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Liebert® LVC

Technical Manual

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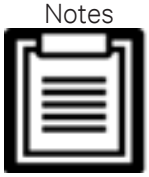
Purpose of the Document

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 	*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 degradetion, or interruption in service, follow the warning instruction carefully.*
Notes 	*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.*

Version History

Version	Revision Date	Issue	Changes
1.2	28-12-2018	31020855	

Table of Contents

Chapter 1: Product Overview

1.1. Appearance

The Main components of the condenser include the heat exchanger, fan, fan speed controller and pressure sensor. The appearance and position of other components are as shown in Figure 1-1. For more details, refer to Liebert LVC User Manual Chapter 2.

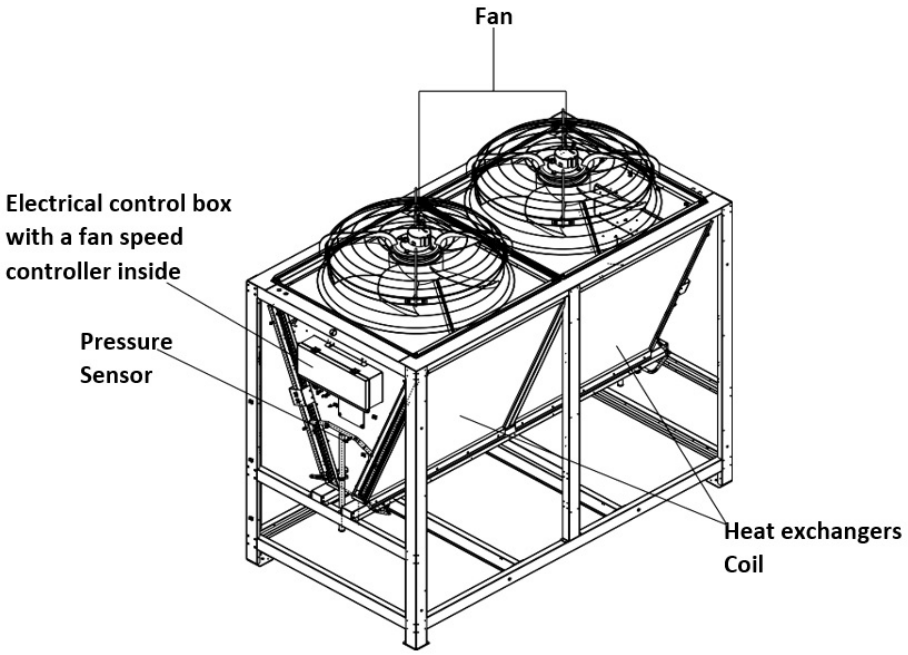


Figure 1-1 LVC Condenser

Chapter 1: Nomenclature

Nomenclature of the condenser is shown in Table 2-1.

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		

Chapter 3: Technical Parameters

This chapter introduces the environmental parameters, mechanical parameters and performance parameter of the condenser.

3.1. Environmental Parameters

3.1.1. Parameters of Storage Environment

Refer to Table 3-1 for parameters of storage environment.

Table 3-1 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.

3.1.2. Parameters of Operating Environment

Refer to Table 3-2 for parameters of operating environment.

Table 3-2 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 ≤ ΔH ≤ 20m. Installation mode vertical upward mode.
Ambient Temperature	Outdoor temperature -25 °C ~ + 45 °C. Low temperature accessories are required are required if the temperature is between -35 °C ~ + 20 °C.
Operation Power	400V ± 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.*

3.2. Mechanical Parameter

3.2.1. Mechanical Parameters of Condenser

The condenser structure is shown in Figure 3-1. The mechanical parameters of each model are listed in Table 3-3.

