



Liebert® CRV4 - 025 to 060

Precision Air Conditioning

Technical Manual

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Purpose of the Document

This document applies to the series of precision air conditioners and cooling solutions which maintain optimal environmental control of technological ecosystems at minimal operating costs. This document gives an overview of the specifications, installation, commissioning, and maintenance procedures with troubleshooting from the user perspective. The figures used in this document are for reference only.

Please read this manual carefully before installing, maintaining, and troubleshooting.

Vertiv™ Liebert® CRV4 series precision CRAC is a professional device, only professionals are permitted to access the unit and is kept in a place where access is restricted to common people.

Styling used in this Guide

The styles used in the manual will be defined as mentioned in the following table:

Situation	Description
<u>Warning/Danger/Caution</u> 	The <i>Warning/Danger/Caution</i> note indicates a hazardous or potentially harmful situation that can result in death or injury. It also indicates instructions that need to be adhered to, failing which may result in danger and safety issues thereby having an adverse effect on the reliability of the device and security. Even for practices not related to physical injury, to avoid equipment damage, performance degradation, or interruption in service, follow the warning instruction.
<u>Note</u> 	The <i>Note</i> section indicates additional and useful information. It also calls attention to best practices and industry-best protocols that are standardized and help make maximum utilization of the resources at hand. Helpful information related to the product also comes under the <i>Note</i> heading, helping the users with the definitions, concepts, and terminologies used in the manual.

Version History

Version	Revision Date	Issue	Changes
V1.3.1	08.05.2022	31020877	---

Safety Precautions and Measures

The important safety precautions and measures that should be followed during the installation and maintenance are described in the following sections.

Read the manual prior to installation and operation of the unit. Only qualified personnel should move, install, or service this equipment.

Before working on the equipment, the user reads and considers all precautions, compliance and safety measures. The unit control must be used exclusively for the purpose which it is intended for; the manufacturer takes no liability for incorrect use or a modification to the unit control.

Adhere to all the Warnings and Cautionary measures included in the manual.



Please read this manual carefully before installing, maintaining and troubleshooting; especially the Warning/Danger/Caution information in the User Guide. Apart from the User Guide, also pay attention to the warning labels on the unit and its components.

This manual is retained for the entire service life of the unit. The user must read all the precautions, danger, warnings, and cautionary measures mentioned in the manual prior to carrying out any operations on the unit. Each unit is equipped with an electric insulation which allows the users to work in safe conditions. The main switch is positioned on the electrical panel cover; to access it, open the right door. Before any maintenance operation, switch off the unit with this electrical insulation device to eliminate risks such as electrical shocks, burns, automatic restarting, moving parts, and remote control. The panel key, supplied along with the unit, must be kept by the personnel responsible for the maintenance. The protective covers can be removed after the electric power has been cut off by opening the main switch.

In the following sections, notice the various cautionary measures and warnings that need to be read carefully prior to installing or operating the system.

Disconnect the local and remote power supplies prior to working with the unit.

Prior to the installation process, read all the instructions, verify if all the parts are in place, and check the nameplate to ensure the voltage matches the available utility power for the unit.

The controller doesn't isolate power from the unit even in the Off mode, and some internal components still require and receive power during the Off mode.

If the unit door is open while the fans are operating, the airflow may result in abrupt slamming of the door resulting in injury. Another aspect is the presence of small objects in the fans bay that can result in object ejection during the fan start-up and there is a probable risk of being hit by these objects resulting in grievous injury and causing equipment damage.

The unit contains fluids and gases under high pressure. Therefore, the pressure should be relieved before working with the piping.

Various components such as compressors, refrigerant discharge lines, and humidifiers are extremely hot during the unit operation. Therefore, allow sufficient time for the unit to cool down before working with the unit cabinet. Handle the unit with extreme caution and wear safety equipment such as protective gloves, safety shoes, and arm protection while working with the hot compressors, discharge lines, and reheats.

There is a risk of water leaking that can damage both the equipment and the building. Effective water drain connection and facilities should be available. Installation should be precise. Implementation of the application and service practices should be appropriate and fault-free. Failure to comply with these norms will result in water leakage from the unit. Water leakage can lead to massive damage and loss of critical equipment in the hosting ecosystem. Therefore, care should be taken to ensure that the unit is not located directly above any equipment that could sustain damage due to water and excessive moisture. Use of a leak detection system for the unit and system supply lines are recommended by Vertiv Co.

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Chapter 1: Introduction

Vertiv™ Liebert® CRV4 series air conditioner (“Liebert CRV4” for short hereafter) is an elegant row-cooling equipment, which should not be accessible to the general public. This chapter introduces the model description, product introduction, features, and main components of the Liebert CRV4 series of air conditioner.

1.1. Product Introduction

The Liebert CRV4 series is the next generation series of air conditioners that provide precise environmental control. Liebert CRV4 air conditioners are products that are specifically created and designed for the small to medium data centers, computer rooms, and similar ecosystems which require a high degree of accuracy and precision. It addresses the needs and challenges associated with such applications and setups. It caters to sensitive applications that need a suitable environment for optimal performance. Therefore, care should be taken when testing these products to maintain favorable conditions for mission-critical equipment. Precision Air Conditioning must not only keep room conditions within a specific range but also must have the capability to react quickly to drastic changes in the heat-load and prevent wide temperature fluctuations.

The Liebert CRV4 air-cooled AC unit is packed with features such as high reliability, high sensible heat ratio, and large airflow. The unit has an air-cooled single circuit system and configured with EC fan.

The Liebert CRV4 series air-cooled air conditioning is a stand-alone, direct expansion system with variable capacity, available in both 300 mm (25 kW) and 600 mm (35, 45 & 60 kW) versions, complete with roof or wall-mounted condenser. It is ideally suited for rack-level cooling, specifically designed for high return air temperatures. The Liebert CRV4 optimizes air distribution and maximizes efficiency, delivering both cost and economical operation.

1.2. Model Nomenclature

The Liebert CRV4 air conditioner series is fully-defined by twenty-five digits, as represented in [Table 1-1](#).

Table 1-1 Liebert® CRV4 Model Nomenclature

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	
C	R	0	2	5	R	A	1	N	8	S	7	1	2	E	3	0	0	0	0	C	V	0	4	0	
Digit 1, 2 Product Model													Digit 15 Coil and Valves												
CR				CRV									E		Standard DX Air- Cooled Coil, EEV										
Digit 3, 4, 5 Cooling Capacity kW													Digit 16 Enclosure Options												
025/ 035/ 045/ 060				Nominal Cooling Capacity- kW									3		Black Color Sand Grain Coating, EG7021										
Digit 6 Air Discharge													Digit 17 Mains Switch High Voltage Options												
R				Horizontal Airflow with Baffle									0		None										
H				Horizontal Airflow without Baffle									A		Dual Power Supply Interlocking Contactor										
Digit 7 System Type													Digit 18 Installation Options												
A				Air-cooled									0		None, Standard Pipe, No Low Ambient Kit										
P				Refrigerant Pump Cooling									H		Reheat & Humidity Lockout										
Digit 8 Airflow													Digit 19 Monitoring												
1				EC Plug Fan									L		Air-cooled, Long Pipe > 30 m										
													C		Low Ambient Kit										
Digit 9 Power Supply													Digit 20 Sensors												
N				380 V - 415 V/ 3 Ph/ 50-60 Hz+N									B		Low Ambient Kit+Long Pipe										
													S		SIC Card										
Digit 10 Cooling System													Digit 21 Packaging												
8				EC Compressor, Single Circuit, R410A									P		Packaging- Standard Cardboard and Wooden Pallet										
L				EC Compressor, Single Circuit, R410A, Single Pump									C		Packaging- Wooden Crate										
Digit 11 Humidification													Digit 22 Special Requirements												
0				None									W		Wet Film Humidifier										
S				Electrode Humidifier									A		SFA-None										
Digit 12 Display													Digit 23 Order Identifier												
S				Standard Display									V		Condensate Pump										
7				Global HMI 7” Screen									0		Bottom Piping										
Digit 13 Re-heating													Digit 24 Order Identifier												
0				None									1		Top Piping										
1				Electrical Heating Std. 1 Stage									4		CRV4										
Digit 14 Filtration													Digit 25 Order Identifier												
2				G4									0		Industry Code										
0				G4+Filter Clog Switch									1		Telecom Code										

The standard components are represented in '**Bold Italic**' font in [Table 1-1](#).

1.3. Product Appearance

Figure 1-1 shows the appearance of various models in the Liebert® CRV4 series.



Figure 1-1 Appearance of the Liebert CRV4 Air Conditioner

1.4. Main Components

The indoor unit of the Liebert CRV4 includes EC compressor, evaporator, electronic expansion valve (EEV), humidifier, EC fan, electrical heater, sight glass, filter dryer and micro-controller.

1.4.1. EC Compressor

The Liebert CRV4 series comprises a scroll compressor which has promising features such as: low operating noise, less vibration, and high reliability. Its compactness, smooth compression with scroll operation and high energy efficiency ratio make it an ideal compressor for the CRV4 series; and it also has a Rotalock (screw thread) connection mode that makes the maintenance more easier.

1.4.2. Evaporator

Liebert CRV4 series is equipped with a 7 mm copper tube finned evaporator with high heat dissipation efficiency. This evaporator facilitated with a 'distributor', which is designed to ensure even distribution of refrigerant in each loop of the evaporator. The distributor is also validated according to each specific model of Liebert CRV4 series that improves the evaporator efficiency to a great extent.

1.4.3. Electronic Expansion Valve (EEV)

The EEV is designed for modulating control of the refrigerant mass-flow with precision. The EEV collects temperature and pressure signals at the same time to accurately regulate the refrigerant flow.

1.4.4. Electrode Humidifier

Electrode humidifier adopts a simple structure form with large humidifying volume and high efficiency. It enables easy disassembly and maintenance.

1.4.5. EC Fan

The EC fan has the characteristics of high efficiency, energy saving, space saving and hot-swappable design.

1.4.6. Electrical Heater

PTC heater is used. It features fast heating speed, even heat distribution, and supports safe & reliable working.

1.4.7. Sight Glass

The sight glass is the window of the system cycle, for observing the refrigerant state, mainly the moisture content of the system. When the moisture content exceeds the standard value, the color will be changed in the sight glass.

1.4.8. Filter Dryer

The filter dryer eliminates the moisture effectively in the system, and also filtrates the impurities generated during the long-term system operation so as to ensure normal system operation.

1.4.9. Display Screen

The Liebert® CRV4 air conditioning unit is configured with 7-inch HMI color screen or LCD screen. The user interface operation is simple. The multi-level password protection feature can effectively prevent unauthorized operation. It also provides power failure auto-restoration and high & low voltage protection functions. The operation status of the components are available on the respective menus. The expert-level fault diagnosis system can automatically display the current fault information, facilitating easy maintenance. It can store up to 1000 historical event records.

1.4.10. Remote Monitoring Software

The Liebert CRV4 air-cooled air conditioner adopts the modbus communication protocol (Modbus protocol); through the configured RS485 port. The Liebert CRV4 air conditioner can communicate with the host computer and receives the control instructions of the host software.

1.5. Options Components

1.5.1. Air Pressure Difference Switch

The switch is used to detect if the unit filter is clogged, and send alarm signals to the control board.

1.5.2. Water Leakage Detection Kit

The kit is used to detect water-under-floor, and send alarm signals to the control board, if detects water under floor condition.

1.5.3. Remote Temperature Sensor Kit

The sensor is used to monitor the temperature of other devices in the equipment room, and the temperature can be used as the control temperature of the unit.

1.5.4. Monitoring Card

The RDU-SIC monitoring card is used, and it provides an RJ45 port and a USB port.

- Using the Web browser to monitor your intelligent equipment and the environment through the Web server function provided by the SIC card.
- Using the Network Management System (NMS) to monitor customers' intelligent equipment and the environment through the SNMP agent function provided by the SIC card.
- Using the equipment room management software (RDU-Manager) to monitor customers' intelligent equipment and the environment through the TCP/IP port provided by SIC card.
- Using the centralized management software (Nform) to monitor customers' intelligent equipment through the Vertiv Server function provided by the SIC card.

1.5.5. Dual Power Module

Liebert® CRV4 unit is equipped with a highly efficient dual power module with minimum electrical losses. The unit has built-in two power modules as a back up to each other to ensure seamless operation, thereby providing reliability and stability to the system.



If the CR025 unit is equipped with top piping connection arrangement, then dual power module option is not available in the unit; for more details contact Vertiv representative.

Chapter 2: Technical Parameters

This chapter introduces the technical parameters of the Liebert® CRV4 series AC.

2.1. Mechanical Parameters

2.1.1. Mechanical Parameters Of Indoor Unit

The mechanical parameters of the indoor unit are shown in [Figure 2-1](#) and [Table 2-1](#).

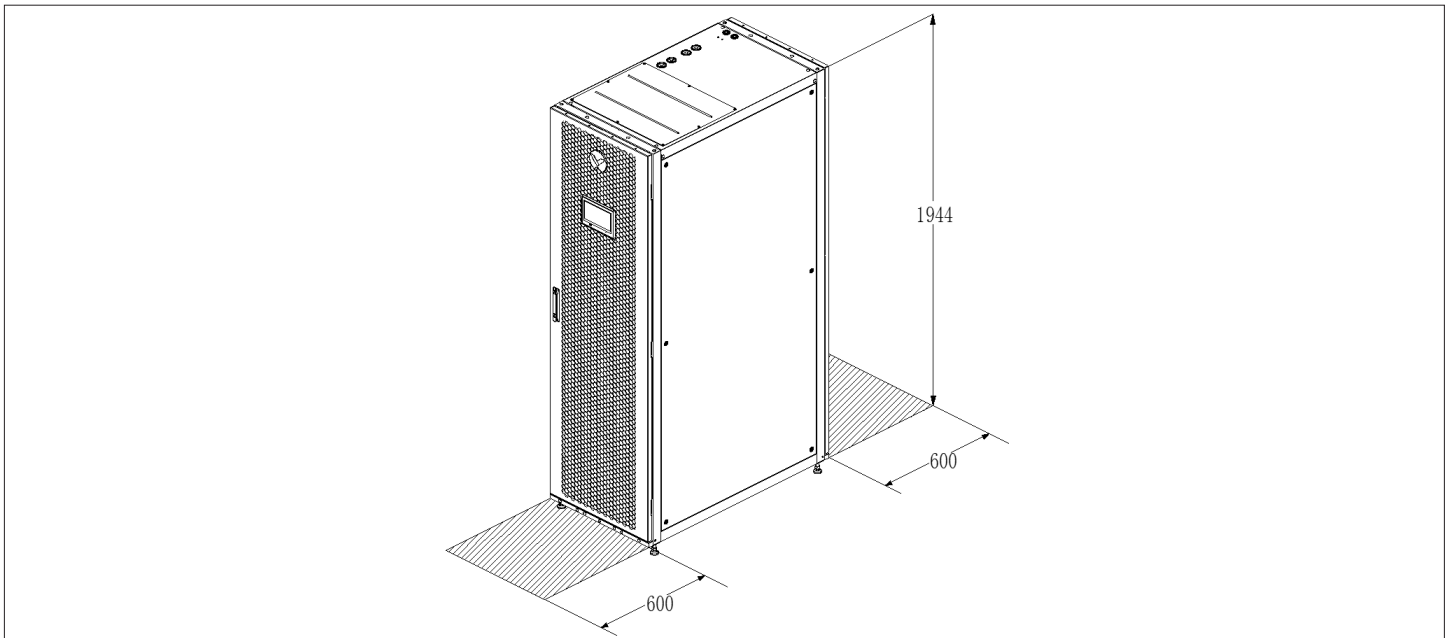


Figure 2-1 Mechanical Parameters of Indoor Unit (unit: mm)

Table 2-1 Mechanical Parameters of Indoor Unit

Model	Dimensions (W × D × H)		Net Weight (kg)
	mm	inch	
CR025RA (Including anchor bolts)	300×1100×2000	11.8"×43.3"×78.7"	235
CR025HA (Excluding anchor bolts)	300×1200×2200	11.8"×47.2"×86.6"	255
CR035RA (Including anchor bolts)	600×1100×2000	23.6"×43.3"×78.7"	320
CR035HA (Excluding anchor bolts)	600×1200×2200	23.6"×47.2"×86.6"	350
CR045RA & CR060RA (Including anchor bolts)	600×1100×2000	23.6"×43.3"×78.7"	335
CR045HA & CR060HA (Excluding anchor bolts)	600×1200×2200	23.6"×47.2"×86.6"	365

2.1.2. Locations & Dimensions Of Base Plate Pipe Outlet

The locations of the pipe inlets and outlets on the unit base plate are shown in [Figure 2-2](#).

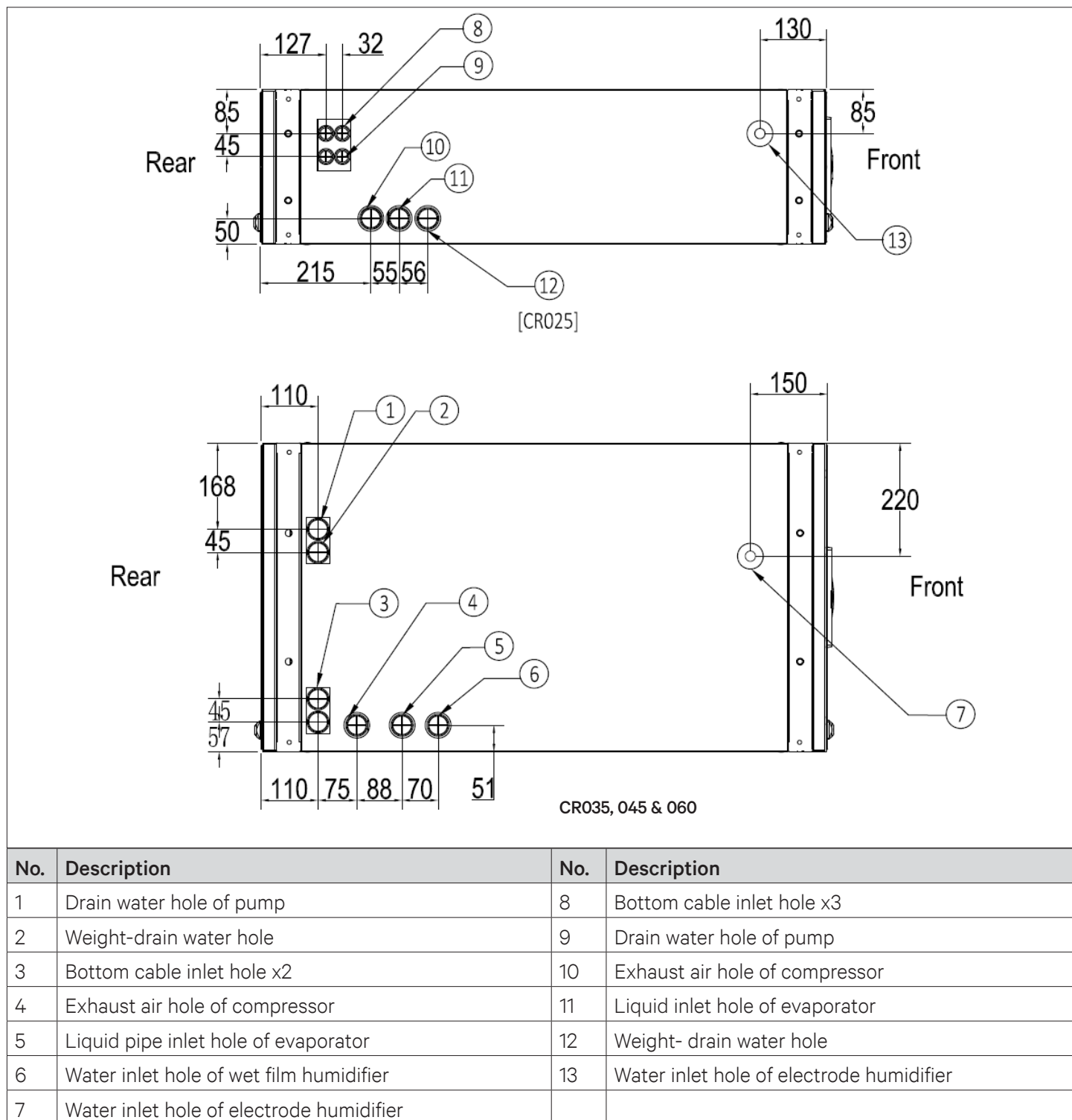


Figure 2-2 Position of the Piping Connection on the Base Plate

2.1.3. Top Plate Piping Locations & Dimensions

The locations of the pipe inlets and outlets on the unit top plate are shown in [Figure 2-3](#).

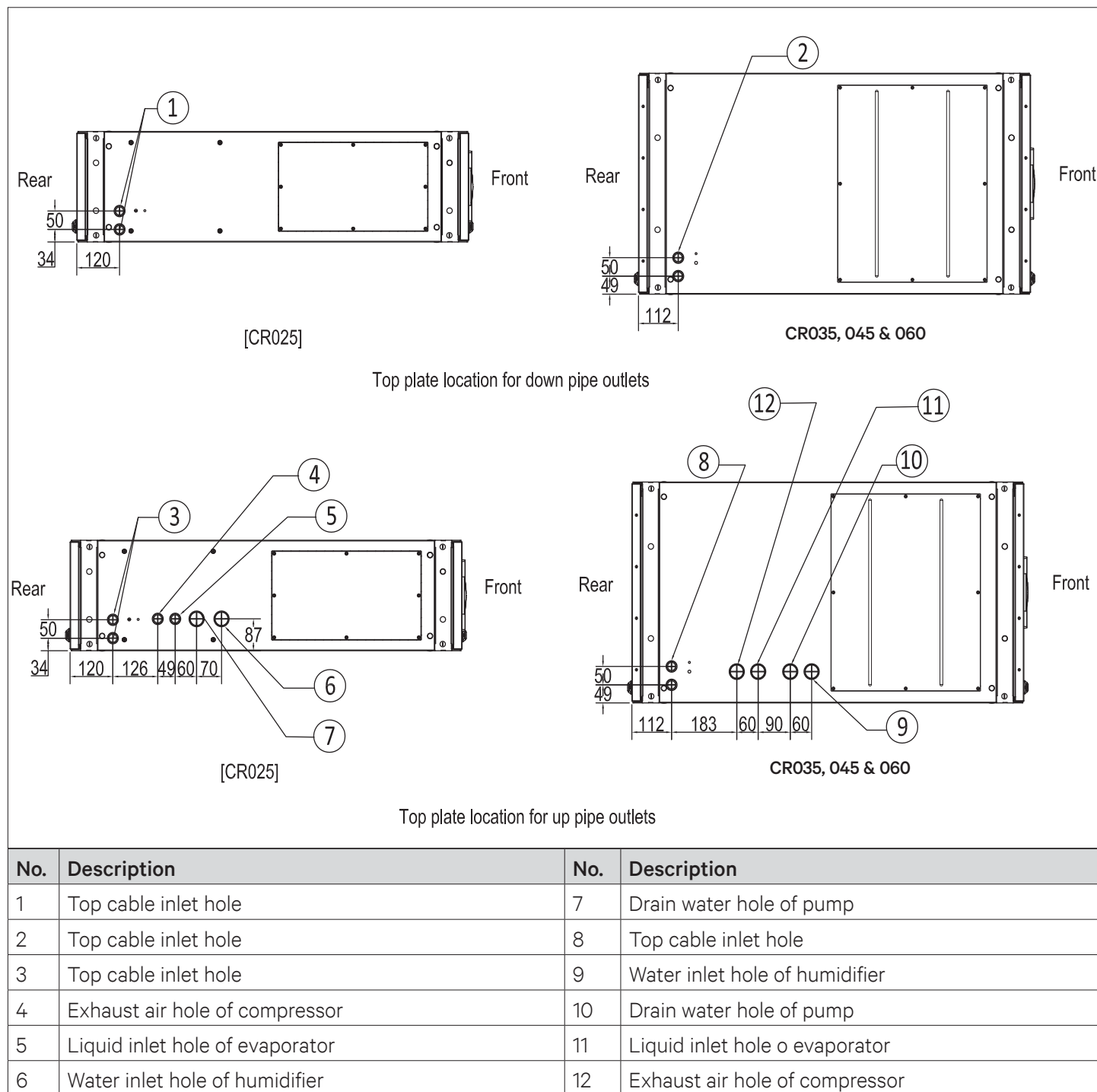


Figure 2-3 Position of the Piping Connection on the Top Plate

2.1.4. Location of Front Air Outlet

The location of the air outlet at the front are shown in [Figure 2-4](#).

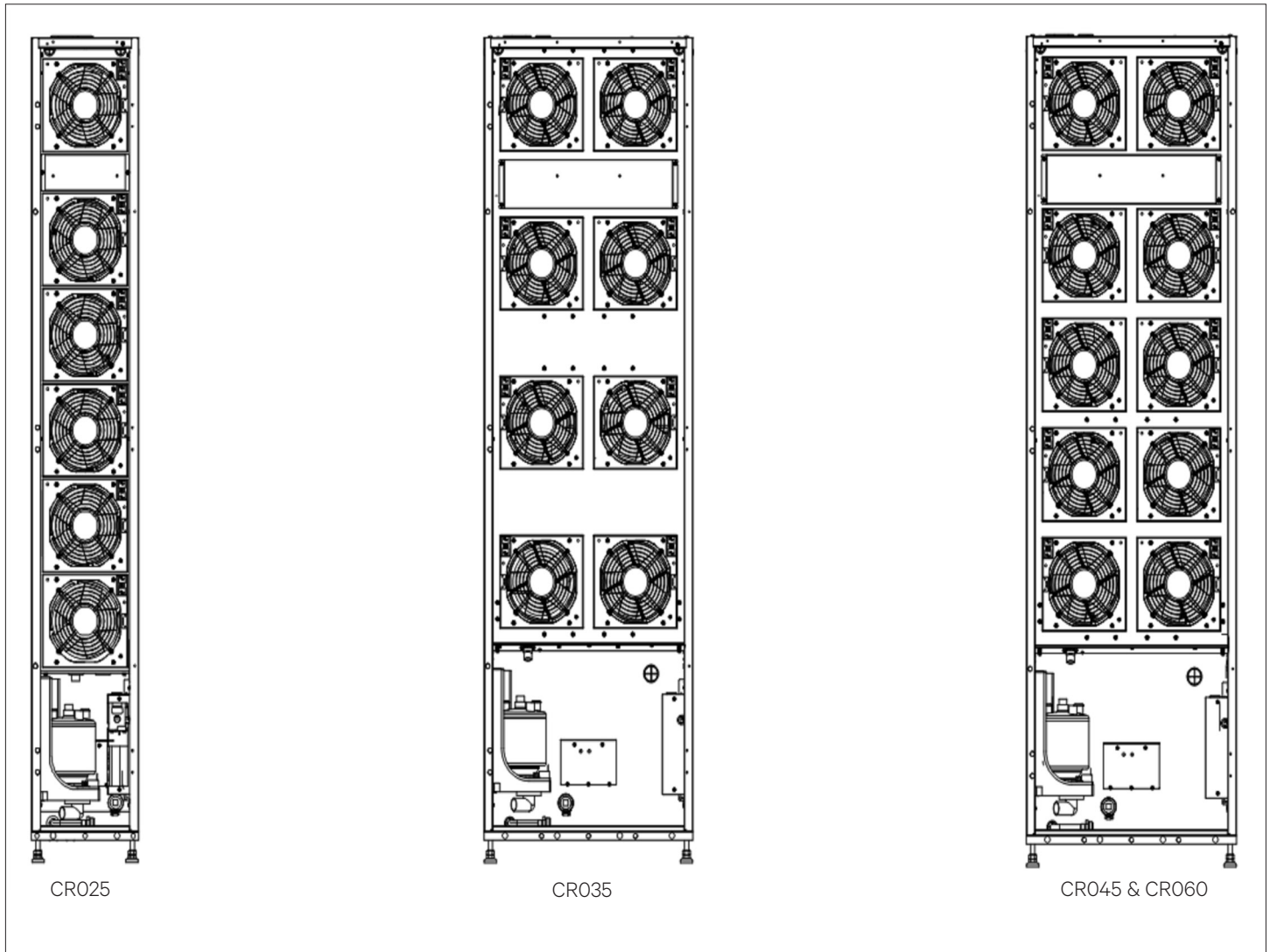


Figure 2-4 Locations of Front Air Outlets (unit: mm)



To prevent damage of the power cables due to wear and tear, the cable entry holes are fitted with bushes for smoother routing of the cabling.

