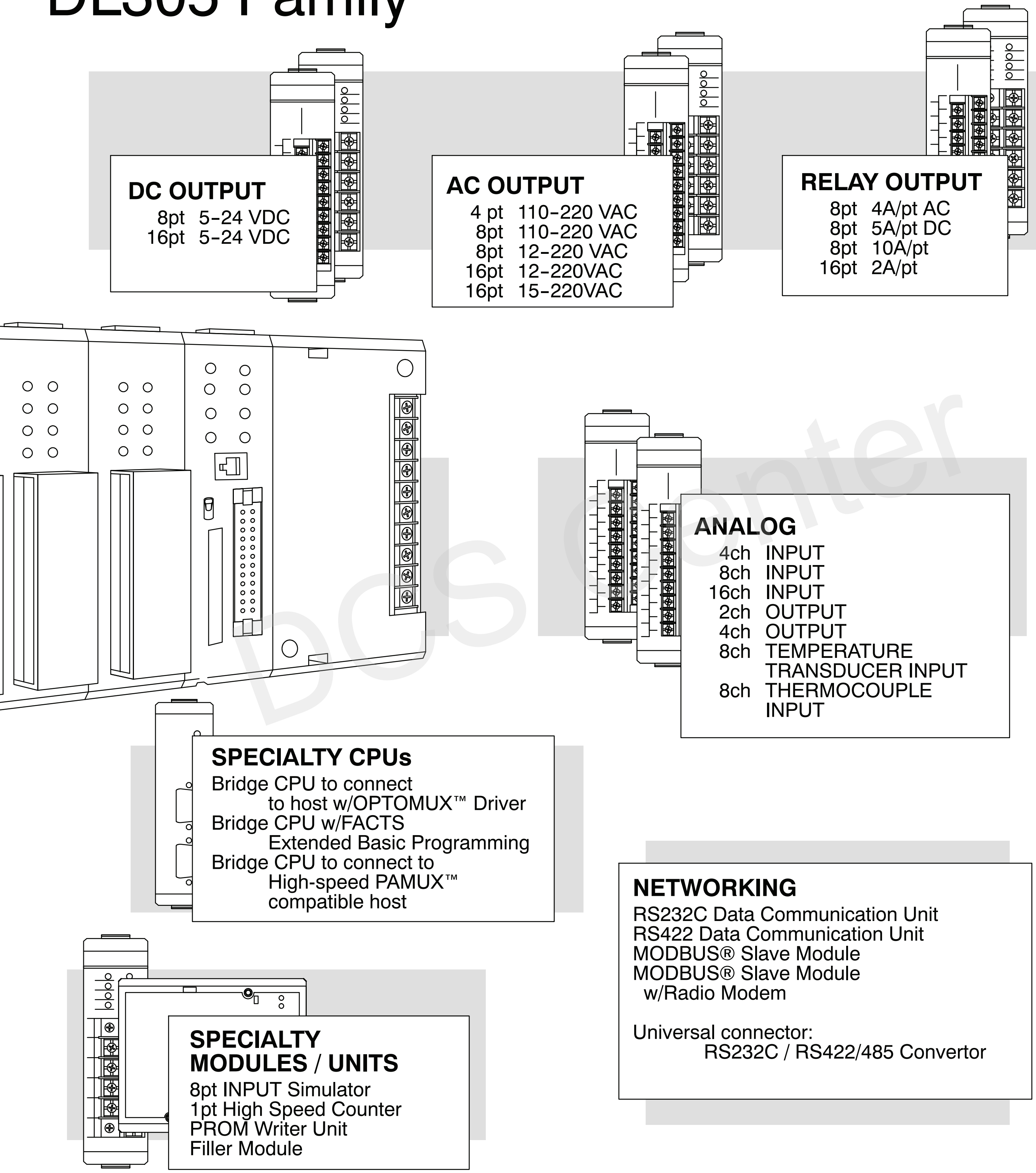
DL305 Family



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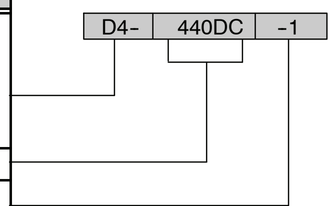
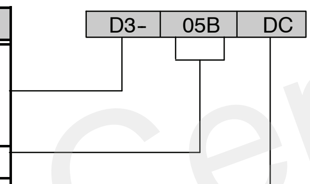
*Direct*LOGIC Part Numbering System

As you examine this manual, you will notice there are many different products available. Sometimes it is difficult to remember the specifications for any given product. However, if you take a few minutes to understand the numbering system, it may save you some time and confusion. The charts below show how the part numbering systems work for each product category. Part numbers for accessory items such as cables, batteries, memory cartridges, etc. are typically an abbreviation of the description for the item.

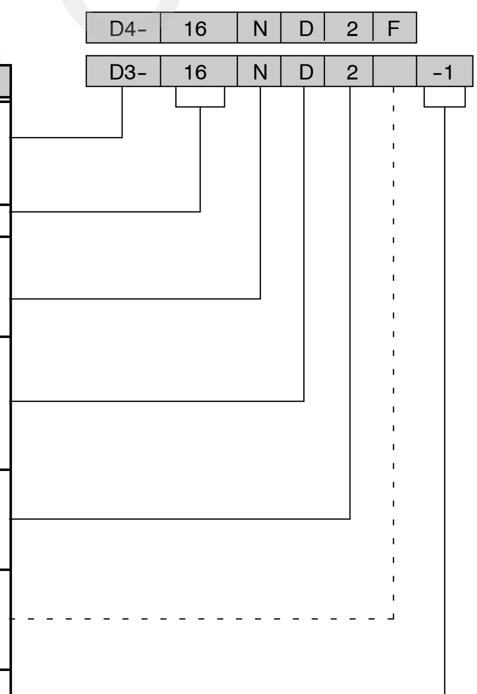
CPUs **Specialty CPUs**	
Product family	D1/F1 D2/F2 D3/F3 D4/F4
Class of CPU / Abbreviation	230...,330...,430...
Denotes a differentiation between Similar modules	-1, -2, -3, -4



Bases	
Product family	D2/F2 D3/F3 D4/F4
Number of slots	##B
Type of Base	DC or empty



Discrete I/O	
DL205 Product family DL305 Product family DL405 Product family	D2/F2 D3/F3 D4/F4
Number of points	04/08/12/16/32
Input Output Combination	N T C
AC DC Either Relay	A D E R
Current Sinking Current Sourcing Current Sinking/Sourcing	1 2 3
High Current Isolation Fast I/O	H S F
Denotes a differentiation between Similar modules	-1, -2, -3, -4



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Analog I/O	
DL205 Product family	D2/F2
DL305 Product family	D3/F3
DL405 Product family	D4/F4
Number of channels	02/04/08/16
Input (Analog to Digital)	AD
Output (Digital to Analog)	DA
Combination	AND
Isolated	S
Denotes a differentiation between Similar modules	-1, -2, -3, -4

F3-	04	AD	S	-1

Alternate example of Analog I/O using abbreviations

F3-	08	THM	-n

note: -n indicates thermocouple type such as: J, K, T, R, S or E

Communication and Networking Special I/O and Devices Programming	
DL205 Product family	D2/F2
DL305 Product family	D3/F3
DL405 Product family	D4/F4
Name Abbreviation	see example

D4-	DCM	DCM (Data Communication Module)
D3-	HSC	HSC (High Speed Counter)
D3-	HPP	HPP (RLL PLUS Handheld Programmer)

CoProcessors and ASCII BASIC Modules	
DL205 Product family	D2/F2
DL305 Product family	D3/F3
DL405 Product family	D4/F4
CoProcessor	CP
ASCII BASIC	AB
64K memory	64
128K memory	128
512K memory	512
Radio modem	R
Telephone modem	T

F4-	CP	128	- R

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Quick Start for PLC Validation and Programming

If you have experience with PLCs, or want to setup a quick example, this section is what you want to use. This example is not intended to explain everything needed to start-up your system. It is only intended to provide a general picture of what is needed to get your system powered-up.

Step 1: Unpack the DL305 Equipment

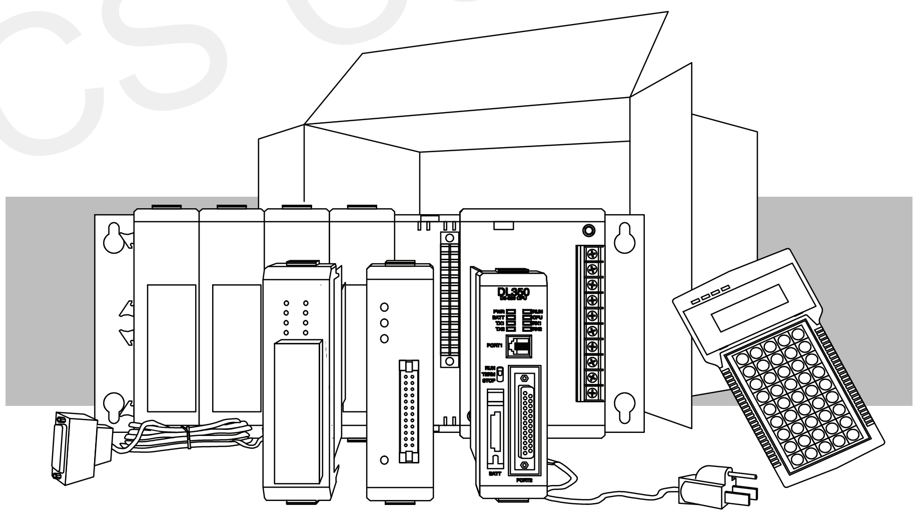
Unpack the DL305 equipment and verify you have the parts necessary to build this demonstration system. The minimum parts needed are as follows:

- Base
- CPU
- D3-08ND2 DC input module or a D3-08SIM input simulator module
- D3-08TD2 DC output module
- *Power cord
- *Hook up wire
- *A 24 VDC toggle switch (if not using the input simulator module)
- *A screwdriver, regular or Phillips type

* These items are not supplied with your PLC.

You will need at least one of the following programming options:

- ***Direct***SOFT Programming Software, ***Direct***SOFT Manual, and a programming cable (connects the CPU to a personal computer), or
- D2-HPP Handheld Programmer and the Handheld Programmer Manual



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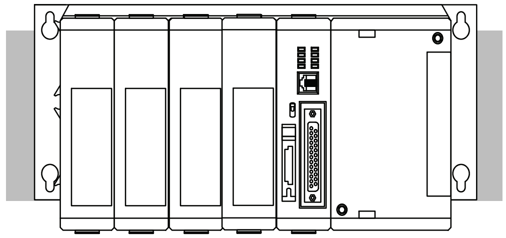
Step 2: Install the CPU and I/O Modules

Insert the CPU and I/O into the base. The CPU must go into the first slot of the base (adjacent to the power supply).

- Each unit has a plastic retaining clip at the top and bottom.
- With the unit square to the base, slide it in using the upper and lower guides.
- Gently push the unit back until it is firmly seated in the backplane and the plastic clips lock in place.

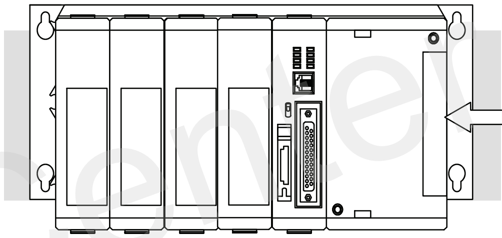


CPU must reside in first slot!

Placement of discrete, analog and relay modules are not critical and may go in any slot in any base however for this example install the output module in the slot next to the CPU and the input module in the next. Limiting factors for other types of modules are discussed in Chapter 4, System Design and Configuration. You must also make sure you do not exceed the power budget for each base in your system configuration. Power budgeting is also discussed in Chapter 4.

Step 3: Remove Terminal Strip Access Cover

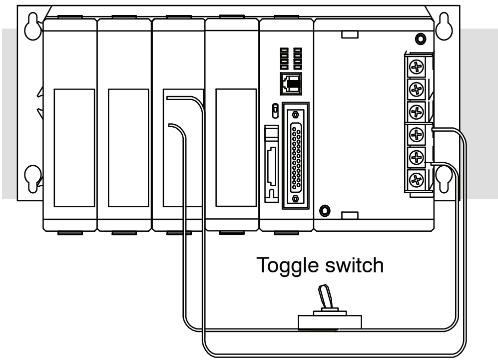
Remove the terminal strip cover. It is a small strip of clear plastic that is located on the base power supply.



Step 4: Add I/O Simulation

To finish this quick start exercise or study other examples in this manual, you will need to install an input simulator module (or wire an input switch as shown below), and add an output module. Using an input simulator is the quickest way to get physical inputs for checking out the system or a new program. To monitor output status, any discrete output module will work.

Wire the switches or other field devices prior to applying power to the system to ensure a point is not accidentally turned on during the wiring operation. Wire the input module (X0) to the toggle switch and 24VDC auxiliary power supply on the CPU terminal strip as shown. Chapter 2, Installation, Wiring, and Specifications provides a list of I/O wiring guidelines.



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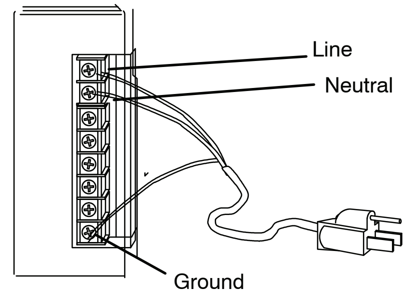
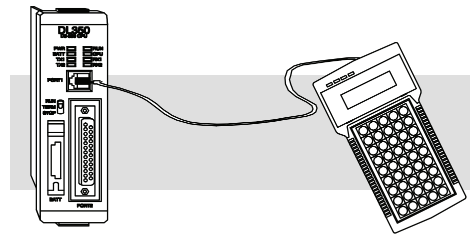
Step 5: Connect the Power Wiring

Connect the wires as shown. Observe all precautions stated earlier in this manual. For details on wiring see Chapter 2, Installation, Wiring, and Specifications. When the wiring is complete, replace the CPU and module covers. Do not apply power at this time.



Step 6: Connect the Handheld Programmer

Connect the D2–HPP to the top port (RJ style phone jack) of the CPU using the appropriate cable.



