FrizCon

PPI
The Perfection Experts

Deep Freezer Controller with Graphic Display

User Manual

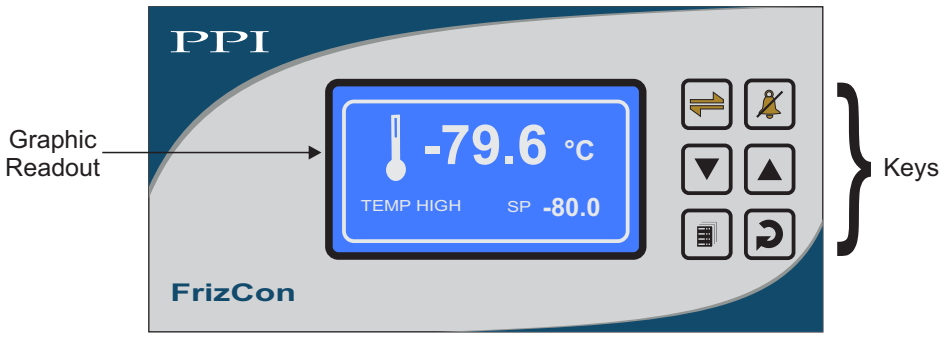
CONTENTS

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 & Process / Event Alarm Status. The Process Status Information 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.
	Alarm Acknowledge	Press to acknowledge and mute (if active) 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

Upon power-up the controller displays model name, Hardware Version and Firmware Version for 2 seconds as shown in figure 2.1.

Figure 2.1

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, Filter Temperature monitoring (if enabled), Door Status & Compressor High/Low Pressure Fault Monitoring and Single / Cascade Control Loop execution.

Main Screen

This is the default screen as shown in the figures 2.2.

Figure 2.2

In case of measured value errors, the messages listed in Table 2.1 flash in place of process value as illustrated in Figure 2.3.

Table 2.1

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

Figure 2.3

The Process / Event Alarm Status space on the screen may show one or more of the several messages listed in Table 2.2 depending upon the existence of active alarms. In case of co-existence of multiple active alarms, the messages are scrolled one after the other with an approximate time interval of 3 seconds. Also if there is no active alarm, the message space is blank.

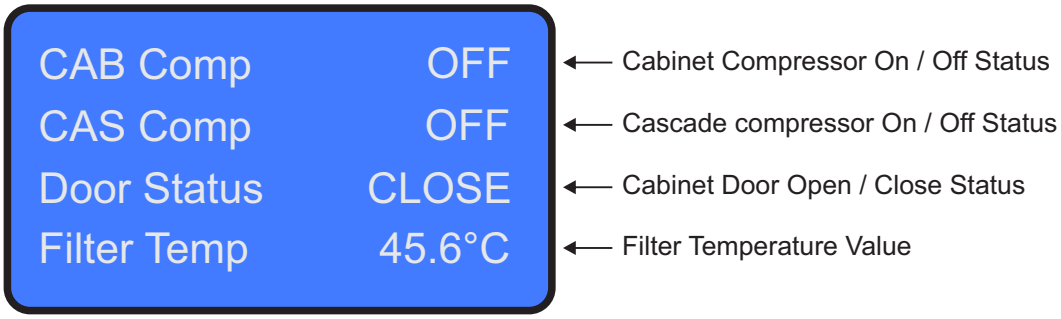
Table 2.2

Message String	Process / Event Alarm Status
TEMP HIGH	The measured temperature is in Process High Alarm State.
TEMP LOW	The measured temperature is in Process Low Alarm State.
DOOR OPEN	The Equipment / Chamber door is open for a time longer than the set 'DOOR ALRM DLY' time.
CAS HPLP	In cascade mode, **Cascade** Compressor is in High or Low Pressure fault.
CAB HPLP	In cascade or non-cascade mode, **Cabinet** Compressor is in High or Low Pressure fault.
FLTR HI	The filter Temperature is above set high limit.
FLTR VHI	The filter Temperature is above set cut-off limit.

Process Status Screen

The Process Status Screen is shown upon pressing ⇌ (Scroll) key from Main Screen. As depicted in Figure 2.4; the screen shows Door Open / Close Status, Cascade / Cabinet Compressor On-Off Status & Filter Temperature Value.

Figure 2.4



Note : 1. If Filter Operation is disabled, the Filter Temperature Value is not shown.
2. In Non-Cascade mode, Cascade compressor On/Off Status is not shown.
3. If Door Status monitoring is disabled, Door Status (Open / Close) is not shown.

