Clavex GD

PPI
The Perfection Experts

Vertical Autoclave Controller
with Graphic Display
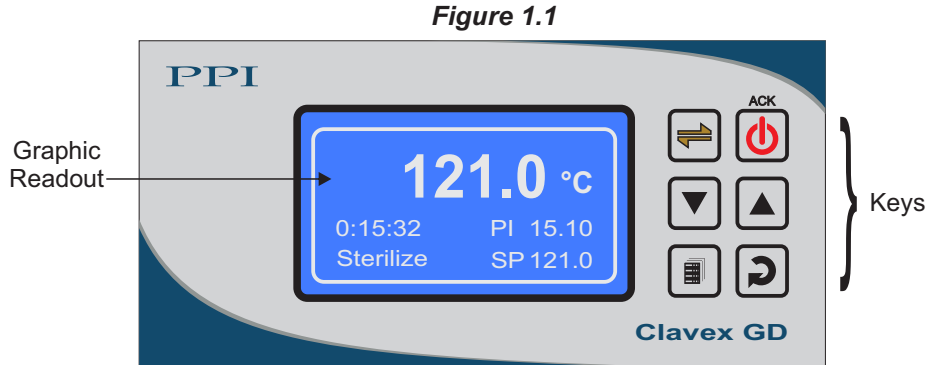

PPI

121.0 °C

0:15:32
Sterilize

PI 15.10
SP 121.0

ACK

Clavex GD

User Manual

CONTENTS

Section 1

FRONT PANEL LAYOUT

The Controller front panel comprises of Graphic Readout and Membrane Keys as shown in Figure 1.1 below.

Figure 1.1

GRAPHIC READOUT

The Graphic Readout is a 128 X 64 Pixel Monochrome LCD Display. In Normal operation mode the Readout shows measured Temperature Value, Set Temperature Value, Alarm Status, Autoclave Cycle Status & Remaining Sterilization Time while Sterilization in progress. Other Process Status can be viewed using Scroll Key.

In Set-up Mode, the Readout displays parameter names and values that can be edited using front keys.

KEYS

There are six tactile keys provided on the front panel for configuring the controller and setting-up the parameter values.

The Table 1.1 below lists each key (identified by the front panel symbol) and the associated function.

Table 1.1

Symbol	Key	Function
⇄	Scroll	Press to scroll through various Process Information Screens in Normal Operation Mode.
⏻	Cycle Start & Alarm Acknowledge	Press to Start / Abort Autoclave Cycle. In case of process under alarm condition, press to acknowledge and mute the alarm output.
▼	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.
🗐	SET-UP	Press to enter or exit set-up mode.
↩	ENTER	Press to store the set parameter value and to scroll to the next parameter.

Section 2
BASIC OPERATIONS

Figure 2.1

POWER-UP DISPLAY

Upon power-up the controller displays Hardware Version and Software Version for 2 seconds as shown in figure 2.1.

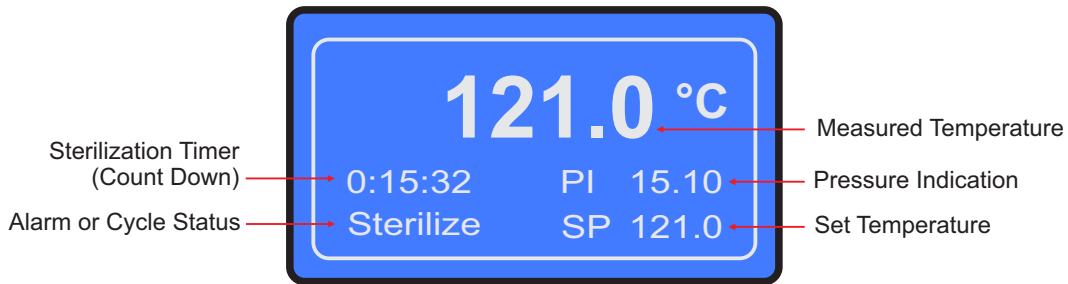|	
H/W Version	01
S/W Version	01
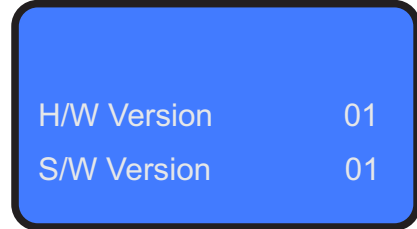
RUN MODE

After the Power-up display, the controller enters into RUN Mode. This is the normal operation mode wherein the controller starts PV measurements, Alarm monitoring and Autoclave Cycle Operation.

Main Screen

The Main screen is illustrated in the figure 2.2 below.

Figure 2.2

Sterilization Timer (Count Down)
Alarm or Cycle Status

121.0 °C
0:15:32   PI   15.10
Sterilize   SP 121.0

Measured Temperature
Pressure Indication
Set Temperature

Measured Temperature : This field shows the measured autoclave Temperature in °C. In case of measured value errors, the messages listed in Table 2.1 flash in place of Temperature Value. Refer figure 2.3 for example.

Pressure Indication : This field shows either measured autoclave pressure (if pressure sensor is connected) or computed saturated steam pressure (if enabled). The pressure is indicated either in PSI (e.g. PI 15.10) or KG/Cm² (e.g. KG 1.05) depending on user selection.

Sterilization Timer : This field shows the remaining sterilization time (HH:MM:SS) once the sterilization starts.

Set Temperature : This field shows the Set Value for sterilization in °C.

Alarm or Cycle Status : This field usually shows the autoclave cycle status. However if an alarm condition occurs then this filed shows the Alarm Message.

Table 2.1

Message	Error Type	Cause
OPEN	Sensor Open	RTD Pt100 / Thermocouple is Broken / Open
OVR	Over-range	Temperature above Max. Specified Range
UNR	Under-range	Temperature below Min. Specified Range

Figure 2.3

OPEN
PV Fault   SP **25.0**
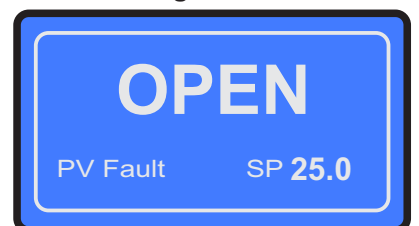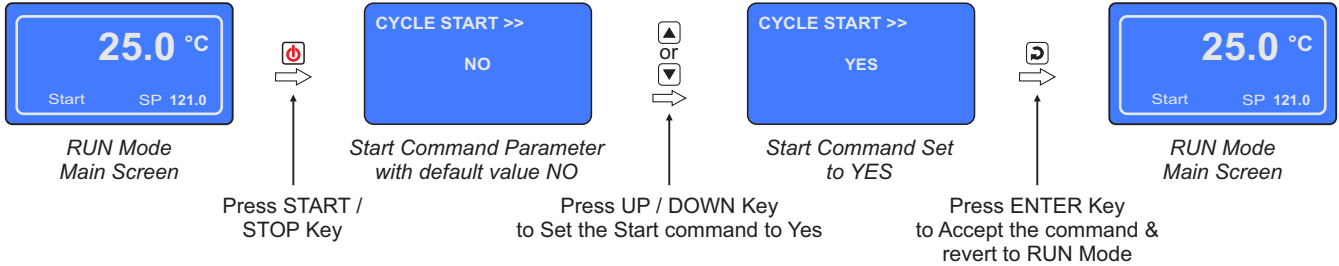
CYCLE START / STOP COMMAND

While the main screen is being displayed, the 🔴 (Start / Stop) key can be used to start a new sterilization cycle or to stop (abort) a running cycle. Note that Start & Stop commands are mutually exclusive. The Figure 2.4 below illustrates how to issue Start command. Follow same procedure for Stop command.

