neuro 104

PPI
The Perfection Experts

Open Loop Motorised Valve Controller

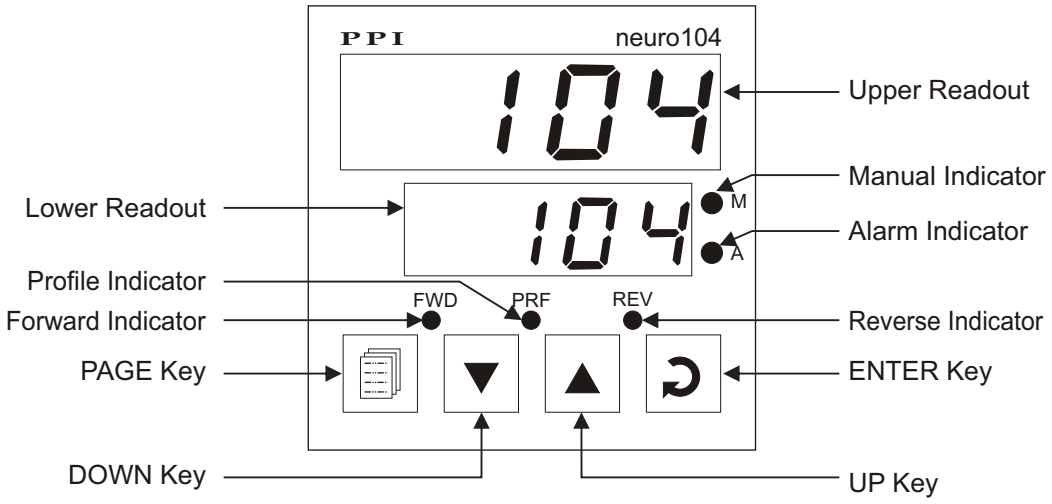
User Manual

CONTENTS

Section 1
FRONT PANEL LAYOUT

The controller front panel comprises of digital readouts, LED indicators and membrane keys as shown in Figure 1.1 below

Figure 1.1



READOUTS

The Upper Readout is a 4 digit, 7-segment bright red LED display and usually displays the PV (Process Value). In Program Mode, the Upper Readout displays parameter values.

The Lower Readout is a 4 digit, 7-segment bright green LED display and usually displays SP (Control/Auxiliary). If Profile mode is active; either the “Ramping Setpoint” or the “Balance Soak Time” is the parameters

The indications on the Upper and Lower Readouts, in general, depend on the mode of operation and configuration parameters. Refer respective sections for more details.

INDICATORS

There are five front panel red LED indicators. These indicators show various statuses. The Table 1.1 below lists each LED indicator (identified by the front panel legend) and the associated status it indicates.

Table 1.1

Indicator	Function
M	• Glows if the Manual (Hand) mode is active. • Remains OFF if Automatic (Auto), Standby or Profile mode is active.
A	Indicates Alarm Status if OP3 is configured as Alarm. • Flashes while the Alarm is active. • Remains OFF while the Alarm is inactive or if OP3 is configured as Recorder / Retransmission.
FWD	• Indicates Output-1 ON/OFF status while the controller is driving the motor to travel the valve in Forward (Open) direction.

Indicator	Function
REV	• Indicates Output-2 ON/OFF status while the controller is driving the motor to travel the valve in Reverse (Close) direction.
PRF	Indicates Profile status if the Profile mode is Enabled. • Flashes while the controller is executing ramp/soak Profile Cycle. • Glows continuously if the Profile Cycle is in HOLD state. • Remains OFF, if not executing a Profile Cycle.

KEYS

There are four tactile keys provided on the front panel for configuring the controller, setting-up the parameter values and selecting Operation Modes.

The Table 1.2 below lists each key (identified by the front panel symbol) and the associated function.

Table 1.2

Symbol	Key	Function
	PAGE	Press to enter or exit set-up mode.
	DOWN	Press to decrease the parameter value. Pressing once decreases the value by one count; keeping pressed speeds up the change.
	UP	Press to increase the parameter value. Pressing once increases the value by one count; keeping pressed speeds up the change.
	ENTER	Press to store the set parameter value and to scroll to the next parameter on the PAGE.

The keys are also assigned various other functions while the controller is in MAIN Display Mode. The key-functions depend on the mode of operation (Automatic, Manual (Hand), Standby or Profile) and are described in the *Section 2 : Basic Operations.*

Section 2
BASIC OPERATIONS

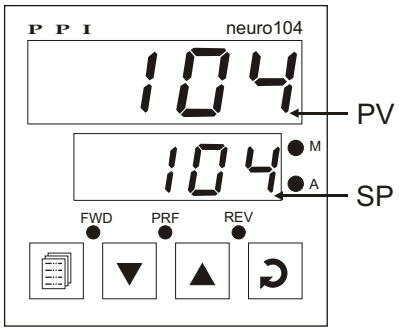
POWER-UP

Upon switching on the power to the controller, all displays and indicators are lit on for approximately 3 seconds during which time the controller runs through a self-test sequence. This is followed by the indication of the controller model name n.104 on the Upper Readout and the firmware version 1.01.0 on the Lower Readout, for approximately 1 second.

MAIN DISPLAY MODE

After the Power-up display sequence, the Upper Readout starts showing the measured PV (Process Value) and the Lower Readout displays the SP (Control/Auxiliary) if Manual (Hand) or Standby mode is not active or Profile Cycle is not running. This is called the MAIN Display Mode and this is the one that shall be used most often. The MAIN Display Mode is depicted in Figure 2.1

Figure 2.1



FIRST TIME / NEW INSTALLATION

For a first-time installation of a new controller or if the controller is removed from one application and installed on different application, it is recommended to place the controller in Stand-by mode (Refer *Sub-section : Operation Modes*) until the parameter setting is done and subsequently observe the following sequence of parameter settings that are required for controller's intended operation. (Refer *Section 3 : Pages & Parameters* for details on parameter settings).

1. Set the Configuration Parameters on PAGE-12.
2. Set the Supervisory Parameters on PAGE-13.
3. Set the Profile Parameters (if required) on PAGE-14.
4. Set the OP3 Function Parameters (if required) on PAGE- 15.
5. Set the Alarm Parameters (if required) on PAGE-11.
6. Set the Control Parameters (if required) on PAGE-10.

Upon completion of parameters settings, the controller reverts to MAIN Display Mode. The controller, now, can be programmed to operate in one of the intended Operation Modes as described below

OPERATION MODES

The controller can be programmed to operate in one of the four modes of operation, viz., Automatic, Manual (Hand), Standby and Profile mode. These modes are described below:

- **Automatic (Auto) Mode**

In this mode, the controller automatically adjusts the Valve Position (%Open) in accordance with the control demand signals, by driving the motor in either Forward (Open) or Reverse (Close) direction to maintain the PV at the SP. The Upper Readout displays the PV and the Lower Readout displays the SP.

The motorised valve algorithm operates in the boundless mode, which does not require a position feedback potentiometer for control purpose. The control demand signals are voltage pulses (that drive either Forward or Reverse Relay) the duration of which are computed based on the set values for the parameters: 'Motor Run Time', 'Valve Inertia Time', 'Valve Backlash Time' and 'Minimum On Time' for motor. (For details, refer *Section 4: Control Parameters*).

The SP on the Lower Readout can be adjusted directly (if the Set-up mode is enabled under supervisory level in PAGE-13 parameter list) as explained later in this section.

- **Manual (Hand) Mode**

In this mode of operation, the Valve Position is manually adjustable by the user. The controller maintains the Valve Position set by the user, regardless of the SP and the PV.

Activating Manual Mode and Adjusting Valve Position

The Manual mode can be activated only if it is enabled under supervisory level in PAGE-13 parameter list. If enabled, step through the following sequence to activate the Manual mode and adjust the Valve Position.

1. Hold ENTER key depressed for approximately 2 seconds until front panel indicator M turns on.
2. Release Enter key. The controller is now placed in Manual mode. The Upper Readout displays the PV and the Lower Readout indicates P on the leftmost digit followed by 3 blank digits.
3. Adjust the Valve Position using the UP and DOWN keys. Press and hold UP or DOWN key to drive the motor for traveling the valve in Forward (Open) or Reverse (Close) direction, respectively. The motor remains operational as long as the key is depressed.

De-activating Manual Mode Operation

Once the Manual mode is activated, it remains in Manual mode until de-activated. To de-activate the Manual mode and return to the original mode of operation:

1. Hold the ENTER key depressed for approximately 2 seconds until the front panel indicator M turns off.
2. Release Enter key. The Manual mode is now de-activated and the controller resumes its original mode of operation.

Notes:

1. If the Manual mode is active and it is Disabled (in PAGE-13 parameter list), the controller gets locked in Manual mode with the last set Valve Position. That is, the Manual mode can neither be de-activated using ENTER key (as described above) nor the Valve Position can be altered using UP/DOWN keys. To de-activate the Manual mode or to alter the Valve Position, the Manual mode must be Enabled in the PAGE-13 parameter list.
2. If the Manual mode is activated while running a Profile Cycle, the controller enters into Manual mode. However, the execution of the current segment of the Profile Cycle is suspended and the Profile Cycle is kept in HOLD state. (The front panel indicator PRF glows continuously to indicate that the Profile Cycle is in HOLD state). The controller returns back to the Profile mode and starts executing the Profile Cycle after de-activation of the Manual mode (The front panel indicator PRF starts flashing to indicate that the Profile Cycle is in RUN state).
3. The Manual mode cannot be activated while Tuning is in progress. Also, if the 'Tune Command' is issued while in Manual mode, the controller starts executing the Tuning operation. After completion of Tuning, the controller resumes the Manual mode.
4. The Manual mode cannot be activated if the controller would have been originally operated in Standby mode.
5. If the Standby is activated while the controller is operating in Manual mode, the controller automatically keeps the Output-2 Relay continuously ON to drive the motor to travel the valve in Reverse (Close) direction completely (The front panel indicator REV glows continuously) and does not allow Valve Position adjustment. To adjust the Valve Position, the user has to first de-activate the Standby mode. Upon de-activating the Standby mode, the controller resets and restarts from MAIN display (Auto mode). The user has to re-activate the Manual mode and adjust the Valve Position (if required).
6. If the power supply to the controller is switched-off or a power-failure occurs while the controller is operating in Manual mode; upon resumption of power, the controller continues to operate in Manual mode with maintaining the last user adjusted Valve Position prior to power-failure.

Caution

Manual mode is generally used for test and commissioning purposes, take care not to leave the controller in this mode since damage or personal injury could occur.

Bumpless Transfer

The transfer from Automatic mode to Manual mode or vice-a-versa is Bumpless. That is, while transferring from Automatic mode to Manual mode, the controller maintains the Valve to the last adjusted Position in the Automatic mode until adjusted by the user. Similarly, upon returning from the Manual mode, the controller starts adjusting the Valve from the Position last adjusted by the user in the Manual mode. This bumpless (smooth) transfer ensures quick regain of the PV control without causing sudden large jerks that could be harmful to the process.

Note:
The Bumpless Transfer is not strictly applied while transferring to and from Manual mode if the controller is operating in Profile mode.

The X-PRESS Algorithm Can Eliminate the Need of Manual mode Operation on Start-up

In many applications where the process is subject to sustained or prolonged start-up overshoot, the Manual mode is often used to minimize the time to bring the process into operation upon start-up. This requires operating the process in Manual mode and adjusting the Valve Position in steps to bring the PV to a desired level and then transferring the control to Automatic mode operation. The *neuro 104* controller incorporates highly advanced *"X-PRESS"* algorithm. The Overshoot Inhibit block of the X-PRESS algorithm can be enabled in PAGE-13 parameter list to overcome the start-up overshoot problem and thus eliminating the need of Manual mode operation during process start-up. (For detailed working of the Overshoot Inhibit function, refer *Section 11: The X-PRESS Algorithm*).

- **Standby Mode**

In this mode of operation, the controller drives the motor to turn the Valve in Reverse (Close) direction completely to make the output OFF along with the alarm signal (if ON) and only indicates the PV and SP on the Upper and Lower Readout, respectively.

Activating Standby Mode

The Standby mode can be activated only if it is enabled under supervisory level in PAGE-13 parameter list. If enabled, step through the following sequence to activate the Standby mode.

1. Press PAGE key. The Lower Readout displays PAGE (PAGE) and the Upper Readout displays 0 (0).
2. Press ENTER key. The Lower Readout displays StbY (Standby) and the Upper Readout displays no (No).
3. Press UP key to select YES (Yes) on the Upper Readout. Press ENTER key to register the YES Command.

Upon pressing ENTER key, the controller drives the motor to turn the valve fully Close by keeping Reverse Relay continuously ON (the front panel indicator REV glows) and the alarm signal (if ON) turns OFF. The PV on the Upper Readout starts flashing to indicate that the controller is in Standby mode. If However, for any reason, after setting the Upper Readout to YES by pressing UP key, if the Standby mode is not to be activated yet; press DOWN key once to select **no** on the Upper Readout and then press ENTER key to register the no Command and scroll to the next parameter

.

De-activating Standby mode

Once the Standby mode is activated, it remains in Standby mode until de-activated. To de-activate the Standby mode:

1. Press PAGE key. The Lower Readout displays PAGE (PAGE) and the Upper Readout displays 0 (0).
2. Press ENTER key. The Lower Readout displays StbY (Standby) and the Upper Readout displays YES (Yes).

3. Press DOWN key to select [no] (no) on the Upper Readout. Press ENTER key to register the YES Command.

Upon pressing ENTER key, the controller resets and restarts followed by turning ON the output and alarm signal (if alarm condition exists) and reverts to MAIN display (Auto mode).

Notes:

1. If the Standby mode is active and it is Disabled (in PAGE-13 parameter list), the controller gets locked in Standby mode. That is, the Standby mode cannot be de-activated, as upon entering PAGE 0, the Standby de-activation Command is not available and the display shows next parameter. To de-activate the Standby mode, it must be Enabled in the PAGE-13 parameter list.
2. If the PV is in Alarm condition prior to activation of Standby mode, upon de-activation of Standby mode, if the Alarm Inhibit (for details of Alarm Inhibit, refer *Section 7: Alarm Parameters*) is set to YES, the alarm system remains disabled until the PV is found within limit(s). Once the PV is within limit, the alarm gets activated should the PV cross the set limit(s). If the Alarm Inhibit is set to no, the alarm gets activated immediately upon de-activation of the Standby mode if the alarm condition exists.
3. If the controller would have operated originally in Manual (Hand) mode, upon activating the Standby mode, the controller automatically drives the motor to turn the Valve in Reverse (Close) direction completely. The front panel indicator REV glows continuously. The Valve Position can not be adjusted in the Standby mode.
4. The Standby mode cannot be activated in the following conditions. That is, upon entering PAGE 0, the Standby mode activation Command can not be issued, as pressing UP key to issue activation Command, has no effect.
   - If the Tuning is in progress.
   - If the Profile Cycle is running.
5. If the 'Tune Command' is issued while in Standby mode, the controller starts executing Tuning operation. After completion of Tuning the controller returns to Automatic mode. The Standby mode has to be re-activated (if required).
6. If the Power Supply to the controller is switched-off or a Power-failure occurs while the controller is operating in Standby mode; upon resumption of power, the controller continues to operate in Standby mode.
7. The alarm on PV Error conditions (if selected) is provided in Standby mode.
8. All other parameter settings are allowed in Standby mode.
9. While de-activation of Standby mode, even though the controller resets and restarts from power-on display sequence, the entire user set parameter values remain intact.


Caution

Be careful, as in Standby mode, the controller does not provide any output of alarm as well as control signal during process abnormalities.

- **Profile Mode**

In this mode of operation, the controller executes a 4 Ramp + 4 Soak Profile Cycle upon issuing 'Profile Start Command'.

Step through the following sequence to start the Profile Cycle.

Issuing Profile Start Command

The 'Profile Start Command' can be issued only if the Profile mode is enabled in PAGE-14 parameter list. If enabled, step through the following sequence to issue 'Profile Start Command'.

1. Press PAGE key. The Lower Readout displays PAGE (PAGE) and the Upper Readout displays 0 (0).
2. Press ENTER key until the Lower Readout displays Strt (Start) and the Upper Readout displays no (No).
3. Press UP key to select YES (Yes) on the Upper Readout. Press ENTER key to register the YES Command.

Upon pressing ENTER key, the controller starts running Profile Cycle. If, however, for any reason, after setting the Upper Readout to YES by depressing the UP key, if the Profile Cycle is not to be started yet; press DOWN key once to select no on the Upper Readout and then press ENTER key to register the no Command.

While the controller is running a Profile Cycle, the following display indications are available.

1. The front panel indicator PRF flashes, if the Profile Cycle is running (RUN) state.
2. If the PV falls outside the Ramp or Soak Hold Band, the indicator PRF glows continuously to indicate that the Profile Cycle is in HOLD state.
3. The Upper Readout continues to display the measured PV.
4. The Lower Readout displays either “Ramping Setpoint” (if a Ramp Segment is in progress) or “Remaining Soak-Time” (if a Soak Segment is in progress).

Upon holding the UP key depressed, the Lower Readout indicates the Profile Status, that is, the current segment in progress: r1, r2, S1, S2 and so on for Ramp-1, Ramp-2, Soak-1, Soak-2 and so on, respectively. This feature facilitates user to view the currently running segment number of the Profile Cycle while in RUN / HOLD state.

Issuing Profile Abort Command

While the Profile Cycle is running, if for any reason, the Profile Cycle is to be aborted manually, step through the following sequence to issue ‘Profile Abort Command’.

