Liebert® CRV+ CW Series
Precision Air Conditioning

User Manual

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Purpose of the Document

This document applies to the series of precision air conditioners and cooling solutions which maintain an 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.

Styling used in this Guide

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

Situation	Description
Warning/Danger/Caution 	*The **Warning/Danger/Caution** 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, the content under the Warning heading is used for precautions which need to be taken which, otherwise, could result in equipment damage, performance degradation, or interruption in service.*
Note 	*The **Note** 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 Note heading, helping the users with the definitions, concepts, and terminologies used in the manual.*

Version History

Date	Issue	Revision	Change
15.03.2018	31013654	V1.2	-

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.

The user reads and considers all the precautions, compliance, and safety measures before working on the equipment. 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 Manual. Apart from the User Manual, also pay attention to the Warning labels on the unit and its components.

This manual is retained for the entire service life of the machine. The user must read all the precautions, danger, warnings, and cautionary measures mentioned in the manual prior to carrying out any operations on the machine. Each machine 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; Open the right door to access it. Before any maintenance operation, switch off the machine with this electronic 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, look at 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 that the voltage matches the utility power that is available for that unit.

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

There is a risk of leaking water that can cause damage to the equipment as well as the building. There should be an effective water drain connection and facilities. Installation should be precise. Implementation of the application and service practices should be suitable and fault-free. Not complying with these norms will result in water leakage from the unit. Water leakage can result in massive damage and loss of critical equipment in the hosting ecosystem. Therefore, care should be taken to ensure that the unit must not be located directly above any equipment that could sustain damage due to water and excessive moisture. Using a leak detection system for the unit and system supply lines are recommended by Vertiv Co.

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PART I
GENERAL INFORMATION

1 Product Overview

1.1 Product Introduction

The Liebert CRV+ Chilled Water Precision Air Conditioner (CRV+ CW) is the next generation series of air conditioners that provide precise environmental control. The Liebert CRV+ CW models are the latest in the long line of modern enterprise-grade products from the Liebert family. Incorporating the high standards associated with the Liebert name, the CRV+ CW series utilizes the latest technology, system components, and streamlined manufacturing process.

Liebert CRV+ CW air conditioners are specifically created and designed for the small-and-medium data centers, computer rooms, and similar systems, which call for a high degree of accuracy and precision. It addresses the needs and challenges associated with such applications and setups. It caters to sensitive applications which need a suitable environment for optimal performance. Therefore, utmost care should be taken while providing a favorable environment for mission-critical equipment as even a slight deviation may lead to inaccurate results. Precision Air conditioners must not only keep room conditions within a specific range but also have the precision to respond quickly to drastic changes in heat load and prevent wide temperature fluctuations in the conditioned space.

The CRV+ CW unit is packed with features such as high reliability, high sensible heat ratio, and large airflow.

1.2 Model Description

The Liebert CRV+ CW cooling unit is a comprehensive system that includes all the main functions fundamental to precision cooling units such as cooling, humidification, re-heating, air filtration, condensation management, temperature and humidity control, alarm functions, and compatibility with data communications. Liebert CRV+ CW is designed to comply with mission-critical requirements and ensure that servers are maintained at the correct temperature and humidity levels.

Following is the image of the Liebert CRV+ CW unit which depicts the location of the various components in the unit:

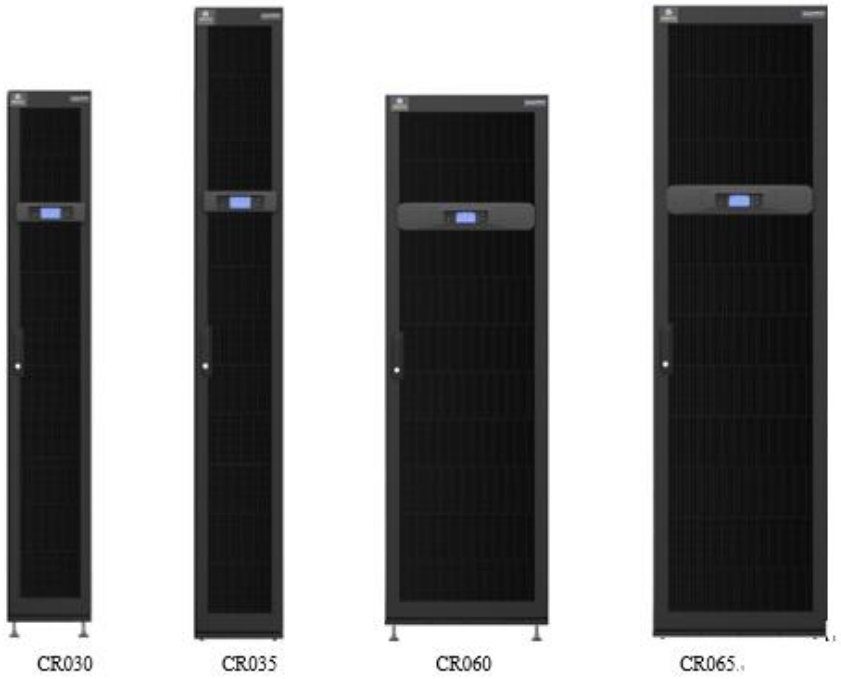


Figure 1-1 CRV+ chilled water model

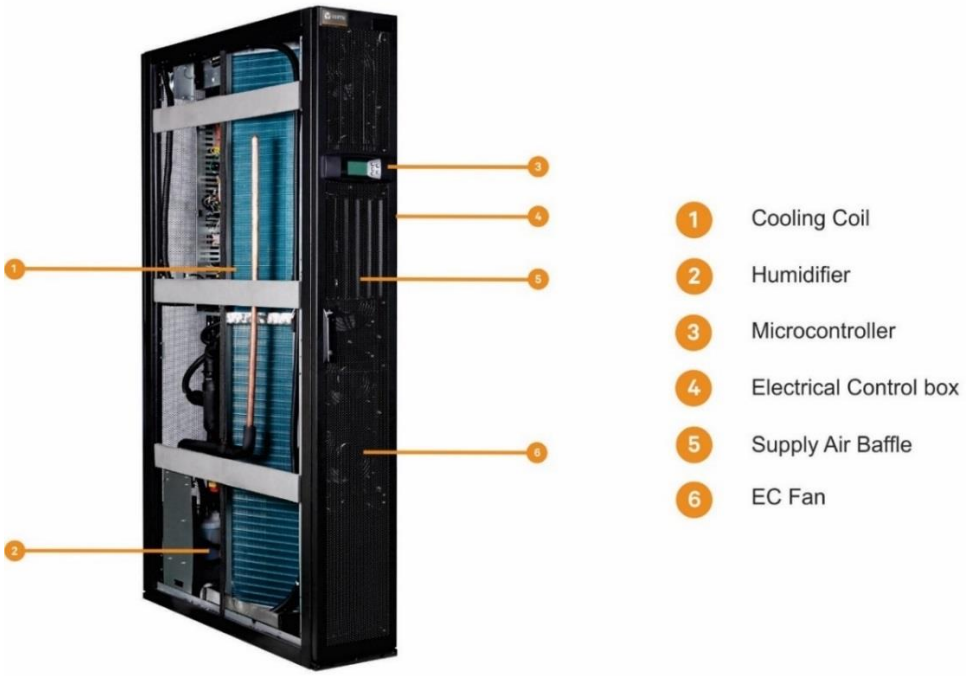


Figure 1-2 Components of CRV+ chilled water

1.3 Model Nomenclature

Following is the model nomenclature for the CRV+ CW precision air conditioner:

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	3	0	R	C	1	4	2	S	S	1	0	H	1	A	0	0	L	P	V	0	0	0

1 ~ 2	Series Name Description	
	CR	Liebert CRV+
3 ~ 5	Cooling Capacity	
	030	Nominal cooling capacity
6	Air Discharge	
	R	Horizontal air supply with guide grill
	H	Horizontal air supply without guide grill
7	System Type	
	C	Chilled water
8	Fan Type	
	1	EC plug fan
9	Power Supply	
	3	380V~415V/3ph/50Hz+N
	T	380V~415V/3ph/60Hz+N
	4	220V~240V/1ph/50Hz
	5	220V~240V/1ph/60Hz
10	Cooling System	
	2	CW Two way Valves
11	Humidification	
	0	None
	S	Electrode humidifier
12	Display	
	S	Standard Display
13	Re-Heating	
	0	None
	1	Electric heating Std 1 Stage
14	Filtration	
	4	G3
	2	G4
	0	G4 + Filter clog switch
15	Coil and valve	
	H	CW coil, High Pressure MBV
16	Enclosure Option	
	1	Standard Color black orange peel grain coating
17	Main Switch High Voltage Option	
	0	None
	A	Dual power supply, Interlocking Contactor
18	Installation Option	
	0	None
19	Monitor	
	0	RS485
	S	SIC card
20	Sensor	
	0	None
	L	Water flow sensor
21	Package	
	P	Packaging - Standard Cardboard and Wooden Pallet
	C	Packaging - Wooden crate
22	Special Requirements	
	A	None
	V	Condensate Pump
23 ~ 25	Order Identifier	

Figure 1-3 Nomenclature

1.4 Components

1.4.1 Cooling coil

The copper cooling coil used in the Liebert CRV+ CW models is in a fin-tube design providing high efficiency, high SHR, and low air-side pressure drop. The water circuits are specifically designed for even distribution to improve heat transfer whilst maintaining pressure drop. The coil fins have a hydrophilic coating as standard. The condensate pan is made from stainless steel (CR030 & CR060) and galvanized steel (CR035 & CR065).

Figure 1-4 Cooling coil

1.4.2 EC Fans

The EC Fans used in the Liebert CRV+ CW models are energy-efficient and innovative with integrated electronics and a maintenance-free design.

- Ability to regulate the airflow and reduce the fan input power leading to high energy-efficiency
- Easy-to-connect facility with minimum wiring leading to high performance with a great variety of possible air flow rates

Figure 1-5 shows the EC Fans used in the models belonging to the CRV+ series:

CR030 & CR035

CR060 & CR065

Figure 1-5 EC Fans

1.4.3 Micro-processor based controller

The Micro-Controller used in CRV+ CW provides a simple operational user-interface and is developed using the latest and highly advanced PID regulation technology.

- Multilevel Password protection
- Self-recovery upon power failure, high-voltage & low-voltage protection Phase loss protection
- Automatic phase-sequence switching upon the antiphase and rotate speed control of the outdoor fan
- High-end Fault diagnostic system to facilitate easy equipment maintenance

The operational time of all the main components can be identified by browsing through the menu pages. A built-in expert-level fault diagnosis system helps to display the current fault information automatically, thereby facilitating the maintenance. It can store up to 500 records of history events. The controller is configured with the RS485 port and MODBUS protocol is used.

Figure 1-6 Microprocessor controller

1.4.4 Water flow Regulation valve

- A water flow regulation valve adjusts the chilled water flow quantity based on the cooling requirements. Connection to the system pipes is made through threaded joints.
- Easy for installation and maintenance, thereby reducing the project installation costs.
- Available in 2-way or 3-way valve options; the standard unit comes equipped with the 2-way valves.

Figure 1-7 shows the image of a 2-way water flow regulation valve:

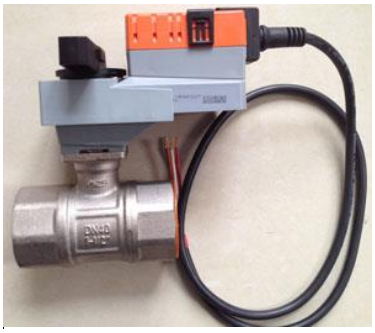


Figure 1-7 2-way water flow regulation valve

1.4.5 Air filter

The air filter provided in the return air section of the unit complies with US ASHRAE52-76 and Eurovent 4/5 standards, with a dust resistance value of 90% (EU4 standard). To ensure the normal operation of the filter, the filter service alarm logic is provided by the controller. The default fan running time is 2000 hours (set as per the local running environment) when the time is exceeded, the filter service alarm is triggered. The user needs to replace the filter based on the clogging condition of the filter. The filter must be checked once a month, and be replaced as required during operation.

Figure 1-8 Air filter

1.4.6 Levelling feet

Liebert CRV+ CW air conditioner is installed in the middle of the racks, so at least one side of the unit is adjacent to the server cabinet. After each part of the cabinet is installed, the cabinet needs to be levelled which is done by the means of levelling feet installed at the bottom of the unit.

1.4.7 Water under floor sensor

If the unit is equipped with a water-under-floor sensor it is used to detect water under the floor and send alarm signals to the control board.

1.5 Optional Components

1.5.1 Electrode Humidifier

The unit is fitted with an electrode boiler humidifier suitable for use with water of varying degrees of hardness, only if the water is not treated or de-mineralized (hardness range < 600 ppm). The humidifier is complete with a water inlet valve and a maximum water level sensor.

Steam from the cylinder is mixed with the discharge air from the evaporating coil by means of a copper steam distributor.

The unit controller monitors the condition of the steam cylinder and generates an alarm when the cylinder needs to be changed. Cylinder replacement is easy and quick.

The humidifier is complete with a self-adapting flow control system, which monitors and controls the electrical current passing through the cylinder. Output adjustment is from 30-100% via the unit controller.

Figure 1-9 Electrode humidifier

1.5.2 Electric Heater

The electrical heater consists of heating resistors having a rigid design for extended operational life and are normally utilized to maintain room dry-bulb conditions during a system call for dehumidification. The material of construction for the heater is finned armored stainless steel which is used to maintain a low surface power density. Ionization effects are eliminated owing to the low heater surface temperature.

Heating control is of the ON-OFF type. The heater is phase balanced and a manual reset safety thermostat is provided to disable them in the event of a high temperature.

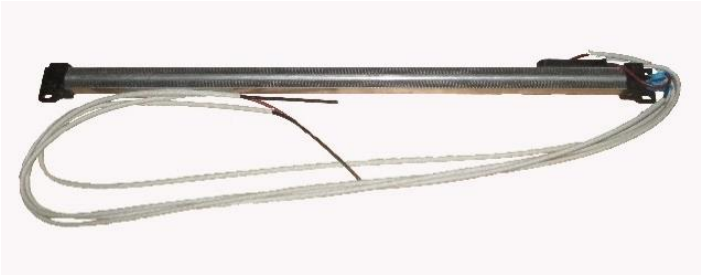


Figure 1-10 Electric Heater

1.5.3 Condensate pump

Adopt a DC brushless pump, having idling protection and overload protection functions.

1.5.4 Filter pressure difference switch

The filter pressure difference switch can measure the pressure difference between the two sides of the filter. If the filter is too dirty and the ventilation is poor, the pressure difference will increase. When the pressure difference exceeds the set value, it will alarm.

1.5.5 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 the intelligent equipment and the environment through the Web server function provided by the SIC card.
- Using the network management system (NMS) to monitor the intelligent equipment and the environment through the SNMP agent function provided by the SIC card.
- Using the machine room management software (RDU-Manager) to monitor the intelligent equipment and the environment through the TCP/IP port provided by SIC card.

Either SNMP (via the RDU-SIC card) or Modbus (via RS485 port) can be used with the CRV+CW, but cannot be used in conjunction with each other.

1.5.6 Supply Air Baffle

A field adjustable, supply air baffle is used in the discharge air stream. It can be quickly and easily configured to redirect the airflow, for a wide variety of applications.

1.5.7 Water Flow Sensor

If the unit is equipped with a water flow sensor, the unit will be able to detect the amount of chilled water usage. This will be translated to amount of BTU/h or kW cooling capacity provided by the unit, shown at the controller display.

1.5.8 Additional Remote Rack Temperature Sensors

The unit can be equipped to connect to remote temperature sensors mounted on racks to detect the temperature. The sensors can be located within controlled air-conditioned space such as the place in the room, and the air inlet and outlet of the cabinet. The user can set the max./min./average temperature as the controlling parameters as an input to the microprocessor controller to modulate the fan speed and flow rate through the chilled water valve.

The remote temperature sensor need to be configured on site. Each unit is configured with 2 supply air temperature sensors and 1 temperature humidity sensor.

Each unit can be configured with up to a maximum number of 6 remote temperature sensors.

1.5.9 Dual Power Supply Auto Alternate (Interlocking contactor)

Dual Power Supply Auto Alternate to provide two-way external power input interface which automatically detects available/energized source of power in case of power outage from any of the two power sources.

1.6 Working Conditions

In this section, the Environmental conditions including the Operating and Storage Environment are mentioned.

1.6.1 Operating Environment

The operating environment of Liebert CRV+ CW meets the requirements of GB4798.3-2007. For more details, check the information in the Table 1.1.

Table 1.1

Item	Requirements
Indoor Ambient temperature	18°C to 45°C
Indoor Unit Protection Level	IP20
Altitude	<2000m, consult Vertiv for altitude higher than 2000m
Operation Voltage Range	CR030/CR035 → (220 to 240) V ± 10%, 50-60Hz, 1 ph CR060/CR065 → (380 to 415) V ± 10%, 50-60Hz, 3N
Indoor Contamination level	Level 2 – Office environment

1.6.2 Storage Environment

The following table 1.2 describes the Storage environment parameters.

Table 1.2

Item	Requirements
Storage environment	Indoor, clean (without dust)
Ambient humidity	< 95%RH
Ambient temperature	-40°C ~ +70°C
Storage time	Total transportation and storage time should not exceed six months. Otherwise, the performance needs to be re-calibrated

1.6.3 Basic Performance Parameters

The following Table 1.3 depicts the basic performance parameters for the CRV+ CW system:

Table 1.3

Model	Nominal cooling capacity (kW)	Power (kW)	Heating capacity (kW)	Humidification capacity (kg/h)
CR030	30.3	1.05	3	1.5
CR035	33.5	1.05	3	NA
CR060	59.1	1.52	6	1.5
CR065	63.8	1.59	6	NA

- *Capacity measured at return air 37 °C & 24% RH; CHW in/out: 10/15°C.*

PART II
INSTALLATION

2 Installation

The Installation process consists of the following procedures:

- Pre-installation
- Installation Preparation
- Mechanical Installation
- Electrical Installation

2.1 Pre-installation

Pre-installation contains the following:

- Transportation & Movement
- Unpacking
- Inspection

2.1.1 Transportation & Movement

When it comes to transporting the system, Railroad is the most preferable choice. However, if railroad transportation is not possible, then the truck transport option is an optimal choice. One precaution is to choose roads that do not have too many bumps and if any, avoid it as much as possible.

- Liebert CRV+ CW systems are on the heavier side and therefore, it is recommended that equipment like an electric forklift is utilized for these heavy-duty systems.
- Move the equipment to a location which is near the installation site.
- If an electric forklift is used, insert the tines of the forklift below the pallet as displayed in Figure 2-1. Align the tines with the center of gravity to prevent the equipment from falling over. Figure 2-1 depicts the way the tines of the forklift are inserted below the pallet and in the same image, the graphic to the right indicates that the tines are aligned with the center of gravity to prevent the equipment from falling over:

Figure 2-1 Moving the equipment using a Forklift truck

While moving the indoor unit, the obliquity must be maintained at an angle of 75° to 105°.

