

## MODEL PCU - PROCESS CONTROL UNIT



- 100 MSEC SAMPLING PERIOD WITH 0.15% ACCURACY
- ON DEMAND AUTO-TUNING OF PID CONTROL SETTINGS
- DUAL LED DISPLAYS FOR SIMULTANEOUS INDICATION OF PROCESS VALUE AND SETPOINT OR SECOND ANALOG INPUT
- ACCEPTS EITHER 0 to 10 VDC OR 0 to 20 mA DC INPUTS

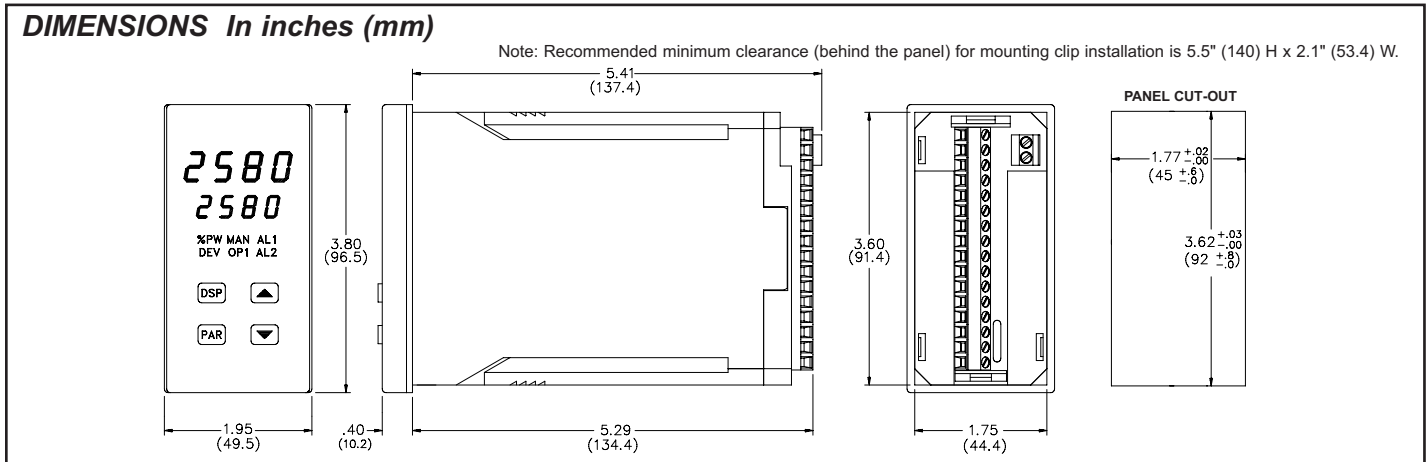
- SELF-DIAGNOSTICS
- FULL PID CONTROL WITH REDUCED OVERSHOOT
- OPTIONAL RS485 SERIAL COMMUNICATIONS INTERFACE
- OPTIONAL DUAL ALARM OUTPUTS (USES OUTPUT MODULES)
- OPTIONAL SECONDARY OUTPUT (USES OUTPUT MODULE)
- OPTIONAL LINEAR 4 to 20 mA OR 0 to 10 VDC OUTPUT FOR CONTROL OR PROCESS VALUE RE-TRANSMISSION
- OPTIONAL MOTORIZED VALVE POSITION CONTROL AND VALVE FAIL ALARM
- OPTIONAL SECOND ANALOG INPUT FOR REMOTE SETPOINT AND CASCADE CONTROL
- OPTIONAL NEMA 4X/IP65 SEALED FRONT BEZEL
- STATUS INDICATORS FOR OUTPUTS AND CONTROL MODES
- PROGRAMMABLE USER INPUT (DIGITAL) FOR ADDED FLEXIBILITY
- MANUAL/AUTOMATIC AND LOCAL/REMOTE SETPOINT CONTROL MODES
- SETPOINT RAMPING FOR PROCESS STARTUP
- PARAMETER SECURITY VIA PROGRAMMABLE LOCKOUTS
- FIELD REPLACEABLE AND INTERCHANGEABLE OUTPUT MODULES (Relay, Logic/SSR Drive and Triac)

### DESCRIPTION

The PCU Controller accepts either 0 to 10 VDC or a 0 to 20 mA DC input signal, precisely scales the process signal according to programmable scaling points, and provides an accurate output control signal (*time proportional, linear, or valve position*) to maintain a process at the desired control point. A comprehensive set of easy to use program instructions allows the controller to solve various applications.

The controller can operate in the PID control mode for both the main output and optional secondary output, with on-demand auto-tune, that establishes the tuning constants. The PID tuning constants may be fine-tuned by the operator at any time and then locked-out from further modification. The controller employs a unique overshoot suppression feature, which allows the quickest response without excessive overshoot. The unit can be transferred to operate in the manual mode, providing the operator with direct control of the output. The controller may also be programmed to operate in the ON/OFF control mode with adjustable hysteresis.

Dual 4-digit displays allow viewing of the process value and setpoint simultaneously. Front panel indicators inform the operator of the controller and output status. Replaceable and interchangeable output modules (*Relay, Logic/SSR Drive, or Triac*) can be installed for the main control output, alarm output(s) and secondary output.



## OPTIONS

Optional dual alarms can be configured to activate according to a variety of actions (Absolute HI or LO, Deviation HI or LO, Band IN or OUT and Valve Fail Detect) with adjustable hysteresis. A standby feature suppresses the output during power-up until the process stabilizes outside the alarm region. An optional secondary output is available (*for processes that require cooling*) that provides increased control accuracy and response.

A linear 4 to 20 mA or 0 to 10 VDC output signal is available to interface with actuators, chart recorders, indicators, or other controllers. The output signal can be digitally scaled and selected to transmit one of the following: % output power, measurement value, process measurement value deviation or setpoint value. Valve Positioner and Second Analog Input Models have the adjustable output demand dampening, output deadband and output update time parameters to expand the versatility of the PCU to control devices.

The optional Motorized Valve Positioner directly controls the position of a valve by the use of twin outputs (open and close) to control the direction of motor rotation. The motor position defines the opening position of the valve. Two control modes are possible: position control, that makes use of the slidewire feedback signal supplied with the positioner and velocity control, in which no slidewire feedback signal is used. Parameters are provided to adjust the operation of the valve. These include:

- Valve activity hysteresis
- Valve update time
- Variable control dampening
- Slidewire signal fail action
- Adjustable valve position limits

The Valve Positioner PCU achieves tight process control, yet minimizes unnecessary valve activity. An alarm event output or display alarm can be programmed under loss of slidewire feedback or under valve fail detection.

