DL405 Family of Products

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

CPUs

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

Memory cartridges

- UVPROM - 15.5K (D4-UV-2)

Programming

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

Bases

- 4-slot base (D4-04B-1)
- 6-slot base (D4-06B-1)
- 8-slot base (D4-08B-1)

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

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

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 (F4-08RTD)
- 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 (H4-CTRIO)
- 8/16 channel input simulator (D4-16SIM)
- 4-loop temperature controller (F4-4LTC)
- BASIC CoProcessor Module
- 128K triple port (F4-CP128-1)

CPU-Slot Server controllers

- Ethernet base controller (H4-EBC)

Remote I/O modules

- Ethernet
- Ethernet remote Client Module
  (H4-ERM100)
- Ethernet base Controller (Server)
  (H4-EBC)
- Remote I/O protocol (serial)
- Remote I/O Client Module (D4-RM)
- 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 16-bit words and are useful for data storage, etc.

What type of memory do you need? The D4-454 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 D4-454 specifications tables on the next page with 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 D4-454 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.

Performance

If you have a time-critical application where every millisecond is important, then the D4-454 CPU, with the fastest overall scan time, is the right choice. The D4-454 is very fast at performing even the most basic of math or data instructions and will provide a faster overall scan time.

D4-454 Parameters	
Features	**D4-454**
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	D2-BAT-1 (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 D4-454. 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 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*
Total CPU memory I/O pts. available (actual I/O points depend on I/O configuration selected)	8192 (X+Y+GX+GY)
I/O module point density	2/4/8/16/32/64
I/O module slots per base	4/6/8
Local/local expansion	1024 in/1024 out
Serial Remote I/O (including local & exp. I/O	4224 max.
	3
Remote I/O Channels	512, 2048
I/O pts. per remote module channel	Yes,
	8192 max.
Ethernet Remote I/O (including local/exp. I/O)	(Including local and exp. I/O)
discrete I/O pts.	Map into V-memory
	Limited by power budget
Analog I/O channels	16,384 (16 fully expanded
Remote I/O channels	H4-EBC Servers using
I/O per remote channel	V-memory and bit-of-word
	instructions)
Performance	
Contact execution (boolean)	0.96 µs
Typical scan (1K boolean)	4–5 ms
Programming and Diagnostics	
RLL ladder style	Yes
RLL PLUS/flowchart style (Stages)	Yes/1024
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
Timed interrupt	Yes
Integer math	Yes
Floating-point math	Yes
Trigonometric functions	Yes
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
DirectNET	Yes
Modbus Client/Server	Yes
ASCII out (Print)	Yes
Maximum baud rate	38.4K
*Battery used for Real Time Clock backup	

D4-454 Key Features

D4-454 CPU

D4-454 $1,026.00

D4-454DC-1 $1,180.00

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.
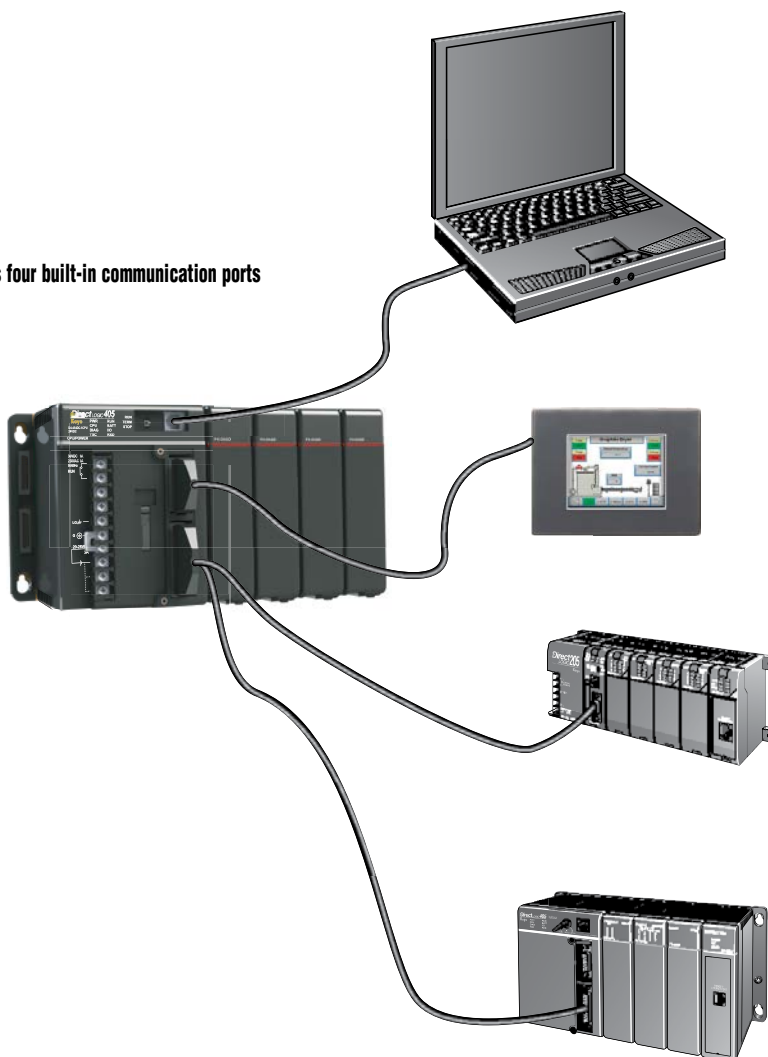
Floating-point Math

