



Liebert® LVC

User Manual

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Purpose of the Document

This document applies to the Liebert LVC used in precision air conditioners and cooling solutions which maintain an optimal environmental control of technological ecosystems at minimal operating costs. This document gives an overview of the technical specification and parameters. The figures used in this document are for reference only.

Styling used in the Guide

The styles used in this manual are defined in the following table:

Situation	Description
Warning/Danger/Caution 	<i>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, to avoid equipment damage, performance degradation, or interruption in service, follow the warning instruction carefully.</i>
Notes 	<i>The Note section indicates additional and useful information, It also calls attention to best practices and industry-best protocols that are standardized and help make maximum utilization of the resources at hand. Helpful information related to the mainstream content also comes under the Note heading helping the users with the definitions, concepts, and terminologies used in the manual.</i>

Version History

Version	Revision Date	Issue	Changes
1.2	28-12-2018	31013644	

Table of Contents

Chapter 1: Product Overview	1
1.1. Model Description.....	1
1.2. Nomenclature.....	2
1.3. Technical Parameters.....	3
1.3.1. Mechanical Parameters.....	3
1.3.2. Mounting Base Dimensions.....	4
1.3.3. Parameters of Operating Environment.....	5
1.3.4. Parameters of Storage Environment.....	5
Chapter 2: Installation	6
2.1. Moving, Unpacking and Inspection	6
2.1.1. Moving.....	6
2.1.2. Unpacking.....	7
2.1.3. Inspection	8
2.2. Installation Notes.....	8
2.3. Space Requirements.....	10
2.4. Installation Procedures.....	14
2.4.1. Installing Pipelines.....	14
2.4.2. Connecting External Power.....	15
Chapter 3: Spray Cooling Module (Optional Component)	18
3.1. Introduction of Spray Cooling Module.....	18
3.2. Requirements of Spray Water Quality	18
3.3. Pipe Installation of Spray Water System	19
3.3.1. Water Softener	20

3.3.2. Water Filter	21
3.4. Electrical Control Box of Spray Cooling Module	21
3.5. Pre-Commissioning (Trial running) of Spray Cooling Module	21
3.6. Antifreeze Maintenance of Spray Water System.....	22
3.6.1. Antifreeze Maintenance of Spray Cooling Module.....	22
3.6.2. Antifreeze Maintenance of Spray Water System	23
Chapter 4: Application of Fan Speed Controller	24
4.1. HMI	24
4.1.1. RS485 Serial Communication Port.....	24
4.1.2. Keys and LCD	24
4.2. Operation Description of HMI	25
4.2.1. Initial Interface	25
4.2.2. Main Menu Interface	26
4.2.3. Analog Main Menu Interface	26
4.2.4. Current Alarm Main Menu Interface.....	26
4.2.5. Historical Alarm Main Menu Interface.....	28
Chapter 5: Maintenance and Troubleshooting.....	29
5.1. Maintenance	29
5.1.1. Maintenance of Condenser Components.....	29
5.1.2. Maintenance of Spray Water System.....	31
5.2. Troubleshooting	31
Appendix I: Circuit Diagram	35
Appendix II: Hazardous Substances.....	37

Chapter 1: Product Overview

1.1. Model Description

Liebert LVC is a professional equipment, which is situated in restricted area and can be accessed by authorized personnel only. This chapter introduces the nomenclature, main components and technical parameters of the Liebert LVC. The main component of the condenser includes heat exchanger, fan, fan speed controller and pressure sensor. The appearance and position of the components are shown in Figure 1-1.

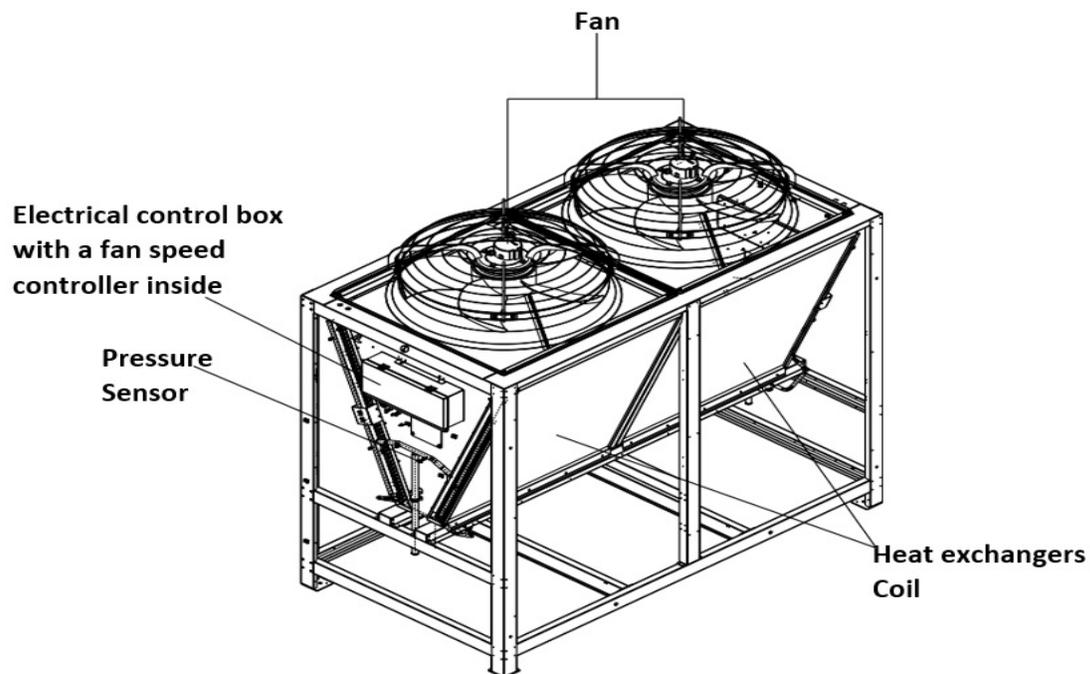


Figure 1-1 LVC Condenser

1.2. Nomenclature

Nomenclature of the condenser is shown in Table 1-1.

Table 1-1 LVC Condenser Model Nomenclature

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
L	V	C	0	8	8	S	E	2	N	0	P	H	C	E	0	0	0
Digit 1,3 Product Series									Digit 12 Panel Material								
LVC			Liebert V-Shaped Condenser						P			Painted Hot Dip Galvanized Steel + Aluminium					
Digit 4-6 Heat Rejection Capacity kW									S			Stainless Steel + Anodized Aluminium					
088			88 kW						Digit 13 Coil Fins Anti Corrosion Class								
Digit 7 Fan Quality/Sound Level									0			C2					
S			2-Fan, Standard Sound						H			C3 & C4					
L			2-Fan, Low Sound						E			C5					
Digit 8 Control Type									Digit 14 Packaging								
E			EC Fan Control						P			Packaging - Cardboard					
Digit 9 Circuit / Refrigerant									C			Packaging - For Export					
2			Two Refrigerant Circuit, R22/R407						Digit 15 Special Requirements								
4			Two Refrigerant Circuit, R410A						A			None					
Digit 10 Power Supply									E			For Export					
3			380-415V/3ph/50Hz+N						Digit 16 Order Identifier								
N			380-415V/3ph/50Hz/60Hz+N									0~9					
T			380-415V/3ph/60Hz+N						Digit 17 Order Identifier								
Digit 11 Energy – Saving Kit												0~9					
0			None						Digit 18 Order Identifier								
E			Pump Energy Saving Module									0~9					
S			Spray Cooling Module														
R			Spray Cooling Module + Pump Energy Saving Module														

1.3. Technical Parameters

1.3.1. Mechanical Parameters

The condenser structure is shown in Figure 1-2. The mechanical parameters of each model are listed in Table 1-2.

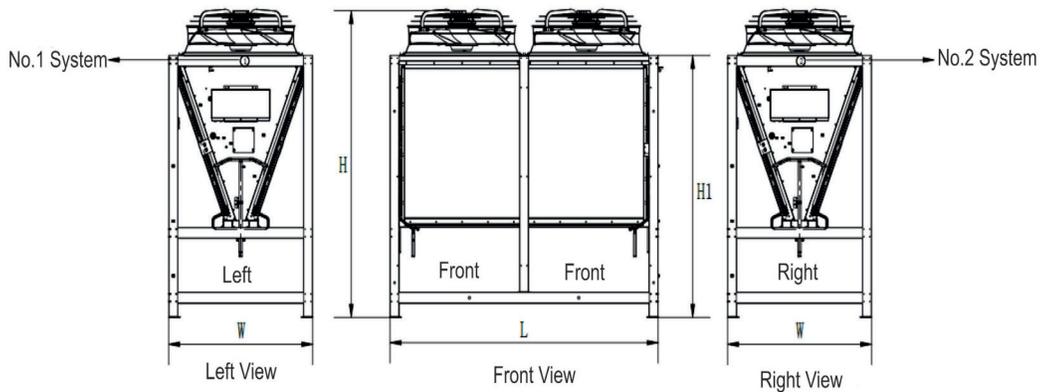


Figure 1-2 LVC Condenser Structure

Table 1-2 Mechanical Parameters

Model	Weight without Spray (kg)	Weight with Spray (kg)	Fan Number	Dimension (mm/inch)			
				L	H	W	H1
LVC088	315	355	2	2330/91.7"	1709/67.3"	1100/43.3"	1442/56.8"
LVC106	340	380	2	2330/91.7"	1709/67.3"	1100/43.3"	1442/56.8"
LVC140	415	460	2	2330/91.7"	2222/87.5"	1250/49.2"	1912/75.3"
LVC152	430	475	2	2330/91.7"	2222/87.5"	1250/49.2"	1912/75.3"
LVC170	450	495	2	2330/91.7"	2222/87.5"	1250/49.2"	1912/75.3"



- Figure 1-2 shows the serial number labels to determine system 1 and 2. There will be stickers with serial numbers pasted on LVC condensers to identify each system.
- There is a height difference of the condenser unit due to the different heights of individual fan model.

1.3.2. Mounting Base Dimensions

The mounting base is shown in Figure 1-3, and the specific mounting base dimensions of each model are listed in Table 1-3.

