



MODULAR TYPE AIR COOLED WATER CHILLER

Technical Manual



TWO SYSTEMS

60kW: U shape heat exchanger
80kW and 100kW: V shape heat exchanger



FOUR SYSTEMS

60kW: V shape heat exchanger
80kW and 100kW: V shape heat exchanger

CARDIFF CAWHT/SM SERIES
R22
R22

TECHNICAL BOOKLET

COMPANY
WITH QUALITY SYSTEM
CERTIFIED BY NGV
===ISO 9001:2000 ===

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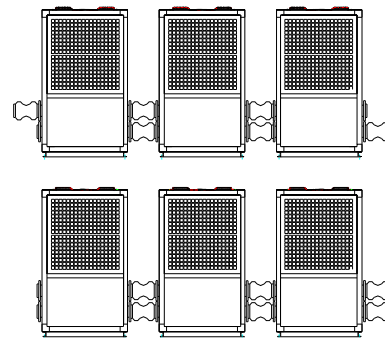
UNIT DESCRIPTION AND TECHNICAL DATA

UNIT DESCRIPTION AND TECHNICAL DATA

Unit description

CARDIFF CAWHT/SM series air cooled water chillers and heat pumps are designed for outdoor installation and generally for both commercial and industrial application with the ability of 24 hours/day operation. The units are factory tested and on site installation will be completed only by connecting with the water kit components and power supply.

The master module can work independently or together with up to 31 slave modules.



PIPING CONNECTION METHODS BETWEEN MORE THAN 1 UNIT (Tube in Tube)

Nomenclature

C AW H R T C MM 80 T
 ① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨

- ① **C: CARDIFF** product
- ② Unit type
AA: Air to Air
AW: Air to Water
WW: Water to Water
- ③ **C:** Cooling only
H: Heat pump
- ④ Heat Recovery type
 --:without heat recovery
R:with heat recovery

- ⑤ Heat exchanger
T: tube in tube type
S: shell and tube type
P: plate type
- ⑥ Refrigerant type
 --: R22
A: R410a
B: R134a
C: R407c

- ⑦ Modular type
MM: Modular Master
MS: Modular Slave
- ⑧ Model
- ⑨ **T:** Two systems
F: Four systems
S: Six systems

Construction features

Structure

Panels and frame are made from galvanized steel protected with polyester powder painting to ensure total resistance to atmospheric agents.

Hermetic compressors

Three phase scroll type compressor, with built-in thermal overload cut-out and crankcase heater, mounted on rubber vibration dampers.

Fans

External rotor type axial fans, equipped with three phase direct drive motors, low noise 8 poles, protection level IP54, provided with a protective outlet grille.

UNIT DESCRIPTION AND TECHNICAL DATA

Evaporator

Evaporator built with high efficiency tube in tube type heat exchanger, factory insulated with flexible close cell material. (shell and tube heat exchanger is optional)

Condenser

Coils are consisting of seamless copper tubes mechanically expanded into blue hydrophilic aluminum fins. Two systems, 60kW - U shape heat exchanger, 80kW and 100kW - V shape heat exchanger. Four systems, 60 80 and 100kW - V shape heat exchanger.

Heat recovery exchanger optional

Refrigerant circuit

Copper tube connection with charge valves, filter drier, sight glass, Gas-liquid separator, thermostatic expansion valve, high & low pressure switch. The heat pump unit is completed also with four-way valve, liquid receiver and one way valve.

Hydronic circuit

Built with galvanized pipe, complete with water discharge connection for tube in tube heat exchanger and flange type hydraulic connectors in two directions easy for connections from both sides of the units.

Power and electrical control panel

Electrical accessible components from side panel, consists of:

- ◇ Compressor contactor and Fan contactor
- ◇ Compressor protection breaker and Fan protection breaker
- ◇ Phase sequence relay
- ◇ Microprocessor with function display (display only for master/packaged unit)
- ◇ Pre-arranged interface for remote on/off control
- ◇ Pre-arranged interface for compressor running light
- ◇ Pre-arranged interface for alarm light

Microprocessor control system

Microprocessor can monitor the operating conditions of the main parts and avoid the occurrence of the hazardous situations: Programmable electronic microprocessor receives commands from the keypad control board installed on the units. The microprocessor control can monitor the operating conditions of the critical parts to avoid the occurrence of the hazardous situations.


The electronic board controls:

- ◇ Digital input from a set of push buttons situated on the keypad control board:
 - ◆ Regulation of temperature settings for water inlet/outlet,
 - ◆ Management of defrosting (only for heat pump),
 - ◆ Safety timers,
 - ◆ Management of water pump;
 - ◆ Compressor delay relay;
 - ◆ Anti-freeze protection in winter;
 - ◆ Automatic timing On/Off by timer;
- ◇ Alarm management and signaling;
- ◇ Alarm buzzer and reset;
- ◇ Remote On/Off control;
- ◇ Management of compressor operating hours balance;
- ◇ Visual signaling on display:

Inlet and outlet water temperature; Set point and differential setting;

Alarm decodification; Cooling and heating mode operation;

Operating hours of compressors; Self diagnosis with continuous checks on machine operating status.

 **Optional accessories** paddle flow switch/Metallic filter for hydraulic circuit/water pump/Rubber antivibration mounting.

Technical data 60kW

Model CAWHT/SMM60T	Unit	60x1	60x2	60x3	60x4	60x5	60x6	60x7	60x8	
Cooling										
Nominal cooling capacity*	kW	60	60x2	60x3	60x4	60x5	60x6	60x7	60x8	
Heating										
Nominal heating capacity**	kW	65	65x2	65x3	65x4	65x5	65x6	65x7	65x8	
Hermetic compressor										
Type	/	Scroll								
N° of compressor/system	n°	2/2	4/4	6/6	8/8	10/10	12/12	14/14	16/16	
Cooling power input *	kW	10.2x2	10.2x4	10.2x6	10.2x8	10.2x10	10.2x12	10.2x14	10.2x16	
Heating power input **	kW	11.2x2	11.2x4	11.2x6	11.2x8	11.2x10	11.2x12	11.2x14	11.2x16	
Step controls	%	0-50-100 (Single unit)								
Axial fan										
Air flow	m ³ /h	28000	46000	84000	112000	140000	168000	196000	224000	
Rated power × Quantity	kW x n°	0.55x2	0.55x4	0.55x6	0.55x8	0.55x10	0.55x12	0.55x14	0.55x16	
Evaporator										
Type	/	Tube in Tube heat exchanger (Shell and Tube is optional)								
Water flow (Tube In Tube)	m ³ /h	10.3	20.6	30.9	41.2	51.5	61.8	72.1	82.4	
Water flow (Shell and Tube)	m ³ /h	10.3	20.6	30.9	41.2	51.5	61.8	72.1	82.4	
Water side pressure drop***	kPa	49	From 30 to 60							
Water connection size	DN	125								
Refrigerant										
Type	/	R22								
Charge quantity	Kg	9×2	9×4	9×6	9×8	9×10	9×12	9×14	9×16	
Oil										
Type	/	3GSD								
Charge quantity	ml	3000×2	3000×4	3000×6	3000×8	3000×10	3000×12	3000×14	3000×16	
Electrical										
Power supply	v/ph/hz	380V/3H/50HZ								
Max. power input	kW	21.5x1	21.5x2	21.5x3	21.5x4	21.5x5	21.5x6	21.5x7	21.5x8	
Max. input current	A x n°	43.2x1	43.2x2	43.2x3	43.2x4	43.2x5	43.2x6	43.2x7	43.2x8	
Max. starting current ****	A	138	138	138	138	138	138	138	138	
Overall dimensions										
Length	U type coil	mm	2090(Single unit)							
Width		mm	1200 (Single unit)							
Height		mm	1900 (Single unit)							
Net weight	U type coil	Kg	670x1	670x2	670x3	670x4	670x5	670x6	670x7	670x8
Gross weight		kg	690x1	690x2	690x3	690x4	690x5	690x6	690x7	690x8
Sound pressure level *****	U type coil	dB(A)	69	70	71	72	73	74	75	76

Note;

* Ambient temperature 35°C; evaporator water in/out 12/7 °C;

** Ambient temperature WB 7 °C, DB 6 °C; condenser water in/out temperature 40/45 °C;

*** In the nominal water flow condition the pressure drop is between this range.

**** Refer to max starting current for one compressor, as the compressor starts up always one by one;

***** Sound pressure measured at a distance of 1 m and a height of 1.5 m above the ground in a dear field (fan side).

Technical data 80kW

Model CAWHT/SMM80T	Unit	80x1	80x2	80x3	80x4	80x5	80x6	80x7	80x8	
Cooling										
Nominal cooling capacity*	kW	80	80x 2	80 x3	80 x 4	80 x 5	80x 6	80 x 7	80x 8	
Heating										
Nominal heating capacity**	kW	89.6	89.6x 2	89.6 x 3	89.6x4	89.6x 5	89.6x 6	89.6x 7	89.6x 8	
Hermetic compressor										
Type	/	Scroll								
N° of compressor/system	n°	2/2	4/4	6/6	8/8	10/10	12/12	14/14	16/16	
Cooling power input*	kW	14.9x2	14.9x4	14.9x6	14.9x8	14.9x10	14.9x12	14.9x14	14.9x16	
Heating power input**	kW	16.4x2	16.4x4	16.4x6	16.4x8	16.4x10	16.4x12	16.4x14	16.4x16	
Step controls	%	0-50-100 (Single unit)								
Axial fan										
Air flow	m ³ /h	33000	66000	99000	132000	165000	198000	231000	264000	
Rated power × Quantity	kW x n°	0.55x3	0.55x6	0.55x9	0.55x12	0.55x15	0.55x18	0.55x21	0.55x24	
Evaporator										
Type	/	Tube in Tube heat exchanger (Shell and Tube is optional)								
Water flow (Tube In Tube)	m ³ /h	13.8	27.6	41.4	55.2	69	82.8	96.6	110.4	
Water flow (Shell and Tube)	m ³ /h	13.8	27.6	41.4	55.2	69	82.8	96.6	110.4	
Water side pressure drop ***	kPa	49	From 30 to 60							
Water connection size	DN	65								
Refrigerant										
Type	/	R22								
Charge quantity	Kg	12×2	12×4	12×6	12×8	12×10	12×12	12×14	12×16	
Oil										
Type	/	3GSD								
Charge quantity	ml	8100×2	8100×4	8100×6	8100×8	8100×10	8100×12	8100×14	8100×16	
Electrical										
Power supply	v/ph/hz	380V/3PH/50HZ								
Max. power input	kW	31.45x1	31.45x2	31.45x3	31.45x4	31.45x5	31.45x6	31.45x7	31.45x8	
Max. input current	A x n°	62.9x1	62.9x2	62.9x3	62.9x4	62.9x5	62.9x6	62.9x7	62.9x8	
Max. starting current ****	A	196.8	196.8	196.8	196.8	196.8	196.8	196.8	196.8	
Overall dimensions										
Length	V type coil	mm	2400 (Single unit)							
Width		mm	1170 (Single unit)							
Height		mm	2000 (Single unit)							
Net weight	V type coil	Kg	1020x1	1020x2	1020x3	1020x4	1020x5	1020x6	1020x7	1020x8
Gross weight		kg	1040x1	1040x2	1040x3	1040x4	1040x5	1040x6	1040x7	1040x8
Sound pressure level*****	V type coil	dB(A)	69	70	71	72	73	74	75	76

Note;

* Ambient temperature 35°C; evaporator water in/out 12/7 °C;

** Ambient temperature WB 7 °C, DB 6 °C; condenser water in/out temperature 40/45 °C;

*** In the nominal water flow condition the pressure drop is between this range.

**** Refer to max starting current for one compressor, as the compressor starts up always one by one;

***** Sound pressure measured at a distance of 1 m and a height of 1.5 m above the ground in a dear field (fan side).

Technical data 100kW

Model CAWHT/SMM100T	Unit	100x1	100x2	100x3	100x4	100x5	100x6	100x7	100x8	
Cooling										
Nominal cooling capacity*	kW	100	100x2	100x3	100x4	100x5	100x6	100x7	100x8	
Heating										
Nominal heating capacity**	kW	112	112x2	112x3	112x4	112x5	112x6	112x7	112x8	
Hermetic compressor										
Type	/	Scroll								
N° of compressor/system	n°	2/2	4/4	6/6	8/8	10/10	12/12	14/14	16/16	
Cooling power input*	kW	19x2	19x4	19x6	19x8	19x10	19x12	19x14	19x16	
Heating power input**	kW	20.9x2	20.9x4	20.9x6	20.9x8	20.9x10	20.9x12	20.9x14	20.9x16	
Step controls	%	0-50-100 (Single unit)								
Axial fan										
Airflow	m ³ /h	42000	84000	126000	168000	210000	252000	294000	336000	
Rated power × Quantity	kW x n°	0.75x3	0.75x6	0.75x9	0.75x12	0.75x15	0.75x18	0.75x21	0.75x24	
Evaporator										
Type	/	Tube in Tube heat exchanger (Shell and Tube is optional)								
Water flow (Tube In Tube)	m ³ /h	17.2	34.4	51.6	68.8	86	103.2	120.4	137.6	
Water flow (Shell and Tube)	m ³ /h	17.2	34.4	51.6	68.8	86	103.2	120.4	137.6	
Water side pressure drop***	kPa	49	From 30 to 60							
Water connection size	DN	80								
Refrigerant										
Type	/	R22								
Charge quantity	Kg	15×2	15×4	15×6	15×8	15×10	15×12	15×14	15×16	
Oil										
Type	/	3GSD								
Charge quantity	ml	8100×2	8100×4	8100×6	8100×8	8100×10	8100×12	8100×14	8100×16	
Electrical										
Power supply	V/Ph/H	380/3/50HZ								
Max. power input	kW	40.25x1	40.25x2	40.25x3	40.25x4	40.25x5	40.25x6	40.25x7	40.25x8	
Max. input current	A x n°	80.5x1	80.5x2	80.5x3	80.5x4	80.5x5	80.5x6	80.5x7	80.5x8	
Max. starting current****	A	250.8	250.8	250.8	250.8	250.8	250.8	250.8	250.8	
Overall dimensions										
Length	V type coil	mm	2700 (Single unit)							
Width		mm	1170(Single unit)							
Height		mm	2000 (Single unit)							
Net weight	V type coil	Kg	1290x1	1290x2	1290x3	1290x4	1290x5	1290x6	1290x7	1290x8
Gross weight		Kg	1310x1	1310x2	1310x3	1310x4	1310x5	1310x6	1310x7	1310x8
Sound pressure level *****	V type coil	dB(A)	69	70	71	72	73	74	75	76

Note;

* Ambient temperature 35°C; evaporator water in/out 12/7 °C;