2.2. Component Parameters

Table 2-2 gives the basic parameters of CR025 unit.

Table 2-2 Basic Parameters of CR025 Unit

Component		Unit Model	
		CR025RA1N-8S712E30000PV040	CR025HA1N-80S02E30000PV041
Compressor	Type	DC brushless scroll compressor	DC brushless scroll compressor
	Quantity	1	1
Fan	Type	EC fan with external power module	EC fan with external power module
	Quantity	6	6
Expansion valve	Type	Electronic expansion valve	Electronic expansion valve
	Quantity	1	1
Evaporator coil	Type	Tube-fin heat exchanger	Tube-fin heat exchanger
	Windward area (m ²)	0.988	0.988
	Rated windward speed (m/s)	1.46	1.46
	Maximum windward speed (m/s)	1.55	1.55
Electrical heater	Type	Level one electrical heater, PTC	None
	Heating power (kW)	3	None
Humidifier	Type	Electrode humidifier	None
	Humidifying capacity (kg/h)	1.5	None
Air filter	Grade	G4 (EU4)	G4 (EU4)
Monitoring card	Type	RDU-SIC monitoring card, providing an RJ45 port and a USB port	
	Quantity	The unit can be configured with at most 1pcs of monitoring card	
Condensate pump	Head (m)	6±1	6±1
Wind-leading grill	-	Available	None

Table 2-3 gives the basic parameters of CR035 unit.

Table 2-3 Basic Parameters of CR035 Unit

Component		Unit Model	
		CR035RA1N 8S712E30000PV040	CR035HA1N- 80S02E30000PV041
Compressor	Type	DC brushless scroll compressor	DC brushless scroll compressor
	Quantity	1	1
Fan	Type	EC fan with external power module	EC fan with external power module
	Quantity	8	8
Expansion valve	Type	Electronic expansion valve	Electronic expansion valve
	Quantity	1	1
Evaporator coil	Type	Tube-fin heat exchanger	Tube-fin heat exchanger
	Windward area (m ²)	1.27	1.27
	Rated windward speed (m/s)	1.75	1.75
	Maximum windward speed (m/s)	1.86	1.86
Electrical heater	Type	Level one electrical heater, PTC	None
	Heating power (kW)	6	None
Humidifier	Type	Electrode humidifier	None
	Humidifying capacity (kg/h)	1.5	None
Air filter	Grade	G4 (EU4)	G4 (EU4)
Monitoring card	Type	RDU-SIC monitoring card, providing an RJ45 port and a USB port	
	Quantity	The unit can be configured with at most 1pcs of monitoring card	
Condensate pump	Head (m)	6±1	6±1
Wind-leading grill	-	Available	None

Table 2-4 gives the basic parameters of CR045 & CR060 unit.

Table 2-4 Basic Parameters of CR045 & CR060 Unit

Component		Unit Model	
		CR045(&060)RA1N-8S712E30000PV040	CR045(&060)HA1N-80S02E30000PV041
Compressor	Type	DC brushless scroll compressor	DC brushless scroll compressor
	Quantity	1	1
Fan	Type	EC fan with external power module	EC fan with external power module
	Quantity	10	10
Expansion valve	Type	Electronic expansion valve	Electronic expansion valve
	Quantity	2	2
Evaporator coil	Type	Tube-fin heat exchanger	Tube-fin heat exchanger
	Windward area (m ²)	1.27	1.27
	Rated windward speed (m/s)	2.08	2.08
	Maximum windward speed (m/s)	2.23	2.23
Electrical heater	Type	Level one electric heater, PTC	None
	Heating power (kW)	6	None
Humidifier	Type	Electrode humidifier	None
	Humidifying capacity (kg/h)	1.5	None
Air filter	Grade	G4(EU4)	G4(EU4)
Monitoring card	Type	RDU-SIC monitoring card, providing an RJ45 port and a USB port	
	Quantity	The unit can be configured with at most 1pcs of monitoring card	
Condensate pump	Head (m)	6±1	6±1
Wind-leading grill	-	Available	None

2.3. Performance Parameters

The rated refrigerating capacity of the Liebert® CRV4 series AC is given in [Table 2-5](#). User can only follow the rated performance to select matched model. For CR060 see Table 2.6.1

Table 2-5 Rated Performance of Air-cooled Unit

Item	Condensing Temperature: 45 °C		
	CR025	CR035	CR045
40 °C DB 20% RH			
Total refrigeration capacity (kW)	28.15	39.54	49.12
Sensible cooling capacity (kW)	28.03	38.75	46.73
Unit input power (kW)	6.75	9.22	12.27
Heat dissipation capacity (kW)	34.90	48.76	61.39
Air supply temperature (°C)	24.01	26.2	26.21
37 °C DB 24% RH			
Total refrigeration capacity (kW)	26.61	38.58	45.14
Sensible cooling capacity (kW)	26.45	37.67	43.83
Unit input power (kW)	6.72	9.2	12.12
Heat dissipation capacity (kW)	33.33	47.78	57.26
Air supply temperature (°C)	21.92	23.66	24.07
35 °C DB 26% RH			
Total refrigeration capacity (kW)	25.48	37.4	43.92
Sensible cooling capacity (kW)	25.42	36.59	42.69
Unit input power (kW)	6.72	9.18	12.07
Heat dissipation capacity (kW)	32.20	46.58	55.99
Air supply temperature (°C)	20.61	22.05	22.51
32°C DB 29%RH			
Total refrigeration capacity (kW)	24.13	35.64	41.38
Sensible cooling capacity (kW)	23.91	35.02	40.28
Unit input power (kW)	6.68	9.12	12.01
Heat dissipation capacity (kW)	30.81	44.76	53.39
Air supply temperature (°C)	18.59	19.81	20.27

Item	Condensing Temperature: 45 °C		
	CR025	CR035	CR045
30 °C DB 34%RH			
Total refrigeration capacity (kW)	22.51	34.01	39.83
Sensible cooling capacity (kW)	22.42	33.47	38.78
Unit input power (kW)	6.74	9.12	12.00
Heat dissipation capacity (kW)	29.25	43.13	51.83
Air supply temperature (°C)	17.69	18.39	18.81



- The refrigeration capacity is the net value. All capacities are nominal values; the actual performance value has $\pm 5\%$ difference from the nominal value.
- The data in the table is rated data with standard filter G4 configured. Some option or cooperation with option may reduce the air volume.
- For the standard air volume, see [Table 2-5](#).

The Liebert® CRV4 Series AC is design to operate at maximum cooling capacity to quickly reduce the relatively high temperature of its surrounding, for more operating mode details consult Vertiv representative. The cooling performance parameters details of the unit is given in [Table 2-6](#).

Table 2-6 Cooling Performance Parameters of Air-cooled Unit

Item	Condensing Temperature: 45 °C		
	CR025	CR035	CR045
40 °C DB 20% RH			
Total refrigeration capacity (kW)	30.64	42.54	51.15
Sensible cooling capacity (kW)	30.10	41.65	49.19
Unit input power (kW)	8.05	10.67	13.64
Heat dissipation capacity (kW)	38.69	53.21	64.79
Air supply temperature (°C)	23.80	25.29	25.51
37 °C DB 24% RH			
Total refrigeration capacity (kW)	28.85	40.96	47.51
Sensible cooling capacity (kW)	28.67	40.25	46.21
Unit input power (kW)	7.82	10.58	13.40
Heat dissipation capacity (kW)	36.67	51.54	60.91
Air supply temperature (°C)	21.66	22.77	23.42

Item	Condensing Temperature: 45 °C		
	CR025	CR035	CR045
35 °C DB 26% RH			
Total refrigeration capacity (kW)	27.55	39.62	46.00
Sensible cooling capacity (kW)	27.37	38.88	44.86
Unit input power (kW)	7.83	10.55	13.34
Heat dissipation capacity (kW)	35.38	50.17	59.34
Air supply temperature (°C)	20.45	21.39	21.85
32 °C DB 29% RH			
Total refrigeration capacity (kW)	25.99	37.57	43.36
Sensible cooling capacity (kW)	25.82	37.01	42.23
Unit input power (kW)	7.78	10.45	13.27
Heat dissipation capacity (kW)	33.77	48.02	56.63
Air supply temperature (°C)	18.38	19.12	19.73
30 °C DB 34% RH			
Total refrigeration capacity (kW)	24.50	35.96	41.83
Sensible cooling capacity (kW)	24.22	35.45	40.75
Unit input power (kW)	7.75	10.45	13.22
Heat dissipation capacity (kW)	32.25	46.41	55.05
Air supply temperature (°C)	17.29	17.73	18.20

Table 2-6.1 CR060 Cooling Performance Parameters of Air-cooled Unit

Liebert® CRV060 performance, condensing temperature 45°C.

For more operating mode details consult Vertiv representative.

Return Air DB (°C)	Return Air RH (%)	Ambient Temp (°C)	Cond Temp (°C)	Total Air Flow (CMH)	Net Total Cap (kW)	Net Sens Cap (kW)	SHR	Indoor Fan Power (kW)	Indoor Power (kW)
40	23	35	/	10200	56.7	56.7	1	1.79	17.25
36	25	35	/	10200	53.1	53.1	1	1.79	17.05
32	30	35	/	10200	49.9	49.4	0.99	1.79	16.92
30	35	35	/	10200	49.4	45.3	0.917	1.83	16.94
28	40	35	/	10200	48.6	41.5	0.854	1.87	16.91

2.4. Electrical Parameters

Table 2-7 Full Load Current [unit - ampere (A)]

Model	Standard Model	Standard Model with Electrical Heater	Standard Model with Humidifier	Standard Model with Electrical Heater and Humidifier
CR025R/HA	21.7	22.7	23.4	23.4
CR035R/HA	29.3	36.9	30.8	36.9
CR045R/HA	39.1	44.3	39.1	44.3
CR060R/HA	48.1	54.0	48.2	54.0

2.5. Noise Parameters

The noise parameters of the Liebert® CRV4 AC series is given in [Table 2-8](#).

Table 2-8 Noise Parameters of Liebert CRV4 Series AC

Model	Air Volume (m³/h)		Unit SPL (1m away from the Unit Front, dBA)	Unit SPL (2m away from the Unit Front, dBA)
CR025	Rated air volume	5200	78.3	75.4
CR035	Rated air volume	8000	80.8	77.5
CR045 & 060	Rated air volume	9500	82.2	80.5



- SPL is sound pressure level

Chapter 3: Mechanical Parameters Requirements

This chapter introduces the application instruction of the Liebert® CRV4 series AC, including operating condition, overall system arrangement, refrigeration connection, electrical connection, piping and temperature sensors connections.

3.1. Operating Environment

The operating environment requirements for Liebert CRV4 are given in [Table 3-1](#).

Table 3-1 Operating Environment Requirements

Item	Requirement	
Ambient temperature	Indoor	18 °C to 40 °C, 20% to 60% RH
	Outdoor	-20 °C to +45 °C, if a low temperature kit is configured, the lowest outdoor operation temperature is -34 °C.
Protection level (outdoor unit)	IP20	
Altitude	<1000 m, Derating is required when located altitude is above 1000 m.	
Operation voltage range	380 V to 415 V±10%, 3 Ph+N ~50Hz / 60Hz	

3.2. Storage Environment

The storage environment requirements for Liebert CRV4 are given in [Table 3-2](#).

Table 3-2 Storage Environment Requirements

Item	Requirement
Storage environment	Indoor, clean, no dust
Ambient humidity	< 95% RH
Ambient temperature	-40 °C to +70 °C
Storage time	Total transportation and storage time should not exceed six months, otherwise the performance of the system needs to be re-calibrated.



Please contact Vertiv representative when operating in the following conditions

- The voltage of the air conditioning unit is beyond the range of the operating voltage.
- The altitude is higher than 1000 m.
- If the application condition is other than [Table 3-1](#).

3.3. System Installation Modes

The Liebert® CRV4 series adopts air-cooled heat dissipation with matching Liebert condensers such as Liebert LVC or Liebert LSF. The installation modes of the Liebert CRV4 series are shown in [Figure 3-1](#) and [Figure 3-2](#).

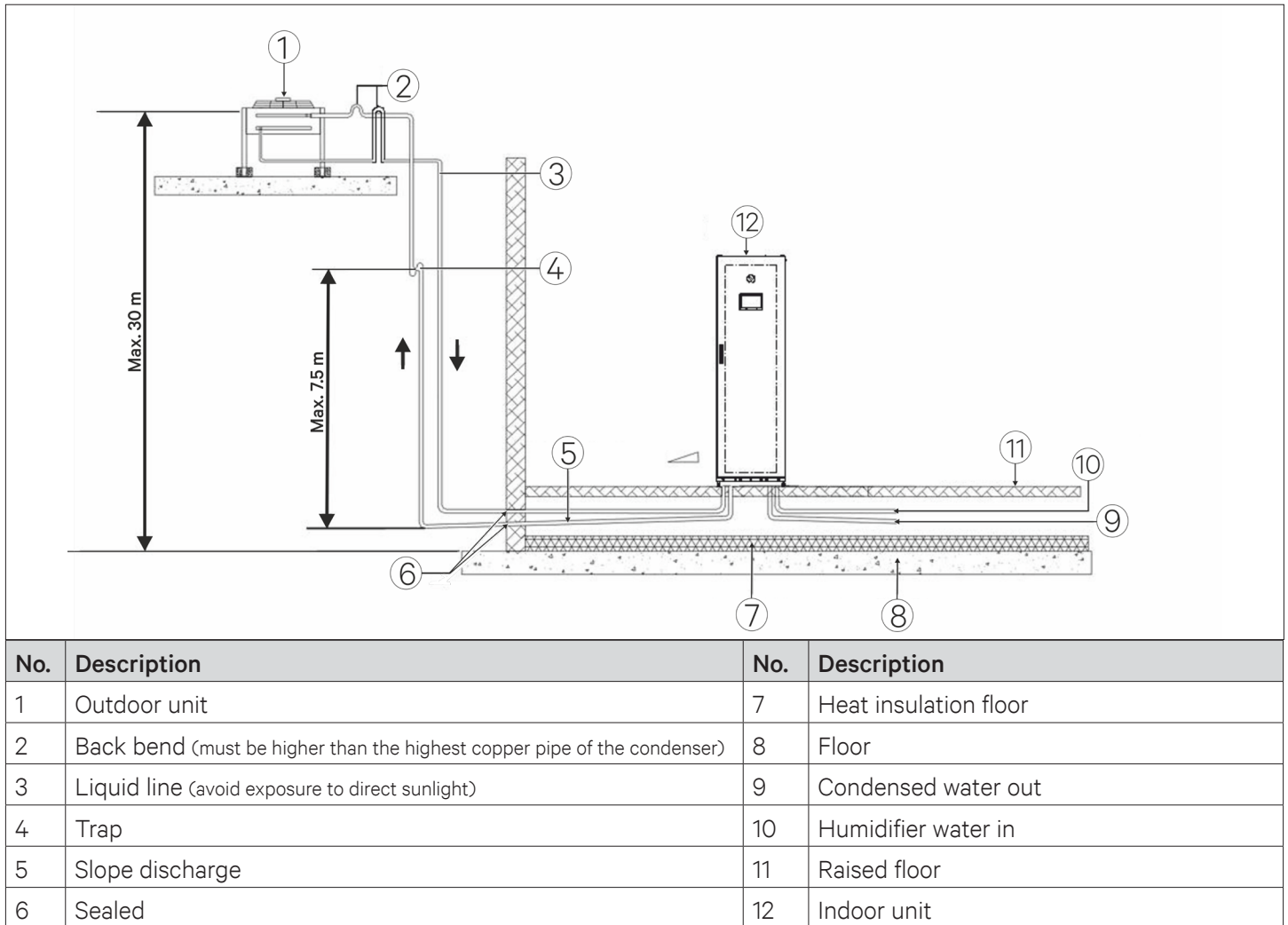


Figure 3-1 The Outdoor Unit is Placed Higher than the Compressors during Installation

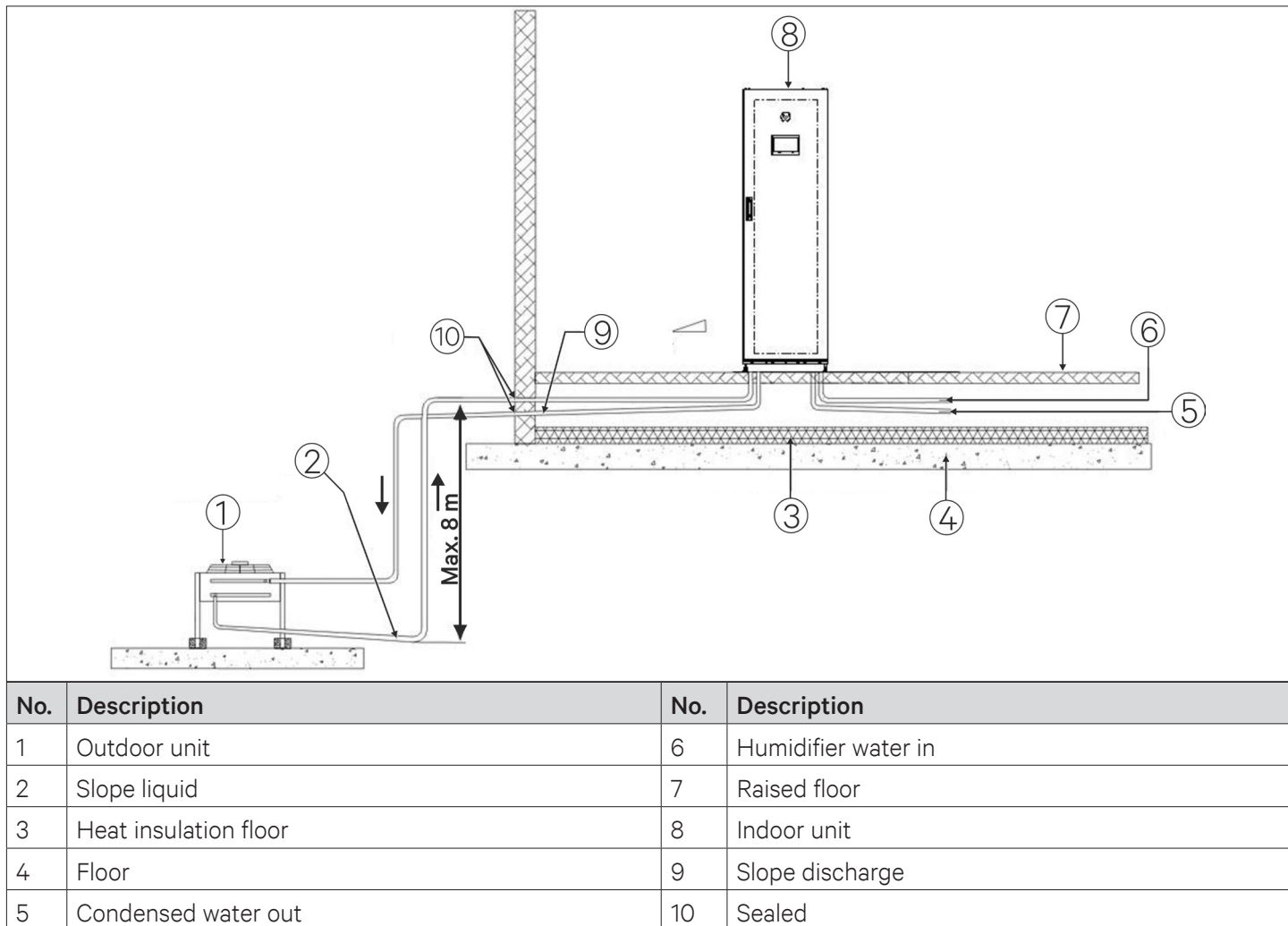


Figure 3-2 The Outdoor Unit is Lower than the Compressor during Installation

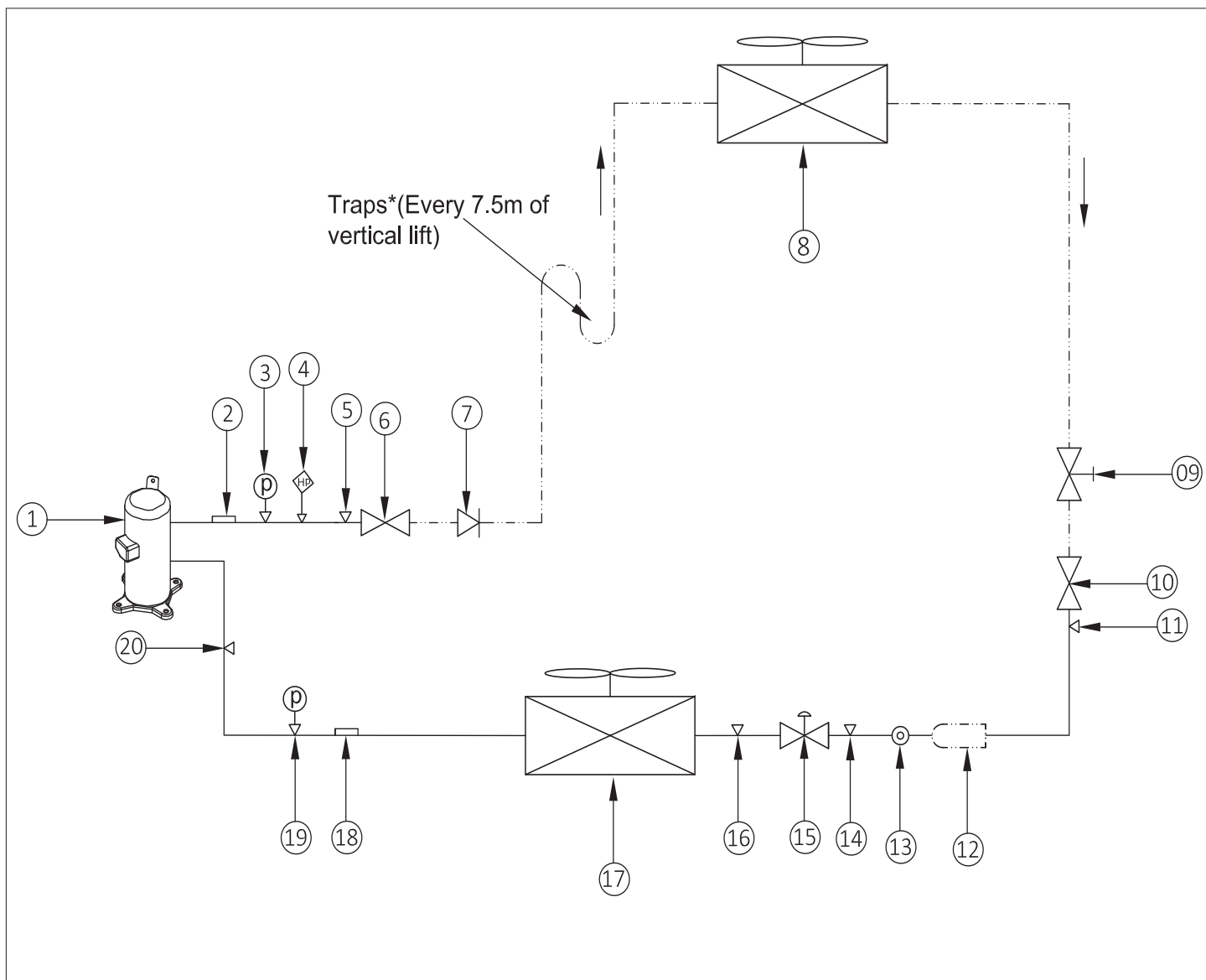


- In [Figure 3-1](#), the outdoor unit is installed higher than the compressor. Therefore, an inverted backbend is fitted to the discharge line and the liquid line of the outdoor unit. The modification is essential as it helps prevent the liquid refrigerant from flowing back once the outdoor unit (condenser) stops.
- The top end of the inverted backbend must be installed higher than the ultimate level of the copper piping of the outdoor unit. However if the outdoor unit is installed lower than the compressor not modification is required.

3.4. System Arrangement during Installation

3.4.1. General Arrangement

The system arrangement diagram of the refrigeration system for Liebert® CRV4 air-cooled AC unit is shown in [Figure 3-3](#).



No.	Description	No.	Description
1	Compressor	11	Schrader valve
2	Discharge temperature sensor	12	Filter dryer
3	High pressure sensor	13	Sight glass
4	High pressure switch	14	Schrader valve
5	Schrader valve	15	Electronic Expansion Valve (EEV)
6	Ball valve	16	Schrader valve
7	Check valve+	17	Evaporator coil
8	Condenser coil	18	Suction temperature sensor
9	Solenoid valve+	19	Low pressure sensor
10	Ball valve	20	Schrader valve

Figure 3-3 Air-cooled System Arrangement Diagram



The following points should be considered before checking out the overall layout diagram

- ————— : *Factory piping*
- - - - - : *Field piping (by technical personnel)*
- Components (marked with *) are not supplied by Vertiv but are recommended for proper circuit operation and maintenance.
- Additional components (marked with +) are required when the equivalent length exceeds 30 m.

3.4.2. Connection of the Copper Piping between the Indoor and Outdoor Units

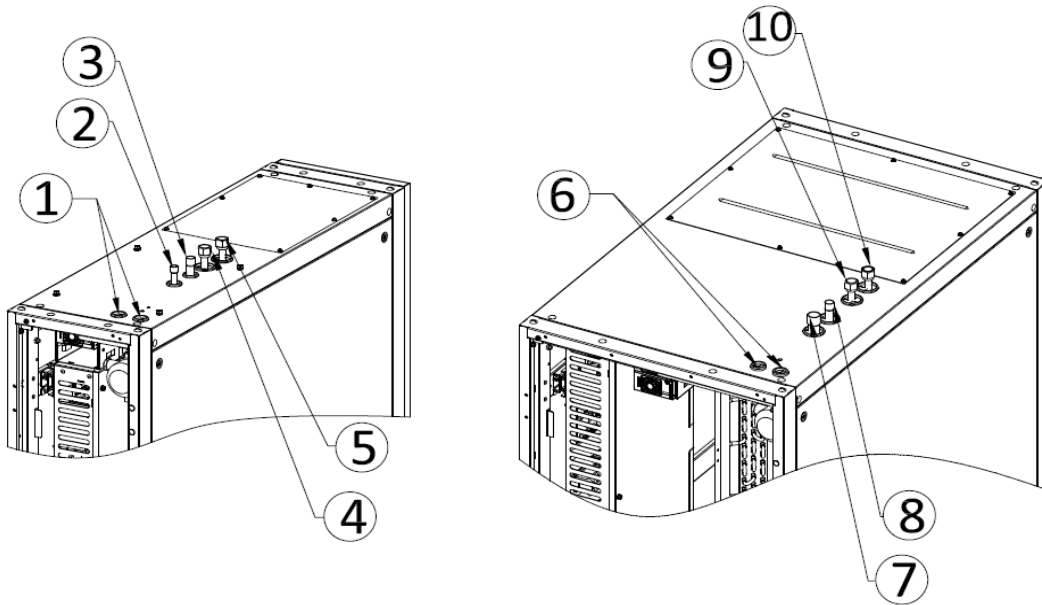
- The indoor and outdoor units are connected through brazed copper piping. Select the appropriate dimension (pipe diameter) of piping connecting the indoor and the outdoor unit. Considering the effect of the diameter of copper piping on the pressure drop of the system, the pipe dimensions of the indoor and outdoor units should be determined according to the specifications in [Table 3-3](#) or contact Vertiv representative.
- The unit has refrigerating pipe connectors and labels on its top and bottom as shown in [Figure 3-4](#) and [Figure 3-5](#). Notes and instruction labels are pasted onto the discharge and liquid piping. Therefore, ensure that the piping must be wrapped with a wet cloth before brazing to protect the labels from burning.
- Connect the discharge pipe and liquid pipe of the indoor unit according to the instructions on the labels.
- Horizontal sections of the discharge pipe should be sloped down from the compressor with a slope of at least 1:200 (5 mm down for each 1 m run). The discharge pipes should be insulated where they are routed in the conditioned space (including under a raised floor).

