



Liebert CRV+ Precision Air Conditioner

User Manual



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Purpose of the Document

This document applies to the Liebert CRV+ series of precision air conditioners and cooling solutions which maintain an optimal environmental control mainly for testing laboratories, data center rooms and similar technological ecosystems at minimal operating costs. This document explains the product description, installation measures, operational workflow, maintenance, and detailed aspects from the user perspective. The figures used in this document are for reference only.

Please read this manual carefully before installing, maintaining, and troubleshooting, especially the warning information in the manual

Styling used in this Guide

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

Situation	Description
<p>Warning/Danger/Caution</p> 	<p>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.</p>
<p>Note</p> 	<p>The Note section indicates additional and useful information, including tips and tweaks. 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 mainstream stuff also comes under the Note heading helping the users get to grips with the definitions, concepts, and terminologies used in the manual.</p>

Version History

Issue	Revision	Changes
1	V1.0	---

Safety Precautions & Measures

The important safety precautions and measures that should be followed during the installation and maintenance of the Liebert CRV+ models 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 takes into account 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 Guide. Apart from the User Guide, also pay attention to the warning labels on the unit and its components.

This manual is retained for the entire service life of the 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 electrical 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 in order 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 section, take a 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. Another aspect is the presence of small objects in the fans bay which may result in object ejection during the fan start-up and there is a probable risk of being hit by these objects leading to grievous injury as well as causing equipment damage.



The CRV+ unit isolation switch is inside the unit. The line side of this switch contains live high voltage. In order to ensure there is no voltage inside the unit, install and open a remote isolation switch.

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

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

There is a risk of 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 unit and system supply lines are recommended by *Vertiv Co.*

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PART I

GENERAL INFORMATION

Chapter 1 Introduction

The Liebert CRV+ series is the next generation series of air conditioners that provide precise environmental control. The Liebert CRV+ 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+ series utilizes the latest technology, system components, and streamlined manufacturing process.

Liebert CRV+ air conditioners are products that are specifically created and designed for the small-and-medium data centers, computer rooms, and similar ecosystems 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, care should be taken while testing these sensitive products or maintaining a favorable environment for mission critical equipment, as even a slight deviation may lead to inaccurate results. Precision Air Conditioning must not only keep room conditions within a specific range but also must have the precision to react quickly to a drastic change in heat load and prevent wide temperature fluctuations.

The CRV+ air cooled AC unit is packed with features such as high reliability, high sensible heat ratio, and large airflow. The unit is an air-cooled single cooling system and configured with DC Speed Regulation back- inclined centrifugal fan.

Packed with a host of features, it lowers the sound emissions significantly and thereby reduces the noise pollution. It is a top-notch system that adheres to the standard in Precision Air Cooling in terms of energy-efficiency, space requirements, and reliability.

Figure 1-1 shows the appearance of various models in the Liebert CRV+ series:



Figure 1-1 Models in the CRV+ series

1.1 Model Nomenclature

The model nomenclature of the CRV+ air cooled unit is shown in Figure 1-2:

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
C	R	0	2	5	H	A	1	3	8	O	S	O	2	E	1	O	O	O	O	C	V	O	O	O

Bit 1 and Bit 2 Product Model	
CR	Liebert CRV+
Bit 3 ~ Bit 5 Series Name Description	
025	Nominal Capacity
Bit 6 Air Discharge	
R	Horizontal supply with guide grill
H	Horizontal supply without guide grill
Bit 7 System Type	
A	Air cooled
Bit 8 Airflow	
1	EC Fan
Bit 9 Power Supply	
3	380-415V/3 ph/50Hz +N
T	380/3 ph/60Hz +N
Bit 10 System Configuration	
8	R-410A brushless scroll compressor
Bit 11 Humidifier	
O	None
S	Electrode humidifier
Bit 12 Display	
L	Large Display
S	Standard display panel
Bit 13 Heating	
O	None
1	Electrical heater
Bit 14 Filter	
O	G4 with filter clogged switch
2	G4
Bit 15 Coil and value	
E	Standard DX Air Cooled Coiled & Electronic Expansion Valve (EEV)
Bit 16 Cabinet Color	
1	Standard color (Z-7021 black-grey)
Bit 17 High Pressure Option	
O	None
Bit 18 Low Voltage Locking Option	
O	None
Bit 19 Monitor	
O	None
S	SIC Card
Bit 20 Detector	
O	None
Bit 21 Package	
P	Domestic
C	Overseas (sea worthy)
Bit 22 Special Function	
A	None
V	With condensate drain pump
Bit 23~25 Special Identifier for order	
O	None

Figure 1-2 Model Nomenclature

1.2 Basic Performance Parameters

The basic performance parameters of the Liebert CRV+ AC series are given in Table within Listing 1.1.

Listing 1.1

Model	Nominal cooling capacity (kW)	Power (kW)	Heating capacity (kW)	Humidification capacity (kg/h)
CR012	13.6	3.3	2	/
CR025	20.8	6.1	3	1.5
CR035	38.1	10.1	5.5	1.5

Condition: Return air 37°C, 24%RH & 45°C condensing temperature

1.3 Product Description

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

Figure 1-3 shows the various components and their respective locations:

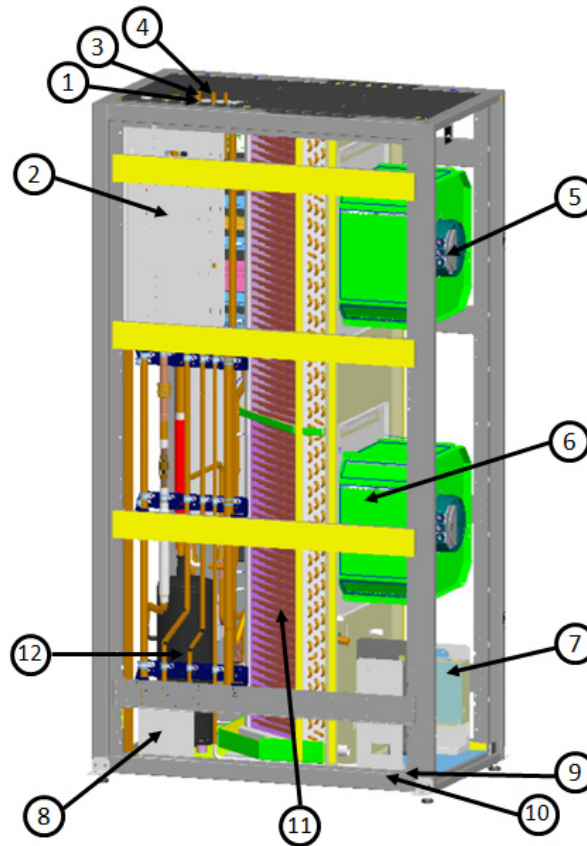


Figure 1-3 Components and their locations

Listing 1.2

Item	Description	Item	Description
1	Top electrical entrance	7	Humidifier
2	Electric box	8	Condensate pump
3	Top humidifier water supply condesate-pump drain	9	Bottom electrical entrance
4	Supply and Return	10	Bottom condensate-pump drain
5	EC plug fans	11	Evaporator Coil
6	Electric heaters	12	Compressor
Model		Dimensions (W x D x H)(mm)	
CR012HA1380S02E10000PV000		300 x 1100 x 2000	
CR012RA1380S12E10000PV000			
CR025HA1380S02E10000PV000		300 x 1100 x 2000	
CR025RA138SS12E10000PV000			
CR035HA1380S02E10000PV000		600 x 1100 x 2000	
CR035RA138SS12E10000PV000			

In the following sections, take a look at the list of components used in the Liebert CRV+ Precision Air conditioning series.

1.3.1 DC Brushless Compressor

The Liebert CRV+ series models comprise of a DC Brushless compressor which has a host of promising features as mentioned in the following list:

- Low operational noise
- Rapid Cooling
- Less Vibration

Moreover, there are no brushes compared to typical DC motors. Its compactness, reliability, longer life time, and better capacity control combined with streamlined energy-efficiency make it an ideal compressor to bank on for the CRV+ series.

Figure 1-4 shows the image of a DC brushless compressor:



Figure 1-4 DC Brushless compressor

1.3.2 Fan

The EC Fans used in the Liebert CRV+ 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:

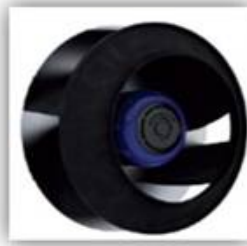


Figure 1-5 EC Fans

1.3.3 Evaporator

The sophisticated design of the distributor ensures that the refrigerant is distributed evenly in each loop, thereby improving the effectiveness of the heat exchanger.

- Streamlined Heat exchanger design and air distribution for optimum performance
- Fin-tube heat exchanger for higher efficiency

Figure 1-6 shows the image of an Evaporator:



Figure 1-6 Evaporator

1.3.4 Electronic Expansion Valve (EEV)

The EEV is designed for modulating control of the refrigerant mass flow with precision. The EEV collects temperature and pressure signals at the same time to accurately regulate the refrigerant flow. The EEV's wide operating envelope also lowers down the condensing pressure, thereby resulting in significant energy savings.

- Designed for modulating control of the refrigerant mass flow with precision
- Ensures effective control on super-heating at the end of the evaporator
- Better low load capacity
- Designed for easy Installation-and-Service

Figure 1-7 depicts the image for the EEV used in the CRV+ Series:



Figure 1-7 EEV

1.3.5 Electrode Humidifier

The Electrode humidifier helps to maintain constant humidity in test chambers and is quite efficient in small-and medium-load applications.

Figure 1-8 depicts the image of an Electrode Humidifier:



Figure 1-8 Electrode Humidifier

1.3.6 Electric Heater

In the CRV+ models, the PTC heaters are used as they have lower running temperatures, thereby ensuring operational safety.

- Less susceptible to overheating and long lasting due to less wear
- Lower Maintenance and Smooth operation

Figure 1-9 shows an image of the Electric Heater:



Figure 1-9 PTC heater

1.3.7 Sight Glass

The sight glass is a utility for observing the refrigerant state; specifically the moisture content of the system. If the moisture content exceeds the levels of defined standards, the color changes, thereby, indicating irregularity in the moisture content.

1.3.8 Filter Drier

Moisture can adversely affect the operations and service life of a system in the refrigeration lifecycle. In order to rectify that condition, filter driers are used to filter out particles, remove, and hold moisture to prevent it from circulating through the system.

1.3.9 Micro-Controller

The Micro-Controller used in CRV+ 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 anti - phase and rotate speed control of the outdoor fan
- High-end Fault diagnostic system to facilitate easy equipment maintenance

Figure 1-10 shows the image of the micro-controller:



Figure 1-10 Display panel of the Controller

1.3.10 Condenser

The Liebert range of air condensers offers many advantages, some of which are listed below:

- Sharp and Powerful design
- Antirust aluminum cabinets
- Low sound levels
- High reliability over a wide range of ambient conditions

Figure 1-11 shows the image of the condenser used in the CRV+ series:



Figure 1-11 Condenser

For more information on the condenser, refer to the separate condenser manual which explains the entire condenser ecosystem in detail.

1.4 Optional Equipment

The Liebert CRV+ series is compatible with multiple temperature/humidity sensors based on the requirement.

An interesting development is the compatibility with the Liebert CRV+ series models with the Modbus protocol. Through the configured RS 485 port or TCP/IP port, the CRV+ systems can communicate with the host computer in addition to remotely taking charge of the host software.

1.5 Working Conditions

In this section, take a look at the environmental conditions including the Operating and Storage environment.

1.5.1 Operating Environment

The table in Listing 1.3 defines the Operating environment parameters including the Ambient Temperature, Protection level, Altitude, and Voltage range.

Listing 1.3

Item	Requirement	
Ambient temperature	Indoor	18°C ~ 40°C
	Outdoor	CR012: -15°C ~ +45°C, if a low temperature kit is configured, the lowest outdoor operation temperature is -34°C
		CR025 and CR035: -20°C ~ +45°C, if a low temperature kit is configured, the lowest outdoor operation temperature is -34°C
Protection level (indoor unit)	IP20	
Altitude	< 1000m. Above that, please contact Vertiv Co.	
Operation voltage range	(380 ~ 415)V ± 10%, 3N ~ 50Hz / 60Hz	

1.5.2 Storage Environment

The following table in Listing 1.4 defines the Storage Environment parameters including the ambient humidity, ambient temperature, and storage time conditions.

Listing 1.4

Item	Requirement
Storage environment	Indoor, clean (without dust)
Ambient humidity	< 95%RH
Ambient temperature	-33°C ~ +70°C
Storage time	Total transportation and storage time should not exceed six months. Otherwise, the performance needs to be re-calibrated

1.5.3 Refrigerant Charging Requirement





Another essential aspect is the quality and make of the refrigerant oil. Adding poor quality oil, counterfeit oil, or oil for a different model will damage the system. The quality issue due to the wrong refrigerant oil will result in voiding of the warranty.

Low quality or counterfeit refrigerant will damage the system drastically. Use the refrigerant approved by Vertiv Co., Ltd. to avoid the system abnormality or damage caused by using other brands of refrigerant.

Listing 1.5 depicts the refrigerant brands, which are approved by Vertiv Co. Ltd.

Listing 1.5

Brand	Logo	Note
DU PONT		The DU PONT refrigerant adapts a custom made package
JUHUA		

Part II

INSTALLATION

Chapter 2 Installation

The Installation process consists of the following procedures, namely-

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

2.1 Pre-installation

Pre-installation contains the following 3 sub sections, namely-

- 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+ 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 in the vicinity of 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

In the previous figure (Figure 2-1), the air conditioner is lifted using the forklift truck and is aligned with the center of gravity. While moving the indoor unit, the obliquity has to be maintained with 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:

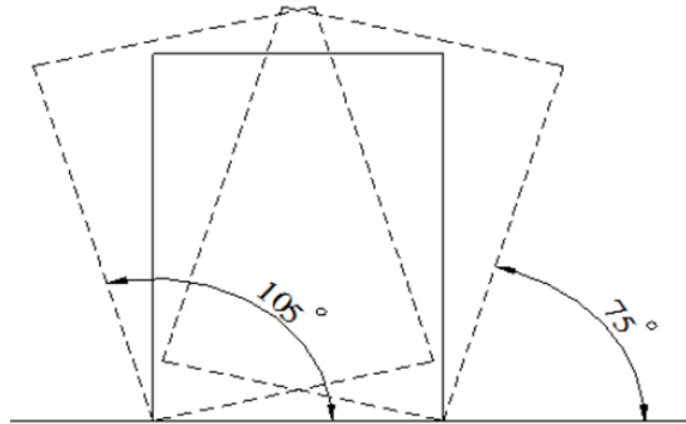


Figure 2-2 Obliquity of the system

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.

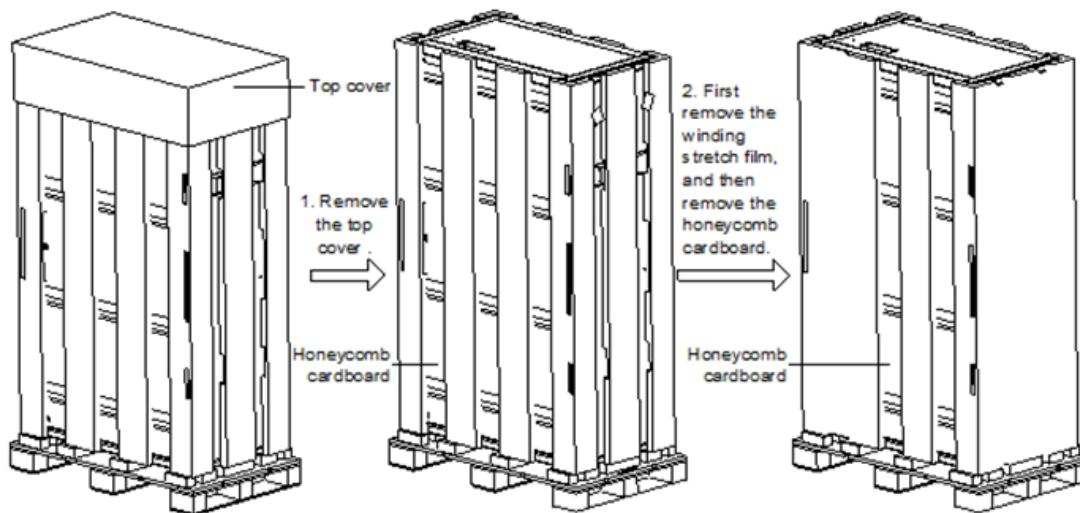


Figure 2-3 Unpacking the outer package

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.

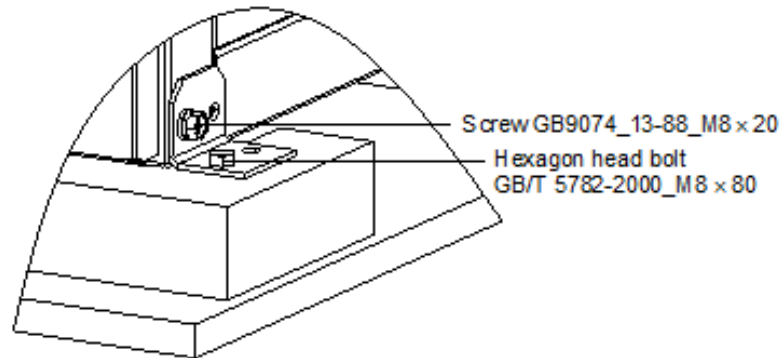


Figure 2-4 Screws on the pallet

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+ series of air conditioners is streamlined for maintaining a favorable environment for data centers, computer rooms, and similar ecosystems. Strict adherence to the installation procedures is mandatory in order 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 at a 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+** 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+ 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 and in a hot aisle and cold aisle arrangement.

Allocate space so that it is accessible for the qualified service personnel for repairs, servicing, and maintenance. For the CRV+ range, maintenance space must be allocated at the front and rear of the equipment.

At the least, a space of 600 mm 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.

The allocated space is to facilitate regular maintenance tasks such as replacement of the filter, blower, and humidifier among others.

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

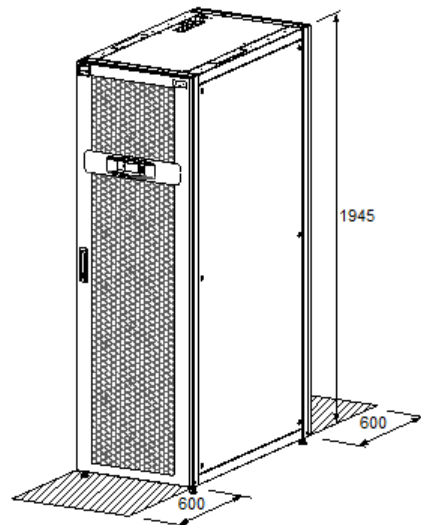


Figure 2-5 CRV+ maintenance space



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

2.2.3 Installation Tools

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

Listing 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	

The tools mentioned in Listing 2.1 are generic and commonplace; however, depending on various factors such as site environment, cables, installation equipment, and on-site electrical connections these tools may vary in a real-time scenario.



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+ 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 taken into account.

- Prior to installation, ensure that the installation procedures have been read and implemented as per the requirement. (Refer to section 2.2 on Installation Preparation for the 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.
- The CRV+ cooling units are designed for split-floor installation. The indoor unit must be installed on the floor of the equipment room or computer room. The outdoor unit must be installed outdoors or on the floor of the other rooms as per the building architecture.
- Industry-wide standards are followed for the selection, layout, and fixing of pipes.
- Several factors such as pressure drop, compressor oil return, noise reduction, and vibration are considered during the design and installation process.
- Follow the design drawings strictly when installing the equipment. Reserve space as per the maintenance and serviceability instructions in the previous chapter on Installation Preparation. The manufacturer's engineering dimension drawings must be taken as a reference while installing the equipment.