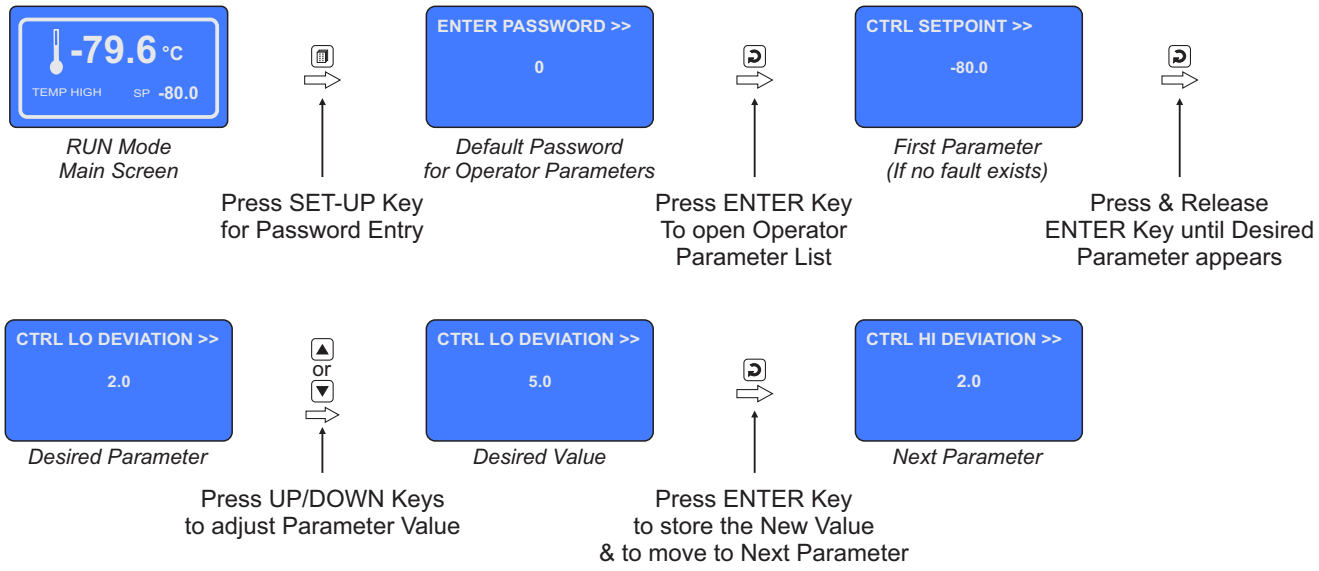
Section 3

OPERATOR PARAMETERS

The Operator Parameters are accessible under PASSWORD 0. The list includes parameters for Fault Acknowledgments (If any fault exists), Control Setpoint adjustment, Alarm Setpoints adjustment & Zero-offset adjustments.

The Figure 3.1 shows how to access Operator Parameters. The Example illustrates changing the Low Deviation alarm value.

Figure 3.1



The Table 3.1 below described the Operator Parameters in detail.

Table 3.1

Parameter Description	Settings (Default Value)
FILTER REPAIR ACK >> This parameter appears if the system has been cutoff due to filter temperature exceeding set cutoff limit. Set this parameter to 'Yes' after the fault has been removed and the system can be restarted.	Yes No (Default : No)
CASCADE HPLP ACK >> **CABINET HPLP ACK >>** One of the above parameters appears in case of compressor pressure fault (High or Low). Set this parameter to 'Yes' after the fault has been removed and the system can be restarted.	Yes No (Default : No)
CTRL SETPOINT >> This is the Setpoint value at which the cabinet / freezer temperature value is to be maintained.	Setpoint Low Limit to Setpoint High Limit (Default : -80.0)

Parameter Description	Settings (Default Value)
CTRL LO DEVIATION >> Sets *Negative* deviation (offset) limit from control setpoint for *Low Alarm* activation.	0.2 to 99.9 (Default : 2.0)
CTRL HI DEVIATION >> Sets *Positive* deviation (offset) limit from control setpoint for *High Alarm* activation.	0.2 to 99.9 (Default : 2.0)
CTRL ZERO OFFSET >> This value is algebraically added to the measured *Cabinet / Freezer* Temperature Value to derive the final value that is displayed and compared for Alarm / Control. Use this value to nullify any known constant error. Final Cabinet / Freezer Temperature = Measured Value + Offset	-50.0 to 50.0 (Default : 0.0)
FILTER ZERO OFFSET >> **or** **COIL ZERO OFFSET >>** **(Available only if AI-2 Input Sensor is deployed for either Filter or Coil Temperature monitoring)** This value is algebraically added to the measured *Filter* / *Coil* Temperature Value to derive the final value that is displayed and compared for Alarm and / or Control purpose. Use this value to nullify any known constant error. Final Filter / Coil Temperature = Measured Value + Offset	-50.0 to 50.0 (Default : 0.0)
DEFROST START >> **DEFROST STOP >>** These commands are applicable only if Defrost feature is set to Manual Mode. Selecting Start commences defrost by switching the compressors OFF and switching the defrost output ON. The defrost operation can be deactivated by issuing Stop command.	Start Stop (Default : NA)
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.