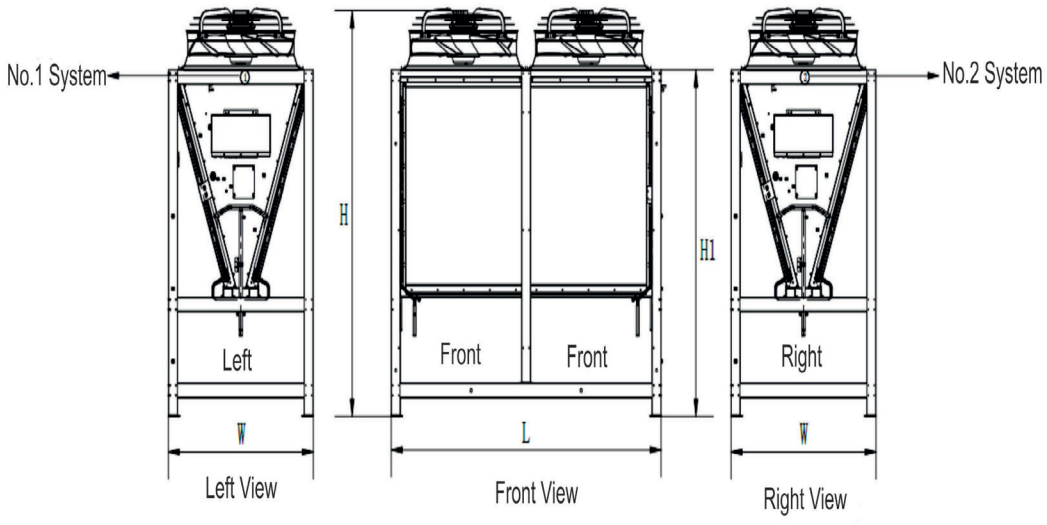


Figure 3-1 Condenser Structure

Table 3-3 Mechanical Parameters

Model	Weight without Spray (kg)	Weight with Spray (kg)	Fan Number	Dimension (mm/inch)				Gas Pipe Outer Diameter (mm/inch)	Liquid Pipe Outer Diameter (mm/inch)
				L	H	W	H1		
LVC088	315	355	2	2330 / 91.7”	1709 / 67.3”	1100 / 43.3”	1442 / 56.8”	28/1.1”	22/0.9”
LVC106	340	380	2	2330 / 91.7”	1709 / 67.3”	1100 / 43.3”	1442 / 56.8”	28/1.1”	22/0.9”
LVC140	415	460	2	2330 / 91.7”	2222 / 87.5”	1250 49.2”	1912 / 75.3”	28/1.1”	22/0.9”
LVC152	430	475	2	2330 / 91.7”	2222 / 87.5”	1250 49.2”	1912 / 75.3”	28/1.1”	22/0.9”
LVC170	450	495	2	2330 / 91.7”	2222 / 87.5”	1250 49.2”	1912 / 75.3”	28/1.1”	22/0.9”

- *Figure 3-1 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.*

3.2.2. Mounting Base Dimensions

The mounting base is shown in Figure 3-2 and the specific mounting base dimensions of each model are listed in Table 3-4.

