Clavex Plus

PPI
The Perfection Experts

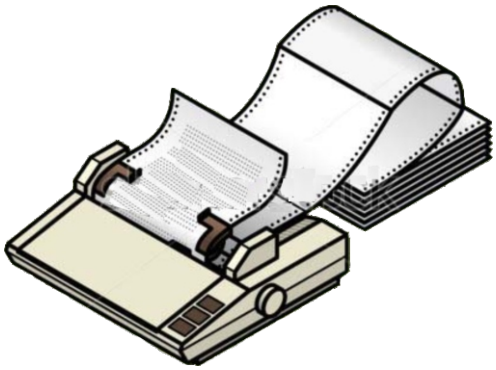
Advanced Autoclave Controller

with

Recording + 4 Channel Mapping + Pressure Indication

with

PC Software & Printer Interface



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 160 X 80 Pixel Monochrome LCD Display. In Normal operation mode the Readout shows measured Temperature Value, Set Temperature Value, Measured Pressure (if enabled), Alarm Status, Cycle Status / Elapsed Soak Time & Date/Time. Other process information like Mapping Channels PVs & Process Status can be viewed using screen scroll feature.

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.
ACK	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

POWER-UP DISPLAY

Figure 2.1

Upon power-up the controller display shows screen depicted in Figure 2.1(a) for 2 Seconds. This screen shows the controller model name, Hardware Version and Firmware Version. The controller runs through a self-test sequence for checking its Real Time Clock, SD Memory Card, internal Communication Link and Parameter Storage Memory (EEPROM).

RUN MODE

After the Power-up display sequence the controller enters into RUN Mode. This is the normal operation mode wherein the controller starts PV measurements, Alarm monitoring and Autoclave Cycle execution when started. The Display comprises of several screens described below. The screens appear one-after-the-other upon pressing ⇌ (Scroll) Key while in RUN Mode.

Main Screen

The Main Screen appearance depends on whether pressure measurement is enabled or disabled, as shown in figures 2.2(a) & 2.2(b), respectively.

Figure 2.2 (a) : Pressure Measurement Enabled

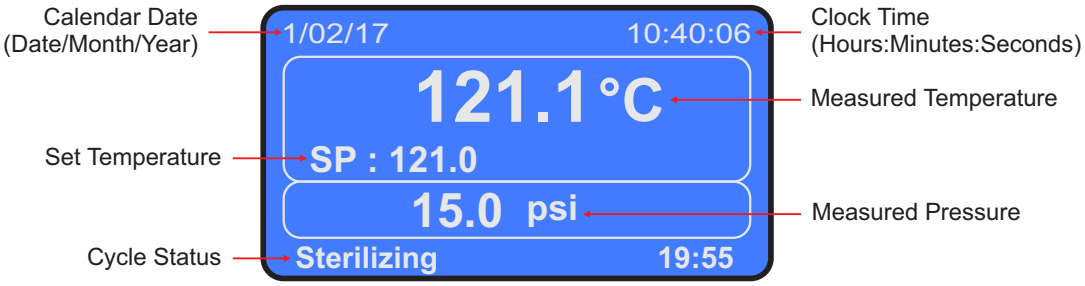


Figure 2.2 (b) : Pressure Measurement Disabled

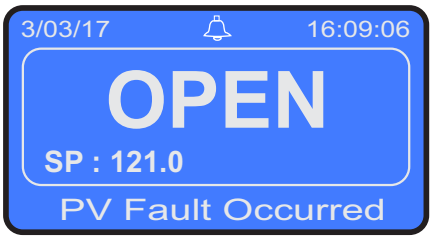
The Temperature Value shown on the screen is the one used for control purpose and is dependent on the strategy set by the user. Refer parameter "**CTRL PV STRATEGY**" in *Section 4 : SUPERVISORY PARAMETERS.*

In case of measured temperature value errors, the messages listed in Table 2.1 flash in place of temperature value. The symbol 🔔 is shown at the top middle and the message 'PV Fault Occurred' at the bottom of the screen. Refer figure 2.3 for illustration.

Table 2.1

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

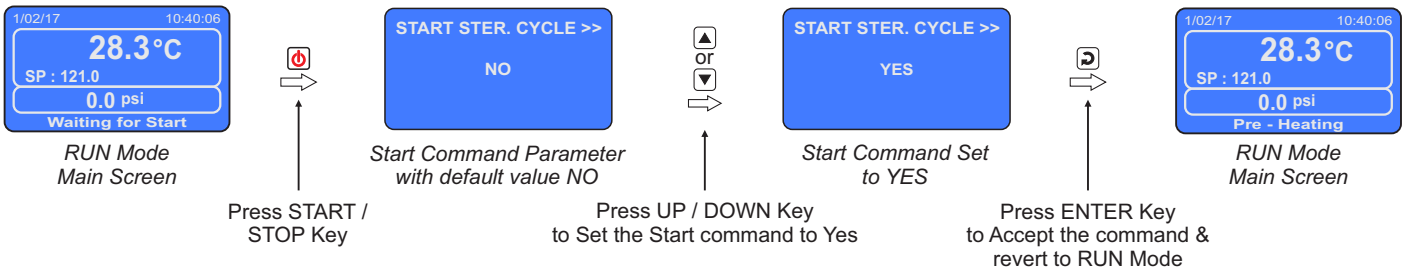
Figure 2.3



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



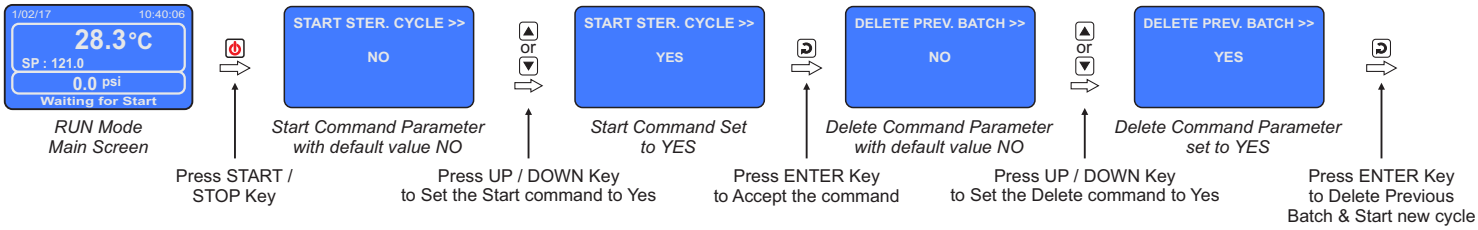
Note :

If a Start command is issued while the stored records for the previous batch (cycle) are yet to be uploaded to the PC, the controller prompts to delete the previous batch.

