PV200

Closed-loop Proportional Valve Controller

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Welcome

Welcome to **High Country Tek** Inc. HCT is North America's foremost independent designer and producer of modular, ruggedized digital and analog electronic controllers for the fluid power industry.

From our factory in California, we manufacture 'specialty' controllers for specific functions and the user programmable 'DVC family' to enable large area networked system solutions.

The modules are used in mobile, industrial and marine applications. They are also applied successfully in other industry segments.

HCT products are encapsulated in solid flame resistant material for maximum durability, electrical integrity and complete environmental security.

HCT is a market leader in many application arenas, including hydraulic generator, *e-Fan* and hydraulic fan system controls. These controllers facilitate significant fuel, emission and operational savings.

HCT's market neutrality offers integration with any hydraulic OEM valves, pumps, sub-systems or systems.

For more information, please visit us at: **www.hctcontrols.com**.

Cautions

Changing setup values or operating modes while a machine is running may cause unintended machine movement. It could lead to possible **injury** or **death**. Any moving parts should be disabled prior to changing setup values or operating modes. In every case, exercise caution and work should be completed only by qualified personnel.

Product Application Guidelines

ALWAYS do the following

- FULLY read this manual and accompanying data sheets BEFORE starting.
- Isolate this unit from all other equipment BEFORE any form of welding.
- Isolate the controller from ANY form of battery charging or battery boosting.
- Be aware of the electrical & mechanical connections, and the expected reactions of the equipment.
- Operate the units within the temperature range.
- Use the correct tools to do the job (i.e. P.C., software) etc.
- Separate High Voltage AC cables from Low Voltage DC signal and supply cables.
- Make sure power supply is CORRECT, ELECTRICALLY CLEAN, STABLE, and rated for the full load.
- Make sure the controller output voltage & current is compatible with the equipment.
- All unused wires / terminals should be terminated safely.
- Ensure ALL connectors have no unintended SHORT or OPEN circuits.
- Ensure ALL connectors are wired correctly, secure, locked in place and fully connected.
- Disconnect or connect wires to or from this unit only when the power supply is disconnected.
- Use adequate screening in areas of intense Radio Frequency fields.
- Ensure ALL work areas are clear of personnel before operating the controller.
- Follow and abide by local and country health & safety standards.

PV200 Controller

The ProValve200 controller drives proportional solenoid valves in a closed loop system. When the feedback is **greater** than the command, coil **A** receives current; when the feedback is **less** than the command, coil **B** receives current. The current is proportional to the difference between the command input and the feedback.

Once configured, the settings are permanently stored in the controller memory.

PV200 Features

- Easily configured using HCT Graphical User Interface (GUI) or HCT Hand Held Interface (HHI)
- LED indication of power, output current and fault status
- DIN-rail mount housing with removable terminal blocks
- Single mode for dual coil closed-loop position control
- All input and output limits are independently adjustable
- Adjustable output with short circuit protection
- Fully adjustable PID control loop

Operating Specifications

Supply Voltage	12 to 30VDC		
Supply Current	Valve current + 50mA (Quiescent Max)		
Output Current	Standard: 2.5A max	**-L:** 500mA MAX	
Coil Resistance	Standard: 2Ω MIN	**-L**: 10Ω MIN	
Dither Frequency	35, 41, 49, 61, 81, 122, 244Hz (Select OFF for PWM frequency 15.63KHz)		
Analog Input Range	[0, 10]V, [0, 5]V, [0, 20]mA		
Analog Input Impedance	**>** 100KΩ for voltage input	500Ω for current input.	
Digital Input Range	**-24:** 12 to 30VDC	**-115:** 100 to 130VAC	**-230:** 210 to 250VAC
Digital Input Impedance	**-24:** 3.3kΩ	**-115:** 33kΩ	**-230:** 75Ω
Process Linearity	±0.1% of full input range		
Process Repeatability	±0.2% of full input range		
Process Control	PID control Loop, 10ms loop time		
Operating Temperature Range	0º to 70º C (operating); -40º to 85º C (storage)		
Enclosure	Compact		
Dimensions	Inch: 3.9 L x 4.5 W x 0.4 H, Mm: 99 L x 114.5 W x 10 H		

Physical Description

The boxed numbers 1 to 16 represent the terminal positions. A label on the side of the module provides a list of terminal functions.

The “POWER” LED is green when the applied voltage is within the operating range.