1. Press PAGE key. The Lower Readout displays PAGE (PAGE) and the Upper Readout displays 0 (0).
2. Press ENTER key. until the Lower Readout displays Abrt (Abort) and the Upper Readout displays no (No).
3. Press UP key to select YES (Yes) on the Upper Readout. Press ENTER key to register the YES Command.

Upon pressing ENTER key, the controller stops the running Profile Cycle. The front panel LED indicator PRF turns OFF to indicate that the Profile Cycle is aborted and the display returns to Automatic (Auto) mode.

Once the current Profile Cycle is aborted, a fresh Profile Cycle can be initiated by issuing a fresh ‘Profile Start Command’.

Notes:

1. The ‘Profile Abort Command’ is available on PAGE-0 only if its availability is enabled under supervisory level in PAGE-13 parameter list. Else, the only way to abort the Profile Cycle is to disable the Profile mode in PAGE-14 parameter list.
2. If the controller would have operated originally in Manual (Hand) mode, then upon issuing ‘Profile Start Command’, the Profile Cycle enters into HOLD state (the front panel indicator PRF glows continuously). The execution of the Profile Cycle is suspended until the controller returns back to the Profile mode after de-activation of the Manual mode.
3. If the controller would have operated originally in Standby mode, then upon issuing ‘Profile Start Command’, the controller exits Standby mode and starts executing the Profile Cycle (the front panel indicator PRF flashes). Upon completion of Profile Cycle, the controller returns to Automatic mode.
4. If the controller would have been originally in Tuning operation, then upon issuing ’Profile Start Command’, the Profile Cycle enters into HOLD state (the front panel indicator PRF glows continuously). The execution of the Profile Cycle is suspended until the controller returns back to the Profile mode after completing Tuning operation.

(Refer *Section 12: Setpoint Profile* for more details on the Profile mode operation.)

SET-UP MODE

The SP value can be directly adjusted on the Lower Readout while the controller is in the MAIN Display Mode except the case of Manual or Profile mode operation. In case of Standby mode, the SP can be adjusted but the adjusted value will be effective only if the controller is put back into the Auto mode. This is called Set-up mode. The SP adjustment is permitted only if it is enabled under supervisory level in PAGE-13 parameter list. If enabled, step through the following sequence to adjust the SP value:

1. Press and release UP or DOWN key once. The Lower Readout starts flashing.
2. Use UP/DOWN keys to adjust the SP value. Pressing UP or DOWN key once changes the value by one count; holding the key pressed speeds up the rate of change.
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. Note that the altered value becomes effective only after ENTER key operation.

Notes:

1. It is a must to press the ENTER key after adjusting the SP else, the new value will not be registered / stored. The controller waits (approx. for 30 seconds) by flashing new SP value. If the ENTER key is not pressed within wait time, the altered value will not store in the controller memory and the previous set value will be retained. Also, if the power failure occurs prior to pressing ENTER key, upon resumption of power, the controller will not store the altered value and retain the previous set value.
2. The SP is adjustable to any value between the 'Setpoint Low' and 'Setpoint High' set in PAGE-12 parameter list.
3. The SP is displayed and adjusted with the same unit and resolution as that for the PV.
4. The SP adjustment is also permitted in Operator Parameter list (PAGE-0) if it is enabled under supervisory level in PAGE-13 parameter list. This facilitates user to adjust the SP value in the following conditions:
   - If the Set-up mode is disabled under supervisory level in PAGE-13 parameter list.
   - If the Lower Readout is occupied to display P followed by 3 blank digits while in Manual (Hand) mode.
   - If the Lower Readout is occupied to display Profile Status while Profile Cycle is running.
   - If the Lower Readout flashes tUnE (Tune) while Tuning operation is in progress. Notice that the controller will continue the Tuning operation, however, the Tuning shall be carried out with respective to the altered SP value.
5. The SP can be adjusted even in "Parameter Locking" condition if the Set-up mode is enabled under supervisory level in PAGE-13 parameter list.

TUNE INDICATION

Upon issuing 'Self Tune Command', the controller starts Tuning itself to the process under control.

While the controller is executing Tuning operation, the Lower Readout flashes the message tUnE (Tune). 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. The controller reverts to the original Operation Mode which was operated prior to Tuning.

OPERATOR PARAMETERS

The PPI *neuro* series controllers facilitate a separate PAGE for Operator Parameters to provide the operational ease for normal day-to-day operations and to avoid unauthorized access to the controller's Program Mode.

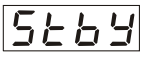
Step through the followings to adjust the Operator Parameter values.

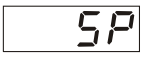
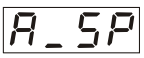
1. Press and release PAGE key. The Lower Readout shows PAGE (PAGE) and Upper Readout shows 0 (0).
2. Press ENTER key. The Lower Readout shows prompt for the first parameter and Upper Readout shows corresponding setting (Refer Table 2.1 below) depending upon the controller configuration.

3. Use UP/DOWN key to set the values and press ENTER key to register the set value and scroll to next parameter. Upon pressing ENTER key while last parameter in the list, the controller returns to MAIN Display Mode.

The Operator Parameters are grouped on PAGE-0 and listed in Table 2.1 below followed by their respective definitions.

Table 2.1

Parameter Description	Settings (Default Value)
STAND BY MODE  This parameter is available and applicable only if Standby mode is enabled in PAGE-13 parameter list and has two possible settings. It serves both as a Command to activate / de-activate a Standby mode and as an annunciation of the Standby mode operation. If enabled, the two possible settings are: (a) No As a Command it de-activates the Standby mode. As an annunciation, it indicates that the Standby mode has been de-activated and not in operation. (b) Yes As a Command it activates the Standby mode. The controller enters into Standby mode display upon issuing this Command. As an annunciation, it indicates that the Standby mode has already been activated and in operation.	 No  Yes (Default : No)
PROFILE START COMMAND  This parameter is available and applicable only if Profile mode is enabled in PAGE-14 parameter list and the Profile Cycle is not yet started, aborted or over. It has two possible settings. It serves as a Command to start (run) the Profile Cycle and the Profile Cycle status indication. If enabled, the two possible settings are: (a) No As an annunciation, this indicates that either the Profile Cycle has been over, aborted or not started yet. If for any reason, the Profile Cycle is not to be started yet, issue this as a Command. (b) Yes This Command starts running the Profile Cycle.	 No  Yes (Default : No)

Parameter Description	Settings (Default Value)
PROFILE ABORT COMMAND  This parameter is available and applicable only if its availability in Operator Parameter list is enabled under supervisory level in PAGE- 13 parameter list and Profile Cycle is already started. It has two possible settings. It serves as a Command to abort (stop) the running Profile Cycle and the Profile Cycle status indication. The two possible settings are: (a) No As an annunciation, this indicates that the Profile Cycle has not been aborted and is currently in running state. If the Profile Cycle is not to aborted yet, issue this as a Command to continue the running Profile Cycle. (b) Yes If for any reason, the running Profile Cycle is required to stop, issue this Command. This Command aborts (stops) the running Profile Cycle	 No  Yes (Default : No)
CONTROL SETPOINT  This is the default active Setpoint that the controller respects for the control purpose. The controller attempts to maintain (regulate) the PV at this Setpoint unless the Manual or Standby mode is activated or a Profile Cycle is running. The Control Setpoint (SP) is expressed in the same unit and resolution as that for PV. If the parameter 'Input Type' is altered in PAGE-12 parameter list, the Control Setpoint (SP) value automatically set to Minimum Range specified for the altered 'Input Type'. It is, therefore, imperative that this parameter value be re-adjusted to the required value after configuring the controller for a new 'Input Type'. This parameter could also be adjusted on Lower Readout in MAIN display if Set-up Mode is enabled in PAGE-13 parameter list.	Setpoint Low to Setpoint High (Default : -200)
AUXILIARY SETPOINT  This is an Auxiliary Setpoint, available and applicable only if Auxiliary Setpoint mode is enabled (by selecting the option to 'Auxiliary Setpoint') in PAGE-13 parameter list and the respective hardware module is fitted. This Setpoint is activated only if the controller detects the potential free contacts closure or Digital Pulse voltage less than 0.5 V via the Auxiliary Setpoint selection hardware module. When activated, the controller attempts to maintain (regulate) the PV at the Auxiliary Setpoint (ASP).The Auxiliary Setpoint is treated same as Control (Main) Setpoint (described above) except for	Setpoint Low to Setpoint High (Default : -200)

Parameter Description	Settings (Default Value)
Tuning. Note that the Tuning operation is always performed with respect to the Control (Main) Setpoint (SP). When, the Auxiliary Setpoint mode is disabled (by selecting the option to other than 'Auxiliary Setpoint') in PAGE-13 parameter list, the controller treats Control (Main) Setpoint (SP) as an active Setpoint.	
ALARM SETPOINT AL.SP This parameter is available only if 'Alarm Type' is selected to 'Process High' or 'Process Low'. If the alarm type is selected as 'Process High', the alarm is activated whenever the measured PV is at or below the set value. alarm is activated whenever the measured PV is at or above the set value. Similarly, if the alarm type is selected as 'Process Low', the alarm is activated whenever the measured PV is at or below the set value.	Throughout the range for the selected Input Type For Process Low : -200 For Process High : 1300
ALARM DEVIATION AL.dE This parameter is available only if 'Alarm Type' is selected to 'Deviation Band' and sets a deviation band above or below the SP depending upon the Negative (-) or Positive (+) value for this parameter, respectively. The Alarm is activated if the PV rises above (Positive value) or falls below (Negative value) the deviation band.	-999 to 999 (Default : 3)
ALARM BAND AL.bA This parameter is available only if 'Alarm Type' is selected to 'Window Band' and sets a symmetrical band around the SP. The alarm is activated if the PV exceeds the band in either direction. **Note:** The Control (Main) Setpoint, Auxiliary Setpoint and Alarm Parameters are available for adjustment only if their adjustment is enabled under supervisory level in PAGE-13 parameter list, else available for view only. (For more details on Alarm Parameters, Refer *Section 5 : Alarm Parameters*.)	3 to 999 (Default : 3)

PV ERROR INDICATIONS

In case of PV exceeding the Minimum or Maximum Range specified for the selected 'Input Type' or in case of input sensor (Thermocouple / RTD or DC Linear Current/Voltage signal) open / broken; the Upper Readout flashes the Error Messages as listed in Table 2.2. The Figure 2.2 illustrates an open sensor condition.

Figure 2.2

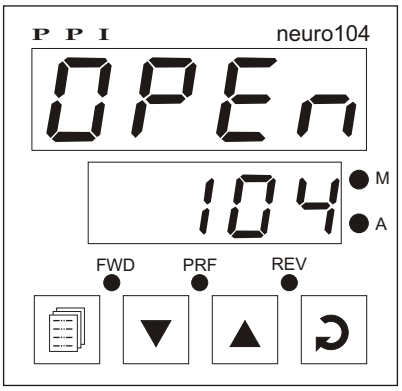


Table 2.2

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

Notes:

1. In case of Over-range and Under-range PV Error condition, the Output-2 Relay is kept continuously ON to drive the motor for turning the valve in Reverse (Close) direction completely.
2. For Temperature Sensor (Thermocouple and RTD Pt100) inputs, under Sensor Break (open) condition; the Valve Position is dependent upon the 'Valve Position Strategy' selected by the user in PAGE-12 parameter list (Refer *Sub Section : Sensor Break Protection* later).
3. For DC Linear inputs, in the input open condition, the Upper Readout displays value corresponding to 0 (zero) level signal. For example, consider 4-20 mA input signal scaled to display 0.0 to 100.0. The Upper Readout then shows approximately -25.0 (corresponding to 0 mA) upon input open.
4. In case of 3-wire RTD sensor input, if the compensating lead (connected at rear panel terminal number 3) is not connected or gets open, the controller does not indicate PV error but the measured value is not compensated for the lead resistance.
5. In case Tuning operation is in progress, the controller automatically aborts the Tuning operation upon detecting the PV error condition.
6. In case Profile Cycle is running, the controller automatically holds the Profile Cycle upon detecting the PV error condition. (The front panel indicator PRF glows continuously to indicate the Profile Cycle Hold status.)
7. In PV Error conditions, the respective alarm (if selected in PAGE-11 parameter list) gets activated. (Refer *Section 7: Alarm Parameters* for further details)

ALARM STATUS UNDER PV ERROR CONDITIONS

The alarm status under PV error conditions depend upon the type of the PV error and the 'Alarm Type', as described below:

- **Under-range**

  Since this error occurs when the PV falls below the minimum range specified for the selected 'Input Type', the alarm signal is generated by comparing the set alarm limits with the minimum range value. This means that the alarm gets activated if the set 'Alarm Type' is either 'Process Low' or 'Negative Deviation' or 'Window Band'.

- **Over-range**

  Since this error occurs when the PV exceeds the maximum range specified for the selected 'Input Type', the alarm signal is generated by comparing the set alarm limits with the maximum range value. This means that the alarm gets activated if the set 'Alarm Type' is either 'Process High' or 'Positive Deviation' or 'Window Band'.

- **Open (Input sensor open or broken)**

  For Thermocouple and RTD Pt100, the input sensor open error is treated as Over-range. However, for DC Linear inputs (mV/V/mA), the input sensor open error is treated as Under-range (as the measured PV under input open condition corresponds to the 0 level signal).

The Table 2.3 below summarizes the alarm status under various PV error conditions. The alarm ON status means the alarm is activated and OFF means the alarm is not activated.

Table 2.3

PV ERROR TYPE	ALARM TYPE	ALARM STATUS
Under-range	Process Low	ON
	Process High	OFF
	Negative Deviation	ON
	Positive Deviation	OFF
	Window Band	ON
Over-range or Open	Process Low	OFF
	Process High	ON
	Negative Deviation	OFF
	Positive Deviation	ON
	Window Band	ON

SENSOR BREAK PROTECTION

The controller facilitates the Sensor Break Protection for Temperature Sensors like Thermocouples (J, K, T, R, S, B, N & Reserved) and RTD Pt100 as described below:

- The broken or open sensor is indicated by flashing OPEN (Sensor Open) as Sensor Break Indication on the controller Upper Readout and the alarm is activated if set as 'Process High'.
- While detecting Sensor Break, the PV rises rapidly before Sensor Break Condition occurs. The Sensor Open/Break is detected by an Overrange input signal exceeding the maximum of linearisation table.
- Upon detecting the Sensor Break Condition, the controller enters into Open Loop mode and depending upon the 'Sensor Break Strategy' selected, the controller maintains the Valve at the Position that it was maintaining prior to sensor break condition or fully close or fully open until the Sensor Break Condition is removed.

(For more details on 'Sensor Break Strategy', refer *Section 6: Configuration Parameters.*)

Section 3
PAGES AND PARAMETERS

ORGANIZATION

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

The parameters are always presented in a fixed format: The Lower Readout displays the parameter prompt (Identification Tag) and the Upper Readout displays the set value. The parameters appear in the same sequence as listed in their respective sections.

For convenience and ease of memorizing, the various parameters have been arranged in different groups depending upon the functions the parameters represent. Each group is assigned a unique PAGE NUMBER for its access and the parameters within each group are presented for settings depending upon the function(s) selected.

PROGRAM MODE

It is recommend to put the controller into Standby mode as described in *Section 2: Basic Operations* before entering the Program Mode.

The Program Mode allows the user to view or modify the parameter values. The entry from MAIN Display Mode to Program Mode requires appropriate setting of the PAGE NUMBER. Follow the steps below to open a desired PAGE for setting the parameter values:

Figure 3.1

1. Press and release PAGE key. The Lower Readout shows PAGE and the Upper Readout shows 0. See Figure 3.1.
2. Adjust the Upper Readout to the desired PAGE NUMBER using the UP/DOWN keys. Pressing the UP or DOWN key once, changes the value by one count. Holding the key pressed speeds up the rate of change.
3. Press and release ENTER key. The Lower Readout shows the prompt for the first parameter listed in the PAGE and the Upper Readout shows its current value.

Note:

If the entered PAGE NUMBER is invalid (contains no parameter list or any associated function), the controller reverts to the MAIN Display Mode.

Adjusting Parameter Values

Once a PAGE is accessed, step through the following sequence to adjust the values of the desired parameters:

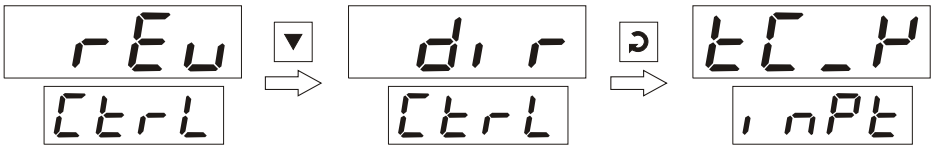
1. Press and release the ENTER key until the prompt for the required parameter appears on the Lower Readout. The last parameter in the list rolls back to the first parameter.
2. Use UP / DOWN keys to adjust the parameter value.

Note that some parameters (examples; 'Alarm Setpoint', 'Proportional Band', etc.) have numeric values while others (examples; 'Control Logic', 'Alarm Inhibit', etc.) have a series of options. If adjusting a numeric value; depressing the UP/DOWN key once, increases/decreases the parameters value by one digit. For parameters having a series of options, depressing the UP/DOWN key once takes you to the next/previous option. In each case, keeping the UP/DOWN key pressed speeds up the rate. If the value reaches the maximum / minimum settable value/option, the Upper Readout flashes and the UP (if maximum value is reached) or DOWN (if minimum value is reached) key has no effect.

3. Press and release the ENTER key. The new value gets stored in the controller's non-volatile memory and the next parameter in the list is displayed.

The Figure 3.2 illustrates the example of altering the value for the parameter 'Control Logic'.