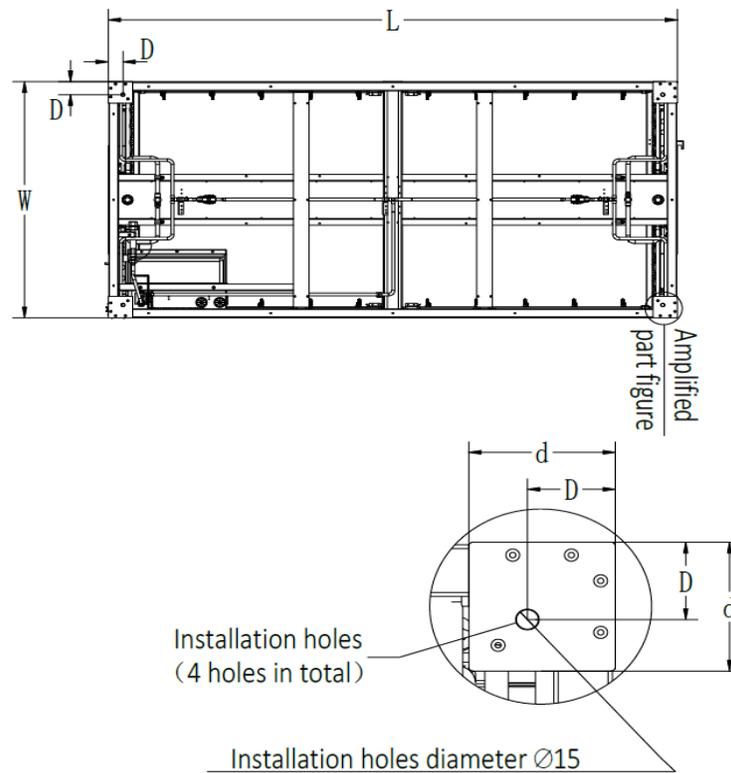


Figure 1-3 Mounting Base Figure

Table 1-3 Mounting base dimensions (unit: mm/inch)

Model	L	W	D	d
LVC088	2330/91.7"	1100/43.3"	60/2.4"	80/3.2"
LVC106	2330/91.7"	1100/43.3"	60/2.4"	80/3.2"
LVC140	2330/91.7"	1250/49.2"	60/2.4"	80/3.2"
LVC152	2330/91.7"	1250/49.2"	60/2.4"	80/3.2"
LVC170	2330/91.7"	1250/49.2"	60/2.4"	80/3.2"



- It is recommended to use M12 x 4 bolts to fix the mounting base to the round holes at the installation site.
- It is recommended to use rubber cushions between mounting foot and the installed base to absorb vibration.

1.3.3. Parameters of Operating Environment

Refer to Table 1-4 for parameters of operating environment

Table 1-4 Parameters of Operating Environment

Item	Requirement
Installation position	The standard equivalent distance between the indoor unit and the condenser is 30m. Vertical difference* ΔH : $-5 \leq \Delta H \leq 20$ m. Installation mode vertical upward mode.
Ambient Temperature	Outdoor temperature $-25 \sim + 45$ °C. Low temperature accessories are required are required if the temperature is between -35 °C~ $+ 20$ °C
Operation Power	400V $\pm 10\%$, 50/60 Hz
Altitude	≤ 1000 m. Derating is required if the altitude exceed 1000m
Protection level	Electrical control box and fan: IP55; Total unit; IPX5
Note*: - Indicates the condenser is above the indoor unit if the value is positive otherwise the value is negative.	



- When the equivalent distance between the indoor unit and the condenser exceeds 30m, refer to Section 5.4.2- Refrigerant pipe equivalent length in "Liebert PEX Series Air Conditioner Technical Manual" for the requirement of the equivalent length.
- If the spray cooling module is installed in the condenser, it is advisable to drain-out water before winter to avoid the frost cracking of spray cooling equipment.

1.3.4. Parameters of Storage Environment

Refer to Table 1-5 for parameters of storage environment

Table 1-5 Parameters of Storage Environment

Item	Requirement
Storage environment	Clean indoor environment with good ventilation and no dust
Ambient Temperature	-40 °C~ $+ 70$ °C
Ambient relative humidity	5%RH ~ $+70\%$ RH
Storage time	Total transportation and storage time should not exceed six months, otherwise the performance of the system need to re-calibrated.

Chapter 1: Installation

1.1. Moving, Unpacking and Inspection

1.1.1. Moving

It is recommended to use the mechanical transport equipment such as a forklift or a crane while unloading and transferring the condenser closest to the installation site. When a forklift is used, insert the tines of the forklift shown in Figure 2-1 and 2-2 (Considering the single fan condenser for example).

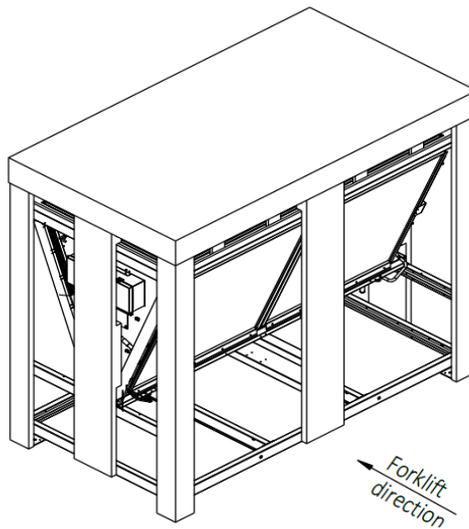


Figure 1-1 Forklift Direction 1

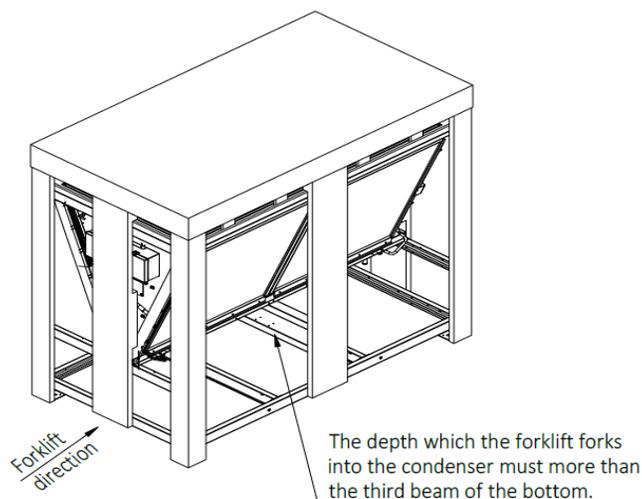


Figure 1-2 Forklift Direction 2

When a crane is used, refer to Figure 2-3 to lift the package.

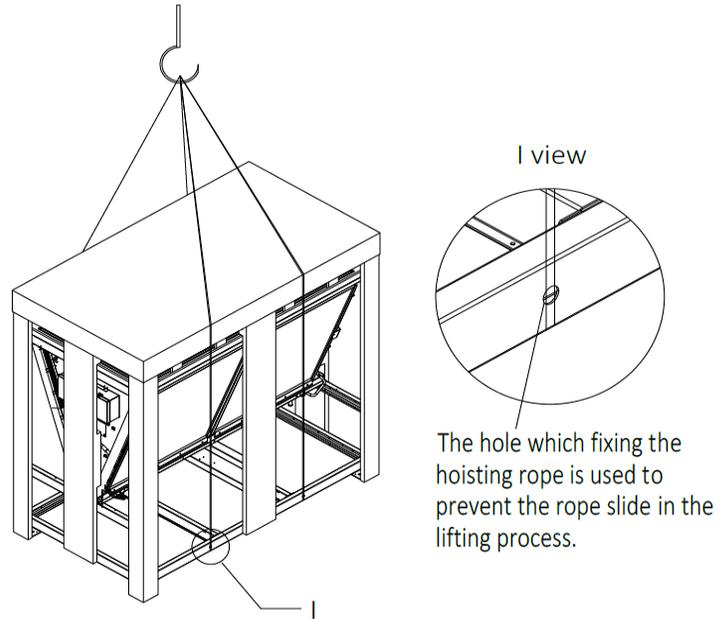


Figure 1-3 Crane Lifting



- Before lifting, please to ensue the lifting capacity of the equipment is greater than the weight of the unit, refer the weight of the unit in the Technical Specification as per model number.
- There are two holes in each of the front and back bottom beams for fixed lifting ropes, and the lifting ropes need to go through the beam opening. The user can also use a cord or other method to fix lifting ropes here, to prevent the rope sliding during the lifting process.
- It is prohibited to install lifting bolts in other parts of the unit frame bottom. When installing the lifting equipment, it is necessary to shelter the surface and fins of the unit, to avoid scratching.
- The warning board should be utilized in work area, it is prohibited to non-relevant personnel to enter.
- The lifting of units is a dangerous operation, which must be a responsibility of the skilled technicians and avoid the non-professional personnel to operate.
- If high wind speed is identified on site, please stop lifting work, until it is back to normal.

1.1.2.Unpacking

Remove the frame package and foam of the condenser without removing the protection cardboard of the fins. The protection cardboard of fins and the cushion pad of U tube located at the end of the condenser should be removed after the condenser is in its installation position.



- *Do not touch the copper pipes to avoid distortion and system leakage, while moving the condenser manually.*

1.1.3. Inspection

After the product arrival, you should check the accessories against the packing list. If any parts are found missing, or damaged, please report to the local offices of the carrier and Vertiv Co. immediately.

1.2. Installation Notes

The installation notes of the condenser are as follows

1. To ensure the heat dissipation capacity, install the condenser in the place with sufficient airflow. Do not install it where the coil of the condenser may be obstructed by dust or snow. Ensure that there is no steam of waste heat around.
2. The condenser must be installed on the ground of outdoor or other room that should be mounted on a plain surface. It can be an elevated installation by concrete column or steel I-beam, it is required that the installed base bearing capacity must be 1.5 to 2 times more than the weight of the condenser.
3. To reduce the impact of noise around the environment, the condenser should be installed away from the residential areas (≥ 15 m).
4. Be careful not to damage the waterproof layer of the building, when the condenser is installed on the roof of the building. Please observe the relevant rules of local premises.
5. Position the condenser higher than the indoor unit to ensure normal oil return.
6. Follow the vertical upward installation direction. For the convenience of installation and maintenance, please install the No.1 system (as shown in Figure 2-4) on the same side of same row (as shown in Figure 2-5 & 2-6)
7. When the condensers are installed front-and-back side by side, please install the same height condensers (as shown in Table 1-2) in a place (as shown Figure in 2-7) to avoid return airflow short circuit.
8. If the condenser is installed in the place where children are accessible, a fence must be installed to restrict the entry around the condenser.

