EPSILON

PPI
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**Self Tune PID
Process Controller
with Ramp / Soak Profile**

CE

User Manual

CONTENTS

For Size 48X48

For Size 96X96

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
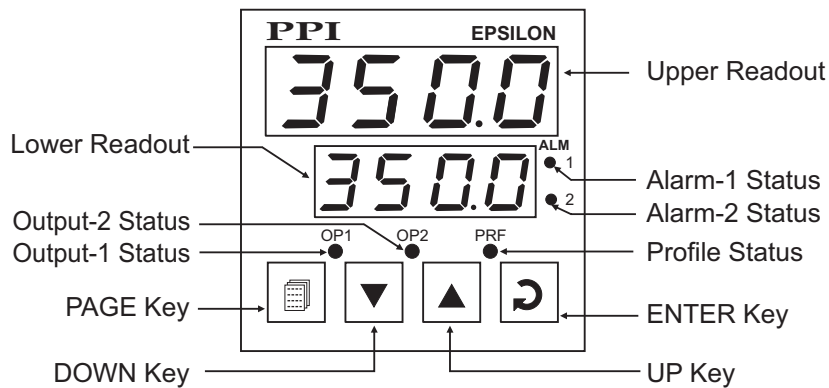
READOUTS

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

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

INDICATORS

The front panel indicators are red LED's that show the status related to control, alarms and operation mode. Refer Table 1.1 below for details.

Table 1.1

LED	Status
OP1	• Indicates Output-1 ON/OFF status if the Control Output Type is Relay / SSR. • Remains OFF if the Control Output Type is DC Linear.
OP2	• Indicates Output-2 ON/OFF status if the Control Output Type is Relay / SSR. • Remains OFF if the Control Output Type is DC Linear.
ALM 1	• Flashes while Alarm-1 is active.
ALM 2	• Flashes while Alarm-2 is active.
PRF	• Flashes while the Ramp/Soak profile is in progress. • Glows continuously if profile is in HOLD state. • Remains OFF if profile is not in progress.

KEYS

There are four tactile keys provided on the front panel for configuring the controller, setting-up the parameter values and selecting Operation Modes. Refer Table 1.2 for detailed key operations.

Table 1.2

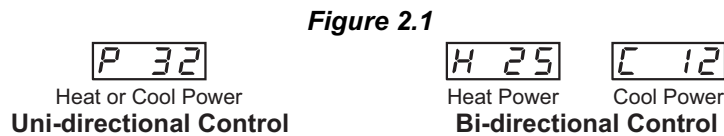| Symbol	Key	Function
🗐	PAGE	Press to enter or exit set-up mode.
▼	DOWN	Press to decrease the parameter value. Pressing once decreases the value by one count; keeping pressed speeds up the change.
▲	UP	Press to increase the parameter value. Pressing once increases the value by one count; keeping pressed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

Section 2
BASIC OPERATION

POWER-UP

Upon power-up, all displays and indicators are lit on for approximately 3 seconds. This is followed by the indication of the controller model name $\boxed{EP5L}$ on the Upper Readout and the firmware version $\boxed{01.01}$ 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 Setpoint Value. This is the MAIN Display Mode that shall be used most often.

% Output Power Indication

In PID control mode, the Lower Readout can be toggled using ENTER key to indicate either % output power or setpoint value SP. The output power is indicated with the left most digit showing 'P', 'H' or 'C' depending upon uni-directional (Heat or Cool) or bi-directional (Heat and Cool) control mode. Refer Figure 2.1 below.

Figure 2.1

$\boxed{P\ 32}$ $\boxed{H\ 25}$ $\boxed{C\ 12}$
Heat or Cool Power   Heat Power   Cool Power
Uni-directional Control   **Bi-directional Control**

Adjusting SP (Control Setpoint)

If permitted at Supervisory Level, the SP value can be directly adjusted on the Lower Readout in the MAIN Display Mode. While the Lower Readout shows the control setpoint, step through the following sequence for adjusting 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.

3. Press and release ENTER key. The Lower Readout stops flashing and the new set value is registered and stored.

Tune Mode Indication

The Lower Readout flashes $\boxed{tunE}$ while the controller is Tuning. Do not disturb the process or alter any parameter values while Tuning is in progress. The "Tune" message automatically disappears upon completion of Tuning procedure.

Profile Mode Indications

While a Profile Cycle is in progress, the front panel indicator 'PRF' flashes or glows steadily. The steady glowing indicates that though the profile is active, it is currently in HOLD state. Also, the Lower Readout shows the Profile Setpoint instead of the control setpoint SP. The % Output Power (if PID Control) can be viewed by toggling the Lower Readout using ENTER key.

Note
While Profile Cycle is in progress, the Control Setpoint SP can still be adjusted on Lower Readout. While the Lower Readout shows Profile Setpoint, use UP/DOWN keys to adjust the control setpoint SP as described earlier.

PV Error Indications
The PV Error type is flashed on the Upper Readout. For different errors and the causes, refer Table 2.1 below.

Table 2.1

Message	Error Type	Cause
$\boxed{Or}$	Over-range	PV above Max. Range
$\boxed{Ur}$	Under-range	PV below Min. Range
$\boxed{OPEn}$	Sensor Open	Thermocouple / RTD broken

CONTROL / ALARM STATUS UNDER PV ERROR CONDITIONS

a)   The tuning, if in progress, is aborted.

b)   The Profile Cycle, if in progress, enters in HOLD state.

c)   Under *Over-range* or *Under-range* error condition, all the control outputs are switched off. However, under *Sensor Open* error, the PID control output power is maintained at the value set for the parameter "Sensor Break Output Power" on PAGE-12.

d)   For Alarm activation, the under-range condition is treated as minimum PV, whereas the over-range and open conditions are treated as maximum PV. Thus, Process High, positive Deviation Band and Window Band alarms activate under *Over-range/Open error*. Similarly, Process Low, negative Deviation Band and Window Band alarms activate under *Under-range error*.

STANDBY MODE

This mode allows the operator to put the controller in '*indication-only*' mode wherein all the output control signals as well as Alarm Relays are forced OFF. This may be desired prior to the start of a new process batch.

If enabled at supervisory level, the standby mode can be activated or de-activated by setting the parameter 'Standby' to Yes or No respectively. The standby parameter is available on operator page, explained later in the section.

Notes:
1.   *The Standby and Tuning modes are mutually exclusive. If Standby mode is activated while the controller is tuning, the controller aborts tuning operation and enters Standby mode.*

2.   *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.*

OPERATOR PAGE AND PARAMETERS

The controller provides a separate page that contains parameters that require frequent settings by the operator. The page is called *Operator Page* and the parameters are called *Operator Parameters*. The availability of operator parameters is controlled at supervisory level and the parameter setting is not affected by the master lock status.

Accessing Operator Page & Adjusting Parameters

Step through the following sequence to open the operator page and to adjust the operator parameter values.

1.   Press and release PAGE key. The Lower Readout shows $\boxed{PAGE}$ (PAGE) and Upper Readout shows $\boxed{0}$ (0).

2.   Press ENTER key. The Lower Readout shows prompt for the first available operator parameter and the Upper Readout shows value for the parameter.

3.   Use UP / DOWN keys to adjust the value and then press ENTER key to store the set value and scroll to next parameter.

The controller automatically reverts to MAIN Display Mode upon scrolling through the last operator parameter. Alternatively, use PAGE key to return to MAIN Display Mode.
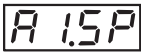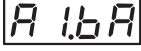
The operator parameters are described in Table 2.2. Note that the parameters presented on operator page depend upon the functions selected/enabled and supervisory level permissions.

The operator parameter list mainly includes :

a)   Profile related commands like Start, Abort, Pause, Skip etc.
b)   Standby mode entry / exit.
c)   Control Setpoint (SP) value.
d)   Alarm-1 Setpoint / Band values.
e)   Alarm-2 Setpoint / Band values.

Table 2.2

Parameter Description	Settings (Default Value)
END OF PROFILE ACKNOWLEDGE `EOP.A` This parameter is available if Output-2 (OP2) and / or Output-3 (OP3) Relay/SSR is programmed to turn ON as an 'End-of-Profile' signal. Set this parameter to 'Yes' (after end of profile is reached) to acknowledge the Alarm and to turn OFF the output.	`no` No `YES` Yes (Default : No)
PROFILE START COMMAND `Strt` These parameters are mutually exclusive. Use 'Start' command to commence a new Profile Cycle and 'Abort' command to abort / terminate a running Profile cycle. Set the value to 'Yes' to issue the command.	`no` No `YES` Yes (Default : No)
PROFILE ABORT COMMAND `Abrt` These parameters are mutually exclusive. Use 'Start' command to commence a new Profile Cycle and 'Abort' command to abort / terminate a running Profile cycle. Set the value to 'Yes' to issue the command.	`no` No `YES` Yes (Default : No)
PROFILE PAUSE COMMAND `PAUS` This parameter is available while a profile cycle is in progress and can be used to pause (halt) the profile as long as desired. Set the command to 'Yes' for pausing and 'No' to continue. Under Pause state, the ramp segment stops ramping while the soak segment stops counting down the timer.	`no` No `YES` Yes (Default : No)
SEGMENT SKIP COMMAND `SY IP` Use this command to terminate a running profile segment and to move to the next segment. Skipping the last segment will result in completion of the current profile cycle.	`no` No `YES` Yes (Default : No)
(DE)ACTIVATE STANDBY MODE `Stby` This parameter is available and applicable only if Standby mode is enabled at supervisory level. Set the parameter value to 'Yes' or 'No' for entering and exiting the Standby mode, respectively.	`no` No `YES` Yes (Default : No)
CONTROL SETPOINT `SP` This is the Setpoint value that the controller respects for the control purpose while it is not running a profile or not in standby / tuning mode.	Setpoint Low Limit to Setpoint High Limit (Default : -199)
AUXILIARY CONTROL SETPOINT `AU.SP` The alternate control setpoint that the controller respects for control purpose when selected through remote input terminals. This parameter is available only if the hardware *Remote Input* module is fitted and if the selected Utility Option is *Auxiliary Setpoint.*	Setpoint Low Limit to Setpoint High Limit (Default : -199)

Parameter Description	Settings (Default Value)
ALARM-1 SETPOINT `A 1.SP` The setpoint / Band value (depending upon the type of Alarm) for Alarm-1. This parameter is not available if the selected Alarm type is 'None'.	Throughout the range for the selected Input Type (Default : For Process Low : -199 For Process High : 1376)
ALARM-1 DEVIATION BAND `A 1.dE` The Definitions / Descriptions are same as Alarm 1 Setpoint	-999 to 999 **or** -999.9 to 999.9 (Default : 5 or 5.0)
ALARM-1 WINDOW BAND `A 1.bA` The Definitions / Descriptions are same as Alarm 1 Setpoint	3 to 999 **or** 0.3 to 999.9 (Default : 5 or 5.0)
ALARM-2 SETPOINT `A2.SP` The Definitions / Descriptions are same as Alarm 1 but applied to Alarm 2.	Throughout the range for the selected Input Type (Default : For Process Low : -199 For Process High : 1376)
ALARM-2 DEVIATION BAND `A2.dE` The Definitions / Descriptions are same as Alarm 1 but applied to Alarm 2.	-999 to 999 **or** -999.9 to 999.9 (Default : 5 or 5.0)
ALARM-2 WINDOW BAND `A2.bA` The Definitions / Descriptions are same as Alarm 1 but applied to Alarm 2.	3 to 999 **or** 0.3 to 999.9 (Default : 5 or 5.0)

Section 3
SET-UP MODE : ACCESS AND OPERATION

The various parameters are arranged in different groups, called PAGES, depending upon the functions they represent. Each group is assigned a unique numeric value, called PAGE NUMBER, for its access.

