

## CPU General Specifications

Features	DL430	DL440	DL450
Total Program memory (words)	6.5K	14.5K / 22.5K*	22.8K / 30.8K*
Ladder memory (words), built-in	3.5K	7.5K / 15.5K*	7.5K / 15.5K*
V-memory (words)	3.0K	7.0K	15.3K
Scan Time, typical (1 K boolean)	8 – 10 mS	2 – 3 mS	4 – 5 mS
Run time edit	No	Yes	Yes
RLL and RLL <i>PLUS</i> Programming	Yes	Yes	Yes
Handheld programmer with cassette tape interface	Yes	Yes	Yes
<b>DirectSOFT</b> 32 programming for Windows™	Yes	Yes	Yes
Built-in communication ports	2 ports	2 ports	4 ports
CMOS RAM	No	w/mem. cartridge	w/mem. cartridge
UVPROM	No	w/mem. cartridge	w/mem. cartridge
EEPROM	Standard on CPU	w/mem. cartridge	w/mem. cartridge
FLASH RAM	No	No	Standard on CPU
Compatible with:			
CoProcessor™ modules	Yes	Yes	Yes
Networking modules	Yes	Yes	Yes
RS232C/RS422 Data Comm. Module	Yes	Yes	Yes
Total I/O	1152	1664	3584
Total I/O available as:			
Local I/O / Local expansion I/O / Remote I/O	640	640	4096
Remote I/O	512 max.	1024 max.	2048 max.
Remote I/O Channels	2	2	3
Local discrete input points maximum	320	320	1024
Local discrete output points maximum	320	320	1024
Local analog input channels maximum	320**	320**	512**
Local analog output channels maximum	320**	320**	512**
Maximum number of channels / masters (remote or slice) per local CPU base	2	2	2
Remote I/O Distance	3300 ft. (1000m)	3300 ft. (1000m)	3300 ft. (1000m)
Discrete I/O Module Point Density	8/16/32/64	8/16/32/64	8/16/32/64
Slots per Base	4/6/8	4/6/8	4/6/8

\* The first values represent CPUs using the 7.5K memory cartridge and the second value is for using 15.5K memory cartridges.

\*\* Additional Discrete and Analog I/O can be supported (within the power budget) through the use of remote I/O.

Feature	DL430	DL440	DL450
Number of instructions available (see Chapter 5 for a description of the available instructions)	113	170	210
Control relays	480	1024	2048
Special relays (system defined)	288	352	512
Stages in RLL <sup>PLUS</sup>	384	1024	1024
V-memory	3072 words	7168 words	15360 words
Timers	128	256	256
Counters	128	128	256
Immediate I/O	Yes	Yes	Yes
Interrupt input	8 points	16 points	16 points
Subroutines	No	Yes	Yes
For/Next Loops	No	Yes	Yes
Drum Timers	No	No	Yes
Math	Integer	Integer	Integer and Floating Point
PID Loop Control, built-in	No	No	16 loops
Time of Day Clock/Calendar	No	Yes	Yes
Internal diagnostics	Yes	Yes	Yes
Password security	No	Yes	Yes, multi-level
System and user error log	No	Yes	Yes
Battery backup	Yes	Yes	Yes