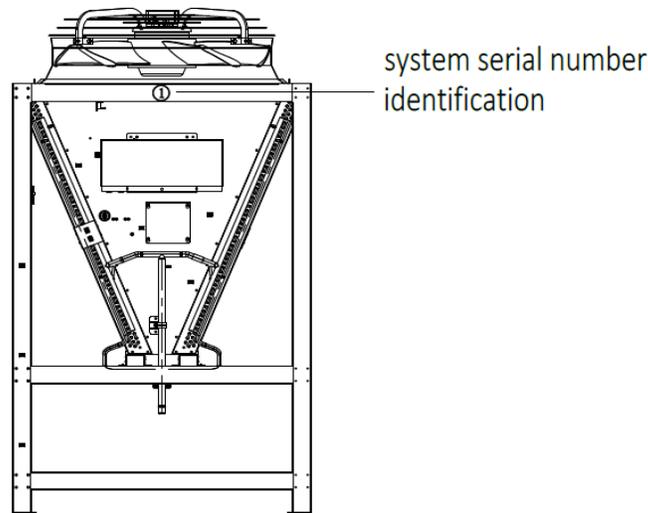


Figure 1-4 System Serial Number Identification

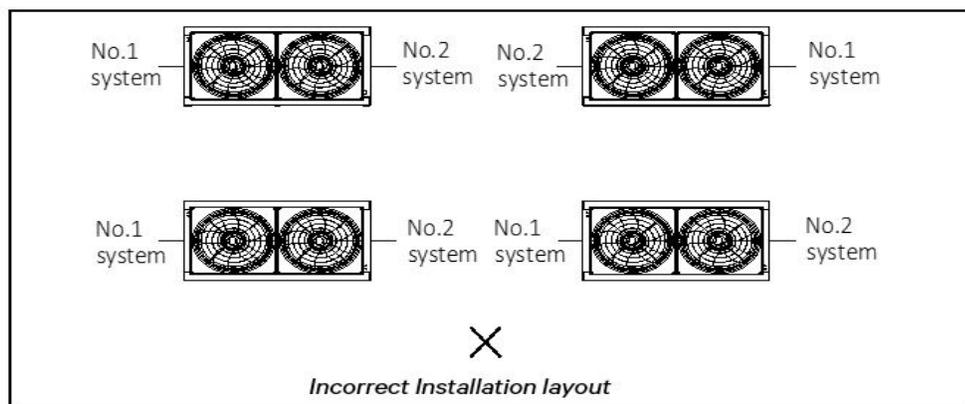
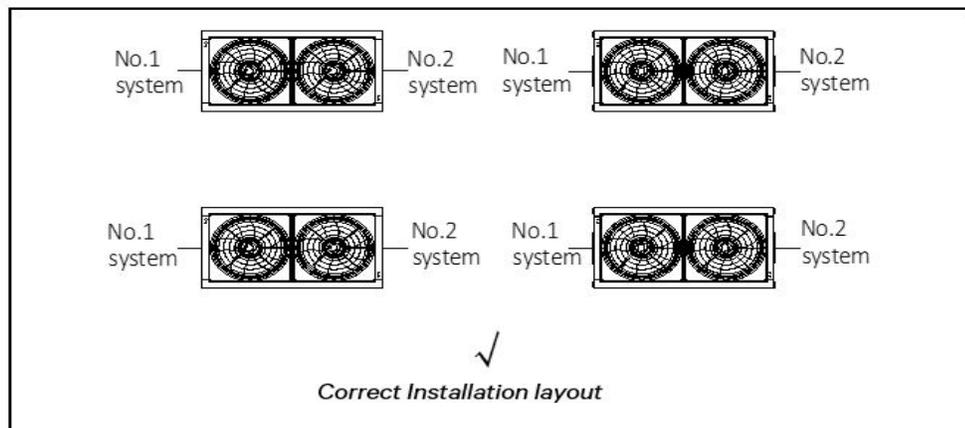


Figure 1-5 Spread Evenly Installation Layout Overhead View

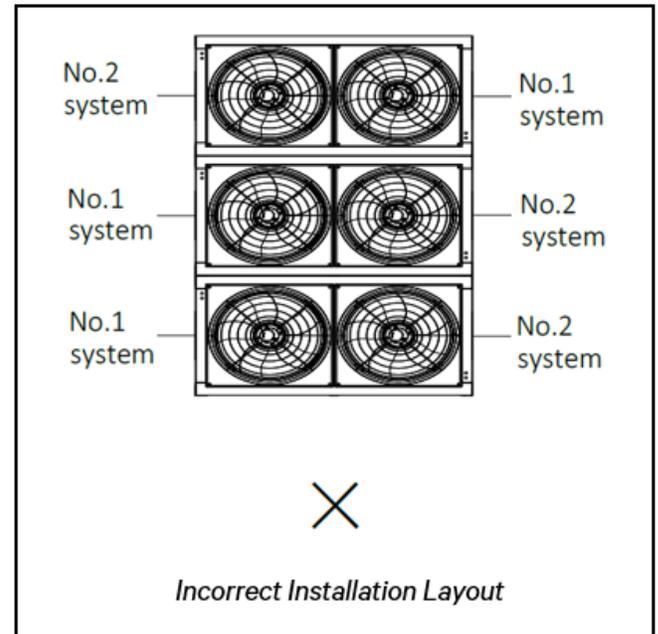
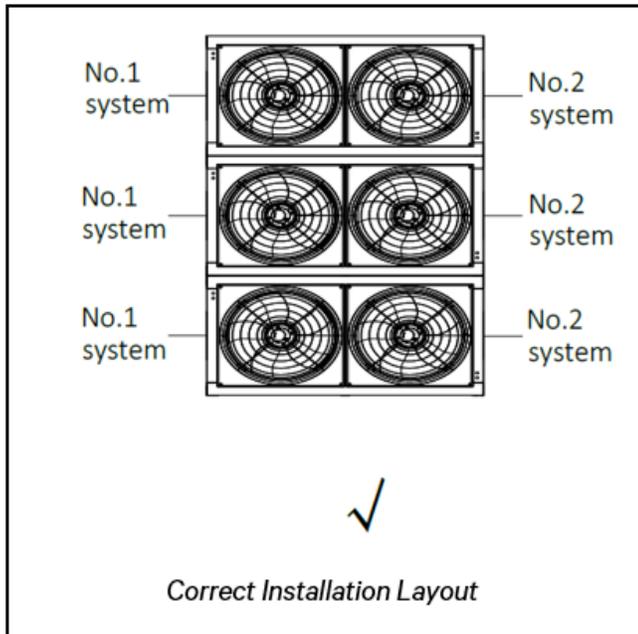


Figure 1-6 Front-and-Back Side by Side Installation Layout Overhead View

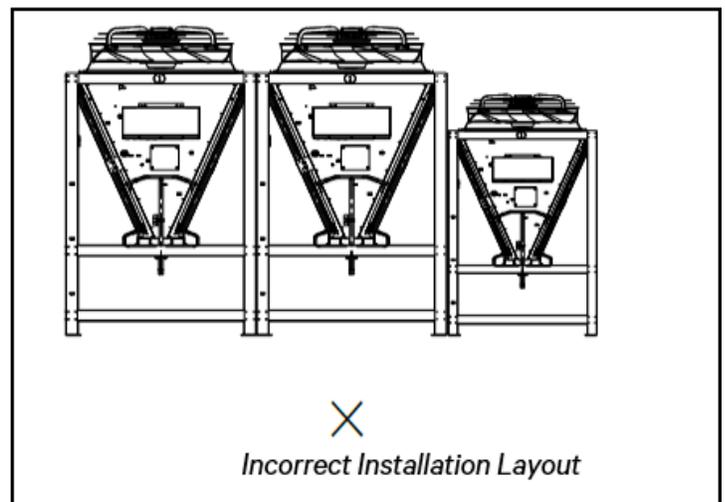
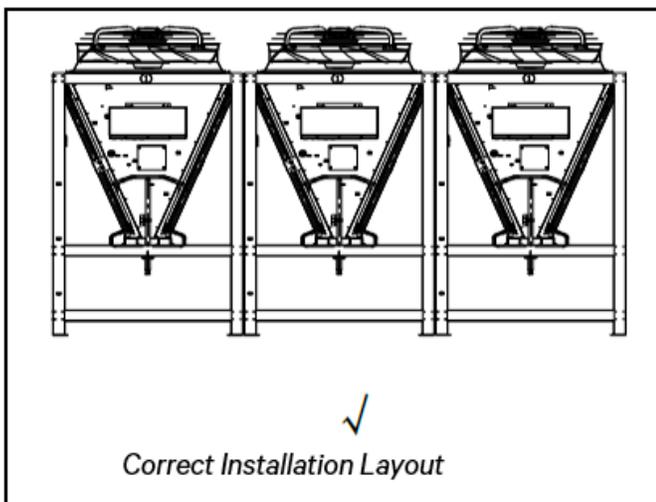


Figure 1-7 Front-and-Back Side by Side Installation Layout Left View

1.3. Space Requirements

- A 4000mm clearance is required around the condenser air outlet.
- At least 1250mm service space is required on one side of the condenser.
- The engineered mounting bracket requires four sides to be hollowed out, which can be ventilated freely.

In the following Figure 2-8 & 2-9. “h” is engineered mounted bracket height “h1” is enclosure height, “a” is the

distance between the condenser and envelope, “b” and “c” is the distance between two condensers.

- It is recommended to install the No.1 system on the same side (as shown in Figure 2-5 & 2-6) to convenient installation.
- If condensers cannot move to the installation location at one time as per site situation, it is required to reserve adequate distance between condensers before second installation.
- The condenser needs sufficient installation and service space around the installation place. And the specific space requirements are shown in Figure 2-8, 2-9 & 2-10 and Table 2-1 & 2-2.