Figure 2-2 depicts the 75° to 105° obliquity that is suitable to move the air conditioning package to the vicinity of the desired location:

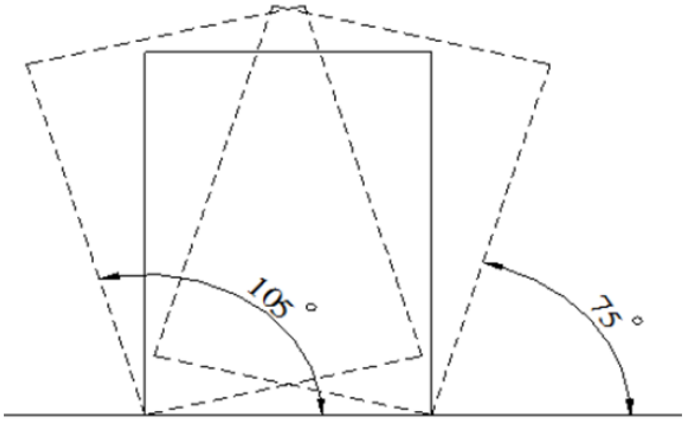


Figure 2-2 Obliquity of the system

2.1.2 Unpacking

- The cabinet uses a honeycomb cardboard and winding stretch film for packaging purposes. Shift the product to a location closer to the final installation site prior to unpacking the unit.
- Initially, remove the top cover and winding stretch film. Next, remove the honeycomb cardboard as depicted in Figure 2-3.

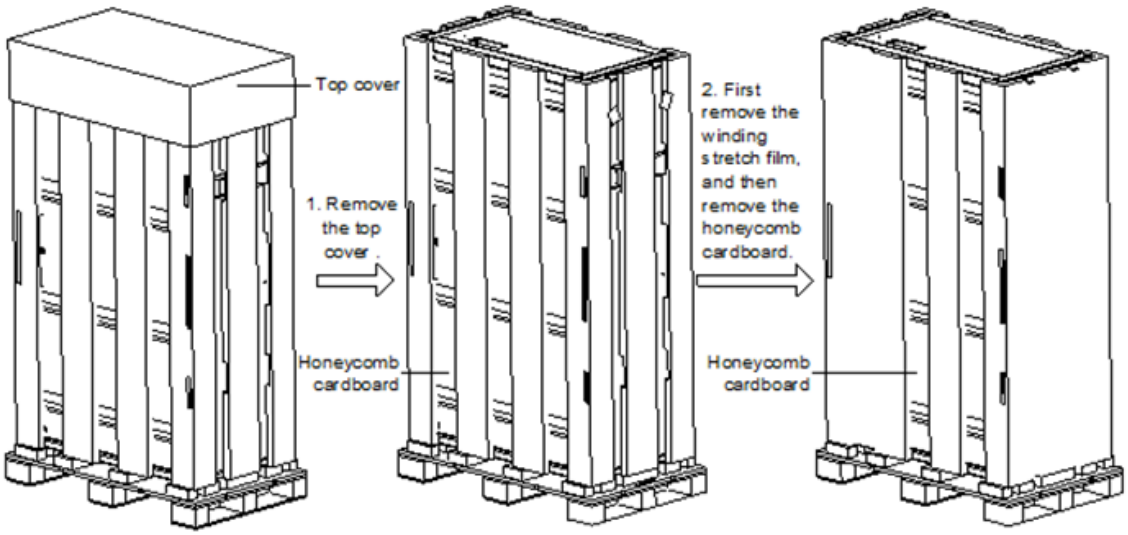


Figure 2-3 Unpacking the outer package

- The unit is fixed on the packing pallet with M8*20 and M8*80 screws. Use a 17mm open-end spanner, ratchet spanner, or sleeve to remove the screws.

Refer to Figure 2-4 to see the schematic diagram for the same.

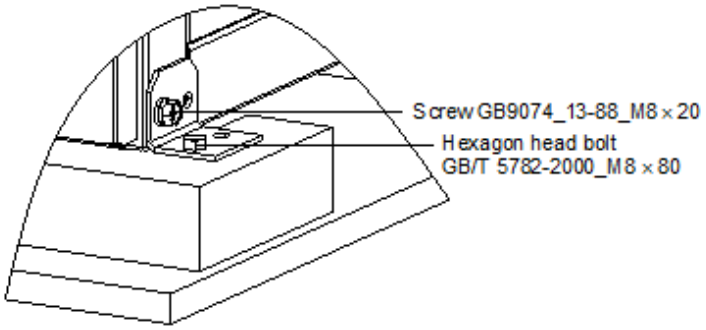


Figure 2-4 Screws on the pallet

2.1.3 Inspection

- Moving forward, check the system fittings and its components against the packing list to ensure that everything is in place and the assembly is intact.
- If any parts or components are missing or damaged, immediately report to the carrier about the same. If hidden damages are observed, then contact the local offices of that carrier as well as *Vertiv Co.* at the earliest.

2.2 Installation Preparation (Site Preparation)

The CRV+ CW series of air conditioners is streamlined for maintaining a favorable environment for data centers, computer rooms, and similar systems. Strict adherence to the installation procedures is mandatory to ascertain proper installation of the air conditioner.

2.2.1 Equipment Room Requirement

The equipment room must be prepared to ensure a smooth operation flow and obtain accurate results. The equipment room must meet the standards for appropriate ventilation and heating. The design specifications for the air conditioners must be ideal and should match the energy-efficient design standards.

Following are the requirements for maintaining a favorable room environment prior to installation:

- The equipment room should be well insulated and have a sealed damp-proof layer.
- The outdoor air entering in should be kept minimum. The outside air will add the loads of heating, cooling, humidifying, and dehumidifying of the system. It is recommended that the inhalation of outside air be kept below 5% of the total indoor airflow.
- All the doors and windows should be properly sealed to minimize the leakage. The seams should be as narrow as possible.

Vertiv Co. recommends that the site preparation is defined as per the requirements. However, if these requirements are not met, rectifications must be made on the site so that it complies with the specified requirements and conditions. However, if the recommended rectifications or modifications are not implemented, then Vertiv Co. does not guarantee the accuracy and precision of the temperature and humidity provided by the Liebert CRV+ CW models. One important aspect to be considered is that the indoor unit must not be used for the outdoor environment.

2.2.2 Installation Space requirements

Air conditioners in the Liebert CRV+ CW series are advanced precision air cooling units and therefore, these air conditioners must be installed, preferably in a row of cabinets with high heat density, in a hot aisle and cold aisle arrangement.

- Allocate space so that it is accessible to the qualified service personnel for serviceability repairs, servicing, and maintenance. When it comes to servicing, repairs, and maintenance, space must be allocated so that it is accessible.
- At the least, a space of 600mm must be assigned for maintenance purposes in front of the system. A minimum space of 600mm must be assigned for maintenance on the rear of the system.

Figure 2-5 depicts the space allocated for servicing and maintenance.

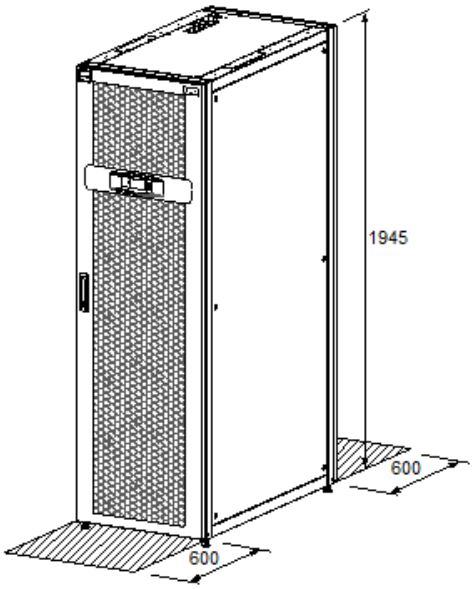


Figure 2-5 CRV+ Maintenance Space

Contact the Vertiv Co. team for special applications, which would need some modifications to work at an optimal level.

2.2.3 Installation Tools

Table 2.1 shows the generic toolsets and utilities used in the installation and maintenance process:

Table 2.1

Name	Drawing	Name	Drawing
Electric hand drill		Adjustable wrench	
Slotted screwdriver		Cross head screwdriver	
Stepladder		Forklift	
Drill		Wire cutting pliers	
Claw hammer		Diagonal cutting pliers	
Insulating shoes		Antistatic gloves	
Electrician knife		Cable ties	
Insulating tape		Insulating gloves	
Crimping pliers		Heat shrinkable tube	
Insulated torque wrench		Torque screwdriver	
Multimeter		Clip-on ammeter	

Ensure that the tools used in the installation, operation, and maintenance processes are insulated. This safety measure is important for professionals and service personnel who work with this CRV+ CW range air conditioner.

2.3 Mechanical Installation

Proper installation is important to achieve optimal performance and prolong the product life. In this section, the mechanical installation will be discussed in detail to help the personnel get to grips with the installation process.

Before proceeding with the mechanical installation, the following safety precautions need to be considered.

- *Prior to installation, ensure that the installation procedures have been read and implemented as per the requirement. (Refer to section 2.2 Installation Preparation for more details). Check if any modifications are made to the plumbing, wiring, or ventilation facility before mounting the equipment. Once the installation preparations are taken into consideration, move on to the next step in the installation process, and eventually set up the system.*
- *Industry-wide standards are followed for the selection, layout, and fixing of pipes.*
- *Follow the design drawings strictly when installing the equipment. Reserve space as per the maintenance and serviceability instructions in the section 2.2 Installation Preparation. The manufacturer's engineering dimension drawings must be taken as a reference while installing the equipment.*
- *Always remember that local rules and regulations as well as the local industry standards must be strictly given precedence during the installation process.*

2.3.1 Product Dimensions

The dimensions and weight of the indoor unit are displayed in Figure 2-6 and in the Table 2.2 respectively.

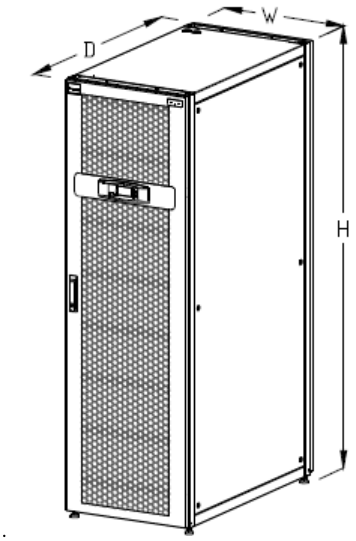


Figure 2-6 Mechanical Parameters

Table 2.2

Model	Dimensions (W*D*H)	Net Weight (KG)	Operating Weight
CR035	300×1200×2200	200	210
CR030	300×1100×2000	180	188
CR065	600×1200×2200	330	347
CR060	600×1100×2000	300	315

2.3.2 Locations & Dimensions of Base Plate Pipe Outlets

The position and dimensions of the holes on the bottom plate of the unit are shown in Figure 2-7, Figure 2-8, Figure 2-9 and Figure 2-10.

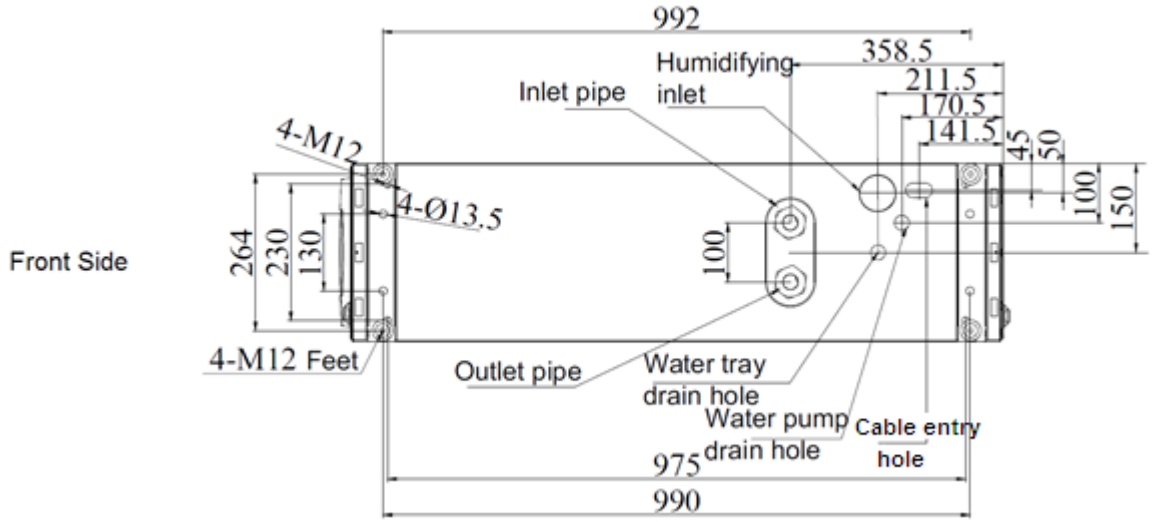


Figure 2-7 CR030

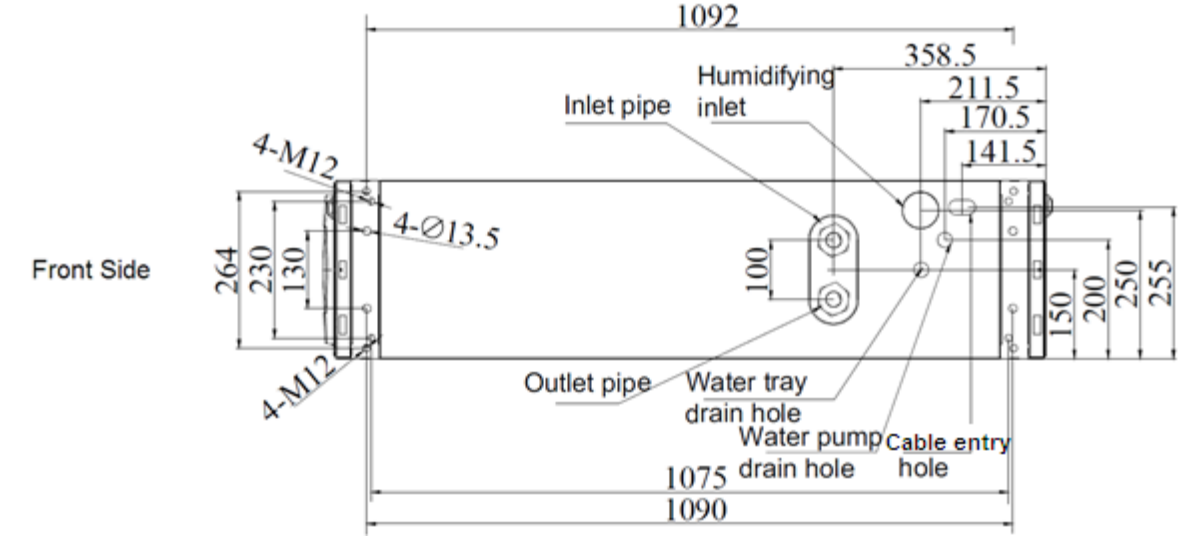


Figure 2-8 CR035

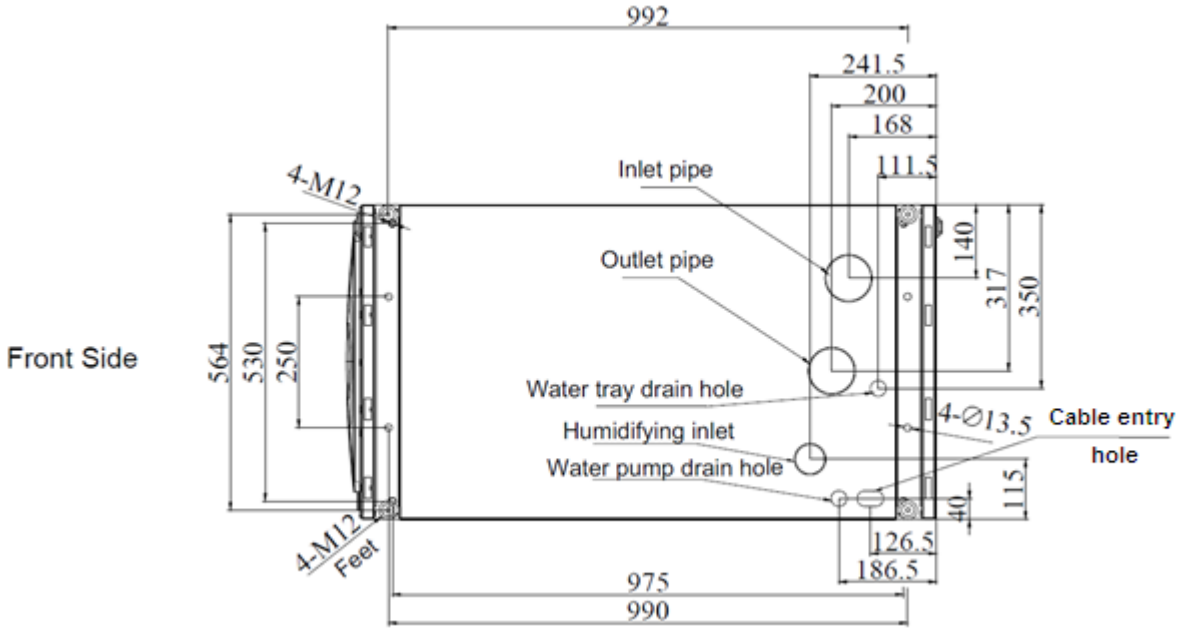


Figure 2-9 CR060

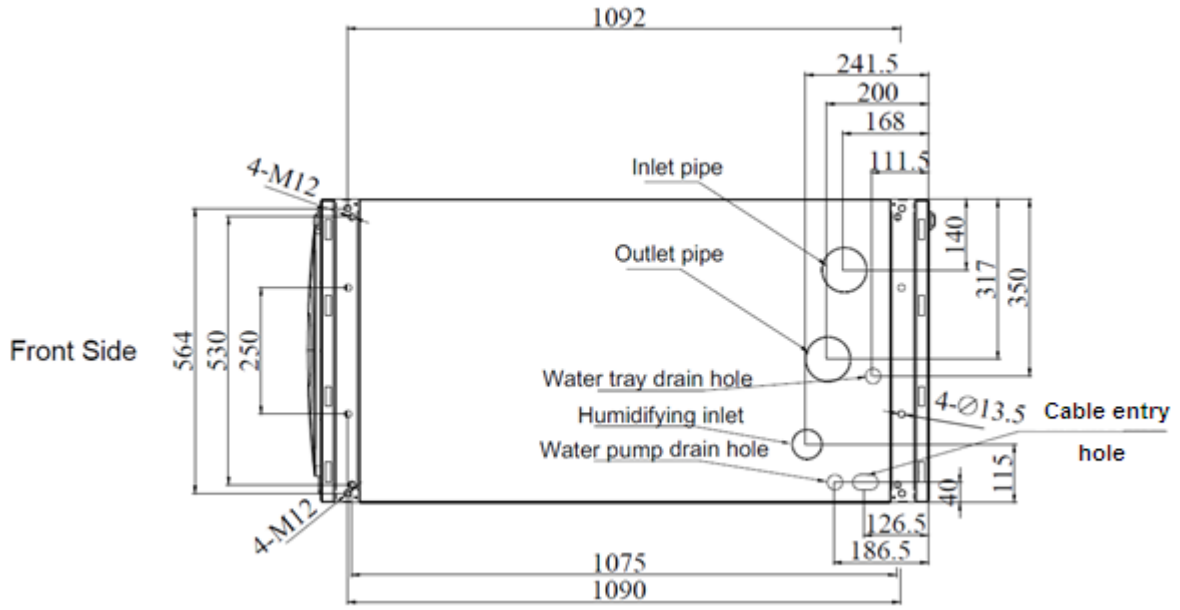


Figure 2-10 CR065

2.3.3 Locations & Dimensions of Top Plate Outlet

The cable entry position and dimensions on the top cover of the unit are shown in Figure 2-11, 2-12, 2-13 and 2-14:

