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DL405 CPU Comparisons

DL405 CPU Specifications			
	D4-430	***D4-440***	***D4-450***
System Capacity			
Total memory available (words)	6.5K	22.5K	30.8K
Ladder memory (words)			
built-in memory	3.5K EEPROM	None, requires MC	7.5K flash
with memory cartridge	N/A	up to 15.5K	up to 15.5K
V-memory (words)	3.0K	7.0K	15.3K
Battery backup	Yes	Yes	Yes
Total CPU memory I/O pts. available ***(actual I/O points depend on I/O configuration selected)***	1664 (X+Y+CR+GX)	2688 (X+Y,+CR+GX)	8192 (X+Y+GX+GY)
I/O module point density	2/4/8/16/32/64	2/4/8/16/32/64	2/4/8/16/32/64
I/O module slots per base	4/6/8	4/6/8	4/6/8
Local/local expansion	320 in/320 out	320 in/320 out	1024 in/1024 out
Serial remote I/O (including local & exp. I/O	1664 max.	1664 max.	4224 max.
Remote I/O Channels	2	2	3
I/O pts. per remote module channel	512	512	512; 2048 (port 3)
Ethernet Remote I/O (including local/exp. I/O)	Yes	Yes	Yes
discrete I/O pts.	1664 max. (Including local and exp.I/O)	2688 max. (Including local and exp.I/O)	8192 max. (Including local and exp.I/O)
Analog I/O channels	map into V-memory	map into V-memory	map into V-memory
Remote I/O channels	Limited by power budget	Limited by power budget	Limited by power budget
I/O per remote channel	16,384 (limited to 1664)	16,384 (limited to 2688)	16,384 (16 fully expanded H4-EBC slaves using V-memory and bit-of-word instructions)
Performance			
Contact execution (boolean)	3.0µs	0.33µs	0.96µs
Typical scan (1K boolean)	8-10ms	2-3ms	4-5ms
Programming and Diagnostics			
RLL ladder style	Yes	Yes	Yes
RLL PLUS/flowchart style (Stages)	Yes/384	Yes/1024	Yes/1024
Run time editing	No	Yes	Yes
Supports Overrides	No	No	Yes
Variable/fixed scan	Variable	Variable	Fixed or variable
Instructions	113	170	210
Control relays	480	1024	2048
Timers	128	256	256
Counters	128	128	256
Immediate I/O	Yes	Yes	Yes
Subroutines	No	Yes	Yes
For/next loops	No	Yes	Yes
Timed interrupt	No	Yes	Yes
Integer math	Yes	Yes	Yes
Floating-point math	No	No	Yes
Trigonometric functions	No	No	Yes
Table instructions	No	Yes	Yes
PID	No	No	Yes
Drum sequencers	No	No	Yes
Bit of word	No	No	Yes
Real-time clock/calendar	No	Yes	Yes
Internal diagnostics	Yes	Yes	Yes
Password security	No	Yes	Multi-level
System and User error log	No	Yes	Yes
IBox instructions	No	No	Yes
CPU Ports Communications			
Built-in ports	2 ports	2 ports	4 ports
K-sequence (proprietary protocol)	Yes	Yes	Yes
DirectNET	Yes	Yes	Yes
Modbus master/slave	No	No	Yes
ASCII out (Print)	No	No	Yes
Maximum baud rate	19.2K	19.2K	38.4K

D4-450 Key Features



D4-450 CPU

The D4-450 provides all the capabilities of the D4-430 and D4-440 CPUs, plus several additional features such as *Direct*SOFT5 IBox instructions.

Built-in CPU communications ports

The D4-450 offers four built-in ports for extra convenience. The 15-pin port offers our proprietary K-sequence protocol and is primarily used for programming connections to a D4-HPP-1 handheld programmer or to a PC running *Direct*SOFT software. It can also be used to connect to a *C-more* panel or other operator interfaces. The 6-pin phone jack also supports K-sequence; plus, it can be a *Direct*NET slave port or an ASCII output port. The bottom 25-pin port contains two logical ports with different pins for each port. It is primarily a networking port that supports *Direct*NET master/slave or Modbus master/slave protocols. The bottom port can be used as an ASCII output port for connections to devices that can accept ASCII input. It can also be used as a remote I/O Master. The Communications Ports table on the next page has a complete description of each port.

16 PID loops

The D4-450 CPU can process up to 16 PID loops directly in the CPU. You can select from various control modes including automatic control, manual control, and cascade control. There are a wide variety of alarms including Process Variable, Rate of Change, and Deviation. The various loop operation parameters are stored in V-memory, which allows easy access from operator interfaces. Setup is accomplished with our *Direct*SOFT Programming Software. An overview of the various loop specifications and features is on page D4-13.

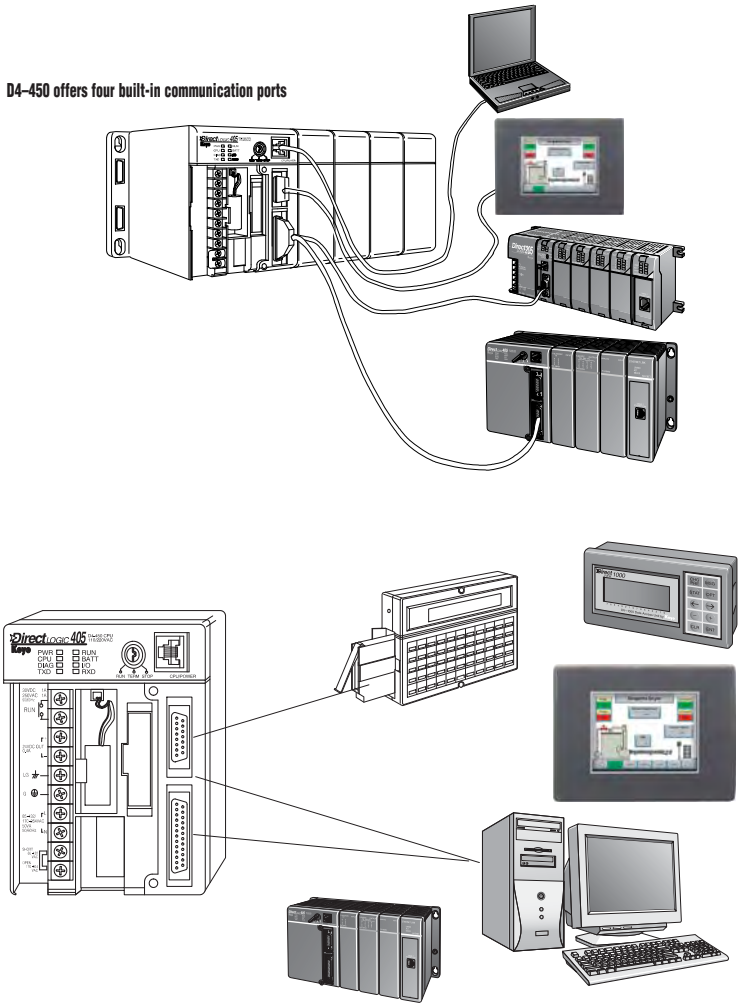
Floating-point math

The D4-450 CPU supports IEEE format floating-point math calculations. This feature means the D4-450 includes full trigonometric functions and various forms of integer/floating point number conversions.

Power supplies

We offer a choice of three power supplies for the DL450 CPU. The power supplies are built into the CPU. Available power supplies are:

- 110/220 VAC version - D4-450
- 24 VDC version - D4-450DC-1
- 125 VDC version - D4-450DC-2

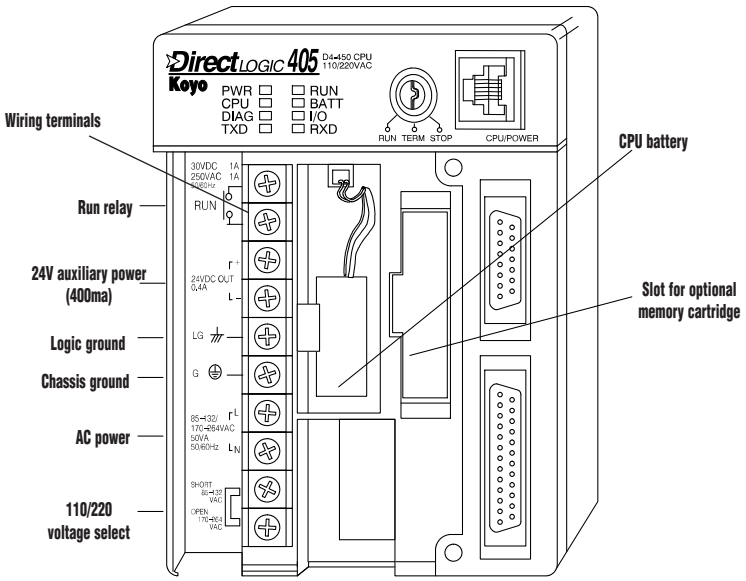


Note: if you are considering a D4-450 CPU to replace a CPU in an existing system, and the system uses specialty modules with an F4 prefix, then these modules may require an upgrade to operate with the D4-450. Contact our Technical Services group prior to placing your order for more information. (This note does not apply to analog modules.)

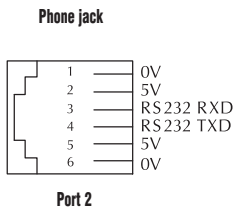
D4-450 Features

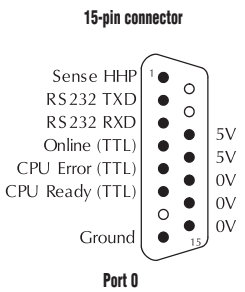
The diagrams on this page show the various hardware features found on the D4-450 CPU.

