ClaveX

PPI
The Perfection Experts

Autoclave Controller

User Manual

CONTENTS

Section 1

FRONT PANEL LAYOUT

Figure 1.1 (a) : 48 X 48 Version

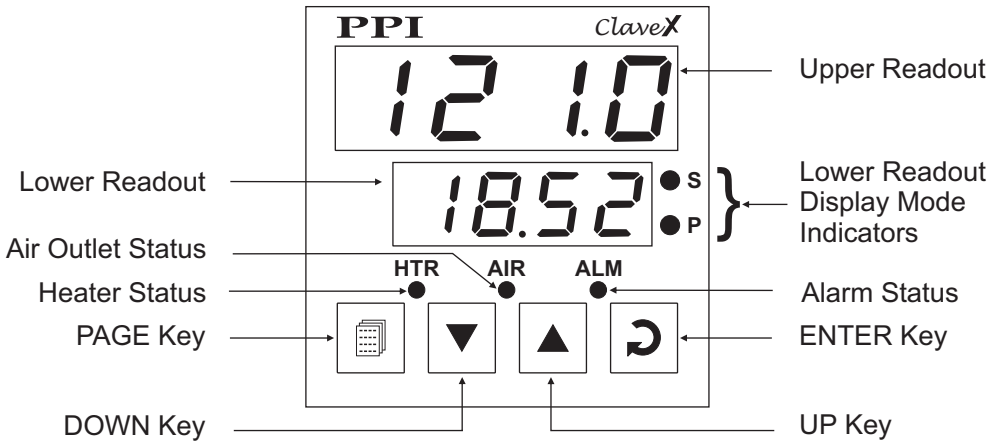
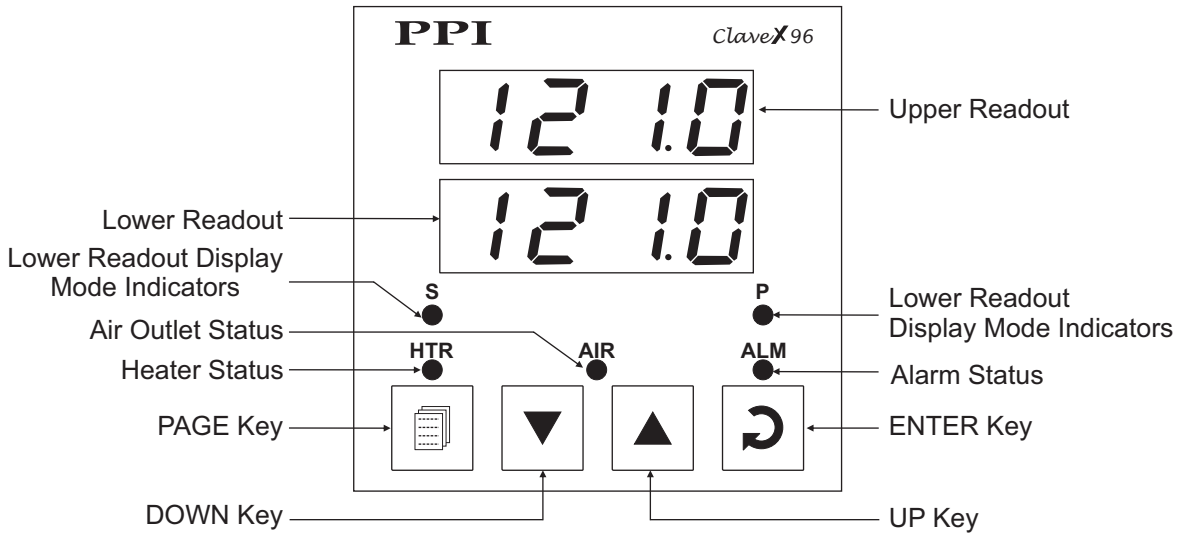


Figure 1.1 (b) : 96 X 96 Version



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 Temperature Value in °C. 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 either Control Setpoint value or Saturated Steam Pressure value or the balance Soak Time value, depending on the autoclave cycle state. 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