Set the parameter 'Delete Prev. Batch' to "YES" if it is desired to discard the stored batch records & to proceed with a new cycle (batch). The figure 2.5 below illustrates how to discard & proceed with new batch.

If it is desired to upload the previous batch records prior to running a new batch, Set the parameter 'Delete Prev. Batch' to "NO". The controller returns to RUN Mode screen.

Figure 2.5



CYCLE STATUS AND PROCESS ERROR INDICATION

The bottom screen field displays Cycle Status or Process Error as listed in tables 2.2 & 2.3 respectively.

Table 2.2 : Cycle Status

Status	Remark
15.0 psi Waiting for Start	The Autoclave is in idle state. Issue a start command to commence a new cycle.
15.0 psi Pre - Heating	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.
15.0 psi Heating	The Air Outlet valve is closed. Heating is taking place. This state continues until the sterilization (soaking) setpoint is reached.
15.0 psi Sterilizing 19:55	The sterilization timer is started. The bottom right screen field shows the count-down value for the Sterilization Timer.
15.0 psi End : Timer 2:30	The Sterilization time is over. This state is show if the Cycle-End strategy is time based. The bottom right screen field shows the count-down End Timer.
15.0 psi End : Temp 112	The Sterilization time is over. This state is show if the Cycle-End strategy is temperature based. The bottom right screen field shows the Set Temperature at which the cycle will end.
15.0 psi Process Completed	The autoclave cycle is completed.

Table 2.3 : Process Error (Alarm)

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

Mapping Status Screen

Figure 2.4

The Mapping Status Screen is shown upon pressing (Scroll) key from Main Screen.

The Controller provides 4 channels for control and mapping. The user can select from 1 to 4 channels. The channels not selected are not consider for measurement / control. In case lesser mapping channels are configured, the skipped channels are shown as NA (Not Applicable). The mapping status screen for 3 channels is shown in the figure 2.4.

Process Status Screen

The Process Status Screen is shown upon pressing (Scroll) key from Mapping Status Screen. As depicted in Figure 2.5; the screen shows F0 value in Minutes (0.01 resolution), the Boiler Heater Status (ON / OFF) & Air Valve position (CLOSE / OPEN).

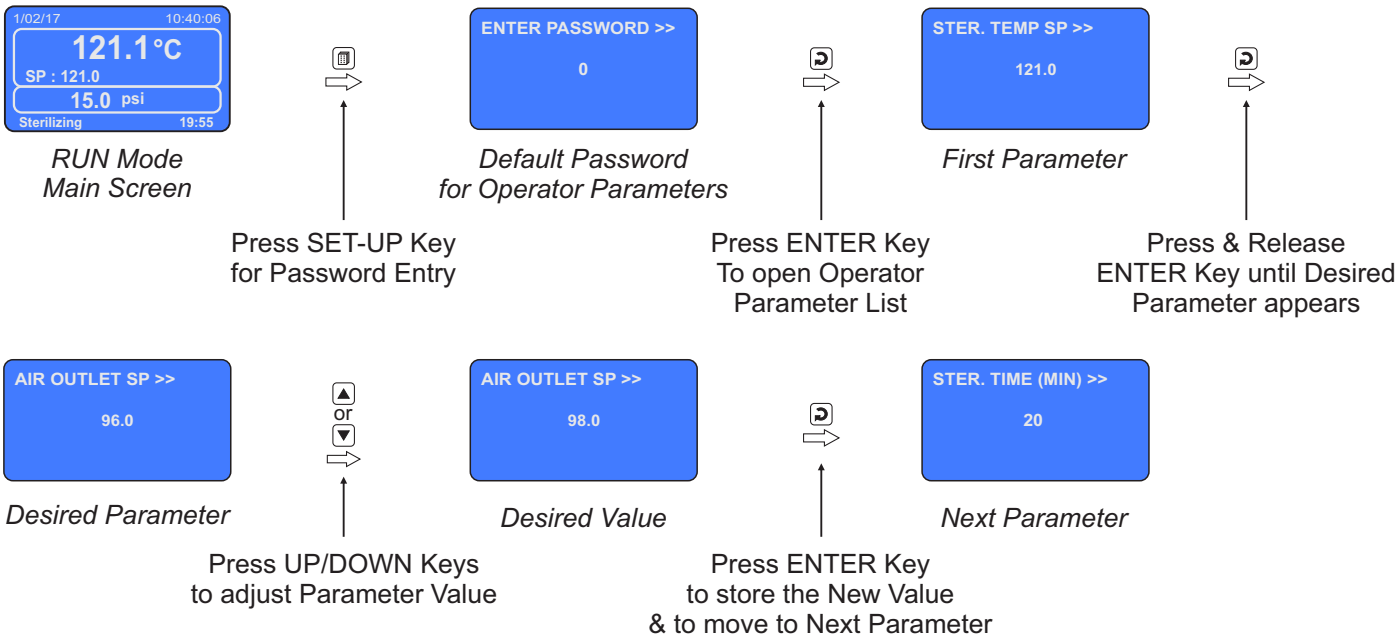
Figure 2.5

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)
SELECT PRNT OPTION>> **(This command is available only if Printer Function is enabled and Printer is powered and connected)** *None* Skip Printing. *Print (New)* Prints all the available records since previous '*Print (New)*' command. *Re-Print (Old)* Re-Prints the records that were printed upon issuing previous '*Print (New)*' command.	None Print (New) Re-Print (Old) (Default : None)

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 (MIN)>> The time duration in 'Minutes' for which the autoclave temperature is maintained at the set sterilization setpoint value.	1 to 999 (Default : 20 min)
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.

