Liebert DM Series
Precision Air Conditioner

User Manual

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Purpose of the Document

This document applies to the Liebert DM 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
Warning/Danger/Caution 	The Warning/Danger/Caution note indicates a hazardous or potentially harmful situation that can result in death or injury. It also indicates instructions that need to be adhered to, failing which may result in danger and safety issues thereby having an adverse effect on the reliability of the device and security. Even for practices not related to physical injury, the content under the Warning heading is used for precautions which need to be taken which, otherwise, could result in equipment damage, performance degradation, or interruption in service.
Note 	The Note section indicates additional and useful information 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.

Version History

Issue	Revision	Changes
1	1.0	-------

Safety Precautions and Measures

The important safety precautions and measures that should be followed during the installation and maintenance of the Liebert DM 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 electric insulation which allows the users to work in safe conditions. The main switch is positioned on the electrical panel cover; Open the right door to access it. Before any maintenance operation, switch off the machine with this electronic insulation device 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 unit contains fluids and gasses 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

1 Introduction

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

Liebert DM air conditioners are products that are specifically created and designed for cooling the electrical devices. It is applicable to equipment rooms, computer rooms, and similar ecosystems which call for a high degree of accuracy and precision in maintaining the ambient temperature. 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 DM 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 DM series:

Figure 1-1

1.1 Model Nomenclature

The model nomenclature of the Liebert DM AC is shown in Figure 1-2:

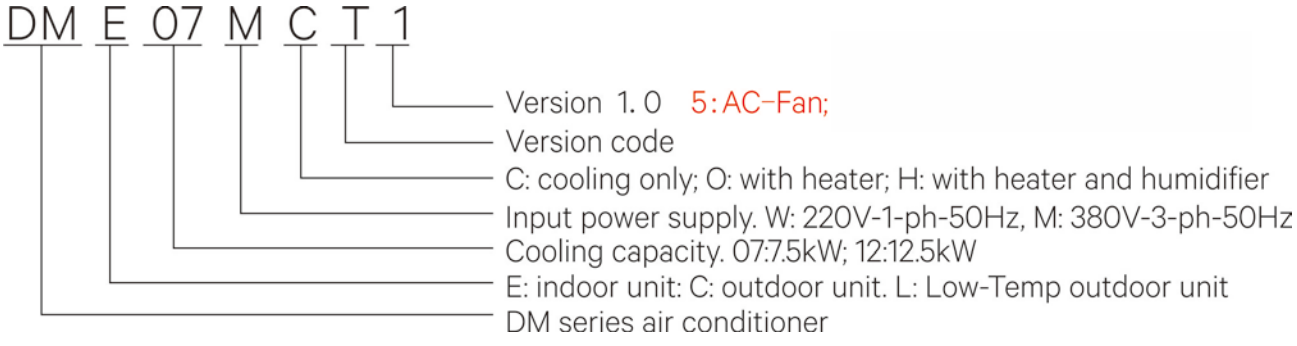


Figure 1-1

1.2 Basic Performance Parameters

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

Listing 1.1

Model	Nominal cooling capacity (kW)	Power (kW)	Annual energy efficiency ratio	Heating capacity[1] (kW)	Humidification capacity [2] (kg/h)
DME07M**5	6.85	2.36	2.9	3.2	1.5
DME12M**5	11.9	4.1	2.9	3.2	1.5

[1]: The heating capacity is only for the models with heating function;
[2]: The humidification capacity is only for the models with humidification function

1.3 Product Description

The Liebert DM AC 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 DM AC 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:

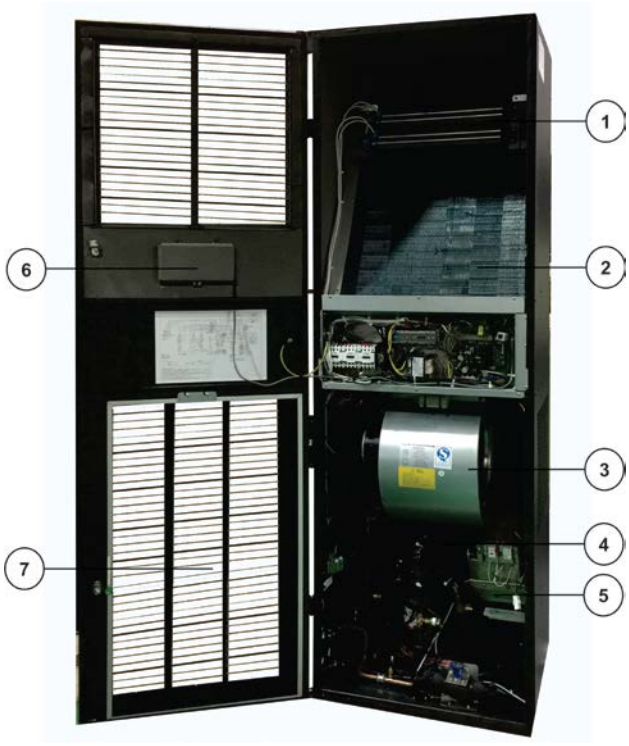


Figure 1-2

Listing 1.2

Item	Description	Item	Description
1	Heater	2	Evaporator
3	Centrifugal Fan	4	Compressor
5	Infrared Humidifier	6	Microcontroller Display
7	Filter		

In the following sections, take a look at the list of components used in the Liebert DM AC series.

1.3.1 Compressor

The Liebert DM AC series models comprise of a scroll compressor which has a host of promising features such as low operating noise, less vibration and high reliability. Its compactness, smooth compression with scroll operation and high energy efficiency ratio makes it an ideal compressor to bank on for the DM series.

Figure 1-3 shows the image of a compressor.

Figure 1-4

1.3.2 Evaporator

Heat exchanger design and appropriate air distributions are important factors that determine optimum performance. The Evaporator used in the Liebert DM AC models consists of a fin-tube heat exchanger for higher efficiency. The sophisticated design of the distributor ensures that the refrigerant is distributed evenly in each loop, thereby improving the effectiveness of the heat exchanger.
Figure 1-5 shows the image of an Evaporator.

Figure 1-5

1.3.3 Thermal expansion valve (TXV)

The thermal expansion valve controls the amount of refrigerant flow into the evaporator thereby controlling the superheat at the outlet of the evaporator. Liebert DM consists of a thermal expansion

valve with external equalizer type. It collects temperature and pressure signals at the same time to accurately regulate the refrigerant flow.

Figure 1-5 depicts the image for the TXV:

Figure 1-6

1.3.4 Micro-processing Controller

The Controller adheres to the latest and highly advanced PID regulation technology. It provides a simple operation user interface with multi-level password protection, self-recovery upon power failure, high-voltage & low-voltage protection, phase loss protection, automatic phase-sequence switching upon anti-phase and rotate speed control of the outdoor fan. The expert-level fault diagnoses system can automatically display current fault information to facilitate equipment maintenance by maintenance personnel.

Figure 1-7 depicts the panel of the Microcontroller:

Figure 1-7

1.3.5 Strainer

The Strainer filters the impurities generated during long-term system operation and ensures normal system operation.

1.3.6 Filter

Moisture can have an adverse effect on the operation and life of a system in the refrigeration cycle. To counter that effect, Filter-driers are used to filter out particles, and remove and hold moisture to prevent it from circulating through the system. The Liebert DM AC consists of nylon filter material with big mesh. The filter features compact structure and easy maintenance. It can be washed repeatedly.

1.3.7 Centrifugal Fan

Centrifugal fans are rigid and strong metal fans. Its axial flow blades help in reducing the noise. The single-phase motor with high performance is customized based on the power grid of base stations, so it can work over a wide voltage range with high reliability. It features large airflow, long blowing distance, direct driving and easy maintenance.

Figure 1-8 depicts the image for the Centrifugal Fan:

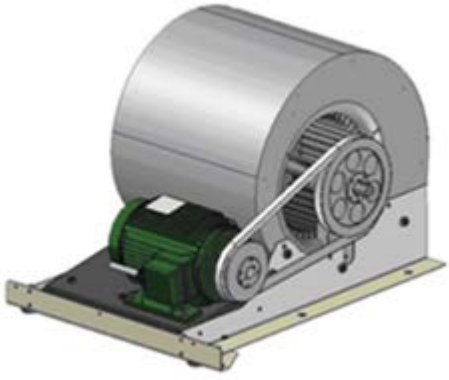


Figure 1-8

1.3.8 Condenser

The Liebert range of air-cooled condensers offers many advantages, including sharp design, antirust aluminum cabinets, low sound levels, and reliable operations over a wide range of ambient conditions.

Figure 1-9 depicts the image of a condenser:

Figure 1-9

1.3.9 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.

1.3.10 Infrared Humidifier

The infrared humidifier consists of infrared humidifier lamp, water injection valve, humidifying water dish, temperature alarm protection devices and water level alarm device.

The infrared humidifier in the Liebert DM series provides quicker and more responsive operation which is quite important for mission-critical applications. These humidifiers reduce the dependency of water quality and simultaneously achieve full capacity in quick time using almost any water quality.

Figure 1-10 depicts the image of a Humidifier.

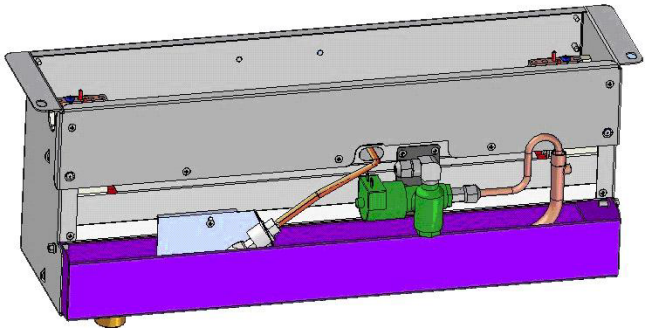


Figure 1-10 Humidifier

1. The electrode humidifier should be installed and tested at the factory.
2. The Liebert DM AC can control the ambient humidity only after a humidifier is installed.

1.4 Optional Components

1.4.1 Electric Heater

The PTC electric heaters are used as they have lower running temperatures thereby ensuring operational safety. PTC heaters are less susceptible to overheating and therefore, are long lasting due to less wear. Lower maintenance and smooth functioning make it an important utility in Liebert DM AC models.

Figure 1-11 shows an image of the Electric Heater:

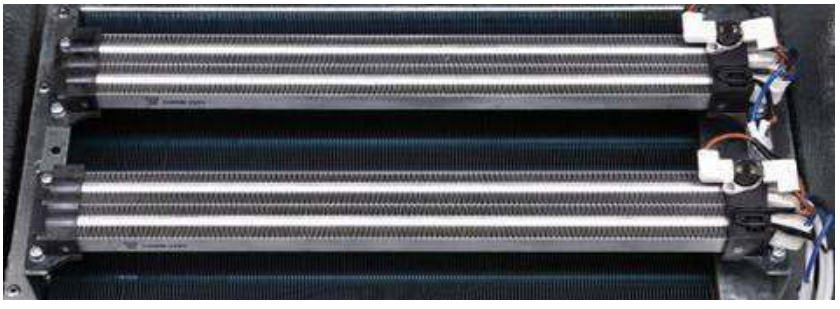


Figure 1-11

1.4.2 Remote Monitor

The Liebert DM AC communicates with the host computer through a configured RS485 port and receives the control of the host software. Select and configure a monitoring card to realize different monitoring functions. For the descriptions of the host monitoring software RDU-Cooling developed by Vertiv Co., *Refer to Appendix 4 RDU-Cooling Air-Conditioner Single-Unit Manager Software Introduction.*

1.4.3 Energy-Saving Card

The Liebert DM AC can monitor the maximum room temperature with the energy-saving card located outside the unit cabinet. The card is placed in position with high heat load and temperature. Up to four cards can be used for an AC unit. When the temperatures measured by all energy-saving cards are lower than the set-point in 'Sleep Mod' and the only indoor fan is running; if the 'Sleep Mod' is set to 'ENAB', the AC unit will turn off the indoor fan and enter the sleep mode for saving the energy.

1.4.4 Power SPD

The power SPD is used for the second level (C level) lightning over-voltage protection of the AC power. It can be easily maintained and provides status indicating and alarm function.

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	Requirements
Installation position	The maximum equivalent horizontal distance between the indoor unit and outdoor unit[1]: 50m; Vertical distance ΔH[2]: -5m ≤ ΔH ≤ 20m
Installation mode	Indoor unit: vertical mode, mounting base ≥ 150mm; outdoor unit: horizontal airflow mode
Ambient temperature	Indoor: 0°C ~ 40°C Outdoor: standard model, -15°C ~ +45°C; Low-Temp model, -34°C ~ +45°C
Ambient humidity	30%RH ~ 80%RH
Protection level	Outdoor unit: IPX4
Altitude	< 1000m. Derating is required when the altitude exceeds 1000m
Operation voltage range	380V (-15% ~ +15%), settable according to different environments, the tolerance is 3%
Note: [1]: For the equivalent lengths of parts, refer to Listing 2.5 [2]: The value is positive if the outdoor unit is installed above the indoor unit; negative if the indoor unit is installed above the outdoor unit	

1.5.2 Storage Environment

The following table 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	5%RH ~ 85%RH
Ambient temperature	-40°C ~ +70°C
Storage time	Total transportation and storage time should not exceed six months. Otherwise, the performance needs to be re-calibrated

Another essential aspect is the quality and the 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 the voiding of warranty.

1.5.3 Refrigerant Charging Requirement

The low quality or counterfeit refrigerant will damage the system severely. Please use the refrigerant approved by Vertiv Co., Ltd. For the system abnormality or damage caused by using other brands of refrigerant, Refer the table in listing 1.5 for the refrigerant brands approved by Vertiv Co., Ltd.

Listing 1.5

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

Part II
INSTALLATION

2 Installation

2.1 Pre-Installation

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

- Transportation and Movement
- Unpacking
- Inspection

2.1.1 Transportation and Movement

When transporting the system, Railroad is a 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.

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

In the previous 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 at an angle of 75° to 105°.

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

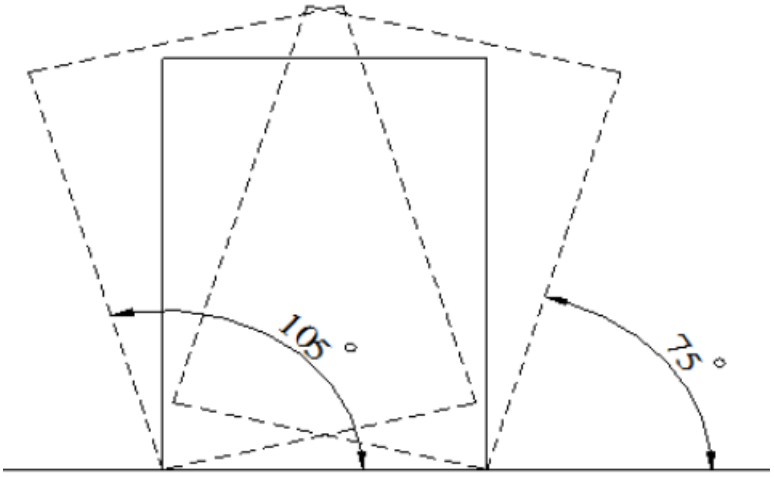


Figure 2-2

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.

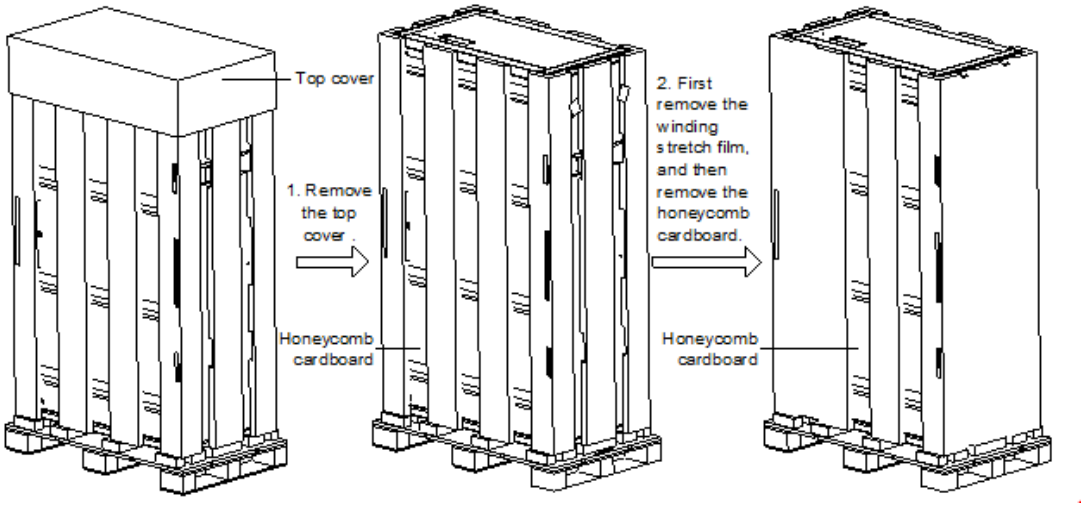


Figure 2-3

The unit is fixed on the packing pallet with M8*20 and M8*80 screws. Use a 17 mm open-end spanner, ratchet spanner, or sleeve to remove the screws.
Figure 2-4 to shows the schematic diagram:

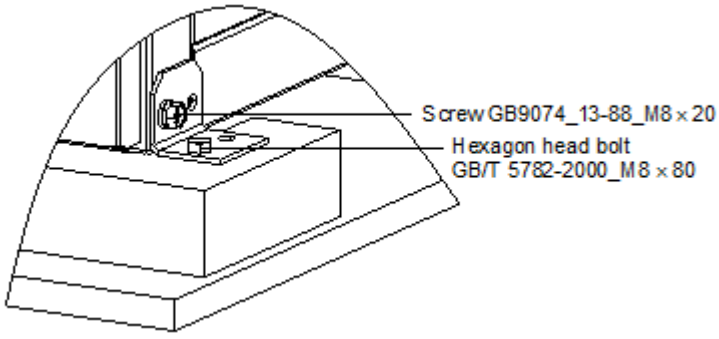


Figure 2-4

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 Liebert DM AC 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 most important elements for maintaining normal environmental control in the conditioned room are damp proof and heat preservation.*

➢ *The outside air will add to the loads of heating, cooling, humidifying and dehumidifying of the system. It is recommended that the inhalation of outside air should be kept below 5% of the total indoor airflow.*
➢ *All the doors and windows should be properly sealed to minimize the leakage and 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 DM model. 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 DM AC series are advanced precision air cooling units and therefore, these air conditioners must be installed, preferably in a capacious floor space to ensure its normal operation.

The Liebert DM AC can generate condensate water. Water leakage can cause damage to other precise equipment nearby. Do not install the AC units in the vicinity of any precision equipment. The installation site must provide drainpipes.

The installation location requirements are given as follows:

- Avoid locating the indoor unit in confined areas that affect the airflow pattern, shorten cooling cycles and result in down-draft and air noise.
- Avoid locating the indoor unit in an alcove or at the extreme end of a long, narrow room.
- Avoid locating multiple indoor units close to each other. This can result in crossing air patterns, uneven loads and compete for operation.
- Do not install additional devices (such as smoke detectors) over the cabinet for facilitating routine maintenance.

The following Figure 2-5 depicts the installation location of the indoor unit.