Table 3-3 Recommended Pipe Sizes (unit: mm)

Model	CR025		CR035		CR045 & CR060	
Pipe Length	D	L	D	L	D	L
10m	19	12.7	19	16	22	16
20m	19	16	22	16	25	19
30m	22	16	25	16	28	19
40m*	22	16	25	19	28	22
50m*	22	19	25	22	28	22

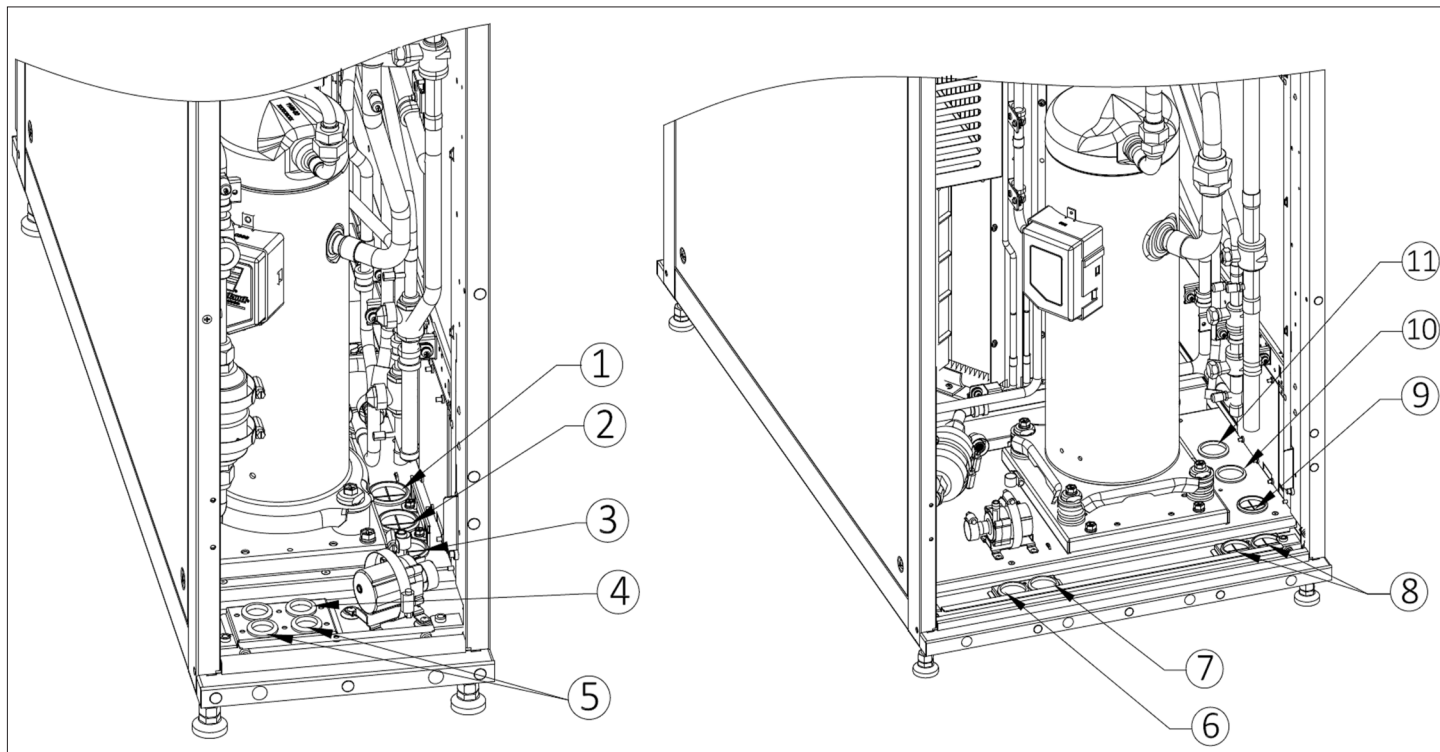


- A long piping kit is required for Equivalent Length marked with *.
- D: Discharge line; L: Liquid Line
- If the pipe length exceeds 50 m or drops over 30 m, consult Vertiv representative for details.
- If the outdoor environment temperature is lower than -20 °C, a low-temperature kit is needed, consult Vertiv representative for details.



No.	Description	No.	Description
1	Top cable inlet hole	6	Top cable inlet hole
2	Exhaust air hole of compressor	7	Exhaust air hole of compressor
3	Liquid pipe inlet hole of evaporator	8	Liquid pipe inlet hole of evaporator
4	Drain water hole of pump	9	Drain water hole of pump
5	Water pipe inlet hole of humidifier	10	Water pipe inlet hole of humidifier

Figure 3-4 Top Plate Piping Connection



No.	Description	No.	Description
1	Weight-drain water hole	7	Weight- drain water hole
2	Liquid pipe inlet hole of evaporator	8	Bottom cable inlet hole
3	Exhaust air hole of compressor	9	Exhaust air hole of compressor
4	Drain water hole of pump	10	Liquid pipe inlet hole of evaporator
5	Bottom cable inlet hole	11	Water pipe inlet hole of wet film humidifier
6	Drain water hole of pump		

Figure 3-5 Bottom Plate Piping Connection



For bottom piping: before brazing the compressor discharge pipe and liquid pipe, follow the instruction labeled on the copper pipe; cut the copper pipe using a cutter (a little bit of the compressor lubricant oil may leak); however, do not braise the copper cap on the seal directly as it may result in heating of the oil following which it may catch fire.



The exposure time of system piping must not exceed 15min. Longer exposure will lead to the compressor lubricant oil being affected by moisture, which can affect the life of the key components and the system operation stability.

3.4.3. Installing Long Piping Kit (for site installation)

There are instances where the one-way equivalent length of the pipe exceeds 30 m. Or suppose the vertical distance between the outdoor and the indoor units exceeds the value in [Table 3-4](#). Prior to installation, consult Vertiv representative whether to use the long piping kit and for the equivalent length of the recommended pipe (consider the resistance loss calculation at the bends). The equivalent length of each kit is shown in [Table 3-5](#), and should be selected according to the field condition.

Table 3-4 Vertical Distance between the Indoor and Outdoor Units

Items	Distance
Maximum equivalent lengths from the indoor unit to the outdoor	50 m
Outdoor unit is higher than the Indoor unit	Maximum: 30 m
Outdoor unit is lower than the indoor unit	Maximum: 8 m
Traps on the vertical refrigerant discharge pipe	Install trap every 7.5 m

Table 3-5 Equivalent Length of the Partial Components

Outer Diameter (OD) of the Liquid Pipe (inch)	Equivalent Length (m)		
	90° bend	45° bend	T Type 3-way
3/8	0.21	0.10	0.76
1/2	0.24	0.12	0.76
5/8	0.27	0.15	0.76
3/4	0.3	0.18	0.76
7/8	0.44	0.24	1.1
1-1/8	0.56	0.3	1.4



- If the vertical distance between indoor and outdoor units exceeds the values in [Table 3-4](#), consult Vertiv representative.
- U' trap should be installed for every 7.5 m of vertical distance consult Vertiv representative for details.
- There is no necessity of cutting the indoor unit pipes while installing the solenoid valve.

After the entire system is installed, open the ball valve to keep the pressure and carry out the vacuum operation, thereby avoiding the moisture absorption of the compressor lubricant oil. Thus, it accounts for operational safety and also extends the service life of the compressor; for electrical connections related to the long piping kit, refer to the *Liebert® CRV4 User Manual Chapter 4 Electrical Connection*.

3.4.4. Check Valve Installation

The check valve must be installed closely to the indoor unit, attention should be paid to the arrow on the valve body while brazing the check valve. The arrow indicates the flow direction of refrigerant in the valve body as shown in [Figure 3-6](#). Ensure that the arrow points towards the outdoor unit.

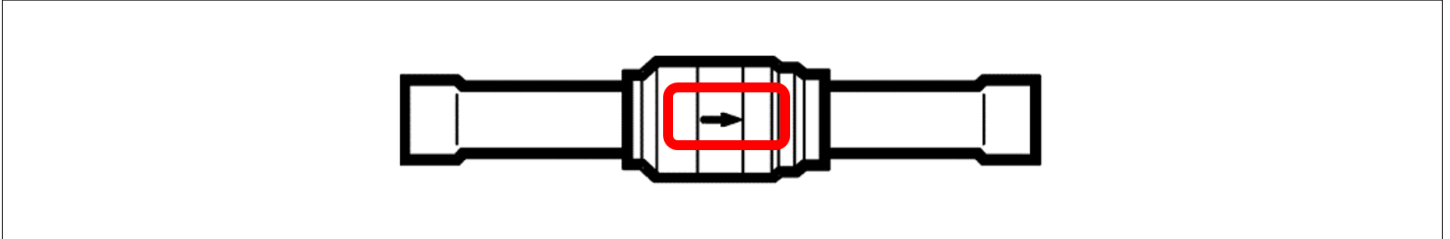


Figure 3-6 Horizontal Check Valve Installation

3.4.5. Installing the Solenoid Valve

The solenoid valve must be installed closely to the indoor unit. The solenoid valve is supplied loose to install at the site. Mount the solenoid valve horizontally in the refrigerant piping as shown in [Figure 3-7](#). Ensure that the arrow points towards the indoor unit, as the arrow indicates the flow direction of the refrigerant in the valve.



Figure 3-7 Horizontal Solenoid Valve Installation

After brazing, install the coil and remove the cover of the cabling terminals. Direct the cable through the cable hole in the cover and plug the two terminals and reinstall the cover. [Figure 3-8](#) shows the process of connecting the cables of the solenoid valve in a liquid pipe

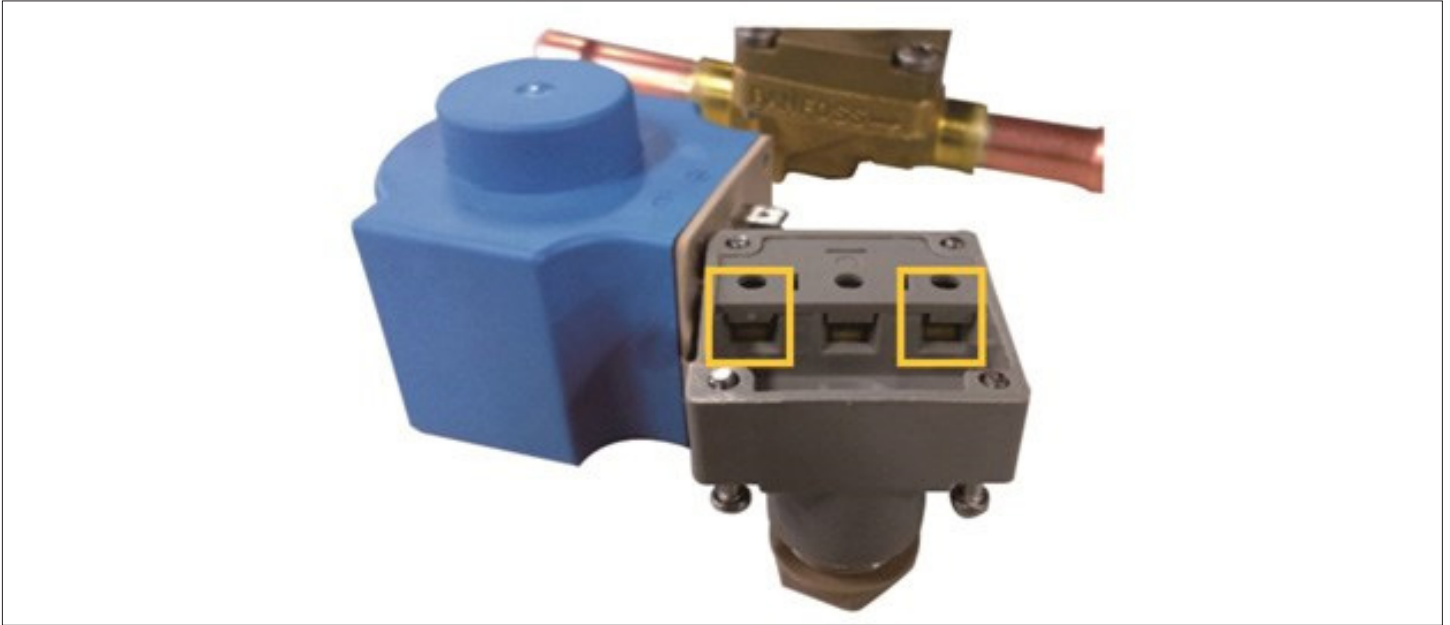


Figure 3-8 Position of Cable Terminals the Solenoid Valve

Finally, mount the coil on the valve body and press the coil tightly to ensure complete contact between the coil and valve body is firmly done for better understanding refer [Figure 3-9](#).

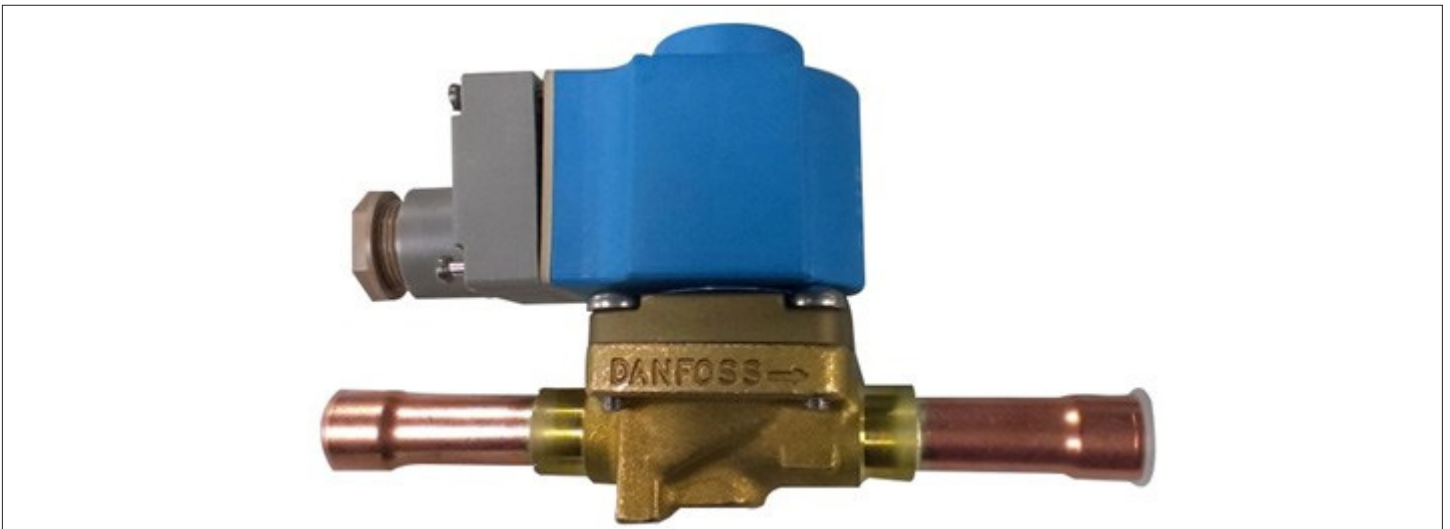


Figure 3-9 Assembly of the Coil and Solenoid Valve

3.5. Charging Refrigerant and Adding Lubricant Oil

3.5.1. Charging Refrigerant

The Liebert® CRV4 air-cooled series air conditioner is charged in the factory with 2 bar nitrogen for shipping. [Table 3-6](#), [Table 3-7](#) and [Table 3-8](#) are the standard refrigerant charge for outdoor (Vertiv™ Liebert® LSF/ Vertiv™ Liebert® LVC) and indoor units respectively.

Table 3-6 Refrigerant Charging Amount of the Liebert LSF Outdoor Unit (unit: kg)

Outdoor Unit Model	LSF38	LSF42	LSF52	LSF62	LSF76	LSF85
Recommended charging amount	3.93	4.12	5.12	5.86	6.72	7.9

Table 3-7 Refrigerant Charging Amount of the Liebert LVC Outdoor Unit (unit: kg)

Outdoor Unit Model	LVC088	LVC106	LVC140	LVC152	LVC170
Recommended charging amount	4.12	5.12	5.86	6.72	7.90

Table 3-8 Refrigerant Charging Amount of the Indoor Unit (unit: kg)

Indoor Unit Model	CR025	CR035	CR045 & CR060
Standard charging amount	2.47	3.12	3.44

The recharging amount of the refrigerant is calculated using the following formula:

Refrigerant refilling amount (kg) = Recommended refrigerant charging amount of outdoor unit + recommended refrigerant charging amount of indoor unit + refrigerant charging amount of per meter liquid pipe (kg/m) × total length of liquid pipe (m)

Refer to the [Table 3-9](#) for the refrigerant recharging amount of per meter liquid pipe for different ODs:

Table 3-9 Amount of Refrigerant per Unit Length of Liquid Pipe

Liquid Pipe OD (mm)	Refrigerant Recharging Amount of per meter Liquid Pipe (kg/m)	Liquid Pipe OD (mm)	Refrigerant Recharging Amount of per meter Liquid Pipe (kg/m)
12.7	0.107	22	0.321
16	0.174	25	0.431
19	0.245	28	0.517

For the refrigerant charging method, refer to Liebert® CRV4 User Manual Section 5.2.2 Commissioning Procedures.

3.5.2. Adding Lubricant Oil

The charging refrigerant can dilute the lubricant oil in the system and affects the lubricating & cooling properties of the lubricant oil. Therefore, the lubricant oil should be added in the beginning. The lubricant oil used in the Liebert® CRV4 air conditioner is given in [Table 3-10](#).

Table 3-10 Types of Lubricant Oil

Unit Model	Types of Refrigeration Oil
CR025	POE (32-3MAF)
CR035	PVE (FVC68D)
CR045 & CR060	POE (32-3MAF)

[Table 3-11](#) provides the amount of lubricant oil to be added.

Table 3-11 Adding Lubricant Oil

Liquid Pipe OD (mm)	CR025, CR035, CR045, CR060	
	30 m	>30 m
12.7	Lubricant oil charging is not needed	Amount of lubricant oil (ml) to be added = More than 30 m part even pipe added amount of refrigerant × 10%
16		
19		
22		
25		



- Consult Vertiv representative for more details on adding the lubricant oil.
- CR025, CR045 and CR060 units use POE type (32-3MAF) lubricant oil, and CR035 units use PVE type (FVC68D) lubricant oil



- Do not use inferior quality refrigerant.
- For any consequences resulting from inferior quality refrigerant, Vertiv does not assume warranty responsibility.
- Select the type of lubricant oil in accordance with the compressor manufacturer's specification.

3.6. Liebert® CRV4 Cable Connection of Indoor Unit

3.6.1. Electrical Port Location of the Indoor Unit

For any model in the Liebert CRV4 series, open the rear panel of the indoor unit following which the specific layout and locations of the low voltage components can be viewed as shown in [Figure 3-10](#). For detailed layout information on low voltage components, refer to the labels on the cabinets and units.

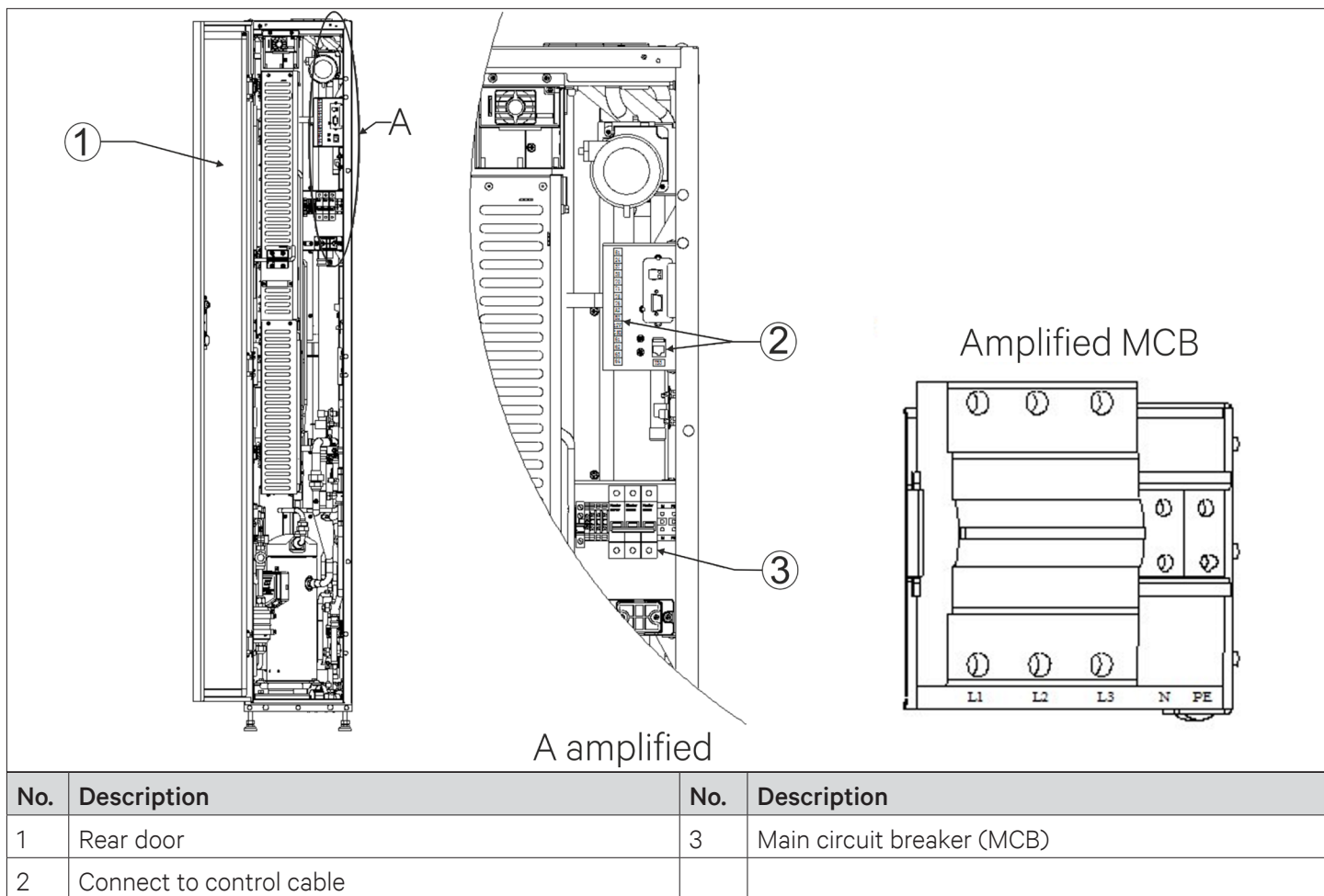


Figure 3-10 Cable Connection of the Electrical Control Box and the Terminals

Table 3-12 MCB Current of the Models

Model	MCB	Current [ampere (A)]
CR025	NDM1-63C40/3	40
CR035	NDM1-63C50/3	50
CR045	NDM1-63C63/3	63
CR060	NDM1-80C80/3	80

3.6.2. Connecting the Power Cable of the Indoor unit

The specific location of the power port of the indoor unit is shown in [Figure 3-10](#). Connect the supply terminals L1-L3, N, and PE to their respective counterparts of the external power supply respectively. Fix the input cables to the cable clamp, located on the inner side panel of the unit. The top cable entry and bottom cable entry holes are shown in [Figure 3-11](#).

For the cable specifications, refer to the full-load current (FLA) described in the [Table 3-13](#).

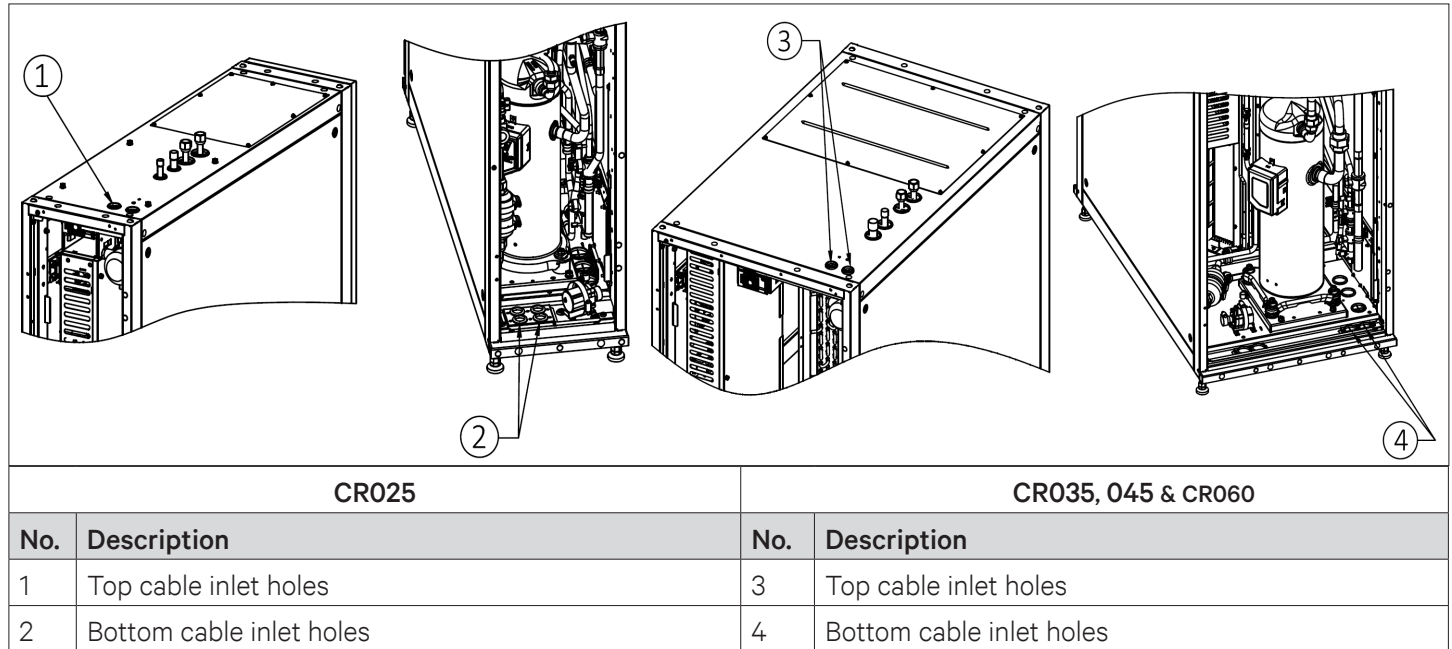


Figure 3-11 Top and Bottom Cable Entry Holes



The cable sizes must strictly meet and adhere to the local cabling regulations and protocols as it supersedes every type of connection.

Table 3-13 Full Load Current [unit - ampere (A)]

Model	Standard Model	Standard Model with Electrical Heater	Standard Model with Humidifier	Standard Model with Electrical Heater and Humidifier
CR025R/HA	21.7	22.7	23.4	23.4
CR035R/HA	29.3	36.9	30.8	36.9
CR045R/HA	39.1	44.3	39.1	44.3
CR060R/HA	48.1	54.0	48.2	54.0

3.6.3. Connecting the Control Cables

The location of the terminal block for on-site cable connections is shown in [Figure 3-10](#). The enlarge view of the terminals are shown in [Figure 3-12](#).