2.3.1 System arrangement during installation

The general arrangement of the CRV+ air cooled AC unit is depicted in Figure 2-6.

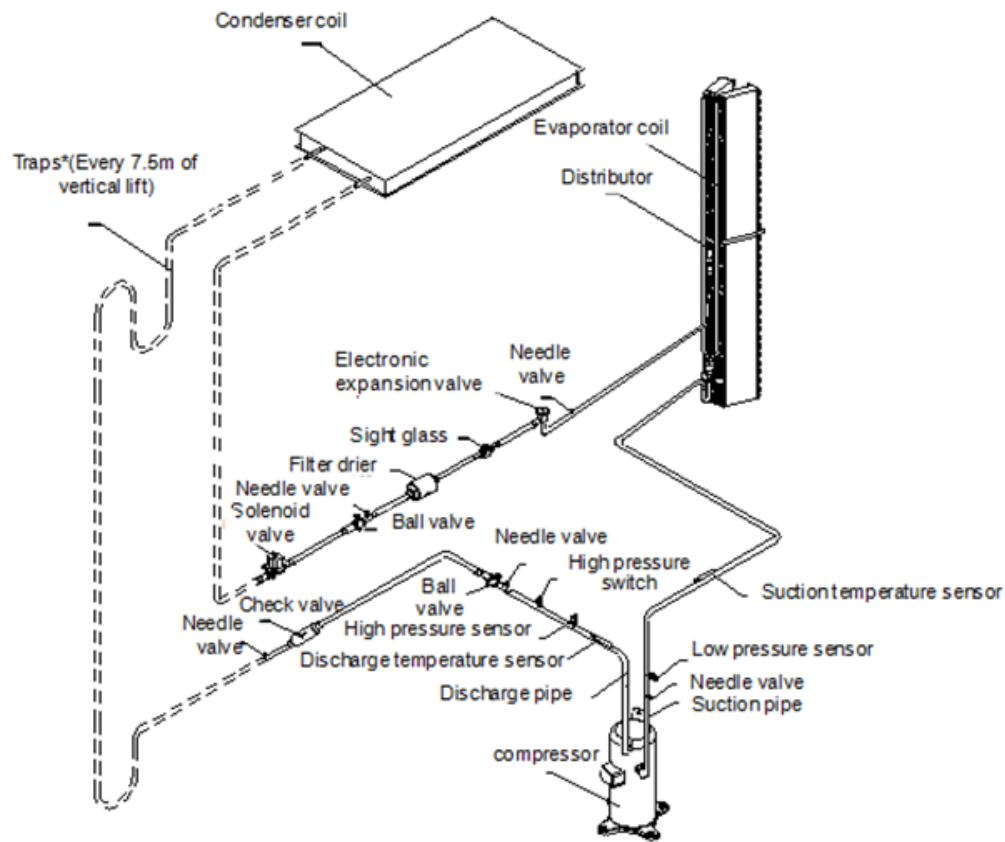


Figure 2-6 System Arrangement

=====: Factory piping.

-----: Field piping (by technical personnel).



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

The single system is used as an example to describe the entire system.

- Vertiv staff and qualified professionals lay out the piping in the laboratory.
- Piping is done by technicians.
- Components (marked with *) are not supplied by Vertiv Co. but are recommended for proper circuit operation and maintenance.
- Additional components (marked with +) are required when the equivalent length exceeds 30m.

2.3.2 System Installation Mode

The system installation schematic diagram explains the process of installation for the Condenser:

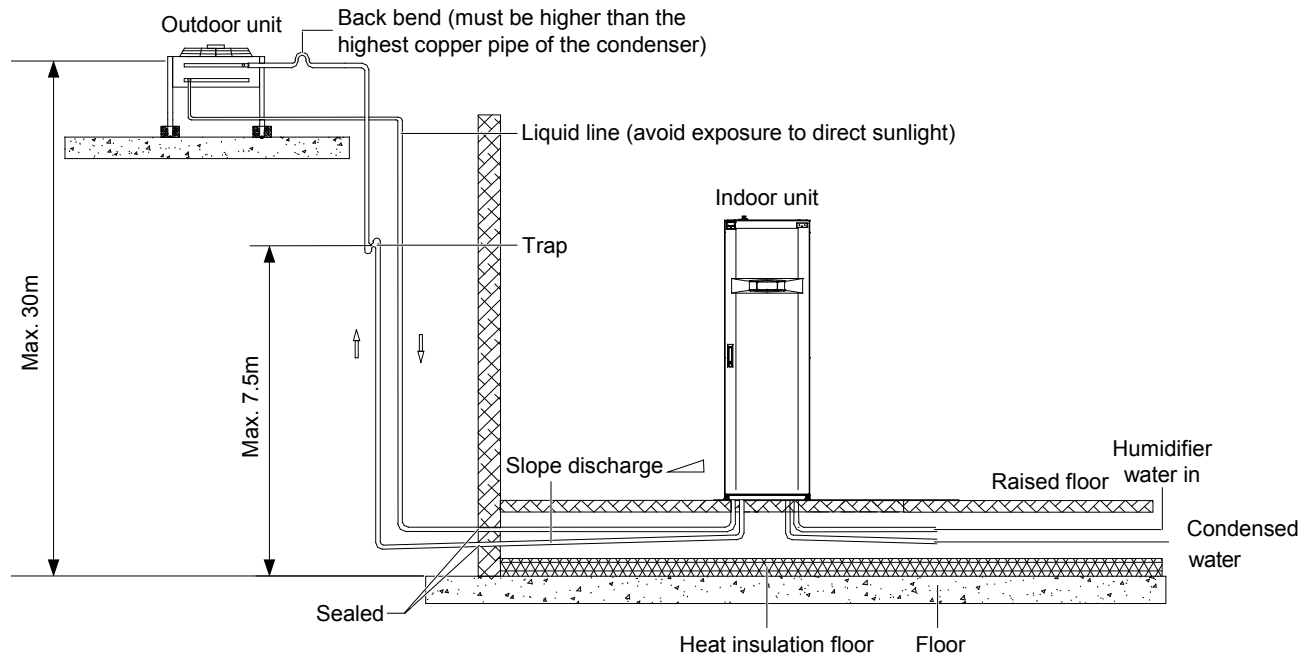


Figure 2-7 Condenser is placed higher than the Compressors during installation

In Figure 2-7, the condenser is installed higher than the compressor. Therefore, an inverted back bend is fitted to the discharge line and the liquid line of the condenser. The modification is essential as it helps prevent the liquid refrigerant from flowing back once the condenser stops. The top end of the inverted backbend must be installed higher than the ultimate level of the copper pipe of the condenser.

However, if the condenser is installed lower than the compressor, then there is no modification required as it fits the bill perfectly.

Figure 2-8 depicts the schematic diagram of system installation when the condenser is installed at a lower level than the compressor.

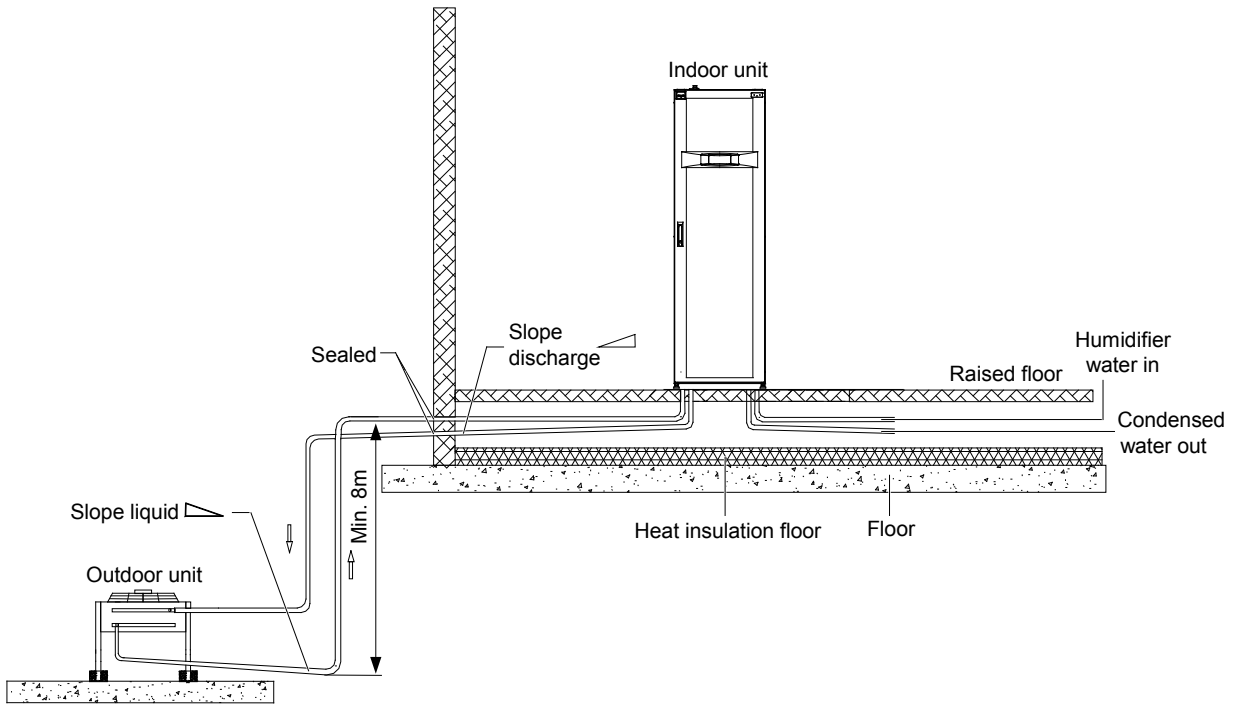


Figure 2-8 The Condenser is lower than the Compressor during installation

2.3.3 Product Dimensions

The dimensions and weight of the indoor unit are displayed in Figure 2-9 and in the table within Listing 2.2.

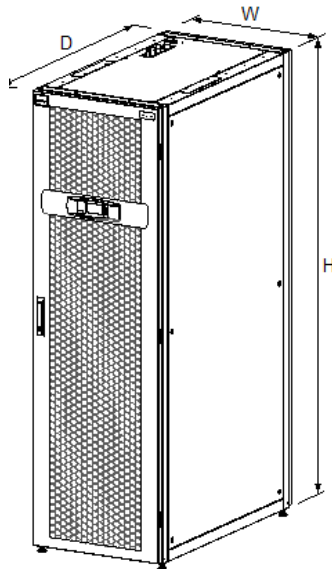


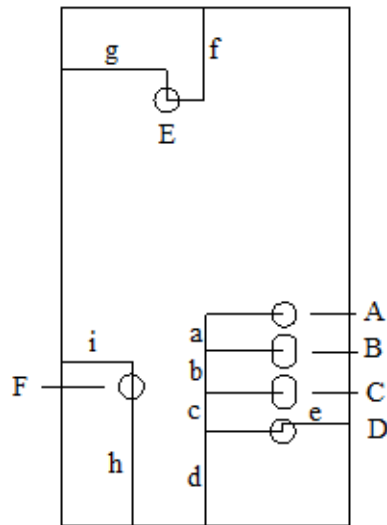
Figure 2-9 Dimensions of an indoor unit

Listing 2.2

Model	Dimensions (W × D × H) (mm)	Net weight (kg)
CR012HA1380S02E10000PV000	300×1100×2000	210
CR012RA1380S12E10000PV000		215
CR025HA1380S02E10000PV000	300 × 1100 × 2000	250
CR025RA138SS12E10000PV000		260
CR035HA1380S02E10000PV000	600 × 1100 × 2000	315
CR035RA138SS12E10000PV000		335

Base Plate pipe outlet Location & Dimensions

The locations of the pipe inlets and outlets on the unit base plate are shown in Figure 2-10:



A: Drainage hole of pump

B: Liquid pipe hole

C: Discharge pipe hole

D: Cable entry hole

E: Inlet hole of humidifier

F: Drainage hole of water tray

Figure 2-10 Base Plate Location for pipe outlets

The following table in Listing 2.3 depicts the dimensions of the base plate pipe outlet:

Listing 2.3

Model	a	b	c	d	e	f	g	h	l
CR012	/	43	44	130	44	/	/	130	205
CR025	72	88	64	131	45	161	135	131	205
CR035	48	62	45	127	49	267	360	171	120

Top plate pipe outlet Locations & Dimensions

The locations of the pipe inlets and outlets on the unit top plate are shown in Figure 2-11:

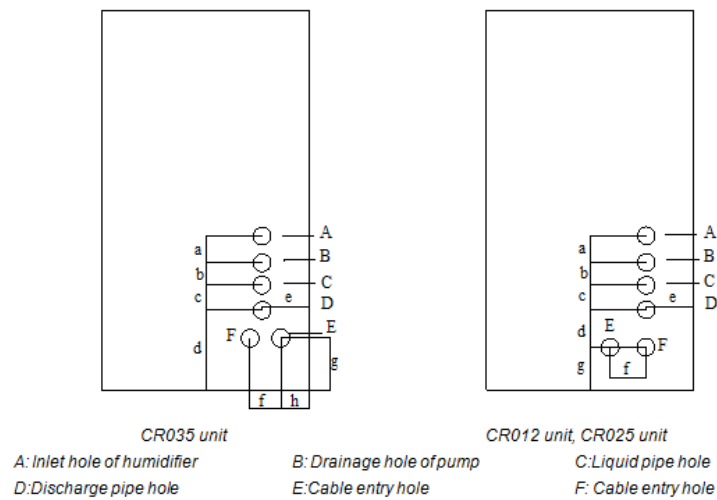


Figure 2-11 Top plate locations for pipe outlets

The following table in Listing 2.4 depicts the dimensions of the top plate pipe outlet:

Listing 2.4

Model	a	b	c	d	e	f	g	h
CR012	/	80	39	125	100	40	106	110
CR025	55	80	39	125	100	40	106	110
CR035	47	38	71	233	137	50	155	118

Front air outlet Locations and Dimensions

The location and dimensions of the air outlet at the front are shown in Figure 2-12:

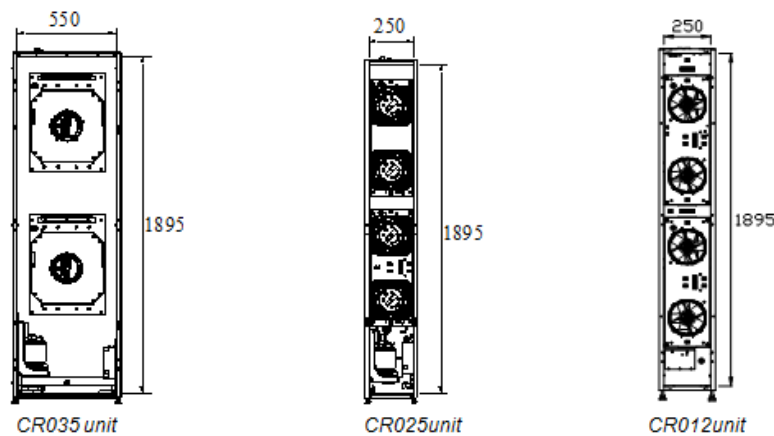


Figure 2-12 Front air outlet locations & dimensions (unit: mm)

To prevent damage of the power cable, the cable entry hole is fitted with brushing for protection.

2.3.4 Installation Procedures

The CRV+ series of air conditioners is used between racks and one side of it is adjacent to the server cabinet. The CRV+ series of Air Conditioners is especially used in small-and medium-range data centers, computer rooms, and similar ecosystems.

Leveling the cabinet

Once all the components of the cabinet have been installed, level the cabinet. The following section is a step-by-step illustration of the process of leveling the cabinet:

- Place the cabinet in the desired location (preferably an open ground). Use a movable wrench to loosen the fixing nuts on the four foot bolts in a clockwise sequence.
- Rotate the hexagon bolts on the bottom of the feet clockwise or counter-clockwise till the feet rises or drops to an appropriate position. Use a gradienter to ensure that the cabinet is in a uniform level state.

Refer to the Figure 2-13 to understand the process better:

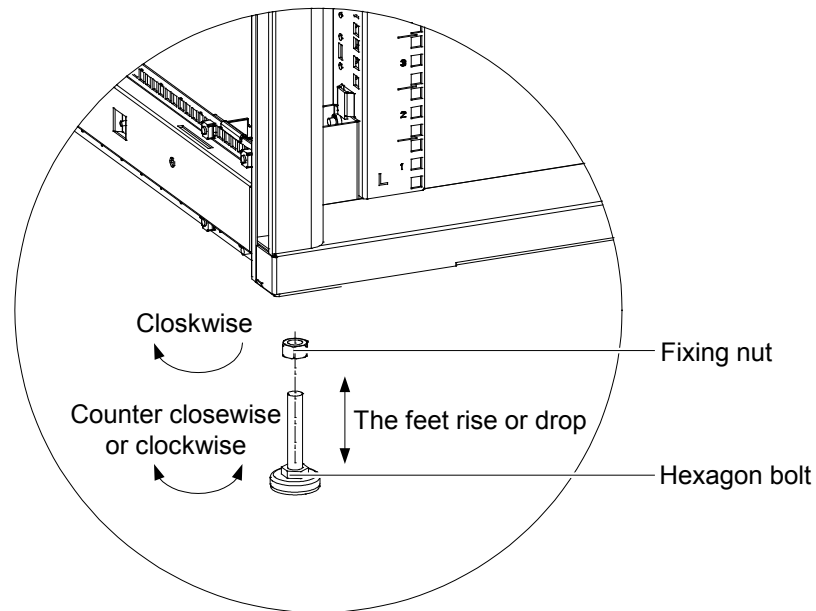


Figure 2-13 Leveling the cabinet

- Screw down the fixing nuts on the feet bolts counter-clockwise and the leveling gets completed. If the machine room has a mounting bracket, and its width does not exceed 30mm, remove the feet and fix the cabinet onto the mounting bracket.

Removing the Feet and Fixing cabinet



Before explaining the task of removing the feet and eventually fixing the cabinet, it is vital that 2 persons 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

- Use a moveable wrench to loosen the fixing nuts on the four feet bolts in a clockwise sequence.
- 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 2-14.

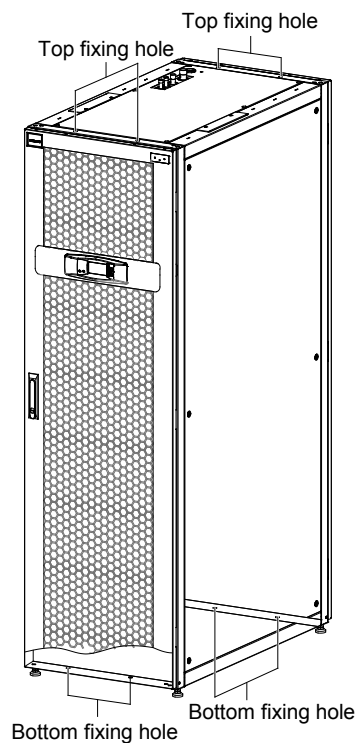


Figure 2-14 Fixing holes of the cabinet

- Install bolts in the four holes at the bottom to fix the cabinet onto the floor bracket of the machine room.
- 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.

Cabinet Connection

The cabinet connectors come along with the accessories. Connect the unit with adjacent cabinets using the cabinet connectors. The following section depicts the procedures for connecting the cabinet:



Before connecting the cabinet, level the cabinet as mentioned in the earlier section (Refer to section [Leveling the cabinet](#) for in-depth information).

- Loosen the fixing screw of the cabinet connector on the frame of the cabinet.
- Rotate the cabinet connector 90 ° to the horizontal position. Use M5 countersunk head screws to fix it on the cabinet frame. (Side of the door lock) as depicted in Figure 2-15.