** Ambient temperature WB 7 °C, DB 6 °C; condenser water in/out temperature 40/45 °C;

*** In the nominal water flow condition the pressure drop is between this range.

**** Refer to max starting current for one compressor, as the compressor starts up always one by one;

***** Sound pressure measured at a distance of 1 m and a height of 1.5 m above the ground in a dear field (fan side).

Technical data 60kW

Model CAWHT/SMM60F	Unit	60x1	60x2	60x3	60x4	60x5	60x6	60x7	60x8	
Cooling										
Nominal cooling capacity*	kW	60	60x2	60x3	60x4	60x5	60x6	60x7	60x8	
Heating										
Nominal heating capacity**	kW	65	65x2	65x3	65x4	65x5	65x6	65x7	65x8	
Hermetic compressor										
Type	/	Scroll								
N° of compressor/system	n°	4/4	8/8	12/12	16/16	20/20	24/24	28/28	32/32	
Cooling power input*	kW	4.9x4	4.9x8	4.9x12	4.9x16	4.9x20	4.9x24	4.9x28	4.9x32	
Heating power input**	kW	5.4x4	5.4x8	5.4x12	5.4x16	5.4x20	5.4x24	5.4x28	5.4x32	
Step controls	%	0-50-100 (Single unit)								
Axial fan										
Air flow	m ³ /h	28000	46000	84000	112000	140000	168000	196000	224000	
Rated power × Quantity	kW x n°	0.55x2	0.55x4	0.55x6	0.55x8	0.55x10	0.55x12	0.55x14	0.55x16	
Evaporator										
Type	/	Tube in Tube heat exchanger (Shell and Tube is optional)								
Water flow (Tube In Tube)	m ³ /h	10.3	20.6	30.9	41.2	51.5	61.8	72.1	82.4	
Water flow (Shell and Tube)	m ³ /h	10.3	20.6	30.9	41.2	51.5	61.8	72.1	82.4	
Water side pressure drop***	kPa	49	From 30 to 60							
Water connection size	DN	65								
Refrigerant										
Type	/	R22								
Charge quantity	Kg	4.7×4	4.7×8	4.7×12	4.7×16	4.7×20	4.7×24	4.7×28	4.7×32	
Oil										
Type	/	3GSD								
Charge quantity	ml	1400×4	1400×8	1400×12	1400×16	1400×20	1400×24	1400×28	1400×32	
Electrical										
Power supply	v/Ph/hz	380/3/50								
Max. power input	kW	20.7x1	20.7x2	20.7x3	20.7x4	20.7x5	20.7x6	20.7x7	20.7x8	
Max. input current	A x n°	41.4x1	41.4x2	41.4x3	41.4x4	41.4x5	41.4x6	41.4x7	41.4x8	
Max. starting current ****	A	79.2	79.2	79.2	79.2	79.2	79.2	79.2	79.2	
Overall dimensions										
Length	V type coil	mm	1980 (Single unit)							
Width		mm	1000(Single unit)							
Height		mm	1900 (Single unit)							
Net weight	V type coil	Kg	660x1	660x2	660x3	660x4	660x5	660x6	660x7	660x8
Gross weight		kg	680x1	680x2	680x3	680x4	680x5	680x6	680x7	680x8
Sound pressure level *****	V type coil	dB(A)	69	70	71	72	73	74	75	76

Note;

* Ambient temperature 35°C; evaporator water in/out 12/7 °C;

** Ambient temperature WB 7 °C, DB 6 °C; condenser water in/out temperature 40/45 °C;

*** In the nominal water flow condition the pressure drop is between this range.

**** Refer to max starting current for one compressor, as the compressor starts up always one by one;

***** Sound pressure measured at a distance of 1 m and a height of 1.5 m above the ground in a dear field (fan side).

Technical data 80kW

Model CAWHT/SMM80F	Unit	80x1	80x2	80x3	80x4	80x5	80x6	80x7	80x8	
Cooling										
Nominal cooling capacity*	kW	80	80x 2	80 x3	80 x 4	80 x 5	80x 6	80 x 7	80x 8	
Heating										
Nominal heating capacity**	kW	89.6	89.6 x 2	89.6 x 3	89.6x4	89.6 x 5	89.6x 6	89.6x 7	89.6x 8	
Hermetic compressor										
Type	/	Scroll								
N° of compressor/system	n°	4/4	8/8	12/12	16/16	20/20	24/24	28/28	32/32	
Cooling power input *	kW	7.0x4	7.0x8	7.0x12	7.0x16	7.0x20	7.0x24	7.0x28	7.0x32	
Heating power input **	kW	7.7x4	7.7x4	7.7x12	7.7x16	7.7x20	7.7x24	7.7x28	7.7x32	
Step controls	%	0-50-100 (Single unit)								
Axial fan										
Airflow	m ³ /h	33000	66000	99000	132000	165000	198000	231000	264000	
Rated power × Quantity	kW x n°	0.55x3	0.55x6	0.55x9	0.55x12	0.55x15	0.55x18	0.55x21	0.55x24	
Evaporator										
Type	/	Shell and tube heat exchanger (Tube in Tube is optional)								
Water flow (Tube In Tube)	m ³ /h	13.8	27.6	41.4	55.2	69	82.8	96.6	110.4	
Water flow (Shell and tube)	m ³ /h	13.8	27.6	41.4	55.2	69	82.8	96.6	110.4	
Water side pressure drop***	kPa	49	From 30 to 60							
Water connection size	DN	65								
Refrigerant										
Type	/	R22								
Charge quantity	Kg	6×4	6×8	6×12	6×16	6×20	6×24	6×28	6×32	
Oil										
Type	/	3GSD								
Charge quantity	ml	4100×4	4100×8	4100×12	4100×16	4100×20	4100×24	4100×28	4100×32	
Electrical										
Power supply	v/Ph/hz	380/3/50HZ								
Max. power input	kW	29.7x1	29.7x2	29.7x3	29.7x4	29.7x5	29.7x6	29.7x7	29.7x8	
Max. input current	A x n°	59.4x1	59.4x2	59.4x3	59.4x4	59.4x5	59.4x6	59.4x7	59.4x8	
Max. starting current ****	A	112.2	112.2	112.2	112.2	112.2	112.2	112.2	112.2	
Overall dimensions										
Length	V type coil	mm	2400 (Single unit)							
Width		mm	1170 (Single unit)							
Height		mm	2000 (Single unit)							
Net weight	V type coil	Kg	1020x1	1020x2	1020x3	1020x4	1020x5	1020x6	1020x7	1020x8
Gross weight		kg	1040x1	1040x2	1040x3	1040x4	1040x5	1040x6	1040x7	1040x8
Sound pressure level *****	V type coil	dB(A)	69	70	71	72	73	74	75	76

Note;

* Ambient temperature 35°C; evaporator water in/out 12/7 °C;

** Ambient temperature WB 7 °C, DB 6 °C; condenser water in/out temperature 40/45 °C;

*** In the nominal water flow condition the pressure drop is between this range.

**** Refer to max starting current for one compressor, as the compressor starts up always one by one;

***** Sound pressure measured at a distance of 1 m and a height of 1.5 m above the ground in a dear field (fan side).

Technical data 100kW

Model CAWHT/SMM100F	Unit	100x1	100x2	100x3	100x4	100x5	100x6	100x7	100x8	
Cooling										
Nominal cooling capacity*	kW	100	100x2	100x3	100x4	100x5	100x6	100x7	100x8	
Heating										
Nominal heating capacity**	kW	112x1	112x2	112x3	112x4	112x5	112x6	112x7	112x8	
Hermetic compressor										
Type	/	Scroll								
N° of compressor/system	n°	4/4	8/8	12/12	16/16	20/20	24/24	28/28	32/32	
Cooling power input *	kW	8.5x4	8.5x8	8.5x12	8.5x16	8.5x20	8.5x24	8.5x28	8.5x32	
Heating power input **	kW	9.4x4	9.4x8	9.4x12	9.4x16	9.4x20	9.4x24	9.4x28	9.4x32	
Step controls	%	0-50-100 (Single unit)								
Axial fan										
Air flow	m ³ /h	42000	84000	126000	168000	210000	252000	294000	336000	
Rated power × Quantity	kW x n°	0.75x3	0.75x6	0.75x9	0.75x12	0.75x15	0.75x18	0.75x21	0.75x24	
Evaporator										
Type	/	Shell and tube heat exchanger (Tube in Tube is optional)								
Water flow (Tube In Tube)	m ³ /h	17.2	34.4	51.6	68.8	86	103.2	120.4	137.6	
Water flow (Shell and tube)	m ³ /h	17.2	34.4	51.6	68.8	86	103.2	120.4	137.6	
Water side pressure drop***	kPa	49	From 30 to 60							
Water connection size	DN	80								
Refrigerant										
Type	/	R22								
Charge quantity	Kg	7.5×4	7.5×8	7.5×12	7.5×16	7.5×20	7.5×24	7.5×28	7.5×32	
Oil										
Type	/	3GSD								
Charge quantity	ml	4100×4	4100×8	4100×12	4100×16	4100×20	4100×24	4100×28	4100×32	
Electrical										
Power supply	v/Ph/hz	380/3/50HZ								
Max. power input	kW	36.3x1	36.3x2	36.3x3	36.3x4	36.3x5	36.3x6	36.3x7	36.3x8	
Max. input current	A x n°	72.6x1	72.6x2	72.6x3	72.6x4	72.6x5	72.6x6	72.6x7	72.6x8	
Max. starting current****	A	139.8	139.8	139.8	139.8	139.8	139.8	139.8	139.8	
Overall dimensions										
Length	V type coil	mm	2700 (Single unit)							
Width		mm	1170 (Single unit)							
Height		mm	2000 (Single unit)							
Net weight	V type coil	Kg	1270x1	1270x2	1270x3	1270x4	1270x5	1270x6	1270x7	1270x8
Gross weight		Kg	1290x1	1290x2	1290x3	1290x4	1290x5	1290x6	1290x7	1290x8
Sound pressure level *****	V type coil	dB(A)	69	70	71	72	73	74	75	76

Note;

* Ambient temperature 35°C; evaporator water in/out 12/7 °C;

** Ambient temperature WB 7 °C, DB 6 °C; condenser water in/out temperature 40/45 °C;

*** In the nominal water flow condition the pressure drop is between this range.

**** Refer to max starting current for one compressor, as the compressor starts up always one by one;

***** Sound pressure measured at a distance of 1 m and a height of 1.5 m above the ground in a dear field (fan side).

Cooling performance

Mod	T _a : [°C]	Returning water temperature [°C]											
		10		12		14		16		18		20	
		kW _f	kW _e	kW _f	kW _e	kW _f	kW _e	kW _f	kW _e	kW _f	kW _e	kW _f	kW _e
60	23	63.88	15.90	67.59	16.50	71.38	17.10	75.18	17.70	79.06	18.30	82.94	18.90
	25	62.38	16.80	66.26	17.40	70.06	17.90	73.76	18.50	77.38	19.10	81.62	19.80
	27	34.15	17.60	64.06	18.40	66.71	18.60	71.82	18.90	73.50	19.10	76.94	19.70
	29	60.00	18.50	62.91	19.10	65.91	19.30	70.59	19.60	72.79	19.70	76.24	20.20
	31	58.76	19.40	62.38	19.80	64.94	20.10	69.79	20.40	71.56	20.40	75.18	20.90
	33	57.62	20.20	61.06	20.60	63.62	20.90	67.68	21.20	70.41	21.20	73.68	21.80
	35	56.56	21.00	60.00	21.50	63.09	21.70	66.71	22.00	69.09	22.00	72.26	22.70
	37	55.32	21.90	58.85	22.40	61.41	22.50	65.21	22.90	67.85	22.90	70.24	23.50
	39	54.00	22.70	57.97	23.20	60.18	23.60	63.79	23.70	66.35	23.80	69.26	24.30
	41	52.94	23.60	56.82	24.40	59.21	24.40	62.29	24.60	64.94	24.70	67.85	25.40
43	51.79	24.40	55.32	25.30	57.79	25.50	60.71	25.50	63.88	25.80	66.26	26.30	
80	23	85.18	23.26	90.12	24.14	95.18	25.01	100.24	25.89	105.41	26.77	110.59	27.65
	25	83.18	24.57	88.35	25.45	93.41	26.18	98.35	27.06	103.18	27.94	108.82	28.96
	27	45.53	25.75	85.41	26.92	88.94	27.21	95.76	27.65	98.00	27.94	102.59	28.82
	29	80.00	27.06	83.88	27.94	87.88	28.23	94.12	28.67	97.06	28.82	101.65	29.55
	31	78.35	28.38	83.18	28.96	86.59	29.40	93.06	29.84	95.41	29.84	100.24	30.57
	33	76.82	29.55	81.41	30.13	84.82	30.57	90.24	31.01	93.88	31.01	98.24	31.89
	35	75.41	30.72	80.00	31.45	84.12	31.74	88.94	32.18	92.12	32.18	96.35	33.21
	37	73.76	32.04	78.47	32.77	81.88	32.91	86.94	33.50	90.47	33.50	93.65	34.38
	39	72.00	33.21	77.29	33.94	80.24	34.52	85.06	34.67	88.47	34.81	92.35	35.55
	41	70.59	34.52	75.76	35.69	78.94	35.69	83.06	35.98	86.59	36.13	90.47	37.15
43	69.06	35.69	73.76	37.01	77.06	37.30	80.94	37.30	85.18	37.74	88.35	38.47	
100	23	106.47	29.77	112.65	30.89	118.97	32.01	125.29	33.14	131.76	34.26	138.24	35.38
	25	103.97	31.45	110.44	32.57	116.76	33.51	122.94	34.63	128.97	35.76	136.03	37.07
	27	56.91	32.95	106.76	34.45	111.18	34.82	119.71	35.38	122.50	35.76	128.24	36.88
	29	100.00	34.63	104.85	35.76	109.85	36.13	117.65	36.69	121.32	36.88	127.06	37.82
	31	97.94	36.32	103.97	37.07	108.24	37.63	116.32	38.19	119.26	38.19	125.29	39.13
	33	96.03	37.82	101.76	38.57	106.03	39.13	112.79	39.69	117.35	39.69	122.79	40.81
	35	94.26	39.31	100.00	40.25	105.15	40.62	111.18	41.19	115.15	41.19	120.44	42.50
	37	92.21	41.00	98.09	41.93	102.35	42.12	108.68	42.87	113.09	42.87	117.06	43.99
	39	90.00	42.50	96.62	43.43	100.29	44.18	106.32	44.37	110.59	44.56	115.44	45.49
	41	88.24	44.18	94.71	45.68	98.68	45.68	103.82	46.05	108.24	46.24	113.09	47.55
43	86.32	45.68	92.21	47.36	96.32	47.74	101.18	47.74	106.47	48.30	110.44	49.24	

kW_f: Cooling capacity [kW]

kW_e: Compressor power input [kW]