Figure 2.4

| RUN Mode Main Screen | Press START / STOP Key | Start Command Parameter with default value NO | Press UP / DOWN Key to Set the Start command to Yes | Start Command Set to YES | Press ENTER Key to Accept the command & revert to RUN Mode | RUN Mode Main Screen |

CYCLE STATUS AND PROCESS ERROR INDICATION

The Alarm / Cycle Status field on the main screen displays Cycle Status or Process Errors as listed in tables 2.2 & 2.3 respectively.
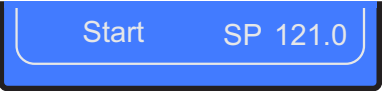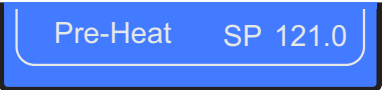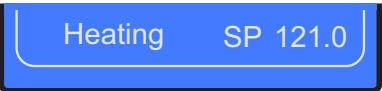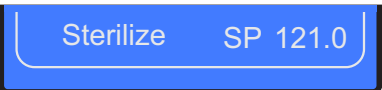
Table 2.2 : Cycle Status
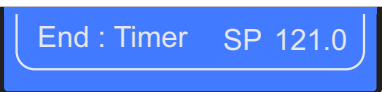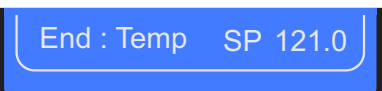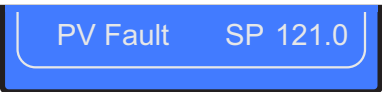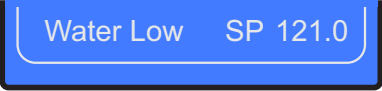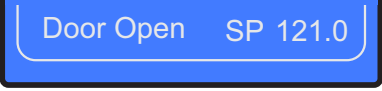
Status	Remark
Start SP 121.0	The Autoclave is in idle state. Issue a start command to commence a new cycle.
Pre-Heat SP 121.0	The Air Outlet valve is open. Steam is replacing the Air and Pre-Heating is taking place. This state continues until air valve shut off setpoint is reached.
Heating SP 121.0	The Air Outlet valve is closed. Heating is taking place. This state continues until the sterilization (soaking) setpoint is reached.
Sterilize SP 121.0	The sterilization timer is started. The count-down value for the Sterilization Timer is shown above this message.
End : Timer SP 121.0	The Sterilization time is over. This state is show if the Cycle-End strategy is time based. The count-down End Timer is shown above this message.
End : Temp SP 121.0	The Sterilization time is over. This state is show if the Cycle-End strategy is temperature based. The Set Temperature at which the cycle will end is shown above this message.
Complete SP 121.0	The autoclave cycle is completed.

Table 2.3 : Process Error (Alarm)

Error	Remark
PV Fault SP 121.0	The process value used for control is under fault.
Water Low SP 121.0	The water level in steam generating boiler is low.
Door Open SP 121.0	The autoclave door is open.
Below ARSP SP 121.0	While sterilization in progress, the autoclave temperature dropped down below air valve shut off setpoint.
Above SFSP SP 121.0	The autoclave temperature exceeded the set safety limit.

Process Status Screen
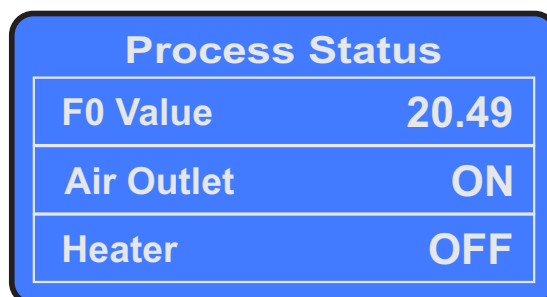
The Process Status Screen is shown upon pressing ⇌ (Scroll) key from Main Screen. As depicted in Figure 2.5; the screen shows F_0 Value, Air Outlet Status & Heater Status.

Figure 2.5

Process Status	
F0 Value	20.49
Air Outlet	ON
Heater	OFF

Section 3
OPERATOR PARAMETERS

The Operator Parameters are accessible under PASSWORD 0.

The Figure 3.1 shows how to access Operator Parameters. The Example illustrates changing the Air Outlet SP value from 96.0 to 98.0.

Figure 3.1
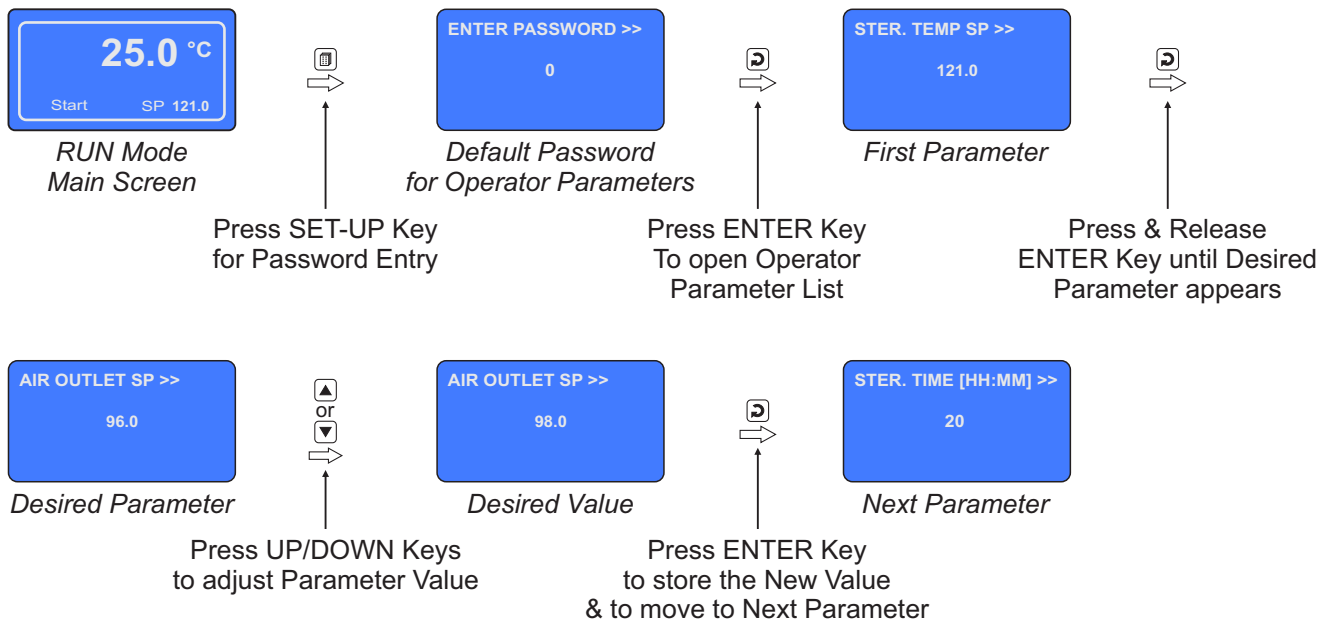
The Table 3.1 below described the Operator Parameters in detail.