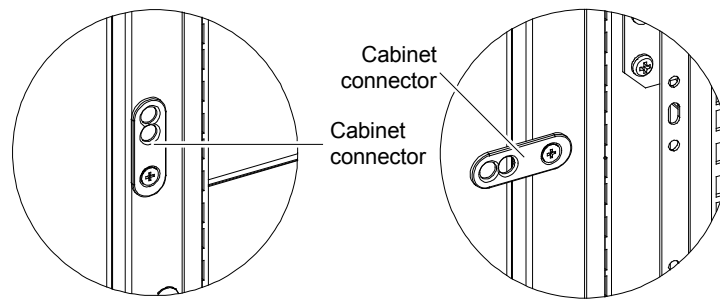


Figure 2-15 Rotating the Cabinet connector

- 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 2-16.

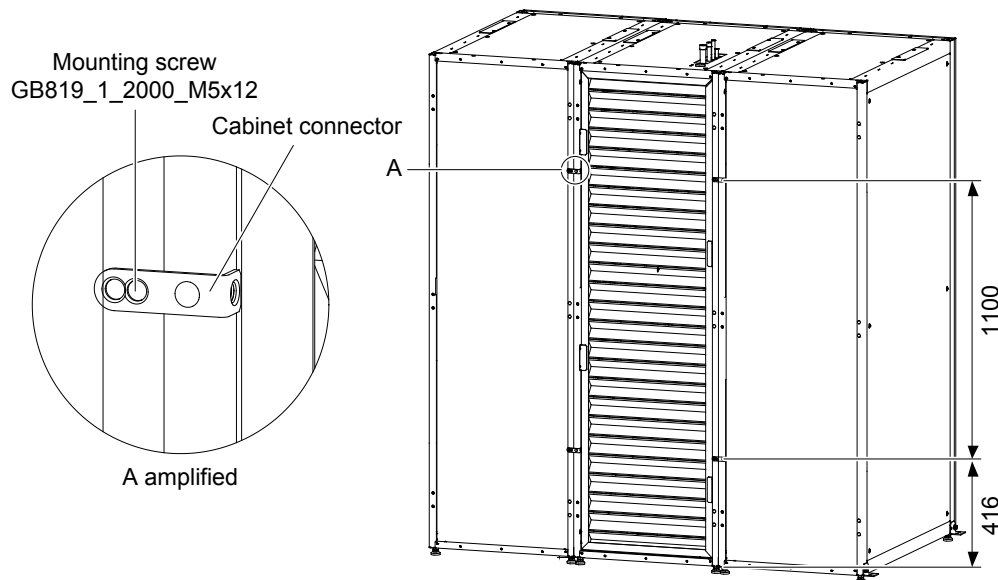


Figure 2-16 Schematic diagram for connecting the cabinet

Install the other 6 cabinet connectors based on the same method.

2.3.5 Piping

The pipes to be included in the Piping process of the AC are listed below:

- Condensed water drainage pipe of the indoor unit;
- Water inlet pipe of the electrode humidifier;
- Connection of the copper pipe (discharge pipe and liquid pipe) between the indoor unit and outdoor unit;
- Pipe extension kit (optional).

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



- *All the joints of the refrigerating pipes must be silver-brazed.*
- *The selection, layout, and fixing of the pipes will conform to the industry standards and norms.*
- *Vacuum pumping and refrigerant charging operations, and procedures must conform to the industry standards.*
- *Pressure drop, compressor oil return, noise return, and vibration must be considered during the designing and installation process.*

Removing 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 flak will be removed, followed by removing the top filter.
- Use the same method to remove the bottom filter.

Figure 2-17 depicts the process of removing the filters:

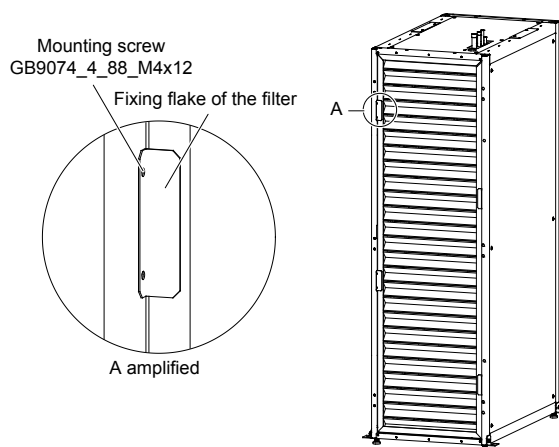


Figure 2-17 Removing the Filters

Connecting the condenser water drainage pipe of the indoor unit

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

- The unit is configured to adopt the top drain mode by default; therefore, connect the drainage pipe of the pump upwards to the top drainage copper pipe.
- Fix the drainage pipe to the drainage pipe connector with the hose clamps available in the shipped accessories. The torque of the hose clamp is 15 kg cm.
- Connect the drainage pipe to the drainage hole on the top of the cabinet.
- To drain water from the bottom, direct the soft drainage pipe through the drainage hole of the pump.
- Fix the pipe to the copper pipe connector with the hose clamp. Moving forward, connect it to the outer drainage pipe.

The outer diameter of the copper pipe is 12.7 mm and internal diameter of the soft pipe is 9 mm.

However, if the unit is not configured with a pump, the drainage pipe of the water tray should go through the drainage hole of the tray and connect to the outer drainage pipe. The Trap is essential to drain the condensate water.

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



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

The trap is mandatory and should be located 30 cm below the water tray. The tray must be kept under the movable floor.

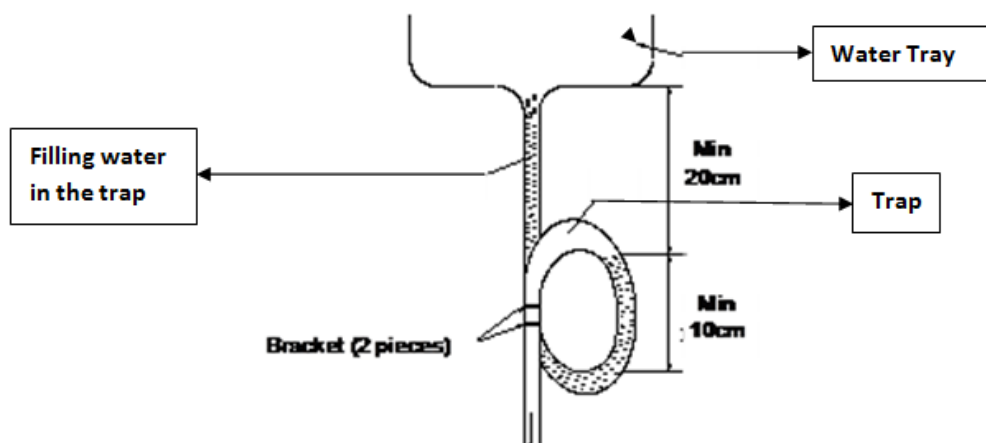


Figure 2-18 Process of draining the Condensate water



- Don't cut off the brackets of the trap lest the smooth draining gets destroyed
- Filling water to the trap before the unit is powered on
- Use a Teflon belt between the flexible pipes and connector to avoid water leakage
- The electrode humidifier contains flowing hot water, thus the plastic pipe must be resistant to heat higher than 90° C

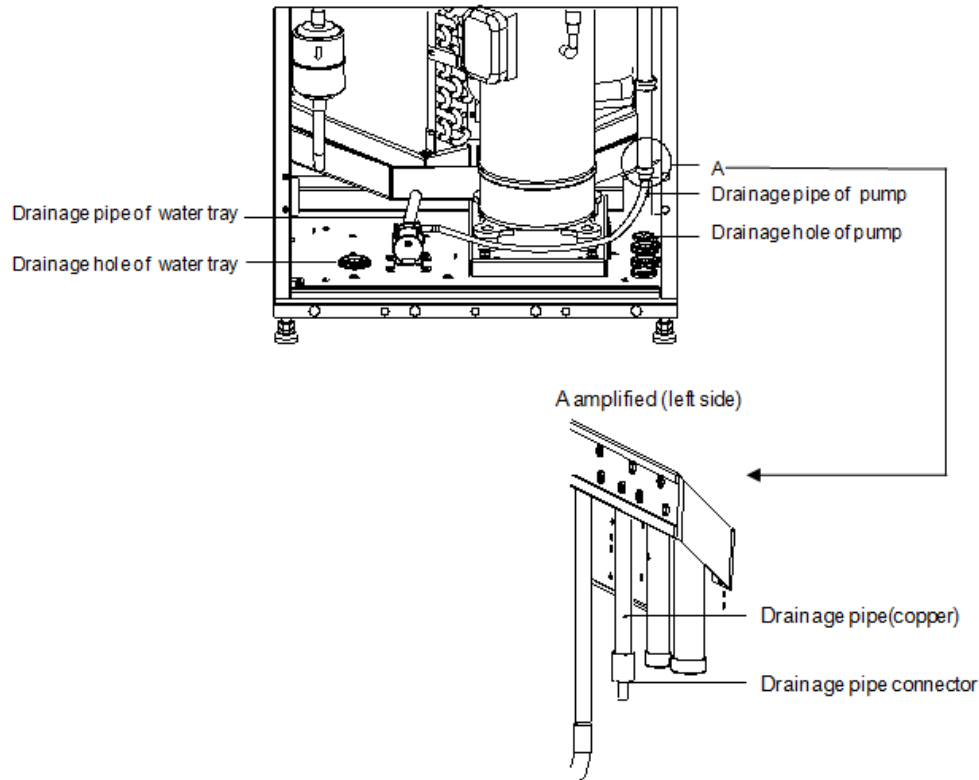


Figure 2-19 Connection of drainage pipes

Connecting the Water Inlet Pipe of an Electrode Humidifier

- Water pipes should be connected for the electrode humidifier.
- By default, the unit adheres to a top water inlet mode. If the water has to be filled from the top, there is no need to change the water inlet pipe in the unit. In this case, connect a water inlet pipe to the water inlet hole on the top of the cabinet.
- However, if the water has to be filled from the bottom, unscrew the connector of the water inlet soft pipe of the humidifier. The water inlet soft pipe needs to be routed through the rubber plug hole close to the humidifier and connected to the outer water inlet pipe. Screw down a threaded connector onto the water inlet pipe to complete the fixing process. Other connecting modes can also be selected by the engineering methodologies, but the connections must be sealed to avoid water leakage. The pressure range of the main pipe should be in the range of 100kPa – 700kPa.



In some cases, the process needs to be in compliance with the local laws and regulations resulting in the introduction of some other components.

Figure 2-20 depicts the connection of the bottom water inlet pipe of the electrode humidifier:

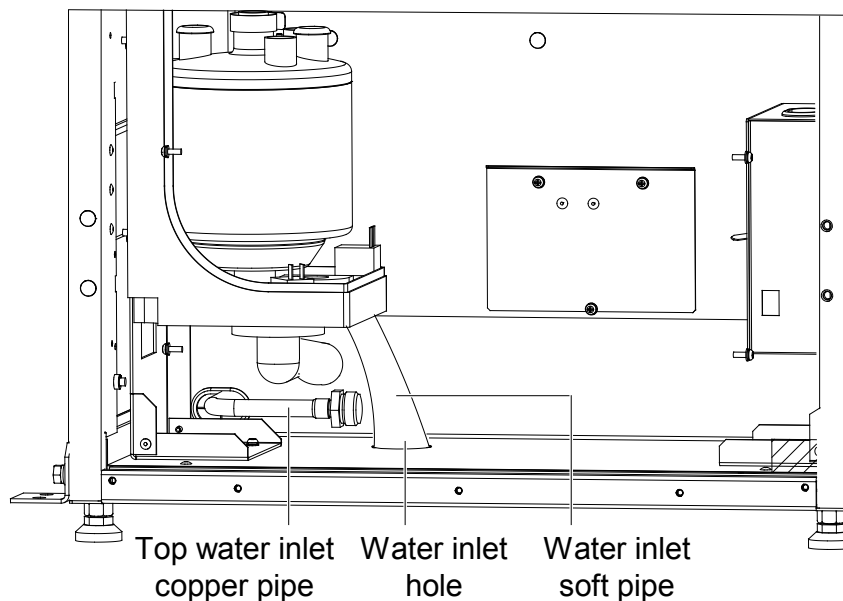


Figure 2-20 Connection of bottom water inlet pipe of electrode humidifier

Connecting the Copper pipes between the Indoor and Outdoor unit

The indoor and outdoor units are connected through welded copper pipes. Considering the effect of the pipe diameter on the system pressure drop, the pipe diameter of the indoor unit and outdoor unit should be determined by the specifications mentioned in the table under Listing 2.5. Alternatively, contact the Vertiv support office to seek the help of the technician for gauging the length and diameter.

Listing 2.5

Model	CR012		CR025		CR035	
Pipe length	D	L	D	L	D	L
10m	16	12.7	16	12.7	19	16
20m	16	12.7	19	16	22	19
30m	19	12.7	22	16	25	19
40m*	19	16	22	16	25	19
50m*	19	16	22	19	25	22



- A pipe extension kit is required for Equivalent Length marked with *.
- D: Discharge line; L: Liquid Line
- Consult Vertiv Co. If the pipe length exceeds 50m or 30m.
- If the outdoor environment is lower than -20 °C, a low temperature kit is required. Therefore, consult Vertiv Co. for the same.

The unit has refrigerating pipe connectors and labels on its top and bottom as shown in Figure 2-21 and Figure 2-22.

During welding, do not burn the labels. The labels assist and point out the connections to the discharge pipe and liquid pipe of the indoor unit. The horizontal sections of the discharge pipes must be tilted downwards from the compressor with a slope of at least 1:200 (5mm down for every 1m run). The discharge pipes must be insulated from heat at the location they are routed in the conditioned space (including the raised floor).

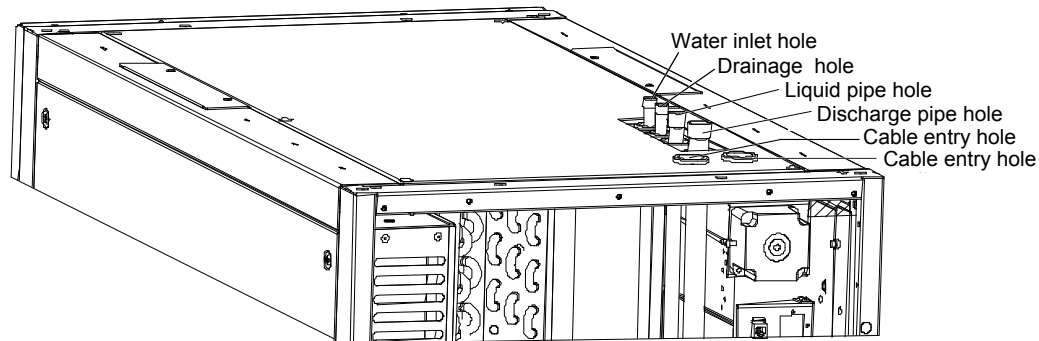


Figure 2-21 Top pipe connectors

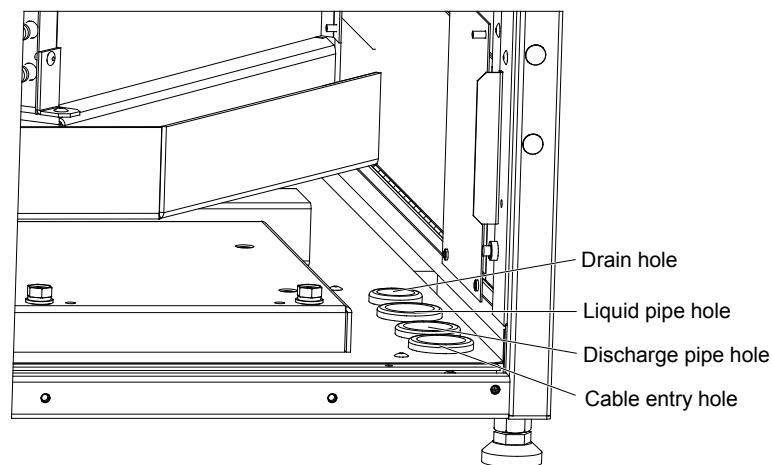


Figure 2-22 Bottom Pipe connectors



- For bottom piping, before welding the compressor discharge pipe and liquid pipe, follow the requirement labeled on the copper pipe; Cut the copper pipe using a cutter (a little bit of the compressor lubricating oil may leak); however, do not weld the copper cap on the seal directly as it may result in heating of the oil following which it may catch fire.
- The exposure time of the system pipes should not exceed 15 minutes. If exposed for too long, it will lead to the POE refrigeration oil being affected with damp. It may result in an adverse effect on the life of the key components and the stability of the system operation.

Installing Pipe Extension Kit (for site installation)

There are instances where the one-way equivalent length of the pipe exceeds 30m. Or suppose the vertical distance between the condenser and the indoor unit exceeds the value in the first table in the following Listing 2.6.

Listing 2.6

Vertical distance between the Indoor and Outdoor unit

Positioning of the Outdoor Unit	Height
Outdoor unit is higher than the Indoor unit	Maximum : + 30m
Outdoor unit is lower than the indoor unit	Minimum : - 8m

Equivalent length of the partial components

Outer diameter (OD) of the liquid pipe (inches)	Equivalent length (meters)		
	90° bend	45° bend	T Type 3-way
3/8	0.21	0.10	0.76
1/2	0.24	0.12	0.76
5/8	0.27	0.15	0.76
3/4	0.3	0.18	0.76
7/8	0.44	0.24	1.1
1-1/8	0.56	0.3	1.4



A trap must be installed every 7.5m of the vertical distance. Please consult Vertiv for such specific inquiry and installation.

There is no necessity of cutting the indoor unit pipes while installing the solenoid valve.

After the entire system is installed, open the ball valve to keep the pressure and carry out the vacuum operation, thereby avoiding the moisture absorption of the compressor refrigeration oil. Thus, it accounts for operational safety and also extends the service life of the compressor (For electrical connections related to the pipe extension kit, refer to the Electrical Installation section).

Take a look at the procedure for installing the Solenoid valve in the liquid pipe:

The solenoid valve must be as close to the indoor unit as possible. The valve body and coil of the solenoid valve are separated when the valve is shipped out.

- 1) Mount the valve body horizontally in the refrigerant pipe as shown in Figure 2-23. Pay attention to the arrow on the valve body as the arrow indicates the flow direction of the refrigerant in the valve. Ensure that the arrow points towards the indoor unit.



Figure 2-23 Installing the Solenoid valve horizontally

- 2) After welding, install the coil and remove the cover of the wiring terminals. Direct the cable through the cable hole in the cover and plug the two terminals and reinstall the cover.

Figure 2-24 shows the process of connecting the cables of the solenoid valve in a liquid pipe:



Figure 2-24 Connecting the cables of the Solenoid valve

- 3) Finally, clip the coil of the valve body, press the coil tightly to ensure complete contact between the coil and valve body as displayed in Figure 2-25.

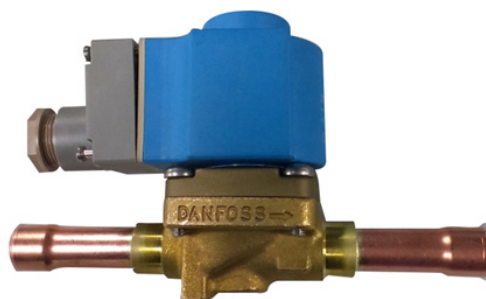


Figure 2-25 Fixing the coil

Charging Refrigerant and Adding Refrigeration Oil

The Liebert CRV+ air conditioners come pre-charged in the factory with 2Bar Nitrogen. The table in Listing 2.7 indicates the standard charged amount. The users can determine the charging amount of the

refrigerant according to the system configuration and the length of the connection pipes between the indoor and outdoor unit.

