# DL405 Family of Products

This page provides an overview of the variety of products found in the DL405 family.

### **CPUs**

- <u>D4-454</u> 110/220 VAC P/S
- <u>D4-454DC-1</u> 24VDC P/S 30.8K total memory 16 PID loops with auto-tune

### Memory cartridges

• UVPROM - 15.5K (<u>D4-UV-2</u>)

### Programming

 DirectSOFT Programming for Windows (PC-DSOFT6) Handheld programmer (D4-HPP-1)

#### Bases

- 4-slot base (<u>D4-04B-1</u>)
- 6-slot base (<u>D4-06B-1</u>)
- 8-slot base (<u>D4-08B-1</u>)

## Local expansion base power supplies

- 110/220 VAC P/S (D4-EX)
- 24VDC P/S (D4-EXDC)

### Discrete input modules

- DC input
- 16-point 12-24 VDC (D4-16ND2)
- 16-point 12–24 VDC (1ms response) (D4-16ND2F)
- 32-point 24VDC (<u>D4-32ND3-1</u>)
- 64-point 20–28 VDC (<u>D4-64ND2</u>) AC input modules
- 8-point 110/220 VAC (<u>D4-08NA</u>)
- 16-point 110VAC (<u>D4-16NA</u>)
- AC/DC input modules
- 16-pt 12–24 VAC/DC (<u>D4-16NE3</u>)

## Discrete output modules

- DC output modules
- 16-point 5-24 VDC (D4-16TD1)
- 16-point 12-24 VDC (D4-16TD2)
- 32-point 5–26 VDC (<u>D4-32TD1</u>)
- 32-point 12-24 VDC (D4-32TD2)
- 64-point 5-26 VDC (D4-64TD1)
- AC output modules
- 8-point 18–220 VAC (<u>D4-08TA</u>)
- 16-point 18–220 VAC (<u>D4-16TA</u>)
- Relay output modules
- 8-point 2A (<u>D4-08TR</u>)
- 8-point 5A/pt (isolated) (<u>F4-08TRS-2</u>)
- 8-point 10A/pt (isolated) (<u>F4-08TRS-1</u>)
- 16-point 1A/pt (<u>D4-16TR</u>)

### Analog modules(12-bit)

- Analog input
- 4-channel in, current/voltage (F4-04AD)
- 4-channel in, current/voltage (isolated) (F4-04ADS)
- 8-channel in, current/voltage (F4-08AD)
- 16-channel in, current (F4-16AD-1)
- 16-channel in, voltage (F4-16AD-2)
- Analog output
- 4-channel out, current (F4-04DA-1)
- 4-channel out, voltage (F4-04DA-2)
- 8-channel out, current (F4-08DA-1)
- 8-channel out, voltage (F4-08DA-2)
- 16-channel out, current (F4-16DA-1)
- 16-channel out, voltage (F4-16DA-2)
- Temperature Input
- 8-channel in, type J thermocouple (F4-08THM-J)

### Analog modules(16-bit)

- Temperature Input
- 8-channel in, RTD (<u>F4-08RTD</u>)
- 8-channel in, thermocouple (F4-08THM)
- Analog output
- 4-channel out, current (isolated) (F4-04DAS-1)
- Communications/ networking modules
- Ethernet communications [H4-ECOM100]
- Data communications (D4-DCM)
- Modbus Client (F4-MAS-MB)

### Specialty modules

- High-speed counter I/O (<u>H4-CTRIO</u>)
- 8/16 channel input simulator (<u>D4-16SIM</u>)
- 4-loop temperature controller (<u>F4-4LTC</u>)
- BASIC CoProcessor Module
- 128K triple port (<u>F4-CP128-1</u>)

## CPU-Slot Server controllers

• Ethernet base controller (H4-EBC)

### Remote I/O modules

- Ethernet
- Ethernet remote Client Module (<u>H4-ERM100</u>)
- Ethernet base Controller (Server) (<u>H4-EBC</u>)
- Remote I/O protocol (serial)
- Remote I/O Client Module (<u>D4-RM</u>)
- Remote I/O Server 110/220 VAC (D4-RS)

## DL405 CPUs

#### System capacity

System capacity is the ability of the CPU to accommodate a variety of applications. Here are a few key considerations when determining system capacity:

How much memory do you need? Consider both ladder memory and data registers (V-memory). For ladder memory, most boolean instructions require one word. Some other instructions, such as timers, counters, etc., require two or more words. Our V-memory locations are

#### Performance

If you have a time-critical application where every millisecond is important, then the <u>D4-454</u> CPU, with the fastest overall scan time, is the right choice. The <u>D4-454</u> is very fast at performing even the most basic of math or data instructions and will provide a faster overall scan time. 16-bit words and are useful for data storage, etc.

What type of memory do you need? The <u>D4-454</u> has 15.5K of built in M-RAM ladder memory and no memory cartridge is needed.