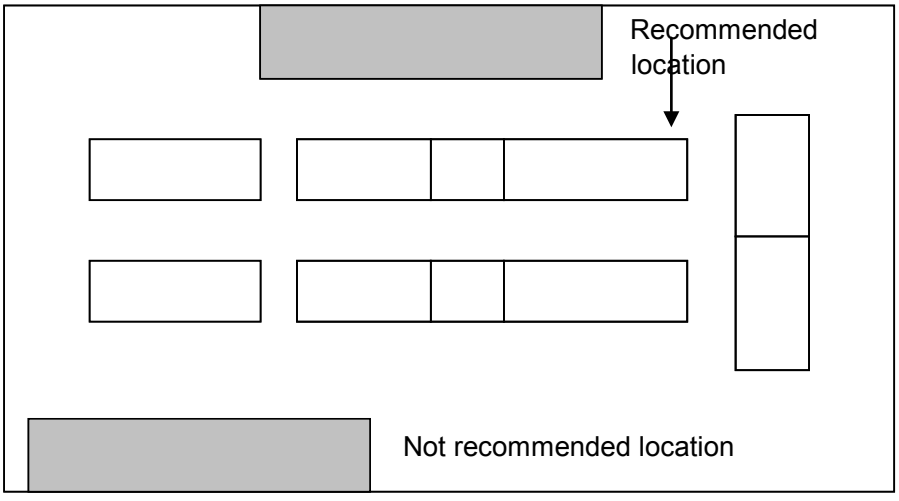


Figure 2-5

2.2.3 Installation Tools

The following table in 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	
Multi-meter		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 Liebert DM 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 for the Installation Site preparation). 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 Liebert DM 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 system general arrangement diagram is depicted in Figure 2-6.

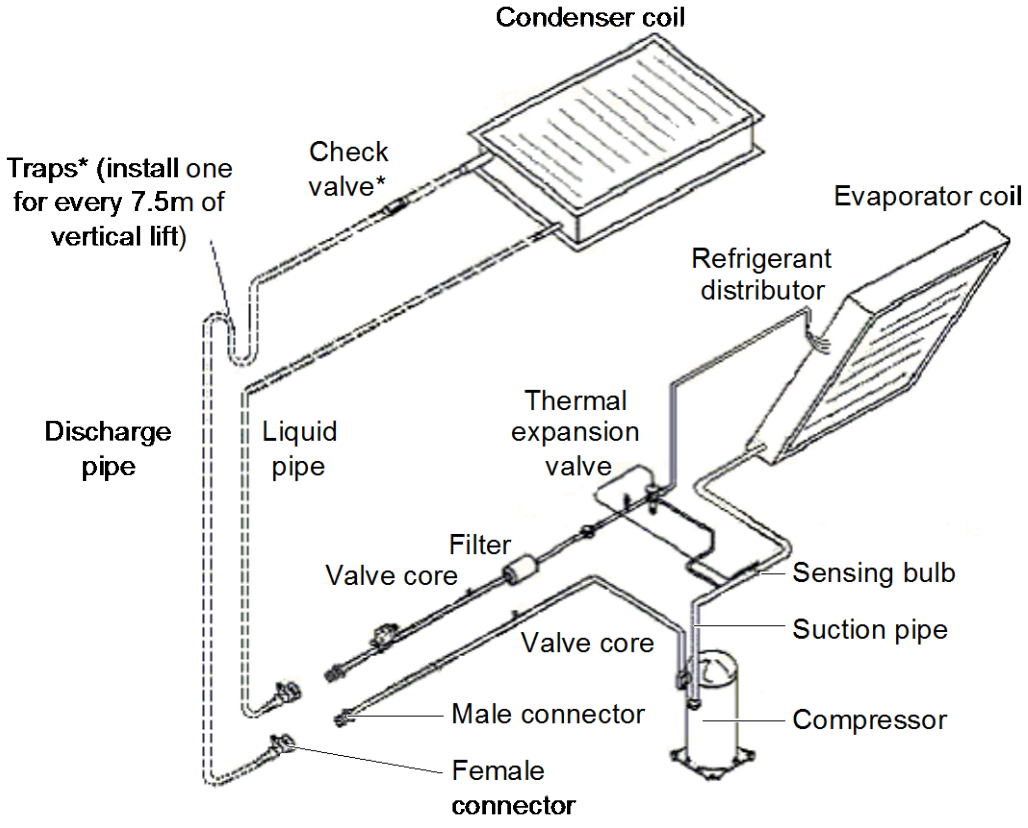


Figure 2-6 General arrangement diagram

1. ═══════ : Factory piping
2. ========== : Field piping (by technicians)

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 Co. 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.*

The standard pipe sizes are shown in Table within Listing 2.2.

Listing 2.2

Actual cooling capacity	Pipe length (m)	Discharge pipe	Liquid pipe

			OD	OD
Liebert DM AC series	7.5kW unit	5	1/2” (12mm)	3/8” (10mm)
	12.5kW unit	5	5/8” (16mm)	1/2” (12mm)

2.3.2 System Installation Mode

The Liebert DM AC is available in two installation modes:

- *Outdoor unit installed higher than Indoor unit*
- *Indoor unit installed higher than Outdoor unit.*

The schematic diagram of Outdoor Unit installed higher than Indoor unit is depicted in Figure 2-7

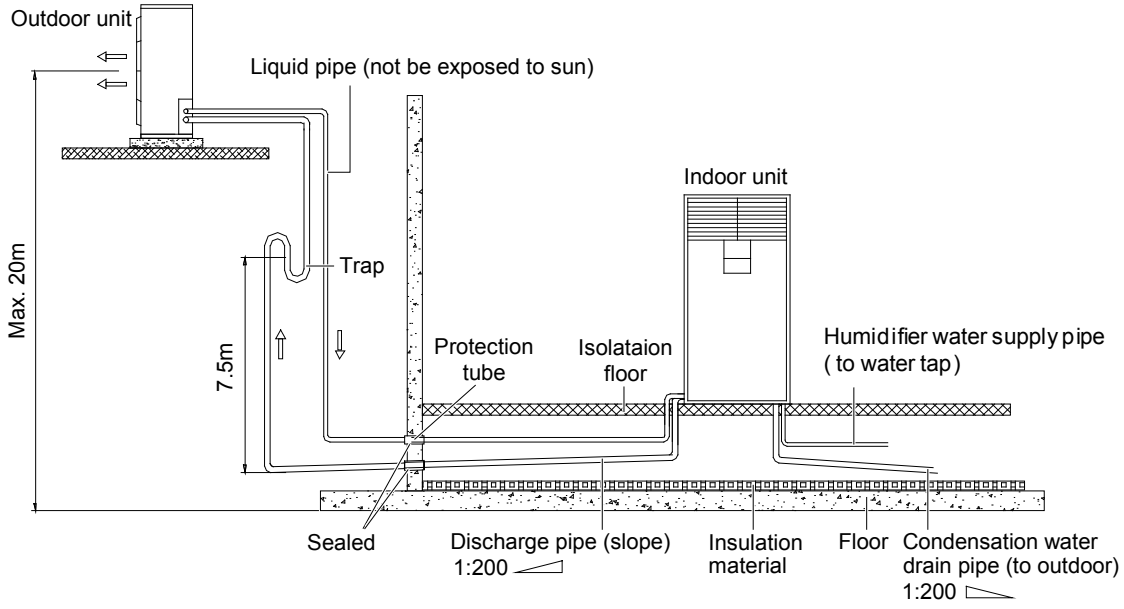


Figure 2-7 Outdoor unit above indoor unit

The schematic diagram of Indoor Unit installed higher than Outdoor unit is depicted in Figure 2-8

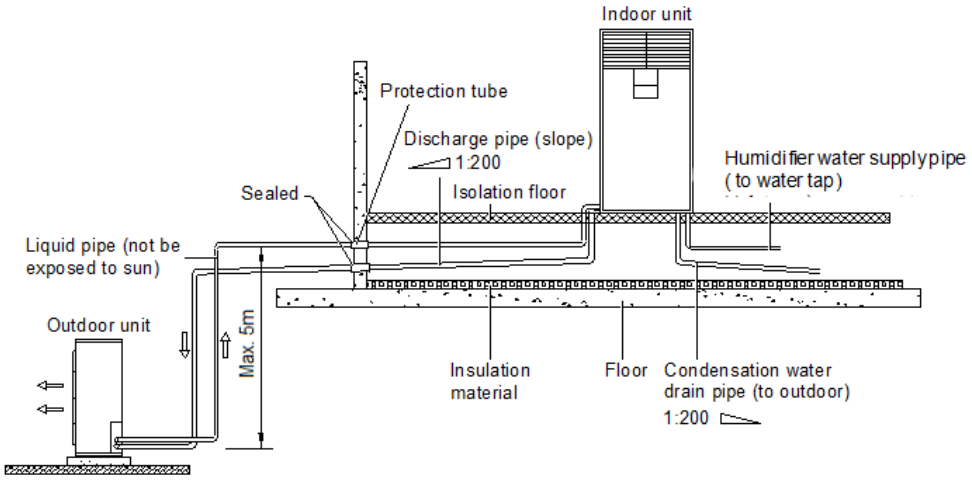


Figure 2-8 Indoor unit above outdoor unit

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 2.3

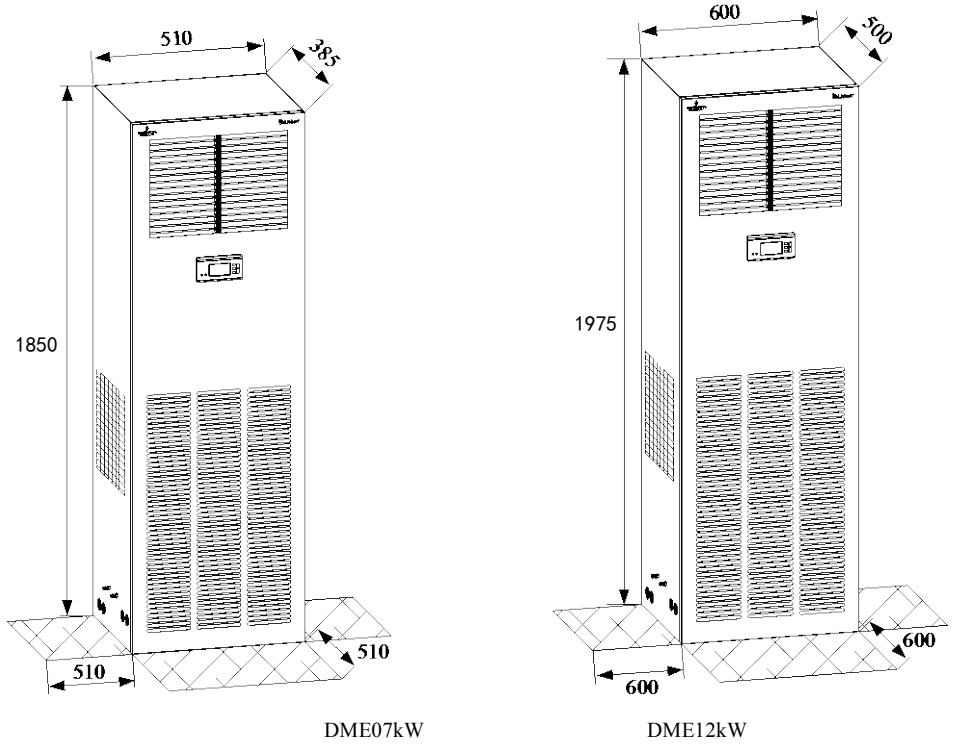
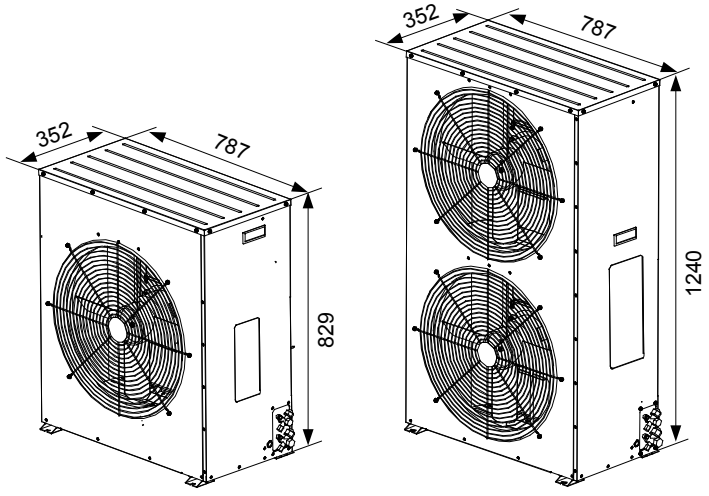


Figure 2-9 Dimensions of indoor unit (unit: mm)

The shadows in Figure 2-10 indicate a reasonable installation and service space. The two sides of the unit need air inlet. Adequate service space must be reserved for the unit to facilitate maintenance. The AC unit equipped with a heater should be kept a distance of minimum 150 mm from combustible substance. When testing the AC unit, keep the external static pressure below 150Pa lest the air volume becomes too low and the heater becomes too hot.

2.3.4 Outdoor unit

The mechanical parameters of the outdoor unit are shown in Figure 2-10, 2-11 and Table 2.3



2-10 Dimensions of standard outdoor unit (unit: mm)

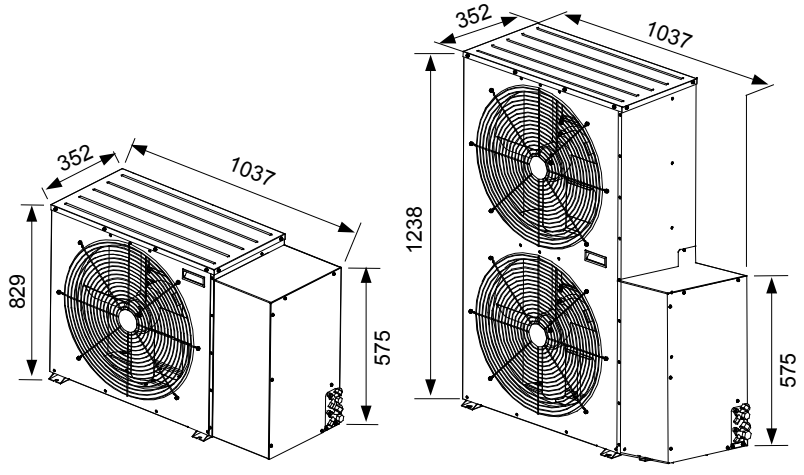


Figure 2-11 Dimensions of Low-Temp outdoor unit (unit: mm)

Listing 2.3

Model	Cooling capacity (kW)		Dimensions (W × D × H) in mm	Net weight (kg)
Indoor unit	7.5		510 × 385 × 1850	100
	12.5		600 × 500 × 1975	155
Outdoor unit	Standard model	7.5	787 × 352 × 829	40
		12.5	787 × 352 × 1240	60
	Low-Temp model	7.5	1037 × 352 × 829	55
		12.5	1037 × 352 × 1238	90

2.3.5 Indoor Unit Installation

1. The outline and dimensions of the mounting base are shown in Figure 2-12.

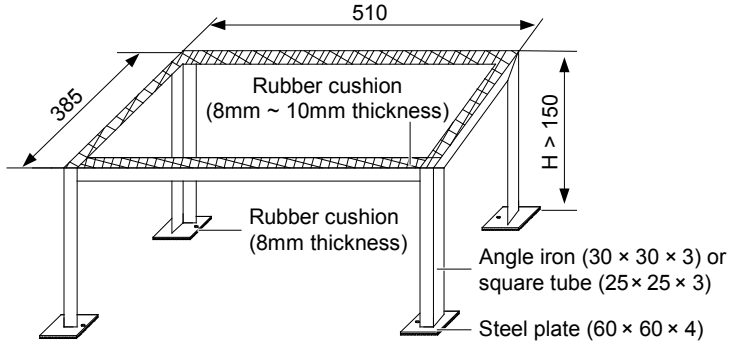


Figure 2-12 Mounting base of DME07kW indoor unit

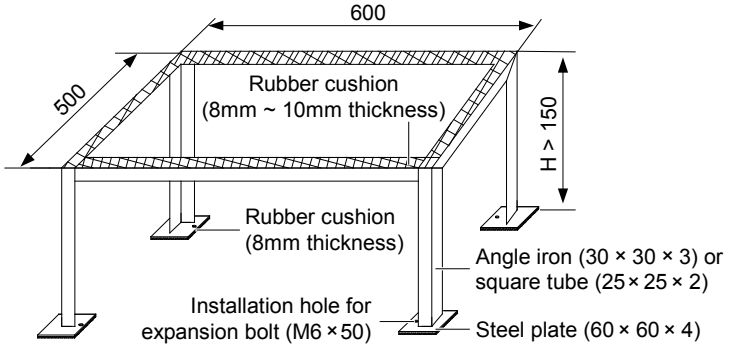


Figure 2-13 Mounting base of DME12kW indoor unit

Mounting base (unit: mm)

2. Lay a rubber cushion with 8mm ~ 10mm thickness on the mounting base, as shown in above figure.

3. Place the indoor unit onto the mounting base and secure it with nuts, spring washers, flat washers and bolts.

4. Rotate the grilles to regulate the airflow direction of the indoor unit, and the regulating angle is 45°, as shown in Figure 2-14.

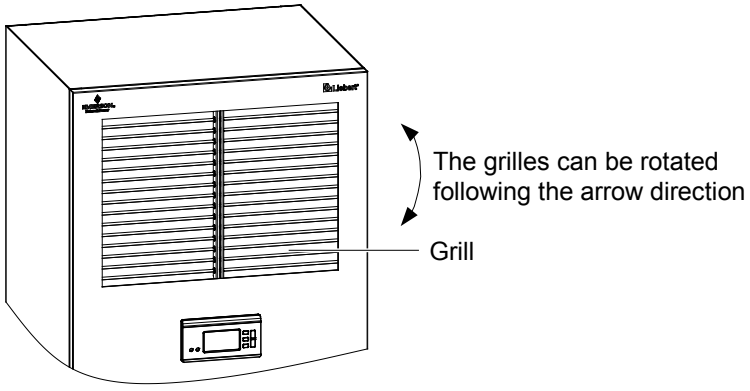


Figure 2-14 Regulating airflow direction

2.3.6 Outdoor Unit Installation

The installation location requirements are mentioned as follows:

- *Install the outdoor unit in a place which is secure and easy for maintenance. Do not install it on ground-level sites with public access and be away from residential areas.*
- *Do not locate it directly in the environment that requires low noise.*
- *To ensure heat dissipation effect, locate it in a clean area, which is away from loose dirt and foreign matter to avoid clogging the heat exchanger.*
- *Do not locate it in the vicinity of steam, hot air and exhausts.*
- *Keep a clearance of more than 450 mm between the outdoor unit and the wall, obstruct and adjacent devices.*
- *Avoid areas where snow will accumulate at the air inlet and outlet side of the outdoor unit.*
- *Prepare a solid base capable of supporting the outdoor unit weight (refer listing 2.3). The base should be at least 50mm higher than the surrounding ground and 50mm larger than the dimensions of the outdoor unit base, as depicted in Figure 2-17.*

2.3.7 Procedure

- *Place the outdoor unit on the base.*
- *Secure the outdoor unit onto the base with expansion bolts. The installation hole size of the base is shown in Figure 2-15 and Figure 2-16.*

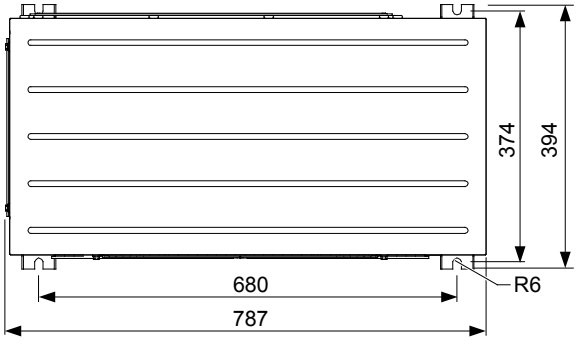


Figure 2-15 Installation hole dimensions of standard outdoor unit base (top view, unit: mm)

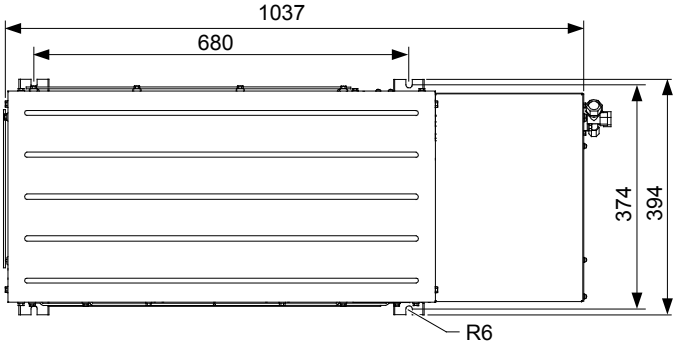


Figure 2-16 Installation hole dimensions of Low-Temp outdoor unit base (top view, unit: mm)

If multiple outdoor units are needed to be installed one above the other, refer Figure 2-17 to install them.