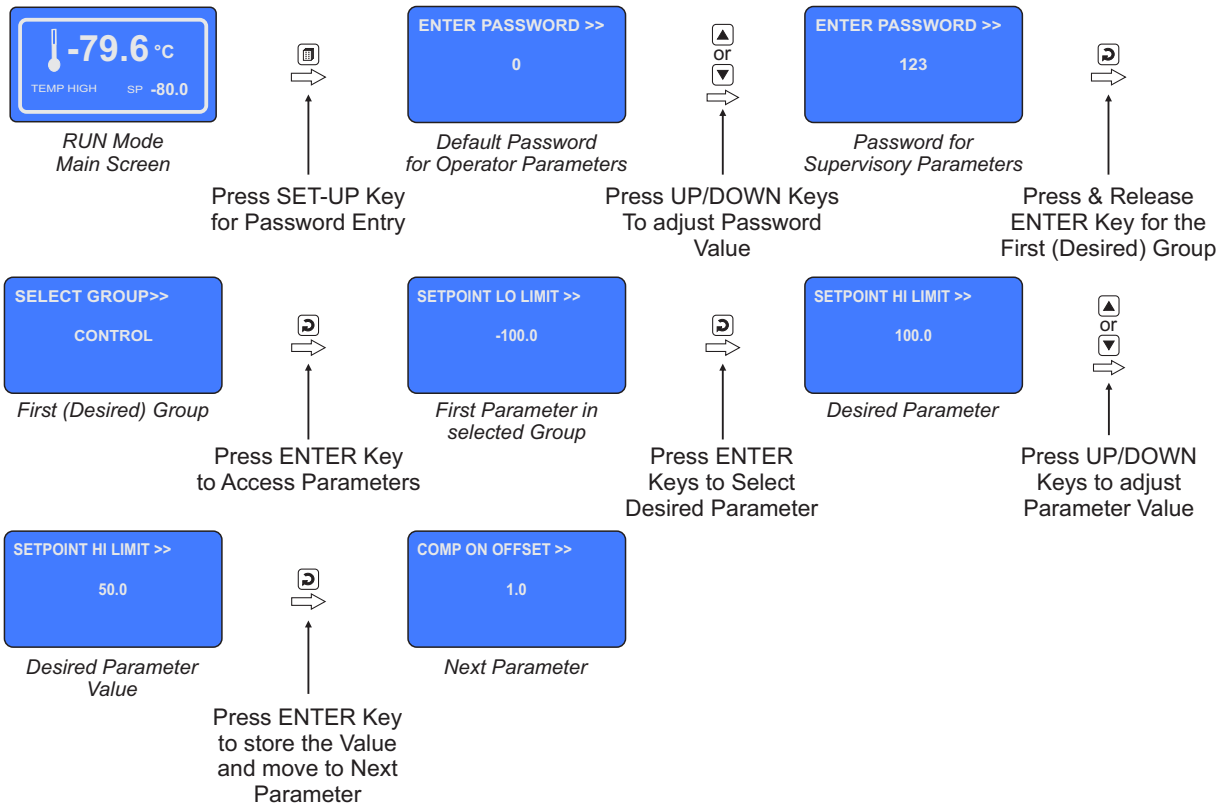
Table 4.1

Group	Parameters
Serial Parameter	Device ID, Baud Rate, Parity, Serial Write
Control	Setpoint Low Limit, Setpoint High Limit, 'Compressor-On' Offset, 'Compressor-Off' Offset
Password	Change Password
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 100.0 to 50.0 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 multiple parameters need to be set under the selected Group.
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 on the Control Setpoint value.	-100.0 to Setpoint HI Limit (Default : -100.0)
SETPOINT HI LIMIT >> This parameter sets the maximum limit on the Control Setpoint value.	**'Single' or 'Single with Filter' Compressor Mode** Setpoint LO Limit to 100.0 **'Cascade' or 'Cascade with Filter' or 'Cascade with Coil' Compressor Mode** Setpoint LO Limit to Cascade SP (Default : -10.0)
COMP ON OFFSET >> This parameter sets a positive deviation from the control setpoint for switching the compressor(s) ON. For example, if the control setpoint is -80.0 and COMP ON OFFSET is 1.0 then the compressor(s) will turn-on if the cabinet temperature value rises above -79.0 (-80.0 + 1.0 = -79.0).	0.1 to 99.9 (Default : 1.0)
COMP OFF OFFSET >> This parameter sets a negative deviation from the control setpoint for switching the compressor(s) OFF. For example, if the control setpoint is -80.0 and COMP OFF OFFSET is 0.5 then the compressor(s) will turn-off if the cabinet temperature value falls below -80.5 (-80.0 - 0.5 = -80.5).	0.1 to 99.9 (Default : 0.1)

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.	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.

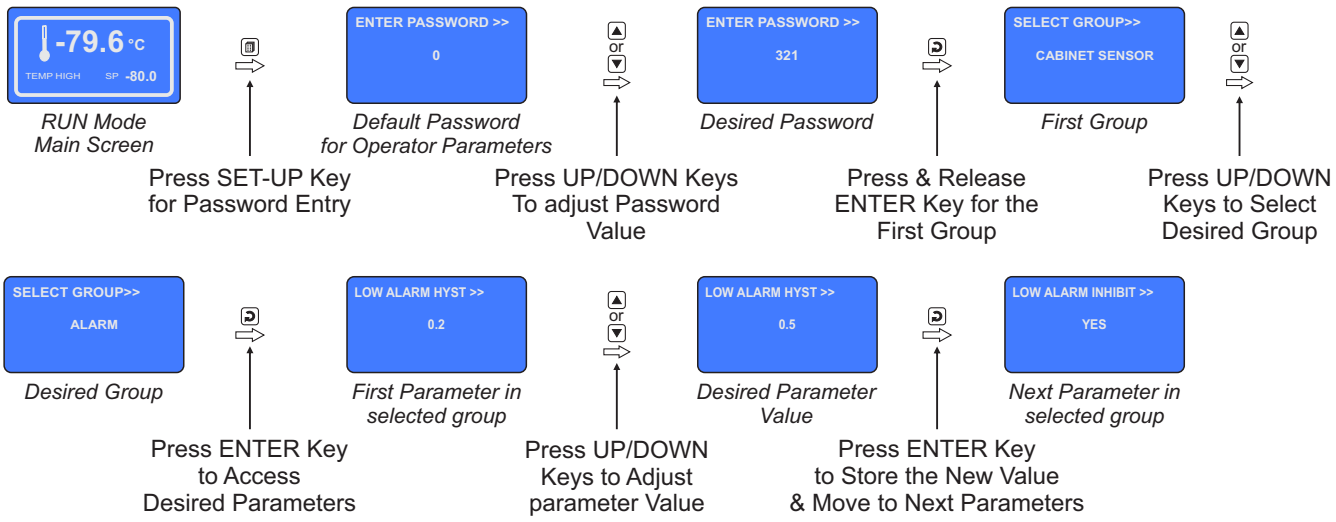
Table 5.1

Group	Parameters
Cabinet Sensor	Input Type, Signal Low, Signal High, Range Low, Range High, Filter Constant
Filter / Coil Sensor	Input Type, Signal Low, Signal High, Range Low, Range High, Filter Constant
Alarm Parameters	Low Alarm Hysteresis, Low Alarm Inhibit, High Alarm Hysteresis, High Alarm Inhibit
Compressor Operation	Operation Mode, CASCADE SP, Off to On Delay, Switching Delay, Cascade Compressor Hysteresis
Filter Operation	Alarm SP, Alarm Hysteresis, Cut-Off SP
Defrost Operation	Enable/Disable, Defrost Time, Defrost Interval
Door Open	Enable/Disable, Switch Logic, Door Alarm Delay
Cascade Comp HPLP	Enable/Disable, Switch Logic
Cabinet Comp HPLP	Enable/Disable, Switch 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 'Low Alarm Hysteresis' that is located under group 'Alarm' from 0.2°C to 0.5°C.