How many I/O points are required? You will need to know how many field devices are required. Compare the <u>D4-454</u> specifications tables on the next page with

D4-454 Parameters						
Features	<u>D4-454</u>					
Total Memory	46.8K					
Ladder Memory	31.5K					
DirectSOFT	Yes, version 6.1 or later					
Memory Cartridge	No, (same amount of memory as the largest memory cartridge)					
Battery	<u>D2-BAT-1</u> (CR2354)					
Mode Switch	Toggle Switch (Same position/ function)					
Port 1 and 3 Baud Rate	2400, 4800, 9600, 19200, 38400					
Port 1 and 3 Settings	8 data bits, 1 start bit, 1 stop bit, Odd, Even or No parity					
Port 2 Protocol	DirectNet (Client/Server), K-sequence, Non-procedure, Modbus RTU (Client/ Server)					
Firmware Update	Supported from all ports					

NOTE: Any hardware with a date code less than 09X0 or with a first digit that is not 0, 1, or 2 may not work with the <u>D4-454</u>. We suggest that any hardware older than ten years and not currently sold on the AutomationDirect.com website be upgraded to a newer version. your application requirements.

Are there any remote I/O points? In many applications, the cost of bringing the individual control wiring back to the PLC control panel can be reduced by the use of remote I/O. The <u>D4-454</u> CPU has built-in serial remote I/O connections on the lower 25-pin port; or use Ethernet Remote I/O for fast and easy set-up and communications.

D4-454 Unsupported Modules Table					
Bases	Retired				
D4-04B, D4-04BNX	Yes				
D4-06B, D4-06BNX	Yes				
D4-08B, D4-08BNX	Yes				
Input Modules					
D4-32ND3-2	Yes				
D4-16NA-1	Yes				
Output Modules					
D4-08TD1	Yes				
Comm Modules					
H4-ECOM	Yes				
Remote I/O Modules					
D4-ERM	Yes				
D4-ERM-F	Yes				
Specialty Modules					
D4-PULS	Yes				
D4-HSC	Yes				
F4-CP128-R	Yes				
F4-CP512-1	Yes				

## **DL405 CPU Specifications**

DL405 CPU Specifications						
	D4-454					
System Capacity						
Total memory available (words)	46.8K					
Ladder memory (words)						
built-in memory	31.5K					
with memory cartridge	N/A					
V-memory (words)	15.3K					
Battery backup	Yes, MRAM*					
Iotal CPU memory I/O pts. available	8192 (X+Y+GX+GY)					
(actual)	2/4/8/16/32/64					
I/O module point density	4/6/8					
I/O module slots per base	1024 in/1024 out					
Local/local expansion	4224 max.					
Serial Remote I/O (including local &	3					
exp. I/O	512, 2048					
I/O ats, per remote module	Yes,					
channel	8192 max.					
Ethernet Remote I/O (including	(Including local and exp.					
local/exp. I/O)	I/U) Man into \/ marray					
discrete I/O pts.	limited by newer budget					
	16 384 (16 fully expanded					
Analog I/O channels	H4-FBC Servers using					
Remote I/O channels	V-memory and hit-of-word					
I/O per remote channel	instructions)					
Performance						
	0.96.00					
Typical scan (1K boolean)	0.30 μs 4–5 ms					
Programming and Diagnostics						
Pi Lladdar atula	Vee					
RLL Iduuel Siyle RLL DI US/flowchart style (Stages)	105 Vec/102/					
Run time editing	Yes					
Supports Overrides	Yes					
Variable/fixed scan	Fixed or variable					
Instructions	210					
Control relays	2048					
Timers	256					
Counters	256					
Immediate I/O	Yes					
Subroutines	Yes					
For/next loops	Yes					
limed interrupt	Yes					
Integer math	TeS Voc					
rioaung-point math	Vec					
Table instructions	Yes					
PID	Yes					
Drum sequencers	Yes					
Bit of word	Yes					
Real-time clock/calendar	Yes					
Internal diagnostics	Yes					
Password security	Multi-level					
System and User error log	Yes					
IBox instructions	Yes					
CPU Ports Communications						
Built-in ports	4 ports					
K-sequence (proprietary protocol)	Yes					
DirectNE I	Yes					
	res					
ASCII OUL (MINI) Maximum baud rata	105 38 /K					
	JU.4N					
*Battery used for Real Time Clock backup						

## **D4-454 Key Features**



#### D4-454 CPU\*

The D4-454 CPUs provides tremendous capability using updated microprocessor technology allowing the D4-454 to be the CPU of choice for the DL405 family.

#### Built-in CPU Communications Ports

The D4-454 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 PC running DirectSOFT6 programming software (version 6.1 or later) or to a D4-HPP-1 handheld programmer. It can also be used to connect to a *C-more* panel or other operator interfaces. The 6-pin phone jack supports K-sequence; DirectNET Client/ Server, ASCII output and Modbus RTU Client/Server protocols. The bottom 25pin port contains two logical ports with different pins for each port. It is primarily a networking port that supports DirectNET Client/Server or Modbus Client/Server 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 Client. The Communications Ports table on the next page has a complete description of each port.

\* The D4-454 CPU is a direct replacement for the retired D4-450 CPU.

#### 16 PID Loops

The D4-454 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 DirectSOFT6 Programming Software. An overview of the various loop specifications and features is on page tDL4-7.