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

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 25-pin 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.
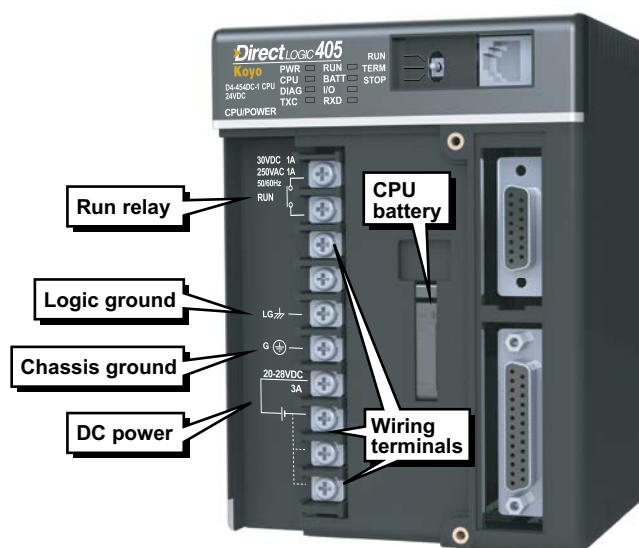
D4–454 offers four built-in communication ports

NOTE: Any hardware older than tens years old may not work with the D4-454. 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

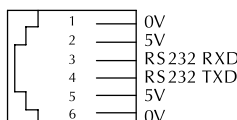The diagram on this page shows the various hardware features found on the D4-454 CPU.

CPU Keyswitch	
RUN	Forces CPU to RUN mode. Locks Comm port - will not receive incoming data.
TERM	Allows peripherals (HPP, DCM, DirectSOFT, etc.) to select operating mode
STOP	Forces CPU out of RUN
CPU Status Indicators		

PWR	ON	CPU power good
	OFF	CPU power failure
RUN	ON	CPU is in RUN mode
	OFF	CPU is in STOP mode
CPU	ON	CPU self-diagnostics error
	OFF	CPU self-diagnostics good
BATT	ON	CPU battery is low
	OFF	CPU battery is good or disabled
DIAG	ON	CPU diagnostics or local bus error
	OFF	CPU diagnostics or local bus good
I/O	ON	I/O self-diagnostics error
	OFF	I/O self-diagnostics good
TXD	ON	Data is being transmitted
	OFF	No data is being transmitted
RXD	ON	Data is being transmitted
	OFF	No data is being transmitted

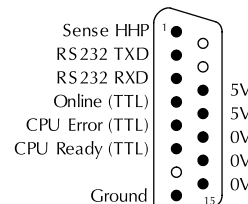| *Communications Ports*	
Phone Jack Port 2	General purpose port for RS232. Baud rate is selectable up to 38.4Kb. Connects to DirectSOFT programming software, *C-more* panels, network, etc. Supports K-sequence protocol, DirectNET (Client or Server) protocol, Non-squence (ASCII out), and Modbus RTU (Client or Server) protocol.
15-pin Port 0	Programming port, RS232, 9600 baud, connects to HPP, DirectSOFT, DV-1000, *C-more* panels, etc. K-sequence protocol (fixed station address=1)
25-pin Port 1 and Port 3	General purpose port for RS232 and RS422 (RS485 Remote I/O Client available on Port 3 only.) Baud rate selectable via software up to 38.4K baud. Connects to DirectSOFT, *C-more* panels, network,etc Two logical ports (separate pins on connector). Software selectable protocol includes: Protocol Port 1 Port 3 K-sequence 3 3 DirectNETClient/Server 3 3 Modbus Client/Server 3 3 Remote I/O n/a 3 ASCII Out 3 3