Figure 3.2



Notes:

1. It is a must to press the ENTER key after altering the value of a parameter else the new value will not be registered / stored. That is, a return to the MAIN Display Mode (by depressing PAGE key) without pressing the ENTER key will not store the altered value in the controller memory and the previous set value will be retained. Also, if the power failure occurs prior to pressing ENTER key, upon resumption of power, the controller reverts to MAIN Display Mode without storing the altered value and retaining the previous set value.
2. If the controller is left in Program Mode for more than 30 seconds without any key operation, the controller automatically exits the Program Mode and returns to the MAIN Display Mode.

CONDITIONAL PARAMETERS

As discussed above the various parameters (user set values) are grouped and listed in separate PAGES. For convenience, each PAGE contains a list of parameters that relate to some specific functions or operations.

Note, however, that not all parameters are always presented to the user. Some parameters are presented only if the corresponding function or Operation Mode is selected. Such parameters are called the conditional parameters, as their availability is dependent on the options selected for some other parameters (in the same or other PAGE). For example, consider the 'Alarm Parameters' contained in PAGE-11 parameter list. These parameters are presented only if the 'Alarm Type' is selected to other than 'None'.

Suppressing the conditional parameters (if the conditions are not met) avoids ambiguity and makes the parameter list more comprehensive. Refer the definitions below each parameter table (listed in the following 6 sections) for the conditional parameters. Also note that the parameters appear in the same sequence as shown in the table for each PAGE.

PARAMETER LOCKING

Though access to any PAGE is always permitted, the adjustment of the parameter values, however, can be Locked at the supervisory level. If the Lock is enabled, the parameter values on each PAGE can only be viewed but can not be adjusted. That is, the UP/DOWN key functions are inhibited. This feature facilitates the supervisory level to protect the parameter values from unauthorized tampering or accidental alterations by the operator.

The controller is shipped from the factory in Unlocked (Lock disabled) condition. The user can enable the Lock once the initial configuration and installation is done.

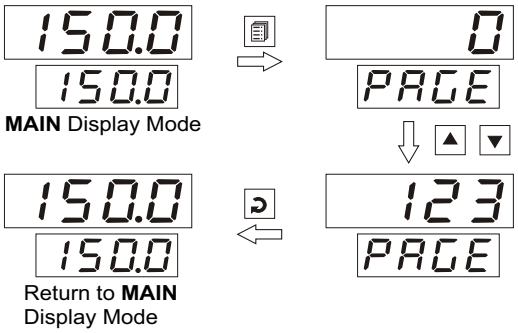
For enabling / disabling the Lock, step through the following sequence:

Locking

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. Adjust the Upper Readout to the value 123 using UP/DOWN keys.
3. Press and release ENTER key. The controller returns to the MAIN Display Mode with the Lock enabled.

The Figure 3.3 below illustrates the Locking procedure.

Figure 3.3



Unlocking

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. Adjust the Upper Readout to the value 123 using UP/DOWN keys.
3. Press and release ENTER key. The controller returns to the MAIN Display Mode.
4. Repeat steps 1 through 3. This time the controller returns to the MAIN Display Mode with the Lock disabled (Unlocked) condition.

Notes:

1. Since, there is no front panel indication of Lock enabled condition, ensure that the Lock is enabled by trying to adjust the parameter value on any valid PAGE in Program Mode.
2. If the Set-up Mode is enabled under supervisory level in PAGE-13 parameter list, the SP can be adjusted on the Lower Readout even under parameter Lock enabled condition. The supervisory level, thus, can allow or disallow the SP adjustment to the operator by enabling or disabling the Set-up Mode in PAGE-13 parameter list prior to Lock enabled.
3. If the Manual mode is enabled under supervisory level in PAGE-13 parameter list, the Manual mode activation and subsequent adjustment of the Valve Position is available even under parameter Lock enabled condition. The supervisory level, thus, can allow or disallow the Manual mode operation to the operator by enabling or disabling the Manual mode in PAGE-13 parameter list prior to Lock enabled.
4. The “Parameter Locking” is not applied for PAGE-0 (i.e.; Operator Parameters). However, the supervisory level can allow or disallow the parameter adjustment to the operator by enabling or disabling the parameter adjustment in PAGE-13 parameter list prior to Lock enabled.
5. The facility for “Setting Default Values” by accessing PAGE-99 is also inhibited (Locked) under parameter Lock enabled condition. Accessing PAGE-99 shall be treated as an invalid PAGE NUMBER.
6. Notice that it requires entering PAGE NUMBER 123 once for Locking but twice for Unlocking. Also, for Unlocking, the PAGE NUMBER 123 must be entered twice during the same duration for which the controller is powered. That is, entering the PAGE NUMBER 123 once prior to power loss and once after resumption of power shall not Unlock.
7. Do not forget to enable the Lock again if it was Unlocked for some parameter value alteration.

SETTING DEFAULT VALUES

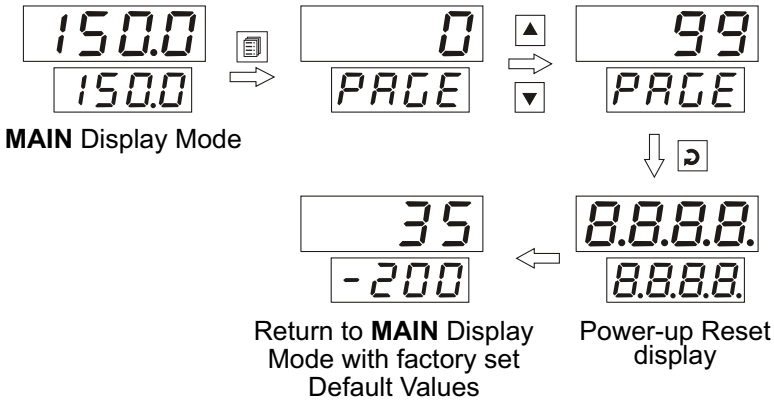
The controller is shipped from the factory with all the parameter set to their default factory set values. Thus, for the first-time installation there is no need for re-setting the parameters to their default values. However, in case the controller is removed from a particular application and fitted on a different application, it is recommended to reset all the parameters to their default values before configuring the controller for new installation.

Follow the steps below for re-setting the parameters to default values :

1. Ensure that the controller is Unlocked for parameter adjustments.
2. 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.
3. Adjust the Upper Readout to the numeric value 99 using UP/DOWN keys.
4. Press and release ENTER key. The controller resets and restarts from Power-up display sequence with all the parameters set to their factory set default values.

The Figure 3.4 below illustrates the “Setting Default Value” procedure while the controller was operating in ‘0.1’ resolution and ‘°F’ unit.

Figure 3.4



Note:

Notice that after carrying out the “Setting Default Value” procedure, all the resolution and unit based parameters (like PV, SP, ‘Setpoint Low’ and ‘Setpoint High’, ‘Proportional Band’, ‘Alarm Setpoint’, ‘Deviation Band’ and ‘Window Band’ Alarm, ‘Profile Target Setpoints’, ‘Ramp/Soak Holdback Band’ etc.) are set to the resolution of ‘1’ and unit of ‘°C’ as, by default, the controller sets ‘Input Type’ to ‘K Type Thermocouple’ and ‘Unit Selection for PV’ to ‘°C’ (Refer *Section 6 : Configuration Parameters* for more details*)*.

Section 4
CONTROL PARAMETERS

The Control Parameters are grouped on PAGE-10 and define the constants required by a particular control algorithm for the purpose of computing and outputting the control signals.

The Table 4.1 below lists the parameters followed by the definitions for each parameter.

Table 4.1

Parameter Description	Settings (Default Value)
PROPORTIONAL BAND  *(Available for PID Control only)* Sets proportional gain (% power per unit error). Defined in same units and resolution as that for PV.	1 to 999 Units (Default : 50 units)
INTEGRAL TIME  *(Available for PID Control only)* Sets integral time constant in seconds. Setting the value to 0, cuts-off the integral action.	1 to 1000 Units (Default : 100 units)
DERIVATIVE TIME  *(Available for PID Control only)* Sets derivative time constant in seconds. Setting the value to 0, cuts-off the derivative action.	0 to 250 Units (Default : 25 units)
MOTOR RUN TIME (TRAVEL TIME)  This parameter defines the time taken by the motor to travel the valve from its fully Close position (one physical end) to the fully Open position (the other physical end). The controller uses this value to compute the Pulse Time for which to energize the Forward or Reverse Relay in order to shift the Valve Position by a specific amount. The controller implements the '%Output Power' by adjusting the Pulse Time for which the respective Relay will be ON as a % of the 'Motor Run Time'. For example; if the 'Motor Run Time' is set to 60.0 seconds and if the '%Output Power' demand is 50%, the Pulse Time duration for Relay is computed (and implemented) as follows: Pulse Time = 50% X 60 = (50/100) X 60 = 30 Seconds However, if the parameters values like 'Valve Inertia Time', 'Valve Backlash Time' and 'Minimum ON Time' for motor are set to other than 0, the final Pulse Time will be computed as under: Final Pulse Time = (Pulse Time - Valve Inertia Time) + Backlash Time + Minimum ON Time	Minimum ON Time to 240.0 (Default :30.0)

Parameter Description	Settings (Default Value)
If the 'Valve Inertia Time' is set to 5 seconds, 'Valve Backlash Time' is set to 3 seconds and 'Minimum ON Time' is set to 4 seconds; as per the above example; the Final Pulse Time will be calculated as: Final Pulse Time = (30 - 5) + 3 + 4 = 32 seconds The 'Motor Run Time' is expressed in seconds and settable in 1 second resolution. The motor run time should be very accurately measured and entered as a value for this parameter. The minimum value set for this parameter is restricted to the value set for the parameter 'Minimum On Time' for the motor.	
VALVE INERTIA TIME  This parameter defines the time taken by the valve (and motor) to stop moving after the drive pulse is removed. This is due to the mechanical inertia of the valve (and motor) and is independent of the direction (Forward or Reverse) of the motion.	0.0 to 20.0 (Default :0.0)
VALVE BACKLASH TIME  This parameter defines the time taken by the gear-teeth to get locked while changing the direction (from Forward to Reverse or vice-a-versa).	0.0 to 20.0 (Default :0.0)
MINIMUM ON TIME  This parameter, defines the minimum pulse duration (Forward or Reverse) that the controller will execute. That is, the controller holds and accumulates the Valve Position shifts demanded by the control algorithm until it equals or exceeds the 'Minimum On Time' set by the user.	0.3 to Motor Run Time (Default :1.0)

Section 5
ALARM PARAMETERS

The Alarm Parameters are grouped on PAGE-11. The controller is provided with 1 “soft” alarm, that is, the alarm can be set and generated even if the corresponding output module is not fitted or assigned to other function. The front panel indicator A indicates the alarm status. The alarm status is also available via digital communication, if the communication module is fitted. The ‘Alarm Type’ can be selected as either ‘Process Alarm’ or ‘End of Profile Alarm’.

For the ‘Process Alarm’ function, the controller continuously compares the PV with either SP (for ‘Deviation Band’ and ‘Window Band’ alarm type) or an independent ‘Alarm Setpoint’ (for ‘Process High’ & ‘Process Low’ alarm type). An alarm signal is generated if the PV falls outside the set alarm limit(s). Also, if the output module (OP3) is fitted, the Relay/SSR is energized under alarm condition and de-energized upon removal of the alarm condition depending upon the ‘Alarm Logic’ selected. The alarm switching is separated by a settable value of ‘Alarm Hysteresis’ to avoid fluctuations in alarm status near boundary conditions.

For ‘End of Profile’ Alarm, the controller energizes output module (OP3) for approximately 10 seconds to alert the user for end of Profile Cycle

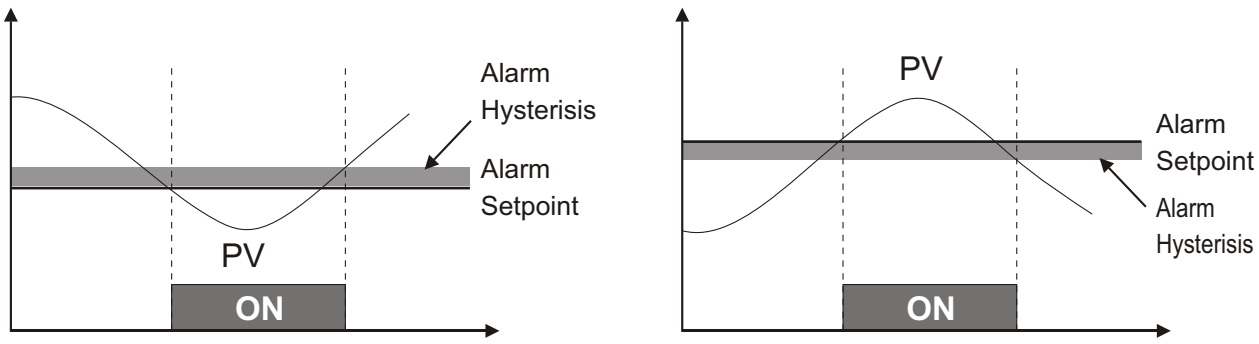
The Table 5.1 below lists the parameters followed by the definitions for each parameter.

Table 5.1

Parameter Description	Settings (Default Value)
ALARM TYPE AL Select the Alarm activation type. Selecting ‘None’ will disable the alarm and suppress all the related parameters for Alarm-1.	nonE None P_Lo Process Low P_hi Process High dE Deviation Band bAnd Window Band EOP End of Profile (Default :None)
ALARM SETPOINT AL.SP *(Available for Process High or Process Low Alarm-1 Type)* Sets Alarm limit independent of control setpoint.	Min. to Max. Range specified for the selected Input Type For Process Low : -200 For Process High : 1300
ALARM DEVIATION AL.dE *(Available for Deviation Band Alarm-1 Type)* Sets positive or negative deviation (offset) limit from control setpoint for High or Low Alarm-1 activation, respectively.	-999 to 999 (Default :3)
ALARM BAND AL.bA *(Available for Window Band Alarm-1 Type)* Sets symmetrical positive and negative deviation (offset) limits from control setpoint for both High and Low Alarm-1 activation.	3 to 999 (Default :3)

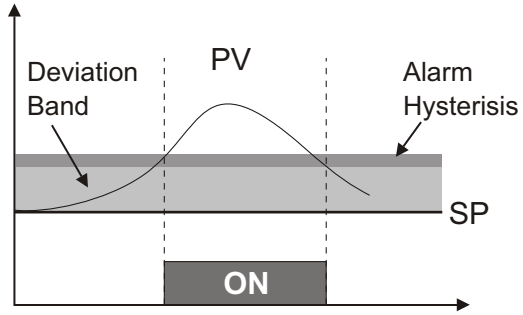
Parameter Description	Settings (Default Value)
ALARM HYSTERESIS AL.HY Sets differential (dead) band between Alarm-1 switching ON and OFF states.	1 to 999 (Default :2)
ALARM LOGIC AL.LG This parameter is available and applicable only if the alarm type is other than 'None' or 'End Of Profile' and useful if the alarm is used as a "hard" alarm by fitting the corresponding output module (Relay/SSR). If the parameter is set as 'Direct', the Relay/SSR energizes under alarm condition and remains de-energized otherwise. For 'Reverse' setting, the Relay/SSR de-energizes under alarm condition and remains energized otherwise. Generally, the 'Direct' setting is used for audio/visual alarm output and the 'Reverse' setting is used for tripping the process under alarm condition.	dir Direct rEv Reverse (Default : Direct)
ALARM INHIBIT AL.ih Set to Yes to suppress Alarm-1 activation upon power-up or process start-up.	YES Yes no No (Default :Yes)

Figure 5.1

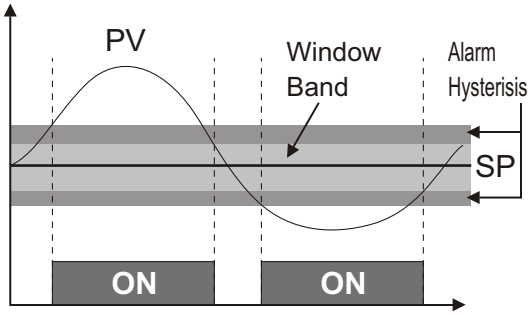


(a) Process Low Alarm

(b) Process High Alarm



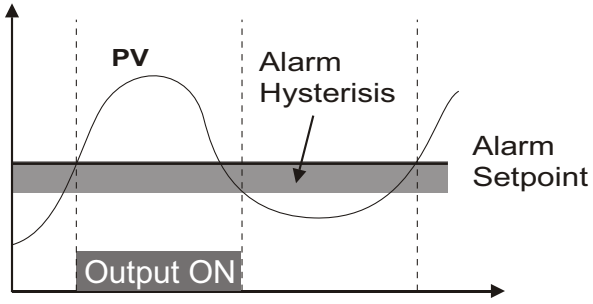
(c) Deviation Band Alarm

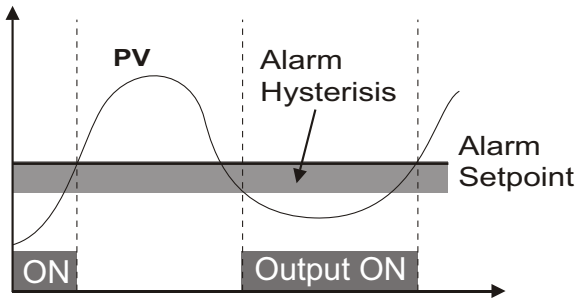


(d) Window Band Alarm

The 'Direct' and 'Reverse' Alarm Logics for 'Process High' alarm type are illustrated below in Figures 5.2(a) and 5.2(b).