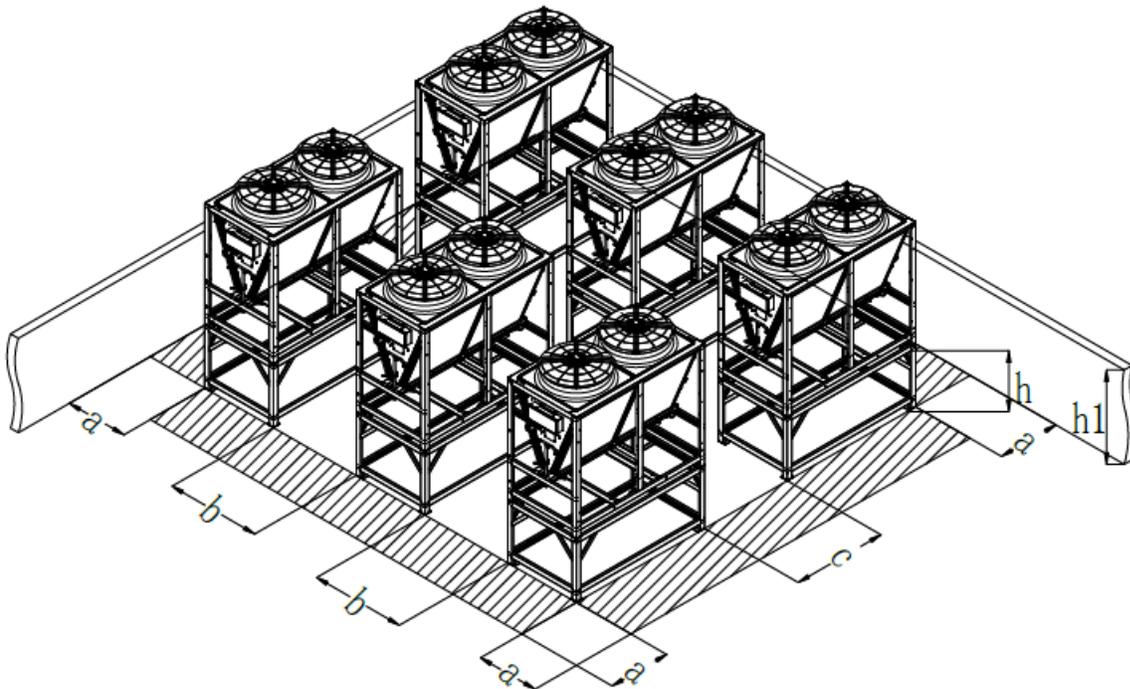


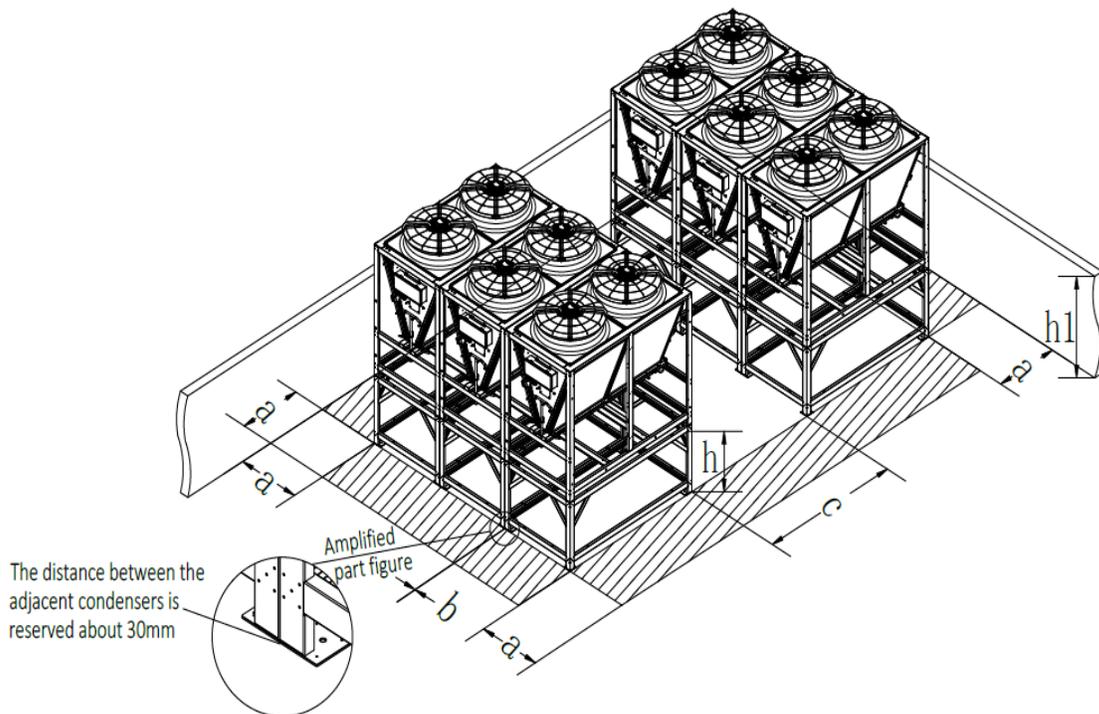
Figure 1-8 Spread evenly installation space required



- In Figure 2-8 the space requirement is based on the area of the building to provide the minimum spacing for air circulation within 10 m around the installation site. If the air circulation is not sufficient, please consult Vertiv personnel for technical confirmation.

Table 1-1 Spread Evenly Installation Space Required

The quantity of installed condensers is less than 30					
Model	h (engineered mounting bracket height)	h1	a	b	c
LVC088 / LVC106	$0 \leq h < 0.5$	≤ 1	≥ 1.5	≥ 1.8	≥ 1.0
	≥ 0.5			≥ 1.4	
LVC140	$0 \leq h < 0.5$			≥ 2.0	
	≥ 0.5			≥ 1.6	
LVC152 / LVC170	$0 \leq h < 0.5$			≥ 2.2	
	≥ 0.5			≥ 1.8	
The quantity of installed condensers between 30-50					
Model	h (engineered mounting bracket height)	h1	a	b	c
LVC088 / LVC106	$0 \leq h < 0.5$	≤ 1	≥ 1.5	≥ 2.0	≥ 1.0
	≥ 0.5			≥ 1.6	
LVC140	$0 \leq h < 0.5$			≥ 2.2	
	≥ 0.5			≥ 1.8	
LVC152 / LVC170	$0 \leq h < 0.5$			≥ 2.5	
	≥ 0.5			≥ 2.0	


Figure 1-9 Side by Side Installation Space Requirement

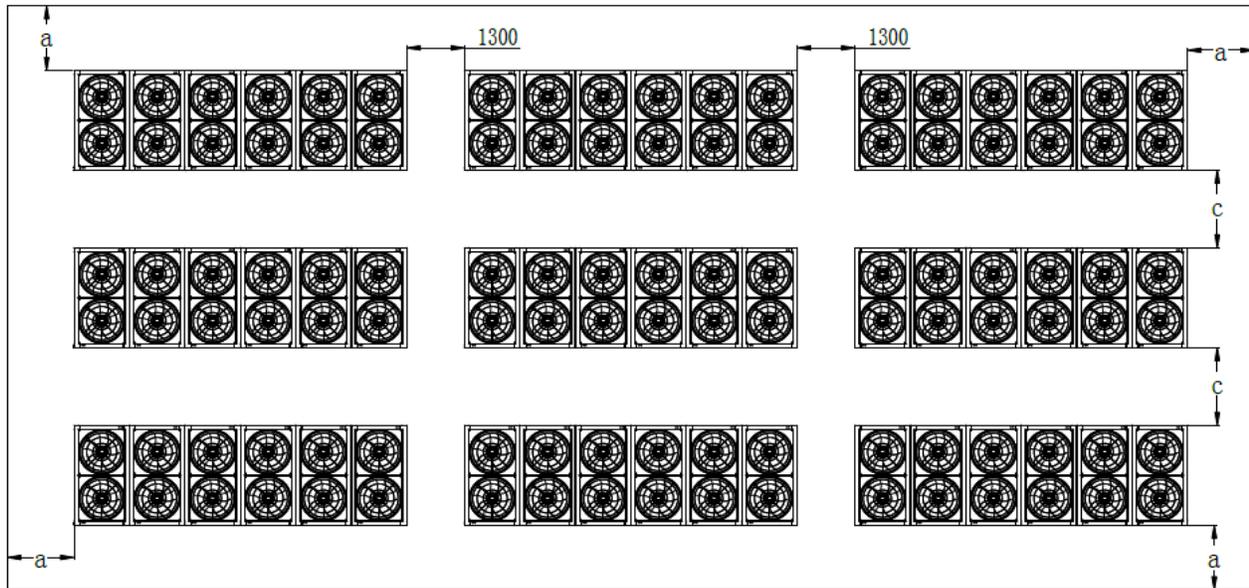


Figure 1-10 Side by Side Installation Space Overhead View

Table 1-2 Side by Side Installation Space Requirement (unit: mm)

The quantity of installed condensers is less than 30					
Model	h (engineered mounting bracket height)	h1	a	b	c
LVC088 / LVC106	$0.5 \leq h < 1.0$ ^①	≤1	≥1.5	0.03 ^②	≥1.8
	≥1.0				≥1.4
LVC140	$0.5 \leq h < 1.0$ ^①				≥2.0
	≥1.0				≥1.6
LVC152 / LVC170	$0.5 \leq h < 1.0$ ^①				≥2.2
	≥1.0				≥1.8
The quantity of installed condensers between 30-50					
Model	h (engineered mounting bracket height)	h1	a	b	c
LVC088 / LVC106	$0.5 \leq h < 1.0$ ^①	≤1	≥1.5	0.03 ^②	≥2.0
	≥1.0				≥1.6
LVC140	$0.5 \leq h < 1.0$ ^①				≥2.2
	≥1.0				≥1.8
LVC152 / LVC170	$0.5 \leq h < 1.0$ ^①				≥2.4
	≥1.0				≥2.0



1. When the condensers are installed side by side, at least 0.5m engineered mounting bracket height is required, which can increase the return air area and reduce the wind resistance.
2. When the condensers are installed side by side, the distance between the adjacent condensers is reserved about 30mm, so the condenser can be lifted out for maintenance.
3. Figure 2-10, when multiple condensers are installed side by side, it is suggested that the width of 1300mm is reserved for every 6 condensers for maintenance.
4. The space requirement of condensers is based on enclosure height less than 1m in Table 2-1 & 2-2. If enclosure height more than 1m, it is must to increase engineered mounting bracket height. Please consult Vertiv personnel for technical confirmation.
5. The maximum number of side by side condenser which can be installed is 10.

1.4. Installation Procedures



- Before commencing any copper-pipe welding process, release all Nitrogen charges from the indoor and outdoor units.

1.4.1. Installing Pipelines



- Protect copper pipes from any surrounding heat sources. Separate the copper pipes from structures or other obstacles using rigid supports. Avoid dust and water vapor to entered in copper pipes.
- Use a good quality, silver-based solder for all brazed connections. Use refrigeration grade copper pipes and fittings throughout the installation. Remove all Nitrogen from pipes during brazing to prevent oxidation.

1. Location of gas and liquid pipe: The location of gas and the liquid pipe is shown in Figure 2-11. The location parameters of each model are listed in Table 2-3.

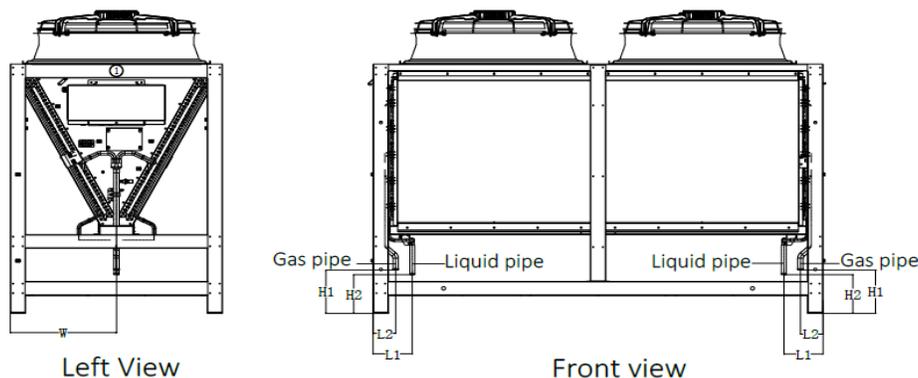


Figure 1-11 The Position of Gas and Liquid Pipe

Table 1-3 Side by Side Installation Space Requirement (unit: mm/inch)

Model	L1	L2	W	H1	H2	Gas pipe outer dia.	Liquid pipe outer dia.
LVC088 / LVC106	203 / 7.9"	115 / 4.5"	550 / 21.7"	251 / 9.9"	223 / 8.8"	28 / 1.1"	22/ 0.9"
LVC140	203 / 7.9"	115 / 4.5"	625 / 24.6"	460 / 18.1"	427 / 16.8"	28 / 1.1"	22/ 0.9"
LVC152 / LVC170	203 / 7.9"	115 / 4.5"	625 / 24.6"	224 / 8.8"	195 / 7.7"	28 / 1.1"	22/ 0.9"

- 2. Identify the outer diameter of gas and liquid pipe:** Refer to installing unit pipes in 'Liebert Indoor Air Conditioner User Manual' for pipe outer diameter.
- 3. Identify the condenser installation height:** Refer to installing unit pipes in 'Liebert indoor Air Conditioner User Manual' for installation height.
- 4. Install the pipes:** Install the pipes according to the actual situation and national codes and standards.