<table>
<tr><th>Indicator</th><th>Status</th></tr>
<tr><td>HTR</td><td>Indicates Heater On/Off status.</td></tr>
<tr><td>AIR</td><td>Indicates Air Outlet valve On/Off status.</td></tr>
<tr><td>ALM</td><td>Flashes while the Alarm is active.</td></tr>
<tr><td>S
P</td><td>These two indicators together indicate the parameter name whose value is currently being displayed on the Lower Readout.
<table>
<tr><th>S</th><th>P</th><th>What Lower Readout Indicates</th></tr>
<tr><td>OFF</td><td>OFF</td><td>StrE (Start) message.
(The controller is waiting for a ‘Start’ command to initiate a new autoclave cycle.)</td></tr>
<tr><td>ON</td><td>ON</td><td>Control Setpoint.</td></tr>
<tr><td>OFF</td><td>ON</td><td>Saturated steam pressure in Kg/cm² or PSI.</td></tr>
<tr><td>ON</td><td>OFF</td><td>Soak Time Counter.</td></tr>
</table></td></tr>
</table>

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; holding 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 OPERATIONS

POWER-UP

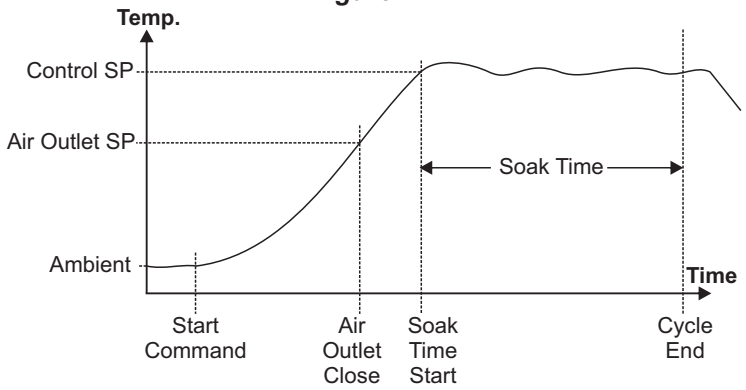
Upon power-up all displays and indicators are lit on for approximately 3 seconds. This is followed by the indication of the controller model name CLAV on the Upper Readout and the firmware version 0.102 on the Lower Readout, for approximately 1 second.

MAIN DISPLAY MODE

After the Power-up display sequence, the Upper Readout starts showing the Temperature Value in °C and the Lower Readout indication depends on the autoclave cycle state (described below). This is the MAIN Display Mode that shall be used most often.

Autoclave Cycle Operation

Figure 2.1



Step 0 (Idle State - Start Command Awaited)

The Lower Readout shows the message StrE (Start). The front panel indicators S and P are off. The heater is kept OFF and the air outlet is kept ON. Use either front panel 'ENTER' Key or back panel Remote Key to issue 'Start' command to initiate a new autoclave cycle.

Step 1 (Temperature Raised to Air Outlet SP)

The Lower Readout shows the Control Setpoint value. The front panel indicators S and P are both on, indicating that the SP value is being shown on the Lower Readout. Both the heater and air outlet are maintained ON. As soon as the Temperature reaches the Air Outlet SP, the air outlet is turned OFF.

Step 2 (Temperature Raised to Control SP)

The Lower Readout shows the Saturated Steam Pressure value in either Kg/cm² or PSI after the temperature crosses 100.0°C. The front panel indicator S is off while P is on, indicating that the Pressure value is being shown on the Lower Readout. The heater is kept ON until the temperature reaches the Control SP. As soon as the temperature reaches the Control SP, the soak timer starts counting down. (For the detailed Soak Timer operation, refer *Section 5 : Soak Timer Parameters.)*

Step 3 (Temperature Maintained at Control SP)

The Lower Readout shows the balance Soak Time in Minutes:Seconds format. The front panel indicator P is off. The indicator S flashes if the timer is counting down and glows steadily if the timer is in hold state. The heater is appropriately switched ON and OFF to maintain the temperature at Control SP while the Soak Timer is counting down to 0. During this time the Saturated Steam Pressure value can be viewed by holding the UP or DOWN key pressed.

Upon completion of Soak Time, the cycle ends and the controller re-enters Step 0 (Idle State).