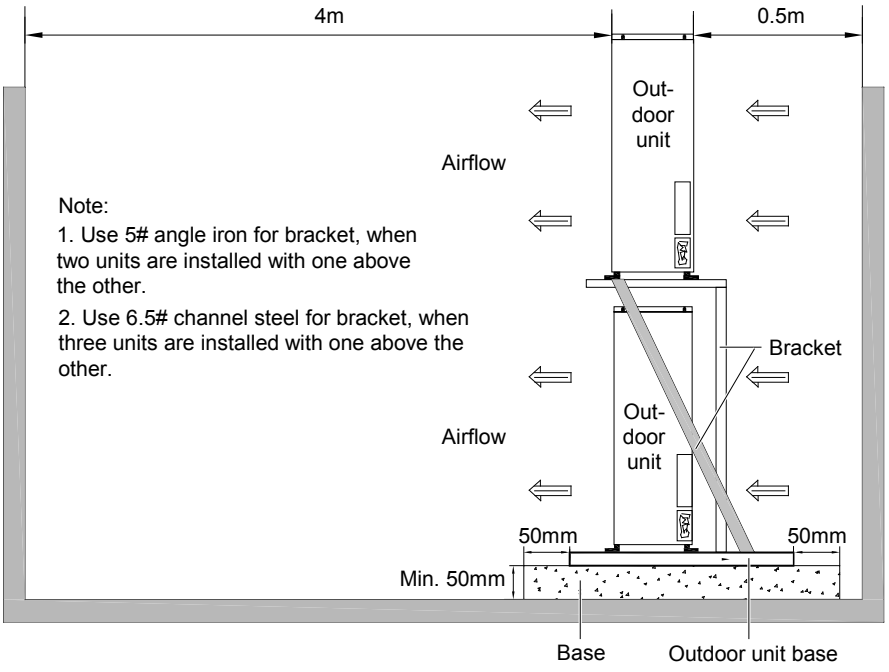


Figure 2-17

2.3.8 Piping for AC Unit

General Principles

- *Copper pipes with a quick thread connector should be used to connect to the indoor and the outdoor unit. If the pipe length exceeds the standard pipe length (refer listing 2.2) and the straight copper pipe is used, piping joints must be brazed.*
- *Standard industry procedures must be followed in the selection and placement of pipe, and charging with refrigerant (only when the pipeline is too long). The standard refrigerant of the AC unit is R407C.*
- *Considerations must be given to pipeline pressure drop, oil return to the compressor, to avoid oil leakage and clogging in parts of the system and minimize noise and vibration to the greatest extent.*
- *Always consult Vertiv Co. before installation on the measures such as, using extended piping kit are needed, if the equivalent length exceeds 30m, or if the vertical distance between the indoor unit and the outdoor unit exceeds the values as mentioned in Table within Listing 2.4.*

Listing 2.4

Relative position	Value
Outdoor unit installed higher than indoor unit	Maximum: 20m
Outdoor unit installed lower than indoor unit	Maximum: 5m

- *The equivalent length of each part is given in Table within Listing 2.5. The resistance loss caused by elbows and valves has been taken into consideration. The installer should confirm if these values are appropriate for site conditions.*

Listing 2.5

Liquid pipe OD (inch)	Equivalent length (m)		
	90° elbow	45° elbow	T-type three 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

2.3.9 Installation Notes Of Connector

Utmost care should be taken while connecting the quick thread connector. Read the following steps before carrying out the connections:

1. Remove the dust-proof caps.
2. Carefully wipe coupling seats and threaded surface with a clean cloth.
3. Lubricate the male thread with the refrigerant oil.
4. Thread the coupling halves together by hand to ensure that the threads mate properly.
5. Tighten the coupling body's hexagon nut and union valve until a definite resistance is felt.
6. Use a marking pen to draw a line lengthwise from the coupling union nut to the bulkhead. Tighten the nuts an additional quarter turn with two wrenches. The misalignment of the lines indicates how much the coupling has been tightened. The final quarter turn is necessary to ensure that the joint does not leak. Two wrenches must be used to cooperate with each other during connection because using one wrench can damage the coupling copper lines easily.

The recommended torque values are mentioned in Table within Listing 2.6.

Listing 2.6

Coupling size	Torque value (N-m)
5/8”	7 ~ 8
3/4”, 7/8”	25 ~ 32

2.3.10 Required Pipe Connections

Refer Figure 2-7; the required pipe connections are mentioned as follows:

The refrigerant pipe between the indoor unit and the outdoor unit (discharge pipe and liquid pipe).

Drain pipe of the indoor unit.

The following pipe connection is required if a humidifier is selected.

Water supply pipe to the humidifier.

Before starting, ensure that all the pipe connections have been completed without leakage after engineering installation.

2.3.11 Connecting Refrigerant Pipe

The following notes should be considered while connecting a refrigerant pipe:

1. The indoor unit and outdoor unit should be determined based on the specifications mentioned in Table within listing 2.7. If longer pipes are required, contact Vertiv Co. or the concerned sales agency.
2. The liquid pipe is the refrigerant liquid pipe of the outdoor unit outlet. Thereby, a reasonable pipe diameter and length should be selected for the liquid pipe to ensure that the pressure drop of the refrigerant liquid through the pipe during unit operation does not exceed 40kPa (5psi ~ 6psi).
3. The pipe should be installed and removed with utmost care so that they will not get kinked or damaged. Ensure to use the tube benders and make all the bends before making connections to either end.
4. If the joint mode is needed, all refrigerant piping should be connected with silver-brazed joints.
5. Check the piping supports, leakage testing, dehydration of refrigerant pipes and evacuation before use. A vibration isolating support should be used to isolate the refrigeration pipes from the building.
6. Use a soft and flexible material to pack around the pipes to protect them from damage caused by going through openings in walls and to reduce vibration transmission.
7. While installing the outdoor unit 7.5m higher than the indoor unit, a trap should be installed on the discharge pipe. This trap will retain refrigerant oil in the off cycle of the compressor. When the

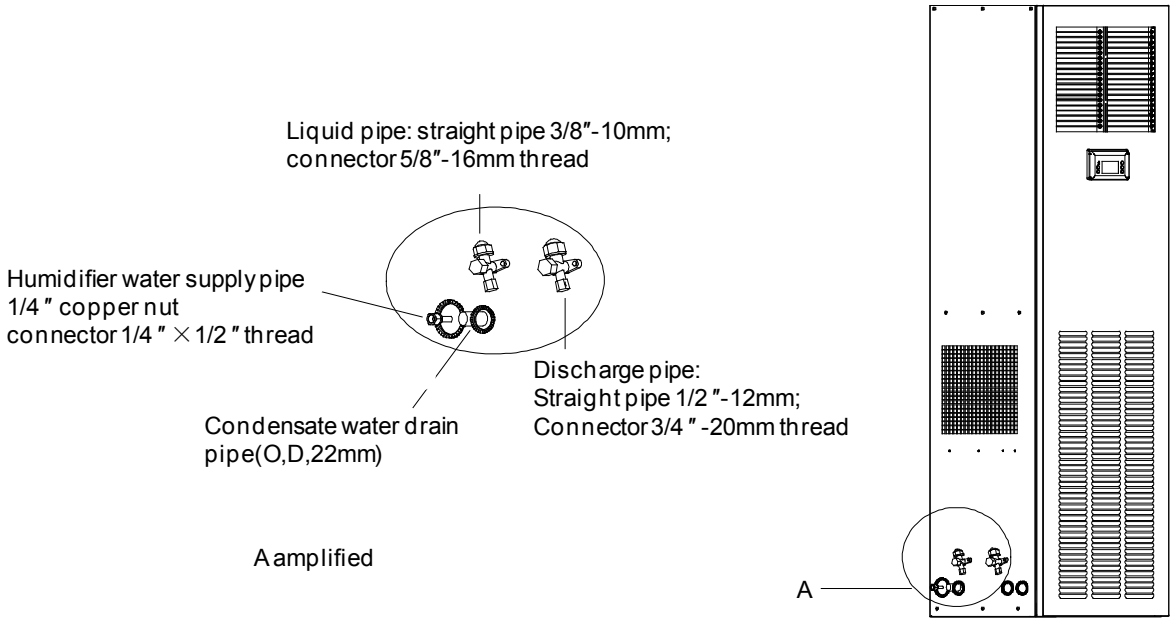
compressor starts, oil in the trap will be carried up the vertical riser and return to the compressor immediately.

Listing 2.7 Recommended pipe sizes (unit: mm)

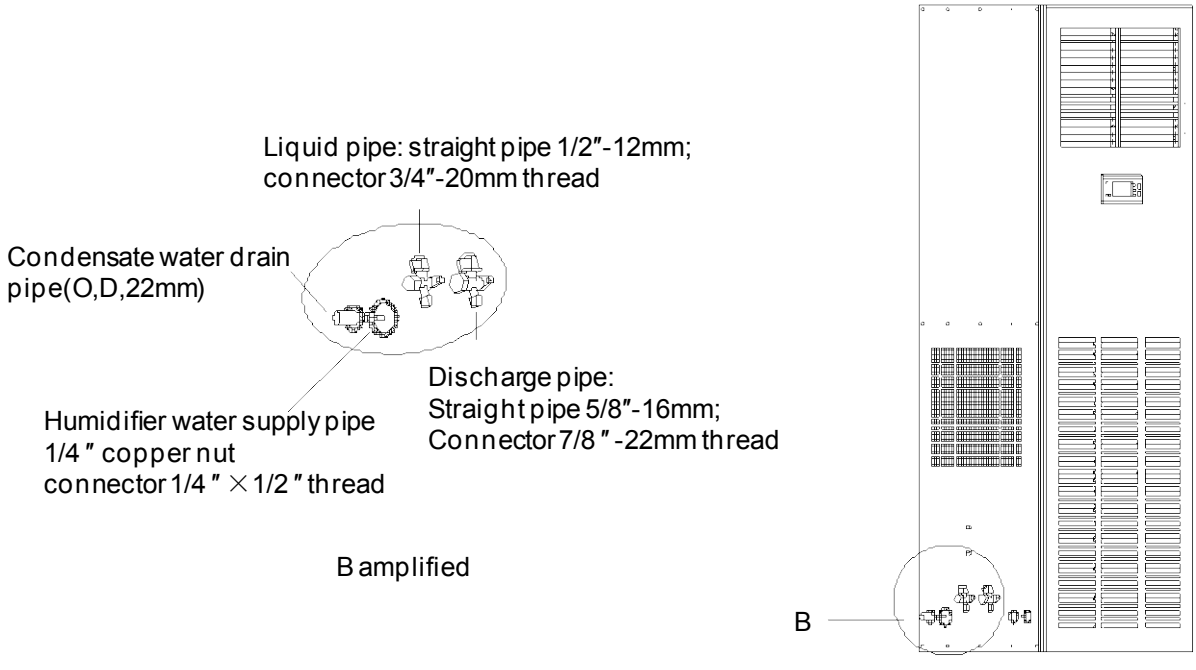
Model	DME07		DME12	
Pipe length	D	L	D	L
10m	12.7	9.52	16	12.7
20m	12.7	9.52	16	12.7
30m	16	9.52	19	12.7
40m*	16	9.52	19	12.7
50m*	19	9.52	22	12.7
Note: 1. A pipe extension kit is required for 'Eq.Lgth' marked with *. 2. D: discharge line, L: liquid line. 3. Consult Vertiv Co. if the pipe length exceeds 50m.				

2.4 Pipe connector position

The pipe connectors inside the indoor unit are shown in Figure 2-18.



Pipe connectors inside DME07kW indoor unit



Pipe connectors inside DME12kW indoor unit

Figure 2-18

2.4.1 Connecting discharge pipe

Connect one end of the discharge pipe to the discharge pipe connector of the indoor unit (shown in Figure 2-18) and the other end to the discharge pipe connector of the outdoor unit (shown in Figure 2-19).

The discharge pipe is the pipe at the compressor discharging side. Its horizontal section should be sloped downward, away from the compressor, with a slope of at least 1:200 (5mm down for each 1m run). The discharge pipe should be insulated where it is routed in the conditioned space (including under a raised floor).

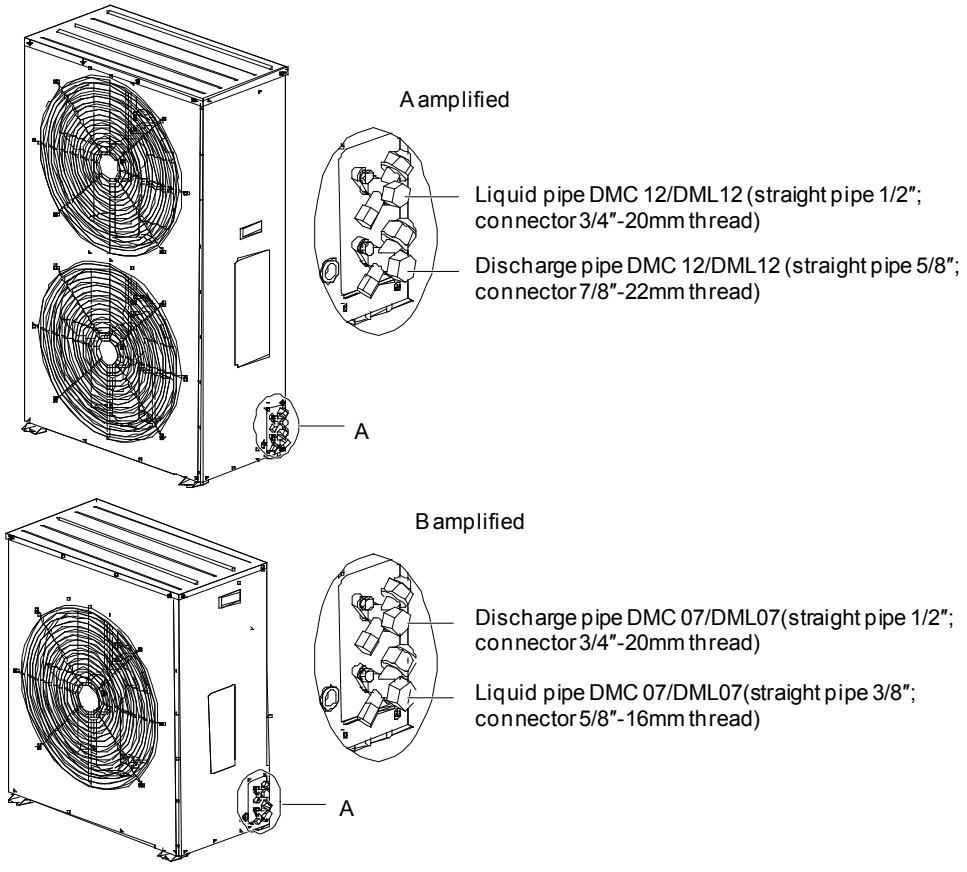


Figure 2-19 Refrigerant pipe connectors of outdoor unit

2.4.2 Connecting liquid pipe

Connect one end of the liquid pipe to the liquid pipe connector of the indoor unit (shown in Figure 2-18) and the other end to the liquid pipe connector of the outdoor unit. (shown in Figure 2-19).

2.4.3 Connecting Drain Pipe Of Indoor Unit

The drainage pipe of the indoor unit equipped with a humidifier must be able to endure the hot water up to 90℃. Use galvanized steel pipe, aluminum-plastic composite pipe with hot water type or PP-R polypropylene plastic pipe with hot water type as the drainage pipe.

Connect one end of the drain pipe to the connector of condensate water drain pipe (shown in Figure 2-18). Pipe with I.D 22 mm should be used as the indoor unit provides copper pipe of O.D 22 mm to connect with the drainage pipe. One of the accessories used is a clamp to fix the outdoor drainage pipe.

2.4.4 Connecting Humidifier Water Supply Pipe (If Applicable)

An isolation valve should be installed on the humidifier water supply pipe for easy maintenance.

Connect the humidifier water supply pipe to the connector of the AC unit shown. The unit provides the humidifier with copper pipe (O.D 6.35mm). The 1/4" copper nut at the end of the copper pipe and the 1/4" × 1/2" conversion copper thread connector has been connected to the copper nut to avoid losing them.

Where the main pipe pressure may rise above 700kPa (The main pipe pressure should be between 100kPa ~ 700kPa), a pressure reducer should be fitted.

Where the main pipe pressure falls below 100kPa, a water tank and pump system should be used.

Some products may include components required by local codes.

2.4.5 Removing Transportation Fastener And Vibration Absorber

To protect partial components from damaging and distorting due to bumping, impact and resonation; fasteners and vibration absorbers are mounted at certain locations before delivery. Remove the fasteners and vibration absorbers before the installation and commissioning.

Removing transportation fixing plate of the compressor

To reduce the compressor's operational noise and vibration; the vibration absorbing cushions are added to the compressor base. However, such a method cannot suitably restrain the equipment vibration during transportation and would result in loosened connections and wear of certain parts. To prevent this, three U-shaped fixing plates are added to the compressor base, as shown in Figure 2-20.

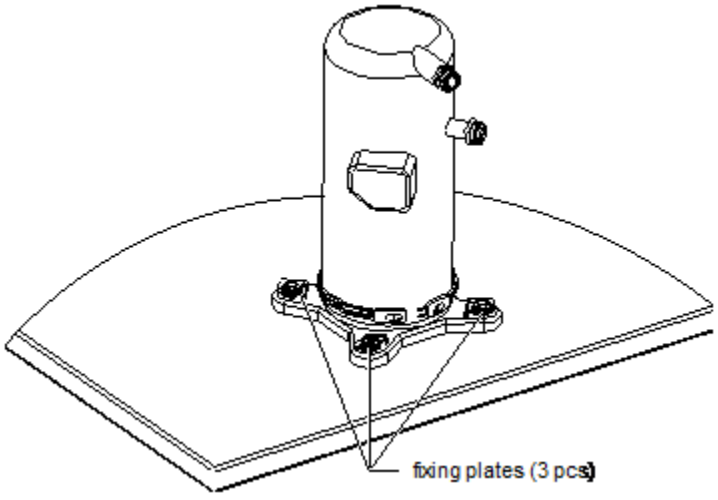


Figure 2-20

After the installation and before commissioning, remove the three U-shaped fixing plates, and then restore the bolts and washers. The fastening torque of the bolts is (12 ± 1) Nm.