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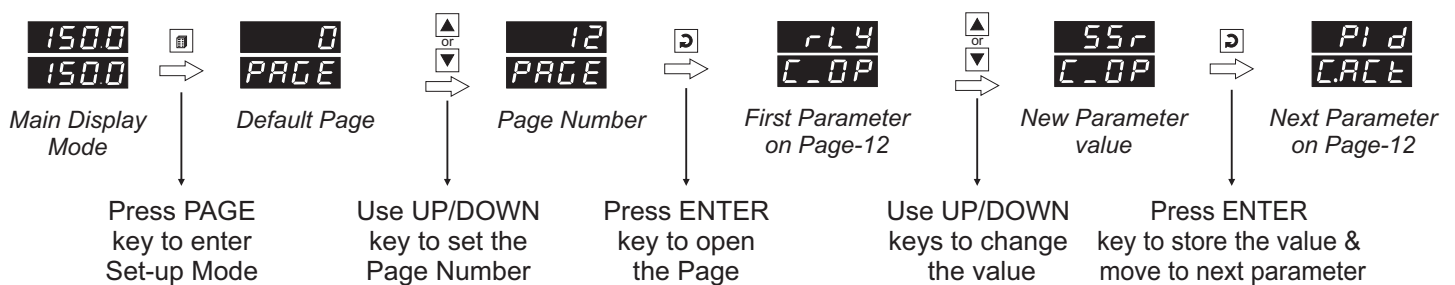
SET-UP MODE

The Set-up Mode allows the user to view and modify the parameter values. Follow the steps below for setting the parameter values:

1.   Press and release PAGE key. The Lower Readout shows $\boxed{PAGE}$ (PAGE) and Upper Readout shows $\boxed{0}$ (0).

2.   Use UP / DOWN keys to set the desired PAGE NUMBER.

3.   Press and release ENTER key. The Lower Readout shows the prompt for the first parameter listed in the set PAGE and the Upper Readout shows its current value. If the entered PAGE NUMBER is invalid (contains no parameter list or any associated function), the controller reverts to the MAIN Display Mode.

4.   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).

5.   Use UP / DOWN keys to adjust the parameter value. The display flashes if UP key is pressed after reaching the maximum value or DOWN key is pressed after reaching the minimum value.

6.   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 3.1 illustrates the example of altering the value for the parameter 'Control Output'.

Figure 3.1

| Main Display Mode | Default Page | Page Number | First Parameter on Page-12 | New Parameter value | Next Parameter on Page-12 |

| Press PAGE key to enter Set-up Mode | Use UP/DOWN key to set the Page Number | Press ENTER key to open the Page | Use UP/DOWN keys to change the value | Press ENTER key to store the value & move to next parameter |

Notes
1.   *Each page contains a fixed list of parameters that are presented in a pre-determined sequence. Note however that the availability of a few parameters, called Conditional Parameters, depend upon the settings for some other parameters. For example, the parameter 'Control Hysteresis' for Output-1 is available only if, the set value for the parameter 'Control Action' is 'On-Off'.*

2.   *To exit the set-up mode and return to the MAIN Display Mode, press and release PAGE key.*

3.   *If no key is pressed for approximately 30 seconds, the set-up mode times out and reverts to the MAIN Display Mode.*
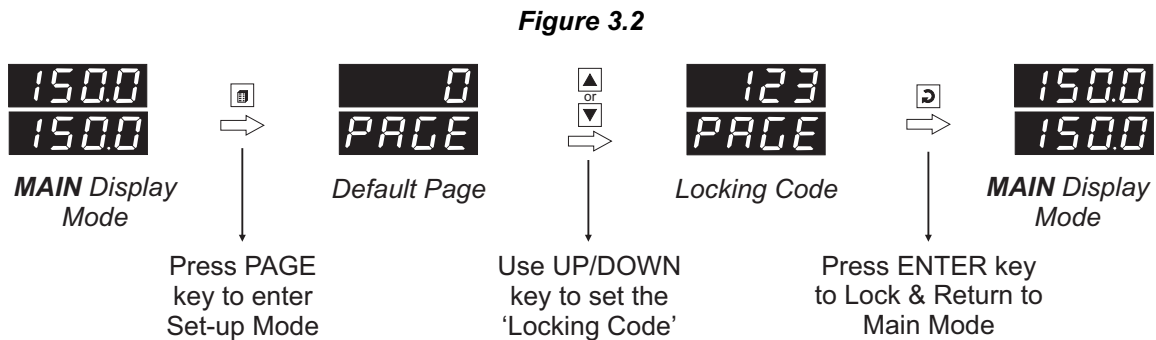
MASTER LOCKING

The controller facilitates locking all the PAGES (except Operator PAGE) by applying Master Lock Code. Under Locking, the parameters are available for *view only* and can not be adjusted. The Master Lock, however, does not lock the operator parameters. This feature allows protecting the rather less frequently used parameters against any inadvertent changes while making the frequently used operator parameters still available for any editing.

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

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

The Figure 3.2 below illustrates the Locking procedure.

Figure 3.2

MAIN Display Mode	*Default Page*	*Locking Code*	*MAIN* Display Mode
Press PAGE key to enter Set-up Mode	Use UP/DOWN key to set the 'Locking Code'	Press ENTER key to Lock & Return to Main Mode	
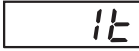
UnLocking

Repeat the Locking procedure twice for unlocking.

Section 4
CONTROL PARAMETERS

Visit www.ppiindia.net. Refer technical notes on CONTROL and TUNING for detailed understanding of the parameters / terminologies used for describing control parameters in this section.

The parameters presented on PAGE-10 depend upon the type of algorithm selected for the control purpose, viz., On-Off, Pulsed On-Off and PID. The parameter list further extends if the selected control mode is bi-directional (that is, heat-cool control). Refer Table 4.1 for the parameter descriptions and settings.

Table 4.1

Parameter Description	Settings (Default Value)
PROPORTIONAL BAND `Pb` *(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 `It` *(Available for PID Control only)* Sets integral time constant in Seconds. Setting the value to 0, cuts-off the integral action.	0 to 3600 Seconds (Default : 100 Sec.)
DERIVATIVE TIME `dt` *(Available for PID Control only)* Sets derivative time constant in Seconds. Setting the value to 0, cuts-off the derivative action.	0 to 600 Seconds (Default : 16 Sec.)
CYCLE TIME `Ct` *(Available for PID Control only)* Sets the total 'On + Off' time in Seconds for time proportional power output through Relay / SSR for OP1.	0.5 to 100.0 Seconds (in steps of 0.5 secs.) (Default : 10.0 Sec.)
*RELATIVE COOL GAIN `rEL.C` *(Available for PID Control with bi-directional, that is, Heat-Cool mode)* Sets the ratio of cooling power to the heating power.	0.1 to 10.0 (Default : 1.0)
*COOL CYCLE TIME `C.Ct` *(Available for PID Control with bi-directional, that is, Heat-Cool mode)* Sets the On + Off cycle time in Seconds for time proportional power output through Relay / SSR for OP2.	0.5 to 100.0 Seconds (in steps of 0.5 secs.) (Default : 10.0 sec.)
HYSTERESIS `HYSt` *(Available for On-Off or Pulsed On-Off Control only)* Sets differential (dead) band between On-Off switching for OP1.	1 to 999 (Default : 2)
PULSE TIME `PL.t` *(Available for Pulsed On-Off Control only)* Sets the total 'On + Off' pulse time in Seconds for Relay / SSR output for OP1.	Pulse ON Time to 120.0 Seconds (Default : 2.0 sec.)

Parameter Description	Settings (Default Value)
ON TIME　　　　　　　　　　　　　$\boxed{On.t}$ *(Available for Pulsed On-Off Control only)* Sets the ON pulse time in Seconds for Relay/SSR Output for OP1.	0.1 to Value set for Pulse Time (Default : 1.0)
*COOL HYSTERESIS　　　　　　　　$\boxed{C.HYS}$ *(Available for On-Off or Pulsed On-Off Control with bi-directional mode)* Sets differential (dead) band between On-Off switching for OP2.	1 to 999 (Default : 2)
*COOL PULSE TIME　　　　　　　　$\boxed{C.PL.t}$ *(Available for Pulsed On-Off Control with bi-directional mode)* Sets the total 'On + Off' pulse time in Seconds for Relay / SSR Output for OP2.	Cool ON Time to 120.0 Seconds (Default : 2.0)
*COOL ON TIME　　　　　　　　　$\boxed{C.On.t}$ *(Available for Pulsed On-Off Control with bi-directional mode)* Sets the ON pulse time in Seconds for Relay/SSR Output for OP2.	0.1 to Value set for Cool Pulse Time (Default : 1.0)
HEAT POWER LOW　　　　　　　　　$\boxed{PL}$ *(Available for PID Control only)* Sets the lower % Output power limit for OP1.	0 to Power High (Default : 0)
HEAT POWER HIGH　　　　　　　　　$\boxed{PH}$ *(Available for PID Control only)* Sets the higher % Output power limit for OP1 .	Power Low to 100 (Default : 100)
*COOL POWER LOW　　　　　　　　$\boxed{C.PL}$ *(Available for PID Control with bi-directional, that is, Heat-Cool mode)* Sets the lower % Output power limit for OP2.	0 to Cool Power High (Default : 0)
*COOL POWER HIGH　　　　　　　$\boxed{C.PH}$ *(Available for PID Control with bi-directional, that is, Heat-Cool mode)* Sets the higher % Output power limit for OP2.	Cool Power Low to 100 (Default : 100)

* The parameters marked with *asterisk* symbol are available only if the controller is supplied with Bi-Directional control (Heat + Cool) mode option.
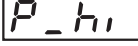
Section 5

ALARM PARAMETERS

Visit www.ppiindia.net. Refer technical notes on ALARM for detailed understanding of the parameters/terminologies used for describing the Alarm parameters in this section.

The parameters required for configuring Alarm-1 and Alarm-2 are grouped on PAGE-11. The configuration includes selecting the type of Alarm, setting the hysteresis value, enabling / disabling start-up alarm suppression, etc. Refer Table 5.1 for parameter description & settings.

Table 5.1

Parameter Description	Settings (Default Value)
ALARM-1 TYPE `AL _ 1` Select the Alarm-1 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 (Default : None)
ALARM-1 SETPOINT `A 1.SP` *(Available for Process High or Process Low Alarm-1 Type)* Sets Alarm limit independent of control setpoint for Alarm-1.	Min. to Max. Range specified for the selected Input Type (Default : Min or Max Range)
ALARM-1 DEVIATION BAND `A 1.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 **or** -999.9 to 999.9 (Default : 5)
ALARM-1 WINDOW BAND `A 1.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 : 5)
ALARM-1 HYSTERESIS `A 1.HY` Sets differential (dead) band between Alarm-1 switching ON and OFF states.	1 to 999 (Default : 2)
ALARM-1 INHIBIT `A 1. h` Set to 'Yes' to suppress Alarm-1 activation upon power-up or process start-up.	`no` No `YES` Yes (Default : No)
ALARM-2 TYPE `AL _ 2` Select the Alarm-2 activation type. Selecting 'None' will disable the alarm and suppress all the related parameters for Alarm-2.	`nonE` None `P_Lo` Process Low `P_hi` Process High `dE` Deviation Band `bAnd` Window Band (Default : None)

Parameter Description	Settings (Default Value)
ALARM-2 SETPOINT `A2.SP` *(Available for Process High or Process Low Alarm-2 Type)* Sets Alarm limit independent of control setpoint for Alarm-2.	Min. to Max. Range specified for the selected Input Type (Default : Min or Max Range)
ALARM-2 DEVIATION BAND `A2.dE` *(Available for Deviation Band Alarm-2 Type)* Sets positive or negative deviation (offset) limit from control setpoint for High or Low Alarm-2 activation, respectively.	-999 to 999 (Default : 5)
ALARM-2 WINDOW BAND `A2.bA` *(Available for Window Band Alarm-2 Type)* Sets symmetrical positive and negative deviation (offset) limits from control setpoint for both High and Low Alarm-2 activation.	3 to 999 (Default : 5)
ALARM-2 HYSTERESIS `A2.HY` Sets differential (dead) band between Alarm-2 switching ON and OFF states.	1 to 999 (Default : 2)
ALARM-2 INHIBIT `A2.ih` Set to Yes to suppress Alarm-2 activation upon power-up or process start-up.	`no` No `YES` Yes (Default : No)

Section 6
CONFIGURATION PARAMETERS

The controller is provided with a variety of hardware options and software features to cater to a host of applications. The controller thus needs to be appropriately configured in terms of inputs / outputs and other features like control algorithm, digital filter, etc.