Step 7: Switch On the System Power

Apply power to the system and ensure the PWR indicator on the CPU is on. If not, remove power from the system and check all wiring and refer to the troubleshooting section in Chapter 9 for assistance.

Step 8: Enter the Program

Slide the Mode Switch on the CPU to the STOP position and then back to the TERM position. This puts the CPU in the program mode and allows access to the CPU program. The PGM indicator should be illuminated on the HPP. Enter the following keystrokes on the HPP:

NOTE: It is not necessary for you to configure the I/O for this system since the DL350 CPU automatically examines any installed modules and establishes the correct configuration.

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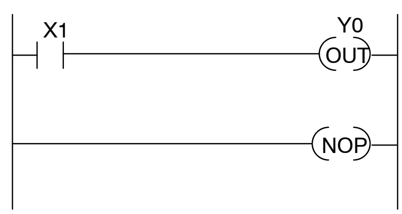
Handheld Programmer Keystrokes

$ STR	→	B 1	ENT
GX OUT	→	C 2	ENT



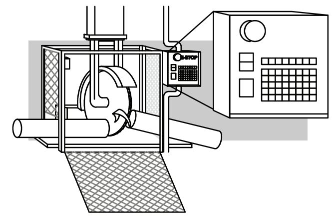
After entering the simple example program slide the switch from the TERM position to the RUN position and back to TERM. The RUN indicator on the CPU will come on indicating the CPU has entered the run mode. If not repeat Step 8 insuring the program is entered properly or refer to the troubleshooting guide in chapter 9.

During Run mode operation, the output status indicator on the output module should reflect the switch status. When the switch is on the output should be on.

Steps to Designing a Successful System

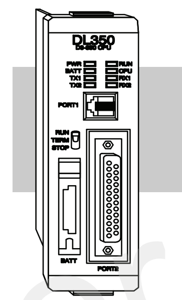
Step 1: Review the Installation Guidelines

Always make safety your first priority in any system application. Chapter 2 provides several guidelines that will help provide a safer, more reliable system. This chapter also includes wiring guidelines for the various system components.



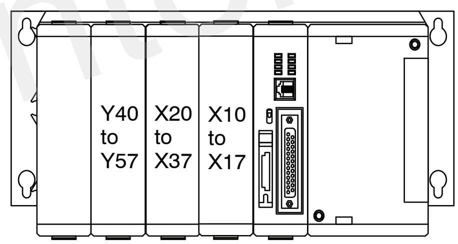
Step 2: Understand the CPU Setup Procedures

The CPU is the heart of your automation system. Make sure you take time to understand the various features and setup requirements.



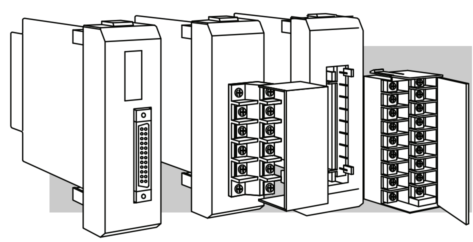
Step 3: Understand the I/O System Configurations

It is important to understand how your local I/O system can be configured. It is also important to understand how the system Power Budget is calculated. This can affect your I/O placement and/or configuration options.



Step 4: Determine the I/O Module Specifications and Wiring Characteristics

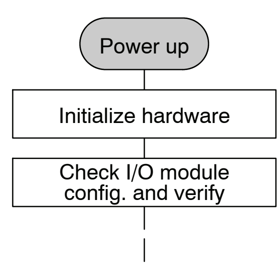
There are many different I/O modules available with the DL305 system. Chapter 2 provides the specifications and wiring diagrams for the discrete I/O modules.



NOTE: Specialty modules have their own manuals and are not included in this manual.

Step 5: Understand the System Operation

Before you begin to enter a program, it is very helpful to understand how the DL305 system processes information. This involves not only program execution steps, but also involves the various modes of operation and memory layout characteristics. See Chapter 3 for more information.



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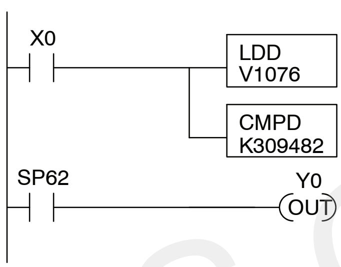
Step 6: Review the Programming Concepts

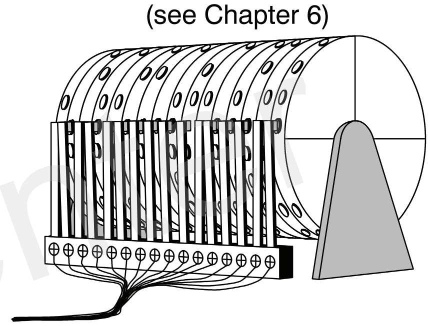
The DL305 provides four main approaches to solving the application program, including the PID loop task depicted in the next figure.

- RLL diagram-style programming is the best tool for solving boolean logic and general CPU register/accumulator manipulation. It includes dozens of instructions, which will augment drums, stages, and loops.
- The DL350 has four timer/event drum types, each with up to 16 steps. They offer both time and/or event-based step transitions. Drums are best for a repetitive process based on a single series of steps.
- Stage programming (also called RLL*Plus*) is based on state-transition diagrams. Stages divide the ladder program into sections which correspond to the states in a flow chart of your process.
- The DL350 PID Loop Operation uses setup tables to configure 4 loops. Features include; auto tuning, alarms, SP ramp/soak generation, and more.

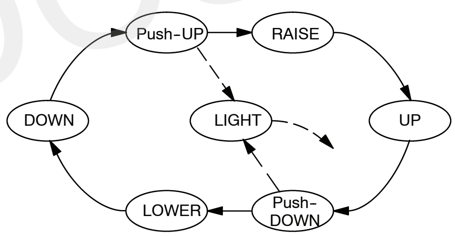
Standard RLL Programming
(see Chapter 5)



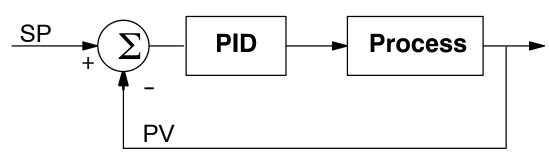
Timer/Event Drum Sequencer
(see Chapter 6)



Stage Programming
(see Chapter 7)



PID Loop Operation
(see Chapter 8)



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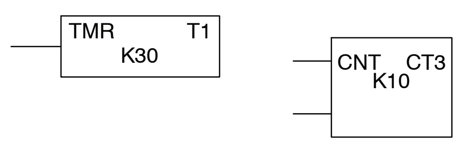
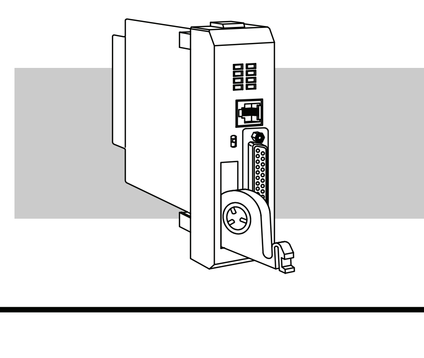
Step 7: Choose the Instructions

Once you have installed the system and understand the theory of operation, you can choose from one of the most powerful instruction sets available.



Step 8: Understand the Maintenance and Troubleshooting Procedures

Equipment failures can occur at any time. Switches fail, batteries need to be replaced, etc. In most cases, the majority of the troubleshooting and maintenance time is spent trying to locate the problem. The DL305 system has many built-in features that help you quickly identify problems. Refer to Chapter 9 for diagnostics and troubleshooting tips.



2

Installation, Wiring, and Specifications

In This Chapter. . . .

DCS Center

Safety Guidelines

NOTE: Products with CE marks perform their required functions safely and adhere to relevant standards as specified by CE directives provided they are usedaccording to their intended purpose and that the instructions in this manual areadhered to. The protection provided by the equipment may be impaired if thisequipment is used in a manner not specified in this manual. A listing of ourinternational affiliates is available on our web site: http://www.automationdirect.com.

WARNING: Providing a safe operating environment for personnel and equipment is your responsibility and should be your primary goal during system planning and installation. Automation systems can fail and may result in situations that can cause serious injury to personnel or damage to equipment. Do not rely on the automation system alone to provide a safe operating environment. You should use external electromechanical devices, such as relays or limit switches, that are independent of the PLC application to provide protection for any part of the system that may cause personal injury or damage.

Every automation application is different, so there may be special requirements for your particular application. Make sure you follow all national, state, and local government requirements for the proper installation and use of your equipment.

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Plan for Safety

The best way to provide a safe operating environment is to make personnel and equipment safety part of the planning process. You should examine *every* aspect of the system to determine which areas are critical to operator or machine safety.

If you are not familiar with PLC system installation practices, or your company does not have established installation guidelines, you should obtain additional information from the following sources.

- NEMA — The National Electrical Manufacturers Association, located in Washington, D.C., publishes many different documents that discuss standards for industrial control systems. You can order these publications directly from NEMA. Some of these include:
  ICS 1, General Standards for Industrial Control and Systems
  ICS 3, Industrial Systems
  ICS 6, Enclosures for Industrial Control Systems
- NEC — The National Electrical Code provides regulations concerning the installation and use of various types of electrical equipment. Copies of the NEC Handbook can often be obtained from your local electrical equipment distributor or your local library.
- Local and State Agencies — many local governments and state governments have additional requirements above and beyond those described in the NEC Handbook. Check with your local Electrical Inspector or Fire Marshall office for information.

Three Levels of Protection

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

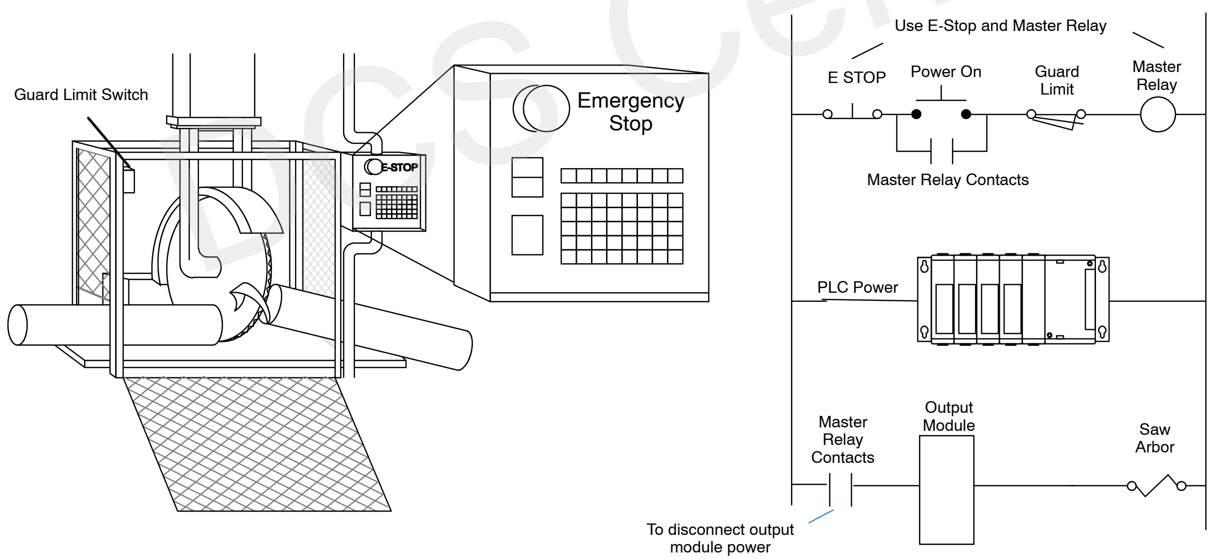
- Emergency stop switch for disconnecting system power.
- Mechanical disconnect for output module power.
- Orderly system shutdown sequence in the PLC control program.

Emergency Stops

It is recommended that emergency stop circuits be incorporated into the system for every machine controlled by a PLC. For maximum safety in a PLC system, these circuits must not be wired into the controller, but should be hardwired external to the PLC. The emergency stop switches should be easily accessed by the operator and are generally wired into a master control relay (MCR) or a safety control relay (SCR) that will remove power from the PLC I/O system in an emergency.

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

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



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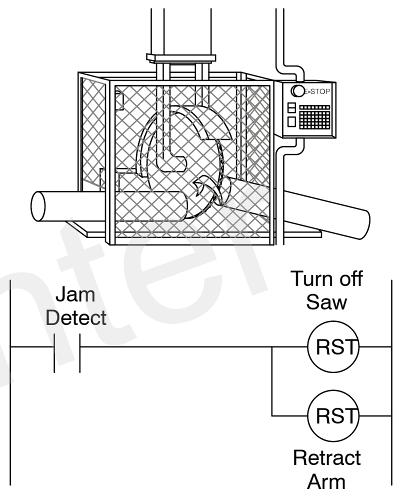
Emergency Power Disconnect

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

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

Orderly System Shutdown

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



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

Class 1, Division 2 Approval

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

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

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

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Mounting Guidelines

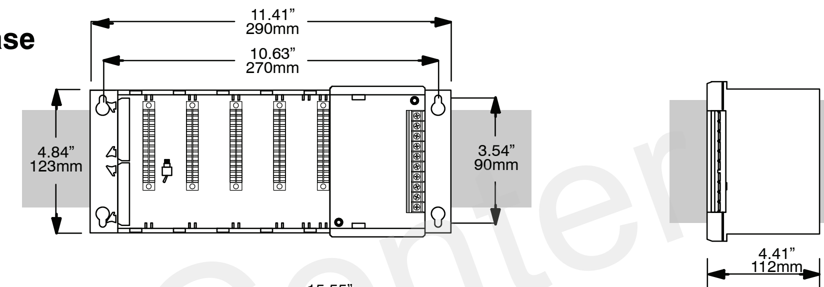
Before installing the PLC system you will need to know the dimensions for the components. The diagrams on the following pages provide the component dimensions to use in defining your enclosure specifications. Remember to leave room for potential expansion.