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 > CABINET SENSOR

<table>
<tr><th>Parameter Description</th><th>Settings
(Default Value)</th></tr>
<tr><td>INPUT TYPE >>
Select Input type in accordance with the type of Temperature sensor / transmitter connected for measurement.</td><td>Refer Table 5.2
(Default : RTD Pt100)</td></tr>
<tr><td>SIGNAL LO >>
(Available for DC linear mA & Volts Inputs only)
The transmitter output signal value corresponding to Range Low process value. Refer Appendix-B : 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 mA & Volts Inputs only)
The transmitter output signal value corresponding to Range High process value. Refer Appendix-B : 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 mA & Volts Inputs only)
The process value corresponding to the Signal Low value from the transmitter. Refer Appendix-B : 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 mA & Volts Inputs only)
The process value corresponding to the Signal High value from the transmitter. Refer Appendix-B : DC Linear Signal Interface for details.</td><td>RANGE LO to 999.9
(Default : 100.0)</td></tr>
</table>

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 30.0 (Default : 0.5)

FACTORY > COIL / FILTER SENSOR

The Parameter Descriptions are the same as described for the parameters for **CABINET SENSOR** above.

Table 5.2

What it means	Range (Min. to Max.)	Resolution
3-wire, RTD Pt100	-199.9 to 600.0°C	Fixed 0.1°C
0 to 20mA DC current	-199.9 to 999.9 units	Fixed 0.1 unit
4 to 20mA DC current		
0 to 5.0V DC voltage		
0 to 10.0V DC voltage		
1 to 5.0V DC voltage		

FACTORY > ALARM PARAMETERS

Parameter Description	Settings (Default Value)
LOW ALARM HYST >> This parameter sets a differential (dead) band between the ON and OFF Alarm status change. Keep it large enough to avoid frequent switching of the Alarm Status/Relay.	0.1 to 99.9 (Default : 0.2)
LOW ALARM INHIBIT >> *Disable* The Alarm is not suppressed during the start-up Alarm conditions. *Enable* The Alarm activation is suppressed until the Temperature value is within Alarm limits from the time the controller is switched ON. This allows suppressing the Alarm during the start-up Alarm conditions.	Disable Enable (Default : Enable)
HIGH ALARM HYST >> **HIGH ALARM INHIBIT >>** The Parameter descriptions are the same as that for Low Alarm.	

FACTORY > COMPRESSOR OPERATION

Parameter Description	Settings (Default Value)
OPERATION MODE>> *Single* Single compressor (for Deep Freezer). *Single with Filter* Single compressor (for Deep Freezer) with Filter temperature monitoring. *Cascade* Dual compressors in Cascade Mode (for Ultra - Low Cooling Cabinets). *Cascade with Filter* Dual compressors in Cascade Mode (for Ultra - Low Cooling Cabinets) with Filter temperature monitoring. *Cascade with Coil* Dual compressors in Cascade Mode (for Ultra - Low Cooling Cabinets) with Return Coil temperature monitoring for control. For Details Refer Appendix-A : *Single & Cascade Operation Modes*	Single Single with Filter Cascade Cascade with Filter Cascade with Coil (Default : Cascade with Coil)

Parameter Description	Settings (Default Value)
CASCADE SP>> ***(Available for 'Cascade' or 'Cascade with Filter' or 'Cascade with Coil' Operation Mode)*** Refer Appendix-A : *Single & Cascade Operation Modes*	-70.0 to 10.0 (Default : -30.0)
OFF TO ON DELAY>> Refer Appendix-A : *Single & Cascade Operation Modes*	0 to 1000 Sec (Default : 200 Sec)
SWITCHING DELAY>> ***(Available for 'Cascade' or 'Cascade with Filter' or 'Cascade with Coil' Operation Mode)*** Refer Appendix-A : *Single & Cascade Operation Modes*	0 to 1000 Sec (Default : 15 Sec)
CASCADE COMP HYST >> ***(This parameter is available only if Operation Mode is selected as 'Cascade with Coil')*** This parameter value sets a positive dead band that in conjunction with 'Cascade SP' determines the cabinet compressor switching upon power up condition. Refer Appendix-A : *Single & Cascade Operation Modes*	1 to 50.0 (Default : 20)

FACTORY > FILTER OPERATION

Parameter Description	Settings (Default Value)
FILTER ALARM SP >> This parameter sets the value for **warning** against the filter temperature rise. If the filter sensor temperature exceeds this set value then alarm is activated.	-100.0 to 100.0 (Default : 55.0)
FILTER ALARM HYST >> This parameter sets a differential (dead) band between the ON and OFF Alarm status change. Keep it large enough to avoid frequent switching of the Alarm Status/Relay.	0.1 to 99.9 (Default : 0.2)
FILTER CUT-OFF SP >> This parameter sets the value for **danger** against the filter temperature rise. If the filter sensor temperature exceeds this set value then compressor(s) are switched-off for safety. The Compressor(s) are switched-on again only after fault is removed and acknowledged.	Filter Alarm SP to 100.0 (Default : 60.0)

FACTORY > DEFROST OPERATION

Parameter Description	Settings (Default Value)
OPERATION >> *Disable* Defrost Operation is Disabled. *Automatic* Defrost output is activated at user set 'Defrost Interval' for the set 'Defrost Time'. *Manual* Defrost output is activated & de-activated through operator parameter.	DISABLE AUTOMATIC MANUAL (Default : DISABLE)
DEFROST TIME [M:S] >> Time duration for which the defrost output is activated.	1 to 99.59 (Min:Sec) (Default : 5 Sec)
DEFROST INTERVAL [H:M] >> Periodic time interval for activating defrost output.	1 to 99.59 (Hour:Min) (Default : 8 Min)

FACTORY > DOOR OPEN

Parameter Description	Settings (Default Value)
ENABLE >> Set to 'Yes' if Switch is mounted for detecting door *Open / Close* position.	NO YES (Default : NO)
SWITCH LOGIC >> *Open : Door Open* The Door position is considered *Open* if the switch is OPEN. *Close : Door Open* The Door position is considered *Open* if the switch is CLOSE.	OPEN : DOOR OPEN CLOSE : DOOR OPEN (Default : CLOSE : DOOR OPEN)
DOOR ALRM DLY [SEC] >> This parameter sets a timer. From the time the door is opened, the timer begins counting down. If the door is not closed before the timer reaches 0, the *Door Open* alarm is activated.	0 to 1000 Sec (Default : 60 Sec)