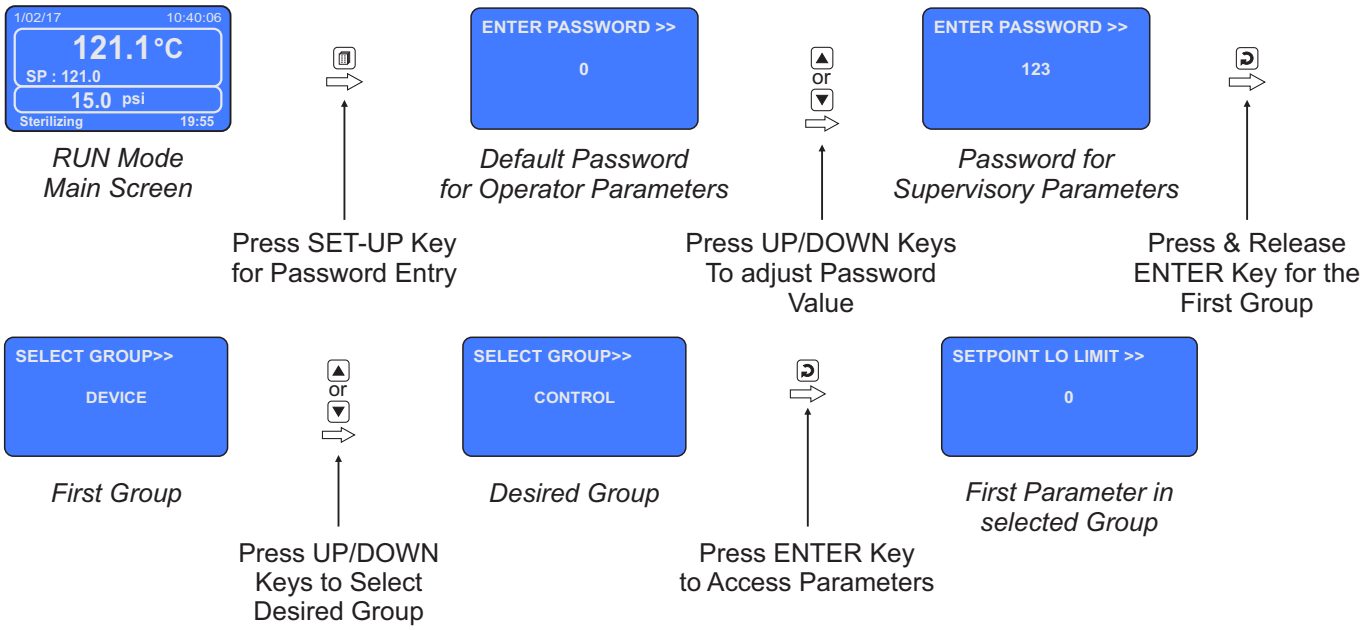
Table 4.1

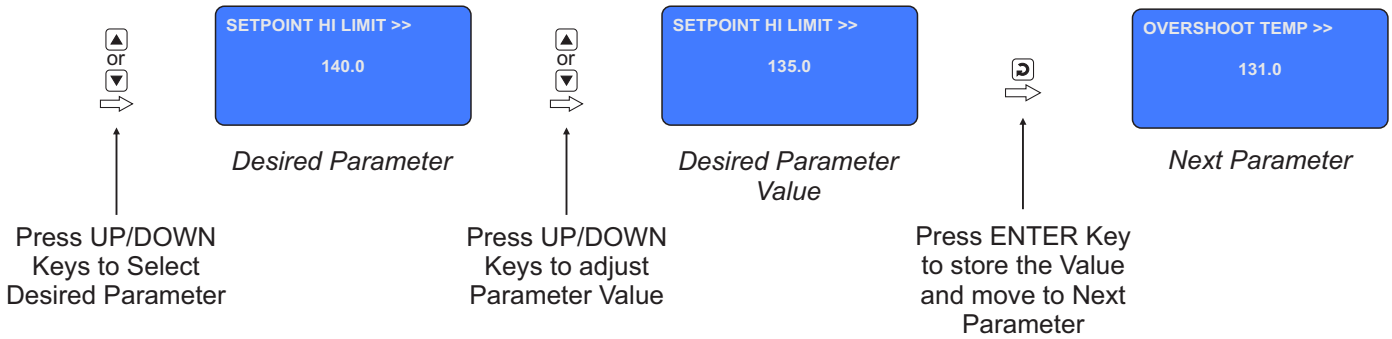
Group	Parameters
Device	Record Interval (Sec), RTC Time, RTC Date, RTC Month, RTC Year, Device ID
Control	Setpoint Low Limit, Setpoint High Limit, Overshoot Temperature, Control PV Strategy, Cycle End Strategy, Cycle End Timer, Cycle End Temperature, Control Band, End of Process Alarm Time, Hold Pressure
Sterilization	Sterilization Stop Temperature, Sterilization Reset Temperature,
PV Offset	Pressure Offset, MAP-1 Offset, MAP-2 Offset, MAP-3 Offset, MAP-4 Offset,
Password	Change Password
Printer Setting	Line Per Page, Top Margin, Bottom Margin, Header & Footer, Enable
Exit	Exit Set-up Mode (Yes / No)

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





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 > DEVICE

Parameter Description	Settings (Default Value)
REC. INTERVAL (SEC) >> The Controller generates and stores periodic records at the interval set by this parameter. The time units are in Seconds.	1 to 300 Sec (Default : 60 Sec.)
RTC TIME >> Set current clock time in Hrs:Min (24 Hours format).	0 to 23 for Hour 0 to 59 for Min (Default : NA)
RTC DATE >> Set current calendar date.	1 to 31 (Default : NA)
RTC MONTH >> Set current calendar month.	1 to 12 (Default : NA)
RTC YEAR >> Set current calendar year.	2000 to 2099 (Default : NA)
DEVICE ID >> Unique numeric code assigned to the controller for identification by the remote PC for serial communication. Set the value as required by the remote PC.	1 to 127 (Default : 1)