The PAGE-12 presents configuration parameters that are listed below in Table 6.1 .

Table 6.1

Parameter Description	Settings (Default Value)
CONTROL OUTPUT (OP1) TYPE `C_OP` Select the output type in accordance with the hardware configuration for Output-1 (OP1).	`rLY` Relay `SSr` SSR `0-20` 0 - 20 mA `4-20` 4 - 20 mA `0-5` 0 - 5 V `0-10` 0 - 10 V (Default : Relay)
CONTROL ACTION `C.Act` Select appropriate Control Algorithm suited for process requirement.	`On.OF` On-Off `PULS` Pulse `P Id` PID (Default : PID)
CONTROL LOGIC `CtrL` Select Reverse (*heat* logic) or Direct (*cool* logic).	`rEu` Reverse `norn` Normal (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.	Refer Table 6.2 (Default : Type K)
PV RESOLUTION `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 UNITS `Unit` *(Available for Thermocouple / RTD Inputs)* Selects temperature measurement units in °C or °F .	`°C` °C `°F` °F (Default : °C)
PV RANGE LOW `r.Lo` *(Available for DC Linear Inputs)* Sets process value corresponding to minimum DC Linear signal input (e.g., 0 V, 0 mA, 4 mA, etc.)	-1999 to 9999 (Default : 0)

Parameter Description	Settings (Default Value)
PV RANGE HIGH `r.hi` *(Available for DC Linear Inputs)* Sets process value corresponding to maximum DC Linear signal input (e.g., 5 V, 10 V, 20 mA, etc.)	-1999 to 9999 (Default : 1000)
SETPOINT LOW LIMIT `SP.Lo` Sets minimum permissible control setpoint value.	Min. Range for the selected Input Type to Setpoint High Limit (Default : -199)
SETPOINT HIGH LIMIT `SP.hi` Sets maximum permissible control setpoint value.	Setpoint Low Limit to Max. Range for the selected Input Type (Default : 1376)
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	-199 to 999 **or** -199.9 to 999.9 (Default : 0)
DIGITAL FILTER TIME CONSTANT `FiLt` Sets the time constant, in Seconds, for the low-pass digital filter applied to the measured PV. The filter helps smoothening / averaging the signal input and removing the undesired noise.	0.5 to 60.0 Seconds (in steps of 0.5 Seconds) (Default : 2.0 Sec.)
SENSOR BREAK OUTPUT POWER `Sb.OP` *(Available for PID control only)* In case of Thermocouple / RTD broken or disconnected, the controller outputs this power value under open loop condition.	-100 to 100 (Default : 0)

Table 6.2

Option	What it means	Range (Min. to Max.)	Resolution
tC_J	Type J Thermocouple	0 to +960°C / +32 to +1760°F	Fixed 1°C / 1°F
tC_k	Type K Thermocouple	-200 to +1376°C / -328 to +2508°F	
tC_t	Type T Thermocouple	-200 to +385°C / -328 to +725°F	
tC_r	Type R Thermocouple	0 to +1770°C / +32 to +3218°F	
tC_S	Type S Thermocouple	0 to +1765°C / +32 to +3209°F	
tC_b	Type B Thermocouple	0 to +1825°C / +32 to +3218°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		
1-5	1 to 5.0V DC voltage		

Section 7

SUPERVISORY PARAMETERS

The supervisory level responsibilities include exercising control over operator, making process related decisions and controlling the availability of process data for remote use. The PAGE-13 parameters allow implementation of supervisory level decisions. The Table 7.1 below list supervisory parameters.

Table 7.1

Parameter Description	Settings (Default Value)
SELF-TUNE COMMAND `tUnE` *(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` No `YES` Yes (Default : No)
OVERSHOOT INHIBIT `oS.h` *(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.	`dSbL` Disable `EnbL` Enable (Default : Disable)
OVERSHOOT INHIBIT FACTOR `Oi h.F` *(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 : 1.0)
SP ADJUSTMENT ON LOWER READOUT `SPLr` Supervisory permission for control setpoint editing on Lower Readout. Set to 'Enable' for permission.	`dSbL` Disable `EnbL` Enable (Default : Enable)
SP ADJUSTMENT ON OPERATOR PAGE `SP.OP` Supervisory permission for control setpoint editing on Operator Page. Set to 'Enable' for permission.	`dSbL` Disable `EnbL` Enable (Default : Enable)
ALARM SP ADJUSTMENT ON OPERATOR PAGE `AL.SP` Supervisory permission for Alarm setpoint adjustments on Operator Page. Set to 'Enable' for permission.	`dSbL` Disable `EnbL` Enable (Default : Disable)
STANDBY MODE `StbY` Supervisory control over availability of Standby (entry / exit) command on Operator Page. 'Enable' for availability.	`dSbL` Disable `EnbL` Enable (Default : Disable)
PROFILE ABORT COMMAND ON OPERATOR PAGE `Abrt` Supervisory control over availability of 'Profile-Abort' command on Operator Page. 'Enable' for availability.	`dSbL` Disable `EnbL` Enable (Default : Disable)

Parameter Description	Settings (Default Value)
UTILITY OPTION SELECTION `OPtn` Enable / Disable the available utility feature. Set to 'None' for disabling utility feature.	`nonE` None `SrL.C` Serial Comm. `AU.SP` Auxiliary Setpoint (Default : Serial Comm.)
BAUD RATE `bAUd` Communication speed in 'Bits per Second'. Set the value to match with the host baud rate.	`4.8` 4800 `9.6` 9600 `19.2` 19200 `38.4` 38400 `57.6` 57600 (Default : 9.6)
COMMUNICATION PARITY `PAri` One of the communication error trapping features. Select the data packet parity as implemented by the host protocol.	`nOnE` None `EuEn` Even `Odd` Odd (Default : Even)
CONTROLLER ID NUMBER `Id` 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 `ConE` Setting to 'No' disallows the host to set or modify any parameter value. The value however can be read by the host.	`no` No `YES` Yes (Default : No)

Section 8

PROFILE PARAMETERS

Visit www.ppiindia.net. Refer technical notes on PROFILE for detailed understanding of the parameters/ terminologies used for describing the profile parameters in this section.

The profile utility requires profile configuration and profile settings. Also, the utility facilitates viewing the various status related information and allows on-line alterations of the operation parameters. To simplify profile operation, the rather large list of parameters has been split in multiple pages as under.

PAGE-16 : Profile Configuration
Configure profile in terms of the number of segments, number of cycles (repeats), output status upon profile completion and power fail recovery method. Refer Table 8.1.

PAGE-14 : Profile Settings
Set individual profile segment for the target setpoint, time interval, hold back type and hold back value. Refer Table 8.2.

PAGE-1 : Status Information
View the current status of a running profile such as the segment type in progress, the running ramping setpoint value or balance soak time, the number of repeats remaining, etc. Refer Table 8.3 .

PAGE-2 : On-line Alterations
The profile facilitates altering the running segment of the profile for the current execution without affecting the profile settings on PAGE-14. That is, the changes made to the parameter values become applicable for the current execution of the segment only. This allows adjusting the profile, if required, in accordance to some unexpected process changes. Refer Table 8.4.

PAGE-0 (Operator Page) : Profile Commands
(Refer section "Basic Operation" for parameter listing and definitions)

Start a new profile cycle or abort a running profile cycle. Also, a running segment can be paused or skipped.

Except for operator page, all the pages along with the parameter listing and definitions are described below.

Table 8.1

Parameter Description	Settings (Default Value)
Profile Configuration Parameters : PAGE 16	
ENABLING PROFILE FEATURE `Pr OF` Enable or Disable the setpoint profile feature. *Disabling the feature will suppress all other profile related parameters.*	`dSbL` Disable `EnbL` Enable (Default : Disable)
NUMBER OF SEGMENTS `n.SEG` Set the number of segments to constitute the setpoint profile.	1 to n (n = 4, 8, 12 or 16 depending on factory configuration) (Default : n)
NUMBER OF REPEATS `n.rPt` Set the number of times the profile is to be repeated before end of profile. The last segment of the profile cycle is followed by the first segment for the next repeat.	1 to 9999 (Default : 1)
COMMON HOLDBACK `Co.Hb` The profile allows either *Common* or *Independent* Holdback type and value for each of the profile segments. Set this parameter to 'Yes' if common settings are desired for the Holdback feature.	`no` No `YES` Yes (Default : No)

Parameter Description	Settings (Default Value)
OUTPUT OFF `OP.OF` Set to 'Yes' if after the end of profile, all the control outputs are to be *forced Off* till the issuance of next profile Start command.	`no` No `YES` Yes (Default : No)
'POWER FAIL RECOVERY' STRATEGY `Pr.FL` Abort A running profile shall terminate in case of power failure. Continue (a) If a ramp segment was in progress at the time of power failure then the ramp segment execution resumes with the profile setpoint prevailing at the time of power failure. (b) If a soak segment was in progress at the time of power failure then the soak segment execution resumes with the balance time.	`Abrt` Abort `Cont` Continue (Default : Continue)

Table 8.2

Parameter Description	Settings (Default Value)
Profile Setting Parameters : PAGE 14	
SEGMENT NUMBER `SEG.n` Select profile segment number for which the Target Setpoint/Time Interval values are to be edited.	1 to n (n = 4, 8, 12 or 16 depending on factory configuration) (Default : 1)
TARGET SETPOINT `t_SP` Set the Target (End) value for the selected profile segment number.	Min. to Max. Range specified for the selected Input Type (Default : -199)
TIME INTERVAL `t ir̄E` Set the time duration of ramping or soaking for the selected profile segment number.	0 to 9999 Minutes (Default : 0)
HOLDBACK TYPE `Hb.tY` Disable the Holdback Band or set the scope (up, down or both) for the profile holdback feature.	`nonE` None `UP` Up `dn` Down `both` Both (Default : None)
HOLDBACK VALUE `Hb.uL` *(Available only holdback type in other than None).* Set the band value (deviation from profile setpoint) for the profile holdback feature.	1 to 999 (Default : 1)

Table 8.3

Lower Readout Prompt	Upper Readout Information
Profile Status Information : PAGE 1	
`A.SEG`	**Active Segment Number** The current profile segment (ramp / soak) number in progress.
`S.tYP`	**Segment Type** `rAmP` The current segment is Ramp. `SOAK` The current segment is Soak.
`t_SP`	**Target Setpoint** Target setpoint value for the current segment.
`r_SP`	**Ramping Setpoint** The instantaneous Ramping Setpoint value, if the current segment type is Ramp.
`b.t im`	**Balance Time** The remaining time, in minutes, that the current segment shall take for completion.
`b.rPt`	**Balance Repeats** The remaining profile repeats.

Table 8.4

Parameter	Effect on the running segment
On-Line Alteration Parameters : PAGE 2	
`t imE` **Time Interval**	The time interval for a *Ramp* segment actually determines the RATE at which the setpoint steps towards the target setpoint. Thus, altering the time interval shall immediately affect the 'Ramp Rate' for the current segment. If the time interval is modified for the *Soak* segment then the elapsed time so far is ignored and the soak timer starts counting down to 0 from the altered time interval value.
`Hb.tY` **Holdback Type**	The modified Holdback Band Type is applied immediately on the current segment.
`Hb.uL` **Holdback Value**	The modified Holdback Band Value is applied immediately on the current segment.
`b.rPt` **Balance Repeats**	The modified repeats become the new target repeats with immediate effect.