FACTORY > CASCADE COMP HPLP *(Available for 'Cascade' or 'Cascade with Filter' or 'Cascade with Coil' Operation Mode)*

Parameter Description	Settings (Default Value)
ENABLE >> Set this parameter to 'Yes' if cascade compressor pressure fault switch is connected. If there is either High or Low pressure fault then both Cascade & Cabinet compressors are switched-off for safety. The Compressors are switched-on again only after fault is removed and acknowledged.	NO YES (Default : NO)
SWITCH LOGIC >> *Open : HP-LP* The OPEN Switch position indicates Pressure Fault. *Close : HP-LP* The CLOSE Switch position indicates Pressure Fault.	OPEN : HP-LP CLOSE : HP-LP (Default : CLOSE : HP-LP)

FACTORY > CABINET COMP HPLP

Parameter Description	Settings (Default Value)
ENABLE >> Set this parameter to 'Yes' if cabinet compressor pressure fault switch is connected. If there is either High or Low pressure fault then Cabinet compressor (and also Cascade Compressor in case of Cascade Mode) are switched-off for safety. The Compressor(s) are switched-on again only after fault is removed and acknowledged.	NO YES (Default : NO)
SWITCH LOGIC >> *Open : HP-LP* The OPEN Switch position indicates Pressure Fault. *Close : HP-LP* The CLOSE Switch position indicates Pressure Fault.	OPEN : HP-LP CLOSE : HP-LP (Default : CLOSE : HP-LP)

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)

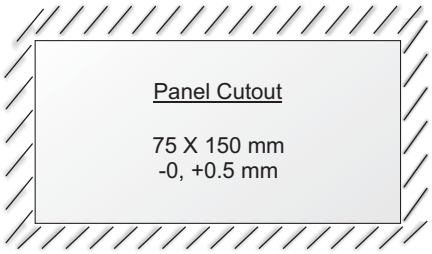
Section 6

PANEL MOUNTING AND ELECTRICAL CONNECTIONS

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

PANEL CUTOUT

Figure 6.1



PANEL 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.

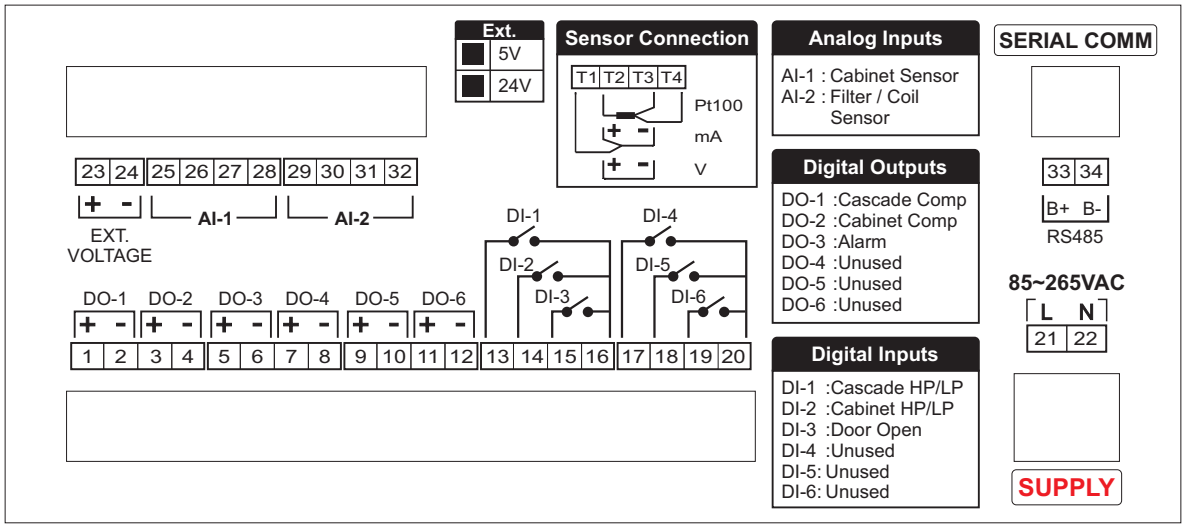
ELECTRICAL CONNECTIONS

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). 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.

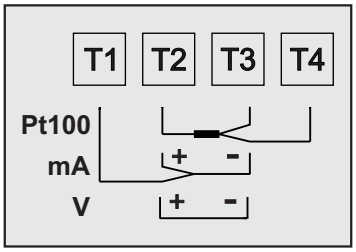
Figure 6.2



TEMPERATURE SENSOR INPUT

Connect 3-wire RTD Pt100 Temperature Sensor or Temperature Transmitter with mA/V output as shown below.

Figure 6.3



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.

Temperature 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.

Temperature 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 optionally with inbuilt 5V @ 15 mA **OR** 24V @ 40 mA DC Excitation Voltage. The Excitation Voltage can be used to power external Temperature Transmitters.

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

DIGITAL OUTPUTS

Cascade Compressor Output (Terminals : 1, 2)
Cabinet Compressor Output (Terminals : 3, 4)
Alarm Output (Terminals : 5, 6)

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.

