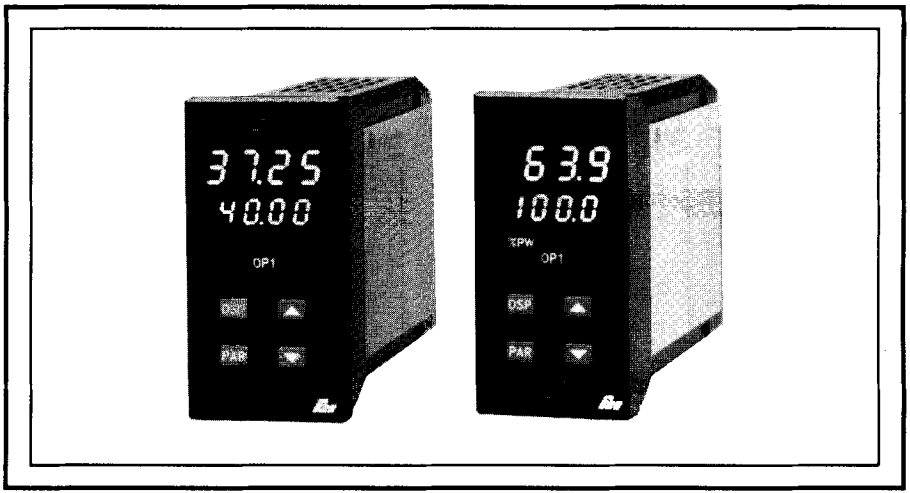
THE PROCESS SETPOINT CONTROLLER



MODEL PSC INSTRUCTION MANUAL

INTRODUCTION

The Process Setpoint Controller Unit (PSC) is a multi-purpose series of industrial control products that are field-programmable for solving various applications. This series of products is built around the concept that the end user has the capability to program different personalities and functions into the unit in order to adapt to different indication and control requirements.

The PSC unit, which you have purchased, has the same high quality workmanship and advanced technological capabilities that have made Red Lion Controls the leader in today's industrial market.

Red Lion Controls has a complete line of industrial indication and control equipment, and we look forward to servicing you now and in the future.

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GENERAL DESCRIPTION

The PSC is a setpoint controller suitable for time vs. process control applications. The PSC Controller accepts either a 0-10VDC or a 4-20mA DC input signal, precisely scales the process signal, according to programmable scaling points, and provides an accurate output control signal *(time proportional or linear)* to maintain a process at the desired control point. A comprehensive set of easy to use steps allows the controller to satisfy various applications. The user input can be programmed to perform a variety of controller functions.

Dual 4-digit displays allow viewing of the measured process value and setpoint or the process and profile status simultaneously. Front panel indicators inform the operator of controller status and output states. Replaceable output modules (Relay, Logic/SSR drive or Triac) can be fitted to the main control output, alarm output(s) or timed event output(s), and secondary output.

The PSC has been designed to simplify the set-up and operation of a controlled setpoint profile program. The setpoint program is easily entered and controlled through the front panel. Full display capabilities keep the operator informed of the process value, profile status, output states, and setpoint value.

The controller can operate in the standard PID control mode for both Output 1 and Output 2 with on-demand auto-tune which establishes the PID gain set. The PID gain set can be fine tuned by the operator at any time or may be locked from further modification. The unit can be transferred to the manual control mode providing the operator with direct control of the output.

The PSC features four programs or profile recipes, each with up to eight ramp/soak segments, which can be easily stored and executed at any time. Longer profiles can be achieved by linking one or more profiles together, creating a single profile of up to 32 ramp/soak segments. Process profile conformity is assured during either soak (hold) phases or both ramp and hold phases by an adjustable error band parameter. The program repeat function cycles the profile either continuously or a set number of times. Power-on options automatically re-start, stop, or resume a running profile. The profile can be controlled via the front panel buttons, the user input, or the optional serial communications port.

Four control points, each having a setpoint and PID parameter set, are available for instant front panel implementation during batch changeover, or other process conditions. A control point may have its PID gain set values disabled when implementing the control point.

The optional RS-485 multidrop serial communications interface provides the capability of two-way communication between a PSC 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 0-99. 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.

Optional alarm output(s) may be configured to operate as a timed event output or as a standard alarm output. As an alarm output it may be configured to activate according to a variety of actions (Absolute HI or LO, Deviation HI or LO, or Band IN or OUT) with adjustable hysteresis. Also, a standby feature suppresses the output(s) on power-up until the process stabilizes outside the alarm region. Timed event output(s) allow the controller to activate other equipment while a programmed profile is running. Each profile can define up to 16 event states (phases), for each output.

An optional secondary output is available for processes that require cooling or a comparable function which provides increased control accuracy and response.

The optional linear 4-20mA output signal is available to interface with final actuators, chart recorders, indicators, or other controllers. The 4-20mA output signal can be digitally scaled and selected to transmit one of the following:

- % Output Power
- Measurement Value
- Measurement Value Deviation
- Setpoint Value

An optional NEMA 4X/IP65 rated bezel is available for washdown 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.

INSTALLATION & CONNECTIONS

Standard Unit Installation

Prepare the panel cutout to the dimensions shown in the installation figure. Remove the panel latch and cardboard sleeve from the unit and discard the cardboard sleeve. The unit should be installed with the bezel assembly in place. Insert the unit into the panel cutout. While holding the front of the unit in place, push the panel latch over the rear of the unit so that the tabs of the panel latch engage in the slots on the case. The panel latch should be engaged in the farthest forward slots possible. Tighten the screws evenly until the unit is snug in the panel.

Nema 4X/IP65 Unit Installation

The optional NEMA 4X/IP65 PSC Controller is designed to provide a watertight seal in panels with a minimum thickness of 1/8 inch. Prepare the panel cutout to the dimensions shown in the installation figure. Carefully apply the adhesive side of the panel gasket to the panel cutout. Remove the panel latch and cardboard sleeve from the unit and discard the cardboard sleeve. The unit should be installed with the bezel assembly in place and the bezel screws tightened slightly. Insert the unit into the panel cutout. While holding the front of the unit in place, push the panel latch over the rear of the unit so that the tabs of the panel latch engage in the slots on the case. The panel latch should be engaged in the farthest forward slot possible. To achieve a proper seal, tighten the latch screws evenly until the unit is snug in the panel (torque to approximately 7in-lbs [79N-cm]). Do NOT over-tighten the screws.

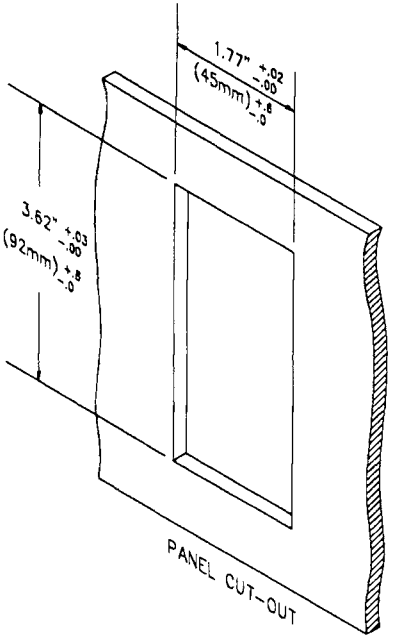
Note: The installation location of the controller is important. Be sure to keep it away from heat sources (ovens, furnaces, etc.), away from direct contact with caustic vapors, oils, steam, or any other process by-products in which exposure may effect proper operation.

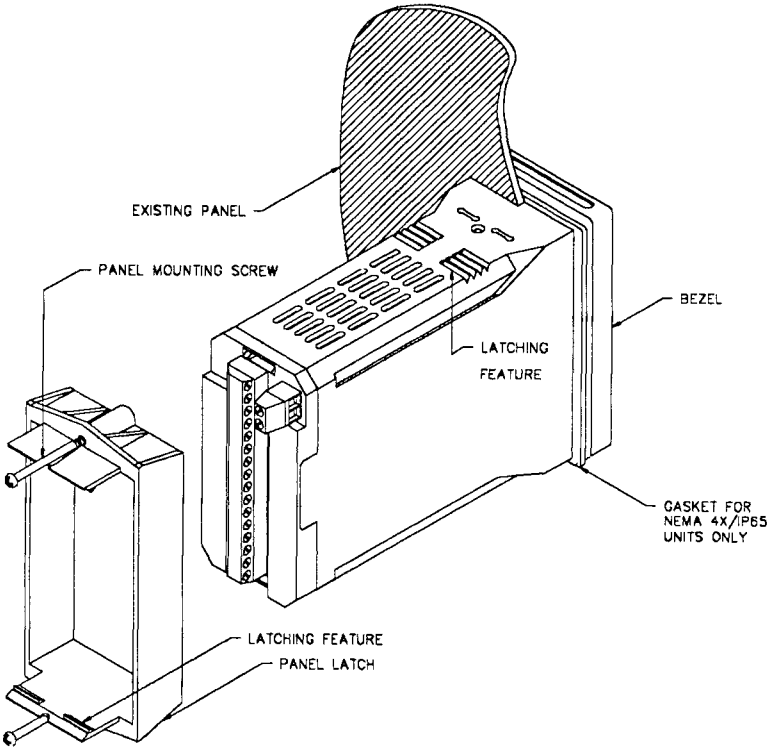
Note: Prior to applying power to the controller, the internal AC power selector switch must be set. Damage to the controller may occur if the switch is set incorrectly.

Unit Removal Procedure

To remove a NEMA 4X/IP65 or standard unit from the panel, first unscrew and remove the panel latch screws. Insert flat blade screwdrivers between the latch and the case on the top and bottom of the unit so that the latches disengage from the grooves in the case. Push the unit through the panel from the rear.

PANEL INSTALLATION & REMOVAL





Removing Bezel Assembly

The bezel assembly must be removed from the case to install or replace output modules, or to set the 115/230VAC selector switch. To remove a standard bezel assembly (without bezel securing screws) press the latch under the lower bezel lip and withdraw the bezel assembly. To remove the sealed NEMA 4X/IP65 bezel assembly, loosen the two bezel securing screws until a slight "click" is felt (the screws are retained in the bezel) and withdraw the assembly. It is recommended to disconnect power to the unit and to the output control circuits to eliminate the potential shock hazard with the bezel assembly removed.

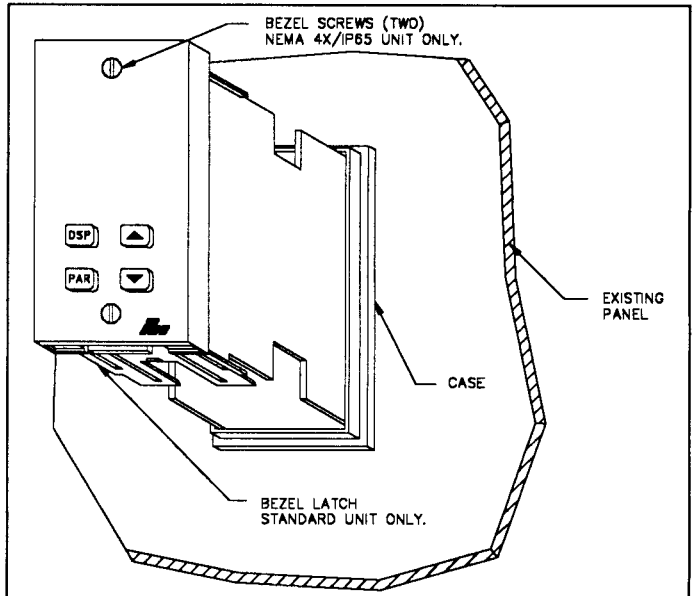
Note: The bezel assembly contains electronic circuits which are damaged by static electricity. Before removing the assembly, discharge stray static electricity on your body by touching an earth ground point. It is also important that the bezel assembly be handled only by the bezel itself. Additionally, if it is necessary to handle a circuit board, be certain that hands are free from dirt, oil, etc., to avoid circuit contamination which may lead to malfunction.

Installing Bezel Assembly

To install the standard bezel assembly, insert the assembly into the case until the bezel latch snaps into position.

To install the NEMA 4X/IP65 bezel assembly, insert the assembly into the case and tighten the bezel screws uniformly until the bezel contacts the case and then turn each screw another half turn to insure a watertight seal (do not over-tighten screws).

Note: When substituting or replacing a bezel assembly, be certain that it is done with the same model using the same Output Modules. Damage to the controller may result if the unit's output modules are not the same. A NEMA 4X/IP65 and a standard bezel assembly are NOT interchangeable.

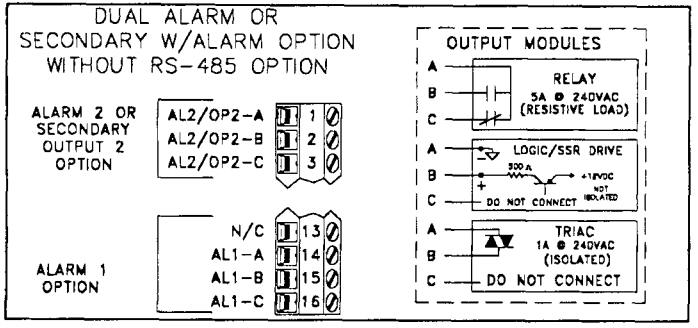


Output Modules

The main control, optional alarm, and optional secondary output sockets must be fitted with the appropriate output module. Output modules are shipped separately and must be installed by the user.

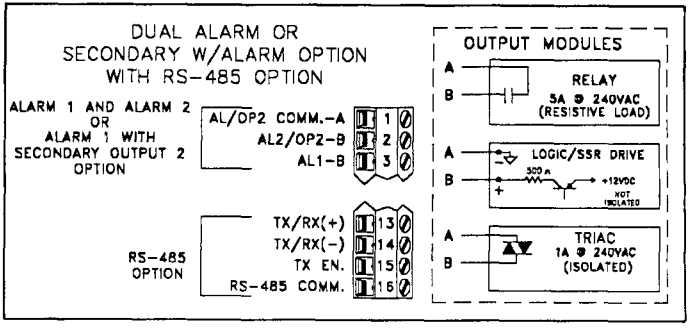
Output Variations Without RS-485 Option

The Dual Alarm or the Secondary with Alarm output, without the RS-485 option, has independent outputs. Therefore, the secondary output and/or alarm output(s) can be installed with any combination of output modules.



Output Variations With RS-485 Option

The Dual Alarm or the Secondary with Alarm output, with RS-485 option, does not have independent outputs. In this case, the secondary output and/or alarm output(s) must have the same type of output modules installed since they share the common terminal.



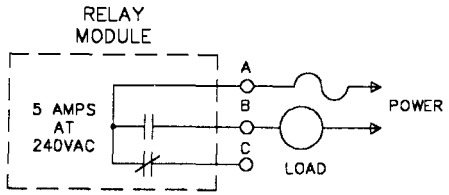
Installing Output Modules

To install an output module into the controller, remove the bezel assembly from the case (see Removing Bezel Assembly). Locate the correct output module socket (OP1, AL1, or AL2/OP2, see hardware figure or label outside of case) and plug the output module into the socket. No re-programming is required. If changing an output module type, be sure the appropriate output interface wiring changes are made. Re-install the bezel assembly when complete.

OUTPUT MODULE "OUTPUT ON" STATE

Relay	Normally open contact is closed.
Logic/SSR Drive	Source is active.
Triac	Solid state switch is closed.

Typical Connections

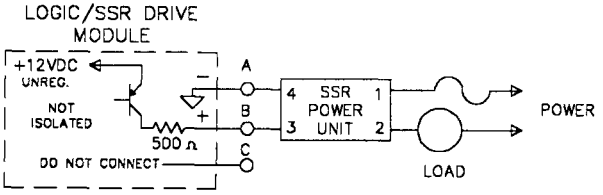


Relay:

Type: Form-C

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

Life Expectancy: 100,000 cycles at maximum load rating.

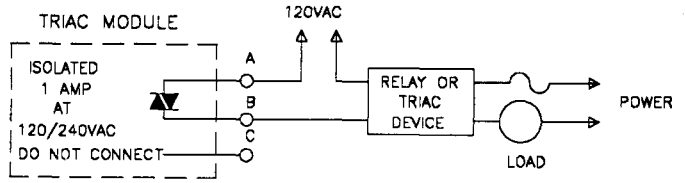


Logic/SSR Drive:

Type: Non-isolated switched DC, 12VDC typ. (internal 500Ω resistance).

Drive: 10mA max. (400ohm external load).
Drives up to three SSR Power Units.

Protection: Short-circuit protected.



Triac:

Type: Isolated, Zero Crossing Detection.

Rating:

Voltage: 120/240VAC.

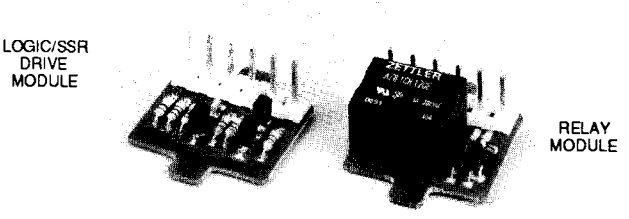
Max. Load Current: 1Amp @ 35°C
0.75Amp @ 50°C

Min. Load Current: 10mA

Off State Leakage Current: 7mA max.

Operating Frequency: 20 to 500Hz.

Protection: Internal Transient Snubber, Fused.

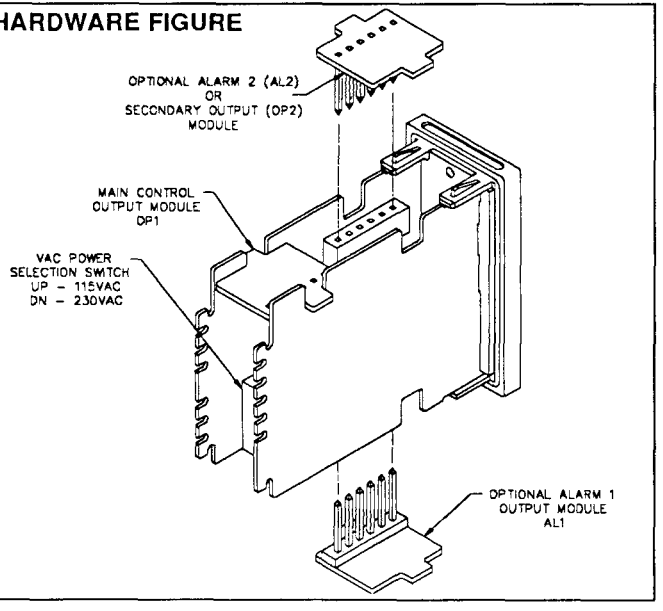


Select AC Power (115/230VAC)

The AC power to the unit must be selected for either 115VAC or 230VAC. The selector switch is located inside the case near the rear of the unit on the main circuit board (see hardware figure and/or label on inside or outside of case). The unit is shipped from the factory with the switch in the 230VAC position.

Note: Damage to the controller may occur if the AC selector switch is set incorrectly.

HARDWARE FIGURE



Wiring Connections

After the unit has been mechanically mounted, it is ready to be wired. All wiring connections are made on a fixed terminal block. When wiring the unit, use the numbers on the label to identify the position number with the proper function. Strip the wire leaving approximately 1/4"(6mm) bare wire exposed (stranded wires should be tinned with solder). Insert the wire into the terminal and tighten the screw until the wire is clamped in tightly. Each terminal can accept up to two, 18-gauge wires. Wire each terminal block in this manner.

Signal Wiring

To minimize the chance of coupling noise into the signal wires, which could cause poor controller performance, certain guidelines for signal wire routing must be followed.

A) Never run signal wires in the same conduit or raceway with conductors feeding motors, solenoid, SCR power units, heaters, compressors, relays, etc. Ideally, signal wires should be run in a separate conduit.

B) When shielded wire is used, connect the shield to COMM (terminal #10) of the controller and leave the other end of the shield unconnected and insulated from machine ground.

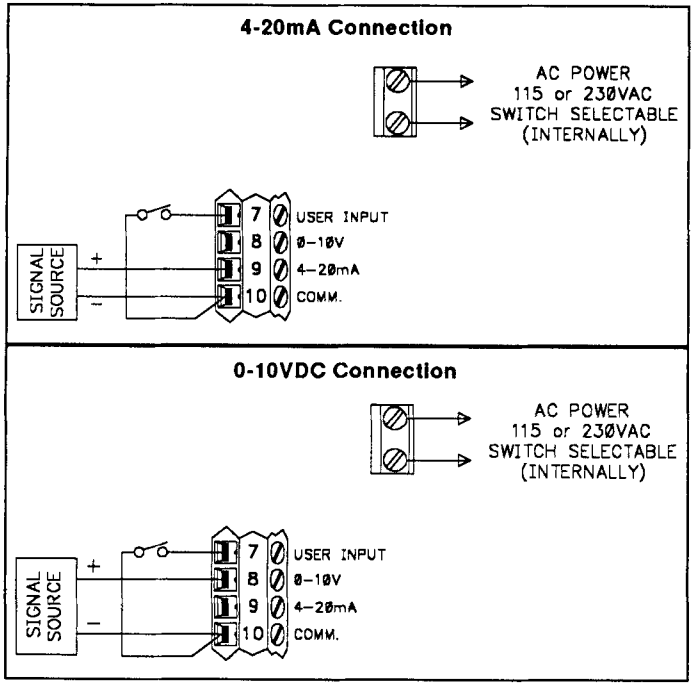
C) Longer runs stand an increased chance for noise pick-up. Plan the installation to minimize distances.

D) Keep wires separated within electrical enclosures to further minimize noise pick-up.

User Input Wiring

The programmed User Input function is performed when terminal #7 is used in conjunction with common (terminal #10). Any form of mechanical switch may be connected to terminal #7. Sinking open collector logic with less than .7V saturation may also be used (no pull-up resistance is necessary).

Note: Do not tie the commons of multiple units to a single switch. Use either a multiple pole switch for ganged operation or a single switch for each unit.



AC Power Wiring

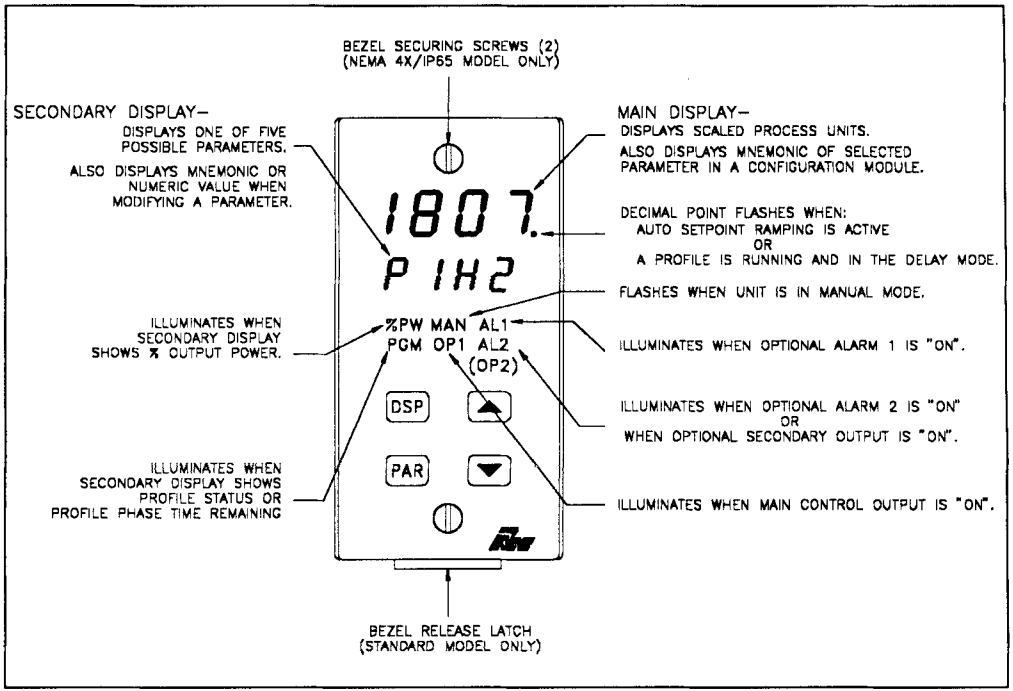
Primary AC power is connected to the separate two position terminal block labeled AC. To reduce the chance of noise spikes entering the AC line and affecting the controller, a separate AC feed should be used to power the controller. Be certain that the AC power to the controller is relatively "clean" and within the -15%, +10% variation limit. Connecting power from heavily loaded circuits or circuits that also power loads that cycle on and off, (contacts, relays, motors, etc.) should be avoided.

FRONT PANEL DESCRIPTION

The front panel bezel material is flame and scratch resistant tinted plastic. Available is an optional NEMA 4X/IP65 version which has a bezel that meets NEMA 4X/IP65 requirements, when properly installed. There are two 4-digit LED displays, a red upper Main Display and a lower green Secondary Display.

There are up to six annunciators depending on options installed, with red backlighting, which illuminate to inform the operator of the controller and output status.

Four front panel buttons are used to access different modes and parameters. The following is a description of each button.



Button Functions

DSP - In the normal operating mode, the Display (DSP) button is used to select one of the four parameters in the secondary display or the display can be programmed to be blank. In the Configuration Parameter Modes, pressing this button causes the unit to exit (escape) to the normal operating mode with NO changes made to the selected parameter.

UP, DN - In the normal operating mode, the up/dn buttons can be used to modify the setpoint value, % output power (manual mode only), the profile status, or the profile phase time remaining, when viewed in the secondary display. The variables for each parameter are selected using the up/dn buttons. In the Hidden Mode, the up/dn buttons can be used to reset alarm(s), event output(s), select auto or manual operation, invoke or cancel auto-tune, load a control point, or change the status of a running profile.

PAR - The Parameter (PAR) button is used to access, enter, and scroll through the available parameters in any mode.

OPERATION OVERVIEW

Controller Power-up

Upon applying power, the controller delays control action and scaled process indication for five seconds to perform several self-diagnostic tests and displays basic controller information. Initially, the controller illuminates both displays and all annunciators to verify that all display elements are functioning. Following, the controller displays the programmed input type in the Main display. Concurrently, it displays the current revision number of the operating system software in the bottom display. The controller checks for correct internal operation and displays an error message (E-XX) if an internal fault is detected (see Troubleshooting).

A profile can be programmed to Start (run mode), Stop (off mode), or Resume on power-up (see "Profile Power Cycle Status Parameter" section).

Upon completion of this sequence, the controller begins control action by displaying the process value and updating the outputs based upon the PID control value.

Controller Power Down

At power down, the steady state control value as well as all parameters and control modes are saved, to provide a quick and predictable process response on the next power-up.

When powering down the process, it is important to power down the controller at the same time. This prevents the reset action of the controller from shifting the proportional band while the process signal is dropping, which prevents excessive overshoot on the next process start-up.