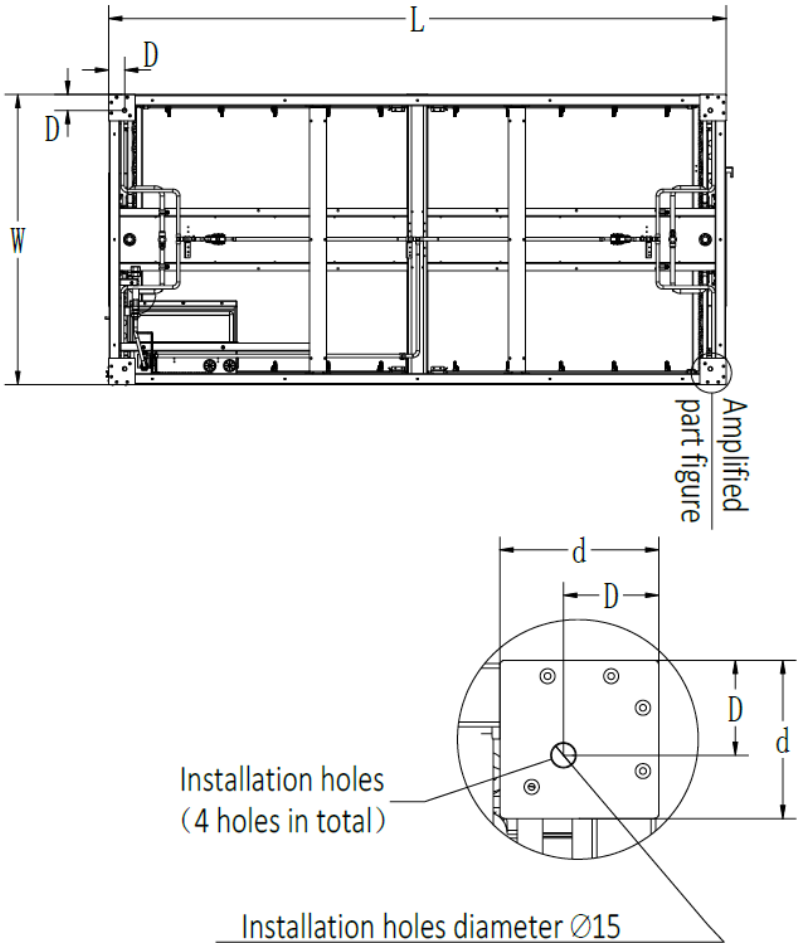


Figure 3-2 Mounting Base

Table 3-4 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.*

3.3. Performance Parameters

Performance parameters include electrical design parameters, fan design parameters heat exchanging capacity and noise parameters.

3.3.1. Electrical Design Parameters

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 3-5.

Table 3-5 Operating 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

- *The power supply of condenser is provided by user site.*
- *It is recommended to use the 20 AWG (0.52mm^2) cable for the condenser start/stop signal cable.*

3.3.2. Fan Design Parameters

Fan design parameters of condenser are listed in Table 3-6.

Table 3-6 Fan Design Parameters

Model	Number of Fan	Diameter (mm/inch)	Rated Air Flow (m^3/h)	Rated Current (A)	Rated Power (kW)
LVC088	2	800/31.5”	2x15000	2x2.0	2x0.7
LVC106	2	800/31.5”	2x14600	2x2.0	2x0.7
LVC140	2	910/35.8”	2x23900	2x4.1	2x1.5
LVC152	2	910/35.8”	2x24200	2x4.1	2x1.5
LVC170	2	910/35.8”	2x23300	2x4.1	2x1.5

- *The rated air flow, rated current and rated power of the fan (operating at 400V) are provided by the factory.*

3.3.3. Heat Exchanging Capacity

The heat exchanging capacities of each model (Unit: kW) are shown in Table 3-7, Table 3-8, and Table 3-9.

Table 3-7 Heat Exchanging Capacity Parameters (R22)

Model	TD (Heat exchanging temperature difference K)				
	283	285	288	291	293
LVC088SE2	2x29.2	2x35.6	2x45.3	2x54.9	2x61.4
LVC106SE2	2x35.4	2x42.7	2x53.8	2x64.8	2x72.0
LVC140SE2	2x44.3	2x53.9	2x67.9	2x81.9	2x91.2
LVC152SE2	2x48.9	2x59.5	2x75.0	2x90.5	2x100.8
LVC170SE2	2x55.0	2x66.7	2x83.9	2x101.0	2x112.4

Table 3-8 Heat Exchanging Capacity Parameters (R410A)

Model	TD (Heat exchanging temperature difference K)				
	283	285	288	291	293
LVC088SE4	2x30.2	2x36.9	2x47.0	2x57.1	2x63.9
LVC106SE4	2x37.0	2x44.8	2x56.6	2x68.3	2x76.1
LVC140SE4	2x45.3	2x55.1	2x69.8	2x84.5	2x94.2
LVC152SE4	2x51.1	2x62.2	2x78.8	2x95.4	2x106.5
LVC170SE4	2x56.9	2x69.0	2x87.2	2x105.3	2x117.3

Table 3-9 Heat Exchanging Capacity Parameters (R407C)

Model	TD (Heat exchanging temperature difference K)				
	283	285	288	291	293
LVC088SE2	2x26.7	2x32.5	2x41.4	2x50.2	2x56.1
LVC106SE2	2x32.2	2x38.9	2x49.1	2x59.1	2x65.7
LVC140SE2	2x40.3	2x48.9	2x61.8	2x74.5	2x83.0
LVC152SE2	2x44.2	2x53.7	2x67.8	2x81.9	2x91.3
LVC170SE2	2x49.8	2x60.4	2x76.0	2x91.6	2x102.0

3.3.4. Noise Parameters

During noise testing of fan, testing voltage is equal to output voltage of the fan speed controller; and heat exchanging capacity and the fan speed setting value remains consistent. The noise is in accordance with GB/T 17758-2010 standard. Refer Table 3-10 for noise test conditions, and noise test unit layout in Figure 3-3. The noise parameters of each model are shown in Table 3-11.