Notes

1) If the controller is supplied with 'Water Level Input' option, the running cycle is aborted if Low water level is detected. Also, a new start command is not accepted until the water level error is removed. While the level is low, the Lower Readout flashes the message L.LO (Low Level).

2) After start of the Soak timer; if for any reason, the temperature falls below the Air Outlet SP or rises above the Control SP by more than the 'Fail-safe Deviation', the Autoclave cycle is aborted.

PV Error Indications

The PV Error type is flashed on the Upper Readout. Refer Table 2.1.

Table 2.1

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

ALARM FUNCTIONS

The Output - 3 Relay/SSR is provided as an Alarm Output that activates under the following conditions.

1. End of Soak Timer

   The Alarm activates as soon as the soak timer reaches 0.This alarm indicates the end of the currently running autoclave cycle.

2. Process High

   The Alarm activates if the temperature deviates above the control setpoint by more than the set band value (see 'Operator Page and Parameters').

3. PV Error

   The Alarm activates if the measured temperature value crosses the specified Max. or Min. range for the selected sensor type (that is, under or over range). The Alarm also activates if the sensor input is disconnected.

Under any of the above Alarm conditions, press the front panel 'ENTER' key to acknowledge the Alarm (de-activated the relay).

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 these parameters are 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 PAGE (PAGE) and Upper Readout shows 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 the 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 below.

Table 2.2

Parameter Description	Settings (Default Value)
CONTROL SETPOINT SP The Setpoint value at which the autoclave temperature value is maintained for the set soak time duration.	Setpoint Low Limit to Setpoint High Limit (Default : 121.0)
AIR OUTLET SETPOINT Ar.SP The setpoint value at and above which the Air Outlet valve is kept closed to build saturated steam pressure.	Setpoint Low Limit to Setpoint High Limit (Default : 100.0)
SOAK TIME SoAt The time duration in 'Minutes' for which the autoclave temperature is maintained at the set control setpoint value.	1 to 999 Minutes (Default : 20)
HIGH ALARM DEVIATION SETPOINT AL.SP The positive deviation value above the control setpoint for Process High Alarm.	1 to 10 or 0.1 to 10.0 (Default : 5.0)
FAIL-SAFE DEVIATION SETPOINT SF.SP The positive deviation value above the control setpoint for automatic abortion of the cycle for safety. Upon abortion, the heater is switched off and the air outlet valve is opened to release the pressure.	3 to 20 or 0.3 to 20.0 (Default : 10.0)
CYCLE ABORT COMMAND Abrt Set to 'Yes' (to be followed by proper pass code entry) to abort a running autoclave cycle.	no No YES Yes
CYCLE ABORT PASS CODE CodE After setting the Cycle Abort Command to 'Yes', set this pass code to an appropriate value for actual cycle abortion.	0 to 250 (Default : 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.

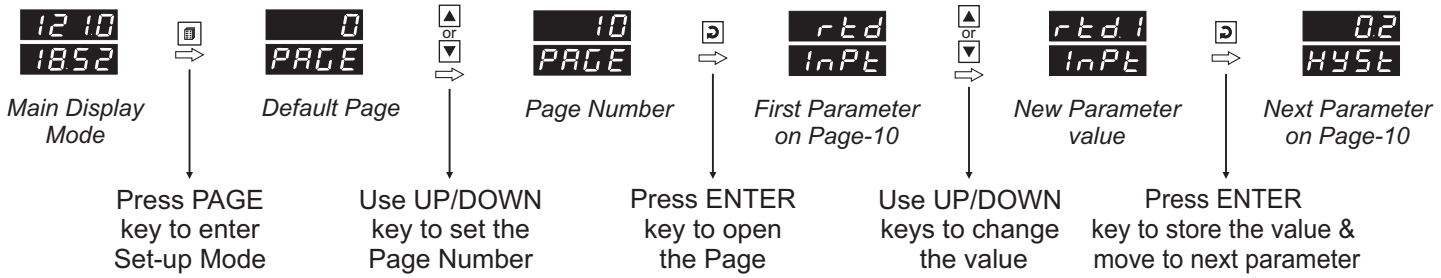
SET-UP MODE

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 PAGE and the Upper Readout shows page number 0. Refer Figure 3.1.
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 'Input Type'.

