sub-Zero ®

INDIA
www.pvrcontrols.com

OPERATING INSTRUCTIONS

sub-Zero ®

SZ-FC- 4000

Introduction :

This is a two-compressor controller with an inbuilt Free Cooling Capability.

It is specifically designed to maintain the Shelter temperature at a desired level with the help of Compressors or by using Free Cooling concept at low ambient to save energy.

MAIN FEATURES:
1. Free Cooling concept: Incase of low ambient conditions controller will switch off the compressors and use outside ambient air with the help of dampers to maintain shelter temperature.

2. Separate settings for individual cooling units.

3. Incase one compressor is not capable of handling the load the second compressor will activate and both compressors will cutout at the lowest set point in Compressor cooling mode.

4. The controller features cycling of compressors so that there is no overload on one compressor.

5. Current sensing of both the compressors is provided to protect them by switching them OFF in adverse conditions.

6. Separate HP, LP and MCB inputs to protect compressors.

7. Separate alarm outputs are with the LED display for easy diagnostics.

Set Point	Function : To set the setpoint for compressors.
Press & hold set key for 4 seconds and release.	Display will show 0 and flash. Press Up/Down keys to enter password. User can go into set mode by entering correct password.

Set Point 1

Min	Max	Fac.
L3+2	P2-1	24^0C

Set Point 2

Min	Max	Fac.
L3+2	P2-1	25^0C

SET

Comp1LED will flash along with respective set point for compressor1. The setpoint1 value can now be changed by using the UP/DOWN keys. After achieving the desired value, press the set key and you will see "----" which confirms that the set point has been stored in memory. Comp2 LED will flash along with respective set point for compressor 2. In the similar manner use UP/DOWN key to set the desired value and press set key to confirm the settings.

1

| Parameter Setting	Function : To set the other parameters of the controller.
Hold up & down keys simultaneously for 4 seconds.	Display will show 0 & flash. To enter programming mode enter correct password by using Up/Down keys and press set key. Once user enters correct password display will show P2 and flash. To go to other parameters, use up / down keys. If user enters incorrect password, controller will come out of programming mode and will display temperature.

CT1

CT2

2

P1 Parameter	Function : Unit selection parameter of Controller .
To change P1 parameter, Press the SET key.	Use UP/DOWN key to set desired value. When P1 is set to 0 = Both Cooling units are selected. 1 = Cooling Unit 1 is selected. 2 = Cooling Unit 2 is selected.

Min	Max	Fac.
0	2	0

Example : Setting this parameter at 1 will select Unit1 only,unit2 will be off. Setting this parameter to 0 will allow to function both the units simultaneously.

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P2 Parameter	Function : To set high temperature limit.
To change P2 parameter, Press the SET key.	Use UP/DOWN key to set desired value. Once set at a particular value, this will not allow both set points to go above this value and below P3 setting.

Min	Max	Fac.
XX^0C	50^0C	35^0C

XX^0C : Largest set point+1

Ht

(Message on Display)

Example : Setting this parameter at 35^0C will not allow both set points to go above 35^0C. Also if the temperature reaches 35^0C, the display will show Ht (High Temperature), indicating that the temperature has reached or gone above the value of this parameter.

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P3 Parameter	Function : To set low temperature limit.
To change P3 parameter, Press the SET key.	Use UP/DOWN key to set desired value. Once set at a particular value, this will not allow both set points to go below this value and above P2 setting.

Min	Max	Fac.
0^0C	L3	20^0C

Lt

(Message on Display)

Example : Setting this parameter at 10^0C will not allow both set points to go below 10^0C. Also if the temperature reaches 10^0C, the display will show Lt (Low Temperature), indicating that the temperature has reached or gone below the value of this parameter.

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P4 Parameter	Function : To set the differential of set point 1 and set point 2.
To change P4 parameter, Press the SET key.	Comp1 LED and differential of compressor1 will flash. Use UP/DOWN keys to set desired value. Once desired value is set, press set key and you will see "---", this confirms differential for Compressor 1 has been stored. Immediately after up key is pressed comp2 LED flashes alongwith the differential for compressor 2. Use UP/DOWN keys to set desired value. Once desired value is set, press set key and you will see "---", this confirms differential for Compressor 2 has been stored.