Table 3-10 Noise Test Condition (unit: °C)

Indoor Air Condition		Outdoor Air Condition	
Dry-bulb temperature	Wet-bulb temperature	Dry-bulb temperature	Wet-bulb temperature
23	17	35	--

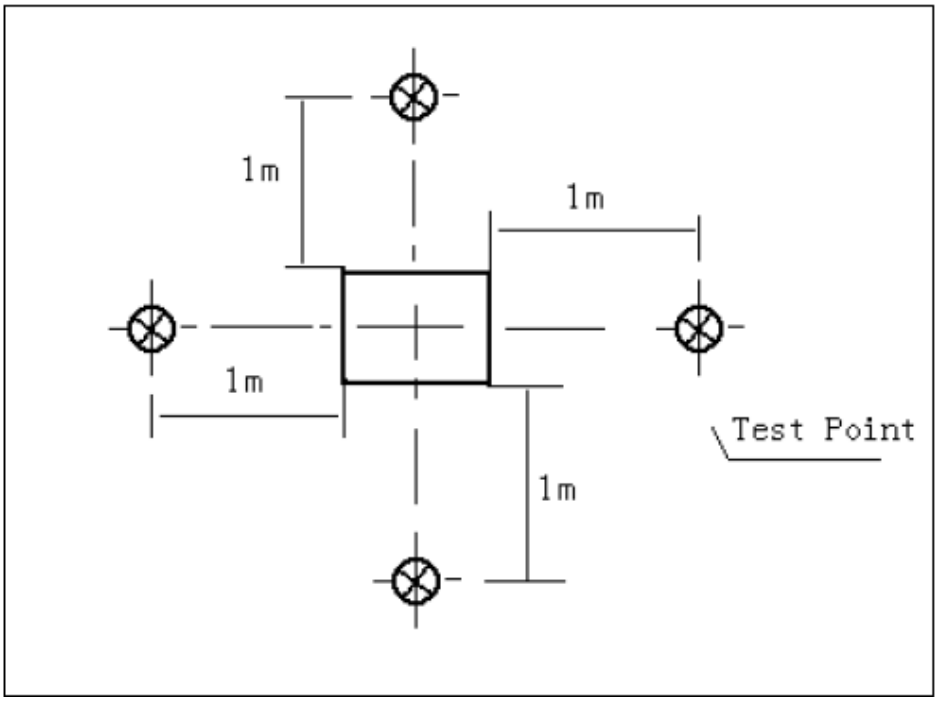


Figure 3-3 Top View of Noise Test Schematic Diagram

- *The Table 3-11 value are calculated 1m free distance from the system.*

Table 3-11 Noise Test Parameter (unit: dBA)

Model	Noise Value
LVC088	≤66
LVC106	≤68
LVC140	≤68
LVC152	≤68
LVC170	≤68

Chapter 4: Spray Cooling Module (Optional Component)

4.1. 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 4-1.

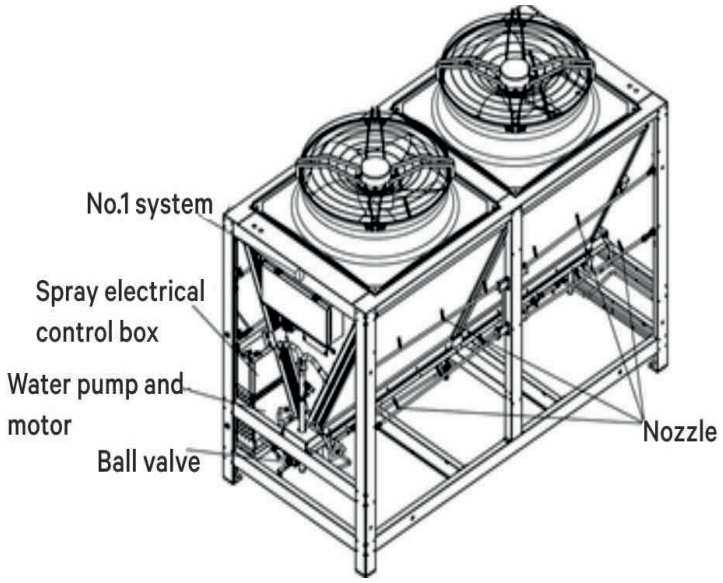


Figure 4-1 Spray Cooling Module

4.2. Requirement of Spray Water Quality

It is must to use soft water or pure water for spray system, the requirements of water quality are shown in Table 4-1.