2.4.6 Adding Refrigerant For Long Pipe System

The Liebert DM AC has been charged with appropriate refrigerant before delivery. If the connecting pipe between the indoor unit and the outdoor unit is longer than 10m, add refrigerant to the system in order to ensure normal system operates based on the following formula:

Adding refrigerant amount (kg) = adding refrigerant amount per meter of liquid pipe (kg/m) × total length of extended liquid pipe (m)

Refer Table within listing 2.8 for the adding refrigerant amount per meter of liquid pipe with different OD liquid pipes.

Total length of extended liquid pipe (m) = total length of liquid pipe (m) - 5m.

Listing 2.8

Liquid pipe OD (inch)	Adding refrigerant amount per meter (kg/m)
3/8	0.060
½	0.112
5/8	0.181
¾	0.261
7/8	0.362
1-1/8	0.618

2.4.7 Check List

Confirm the items listed in the table under listing 2.9 on completion of Mechanical Installation.

Listing 2.9

Item	Result
Proper clearance for service access is maintained around the AC unit	
The equipment is placed vertically and mounting fasteners are fastened	
Check compressor mountings to avoid vibration later	
The pipes between the indoor unit and outdoor unit are completed. The quick connector valves of the indoor unit and outdoor unit are fully opened	
Suction pipes should be insulated properly	
The drain pipe is connected and insulated	
Water supply pipe is connected to the humidifier (if required)	
All pipe connectors are tight	
After installation, foreign materials in and around the equipment are removed (such as shipping materials, construction materials, tools, and so on)	
Rotate the fan blades with the hand; the fan rotates freely without unusual noise	

2.5 Electrical Installation

In this chapter, the electrical installation of the Liebert DM 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 DM 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 250 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 250 circuit ratio.

2.5.1 On-site Wire connections

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

- *Power cable of the indoor unit: 3P5W (3×L +N +PE).*
- *Power cable of the outdoor unit: standard model (L + N + PE) and Low-Temp model (L + L' + N + PE).*
- *Unit monitoring and control cable (if the remote control is applicable).*
- *Energy-saving card cable (if applicable).*

2.5.2 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. Power supply cords should not be lighter than ordinary PVC sheathed flexible cord GB5023.1 (IDT IEC60277) of the No. 53 line.*
- *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: 3P5W (380Vac, 50Hz, 3×L +N +PE).*
- *The electrical installation must be completed by trained professionals.*
- *Prior to wiring, a voltmeter must be used to measure the power voltage and ensure that the power has been switched off.*
- *An all-pole disconnection device must be configured upstream the device to ensure operation safety.*
- *If the supply cord is damaged, to avoid danger, a replacement must be made by the manufacturer, the maintenance department or similar department professional replacement.*

2.5.3 Connecting Power Cable Of Indoor Unit

The recommended cable size is not less than 10AWG (6 mm2).

Use the provided inner hexagon wrench to rotate the indoor unit locks, open the front door. At this point, the power output terminal of the indoor unit is revealed at the left side panel, as shown in Figure 2-21.

The Figure 2-21shows the Power connection position of indoor unit:

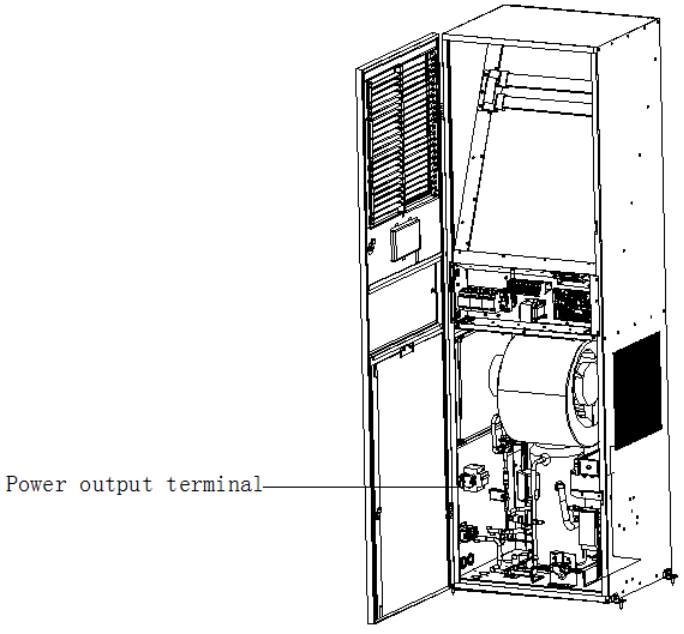


Figure 2-21

Lead the power cable through the cabling hole, connect it to the power output terminal of the indoor unit, and fasten it with a cable clamp, as shown in Figure 2-22. Connect the other end to the AC power outside the AC system.

The Figure 2-22 depicts the input and output power wiring of the indoor unit.

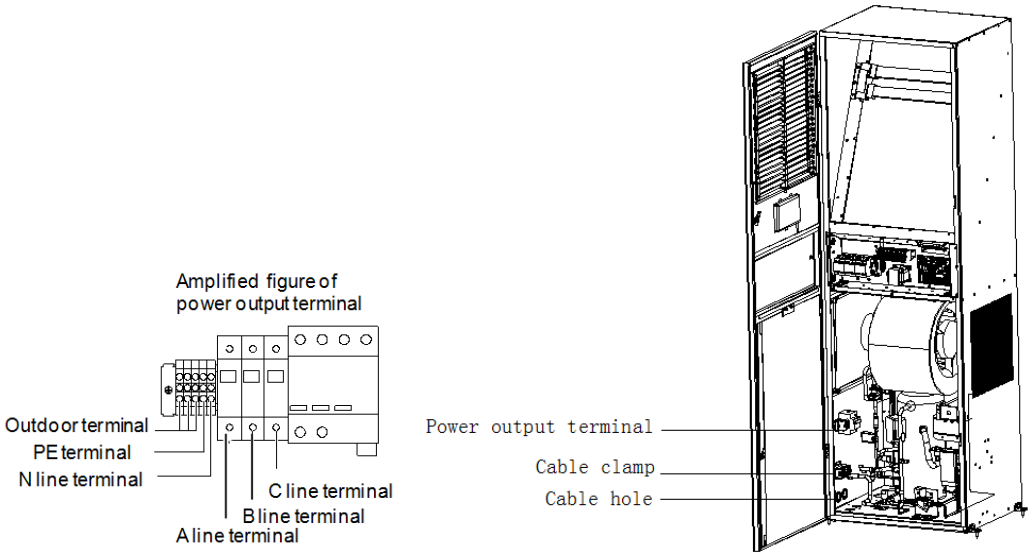


Figure 2-22

- *Use copper cables only and ensure that all connections are solid while wiring*
- *Make sure that the power voltage matches the voltage specified on the unit nameplate.*
- *Install a disconnect switch before the power input of the indoor unit to isolate the unit for maintenance. Connect the power cable to the disconnect switch and then to the unit.*
- *Cut off the power to the unit before maintenance inside the unit because the unit contains high voltage*

2.5.4 Connecting Power Cable Of Outdoor Unit

The standard length of the outdoor unit power cable is 8m, if a longer cable is required, contact Vertiv Co. The recommended cable size is not less than 18AWG (0.75mm2).

Connect one end of the outdoor unit power cable to the power output terminal of the indoor unit (shown in Figure 2-22) and the other end to the power connection terminals of the outdoor unit (shown in Figure 2-23 and Figure 2-24).

The Figure 2-23 shows the Power connection of standard model outdoor unit

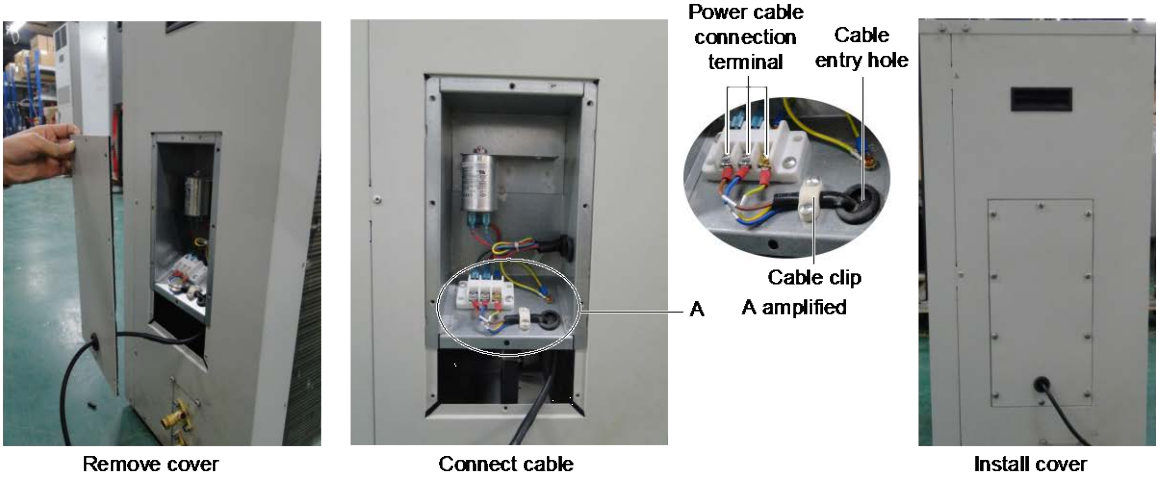


Figure 2-23

The Figure 2-24 shows the Power connection of Low-Temp model outdoor unit.

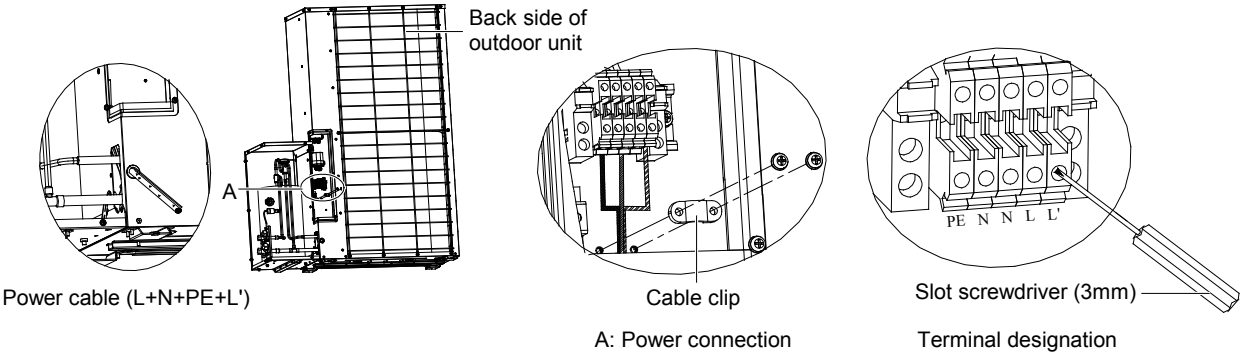
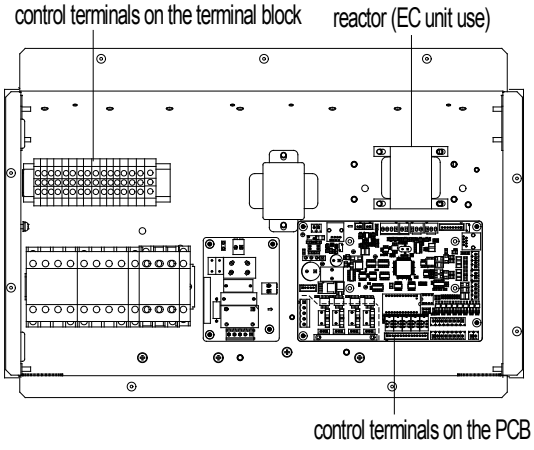


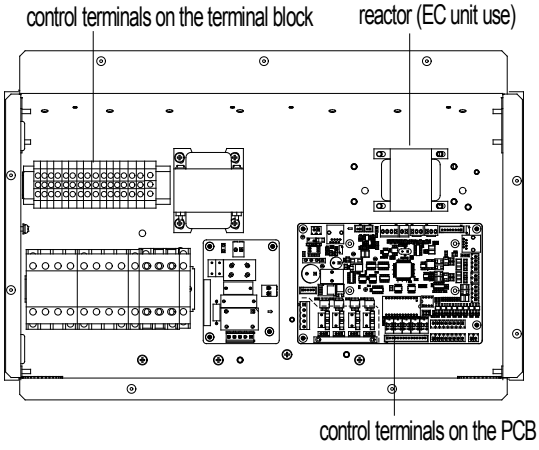
Figure 2-24

2.5.5 Connecting Control Terminals

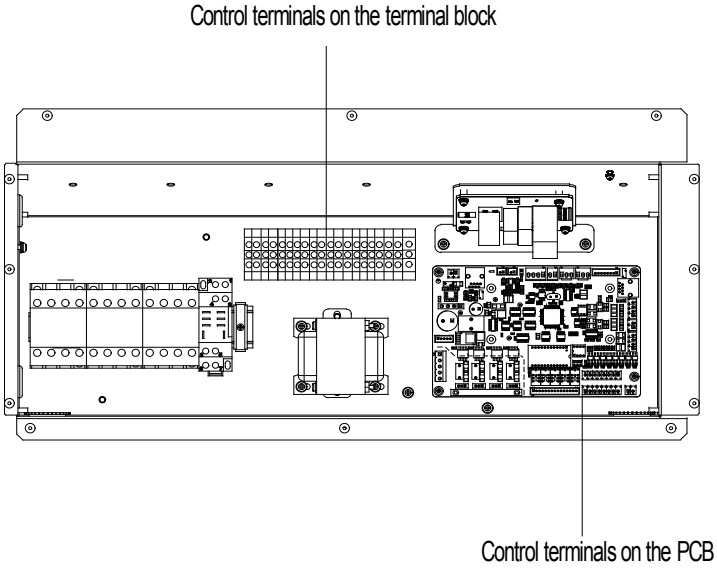
The control terminals are located on the PCB and terminal block of the electrical control box, as shown in Figure 2-25.



7.5KW single cooling unit



7.5KW humidification unit



12KW cooling unit

Figure 2-25 Control terminal position

The control terminals on the PCB are shown in Figure 2-26; the control terminals on the terminal block are shown in Figure 2-27.

Before connecting the control cables, the service personnel must take anti-static measure.

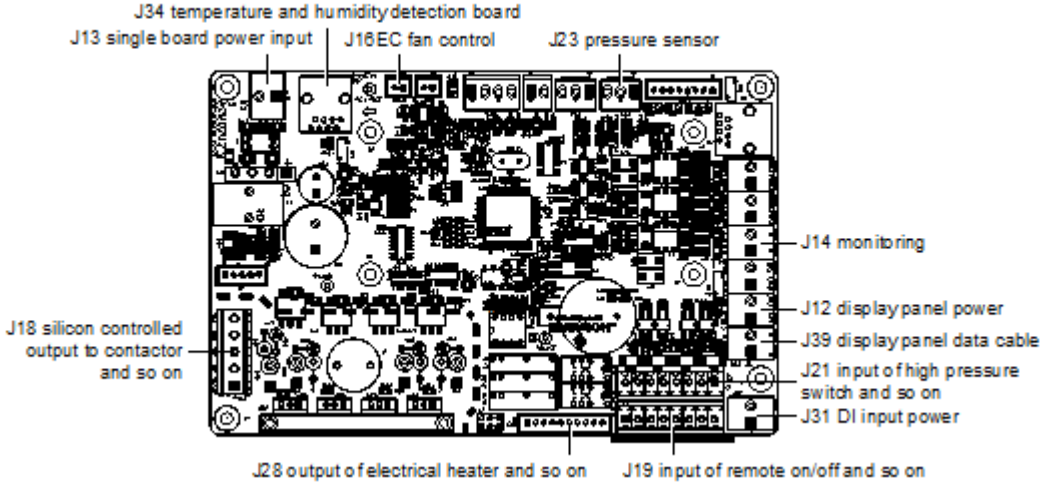


Figure 2-26 Control terminals on the PCB

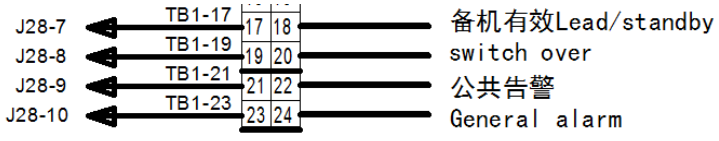


Figure 2-27 Control terminals on the terminal block

Remote shutdown

The PIN5 and PIN6 of the remote shutdown J19 can be used to remotely control the unit ON/OFF status, stopping the unit operation depending on the particular time. If the input of remote shutdown terminal is shorted and the AC unit power is switched on, the AC unit outputs normally. If the terminal is open, the AC unit will stop outputting. The remote shutdown terminal has been shorted before delivery. If the control cable of remote shutdown needs to be connected onsite, remove the short cable and connect the outer controller to the remote shutdown terminal.

SPD (Customer 1 terminal)

When the PIN1 and PIN2 of the customer 1 terminal (control terminal) J19 are not connected to SPD signal, they can connect with an alarm signal except for the AC system. Any outer alarm signal with NO dry contact can be connected to the customer terminal. After the outer alarm signal is connected, set the corresponding customer alarm information in micro-processing controller. For more details, refer to Customer Alarm in 3.4.2 Alarm Menu. If there is no alarm signal connected, the input state of the customer terminal is the same as the settings. If the outer alarm is generated, the input state of the customer terminal is different from the settings. The AC system will generate an audible alarm and LCD screen on the micro-processing controller will display the corresponding alarm information. If a computer using Vertiv Co. host monitoring software is connected, then the alarm will be displayed on that computer too.

If the power SPD is configured, the PIN1 and PIN2 of the customer 1 terminal J19 has been connected with alarm signal of power SPD in the factory and the alarm is set to be normally closed (NC).

General alarm terminal

The general alarm relay connected with 19 and 20 on the terminal block (see Figure 6-7) has a set of NC dry contact, which can be set to normally closed by using the software. When a serious alarm is generated, the contact is closed. This can be used to send a remote alarm, sending signals to the building management system or dialing the paging system automatically.

Lead/standby switchover and requirement terminals

The PIN18 and PIN20 of the lead/standby switchover the terminal and the PIN7 and PIN8 of the requirement terminal J19 (see Figure 2-27) are used to connect two AC units working in master-slave mode.

Figure 2-28 shows the Connection in master-slave mode.