Table 3.1

Parameter Description	Settings (Default Value)
STER. TEMP SP >> The Sterilization Setpoint Value. The autoclave temperature value is maintained at this setpoint for the set sterilization time.	SETPOINT LO LIMIT to SETPOINT HI LIMIT (Default : 121.0 °C)
AIR OUTLET SP >> The setpoint value at and above which the Air Outlet valve is kept closed to build saturated steam pressure.	SETPOINT LO LIMIT to SETPOINT HI LIMIT (Default : 100.0 °C)
STER. TIME [HH:MM] >> The time duration in 'Hours:Minutes' for which the autoclave temperature is maintained at the set sterilization setpoint value.	0.01 to 99.59 (HH:MM) (Default : 00.10 min)

Parameter Description	Settings (Default Value)
CHANGE PASSWORD >> The Controller is shipped from the factory with a default password (0) for accessing the parameters reserved for Operator. However, if required the password can be changed by setting the new value for this parameter. (The new password replaces the old password. That is, the old password is no longer valid. it is user's responsibility to memorize the password.)	1 to 100 (Default : 0)

Section 4
SUPERVISORY PARAMETERS

The various parameters have been assembled in different groups under the default factory password 123.

Refer Table 4.1 below for a quick summary of parameters under different groups. Each parameter has been described in subsequent sections.

Table 4.1

Group	Parameters
Serial Parameter	Device ID, Baud Rate, Parity, Serial Write
Control	Setpoint Low Limit, Setpoint High Limit, Overshoot Temperature, Cycle End Strategy, Cycle End Timer, Cycle End Temperature, Control Band, End of Process Alarm Time
Sterilization	Sterilization Stop Temperature, Sterilization Reset Temperature
PV Offset	Temperature Zero Offset
Password	Change Password
Exit	Exit Set-up Mode (No / Yes)

Accessing Group & Parameters

The Figure 4.1 below illustrates how to access the group and parameters. The example shows changing the value for the parameter 'Setpoint High Limit' from 140.0 to 135.0 that is located under group 'Control'.

Figure 4.1

25.0 °C TEMP HIGH SP **25.0** *RUN Mode* *Main Screen*	**ENTER PASSWORD >>** 0 *Default Password* *for Operator Parameters*	**ENTER PASSWORD >>** 123 *Password for* *Supervisory Parameters*
Press SET-UP Key for Password Entry	Press UP/DOWN Keys To adjust Password Value	Press & Release ENTER Key for the First (Desired) Group
SELECT GROUP>> Serial *First Group*	**SELECT GROUP>>** Control *Desired Group*	**SETPOINT LO LIMIT >>** 0.0 *First Parameter in* *selected Group*
Press UP/DOWN Keys to Select Desired Group	Press ENTER Key to Access Parameters	Press ENTER Keys to Select Desired Parameter
SETPOINT HI LIMIT >> 140.0 *Desired Parameter*	**SETPOINT HI LIMIT >>** 135.0 *Desired Parameter* *Value*	**OVERSHOOT TEMP >>** 131.0 *Next Parameter*
Press UP/DOWN Keys to adjust Parameter Value	Press ENTER Key to store the Value and move to Next Parameter	

Notes

1. The Last Parameter in the selected Group rolls back to the 'SELECT GROUP' screen again to avoid re-entering the password in case parameters under multiple groups need to be set.

2. Select group 'EXIT' & set parameter 'EXIT SET-UP MODE' to 'YES' for returning to Main Display Mode. Alternately use Setup Key for instant revert to Main Display Mode.

Parameter Descriptions

The various Supervisory Parameters have been described with their respective group & sub-group.

SUPERVISORY > SERIAL PARAMETERS

Parameter Description	Settings (Default Value)
DEVICE ID >> Unique numeric code assigned to the indicator for identification by the host. Set the value as required by the host.	1 to 127 (Default : 1)
BAUD RATE >> Communication speed in 'Bits per Second'. Set the value to match with the host baud rate.	2400 4800 9600 19200 38400 57600 (Default : 9600)
PARITY >> One of the communication error trapping features. Select the data packet parity as implemented by the host protocol.	None Even Odd (Default : Even)
SERIAL WRITE >> Setting to 'No' disallows the host to set / modify any parameter value. The host, however, can read the value.	No Yes (Default : No)

SUPERVISORY > CONTROL

Parameter Description	Settings (Default Value)
SETPOINT LO LIMIT >> This parameter sets the minimum limit for all the setpoint values (Ster. Temp SP, Air Outlet SP, etc.).	0.0 to Setpoint HI Limit (Default : 90.0 °C)
SETPOINT HI LIMIT >> This parameter sets the maximum limit for all the setpoint values (Ster. Temp SP, Air Outlet SP, etc.).	Setpoint LO Limit to 600.0 °C (Default : 150.0 °C)
OVERSHOOT TEMP >> This parameter sets the maximum permissible temperature value above which the autoclave cycle is aborted and the process is shut off.	Sterilization SP to Control SP HI (Default : 131.0 °C)
CYCLE END STRATEGY >> This parameter sets the strategy for completion of the sterilization cycle. *IMMEDIATE STOP* The sterilization cycle is completed as soon as the sterilization time is elapsed. The Steam heater is switched off & the air valve is opened. *TIMER BASED STOP* After completion of sterilization time, the Steam heater is switched off. The Cycle End Timer starts counting down & when it reaches 0, the cycle is completed. The air valve is now opened. *TEMP BASED STOP* After completion of sterilization time, the Steam heater is switched off. The temperature starts falling down & when it reaches the Cycle End Temperature set value, the cycle is completed. The air valve is now opened.	Immediate Stop Timer Based Stop Temp Based Stop (Default : Immediate Stop)
CYCLE END TIMER >> *(Available if the 'Cycle End Strategy' is set to "Timer Based Stop")* This parameter sets the time value that must elapse after the completion of sterilization time before the air valve is opened & the cycle is ended.	1 to 60 Minutes (Default : 5 Min)
CYCLE END TEMP >> *(Available if the 'Cycle End Strategy' is set to "Temp Based Stop")* This parameter sets the limit below which the final temperature value must fall after the completion of sterilization time before the air valve is opened & the cycle is ended.	Control SP LO to Sterilization SP (Default : 100.0 °C)