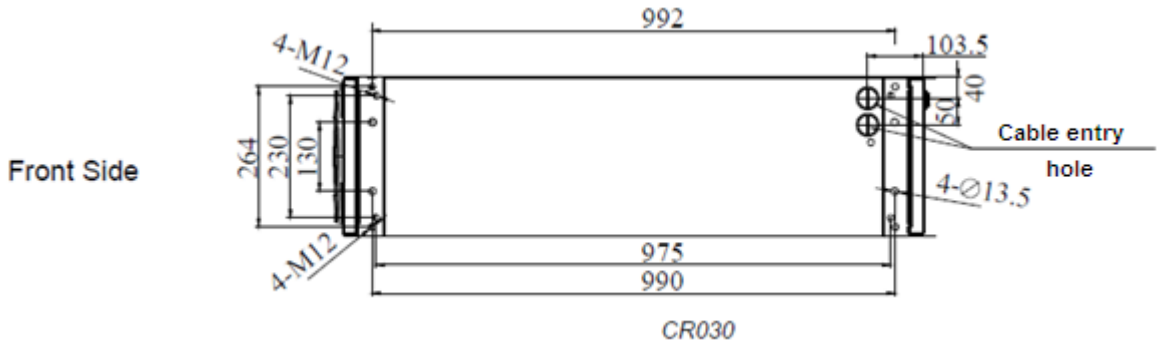


Figure 2-11 Dimensions on Top cover for CR030

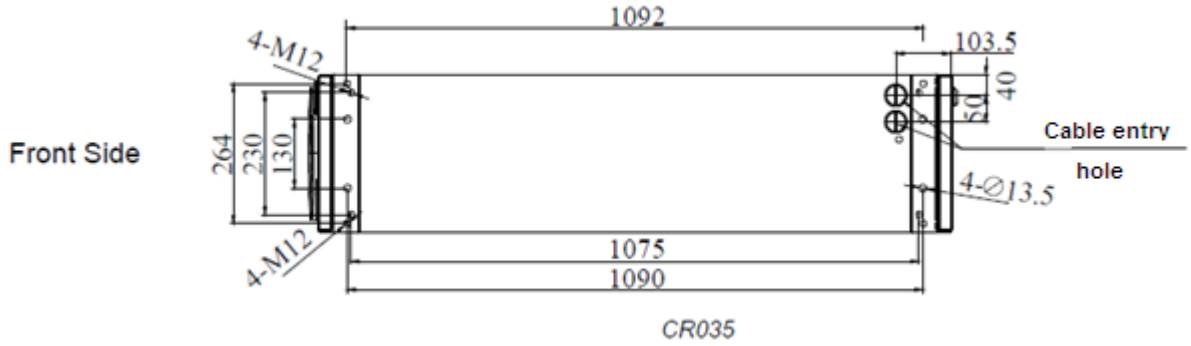


Figure 2-12 Dimensions on Top cover for CR035

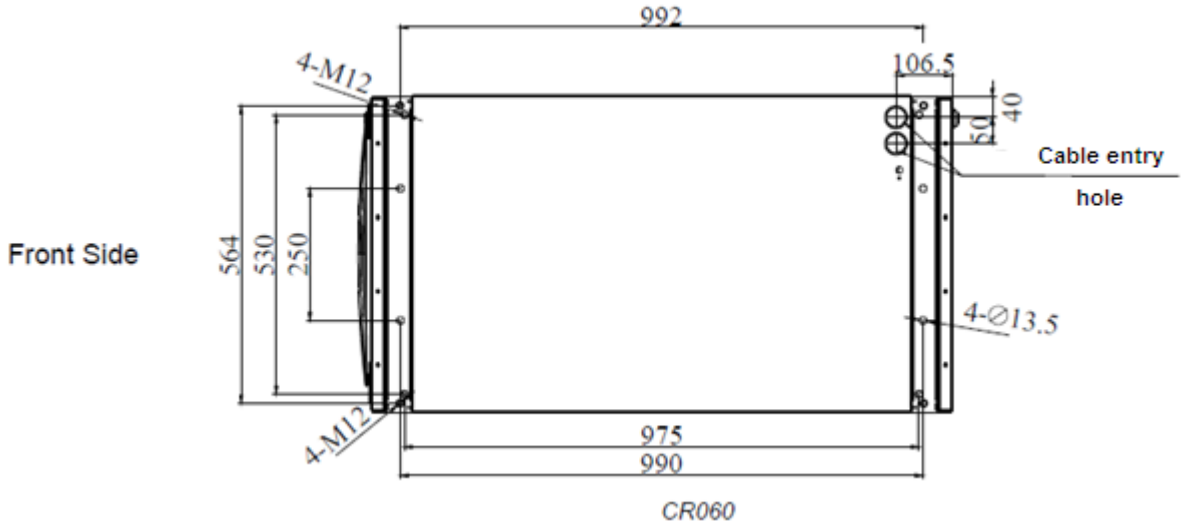


Figure 2-13 Dimensions on Top cover for CR060

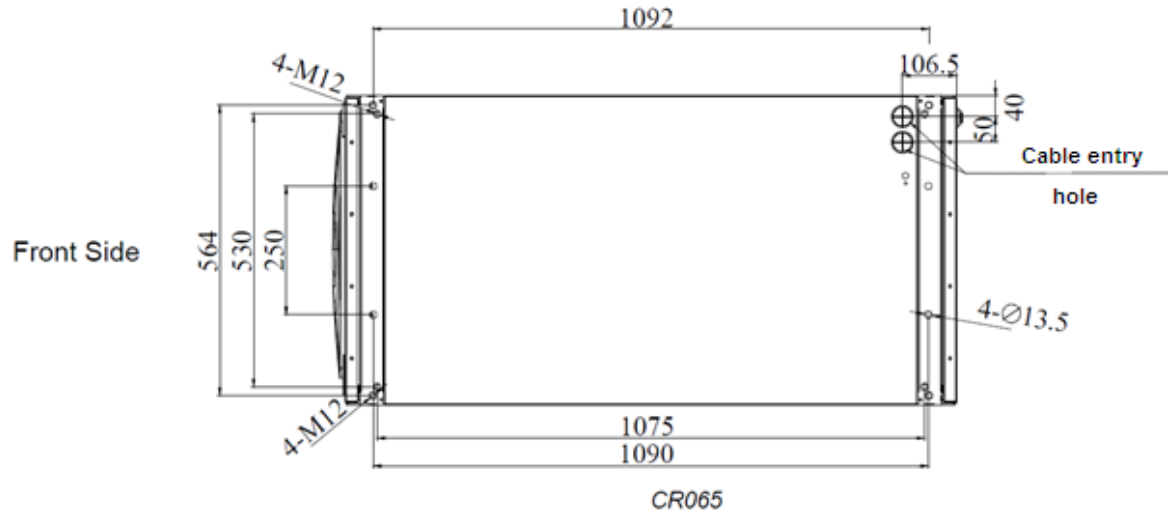


Figure 2-14 Dimensions on the Top cover for CR065

Be sure to mount the sleeve to the cable holes to avoid cutting the power cables.

2.3.4 Installing the Cabinet

In this section, the following topics will be covered:

- Levelling the cabinet
- Remove Levelling Feet & Fastening
- Cabinet connection

➢ Levelling the Cabinet

Liebert CRV+ CW air conditioner is installed in the middle of the racks; therefore, at least one side of the unit is on the side of the server cabinet. After each part of the cabinet is installed, the cabinet needs to be levelled.

Following is the procedure for levelling the cabinet:

1) Place the cabinet on an open ground
2) Use a movable wrench to loosen the four fastening nuts on the four levelling screw rods in a clockwise direction (Refer Figure 2-15).
3) Rotate the hex bolts at the bottom of the levelling foot till the foot is raised or lowered to the ideal position.
4) Use a levelling meter to ensure that the cabinet is in a levelling position.

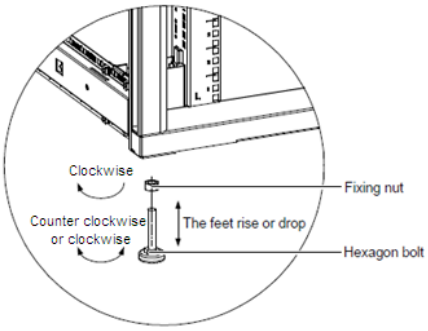


Figure 2-15 Levelling foot

5) Tighten the fastening nuts on the levelling screw rod in a counter-clockwise direction to complete the adjustment process. If there is a mounting bracket in the equipment room and its width does not exceed 30mm, remove the feet and fix the cabinet on the mounting bracket.

➢ Removing the Feet & Fixing the cabinet

Before explaining the task of removing the feet and eventually fixing the cabinet, it is vital that 2 people will be required for this operation to avoid personal injury and cabinet damage.

Following are the instructions to be followed for removing the feet and fixing the cabinet:

➢ Removing the feet

1) Use a moveable wrench to loosen the fixing nuts on the four fleet bolts in a clockwise sequence.
2) Rotate the hexagon bolts on the bottom of the feet clockwise till the feet drops from the cabinet frames.

➢ Fixing the cabinet

The cabinet provides two holes (diameter: 13.5 mm) respectively on its top, bottom, front, and rear as depicted in Figure 2-16.

1) Install bolts in the four holes at the bottom to fix the cabinet on to the floor bracket of the machine room.
2) Install bolts in the four holes at the top to fix the cabinet to connect the cabinet with the top bracket of the machine room.

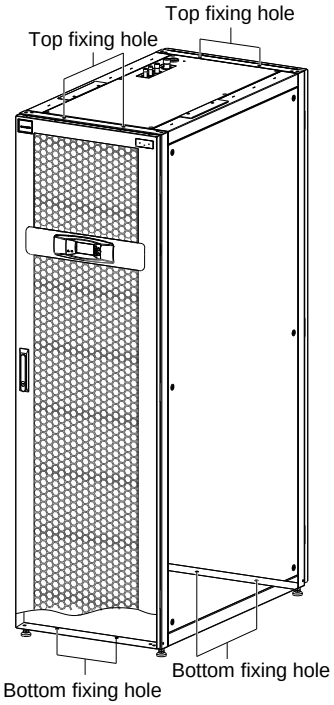


Figure 2-16 Fixing holes of the cabinet

➢ Cabinet Connection

The cabinet connectors come along with the accessories. Connect the unit with adjacent cabinets using the cabinet connectors.

Before connecting the cabinet, level the cabinet as mentioned in the earlier section (Refer the section Levelling the Cabinet).

1) Loosen the fixing screw of the cabinet connector on the frame of the cabinet.
2) Rotate the cabinet connector 90° to the horizontal position. Use M5 counter-sunk head screws to

fix it on the cabinet frame (Side of the door lock) as depicted in Figure 2-17.

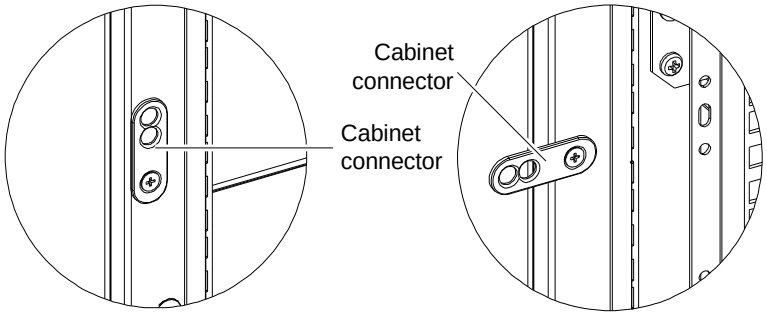


Figure 2-17 Rotating the Cabinet connector

3) Use the M5 countersunk head screws to fix the cabinet connector (L-shaped) in the installation holes of the cabinet frame (side of the hinge) and rack frame adjacent to the cabinet as depicted in Figure 2-18.

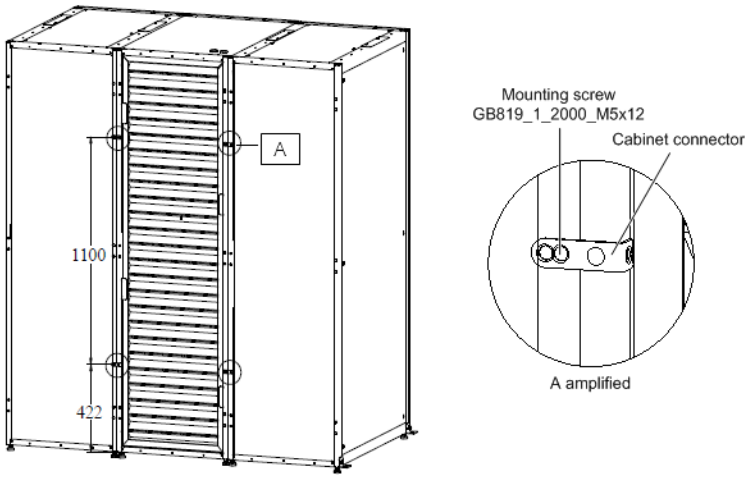


Figure 2-18 For the CR030 and CR060 units

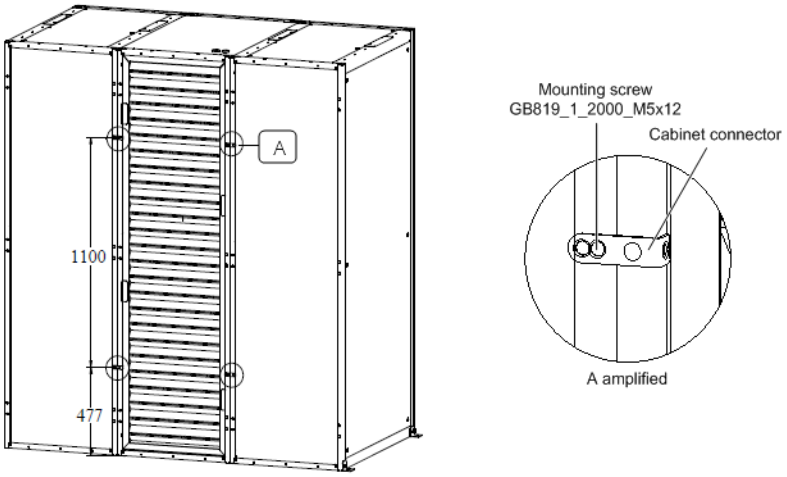


Figure 2-19 For the CR035 and CR065 units

4) Use the same method to fix the other cabinet kit.

2.3.5 Piping

Four kinds of pipes need to be installed in the piping installation process, namely-

- Inlet & Outlet Chilled water pipes
- Condensate Drain Pipe
- Water Inlet pipe

The following points need to be taken into consideration during the Piping process:

- *The selection, layout, and fixing of the pipes will conform to the industry standards and norms.*
- *Pipe Pressure drop must be considered during the designing and installation process.*

➢ **Remove Filters**

- Before the connection of the pipes in the indoor unit, the filters need to be removed. Open the rear door of the cabinet to reveal the 2 filters, namely - the top and bottom filters.
- Next, proceed to remove the fixing flake of the top filter. Prior to the removal of the fixing flake, the screws of the flake need to be loosened. Then, the fixing flake will be removed, followed by removing the top filter. Use the same method to remove the bottom filter.

Figure 2-20 depicts the process of removing the filters:

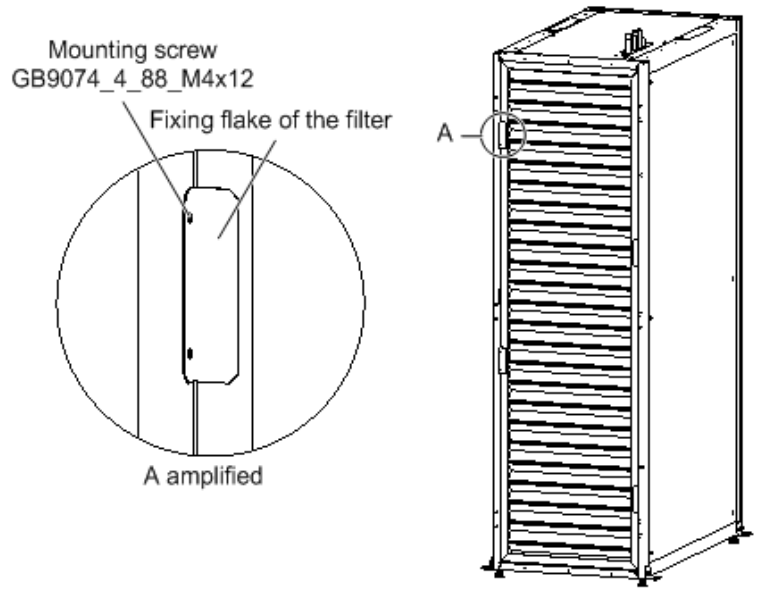


Figure 2-20 Removing the Filter

➢ **Connection of the inlet and outlet chilled water pipes**

1) Connect the incoming and drainage chilled water pipes. The connection position of the pipes is as shown in Figure 2-21.
2) The inlet and outlet chilled water pipes are connected via screw threads.
3) The water pressure should be able to overcome the water pressure drop generated by all the components in the system; considering the water pressure rise due to scales and residuals generated during the long term operation of the system, maintain a 20-25% redundancy while selecting the head-up components. The weight of the water pipe connected to the unit must be borne by the unit.

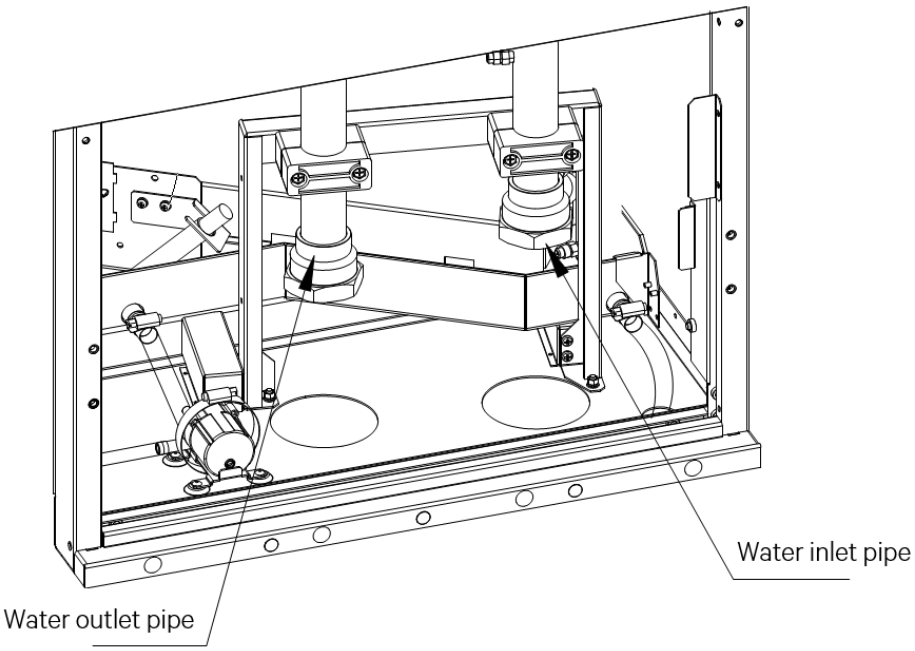


Figure 2-21 Chilled water inlet and outlet pipes

4) If the incoming water temperature is 7-25˚C, the incoming water pressure should not exceed 1600KPa.