T_a: External air temperature [°C]*

Temperature difference of evaporator water in/out: 5 °C

Heating performance

Mod	T _a : [°C]	Returning water temperature [°C]									
		35		38		40		43		45	
		kW _r	kW _e	kW _r	kW _e	kW _r	kW _e	kW _r	kW _e	kW _r	kW _e
60	-7	35.75	19.13	34.36	20.00	34.26	20.55	33.06	20.99	32.04	21.20
	-5	38.26	19.35	37.61	20.33	37.14	20.88	36.12	21.64	35.38	21.97
	-3	44.11	19.57	43.64	20.66	43.27	21.31	42.53	22.19	41.97	22.73
	-1	46.80	19.78	46.43	20.99	46.15	21.75	45.59	22.73	45.22	23.39
	1	49.68	20.11	49.40	21.31	49.12	22.19	48.75	23.28	48.47	24.05
	3	59.15	20.44	58.87	21.75	58.69	22.63	58.41	23.83	58.22	24.70
	5	62.21	20.77	61.94	22.19	61.84	23.06	61.56	24.37	61.38	25.25
	7	65.37	21.20	65.46	22.63	65.00	23.50	64.72	24.92	64.63	25.80
	9	68.71	21.64	68.44	23.06	68.25	23.94	67.97	25.36	67.79	26.34
	11	71.50	22.08	71.78	23.50	71.59	24.37	71.22	25.80	70.94	26.78
	13	75.77	22.52	75.31	23.94	74.94	24.92	74.47	26.23	74.10	27.22
	15	79.39	23.06	78.74	24.48	78.37	25.36	77.72	26.67	77.26	27.54
	17	83.20	23.61	82.46	25.03	81.90	25.90	80.97	27.11	80.32	27.87
	19	87.10	24.27	86.17	25.58	85.43	26.34	84.31	27.54	83.39	28.20
21	91.09	25.25	89.98	26.67	89.14	27.33	87.84	28.42	86.91	29.07	
80	-7	49.28	28.04	47.36	29.32	47.23	30.12	45.57	30.76	44.16	31.09
	-5	52.74	28.36	51.84	29.80	51.20	30.60	49.79	31.73	48.77	32.21
	-3	60.80	28.68	60.16	30.28	59.65	31.25	58.62	32.53	57.86	33.33
	-1	64.51	29.00	64.00	30.76	63.62	31.89	62.85	33.33	62.34	34.29
	1	68.48	29.48	68.10	31.25	67.71	32.53	67.20	34.13	66.82	35.25
	3	81.54	29.96	81.15	31.89	80.90	33.17	80.51	34.93	80.26	36.21
	5	85.76	30.44	85.38	32.53	85.25	33.81	84.86	35.73	84.61	37.01
	7	90.11	31.09	90.24	33.17	89.60	34.45	89.22	36.53	89.09	37.81
	9	94.72	31.73	94.34	33.81	94.08	35.09	93.70	37.17	93.44	38.62
	11	98.56	32.37	98.94	34.45	98.69	35.73	98.18	37.81	97.79	39.26
	13	104.45	33.01	103.81	35.09	103.30	36.53	102.66	38.46	102.14	39.90
	15	109.44	33.81	108.54	35.89	108.03	37.17	107.14	39.10	106.50	40.38
	17	114.69	34.61	113.66	36.69	112.90	37.98	111.62	39.74	110.72	40.86
	19	120.06	35.57	118.78	37.49	117.76	38.62	116.22	40.38	114.94	41.34
21	125.57	37.01	124.03	39.10	122.88	40.06	121.09	41.66	119.81	42.62	
100	-7	61.60	35.85	59.20	37.49	59.04	38.52	56.96	39.34	55.20	39.75
	-5	65.92	36.26	64.80	38.11	64.00	39.13	62.24	40.57	60.96	41.18
	-3	76.00	36.67	75.20	38.72	74.56	39.95	73.28	41.59	72.32	42.62
	-1	80.64	37.08	80.00	39.34	79.52	40.77	78.56	42.62	77.92	43.85
	1	85.60	37.70	85.12	39.95	84.64	41.59	84.00	43.64	83.52	45.07
	3	101.92	38.31	101.44	40.77	101.12	42.41	100.64	44.66	100.32	46.30
	5	107.20	38.93	106.72	41.59	106.56	43.23	106.08	45.69	105.76	47.33
	7	112.64	39.75	112.80	42.41	112.00	44.05	111.52	46.71	111.36	48.35
	9	118.40	40.57	117.92	43.23	117.60	44.87	117.12	47.53	116.80	49.38
	11	123.20	41.39	123.68	44.05	123.36	45.69	122.72	48.35	122.24	50.20
	13	130.56	42.21	129.76	44.87	129.12	46.71	128.32	49.17	127.68	51.02
	15	136.80	43.23	135.68	45.89	135.04	47.53	133.92	49.99	133.12	51.63
	17	143.36	44.25	142.08	46.92	141.12	48.56	139.52	50.81	138.40	52.25
	19	150.08	45.48	148.48	47.94	147.20	49.38	145.28	51.63	143.68	52.86
21	156.96	47.33	155.04	49.99	153.60	51.22	151.36	53.27	149.76	54.50	

kW_r: Heating capacity [kW] kW_e: Compressor power input [kW] T_a: External air temperature [°C]**Temperature difference of evaporator water in/out: 5 °C

Cooling performance

Mod	T _a : [°C]	Returning water temperature [°C]											
		10		12		14		16		18		20	
		kW _f	kW _e	kW _f	kW _e	kW _f	kW _e	kW _f	kW _e	kW _f	kW _e	kW _f	kW _e
60	23	63.88	15.31	67.59	15.89	71.38	16.46	75.18	17.04	79.06	17.62	82.94	18.20
	25	62.38	16.17	66.26	16.75	70.06	17.23	73.76	17.81	77.38	18.39	81.62	19.06
	27	34.15	16.95	64.06	17.72	66.71	17.91	71.82	18.20	73.50	18.39	76.94	18.97
	29	60.00	17.81	62.91	18.39	65.91	18.58	70.59	18.87	72.79	18.97	76.24	19.45
	31	58.76	18.68	62.38	19.06	64.94	19.35	69.79	19.64	71.56	19.64	75.18	20.12
	33	57.62	19.45	61.06	19.83	63.62	20.12	67.68	20.41	70.41	20.41	73.68	20.99
	35	56.56	20.22	60.00	20.70	63.09	20.89	66.71	21.18	69.09	21.18	72.26	21.86
	37	55.32	21.09	58.85	21.57	61.41	21.66	65.21	22.05	67.85	22.05	70.24	22.63
	39	54.00	21.86	57.97	22.34	60.18	22.72	63.79	22.82	66.35	22.91	69.26	23.40
	41	52.94	22.72	56.82	23.49	59.21	23.49	62.29	23.68	64.94	23.78	67.85	24.45
43	51.79	23.49	55.32	24.36	57.79	24.55	60.71	24.55	63.88	24.84	66.26	25.32	
80	23	85.18	21.93	90.12	22.75	95.18	23.58	100.24	24.41	105.41	25.24	110.59	26.06
	25	83.18	23.17	88.35	24.00	93.41	24.69	98.35	25.51	103.18	26.34	108.82	27.31
	27	45.53	24.27	85.41	25.37	88.94	25.65	95.76	26.06	98.00	26.34	102.59	27.17
	29	80.00	25.51	83.88	26.34	87.88	26.62	94.12	27.03	97.06	27.17	101.65	27.86
	31	78.35	26.75	83.18	27.31	86.59	27.72	93.06	28.13	95.41	28.13	100.24	28.82
	33	76.82	27.86	81.41	28.41	84.82	28.82	90.24	29.24	93.88	29.24	98.24	30.06
	35	75.41	28.96	80.00	29.65	84.12	29.93	88.94	30.34	92.12	30.34	96.35	31.30
	37	73.76	30.20	78.47	30.89	81.88	31.03	86.94	31.58	90.47	31.58	93.65	32.41
	39	72.00	31.30	77.29	31.99	80.24	32.55	85.06	32.68	88.47	32.82	92.35	33.51
	41	70.59	32.55	75.76	33.65	78.94	33.65	83.06	33.93	86.59	34.06	90.47	35.03
43	69.06	33.65	73.76	34.89	77.06	35.17	80.94	35.17	85.18	35.58	88.35	36.27	
100	23	106.47	26.81	112.65	27.82	118.97	28.83	125.29	29.84	131.76	30.85	138.24	31.87
	25	103.97	28.33	110.44	29.34	116.76	30.18	122.94	31.19	128.97	32.20	136.03	33.38
	27	56.91	29.67	106.76	31.02	111.18	31.36	119.71	31.87	122.50	32.20	128.24	33.22
	29	100.00	31.19	104.85	32.20	109.85	32.54	117.65	33.05	121.32	33.22	127.06	34.06
	31	97.94	32.71	103.97	33.38	108.24	33.89	116.32	34.40	119.26	34.40	125.29	35.24
	33	96.03	34.06	101.76	34.73	106.03	35.24	112.79	35.74	117.35	35.74	122.79	36.76
	35	94.26	35.41	100.00	36.25	105.15	36.59	111.18	37.09	115.15	37.09	120.44	38.27
	37	92.21	36.92	98.09	37.77	102.35	37.94	108.68	38.61	113.09	38.61	117.06	39.62
	39	90.00	38.27	96.62	39.12	100.29	39.79	106.32	39.96	110.59	40.13	115.44	40.97
	41	88.24	39.79	94.71	41.14	98.68	41.14	103.82	41.48	108.24	41.65	113.09	42.83
43	86.32	41.14	92.21	42.66	96.32	42.99	101.18	42.99	106.47	43.50	110.44	44.34	

kW_f: Cooling capacity [kW]

kW_e: Compressor power input [kW]

T_a: External air temperature [°C]*

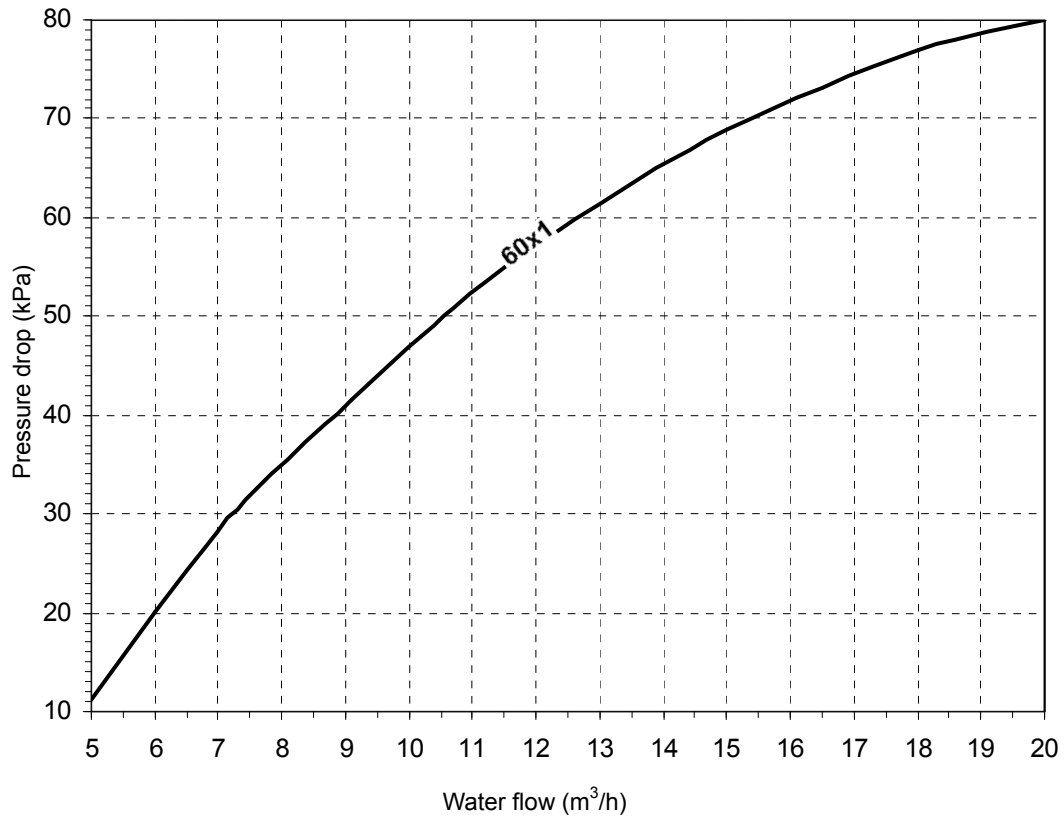
Temperature difference of evaporator water in/out: 5 °C

Heating performance

Mod	T _a : [°C]	Returning water temperature [°C]									
		35		38		40		43		45	
		kW _r	kW _e	kW _r	kW _e	kW _r	kW _e	kW _r	kW _e	kW _r	kW _e
60	-7	35.75	18.48	34.36	19.32	34.26	19.85	33.06	20.27	32.04	20.48
	-5	38.26	18.69	37.61	19.64	37.14	20.17	36.12	20.91	35.38	21.22
	-3	44.11	18.90	43.64	19.95	43.27	20.59	42.53	21.43	41.97	21.96
	-1	46.80	19.11	46.43	20.27	46.15	21.01	45.59	21.96	45.22	22.59
	1	49.68	19.43	49.40	20.59	49.12	21.43	48.75	22.49	48.47	23.23
	3	59.15	19.74	58.87	21.01	58.69	21.86	58.41	23.02	58.22	23.86
	5	62.21	20.06	61.94	21.43	61.84	22.28	61.56	23.54	61.38	24.39
	7	65.37	20.48	65.46	21.86	65.00	22.70	64.72	24.07	64.63	24.92
	9	68.71	20.91	68.44	22.28	68.25	23.12	67.97	24.49	67.79	25.45
	11	71.50	21.33	71.78	22.70	71.59	23.54	71.22	24.92	70.94	25.87
	13	75.77	21.75	75.31	23.12	74.94	24.07	74.47	25.34	74.10	26.29
	15	79.39	22.28	78.74	23.65	78.37	24.49	77.72	25.76	77.26	26.61
	17	83.20	22.81	82.46	24.18	81.90	25.02	80.97	26.18	80.32	26.92
	19	87.10	23.44	86.17	24.71	85.43	25.45	84.31	26.61	83.39	27.24
21	91.09	24.39	89.98	25.76	89.14	26.40	87.84	27.45	86.91	28.08	
80	-7	49.28	26.41	47.36	27.62	47.23	28.37	45.57	28.98	44.16	29.28
	-5	52.74	26.71	51.84	28.07	51.20	28.83	49.79	29.88	48.77	30.34
	-3	60.80	27.02	60.16	28.53	59.65	29.43	58.62	30.64	57.86	31.39
	-1	64.51	27.32	64.00	28.98	63.62	30.04	62.85	31.39	62.34	32.30
	1	68.48	27.77	68.10	29.43	67.71	30.64	67.20	32.15	66.82	33.20
	3	81.54	28.22	81.15	30.04	80.90	31.24	80.51	32.90	80.26	34.11
	5	85.76	28.68	85.38	30.64	85.25	31.85	84.86	33.66	84.61	34.86
	7	90.11	29.28	90.24	31.24	89.60	32.45	89.22	34.41	89.09	35.62
	9	94.72	29.88	94.34	31.85	94.08	33.05	93.70	35.02	93.44	36.37
	11	98.56	30.49	98.94	32.45	98.69	33.66	98.18	35.62	97.79	36.98
	13	104.45	31.09	103.81	33.05	103.30	34.41	102.66	36.22	102.14	37.58
	15	109.44	31.85	108.54	33.81	108.03	35.02	107.14	36.83	106.50	38.03
	17	114.69	32.60	113.66	34.56	112.90	35.77	111.62	37.43	110.72	38.49
	19	120.06	33.51	118.78	35.32	117.76	36.37	116.22	38.03	114.94	38.94
21	125.57	34.86	124.03	36.83	122.88	37.73	121.09	39.24	119.81	40.15	
100	-7	61.60	32.44	59.20	33.92	59.04	34.85	56.96	35.59	55.20	35.96
	-5	65.92	32.81	64.80	34.47	64.00	35.40	62.24	36.70	60.96	37.26
	-3	76.00	33.18	75.20	35.03	74.56	36.14	73.28	37.63	72.32	38.55
	-1	80.64	33.55	80.00	35.59	79.52	36.88	78.56	38.55	77.92	39.66
	1	85.60	34.10	85.12	36.14	84.64	37.63	84.00	39.48	83.52	40.78
	3	101.92	34.66	101.44	36.88	101.12	38.37	100.64	40.41	100.32	41.89
	5	107.20	35.22	106.72	37.63	106.56	39.11	106.08	41.33	105.76	42.82
	7	112.64	35.96	112.80	38.37	112.00	39.85	111.52	42.26	111.36	43.74
	9	118.40	36.70	117.92	39.11	117.60	40.59	117.12	43.00	116.80	44.67
	11	123.20	37.44	123.68	39.85	123.36	41.33	122.72	43.74	122.24	45.41
	13	130.56	38.18	129.76	40.59	129.12	42.26	128.32	44.48	127.68	46.15
	15	136.80	39.11	135.68	41.52	135.04	43.00	133.92	45.23	133.12	46.71
	17	143.36	40.04	142.08	42.44	141.12	43.93	139.52	45.97	138.40	47.26
	19	150.08	41.15	148.48	43.37	147.20	44.67	145.28	46.71	143.68	47.82
21	156.96	42.82	155.04	45.23	153.60	46.34	151.36	48.19	149.76	49.30	

kW_r: Heating capacity [kW] kW_e: Compressor power input [kW] T_a: External air temperature [°C]**Temperature difference of evaporator water in/out: 5 °C

Water side pressure drop



Water pump available head pressure calculations

Example:

Suppose we calculate the available head pressure of 60 unit under the nominal condition, ie, water in/out temp. 12/7 °C, ambient temp. 35 °C.

