ProValve 200

Electronic Closed Loop Proportional Valve Controller

D-PV200-D

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The ProValve 200 is an electronic control module for use with proportional solenoid valves in a closed loop system. The integrated process controller monitors the process feedback and adjusts the current to the solenoids of the valve to achieve the desired position. This closed loop approach simplifies system level control by removing the need for complicated control loops. The module includes indicators on the front panel to provide an overview of the operating status. System configuration is accomplished through a convenient remote terminal. All settings are stored in permanent memory within the unit. The unit is housed in an attractive, compact enclosure.

- Various analog input options with digital enable and override capability
- Easily configured using WhiteOak Windows based software, a hand-held interface, or terminal emulation software
- Front panel indicators for Power, Output Current and System Faults
- Standard 35mm DIN rail mounting
- Removable terminals to simplify wiring and maintenance
- Efficient 15.6 kHz PWM operation
- Selectable dither frequency up to 244 Hz
- Adjustable current limited output with short circuit protection
- Independently adjustable minimum and maximum for setpoint and feedback inputs
- Full-featured PID control loop
- Microprocessor controlled for consistent, reliable performance

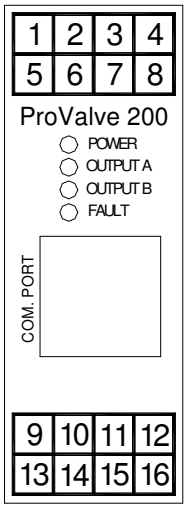
Operating Specifications:

Supply Voltage	12 to 30VDC
Supply Current	I_{SOL} + 50mA†
Output Current	Standard: 2.5A MAX. **-L**: 500mA MAX.
Solenoid Resistance	Standard: 2 Ω MIN. **-L**: 10 Ω MIN.
Dither Settings	Off, 35, 41, 49, 61, 81, 122, 244 Hz
Analog Input Range	0 to 10V, 0 to 5V, 0-20mA, 4-20mA
Digital Input Range	**-24** 12 to 30 VDC Positive or Negative Logic **-115** 100 to 130 VAC **-230** 210 to 250 VAC
Digital Input Impedance	**-24** 3.3kΩ **-115** 33kΩ **-230** 75kΩ
Process Linearity	±0.1% of full input range
Process Repeatability	±0.2% of full input range
Process Control	PID Control Loop, 10 ms loop time
Operating Temperature Range	0º to 70º C

† Additional current is required when the hand held interface is attached.

Physical Description

The ProValve 200 faceplate is shown at the right. The boxed numbers represent the relative terminal positions. A label on the side of the module provides a list of terminal functions.



There are four indicator lamps. The green lamp labeled POWER indicates that proper voltage is supplied. The yellow lamps labeled OUTPUT A and OUTPUT B provide an indication of the current being supplied to the solenoid outputs. The red lamp marked FAULT displays the over current protection status. This lamp will light as the result of a short circuit or over current fault. It will remain lit until the command signal has been removed to clear the fault.

The final item on the front panel is the communications port. The hand held interface or a PC interface cable may be connected to this port. The port allows for configuration and monitoring of the operating parameters. The port utilizes a standard RS-232 interface.

User Interface

The ProValve 200 has a number of internal settings which allow each unit to be configured for the application in which it is used. These settings are accessed in one of three ways:

- A PC running WhiteOak Terminal software
- The WhiteOak hand-held interface
- A PC running terminal emulation software

All three methods use the communication port on the front of the module. Connection to a PC requires a RJ-11 to DB9 converter (see *Wiring* for details).

The WhiteOak Terminal software is a Windows based program that provides a convenient interface to the ProValve 200. The program gives the user the ability to view and make changes to the configuration. It also allows the user to store complete configurations in files on the PC. These files can then be recalled to program new units or update existing ones.

The hand held interface is a stand-alone option. Because it is powered from the serial port and fully self contained, the interface and cable are all that is required. This is a good alternative for field installations where a PC might not be convenient.

The final option is a PC running terminal emulation software. The ProValve 200 can be accessed through most terminal emulation programs such as HyperTerminal or Procomm. Refer to the following table for communications settings.