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

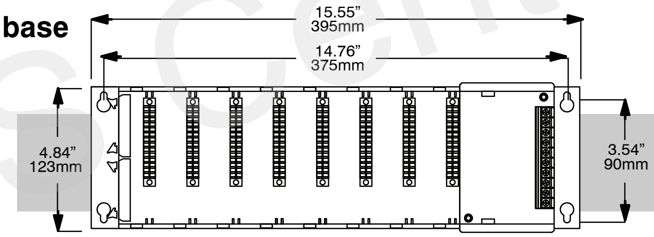
Base Dimensions

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

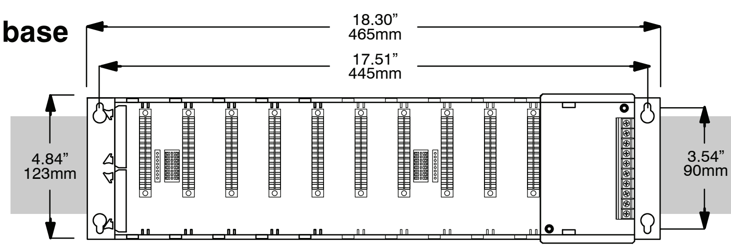
5 slot base



8 slot base



10 slot base



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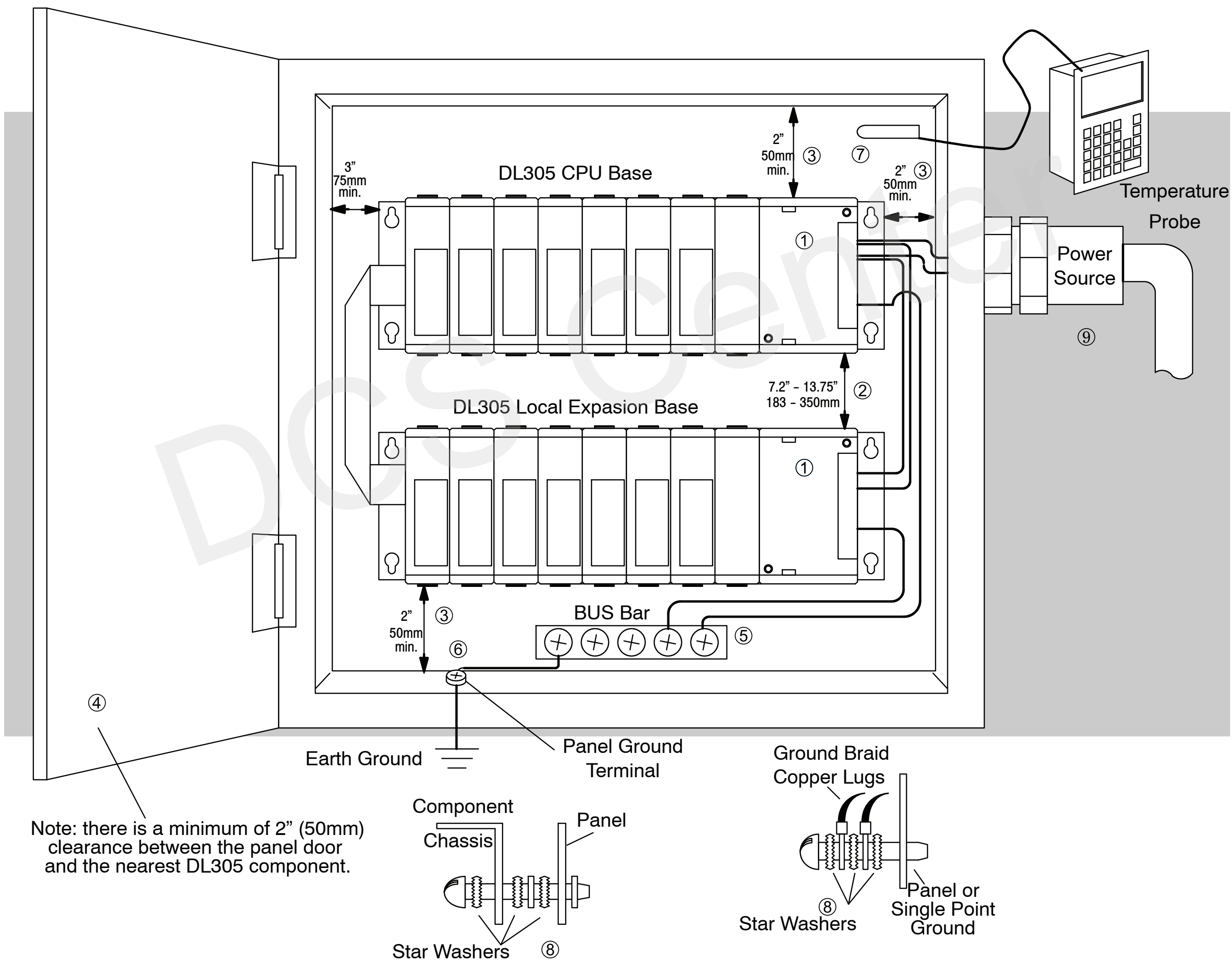
Panel Mounting and Layout

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

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



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

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

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

Enclosures

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

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

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Environmental Specifications

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

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

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

Agency Approvals

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

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

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Marine Use

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

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

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

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

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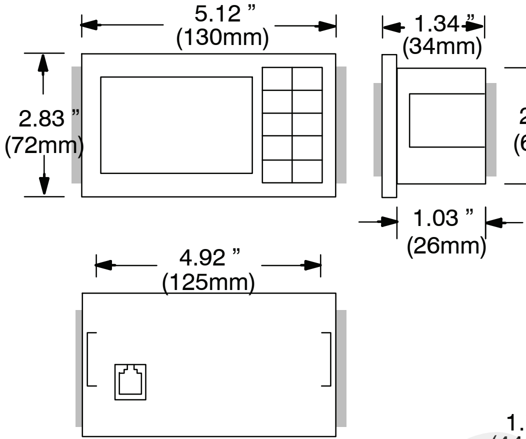
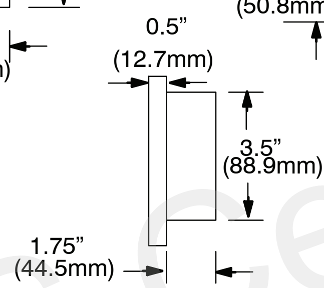
Component Dimensions

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

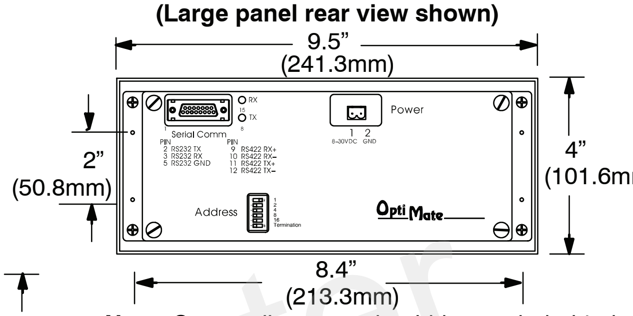
NOTE: If you are using other components in your system, make sure you refer to the appropriate manual to determine how those units can affect mounting dimensions.

***Direct*VIEW 1000**

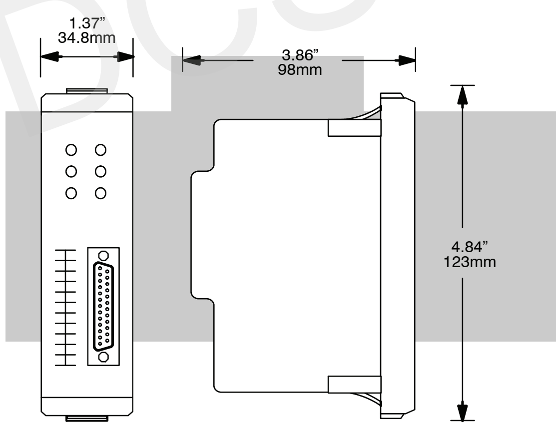




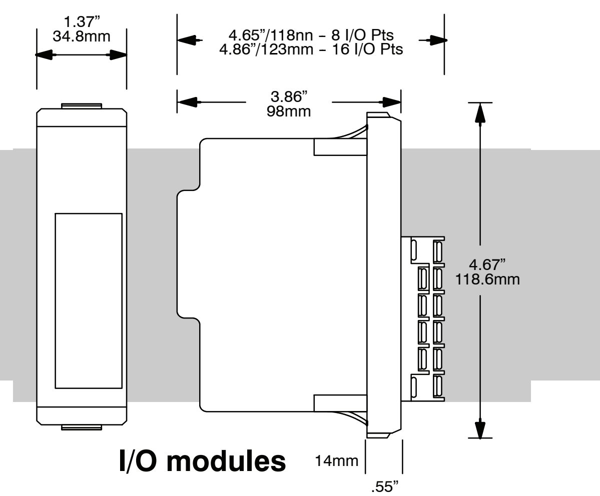
Optimation Units
(Large panel rear view shown)



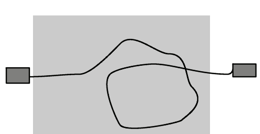
Note: Space allowance should be made behind the panel for the serial cable, and power connector. If you will be adding or removing panels for a multi-drop, then you may want to allow for hand room to reach the address switch on the back. We recommend 4 inches.



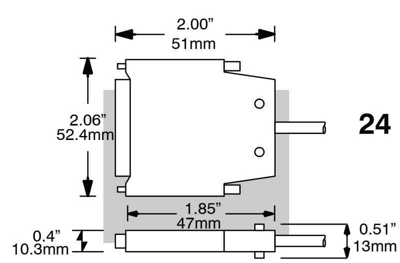
I/O module w/24 pin connector



I/O modules



Handheld programmer cable



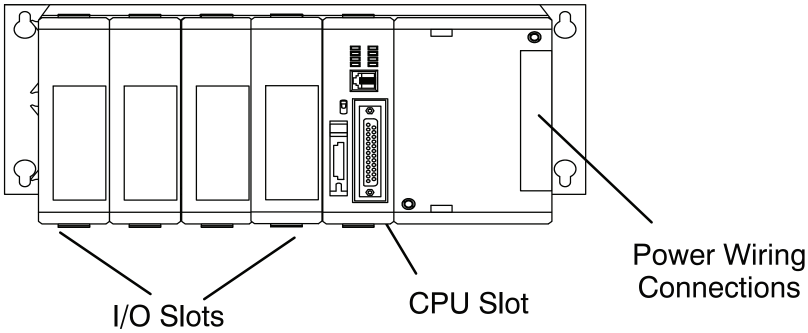
24 pin connector

Installing DL305 Bases

Choosing the Base Type

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

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

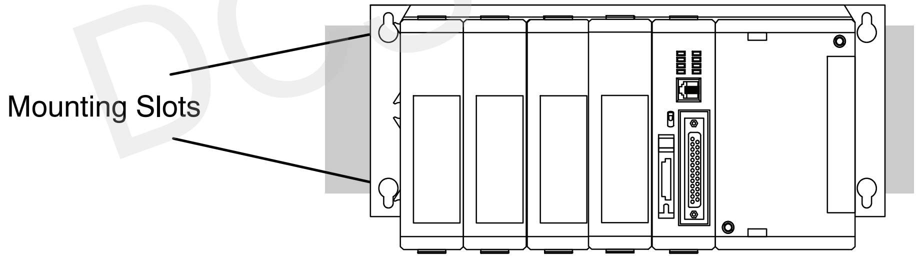


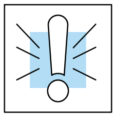
Your choice of base depends on three things.

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

Mounting the Base

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





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

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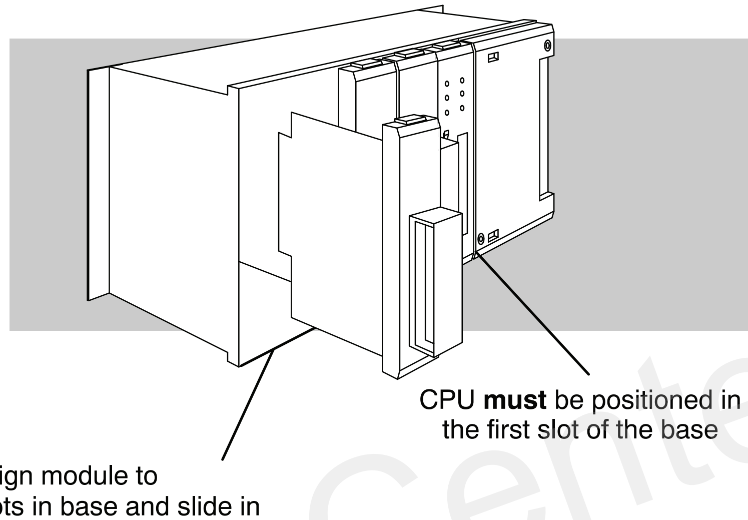
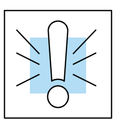
Installing Components in the Base

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





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

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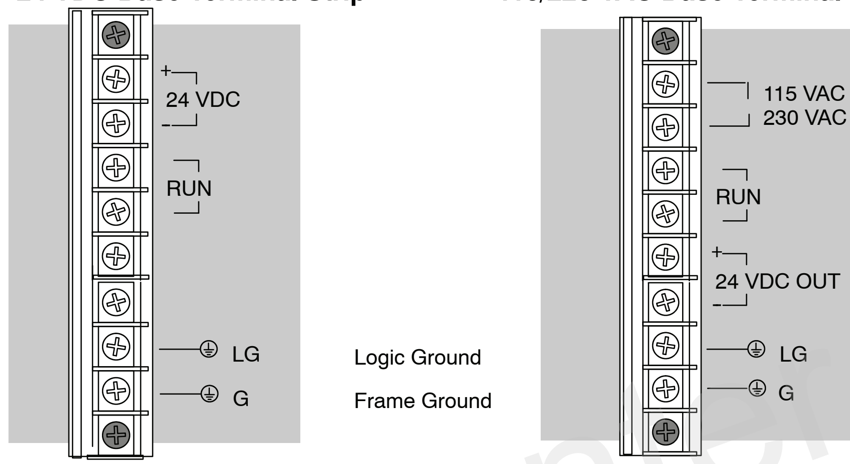
Base Wiring Guidelines

