FPC - 3T

PPI
The Perfection Experts

Flame-Proof Temperature Controller
with
Programmable Alarm

User Manual

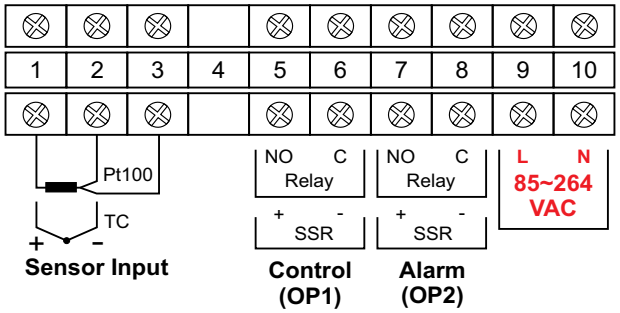
CONTENTS

Section 1
ELECTRICAL CONNECTIONS

WARNING
MISHANDLING / NEGLIGENCE CAN RESULT IN PERSONAL DEATH OR SERIOUS INJURY.

Fixed screw type terminal blocks are provided for making electrical connections as shown in figure 1.1 below.

Figure 1.1

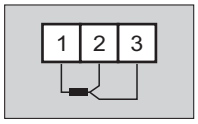


SENSOR INPUT

The controller accepts Thermocouples (J or K Type) and RTD Pt100 Sensor. Connect Thermocouple or RTD Pt100 as described below.

RTD Pt100, 3-wire

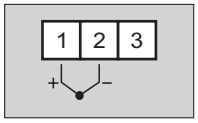
Figure 1.2(a)



Connect single leaded end of RTD bulb to terminal 1 and the double leaded ends to terminals 2 and 3 (interchangeable) as shown in Figure 1.2 (a). Use copper conductor leads of very low resistance. Ensure that all 3 leads are of the same gauge and length. Avoid joints in the cable.

Thermocouple

Figure 1.2(b)



Connect Thermocouple Positive (+) to terminal 1 and Negative (-) to terminal 2 as shown in Figure 1.2 (b). Use correct type of extension lead wires or compensating cable. Avoid joints in the cable.

OUTPUT-1 & OUTPUT-2

The Output-1 & Output-2 are factory configured as either Relay (standard) or SSR (optional).

Figure 1.3(a) : **Relay Outputs**

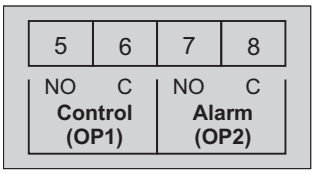
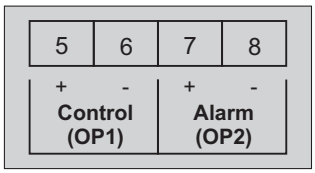


Figure 1.3(b) : **SSR Outputs**



Relay

N/O (Normally Open) & C (Common) contacts are potential-free and are rated 7A/250 VAC (resistive load). Refer Figure 1.3(a) : Relay Outputs.

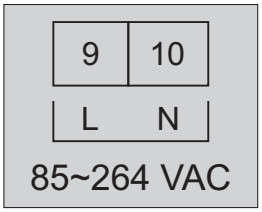
SSR

DC Voltage level is generated for switching the external SSR (Solid State Relay). Connect (+) and (-) terminals of SSR to controller terminals 5 (and 7) and 6 (and 8), respectively. Use Zero-Crossover, 3 to 30 VDC operated SSR, rated approximately 1.5 times the actual load rating. Use appropriate Heat Sink for load ratings exceeding 10 A.

POWER SUPPLY

The controller accepts single phase, 50/60 Hz Line Voltage ranging from 85 to 264 VAC. Use well-insulated copper conductor wire of the size not smaller than 0.5 mm^2 for power supply connections. Connect Line Voltage as shown in Figure 1.4.