Parameter Description	Settings (Default Value)
CTRL BAND >> This parameter sets a hysteresis (dead) band below the 'Sterilization Temperature SP' for switching the steam heater On-Off. The heater is switched Off if the final temperature value exceeds the SP. The heater is Switched On when the final temperature value falls below the SP by this band value.	0.1 to 99.9 (Default : 0.2 °C)
EOP ALARM TIME [SEC] >> This parameter sets a time interval for which the alarm output is activated after the completion of sterilization cycle. If set to 0, the alarm will remain activated until acknowledged.	0 to 250 Sec. (Default : 10 Sec)

SUPERVISORY > STERILIZATION

Parameter Description	Settings (Default Value)
STERI. STOP TEMP >> This parameter sets a limit below the 'Ster. Temp SP'. After start of the Sterilization timer, whenever the final temperature value falls below this boundary, the timer is paused. The timer resumes when the temperature rises above this boundary.	Air Valve SP to Sterilization SP (Default : 120.5 °C)
STERI. RESET TEMP >> This parameter sets a limit below the 'Steri. Stop Temp'. After start of the Sterilization timer, if the final temperature value falls below this boundary, the timer is reset. The timer starts counting down again the full set value for 'Ster. Time' when the temperature rises to the 'Ster. Temp SP'.	Air Valve SP to Sterilization SP (Default : 120.0 °C)

SUPERVISORY > PV OFFSET

Parameter Description	Settings (Default Value)
TEMP ZERO OFFSET >> This value is algebraically added to the measured Temperature to derive the actual value that is displayed. Use this value to nullify any known constant measurement error. Actual Value = Measured Value + Zero Offset	-50.0 to 50.0 (Default : 0.0)

Parameter Description	Settings (Default Value)
PRESSURE OFFSET >> (***This parameter is available & applicable for measured pressure through pressure sensor / transmitter***) This value is algebraically added to the measured Pressure Value to derive the actual value that is displayed. Use this value to nullify any known constant measurement error. Actual Pressure Value = Measured Pressure Value + Pressure Offset	-500 to 500 Counts (Default : 0.0)

SUPERVISORY > PASSWORD

Parameter Description	Settings (Default Value)
CHANGE PASSWORD >> The Controller is shipped from the factory with a default password (123) for accessing the parameters reserved for the equipment manufacturer. However, if required the password can be changed by setting the new value for this parameter. (The new password replaces the old password. That is, the old password is no longer valid. it is user's responsibility to memorize the password.)	1000 to 1999 (Default : 123)

SUPERVISORY > EXIT

Parameter Description	Settings (Default Value)
EXIT SETUP MODE >> Select 'Yes' to quit *Setup* mode and return to *Main Display* mode.	NO YES (Default : NO)

Section 5
FACTORY PARAMETERS

The various parameters have been assembled in various group under the default factory password 321.

Refer Table 5.1 below for a quick summary of parameters under different groups. Each parameter has been described in subsequent sections.
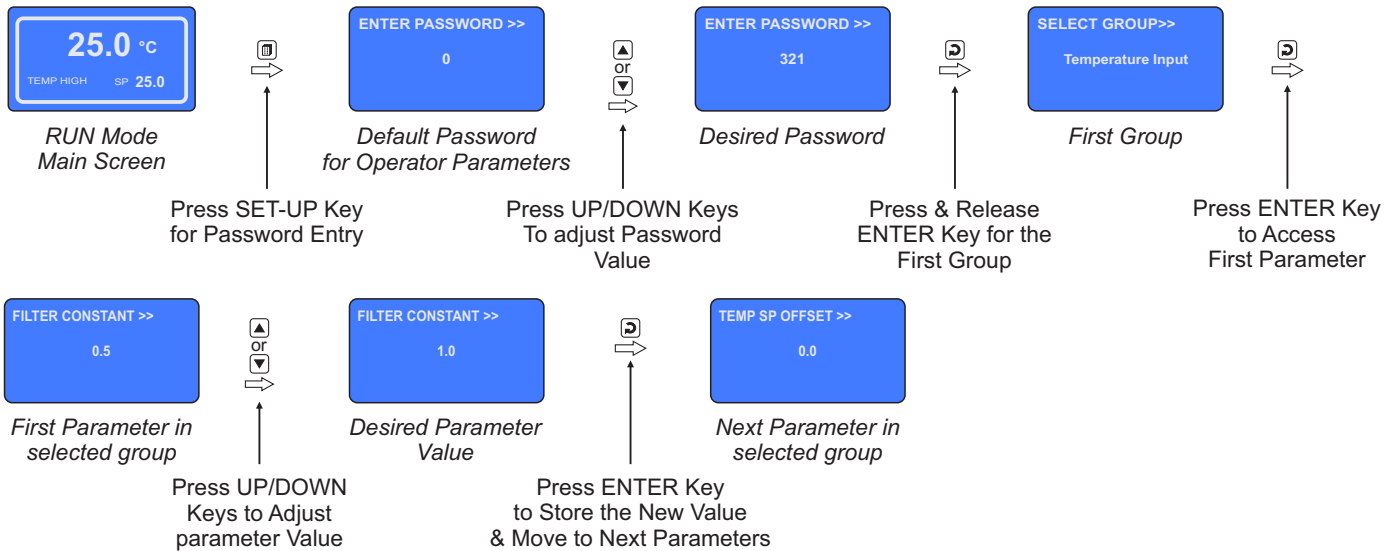
Table 5.1

Group	Parameters
Temperature Input	Filter Constant, Temperature SP Offset
Pressure Input	Pressure Indication, Units, Resolution, Input Type, Signal Low, Signal High, Range Low, Range High
Digital Inputs	Remote Cycle Start, Water Level Detect, Water Level Logic, Door Open Detect, Door Open Logic
Factory Default	Set to Default No/Yes
Password	Change Password
Exit	Exit Set-up Mode No/Yes

Accessing Group & Parameters

The Figure 5.1 below illustrates how to access the group and parameters. The example shows changing the value for the parameter 'Filter Constant' that is located under group 'Temperature Input' from 0.5 Sec to 1.0 Sec.

Figure 5.1

25.0 °C		**ENTER PASSWORD >>**		**ENTER PASSWORD >>**		**SELECT GROUP>>**	
TEMP HIGH SP **25.0**		0		321		**Temperature Input**	
RUN Mode Main Screen		*Default Password for Operator Parameters*		*Desired Password*		*First Group*	
	Press SET-UP Key for Password Entry		Press UP/DOWN Keys To adjust Password Value		Press & Release ENTER Key for the First Group		Press ENTER Key to Access First Parameter

FILTER CONSTANT >>		**FILTER CONSTANT >>**		**TEMP SP OFFSET >>**
0.5		1.0		0.0
First Parameter in selected group		*Desired Parameter Value*		*Next Parameter in selected group*
	Press UP/DOWN Keys to Adjust parameter Value		Press ENTER Key to Store the New Value & Move to Next Parameters	

Notes

1. The Last Parameter in the selected Group rolls back to the 'SELECT GROUP' screen again to avoid re-entering the password in case parameters under multiple groups need to be set.