Base Wiring

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

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

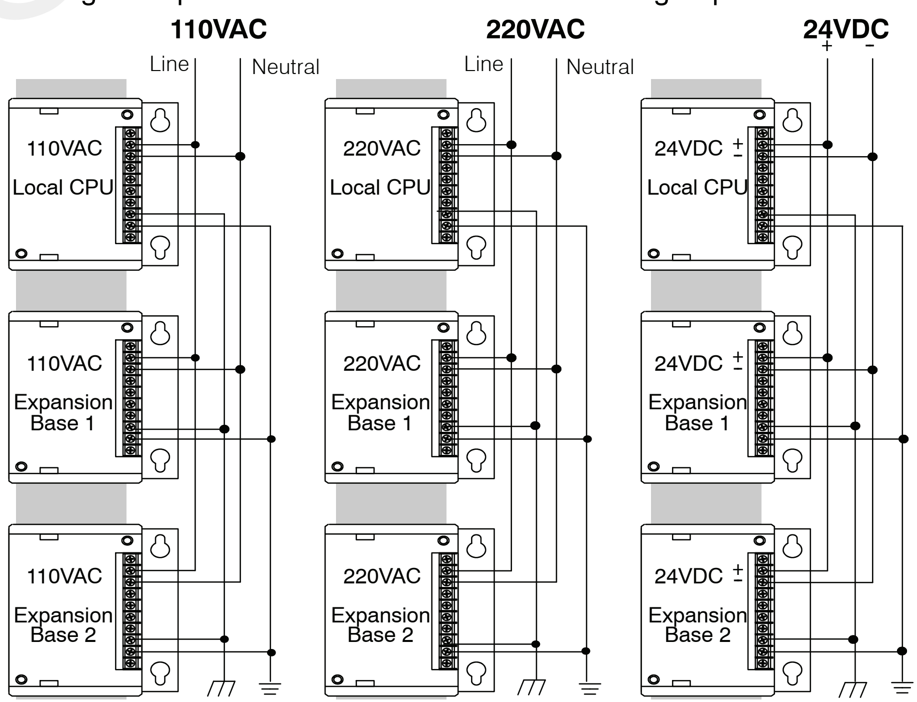
24 VDC Base Terminal Strip **110/220 VAC Base Terminal Strip**



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

Expansion Base Wiring

The following example illustrates connections when using Expansion bases.



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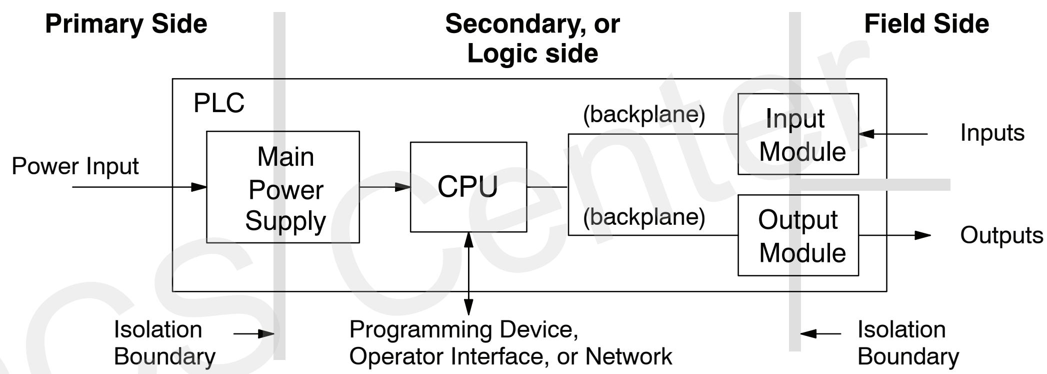
I/O Wiring Strategies

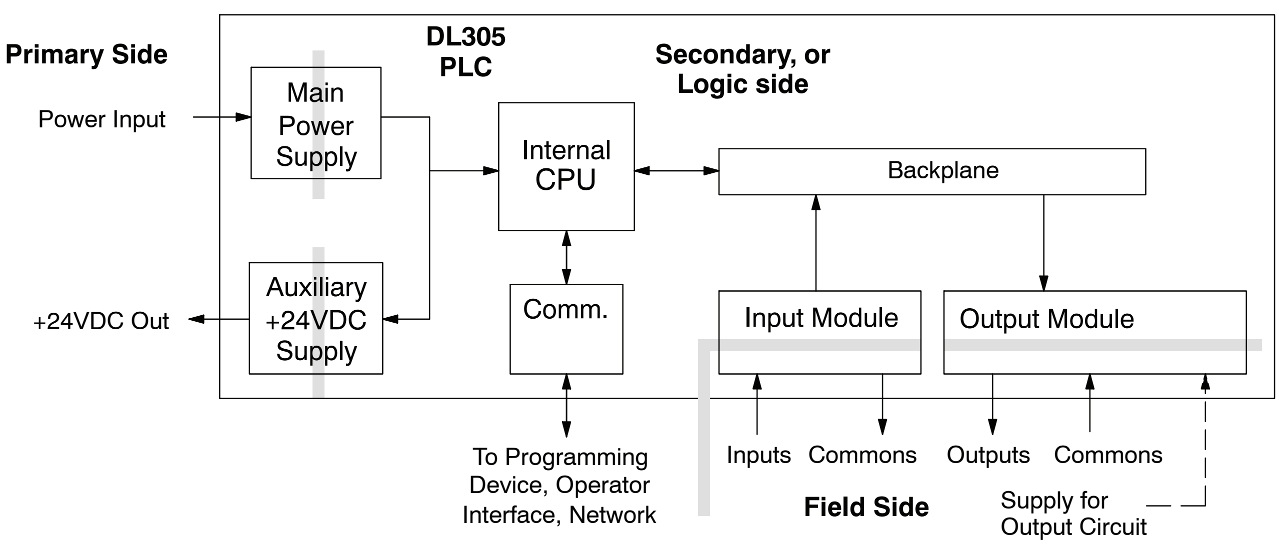
The DL305 PLC system is very flexible and will work in many different wiring configurations. By studying this section before actual installation, you can probably find the best wiring strategy for your application . This will help to lower system cost, wiring errors, and avoid safety problems.

PLC Isolation Boundaries

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



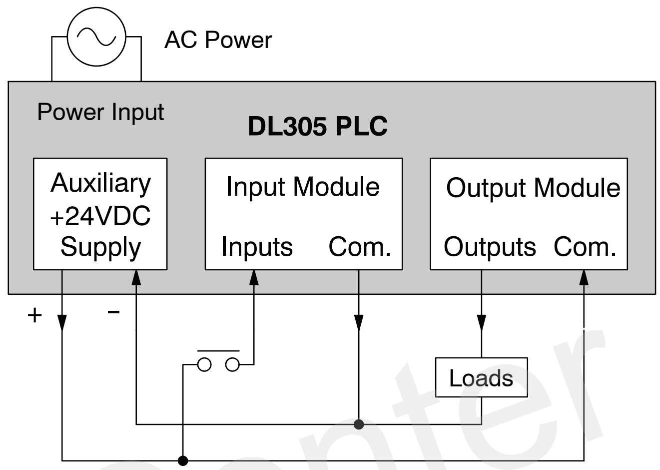
The next figure shows the physical layout of a DL305 PLC system, as viewed from the front. In addition to the basic circuits covered above, AC-powered bases include an auxiliary +24VDC power supply with its own isolation boundary. Since the supply output is isolated from the other three circuits, it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



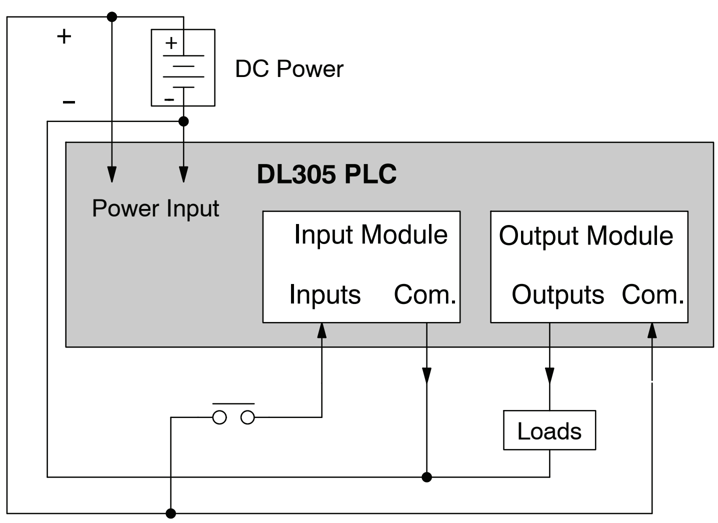
In some cases, using the built-in auxiliary +24VDC supply can result in a cost savings for your control system. It can power combined loads up to 100 mA. Be careful not to exceed the current rating of the supply. If you are the system designer for your application, you may be able to select and design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

Powering I/O Circuits with the Auxiliary Supply

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



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



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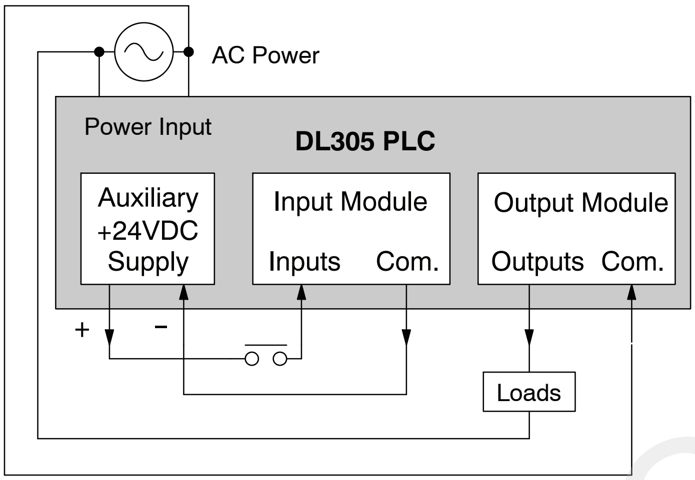
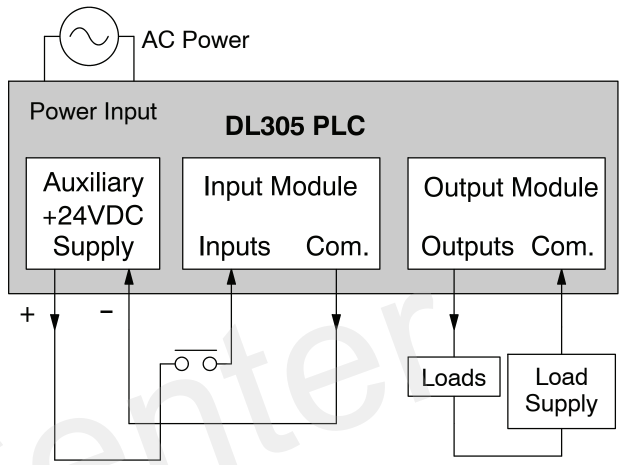
Powering I/O Circuits Using Separate Supplies

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

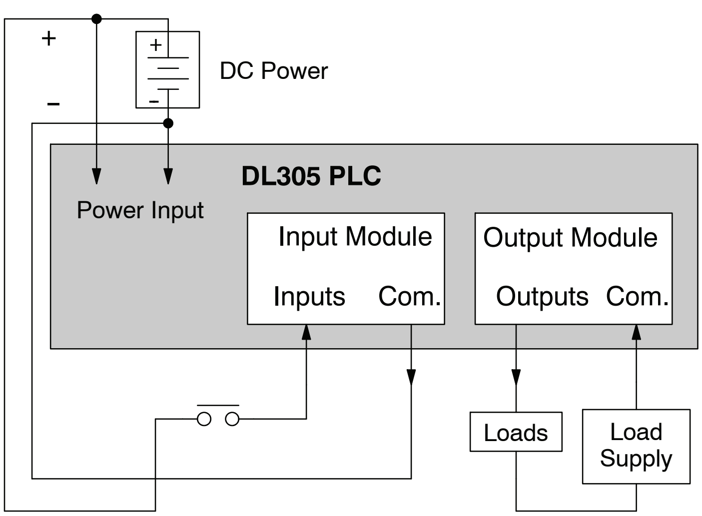
If the loads cannot be powered from the PLC supply, then a separate supply must be used as shown to the right in the figure below.

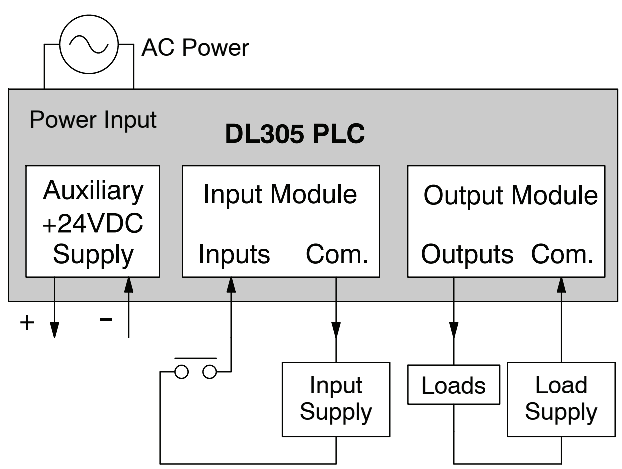




Some applications will use the PLC external power source to also power the input circuit. This typically occurs on DC-powered PLCs, as shown in the drawing below to the left. The inputs share the PLC power source supply, while the outputs have their own separate supply.