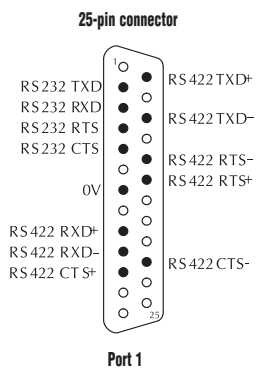
CPU Keyswitch		
RUN	Forces CPU to RUN mode. Locks Comm port - will not receive incoming data.	
TERM	Allows peripherals (HPP, DCM, *Direct*SOFT, etc.) to select operating mode	
STOP	Forces CPU out of RUN	
CPU Status Indicators		
PWR	ON OFF	CPU power good CPU power failure
RUN	ON OFF	CPU is in RUN mode CPU is in STOP mode
CPU	ON OFF	CPU self-diagnostics error CPU self-diagnostics good
BATT	ON OFF	CPU battery is low CPU battery is good or disabled
DIAG	ON OFF	CPU diagnostics or local bus error CPU diagnostics or local bus good
I/O	ON OFF	I/O self-diagnostics error I/O self-diagnostics good
TXD	ON OFF	Data is being transmitted No data is being transmitted
RXD	ON OFF	Data is being transmitted No data is being transmitted
Communications Ports		
Phone Jack Port 2	Programming Port, RS232C, baud rate selectable up to 38.4Kb. Connects to *Direct*SOFT, DV-1000, *C-more* panels, network, etc. K-sequence protocol, *Direct*NET protocol (slave only), ASCII out	
15-pin Port 0	Programming port, RS232C, 9600 baud, connects to HPP, *Direct*SOFT, DV-1000, *C-more* panels, etc. K-sequence protocol (fixed station address=1)	
25-pin Port 1 and Port 3	General purpose port for RS232C and RS422. (RS485 Remote I/O Master available on Port 3 only.) Baud rate selectable via software up to 38.4K baud. Connects to *Direct*SOFT, *C-more* panels, network, etc. Two logical ports (separate pins on connector). Software selectable protocol includes: *Protocol* — *Port 1* — *Port 3* K-sequence ✓ ✓ DirectNETMaster/Slave ✓ ✓ Modbus Master/Slave ✓ ✓ Remote I/O n/a ✓ ASCII Out ✓ ✓	

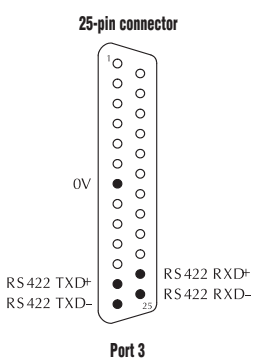


D4-450 communications ports pin-out









D4-450 Fixed or Variable Scan

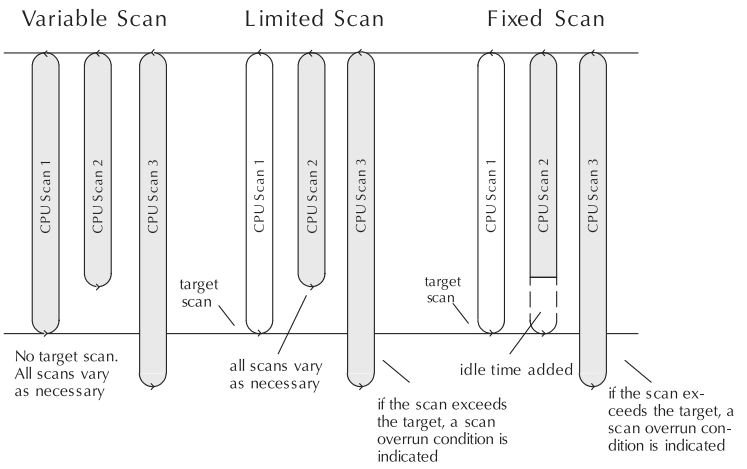
D4-450 Scan control

The D4-450 CPU provides several scan control options, which are useful in some high-speed machine control applications.

Variable — The scan varies as necessary from scan to scan. The actual scan time depends on the instructions being executed.

Limited — This is similar to a variable scan in that the scan varies as necessary. However, if the actual scan time exceeds a specified target scan time, then a scan overrun condition is indicated.

Fixed — If the scan is finished before the time specified, idle time is added to ensure a fixed scan period. If the scan exceeds the time specified, the scan is extended to ensure all instructions are executed. A scan overrun condition is also reported.



Memory

The D4-450 has 7.5K of flash memory on board. Upgrade to 15.5K by choosing an optional memory cartridge listed on page D4-14. The memory cartridge is recommended since it is removable in the event of problems.

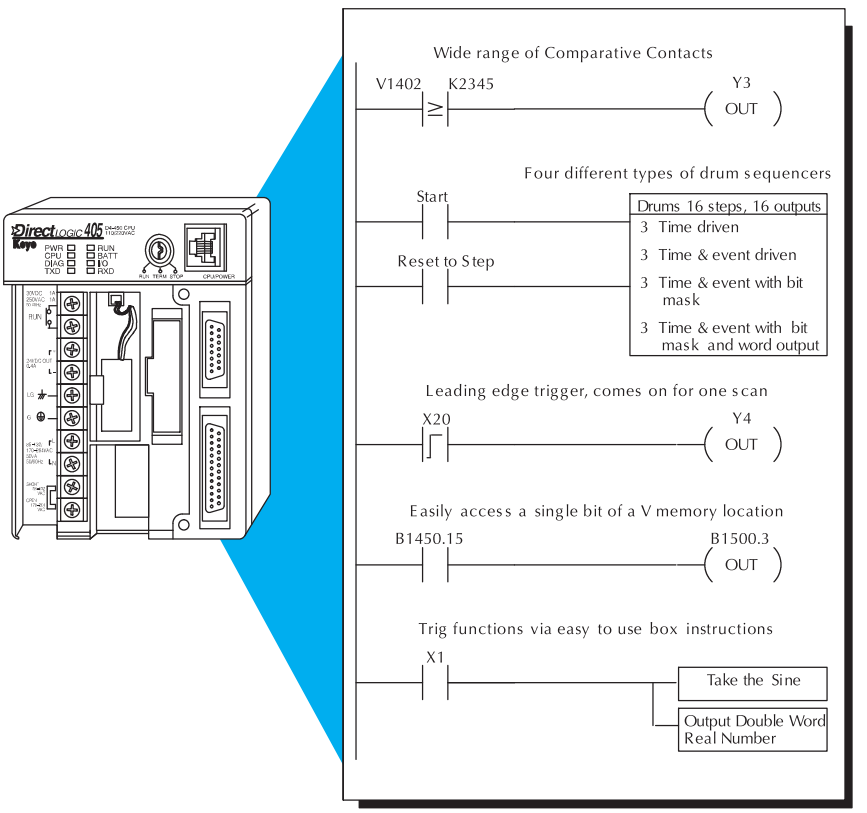
Full array of instructions

Imagine if someone asked you to write a book, but then told you that you could only use 50 different words? That would be a tough job! The same is true for writing a PLC program. The right instruction can greatly simplify your control program.

The D4-450 supports over 200 powerful instructions. These include:

- Four types of drum sequencers, each with 16 steps and up to 16 outputs
- Leading and trailing edge triggered oneshots
- Bit of word manipulation (bit set, reset, etc.)
- Trigonometric functions
- Floating point conversions
- ***Ibox*** instructions that simplify tasks such as configuring analog modules or performing complex math equations

Rel. 2.1 of DirectSOFT, is required to program the D4-450.



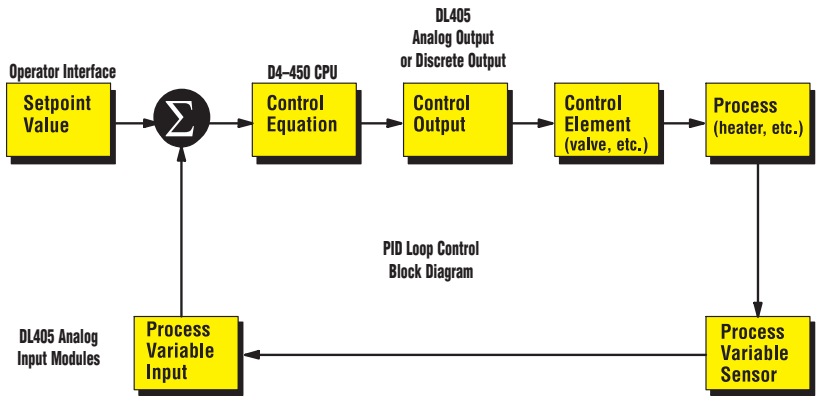
Note: if you are considering a D4-450 CPU to replace a CPU in an existing system, and the system uses specialty modules with an F4 prefix, then these modules may require an upgrade to operate with the D4-450. Contact our Technical Services group prior to placing your order for more information. (This note does not apply to Analog modules.)

D4-450 PID loops

PID Loop Specifications and Key Features	
Number of Loops	Selectable, 16 maximum
CPU V-memory Required	32 V-memory locations per loop selected (An additional 32 V-memory locations per loop required if using Ramp/Soak)
PID Algorithm	Position or velocity form of the PID equation. Optionally specify direct or reverse acting, square root of the error and error squared control.
Auto Tuning	Open loop step response method and closed loop limit cycle method.
Sample Rate	Specify the time interval between PV samples, 0.05 to 99.99 in units of seconds or minutes. If using all 16 loops, the smallest sample rate is limited to either 0.2 seconds or (PLC scan time x number of loops).
Loop Operation Modes	Loop can be in automatic control, manual (operator) control, or cascade control. PV alarm monitoring continues when loops are in manual mode.
Ramp/Soak	Up to 16 steps (8 ramp, 8 soak) per loop, with indication of Ramp/Soak step.
Square Root PV	Specify a square root of the PV for a flow control application.
Limit SP	Specify a maximum and minimum value for allowable setpoint changes.
Limit OUT	Specify a maximum and minimum value for the output range.
Gain	Specify proportional gain of 0.01 to 99.99.
Reset	Specify integral time of 0.1 to 99.98 in units of seconds or minutes.
Rate	Specify the derivative time, 0.00 to 99.99 seconds.
Rate Limiting	Specify a derivative gain limiting coefficient to filter the PV used in calculating the derivative term (0 to 20).
Bumpless Transfer I	Bias and setpoint are initialized automatically when the loop is switched from manual to automatic. This provides for a bumpless transfer, which reduces the chance of sharp changes in the output as a result of entering automatic mode.
Bumpless Transfer II	Bias is set equal to the Output when the module is switched from manual to automatic. This allows switching in and out of automatic mode without having to re-enter the setpoint.
Step Bias	Provides proportional bias adjustment for large setpoint changes. This may stabilize the loop faster and reduce the chance of the output going out of range. Step bias should be used in conjunction with the normal adjusted bias operation.
Anti-windup	If the position form of the PID equation is specified, the reset action is stopped when the PID output reaches 0 or 100%. Select adjusted bias or freeze bias operation.
Error Deadband	Specify an incremental value above and below the setpoint in which no change in output is made.
Error Squared	Squaring the error minimizes the effect a small error has on the Loop output, however, both Error Squared and Error Deadband control may be enabled.
Alarm Specifications	
Deadband	Specify 0.1% to 5% alarm deadband on all alarms except Rate of Change.
PV Alarm Points	Specify PV alarm settings for low-low, low, high, and high-high conditions. You can also specify a deadband to minimize the alarm cycles when the PV approaches alarm limits.
PV Deviation	Specify alarms to indicate two ranges of PV deviation from the setpoint value (yellow and red deviation).
Rate of Change	Specify a rate-of-change limit for the PV.