5) The incoming water/drainage pipes must be thermally preserved. The table 2.3 shows the connection dimensions of the incoming and drainage chilled water pipes for the unit.

Table 2.3

Model	Thread connector & Outer diameter of the incoming and drainage chilled water (mm)
CR030/ CR035	ID28.3 X Rp1-1/4", 28
CR060/ CR065	ID 38.2 X Rp1-1/2", 38

The chilled water pipe is shown in Figure 2-22. Following is the description of the chilled water pipe:

- Use copper, steel, or aluminium pipes
- Place the pipes on the saddle-shaped bracket (shown as 1) in Figure 2-22.
- Use the thermal insulation pipes (shown as 2 in the same Figure 2-22) mainly to insulate the pipes thermally.
- Install the ball valves (shown as 3 in Figure 2-22) at the end in the inlet and outlet of the air conditioner for easy maintenance and repair.
- Install a temperature meter (shown as 4) and a pressure gauge meter (shown as 5) at the inlet and outlet of the air conditioner.
- Install a drainage connector (shown as 6) at the lowest point of the circuit.
- Vertiv recommends installation of water flow sensors on the incoming water pipe in the horizontal or vertical positions. The upstream and downstream of the sensors should have the direct pipe sections of the same diameters as the flow sensors with length data respectively not less than 10DN and 5 DN
- Use Water/Glycol to charge the circuit.

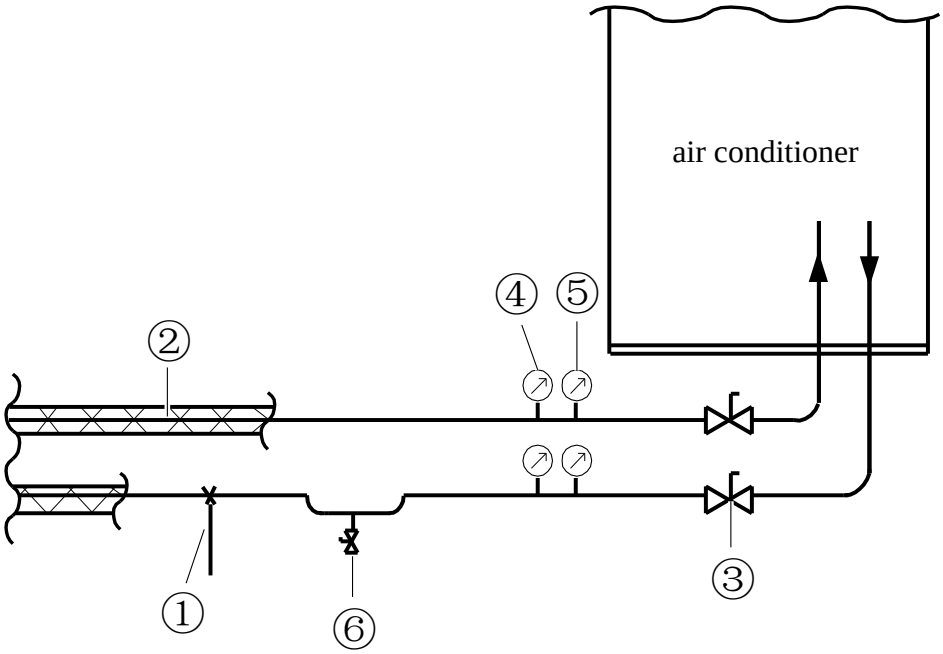


Figure 2-22 Chilled water circuit

➢ **Connecting condensate drain pipe of the indoor unit**

- The unit uses the dual-drainage design.
- The condensed water from the electrode humidifier and chiller water coil is accumulated in the water pan. It is drained by the drainage pipe and water pan drainage pipe.
- If there is no pump, lead the soft pipes at the water pan through the two drainage holes on the bottom plate (Refer to Figure 2-23 for the same)
- Next, connect the external drainage pipe.
- The inner diameter of the pump drainage soft pipe is 9 mm, and the inner diameter of the water pan drainage soft pipe is 16mm.

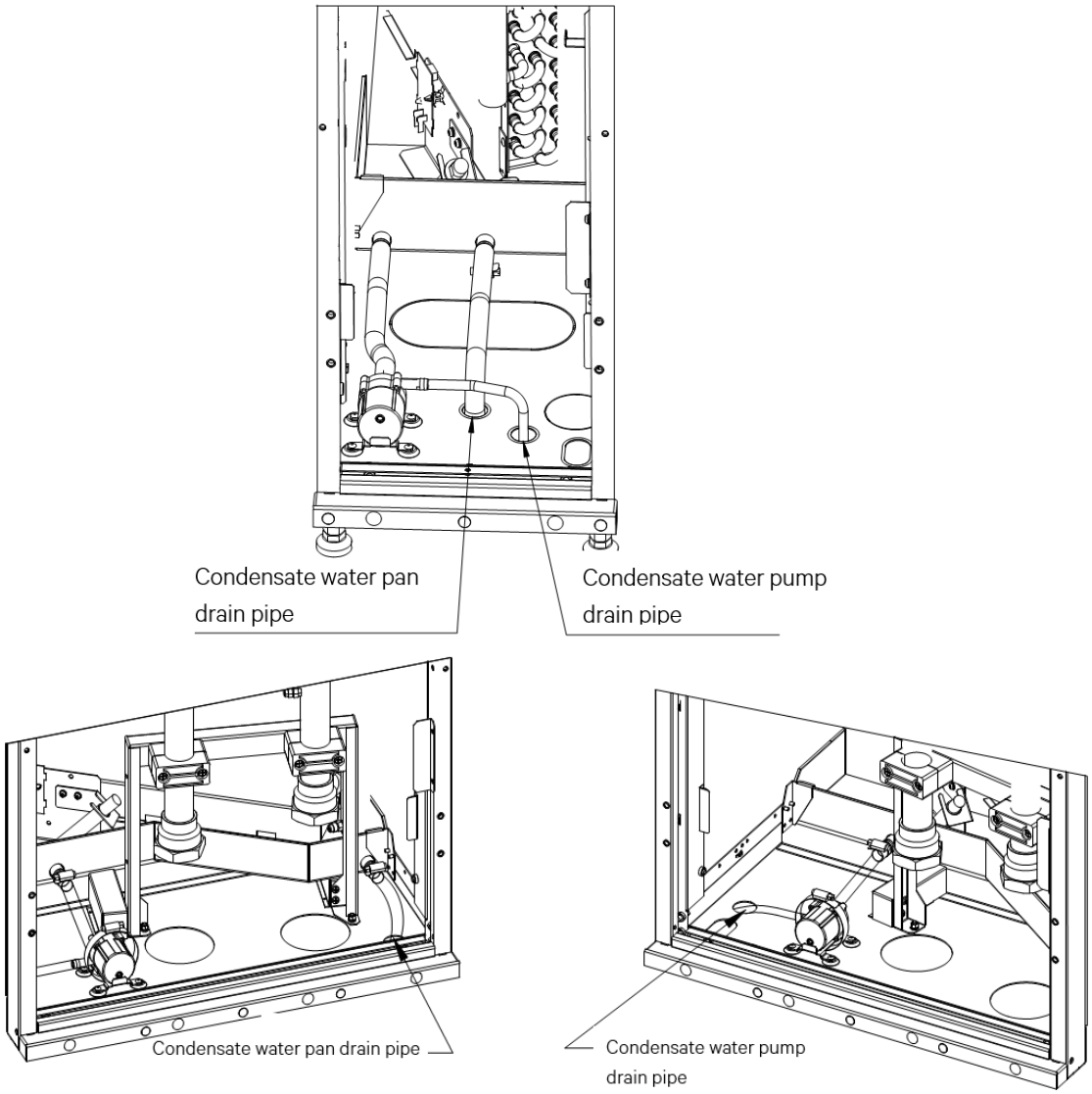


Figure 2-23 Condensate water drain pipes

- To ensure the drainage of the condensed water, a water trap must be installed outside of the cabinet. (Refer figure 2-24.)

  The requirements are as follows:

  - Use a galvanized steel pipe, PVC, or flexible polyethylene pipe.
  - Allowance up to 2% for the inclination along the draining direction.
  - A water trap 1 (As shown in fig. 2-24) must be installed 30 cm below the water pan 2 (As shown in fig. 2-24), and the trap must be installed in the movable floor under the unit.
  - Charge water 3 (As shown in fig. 2-24) in the water trap.

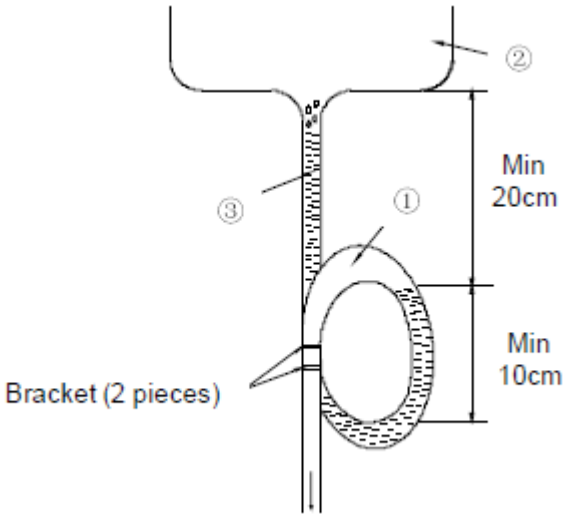


Figure 2-24 Drainage of condensed water

- *Do not cut off the bracket of the water trap. If the bracket is cut off, the drainage of the condensed water will be affected.*
- *Before startup, charge water in the water trap to avoid the air bypass through the drain pipe.*
- *To avoid any water leakage, use a Teflon raw tape between the flexible pipes and connectors.*
- *Install the check valve on site externally in the condensate drain piping.*

➢ Connecting the Incoming water pipe of the Electrode humidifier

1) Lead the incoming water pipe connector (3/4" GAS) of the humidifier canister through the rubber holes of the humidifier on the bottom plate of the cabinet.
2) Connect the external incoming water pipe.
3) Tighten the screw thread connector of the incoming water pipe and tighten the connector. Since there is an inner sealing ring, the raw tape is not required.
4) Remember that other connection modes can also be selected depending on the site condition.
5) Ensure that the connection is well sealed to prevent any leakage.
6) The pipe pressure is 100kPa ~ 700kPa. If the pressure exceeds 700kPa, a pressure reducer should be fitted. If the pressure falls below 100kPa, a water tank and pump system should be used.
7) Since the electrode humidifier contains flowing hot water, the water pipe must be resistant to heat that is higher than 90˚C.

Some products may include components as per the local codes and regulations.

➢ Adjusting the Air Guidance Grille

- Adjust the direction of the air guidance grille based on the installation position of the Liebert CRV+ CW air conditioner.
- The grille contains several blocks – remove the screws on the left and right hand side of the grill followed by rotating it by 180˚. The mounting screws of the grille are shown in Figure 2-25.
- Replace screws.

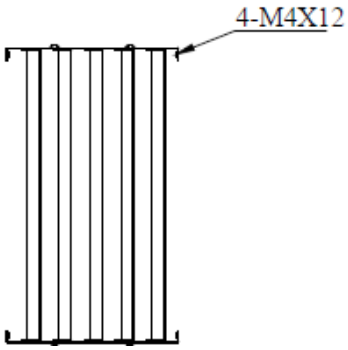


Figure 2-25 Position of the screws on the grille

➢ **Blocking the holes on the Top plate of the cabinet**

- There are some small holes on the top plate of the cabinet for the convenience of the field installation (to connect to the top cabling bracket). After the field installation of the cabinet, use rubber plugs and bolts in the accessories to block the remaining holes. This prevents water from entering the cabinet.
- Use M13.5 plugs to block the 4 holes on the top plate of the cabinet.
- Use M12*30 bolts to block the eight holes on the top plate as shown in Figure 2-26.

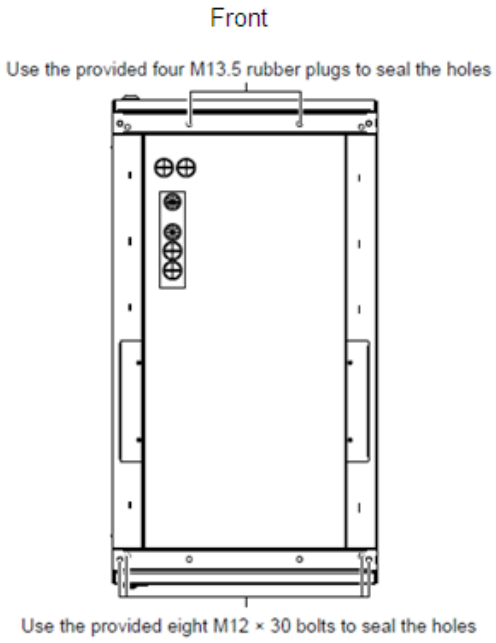


Figure 2-26 Blocking the holes on the top of the cabinet (Top view)

➢ **Leakage Water Detector**

- Install the leakage water detector. Confirm the alarm information through the controller.
- The recommended installation locations of the detectors are shown in Figure 2-27.

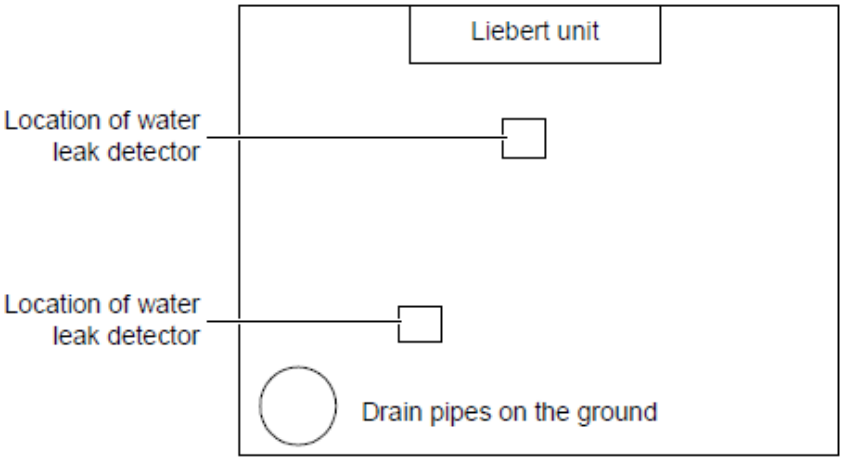


Figure 2-27 Recommended installation locations of the leakage water detectors

- *The detectors should be far away from the wet water trap or drainage ditch on the floor. Ideally, it should be 2m or 2.5m away from the unit.*
- *Do not install it under the unit.*
- *Ensure that the power supply of the control unit is powered off before assembly or prior or the circuit connections.*
- *Do not use the leak detector near combustible liquids, or to detect combustible liquids.*

2.3.6 Installation Inspection

Once the mechanical installation is complete, check the document task list for ascertain if the installation has been done correctly.

The table 2.4 shows the installation inspection checklist:

Table 2.4

Items	Results
Sufficient space is left around the unit for maintenance purposes	
The equipment is installed vertically and the installation fasteners have been fixed	
The airflow direction of the grille has been adjusted (if necessary)	
The drain pipe has been connected	
The water supply pipe for the electrode humidifier has been connected	
All pipe joints have been made and fixed correctly	

2.4 Electrical Installation

In this section, the electrical installation is explained in detail.

The air conditioners in the Liebert CRV+ CW series are used in industrial, commercial, or other applications. It is not tailored for general access. The total power rating is larger than 1 KW and is in line with the IEC61000-3-12 standard. It provides an interface with a short circuit ratio greater or equal to 350 between the power supply and grid. Users should get permission from the utility power department to ensure that the air conditioner connects to the power source with a short circuit ratio of nothing less than 350.

2.4.1 Installation Notes

- The connections of all the power cables, control cables, and ground cables should follow the local and national electrical regulations.
- Observe the unit nameplate for the full load current. The cables sizes must meet the conditions as specified in the local wiring protocols and rules.
- The mains supply requirement – CR030/CR035: (220 to 240) V±10%; 50/60 Hz, 1 pH; CR060/CR065: (380 to 415) V±10%, 50/60 Hz, 3N~.
- The power soft cable is a Y-type connection. If damaged, it must be replaced immediately to eliminate the dangers. The replacement procedure must be carried out by an authorized professional or experienced service personnel.
- The electrical installation and maintenance must be carried out by authorized personnel only.
- Prior to the wiring, a voltmeter must be used to measure the power supply voltage and ensure that the power supply has been switched off.
- Use screws, guide rails, or other modes to fix the device firmly during the installation process to avoid movement or shaking during the start-up or operation mode.
- For the air conditioner configured with EC fans, the unit power grid adheres to the TN or TT star connection power distribution system. However, if there is a need to configure different connections, contact the Vertiv support team.
- A breaking device will be provided to disconnect from the power supply.
- The power soft cable should not be lighter than an ordinary PVC-sheathed based on the 53 line in accordance with the GB5023.1 (idt IEC60277) standards. For appliance of outdoor, the power cable should be not lighter than Chloroprene rubber sheathed flexible cord which is 57 line according to IEC 60245.

2.4.2 Wiring of the Unit

➢ Electrical connection location of the indoor unit

For any model in the CRV+ CW series, open the back door of the indoor unit following which the specific layout and locations of the low voltage components can be viewed as depicted in Figure 2-28. For detailed layout information on low voltage components, refer to the labels on the cabinets and units.

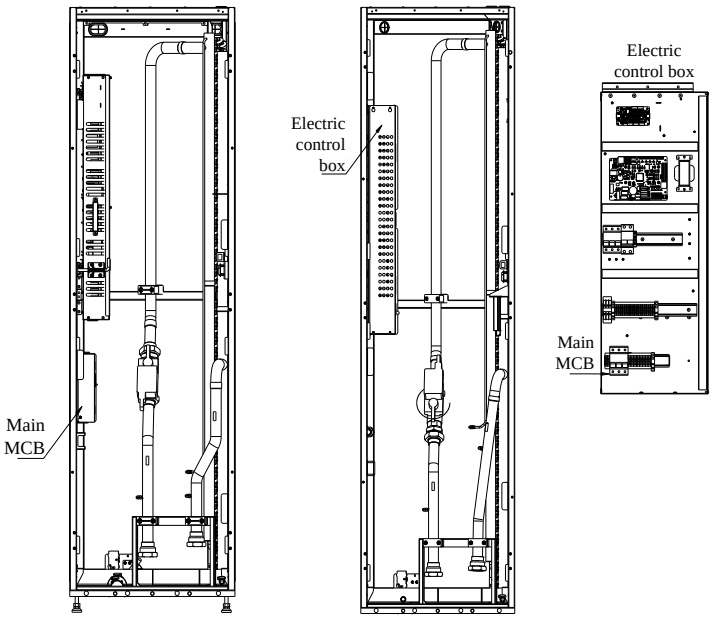


Figure 2-28 Positions of main MCB (with rear door opened)

Table 2.5 Rated full load ampere (FLA) (unit: A)

Model	Model without heater or humidifier	Model with heater	Model with humidifier	Model with heater & humidifier
CR035	10	25 (Option)	21 (SFA)	25 (SFA)
CR030	10	25	21	25
CR065	6	20 (Option)	16 (SFA)	20 (SFA)
CR060	6	20	16	20

Note:: Electrical heater is option for CR035&CR065, steam humidifier need SFA for

CR035&CR065.