2. Select group 'EXIT' & set parameter 'EXIT SET-UP MODE' to 'YES' for returning to Main Display Mode. Alternately use Setup Key for instant revert to Main Display Mode.

Parameter Descriptions

The various Factory Parameters have been described with their respective group & sub-group.

FACTORY > TEMPERATURE INPUT

Parameter Description	Settings (Default Value)
FILTER CONSTANT >> 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. The higher the filter value the lower the indication response to the PV changes and vice-a-versa.	0.5 to 60.0 Sec. (Default : 0.5 Sec.)
TEMP SP OFFSET >> This value is algebraically added to the Sterilization SP Value to shift the heater switching band upward so as to minimize the frequency of chamber Temperature falling below to the level where sterilization timer is paused.	0.0 to 10.0 °C (Default : 0.0 °C)

FACTORY > PRESSURE INPUT

Parameter Description	Settings (Default Value)
PRESSURE INDICATION >> *None* Pressure indication is disabled. *Computed* Indicates Saturated Steam Pressure computed based on Steam Temperature. *Measured* Indicates the pressure measured by connecting pressure sensor / transmitter to Analog Input 2 terminals.	None Computed Measured (Default : None)

Parameter Description	Settings (Default Value)
UNITS >> This parameter is not available if pressure indication is disabled. For ***Computed Pressure*** the units available are : PSI or KG/CM^2. For ***Measured Pressure*** the selected units is for indication purpose only. The actual value is derived based on the parameters set for the pressure transmitter (Signal Low, Signal High, Range Low & Range High).	PSI KG/CM^2 BAR EU (Default : PSI)
RESOLUTION >> (***Available for Measured Pressure only***) Use this parameter to select the resolution (decimal point) for pressure measurement. This is also used for setting the values for the parameters "Range Lo" & "Range Hi".	1 0.1 0.01 0.001 (Default : 0.1)
INPUT TYPE >> (***Available for Measured Pressure only***) Select Input type in accordance with the type of Pressure sensor / transmitters connected.	0-20mA 4-20mA 0-5V 0-10V 1-5V (Default : 0-5V)
SIGNAL LO >> (***Available for Measured Pressure only***) The pressure transmitter output signal value corresponding to Range Low process value. Refer *Appendix-B : DC Linear Signal Interface* for details. **SIGNAL HI >>** (***Available for Measured Pressure only***) The pressure transmitter output signal value corresponding to Range High process value. Refer *Appendix-B : DC Linear Signal Interface* for details.	<table><tr><th>Input Type</th><th>Settings</th></tr><tr><td>0 to 20 mA</td><td>0.00 to 20.00</td></tr><tr><td>4 to 20 mA</td><td>4.00 to 20.00</td></tr><tr><td>0 to 5 V</td><td>0.000 to 5.000</td></tr><tr><td>0 to 10 V</td><td>0.00 to 10.00</td></tr><tr><td>1 to 5 V</td><td>1.000 to 5.000</td></tr></table> Default : Signal Low 0.000 Signal High 5.000
RANGE LO >> (***Available for Measured Pressure only***) The process value corresponding to the Signal Low value from the pressure transmitter. Refer *Appendix-B : DC Linear Signal Interface* for details.	0 to 9999 Counts (Default : 0.0)
RANGE HI >> (***Available for Measured Pressure only***) The process value corresponding to the Signal High value from the pressure transmitter. Refer *Appendix-B : DC Linear Signal Interface* for details.	0 to 9999 Counts (Default : 100.0)

FACTORY > DIGITAL INPUTS

Parameter Description	Settings (Default Value)
REMOTE CYCLE START >> Set this parameter to 'Yes' if a switch is connected to the controller rear terminals for issuing Cycle Start command. A switch Open to Close transition is treated as Start command.	NO YES (Default : NO)
WATER LEVEL DETECT >> Set to 'Yes' if water level Sensor(s) is mounted for detecting Low water level. An alarm is generated if Water Level is detected low and any cycle start command is ignored. If the water level is detected low while the cycle is in progress, the cycle is aborted & alarm is activated.	NO YES (Default : NO)
WATER LEVEL LOGIC >> **(Available only if the Parameter 'WATER LEVEL DETECT' is set to "Yes")** ***Open : Water Level Low*** The water level is considered Low if the switch is OPEN. ***Close : Water Level Low*** The water level is considered Low if the switch is CLOSE.	OPEN : WATER LO CLOSE : WATER LO (Default : CLOSE : WATER LO)
DOOR OPEN DETECT >> Set to 'Yes' if switch is mounted for detecting door *Open / Close* position. An alarm is generated if the door is detected open and any cycle start command is ignored while the door is open. If the door is detected open while the cycle is in progress, the cycle is aborted & alarm is activated.	NO YES (Default : NO)
DOOR OPEN LOGIC >> **(Available only if the Parameter 'DOOR OPEN DETECT' is set to "Yes")** ***Close : Door Open*** The Door position is considered Open if the switch is CLOSE. ***Open : Door Open*** The Door position is considered Open if the switch is OPEN.	CLOSE : DOOR OPEN OPEN : DOOR OPEN (Default : CLOSE : DOOR OPEN)

FACTORY > FACTORY DEFAULT

Parameter Description	Settings (Default Value)
SET TO DEFAULT >> Set to 'Yes' to set all the parameter values to their Default Values.	NO YES (Default : NO)

FACTORY > PASSWORD

Parameter Description	Settings (Default Value)
CHANGE PASSWORD >> The Controller is shipped from the factory with a default password (321) for accessing the parameters reserved for the equipment manufacturer. However, if required the password can be changed by setting the new value for this parameter. (The new password replaces the old password. That is, the old password is no longer valid. it is user's responsibility to memorize the password.)	2000 to 2999 (Default : 321)

FACTORY > EXIT

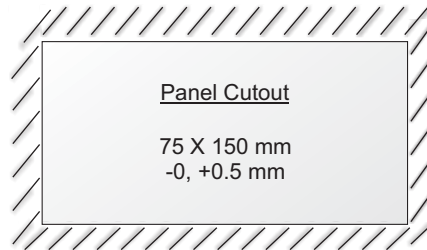| Parameter Description	Settings (Default Value)
EXIT SETUP MODE >> Select 'Yes' to quit *Setup* mode and return to *Main Display* mode.	NO YES (Default : NO)

Section 6

PANEL MOUNTING AND ELECTRICAL CONNECTIONS
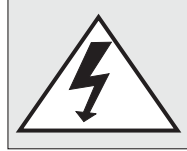
WARNING
MISHANDLING / NEGLIGENCE CAN RESULT IN PERSONAL DEATH OR SERIOUS INJURY.

