Refrigeration (Deep Freezer) Controller (Single or Cascade Compressors)

PPI
The Perfection Experts

FrizCon 96

128 X 64 Monochrome Graphic Display
Single or Cascade Compressor Strategy
Auxiliary Analog Input for Coil / Filter Temperature
Compressor Control with Setable Time Delay
¼ DIN (96x96) Compact Enclosure

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User Manual

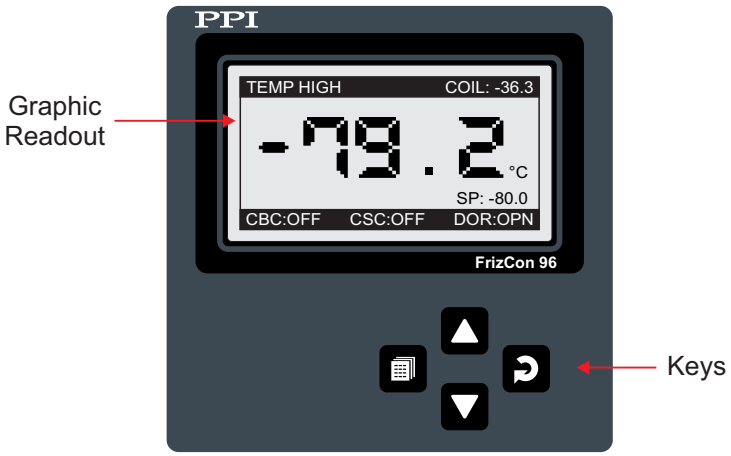
CONTENTS

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 display shows measured Cabinet Temperature, Cabinet Temperature Setpoint, Coil / Filter Temperature and various Statuses like Cabinet & Cascade Compressor On/Off, Door Status & Alarms.

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

KEYS

There are four 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 (in Set-up Mode)
	PAGE	Press to enter or exit set-up mode.
	DOWN	Press to decrease the parameter value. Pressing once decreases the value by one count; keeping pressed speeds up the change.
	UP	Press to increase the parameter value. Pressing once increases the value by one count; keeping pressed speeds up the change.
	ENTER	Press to store the set parameter value and to scroll to the next parameter in setup mode. Can also be used as Alarm Acknowledgment in normal operation mode.

Section 2

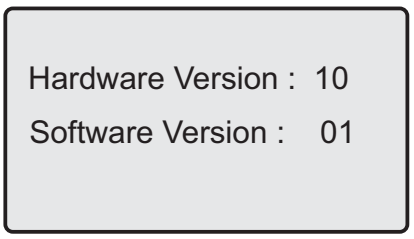
BASIC OPERATIONS

POWER-UP DISPLAY

Upon powering up, the display shows the Model Name (FrizCon 96) followed by the Hardware Version and Software Version for approximately 2 seconds each as shown in figure 2.1(a) & 2.1(b).

Figure 2.1 (a)

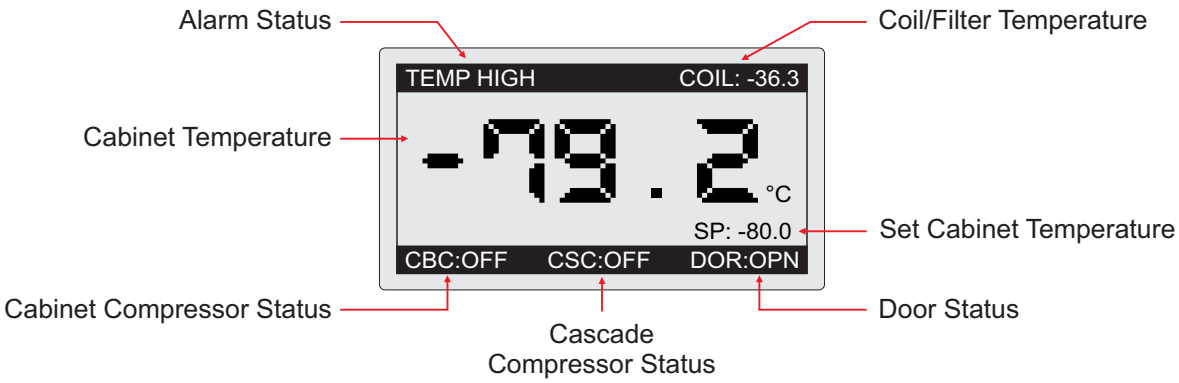
Figure 2.1(b)



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 Control Loop execution. The information displayed is depicted in the figure 2.2 below.

Figure 2.2



PV Error Indication

In case of measured cabinet & coil / filter temperature value errors, the messages listed in Table 2.1 are displayed in place of temperature values.

Table 2.1

Message	Error Type	Cause
OPEN	Sensor Open	Sensor (RTD Pt100) Broken / Open.
OVER	Over-range	Measured Temperature value is above 99.9 °C (Max. displayable value).
UNDR	Under-range	Measured Temperature value is below -99.9 °C (Min. displayable value).

Alarm Status Indication

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.
CSC HPLP	In cascade mode, **Cascade** Compressor is in High or Low Pressure fault.
CBC 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.

Cabinet Compressor Status Indication

CBC:OFF	Cabinet Compressor Off	CBC:ON	Cabinet Compressor On

Cascade Compressor Status Indication

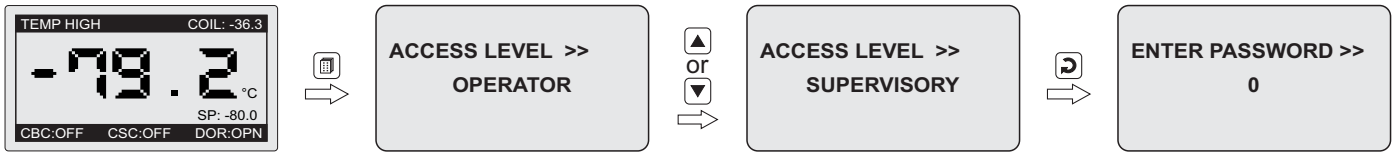
CSC:OFF	Cascade Compressor Off	CSC:ON	Cascade Compressor On

Door Status Indication

DOR:CLS	Door Close	DOR:OPN	Door Open

SETUP MODE

This Mode can be entered by pressing the Page Key from Run Mode. This mode allows controller parameter settings. The parameters are organized under three Access Levels; Operator, Supervisory, and Factory. Each level is protected using a numeric password. The below diagram shows an example of how to enter the Supervisory Access level. The parameters under each Access level are described in subsequent sections.