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





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Sinking / Sourcing Concepts

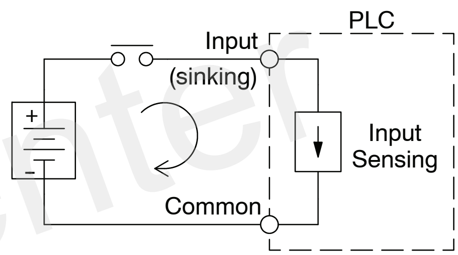
Before going further in the study of wiring strategies, you must have a solid understanding of “*sinking*” and “*sourcing*” concepts. Use of these terms occurs frequently in input or output circuit discussions. It is the goal of this section to make these concepts easy to understand, further ensuring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

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

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

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

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



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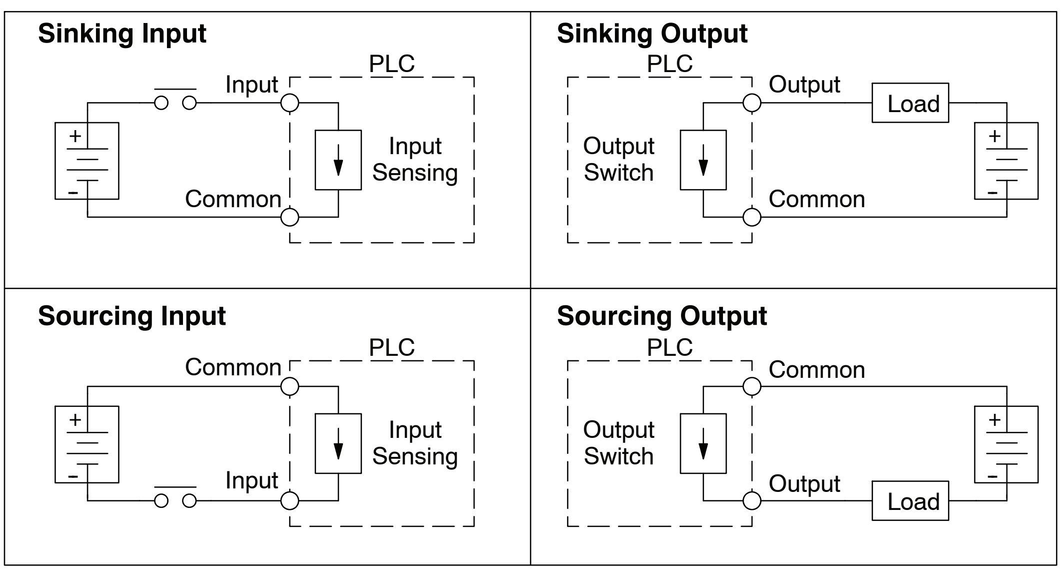
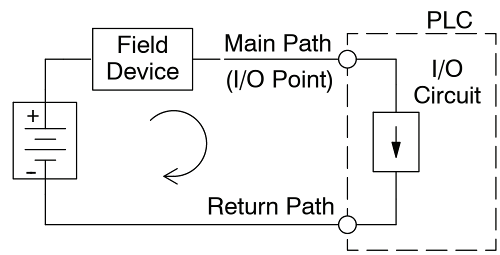
By applying the circuit principle above to the four possible combinations of input/output sinking/sourcing types as shown below. The I/O module specifications at the end of this chapter list the input or output type.

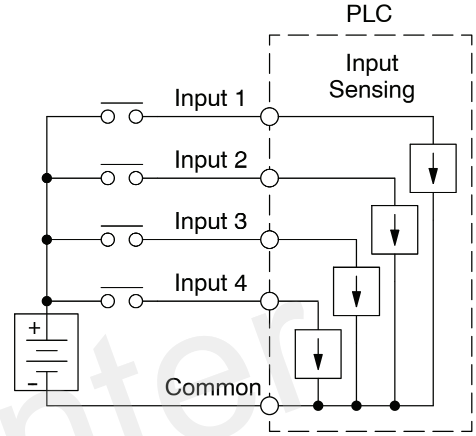


I/O "Common" Terminal Concepts

In order for a PLC I/O circuit to operate, current must enter at one terminal and exit at another. Therefore, at least two terminals are associated with every I/O point. In the figure to the right, the Input or Output terminal is the *main path* for the current. One additional terminal must provide the *return path* to the power supply.



If there was unlimited space and budget for I/O terminals, every I/O point could have two dedicated terminals as the figure above shows. However, providing this level of flexibility is not practical or even necessary for most applications. Therefore, most Input or Output points on PLCs are in groups which share the return path (called *commons*). The figure to the right shows a group (or *bank*) of 4 input points which share a common return path. In this way, the four inputs require only five terminals instead of eight.



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

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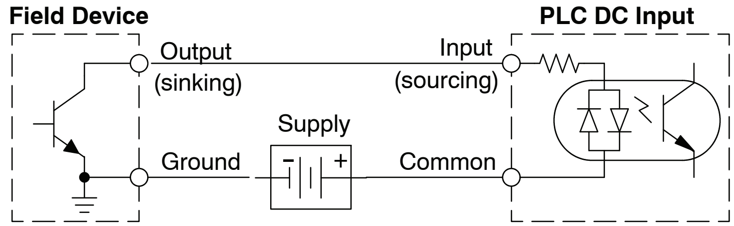
Connecting DC I/O to "Solid State" Field Devices

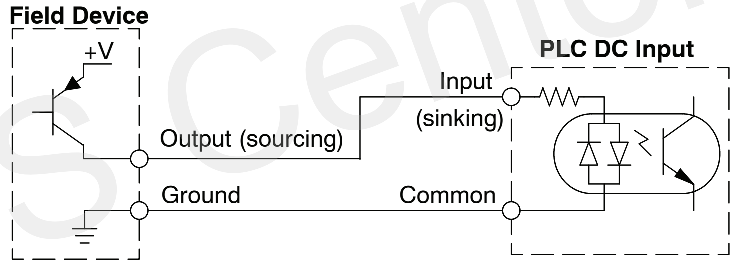
In the previous section on Sourcing and Sinking concepts, the DC I/O circuits were explained to sometimes will only allow current to flow one way. This is also true for many of the field devices which have solid-state (transistor) interfaces. In other words, field devices can also be sourcing or sinking.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

Solid State Input Sensors

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



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



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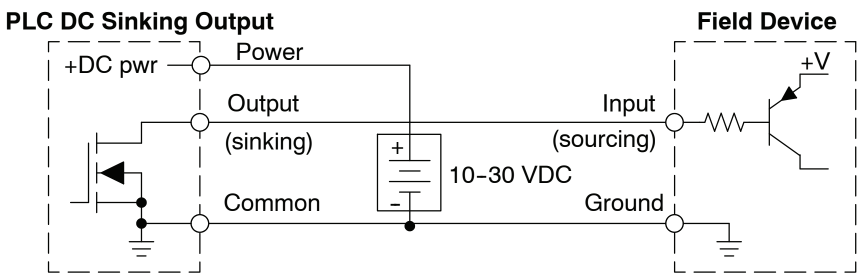
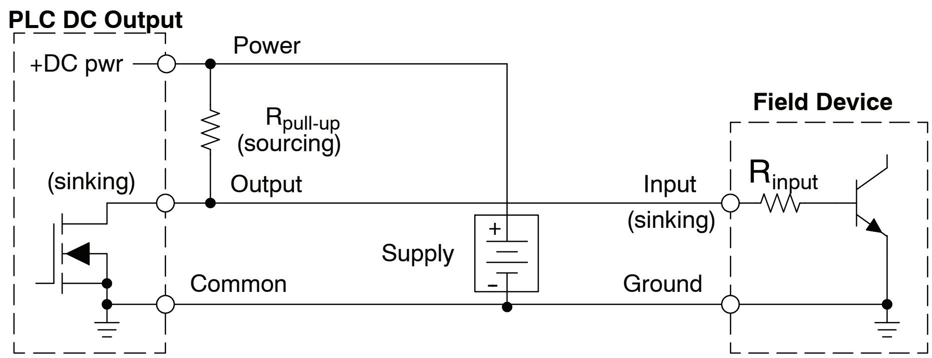
Solid State Output Loads

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

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



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



NOTE 1: DO NOT attempt to drive a heavy load (>25 mA) with this pull-up method
NOTE 2: Using the pull-up resistor to implement a sourcing output has the effect of inverting the output point logic. In other words, the field device input is energized when the PLC output is OFF, from a ladder logic point-of-view. Your ladder program must comprehend this and generate an inverted output. Or, you may choose to cancel the effect of the inversion elsewhere, such as in the field device.

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

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

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

Relay Output Guidelines

Four output modules in the DL305 I/O family feature relay outputs: D3-08TR, F3-08TRS-1, F3-08TRS-2, D3-16TR. Relays are best for the following applications:

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

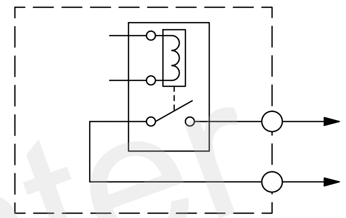
Some applications in which NOT to use relays:

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

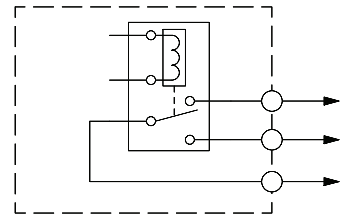
Relay outputs in the DL305 output modules are available in two contact arrangements, shown to the right. The Form A type, or SPST (single pole, single throw) type is normally open and is the simplest to use. The Form C type, or SPDT (single pole, double throw) type has a center contact which moves and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

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

Relay with Form A contacts



Relay with Form C contacts



Surge Suppresion For Inductive Loads

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

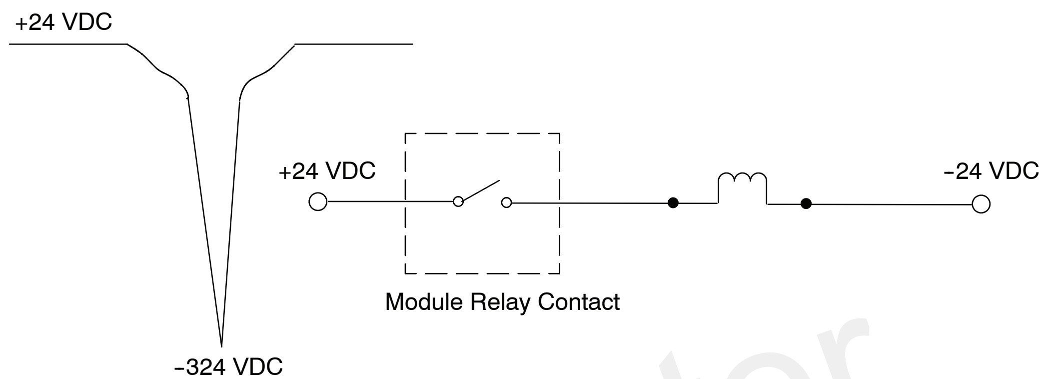
When switching a DC-supplied inductive load the full supply voltage is always present when the relay contact opens (or "bounces"). When switching an AC-supplied inductive load there is one chance in 60 (60 Hz) or 50 (50 Hz) that the relay contact will open (or "bounce") when the AC sine wave is zero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

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

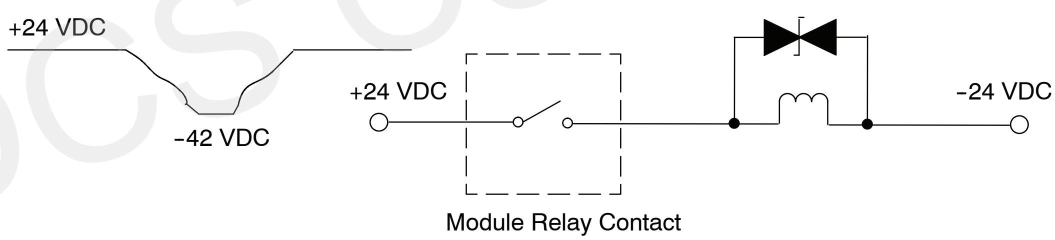
Transient Voltage Suppressors (TVS or transorb) provide the best surge and transient suppression of AC and DC powered coils, providing the fastest response with the smallest overshoot.

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

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



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



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

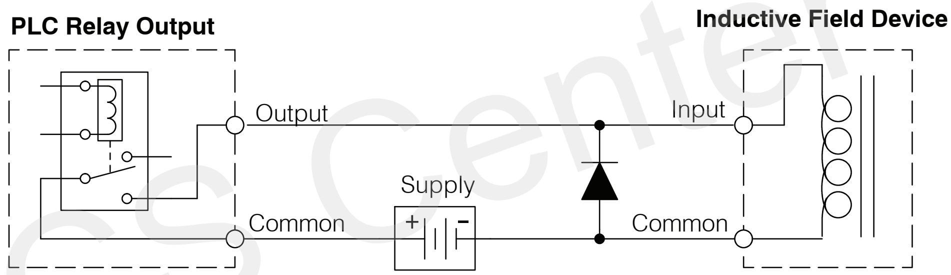
Vendor / Catalog	Type (TVS, MOV, Diode)	Inductive Load Voltage	Part Number
AutomationDirect Transient Voltage Suppressors, LiteOn Diodes; from DigiKey Catalog: Phone 1-800-344-4539	TVS TVS TVS Diode	110/120 VAC 24 VDC 220/240 VAC 12/24 VDC or VAC 12/24 VDC	ZL-TD8-120 ZL-TD8-24 P6K350CA Contact Digi-key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

Prolonging Relay Contact Life

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

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

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



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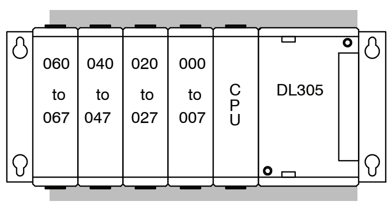
I/O Modules Position, Wiring, and Specification

Slot Numbering

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

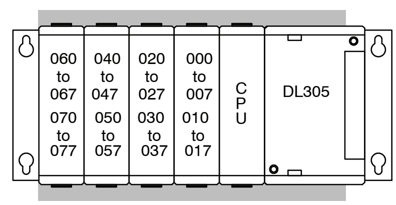
The examples below show the I/O numbering for a 5 slot local CPU base with 8 point I/O and a 5 slot local CPU base with 16 point I/O using the xxxxx-1 bases.

