# DL405

# Installation and I/O Manual

Manual Number  D4-INST-M

# WARNING

Thank you for purchasing automation equipment from Automationdirect.com. We want your new *Direct*LOGIC™ automation equipment to operate safely. Anyone who installs or uses this equipment should read this publication (and any other relevant publications) before installing or operating the equipment.

To minimize the risk of potential safety problems, you should follow all applicable local and national codes that regulate the installation and operation of your equipment. These codes vary from area to area and usually change with time. It is your responsibility to determine which codes should be followed, and to verify that the equipment, installation, and operation is in compliance with the latest revision of these codes.

At a minimum, you should follow all applicable sections of the National Fire Code, National Electrical Code, and the codes of the National Electrical Manufacturer's Association (NEMA). There may be local regulatory or government offices that can also help determine which codes and standards are necessary for safe installation and operation.

*Equipment damage or serious injury to personnel can result from the failure to follow all applicable codes and standards. We do not guarantee the products described in this publication are suitable for your particular application, nor do we assume any responsibility for your product design, installation, or operation.*

If you have any questions concerning the installation or operation of this equipment, or if you need additional information, please call us at 1–770–844–4200.

This publication is based on information that was available at the time it was printed. At Automationdirect.com, we constantly strive to improve our products and services, so we reserve the right to make changes to the products and/or publications at any time without notice and without any obligation. This publication may also discuss features that may not be available in certain revisions of the product.

# Trademarks

This publication may contain references to products produced and/or offered by other companies. The product and company names may be trademarked and are the sole property of their respective owners.Automationdirect.com disclaims any proprietary interest in the marks and names of others.

Stage is a trademark of Koyo Electronics Industries Co., LTD. Think & Do Software is a trademark of Think & Do Software, Inc. Texas Instruments is a registered trademark of Texas Instruments, Inc. TI, TIWAY, Series 305, Series 405, TI305, and TI405 are trademarks of Texas Instruments, Inc. Siemens and SIMATIC are registered trademarks of Siemens, AG. GE is a registered trademark of General Electric Corporation. Series One is a registered trademark of GE Fanuc Automation North America, Inc. MODBUS is a registered trademark of Gould, Inc. IBM is a registered trademark of International Business Machines. MS-DOS and Microsoft are registered trademarks of Microsoft Corporation. Windows and Windows NT are trademarks of Microsoft Corporation. OPTOMUX and PAMUX are trademarks of OPTO 22.
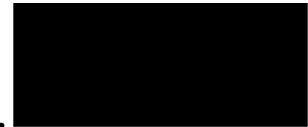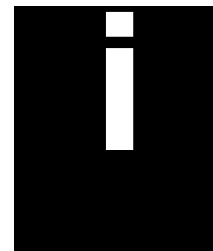
# Manual Revisions

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

**Title:** DL405 Installation and I/O Manual
**Manual Number:** D4–INST–M

| Issue | Date | Effective Pages | Description of Changes |
|---|---|---|---|
| Original | 12/99 | Cover/Copyright<br>Contents<br>1-1 – 1-4<br>2-1 – 2-9<br>3-1 – 3-64 | Original Issue |

# Table of Contents

## Getting Started

## Installation

## I/O Wiring and Specifications

# Getting Started

**1**

# About This Manual

**The Purpose of this Manual**

This manual is written for the user of non-traditional CPU-slot controllers or I/O controllers who are also using our DL405 I/O products. This manual shows you how to install and wire the equipment. It provides specifications for input and output modules. It also helps you understand how to interface these products to other devices in a control system.
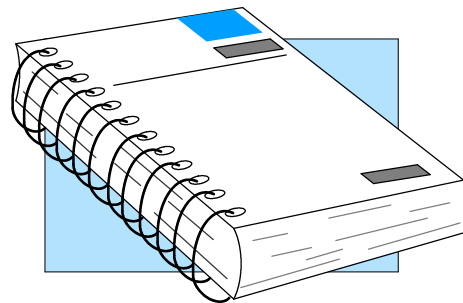
**Supplemental Manuals**

In addition to this manual, you will want to have the appropriate manual for your CPU-slot controller and for the PC-based control software you will be using.

**Technical Support**

We strive to make our manuals the best in the industry. We rely on your feedback to let us know if we are reaching our goal. If you cannot find the solution to your particular application, or, if for any reason you need additional technical assistance, please call us at

**770-844-4200**.

The technical support group is glad to work with you in answering your questions. They are available **weekdays from 9:00 a.m. to 6:00 p.m. Eastern Time**. Please visit our site on the worldwide web where you can find technical and nontechnical information about our products and our company.

**http://www.automationdirect.com**.

If you have a comment or question about any of our products, services, or manuals, please fill out and return the 'Suggestions' card that was shipped with this manual.

| **Key Topics for Each Chapter** | The beginning of each chapter will list the key topics that can be found in that chapter. |
|---|---|
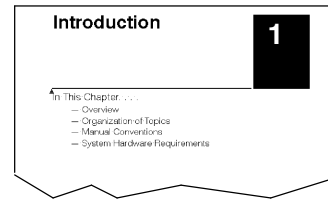
**Chapters**    The main contents of this manual are organized into the following three chapters:
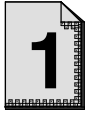
**1**    **Getting Started**    introduces the various components of a DL405 system. Also includes tips on getting started and how to design a successful system.
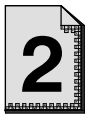
**2**    **Installation and Wiring**    shows how to prepare for system installation, and gives safety guidelines to help protect your personnel and machinery

**3**    **I/O Wiring and Specifications**    Includes system and I/O wiring diagrams, and discrete I/O module specifications.

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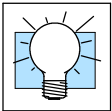
When you see the "light bulb" icon in the left-hand margin, the paragraph to its immediate right will give you a **special tip**.
The word **TIP:** in boldface will mark the beginning of the text.

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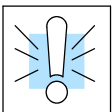
When you see the "exclamation mark" icon in the left-hand margin, the paragraph to its immediate right will be a **warning**. This information could prevent injury, loss of property, or even death (in extreme cases).
The word **WARNING:** in boldface will mark the beginning of the text.

# DL405 System Components

**Bases**          Three base sizes are available in the system: 4 slot, 6 slot and 8 slot.

**I/O Configuration**   The CPU slot controllers can support up to 512 I/O points in an eight slot base with up to three expansion bases.

**I/O Modules**    The DL405 family provides some of the most powerful modules in the industry. There is a complete range of discrete modules which support 24 VDC, 125 VDC, 110/220 VAC and up to 10A relay outputs. Analog modules provide 12 and 16 -bit resolution and several selections of input and output signal ranges (including bipolar).

At this time, only the D4-HSC High Speed Counter Specialty Module is supported; no other intelligent modules are supported.

The controllers available at the time this manual was printed are:

- Ethernet Base Controller
    - H4-EBC
    - H2-EBC-F
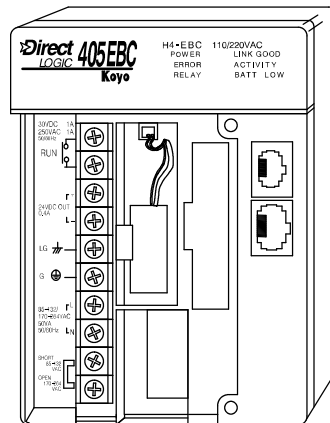


**H4-EBC**
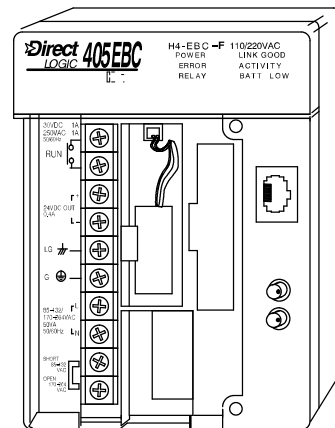
**H4-EBC-F**

# Installation

**2**

---

In This Chapter. . . .

---

# Safety Guidelines

**WARNING:** Providing a safe operating environment for personnel and equipment is your responsibility and should be a 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. Use external electromechanical devices, such as relays or limit switches, that are independent of the DL405 system to provide protection for any part of the system that may cause personal injury or damage.

Every automation application is different, therefore, there may be special requirements for your particular application. Be sure to follow all National, State, and local government requirements for the proper installation and use of your equipment.

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

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

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

**Safety Techniques**
The publications mentioned provide many ideas and requirements for system safety. It is recommended to follow these regulations as a minimum. Using the techniques listed below will further help reduce the risk of safety problems.

- Orderly system shutdown sequence in the control program.
- System power disconnects (guard limits, emergency stop switches, etc.)

**Orderly System Shutdown**

The control program can provide the first level of protection when used to identify machine problems. After analyzing your application, identify any shutdown sequences that must be performed. Typical problems include part jams, empty bins, etc. that do not pose a risk of personal injury or equipment damage.

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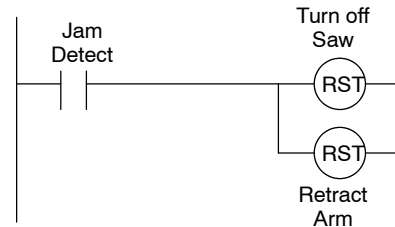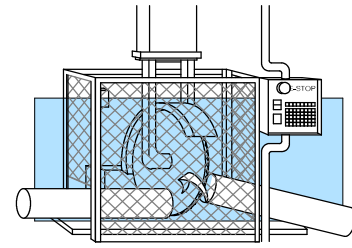
**System Power Disconnect**

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

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

The machine operator must also have a quick and easy method of manually disconnecting *all* system power. This is accomplished with a mechanical device that is clearly labeled as an **Emergency Stop** switch.
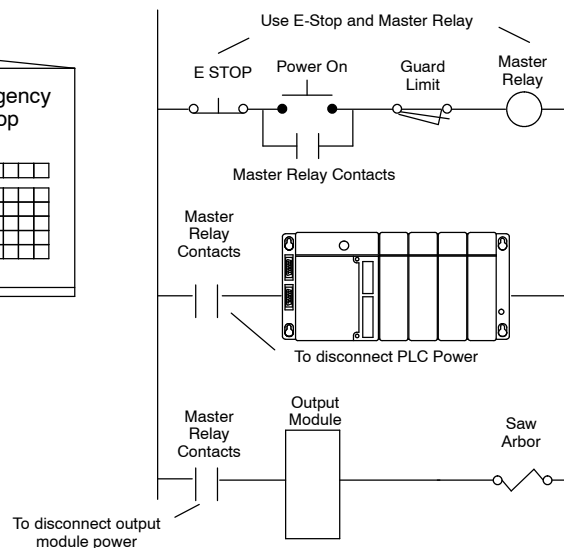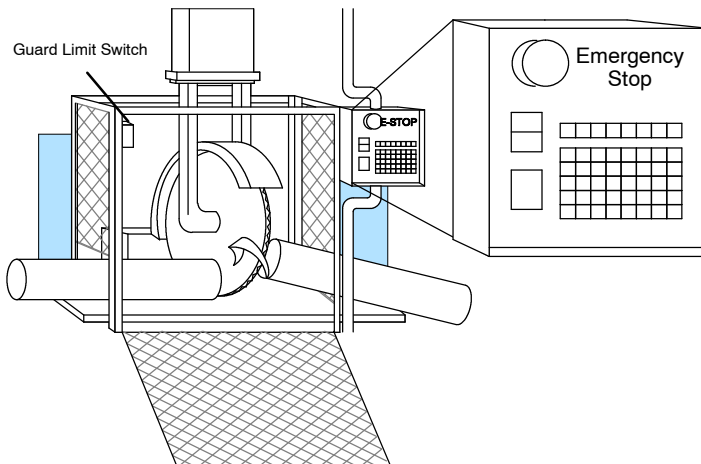
After an Emergency shutdown or any other type of power interruption, there may be requirements that must be met before the control program can be restarted. For example, there may be specific register values that must be established (or maintained from the state prior to the shutdown) before operations can resume. In this case, you may want to use retentive memory locations, or include constants in the control program to ensure a known starting point.

# Mounting Guidelines

In addition to the panel layout guidelines, other specifications can affect the installation of a DL405 system. Always consider the following:

- Environmental specifications
- Power supply specifications
- Regulatory Agency Approvals
- Enclosure Selection and Component Dimensions

**Base Dimensions**    The following diagram shows the outside dimensions and mounting hole locations for the 4-slot, 6-slot, and 8-slot bases. Make sure you follow the installation guidelines to allow proper spacing from other components.

4.312"
110mm

1.37"
34.8mm

**Controller**

**Module**
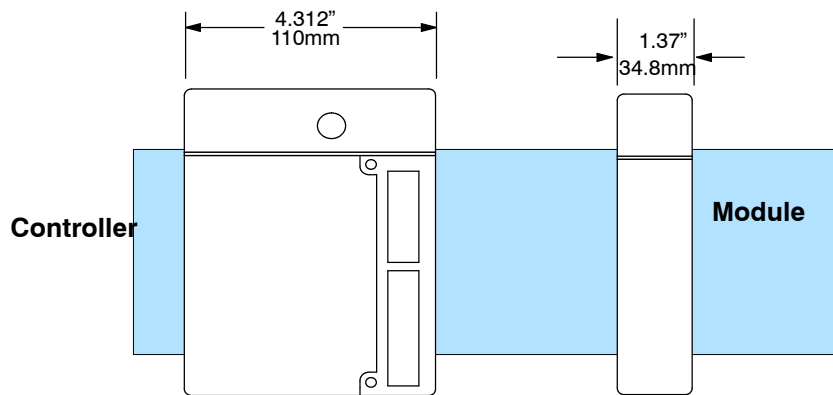
4 holes, clearance for M4 screw

**4 Slot Base**

**6 Slot Base**

0.47"
12 mm

11.54"
293mm

10.83"
275mm

14.45"
367mm

13.74"
349mm

5.91"
150mm

4.69"
119mm

0.75"
19 mm

**8 Slot Base**

0.28"
7 mm

Mounting hole close-up

0.47"
12 mm

17.36"
441mm

16.65"
423mm

5.91"
150mm

4.69"
119mm
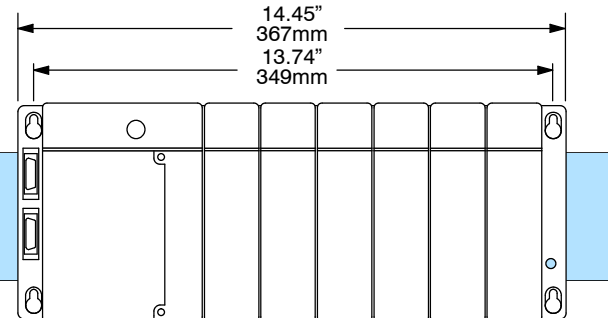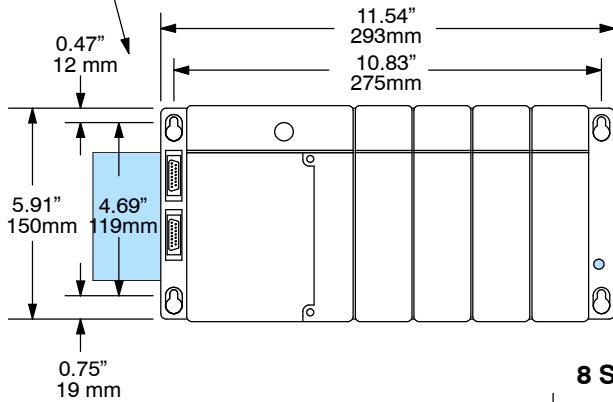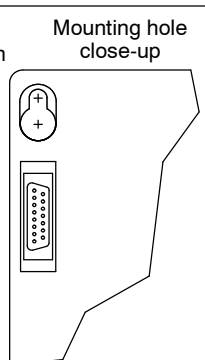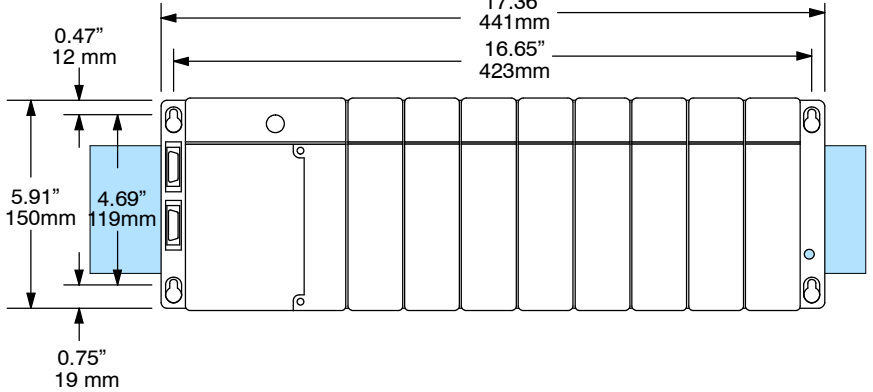
Base mounting dimensions given to upper (fully seated) location

0.75"
19 mm

## Panel Layout & Clearances

There are many things to consider when designing the panel layout. The following items correspond to the diagram shown. Note: there may be additional requirements, depending on your application and use of other components in the cabinet.

1.  The bases must be mounted horizontally to provide proper ventilation.
2.  There should be a minimum of 7.2" (183mm) and a maximum of 13.75" (350mm) between bases.
3.  A minimum clearance of 2" (50mm) between the base and the top, bottom and right side of the cabinet should be provided.
4.  A minimum clearance of 3" (75mm) between the base and the left side of the cabinet should be provided.
5.  There must be a minimum of 2" clearance between the panel door and the nearest DL405 component.
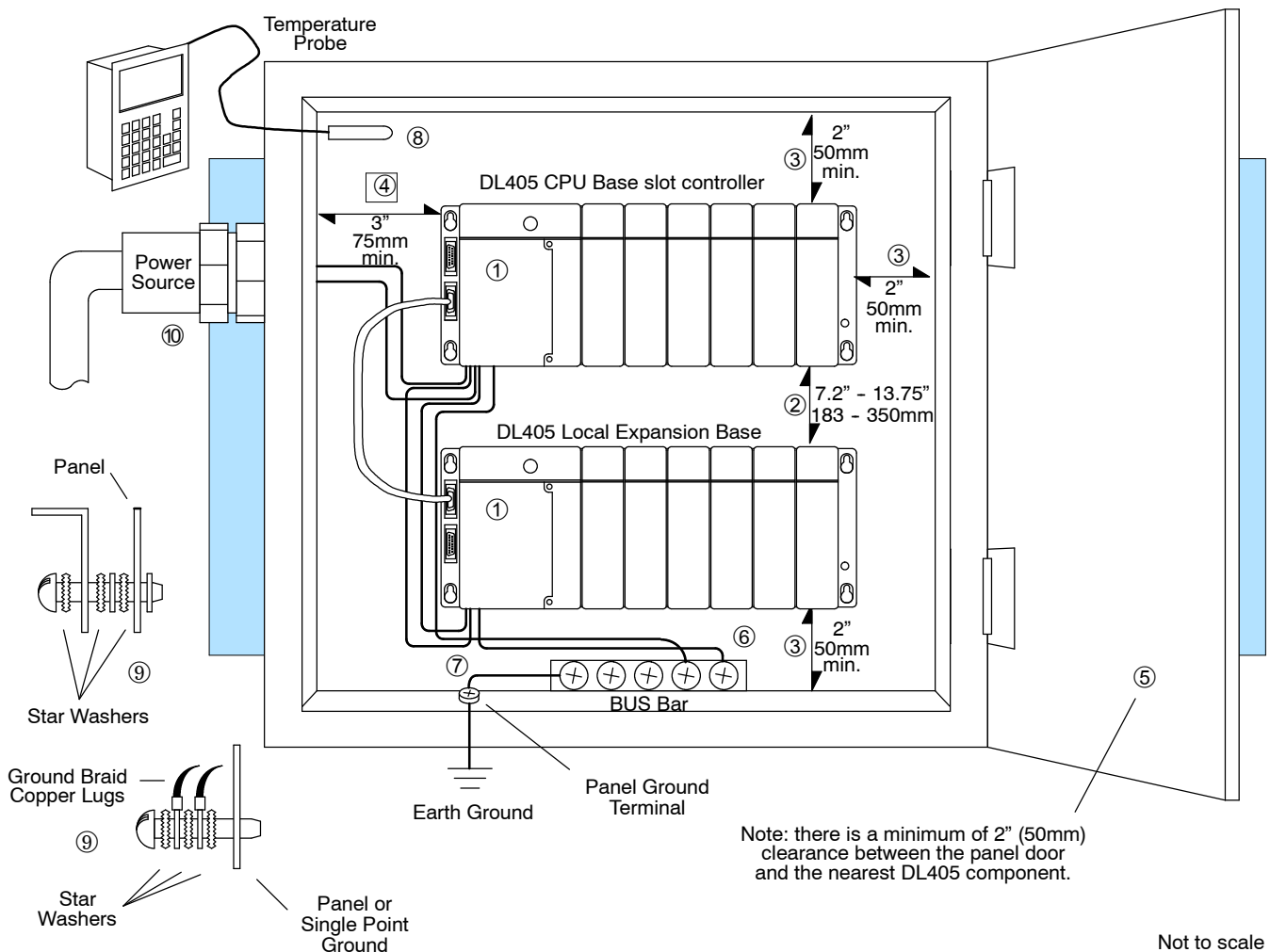


6.  Connect the ground terminal on the DL405 base to a single point ground. Use copper stranded wire to achieve a low impedance. Copper eye lugs should be crimped and soldered to the ends of the stranded wire to ensure good surface contact. Remove anodized finishes and use copper lugs and star washers at termination points. A rule of thumb is to achieve 0.1 ohm of DC resistance between the DL405 base and the single point ground.

7. 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 area.

   A good common ground reference (Earth ground) is essential for proper operation of the DL405, which include:

   a) Installing a ground rod as close to the panel as possible.
   b) Connection to incoming power system ground.

8. Installations where the ambient temperature may approach the lower or upper limits of the specifications should be evaluated properly. To do this 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 DL405 system, measures such as installing a cooling/heating source must be taken to get the ambient temperature within the DL405 operating specifications.

9. 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.

10. The DL405 system is designed to be powered by 110/220 VAC 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 DL405 system. Applications of DL405 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, cooling, and maintenance

**Agency Approvals**

Some applications require agency approvals. The DL405 agency approvals for which DL405 products are submitted are;

- UL (Underwriters' Laboratories, Inc.)
- CE EMC (Electromagnetic Compatibility)
- CUL (Canadian Underwriters' Laboratories)

A complete listing of agency approvals for each product in the DL405 family is available in the sales catalog, or you may call 1–770–844–4200.

2-7

**Environmental Specifications**

The following table lists the environmental specifications that generally apply to the DL405 system (Slot Controller, Expansion Unit, Bases, I/O Modules). 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 140° F (0° C to 60° 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 |

**Power**

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

| Specifications | |
|---|---|
| Voltage withstand (dielectric strength) | 1 min. @ 1500 VAC between primary, secondary, field ground and run relay |
| Insulation resistance | > 10Mο at 500 VDC |
| Input voltage range H4–EBC (–F)/ D4–EX | 85–132 VAC (110 range) / 170–264 VAC (220 range) |
| Input voltage range D4–EXDC | 20–29 VDC (24VDC) less than 10% ripple |
| Input voltage range D4–EXDC–2 | 90–146 VDC (125 VDC) less than 10% ripple |
| Maximum inrush current H4–EBC (F) / D4–440 / D4–EX | 20A |
| Maximum inrush current D4–EXDC | 10A |
| Maximum inrush current D4–EXDC–2 | 20A |
| Maximum power H4–EBC (F)/D4–EX | 50VA |
| Maximum power D4–EXDC | 38W |
| Maximum power D4–EXDC–2 | 30W |
| 24VDC Auxiliary Power Supply H4–EBC (F)/D4–EX | 20–28 VDC @ 0.4A maximum, ripple > 1V p-p |

# Installing DL405 Bases

**Three Sizes of Bases**

All I/O configurations of the DL405 will use a selection of either 4, 6 or 8 slot base(s). Local and expansion bases can be 4, 6, or 8-slot in size. Local and expansion bases differ only in how they are wired in a system.

Expansion cable input connection

**Local Base**

Expansion cable output connection

Expansion cable

8 slot base

**Expansion Bases**

Expansion Power Supplies

6 slot base

4 slot base

**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.

**Mounting the Base**

The CPU slot controller/Expansion Unit must always be installed in the left-most slot in a base. This slot is marked on the base as P/S, CPU. The I/O modules can be installed in any remaining slots. It is not necessary for all slots to be filled for your system to work correctly. You may use filler modules to fill the empty slots in the base.

The base is secured to the equipment panel or machine using four M4 screws in the corner locations shown to the right. The mounting cut-outs allow removal of the base after installation, without completely removing the mounting screws. Full mounting template dimensions are given in the previous section on Mounting Guidelines.

Mounting hole close-up

Base mounting holes, 4 locations
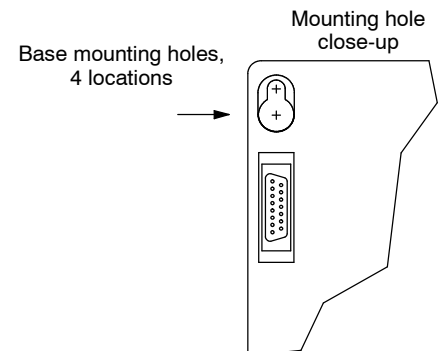
**Installing Components in the Base**

1. Note the components have plastic tabs at the bottom and a screw at the top.

2. With the device tilted slightly forward, hook the plastic tabs into the notch on the base.

3. Then gently push the top of the component back toward the base until it is firmly installed into the base.

4.  Now tighten the screw at the top of the device to secure it to the base.
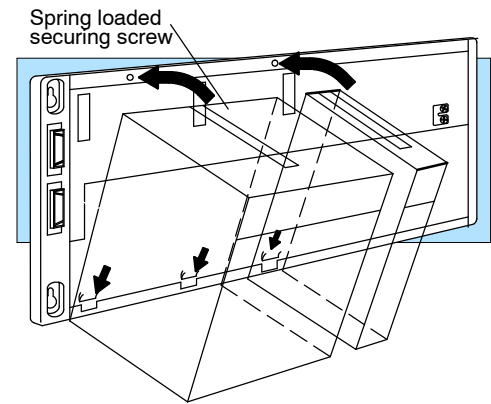
Spring loaded securing screw

**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.**

**Base Wiring**

The main power terminal connections are under the front covers of the controllers. Please refer to the applicable User manual for the base wiring guidelines.

