Ener-Save SDN. BHD.

Operating and Maintenance Manual

For Water-Cooled Scroll Compressor Chiller

90 HP
HC Refrigerant Gas
415V-50Hz

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1.0 INTRODUCTION

1.0 Introduction

Water-cooled chiller is designed for indoor installation, room temperature for operating and standby condition is 10°C to 45°C. The chiller consists of 3 unit of high efficiency COPELAND Scroll Compressor and each compressor is driven by soft-starter to improve the compressor start-up performance. It charged with Hydro-Carbon refrigerant (HC-22a), this refrigerant is environment friendly. Due to the refrigerant's unique property, the chiller can archive the rated cooling capacity but with lower power consumption.

1.1 Components

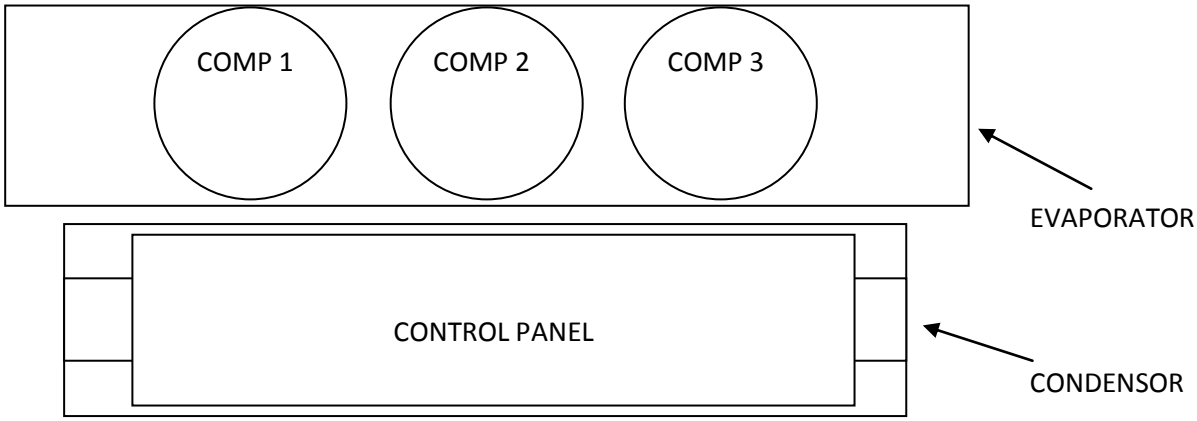

Figure 1: Components Location.

2.0 UNIT CONFIGURATION

2.0 Unit Configuration

The chiller unit has three refrigerant circuits. Each circuit consists a shell and tube water-cooled condenser, a single three-circuited shell and tube evaporator, interconnecting refrigerant piping and control panel with associated pressure switches and sensors.

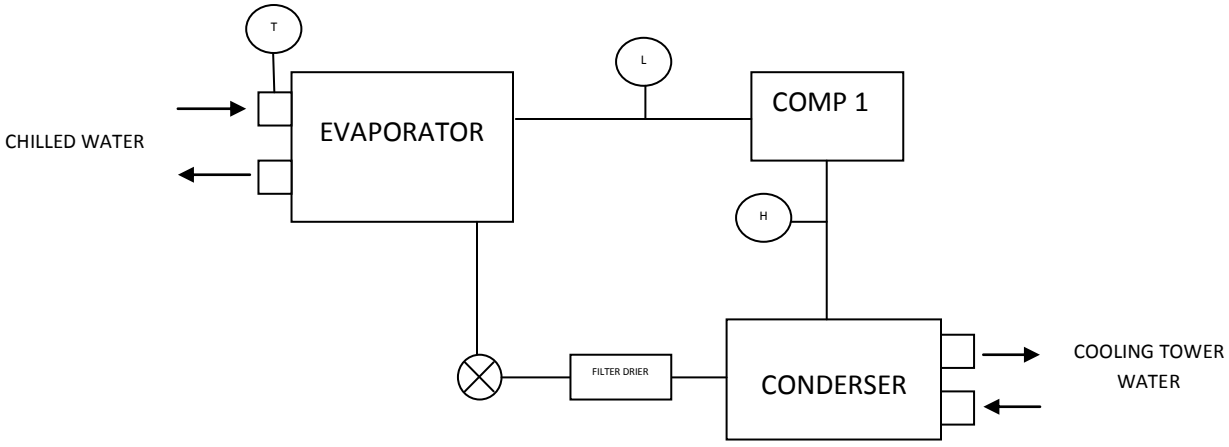

Figure 2: Schematic Piping Diagram. (One of Three Circuits for Chiller)