The tables in Listing 2.7 depict the recommended charging amount of the outdoor unit and the recommended charging amount for the indoor unit.

Listing 2.7

Recommended refrigerant charging amount of the outdoor unit

Outdoor unit model	LSF 12	LSF32	LSF38	LSF42	LSF52	LSF76
Recommended charging amount	2.44	3.24	3.93	4.4	5.73	6.39

Recommended refrigerant charging amount of the indoor unit

Indoor unit model	CR012	CR025	CR035
Standard charging amount	2.41	4.52	5.24

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

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

Refer to the table in Listing 2.8 for the refrigerant refilling amount of per meter liquid pipe for different ODs:

Listing 2.8

Liquid pipe OD (mm)	Refrigerant refilling amount of per meter liquid pipe (kg/m)
12.7	0.107
16	0.174
19	0.245
22	0.321
25	0.431
28	/

The refilled refrigerant will dilute the POE oil in the system and plays a major role in the lubrication and cooling effects of the POE oil. Thus, it is for this purpose that the refrigerant oil must be added.

The refrigeration oil used in the Liebert CRV+ air conditioner is depicted in the table in Listing 2.9:

Listing 2.9

Unit model	Types of refrigeration oil
CR 012	PVE (FV505)
CR025	POE (RL32H)
CR035	PVE (FVC68D)

Table depicting the amount of refrigeration oil to be added

Refrigeration oil adding amount with different pipe length (length unit: mm, refrigeration oil unit: ml)							
Liquid pipe OD (mm)	CR012						
	10	20	30	35	40	45	50
12.7	Refrigeration oil charging is not needed			Refrigeration oil charging is not needed		15	30
16				15	30	45	60
Liquid pipe OD (mm)	CR025						
	10	20	30	35	40	45	50
12.7	Refrigeration oil charging is not needed			Refrigeration oil charging is not needed			32
16				11	19	28	37
19				35	48	60	72
Liquid pipe OD (mm)	CR035						
	10	20	30	35	40	45	50
16	Refrigeration oil charging is not needed			Refrigeration oil charging is not needed			13
19				12	24	37	49
22				39	55	71	87



Consult Vertiv Co. for adding the refrigeration oil



Do not use poor quality refrigeration oil as it can damage the system

- Select the right make and type of refrigeration oil depending on the model.
- If any error or damage occurs due to adding the incorrect make and type of oil, the warranty will be void.

2.3.6 Removing Transportation Fastener and Vibration Absorber

Certain fasteners and vibration absorbers are mounted on the equipment to protect partial components from getting damaged and distorted due to bumping, impact, and resonance.

Removal of these fasteners and absorbers is necessary before installation and commissioning.

Removing Pipe fixity

If the copper pipe gets close to the metal plate, it may result in wear and tear of the copper pipe. To prevent this from occurring, vibration absorbers are fitted between them. However, these objects need to be removed and then the area must be cleaned prior to installing and commissioning.

Removing limiting piece of the electrical control box

The electric control box may move during transportation. To prevent this abrupt movement, a limiting piece of the electric control box is installed before delivery. The limiting piece has to be removed before operating the unit so that the maintenance personnel can slide out the electrical control box during maintenance.

Adjusting the wind-leading grill

Adjust the installation direction of the wind-leading grill to lead wind to the left or right depending on the installation location of the Liebert CRV+ series air conditioners. The wind-leading grill is composed of several pieces. Remove the screws on both sides of the single piece of the wind-leading grill, rotate it by 180°. Install it back to change the wind direction.

Figure 2-26 shows the mounting screws of a single piece of the wind-leading grill:

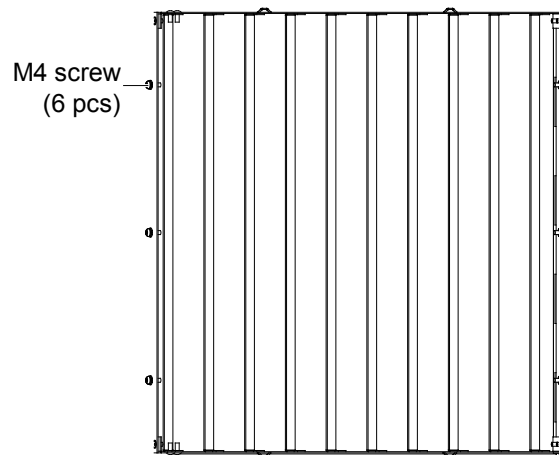


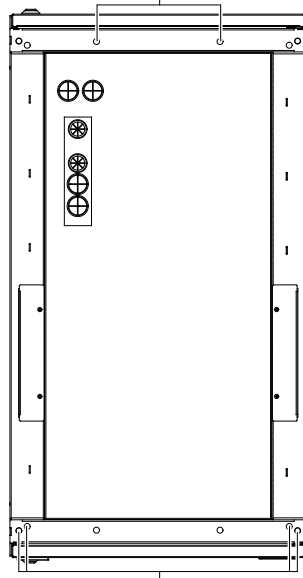
Figure 2-26 Fixed mode of the wind leading grill

Sealing the holes of the top plate of the cabinet

Holes are reserved at the top of the cabinet to facilitate smooth on-site installation as well as the connection of the rack on the top of the machine room. After the cabinet is installed on the site, seal the remaining holes using rubber plugs and bolts. Use M13.5 rubber plugs to seal four holes at the top of the cabinet and M12*30 bolts to seal 8 holes at the top plate of the cabinet. This prevents water from entering the cabinet.

Figure 2-27 depicts the schematic diagram of sealing the holes on the top plate of the cabinet.

Use the provided four M13.5 rubber plugs to seal the holes



Use the provided eight M12 × 30 bolts to seal the holes

Figure 2-27 Sealing the top holes of the cabinet

2.3.7 Checklist for completed mechanical installation

Following are the points in the checklist (Refer Listing 2.10) that need to be verified and confirmed to ensure that the mechanical installation was implemented successfully:

Listing 2.10

Item	Result
Sufficient space is kept for maintenance, according to the user manual.	
The equipment is placed vertically and mounting fasteners are fastened	
The pipes between the indoor unit and outdoor unit are completed. The ball valves of the indoor unit and outdoor unit are fully opened	
The wind direction of the wind-leading grill has been adjusted (if required)	
Drainage pipe is connected	
Water supply pipe is connected to the electrode humidifier	
All pipe connectors are tight	
The fasteners used for transportation have been removed	
After installation, foreign materials in and around the equipment are removed (such as shipping materials, construction materials, tools, and so on)	

As soon as the mechanical installation has been implemented and completed accurately, then the electrical installation of the product and its components can be carried out.

2.4 Electrical Installation

In this chapter, the electrical installation of the CRV+ air cooled units is explained in-depth to help users get to grips with the various tasks which include the task introduction, notes, and cable connections of the indoor unit apart from the checklist.



The air conditioners in the Liebert CRV+ series are professional devices used in industrial, commercial, or other professional occasions. It is not tailored for the general public. The total rating power is larger than 1 kW and is in with the IEC61000-3-12 standard. A port of less than a 350 short circuit requires is required between the user power and the grid. Permission is required from the power supply department to ensure that the air conditioner is connected to a power no less than 350 circuit ratio.

2.4.1 On-site Wire connections

Following are the wires to have to be connected in/on the site:

- Power cable and control cabinet of the indoor unit
- Solenoid valve cable of the pipe extension kit (an optional requirement)
- Outdoor unit (air-cooled), control Signal and Power cable
- Input and Output control the cable of the unit

2.4.2 Installation Notes

- The connections of all the power cables, control cables, and ground cables should be in compliance with 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.
- Mains supply requirement: (380 to 415) V \pm 10%; 50 Hz/60-Hz, 3N-
- The power soft cable is a Y-type connection. If damaged, it has to 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 an authorized personnel or a trained engineer well-versed with the inner workings of the electrical connection (For example, service engineer from the manufacturer's side).
- 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 another type of power grid, contact the Vertivsupport team for the same.

- An appropriate all –pole disconnection device must be supplied.
- SCCR of the CRV+ air cooled unit - 5 kA
- The power soft cable should not be lighter than an ordinary PVC-sheathed according to the 53 line according to GB5023.1(idt IEC60277)
- 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.

2.4.3 Connecting cables of the Indoor unit

This section deals with the different types of connections related to the indoor unit, namely–

- Electrical port location of the indoor unit
- Connecting the Power cables of the indoor unit
- Connecting the Control cables
- Connecting the Solenoid valve of the Pipe extension kit (Optional)

Electrical Port location of the indoor unit

For any model in the CRV+ 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 pasted on the cabinets and units.

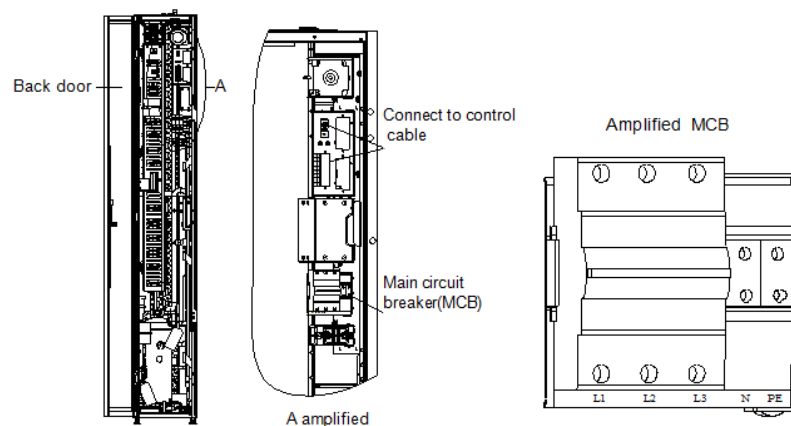


Figure 2-28 Unit electrical control box and cable connection (open the back door 120°)

Listing 2.11

MCB current

Model	MCB	Current(A)
CR012	NDM1-63C32/3	32
CR025	NDM1-63C40/3	40
CR035	NDM1-63C50/3	50

Connecting the Power cable of the Indoor unit

The specific location of the power port of the indoor unit is depicted in Figure 2-28. Connect the supply terminals L1-L3,N and PE to their respective counterparts of the external power supply respectively.

Fix the input cables to the cable clamp, located on the inner side panel of the unit. The top cable entry hole and bottom cable entry hole as depicted in Figure 2-29.

For the cable specifications, refer to the full-load current (FLA) described in the table within Listing 2.12.

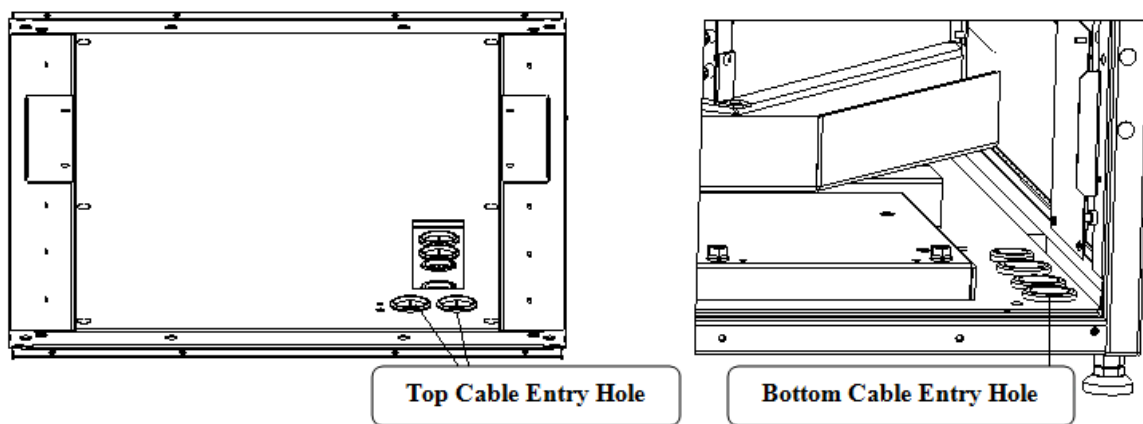


Figure 2-29 Top and bottom cable entry holes



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

Listing 2.12

Full Load current (unit A)

Model	Standard model	Standard model with electric heater	Standard model with humidifier	Standard model with electric heater & humidifier
CR012HA1380S02E10000PV000	19.1	19.1	/	/
CR012RA1380S12E10000PV000	19.1	/	/	/
CR025HA1380S02E10000PV000	24.9	24.9	26	26
CR025RA138SS12E10000PV000	26	/	/	/
CR035HA1380S02E10000PV000	31.6	46.6	42.3	46.6
CR035RA138SS12E10000PV000	46.6	/	/	/

The location of the terminal block for cable connections in the site is depicted in Figure 2-28. The amplified view of the terminals is shown in Figure 2-30.

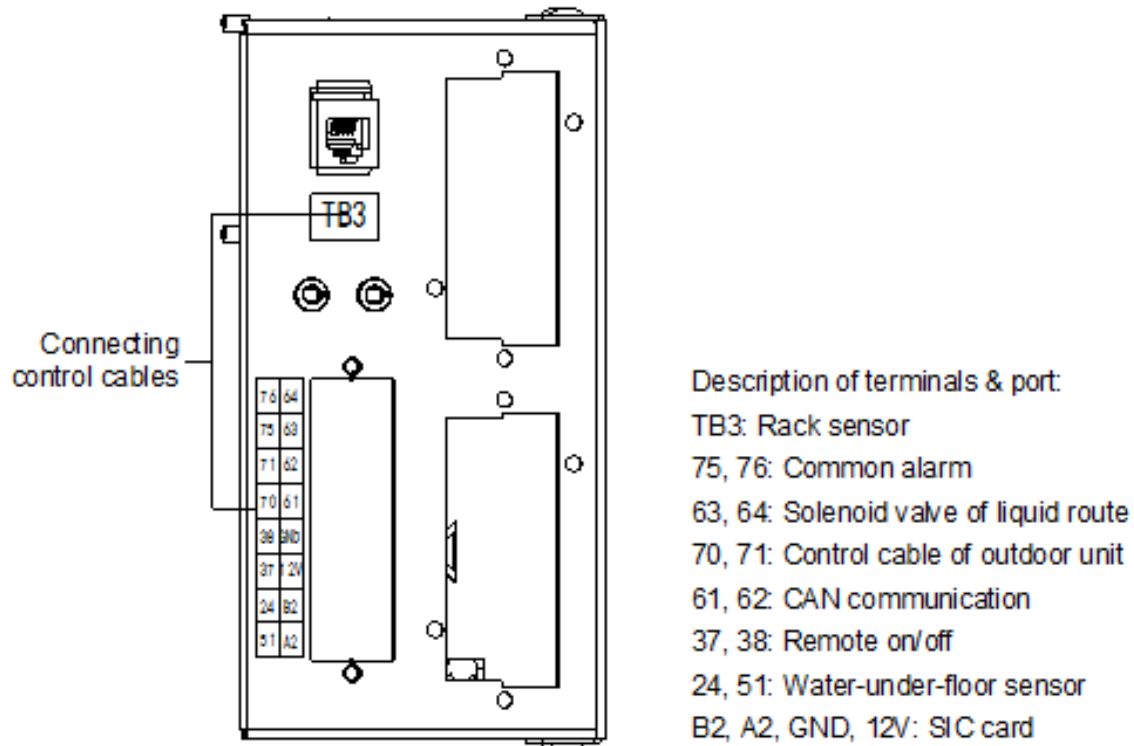


Figure 2-30 Terminal Block for cable connection in the site



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

Water-under-floor sensor

If a water-under-floor sensor is equipped, connect one end of the sensor to terminal 51# and the other end to common terminal 24#.

Each unit can be connected with multiple sensors in parallel, but there would be only one water-under-floor alarm.

SIC card

If a SIC card is equipped, connect A#, B#, GND#, and 12# on the SIC card to the respective counterparts on the terminal block. Refer to Appendix 1 Circuit Diagram for in-depth information.

Rack sensor

Each unit can be connected with a maximum of 10 temperature sensors. It is recommended that the sensors be located in front of the heat loads to achieve the most precise temperature. If the sensors are connected in series (see Figure 2-31), each temperature sensor monitors the temperature of air entering each rack, and the read temperature value is used to control unit operation. The standard location of the sensor is 1.5m height. Therefore, the sensors should be placed in positions as depicted in Figure 2-31, or the devices cannot operate appropriately.

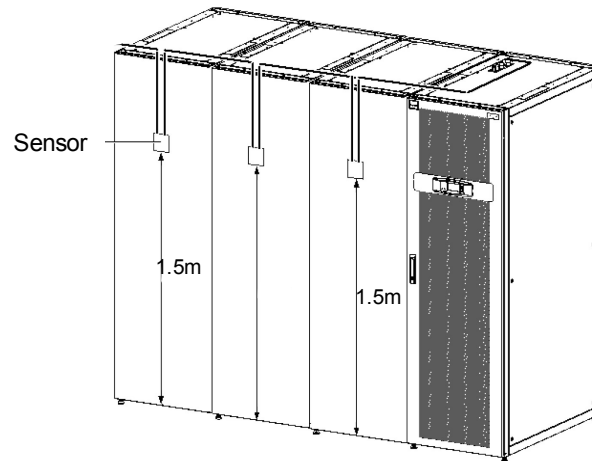


Figure 2-31 Layout figure of rack sensors

Following is the procedure to connect sensors for Liebert CRV+ models:

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

Rack temperature sensor IRM-S01 address settings are depicted in the table in Listing 2.13.

Listing 2.13

Sensor	1	2	3	4	5	6	ID	
Rack temperature 1	0	0	0	0	0	1	1	ON — "1"; OFF — "0"
Rack temperature 2	0	0	0	0	1	0	2	
Rack temperature 3	0	0	0	0	1	1	3	
Rack temperature 4	0	0	0	1	0	0	10	

Sensor	1	2	3	4	5	6	ID	
Rack temperature 5	0	0	0	1	0	1	11	
Rack temperature 6	0	0	0	1	1	0	12	ON — "1"; OFF — "0"
Rack temperature 7	0	0	0	1	1	1	13	
Rack temperature 8	0	0	1	0	0	0	20	
Rack temperature 9	0	0	1	0	0	1	21	
Rack temperature 10	0	0	1	0	1	0	22	

Remote Shutdown

As depicted in Figure 2-30, terminals 37# and 38# can be connected to the remote shutdown switch. The terminals must be shorted before delivery. If a remote shutdown signal is to be connected, remove the short-connect cable.



Closing the terminals 37# and 38# will shut down the unit.

Control signals of the outdoor unit

Terminals 70# & 71# are the control signal input terminals of the outdoor unit. Their On and Off state is the same as that of the compressor 2#. They can be connected to the compression rotation speed-control terminals on the control board of the outdoor unit. However, connecting them is an option depending on the requirement.

External Common Alarm

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

The users have to obtain the power supply of external common alarm system. For an in-depth definition of the other terminals, refer to the Circuit Diagram in the Appendix-1.

Connecting the Solenoid valve of the Pipe Extension kit - (Optional for Site Installation)

The solenoid valve of the pipe extension kit consists of 2 control cables which are connected to their respective terminals of the control board. For more specific connecting points on the interface board, refer to the connecting terminal number of the liquid route solenoid valve depicted in the Circuit Diagram in the Appendix-1 section.

Checklist for the Completed Installation

Confirm the items listed in the table under Listing 2.14 on completion of the electrical installation:

Listing 2.14

Items to be inspected	Results
The power voltage is the same as the rated voltage on the unit nameplate	
No open-circuit or short-circuit exists in the electrical connection	
Confirm if the power cables and earth cables connected to the disconnect switch, indoor unit, and outdoor unit are correct as per the norms.	
The circuit breakers or fuses have correct ratings for the installed equipment (Take the current listed in the table under Listing 6.1 into consideration before selecting the respective circuit breakers or fuses)	
The control connections are configured and subsequently, fixed properly	
All the wiring and connector connections, including the fixing blocks are fixed firmly and appropriately.	