Process Start-up

After starting the process, the controller's PID settings must be initially "tuned" to the process for optimum control. Tuning consists of adjusting the Proportional Band, Integral Time, and Derivative Time parameters to achieve the optimum response to a process disturbance. Once the controller is tuned, it may need to be re-tuned if the process has been changed significantly. Several options exist for tuning these parameters:

A) Use the controller's built-in Auto-Tune feature (see Auto-Tune).
B) Use a manual tuning technique (see manual tuning).
C) Use a third party tuning software package (generally expensive and not always precise).
D) Use values based on control loop experience or values from a similar process.

If the controller is a replacement, the PID settings from the unit replaced may be used as good initial values. Be sure to consider any differences in the units and the PID settings when replacing. The PID settings may be fine tuned by using the techniques outlined in the PID Control section. After tuning the controller to the process, it is important to power the load and the controller at the same time for best start-up response.

Manual (user) & Automatic Operation

The controller can be transfered between Automatic control (closed loop; PID or ON/OFF control) and Manual control (open loop). Placing the controller in the Manual Mode does not impede the advancement or operation of a running profile. In the Hidden Function Mode, the "trnf" parameter allows the operator to select the desired operating mode. To allow front panel switching between control modes, program the transfer (trnf) parameter to "Enbl" in the Lockout module. The User Input or RS-485 serial interface option may also be used to perform the auto/manual transfer function, independent of the setting in the Lockout module.

Manual operation provides direct control of the output(s) from 0 to +100%, or -100% to +100% if secondary output is installed. The MAN (manual) annunciator flashes to indicate that the unit is in manual operation.

In the Manual Mode, the output power can be adjusted using the front panel arrow buttons when % output power is viewed in the lower display. If the % output power is locked or read only, then the output power can be adjusted in the unprotected parameter mode when OP is viewed. With the serial option, the % output power can be modified independent of what is viewed in the display as long as the unit is in the manual mode.

When transferring the controller mode from/to automatic, the control power output(s) remain constant, exercising true "bumpless" transfer. When transferring from manual to automatic, the power initially remains steady but integral action will correct (if necessary) the closed loop power demand at a rate proportional to the Integral Time. The programmable high and low power limit values are ignored when the unit is in manual operation.

Profile Operating Modes

Run Mode

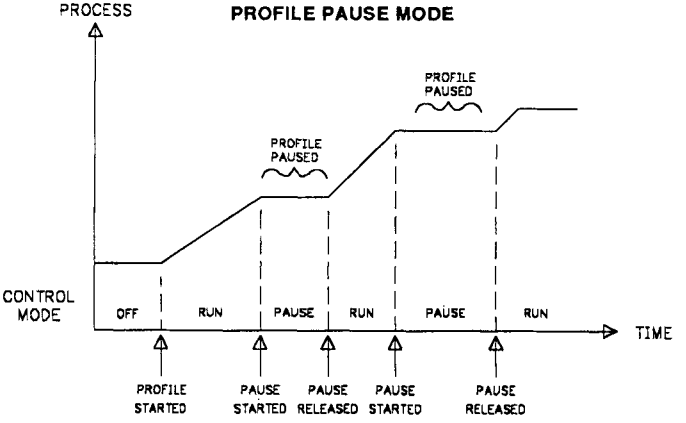
The controller is in the Run Mode when a profile is executing. While in the Run Mode, the profile can be stopped (Off Mode), paused (Pause Mode) or advanced to the next phase. A profile is started and placed into the Run Mode either manually or automatically when the controller is powered-up. The advancement of the profile can be viewed in the secondary display.

Off Mode

The Off Mode signifies that all profiles are dormant. The Off Mode is achieved by manually terminating a profile in progress or by allowing a profile to run to completion. When a profile ends or is terminated, the active setpoint is the last hold setpoint value. A profile terminated during a ramp or hold phase results in the active setpoint value to be the setpoint value at the instant of termination.

Pause Mode

The Pause Mode signifies that a profile is active but the time base is stopped. The pause mode is caused only by a manual action. Pausing a profile during a ramp phase stops the ramp and the controller maintains the setpoint value at the instant of the pause action. During hold phases, the timing of the hold phase is stopped. The use of pause mode effectively lengthens the total run time of a profile. Pause mode is indicated by "PAUS" flashing in the profile control status display. A profile can be placed in the pause mode via the front panel buttons, the user input, or the serial communications option. The unit remains in the pause mode until a continue operation is performed. The continue operation places the profile into the run mode.

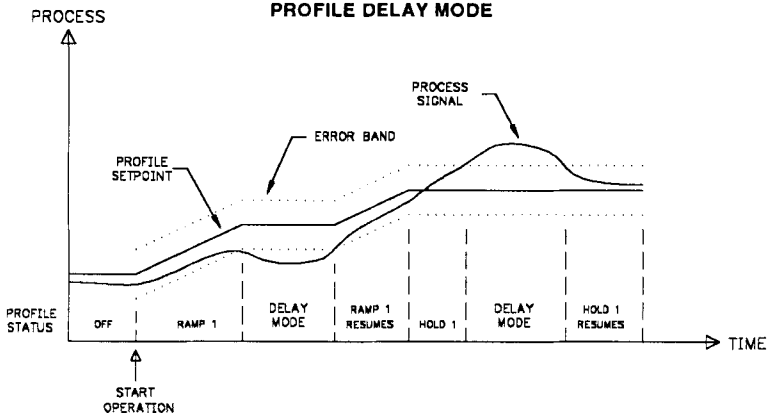


Delay Mode

The Delay Mode signifies that a profile is active but the time base, or profile advancement is stopped. This is caused by automatic action of the controller when the scaled process signal deviates more than a specified amount from the profile setpoint. The Delay Mode is similar to the pause mode, except the delay mode is invoked automatically by the controller.

The Profile Deviation Error Band programmed for a positive value, allows the Delay Mode to be invoked only during hold phases. A negative value allows the delay mode to be invoked during *"both"* ramp and hold phases. The profile automatically resumes when the process value is within the prescribed error band value. The Delay Mode is indicated by "dELy" flashing in the profile control status display and by a flashing decimal point in the upper main display. The Delay Mode can be terminated manually by changing the deviation error band value to a larger value or to zero for off. The new error band value takes effect immediately.

PROFILE DELAY MODE



Controlling A Profile

Profile Start Operation

A profile always starts at the first ramp phase and the setpoint value ramps from the current process value. The profile can be programmed to ramp from a known setpoint value (see Ramp Phase section). Link-started profiles use the last target setpoint level as the starting point. A profile is started from the off mode, which places the controller into the run mode. To re-start a running profile from the beginning, it is necessary to first stop the profile.

Start Operation From The Profile Control Status Display

1. Verify the profile control status display (P-CS) is enabled in lockout programming.
2. Profile must be in the off mode (no profiles running).
3. Press and hold "up" button for three seconds until "Pr-1" appears.
4. Select the desired profile by using the "up/down" buttons.
5. Press the "PAR" button to start the selected profile. The unit displays "Strt" in the secondary display and starts the profile. If the "PAR" button is not pressed within five seconds, no action is taken.

Start Operation From The Hidden Mode

1. Verify profile access (PrAC) in the hidden mode is enabled in lockout programming.
2. Profile must be in the off mode (no profiles running).
3. Press and hold the "PAR" button for three seconds to enter the hidden mode.
4. Scroll to "Prun" (if necessary) by pressing the "PAR" button.
5. When "Prun" is displayed, use the "up/down" buttons to select the desired profile (Pr-1, Pr-2, Pr-3, or Pr-4).
6. Press the "PAR" button to start the selected profile. The unit displays "End" in the secondary display and starts the profile. If a selection is not made within ten seconds, no action is taken.

Start Operation Using The User Input

The user input can only start profile #1.

User Input Selected For Run/Stop (P1rS):

A low to high transition at terminal # 7 always starts profile 1.

User Input Selected For Run/Pause (P1rH):

A low to high transition at terminal # 7 starts profile 1, if no profiles are in the pause mode.

Note: Refer to input module 1, user input section, for more details.

Start Operation On Power-Up

If power is interrupted or removed from the unit, the profile can be programmed to automatically start when power is restored. In the Setpoint Profiles Module (8-Pr), a profile can be programmed to automatically re-start on power-up. The "Strt" option must be selected for each profile (see power cycle status parameter for details).

Start Operation Via The RS-485 Serial Option

Any profile can be started via the serial communications option. Transmit the unit address, command letter with the value identifier and the desired profile number via the serial port (see serial communication section for details).

Shown below is a typical command string.

Start profile 2 of PSC unit 6.

N6CU2*

Profile Stop Operation

Stopping a profile places the controller into the off mode.

When a profile is stopped, the active setpoint value is the old profile setpoint value.

Stop Operation From The Profile Control Status Display

1. Verify the profile control status display (P-CS) is enabled in lockout programming.
2. Press and hold the "up/down" buttons simultaneously for three seconds.
3. "OFF" appears in the secondary display and the profile is placed in the off mode.

Stop Operation From The Hidden Mode

1. Verify profile access (PrAC) in the hidden mode is enabled in lockout programming.
2. Press and hold the "PAR" button for three seconds to enter the hidden mode.
3. Scroll to "Prun" (if necessary) by pressing the "PAR" button.
4. When "Prun" is displayed, use the "up/down" buttons to select stop (OFF).
5. Press the "PAR" button to stop the profile. The unit displays "End" in the secondary display and stops the profile. If a selection is not made within ten seconds, no action is taken.

Stop Operation On Power-Up

If power is interrupted or removed to the unit, the profile can be programmed to automatically stop when power is restored. In the Setpoint Profiles Module (8-Pr), each profile must be selected for the "Stop" option (see power cycle status parameter for details).

Stop Operation Via The RS-485 Serial Option

A running profile can be stopped via the serial communications option. Transmit the unit address, command letter, with the value identifier and number via the serial port (see serial communication section for details).

Shown below is a typical command string.

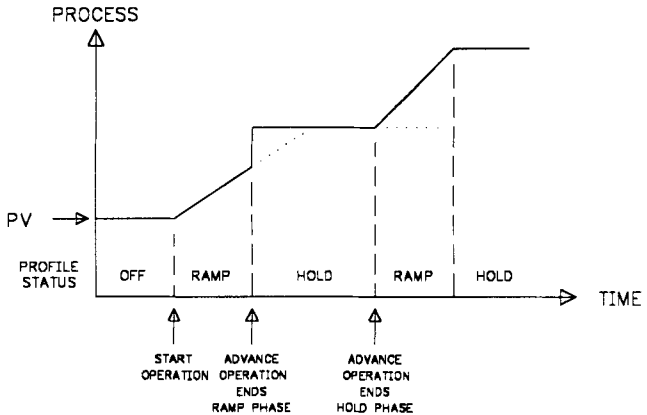
Stop the currently running profile of PSC unit 6.

N6CU5*

Profile Advance Operation

Advancing a profile ends the currently active phase and begins the next phase of the profile. The total run time of the profile is shortened by using the advance operation. Profiles in the pause mode must have a continue operation performed before an advance operation. The profile can be advanced from the delay mode.

PROFILE ADVANCE FUNCTION



Advance Operation From The Profile Control Status Display

1. Verify the profile control status display (P-CS) is enabled in lockout programming.
2. Press and hold the "up" button for three seconds.
3. "Adnc" appears in the secondary display and the profile advances to the next phase.

Advance Operation From The Hidden Mode

1. Verify profile access (PrAC) in the hidden mode is enabled in lockout programming.
2. Press and hold the "PAR" button for three seconds to enter the hidden mode.
3. Scroll to "Prun" (if necessary) by pressing the "PAR" button.
4. When "Prun" is displayed, use the "up/down" buttons to select advance (Adnc).
5. Press the "PAR" button to advance the profile to the next phase.
6. The unit displays "End" in the secondary display and the profile advances to the next phase. If a selection is not made within ten seconds, no action is taken.

Advance Operation Via The RS-485 Serial Option

A running profile can be advaced to the next phase via the serial communications option. Transmit the unit address, command letter, the value identifier and number via the serial port (see serial communication section for details).

Shown below is a typical command string.

Advance the currently running profile of PSC unit 6 to the next phase.

N6CU8*

Profile Pause Operation

The pause mode freezes the state of the profile. The controller maintains the setpoint value at the instant the profile is placed into the pause mode. The profile must have a continue operation performed to resume the profile operation.

Pause Operation From The Profile Control Status Display

1. Verify the profile control status display (P-CS) is enabled in lockout programming.
2. Press and hold the "down" button for three seconds.
3. "PAUS" appears in the secondary display and the profile is placed in the pause mode.

Pause Operation From The Hidden Mode

1. Verify profile access (PrAC) in the hidden mode is enabled in lockout programming.
2. Press and hold the "PAR" button for three seconds to enter the hidden mode.
3. Scroll to "Prun" (if necessary) by pressing the "PAR" button.
4. When "Prun" is displayed, use the "up/down" buttons to select pause (PAUS).
5. Press the "PAR" button to pause the profile.
6. The unit displays "End" in the secondary display and the profile is paused. If a selection is not made within ten seconds, no action is taken.

Pause Operation Using The User Input

The user input can pause a running profile.

User Input Selected For Run/Pause (P1rH):

A low level at terminal # 7 pauses a profile that is running.

Note: Refer to input module 1, user input section, for more details.

Pause Operation Via The RS-485 Serial Option

A profile can be paused via the serial communications option. Transmit the unit address, command letter, with the value identifier and number via the serial port (see serial communication section for details).

Shown below is a typical command string.

Pause the currently running profile of PSC unit 6.

N6CU6*

Profile Continue Operation

The continue operation resumes operation of a profile that is in the pause mode. The continue operation places the profile back into the run mode. The profile resumes normal execution from the point where it was paused.

Continue Operation From The Profile Control Status Display

1. Verify the profile control status display (P-CS) is enabled in lockout programming.
2. Profile must be in the pause mode.
3. Press and hold the "up" button for three seconds.
4. "Cont" appears in the secondary display and the profile is placed into the run mode.

Continue Operation From The Hidden Mode

1. Verify profile access (PrAC) in the hidden mode is enabled in lockout programming.
2. Unit must be in the pause mode.
3. Press and hold the "PAR" button for three seconds to enter the hidden mode.
4. Scroll to "Prun" (if necessary) by pressing the "PAR" button.
5. When "Prun" is displayed, use the "up/down" buttons to select continue (Cont).
6. Press the "PAR" button to continue the profile.
7. The unit displays "End" in the secondary display and the profile resumes to run. If a selection is not made within ten seconds, no action is taken.

Continue Operation Using The User Input

The user input can continue a paused profile.

User Input Selected For Run/Pause (P1rH):

A high level continues the profile.

Note: Refer to input module 1, user input section, for more details.

Continue Operation Via The RS-485 Serial Option

A paused profile can be continued via the serial communications option. Transmit the unit address, command letter, with the value identifier and number via the serial port (see serial communication section, for details).

Shown below is a typical command string.

Continue profile 2 of PSC unit 6.

N6CU7*

Reset Event Outputs Operation

The Timed Event Output(s) may be manually reset to the "Off" state at any time during profile execution. Once reset, the outputs remain reset until the profile advances to the next phase and updates the event output states.

Reset Timed Event Output(s) From The Hidden Mode

1. Verify alarm access (ALrS) in the hidden mode is enabled in lockout programming.
2. Press and hold the "PAR" button for three seconds to enter the hidden mode.
3. Scroll to "ALrS" (if necessary) by pressing the "PAR" button.
4. Press the "up" button to reset event output 1. Press the "down" button to reset event output 2. An event output remains reset during phase transitions if the buttons are held.
5. The "up" or "down" button must be pressed within ten seconds to reset an event output. If an output is not reset within ten seconds, no action is taken.

Reset A Timed Event Output Using The User Input

The user input can reset the timed event outputs.

Note: The reset operation via the user input resets "Both" AL1 and AL2, independent of their operation as an alarm or event output.

User Input Selected For Alarm Reset (ALrs):

A low level resets the timed event outputs. As long as the input is held low, the output(s) remain reset.

Note: Refer to input module 1, user input section, for more details.

Reset A Timed Event Output Via RS-485 Serial Option

A timed event output can be reset via the serial communications option. Transmit the unit address, command letter, with the value identifier via the serial port (see serial communication section, for details).

Shown below is a typical command string.

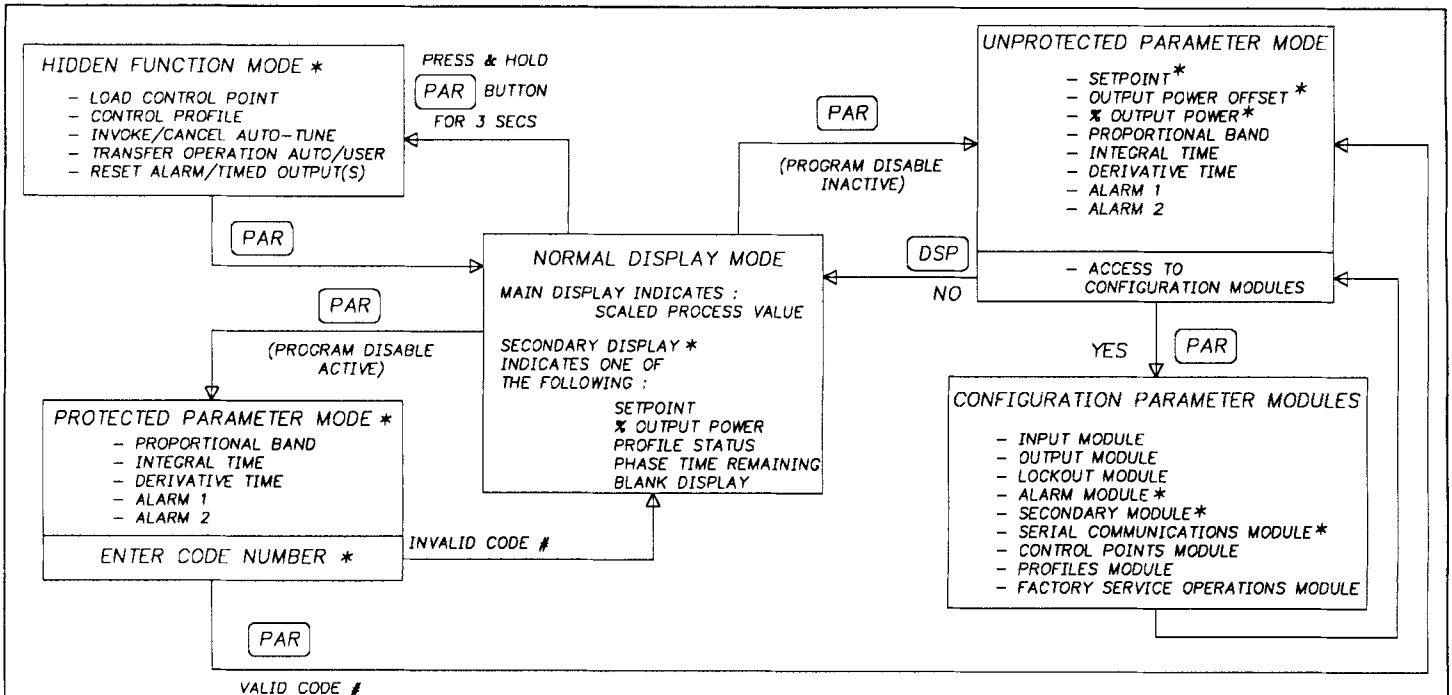
Reset timed event output 2 of PSC unit 6.

N6RH*

Configuration Of Parameters

As supplied from the factory, the controller parameters have been programmed to the values listed in the Quick Reference Tables. The user must modify the values, if necessary, to suit the application.

Operation and configuration of the controller is divided into five distinct operational/programming modes to simplify the operation of the controller: Normal Display Mode, Unprotected Parameter Mode, Protected Parameter Mode, Hidden Function Mode, and Configuration Parameter Modules.



✳ These parameters may not appear due to unit configuration or programming set-ups.

Note: In any mode or module, DSP returns the controller to the normal display mode.

Parameter Entry

The PAR button is used to select the desired parameter. To modify the parameter setting, use the UP and DOWN buttons, and then press PAR to enter the new value. The controller will progress to the next parameter. In a Configuration Parameter Module, pressing the DSP button causes the new value to be rejected, the controller displays "End", and returns to the Normal Display Mode. For those parameters outside the Configuration Parameter Modules, the new value takes effect and is committed into controller memory WHILE the value is keyed in. The following is a list of these commonly modified parameters:

Setpoint
Output Power
Output Power Offset
Proportional Band
Integral Time
Derivative Time
Alarm 1 Value
Alarm 2 Value

Note: While in a Configuration Parameter Module, all new parameters are rejected and the old ones recalled if power is lost to the controller. If power is removed while modifying ANY parameter, be certain to check the parameter for the proper value.

Normal Display Mode

In the normal display mode, the scaled process value is always displayed in the main display. By successively pressing the DSP button, one of five parameters can be viewed in the secondary display:

Setpoint
% Output Power
Profile Control Status
Profile Phase Time Remaining
Blank

Each of these displays can be independently locked out from appearing or from being modified by the user (see parameter lockout section).

Modifying A Secondary Display Parameter From The Front Panel

The controller must be in the normal display mode to modify any of the secondary display parameters. Four parameters can be modified when viewed in the secondary display (if not locked). The display may be programmed to be blank. Pressing the DSP button scrolls through the secondary display parameters. The following describes how these parameters can be modified when viewed in secondary display.

Setpoint Value Display

Use the up and down arrow buttons to modify the setpoint value when viewed (if not locked). If locked, the setpoint can be changed in the unprotected or protected mode when "SP" is viewed, independent of viewing in the secondary display. The setpoint value is constrained to the programmable setpoint limit values (SPLO & SPHI, input module 1).

The profile setpoint value can be changed during profile operation to effect immediate changes to the profile. If locked, the target setpoint value can be changed when viewed in the protected mode. Permanent changes to the profile setpoint value must be done in the profiles module (8-Pr). Changing the setpoint value may cause the profile to enter the delay mode if the errror band parameter is enabled.

The ramping setpoint value is displayed during ramp phases. Immediate changes made to the ramping setpoint value do not alter the ramp rate, but does change the ramp time remaining to the next target setpoint level. This action either lengthens or shortens the total time remaining. The phase time remaining is effected the instant the setpoint value is changed.

The holding setpoint value is displayed during hold phases. A change to the holding setpoint value causes the controller to immediately operate at the new setpoint level. In addition, the next ramp phase begins ramping from the modified setpoint value to the target setpoint value.

% Output Power Display

The % output power can only be changed when the unit is in the manual mode. The annunciator **%PW** lights when viewed, then use the up and down arrow buttons to modify the % output power (if not locked). If locked, the % output power can be changed in the unprotected or protected mode when "OP" is viewed, independent of viewing in the secondary display. The % output power is not constrained to the programmable output power limit values (OPLO & OPHI, output module 2).

Profile Control Status Display

The annunciator PGM lights when either the profile control status or the phase time remaining is displayed. The profile control status indicates the current mode of a profile. The table shows various displays for profile modes.

Profile Status Display	Description
OFF	Profile is off. No profiles running.
P1r1	Profile #1 is running and in ramp phase #1.
P2H8	Profile #2 is running and in hold phase #8.
P3r4	Profile #3 is running and in ramp phase #4.
PAUS	Profile is Paused (PAUS flashes). Currently running profile is in the pause mode.
dELy	Profile is Delayed (dELy flashes). Currently running profile is in the delay mode.

The front panel buttons allow the operator to change the profile status. The operation of a profile is controlled directly from the profile control status display, if not locked (see controlling a profile section for details).

Profile Phase Time Remaining Display

The annunciator PGM lights when either the phase time remaining or the profile control status is viewed. Use the up/down front panel buttons to change the time remaining, if not locked. The ramp or hold phase time remaining can be changed during profile operation to effect immediate changes to the profile. Permanent changes to the profile must be done in the profiles module (8-Pr).

During ramp phases the display indicates the time remaining until the next hold phase. If the time remaining is changed during a ramp phase, the controller calculates a new, but temporary, ramp rate. The setpoint ramps at the new ramp rate value to the next setpoint level. The new ramp rate may be at a faster or slower rate depending on the direction that the time remaining was changed. Changing the time remaining value to zero causes an immediate advance to the next hold phase, unless the profile is in the pause mode. In this case, when the profile is placed back into the run mode, the profile immediately advances to the next hold phase.

During hold phases the display indicates time remaining until the next ramp phase. Changes to the time remaining during a hold phase effect the duration of the hold phase. A value of zero causes the profile to advance to the next ramp phase unless the profile is in the pause mode.

Changing the time remaining effects the total run time of the profile. When the profile is in the off mode, "0.0" minutes is displayed in the phase time remaining display.

UNPROTECTED PARAMETER MODE

The Unprotected Parameter Mode is accessed by pressing the PAR button from the normal display mode with program disable inactive. In this mode, the operator has access to the list of the most commonly modified controller parameters. At the end of the list, a configuration "access point" allows the operator to enter the configuration parameter modules. These modules allow access to the fundamental set-up parameters of the controller. When the program list has been scrolled through, the controller displays "End" and returns to the normal display mode. The unit automatically returns to the normal display mode if a button is not pressed within eight seconds.

Unprotected Parameter Mode Reference Table

Display	Parameter	Range and Units (Factory Setting Value)	Description/ Comments
SP	Setpoint	Must be within range of limits SPLO, SPHI (0)	Appears only if setpoint value is locked (LOC) or read only (rEd). During a profile ramp phase, indicates the target setpoint value.
OPOF	%Output Power Offset	-99.9% to 100.0% (0.0)	Appears only if integral time (Intt) = 0 and controller is in automatic mode.
OP	Output Power	-99.9% to 100.0% (0.0)	Appears only if controller is in user (manual) mode and % output power is locked (LOC) or read only (rEd). This parameter is not limited to output power limits (OPLO & OPHI)
ProP	Proportional Band	0.0 to 999.9% of selected input range (4.0)	0.0% is ON/OFF control. If = 0.0%, set control hysteresis appropriately.
Intt	Integral Time	0 to 9999 sec. (120)	0 is off. This parameter does not appear if proportional band = 0.0%.
dErt	Derivative Time	0 to 9999 sec. (30)	0 is off. This parameter does not appear if proportional band = 0.0%.
AL-1	Alarm 1 Value	-999 to 9999 (0)	This parameter does not appear if the alarm option is not installed or is configured as a timed event output.
AL-2	Alarm 2 Value	-999 to 9999 (0)	This parameter does not appear if the alarm option is not installed or is configured as a timed event output. Also does not appear if the secondary option is installed.
CNFP	Configuration Access Point	NO YES 1-IN 2-OP 3-LC 4-AL 5-O2 6-SC 7-CP 8-PR 9-FS	Return to normal display mode. Enter Configuration modules. Configure input parameters. Configure output parameters. Configure parameter lockouts. Configure alarms (optional) Configure secondary output (optional) Configure serial communications (optional) Configure control points Configure profiles Factory service operations (Qualified technicians only)
End	Unit returns to normal display mode.	—	Brief display message.