Table 4-1 The Requirements of Water Quantity

Item	Electrical Conductivity (25 °C, S/cm)	Hardness (mg /L, CaCO3)	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 and corrosion, water pump damage, affects the normal operation of the spray system and the effective convection heat transfer of the condenser.*

4.3. 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 4-2.

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.

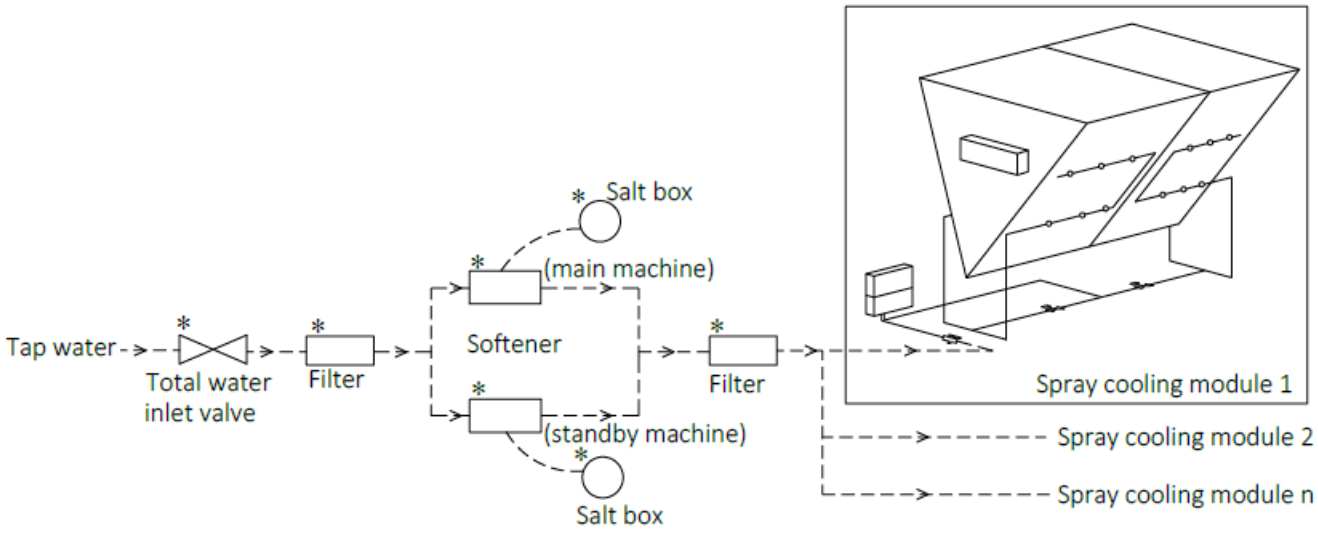


Figure 4-2 Pipe Installation Spray Cooling Module

- *----------: 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 4-2.

Table 4-2 The Water Consumption of Model

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

Chapter 5: Fan Speed Controller

This chapter introduces the use of the fan speed controller, Human-Machine Interface (HMI).

This chapter also features the details of the fan speed controller along with control logics, wiring terminals, and HMI operation, protection function and alarm function.

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

5.1. Control Logic

Fan speed control has four modes normal, noise reduction, energy-saving and pressure reduction. The control fan is adjusted according to present parameters and curves to avoid the frequency resonance.

Table 5-1 Normal Mode

Model	VSC02Z
Speed Control Mode	According to pressure control, control mode is shown in Figure 5-1.