Differential 1

Min	Max	Fac.
1^0C	20^0C	2^0C

Differential 2

Min	Max	Fac.
1^0C	20^0C	2^0C

Example : If compressor1 set point is set at 24^0C, and differential is set at 2^0C, then when the system reaches 26^0C (24^0C+2^0C), relay for compressor1will be ON. When the system reaches 26^0C, relay for compressor1 will be OFF since the differential is 2^0C.

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P5 Parameter	Function : To set probe calibration for shelter temperature sensor.
To change P5 parameter, Press the SET key.	Use UP/DOWN keys to set desired value. In time it may be possible that the display may be offset by a degree or so. To compensate for this error, you may need to add or minus the degrees required to achieve the correct temperature.

Min	Max	Fac.	**Example :** Temperature on the display is 28^0C, whereas the actual temperature is 29^0C. User need to set the P5 parameter to 1, which means once out of the programming mode, the display will show temperature 29^0C (28^0C+1^0C).
-10^0C	10^0C	0^0C	

P6 Parameter	Func.: To Set time delay between relay restart time for comp1 and comp2.
To change P6 parameter, Press the SET key.	Comp1 LED along with time delay for comp1 will flash. Use UP/DOWN keys to set desired value. Once desired value is achieved, press set key and you will see "---" which confirms time delay for Compressor 1 has been stored in memory. After pressing UP key comp2 LED flashes along with the delay for comp2. Use UP/DOWN keys to set desired, value. Once desired value is achieved, press set key and you will see "---" which confirms time delay for Compressor 2 has been stored in memory.

Time Delay 1

Min	Max	Fac.
0 Min	20 Min	3 Min

Time Delay 2

Min	Max	Fac.
0 Min	20 Min	3 Min

Example : If this parameter is set to 1 min, once the Compressor is OFF, it will be ON, only after 1 min, though temp. ON condition is achieved earlier.

t2 Parameter	Function : To set the time delay, to start comp 2 incase comp 1 cannot achieve the lower set point.
To change t2 parameter, Press the SET key.	This function is used to switch on the second compressor incase the heat load cannot be met with one compressor.

Min	Max	Fac.	**Example :** If set point 1 is 23 and set point 2 is 25 and if t2 para is set to 9 minutes, if the second comp. cuts out at 25, if comp. 1 is not able to achieve 23 for a period of 9 minutes, then after 9 minutes, second compressor will be switched ON and both compressors will cutout at the lower set point. If t2 is set less than P6, then P6 para will override t2 parameter. If set to 0, this feature is disabled.
0 Min	30 Min	9 Min	

t3 Parameter	Function : To set minimum off time between two compressor.
To change t3 parameter, Press the SET key.	This parameter is used to set the time delay between switching off of both compressors so that they do not switch off simultaneously.

Example : If this parameter is set to 5 seconds the second compressor will switch OFF after a 5 seconds from the first compressor if both are switching OFF simultaneously. |

Min	Max	Fac.	
0 Sec	15 Sec	5 Sec	If set to 0, this feature will not activate.

t4 Parameter	Function : To set the time delay, to avoid overloading of either compressor.
To change t4 parameter, Press the SET key.	This function is used to avoid overloading of any one compressor working at a stretch over a period of time.

| Min | Max | Fac. | **Example :** If this parameter is set at 12 hours, the setpoint, differential & time delay of both compressors will interchange after 12 hours The interchange will occur every 12 hours.

Time calculation will start at power on. This helps by not overworking any one compressor for long hours and increases compressor life. If for any reason the t4 and setpoints have been changed,the time calculation will start from the last change in any of these parameters. |
|---|---|---|---|
| 0Hr | 12Hrs | 12Hrs | |

Ad Parameter	Function: To set power on time delay for High temp alarm .
To change Ad parameter, Press the SET key.	Use UP/DOWN keys to set desired value. This paarameter sets a time delay on power on for the High temperature Alarm.

Min	Max	Fac.	**Example :** If this parameter is set to 20 Min, once the unit is powered on the high temperature alarm will not activate for 20 minutes even if there is a fault. This is very useful to avoid the nuisance alarm when a unit is switched ON and the Room temp. is above the set value of P2 parameter. After 20mins if the temperature is above P2 parameter then Display will show "Ht" and Alarm relay will activated.
0 Min	20 Min	20 Min	

C0 Parameter	Function : To set low current limit for compressor1.
To change C0 parameter, Press the SET key.	Use UP/DOWN keys to set desired value. This parameter is used to switch off the compressor incase it draws lower than the set current.