Figure 1.4



Section 2

DISPLAY BOARDS : LAYOUT AND OPERATION

Figure 2.1(a) : **Front Display**

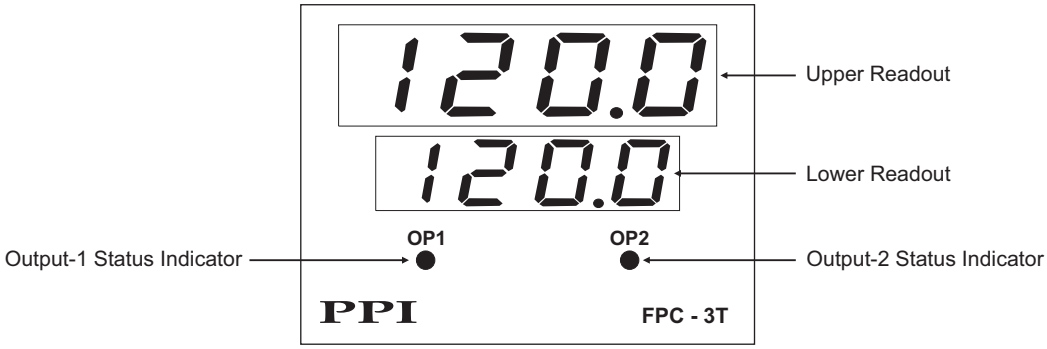
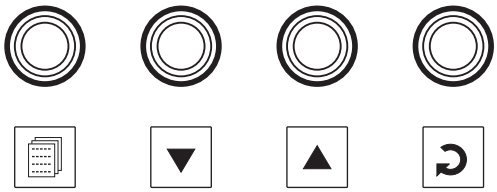


Figure 2.1(b) : **Front Keys**



READOUTS

The Upper Readout is a 4 digit, 7-segment bright red LED display and usually displays the Measured Temperature. In Set-up Mode, the Upper Readout displays parameter values/options.

The Lower Readout is a 4 digit, 7-segment bright green LED display and usually displays SP (Control Setpoint) or % Output Power. In Set-up Mode, the Lower Readout displays prompts for the parameters.

INDICATOR

The Table 2.1 below lists the three front panel indicators (identified by the Front panel legend) and the associated status.

Table 2.1

Indicator	Function
OP1	Indicates Output-1 ON/OFF status.
OP2	• Flashes if OP-2 is configured as Alarm and if alarm is active. • Indicates ON/OFF status if OP-2 is configured as Auxiliary Control.

KEYS

There are four push buttons provided on the front panel for configuring the controller and setting-up the parameter values. The Table 2.2 lists each button (identified by the front panel symbol) and the associated function.

Table 2.2

Symbol	Button	Function
	PAGE	Press to enter / exit Set-up mode.
▼	DOWN	Press to decrease the parameter value. Pressing once decreases the value by one count; holding the button pressed speeds up the change.
▲	UP	Press to increase the parameter value. Pressing once increases the value by one count; holding the button pressed speeds up the change.
	ENTER	Press to store the set parameter value and to scroll to the next parameter.

POWER UP

Upon switching on the power to the controller, all displays and indicators are lit on for approximately 3 seconds. This is followed by the indication of the model name FPC on the Lower Readout and v01.1 on Upper Readout.

MAIN DISPLAY

After the Power-up display sequence, the controller enters MAIN Display Mode. The Upper Readout shows the measured Temperature Process Value and the Lower Readout displays the SP (Control Setpoint). The MAIN Display Mode is the one that shall be used most often.

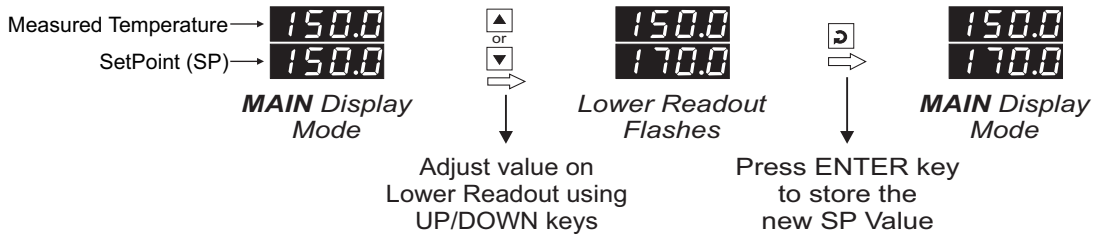
If the controller is configured to operate in PID Control Mode; the Lower Readout can be toggled to indicate either SP or % Output Power using the ENTER Key. The default Lower Readout upon Power-up is SP. While indicating % Power, the left most digit indicates P and remaining digits indicate power value.