Figure 3.1



Notes

1. *To exit the set-up mode and return to the MAIN Display Mode, press and release PAGE key.*
2. *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 cannot 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.

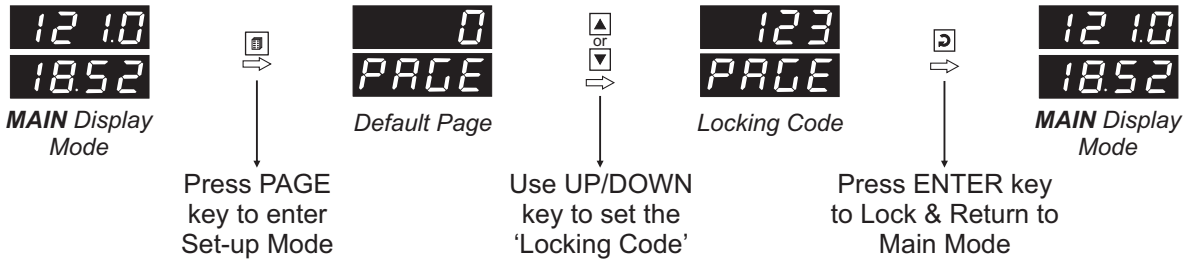
For enabling / disabling the Lock, step through the following sequence:

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



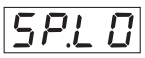
UnLocking

Repeat the Locking procedure twice for unlocking.

Section 4

I / O CONFIGURATION PARAMETERS

Table 4.1

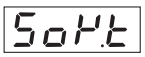
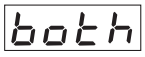
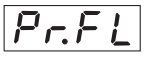
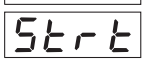
Parameter Description	Settings (Default Value)
HYSTERESIS  Sets a differential (dead) band between the ON and OFF heater states. Keep it large enough to avoid frequent switching of the heater without losing the desired control accuracy.	1 to 999°C or 0.1 to 99.9°C (Default : 0.2)
SETPOINT LOW LIMIT  Use this limit to prevent accidental under settings of the 'Control' and 'Air Outlet' setpoints.	Min. Range for the selected Input Type to Setpoint High (Default : 90.0)
SETPOINT HIGH LIMIT  Use this limit to prevent accidental over settings of the 'Control' and 'Air Outlet' setpoints.	Setpoint Low to Max. Range for the selected Input Type (Default : 150.0)
UNITS FOR PRESSURE  Select the units for saturated steam pressure from Kg/cm² and PSI.	 Kg/cm²  PSI (Default : Kg/cm²)

Section 5

SOAK TIMER PARAMETERS

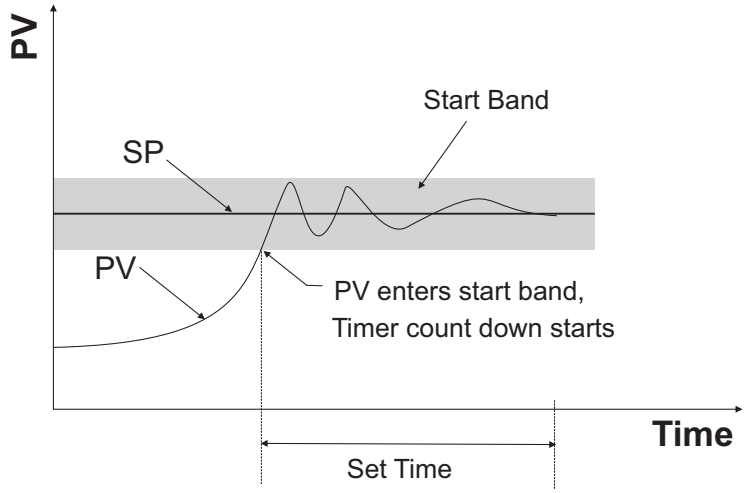
(Refer end of this section for detailed Soak Timer Operation)