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 to Setpoint HI Limit (Default : 90 °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 °C (Default : 150 °C)
OVERSHOOT TEMP >> This parameter sets the maximum permissible temperature value above which the autoclave cycle is aborted and the process is shut off.	Ster. Temp SP to Setpoint HI Limit (Default : 131 °C)
CTRL PV STRATEGY >> This parameter sets the strategy for computing the final temperature value that is used for control, alarm & F0 value etc. ***PV ON MAP-1*** The measured MAP-1 sensor value is used as the final temperature value. ***AVERAGE PV*** The average of all the selected MAP sensors is used as the final value. The sensor(s) under error are ignored. ***PV MAP1 FAIL-AVERAGE*** This is a mixed strategy. If there is no fault with the MAP-1 sensor, the measured MAP-1 sensor value is used as the final temperature value. If the MAP-1 sensor fails, the average of other selected MAP sensors that are not faulty is used as final temperature. ***PV MIN MAX*** From the Start command till the end of sterilization time, the Minimum of all the selected MAP sensors is used as the final temperature value. From sterilization time end till the completion of the cycle, the Maximum of all the selected MAP sensors is used as the final temperature value.	PV On Map-1 Average PV PV Map1 Fail-average PV Min Max (Default : PV On Map-1)

Parameter Description	Settings (Default Value)
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 is elapsed 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.	Setpoint LO Limit to Sterilization Temp (Default : 100 °C)
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 ALRM 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)
HOLD PRESSURE >> This parameter is provided for printing the autoclave pressure value in the report generated by the PC. This value is printed as Hold Pressure in the report.	Min. to Max. Pressure Range set for the Pressure Sensor (Default : 15 psi)

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 Outlet SP to Sterilization Temp (Default : 120.5 °C)
STERI. RESET TEMP >> This parameter sets a limit below the 'Ster. 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 Outlet SP to Sterilization Temp (Default : 120.0 °C)

SUPERVISORY > PV OFFSET

Parameter Description	Settings (Default Value)
PRESSURE OFFSET >> 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	-50.0 to 50.0 (Default : 0)
MAP-1 OFFSET >> **MAP-2 OFFSET >>** **MAP-3 OFFSET >>** **MAP-4 OFFSET >>** This value is algebraically added to the measured Temperature Value at individual Mapping Channel to derive the actual value. Use this value to nullify any known constant measurement error for each mapping channel. Actual Mapping Channel Temperature Value = Measured Value + Map Offset	-50.0 to 50.0 (Default : 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 > PRINTER SETTING

Parameter Description	Settings (Default Value)
LINE PER PAGE >> This parameter sets the page length in terms of total print lines including the top and bottom margins.	25 to 100 (Default : 60)
TOP MARGINE >> This parameter sets the blank space in terms of numbers of lines from the top edge of the print page.	1 to 5 (Default : 2)
BOTTOM MARGINE >> This parameter sets the blank space in terms of numbers of lines above the bottom edge of the print page.	1 to 5 (Default : 2)
HEADER & FOOTER >> *No* Header / Footer never printed. *On First Page* Header / Footer is printed on the first page only. *Every Page* Header / Footer is printed on every page.	No On First Page Every Page (Default : No)
ENABLE >> *No* Disables Printer function and suppresses all print related commands / parameters. Yes Enables Printer function.	YES NO (Default : NO)

SUPERVISORY > EXIT

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

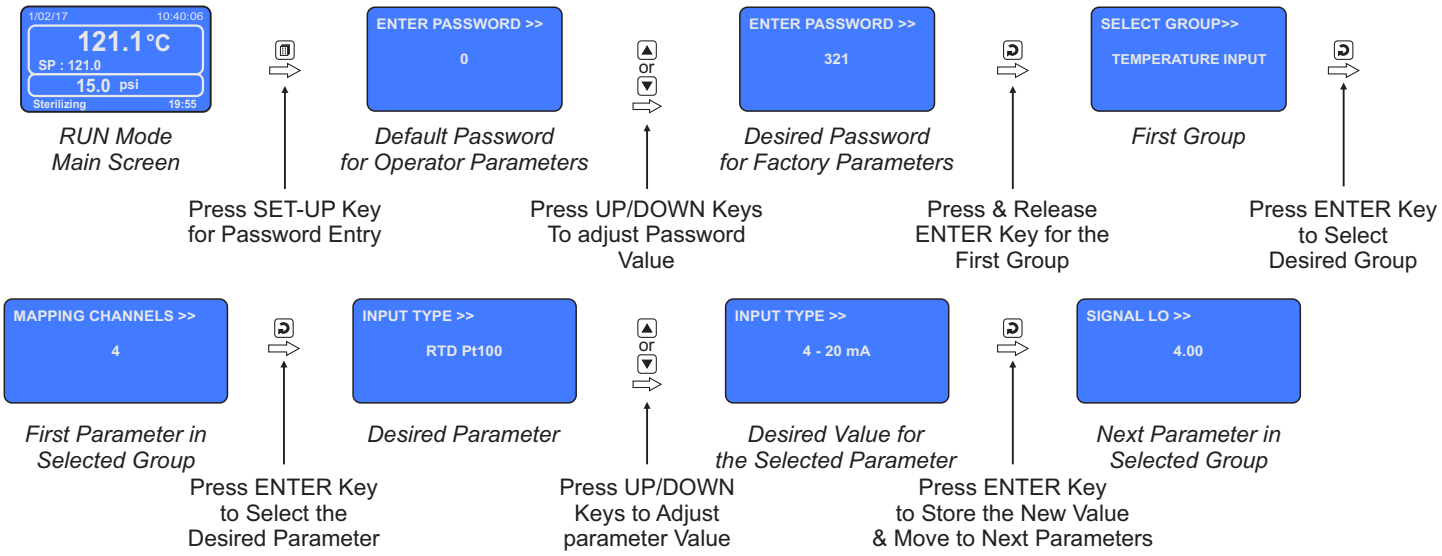
Table 5.1

Group	Parameters
Temperature Input	Mapping Channels, Input Type, Signal Low, Signal High, Range low, Range High, Temperature Setpoint Offset
Pressure Input	Pressure Enable, 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 Yes/No
Password	Change Password
Exit	Exit Set-up Mode Yes/No

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 'Input Type' located under group 'Temperature Input' from 'RTD Pt100' to '4 - 20 mA'.