➢ Connecting the Power Cables

The procedure for connecting the power cables are explained in the following list:

- Confirm the following points before an electrical connection
  - ✓ All the electrical connections must be intact
  - ✓ All the electrical components must be intact.
  - ✓ Tighten all the terminal bolts
  - ✓ The power supply voltage and frequency must be consistent with the contents of the unit.
- The power cables of the air conditioner unit are led into the unit from the top or bottom of the air conditioner.
- They are connected to the main MCB. The CR030 and CR060 units have dual power supply

supporting the dual power inputs.

- The position of the main MCB is shown in Figure 2-28. The L1 to L3, N and PE are respectively connected to the corresponding terminals of the external power supply.
- Reserve the redundancy of the incoming cables and fix the cables to the cable clamp, which is located on the inner side board of the unit. The cable inlet holes at the bottom and the top as shown in section 2.3.2.
- Refer to the Current values of the main MCB to select the cables as depicted in the table 2.5 in the preceding section Electrical connection location of the indoor unit.

The cable sizes should meet the local wiring regulations and protocols.

➢ Connecting the Control Cables

The field connection terminals are shown in Figure 2-29 and the amplified diagram is shown in Figure 2-30.

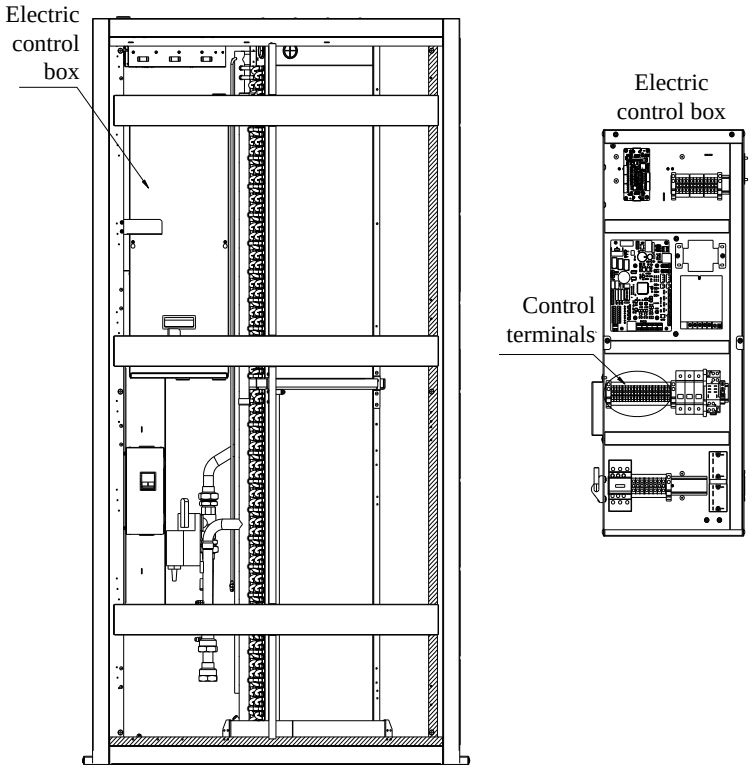


Figure 2-29 Position of Control Cables

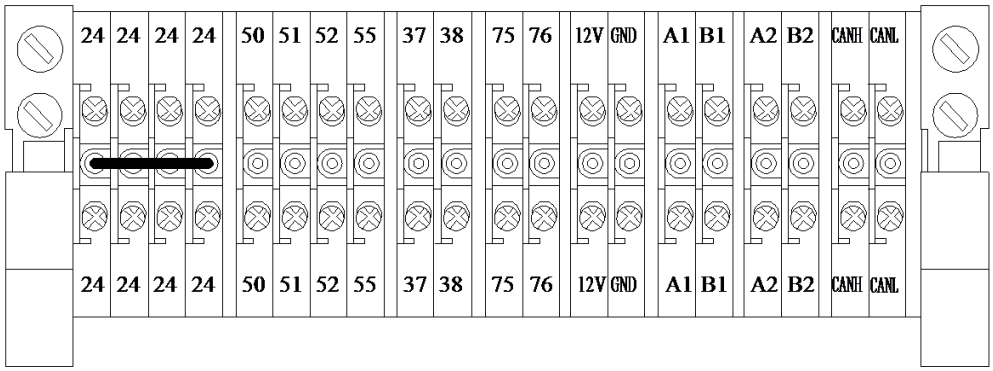


Figure 2-30 Amplified Diagram of Control connections

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

Water under-floor sensor

In case of a water under-floor sensor, connect one end of the sensor to terminal 51#, and the other end to the common terminal 24# of sensors can be connected in parallel.

High level communication and Monitoring

In case of a SIC Card, connect the A#, B#, GND#, and 12# on the SIC card respectively to A2#, B2#, GND#, and 12V# on the terminal block, and see Appendix 1 Circuit diagram for more details.

Alternatively, Modbus RTU can be used by connecting directly to terminals A2# and B2#. The RDU-SIC card is not necessary for utilizing the in-built Modbus RTU protocol.

Either SNMP (via the RDU-SIC card) or Modbus can be used with the CRV+, but cannot be used in conjunction with each other.

Rack Sensor

- Connect the remote temperature and humidity sensors on the rack to detect the temperature and humidity at any place within the air conditioner regulation range such as the place in the room, the air inlet, and outlet of the cabinet.
- The Max/Min/Average temperature can be set as the control temperature through the controller in order to control the fan speed and opening of the chilled water valve.
- The remote temperature and humidity sensor can be configured on the site.
- Up to 6 temperature sensors can be configured for each unit. It is recommended to arrange the sensor in front of the thermal load to acquire the most accurate temperature value. If the sensors are connected in a series, each temperature sensor monitors the air temperature of each rack, and the acquired temperature is used to control the operation of the unit.
- The standard position of the sensor is the place that is at a height of 1.5m as shown in Figure 2-31 (in the figure, the sensors are also connected in a series).

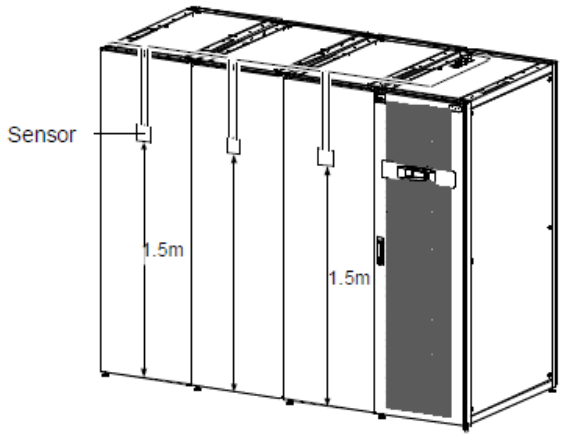
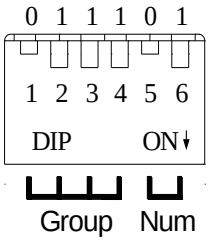


Figure 2-31 Arrangement of rack sensor

- Therefore, the sensor must be placed at the position as shown in Figure 2-31 for it to work accurately; if not properly positioned, the equipment will not function effectively.
- Connect the terminal of the temperature sensor to the 10DI port. After connecting the cables, lead the cables out from the top/bottom of the unit. Connect the cables to the first sensor and then from the first sensor to the second sensor and so on to form a chain in the series.
- The temperature sensor should be fixed in front of the hottest thermal source in the rack.
- Do not fix the sensor in front of an empty slot. During the operation, each sensor is attached to the front of the rack with the aid of a magnet. The sensor should be fixed where there is least cold air flow.

- The address setting of the temperature sensor IRM-S01T is shown in the following table 2.7. The DIP switch of the temperature and humidity sensor is used to set the sensor address. It communicates with the control board via the MODBUS protocol. The sensor address contains the Group No. and Sequence number in the group. DIP1 to DIP4 is used to set the Group No. whereas DIP5 to DIP6 is used to set the sequence number in the group.
- If the sensor address is 71, the setting method is as shown in Figure 2-32 wherein 0111 represents Group No. 7 and 01 represents the sequence number 1 within the group.



Note: 1. If the DIP switch is set to ON, this means 1,
2. The sensor address cannot be set to 00

Figure 2-32 Sensor Address Settings

The setting of the DIP switches DIP1 to DIP6 is shown in the table 2.6.

Table 2.6

DIP1 to DIP4	Group No.	DIP1 to DIP4	Group No.	DIP1 to DIP4	Group No.	DIP5 to DIP6	Sequence No.
0 0 0 0	0	0 1 1 0	6	1 1 0 0	C	0 0	0
0 0 0 1	1	0 1 1 1	7	1 1 0 1	D	0 1	1
0 0 1 0	2	1 0 0 0	8	1 1 1 0	E	1 0	2
0 0 1 1	3	1 0 0 1	9	1 1 1 1	F	1 1	3
0 1 0 0	4	1 0 1 0	A				
0 1 0 1	5	1 0 1 1	B				

The address settings of the remote temperature and humidity sensors are shown below in the table 2.7.

Table 2.7

ID Number	DIP						
	1	2	3	4	5	6	
Remote temperature and humidity 1	0	0	1	0	0	0	ON — "1" OFF — "0"
Remote temperature and humidity 2	0	0	1	0	0	1	
Remote temperature and humidity 3	0	0	1	0	1	0	
Remote temperature and humidity 4	0	0	1	0	1	1	
Remote temperature and humidity 5	0	0	1	1	0	0	
Remote temperature and humidity 6	0	0	1	1	0	1	

The address settings of the remote temperature and humidity sensors 1 to 6 are respectively 20, 21, 22, 23, 30, and 31. While configuring the remote temperature sensors, if the number of sensors is less than 6, configure them based on the sequence. For example, if there are only 3 sensors, the addresses are 20, 21, and 22; remember that the numbers must be consecutive. The remote temperature and humidity sensor as mentioned earlier must be configured on the site.

➢ Remote Shutdown

- As shown in Figure 2-3030, the 37# and 38# terminals can be connected to the Remote Shutdown switch. These terminals have been short-circuited before shipment.
- Remove the short circuit cable when there is a need to connect the Remote Shutdown signal.

When 37# and 38# are opened, the unit will shut down.

➢ **External General Alarm**

- In figure 2-30, Terminals 75# and 76# can be connected to the external general alarms. The output signals to external alarm devices, such as an alarm indicator.
- When a critical alarm occurs, the contact will be closed to trigger remote alarms, send signals to the building management systems or dial the paging systems automatically. The power supply of the external general alarm system is configured at the customer end.

  For more details refer the circuit diagrams in Appendix section.

2.4.3 Installation Inspection

After the electrical installation, refer to Table 2.8 for confirmation.

Table 2.8

Items	Results
The power supply voltage meets the rated voltage on the unit nameplate	
The system electric loop has no open circuit or short circuit	
The ratings of the MCBs, and fuses are correct	
The control cables are securely connected	
All the cable connections are fastened with no loose screws	

Once the above inspection is done, proceed to commissioning of the unit.

Do not power on the unit until a Vertiv engineer has confirmed the connections.

2.5 Commissioning

This section gives an overview of the Commissioning process.

Remember that the Commissioning process is to be strictly performed by Vertiv Engineers only. If the customer performs the Commissioning and there is a malfunction, then the warranty will be void. Therefore, only authorized professionals from Vertiv Co. can perform the Commissioning process.

2.5.1 Preparation and Checks prior to Commissioning

➢ **Mechanical section on Commissioning**

1) Check if the water supply & drain pipe system of the humidifier is connected correctly. Make sure that there is no leakage.
2) Check if the drainage pipe of the condensed water has been connected and the drainage function is normal.
3) Check if the filters have been installed in the correct positions without damage. Also, check if the surface is clean.
4) Check if the air inlet and outlet areas of the unit are not blocked.

➢ **Electrical section on Commissioning**

1) Check if the voltage of the main power supply is within ±10% of the rating.
2) Check if the power or control cables are connected accurately. Fasten all the connecting terminals.
3) Confirm if the power cables and low voltage control cables are laid away from each other.
4) Check and confirm that the water level switch cables have been connected correctly; also check if the water level floating rod can operate normally.

2.5.2 Commissioning procedures

1) Turn off all the MCBs of various parts. Turn on the isolation switches and control MCBs. Check and

confirm that the control voltage is 24Vac ±10%.

2) Turn on the fan MCB to check if the fans run normally. Measure all the operational phase-currents of the fan.

3) Unplug the water valve from the unit; open the value till the maximum as shown in Figure 2-33. Press the manual button and rotate the valve rod to the horizontal position.

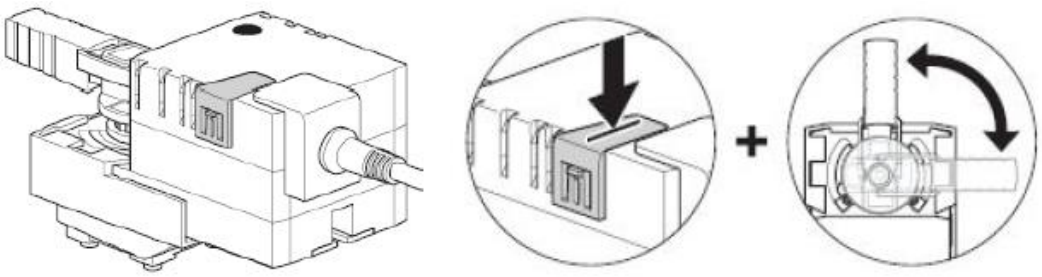


Figure 2-33 Water valve and manually opening the valve

4) Open the air discharge valve on the water return pipe to discharge the air through the coil. Close the air discharge valve when the water flows out. Check the pressure of the unit and then re-connect the valve connection.

5) If the unit does not run after the commissioning, open the water discharge valve at the bottom of the unit to discharge the water in the pipes to prevent freezing of the water in the pipe during low-temperature time.

2.5.3 Complete inspection after Commissioning

The following table 2.9 shows the parameters that need to be inspected post commissioning:

Table 2.9

Inspection items	Results
Check and confirm that all the output functions are automatic	
Check if the temperature & humidity settings and control precisions are set correctly	

Part III
System Operation & Maintenance

3 System Operation & Maintenance

3.1 Micro-controller

3.1.1 Features

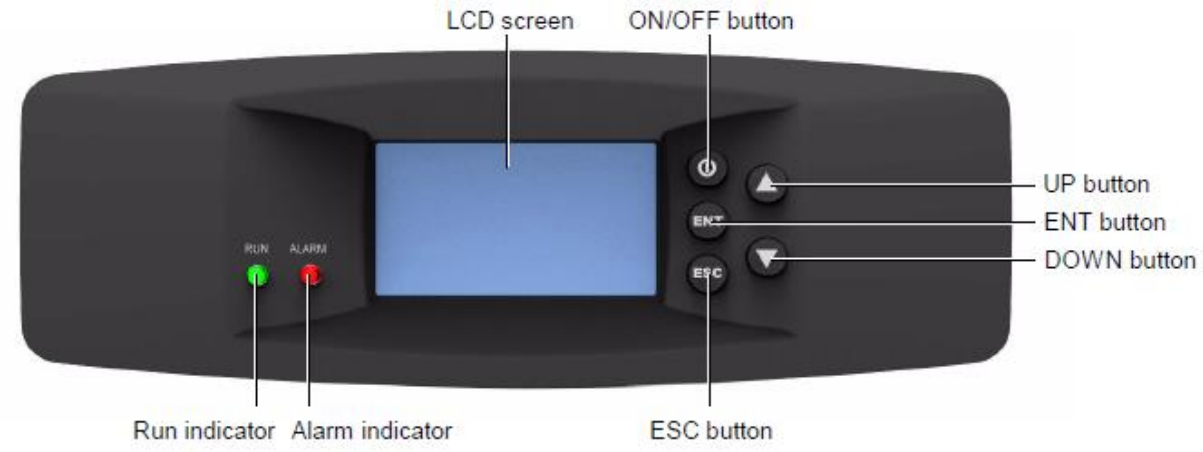


Figure 3-1 Micro-Controller

Following are the features of the micro-controller:

- The micro-controller is used for menu operation. It can monitor and display the operation status of the CRV+ CW unit to keep the environment within a setting range.
- It comprises a 128*64 dot matrix LCD screen with white backlight with an easy-to-use interface.
- It provides a three-level password protection to effectively prevent unauthorized operation.
- It provides the functions, including self-recovery upon power failure, high voltage and low voltage protection, phase loss and anti-phase protection.
- It accurately displays the running time of critical components through menu operation.
- The expert-level fault diagnosis system can automatically display the current fault information to facilitate maintenance personnel in servicing and repair.
- It can store up to 500 historical alarm records.

3.1.2 Control buttons

The micro-controller provides 5 control buttons as depicted in Figure 3-2:

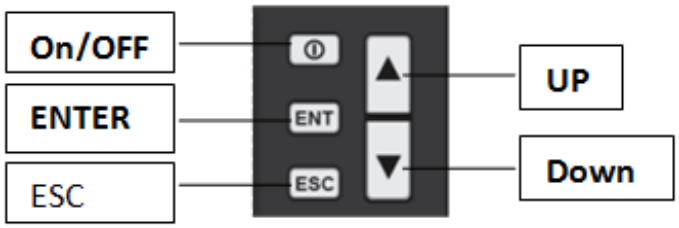


Figure 3-2 Control Buttons

Table 3.1 includes the detailed functions of the control buttons:

Table 3.1

Control button	Function descriptions
ON/OFF button	Press this button for 3s to turn on or turn off the AC unit
Enter button (ENT)	Enter the selected menu screen. Validate the parameter setting value
Esc button (ESC)	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

3.1.3 Common Operational function examples

Following are the examples that depict the way the microcontroller works in almost all the options.

➢ Example 1 – Accessing the Main menu

After the unit is powered on, the unit starts up.
Following are the step-by-step instructions to access the Main menu.

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

➢ Example 2 – How to change parameters

The procedure is the same for all parameters. In this example, the Hi Sup Temp in Alarm Stpt screen is used for illustration purposes:

Following are the step-by-step instructions for changing parameters for the Hi Sup Temp option:

- Press the Up and Down button to move the cursor to Alarm menu option in Main Menu section.
- To enter the Alarm Menu, press the Enter button.
- Press the Up and Down button to move the cursor to the Alarm Setting option on the Alarm Menu screen.
- Press the Enter button to access the Alarm Setting screen.
- Press the Up and Down button to move the cursor on Hi Temp of Supply Air.
- Press the Enter button to highlight the parameter field of Hi Temp of Supply Air.
- In order to select the parameter option, scroll using the UP and Down buttons.
- Select/change the specific Parameter.
- Press the Enter button to confirm, following which the changes will take effect. If the Enter button is not pressed, the changes will not take place.
- Press the Esc button to return to the previous menu screen.

3.1.4 Control Screen

➢ Main Screen

Once the air conditioner is powered on, the main page screen is displayed after 10 seconds of the startup

delay as depicted in Figure 3-3:

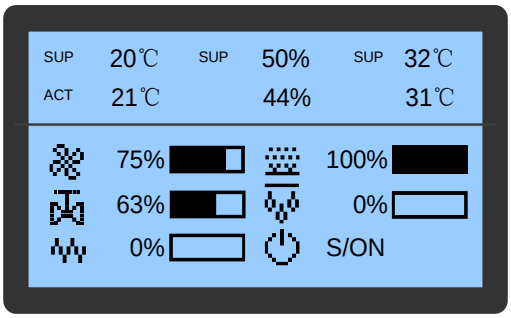


Figure 3-3 Main Screen

It displays the air supply temperature, humidity setting, and return air temperature in the first row. It displays the actual air supply temperature, actual humidity, and actual return air temperature in the second row.