Need Temperature Control?

If you're only interested in controlling temperature, then there may be a better solution than the D4-450 CPU. Check out the F4-4LTC module. This module has the capabilities of our single loop controllers built into one economical module! Detailed specifications can be found later in this section. This module can directly control up to four loops and it even includes built-in relay outputs for heater or chiller control! If you use the built-in PID capability of the D4-450 CPU, you still have to purchase the analog input modules and the output modules (either discrete or analog) in order to complete the loop. This can result in a much higher overall cost when compared to the F4-4LTC.

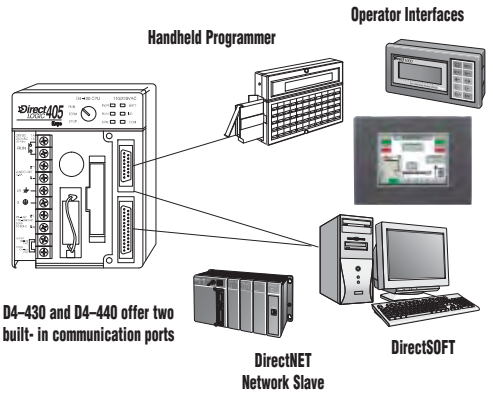


D4-440/430 Key Features

DL440 CPU

D4-440 <--->
D4-440DC-1 <--->
D4-440DC-2 <--->





DL430 CPU

D4-430 <--->



D4-440 CPU

The D4-440 provides a subset of the D4-450's capabilities. If you need fast boolean execution, good communications, and complex math or PID isn't required, this is the CPU for you.

Instruction set

The D4-440 instruction set includes most of the capabilities of the D4-450. The D4-440 does not support some of the more advanced instructions such as PID, floating point math, drum sequencers, trig. functions, IBoxes, etc.

Two built-in communication ports

D4-440 offers two communication ports. The top port can be used for a direct connection to a personal computer for programming, to our handheld programmer, to our DV-1000, or to operator interfaces and touch panels. The bottom port is a slave-only port and supports our *Direct*NET or K-sequence protocol at speeds up to 19.2K baud.

Range of power supplies

The D4-440 provides a wide range of power supply options:

- 110/220 VAC
- 24 VDC
- 125 VDC

Memory cartridges

The table below shows the memory cartridges available for the D4-440 and D4-450. The D4-440 requires a memory cartridge for program storage. The D4-450 has 7.5K of built-in FLASH program memory. However, you can use a memory cartridge instead of the built-in memory if you need more program space. (The D4-430 has built-in program memory and cannot use a memory cartridge.)

D4-430 CPU

The D4-430 is the most economical CPU in the DL405 product family. If you are primarily looking at the DL405 because of I/O form factor or reasons that don't require tons of CPU horsepower, try the D4-430.

Two built-in communication ports

The D4-430 also offers two communication ports. The top port can be used for a direct connection to a personal computer for programming, to our handheld programmer, to the DV-1000, or to operator interfaces and touch panels. The bottom port is a slave-only port and supports *Direct*NET protocol at speeds up to 19.2K.

Built-in EEPROM memory

One advantage of the D4-430 is 3.5K of built-in EEPROM program memory. A memory cartridge is not required.

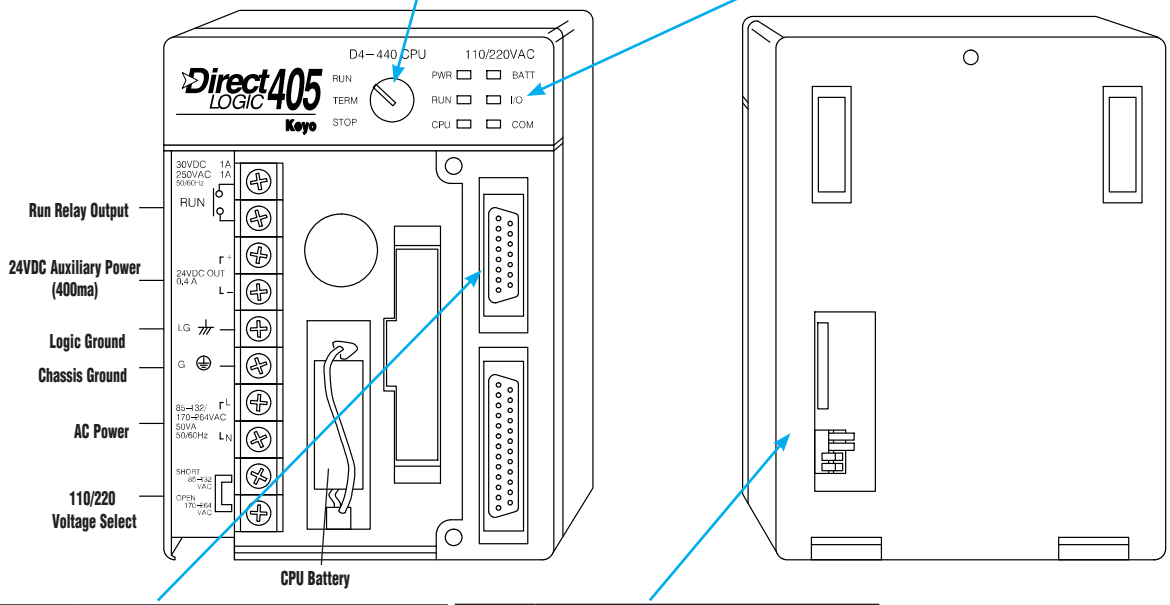
	D4-RAM-1 <--->	D4-RAM-2 <--->	D4-UV-2 <--->	D4-EE-2 <--->
Program Storage Capacity	7.5K	15.5K	15.5K	15.5K
Cartridge Battery Type	Lithium	Lithium	None	None
Writing Cycle Life	N/A	N/A	1,000	>10,000
Write Inhibit	Internal jumper	Internal jumper	N/A	Internal jumper
Memory Clear Method	Electrical	Electrical	Ultraviolet light	Electrical

D4-440/430 Features

The following diagram shows the various hardware features found on the D4-440 CPU. The D4-430 looks the same, except that the memory cartridge slot can not be used.

CPU Keyswitch	
RUN	Forces CPU to RUN mode
TERM	Allows peripherals (HPP, DCM, *Direct*SOFT, etc.) to select operating and TEST modes.
STOP	Forces CPU to STOP mode

CPU Status Indicators					
PWR	ON OFF	CPU power good CPU power failure	***BATT***	ON OFF	CPU battery low CPU battery good
RUN	ON OFF	CPU in RUN mode CPU in STOP mode	***I/O***	ON OFF	I/O diagnostics error I/O diagnostics OK
CPU	ON OFF	CPU diagnostic error CPU diagnostics OK	***COM***	ON OFF	Communication error Communication OK

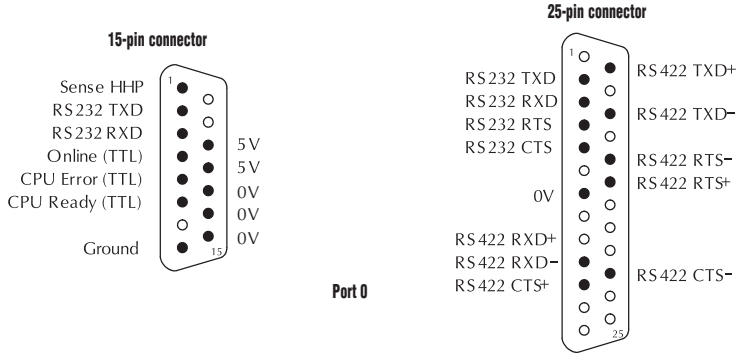


Communication Ports	
15 Pin	Programming port, RS232C, 9600 Baud, K-sequence protocol, connects to HPP, *Direct*SOFT, DV-1000 and some operator interfaces
25 Pin	Auxiliary port, R232C or RS422, Baud rate selectable via CPU dipswitch, K-sequence protocol, *Direct*NET protocol (slave only) connects to *Direct*NET, *Direct*SOFT, and other operator interfaces

CPU Dipswitch		
SW1	ON OFF	CPU battery disabled CPU battery enabled
SW2	ON OFF	Station address is 1 Station address set by HPP

SW3	SW4	Baud
OFF	OFF	300
OFF	ON	1,200
ON	OFF	9,600
ON	ON	19,200

D4-430/D4-440 communications ports pin-outs



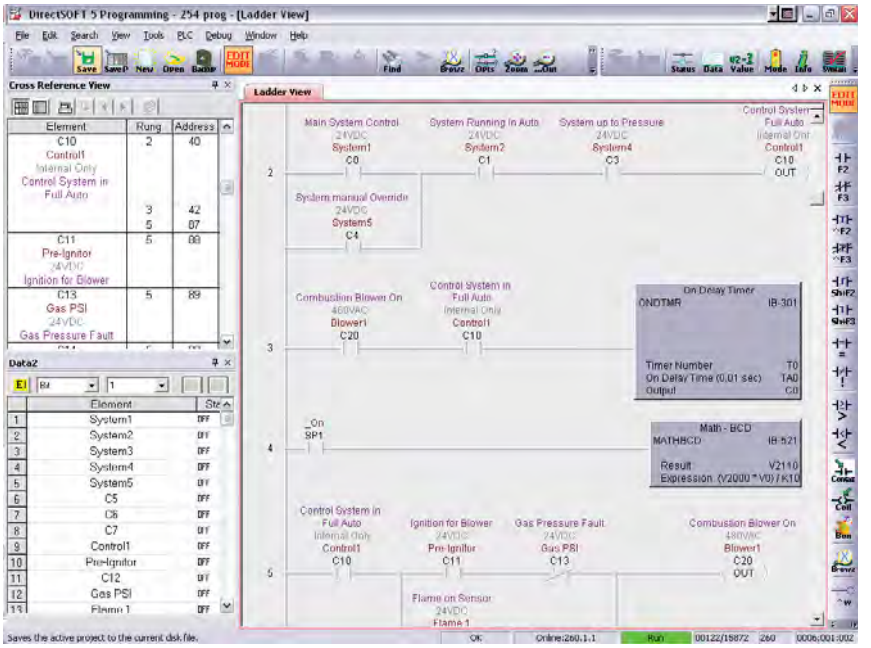
DL405 Programming Tools and Cables

Select a programming device

There are two tools for programming the DL405 CPUs: *Direct*SOFT PC-based programming software and the D4-HPP-1 handheld programmer.