Figure 5.1



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 multiple parameters need to be set under different Group.
2. Select group 'EXIT' & set parameter 'EXIT SET-UP MODE' to 'YES' for returning to Main Display Mode. Alternately use Set-up 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

<table>
<tr><th>Parameter Description</th><th>Settings
(Default Value)</th></tr>
<tr><td>MAPPING CHANNELS >>
The Controller supports up to 4 temperature sensor channels for Control & Mapping. This parameter allows the user to select the desired numbers of channels.</td><td>1 to 4
(Default : 4)</td></tr>
<tr><td>INPUT TYPE >>
This parameter is common and thus applied to all Mapping Channels.

Select Input type in accordance with the type of Temperature sensor / transmitter connected for measurement.</td><td>RTD Pt100
0-20mA
4-20mA
0-5V
0-10V
1-5V
(Default : RTD Pt100)</td></tr>
<tr><td>SIGNAL LO >>
(Available for DC linear V & mA Temperature Inputs only)

The temperature transmitter output signal value corresponding to Range Low process value. Refer Appendix-C : DC Linear Signal Interface for details.</td><td><table><tr><th>Input Type</th><th>Settings</th><th>Default</th></tr><tr><td>0 to 20 mA</td><td>0.00 to Signal High</td><td>0.00</td></tr><tr><td>4 to 20 mA</td><td>4.00 to Signal High</td><td>4.00</td></tr><tr><td>0 to 5 V</td><td>0.000 to Signal High</td><td>0.000</td></tr><tr><td>0 to 10 V</td><td>0.00 to Signal High</td><td>0.00</td></tr><tr><td>1 to 5 V</td><td>1.000 to Signal High</td><td>1.000</td></tr></table></td></tr>
<tr><td>SIGNAL HI >>
(Available for DC linear V & mA Temperature Inputs only)

The temperature transmitter output signal value corresponding to Range High process value. Refer Appendix-C : DC Linear Signal Interface for details.</td><td><table><tr><th>Input Type</th><th>Settings</th><th>Default</th></tr><tr><td>0 to 20 mA</td><td>Signal Low to 20.00</td><td>20.00</td></tr><tr><td>4 to 20 mA</td><td>Signal Low to 20.00</td><td>20.00</td></tr><tr><td>0 to 5 V</td><td>Signal Low to 5.000</td><td>5.000</td></tr><tr><td>0 to 10 V</td><td>Signal Low to 10.00</td><td>10.00</td></tr><tr><td>1 to 5 V</td><td>Signal Low to 5.000</td><td>5.000</td></tr></table></td></tr>
<tr><td>RANGE LO >>
(Available for DC linear V & mA Temperature Inputs only)

The process value corresponding to the Signal Low value from the temperature transmitter. Refer Appendix-C : DC Linear Signal Interface for details.</td><td>-199.9 to RANGE HI
(Default : 0.0)</td></tr>
<tr><td>RANGE HI >>
(Available for DC linear V & mA Temperature Inputs only)

The process value corresponding to the Signal High value from the temperature transmitter. Refer Appendix-C : DC Linear Signal Interface for details.</td><td>RANGE LO to 999.9
(Default : 100.0)</td></tr>
<tr><td>TEMP SP OFFSET >>
This parameter value is algebraically added to the Sterilization Temperature SP (STER. TEMP SP) to shift the heater ON-OFF switching so that the measured PV is always maintained above the Sterilization Temperature SP.</td><td>0.0 to 10.0
(Default : 0.0)</td></tr>
</table>

Parameter Description	Settings (Default Value)
For Example: Consider : STER. TEMP SP = 121.0, TEMP SP OFFSET = 0.5 & CTRL BAND = 0.2 Heater Switch Off Temp = 121.5 (121.0 + 0.5) Heater Switch On Temp = 121.3 (121.5 - 0.2)	

FACTORY > PRESSURE INPUT

Parameter Description	Settings (Default Value)
PRESSURE ENABLE >> Set this parameter to 'Yes' if pressure sensor is connected for measurement and indication.	YES NO (Default : NO)
UNITS >> The value selected for this parameter is used for indication purpose only. The selected units are displayed next to the measured pressure value on the main screen.	PSI KG/CM^2 BAR EU (Default : PSI)
RESOLUTION >> 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 >> 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 >> The pressure transmitter output signal value corresponding to Range Low process value. Refer *Appendix-C : DC Linear Signal Interface* for details.	Input Type / Settings / Default 0 to 20 mA / 0.00 to Signal High / 0.00 4 to 20 mA / 4.00 to Signal High / 4.00 0 to 5 V / 0.000 to Signal High / 0.000 0 to 10 V / 0.00 to Signal High / 0.00 1 to 5 V / 1.000 to Signal High / 1.000
SIGNAL HI >> The pressure transmitter output signal value corresponding to Range High process value. Refer *Appendix-C : DC Linear Signal Interface* for details.	Input Type / Settings / Default 0 to 20 mA / Signal Low to 20.00 / 20.00 4 to 20 mA / Signal Low to 20.00 / 20.00 0 to 5 V / Signal Low to 5.000 / 5.000 0 to 10 V / Signal Low to 10.00 / 10.00 1 to 5 V / Signal Low to 5.000 / 5.000

Parameter Description	Settings (Default Value)
RANGE LO >> The process value corresponding to the Signal Low value from the pressure transmitter. Refer *Appendix-C : DC Linear Signal Interface* for details.	-1999 to RANGE HI (Default : 0.0)
RANGE HI >> The process value corresponding to the Signal High value from the pressure transmitter. Refer *Appendix-C : DC Linear Signal Interface* for details.	RANGE LO to 9999 (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.	YES NO (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.	YES NO (Default : NO)
WATER LEVEL LOGIC >> 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.	YES NO (Default : NO)

Parameter Description	Settings (Default Value)
DOOR OPEN LOGIC >> 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.	YES NO (Default : NO)

FACTORY > PASSWORD

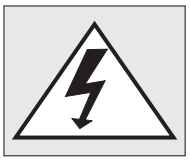
Parameter Description	Settings (Default Value)
CHANGE PASSWORD >> The Controller is shipped from the factory with a default password (321) for accessing the parameters reserved for the equipment manufacturer. However, if required the password can be changed by setting the new value for this parameter. (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.	YES NO (Default : NO)

Section 6

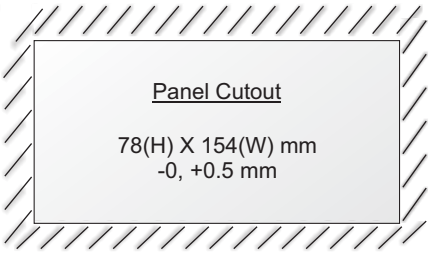
PANEL MOUNTING AND ELECTRICAL CONNECTIONS



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

PANEL CUTOUT

Figure 6.1



PANEL 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.