Figure 5.2

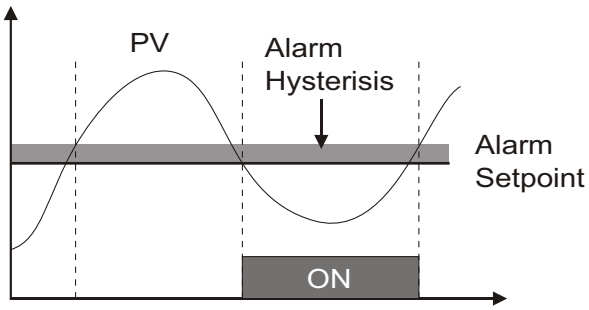




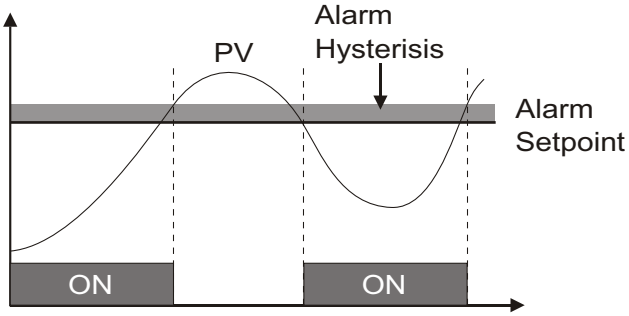
The Figures 5.3(a) and 5.3(b) below illustrate the effect of setting the 'Alarm Inhibit' parameter to 'Yes' and 'No', respectively. The example shown is for 'Process Low' alarm type.

Refer Figure 5.3 (b). Notice that in case of the 'Alarm Inhibit' set to 'No', the alarm is activated, after power-up, even before the **PV** first reaches the 'Alarm Setpoint'.

Figure 5.3



(a) Alarm Inhibit set to 'Yes'



(b) Alarm Inhibit set to 'No'

Section 6
CONFIGURATION PARAMETERS

The Configuration Parameters are grouped on PAGE-12 and allows the user to configure the controller to match with the available input sensor and the load drive. It also present s the parameters for conditioning the input sensor signal and sensor break protection.

The Table 6.1 below lists the parameters followed by the definition of each parameter.

Table 6.1

Parameter Description	Settings (Default Value)
CONTROL LOGIC CtrL Select Reverse (*heat* logic) or Direct (*cool* logic).	rEu Reverse dir Direct (Default : Reverse)
INPUT TYPE inPt Select Input type in accordance with the type of Thermocouple or RTD, sensor or transducer output connected for process value measurement. Ensure proper hardware jumper settings, if required.	Refer Table 6.2 (Default : Type K)
UNIT SELECTION FOR PV Unit *(Available for Thermocouple / RTD Inputs)* Selects temperature measurement units in °C or °F.	°C °F (Default : °C)
RESOLUTION FOR PV rSLn *(Not Available for Thermocouple Inputs)* Sets the process value indication resolution (decimal point). All the resolution based parameters (control setpoint, hysteresis, alarm setpoints etc.) then follow this resolution setting.	Refer Table 6.2 (Default : 1)
PV RANGE LOW r.Lo *(Available for DC Linear Inputs)* Sets process value corresponding to minimum DC Linear signal input (e.g., 0V, 0mA, 4mA, etc.)	Refer Table 6.2 (Default : 0)
PV RANGE HIGH r.hi *(Available for DC Linear Inputs)* Sets process value corresponding to minimum DC Linear signal input (e.g., 5V, 10V, 20mA, etc.)	Refer Table 6.2 (Default : 1000)
SETPOINT LOW SP.Lo Sets minimum permissible control setpoint value.	Min. Range to Setpoint High for the selected Input Type (Default : -200)

Parameter Description	Settings (Default Value)
SETPOINT HIGH SP.hi Sets maximum permissible control setpoint value.	Setpoint Low to Max. Range for the selected Input Type (Default : 1300)
OFFSET FOR PV OFSt This value is algebraically added to the measured PV to derive the final PV that is displayed and compared for alarm / control. Final PV = Measured PV + Offset	-1999 to 9999 (Default : 0)
DIGITAL FILTER FOR PV FiLt Sets the time constant, in seconds, for the low-pass digital filter applied to the measured PV. The filter helps smoothing / averaging the signal input and removing the undesired noise.	0.5 to 25.0 Seconds (in steps of 0.5 Seconds) (Default :1.0)
SENSOR BREAK (OPEN) STRATEGY S.brK *(Available for PID control only)* In case of Thermocouple / RTD broken or disconnected, the controller outputs this power value under open loop condition.	Stn Stationary CLOS Close OPEn Open (Default : Close)

Table 6.2

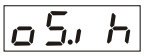
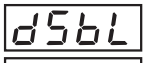
Option	What it means	Range (Min. to Max.)	Resolution
tC_J	Type J Thermocouple	0 to +760°C / +32 to +1400°F	Fixed 1°C / 1°F
tC_K	Type K Thermocouple	-200 to +1300°C / -328 to +2372°F	
tC_t	Type T Thermocouple	-200 to +350°C / -328 to +662°F	
tC_r	Type R Thermocouple	0 to +1700°C / +32 to +3092°F	
tC_S	Type S Thermocouple	0 to +1700°C / +32 to +3092°F	
tC_b	Type B Thermocouple	+200 to +1700°C / +392 to +3092°F	
tC_n	Type N Thermocouple	0 to +1300°C / +32 to +2372°F	
rESu	Reserved for customer specific Thermocouple type not listed above. The type shall be specified in accordance with the ordered (optional on request) Thermocouple type.		
rtd	3-wire, RTD Pt100	-199 to +600°C / -328 to +1112°F **or** -199.9 to 600.0°C / -199.9 to 999.9°F	User settable 1°C / 1°F or 0.1°C / 0.1°F
0-20	0 to 20mA DC current	-1999 to +9999 units	User settable 1 / 0.1 / 0.01/ 0.001 units
4-20	4 to 20mA DC current		
0.050	0 to 50mV DC voltage		
0.200	0 to 200mV DC voltage		
1.25	0 to 1.25V DC voltage		
5.0	0 to 5.0V DC voltage		
10.0	0 to 10.0V DC voltage		

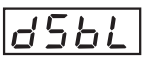
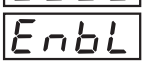
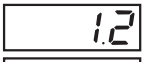
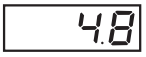
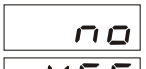
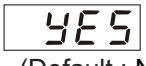
Section 7
SUPERVISORY PARAMETERS

The Supervisory Parameters are grouped on PAGE-13 and pertain to the controller's supervisory utility feature to exercise the supervisory control over the operator level.

All the parameters except Serial Communication and Auxiliary Setpoint are software modules that are supplied as standard features. The Serial Communication and Auxiliary Setpoint, however, are a firmware (software plus hardware) and thus requires optional hardware module to be fitted in the controller for its operation. Note that the Serial Communication and Auxiliary Setpoint parameters are mutually exclusive. The Table 7.1 below lists the parameters required for the operations of the supervisory utility features followed by definition of each parameter.

Table 7.1

Parameter Description	Settings (Default Value)
SELF-TUNE COMMAND  *(Available for PID control only)* Set to 'Yes' to initiate a new tuning cycle or set to 'No' to abort a tuning operation in progress.	 No  Yes (Default : No)
OVERSHOOT INHIBIT  *(Available for PID control only)* Enabling this feature controls the PV rise or fall upon process start-up in order to reach the control setpoint with as minimum overshoot as possible.	 Disable  Enable (Default : Disable)
OVERSHOOT INHIBIT FACTOR  *(Available for PID control with Overshoot Inhibit enabled)* This parameter adjusts the effectiveness of the Overshoot Inhibit feature. Increase the value if the overshoot is curbed but the PV takes longer to reach the SP. Decreases the value if the overshoot persists.	1.0 to 2.0 (Default : 1.2)
SP ADJUSTMENT ON LOWER READOUT  Supervisory permission for control setpoint editing on Lower Readout. Set to 'Enable' for permission.	 Disable  Enable (Default : Enable)
SP ADJUSTMENT ON OPERATOR PAGE  Supervisory permission for control setpoint editing on Operator Page. Set to 'Enable' for permission.	 Disable  Enable (Default : Enable)
MANUAL MODE  Supervisory permission for Manual mode operation. Set to 'Enable' for permission.	 Disable  Enable (Default : Disable)

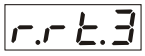
Parameter Description	Settings (Default Value)
ALARM SP ADJUSTMENT ON OPERATOR PAGE  Supervisory permission for Alarm setpoint adjustments on Operator Page. Set to 'Enable' for permission.	 Disable  Enable (Default : Disable)
STANDBY MODE  Supervisory control over availability of Standby (entry / exit) command on Operator Page. 'Enable' for availability.	 Disable  Enable (Default : Disable)
PROFILE ABORT COMMAND ON OPERATOR PAGE  Supervisory control over availability of Profile Abort command on Operator Page. 'Enable' for availability.	 Disable  Enable (Default : Disable)
AUXILIARY SETPOINT OR SERIAL COMM. OPTION SELECTION  This parameter allows the user to configure the controller in either Auxiliary Setpoint or Serial Communication mode options. When the 'Auxiliary Setpoint' option is selected, the controller treats the Auxiliary Setpoint (ASP) same as Control (Main) Setpoint (SP) and attempts to maintain PV at the Auxiliary Setpoint upon detecting the potential free contact closure of external switch / Relay or a TTL-compatible voltage level below 0.5 Volts by the hardware module. When the 'Serial Communication' option is selected, the following parameters are available and applicable for Serial Communication function provided the respective hardware module is fitted.	 None  Serial Comm.  Auxiliary Setpoint (Default : None)
BAUD RATE  Communication speed in 'Bits per Second'. Set the value to match with the host baud rate.	 1200  2400  4800  9600 (Default : 9.6)
CONTROLLER ID NUMBER  Unique numeric code assigned to the controller for identification by the host. Set the value as required by the host.	1 to 127 (Default : 1)
COMMUNICATION WRITE ENABLE  Setting to 'No' disallows the host to set or modify any parameter value. The value however can be read by the host.	 No  Yes (Default : No)

Section 8
PROFILE PARAMETERS

The Profile Parameters are grouped on PAGE-14 and pertain to the Ramp / Soak Profile utility. The controller comes with an in-built 4 Ramp + 4 Soak Profile (Refer *Section 12: Setpoint Profile* for details). The Table 8.1 below lists the parameters followed by the definition of each parameter.

Table 8.1

Parameter Description	Settings (Default Value)
PROFILE MODE SELECTION PrOF This parameter can be set as 'Enable' or 'Disable' to activate or de-activate the controller's operation in Profile mode. If enabled, the controller executes a 4 Ramp + 4 Soak Profile upon issuing 'Profile Start Command'.	dSbL Disable EnbL Enable (Default : Enable)
RAMP HOLD BAND r.bnd This parameter sets the allowable deviation between the PV and the Ramping Setpoint while running a ramp segment. Should the PV fall outside this band, the Setpoint ramping holds until the PV enters the band again. This parameter can be used to ensure that the PV follows the set Ramp Rate within allowable limits as far as possible. Set this value to 0 if Ramp Hold back function is not required. This parameter is expressed in the same unit and resolution as that for PV.	0 to 250 (Default : 0)
SOAK HOLD BAND S.bnd This parameter sets the allowable deviation of PV from the Target Setpoint while executing a soak segment. Should the PV fall outside this band, the controller suspends execution of the soak time until the PV enters the band again. This parameter can be used to ensure that the PV is maintained at the Target Setpoint within allowable limits as far as possible. Set this value to 0 if Soak Hold back function is not required. This parameter is expressed in the same unit and resolution as that for PV.	0 to 250 (Default : 0)
RAMP RATE-1 r.rt.1 This parameter sets the rate at which the setpoint ramps to the first Target Setpoint from the PV at the start of a new Profile Cycle. The value is set in terms of "Units per Minute". For e.g., a Ramp Rate of 1.25, for Temperature input, means the Setpoint shall ramp to the Target Setpoint at a rate of 1.25°C per Minute. The setting resolution of this parameter is independent of the displayed PV resolution. If set to 0, the Ramp Setpoint immediately equals the Target Setpoint-1.	0.00 to 99.99 (Default : 0.00)
TARGET SETPOINT-1 tSP.1 This parameter sets the target level for the first ramp segment. The Setpoint ramps to this level with Ramp Rate-1 upon initiation of the Profile Cycle by issuing 'Profile Start Command'.	Min. to Max. Range Specified for the Selected Input Type (Default : -200)

Parameter Description	Settings (Default Value)
This parameter is expressed in the same unit and resolution as that for PV. By default, this parameter value is set to the Minimum Range value specified for the selected 'Input Type'. If the 'Input Type' is altered, this parameter value automatically set to the Minimum Range value of the altered 'Input Type'.	
SOAK TIME-1  This parameter sets the time duration for which the Setpoint is maintained at Target setpoint-1. This segment is skipped if set to 0, that is, the Setpoint starts ramping to Target Setpoint-2 as soon as it reaches to Target Setpoint-1. This parameter is expressed in minutes and settable in 1 minute resolution.	0 to 9999 (Default : 0)
RAMP RATE-2  This parameter sets the rate at which the Setpoint ramps from Target. Setpoint-1 to Target Setpoint-2. The setting resolution of this parameter is independent of the displayed PV resolution. If set to 0, the Ramp Setpoint immediately equals to the Target Setpoint-2.	0.00 to 99.99 (Default : 0.00)
TARGET SETPOINT-2  This parameter sets the target level for the second ramp segment. The Setpoint ramps to this level with Ramp Rate-2 from Target Setpoint-1. This parameter is expressed in the same unit and resolution as that for PV. By default, this parameter value is set to the Minimum Range value specified for the selected 'Input Type'. If the 'Input Type' is altered, this parameter value automatically set to the Minimum Range of the altered 'Input Type'.	Min. to Max. Range Specified for the Selected Input Type (Default : -200)
SOAK TIME-2  This parameter sets the time duration for which the Setpoint is maintained at Target Setpoint-2. This segment is skipped if set to 0, that is, the Setpoint starts ramping to Target Setpoint-3 as soon as it reaches to Target Setpoint-2. This parameter is expressed in minutes and settable in 1 minute resolution.	0 to 9999 (Default : 0)
RAMP RATE-3  This parameter sets the rate at which the Setpoint ramps from Target . Setpoint-2 to Target Setpoint-3. The setting resolution of this parameter is independent of the displayed PV resolution. If set to 0, the Ramp Setpoint immediately equals to the Target Setpoint-3.	0.00 to 99.99 (Default : 0.00)

Parameter Description	Settings (Default Value)
TARGET SETPOINT-3  This parameter sets the target level for the Third ramp segment. The Setpoint ramps to this level with Ramp Rate-3 from Target Setpoint-2. This parameter is expressed in the same unit and resolution as that for PV. By default, this parameter value is set to the Minimum Range value specified for the selected 'Input Type'. If the 'Input Type' is altered, this parameter value automatically set to the Minimum Range of the altered 'Input Type'.	Min. to Max. Range Specified for the Selected Input Type (Default : -200)
SOAK TIME-3  This parameter sets the time duration for which the Setpoint is maintained at Target Setpoint-3. This segment is skipped if set to 0,that is, the Setpoint starts ramping to Target Setpoint-4 as soon as it reaches to Target Setpoint-3. This parameter is expressed in minutes and settable in 1 minute resolution.	0 to 9999 (Default : 0)
RAMP RATE-4  This parameter sets the rate at which the Setpoint ramps from Target Setpoint-3 to Target Setpoint-4. The setting resolution of this parameter is independent of the displayed PV resolution. If set to 0, the Ramp Setpoint immediately equals to the Target Setpoint-4.	0.00 to 99.99 (Default : 0.00)
TARGET SETPOINT-4  This parameter sets the target level for the fourth ramp segment. The Setpoint ramps to this level with Ramp Rate-4 from Target Setpoint-3. This parameter is expressed in the same unit and resolution as that for PV. By default, this parameter value is set to the Minimum Range value specified for the selected 'Input Type'. If the 'Input Type' is altered, this parameter value automatically set to the Minimum Range value of the altered 'Input Type'.	Min. to Max. Range Specified for the Selected Input Type (Default : -200)
SOAK TIME-4  This parameter sets the time duration for which the setpoint is maintained at Target setpoint-4. This segment is skipped if set to 0. The Profile Cycle is over at the end of this segment. If the parameter 'Output Off' is set to 'No', the controller starts controlling the PV with respect to the SP (Control/Auxiliary). If alarm type is selected as 'End of Profile', the OP3 Relay / SSR (if fitted) energizes for approximately 10 seconds at the end of this segment. This parameter is expressed in minutes and settable in 1 minute resolution.	0 to 9999 (Default : 0)

Parameter Description	Settings (Default Value)
OUTPUT OFF OP.OF This parameter allows the user to set the strategy as regards what the controller shall do after completion of a running Profile Cycle. If this parameter is set to 'Yes', the controller keeps the Control Output(s) OFF until a next 'Profile Start Command' is issued or the Profile Cycle is aborted. If, however, this parameter is set to 'No', the controller behaves as a single loop controller and maintains the PV at the user set value for the SP(Control/Auxiliary).	no No YES Yes (Default : No)

Section 9
OP3 FUNCTION PARAMETERS

The OP3 Function Parameters are grouped on PAGE-15 and allow the user to configure the controller for the following function if the respective hardware module is fitted.

- Configure OP3 Function to Alarm Output.
- Configure OP3 Function to Retransmission (Recorder) Output.

The Table 9.1 below lists the parameters followed by the definitions for each parameter.