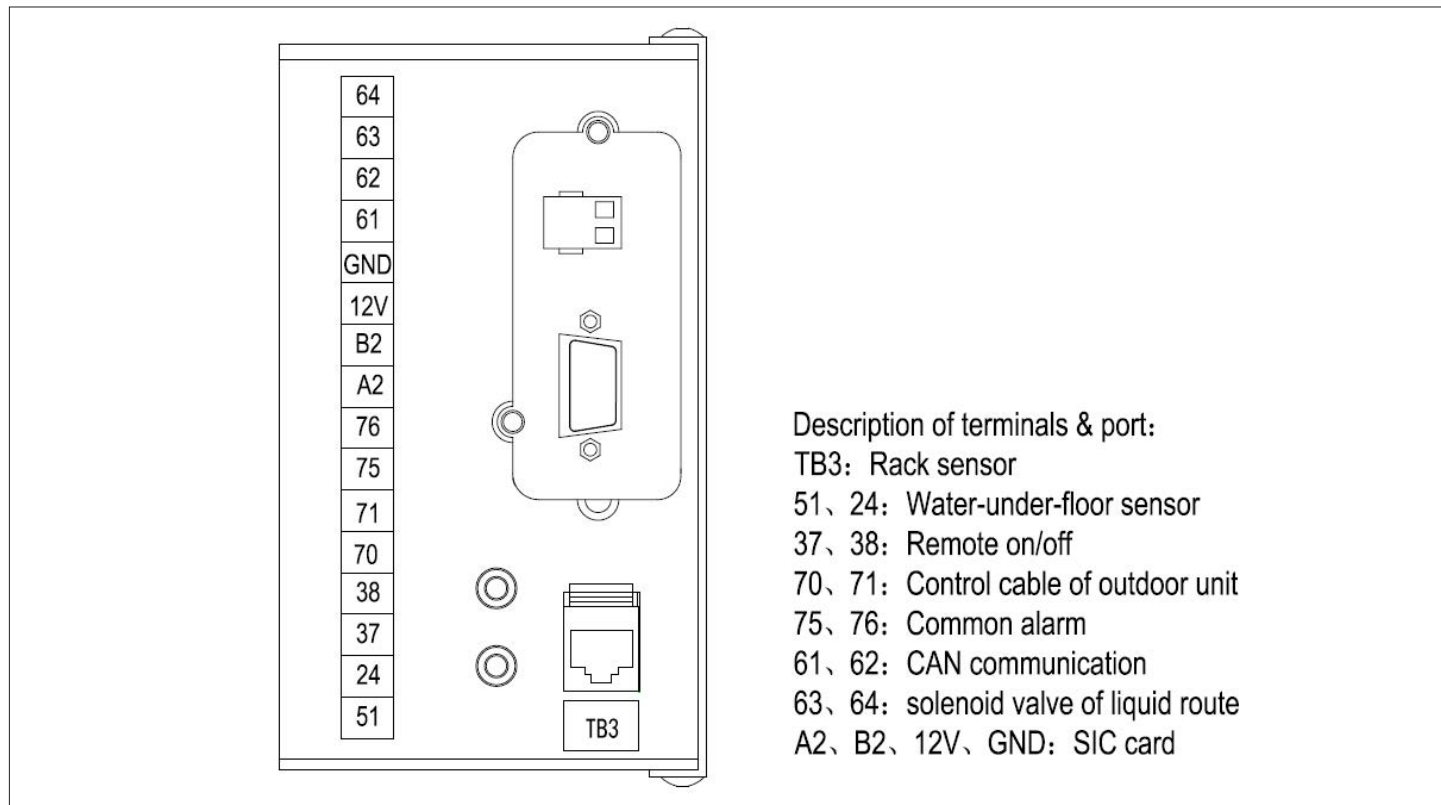


Figure 3-12 The Enlarged View of the Terminals

The description of terminals and ports shown in [Figure 3-12](#)

Terminals and Port	Description
51, 24	Water-under-floor-sensor
37, 38	Remote On/ Off
70, 71	Control cable of outdoor unit
75, 76	Common alarm
61, 62	Can communication
63, 64	Solenoid valve of liquid route
A2, B2, 12V, GND	SIC Card
TB3	Rack sensor



The connection personnel must take anti-static measures before connecting the control cables

Remote Shutdown

As shown in [Figure 3-12](#) terminals 37# and 38# can be connected to the remote shutdown switches. The terminals must be short-connected before delivery. If a remote shutdown terminals are connected at the time of commissioning, remove the short-connect cable. Closing the terminals 37# and 38# will shut down the unit.

3.6.4. Control Signals of the Outdoor Unit

Terminals 70# & 71# are the control signal input terminals of the outdoor unit. Their On and Off state is same as that of the compressor. They can be connected to the compressor rotation speed control terminals on the control board of the outdoor unit. However, connecting them is an option depending on the requirement.

3.6.5. External General Alarm

Terminals 75# and 76# can be connected to the external general alarms. They generate signals to external alarm devices such as an alarm indicator. When the critical alarm occurs, the contact will be closed to trigger remote alarms, send signals to the building management system, or dial the paging system automatically.

The users have to obtain the power supply of external general alarm system. For a in-depth definition of the other terminals, refer to the *Liebert® CRV4 User Manual Circuit Diagram in Appendix I*.

3.6.6. Water-Under-Floor Sensor

If a water-under-floor sensor is equipped, connect one end of the sensor to terminal 51# and the other end to common terminal 24#. Each unit can be connected with multiple sensors in parallel, but there would be only one water-under-floor sensor alarm.

3.6.7. SIC Card (optional Unity Card)

If a SIC card is configured, connect A#, B#, GND#, and 12# on the SIC card to the respective counterparts on the terminal block. SIC card can be configured based on the user requirement. Refer *Liebert® CRV4 User Manual for Circuit Diagram in Appendix I* for in-depth connection information.

3.6.8. Teamwork Control

If user need to use the teamwork control function, you should connect the communication cable to terminals 61# & 62# on the TB2 terminal block.

3.6.9. Connecting the Solenoid Valve of the Long Piping Kit- (Optional for site installation)

The solenoid valve of the long piping kit consists of two control cables which are connected to their respective terminals on the control board. For more specific connecting points on the interface board, refer to the connecting terminal number of the liquid route of solenoid valve shown in the *Liebert® CRV4 User Manual Circuit Diagram in Appendix I*.

3.7. Connecting the Condensate Water Drainage Piping of the Indoor Unit

The condensed water of the electrode humidifier and the evaporator converge to a common water pan following which it is drained through the drainage pipe of the drain pump.

1. The unit is configured to adopt the bottom drain mode by default; therefore, to drain water from the bottom, direct/ route the soft drainage pipe through the drainage hole of the pump, and then connect it to the outer drainage pipe.
2. For the unit with top piping connection: If user wants to drain water from the top of the unit, then user needs to connect the drainage pipe of the drainage pump outlet to the top drain water copper pipe. A check valve should be installed on the connecting part between the top drain water copper pipe and the connecting piping of the system.
3. This prevents the backflow of the water in the connecting pipes to the water pan. User can use a clamp from the accessories box to fix the drain pipe to the drain connector, and the fixing torque is 15 kg.cm, refer [Figure 3-13](#) for better understanding.
4. Then connect the drain pipe at the drainage hole located on the top of the cabinet (pipe connector has been installed, 1/2"-BSP) as shown in [Figure 3-6](#).
5. Regardless the water is drained from the upper or the lower parts of the unit through water pump, the check valve must be installed at the exit of the unit.

The outer diameter of the copper pipe is 12.7 mm and an internal diameter of the hose pipe is 9 mm. However, if the unit is not configured with the pump, the drainage pipe of the water pan should go through the drainage hole of the pan and must connect to the outer drainage pipe. The water-trap is essential to drain the condensate water.



The following points are to be taken into consideration about the water-trap:

- Adopt a galvanized steel, PVC, or polyethylene pipe with a fair amount of flexibility.
- Allow a slope of 2% towards the direction of the drainage flow

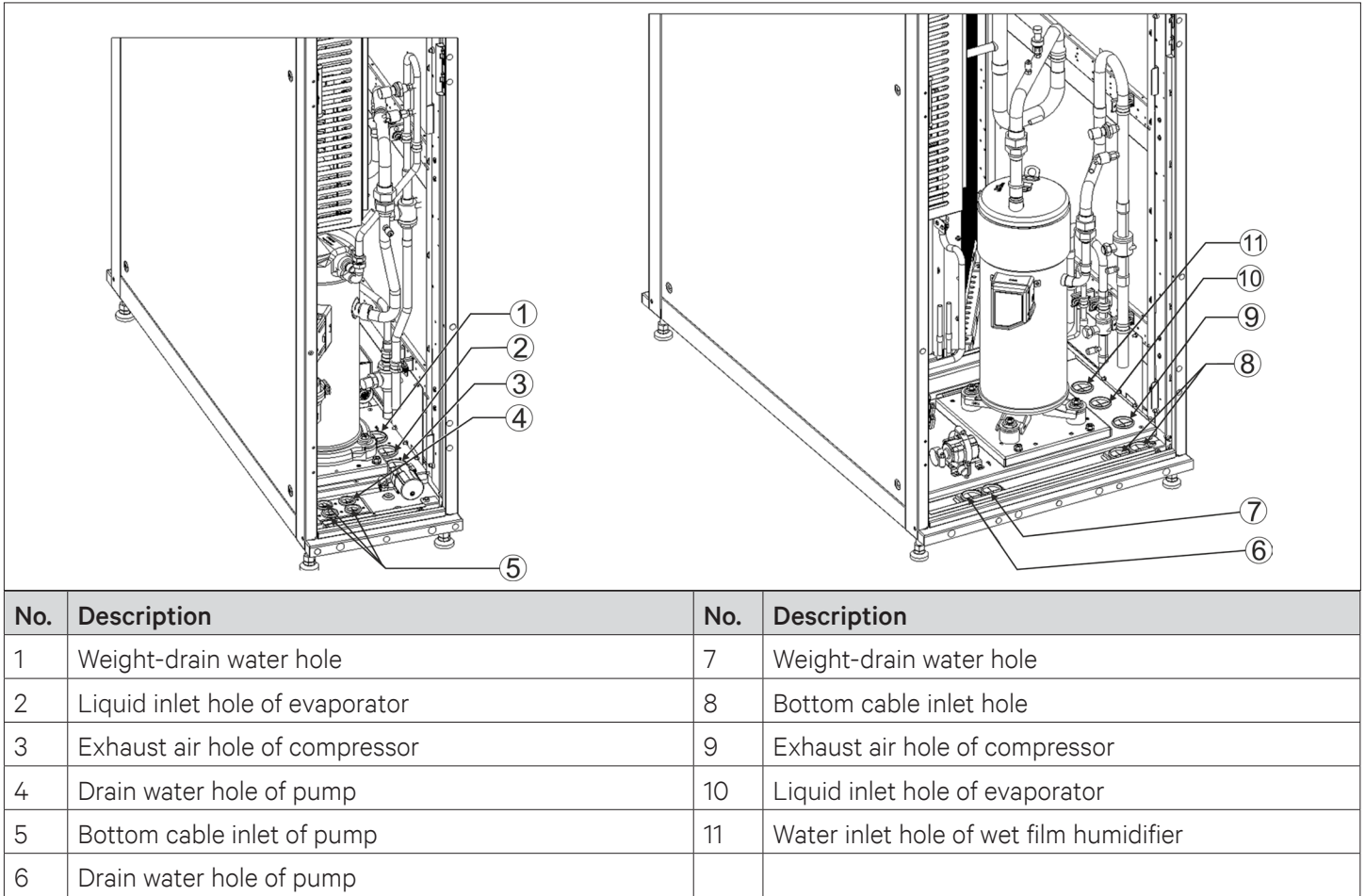


Figure 3-13 Connection of the Drain Piping

The water-trap is mandatory and should be located 30 cm below the condensate-drain-pan and the water-trap must be installed in the floor under the unit. The pan must be kept under the removable floor. [Figure 3-14](#) shows the arrangement of the water-trap and condensate drain pan.

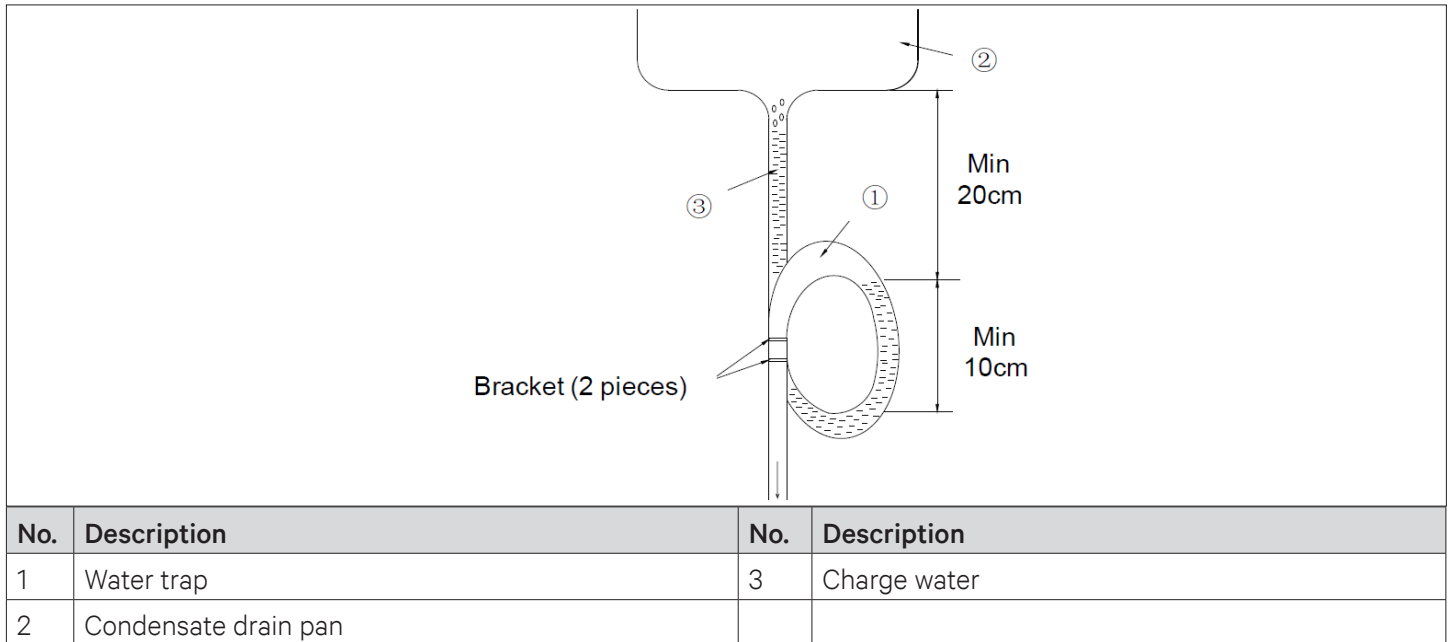


Figure 3-14 Draining the Condensate Water



- Do not cut-off the brackets of the water-trap, otherwise the drainage of the condensed water will be affected.
- Prior to startup, fill the charge water in the water-trap to avoid blowing the water.
- To avoid water leakage, use a Teflon sealing tape between flexible pipes and connectors.
- The electrode humidifier contains flowing hot water; thus, the plastic pipe must be resistant to heat higher than 90 °C.

3.7.1. Electrode Humidifier Water Inlet Piping Connection

By default, the water inlet pipes should be connected to the electrode humidifier from the bottom. If the water has to be filled from the bottom, then there is no need to change the water inlet piping connection in the unit. In this case, only connect a water inlet pipe to the water inlet hole located at the base of the cabinet, as shown in [Figure 3-15](#).

However, if the water has to be filled from the top, unscrew the connector of the water inlet hose pipe of the humidifier. The water inlet hose pipe needs to be routed through the rubber plug hole close to the humidifier and then connect it to the outer water inlet pipe. Screw a threaded connector onto the water inlet pipe to complete the fixing process. Other connecting modes can also be selected by the engineering methodologies, but the connections must be sealed to avoid water leakage. The pressure range of the main pipe should be in the range of 100 kPa to 700 kPa. If the pressure exceeds 700 kPa, then there should be an arrangement of pressure reducer. If the pressure falls below 100 kPa, a water tank and pump system should be fitted.



In some cases, the process needs to be in compliance with the local laws and regulations resulting in the installation of some other supporting components, for more details consult Vertiv representative.

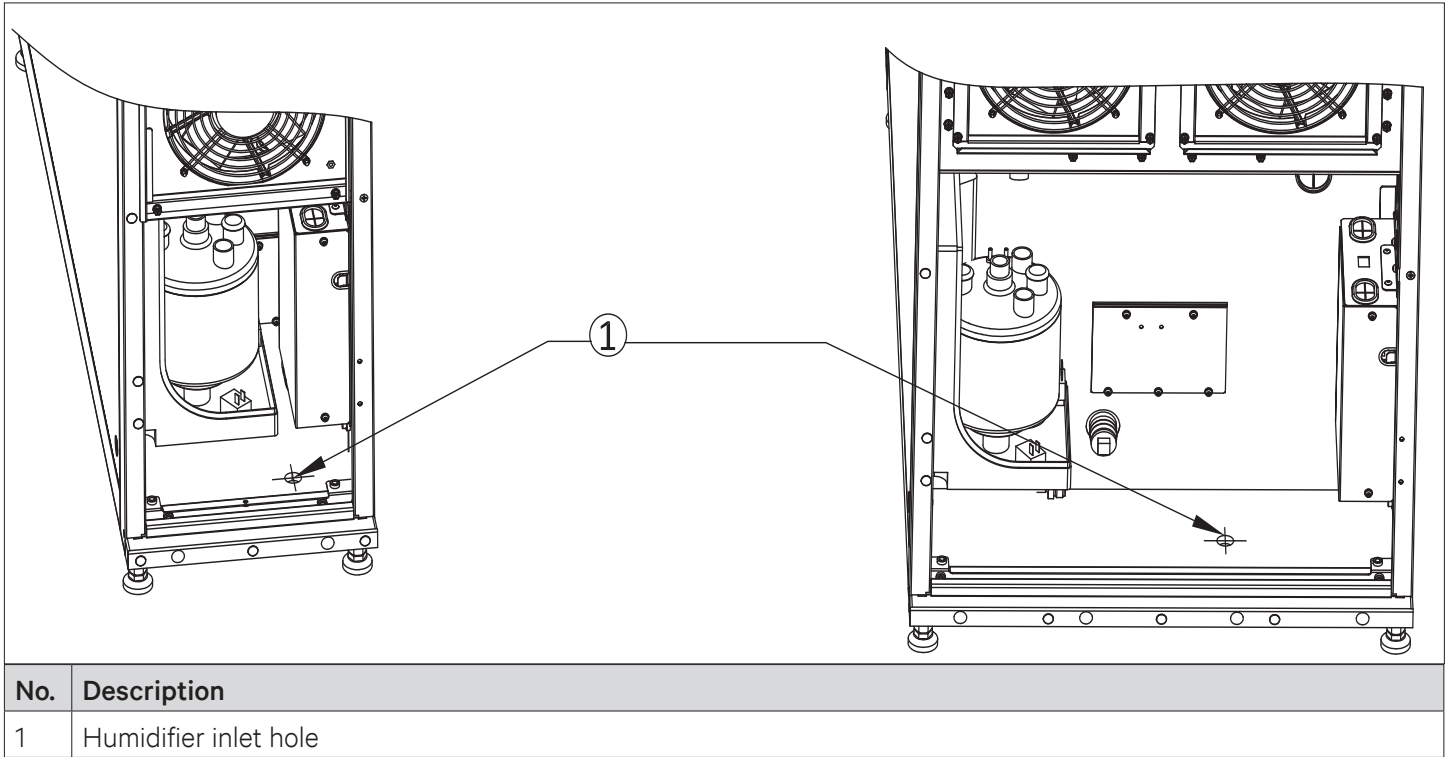
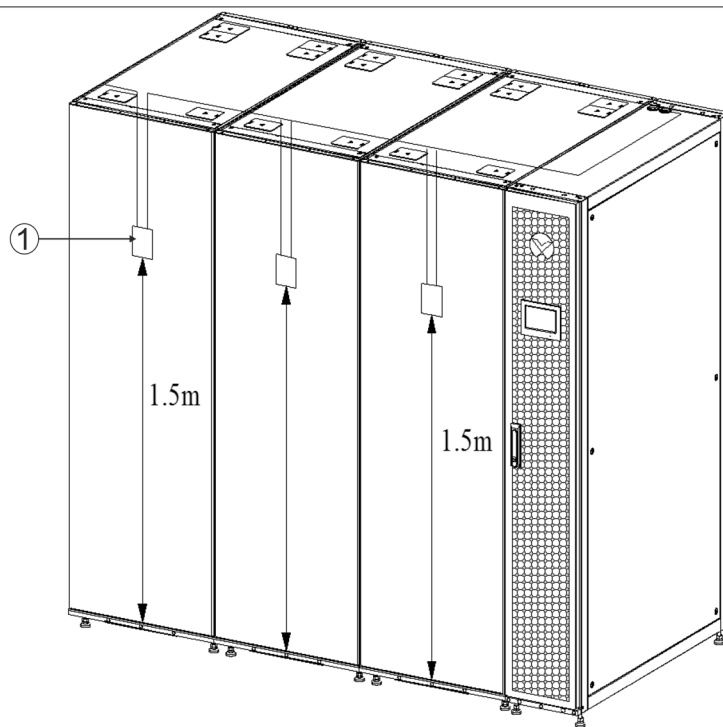


Figure 3-15 Electrode Humidifier Water Inlet Pipe Connection from Bottom

3.7.2. Rack Temperature Sensor

Each air-cooled unit can be connected with a maximum of 6 temperature sensors. It is recommended that the sensors be located in front of the heat-loads to achieve the most precise temperature. If the sensors are connected in series (refer [Figure 3-16](#)), each temperature sensor monitors the temperature of air entering each rack, and the read temperature value is used to control unit operation. The standard location of the sensor is 1.5 m height from the base of the unit. Therefore, the sensors should be placed in positions as shown in [Figure 3-16](#), or the devices cannot operate appropriately.



No.	Description
1	Temperature sensor

Figure 3-16 Layout of Rack Temperature Sensors

Following is the procedure to connect sensors for Liebert® CRV4 models:

1. Insert the connector of the rack temperature sensor in the TB3 point. On connecting the cable, route the cable through the top or bottom of the unit following which it should be connected to the first sensor. Connect the first sensor to the second sensor. Thus, the sensors are connected in a daisy-chain.
2. Fix the temperature sensor in front of the hottest source inside the rack. Do not fix it in front of the empty sub-rack. Affix the sensor on the rack surface using the magnets provided in the kit. The sensor must be fixed in a position that is mostly short of cool air.

Rack temperature sensor IRM-S02TH address settings are given in the [Table 3-14](#).

Table 3-14 IRM-S02TH Address Setting

Sensor	1	2	3	4	5	6	ID	ON — “1”; OFF — “0”
Rack temperature 1	0	0	0	1	0	0	10	
Rack temperature 2	0	0	0	1	0	1	11	
Rack temperature 3	0	0	0	1	1	0	12	
Rack temperature 4	0	0	0	1	1	1	13	
Rack temperature 5	0	0	1	0	0	0	20	
Rack temperature 6	0	0	1	0	0	1	21	

Chapter 4: Micro-Controller (Color Screen)

This section introduces the controller features, control screen details, basic system maintenance, and routine troubleshooting which enables the customer to understand the functioning of the unit. It helps user gain insight into the inner workings of the product comprising the information such as System setup, Alarm menus, and Basic operations of the controller interface.

4.1. Features

Following are the features of the micro-controller:

1. The micro-controller is used for monitoring and displaying the operation status of the Liebert® CRV4 unit to keep the environment within a setting range.
2. The Liebert CRV4 air conditioning is configured with 7-inch HMI color screen, which makes user interface operation simple.
3. It provides a three-level password protection to effectively prevent unauthorized operation.
4. It provides the functions, including self-recovery upon power failure, high voltage and low voltage protection, phase loss and anti-phase protection.
5. User can accurately understand the main parameters and operating status of the system through menu operation.
6. Real time display of measured Temp & Hum curves.
7. It accurately displays the running time of critical components through menu operation.
8. The expert-level fault diagnosis system can automatically display the current fault information to facilitate maintenance personnel in servicing and repair.
9. It can store up to 1000 historical alarm records.

4.2. Appearance

The unit has a 7-inch HMI color display and its appearance is shown in [Figure 4-1](#)



Figure 4-1 Color Screen

The Liebert® CRV4 series display indicator lamp has four colors; corresponding colors and their functions are described in [Table 4-1](#).

Table 4-1 Function Description

Indicator Color	Description
Blue	Starting display
Yellow	Display system shutdown or failure in the control panel communications.
Green	System operating normally
Red	Alarm in system and buzzer

4.3. Control Screen

4.3.1. Main Screen

After the startup is completed, enter the main interface. The top part of the color screen displays the menu button, first page button, time and date, and unlock button. User cannot enter the menus as the menu button is not unlocked. Click the unlock button and enter correct password, the top part of the screen will display temperature / humidity setting button, curve button and On/Off button as shown in [Figure 4-2](#); user can switch the On/Off functions by pressing the On/Off button for at least 3seconds.

As shown in the left half part of [Figure 4-2](#), the text on the left of the control mode displays the humidity control mode (air supply humidity control); the text on the right displays the temperature control mode (default air supply control mode, and is consistent with the compressor control mode); and the temperature value in the circle shows actually measured temperature / humidity values (default is air supply temperature) in current mode; the humidity value means the air supply humidity. For the two triangles on the edge of perimeter, the left

one means the air supply humidity setpoint and the right one means the temperature setpoint in current mode. Clicking toggle button 1 can switch the display between the graphic display and table display. Click the setting button can enter the temperature / humidity setting interface to set the temperature / humidity.

As shown in the right half of [Figure 4-2](#), the sensor data or alarm data is displayed. Click the toggle button 2 to switch between the sensor data and the alarm data.



Figure 4-2 Color Display Screen - Unlock

Table 4-2 provides the list of menu keys and its functional description:

Table 4-2 Color Screen Button Functional Description

Touch Keys	Functional Description
Menu button	Press this button to display the main menu page by page and enter the various sub-menus.
User button	Press this button to enter the main page to see the systems primary data readings.
Setting button	Press this button to enter the temperature and humidity settings page, which can set the system temperature and humidity, and the control mode.
Graph button	Click this button to enter the curve interface, user can view the average return air temperature, the remote average temperature, the average air supply temperature, and the average air supply humidity of 0 to 48Hour.
Time display	Displays the current time.
ON/OFF button	Unit is Off, press the button at least 3seconds, the unit will boot; the unit is running, press the button at least 3seconds, the unit will shut down.
Unlock button	Press the unlock button, enter the correct user login password to access; the menu icon appears after log-on to set parameters; click the unlock button to enter the unlocked interface.
Operating status	Displays the current operating status of the unit (shutdown, operation, standby, lock, communication interruption).
Toggle button 1	Press the toggle button to switch between the graphical display mode and the list display mode.
Toggle button 2	Press this button to switch between the current sensor readings and alarm pages.
Control mode	Display the current setting value of the unit and the environment conditions of the equipment room, as described in the following main interface control mode.
Status display	Displays the current state of the unit.
Sensor reading list	Displays the current operating status of each sensor and its respective components.
Alarm list	Displays all the current alarms.

4.3.2. Main Interface Control Mode

The main interface is divided into temperature control mode, humidity control mode, temperature value in current control mode, theoretical supply air humidity value, and three read-only status of temperature / humidity setting value.

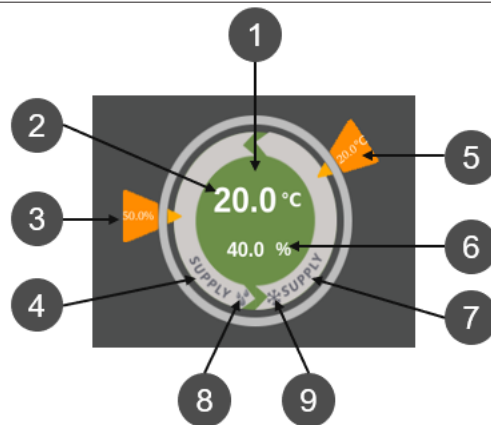


Figure 4-3 Control Mode Diagram

Table 4-3 Description of Control Mode Diagram

No.	Description
1	The colors in the circle are red, gray and green (depending on the status of the unit).
2	The measured supply air temperature value changes with the change of the compressor's current control mode.
3	The humidity setting value changes and rotates clockwise between 30° - 150° polar coordinate angles according to the range of humidity setting value. When the humidity setting is at minimum value, the value is 30° in the polar coordinate; when the humidity setting value is at maximum value, and the humidity setting value is 150° in the polar coordinate.
4	Humidity control is the air supply humidity control by default, showing "supply".
5	The temperature setting value changes and rotates clockwise between 30° - 150° polar coordinate angles according to the range of temperature setting value. When the temperature setting is at minimum value, the value is 30° degrees in the polar coordinate; when the temperature setting value is at maximum value, and the temperature setting value is 150° degrees in the polar coordinate.
6	Theoretical air supply humidity value.
7	The current control mode of compressor is air supply humidity control by default, showing "supply".
8	 means humidity.
9	 means temperature.