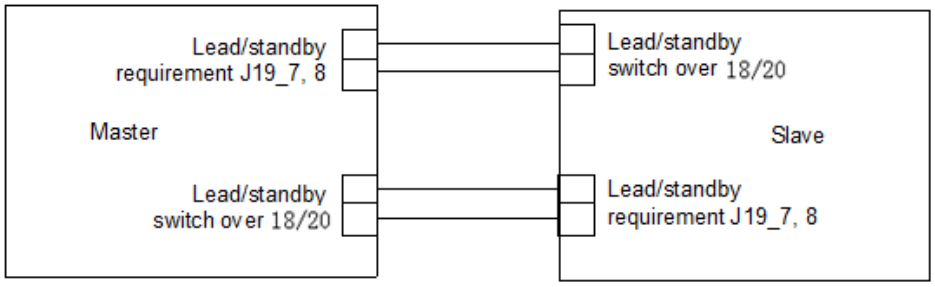


Figure 2-28

2.5.6 Connecting Monitoring Port Cable

The RS485 port of the Liebert DM indoor unit is located on the J39 terminal on the PCB (see Figure 2-26), uses a twisted-pair communication cable to connect it to the upper machine.

Multiple Liebert DM AC's can recognize simultaneous multi-units monitoring through RS485 bus. Taking RDU-Cooling host monitoring software developed by Vertiv Co. for example, Figure 2-29 introduces to a networking mode of RS485 bus monitoring two AC units simultaneously.

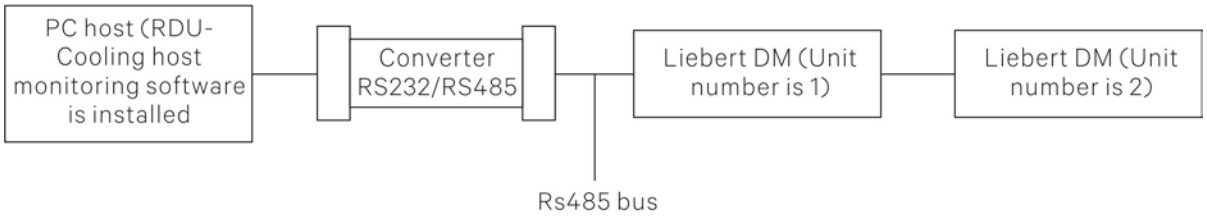


Figure 2-29 Networking mode monitoring two AC units

2.5.7 Connecting Energy-Saving Card

The Figure 2-20 shows the energy-saving card:

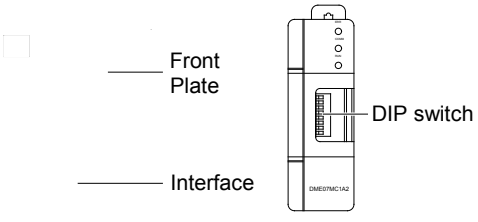


Figure 2-20

Use 4-core shielded cables with a recommended cable diameter not less than 20AWG (0.52 mm2) to connect the energy-saving card. Make sure that the two ends of the shielded layer and the energy-

saving card are grounded reliably to increase the anti-interference ability. The grounding cable should not exceed 10 cm, and the cable size should be above 2 mm2. Make sure that all connections are tight.

Use the energy-saving card according to the following steps:

- *Open the front plate of the energy-saving card plastic shell and take out the energy-saving cardboard along with the card slot inside the plastic shell. The Figure 2-21 shows the energy-saving cardboard.*

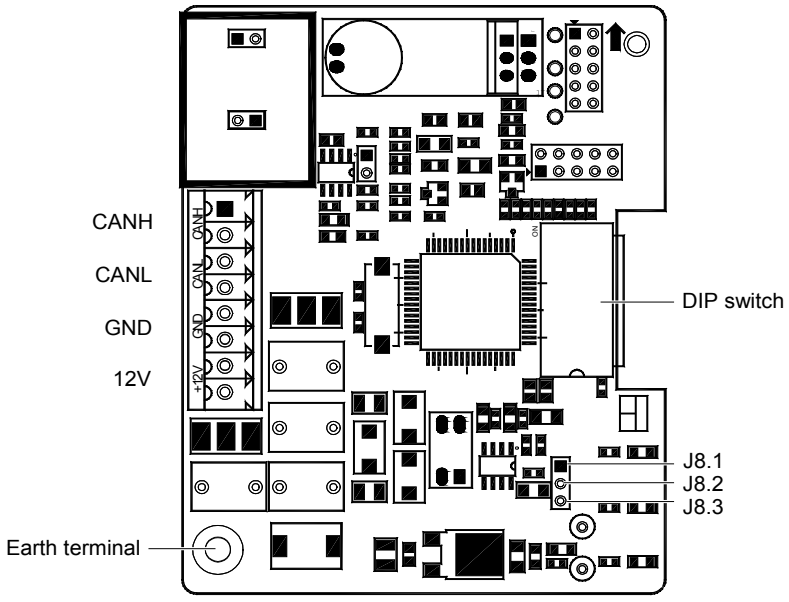


Figure 2-21

- *Short the terminals J8.1 and J8.2 in the furthest energy-saving card and short the terminals J8.2 and J8.3 in other cards.*
- *Ground the cards appropriately.*
- *Put the energy-saving card into the shell along with the card slot and replace the front plate.*
- *Use 4-core shielded cables to connect the Liebert DM control board on the rear portion of the front door of the indoor unit to 12V, GND, CANH and CANL interfaces of the energy-saving card; then snap the accessory magnetic buckle on the shield cable close to the control board end.*
- *Use 4-core shielded cables to serially connect 12V, GND, CANH and CANL interfaces of other cards (if more than one card is used).*
- *Ground the shielded cables appropriately.*
- *Set bits 1 and 2 of the DIP switch to card address and other bits to 0 (ON: 0, OFF: 1).*
- *Fix the energy-saving card in position with the heavy room temperature load with screws or the card slot in the shell.*
- *Enter Sleep Mod menu to view whether the temperature of the energy-saving card is normal.*
- *Figure 2-22 and Figure 2-23 indicates the connection modes of a single card and multi-cards respectively.*

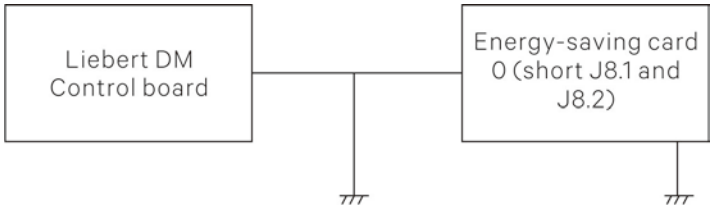


Figure 2-22 Connection of single card

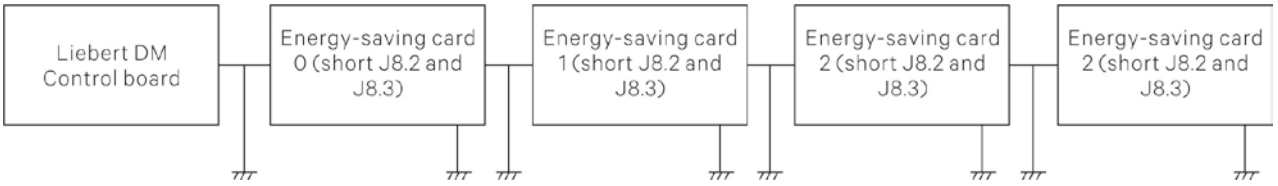


Figure 2-23 Connection of multi-cards

2.5.8 Checklist

Confirm the items in the table under listing 2.10 on completion of Electrical Installation.

Listing 2.10

Item	Result
No open-circuit or short-circuit in the electrical connection exists	
The power voltage is the same as the rated voltage on the unit nameplate	
The power cables and earth cables connected to the disconnect switch, indoor unit and outdoor unit are connected properly	
The circuit breakers or fuses have the proper ratings for equipment installed.	
The control connections are completed.	
All wiring and connector connections are tight. The fixing bolts are tight.	

After confirming the preceding points, start the start-up inspection & function testing.

Before starting the System Operations and Commissioning, adhere to the following points as mentioned in the checklist:

Listing 2.11

Pre-Commissioning Checklist		
Name of Customer: Site Location: Details:		
SL	Indoor Unit positioning & Power cabling, CU piping, GI piping	Remar
1	Indoor units are properly spaced with maintenance point view, minimum gap of 6" is maintained on back side & in between the	
2	Proper leveling of Liebert DM indoor stand with proper grouting	
3	Drip tray installed properly with silicon sealant applied on the	
4	Units are installed properly with rubber pads in between the unit	
5	Proper earthing is provided in the mains power supply as well as body earthing for PAC unit	
6	Power cable is provided with proper sizing of cable to suit the full	
7	Power supply is connected to the mains switch with proper lugs &	
8	Mains power cable is not routed with low voltage cables	
9	Soap leak test on brazing joints & also in Cu piping	
10	Pressure holding time	
11	Quality of copper piping laying, equidistance in-between two pipes, Quality of copper piping laying, equidistance in-between	
12	Initial U trap provided near the indoor unit	
13	U traps provided after every 7 RMT in vertical length (if require)	
14	Inverted U trap provided near the outdoor unit	
15	Copper pipe with insulation are tagged properly to indicate the	
16	Proper supporting for refrigerant piping is done	
17	Copper pipes are painted with proper color code	
18	Additional piping kit installed in case vertical distance between indoor to outdoor is	
19	Cable trays are used of proper gauges & quality. Ensure supports provided at equal distance to avoid the sag on cable tray	
20	Dressing & proper routing condenser cable	
21	Condenser cable & copper pipes are tagged with unit No & circuit	
22	Sufficient fresh air for condenser	
23	No hot air short cycling for condenser	

Pre-Commissioning Checklist		
24	Proper earthing is done for condenser	
25	Proper supporting given for the condenser in case condensers are mounted one above	
26	Concrete pedestal are provided for the condenser stand	
27	Rubber pads are provided in between the condenser & stands	
28	Condenser coils & Copper pipes U bends are painted with	
29	Proper slope is maintained for drain pipes	
30	U traps is provided at end drain pipe	
31	Isolating valve provided on inlet of humidifier piping	
32	Fresh water head pressure maintained of 21 - 100 PSI & with PPM level of 80 to 300 (optional)	
33	Ensure no leakage in the humidifier & drain piping before	

PART III

SYSTEM OPERATION & GENERAL MAINTENANCE

3 System Operation

This chapter introduces the system operation, start-up inspection, function testing, general maintenance and preliminary troubleshooting of the Liebert DM AC.

3.1 Start-Up Inspection

Prior to starting up the system; inspection of the state of the parts is required. The requirements for start-up inspection are mentioned in the following table within listing 3.1

Listing 3.1

Item	Inspection requirements
Panel	No damage, well insulated and clean
Filter	Installed in place and reliably, no damage and clean
Power supply	Measure and record the voltage before the system is powered on. Power cables are connected reliably
Outdoor unit	The outdoor unit is installed reasonably; the pipes are supported and sloped down properly; the trap is installed in a correct position
Fan	No obstruction material in inlet and outlet area
Humidifier (if applicable)	Water supply pipe and drain pipe are connected; water level sensor is secured correctly
Heater (if applicable)	Heating components are secured reliably
Power SPD (if applicable)	The module is secured reliably
Controller	The wiring connections are tight

After inspecting and confirming the preceding items, power on the AC unit. The inspection requirements after starting-up are mentioned in the following table within listing 3.2.

Listing 3.2

Item	Inspection requirements
Fan	The rotation direction is correct; record the rated full load current and actual current of the fan motor
Heater (if applicable)	Record the heater current
Outdoor fan	The rotation direction is correct; record the rated full load current and actual current of the fan motor
Others	Record the user setpoints, return air temperature, suction pressure, discharge pressure, compressor current and discharge air temperature

3.2 Micro-Processing Controller

The Micro-processing controller for Liebert DM AC comes packed with potential features that help monitor and manage the AC unit.

3.2.1 Features

The micro-processing controller has the following features:

- *Adopt menu operation. It can monitor and display the operation status of precise cooling AC unit to keep the environment within a setting range.*
- *Adopt a 128 × 64 dot LCD screen with white backlight. The user interface is easy-to-use.*
- *Provide three-level password protection to prevent unauthorized operation effectively.*
- *Provide the functions, including self-recovery upon power failure, high-voltage & low-voltage protection, phase loss protection and automatic phase-sequence switching upon anti-phase.*
- *Accurately know the running time of important components through menu operation.*
- *The expert-level fault diagnoses system can automatically display the current fault information to facilitate maintenance personnel in equipment maintenance.*
- *Store up to 200 historical alarm records.*
- *Configured with an RS485 port.*

3.2.2 Appearance

The micro-processing controller panel is depicted in Figure 3-1.

Figure 3-1

3.2.3 LCD Screen

The LCD screen displays English menus with white backlight. When the system is operating normally, it displays the current temperature & humidity (humidity display is optional).

Only the unit configured with a humidifier can display humidity; refer to section Select Options in 3.4.5 System Menu for more details.

It also displays unit output status (cooling, heating, dehumidifying and humidifying), unit mode (single, lead, standby), unit operation status (running, standby, locked), alarm information and current date & time, as depicted in Figure 3-2.

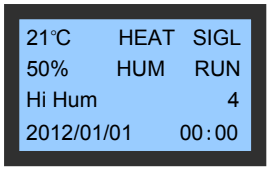


Figure 3-2

A detailed operating status of a specific component and alarm information is available on the Main Menu screen. The selected menu item will be highlighted while browsing. The digit to be changed will be highlighted while the user is changing the settings.

3.2.4 Control Buttons

The micro-processing controller provides five control buttons, as depicted in Figure 3-3

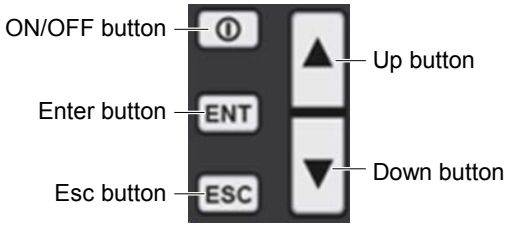


Figure 3-3

The functions of the control buttons are described in Table within Listing 3.3

Listing 3.3

Control button	Function descriptions
ON/OFF button	Press this button for 3s to turn on or off the unit
Enter button (ENT)	Enter the selected menu screen. Validate the parameter setting value
Esc button (ESC)	Exit the current menu and return to the Normal screen or previous menu screen. Abort parameter change; silence the audible alarm
Up button	Move the cursor up or increase the parameter value. For a toggle selection: scroll through the options. For a multi-screen menu: scroll up the screen
Down button	Move the cursor down or decrease the parameter value. For a toggle selection: scroll through the options. For a multi-screen menu: scroll down the screen

3.2.5 Control Buttons Operation Example

Example 1: Inputting password to enter the Main Menu

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 on 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: Changing parameters

This section depicts the process of changing parameters. In this example, Hi Temp in Alarm Output screen is used for illustration purposes. Following are the step-by-step instructions for changing parameters:

- *Press the Up or Down button to move the cursor on the Alarm Menu menu in the Main Menu screen.*
- *Press the Enter button to enter the Alarm Menu menu.*
- *Press the Up or Down button to move the cursor on Alarm Setting in the Alarm Menu screen.*
- *Press the Enter button to enter the Alarm Setting screen.*
- *Press the Up or Down button to move the cursor on Hi-Temp.*
- *Press the Enter button to highlight the parameter field of Hi-Temp.*
- *Press the Up or Down button to select the parameter option.*
- *After selecting, press the Enter button to confirm. The parameter 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-Temp will be retained.

3.2.6 ON Screen

After the AC unit is powered on, the LCD screen will display the ON screen, as shown in Figure 3-4.

Figure 3-4

3.2.7 Language Screen

After the AC unit is powered on, the language screen will be displayed after 10 seconds (default) for choosing the language or through pressing the Enter button directly, as shown in Figure 3-5.

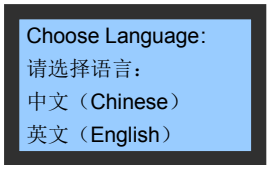


Figure 3-5

3.2.8 Normal Screen

After the AC unit is powered on, the Normal screen will be displayed after 20 seconds (default) for heat startup delay or by pressing the Enter button directly, as shown in Figure 3-6. The Normal screen displays the following information: the current temperature and humidity, unit operation state (cooling, heating, dehumidifying, humidifying), unit mode (single, lead, standby), unit operation status (running, standby, locked, off, sleep), alarm information and current date & time.

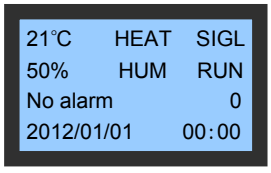


Figure 3-6

3.2.9 Password Screen

Press the Enter button on the Normal screen following which the Password screen appears as depicted in Figure 3-7.

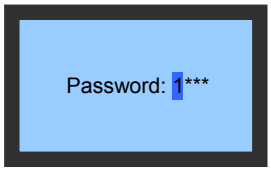


Figure 3-7

The table in Listing 3.4 depicts the 3 levels of passwords for accessing the menu. The detailed descriptions are mentioned in Table within Listing 3.4

Listing 3.4

Password level	User	Initial password	Remark
Level 1	General operator	0001	Browse all menu information. Only set temperature and humidity setpoints (see Figure 3-13) and cannot change any values and settings
Level 2	Maintenance personnel	-	Set all parameters
Level 3	Factory technician	-	-

For detailed operation on entering the password, *refer to section 3.2.5 Operation Example.*

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.

3.3 Function Testing

The AC unit carries hazardous voltage. Cut off the power before testing the equipment. The test should be done under the guidance of Vertiv Co.'s professional maintenance personnel or trained service personnel.

3.3.1 Cooling

The temperature set point should be adjusted based on the Set Points *(Refer section 3.4.3)* up to 5°C (10°F) lower than the indoor temperature. Then, the control system should trigger the cooling demand and the compressor starts working. At least after 3 minutes of cooling, adjust the temperature set point to 5°C (10°F) higher than the indoor temperature. If the compressor stops working, it means that the cooling function is normal.

Restore the temperature set point to the default or the original value after the test

3.3.2 Heating

The temperature set point should be adjusted based on the Set Points *(Refer section 3.4.3)* up to 5°C (10°F) higher than the indoor temperature. Then the control system should trigger the heating demand and the heater starts working. Adjust the temperature set point to 5°C (10°F) lower than the indoor temperature. If the heater stops working, it signifies that the heating function is normal.

Restore the temperature set point to the default or the original value after the test.

3.3.3 Humidifying

The humidity set point should be adjusted based on the Set Points *(Refer section 3.4.3)* to 10% higher than the indoor relative humidity. Then, the control system should trigger the humidifying demand and the humidifier starts working. Adjust the humidity set point to 10% lower than the indoor relative humidity. If the humidifier stops working, it signifies that the humidifying function is normal.

Restore the humidity set point to the default or the original value after the test.

3.3.4 Dehumidifying

The humidity set point should be adjusted based on the Set Points *(Refer section 3.4.3)* to 10% lower than the indoor relative humidity. Then, the control system should trigger the dehumidification demand and the fan starts running at a low speed. Adjust the humidity set point to 10% higher than the indoor relative humidity. If the fan automatically starts running at a higher speed, it signifies that the dehumidification function is normal. Note that during the testing process, if the indoor temperature is 3°C higher than the temperature set point, the system may enter a forced cooling mode and the dehumidification demand will not be responded.

Restore the humidity set point to the default or the original value after the test

3.3.5 Checking Refrigerant Charge Capacity of Low-Temp Outdoor

The Low-Temp outdoor unit has been charged with refrigerant before delivery.

The refrigerant charge capacity should be proper after powering on; it can be verified using the following method:

When the high pressure is not lower than 240psig (16.5bar), the liquid level of the refrigerant will reach the 1/2 point of the tank sight glass. When the ambient temperature is low and the high pressure cannot meet the requirement, the user can block the part of the upside and downside of the air intake uniformly to obtain required pressure.