Legend:

H High Pressure Switch

L Low Pressure Switch

T Temperature Sensor

Thermostatic Expansion Valve

2.1 Field Wiring Diagram

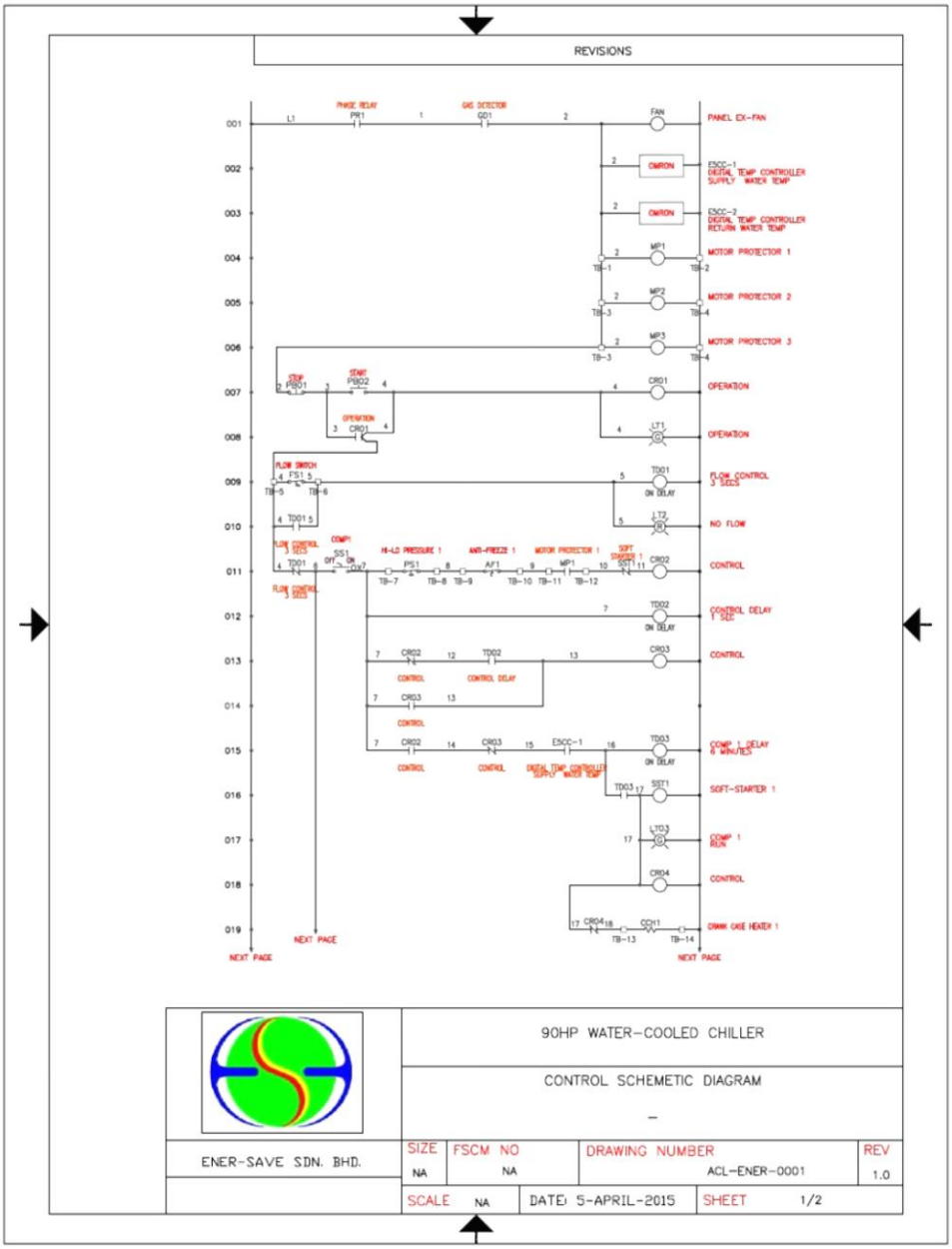

Figure 3: Electrical Control Schematic diagram 1.