Table 5.1

Parameter Description	Settings (Default Value)
SOAK TIME  The time duration in 'Minutes' for which the autoclave temperature is maintained at the set control setpoint value.	1 to 999 Minutes (Default : 20)
TIMER-START BAND  The temperature band around the control setpoint. The soak timer starts counting down once the Temperature enters this band.	1 to 5 **or** 0.1 to 5.0 (Default : 1.0)
HOLDBACK STRATEGY  *None* Temperature based timer pause is not required. *Up* Timer is paused if Temperature is outside holdband and *above* Control SP . *Down* Timer is paused if Temperature is outside holdband *below* Control SP. *Both* Timer is paused if Temperature is outside holdband both *above* and *below* Control SP.	 None  Up  Down  Both (Default : Down)
HOLD BAND  Sets the temperature limit(s) with respect to the SP for the soak timer to pause. This ensures guaranteed soak time elapse.	1 to 5 **or** 0.1 to 5.0 (Default : 1.0)
END-OF-SOAK ALARM TIME  The Output-3 Relay/SSR activates at the end of soak timer to indicate an end of the running autoclave cycle. This parameter value sets the time interval for which the Alarm output remains activated before turning off. (The user can also use Acknowledgment key to turn off the output.)	5 to 250 Sec. (Default : 10 Sec.)
POWER-FAIL RECOVERY METHOD  *Abort* The timer operation is suspended until a new start command is issued. *Start* The timer re-runs the complete soak time. *Continue* The Soak Timer resumes operation for the balance time.	 Abort  (Re)Start  Continue (Default : Continue)

SOAK TIMER OPERATION

Figure 5.1



Basic Operation

The Soak Timer is essentially a Setpoint Dependent Timer. That is, after issuance of Start Command, the count down starts only after the Temperature Value reaches within timer 'Start Band'. The timer start band is a symmetrical band centered around the Control Setpoint. For example, for a start band of 1.0°C and Control Setpoint value of 121.0°C, the count down begins once the Temperature Value reaches within 120.0°C (Control Setpoint - Start Band) to122.0°C (Control Setpoint + Start Band). Note that, once the Temperature Value enters 'Start Band', the timer continues to run regardless of whether the Temperature Value remains within or outside the 'Start Band'.

Hold Band Operation

The timer is also provided with a 'Hold Band' that can be enabled to make sure that the timer counts down *only while* the Temperature Value is within the 'Hold Band'. That is, the timer pauses (stops counting down) whenever the Temperature Value is outside the 'Hold Band'. The 'Hold Band' is set with respect to the Control Setpoint and can be set above or below or above and below the Control Setpoint. For example, a 1.0°C Hold Band below the Control Setpoint (say,121.0°C) will force the timer in pause state whenever the Temperature Value is equal to or less than 120.0°C (Control Setpoint - Hold Band).

Power-fail Recovery Modes

The timer facilitates 3 different power-fail recovery modes, viz., *Continue*, *Re-start* and *Abort*. In *Continue* mode, the timer resumes to execute the balance soak time once the Temperature Value is detected within Hold Band. In *Re-start* mode, the timer executes the complete set time all over again. In *Abort* mode, the timer stops execution until a start command is issued.

Section 6

PAGE-11 : SUPERVISORY PARAMETERS

Table 6.1

Parameter Description	Settings (Default Value)
OFFSET FOR TEMPERATURE VALUE OFSt This parameter adds positive or negative offset to the Measured Temperature Value for removal of thermal gradient or known sensor error.	-1999 to 9999 or -199.9 to 999.9 (Default : 0.0)
DIGITAL FILTER FOR TEMPERATURE VALUE FLtr This value determines the averaging rate of change of Measured Temperature Value and thus helps removing undesired rapid changes in the measured Temperature Value. The higher the filter value the better the averaging but the slower the response to actual changes.	0.5 to 25.0 Seconds in steps of 0.5 Seconds (Default : 1.0)
OPERATOR PARAMETER LOCKING OPr.L Setting this parameter to 'Yes' enables the supervisor to disallow the operator to edit the Control Setpoint, Air Outlet Setpoint and the Soak Time duration on the Operator Page.	no No YES Yes (Default : No)
PASS CODE FOR CYCLE ABORT CodE Set the pass code that the operator must enter if he needs to abort a running autoclave cycle by setting the Abort command to 'Yes' on the operator page.	1 to 250 (Default : 22)
UTILITY OPTION OPtn *None* No optional utility module is fitted / functional. *Serial Communication* The optional utility module is RS485/RS232 serial communication port. *Cycle Start* The optional utility module is Digital Input (potential-free contact closure) for Cycle Start Command. An open to close contact will initiate a new Autoclave Cycle. *Water Level* The optional utility module is Digital Input (potential-free contact closure) for Water Level checking.	nonE None SrL.C Serial Comm. Strt Cycle Start LEvL Water Level (Default : None)
SLAVE ID Id *(Available for Utility Option 'Serial Comm.' only)* This parameter assigns a unique identification number that the Master Device can use to address the instrument for data transactions.	1 to 127 (Default : 1)