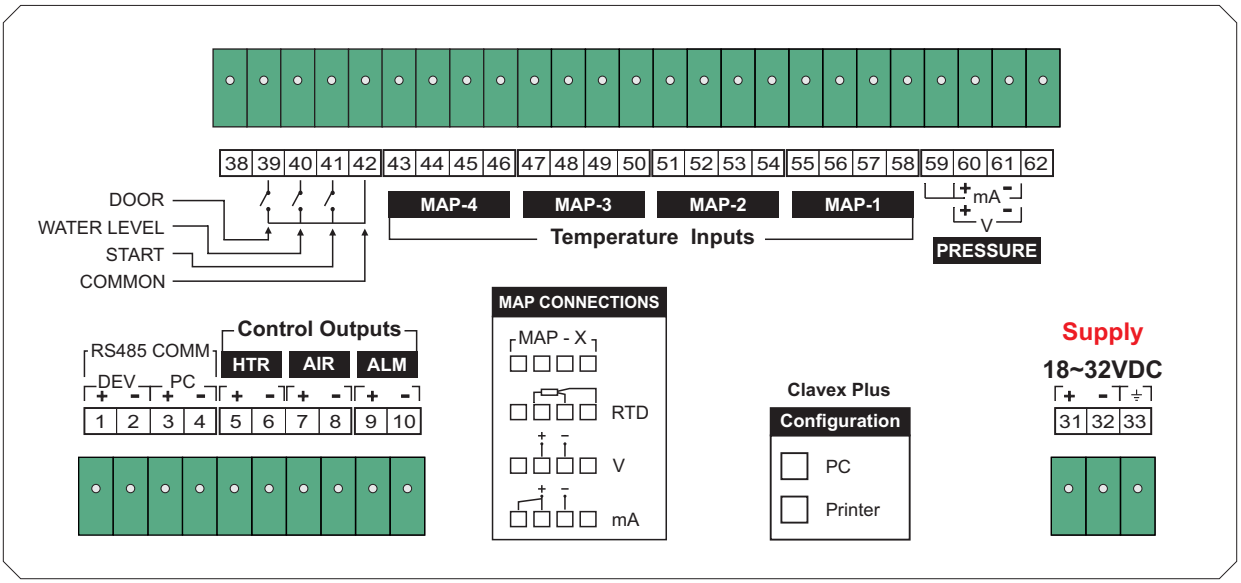
ELECTRICAL CONNECTIONS

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 low-level signal cables (like **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 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



DESCRIPTIONS

The back panel connections are described as under:

Temperature & Pressure Sensor / Transmitter Inputs

The connections are described below in Figure 6.3 & Table 6.1. Note that RTD Pt100 input is applicable only for Temperature Mapping Channels.

Figure 6.3

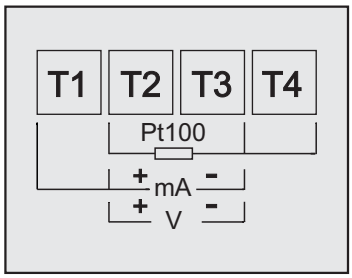


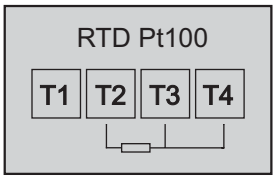
Figure 6.1

	PRESSURE Terminals	MAP-1 Terminals	MAP-2 Terminals	MAP-3 Terminals	MAP-4 Terminals
T1	59	55	51	47	43
T2	60	56	52	48	44
T3	61	57	53	49	45
T4	62	58	54	50	46

RTD Pt100, 3-wire

Connect single leaded end of RTD bulb to terminal T2 and the double leaded ends to terminals T3 & T4 as shown in Figure 6.4(a). 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 6.4 (a)



DC Voltage (V) Input

The Figures 6.4(b) depicts wiring connections for voltage output transmitter. An external Excitation Voltage source should be used for powering the transmitter.

Figure 6.4 (b)

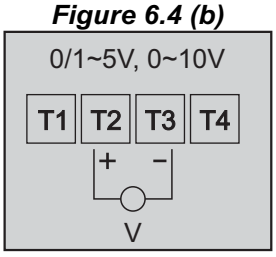
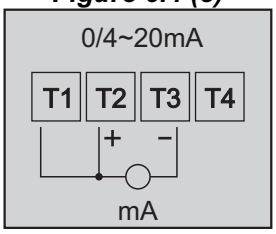


Figure 6.4 (c)



DC Current (mA) Input

The Figures 6.4(c) depict wiring connections for current output transmitter. Note that terminals T1 & T2 should be shorted. An external Excitation Voltage source should be used for powering the transmitter.

Heater Control Output (Terminals : 5, 6)
Air Valve Control Output (Terminals : 7, 8)
Alarm Output (Terminals : 9, 10)

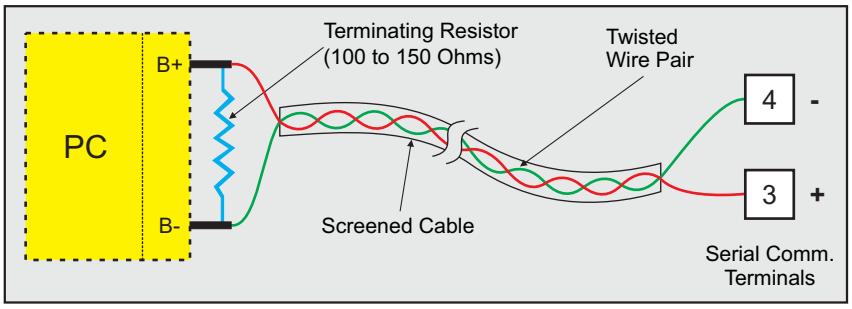
All the above control & alarm outputs are Voltage pulses (12VDC @ 40mA) for driving external SSR or Relay. The '+' and '-' terminals are for voltage 'Source' and 'Return' paths, respectively.