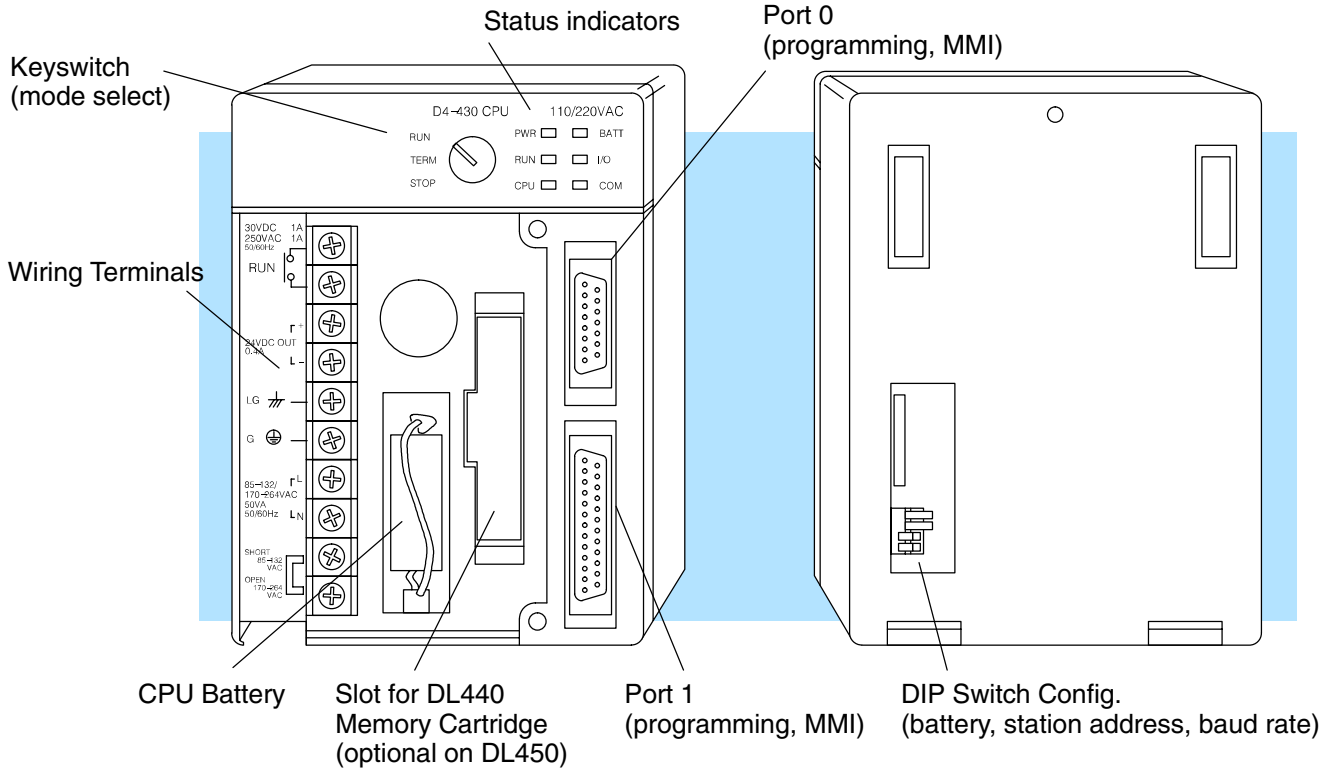
## CPU Electrical Specifications

Parameter	DL430/DL440/DL450	DL440/450DC-1	DL440/450DC-2
Input Voltage, Nominal	120 VAC	24 VDC	125 VDC
Input Voltage Range	100–120 VAC and 196–240 VAC +10% –15%	20–29 VDC	100–132 VDC +10% –15%
Input Voltage Ripple	N/A	less than 10%	less than 10%
Inrush Current, maximum	20 A	10 A	20 A
Power Consumption, maximum	50 VA	38W	30 W
Voltage withstand (dielectric strength)	1 min. at 1500 VAC between primary, secondary, field ground and run relay		
Insulation resistance	> 10M $\Omega$ at 500 VDC		
Output Voltage, auxiliary power supply	20–28 VDC (24 nominal), ripple more than 1V P-P (N/A on DL440–DC–1 and DL440–2)		
Output Current, auxiliary power supply	24 VDC @ 400 mA maximum		