Baud Rate	2400
Data Bits	8
Parity	None
Stop Bits	1
Flow Control	None
Local Echo	Off
Append Line Feeds on Incoming Line Ends	Off

Configuration

All interface operations are accomplished with the use of 4 buttons in each of the three methods. The buttons are Lock, Unlock, Up, and Down. The hand held interface represents these in graphical form as padlocks and arrows. The same symbols are used on the buttons in the WhiteOak Terminal software and can be activated with the mouse. The program also recognizes menu commands and short-cut keys. The keys used are '/'(lock), '*'(unlock), '+'(up), and '-'(down). These same keys are used with terminal emulation software to access the functions.

The data displays for the three methods are very similar. The hand held interface has a two-line LCD display. The WhiteOak Terminal software has a graphical representation of that display. When using terminal emulation software, two lines of data will be displayed in the terminal window.

The up and down arrows are used to navigate through the parameter list. When either button is pressed the display will be updated with the next parameter in the list. The parameter name will appear on the first line and the associated setting will appear on the second line. The list is accessed in a circular fashion, stepping down from the last parameter to the first and vise-versa.

There are three types of parameters in the list: fixed; monitor; and variable. Fixed parameters are used to show things such as the module's firmware version number. Fixed parameters do not change. Monitor parameters display things such as output current or system voltage. These parameters are constantly updated when the module is functioning. Variable parameters are those which can be changed by the user in order to configure the module. Examples of this type are target deadband and maximum output current. For convenience, some parameters combine variable and monitor types on one line. This allows the user to set a variable according to the current monitor value.

To change the setting of a variable parameter, the user must press the unlock button to place the system in edit mode. While in edit mode the display will show an asterisk (*) at the

beginning of the second line. In edit mode the up and down buttons are used to change the value of the parameter. For parameters which contain both variable and monitor data, the monitor data is shown surrounded by square brackets. Pressing the unlock button again while in edit mode will immediately load the current monitor value into the variable. Once the desired setting is displayed, pressing the lock button will save the parameter and end edit mode.

Parameter List

The following table outlines the parameter list for the ProValve 200. Along with the name of the parameter, the table lists the limits and units for each item.

Parameter	Limits	Units
PROVALVE 200		Version #
PROPORTIONAL	0.0 to 100.0	%
INTEGRAL	0.0 to 2.5	Sec
DERIVATIVE	0.0 to 100.0	%
TARGET DEADBAND	0.0 to 25.0	%
INVERT TARGET	YES/NO	N/A
TARGET MINIMUM	0.0 to 100.0	%
TARGET MAXIMUM	0.0 to 100.0	%
POSITION MINIMUM	0.0 to 100.0	%
POSITION MAXIMUM	0.0 to 100.0	%
A MINIMUM OUTPUT	0.0 to 2.5*	Amps
A MAXIMUM OUTPUT	0.0 to 2.5*	Amps
A OVERRIDE	0.0 to 2.5*	Amps
B MINIMUM OUTPUT	0.0 to 2.5*	Amps
B MAXIMUM OUTPUT	0.0 to 2.5*	Amps
B OVERRIDE	0.0 to 2.5*	Amps
DITHER FREQ.	OFF to 244	Hz.
OUTPUT CURRENT		Amps
SUPPLY VOLTAGE		Volts
FAULT STATUS		Fault

* 0 to 500mA for **–L** version

PROVALVE 200 This is the title parameter. The name of the unit and the firmware version are displayed. The title parameter is fixed.

PROPORTIONAL The Proportional parameter represents the proportional term in the PID control loop. This parameter determines how responsive the system is to error. The higher the proportional setting is the faster the response will be. Also, higher settings result in shorter ramp time from maximum output to minimum output. The Proportional parameter is variable.

INTEGRAL The Integral parameter represents the integrall term in the PID control loop. The integral term is an accumulation of error over time. The parameter sets the rate at which the error term is accumulated. A shorter time will result in more integral control while a longer time will result in less integral control. A value of zero will disable the integral term. The Integral parameter is variable.

DERIVATIVE The Derivative parameter represents the derivative term in the PID control loop. The derivative term reflects the rate of change of error. The higher the derivative setting is the more the system will respond to sudden changes. The Derivative parameter is variable.