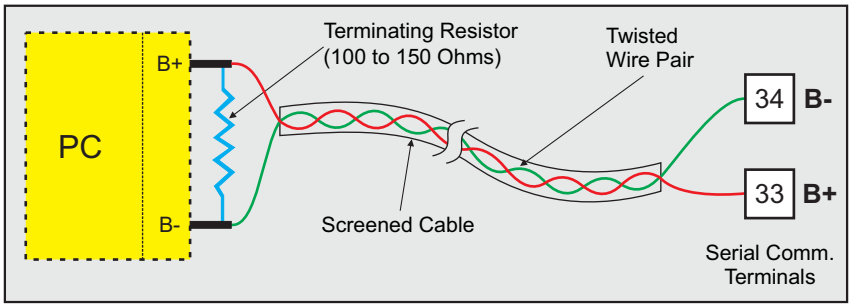
DIGITAL INPUTS

Cascade Compressor HP/LP (Terminals 13, 16)
Cabinet Compressor HP/LP (Terminals 14, 16)
Door Open (Terminals 15, 16)

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)

Figure 6.4



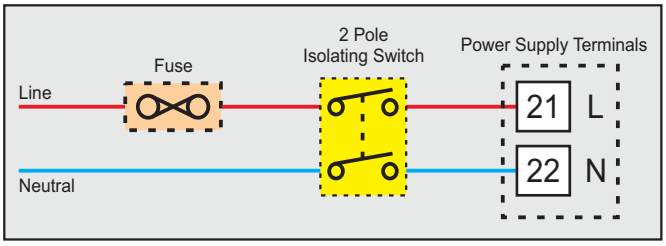
The controller Communication Port is RS485 and requires a similar port at the host (master) end. If, however, the host port is different (say, RS232 or USB), use appropriate protocol converter (say, RS485-RS232 or USB to RS485) for interface.

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.

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



APPENDIX-A
SINGLE & CASCADE OPERATION MODE

Before explaining Single & Cascade Operations, the terms *'Compressor Off-to-On Time Delay'* & *'Cascade Compressor Switching Time Delay'* are explained below.

Compressor Off-to-On Time Delay

Once the compressor is switched off, a time delay is desired before it is turned ON again. The time delay prevents the possible damage due to short cycling. When the compressor switches off, it spins backward as pressure equalizes. If compressor is energized while it is still spinning backward, it continues to run backward until it trips on internal overloads. This may cause damage to the compressor.

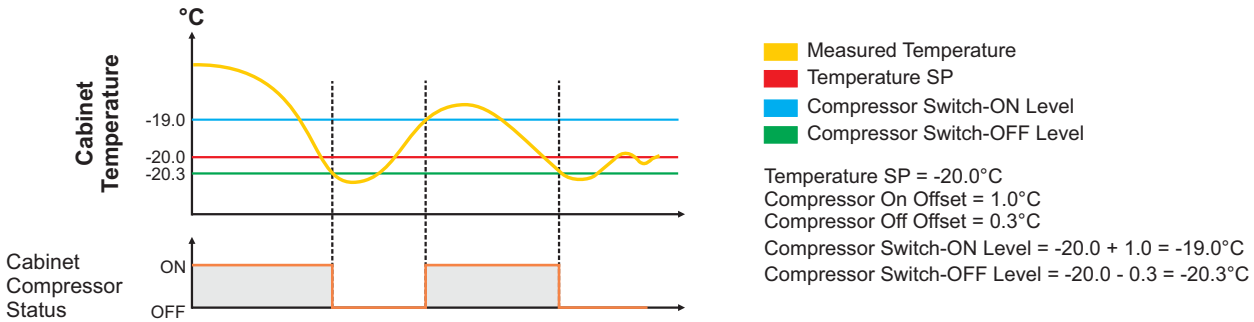
The time delay cycle is executed every time the compressor is turned off. The compressor turning off may be a result of power failure or the on-off control algorithm executed by the controller. The controller in "Auto Mode" monitors the Process Value (PV) against the Set-Point (SP) and attempts to switch the compressor *ON* or *OFF* depending upon whether the PV is *above* or *below* the SP.

The time delay starts counting down from the instance the compressor is switched off. The compressor is inhibited from switching-on until the delay elapses regardless of the difference between the PV and SP. Once the time delay is elapsed, the control algorithm switches the compressor ON as and when the PV is above SP.

Cascade Compressors Switching Time Delay

For Ultra Low temperature applications, two compressors are operated in Cascade Mode. The first compressor, Cascade Compressor, is turned-on first as the system is started from ambient. Once the temperature drops to a pre-determined level (say, -10 °C), the second compressor, Cabinet Compressor, is turned-on. Both these compressors force the temperature to reach the ultra low cabinet temperature setpoint (say, -80 °C). Now the temperature is maintained at cabinet setpoint by switching both compressors On & Off in a sequence with a time delay. That is, when the temperature drops below the setpoint, first the cabinet compressor is turned-off and after a time delay the cascade compressor is turned-off. Likewise when the temperature rises above the setpoint, first the cascade compressor is turned-on and after the time delay the cabinet compressor is turned-on. This time delay is referred as Compressor Cascade Switching Time Delay.

Single Compressor Operation Mode



The compressor is turned ON if the chamber air temperature value is above the Temperature SP by an amount set by the parameter 'Compressor On Offset'. That is;