### **Floating-point Math**

The D4-454 CPU supports IEEE format floating-point math calculations. This feature means the D4-454 includes full trigonometric functions and various forms of integer/floating point number conversions.

#### **Power Supplies**

We offer a choice of two built-in power supplies for the D4-454 CPUs. Available choices are an AC source or DC source:

- 110/220 VAC version D4-454
- 24VDC version D4-454DC-1



NOTE: Any hardware older than tens years old may not work with the <u>D4-454</u>. We suggest that any hardware older than ten years and not currently sold on the AutomationDirect.com website be upgraded to a newer version.

## **D4-454 Features**

The diagram on this page shows the various hardware features found on the D4-454 CPU.

CPU Keyswitch								
RUN	Forces will not	CPU to RUN mode. Locks Comm port - receive incoming data.						
TERM	Allows p etc.) to	Allows peripherals (HPP, DCM, DirectSOFT, etc.) to select operating mode						
STOP	Forces	Forces CPU out of RUN						
	CP	U 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						
1/0	ON I/O self-diagnostics error OFF I/O self-diagnostics good							
ΤΧΟ	ON OFF	Data is being transmitted No data is being transmitted						
RXD	ON Data is being transmitted OFF No data is being transmitted							
	Con	nmunications Ports						
Phone Jack Port 2	<ul> <li>General purpose port for RS232. Baud rate is selectable up to 38.4Kb. Connects to DirectSOFT programming software, <i>C-more</i> panels, network, etc. Supports K-sequence protocol, DirectNET (Client or Server) protocol, Non-squence (ASCII out), and Modbus RTU (Client or Server) protocol.</li> </ul>							
15-pin Port 0	Programming port, RS232, 9600 baud, connects to HPP, DirectSOFT, DV-1000, <i>C-more</i> panels, etc. K-sequence protocol (fixed station address=1)							
25-pin Port 1 and Port 3	Genera (RS485 only.) Baud ra baud. Connec network Two log Softwar Protoco K-seque DirectN Modbus Remote ASCII C	I purpose port for RS232 and RS422 Remote I/O Client available on Port 3 te selectable via software up to 38.4K ts to DirectSOFT, <b>C-more</b> panels, ,etc ical ports (separate pins on connector). e selectable protocol includes: I Port 1 Port 3 ence 3 3 ETClient/Server 3 3 c Client/Server 3 3 : I/O n/a 3 Dut 3 3						

#### **D4-454 CPU Hardware Features**



### D4-454 communications ports pin-out

#### Phone jack

#### 15-pin connector



Port 2

#### 25-pin connector







### **D4-454 Features**

#### D4-454 Scan control

The <u>D4-454</u> 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 memory of the D4-454 is fully contained in the CPU and stored in MRAM which is a non-volatile form of memory. No memory card is required. The battery is used for retention of the Real Time Clock.

#### 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 D4-454 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



DirectSOFT 6.1 or later, is required to program the D4-454.





## D4-454 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 <u>D4-454</u> CPU. Check out the <u>F4-4LTC</u> 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 D4-454 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.



## **DL405 Programming Tools and Cables**

#### Select a programming device

There are two tools for programming the DL405 CPUs: DirectSOFT PC-based programming software and the <u>D4-HPP-1</u> handheld programmer.

#### DirectSOFT 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 DirectLOGIC Overview Section DL in this catalog for detailed information on DirectSOFT.

Direct Soft Part Number	Price	Description
<u>D4-HPP-1</u>	Retired	Handheld Programmer
<u>PC-DSOFT6</u>	\$00?e3:	Programs all PLC families DL05/06/105/205/305/405
<u>PC-DS100</u>	Free	Free version of DirectSOFT; programs all DirectLOGIC PLC CPUs; limited to 100 word program

#### DL405 programming cables

Choose the proper cable to connect the DL405 CPU to your PC running DirectSOFT.

CPU	Price	Port	Cable	Price
		Top port (15 pin)	D4-DSCBL	\$-04ni:
<u>D4-454</u>	\$;-001ius:	Lower port (25pin)	r port pin) <u>D3-DSCBL-2</u> \$04	\$04nh:
		Phone jack (RJ12)	D2-DSCBL	\$04nd:

#### Handheld programmer

The <u>D4-HPP-1</u> 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.

Direct4	)5HPP 🛛	IANDHELD	PROGRA	MMER	0					]
IP RUN         ITEST           IP ROM         IIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIII										
A	NOT	C ISG	SG	ADD	K(CON)		<b>*</b>	WD ST	BIT ST	EXIT AUX
AND		H		J JB	PNTR	S(SG)	TEST 7	ON 8	] <mark>FF</mark> ~[	FIND
OR K				MUL	Z(SPD)		E(H)	F(H)	ů	PREV
		SR .	BCD	Ē	C(CR)	ASC	B(H)	C(H)	D(H) 3	NXT
	RST			ž	<u><u></u></u>	Y	A(H)			
D4-HF	PP-1				0					Koyo



#### Pin labeling conforms to IBM DTE and DCE standards