# I/O Wiring and Specifications

**3**

In This Chapter. . . .

# I/O Wiring Strategies

The DL405 system is very flexible and will work in many different wiring configurations. By studying this section before actual installation, you should find the best wiring strategy for your application . This will help to lower system cost, wiring errors, and avoid safety problems.

**DL405 System Isolation Boundaries**

DL405 system 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 that 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 DL405 system, it is extremely important to avoid making external connections that connect logic side circuits to any other.*
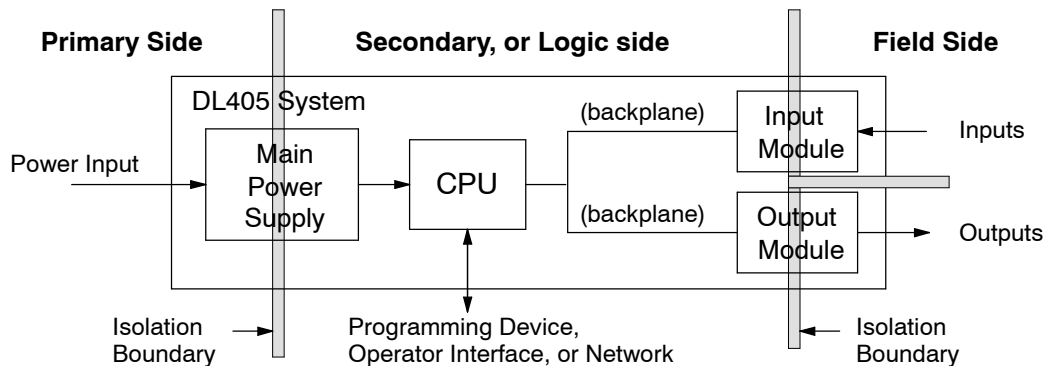


The next figure shows the physical layout of a DL405 system, as viewed from the front. In addition to the basic circuits covered above, AC-powered units include an auxiliary +24VDC power supply with its own isolation boundary. Since the supply output is isolated from the other three circuits, it can power input and/or output circuits!
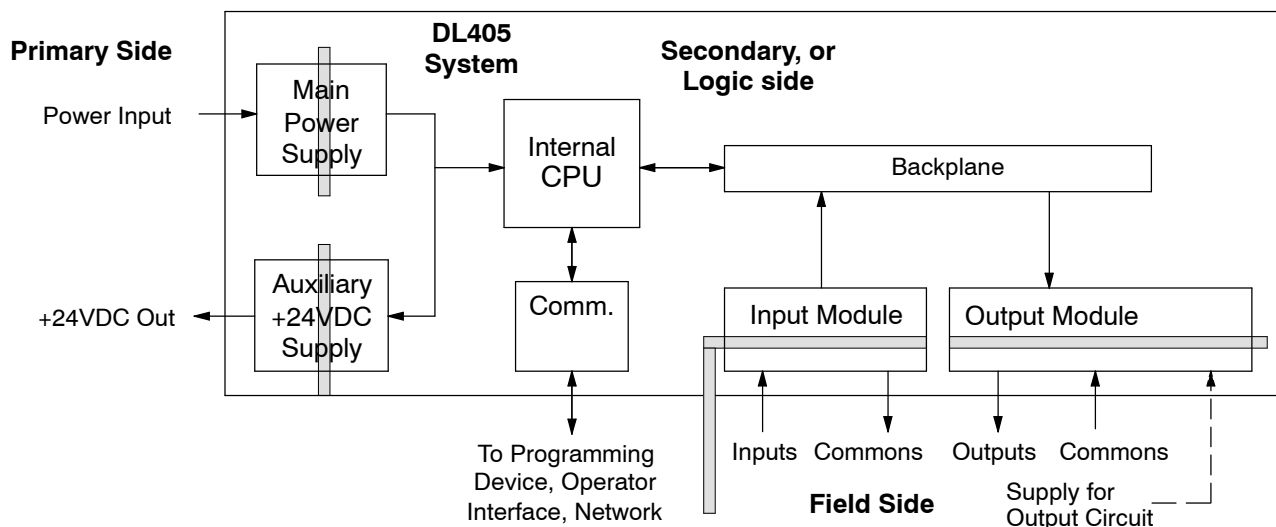
In some cases, using the built-in auxiliary +24VDC supply can result in a cost savings for your control system. It can power combined loads up to 400 mA. Be careful not to exceed the current rating of the supply. If you are the system designer for your application, you may be able to select and design in field devices which can use the +24VDC auxiliary supply.

**Powering I/O Circuits 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 DL405 system, 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 system supply, then a separate supply must be used as shown to the right in the figure below.
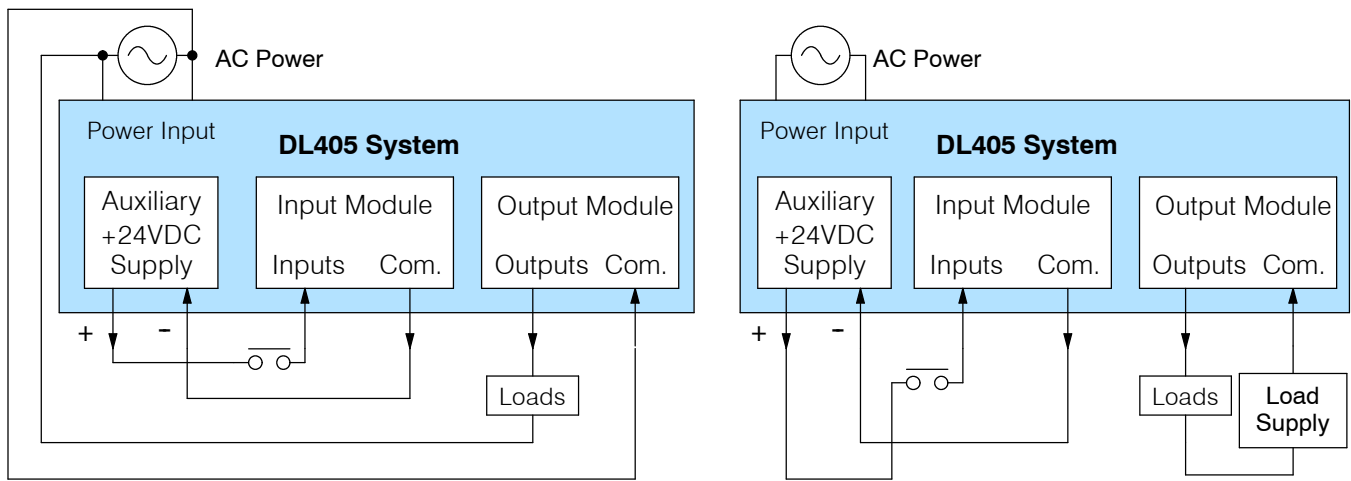
A worst-case scenario, from a cost and complexity view-point, is an application which requires separate power sources for the DL405 system, input devices, and output loads. The example wiring diagram below on the right shows how this can work, but also that the auxiliary supply output is an unused resource.
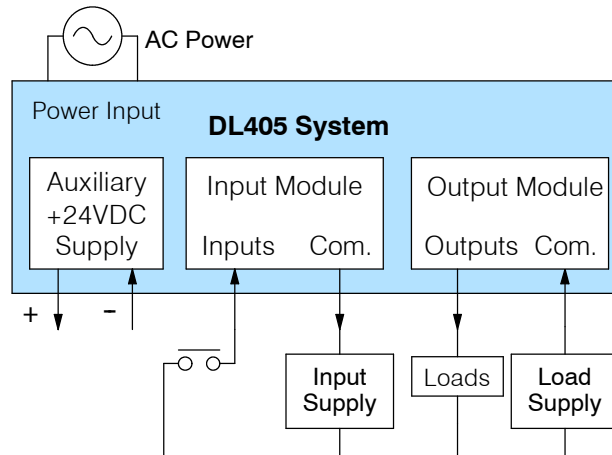
**Sinking / Sourcing Concepts**

This next section helps to provide 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 success in installation.

<div align="center">

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

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

</div>

*Sinking and sourcing terminology only applies to DC input and output circuits* because of the reference to (+) and (–) polarities. 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 illustrates a "sinking" input. To properly connect the external supply, we just have to connect it so the input *provides a path to ground (-)*. Start at the DL405 system 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, we have completed the circuit. Current flows in the direction of the arrow when the switch is closed.
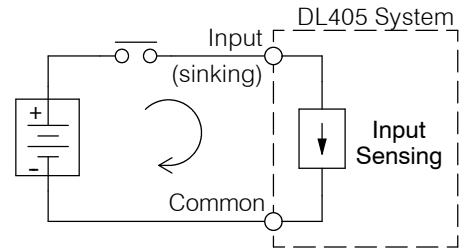


By applying the circuit principle above to the four possible combinations of input/output sinking/sourcing types, you have the four circuits as shown below. The I/O module specifications at the end of this chapter list the input or output type.
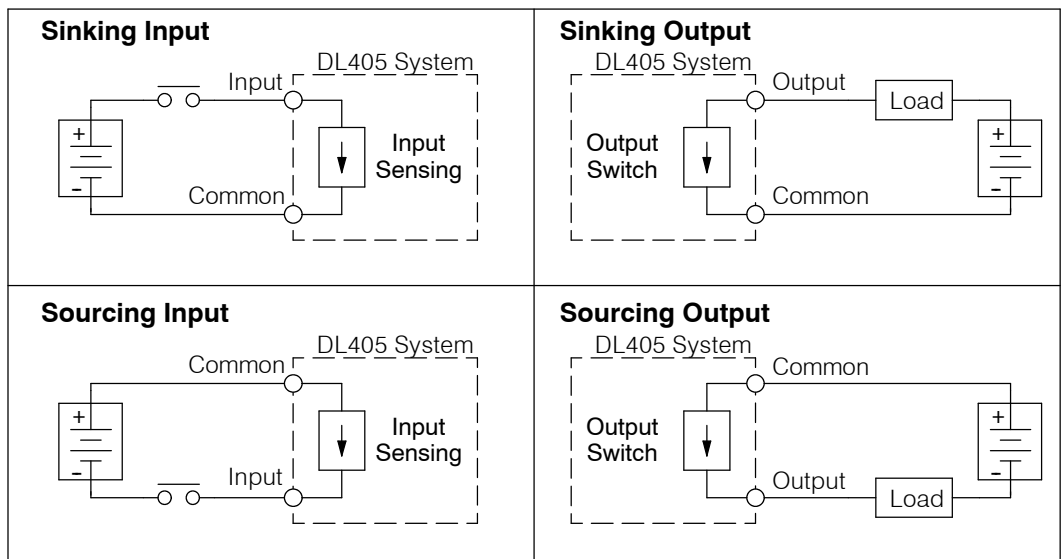
**I/O "Common" Terminal Concepts**

In order for an I/O circuit to operate, current must enter at one terminal and exit at another. This means 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.
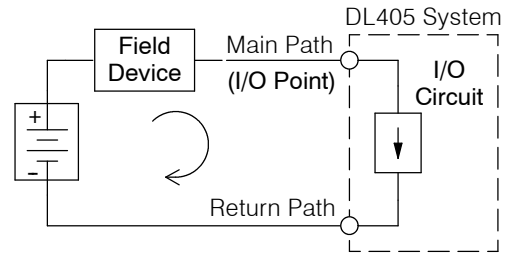
If there was unlimited space and budget for I/O terminals, then every I/O point could have two dedicated terminals as the figure above shows. However, providing this level of flexibility is not practical or even necessary for most applications. Most Input or Output points are in groups which share the 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.
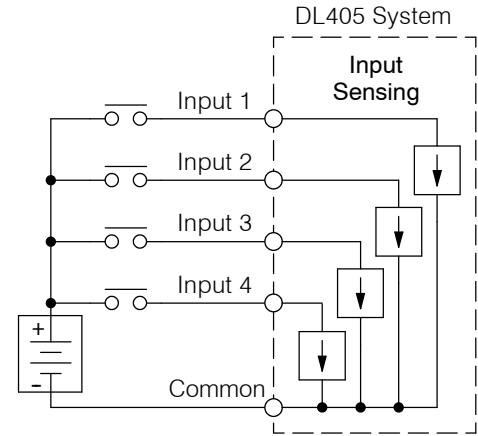
**NOTE:** In the circuit above, the current in the common path is 4 times any channel's input current when all inputs are energized. This is important in output circuits where heavier gauge wire is sometimes necessary on commons.

Most DL405 input and output modules group their I/O points into banks that share a common return path. The best indication of I/O common grouping is on the wiring label, such as the one shown to the right. The miniature schematic shows two circuit banks with eight input points in each. The common terminal for each is labeled "CA" and "CB", respectively.

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

AC supply     DC supply     AC or DC supply

Input Switch     Output Load
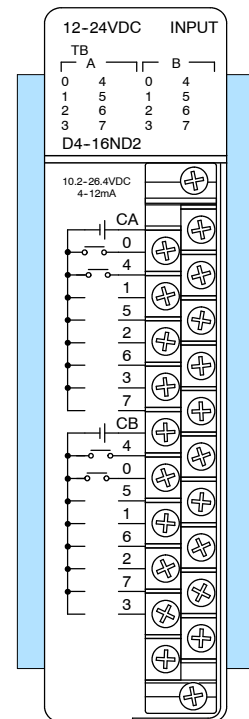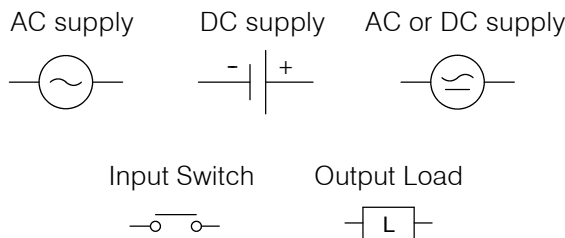
**Connecting DC I/O to "Solid State" Field Devices**

In the previous section on Sourcing and Sinking concepts, we explained that DC I/O circuits 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 DL405 DC input modules are flexible in that 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 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.

Field Device | DL405 System DC Input

Output (sinking) — Input (sourcing)

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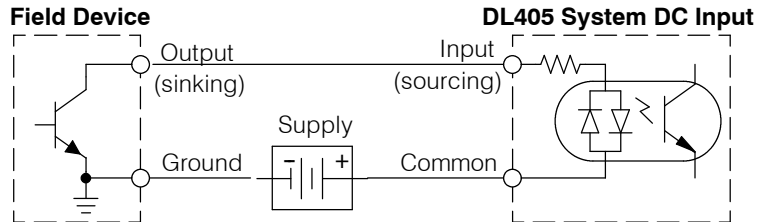
In the next circuit, a field device has an open-emitter PNP transistor output. It sources current to the input point, which sinks the current back to ground. Since the field device is sourcing current, no additional power supply is required.

Field Device

DL405 System DC Input

+V

Output (sourcing) — Input (sinking)

Ground — Common
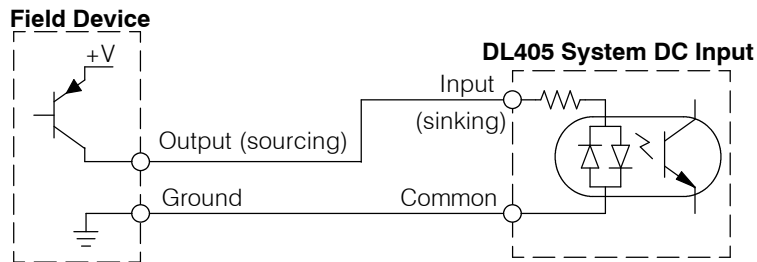
**Solid State Output Loads**

Sometimes an application requires connecting an 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 DL405 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 output point sinks current to the output common when energized. It is connected to a sourcing input of a field device input.

DL405 System DC Sinking Output | Field Device

+DC pwr — Power

Output (sinking) — Input (sourcing) — +V

Common — 10–30 VDC — Ground
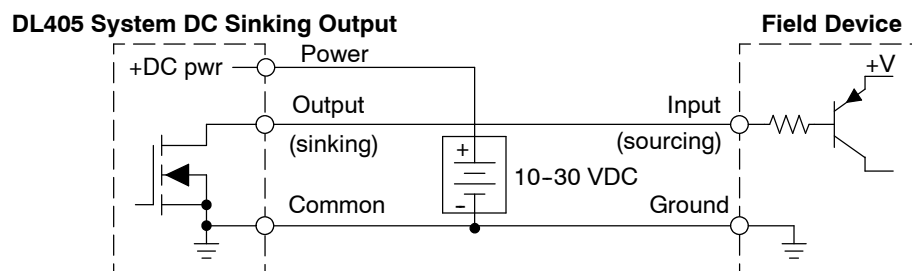
In the next example a sinking DC output point is connected to the sinking input of a field device. This is different, because both the DL405 system output and field device input are sinking type. Since the circuit must have one sourcing and one sinking device, a sourcing capability is added to the system output by using a pull-up resistor. In the circuit below, connect $R_{pull-up}$ from the output to the DC output circuit power input.

**DL405 System DC Output**
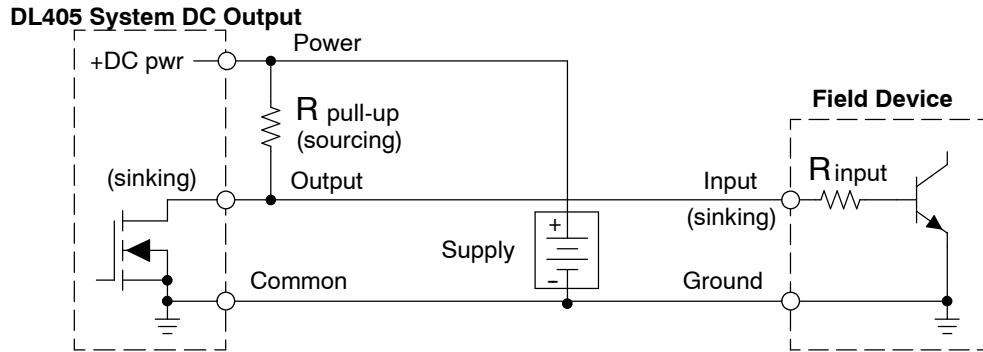


**NOTE 1:** DO NOT attempt to drive a heavy load (>25 mA) with this pull-up method
**NOTE 2:** Using the pull-up resistor to implement a sourcing output has the effect of inverting the output point logic. In other words, the field device input is energized when the DL405 system output is OFF, from a 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 $R_{pull-up}$. In order to do so, the nominal input current to the field device ($I_{input}$) when the input is energized needs to be identified. 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 $R_{pull-up}$. Next calculate the power $P_{pull-up}$ (in watts), in order to size $R_{pull-up}$ properly.

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

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

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.

**DL405 System DC Sourcing Output**

Specifications
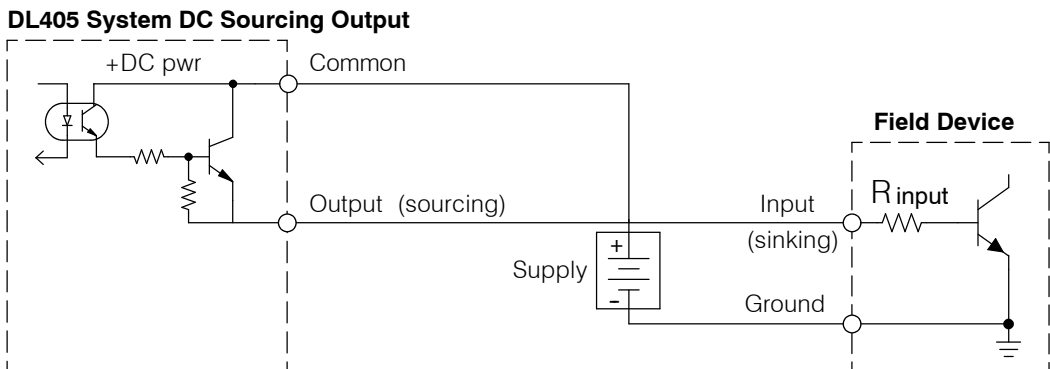
**Relay Output Guidelines**

Four output modules in the DL405 I/O family feature relay outputs: D4–08TR, F4–08TRS–1, F4–08TRS–2, D4–16TR. 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 DL405 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**
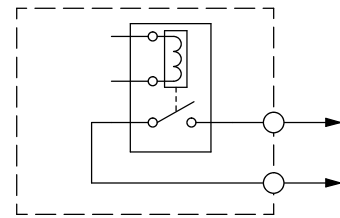


**Relay with Form C contacts**
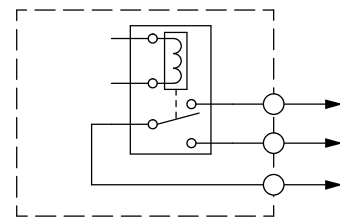


**Prolonging Relay Contact Life**

Relay contacts wear according to the amount of relay switching, amount of spark created at the time of open or closure, and presence of airborne contaminants. However, there are some steps you can take to help prolong the life of relay contacts:

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

**DL405 Relay Output**                                                              **Inductive Field Device**
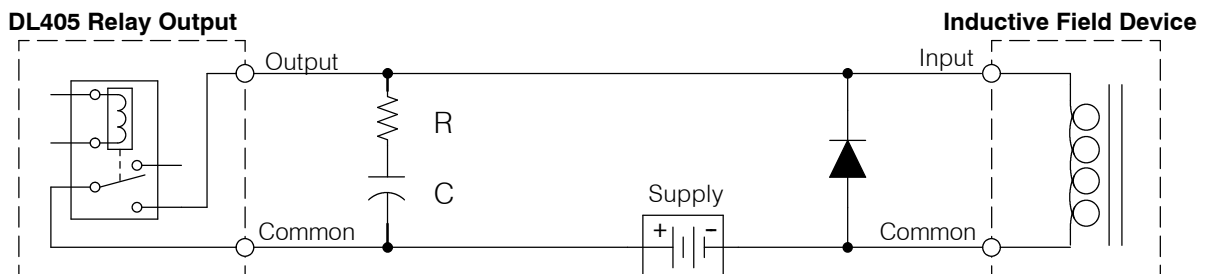
Adding external contact protection may extend relay life beyond the number of contact cycles listed in the specification tables for relay modules. High current inductive loads such as clutches, brakes, motors, direct-acting solenoid valves, and motor starters will benefit the most from external contact 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:

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

C minimum = 0.001 µF, the voltage rating of C must be    V, non-polarized
R minimum = 0.5 O, 1/2 W, tolerance is    5%

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

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

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

Now, finding the values of R and C:

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

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

$$x = 1 + \frac{50}{169.7} = 1.29 \qquad R\ (O) = \frac{169.7}{10 \times 0.707^{1.29}} = 16 \text{ O, } 1/2 \text{ W,} \quad 5\%$$

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 just 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 Module Wiring and Specifications

**Module Placement**   Before wiring the I/O modules in your system to field devices, it's very important to make sure each I/O module is in the right slot and base in the system. Costly wiring errors may be avoided by doing the following:
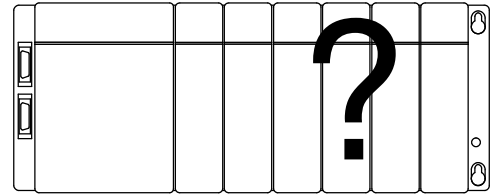
- Perform the power budget calculations for each base to verify the base power supply can power all the modules in the base.
- Whenever possible, keep modules with high voltage and current wiring away from sensitive analog modules.