*Direct*SOFT programming software

Our powerful Windows-based programming packages make it easy for you to program and monitor your DL405 PLC system. The version of the software that supports the DL405 CPUs is described in the table below. See the Software section in the desk reference for detailed information on *Direct*SOFT.

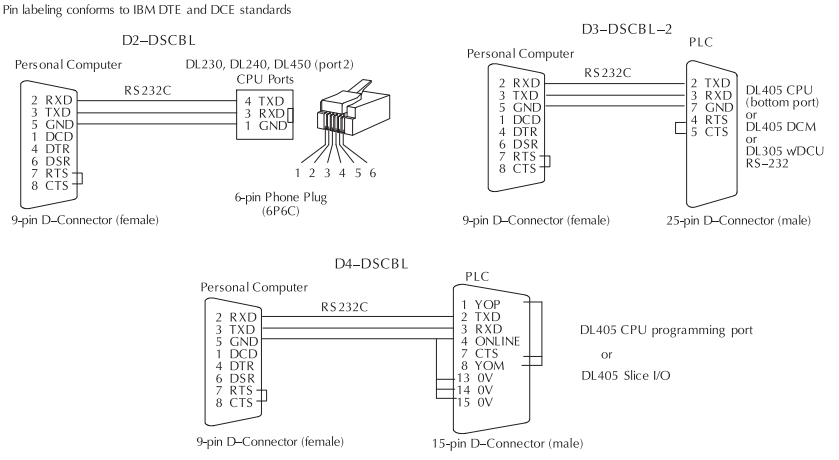


*Direct*Soft Part Number	Price	Description
PC-DSOFT5	<--->	Programs all PLC families DL05/06/105/205/305/405

DL405 programming cables

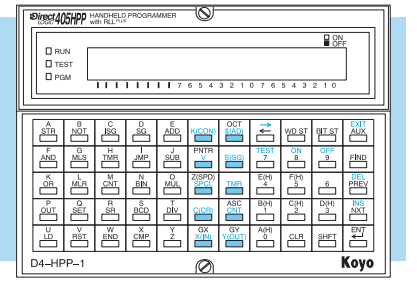
Choose the proper cable to connect the DL405 CPU to your PC running *Direct*SOFT.

CPU	Price	Port	Cable	Price
D4-430/ D4-440	<--->	Top port (15 pin)	***D4-DSCBL***	<--->
	<--->	Lower port (25 pin)	***D3-DSCBL-2***	<--->
D4-450	<--->	Top port (15 pin)	***D4-DSCBL***	<--->
		Lower port (25pin)	***D3-DSCBL-2***	<--->
		Phone jack (RJ12)	***D2-DSCBL***	<--->



Handheld programmer

The D4-HPP-1 handheld programmer connects to the 15-pin port on any of the DL405 CPUs. A memory cartridge is located on the side of the handheld programmer. This slot allows you to copy memory cartridges (including UV PROMs) and transfer data/programs between the CPU and a memory cartridge.



There are three optional connecting cables available for use with the D4-HPP-1 programmer:

- D4-HPCBL-1: 3m cable
- D4-HPCBL-2: 1.5m cable
- D4-CASCBL: cassette cable

Need additional Communications Ports?

Do you need communications ports in addition to the built-in CPU communications ports to connect to an operator interface or HMI? Would you like to connect to a network of other AUTOMATIONDIRECT products, or a Modbus RTU or Ethernet network? If yes, then choose between the H4-ECOM Ethernet communications module or the D4-DCM serial data communications module. Both modules' specifications and communications details are covered later in this section.

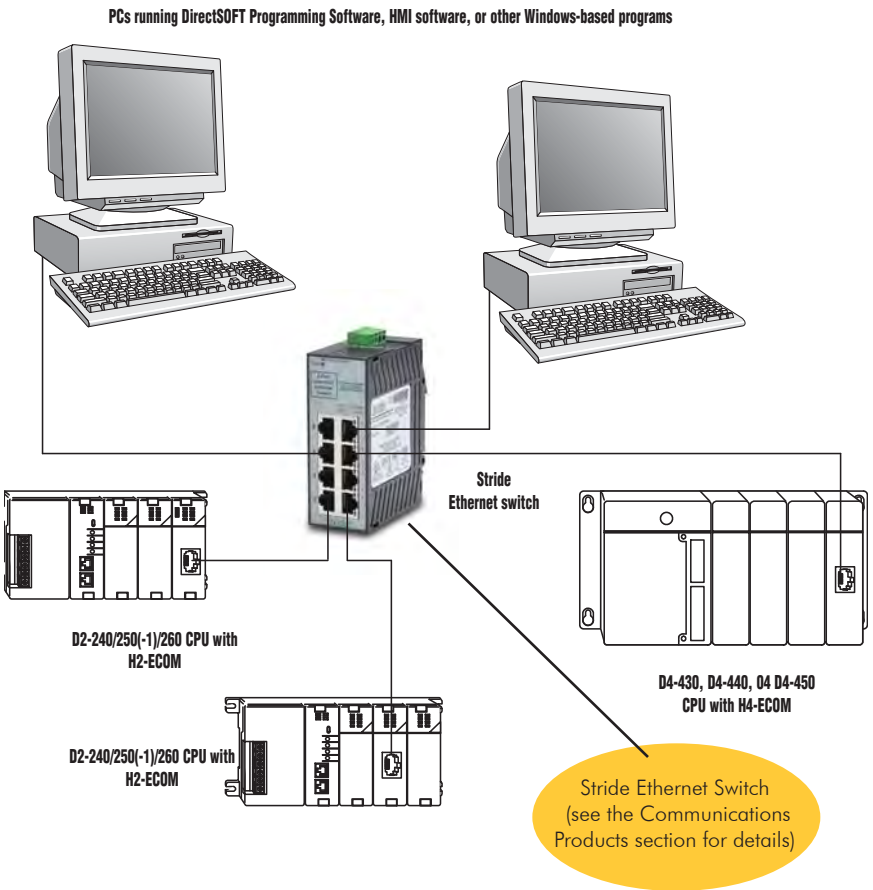
Ethernet networking with the H4-ECOM

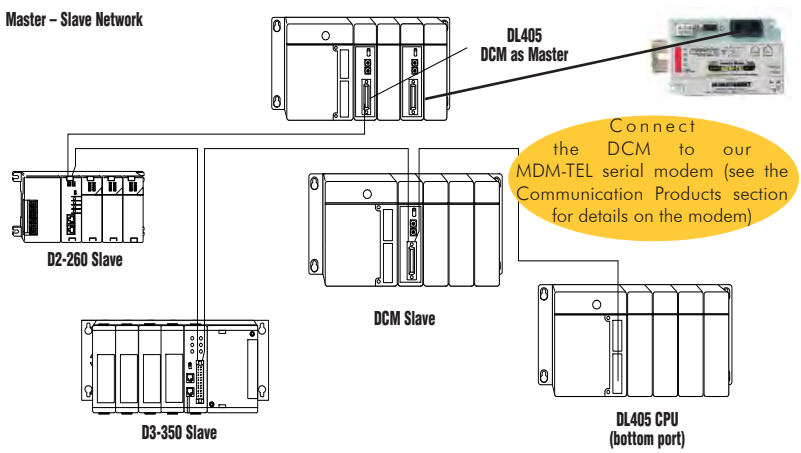
All DL405 CPUs support the H4-ECOM/ECOM100 module, which makes Ethernet networking a snap. The H4-ECOM/ECOM100 module supports industry-standard 10Base-T networking with an RJ45 port. The H4-ECOM-F has ST-style bayonet connectors for 10BaseFL fiber optic connections. The ECOM modules use standard cables, hubs and repeaters, which are available from a large number of suppliers. A virtually unlimited number of PLCs can be connected to an Ethernet network using ECOM modules. This is the fastest data transfer rate we offer for your HMI or other Windows-based software. Use *Direct*SOFT to program any PLC on the network, and when monitoring your operating PLC, you will see much faster updates with Ethernet and the ECOM modules.

Serial networking with the D4-DCM

All DL405 CPUs support the D4-DCM Data Communications Module that can serve as a *Direct*Net master/slave, *Direct*Net peer, or a Modbus RTU slave. The D4-DCM supports RS-232 and RS-422 communications. You can program the CPU through the DCM locally, or if a PC is the RS-422 master, you can use *Direct*SOFT to program any PLC on the network.

Note: The DL405 CPUs also support a Modbus RTU master module for connection to a Modbus RTU network. This module is listed later in this section.





Select the I/O Modules

There are several factors you should consider when choosing an I/O module.

1. **Environmental specifications:** To what environmental conditions will the I/O modules be subjected?

2. **Hardware specifications:** Does this product have the right features, performance, and capacity to adequately serve your application?