The “OUTPUT A” and “OUTPUT B” LEDs are yellow and the brightness will vary with the output current.

In the case of a fault the “FAULT” LED will display solid red. See Fault Status for details.

The PV200 communicates with the Graphical User Interface through RJ-11 to DB9 convertor. It must be powered when configuring the settings.

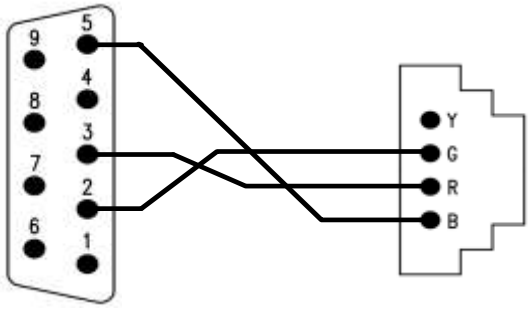
User Interface

The PV200 has a number of internal settings.

Users can open the Graphical User Interface to view, make changes and save the settings in a data file which can be uploaded to any PV200 controller.

The Hand Held Interface can also be used to view and make changes, but this device does not have the capability to save the settings in a data file. The programmer, cable and adapter are self-contained which makes the HHI a viable alternative for field work.

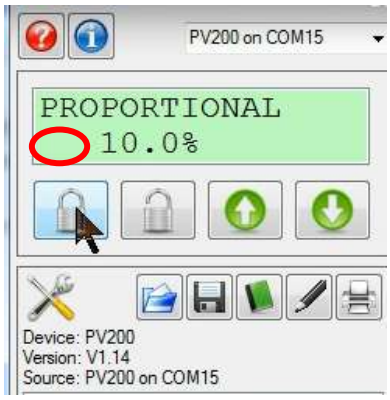
The following diagram shows the RJ-11 to DB9 converter pinout:



Configuration

The GUI has 4 buttons (ran from a PC): Lock, Unlock, Up, and Down. There are short-cut keys: '/'(lock), '*'(unlock), '+'(up), and '-'(down).

The HCT Hand Held Interface has the same 4 buttons and 2-line LCD.



Use the up and down arrows to navigate through the parameter list. The display will show the next parameter in the list when pressed. The parameter name is on the first line and the value is on the second line. The list is in circular, stepping down from the last parameter to the first and vice-versa.

There are three types of parameters: **fixed; monitor; and variable**. **Fixed** parameters show the module's firmware version, etc. **Monitor** parameters display output current and system voltage. Use **variable** parameters to configure the controller, such as maximum output current, operating mode, etc. Some parameters combine variable and monitor in one line. Use it to set a variable according to the current monitor value.

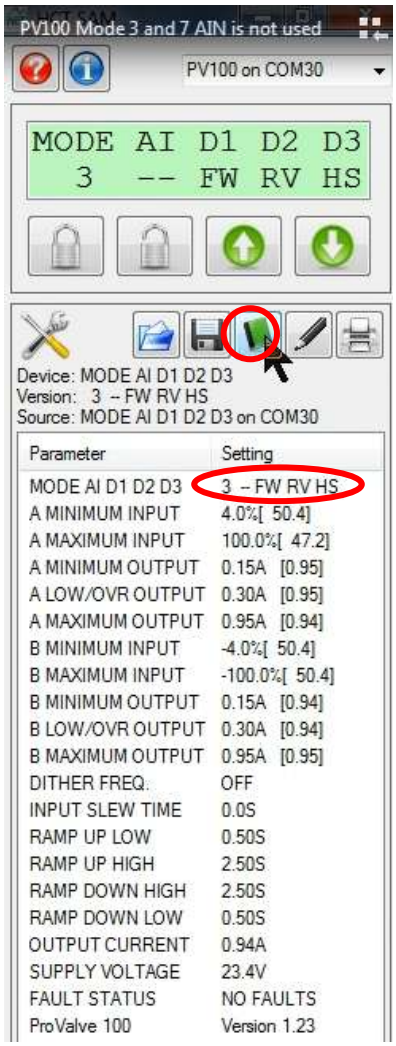
Press the unlock button to enter the edit mode. An asterisk (*) will appear at the beginning of the second line. Use the up and down buttons to change the value. For parameters containing both variable and monitor, the monitor data is in square brackets.