The lower half of the screen shows the unit output status such as the fan speed, water valve opening, heating status, dehumidifying and humidifying status, unit property, and unit running status (Off, On, & Standby).

The icons and their definitions are displayed in the table 3.2.

Table 3.2 Main screen icons

Icons	Definitions
	Fan rotating speed. Displaying the percentage of actual fan rotating speed
	Water valve opening displays the water valve openness output percentage
	Heating state. Displaying 100% in heating mode, otherwise, displaying 0%. In two-stage heater, 50% is displayed if one stage is on and 100% is displayed if both stages are on
	Humidifying state. Displaying 100% in humidifying mode, otherwise, displaying 0%
	Dehumidifying state. Displaying 100% in dehumidifying mode, otherwise, displaying 0%
	Unit property/operation status. S: single; T: teamwork; ON running; R-OFF: remote shutdown; L-OFF: local shutdown; M-OFF: monitoring shutdown; and MANU: manual mode;

While using RDU-A to perform the teamwork control, the unit property will display Single Unit, and the Standby status will not be displayed.

➢ Password Screen

Press the Enter button on the Normal screen following which the Password screen appears as depicted in Figure 3-4.

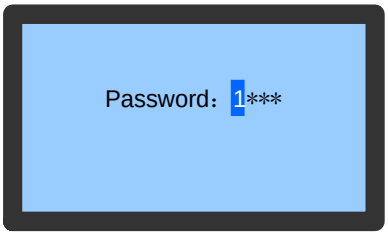


Figure 3-4 Password interface

The Table 3.3 depicts the 3 levels of passwords for accessing the menu.

Table 3.3 Password Level

Password level	User	Initial password	Remark
Level 1	General operator	0001	Browse all menu information. Only set temperature and humidity setpoints and cannot change any values and settings

Level 2	Maintenance personnel	/	Browse all menu information. Set all parameters
Level 3	Factory technician	/	/

On entering an incorrect password, the users cannot change the settings; 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 users do not enter a password and press the Enter button, then similar to the incorrect password example, the users can view the menu settings but cannot change any parameters.

3.1.5 Menu Structure

➢ Main Menu

On entering the correct password and confirming it, the users will gain access to the Main Menu screen.

On selecting a menu item, that item will be highlighted.

Figure 3-5 depicts the Main Menu screen:

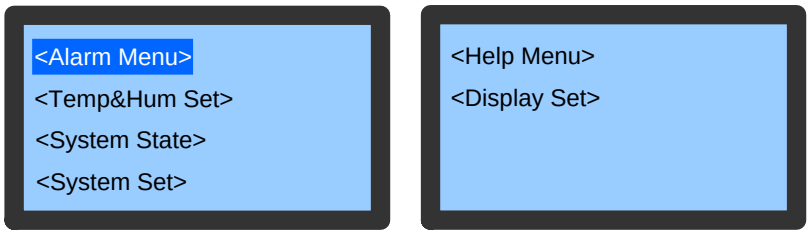


Figure 3-5 Main Menu

➢ Alarm Menu

On the Main Menu screen, the users must click on Alarm Menu to gain access to the Alarm Menu interface. Press the Up and Down button to scroll up or down the menu items.

Figure 3-6 depicts the Alarm Menu screen:

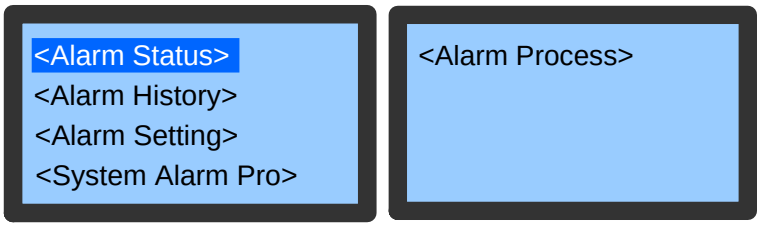


Figure 3-6 Alarm Menu

➢ Alarm Status

Active alarm statuses. Including Active Alarms (Total number of active alarms), ALM (Alarm Serial No. and Alarm Type), and Time (Alarm Start time) are some of the menu items and information displayed in this menu.

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

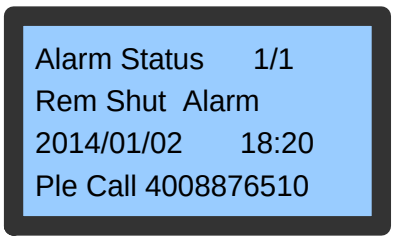


Figure 3-7 Alarm Status

➢ 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 and Alarm Type., Alarm Time (Start and End Time) as shown in Figure 3-8.

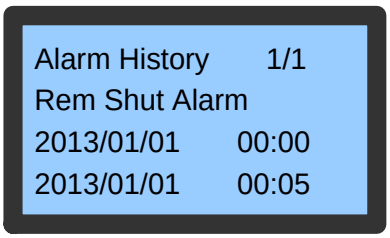


Figure 3-8 Alarm History

The latest Alarm SN is the largest number. Press the Up or Down button to scroll through the status records if more than one alarm is activated. Up to 500 historical alarm records can be stored. They will not be cleared upon system Power-Off.

➢ Alarm Setting

For the Alarm Setting sub-menu, refer Appendix 6 Alarms.

Default System settings should not be changed. However, if deemed necessary, configure and alter the settings under the guidance of a Vertiv engineer or qualified technician.

➢ System Alarm Pro

In the System Alarm Pro menu, the users can browse and set all the alarms. The specific system alarm pro sub-menus are shown in Appendix 5 Menu structure of Micro-Processing Controller. Use the Up and Down buttons to select the required sub-menu.

The system Alarm Pro menus can be set to Enabled and Disabled or Off, and the output logic is shown in the following table 3.4.

Table 3.4

Setting values	Alarm history	Alarm status record	Alarm sound	Alarm prompt
Enabled	Yes	Yes	Yes	Yes
Disabled	Yes	Yes	None	None
Off	None	None	None	None

The Fan Alarm, Air flow loss, Air Return Temp, Air Return Hum, Air Flow NTC Fault, Repetitive Address, Master Unit loss, & Slave Unit loss are major alarms and cannot be set to Off – they can be set to only Enabled or Disabled.

➢ Alarm Process

In alarm process menus, user can clear the alarm information, clear the filter running time, and set the tripping mode on Floor alarm.

➢ Temperature & Humidity Setting

Go to the Main Menu and go to Temp & Hum Set and access the screen as shown in Figure 3-9.

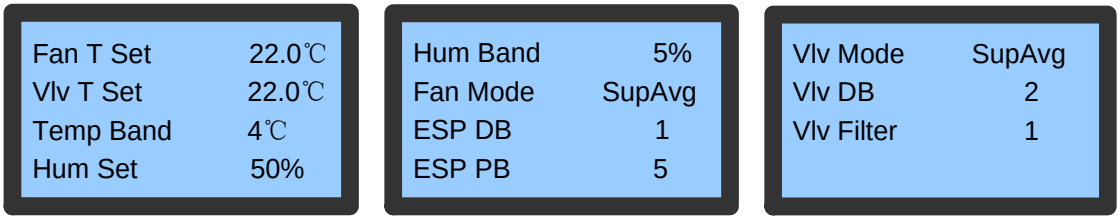


Figure 3-9 Temperature & Humidity Settings

Press Enter following which the Temperature and Humidity settings will be changed.

➢ System State

Select System State from the Main Menu to gain access to the System State menu.

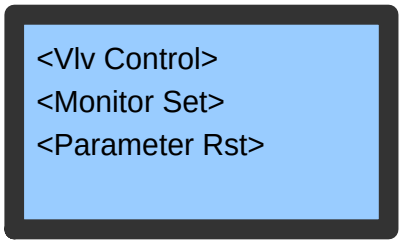


Figure 3-10 System State

➢ System Settings

Select System Set from the main menu to gain access to System settings as shown in Figure 3-11. The user level password can only be used to set the temperature dead band and humidity dead band. The other menu is open to the maintenance personnel's only.

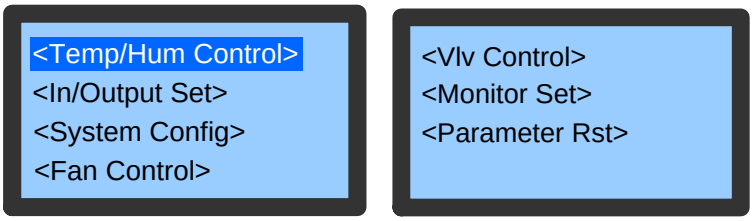


Figure 3-11 System Settings

➢ **Help Menu**

Select the Help Menu from the Main Menu screen to enter the Help screen as shown in Figure 3-12.

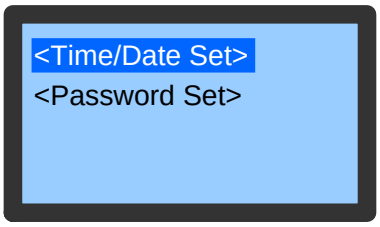


Figure 3-12 Help Menu

➢ **Display Set**

Select the Display Set option in the Main Menu to see the various display settings in the controller menu.

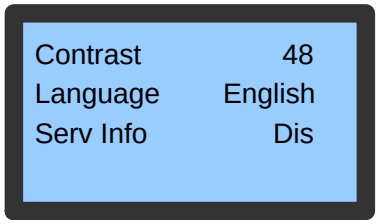


Figure 3-13 Display Settings

3.2 Teamwork

Master unit will share teamwork parameters, temperature and humidity set point, air pressure set point, temperature difference set point, teamwork air pressure, fan control mode, water valve control mode, temperature and humidity dead band, humidity proportional band, temperature proportional band, algorithm and teamwork control parameters to the slave unit. Slave unit upload air pressure measurements, air pressure weight, forced cooling signs, high temperature alarm signs, serious alarm signs, independent operation signs and humidity control failure signs to the master unit.

3.2.1 Main and standby functions

1) The usual condition of standby unit is the fan off (other parts associated with the fan are also closed).
2) The main unit will look for openable units in the available units.
3) When a working unit occurs the one of the following situations, such as offline, shutdown, serious alarm, forced cooling, independent operation, a standby unit will start to operate. Among them, Shutdown and the “serious alarms” will cause the unit to go into standby. The “secondary alarms” will remove the unit from the “running unit” number, but will continue to operate.

Serious alarms: Power failure, Loss of air flow, Fan check board fault, Fan fault alarm, Floor water overflow alarm (setting shut down).

Secondary alarms: Offline, Forced cooling, high temperature alarm, independent operation.

When the active/standby switchover is performed, the running unit will enter the standby state.

Rotation functions

Mode: Teamwork

Unit Quantity: 10

Standby Unit: 3

Rotation Units: 2

Rotation Frequency: Wednesday

Rotation Time: 10:00

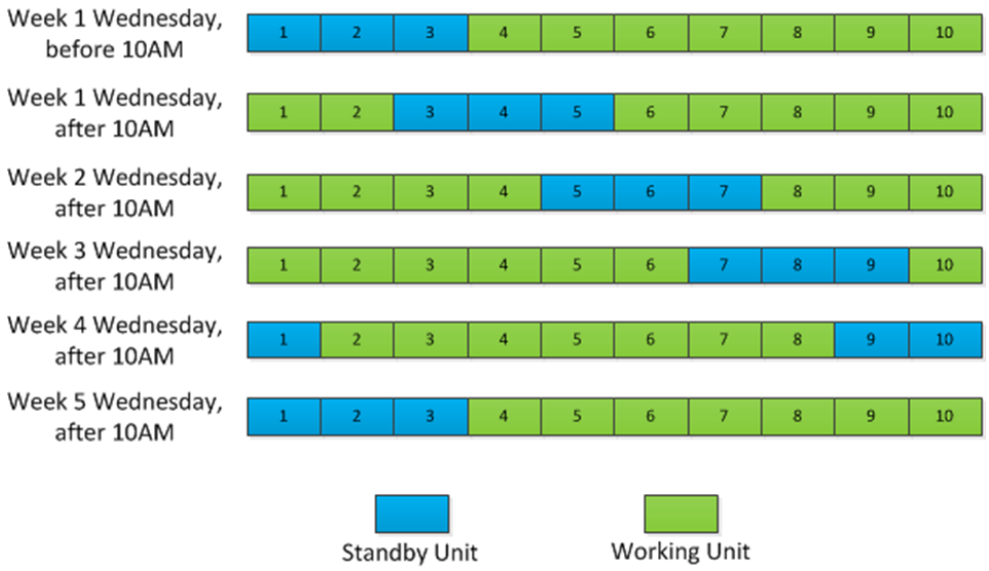


Figure 3-14

3.2.2 Wiring connection:

The Liebert CRV+CW units can achieve teamwork via CAN bus connection.

1. Connect all units as given in the below diagram; connect each CANH and each CANL terminals with CAN bus cables. Terminal CANH and CANL in TB is connected to J20 on the PACC. The Max total distance is 150m.

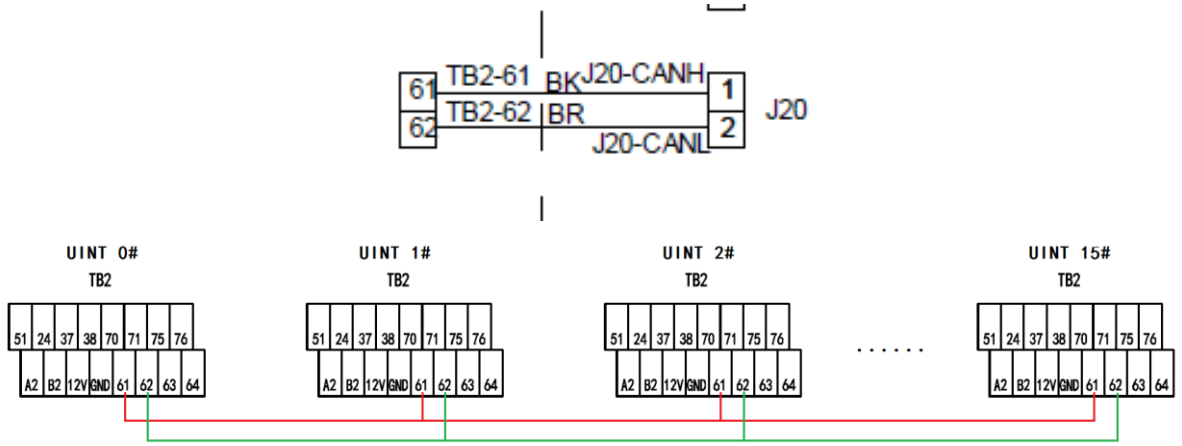


Figure 3-15 The CAN Connection between J20 and TB terminal block

2. For the first and last units among the networking units, short circuit pin 1 and pin 2 of J27 with a jumper cap as below diagram. If there are only two units, short circuit with jumper cap the pins of both units.

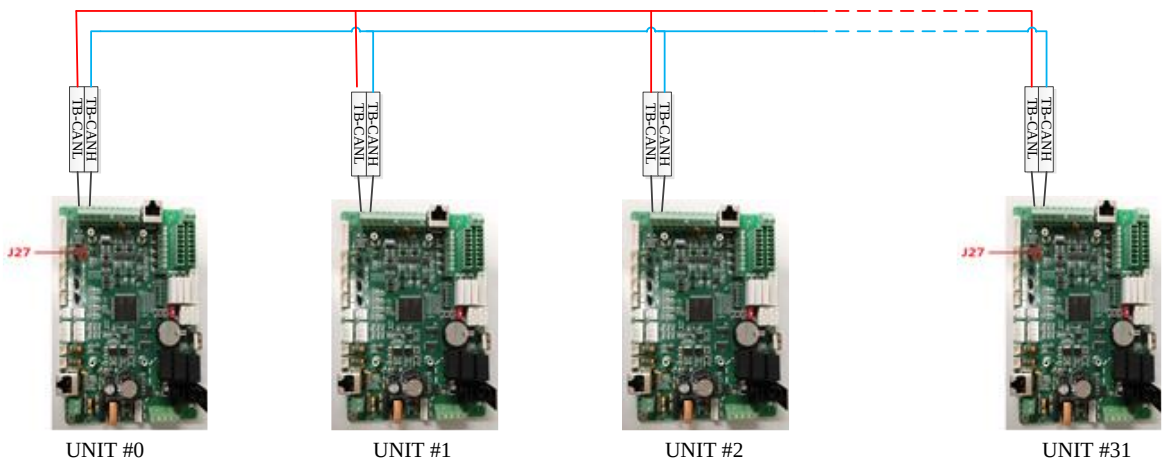


Figure 3-16 TBCANH/TBACNL Connection

3.2.3 Parameter setting:

Teamwork Parameter List

Menu	Parameter Name	Default	Range
Teamwork Settings	Mode	Single	Single/Team
	Share Para	No	No/Yes
	Unit Addr	0	0~15
	Units Qty	1	1~16
	Stdby Qty	0	0 ~ (Units Qty -1)
	Rotate Qty	0	0~min (Working Qty, Standby Qty)
	Rot Freq	None	None/Daily/MON/TUE/WED/THU/FRI/SAT/SUN
	Rotate At	12：00	00：00~23：00
	M-Rotate	No	No/Yes

Unit with teamwork address 0 is defined as the master unit. Units with non-zero address are defined as the slave units. Teamwork parameters only can be set in master unit, and share to the slave units. Teamwork address is setting by dialing code SW3 on the PACC. The dialing code will set as the following:

Teamwork Addr Set	Dial code ON-"0" OFF-"1"							
	8	7	6	5	4	3	2	1
0	0	0	0	0	0	0	0	0
1	0	0	0	0	0	0	0	1
2	0	0	0	0	0	0	1	0
15	0	0	0	1	1	1	1	1

Select **Team Control** from the **System Set,** the following menus appear:

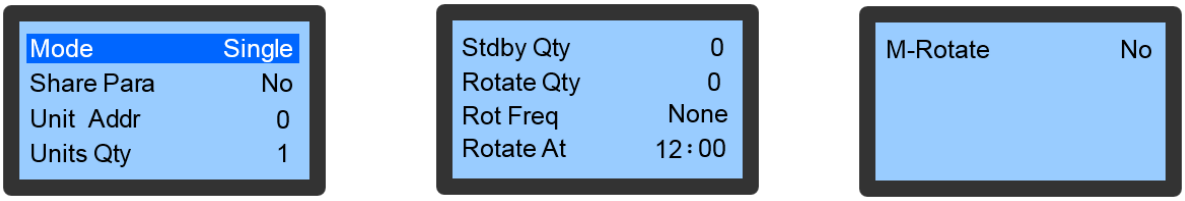


Figure 3-17 Teamwork control menu

- **Mode:** Selections are Single or Team.

- **Share Para:** When select “Yes”, Mater unit shares some parameters as Hign and Low temperature alarm setpoint, High and Low humidity alarm setpoint and so on. When mater unit modify the team parameter, the parameter of slave unit will change at the same time.
- **Unit Addr:** Range is 0~15 Master unit is 0; others are 1, 2, 3..., etc. Teamwork address must be consecutive. Example: There are 8 units in teamwork, thus teamwork address must be 0, 1, 2, 3, 4, 5, 6, 7.
- **Units Qty:** Range is 1~16. Example: There are 8 units in teamwork, thus set as 8.
- **Stdby Qty:** Range is 0~ (Unit Qty-1). Example: There are 8 units in teamwork, thus standby quantity can be any of from 0 to 7.
- **Rotate Qty:** Defines number of unit rotate at each rotation. This parameter is effective only when Rotation Freq is other than None and Rotation Qty is non-zero. Example: Unit Qty is 8. Standby Qty is 1. Rotation Qty is 1. Operation units are 0 to 6. At the time of rotation, operation unit changes to 1 to 7. Rotation Qty cannot exceed the minimun number of “Running Qty” and “Stdby Qty”.
- **Rot Freq:** Defines for how many days (or which day) rotation occurs. Select None to disable rotation function.
- **Rotate At:** The time when rotation occurs.
- **M-Rotate:** During teamwork debugging, each manual rotation will execute a regular rotation with rotation quantity of one.