Table 9.1

Parameter Description	Settings (Default Value)
OUTPUT-3 FUNCTION SELECTION OP3.F This parameter allows the user to select the function for the OP3 / module as either 'Alarm' output (Relay / SSR module) or 'Retransmission' output (DC Linear module). If selected as 'Retransmission' (Recorder), the controller outputs the DC Linear signal on OP3 module else, the Output-3 is activated / de-activated as per Alarm status.	ALrn Alarm rEC Recorder Output (Default :Alarm)
RECORDER OUTPUT TRANSMISSION trnS This parameter is available and applicable only if 'Output-3 Function' is selected for 'Retransmission' (Recorder) output and allows the user to select the Recorder Output Transmission proportional to either PV (Process Value) or SP (Control / Auxiliary).	Pv Process Value SP Setpoint (Default :Process Value)
RECORDER OUTPUT TYPE rEC.O This parameter is available and applicable only if 'Output-3 Function' is selected for 'Retransmission' (Recorder) output and sets the range for the recorder signal output as 0-20 mA, 4-20 mA, 0-5 V or 0-10 V. The controller outputs a linear 0-20 mA, 4-20 mA, 0-5 V or 0-10 V signal, through OP3 DC Linear module, proportional to the PV or SP (as selected) within 'Recorder High' and 'Recorder Low' values.	0-20 0 to 20 mA 4-20 4 to 20 mA 0-5 0 to 5 Volts 0-10 0 to 10 Volts (Default :4 to 20mA)
RECORDER LOW rEC.L Refer parameter 'Recorder High' below.	Min. to Max. Range Specified for the Selected Input Type (Default : -200)

Parameter Description	Settings (Default Value)
RECORDER HIGH rEC.h The 'Recorder Low' and 'Recorder High' defines the PV / SP range for which the controller outputs the DC Linear Signal as Retransmission (Recorder) Output that is linearly proportional to PV / SP. The minimum signal level corresponds to the set value for the 'Recorder Low' parameter and the maximum signal level corresponds to the set value for the 'Recorder High' parameter. The output signal is then linearly scaled between these two limits to derive the output signal corresponding to measured PV / SP.	Min. to Max. Range Specified for the Selected Input Type (Default : 1300)

Note:
If the 'Recorder Low' parameter is set to a value greater than that for 'Recorder High' and the 'Recorder High' parameter is set to a value less than that for 'Recorder Low', the relationship between the PV / SP and the Recorder output is reversed. As per the above-cited example; if the 'Recorder Low' is set to 200°C and 'Recorder High' is set to 0°C, the controller outputs 4 mA when PV / SP is equal to 200°C and 20 mA when PV / SP equal to 0 °C.

In case, the required Recorder Minimum / Maximum Output signal levels do not match exactly with the available Recorder Minimum/Maximum signal levels, follow the steps below to interface the same.

The steps below illustrate, as an example for clear understanding, how a Recorder recording 20.0 to 100.0%RH (PV) for 0 to 10mA linear signal input can be interfaced.

1. Select the 'Recorder Output Type' that is greater than the Recorder signal input range. Since the Recorder signal input range (0 to 10 mA) falls within 0 to 20 mA range, select this range as the 'Recorder Output Type'.

2. For setting 'Recorder Low' Recorder will record for the input signal of 0 mA, by solving the straight-line equation of the form $y = mx + c$, applied to the Recorder.

   y = Recorder Output to be computed for the value of x
   m = (Recorder Output Range) / (Recorder Input Range)
   x = Recorder Input Signal
   c = Recorder Minimum Output

First compute the value for m,

Recorder Output Range = 100.0%RH - 20.0%RH = 80.0%RH
Recorder Input Range = 10 mA - 0 mA = 10 mA

Thus,

$m = 80.0 / 10 = 8$ (%RH/mA)

Now compute the value of y for $x = 0$ mA,

$y = mx + c = 8 \times 0 + 20.0$
$= 0 + 20.0 = 20.0\%$ RH

Set this value of y (20.0) as the 'Recorder Low' value

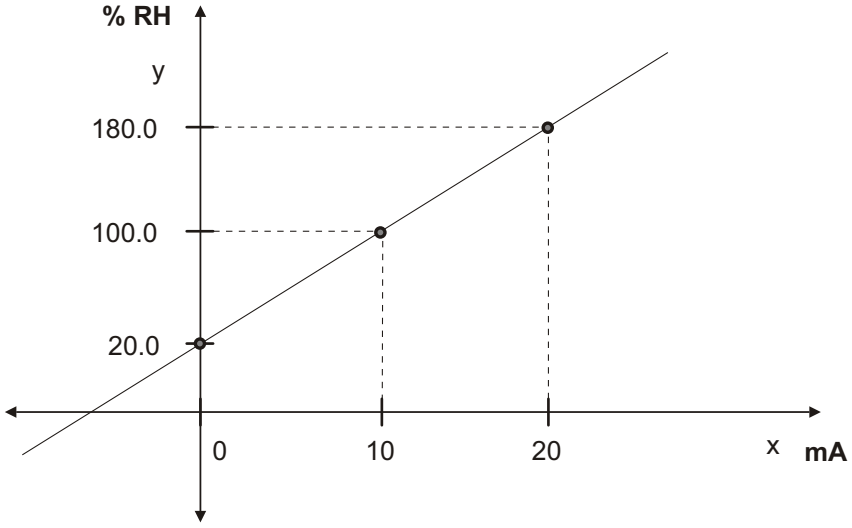
3. For setting 'Recorder High' value, compute the %RH that the Recorder will record for the input signal of 20 mA, by solving the same equation but for $x = 20$ mA.

Thus,

$y = mx + c = 8 \times 20 + 20.0$
$= 160 + 20.0 = 180.0\%\ RH$

Set this value of y (180.0) as the 'Recorder High' value.

Figure 9.1



The graph shown in Figure 9.1 above represents the straight line calculated in the above example with the respective (x, y) coordinates.

That is, for x = 20 mA, y = 180.0 %RH
And x = 0 mA, y = 20.0 %RH

Hence, for x = 10 mA, y = 100.0 %RH
And x = 0 mA, y = 20.0 %RH

Thus, by setting the 'Recorder High' value to 180.0 and 'Recorder Low' value to 20.0, the controller outputs 10 mA when the PV is 100.0 % RH and 0 mA when the PV is 20.0 %RH. By default, the 'Recorder Low' and 'Recorder High' parameter value are settable within the 'Range Low' and 'Range High' values, respectively, specified for the selected 'Input Type'. If the 'Input Type' is altered, the 'Recorder Low' and 'Recorder High' parameter values automatically set to the Minimum Range value and Maximum Range High value of the altered 'Input Type', respectively. The 'Recorder Low' and 'Recorder High' parameters are expressed in the same unit and resolution as that for PV.

Section 10
TUNING

SELF-TUNING

The PPI model *neuro 104* incorporates, as a standard feature, the tune-on-demand Tuning, called the Self-Tuning.

The Self-Tuning is a one-time Tuning (or tune-on-demand) which works by switching ON/OFF the Forward and Reverse Relay to travel the valve in fully Forward direction (Open) and fully Reverse direction (Close) for inducing oscillations in the PV. From the amplitude and period of oscillations, it calculates the tuning parameter (PID) values.

The Self-Tuning is usually required at the time of initial installation of the controller. If there are no significant changes in the SP or load conditions, re-tuning the controller is seldom required. If, however, the control subsequently becomes unstable (due to changes in process characteristics), the user must re-tune the controller for the new conditions.

Though, the Self-Tuning can be initiated anytime, it is recommended (and not mandatory) to start the Self-Tuning from the start-up (usually ambient) condition to achieve the best results. This is recommended for the processes that start-up with full load conditions because the controller can then make accurate measurements of the process's initial parameters that are used to control overshoots/undershoots.

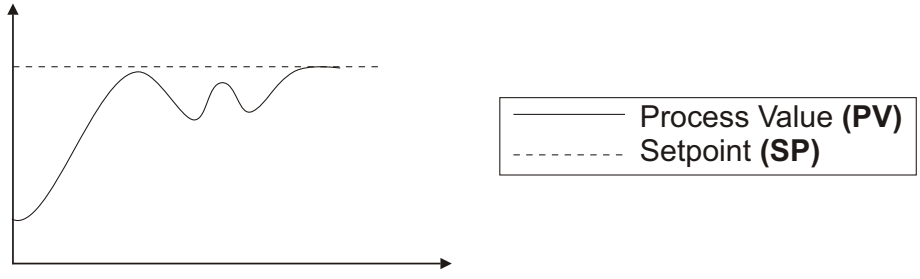
General Procedure for Self - Tuning

Whether Self-Tuning the controller near the SP or from the ambient, the general steps to follow are described below. It is assumed that the controller has been properly configured and installed.

1. Set the SP to the value at which the process will be maintained most of the time.
2. Set the desired values for the parameters 'Motor Run Time', 'Valve Inertia Time' and 'Valve Backlash Time'
3. Access to PAGE-13. Set the tUnE (Tune) parameter to YES (Yes) and press ENTER key.
4. The controller now starts inducing oscillations in PV by switching ON/OFF the Forward and Reverse Relay to travel the valve in Forward (Open) direction and Reverse (close) direction in accordance with the PV position with respect to predetermined level from SP. The Upper Readout shows the PV and the Lower Readout continuously tUnE flashes (Tune) message. After two cycles of oscillation the Tuning will be completed.
5. Upon successful completion of the Tuning, the tUnE message on the Lower Readout disappears. The controller calculates PID values and starts operating in the set mode of operation (Automatic, Manual, Standby or Profile).

The Figure 10.1 below illustrates the typical behavior of Self-Tuning.

Figure 10.1



Notes:

1. The Self-Tuning can be initiated from any mode of operation (Automatic, Manual, Standby or Profile). If the controller is in Automatic mode prior to Self-Tuning, the controller automatically starts maintaining PV at SP upon completion of Self-Tuning procedure.
2. If the Self-Tuning is terminated abnormally or aborted manually, the controller returns to the original mode of operation prior to Self-Tuning while the PID values also take the values prior to Self-Tuning.
3. Once, the PID parameters are set automatically by Self-Tuning procedure, these parameter values are stored in controller non volatile memory. Therefore, it is not necessary to execute the Self-Tuning again. However, if the operating conditions are changed, it is recommended to re-tune the controller.
4. In case of power-failure while Self-Tuning is in progress, the Self-Tuning automatically resumes from the appropriate step upon resumption of power. If there are possibilities of frequent and long power failures, the Self-Tuning might take considerable time for completion.
5. Avoid applying Self-Tuning in the following processes
    - As the 'Relay-Amplitude' Tuning method implemented in *neuro 104* requires oscillations of PV around a predetermined level (calculated based on the SP value), avoid Self-Tuning to the processes that can be disturbed due to temporary moving the valve in fully Forward (Open) and fully Reverse (Close) direction for inducing oscillations in PV.
    - Processes which require quick response such as pressure, flow rate processes.
    - Processes where Overshoots or Undershoots are not desirable.
    - Processes which are taking too much time for Tuning (may be due to some external influences like excessive heating in the adjoining chamber, etc.) and the controller may not tune properly with the process characteristics.

Caution

Do not make any changes to the controller parameters while the Self-Tuning is in progress.

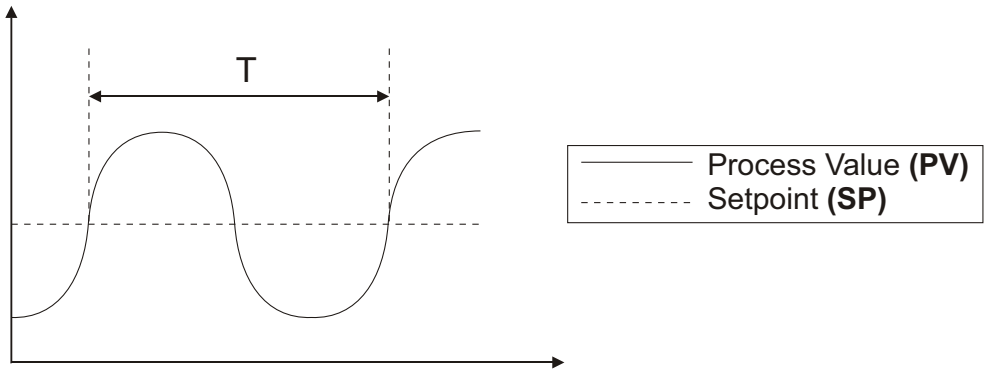
MANUAL TUNING

The processes in which the Self-Tuning should be avoided, it is recommended to apply the Manual Tuning for such processes as described below. There are several standard techniques available. The one described below is the simplest and the most popular *'Zeigler Nichols Closed-loop Cycling'* method.

The Manual Tuning requires that the PV be tracked over time. If the controller is equipped with the Retransmission (Recorder) output option, connect a chart recorder to its terminals and set the Retransmission (Recorder) Output parameters on PAGE-11 appropriately or if the controller is equipped with Serial Comm. Option, obtain the graph of displayed PV on Recorder or Master Device like PC. In case, the controller is not equipped with any option, the graph of the displayed PV against Time can be plotted manually.

The closed-loop cycling method requires forcing the process to oscillate by placing the controller in proportional-only mode (that is cutting-off Integral and Derivative actions) by setting a very small value for the ‘Proportional Band’. The control loop cycles with a characteristic frequency, as shown in the Figure 10.2 below. This is a very accurate representation of the process’s time responsiveness and is used to calculate the ‘Integral’ and ‘Derivative time’ constants of the controller.

Figure 10.2



Follow the steps below for Tuning the controller manually.

1. Set the value of the SP at which the Manual Tuning is desired or slightly below if the overshoots caused by the oscillations near the operating value are damaging.
2. Cut-off Integral and Derivative actions by setting the parameter values to 0.
3. Set the 'Motor Run Time' to the time taken to travel the valve from its fully close position (one physical end) to fully open position (other physical end) or vice-a-versa.
4. Set the 'Valve Inertia Time' and 'Valve Backlash Time' (if required) to the appropriate values.
5. Set the 'Minimum ON Time' to execute the minimum pulse duration (Forward or Reverse) to drive the motor to initiate valve movement.
6. Reduce 'Proportional Band' value until the PV oscillates. Since the controller is operating in proportion-only mode, the PV oscillations shall occur with an offset error. Ignore this error and measure the period of oscillation as T, as shown in the Figure 10.2 above.
7. Keep increasing the 'Proportional Band' value in small steps until the PV just stabilizes. Allow enough time between the steps for the process to response to the changes made. Note the value of the 'Proportional Band' at which the oscillations just cease (stop), as P.
8. Compute the 'Proportional Band', 'Integral Time' and 'Derivative Time' from the measured values of P and T as per the following Table 10.1.
9. Set these values for the controller parameters 'Proportional Band', 'Integral Time' and 'Derivative Time' in PAGE-10 parameter list.

Table 10.1

Type Of Control	Proportion Band Pb	Integral Time It	Derivative Time dt
Proportional Only	2 X **P**	OFF	OFF
Proportional + Integral (P + I)	2.22 X **P**	0.8 X **T**	OFF
Proportional + Integral + Derivative (P + I + D)	1.67 X **P**	0.5 X **T**	0.13 X **T**

TROUBLESHOOTING PID TUNING

After carrying out Self-Tuning or Manual Tuning procedure, if the process control loop is slightly unstable and oscillates, it may be due to the fact that the loop was not properly tuned or the procedures described above are not quite appropriate for this loop. In such cases, instead of repeating the extensive Tuning procedures, several things can be tried out to repair the Tuning of the control loop as described below:

- Compare the period of oscillation (T) (Refer Figure 10.2) to the 'Integral Time' constant setting. If the 'Integral Time' is very small, slightly increase it. The 'Integral Time' constant can be increased atleast as long as the period of oscillation.
- If the control loop continues to oscillate, slightly increase 'Proportional Band' value to eliminate the oscillations
- Some control loops have certain physical characteristics which prevent them from being tuned with derivative action. For example; in a process where air, gas, liquid or pressure is to be controlled. Upon adjusting the 'Integral Time' constant and 'Proportional Band' as stated above if the loop does not stabilize, try reducing or removing the 'Derivative Time' constant.
- If the 'Minimum ON Time' to drive the motor for initiating valve movement is set too large, it may impare the effectiveness of the Tuning and control and increase the risk of oscillations. Set the 'Minimum ON Time' value appropriately so as it cannot affect the valve movements as well as eliminates oscillations.

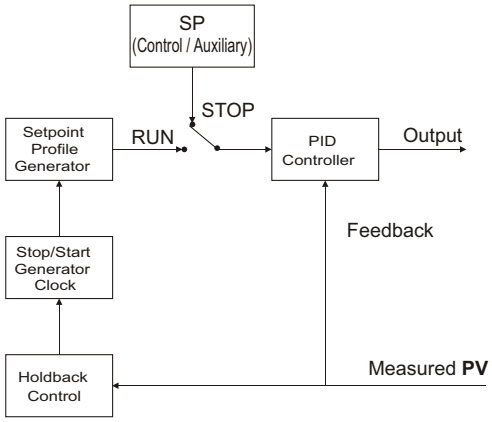
Section 11
SETPOINT PROFILE

There are a host of applications that require the PV to follow a series of straight-line segments, called “Profile”.

The neuro 104 controller incorporates software modules, the Setpoint Generator module and the Timer module, which generate a fixed-format, 8-segment Profile: 4 Ramp + 4 Soak, each Ramp followed by a Soak. The Setpoint Generator module generates the ramp segment in accordance with the set values of Ramp Rate and the Target Setpoint. The Timer module counts the time pulses to execute the user set Soak Time at the specified Target Setpoint.

The Figure 11.1 below illustrates conceptual block diagram of a Profile mode operation.