**NOTE:** Please refer to the applicable Base Controller User manual for the power budget requirements and worksheets.

**I/O Module Status Indicators**   The diagram below shows the status indicator location for common I/O modules.



Status indicators

Display status (selects a group of signals to be displayed)

Loose terminal block indicator

Blown fuse (non-replaceable) indicator (Output modules only)

Wire tray
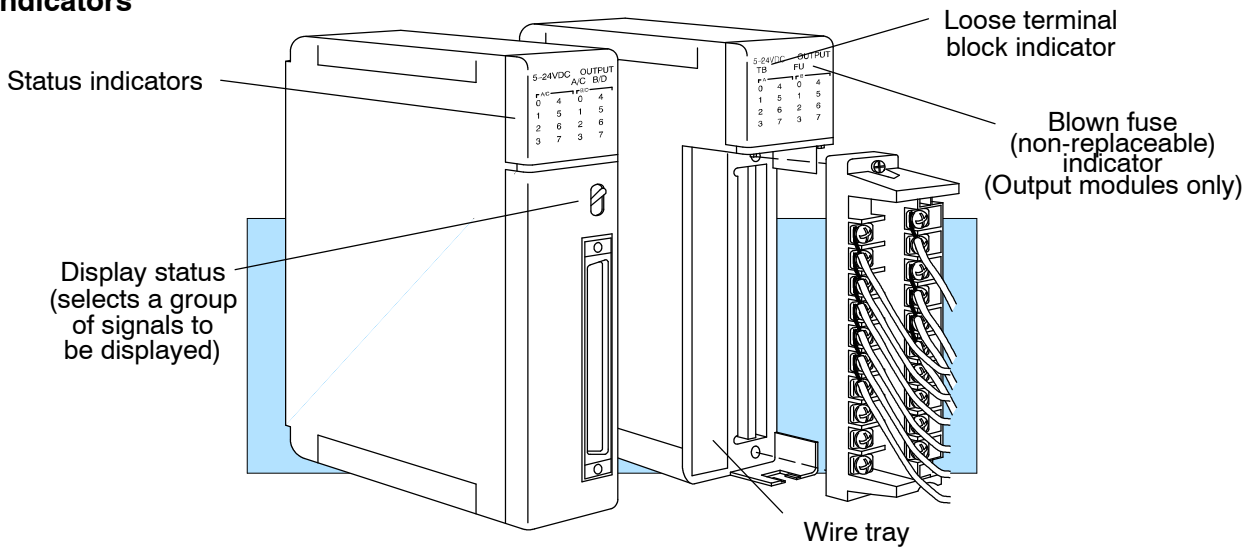
**Color Coding of I/O Modules**   The DL405 family of I/O modules have a color-coded stripe on the front bezel to help identify whether the module type is input, output, or special module. The color code description is listed below:

Color Bar

| Module Type | Color Code |
|---|---|
| Discrete/Analog Output | Red |
| Discrete/Analog Input | Blue |
| Other | White |
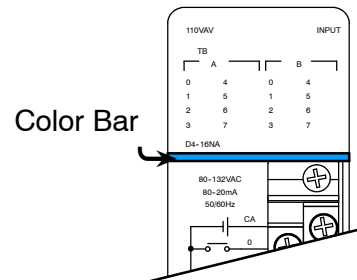
**Wiring a Module with a Terminal Block**

You must first remove the front cover of the module prior to wiring. To remove the cover depress the bottom tab of the cover and tilt the cover up to loosen from the module.

All DL405 I/O module terminal blocks are removable for your convenience. To remove the terminal block loosen the retaining screws and and lift the terminal block away from the module. When you return the terminal block to the module make sure the terminal block is tightly seated. Be sure to tighten the retaining screws. You should also verify the loose terminal block LED is off when system power is applied.

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



Loose terminal block LED indicator

Retaining screw

Retaining screw

Terminal screws

Push tab and lift to remove

I/O module wiring tray
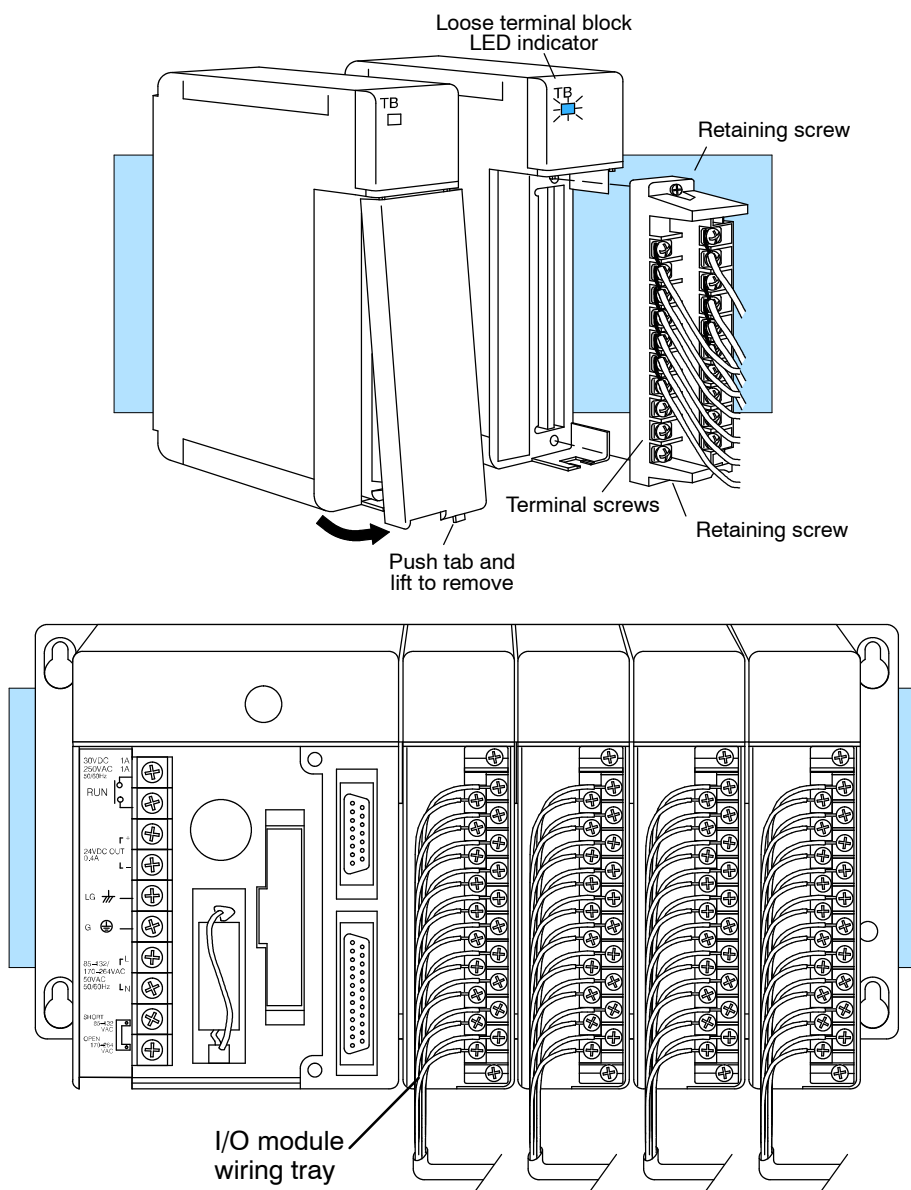
**Wiring a Module using a Ribbon Cable/Solder Type Connector**

The 32 point and 64 point modules use a different style of connector due to the increased number of I/O points. There are two types of connectors used with the higher density modules. One is a D-shell connector, which requires soldering. The other is a ribbon cable type of connector which simply crimps onto a ribbon cable.

For the 64 point modules, you must either use ribbon cable connectors, or special solder type connectors designed specifically for the 64 point modules. Order part number D4–IO3264S, which includes 2 solder-type connectors in the pack, or order D4–IO32R, which contains 2 ribbon cable type connectors in the pack.

**NOTE:** For another alternative wiring solution, consider using Automationdirect.com's *ZIP*Link Connection systems. The *ZIP*link cables plug directly into a Automationdirect.com I/O module. The opposite end is connected to a *ZIP*link connector module. Please refer to our catalog for more information on these products.



32 pt. Module

D-sub type connector

OR

64pt. Module

Ribbon connector

Ribbon cable

Terminal block
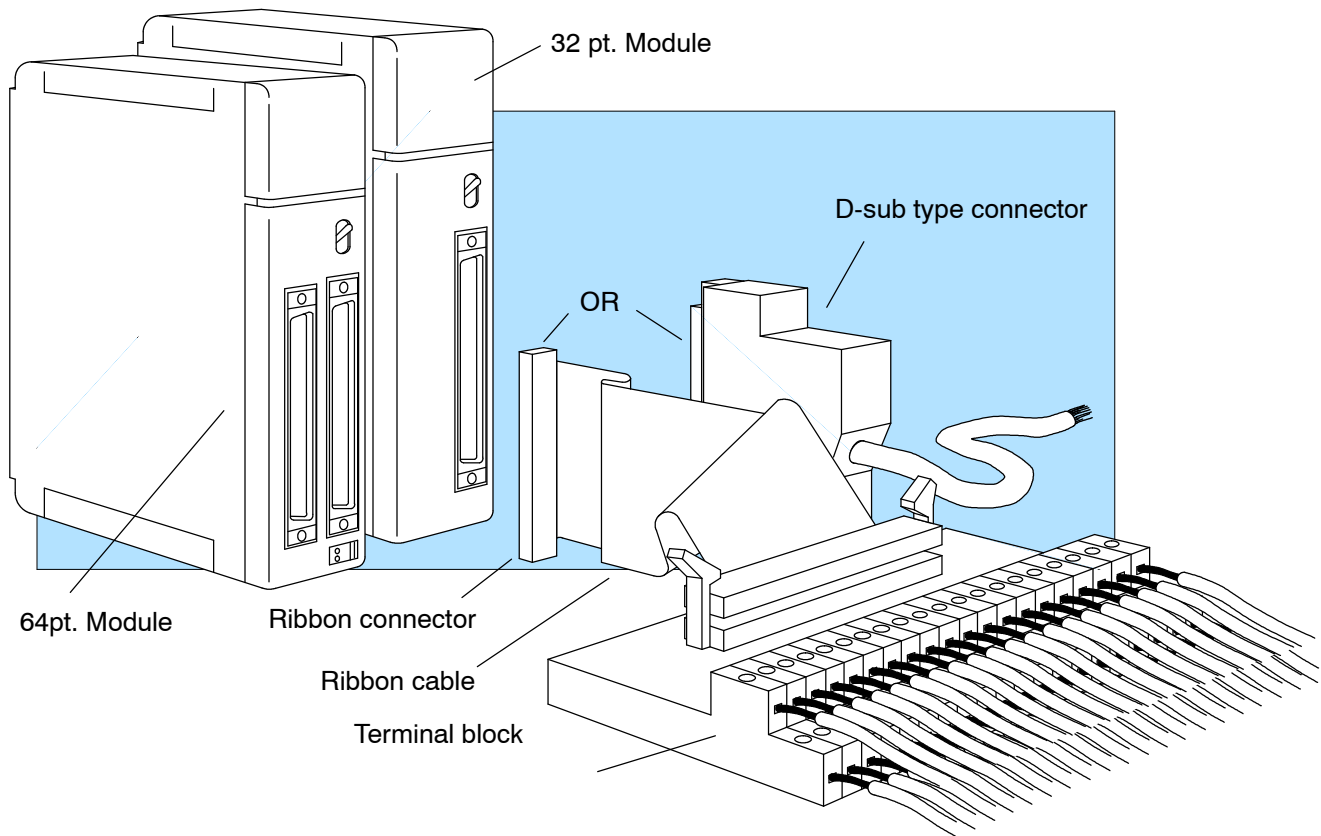
**Part Numbers for Module Connectors**

Both types of connectors are available from Automationdirect.com. These same connectors are also available from other Fujitsu Microelectronics, Inc. Use the following part numbers to order these connectors.

Automationdirect.com Part Numbers

- D4-IO3264R — Ribbon cable connectors, 2 in a pack. Can be used on either 32 point or 64 point modules.

- D4-IO3264S — Solder type connector, 2 in a pack. Can be used on either 32 point or 64 point modules.

Fujitsu Part Numbers

For connectors made by Fujitsu, you may contact Fijitsu at the following address:

Fujitsu Microelectronics, Inc.
Electronic Components Division
3545 North First Street
San Jose, CA 95134-1804 USA
408-922-9000

- FCN-367J040-AU/F, or -AG/F — 32 / 64 point ribbon cable connector
- FCN-361J040-AU, or -AG — 32 / 64 point solder type connector

(AU connectors use gold over palladium plating. AG connectors use silver plating.)

**Vendors For the Parts Used in the Terminal Block Configuration**

If you wish to use a terminal block with your 32 or 64 point module, here is a partial list of vendors who can provide the parts you will need to build the configuration shown earlier consisting of a ribbon cable, a ribbon cable connector and a terminal block.

| Vendors | |
|---|---|
| 3M Electronic Products Division<br>6801 River Place Blvd.<br>Austin, TX 78726-9000<br>800-225-5373 | DuPont Connector Systems<br>Barley Mill Plaza<br>Wilmington, DE 19898-0019<br>800-237-2374 |
| Augat/RDI<br>525 Randy Rd.<br>Carol Stream, IL 60188<br>708-682-4100 | Phoenix Contacts Products<br>P.O. Box 4100<br>Harrisburg, PA 17111-0100<br>717-944-1300 |
| AMP Incorporated<br>P.O. Box 3608<br>Harrisburg, PA 17105-3608<br>717-564-0100 | Thomas & Betts Electronics Div.<br>200 Executive Center Drive<br>Greenville, SC 29616<br>803-676-2900 |
| Cooper Industries, Belden Div.<br>P.O. Box 1980<br>Richmond, IN 47375<br>317-983-5200 | Weidmuller, Inc.<br>821 Southlake Blvd.<br>Richmond, VA 23236<br>804-794-2877 |
| Newark Electronics<br>4108 North Ravenswood Ave.<br>Chicago, Il 60640<br>312-784-5100 | (Newark Electronics is a distributor for all of the above product manufacturers except for Phoenix Contacts Products) |

I/O Wiring and Specifications

**Ribbon Cable**

The chart below lists cables which can be used to connect the terminal block with a 32 I/O module. The cables are 40 conductors with a .050" pitch PVC stranded ribbon cable.

| Description/Type | Vendor | Part Number |
|---|---|---|
| Gray / 26 AWG | 3M | 3801 / 40 |
| Gray / 26 AWG | Belden | 9L260 40 |
| Gray / 28 AWG | Belden | 9L280 40 |
| Gray / 28 AWG | DuPont | 76825–040 |
| Gray / 28 AWG | AMP | 499116–5 |
| Color coded / 26 AWG | 3M | 3811 / 40 |
| Color coded / 28 AWG | Belden | 9R280 40 |
| Color coded / 28 AWG | DuPont | 76177–040 |

**Ribbon Cable Connectors**

The ribbon cable connectors listed below are for attaching the ribbon cable to the terminal block. The cables are all .100" x .100" 2 x 20 female ribbon connectors with a center bump.

| Description/Type | Vendor | Part Number |
|---|---|---|
| Connector | 3M | 3417–7640 |
| Strain Relief | 3M | 3448–3040 |
| Connector | 3M | 3417–7640 |
| Strain Relief | 3M | 3448–3040 |
| Connector (pre-assembled) | 3M | 89140–0103–T0 |
| Strain Relief | 3M | 3448–89140 |
| Connector (with strain relief) | Thomas & Betts | 622–4041 |
| Connector (pre-assembled) | AMP | 746286–9 |
| Strain Relief | AMP | 499252–1 |
| Connector (with strain relief) | DuPont | 66902–240 |
| Connector (with strain relief) | Molex | 15–29–9940 |

**Interface Terminal Block**

Below are terminal blocks which can be used to transition a 40 conductor ribbon cable to 40 discrete field wires. The terminal block features are: 2 x 20 .100" x .100" pin center (male) connector head terminals (.2" centers) accepting 22–12 AWG, no fuses.

| Description/Type | Vendor | Part Number |
|---|---|---|
| Panel Mount | Weidmuller | RI–40A /914897 |
| Rail Mount | | RI–40A /914908 |
| Rail Mount | Phoenix Contacts | FLKM 40 / 2281076 |
| Special Mount (DIN rail compatible) includes ribbon connector | Augat/RDI | 2M40FC |

**I/O Wiring Checklist**

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

Step1 –       Note the limits 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 |
| 16 point | 14 |
| 32 point – common | 20 |
| 32 point – other | 24 |
| 64 point | 24 (requires ribbon cable) |
| F4–08THM–X | 10 (Thermocouple wire) |

**Note:** 12 AWG Type TFFN or Type MTW can be used on 8pt. modules. 14 AWG Type TFFN or Type MTW can be used on 16pt. modules.

Step2 –       Always use a continuous length of wire. Do not splice wires to attain a needed length.

Step3 –       Use the shortest possible wire length.

Step4 –       Where possible use wire trays for routing .

Step5 –       Avoid running wires near high energy wiring.

Step6 –       Avoid running input wiring close to output wiring where possible.

Step7 –       To minimize voltage drops when wires must run a long distance, consider using multiple wires for the return lines.

Step8 –       Where possible avoid running DC wiring in close proximity to AC wiring.

Step9 –       Avoid creating sharp bends in the wires.

Step10 –       **IMPORTANT!** To help avoid 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.



External Fuses (shown with DIN Rail, fuse blocks)
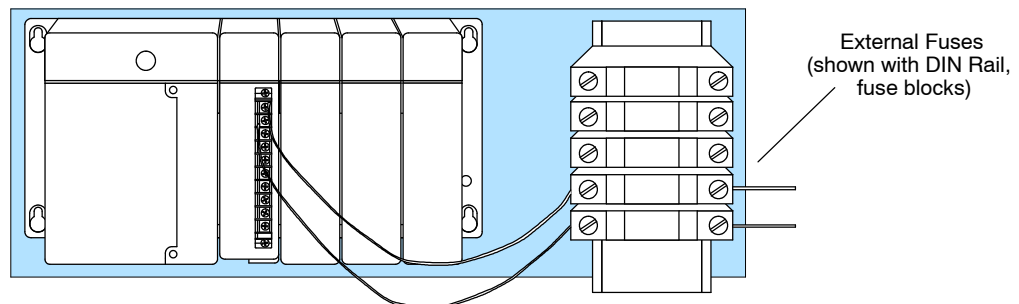
**NOTE:** For modules which have soldered-in or non-replaceable fuses, we recommend that you return your module to us and let us replace your blown fuse(s) since disassembling the module will void the warranty.

**DL405 Discrete Input Module Chart**

The following table lists the available DL405 input modules.

| DL405 Input Module Type | Number of Input Points | DC Current Sink Input | DC Current Source Input | AC Input |
|---|---|---|---|---|
| D4–16ND2 | 16 | | ✓ | |
| D4–16ND2F | 16 | | ✓ | |
| D4–32ND3–1 | 32 | ✓ | ✓ | |
| D4–32ND3–2 | 32 | ✓ | ✓ | |
| D4–64ND2 | 64 | ✓ | | |
| D4–08NA | 8 | | | ✓ |
| D4–16NA (–1) | 16 | | | ✓ |
| D4–16NE3 | 16 | ✓ | ✓ | ✓ |
| F4–08NE3S | 8 | ✓ | ✓ | ✓ |
| D4–08ND3S | 8 | ✓ | ✓ | |

**DL405 Discrete Output Module Chart**

The following table lists the available DL405 output modules. Specifications begin after the input modules' specifications.

| DL405 Output Module Type | Number of Output Points | DC Current Sink Output | DC Current Source Output | AC Output |
|---|---|---|---|---|
| D4–08TD1 | 8 | ✓ | | |
| F4–08TD1S | 8 | ✓ | | |
| D4–16TD1 | 16 | ✓ | | |
| D4–16TD2 | 16 | | ✓ | |
| D4–32TD1 | 32 | ✓ | | |
| D4–32TD1–1 | 32 | ✓ | | |
| D4–32TD2 | 32 | | ✓ | |
| D4–64TD1 | 64 | ✓ | | |
| D4–08TA | 8 | | | ✓ |
| D4–16TA | 16 | | | ✓ |
| D4–08TR | 8 | ✓ | ✓ | ✓ |
| F4–08TRS–1 | 8 | ✓ | ✓ | ✓ |
| F4–08TRS–2 | 8 | ✓ | ✓ | ✓ |
| D4–16TR | 16 | ✓ | ✓ | ✓ |

**Special Input Module Chart**

| Specification | F4-08THM-n | F4-08RTD |
|---|---|---|
| Channels | 8 | 8 |
| Input Ranges | Type E: −270/1000°C (−450/1832°F)<br>Type J: −210/760°C (−350/1390°F)<br>Type K: −270/1370°C (−450/2500°F)<br>Type R: 0/1768°C (−32/3214°F)<br>Type S: 0/1768°C (−32/3214°F)<br>Type T: −270/400°C (−450/752°F)<br>Type C: 0/2320°C (−32/4208°F)<br>Type B: 141/1820°C (286/3594°F)<br>Type P: −99/1395°C (−146/2543°F)<br>−1: 0 to 50mV<br>−2: 0 to 100mV<br>−3: 0 to 25mV | Pt100Ω: −200.0/850.0°C<br>(−328/ 562°F)<br>Pt1000Ω: −200.0/595.0°C<br>(−328/1103°F)<br>jPt100Ω: −38.0/450.0°C<br>(−36/842°F)<br><br>Cu. 25Ω, Cu. 10Ω:<br>−200.0/260.0°C<br>(−328/500°F) |
| Resolution | 12 bit (1 in 4096) | 15 bit (1 in 32768) |
| Maximum Inaccuracy | 1° C type J,K,E,T thermocouples<br>3° C type R,S,B,C,P thermocouples | 0.2% at 25°C (77°F) |

**Special Input Module Chart**

| Specification | F4-08THM |
|---|---|
| Channels | 8 |
| Input Ranges | Type J: −190/760°C (−310/1400°F)<br>Type E: −210/1000°C (−346/1832°F)<br>Type K: −150/1372°C (−238/2502°F)<br>Type R: 65/1768°C (149/3214°F)<br>Type S: 65/1768°C (149/3214°F)<br>Type T: −230/400°C (−382/752°F)<br>Type B: 529/1820°C (984/3308°F)<br>Type N: −70/1300°C (−94/2372°F)<br>Type C: 65/2320°C (149/4208°F)<br>−1: 0 to 50mV<br>−2: 0 to 100mV<br>−3: 0 to 25mV |
| Resolution | 16 bit (1 in 65535) |
| Maximum Inaccuracy | 3° C (excluding thermocouple error) |

**Analog Input Module Chart**

| Specification | F4-04AD | F4-04ADS | F4-08AD |
|---|---|---|---|
| Channels | 4 | 4 | 8 |
| Input Ranges | 0–20 mA, 4–20 mA, 1–5V, 0–5V, 0–10V, 5V, 10V | 0–20 mA, 4–20 mA, 1–5V, 0–5V, 0–10V, 5V, 10V | 0–20 mA, 4–20 mA, 1–5V, 0–5V, 0–10V, 5V, 10V |
| Resolution | 12 bit (1 in 4096) | 12 bit (1 in 4096) | 12 bit (1 in 4096) |
| Input Type | Single ended | Isolated | Single ended |
| Maximum Inaccuracy | 0.4% at 25°C (77°F)<br>0.55% at 0° to 60° C<br>(32° to 140°F) | 0.4% at 25°C (77°F)<br>0.7% at 0° to 60°C<br>(32° to 140°F) | 0.3% at 25°C (77°F)<br>0.5% at 0° to 60°C<br>(32° to 140°F) |

**Analog Output Module Chart**

| Specification | D4–02DA | F4–04DA | F4–04DA–1 |
|---|---|---|---|
| Channels | 2 | 4 | 4 |
| Output Ranges | 4–20 mA, 1–5V, 0–10V | 4–20 mA, 0–5V, 0–10V, 5V,  10V | 4–20mA |
| Resolution | 12 bit (1 in 4096) | 12 bit (1 in 4096) | 12 bit (1 in 4096) |
| Output Type | Independent | Single ended | Single ended |
| Maximum Inaccuracy | 0.2% at 25°C (77°F) | 0.5% at 60°C (unipo.) 0.7% at 60°C (bipol.) 0.8% at 60°C (curr.) | 0.1 % at 25°C (77°F) 0.3 % at 0 to 60°C (32 to 140°F) |
| **Specification** | **F4–04DA–2** | **F4–08DA–1** | **F4–16DA–1** |
| Channels | 4 | 8 | 16 |
| Output Ranges | 0–5V, 0–10V,  5V, 10V | 4–20mA | 4–20 mA |
| Resolution | 12 bit (1 in 4096) | 12 bit (1 in 4096) | 12 bit (1 in 4096) |
| Output Type | Single ended | Single ended | Single ended |
| Maximum Inaccuracy | 0.2 % at 25°C (77°F) 0.4% at 0° to 60°C (32° to 140°F) | 0.2% at 25°C (77°F) 0.4% at 0° to 60°C (32° to 140°F) | 0.2 % at 25°C (77°F) 0.4 % at 0° to 60°C (32° to 140°F) |
| **Specification** | **F4–04DAS–1** | **F4–08DA–2** | **F4–16DA–2** |
| Channels | 4 | 8 | 16 |
| Output Ranges | 4–20 mA | 0–5v, 0–10v | 0–5v, 0–10v, Combination of both |
| Resolution | 16 bit (1 in 65536) | 12 bit (1 in 4096) | 12 bit (1 in 4096) |
| Output Type | Single ended | Single ended | Single ended |
| Maximum Inaccuracy | 0.07 % at 25°C(77°F) 0.18% at 0° to 60°C (32° to 140°F) | 0.2% at 25°C (77°F) 0.4% at 0° to 60°C (32° to 140°F) | 0.2 % at 25°C (77°F) 0.4 % at 0° to 60°C (32° to 140°F) |

Specifications

# Glossary of Specification Terms

| | |
|---|---|
| **Inputs or Outputs Per Module** | Indicates number of electrical input or output points per module and designates current sinking, current sourcing, or either. |
| **Commons Per Module** | Number of electrical commons per module. A common is a connection to an input or output module which is shared by multiple I/O circuits. It is ususally in the return path to the power supply of the I/O circuit. |
| **Input Voltage Range** | The operating voltage range of an input circuit, measured from an input point to its common terminal, when the input is ON. |
| **Output Voltage Range** | The output voltage range of an output circuit, measured from an output point to its common terminal, when the output is OFF. |
| **Peak Voltage** | Maximum voltage allowed for an input or output circuit for a short duration. |
| **AC Frequency** | AC modules are designed to operate within a specific frequency range. |
| **ON Voltage Level** | The minimum voltage level at which an input point will turn ON. |
| **OFF Voltage Level** | The maximum voltage level at which an input point will turn OFF. |
| **Input Impedance** | The electrical resistance measured between an input point and its common point. Since this resistance is non-linear, it may be listed for various input currents. |
| **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 required for an 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** | The +5VDC power from the base required to operate the module. Be sure to observe the base power budget calculations. |
| **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. |
| **Status Indicators** | The LEDs that indicate the ON/OFF status of an input or output point. These LEDs are electrically located on the logic (CPU) side of the I/O interface circuit. |
| **Terminal Type** | Indicates whether the module's connector is removable or non-removable. |
| **Weight** | Indicates the weight of the module. |
| **Fuses** | Protective device for an output circuit, which stops current flow when current exceeds the fuse rating current. It may be replaceable or non-replaceable, or located externally or internally. |