Min	Max	Fac.	Example : If this parameter is set at 1A, the controller will trip comp1 if it draws less than 1A.Controller will restart the compressor after the set time delay. If after 3 retries within 1 hour, current drawn is still less than 1A, the controller will trip the compressor on fault and activate the respective alarm relay. Also display will flash "UL". **Once fault is rectified user has to press reset key for 4 seconds to restart the Compressor.**
1A	C2	1A	
	Unit1		

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C1 Parameter	Function : To set low current limit for compressor2.
To change C1 parameter, Press the SET key.	Use UP/DOWN keys to set desired value. This parameter is used to switch off the compressor incase it draws lower than the set current.

Min	Max	Fac.	Example : If this parameter is set at 1A, the controller will trip comp2 if it draws less than 1A. Controller will restart the compressor after the set time delay. If after 3 retries within 1 hour, current drawn is still less than 1A, the controller will trip the compressor on fault and activate the respective alarm relay. Also display will flash "UL". **Once fault is rectified user has to press reset key for 4 seconds to restart the Compressor.**
1A	C3	1A	
	Unit2		

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C2 Parameter	Function : To set high current limit for compressor1.
To change C2 parameter, Press the SET key.	Use UP/DOWN keys to set desired value. This parameter is used to switch off the compressor1 incase it draws higher than the set current.

Min	Max	Fac.	Example : If this parameter is set at 10A, the controller will trip comp1 if it draws more than 10A.Controller will restart the compressor after the set timedelay. If after 3 retries within 1 hour, current drawn is still more than 10A, the controller will trip the compressor on fault and activate the respective alarm relay. Also display will flash "OL". **Once fault is rectified user has to press reset key for 4 seconds to restart the Compressor.**
C0	20A	10A	
	Unit1		

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C3 Parameter	Function : To set high current limit for compressor2.
To change C3 parameter, Press the SET key.	Use UP/DOWN keys to set desired value. This parameter is used to switch off the compressor2 incase it draws higher than the set current.

Min	Max	Fac.	Example : If this parameter is set at 10A, the controller will trip comp2 if it draws more than 10A.Controller will restart the compressor after the set time delay.If after 3 retries within 1 hour, current drawn is still more than 10A, the controller will trip the compressor on fault and activate the respective alarm relay. Also display will flash "OL". **Once fault is rectified user has to press reset key for 4 seconds to restart the Compressor.**
C1	20A	10A	
	Unit2		

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C4 & C5 Parameter	Function: To set time delay for curent alarms.
To change C4 & C5 parameter, Press the SET key.	Use UP/DOWN keys to set desired value. This parameter sets a time delay on compressor start up before Overload ,Underload.

Min	Max	Fac.	Example : If this parameter is set to 1 Min, once the compressor is on will ignore Overload, Underload for 1min.If the fault persists even after 1min then controller will sense Overload,Underload faults as described in C0, C1, C2& C3 parameters. C4 = Delay for Comp1 Alarms. C5 = Delay for Comp2 Alarms.
0 Min	30 Min	1 Min	

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L1 Parameter	Function : Free cooling Enable/ Disable for Unit1
To change L1 parameter, Press the SET key.	Use UP/DOWN key to set desired value. When L1 is set to 0 = Free cooling for Unit1 is disabled. 1 = Free cooling for Unit1 is enabled.

Min	Max	Fac.	Example : Setting this parameter at 1 will enable the Free cooling for unit1-damper1, motor1 and compressor1 will work according to conditions of Room, Ambient temperature and Room Humidity.
0	1	1	

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L2 Parameter	Function : Free cooling Enable/ Disable for Unit2
To change L2 parameter, Press the SET key.	Use UP/DOWN key to set desired value. When L2 is set to 0 = Free cooling for Unit1 is disabled. 1 = Free cooling for Unit1 is enabled.

Min	Max	Fac.	**Example :** Setting this parameter at 1 will enable the Free cooling for unit2 -damper2, motor2 and compressor2 will work according to conditions of Room, Ambient temperature and Room Humidity.
0	1	1	

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L3 Parameter	Function : Free cooling setpoint.
To change L3 parameter, Press the SET key.	Use UP/DOWN key to set desired value.