Unit cooling capacity:	60 kW
Unit water flow:	$60 / (1,1666 \times 5) = 10.28 \text{ m}^3/\text{h}$
If the selected water pump total head pressure is 200 kPa	
Unit water system pressure drop:	49 kPa
Available head pressure:	$200 - 49 = 151 \text{ kPa}$

Fouling factor correction coefficient

Fouling factor [$\text{m}^2 \text{ }^\circ\text{C} / \text{W}$]	Evaporator		Recovery condenser	
	F_1	FP_1	F_2	FP_2
0 clean heat exchanger	1	1	1	1
$4,4 \times 10^{-5}$	0,98	0,99	0,99	1,03
$8,8 \times 10^{-5}$	0,96	0,98	0,98	1,04
$17,6 \times 10^{-5}$	0,93	0,97	0,95	1,06

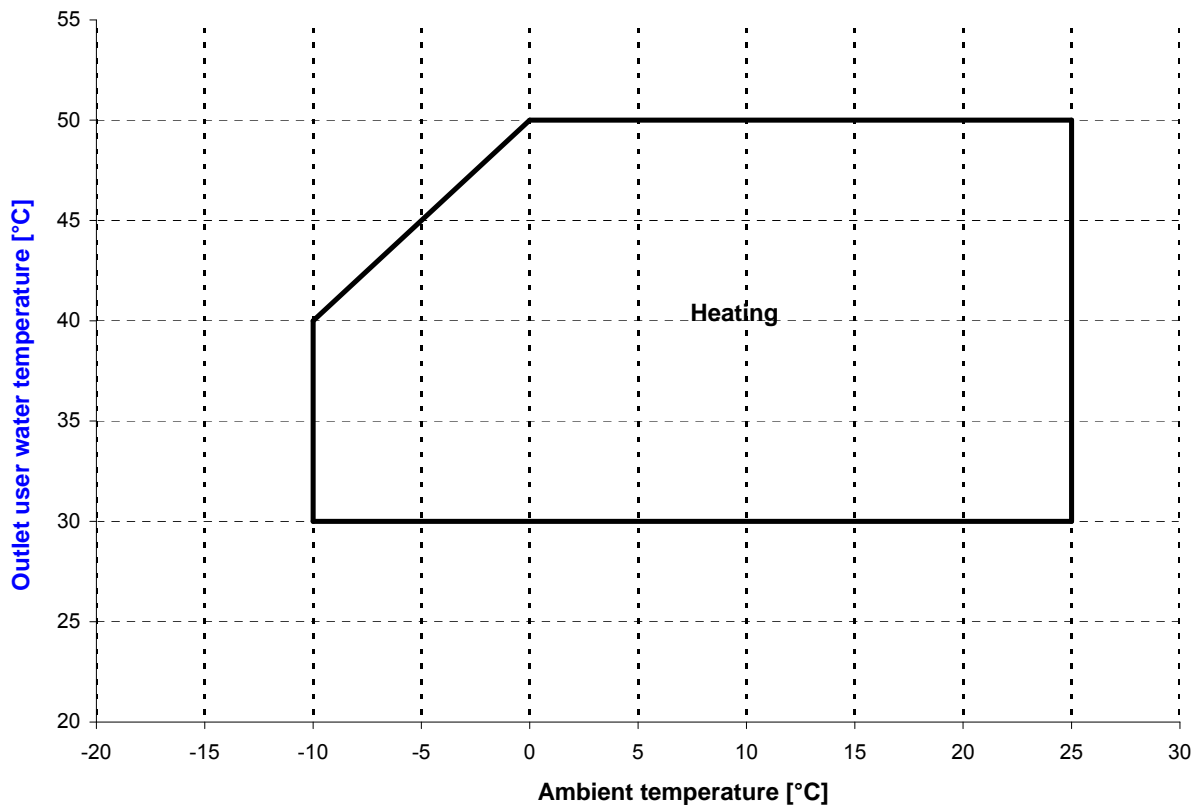
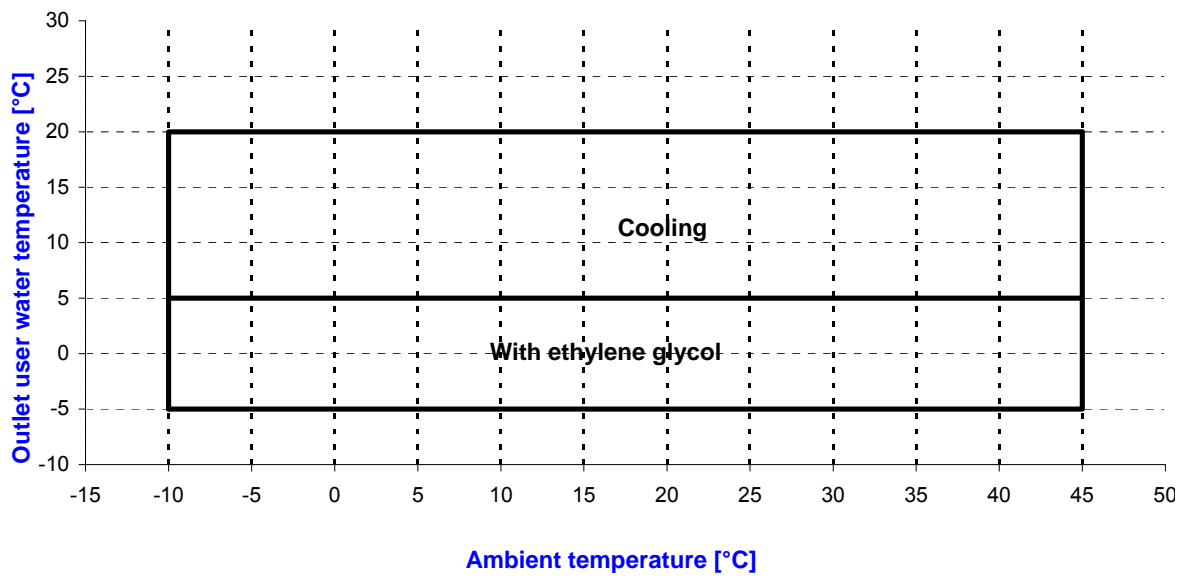
$F_1 - F_2$ = Energy correction coefficient

$FP_1 - FP_2$ = Compressor power input correction coefficient

The performance data given refer to conditions with clean heat exchangers (fouling factor =1). For different fouling factors, unit performances should be corrected with the correction factors shown above.

UNIT DESCRIPTION AND TECHNICAL DATA

Operating range



Water thermal difference for all versions: min. 3 °C, max 8 °C.

Sound pressure level

Model	Octave band [Hz]							Total
	125	250	500	1000	2000	4000	8000	
	dB	dB	dB	dB	dB	dB	dB	dB(A)
60x1	81	78	74	71	67	66	64	69
60x2	81	77	75	72	68	67	65	70
60x3	82	80	77	72	69	68	66	71
60x4	82	81	78	74	69	68	67	72
60x5	83	82	78	75	72	70	68	73
60x6	84	83	78	76	73	72	70	74
60x7	85	83	80	77	74	72	71	75
60x8	86	84	81	78	75	74	72	76
80x1	81	78	74	71	67	66	64	69
80x2	81	77	75	72	68	67	65	70
80x3	82	80	77	72	69	68	66	71
80x4	82	81	78	74	69	68	67	72
80x5	83	82	78	75	72	70	68	73
80x6	84	83	78	76	73	72	70	74
80x7	85	83	80	77	74	72	71	75
80x8	86	84	81	78	75	74	72	76
100x1	81	78	74	71	67	66	64	69
100x2	81	77	75	72	68	67	65	70
100x3	82	80	77	72	69	68	66	71
100x4	82	81	78	74	69	68	67	72
100x5	83	82	78	75	72	70	68	73
100x6	84	83	78	76	73	72	70	74
100x7	85	83	80	77	74	72	71	75
100x8	86	84	81	78	75	74	72	76

Reference point: sound pressure level measured in free field conditions, at 1 m from the unit, at 1.5 m from the floor level condensing coil side. Installation distance between the units is 400mm.

Sound pressure level

Model	Octave band [Hz]							Total
	125	250	500	1000	2000	4000	8000	
	dB	dB	dB	dB	dB	dB	dB	dB(A)
60x1	81	78	74	71	67	66	64	69
60x2	81	77	75	72	68	67	65	70
60x3	82	80	77	72	69	68	66	71
60x4	82	81	78	74	69	68	67	72
60x5	83	82	78	75	72	70	68	73
60x6	84	83	78	76	73	72	70	74
60x7	85	83	80	77	74	72	71	75
60x8	86	84	81	78	75	74	72	76
80x1	81	78	74	71	67	66	64	69
80x2	81	77	75	72	68	67	65	70
80x3	82	80	77	72	69	68	66	71
80x4	82	81	78	74	69	68	67	72
80x5	83	82	78	75	72	70	68	73
80x6	84	83	78	76	73	72	70	74
80x7	85	83	80	77	74	72	71	75
80x8	86	84	81	78	75	74	72	76
100x1	81	78	74	71	67	66	64	69
100x2	81	77	75	72	68	67	65	70
100x3	82	80	77	72	69	68	66	71
100x4	82	81	78	74	69	68	67	72
100x5	83	82	78	75	72	70	68	73
100x6	84	83	78	76	73	72	70	74
100x7	85	83	80	77	74	72	71	75
100x8	86	84	81	78	75	74	72	76

Reference point: sound pressure level measured in free field conditions, at 1 m from the unit, at 1.5 m from the floor level condensing coil side. Installation distance between the units is 400mm.

THEORETICAL SOUND REDUCING VALUES WITH DISTANCE VARIATION IN FREE FIELD

Distance	m	1	2	3	4	5	6	7	8	9	10
Attenuation	dB	0	6	9,5	12	14	15,5	17	18	19	20

ETHYLENE GLYCOL SOLUTIONS

The use of ethylene glycol mixtures is intended to prevent freezing in chiller heat exchangers. The use of low freezing point mixtures causes a modification in the main thermodynamic properties of the units. The major parameters affected by the use of glycol mixtures are the following:

- ◇ Cooling capacity
- ◇ Power input
- ◇ Mixture flow
- ◇ Pressure drop

In the table below are reported correction factors referred to the most common ethylene glycol mixtures.

Glycol percentage [%]	10	20	30	40	50
Freezing point [°C]	-3,20	-7,80	-14,10	-22,30	-33,80
Cooling capacity corr. factor	0,986	0,980	0,973	0,966	0,960
Power input corr. factor	1,000	0,995	0,990	0,985	0,975
Mixture flow corr. factor	1,023	1,054	1,092	1,140	1,200
Pressure drop corr. factor	1,061	1,114	1,190	1,244	1,310

CALCULATION EXAMPLE

An example can help to use properly the coefficients reported in the table.

Suppose that a 60 presents the following performances at the nominal working conditions:

Cooling capacity:	60 kW
Input power:	20.4 kW
Water temp. in-out:	12/7 °C
Water flow:	About 10.3m ³ /h
Pressure drops:	49 kPa

With a 30% glycol mixture these parameters will change to the following values, according to the correction factors:

Cooling capacity:	$60 \times 0,973 = 58.38$ kW
Input power:	$20.4 \times 0,990 = 20.19$ kW
Mixture flow:	$58.38 / (1.1666 \times 5) \times 1.092 = 10.04$ m ³ /h

From the pressure drop the value corresponding to the new mixture flow:

$$10.04 \text{ m}^3/\text{h} \implies 46 \text{ kPa}$$

The correct pressure drop corresponding to a 30% glycol mixture will be:

$$46 \times 1.190 = 54.7 \text{ kPa}$$

Low temperatures corrections factors

Outlet water temperature	2 °C	0 °C	-2 °C	-4 °C	-6 °C
Cooling capacity	0,628	0,569	0,510	0,459	0,410
Compressor power input	0,868	0,830	0,802	0,774	0,745
Minimum glycol percentage	10%	20%	20%	30%	30%

Calculation example

Suppose that for a unit performances should be required at the following conditions:

- Evap. in/out water temperature: 0/-4 °C
- Glycol: 30%
- Ambient temperature: 35 °C

For such a unit nominal performances (inlet/outlet water temp. 12/7 °C, ambient temperature 35 °C) are:

Cooling capacity: 60 kW

Input power: 20.4 kW

Performances at the required conditions can be calculated as follows:

1st step:

Performances are calculated without taking in account the use of glycol mixtures.

Cooling capacity: $60 \times 0.459 = 27.54$ kW

Input power: $20.4 \times 0.774 = 15.79$ kW

2nd step:

The use of glycol mixtures is taken in account (please refer to glycol correction factor tables). In our case we have (30% glycol):

Cooling capacity: $27.54 \times 0.973 = 26.79$ kW

Input power: $15.79 \times 0.990 = 15.63$ kW

Mixture flow: $26.79 / (1,1666 \times 5) \times 1.092 = 5.43$ m³/h

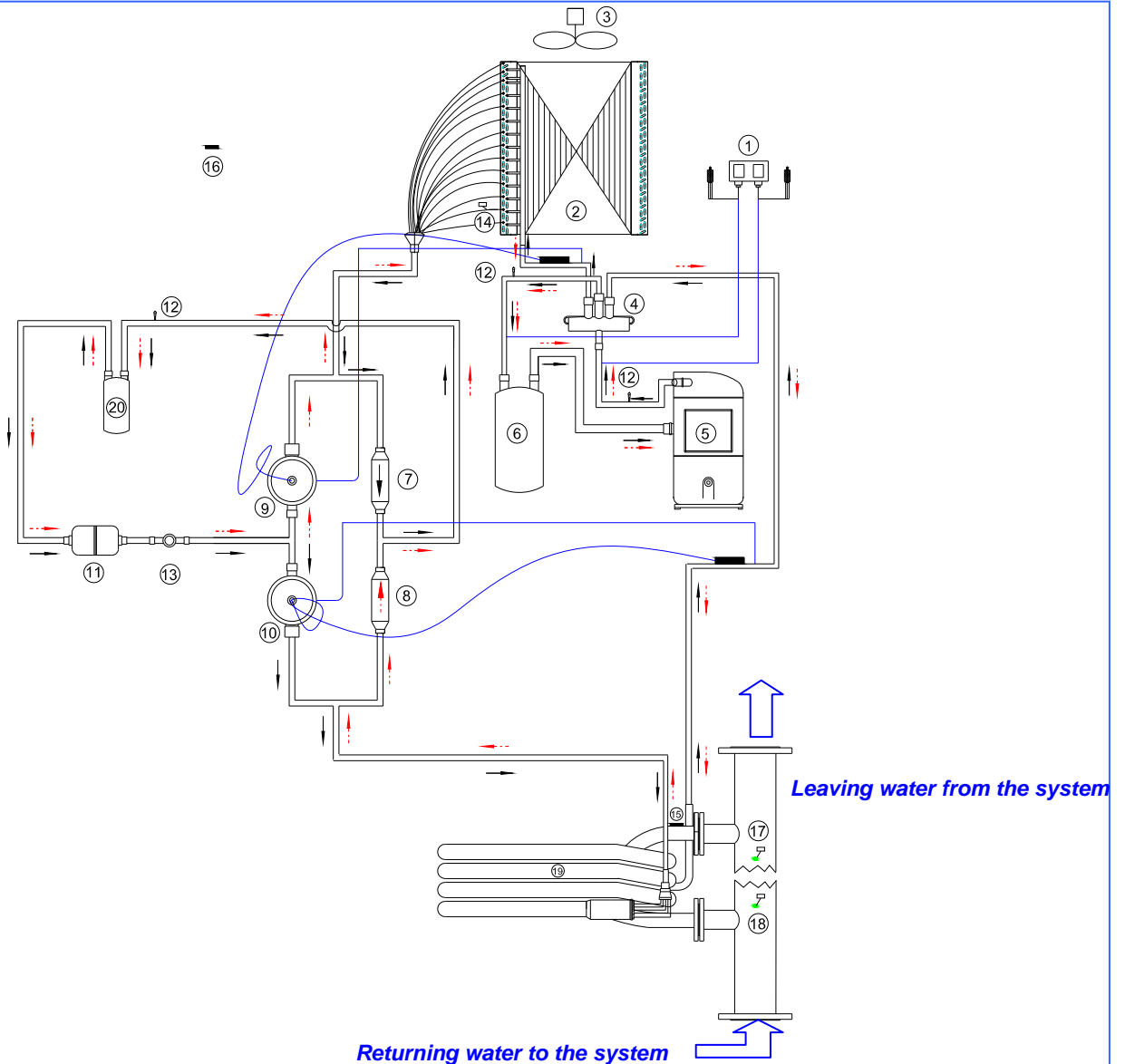
From the pressure drop the value corresponding to the new mixture flow (5.43 m³/h ==> 15 kPa) can be read.