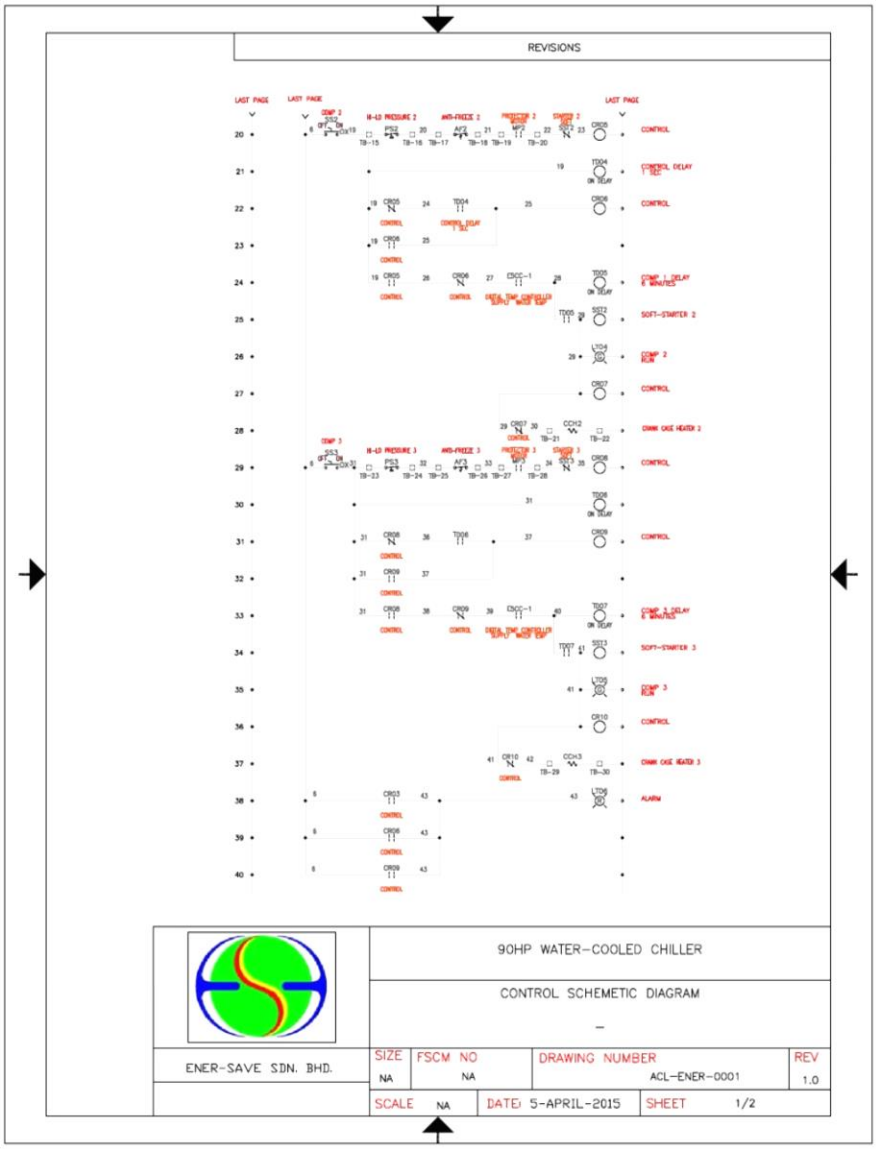

Figure 4: Electrical Control Schematic diagram 2.