Do not power on or operate the installed unit as Vertiv's authorized professional technicians have to perform a check and confirm whether it is good to go. Starting up and Operating the unit should only commence if the commissioning process is successful, following which Vertiv's engineers give the go-ahead

2.5 Commissioning Overview

In Commissioning, there are 4 different sections starting with a Self Check, Preparation, Inspection of Auxiliary parts and Cables, Start-up Inspection, Operating instructions, and Refrigerant Oil re-filling and Troubleshooting.



Remember that the Commissioning process can be performed only by Vertiv's authorized personnel and engineers. This section is for informational purposes only.

2.5.1 Self Check

In self check, verify whether the construction and installation meet the standard requirements to ensure normal operation and enhanced service life of the unit.

Vertiv's engineers and personnel need to perform the check-up as per the table in Listing 2.15.

Listing 2.15

Items	Inspection contents	Results
Room environment	Thermal isolation, moisture proof and sealing performances of protective structure	
Mounting base	Whether the fixing is reliable and whether the vibration proof pad between the base and the unit is well installed	
Display panel	Not damaged, good insulation and clean surface	
Compressor	The fixing metal plate at the bottom has been removed and the compressor has been fixed as well.	
Filter net	All the filter nets have been installed in the right positions. Not damaged and clean surface.	
Outdoor unit	The outdoor unit has been installed in the right position. Pipes are supported properly with suitable inclination; The oil trap has been installed in the right position.	
Fan	The air inlet and outlet areas are not blocked; When rotating the blades, the blades shall not be stuck or have abnormal noises.	
Heater (if installed)	The heating component has been firmly fixed and the heating cables are reliably connected.	
Power supply	Check whether the voltage, phase rotation and frequencies of the front end power supplies for the indoor and outdoor units are normal, and whether the power supply cables are well connected and whether each functional circuit breaker and contactor are reliably connected.	
SPD (if installed)	The SPD module should not be loosened, and the alarm terminals should be correctly connected.	
Controller	All the control wirings are reliable.	
Pipes	The pipes are connected and supported reliably; The extension kit (single direction valve and solenoid valve) is installed in the right positions and directions; There is no exposed copper pipe and the thermal insulation cotton is well attached.	

2.5.2 Preparations for Startup



In this section, the following sections would be explained in brief to help users understand the basics of the Commissioning process, but do remember that the commissioning will be done by authorized engineers or trained personnel of Vertiv Co. only.

Inspection of Pipes

1. Checking the nitrogen pressure dwelling of the cooling pipes of the air cooled unit:

Requirements: Use high pressure nitrogen to dwell pressure. Dwell pressure is 40 bar, the dwell time ≥ 24h and the pressure values before and after the dwell will be the same.

Since the single direction valve is a standard configuration of the unit, the vacuuming mode should be enabled (open the solenoid valve in liquid pipe), when performing nitrogen pressure dwelling or discharging the nitrogen after the pressure dwelling.

2. Installing the connection pipes

- Check if the equivalent length of the single-way pipe of the air cooled unit exceeds 30m
- Check whether the extension kit and oil trap are installed
- Confirm if the corresponding refrigerant oil needs to be re-filled



Refill the oil from the needle valve that is behind the expansion valve.

- Check if the rated voltage of the solenoid valve on the liquid pipe meets the requirements
- Check the relative positions between the condenser and the outdoor unit. If the condenser is higher than the outdoor unit, the liquid pipe should be at a greater height than the “U” bend of the condenser coil.

3. Vacuuming

- Open all the ball valves and solenoid valves in the refrigerant pipes of the air cooled unit;



Enable the vacuuming mode, and open the solenoid valve in liquid pipes.

- Vacuum from both the high and low pressure locations according to the indications of the labels; Requirements: The vacuum rate of the system should be below 20Pa (absolute pressure); Vacuum pressure dwell time is 4h, while the pressure should not be increased, and the sight glass indicates the dry status.

Inspection of Auxiliary Parts and Cables

1. Check if the drainage is normal
2. Check the electric circuits:
 - Fasten all the electrical connections, and make sure that there is no short circuit and open circuit and the insulation is good;

Check the main power supply voltage of the unit.

2.5.3 Startup Inspection

1. Open the corresponding circuit breaker of each component of the unit, close the general circuit breaker and the transformer circuit breaker, and check the control voltage;
2. Check the indoor fan:
 - Close the fan circuit breaker; manually set the 75% output to check the fan running current.
3. Check the Electric Heating kit:
 - Close the Electric Heating circuit breaker, manually start the Electric Heating device, check the Electric Heating running current, and close the Electric Heating device after the operations are done.
4. Check the air cooled condenser:
 - Check if the condenser is installed correctly, including whether the wiring is correct, whether the fan is reliably fixed, and whether the fan blades scratch the fan frame, and whether the alien objects near the condenser have been cleared away.
 - Run the fan to check if the fan rotates normally and check the input voltage.
5. Charge refrigerant and startup:
 - The air cooled unit needs to be charged with refrigerant on site, charge the suitable amount of liquid refrigerants according to the indications on the label;

After charging the refrigerants, do not turn on the compressor and charge the refrigerant dynamically until the crank case heating device has been pre-heated for longer than 12h. For dynamic filling of the refrigerants, the charging speed should not be high in order to avoid the compressor damage;



There is a standard charging amount (see User Manual) for each air cooled unit according to the different connecting conditions, so be sure to refer to the calculated charging amount to avoid over charge.

- Manually set the 75% output for the fan, start the compressor after 5min -> adjust the compressor output -> slowly charge the refrigerant to the location indicated by the label on the low pressure side.

In the meantime, check the operating current and voltage of the condenser.

Requirements: When the compressor runs at 100%, ensure the 25-40°C **discharge superh** should be no bubbles in the sight glass, and the reference condensate depression is 3-5 °C. **The suction** pressure is 8-10kg, discharge pressure is 21-23kg, and the superheat is more than 12°C. **For the low** temperature liquid storage system, be sure to operate according to relevant instruction files.



The unit should first be dynamically charged from the needle valve. If some units cannot be charged during the later charging stage, it can be charged from the suction port, but monitor the charging speed. The unit uses the high pressure chamber compressor that can be easily damaged if the charging is made through the suction port;

Charge the unit respectively at 50%, 70% and 100% compressor outputs until there is no bubble;

The unit may be stopped due to “low superheat” if the charging speed is high and the superheat is below 10 °C (auto reset after 3min), and after the alarm reset, manually start the compressor;

In manual control mode, the pump will not be opened automatically, so for the unit with pump, open the pump according to the condensation conditions.

Record the running parameters of the cooling system according to the requirements of CRV+ Air Cooled Air Conditioner Startup and Commissioning Report.

Record the parameters Operating Instructions

1. Start the manual mode

Start up from the panel – Enter level 2 password – Set the system – Manual Mode – Manual Mode Enabled – Set to “Y”

2. Start vacuum mode

Enable Manual Mode—Vacuum mode—Set to “Y”

- 1) Close the transformer circuit breaker;
- 2) Ignore the “Fan/Power Failure” alarm after startup;
- 3) If the vacuuming starts before the vacuuming mode is started, “low pressure sensor fault” alarm will occur after startup, and then ignore this alarm.

3. Manually start / stop each component

Enable Manual Mode—Start / stop the output of corresponding component—The output percentage value of the compressor and fan can be adjusted after they are started up

- 1) Output percentage value of the compressor cannot be adjusted until the compressor has started up for about 5min (i.e., the soft start is over);
- 2) After the compressor is off (includes manual turn-off and unit shutdown), the compressor will be in soft shutdown status (in manual mode - the soft shutdown status is displayed as “Y”), but still keeps derated speed output. After the soft shutdown phase is ended (about 5-10min), the compressor is off. In order to ensure the reliability of the compressor, avoid directly turning off the circuit breaker of the compressor.



Refer to the Refrigerant refill and charging section in the user manual for the calculations.

Once the commissioning is completed, the Vertiv engineers will confirm the same using the checklist in Listing 2.16

Listing 2.16

Check item	Result
Check and confirm that all the output functions are automatic	
Check that the Temperature & Humidity settings as well as the control precisions are configured correctly	
Make sure all the other functions are configured and set correctly	

PART III

SYSTEM OPERATION & GENERAL MAINTENANCE

Chapter 3 System Operation & General Maintenance

This section contains content related to the Controller, basic System maintenance, and Routine Troubleshooting which enables the customer to get to grips with the functioning of the equipment. It helps customers gain insight into the inner workings of the product comprising of information such as System Setup, Alarm menus, and basic Maintenance.

3.1.1 Micro-Controller

The Micro-controller for CRV+ air conditioners comes packed with potential features that help monitor and manage the AC unit.

Figure 3-1 depicts the appearance of the micro-processing controller:

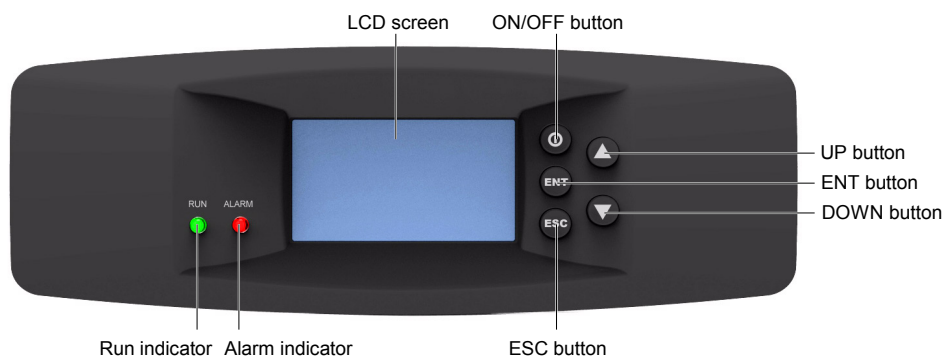


Figure 3-1 Appearance of the micro controller

3.1.2 Control buttons

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

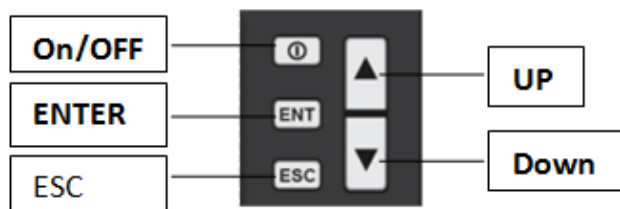


Figure 3-2 Control Buttons

The table in Listing 3.1 includes the detailed functions of the control buttons:

Listing 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

Control button	Function descriptions
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 micro-controller works in almost all the options.

Example 1

This section depicts the process where the password is entered to access the Main Menu. After the unit is powered on, the unit starts up.

Following are the step-by-step instructions that can need to be adhered and implemented to enter 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

This section depicts the process of changing parameters. The procedure is the same for almost 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 of changing parameters for the Hi Sup Temp option:

- Press the Up and Down button to move the cursor to the Alarm menu option in the 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 Set option on the Alarm Menu screen.
- Press the Enter button to access the Alarm Set screen.
- Press the Up and Down button to move the cursor to the Alarm Stpt in the Alarm Set Screen.
- Press the Enter button to enter the Alarm Stpt screen.
- Press the Enter button to highlight the parameter field of Hi Sup Temp.
- 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 it following which the changes will take effect.
- Press the Esc button to return to the previous menu screen.



On changing the parameters, the Enter button needs to be pressed in order to confirm it. If the Enter button is not pressed, it means that the confirmation of the parameter change has not taken place. Therefore, on non-confirmation, the original value of the Hi Sup Temp will be retained.

3.1.4 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:

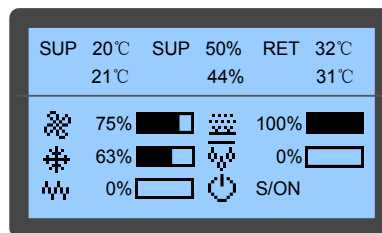








Figure 3-3 Normal Screen

It displays the settings and actual values of the current air supply temperature in the first queue, humidity in the second queue, and air return temperature in the third queue. When the compressor mode or fan mode is set to Remote, the queue displays the remote temperature. In the lower part of the screen, it displays the unit output status (fan, cooling, heating, dehumidifying, and humidifying) and unit operation status (off, running, standby, and locked).

The icons on the main screen indicate the unit output status, unit property, and unit operating status. The icons and their definitions are displayed in the table in Listing 3.2.

Listing 3.2

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

3.1.5 Password interface

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

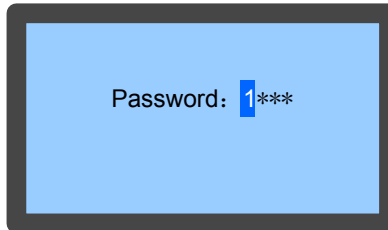


Figure 3-4 Password Interface

The table in Listing 3.3 depicts the 3 levels of passwords for accessing the menu. The detailed explanation is provided in the same table:

Listing 3.3

Password level	User	Initial password	Remark
Level 1	General operator	1490	Browse all menu information. Only set temperature and humidity Setpoints (see Figure 5-19) 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 Normal 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.

3.1.6 Menu Structure

In this section, the different kinds of menu and sub-menu options will be discussed to help users get a grip on the Controller functions.

Main Menu

By entering the correct credentials for the password and confirming it, the Main Menu screen will be accessible. For more information, refer to the Appendix 2 Menu Structure which defines the menu structure of the Micro-processing controller.

On selecting a menu item, that item will be highlighted. Figure 7-5 depicts the Main Menu screen:



Figure 3-5 Main Menu Screen

Remember that the users can change the settings of most of the parameters; however, there are some parameters that cannot be modified or altered (basically cannot be set).

The table in Listing 3.4 describes the different menu items on the Main Menu screen:

Listing 3.4

Menu item	Descriptions
Alarm Menu	The users can perform various tasks such as viewing the alarm status, historical records, abnormal high pressure records and, resetting and modifying the alarm parameters to mention a few
Temp & Hum Set	The users can perform tasks such as setting the Compressor or Fan mode, defining the temperature and humidity Setpoints, and other relevant parameters among other tasks
System State	The users can perform various tasks ranging from viewing the system operating state, ambient temperature and humidity, system input and output, system operating time, and calibrating the analog signals among others
System Set	The users can set the basic parameters of the system and operating parameters of the compressor, fan, and the EEV, configure optional functions and set the manual mode in addition to several other tasks
Help Menu	The users can define the Time, change the password and view important version information. `Set the time; change password; view version information
Display Set	The users can adjust the screen contrast and alter the language

Alarm Menu

On the Main Menu screen, click on the 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 shows the Alarm Menu screen:

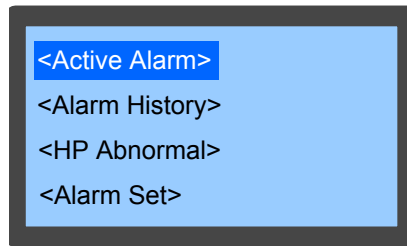


Figure 3-6 Alarm Menu

Active Alarm

The Active Alarm menu is used to monitor the present alarm status of the AC unit. It prompts with No alarm and detailed alarm status information.

Figure 3-7 shows the Active Alarm menu:

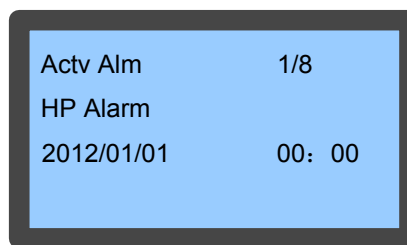


Figure 3-7 Active Alarm



- The latest Alarm SN is the biggest number.
- Press the UP or Down button to scroll through the Alarm status records if more than one alarm is activated. The Alarm status records will be automatically cleared when the system is powered off.

Alarm History

The Alarm History menu is used to view the historical alarm records of the AC unit. It also displays the Alarm type, Alarm Start time and Alarm End time.

Figure 3-8 depicts the Alarm History screen:

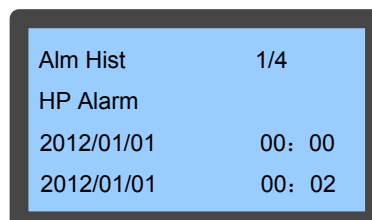


Figure 3-8 Alarm History menu

- Press the Up or Down button in order to scroll through the historical alarm records if there is more than one activated alarm.
- The Alarm History function can store up to 200 Historical Alarm records; however, unlike the Active Alarm mode, the historical records will not be cleared despite the system being powered off.

HP Abnormal

The HP Abnormal menu is used to view the abnormal records related to high pressure. It is depicted in XX/YY format where XX is the serial number of the high pressure abnormal record and YY is the total number of the high pressure abnormal records. It also includes the start time and end time of the abnormal record.

Figure 3-9 shows the HP Abnormal screen:

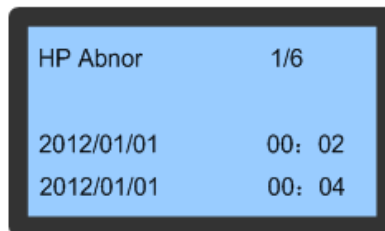


Figure 3-9 HP Abnormal menu

At times, there is more than 1 abnormal record. In such scenarios, press the Up and Down button to scroll through the several abnormal records.



There is a provision of storing up to 50 records which will not get erased even when the system is powered off.

Alarm Set

On selecting the Alarm Set option on the Alarm Menu screen, the users will be directed to the Alarm Settings menu as depicted in Figure 3-10.

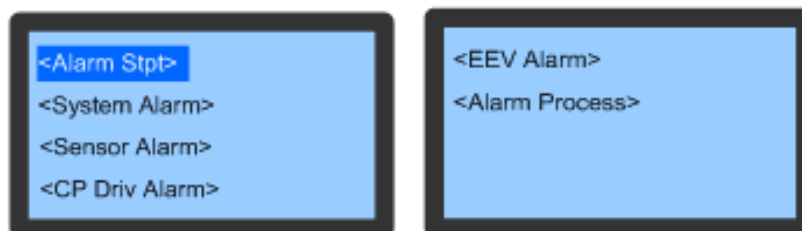


Figure 3-10 Alarm Setting menu

Press the UP and Down to scroll through the menu. The Alarm Set settings will not be lost despite a power failure.



Changing the default value of the Alarm settings is not recommended. However, if a change is necessary, change the settings under the guidance of trained professionals.

Alarm Set point (Alarm Stpt)

Select the Alarm Setpoint (displayed as Alarm Stpt) to view the Alarm Setpoint menu. Press the Up and Down buttons to scroll through the menu.

Figure 3-11 depicts the Alarm Setpoint menu:

Hi Sup Temp	27.0°C	Hi Ret Hum	60%	Filt Maint	90D
Lo Sup Temp	8.0°C	Lo Ret Hum	15%	Rem Sw Pol	NC
Hi Ret Temp	40.0°C	Power OV	12%	Comm Alm Pol	NO
Air Lst Δ T	16.0°C	Power LV	-14%		

Figure 3-11 Alarm Setpoint menu

System Alarm

Select the System Alarm item on the Alarm Set screen to enter the screen as depicted in Figure 3-12. Press the Up or Down button to scroll through the menus.