PROTECTED PARAMETER MODE

The Protected Parameter Mode is accessed from the normal display mode by pressing the PAR button with program disable active. In this mode, the operator has access to the list of the most commonly modified controller parameters that have been "unlocked" in the configuration parameter lockouts module. Depending on the code number entered in the lockout module, access to the unprotected parameter mode and hence, the configuration parameter modules, is possible. The controller returns to the normal display mode if the unprotected mode and configuration modules cannot be accessed.

Protected Parameter Mode Reference Table

Display	Parameter	Range and Units (Factory Setting Value)	Description/ Comments
ProP	Proportional Band	0.0 to 999.9% of selected input range (4.0)	0.0% is ON/OFF control. If = 0.0%, set control hysteresis appropriately. This parameter does not appear if locked (LOC).
Intt	Integral Time	0 to 9999 sec. (120)	0 is off. This parameter does not appear if proportional band = 0.0% or locked (LOC).
dErt	Derivative Time	0 to 9999 sec. (30)	0 is off. This parameter does not appear if proportional band = 0.0% or locked (LOC).
AL-1	Alarm 1 value	-999 to 9999 (0)	This parameter does not appear if the alarm option is not installed, locked (LOC), or configured as a timed event output.
AL-2	Alarm 2 value	-999 to 9999 (0)	This parameter does not appear if the alarm option is not installed, the secondary option is installed, locked (LOC), or configured as a timed event output.
Code	Access code to unprotected mode	0 to 250 (0)	To gain access to unprotected mode, enter the same value for Code as entered in parameter lockouts. This parameter does not appear if zero is entered in code parameter lockout.
End	Unit returns to normal display mode		Brief display message display mode

Front Panel Program Disable

There are several ways to limit operator access to the programming of parameters from the front panel buttons. The settings of the parameters in the parameter lockout module, the code number entered, and the state and/or function of the user input (terminal #7) affect front panel access.

The following chart describes the possible program disable settings.

TERMINAL #7 User Input Programmed For PLOC	Code Number	Description
Inactive	0	Full access to all modes and parameter modules.
Active	0	Access to protected parameter mode only. Code number will NOT appear.
Active	Any # between 1 & 250	Access to protected parameter mode. Correct programmed code number allows access to unprotected parameter mode and configuration modules.
NOT programmed for PLOC	0	Full access to all modes and parameter modules.
NOT programmed for PLOC	Any # between 1 & 250	Access to protected parameter mode. Correct programmed code number allows access to unprotected parameter mode and configuration modules.

Note: A universal code number 222 can be entered to gain access to the unprotected mode and configuration modules, independent of the programmed code number.

HIDDEN FUNCTION MODE

The Hidden Function Mode is only accessible from the normal display mode by pressing and holding the PAR button for three seconds. In this mode, five controller functions can be performed.

Automatic/Manual Transfer
Initiate/Cancel Auto-tune
Reset Alarm/Timed Event Output(s)
Load Control Point
Control Profile Status

Each function may be "locked out" in the configuration parameter lockouts module. The PAR button is used to scroll to the desired function and the up and down buttons are used to select the operation. Pressing the PAR button while the function is displayed executes the function and returns the unit to the normal display mode. Pressing the DSP button exits this mode with no action taken. The unit automatically returns to the normal display mode if a function is not executed in eight seconds.

Hidden Function Mode Reference Table

Display	Parameter	Range and Units (Factory Setting Value)	Description/Comments
CP	Load Control Point	NO cp-1 cp-2 cp-3 cp-4 (NO)	This step does not appear if locked (LOC). Exits to normal display mode if executed. Select control point to load the press PAR to implement.
PruN	Control profile status	Pr-1 Pr-2 Pr-3 Pr-4 (OFF)	This step does not appear if locked (LOC), or profile is running. Exits to normal display mode if executed. Select profile to start, then press PAR button.
		Adnc Cont PAUS OFF (Cont)	This step does not appear if locked (LOC), or profile is in OFF mode. If profile is running, select control mode, then press PAR button.
trnF	Transfer mode of operation	Auto - Automatic control User - Manual control (Auto)	This step does not appear if locked (LOC). Exits to normal display mode if executed.
tUNE	Auto-Tune invocation	YES/NO (NO)	Yes: starts /restarts auto-tune sequence. No: terminates auto-tune sequence. This step does not appear if locked (LOC) or exits to normal display mode if executed.
ALrS	Reset alarm/ timed event output(s)	UP key resets Alarm 1/event output 1 DOWN key resets Alarm 2/event output 2	This step does not appear if alarm option not installed, if locked (LOC) or previous step performed.

CONFIGURATION PARAMETER MODULES

Accessible from the unprotected parameter mode, the configuration parameter modules allow the operator access to the controller's fundamental set-up parameters. There are nine possible configuration stages that can be accessed. At the configuration stage access point "CNFP", the operator uses the UP & DOWN arrow buttons to select the desired configuration parameter module. Press the PAR button to enter the module where the settings can be viewed or modified.

The PAR button is used to scroll through the parameters and the UP and DOWN buttons are used to modify the parameter value. The PAR button enters the desired choice, advancing to the next parameter. The operator can press the DSP button to exit (escape) without modifying the parameter, which returns the unit to the normal display mode. After the parameters in a module are viewed or modified, the unit returns to the configuration access point, allowing access to other modules.

Input Module (1- IN)

The controller has several input set-up parameters which must be programmed prior to setting any other controller parameters.

Input Type (type)

Select the signal input type Voltage (VOLT), or Current (CURR). The appropriate signal input terminal for voltage is #8 and for current is #9.

Decimal Point Position (dCPt)

Select the desired decimal point position for the scaled display. The selected decimal point position appears in the following parameters; setpoint rnd, dSP1, dSP2, SPLO, SPHI, SP, AL1, AL2, db-2, AHYS, CHYS, control point module, and profile module.

0
0.0
0.00
0.000

Rounding Increment (rnd)

Rounding values other than "1" causes the scaled number to 'round' to the nearest rounding increment selected (ie. rounding of '5' cause '122' to round to '120 and '123 to round to '125'). If the process is inherently jittery, the display value may be rounded to a higher value than "1". If the range of the process exceeds the required resolution, (ex. 0-1000 PSI, but only 10 PSI resolution required), a rounding increment of 10 will effectively make the display more stable.

This programming step is usually used in conjunction with programmable digital filtering to help stabilize display readings (If display stability appears to be a problem and the sacrifice in display resolution is unacceptable, program higher levels of digital filtering or increase the level of process dampening.) Rounding increments of 10,20,50, and 100 may also be used to add "dummy zeroes" to the scaled readings, as desired.

1
2
5
10
20
50
100

The rounding increment is for the controller's display only and does not affect (degrade) the control accuracy of the unit.

Input Signal Filter (FLtr)

Select the relative degree of input signal filtering. The filter is an adaptive digital filter which discriminates between measurement noise and actual process changes, therefore, the influence on step response time is minimal. If the signal is varying too greatly due to measurement noise, increase the filter value. Additionally, with large derivative times, control action may be too unstable for accurate control. Increase the filter value. Conversely, if the fastest controller response is desired, decrease the filter value.

0-minimal
1-normal
2-increased
3-maximum

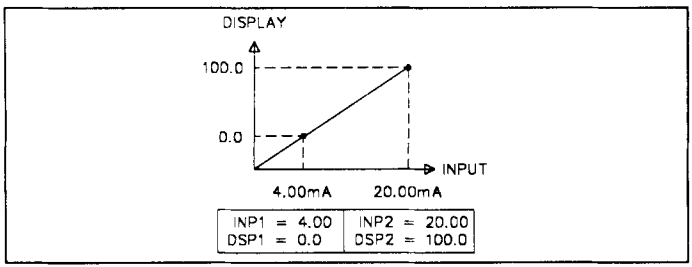
Input Module (1- IN) (Cont'd)

Scaling Points

Prior to installing and operating the indicator, it may be necessary to change the scaling to suit the display units particular to the application. Although the unit has been programmed at the factory, the scaling will generally have to be changed.

The indicator is unique in that two different scaling methods are available. The operator may choose the method that yields the easier or more accurate calibration. The two scaling procedures are similar in that the operator keys in the display values and either keys in or applies a signal value that corresponds to those scaling points. The location of the scaling points should be near the process end limits, for the best possible accuracy.

Once these values are programmed (coordinates on a graph), the indicator calculates the slope and intercept of the signal/display graph automatically. No span/zero interaction occurs, making scaling a one-pass exercise.



Before programming the indicator, it is advised to organize all the data for the programming steps to avoid possible confusion.

To scale the indicator, two signal values and two display values that correspond to the signal values must be known. These four values are used to complete the scaling operation. An example is listed below:

Scaling Point #1		Scaling Point #2
0.0% @ 4.00mA	AND	100.0% @ 20.00mA

Reverse acting indication can be accomplished by either reversing the two signal points or the display value points, but not both. If both are reversed, then forward (normal) acting indication will occur. In either case, do not reverse the input wires to correct the action.

Display Values (dSP1 & dSP2)

Key-in the display value for scaling point one and scaling point two.

dSP1 -999 to 9999 (Ex. 0.0%)
dSP2 -999 to 9999 (Ex. 100.0%)

Signal Input Values (INP1 & INP2)

The signal input value can either be keyed in via the front panel buttons or an input signal can be applied to the appropriate signal input terminals. When entering the signal input parameter, the unit is in the key-in mode.

Key-In Method

Key-in the signal value for scaling point one and scaling point two.

INP1 -999 to 9999 (Ex. 0.00 VDC or 4.00mA DC)
INP2 -999 to 9999 (Ex. 10.00 VDC or 0.00mA DC)

Signal Input Method

To change to the apply signal method press the DSP button. Front panel annunciators %PW and DEV will flash, and the display indicates the signal value applied to the input terminals. The unit can be toggled to the key-in method by pressing the DSP button again.

Signal Range	Display Range
4.00 to 20.00mA DC	0.00 to 20.00
0.00 to 10.00 VDC	0.00 to 10.00

When the desired value is indicated on the display, press the PAR button to store the value and advance to the next parameter.

Setpoint Limit Values (SPLO & SPHI)

The controller has programmable high and low setpoint limit values to restrict the setting range of the setpoint. Set the limit values so that the setpoint value cannot be set outside the safe operating area of the process.

SPLO - -999 to 9999
SPHI - -999 to 9999

Auto Setpoint Ramp Rate (SPrP)

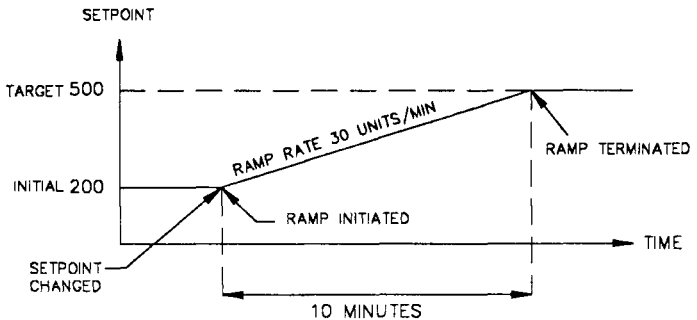
The setpoint can be programmed to ramp independent of the controller's display resolution. The setpoint ramp rate can reduce shock to the process, reduce overshoot on start-up or setpoint changes, or ramp the process at a controlled rate

SPrP - 0.1 to 999.9 units/minute

A ramp value of zero disables setpoint ramping. If the user input is programmed for setpoint ramp, it affects the enabling and disabling of setpoint ramping (refer to user input section). Setpoint ramping is initiated on power-up or when the setpoint value is changed and is indicated by a decimal point flashing in the far right corner of the main display.

Note: The auto setpoint ramp rate is independent from the operation of a profile.

Once the ramping setpoint reaches the target setpoint, the setpoint ramp rate is disengaged until the setpoint is changed again. If the ramp value is changed during ramping, the new ramp rate takes effect. If the setpoint is ramping prior to invoking Auto-Tune, the ramping is suspended during Auto-Tune and then resumed afterward using the current main display value as the starting value. Deviation and band alarms are relative to the target setpoint, not the ramping setpoint. If the analog output is programmed to transmit the setpoint value, the instantaneous ramping setpoint value is transmitted.



Note: Depending on the ramp rate relative to the process dynamics, the actual scaled process value may not track the ramping setpoint value.

User Input (InPt)

The User Input requires the input to be in its active state for 100msec minimum to perform the function. The unit will execute all functions in 100msec, except the print request function which requires 110 to 200msec for a response. A function is performed when the User Input (terminal 7), is used in conjunction with common (terminal 10).

Note: Do not tie the commons of multiple units to a single switch. Either use a multiple pole switch for ganged operation or a single switch for each unit. Transition activated functions do not occur on controller power-up.

Below is a list of the available functions.

PLOC - Program Lock. A low level enables the program disable function which places the unit in the Protected Parameter Mode. A high level disables the program disable function.

Note: Front panel disable is possible without using this program lock function, refer to front panel program disable section.

ILOC - Integral Action Lock. A low level disables the integral action of the PID computation. A high level resumes the integral action.

trnF - Auto/Manual Transfer. A negative transition places the unit in the manual (user) mode and a positive transition places the unit in the automatic operating mode. The output is "bumpless" when transferring to either operating mode.

SPrP - Setpoint Ramp. A low level terminates auto setpoint ramping and the controller operates at the target setpoint. Terminating auto setpoint ramping is the same as setting the ramp rate to zero (SPrP = 0.0). A high level enables the auto setpoint ramp rate.

Note: This does not operate with a profile.

ALrS - Alarm/Timed Event Output Reset. If the alarm option is installed, a low level resets the alarm/timed event output(s) to their inactive state as long as the user input is low.

Prnt - Print Request. A low level transmits the print options selected in the serial communications module (6-SC). If the user input is held low, after the printing is complete a second print request is issued.

User Input (InPt) (Cont'd)

CP - Control Point Select. A high to low transition loads Control Point 2 into the memory of the controller. The controller now operates with data of Control Point 2. A low to high transition loads Control Point 1 into the memory of the controller. The controller now operates with data of Control Point 1.

Note: Control Point data loaded into memory overwrites the existing data setpoint and optionally the PID gain set. Control Points may be loaded during profile operation.

P1rH - Profile Run/Pause. A low level pauses any running profile. A high level allows a paused profile to resume. A low to high transition starts Profile 1, if no other profile was running.

P1rS - Profile Run/Stop. A low level stops any running profile. A high level allows any profile to run. A low to high transition always starts profile 1.

Output Module (2-OP)

The controller has parameters which affect how the control output responds to process changes and signal overdrive actions.

Time Proportioning Cycle Time (CYCt)

The selection of cycle time depends on the time constant of the process and the type of output module used. For best control, a cycle time equal to 1/10 of the process time constant is recommended; longer cycle times could degrade process control, and shorter cycle times will provide little benefit at the expense of shortened relay life. When using a Triac module or when using the Logic/SSR drive output module with the SSR Power Unit, a relatively short cycle time may be selected.

A setting of zero keeps the main control output and front panel indicator off. Therefore, if using the 4-20mA analog output for control, the main output and indicator can be disabled.

CYCt 0 to 120 seconds

Output Control Action (OPAC)

The main control output (OP1) channel is programmable for reverse acting or direct acting. Most control applications use reverse acting *(see ON/OFF Control section)*.

OPAC - rev (Reverse acting)
drct (Direct acting)

The 4-20mA linear DC analog output, when assigned to output power (OP) for control purposes, will always follow the controller output power demand. A direct acting linear output signal can be implemented in two ways:

1. Use "direct" for output control action (OPAC).
2. Interchange the two analog output scaling points ANLO & ANHI (see Linear DC analog output in the output parameter module section).

Note: When using a relay output module, the control action may also be reversed by using the normally closed contacts.

Output Power Limits (OPLO & OPHI)

Enter the safe output power limits for the process. These parameters may also be used to limit the minimum and maximum controller power due to process disturbances or setpoint changes to reduce overshoots by limiting the process approach level.

OPLO & OPHI - 0 to 100%

If the secondary output option is installed, the limits range from:

OPLO & OPHI - -100 to 100%

With the secondary output option installed, the Lower Limit can be set to less than 0% to limit maximum secondary output power or set to greater than 0% to limit minimum main control output power. Set the High Limit to less than 0% to limit minimum secondary output power or greater than 0% to limit maximum main control output power. When controlling power in the manual mode, the output power limits do not take affect.

Input Overdrive Preset Power (OPFL)

If input overdrive signal is detected, the control output (OP1) will default to a preset power output settings.

Note: The controller does not detect an open or short sensor.

OPFL - 0% to 100%
0 = OP1 output full "off"
100 = OP1 output full "on"

If the secondary output option is installed, the range is extended from:

OPFL - -100% to +100%

At 0% both outputs will be off, at 100% OP1 is on and OP2 is off, and at -100% OP2 is on and OP1 is off. The alarm outputs always have an up-scale drive (+9999), independent of this setting, for an input overdrive signal.

The following table shows the relationship between the signal input, display indication, and the output status.

NOTE: Display will flash between scaled process value and "OLOL", or "ULUL".

4 - 20mA Range

Input Signal (approx.)	Display	OP1/OP2 Outputs
26.00mA	SENS	Input overdrive preset power (OPFL) setting
21.00mA	OLOL	Normal Output Operation
↕	Scaled Value	Normal Output Operation
-1.00mA	ULUL	Normal Output Operation
-2.00mA	SENS	Input overdrive preset power setting

0 - 10V Range

13.00V	SENS	Input overdrive preset power setting
10.50V	OLOL	Normal Output Operation
↕	Scaled Value	Normal Output Operation
-0.50V	ULUL	Normal Output Operation
-1.00V	SENS	Input overdrive preset power (OPFL) setting

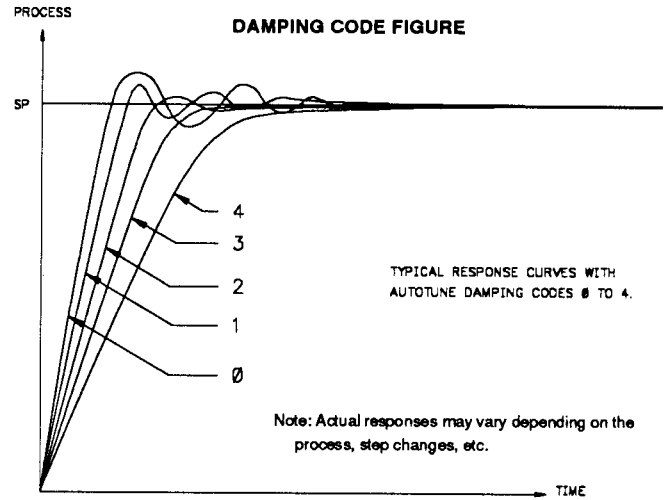
On/off Control Hysteresis Band (CHYS)

The controller can be placed in the ON/OFF control mode by setting the proportional band to 0.0%. The control hysteresis value affects only the main control output (OP1). The hysteresis band should be set to a minimum value to eliminate output chatter at the setpoint. Set the hysteresis band to a sufficient level prior to invoking auto-tune.

CHYS 1 to 250 units

Auto-Tune Damping Code (tcod)

Prior to invoking Auto-tune, the damping code should be set to achieve the desired damping level under PID control. When set to 0, this yields the fastest process response with some overshoot. A setting of 4 yields the slowest response with the least amount of overshoot. Damping codes of 0 or 1 are recommended for most processes.



Linear DC Analog Output (ANAS, ANLO, & ANHI) (Optional)

The 4-20mA Linear DC output can be programmed to transmit one of four controller parameters:

ASSIGN DC OUTPUT (ANAS):

INP - Scaled input process value
OP - Percent output power
dEV - Process setpoint deviation
SP - Process setpoint value

With high and low digital scaling points, the range of the Linear DC output can be set independent of the controller's range.

ANLO (4mA) - -999 to 9999
ANHI (20mA) - -999 to 9999

This allows interfacing directly with chart recorders, remote indicators, slave controllers, or linear power control units. The output is isolated from input common and located on rear terminals #11 (OUT+) & #12 (OUT-). When using the linear DC analog output for main control by assigning the DC output for percent output power, the front panel indicator OP1 can be disabled by setting the time proportioning cycle time equal to zero. This also disables the main control output, OP1.

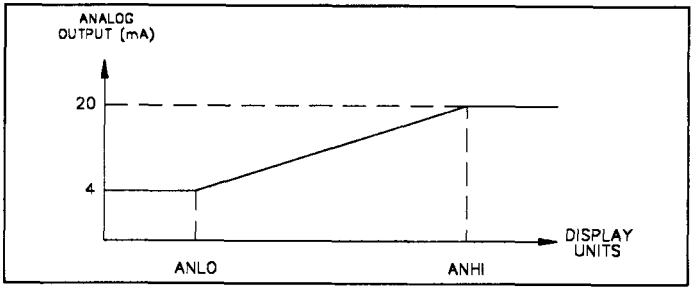
If transmitting the setpoint value, (for cascaded control with additional controllers), the controller will transmit the instantaneous ramping setpoint, not the target value, when the controller is actively ramping the setpoint.

EX1.) Chart Record Process Display Value:

The process range is 300-700. Programming 300 for ANLO (4mA value) and 700 for ANHI (20mA value) yields full scale deflection for a chart recorder (4-20mA). The 4-20mA output is assigned to transmit the input process (ANAS = INP).

EX2.) Linear Control Output:

A linear DC input power control unit is used for process control. Programming 0.0% for ANLO (4mA value) and +100.0% for ANHI (20mA value) configures the output. The 4-20mA output is assigned to transmit percent output power (ANAS = OP).



Lockouts Module (3-LC)

The controller can be programmed to limit operator access to various parameters, control modes, and display contents. The configuration of the lockouts is grouped into three sections: Lower Display Lockouts, Protected Mode Lockouts and Hidden Mode Lockouts.

Lower Display Lockouts (SP, OP, P-cs, P-tr, UdSP)

The contents of the secondary display can be changed in the normal display mode by successively pressing the DSP button. This scrolls through the four possible display parameters, if enabled. Each parameter can be set for one of the following:

LOC (Lockout) - Prevents the parameter from appearing in the secondary display.
rEd (Read only) - Parameter appears, but cannot be modified.
Ent (Entry) - Parameter appears and can be modified.

The five lower display content possibilities are:

SP	- Setpoint Value
OP	- % Output Power
P-CS	- Profile Control Status
P-tr	- Profile Phase Time Remaining
bdSP	- Blank Display

If a parameter is active in the lower display and then subsequently locked out, press "DSP" once in the normal display mode to remove it from the display.

If all parameters are set to lock "LOC", the display will remain on the last parameter that was viewed.

Protected Mode Lockouts (Code, PID, & AL)

The protected mode is active when program disable is active. The PID and Alarm parameters can be set for one of the following:

LOC (Lockout) - Prevents the parameter from appearing in the display
rEd (Read only) - Parameter appears, but cannot be modified.
Ent (Entry) - Parameter appears and can be modified.

The PID setting allows access to Proportional Band (ProP), Integral Time (Intt), and Derivative Time (dErt) parameters. Alarm 1 and 2 values (AL1 & AL2) may also be locked out if installed.

A code number to enter the unprotected mode can be programmed into the controller. To enter the unprotected mode from the protected mode, the code number must match the code number entered. Refer to front panel program disable section for access levels.

Code - 0 to 250

Hidden Mode Lockouts (ALrS, CPAC, PrAC, trnF, & tUNE)

The hidden mode is accessible from the normal display mode by pressing and holding the PAR button for three seconds. The parameters can be set for:

LOC (Lockout) - Prevents the parameter from appearing in the display.
ENbL (Enable) - Allows operator to perform function.

The five controller functions are executed in hidden mode and are accessible independent of the status of program disable.

ALrs - Reset (override) an alarm/timed event output(s).
trnF - Transfer controller from or to automatic to manual operation.
CPAC - Load 1 of the 4 control points (CP).
PrAC - Allows the operator to start one of the 4 profiles. If a profile is running, the status (Adnc, Cont, PAUS, or OFF) can be changed.
tUNE - Invoke or cancel Auto-Tune.

Alarm Module (4-AL) (Optional)

The controller may be optionally fitted with the dual alarm option (AL1 and AL2), or a single alarm with the secondary output option (AL1 and OP2). One of three types of output modules (Relay, Logic/SSR Drive or Triac) must be ordered separately and installed into the alarm channel socket.

Note: Units with RS-485 serial option must have the same type of modules installed for the Dual Alarms setup.

The output modules may be replaced or interchanged (with appropriate wiring considerations) at any time without re-programming the controller.

A front panel annunciator illuminates to indicate that the alarm output is on (AL1 for alarm 1 and AL2 for alarm 2).

Note: When deviation low-acting with positive alarm value (d-LO), deviation high-acting with negative value (d-HI), or Band inside-acting (b-IN) is selected for the alarm action, the indicator is "OFF" when the alarm output is "ON".

The alarm values can be accessed in configuration module (4-AL), the unprotected mode, and in the protected mode, if not locked.

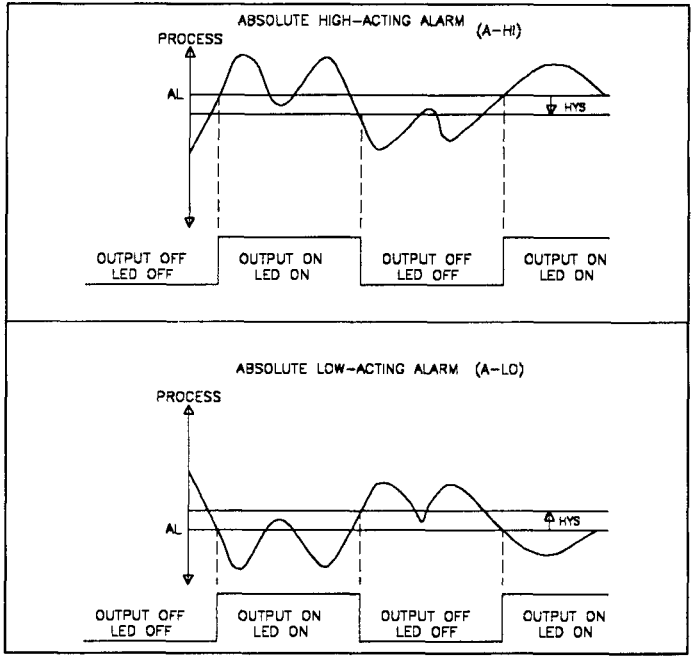
CAUTION: In applications where equipment or material damage, or risk to personnel due to controller malfunction could occur, an independent and redundant process limit indicator with alarm outputs is strongly recommended. Red Lion Controls offers various units, such as an IMP, IMD1, or IMD2, that may be used for this purpose. The indicators should have independent input sensors and AC power feeds from the other equipment.

Alarm Action (Act1, Act2)

The alarm(s) may be independently configured for one of six possible alarm modes or configured to operate as a timed event output(s). The timed event output(s) are programmed in profiles module 8 (8-Pr).