PANEL CUTOUT

Figure 6.1

Panel Cutout

75 X 150 mm
-0, +0.5 mm

PANEL MOUNTING

Follow the steps below for mounting the instrument on panel :

1. Prepare a cutout to the size shown in Figure 6.1.

2. Remove the Panel Mounting Clamp from the instrument Enclosure.

3. Insert the rear of the enclosure through the panel cutout from the front of the mounting panel.

4. Fix the mounting clamp pair such that it ensures secured mounting of the enclosure against the panel wall.

ELECTRICAL CONNECTIONS

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 Sensor cables (RTD / mA / mV / V). 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 back side of the controller enclosure. The diagram shows the terminals viewed from the **REAR SIDE** with the controller label upright. Refer figure 6.2.
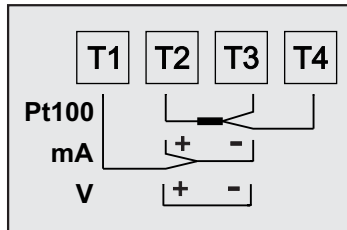
Figure 6.2
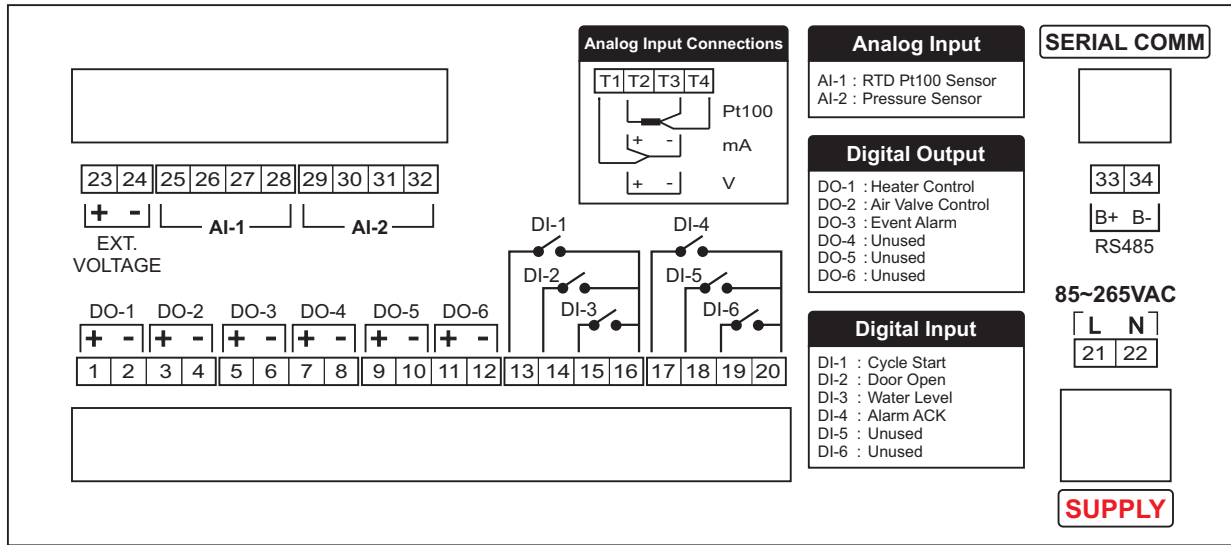
TEMPERATURE SENSOR INPUT

Connect Thermocouple or 3-wire RTD Pt100 sensor as shown below.

Figure 6.3

Temperature Sensor RTD Pt100, 3-wire

Connect single leaded end of RTD bulb to terminal T2 and the double leaded ends to terminals T3 and T4 (interchangeable) as shown in Figure 6.3. Use low resistance copper conductor leads of the same gauge and length. Avoid joints in the cable.

Pressure Transmitter with DC Current (mA) Output

Connect mA output from the transmitter across terminal T2 (+) & T3 (-). Also short terminals T1 & T2. Use internal (if ordered) or external Excitation Voltage for powering the transmitter.

Pressure Transmitter with DC Voltage (V) Output

Connect V output from the transmitter across terminal T2 (+) & T3 (-). Use internal (if ordered) or external Excitation Voltage for powering the transmitter.

DC Excitation Voltage (Terminals : 23, 24)

The Controller is supplied with inbuilt 24V @ 50 mA DC Excitation Voltage. The Excitation Voltage can be used to power external Pressure Transmitters.

The '+' and '-' terminals are for voltage 'Source' and 'Return' paths, respectively.

DIGITAL OUTPUTS

Heater Control Output (Terminals : 1, 2)
Air Valve Control Output (Terminals : 3, 4)
Event Alarm Output (Terminals : 5, 6)

All the above Control & Alarm outputs are Voltage pulses (12VDC @ 40mA, Short-circuit protected) for driving external SSR or Relay. The '+' and '-' terminals are for voltage 'Source' and 'Return' paths, respectively.

DIGITAL INPUTS

Cycle Start (Terminals 13, 16)
**Door Open** (Terminals 14, 16)
Water Level (Terminals 15, 16)
Alarm Acknowledge (Terminals 17, 20)

Potential-free contact closure input terminals are provided as digital inputs. An 'Open' or 'Close' switch position is detected as input.

## PC COMMUNICATION PORT (Terminals 33, 34)

The controller Communication Port is RS485 and requires a similar port at the host (master) end. If, however, the host port is different (say, RS232 or USB), use appropriate protocol converter (say, RS485-RS232 or USB to RS485) for interface.

For reliable noise free communication, use a pair of twisted wires inside screened cable as shown in Figure 6.4. 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.


Figure 6.4
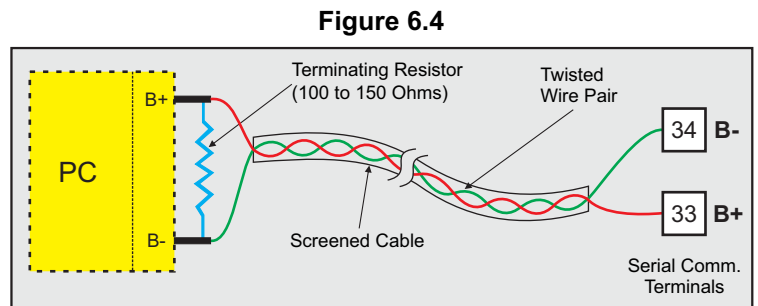
POWER SUPPLY (Terminals 21, 22)

As standard, the module 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 0.5mm² for power supply connections ensuring proper polarity as shown in Figure 6.5. The module is not provided with fuse and power switch. If necessary, mount them separately. Use a time lag fuse rated 1A @ 240 VAC.