Min	Max	Fac.	**Example :** If this parameter is set to 22^{0}C then controller will work in free cooling mode if the ambient temperature is below 22^{0}C. But if the ambient temperature is>=22^{0}C, controller will switch to Compressor cooling mode.
P3	XX^{0}C	22^{0}C	
	XX : Smallest set point-2		

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L4 Parameter	Function : To set the differential for damper.
To change L4 parameter, Press the SET key.	Use UP/DOWN key to set desired value.

Min	Max	Fac.	**Example :** If L4 is set to 2^{0}C then in Free cooling mode controller will open the dampers when shelter temperature reaches or goes above the smallest set pt + 2^{0}C and will close the dampers at smallest set point.
1^{0}C	4^{0}C	2^{0}C	

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L5 Parameter	Function :To set Humidity set point to allow free cooling.
To change L5 parameter, Press the SET key.	Use UP/DOWN key to set desired value. If L5 is set to 70% and if shelter RH reaches or goes above 70% then the controller will close the dampers in steps. This will depend on L6 parameter.

Min	Max	Fac.	**Example :** If L5 parameter is set to 70%. Then if the Shelter RH goes above 70% ,Free Cooling will be OFF and Damper will be closed. Also Compressor will be switched ON . If L6 parameter is set 5% and if RH goes below 70% (70-5), Compressor will be switched OFF and Free Cooling will be ON, if Room Temperature is suitable.
35%	88%	70%	

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L6 Parameter	Function :To set differential for Humidity.
To change L6 parameter, Press the SET key.	Use UP/DOWN key to set desired value.
	Example : As explained for L5 parameter.

Min	Max	Fac.
3%	10%	5%

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d0 Parameter	Function :To enable/disable HP fault input for Unit1.
To change d0 parameter, Press the SET key.	Use UP/DOWN key to set desired value. **Example :** If d0 is set to 1 = HP1 fault input is enabled. 0 = HP1 fault inputs is disabled. Setting this parameter to 0 will ignore Hp1 fault for compressor1. If this parameter is set to 1 then controller will detect HP1 trip and incase of 3 HP1 trips in 1 hour or less time controller will trip the compressor1 on fault and activate the respective alarm relay. Also display will flash HP. **After attending the fault user has to press RST key for 4 seconds to restart compressor.**

Min	Max	Fac.
0	1	1

24

d1 Parameter	Function :To enable/disable HP fault input for Unit2.
To change d1 parameter, Press the SET key.	Use UP/DOWN key to set desired value. **Example :** If d1 is set to 1 = HP2 fault input is enabled. 0 = HP2 fault input is disabled. Setting this parameter to 0 will ignore HP2 fault for compressor2. If this parameter is set to 1 then controller will detect HP2 trip and incase of 3 HP2 trips in 1 hour or less time controller will trip the compressor2 on fault and activate the respective alarm relay. Also display will flash HP. **After attending the fault user has to press RST key for 4 seconds to restart compressor.**

Min	Max	Fac.
0	1	1

25

d2 Parameter	Function :To enable/disable LP fault input for Unit1.
To change d2 parameter, Press the SET key.	Use UP/DOWN key to set desired value. **Example :** If d2 is set to 1 = LP1 fault input is enabled. 0 = LP1 fault input is disabled. Setting this parameter to 0 will ignore LP1 fault for compressor1. If this parameter is set to 1 then controller will detect LP1 trip and incase of 3 LP1 trips in 1 hour or less time controller will trip the compressor1 on fault and activate the respective alarm relay. Also display will flash LP. **After attending the fault user has to press RST key for 4 seconds to restart compressor.**

Min	Max	Fac.
0	1	1

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d3 Parameter	Function :To enable/disable LP fault input for Unit2.
To change d3 parameter, Press the SET key.	Use UP/DOWN key to set desired value. **Example :** If d3 is set to 1 = LP2 fault input is enabled. 0 = LP2 fault input is disabled. Setting this parameter to 0 will ignore LP2 fault for compressor2. If this parameter is set to 1 then controller will detect LP2 trip and incase of 3 LP2 trips in 1 hour or less time controller will trip the compressor2 on fault and activate the respective alarm relay. Also display will flash LP. **After attending the fault user has to press RST key for 4 seconds to restart compressor.**

Min	Max	Fac.
0	1	1

27

LP Parameter	Function : To lock/unlock keypad.
To change LP parameter, Press the SET key.	Use UP/DOWN keys to set desired value. This parameter can lock the keypad so that tampering is not possible by bystanders. 0 = Keypad unlocked. 1 = Keypad locked. When locked all parameters can only be viewed, but can not be modified.