There are three types of main interface unit status colors, as shown in Figure 4-4 below:



Figure 4-4 Unit Status Color

Table 4-4 Unit Status Color Description

Status	System Status Description
Red	Power-On, sensor data is not in the normal range or is invalid
Gray	Off state
Green	Power-On, status is within the normal range

4.3.3. Password Interface

Press on the unlock icon in the upper right corner of the display, the password interface is displayed, as shown in Figure 4-5.

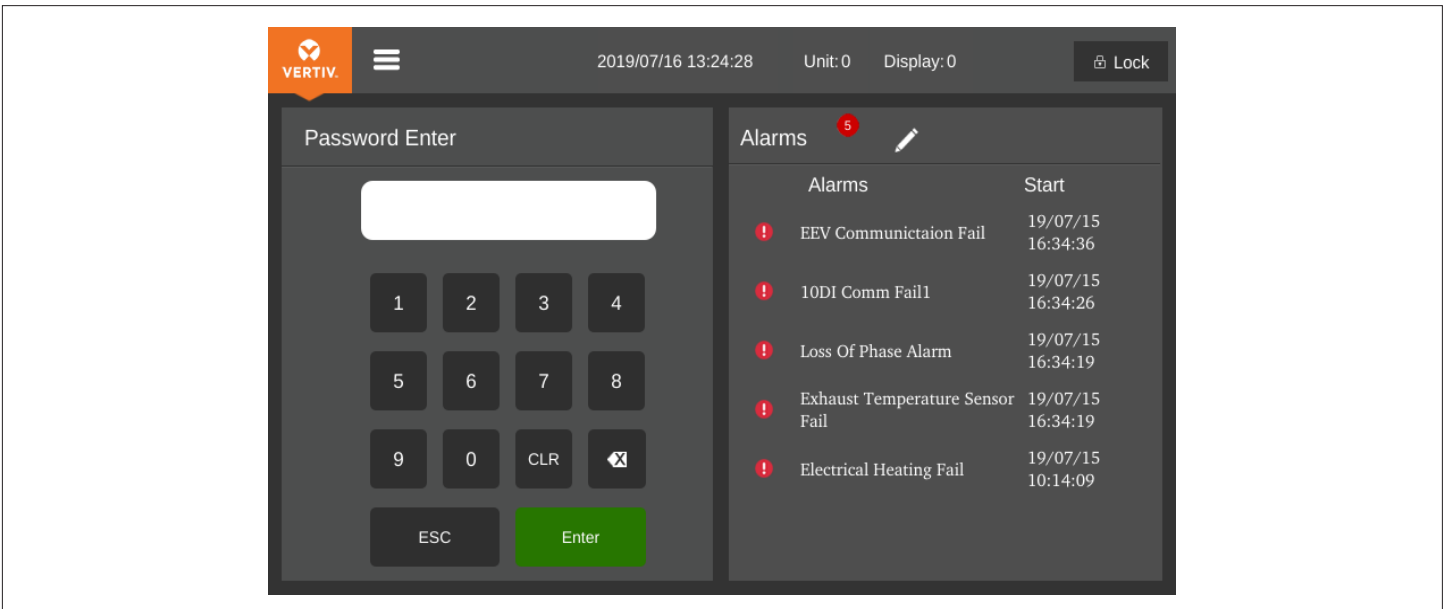


Figure 4-5 Password Interface

The three levels of passwords for accessing the menu are given in [Table 4-5](#).

Table 4-5 Password Level

Password level	User	Initial password	Remark
Level 1	General operator	1490	Browse all menu information. Set temperature setpoint, humidity setpoint ; time setting and display language.
Level 2	Maintenance personnel	-	Browse all menu information. Set all parameters except display address
Level 3	Factory technician	-	-

User cannot change the setting when entering an incorrect password. However, they can view the menu. To go back to the Main screen, press the Esc button and then click on the Enter button to get access to the Password interface again.



If the user do not enter a password and press the Enter button, the user can view the menu settings but cannot change any parameters, similar to the incorrect password example.

4.4. Menu Structure

4.4.1. Main Menu

The Main Menu screen is accessible by entering and confirming the correct password credentials, as shown in [Figure 4-6](#). For more information on Main Menus, refer to the Appendix 2 Display Menu Structure Diagram.

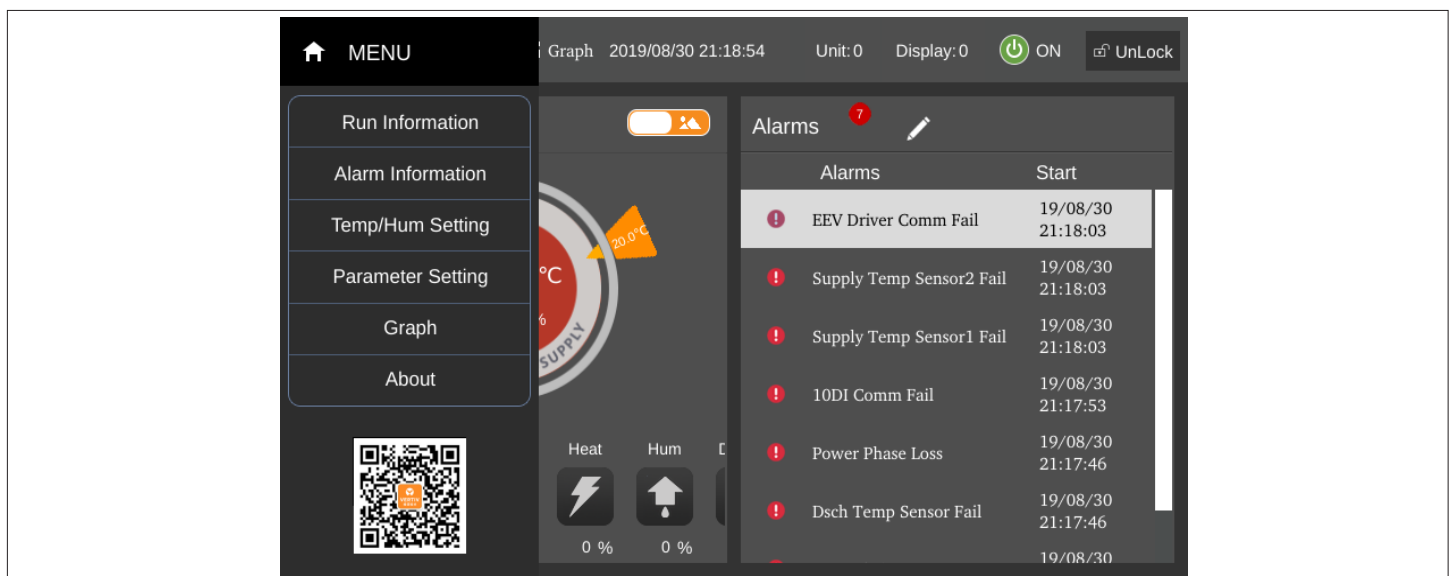


Figure 4-6 Main Menu

The menu structure is described in [Table 4-6](#).

Table 4-6 Main Menu Description

Menu Item		Descriptions
Menu	Run Information	View temperature/ humidity information, Switch status, power information, Teamwork information
	Alarm Information	View system active alarms history alarms and hp abnormal record
	Temp & Hum setting	Set the temperature/ humidity value
	Param Setting	Set alarm setpoint, alarm attribute, communication settings, teamwork settings, time settings, display settings and password setting
	Graph	View return air temperature curve, return air humidity curve, supply air temperature curve, and remote temperature curve
	About	View the controller software and hardware version number, and the software and hardware version number of the LCD
Homepage		Display operating status, operating data, alarm data, sensor data
Setting		Temperature/ humidity setting under the same menu
Curve		Temperature/ humidity curve under the same menu

4.4.2. Run Information

In the main menu, select **Run Information** to enter the interface as shown in [Figure 4-7](#), including temperature and humidity information, switch status, power information, and teamwork information.

- **Temp/Hum information**

The **Temperature/ Humidity** menu displays the temperature/ humidity parameters of the device in real time, including return air temperature/ humidity, supply air temperature, remote temperature and other information, as shown in [Figure 4-7](#) of temperature/ humidity information. Press the scroll bar to the extreme right to navigate information to the far right.

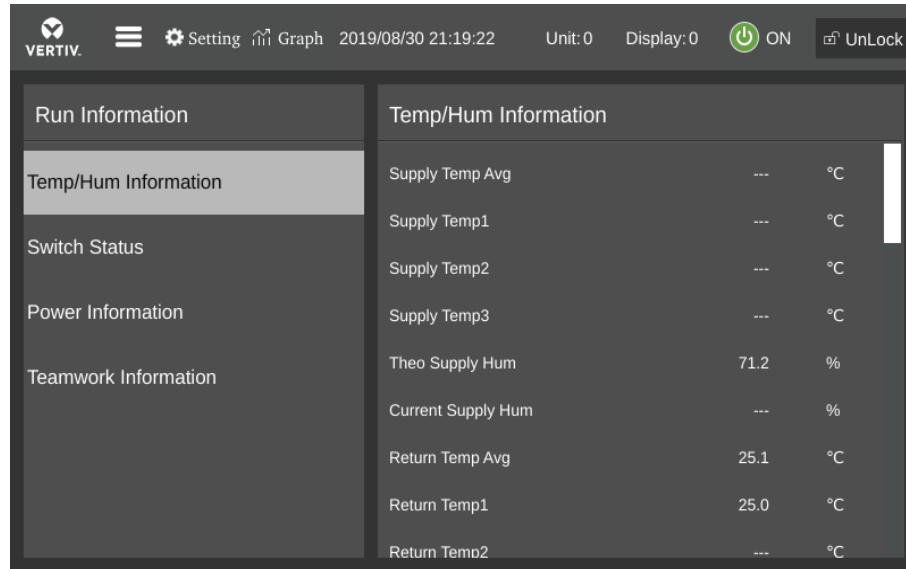


Figure 4-7 Temperature Humidity Information

- **Switch status**

The **Switch status** menu displays the switch status of each electrical component, as shown in [Figure 4-8](#).

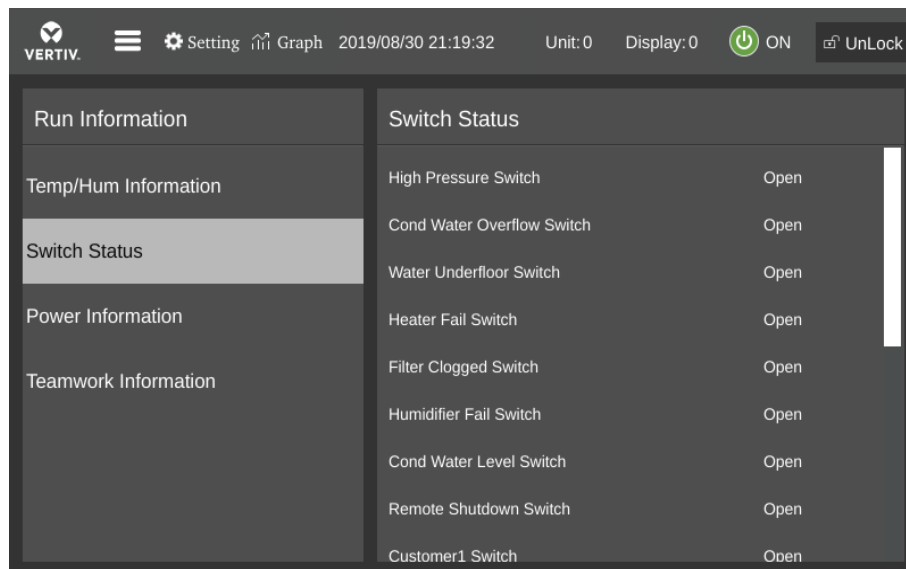


Figure 4-8 Switch Status Information

- **Power Information**

The Power Information menu displays the three-phase voltage and frequency, as shown in [Figure 4-9](#).

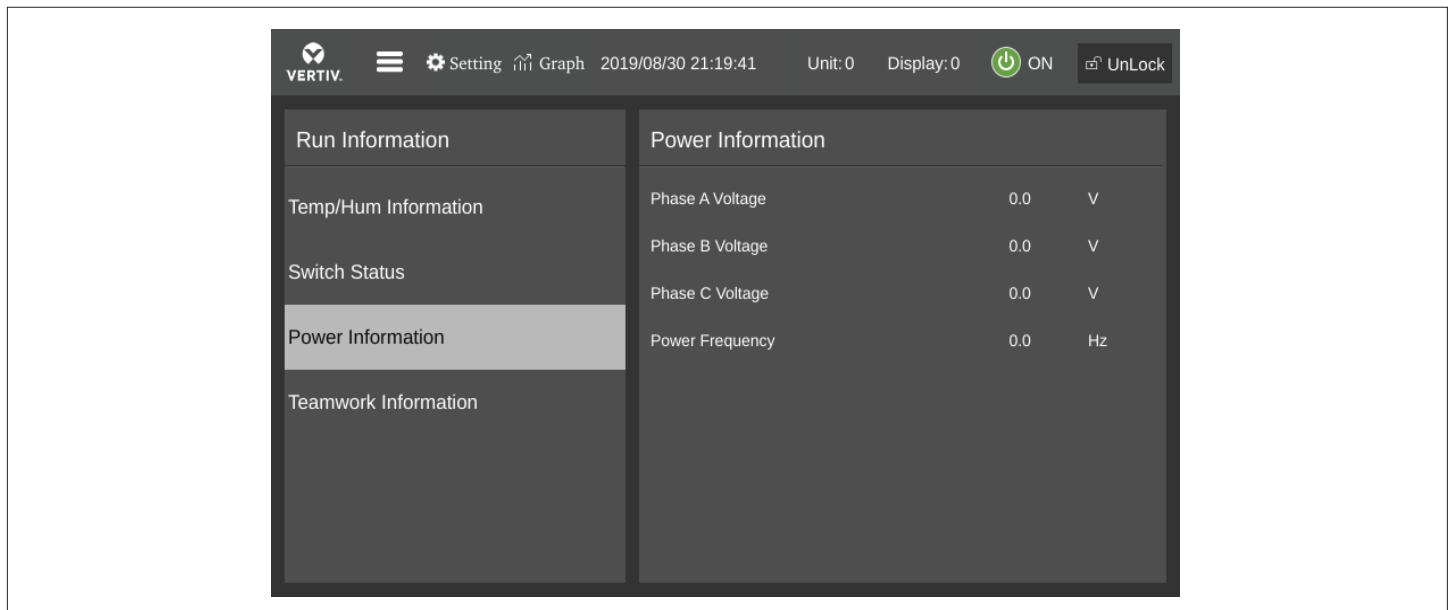


Figure 4-9 Power Information

- **Teamwork Information**

The Teamwork Information menu displays the status of the group information, as shown in [Figure 4-10](#).

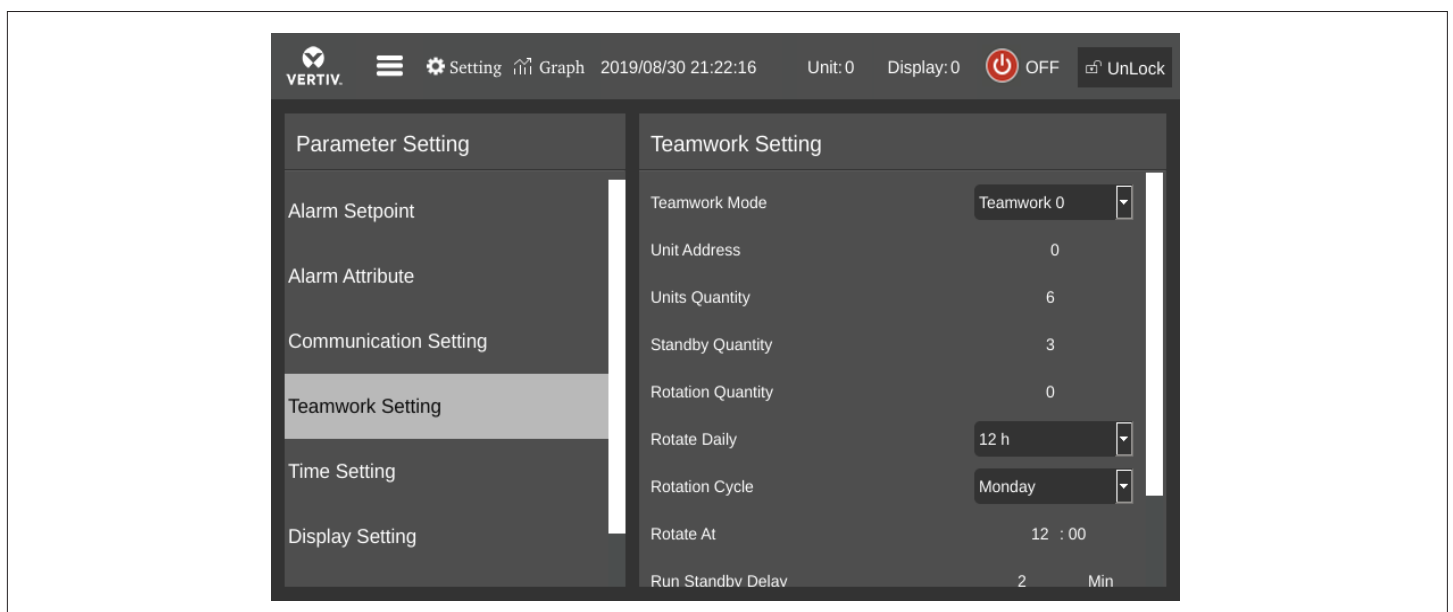


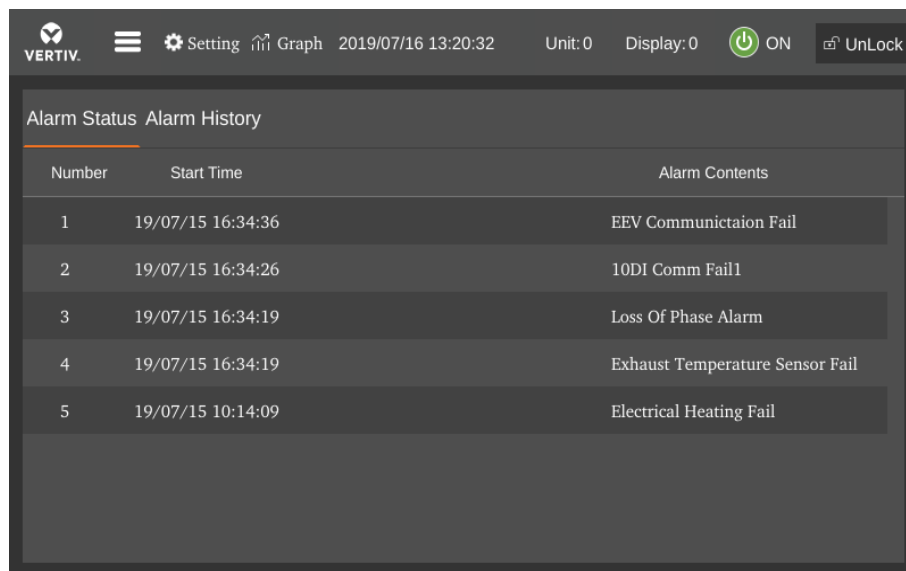
Figure 4-10 Teamwork Information

4.5. Alarm Information

Press the **Alarm Information** icon in the main menu to enter the page as shown in [Figure 4-11](#). It contains two pages: alarm status and alarm history.

- **Alarm Status**

The **Alarm Status** page is used to monitor the current alarm status record of the AC unit, indicating no alarm or specific alarm status information. Specific alarm status information includes serial number, alarm content, alarm time, as shown in [Figure 4-11](#).



Alarm Status Alarm History		
Number	Start Time	Alarm Contents
1	19/07/15 16:34:36	EEV Communicatoin Fail
2	19/07/15 16:34:26	10DI Comm Fail1
3	19/07/15 16:34:19	Loss Of Phase Alarm
4	19/07/15 16:34:19	Exhaust Temperature Sensor Fail
5	19/07/15 10:14:09	Electrical Heating Fail

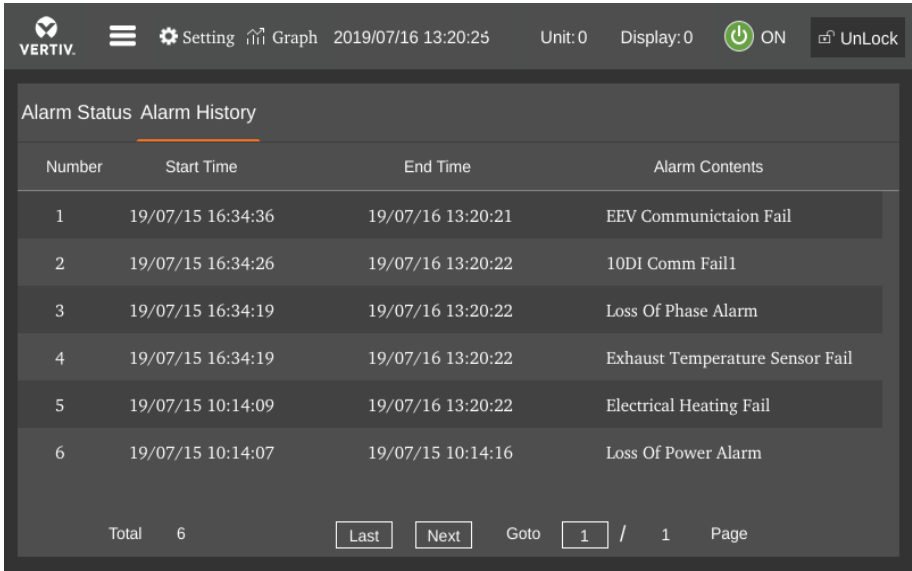
Figure 4-11 Alarm Status



- The latest Alarm SN is the least number. Press the Up or Down button to scroll through the status records if more than one alarm is activated.
- They will be cleared upon system Power-Off.

- **Alarm History**

The **Alarm History** is used to view the historical alarm records, including the Alarm Status Number (quantifiable number of history alarms), Alarm Serial Number, Alarm Type, and Alarm Time (Start and End Time) as shown in [Figure 4-12](#).



Number	Start Time	End Time	Alarm Contents
1	19/07/15 16:34:36	19/07/16 13:20:21	EEV Communicatoin Fail
2	19/07/15 16:34:26	19/07/16 13:20:22	10DI Comm Fail1
3	19/07/15 16:34:19	19/07/16 13:20:22	Loss Of Phase Alarm
4	19/07/15 16:34:19	19/07/16 13:20:22	Exhaust Temperature Sensor Fail
5	19/07/15 10:14:09	19/07/16 13:20:22	Electrical Heating Fail
6	19/07/15 10:14:07	19/07/15 10:14:16	Loss Of Power Alarm

Total 6 Last Next Goto 1 / 1 Page

Figure 4-12 Alarm History



- Press the Up or Down button to scroll through the status records if more than one alarm is activated.
- Up to 1000 historical alarm records can be stored. They will not be cleared upon system Power-Off.

4.5.1. Temperature and Humidity

Select the **Temperature Humidity** setting in the main menu to enter the interface as shown in [Figure 4-13](#) including temperature settings and humidity settings.

- **Temp Setting**

The **Temp Setting** menu interface is shown in [Figure 4-13](#). The user can set the supply air temperature, return air temperature, remote air temperature, and temperature difference under this menu.

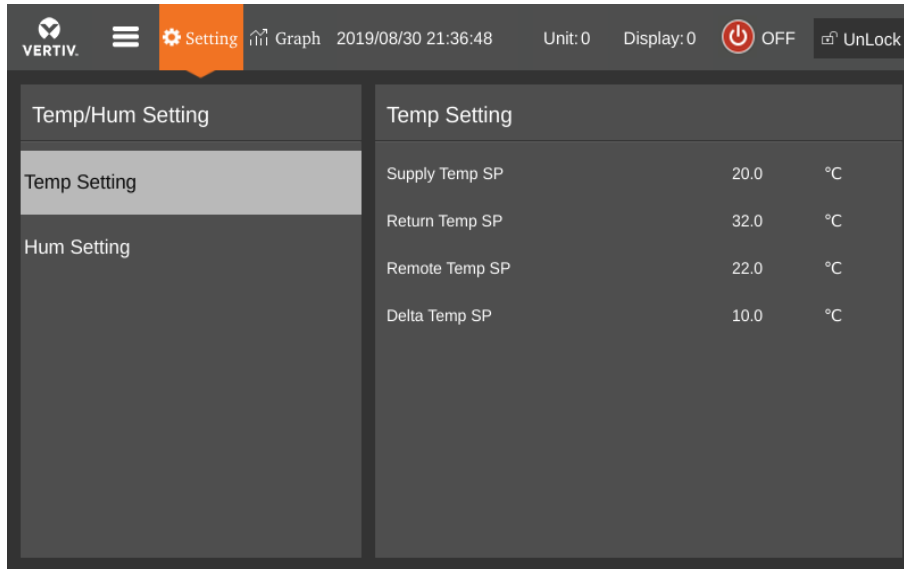


Figure 4-13 Temp Setting

- **Hum Setting**

The Hum Setting menu interface is shown in [Figure 4-14](#). The user can set the humidity setting value under this menu.

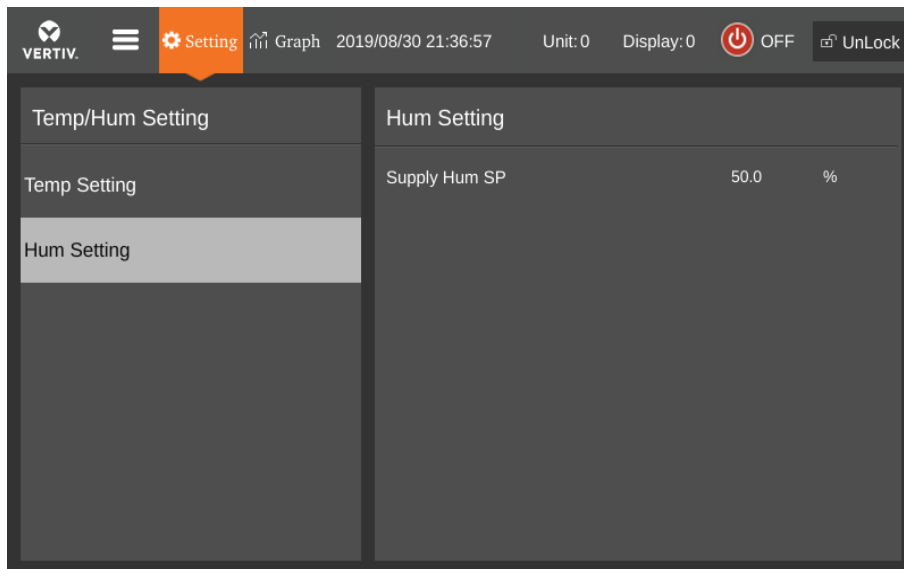


Figure 4-14 Hum Setting

4.5.2. Parameter Setting

Select **Parameter Setting** from the main menu to enter the interface as shown in [Figure 4-15](#), including alarm setpoint, alarm attribute, communication setting, teamwork setting, time setting, display setting and password setting.

- **Alarm Setpoint**

The Alarm Setpoint menu interface is shown in [Figure 4-15](#).