ADJUSTING SP

The SP value can be directly adjusted on the Lower Readout while the controller is in the MAIN Display Mode and the Lower readout is showing SP value. Step through the following sequence to adjust the SP value:

1. Press and release UP/DOWN key once. The Lower Readout starts flashing.
2. Use UP/DOWN keys to adjust the SP value.
3. Press and release ENTER key. The Lower Readout stops flashing and the set value is registered and stored in the controller's non-volatile memory.

Figure 2.2



TEMPERATURE ERROR INDICATION

In case the Temperature falls below the Minimum Range or rises above the Maximum Range specified for the selected 'Input Type' or in case the input sensor is open / broken; the Upper Readout flashes the error messages listed in Table 2.3 below. The Figure 2.3 illustrates an open sensor condition.

Figure 2.3

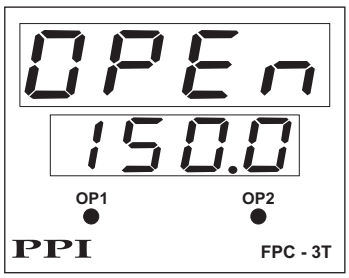


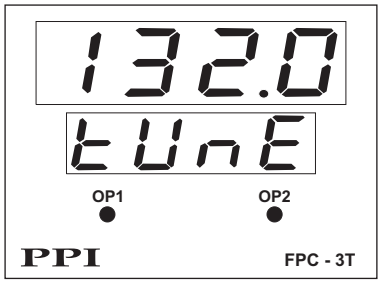
Table 2.3

Message	PV Error Type
Or	Over-range (Temperature above Max. Range)
Ur	Under-range (Temperature below Min. Range)
OPEn	Open (Sensor open / broken)

TUNE INDICATION (Applicable for PID Control Only)

Upon issuing 'Self Tune Command', the controller starts tuning itself to the process under control. While the controller is busy in Tuning itself to the process, the Lower Readout flashes the message "Tune", as shown in figure 2.4 below. The user is advised not to disturb the process or alter any parameter values while the "Tune" message is being flashed. The "Tune" message automatically disappears upon completion of Tuning procedure and the controller reverts to MAIN Display Mode.

Figure 2.4



Section 3

SET-UP MODE : ACCESS AND OPERATION

The controller requires various user settings that determine how the controller will function or operate. These settings are called Parameters.

For the convenience and ease of operation, the various parameters have been grouped separately depending upon the functions they define. Each such group is called a PAGE. Each PAGE is assigned a unique number, called PAGE NUMBER, for its access. The parameters contained in a PAGE are presented in a fixed sequence to the user for setting. The user can access a desired PAGE by entering its PAGE NUMBER and can select and set the desired parameter values.

PARAMETER PROMPTS

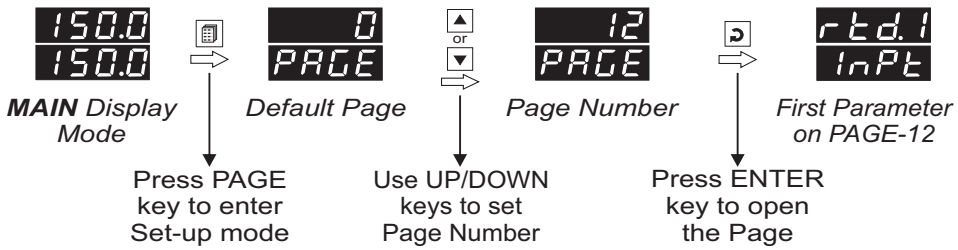
Each parameter has an identifying tag, called the Parameter Prompt. While setting parameter values in a PAGE, the parameter prompt is always displayed on the Lower Readout and its current value is displayed on the Upper Readout.

ACCESSING A PAGE

Each PAGE is accessible only from the MAIN Display Mode. That is, from the current PAGE, the user must return to the MAIN Display Mode before the other PAGE can be accessed.

Figure 3.1 illustrates access to the desired PAGE from MAIN Display Mode.