3. **Field termination:** How does this module connect to your field devices? For DC modules, do you need a sinking or sourcing module?

4. **Power budget:** It is very important that your module selections operate within the base power budget. Refer to the power budget description later in this section.

Check the environmental specifications

The following table lists environmental specifications that globally apply to the DL405 system (CPU, Expansion Unit, Bases, and I/O modules). Be sure the modules you choose are operated within these environmental specifications.

Specification	Rating
Storage Temperature	-4°F - 158°F (-20°C to 70°C)*
Ambient Operating Temperature	32°F - 140°F (0° to 60°C)*
Ambient Humidity	5% - 95% relative humidity (non-condensing)**
Vibration Resistance	MIL STD810C, Method 514.2
Shock Resistance	MIL STD810C, Method 516.2
Noise Immunity	NEMA(ICS3-304)
Atmosphere	No corrosive gases

*Storage temperature for the Handheld Programmer is 14° to 149°F (-10° to 65°C).
Storage temperature for the DV-1000 is -4 to 158°F (-20 to 70°C).
Operating temperature for the DV-1000 is 32° to 122° F (0° to 50°C).
**Ambient humidity for the Handheld Programmer is 20% to 90% non-condensing.
Ambient humidity for the DV-1000 is 30% to 95% non-condensing.

Review hardware specifications

The hardware specifications for every DL405 module are described later in this section. Discrete module specifications are in a format similar to the example shown. Take time to understand the specification chart, the derating curve, and the wiring diagram. The specialty modules specifications are shown in a format relevant for each module. All of these module specifications should help you determine if the module is right for your application.

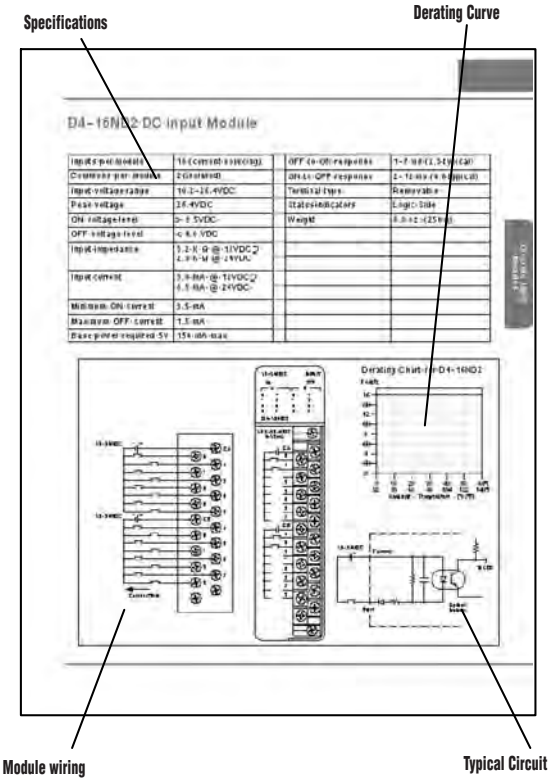
Understand the factors affecting field termination

Physical wire terminations: In general, DL405 modules use four types of field terminations. They include: removable terminal blocks (included on all 8 and 16 point modules), specialty D-sub connectors (used on 32 and 64 point modules), standard D-sub connectors (used on most specialty intelligent modules), and phone jack style (used on some specialty modules and included in the universal cable kit).

High-density modules do not come with connectors. To create a custom cable, solder or ribbon-style connectors are sold two per pack, and must be ordered separately. See the individual I/O specification sheets for the part numbers. The easiest way to wire high-density modules is with pre-wired *ZIP*Link cables and connector modules.

Sinking and sourcing for DC field devices: If you are using a DC-type of field device, you should determine whether the device is a sinking or sourcing configuration. This may affect your module selection since it determines the manner in which the device must be wired to the module.

AUTOMATIONDIRECT offers both sinking and sourcing modules. Refer to the Appendix for a complete explanation on sinking and sourcing and how this could affect your system.



I/O Modules

H4-CTRIO high-speed counter module vs. D4-HSC high speed counter module

Select the H4-CTRIO instead of the D4-HSC if your application requires:

- More than one quadrature encoder
- More than one single up counter
- Pulse outputs
- Output operations on the module based on counts, without interaction with the CPU scan

The CTRIO is configured using a Windows-based "Wizard" utility, eliminating the need for ladder logic programming to configure the module. Multiple CTRIO modules can be used in a base to support additional input/output pulse trains.

Analog module selection tips

If you're going to control the speed of an AC inverter or drive with the DL405 analog module, make sure you select either the current sourcing F4-04DAS-1 or voltage sourcing F4-04DAS-2 isolated analog output module. Complete module specifications are listed later in this section.

*ZIP*Link connection systems

*ZIP*Links consist of PLC interface cables and connector modules that offer "plug and play" capability by plugging one end of the *ZIP*Link cable into an I/O module and the other end into the *ZIP*Link connector module. This eliminates the tedious process of wiring PLC I/O to terminal blocks. For more information, refer to Wiring System for DL405 PLCs later in this chapter or the Wiring Solutions section in this catalog.

DIN*nectors* terminal blocks

DIN*nectors* are DIN rail mounted connectors or terminal blocks. All DIN*nectors* are UL, CSA, VDE, SEV, RINA and IEC approved. Refer to the Terminal Blocks & Wiring Systems section of this catalog for details.

Need spare parts?

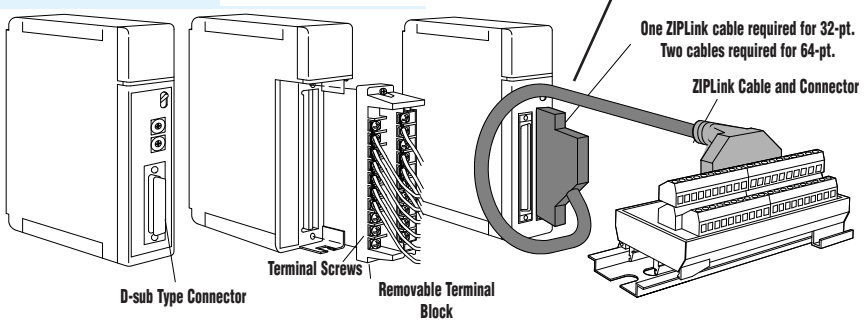
Sometimes it is helpful to have extra I/O module connectors or spare fuses. The DL405 spare parts and accessories are listed below:

D4-FUSE-2 (<--->)	Fuses for F4-08TRS-2
D4-ACC-1 (<--->)	CPU spare kit (covers and screws)
D4-ACC-2 (<--->)	Screws for 8-pt. I/O module terminals
D4-ACC-3 (<--->)	Screws for 16-pt. I/O module terminals
D4-FILL (<--->)	Filler module to cover empty I/O slots
D4-8IOCON (<--->)	8-pt. module terminal blocks
D4-16IOCON (<--->)	16-pt. module terminal blocks
D4-IOCVR (<--->)	Replacement terminal block covers
ZL-D24-CON-R (<--->)	32/64-pt. ribbon-style connectors
ZL-D24-CON-X (<--->)	32/64-pt. solder-style connectors

Now that you understand the factors affecting your choice of I/O modules, it's time to choose the ones that best fulfill your needs. Review the module specifications later in this section. (See the DL405 Price List for a complete list of part numbers.) If you have any questions, give us a call. When you have selected the modules you need, proceed to the next section to choose an I/O configuration scheme that best suits your application.

*ZIP*Links eliminate the tedious process of wiring the PLC I/O to terminal blocks. See the Terminal Blocks & Wiring Systems section for details.

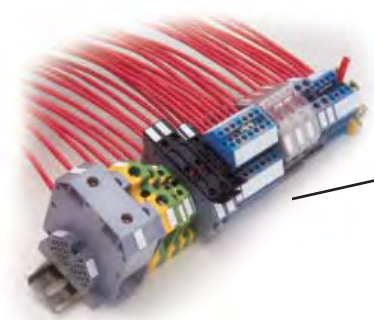
*ZIP*Link connection system



This module can be used with ZIPLINK CONNECTION SYSTEMS

This logo is placed by each I/O module that supports *ZIP*Link connection systems. (The I/O modules are listed at the end of this section). See the Terminal Blocks & Wiring Systems section of this catalog for complete information on *ZIP*Links.

DIN*nectors* terminal blocks



DIN*nectors* provide a means of connecting and identifying two or more wires within the demands of an industrial environment. See the Terminal Blocks & Wiring Systems section for details.

Select an I/O Configuration

Four configurations for system flexibility

The DL405 system offers four major configurations of I/O. The choices are described on the following two pages. Keep these choices in mind as you plan your I/O system.

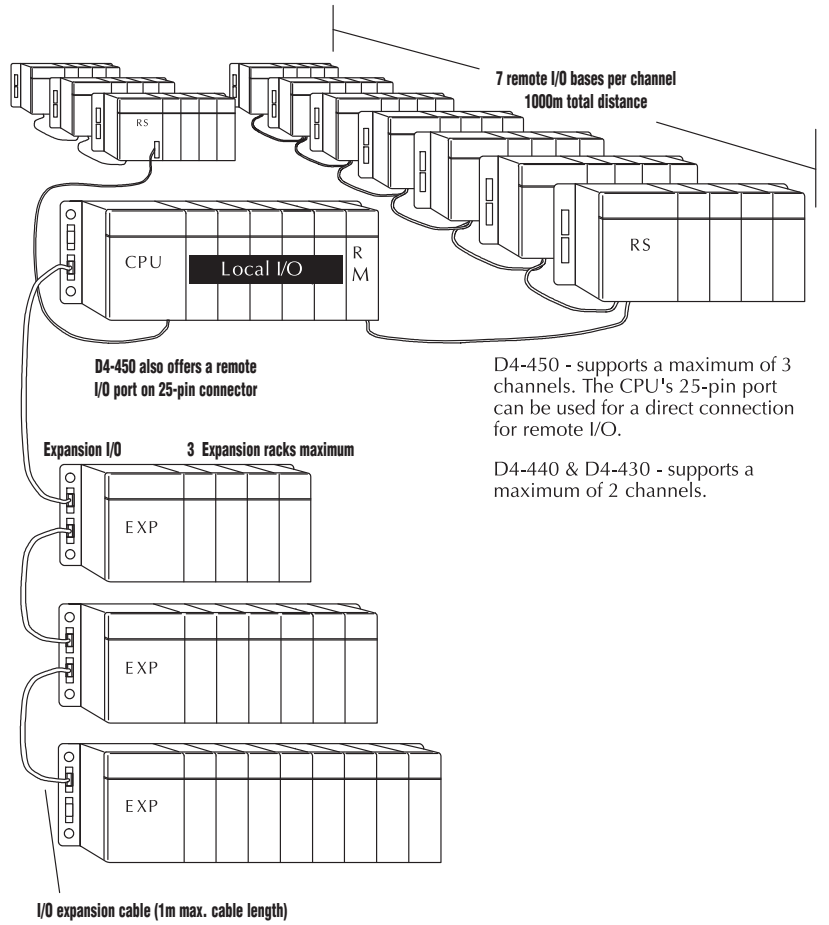
Local I/O

The local base is the base that holds the CPU. The term "local I/O" refers to the modules that reside in the base with the CPU. Each local I/O point is updated on every CPU scan. Up to 512 points are available in the local base by using 64-point modules (requires a D4-440 or D4-450).