Figure 6.5

<div align="center">
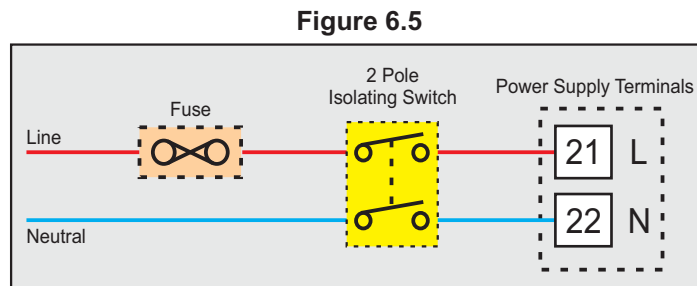
APPENDIX - A

AUTOCLAVE CYCLE OPERATION

</div>
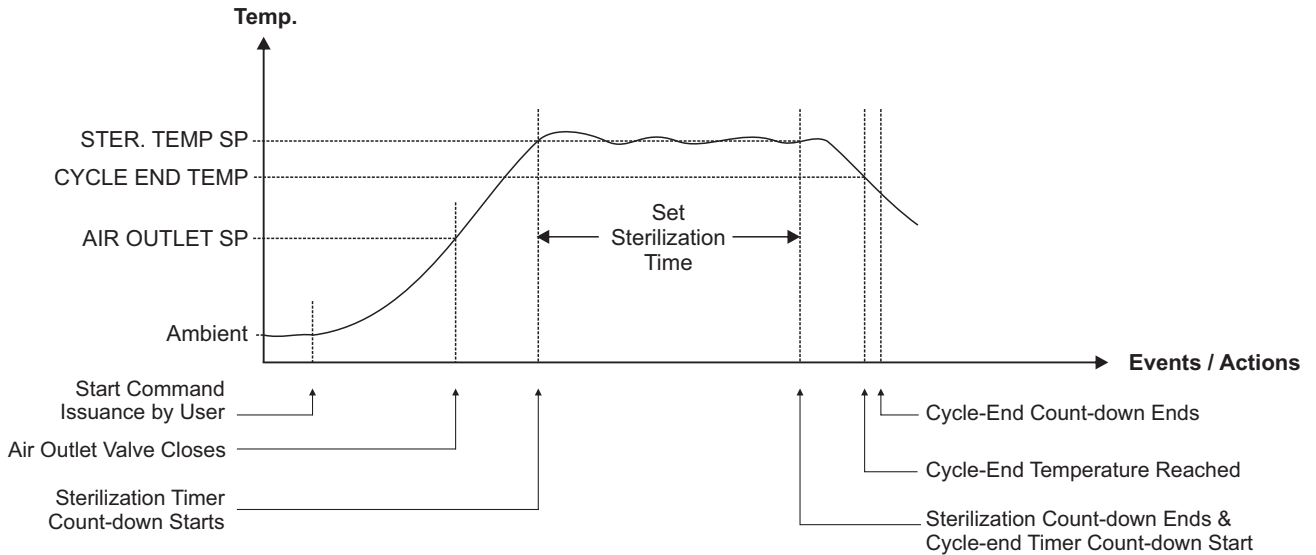
Step 0 (Cycle State : Waiting for Start)

The Cycle State field (at main screen bottom) shows the message "Waiting for Start".

The heater is OFF and the air outlet is OPEN. Use either front panel [ACK ⏻] Key or back panel Remote cycle start (if enabled) to issue 'Start' command to initiate a new autoclave cycle.

If the Water level is low or Door is open, the start command is ignored.

If the stored records for the previous batch have not been uploaded to the PC, the controller prompts to delete the records prior to start the new batch. If it is desired to discard the stored records then set 'yes' to delete the records & proceed with the new batch.

After a successful Start command, the controller enters into pre-heating state. The F0 value is reset to zero & data recording starts.

Step 1 (Cycle State : Pre-Heating)

The Cycle State field (at main screen bottom) shows the message "Pre-Heating".

The heater is turned ON. The air outlet is still OPEN. As soon as the Temperature reaches the Air Outlet SP (say, 100.0°C), the air outlet is CLOSED & F0 calculation starts. The controller enters into the heating state.

Step 2 (Cycle State : Heating)

The Cycle State field (at main screen bottom) shows the message "Heating".

In this state, the heater is kept ON until the temperature reaches the Sterilization Temp SP (say, 121.0°C). As soon as the temperature reaches the STER. TEMP SP, the controller enters into sterilization state.

Step 3 (Cycle State : Sterilizing)

The Cycle State field (at main screen bottom) shows the message "Sterilizing" on the left & the balanced sterilization time (in Min:Sec) on the right.

The sterilization timer starts counting down. The heater is appropriately switched ON and OFF to maintain the temperature at Sterilization Temp SP while the Timer is counting down to 0.

While counting down;

(a) If the PV falls below the STER. STOP TEMP (say, 120.0°C), the timer enters the hold state i.e. it stops counting down until the PV rises above the STER. STOP TEMP again.

(b) If the PV falls below the STER. RESET TEMP (say, 119.5°C), the timer value is reset to the initial set value. That is, after the temperature reaches the STER. TEMP SP, the timer starts counting down again from the original set value (that is, full sterilization time is executed again).

After the sterilization time has elapsed, the heater is turned OFF. The F0 value computation stops & the controller executes the Cycle-End strategy.

Step 4 (Cycle State : Cycle End)

There are 3 possible settings for the cycle end state.

Immediate Stop

The autoclave cycle ends immediately after the Sterilization time is over. The heater is switched off & the air outlet is opened.

Timer Based Stop

Once the sterilization time is over, the heater is switched off & the user set CYCLE END TIMER is run. The Cycle State field (at main screen bottom) shows the message "End : Timer" on the left & the balance end-time (in Min:Sec) on the right.

When the cycle end timer reaches 0, the air outlet is opened & the cycle ends.

Temp Based Stop

Once the sterilization time is over, the heater is switched off. The controller waits till the temperature falls below CYCLE END TEMP. The Cycle State field (at main screen bottom) shows the message "End : Temp" on the left & the set temperature value on the right.

When the temperature falls below the cycle end temperature, the air outlet is opened & the cycle ends.

Upon end of cycle the controller enters process complete state.

Step 5 (Cycle State : Process Completed)

The Cycle State field (at main screen bottom) shows the message "Process Completed".

The heater is off & the air outlet is open. The alarm output relay is energized for the time interval set by the parameter "EOP ALRM TIME (SEC)".

The controller waits for the operator acknowledgment. Upon pressing the [ACK ⏻] button the controller re-enters step 0, that is, cycle state "Waiting for Start". Note that the F0 value is retained until the start command for the next cycle is issued.

Notes

1) The running autoclave cycle is aborted if Low water level is detected.

2) After start of the sterilization timer; if for any reason, the temperature falls below the AIR OUTLET SP or rises above the OVERSHOOT TEMP (the 'Fail-safe Value'), the Autoclave cycle is aborted.

POWER FAILURE DURING CYCLE OPERATION

If the power fails while an Autoclave Cycle is in progress, the cycle state after power resumption depends upon the temperature value. Refer table below for the cycle re-start state against the temperature value at the time of power resumption.

TEMPERATURE VALUE UPON POWER RESUMPTION	CYCLE RE-START STATE
The temperature is above STER. STOP TEMP	The controller starts executing the balance soak time.
The temperature is above STER. RESET TEMP & below STER. STOP TEMP	The controller waits till the temperature rises above STER. STOP TEMP & then starts executing the balance soak time.
The temperature is above AIR OUTLET SP & below STER. RESET TEMP	The controller waits till the temperature reaches STER. TEMP SP & then starts executing the full soak time all over again.
The temperature is below AIR OUTLET SP	The cycle is aborted.