Figure 3.1

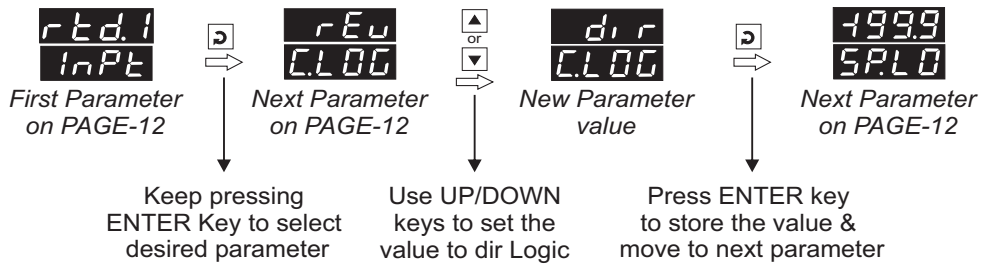


ADJUSTING PARAMETER VALUES

For accessing and adjusting the parameter, one must first open the PAGE containing the parameter.

Figure 3.2 illustrates how to access the desired parameter(s) and adjust the corresponding value(s). The example shows accessing the parameter ‘Control Logic’ and changing its value from ‘Reverse’ to ‘Direct’. Press PAGE key to revert to MAIN Mode.

Figure 3.2



PARAMETER LOCKING

For protecting the parameter values from unauthorized / accidental alterations, the parameter adjustments can be Locked. The Operator Page is not affected by locking.

Locking

Follow the steps below to apply Locking when the controller is unlocked.

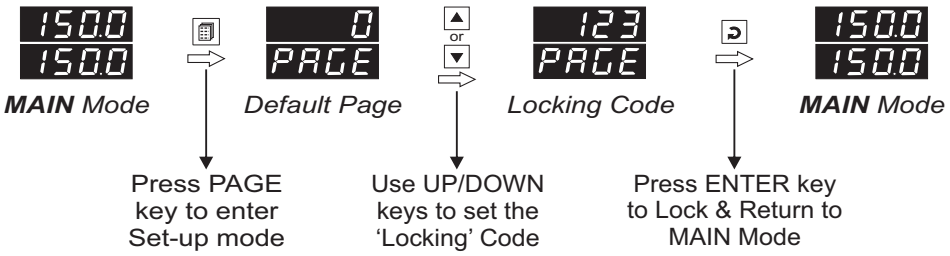
1. Press and release PAGE key while the controller is in the MAIN Display Mode. The Lower Readout shows PAGE and the Upper Readout shows 0.

2. Use UP / DOWN keys to set the Page Number to 123 on the Upper Readout.

3. Press and release ENTER key. The controller returns to the MAIN Display Mode with the Lock enabled.

The Figure 3.3 illustrates the steps for Locking.

Figure 3.3



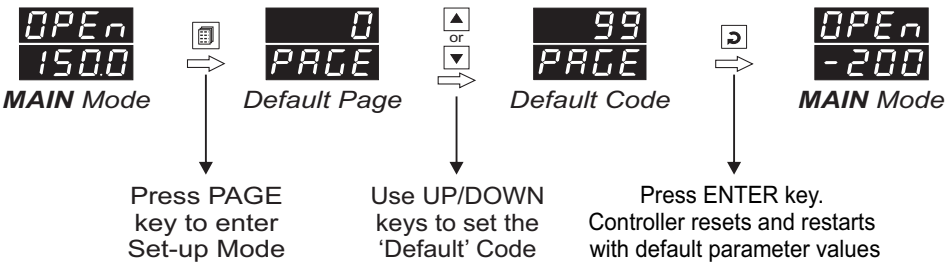
Un-Locking

For Un-Locking, repeat the sequence of steps shown in figure 3.3 twice.

SETTING DEFAULT VALUES

The controller is shipped from the factory with all the parameters set to their default values. Refer Figure 3.4 above for regaining the factory default values.

Figure 3.4



Section 4

INPUT / OUTPUT CONFIGURATION PARAMETERS : PAGE-12

Refer Table 4.1 for the parameter descriptions and settings.