- *If the indoor unit is dual system unit, it is required to connect the gas and liquid pipe of the same indoor unit No.1 system and condenser No.1 system, connect the gas and liquid pipe of same indoor unit No.2 system and condenser No.2 system.*
- *If indoor unit is a single-system unit, it is required to number the condenser and indoor unit respectively. This will avoid gas and liquid pipe connection error. Such as No.1 indoor unit connected with No.1 condenser No.1 system, No.2 indoor unit connected with No.1 condenser No.2 system.*
- *According to the actual situation, plan the condenser installation location and reduce the distance connected with the pipe of indoor unit.*

1.4.2. Connecting External Power

1. Identify the cable specifications

A condenser has two systems. It is required to the condenser No.1 system and No.2 system to powered supply respectively. Select the appropriate power supply cables (L1/L2/L3/N/PE) and control cables (two core wires) of the condenser according to the Full Load Current and the Installation Distance as shown in Table 2-4.

Table 1-4 Operation Current of Condenser Under Full Load

Condenser Model	FLA (Without Spray) (A)	FLA (With Spray) (A)
LVC088	2x2.3	2x4.3
LVC106	2x2.3	2x4.3
LVC140	2x5.0	2x7.0
LVC152	2x5.0	2x7.0
LVC170	2x5.0	2x7.0



- It is recommended to use the 20 AMG (0.52mm²) cable as the control condenser start / stop signal cable.
- Outdoor cable between indoor unit and the condenser need to be shielded by protected pipes.
- The cables should not be in contact with any hot object. Over-current protective device or similar device should be provided in the installation circulation (select as shown in Table 2-4).

2. Connect the Cables

External power cable and compressor signal cable are connected from No.1 system and No.2 system respectively, for specific wiring details refer Figure 2-12 and Appendix-I Circuit Diagram for the connections of external power cables. To protect against the thunderstorm conditions, grounding line must be connected with the bolt of condenser lighting protection connection in the electrical control box of No.1 system and No.2 system respectively.

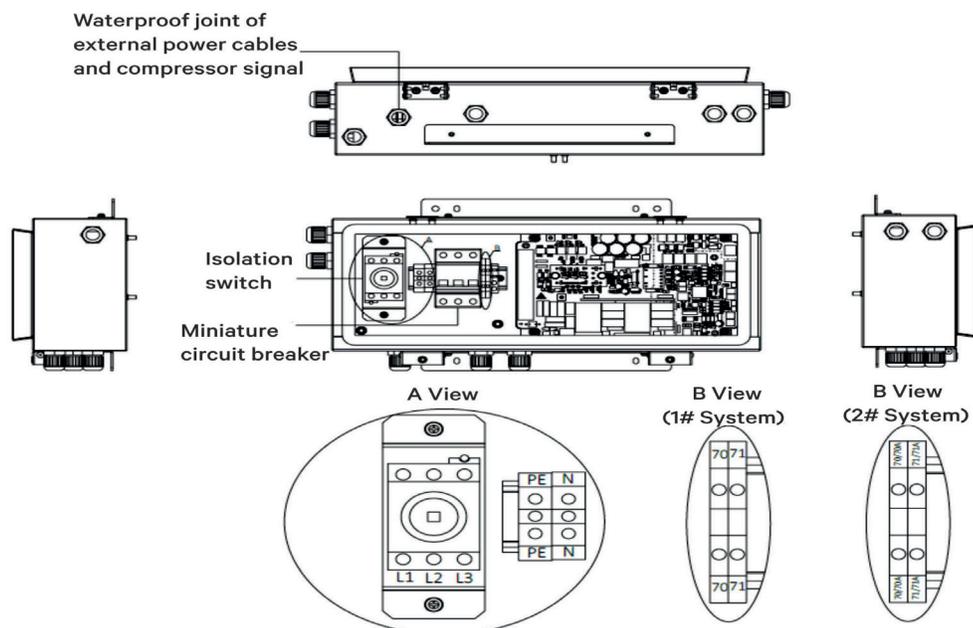


Figure 1-12 Connection Figure of External Power Cables



- *The external power cables and the compressor signal cables enter the electrical control box through the waterproof joint of external power cable whose inner diameter is 13~18 mm.*
- *After connecting the external power cables, it is suggested to apply waterproof sealant treat threading hole to avoid any possible rain-water entrance and to ensure the good waterproof performance of electrical control box.*
- *All wiring must be fixed by clamp before entering the electrical control box.*
- *External power cables and compressor signal cables should be connected to the corresponding terminals in the electrical box.*

Chapter 3: Spray Cooling Module (Optional Component)

3.1. Introduction of Spray Cooling Module

The spray system turns the water into tiny particles which in turn evaporate and cool the air. It helps in reducing the dry bulb temperature of air running into the coil. Additionally, the water mist sprinkled on the fins surface, reduces the temperature of the fins surface and increases the convection heat transfer effect of the condenser.

The main components of the spray cooling module are ball valve, water pump, motor, and nozzle. The appearance and position of all the components are shown in Figure 3-1.

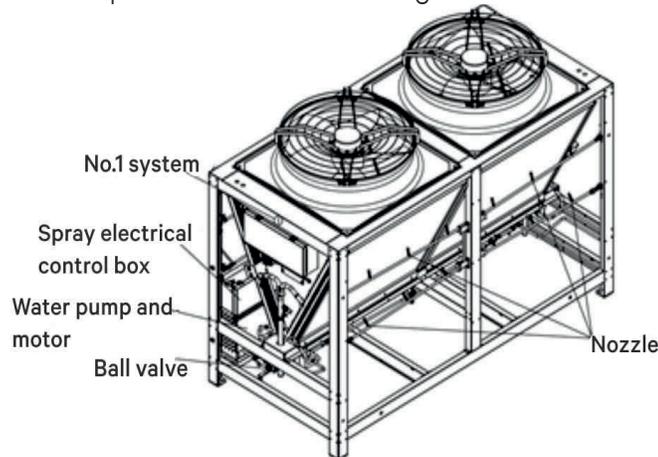


Figure 3-1 Spray Cooling Module

3.2. Requirements of Spray Water Quality

It is must to use soft water or pure water for spray system, the requirements of water quality as shown in Table 3-1.

Table 3-1 The Requirements of Water Quantity

Item	Electrical Conductivity (25°C, uS/cm)	Hardness (mg/L, CaCO ₃)	pH (25°C)	Chloride Content (mg/L)	Silica Content (mg/L)	Temperature (°C)
Requirement	< 100	< 50	6.5 < pH < 8.5	< 20	< 5	5-40



- *The use of tap water without softening treatment will cause nozzle clogging, fine scaling & corrosion, water pump damage, affects the normal operation of the spray system and the effective convection heat transfer of the condenser.*

3.3. Pipe Installation of Spray Water System

The total water inlet valve is connected with the inlet filter, water softener, outer filter and inlet ball valve to complete the connection of the spray water piping between user tap and spray cooling module. Pipe installation for spray water system is depicted in Figure 3-2.

Spray water mist cannot be evaporated completely, part of the water drops down to the ground from the condenser fins surface. So, it is required to install dam in the area of spray cooling module to conveniently drain the water to the drainage.

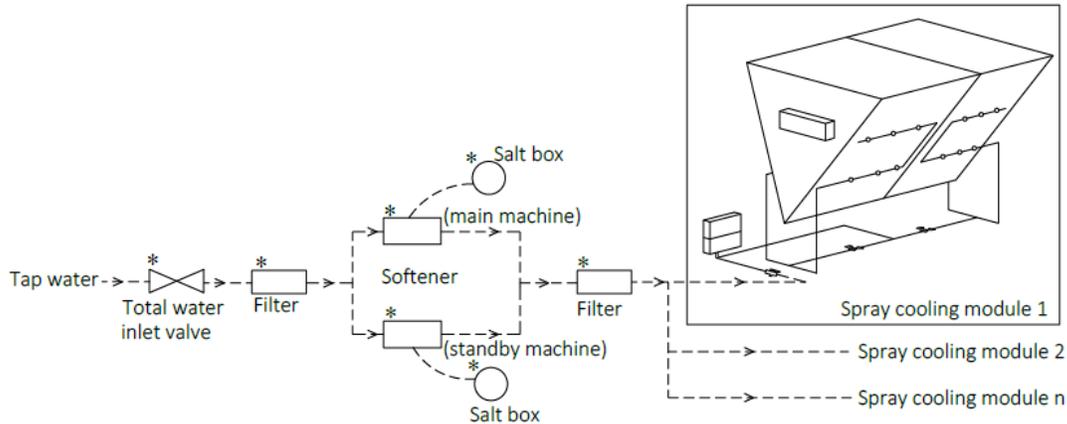


Figure 3-2 Pipe Installation Spray Cooling Module



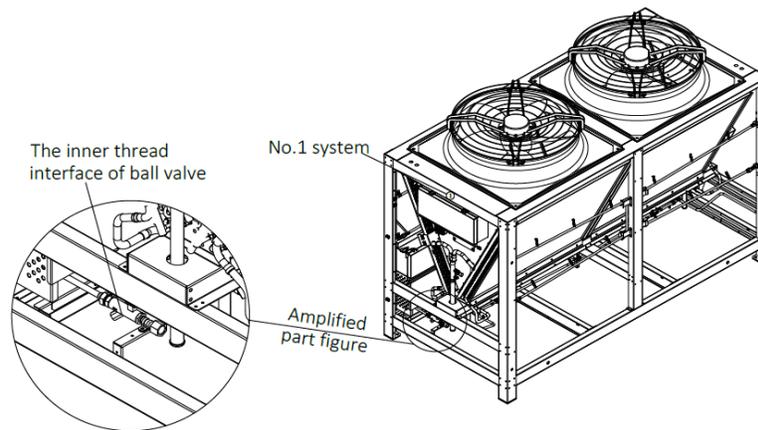
- -----: Pipe provided by the manufacturer.
- _____: Pipe be installed on the site (completed by technical personnel).
- * these components are not installed in the condenser, in order to ensure the normal operation of the spray cooling module, these components should be installed as close as possible to the spray cooling module, to reduce the water supply and drainage.
- Select suitable piping material according to the site conditions. The pipeline installation should follow the standards of water supply and drainage.
- The water supply pressure of spray cooling module is between 0.5 and 3 bar, if the water pressure is low a booster pump should be installed. And if the water pressure is high, a pressure reduction valve should be installed.
- Spray cooling module with main pipe and branch pipe needs to be drained regularly, it is recommended to drain water before winter, to prevent the formation of ice.

The water pressure and diameter of the spray water system main pipe should meet the total water consumption of all the spray cooling modules. The water pressure and diameter of each branch pipes should meet the water consumption of the corresponding spray cooling module. The water consumption of each model as shown in Table 3-2.

Table 3-2 The Water Consumption of Model

Model	Water Consumption (m ³ /h)
LVC088 / LVC106	0.13
LVC140 / LVC152 / LVC170	0.21

The inner thread interface of G1/2" is reserved in the spray cooling module, the interface is under the condenser No.1 system, as shown in Figure 3-3.


Figure 3-3 Ball Valve of Spray Cooling Module

3.3.1. Water Softener

It is required to connect a separate power supply wiring to the softener. Select the power supply cables according to the full load current of the water softener. The water provided from water softener should meet the total water consumption of all the spray cooling modules, as shown in Table 3-2.

It is recommended to adopt a standby softener switching operation as a backup. When the main softener is regenerating or in maintenance, it can be switched with the standby softener to the operations, to ensure continuous supply of soft water for spray system.