Min	Max	Fac.
0	1	1

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E1 Parameter	Function : This parameter is used to set the compressor Relay status on Room probe failure.
To change E1 parameter, Press the SET key.	Use UP/DOWN keys to set desired value. When set to 0 both the relays will stay ON with initial start-up delay as set by P6 parameter. When set to 1 both compressor performs a duty cycle of 10 minutes ON and 4 minutes OFF. When set to 2 both relays will be continuously OFF.

Min	Max	Fac.
0	2	0

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PA Parameter	Function : To change password.
To change PA parameter, Press the SET key.	Use UP/DOWN keys to change password. User can not enter into program mode, set mode if correct password is not entered.

Min	Max	Fac.
0	99	99

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FS Parameter	Function : To restore the default settings of the controller.
To change FS parameter, Press the SET key.	When set to 1 all parameters are programmed to factory values. Useful to debug setting related problems.

Min	Max	Fac.
0	1	0

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EP Parameter	Function : To end programming.
To end programming press the SET key.	Once the set key is pressed, the controller goes into the normal mode and displays the temperature and all settings are recorded.

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Operating messages and Icon status		
Message	Description	Parameter
Ht	Temperature equal to or above the maximum limit of the set point.	P2
Lt	Temperature equal to or below the minimum limit of the set point.	P3
PP	Probe short circuit, circuit open or without probe, or temperature >70^{0}C or <0 ^{0}C	
UL	Compressor Drawing less current than the set value.	C0, C1, C4, C5
OL	Compressor Drawing more current than the set value.	C2, C3, C4, C5
HP/LP	HP/LP fault for Compressors	d0,d1,d2,d3
CP	CT input error.	
⚊○● ON/OFF	Keypad locked/unlocked.	LP

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IMPORTANT NOTES

1. Power keys for unit1 and unit2.
If the power key is pressed for 4 seconds the unit will toggle between ON and OFF status.
2. The ON/OFF status of the units will be retained on power loss.

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Front Sticker :
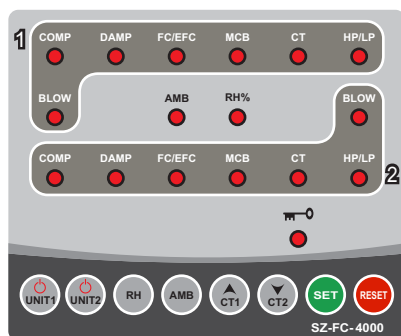
35

| Key Functions	
Key	Function
▲ CT1	In normal Mode, this key is used to view Compressor1 Current . In program/Set mode used to increament parameter value.
▼ CT2	In normal Mode, this key is used to view Compressor2 Current . In program/Set mode used to decreament parameter value.
AMB	This key used to view Ambient Temperature.
RH	This key used to view Shelter Humidity(%RH).
SET	This key used to enter set mode and also used to save parameters in program/set mode.
RESET	This key used to reset any pending faults in the controller.
⏻ UNIT1	This key used to switch ON/OFF UNIT1.
⏻ UNIT2	This key used to switch ON/OFF UNIT2.

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LED Indications and Status		
LED	LED Status	Description
FC/EFC	ON	Free Cooling is ON.
	OFF	Free/Emergency Cooling is OFF.
	Flashing	Emergency Cooling is ON.
DAMPER	ON	Damper Actuator in motion
	OFF	Damper Actuator Stopped.
BLOWER	ON	BLOWER is ON.
	OFF	BLOWER is OFF.
	Flashing	BLOWER in time delay.
COMP	ON	COMPRESSOR is ON.
	OFF	COMPRESSOR is OFF.
	Flashing	COMPRESSOR in time delay.
	Flashing (in prog. And set mode)	Represents the respective units.
MCB	ON	MCB FAULT
CT	ON	CT FAULT Overload
	Flashing	CT FAULT Underload
HP/LP	ON	HP FAULT
	Flashing	LP FAULT

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LED Indications and Status		
LED	LED Status	Description
AMB PROBE	ON	Ambient Temperature Probe Fail .
RH PROBE	ON	RH Probe fail(RH>90%).
	Flashing	RH Probe fail(RH<30%).