# D4-08ND3S DC Input

| | |
|---|---|
| Inputs per module | 8 (sink/source) |
| Commons per module | 8 (isolated) |
| Input voltage range | 20–52.8VDC |
| Peak voltage | 52.8VDC |
| ON voltage level | >18 V |
| OFF voltage level | < 7V |
| Input impedance | 4.8 K O |
| Input current @ 24 / 48 VDC | 5 mA / 10 mA |
| Minimum ON current | 3.5 mA |
| Maximum OFF current | 1.5 mA |
| Base power required 5V | 100 mA max |
| OFF to ON response | 3–10 ms |
| ON to OFF response | 3–12 ms |
| Terminal type | Removable |
| Status indicators | Logic Side |
| Weight | 8.8 oz. (250 g) |

# D4-16ND2 DC Input

| | |
|---|---|
| Inputs per module | 16 (current sourcing) |
| Commons per module | 2 (isolated) |
| Input voltage range | 10.2–26.4VDC |
| Peak voltage | 26.4VDC |
| ON voltage level | > 9.5VDC |
| OFF voltage level | < 4.0 VDC |
| Input impedance | 3.2 KO @ 12VDC<br>2.9 KO @24VDC |
| Input current @ 12 / 24VDC | 3.8 mA / 8.3 mA |
| Minimum ON current | 3.5 mA |
| Maximum OFF current | 1.5 mA |
| Base power required 5V | 150 mA max |
| OFF to ON response | 1–7 ms (2.3 typical) |
| ON to OFF response | 2–12 ms (4.6 typical) |
| Terminal type | Removable |
| Status indicators | Logic Side |
| Weight | 8.8 oz. (250 g) |



Current sourcing configuration shown
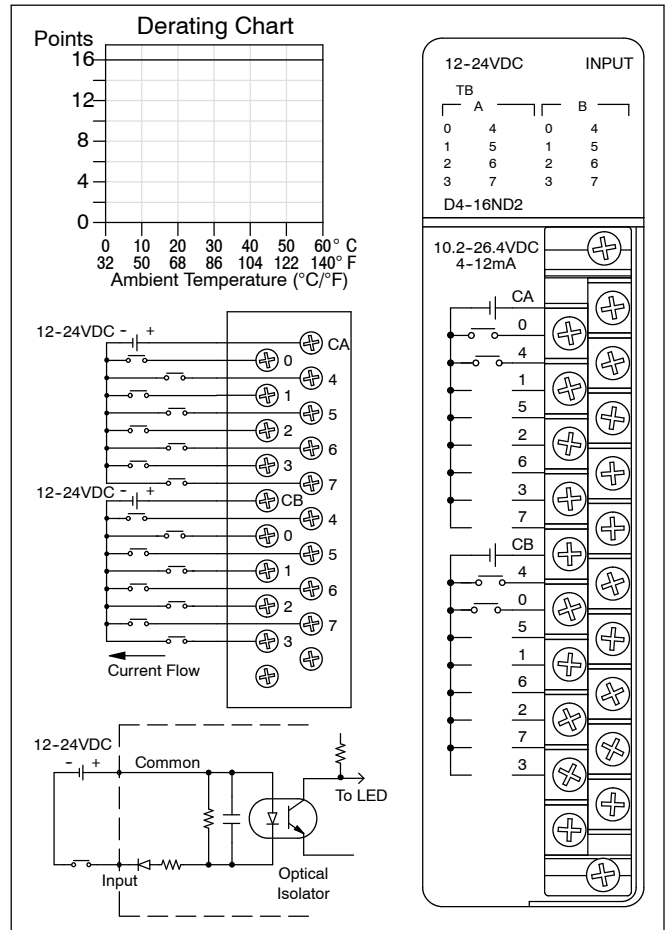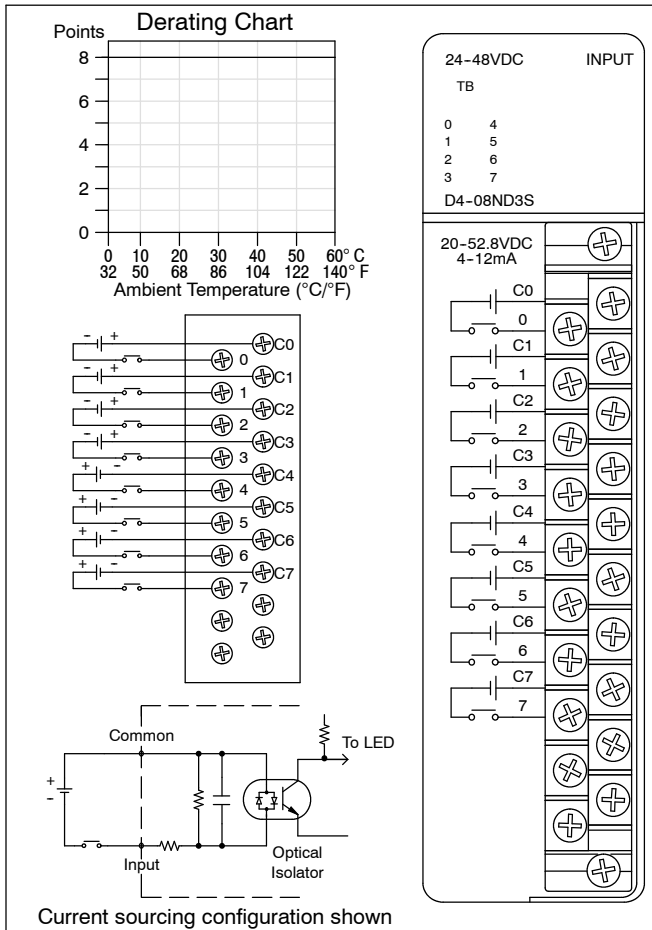
## D4-16ND2F DC Input

| | |
|---|---|
| Inputs per module | 16 (current sourcing) |
| Commons per module | 2 (isolated) |
| Input voltage range | 10.2–26.4VDC |
| Peak voltage | 26.4VDC |
| ON voltage level | > 9.5VDC |
| OFF voltage level | < 4.0VDC |
| Input impedance | 3.2 K O @ 12VDC<br>2.9 K O @ 24VDC |
| Input current @ 12 / 24 VDC | 3.8 mA / 8.3 mA |
| Minimum ON current | 3.5 mA |
| Maximum OFF current | 1.5 mA |
| Base power required 5V | 150 mA max |
| OFF to ON response | 1 ms |
| ON to OFF response | 1 ms |
| Terminal type | Removable |
| Status indicators | Logic Side |
| Weight | 8.8 oz. (250 g) |

## D4-16SIM Input Simulator

| | |
|---|---|
| Inputs per module | 8 or 16, selectable |
| Base power required 5V | 150 mA Max |
| Terminal type | None |
| Status indicators | Logic Side |
| Weight | 8.8 oz. (250 g) |



8 or 16 input point selection switch is located on the back of the module

Switch position is indicated by the LEDs above the input switches

# D4-32ND3-1, 24VDC Input

| Inputs per module | 32 (sink/source) |
|---|---|
| Commons per module | 4 (isolated) |
| Input voltage range | 20–28VDC |
| Peak voltage | 30VDC |
| ON voltage level | > 19V |
| OFF voltage level | < 10 V |
| Input impedance | 4.8 K O |
| Input current | 5 mA |
| Minimum ON current | 3.5 mA |
| Maximum OFF current | 1.6 mA |
| Base power required 5V | 150 mA max |
| OFF to ON response | 2–10 ms |
| ON to OFF response | 2–10 ms |
| Terminal type | Removable, 40 pin conn. |
| Status indicators | Logic Side |
| Weight | 6.6 oz. (190 g) |

# D4-32ND3-2 5-12VDC Input

| Inputs per module | 32 (sink/source) |
|---|---|
| Commons per module | 4 (isolated) |
| Input voltage range | 4.75–13.2VDC (TTL, CMOS) |
| Peak voltage | 15VDC |
| ON voltage level | > 4 V (use pullup R for TTL in) |
| OFF voltage level | < 2 V |
| Input impedance | 1.6 KO |
| Input current | 3.1 mA @ 5V, 7.5 mA @ 12V |
| Minimum ON current | 1.8 mA |
| Maximum OFF current | 0.8 mA |
| Base power required 5V | 150 mA max |
| OFF to ON response | 1–4 ms |
| ON to OFF response | 1–4 ms |
| Terminal type | Removable, 40 pin conn. |
| Status indicators | Logic Side |
| Weight | 6.6 oz. (190 g) |



Derating Chart — D4-32ND3-1. Use Display Select switch to view (A0-A7, B0-B7) or (C0-C7, D0-D7). Current sinking config. shown



Derating Chart — D4-32ND3-2. Use Display Select switch to view (A0-A7, B0-B7) or (C0-C7, D0-D7). Current sinking config. shown

# D4–64ND2, 24 VDC Input Module

| Module Location | CPU base only * | Base power required 5V | 300 mA max |
|---|---|---|---|
| Inputs per module | 64 (current sourcing) | External power required (optional) | 24VDC 10%, 320mA max |
| Commons per module | 8 (isolated) | OFF to ON response | 2.5 ms (typical) |
| Input voltage range | 20 – 28 VDC | ON to OFF response | 5.0 ms (typical) |
| Peak voltage | 30 VDC | Terminal type | 2, Removable 40 pin connectors (sold separately) |
| ON voltage level | > 20 V | | |
| OFF voltage level | < 13 V | Status indicators | Logic Side |
| Input impedance | 4.8 K O | Weight | 7.8 oz. (220 g) |
| Input current | 5.0 mA @ 24 VDC | | |
| Minimum ON current | 3.6 mA | | |
| Maximum OFF current | 2.6 mA | | |
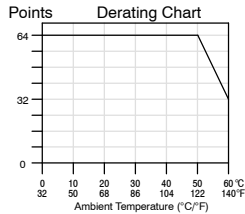
Since there are only 32 LEDs on the module, you can only display the status for 32 points at one time. In the A - B position the status of the first group of 32 input points (A0-A17, B0-B17) are displayed (connector 1). In the C - D position the status of the second group of 32 input points (C0-C17, D0-D17) are displayed (connector 2).
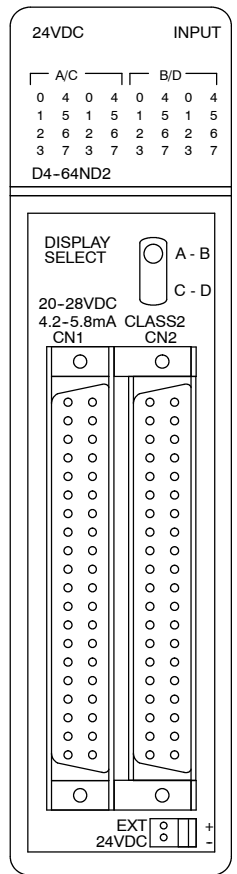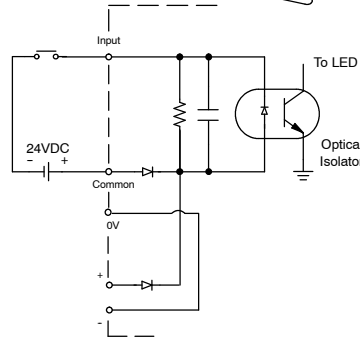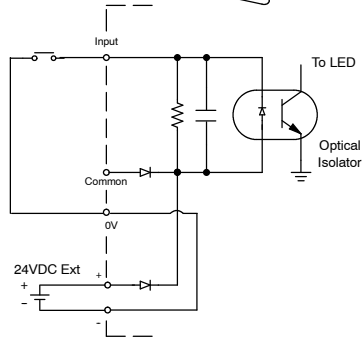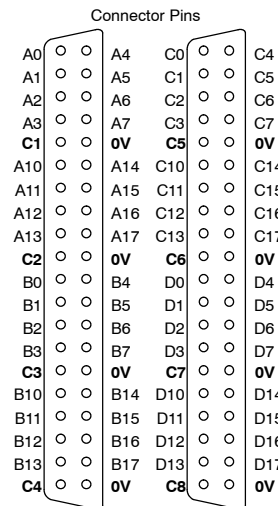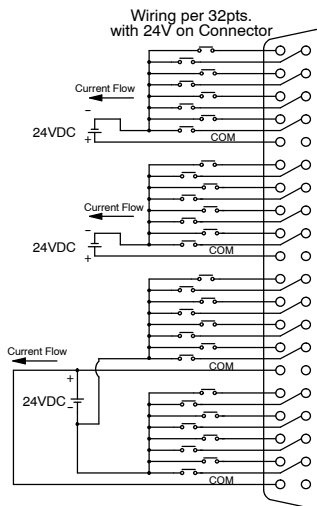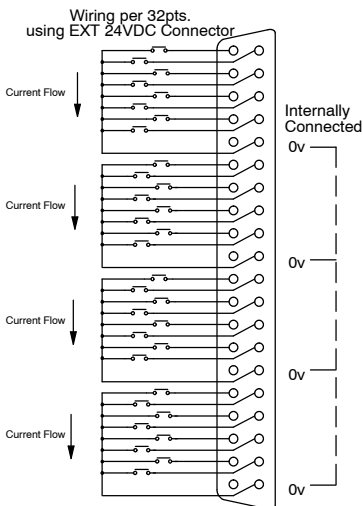


Derating Chart



Wiring per 32pts. using EXT 24VDC Connector



Wiring per 32pts. with 24V on Connector



Connector Pins

| A0 | | A4 | C0 | | C4 |
|---|---|---|---|---|---|
| A1 | | A5 | C1 | | C5 |
| A2 | | A6 | C2 | | C6 |
| A3 | | A7 | C3 | | C7 |
| **C1** | | **0V** | **C5** | | **0V** |
| A10 | | A14 | C10 | | C14 |
| A11 | | A15 | C11 | | C15 |
| A12 | | A16 | C12 | | C16 |
| A13 | | A17 | C13 | | C17 |
| **C2** | | **0V** | **C6** | | **0V** |
| B0 | | B4 | D0 | | D4 |
| B1 | | B5 | D1 | | D5 |
| B2 | | B6 | D2 | | D6 |
| B3 | | B7 | D3 | | D7 |
| **C3** | | **0V** | **C7** | | **0V** |
| B10 | | B14 | D10 | | D14 |
| B11 | | B15 | D11 | | D15 |
| B12 | | B16 | D12 | | D16 |
| B13 | | B17 | D13 | | D17 |
| **C4** | | **0V** | **C8** | | **0V** |



24VDC  INPUT

D4–64ND2

DISPLAY SELECT   A - B   C - D

20-28VDC
4.2-5.8mA   CLASS2
CN1   CN2

EXT 24VDC

* Module location – this module placement is restricted to the local base on DL430/DL440 systems. It may also be placed in expansion bases in DL450 systems that are using the new (–1) bases.
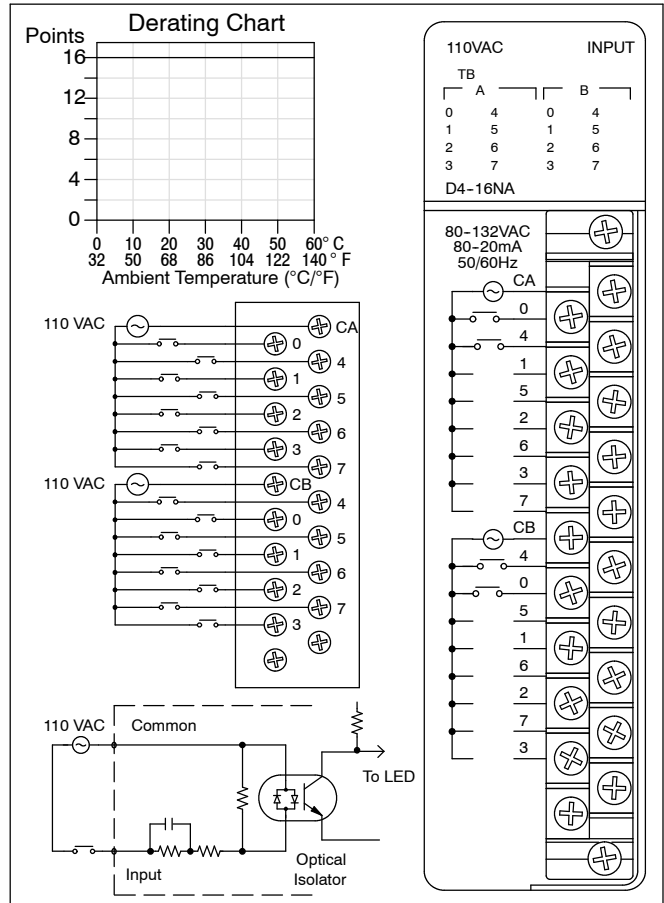
# D4-08NA 110-220VAC Input

| Inputs per module | 8 |
|---|---|
| Commons per module | 2 (isolated) |
| Input voltage range | 80–265VAC |
| Peak voltage | 265VAC |
| AC frequency | 47–63 Hz |
| ON voltage level | > 70V |
| OFF voltage level | < 30 V |
| Input impedance | 12 K O |
| Input current | 8.5 mA @100VAC 20 mA @ 230VAC |
| Minimum ON current | 5 mA |
| Maximum OFF current | 2 mA |
| Base power required 5V | 100 mA max |
| OFF to ON response | 5–30 ms |
| ON to OFF response | 10–50 ms |
| Terminal type | Removable |
| Status indicators | Logic Side |
| Weight | 8.4 oz. (240 g) |

# D4-16NA 110VAC Input

| Inputs per module | 16 |
|---|---|
| Commons per module | 2 (isolated) |
| Input voltage range | 80–132VAC |
| Peak voltage | 132VAC |
| AC frequency | 47–63 Hz |
| ON voltage level | > 70V |
| OFF voltage level | < 20 V |
| Input impedance | 8 K O |
| Input current | 14.5 mA @120VAC |
| Minimum ON current | 7 mA |
| Maximum OFF current | 2 mA |
| Base power required 5V | 150 mA max |
| OFF to ON response | 5–30 ms |
| ON to OFF response | 10–50 ms |
| Terminal type | Removable |
| Status indicators | Logic Side |
| Weight | 9.5 oz. (270 g) |
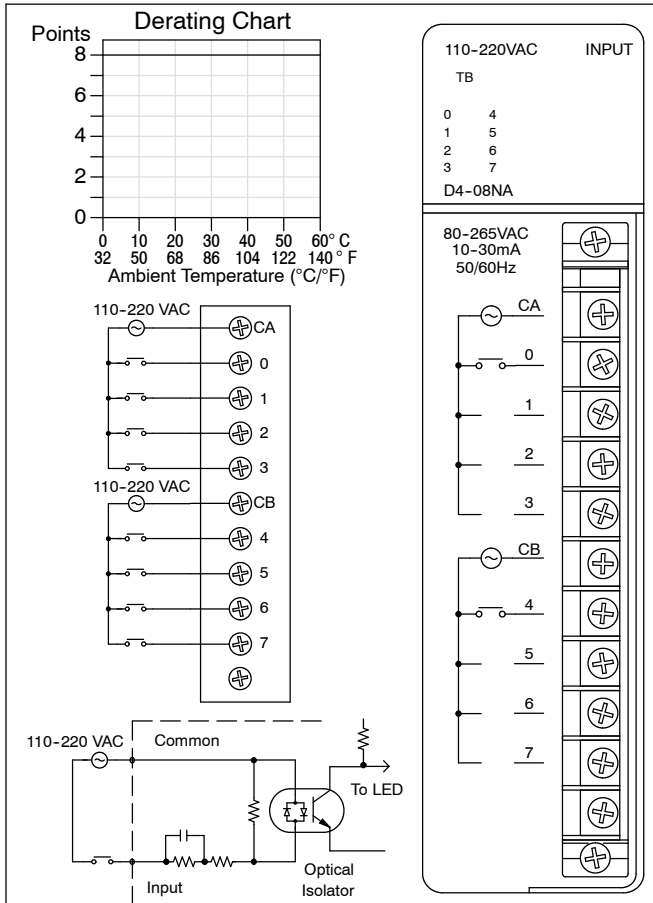
# D4--16NA--1 220VAC Input

| | |
|---|---|
| Inputs per module | 16 |
| Commons per module | 2 (isolated) |
| Input voltage range | 187--238VAC |
| Peak voltage | 265VAC |
| AC frequency | 47--63 Hz |
| ON voltage level | > 150V |
| OFF voltage level | < 40 V |
| Input impedance | 22 K O |
| Input current | 10.0 mA @220VAC |
| Minimum ON current | 7 mA |
| Maximum OFF current | 2 mA |
| Base power required 5V | 150 mA max |
| OFF to ON response | 5--30 ms |
| ON to OFF response | 10--50 ms |
| Terminal type | Removable |
| Status indicators | Logic Side |
| Weight | 9.5 oz. (270 g) |
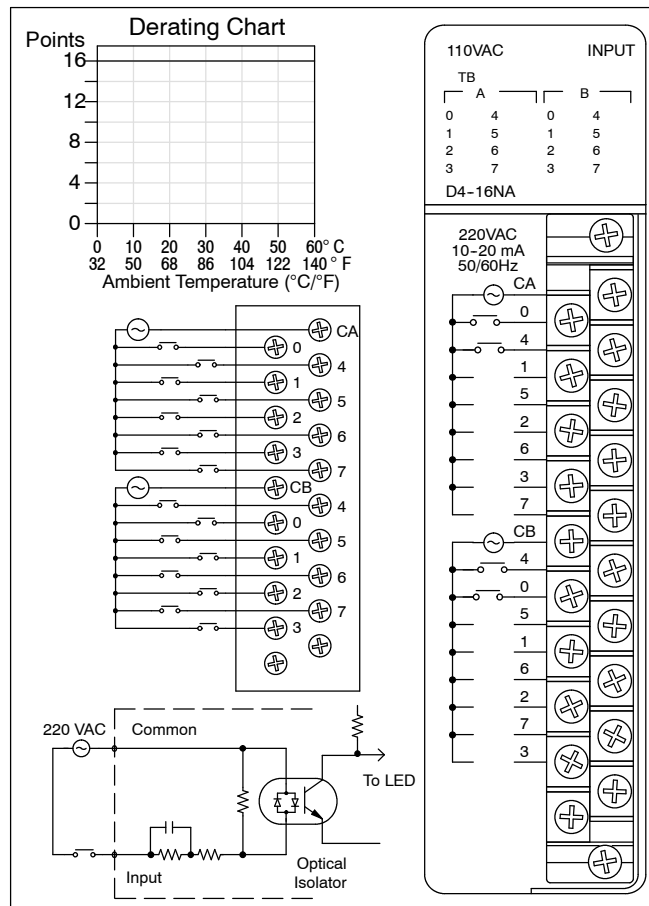
# D4-16NE3 12-24VAC/DC Input

| | |
|---|---|
| Inputs per module | 16 (sink/source) |
| Commons per module | 2 (isolated) |
| Input voltage range | 10.2–26.4VAC/VDC |
| Peak voltage | 37.5VAC/VDC |
| AC frequency | 47–63 Hz |
| ON voltage level | > 9.5V |
| OFF voltage level | < 3.0V |
| Input impedance @ 12V/24V | 3.2 K O / 2.9 K O |
| Input current @ 12V / 24V | 3.8 mA / 8.3 mA |
| Minimum ON current | 4 mA |
| Maximum OFF current | 1.5 mA |
| Base power required 5V | 150 mA max |
| OFF to ON response | 5–40 ms |
| ON to OFF response | 10–50 ms |
| Terminal type | Removable |
| Status indicators | Logic Side |
| Weight | 8.8 oz. (250 g) |

# F4-08NE3S 90-150VAC/DC In

| | |
|---|---|
| Inputs per module | 8 (sink/source) |
| Commons per module | 8 (isolated) |
| Input voltage range | 90–150 VAC/VDC |
| Peak voltage | 350 peak < 1ms |
| AC frequency | 47–63 Hz |
| ON voltage level | > 90 VDC / 75VAC |
| OFF voltage level | < 60 VDC / 45VAC |
| Input impedance | 22 K O |
| Input current | 5.5 mA @ 120V |
| Minimum ON current | 4 mA |
| Maximum OFF current | 2 mA |
| Base power required 5V | 90 mA max |
| OFF to ON response | 8 ms |
| ON to OFF response | 15 ms |
| Terminal type | Removable |
| Status indicators | Logic Side |
| Weight | 9 oz. (256 g) |