Hi Sup Temp	ENA	Hi Ret Hum	ENA	Lo Exh SH	ENA
Lo Sup Temp	ENA	Lo Ret Hum	ENA	Lo Exh Lock	ENA
Hi Ret Temp	ENA	Hi Exh Temp	ENA	HP Abnor	ENA
Air Lost	ENA	Hi Exh Lock	ENA	HP Alm	ENA
HP Lock	ENA	Power OV	ENA	Water Alm	ENA
LP Alm	ENA	Power LV	ENA	Water UF	ENA
LP Lock	ENA	Power PL	ENA	Fan Alm	ENA
Power Lost	ENA	LP Sen Lock	ENA	Heat Alm	ENA
		Humd Alm	ENA		
		Filt Alm	ENA		
		Filt Maint	ENA		
		Remote Alm	ENA		

Figure 3-12 System Alarm Menu

Listing 3.5

Settings	Alarm history record	Alarm status record	Audible alarm	Alarm prompt
ENA	Yes	Yes	Yes	Yes
DISA	Yes	Yes	No	No
OFF	No	No	No	No



The following alarms are crucial fault alarms and hence, cannot be set to OFF. However, they can be set to ENA and DISA.

- Air Lost
- Hi Exh Temp
- Hi Exh Lock
- Lo Exh SH
- Lo Exh Lock
- HP Abnor
- HP Alm
- HP Lock
- LP Alm
- LP Lock
- LP Sen Lock
- Water Alm
- Water UF
- Fan Alm
- Heat Alarm
- Remote Alm

Sensor Alarm

Select the Sensor Alarm item on the Alarm Set screen to access the menu. Press the Up and Down button to scroll through the menu items in the Sensor Alarm menu.

Figure 3-13 depicts the Sensor Alarm menu items.

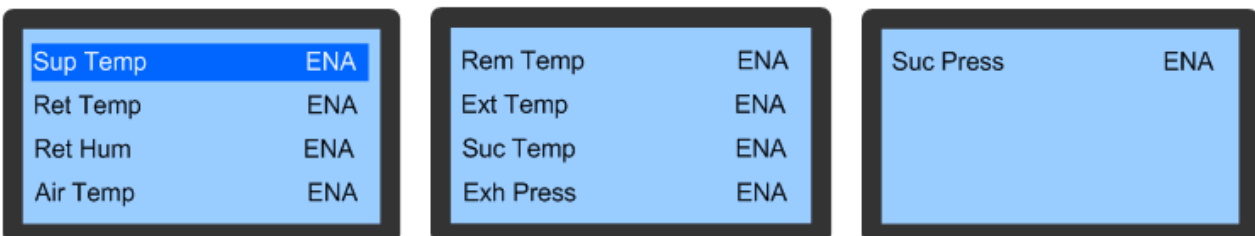


Figure 3-13 Sensor Alarm



The following alarms are crucial fault alarms and cannot be set to OFF. However, they can be set to ENA and DISA.

- Ext Temp
- Suc Temp
- Exh Press

CP Driver Alarm

Select the CP Driver Alarm on the Alarm Set screen to access the items. Press the Up or Down button to scroll through the menus.

Figure 3-14 depicts the CP Driver Alarm menu:

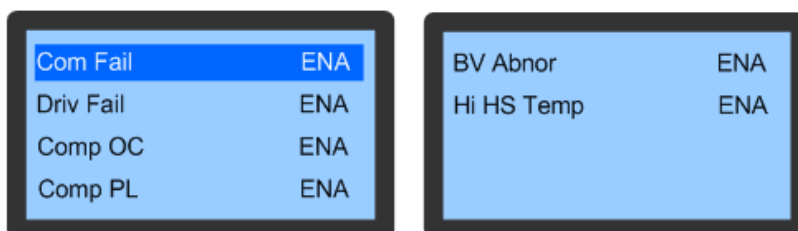


Figure 3-14 CP Driver alarm menu



The CP Driver Alarms are crucial fault alarms, which cannot be set to OFF; however, they can be set to ENA and DISA.

EEV Alarm

- Select the EEV Alarm on the Alarm Set screen to access its menu.
- Press the Up or Down button to scroll through the menus.

Figure 3-15 depicts the EEV Alarm menu:

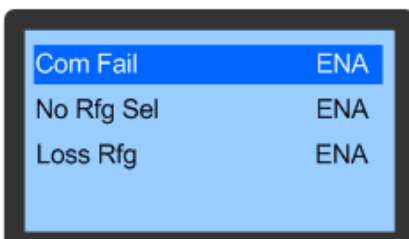


Figure 3-15 EEV Alarm

The EEV Alarms are crucial fault alarms, which cannot be set to OFF; however, they can be set to ENA and DISA.

Alarm Process

On clicking the Alarm Process item in the Alarm Settings menu, the following screen as depicted in Figure 3-16, will be displayed:

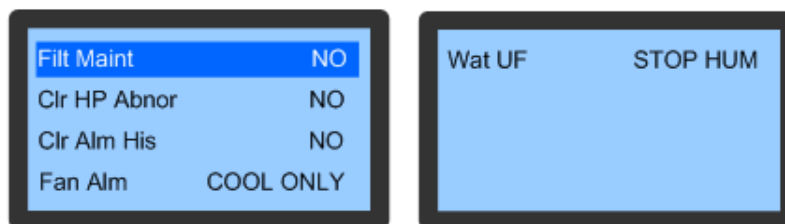


Figure 3-16 Alarm Process

The users can configure settings related to the maintenance and upkeep of the Filter. This facilitates the periodic check-up. Records related to HP abnormality (HP Abnormal is used to view the high pressure abnormal records of the AC unit) can be cleared in the Alarm Process function. Another statistic that can be cleared is the Alarm History.

Temperature and Humidity Settings

On selecting the Temp & Hum Set menu item in the Main Menu, the users will gain access to the following screen (Refer Figure 3-17):

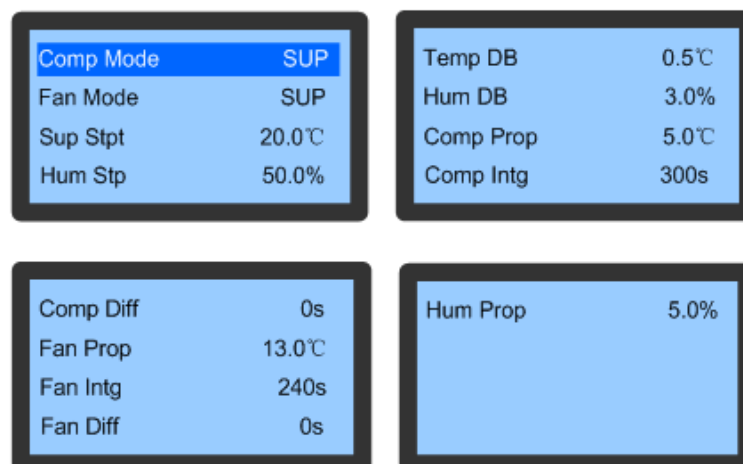


Figure 3-17 Temperature & Humidity screen



The Temperature and Humidity settings will not be cleared despite system power-off.

The temperature setting is the target temperature of compressor operation which should ideally be the same as Comp Mode. The temperature settings are set through the Sup Stpt when SUP is selected for Comp mode. When REM is selected as the Comp mode, the temperature is set through Ret Stpt; When REM is selected as the Comp Mode, the temperature settings are set through the REM Stpt.

When the same mode is selected for Comp Mode and Fan Mode, the temperature settings are also the same; when different modes are selected, an extra item of Fan ΔT temperature settings plus Fan will appear in the menu, the temperature setting plus Fan ΔT is the target temperature of fan operation.

System State

Select the cursor to System State on the Main Menu screen to enter the system state screen. On choosing System State, the users will be directed to the following figure (Refer 3-18)



Figure 3-18 System State screen

Run State

The Run State item, on being selected in the System State menu, displays the important operating parameters of devices, including ambient temperature/humidity, and the prevalent states of the compressor, fan, and EEV.

Figure 3-19 depicts the Run State displaying the running state of the compressor, fan and EEV:

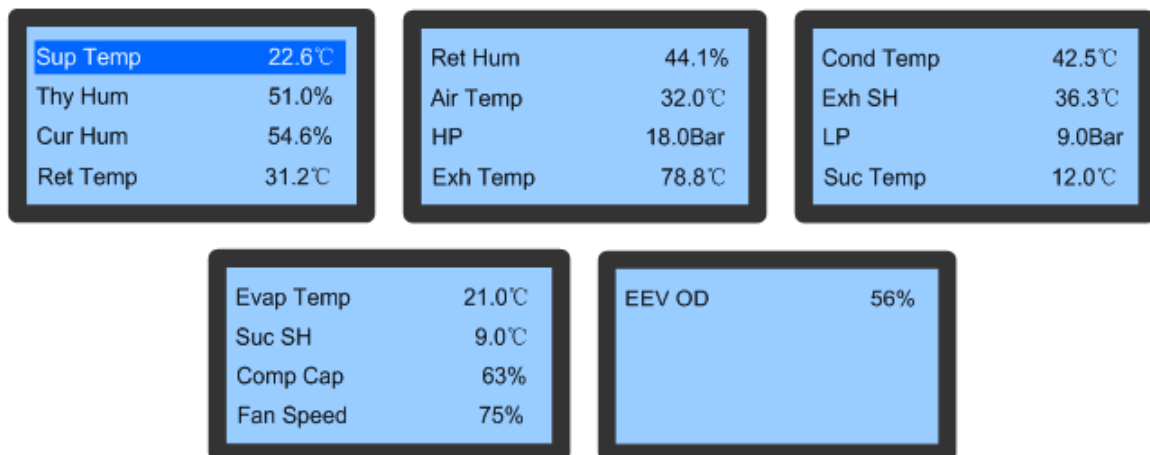


Figure 3-19 Run State

Analog Signal

The Analog Signal displays the Temperature and Humidity of the device environment, pressure, temperature, 3-ph voltage, and frequency relevant to the compressor in addition to adjustments of these analog signals as depicted in Figure 3-20.

Sup Temp1	22.5℃	Ret Temp	31.2℃	Air Temp	32.0℃
Adj S.T1	0.0℃	Adj R.T	0.0℃	Adj A.T	0.0℃
Sup Temp2	22.7℃	Ret Hum	44.1%	Exh Temp	78.8℃
Adj S.T2	0.0℃	Adj R.H	0.0%	Adj E.T	0.0℃

Suc Temp	12.0℃	LP	9.0Bar	Phase C	220.5V
Adj S.T	0.0℃	Adj LP	0.0Bar	Frequency	50.0Hz
HP	18.0Bar	Phase A	220.3V	Sw Code	0
Adj HP	0.0Bar	Phase B	221.2V		

Figure 3-20 Analog Signals

Switch Signals

After going through the menu, the current input and output states of the devices can be viewed using the Switch Signals utility.

Figure 3-21 shows the screen for the Switch Signals function:

<table> <tr><td>Remote Sw</td><td>ON</td></tr> <tr><td>HP Sw</td><td>OFF</td></tr> <tr><td>Water Lv</td><td>OFF</td></tr> <tr><td>Water Alm</td><td>OFF</td></tr> </table>	Remote Sw	ON	HP Sw	OFF	Water Lv	OFF	Water Alm	OFF	<table> <tr><td>Water UF</td><td>OFF</td></tr> <tr><td>Filt Alm</td><td>OFF</td></tr> <tr><td>Heat Alm</td><td>OFF</td></tr> <tr><td>Humd Alm</td><td>OFF</td></tr> </table>	Water UF	OFF	Filt Alm	OFF	Heat Alm	OFF	Humd Alm	OFF
Remote Sw	ON																
HP Sw	OFF																
Water Lv	OFF																
Water Alm	OFF																
Water UF	OFF																
Filt Alm	OFF																
Heat Alm	OFF																
Humd Alm	OFF																
<table> <tr><td>Fan Output</td><td>ON</td></tr> <tr><td>Comp Output</td><td>ON</td></tr> <tr><td>Heat Output</td><td>OFF</td></tr> <tr><td>Humd Output</td><td>ON</td></tr> </table>	Fan Output	ON	Comp Output	ON	Heat Output	OFF	Humd Output	ON	<table> <tr><td>Pump Output</td><td>OFF</td></tr> <tr><td>Liquid Valve</td><td>ON</td></tr> <tr><td>Comm Alm</td><td>OFF</td></tr> </table>	Pump Output	OFF	Liquid Valve	ON	Comm Alm	OFF		
Fan Output	ON																
Comp Output	ON																
Heat Output	OFF																
Humd Output	ON																
Pump Output	OFF																
Liquid Valve	ON																
Comm Alm	OFF																

Figure 3-21 Switch Signals

Run Time

The Run Time menu is depicted in Figure 3-22. The data on this screen will not be lost or cleared during a power failure or when set the system to the OFF state. It indicates the running time of the components through this menu.

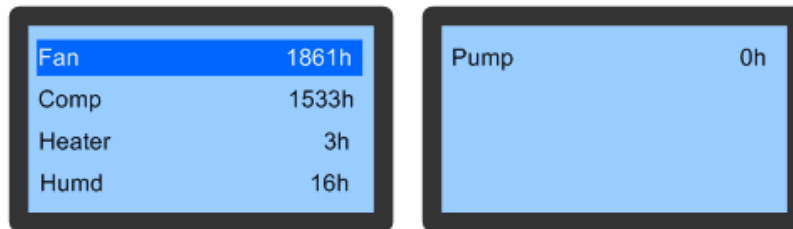


Figure 3-22 Run Time menu

On/Off Record

Select the On/Off Record item on the System State screen following to access its menu. Users can view the start and stop records of important components using this facility. The data will not be lost during the power-off state or power failure.

Figure 3-23 depicts the On/Off Record screen:

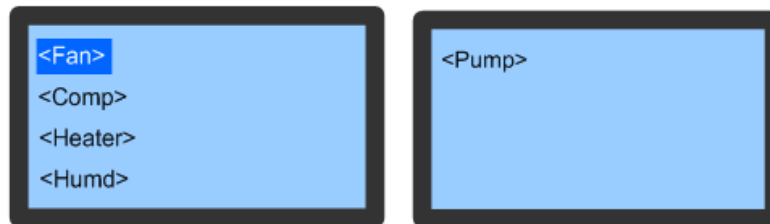


Figure 3-23 On/Off Record menu

For example, select the Fan item on the On/Off Record screen. It will display the data in XX/YY format where XX is the serial number of the start and stop record while YY is the total number of start and stop records.

Figure 3-24 depicts the records of the fan component.

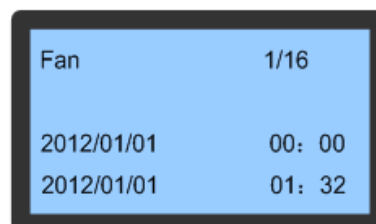


Figure 3-24 Fan records

System Set

Choose the System Set item from the Main Menu screen to access the System settings menu. The parameters of System Settings will not be cleared or lost due to the power-off state or power failure.

Figure 3-25 depicts the menu items of the System Settings menu:



Figure 3-25 System Settings menu

Common Settings

Common Settings is a menu item in the System Settings menu. It displays the basic System settings of various attributes.

Figure 3-26 depicts the Common Settings menu:

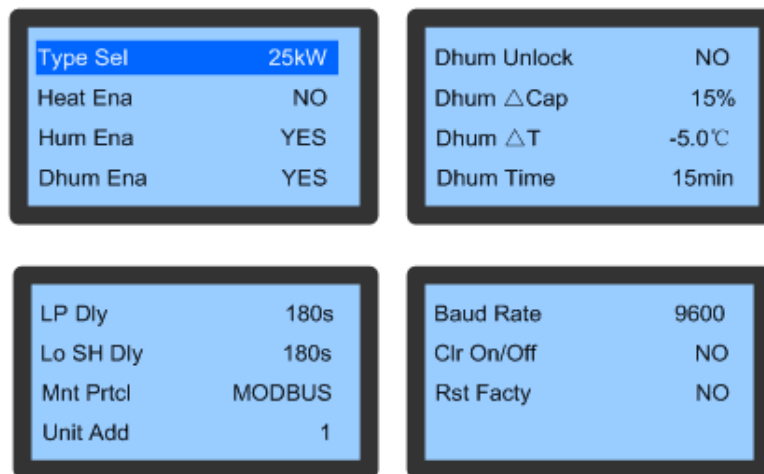


Figure 3-26 Common Settings

In the Common Set menu, there is a Restore Factory (RstFcty) function. Move the cursor using the Up or Down button to scroll to this function. Press Enter followed by selecting Yes or No using the Up and Down button. Press Enter to confirm.



On selecting Yes, all the system settings will be reset to the original factory values. However, the Run Time or Historical Alarm data will not be cleared.

Use the Reset Factory option with caution as it can clear all user settings and shut down the unit.

Fan Set

The Fan Set screen is depicted in Figure 3-27:

Min Analog	30%	Std Speed	75%	Max Step	1.0%/s
Max Analog	100%	Std CFC	100%	Start Dly	10s
Min Speed	40%	Hum Speed	75%	Stop Dly	30s
Min CFC	0%	Min Step	0.1%/s	Decel Dly	5s

LP Max	5.8Bar	Fan1 State	NORM
LP Cur	7.5Bar	Fan2 State	NORM
HP Cur	11.5Bar	Fan3 State	NORM
HP Min	13.5Bar	Fan4 State	NORM

Figure 3-27 Fan Settings



Fan 1 State – Fan 4 State are read-only values. On selecting 35 kW, only the Fan 1 State and Fan 2 State will be displayed.

Comp Set

The Comp Set screen is depicted in Figure 3-28.

Min Cap	23%	Output DB	2.8%	Min Run	10min
Std Cap	100%	Start Rqt	50%	Min Stop	4min
Max Cap	125%	Stop Rqt	-150%	M.C Run	120min
Start Cap	70%	WSK Period	180s	O.R Cap	70%

O.R Cyc	240min	HP Cur	11.5Bar
O.R Run	5min	HP Max	13.5Bar
LP Min	5.8Bar		
LP Cur	7.5Bar		

Figure 3-28 Comp Set items

EEV Set

The EEV Set screen is depicted in Figure 3-29.

SH Stpt	15.0°C
SH Close	8.0°C
MOP	11.0Bar
Start OD	50%
Start Time	60s
Cont Time	60s

Figure 3-29 EEV Settings

Manual Mode

The Manual Mode helps set the parameters of certain components while a few settings cannot be altered as they are only read-only attributes.

Manual Ena	YES	Comp Output	ON	Heat Output	OFF
Fan Speed	75%	Soft Off	NO	Humd Output	ON
Fan Output	ON	Vacum State	NO	Pump Output	OFF
Comp Cap	63%	Liquid Valve	OFF	Comm Alm	OFF

Figure 3-30 Manual Mode

If the manual mode for a component is selected, the output can be manually controlled. For example, if Yes is selected for Manual Ena, then the Fan Speed can be set at 75% and the Output can be changed to the ON state.

Some components have dependencies and that should be taken into consideration, prior to configuring the settings for those utilities. For example, the fan has to be started, prior to setting the Comp Output, Heat Output, and Humd Output values.

Some parameters such as Soft Off and Liquid Valve cannot be set as they are read—only attributes. Exiting the manual mode has to be done manually.



Preferably, only qualified personnel or trained professionals should be allowed to use the system in Manual Mode.

Sel Option

The Sel Option (Selected Option) can be viewed using this facility. In this menu, the parameters of remote temperature adjustment will not be cleared on powering off the system or in case of a power failure.

Figure 3-31 depicts the Selected Option screen:

Pump Conf	YES
Rem Temp Num	10
Avg Rem	24.0℃
Rem Temp1	24.1℃

Adj R.T1	0.0℃
Rem Temp2	24.0℃
Adj R.T2	0.0℃
Rem Temp3	24.1℃

Adj R.T3	0.0℃
Rem Temp4	24.1℃
Adj R.T4	0.0℃
Rem Temp5	23.9℃

Adj R.T5	0.0℃
Rem Temp6	24.2℃
Adj R.T6	0.0℃
Rem Temp7	24.0℃

Adj R.T7	0.0℃
Rem Temp8	23.8℃
Adj R.T8	0.0℃
Rem Temp9	24.1℃

Adj R.T9	0.0℃
Rem Temp10	23.8℃
Adj R.T10	0.0℃

Figure 3-31 Sel Option menu items

Help Menu

Figure 3-32 depicts the Help Menu screen:

<Date&Time>
<Password>
<Version Info>
<Enab 1st Run>

Figure 3-32 Help Menu

In Figure 3-32, all the options are functional, except for the Enab 1st Run which cannot be even viewed by the users.