If the liquid level cannot meet the requirement, discharge or refill the refrigerant for a proper liquid level length. Reclaim the discharged refrigerant according to correlative requirement.

3.4 Micro-Processing Controller Menu Options

3.4.1 Main Menu

On entering the correct credentials for the password and confirming it, the users will gain access to the Main Menu screen. For more information, *refer to the section Appendix - 2 -Menu Structure*.

Enter the password in the Password screen and confirm following which the Main Menu screen will appear, as shown in Figure 3-8.

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

For detailed setting procedures, *refer to section 3.2.5 Operation Example. For the setting ranges* of the menu items that can be set, *refer to Appendix - 3 Parameter Setting Table*.

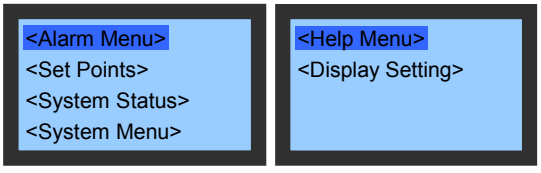


Figure 3-8

The table under Listing 3.5 describes the different menu items on the Main Menu screen

Listing 3.5

Menu item	Descriptions
Alarm Menu	Set alarm parameters; browse alarm historical records and alarm status records
Set Points	Set temperature & humidity setpoints and their sensitivities
System Status	Browse ambient temperature & humidity, system output status and system running records; browse and set system time
System Menu	Set system parameters and system options; calibrate sensor; change password; output system diagnoses; restore factory parameters; configure optional function
Help Menu	Browse factory information, product information and maintenance information
Display Setting	Adjust the screen contrast

3.4.2 Alarm Menu

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

Figure 3-8 depicts the Alarm Menu screen:

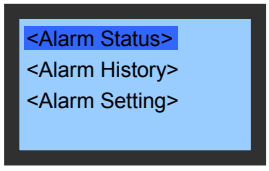


Figure 3-9

Alarm Status

The Alarm Status menu is used to monitor the present alarm status of the AC unit and prompt No Alarm or detailed alarm status information.

The detailed alarm status information includes XX/YY, alarm type and alarm start time, as shown in Figure 3-10. XX is the serial number of alarm status record and YY is the total number of alarm status record.

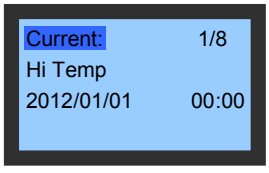


Figure 3-10

- *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 upon system power-off.*

Alarm History

The Alarm History menu is used to view the historical alarm records of the AC unit, including XX/YY, alarm type, alarm start time and alarm end time (if the alarm is not ended, the screen displays Not Ended Yet), as shown in Figure 3-11. XX is the screen of the historical alarm record and YY is the total number of the historical alarm records.

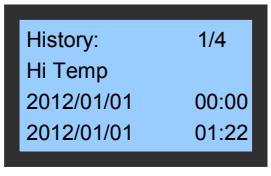


Figure 3-11

- *Press the Up or Down button to scroll through the historical alarm records if more than one alarm is activated.*
- *Up to 200 historical alarm records can be stored. They will not be cleared upon system power-off.*

Alarm Setting

The Alarm Setting settings will not be lost when the power fails. The Alarm Setting screen is depicted in Figure 3-12. *For detailed setting range, refer to Appendix - 3 Parameter Setting Table.*

It is not recommended to change the defaults. If the change is necessary, change them under the guidance of the trained professionals.

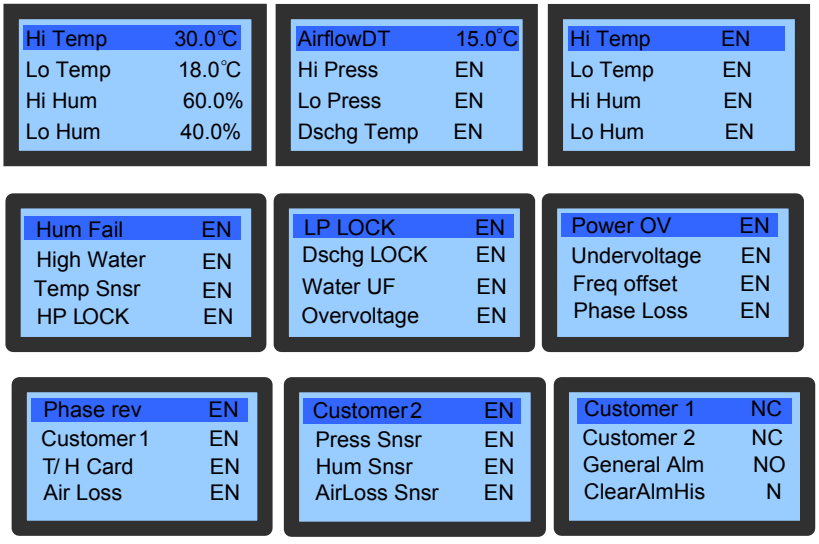


Figure 3-12

Listing 3.5

Settings	Alarm history record	Alarm status record	Audible alarm	Alarm prompt
EN	Yes	Yes	Yes	Yes
DIS	Yes	Yes	No	No
MSG	No	No	No	No

The alarms Hi Press, Lo Press and Hi-Temp are serious fault alarms. So they cannot be set to OFF, but can only be set to EN and DIS.

Customer Alarm

The AC unit is provided with two customer alarms, including customer 1 and customer 2; it corresponds to PIN1, 2 of the control terminals J19 and PIN5, 6 of J19 respectively.

The customer alarm can be set to 'NO' or 'NC'. The user can set them according to the actual alarm signal of the control terminals. If the power SPD is selected, the customer 1 alarm terminal has been connected with power SPD alarm signal before delivery and the customer 1 has been set to 'NC'.

3.4.3 Set Points

On the Main Menu screen, the user can select the Set Points option to gain access to the Set points menu as depicted in Figure 3-13.

The Set Points settings will not be lost when the power fails. *For detailed setting ranges, refer to Appendix - 3 Parameter Setting Table.*

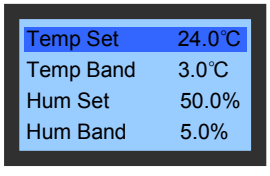


Figure 3-13

3.4.4 System Status

On the Main Menu screen, the user can select the System Status option to gain access to the System Status menu as depicted in Figure 3-14.

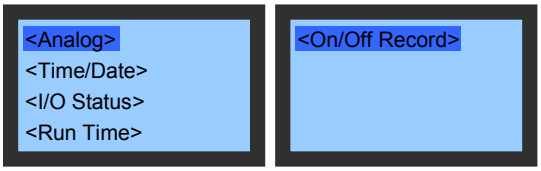


Figure 3-14

Analog

The Analog menu displays the indoor temperature & humidity, 3-ph voltage & frequency and condenser pressure with a decimal in real time, as depicted in
Figure 3-15.

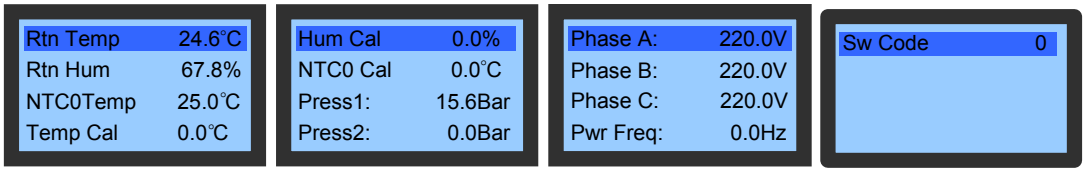


Figure 3-15

Time/Date

The Time/Date screen displays the current time and date of the system in the Year/Month/Date format and Hour/Minute/Second, as depicted in Figure 3-16.

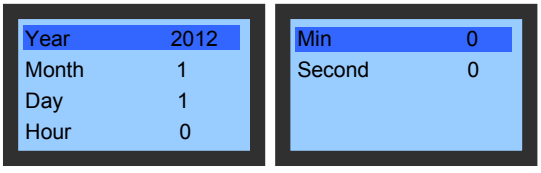


Figure 3-16

I/O Status

The I/O Status screen is depicted in Figure 3-17. The user can browse the current input and output status of the unit on the screen. If Manual Run Enab is set to 'YES', the output can be controlled manually. If the manual output is inner fan output then the rest of the outputs will be closed; if the manual output is electrical heater output, the inner fans will be started up simultaneously and the rest of the outputs will be closed. The system will exit the manual mode in an hour automatically if the user does not exit the manual mode.

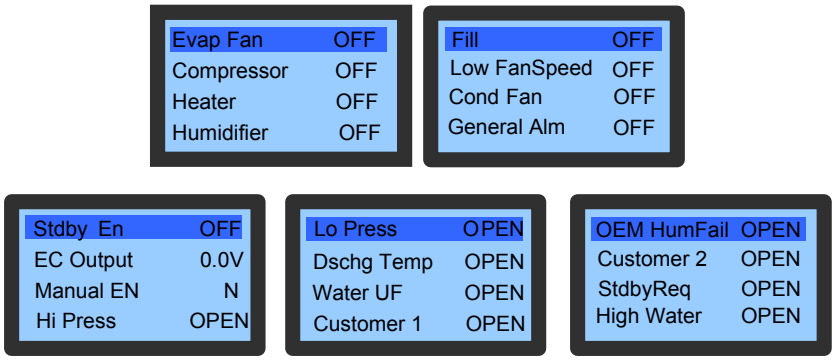


Figure 3-17

Run Time

The user can browse the current operation hours of the equipment on the screen. The Run Time screen is depicted in Figure 5-18.

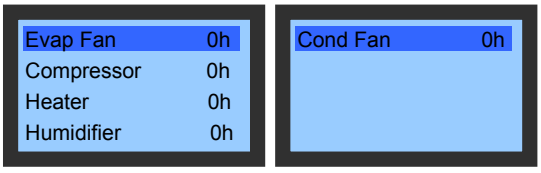


Figure 3-18

Users can view the start and stop records of important components using this facility. Select the On/Off Record item on the Run Records screen following to access its menu.

Figure 3-19 depicts the On/Off Record screen:

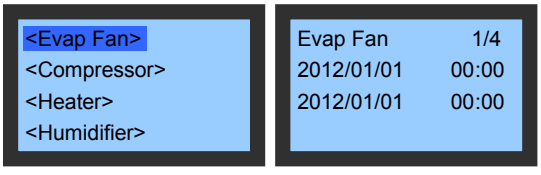


Figure 3-19

3.4.5 System Menu

On the Main Menu screen, the user can select the System Menu option to gain access to the System Menu as depicted in Figure 3-20

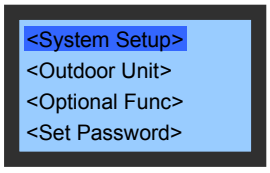


Figure 3-20

System Setup

The System Setup settings will not be lost in case of the power failure. The menu screen is depicted in Figure 3-21. For detailed setting ranges, *refer to Appendix - 3 Parameter Setting Table.*

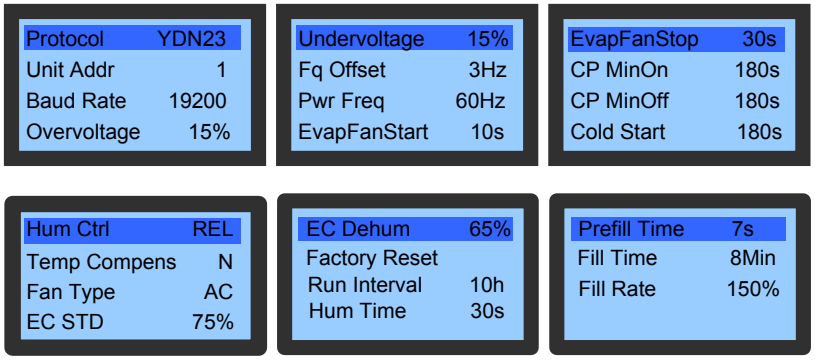


Figure 3-21

Factory Reset

Use Up or Down button to move the cursor to Reset Factory in the Setup System menu and press the Enter button. Use Up or Down button to set it to YES or No and press the Enter button to validate the setting. If Yes is selected, all system set points will be restored to the factory-recommended values, but the operation time and history alarm records will not be cleared.

As the Factory Reset will clear all set points configured by the user and the AC unit will be turned off, always be cautious to use it.

Outdoor Unit

The Outdoor Unit menu screen is depicted in Figure 3-22.

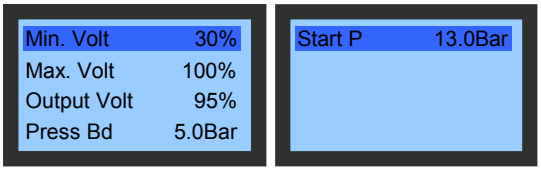


Figure 3-22

Optional Function

The Optional Func will not be lost in case of the power failure. The menu screen is depicted in Figure 3-23. For detailed setting range, *refer to Appendix 3 - Parameter Setting Table.*

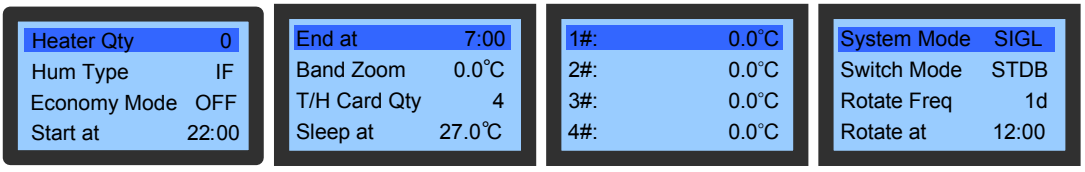


Figure 3-23

Only when the energy-saving card No. is not zero, the Sleep Mod can start. Only the Liebert DM AC equipped with more than one energy-saving card (dedicated) can enter the Sleep Mod. The lead unit and standby unit cannot use the same card.

When a lead unit and a standby unit are available, the user must set one of them as the lead unit. If the user sets both of them as the standby units, they cannot work normally.

Change Password

The Change Password settings will not be affected in case of power failure. The menu screen is depicted in Figure 3-24.

Figure 3-24

3.4.6 Help Menu

On the Main Menu screen, the user can select the Help Menu option to gain access to the Help Menu screen as depicted in Figure 3-25. The En Activation is not disclosed to the users.

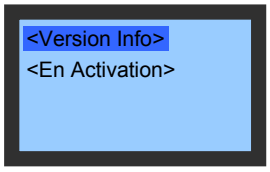


Figure 3-25

Version Info

The Version Info menu is used to browse the version Info, as depicted in Figure 3-26.

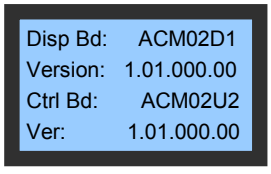


Figure 3-26

3.4.7 Display Set

On the Main Menu screen, the user can select the Display Set option to gain access to the Display Set screen as depicted in Figure 3-27.

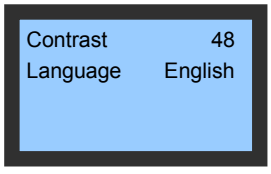


Figure 3-27

4 General Maintenance

This section deals with the system operation and maintenance of the Liebert DM AC. In this section, 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, indoor unit, outdoor unit and inspection checklist. 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*

4.1 Electric Inspection

Visual checks need to be carried out to check the correctness of electrical connections and circuit corrosion of the control board, power detection board, filter board, display board and THS board on a semi-annual basis.

The micro-processing controller has five circuit boards which jointly complete the system fault detection, input and output.

Inspect the boards one by one according to the following procedures:

- *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 the 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 a 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.*
- *Check if the power cables are damaged; get them replaced by a qualified/certified electrician.*

All circuit boards are not hot-pluggable. A Large instant current will be produced if the board is plugged or unplugged with powering on and it may lead to unrepairable damage to the circuit. The control board can only be maintained after the micro-processing controller is powered off.

4.2 Indoor Unit Maintenance

4.2.1 Filter

The filter is a consumable part. Its replacement interval is directly related to the cleanliness status of the equipment room. In order to maintain efficient operation, the filter should be checked monthly and replaced or washed as recommended. The filters of the indoor unit are installed on the front door and side panel.

To remove the Filter on the front door:

- *Unscrew the fixing screws on the filter stator;*
- *Remove the filter stator to take out the filter on the front door, as depicted in Figure 4-1.*

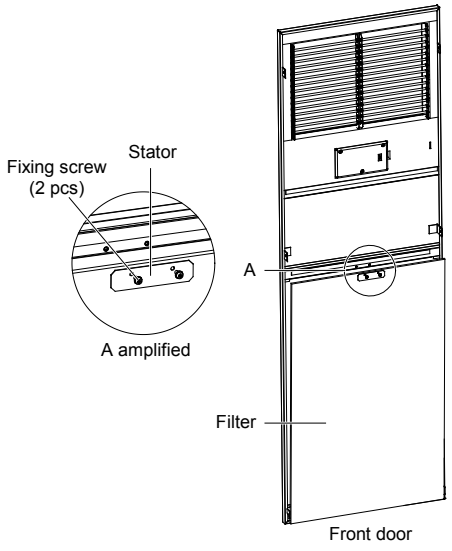


Figure 4-1

Filter on the side panel:

- *Unscrew (do not remove) the fixing screws on the filter stator and move the stator along the guide rail.*
- *Take out the filter on the side panel, as depicted in Figure 4-2.*

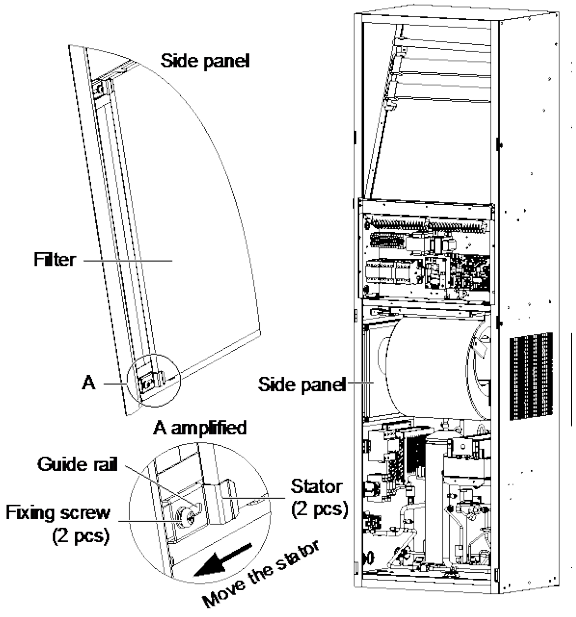


Figure 4-2

4.2.2 Fan

The monthly inspection items of the fan kit include:

- *motor operation status*
- *impeller status*
- *fan kit fixation*
- *clearance between fan and impeller.*

Monthly inspection of motor bearing and impeller should be carried out and replace it if any damage has occurred.

Check whether the impeller is tightly mounted on the rotor of the motor and does not rub against its neighboring metal components during rotation.

Since the fan kit operates continuously 24 hours a day, any unusual airflow obstruction must be cleared in time to avoid the damage to the cooling system and other system components caused by reduced air volume.

4.2.3 Drain Pipe

For normal operation of the drain pipe, inspection of the water tray should be carried out periodically.

Ensure that there are no foreign particles or any leakage present in the drain pipe.