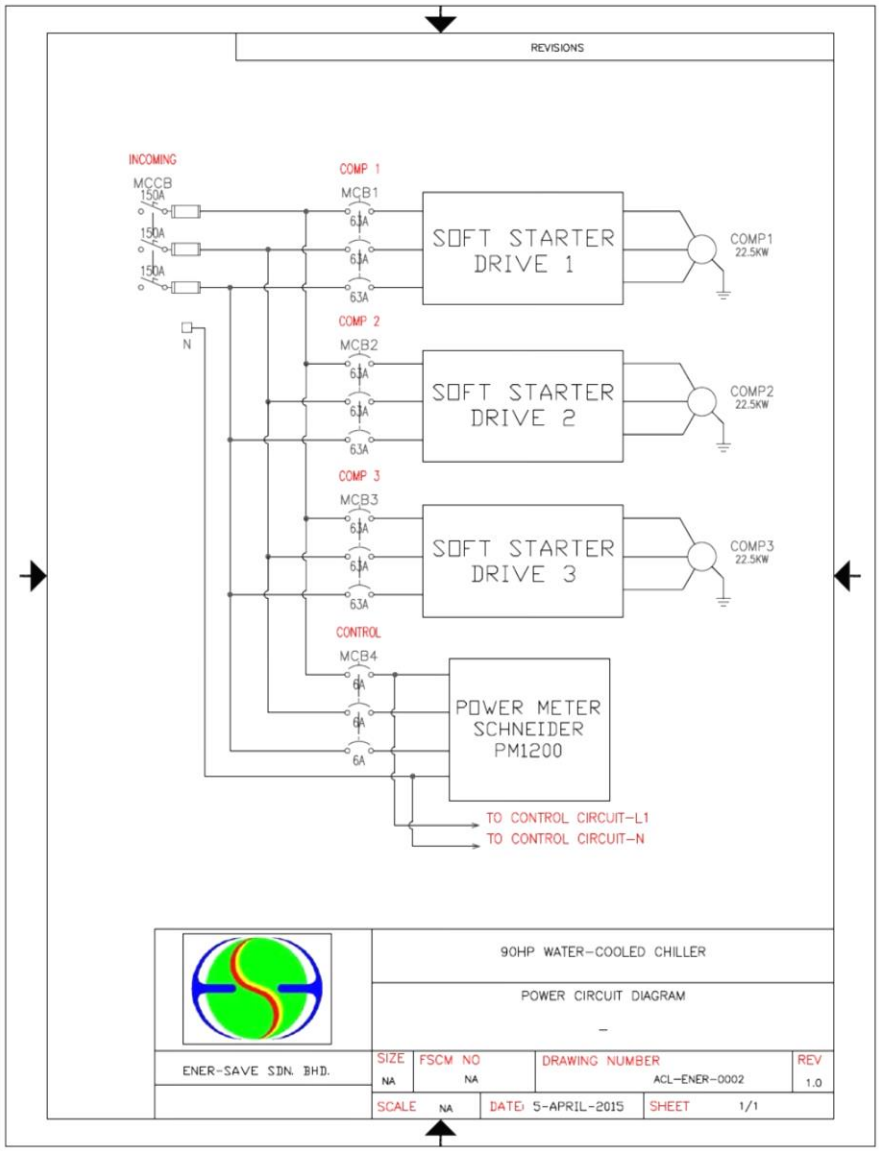

Figure 5: Electrical Control Schematic diagram 3.