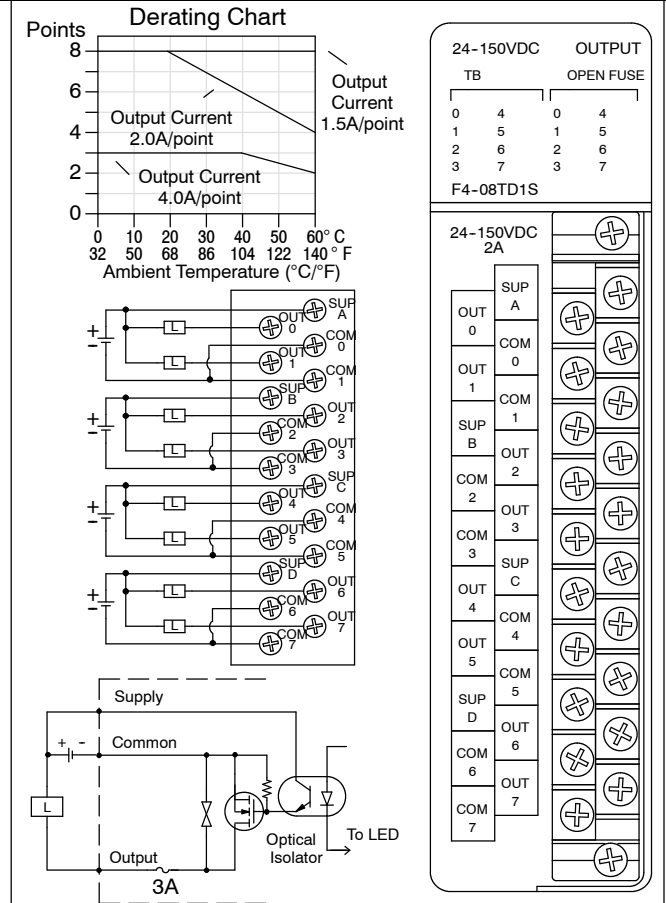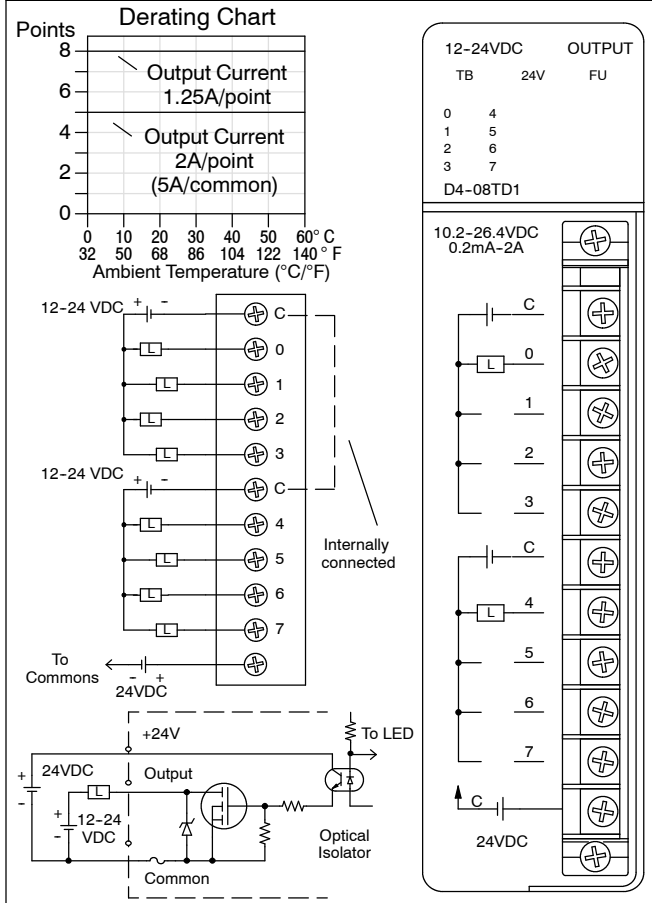Current sourcing configuration shown
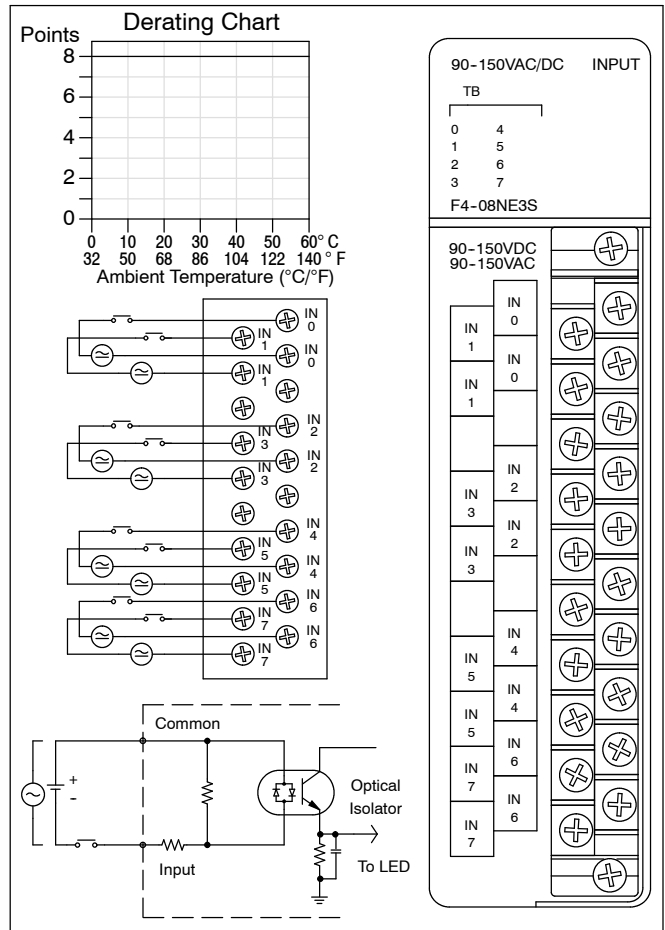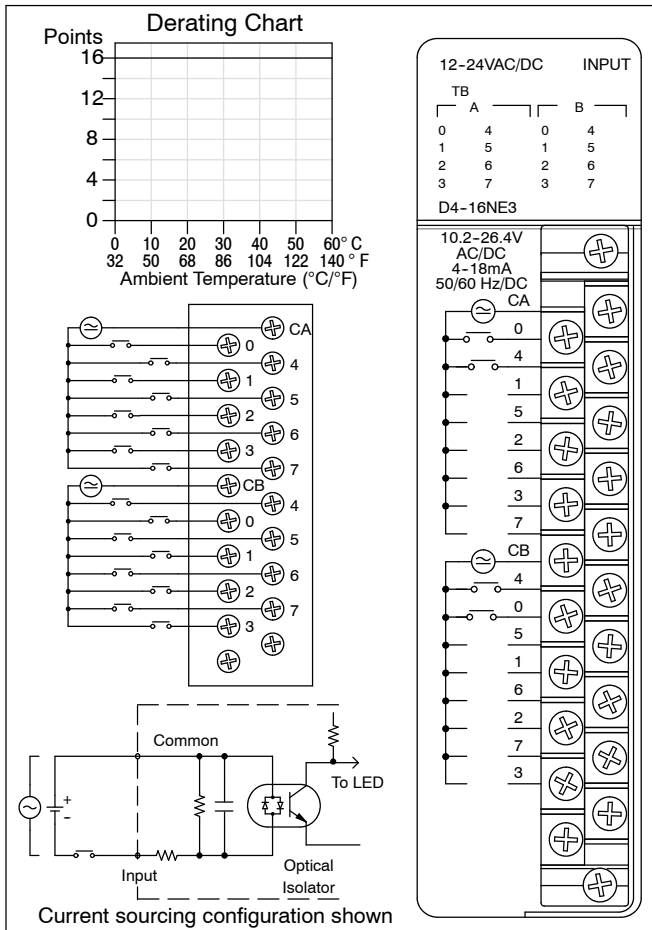
## D4-08TD1 12-24 VDC Output

| | |
|---|---|
| Outputs per module | 8 (current sinking) |
| Commons per module | 2 internally connected |
| Operating voltage | 10.2–26.4VDC |
| Output type | NMOS FET (open drain) |
| Peak voltage | 40VDC |
| ON voltage drop | 0.5VDC @ 2A, 0.2 VDC @1A |
| Max current (resistive) | 2A / point, 5A / common |
| Max leakage current | 0.1mA @ 40VDC |
| Max inrush current | 12A for 10 ms, 6A for 100 ms |
| Minimum load | 0.2mA |
| Base power required 5V | 150mA max |
| External DC required | 24VDC    10%@35 mA |
| OFF to ON response | 1 ms |
| ON to OFF response | 1 ms |
| Terminal type | Removable |
| Status indicators | Logic Side |
| Weight | 8.4 oz. (240 g) |
| Fuses (non-replaceable) | 1 (7A) per common |

## F4-08TD1S 24-150 VDC Isolated Out

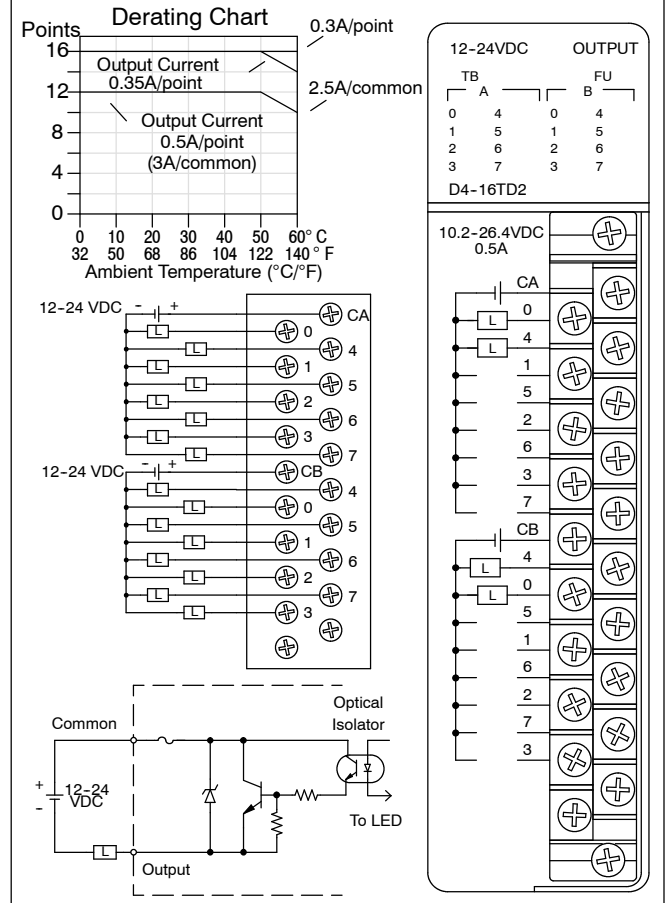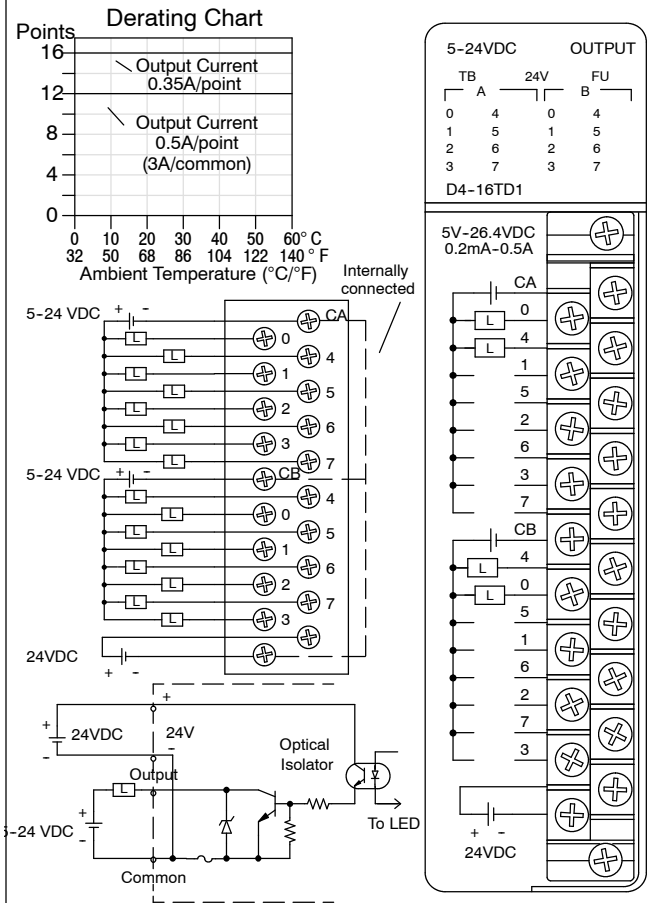| | |
|---|---|
| Outputs per module | 8 (current sinking) |
| Commons per module | 4 (isolated) |
| Operating voltage | 24–150VDC |
| Output type | MOS FET |
| Peak voltage | 200 VDC, <1mS |
| ON voltage drop | 1VDC @ 2A |
| Max current | 2A / point, 4A / common |
| Max leakage current | 5 µA |
| Max inrush current | 30A /1ms, 6A / 10ms, 3A / 100ms |
| Minimum load | N/A |
| Base power required 5V | 295 mA max |
| External DC required | None |
| OFF to ON response | 25 µs |
| ON to OFF response | 25 µs |
| Terminal type | Removable |
| Status indicators | Logic Side |
| Weight | 10 oz. (282 g) |
| Fuses (non-replaceable) | 1 (3A) per output |





I/O Wiring and Specifications

# D4-16TD1 5-24 VDC Output

| Outputs per module | 16 (current sinking) |
|---|---|
| Commons per module | 2 internally connected |
| Operating voltage / peak | 4.5–26.4VDC, 40 VDC Peak |
| Output type | NPN Open collector |
| ON voltage drop | 0.5V @ 0.5A, 0.2V @ 0.1A |
| Max current (resistive) | 0.5A / point, 3A / common |
| Max leakage current | 0.1mA @ 40VDC |
| Max inrush current | 2A for 10 ms, 1A for 100 ms |
| Minimum load | 0.2mA |
| Base power required 5V | 200mA max |
| External DC required | 24VDC   10% @125mA |
| OFF to ON response | 0.5 ms |
| ON to OFF response | 0.5 ms |
| Terminal type | Removable |
| Status indicators | Logic Side |
| Weight | 9.5 oz. (270 g) |
| Fuses (non-replaceable) | 1 (5A) per common |

# D4-16TD2, 12-24 VDC Output

| Outputs per module | 16 (current sourcing) |
|---|---|
| Commons per module | 2 (isolated) |
| Operating voltage / peak | 10.2–26.4 VDC, 40 VDC Peak |
| Output type | NPN Emitter Follower |
| ON voltage drop | 1.5 VDC @ 0.5A |
| Max current (resistive) | 0.5A / point, 3A / common @ 50° C, 2.5A /common @ 60°C |
| Max leakage current | 0.1mA @ 40 VDC |
| Max inrush current | 2A for 10 ms, 1A for 100 ms |
| Minimum load | 0.2mA |
| Base power required 5V | 400mA max |
| External DC required | None |
| OFF to ON response | 1 ms |
| ON to OFF response | 1 ms |
| Terminal type | Removable |
| Status indicators | Logic Side |
| Weight | 9.8 oz. (280 g) |
| Fuses (non-replaceable) | 1 (5A) per common |

# D4-32TD1, 5-24VDC Output

| Outputs per module | 32 (current sinking) |
|---|---|
| Commons per module | 4 (isolated) |
| Operating voltage | 4.75–26.4 VDC |
| Output type | NPN Open Collector |
| Peak voltage | 36 VDC |
| ON voltage drop | 0.6 VDC @ 0.2A |
| Max current (resistive) | 0.2A / point, 1.6A / common |
| Max leakage current | 0.1mA @ 36 VDC |
| Max inrush current | 1A for 10 ms, 0.5A for 100 ms |
| Minimum load | 0.1mA |
| Base power required 5V | 250mA max |
| External DC required | 24VDC    10%, 140mA max |
| OFF to ON response | 0.1 ms |
| ON to OFF response | 0.1 ms |
| Terminal type | Removable |
| Status indicators | Logic Side |
| Weight | 6.7 oz. (190 g) |
| Fuses | None |
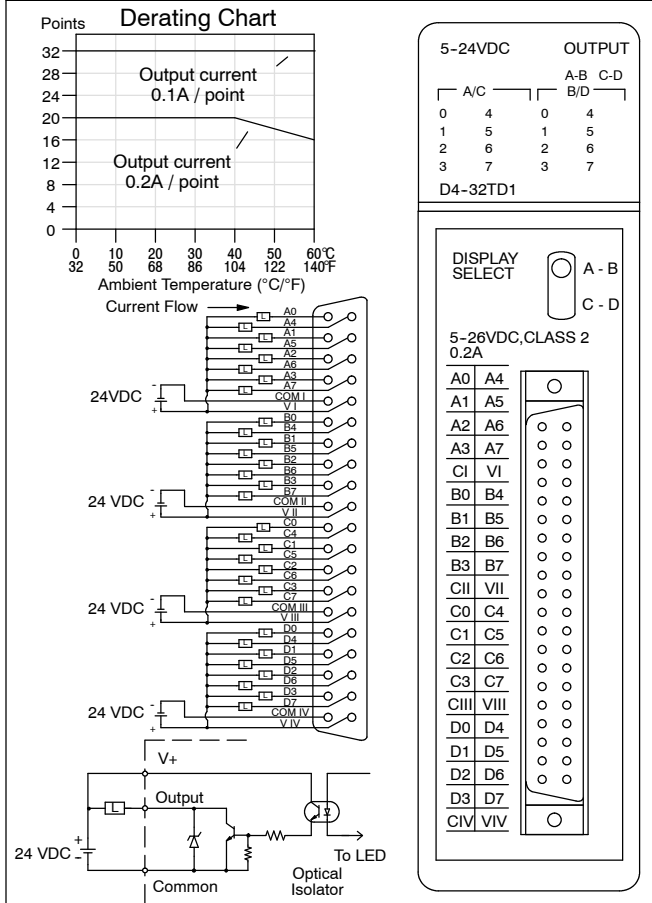
# D4-32TD1-1, 5-15VDC Output

| Outputs per module | 32 (current sinking) |
|---|---|
| Commons per module | 4 (isolated) |
| Operating voltage | 5–15 VDC |
| Output type | NPN Open Collector (w / pullup) |
| Peak voltage | 16.5 VDC |
| ON voltage drop | 0.4 VDC @ 0.1A |
| Max current (resistive) | 0.09A/pt, 0.72A/com, 2.88A/ mod. |
| Max leakage current | 0.01mA @ 16.5 VDC |
| Max inrush current | 0.5A for 10ms, 0.2A for 100ms |
| Minimum load | 0.1mA |
| Base power req., 5V | 250mA max |
| External DC required | 5–15VDC    10%, 700mA max |
| OFF to ON response | 0.1 ms |
| ON to OFF response | 0.1 ms |
| Terminal type | Removable |
| Status indicators | Logic Side |
| Weight | 6.7 oz. (190 g) |
| Fuses | None |
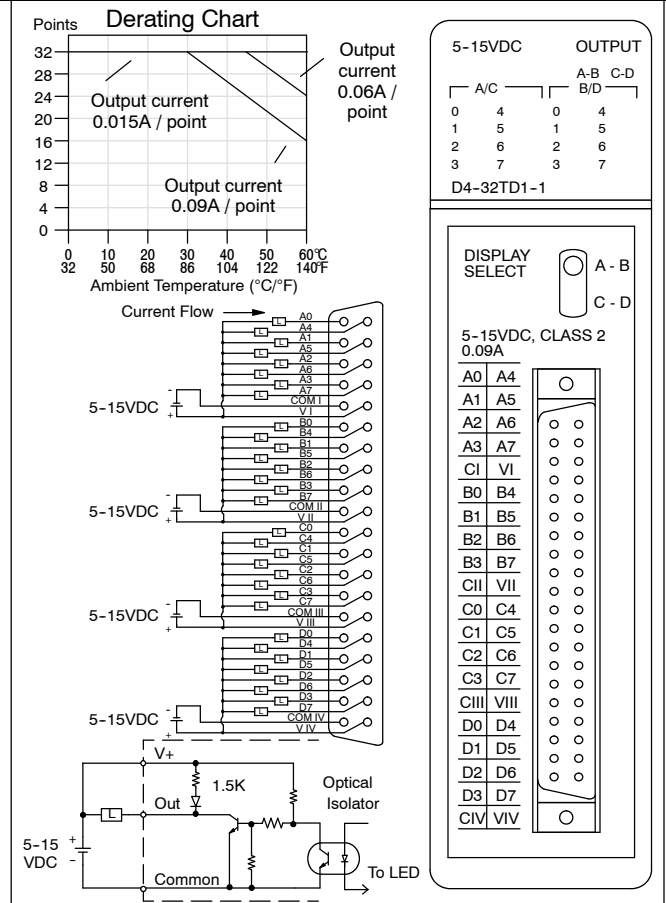
# D4-32TD2, 12-24 VDC Output Module

| | | | |
|---|---|---|---|
| Outputs per module | 32 (current sourcing) | External DC required | 10.8-26.4VDC 1A / common including load |
| Commons per module | 4 (isolated) | | |
| Operating voltage | 10.8-26.4 VDC | | |
| Output type | PNP Open Collector | OFF to ON response | < 0.2 ms |
| Peak voltage | 30 VDC | ON to OFF response | < 0.2 ms |
| ON voltage drop | 0.6 VDC @ 0.2A | Terminal type | Removable |
| Max current (resistive) | 0.2A / point 1.0A / common 4.0A / module | Status indicators | Logic Side |
| | | Weight | 6.7 oz. (190 g) |
| Max leakage current | 0.01mA @ 26.4 VDC | Fuses | None |
| Max inrush current | 500 mA for 10 ms | | |
| Minimum load | 0.2mA | | |
| Base power required 5V | 350mA max | | |

Derating Chart for D4-32TD2



Only 16 status points can be displayed at one time on the front of the module.
In the A - B position the status of the first group of 16 output points (A0–A7, B0–B7) is displayed.
In the C - D position the status of the second group of 16 output points (C0–C7, D0–D7) is displayed.

# D4-64TD1, TTL/CMOS/5–24 VDC Output Module

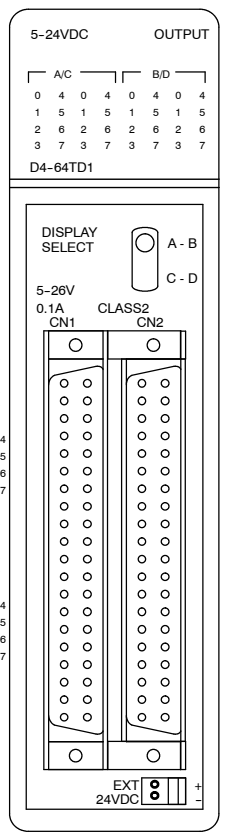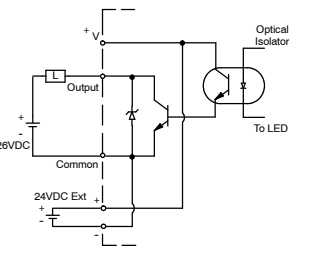| | | | |
|---|---|---|---|
| Module Location | CPU base only * | Minimum load | 0.1mA |
| Outputs per module | 64 (current sinking) | Base power required 5V | 800mA max |
| Commons per module | 8 (isolated) | | |
| Operating voltage | 4.75–26.5 VDC | | |
| Output type | NPN Open Collector | External DC required | 24VDC   10%, (800mA + 50mA per common) 7.0A total max |
| Peak voltage | 36 VDC | OFF to ON response | < 0.1 ms |
| ON voltage drop | 0.6 VDC @ 0.1A | ON to OFF response | < 0.2 ms |
| Max current (resistive) | 0.1A / point 1.0A / common 8.0A / module | Terminal type | 2, Removable 40-pin connectors (sold sep.) |
| | | Status indicators | Logic Side |
| Max leakage current | 0.01mA @ 36 VDC | Weight | 7.4 oz. (210 g) |
| Max inrush current | 1A for 1 ms 700mA for 100 ms | Fuses | None |
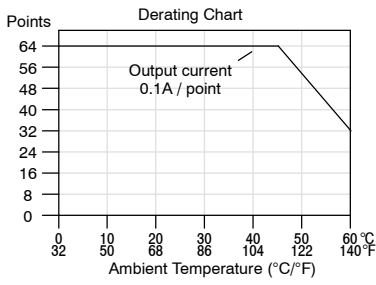
Only 32 status points can be displayed at one time on the front of the module. In the A - B position the status of the first group of 32 output points (A0–A17, B0–B17) are displayed (connector 1). In the C - D position the status of the second group of 32 output points (C0–C17, D0–D17) are displayed (connector 2).
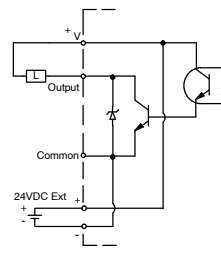
* Module location – this module placement is restricted to the local base on DL430/DL440 systems. It may also be placed in expansion bases in DL450 systems that are using the new (–1) bases.