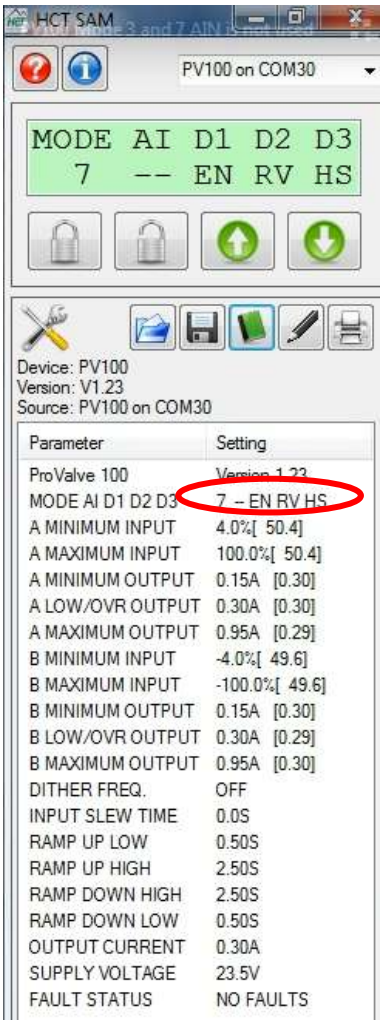
Press the lock button to save the parameters and end edit mode.

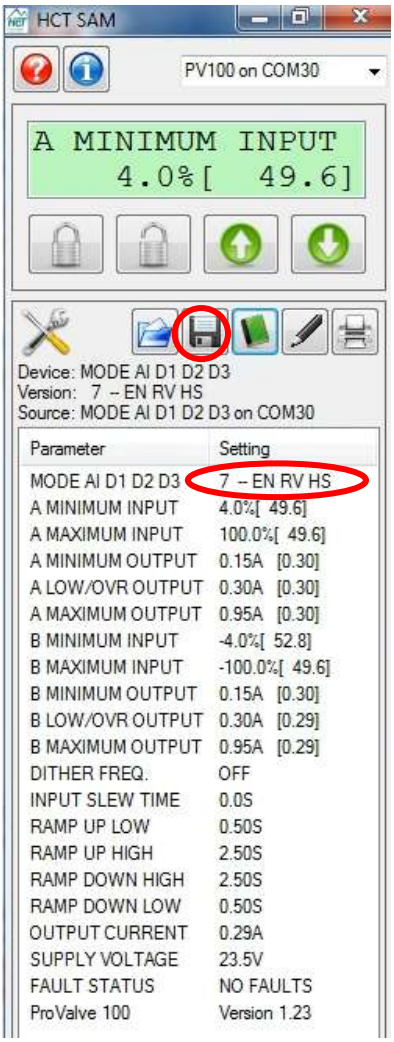
When the lock button is pressed, the changes take effect immediately. Change values only when the machine is **NOT** running.

“Read settings from controller” displays a static table of values from non-volatile memory. The changes made to the settings by selecting “lock” are not updated in the table unless “read settings from controller” is selected again.

To save the settings into a file for future use, click “read settings from controller” before clicking “save settings to file”.