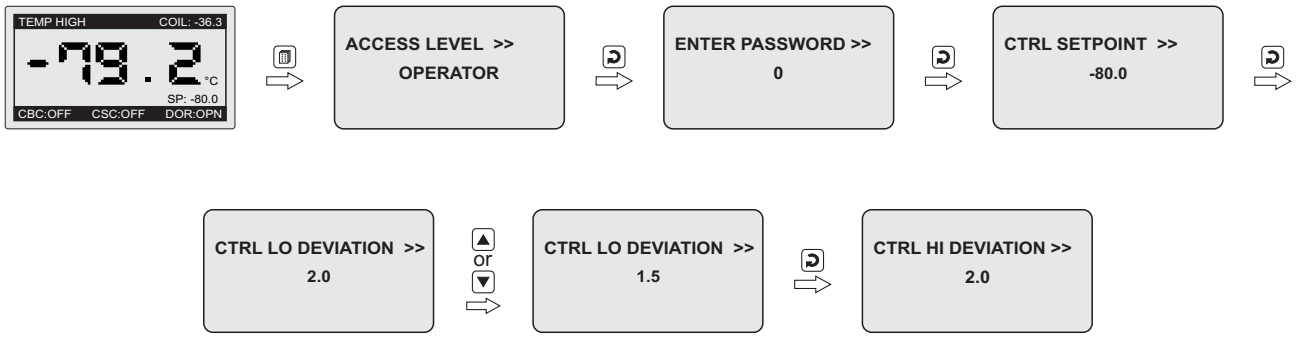
Section 3

OPERATOR ACCESS LEVEL

The Operator Parameters are accessible under default password 0. The list includes parameters for adjusting Control & Alarm setpoints, acknowledge various alarms, and issuing manual defrost commands.

The Figure 3.1 shows how to access Operator Parameters. The Example illustrates changing the low deviation alarm setpoint from 2.0 to 1.5.

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 maintained.	Setpoint Low Limit to Setpoint High Limit (Default : -80.0 °C)
CTRL LO DEVIATION >> Sets *Negative* deviation (offset) limit from control setpoint for *Low Alarm* activation. E.g.; If the Control Setpoint is -80.0 °C and the Low Deviation is 2.0 then the Low Alarm Limit is : -80.0 - 2.0 = -82.0 °C.	0.2 to 99.9 °C (Default : 2.0)

Parameter Description	Settings (Default Value)
CTRL HI DEVIATION >> Sets *Positive* deviation (offset) limit from control setpoint for *High Alarm* activation. E.g.; If the Control Setpoint is -80.0 °C and the Low Deviation is 2.0 then the Low Alarm Limit is : -80.0 + 2.0 = -78.0 °C.	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)
COIL ZERO OFFSET >> **or** **FILTER ZERO OFFSET >>** **(Available only if Coil/Filter Temperature Sensor Input is enabled)** This value is algebraically added to the measured *Coil / Filter* 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 Coil / Filter 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. Issuing Start command commences defrost by switching the compressors OFF. The defrost operation can be deactivated by issuing Stop command.	Start Stop
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. Set to 'Yes' for changing the Password.	No Yes (Default : No)
NEW PASSWORD >> This parameter is presented if 'Change Password' is set to 'Yes'. Set the new password value.	0 to 3000 (Default : 0)

Section 4

SUPERVISORY ACCESS LEVEL

The Supervisory Parameters are accessible under default password 123. The parameters are arranged in various groups for convenient access. Refer Table 4.1 below for a quick summary of parameters under different groups. Each parameter has been described in subsequent sections.

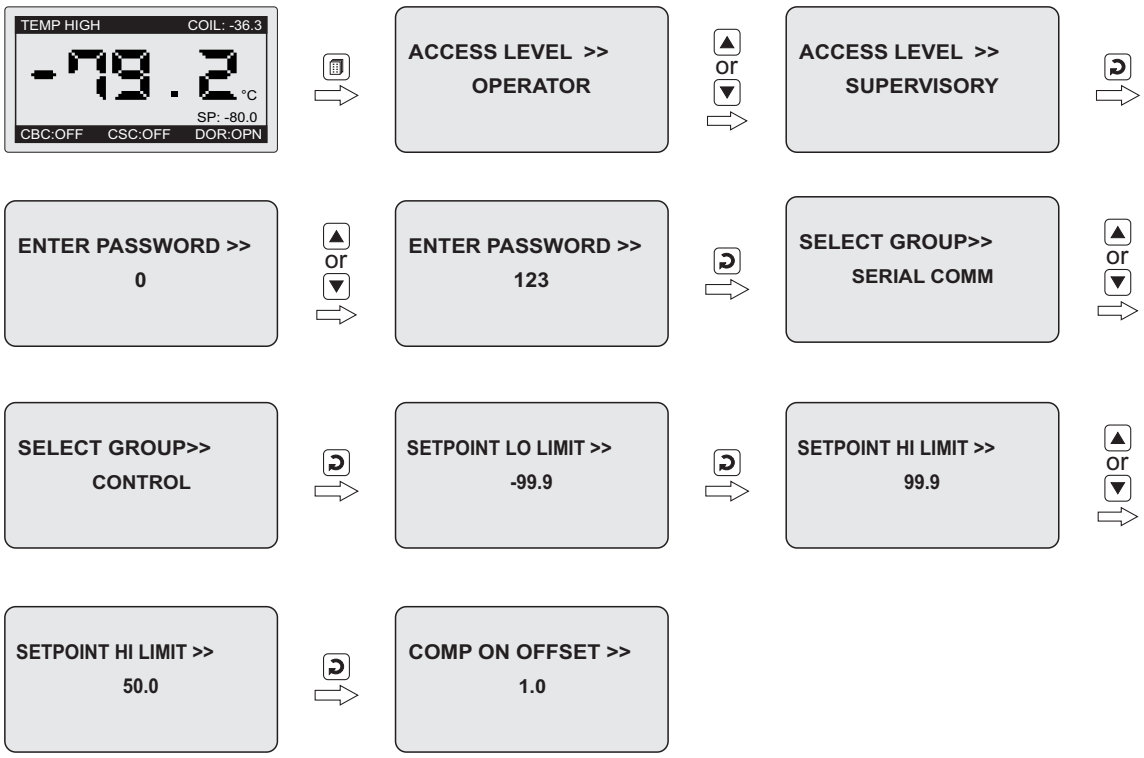
Tabel 4.1

Group	Parameters
Serial Communication	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 its parameters under Supervisory Level. The example shows accessing the group CONTROL and changing the value for the parameter 'SETPOINT HI LIMIT' from 99.9 to 50.0.