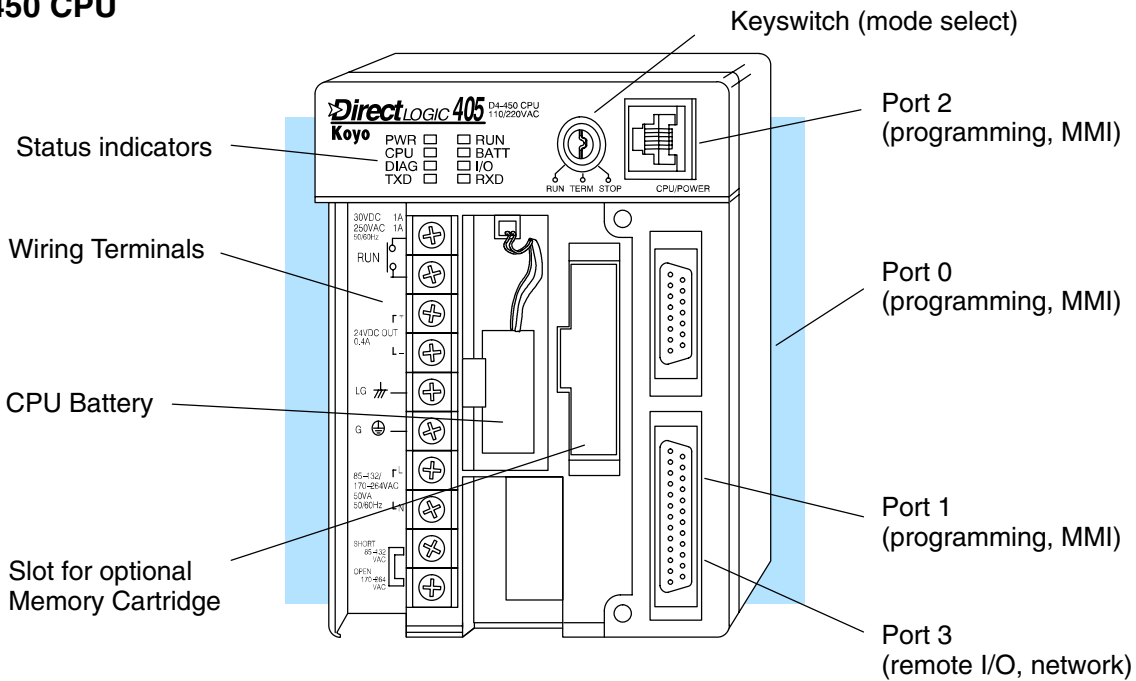
# CPU Hardware Features

The following diagram shows the main external features of the DL405 CPUs.

## DL430/DL440 CPUs



## DL450 CPU



## Communication Ports

### Port 0 Specifications

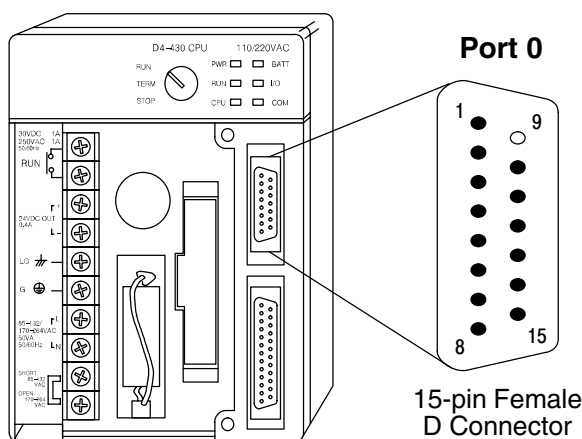


430 440 450

DL405 CPUs provides up to four communication ports. The DL430/DL440 CPUs have two ports, while the DL450 CPU has a total of four ports.

The first port (all CPUs) is located on the 15 pin D-shell connector. It is for general programming such as **DirectSOFT32**, or operator interface connections. The D4-HPP handheld programmer can only be used on this port on the CPU. The operating parameters for Port 0 are permanently set to the values shown.

- 15 Pin female D type connector
- Protocol: K sequence
- RS232C, non-isolated, distance within 15 m (approx. 50 feet)
- 9600 baud, 8 data bits, 1 start, 1 stop bit, odd parity
- Asynchronous, Half duplex, DTE



Port 0 Pin Descriptions (All CPUs)		
1	YOP	Sense connection between HPP and CPU
2	TXD	Transmit Data (RS232C)
3	RXD	Receive Data (RS232C)
4	ONLINE	Request Communication (TTL)
5	ABNO	CPU Error (TTL)
6	PRDY	CPU ready to communicate (TTL)
7	CTS	Clear to Send (RS232C)
8	YOM	Sense connection between HPP and CPU
9	-	Not Used
10	LCBL	Sense cable connection (TTL)
11	5V2	5 VDC for HPP logic
12	5V2	5 VDC for LCD backlight
13	0V	Logic ground
14	0V	Logic ground
15	0V	Logic ground