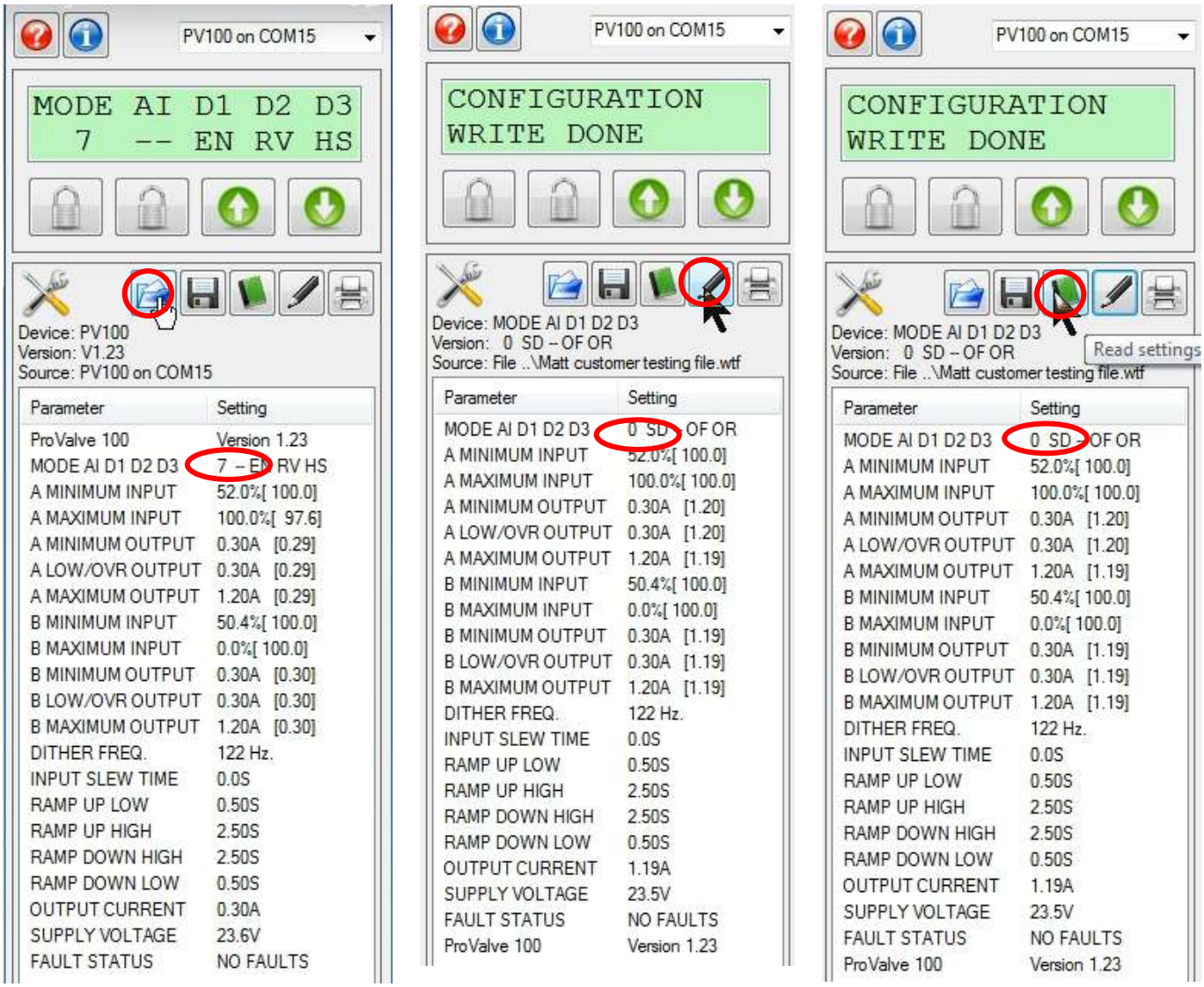






When uploading settings from a data file, the static table shows the settings from the data file, but they are not in the controller yet.

Click “write settings to controller” before clicking “read settings from controller”. After this step, the static table will display the PV200 settings from the data file.



Parameter List

This table outlines PV200 parameters, the limits and units for each parameter.

Parameter	Limits	Units
PV200		Version #
Proportional gain	0.0 to 100.0	%
Integral time	0.0 to 2.5	Sec
Derivative gain	0.0 to 100.0	%
Target deadband	0.0 to 25.0	%
Invert target	Yes/No	NA
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 2.50*	A
A Maximum output	0.0 to 2.50*	A
A Override	0.0 to 2.50*	A
B Minimum output	0.0 to 2.50*	A
B Maximum output	0.0 to 2.50*	A
B Override	0.0 to 2.50*	A
Dither frequency	35, 41, 49, 61, 81, 122, 244 (select OFF for PWM frequency 15.63KHz)	Hz
Output current		A
Supply voltage		Volts
Fault status		Fault

*0 to 500mA for **–L** version

PV200 - The title parameter is fixed. It displays the model number and the firmware version.

PROPORTIONAL GAIN – Sets the P term in a PID control loop. It is a multiplication of the error added to the output. The higher the setting, the faster the response will be. Also, higher settings result in shorter ramp time, but it can cause oscillation. It is variable type.

INTEGRAL TIME – Sets the I term in a PID control loop. It is the sum of the error over time. It overcomes an offset in the output or to correct for small deviations over time. A shorter time will result in more integral control but can cause oscillation. A value of zero will disable the integral term. It is variable type.

DERIVATIVE GAIN – Sets the D term in a PID control loop. It is the rate of change of error. The higher the derivative gain, the quicker the system will respond to sudden changes. It is variable type.