Section 9
OP2 & OP3 FUNCTION PARAMETERS

The controller is supplied with two optional hardware plug-in modules, viz., OP2 and OP3. The modules are interchangeable and factory configured for either Relay / SSR (jumper selectable) or DC Linear Voltage or DC Linear Current.

The OP2 module can be programmed to function as an Output for any one of the followings : Alarm-1, End of Profile, Cool Control for Bi-directional Control, Auxiliary Control or Blower Control.

The OP3 module can be programmed to function as an Output for any one of the followings : Alarm-2, End of Profile or PV/SP Re-transmission.

The OP2 and OP3 function selection and the related parameters are listed below in Table 9.1.

Table 9.1

Parameter Description	Settings (Default Value)
OUTPUT-2 FUNCTION SELECTION `OP2.F` *(Applicable for OP2 hardware module, if fitted)* Select the function / feature to which the OP2 module is to be logically attached for activation.	`nonE` None `ALrn` Alarm `C.Con` Cool Control `EOP` End Of Profile `CtrL` Auxiliary Control `bLor` Blower (Default : None)
ALARM-1 LOGIC `A1.LG` *(Available if OP2 function is Alarm)* Select 'Normal' for Audio / Visual Alarm or 'Reverse' for Tripping the system.	`norn` Normal `rEu` Reverse (Default : Normal)
OUTPUT-2 TYPE `OP2.t` *(Available if OP2 function is Cool Control)* Select the type of OP2 module fitted (that is, Relay / SSR, DC Current or DC Voltage) as Output-2.	`rLY` Relay `SSr` SSR `0-20` 0 - 20 mA `4-20` 4 - 20 mA `0-5` 0 - 5 V `0-10` 0 - 10 V (Default : Relay)
OP2 EVENT STATUS `O2.E.S.` *(Available if OP2 function is End of Profile)* Selecting 'ON' keeps the OP2 OFF while profile is in progress and turns ON at the end of profile. Selecting 'OFF' keeps the OP2 ON while profile is in progress and turns OFF at the end of profile.	`On` ON `OFF` OFF (Default : ON)

Parameter Description	Settings (Default Value)
OP2 EVENT TIME `O2.E.t.` *(Available if OP2 function is End of Profile & if OP2 Event Status set to ON)* Set the time (in selected units) for which the OP2 is to be kept ON after the End of Profile. For indefinite time interval, set the value to 0.	0 to 9999 (Default : 0)
OP2 EVENT TIME UNITS `O2.Ut` *(Available if OP2 function is End of Profile & if OP2 Event Status set to ON)* Select time units for the parameter 'OP2 Event Time'.	`SEC` Seconds `n in` Minutes `HoUr` Hours (Default : Seconds)
OFFSET VALUE FOR AUXILIARY CONTROL SETPOINT `SP.2` *(Available if OP2 function is Auxiliary Control)* This parameter value is algebraically added to the Control SP to obtain the setpoint value for the Auxiliary Control. Can be set as positive value or negative value. Auxiliary Control Setpoint = Control Setpoint (SP) + Offset Value	-199 to 999 or -199.9 to 999.9 (Default : 0)
AUXILIARY CONTROL HYSTERESIS `HYS.2` *(Available if OP2 function is Auxiliary Control)* Differential (dead) band between the ON and OFF control states.	1 to 999 or 0.1 to 999.9 (Default : 2)
AUXILIARY CONTROL LOGIC `LOG.2` *(Available if OP2 function is Auxiliary Control)* If set to 'Normal', the output remains ON for PV *below* Setpoint and OFF otherwise. If set to 'Reverse', the output remains ON for PV *above* Setpoint and OFF otherwise.	`norn` Normal `rEu` Reverse (Default : Normal)
OFFSET VALUE FOR BLOWER CONTROL SETPOINT `bL.SP` *(Available if OP2 function is Blower Control)* This parameter value is algebraically added to the Control SP to obtain the setpoint value for the Blower Control. Can be set as positive value or negative value. Blower Control Setpoint = Control Setpoint (SP) + Offset Value	0 to 25 or 0.0 to 25.0 (Default : 0)
BLOWER CONTROL HYSTERESIS `bL.HY` *(Available if OP2 function is Blower Control)* Differential (dead) band between the blower ON and OFF states.	1 to 25 or 0.1 to 25.0 (Default : 2)
BLOWER CONTROL TIME DELAY `t.dLY` *(Available if OP2 function is Blower Control)* This parameter is mainly used for Compressor Load. The set time delay is elapsed each time before the compressor is switched ON. Set the value to 0 if no time Delay is required.	0.00 to 10.00 Min. Sec (in steps of 5 Seconds)

| Parameter Description	Settings (Default Value)
OUTPUT-3 FUNCTION SELECTION `OP 3.F` *(Applicable for OP3 hardware module, if fitted)* Select the function / feature to which the OP3 module is to be logically attached for activation.	`nonE` None `ALrm` Alarm `EOP` End Of Profile `rEC` Recorder (Default : Alarm)
ALARM-2 LOGIC `A2.LG` *(Available if OP3 function is Alarm)* Select 'Normal' if Alarm-2 is to activate an Audio / Visual alarm. Select 'Reverse' if Alarm-2 is to Trip the system.	`norm` Normal `rEu` Reverse (Default : Normal)
OP3 EVENT STATUS `O 3.E.S.` *(Available if OP3 function is End of Profile)* Selecting 'ON' keeps the OP3 OFF while profile is in progress and turns ON at the end of profile. Selecting 'OFF' keeps the OP3 ON while profile is in progress and turns OFF at the end of profile.	`On` ON `OFF` OFF (Default : ON)
OP3 EVENT TIME `O 3.E.t.` *(Available if OP3 function is End of Profile & if OP3 Event Status is set to ON)* Set the time (in selected units) for which the OP3 is to be kept ON after the End of Profile. For indefinite time interval, set the value to 0.	0 to 9999 (Default : 0)
OP3 EVENT TIME UNITS `O 3.Ut` *(Available if OP3 function is End of Profile & if OP3 Event Status is set to ON)* Select time units for the parameter 'OP3 Event Time'.	`SEC` Seconds `min` Minutes `HoUr` Hours (Default : Seconds)
SELECT PV OR SP FOR RECORDER TRANSMISSION `trnS` *(Available if OP3 function is recorder)* Select the parameter (process value or setpoint) which is to be transmitted for remote recording / control.	`Pu` Process Value `SP` Setpoint (Default : Process Value)
RECORDER OUTPUT TYPE `rEC.o` *(Available if OP3 function is recorder)* Select the type of OP3 module fitted (DC Current or DC Voltage) as Output-3.	`0 - 20` 0 - 20 mA `4 - 20` 4 - 20 mA `0 - 5` 0 - 5 V `0 - 10` 0 - 10 V (Default : 0 - 20 mA)

Parameter Description		Settings (Default Value)
RECORDER LOW `rEC.L` *(Available if OP3 function is recorder)* Set the minimum parameter value (SP or PV) that shall correspond to the minimum recorder output signal level (0 mA or 4 mA or 0 V).		Min. to Max. Range Specified for the Selected Input Type (Default : -199)
RECORDER HIGH `rEC.H` *(Available if OP3 function is recorder)* Set the maximum parameter value (SP or PV) that shall correspond to the maximum recorder output signal level (20 mA or 10 V or 5 V).		Min. to Max. Range Specified for the Selected Input Type (Default : 1376)

Section 10

HARDWARE ASSEMBLY AND CONFIGURATIONS

The Figure 10.1 below shows the controller outer-case viewed with front label upright.

Figure 10.1
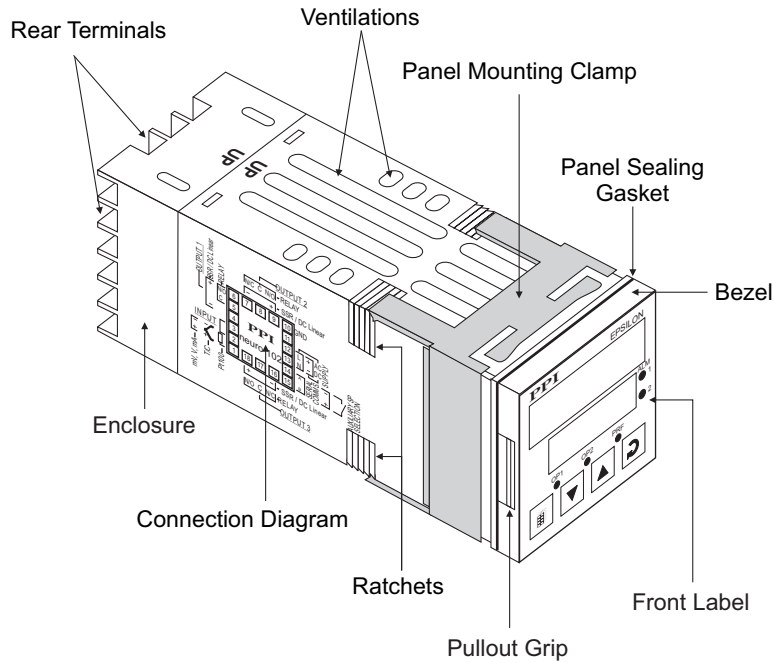
ELECTRONIC ASSEMBLY

The basic electronics assembly (without any plug-in modules), comprises of 3 Printed Circuit Boards (PCB). When viewed from the front; the CPU PCB is to the right, Power-supply PCB is to the left and the Display PCB is behind the bezel.

The electronic assembly can be removed from the plastic enclosure and placed back as described and illustrated in Figure 10.2.

Figure 10.2
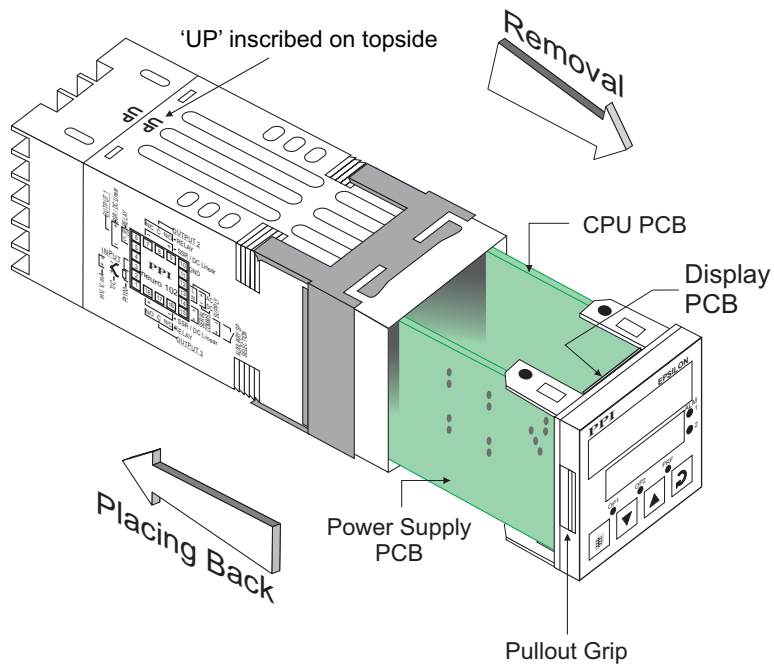
Removing Assembly from Enclosure

With the controller upright, 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.

Placing Assembly Back into Enclosure

With the controller upright (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. Ensure that the bezel fits in tight on the Enclosure-front to secure the panel-sealing gasket.