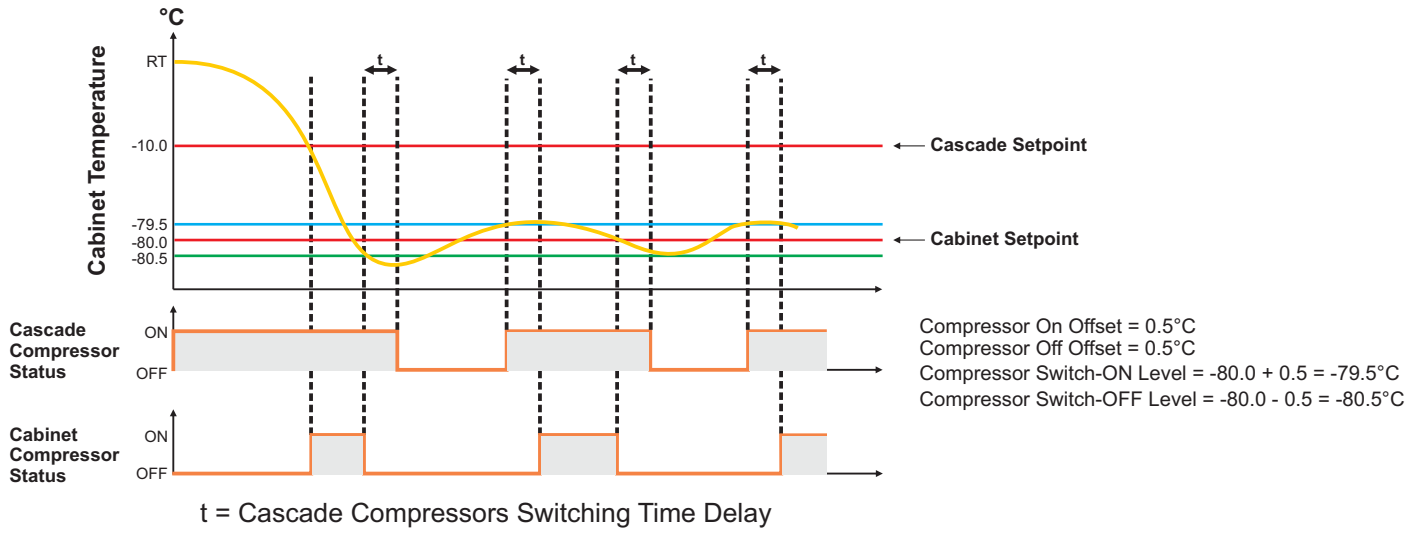
Compressor Switch - ON Level = (Temperature SP) + (Compressor On Offset)

The compressor is turned off if Temperature value falls below the Temperature SP by an amount set by the parameter 'Compressor Off Offset'. That is;

Compressor Switch - OFF Level = (Temperature SP) – (Compressor Off Offset)

Cascade Compressors Operation Mode (without Coil Sensor)

Note : For the clarity sake, the *Compressor On-to-Off Time Delay* is not shown in the figure.

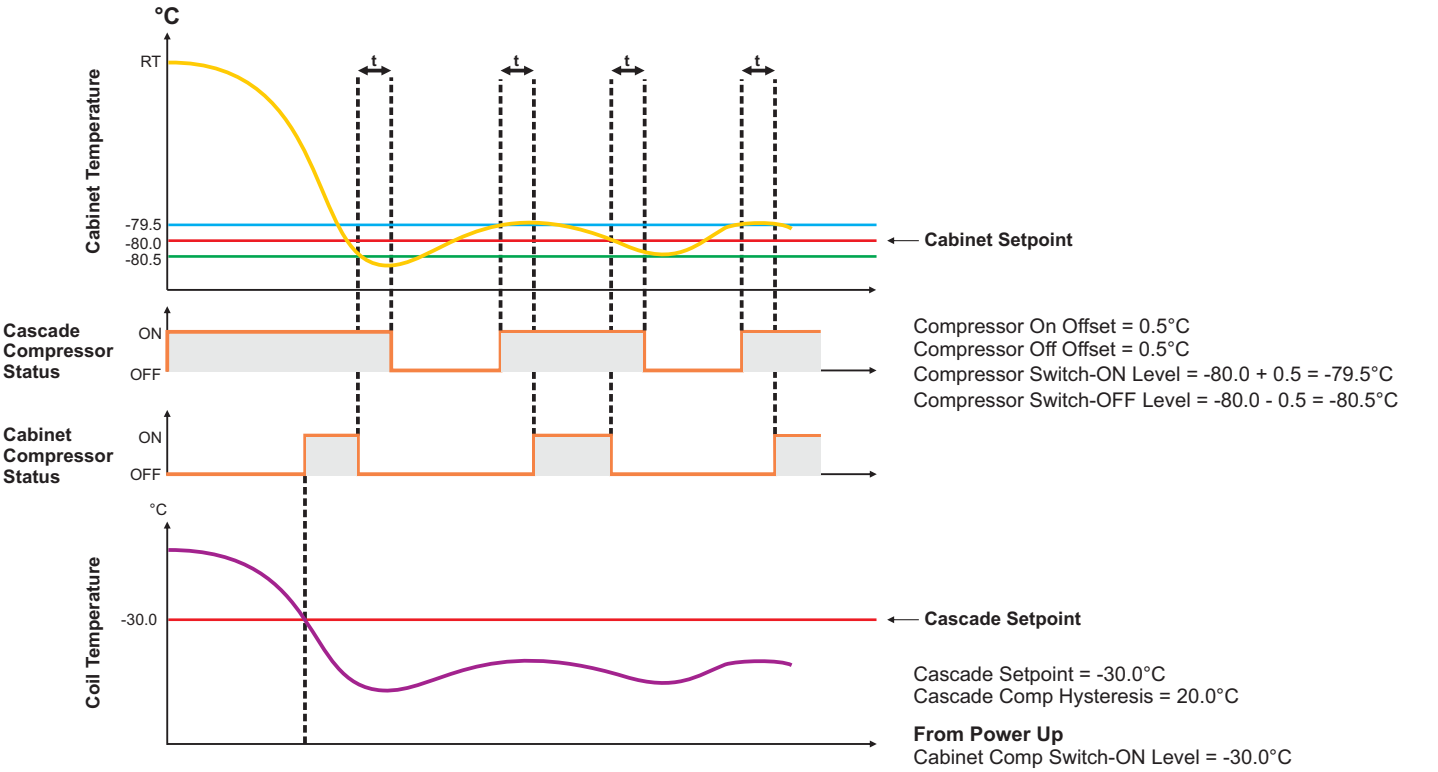


t = Cascade Compressors Switching Time Delay

Note : The setpoint values shown in above figure are for illustration purpose only.

Cascade Compressors Operation Mode (with Coil Sensor)

Note : For the clarity sake, the *Compressor On-to-Off Time Delay* is not shown in the figure.



t = Cascade Compressors Switching Time Delay

Note : The setpoint values shown in above figure are for illustration purpose only.