2.2 Control Panel Layout

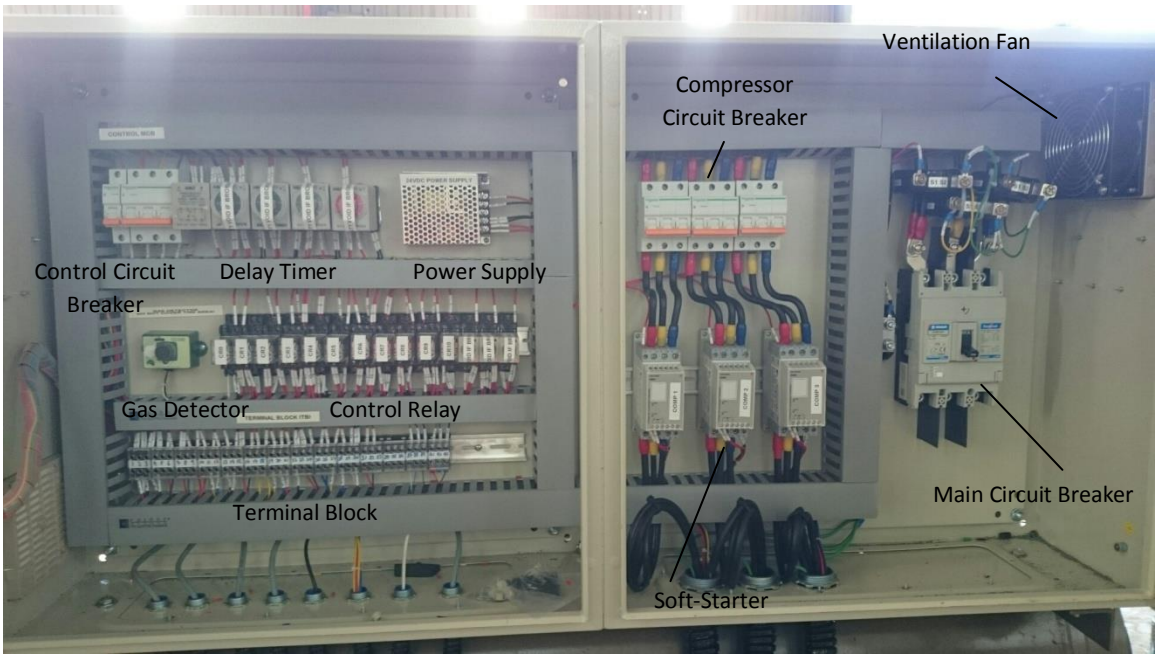

Figure 6: Control Panel Layout (3 Compressor Unit)

2.3 Motor Protector Module

The motor protection system consists of an external control module, located on each compressor, motor terminal box, connected to a series of thermistors located in the motor windings and the compressor discharge port. If the windings experience an over-temperature condition or the discharge temperature is excessive, the module will trip and shut off the compressor.

Warning!!

Disconnect the compressor three-phase power before removing the terminal box cover. Removal of the terminal box cover will expose the three-phase power connections. Contact live three-phase can cause serious injury or death..

3.0 START-UP AND SHUTDOWN

3.0 Start-Up and Shutdown

Pre Start-up

1. The chilled-water system should be flushed and cleaned. Proper water treatment is required to prevent corrosion and organic growth.
2. With main disconnect open, check all electrical connections in control panel and starter to be sure they are tight and provide good electrical contact. Although connections are tightened at the factory, they can loosen enough in shipment to cause a malfunction.
3. Check and inspect all water piping. Make sure flow direction is correct and piping is made to correct connection on evaporator and condenser.
4. Open all water flow valves to the condenser and evaporator.
5. Flush the cooling tower and system piping to be sure the system is clean. Start evaporator pump and manually start condenser pump and cooling tower. Check all piping for leaks. Vent the air from the evaporator and condenser water circuit, as well as from the entire water system. The cooler circuit should contain clean, treated, non-corrosive water.
6. Check compressor oil level. Prior to start-up, the oil level should cover at least one-third of the oil sight glass located in the equalizing line between the compressors or on the compressor.
7. Check the actual line voltage to the unit to make sure it is the same as called for on the compressor nameplate, within + 10%, and that phase voltage unbalance does not exceed 3%. Verify that adequate power supply and capacity is available to handle load.
8. Make sure all wiring and fuses are of the proper size.
9. Verify that all mechanical and electrical inspections by code authorities have been completed.

Start-Up

1. Open the compressor discharge shutoff valves until back-seated. Always replace valve seal caps.
2. Put the main power and control circuit disconnects to the “on” position.
3. Make the Incoming Phase Sequence is correct and the Phase Relay will indicate “ON” if the incoming phase sequence is correct.
4. Verify crankcase heaters have operated for at least 12 hours prior to start-up. Crankcase should be warm to the touch.
5. Check that the OMRON Temperature Controller is set to the desired chilled water temperature.
6. Check resets of all equipment protection controls.
7. Turn on the condenser water pump and chilled water pump. Make sure the water is being flow thru the condenser and evaporator.
8. Start the system by pushing the “Start” button on control panel.
9. If water is not being flow thru condenser and evaporator, the “Flow Switch” light up.
10. Select the compressor to run by turn on the compressor selector switch.

11. System should be running after 5 minutes of delay.
12. After running the unit for a short time, check the oil level in each compressor crankcase and check for flashing in the refrigerant sight glass.

3.1 Weekend or Temporary Shutdown

1. Simply press “STOP” button on chiller’s control panel will stop the current operation.
2. Leave the main breaker and control circuit breaker in “ON” position to let the crankcase heater to run.
3. Turn off the chilled water pump.

   Note: With the unit in this condition, it will not restart until these switches are turned back on. It is important that the compressors pump down before the water flow to the unit is interrupted to avoid freeze-up in the evaporator.