The optional Second Analog Input (0 to 20 mA DC) can be configured as a remote setpoint signal or as a secondary process signal. Configuration of the second analog input as a remote setpoint signal allows ratio control, master setpoint/multiple slave operation, and the ability to cascade the PCU with another controller (external cascade). Configuration of the second input as a secondary process signal allows operation as a two-process cascade controller within a single unit (internal cascade). In either control mode, parameters are provided to scale, configure, communicate and monitor the activity of both analog inputs. A square law linearizer function can be used to linearize signals derived from flow transmitters.

The optional RS485 multidrop serial communication interface provides two-way communication between a PCU unit and other compatible equipment such as a printer, a programmable controller, or a host computer. In multipoint applications the address number of each unit on the line can be programmed from zero to ninety-nine. Up to thirty-two units can be installed on a single pair of wires. The Setpoint value, % Output Power, Setpoint Ramp Rate, etc. can be interrogated or changed by sending the proper command code via serial communications. Alarm output(s) may also be reset via the serial communications interface option.

An optional NEMA 4X/IP65 rated bezel is available for wash down and/or dirty environments, when properly installed. Modern surface-mount technology, extensive testing, plus high immunity to noise interference makes the controller extremely reliable in industrial environments.

## SAFETY SUMMARY

All safety related regulations, local codes and instructions that appear in the manual or on equipment must be observed to ensure personal safety and to prevent damage to either the instrument or equipment connected to it. If equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.

Do not use the PCU to directly command motors, valves, or other actuators not equipped with safeguards. To do so, can be potentially harmful to persons or equipment in the event of a fault to the unit. An independent and redundant limit indicator with alarm outputs is strongly recommended. Red Lion Controls offers various units (such as an IMP, IMD1 or IMD2) that may be used for this purpose. The indicators should have input sensors and AC power feeds independent from other equipment.

## SPECIFICATIONS

### 1. DISPLAY: Dual 4-digit

**Upper Process Display:** 0.4" (10.2 mm) high red LED

**Lower Auxiliary Display:** 0.3" (7.6 mm) high green LED

**Display Messages (Model dependent):**

- "OLOL" - Appears when measurement exceeds +105% input range.
- "ULUL" - Appears when measurement exceeds -5% input range.
- "SENS" - Appears when measurement exceeds "OLOL" & "ULUL" range.

- "...." - Appears when display values exceed + display range.
- "-..." - Appears when display values exceed - display range.
- "SLid" - Appears when loss of slidewire signal is detected.
- "VALV" - Appears when valve actuator error is detected.

2. **POWER:** Switch selectable 115/230 VAC (+10%, -15%) no observable line variation effect, 48 to 62 Hz, 10 VA.

### 3. ANNUNCIATORS:

#### LED Backlight Status Indicators (Model dependent):

- %PW - Lower auxiliary display shows power output in (%).
- DEV - Lower auxiliary display shows deviation (*error*) from process setpoint.
- OP1 - Main control output is active.
- AL1 - Alarm #1 is active.
- AL2 - Alarm #2 is active (*for Dual Alarm Option*).
- OP2 - Secondary output is active (*for Secondary Output Option*).
- OPN - Valve positioner OPEN output is active (*for Valve Positioner Option*).
- CLS - Valve positioner CLOSE output is active (*for Valve Positioner Option*).
- SEC - Lower auxiliary display shows second analog input (*for Second Analog Input Option*).
- MAN - Flashing: Controller is in Manual control mode.
- REM - ON: controller is in remote setpoint mode (*Second Analog Input Option*).
- OFF: controller is in local setpoint mode (*Second Analog Input Option*).
- Flashing: controller is in Manual control mode (*Second Analog Input Optional*).

4. **CONTROLS:** Four front panel push buttons for modifying and setup of controller functions and one external input for parameter lockout or other functions.

### 5. SIGNAL INPUT:

**Sample Period:** 100 msec typ.

**Response Time:** 300 msec typ. (*to within 99% of final value w/step input*)

**Signal Overdrive Threshold:**

**10 V Range:** 13 V typ.

**20 mA Range:** 26 mA typ.

**Signal Overdrive Response:**

**Main Control Output:** Programmable preset output

**Display:** "SENS"

**Alarms:** Upscale drive

**DC Linear:** Programmable preset output

**Normal Mode Rejection:** 40 dB typ. @ 50/60 Hz (*improves with increased digital filtering*).

**Common Mode Rejection:** 100 dB typ., DC to 60 Hz

**Protection:** Input overload 120 VAC for 30 seconds.

**Range And Accuracy:**

SIGNAL RANGE	ACCURACY (% OF UNSCALED READING)	MAXIMUM INPUT	INPUT IMPEDANCE	RESOLUTION
0 to 10 VDC	±(0.15% + 3 mV)	300 VDC	1 MΩ	10 mV
0 to 20 mA DC	±(0.15% + 6 μA)	200 mA DC	10 Ω	10 μA

### 6. OUTPUT MODULES [Optional] (For All Output Channels):

#### Relay:

**Type:** Form-C (*Form-A with some models. See Ordering Information.*)

**Rating:** 5 Amps @ 120/240 VAC or 28 VDC (*resistive load*), 1/8 HP @ 120 VAC (*inductive load*) max.

**Life Expectancy:** 100,000 cycles at max. load rating. (*Decreasing load and/or increasing cycle time, increases life expectancy.*)