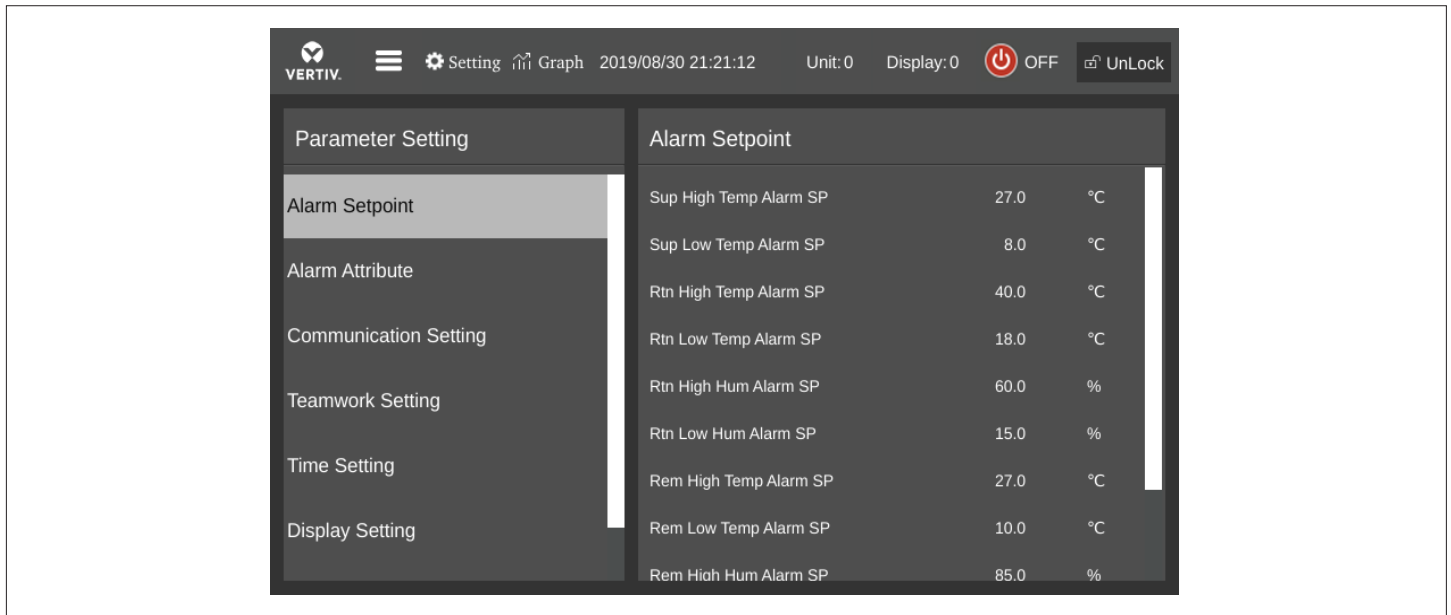


Figure 4-15 Alarm Setpoint

- **Alarms Attribute**

The Alarms Attribute menu interface is shown in [Figure 4-16](#).

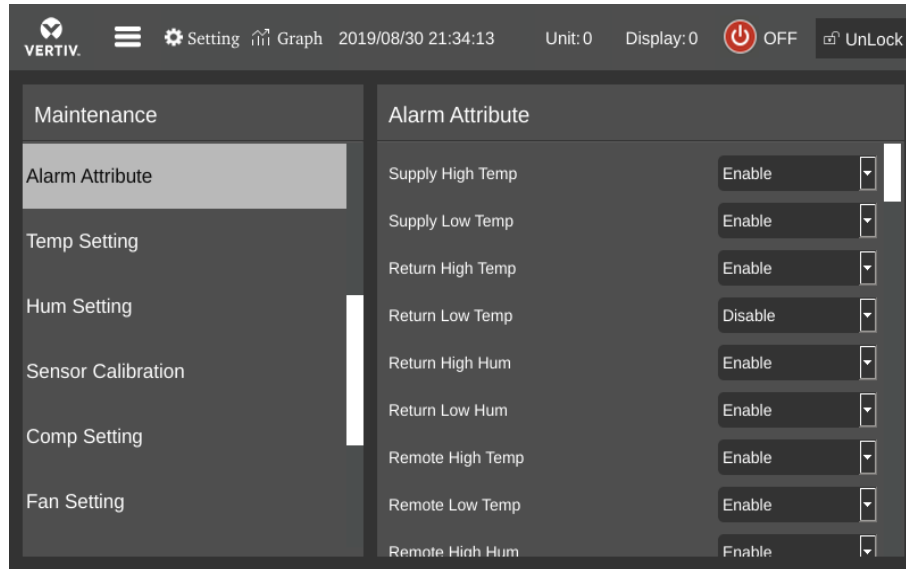


Figure 4-16 Alarms Attribute



Do not change the default values of the initial settings. It is recommended to change the settings only under the guidance of qualified service professional.

- **Communication Setting**

The **Communication setting** menu interface is shown in [Figure 4-17](#), communication setting screen, the system parameters can be set to monitoring protocol, monitor baudrate and monitor address.

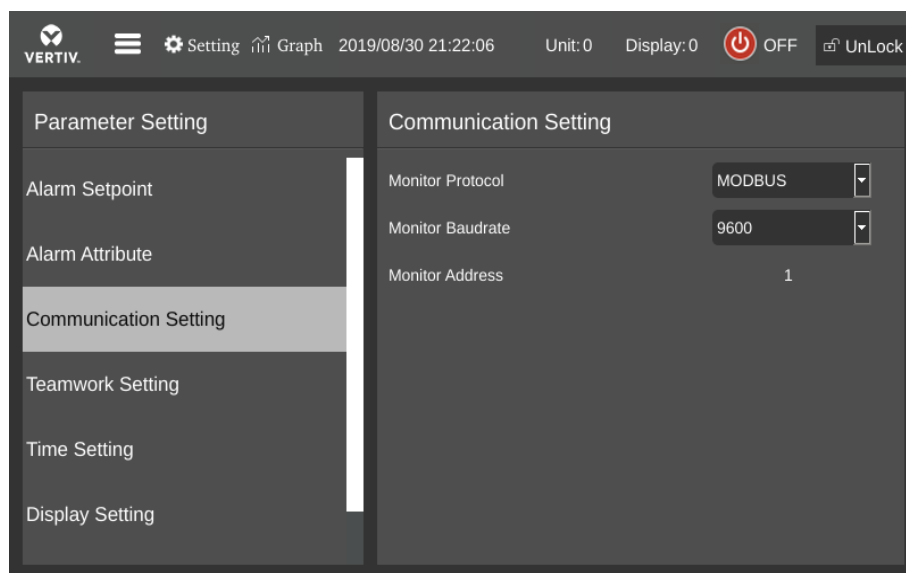


Figure 4-17 Communication Setting

- **Teamwork Setting**

The Teamwork Setting menu interface is shown in [Figure 4-18](#).

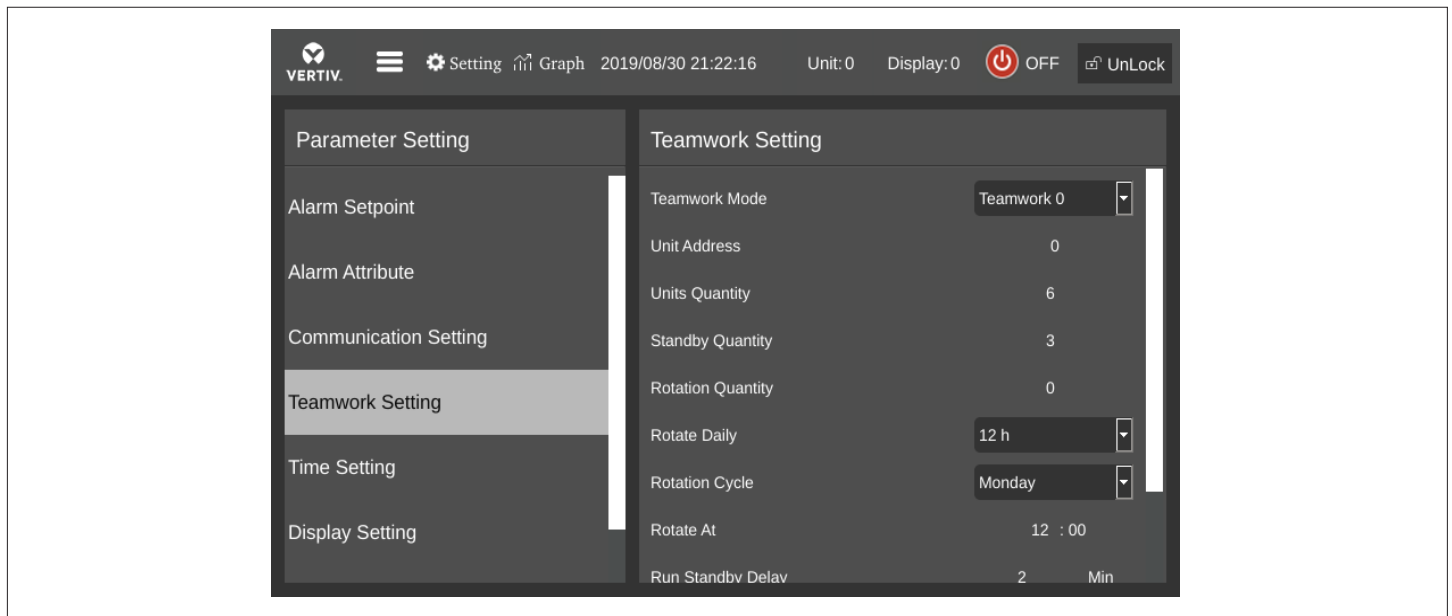


Figure 4-18 Teamwork Setting

- **Time Setting**

The Time Setting menu interface is shown in [Figure 4-19](#).

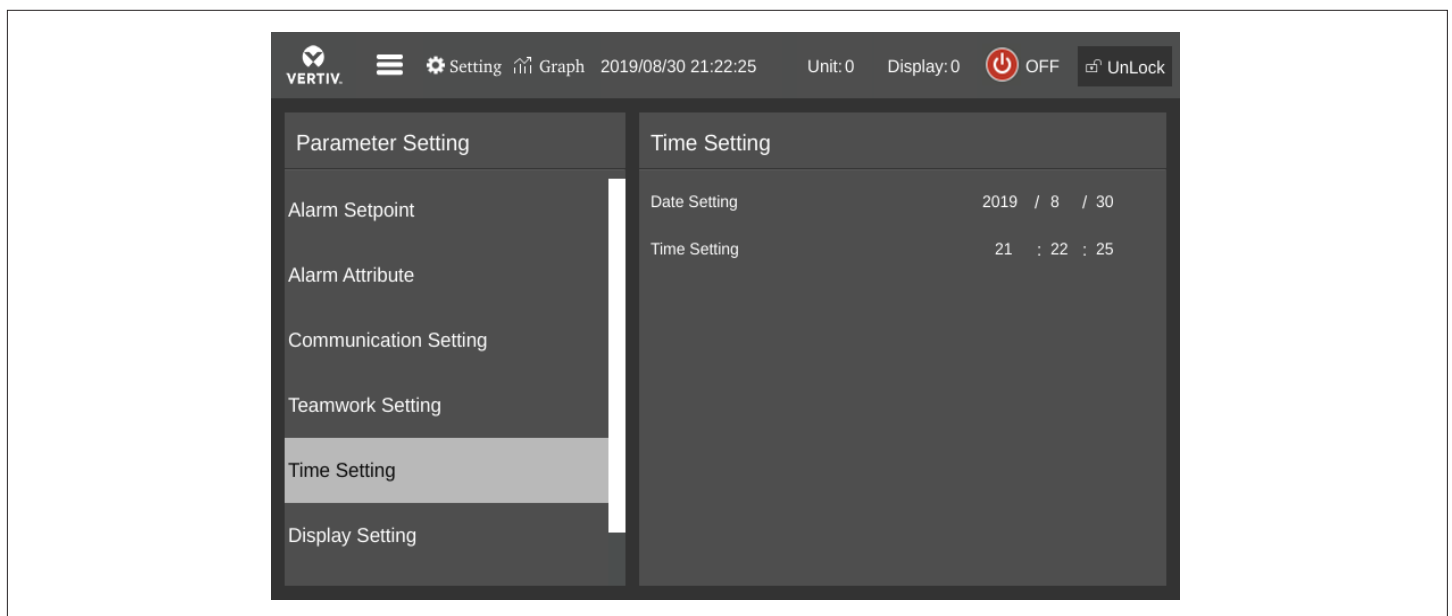


Figure 4-19 Time Setting

- **Display Setting**

The Display Setting menu interface is shown in [Figure 4-20](#).

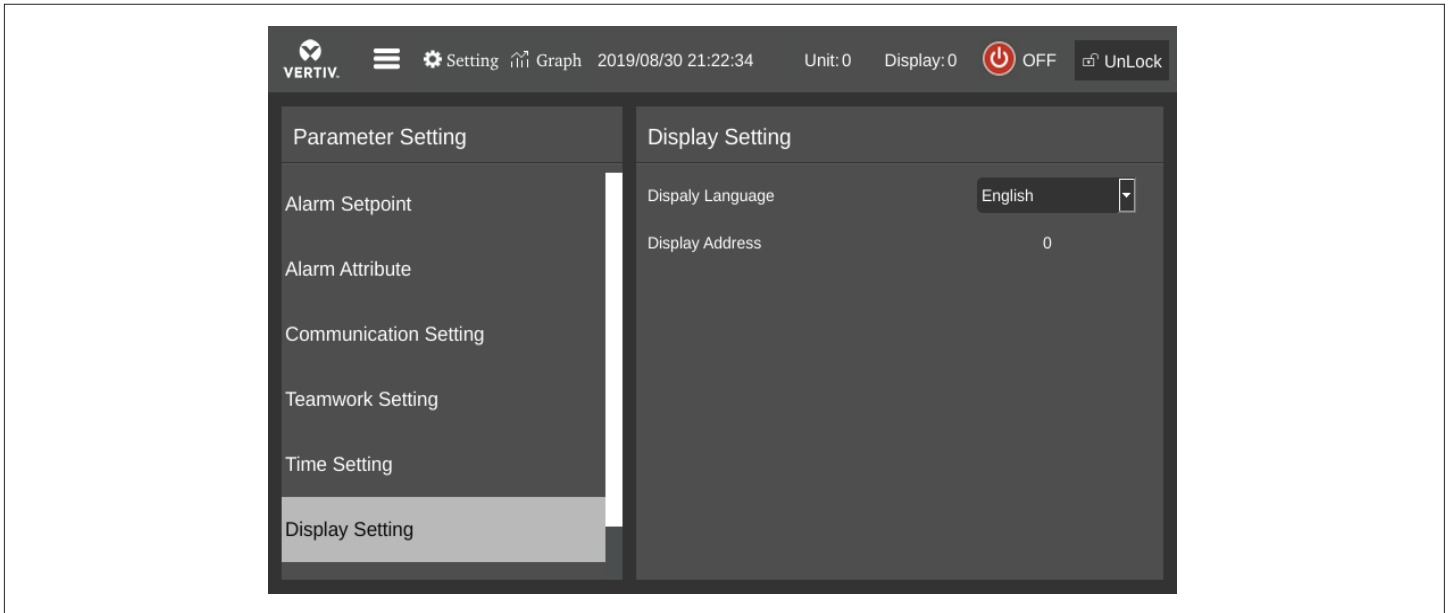


Figure 4-20 Display Setting

- **Password Setting**

The Password Setting menu interface is shown in [Figure 4-21](#).

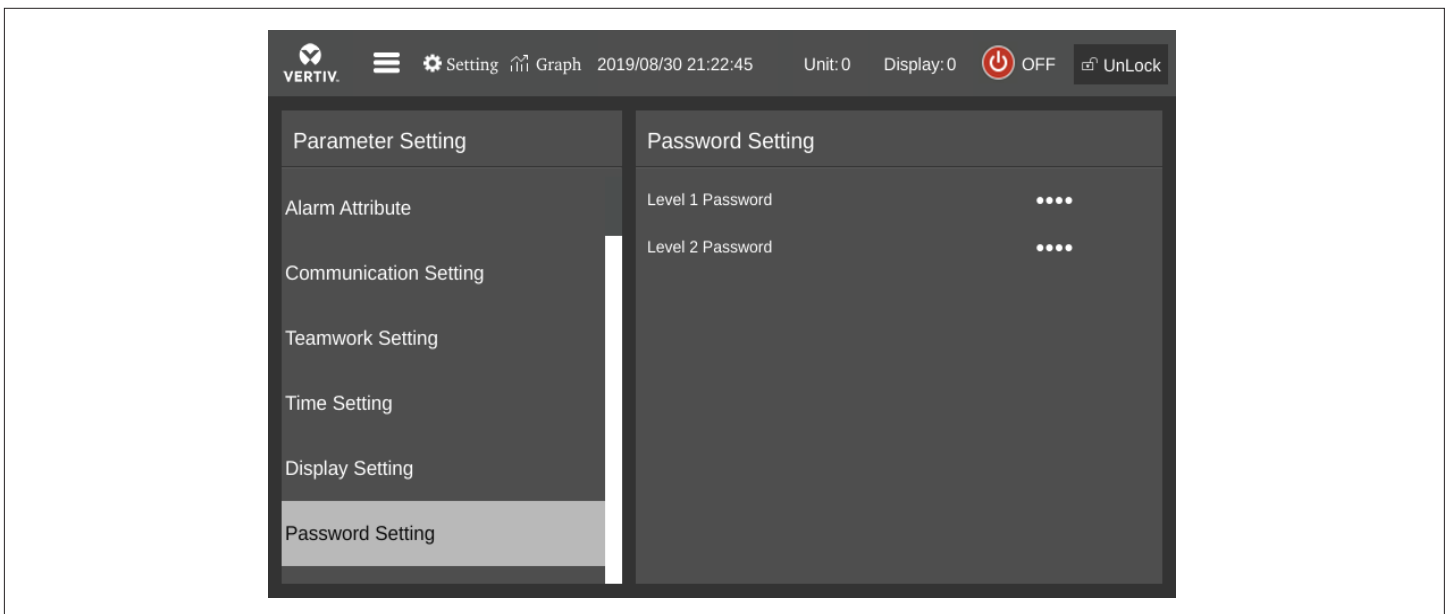


Figure 4-21 Password Setting

4.5.3. Graph

Select **Graph** in the main menu to enter the interface as shown in [Figure 4-22](#). Under this menu, the user can query the curve of return temperature, return humidity, supply temperature, and remote temperature of 0 to 48 Hours.

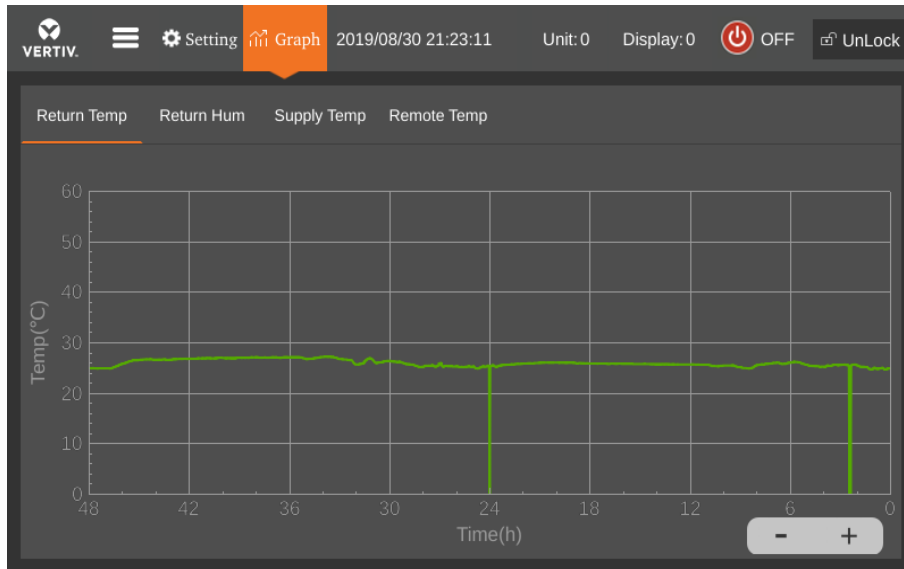


Figure 4-22 Graph

4.5.4. About

The **About** menu is used to query the software model and version number, as shown in [Figure 4-23](#).

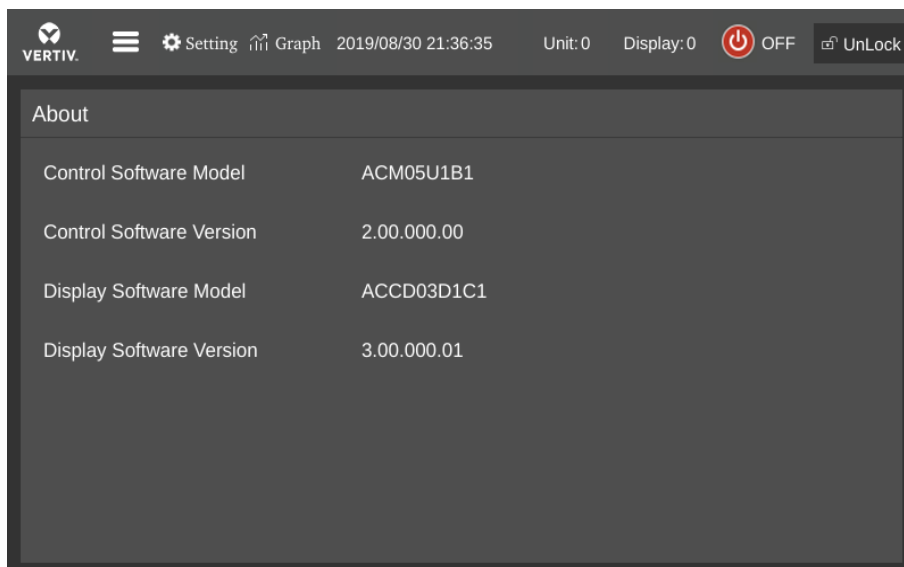


Figure 4-23 About

Chapter 5: Micro-Controller (Text-screen)

This chapter provides a detailed description on feature, appearance, color screen, control buttons, control interface and menu structure of the Liebert® CRV4 precision air conditioner. It also helps the user gain insight of the inner workings of the product which include the information such as system setup, alarm menus and basic maintenance.

5.1. Features

Following are the features of the micro-controller:

1. The micro-controller is used for monitoring and displaying the operation status of the Liebert CRV4 unit to keep the environment within a setting range.
2. It comprises a 128x64 dot matrix LCD screen with white backlight and an easy-to-use interface.
3. It provides a three-level password protection to effectively prevent unauthorized operation.
4. It provides the functions, including self-recovery upon power failure, high and low voltage protection, phase loss and protection against phase-reversal.
5. It accurately displays the running time of critical components through menu operation.
6. The expert-level fault diagnosis system can automatically display the current fault information to facilitate technician personnel in maintenance activities.
7. It can store up to 1000 historical alarm records.
8. Configure the RS485 interface, using MODBUS-RTU communication protocol.

5.2. Appearance

The micro-processing controller panel is shown in [Figure 5-1](#).

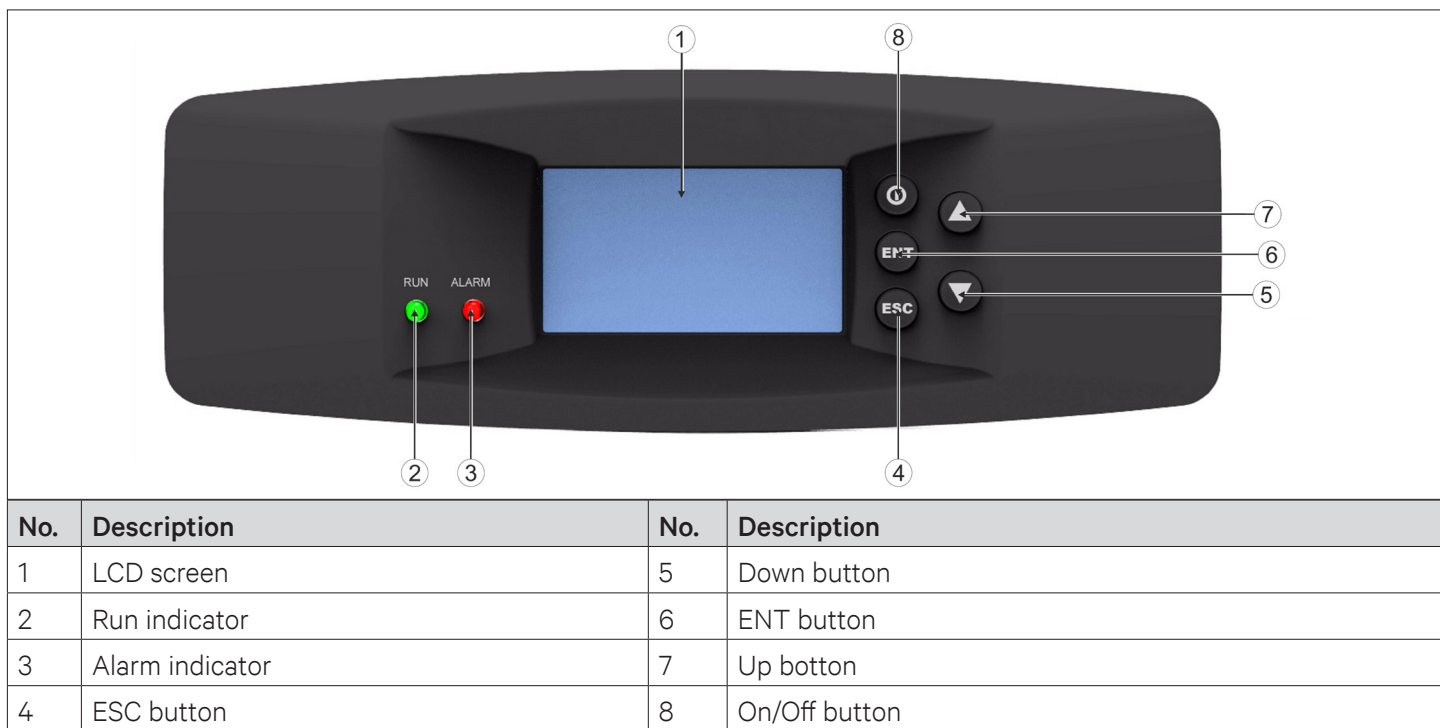


Figure 5-1 Appearance of the Micro Controller

5.3. Graphic Color Screen

The LCD screen default language setting is English, white backlight. It displays the current air supply temperature in the first queue, humidity in the second queue, and air return temperature in the third queue. When the compressor mode or fan mode is set to Remote, the queue displays the remote temperature. In the lower part of the screen, it displays the unit output status (fan, cooling, heating, dehumidifying, and humidifying) and unit operation status (off, running, standby, and locked). The icons on the main screen indicate the unit output status, unit properties, and unit operating status. Refer [Figure 5-2](#) for better understanding.

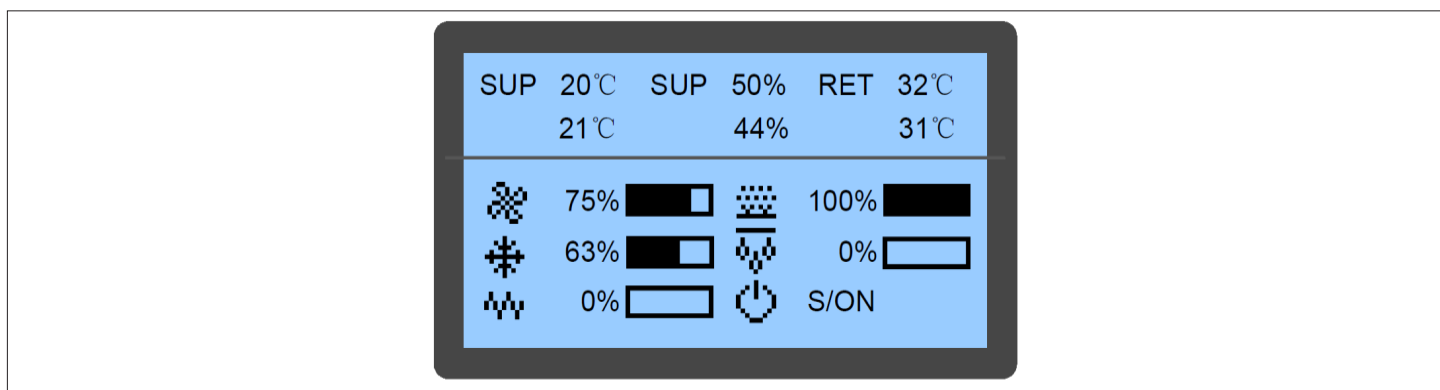


Figure 5-2 Main Screen

More detailed information such as the operating status of a component and temperature/humidity can be obtained from the main menu. When browsing the menu, the current menu item is highlighted; when the setting is modified, the current modification bit is highlighted.

5.4. Control Buttons

5.4.1. Function Description

The micro-controller provides five control buttons as shown in [Figure 5-3](#).