Figure 10.3
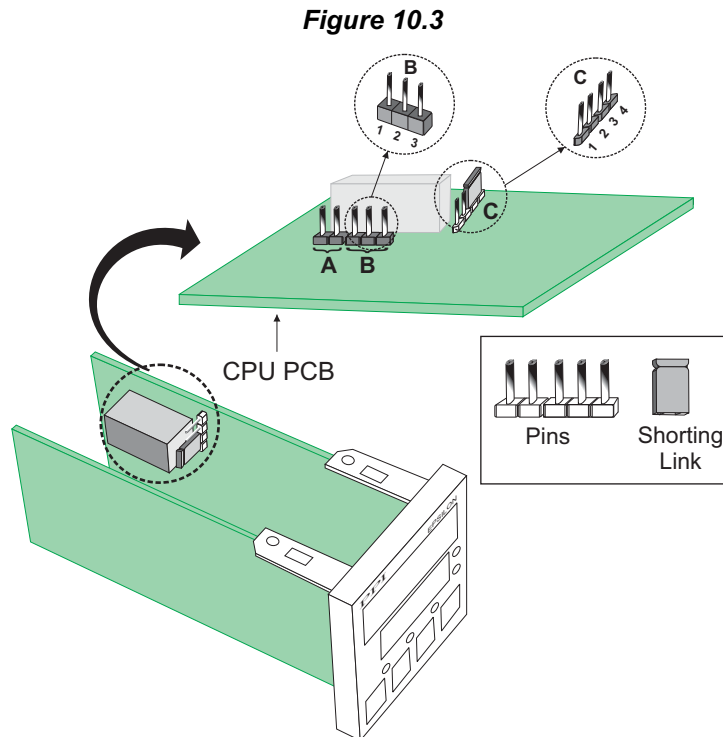
The Input type and the Output-1 type are user configurable and thus require, besides parameter selections, proper jumper-settings prior to electrical connections. The jumper settings are provided in the form of Pins & Shorting-Link arrangements on the CPU PCB towards the rear end as shown in Figure 10.3. The Jumper setting marked A is for Input configuration whereas those marked B & C are for Output-1 configuration.

INPUT : Jumper Settings - **A**

For DC Linear Current Inputs (0-20 mA or 4-20 mA), short the Pins using Shorting-Link as shown in Figure 10.4 (a). For all other Input types, keep the Shorting-Link parked leaving the Pins open, as shown in Figure 10.4 (b).

OUTPUT-1 : Jumper Settings - **B & C**

Besides the parameter settings, the Output-1 configuration requires jumper settings marked B & C for different output type selections as shown in the Table 10.1 below.
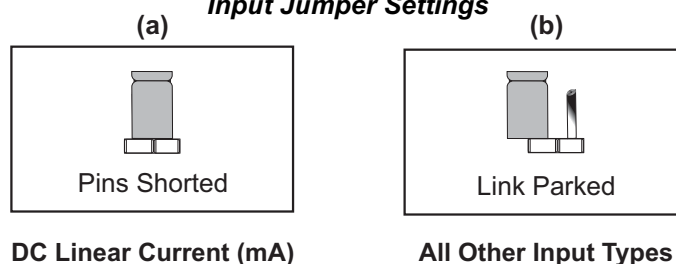
Figure 10.4
Input Jumper Settings

Table 10.1
Output-1 Jumper Settings

Output Type	Jumper Setting - B	Jumper Setting - C
Relay		
SSR Drive		
DC Linear Current (or Voltage)		

MOUNTING PLUG-IN MODULES

The controller supports up to 3 plug-in modules, viz. *Output-2 Module* (Relay/SSR or DC Linear), *Output-3 Module* (Relay/SSR or DC Linear) and *Option Module* (RS485 Serial Port or Digital Input for Auxiliary Setpoint selection). These modules are either pre-fitted while the controller is shipped from the factory or can be fitted by the user later.

All 3 plug-in modules are provided with female sockets that directly fit into the corresponding male plugs provided on either Power-supply PCB or CPU PCB. The *Output-2* and *Option* Modules fit into plugs provided on Power-supply PCB whereas the *Output-3* Module fits into plug provided on the CPU PCB.

OUTPUT-2 & OUTPUT-3 : Modules and Jumper Settings

The *Output-2* and *Output-3* Modules come in three versions, viz., Relay/SSR, DC Linear Voltage and DC Linear Current. Both the modules are identical and, thus, can be fitted interchangeably in Output-2 or Output-3 positions.

Relay / SSR Module

This module can be configured for either Relay or SSR output through proper jumper selection. Two jumper settings A and B, as shown in Figure 10.5 are required for Relay or SSR selection. Refer Table 10.2.
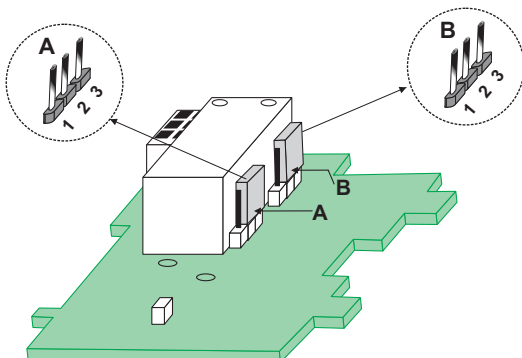
Figure 10.5
Relay/SSR Module
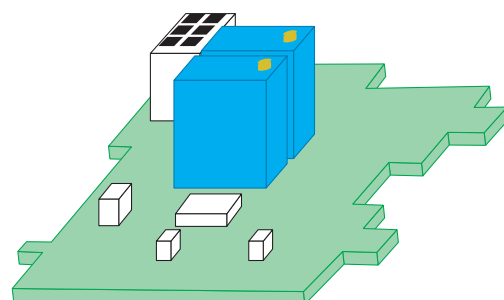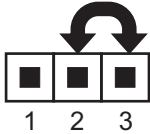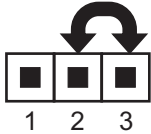

Figure 10.6
DC Voltage/Current Module
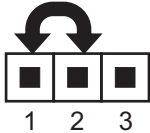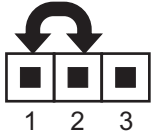
Table 10.2

Output Type	Jumper Setting - A	Jumper Setting - B
Relay	◼ ◼ ◼ 1　2　3	◼ ◼ ◼ 1　2　3
SSR	◼ ◼ ◼ 1　2　3	◼ ◼ ◼ 1　2　3

DC Linear Voltage / Current Module

The DC Linear Module is factory configured for either Current or Voltage output. The current output can be configured for 0-20 mA or 4-20 mA and similarly the voltage output can be configured for 0-5 V or 0-10 V through parameter settings. No jumper settings are required. Refer Figure 10.6.

MOUNTING / UN-MOUNTING OF MODULES

The Figures 10.7 & 10.8 illustrate how to mount the plug-in Output-2 & Output-3 module, respectively. Notice the orientation of the controller and a few identifying components shown in figures to help locate the plugs for the modules. Ensure that the socket snap-fits into the plug and the 2 projected parts on the module fit into the 2 slots provided on the Power-Supply / CPU PCB for proper electrical contacts and secured fitting.

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

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

2. Pull the module outward to unlock the socket from the plug.
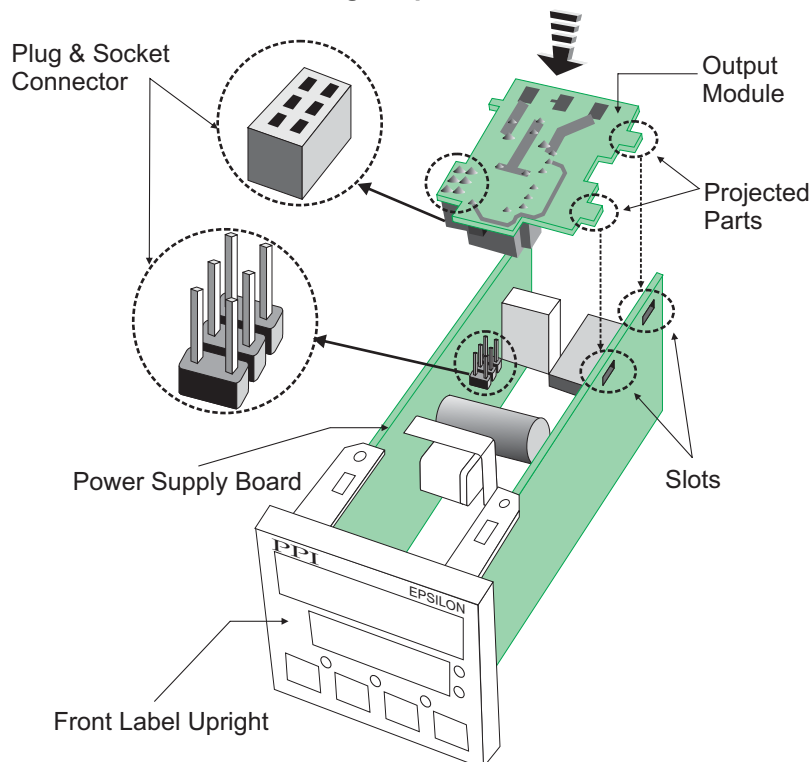
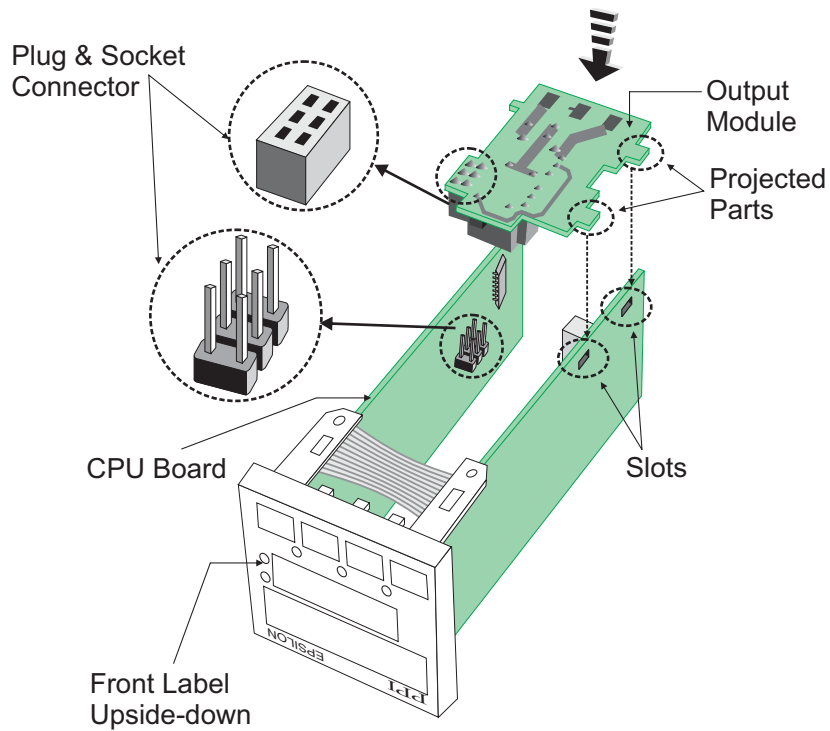*Figure 10.7*
Mounting Output-2 Module

Figure 10.8
Mounting Output-3 Module

Plug & Socket
Connector

Output
Module

Projected
Parts

CPU Board

Slots

Front Label
Upside-down

The plug for the Serial Communication or Auxiliary SP Selection module is located on the Power-supply PCB. The Figure 10.9 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 10.9
Mounting Serial Communication/Auxiliary SP Selection Module