3.3 General Maintenance

This chapter deals with the system operation and maintenance of the Liebert CRV+ range of air conditioners. It includes the maintenance of electrical parts and connections, refrigerant system maintenance guidelines, routine monthly and bi-annual checklists, and drainage system maintenance among others. It also discusses the basic troubleshooting which can be understood from a user perspective.

Prior to operation and maintenance, voltage may be present in the equipment which can be fatal. All notes, warnings, and cautionary warnings marked on the equipment as well as the ones mentioned in the manual must be considered, otherwise, it may lead to injury and fatality.

Disconnect local and remote power supplies before operating or working with the equipment.

Only qualified personnel are to operate and handle the equipment. Careful and cautionary measures are conveyed to the professional personnel and therefore, only those personnel may perform maintenance on these machines.

Check the label of the components of the unit as well as the manual to ensure all aspects are taken into account before operation and maintenance.

Follow all the local codes, protocols, and regulations prior to maintenance.
Read all the instructions to verify that all the parts are included and check the nameplate to ensure that the voltage matches the available utility power.

3.3.1 Routine Maintenance & Inspection (Monthly)

Following is the monthly routine maintenance and inspection list for CRV+ CW:

Table 3.5

Parts	Inspection Items	Remark
Filters	Check for clogging or damage in filters	
	Clean the filters	
Fan	Fan blades are not distorted	
Chilled water system	Check the temperature of inlet and outlet chilled water	
	Check if the condensed water pan is dirty or clogged	
Humidifier system	Check if the water pan and drainage pipes are clogged	

3.3.2 Routine Maintenance & Inspection (Half-Yearly)

Following is the bi-annual routine maintenance and inspection list for CRV+ CW:

Table 3.6

Parts	Inspection Items	Remark
Fan	Fan blades are not distorted	
	Check and fasten the circuit connections	
Chilled water system	Clean the piping system	
	Check the electrical ball valve functions	
	Check if the water system has leakages	
	Check the chilled water pipes, and the pipes must have bracket and should not be close to the wall, floor or fixing frames and other vibrating sources	
Electrical control parts	Check and fasten the circuit connections (breakers, contactors, cables etc.)	
Heating system	Check the re-heater operation	
	Check the corrosion situation of the components	

3.3.3 Self Diagnosis function

The micro-controller features a diagnostic function that enables to turn on/off the components in the site manually to check their functionality.

3.3.4 Electrical Connection Inspection

➢ Electrical Maintenance

Inspect and check the appearance of the electrical connections and take actions as per the mentioned procedures:

- Conduct an overall electrical insulation test.
- Check whether all the cables are properly connected. Disconnect the fuses or MCBs of the control part during the test lest the high voltage damage the control components.
- Check the contactors before turning on the power and ensure that they can act freely without obstruction.
- Clean the electrical and control elements of dust with brush or dry compressed air.
- Check the closing of the contactors for arcs and signs of burning. Replace the contactors if necessary.
- Fasten all the electric connection terminals.
- Check if the sockets and plugs are in prime condition. Replace those which are loosened.

- If the power cables are damaged, replace the cables with the help of qualified technicians or professionals.

➢ **Control & Maintenance**

Carry out the visual inspection and simple function test by referring to the following procedures:

- Visually inspect the power transformers and isolation transformers, and test the output voltage.
- Check for signs of ageing on the control interface board, control board, temperature and humidity sensor board, and fuse board.
- Clean the electric control elements and the control board of dust and dirt with brush and electronic dust removing agents.
- Check and fasten the I/O ports at the control interface board, including the connection between the control board and control interface board. Also, check the connection between the temperature/humidity sensor board and the interface board.
- Check the connection between the user terminals (70#, 71#, 37#, & #38) and the control interface board.
- Use high-precision temperature and humidity measuring meters to measure and calibrate the temperature and humidity sensors.
- Adjust the setpoints. Check the action of the functional parts and auto-flush control logic of the water pan of the infrared humidifier based on the control logic.
- Simulate and check the operation of the protection devices including the high and low-pressure alarm, high and low temperature alarm, high water- level alarm, and over-temperature precision.

3.3.5 Filter maintenance Guidelines

- The filter in the unit complies with the US ASHRAE52-76 and Eurovent 4/5 standards. The dust resistance value is 90% (EU4 standard). To ensure the normal operation of the filter, the filter service alarm logic is provided by the controller.
- The default fan running time is 2000 hours (can be set based on the local running environment). When this time is exceeded, the filter service alarm is activated and triggered.
- The users need to replace the filter based on the clogging condition of the filter., the filter checking has to be done on a monthly basis and be replaced as per the requirements during operation.

3.3.6 Maintenance Guidelines for the Fan Kit

The periodic inspection of the fan kit includes the motor operation status, fan blade status, fan kit fixation, and clearance between the fan and impeller.

- Check if the fan kit and impeller are fixed correctly and firmly. Ensure that the fan blade doesn't rub against its neighbouring metal components during rotation. In addition, any abnormal block to the ventilation channel will be cleared in time to avoid the influence of the low air flow to the cooling system.
- The CR030 and CR035 fans need main power supply with 48Vac input whereas the CR060 and CR065 fans need 380Vac power supply. The fans exercise the speed regulation based on the 0-10 Vdc analog signal output from the control board. If the EC Fan is in an abnormal state, check the analog signals and the power supply. The fan failure alarm of the control board is serially connected with the alarms of the EC Fan. When the EC Fan speed is abnormal, the unit will generate an EC Fan fault alarm.

- *Risk of electric shock and contact with high speed rotating fans can cause injury or death.*
- *Do not perform maintenance on fan when fan is running.*
- *Do not touch fan during operation of unit.*

3.3.7 General Maintenance for the Electrode Humidifier

➢ Operating Guidelines for the Electrode Humidifier

The Humidifier kit consists of a bracket (including water pressure components such as inlet solenoid valve and outlet solenoid valve), humidifier canister, humidification control board CPY (located in a metal box close to the humidifier), power frequency transformer, high frequency current transformer, contactor, relay, relay socket, water-in pipe, drain pipe, and steam pipe as shown in Figure 3-18.

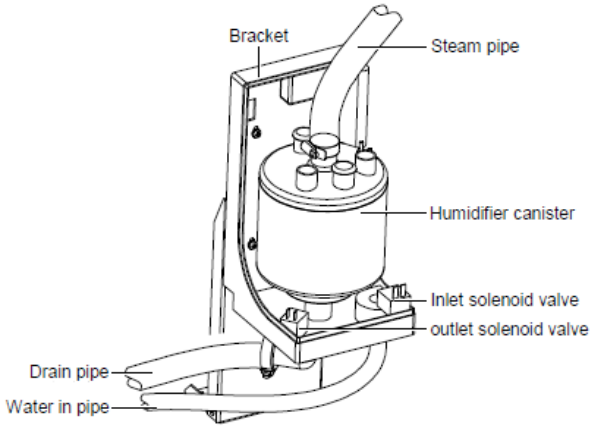


Figure 3-188 Humidifier

The micro-controller calculates if humidification is required based on the humidity and temperature values from the temperature humidity sensor. If a call for humidification is registered, the micro-controller will send a humidification command to the humidification control board and provide 24V power to it. Then the humidification control board will start the humidification process. The Humidification control board adopts on/off operation mode, and controls the humidification operation based on the programmed procedure. The humidification control board is located in a metal box close to the humidifier and its interfaces are shown in Figure 3-19.

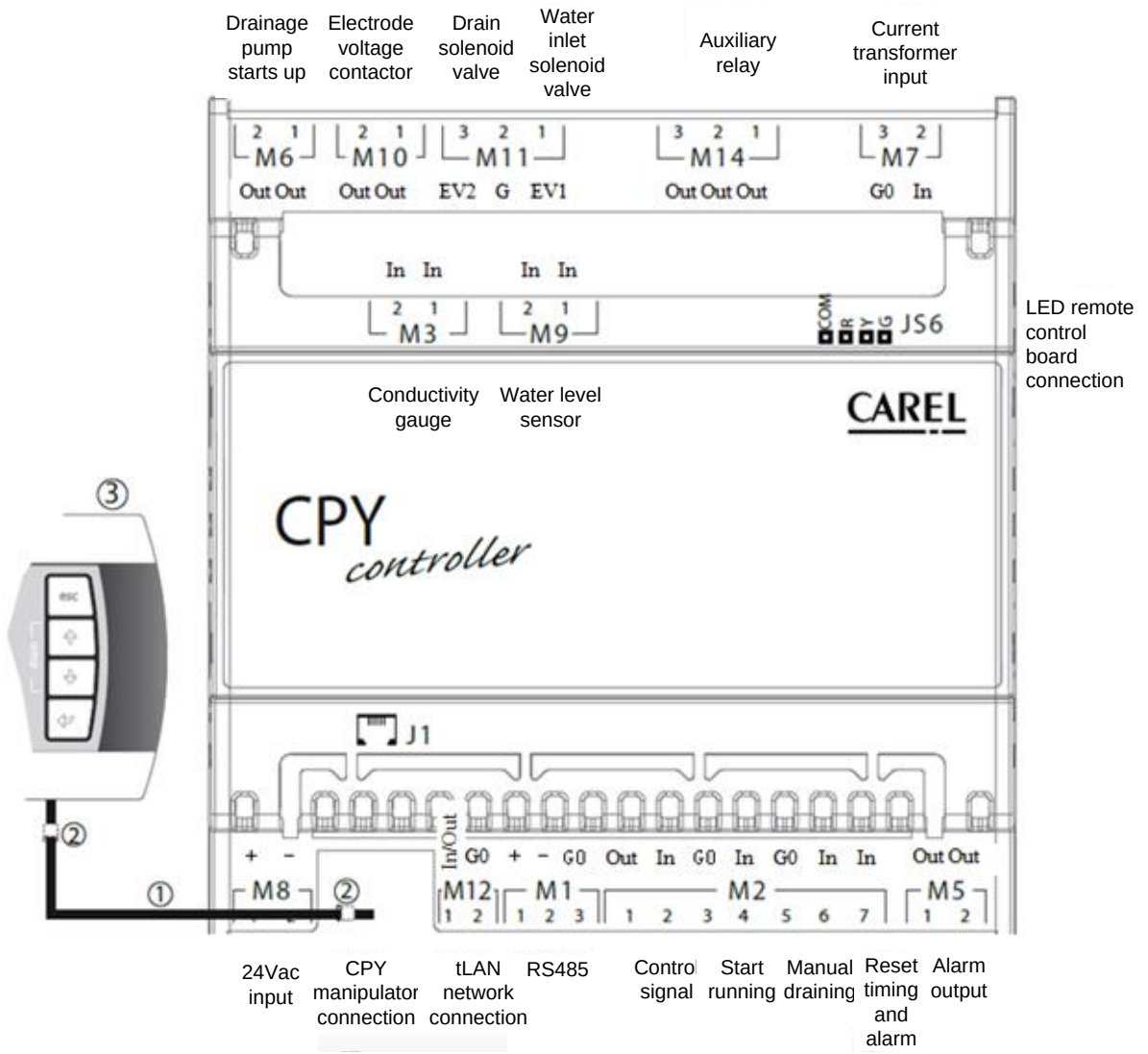


Figure 3-19 Interface of humidification control board

➢ Replacing Humidifier

Due to the sediments in the water drained from the humidifier, the humidifier tray must be cleaned periodically to avoid clogging of the tray and the drainage pipe. The cleaning cycle varies with the water quality, as well as the humidification operation time. Timely cleaning of the humidifier tray must be done every month as per the recommendations of the Vertiv engineers.

As a consumable, the humidifier doesn't require regular cleaning. If the water keeps entering the humidifier or the input voltage of the humidification electrode is normal, but the water fails to boil, It means that the humidifier has reached its service life and needs replacement.

Following are the procedures to replace the humidifier:

1) Place the RUN/DRAIN switch to the DRAIN position to forcefully empty the humidifier.
2) Turn off the humidifier via the circuit breaker
3) Turn off the AC power.
4) Remove the connection cable of the humidification electrode and high-water level probe from the canister.
5) Loosen the steam outlet hose clamps and remove the steam hose from the canister fitting.
6) Remove the canister from the humidifier bracket. Pay attention to protect the O-ring.

Canister and Steam hose may be very hot! Allow the humidifier to cool before replacement.

Reverse the previous steps to re-assemble the humidifier.

1) Protect the O-ring between the sealing canister bottom and the humidifier bracket.
2) Check and ensure that the steam outlet hose is connected without leakage.
3) Connect the power cable correctly. The cable fastening nut is tightened with the torque of 2-3Nm.
4) Restore the humidity setpoint to the original setting

Figure 3-19 Humidifier Tray

3.3.8 Electric Heater Maintenance Guidelines

- If an optional heater has been used, it should be maintained monthly. Ensure that no dust or foreign matter collects on its surface. Also ensure that the heater is fixed correctly and the cable connections are reliable.
- The heater elements will heat continuously in normal condition. Inspect the heater every six months for its normal functioning.
- If there is no heating effect at all when there is a heating requirement, the heater needs to be changed. If the heater needs to be changed, contact the Vertiv Co. maintenance personnel.

3.3.9 Cooling system Maintenance guidelines

- The components of the chilled water system should be inspected monthly for any abnormality and abrasions.
- Inlet and outlet water pipes must be properly fixed and not allowed to vibrate against wall, floor, or the unit frame.
- Inspect all water pipes and fixing brackets every six months for signs of wear and tear.

3.3.10 Drain System Maintenance Guidelines

To ensure the normal drainage, the water pan should be checked regularly to ensure that there are no water scales, alien objects, and leakage in the water pan. For more information contact Vertiv. Co. maintenance personnel.

3.4 Troubleshooting

Troubleshooting is to be performed by trained and qualified service personnel. Checklists have been provided for reference purposes only.

- *Certain circuits carry lethal voltages. Only professional technicians are authorized to maintain the machine. Extreme care and caution is required while troubleshooting online.*
- *If jumpers are used for troubleshooting, remember to remove the jumpers after the troubleshooting failing which the connected jumpers may bypass certain control functions and increase the risk to the equipment.*

3.4.1 Troubleshooting the fan

The fan troubleshooting is described in the following table 3.7.

Table 3.7

Symptom	Potential causes	Items to be examined or handled
Unit fan fail to start	Fan power supply failure	Check if the fan MCB is closed; When the MCB is closed, check if the phase voltage is normal
	Control board failure	Check J15 on the micro processor control board to judge if the control board fails
	Fan power module failure	Check the alarm indicator of the fan power module if the control board fails
	EC fan fault	1. Check if the fans L1, L2 and L3 are power-off, or have phase failure or undervoltage; 2. Check if the analog output is in the range of 0 to 10Vdc; 3. Check if the motor is blocked (over current); 4. Check if the motor is over heat If the issue is #1, #2 or #3, the motor can recover its operation after clearing the fault; If the motor is over heat, power off the fan, and re-power on after the motor cools down.

3.4.2 Heating System Troubleshooting

The heating system troubleshooting is explained in the table 3.8.

Table 3.8

Symptom	Potential causes	Items to be examined or handled
Heating system does not operate, and the contactor does not close	No heating demand	Check the microprcoessor status to confirm if there is a heating demand
	Heating system safety equipment disconnection	Use a multimeter to check the resistance of the temeprature control device, if the resistance is very big, the safety device may be opened. Then check if the fuse is opened and check if the temperature control device is damaged, and use an Ohm-meter to check if the electric heater is damaged by checking the resistance
Contactor closed, no heating effect	Power failure of heater	Check if the heating MCB is closed; When the heating contactor is closed, check if the L1, L2 and L3 voltages of contactor are normal
	Heater burnout	Cut the power, and use an Ohm-meter to check if the electric heater is damaged by checking the resistance

3.4.3 Cooling System Troubleshooting

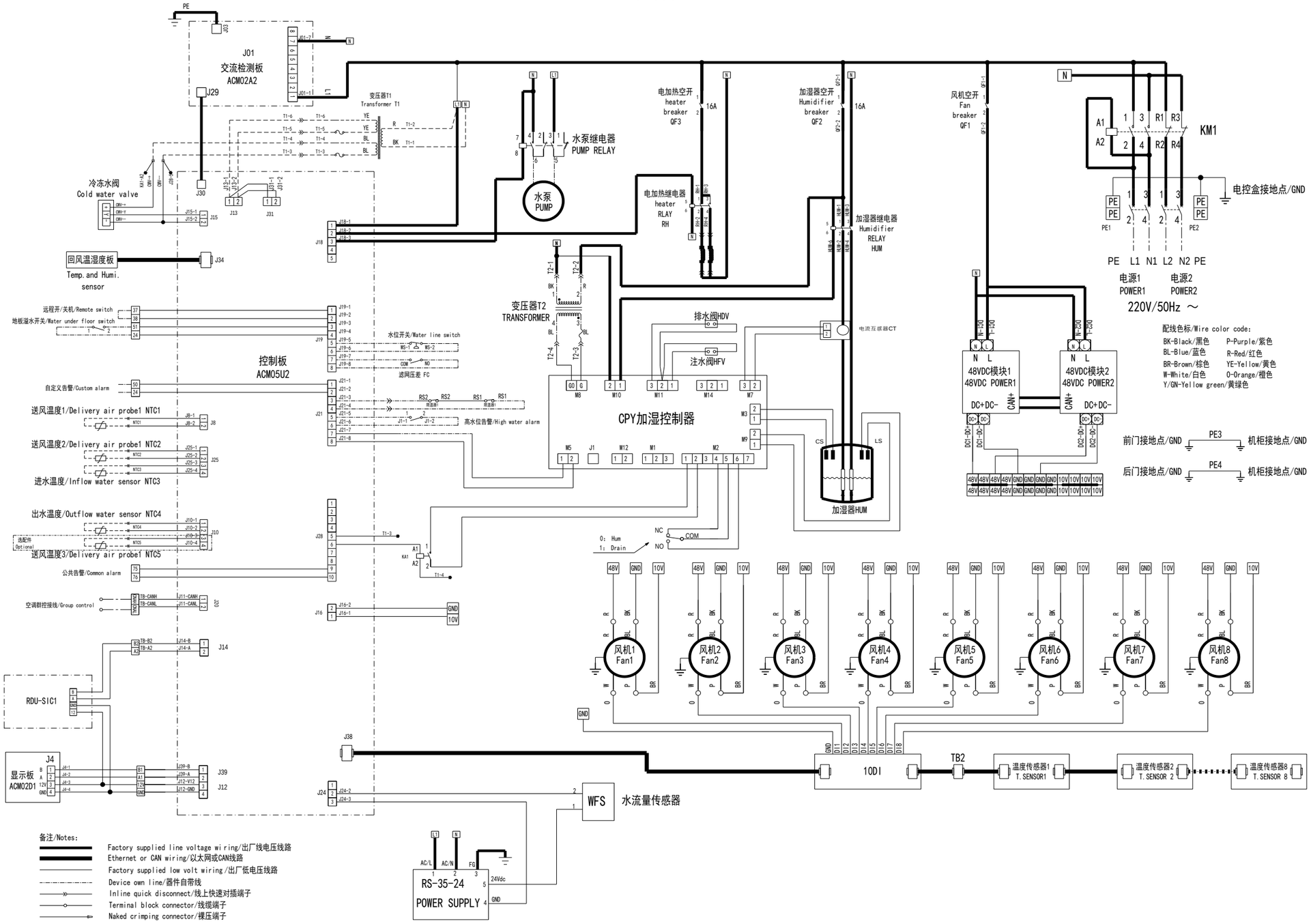
The cooling system troubleshooting is explained in the table 3.9.