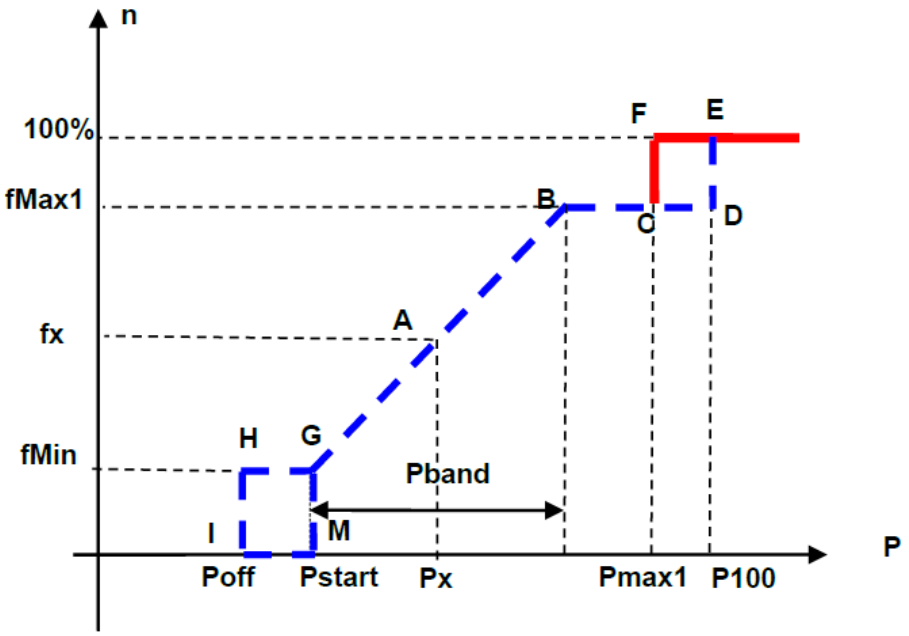


Figure 5-1 Normal Control Logic Schematic Diagram

The control mode is suitable for all kind of application to ensure the efficient operation of the system. The control logic of running process follow I -M -G -A -B -C -D -E -F -C -B -A -G -H -I, among them A point is the corresponding point of condensation pressure between the B -G range.

5.1.1. Noise Reduction Mode

This control mode is suitable for the application of high noise requirement. In some cases, this mode has slight effect on the refrigerating capacity of the whole unit. The fan control logic of noise reduction mode can refer to the control logic normal mode.

5.1.2. Energy-Saving/Pressure Reduction Mode

This control mode is suitable for the application of high energy efficiency requirement and poor operating environment control logic. Refer to Figure 5-2.

1. When the condensation pressure starts rising: If the condensation pressure is lower than the maximum pressure, then control mode is adjusted by PID. If the condensation pressure is higher than the maximum pressure, then fan rotational speed is incremented to 100%.

2. When the condensation pressure starts falling: If the condensation pressure is higher than the maximum pressure, then fan speed is maintained at 100%. If the condensation pressure is lower than Pmax -Pmaxsd, then fan rotational speed drops to below maximum fan speed. The control mode is modulated by PID.