- *If the softener is installed outside, to prevent softener exposure to the sun rays and rainwater for long time, a close cabinet should be installed to cover the softener.*
- *The softener should be installed in drainage piping site to easily drained the waste water during the operation of softener.*
- *Monitor the water harness of softener regularly. Add the industrial salt and replace the resin in-time.*

3.3.2. Water Filter

To ensure the normal operation of spray system, it is must to install water filter in the inlet and outlet of water softener. Filtering level $\leq 150\mu\text{m}$.

3.4. Electrical Control Box of Spray Cooling Module

The main components of electric control box include miniature circuit breaker, electric relay, capacitance, filter board and voltage transformer. The appearance and position of electrical control box are shown in Figure 3-4.

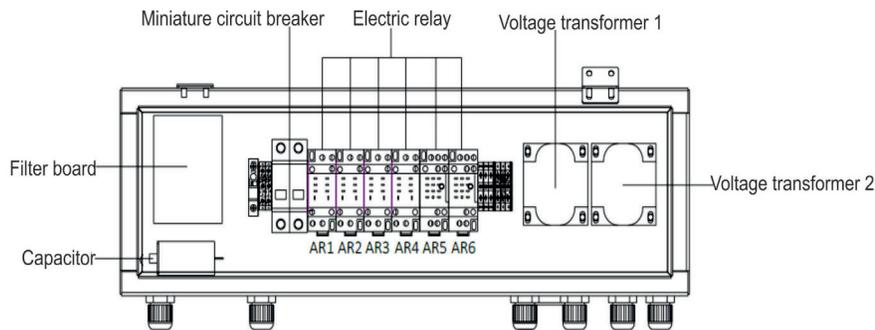


Figure 3-4 Electrical Control Box of Spray Cooling Module

3.5. Pre-Commissioning (Trial running) of Spray Cooling Module

Spray cooling module pre-commissioning steps

1. After connecting the water pipe (refer to Section 3.3 'Pipeline Installation of Spray Water System') to pressure resistance, test the water pressure according to the requirement of the relevant specifications.
2. Open the total water inlet valve, water filter and water softener, to confirm the softening water equipment is operating normally.
3. Open the ball valve of spray cooling module as shown in Figure 3-4, then unscrew the drainage export of the pump water inlet & outlet pipeline connected with the drainage export of No.1 & No.2 systems and pressure gauge, then measure required the water pressure is between 0.5- 3.0 bar.
4. Remove the pressure gauge and tighten the drainage export and start troubleshooting of spray cooling module.
5. Close the 'Miniature circuit breaker' of the spray cooling module of the condenser No.1 system and No.2 system as shown in Figure 3-4. Enter to the configuration menu interface of the control board, set the setting value of the No.1 system and No.2 system parameters in the controller C44 to 1, and value of C45 to 1.
6. Take a trial run of the spray cooling module at least for 3min. It is required to observe the smooth operation

of the water pump and solenoid valve. Also observe the nozzle can spray out the water mist, and the spray water pipe is not leaking.

7. Set the setting values of the No.1 system and No.2 system parameters in the controller C45 to 2 and unscrew the Y-shape filter of the ball valve. Then, clean the filter screen to reinstall it.
8. Set the setting value of C45 to 0 to complete the trial running of spray cooling module.



- *The power supply for the entire spray cooling module comes from No.1 system, so the spray system of No.2 system is required to run separately, such that the No.1 system does not get power off.*
- *Refer to 4.2 Operation Description of HMI for setting configuration.*

3.6. Antifreeze Maintenance of Spray Water System

When the temperature is below 0°C, the water system pipe will be frozen, leading to frost damage the water pipe, the water softener, the water filter, the pump and the ball valve. To avoid the damage, drain the water of the spray water pipes and the spray cooling module before winter.

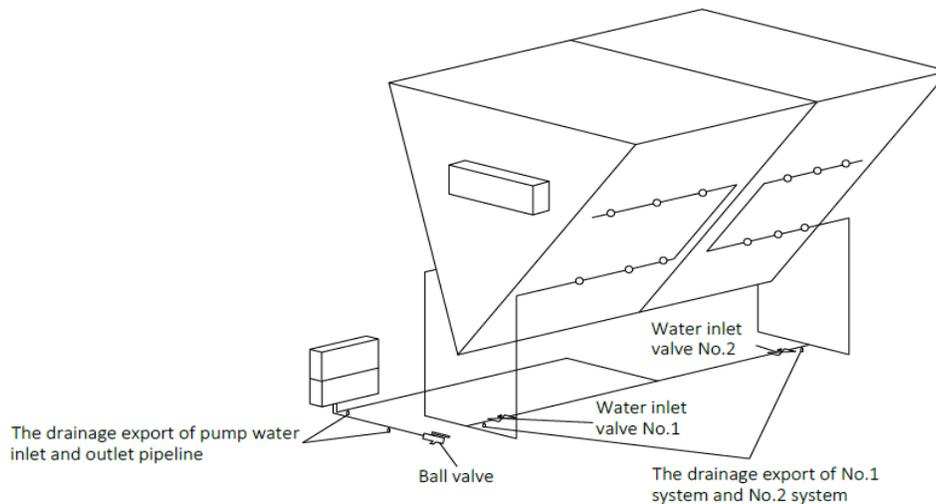


Figure 3-5 Drainage Export of Spray Cooling Module

3.6.1. Antifreeze Maintenance of Spray Cooling Module

Close the ball valve and miniature circuit breaker (see Figure 3-4) of the spray cooling module, unscrew the drainage export of the pump water inlet and outlet pipe, unscrew the drainage export of the No.1 system and No.2 system (as shown in Figure 3-5). Drain the water of spray cooling module, so that compressed air can be used to blow the residual water.

3.6.2. Antifreeze Maintenance of Spray Water System

Close water supply inlet water valve from user of the main pipeline, unscrew the drainage export of the main pipe and each branch pipes. After drain the water of all drainage export, compressed air can be used to blow-off the residual water in the pipeline; simultaneously, drain the water of the filter, softener and salt box.



- *To avoid the leakage of the spray system in the next year, tightened the valve core and the valve cap after draining the water.*
- *Before the operation of the spray system in the next year, the leakage and damage of the spray water system should be checked according to the trial running of the spray cooling module. Refer to Section 3.5 Pre-commissioning (Trial running) of Spray Cooling Module for trial operation in 'Liebert LVC User Manual'.*

Chapter 4: Application of Fan Speed Controller

This chapter introduces the use of the fan speed controller, introduction of Human-Machine Interface (HMI) and operation of HMI. This chapter also features the details of the fan speed controller, along with control logics, wiring terminals, HMI operation, protection function and alarm function.



- *It is recommended that users should not operate the fan speed controller unless necessary.*

4.1. HMI

The fan speed controller operation and setup are provided through, RS485 serial communication port, keys and LCD.

4.1.1. RS485 Serial Communication Port

The RS485 serial communication port is a port that is connected to the computer using factory-define protocol. It is used for the factory commissioning and maintenance.

4.1.2. Keys and LCD

The keys and LCD, which can realize the functions in Table 4-1, provide the HMIs for maintenance personnel. Refer to Section 4.2 for Operation Description of HMI for operation of keys and LCD HMI.

Table 4-1 Function Descriptions of Keys and LCD

Serial Number	Function	Description
F	Query the acquisition data in real time	The acquisition data include condensing pressure, ambient temperature, output percentage, the state of fan enable signal and the state of alarm
A	Query the current alarm data in real time	The current alarm data includes phase loss alarm, PIM over temperature, fan failure, fan failure locked, pressure sensor failure, EEPROM read fault alarm, hardware over current, bus over voltage, spray high pressure alarm, spray water system alarm, spray low pressure alarm, fan not configuring alarm and NTC failure
H	Query the history alarm data in real time	The latest saved 100 historical alarms can be queried

Serial Number	Function	Description
C	Query the acquisition data in real time	The configured parameter includes running pressure, pressure controlling range, minimum output frequency, maximum output frequency, fan number and pressure sensor type, refrigerant type, jump frequency 1, jump frequency 1 range, jump frequency 2, jump frequency 2 range, jump frequency 3, jump frequency 3 range, the curve of frequency control, manual mode, manual mode output frequency; or resume the default values

The keys and LCD are on the upper right corner of the fan speed controller board, as shown in Figure 4-1.

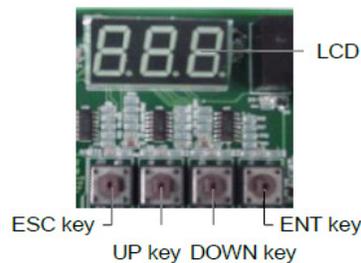


Figure 4-1 Keys and LCD

4.2. Operation Description of HMI

4.2.1. Initial Interface

The LCD will alternately display 'F00' (the maximum pressure logo) and the larger of condensing pressure 1 and condensing pressure 2 when the fan speed controller is powered on initially. The display order is shown in Figure 4-2.

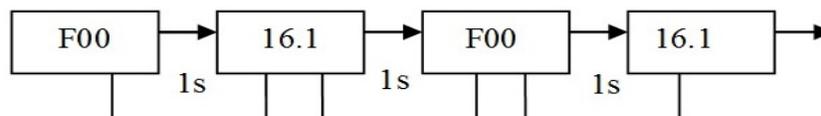


Figure 4-2 Display Order of the Initial Interface



- The "16.1" is only an example, and the actual value is determined by the sampling result

4.2.2. Main Menu Interface

Press the ESC key on the initial interface, and the Main Menu Interface will appear on the LCD. It includes the Analog main menu interface, Current alarm main menu interface, Historical alarm main menu interface and Configuration main menu interface. To select scroll through the different main menu interface options press the UP key and DOWN key and to enter the submenu of the current main menu on the main interface press the ENT key. The switching operation processes and orders of the main menus are shown in Figure 4-3.

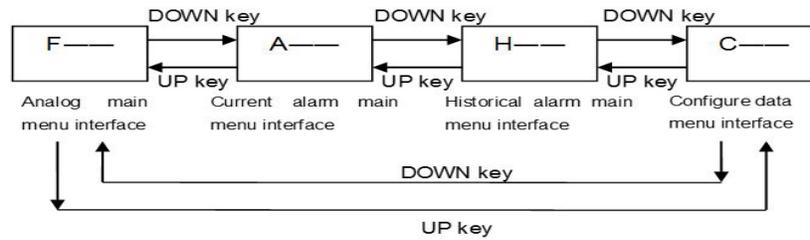


Figure 4-3 Switching Operation Processes and Orders of the Main Menus

4.2.3. Analog Main Menu Interface

Press the ENT key to enter the Analog submenu interface when the current main menu interface shows 'F__' (the symbol of Analog main menu). The switching operation processes and orders of the Analog submenu are shown in Figure 4-4.