Absolute High Acting	(A-HI)	
Absolute Low Acting	(A-LO)	
Deviation High Acting	(d-HI)	- Tracks Setpoint Value
Deviation Low Acting	(d-LO)	- Tracks Setpoint Value
Band Inside Acting	(b-in)	- Tracks Setpoint Value
Band Outside Acting	(b-Ot)	- Tracks Setpoint Value
Timed Event Output	(P-Ev)	

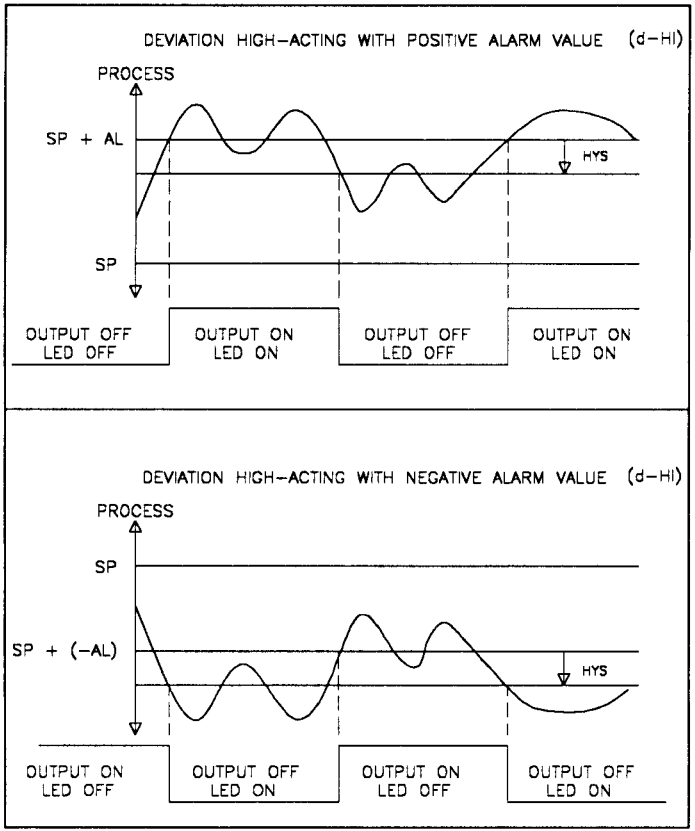
Note: If an alarm is programmed for Timed Event Output (P-Ev), the remaining alarm parameters are not applicable.

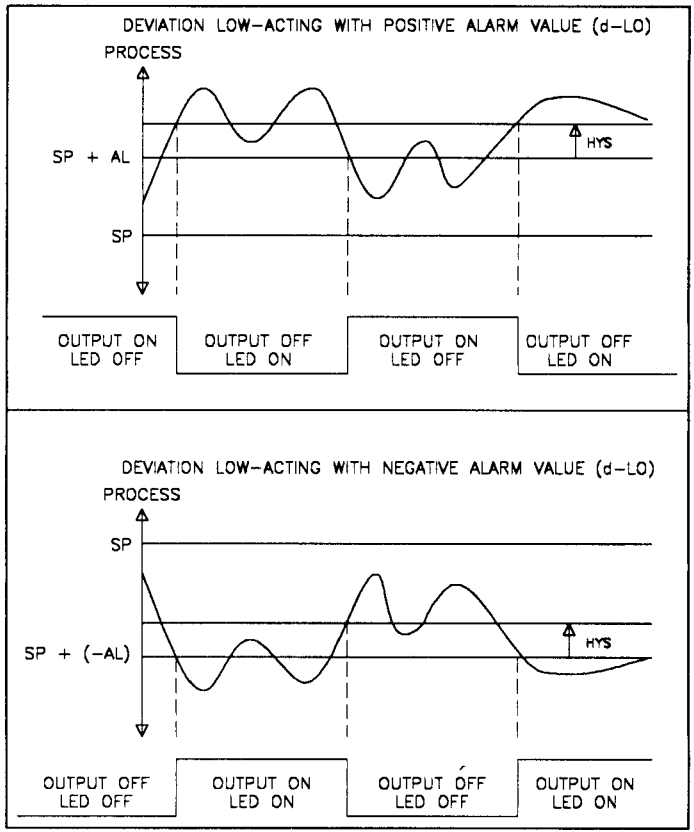


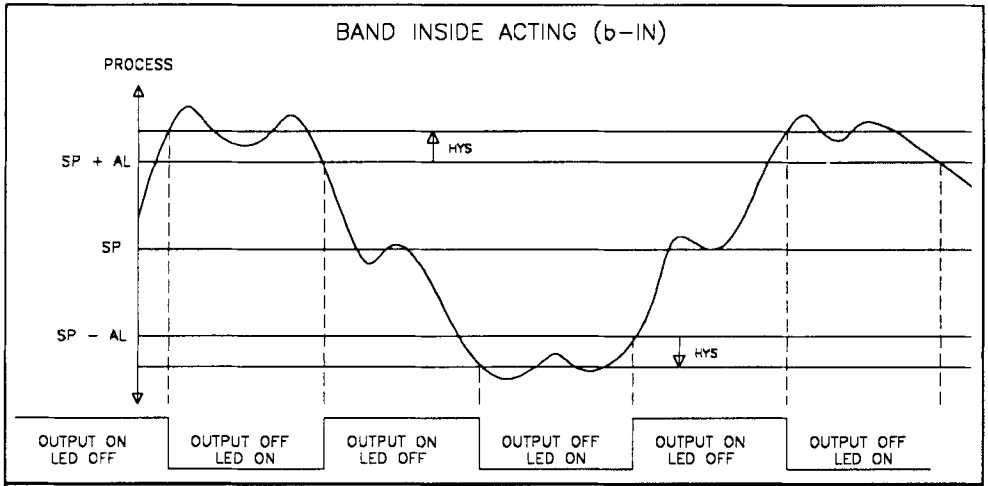
Alarms configured for deviation or band action, track the setpoint during ramp and hold phases of a profile. Deviation and band alarms trigger from the target setpoint when the auto setpoint ramp rate (SPrP) feature is enabled.

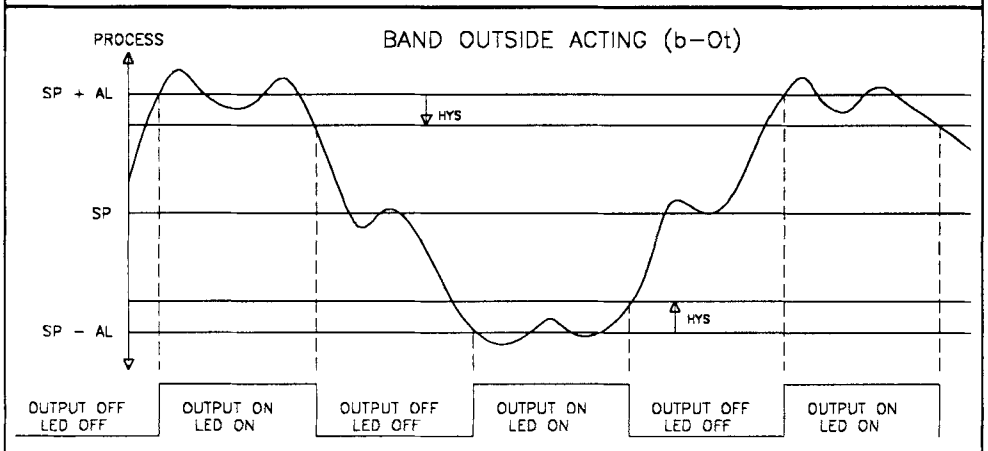
The alarm action figures describe the status of the alarm output and the front panel indicator for various over/under process conditions. (See output module "OUTPUT ON" state table for definitions, under installing output modules section.) The alarm output waveform is shown with the output in the automatic reset mode.

Note: Select the alarm action with care. In some configurations, the front panel indicator (LED) might be "OFF" while the output is "ON".


DEVIATION HIGH–ACTING WITH POSITIVE ALARM VALUE (d–HI)
PROCESS
SP + AL
HYS
SP
OUTPUT OFF LED OFF
OUTPUT ON LED ON
OUTPUT OFF LED OFF
OUTPUT ON LED ON
DEVIATION HIGH–ACTING WITH NEGATIVE ALARM VALUE (d–HI)
PROCESS
SP
SP + (–AL)
HYS
OUTPUT ON LED OFF
OUTPUT OFF LED ON
OUTPUT ON LED OFF
OUTPUT OFF LED ON


DEVIATION LOW–ACTING WITH POSITIVE ALARM VALUE (d–LO)
PROCESS
SP + AL
HYS
SP
OUTPUT ON LED OFF
OUTPUT OFF LED ON
OUTPUT ON LED OFF
OUTPUT OFF LED ON
DEVIATION LOW–ACTING WITH NEGATIVE ALARM VALUE (d–LO)
PROCESS
SP
SP + (–AL)
HYS
OUTPUT OFF LED OFF
OUTPUT ON LED ON
OUTPUT OFF LED OFF
OUTPUT ON LED ON


BAND INSIDE ACTING (b-IN)
PROCESS
SP + AL
SP
SP - AL
HYS
HYS
OUTPUT ON LED OFF
OUTPUT OFF LED ON
OUTPUT ON LED OFF
OUTPUT OFF LED ON
OUTPUT ON LED OFF
OUTPUT OFF LED ON


PROCESS
BAND OUTSIDE ACTING (b-Ot)
SP + AL
SP
SP - AL
HYS
HYS
OUTPUT OFF LED OFF
OUTPUT ON LED ON
OUTPUT OFF LED OFF
OUTPUT ON LED ON
OUTPUT OFF LED OFF
OUTPUT ON LED ON

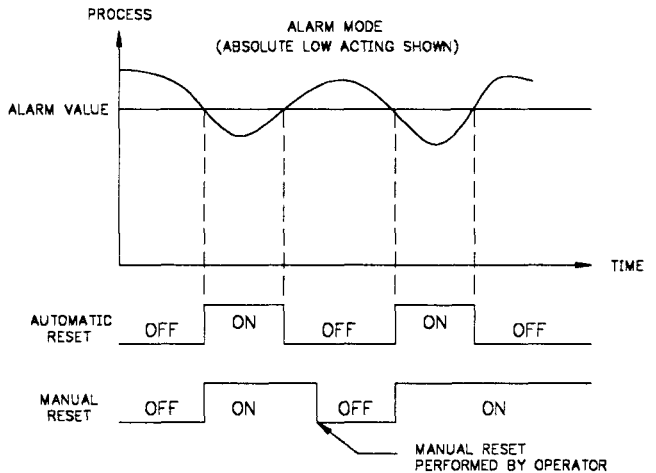
Alarm Reset (rSt1, rSt2)

Each alarm reset action may be independently configured.

LAtC - Latching
Auto - Automatic

Latched alarms require operator acknowledgment to reset the alarm condition. The front panel buttons can be used to reset an alarm when the controller is in the hidden mode (see hidden function mode). An Alarm condition may also be reset via the RS-485 serial interface or by the user input. Automatic (Auto) reset alarms are reset by the controller when the alarm condition clears. The alarm reset figure depicts the reset types.

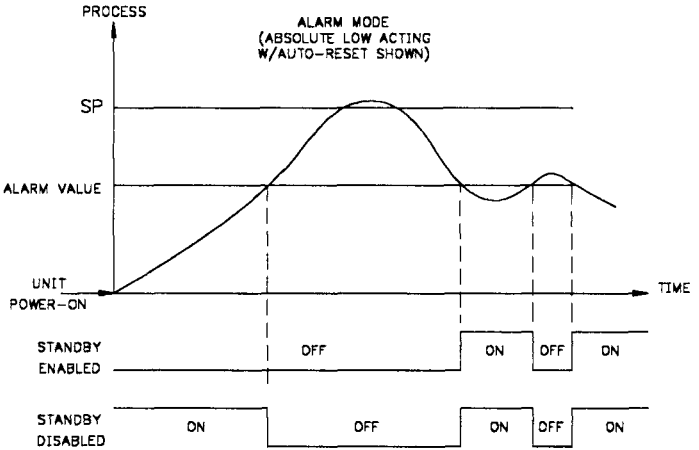
ALARM RESET SEQUENCE



Alarm Standby Delay (Stb1, Stb2)

The alarm(s) may be independently configured to exhibit a power-on, standby delay which suppresses the alarm output from turning "ON" until the process first stabilizes outside the alarm region. After this condition is satisfied, the alarm standby delay is canceled and the alarm triggers normally, until the next controller power-on. The alarm standby delay figure depicts a typical operation sequence.

ALARM STANDBY DELAY SEQUENCE



Alarm Value (AL-1, AL-2)

The alarm values are either absolute (absolute alarms) or relative to the setpoint value (deviation and band alarms). An absolute alarm value is the value that is entered. A relative alarm value is offset from the process setpoint value by the amount entered and tracks the setpoint value as it changes. AL-1 and AL-2 - -999 to 9999

If the alarm action is set as a Band Alarm, then only a positive value can be entered. AL-1 and AL-2 - 0 to 9999

Alarm Hysteresis (AHYS)

The alarm(s) values have a programmable hysteresis band to prevent alarm output chatter near the alarm trigger setpoint. The hysteresis value should be set to eliminate this effect. A value of 2 to 5 is usually sufficient for most applications. A single alarm hysteresis value applies to both alarms.

Refer to the alarm action figures for the effect of hysteresis on the various alarm types.

AHYS - 1 to 250

Secondary Output Module (5-02) (Optional)

The optional secondary output (OP2) operates as an independent output for systems that use heat/cool, PH balance, etc. One of the three types of output modules (Relay, Logic/SSR Drive or Triac) must be ordered separately and installed into the cooling channel socket.

Note: Units with the RS-485 serial communications option must have the same type of modules installed for the secondary output and alarm output.

The output modules may be replaced or interchanged (with appropriate wiring considerations) at any time without re-programming the controller.

The front panel indicator OP2 illuminates when the secondary output is on. (See Output Module "OUTPUT ON" State Table for definition, under installing output modules section). Secondary output power is defined as ranging from -100% (full ON) to 0% (OFF, unless a deadband overlap is used).

Cycle Time (CYC2)

A value of 0 turns off the secondary output, independent of the power demand.

CYC2 - 0 to 120 seconds

Relative Gain (GAN2)

This parameter defines the gain of the secondary band relative to the main output band. A value of 0.0 places the secondary output into ON/OFF control mode with the parameter (db-2) becoming the secondary output hysteresis. This may be done independent of the main output control mode (PID or ON/OFF). Relative gain is generally set to balance the effects of OP2 to that of OP1 for best control.

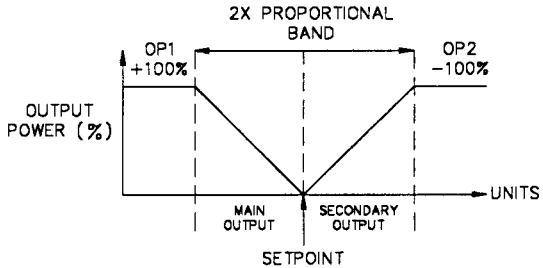
GAN2 - 0.0 to 10.0

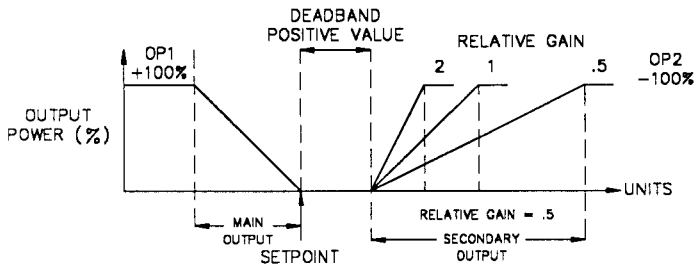
Overlap/Deadband (db-2)

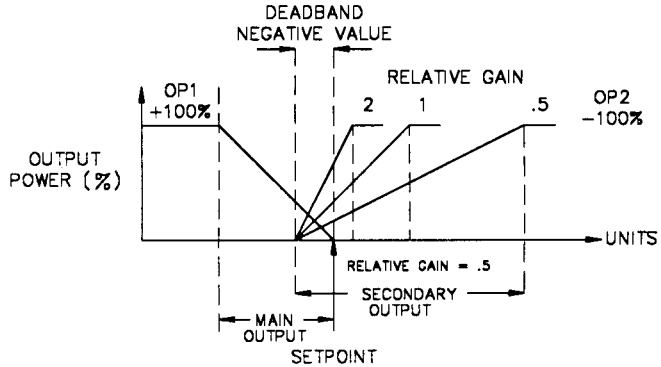
This parameter defines the area in which both main control output and secondary output are active (negative value) or the deadband area between the bands (positive value). If an overlap is specified, the displayed percent output power is the sum of the main power (OP1) and the secondary power (OP2).

db-2 - -999 to 9999

If relative gain is zero, the secondary output operates in the ON/OFF mode, with this parameter becoming the secondary output hysteresis (positive value only). This parameter should be set prior to invoking Auto-Tune. The operation figures illustrate the effects of different deadbands.







In practice with the secondary output, observe the controlled process characteristics and if the process remains above setpoint with a sluggish return, increase the relative gain. Similarly, if the process drops too sharply with an overall saw-tooth pattern, decrease the relative gain. Alter the deadband overlap until a smooth response in the controlled process is observed during band transition.

Serial Communications Module (6-SC) (Optional)

When communicating with a PSC unit via the serial port, the data formats of both units must be identical. A print operation occurs when the user input, programmed for the print request function is activated, when a "P" command is sent via the serial communications port, or after the time expires for the automatic print rate,if enabled. Serial communication is covered in detail in the RS-485 SERIAL COMMUNICATIONS SECTION.

Baud Rate (bAUd)

The available baud rates are:
300, 600, 1200, 2400, 4800, or 9600

Parity Bit (PArb)

Parity can be odd, even, or no parity.

Address Number (Addr)

Multiple units connected on the same RS-485 interface line must each have a different address number. A value of 0 does not require the address specifier command, when communicating with the PSC. The address numbers range from 0 to 99.

Abbreviated or Full Transmission (Abrv)

When transmitting data, the PSC can be programmed to suppress the address number, mnemonics, units, and some spaces by selecting YES. An example of abbreviated and full transmission are shown below:

NO -	6 SET 123.8F<CR> <LF>	Full Transmission
YES -	123.8<CR> <LF>	Abbreviated Transmission

Print Rate (PrAt)

The PSC can be programmed to automatically transmit the selected print options at the programmed print rate. Selecting 0 disables the automatic print rate feature.

PrAt - 0 to 9999 seconds

Print Options (PoPt)

Selecting YES for the print options will allow the operator to scroll through the available options using the PAR button. The up and down arrow keys toggle between "yes" and "no" with "yes" enabling the option to be printed when a print function occurs.

INP	Print Input Process Value
SEt	Print Setpoint Value
OPr	Print % Output Power Value
Pbd	Print % Proportional Band Value
INt	Print Integral Time Value
dEr	Print Derivative Time Value
AL1	Print Alarm 1 Value
AL2	Print Alarm 2 Value
dEv	Print Deviation From Setpoint Value
OFP	Print % Output Power Offset Value
r-P	Print Setpoint Ramp Rate Value
CrG	Print Relative Gain Value
Cdb	Print Deadband Value
P-t	Print Profile Phase Time Remaining
P-S	Print Profile Operation Status

Control Points Module (7-CP)

There are four Control Points, each having a setpoint value and an associated PID gain set value. A control point can be implemented at any time to accommodate changing process requirements due to batch changeover, level changes, etc.

The PID gain set values (ProP, Int, & Dert) may be optionally implemented with the setpoint value. A Control Point can be loaded from the hidden mode or by the user input (control points 1 and 2 only, see user input control point (CP) function).

The control point overwrites the previous setpoint and optionally the PID values. The unit begins controlling based on these new values. When a control point is loaded, the controller suppresses the output 'bump' usually associated with PID gain changes. Control points must be manually loaded and may be used in conjunction with a running profile.

Control Point Set-up (CSEt)

Select the control point to be configured.

NO
CP-1
CP-2
CP-3
CP-4

Selecting NO returns the unit to the configuration access point.

Setpoint Value (SP-n)

Enter the process setpoint value for the selected control point. This value is constrained to the setpoint low (SPLO) and setpoint high (SPHI) range limits (see inputs configuration module).

SP-n - -999 to 9999

PID Values(Pid)

Choose the option of loading the PID gain set values with setpoint value when implementing a Control Point.

NO - Disables PID entries and returns to control point set-up (CSEt).

YES - PID gain set is implemented when control point is loaded. Enter the desired PID gain set values.

Pb-n - Proportional Band 0.0 to 999.9%
It-n - Integral Time 0 to 9999 secs
dt-n - Derivative Time 0 to 9999 secs

Profiles Module (8-Pr)

Prior to programming a profile, it is recommended to configure the basic controller operation. A profile is a series of one or more programmable ramp and hold phases. A minimum of three parameters are required for a profile:

Ramp Rate (Pnrn)
Target Setpoint (PnLn)
Hold Time (PnHn)

Each profile can be programmed with up to eight ramp and hold phases. Associated with each profile is a timed event output set that updates as the profile advances. Additional parameters are provided which enhance the controller and profile capabilities.

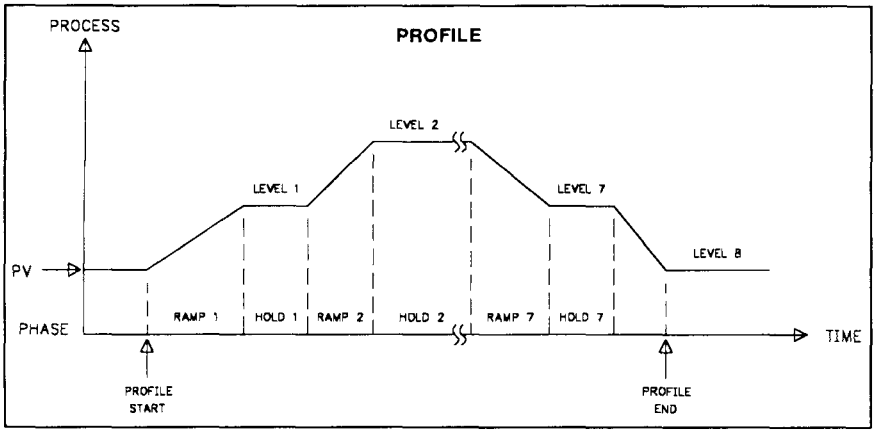
Profile Set-Up

Select which profile or timed event output to program.

PSEt -	Pr-1	Profile 1
	Pr-2	Profile 2
	Pr-3	Profile 3
	Pr-4	Profile 4
	PE-1	Timed event output for profile 1
	PE-2	Timed event output for profile 2
	PE-3	Timed event output for profile 3
	PE-4	Timed event output for profile 4

The programming parameters for each profile are the same. The operator programs each phase and continues until all eight phases are programmed or a ramp rate of -0.1 is entered. Shown below are the parameters for profile 1.

Pr-1 -	P1CC	Cycle count	P1L4	Setpoint level 4
	P1L1	Linking	P1H4	Hold time 4
	P1St	Power cycle status	P1r5	Ramp rate 5
	P1Eb	Error band	P1L5	Setpoint level 5
	P1r1	Ramp rate 1	P1H5	Hold time 5
	P1L1	Setpoint level 1	P1r6	Ramp rate 6
	P1H1	Hold time 1	P1L6	Setpoint level 6
	P1r2	Ramp rate 2	P1H6	Hold time 6
	P1L2	Setpoint level 2	P1r7	Ramp rate 7
	P1H2	Hold time 2	P1L7	Setpoint level 7
	P1r3	Ramp rate 3	P1H7	Hold time 7
	P1L3	Setpoint level 3	P1r8	Ramp rate 8
	P1H3	Hold time 3	P1L8	Setpoint level 8
	P1r4	Ramp rate 4	P1H8	Hold time 8



Changes can be made to any profile parameter while the profile is running. Ramp rate, hold time, and setpoint level changes take effect as the profile advances. If a change is made to a phase that is active, the change is not recognized until the next time the profile is run.

From the normal display mode, the phase time remaining and target setpoint value allow temporary changes to a running profile. These changes take effect immediately.

Profile Cycle Count (PnCC)

Once a profile is started, it runs the programmed number of cycles and then automatically defaults to the off mode. If this parameter is changed while the profile is running, the new value does not take effect until the profile is stopped (off mode). It is not possible to examine the number of profile cycle counts that a profile has completed. A cycle count value of 0 prevents the profile from operating.

A cycle count value of 250 allows continuous profile cycling.

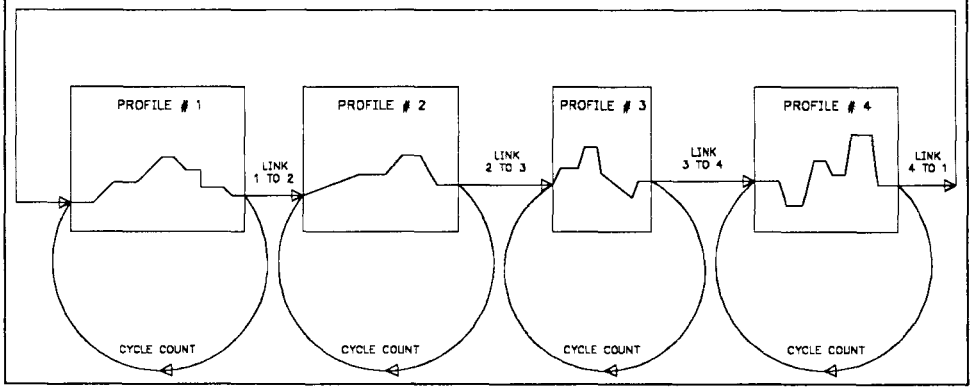
Profile Linking (PnLn)

Each profile can have up to eight ramp and eight hold phases programmed. If more than eight phases are required, profiles may be linked together. Linking allows the next profile to automatically start when the current profile has completed its cycle count. A single profile can be expanded up to 32 ramp and hold phases of execution by linking.

P1Ln - Selecting YES links profile 1 to profile 2.
P2Ln - Selecting YES links profile 2 to profile 3.
P3Ln - Selecting YES links profile 3 to profile 4.
P4Ln - Selecting YES links profile 4 to profile 1.

Profiles execute the prescribed number of cycle counts prior to linking to the next profile. A linked profile uses the last setpoint value of the previous profile as its starting point. The linking parameter can be changed during profile operation.

PROFILE CYCLE COUNT & LINK FEATURES



Profile Power Cycle Status (PnSt)

Upon controller power-on, several profile operating modes exist. Each profile has an independent power cycle status.

StOP - Stop places a profile into the Off mode, regardless of the mode prior to power down.

CONt - Continue resumes the operation of a running profile (including event output states) at the point where power was removed to the controller.

Strt - Start automatically re-starts a profile. This is useful for automatic execution, soft-start profile at power-up, or automatic execution of a standard profile.

Power cycle status may be changed while a profile is running. The options of the power cycle status may create conflicts between one or more profiles. The priority structure for the power cycle status is:

Priority #1 - The profile that was running and programmed for continue resumes operation when power is restored.

Priority #2 - If the profile that was running prior to power down is not programmed for continue, any profile programmed for start will re-start. Profile 1 has the highest priority.