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 Page Key for instant revert to Main Display Mode.

Parameter Descriptions

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

SUPERVISORY > SERIAL COMM

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.	9600 19200 38400 (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 values.	No Yes (Default : Yes)

SUPERVISORY > CONTROL

Parameter Description	Settings (Default Value)
SETPOINT LO LIMIT >> This parameter sets the minimum limit on the Control Setpoint value.	-99.9 to 99.9 (Default : -99.9)
SETPOINT HI LIMIT >> This parameter sets the maximum limit on the Control Setpoint value.	-99.9 to 99.9 (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)

Parameter Description	Settings (Default Value)
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 Operator. However, if required the password can be changed by setting the new value for this parameter. Set to 'Yes' for changing the Password.	No Yes (Default : No)
NEW PASSWORD >> This parameter is presented if 'Change Password' is set to 'Yes'. Set the new password value.	0 to 3000 (Default : 123)

SUPERVISORY > EXIT

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

Section 5

FACTORY ACCESS LEVEL

The Factory Parameters are accessible under default password 321. The parameters are arranged in various groups for convenient access. Refer Table 5.1 below for a quick summary of parameters under different groups. Each parameter has been described in subsequent sections.

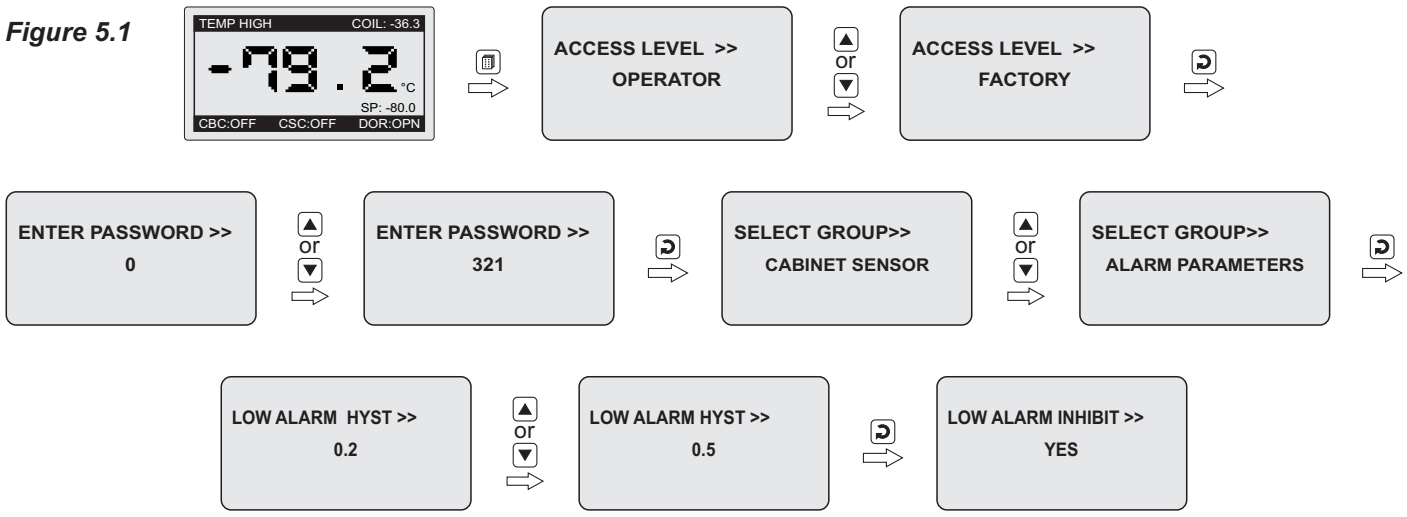
Table 5.1

Group	Parameters
Cabinet Sensor	Input Type, Signal Low, Signal High, Range Low, Range High, PV Filter Time
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
Coil / Filter Sensor	Input Type, Signal Low, Signal High, Range Low, Range High, PV Filter Time
Filter Operation	Alarm SP, Alarm Hysteresis, Cut-Off SP
Defrost Operation	Mode, Defrost Time, Defrost Interval
Door Monitoring	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 its parameters under Factory Level. The example shows accessing the group ALARM PARAMETERS and changing the value for the parameter 'LOW ALARM HYST' from 0.2 to 0.5.

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.

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-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 mA & Volts Inputs only)

The 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 mA & Volts Inputs only)

The process value corresponding to the Signal Low value from the transmitter. Refer Appendix-C : DC Linear Signal Interface for details.</td><td>-99.9 to 99.9
(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-C : DC Linear Signal Interface for details.</td><td>-99.9 to 99.9
(Default : 99.9)</td></tr>
</table>

Parameter Description	Settings (Default Value)
PV FILTER TIME >> 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 > ALARM PARAMETERS

Parameter Description	Settings (Default Value)
LOW ALARM HYST >> This parameter sets a differential (dead) band between the ON and OFF Control Low Deviation 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 >> *No* The Alarm is not suppressed during the start-up Alarm conditions. *Yes* The Alarm activation is suppressed until the Temperature value is within Alarm limits from the time the controller is powered. This allows suppressing the Alarm during the start-up Alarm conditions.	No Yes (Default : Yes)
HIGH ALARM HYST >> **HIGH ALARM INHIBIT >>** The Parameter descriptions are the same as that for Low Alarm but applied to Control High Deviation 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)
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 : 20.0)

FACTORY > COIL / FILTER SENSOR

This parameter is dependent on the set value for COMPRESSOR OPERATION parameter. For Single & Cascade operation this parameter is not available. The parameter descriptions are the same as described for the parameters for **CABINET SENSOR**.

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 > FILTER OPERATION

This parameter is dependent on the set value for COMPRESSOR OPERATION parameter and is available for Single with Filter & Cascade with Filter operation only.