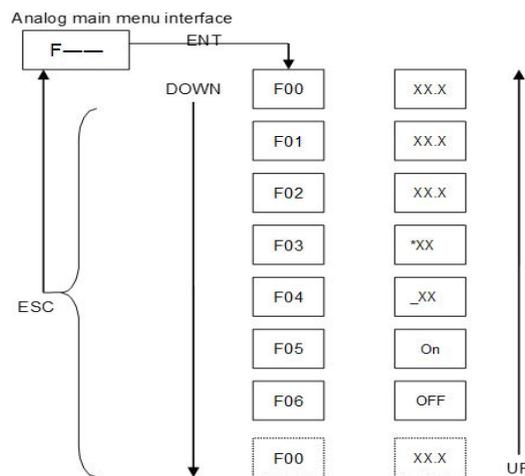


Figure 4-4 Switching Operation Processes and Orders of the Analog Submenu

4.2.4. Current Alarm Main Menu Interface

Press the ENT key to enter in the current alarm submenu interface, when the current main menu interface shows 'A__' (the symbol of current alarm main menu). The switching operation process and order of the current alarm submenu are shown in Figure 4-5, and the Current alarm main menu ID significances are shown in Table 4-2.

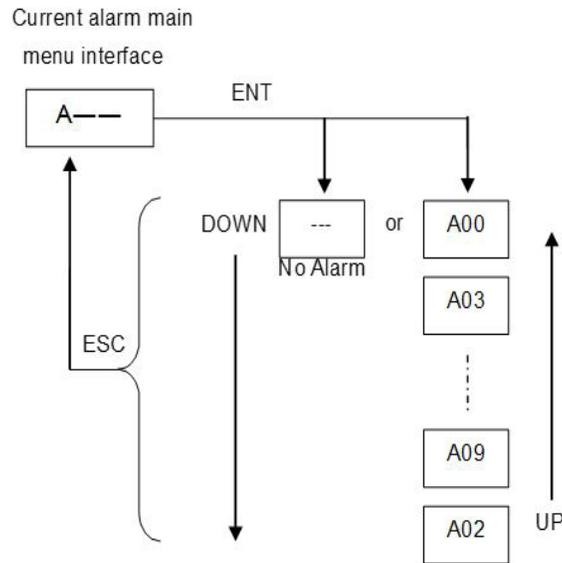


Figure 4-5 Switching Operation Processes and Orders of the Current Alarm Submenu



- The alarm is displayed as 'A' + "alarm code"..

Table 4-2 Current alarm main menu ID significances

Alarm	Code
Power failure	00
PIM over temperature	01
Fan failure	02
Spray water system alarm	03
Fan failure locked	04
Pressure sensor failure	06
EEPROM read fault alarm	07
Hardware over current	08
Bus over voltage	09
Communication failure	0A
Spray high pressure alarm	0b
Spray low pressure alarm	0C
NTC failure	0d
Fan not configuring alarms	0E
Bus under voltage alarm	0F

4.2.5. Historical Alarm Main Menu Interface

Press the ENT key to enter the historical alarm submenu interface when the current main menu interface shows 'H__' (the symbol of historical main menu). The latest saved 100 historical alarms can be queried. Press the UP and DOWN keys to scroll through the displayed first to the last alarm. When multiple alarm information is produced, the alarm information ID are arranged in chronological order. The latest alarm appears in the front, no warning shows "---". The switching operation process and order of the historical main menu are shown in Figure 4-6.

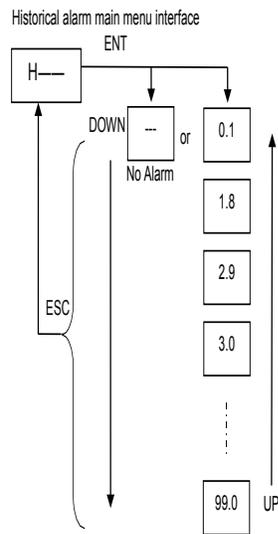


Figure 4-6 Switching Operation Processes and Orders of the Historical Main Menu



- The alarm is displayed as “alarm number” + “alarm code”.

Chapter 5: Maintenance and Troubleshooting

This chapter introduces the maintenance and troubleshooting of the condenser. User should check the condenser regularly and solve the problems in time.



- *It is recommended the maintenance of the condenser should be done by technicians.*
- *Except for the commissioning items that must be carried out with power-on, during maintenance, the power of the indoor unit and the air switch of the condenser must be cut off.*

5.1. Maintenance

5.1.1. Maintenance of Condenser Components

- **Refrigeration system**

1. Check that the refrigeration pipes are firmly fixed. The refrigeration pipes shall not shake with the vibration of wall, earth or equipment frame. Otherwise, reinforce the refrigeration pipes with fastening objects.
2. Check that there is no oil on the accessories of all refrigeration pipes, and make sure that the pipes do not leak.

- **Heat exchanger**

1. Clean the fins of the heat exchanger regularly. There is a cleaning window under each electrical box of the No. 2 system of the condenser, as shown in the Figure 5-1. During cleaning, ensure the power is off, electrical box be sealed well and control the blow-off angles is less than 45° between blowing off direction and condenser airflow direction.

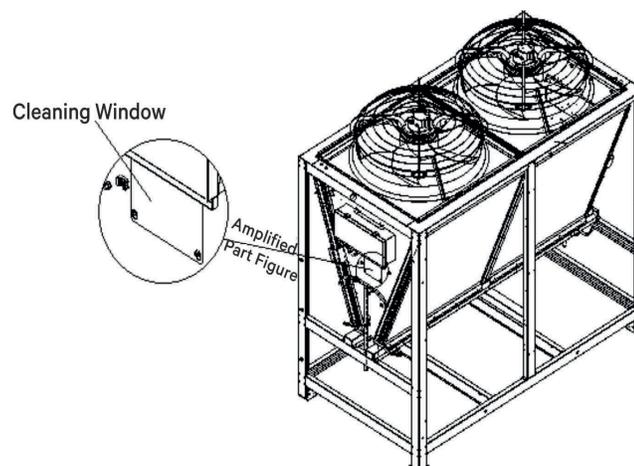


Figure 5-1 Cleaning Window

2. Clean the fins of the heat exchanger with fins detergent, if the condenser airflow is blocked.
3. Check for damaged fins and maintain them in time.
4. Avoid snow accumulation around the condenser in winter.



- *The cleaning agent should not contain acidic composition.*

- **Fan**

Check that the fan runs smoothly. Observe the issues such as abnormal noise, vibration and failure of bearing.

- **Fan speed controller**

Check that the fan speed controller board operates normally. If not, replace it as illustrated in Figure 5-2.



- *Take a note, the positions of the bolt installation holes on the fan speed controller could be different on the actual product.*

The fan speed controller is inside the electrical control box, refer to Figure 5-2 to remove the fan speed controller board, there are 4 screws in each corner of the controller box.

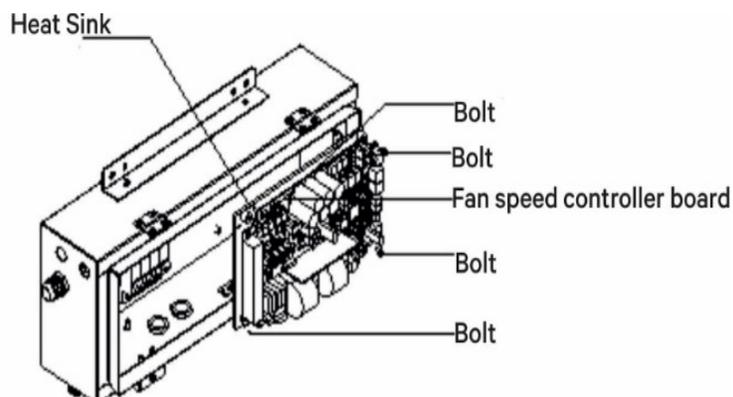


Figure 5-2 Removing the Fan Speed Controller Board

5.1.2. Maintenance of Spray Water System

- **Nozzle**

1. Compare the water mist area of different nozzles, it is possible to judge whether the nozzle is clogging. If the nozzle is clogging, clean or replace it.
2. Check that the nozzle bases are firmly fixed, to ensure no leakage.

- **Pump and Motor**

1. Check the operation of the pump regularly. Through the control board check whether current alarm menu interface has AOb or AOC alarm to judge the operation of the pump.
2. Check that the motor runs smoothly. Observe the issues such as abnormal noise and vibrations.

- **Ball Valve**

1. Clean the filter screen of the ball valve regularly.

- **Water Softener**

1. Check that the program control runs normally. If there is an anomaly, please deal with the corresponding fault.
2. Check regularly whether multichannel valve clogging. If necessary, clean the control valve to ensure the smooth piping.
3. Monitor the water hardness of softener regularly. Add the industrial salt and replace the resin in time.

- **Water Filter**

1. Clean the filter core regularly. If it is necessary, replace the filter core.

- **Spray Water Pipeline**

1. Check that the connector of the spray pipes is firmly fixed. If there is leakage, the connector should be tightened.

5.2. Troubleshooting

Refer Table 5-1 for alarm troubleshooting.