Table 4.1

Parameter Description	Settings (Default Value)
INPUT TYPE InPt Select Input type in accordance with the type of sensor (Thermocouple or RTD) connected for temperature measurement.	Refer Table 4.2 for various available 'Input Types' along with their respective Ranges and Resolutions. (Default : Type K)
CONTROL LOGIC C.LOG *Reverse* Heating Control (Output Power *decreases* with increase in Temperature). *Direct* Cooling Control (Output Power *increases* with increase in Temperature).	rEu Reverse dir Direct (Default : Reverse)
SETPOINT LOW SP.LO Sets minimum permissible control setpoint value.	Min. Range to Setpoint High for the selected Input type (Default : Min. Range for the Selected Input Type)
SETPOINT HIGH SP.H1 Sets maximum permissible control setpoint value.	Setpoint Low to Max. Range for the selected Input type (Default : Max. Range for the Selected Input Type)
OFFSET FOR MEASURED TEMPERATURE OFSt This value is algebraically added to the measured Temperature to derive the final temperature that is displayed and compared for alarm / control. Final Temperature = Measured Temperature + Offset	-1999 to 9999 **or** -199.9 to 999.9 (Default : 0)
DIGITAL FILTER FiLt This value determines the averaging rate of measured temperature and thus helps removing undesired fast changes in the measured temperature. The higher the value the better the averaging but the slower the response to actual changes. The default value, 1.0 Second, is appropriate in most cases.	0.5 to 25.0 Seconds (in steps of 0.5 Seconds) (Default : 1.0)

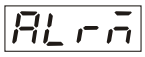
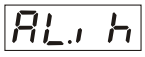
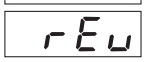
Table 4.2

Option	What it means	Range (Min to Max)	Resolution
tc_J	Type J Thermocouple	0 to +960°C	1°C
tc_K	Type K Thermocouple	-200 to +1375°C	1°C
rtd	3-wire, RTD Pt100	-199 to +600°C	1°C
rtd.1	3-wire, RTD Pt100	-199.9 to +600.0°C	0.1°C

Section 5
ALARM PARAMETERS : PAGE-11

Refer Table 5.1 for the parameter descriptions and settings.

Table 5.1

Parameter Description	Settings (Default value)
ALARM TYPE  Sets the Alarm type; *None* Alarm Output not required (relay remains off). *Process Low* The alarm activates for Temperature less than or equal to Alarm Setpoint. *Process High* The alarm activates for Temperature greater than or equal to Alarm Setpoint. *Deviation Band* The alarm activates if the Temperature deviation from SP is greater than the set positive or negative 'Deviation Band' value. *Window Band* The alarm activates if the Temperature deviation from SP is greater than the set 'Window Band' value in either direction.	 None  Process Low  Process High  Deviation Band  Window Band (Default : None)
ALARM INHIBIT  *No* Alarm is not suppressed for start-up condition. *Yes* The Alarm activation is inhibited (suppressed) until the Temperature is found within alarm limits from the time the controller is switched ON.	 Yes  No (Default : Yes)
ALARM LOGIC  *Normal* The Alarm output (Relay/SSR) remains ON under alarm condition; OFF otherwise. Useful for Audio / Visual Alarm. *Reverse* The Alarm output (Relay / SSR) remains OFF under alarm condition; ON otherwise. Useful for Tripping the system under control.	 Normal  Reverse (Default : Normal)

Section 6
CONTROL PARAMETERS : PAGE-10

Refer Table 6.1 for the parameter descriptions and settings.

Table 6.1

Parameter Description	Settings (Default Value)
CONTROL MODE  Select appropriate Control Algorithm suited for process requirement. *On-Off* The control algorithm tends to maintain the **Temperature** at **SP** by either switching the output fully OFF or fully ON. The On and Off switching is differentiated by the user settable 'Hysteresis'. *PID* The control algorithm uses a 2nd order equation to compute the '% Output Power' required to maintain the **Temperature** at **SP**. The constants P, I, D are automatically set by the controller by issuing Self-Tune command.	 On-Off  PID (Default : PID)
HYSTERESIS (*For On-Off Control only*)  Sets differential (dead) band between On-Off switching of the control output (Relay/SSR).	1 to 999 or 0.1 to 99.9 (Default : 2 or 0.2)
CYCLE TIME (*For PID Control only*)  For time-proportionating PID control, the output power is implemented by adjusting the ratio of ON : OFF time of a fixed time interval, called 'Cycle Time'. Larger Cycle Time ensures longer Relay/SSR life but may result in poor control accuracy and vice-a-versa. *The recommended Cycle Time values are; 20 sec. for Relay and 1 sec. for SSR .*	0.5 to 120.0 Seconds (in steps of 0.5 Seconds) (Default : 20.0 Sec)
PROPORTIONAL BAND (*For PID Control only*)  The Proportional Band is defined in terms of process value deviation from the setpoint (also known as process error). Within the band the output power is varied from maximum (100%) at maximum deviation to minimum (0%) at minimum deviation. The process value thus tends to stabilize at a point within the band where the power input equals losses. Larger Band results in better stability but larger deviation. The Proportional Band value is automatically calculated by controller's Self-Tune feature and seldom requires any manual adjustments.	0.1 to 999.9 (Default : 10.0)