TARGET DEADBAND – Sets the error tolerance of the PID loop. The control will only respond to error greater than the Target Deadband parameter. It is variable type.

INVERT TARGET – Sets the target position input inverted. This will result in the minimum signal corresponding to the max target value and vise-versa. It is variable type.

TARGET MINIMUM- Sets the minimum target position input (0 to 100%). The value in the brackets is the present command input.

TARGET MAXIMUM - Sets the maximum target position input (0 to 100%). The value in the brackets is the present command input.

POSITION MINIMUM - Sets the minimum actual position input (0 to 100%). The value in the brackets is the present command input.

POSITION MAXIMUM - Sets the maximum actual position input (0 to 100%). The value in the brackets is the present command input.

A MINIMUM OUTPUT - Sets the minimum output current for coil A (Amps). The value in the brackets is the present command input.

A MAXIMUM OUTPUT - Sets the maximum output current for coil A (Amps). The value in the brackets is the present output current.

A OVERRIDE - Sets the output current for a digital forward override command. No ramping takes place during override operations. The value in the brackets is the present output current.

B MINIMUM OUTPUT - Sets the minimum output current for coil B (Amps). The value in the brackets is the present command input.

B MAXIMUM OUTPUT - Sets the maximum output current for coil B (Amps). The value in the brackets is the present output current.

B OVERRIDE - Sets the output current for a digital reverse override command. No ramping takes place during override operations. The value in the brackets is the present output current.

DITHER FREQ. - Set the PWM or dither frequency according to the valve specifications. This parameter is variable. Options: 35, 41, 49, 61, 81, 122, 244, (Select OFF for 15.63KHz)

OUTPUT CURRENT - Displays the present output current. This parameter is a monitor type.

SUPPLY VOLTAGE - Displays the module's power supply voltage. It is helpful for troubleshooting. This parameter is a monitor type.

FAULT STATUS - The Fault LED displays solid red light for both coil open and short until cycling the power to clear the fault. Moving command signal out of active range will not clear faults.

PID Control

The PV200 utilizes a PID control loop algorithm. PID control uses process feedback to correct for error. The error correction factors are proportional, integral, and derivative.

In the PV200, the error is the difference between the target and actual position inputs. This error is fed into the PID loop which results in a signal to drive one of the two solenoid outputs. The output causes a change in position and therefore reduces the error.

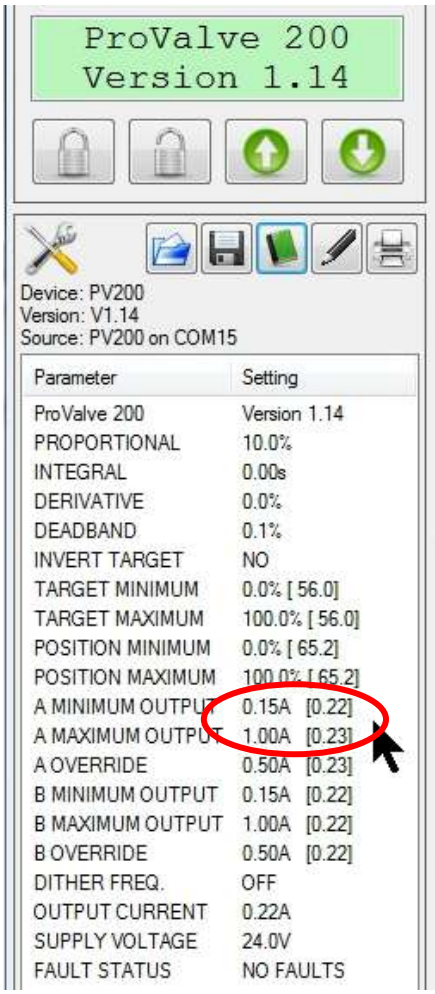
The proportional gain produces an output proportional to the error. If there is a large error, the output will be high. If there is a small error, the output will be low. In many systems, only proportional error correction is needed.

The integral time produces an output relative to the accumulation of error over time. The integral time can provide a damping effect which minimizes overshoot. It can also adjust for small offsets. The integral time in the PV200 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 PV200 also incorporates anti-windup control which prevents integral accumulation when output is at the maximum level.