### Port 1 Specifications

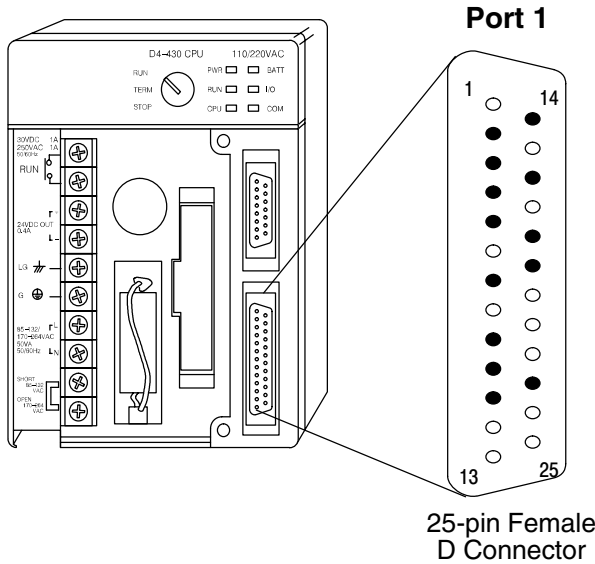


430 440 450

Port 1 (all CPUs) is located on the 25-pin connector, and is called the “secondary comm port” for the DL430/DL440 CPUs. The secondary comm port address is stored in the memory cartridge along with the I/O configuration. It is for general programming such as **DirectSOFT32**, operator interfaces, and networking, but it cannot connect to the handheld programmer. Port 1 provides additional features such as programmable baud rate, parity, ASCII/Hex mode and network address. Its RS422 signals support multidrop networking and programming applications.

The baud rate and station address override is selected by dip switches on the rear of the DL430/DL440 CPUs. The DL450 uses Aux functions to set the same parameters (it has no DIP switches). RS232C or RS422 is selected by cabling to the proper signal pin sets on the connector. Parity, ASCII/Hex mode and station address are selected by AUX (auxiliary) functions with a programming device.

- 25 Pin female D type connector
- Protocols: K-sequence, **DirectNet**. The DL450 additionally supports Non-Sequence and MODBUS protocols. (Note: The DL430 cannot support K-sequence on ports 0 and 1 simultaneously. Use **DirectNet** on port 1 if port 0 is used for communications).
- RS232C / RS422, Selectable address 1-90 (use Aux function)
- 300/ 600/ 1200 / 2400 / 4800 / 9600 / 19200 / (38400 DL450 only) baud
- Hex / ASCII modes (use Aux function to configure)
- 8 data bits, 1 start, 1 stop bit, Odd, Even or No parity
- Asynchronous, Half duplex (use Aux function to configure), DTE



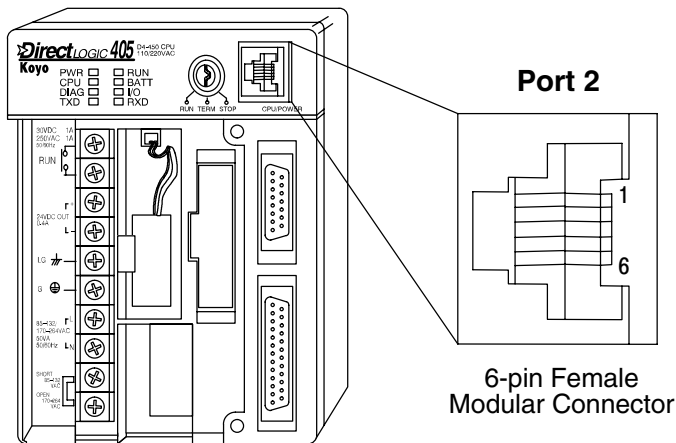
Port 1 Pin Descriptions (All CPUs)		
1	–	Not used
2	TXD	Transmit Data (RS232C)
3	RXD	Receive Data (RS232C)
4	RTS	Request to Send (RS232C)
5	CTS	Clear to Send (RS232C)
6	–	Not used
7	SG	Signal ground (RS232C/RS422)
8	–	(port 3 on DL450)
9	RXD+	Receive Data + (RS422)
10	RXD–	Receive Data – (RS422)
11	CTS+	Clear to Send + (RS422)
12	–	(port 3 on DL450)
13	–	(port 3 on DL450)
14	TXD+	Transmit Data + (RS422)
15	–	Not used
16	TXD–	Transmit Data – (RS422)
17	–	Not used
18	RTS–	Request to Send – (RS422)
19	RTS+	Request to Send + (RS422)
20	–	Not used
21	–	Not used
22	–	Not used
23	CTS–	Clear to Send – (RS422)
24	–	(port 3 on DL450)
25	–	(port 3 on DL450)

### Port 2 Specifications

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  440
  450

The operating parameters for Port 2 on the DL450 CPU are configurable using Aux functions on a programming device.