APPENDIX - B

DC LINEAR SIGNAL INTERFACE

This appendix describes the parameters required to interface process transmitters that produce Linear DC Voltage (mV/V) or Current (mA) signals in proportion to the measured process values. A few examples of such transmitters are;

1. Pressure Transmitter producing **4 to 20 mA** for **0 to 5 psi**

2. Relative Humidity Transmitter producing **1 to 4.5 V** for **5 to 95 %RH**

3. Temperature Transmitter producing **0 to 20 mA** for **-50 to 250 °C**

The instrument (indicator/controller/recorder) that accepts the linear signal from the transmitter computes the measured process value by solving the mathematical equation for Straight-Line in the form:

$$Y = mX + C$$

Where;

    X :   Signal Value from Transmitter

    Y :   Process Value Corresponding to Signal Value X

    C :   Process Value Corresponding to X = 0 (Y-intercept)

    m :   Change in Process Value per unit Change in Signal Value (Slope)
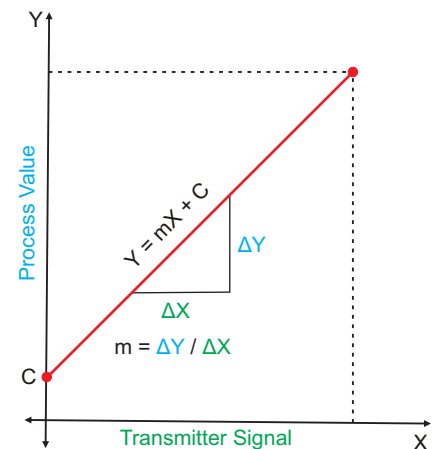
As is evident from the aforementioned transmitter examples, different transmitters produce signals varying both in *Type* (mV/V/mA) and *Range*. Most PPI instruments, thus, provide programmable Signal Type and Range to facilitate interface with a variety of transmitters. A few industry standard signal types and ranges offered by the PPI instruments are: 0-50mV, 0-200mV, 0-5 V, 1-5 V, 0-10V, 0-20 mA, 4-20 mA, etc.

Also, the output signal range (e.g. 1 to 4.5 V) from different transmitters corresponds to different process value range (e.g. 5 to 95 %RH); the instruments thus also provide facility for programming the measured process value range with programmable Resolution.

The linear transmitters usually specify two signal values (Signal Low and Signal High) and the corresponding Process Values (Range Low and Range High). In the example Pressure Transmitter above; the Signal Low, Signal High, Range Low & Range High values specified are: 4 mA, 20 mA, 0 psi & 5 psi, respectively.

In summary, the following 6 parameters are required for interfacing Linear Transmitters:

1. Input Type   : Standard DC Signal Type in which the transmitter signal range fits (e.g. 4-20 mA)

2. Signal Low   : Signal value corresponding to Range Low process value (e.g. 4 mA)

3. Signal High   : Signal value corresponding to Range High process value (e.g. 20 mA)

4. PV Resolution   : Resolution (least count) with which to compute process value (e.g. 0.01)

5. Range Low   : Process value corresponding to Signal Low value (e.g. 0.00 psi)

6. Range High   : Process value corresponding to Signal High value (e.g. 5.00 psi)

The following examples illustrate appropriate parameter value selections.

Example 1: Pressure Transmitter producing **4 to 20 mA** for **0 to 5 psi**
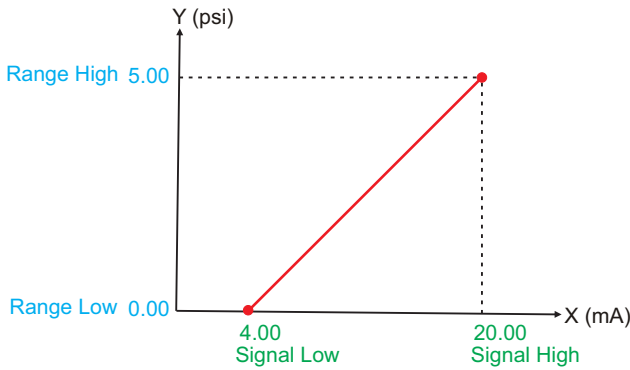
Presume the pressure is to be measured with 0.01 Resolution, that is 0.00 to 5.00 psi.

|		
Input Type	:	4-20 mA
Signal Low	:	4.00 mA
Signal High	:	20.00 mA
PV Resolution	:	0.01
Range Low	:	0.00
Range High	:	5.00

Example 2: Relative Humidity Transmitter producing **1 to 4.5 V** for **5 to 95 %RH**
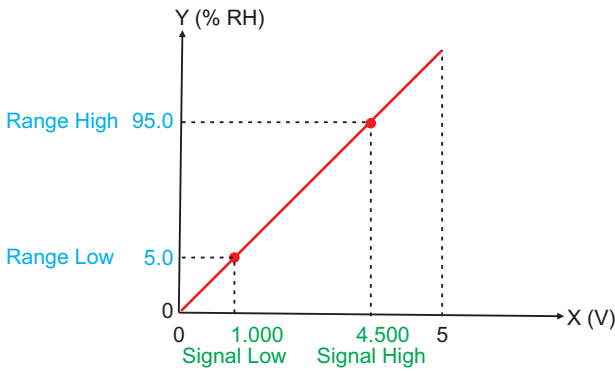
Presume the humidity is to be measured with 0.1 Resolution, that is 0.0 to 100.0 %.

Input Type	:	0-5 V
Signal Low	:	1.000 V
Signal High	:	4.500 V
PV Resolution	:	0.1
Range Low	:	5.0
Range High	:	95.0

Example 3: Temperature Transmitter producing **0 to 20 mA** for **-50 to 250 °C**
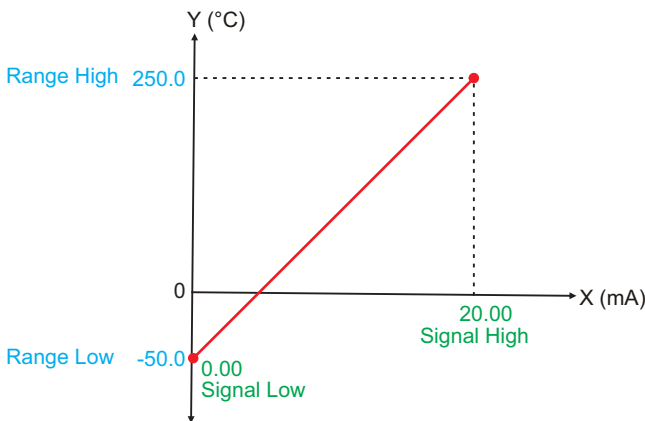
Presume the Temperature is to be measured with 0.1 Resolution, that is -50.0 to 250.0°C.

Input Type	:	0-20 mA
Signal Low	:	0.00 mA
Signal High	:	20.00 mA
PV Resolution	:	0.1
Range Low	:	-50.0
Range High	:	250.0