Date & Time

This facility displays the current date and time of the system in the Year/Month/Date and Hour/Minute/Second format:

Figure 3-33 depicts the Date and Time screen:

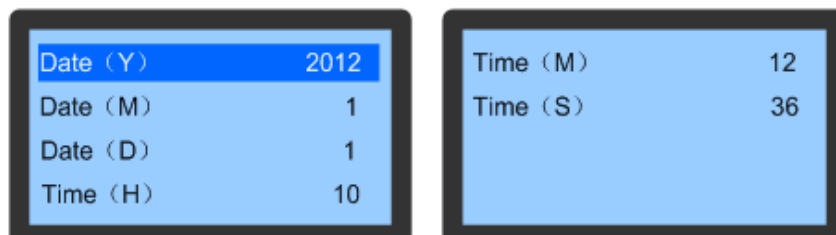


Figure 3-33 Date & Time screen

Password

The Password settings will not be lost in case of a power failure.

Figure 3-34 depicts the Password menu:

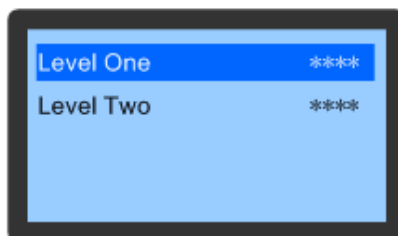


Figure 3-34 Password Menu screen

Version Info

This facility is used to view the software version as depicted in Figure 3-35:

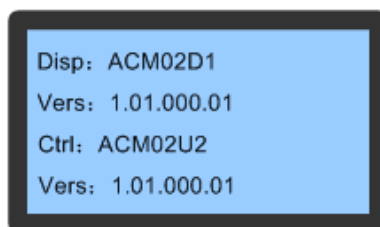


Figure 3-35 Version Info

Display Set

Finally, select Display Set on the Main menu screen to see the menu items as depicted in Figure 3-36:

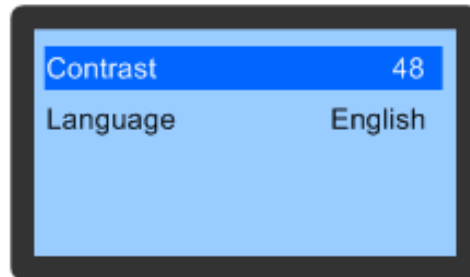


Figure 3-36 Display Set

3.2 General Maintenance

This chapter deals with the system operation and maintenance of the Liebert CRV+ range of air conditioners. In this chapter, the following points or items will be discussed to help users get to grips with the routine inspections and checks from a user-perspective. 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, lethal 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.*
- *Qualified and Professional Maintenance personnel are the ones supposed 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.

3.2.1 Routine Maintenance & Inspection (Monthly)

Following is a checklist which contains parts and components that are to be checked to ensure proper and accurate functionality. In addition to that, there may be wear and tear of the equipment.

Therefore, it is essential that all the checks are performed to ensure a smooth flow in operations. The table under Listing 3.6 depicts the inspection tasks and actions that need to be implemented and carried out every month during maintenance of the various components in the CRV+ series of air conditioners.

Listing 3.6

Components	Item	Remark
Filter	Check for clogging or damage	
	Check the filter clogging switch	
	Clean the filter	
Fan	The Fan blades are not distorted	
	The bearings are not worn out	
Compressor	Check for leakage	
	Listen to the operation sound, observe the operation vibration	
Air cooled condenser	Make sure that the condenser coil is clear from dirt and debris. Clean if required.	
	The fan base should be firm	
	The fan vibration absorber is not deteriorated or damaged	
	The SPD board should be effective (in the seasons when there are storms, the SPD board should be checked once a week)	
	The refrigerant pipes are properly supported	
Refrigeration system	Check the suction pressure	
	Check the discharge pressure	
	Check the refrigerant pipes for signs of leaks	
	Check the moisture condition in the system through the sight glass	
	Check the electronic expansion valve	
Heating system	Check the re-heater operation	
	Check the erosion situation of the components	

3.2.2 Routine Maintenance and Inspection (Half -Yearly)

Following is a checklist (Refer Listing 3.7) of the items and functions that need to be checked bi-annually to ensure a smooth operational flow and check the functionality as well as the wear-and-tear of the components in the Liebert CRV+ range of air conditioners.

Listing 3.7

Components	Item	Remark
Air Filter	Check for clogging or damage	
	Check the filter clogging switch	
	Clean the filter	
Fan	The Fan blades are not distorted	
	The bearings are not worn out	
	Check and fasten the circuit connections	
Compressor	Check for leakage	
	Listen to the operation sound, observe the operation vibration	
	Check and fasten the circuit connections	
Air-cooled condenser (if used)	Check the fins cleanness	
	The fan base should be firm	
	The fan vibration absorber is not deteriorated or damaged	
	The SPD board should be effective (in the seasons, when the storms are common, the SPD board should be checked	

Components	Item	Remark
	once a week)	
	Check the voltage regulating function of the rotation speed controller	
	The temperature switch is set at the required position	
	The refrigerant pipes are properly supported	
	Check and fasten the circuit connections	
Refrigeration system	Check the suction pressure	
	Check the discharge pressure	
	Check the refrigerant pipes	
	Check the moisture condition in the system through the sight glass	
Heating system	Check the re-heater operation	
	Check the erosion situation of the components	
	Check and fasten the circuit connection	
Electric control part	Check the fuse and the MCB	
	Check and fasten the circuit connections	
	Check the control program	
	Check the contactor action	

3.2.3 Self-Diagnosing Functions

The micro controller has a built-in diagnostic function that helps to turn on/off the components and check their functionality.

3.2.4 Maintenance of Electrical Control utilities

In this section, the following processes will be discussed in brief, namely-

- Maintenance of Electric parts
- Maintenance of Control System
- Water Leak detector

Maintenance of Electric Parts

Visual checks and handling needs to be carried out to check the correctness of electrical connections for the following items:

- Conduct the electrical insulation test on the system to find out bad electrical connections and contacts. Disconnect all the fuses and MCBs of the control part during the test as high voltage from the insulation test could damage the components.
- Check the contactors prior to powering on the unit to ensure that the contactors can hold and un-hold freely.
- Clean the electrical and control components off dust with brush or dry compressed air.
- Check the closing of contactors for arcs or signs of burning. Replace the contactors, if required.
- Fasten all the electrical connection terminals
- Check that the sockets and plugs are in good condition. Replace the contactors, if required.
- If the power cables are damaged, get them replaced by a qualified/certified electrician.

Maintenance of Control System

Appearance checks and simple, functional tests, coupled with handling of control parts needs to be carried out on the following items:

- Carry out visual checks on the power transformers and isolation transformers for any burn marks followed by testing the output voltage (of the indoor unit and outdoor condensers).
- Check for signs of ageing on the control interface board, control board, temperature and humidity sensor boards, and fuse boards.
- Clean the electrical control components and control board to remove dust. Debris, dust, and dirt must be removed, preferably by a dust removing agent.
- Check and fasten the Input/Output ports on the control interface board. It should also include the connections between the control board and control interface boards as well as between the Temperature/Humidity sensor boards and the control interface board.
- Check the connection between the user terminals (70#, 71#, 37#, and 38#) and the control interface board.
- Check the output connections between the control interface board and various components including contactors and solenoid valves for liquid pipes. Inspect the input connection between the control interface board and various components, including high pressure switches, heating over-temperature protection switches, discharging temperature and high pressure sensors. Specifically, check the inserting terminals such as high pressure switches and heating over-temperature switch followed by replacing the component if it is loosened or in poor condition.
- Replace the faulty electric components such as faulty control fuses (or MCBS) and control boards.
- Check the trunking or insulation condition of the control and power cable connected to the condenser from the indoor unit. Replace the cable, if required.
- Use a temperature /humidity measuring meter with high precision to proofread and calibrate temperature/humidity sensor.
- Regulate the setting point. Meanwhile, check the action of the various function components according to the control logic
- Simulate and inspect the operation-and-working states of protecting units such as high/low pressure alarm, high/low temperature alarm, high water level alarm, and over-temperature alarm and over-temperature protection.
- Check the sensors.

Water leak Detector

Lay water leak detectors and confirm the alarm information through the controller. The detector should be located away from any water pool or drainage trench on the floor, 2 to 2.5 meters away from the unit. Do not place it directly under the machine.

Figure 3-37 shows the recommended location for the water leak detector:

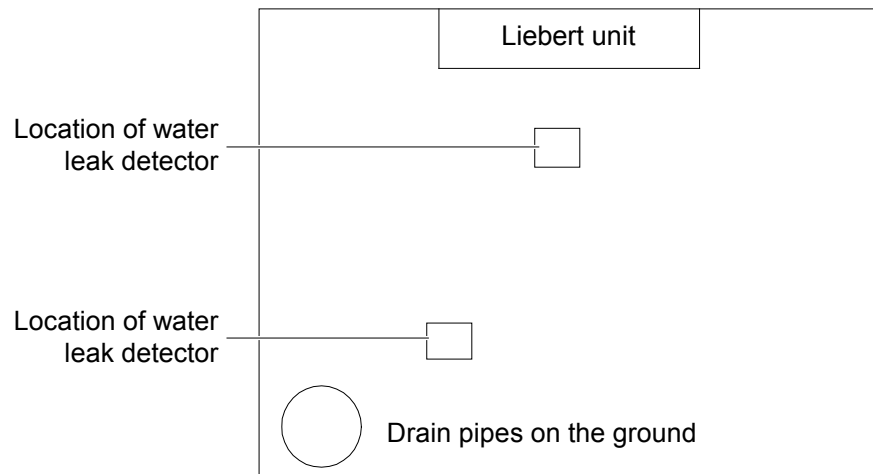


Figure 3-37 Recommended location for the water leak detector



- Ensure that the power supply of the control unit has been disconnected before connecting any mechanical parts or cables.
- Do not use the water leak detector in the vicinity of flammable liquids; do not use it to detect any flammable liquids.

3.2.5 Air Filter Maintenance

The efficiency of the configured filter is 30%, in compliance with industry standards such as the America ASHRAE52-76 and Eurovent 4/5 standard; the dust resistance value is 90% (EU4 standard).

- Set the filter maintenance and alarm logic to ensure efficient operation. The fan operating time is 2160 hours by default (though the time is set and customized based on the local operating environment); the filter maintenance alarm is triggered based on the configuration and settable operation time.
- Check and replace the filter according to its dust and clogging condition. During normal operations, the filter needs to be checked once a month and replaced as per the requirement.



Cut off the power before replacing the filter. Clear the fan operating time after replacing the filter.

3.2.6 Fan Kit Maintenance

Regular checking of the EC fans includes inspection of the motor operating status, fan impeller state, and co-operative clearance between the fan and wind-leading ring.

Check whether the fan or the wind-leading ring has been installed properly and firmly. Ensure that the fan blades do not hit the adjacent metal plates under any circumstances. Clear the clogging element of air duct to avoid damage to the refrigerating system and other system kits due to reduced air volume.

In addition, the fan fault alarm of the control board and alarm point of the EC Fan is connected in series. If the rotating speed is abnormal, the unit will ideally generate an EC fan fault alarm.



- Turn off the fan/unit prior to replacement of the filter
- The speed regulating control board of the outdoor EC fan has a possibility of an electric shock leading to injury. Therefore, do not touch the board when the unit is powered on.
- While the unit is powered on, do not strictly touch the fan mesh enclosure as it may end up damaging caused by the fan operation.

3.2.7 Electrical Heater Maintenance

Following are the basic instructions relevant to the maintenance of the Electrical Heater from the user perspective:

- If an optional electrical heater is used, then it should be monitored periodically.
- Ensure that there is no dust, debris, or foreign matter on the surface. The heater elements will heat continuously in the normal state.
- Inspect the heater every six months for its functionality

If the heating is not effective, the electric heater needs to be replaced. For replacement, contact the maintenance personnel and support team of Vertiv.

3.2.8 Refrigerating System Maintenance

Following are the basic instructions relevant to the maintenance of the Refrigerating system:

- Check the refrigerating system once a month to ensure the system functionality.
- Perform a visual check for detecting signs of wear and tear.
- Regular inspection is a good practice to ensure long service life of the refrigerating system.
- Check the refrigerant pipes once every 6 months to ensure that there is no wear and tear.

3.2.9 Drainage system maintenance

- Inspect the water tray periodically for ensuring normal operation of the drainage pipe.
- Ensure no sediments, debris, foreign matter, or leakage occurs in the water tray.

3.2.10 Troubleshooting

Troubleshooting is to be performed by the trained and qualified service personnel. However, the checklists have been provided just for reference purposes.



- *Certain circuits carry lethal voltages. Only professional technicians are allowed 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.*

Listing 3.8

Troubleshooting the fan

Symptom	Possible causes	Items to be checked
EC fan can't be started	Power Supply Disconnected	Check whether the fan MCB is closed; If the MCB is closed, check if the power voltage of each phase is normal
	Control board faulty	Check J15 on the micro-processing control board, to ascertain whether the control board is faulty or functions correctly
	Fan power module faulty	Check the alarm lamp on the fan power module to ascertain whether it is faulty or functions correctly
	EC fan faulty	Check L1, L2, and L3 of the fan against power failure, phase loss, and low voltage
		Check whether the analog output is within the specific range of 0 ~ 10Vdc as per the requirement
		Check whether the motor is clogged (due to large current)
		Check whether the motor is too hot
		Check for Hall failure



- *If the previous three problems (i.e. Motor Clogging, Hot Motor, or Hall failure) occurs, the motor can restore normal operation after the faults are cleared.*
- *If the motor is too hot, cut off the fan power; after the motor cools down, power on it again for recovery.*
- *In the event of a hall failure, factory service is required to fix the issue.*

Troubleshooting of the Heating system

Symptom	Possible causes	Items to be checked or handling method
Heating system does not start, the contactor does not close	No heating demand	Check the state of the micro-processing controller, and confirm if there is a requirement for the heating command
	Safety device of the heating system is open	Use a multi-meter to measure the resistance on both ends of the temperature controller; if the resistance is very large, it indicates that the safety device may be open. Next, check whether the fuse is open and the temperature controller is damaged. Measure the resistance of the heater with an ohmmeter to judge if the heater is damaged
The Contactor closes, but heating is ineffective	Heater main power is off	Check if the heater's MCB is turned ON; Check whether the L1, L2, and L3 voltages are normal when the contactor is energized
	Electric heater burned	Turn off the power; then physically check the condition of the heater.

Troubleshooting of compressor and cooling system

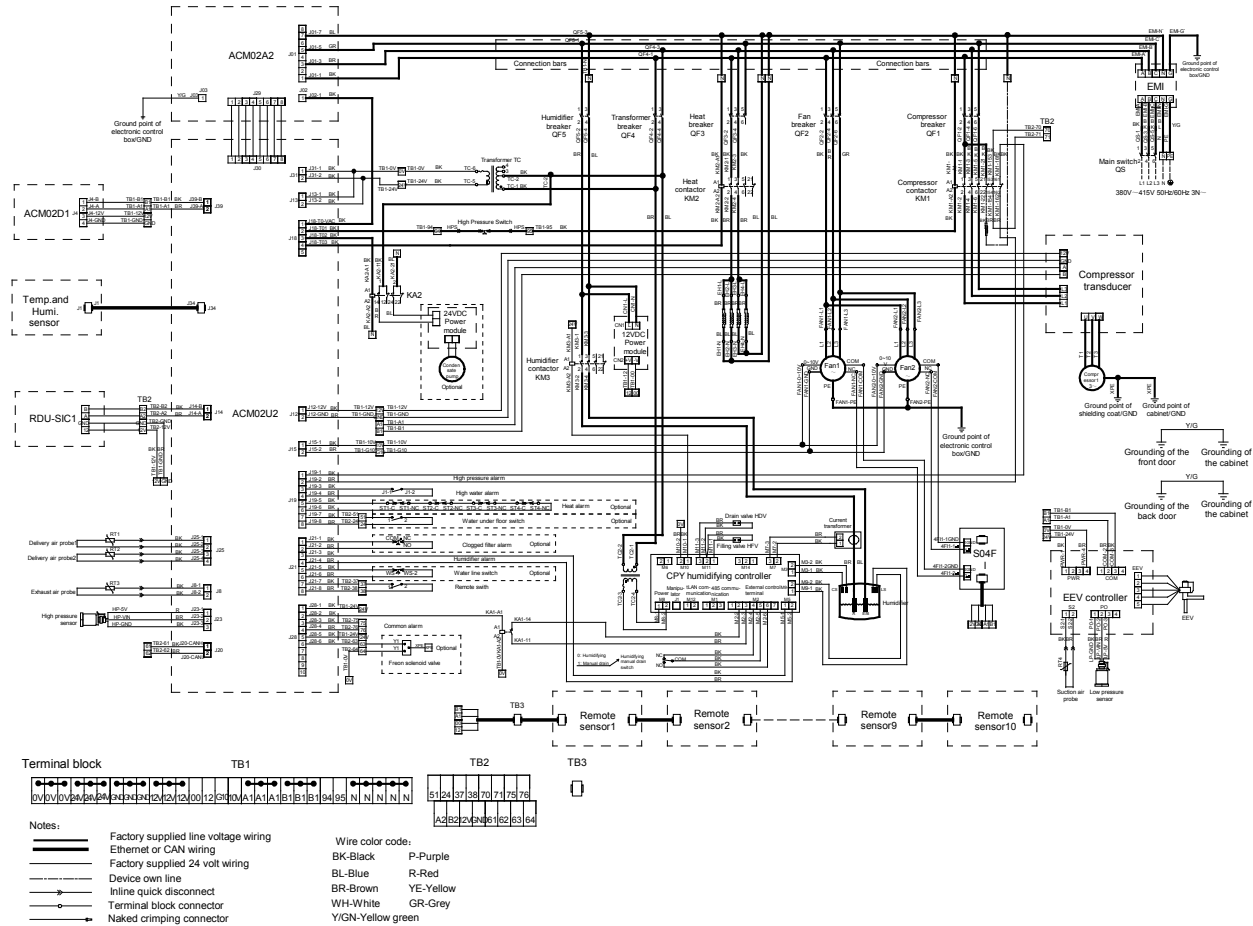
Symptom	Possible causes	Items to be checked or handling method
Compressor can't be started	Does not power on (Shutdown)	Check the main power against under-voltage, over-voltage, and phase loss
	MCB and contactor faulty	Check the compressor MCB, contactor, and connecting cables
	Alarm lock	View the unit alarm records, replace the damaged component and power it on again
	Compressor coils shorted and burnt	Check the motor and replace it in case of any defects or malfunction
The Contactor does not get closed, and the compressor does not start	Low discharging overheat degree alarm	Check the state of the micro-processing controller
	High pressure MCB action	Check if there is an HP alarm.
	Discharging temperature alarm	Check whether a discharging low/high temperature alarm exists
	Low pressure alarm	View if a low pressure alarm exists in the history alarm
	Contactor faulty	Check if the contactor is able to energize.
	Compressor driver faulty	Check the compressor driver
The Contactor does not get closed, and the compressor does not start	The Compressor internal protector is open	Check whether the compressor coil is an open circuit. In such a scenario, wait till the coil is cooled following which it will be restored automatically