**Logic/SSR Drive:** Can drive multiple SSR Power Units.

**Type:** Non-isolated switched DC, 12 VDC typ.

**Drive:** 45 mA max.

#### Triac:

**Type:** Isolated, Zero Crossing Detection

#### Rating:

**Voltage:** 120/240 VAC

**Max. Load Current:** 1 Amp @ 35°C  
0.75 Amp @ 50°C

**Min. Load Current:** 10 mA

**Off State Leakage Current:** 7 mA max. @ 60 Hz

**Operating Frequency:** 20 to 400 Hz

**Protection:** Internal Transient Snubber, Fused

### 7. MAIN CONTROL OUTPUT:

**Control:** PID or ON/OFF

**Output:** Time proportioning or linear DC

**Hardware:** Plug-in, replaceable output modules

**Cycle time:** Programmable

**Auto-tune:** When selected, sets proportional band, integral time, and derivative time values.

**Signal Overdrive Action:** Programmable

## SPECIFICATIONS (Cont'd)

8. **SECONDARY OUTPUT (Optional):**  
**Control:** PID or ON/OFF  
**Output:** Time proportioning or linear DC  
**Hardware:** Plug-in, replaceable output modules  
**Cycle time:** Programmable  
**Proportional Gain Adjust:** Programmable  
**Deadband Overlap:** Programmable
9. **LINEAR DC OUTPUT (Optional):** With digital scale and offset, programmable deadband and update time.  
**4 to 20 mA:**  
**Resolution:** 1 part in 3500 typ.  
**Accuracy:**  $\pm(0.1\% \text{ of reading} + 25 \mu\text{A})$   
**Compliance:** 10 V (500  $\Omega$  max. loop impedance)  
**0 to 10 VDC:**  
**Resolution:** 1 part in 3500 typ.  
**Accuracy:**  $\pm(0.1\% \text{ of reading} + 35 \text{ mV})$   
**Min. Load Resistance:** 10 K $\Omega$  (1 mA max.)  
**Source:** % output power, setpoint, deviation, or process value (Available for OP1 or OP2, but not both.)
10. **MOTORIZED VALVE POSITIONER (Optional):**  
**Two Outputs:** Valve open and valve close or Linear DC (optional)  
**Hardware:** Plug-in, replaceable output modules  
**Three Inputs:** Slidewire feedback, signal fail detect (Isolated from main input)  
**Slidewire Resistance:** 100  $\Omega$  to 100 K $\Omega$   
**Slidewire Exciting Voltage:** 0.9 VDC typ.  
**Slidewire Fail Action:** programmable  
**Control Mode:** Position mode (with slidewire) and velocity mode (w/o slidewire).  
**Control Deadband:** 1% to 25.0% (position mode)  
0.1 to 25.0 seconds (velocity mode)  
**Update Time:** 1 to 250 seconds  
**Motor Time (open, close):** 1 to 9999 seconds  
**Position Limits:** Adjustable 0.0 to 100.0% of valve stroke  
**Valve Fail Time:** Off to 9999 seconds  
**Alarm mode:** Dual acting; loss of slidewire feedback signal and valve fail detection
11. **SECOND ANALOG INPUT:**  
**Range:** 0 to 20 mA (Isolated from main input)  
**Overload:** 100 mA<sub>MIN</sub> (steady state)  
**Input Resistance:** 10  $\Omega$  typ.  
**Voltage Drop (@ 20 mA):** 0.2 V typ.  
**Accuracy:** 0.15% of reading  $\pm 10 \mu\text{A} \pm 1 \text{ LSD}$   
**Scale Range:** -999 to 9999
12. **SERIAL COMMUNICATION:**  
**Type:** RS485 Multi-point, Balanced Interface  
**Communication Format:**  
**Baud Rate:** Programmable from 300 to 9600  
**Parity:** Programmable for odd, even, or no parity  
**Frame:** 1 start bit, 7 data bits, 1 or no parity bit, 1 stop bit  
**Unit Address:** Programmable from 0 to 99, max. of 32 units per line  
**Transmit Delay:** 100 msec min., 200 msec max.  
**RS485 Common:** Isolated from signal input common  
**Auto Print Time:** Off to 9999 seconds between print-outs
13. **USER INPUT (Optional):** Internally pulled up to +5 VDC.  
 $V_{IN} = 5.25 \text{ VDC}$  MAX;  $V_{IL} = 0.85 V_{MAX}$ ;  $V_{IH} = 3.0 V_{MIN}$ .  
Available on all second input (MVP & ANA) models, and on models with RS485.  
**Response Time:** 100 msec max.  
**Functions:** Program Lock  
Integral Action Lock  
Auto/Manual Mode Select  
Setpoint Ramp Select  
Reset Alarms  
Print Request  
Local/Remote Setpoint Select
14. **ALARMS (Optional):**  
**Hardware:** Plug-in, replaceable output module  
**Modes:** Absolute high acting  
Absolute low acting  
Deviation high acting  
Deviation low acting  
Inside band acting  
Outside band acting  
Valve fail  
Second Analog Input monitoring  
**Reset Action:** Programmable; automatic or latched  
**Standby Mode:** Programmable; enable or disable  
**Hysteresis:** Programmable

**Signal Overdrive Action:** Upscale

**Annunciator:** LED backlight for "AL1", "AL2", (Alarm #2 not available with secondary output or motorized valve position option.)

### 15. ENVIRONMENTAL CONDITIONS:

**Operating Temperature Range:** 0 to 50°C

**Storage Temperature Range:** -40 to 80°C

**Span Drift (maximum):** 100 ppm/°C, main input; 150 ppm/°C, second input

**Zero Drift (maximum):**

**4 to 20 mA DC Range:** 0.5  $\mu\text{A}/^\circ\text{C}$

**0 to 10 VDC Range:** 0.2 mV/°C

**Second Input:** 2  $\mu\text{A}/^\circ\text{C}$

**Relative Humidity:** Less than 85% RH (non-condensing)

**Altitude:** Up to 2000 meters

### 16. ISOLATION BREAKDOWN RATINGS:

**All inputs and outputs with respect to AC line:** 2300 V<sub>MIN</sub>

**Analog Outputs, Second Analog Input or Slidewire Input with respect to main input:** 500 V<sub>MIN</sub>

### 17. CERTIFICATIONS AND COMPLIANCES:

#### SAFETY

UL Listed, File #E137808, UL508, CSA C22.2 No. 14-M95

LISTED by Und. Lab. Inc. to U.S. and Canadian safety standards

UL Recognized Component, File # E156876, UL873, CSA C22.2 No. 24 Recognized to U.S. and Canadian requirements under the Component Recognition Program of Underwriters Laboratories, Inc.

Type 2 or 4X Enclosure rating (Face only), UL50

IECEE CB Scheme Test Certificate #UL1239-156876/USA,

CB Scheme Test Report #96ME50279-070794

Issued by Underwriters Laboratories, Inc.

IEC 1010-1, EN 61010-1: Safety requirements for electrical equipment for measurement, control, and laboratory use, Part 1.