4.2.4 Heater

If the optional heater is used, it should be maintained periodically. Ensure that there is no dust or any foreign particles collected on its surface; the heater is fixed appropriately and the cable connections.

The heater elements will heat continuously in the normal station. Inspection of the heater should be carried out bi-annually for its normal operation.

If in case the heater needs to be replaced, please contact the Vertiv Co. maintenance personnel.

The heater cable must be leaded through the thimble socket, and then connected to the heater.

4.2.5 Humidifier

The humidifier kit consists of infrared lamp, water supply solenoid valve, water tray, high temperature protect device and water high level protect the device.

The micro-processing controller calculates whether the humidification is required based on the temperature and humidity values from the THS. If a call for humidification is registered, the micro-

processing controller will send a humidification command and provide 24V power to it. Then the water filling valve will start the humidification operation.

The top temp-switch will act to cut off the lamp power to stop humidifying when abnormal airflow causes high temperature around humidifier. The temp-switch should be reset manually to light up the lamp as depicted in figure 4-3.

When the water tray is dry burned, the dry burned protection switch will act to cut off the lamp power to stop humidifying. The dry burned protection switch should be reset manually to light up the lamp as depicted in figure 4-4.

As the sediment exists in the water drained from the humidifier, the humidifier water tray should be cleaned periodically to assure humidifier running efficiently. The cleaning cycle varies with the local water quality It is recommended to clean (when necessary) the humidifier tray once in a month. Far-infrared humidifier itself automatic flushing function can effectively extend the time interval between cleanings; however, regular inspection and maintenance are still essential.

The Cleaning steps are mentioned as following:

- *Remove the water level standpipe to drain the water tray;*
- *Disconnect the drainage pipe;*
- *Disconnect the power of lamp and the signal line of water high-level switch, dry burned protect switch and water supply solenoid valve;*
- *Remove the front fixing screws and disassemble humidifier kits;*
- *Remove fixing screws between bracket and water tray, remove the Up cover kits. Pay attention to protecting the lamp;*
- *Remove the fixing screws at the two ends of the water tray, and pull out the water tray. Cleanse the water tray with water and hard brush;*
- *Restore the humidifier by reversing the preceding procedures.*

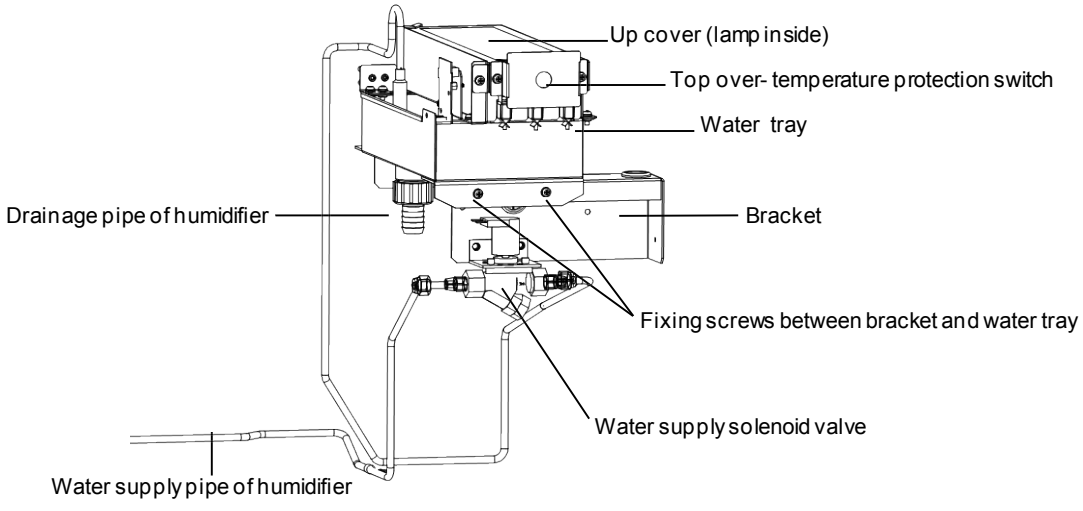


Figure 4-3

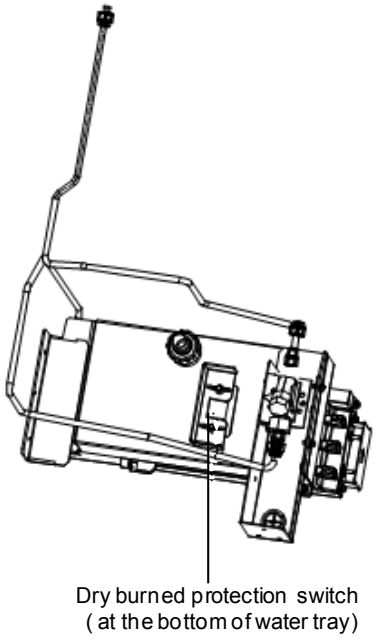


Figure 4-4

Before exercising the humidifier water tray cleaning operation, make sure that the power has been turned off; and also ensure that the water in the water tray is not hot before draining the water from the infrared humidifier water tray so as to avoid personal injury.

4.2.6 Power SPD

The position of the power SPD is depicted in Figure 4-5.

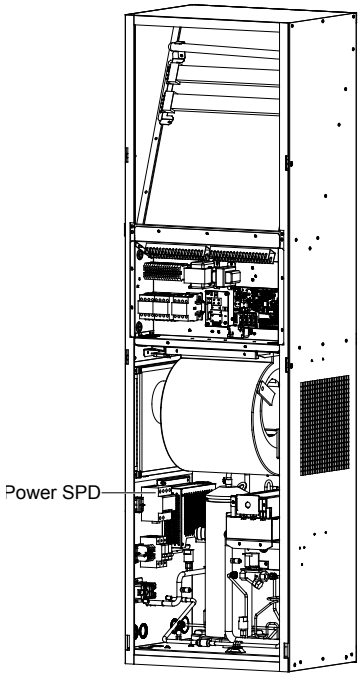


Figure 4-5

The power SPD has four status indicators, as depicted in Figure 4-6. The status indicators are green during normal operation; they turn to red upon failure.

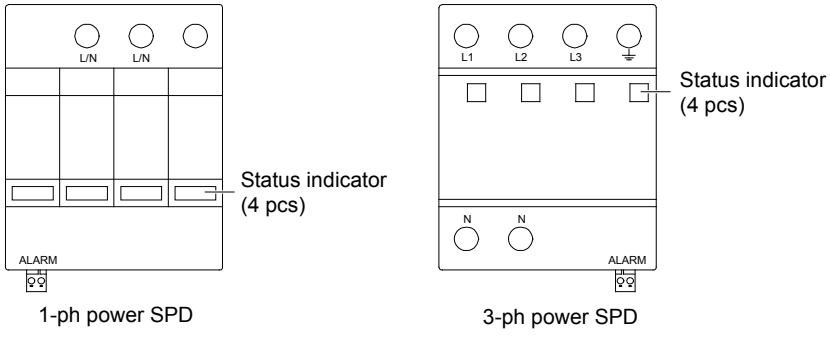


Figure 4-6

The power SPD does not need special maintenance. It needs a regular check for non-loosening and normal status indicating.

If any one of the following phenomena occurs, the power SPD has failed and it needs to be replaced immediately.

1. Any indicator of the power SPD turns red.
2. The customer alarm 1 is generated (see SPD (Customer 1 terminal) in 6.5.1 Connecting Control Terminals).

4.2.7 Thermal Expansion Valve

The thermal expansion valve keeps the evaporator supplied with sufficient refrigerant to satisfy load conditions. Its proper operation can be determined by measuring the superheat level. The correct superheat setting is 5.6°C to 8.3°C (10°F to 15°F).

4.2.8 High-Pressure Switch And Low-Pressure Switch

The discharge pressure and suction pressure will vary significantly with the AC unit load and ambient conditions (Refer the table in Listing 4.1) during normal operation. When the discharge pressure rises to the high-pressure setpoint, the high-pressure switch will activate and the control system will shut down the compressor after ensuring an abnormal input signal of the high-pressure switch.

When the suction pressure is lower than the low-pressure set point, the low-pressure switch will activate and the control system will shut down the cooling system after confirming.

Listing 4.1

Item	psig	MPa
Low pressure	57.5 ~ 99.8	0.397 ~ 0.67
Low-pressure setpoint	20	0.138
Low-pressure recovery point	36.3	0.25
High pressure	180 ~ 275	1.242 ~ 1.895
High-pressure setpoint	400	2.76
High-pressure recovery point	307	2.1

4.2.9 Compressor

The compressor fault is mainly classified into two types:

1. Motor faults (such as winding burnout, insulation failure, short-circuit between coils etc.).

2. Mechanical faults (such as compressing failure, relief valve fault, therm-o-disc fault and so on).

If the operation pressure is not built up, it signifies that the compressor has failed. It can be verified if the suction pressure and discharge pressure are balanced and the motor does not rotate in reverse direction.

The controller has powerful alarm and protection functions to ensure safe operation of the compressor. The maintenance personnel should record the high pressure and low pressure and find out the cause of an alarm protection during periodical maintenance and inspection.

Avoid touching or contacting the residual gas and oils in compressor with exposed skin. Wear long rubber gloves to handle contaminated parts.

Check the following items before replacing the compressor:

- *Check that all fuses and circuit breakers are normal.*
- *Check the working status of the high and low-pressure switches.*
- *Check the relevant historical alarm information.*
- *Check the historical operation records of the compressor.*
- *Check the motor electric characteristic.*

The system contains refrigerant. Reclaim the refrigerant using standard reclaiming equipment before maintenance

To remove and replace the failed compressor adhere to the following procedure:

- *Cut off the power.*
- *Attach suction and discharge gauges to compressor access fittings.*
- *Reclaim the residual refrigerant by using standard reclaiming procedures.*

Releasing of refrigerant to the atmosphere is harmful to the environment. Refrigerant must be recycled in accordance with state and local regulations.

- *Remove the failed compressor.*
- *Install replacement compressor and assemble all the connections. Carry out the pressurization and leakage tests to the system at approximately 150psig (1034kPa).*
- *Evacuate the system twice to 1500 microns and the third time to 500 microns. Break the vacuum each time with clean and dry refrigerant to 2psig (13.8kPa).*
- *Charge the system with refrigerant based on the requirements of the evaporator, condenser and refrigeration lines.*
- *Apply power to and operate the AC unit. Check for proper operation. Refer to the circulation suction pressure and discharge pressure ranges in normal operation, and supplement some refrigerant if necessary.*

4.3 Outdoor Unit Maintenance

4.3.1 Refrigeration System

The components of the refrigerant system should be inspected monthly to find out if any abnormal operations are occurring. Refrigerant pipes must be properly fixed and not allowed to vibrate against the wall, floor or the unit frame. All the refrigerant pipes should be inspected biannually for any signs of wear and tear.

4.3.2 Air-Cooled Condenser

When the airflow through the outdoor unit is restricted, use the compressed air or fin cleaner to clean the condenser off the dust and debris that inhibit airflow. The compressed air should be blown at the reversed airflow direction. In winter, do not let snow to accumulate on the side or underneath the condenser. Check for bent or damaged fins and simply repair them if necessary. Check all refrigerant pipes and capillaries for vibration and support them if necessary. Carefully inspect all refrigerant pipes for signs of oil leakage, determining the leakage position.

4.3.3 Low-Temperature Unit Of Low-Temp Outdoor Unit

The liquid level of the refrigerant should be checked periodically in the fluid reservoir to ensure that no refrigerant leakages occur. For detailed operation, *refer to section 3.3.5 Checking Refrigerant Charge Capacity of Low-Temp Outdoor Unit.*

Periodically check whether the heating belt of the fluid reservoir works normally. See following for details:

When the system is powered on and is in the standby mode, the fluid reservoir pressure is lower than 0.85Mpa, the heating belt preheats the fluid reservoir. If there is no heating, check whether the fuse of the heating belt is blown or if the pressure switch is working normally. After confirming the fault part(s), replace them.

The heating belt fuse specifications in Table within listing 4.2.

Listing 4.2

Manufacturer	Model	Voltage	Rated current
Bussmann	S500-1A	250V	1A
Littelfuse	0217001	250V	1A

4.4 Maintenance Inspection Checklist

Regular inspections are necessary to ensure proper operation of the AC unit.

Listing 4.3

Liebert DM AC			
Date:		Prepared by:	
Model:		Serial Number:	
Type	Maintenance components	Item	Result
Monthly	Filter	Check for restricted airflow	
		Check the filter	
		Clean the filter	
	Humidifier (if applicable)	Check if the water tray is clogged.	
		Check the humidifier lamp	
		Check the sediment of water tray	
	Indoor unit fan	Impellers free of debris and move freely	
		Bearings in good condition	
	Power SPD (if applicable)	Check for indicator color	
	Drain system (including condensate pump)	Check and clean out unit drain pipes, humidifier and tray, condensate pump and building drain pipes	
Semi-annually	Compressor	Signs of oil leaks	
		Vibration isolation	

Liebert DM AC			
Date:		Prepared by:	
Model:		Serial Number:	
Type	Maintenance components	Item	Result
	Refrigerant system	Suction pressure	
		Discharge pressure	
		Superheat	
		Evaporator in tight and clean condition	
		Charging capacity of refrigerant	
		Evident temperature difference between before and after the filter drier	
	Air-cooled condenser	Condenser coil is clean	
		Motor mounted tightly	
		Bearing in good condition	
		Refrigerant pipes properly supported	
	Electric board	Check electrical connections	
		Check the surface for signs of corrosion	
	Electric heater	Check for signs of corrosion	
	Humidifier	Check if the water tray is clogged	
		Check the humidifier lamp	
		Check the sediment of water tray	
		Check and fix connectors	
	Low-Temp low-temperature unit	Check for the liquid level of the refrigerant in fluid reservoir and leak of the fluid reservoir fittings	
		Check whether the heating belt of the fluid reservoir works normally	
Notes:			
Signature:			

4.5 Troubleshooting

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

- *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 4.4

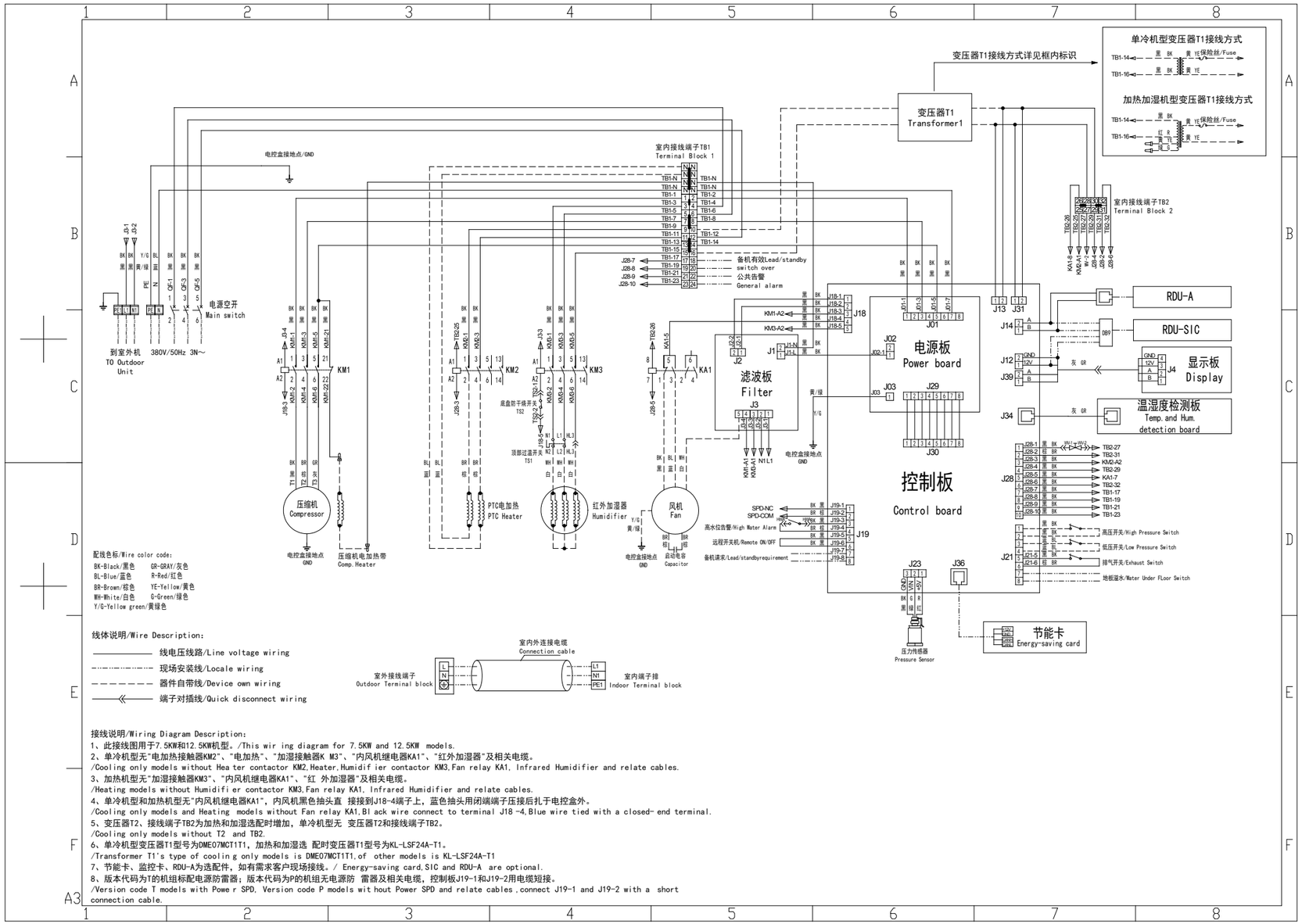
Fault phenomenon	Possible cause	Check or remedy
Unit does not start	No power to unit	Check unit input voltage
	Circuit breaker that controls voltage (at the transformer) is open	Locate short circuit and reset circuit breaker
	Float switch relay has closed due to high water level in the condensate pump sump	Check that drain pipes and pipelines are clogged or that the condensate pump is damaged
	Jumping cables not in place	Check jumping cables on the control board
No cooling	Compressor contactor not pulling in	Check for 24Vac ± 2Vac at the winding. If the voltage is right, check the contactor
	High compressor discharge pressure	See 'High-pressure alarm' for checking and maintenance descriptions
	Plugged strainer	Clean or replace the strainer
	Low refrigerant charge	Use suction and discharge pressure gauge to check the pressure. View whether evident bubbles exits through the sight glass

Fault phenomenon	Possible cause	Check or remedy
High-pressure alarm	Insufficient airflow across condenser	Remove debris from coil surface and air inlet; check the control board for the fan speed regulation performance
	Condenser fan not operating	Check that the cable connection from the control board to the terminal block of outdoor unit is tight; check that the outdoor unit connections are tight; check that the condensate pressure sensor works normally
Heater does not operate	Heat function disabled in Select Options menu	Set Heat to 'ON', refer to Select Options in 3.4.5 System Menu
	No heat demand output from the control system	Adjust temperature setpoint and sensitivity within the required range
	Elements burned out	Turn off the power. Check the element resistance with a multimeter
Display abnormal	Static discharge	Disconnect the system power, and then restart
	Loose connection between display board and control board	Tighten the connection after powering off, and then restart
No display, control buttons do not respond and equipment operates normally	Disconnection between display board and control board	Check the connection between display board and control board
	Display board fault	Replace the display board
No display, control buttons do not respond and equipment has no output	Low power voltage	Check for power voltage
	Communication between control board and display board interrupted	Check the connection between control board and display board
Low-pressure	Refrigerant leakage	Check for leaking place and re-charge