D4-454 CPU Hardware Features

D4-454 communications ports pin-out

Phone jack

Pin	Signal
1	0V
2	5V
3	RS232 RXD
4	RS232 TXD
5	5V
6	0V

Port 2

15-pin connector

Sense HHP
RS232 TXD
RS232 RXD
Online (TTL)
CPU Error (TTL)
CPU Ready (TTL)
Ground
5V
5V
0V
0V
0V

Port 0

25-pin connector

RS232 TXD
RS232 RXD
RS232 RTS
RS232 CTS
0V
RS422 RXD+
RS422 RXD–
RS422 CTS+
RS422 TXD+
RS422 TXD–
RS422 RTS–
RS422 RTS+
RS422 CTS–

Port 1

25-pin connector

0V
RS422 TXD+
RS422 TXD–
RS422 RXD+
RS422 RXD–
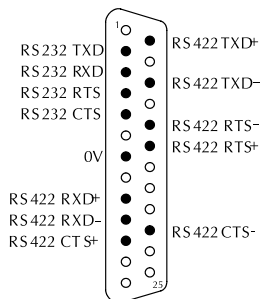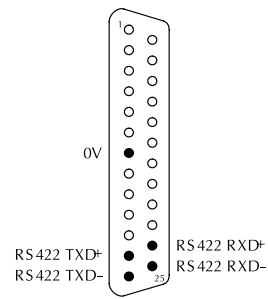
Port 3

D4-454 Features

D4-454 Scan control

The D4-454 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.
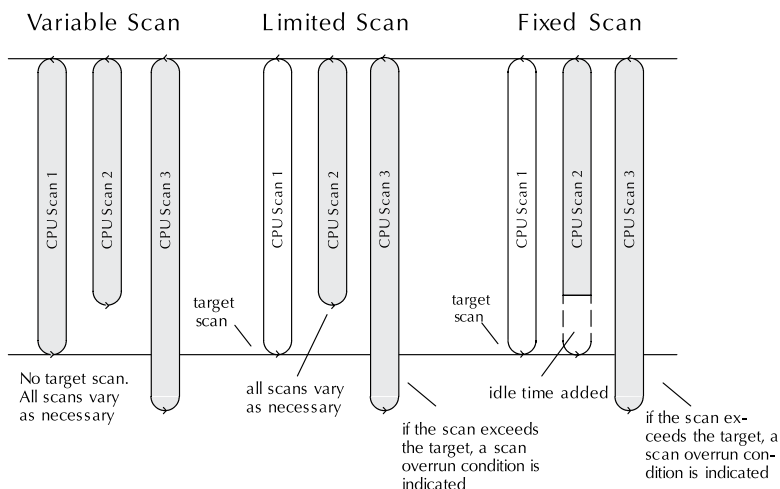
Memory — The memory of the D4-454 is fully contained in the CPU and stored in MRAM which is a non-volatile form of memory. No memory card is required. The battery is used for retention of the Real Time Clock.
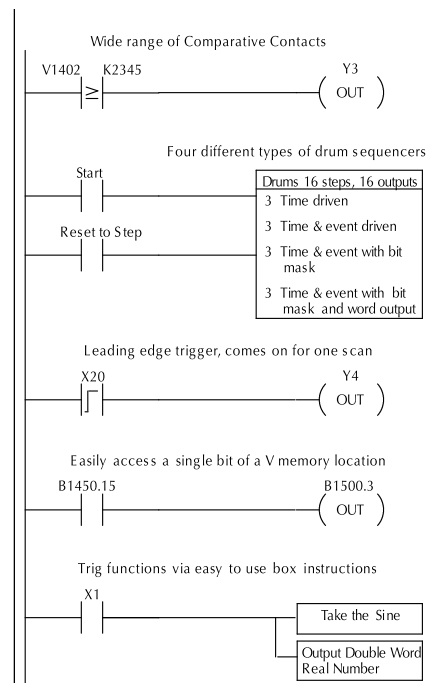
Full array of instructions
Imagine if someone asked you to write a book, but then told you that you could only use 50 different words? That would be a tough job! The same is true for writing a PLC program. The right instruction can greatly simplify your control program.