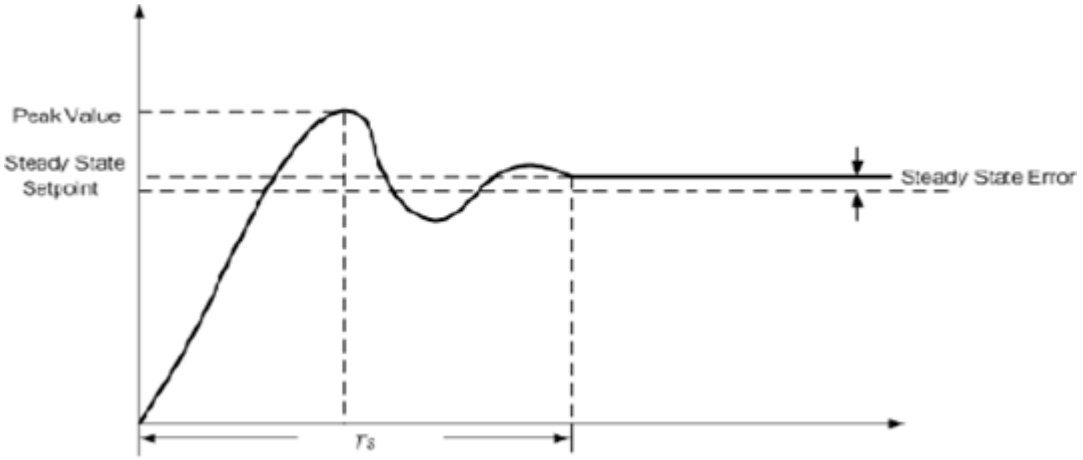
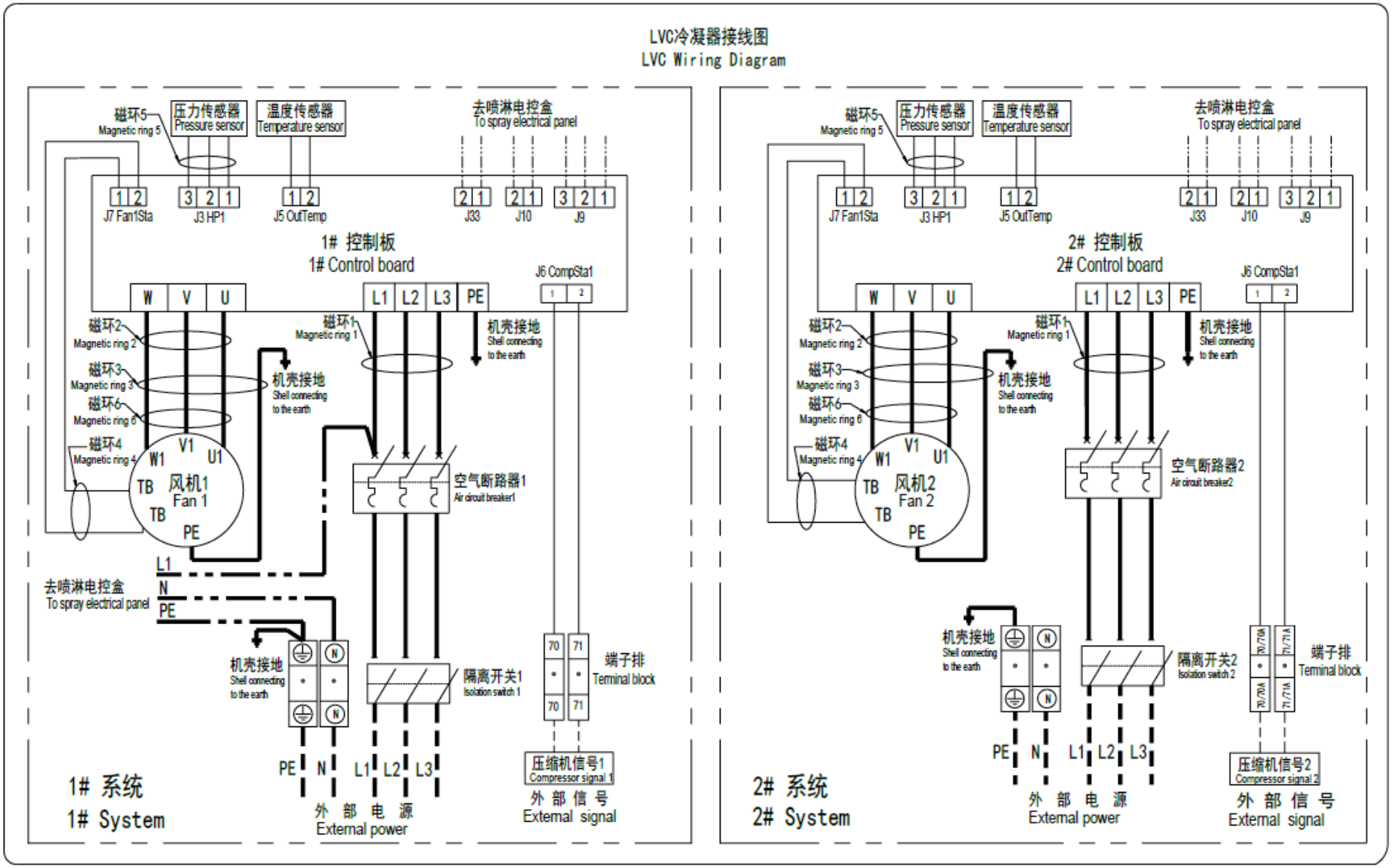
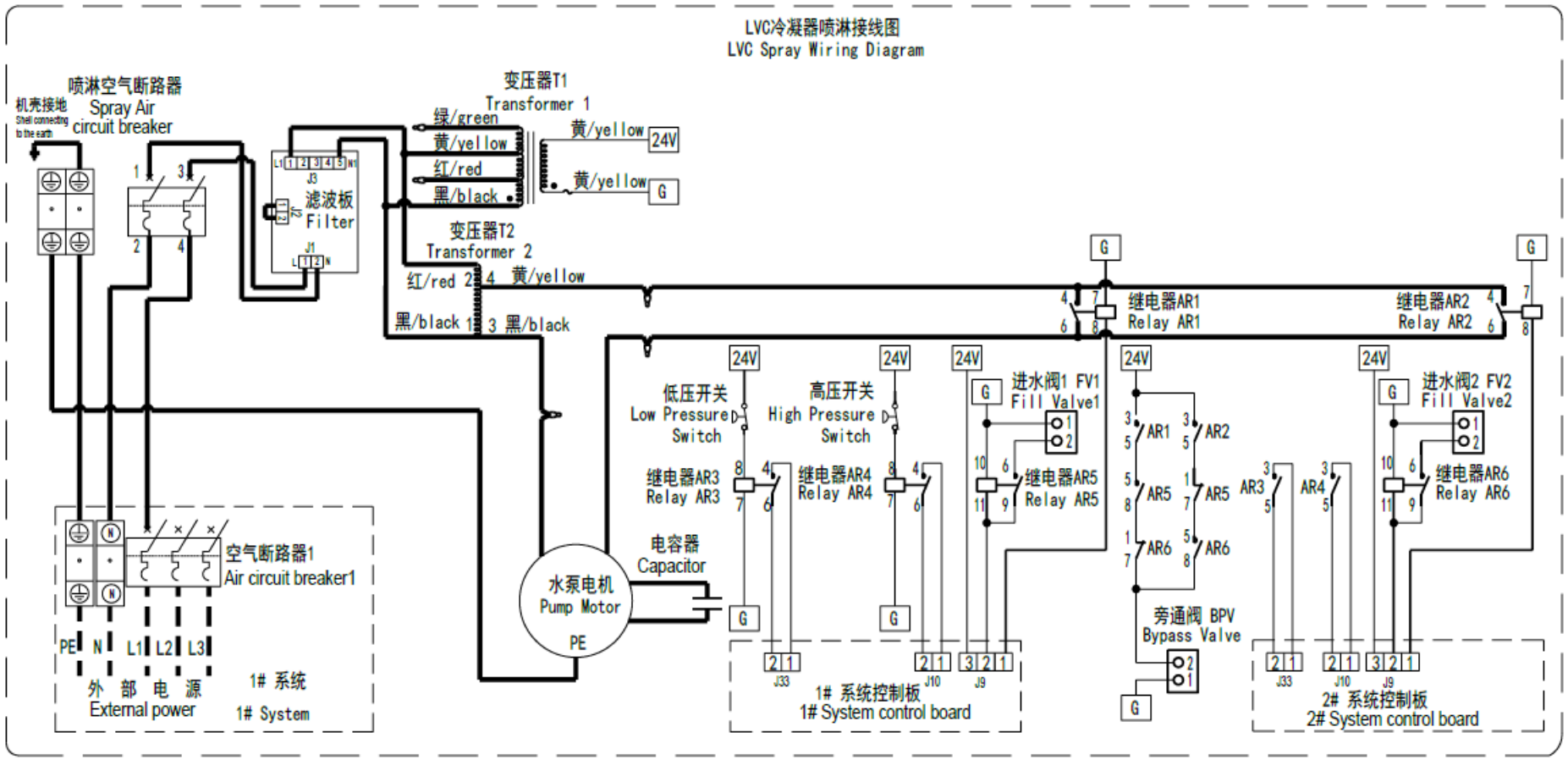


Figure 5-2 Energy- Saving/pressure Reduction Control Logic Schematic Diagram

Appendix I: Circuit Diagram





说明NOTES：

1. 外部电源和压缩机信号线均为现场配线。
   Both external power and compress or signal are wired in field.
2. 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 ca ble half circle (through),
   magnetic ring 4,5 need to circl e around.
3. 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	×	o	o	o	o	o
Fan unit	×	o	×	o	o	o
Electrical Control Unit	×	o	×	o	o	o
PCBA	×	o	o	o	o	o
Heat Exchanger	×	o	o	o	o	o
Copper tube	×	o	o	o	o	o
Cable	×	o	o	o	o	o

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Applicable product: Liebert LVC