Fault phenomenon	Possible cause	Check or remedy
alarm	Outdoor ambient temperature too low	Contact local maintenance engineer
	Outdoor unit fan running at full speed upon low outdoor ambient temperature	Check that the cable connections of outdoor unit are normal; check that the condensate pressure sensor is normal
High-temperature alarm	High-temperature setpoint unreasonable	Reset the setpoint
	Room load exceeding unit design ability	Check for room seal or make capacity expansion
Low temperature alarm	Low-temperature setpoint unreasonable	Reset the setpoint
	Heater operation current improper	Check for heater working operation
High humidity alarm	Setpoint unreasonable	Reset the setpoint
	Vapor barrier not done in the room	Check for the vapor barrier
Low humidity alarm	Setpoint unreasonable	Reset the setpoint
Humidification ineffective	No water in the water tray	Check that the water supply is normal
		Check that the water supply solenoid valve is working
		Check the state of the high water-level switch and water level regulator
		Check that the water supply pipe is not clogged
	The humidification	Check if the contactor voltage is normal

Fault phenomenon	Possible cause	Check or remedy
	contactor does not close	Check if the safety devices of the infrared humidifier are opened such as the over-temperature protection switch and dry burned switch.
	Humidifier main power failure	Check L1, L2 and L3 voltages are normal when the contactor is energized.
		Check if the manual reset switch of humidifier is disconnected.
	Infrared humidifier lamp burned	Replace the lamp

APPENDIX 1 - Crcuit Diagrams



配线色标/Wire color code:

BK-Black/黑色	GR-GRAY/灰色
BL-Blue/蓝色	R-Red/红色
BR-Brown/棕色	YE-Yellow/黄色
WH-White/白色	G-Green/绿色
Y/G-Yellow green/黄绿色	

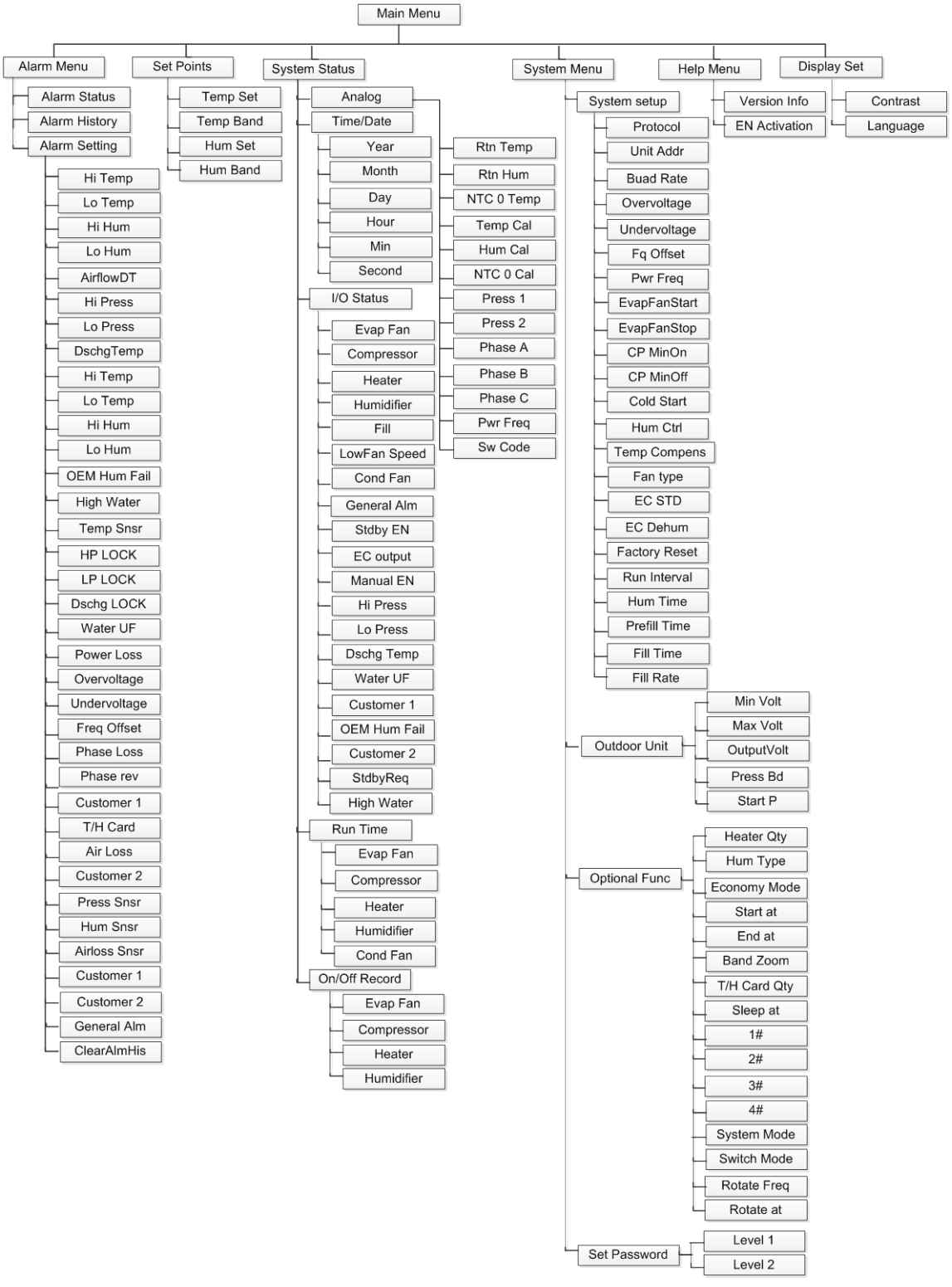
线体说明/Wire Description:

- 线电压线路/Line voltage wiring
- 现场安装线/Locale wiring
- 器件自带线/Device own wiring
- 端子对插线/Quick disconnect wiring

接线说明/Wiring Diagram Description:

1、此接线图用于7.5KW和12.5KW机型。/This wir ing diagram for 7.5KW and 12.5KW models.
2、单冷机型无"电加热接触器KM2"、"电加热"、"加湿接触器K M3"、"内风机继电器KA1"、"红外加湿器"及相关电缆。
/Cooling only models without Hea ter contactor KM2,Heater,Humidif ier contactor KM3,Fan relay KA1, Infrared Humidifier and relate cables.
3、加热机型无"加湿接触器KM3"、"内风机继电器KA1"、"红 外加湿器"及相关电缆。
/Heating models without Humidifier contactor KM3,Fan relay KA1, Infrared Humidifier and relate cables.
4、单冷机型和加热机型无"内风机继电器KA1"，内风机黑色抽头直 接接到J18-4端子上，蓝色抽头用闭端端子压接后扎于电控盒外。
/Cooling only models and Heating models without Fan relay KA1,Bl ack wire connect to terminal J18 -4,Blue wire tied with a closed- end terminal.
5、变压器T2、接线端子TB2为加热和加湿选配时增加，单冷机型无 变压器T2和接线端子TB2。
/Cooling only models without T2 and TB2.
6、单冷机型变压器T1型号为DME07MCT1T1，加热和加湿选 配时变压器T1型号为KL-LSF24A-T1。
/Transformer T1's type of coolin g only models is DME07MCT1T1,of other models is KL-LSF24A-T1
7、节能卡、监控卡、RDU-A为选配件，如有需求客户现场接线。/ Energy-saving card,SIC and RDU-A are optional.
8、版本代码为T的机组标配电源防雷器；版本代码为P的机组无电源防 雷器及相关电缆，控制板J19-1和J19-2用电缆短接。
/Version code T models with Powe r SPD, Version code P models wit hout Power SPD and relate cables ,connect J19-1 and J19-2 with a short connection cable.

APPENDIX 2 Menu Structure



APPENDIX 3 Parameter Setting Table

Menu		Parameter	Default	Setting range
Alarm Menu	Alarm Setpoint	Hi Temp	35°C	25°C ~ 50°C
		Lo Temp	15°C	5°C ~ 20°C
		Hi Hum	65%RH	65%RH ~ 90%RH
		Lo Hum	35%RH	10%RH ~ 35%RH
		AirflowDT	25°C	30°C
		Alarm Setting (general alarm)	EN	MSG, EN, DIS
		Alarm Setting (serious alarm)	EN	DIS, EN
		Customer 1	NC (the unit equipped with SPD is NC by default)	NO, NC
		Customer 2 (remote shutdown)	NC	NO, NC
Set Points		Temp Set	24°C	15°C ~ 35°C
		Temp Band	3°C	1°C ~ 5°C
		Hum Set	50%RH	20%RH ~ 80%RH
		Hum Band	5%RH	1%RH ~ 10%RH
System Status	Analog	Temp Cal	0.0°C	-10°C ~ +10°C
		Hum Cal	0.0%	-10% ~ +10%
		NTC0 Cal	0.0°C	-10°C ~ +10°C
	I/O Status	Manual En	N	Y, N
		Evap Fan	OFF	ON, OFF
		Compressor	OFF	ON, OFF
		Heater	OFF	ON, OFF
		Humidifier	OFF	ON, OFF
		LowFanSpeed	OFF	ON, OFF

Menu		Parameter	Default	Setting range
		Cond Fan	OFF	ON, OFF
System Menu	System Setup	Protocol	1	1 ~ 254
		Unit Addr	YDN23	YDN23, MODBUS
		Baut Rate	19200	1200 ~ 19200
		Overvoltage	15%	10% ~ 30%
		Undervoltage	15%	10% ~ 30%
		Fq Offset	3Hz	2Hz ~ 5Hz
		Pwr Freq	50HZ	50Hz，60Hz
		EvapFanStart	10s	10s ~ 600s
		EvapFanStop	30s	10s ~ 300s
		CP MinOn	180s	60s ~ 300s
		CP MinOff	180s	60s ~ 300s
		Cold Start	180s	30s ~ 240s
		Hum Ctrl	RH	RH, AH
		Temp Compens	OFF	ON, OFF
		Factory Reset	NO	YES, NO
		Fan type	AC	AC, EC
		EC STD	75%	50% ~ 100%
		EC Dehum	65%	40% ~ 90%
		Run Interval	10h	5h~25h
		Hum Time	8min	1min~30min
		Prefill Time	30s	10s~300s
		Fill Time	7s	1s~900s
		Fill Rate	150%	100%~500%
System Menu	Outdoor Unit	Min. Volt	30%	30% ~ 50%
		Max. Volt	100%	60% ~ 100%
		OutputVolt Press Bd	5Bar	4Bar ~ 6Bar
		Start P	13Bar	11Bar ~ 15Bar
	Optional Func	Heater Qty	0	0, 1
		Hum Qty	0	0、IF
	Optional Func_CostSave	Economy Mode	OFF	OFF, ON
		Start at	22:00	18:00 ~ 3:00
		End at	7:00	5:00 ~ 10:00

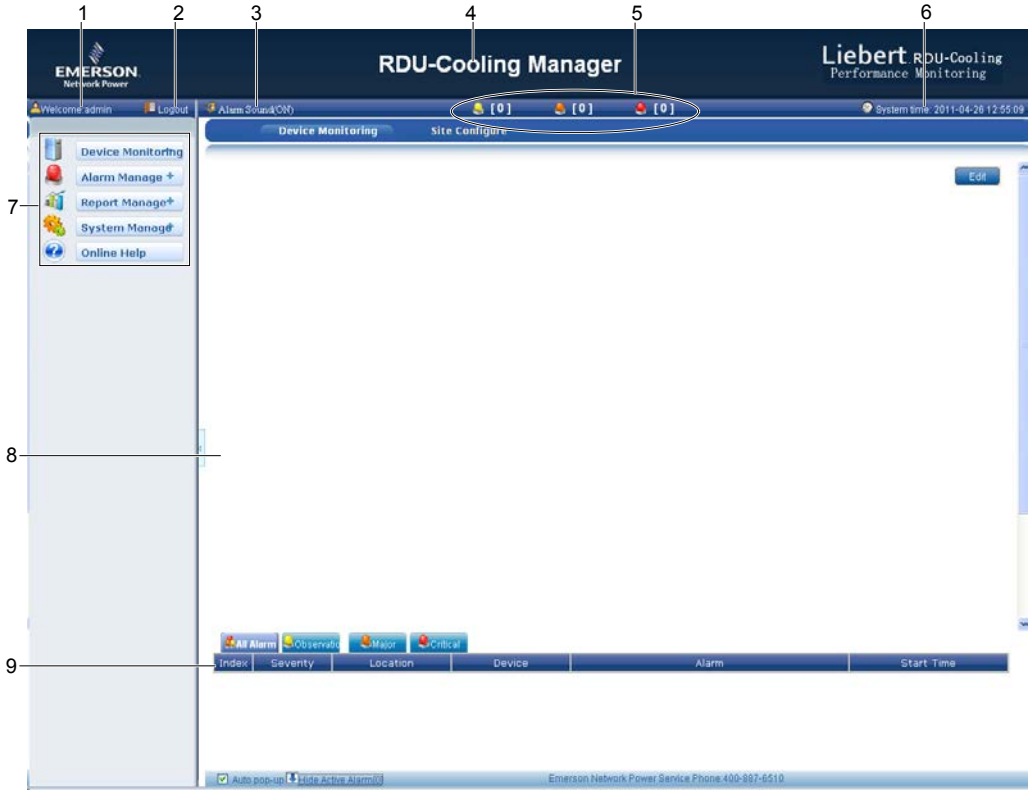
Menu		Parameter	Default	Setting range
	Mod_Economy Mod	Band Zoom	2°C	2°C ~ 10°C
	Optional Func_CostSave Mod_Sleep Mod	T/H Card Qty	0	0 ~ 4
		Sleep at	27°C	15°C ~ 40°C
	Optional Func_Standby	System Mode	SIGL	SIGL, HOST, SPAR
		Switch Mode	STDB	STDB, ROTA
		Rotate Freq	Day	1DAY ~ 7Day
		Rotate at	12:00	0:00 ~ 23:00
	Set Password	Level 1	0001	~ 9999

APPENDIX 4 - RDU-Cooling AC Single-Unit Manager Software Introduction

The RDU-Cooling manager is a monitoring system developed by Vertiv Co., Ltd. to perform monitoring and management over the Liebert DM air conditioner designed by Vertiv Co.

The WEB browser can be used to log in the RDU-Cooling manager to perform monitoring and management over the Liebert DM AC.

After you have logged in the RDU-Cooling manager, the screen displays the primary interface, as shown in Figure 2.



1. Username
2. Logout button
3. Alarm Sound (ON/OFF)
4. System title
5. Number of current alarms
6. System time
7. Menu area
8. Display & operation area
9. Alarm display area

Primary interface of the RDU-Cooling manager

The primary interface of the RDU-Cooling manager consists of three functional areas: menu area, display & operation area and alarm display area.

- *The menu area displays five menus and all submenus, which can be selected by clicking.*
- *The display & operation area displays the operation interface of the selected menu, you can query or configure the information of this menu or perform relevant equipment control operations.*
- *The alarm display area displays all current alarms, click Hide Active Alarm [alarm number], all current alarms will be hidden, and meanwhile, Hide Active Alarm [alarm number] will become Show Active Alarm [alarm number]. If Auto pop-up is ticked, when a new alarm generates, the alarm information will pop up automatically.*

Click the Logout button to log out the current user and return to the login page.

Click Alarm Sound (ON) to turn on the alarm sound, and Alarm Sound (ON) turns to Alarm Sound (OFF).

Functions of the RDU-Cooling manager include:

- *Simple HMI (human-machine interface): The RDU-Cooling manager supports simple HMI function. You can change the site background picture and drag the site or equipment to change its icon location at will.*
- *Data query: Current equipment operating data, current alarm data, curve report and history data of the DM AC can be queried.*
- *Alarm notification: The RDU-Cooling manager can send an e-mail and a short message to the user when an alarm occurs to the equipment.*
- *Remote control: The RDU-Cooling manager provides remote control functions for the DM AC.*
- *Remote adjustment: The RDU-Cooling manager provides remote adjustment functions for the DM AC.*
- *Report management: The RDU-Cooling manager provides alarm report, operating data report, operating data curve report and system log report of the DM AC, and supports multiple pages display of the report and data export functions.*
- *User management: Users can be added, modified, deleted, and given different levels of software operation authorities according to their duties.*

As shown in Appendix 2, the menu area provides five menus, as described in the following table in Listing 4.6:

Menu	Description
Device Monitoring	This menu allows you to add, change and delete device/site; configure alarm notification function; view current analog signal data, status signal data, and alarm information of the device; perform remote control and adjustment over the device
Alarm	This menu allows you to query the real-time alarms and

Menu	Description
Manage	configure the alarm notification parameters
Report Manage	This menu allows you to query history alarm, history device data, curve report, and history system logs. It also provides print and print preview functions
System Manage	This menu includes User Manage and System Title. User Manage menu allows you to add, delete users, modify user information, and give them different levels of operation authorities according to their duties; System Title menu allows you to set the system title of the RDU-Cooling manager
Online Help	The Online Help menu provides an electronic file of the manual. Selecting this menu opens the electronic file of RDU-Cooling Air-Conditioner Single-Unit Manager User Manual

1. The RDU-Cooling software CD is included in the unit accessory for free.
2. For detailed descriptions of RDU-Cooling, refer to RDU-Cooling Air-Conditioner Single-Unit Manager User Manual. This manual is installed together with the software on the computer, and the user can find it through the Online Help menu.

APPENDIX 5 - Hazardous Substances List

Parts	Hazardous Substances					
	Plumbum Pb	Hydrargyrum Hg	Cadmium Cd	Chrome6+ Cr6+	PBB PBB	PBDE PBDE
Cabinet	O	O	O	O	O	O
Cooling parts	O	O	O	O	O	O
Fan unit	O	O	O	O	O	O
Electric control unit	×	O	O	O	O	O
Display screen	×	O	O	O	O	O
PCBA	O	O	O	O	O	O
Heat exchanger	O	O	O	O	O	O
Copper pipe	O	O	O	O	O	O
Cables	O	O	O	O	O	O

O: 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;
X: Means the content of the hazardous substances in at least one of the average quality materials of the part is outside the limits specified in SJ/T11363-2006

Vertiv Co., Ltd. has been committed to the design and manufacturing of environment-friendly products. It will reduce and eventually eliminate the 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 reliable substitute or mature solution:
Applications that contain lead: welding materials(exempt), glass of resistors(exempt), and ceramics(exempt).

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, personal safety or property in the Environment Protection Period starting from the manufacturing date.

Applicable product: Liebert DM Air cooled series precision air conditioner indoor unit

Parts	Hazardous Substances					
	Plumbum	Hydrargyrum	Cadmium	Chrome6+	PBB	PBDE
	Pb	Hg	Cd	Cr6+	PBB	PBDE
Cabinet	O	O	O	O	O	O
Cooling parts	O	O	O	O	O	O
Fan unit	O	O	O	O	O	O
Electric control unit	O	O	O	O	O	O
Heat exchanger	O	O	O	O	O	O
Copper pipe	O	O	O	O	O	O
Cables	O	O	O	O	O	O

O: 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;
X: 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

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 DM Air cooled series precision air conditioner outdoor unit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