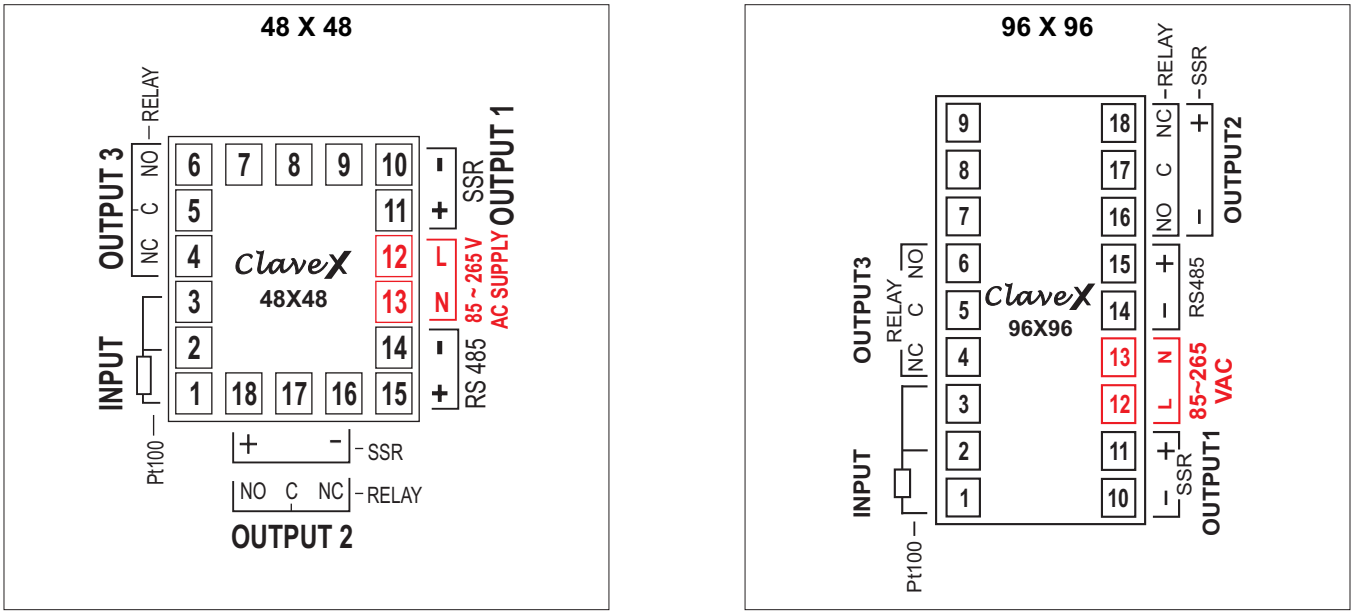
Parameter Description	Settings (Default Value)
BAUD RATE bAUd *(Available for Utility Option 'Serial Comm.' only)* This parameter defines the communication speed expressed in "Bits per second". The Baud Rate must be set to match the Baud Rate set for the Master Device.	1200 1200 2400 2400 4800 4800 9600 9600 (Default : 9600)
COMMUNICATION WRITE ENABLE CoM.E *(Available for Utility Option 'Serial Comm.' only)* *Yes* The Read/Write parameters can be accessed for both reading and writing. *No* The Read/Write parameters can only be accessed for reading. That is, the parameter values cannot be altered through serial communication.	no No YES Yes (Default : Yes)
WATER LEVEL SWITCH LOGIC L.LG *(Available for Utility Option 'Water Level' only)* *Normal* The Water Level is considered LOW if the switch contacts are open. *Reverse* The Water Level is considered LOW if the switch contacts are close.	norM Normal rEv Reverse (Default : Normal)
PRESSURE VIEW PS.En Set this parameter to 'Enable' if it is desired to indicate the Saturated Steam Pressure (computed based on Autoclave Temperature) on the lower readout. If 'Disable' the Saturated Steam Pressure indication is suppressed.	dSbL Disable EnbL Enable (Default : Enable)