TARGET DEADBAND The Target Deadband sets the allowable window of error. The control will only respond to error greater than the Target Deadband parameter. The value represents a percentage of the full position range. The Target Deadband is variable.

INVERT TARGET The Invert Target parameter allows the target position analog input to be inverted. This will result in the minimum signal corresponding to the maximum target value and vise-versa. The Invert Target parameter is variable.

TARGET MINIMUM The Target Minimum parameter is used to establish the low end of the target position input range. The value displayed represents a percentage of the full input range. The value shown in square brackets is the current target position input value. The Target Minimum parameter is a combination variable/monitor type.

TARGET MAXIMUM The Target Maximum parameter is used to establish the high end of the target position input range. The value displayed represents a percentage of the full input range. The value shown in square brackets is the current target position input value. The Target Maximum parameter is a combination variable/monitor type.

POSITION MINIMUM The Position Minimum parameter is used to establish the low end of the actual position input range. The value displayed represents a percentage of the full input range. The value shown in square brackets is the current position input value. The Position Minimum parameter is a combination variable/monitor type.

POSITION MAXIMUM The Position Maximum parameter is used to establish the high end of the actual position input range. The value displayed represents a percentage of the full input range. The value shown in square brackets is the current position input value. The Position Maximum parameter is a combination variable/monitor type.

A MINIMUM OUTPUT The A Minimum Output parameter represents the minimum current required to activate the A solenoid. This is sometimes referred to as the deadband. The value displayed represents the current

in milliamps. The value shown in square brackets is the current output value. The A Minimum Output parameter is a combination variable/monitor type.

A MAXIMUM OUTPUT The A Maximum Output parameter represents the maximum current to be applied to the A solenoid. The value displayed represents the current in milliamps. The value shown in square brackets is the current output value. The A Maximum Output parameter is a combination variable/monitor type.

A OVERRIDE The A Override sets the output current in response to a digital forward override command. No ramping takes place during override operations. The value shown in square brackets is the current output value. The A Override parameter is a combination variable/monitor type.

B MINIMUM OUTPUT The B Minimum Output parameter represents the minimum current required to activate the B solenoid. This is sometimes referred to as the deadband. The value displayed represents the current in milliamps. The value shown in square brackets is the current output value. The B Minimum Output parameter is a combination variable/monitor type.

B MAXIMUM OUTPUT The B Maximum Output parameter represents the maximum current to be applied to the B solenoid. The value displayed represents the current in milliamps. The value shown in square brackets is the current output value. The B Maximum Output parameter is a combination variable/monitor type.

B OVERRIDE The B Override sets the output current in response to a digital reverse override command. No ramping takes place during override operations. The value shown in square brackets is the current output value. The B Override parameter is a combination variable/monitor type.

DITHER FREQ. The Dither Frequency parameter has 8 options for dither control. The choices are Off, 35, 41, 49, 61, 81, 122, and 244 Hz. Dither control provides low frequency modulation which is required in some proportional valve applications. The Dither Frequency parameter is variable.

OUTPUT CURRENT Output Current displays the nominal current being supplied to either of the outputs. The Output Current parameter is a monitor type.

SUPPLY VOLTAGE The Supply Voltage parameter displays the module's power supply voltage. This value may vary slightly from measured value but is included to aid in troubleshooting. The Supply Voltage parameter is a monitor type.

FAULT STATUS - The Fault Status parameter displays the current fault code when a fault exists. The three possible faults are Over Current, Open Output, and Voltage Drop. The Fault Status parameter is a monitor type.

PID Control

The ProValve 200 utilizes a PID control loop algorithm. PID control uses process feedback to correct for error in a system. The error correction factor is determined using the three control terms – proportional, integral, and derivative.

In the ProValve 200, the error is defined as the difference between the target and actual position inputs. This error is fed into the PID loop which results in a signal that drives one of the two solenoid outputs. The output causes a change in position and therefore reduces the error.

The proportional term produces an output in direct proportion to the error. If there is a large error, output will be high. If there is a small error, output will be low. In many systems, only proportional error correction is needed. The proportional parameter in the ProValve 200 is a scalar value.