Expansion I/O

Expansion bases are commonly used when there are not enough I/O slots available in the local base, or when the power budget for the base will be exceeded with the addition of I/O. This configuration requires additional base(s), each of which require a D4-EX Local Expansion Unit in place of the CPU, and a cable to connect the expansion bases to the local CPU base. Up to three expansion bases can be connected to a local CPU base, for a total of four bases. The CPU updates expansion I/O points on every scan. The total number of local and expansion I/O points for the D4-450 is 2048 points. The total for the D4-430 and D4-440 is 640 I/O.

Example of I/O system configurations



D4-450 - supports a maximum of 3 channels. The CPU's 25-pin port can be used for a direct connection for remote I/O.

D4-440 & D4-430 - supports a maximum of 2 channels.

I/O Configurations

Ethernet remote I/O

The DL405 Ethernet Remote I/O system allows you to locate I/O bases at a remote distance from the CPU. For many applications, this can reduce wiring costs by allowing I/O points to be located near the devices they are controlling.

The Ethernet Remote Master module (H4-ERM(100)) is placed in an I/O slot of the local CPU base. Ethernet Base Controller (EBC) modules serve as the Remote Slave Units and are placed in the CPU slot of one or more remote bases. You can use standard DL405 modules in the remote bases. The Remote Slaves are connected to the Master using Category 5 UTP cables for cable runs up to 100 meters. Use repeaters to extend distances and hubs to expand the number of nodes. Our fiber optic version uses industry standard 62.5/125 ST-style fiber optic cables and can be run up to 2,000 meters.

Each H4-ERM(100) module can support up to 16 slaves: 16 H2-EBC systems, 16 Terminator I/O EBC systems, or 16 fully expanded H4-EBC systems.

The PLC, ERM and EBC slave modules work together to update the remote I/O points. These three scan cycles are occurring at the same time, but asynchronously. It is recommended that critical I/O points that must be monitored every scan be placed in the CPU base.

ERM Workbench is an easy-to-use Windows-based software utility that is used to configure the ERM and its remote slaves.

It is highly recommended that a dedicated Ethernet remote I/O network be used for the ERM and its slaves. While Ethernet networks can handle a very large number of data transactions, and normally handle them very quickly, heavy Ethernet traffic can adversely affect the reliability of the slave I/O and the speed of the I/O network. Keep ERM networks, multiple ERM networks and ECOM/office networks isolated from one another.

I/O Configuration Specifications		D4-450	D4-440	D4-430
Total Channels Available	Total number of Remote channels available	3	2	2
Remote I/O	Maximum number of D4-RM per system	2	2	2
	Number of masters built into CPU port	1	0	0
	Maximum I/O points supported per channel	512	512	512
	Maximum I/O points supported	1536	1024	512
	Maximum number of remote I/O bases per channel	7	7	7

Serial remote I/O

Remote I/O solutions allow you to place I/O points at some remote distance from the CPU. The remote I/O points are updated asynchronously to the CPU scan. For this reason, remote I/O applications should be limited to those that do not require the I/O points to be updated on every scan.

Remote I/O requires a remote master to control the remote I/O channel. This master can be a module (D4-RM) in the local CPU base, or the D4-450 CPU (through the 25-pin port). For the D4-RM solution, the CPU updates the remote master, then the remote master handles all communication to and from the remote I/O base by communicating to the remote slave module (D4-RS) installed in each remote base. If you use the D4-450 CPU, then it communicates directly with the D4-RS.

The maximum distance between a Remote Master and a Remote Slave is 3,300 feet (1000 m).

Module Placement and I/O Usage Tables

I/O module placement restrictions

The most commonly used I/O modules for the DL405 system (AC, DC, AC/DC, Relay, and Analog) can usually be used in any base you have in your local, expansion or remote system. However, some specialty modules (and the 64pt. discrete I/O modules) are limited to the CPU base, or our D4-xxB-1 bases. This table lists by category the valid locations for all modules/units in a DL405 system. Keep in mind the power budget may limit where some modules can be placed, since the necessary power may have been consumed.

I/O point usage table for modules

The bottom tables indicate the number of I/O points consumed by each module. Use this information to ensure you stay within the I/O count of the I/O configuration you have chosen. Remember, each CPU supports a different amount of I/O. Check the specifications to determine the I/O limits.

Module/Unit	Local CPU Base	Expansion Base	Remote Base
CPUs	CPU slot only		
Expansion Units		CPU slot only	
8/16/32pt DC Input	✔	✔	✔
64pt DC Input	✔1		
AC Input	✔	✔	✔
AC/DC Input	✔	✔	✔
8/16/32pt DC Input	✔	✔	✔
64pt DC Output	✔1		
DC Input	✔	✔	✔
Relay Output	✔	✔	✔
Analog Input and Output	✔	✔	✔
Thermocouple Input	✔	✔	✔
Remote I/O			
Remote Masters (serial / Ethernet)	✔	✔2	CPU slot only
Remote Slave Unit			
Communications and Networking Modules	✔		
CoProcessor Modules	✔		
Specialty Modules			
Interrupt	Slot 0 only		
with D4-430	Slot 0 and1		
with D4-440/D4-450	✔		
PID	✔	✔3	
4-Loop Temp. Controller	✔	✔	✔
High-speed Counter	✔		
Simulator	✔		

1 – If you are using 64pt. modules, you cannot install any specialty modules in slots 5,6, or 7 of the local CPU base.
2 – Modules can be installed in expansion bases if you are using the D4-450 CPU and ALL bases in the system are D4-xB-1 bases.
3 - D4-HSC only

I/O points required per module

DC Input	*I/O pt.*
D4-08ND3S	8 in
D4-16ND2	16 in
D4-16ND2F	16 in
D4-32ND3-1	32 in
D4-32ND3-2	32 in
D4-64ND2	64 in
AC Input	
D4-08NA	8 in
D4-16NA	16 in
AC/DC Input	
D4-16NE3	16 in
F4-08NE3S	8 in

DC Output	*I/O pt.*
D4-08TD1 (S)	8 out
D4-16TD1	16 out
D4-16TD2	16 out
D4-32TD1, (-1)	32 out
D4-32TD2	32 out
D4-64TD1	64 out
AC Output	
D4-08TA	8 out
D4-16TA	16 out
Relay Output	
D4-08TR	8 out
F4-08TRS-1	8 out
F4-08TRS-2	8 out
D4-16TR	16 out

Analog	*I/O pt.*
F4-04AD	16 or 32 in
F4-04ADS	16 in
F4-08AD	16 in
F4-16AD -1,(-2)	16 in
F4-04DA-1, (-2)	16 out
F4-04DAS-1, (2)	32 out
F4-08DA-1, (-2)	16 out
F4-16DA-1, (-2)	32 out
F4-08RTD	32 in
F4-08THM-n	16 in
F4-08THM	32 in
Communications/Networking	
All modules	0
CoProcessors	
All modules	0

Remote I/O	*I/O pt.*
H4-ERM(100)	0
D4-RM	0
D4-RS	0
D4-RSDC	0
Specialty Modules	
D4-INT	16 in
H4-CTRIO	0
D4-HSC	16 in/32 out
F4-16PID	0
F4-8MPI	0
D4-16SIM	8 or 16 in
F4-4LTC	0

DL405 I/O Addressing

Many of our customers were familiar with other PLC systems prior to trying *Direct*LOGIC products. One of the key differences between various PLC systems is how they treat the I/O module addressing. This section will describe how we address the individual I/O points in a DL405 system.

Octal addressing

The DL405 uses octal addressing. That is, the I/O point addresses do not include any "8s" or "9s". The I/O points start at 0 and continue in increments of 8, 16, 32, or 64 points, depending on the modules being used. We use the designator "X" for inputs and "Y" for outputs.

Automatic addressing

The DL405 CPUs automatically examine any I/O modules in the local CPU and expansion bases to establish the correct I/O configuration and addressing on power-up. The modules don't have to be grouped by type and the discrete input and output modules can typically be mixed in any order. However, there may be restrictions placed on some specialty modules or combinations of modules (Check the Module Placement restrictions). The following diagram shows sample addresses for a simple system containing discrete I/O modules.

For most applications, you never have to change or adjust the configuration. However, if you use automatic addressing and you add modules in between existing modules, the I/O addresses may be subject to renumbering. If you want to add modules in the future, add them to the right of any existing modules to avoid any re-addressing of your I/O points, or use manual addressing.

Manual addressing

The D4-440 and D4-450 CPUs allow you to manually assign I/O addresses for any or all I/O slots on the local or expansion bases. This feature is useful if you have a standard configuration that you must sometimes change slightly to accommodate special requests. It is also useful if you have to leave empty slots in between I/O modules and you do not want an added module to cause addressing problems. In automatic configuration, the addresses are assigned on 8-point boundaries. Manual configuration assumes that all modules are at least 16 points, so you can only assign addresses that are a multiple of 20 (octal). This does not mean you can only use 16, 32, or 64-point modules with manual configuration. You can use 8-point modules, but 16 addresses will be assigned and 8 are unused.