## D4-08TA, 18-220VAC Output

| | |
|---|---|
| Outputs per module | 8 |
| Commons per module | 2 (isolated) |
| Operating voltage | 15–265VAC |
| Output type | SSR (triac) |
| Peak voltage | 265VAC |
| AC frequency | 47–63 Hz |
| ON voltage drop | 1.5VAC @ 2A |
| Max current | 2A / point, 5A / com. @ 30°C<br>2A / common @ 60 °C |
| Max leakage current | 5mA @ 265VAC |
| Max inrush current | 30A for 10 ms, 10A for 100 ms |
| Minimum load | 10 mA |
| Base power required 5V | 250 mA max |
| OFF to ON response | 1 ms |
| ON to OFF response | 1 ms +1/2 AC cycle |
| Terminal type | Removable |
| Status indicators | Logic Side |
| Weight | 11.6 oz. (330 g) |
| Fuses (non-replaceable) | 1 (8A) per common |



## D4-16TA, 18-220VAC Output

| | |
|---|---|
| Outputs per module | 16 |
| Commons per module | 2 (isolated) |
| Operating voltage | 15–265VAC |
| Output type | SSR (triac) |
| Peak voltage | 265VAC |
| AC frequency | 47–63 Hz |
| ON voltage drop | 1.5 VAC @ 0.5A |
| Max current | 0.5A / pt, 3A / common @ 45 °C<br>2A / common @ 60 °C |
| Max leakage current | 4mA @ 265VAC |
| Max inrush current | 15A for 10 ms, 10A for 100 ms |
| Minimum load | 10 mA |
| Base power required 5V | 450 mA max |
| OFF to ON response | 1 ms |
| ON to OFF response | 1 ms +1/2 AC cycle |
| Terminal type | Removable |
| Status indicators | Logic Side |
| Weight | 12.2 oz. (350 g) |
| Fuses (non-replaceable) | 1 (5A) per common |
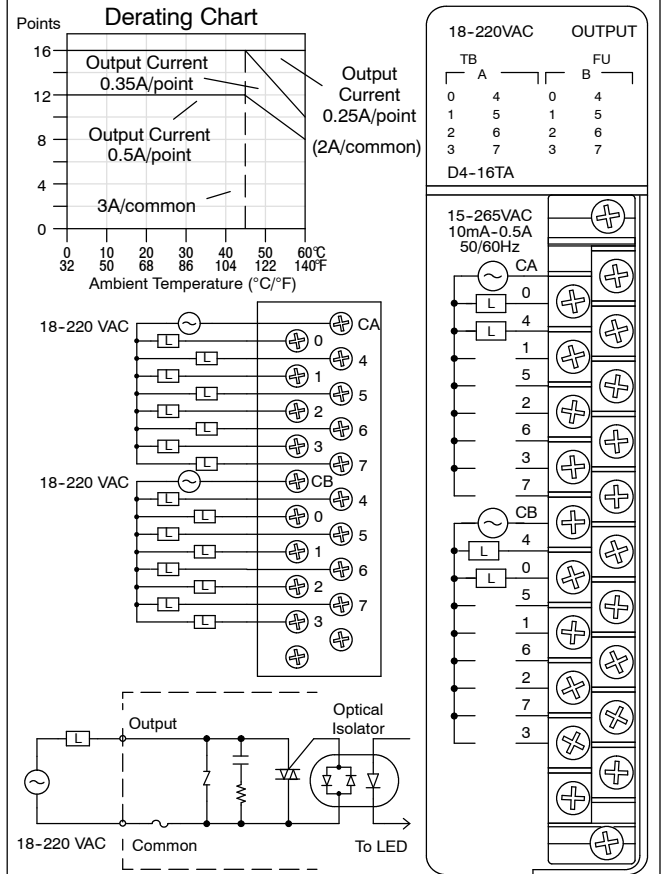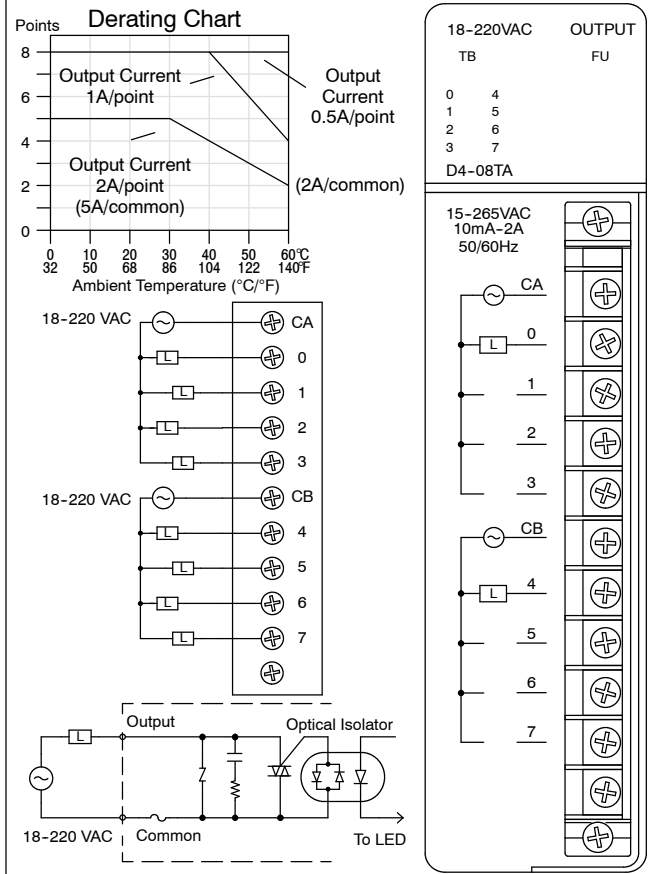
# D4–08TR, Relay Output

| | |
|---|---|
| Outputs per module | 8 relays |
| Commons per module | 2 (isolated) |
| Operating voltage | 5–30VDC / 5–250VAC |
| Output type | Form A (SPST–NO) |
| Peak voltage | 30VDC / 256VAC |
| AC frequency | 47–63 Hz |
| Max current (resistive) | 2A / point, 5A / common |
| Max leakage current | 0.1mA @ 265VAC |
| Max inrush current | 2A |
| Minimum load | 5mA |
| Base power required 5V | 550mA max |
| External DC required | None |
| OFF to ON response | 12 ms |
| ON to OFF response | 12 ms |
| Terminal type | Removable |
| Status indicators | Logic Side |
| Weight | 9.1 oz. (260 g) |
| Fuses (non-replaceable) | 1 (8A) per common |

### Typical Relay Life (Operations)

| Maximum Resistive or Inductive Inrush Load Current | Operating Voltage | | |
|---|---|---|---|
| | 30VDC | 125VAC | 250VAC |
| 2A resistive | 100K | 300K | 200K |
| 2A inductive | 100K | 80K | 60K |
| 0.5A resistive | 800K | 1M | 800K |
| 0.5A inductive | 300K | 300K | 200K |
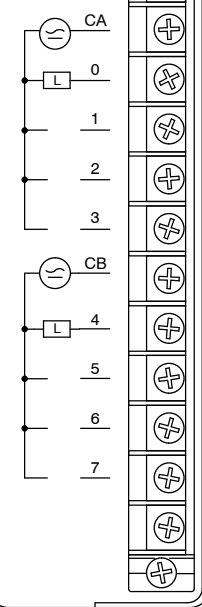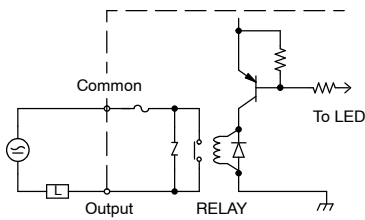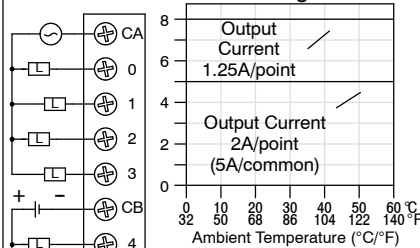


# F4–08TRS–1, Relay Output

| | |
|---|---|
| Outputs per module | 8 relays |
| Commons per module | 8 (isolated) |
| Operating voltage:12–30VDC, 12–125VAC, 125–250VAC* | |
| Output type: 4, Form C (SPDT), 4, Form A (SPST–NO) | |
| Peak voltage | 30VDC / 250VAC @10A |
| AC frequency | 47–63 Hz |
| Max current (resistive) | 10A / point, 40A / module |
| Max leakage current | 0.1mA @ 265VAC |
| Max inrush current | 10A |
| Minimum load | 100mA @12 VDC |
| Base power required 5V | 575mA max |
| External DC required | None |
| OFF to ON response | 7 ms |
| ON to OFF response | 9 ms |
| Terminal type | Removable |
| Status indicators | Logic Side |
| Weight | 13.2 oz. (374 g) |
| Fuses (non-replaceable) | 1 (10A/125V) per common |

### Typical Relay Life (Operations)

| Maximum Resistive or Inductive Inrush Load Current | Operating Voltage | | |
|---|---|---|---|
| | 30VDC | 125VAC | 250VAC |
| 1/4 HP | | 25K | |
| 10.0A | 50K | 50K | |
| 5.0A | 200K | 100K | |
| 3.0A | 325K | 125K | 50K |
| 0.5A | >50M | | |

Maximum DC voltage rating is 120 VDC @ 0.5A, 30,000 cycles typical. Motor starters up to and including NEMA size 3 can be used with this module.

# F4-08TRS-2, Relay Output

| | |
|---|---|
| Outputs per module | 8 relays |
| Commons per module | 8 (isolated) |
| Operating voltage | 12-30VDC, 12-250VAC |
| Output type: 4 Form C (SPDT), 4 Form A (SPST-NO) | |
| Peak voltage | 30VDC / 250VAC @5A |
| AC frequency | 47-63 Hz |
| Max current (resistive) | 5A / point, 40A / module |
| Max inrush current | 10A |
| Minimum load | 100mA @12 VDC |
| Base power required 5V | 575mA max |
| External DC required | None |
| OFF to ON response | 7 ms |
| ON to OFF response | 9 ms |
| Terminal type | Removable |
| Status indicators | Logic Side |
| Weight | 13.8 oz. (390 g) |
| Fuses, (user replaceable) | 1 (10A, 250V) per common |
| | 19379-K-10A Wickman |

### Typical Relay Life (Operations)

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

### Derating Chart



Output Current 5A/point (40A/module)

Maximum DC voltage rating is 120 VDC @ 0.5A, 30,000 cycles typical. Motor starters up to and including NEMA size 3 can be used with this module.



Sample Relay Output Circuit (1 of 4)

Sample Relay Output Circuit (1 of 4)
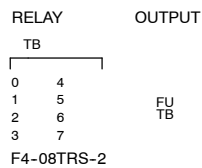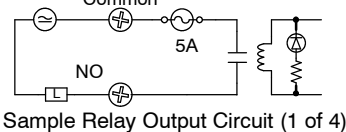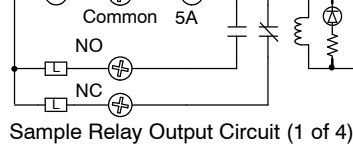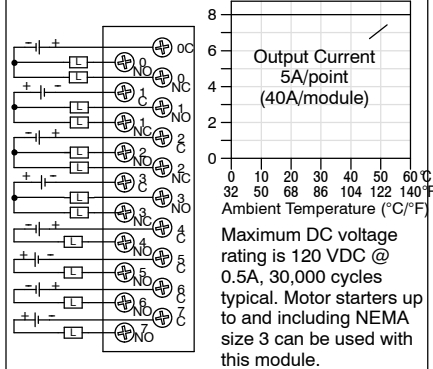
# D4-16TR, Relay Output

| | |
|---|---|
| Outputs per module | 16 relays |
| Commons per module | 2 (isolated) |
| Operating voltage | 5-30VDC / 5-250VAC |
| Output type | Form A (SPST-NO) |
| Peak voltage | 30VDC / 256VAC |
| AC frequency | 47-63 Hz |
| Max current (resistive) | 1A / point, 5A / common |
| Max leakage current | 0.1mA @ 265VAC |
| Max inrush current | 4A |
| Minimum load | 5mA |
| Base power required 5V | 1000mA max |
| External DC required | None |
| OFF to ON response | 10 ms |
| ON to OFF response | 10 ms |
| Terminal type | Removable |
| Status indicators | Logic Side |
| Weight | 10.9 oz. (310 g) |
| Fuses (non-replaceable) | 1 (8A) per common |

### Typical Relay Life (Operations)

| Maximum Resistive or Inductive Inrush Load Current | Operating Voltage | | |
|---|---|---|---|
| | 30VDC | 125VAC | 250VAC |
| 1A resistive | >1M | 500K | 300K |
| 1A inductive | 400K | 200K | 100K |
| 0.5A resistive | >2M | 800K | 500K |
| 0.5A inductive | >1M | 300K | 200K |

### Derating Chart



Output Current 0.6A/point

Output Current 1A/point (5A/common)
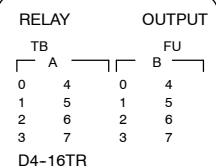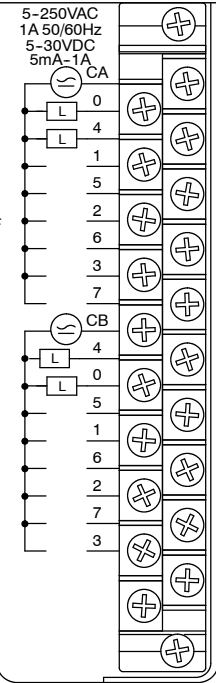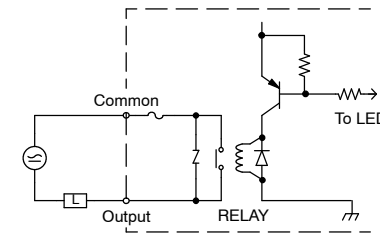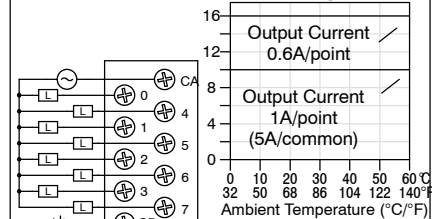
# F4-04AD 4-Channel Analog Input

| Number of Channels | 4 |
|---|---|
| Input Type | Single-ended or differential |
| Input Ranges | 0–5, 1–5, 0–10, 5, 10 VDC, 0–20, 4–20 mA. |
| Resolution | 12 bit (0 to 4095), unipolar 13 bit ( 4095), bipolar |
| Input Impedance | 20 MΩ minimum, voltage input |
| | 250 Ω, 1/2W, 0.1%, 25 ppm/° C current input |
| Max. Continuous Overload | 50 VDC, voltage input, 45 mA, current input |
| Recommended External Fuse | 0.032A, Series 217 fast acting, current inputs |
| Common Mode Voltage Range | 10V maximum |
| Linearity | 0.025% of span ( 1 count maximum, unipolar) |
| Input Stability | 1/2 count |
| Cross Talk | –80 dB, 1/2 count maximum |
| Full Scale Calibration Error | 12 counts maximum, voltage input |
| | 16 counts maximum, at 20.000 mA current input |
| Offset Calibration Error | 1 count maximum, voltage input |
| | 2 counts maximum, at 4.000 mA current input |
| Maximum Inaccuracy | 0.4% maximum @ 25°C (77° F) |
| | 0.55% maximum @ 0 to 60°C (32 to 140° F) |
| Conversion Time | < 6 mS per selected channel |
| Noise Rejection Ratio | Normal mode: –3 dB @ 50 Hz, –6 dB / octave |
| | Common mode: –70 dB, DC to 12 kHz |

| PLC Update Rate | 4 channel per scan max. |
|---|---|
| Digital Input Points Required 16 or 32-bit mode | 16 or 32 (X) input points 12 data bits, 4 bits optional for two's complement mode, 4 channel select bits, 12 bits unused in 32 bit mode |
| Power Budget Requirement | 85 mA (power from base) |
| External Power Supply | 24 VDC, 10%, 100 mA, class 2 |
| 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 |
| Vibration | MIL STD 810C 514.2 |
| Shock | MIL STD 810C 516.2 |
| Insulation Resistance | 10 MΩ, 500 VDC |
| Noise Immunity | NEMA ICS3-304 |

# F4-04AD 4-Channel Analog Input Module

NOTE 1: Shields should be grounded at the signal source.
NOTE 2: Unused channels should be shorted for best noise immunity.
NOTE 3: When a differential input is not used, 0V should be connected to C of the channel.

# F4-04ADS 4-Channel Isolated Analog Input

**Input Specifications**

| Number of Channels | 4 |
|---|---|
| Input Ranges | 0–5V, 0–10V, 1–5V, 5V, 10V, 0–20 mA, 4–20 mA |
| Resolution | 12 bit (1 in 4096) |
| Conversion Method | Successive approximation |
| Input Type | Differential |
| Max. Common Mode Voltage | 750V peak continuous transformer isolation |
| Noise Rejection Ratio | Common mode: –100 dB at 60Hz |
| Active Low-Pass Filtering | –3 dB at 20Hz, –12 dB per octave |
| Input Impedance | 250O 0.1%, 1/2W current input<br>200KO voltage input |
| Absolute Maximum Ratings | 45 mA, current input<br>100V, voltage input |
| Conversion Time | 1 mS per selected channel |
| Linearity Error | 1 count (0.025% of full scale) maximum |
| Full Scale Calibration Error | 8 counts maximum ($V_{in}$ = 20 mA) |
| Offset Calibration Error | 8 counts maximum ($V_{in}$ = 4 mA) |

**General Specifications**

| PLC Update Rate | 4 channel per scan max. |
|---|---|
| Digital Input Points Required | 12 binary data bits, 4 active channel indicator bits |
| Accuracy vs. Temperature | 100 ppm / °C maximum full scale (including maximum offset) |
| Power Budget Requirement | 270 mA @ 5 VDC (from base) |
| External Power Supply | 24 VDC, 10%, 120 mA, class 2 |
| Recommended Fuse | 0.032 A, Series 217 fast-acting, current inputs |
| 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 |
| Vibration | MIL STD 810C 514.2 |
| Shock | MIL STD 810C 516.2 |
| Noise Immunity | NEMA ICS3–304 |

# F4-04ADS 4-Channel Isolated Analog Input Module

**Wiring Diagram**

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

NOTE 2: Unused channels should have V & C & R of the channels jumpered together.
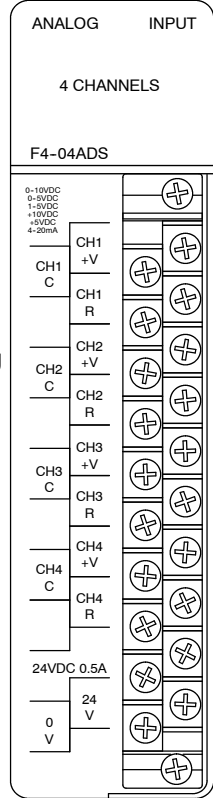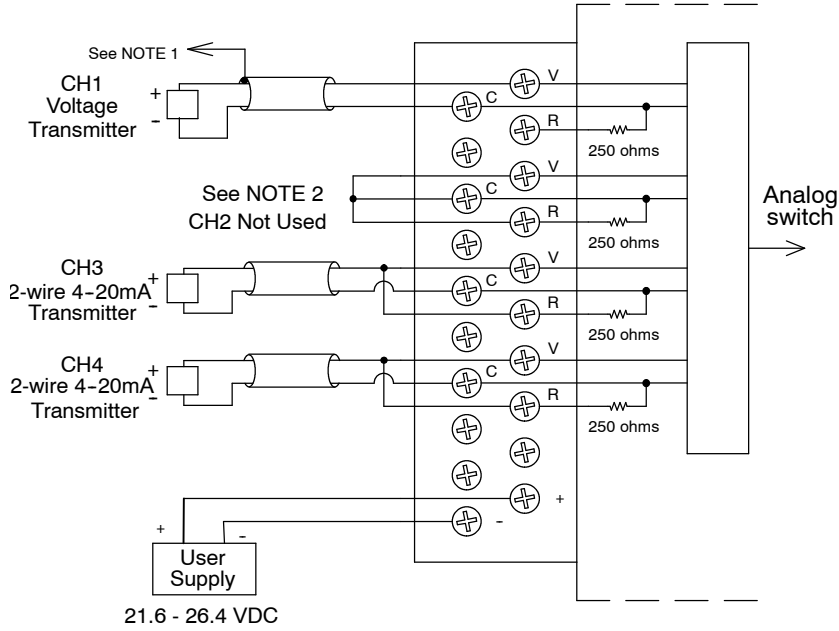
# F4-08AD 8-Channel Analog Input

**Input Specifications**

| Number of Channels | 8, single ended (one common) |
|---|---|
| Input Ranges | 0–5V, 0–10V, 1–5V, 5V, 10V, 0–20 mA, 4–20 mA |
| Resolution | 12 bit (1 in 4096) |
| Active Low-pass Filtering | –3 dB at 20Hz, –12 dB per octave |
| Input Impedance | 250 ohms 0.1%, 1/2W current input >20 Megohms voltage input, 1 Megohm minimum |
| Absolute Maximum Ratings | 45 mA, current input 75V, voltage input |
| Conversion Time | 0.4ms per channel (module conversion) 1 ms per selected channel minimum (CPU) |
| Linearity Error (End to End) | 1 count (0.025% of full scale) maximum |
| Input Stability | 1/2 count |
| Full Scale Calibration Error (Offset error not included) | 12 counts maximum , voltage input 12 counts maximum, @ 20mA current input |
| Offset Calibration Error | 2 counts maximum, unipolar voltage input 4 counts maximum, bipolar voltage input 4 counts maximum, 4 mA current input |

**General Specifications**

| PLC Update Rate | 8 Channel per scan max. |
|---|---|
| Digital Input Points Required | 16 (X) input points total 12 binary data bits, 3 active channel bits, |
| Power Budget Requirement | 75 mA (power from base) |
| External Power Supply | 18–30 VDC, 90 mA, class 2 |
| Recommended Fuse | 0.032 A, Series 217 fast-acting, current inputs |
| Accuracy vs. Temperature | 50 ppm / °C maximum full scale (including maximum offset change of 2 counts) |
| Operating Temperature | 0 to 60°C (32 to 140° F) |
| Storage Temperature | –20 to 70°C (–4° F to 158° F) |
| Relative Humidity | 5 to 95% (non-condensing) |
| Environmental Air | No corrosive gases permitted |
| Vibration | MIL STD 810C 514.2 |
| Shock | MIL STD 810C 516.2 |
| Noise Immunity | NEMA ICS3–304 |

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

# F4-08AD 8-Channel Analog Input Module

NOTE 1: Shields should be grounded at the signal source.
NOTE 2: Unused channels should be connected to 0V
or have current jumpers installed.
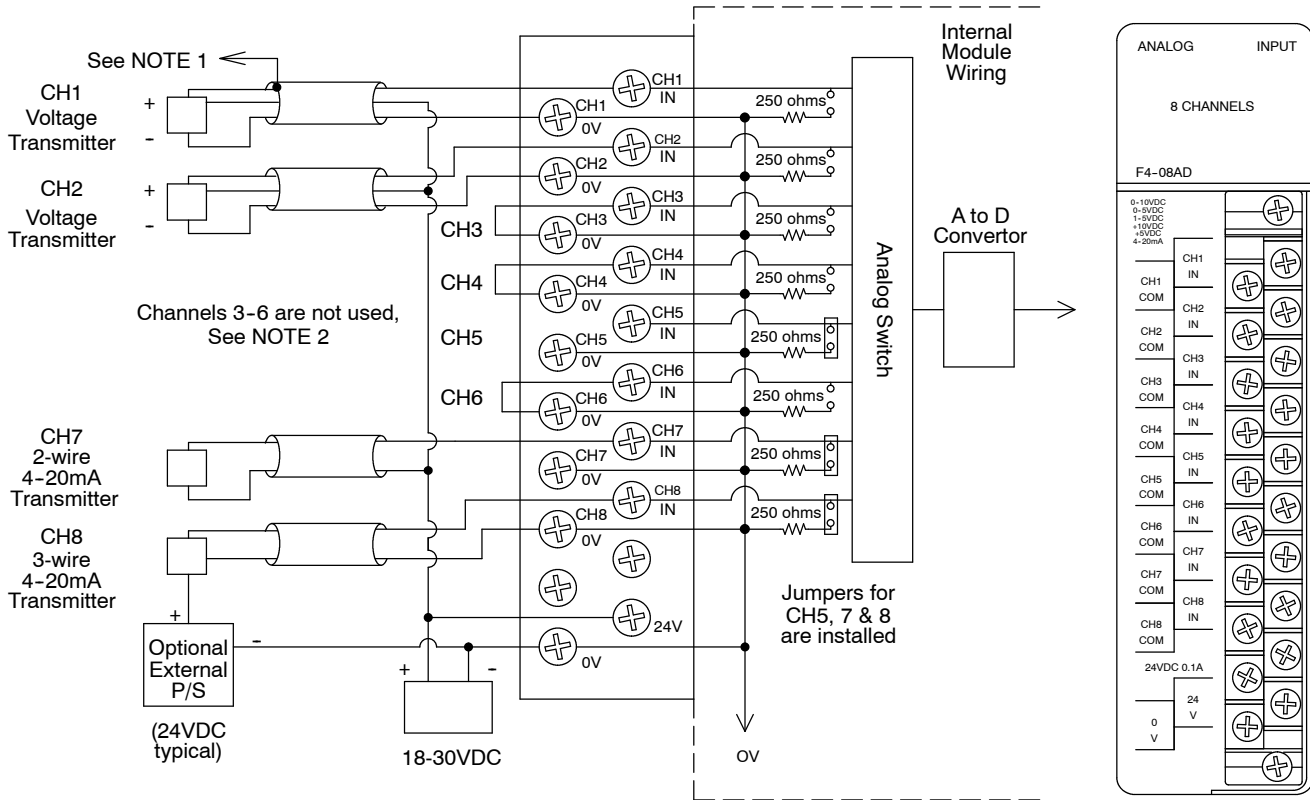


More than one external power supply can be used (see channel 8).