Profile Error Band (PnEb)

The Profile process value can be assured by using the profile Error Band parameter. If the process value deviates outside the error band value while a profile is running, the controller enters the delay mode. In the delay mode, the time base of the profile is held (delayed) until the process value is within the deviation error band. At this time, the profile continues running unless the process value again deviates. These actions assure that the actual process value conforms to the profile. The error band can be programmed for a positive or negative value which is expressed in units.

PnEb - -999 to 9999 units

A Positive Error Band value operates on hold phases only. This is useful when the soak time must be assured without affecting ramp phase time. A Negative Error Band value allows a profile to enter the delay mode on both ramp AND hold phases. This parameter may be altered during profile operation and the new values takes effect immediately. A value of 0 disables Error Band detection.

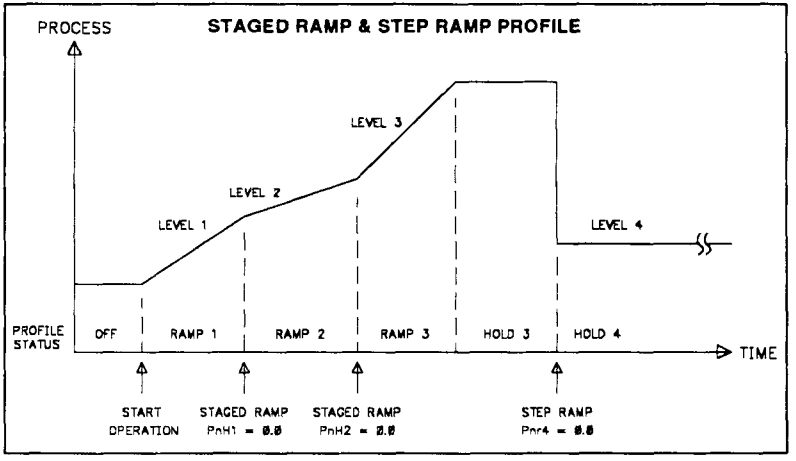
Ramp Phase (Pnrn)

The ramp phase is defined as automatic changing (ramping) of the setpoint value over a discrete time period at a predefined rate. The ramp rate is expressed in tenths of units per minute.

Pnrn - 0.1 to 999.9 units/minute

The slope of the ramp phase (up or down) is automatically determined by the controller using the current setpoint value and target setpoint value. Upon starting a profile, the setpoint value begins ramping from the measured input process value to the target setpoint value. A profile can begin ramping from a defined setpoint level by entering 0.0 for the first ramp phase and 0.0 for the first hold phase. Entering 0.0 causes the profile to advance directly to the target setpoint value and begin the hold phase. This is known as a Step Ramp Phase. Timed Event outputs update at a Step Ramp Phase. The next ramp phase starts after the hold phase times-out.

A "staged" ramp approach is possible by using hold phase times of 0.0 minutes and redefining the new ramp rate(s).



Setpoint Value (PnLn)

The controller ramps to the Target Setpoint Value and then maintains the Target Setpoint Value over the hold phase time. The setpoint value is constrained to the setpoint limit values (SPLO & SPHI).

PnLn - -999 to 9999

Hold Phase (PnHn)

The controller maintains the target setpoint value constant during a hold phase for a fixed period of time. The hold phase is expressed in tenths of minutes. 0.1 to 999.9 minutes

Hold times longer than 999.9 minutes are possible by joining two or more hold phases. Hold phases are joined by setting the in-between ramp rate to 0.0, which skips the ramp phase.

A hold phase time value of 0.0 minutes skips the hold phase. Although Event Outputs assigned to that phase are updated. Two or more ramp phases (staged ramps) may be joined together by setting the in-between hold phase time to 0.0 minutes.

Timed Event Output(s) (Pn 1 to Pn 16)

The alarm channels can be independently configured to operate as an Alarm Output or a Timed Event Output. *The alarm(s)* must be configured in the Alarm Module (4-AL). If configured as an alarm, the output state assignments are ignored.

Timed Event Outputs use AL1 and/or AL2 to signal or activate other equipment during execution of a profile. The Timed Event Outputs are updated at the start of each ramp and hold phase and remain defined for the duration of that phase. Front panel annunciators AL1 or AL2 light, if the Timed Event Output phase is programmed to activate the corresponding alarm output. The table lists the four assignment choices for each phase:

Mnemonic	Description
1F2F	Alarm 1 off, Alarm 2 off
1F2N	Alarm 1 off, Alarm 2 on
1N2F	Alarm 1 on, Alarm 2 off
1N2N	Alarm 1 on, Alarm 2 on

Each phase of the profile corresponds to an Event Output number. One of the output state assignments is programmed to each profile phase. The table lists the correspondence.

Timed Event Output Number	Profile Phase Mnemonic	Description
Pn 1	Pnr1	Ramp Rate 1
Pn 2	PnH1	Hold Time 1
Pn 3	Pnr2	Ramp Rate 2
Pn 4	PnH2	Hold Time 2
Pn 5	Pnr3	Ramp Rate 3
Pn 6	PnH3	Hold Time 3
Pn 7	Pnr4	Ramp Rate 4
Pn 8	PnH4	Hold Time 4
Pn 9	Pnr5	Ramp Rate 5
Pn10	PnH5	Hold Time 5
Pn11	Pnr6	Ramp Rate 6
Pn12	PnH6	Hold Time 6
Pn13	Pnr7	Ramp Rate 7
Pn14	PnH7	Hold Time 7
Pn15	Pnr8	Ramp Rate 8
Pn16	PnH8	Hold Time 8

Note: Each Timed Event Output number can be programmed to one of the output states (1F2F, 1F2N, 1N2F, or 1N2N).

Timed Event Output(s) (Pn 1 to Pn 16) (Cont'd)

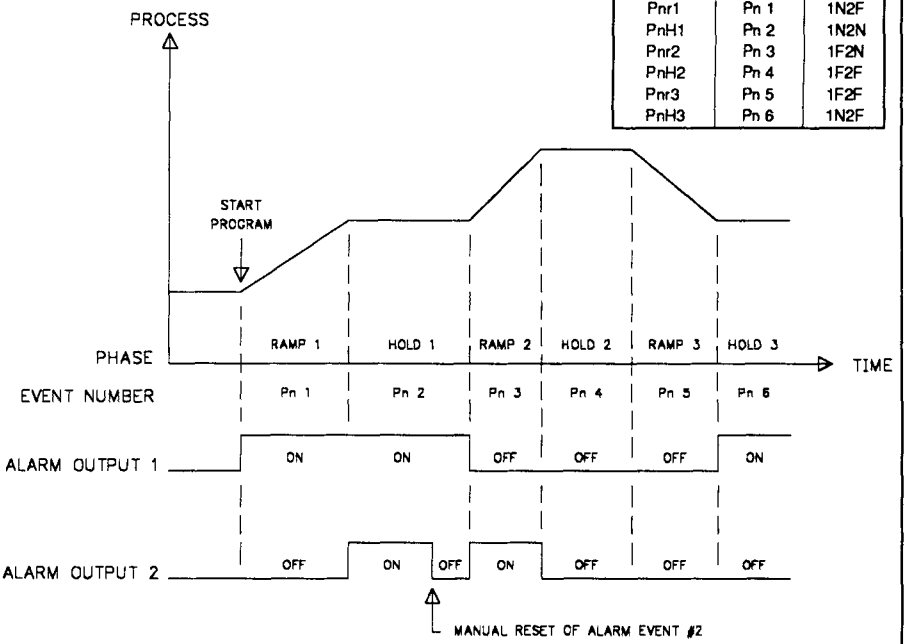
It is possible to have the Event Outputs operate during profile phases by creating 'phantom' phases, whose sole function is to allow a new state of Event Outputs.

Each profile corresponds to a Timed Event Output.

The Event Output(s) may be manually reset to the off state at any time during profile execution. A timed event output may be reset via the user input (if programmed), the front panel buttons (in the hidden mode), or the RS-485 serial communication option. Once reset they remain in that state until the profile advances to the next phase and the event output updates.

TIMED EVENT OUTPUT(S)

Phase	Timed Event Output	
	Number	State
Pnr1	Pn 1	1N2F
PnH1	Pn 2	1N2N
Pnr2	Pn 3	1F2N
PnH2	Pn 4	1F2F
Pnr3	Pn 5	1F2F
PnH3	Pn 6	1N2F



Profile Example

The following example shows the set-up of a profile that executes one time and uses the timed event outputs.

General Requirements:

1. Program data into profile 1.
2. Delay profile if process value is not within 8 units, only during hold phases.
3. Continue profile if power is removed to the controller.
4. Implement User Input for profile 1 run/pause operation.

Profile Requirements:

A. Ramp up from idle process value of 85 to 350 at 4.0/minute (ramp time = 66.3 minutes). Hold at 350 for 20.0 minutes.

B. Ramp up from 350 to 500 at 3.0/minute (ramp time = 50.0 minutes). Hold at 500 for 60.0 minutes.

C. Step ramp up from 500 to 750. No hold phase at 750.

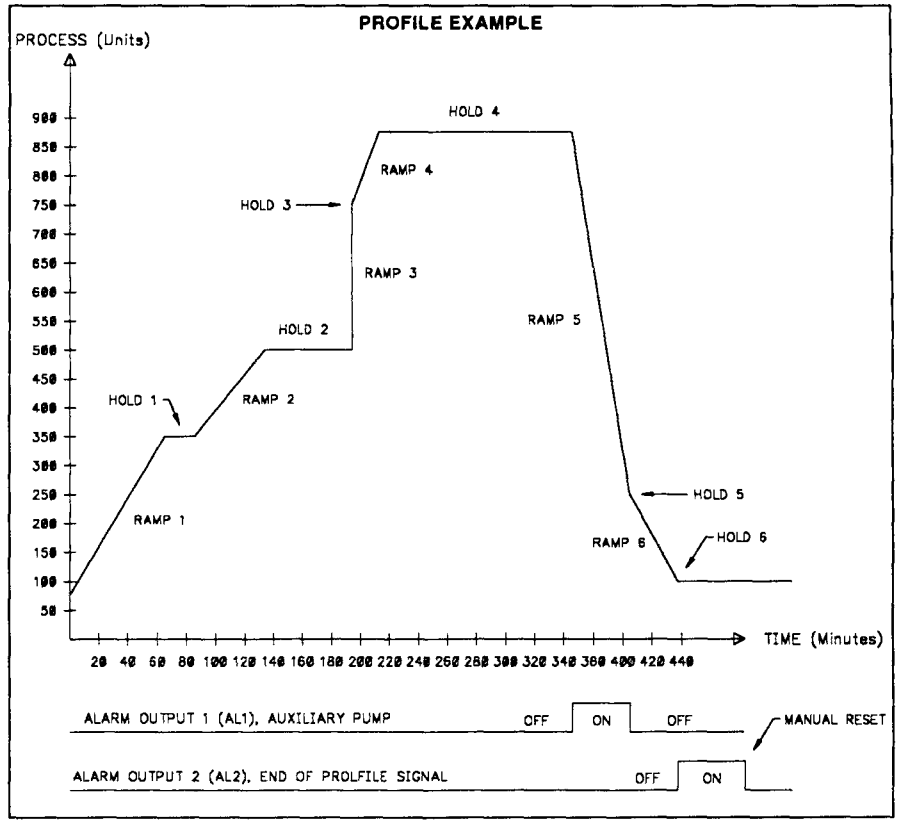
D. Ramp up from 750 to 875 at 7.5/minute (ramp time = 16.7 minutes). Hold at 875 for 2.5 hours (150 minutes).

E. Ramp down from 875 to 250 at 10.0/minute (ramp time = 62.5 minutes). Engage auxiliary pump during this ramp (Event output 1).

F. No hold phase at 250. Turn off auxiliary pump.

G. Ramp down from 250 to 100 at 3.75/minute (ramp time = 40.0 minutes). No hold phase at 100. Turn on end of program signal (Event output #2).

H. End program at 100.



The Programming Data For The Example:

Input Module 1 (1-IN)

Mnemonic	Value	Description
InPt	P1rH	User input is programmed for run/pause operation

Alarm Module 4 (4-AL)

Mnemonic	Value	Description
Act 1	P-Ev	Program alarm 1 for timed event output
Act 2	P-Ev	Program alarm 2 for timed event output

Profile Module 8 (8-Pr)

Mnemonic	Value	Description
P1CC	1	Cycle profile once after started
P1Ln	no	Do not link to profile 2 when done
P1St	Cont	Continue profile operation when power is restored
P1Eb	8	Delay mode if process value deviates ± 8 units
P1r1	4.0	Ramp rate 1 is 4.0/minute
P1L1	350	Setpoint level 1 is 350
P1H1	20.0	Hold time 1 is 20.0 minutes
P1r2	3.0	Ramp rate 2 is 3.0/minute
P1L2	500	Setpoint level 2 is 500
P1H2	60.0	Hold time 2 is 60.0 minutes
P1r3	0.0	Ramp rate 3 is step ramp
P1L3	750	Setpoint level 3 is 750
P1H3	0.0	Hold time 3 is skipped
P1r4	7.5	Ramp rate 4 is 7.5/minute
P1L4	875	Setpoint Level 4 is 875
P1H4	150.0	Hold time 4 is 150.0 minutes
P1r5	10.0	Ramp rate 5 is 10.0/minute
P1L5	250	Setpoint level 5 is 250
P1H5	0.0	Hold time 5 is skipped
P1r6	3.8	Ramp rate 6 is 3.8/minute
P1L6	100	Setpoint level 6 is 100
P1H6	0.0	Hold time 6 is skipped
P1r7	0.1	Ramp rate 7 ends profile

Profile Module 8 (8-Pr) (Cont'd)

Mnemonic	Value	Description
P1 1	1F2F	Keep both outputs off
P1 2	1F2F	Keep both outputs off
P1 3	1F2F	Keep both outputs off
P1 4	1F2F	Keep both outputs off
P1 5	1F2F	Keep both outputs off
P1 6	1F2F	Keep both outputs off
P1 7	1F2F	Keep both outputs off
P1 8	1F2F	Keep both outputs off
P1 9	1N2F	Turn on auxiliary pump
P110	1F2F	Turn off auxiliary pump
P111	1F2F	Keep both outputs off
P112	1F2N	Turn on end of profile signal

Factory Service Operations Module (9-FS)

The Factory Service Operations are programming functions which are performed on an infrequent basis. They include: controller calibration, and reset programming to factory configuration setting. Given the ramifications of these operations, access to each is protected by an access code number. Entering code 66 will restore all parameters to factory settings, the unit will indicate the operation after the PAR button is pressed, by displaying "rSEt" in the lower display momentarily. The calibration operations are detailed in Appendix "F".

Note: Entering code 66 will reset all programming parameters to the factory settings.

Quick Reference Table: Configuration Input Module 1 (1-IN)

Display	Parameter	Range and Units (Factory Setting Value)	Description/ Comments
tYPE	Input type	VOLt - Voltage Curr - Current (Curr)	
dCPt	Decimal Point	0, 0.0, 0.00, or 0.000 (0.0)	If 0.000 is selected scaling points must be a positive value.
rnd	Rounding Increments	1, 2, 5, 10, 50, or 100 (0.1)	Used in conjunction with filtering to stabilize the display reading.
FLtr	Digital filtering for input signal	0 to 3 (1)	Increase number for more filtering effect.
dSP1	Scaling Point #1 Display Value	-999 to 9999 (0.0)	Normally, key-in display low value.
INP1	Scaling Point #1 Input Signal value Key-In Method	-999 to 9999 (4.00)	Normally, key-in input low value. Press DSP button to select signal input method.
	Signal Input Method 4 - 20mADC 0 - 10VDC	0.00 to 20.00 0.00 to 10.00	Normally, apply input low value.
dSP2	Scaling Point #2 Display Value	-999 to 9999 (0.0)	Normally, key-in display high value.
INP2	Scaling Point #2 Input Signal value Key-In Method	-999 to 9999 (20.00)	Normally, key-in input high value. Press DSP button to select signal input method. .
	Signal Input Method 4 - 20mADC 0 - 10VDC	0.00 to 20.00 0.00 to 10.00	Normally, apply input high value.
SPLO	Lower limit set-point range	-999 to 9999 (0.0)	Set low limit below high limit.
SPHI	Upper limit set-point range	-999 to 9999 (999.9)	Set high limit above low limit.
SPrP	Setpoint ramp rate	0.0 to 999.9 units/minute (0.0)	0.0 is off (no ramping)
InPt	User input	PLOC - Program disable ILOC - Integral action on/off trnF - Auto/manual transfer SPrP - Ramp rate on/off ALrS - Reset alarm output(s) Prnt - Print request CP - Control point load P1rH - Run/pause a profile or start profile 1 P1rS - Profile 1 stop/restart (PLOC)	Available with RS-485 option only.

Quick Reference Table: Configuration Output Module 2 (2-OP)

Display	Parameter	Range and Units (Factory Setting Value)	Description/ Comments
CYCt	Cycle time	0 to 120 seconds (2)	0 turns OP1 off.
OPAC	Control action	rEv drct (rEv)	For both PID & ON/OFF control.
OPLO	Output power lower limit range	0% to 100%, OP1 -100% to 100%, OP1 & OP2 (0, no secondary) (-100, secondary)	Set OPLO < OPHI. If secondary option is installed.
OPHI	Output power upper limit range	0% to 100% , OP1 -100% to 100%, OP1 & OP2 (100)	Set OPHI > OPLO. If secondary option is installed.
OPFL	Input overdrive power preset	0% to 100%, OP1 -100% to 100%, OP1 & OP2 (0)	Set to a value to safely control the process in the event of an input overdrive condition.
CHYS	ON/OFF control hysteresis	1 to 250 (1)	Main control output (OP1) only.
tcod	Auto-Tune damping code	0 to 4 (0)	0 = fastest response 4 = slowest response
ANAS	Linear DC 4-20mA output assignment	OP - % output power INP - process value SP - setpoint value dEv - deviation (OP)	This parameter does not appear if analog option is not installed.
ANLO	Linear DC output low. 4mA scaling value	-999 to 9999 (0.0)	Units depend on ANAS selection. This parameter does not appear if analog option is not installed.
ANHI	Linear DC output high. 20mA scaling value	-999 to 9999 (100.0)	Units depend on ANAS selection. This parameter does not appear if analog option is not installed.

Quick Reference Table: Configuration Lockout Module 3 (3-LC)

Display	Parameter	Range and Units (Factory Setting Value)	Description/ Comments
SP	Setpoint access	LOC - lockout rEd - read only Ent - enter (Ent)	Allows access to process setpoint.
OP	Output power access	LOC - lockout rEd - read only Ent - enter (Ent)	Allows direct access to output power. %PW indicator illuminates when parameter is selected in display.
P-CS	Profile status display	LOC - lockout rEd - read only Ent - enter (rEd)	Allows access to profile status. PGM indicator illuminates when parameter is selected in display.
P-tr	Profile time remaining	LOC - lockout rEd - read only Ent - enter (rEd)	Allows access to phase time remaining. PGM indicator illuminates when parameter is selected in display.
bdSP	Blank display	LOC - lockout rEd - read only (rEd)	Blanks secondary display.
Code	Access code	0 to 250 (0)	Refer to front panel disable section for access levels.
PId	PID values enable	LOC - lockout rEd - read only Ent - enter (LOC)	Protected mode lockout
AL	Alarm values enable	LOC - lockout rEd - read only ENt - enter (LOC)	Protected mode lockout
ALrS	Reset alarm/ timed event outputs enable	LOC - lockout ENBL - enable (LOC)	Hidden mode lockout
CPAC	Control point access	LOC - lockout ENBL - enable (LOC)	Hidden mode lockout
PrAC	Ramp/hold profile access	LOC - lockout ENBL - enable (LOC)	Hidden mode lockout
trnF	Automatic/ Manual (user) transfer enable	LOC - lockout ENBL - enable (LOC)	Hidden mode lockout
tUNE	Auto-tune enable	LOC - lockout ENBL - enable (LOC)	Hidden mode lockout

Quick Reference Table: Configuration Alarms Module 4 (4-AL)

Unit returns to configuration access point if alarm(s) are not installed.

Display	Parameter	Range and Units (Factory Setting Value)	Description/ Comments
Act1	Alarm 1 operation mode	A-HI absolute high A-LO absolute low d-HI deviation high d-LO deviation low b-IN band inside b-ot band outside P-Ev timed event output (A-HI)	If changed, check alarm values. If P-Ev is selected, remaining parameters for Alarm 1 does not appear.
rSt1	Alarm 1 reset mode	Auto - automatic LAtc - manual reset (Auto)	Manual reset via hidden mode.
Stb1	Alarm 1 standby function (delay)	yes/no (NO)	Power-up standby delay.
AL-1	Alarm 1 value	-999 to 9999 (0)	If band alarm action, positive values only.
Act2	Alarm 2 operation mode	A-HI absolute high A-LO absolute low d-HI deviation high d-LO deviation low b-IN band inside b-ot band outside P-Ev timed event output (A-HI)	If changed, check alarm value. If P-Ev is selected, remaining parameters for Alarm 2 does not appear.
rSt2	Alarm 2 reset mode	Auto - automatic LAtc - manual reset (Auto)	Manual reset via hidden mode.
Stb2	Alarm 2 standby function (delay)	yes/no (NO)	Power-up standby delay.
AL-2	Alarm 2 value	-999 to 9999 (0)	If band alarm action, positive values only.
AHYS	Alarm Hysteresis value	1 to 250 (1)	Applies to both alarms. Set to eliminate chatter.

Quick Reference Table: Configuration Secondary Module 5 (5-O2)

Unit returns to configuration access point if secondary option not installed.

Display	Parameter	Range and Units (Factory Setting Value)	Description/ Comments
CYC2	cycle time	0 to 120 sec (2)	0 turns OP2 off.
GAN2	Relative gain	0.0 to 10.0 (1.0)	0.0 places cooling output into ON/OFF control mode and db-2 becomes hysteresis value.
db-2	overlap-deadband	-999 to 9999 (0)	Positive value is deadband. Negative value is overlap. If GAN2 = 0, this parameter is OP2 ON/OFF control hysteresis.

Reference Table: Configuration Serial Communications Module 6 (6-SC)

Unit returns to configuration access point if RS-485 serial option is not installed.

Display	Parameter	Range and Units (Factory Setting Value)	Description/ Comments
bAUd	Baud rate	300 to 9600 (1200)	Baud rate of unit must match other equipment.
PArb	Parity bit	odd, even, or no parity (odd)	Parity of unit must match other equipment.
Addr	Unit address	0 to 99 (0)	For multiple units, each unit must have a unique address.
Abrv	Abbreviated or full transmission	yes/no (NO)	Selecting yes, the controller does NOT transmit mnemonics.
PrAt	Auto print rate	0 to 9999 (0)	0 disables auto print function.
PoPt	Print options	yes/no (NO) INP - Input Process Value SEt - Setpoint OPr - % Output Power Pbd - % Proportional Band INt - Integral Time dEr - Derivative Time AL1 - Alarm 1 AL2 - Alarm 2 dEv - Deviation From Setpoint OFP - % Output Power Offset r-P - Setpoint Ramp Rate Crg - Relative Gain Cdb - Deadband P-t - Profile Phase Time Remaining P-S - Profile Operation Status (INP, SEt, OPr)	Selecting yes allows print options to be programmed.

Quick Reference Table: Configuration Control Point Module 7 (7-CP)

Display	Parameter	Range and Units (Factory Setting Value)	Description/ Comments
CSEt	Control Point set-up	NO CP-1 CP-2 CP-3 CP-4 (NO)	NO - Return to CONF Control Point 1 Control Point 2 Control Point 3 Control Point 4
The parameters for the four Control Points are the same. (n = control point 1, 2, 3, or 4.)			
SP-n	Setpoint value for Control Point n	SPLO to SPHI (0)	Limited to setpoint limit values.
PId	PID gain set for Control Point n	NO - disable PID, return to CSEt yES - continue with entry of PID (NO)	PID values to be loaded with setpoint entry, when implemented.
Pb-n	Proportional band for Control Point n	0.0 to 999.9% (4.0)	0.0% = ON/OFF control
It-n	Integral time for Control Point n	0 to 9999 seconds (120)	0 is off. Does not appear if Pb-n = 0.0%.
dt-n	Derivative time for Control Point n	0 to 9999 seconds (30)	0 is off. Does not appear if Pb-n = 0.0%.
Return to "CSet" to program other Control Points if desired.			

Quick Reference Table: Configuration Profile Module 8 (8-Pr)

Display	Parameter	Range and Units (Factory Setting Value)	Description/ Comments
PSEt	Setpoint Profile	No Pr-1 Pr-2 Pr-3 Pr-4 PE-1 PE-2 PE-3 PE-4 (NO)	NO - Return to CNFP Profile 1 Profile 2 Profile 3 Profile 4 Time event output for profile 1 Time event output for profile 2 Time event output for profile 3 Time event output for profile 4
The parameters for the four profiles are the same. (Pn = profile 1, 2, 3, or 4)			
PnCC	Profile n cycle count	0-250 (0)	0= off 250= continuous
PnLn	Profile n link option	YES/NO (NO)	Link if more than 8 ramp/hold phases are required.
PnSt	Profile n power-on status	Stop- Stop profile CONt- Continue profile Strt- Start profile (Stop)	Continue has priority.
PnEb	Profile n error band	-999 to 9999 (0)	0= off. (+) values hold phases only (-) values ramp and hold phases.
Pnr1	Profile n ramp rate 1	0.0 to 999.9 units/minute (0.0)	0.0 = step (instant ramp) -0.1 ends the profile.
PnL1	Profile n setpoint level 1	SPLO to SPHI (0)	Constrained to setpoint limit values.
PnH1	Profile n hold time 1	0.0 to 999.9 minutes (0.0)	0.0 = no hold phase.
Program up to 8 ramp/hold phases. Profile ends when ramp = -0.1 or PnH8 is programmed.			
Pnr8	Profile n ramp rate 8	0.0 to 999.9 units/minute (0.0)	Same as ramp 1.
PnL8	Profile n setpoint level 8	SPLO to SPHI (0)	Same as setpoint 1.
PnH8	Profile n hold time 8	0.0 to 999.9 minutes (0.0)	Same as hold 1.
Profile returns to "PSEt" stage.			

Quick Reference Table: Configuration Profile Module 8 (8-Pr) (Cont'd)

Display	Parameter	Range and Units (Factory Setting Value)	Description/ Comments
The parameters for the four timed event outputs are the same. (Pn = Timed Event Output for profile 1, 2, 3, or 4.)			
Pn 1	Event output number 1, for profile n	1F2F 1F2N 1N2F 1N2N (1F2F)	Assign alarms to timed event output in alarm action. F = OFF ; N = ON 1 = AL1; 2 = AL2
Each event output has the same programmable options. Event updates end when profile ends.			
Pn 16	Event output number 16, for profile n	1F2F 1F2N 1N2F 1N2N (1F2F)	Assign alarms to timed event output in alarm action. F = OFF ; N = ON 1 = AL1; 2 = AL2
Event Output step returns to "PSEt" stage.			