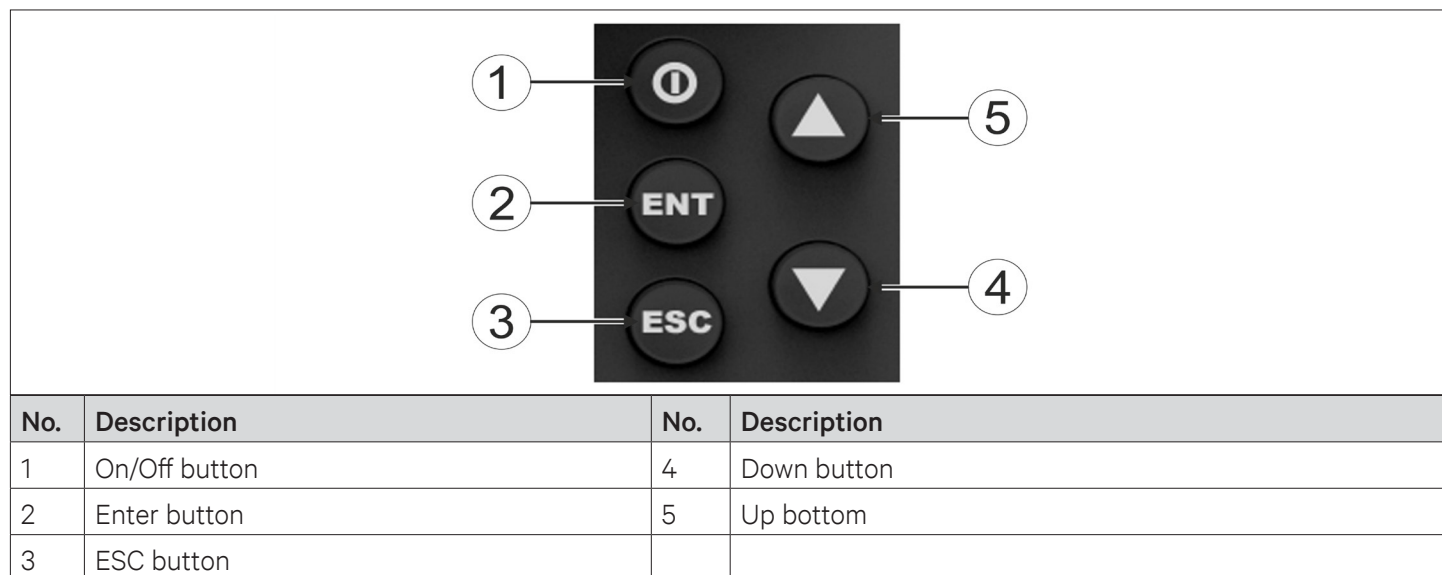


Figure 5-3 Control Buttons Description

[Table 5-1](#) describes the detailed functions of the control buttons.

Table 5-1 Function Description of Control Buttons

Button	Function description
On/ Off 	Switch On/ Off the controller by pressing for 3seconds.
Enter button 	Enter the selected menu screen. Validate the parameter setting value.
Escape button 	Exit the current menu and return to the normal screen or previous menu screen. Abort parameter change; silence the audible alarm.
Up button 	Move the cursor up or increase the parameter value. For a toggle selection: scroll through the options. For a multi-screen menu: scroll up the screen.
Down button 	Move the cursor down or decrease the parameter value. For a toggle selection: scroll through the options. For a multi-screen menu: scroll down the screen.

5.4.2. Operational Examples

Example 1: Enter the password to access the Main Menu

After the unit is powered On, user can enter the Main Menu by following the step-by-step instructions on the Normal screen.

1. Press the Enter button to enter the Password screen.
2. Next, press the Enter button again to highlight the input data field in the Password screen.
3. Press the Up and Down button to change the current password number.
4. Press the Enter button to confirm the password following which the Main Menu screen is populated on the controller screen.

Example 2: Parameter setting

To set the high temperature alarm of the airflow in the Hi Sup Temp in Alarm Stpt menu, perform the following steps:

1. Press the Up and Down button to move the cursor to the Alarm menu option in the Main Menu section.
2. To enter the Alarm Menu, press the Enter button.
3. Press the Up and Down button to move the cursor to the Alarm Set option on the Alarm Menu screen.
4. Press the Enter button to access the Alarm Set screen.
5. Press the Up and Down button to move the cursor to the Alarm Stpt in the Alarm Set Screen.
6. Press the Enter button to enter the Alarm Stpt screen.
7. Press the Enter button to highlight the parameter field of Hi Sup Temp.
8. In order to select the parameter option, scroll using the UP and Down buttons. Select/change the specific Parameter.
9. Press the Enter button to confirm it following which the changes will take effect.
10. Press the Esc button to return to the previous menu screen.



If user do not press the Enter button to validate the changed parameter after the changing the parameter, the change of Hi Sup Temp is invalid.

5.5. Control Screen

5.5.1. Startup Screen

After the system is powered On, the LCD will display the Startup screen as shown in [Figure 5-4](#).

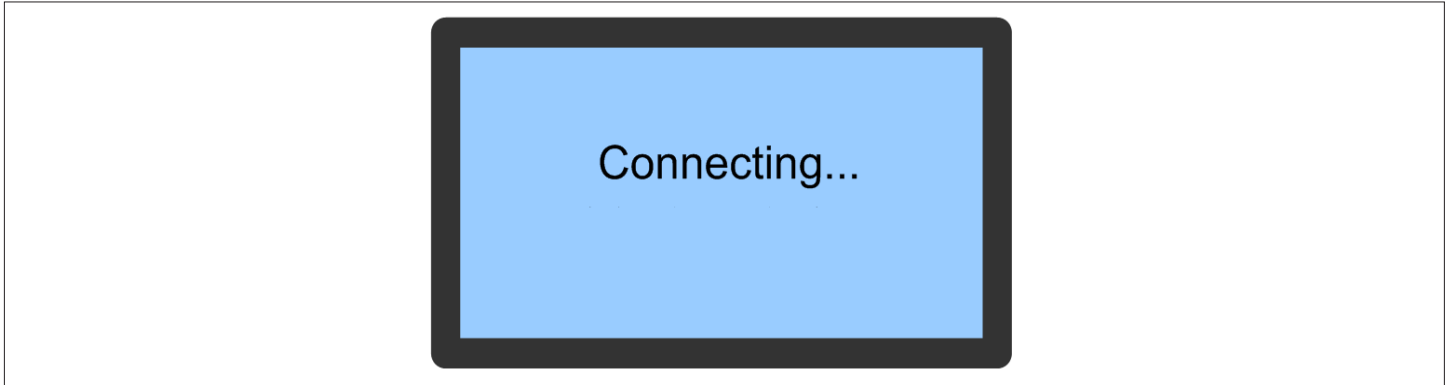


Figure 5-4 Startup Screen

5.5.2. Main Screen

After the unit is powered On, the main page screen is displayed after 10 seconds of the startup as shown in [Figure 5-5](#). It displays the current air supply temperature in the first queue, humidity in the second queue, and air return temperature in the third queue. When the compressor mode or fan mode is set to Remote, the queue displays the remote temperature. In the lower part of the screen, it displays the unit output status (fan, cooling, heating, dehumidifying, and humidifying) and unit operation status (off, running, standby, and locked).

- **Icons**

The icons on the main screen indicate the unit output status, unit properties, and unit operating status. The icons and their definitions are described in [Table 5-2](#).

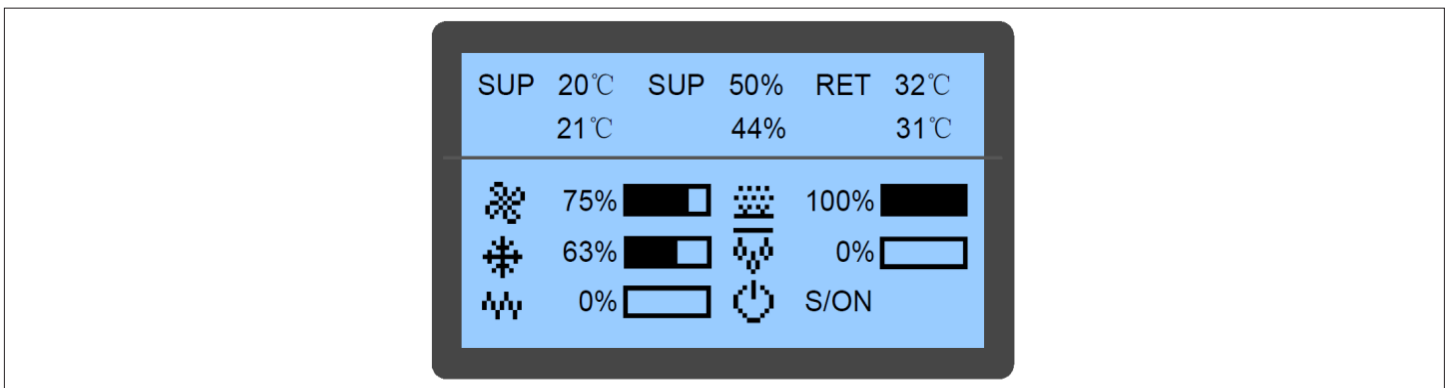


Figure 5-5 Main Screen

Table 5-2 Icons Definition

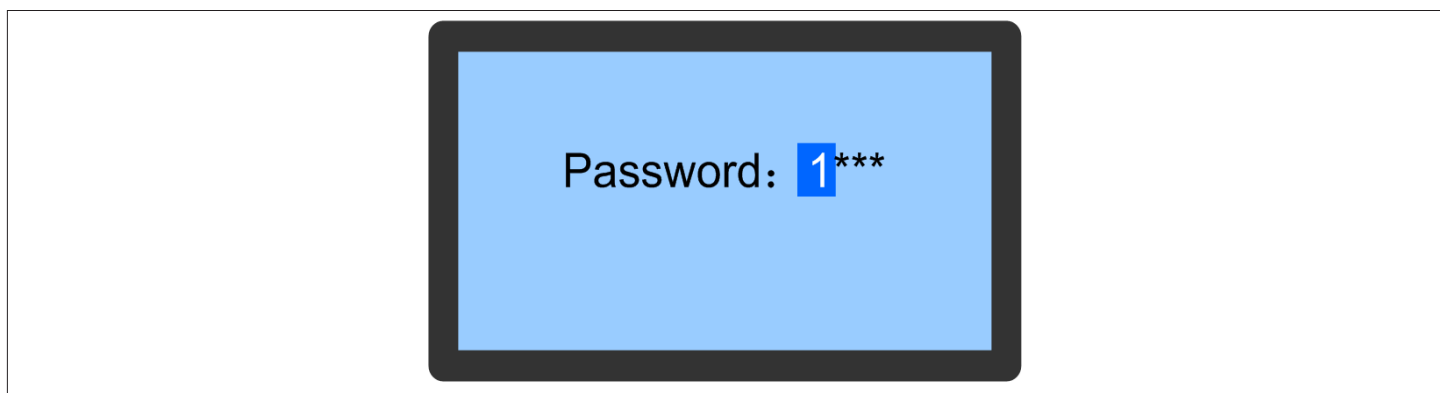
Icons	Definitions
	Fan rotating speed. Displaying the percentage of actual fan rotating speed.
	Compressor capacity. Displaying the percentage of actual compressor capacity.
	Heating state. Displaying 100% in heating mode, otherwise, displaying 0%.
	Humidifying state. Displaying 100% in humidifying mode, otherwise, displaying 0%.
	Dehumidifying state. Displaying 100% in dehumidifying mode, otherwise, displaying 0%.
	Unit properties/ operation status- S: single; T: teamwork; ON: running; R-OFF: remote shutdown; L-OFF: local shutdown; M-OFF: monitoring shutdown; MANU: manual mode; BKUP: backup; Lock: lock



When using RDU-A for teamwork control, the unit attribute will always display “single unit”, and the “standby” status of the running will not be displayed.

5.5.3. Password Interface

Press the Enter button on the Main screen and the Password screen will appear as shown in [Figure 5-6](#).


Figure 5-6 Password Interface Screen

Three levels of passwords are provided for accessing the menus. The detailed descriptions are listed in [Table 5-3](#).

Table 5-3 Password Level

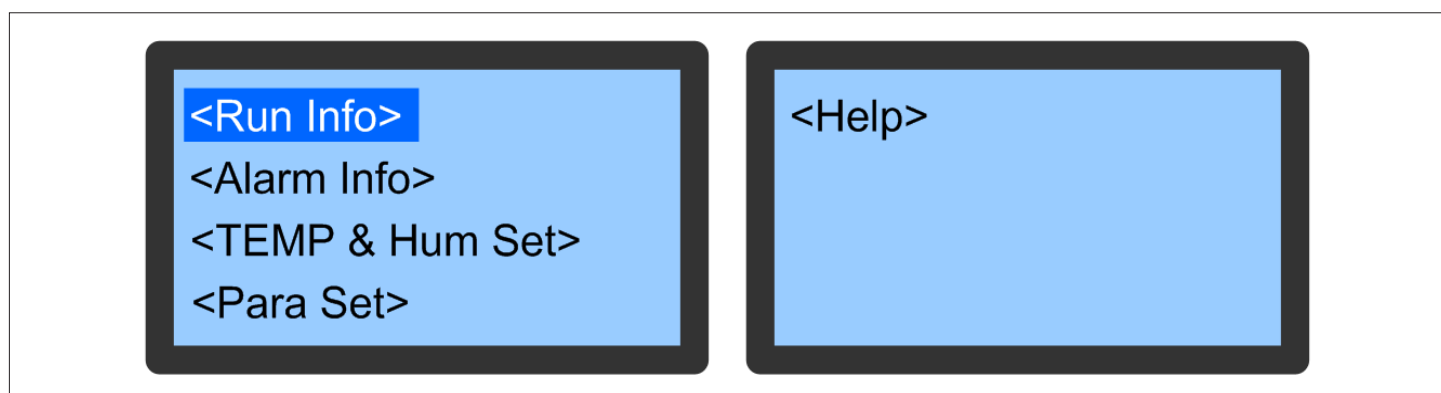
Password Level	User	Initial Password	Remark
Level 1	General operator	1490	Browse all menu information. Only set temperature and humidity Setpoints. Cannot change any values and settings
Level 2	Maintenance personnel	-	Browse all menu information. Set all parameters
Level 3	Factory technician	-	-

For detailed operation on entering the password, refer to [Section 5.4.2](#) Operation Example. If incorrect password is entered in the controller, the menu options can only be viewed, but the parameter settings can not be changed. In this case, to return to the Main screen, User can press the ESC button and then press the Enter button to re-enter the Password interface again.

5.6. Menu Structure

5.6.1. Main Menu

By entering the correct credentials for the password and confirming it, the Main Menu screen will be accessible. For more information, refer to the Appendix 2 Display Menu Structure Diagram which defines the menu structure of the Micro-processing controller. On selecting a menu item, that item will be highlighted. [Figure 5-7](#) shows the Main Menu screens:


Figure 5-7 Main Menu Screens

The users can change most of the parameters setting; however, there are some parameters that cannot be modified or altered.

Table 5-4 describes the different menu items on the Main Menu screen:

Table 5-4 Main Menu Description

Menu Item	Descriptions
Run Info	View temperature / humidity information, airflow pressure information, power information, Teamwork information
Alarm Info	View system active alarms and history alarms
TEMP & Hum Set	Set the temperature / humidity value
Para Set	Set system settings, alarm settings, humidifier settings, airflow pressure settings, display settings, password settings, and teamwork control settings
Help	View the controller software and hardware version number, and the software and hardware version number of the LCD

5.6.2. Run Information

In the Main menu, select **Run Info** to enter the interface as shown in Figure 5-8, including temperature & humidity information, ESP information, power information, and teamwork information.

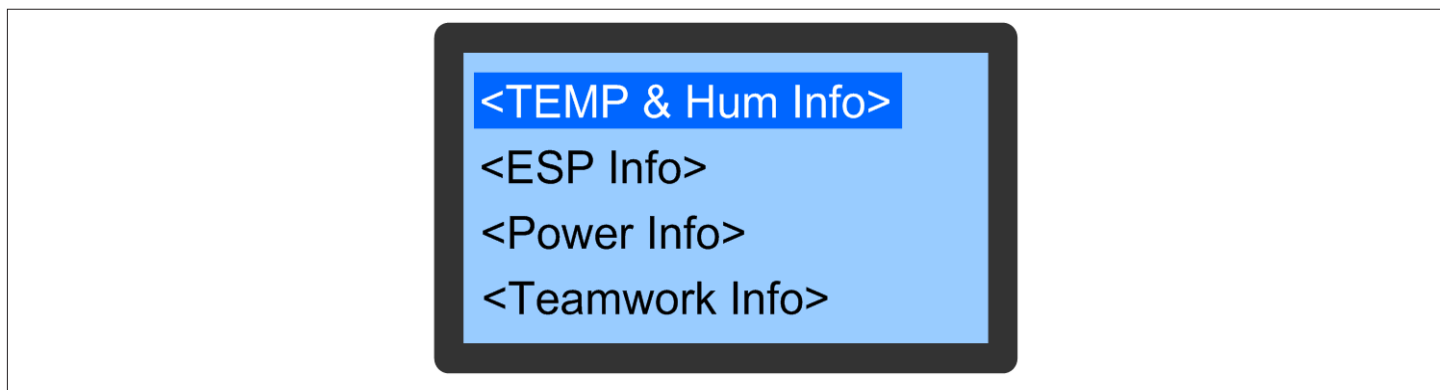


Figure 5-8 Run Information Screen

- **Temperature & Humidity Information**

In the run information menu, select **TEMP / Hum Info** to enter the interface as shown in Figure 5-9. Press the up or down button to scroll up or down to display the options in the menu.

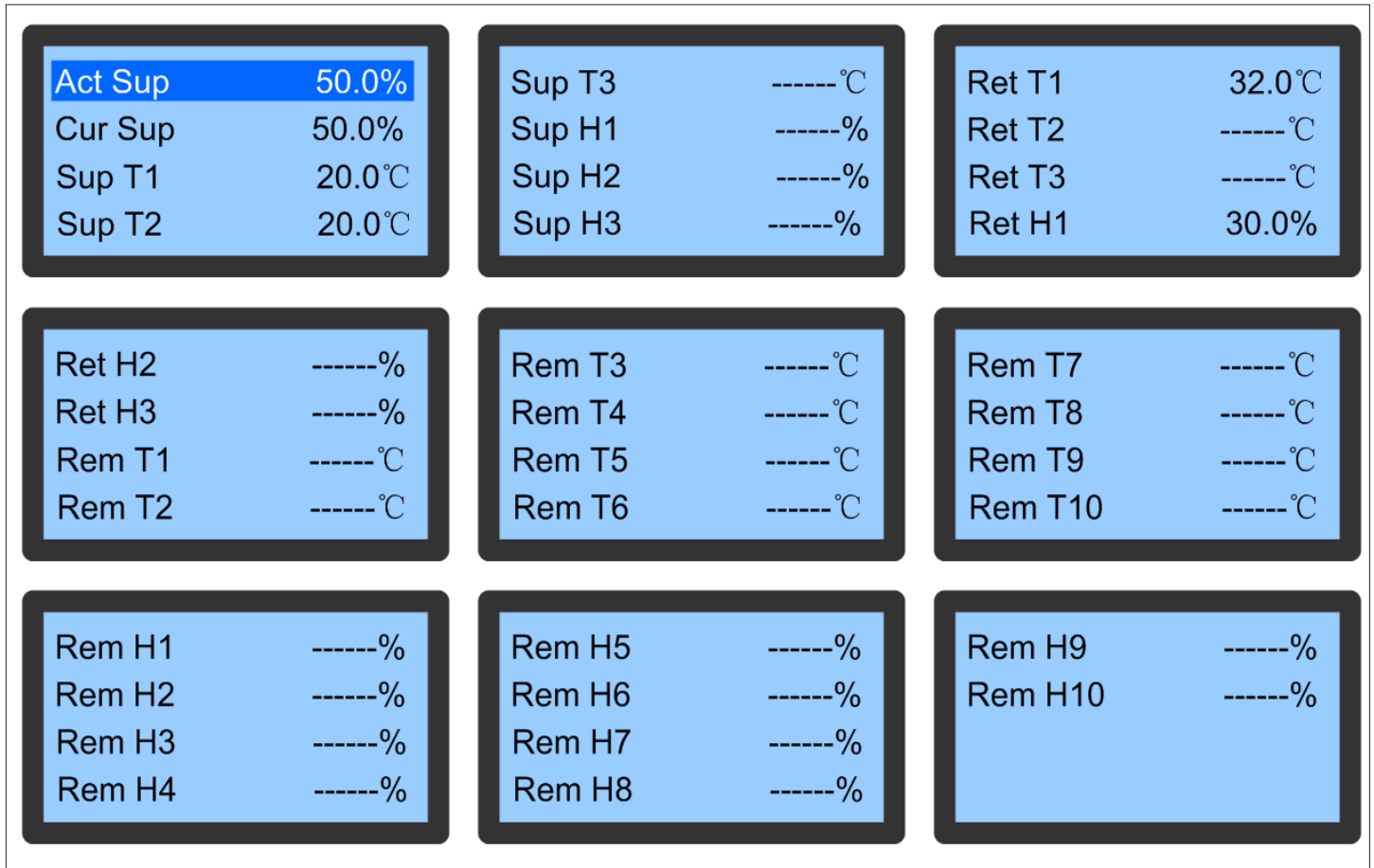


Figure 5-9 Temperature/ Humidity Information Screens

- **ESP Information**

In the run information menu, select **ESP Info** to enter the interface as shown in [Figure 5-10](#).

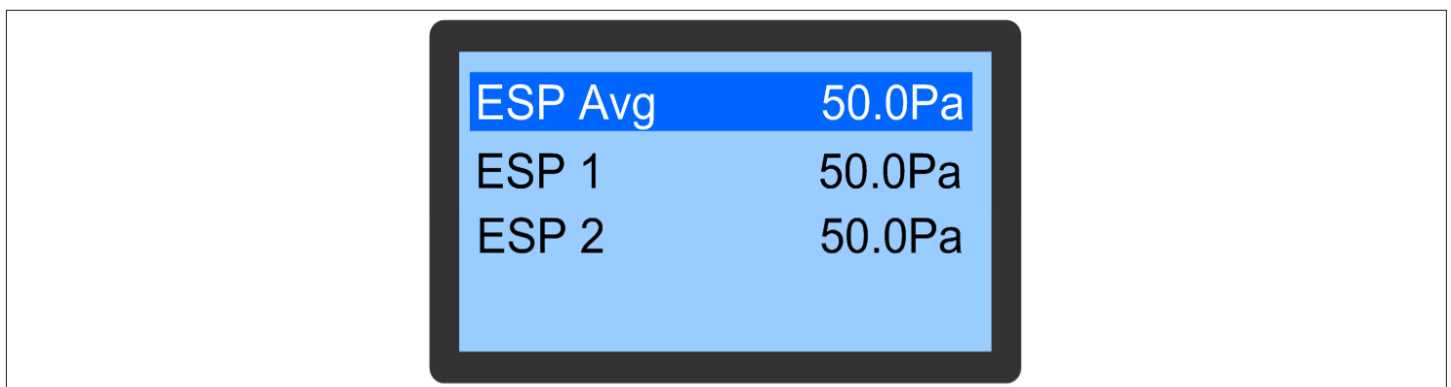


Figure 5-10 ESP Information Screen

- **Power Information**

Select the **Power Info** in the run information menu to enter the interface as shown in [Figure 5-11](#).



Figure 5-11 Power Information Screen

- **Teamwork information**

In the run information menu, select **Teamwork Info** to enter the interface as shown in [Figure 5-12](#).

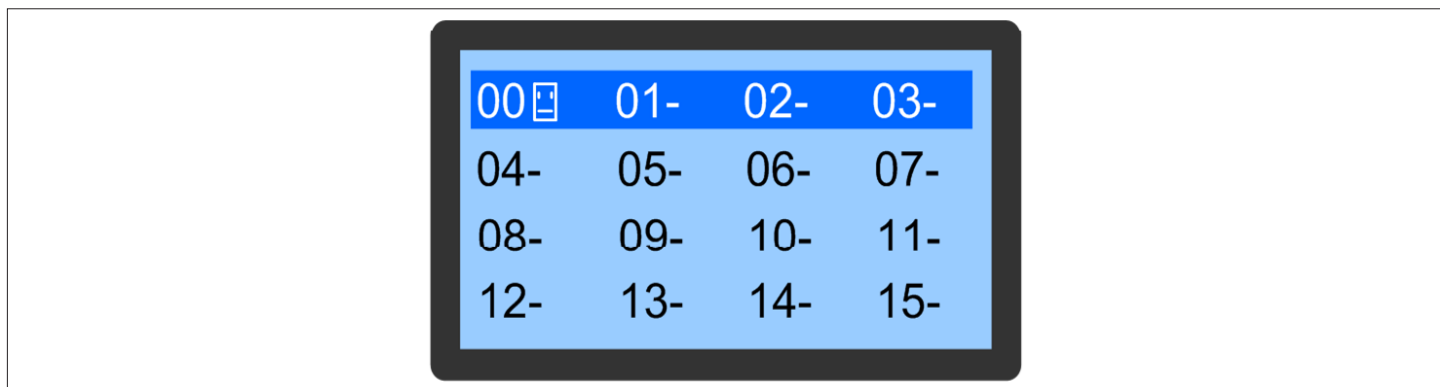


Figure 5-12 Teamwork Information Screen

5.6.3. Alarm Information

In the main menu interface, select **Alarm Info** to enter the interface as shown in [Figure 5-13](#), user can view the active alarm and history alarm information.

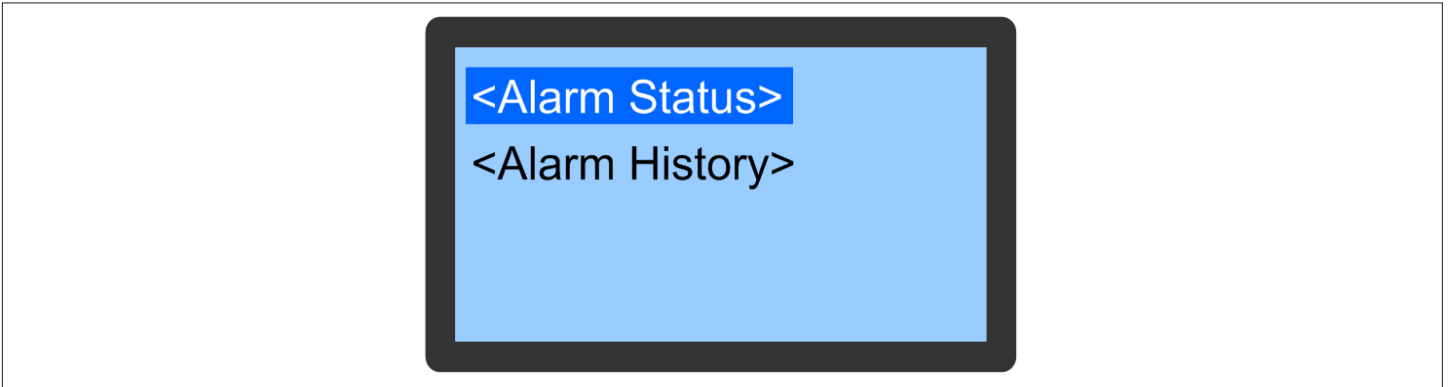


Figure 5-13 Alarm Information Status Screen

- **Alarm Status**

The **Alarm Status** menu is used to monitor the active alarm status records of the unit, indicating no alarm or specific alarm status information. The specific alarm status information includes XX/YY, alarm type, and alarm occurrence time, as shown in Figure 5-14. Among them, XX is the alarm number, which means that the active alarm status record is displayed; YY refers to the total number of alarm status records that currently occurs.