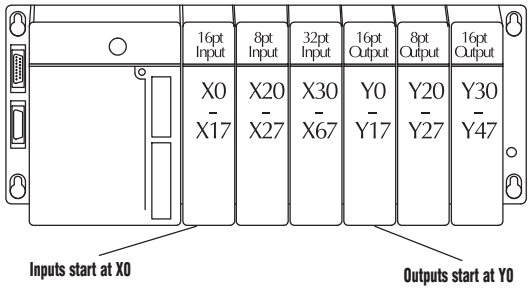
Remote I/O addressing

Remote I/O is very flexible when it comes to I/O addressing. For example, you specify the starting addresses, number of total points, etc. when you set up the system.

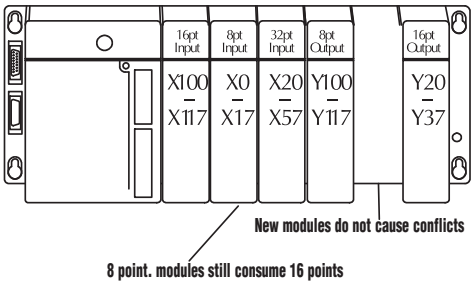
Manual addressing and choice of data type designators

With Remote I/O, you can choose the designator type that is used for the addresses. For example, you could choose to map the remote points into GX data types or GY data types or even into control relays. This can be very helpful in those situations where the local and expansion I/O have consumed all of the X inputs or Y outputs. You make these various choices when you define the setup logic for the remote I/O.

Automatically Assigned Module Addresses



Manually Assigned Module Addresses



Check the Power Budget

Verify your power budget requirements

Your I/O configuration choice can be affected by the power requirements of the I/O modules you choose. When determining the types and quantity of I/O modules you will be using, it is important to remember there is a limited amount of power available from the power supply.

The chart on the opposite page indicates the power supplied and used by each DL405 device. The adjacent chart shows an example of how to calculate the power used by your particular system. These two charts should make it easy for you to determine if the devices you have chosen fit within the power budget of your system configuration.

If the I/O you have chosen exceeds the maximum power available from the power supply, you can resolve the problem by shifting some of the modules to an expansion base or remote I/O base (if you are using remote I/O).

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

Use *ZIP*Links to reduce power requirements

If your application requires a lot of relay outputs, consider using the ZipLink AC or DC relay output modules. These modules can switch high current (10A) loads without putting a load on your base power budget. Refer to Wiring System for DL405 PLCs later in this section for more information.

This logo is placed next to I/O modules that are supported by the *ZIP*Link connection systems.

See the I/O module specifications at the end of this section.



Calculating your power usage

The following example shows how to calculate the power budget for the DL405 system. The example is constructed around a single 8-slot base using the devices shown. It is recommended you construct a similar table for each base in your system.

A				
	Base Number 0	***Device Type***	***5 VDC (mA)***	***External 24 VDC Power (mA)***
B	**CURRENT SUPPLIED**			
	CPU/Expansion Unit /Remote Slave	D4-440 CPU	3700	400
C	**CURRENT REQUIRED**			
	SLOT 0	D4-16ND2	+150	+0
	SLOT 1	D4-16ND2	+150	+0
	SLOT 2	F4-04DA	+120	+100
	SLOT 3	D4-08ND3S	+100	+0
	SLOT 4	D4-08ND3S	+100	+0
	SLOT 5	D4-16TD2	+100	+0
	SLOT 6	D4-16TD2	+100	+0
	SLOT 7	D4-16TR	+1000	+0
D	**OTHER**			
	BASE	D4-08B	+80	+0
	Handheld Programmer	D4-HPP	+320	+0
E	**Maximum Current Required**		***2820***	***100***
F	**Remaining Current Available**		***3700-2820=880***	***400-100=300***

1. Using a chart similar to the 3one above, fill in column 2.
2. Using the tables on the opposite page, enter the current supplied and used by each device (columns 3 and 4). Pay special attention to the current supplied by the CPU, Expansion Unit, and Remote Slave since they differ. Devices which fall into the "Other" category (Row D) are devices such as the Base and the Handheld programmer, which also have power requirements, but do not plug directly into the base.
3. Add the current used by the system devices (columns 3 and 4) starting with Slot 0 and put the total in the row labeled "maximum current required" (Row E).
4. Subtract the row labeled "Maximum current required" (Row E), from the row labeled "Current Supplied" (Row B). Place the difference in the row labeled "Remaining Current Available" (Row F).
5. If "Maximum Current Required" is greater than "Current Supplied" in either column 3 or 4, the power budget will be exceeded. It will be unsafe to use this configuration and you will need to restructure your I/O configuration. Note the auxiliary 24 VDC power supply does not need to supply all the external power. If you need more than the 400mA supplied, you can add an external 24VDC power supply. This will help keep you within your power budget for external power.

DL405 CPU power supply specifications and power requirements

Specification	AC Powered Units	24 VDC Powered Units	125 VDC Powered Units
Part Numbers	D4-450, D4-440, D4-430, D4-EX (expansion base unit), D4-RS (remote slave unit)	D4-450DC-1, D4-440DC-1, D4-EXDC (expansion base unit), D4-RSDC (remote slave unit)	D4-450DC-2 D4-440DC-2
Voltage Withstand (dielectric)	1 minute @ 1,500 VAC between primary, secondary, field ground, and run relay		
Insulation Resistance	> 10MΩ at 500VDC		
Input Voltage Range	85-132 VAC (110 range) 170-264 VAC (220 range	20-28 VDC (24 VDC) with less than 10% ripple	90-146 VDC (125 VDC) with less than 10% ripple
Maximum Inrush Current	20 A	20 A	20 A
Maximum Power	50 VA	38 W	30 W

Power Requirements

Power Supplied

CPUs/Remote Units/ Expansion Units	5 VDC Current Supplied in mA	24V Aux Power Supplied in mA	CPUs/Remote Units/ Expansion Units	5V Current Supplied in mA	24VAux. Power Supplied in mA
D4-430 CPU	3700	400	D4-EX	4000	400
D4-440 CPU	3700	400	D4-EXDC	4000	NONE
D4-440DC-1 CPU	3700	NONE	D4-EXDC-2	3700	NONE
D4-440DC-2 CPU	3700	NONE	D4-RS	3700	400
D4-450 CPU	3100	400	D4-RSDC	3700	NONE
D4-450DC-1 CPU	3100	NONE	H4-EBC	3470	400
D4-450DC-2 CPU	3100	NONE	H4-EBC-F	3300	400

Power Consumed

Power-consuming Device	5V Current Consumed	External 24VD Current Required	Power-consuming Device	5V Current Consumed	External 24VDC Current Required
I/O Bases			**Analog Modules (continued)**		
D4-04B-1	80	NONE	F4-16AD-1	75	100
D4-06B-1	80	NONE	F4-16AD-2	75	100
D4-08B-1	80	NONE	F4-04DA-1	70	75+20per circuit
			F4-04DA-2	90	90
DC Input Modules			F4-04DAS-1	60	60 per circuit
			F4-04DAS-2	60	60 per circuit
D4-08ND3S	100	NONE	F4-08DA-1	90	100+20 per circuit
D4-16ND2	150	NONE	F4-08DA-2	80	150
D4-16ND2F	150	NONE	F4-16DA-1	90	100+20 per circuit
D4-32ND3-1	150	NONE	F4-16DA-2	80	25 max.
D4-32ND3-2	150	NONE	F4-08RTD	80	NONE
D4-64ND2	300 max.	NONE	F4-08THM-n	120	50
			F4-08THM	110	60
AC Input Modules			**Remote I/O**		
D4-08NA	100	NONE	H4-ERM(100)	320(300)	NONE
D4-16NA	150	NONE	H4-ERM-F	450	NONE
AC/DC Input Modules			D4-RM	300	NONE
D4-16NE3	150	NONE	**Communications and Networking**		
F4-08NE3S	90	NONE	H4-ECOM100	300	NONE
DC Output Modules			H4-ECOM-F	670	NONE
D4-08TD1	150	35	D4-DCM	500	NONE
F4-08TD1S	295	NONE	F4-MAS-MB	235	NONE
D4-16TD1	200	125	FA-UNICON	NONE	65
D4-16TD2	400	NONE	**CoProcessors**		
D4-32TD1	250	140			
D4-32TD1-1	250	140 (15V)	F4-CP128-1	305	NONE
D4-32TD2	350	120 (4A max including loads)	**Specialty Modules**		
D4-64TD1	800	NONE	H4-CTRIO	400	NONE
AC Output Modules			D4-INT	100	NONE
D4-08TA	250	NONE	D4-HSC	300	NONE
D4-16TA	450	NONE	F4-16PID	160	NONE
Relay Output Modules			F4-8MPI	225	170
			D4-16SIM	150	NONE
D4-08TR	550	NONE	F4-4LTC	280	75
F4-08TRS-1	575	NONE	**Programming**		
F4-08TRS	575	NONE	D4-HPP-1 (Handheld Prog.)	320	NONE
D4-16TR	1000	NONE	**Operator Interface**		
Analog Modules			DV-1000	150	NONE
			C-more Micro-Graphic	210	NONE
F4-04AD	150	100			
F4-04ADS	370	120			
F4-08AD	75	90			

Dimensions and Installation

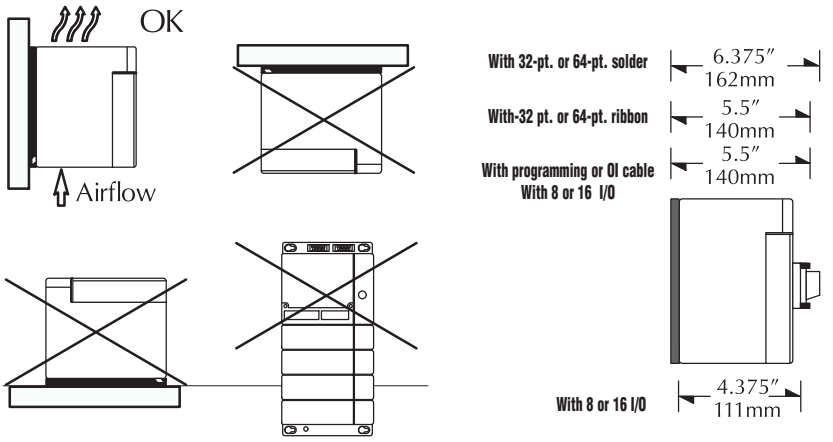
Local base expansion unit, includes 110/220 VAC power supply, requires local I/O expansion cable D4-EXCBL-1 or D4-EXCBL-2It is important to understand the installation requirements for your DL405 system. This will help ensure that the DL405 products operate within their environmental and electrical limits.