Pressure drops: $15 \times 1.190 = 17.85$ kPa

Altitude Correction Factors

The unit ratings are based on sea level. Above sea level apply the following correction factors:

Altitude		Capacity Multiplier	Power Multiplier
feet	meter		
0	0	1	1
2000	610	0.99	1.01
4000	1219	0.98	1.02
6000	1829	0.97	1.03
8000	2438	0.96	1.04
10000	3048	0.95	1.05



Code	Description	Qty	Code	Description	Qty
(1)	High & Low pressure switch	2	(11)	Filter drier	2
(2)	Finned heat exchanger	2	(12)	Service valves	4
(3)	Axial fan	2	(13)	Sight glass	2
(4)	4-way valve	2	(14)	Temperature sensor on finned exchanger	2
(5)	Compressor	2			
(6)	Liquid-gas separator	2	(16)	Ambient temperature sensor	1
(7)	One way valve for cooling	2	(17)	System leaving water temperature sensor	1
(8)	One way valve for heating	2	(18)	System returning water temperature sensor	1
(9)	Thermostatic expansion valve for heating	2	(19)	Tube in tube heat exchanger	2
(10)	Thermostatic expansion valve for cooling	2	(20)	Liquid receiver	2

Note:

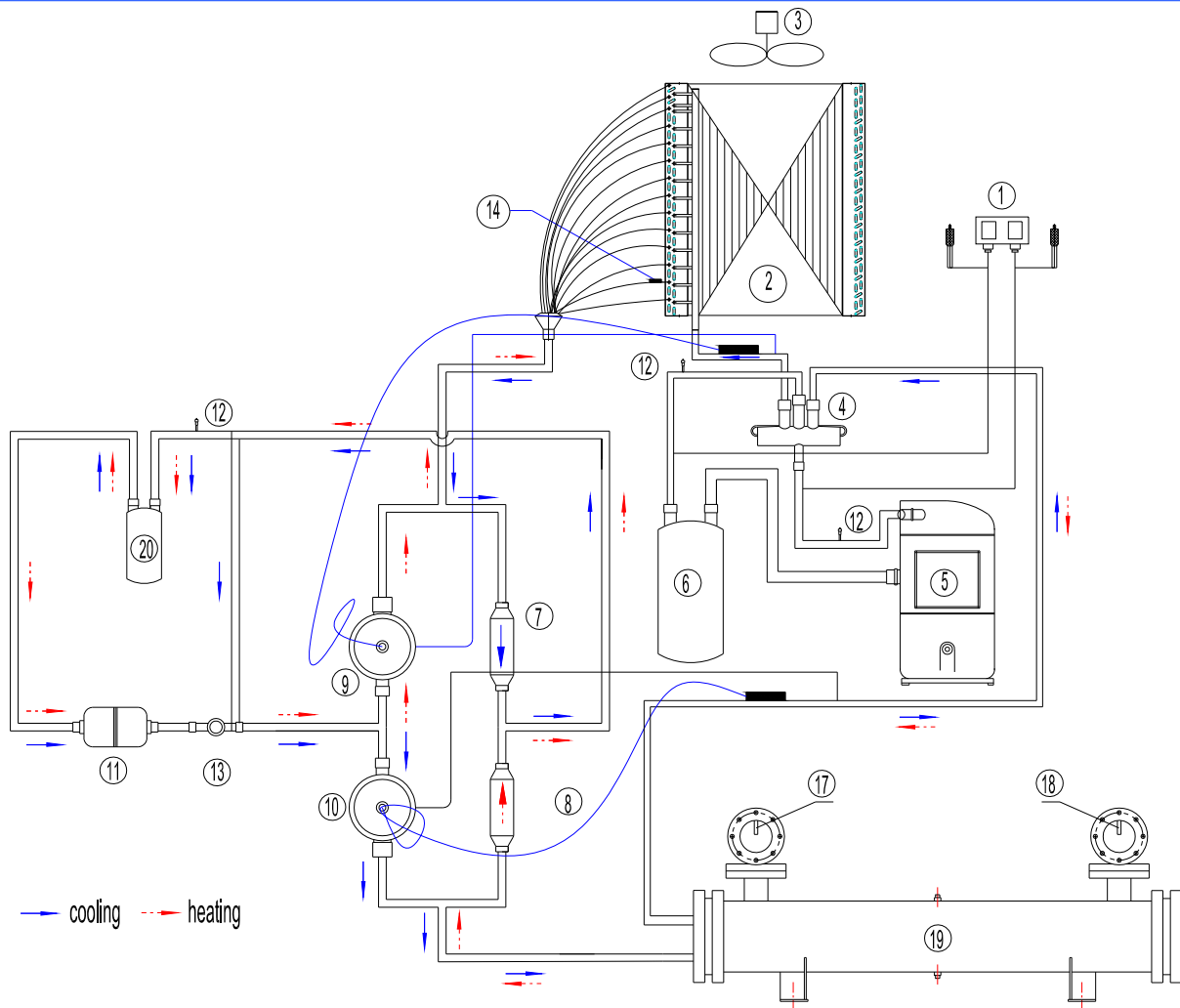
1) → cooling cycle, -→ heating cycle; 2) "Qty" stands for components quantity in one unit.

3) Components (4)(7)(8)(9)(20) are only for heat pump units.

4) Components (17)(18) are available only for master/packaged units, not for slave modules.

SCHEMATIC DIAGRAM 60/80/100

shell and tube is optional



Code	Description	Qty	Code	Description	Qty
(1)	High & Low pressure switch	2	(11)	Filter drier	2
(2)	Finned heat exchanger	2	(12)	Service valves	4
(3)	Axial fan	2	(13)	Sight glass	2
(4)	4-way valve	2	(14)	Temperature sensor on finned exchanger	2
(5)	Compressor	2	(15)		
(6)	Liquid-gas separator	2	(16)	Ambient temperature sensor	1
(7)	One way valve for cooling	2	(17)	System leaving water temperature sensor	1
(8)	One way valve for heating	2	(18)	System returning water temperature sensor	1
(9)	Thermostatic expansion valve for heating	2	(19)	Shell and tube heat exchanger	1
(10)	Thermostatic expansion valve for cooling	2	(20)	Liquid receiver	2

Note:

1) → cooling cycle, - → heating cycle;

2) "Qty" stands for components quantity in one unit.

3) Components (4)(7)(8)(9)(20) are only for heat pump units.

4) Components (17)(18) are available only for master/packaged units, not for slave modules.

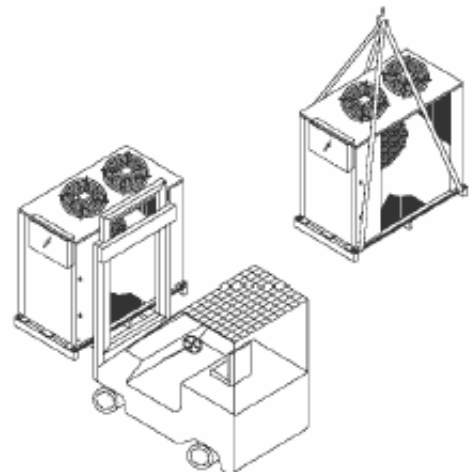
Transport and installation

Lifting and handling

The units are shipped positioned on a wooden pallet.

When unloading and positioning the unit, take the utmost care to avoid any sharp movements or jolting. Internal handling should be done carefully and gently, without using the machine's components as strong points.

The unit can be lifted with the aid of a fork-lift truck, inserting the forks into the supporting pallet or, alternatively, by slinging it with belts, taking care not to damage the sides and cover of the unit (as shown in the figures). In this connection, refer to the weights given in the technical tables. It is necessary to take care not to tilt the machine during these operations.



Throughout lifting, make sure you have securely anchored the unit, to prevent it from accidentally tipping over or falling.

Storage condition

Do not stack more than one packed units for storage.

Unpacking

The unit's packing must be removed carefully without causing any damage to the machine.

Materials receiving

All the units are shipped completely assembled and supplied with refrigerant and oil charged. All electrical panels for operation and control are installed and duly cabled. Each machine has been tested at our plant.

Upon receiving of the unit, the customer shall inspect the machine and check the status of panels, heat exchanging coils and internal refrigerant piping. Eventual damages shall be claimed with the forwarder and reported in details on the delivery note.

Installation



Installation may only be done by experienced technicians, qualified to work with conditioning and cooling systems.



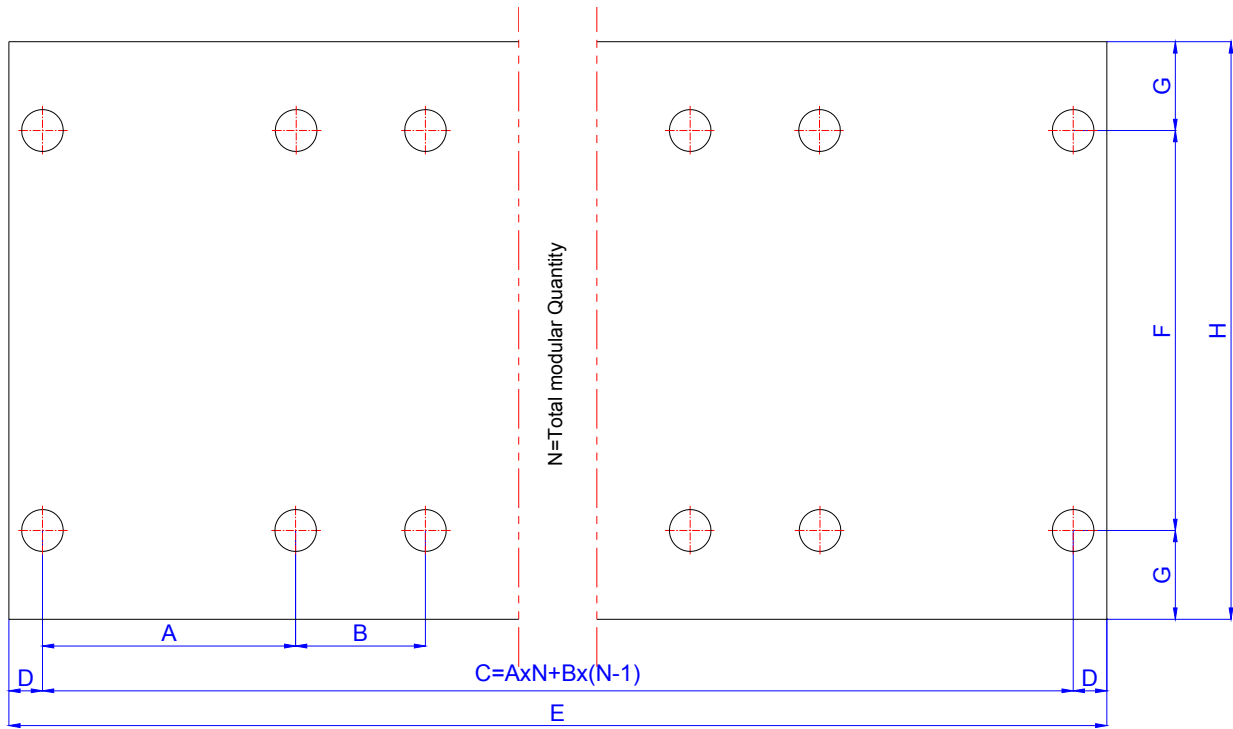
Installation personnel must respect all applicable local or national legislation in effect at the time of machine commissioning.

TECHNICAL SPACES AND POSITIONING

- 1) It is obligatory to pay attention to following points and determine the best location for installing the unit and its connections:
 - ✧ Size and origin of water pipes;
 - ✧ Location of power supply;
 - ✧ Accessibility for maintenance or repairs;
 - ✧ Solidity of the supporting surface;
 - ✧ Ventilation of air-cooled condenser and necessary clearance;
 - ✧ Direction of prevalent winds: avoid positing the unit in such a way that the prevalent winds favour the backflow of air to the condenser coil; a speed of 8 m/s (28.8km/h) already generates a sufficient stagnation pressure to guarantee 60% of the nominal air flow rate. .
 - ✧ Possible reverberation of sound waves.

- 2) All the units are designed and built for outdoor installation: avoid covering them with roof structures or positioning them near plants (even if they only partly cover the unit) which may interfere with the regular ventilation of the unit condenser.
- 3) It is a good idea to create a base of adequate dimensions to support the unit. This precaution becomes essential when the unit is to be installed on unstable ground (various types of soil, gardens, etc.).

a) Layout and dimensions of the base is as below:



b) Dimension of base

Model	60xN	80xN	100xN	60xN	80xN	100xN
Code	two systems			four systems		
heat exchanger	U shape	V shape		V shape		
N	1-32	1-32	1-32	1-32	1-32	1-32
A (mm)	1020	1130	1130	960	1130	1130
B (mm)	min. 520	min. 720	min. 720	min. 520	min. 720	min. 720
C	$C = AxN + Bx(N-1)$					
D (mm)	min. 135	min. 260	min. 260	min. 135	min. 260	min. 260
E	$E = C + Dx2$					
F (mm)	1600	1600	1700	1400	1600	1700
G (mm)	min. 430	min. 520	min. 630	min. 430	min. 520	min. 630
H	$H = F + Gx2$					

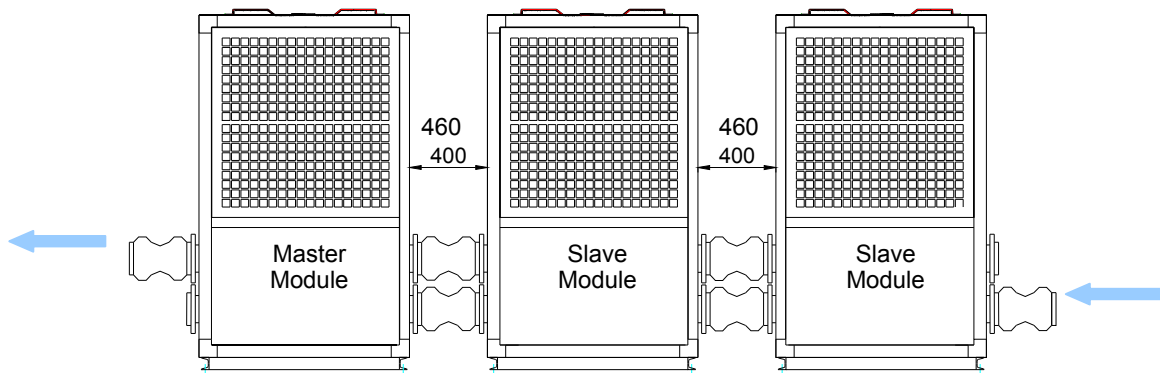
Note:

- a) It is advisable to place a rigid rubber strip between the base frame and the supporting surface.
- b) Whenever more effective insulation is required, it is recommended to use vibrating-damping spring support.