5 Slot Base Using 8 Point I/O Modules



Slot Number: 3—2—1—0

5 Slot Base Using 16 Point I/O Modules



Slot Number: 3—2—1—0

I/O Module Placement Rules

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

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

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

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

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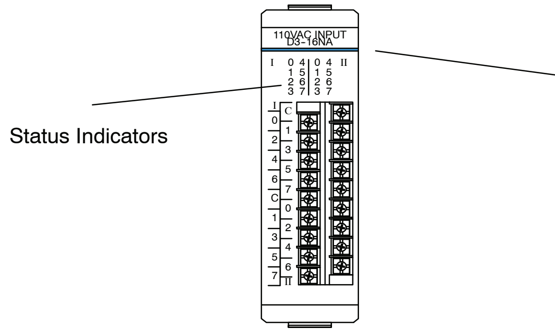
Discrete Module Status Indicators

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

Color Coding of I/O Modules

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



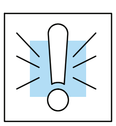
Module Type	Color Code
Discrete/Analog Output	Red
Discrete/Analog Input	Blue
Other	White

Wiring the Different Module Connectors

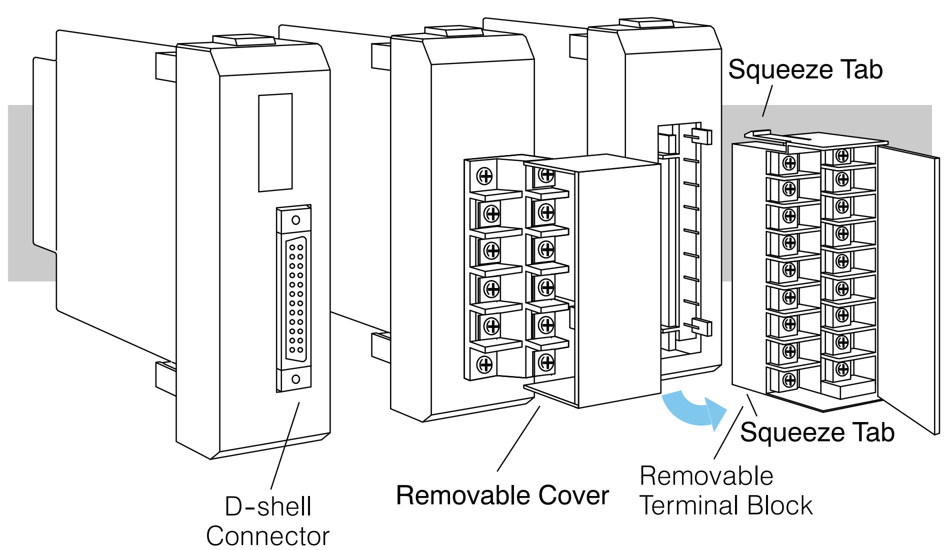
There are three types of module connectors for the DL305 I/O. Some modules have normal screw terminal connectors. Other modules have connectors with recessed screws. The recessed screws help minimize the risk of someone accidentally touching active wiring. The third type has a D–shell connector for special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

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

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



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



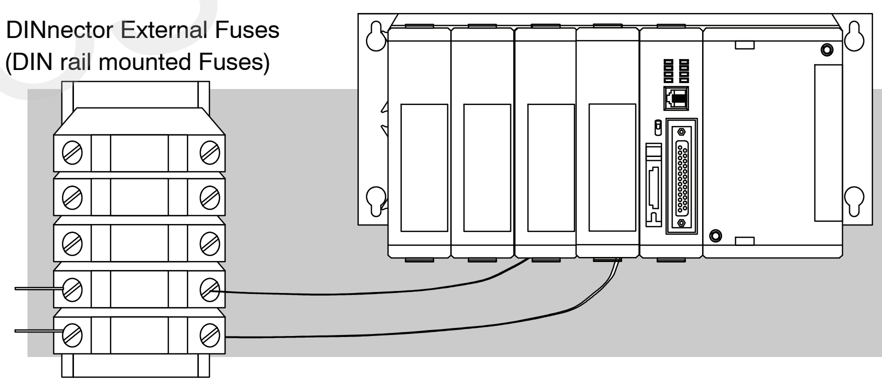
I/O Wiring Checklist

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

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

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

2. Always use a continuous length of wire, do not combine wires to attain a needed length.
3. Use the shortest possible wire length.
4. Use wire trays for routing where possible.
5. Avoid running wires near high energy wiring.
6. Avoid running input wiring close to output wiring where possible.
7. To minimize voltage drops when wires must run a long distance , consider using multiple wires for the return line.
8. Avoid running DC wiring in close proximity to AC wiring where possible.
9. Avoid creating sharp bends in the wires.
10. To reduce the risk of having a module with a blown fuse, we suggest you add external fuses to your I/O wiring. A fast blow fuse, with a lower current rating than the I/O module fuse can be added to each common, or a fuse with a rating of slightly less than the maximum current per output point can be added to each output. Refer to our catalog for a complete line of DINnectors, DIN rail mounted fuse blocks.



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

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Glossary of Specification Terms

Inputs or Outputs Per Module Indicates number of input or output points per module and designates current sinking, current sourcing, or either.

Commons Per Module Number of commons per module and their electrical characteristics.

Input Voltage Range The operating voltage range of the input circuit.

Output Voltage Range The operating voltage range of the output circuit.

Peak Voltage Maximum voltage allowed for the input circuit.

AC Frequency AC modules are designed to operate within a specific frequency range.

ON Voltage Level The voltage level at which the input point will turn ON.

OFF Voltage Level The voltage level at which the input point will turn OFF.

Input Impedance Input impedance can be used to calculate input current for a particular operating voltage.

Input Current Typical operating current for an active (ON) input.

Minimum ON Current The minimum current for the input circuit to operate reliably in the ON state.

Maximum OFF Current The maximum current for the input circuit to operate reliably in the OFF state.

Minimum Load The minimum load current for the output circuit to operate properly.

External DC Required Some output modules require external power for the output circuitry.

ON Voltage Drop Sometimes called "saturation voltage", it is the voltage measured from an output point to its common terminal when the output is ON at max. load.

Maximum Leakage Current The maximum current a connected maximum load will receive when the output point is OFF.

Maximum Inrush Current The maximum current used by a load for a short duration upon an OFF to ON transition of a output point. It is greater than the normal ON state current and is characteristic of inductive loads in AC circuits.

Base Power Required Power from the base power supply is used by the DL305 input modules and varies between different modules. The guidelines for using module power is explained in the power budget configuration section in Chapter 4–5.

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

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

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

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

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

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

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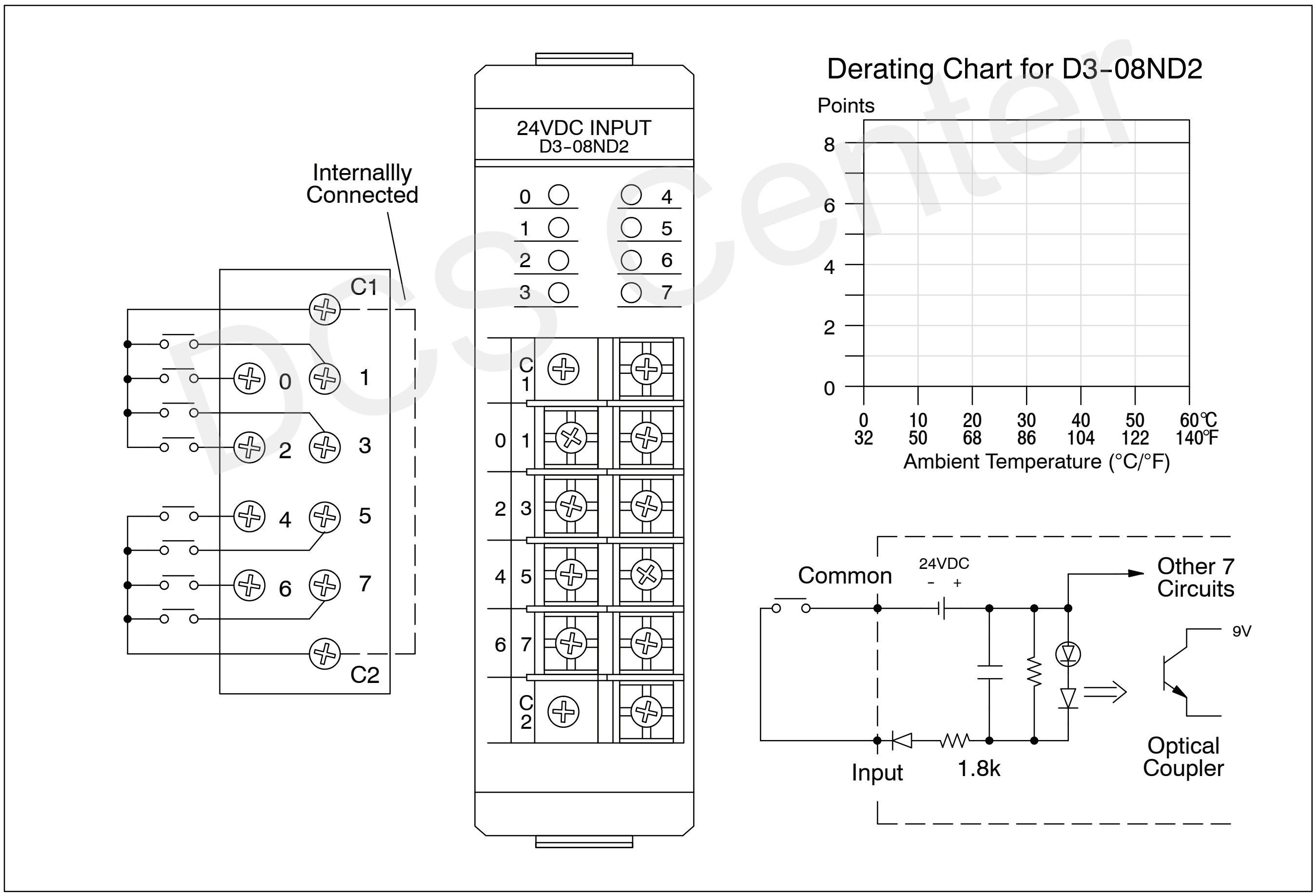
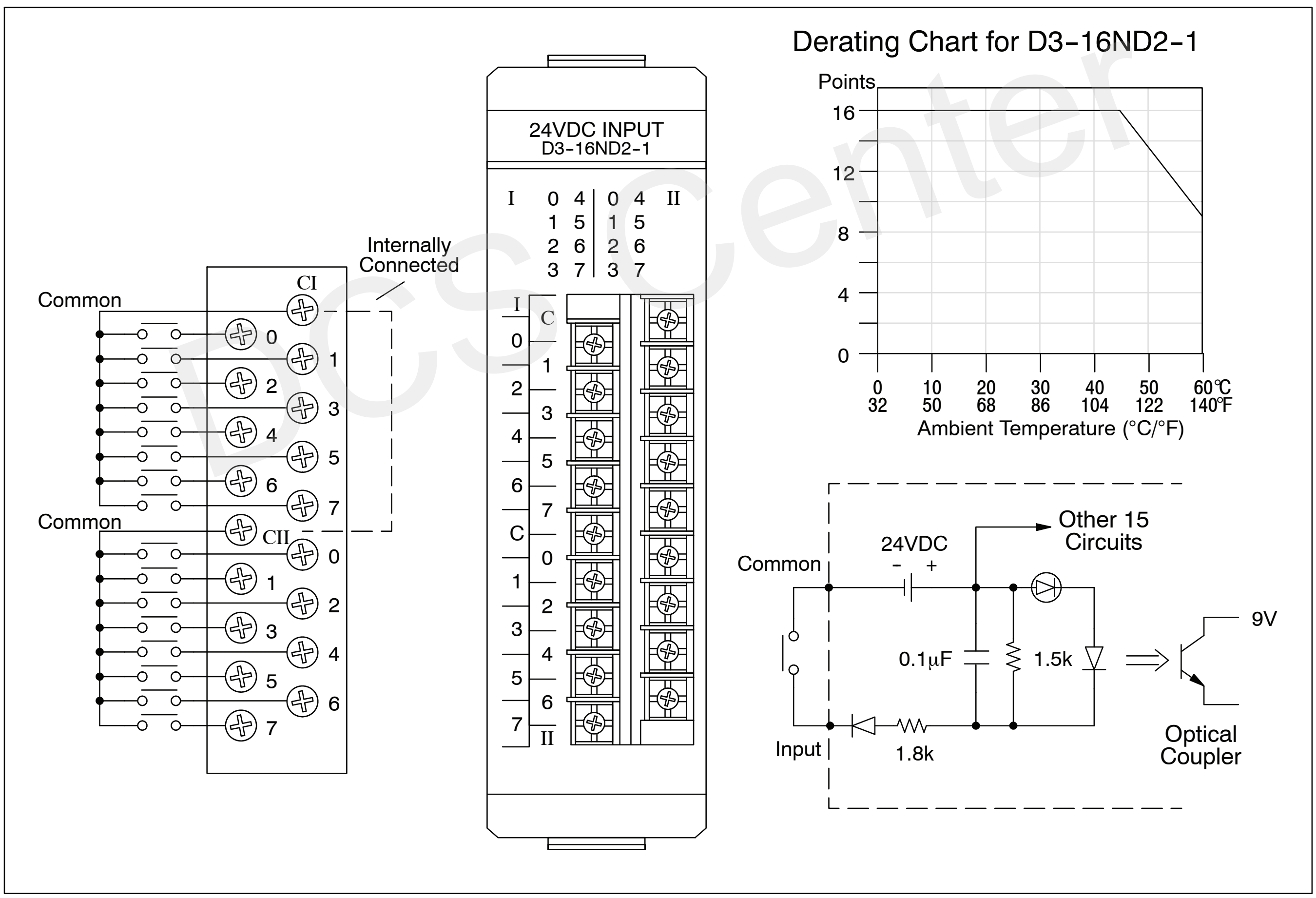
D3-08ND2, 24 VDC Input Module