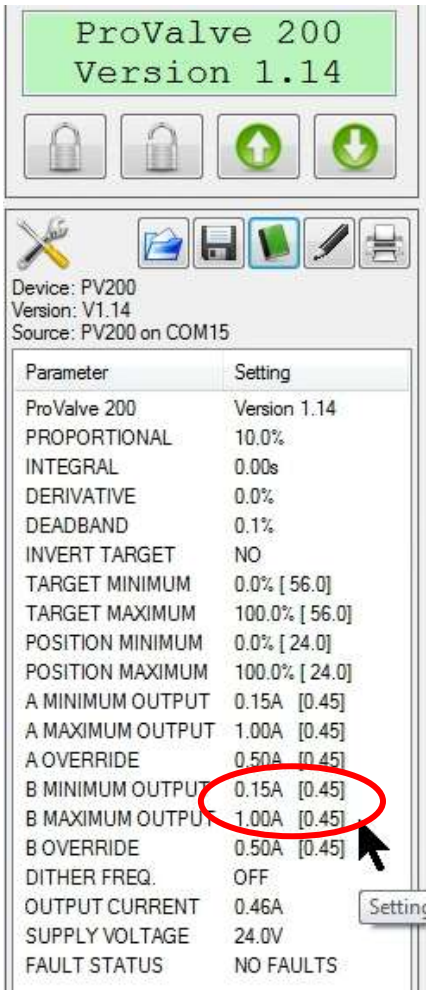
The derivative gain produces an output proportional to the rate of change of the error. A rapid change in the error produces a large derivative value while constant error produces no derivative. The derivative gain can be used to provide fast response to sudden changes in the target set-point.

PV200 closed-loop control:

When the actual position (65%) is greater than the target position (56%), coil **A** receives 0.22A current.

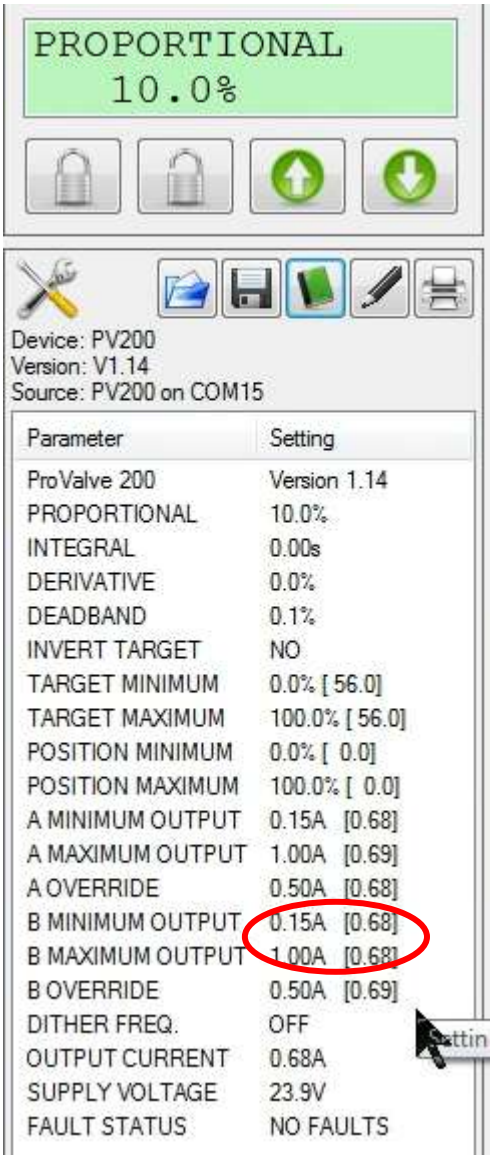


When the actual position 24%, is less than the target position 56%, coil **B** receives 0.45A current.