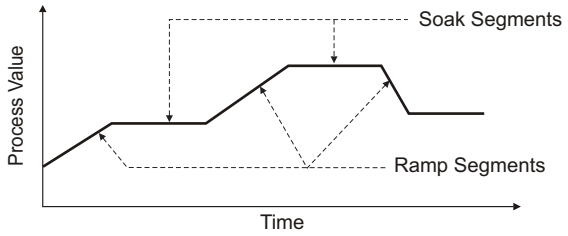
Figure 11.1



PROFILE SEGMENTS

The straight-line segments that form a Profile are called Profile Segments. In the Figure 11.2 below, it can be seen that the Profile segments either ramp (increase or decrease linearly) or remain steady with respect to time. The ramping segment is called RAMP and the steady segment is called SOAK. Each Profile segment is nothing but a “series of Setpoint” that the controller generates.

Figure 11.2



Each ramp segment has an associated slope, called the RAMP RATE, and is defined as the ratio of change in and is defined as the ratio of change in time. The end point of a ramp segment is specified in terms of the PV and is called TARGET SETPOINT. That is, the ramp segment ramps up to the Target Setpoint with the specified Ramp Rate. The ramping could be positive or negative and is determined by the relative position of the Target Setpoint with respect to the start of Ramping Setpoint. The Ramp Rate is expressed in “Units per Minutes”.

Each soak segment has an associated time duration for which the Setpoint holds or rests at the Target Setpoint and is called SOAK TIME. The next ramp segment begins at the end of the Soak Time. The Soak Time is expressed in “Minutes”.

It is obvious from the above definitions that it requires RAMP RATES, TARGET SETPOINTS and SOAK TIMES to define a specific Profile.

The 8 Profile segments are executed in succession, that is, the end of the first segment automatically initiates the second segment and so on until the 8^{th} segment is executed. At the end of the 8^{th}segment, the Profile ends and the control is passed to the SP (Control/Auxiliary) if the parameter ‘Output OFF’ is selected to ‘No’ in PAGE-14 parameter list (Profile Parameters).

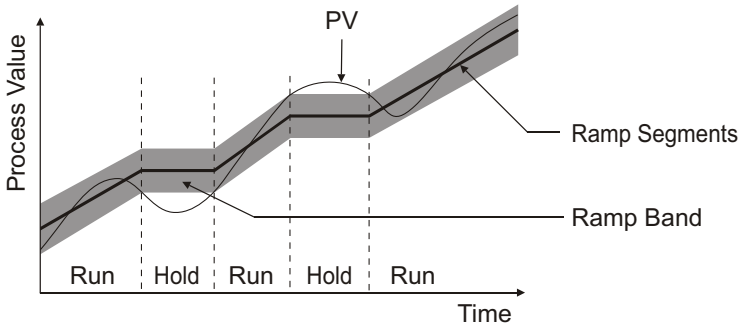
The Profile Cycle follows servo-start, that is, each new Profile Cycle or the resumption of the Profile Cycle upon power-up always begins with the first measured PV as the beginning point of a ramp segment.

HOLDBACK

The neuro 104 controller's Profile feature provides a special facility called the Holdback. The Setpoint Generator module or the Timer module can be forced to enter a HOLD state following the failure to meet certain user-specified conditions. During Hold state, the Setpoint Generator module suspends ramping the Setpoint and the Timer module stops counting the time pulses. The Setpoint Generator and the Timer modules automatically resume their operations upon removal of the conditions that caused Holdback.

During the execution of the ramp segment, due to various reasons (initial inertia of the process, insufficient load capacity at higher Setpoint values to co-op with the set Ramp Rate, etc.), the PV may not respect the Ramping Setpoint as closely as desired. Under such conditions, it may be desired to put the Setpoint Generator in Holdback should the PV deviate from the current Ramp Setpoint value beyond acceptable limits. That is, a band is required to be generated around the ramp segment that will force the Setpoint Generator to Holdback if the PV falls outside this band, as depicted in the Figure 11.3 below.

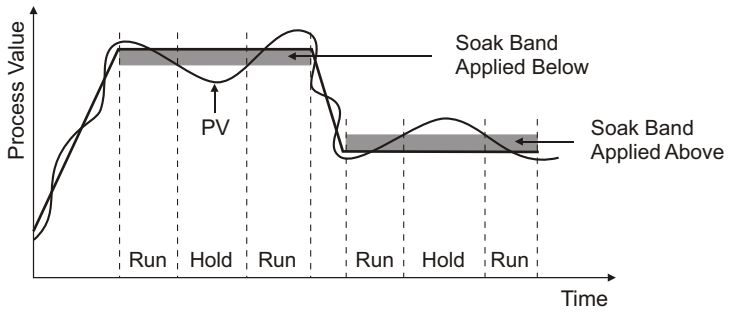
Figure 11.3



The neuro 104 allows specifying this band by setting the value of the parameter 'Ramp Hold Band'. Whenever, the absolute difference between the Ramping Setpoint and the measured PV exceeds this band value, the controller stops ramping of the Setpoint until PV enters the band. This allows the PV a chance to catch-up to the Ramp Setpoint.

During the execution of the soak segment, it may be desired that the soaking time should be counted only while the measured PV is within a specified limit, either below or above the 'Target Setpoint' called 'Soak Hold Band'. That is, whenever the measured PV falls outside soak band, the Timer module stops counting time pulses. Note that, whereas the ramp band is centered around the ramp segment; the soak band is applied only above or below the 'Target Setpoint'. If the 'Target Setpoint' is attained following a positive (rising) ramp, the soak band is applied below the 'Target Setpoint'. If, however, the 'Target Setpoint' is attained following a negative (falling) ramp, the 'Soak Band' is applied above the 'Target Setpoint'. The two cases are depicted in the Figure 11.4 below.

Figure 11.4



One typical application of the soak band is implementing guaranteed soak, that is, to start counting the time pulses only when the measured PV enters the set band limit and keep counting as long as it does not fall outside the limit. Besides guaranteed soak, it is also useful in many heat treatment applications to ensure that the Soak Timer does not start until the PV reaches the 'Target Setpoint' within the band limit.

RELATIVE ALARMS DURING A PROFILE

As already mentioned (in *Section 5: Alarm Parameters*) that the 'Deviation Band' and 'Window Band' alarms are the Relative alarms. While Profile is running, these alarms are relative to the Ramp and Target Setpoints.

Deviation Band Alarm

As already mentioned, this alarm sets the Upper or Lower deviation limit with the respect to the SP. However, in Profile mode, while ramp, the 'Deviation Band' Alarm is applicable to the Ramp Setpoint and while soak, the 'Deviation Band' Alarm is applicable to the 'Target Setpoint'.

For example; if the set value for 'Alarm Deviation' is 3°C, then, during ramp, the alarm activates whenever the measured PV exceeds the Ramp Setpoint by 3°C or more while following the ramping Setpoints and during soak, the alarm activates whenever the measured PV exceeds the 'Target Setpoint' by 3°C or more while maintaining at 'Target Setpoint'.

Similarly, if the set value is -3°C, then, during ramp, the alarm activates whenever the measured PV falls below the Ramp Setpoint by 3°C or more while following the ramping Setpoints and during soak, the alarm activates whenever the measured PV falls below the 'Target Setpoint' by 3°C or more while maintaining at 'Target Setpoint'.

Window Band Alarm

As already mentioned, this alarm sets a symmetrical band around the SP. It defines both Upper and Lower deviation limits. However, in Profile mode, while ramp, the 'Window Band' Alarm is applicable to Ramp Setpoint and while soak, the 'Window Band' Alarm is applicable to 'Target Setpoint'.

For example; band value of 3°C sets a +/- 3°C band symmetrical to Ramp Setpoint and 'Target Setpoint'. That is, during ramp, the alarm is activated if the PV deviation from the ramping Setpoint is greater than or equal to 3°C in either direction while following the ramping Setpoints and during soak, the alarm is activated if the PV deviation from the 'Target Setpoint' is greater than or equal to 3°C in either direction while maintaining at ' Target Setpoint'.

Note:

1. The 'Deviation Band' and 'Window Band' Alarms are applicable only if they are selected for the 'Alarm Type' and the Alarm activation depends on the respective value setting on PAGE-11 parameter list (Alarm Parameters).
2. The 'Deviation Band' and 'Window Band' Alarms have no relevance with the 'Holdback Band'.

POWER-FAILURE DURING A PROFILE CYCLE

The resumption of the Profile Cycle after a power-failure is restored depends on the state of the Profile prior to power-failure. That is, whether a ramp or soak was in progress at the time of power-failure.

Ramp Segment in progress

The execution of the Profile resumes with the same ramp segment that it was executing prior to the power-failure. The ramping of the Setpoint begins with the power-on measured PV (servo-start).

Soak Segment in progress

After a power-failure during soak; upon resumption of power, the PV is first ramped (servo-start) to the 'Target Setpoint' with the corresponding 'Ramp Rate' (for e.g., 'Ramp Rate-1' for 'Target Setpoint-1') and then the balance 'Soak Time' is executed. The controller stores in its non-volatile memory, the 'Soak Time' that was already executed prior to the power-failure.

STATE OF CONTROLLER AFTER END OF PROFILE CYCLE

What the controller shall do after the end of a Profile Cycle depends upon the setting of the parameter OP.OF ('Output Off') available in PAGE 14 parameter list (Profile Parameters).

If the parameter is set to YES (YES), the controller keeps the Reverse Relay contiguously ON to turn the valve in Reverse (Close) direction completely to turn the Output Off as soon as the running Profile Cycle ends and does so until a new cycle is initiated or the Profile utility is disabled.

If, however, the parameter is set to no (No), the controller begins the control loop with respect to the SP. This feature, along with the PAGE-14 parameter list (Profile Parameters), allows the user to freely configure the controller's operation that best suits his application. The followings are the few examples that illustrate how the user can set appropriate values for the SP and the PAGE-14 parameter list (Profile Parameters) to achieve varying application needs.

EXAMPLE -1

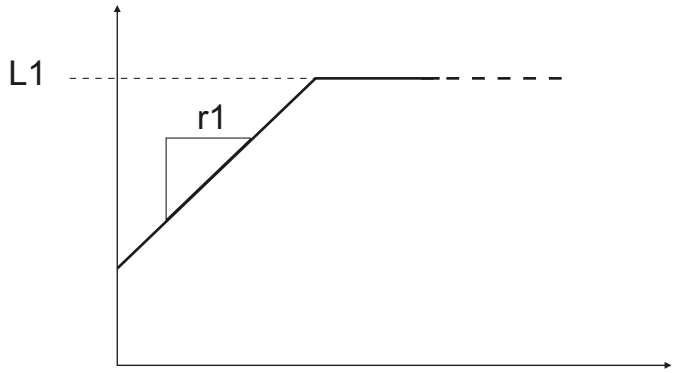
It is required to ramp-up the PV to 'Target Setpoint' (L1) with a 'Ramp Rate' (r1) and then hold the PV at L1 for indefinite time.

Set the following parameters as described: 'Ramp Rate -1' = r 1
'Target Setpoint-1' = L1
SP = L1

Set other 'Ramp Rate' & 'Soak Time' Parameter values to 0.

The other 'Target Setpoint' Parameter Values do not matter.

Figure 11.5



As shown in the Figure 11.5 above, the application calls for a single segment Profile. The reset of the Profile segments are cut-off by setting the corresponding 'Ramp Rates' and 'Soak Times' to 0. As soon as the Ramping Setpoint reaches the 'Target Setpoint' (L1), the Profile Cycle ends. The control is passed to the SP which, too, is set to the value L1. The controller, thus, continues to maintain the PV at L1.

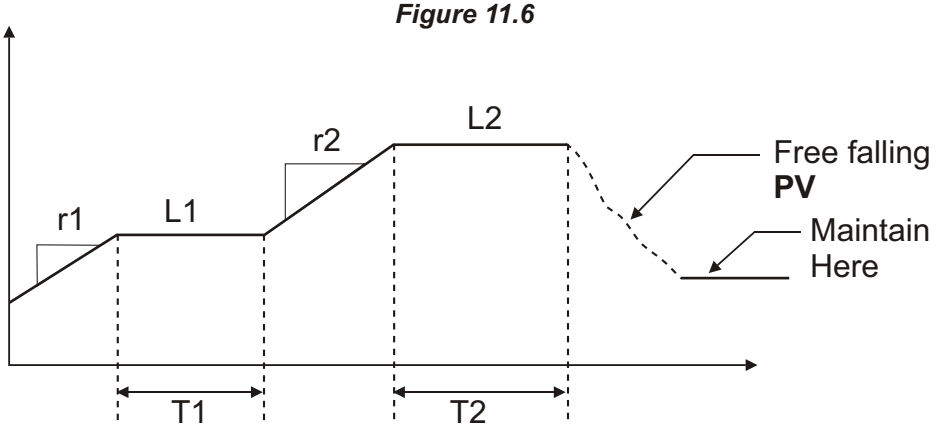
The 'Ramp Hold' and 'Soak Hold' bands can be appropriately set as required or disabled by setting the respective band values to 0.

EXAMPLE -2

It is required to execute a 4 segment Temperature Profile and then maintain the Temperature at a predetermined level until the next 'Profile Start Command' is issued for a fresh Profile Cycle.

The Figure 11.6 below illustrates the requirement with 'Ramp Rates' r1, r2; 'Soak Times' T1, T2 and the 'Target Setpoint' values L1, L2.

Figure 11.6



For this application; the Profile Parameters are set as required. The SP is set to the predetermined level where the PV is to be maintained until the beginning of a next Profile Cycle.

If the Alarm is selected as 'End Of Profile', the controller energizes OP3 for apporx. 10 seconds to alert the user for end of Profile Cycle.

CHANGING PROFILE PARAMETERS DURING PROFILE CYCLE

The effects of altering the Profile Parameter values while running a Profile Cycle depends upon whether the pertaining segment is already executed, yet to be executed or in progress at the time of alterations. The effects are listed below:

1. If the parameter values pertaining to a segment, which has already been executed are altered, there is no immediate effect. The altered values are effective only when running a fresh Profile Cycle.
2. If the parameter values pertaining to a segment, which is yet to be executed are altered, the altered values become effective from the current Profile Cycle itself. That is, the particular segment will be executed with the altered values.
3. If a ramp segment is in progress and its 'Ramp Rate' is altered it will be immediately effected. That is, the balance segment will be executed with the altered 'Ramp Rate'.

   If the 'Target Setpoint' of the running ramp segment is altered, the Ramp Setpoint starts heading to the altered 'Target Setpoint' immediately.
4. If a soak segment is in progress and its 'Soak Time' is altered, the already elapsed time is ignored and the altered value is immediately loaded. That is, the timer starts executing the altered 'Soak Time' value afresh.

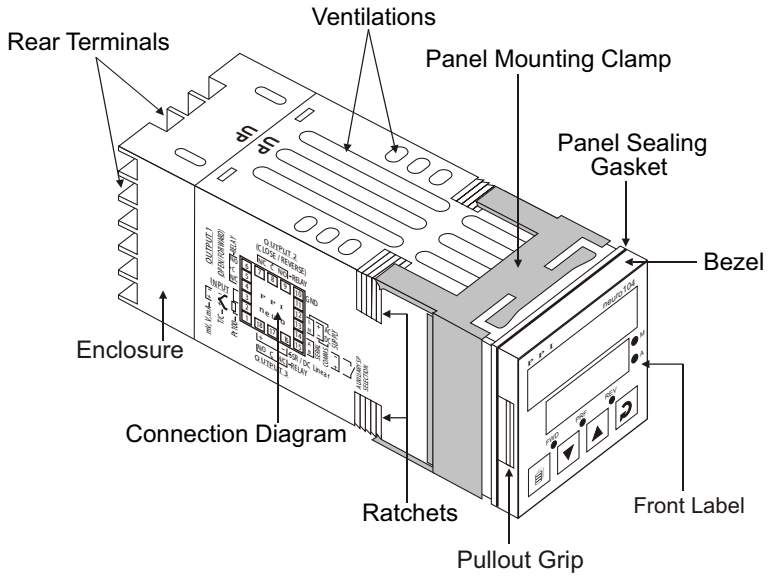
   If the 'Target Setpoint' of the running soak segment is altered, the 'Soak Time' execution continues uninterrupted but the control algorithm attempts to maintain the PV at the altered value of 'Target Setpoint' without applying any 'Ramp Rate'.

Section 12

HARDWARE ASSEMBLY & CONFIGURATIONS

OUTER CASE

Figure 12.1



The Figure 12.1 above shows the controller outer-case when viewed with controller front label upright. The controller outer case is a rigid plastic Enclosure into which the electronics assembly fits. The Enclosure in turn fits into the standard DIN size panel cutout, as described in *Section 13 : Mechanical Installation*.

Notice the nomenclatures used to identify the various parts as the same are used throughout the sections describing installation, configuration and electrical connections.

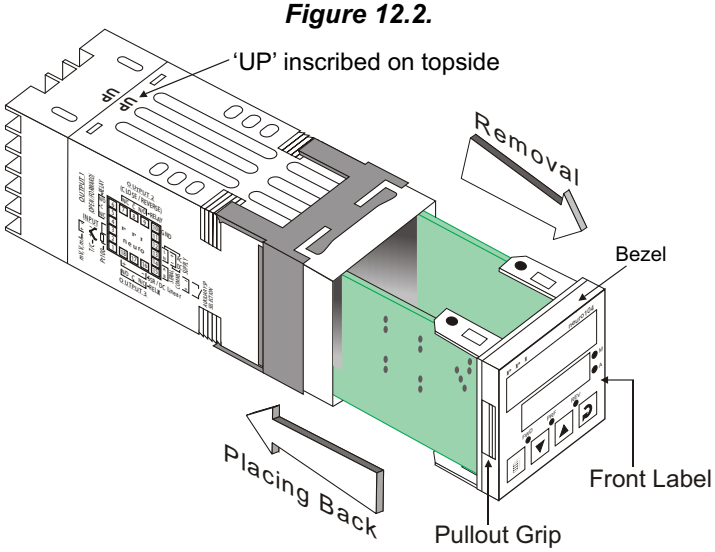
ELECTRONIC ASSEMBLY

The electronic assembly can be removed from the plastic Enclosure and placed back as described below and illustrated in Figure 12.2

Removal

1. Hold the controller with its front label upright.
2. Hold the Bezel with the fingers on the pullout grips provided on the left and right sides of the bezel. Pull the bezel outward. The assembly comes out with the bezel.