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.	-99.9 to 99.9 (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 the compressor(s) are switched-off for safety. The Compressor(s) are switched-on again only after the fault is removed and acknowledged.	Filter Alarm SP to 99.9 (Default : 60.0)

FACTORY > DEFROST OPERATION

Parameter Description	Settings (Default Value)
MODE >> *Disable* Defrost Operation is Disabled. *Automatic* Defrost operation is commenced at user set 'Defrost Interval' by switching of the compressor(s) for the set 'Defrost Time'. *Manual* Defrost operation is commenced by issuing manual start / stop commands.	DISABLE AUTOMATIC MANUAL (Default : DISABLE)
DEFROST TIME [M:S] >> Applicable for Automatic Defrost Mode. Sets the time duration for which the compressor(s) are kept off for the defrost operation.	1 to 99.59 (Min:Sec) (Default : 5 Sec)
DEFROST INTERVAL [H:M] >> Applicable for Automatic Defrost Mode. Sets the periodic time interval for commencing the defrost operation.	1 to 99.59 (Hour:Min) (Default : 8 Min)

FACTORY > DOOR MONITORING

Parameter Description	Settings (Default Value)
ENABLE >> Set to 'Yes' if the door open/close status is to be monitored.	NO YES (Default : NO)
SWITCH LOGIC >> *Open : Door Open* The door position is considered *Open* if the switch contacts are OPEN. *Close : Door Open* The door position is considered *Open* if the switch contacts are 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

This parameter is dependent on the set value for COMPRESSOR OPERATION parameter and is available for Cascade or Cascade with Filter or Cascade with Coil operation only. Refer Appendix-B : **HP / LP DIGITAL INPUT CONNECTION DETAILS.**

Parameter Description	Settings (Default Value)
ENABLE >> Set this parameter to 'Yes' if cascade compressor pressure fault switch is connected. If there is either a High or Low pressure fault then both Cascade & Cabinet compressors are switched-off for safety. The Compressors are switched-on again only after the 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

Refer Appendix-B : **HP / LP DIGITAL INPUT CONNECTION DETAILS.**

Parameter Description	Settings (Default Value)
ENABLE >> Set this parameter to 'Yes' if cabinet compressor pressure fault switch is connected. If there is either a 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 the 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 Operator. However, if required the password can be changed by setting the new value for this parameter. Set to 'Yes' for changing the Password.	No Yes (Default : No)
NEW PASSWORD >> This parameter is presented if 'Change Password' is set to 'Yes'. Set the new password value.	0 to 3000 (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

MECHANICAL INSTALLATION

Installation Precautions

Ensure the following precautions are taken while installing the device:

1. *Environment*
   Install in a location free from corrosive/combustible gases and electrically conductive pollutants.

2. *Temperature & Humidity*
   Avoid rapid temperature changes that may cause condensation. Ensure ambient conditions do not exceed the specified temperature and humidity limits.

3. *Electromagnetic Interference (EMI)*
   Protect the installation site from excessive electrostatic or electromagnetic interference.

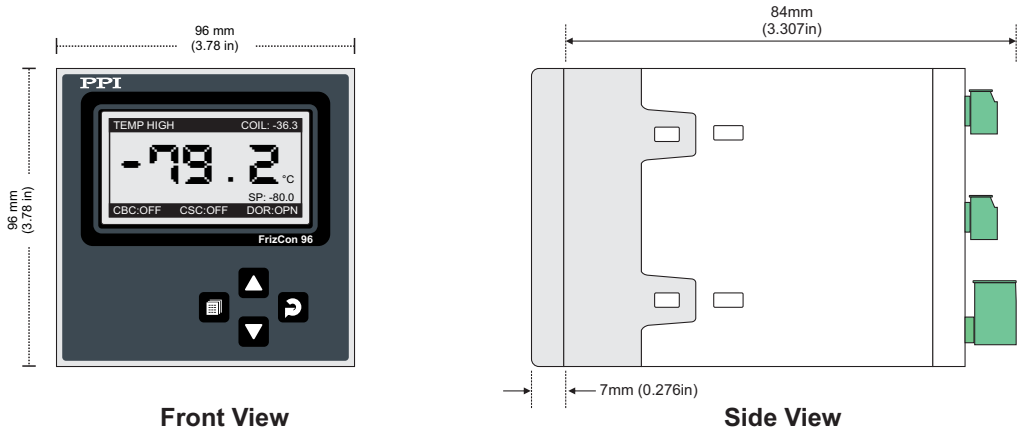
4. *Vibration & Shock*
   Do not mount the device in areas with high vibration or mechanical shock.

5. *External Elements*
   Keep the device away from dust, salt air, direct sunlight, and radiant heat sources.

Outer Dimensions

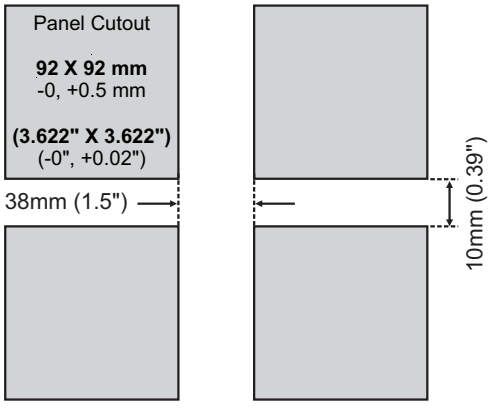
Refer to Figure 6.1 for the outer dimensions of the device.