Quick Reference Table: Configuration Factory Service Operations Module 9 (9-FS)

Display	Parameter	Range and Units (Factory Setting Value)	Description/ Comments
Code	Enter factory service function code	48 - Calibrate instrument	Refer to Appendix F for details
		66 - Reset parameters to factory settings	

RS-485 SERIAL COMMUNICATIONS INTERFACE

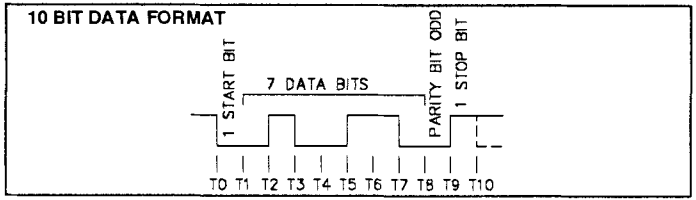
RS-485 communications allows for transmitting and receiving of data over a single pair of wires. This optional feature can be used for monitoring various values, resetting output(s), and changing values, all from a remote location. Typical devices that are connected to a PSC unit are a printer, a terminal, a programmable controller, or a host computer.

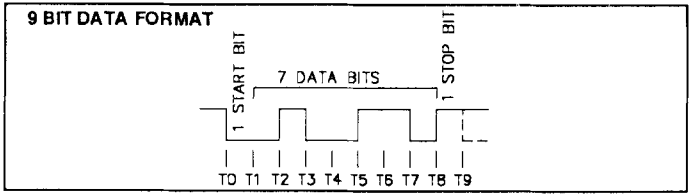
The RS-485 differential (balanced) design has good noise immunity and allows for communication distances of up to 4000 feet. Up to 32 units can be connected on a pair of wires and a common. The RS-485 common is isolated from the controller input signal common to eliminate ground loop problems associated with the input probe. The unit's address can be programmed from 0 to 99. An Optional RLC Serial Converter Module (RS-422 to 20mA current loop) can be installed to expand the unit's flexibility.

Communication Format

The half-duplex communication operation sends data by switching voltage levels on the common pair of wires. Data is received by monitoring the levels and interpreting the codes that were transmitted.

In order for data to be interpreted correctly, there must be identical formats and baud rates between the communicating devices. The formats available for the PSC unit are 1 start bit, 7 data bits, No parity or 1 parity bit (odd or even) and 1 stop bit. The programmable baud rates are; 300, 600, 1200, 2400, 4800, or 9600 baud.





Before serial communication can take place, the unit must be programmed to the same baud rate and parity as the connected equipment. In addition, the loop address number and print options should be known. When used with a terminal or host computer and only one unit is employed, an address of zero (0) may be used to eliminate the requirement for the address specifier when sending a command. If more than one unit is on the line, each unit should be assigned a different address number.

Sending Commands And Data

When sending commands to a PSC unit, a command string must be constructed. The command string may consist of command codes, value identifiers, and numerical data. Below is a list of commands and value identifiers that are used when communicating with the PSC unit.

COMMAND	DESCRIPTION
N (4EH)	Address command; Followed by a one or two digit address number 0-99.
P (50H)	Transmit print options command; Transmits the options selected in the Program Options (PoPt) section.
R (52H)	Reset command; Followed by one of the Value Identifiers (G or H).
T (54H)	Transmit value command; Followed by one of the Value Identifiers (A-M,O,Q).
C (43H)	Control action command; Followed by the Value Identifier (S or U) and number.
V (56H)	Change value command; Followed by one Value Identifier (B-H & J-M,O), then the proper numerical data.

Sending Commands And Data (Cont'd)

VALUE IDENTIFIER	DESCRIPTION	SERIAL MNEMONIC	UNITS
A	Process Display Value	INP	U
B	Setpoint	SET	U
C	Output Power	PWR	%
D	Proportional Band	PBD	%
E	Integral Time	INT	S
F	Derivative Time	DER	S
G	Alarm 1	AL1	U
H	Alarm 2	AL2	U
I	Deviation	DEV	U
J	Output Power Offset	OFP	%
K	Setpoint Ramp Rate *	RMP	R
L	Relative Gain	CRG	G
M	Deadband/Overlap	CDB	U
O	Program Phase Time Remaining	TIM	M
Q	Program Phase Status	STS	—
S	Control Mode 1- Automatic 2- Manual (User)	—	—
U	Program Control 1 = Start Profile 1 Operation 2 = Start Profile 2 Operation 3 = Start Profile 3 Operation 4 = Start Profile 4 Operation 5 = Stop Profile Operation 6 = Pause Profile Operation 7 = Continue Profile Operation 8 = Advance Profile to Next Phase	— — — — — — — — —	— — — — — — — — —

Note: The % output power can be changed only if the controller is in the manual mode of operation.

Profile data cannot be configured via the serial interface. Only status changes can be made to a running profile.

* *The Auto Setpoint Ramp Rate is not associated with a profile. This parameter is programmed in the Input Parameter Module (1-IN) (see Setpoint Ramp Rate for details).*

A command string is constructed by using a command, a value identifier, and a Data value if required. The Data value need not contain the decimal point since it is fixed within the unit, when programmed at the front panel. The PSC will accept the decimal point, however it does not interpret them in any way. Leading zeros can be eliminated, but all trailing zeros must be present.

Example: If an alarm value of 750.0 is to be sent, the data value can be transmitted as 750.0 or 7500. If a 750 is transmitted, the alarm value is changed to 75.0 in the unit.

The address command allows a transmission string to be directed to a specific unit on the serial communications line. When the unit address is zero, transmission of the address command is not required. For applications that require several units, it is recommended that each unit on the line be assigned a specific address.

If they are assigned the same address, a Transmit Value Command, will cause all the units to respond simultaneously, resulting in a communication collision.

The command string is constructed in a specific logical sequence. The PSC does not accept command strings that do not follow this sequence. Only one operation can be performed per command string.

The following procedure should be used when constructing a command string.

1. The first two to three characters of the command string must consist of the Address Command (N) and the address number of the unit (0-99). If the unit address is zero, the address command and number need NOT be sent.
2. The next character in the command string is the command that the unit is to perform (P,R,T,C, or V).
3. A Value Identifier is next if it pertains to the command. The command P (print) does not require a Value Identifier.
4. The numerical data will be next in the command string if the "Change Value" or "Control Action" command is used.
5. All command strings must be terminated with an asterisk * (2AH). This character indicates to the unit that the command string is complete and begins processing the command.

Below are typical examples of command strings.

Ex. 1 Change Proportional Band Value to 13.0% on the unit with an address of 2. Command String: N2VD130*

Ex. 2 Transmit the Process Display Value of the unit with an address of 3. Command String: N3TA*

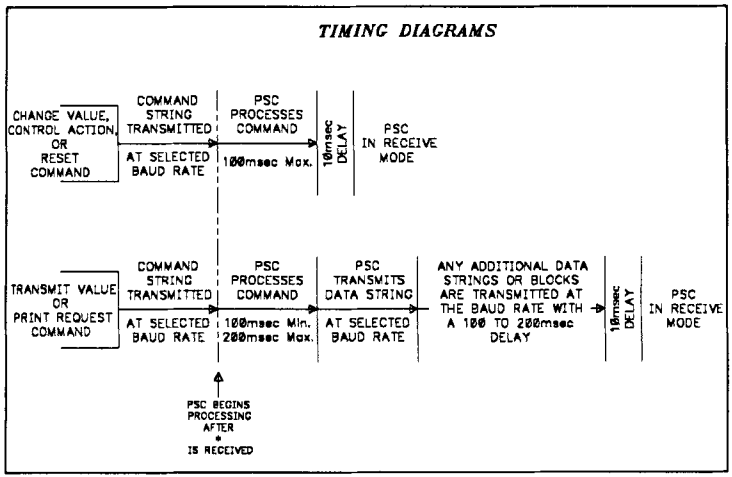
Ex. 3 Reset Alarm Output 1 of the unit with an address of 0. Command String: RG*

Ex. 4 Start profile 1 of the unit with an address of 13. Command String: N13CU1*

If illegal commands or characters are sent to the PSC, the string must be re-transmitted.

When writing application programs in Basic, the transmission of spaces or carriage return and line feed should be inhibited by using the semicolon delimiter with the "PRINT" statement. The unit does not accept a carriage return or line feed as valid characters. See "Terminal Emulation Program" section for a listing of an IBM* PC Basic terminal emulation program.

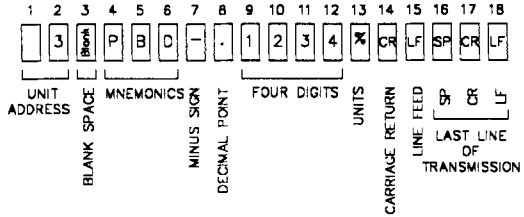
It is recommended that a "Transmit Value" command follow a "Change Value" Command. If this is done, the reception of the data can provide a timing reference for sending another command and insures that the change has occurred. When a "Change Value or Reset" command is sent to the unit, there is time required for the unit to process the command string. The diagrams show the timing considerations that need to be made.



* IBM is a registered trademark of International Business Machines.

Receiving Data

Data is transmitted from the PSC when a "T" Transmit Value or a "P" Transmit Print Options command is sent to the unit via the serial port. Also, when the User Input, programmed for the Print Request function, is activated. The print rate features allows the selected print options to be transmitted at a programmable automatic rate via the serial port. The format for a typical transmission string with mnemonics is shown below:



The first two digits transmitted are the unit address followed by one blank space. If the unit address is 0, the first locations are blank. The next three characters are the mnemonics followed by one or more blank spaces. The numerical data value is transmitted next followed by the identifying units. Negative values are indicated by a "-" sign.

The decimal point position "floats" within the data field depending on the actual value it represents. The numeric data is right justified without leading zeros.

When a "T" command or print request is issued, the above character string is sent for each line of a block transmission. An extra <SP><CR><LF> is transmitted following the last line of transmission from a print request, to provide separation between print outs.

If abbreviated transmission is selected, just numeric data is sent. If abbreviated transmission is NOT selected, the unit transmits Mnemonics and the units.

Receiving Data (Cont'd)

If more than one string is transmitted, there is a 100msec minimum to 200msec maximum built-in time delay after each transmission string and after each block of transmission. When interfacing to a printer, sending mnemonics are usually desirable. Examples of transmissions are shown below:

1 INP 500U<CR><LF>100 - 200msec Mnemonics Sent
1 SET 525U<CR><LF>100 - 200msec
1 PWR 20%<CR><LF><SP><CR><LF>100 - 200msec
-673.5<CR><LF>100 - 200msec NO Mnemonics Sent

The Print Options provide a choice of which PSC data values are to be transmitted. The PSC will transmit the Print Options when either the User Input, programmed for the print request function is activated, a "P" (Transmit Print Options) command is sent to the PSC via the serial port, or the Automatic Print Rate is set for a specific time. The Print Options are programmed in the Serial Communications Module (6-SC) with the available options:

1. Print Display Process Value.
2. Print Setpoint Value.
3. Print % Output Power Value.
4. Print % Proportional Band Value.
5. Print Integral Time Value.
6. Print Derivative Time Value.
7. Print Alarm 1 Value.
8. Print Alarm 2 Value.
9. Print Deviation From Setpoint Value.
10. Print % Output Power Offset Value.
11. Print Setpoint Ramp Rate Value.
12. Print Relative Gain Value.
13. Print Deadband Value.
14. Print Profile Phase Time Remaining.
15. Print Profile Status.

A print-out from a PSC unit with an address of 1 and all print options selected is shown below:

```
1 INP    500U
1 SET    525U
1 PWR   20.0%
1 PBD    4.0%
1 INT    120S
1 DER     30S
1 AL1    600U
1 AL2    475U
1 DEV    -25U
1 OFP    0.0%
1 RMP    0.0R
1 CRG    1.0G
1 CDB     10U
1 TIM    1.6M
1 STS    P2H3
```

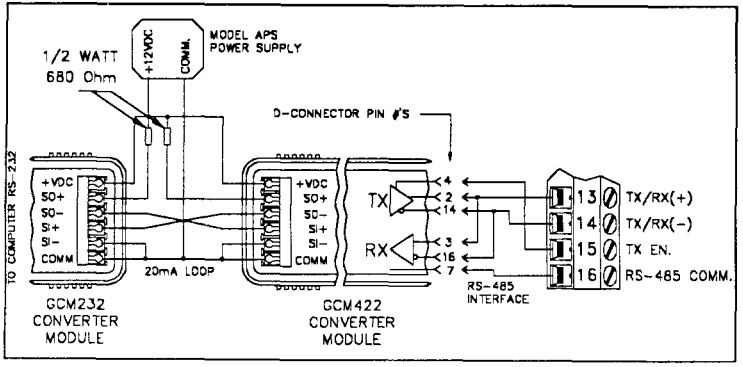
Note: If the secondary option is installed, AL2 is not printed or functional.

Terminal Emulation Program For IBM PC*

Utilizing the Serial communications capability of the PSC requires the use of an RS-485 serial card in the computer. If an IBM* PC compatible computer is used, this card is installed in an expansion slot on the mother-board. The RS-485 card should be configured for "2-wire half-duplex" operation. For this mode of operation, each piece of equipment must be able to switch from receive mode to transmit mode and vice-versa.

The controller is normally in the receive mode. It will automatically switch to the transmit mode when a Transmit Value Command is issued or a Print Request is issued. For the computer to switch from receive to transmit mode, the controlling software must be written to perform this task. On most RS-485 serial cards, the RTS (Request-to-Send) signal can be configured to be used as the direction (transmit/receive) control signal. The controlling software must switch the state of the RTS line when the computer is to switch from transmitting to receiving data. The controller allows 100msec minimum for the computer to switch from transmit to receive mode.

If an RS-485 card cannot be obtained, and only an RS232 port is available, the Red Lion Controls GCM232 & GCM422 converter modules can be used. The GCM232 converts from RS232 to 20mA current loop. The GCM422 converts the 20mA current loop to RS422/RS485. A male 25 pin D connector is required to interface the GCM422 to the unit.



Listed below is a basic program that emulates a terminal. It is written using IBM* PC Basic. The program may need to be modified if using a different basic interpreter. Set up the PSC for a baud rate of 9600. When the program is running, commands can be typed in from the keyboard as shown in the previous examples. An asterisk (*) is used to end all commands, Do **NOT** use the carriage return to end a command.

```
1 REM "FOR THIS PROGRAM TO WORK THE "RS-485" CARD SHOULD BE SET-UP AS COM2"
2 REM "ALSO THE CARD SHOULD USE "RTS" FOR HANDSHAKING"
3 REM "THE PSC UNIT SHOULD BE SET-UP FOR 9600 BAUD, AND ODD PARITY"
4 TXEMPTY = &H60
5 LSR = &H2FD: REM "COMM2 LINE STATUS REGISTER"
6 MCR = &H2FC: REM "COMM2 MODEM CONTROL REGISTER"
10 CLS : CLOSE :
20 OPEN "COM2:9600,0,7,1" FOR RANDOM AS #1
30 ON TIMER(1) GOSUB 300
40 A$ = INKEY$: IF A$ < > " " THEN GOTO 1000: REM "CHECK FOR KEYBOARD INPUT"
50 IF LOC(1) = 0 THEN 40 ELSE 80: REM CHECK FOR INPUT
60 IF LOC(1) = 0 THEN 80: REM "SKIP CLEARING OF BUFFER"
70 B$ = INPUT$(LOC(1), #1): REM "CLEAR BUFFER"
80 F = INP (MCR) AND 253: OUT MCR, F: REM "SET FOR RECEIVE MODE"
90 IF INP(LSR) < > TXEMPTY THEN 90: REM "WAIT UNTIL DONE TRANSMITTING"
100 TIMER ON
110 IF LOC(1) = 0 THEN 110
120 B$ = INPUT$(1, #1)
130 IF B$ = CHR$(10) THEN 160" REM "TO PREVENT DOUBLE SPACING ON PRINT"
140 PRINT B$;
160 IF NOT B$ = " " THEN GOTO 90
170 TIMER OFF
200 GOTO 40
300 TIMER OFF: RETURN 40
1000 D = INP(MCR) OR 2: OUT MCR, D: REM "SET FOR TRANSMIT MODE"
1010 PRINT #1, A$; : PRINT A$; : REM "PRINT KEYSTROKE"
1020 IF A$ = "*" THEN PRINT
1030 IF A$ = "*" THEN IF INP(LSR) < > TXEMPTY THEN 1030 ELSE GOTO 60
1040 A$ = INKEY$: IF A$ < > " " THEN GOTO 1000
1050 GOTO 1010
```

* *IBM is a registered trademark of International Business Machines.*

Serial Connections

When wiring the terminal block at the rear of the unit, refer to the label with the terminal description for installing each wire in its proper location. Only two transceiver wires and a common are needed.

The two data (transceiver) wires connect to the TX/RX(+) and TX/RX(-) terminals, appropriately.

The cable should consist of a shielded twisted pair and in some applications a signal ground may be required to establish a ground reference. The signal ground is required if the equipment does not have internal bias resistors connected to the RS-485 transceiver lines. The signal ground is connected at the RS-485 common of only one PSC unit to the RS-485 equipment. If necessary, the shield can be used as the signal ground.

The signal input common is isolated from the RS-485 common and the 4-20mA analog output "-" terminal.

Note: Do NOT connect any of the commons to the 4-20mA output "-" terminal.

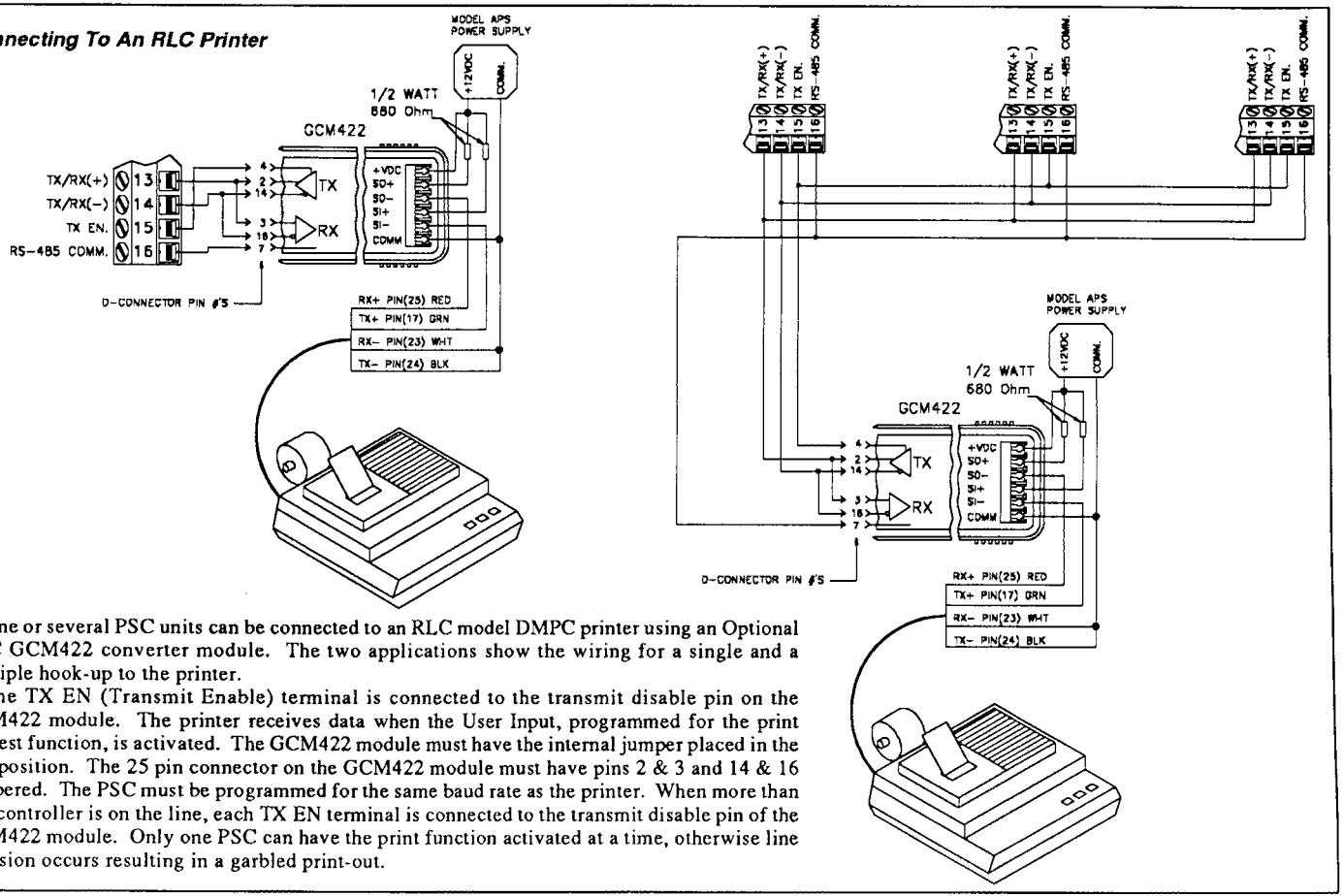
Terminal Descriptions

RS-485 COMM. - Common may be required for communication hook-up.

TX/RX (+) & TX/RX (-) - The PSC transmits and receives on these two terminals which are connected to the external device.

TX EN. - Used with a Red Lion Controls (RLC) GCM422 Serial Converter Module (RS422 to 20mA Loop). Otherwise not normally used.

Connecting To An RLC Printer

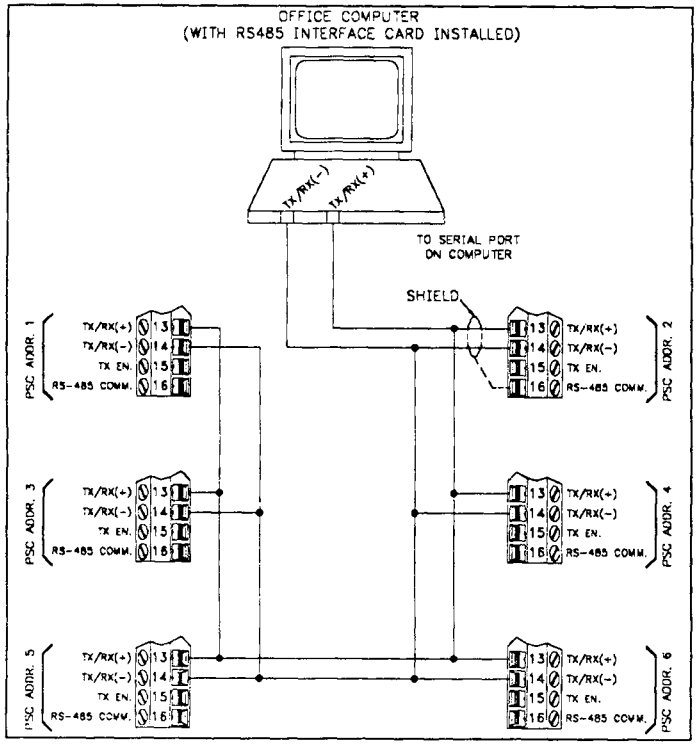


One or several PSC units can be connected to an RLC model DMPC printer using an Optional RLC GCM422 converter module. The two applications show the wiring for a single and a multiple hook-up to the printer.

The TX EN (Transmit Enable) terminal is connected to the transmit disable pin on the GCM422 module. The printer receives data when the User Input, programmed for the print request function, is activated. The GCM422 module must have the internal jumper placed in the 485 position. The 25 pin connector on the GCM422 module must have pins 2 & 3 and 14 & 16 jumpered. The PSC must be programmed for the same baud rate as the printer. When more than one controller is on the line, each TX EN terminal is connected to the transmit disable pin of the GCM422 module. Only one PSC can have the print function activated at a time, otherwise line collision occurs resulting in a garbled print-out.

Connecting To A Host Terminal

Six PSC units are used to control a process in a plant. The PSC units are located at the proper location to optimize the process. A communication line is run to an industrial computer located in the production office. The drawing shows the line connection. Each PSC is programmed for a different address and are all programmed for the same baud rate and parity as the computer (ex 9600 baud, parity even).



An application program is written to send and receive data from the units using the proper commands.

Troubleshooting Serial Communications

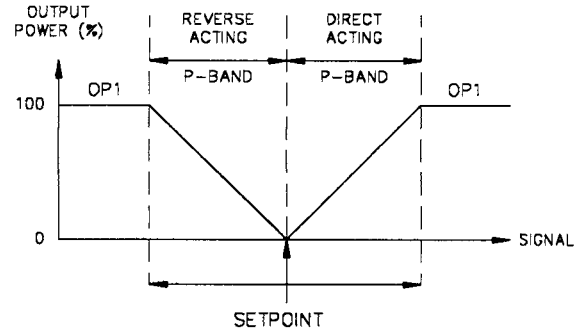
If problems are encountered when interfacing the PSC(s) and host device or printer, the following check list can be used to help find a solution.

1. Check all wiring. Refer to the previous application examples and use them as a guide to check your serial communication wiring. Proper polarity of all units and other peripherals must be observed.
2. If the PSC is connected to a "host computer", device or printer (other than the RLC DMPC), check to make sure that the computer or device is configured with the same baud rate and communication format as the PSC. The communication format the PSC will accept is; 1 start bit, 7 data bits, no parity or 1 parity bit (odd or even), and 1 stop bit.
3. Check the PSC's unit address. If the Address command is not used when transmitting a command to the PSC, the PSC's address must be set to 0. See "Sending Commands & Data" section for command structure.
4. If two-way communications are to be established between the PSC and a computer, have the computer receive transmissions from the PSC first. Activating the User Input, programmed for the print request function, will initiate transmissions from the PSC.
5. When sending commands to the PSC, an asterisk * (2Ah) must terminate the command. After system power-up an asterisk must first be sent to clear the PSC input buffer.
6. In multiple unit configurations, make sure each unit has a different address other than zero.
7. If all of the above has been done, try reversing the polarity of the transceiver wires between the PSC(s) and the RS-485 interface card. Some cards have the polarity reversed.

PID CONTROL

Proportional Band

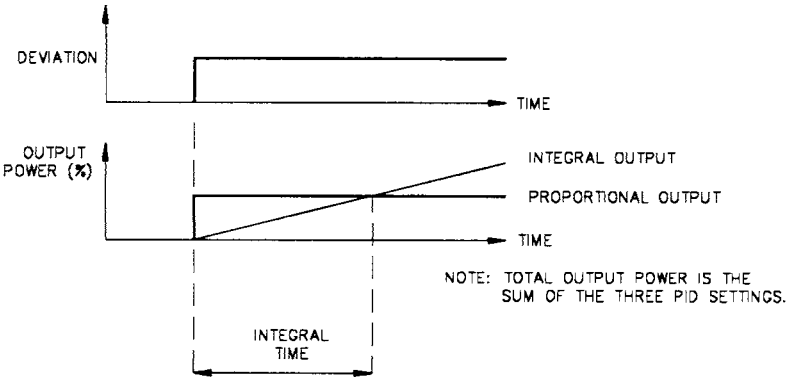
Proportional band is defined as the "band" of units the process changes to cause the percent output power to change from 0% to 100%. The band may or may not be centered about the setpoint value depending upon the steady state requirements of the process. The band is shifted by manual offset or integral action (automatic reset) to maintain zero error. Proportional band is expressed as percent of the scaled display range.