Door Detect Digital Input (Terminals 39, 42)
Water Level Digital Input (Terminals 40, 42)
Cycle Start Digital Input (Terminals 41, 42)

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 3, 4)

Figure 6.5



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), use appropriate protocol converter (say, RS485-RS232) for interface.

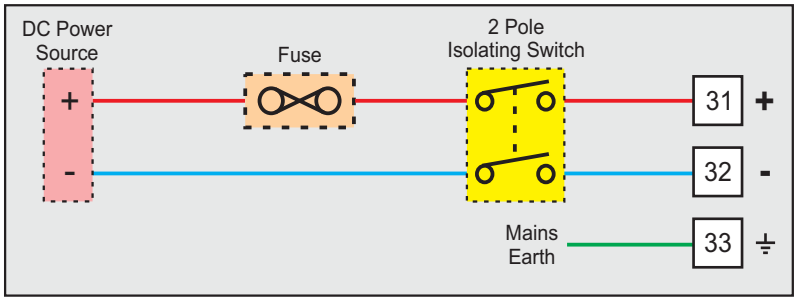
For reliable noise free communication, use a pair of twisted wires inside screened cable as shown in Figure 6.5. The wire should have less than 100 ohms / km nominal DC resistance (Typically 24 AWG or thicker). Connect the terminating resistor (Typically 100 to 150 ohm) at one end to improve noise immunity.

DEVICE COMMUNICATION PORT (Terminals 1, 2)

If the controller supports Dot Matrix Printer, use RS485 Communication Port available on terminals 1 & 2 to connect the external module.

POWER SUPPLY (Terminals 31, 32 & 33)

Figure 6.6

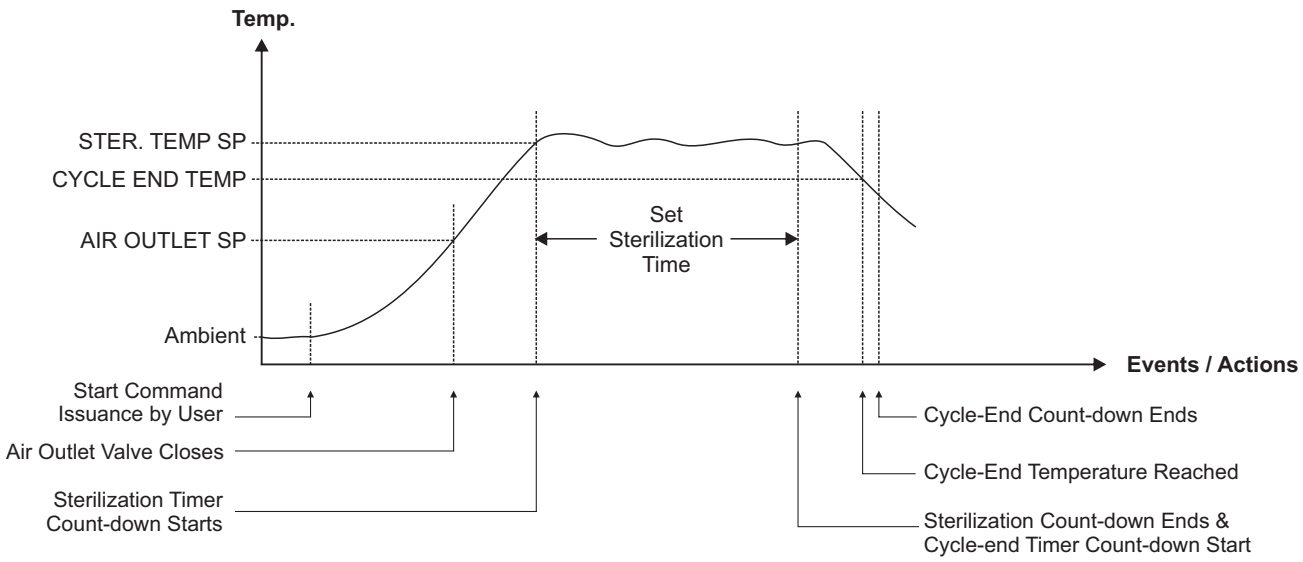


As standard, the Module is supplied with power connections suited for 18 to 32 VDC power source. The accuracy / performance of the Module is not affected by the variations in the supply within specified limits of 18 to 32 VDC. Use well-insulated copper conductor wire of the size not smaller than 0.5mm² for power supply connections ensuring proper polarity as shown in Figure 6.6. The Module is not provided with fuse and power switch. If necessary, mount them separately. Use a slow blow fuse rated for 0.5A current.

For safety and enhanced electrical noise immunity, it is highly recommended to connect Main Power Supply 'Earth' to terminal 33.

APPENDIX - A

AUTOCLAVE CYCLE OPERATION



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

PC REPORT SAMPLE

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Process Precision Instruments

Address: 101, Diamond Industrial Estate, Navghar, Vasai Road (E) Dist. Palghar, Palghar, Maharashtr
401210
Phone: 0250 609 0063

Data Log Report

Equipment Name : Clavex_Plus_11SN/3450989SB
Print Date Time : 24-Feb-17 17:42:14
OPERATOR NAME : Not Logged in
REMARK :
STERILIZATION TEMPERATURE : 121 °C
STERILIZATION HOLD TIME : 15 Min
STER. STOP TEMPERATURE : 120.5 °C
STER. RESET TEMPERATURE : 120 °C
OVERSHOOT TEMPERATURE : 131 °C
HOLD PRESSURE : 15 psi
CONTROL BAND : 0.2 °C
PRINT INTERVAL TIME : 15 Seconds