Figure 6.1



Front View **Side View**

Figure 6.2

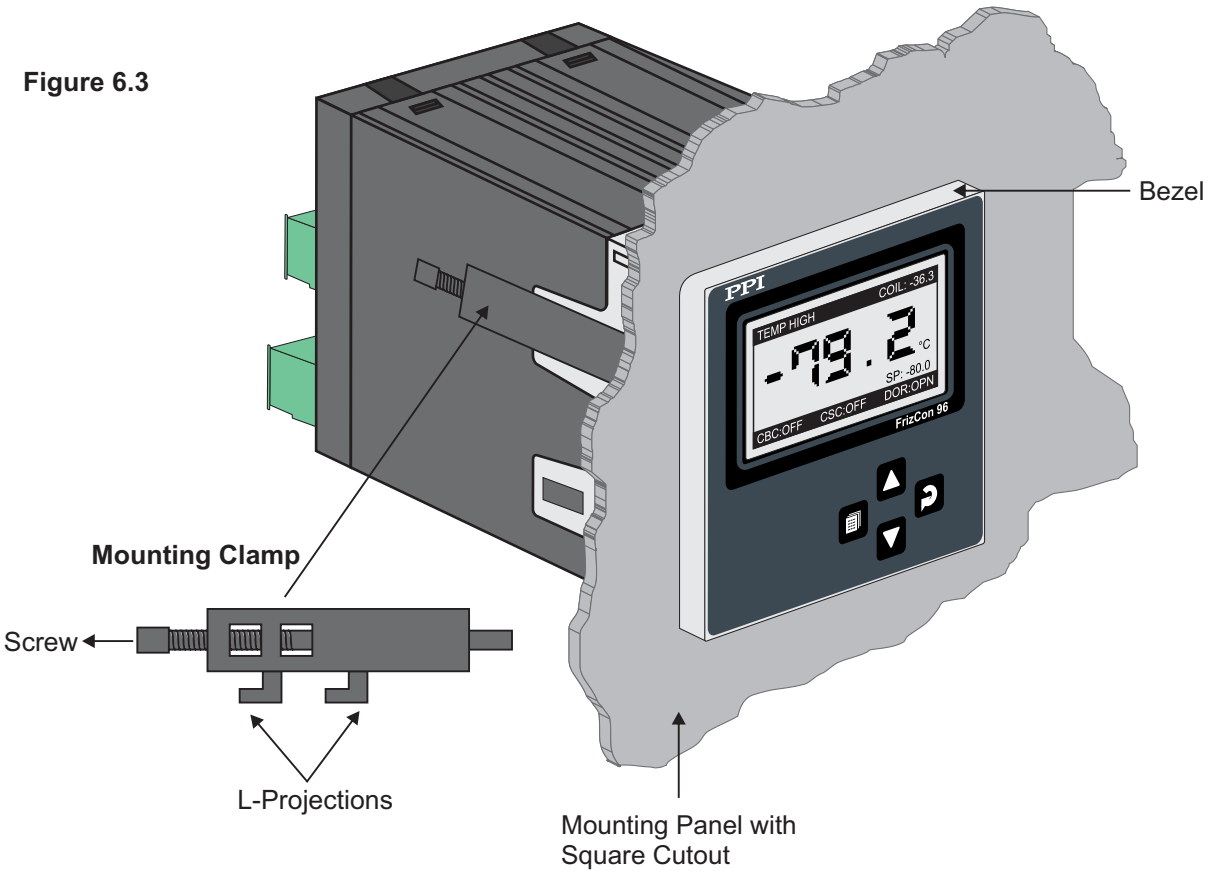


Panel Cutout & Spacing Requirements

- Cutout Size
  [92 × 92, mm, -0, +0.5 mm]
  [3.622" × 3.622", -0, +0.02"]
- Minimum Spacing
  Maintain the recommended clearance if installing multiple devices on the same panel.
- Reference
  See Figure 6.2 for panel cutout dimensions and spacing guidelines.

Panel Mounting Instructions

Figure 6.3



Follow these steps to securely mount the device on a panel:

1. Prepare the Cutout
   Create a square cutout on the panel according to the dimensions in Figure 6.2.

2. Remove Mounting Clamps
   Detach the Mounting Clamps from the device enclosure.

3. Insert the device:
   - From the front of the panel, insert the rear side of the device housing through the cutout.
   - Ensure the device sits squarely against the panel wall.
   - Caution: Apply pressure only on the bezel, not on the front label.

4. Secure with Mounting Clamps:
   - Attach each clamp so that its L-projections fit into the holes on the left and right sides of the enclosure.
   - Tighten the screws until the clamps firmly secure the device against the panel wall.

5. Reference
   - See Figure 6.3 for panel mounting.

Section 7

ELECTRICAL CONNECTIONS

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

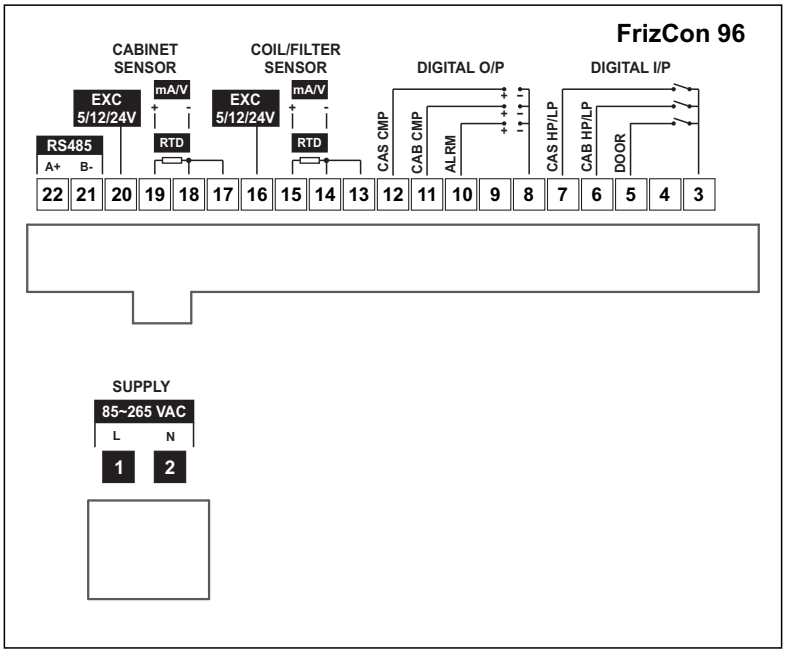
ELECTRICAL CONNECTIONS

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.

Figure 7.1



DESCRIPTIONS

The back panel connections are described as under:

Cabinet Compressor Sensor (Terminals : 20, 19, 18, 17)
Coil/Filter Compressor Sensor (Terminals : 16, 15, 14, 13)

The Controller accepts RTD Pt100 (3-wire / 2-wire), DC Current (mA) or DC Voltage (V) as inputs for the cabinet and the coil/filter temperature measurement. The connections are described below.

Figure 7.2 (a)

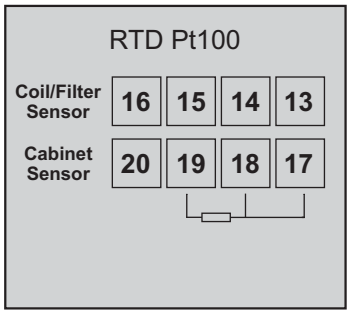


Figure 7.2 (b)

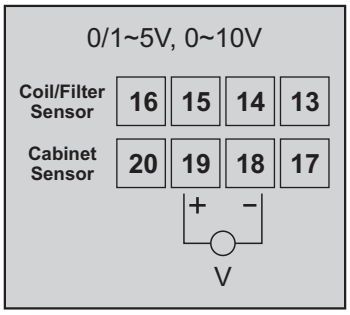
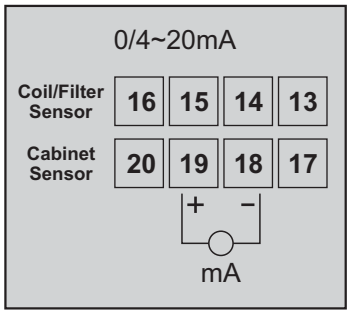


Figure 7.2 (c)



RTD Pt100, 3-wire

Connect single leaded end of RTD bulb to terminal 19 (15) and the double leaded ends to terminals 18 (14) & 17 (13) as shown in Figure 7.2 (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.