Table 5-1 Table of Alarm Troubleshooting

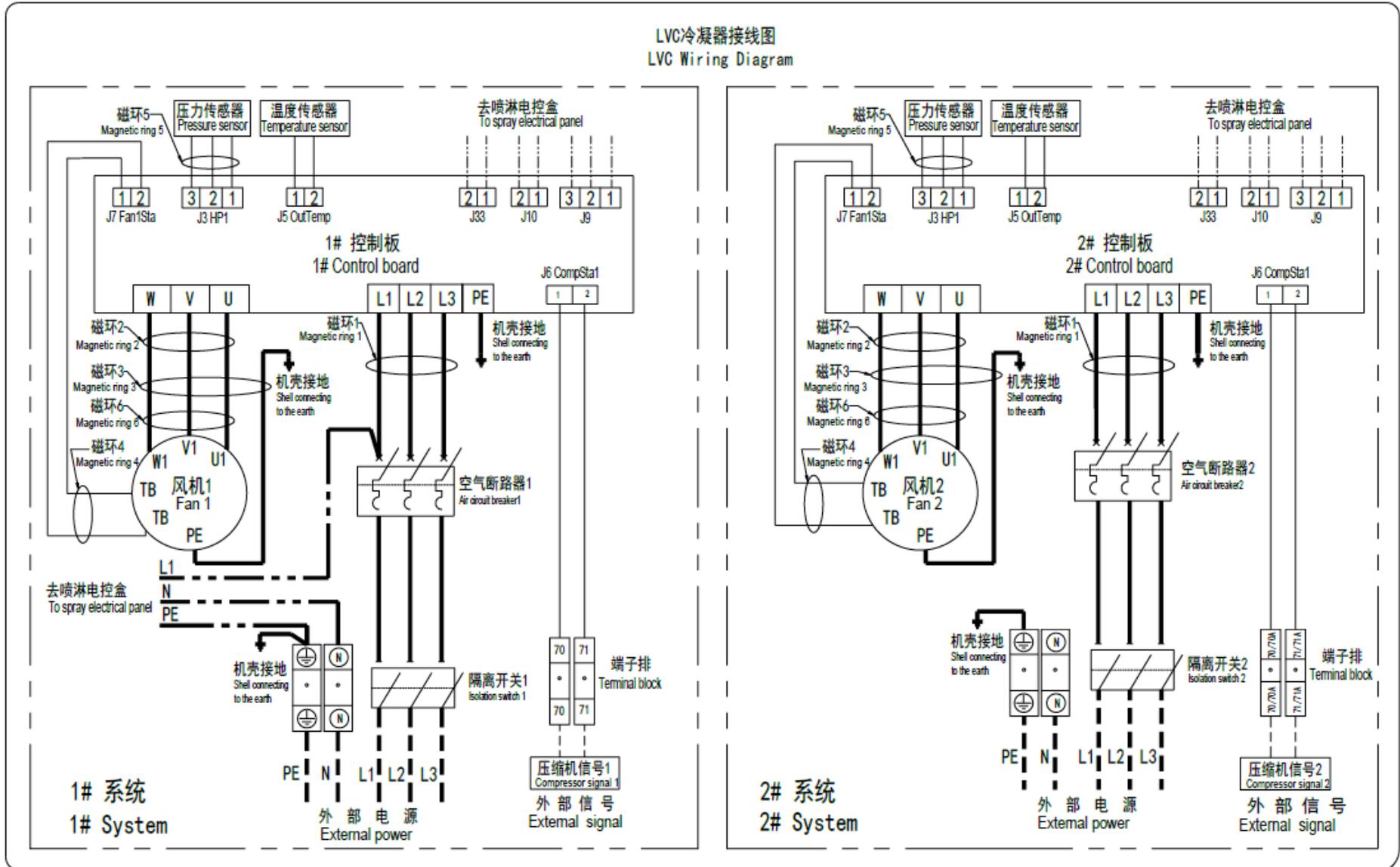
Alarm number ID	Alarm name	Cause	Troubleshooting
A00	Phase loss alarm	One phase or two phases of three-phase voltage are lost	Check that the three-phase voltage is correct
		The fan speed controller board has a hardware fault	Replace the fan speed controller board and compare the result of two boards
A01	PIM over temperature	The fan cannot run normally	Check that the fan runs normally
		The fan speed controller board has a hardware fault	Replace the fan speed controller board and compare the result of two boards
A02	Fan failure	The fan cannot run normally	Check that the fan runs normally
		The AC contactor supplying power for fan has fault or its wire cuts off	Check the wiring of AC contactor; detect the auxiliary contact state of AC contactor
		The fan speed controller board has a hardware fault	Replace the fan speed controller board and compare the result of two boards
A03	Spray water system alarm	Water pipe leakage	Deal with leakage point and compare the result of two boards
		The fan speed controller board has a hardware fault	Replace the fan speed controller board and compare the result of two boards
A04	Fan failure locked	The fan cannot run normally	Check that the fan runs normally
		The AC contactor supplying power for fan has fault or its wire cuts off	Check the wiring of AC contactor; detect the auxiliary contact state of AC contactor
		The fan speed controller board has a hardware fault	Replace the fan speed controller board and compare the result of two boards

Alarm number ID	Alarm name	Cause	Troubleshooting
A06	Pressure sensor failure	The pressure sensor is not installed or its terminal connection is poor	Check the wiring of pressure sensor
		Jumper caps are not used to short terminals J17 and J18 of current pressure sensor	Install the jumper cap when the current pressure sensor is configured
		Pressure sensor failed	Replace the pressure sensor and compare the result of two boards
		The fan speed controller board has a hardware fault	Replace the fan speed controller board and compare the result of two boards
A07	EEPROM read fault	The fan speed controller board has a hardware fault	Replace the fan speed controller board and compare the result of two boards
A08	Hardware over current	The fan cannot run normally	Check that the fan runs normally
		The fan speed controller board has a hardware fault	Replace the fan speed controller board and compare the result of two boards
A09	Bus over voltage	The power supply voltage is abnormal	Check the power supply
		The fan speed controller board has a hardware fault	Replace the fan speed controller board and compare the result of two boards
A0A	Communication failure	Communications wiring fault	Check the Communications wiring
		The fan speed controller board has a hardware fault	Replace the fan speed controller board and compare the result of two boards
A0b	Spray high pressure alarm	The nozzle clogging	Clean or replace the nozzle and compare the result of two boards
		The solenoid valve fault	Replace the solenoid valve and compare the result of two boards
		The high pressure switch fault	Replace the high pressure switch and compare the result of two boards
		The pump fault	Replace the pump and compare the result of two boards
		The fan speed controller board has a hardware fault	Replace the fan speed controller board and compare the result of two boards

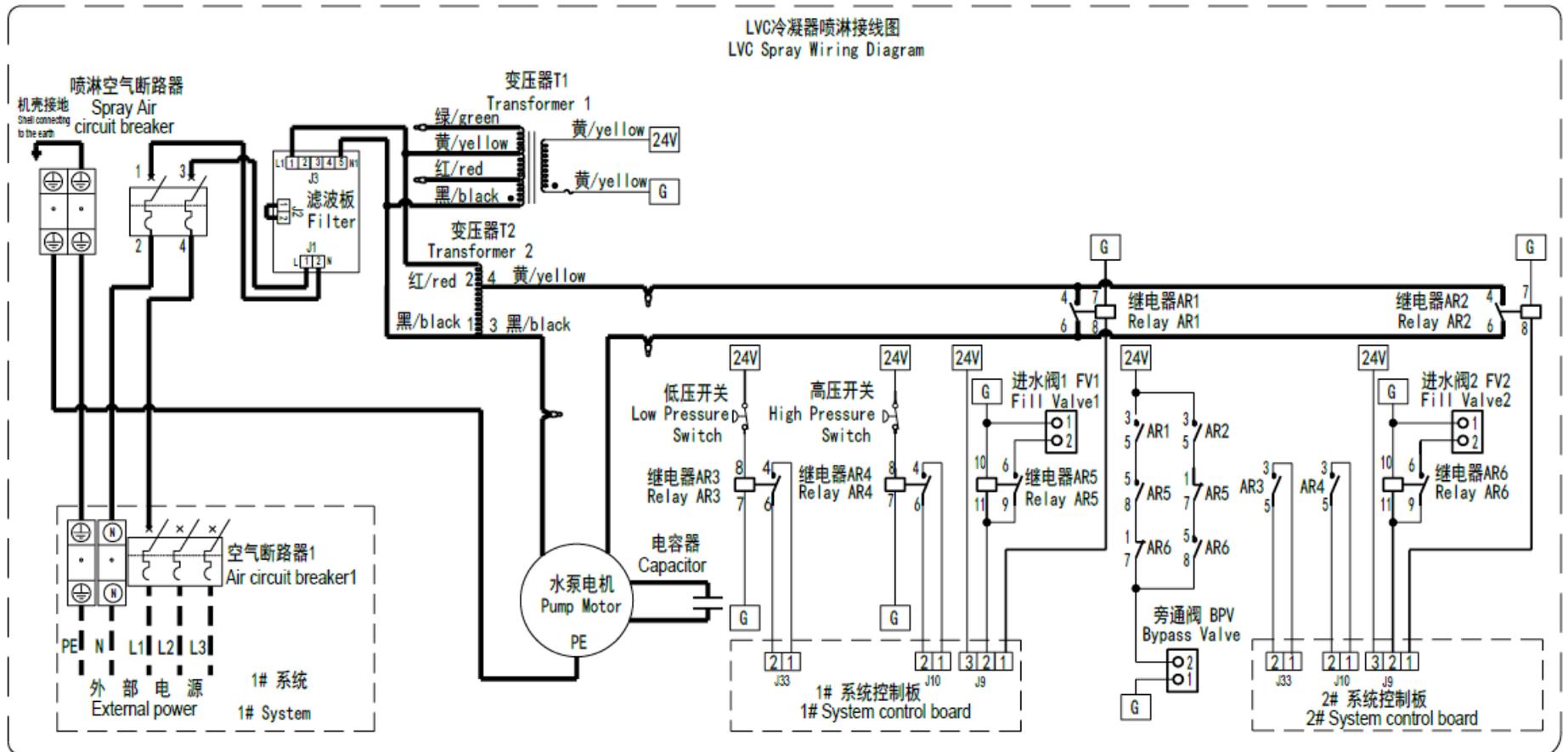
Alarm number ID	Alarm name	Cause	Troubleshooting
AOC	Spray low pressure alarm	The pump fault	Replace the pump and compare the result of two boards
		The pipe is blocked	Clean the pipe system and compare the result of two boards
		The water flow switch fault	Replace the water flow switch and compare the result of two boards
		The fan speed controller board has a hardware fault	Replace the fan speed controller board and compare the result of two boards
A0d	NTC failure	NTC board installation failure	Check the installation
		NTC board failure	Replace the NTC board and compare the result of two boards
		The fan speed controller board has a hardware fault	Replace the fan speed controller board and compare the result of two boards
A0E	Fan not configuring alarms	The control board is not configured	Check the configuration
		The fan speed controller board has a hardware fault	Replace the fan speed controller board and compare the result of two boards
A0F	Bus under voltage	The power supply voltage is abnormal	Check the power supply
		The fan speed controller board has a hardware fault	Replace the fan speed controller board and compare the result of two boards

Appendix I: Circuit Diagram

LVC冷凝器接线图
LVC Wiring Diagram



LVC冷凝器喷淋接线图
LVC Spray Wiring Diagram



说明NOTES:

- 外部电源和压缩机信号线均为现场配线。
Both external power and compressor signal are wired in field.
- 磁环1、2、3、6套线缆半圈（直通），磁环4、5需绕一圈。
Magnetic ring 1,2,3,6 sets of cable half circle (through), magnetic ring 4,5 need to circle around.
- 喷淋是选配件。
Spray is optional kit.

Appendix II: Hazardous Substances

Part Name	Harmful Substance					
	Lead or Plumbum (Pb)	Mercury or Hydrargum (Hg)	Cadmium (Cd)	Hexavalent chromium (Cr (VI))	Polybrominated biphenyls (PBB)	Polybrominated diphenyl ethers (PBDE)
Cabinets	x	o	o	o	o	o
Fan unit	x	o	x	o	o	o
Electrical Control Unit	x	o	x	o	o	o
PCBA	x	o	o	o	o	o
Heat Exchanger	x	o	o	o	o	o
Copper tube	x	o	o	o	o	o
Cable	x	o	o	o	o	o
<p>This form is prepared in accordance with the provisions of SJ/T 11364. O: Means the content of the hazardous substances in all the average quality material of the part is within the limits specified in SJ/T-11363 - 2006 X: Means the content of the hazardous substance in the products through unremitting efforts in research. However, limited specified in SJ/T-11363 - 2006</p>						
<p>Vertiv has been committed to the design and manufacture of environment-friendly products, we will reduce and eliminate toxic and hazardous substances in products through ongoing research. The following application components, or toxic and hazardous substances is not limited to the current level of technology or no reliable alternative mature solution:</p> <ol style="list-style-type: none"> 1. Parts of the above reasons lead: Copper alloy member containing lead; high temperature solder of lead; high temperature solder of lead diodes; uranium glass resistor lead (exempt); electronic ceramics containing lead (exempt); 2. The backlight lamp contains mercury; 3. Distribution of the switch contact portion containing Cadmium and Cadmium compounds 						
<p>About Environment Protection Period: The environment Protection Period of the product is marked on the product. Under normal working conditions and normal use of 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.</p>						
<p>Applicable product: Liebert LVC</p>						