Parameter Description	Settings (Default Value)
INTEGRAL TIME (*For PID Control only*)  The application of proportional band alone results in process value stability within the band but away from the setpoint. This is called steady state Offset Error. The integral action is incorporated for automatic removal of offset error with minimum oscillations. The Integral Time value is automatically calculated by controller's Self-Tune feature and seldom requires any manual adjustments. Setting the value 0 cuts-off Integral action.	0 to 1000 Seconds (Default : 100 Sec)
DERIVATIVE TIME (*For PID Control only*)  It is desired that the controller should respond to any dynamic changes in the process conditions (like variations in load, power supply fluctuations, etc.) fast enough so as to retain the process value near the setpoint. The Derivative Time determines how strong the output power will change in response to the rate of change of measured PV. The Derivative Time value is automatically calculated by controller's Self-Tune feature and seldom requires any manual adjustments. Setting the value 0 cuts-off Derivative action.	0 to 250 Seconds (Default : 25 Sec)

Section 7
SUPERVISORY PARAMETERS : PAGE-13

Refer Table 7.1 for the parameter descriptions and settings.

Table 7.1

Parameter Description	Settings (Default Value)
SELF-TUNE COMMAND tUnE Set this parameter to YES to activate 'Tuning' operation. Select as NO if, for any reason, the 'Tuning' operation in progress is to be aborted.	no No YES Yes (Default : No)
OVERSHOOT INHIBIT ENABLE / DISABLE oS.i h Set this parameter to 'Enable' if the process exhibits unacceptable overshoot upon start-up or a step change in SP. If Enabled, the controller monitors and controls the rate of change of Temperature in order to minimize or eliminate overshoot.	dSbL Disable EnbL Enable (Default : Disable)
OVERSHOOT INHIBIT FACTOR Oi h.F This parameter is available only if 'Overshoot Inhibit' is enabled. Adjust this parameter value to improve the effectiveness of the controller's Overshoot Inhibit feature. Increase the value if the overshoot is curbed but the Temperature takes too long to reach the SP. Decrease the value if the overshoot persists.	1.0 to 2.0 (Default : 1.2)
OP2 SETPOINT EDITING PERMISSION ON OPERATOR PAGE SP.OP The OP2 Setpoint is available on operator page (PAGE 0) for view and adjustment. The adjustment, can be locked by setting this parameter value to 'Disable'. Locking protects the SP from any inadvertent changes.	dSbL Disable EnbL Enable (Default : Enable)

Section 8

OPERATOR PARAMETER : PAGE-0

Refer Table 8.1 for the parameter descriptions and settings.

Table 8.1

Parameter Description	Settings (Default value)
ALARM SETPOINT AL.SP Available *only if* selected 'Alarm Type' is either 'Process High' or 'Process Low'. This parameter value sets the Upper (Process High) or Lower (Process Low) Alarm Limit.	Minimum to Maximum Range specified for the selected Input Type (Default : 0)
ALARM DEVIATION AL.dE Available *only if* selected 'Alarm Type' is 'Deviation Band'. This parameter value can be set as Negative (-) or Positive (+) and gets added to the Control Setpoint (SP) to define either Process Low (negative deviation band) or Process High (positive deviation band) Alarm Limit.	-1999 to 9999 **or** -199.9 to 999.9 (Default : 3 **or** 0.3)
ALARM BAND AL.bA Available *only if* selected 'Alarm Type' is 'Window Band'. This parameter value gets subtracted from the Control Setpoint (SP) to define Process Low and added to the Control Setpoint (SP) to define the Process High Alarm Limit.	3 to 999 **or** 0.3 to 99.9 (Default : 3 **or** 0.3)
SETPOINT LOCKING S.LOC This parameter allows locking the adjustment of the SP on Lower Readout in Main Display Mode. For Locking, set the parameter value to 'Yes'. This allows the operator to protect the SP from any unauthorized changes.	YES Yes no No (Default : No)

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