IP65 Enclosure rating (Face only), IEC 529

#### ELECTROMAGNETIC COMPATIBILITY:

##### Immunity to EN 50082-2

Electrostatic discharge	EN 61000-4-2	Level 2; 4 Kv contact Level 3; 8 Kv air
Electromagnetic RF fields	EN 61000-4-3	Level 3; 10 V/m <sup>1</sup> 80 MHz - 1 GHz
Fast transients (burst)	EN 61000-4-4	Level 4; 2 Kv I/O Level 3; 2 Kv power
RF conducted interference	EN 61000-4-6	Level 3; 10 V/rms <sup>2</sup> 150 KHz - 80 MHz
Power frequency magnetic fields	EN 61000-4-8	Level 4; 30 A/m
<b>Emissions to EN 50081-2</b>		
RF interference	EN 55011	Enclosure class A Power mains class A

#### Notes:

1. Self-recoverable loss of performance during EMI disturbance at 10 V/m.:  
Process and/or analog output signals may deviate during EMI disturbance.

For operation without loss of performance:

Install power line filter, RLC #LFIL0000 or equivalent.

2. Self-recoverable loss of performance during EMI disturbance at 10 Vrms:  
Process and/or analog output signals may deviate during EMI disturbance.

For operation without loss of performance:

Install power line filter, RLC #LFIL0000 or equivalent and 1 ferrite core 1 turn, RLC #FCOR0000 or equivalent, to cable at unit.

Refer to the EMC Installation Guidelines section of the manual for additional information.

### 18. CONNECTION: Jaw-type terminal block

**Wire Range:** 12-30 AWG copper wire

**Torque:** 5-7 inch-lbs (56-79 N-cm)

### 19. CONSTRUCTION: NEMA 2 For Standard Models.

**Front Panel:** Flame and scratch resistant tinted plastic

**Case:** High impact black plastic. (Mounting collar included)

**NEMA 4X/IP65 model only:** Sealed bezel utilizing two captive mounting screws (panel gasket included) This unit is rated for NEMA 4X/IP65 indoor use. Installation Category II, Pollution Degree 2

### 20. WEIGHT: 1.3 lbs (0.6 kgs)

## BASIC OPERATION

The PCU controls a process by measuring the input signal and then calculating a control output power value by use of a modified PID control algorithm. The unit controls the system with the new output power value to keep the process at setpoint. The PID control algorithm incorporates features that provide for high control accuracy and low overshoot from process disturbances.

## FRONT PANEL FEATURES

In the normal operating mode, the unit displays the scaled process value in the upper display. One of four other parameters can be viewed in the lower display:

- Setpoint
- % Power Output
- Deviation
- Second Input Process Value

The parameters can be scrolled through by pressing the DSP button. If enabled, the control setpoint or power output (manual mode only) can be directly modified in this mode.

In the normal operating mode, parameters are selected by use of the PAR button and modified by use of the UP and DOWN buttons. Parameters are then entered by the PAR button, which advances the user to the next parameter. Pressing the DSP button immediately returns the controller to the normal operating mode when making a parameter change. The controller's configuration and parameter settings are stored in an internal E<sup>2</sup>PROM device.

## HARDWARE FEATURES

The fast 100 msec input sampling rate provides quick controller response to a process disturbance, thus providing excellent process control. Measurement accuracy of 0.15% or better, provides closer process control conforming to the desired control setpoint value. The unit accepts either a 0 to 10 VDC or a 0 to 20 mA DC input signal. The AC input power is switch selectable, allowing the unit to operate from either 115 VAC or 230 VAC. Since the controller is serviceable from the front of the panel, the output modules may be easily changed or replaced without disturbing the wiring behind the panel. No re-programming is required when changing or replacing modules.

The optional NEMA 4X/IP65 rated model utilizes two bezel securing screws and a neoprene gasket to guarantee a water tight seal, when properly installed. The standard model simply requires pressing a latch to remove the unit.

Low-drift, highly stable circuitry ensures years of reliable and accurate process control. The recommended two-year re-calibration interval is easily accomplished via the programming menu.

## SETPOINT FEATURES

The controller setpoint can be protected from out of range values by programming the setpoint range limit values. Additionally, safeguards from inadvertent data entry can be programmed.

The setpoint ramp feature ramps the setpoint value at start-up or any time a setpoint change is made, at a user programmable rate. This feature reduces shock to the process and helps to minimize overshoot. The setpoint may also be transmitted by the optional linear DC output for slave control loops.

The second analog input may be configured as a remote setpoint. As such, the controller is easily switched from local/remote setpoint operation via the front panel or user input. Ratio and bias parameters provide on-line scaling of the remote setpoint. Absolute limit values and maximum rate of change of the remote setpoint further enhance controller flexibility.

## INPUT FEATURES

A programmable input filter can be used to stabilize readings from a process with varying or oscillating characteristics, helping to provide better process control. Programmable scaling points allow the controller to display in any engineering unit; flow, level, pressure, etc. Scaling points are used in conjunction with the programmable rounding increment to stabilize a jittery or otherwise hard to read process signal for better indication.

The programmable User Input can be used to control a variety of functions, such as auto/manual transfer of the controller, reset alarm output(s), etc.

The second analog input has independent scaling parameters to match the units of other processes or transmitters, or to match the controller's range.

## OUTPUT FEATURES

Programmable output power limits provide protection for processes where excessive power can cause damage. Automatic signal overdrive detection, for fail-safe operation, causes the controller to default to a programmed output power (upscale or downscale burnout). With adjustable time proportioning cycle time, and programmable DC linear output, the controller can satisfy a wide variety of output requirements.

Programmable dampening output hysteresis and output update time parameters can dramatically reduce actuator activity without degrading control accuracy.

The RS485 Communication option allows the user to access various controller parameters such as the setpoint, % output power, % proportional band, etc. The controller may be set up to transmit various parameters at a programmable automatic print rate.

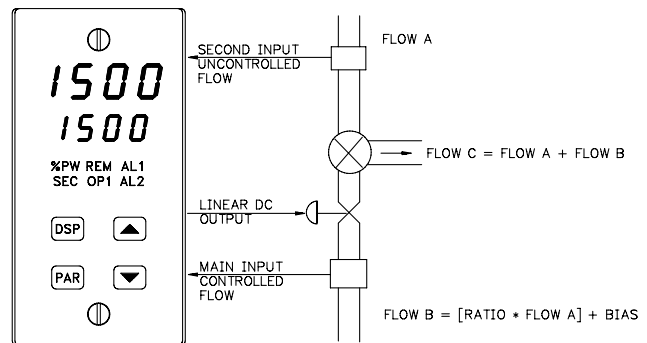
## AUTO-TUNE

The PCU has an auto-tune feature that, on demand, automatically determines the PID control parameters for a particular process. After completion of auto-tune, the PID parameters are automatically optimized for that process and loaded into nonvolatile memory. The operator may view and modify the parameters as desired.