Temperature Transmitter with DC Voltage (V) Output

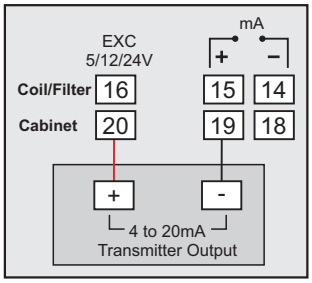
The Figures 7.2 (b) depicts wiring connections for voltage output transmitter. The Excitation Voltage can be obtained from an external source or from the controller.

Temperature Transmitter with DC Current (mA) Output

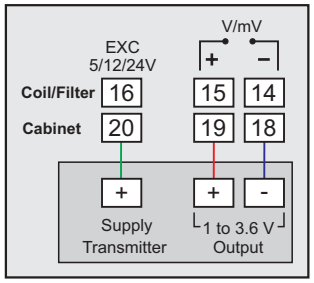
The Figures 7.2 (c) depicts wiring connections for current output transmitter. The Excitation Voltage can be obtained from an external source or from the controller.

Transmitter Excitation Voltage

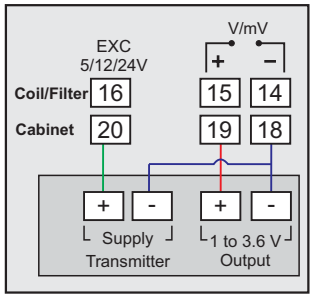
- The Excitation Voltage for powering external transmitters are provided on terminals 20 & 16 for Temperature & Humidity, respectively.
- The device provides a 5VDC @ 15 mA as standard. Optionally 12VDC @ 15 mA or 24VDC @ 50 mA is supplied.
- Wiring for different transmitter types are illustrated in below figures. The 1 to 3.6V output is only for example, the actual output could be any other values like 0 to 5V, 0 to 10V, etc.



2-wire Current Transmitter
(5/12/24VDC Supply)



3-wire Voltage Transmitter
(5/12/24VDC Supply)



4-wire Voltage Transmitter
(5/12/24VDC Supply)

Cascade Compressor Output (terminals : 12, 8)
Cabinet Compressor Output (terminals : 11, 8)
Alarm Output (terminals : 10, 8)

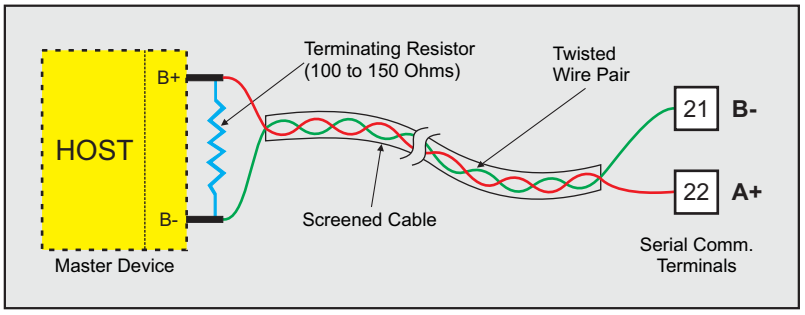
All the above control & alarm outputs are Voltage pulses (12VDC @ 20mA, Short-circuit protected) for driving external SSR or Relay. The '+' and '-' terminals are for voltage 'Source' and 'Return' paths, respectively.

Cascade HP/LP Digital Input (Terminals 7, 3)
Cabinet HP/LP Digital Input (Terminals 6, 3)
Door Open Digital Input (Terminals 5, 3)

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 22, 21)

Figure 7.4



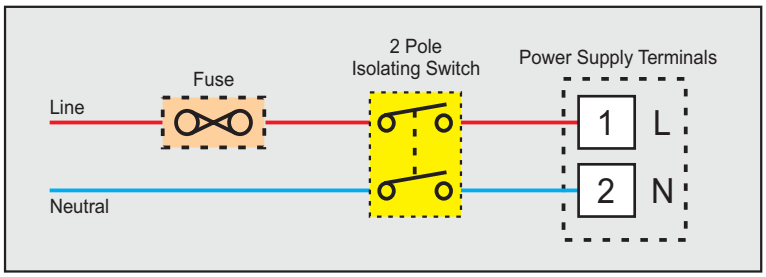
The controller Communication Port is RS485 and requires a similar port at the host (master) end. If, however, the host port is different (say, USB), use appropriate protocol converter (say, USB to RS485) for interface.

For reliable noise free communication, use a pair of twisted wires inside screened cable as shown in Figure 7.4. 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 1, 2)

As standard, the module is supplied with power connections suited for 85 to 265 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 7.5. 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 7.5



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.

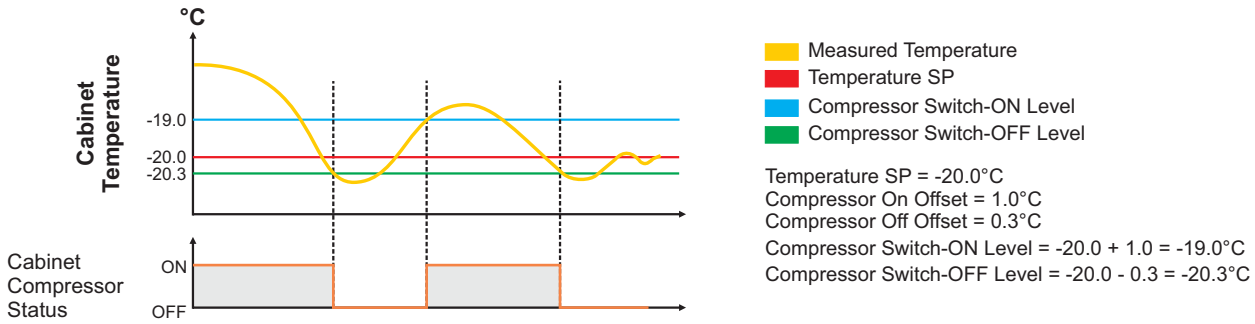
The time delay cycle is executed every time the compressor is turned off. The compressor turning off may be a result of power failure or the on-off control algorithm executed by the controller. The controller in "Auto Mode" monitors the Process Value (PV) against the Set-Point (SP) and attempts to switch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