3.2 Start-Up after Temporary Shutdown

1. Start the water pumps.
2. Check compressor crankcase heaters, crankcase area should be warm.
3. Press “START” button on chiller’s control panel to activate the system.
4. Turn on the compressor by turning on the selector switch of compressor.
5. Observe the unit operation for a short time; make sure nothing unusual sounds or possible cycling of compressors.

4.0 OPERATING SEQUENCE

4.0 Sequence of Operation

The following sequence of operation is typical for water chiller models. The sequence can vary slightly depending upon options.

4.1 Compressor Heaters

With the control circuit power on and the control operation stop, 240V power is applied through the control circuit breaker to the compressor crankcase heaters HTR1, HTR2 and HTR3.

4.2 Compressor Start-up Sequence

When the system operation “START” button is being pressed, the system will follow the table below to start-up the compressor.

Compressor #	Delay of Time (Minutes)	Maximum Starts per Hour
1	5	12
2	6	12
3	7	12

Table 1: Compressor Start-up Timing

Based on the table above, compressor one will be the first to run and second compressor will run and the third one. Each compressor will have the maximum start per hour is because the compressors are driven by soft-starter. Therefore, to protect the soft-starter and compressor, all delay timings are cannot be adjust.

4.3 Compressor Cut-off Sequence

Compressor cut-in and off sequence is controlled by outgoing chilled water temperature and powered by OMRON Digital Temperature Controller. So, all the compressors will base on the setting temperature and outgoing chilled water temperature to run accordingly. The standard sequence for start-up will be compressor 1 > compressor 2> compressor 3. But when it reached the desired temperature, the compressor will be cut-off from compressor 3> compressor 2> compressor 1. Each step will having temperature differences of 1.5°C. The table below will show the compressor operating sequence for chiller system.

Example: Temperature Setting on Controller : 7°C			
Chilled Water Actual Temperature	Status		
	Compressor 1	Compressor 2	Compressor 3
9.0°C	RUN	RUN	RUN
8.5°C	RUN	RUN	OFF
8.0°C	RUN	RUN	OFF
7.5°C	RUN	RUN	OFF
7.0°C	RUN	OFF	OFF
6.5°C	RUN	OFF	OFF
6.0°C	RUN	OFF	OFF
5.5°C	OFF	OFF	OFF
5.0°C	OFF	OFF	OFF

4.4 Setting Temperature Controller

There are 2 unit of temperature controller were mounted on chiller's control panel. Only the top unit of controller is in charge to control the compressor operating sequence. Therefore, only the top unit controller is settable and the bottom unit is for reference only. **Maximum set point** of the controller is **30°C** and the **minimum set point** for controller will be **6°C**.

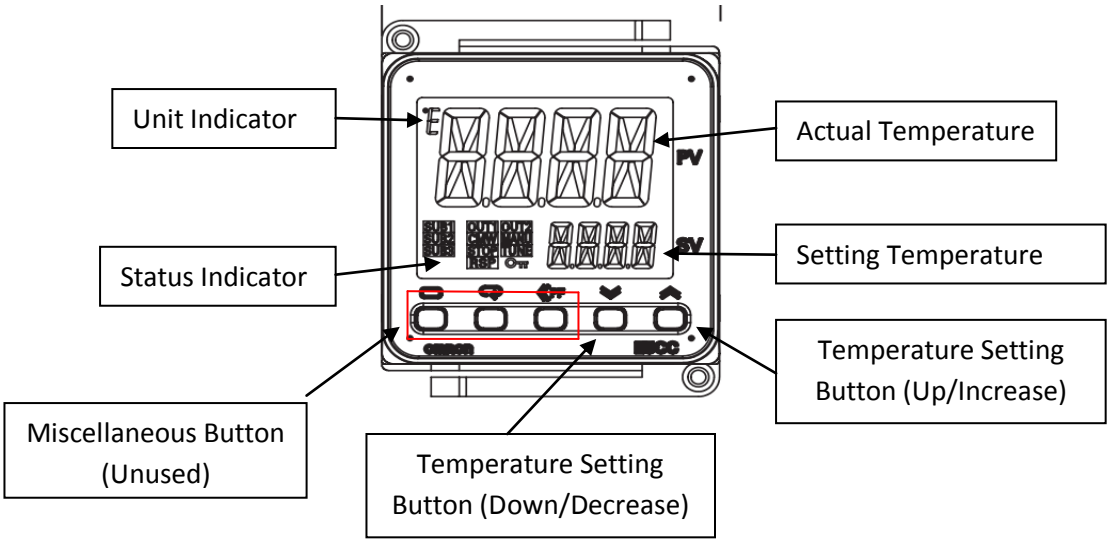

Figure 7: OMRON Digital Temperature Controller.