Auto-tune may be invoked either at start-up or at setpoint, depending on the process requirements. An auto-tune programmable dampening factor produces various levels of process control and response characteristics.

## OPTIONS

### RATIO CONTROL



The PCU configured for ratio operation controls a process as a ratio of another process or to another variable. Ratio control is commonly used for flow applications, however, any two process variables can be controlled in a ratio mode.

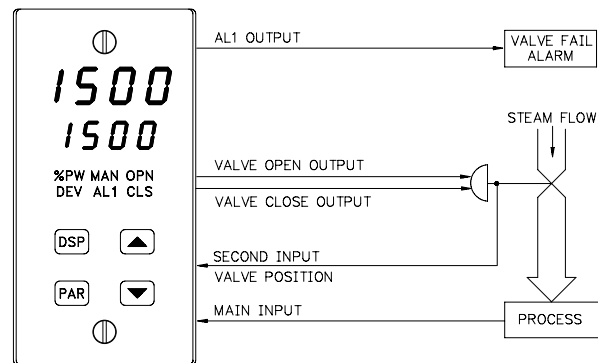
#### Ratio Control Configuration Parameters

- "OPER" - Select ratio mode
- "root" - Select second input square root linearization
- "dPT2" - Select second input decimal point
- "dSP1"
- "INP1"
- "dSP2"
- "INP2"
- "SPr" - Local/Remote Select options
- "InPt" - Program User Input for Local/Remote Setpoint selection

#### Ratio Control Operational Parameters

- "rtio" - Remote setpoint ratio
- "bias" - Remote setpoint bias

### MOTORIZED VALVE POSITIONER



The motorized valve positioner controls the position of a valve directly, by use of "open" and "close" control outputs. The slidewire feedback signals of the valve may optionally be connected to the controller. Alternatively, the controller may be configured for linear input valve control using the 4 to 20 mA DC output.

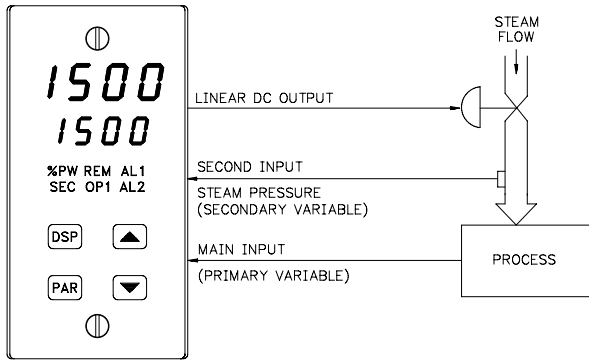
**Motorized Valve Positioner Configuration Parameters**

- Position mode:
  - "VPS1" - Enter or measure valve closed position
  - "VPS2" - Enter or measure valve open position
  - "VUdt" - Enter Valve update time
  - "VPdb" - Enter valve control deadband
  - "VFAL" - Enter valve fail detect time
  - "Act1" - Program alarm as valve fail output
- Velocity mode:
  - "VUdt" - Enter Valve update time
  - "VOPT" - Enter valve open time
  - "VCLT" - Enter valve close time
  - "VOnt" - Enter valve control deadband (minimum on time)

**Internal Cascade Operational Parameters**

- "SP-2" - View secondary setpoint value
- "Pb-2" - Enter secondary proportional band
- "It-2" - Enter secondary integral time
- "dt-2" - Enter secondary derivative time

**INTERNAL CASCADE**

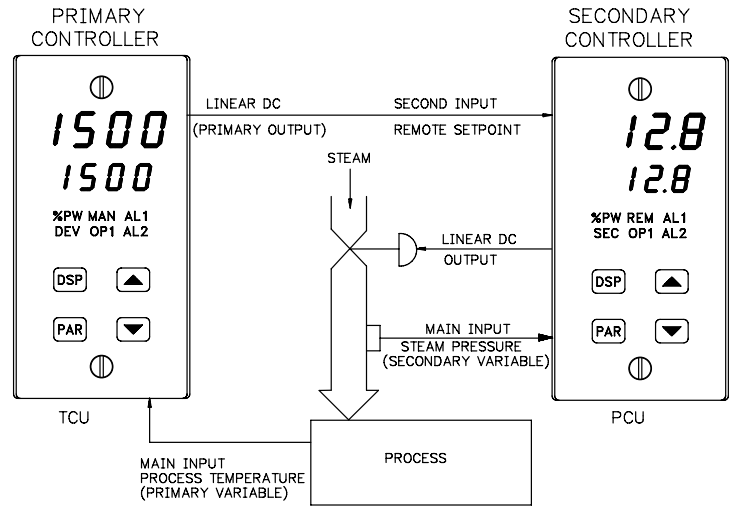


Cascade control allows the process to be divided into two control loops: the primary control loop and the secondary control loop. The secondary loop receives its setpoint from the primary loop to control an intermediate variable (steam pressure). The control level of the intermediate variable is the input to the primary process. The primary loop (main input) controller maintains loop regulation by manipulating the setpoint of the secondary controller. The setpoint of the secondary controller, in turn, changes the intermediate variable. The secondary loop can react faster to disturbances of the intermediate variable, thereby minimizing the effects to the primary control loop. Control loops cascaded in such a manner provide greater control quality than would be possible with single loop control. A single PCU can accomplish two-process cascade control.

**Internal Cascade Configuration Parameters**

- "OPER" - Select cascade mode
- "root" - Select second input square root linearization
- "dPt2" - Select second input decimal point
- "dSP1" - Enter scaling units of second input
- "INP1" - Enter scaling units of second input
- "dSP2" - Enter scaling units of second input
- "INP2" - Enter scaling units of second input
- "OPd2" - Output dampening of secondary

**EXTERNAL CASCADE**



Similar to internal cascade control, external cascade control differs by the employment of two controllers, one of which is equipped with a second analog input configured as a remote setpoint. A PCU controls the secondary loop, while a TCU controls the primary loop.