If the power supply common of an external power supply is not connected to 0V on the module, then the output of the external transmitter must be isolated. To avoid "ground loop" errors, recommended 4-20mA transmitter types are:

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

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

# D4-02DA 2-Channel Analog Output

**Output Specifications**

| Number of Channels | 2 (independent) |
|---|---|
| Output Ranges | 0–10V, 1–5V, 4–20 mA |
| Resolution | 12 bit (1 in 4096) |
| Output Type | Single ended |
| Output Impedance | 0.5Ω maximum, voltage output |
| Output Current | 5 mA maximum, voltage output |
| Load Impedance | 550Ω max., 5.0Ω min.,current output, 2KΩ minimum, voltage output |
| Linearity | 0.1% maximum |
| Accuracy vs. Temperature | 70 ppm / °C maximum |
| Maximum Inaccuracy | 0.2% maximum at 25° C |
| Conversion Method | Integration |
| Conversion Time | Start of scan, 30μS + one scan |

**General Module Specifications**

| PLC Update Rate | 1 or 2 channels per scan |
|---|---|
| Digital Output Points Required | 32 (Y) output points<br>12 binary data bits per channel (24 bits total with 8 unused bits) |
| Power Budget Requirement | 250 mA (from base) |
| External Power Supply | 24VDC,    10%, 300 mA, class 2 |
| 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 |
| Vibration | MIL STD 810C 514.2 |
| Shock | MIL STD 810C 516.2 |
| Insulation Resistance | 10 MO, 500 VDC |
| Noise Immunity | NEMA ICS3–304 |

# D4-02DA 2-Channel Analog Output Module

NOTE 1: Shields should be connected to the 0V
terminal of the module or power supply.
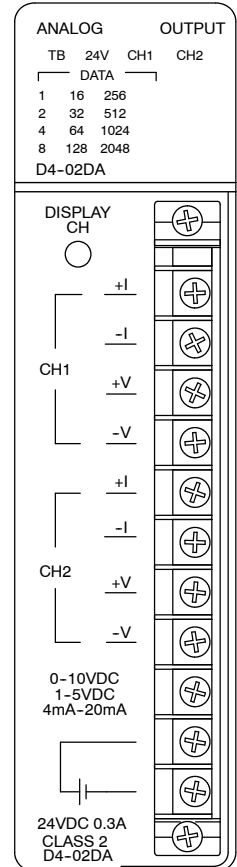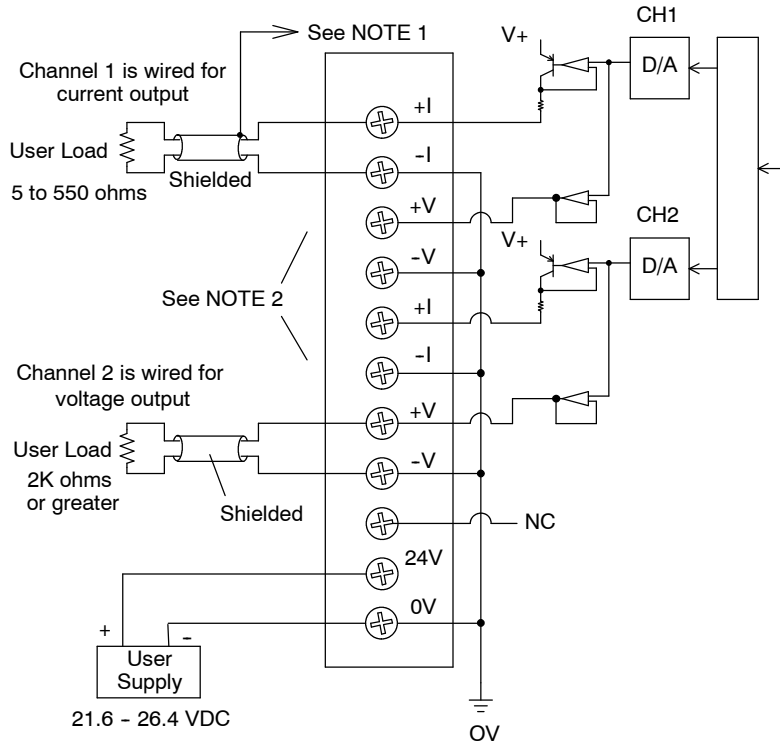
NOTE 2: Unused voltage and current outputs
should remain open (no connections).

# F4-04DA 4-Channel Analog Output

**Output Specifications**

| Number of Channels | 4 |
|---|---|
| Output Ranges | 0–5V, 0–10V, 5V, 10V, 4–20 mA |
| Resolution | 12 bit (1 in 4096) |
| Conversion Method | Successive Approximation |
| Output Type | Single ended, 1 common |
| Output Impedance | 0.2Ω typical, voltage output |
| Load Impedance | 2KΩ minimum, voltage output<br>0Ω minimum, current output |
| Maximum Load / Voltage | 680Ω/18V, 1KΩ/24V, 1.5KΩ/36V,<br>current output |
| Voltage Output Current | 5 mA sink or source |
| Short-Circuit Current | 15 mA typical, voltage output |
| Linearity Error | 1 count ( 0.025%) maximum |
| Gain Calibration Error | 8 counts maximum, voltage output<br>–8 to +11 counts maximum, current output |
| Offset Calibration Error | 2 counts maximum, voltage output<br>–5 to +9 counts maximum, current output |
| Conversion Time | 5 µs maximum, settling time<br>0.3 ms maximum, digital out to analog out |

**General Module Specifications**

| Digital Output Points Required | 16 point (Y) outputs,<br>12 bits binary data, 4 channel select bits |
|---|---|
| Power Budget Requirement | 120 mA @ 5 VDC (from base) |
| External Power Supply | 24 VDC, 100 mA, class 2 10%<br>(add 20 mA for each current loop used) |
| Accuracy vs. Temperature | 50 ppm / °C maximum full scale<br>25 ppm / °C maximum offset |
| 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 |
| Vibration | MIL STD 810C 514.2 |
| Shock | MIL STD 810C 516.2 |
| Noise Immunity | NEMA ICS3-304 |

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

# F4-04DA 4-Channel Analog Output Module

**Wiring Diagram**

NOTE 1: Shields should be connected to the 0V terminal of the module or power supply.
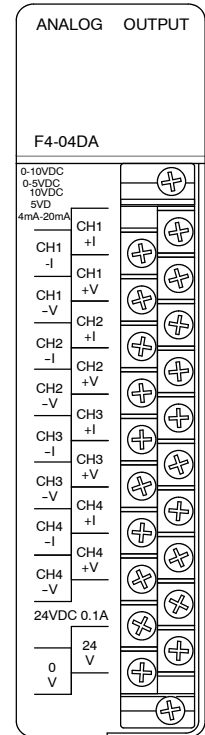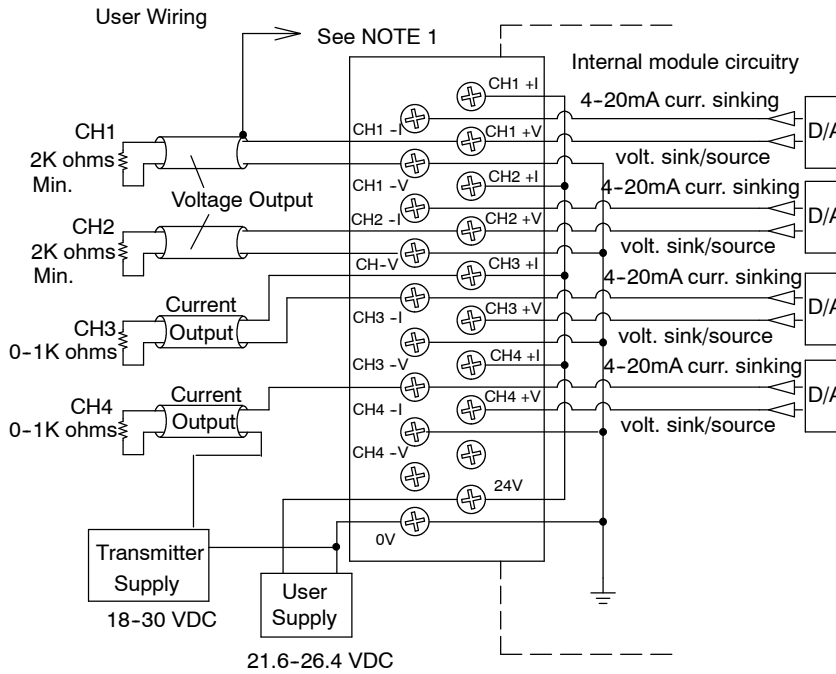
NOTE 2: Unused voltage and current outputs should remain open (no connections).

# F4-04DA-1 4-Channel Analog Current Output

**Output Specifications**

| Number of Channels | 4, single ended (one common) |
|---|---|
| Output Range | 4–20 mA |
| Resolution | 12 bit (1 in 4095) |
| Output Type | Outputs sink 4-20 mA from external supply |
| External Load Resistance | 0O minimum |
| Maximum Loop Supply | 30 VDC |
| Peak Output Voltage | 40 VDC (clamped, transient suppressed) |
| Maximum Load / Power Supply | 620O/18V, 910O/24V, 1200O/30V |
| Linearity Error (best fit) | 1 count ( 0.025%) maximum |
| Gain Calibration Error | 5 counts maximum |
| Offset Calibration Error | 3 counts maximum |
| Maximum Inaccuracy | 0.1% @ 25°C (77°F)<br>0.3% @ 0 to 60°C (32 to140°F) |
| Conversion Time | 100 µs maximum, settling time<br>2.0 ms maximum, digital out to analog out |

**General Module Specifications**

| Digital Output Points Required | 16 point (Y) outputs,<br>12 bits binary data and 4 active channel bits |
|---|---|
| Power Budget Requirement | 70 mA @ 5 VDC (from base) |
| External Power Supply | 21.6–26.4 VDC, 75 mA, class 2<br>(add 20 mA for each current loop used) |
| Accuracy vs. Temperature | 57 ppm / °C full scale calibration range<br>(including maximum offset change, 2 counts) |
| 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 |
| Vibration | MIL STD 810C 514.2 |
| Shock | MIL STD 810C 516.2 |
| Noise Immunity | NEMA ICS3-304 |

# F4-04DA-1 4-Channel Analog Current Output Module

**Wiring Diagram**

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

NOTE 2: Unused current outputs should remain open (no connections).
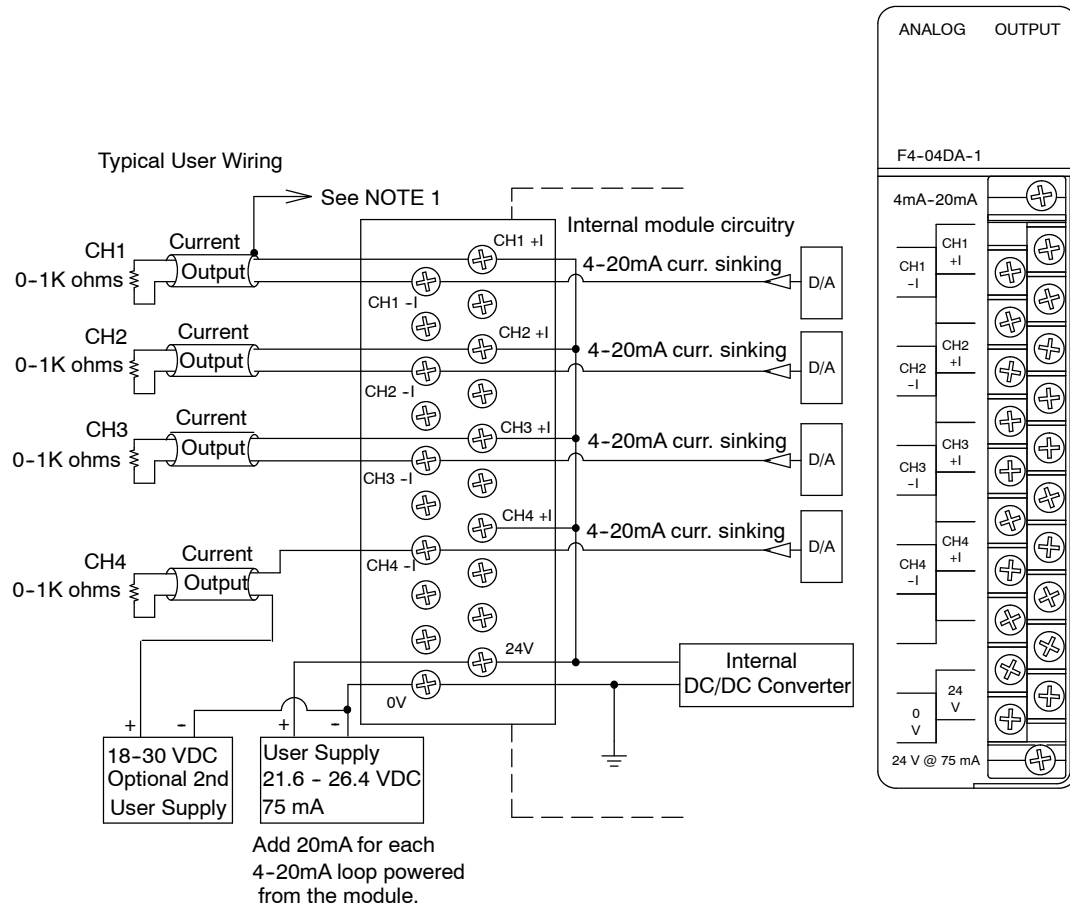
# F4-04DA-2 4-Channel Analog Voltage Output

**Output Specifications**

| Number of Channels | 4, single ended (one common) |
|---|---|
| Output Ranges | 0–5, 0–10,   5 ,    10 VDC |
| Resolution | 12 bit (1 in 4095) |
| Load Impedance | 2KO minimum |
| Load Capacitance | 0.01 uF maximum |
| Voltage Output Current | 5.0 mA sink or source |
| Short-circuit Current | 15 mA typical |
| Linearity Error (end to end) and Relative Accuracy |   1 count (   0.025%) maximum |
| Offset Calibration Error |   3 counts maximum, unipolar   4 counts maximum, bipolar |
| Full Scale Calibration Error |   8 counts maximum, (offset error included) |
| Maximum Inaccuracy | 0.2% @ 25°C (77°F) 0.4% @ 0 to 60° C (32 to140°F) |
| Conversion Time | 5 µs maximum, settling time 2.0 ms maximum, digital out to analog out |

**General Module Specifications**

| Digital Output Points Required | 16 point (Y) outputs, 12 bits binary data, 4 active channel bits or 2 active channel bits and 1 sign bit for bipolar |
|---|---|
| Power Budget Requirement | 90 mA @ 5 VDC (from base) |
| External Power Supply | 21.6–26.4 VDC, 90 mA, class 2 (outputs fully loaded) |
| Accuracy vs. Temperature |   57 ppm / °C full scale calibration change (including maximum offset change, 2 counts) |
| 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 |
| Vibration | MIL STD 810C 514.2 |
| Shock | MIL STD 810C 516.2 |
| Noise Immunity | NEMA ICS3-304 |

# F4-04DA-2 4-Channel Analog Voltage Output Module

**Wiring Diagram**

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

NOTE 2: Unused voltage outputs should remain open (no connections).
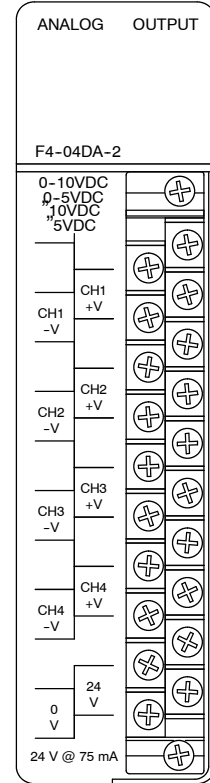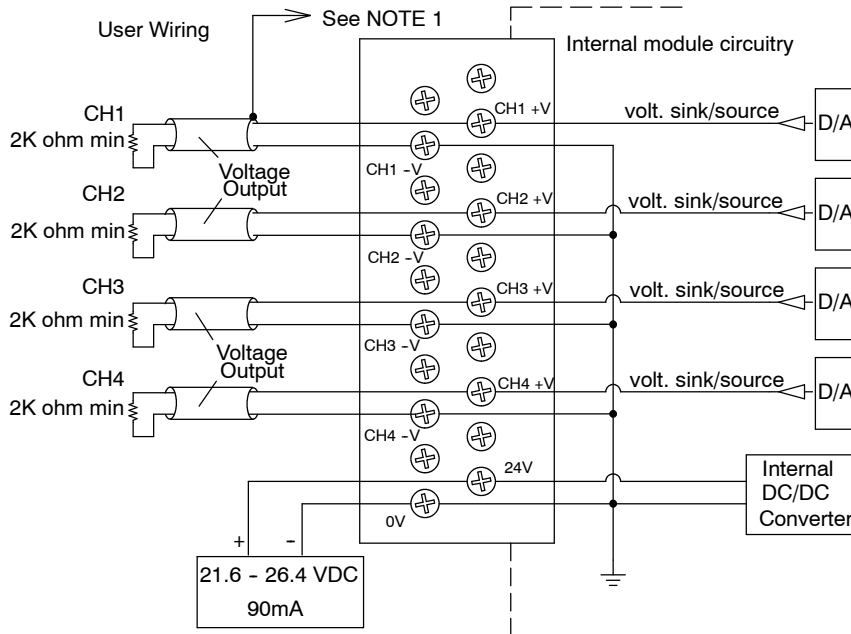
# F4-04DAS-1 4-Channel 4-20mA Isolated Analog Output

**Output Specifications**

| Number of Channels | 4, isolated current sourcing |
|---|---|
| Output Ranges | 4–20mA current |
| Resolution | 16 bit (1 in 65536) |
| Output Type | Outputs source 4–20 mA from external supply |
| Isolation Voltage | 750V continuous, channel to channel, channel to logic |
| Load Impedance | 0Ω – 1375Ω |
| Loop Supply | 12–32VDC |
| Output Loop Compliance | Vin–2.5V |
| Max. Load/Power Supply | 375Ω/12V, 975Ω/24V, 1375Ω/32V |
| PLC Update Rate | 1 channel per scan min., 4 per scan max. |
| Linearity Error (end to end) and Relative Accuracy | 10 count ( 0.015%) maximum |
| Offset Calibration Error | 13 counts ( 0.02%) |
| Gain Calibration Error | 32 counts maximum, (offset error included) |
| Maximum Inaccuracy | 0.07% @ 25°C (77°F) 0.18% @ 0 to 60° C (32 to140°F) |
| Conversion Time | 3ms to 0.1% of full scale |

**General Module Specifications**

| Digital Output Points Required | 32 point (Y) outputs, 16 bits binary data, 2 channel identification bits and 1 output enable |
|---|---|
| Power Budget Requirement | 60 mA @ 5 VDC (from base) |
| External Power Supply | 50 mA per channel |
| Accuracy vs. Temperature | 50 ppm / °C full scale calibration change (including maximum offset change, 2 counts) |
| 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 |
| Vibration | MIL STD 810C 514.2 |
| Shock | MIL STD 810C 516.2 |
| Noise Immunity | NEMA ICS3-304 |

# F4-04DAS-1 4-Channel 4-20mA Isolated Analog Output Module

## Wiring Diagram

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

NOTE 2: Load must be within compliance voltage.

NOTE 3: For non-isolated outputs, connect all 0V's together (0V1 .......0V4) and connect all +V's together (+V1 .......+V4).

Internal module circuitry

User Wiring

Note 3

Transmitter Supply 12-32VDC

N/C

0V1    +V1

-I1    +I1

CH1    4-20mA current sourcing    D/A

0-1375Ω    Note 2    100Ω

Transmitter Supply 12-32VDC

N/C    0V2

+V2    -I2

CH2    4-20mA current sourcing    D/A

0-1375 Ω    Note 2    +I2    100Ω    N/C

Transmitter Supply 12-32VDC

0V3    +V3

-I3    +I3

CH3    4-20mA current sourcing    D/A

0-1375 Ω    Note 2    100Ω

Transmitter Supply 12-32VDC

N/C    0V4

+V4    -I4

CH4    4-20mA current sourcing    D/A

0-1375Ω    Note 2    +14    100Ω

ANALOG    OUTPUT

4 CHANNELS

F4-04DAS-1

4mA-20mA

0V1    +V1

-I1    +I1

0V2    +V2

-I2    +I2

0V3    +V3

-I3    +I3
-I

0V4    +V4

-I4

+I4

# F4-08DA-1 8-Channel Analog Current Output

**Output Specifications**

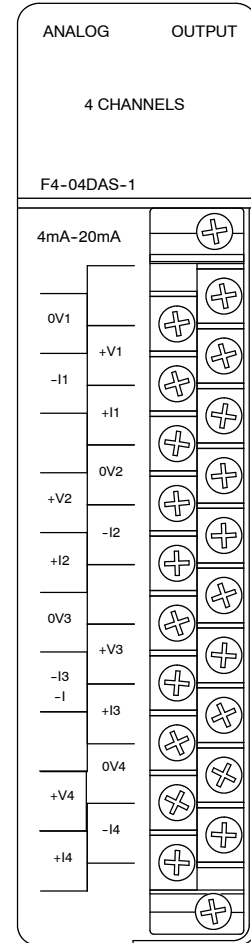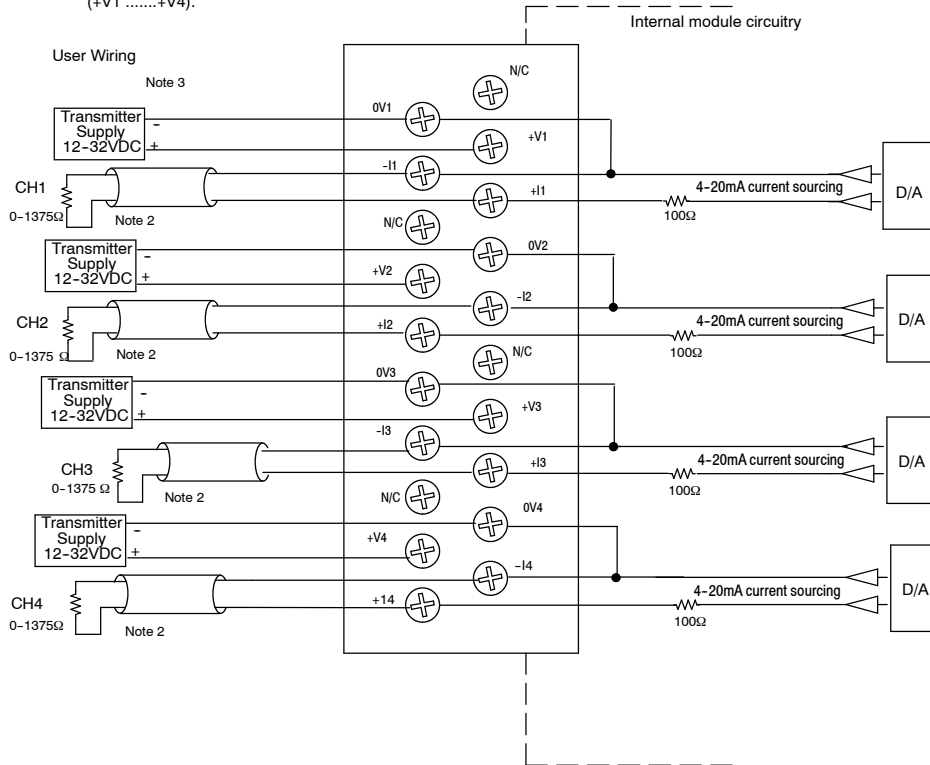| Number of Channels | 8, single ended (one common) |
|---|---|
| Output Range | 4–20 mA current |
| Resolution | 12 bit (1 in 4095) |
| Output Type | Outputs sink 4–20 mA from external supply |
| Peak Output Voltage | 40 VDC (no transient voltage suppression) |
| External Load Resistance | 0–480O at 18V, 220–740O at 24V, 1550–1760O at 48V |
| Maximum Loop Supply | 48 VDC (with load resistance in proper range) |
| Crosstalk | –70 dB, 1 count maximum |
| Linearity Error (end-to-end) and Relative Accuracy | 1 count maximum |
| Full Scale Calibration Error (offset error included) | 8 counts maximum (20mA at 25°C) |
| Offset Calibration Error | 3 counts maximum (4mA at 25°C) |
| Maximum Inaccuracy | 0.2% at 25°C (77°F) 0.4% at 0 to 60°C (32 to140°F) |
| Conversion Time | 400 µs maximum, for full scale change 2.25 to 4.5 mS for digital output to analog out |

**General Module Specifications**

| Digital Output Points Required | 16 point (Y) outputs, 12 bits binary data, 3 bits channel select, 1 bit output enable |
|---|---|
| Power Budget Requirement | 90 mA at 5 VDC (supplied by base power supply) |
| External Power Supply | 21.6-26.4 VDC, 100 mA, class 2 (add 20 mA for each current loop used) |
| Accuracy vs. Temperature | 57 ppm / °C full scale calibration range (including maximum offset change, 2 counts) |
| 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 |
| Vibration | MIIL STD 810C 514.2 |
| Shock | MIL STD 810C 516.2 |
| Noise Immunity | NEMA ICS3-304 |

# F4-08DA-1 8-Channel Analog Current Output Module

**Wiring Diagram**

NOTE 1: Shields should be connected to the 0V of the User
Power Supply at the module terminal block.
NOTE 2: Unused current outputs should remain open (no connections).

Typical User Wiring



Add 20mA for each
4-20mA loop powered
from this supply.