Plan for safety

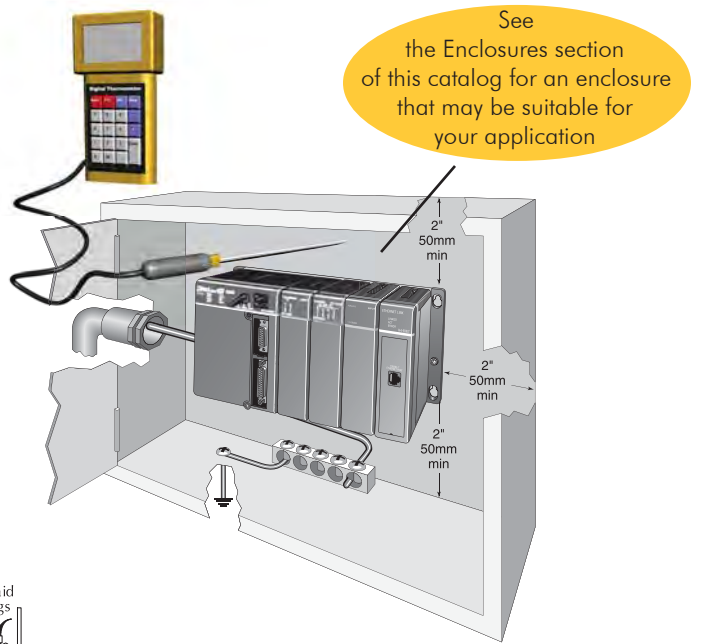
This catalog should never be used as a replacement for the user manual. The user manual, D4-USER-M, contains important safety information that must be followed. The system installation should comply with all appropriate electrical codes and standards.

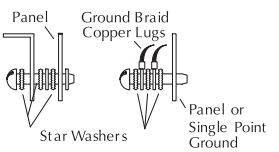
Base dimensions and mounting orientation

Use the diagrams to the right to make sure the DL405 system can be installed in your application. To ensure proper airflow for cooling purposes, DL405 bases must be mounted horizontally. It is important to check these dimensions against the conditions required for your application. For example, it is recommended that you leave 2" depth for ease of access and cable clearance. However, your distance may be greater or less. Also, check the installation guidelines for the recommended cabinet clearances.

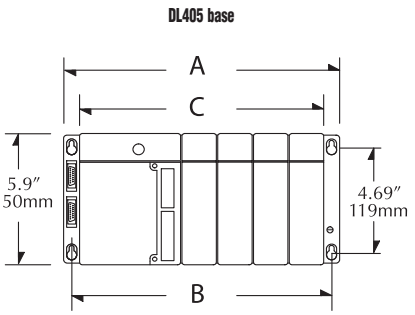


Specification	Rating
Storage Temperature	-4°F - 158°F (-20°C to 70°C)
Ambient Operating Temperature	32°F - 140°F (0° to 60°C)
Ambient Humidity	30% - 95% relative humidity (non-condensing)
Vibration Resistance	MIL STD 810C, Method514.2
Shock Resistance	MIL STD810C, Method516.2
Noise Immunity	NEMA(ICS3-304)
Atmosphere	No corrosive gases





Note: there is a minimum of 2" (50mm) clearance required between the panel door or any devices mounted in the panel door and the nearest DL405 component.



Base	Price	A		B		C	
D4-04B-1	<--->	11.53"	293mm	10.82"	275mm	10.50"	267mm
D4-06B-1	<--->	14.44"	367mm	13.74"	349mm	13.42"	341mm
D4-08B-1	<--->	17.36"	441mm	16.65"	423m	16.32"	423mm

Base Configurations

Four, six, and eight-slot bases

The DL405 product family offers four, six, and eight-slot I/O bases.

Expansion units

The expansion units are only necessary when you want to use local expansion. They are installed in the CPU slot of the expansion bases. They appear very similar to CPUs, but they only contain a power supply. One of the most often asked questions for the DL405 family is, "Does the CPU consume an I/O slot?" The answer is no. The CPU has a special slot in the base and does not consume any of the available I/O slots. The same is true for Expansion Units.

- D4-EX 110/220 VAC power supply
- D4-EXDC 24 VDC power supply
- D4-EXDC-2 125 VDC power supply

and the Remote Slave Units

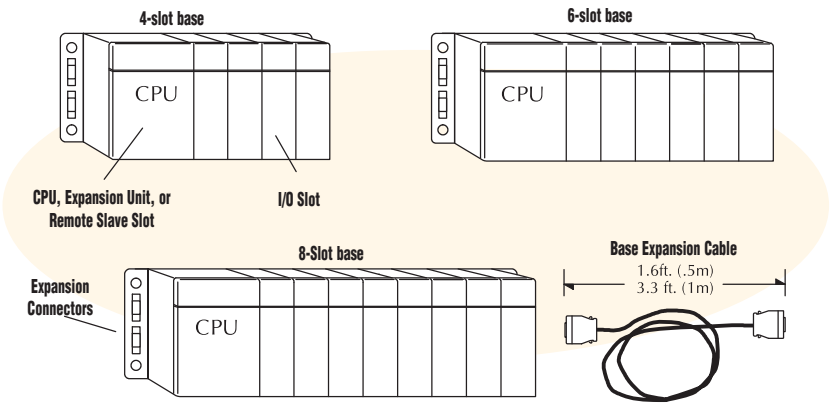
- D4-RS 110/220 VAC power supply

An expansion cable is required to connect each of the expansion bases to the CPU base

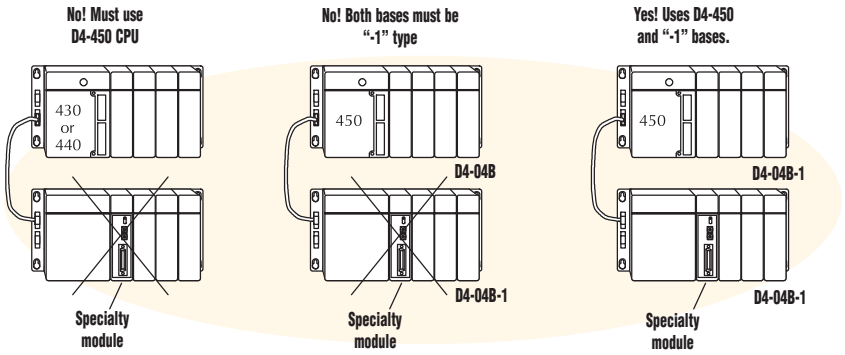
- D4-EXCBL-1 3.08 ft (1m) cable
- D4-EXCBL-2 1.54 ft (0.5m) cable

D4-450 and –1 bases

In the past, a DL405 system has been limited to only accepting specialty modules in the local CPU base. The –1 bases must be used with the D4-450 CPU to remove this limitation. The part numbers for the bases are D4-04B-1, D4-06B-1, and D4-08B-1. (Note: you cannot simply add a –1 base to an existing system to gain specialty modules in expansion bases. Instead, you must replace the CPU base and all other expansion bases as well.) You can add the –1 bases in an older system, but they are subject to the limitations of the regular bases.

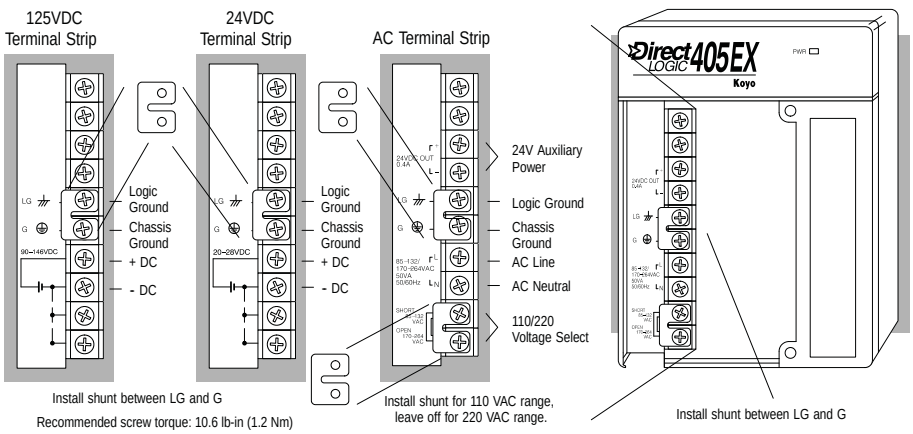


Specialty modules in expansion bases



Part	Description	Price
D4-EX	Local base expansion unit, includes 110/220 VAC power supply, requires local I/O expansion cable D4-EXCBL-1 or D4-EXCBL-2	<--->
D4-EXDC	Local base expansion unit, includes 24 VDC power supply, requires local I/O expansion cable D4-EXCBL-1 or D4-EXCBL-2	<--->
D4-EXDC-2	Local base expansion unit, includes 125 VDC power supply, requires local I/O expansion cable D4-EXCBL-1 or D4-EXCBL-2	<--->
D4-RS	Serial remote I/O slave unit (used with D4-RM), includes 110/220 VAC power supply, uses shielded twisted pair (24 AWG minimum)	<--->
D4-EXCBL-1	Base expansion cable, 3.08 ft. (1m)	<--->
D4-EXCBL-2	Base expansion cable, 1.54 ft. (0.5m)	<--->

Expansion Unit Wiring



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