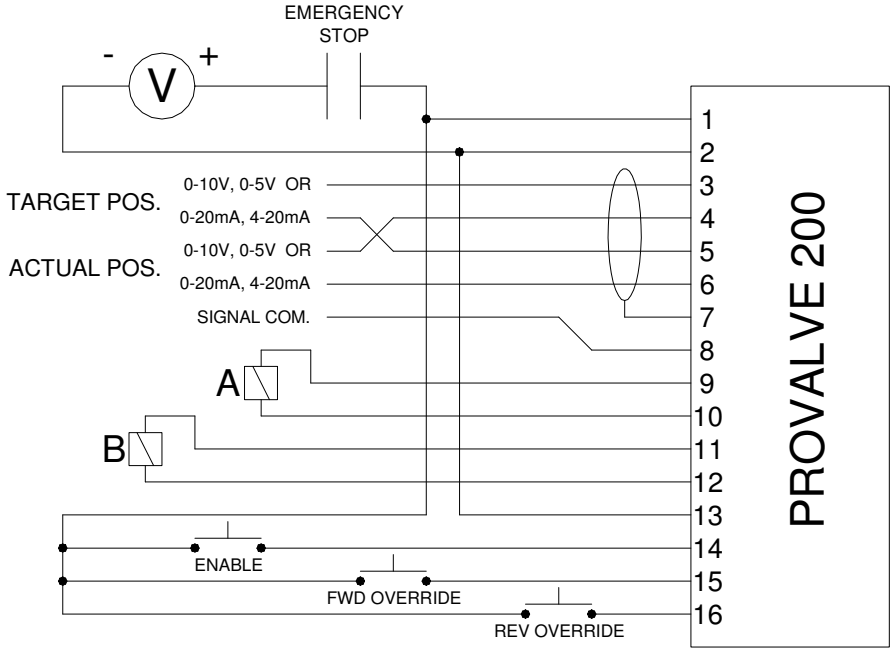
The integral term produces an output relative to the accumulation of error over time. The integral term can provide a damping effect which minimizes overshoot. It can also provide an offset for systems that require output correction which is not symmetrical. The integral value in the ProValve 200 represents how often the error is added to the integral sum. The lower the time value the faster the integral will accumulate and therefore, the more effect it will have on the output. The ProValve 200 also incorporates anti-windup control which prevents integral accumulation when output is at the maximum level.

The derivative term produces an output proportional to the rate of change of the error. A rapid change in the error therefore produces a large derivative value while constant error produces no derivative. The derivative term can be used to provide fast response to sudden changes in the target setpoint. The derivative parameter in the ProValve 200 is a scalar value.

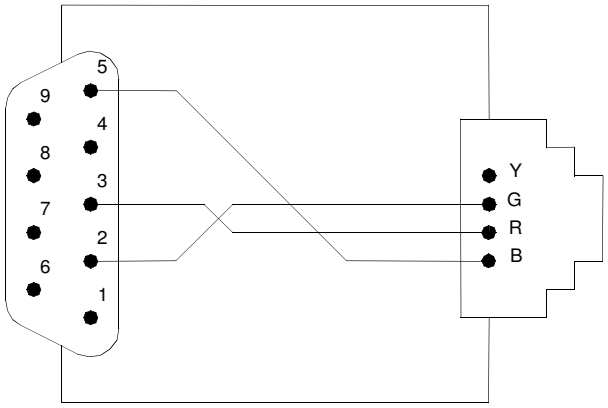
Wiring

Terminal connections are listed in the table below. Following the table is a sample wiring diagram.

#	Name	Description
1	+VDC	Supply Voltage
2	COM	Supply Common
3	TGTV	Target Position (V)
4	POSV	Actual Position (V)
5	TGTI	Target Position (mA)
6	POSI	Actual Position (mA)
7	FG	Frame Ground
8	COM	Supply Common
9	OUT A	Output A
10	COM	Supply Common
11	OUT B	Output B
12	COM	Supply Common
13	DCOM	Digital Input Common
14	ENB	Enable
15	FOR	Forward Override
16	ROR	Reverse Override



The following diagram shows the RJ-11 to DB9 converter pinout:



Ordering Information

The following part numbers should be used when ordering the ProValve 200:

PV200-XX-X

Blank – 0 to 2.5 Amp output
-L – 0 to 500 mA output

24 – 24VDC digital inputs
115 – 115VAC digital inputs
230 – 230VAC digital inputs