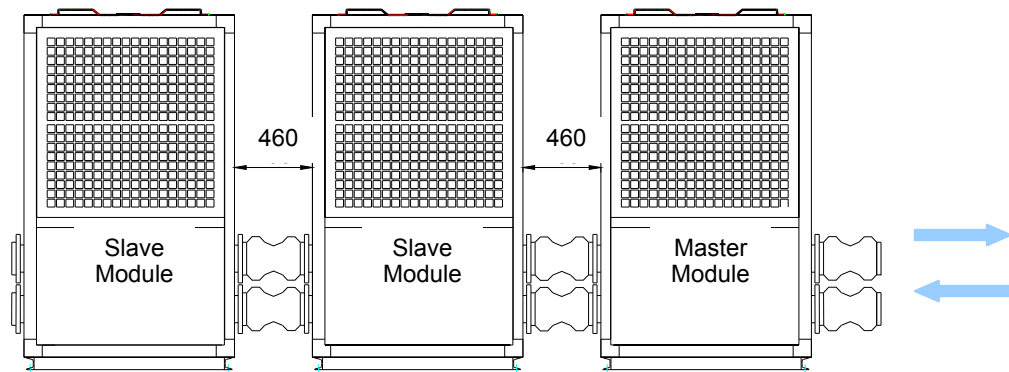
- c) In the case of installation on roofs or intermediate storey, the unit and pipes must be insulated from walls and ceilings by placing rigid rubber joints in between and using supports that are not rigidly anchored to the walls.
- d) If the unit is installed in proximity to private offices, bedrooms or areas where noise levels must be kept down, it is advisable to conduct a thorough analysis of the sound field generated and verify its compatibility with the local laws in force.
- e) It is of fundamental importance to ensure an adequate volume of air both on the intake and outlet sides of the condenser coils; it is very important to prevent the air delivered from being re-aspirated as this may impair the performance of the unit or even cause an interruption in normal operation.

PIPING CONNECTION METHODS BETWEEN MORE THAN 1 UNIT (TUBE IN TUBE)

Method 1



Method 2

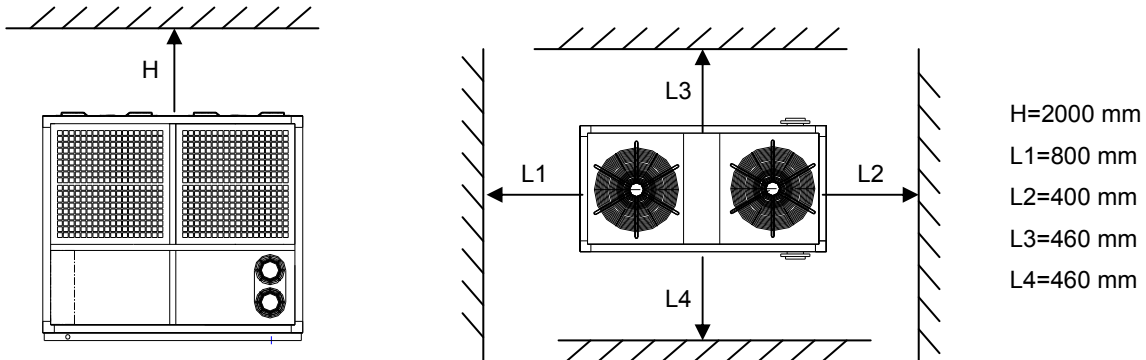


Note:

- a) The minimum space between every two units should be more than 460 mm.
- b) Connect the pipes from one to another chiller using flexible coupling joints to prevent the transmission of vibration and to compensate thermal expansions.

Installation space

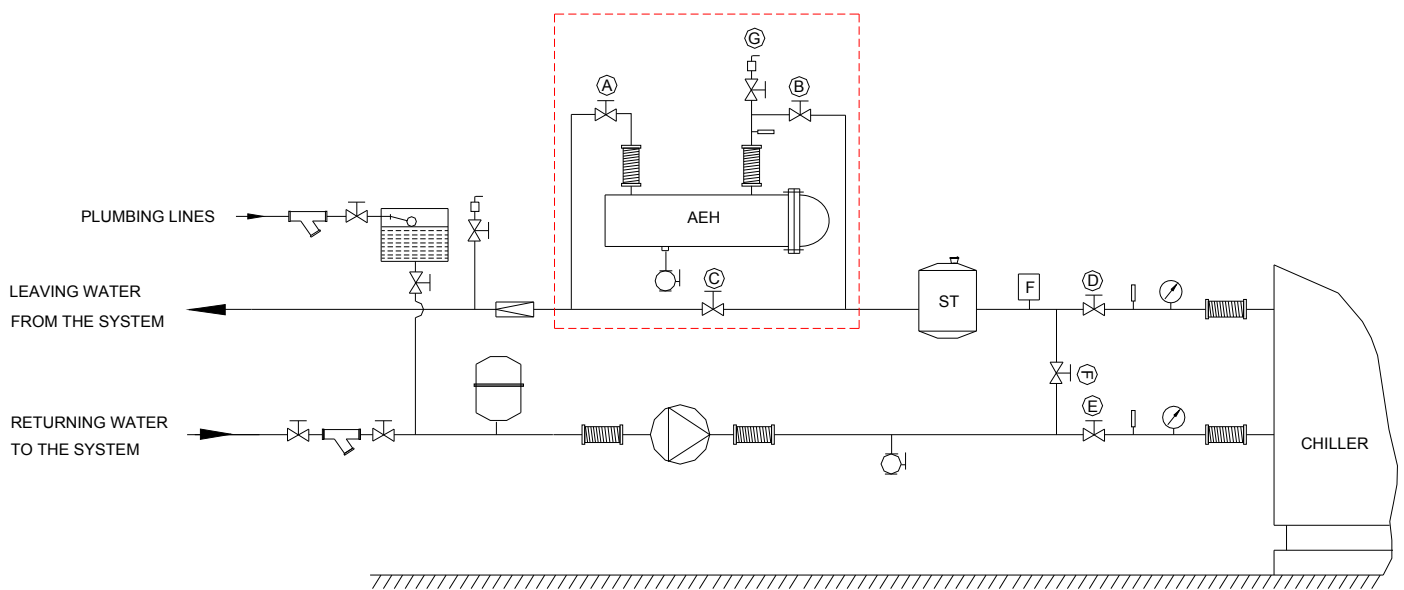
To guarantee the proper functioning of the unit and access for maintenance purposes, it's necessary to comply with the minimum installation clearance requirements (refer to the dimensional drawings below).

















Verify that there are no obstacles in front of the fans air outlet.

WATER CIRCUIT CONNECTIONS

WATER CIRCUIT DIAGRAM



Code	Description	Code	Description
	Metal mesh filter		Pressure gauge
	Manual shut-off valves		Thermometer
	Ball valve		Flexible coupling joint
	Non-return valve		Water flow switch

	Automatic air vent valve		Water pump
	Drain valve		Expansion tank *
	Inertial storage tank		Additional electric heater

Note:

If the water filling system is completed with expansion tank, no need to install this expansion tank.

When setting up the water circuit of the unit, it is advisable to follow the directions below and in any case comply with local or national regulations.

- a) Before connecting the pipes, make sure they do not contain stones, sand, rust, dross or other foreign bodies which might damage the unit.
- b) The connection piping and water pump should be supported in such a way as to avoid its weighing on the unit.
- c) It's mandatory to install in the circuit the following devices:
 - ✧ Water flow switch, which must be set to the flow rates indicated for the system.
 - ✧ Automatic water filling kit to be connected to the water inlet side.
 - ✧ Metal mesh filters (with a mesh not to exceed 1 mm) as close as possible to the evaporator and positioned to allow easy access for routine maintenance, to protect the exchanger from scale or impurities present in the pipes (water inlet/filling).
 - ✧ Expansion tank on the returning water piping to compensate thermal expansions (only for heat pump).
 - ✧ Air vent valves to be placed at the highest points of the hydraulic circuit for the purpose of bleeding air.
 - ✧ Drainage valve at the lowest points of the hydraulic circuit and, where necessary, a drainage tank for emptying out the hydraulic circuit for maintenance purposes or when the unit is taken out of service at the end of season. (This operation may only be carried out when the unit is disconnected from the power supply).
 - ✧ Flexible coupling joints on the water inlet/out side, and also on the two sides of the water pump.
 - ✧ Shut off valves on the system water inlet/outlet piping and before water filling system.
- d) It's recommended to install in the circuit the below devices:
 - ✧ Inertial storage tank for economic functioning;
 - ✧ Pressure gauges on water inlet/outlet;
 - ✧ Thermometers on water inlet/outlet;
 - ✧ Shut off valves on both side of the metal mesh filters, in case of cleaning the filter no need to disconnect the piping.
 - ✧ Non return valve on the leaving water piping.
- e) The water circuit must be set up in such a way as to guarantee that the nominal flow rate of the water supplied to the evaporator remains constant (+/- 15%) in all operating conditions.
- f) Ensure correct insulation as with all water circuit pipes to avoid the formation of condensate and maintain optimal system performance.
- g) It's recommended to install on the leaving water piping the additional electric heater kit for low ambient temperature, when installed, close the shut-off valves A and B and open the valve C. Remember to follow the above drawing indication to connect it to the hydraulic piping in a right way.

- h) When the piping has been completely connected, close the shut-off valves D and E and open the valve F, then switch on the water pump and leave water flush through in order to clean the connecting pipes.
- i) Once the unit has been completely connected, check for leaks in the lines and bleed the air contained in the circuit.

ELECTRICAL CONNECTIONS

The units leave the factory completely cabled and ready for connection to the power supply and for the external interlocks to be connected to the terminals provided inside the electrical box.

Electrical connections must be carried out by qualified personnel in respect of current legislation.

For all electrical work refer to the electrical wiring diagrams in this manual.

You are also recommended to check that the characteristics of the power mains are adequate for the absorptions indicated in the electrical data table below, also bearing in mind the possible of other equipments being used at the same time.

ELECTRICAL DATA

Two systems

Item	Unit	60x1	60x2	60x3	60x4	60x5	60x6	60x7	60x8
Max. power input *	kW	34	34x2	34x3	34x4	34x5	34x6	34x7	34x8
Starting absorbed current	A	142	142	142	142	142	142	142	142
Max. current absorption **	A x n°	56	56x2	56x3	56x4	56x5	56x6	56x7	56x8
Fan motor nominal power input	kW x n°	1.1x2	1.1x4	1.1x6	1.1x8	1.1x10	1.1x12	1.1x14	1.1x16
Fan motor nominal current absorption	A x n°	2.8x2	2.8x4	2.8x6	2.8x8	2.8x10	2.8x12	2.8x14	2.8x16
Power supply	V/Ph/Hz	380-3-50HZ							
Cross section area of power cables	n° of cable x section	3 x16mm ² +N+PE (to single unit)							
Main switch ***	A	50	95	143	192	266	286	335	380
Item	Unit	80x1	80x2	80x3	80x4	80x5	80x6	80x7	80x8
Max. power input *	kW	34	34x2	34x3	34x4	34x5	34x6	34x7	34x8
Starting absorbed current	A	184	184	184	184	184	184	184	184
Max. current absorption **	A x n°	56	56x2	56x3	56x4	56x5	56x6	56x7	56x8
Fan motor nominal power input	kW x n°	1.3x2	0.55x4	0.55x6	0.55x8	0.55x10	0.55x12	0.55x14	0.55x16
Fan motor nominal current absorption	A x n°	2.4x2	2.4x4	2.4x6	2.4x8	2.4x10	2.4x12	2.4x14	2.4x16
Power supply	V/Ph/Hz	380-3-50HZ							
Cross section area of power cables	n° of cable x section	3 x16mm ² +N+PE (to single unit)							
Main switch ***	A	75	150	221	295	370	443	517	591
Item	Unit	100x1	100x2	100x3	100x4	100x5	100x6	100x7	100x8
Max. power input *	kW	47	47x2	47x3	47x4	47x5	47x6	47x7	47x8
Starting absorbed current	A	337	401	465	529	593	657	721	785
Max. current absorption **	A x n°	64	64x2	64x3	64x4	64x5	64x6	64x7	64x8
Fan motor nominal power input	kW x n°	1.3x2	0.55x4	0.55x6	0.55x8	0.55x10	0.55x12	0.55x14	0.55x16
Fan motor nominal current absorption	A x n°	3.2x2	3.2x4	3.2x6	3.2x8	3.2x10	3.2x12	3.2x14	3.2x16
Power supply	V/Ph/Hz	380-3-50HZ							
Cross section area of power cables	n° of cable x section	3 x16mm ² +N+PE (to single unit)							

Main switch ***	A	85	170	253	337	422	506	590	676
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ELECTRICAL DATA

four systems

Item	Unit	60x1	60x2	60x3	60x4	60x5	60x6	60x7	60x8
Max. power input *	kW	27.7x1	27.7x2	27.7x3	27.7x4	27.7x5	27.7x6	27.7x7	27.7x8
Starting absorbed current	A	159	159	159	159	159	159	159	159
Max. current absorption **	A x n°	44.34x1	44.34x2	44.34x3	44.34x4	44.34x5	44.34x6	44.34x7	44.34x8
Fan motor nominal power input	kW x n°	0.55x2	0.55x4	0.55x6	0.55x8	0.55x10	0.55x12	0.55x14	0.55x16
Fan motor nominal current absorption	A x n°	2.4x2	2.4x4	2.4x6	2.4x8	2.4x10	2.4x12	2.4x14	2.4x16
Power supply	V/Ph/Hz	380-3-50HZ							
Cross section area of power cables	n° of cable x section	3 x25mm ² +N+PE (to single unit)							
Main switch ***	A	60	108	162	216	266	324	378	432
Item	Unit	80x1	80x2	80x3	80x4	80x5	80x6	80x7	80x8
Max. power input *	kW	34	34x2	34x3	34x4	34x5	34x6	34x7	34x8
Starting absorbed current	A	212.4	269.2	326	382.8	439.6	496.4	553.2	610
Max. current absorption **	A x n°	56	56x2	56x3	56x4	56x5	56x6	56x7	56x8
Fan motor nominal power input	kW x n°	0.55x2	0.55x4	0.55x6	0.55x8	0.55x10	0.55x12	0.55x14	0.55x16
Fan motor nominal current absorption	A x n°	2.4x2	2.4x4	2.4x6	2.4x8	2.4x10	2.4x12	2.4x14	2.4x16
Power supply	V/Ph/Hz	380-3-50HZ							
Cross section area of power cables	n° of cable x section	3 x25mm ² +N+PE (to single unit)							
Main switch ***	A	75	150	221	295	370	443	517	591
Item	Unit	100x1	100x2	100x3	100x4	100x5	100x6	100x7	100x8
Max. power input *	kW	47	47x2	47x3	47x4	47x5	47x6	47x7	47x8
Starting absorbed current	A	337	401	465	529	593	657	721	785
Max. current absorption **	A x n°	64	64x2	64x3	64x4	64x5	64x6	64x7	64x8
Fan motor nominal power input	kW x n°	1.3x2	0.55x4	0.55x6	0.55x8	0.55x10	0.55x12	0.55x14	0.55x16
Fan motor nominal current absorption	A x n°	3.2x2	3.2x4	3.2x6	3.2x8	3.2x10	3.2x12	3.2x14	3.2x16
Power supply	V/Ph/Hz	380-3-50HZ							
Cross section area of power cables	n° of cable x section	3 x25mm ² +N+PE (to single unit)							
Main switch ***	A	85	170	253	337	422	506	590	676

Note:* Refers to the mains power that must be available in order for the unit to work.