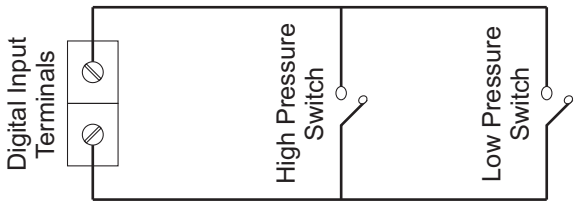
APPENDIX-B
HP / LP DIGITAL INPUT CONNECTION DETAILS

The Digital Input Connections should be in accordance with the types of pressure switches : Normally Open or Normally Closed as described below.

Case 1 : Normally Open

This type of switch has potential-free contacts that are Normally Open. Under Fault condition the contacts are closed. For this type, the Low Pressure & High Pressure switches should be connected in parallel (logically ORed) as shown below.

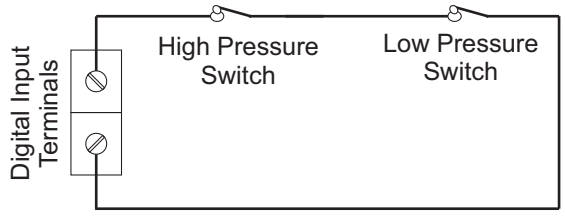
Also the parameters "*Switch Logic*" for Cabinet Compressor HP / LP & Cascade Compressor HP / LP should be set to "Close : HPLP".



Case 2 : Normally Closed

This type of switch has potential-free contacts that are Normally Closed. Under Fault condition the contacts are opened. For this type, the Low Pressure & High Pressure switches should be connected in Series (logically ANDed) as shown below.

Also the parameters "*Switch Logic*" for Cabinet Compressor HP / LP & Cascade Compressor HP / LP should be set to "Open : HPLP".



Note : Make sure that both the Switches used for HP & LP must be of same type (Normally Open or Normally Closed).

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:

$$Y = mX + C$$

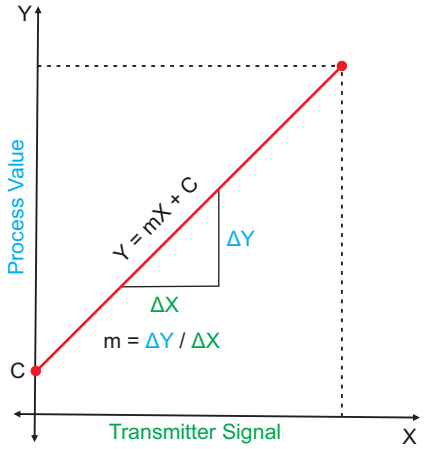
Where;

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: ± 80mV, ± 5 V, ± 1 to ± 5 V, ± 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.

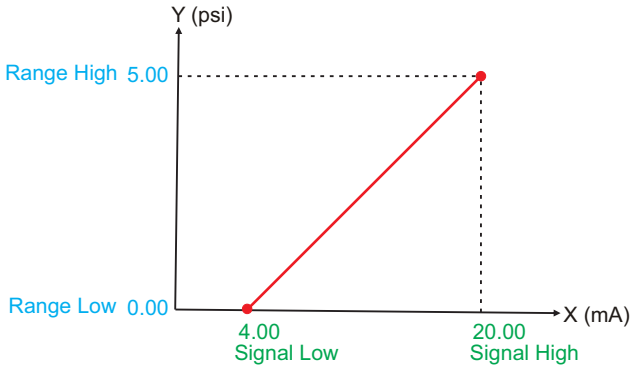
The linear transmitters usually specify two signal values (Signal Low and Signal High) and the corresponding Process Values (Range Low and Range High). In the example Pressure Transmitter above; the Signal Low, Signal High, Range Low & Range High values specified are: 4 mA, 20 mA, 0 psi & 5 psi, respectively.

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. 4.00 mA)
3. Signal High : Signal value corresponding to Range High process value (e.g. 20.00 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.

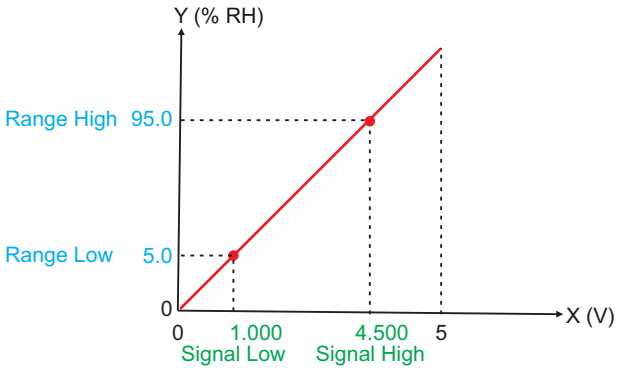
Example 1: Pressure Transmitter producing **4 to 20 mA** for **0 to 5 psi**



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

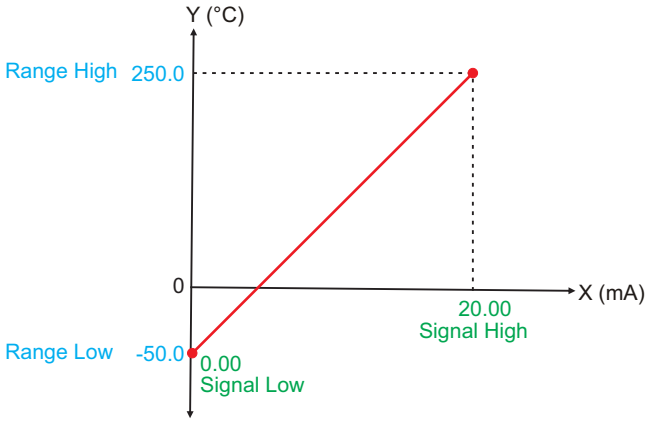
Example 2: Relative Humidity Transmitter producing **1 to 4.5 V** for **5 to 95 %RH**



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

PPI
The Perfection Experts

Process Precision Instruments

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

Jan 2022