Power Supply Board

Serial Communication/
Auxiliary SP Selection
Module

Plug & Socket
Connectors

Front Label
Upside-down
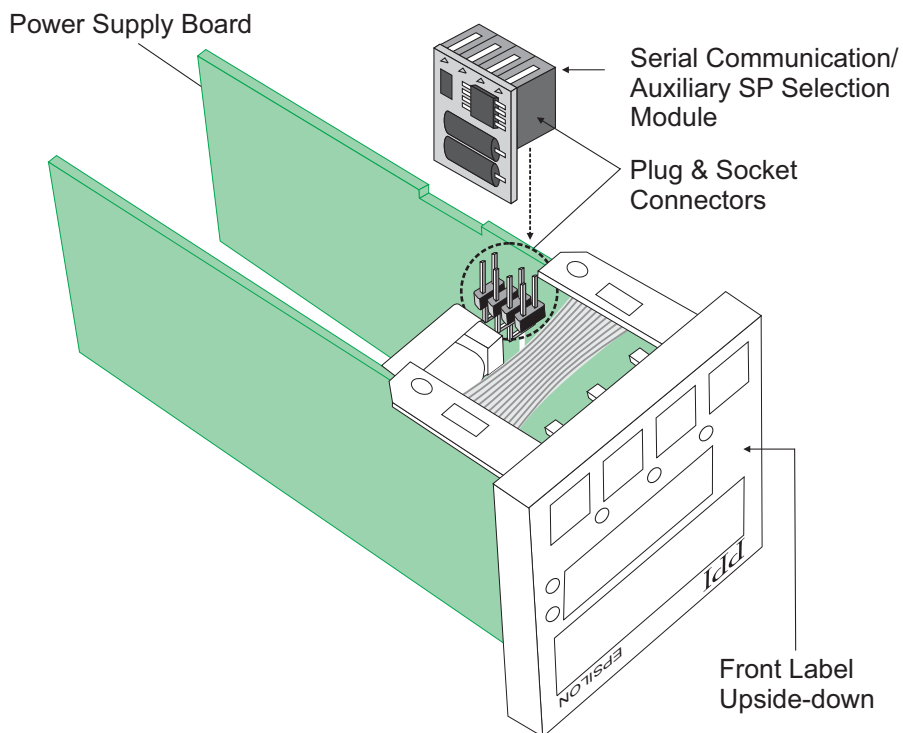
Section 11
MECHANICAL INSTALLATION

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.
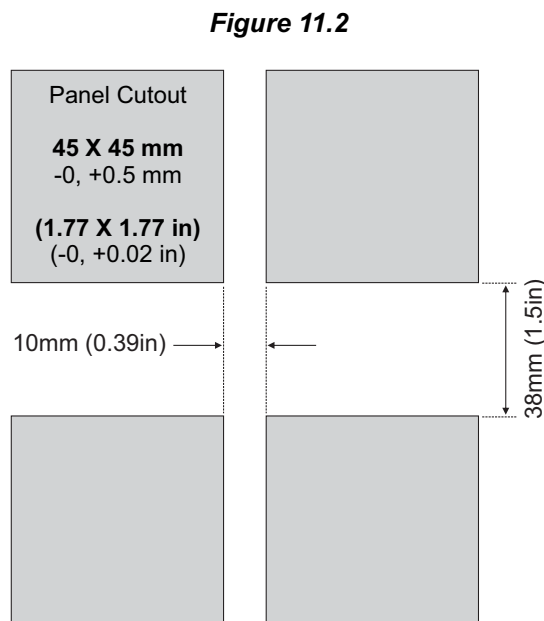
OUTER DIMENSIONS

The Figure 11.1 shows the outer dimensions of the controller.

Figure 11.1

Front View   **Side View**
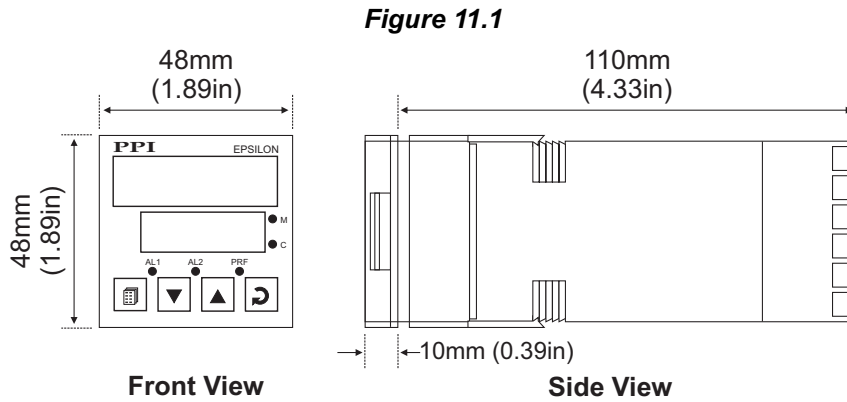
PANEL CUTOUT AND RECOMMENDED MINIMUM SPACING

The Figure 11.2 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 11.2

PANEL MOUNTING

Follow the steps below for mounting the controller on panel:

1. Prepare a square cutout to the size shown in Figure 11.2.

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 11.3. 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 11.3. Ensure that the springs of the clamp push firmly against the rear face of the mounting panel for secured mounting.

Figure 11.3
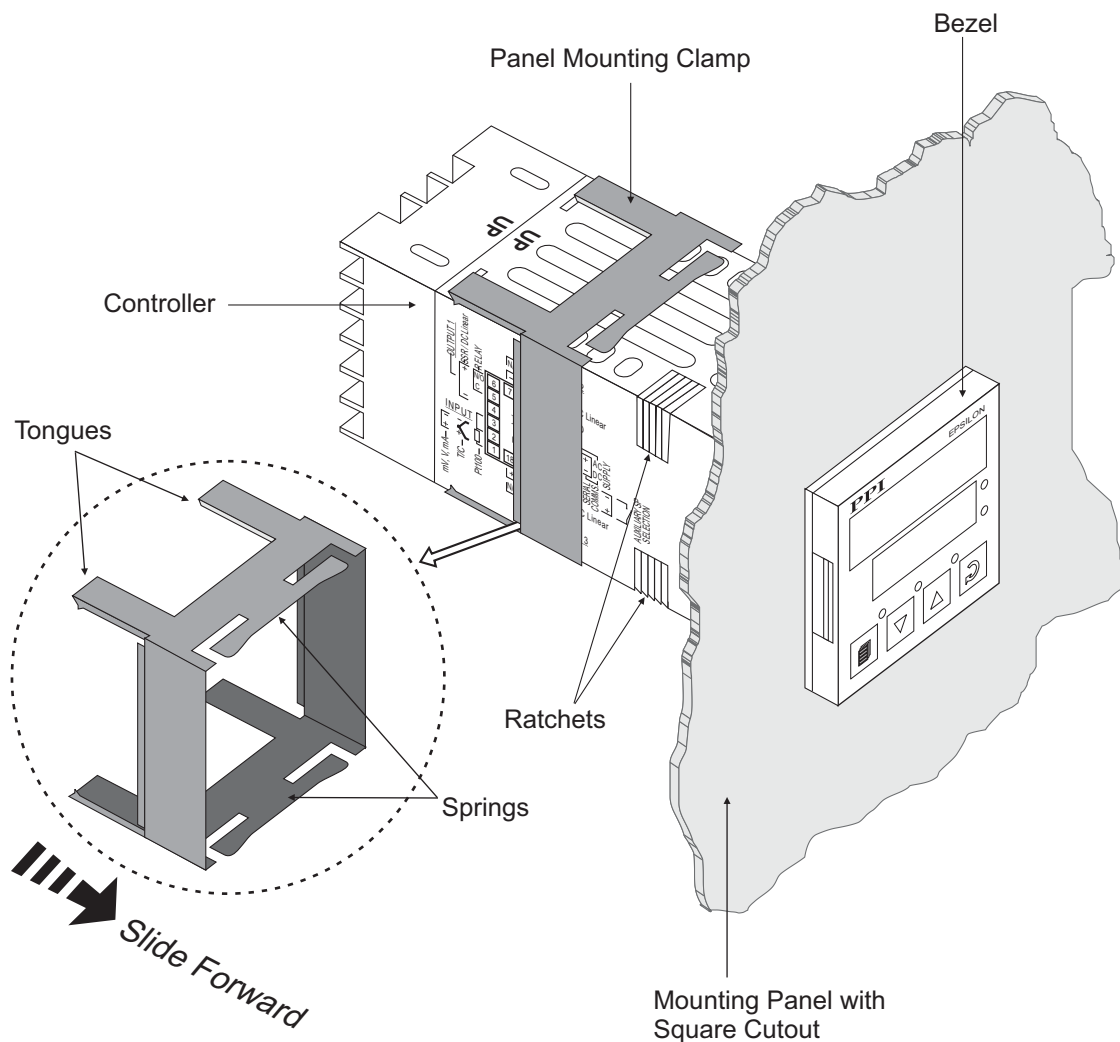
Section 12

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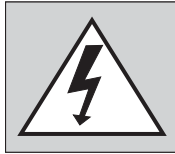
|	WARNING MISHANDLING / NEGLIGENCE CAN RESULT IN PERSONAL DEATH OR SERIOUS INJURY.

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-2, 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 18 to 34 VDC supply voltage option.

The rear panel electrical wiring connection diagram is shown in Figure12.1 below.

Figure 12.1
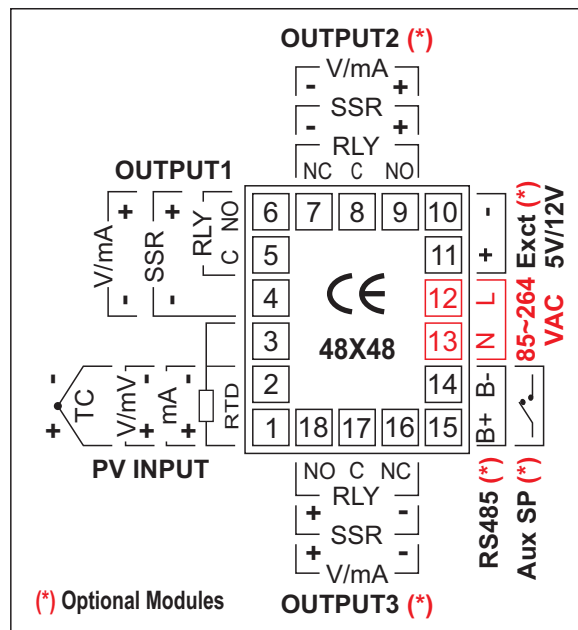
DESCRIPTIONS

The back panel connections are described as under:

INPUT (Terminals : 1, 2, 3)

The controller accepts Thermocouples (J, K, T, R, S, B, N), 3-wire RTD Pt100 and DC Linear Current/Voltage (mV / V / mA) as input.

Figure 12.2 (a)

Thermocouple

Connect Thermocouple Positive (+) to terminal 1 and Negative (-) to terminal 2 as shown in Figure 12.2 (a). Use the correct type of Thermocouple extension lead wires or compensating cable for the entire distance ensuring the correct polarity throughout. Avoid joints in the cable.
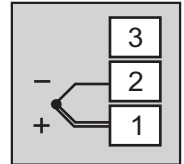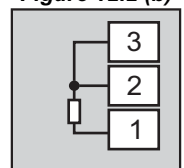

Figure 12.2 (b)

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 12.2 (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.
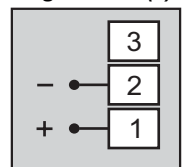

Figure 12.2 (c)

DC Linear Voltage (mV / V)

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 12.2 (c).

Figure 12.2 (d)

DC Linear Current (mA)

Use a shielded twisted pair with the shield grounded at the signal source for connecting mA source. Connect common (-) to terminal 2 and the signal (+) to terminal 1, as shown in Figure 12.2 (d).
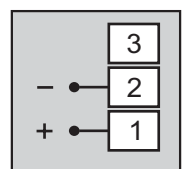
Make sure that the Jumper Pins for Input selection are shorted using the Shorting-Link (Refer *Section 10 Hardware Assembly and Configurations, Input-Jumper Settings*).