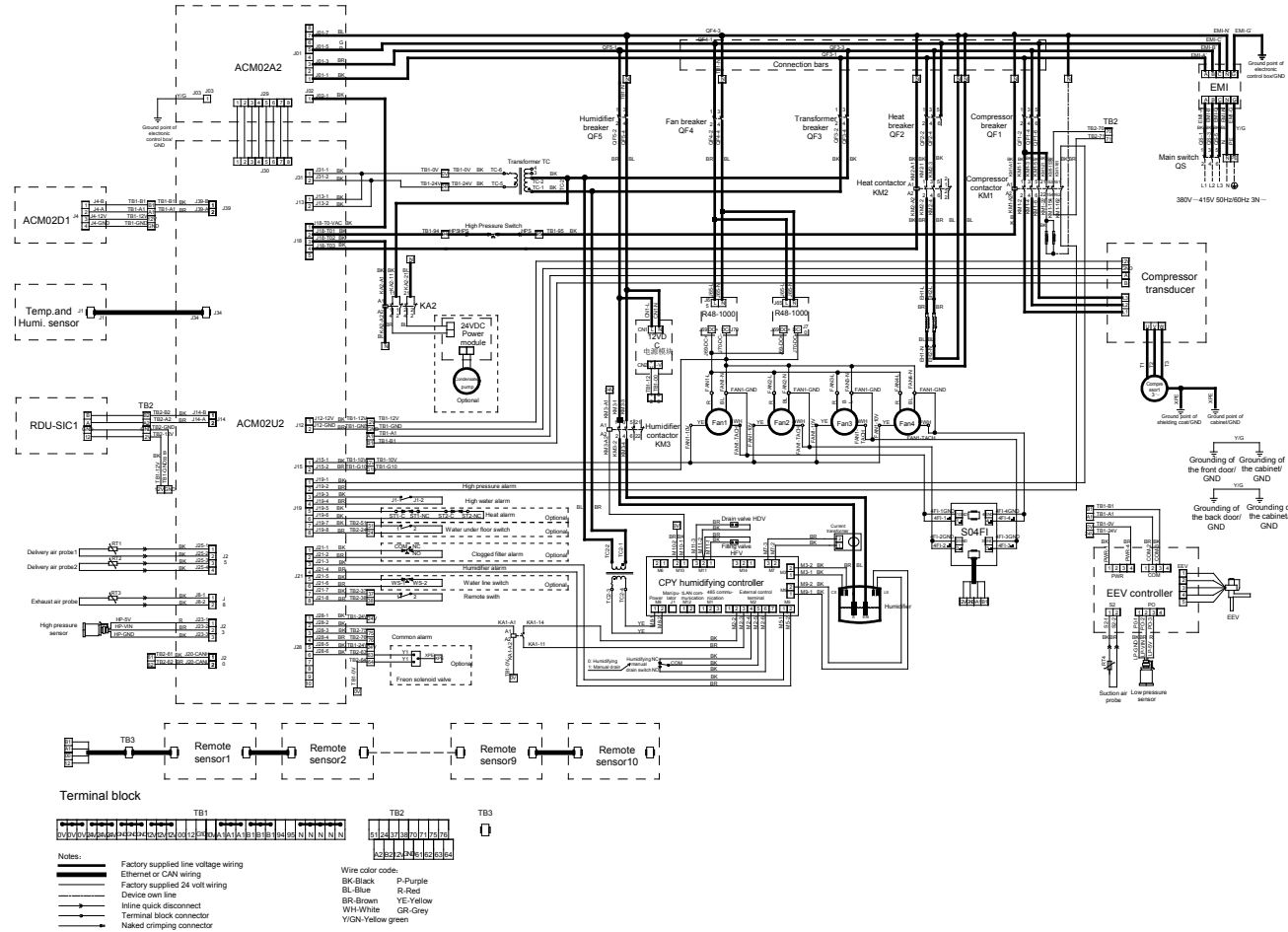
Symptom	Possible causes	Items to be checked or handling method
The Compressor stops after running for 3 minutes. Contactor open	Refrigerant leaked, the low pressure check is too low or abnormal	Check the suction pressure
		Check the circuit of the low pressure sensor
		Calibrate accordingly so that the low pressure sensor reader is within ± 0.3 bar range of the actual pressure
High pressure protection	Condenser clogged	Clean the condenser
	Condenser system does not start	Check the condenser fan for the air-cooled system
	Too much refrigerant has been charged	Check whether the sub-cooling degree is too high
Low exhaust pressure	Refrigerant leaked	Locate the leakage point, repair it and add the refrigerant
	The Fan speed controller of the outdoor unit is faulty, while the output voltage remains 100%, irrespective of the change in the condensing pressure	If the fan speed controller is found faulty, then it has to be replaced
The suction and exhaust pressures do not change after startup	Either the Compressor is reversed or the internal air tightness of the compressor has failed	If the compressor is reversed, exchange any two L lines of the compressor. If the internal air tightness of the compressor has failed and cannot be restored, replace the compressor
Low suction pressure or liquid returned	Insufficient refrigerant in the system	Check for leaks. Seal the leaking point and add the refrigerant
	Air filter too dirty	Replace the air filter
	Filter drier clogged	Replace the filter drier
	Improper superheating degree	Check the control board of the electronic expansion valve (EEV)
	Sensing element of the electronic expansion valve faulty	Replace the sensing element
	Improper air flow distribution	Check the air supply and return system
	Low condensing pressure	Check whether the condenser is faulty
Compressor too noisy	Liquid returned	Refer to the handling methods of "Low suction pressure" or "liquid returned"
	Bearing worn out due to lubricant loss	Add lubricant

Symptom	Possible causes	Items to be checked or handling method
Compressor over-temperature	Too high compression ratio	Check the settings of the HP switch and LP switch, and inspect if the condenser is clogged.
		Check that the fans of the evaporator and condenser are normal
	Too high suction overheat degree	Regulate the EEV or add proper amount of refrigerant

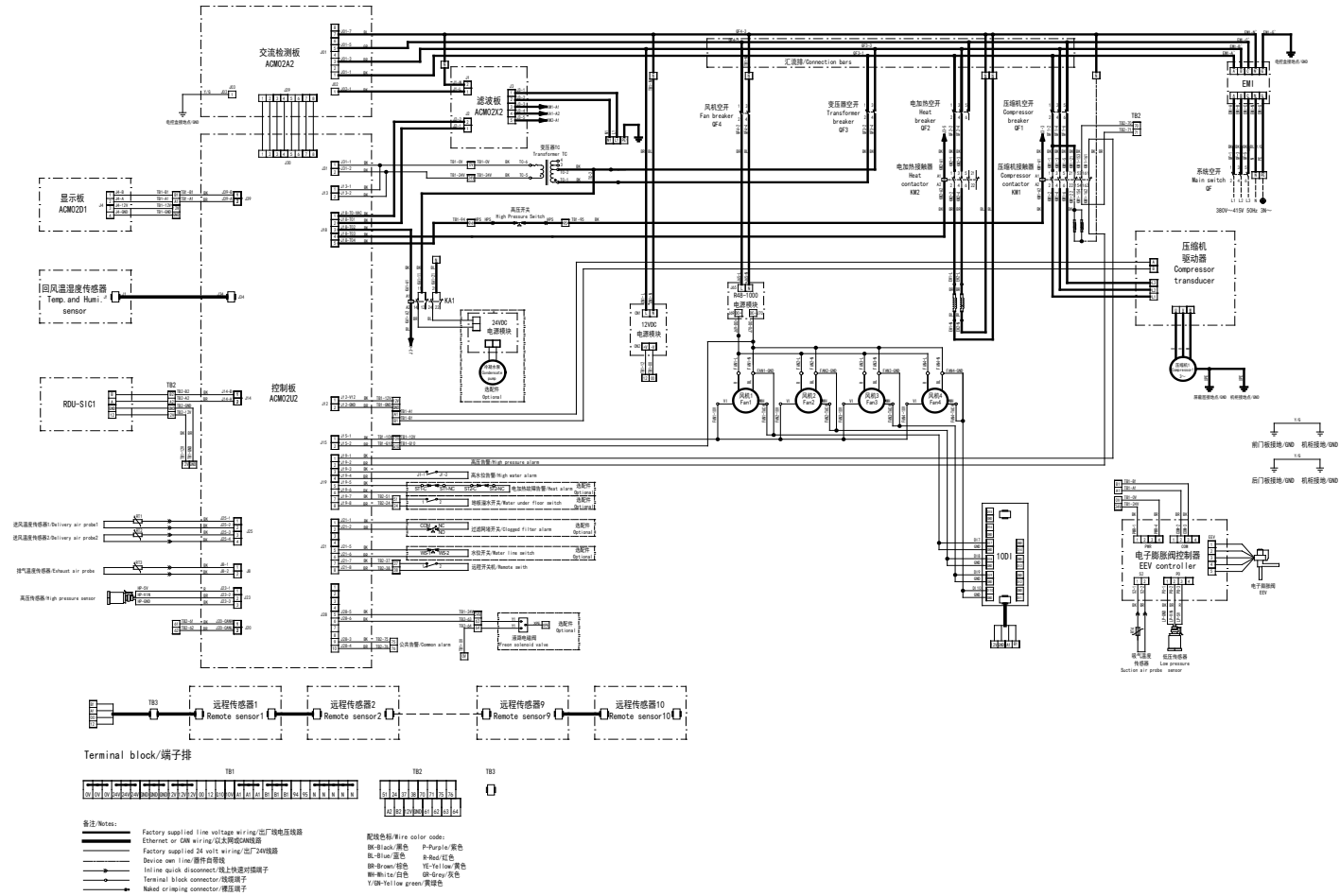
APPENDIX 1 - Circuit Diagrams

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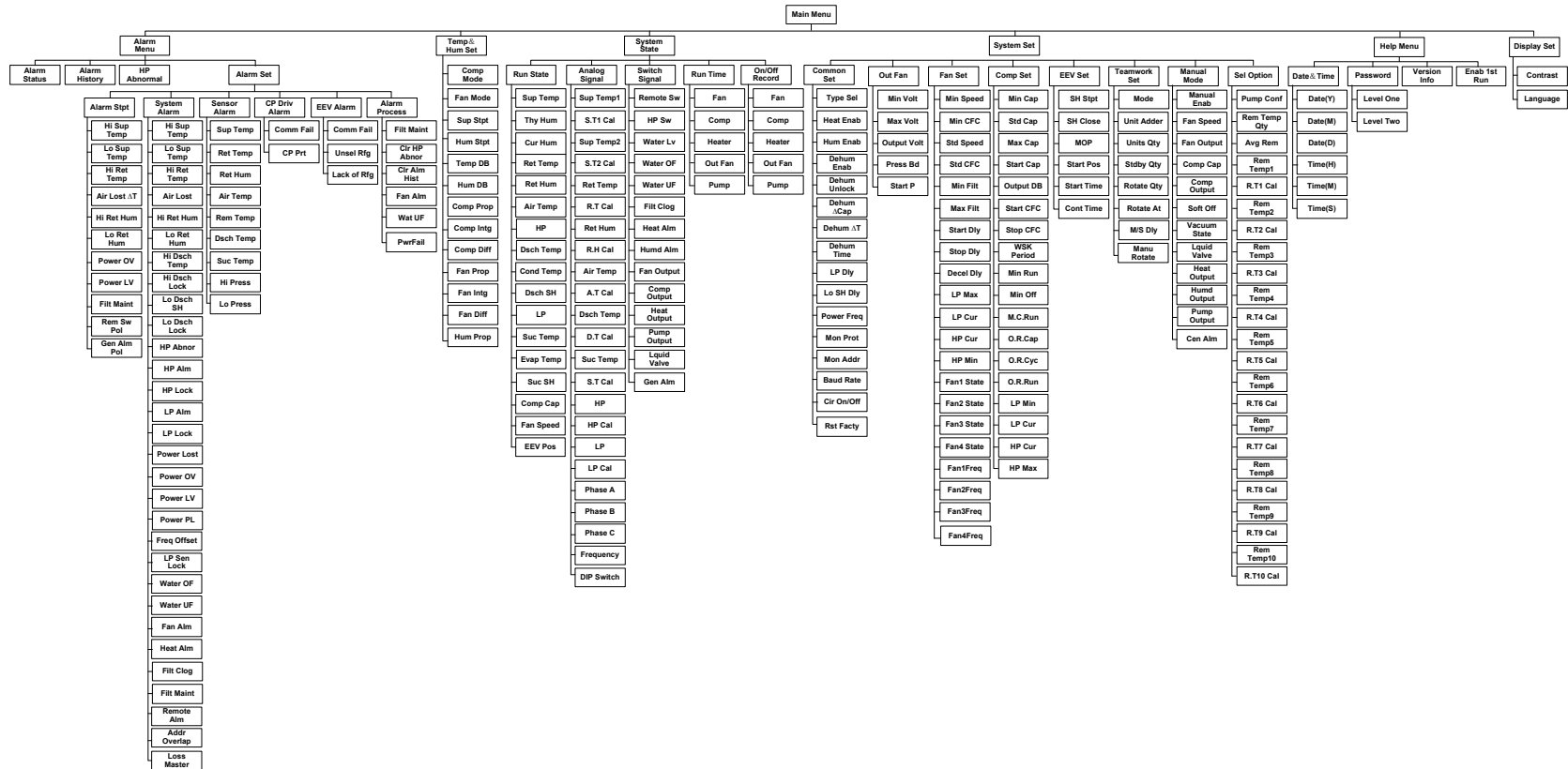




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APPENDIX 3 - Alarm Control Menu Table

Alarm output			
HP Alm	Power OV	HP Pressure Sensor Fail	Humd Alm
LP Alm	Power LV	Heater Fail	
HP Abnor	Power PL	Ext Temp Sensor Alarm	
Hi Exh Temp	Water UF	Fan/Power Module Fail	
Lo Exh SH	Water Alm	Com Fail of EEV	
Hi Ret Temp	Filt Alm	No Rfg Sel	
Lo Sup Temp	Filt Maint	Loss Rfg	
Hi Sup Temp	Air Lost	Suc Temp Sensor Alarm	
Hi Ret Hum	Lp Sen Lock	LP Pressure Sensor Fail	
Lo Ret Hum	Remote Alm	Com Fail of CP Driv	
HP Lock	Ret Temp Sensor Alarm	Driv Fail	
LP Lock	Ret Hum Sensor Alarm	Hi HS Temp	
Hi Exh Lock	Air Temp Sensor Alarm	Comp OC	
Lo Exh Lock	Sup Temp Sensor Alarm	Comp PL	
Power Lost	Rem Temp Sensor Alarm	BV Abnor	

APPENDIX 4 - Hazardous Substances or Elements Declaration

Parts	Hazardous Substances					
	Plumbum	Hydrargyrum	Cadmium	Chrome6+	PBB	PBDE
	Pb	Hg	Cd	Cr6+	PBB	PBDE
Cabinet	○	○	○	○	○	○
Cooling part	○	○	○	○	○	○
Fan unit	○	○	○	○	○	○
Heater unit	○	○	○	○	○	○
Electric control unit	×	○	○	○	○	○
LCD	×	○	○	○	○	○
Heat exchanger	○	○	○	○	○	○
Copper bus	○	○	○	○	○	○
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. has been committed to the design and manufacturing of environment-friendly products. It will reduce and eventually eliminate the hazardous substances in the products through unremitting efforts in research. However, limited by the current technical level, the following parts still contain hazardous substances due to the lack of a reliable substitute or mature solution: 1. The reason that the following parts contain Plumbum: copper alloy, high temperature solders in the products and diode, glass part of resistor (exempted) and electronic ceramic (exempted) contain Plumbum; 2. Backlight bulb contains Hydrargyrum 3. The contacts of MCB in distribution unit contain Cadmium.						
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+ series (range of models) air-cooled Precision Air Conditioner						

APPENDIX 5 - Troubleshooting of Common Startup Faults

Fault phenomena	Possible causes	Corrective actions
Display board does not turn on upon startup	Failure of control board, display board, and transformer TC, or poor connection of cables	Check the input voltage of J4-3 and 4 of display board, and check the output voltage of the J12-1 and 2 of the control board (DC 12V). Check the input voltage of J13 and J31 of the control board, and check the output voltage of the transformer TC (AC 24V) Check the input voltage of TB1-14 and 16 of transformer TC (AC 380V)
Upon startup, the display board is on and there is no display of words	Failure of control board, display board, and transformer TC, or poor connection of cables	Check the control board voltage as above. If the input voltage of display board is normal, check the communication circuit connections of J4-1 and 2 (display board) and J39-1 and 2 (control board). Check if the blinking frequency of the LEDs near J4-1 and 2 (display board) and J39-1 and 2 (control board) is normal.
Communication failure upon startup	Failure of control board, display board, EEV control board, CP control board and 10DI, or control voltage failure	Check the control board voltage as above. First, disconnect the RS485 cables of the EEV control board, CP control board and 10DI, check if there is any communication failure. If there is no communication failure, test the EEV control board, CP control board and 10DI with loads. If yes, disconnect all the cables of the control board and then apply load for test.
Power supply failure (over voltage and under voltage)	Power supply board fault, menu setting error, and poor connection of cables	Check the input voltage of J01 of power supply board and compare the voltage to the system status-analog value-ABC 3-phase voltage. Adjust the alarm menu –alarm setting –alarm setting value - over voltage and under voltage range
Upon startup, the fan does not run, fan failure	Failure of motor, power module and control board, poor connections of main circuit or control circuit	Check the input voltage of the fan (DC 48V) or check the output voltage of the power module (DC 48V). Check the output voltage of the J15-1 and 2 of the control board (DC 0~10V) and check the fan control input voltage (DC 0~10V)
Cooling signal is available, but the compressor does not start up	Compressor contactor does not close: Failure of control board and contactor, or poor connection of control circuit	Check the 220VAC control voltage between A1 and A2 of the contactor, and check if the J18-3 of the control board outputs 220V. If the 220VAC voltage is available, check if the contactor fails.
	Compressor contactor closes: Failure of contactor and compressor, and CP control board	Check if the contactor output voltage is normal Check if CP control board is normal Check the windings of the compressor
Heating signal is available, but the Electric	Heating contactor does not close: Failure of control board and contactor, or poor	Check the 220VAC control voltage between A1 and A2 of the contactor, and check if the J18-1 and 4 of the control board outputs 220V.

Fault phenomena	Possible causes	Corrective actions
Heating device does not start up	connection of control circuit	If the 220VAC voltage is available, check if the contactor fails.
	Heating contactor closes: Failure of contactor and Electric Heating device, or poor connection of control circuit	Check if the contactor input / output voltage is normal, check if the input voltage of the Electric Heating device is normal and if the over temperature protection switch is opened.
Low pressure alarm occurs when starting the compressor	Ball valve in the liquid pipe is not open	Check the temperature and internal pressure of the liquid pipe
CP drive is under protection when starting the compressor	Ball valve in the gas pipe is not open, the circuit breaker of the compressor is not closed	Open the ball valve and close the circuit breaker
High pressure alarm occurs when starting the compressor	Failure of outdoor fan, poor connection of control circuit, input voltage fault, failure of the pressure sensor	Check the menu analog values- Comparison between discharge pressure and gauge pressure, check if the pressures are consistent. Check if system menu –output voltage of the outdoor unit and the actually measured voltage (filter board J3-1 and 2) is consistent. Check the outdoor unit voltage input and fan running current.
Condenser pump does not drain at high water level	Failure of pump, power module and control circuit, or the pump is installed too high	Check if the pump and power module are normal (connect 220VAC to the power module to test the pump function) Adjust the installation locations of the pump and pipes to ensure the pump is below the water line Check if the water level switch (or short circuit J21-5, 6) can make KA1 close, and check if the pump power module has 220V voltage