- 6 Pin female modular (RJ12 phone jack) type connector
- Protocols: **DirectNet** (slave only), K sequence, Non-procedure
- RS232C, 300 / 600 / 1200 / 2400 / 4800 / 9600 / 19200 / 38400 baud
- 8 data bits, 1 start, 1 stop bit; odd, even, or no parity
- Nodes – from 1 to 90



Port 2 Pin Descriptions (DL450)		
1	0V	Power (–) connection (GND)
2	5V	Power (+) connection
3	RXD	Receive Data (RS232C)
4	TXD	Transmit Data (RS232C)
5	5V	Power (+) connection
6	0V	Power (–) connection (GND)

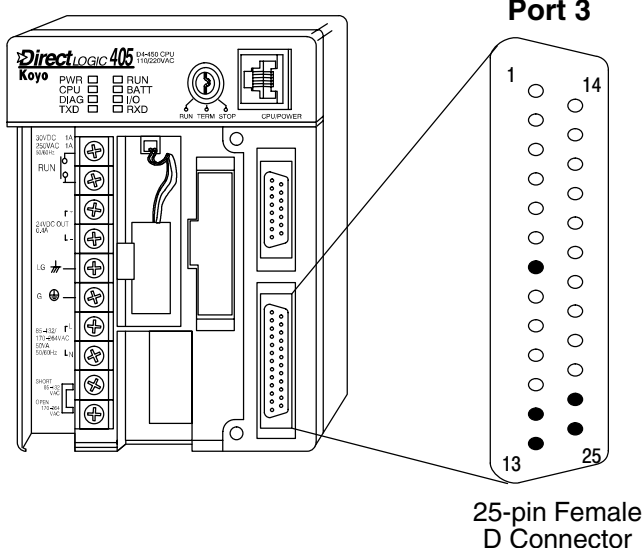
**NOTE:** The 5V pins are rated at 200mA maximum, primarily for use with some operator interfaces.

**Port 3 Specifications**

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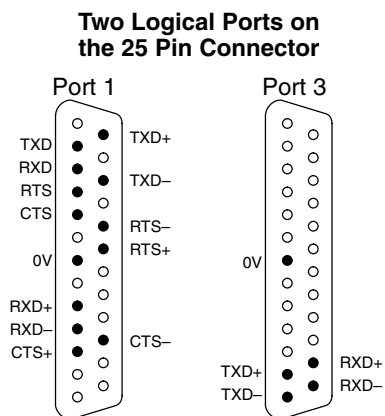
The operating parameters for Port 3 on the DL450 CPU are configurable using Aux functions on a programming device.

- 25 Pin female D type connector
- Protocols: DirectNet, K-sequence, Remote I/O, MODBUS master or slave
- RS422, non-isolated, distance within 1000 ft (3280 ft.)
- 300 / 600 / 1200 /2400 / 4800 / 9600 / 19200 / 38400 baud (DirectNet, K-sequence, MODBUS protocols), 19200 / 38400 (Remote I/O protocol)
- 8 data bits, 1 start, 1 stop bit, odd/none/even parity
- Hex / ASCII modes (use Aux function to configure)
- Selectable address 1-90 (use Aux function to configure)



Port 3 Pin Descriptions (DL450)		
1	-	Not used
2		(port 1)
3		(port 1)
4		(port 1)
5		(port 1)
6	-	Not used
7	SG	Signal ground
8		Not used
9		(port 1)
10		(port 1)
11		(port 1)
12	TXD+	Transmit Data (+), (RS422)
13	TXD-	Transmit Data (-), (RS422)
14		(port 1)
15	-	Not used
16		(port 1)
17	-	Not used
18		(port 1)
19		(port 1)
20	-	Not used
21	-	Not used
22	-	Not used
23		(port 1)
24	RXD+	Receive Data (+), (RS422)
25	RXD-	Receive Data (-), (RS422)

A drawing summarizing the pin locations and functions of ports 1 and 3 on the 25-pin connector is to the right. The two logical ports share two ground pins, but have separate communications data pins. When using both logical ports, you will probably have to make a custom connector which divides the signals in two for two separate cables.



CPU Specifications and Operation

## DL450 PID Loop Features

### Main Features

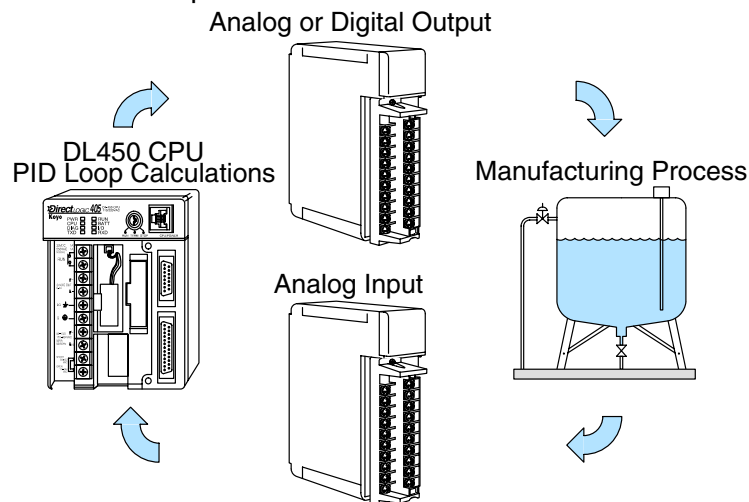
The DL450 process loop control offers a sophisticated set of features to address many application needs. The main features are:

- Up to 16 loops, individual programmable sample rates
- Manual/ Automatic/Cascaded loop capability available
- Two types of bumpless transfer available
- Full-featured alarms
- Ramp/soak generator with up to 16 segments
- Auto Tuning



**NOTE:** The D4-450 CPU's PID algorithm now supports the use of 16-bit analog inputs and outputs, auto tuning and other advanced features. This CPU requires **DirectSOFT32** Version 3.0c Build 58 (or later) and CPU firmware version 1.9 (H8) and 2.446 (SH) (or later) to implement those features. See our website for more information: [www.automationdirect.com](http://www.automationdirect.com).

The DL450 CPU has process control loop capability in addition to ladder program execution. You can select and configure up to sixteen loops. All sensor and actuator wiring connects to standard DL405 I/O modules, as shown below. All process variables, gain values, alarm levels, etc., associated with each loop reside in a Loop Variable Table in the CPU. The DL450 CPU reads process variable (PV) inputs during each scan. Then it makes PID loop calculations during a dedicated time slice on each PLC scan, updating the control output value. The control loops use the Proportional-Integral-Derivative (PID) algorithm to generate the control output command. This chapter describes how the loops operate, and what you must do to configure and tune the loops.



The best tool for configuring loops in the DL450 is the **DirectSOFT32** programming software, Release 2.0 or later. **DirectSOFT32** uses dialog boxes to create a forms-like editor to let you individually set up the loops. After completing the setup, you can use **DirectSOFT32**'s PID Trend View to tune each loop. The configuration and tuning selections you make are stored in the DL450's FLASH memory, which is retentive. The loop parameters also may be saved to disk for recall later.

PID Loop Feature	Specifications
Number of loops	Selectable, 16 maximum
CPU V-memory needed	32 words (V locations) per loop selected, 64 words if using ramp/soak
PID algorithm	Position or Velocity form of the PID equation
Control Output polarity	Selectable direct-acting or reverse-acting
Error term curves	Selectable as linear, square root of error, and error squared
Loop update rate (time between PID calculation)	0.05 to 99.99 seconds, user programmable
Minimum loop update rate	0.05 seconds for 1 to 4 loops, 0.1 seconds for 5 to 8 loops , and 0.2 seconds for 9 to 16 loops
Loop modes	Automatic, Manual (operator control), or Cascade control
Ramp/Soak Generator	Up to 8 ramp/soak steps (16 segments) per loop with indication of ramp/soak step number
PV curves	Select standard linear, or square-root extract (for flow meter input)
Set Point Limits	Specify minimum and maximum setpoint values
Process Variable Limits	Specify minimum and maximum Process Variable values
Proportional Gain	Specify gains of 0.0 to 99.99
Integrator (Reset)	Specify reset time of 0.0 to 99.99 in units of seconds or minutes
Derivative (Rate)	Specify the derivative time from 0.00 to 99.99 seconds
Rate Limits	Specify derivative gain limiting from 1 to 20
Bumpless Transfer I	Automatically initialized bias and setpoint when control switches from manual to automatic
Bumpless Transfer II	Automatically set the bias equal to the control output when control switches from manual to automatic
Step Bias	Provides proportional bias adjustment for large setpoint changes
Anti-windup	For position form of PID, this inhibits integrator action when the control output reaches 0% or 100 % (speeds up loop recovery when output recovers from saturation)
Error Deadband	Specify a tolerance (plus and minus) for the error term (SP-PV), so that no change in control output value is made

Alarm Feature	Specifications
Deadband	Specify 0.1% to 5% alarm deadband on all alarms
PV Alarm Points	Select PV alarm settings for Low-low, Low, High, and High-high conditions
PV Deviation	Specify alarms for two ranges of PV deviation from the setpoint value
Rate of Change	Detect when PV exceeds a rate of change limit you specify