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Connection Sticker

ALARMS

10	9	8	7	6
5	4	3	2	1

UNIT1
UNIT2   HT

UNIT1

6	5	4
3	2	1

DAMPER ACTUATOR

2	3	1
6	5	4
3	2	1

LP
L
N
HP
To Evap Fan

UNIT2

6	5	4
3	2	1

SENSORS

AMB   ROOM

RH
G   R

8	7	6	5
4	3	2	1

B

POWER
230Vac

PHASE 2
NEUTRAL 1

COMP1

⊗	⊗
LINE FROM MCB1	Out to COMP1

COMP2

⊗	⊗
LINE FROM MCB2	Out to COMP2

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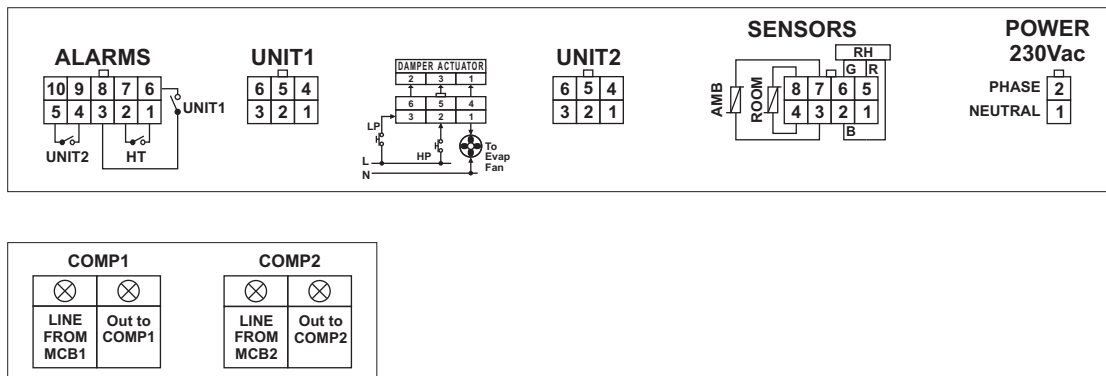
Technical Data :
Housing   : ABS plastic.
Mounting   : Wall mounting.
Connections   : **Compressor :** Screw terminal blocks.
                      ≤ 2.5sqmm one wire/ terminal only.
                      Others : Minifit type connector.
Display   : 2 X 14.2 mm (0.56") LED.
Operating temp. : $5^{o}C$ to $50^{o}C$(non-condensing).
Data storage   : Non-volatile EEPROM memory.
Power input   : 230VAC.
Output :
Damper   : 5A/250Vac.
Relay Comp   : 20A/250Vac.
Alarm   : 5A/250Vac.
Fan   : 10A/250Vac.
Storage temp : $-20^{o}C$ to $70^{o}C$(non-condensing).
Input   : Temp NTC probe, SZ-N75.
                      (For Room & Amb Temp)
                      Humidity, SZ-HS-220.
Range   : $0^{o}C$ to $50^{o}C$.
Resolution   : $1^{o}C$.
Accuracy for temp. : +/- $1^{o}C$.
Accuracy for RH : +/- 5%.
Probe tolerance at $25^{o}C$: +/- $0.3^{o}C$.

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Controller : Controller should be installed in a place protected by vibration, water and corrosive gasses and where ambient temperature does not exceed the values specified in the technical data.
Probe : To give a correct reading, the probe must be installed in a place protected from thermal influences, which may affect the temperature to be controlled.

CAUTION

WIRING: The probe and its corresponding wires should never be installed in a conduit next to control or power supply lines. The electrical wiring should be done as shown in the diagram. The power supply circuit should be connected to a protection switch.

WARNING: Improper wiring may cause irreparable damage and personal injury. Kindly ensure that wiring is done by qualified personnel only.

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Maintenance:

Cleaning : Clean the surface of the controller with a soft moist cloth. Do not use abrasive detergents, petrol, alcohol or solvents.

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OUR OTHER PRODUCTS

sub-Zero®

INDIA

Cold Room Controller
Chiller Controller
Two Compressors Controller
Heating Controller
Humidity Controller
Pressure Controller

CASTLE®

Ball Valves
Globe Valves
Hand Valves
Flow Switches
Solenoid Valves

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