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

Variable Scan — No target scan. All scans vary as necessary

Limited Scan — all scans vary as necessary; if the scan exceeds the target, a scan overrun condition is indicated

Fixed Scan — target scan; idle time added; if the scan exceeds the target, a scan overrun condition is indicated

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

Wide range of Comparative Contacts

Four different types of drum sequencers
Drums 16 steps, 16 outputs
3 Time driven
3 Time & event driven
3 Time & event with bit mask
3 Time & event with bit mask and word output

Leading edge trigger, comes on for one scan

Easily access a single bit of a V memory location

Trig functions via easy to use box instructions
Take the Sine
Output Double Word Real Number

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 D4-454 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 D4-454 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.*

PID Loop Control Block Diagram
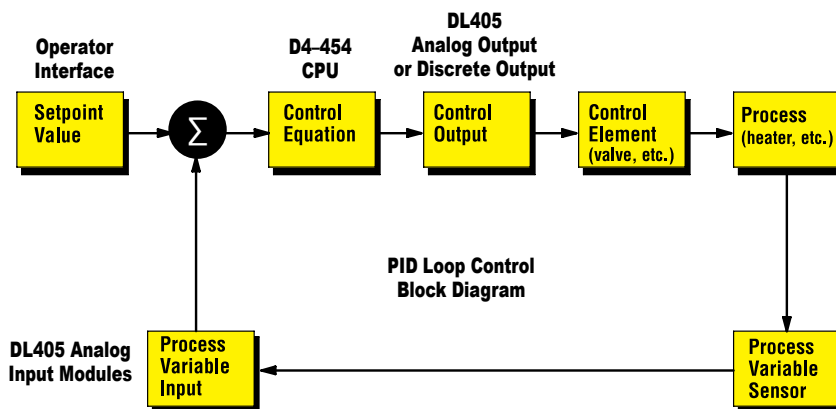
DL405 Programming Tools and Cables

Select a programming device

There are two tools for programming the DL405 CPUs: DirectSOFT PC-based programming software and the D4-HPP-1 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
D4-HPP-1	Retired	Handheld Programmer
PC-DSOFT6	$462.00	Programs all PLC families DL05/06/105/205/305/405
PC-DS100	Free	Free version of DirectSOFT; programs all DirectLOGIC PLC CPUs; limited to 100 word program
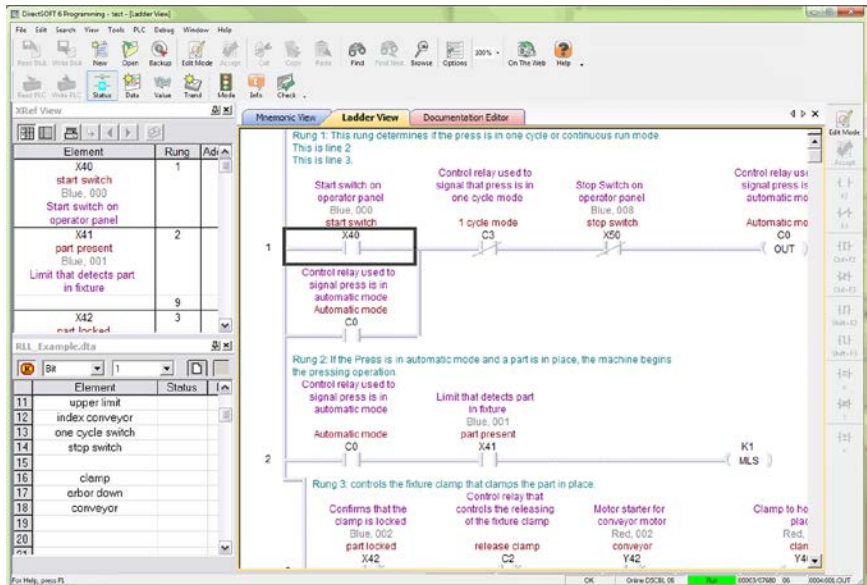
DL405 programming cables

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

CPU	Price	Port	Cable	Price
D4-454	$1,026.00	Top port (15 pin)	D4-DSCBL	$85.00
		Lower port (25pin)	D3-DSCBL-2	$77.00
		Phone jack (RJ12)	D2-DSCBL	$41.50

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.

Pin labeling conforms to IBM DTE and DCE standards