Figure 12.2.

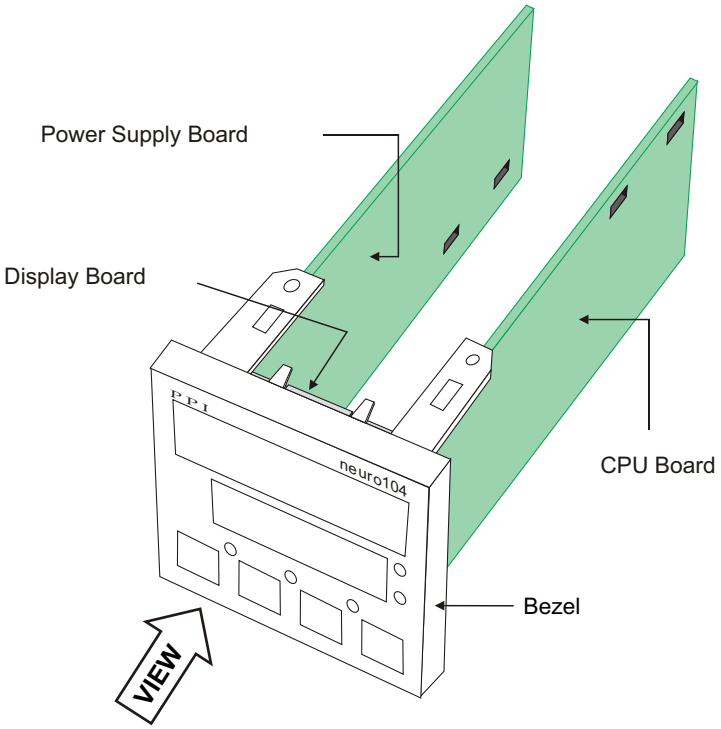


Placing Back

1. Hold the bezel with the front label upright.
2. Hold the Enclosure such that the UP inscribed on the Enclosure is on the topside. Insert the bezel gently with the boards on either side sliding into the guides provided inside of the Enclosure.
3. Ensure that the bezel fits in tight on the Enclosure-front to secure the panel-sealing gasket.

The Figure 12.3 below shows the basic electronics assembly of the controller (without any plug-in modules). The basic electronics assembly of the controller comprises of 3 Printed Circuit Boards. As shown in the figure, when viewed from the front, the CPU board is to the right, Power-supply board is to the left and the Display board is behind the bezel.

Figure 12.3



MOUNTING PLUG-IN MODULES

The controller supports Output-2 (Relay) module which is mandatary to drive the motor to travel the valve in Reverse (Close) direction and 2 optional modules viz. Output-3 (Relay/SSR/DC Linear) module and Serial Communication/Auxiliary Setpoint module. The optional modules are either pre-fitted while the controller is shipped from the factory (if ordered with the basic configuration) or can be fitted by the user if ordered separately (Refer *Appendix D : Ordering Information).*

All 3 modules have female connector (socket) mounted on them, which fit into the respective male connector (plug) provided on either Power-supply board or CPU board. The plugs for mounting Output-2 and Serial comm./Auxiliary SP modules are located on Power-supply board whereas that for Output-3 module are located on the CPU board.

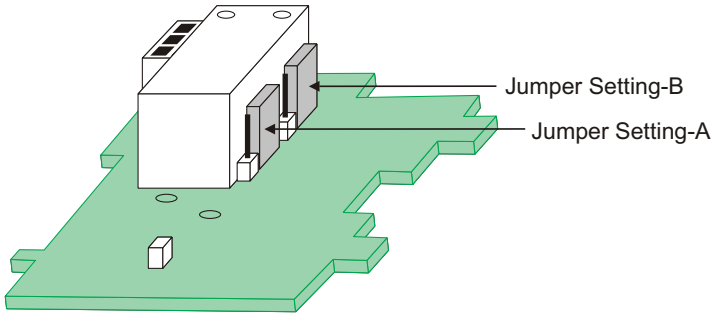
Optional Modules

Output-3 Module

Relay / SSR Module

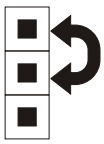
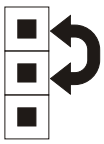
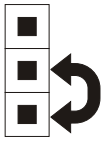
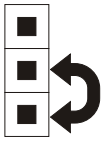
A common module is provided for Relay or SSR output with the provision of jumper selectable configuration for the selection between Relay and SSR voltage pulses. The Figure 12.4 below shows the output module and the jumper arrangement.

Figure 12.4



As shown in above Figure, there are 2 jumper arrangements marked A and B. The selection between Relay and SSR requires both these jumpers A and B to be set appropriately as shown in Table 12.1 below. The double headed arrows show the adjoining Pins that require shorting using the Link.

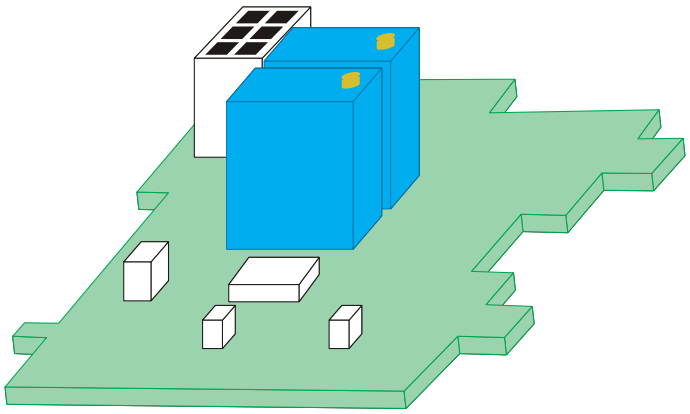
Table 12.1

Output Type	Jumper Setting - A	Jumper Setting - B
Relay (Arrangement shown in Figure 13.4)		
SSR Voltage Pulses		

DC linear Current / Voltage Module

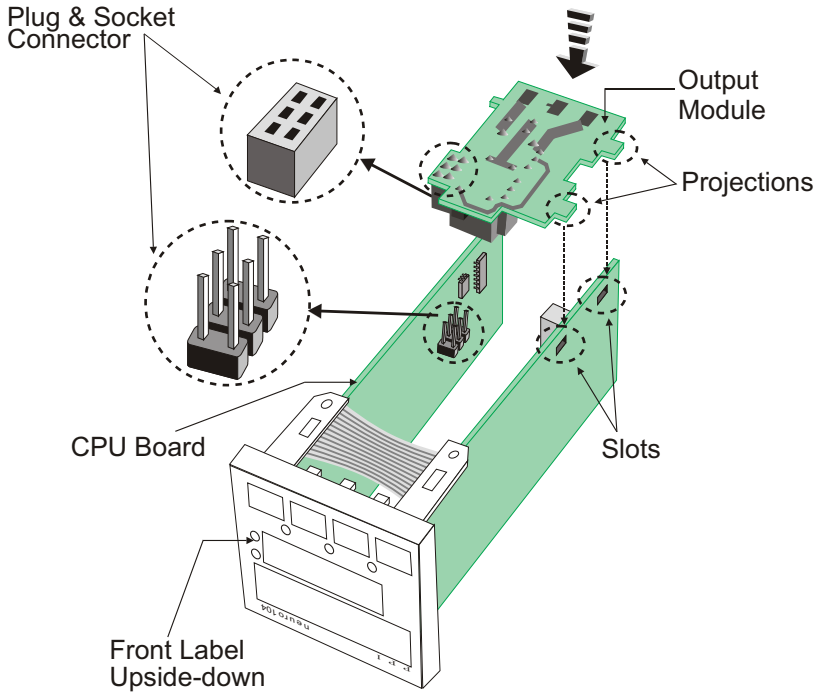
A common module is provided for DC Linear Current or Voltage output. The Figure 12.5 below shows the DC Linear Current / Voltage module. There is no need of any hardware jumper setting for Current or Voltage selection. The required output can be selected by setting the value for the 'Recorder Output Type' parameter in PAGE-15 parameter list.

Figure 12.5



The Figures 12.6 below illustrate how to mount the plug-in Output-3 module. Notice the orientation of the controller and a few identifying components shown in figure to help locate the plugs for the modules. Ensure that the socket snap-fits into the plug and the 2 Projections of the module board fit into the 2 Slots provided on the CPU board for proper electrical contacts and secured fitting.

Figure 12.6
Mounting Output-3 Module



For plugging out the module(s), follow the steps below:

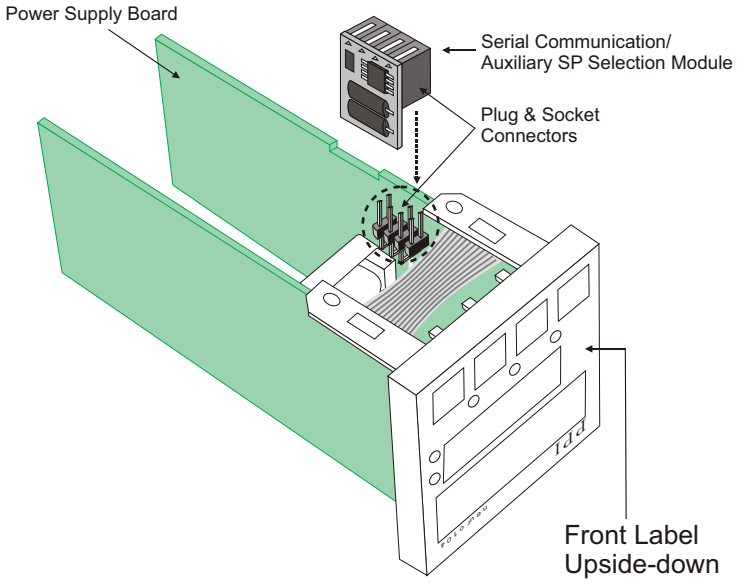
1. Gently pull apart the Power-supply board and the CPU board until the projections of the module board come out of the slots.

2. Pull the module outward to unlock the socket from the plug.

Serial Communication / Auxiliary SP Selection Module

The plug for the Serial Communication or Auxiliary SP Selection module is located on the Power-supply board. The Figure 12.7 below illustrates how to plug-in the Serial Communication/Auxiliary SP module. To plug (or unplug) the module simply insert (or remove) the socket into (or from) the plug.

Figure 12.7
Mounting Serial Communication/Auxiliary SP Selection Module



Section 13

MECHANICAL INSTALLATION

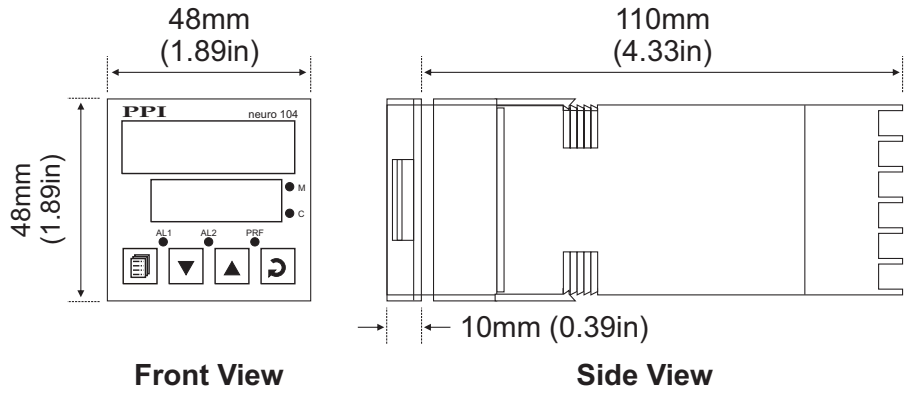
The following precautions should be strictly observed while installing the controller:

1. The place of installation should be free of corrosive/combustible gases and electrically conductive pollution.
2. Ensure that the place of installation is not subject to rapid ambient changes that can cause condensation. Also the Ambient Temperature and Relative Humidity surrounding the controller should not exceed the maximum specified for the proper operation of the controller.
3. The place of installation should be adequately protected against excessive electrostatic or electromagnetic interference.
4. The controller should not be subject to direct vibration or shock.
5. The controller should not be exposed to dust, salt air, direct sunlight or radiant heat.

OUTER DIMENSIONS

The Figure 13.1 shows the outer dimensions of the controller.

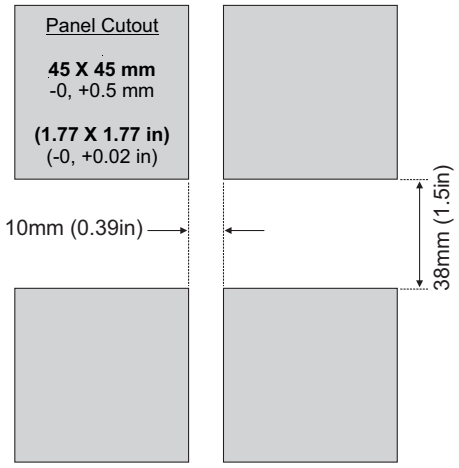
Figure 13.1



PANEL CUTOUT AND RECOMMENDED MINIMUM SPACING

The Figure 13.2 shows the panel cutout requirements for a single controller and also the minimum spacing recommended if several controllers are required to be mounted on a single panel.

Figure 13.2

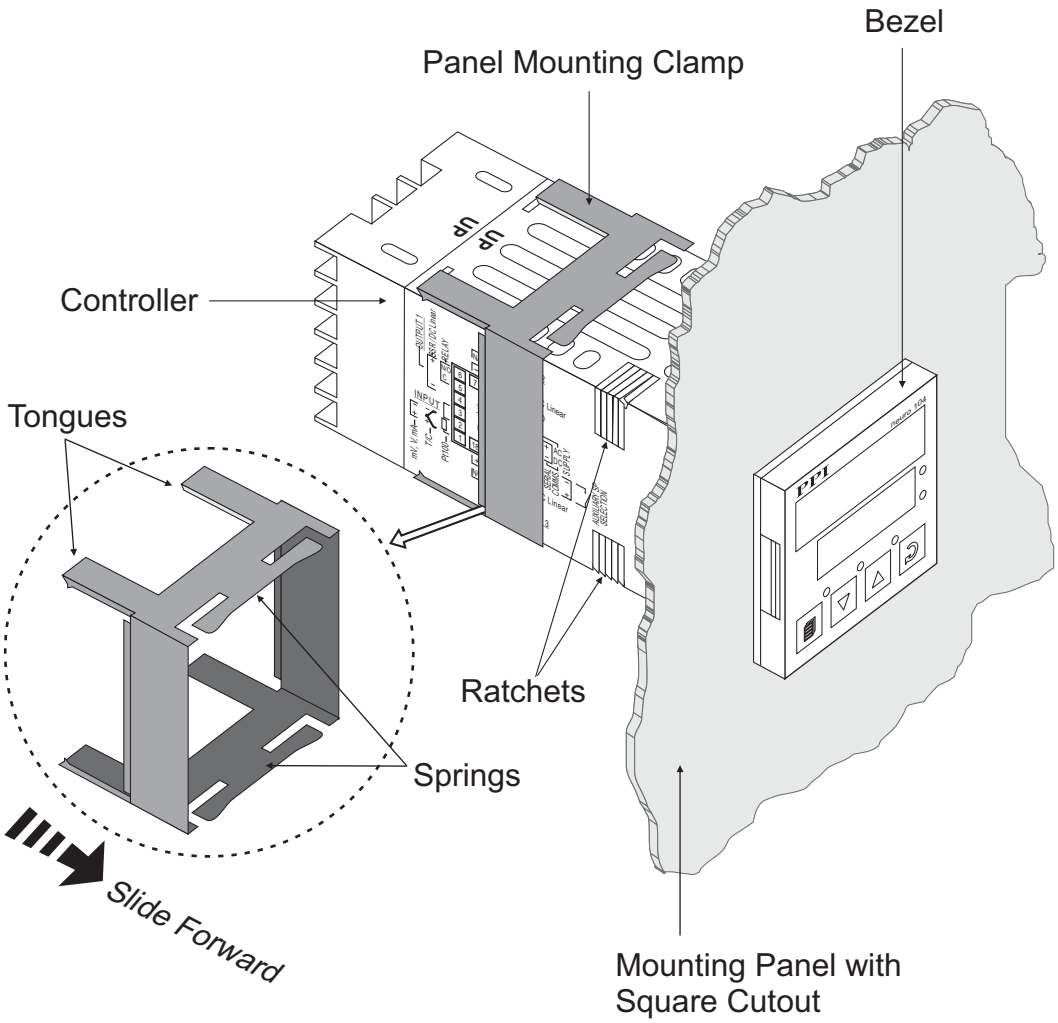


PANEL MOUNTING

Follow the steps below for mounting the controller on panel:

1. Prepare a square cutout to the size shown in Figure 13.2.
2. Remove the Panel Mounting Clamp from the controller Enclosure.
3. Insert the rear of the controller housing through the panel cutout from the front of the mounting panel.
4. Hold the controller gently against the mounting panel such that it positions squarely against the panel wall, see Figure 13.3. Apply pressure only on the bezel and not on the front label.
5. Slide the mounting clamp forward until it is firmly in contact with the rear face of the mounting panel and the tongues of the clamp engage in the ratchets on the controller enclosure, as shown in Figure 13.3. Ensure that the springs of the clamp push firmly against the rear face of the mounting panel for secured mounting.