OUTPUT-1 (Relay Terminals : 5, 6; SSR / DC Linear Terminals : 4, 6)

The Output-1 can be configured (through jumper settings) as either Relay, SSR Drive or DC Linear Current (or Voltage).

Figure 12.3 (a)

Relay

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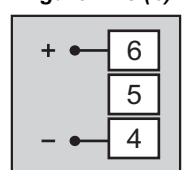

Figure 12.3 (b)
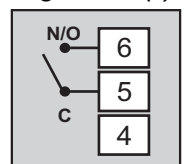
Drive for SSR

DC Voltage level is generated for switching the external SSR (Solid State Relay). Connect (+) and (-) terminals of SSR to controller terminals 6 and 4, respectively. Use Zero-Crossover, 3 to 30 VDC operated SSR, rated approximately 1.5 times the actual load rating. Use appropriate Heat Sink for load ratings exceeding 10 A.
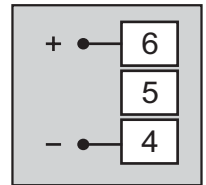
Figure 12.3 (c)

DC Linear Current / Voltage Output

The DC Linear (0/4-20 mA) Current or (0-5/10 V) Voltage output is also available at Terminal 6 (+) and Terminal 4 (-) if the Output-1 is configured for DC Linear.
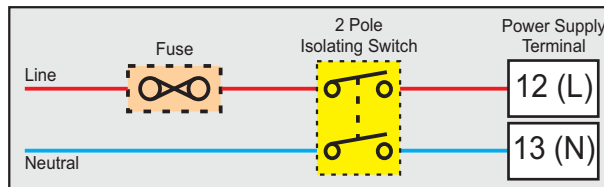
OUTPUT- 2 (Terminals : 7, 8, 9)

OUTPUT- 3 (Terminals : 16, 17, 18)

The Output-2 and Output-3 are available through plug-in modules. The modules are factory configured for either Relay / SSR or DC Linear Voltage or DC Linear Current. The connection descriptions are the same as those described for Output-1.

POWER SUPPLY (Terminals : 12, 13)

Figure 12.4

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.

As standard, the controller is supplied with power connections suited for 85 to 264 VAC. Use well-insulated copper conductor wire of the size not smaller than $0.5mm^2$ for connections. Connect Line (Phase) to terminal 12 and the Neutral (Return) to terminal 13 as shown in Figure 12.4. 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.

SERIAL COMMUNICATION PORT (Terminals : 14 , 15)
(Applicable if the Option plug-in module for RS485 Serial Port is fitted.)
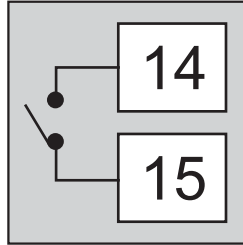
Figure 12.5
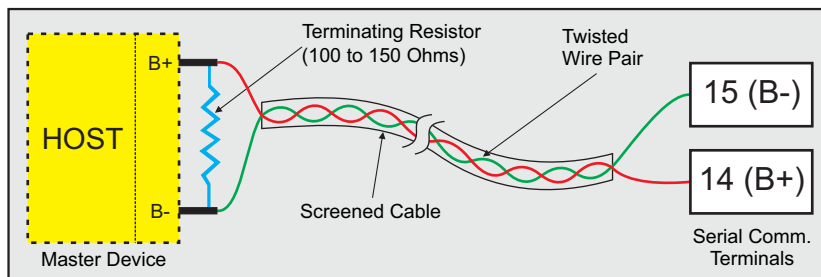
If the Optional plug-in communication board is fitted, connect terminal 15 and 14 of the controller to (+) and (-) terminals of the Master device. For reliable noise free communication, use a pair of twisted wires inside screened cable as shown in Figure 12.5. The wire should have less than 100 ohms / 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.

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

(Applicable if the Option plug-in module for Auxiliary SP Selection is fitted.)

Figure 12.6 (a)

Figure 12.6 (b)

**Potential-free
Contact closure**
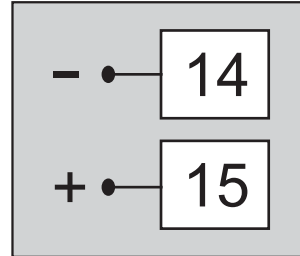
**TTL-Compatible
Voltage Level**

The plug-in Option module for selecting Auxiliary SP is factory configured for either potential-free contact closure or TTL-compatible voltage input.

The Setpoint selection is as under :

(a) Potential-Free Contacts
                OPEN   : Main SP selected
                CLOSE   : Auxiliary SP selected
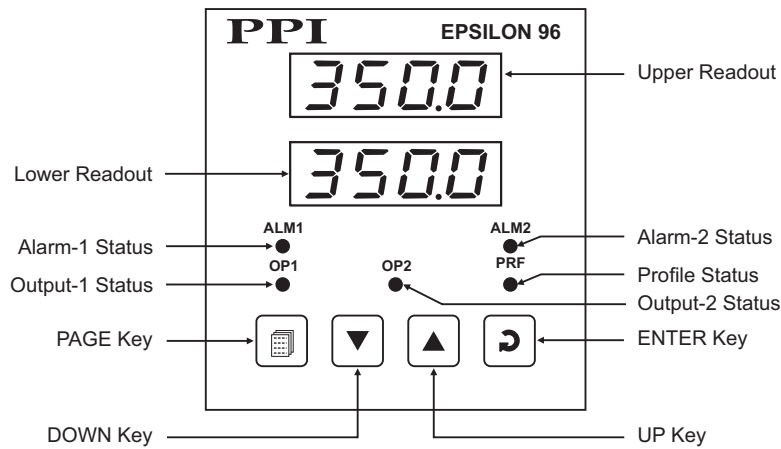
(b) TTL-compatible Voltage
                > 0.6 V   : Main SP selected
                < 0.5 V   : Auxiliary SP selected

EPSILON 96X96

Section 1
FRONT PANEL LAYOUT

Figure 1.1

The front panel contains digital readouts, LED indicators and keys.

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/options.

The Lower Readout is a 4 digit, 7-segment bright green LED display and usually displays SP (Control Setpoint) Value. In Program Mode, the Lower Readout displays parameter names (prompts).

INDICATORS

The Table 1.1 lists each front panel LED and the associated status

Table 1.1

Indicator	Status
OP1	• Indicates Output-1 ON/OFF status if the Control Output Type is Relay / SSR. • Remains OFF if the Control Output Type is DC Linear.
OP2	• Indicates Output-2 ON/OFF status if the Control Output Type is Relay / SSR. • Remains OFF if the Control Output Type is DC Linear.
ALM1	• Flashes while Alarm-1 is active.
ALM2	• Flashes while Alarm-2 is active.
PRF	• Flashes while the Ramp/Soak profile is in progress. • Glows continuously if profile is in HOLD state. • Remains OFF if profile is not in progress.

KEYS

The Table 1.2 lists the four front panel keys 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.

Section 2
BACK PANEL TERMINAL CONNECTIONS

Figure 2.1
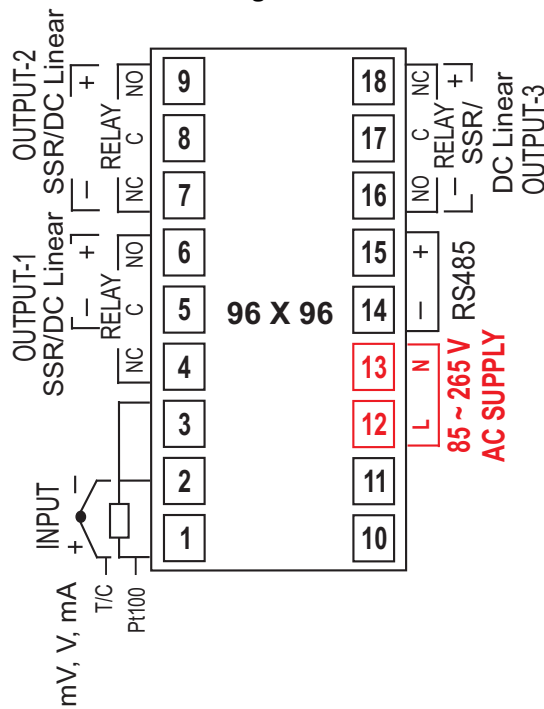
INPUT (Terminals 1, 2 & 3)

The controller accepts Thermocouples (J, K, T, R, S, B, N) or 3-wire RTD Pt100 and DC linear current/Voltage (mV/V/mA) as input.
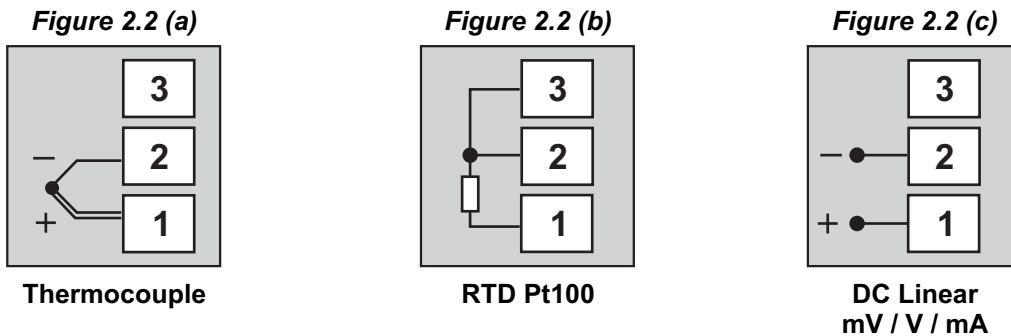
Figure 2.2 (a)	*Figure 2.2 (b)*	*Figure 2.2 (c)*
Thermocouple	**RTD Pt100**	**DC Linear mV / V / mA**

Thermocouple

Connect Thermocouple Positive (+) to terminal 1 and Negative (-) to terminal 2 as shown in Figure 2.2 (a). Use correct type of extension lead wires or compensating cable. Avoid joints in the cable.

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 2.2 (b). Use low resistance copper conductor leads of the same gauge and length.

DC Linear Current/Voltage (mV / V / mA)

Connect DC Linear source common (-) to terminal 2 and the signal (+) to terminal 1, as shown in Figure 2.2 (c). Use a shielded twisted pair with the shield grounded at the signal source end.

OUTPUT-1 (Terminals 4, 5 & 6)

The Output-1 can be configured (through jumper settings) as either Relay, SSR Drive or DC Linear output. Note that either Current (mA) or Voltage is provided as DC Linear output.

Figure 2.3 (a)   *Figure 2.3 (b)*   *Figure 2.3 (c)*

**Output-1 : Relay**   **Output-1: SSR**   **Output-1: mA / V**
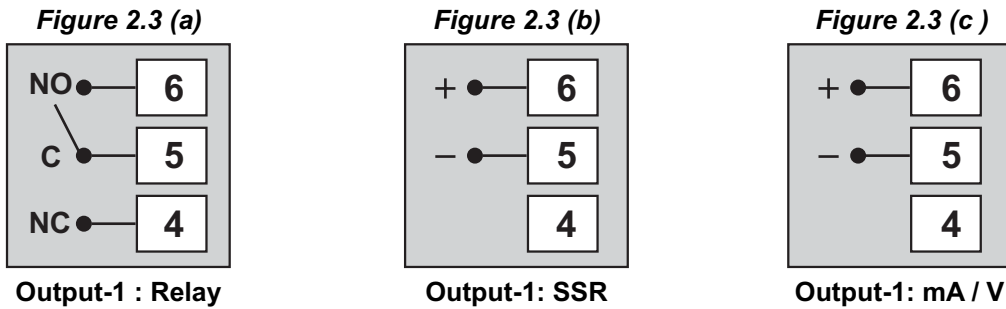
Relay Output

Potential-free Relay changeover contacts NO (Normally Open), C (Common) & NC (Normally Closed) rated 10A/240 VAC (resistive load) are provided as Relay output as shown in Figure 2.3 (a).