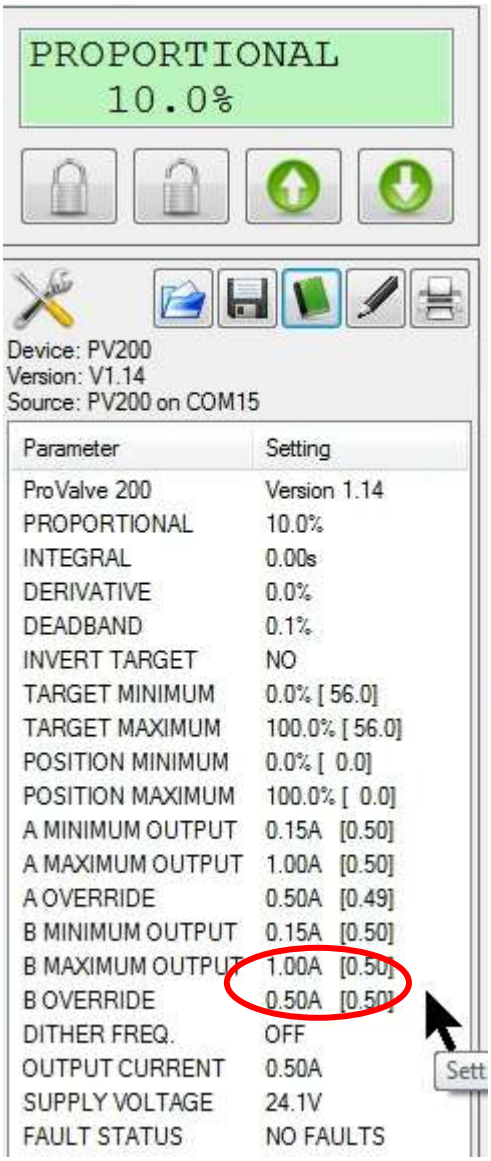


Notice that the current is proportional to the difference between the actual position an the target position.

Before switching the “reverse override” ON, coil B current is 0.68A because the actual position is 0%, less than the target position 56%.

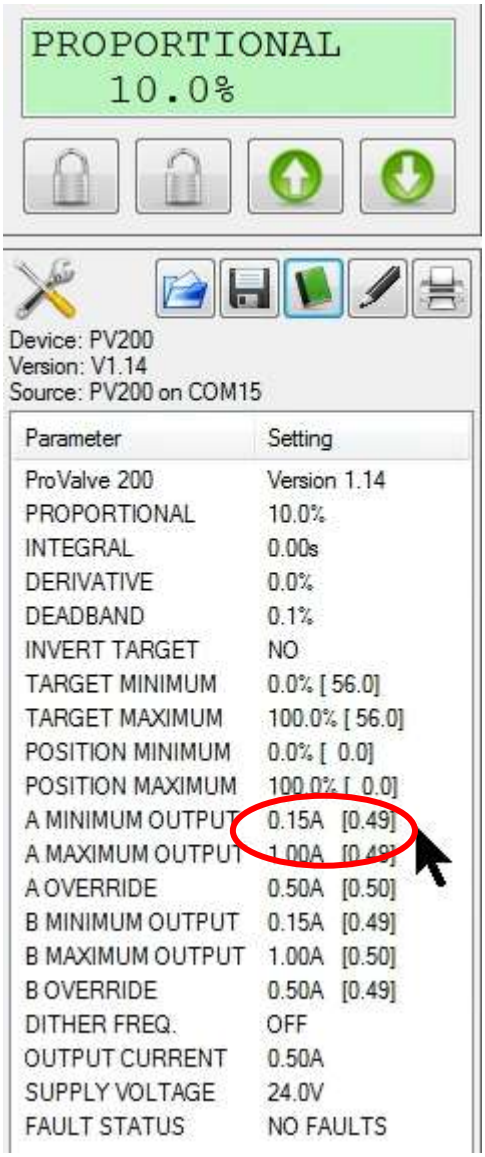


After switching the “reverse override” ON, the PV200 becomes an open loop controller, coil B current is set to the override current setting of 0.5A.