Figure 13.3



Section 14

ELECTRICAL CONNECTIONS

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

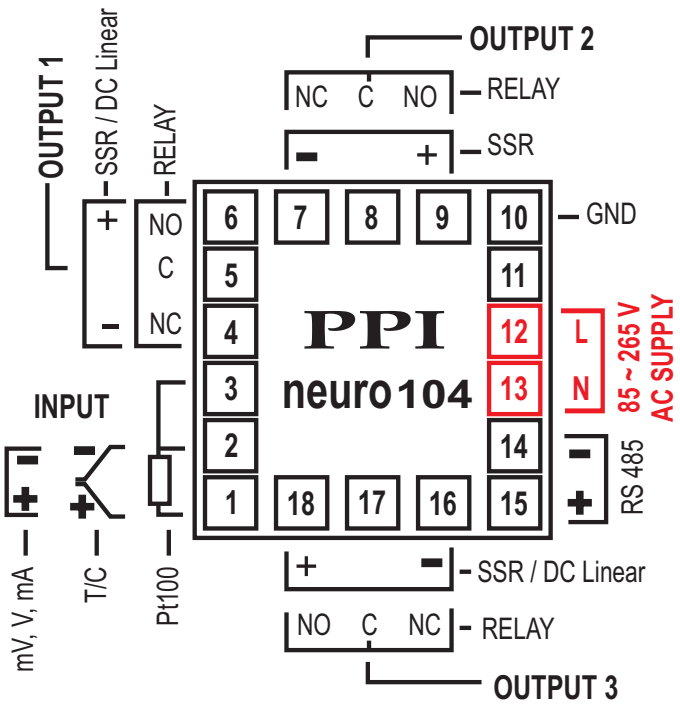
1. The user must rigidly observe the Local Electrical Regulations.
2. Do not make any connections to the unused terminals for making a tie-point for other wires (or for any other reasons) as they may have some internal connections. Failing to observe this may result in permanent damage to the controller.
3. Run power supply cables separated from the low-level signal cables (like Thermocouple, RTD, DC Linear Current/Voltage, etc.). If the cables are run through conduits, use separate conduits for power supply cable and low-level signal cables.
4. Use appropriate fuses and switches, wherever necessary, for driving the high voltage loads to protect the controller from any possible damage due to high voltage surges of extended duration or short-circuits on loads.
5. Take care not to over-tighten the terminal screws while making connections.
6. Make sure that the controller supply is switched-off while making/removing any connections or removing the controller from its enclosure.

CONNECTION DIAGRAM

The Electrical Connection Diagram is shown on the left side of the controller enclosure. The diagram shows the terminals viewed from the REAR SIDE with the controller label upright. Refer the label provided on the Rear Side for terminal numbers. Note that the OUTPUT-3 and the Serial Comm./Auxiliary SP connections are applicable only if the respective plug-in modules are fitted. Also the DC SUPPLY is applicable only if the controller is supplied with 20 to 50 VDC supply voltage option.

The rear panel electrical wiring connection diagram is shown in Figure14.1 below.

Figure 14.1



DESCRIPTIONS

The back panel connections are described as under:

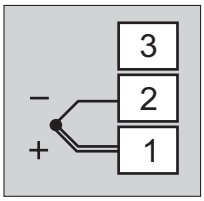
INPUT (Terminals : 1, 2, 3)

The controller accepts Thermocouples (J, K, T, R, S, B, N & Reserved), 3-wire RTD Pt100 and DC Linear Current/Voltage (mV/V/mA) as input. The types and ranges are described in Section 6 : Configuration Parameters.

Thermocouple

Connect Thermocouple Positive (+) to terminal 1 and Negative (-) to terminal 2 as shown in Figure 14.2 (a). The correct type of Thermocouple extension lead wires or compensating cable must be used for the entire distance between the controller and the Thermocouple, ensuring that the correct polarity is maintained throughout. Avoid joints in the cable.

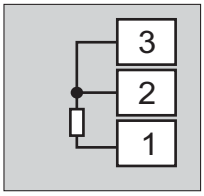
Figure 14.2 (a)



RTD Pt100, 3-wire

Connect single leaded end of RTD bulb to terminal 1 and the double leaded ends to terminal 2 and 3 (interchangeable) as shown in Figure 14.2 (b). Use copper conductor leads of very low resistance ensuring that all 3 leads are of the same gauge and length. Avoid joints in the cable.

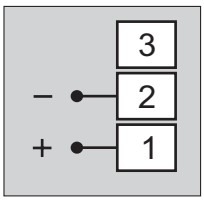
Figure 14.2 (b)



DC Linear Voltage (mV / V / mA)

Use a shielded twisted pair with the shield grounded at the signal source for connecting mV / V source. Connect common (-) to terminal 2 and the signal (+) to terminal 1, as shown in Figure 14.2 (c). The DC Current source is also connected in the similar way.

Figure 14.2 (c)



OUTPUT-1 (Terminals 4, 5 and 6) **& OUTPUT-2** (Terminals 7, 8 and 9)

The Output-1 and Output-2 are configured for Relay outputs to drive the motor for traveling the valve in Forward (Open) and Reverse (Close) direction, respectively. The terminals for Relay output are shown in the Figures 14.3 (a) & (b).

Figure 14.3 (a)

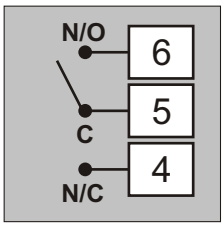
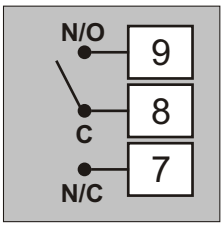


Figure 14.3 (b)



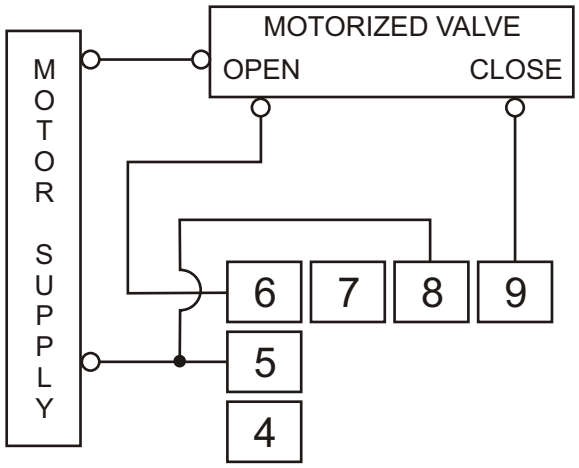
Relay

Potential-free Relay changeover contacts N/O (Normally Open), C (Common) and N/C (Normally Close) rated 2A/240 VAC (resistive load) are provided as Relay output. Use external auxiliary device like contactor with appropriate contact rating for driving the actual load.

The Output-1 terminals internally connect to potential-free Relay changeover contacts, N/O (Normally Open, terminal 6), C (Common, terminals 5) and N/C (Normally Close, terminal 4). The Relay contact is closed during Forward (Open) pulse. This output should be connected for opening the valve, as shown in Figure 14.4 (a).

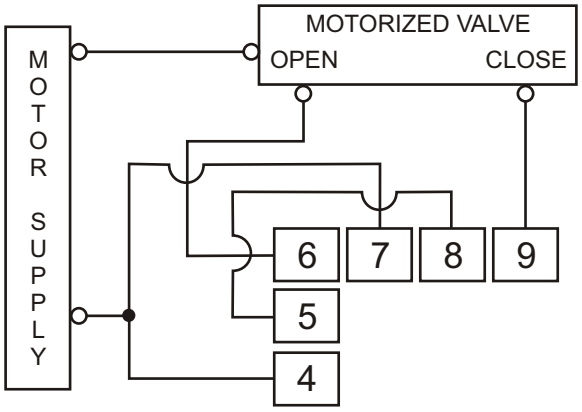
The Output-2 terminals internally connect to potential-free Relay changeover contacts, N/O (Normally Open, terminal 9), C (Common, terminals 8) and N/C (Normally Closed, terminal 7). The Relay contact is closed during Reverse (Close) pulse. This output should be connected for closing the valve, as shown in Figure 14.4 (a).

Figure 14.4 (a)



The controller is designed to switch on either Output-1 or Output-2 (to Open or Close the valve). However, under fault conditions, both Output-1 and Output-2 Relays could be switched on simultaneously. For safety purpose, an interlock can be included which connects the Motor Supply to the valve via “Normally Closed (N/C)” Relay contacts of the Output-1 and Output-2 Relays as shown in Figure 14.4 (b)

Figure 14.4 (b)



Note :

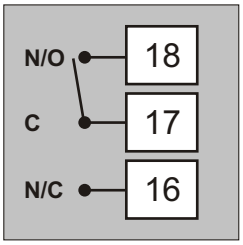
The Output-1 (OP1) and Output-2 (OP2) is configured to drive the motor to travel the valve in Forward (Open) and Reverse (Close) direction, respectively. That is, regardless of the option set for the parameter ‘Control Logic’ as ‘Reverse’ (heat logic) or ‘Direct’ (cool logic), the OP1 Relay always drives the motor to travel the valve in Forward (Open) and OP2 Relay always drives the motor to travel the valve in Reverse (close). This facilitates user to avoid reversing the OP1 and OP2 Relay wiring connections even if the option for the parameter ‘Control Logic’ is changed.

OUTPUT- 3 (Terminals 16, 17 and 18)

The Output-3 module (if fitted) can be configured as either Relay or DC Voltage pulses for driving SSR for Alarm. In case, DC Linear Current (0-4/20 mA) or Voltage (0-5/10 V) for Retransmission (Recorder) output proportional to PV or SP is required, a separate module shall be provided which can be directly replaced with the Relay / SSR module.

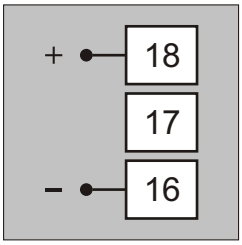
The terminal for Relay, DC Voltage pulses output for SSR & DC Linear Current/Voltage output are shown in above Figure 14.5 (a), (b) & (c) respectively.

Figure 14.5 (a)



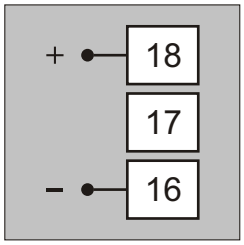
Relay Connections

Figure 14.5 (b)



SSR Connections

Figure 14.5 (c)



DC Linear Current/ Voltage Connections

Relay

Potential-free Relay changeover contacts N/O (Normally Open), C (Common) and N/C (Normally Close) rated 2A/240 VAC (resistive load) are provided as Relay output.

Drive for SSR

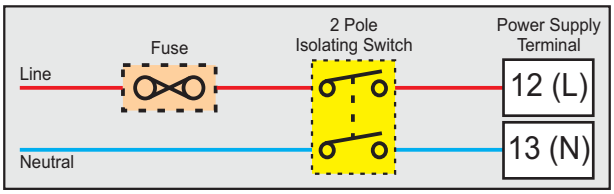
DC Voltage level is generated for switching the external SSR (Solid State Relay). Connect (+) and (-) terminals of SSR to controller terminals 18 and 16, respectively. Use zero-crossover, 3 to 30 VDC operated SSR, rated approximately 1.5 times the actual load rating. Use appropriate Heat Sink for mounting the SSR for load rating exceeding 10 A in case the OP3 Alarm Function is used for tripping the loads.

DC Linear Current / Voltage Output

The DC Linear Current (0/4-20mA) or Voltage (0-5/10V) Retransmission (Recorder) signal is also available at Output-3 if the Output-3 is ordered for DC Linear Retransmission output (Refer *Appendix D: Ordering Information).* The Positive (+) of Retransmission (Recorder) signal is available at Terminal 18 & Negative (-) at terminal 16.

POWER SUPPLY (Terminals : 12, 13)

Figure 14.4



As standard, the controller is supplied with power connections suited for 85 to 264 VAC line supply. Use well-insulated copper conductor wire of the size not smaller than 0.5mm^2 for power supply connections. Connect Line (Phase) supply line to terminal 12 and the Neutral (Return) supply line to terminal 13 as shown in Figure 14.4. The controller is not provided with fuse and power switch. If necessary, mount them separately. Use a time lag fuse rated 1A @ 240 VAC.

For DC Supply, connect Signal (+) & Common (-) to controller terminals 12 & 13, respectively.

Caution

The controller is designed for installation in an enclosure which provides adequate protection against electric shock. Local regulations regarding electrical installation should be rigidly observed. Consideration should be given to prevention of access to the Power Supply terminals by unauthorized personnel. If the Relay contacts are to carry mains (line) voltage, it is recommended that the Relay contacts mains (line) supply should be switched and fused in a similar manner but should be separate from the controller mains (line) supply.

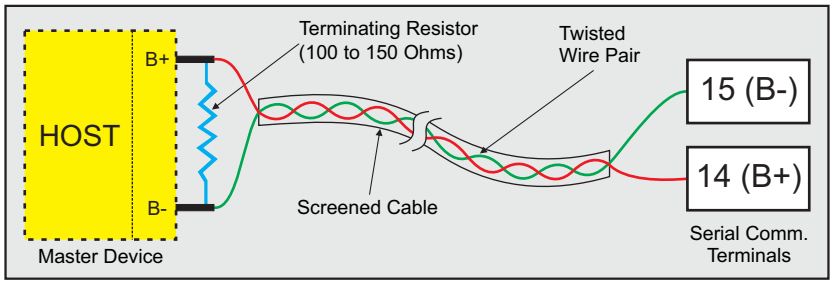
SERIAL COMMUNICATION PORT (Terminals : 14 , 15)

If the optional plug-in communication board is fitted, connect terminal 15 and 14 of the controller to (+) and (-) terminals of the Master device.

In case of RS485 port, connect terminal 15 and 14 of the controller to positive (+) and negative (-) terminals of the master device. In case of RS232 port connect terminal 15 to Txd (Transmit, Terminal 14 to RXD (Receive) and Terminal 10 to GND (Ground).

To ensure reliable operation of the Serial Communication Link (without data corruption due to line noise or reflections), use a pair of twisted wires inside screened cable with the terminating resistor (100 to 150 Ohms) at one end, as shown in Figure 14.7 below.

Figure 14.7



Notes :

1. The communication cable should be a pair of twisted wires inside screened cable as shown in Figure 14.7 above. It should have less than 100 ohms / km nominal DC resistance (Typically 24 AWG or thicker). Connect the terminating resistor (Typically 100 to 150 ohm) at one end to improve noise immunity.
2. Run the communication cables separated from cables (like power supply Relay/Contactor cables etc.). If the cables are run through conduit use a separate conduit for communication cables.
3. Communication cables may run through low level signal cables (like Thermocouple, RTD inputs, DC Linear Current/Voltage outputs) if these cables are not exposed to an interference source.
4. Do not use redundant wires in communication cables for other signals.
5. Ensure that the cable is “daisy chained” between controllers for multi-dropped wiring. That is, run from one controller to the next to the final controller in the chain.

DIGITAL INPUT FOR AUXILIARY SP SELECTION (Terminals : 14, 15)

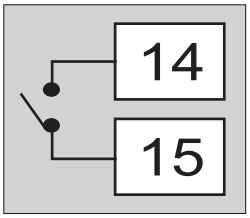
The optional plug-in module is supplied for Digital Input, typically potential-free contacts of a switch/Relay or a TTL-compatible voltage to select Main SP or Auxiliary SP mode. The selection is as follows:

a) Potential-Free : Contacts OPEN :- Main SP selected
Contacts CLOSE :- Auxiliary SP selected

b) TTL-compatible : > 0.6 V :- Main SP selected
< 0.5 V :- Auxiliary SP selected

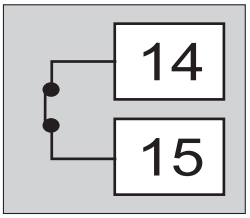
In Potential-free Digital Input, when the contacts are detected as OPEN, the controller is configured in Main SP mode and when the contacts are detected as CLOSE, the controller is configured in Auxiliary SP mode. The connections are shown below in Figure 14.8 (a) & (b).

Figure 14.8 (a)



OPEN : Main SP Mode

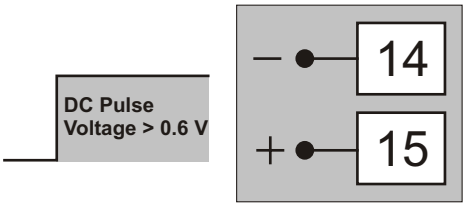
Figure 14.8 (b)



CLOSE : Auxiliary SP Mode

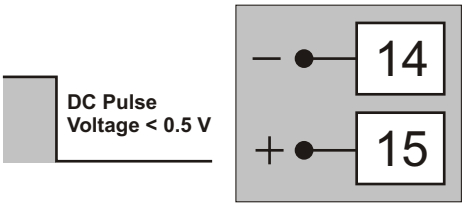
In TTL-compatible Digital Input, when the DC pulse voltage is greater than 0.6 Volts, the controller is configured in Main SP mode and when the DC pulse voltage is less than 0.5 Volts, the controller is configured in Auxiliary SP mode. The connections are shown below in Figure 14.8 (c) & (d).

Figure 14.8(c)



> 0.6 V: Main SP Mode

Figure 14.8(d)



< 0.5 V: Auxiliary SP Mode

Note :
The Auxiliary Setpoint option and the RS485 Serial Communications option are mutually exclusive.

PPI
The Perfection Experts

Process Precision Instruments

101, Diamond Industrial Estate, Navghar, Vasai Road (E),
Dist. Palghar - 401 210.Maharashtra, India
Sales : 8208199048 / 8208141446
Support : 07498799226 / 08767395333
sales@ppiindia.net, support@ppiindia.net

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