To setting the desired temperature:

1. Power up the system and wait until the controller shows the actually temperature.
2. Press once the **TEMPERATURE SETTING BUTTON**, the value of **Setting Temperature** will start blinking.
3. Press the **TEMPERATURE SETTING BUTTON (Up or Down)** to increase or decrease the value. Press and hold the Temperature Setting Button for fast moving of value.
4. Once reached the desire temperature, release the Temperature Setting Button and let it blink for 3 seconds.
5. Once the value is stop blinking, the value is save and stored to the system.

5.0 TROUBLESHOOTING

5.0 Troubleshooting

Table below shows the troubleshooting method allow user to perform solve their problem by their own. If the problem persists, please contact the reseller for support and information.

No	Problem	Possible Causes	Solution
1	Pressed "START" button on panel but no response.	1. Phase Sequence Relay: If detected wrong phase sequence, system won't activate.	• Rectify the incoming supply's sequence and re-activate system.
		2. Hydro-Carbon Gas Detected.	• Check is there any leakage on system. • Ventilate the ambient with fresh air.
		3. DC power supply error.	• Replace the DC power supply.
2	"Flow Switch" Tripped	1. Make sure the water flow is not interrupted.	• Check pipeline's control valve and water flow.
		2. Water pump is off.	• Turn-on the water pump.
		3. Water strainer blocks.	• Clean the water strainer.
		4. Sensor wire disconnected.	• Check and re-connect sensor wire.
3	Temperature Controller Displayed "S.ERR"	1. Sensors wire disconnected.	• Check and re-connect sensor wire.
		2. Sensors malfunction	• Replace the sensor.
		3. Controller setting error	• Contact vendor.

4	"Comp 1" light off and "Fault" light on during operation.	1. Compressor 1 high pressure tripped.	• Check condenser water flow. • Clean condenser if condenser is dirty.
		2. Compressor 1 low pressure tripped.	• Check evaporator water flow. • Evaporator temperature too low. • Refrigerant leakage.
		3. Compressor 1 anti-Freeze tripped.	• Evaporator temperature too low.
		4. Compressor 1 motor protection module tripped.	• Chiller water temperature too high. • Compressor overloaded.
		5. Compressor 1 soft-starter error.	• Compressor overloaded. • Control panel temperature too high.
5	"Comp 2" light off and "Fault" light on during operation.	1. Compressor 2 high pressure tripped.	• Check condenser water flow. • Clean condenser if condenser is dirty.
		2. Compressor 2 low pressure tripped.	• Check evaporator water flow. • Evaporator temperature too low. • Refrigerant leakage.
		3. Compressor 2 anti-Freeze tripped.	• Evaporator temperature too low.
		4. Compressor 2 motor protection module tripped.	• Chiller water temperature too high. • Compressor overloaded.
		5. Compressor 2 soft-starter error.	• Compressor overloaded. • Control panel temperature too high.
6	"Comp 3" light off and "Fault" light on during operation.	1. Compressor 3 high pressure tripped.	• Check condenser water flow. • Clean condenser if condenser is dirty.

		2. Compressor 3 low pressure tripped.	• Check evaporator water flow. • Evaporator temperature too low. • Refrigerant leakage.
		3. Compressor 3 anti-Freeze tripped.	• Evaporator temperature too low.
		4. Compressor 3 motor protection module tripped.	• Chiller water temperature too high. • Compressor overloaded.
		5. Compressor 3 soft-starter error.	• Compressor overloaded. • Control panel temperature too high.
7	"Comp 1" light on and "Fault" light off but Compressor 1 not running.	1. Compressor 1 soft-starter malfunction	• Replace the soft-starter.
8	"Comp 2" light on and "Fault" light off but Compressor 2 not running.	1. Compressor 2 soft-starter malfunction	• Replace the soft-starter.
9	"Comp 3" light on and "Fault" light off but Compressor 3 not running.	1. Compressor 3 soft-starter malfunction	• Replace the soft-starter.