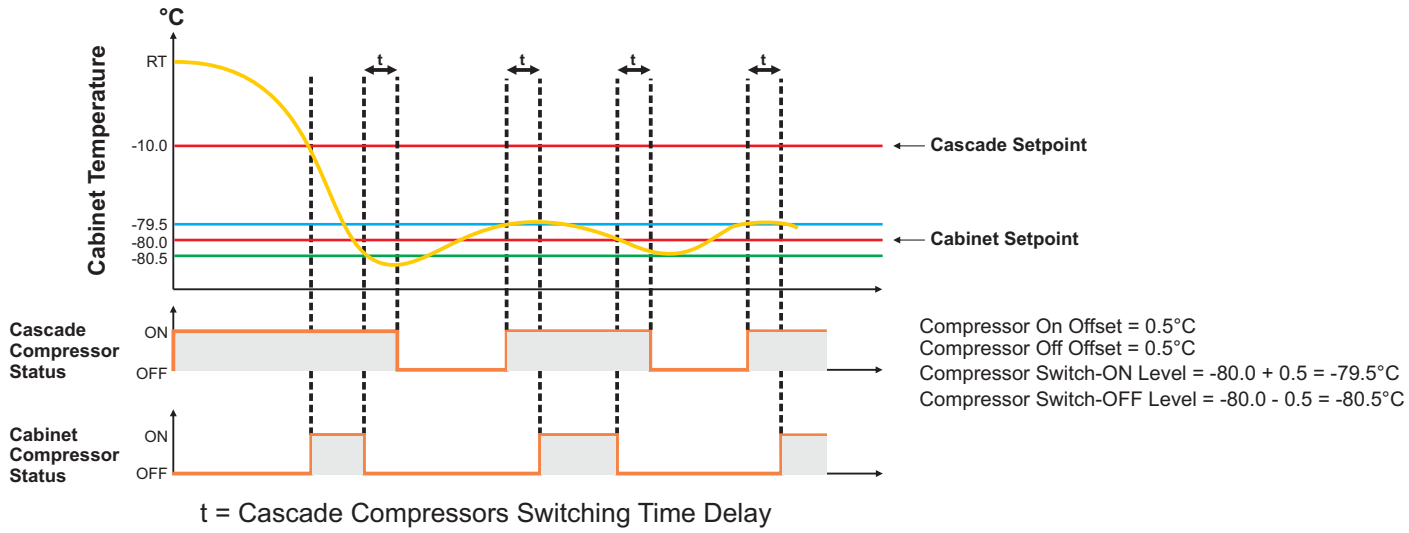
Compressor Switch - ON Level = (Temperature SP) + (Compressor On Offset)

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.

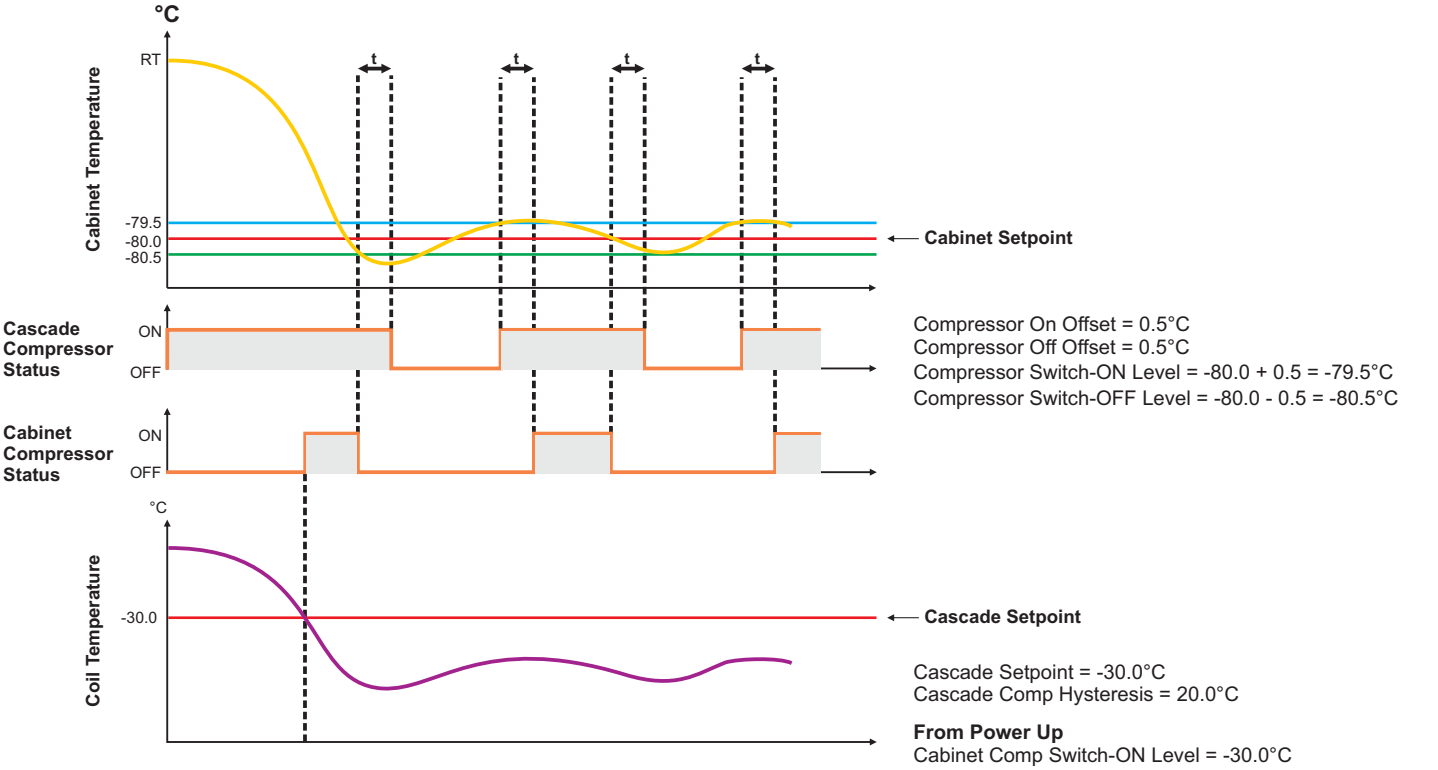


t = Cascade Compressors Switching Time Delay

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

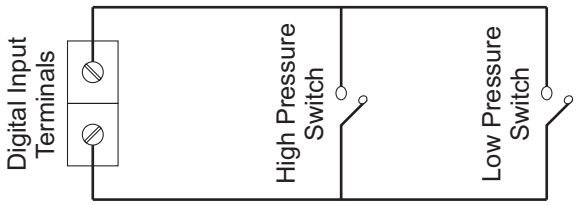
HP / LP DIGITAL INPUT CONNECTION DETAILS

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.