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



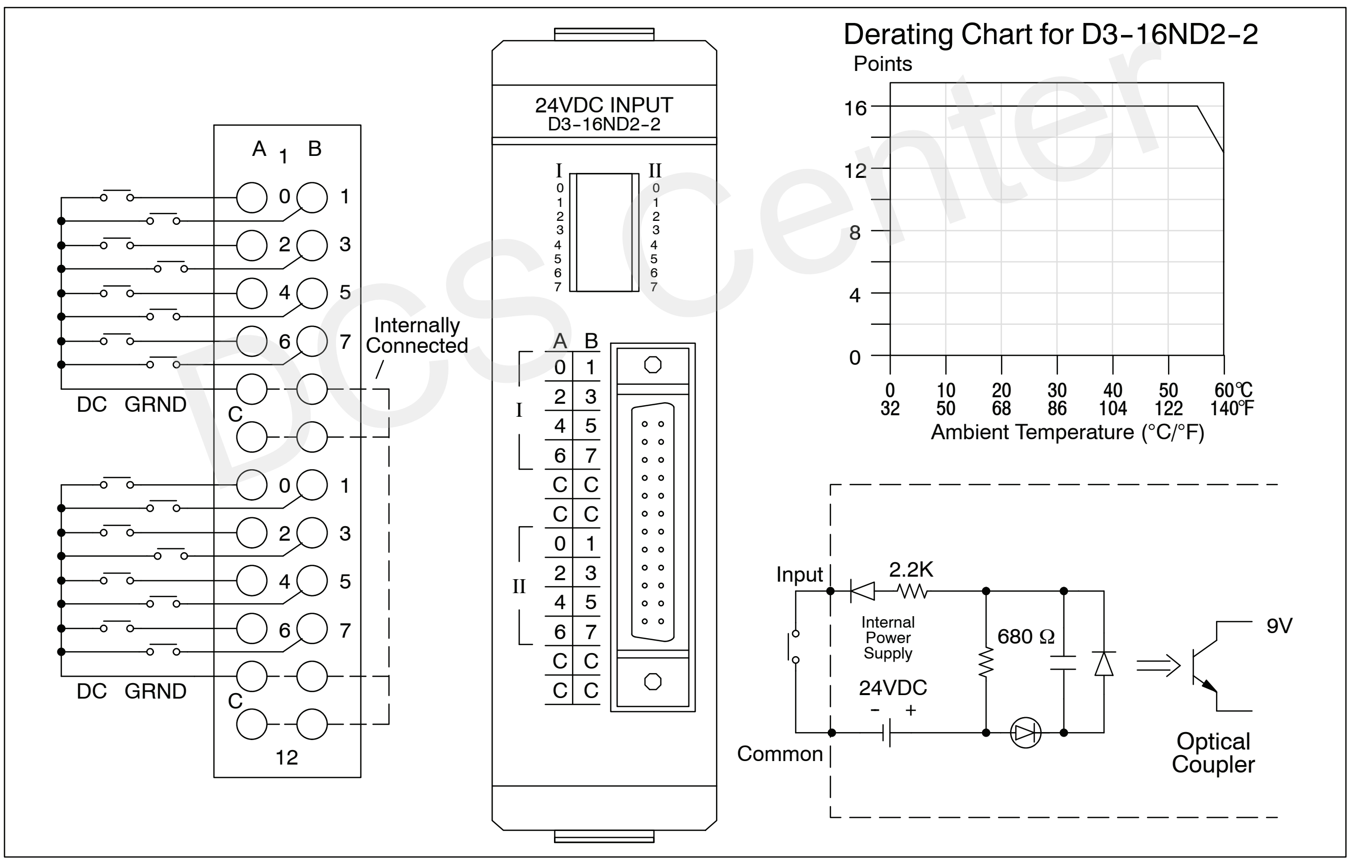
D3–16ND2–1, 24 VDC Input Module

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



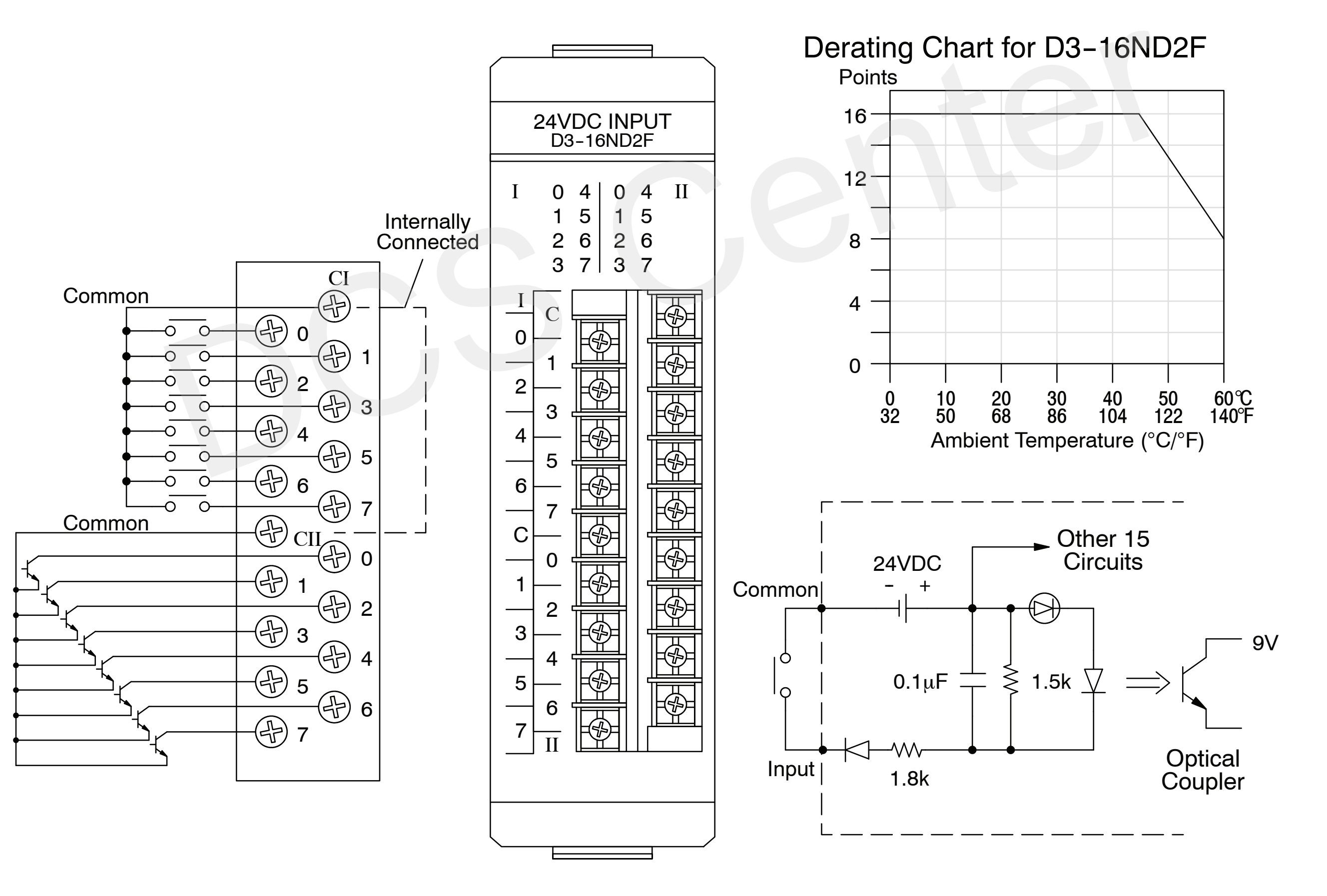
D3–16ND2–2, 24 VDC Input Module Module

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



D3–16ND2F, 24 VDC Fast Response Input Module

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



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

Inputs per module	16 sink/source (jumper selectable sink/ source)*
Commons per module	2 (non-isolated)
Input voltage range	5 VDC TTL & CMOS, 12-24 VDC (jumper selectable)*
Input voltage supplied	Internal (used with sink-ing loads) External (used with sourcing loads)
Peak voltage	100 VDC (35 VDC Continuous)
AC frequency	N/A
ON voltage level	0-1.5VDC @ 5VDC 0-4VDC @ 12-24VDC
OFF voltage level	3.5-5VDC @ 5VDC 10-24VDC @12-24VDC

Base power required	9V 148 mA Max 24V 68 mA Max
Input current	1 mA @ 5VDC 3 mA @ 12-24 DC
Input impedance	4.7K
OFF to ON response	1 ms
ON to OFF response	1 ms
Maximum input rate	500 Hz
Minimum ON current	0.4 mA @ 5VDC 0.9 mA @ 12-24VDC
Maximum OFF current	0.8 mA @ 5VDC 2.2 mA @ 12-24VDC
Terminal type	Removable
Status indicators	Logic side
Weight	5.4 oz. (153 g)

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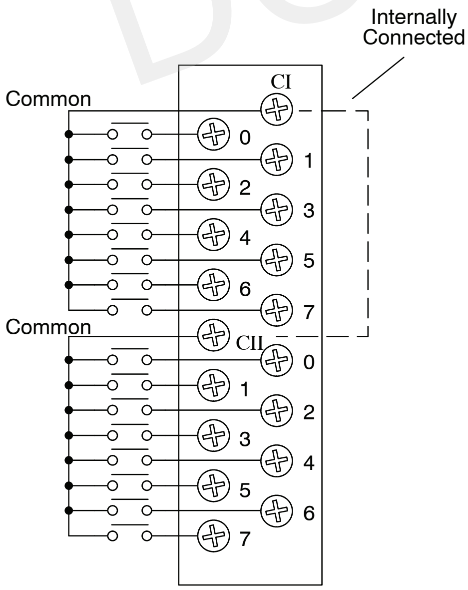
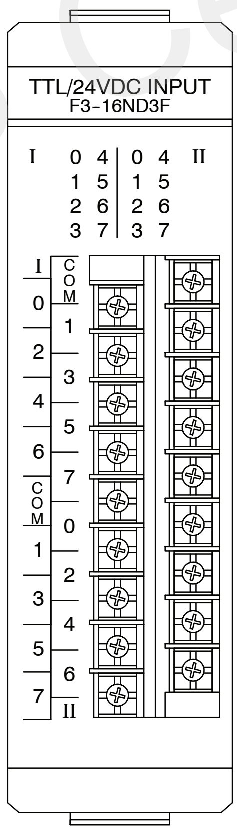
* 12 Inputs are jumper selectable for 5VDC/12-24VDC and Sink Load/Source Load

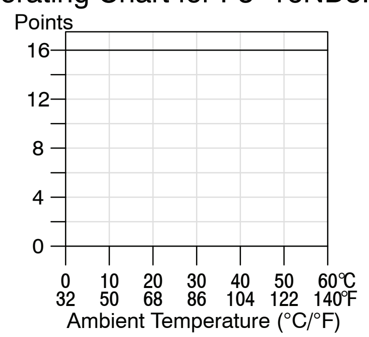
4 Inputs are jumper selectable for 5VDC/12-24VDC and Sink Load/Source Load