**External Cascade Configuration Parameters**

- "OPER" - Select ratio mode
- "root" - Select second input square root linearization
- "dPt2" - Select second input decimal point
- "dSP1" - Enter scaling units of second input
- "INP1" - Enter scaling units of second input
- "dSP2" - Enter scaling units of second input
- "INP2" - Enter scaling units of second input
- "SPtr" - Local/Remote select options

**External Cascade Operational Parameters**

- "rtio" - Remote setpoint ratio
- "bIAS" - Remote setpoint bias

**SETPOINT MASTER CONTROL**

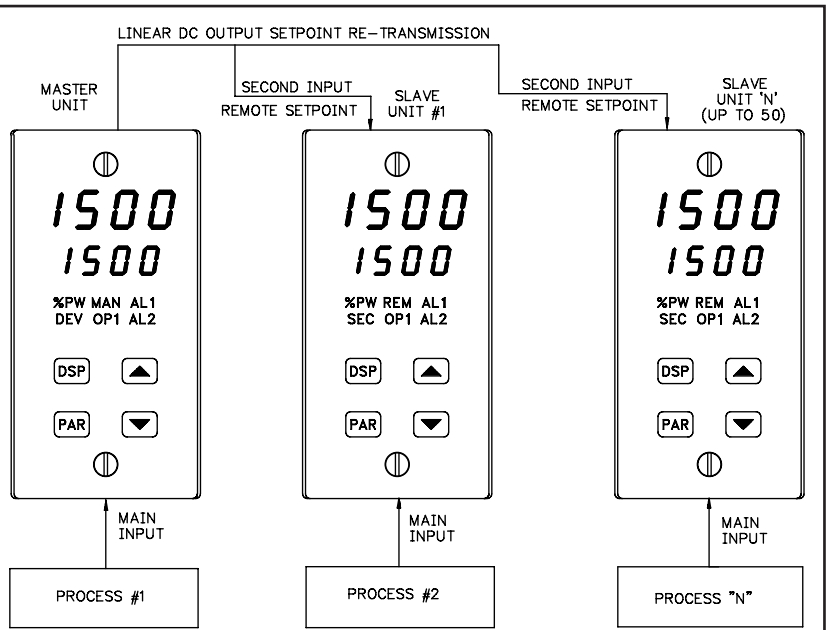
Setpoint Master Control allows automatic setpoint changes to slave controller units (up to 50 units total) from a master PCU controller. The linear DC output of the master is looped with the second analog input of the slave PCU controllers. Each slave unit can have unique remote setpoint ratio and bias values.

**Setpoint Slave Configuration Parameters**

- "OPER" - Select remote setpoint mode
- "root" - Select second input square root linearization
- "dPt2" - Select second input decimal point
- "dSP1" - Enter scaling units of second input
- "INP1" - Enter scaling units of second input
- "dSP2" - Enter scaling units of second input
- "INP2" - Enter scaling units of second input
- "SPLO" - Limit range of remote setpoint
- "SPHI" - Limit range of remote setpoint
- "SPrP" - Limit rate of change of remote setpoint

**Setpoint Slave Operational Parameters**

- "rtio" - Second input ratio
- "bIAS" - Second input bias



## CONTROLLER PROGRAMMING

The PCU has been designed to reduce the operator interaction with the controller while still maintaining a high degree of control accuracy and user flexibility. Front Panel Program Disable allows all of the controller's set-ups to be locked-out from further operator intervention after the initial parameter set-up.

The programming of the controller is divided into four sections:

- Unprotected Parameter Mode
- Configuration Parameter Mode
- Protected Parameter Mode
- Hidden Function Mode

These four programming modes allow the controller to adapt to any required user-interface level.

### UNPROTECTED PARAMETER MODE \*

The unprotected parameter mode is accessible when program disable is inactive or when the proper access code number from the protected mode is entered. The configuration parameter modes can be accessed only from this mode.

- "SP" - Enter Setpoint
- "OP" - Enter output power
- "Prop" - Enter proportional band
- "Intt" - Enter integral time
- "dErt" - Enter derivative time
- "rtio" - Enter Remote Setpoint ratio value
- "bIAS" - Enter Remote Setpoint bias value
- "SP-2" - View internal cascade secondary setpoint demand
- "Pb-2" - Enter internal cascade, secondary proportional band
- "It-2" - Enter internal cascade, secondary integral time
- "dt-2" - Enter internal cascade, secondary derivative time
- "AL-1" - Enter value for alarm #1
- "AL-2" - Enter value for alarm #2
- "CNFP" - Select basic configuration mode
- "End" - Return to normal display mode

### CONFIGURATION PARAMETER MODE

The configuration parameter mode allows the operator to set up the basic requirements of the controller. It is divided into sections which group together related programming steps, such as inputs, outputs, alarms, etc. Upon completion of each section, the program returns to the configuration selection stage allowing the user to return to the normal display mode.

#### Configuration 1, Inputs

- "TYPE" - Select input signal type
- "root" - Select square root linearization of main input \*
- "dCPT" - Select scaled display decimal point position
- "md" - Enter rounding increment and trailing zeroes for scaled display
- "FLtr" - Select level of input filtering
- "dSP1" } - Scale main input
- "INP1" }
- "dSP2" }
- "INP2" }
- "SPLO" - Enter setpoint lower limit
- "SPHI" - Enter setpoint higher limit
- "SPrP" - Enter setpoint ramp rate
- "InPt" - Select user input function \*

#### Configuration 2, Outputs

- "CYCt" - Enter time proportioning cycle time
- "OPAC" - Select control action
- "OPLO" - Enter output power low limit
- "OPHI" - Enter output power high limit
- "OPFL" - Enter signal overdrive power preset
- "OPdP" - Enter output control dampening
- "CHYS" - Enter ON/OFF control hysteresis
- "tcod" - Select auto-tuning dampening
- "ANAS" - Select linear DC output assignment \*
- "ANLO" - Enter linear DC output low scaling value \*
- "ANHI" - Enter linear DC output high scaling value \*
- "ANdb" - Enter linear DC output control deadband \*
- "ANUt" - Enter linear DC output update time \*

#### Configuration 3, Parameter lock-outs

- "SP" - Select degree of setpoint access
- "OP" - Select degree of power access
- "dEv" - Enable deviation display \*
- "IN-2" - Enable second input display \*
- "bdSP" - Enable blank display
- "CodE" - Enter parameter access code
- "PId" - Select degree of PID access
- "PId2" - Select degree of secondary PID access \*
- "rtbS" - Select degree of ratio/bias access \*
- "AL" - Select degree of alarm access \*
- "ALrS" - Enable alarm reset access \*
- "SPSL" - Enable local/remote setpoint selection \*
- "trnF" - Enable auto/manual mode selection
- "tUNE" - Enable auto-tune invocation