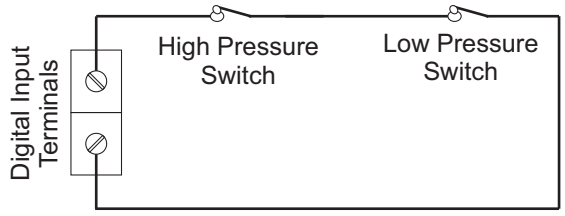
Also the parameters "*Switch Logic*" for Cabinet Compressor HP / LP & Cascade Compressor HP / LP should be set to "Close : HPLP".



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

Overview

Various transmitters generate different signal types, such as mV, V, or mA, with distinct signal ranges. To ensure compatibility with a wide range of transmitters, PPI products offer configurable Signal Type and Range settings.

Common industry-standard signal ranges include:

- 0 to 80 mV, 0 to 160 mV
- 0 to 5 V, 1 to 5 V, 0 to 10 V
- 0 to 20 mA, 4 to 20 mA

Additionally, since transmitters output different signal ranges corresponding to specific process values (e.g., a 1 to 4.5 V signal may represent 5% to 95% RH), PPI products allow users to configure the process value range and resolution.

Required Parameters for Linear Transmitter Interface

For interfacing linear transmitters, the following six parameters must be configured:

Parameter	Definition	Example
Input Type	Defines the standard DC signal type in which the transmitter signal range falls.	4 to 20 mA
Signal Low	The minimum signal value corresponding to the lowest process value.	4.00 mA
Signal High	The maximum signal value corresponding to the highest process value.	20.00 mA
PV Resolution	Defines the smallest measurable unit for the process value.	0.01 psi
Range Low	The process value corresponding to Signal Low.	0.00 psi
Range High	The process value corresponding to Signal High.	5.00 psi

Mathematical Representation

The relationship between transmitter signal values and the corresponding process values follows a straight-line equation:

$$Y = mX + C$$

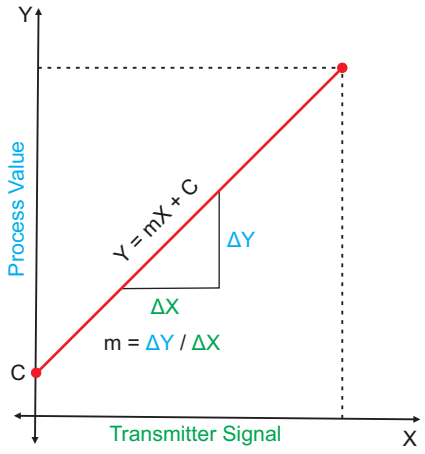
Where;

X : Signal Value from Transmitter

Y : Process Value Corresponding to X

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

m : Slope (Change in Process Value per unit Change in Signal Value)

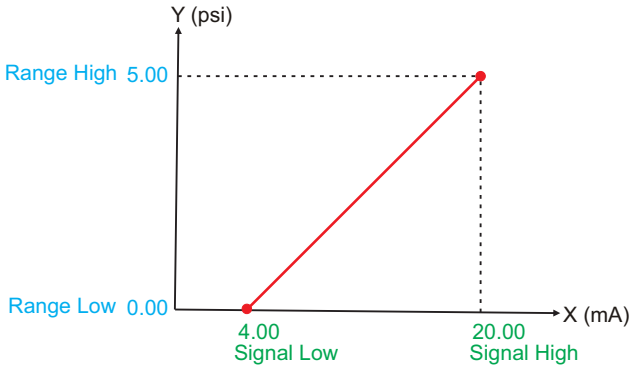


Examples of Transmitter Configurations

Example 1:

Pressure Transmitter (**4 to 20 mA** corresponding to **0 to 5 psi**)

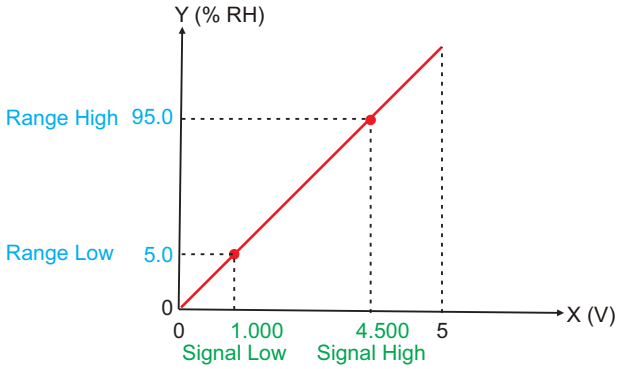
Input Type	:	4-20 mA
Signal Low	:	4.00 mA
Signal High	:	20.00 mA
PV Resolution	:	0.01
Range Low	:	0.00
Range High	:	5.00



Example 2

Humidity Transmitter (**1 to 4.5 V** corresponding to **5 to 95 %RH**)

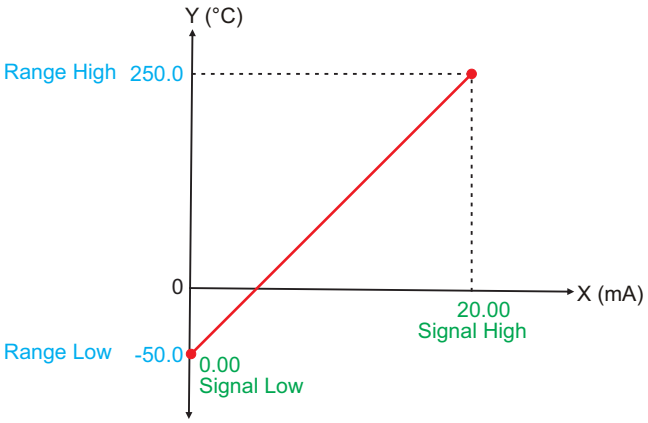
Input Type	:	0-5 V
Signal Low	:	1.000 V
Signal High	:	4.500 V
PV Resolution	:	0.1
Range Low	:	5.0
Range High	:	95.0



Example 3

Temperature Transmitter (**0 to 20 mA** corresponding to **-50 to 250 °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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