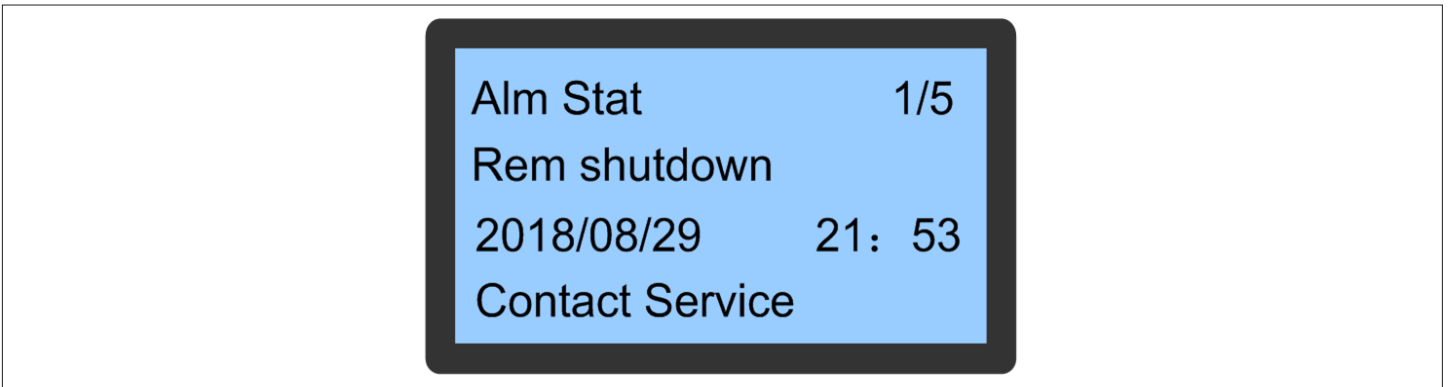


Figure 5-14 Alarm Status Screen



- The last alarm number is the smallest number. When multiple alarms occur, press the up or down button to scroll the query up or down continuously.
- The active alarm record is automatically cleared when the system is powered Off.

- **Alarm History**

The **Alarm History** menu is used to query the historical alarm information of the unit, including XX/YY, alarm type, alarm occurrence time, and alarm end time, as shown in Figure 5-15. Among them, XX is the current history alarm number; YY refers to the total number of history alarm records that currently occurs.

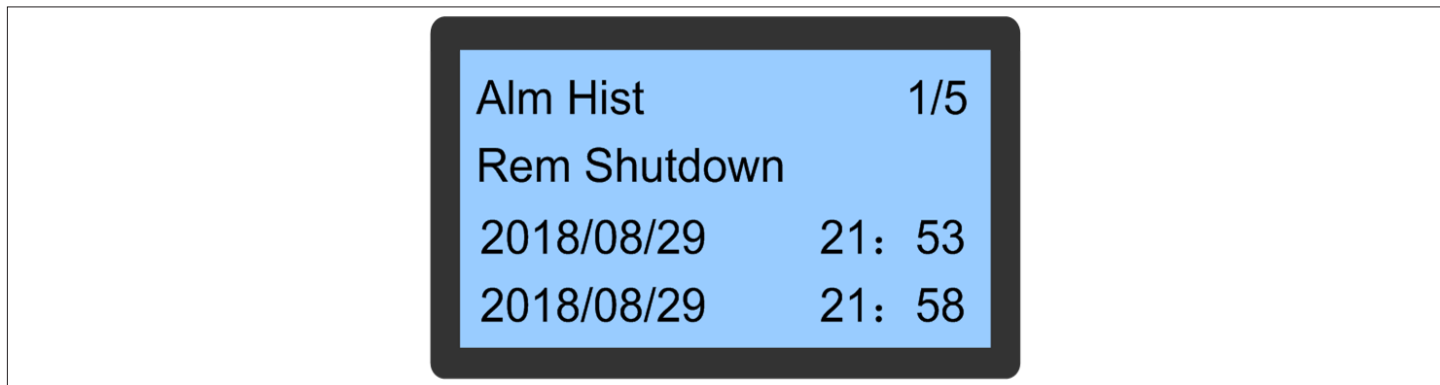


Figure 5-15 Alarm History Screen



- When multiple alarms occur, press the up or down button to scroll up or down the query.
- Up to 1000 history alarm records can be saved.

5.6.4. Temperature & Humidity Settings

Select the **TEMP & Hum Set** on the main menu interface to enter the interface as shown in [Figure 5-16](#). It can be used to set the supply air temperature, remote temperature, return air temperature, difference in temperature and humidity.

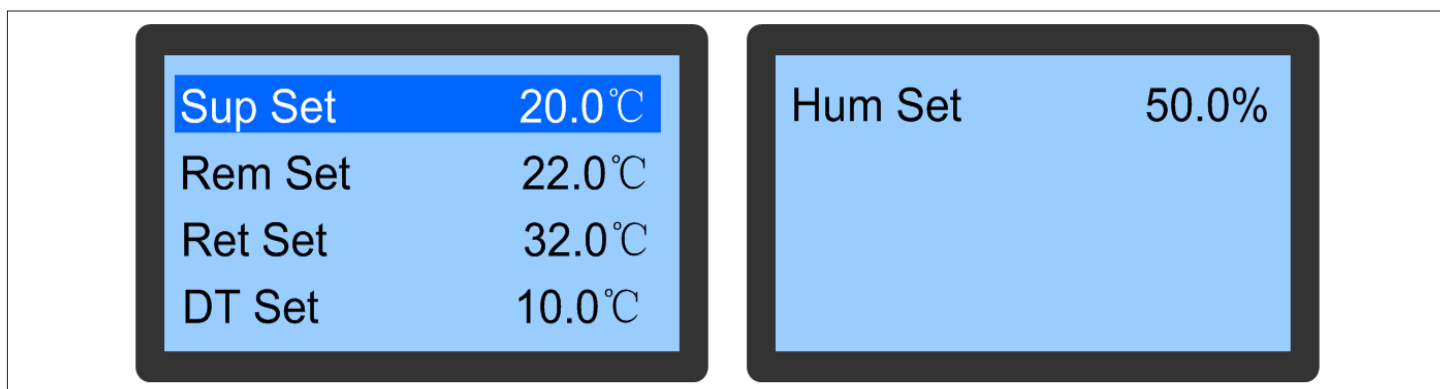


Figure 5-16 Temperature & Humidity Set Screens

5.6.5. Parameter Settings

Select **Para Set** in the main menu to enter the interface as shown in [Figure 5-17](#). The parameters in the system settings are permanently saved.

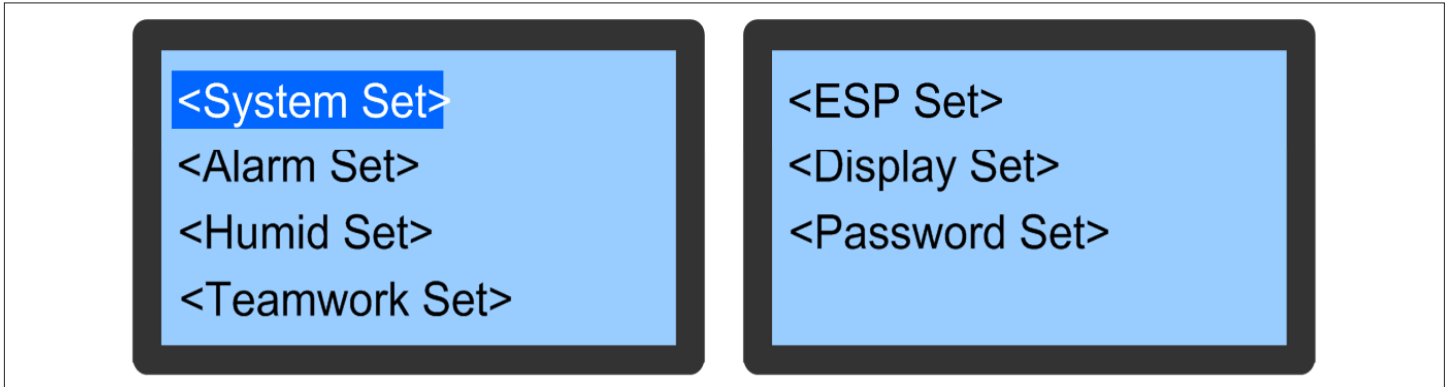


Figure 5-17 Parameter Set Screens

- **System Set**

The **System Set** menu interface screens are shown in [Figure 5-18](#). The monitoring protocol, monitoring address, baud rate, display address, and date and time settings can be changed in the system set menu.

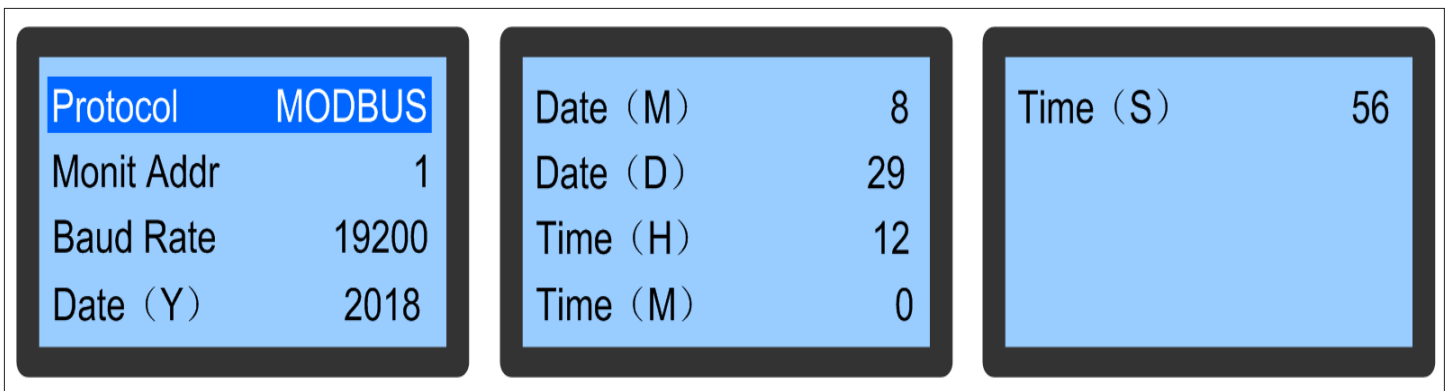


Figure 5-18 System Set Interface Screens

5.6.6. Alarm Set

The **Alarm Set** menu interface screens are shown in [Figure 5-19](#).

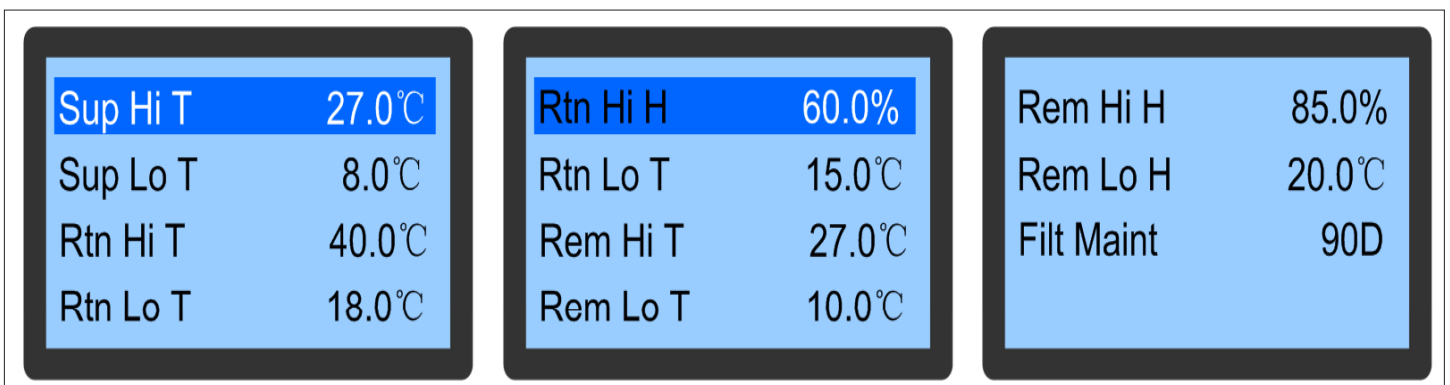


Figure 5-19 Alarm Set Screens



It is not recommended to change the default value of the alarm parameter. If it is necessary, please operate under the guidance of a trained professional.

5.6.7. Humidifier Set

The **Humidifier Set** menu interface is shown in [Figure 5-20](#). In the humidifier setting, user can select electrode humidifier, no humidifier according to the actual situation of the unit.

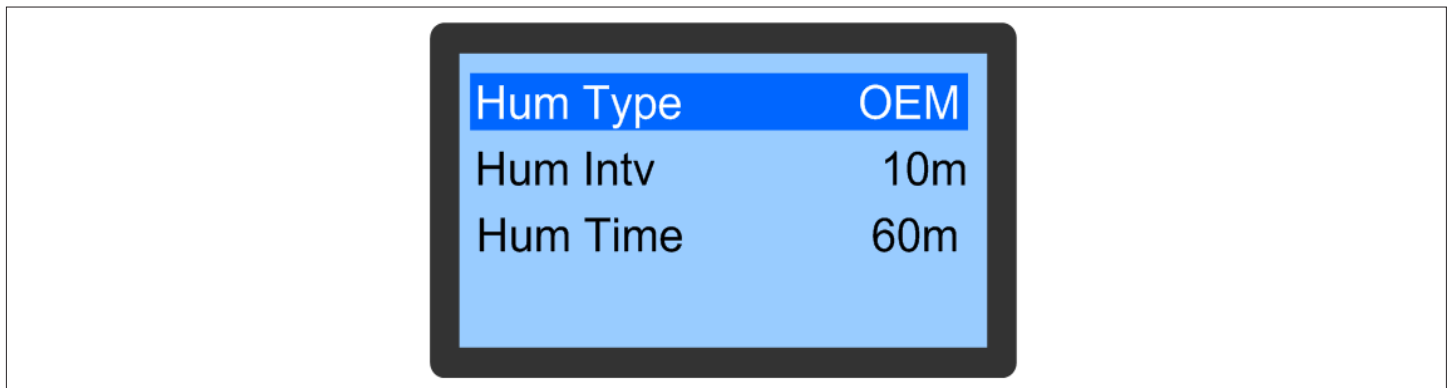


Figure 5-20 Humidifier Set Screen

5.6.8. Teamwork Set

The **Teamwork Set** menu interface is shown in [Figure 5-21](#).

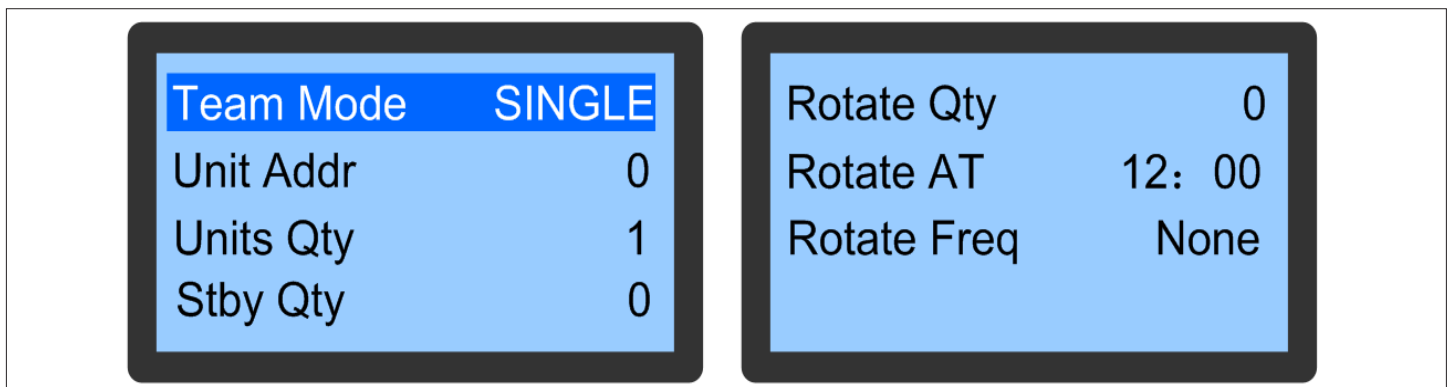


Figure 5-21 Teamwork Set Screens

5.6.9. ESP Set

The **ESP Set** menu interface is shown in [Figure 5-22](#).



Figure 5-22 ESP Set Screen

5.6.10. Display Set

The **Display Set** menu interface is shown in [Figure 5-23](#).

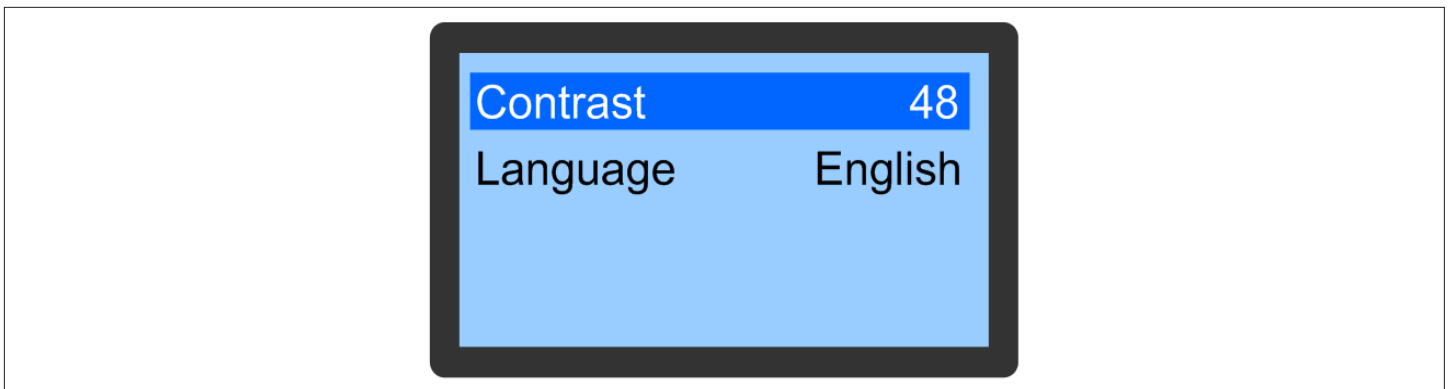


Figure 5-23 Display Set Screen

5.6.11. Password Set

The **Password Set** menu interface is shown in [Figure 5-24](#).

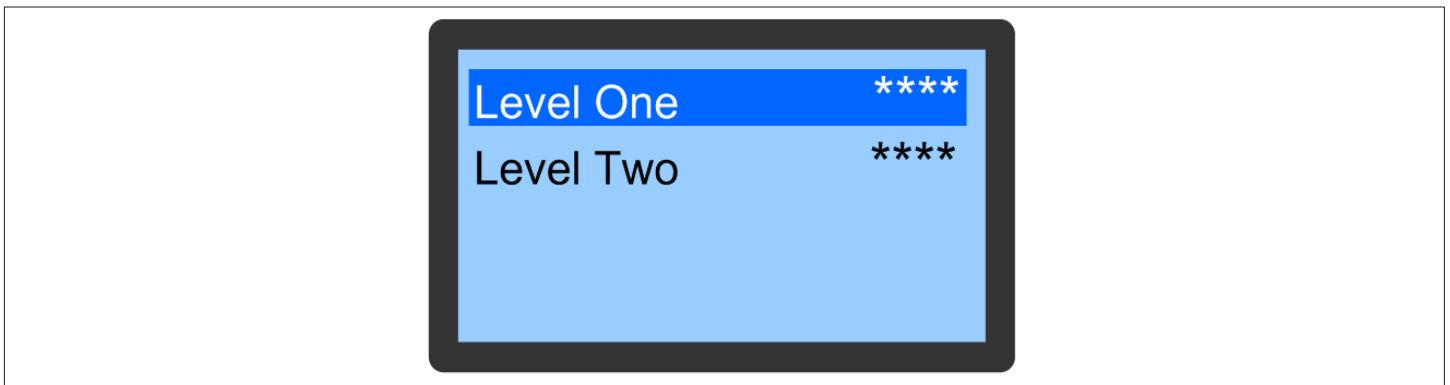


Figure 5-24 Password Screen

5.6.12. Help

The **Help** menu is used to view the software version, as shown in [Figure 5-25](#).

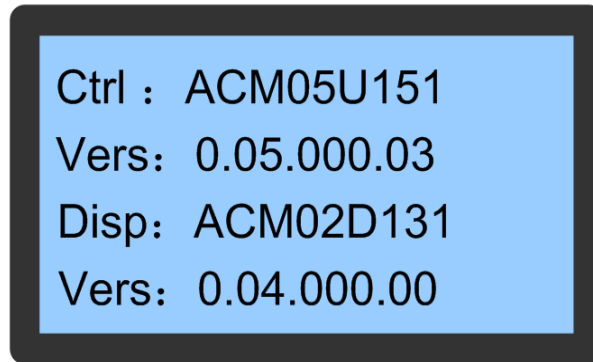
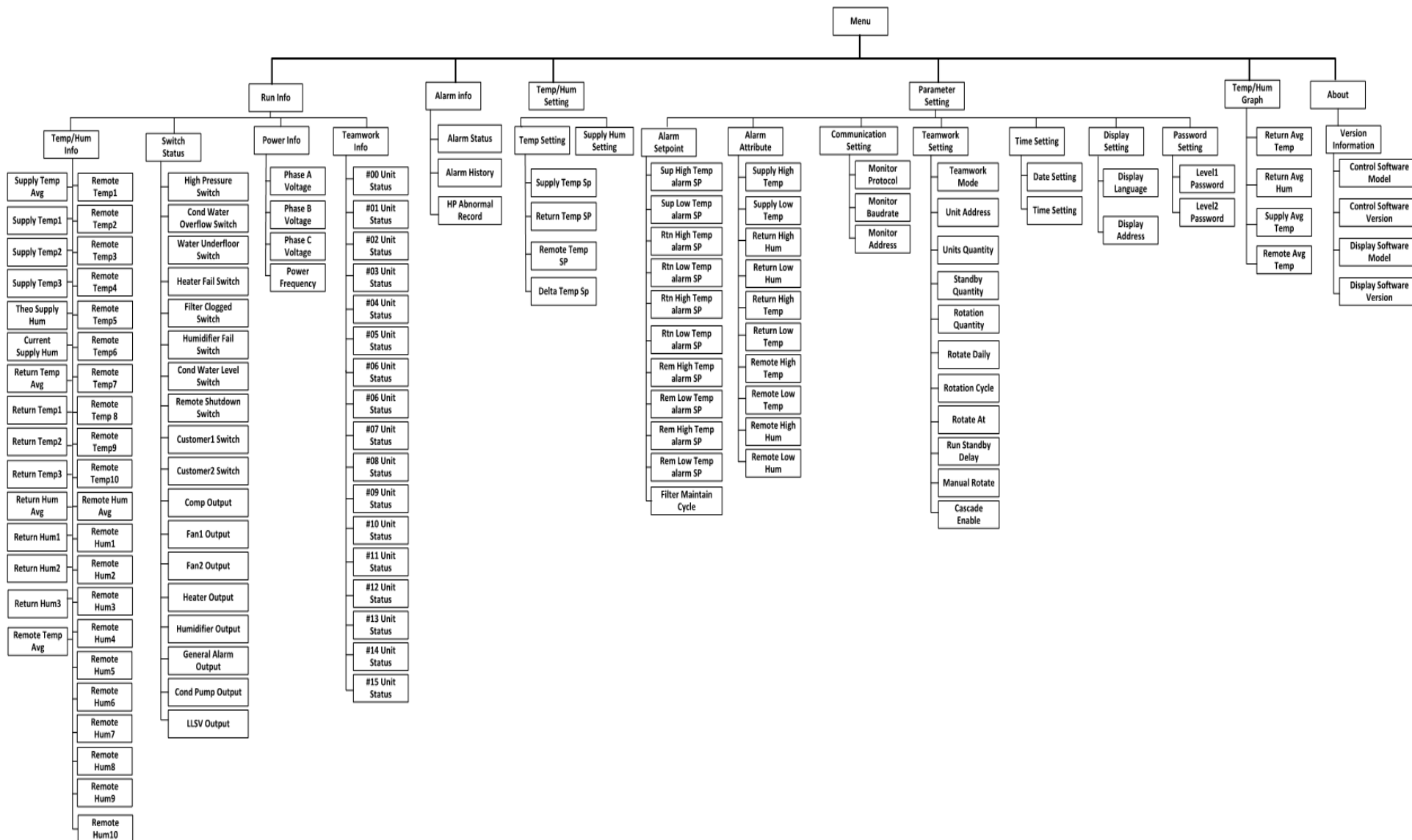
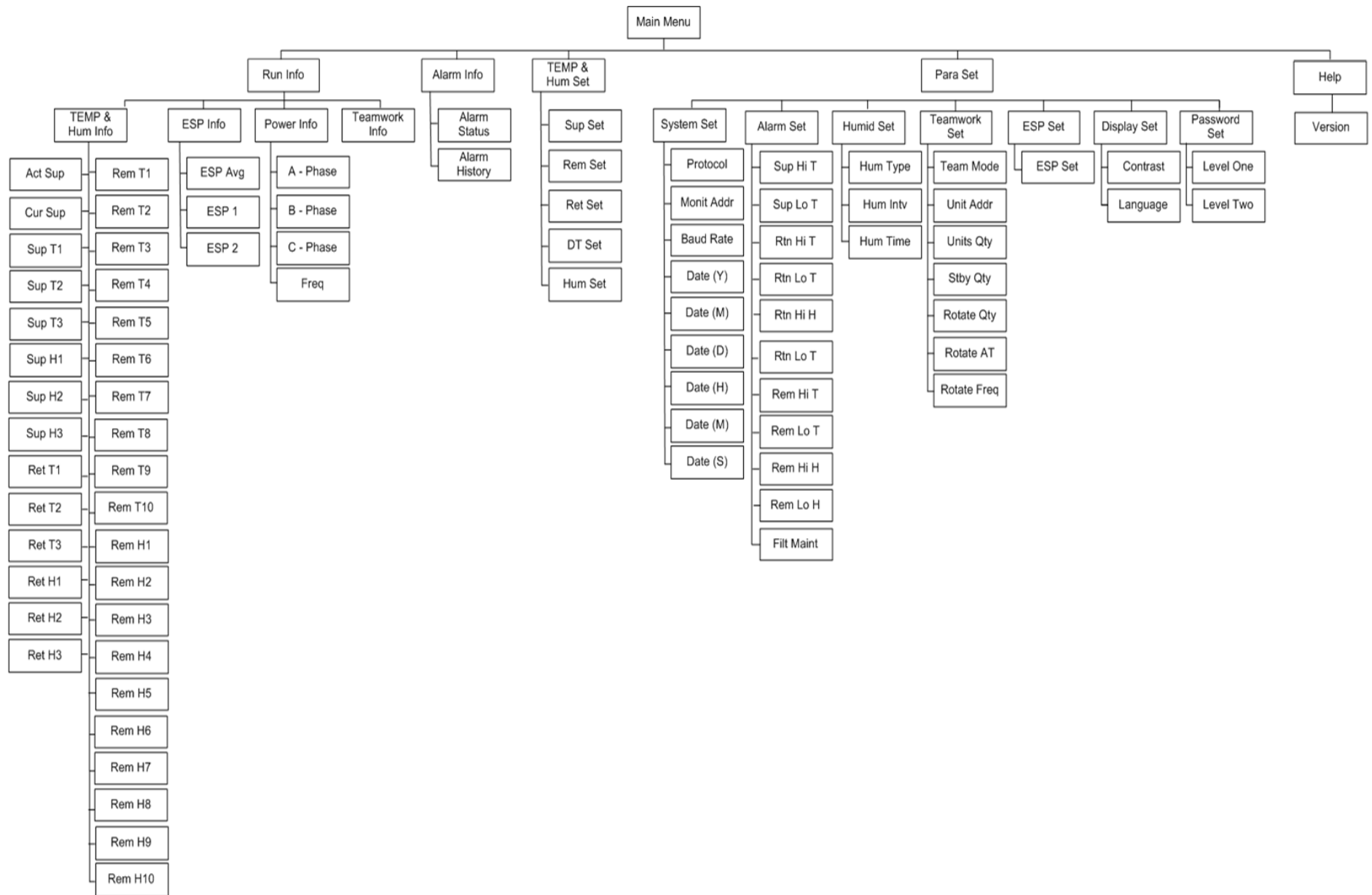


Figure 5-25 Help Screen

Appendix I: Display Menu Structure of the Screens



Display Screen Menus for Graphical Color Screen



Display Screen Menus for LCD Text Screen