#### Configuration 4, Alarms \*

- "Act1" - Select operation mode of alarm #1
- "rSt1" - Select reset mode of alarm #1
- "Stb1" - Enable activation delay of alarm #1
- "AL-1" - Enter value for alarm #1
- "Act2" - Select operation mode of alarm #2
- "rSt2" - Select reset mode of alarm #2
- "Stb2" - Enable activation delay of alarm #2
- "AL-2" - Enter value for alarm #2
- "AHYS" - Enter hysteresis value for both alarms

#### Configuration 5, Secondary Output \*

- "CYC2" - Enter time proportioning cycle time
- "GAN2" - Enter relative gain
- "db-2" - Enter deadband or overlap

#### Configuration 6, Serial Communications \*

- "bAUd" - Select baud rate
- "PARb" - Select parity bit
- "Addr" - Enter unit address number
- "Abrv" - Select abbreviated or full mnemonic transmissions
- "PrAt" - Enter automatic print rate
- "PoPt" - Select parameters to be included in print-out

#### Configuration 7, Second Input \*

- "OPEr" - Select remote setpoint or internal cascade mode
- "root" - Select second input square root linearization
- "dPT2" - Select second input decimal point
- "dSP1" } - Entering scaling parameters of second input
- "INP1" }
- "dSP2" }
- "INP2" }
- "SPtr" - Enter local/remote select options
- "OPd2" - Enter Secondary output control dampening

#### Configuration 8, Motorized Valve Positioner \*

- Position mode: "VPS1" - Enter or measure valve closed position
- "VPS2" - Enter or measure valve open position
- "VUdt" - Enter valve update time
- "VPdb" - Enter valve control deadband
- "VFAL" - Enter valve fail detect time
- Velocity mode: "VUdt" - Enter valve update time
- "VOPT" - Enter valve open time
- "VCLt" - Enter valve close time
- "VOnt" - Enter valve control deadband (minimum on time)

### HIDDEN FUNCTION MODE \*

The hidden function mode is accessible from the normal operating mode. The four functions in this mode may be locked-out individually in configuration 3 parameter lock-out section.

- "SPSL" - Select Local/Remote Setpoint
- "trnF" - Transfer between automatic (PID) control and manual control
- "tUNE" - Invoke/cancel PID Auto-tune
- "ALrS" - Reset latched alarms

\* These parameters may not appear due to option configuration or other programming.

**PROTECTED PARAMETERS MODE \***

The protected parameters mode is enabled when program disable is active. This mode prevents access to the configuration modes without the proper access code number. Only the parameters that are selected in the configuration 3 parameter lock-out section can be accessed.

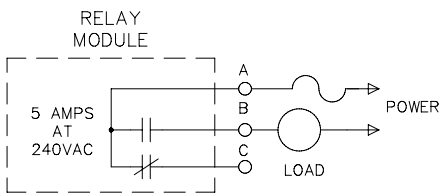
- "ProP" - Enter Proportional band
- "Intt" - Enter integral time
- "dErt" - Enter derivative time
- "rtio" - Enter remote setpoint ratio value
- "bIAS" - Enter remote setpoint bias value
- "SP-2" - Enter internal cascade, secondary setpoint
- "Pb-2" - Enter internal cascade, secondary proportional band
- "It-2" - Enter internal cascade, secondary integral time
- "dt-2" - Enter internal cascade, secondary derivative time

- "AL-1" - Enter value for alarm #1
- "AL-2" - Enter value for alarm #2
- "CodE" - Enter access value to unprotected parameters & configuration parameters

\* These parameters may not appear due to option configuration or other programming.

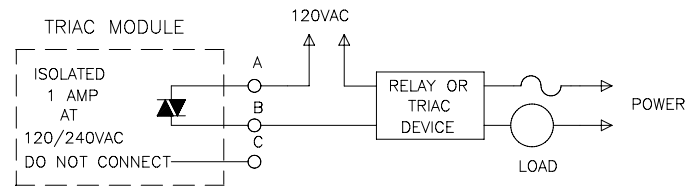
**OUTPUT MODULES**

**TYPICAL CONNECTIONS**



**Relay:**

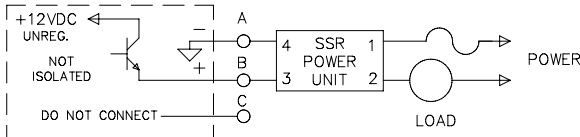
**Type:** Form-C (Form-A with some models. See ordering information.)  
**Rating:** 5 amps @ 120/240 VAC or 28 VDC (resistive load), 1/8 HP @ 120 VAC (inductive) maximum.  
**Life Expectancy:** 100,000 cycles at maximum load rating. (Decreasing load and/or increasing cycle time, increases life expectancy).



**Triac:**

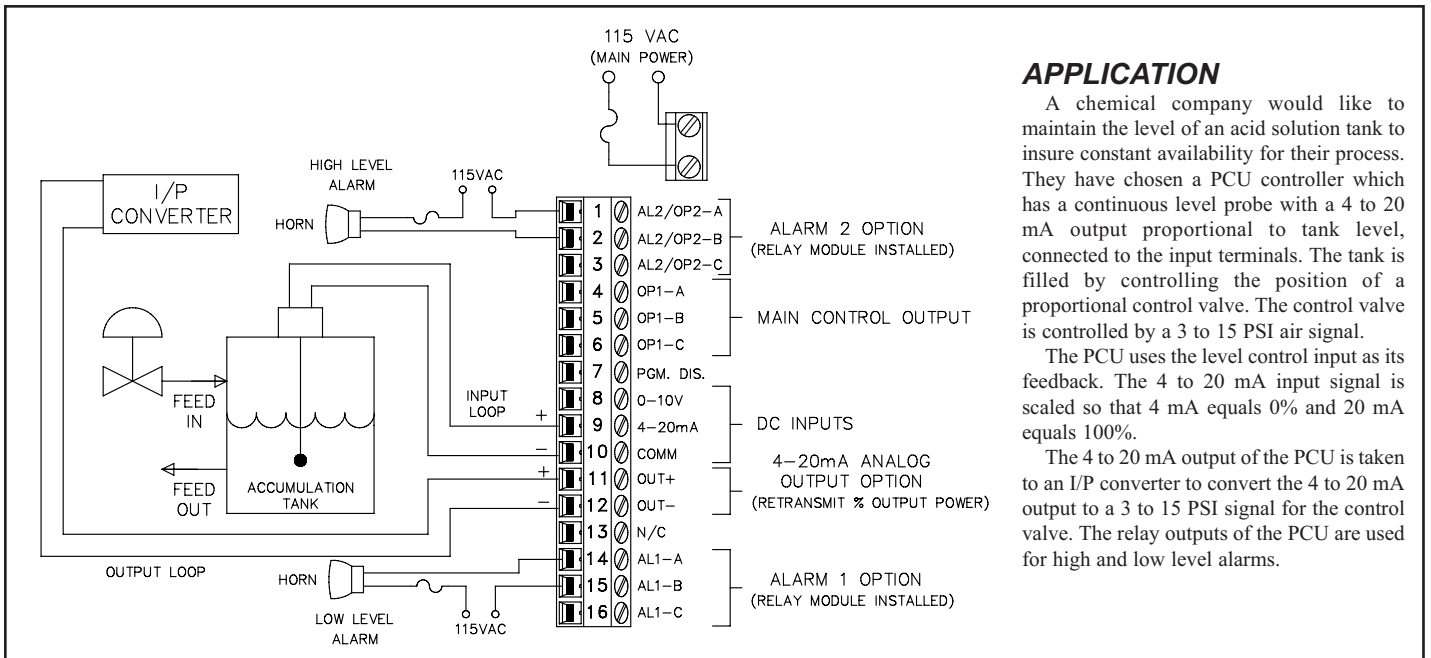
**Type:** Isolated, Zero Crossing Detection  
**Rating:**  
**Voltage:** 120/240 VAC  
**Max. Life Current:** 1 ampere @ 35°C  
 0.75 ampere @ 50°C  
**Min. Load Current:** 10 mA  
**Off State Leakage Current:** 7 mA max. @ 60 Hz  
**Operating Frequency:** 20 to 400 Hz  
**Protection:** Internal Transient Snubber, Fused