Table 3.9

Symptom	Potential causes	Items to be examined or handled
No cooling or dehumidification	Control panel failure	Examine whether there is 24V AC voltage between water valve 24V terminal and COM terminal. If there is not, then the control panel has failures
	Failure to turn on the water valve	Examine whether there is 0 to 10V DC voltage between water valve J15-1 and J15-2 terminal. If there is, then the water valve has failures. Please replace the water valve

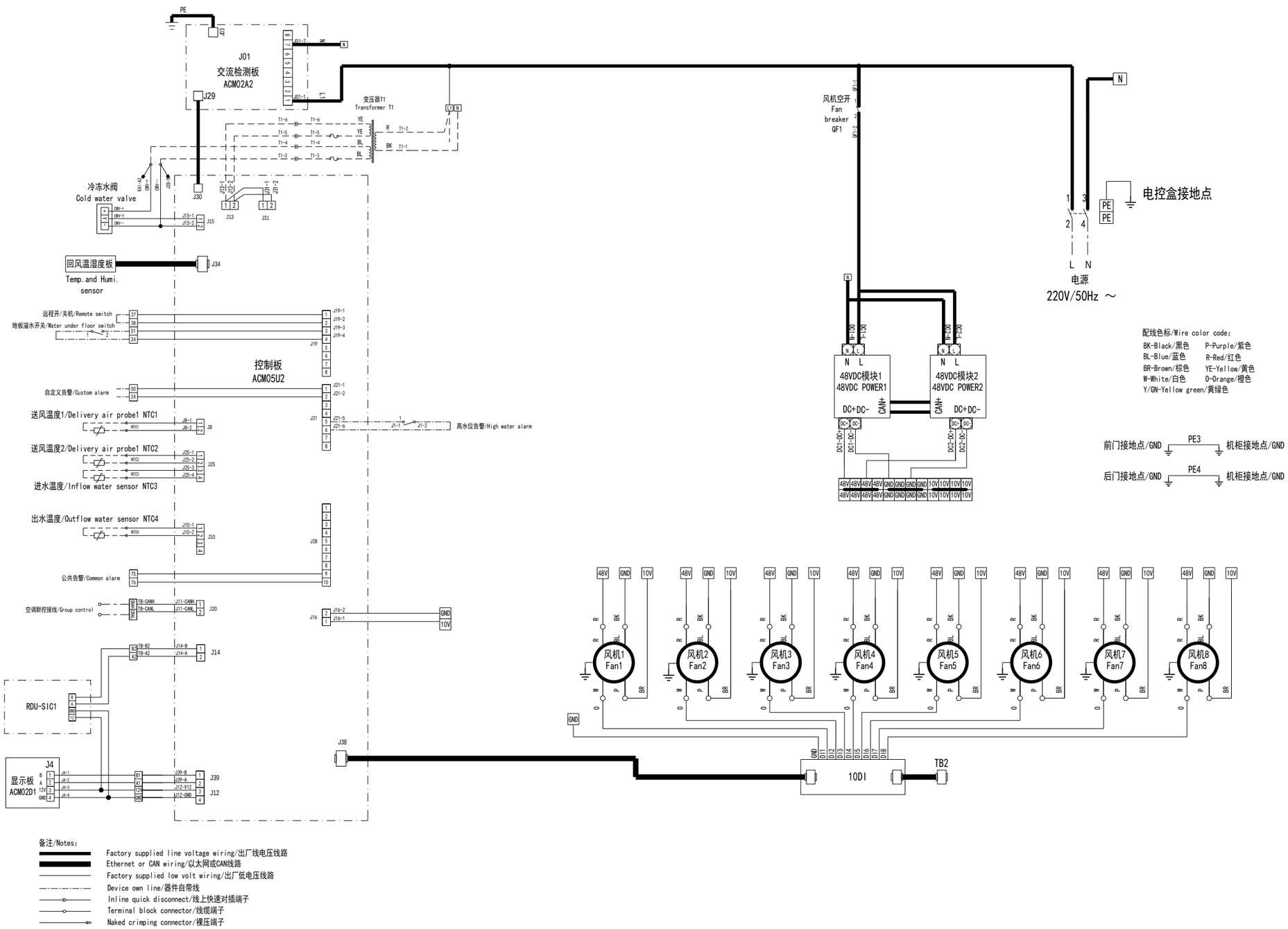
Appendix 1 Circuit Diagram for CR030

CR030

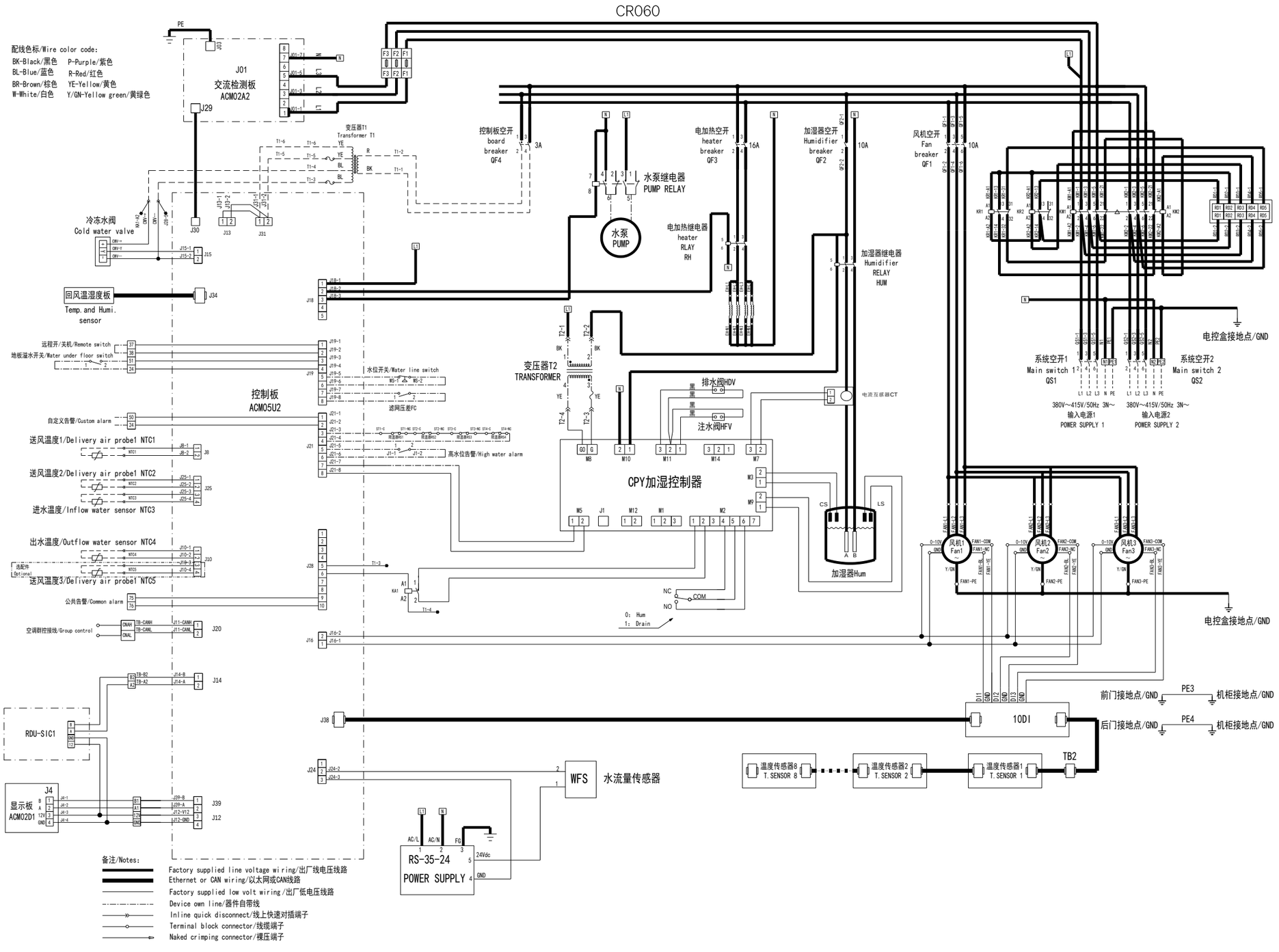


Appendix 2 Circuit Diagram for CR035

CR035

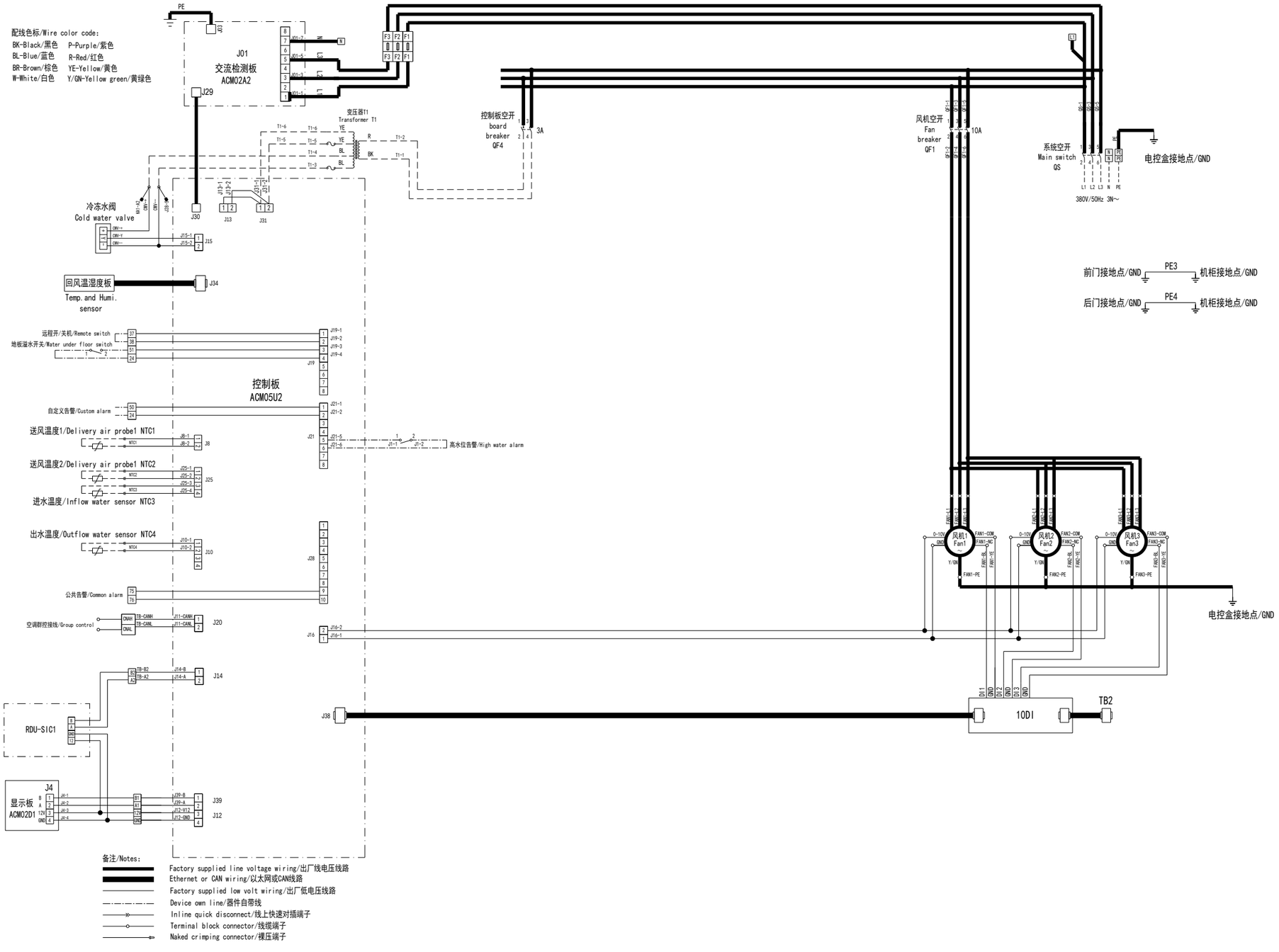


Appendix 3 Circuit Diagram for CR060

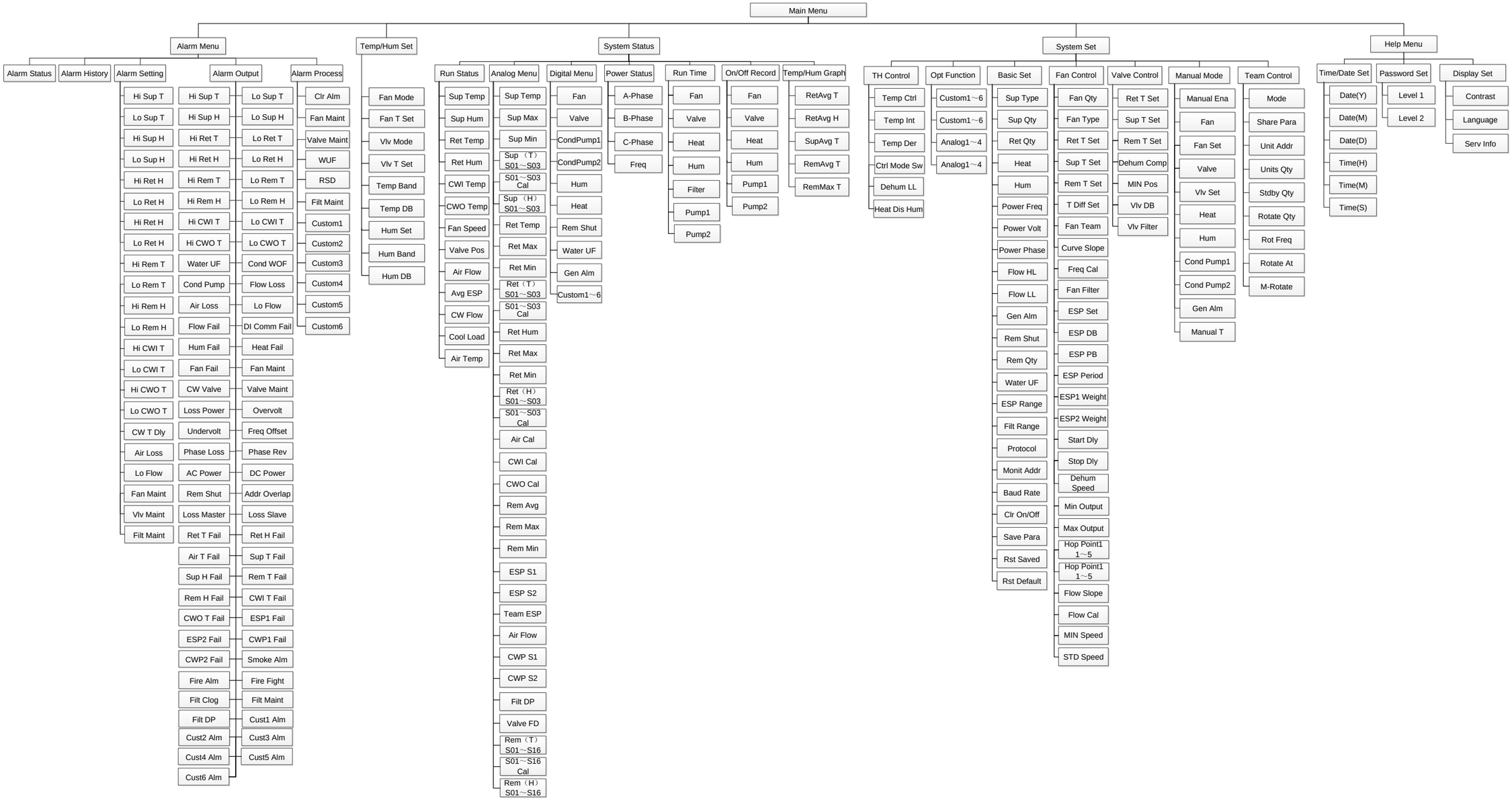


Appendix 4 Circuit Diagram for CR065

CR065



Appendix 5 Menu Structure



Appendix 6 - Alarms

Alarm list			
Remote Shutdown	Filter Maintenance	Incoming Water High Temp.	Water Press. 2 Fault
Flood on Floor	Self Defined 1 Alarm	Hum. Fault	Water Flow Fault
High Water Level Alarm	Self Defined 2 Alarm	Air Return Temp. Fault	Power Loss
Hum. Alarm	Air Return High Hum.	Air Supply Fault	Power Over-volt
Electric Heater Alarm	Air Return Low Hum.	Remote Fault	Power Under-volt
Fan Alarm	Air Return High Temp.	Air Flow NTC Fault	Power Freq. Bias
Pump Alarm	Air Return Low Temp.	Incoming Water NTC Fault	Phase Loss
Smoke Alarm	Air Supply High Temp.	Drain NTC Fault	Phase Reverse
Water Flow Loss	Air Supply Low Temp.	Air Press. 1 Fault	Repetitive Address
Air Flow Loss	Remote High Temp.	Air Press. 2 Fault	Master Loss
Filter Clogged	Remote Low Temp.	Water Press. 1 Fault	Slave Loss

Appendix 7 - Hazardous Substances or Elements Announcement

Parts	Hazardous Substances					
	Plumbum	Hydrargyrum	Cadmium	Chrome^{6+}	PBB	PBDE
	Pb	Hg	Cd	Cr^{6+}	PBB	PBDE
Cabinet	○	○	○	○	○	○
Cooling part	○	○	○	○	○	○
Fan unit	○	○	○	○	○	○
Heater unit	○	○	○	○	○	○
Electric control unit	○	○	○	○	○	○
LCD	×	○	○	○	○	○
PCBA	×	○	○	○	○	○
Heat exchanger	○	○	○	○	○	○
Copper pipe	○	○	○	○	○	○
Cables	○	○	○	○	○	○
○: Means the content of the hazardous substances in all the average quality materials of the part is within the limits specified in SJ/T-11363-2006; ×: Means the content of the hazardous substances in at least one of the average quality materials of the part is outside the limits specified in SJ/T11363-2006						
Vertiv Co., Ltd. has been committed to the design and manufacturing of environment-friendly products. It will reduce and eventually eliminate the harzardous substances in the products through unremitting efforts in research. However, limited by the current technical level, the following parts still contain harzardous substances due to the lack of reliable substitute or mature solution: The reason that the above parts contain plumbum: high temperature solders in the products and diode, glass part of resistor (exempted) and electronic ceramic (exempted) contain plumbum.						
About Environment Protection Period: The Environment Protection Period of the product is marked on the product. Under normal working conditions and normal use of the products observing relevant safety precautions, the hazardous substances in the product will not seriously affect the environment, personnel safety or property in the Environment Protection Period starting from the manufacturing date.						
Applicable product: Liebert CRV+ CW series precision air conditioner						