** Refers to the current that will trigger the internal safety devices of the unit. It is the maximum current allowed in the unit. This value may never be exceeded; it must be used as a reference for determining the size of the power supply line and the related safety devices (refer to the wiring diagram supplied with the units).

*** The main switch is provided by the installer or user self, it is recommended to use an adequate air breaker, bearing in mind the possible of other equipments being used at the same time.



Power to the unit must be turned on only after installation work (mechanical, hydraulic and electrical) has been completed.



Ensure that power supply voltage corresponds to unit ratings (voltage, number of phases, frequency) as specified on the unit data plate.



The cross section of the cable must correspond to the maximum absorbed current to avoid cable overheating

and the length must prevent excessive voltage drops.



The power line should be fitted upstream with a suitable device to protect against short-circuits and leakage to earth, isolating the unit from other equipment.



An efficient grounding connection is obligatory. Failure to grounding the appliance absolves the manufacturer of all liability for damage.



It's forbidden to use the water pipes as grounding.



Voltage must be within a tolerance of $\pm 10\%$ of the rated power supply voltage for the unit, for 3-phase unit the unbalance between the phases must not exceed 3%.



For electrical connections use double insulation cable in conformity with current legislation in the country concerned.

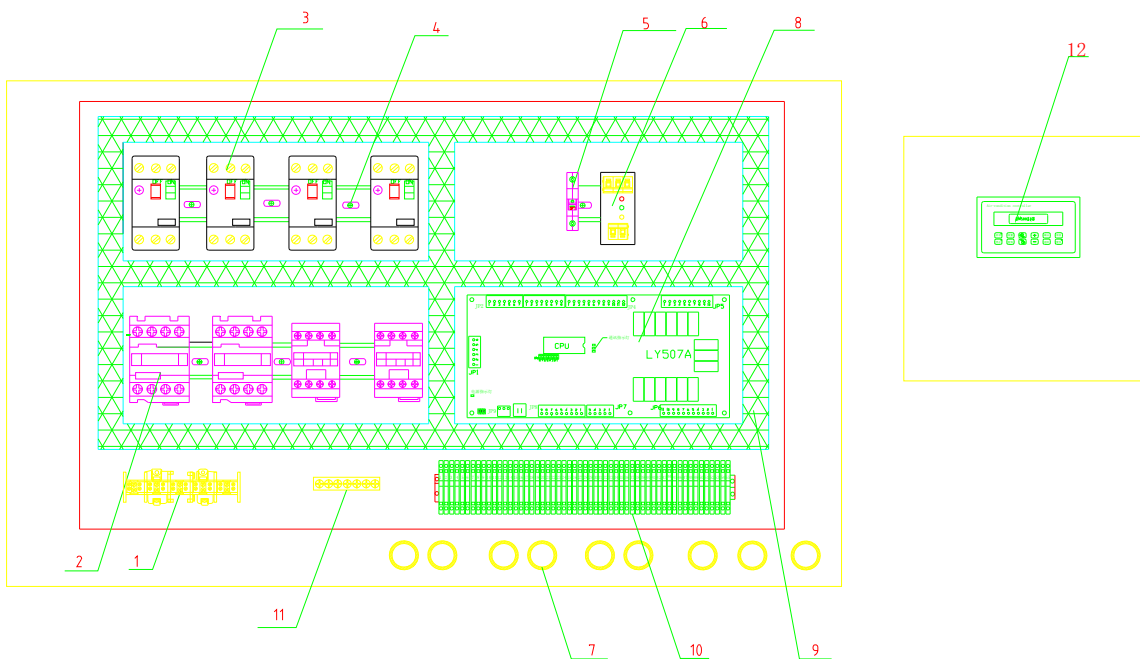
ELECTRICAL POWER CONNECTIONS

For the functional connection of the unit, bring the power supply cable to the electrical box and connect it to terminals, respecting the U-V-W phases, N neutral e PE grounding in three phase units (380~400/3N/50Hz).

The section of the cable must correspond to the maximum absorbed current to avoid cable overheating and the length must prevent excessive voltage drops.

Cable sections and electrical line protections must comply with indications in the Electrical Data table of the manual.

LAYOUT OF CONTROL BOX BUILT IN THE UNIT



1	Power supply terminals	6	Power supply protector
2	AC contactor	8	I/O control
3	breaker	12	DM 500 display

USER SIDE ELECTRIC BOX

It's mandatory to install a control box outside the system for positioning the external interlock connections and other

devices if needed.

CROSS SECTION AREA OF POWER CABLES FROM THE POWER MAINS TO THE USER SIDE ELECTRIC BOX

Model	60x1	60x2	60x3	60x4	60x5	60x6	60x7	60x8
n° of systems	Two systems							
n° of cable x section	3x16mm ²	3x35mm ²	3x50mm ²	3x50mm ²	3x70mm ²	3x95mm ²	3x120mm ²	3x120mm ²
Model	80x1	80x2	80x3	80x4	80x5	80x6	80x7	80x8
n° of systems	Two systems							
no of cable x section	3 x25mm ²	3x50 mm ²	3x70mm ²	3x120mm ²	3x120mm ²	3x150mm ²	3x150mm ²	3x185mm ²
Model	100x1	100x2	100x3	100x4	100x5	100x6	100x7	100x8
n° of systems	Two systems							
no of cable x section	3 x25mm ²	3x50 mm ²	3x75mm ²	3x95mm ²	3x120mm ²	3x150mm ²	3x185mm ²	3x185mm ²

Model	60x1	60x2	60x3	60x4	60x5	60x6	60x7	60x8
n° of systems	Four systems							
n° of cable x section	3 x25mm ²	3x35 mm ²	3x50mm ²	3x70mm ²	3x95mm ²	3x120mm ²	3x120mm ²	3x150mm ²
Model	80x1	80x2	80x3	80x4	80x5	80x6	80x7	80x8
n° of systems	Four systems							
no of cable x section	3 x25mm ²	3x50 mm ²	3x70mm ²	3x120mm ²	3x120mm ²	3x150mm ²	3x150mm ²	3x185mm ²
Model	100x1	100x2	100x3	100x4	100x5	100x6	100x7	100x8
n° of systems	Four systems							
no of cable x section	3 x25mm ²	3x50 mm ²	3x75mm ²	3x95mm ²	3x120mm ²	3x150mm ²	3x185mm ²	3x185mm ²

EXTERNAL INTERLOCKS CONNECTIONS

In the electrical box the manufacturer provides the necessary terminals for the following functions which will be connected by the installer if needed.

- ✧ Remote alarm warning light (1)
 - ✧ Remote compressor running light (2)
 - ✧ Remote on/off control (3)
 - ✧ Water flow switch (4)
 - ✧ Water pump (5)
 - ✧ Additional electric heater for water circuit (6)
 - ✧ Other control or safety devices (7)
- a) If needed the user can install the devices (1) and (2) to where is comfortable for checking the working station of the system.
- b) The remote on/off line switch will help the user to start up and shut down the system from long distance, there are two kinds of switch methods: dial and pulse.
- Dial method

The wire will be connected to an On/off switch, when switch on, if the system is in OFF state, the system will start, and when switch off, if the system is in ON state, the system will stop.

➤ Pulse method

The wire will be connected to a pulse switch, and On/off state of the switch is always in “01010101.....” status, so when the switch acts, if the system is in OFF state, the system will start, and if system is in ON state, the system will stop.

- c) The control wire of water flow switch will be connected to the packaged unit or master module of the system only.
- d) The water pump can be controlled separately or together with other devices by the electronic controller built in the unit,
 - if the water pump is controlled separately, no wire will be connected to the terminals inside the control box built in the unit, in this case remember to manually start up the water pump before switching on the system and stop it after switching off the system.
 - if the water pump is controlled by the electronic controller built in the unit, the start up and shut down will be managed automatically by the controller, please refer to the attached wiring diagram for connection method.



In case of 3-phase water pump ensure the phases are connected correctly.

- e) The additional electric heater kit is used for low ambient temperature; please refer to the attached wiring diagram for connection method.



Strictly observe all instructions on the wiring diagram when making connections.



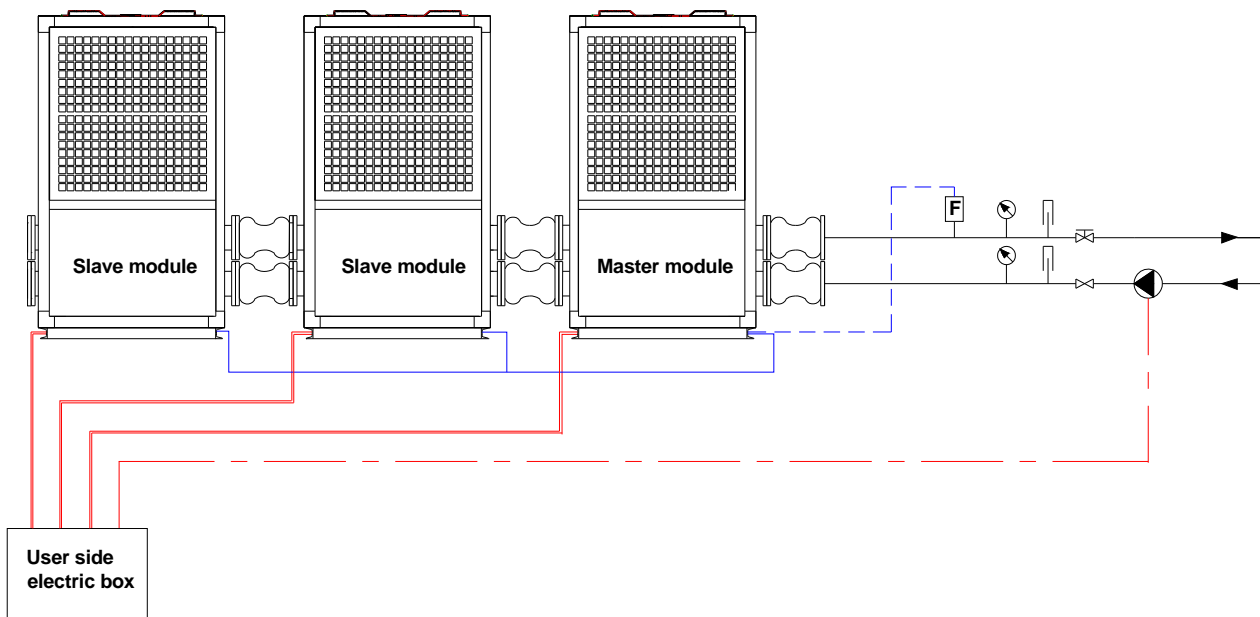
All the necessary components and connection cables for the external interlocks will be provided by the installer or user self.



The water pump must be selected and provided by the installer or user self according to needs, so the electrical data of water pump is not considered into the electrical data included in this manual, please bear in mind to modify adequately the electrical data of the power cable connected by user on the basis of the technical data recommended by the manufacturer.

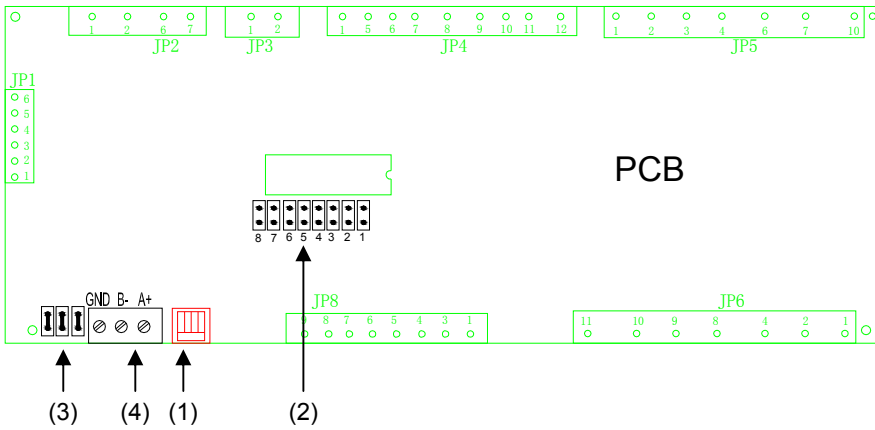
The external interlock connection cables must be positioned at a safe distance from the power supply lines or must be adequately insulated to prevent interference with the electronic controller.

POWER CABLE AND COMMUNICATION WIRE CONNECTION FOR MORE THAN 1 UNITS



Line	Description	Cable type N° of cable x section	<u>Line</u>	Description	Cable type N° of cable x section
----	Control wire of water flow switch	RVV 2 x1mm ²	---	Power cable for water pump	According to power input of water pump
—	Communication wire between units	RVVP 2x0.75mm ²		Power cable for the units	Refer to Electrical data table above

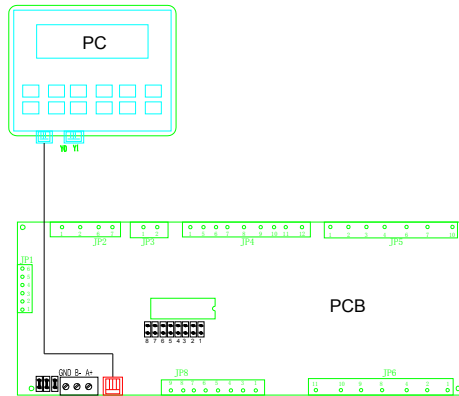
COMMUNICATION WIRE CONNECTION AND ADDRESS BAR LOCATION DESCRIPTION



- (1) Connector for keypad of electronic controller
- (2) Module address bar
- (3) Back-up bridge chips for address bar
- (4) Terminal for communication wire connection between modules

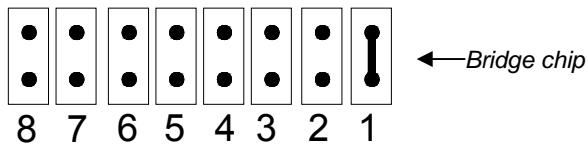
a) Connector for keypad of electronic controller

It is used to connect from the *PC board (PCB)* to the *keypad of the electronic controller (PC)*, the connection is made only in the packaged units or master module of the system.

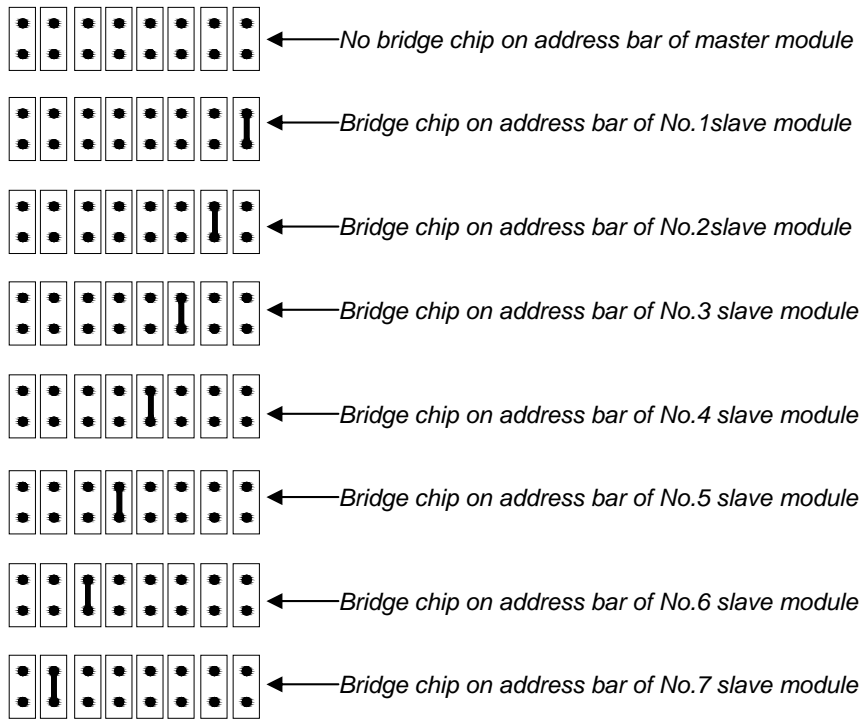


b) Module address bar

The master module can work together with up to 7 slave modules; the communication address of module is differentiated and set by these bars. The addresses of different units are set by the bridge chips.