Reported By : admin
BATCH NAME : 20170224170034

DATE TIME	Control °C	Map1 °C	Map2 °C	Map3 °C	Map4 °C	Pressure [psi]
24-02-2017 17:00:34			----------Start_Command ----------			
24-02-2017 17:00:35	126.2	126.2	OPEN	-1.6	OPEN	55.2
24-02-2017 17:00:35			----------Air_Valve_Close ----------			
24-02-2017 17:00:35			----------Sterilization_Start ----------			
24-02-2017 17:00:48	126.2	126.2	OPEN	-1.6	OPEN	55.2
24-02-2017 17:01:03	126.2	126.2	OPEN	-1.6	OPEN	55.2
24-02-2017 17:01:18	126.2	126.2	OPEN	-1.6	OPEN	55.2
24-02-2017 17:01:33	126.2	126.2	OPEN	-1.6	OPEN	55.2
24-02-2017 17:01:48	126.2	126.2	OPEN	-1.6	OPEN	55.2
24-02-2017 17:02:03	126.2	126.2	OPEN	-1.6	OPEN	55.2
24-02-2017 17:02:18	126.2	126.2	OPEN	-1.6	OPEN	55.2
24-02-2017 17:02:33	126.2	126.2	OPEN	-1.6	OPEN	55.2
24-02-2017 17:02:48	126.2	126.2	OPEN	-1.6	OPEN	55.2
24-02-2017 17:03:03	126.2	126.2	OPEN	-1.6	OPEN	55.3
24-02-2017 17:03:18	126.2	126.2	OPEN	-1.6	OPEN	55.3
24-02-2017 17:14:18	126.2	126.2	OPEN	-1.6	OPEN	56.7
24-02-2017 17:14:33	126.2	126.2	OPEN	-1.6	OPEN	56.8
24-02-2017 17:14:48	126.2	126.2	OPEN	-1.6	OPEN	56.8
24-02-2017 17:15:03	126.2	126.2	OPEN	-1.6	OPEN	56.9
24-02-2017 17:15:18	126.2	126.2	OPEN	-1.6	OPEN	57
24-02-2017 17:15:33	126.2	126.2	OPEN	-1.6	OPEN	57
24-02-2017 17:15:38	126.2	126.2	OPEN	-1.6	OPEN	56.9
24-02-2017 17:15:38			----------Air_Valve_Open ----------			
24-02-2017 17:15:38			----------Sterilization_End ----------			
24-02-2017 17:15:38			ACTUAL F0 VALUE : 49.83			
24-02-2017 17:15:38			Stop_Command - Normal Stop			

Registered By Approved By Checked By

Page No. 2

APPENDIX - C

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:

$$Y = mX + C$$

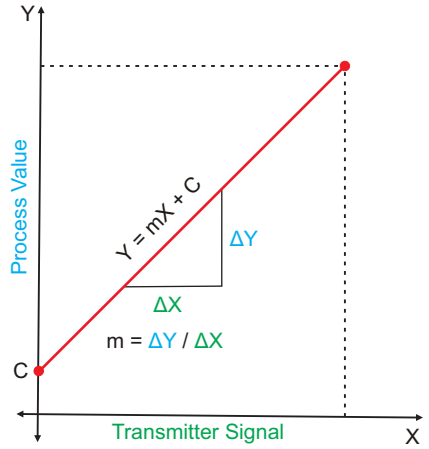
Where;

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.

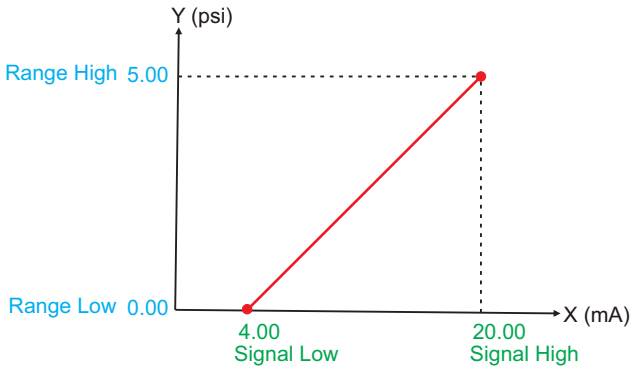
The linear transmitters usually specify two signal values (Signal Low and Signal High) and the corresponding Process Values (Range Low and Range High). In the example Pressure Transmitter above; the Signal Low, Signal High, Range Low & Range High values specified are: 4 mA, 20 mA, 0 psi & 5 psi, respectively.

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.

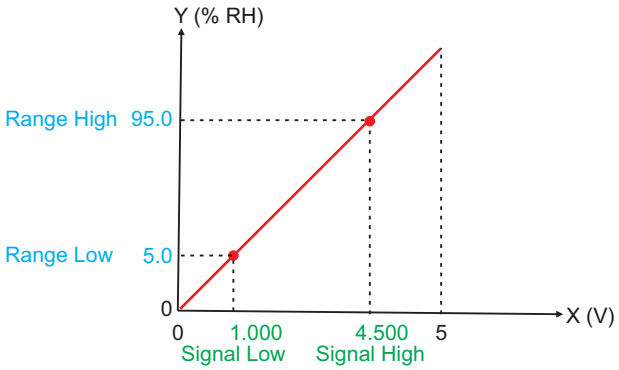
Example 1: Pressure Transmitter producing **4 to 20 mA** for **0 to 5 psi**



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

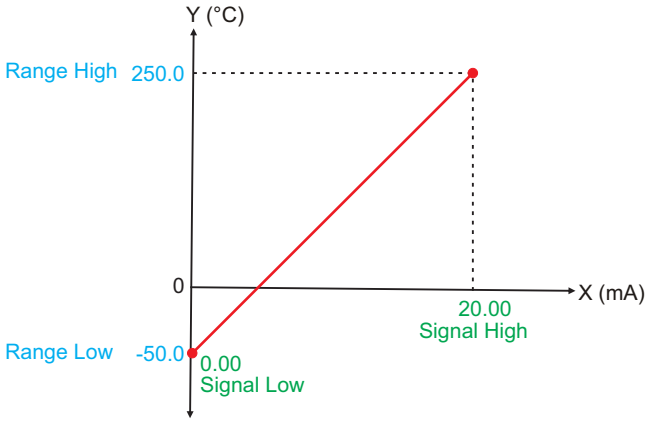
Example 2: Relative Humidity Transmitter producing **1 to 4.5 V** for **5 to 95 %RH**



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

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Jan 2022