**LOGIC/SSR DRIVE MODULE**



**Logic/SSR Drive:** Can drive multiple SSR Power Units.

**Type:** Non-isolated switched DC, 12 VDC typical  
**Drive:** 45 mA maximum.



**APPLICATION**

A chemical company would like to maintain the level of an acid solution tank to insure constant availability for their process. They have chosen a PCU controller which has a continuous level probe with a 4 to 20 mA output proportional to tank level, connected to the input terminals. The tank is filled by controlling the position of a proportional control valve. The control valve is controlled by a 3 to 15 PSI air signal. The PCU uses the level control input as its feedback. The 4 to 20 mA input signal is scaled so that 4 mA equals 0% and 20 mA equals 100%. The 4 to 20 mA output of the PCU is taken to an I/P converter to convert the 4 to 20 mA output to a 3 to 15 PSI signal for the control valve. The relay outputs of the PCU are used for high and low level alarms.

## ORDERING INFORMATION

### MODELS WITHOUT SECOND INPUT OPTIONS

NEMA 4X/IP65 BEZEL	4 to 20 mA ANALOG OUTPUT	0 to 10 VDC ANALOG OUTPUT	ALARM OUTPUTS	COOLING OUTPUT	RS485 COM	PART NUMBER
NO	YES	NO	NO	NO	NO	PCU01000
NO	YES	NO	2	NO	NO	PCU01001
YES	NO	NO	NO	NO	NO	PCU10000
YES	NO	NO	2	NO	NO	PCU10001
YES	NO	NO	1	YES	NO	PCU10002
YES	YES	NO	NO	NO	NO	PCU11000
YES	YES	NO	2	NO	NO	PCU11001
YES	YES	NO	1	YES	NO	PCU11002
YES	YES	NO	2	NO	YES	PCU11004
YES	YES	NO	1	YES	YES	PCU11005
YES	NO	YES	2	NO	NO	PCU12001
YES	NO	YES	2	NO	YES	PCU12004
YES	NO	YES	1	YES	YES	PCU12005

These models have dual alarm outputs, or single alarm with secondary outputs, with shared common terminals (Form A Type). As a result, these outputs should be fitted with the same type of output module. The main output (OP1) may be fitted with any type of output module.

### SECOND ANALOG INPUT MODELS (RSP)

NEMA 4X/IP65 BEZEL	4 to 20 mA ANALOG OUTPUT	0 to 10 VDC ANALOG OUTPUT	ALARM OUTPUTS	COOLING OUTPUT	RS485 COM	PART NUMBER
YES	NO	NO	2	NO	YES	PCU10104
YES	YES	NO	2	NO	NO	PCU11108
YES	NO	YES	2	NO	NO	PCU12108

These models have dual alarm outputs, or single alarm with secondary outputs, with shared common terminals (Form A Type). As a result, these outputs should be fitted with the same type of output module. The main output (OP1) may be fitted with any type of output module.

### MOTORIZED VALVE POSITIONER MODELS (MVP)

NEMA 4X/IP65 BEZEL	4 to 20 mA ANALOG OUTPUT	0 to 10 VDC ANALOG OUTPUT	ALARM OUTPUTS	COOLING OUTPUT	RS485 COM	PART NUMBER
YES	NO	NO	1	NO	YES	PCU10307
YES	YES	NO	1	NO	NO	PCU11306
YES	NO	YES	1	NO	NO	PCU12306

### ACCESSORIES

DESCRIPTION	PART NUMBER
Relay Module	OMD00000
Triac Module	OMD00001
Logic/SSR Drive Module	OMD00003
SSR Power Unit	RLY50000
Single Phase 25 A DIN Rail Mount Solid State Relay	RLY60000
Single Phase 40 A DIN Rail Mount Solid State Relay	RLY6A000
Three Phase DIN Rail Mount Solid State Relay	RLY70000

*Note: Output Modules are NOT supplied with the controller. When specifying the controller, be sure to purchase the appropriate output module for the Main Control Output and if necessary, the alarm output(s), the secondary output, and valve positioner outputs.*

*The Logic/SSR Drive Module is a switched DC source, intended to drive the DC input of an SSR power unit. It should never be connected to line voltage.*

*All modules are packaged separately and must be installed by the user.*

Red Lion Controls  
20 Willow Springs Circle  
York PA 17402  
Tel +1 (717) 767-6511  
Fax +1 (717) 764-0839

Red Lion Controls BV  
Basicweg 11b  
NL - 3821 BR Amersfoort  
Tel +31 (0) 334 723 225  
Fax +31 (0) 334 893 793

Red Lion Controls AP  
31, Kaki Bukit Road 3,  
#06-04/05 TechLink  
Singapore 417818  
Tel +65 6744-6613  
Fax +65 6743-3360