The proportional band should be set to obtain the best response to a disturbance while minimizing overshoot. Low proportional band settings (high gain) result in quick controller response at expense of stability and increased overshoot. Settings that are excessively low will produce continuous oscillations at setpoint. High proportional band settings (low gain) results in a sluggish response with long periods of process "droop". A proportional band of 0.0% forces the controller into ON/OFF control mode with its characteristic cycling at setpoint (see ON/OFF Control).

Integral Time

Integral time is defined as the time, in seconds, in which the output due to integral action alone equals the output due to proportional action with a constant process error. As long as a constant error exists, integral action will "repeat" the proportional action every integral time. Integral action shifts the center point position of the proportional band to eliminate error in the steady state. The units of integral time are seconds per repeat.



Integral action (also known as "automatic reset") changes the output power to bring the process to setpoint. Integral times that are too fast (small times) do not allow the process to respond to the new output value and, in effect, "over compensate" which leads to an unstable process with excessive overshoot. Integral times that are too slow (large times) produce a response which is sluggish to eliminate steady state errors. Integral action may be disabled by setting the time to 0. If done so, the previous integral output power value is maintained.

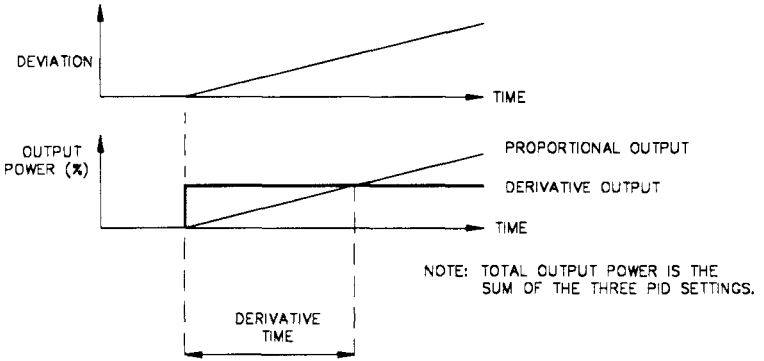
Integral Time (Cont'd)

If integral action is disabled (Automatic Reset), manual reset is available by modifying the output power offset ("OPOF" initially set to zero) to eliminate steady state errors. This parameter appears in unprotected parameter mode when integral time is set to zero. The controller has the feature to prevent integral action when operating outside the proportional band. This prevents "reset wind-up".

Note: The Proportional band shift due to integral action may itself be "reset" by temporarily setting the controller into the ON/OFF control mode (proportional band =0).

Derivative Time

Derivative time is defined as the time, in seconds, in which the output due to proportional action alone equals the output due to derivative action with a ramping process error. As long as ramping error exists, the derivative action will be "repeated" by proportional action every derivative time. The units of derivative time are seconds per repeat.



Derivative action is used to shorten the process response time and helps to stabilize the process by providing an output based on the rate of change of the process. In effect, derivative action anticipates where the process is headed and changes the output before it actually "arrives". Increasing the derivative time helps to stabilize the response, but too much derivative time coupled with noisy signal processes, may cause the output to fluctuate too greatly, yielding poor control. None or too little derivative action usually results in decreased stability with higher overshoots. No derivative action usually requires a wider proportional and slower integral times to maintain the same degree of stability as with derivative action. Derivative action is disabled by setting the time to zero.

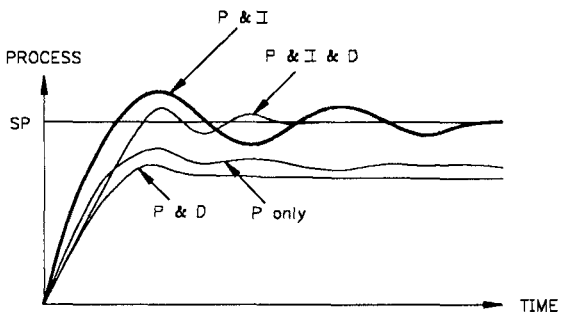
Output Power Offset (Manual Reset)

If the integral time is set to 0 (automatic reset is off), it may be necessary to modify the output power to eliminate errors in the steady state. The Output Power Offset (OPOF) is used to shift the proportional band to compensate for errors in the steady state. The output power offset (OPOF) parameter will appear in the unprotected mode, if the integral time = 0. If integral action (automatic reset) is later invoked, the controller continues from the previous output power offset and updates accordingly.

Pid Adjustments

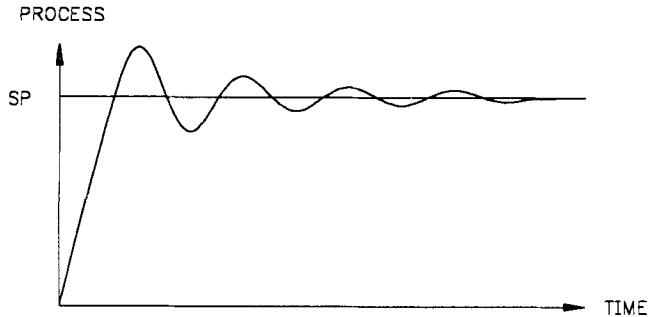
To aid in the adjustment of the PID parameters for improved process control, a chart recorder is necessary to provide a visual means of analyzing the process. Compare the actual process response to the PID response figures with a step change to the process. Make changes to the PID parameters in no more than 20% increments from the starting value and allow the process sufficient time to stabilize before evaluating the effects of the new parameter settings.

TYPICAL RESPONSE OF VARIOUS CONTROL MODES



PROCESS RESPONSE EXTREMES

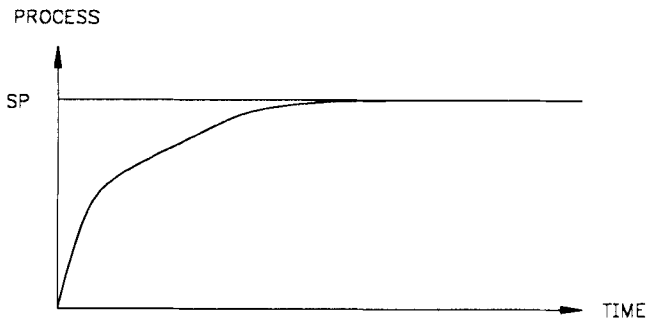
OVERSHOOT AND OSCILLATIONS



TO DAMPEN RESPONSE:

- INCREASE INTEGRAL TIME.
- USE SETPOINT RAMPING.
- USE OUTPUT POWER LIMITS.
- RE-INVOKE AUTO-TUNE WITH A HIGHER DAMPING CODE.
- INCREASE PROPORTIONAL BAND.
- INCREASE DERIVATIVE TIME.
- CHECK CYCLE TIME.

SLOW RESPONSE



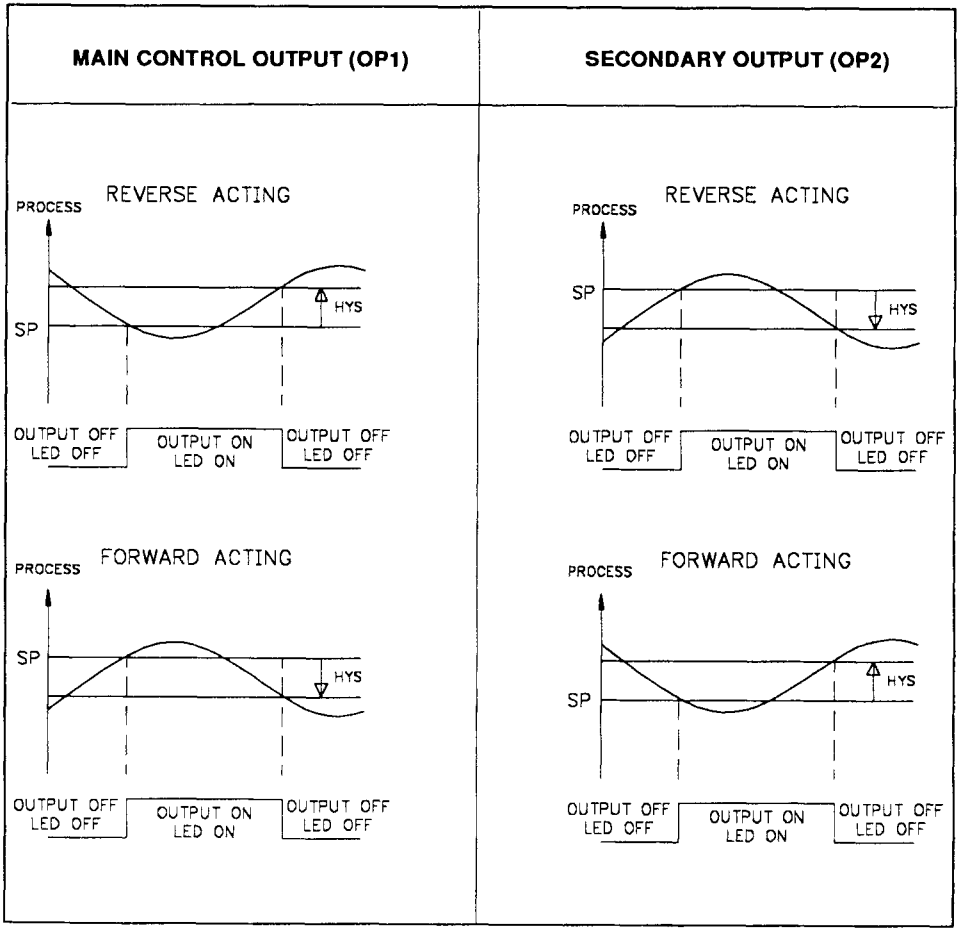
TO QUICKEN RESPONSE:

- DECREASE PROPORTIONAL BAND.
- INCREASE OR DEFEAT SETPOINT RAMPING.
- EXTEND OUTPUT POWER LIMITS.
- RE-INVOKE AUTO-TUNE WITH A LOWER DAMPING CODE.
- DECREASE INTEGRAL TIME.
- DECREASE DERIVATIVE TIME.

ON/OFF CONTROL

The controller can operate in the ON/OFF control mode by setting the proportional band = 0.0 The ON/OFF control hysteresis band (CHYS) parameter can be used to eliminate output chatter around setpoint. The secondary output can also be used in the ON/OFF control by setting the relative gain = 0.0

The phase of the control action can be reversed by the output control action parameter. ON/OFF control is usually characterized by significant temperature oscillations about the setpoint value. Large control hysteresis values makes the oscillations larger. ON/OFF control should only be used where the constant oscillations have little effect on the process.



ON/OFF CONTROL

ON/OFF and PID control can be used for the main output (OP1) and the secondary output (OP2) in several combinations. The following lists the *valid* control modes:

OP1 & OP2 VALID CONTROL MODES

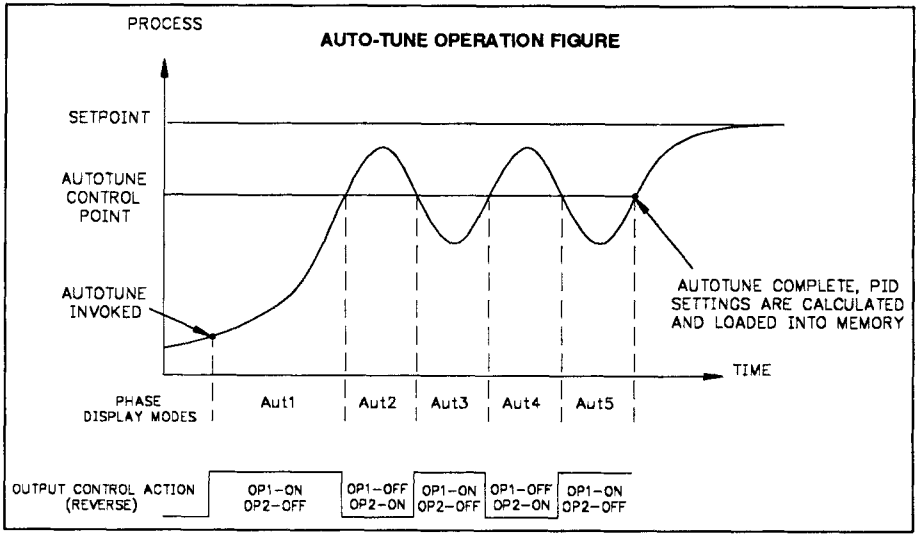
OP1 MODE	OP2 MODE	MANUAL MODE OUTPUT POWER RANGE	OP1 STATE	OP2 STATE
PID	—	0% to +100.0%	OP1-TP	—
ON/OFF (PrOP=0.0)	—	+100.0%	OP1-ON	—
		Any other setting	OP1-OFF	
PID	PID	-100.0% to +100.0%	OP1-TP	OP2-TP
PID	ON/OFF (GAN2=0.0)	0% to +100.0%	OP1-TP	OP2-OFF
		-100.0% to 0%	OP1-TP	OP2-ON
ON/OFF (PrOP=0.0)	ON/OFF (GAN2=0.0)	+100.0%	OP1-ON	OP2-OFF
		-100.0%	OP1-OFF	OP2-ON
		Any other settings	OP1-OFF	OP2-OFF

TP - Time Proportioning
Note: In manual mode, the % output power is not limited to the output power limits (OPLO & OPHI).

AUTO-TUNE

Auto-Tune is a user initiated function in which the controller automatically determines the optimum PID settings based upon the process characteristics. The desired process setpoint should be entered first. Auto-Tune may then be initiated at start-up, from setpoint, or at any other process value point.

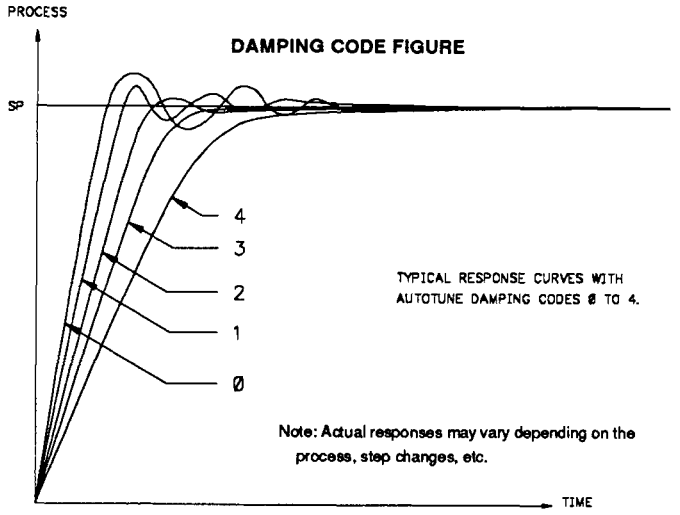
After Auto-Tune is complete, the PID settings remain constant until user modified. As shown in the Auto-Tune Operation figure, Auto-Tune cycles the process at a control point 3/4 of the distance between the current process signal value where Auto-Tune was initiated and the setpoint. The 3/4 control point was selected to reduce the chance of signal overshoot at setpoint when Auto-Tuning at start-up. If Auto-Tuning from setpoint and signal overshoot is unacceptable, place the controller in the user (manual) mode and reduce the power to lower the process signal value. Allow the process to stabilize and execute Auto-Tune from the lower process value. After starting Auto-Tune, the secondary display indicates the current phase (Aut1, Aut2, Aut3, Aut4, & Aut5). If the controller remains in an Auto-Tune phase unusually long, the process or connections may be faulty. Auto-Tune may be terminated at any time without disturbing the previous PID constants. As an alternative to Auto-Tuning, the manual tuning procedure can be used to give satisfactory results.



Prior to initiating Auto-Tune, it is essential that the controller be configured to the application. In particular, control hysteresis (CHYS) and Auto-Tune damping code (tcod) must be set in the Output Parameters section. Generally, control hysteresis of 2-5 units is adequate. The damping code may be set to yield the response characteristics shown in the damping code figure.

A damping code setting of 0 gives the fastest response with some overshoot, and a code of 4 gives the slowest response with minimum overshoot.

For systems using the secondary output, use a damping code of 1 or 2. The relative gain (Gan2) and deadband overlap (db-2) must be set by the user (the controller will not alter these parameters). (See Secondary section for adjustment of these parameters). During Auto-Tune, it is important that external load disturbances be minimized, and if present, other zone controllers idled as these will have an effect on the PID constant determination. Keep in mind for large systems with long time constants, Auto-Tune may take hours to complete.



To Initiate Auto-Tune:

Make sure that Auto-Tuning is enabled in parameter lockouts module.
Place the controller into the normal display mode.
Press PAR for 3 seconds from normal display mode.
Scroll to "tUNE" by use of PAR, if necessary.
Select "YES" and press PAR.
Auto-Tune is initiated.

To Cancel Auto-Tune: (Old PID settings remain in effect).

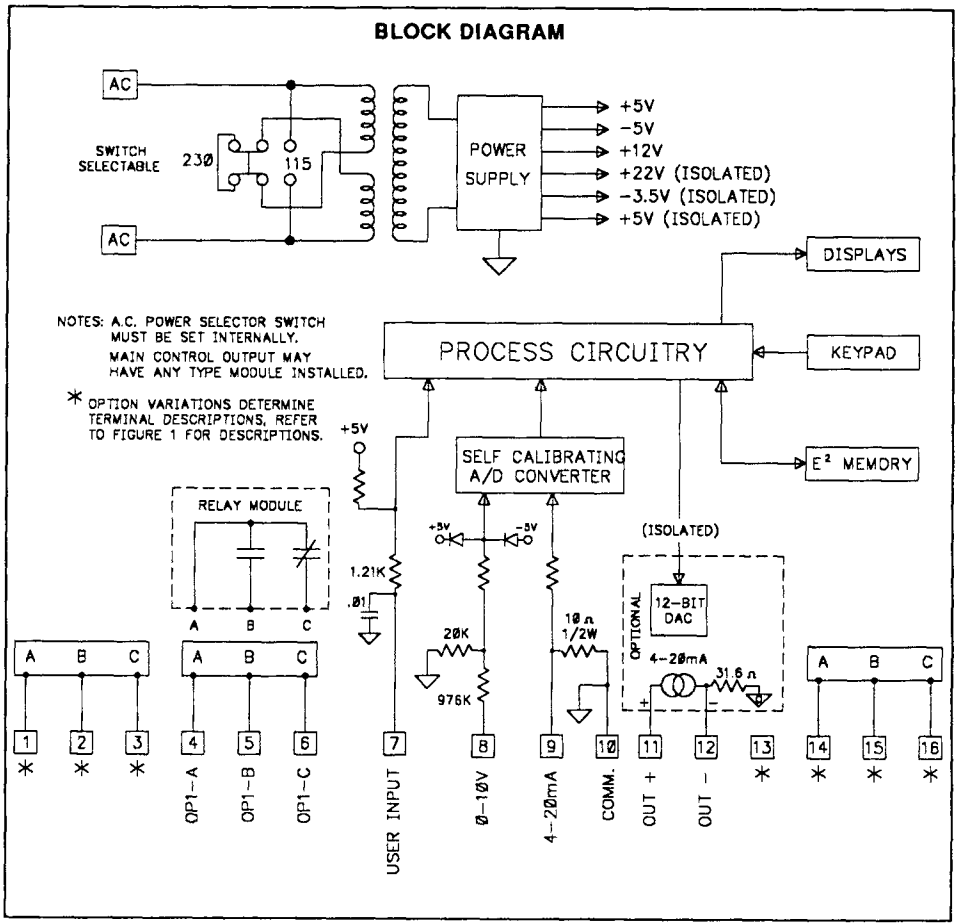
A) Make sure that Auto-Tuning is enabled in parameter lockouts module.
Place the controller into the normal display mode.
Press PAR for 3 seconds from normal display mode.
Scroll to "tUNE" by use of PAR, if necessary.
Select "NO" and press PAR.
Auto-Tune canceled.

B) Or reset the controller by disconnecting AC power.

Note: If using the linear DC output (4-20mA) for control, full power will be applied (+100% OP1 or -100% OP2) regardless of the output power limit settings.

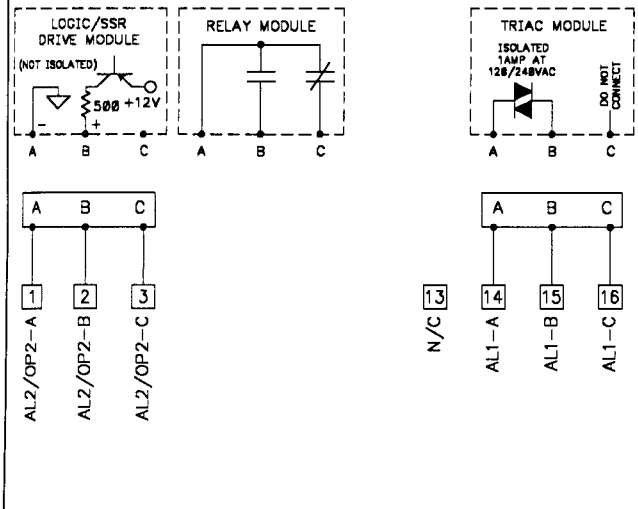
APPENDIX "A" - THEORY OF OPERATION

The PSC reads the input signal from the transducer and scales the signal for the main display. The PSC controls a profile by comparing the scaled process value to the setpoint profile in progress, and calculates the output power value by use of a modified PID control algorithm. The unit then outputs the new control value to the system under control to conform the process to the profile. The PID control algorithm incorporates features which provide good process control and reduced overshoot to minimize process errors. The input signal is filtered by a low-pass filter to increase stability and then is converted to a digital code by a precise analog to digital conversion process. The 4-20mA linear DC current output option features digital scaling and is isolated from controller common. All controller parameters are permanently stored in non-volatile E²PROM. An AC power selector switch permits operation from 115 or 230VAC supplies.



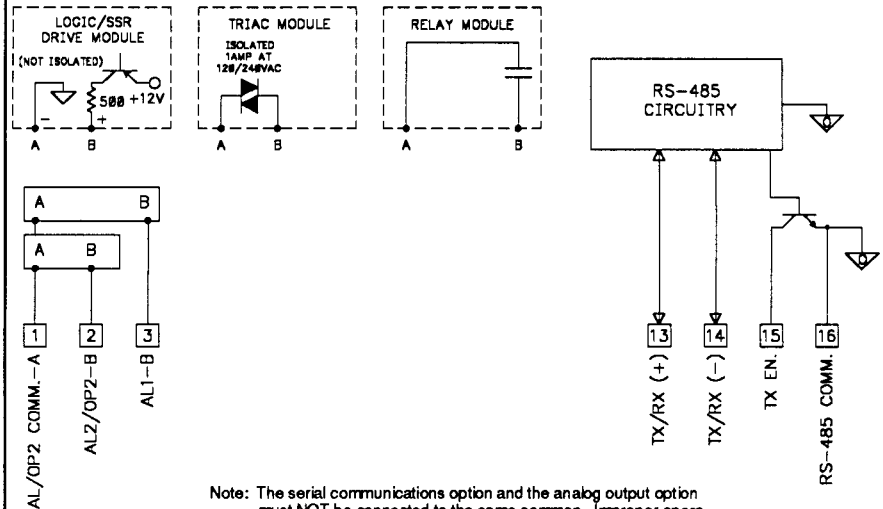
PSC W/O RS-485 OPTION

ANY OUTPUT MODULE (RELAY, LOGIC/SSR DRIVE, OR TRIAC)
MAY BE USED IN ANY OUTPUT SOCKET
(OP1, AL1, OR AL2/OP2).



PSC W/ RS-485 OPTION

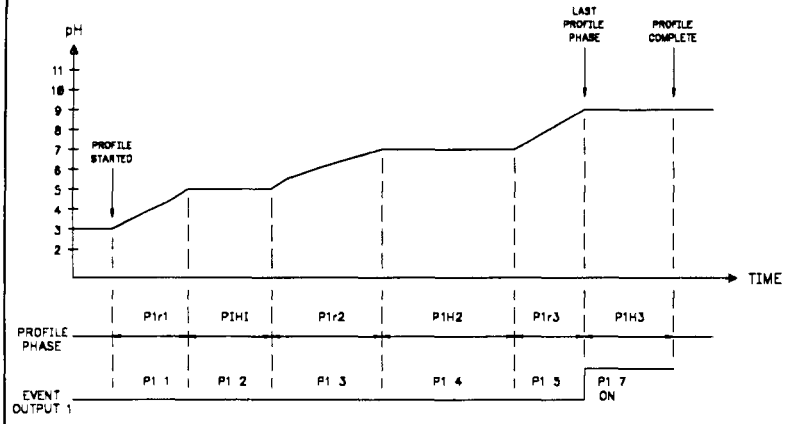
ANY TYPE OUTPUT MODULE (RELAY, LOGIC/SSR DRIVE, OR TRIAC)
MAY BE INSTALLED IN OUTPUT OP1
THE DUAL ALARM OR SECONDARY WALARM OPTION MUST
HAVE THE SAME TYPE MODULE INSTALLED,
SINCE THEY SHARE THE SAME COMMON TERMINAL.

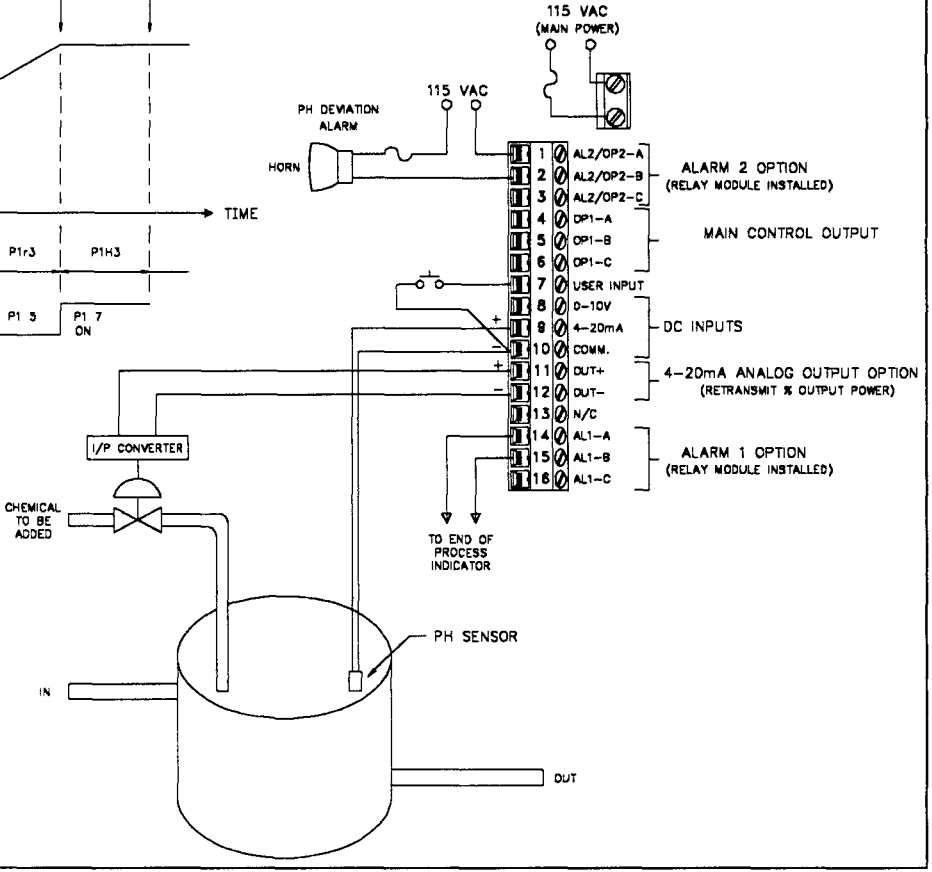


Note: The serial communications option and the analog output option must NOT be connected to the same common. Improper operation of the analog output may result if connected.