SSR Output

Connect (+) and (-) terminals of SSR to terminals 6 & 5, respectively as shown in Figure 2.3 (b). Use Zero-Crossover, 3 to 30 VDC operated SSR.

DC Linear Current/Voltage (mA / V) Output

The DC Linear Current (0/4-20mA) or Voltage (0-5/10V) output is also available at Terminal 6 (+) and Terminal 5 (-) as shown in Figure 2.3 (c) if the Output-1 is configured for DC Linear.

Figure 2.4 (a)   *Figure 2.4 (b)*   *Figure 2.4 (c)*

Relay Output   **SSR Output**   **DC Linear mV/V/mA**
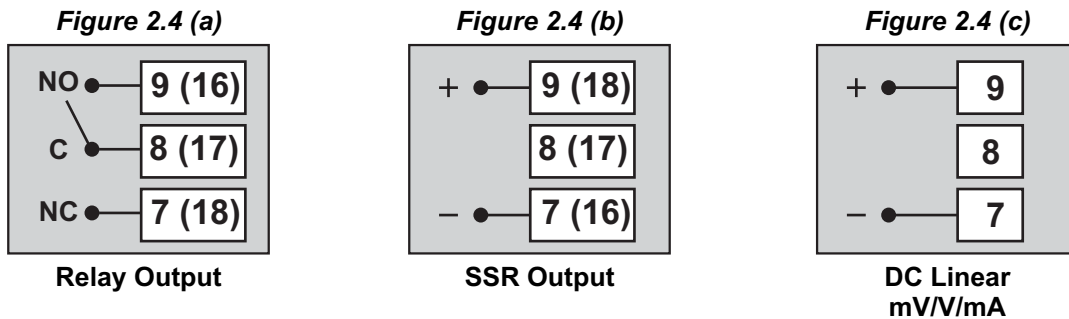
OUTPUT- 2 (Terminals 7, 8 & 9)

The Output-2 is fitted as either Relay/SSR or DC Linear module.

In case of Relay/SSR; the Output-2 is jumper selectable as either Relay or SSR as shown in Figure 2.4(a) & 2.4(b) respectively.

In case of DC Linear; Output-2 is supplied as either DC Current or DC Voltage. Connections are shown in figure 2.4(c).

OUTPUT- 3 (Terminal 16, 17 & 18)

The Output-3 module (if fitted) can be configured as either Relay or SSR through hardware jumper setting as shown in Figure 2.4(a) & 2.4(b) respectively.

Figure 2.5

POWER SUPPLY
The controller accepts single phase, 50/60 Hz Line Voltage ranging from 85 VAC to 264 VAC. Use well-insulated copper conductor wire of the size not smaller than $0.5mm^2$ for power supply connections. Connect Line Voltage as shown in Figure 2.5.
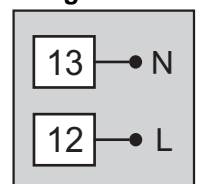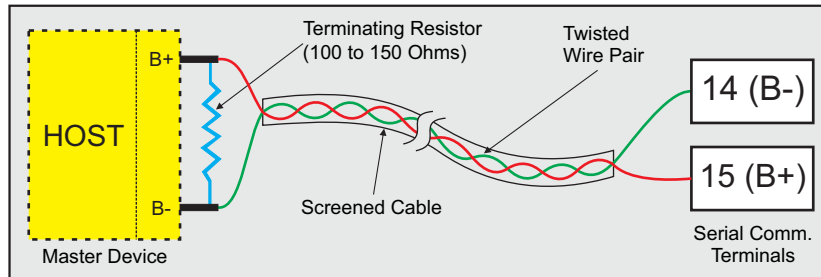
SERIAL COMMUNICATION PORT

(Applicable if the Option plug-in module for RS485 Serial Port is fitted.)
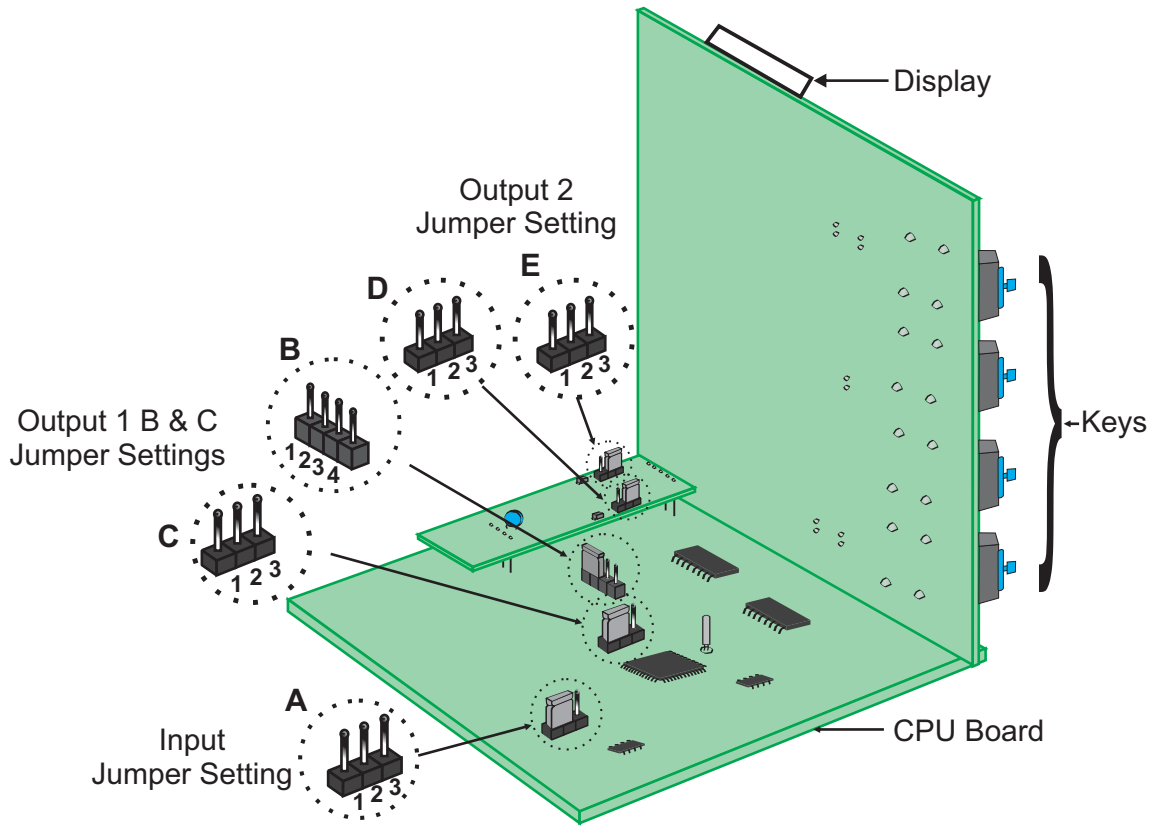
Figure 2.6

Connect terminal 15 and 14 of the controller to the BUS(+) and BUS(-) terminals of the master device. For reliable noise free communication, use a pair of twisted wires inside screened cable as shown in Figure 2.6. The wire 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.

Section 3
INPUT & OUTPUT HARDWARE JUMPER SETTINGS

Figure 3.1

INPUT : Jumper Settings

In addition to parameter settings, the Input Type selection also requires proper jumper settings. For the jumper settings; Pins & Shorting-Link arrangement, marked 'A', is provided on the CPU PCB as shown in Figure 3.1. For Jumper configuration refer Table 3.1.

Table 3.1
Input Jumper Settings

Input Type	Jumper 'A' Setting
Thermocouple, RTD Pt100, mV & V	
DC Linear Current (mA)	

OUTPUT-1 : Jumper Settings

Output-1 Type is user selectable as Relay, SSR, DC Volts or DC Current. Besides the parameter settings, the Output-1 configuration requires proper jumper settings. The jumper setting are provided as Pins & Shorting Link arrangement (marked 'B' & 'C') on CPU PCB, as shown in Figure 3.1 and listed in Table 3.2.

OUTPUT-2 : Jumper Settings

Output-2 is supplied with either Relay/SSR or DC Voltage or DC Current module. In case of Relay/SSR module; the output can be configured as either Relay/SSR using Pins & Shorting Link arrangement (marked 'D' & 'E') on CPU PCB, as shown in Figure 3.1 and listed in Table 3.3.

Table 3.2
Output-1 Jumper Settings

Output Type	Jumper Setting - B	Jumper Setting - C
Relay	4 3 2 1	1 2 3
SSR Drive	4 3 2 1	1 2 3
DC Linear Current (or Voltage)	4 3 2 1	1 2 3

Table 3.3
Output-2 Jumper Settings

Output Type	Jumper Setting - D	Jumper Setting - E
Relay	1 2 3	1 2 3
SSR	1 2 3	1 2 3

OUTPUT-3 : Jumper Settings

Output-3, if fitted, is jumper selectable as either Relay or SSR using Pins & Shorting Link arrangement (marked 'A' & 'B') on Power Supply PCB, as shown in Figure 3.2 and listed in Table 3.4 below.
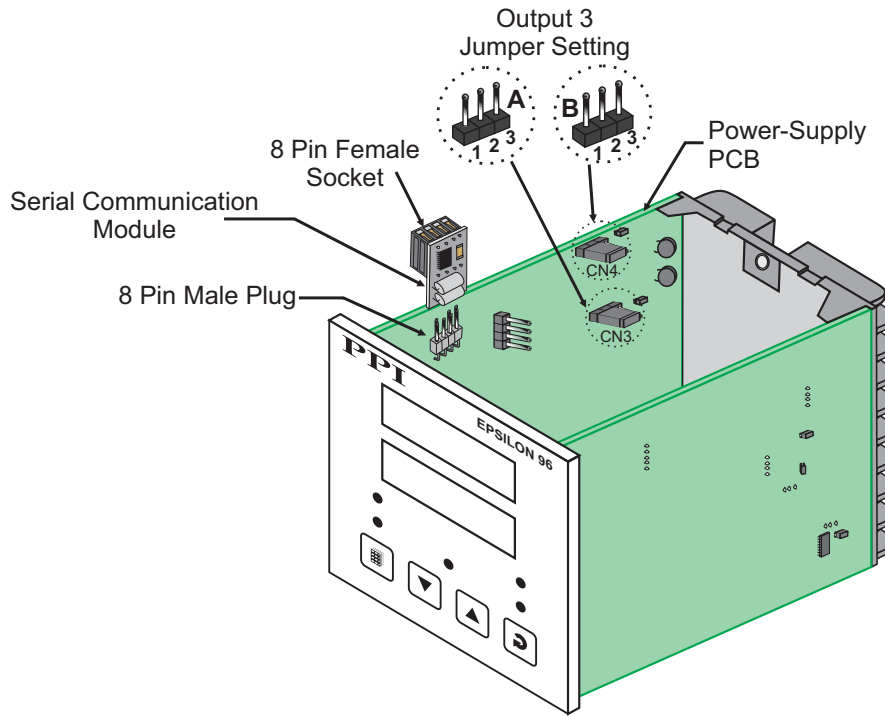
Figure 3.2

Table 3.4
Output-3 Jumper Settings

Output Type	Jumper Setting - A	Jumper Setting - B
Relay	 1 2 3	 1 2 3
SSR	 1 2 3	 1 2 3

Serial Communication Plug-in Module

The 8-Pin Male Plug for mounting the Serial Communication Module is located on the Power-supply PCB, as shown in the Figure 3.2 above. The Serial Communication Module is provided with a 8-Pin female socket on the bottom side for the mounting purpose. To plug (or unplug) the module simply insert (or remove) the socket into (or from) the plug.