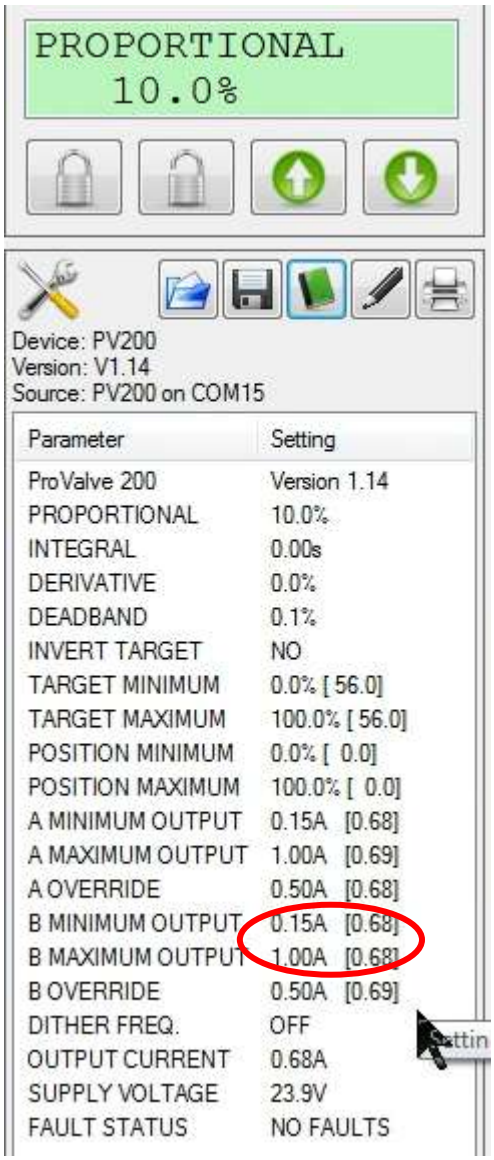


Switch the “reverse override” OFF and switch the “forward override” ON. The PV200 becomes an open loop controller. Coil A current is set to the overr**id**e current setting of 0.5A.

The **Reverse** override has a higher priority than the forward override.



By switching OFF both override inputs, the PV200 resumes normal closed-loop operation and coil B current is 0.68A because the actual position 0% is less than the target position 56%.



Wiring

Terminal connections are listed in the table below.

Terminal	Name	Description
1	+V DC	+24V
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 GND
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

Order Information

The following is a break-down of the PV200 part numbering system:

PV200-XX-X

- Blank = 2.5A max output
- -L = 500mA max output

- 24 = 24VDC digital inputs
- 115 = 115VAC digital inputs
- 230 = 230VAC digital inputs

Required Communication Cables:

For the Hand Held Interface Device: P/N: PCA-1

For the PC software SAM: PN: PCA-1 and P/N: 108-00119

P/N: PCA-1

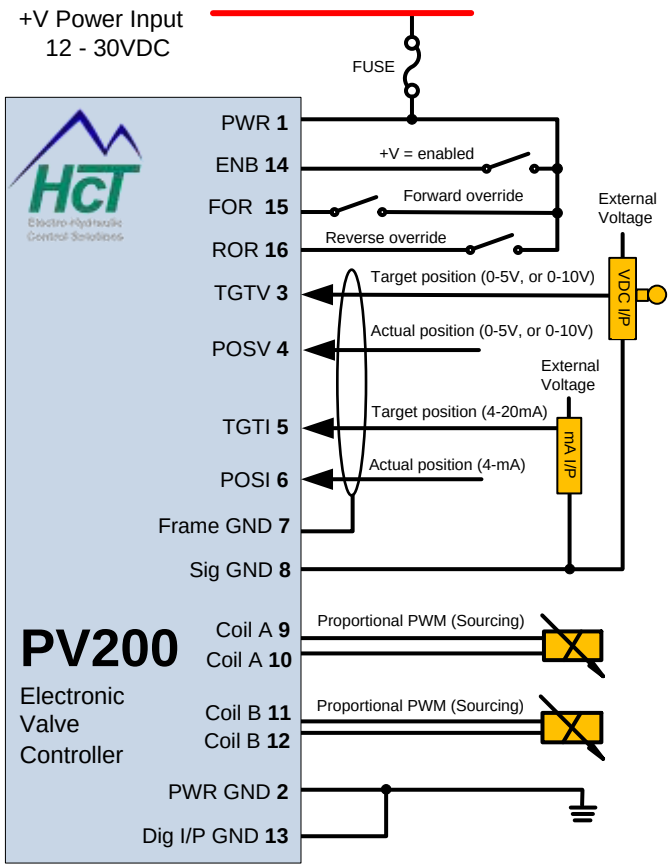
P/N: 108-001119

Application Examples

Dual Solenoid Control

The PV200 can drive two solenoids for closed-loop position control.

Set the dither and output settings according to the valve specifications.



PV200 Closed Loop Proportional Valve Controller

- Mining & Exploration
- Agriculture
- Cranes & lifts
- Refuse & Re-cycling
- Construction
- Off-Road vehicles
- Forestry, Wood & Pulp
- Reclamation & Salvage
- Oil Field & Sands
- Demolition Equipment
- Cooling Solutions
- Military Apparatus
- Specialty Use
- Remote Control
- Power Generation
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