Figure 1

APPENDIX "B" - APPLICATION EXAMPLE





PSC Chemical Treatment Process Application

A chemical treatment process requires the pH of a solution be ramped at staged levels over specific time periods during start-up. The PSC unit is installed to meet this requirement.

After the tank is filled, the PSC's user input is triggered to run profile 1 to start the process. Alarm output 2 signals the operator if the PH level deviates outside the running profile. The error band (profile conformance) is programmed to the desired value to prevent the pH from deviating from the programmed setpoint profile. Timed event output 1 signals that the profile has reached the last phase of the process.

APPENDIX "C" - SPECIFICATIONS AND DIMENSIONS

1. DISPLAY: Dual 4-digit
Upper Process Display: 0.4" (10.2mm) High Red LED
Lower Auxiliary Display: 0.3" (7.6mm) High Green LED
Display Messages:

"OLOL"	-	Appears when measurement exceeds +105% of input range.
"ULUL"	-	Appears when measurement exceeds -5% of input range.
"SENS"	-	Appears when measurement exceeds "OLOL" and "ULUL" range.
"...."	-	Appears when display value exceeds + display range.
"-..."	-	Appears when display value exceeds - display range.

2. ANNUNCIATORS:
6 LED Backlight Status Indicators:

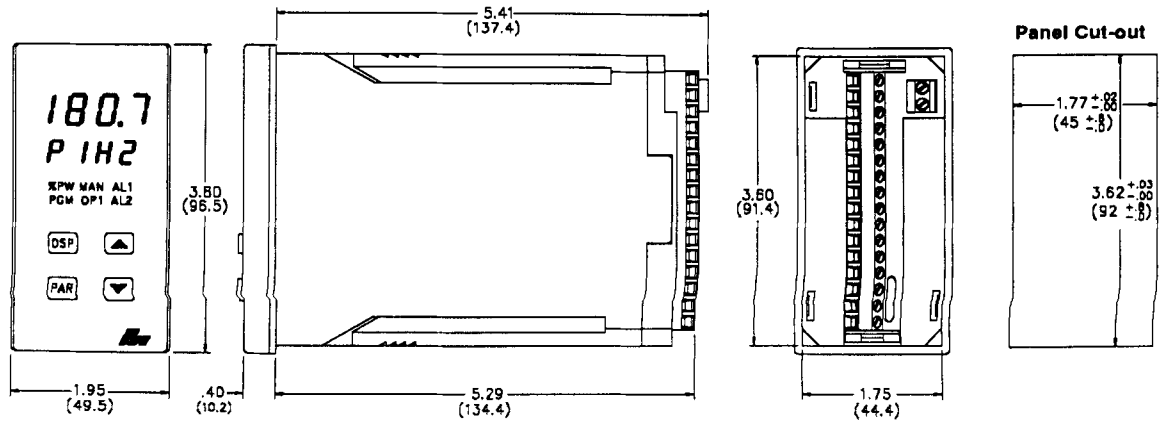
%PW	-	Lower auxiliary display shows power output in (%).
PGM	-	Lower auxiliary display shows profile status or profile time remaining.
MAN	-	Controller is in manual mode.
OP1	-	Main control output is active.
AL1	-	Alarm #1 is active.
AL2	-	Alarm #2 is active (For dual alarm option).
OP2	-	Secondary output is active (For secondary option).

3. CONTROLS: Four front panel push buttons for modifying and setup of controller functions and one external input.

4. SETPOINT PROFILE:
Profiles: 4
Segments Per Profile: 8 ramp/hold segments *(linkable to 32 segments)*.
Ramp Rate: 0.1 to 999.9 units/minute or no ramp.
Hold Time: Off or from 0.1 to 999.9 minutes, can be extended to 500 hours by linking.
Error Band Conformity: Off or from 1 to 9999 units deviation, + value for hold phases, - value for both ramp and hold phases.
Power-On Modes: Stop, auto-start, or profile resume.
Start Mode: Ramps from process value.
Program Auto Cycle: 1 to 249, or continuous.
Event Outputs: 2, time activated with profile [uses Alarm output(s)].
Control: Front panel buttons, user input, or RS-485 communications.

DIMENSIONS In Inches (mm)

Note: Recommended minimum clearance (behind the panel) for panel latch installation is 5.5" (140)H x 2.1" (53.4)W.



5. CONTROL POINTS:
Setpoints: 4
PID gain sets: 4
Control: Front panel buttons or user input.

6. SIGNAL INPUT:
Sample Period: 100mS
Response Time: 300mS *(to within 99% of final value w/step input).*
Signal Overdrive Threshold:
10V Range: 13V
20mA Range: 26mA
Signal Overdrive Response:
Main Control Output: Programmable preset output.
Display: "SENS".
DC Linear: Programmable preset output.
Normal Mode Rejection: 40db @ 50/60Hz
(improves with increased digital filtering).
Common Mode Rejection: 100db, DC to 50/60 Hz.

7. RANGE AND ACCURACY:

Signal Range	Accuracy (% of Unscaled Reading)	Maximum Input	Input Impedance	Resolution
0-10VDC	+/-(0.15% + 3mV)	300VDC	1MΩ	10mV
0-20mADC	+/-(0.15% + 6μA)	200mADC	10Ω	10μA

8. OUTPUT MODULES (For All Output Channels):
(Optional - Must be ordered separately)
Relay:
Type: Form-C *(Form-A with RS-485 option)*
Rating: 5 Amps @ 120/240VAC or 28VDC *(resistive load),*
1/8 HP @ 120VAC *(inductive load).*
Life Expectancy: 100,000 cycles at maximum rating.
(Decreasing load and/or increasing cycle time, increases life expectancy).
Logic/SSR Drive: Can drive up to three SSR Power Units.
Type: Non-isolated switched DC, 12VDC typ
(internal 500Ω resistance).
Drive: 10mA max. (400Ω external load).
Protection: Short-circuit protected.
Triac:
Type: Isolated, Zero Crossing Detection.
Ratings:
Voltage: 120/240VAC
Max Load Current: 1 AMP @ 35°C
0.75 AMP @ 50°C
Min Load Current: 10mA
Off State Leakage Current: 7mA MAX.
Operating Frequency: 20 to 500Hz
Protection: Internal Transient Snubber, Fused.

9. 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 performed, sets proportional band, integral time, and derivative time values.
Signal Overdrive Action: Programmable.

10. 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.

11. LINEAR DC DRIVE (Optional):
Type: Linear 4-20mA with digital scale and offset.
Compliance: 10V (500Ω max. loop impedance).
Resolution: 11 bits.
Accuracy: ±(0.1% of reading + 25μA).
Source: % output power, setpoint, deviation, or process value.
(Available for OP1 or OP2, but not both.)

12. **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
Timed event output(s)
Reset Action: Programmable; automatic or latched.
Delay: Programmable; enable or disable.
Hysteresis: Programmable.
Annunciator: LED backlight for "AL1", "AL2",
(Alarm #2 not available with secondary output).

13. **SERIAL COMMUNICATIONS (Optional):**
Type: RS-485 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 0-99, maximum of 32 units per line.
Transmit Delay: 100msec Minimum, 200msec Maximum.
RS-485 Common: Isolated from signal input common.
Auto Print Time: Off to 9999 seconds between print-outs.

14. **USER INPUT:** V_{IN} Max = 5.25VDC, V_{IL} = .85V_{MAX}; V_{IH} = 2.0V_{MIN}.
Response time: 100msec maximum.
Functions:

Program Lock	Print Request
Integral Action Lock	Load Control Point
Auto/Manual Transfer	Run/Hold Profile 1
Setpoint Ramp Select	Run/Stop Profile 1
Reset Alarms	

15. **POWER:** 115/230 VAC (+10%, -15%) no observable line variation effect, 48-62 Hz, 10VA, switch selectable.
16. **TEMPERATURE EFFECTS:**
Operating Range: 0° to 50°C
Storage Range: -40° to 80°C
Span Drift: 90 ppm/°C
Zero Drift: 0-10VDC Range - 0.2mV/°C
4-20mA DC Range - 0.5µA/°C
Relative Humidity: Less than 85%RH
17. **CONNECTION:** Jaw-type terminal block.
18. **CONSTRUCTION:**
Front Panel: Flame and scratch resistant tinted plastic.
Case: High impact black plastic. (Mounting collar included).
NEMA 4X/IP65 model only: Sealed bezel utilizing 2 captive mounting screws (panel gasket included).
19. **WEIGHT:** 1.3 lbs. (.6 kgs)

Accessory:
External SSR Power Unit:
Switched Voltage Range: 50 to 280VAC *(Nominal: 240VAC)*
Load Current: 45 Amps @ 25°C ambient temperature
35 Amps @ 50°C ambient temperature
On State Input: 3 to 32VDC @ 1500Ω impedance. *(isolated)*
(Use Logic/SSR drive output module)
Off State Input: 0.0 to 1.0 VDC
Size: 5.5" (14cm)L x 4.75" (12cm)W x 2.62" (6.6cm)H

APPENDIX "D" - TROUBLESHOOTING

The majority of problems can be traced to improper connections or incorrect set-up parameters. Be sure all connections are clean and tight, that the correct output module is fitted, and that the set-up parameters are correct.

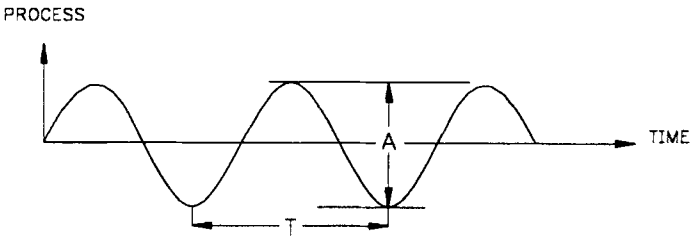
Problems	Possible Cause	Remedies
NO DISPLAY	1. Power off 2. Voltage selector switch in the wrong position. 3. Brown out condition 4. Loose connection or improperly wired. 5. Bezel assembly not fully seated into rear of unit.	1. Check power. 2. Check selector switch position. 3. Verify power reading. 4. Check connections. 5. Check installation.
INDICATOR NOT WORKING	1. Incorrect parameter set-up	1. Check set-up parameters. a. Power-up unit for self-test.
"E-FP" IN DISPLAY	1. Defective front panel button.	1. Press DSP to escape, then check all buttons for proper operation. 2. Replace unit.
"E-UP" IN DISPLAY	1. Internal problem with controller.	1. Replace unit.
"E-E2" IN DISPLAY	1. Loss of set-up parameters due to noise spike.	1. Press DSP to clear then check ALL set-up parameters. a. Check sensor input & AC line for excessive noise. b. If fault persists, replace unit.
"...." or "-..." IN DISPLAY	1. Input display out of range. 2. Loss of set-up parameters.	1. Check unit scaling. 2. Check set-up parameters.
"OLOL" IN DISPLAY	1. Input signal overload. 2. Loss of set-up parameters.	1. Check input signal level. 2. Check set-up.
"ULUL" IN DISPLAY	1. Input signal underload. 2. Loss of set-up parameters.	1. Check input signal level. 2. Check set-up parameters.

Problems	Possible Cause	Remedies
DISPLAY INCORRECT OR DISPLAY WANDERS	1. Lose or corroded connections. 2. Signal source in noisy environment. 3. Controller needs calibration.	1. Check connections. 2. Evaluate signal source location. a. Increase digital input filtering. 3. Check calibration. (See Appendix "F" Calibration Accuracy)
PROCESS NOT STABLE OR SLUGGISH	1. Incorrect PID values.	1. See PID CONTROL.
OUTPUTS NOT WORKING	1. Improperly wired. 2. Incorrect output module. 3. Defective output module.	1. Check wiring. 2. Check output module. 3. Check or replace output module.
LINEAR DC OUTPUT NOT WORKING	1. Too high load resistance. 2. Incorrect programming or scaling. 3. Connections reversed. 4. DC voltage source in loop.	1. Check that maximum load resistance is < 500Ω (10V). 2. Check programming. 3. Check connections. 4. This is an active loop. Remove all DC voltage sources.
CONTROLLER LOCKS UP OR RESETS	1. Noise spikes entering controller due to load switching transients. 2. Defective controller.	1. a. Use Triac output module, if possible. b. Use RC snubbers or similar noise suppressors at load point. (Do NOT use at the controller.) c. Use separate AC feed line to controller. d. Locate controller & signal lines away from noise producing mechanisms (solenoids, transformers, relays, etc.). e. See "Installation Considerations Of Electronic Instruments Controls In Industrial Environments" in RLC catalog. 2. Replace unit.

APPENDIX "E" - MANUAL TUNING

An alternative to Auto-Tuning is manual tuning. The following is a manual tuning procedure for determination of the PID control constants. The method described here is an adaptation of the Ziegler-Nichols Closed Loop Cycling procedure first presented in 1942. This method induces process oscillations, therefore, exercise caution for sensitive systems.

1) Connect a chart recorder to log the process value and set chart speed appropriate for the process.
2) Set proportional band (ProP) to 20.0%.
3) Set integral time (Intt) and derivative time (dErt) to 0.
4) Slowly decrease proportional band (increase controller gain) until process just BEGINS to oscillate. Allow adequate time for the process to respond. If oscillations appear to grow, increase proportional band. Adjust the proportional band until steady oscillations appear.
5) Note the peak-to-peak amplitude of the cycle (A) and multiply it by the desired response, then divide by the full range of the sensor, to obtain the Proportional Band value.
   The period of oscillation (T) is multiplied by the desired response to obtain the desired Integral Time and Derivative Time values.



Parameter	Fast response	Damped response	Slow response
Proportional band	1.0 x A/RANGE	1.4 x A/RANGE	2.0 x A/RANGE
Integral time	0.6 x T	1.0 x T	2.0 x T
Derivative time	0.15 x T	0.25 x T	0.25 x T

APPENDIX "F" - CALIBRATION

Calibration Check

The instrument has been fully calibrated at the factory for the voltage and current inputs. If the unit appears to be indicating or controlling incorrectly, refer to the troubleshooting section before attempting this procedure.

If the controller is suspected of reading incorrectly, the instrument may be checked for indication accuracy without disturbing the factory calibration. The three parameters to be checked are: voltage reading, mA reading, and the 4-20 linear mA output. The following procedures may be used for this purpose.

NOTE: Allow 1/2 hour warm-up before checking these parameters.

Voltage Reading Check

1) Connect a DC volt source with an accuracy of 0.01% or better to terminal #8 (+) and terminal #10 (-).
2) Advance to the configuration parameter modules from the normal display mode.
3) Select the controller to indicate voltage (VOLt), in the input parameter module.
4) Press the "PAR" key until "INP 1" appears in the main display.
5) Press the "DSP" key, once, the "%PW" & "DEV" annunciators will flash.
6) The secondary display will indicate the voltage applied at Terminals 8 & 10.
7) Compare the controller readout to the standard at various points over the range (0-10V). The tolerance is 0.15% of reading +/- 1LSD.
8) Calibrate the controller if the readings are out of tolerance.

Current Reading Check

1) Connect a current source with an accuracy of 0.01% or better to terminal #9 (+) and terminal #10 (-).
2) Advance to the configuration parameter modules from the normal display mode.
3) Select the controller to indicate current (Curr), in the input parameter module.
4) Press the "PAR" key until "INP 1" appears in the main display.
5) Press the "DSP" key, once, the "%PW" & "DEV" annunciators will flash.
6) The secondary display will indicate the current applied at Terminals 9 & 10.
7) Compare the controller readout to the standard at various points over the range (4-20mA). The tolerance is 0.15% of reading +/- 1LSD.
8) Calibrate the controller if the readings are out of tolerance.

Linear mA Output Check

1) Connect an ammeter to the linear output (#11 & #12) with an accuracy of 0.1% or better
2) Set "ANAS" (analog assignment) to "INP", in configure input parameters.
3) Drive the input signal level below the programmed "ANLO" value. Check for 4mA (+/- .02mA).
4) Drive the input signal level above the programmed "ANHI" value. Check for 20mA (+/- .03mA).
5) Calibrate the controller linear mA output if out of tolerance.

Calibration

When re-calibration is required (generally every two years), this procedure should only be performed by qualified technicians using appropriate equipment. Equipment source accuracies of 0.01% or better are required.

The procedure consists of three parts: applying accurate voltage signals, applying precision mA currents and measuring accurate mA currents. Allow a 30 minute warm-up period before starting this procedure.

This procedure may be aborted by disconnecting power to the controller before exiting the configuration mode. The existing calibration will remain in affect.

Configure Step 9 - Factory Service Operations (9-FS)

Display	Parameter	Description/Comments	
Code	Enter factory service function code	48	Calibrate instrument
CAL	Voltage & current calibration	yes/no	Calibration of voltage input is done first.

Voltage And Current Calibration

Connect precision voltage source with an accuracy of 0.01% to terminals (+) #8 and (-) #10 for voltage calibration.

Display	Parameter	Description/Comments
StP1	0.000V step	Apply 0.000V, wait 10 seconds, press PAR
StP2	1.667V step	Apply 1.667V, wait 10 seconds, press PAR
StP3	3.333V step	Apply 3.333V, wait 10 seconds, press PAR
StP4	5.000V step	Apply 5.000V, wait 10 seconds, press PAR
StP5	6.667V step	Apply 6.667V, wait 10 seconds, press PAR
StP6	8.333V step	Apply 8.333V, wait 10 seconds, press PAR
StP7	10.000V step	Apply 10.000V, wait 10 seconds, press PAR
Stp-	Pause	The controller will impose a 5 sec. delay. *(Keep the 10.000V signal applied)* The unit will automatically advance to StPA.
Connect a precision current source with an accuracy of 0.01% to terminals (+) #9 and (-) #10, for current calibration when step A appears.		
StPA	0.000 mA	Apply 0.000mA, wait 10 seconds, press PAR
StPB	20.000 mA	Apply 20.000mA, wait 10 seconds, press PAR
—	—	The unit automatically advances to analog output calibration if the option is installed.

Analog Output Calibration (ANCL)

Connect precision ammeter (0.1% accuracy) to rear terminals (+) #11 and (-) #12.

Display	Parameter	Description/Comments
ANCL	4-20mA analog output calibration	yes/no This parameter will not appear if analog output option is not installed.
ANC1	Analog output 4mA code value	Observe current reading. If 4.00 mA, press PAR. If not equal, modify existing code value using up & down buttons to achieve 4.00 mA. Press PAR.
ANC2	Analog output 20mA code value	Observe current reading. If 20.00 mA, press PAR. If not equal, modify existing code value using up & down buttons to achieve 20.00 mA. Press PAR.

APPENDIX "G" - USER PARAMETER VALUE CHART

Unit Number _____

Mnemonic	Parameter	User Setting
SP	Setpoint	
OPOF	Output Power Offset	
OP	Output Power	
ProP	Proportional Band	
Intt	Integral Time	
dErt	Derivative Time	
AL-1	Alarm 1	
AL-2	Alarm 2	

Configure Input

tYPE	Input Type	
dCPt	Decimal Point	
rnd	Rounding Increment	
FLtr	Digital Filtering	
dSP1	Display Value 1	
INP1	Signal Input Value 1	
dSP2	Display Value 2	
INP2	Signal Input Value 2	
SPLO	Setpoint Lower Limit	
SPHI	Setpoint Upper Limit	
SPrP	Ramp Rate	
InPt	User Input	

Configure Output

CYCt	Cycle Time	
OPAC	Control Action	
OPLO	Output Power Lower Limit Range	
OPHI	Output Power Upper Limit Range	
OPFL	Sensor Fail Power Preset	
CHYS	ON/OFF Control Hysteresis	
tcod	Auto-Tune Damping Code	
ANAS	4-20mA Output Assignment	
ANLO	4mA Value	
ANHI	20mA Value	

Configure Lockouts

Mnemonic	Parameter	User Setting
SP	Access Setpoint	
OP	Access Output Power	
P-cs	Access Profile Status	
P-tr	Access Time Remaining	
UdSP	Access Display Units	
Code	Access Code Number	
PID	Access PID Values	
AL	Access Alarm(s) Values	
ALrS	Enable Reset Alarm(s)	
CPAC	Enable Control Points	
PrAC	Enable Profile Status	
trnF	Enable Auto/Man Transfer	
tUNE	Enable Auto-Tune	

Configure Alarms

Act1	Alarm 1 Operation Mode	
rSt1	Alarm 1 Reset Mode	
Stb1	Alarm 1 Standby Enabled	
AL-1	Alarm 1 Value	
Act2	Alarm 2 Operation Mode	
rSt2	Alarm 2 Reset Mode	
Stb2	Alarm 2 Standby Enabled	
AL-1	Alarm 2 Value	
AHYS	Alarm Hysteresis Value	

Configure Secondary Output

CYC2	OP2 Cycle Time	
GAN2	Relative Gain	
db-2	Overlap/Deadband	

Configure Serial Communications

Mnemonic	Parameter	User Setting
bAUd	Baud Rate	
PArb	Parity Bit	
Addr	Unit Address	
Abrv	Abbrev. or Full Transmission	
PrAt	Automatic Print Rate	
PoPt	Print Options	
	INP	
	SEt	
	OPr	
	Pbd	
	INt	
	dEr	
	AL1	
	AL2	
	dEv	
	OFP	
	r-P	
	Crg	
	Cdb	
	P-t	
	P-s	

APPENDIX "G" - USER PARAMETER VALUE CHART (Cont'd)

Configure Control Points

Mnemonic	Parameter	User Setting CP-1	CP-2	CP-3	CP-4
SP	Setpoint Value				
PID	YES/NO Load With Setpoint Value				
Pb	Proportional Band				
It	Integral Time				
dt	Derivative Time				

Configure Profiles

Mnemonic	Parameter	Pr-1	Pr-2	Pr-3	Pr-4
PnCC	Profile Cycle Count				
PnIn	Profile Link				
PnSt	Profile Status				
PnEb	Profile Error Band				
Pnr1	Profile Ramp Rate 1				
PnI1	Profile Setpoint Level 1				
PnH1	Profile Hold Time 1				
Pnr2	Profile Ramp Rate 2				
PnI2	Profile Setpoint Level 2				
PnH2	Profile Hold Time 2				
Pnr3	Profile Ramp Rate 3				
PnI3	Profile Setpoint Level 3				
PnH3	Profile Hold Time 3				
Pnr4	Profile Ramp Rate 4				
PnI4	Profile Setpoint Level 4				
PnH4	Profile Hold Time 4				
Pnr5	Profile Ramp Rate 5				
PnI5	Profile Setpoint Level 5				
PnH5	Profile Hold Time 5				
Pnr6	Profile Ramp Rate 6				
PnI6	Profile Setpoint Level 6				

Mnemonic	Parameter	User Setting Pr-1	Pr-2	Pr-3	Pr-4
PnH6	Profile Hold Time 6				
Pnr7	Profile Ramp Rate 7				
PnI7	Profile Setpoint Level 7				
PnH7	Profile Hold Time 7				
Pnr8	Profile Ramp Rate 8				
PnI8	Profile Setpoint Level 8				
PnH8	Profile Hold Time 8				

Configure Timed Event Outputs

		PE-1	PE-2	PE-3	PE-4
Pn 1	Event 1				
Pn 2	Event 2				
Pn 3	Event 3				
Pn 4	Event 4				
Pn 5	Event 5				
Pn 6	Event 6				
Pn 7	Event 7				
Pn 8	Event 8				
Pn 9	Event 9				
Pn 10	Event 10				
Pn 11	Event 11				
Pn 12	Event 12				
Pn 13	Event 13				
Pn 14	Event 14				
Pn 15	Event 15				
Pn 16	Event 16				

Controller Operating Mode

Automatic or Manual _____

Auto-Tune Invoked at _____

APPENDIX "H" - ORDERING INFORMATION

MODEL NO.	DESCRIPTION	NEMA 4X/IP65 BEZEL	4-20mA ANALOG OUTPUT	DUAL ALARM	SECONDARY OUTPUT W/ALARM	RS-485 COMM. W/ USER INPUT	PART NUMBERS 115/230VAC
PSC	Process Setpoint Controller	NO	YES	YES	NO	NO	PSC01001
		NO	YES	NO	YES	NO	PSC01002
		NO	YES	YES*	NO	YES	PSC01004
		NO	YES	NO	YES*	YES	PSC01005
		YES	YES	YES	NO	NO	PSC11001
		YES	YES	NO	YES	NO	PSC11002
		YES	YES	YES*	NO	YES	PSC11004
		YES	YES	NO	YES*	YES	PSC11005
—	Relay Module						OMD00000
—	Triac Module						OMD00001
—	Logic/SSR Drive Module						OMD00003
PMK5	Panel Mount Adapter Kit (1/4DIN to 1/8DIN)						PMK50000
—	SSR Power Unit						RLY50000

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) and secondary output. The controller can be fitted with any combination of output modules that do not have the RS-485 option.

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 a line voltage.

* *Units equipped with the RS-485 must have the Dual Alarm or Secondary w/Alarm options fitted with the same type output modules (the Main Output OP1 may be fitted with any type of output module).*

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

LIMITED WARRANTY

The Company warrants the products it manufactures against defects in materials and workmanship for a period limited to one year from the date of shipment, provided the products have been stored, handled, installed, and used under proper conditions. The Company's liability under this limited warranty shall extend only to the repair or replacement of a defective product, at The Company's option. The Company disclaims all liability for any affirmation, promise or representation with respect to the products.

The customer agrees to hold Red Lion Controls harmless from, defend, and indemnify RLC against damages, claims, and expenses arising out of subsequent sales of RLC products or products containing components manufactured by RLC and based upon personal injuries, deaths, property damage, lost profits, and other matters which Buyer, its employees, or sub-contractors are or may be to any extent liable, including without limitation penalties imposed by the Consumer Product Safety Act (P.L. 92-573) and liability imposed upon any person pursuant to the Magnuson-Moss Warranty Act (P.L. 93-637), as now in effect or as amended hereafter.

No warranties expressed or implied are created with respect to The Company's products except those expressly contained herein. The Customer acknowledges the disclaimers and limitations contained and relies on no other warranties or affirmations.



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