# F4-08DA-2 8-Channel Analog Current Output

**Output Specifications**

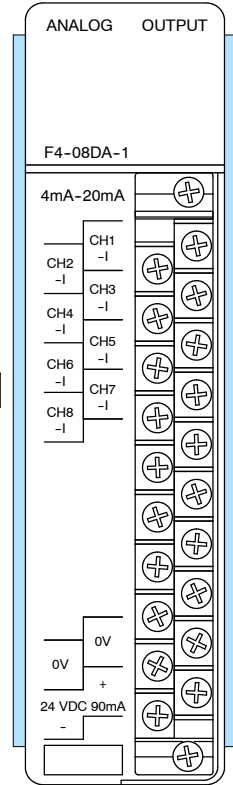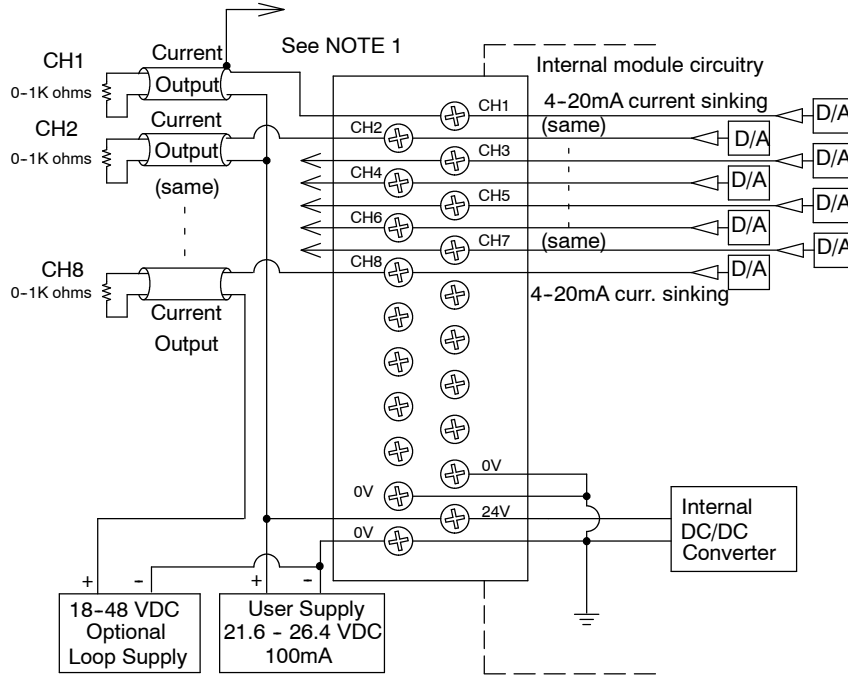| | |
|---|---|
| Number of Channels | 8, single ended (one common) |
| Output Range | 0–5VDC, 0–10VDC |
| Resolution | 12 bit (1 in 4095) |
| Output Type | OVoltage Sourcing 10mA maximum |
| External Load Resistance | 1kO maximum /10kO minimum |
| Crosstalk | –70 dB,  1 count maximum |
| Linearity Error (end-to-end) and Relative Accuracy | 1 count maximum (10VDC at 25°C) |
| Full Scale Calibration Error (offset error included) | 6 counts maximum (10VDC at 25°C) |
| Offset Calibration Error | 3 counts maximum (0VDC at 25°C) |
| Maximum Inaccuracy | 0.2%  at 25°C (77°F) <br> 0.4% at  0 to 60°C (32 to140°F) |
| Conversion Time | 400 µs maximum, for full scale change <br> 4.5 to 9 mS for digital output to analog out |

**General Module Specifications**

| | |
|---|---|
| Digital Output Points Required | 16 point (Y) outputs, <br> 12 bits binary data, 3 bits channel select, <br> 1 bit output enable |
| Power Budget Requirement | 80 mA at 5 VDC (supplied by base power supply) |
| External Power Supply | 21.6-26.4 VDC, 150 mA, class 2 <br> (add 20 mA for each current loop used) |
| Accuracy vs. Temperature | 57 ppm / °C full scale calibration range <br> (including maximum offset change, 2 counts) |
| 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 |
| Vibration | MIIL STD 810C 514.2 |
| Shock | MIL STD 810C 516.2 |
| Noise Immunity | NEMA ICS3-304 |

I/O Wiring and Specifications

# F4-08DA-2 8-Channel Analog Voltage Output Module

NOTE 1: Shields should be connected to the 0V terminal of the User
Power Supply at the module terminal block.

# F4-16DA-1 16-Channel Analog Current Output

**Output Specifications**

| | |
|---|---|
| Number of Channels | 16, single ended (one common) |
| Output Range | 4–20 mA current |
| Resolution | 12 bit (1 in 4095) |
| Output Type | Outputs sink 4–20 mA from external supply |
| Peak Output Voltage | 40 VDC (no transient voltage suppression) |
| External Load Resistance | 0–480O @ 18V, 220–740O @ 24V, 1550–1760O @ 48V |
| Maximum Loop Supply | 48 VDC (with load resistance in proper range) |
| Crosstalk | –70 dB,    1 count maximum |
| Linearity Error (end-to-end) and Relative Accuracy | 1 count maximum (20mA at 25°C) |
| Full Scale Calibration Error (offset error included) | 8 counts maximum (20mA at 25°C) |
| Offset Calibration Error | 3 counts maximum (4mA at 25°C) |
| Maximum Inaccuracy | 0.2% @ 25°C (77°F) 0.4% @ 0 to 60°C (32 to 140°F) |
| Conversion Time | 400 µs maximum, for full scale change 4.5 to 9 mS for digital output to analog out |

**General Module Specifications**

| | |
|---|---|
| Digital Output Points Required | 32 point (Y) outputs, 2 sets each of 12 bits binary data, 3 bits channel select, 1 bit output enable |
| Power Budget Requirement | 90 mA @ 5 VDC (supplied by base) |
| External Power Supply | 21.6 – 26.4 VDC, 100 mA, class 2 (add 20 mA for each current loop used) |
| Accuracy vs. Temperature | 57 ppm / °C full scale calibration range (including maximum offset change, 2 counts) |
| 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 |
| Vibration | MIL STD 810C 514.2 |
| Shock | MIL STD 810C 516.2 |
| Noise Immunity | NEMA ICS3-304 |

# F4-16DA-1 16-Channel Analog Current Output Module

**Wiring Diagram**

NOTE 1: Shields should be connected to the 0V of the User Power
Supply at the module terminal block.

NOTE 2: Unused current outputs should remain open (no connections).

Typical User Wiring

See NOTE 1

Internal module circuitry
4-20mA current sinking

CH1    0-1K ohms    Current Output

CH2    0-1K ohms    Current Output

(same)

CH16   0-1K ohms    Current Output

Internal DC/DC Converter

18-48 VDC Optional Loop Supply

User Supply 21.6 - 26.4 VDC 100mA

Add 20mA for each
4-20mA loop powered
from this supply

ANALOG    OUTPUT

F4-16DA-1

4mA-20mA

# F4-16DA-2 16-Channel Analog Voltage Output

**Output Specifications**

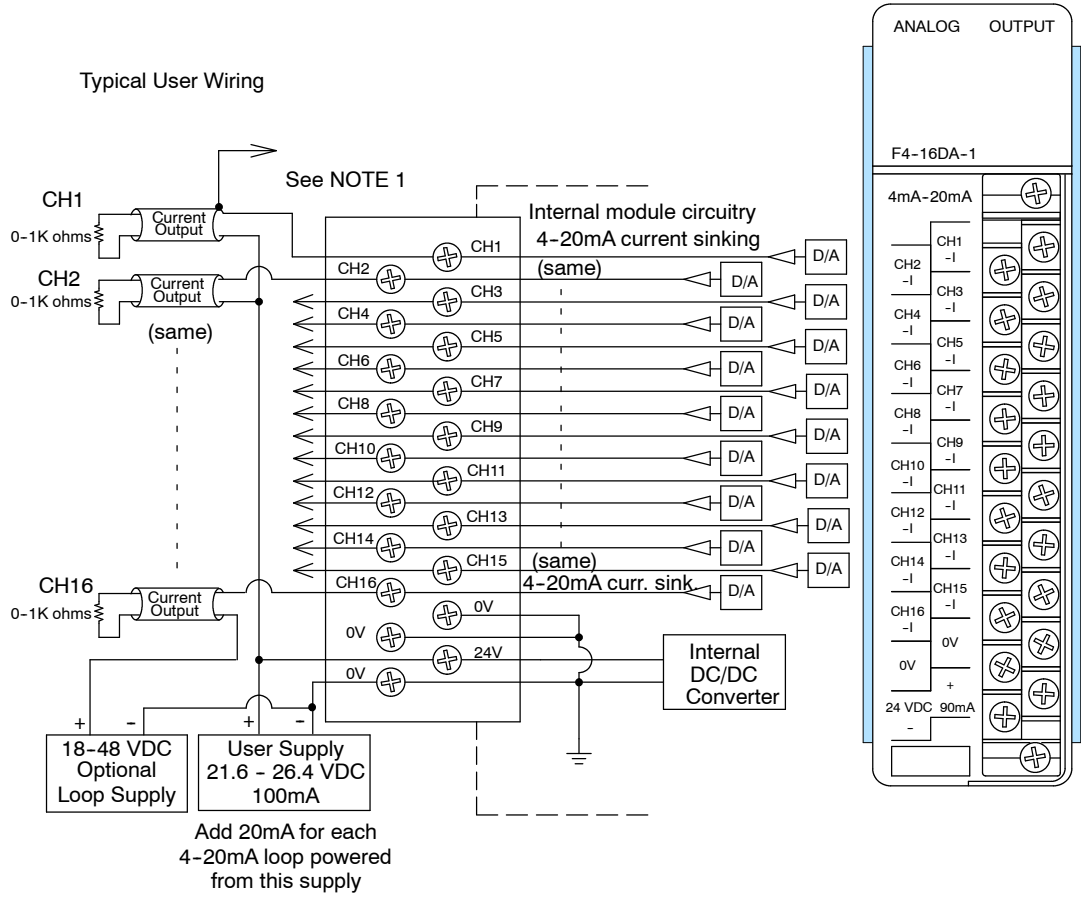| Number of Channels | 16, single ended (one common) |
|---|---|
| Output Range | 0–5VDC, 0–10VDC |
| Resolution | 12 bit (1 in 4095) |
| Output Type | Voltage Sourcing 10mA maximum |
| External Load Resistance | 1kO maximum /10kO minimum |
| Crosstalk | –70 dB,    1 count maximum |
| Linearity Error (end-to-end) and Relative Accuracy | 1 count maximum (10VDC at 25°C) |
| Full Scale Calibration Error (offset error included) | 6 counts maximum (10VDC at 25°C) |
| Offset Calibration Error | 3 counts maximum (0VDC at 25°C) |
| Maximum Inaccuracy | 0.2%   at 25°C (77°F)<br>0.4% at  0 to 60°C (32 to140°F) |
| Conversion Time | 400 µs maximum, for full scale change<br>4.5 to 9 mS for digital output to analog out |

**General Module Specifications**

| Digital Output Points Required | 32 point (Y) outputs,<br>two sets each of 12 bits binary data, 3 bits channel select, 1 bit output enable |
|---|---|
| Power Budget Requirement | 80 mA at 5 VDC (supplied by base power supply) |
| External Power Supply | 21.6-26.4 VDC, 150 mA, class 2<br>(add 20 mA for each current loop used) |
| Accuracy vs. Temperature | 57 ppm / °C full scale calibration range<br>(including maximum offset change, 2 counts) |
| 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 |
| Vibration | MIIL STD 810C 514.2 |
| Shock | MIL STD 810C 516.2 |
| Noise Immunity | NEMA ICS3-304 |

# F4-16DA-2 16-Channel Analog Voltage Output Module

NOTE 1: Shields should be connected to the 0V terminal of the User Power
Supply at the module terminal block.

Typical User Wiring

# F4-08THM 8-Channel Thermocouple Input

**Input Specifications**

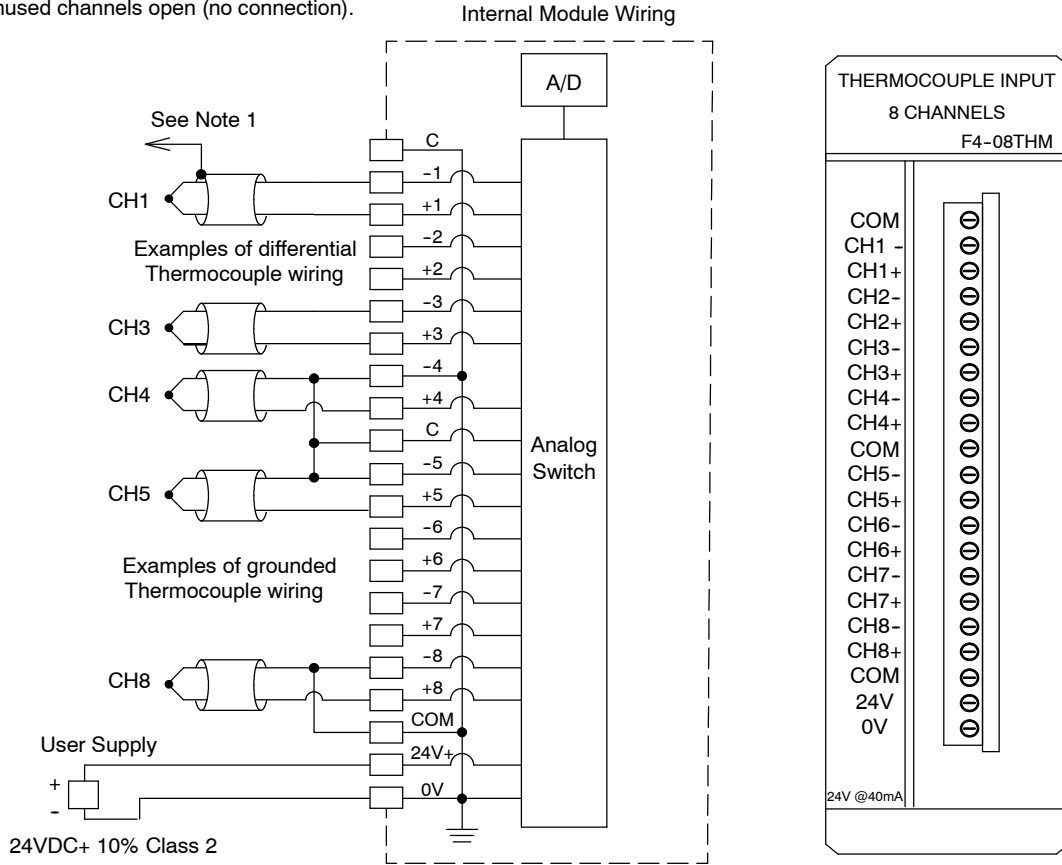| Number of Channels | 8, differential inputs |
|---|---|
| Input Ranges | Type J: –190/760 °C, ——–310/1400 °F<br>Type E: –210/1000 °C, –346/1832 °F<br>Type K: –150/1372 °C, ——–238/2502 °F<br>Type R: 65/1768 °C, 149/3214 °F<br>Type S: 65/1768 °C, 149/3214 °F<br>Type T: –230/400 °C, –382/752 °F<br>Type B: 529/1820 °C, 984/3308°F<br>Type N: –70/1300 °C, –94/2372°F<br>Type C: –65/2320 °C, –146/4208 °F |
| Display Resolution | 0.1° C or 0.1° F |
| Input Impedance | 1MO |
| Absolute Maximum Ratings | Fault-protected input, 50 VDC |
| Cold Junction Compensation | Automatic |
| Conversion Time | 100ms per channel, minimum |
| Linearity Error | .05° C maximum, .01° C typical |
| Full Scale Calibration Error | 13 counts typical, 33 counts max. |
| Maximum Inaccuracy* | .02% @ 25° C |

**General Specifications**

| PLC Update Rate | 8 channel per scan max. |
|---|---|
| Digital Input Points Required | 16 (X) input points, including , 2 channel ID bits, 4 diagnostic bit |
| Power Budget Requirement | 110 mA @ 5 VDC (from base) |
| External Power Supply | 60 mA maximum, 18 to 26.4VDC |
| Operating Temperature | 0° to 60° C (32° to 140° F) |
| Storage Temperature | –20° to 70° C (–4° to 158° F) |
| Accuracy vs. Temperature | 57 ppm / °C maximum full scale |
| Relative Humidity | 5 to 95% (non-condensing) |
| Environmental air | No corrosive gases permitted |
| Vibration | MIL STD 810C 514.2 |
| Shock | MIL STD 810C 516.2 |
| Noise Immunity | NEMA ICS3–304 |

I/O Wiring and
Specifications

# F4-08THM 8-Channel Thermocouple Input Module

Note 1: Terminate shields at the respective signal source.
Note 2: Leave unused channels open (no connection).

Internal Module Wiring



THERMOCOUPLE INPUT

8 CHANNELS

F4-08THM

COM
CH1 -
CH1+
CH2-
CH2+
CH3-
CH3+
CH4-
CH4+
COM
CH5-
CH5+
CH6-
CH6+
CH7-
CH7+
CH8-
CH8+
COM
24V
0V

24V @40mA

A/D

See Note 1

CH1

Examples of differential
Thermocouple wiring

CH3

CH4

CH5

Analog
Switch

Examples of grounded
Thermocouple wiring

CH8

User Supply

+

-

24VDC+ 10% Class 2

C
-1
+1
-2
+2
-3
+3
-4
+4
C
-5
+5
-6
+6
-7
+7
-8
+8
COM
24V+
0V

# F4-08THM-n 8-Channel Thermocouple Input

**Input Specifications**

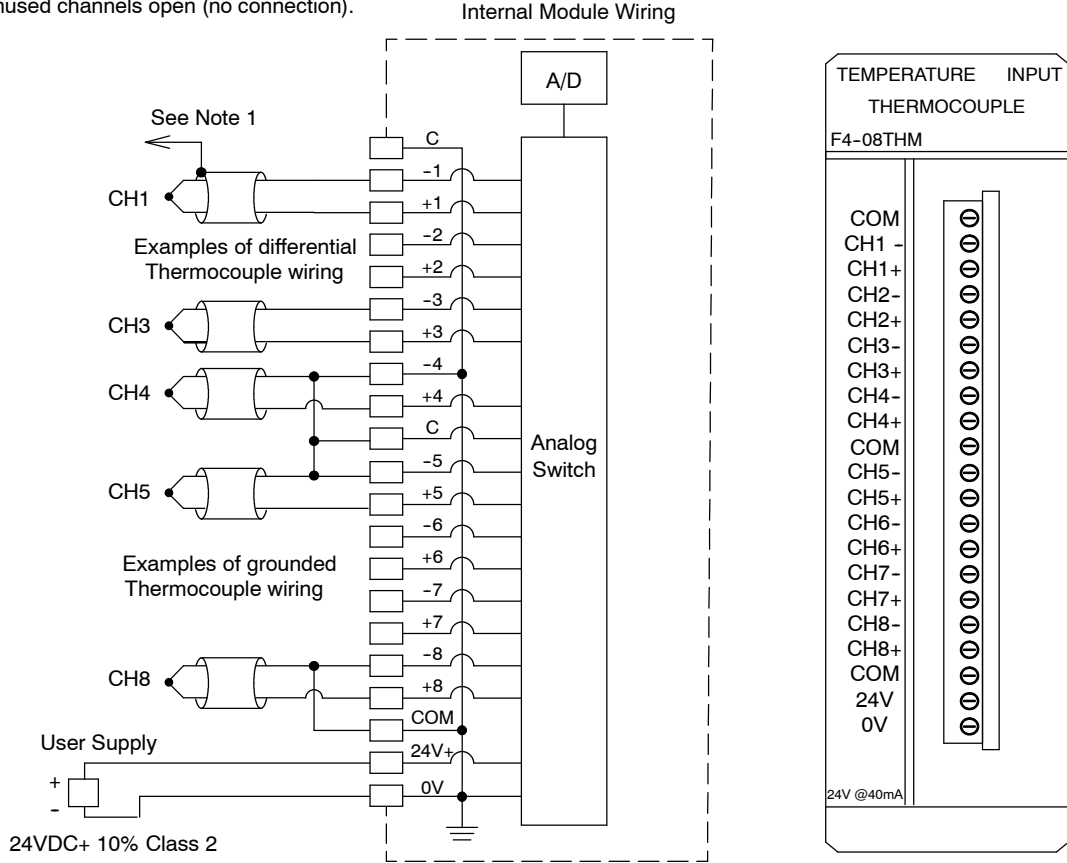| Number of Channels | 8, differential inputs |
|---|---|
| Input Ranges | Type E: –270/1000 °C,     –450/1832 °F<br>Type J: –210/760 °C,       –350/1390 °F<br>Type K: –270/1370 °C,    –450/2500 °F<br>Type R: 0/1768 °C,         32/3214 °F<br>Type S: 0/1768 °C,         32/3214 °F<br>Type T: –270/400 °C,     –450/752 °F<br>Type C: 60/2320 °C,      149/4208°F<br>Type B: 529/1820 °C,    984/3594°F<br>Type P: –99/1395 °C,    –146/2543 °F<br>–1:     0–50 mV<br>–2:     0–100 mV<br>–3:     0–25 mV |
| Resolution | 12 bit (1 in 4096) |
| Input Impedance | 27KO DC |
| Absolute Maximum Ratings | Fault-protected input, 130 Vrms or 100 VDC |
| Cold Junction Compensation | Automatic |
| Conversion Time | 15ms per channel, minimum<br>1 channel per CPU scan |
| Converter Type | Successive approximation |
| Linearity Error | 1 count (0.03% of full scale) maximum |
| Full Scale Calibration Error | 0.35% of full scale |
| Maximum Inaccuracy* | 1° C type J,K,E,T thermocouples<br>3° C type R,S,B,C,P thermocouples |

\* Maximum Inaccuracy is guaranteed for temperatures above –220°C for types E, T, J, and K, and above +100°C for types R and S.

**General Specifications**

| PLC Update Rate | 8 channel per scan max. |
|---|---|
| Digital Input Points Required | 16 (X) input points, including 12 binary data bits, 3 channel ID bits, 1 sign bit |
| Power Budget Requirement | 120 mA @ 5 VDC (from base) |
| External Power Supply | 24 VDC   10%, 50 mA current |
| Operating Temperature | 0° to 60° C (32° to 140° F) |
| Storage Temperature | –20° to 70° C (–4° to 158° F) |
| Accuracy vs. Temperature | 57 ppm / °C maximum full scale |
| Relative Humidity | 5 to 95% (non-condensing) |
| Environmental air | No corrosive gases permitted |
| Vibration | MIL STD 810C 514.2 |
| Shock | MIL STD 810C 516.2 |
| Noise Immunity | NEMA ICS3–304 |

# F4-08THM-n 8-Channel Thermocouple Input Module

Note 1: Terminate shields at the respective signal source.
Note 2: Leave unused channels open (no connection).

# F4--08RTD 8--Channel RTD Input

**Input Specifications**

| Number of Channels | 8 differential inputs |
|---|---|
| Input Ranges | Pt100        --200°C/850°C      (--328°F/1562°F)<br>Pt 1000  --200°C/595°C      (--328°F/1103°F)<br>jPt100       --38°C/450°C       (--36°F/842°F)<br>10ΩCu.  --200°C/260°C      (--328°F/500°F)<br>25ΩCu.  --200°C/260°C      (--328°F/500°F) |
| Display Resolution | 0.01 °C,   0.01 °F ( 3276.7) |
| Resolution | 15-bit (1 in 32768) |
| Absolute Maximum Ratings | Fault-protected input, 22 VDC |
| Converter Type | Charge balancing, 24-bit |
| Sampling Rate | 160 msec per channel |
| Temperature Drift | 5ppm per °C (maximum) |
| Common Mode Range | 0--5 VDC |
| Linearity Error | .05° C maximum, .01° C typical |
| Full Scale Calibration | 1° C |

**General Specifications**

| PLC Update Rate | 8 Channels/Scan max. DL440/DL450 CPUs<br>1 Channel/Scan max. DL430 CPU |
|---|---|
| Digital Input Points Required | 32 (X) input points, 16 binary data bits,<br>3 channel ID bits, 8 fault bits |
| Power Budget Requirement | 80 mA @ 5 VDC (from base) |
| 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 |
| Vibration | MIL STD 810C 514.2 |
| Shock | MIL STD 810C 516.2 |
| Noise Immunity | NEMA ICS3--304 |

I/O Wiring and
Specifications

# F4-08RTD 8-Channel RTD Input Module
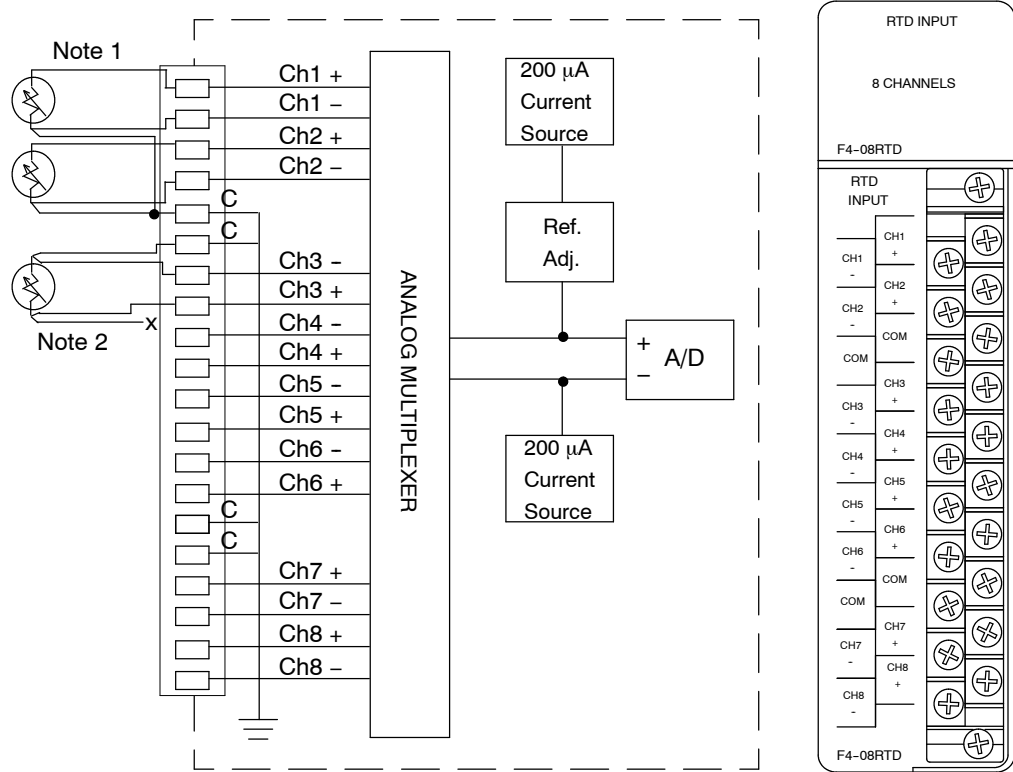


Notes:
1. The three wires connecting the RTD to the module must be the same type and length. Do not use the shield or drain wire for the third connection.
2. If a RTD sensor has four wires, the extra plus (+) sense wire should be left unconnected as shown.