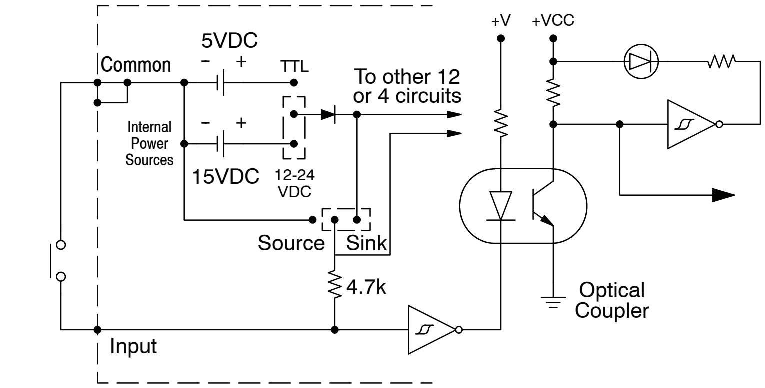


Sinking Load Configuration

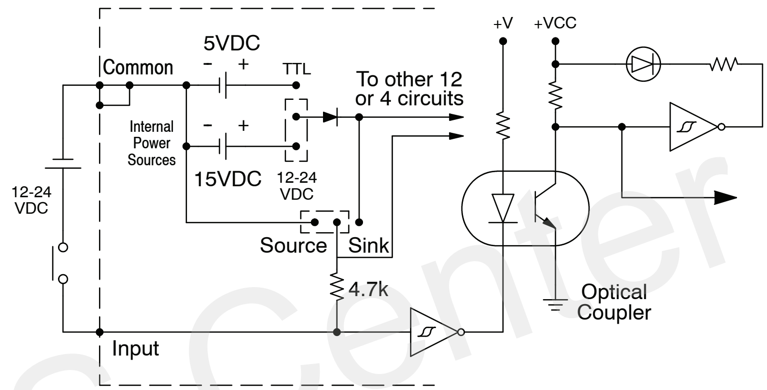


Derating Chart for F3-16ND3F





Jumper selected for 12-24VDC, sinking load configuration



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

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

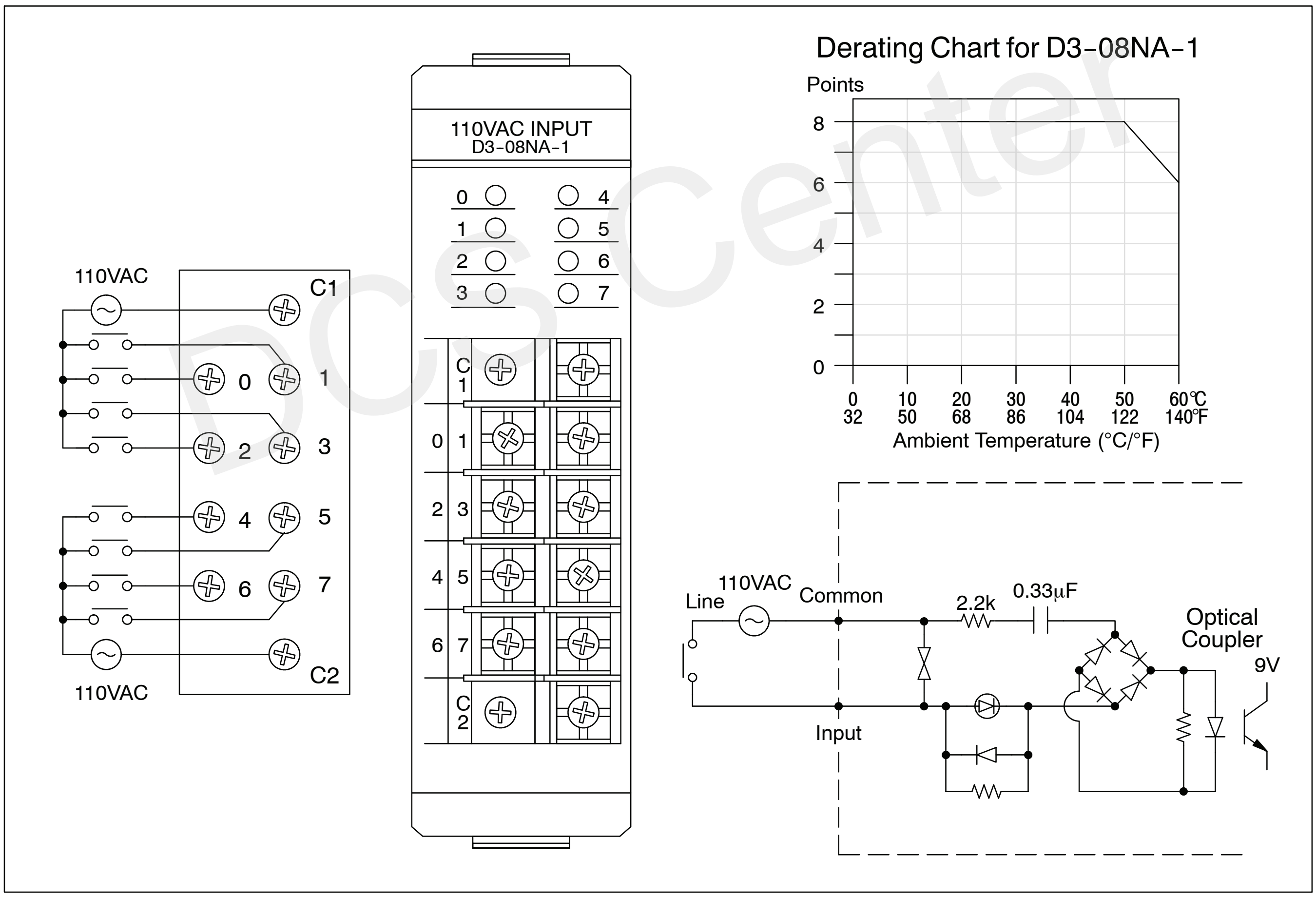
Selection of Operating Mode

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

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

D3–08NA–1, 110 VAC Input Module

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



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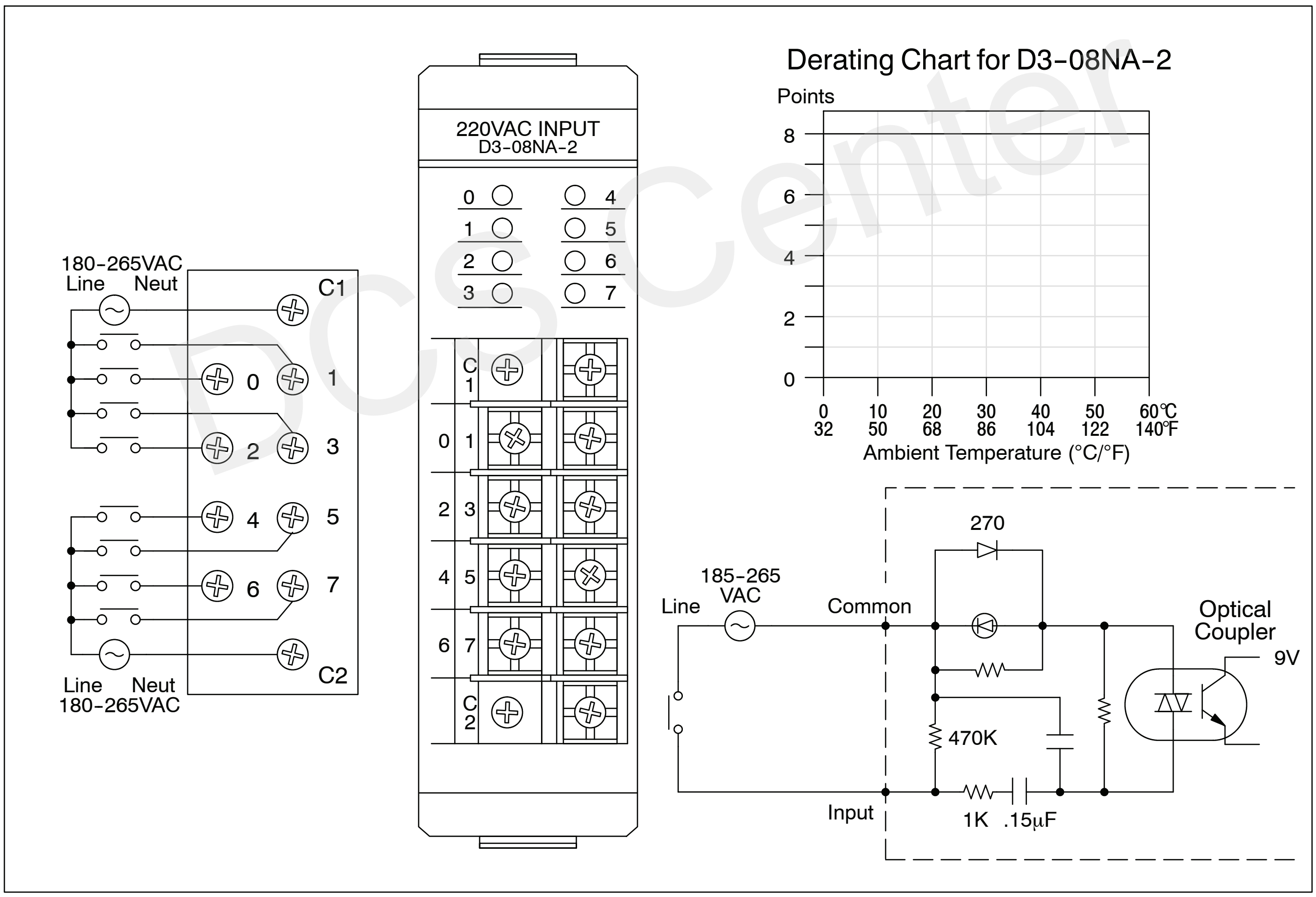
D3–08NA–2, 220 VAC Input Module

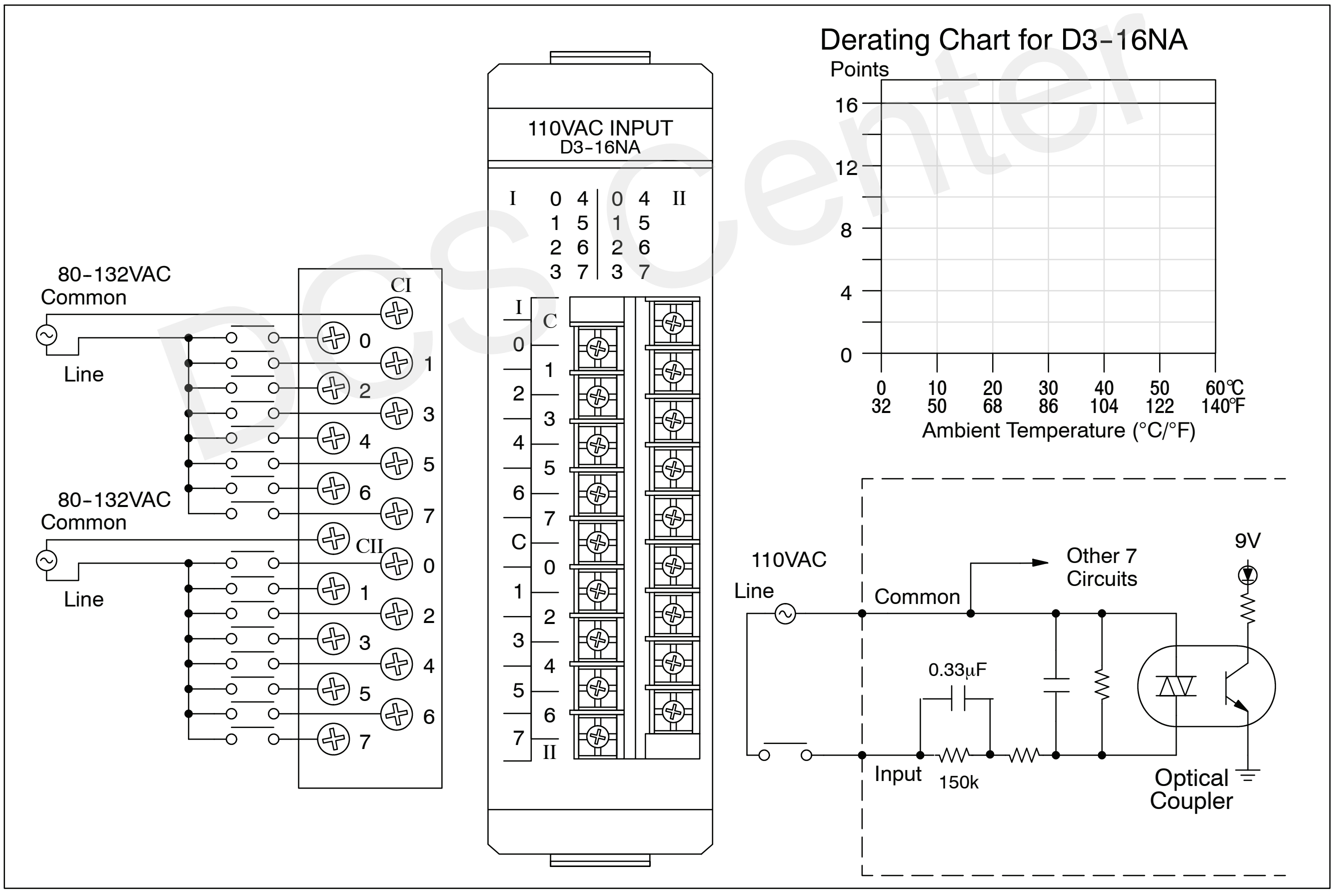
Inputs per module	8	Minimum ON current	10 mA
Commons per module	2 (isolated)	Maximum OFF current	2 mA
Input voltage range	180–265VAC	Base power required	9V 10 mA max 24V N/A
Input voltage supply	External	OFF to ON response	5–50 ms
Peak voltage	265 VAC	ON to OFF response	5–60 ms
AC frequency	50–60Hz	Terminal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



D3–16NA, 110 VAC Input Module

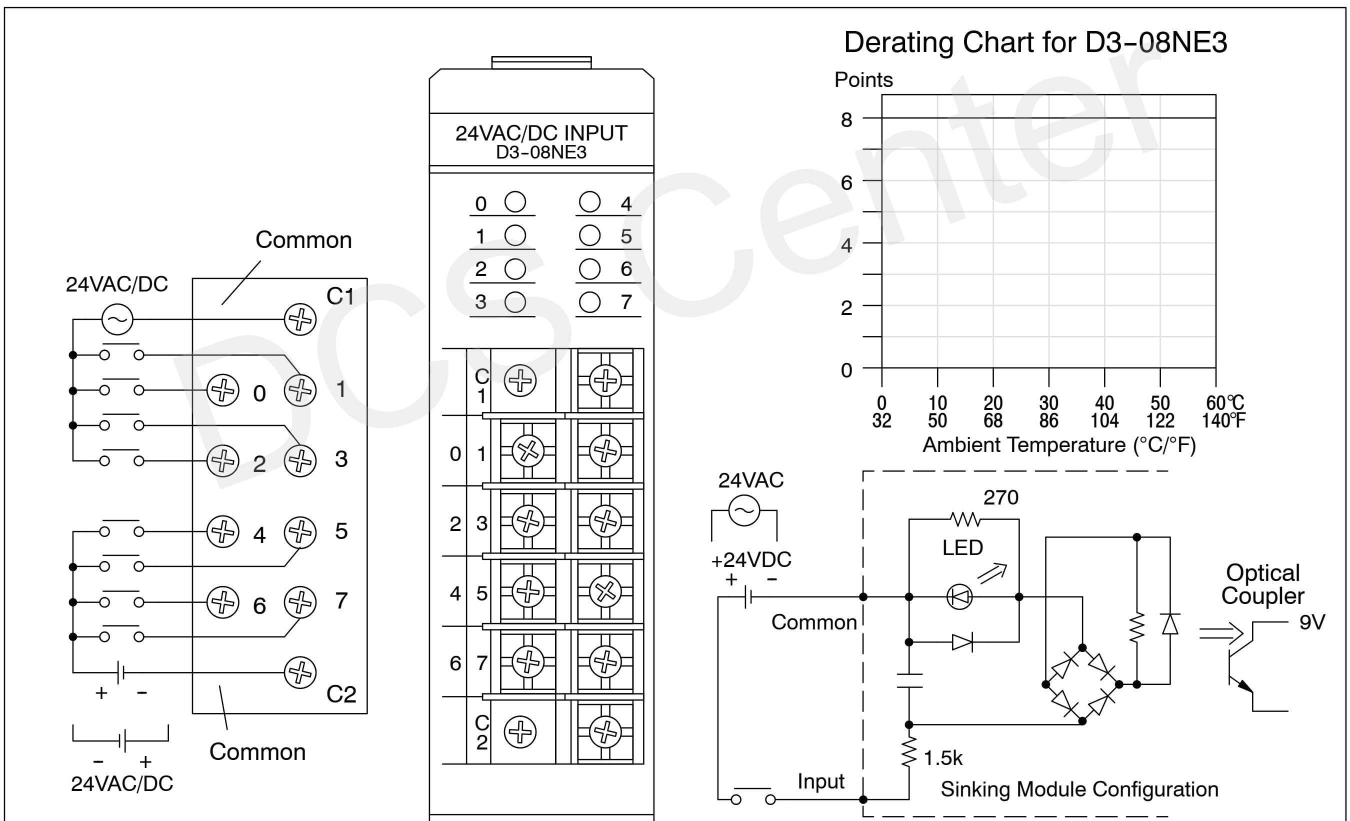
Inputs per module	16	Minimum ON current	8 mA
Commons per module	2 (isolated)	Maximum OFF current	1.5 mA
Input voltage range	80–132VAC	Base power required*	9V 6.25 mA Max/ON pt. 100mA max
Input voltage supply	External		
Peak voltage	132VAC	OFF to ON response	5–50 ms
AC frequency	50–60 Hz	ON to OFF response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

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



D3–08NE3, 24 VAC/DC Input Module

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



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

DCSCenter