Section 7

ELECTRICAL CONNECTIONS

Refer connection diagram shown on the left side of the enclosure. The diagram shows the terminals viewed from the REAR SIDE with the controller label upright.

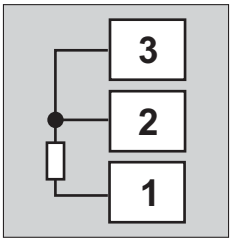
Figure 7.1



TEMPERATURE SENSOR INPUT

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

Figure 7.2

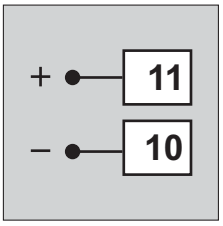


RTD

RTD Pt100, 3-wire

Connect single leaded end of RTD bulb to terminal 1 and the double leaded ends to terminals 2 and 3 (interchangeable) as shown in Figure 7.2. Use low resistance copper conductor leads of the same gauge and length. Avoid joints in the cable.

Figure 7.3



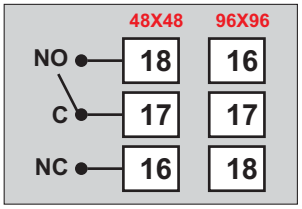
OUTPUT-1 (Heater Control Output)

The Output-1 is factory configured as SSR Drive. Connect (+) and (-) terminals of SSR to terminals 11 & 10, respectively. Use Zero-Crossover, 3 to 30 VDC operated SSR. Refer Figure 7.3.

OUTPUT- 2 (Air Outlet Control)

Output-2 can be configured as either Relay or SSR drive through appropriate jumper settings.

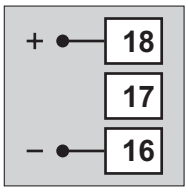
Figure 7.4(a)



Relay Output

Potential-free Relay changeover contacts NO (Normally Open) and C (Common) rated 10A/240 VAC (resistive load). Refer Figure 7.4(a).

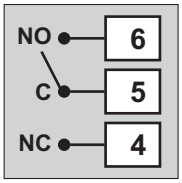
Figure 7.4(b)



SSR Output

Connect (+) and (-) terminals of SSR to terminals 18 & 16, respectively. Use Zero-Crossover, 3 to 30 VDC operated SSR. Refer Figure 7.4(b).

Figure 7.5



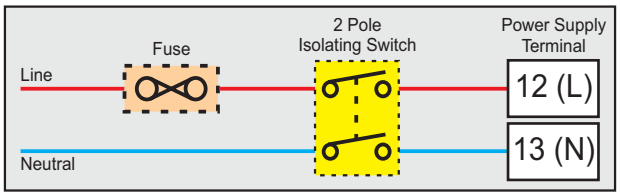
OUTPUT- 3 (Alarm Output)

Relay Output

Potential-free Relay changeover contacts NO (Normally Open) and C (Common) rated 10A/240 VAC (resistive load). Refer Figure 7.5.

POWER SUPPLY

Figure 7.6

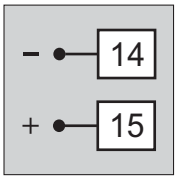


As standard, the controller accepts single phase, 50/60 Hz Line Voltage ranging from 85 VAC to 264 VAC. Use well-insulated copper conductor wire of the size not smaller than 0.5mm² for power supply connections. Connect Line Voltage as shown in Figure 7.6.

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

SERIAL COMMUNICATION PORT

Figure 7.7



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

Connect terminal 15 and 14 of the controller to the positive (+) and negative (-) terminals of the master device (usually PC). Use RS232/RS485 or USB/RS485 converter as a bridge, wherever necessary. Refer Figure 7.7.

PPI
The Perfection Experts

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