Chips position for different modules



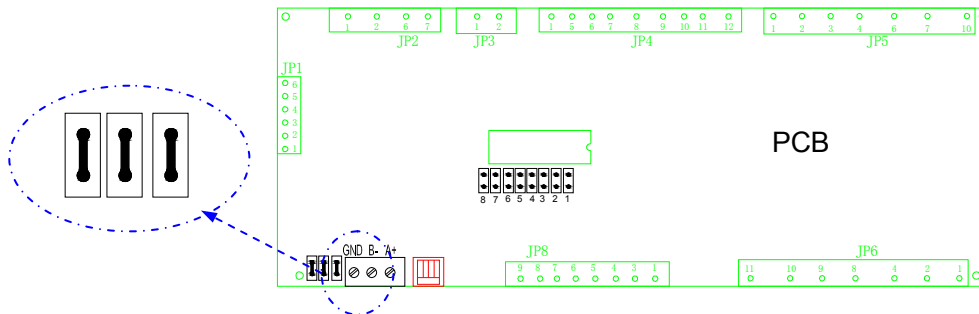
The position of bridge chips is exclusive and unrepeatably in every system, otherwise the system will not start up and alarm code will be displayed on the PC.



The total quantity of modules is pre-set by the manufacturer before the units delivering to the user, if needed please refer to the electronic controller's manual to know how to modify it.

c) *Back-up bridge chips for address bar*

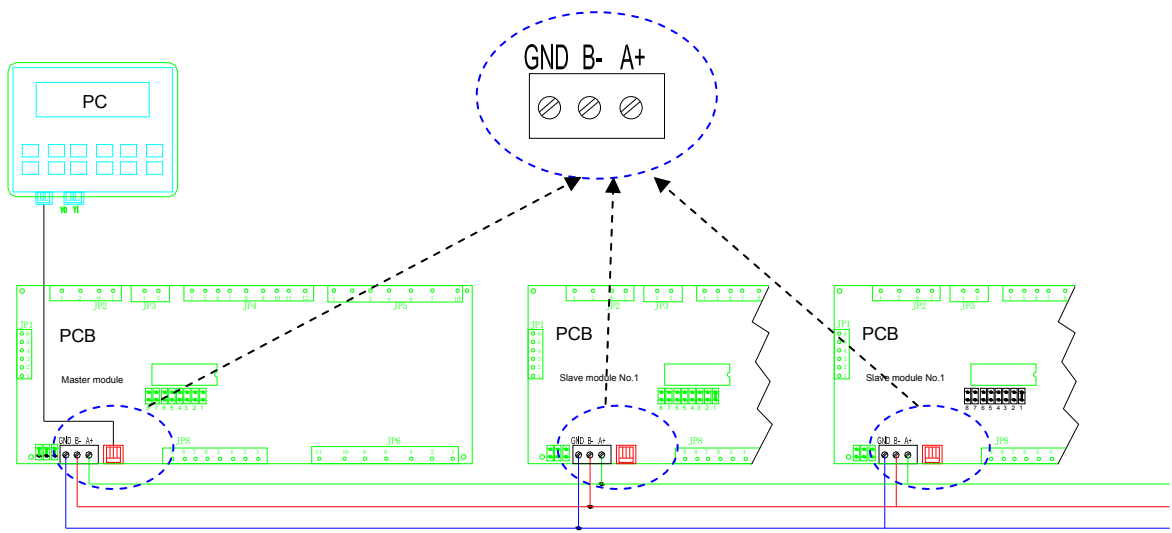
If the bridge chips on the units are broken, these back-up chips will be used to change the broken ones. You can find them only on the PCB of master module..



d) *Terminal for communication wire connection between modules*

All the slave modules are managed by the electronic controller built in the master module, the management will be realized through the communication wires. In case of wrong connections, the system will not start up, and alarm code will be displayed on the PC.

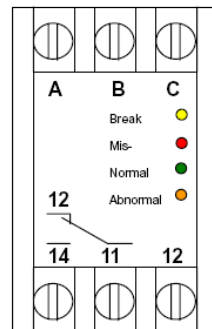
The connection must be made from the master module to all the available slave modules, connecting "GND", "A+" and "B-" on the PCB of master to the corresponding terminals of the PCB of slaves.



PHASE SEQUENCE RELAY

To avoid damage to the scroll compressor if the impeller rotates in the opposite direction (indicated on the phase sequence relay), all units with 3-phase power supply are equipped with a phase sequence relay, which prevents inverted rotation of the compressor by shutting off power supply to the microprocessor in the event of incorrect phase sequence. The start command supplied by the relay (on the electrical panel) is indicated by the illumination of the green led; if this does not occur the two phases on the terminal board must be inverted.

- Break (Yellow Led): lose phase
- Mis- (Red Led): incorrect phase sequence
- Normal (Green Led): normal
- Abnormal (Orange Led): over or under voltage



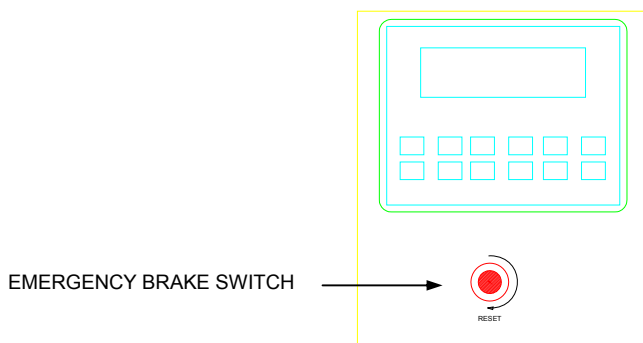
The phase sequence relay is only for the compressors and fan motors built in the units, for the water pump connected to the hydraulic circuit pay attention to ensure the phases are connected correctly.

EMERGENCY BRAKE SWITCH

The emergency break switch is located below the keypad of the controller on the front panel of the electric box, in case that you need to urgently shut down the unit, press this switch to stop the system. Turn the button by clockwise rotation to eliminate the stop and restart the unit.



When the unit is shut down with this switch, the unit is still connected to the power mains, attention to disconnect the units from the power main with the main switch located in the user side control box if needed.



START UP THE UNIT

1) PRELIMINARY CHECKS

Before starting up the unit, make the following checks:

- ✧ Power supply voltage must comply with specifications reported on the serial plate. Admitted tolerance 10%, phase voltage unbalance variation 3%;
- ✧ Power supply must provide adequate current;
- ✧ Check in the electrical enclosure that the power supply terminals and contactors are tight (since they may have loosened during transport, which could lead to malfunctioning);
- ✧ Check that the water system supply and delivery lines are connected according to the marks placed at machine inlet and outlet;
- ✧ Ensure that there are no refrigerant leakages, using a leak detector if required.
- ✧ Check that the air heat exchanger is well ventilated and clean.
- ✧ Ensure correct power supply on the compressor crankcase heater.



- the heater must be activated at least 8 hours before start-up, and is activated automatically when the main switch is turned on.

- to ensure correct operation of the heaters, check that the lower section of the compressor is warm and in any event that it remains 10 ÷ 15°C above the normal ambient temperature.

- to shut down the unit, do not turn off by means of the main switch: in this case the crankcase heaters would not be powered thereby impairing compressor operation on restart.

- ✧ Check that the hydraulic circuit has been vented to remove all residual air and charge gradually while keeping the upper vent valves open which should be fitted by the installer.

2) PIPING CLEAN

- a) Close the manual shut off valves D and E, and then open the valve F.
- b) Start up only the water pump connected to the hydraulic circuit, check the rotation direction; if it is in the opposite direction the two phases must be inverted.
- c) Open the water filling kit and leave water flow through the piping connected outside the system, and then discharge the dirty water.
- d) Clean the metal mesh filter.

3) FILLING THE CIRCUIT

- a) Before filling, check that the water drain valve is closed.
- b) Close the manual shut off valve F, and then open the valve D and E to fill the circuit.
- c) Open the air vent valves of the circuit to remove all the air inside the circuit.
- d) Start up the water pump, and check if the pressure is stable, if no, open again the air vent valve to remove all the residual air.

4) SWITCH ON THE UNIT

- a) Switch on the water pump;
 - ✧ Watch the water pressure gauges installed on the inlet/outlet piping outside the unit, check if the water pressure difference between inlet and outlet is too big, if yes, check the following devices:
 - If the manual shut off valves on water inlet/outlet outside the unit are open.
 - If the metal mesh filter is too dirty.
 - ✧ Watch the water pressure gauges to check if the water pressure is stable, if no, open again the air vent valve to remove all the residual air till the pressure is stable.
 - ✧ Start up the water pump placing the relative switch to ON position.



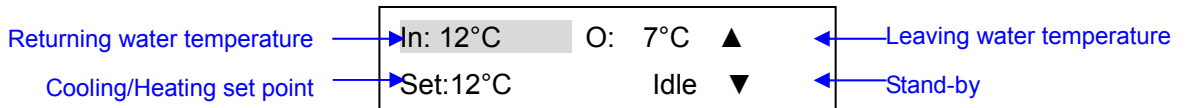
The water pump's contactor can be connected to the external interlock terminals inside the electric box built in the master/package units, in this case the start up and shut down of the pump will be managed automatically by the electronic controller.

b) Start up the unit

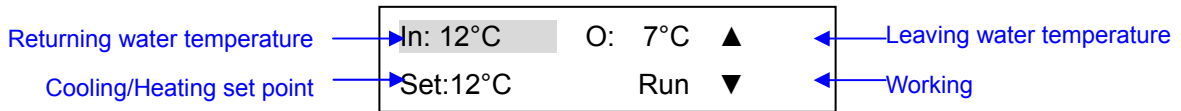
- ✧ Place the main switch to ON position to connect the unit to power mains.
- ✧ When the unit is powered on, the controller will be switched on, welcome message is at first page, and countdown time is highlighted at right down corner.



- ✧ After time countdown, the program goes into **MAIN OPERATION INTERFACE** and display as below,



- ✧ Press **RUN** key to turn on the system.
 - The LED on the right corner of RUN key will illuminate,
 - If the water pump is managed by the electronic controller, when the unit is switched on, the first device to start up is the water pump, which has priority over all other machine components.
 - When the set delay time is up, if the energy load is needed, the definitive machine start-up is enabled and the fan starts up. After another safety interval, the compressor is activated as well.
- ✧ The display of the controller will change to the below picture indicating the unit is in working state.



Any irregularities will be immediately displayed on the display of the control panel.

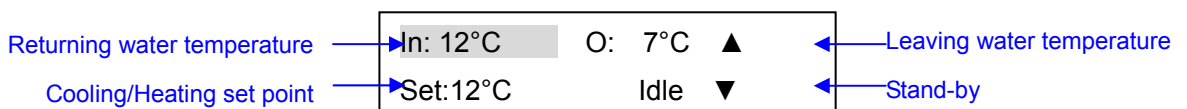
A few minutes after compressor start-up, check that the high/low pressure of refrigerant circuit reading on the gauge is as below:

Item	Position of service valve	Value range	
		Cooling	Heating
High pressure	From the service valve located between the compressor discharge side and fin heat exchanger	1.6~2.1Mpa	1.6~2.1Mpa
Low pressure	From the service valve located between the compressor suction side and tube in tube heat exchanger	0.35~0.65Mpa	0.15~0.45Mpa

5) **SHUT DOWN THE UNIT**

In the main operation interface, press **STOP** key to turn off the unit,

- The compressors will switch off,
- After 10 seconds interval, the fan motors will turn off,
- The last device to shut down is the water pump,
- On the right corner of the second line the "Run" will change to "Idle", and indicate that compressor operating and active operating mode switch off, and the unit will enter into stand-by status.



- The Led on the right corner of STOP key will illuminate, indicating that the unit is still connected to power mains.

✧ *Short term shut down*

For short term shutdown (e.g. weekends), do not turn off by means of the main switch: in this case the crankcase heaters would not be powered thereby impairing compressor operation on restart. Follow the instructions above to switch off the unit temporarily.

The unit must be disconnected from power supply only in the event of prolonged periods of disuse (e.g. seasonal shutdowns).



It is recommended to prevent excessively frequent compressor start-ups and shutdowns due to fluctuations of specific components in the hydraulic circuit. The electronic control enables compressor start-up following shutdown, only if a specific time interval has elapsed (approx. 3 minutes).

✧ *Long-term shutdown*

When a long shutdown period is scheduled, the unit must be cut off from power supply by means of the main switch located by the user or installer.

6) **EMPTYING THE CIRCUIT**

When the unit is out of service, for maintenance or seasonal shutdown purpose, it's recommended to drain completely the water contained in the circuit through the discharge device located at the lowest point of the circuit to ensure complete draining of all the water out the unit.

- ✧ Before emptying, place the main switch in the OFF position to disconnect the unit form power mains.
- ✧ Make sure the shut-off valves of the water circuit are all closed.
- ✧ Open the drain valve outside the unit and all the air vent valves located on the water circuit.



This operation is indispensable if ambient temperatures fall below the fluid freezing point used during the period of disuse (in general for seasonal shutdown).

7) **STARTING UP AFTER PROLONGED SHUTDOWN**

Before starting up the unit again:

- ✧ Check that the air heat exchanger is in good condition, well ventilated and clean.
- ✧ Bleed the air from the water circuit.
- ✧ Check that the water pump is not jammed. Repair it if necessary using a screwdriver to turn the rotor.
Follow the preliminary check steps of the first star up.

MAINTENANCE AND PERIODIC CHECKS

TYPE AND FREQUENCY OF SCHEDULED MAINTENANCE

All maintenance operations must be done by experienced personnel, qualified to work with conditioning and cooling systems. Always switch off the unit to cut off power supply before any maintenance work, even if only inspection is involved.

In order to guarantee regular, efficient unit operation, it is advisable to schedule an overall inspection at regular intervals, in order to prevent irregular functioning which could damage the machine's main components.

PERIODIC CHECKS LIST

Item	Every month	Every 4 months
Check the refrigerant charge and humidity via the sight glass		×
Ensure all electrical terminals are tightened securely inside the electrical panel and on the compressor terminal boards.		×
Ensure that there are no refrigerant leaks from the cooling circuit		×
Ensure that there are no leaks from the hydraulic circuit	×	
Ensure correct operation of the high and low pressure switches		×
Ensure correct operation of the flow switch	×	
Clean the metal filters in the water pipes		×
Check compressor crankcase heaters	×	
Check the noise level of the unit		×
Check correct operation of all control equipments	×	
Check that air heat exchanger is clean		×

ORDINARY MAINTENANCE

a) COOLING CIRCUIT

✧ Check gas charge

Fit a pressure gauge to the pressure outlet on the discharge side and another on the suction side. Start up the unit and check both pressure values once pressure is stabilized.

✧ Check for gas leaks

Use a leak detector to check the cooling circuit.

✧ Check air heat-exchanger condition

After having switched off the unit, check the finned coil and, depending on its condition:

- remove any obstruction from the finned surface which could interfere with air passage,
- eliminate any dust which has deposited using a jet of compressed air,
- wash with water, brushing surfaces lightly,
- dry using compressed air.

b) WATER CIRCUIT

✧ Check water flow switch

While the unit is running normally, slowly close the on-off valve placed on the line which supplies water to the unit. If during this testing phase, the service valve can be closed completely without activating the pressure switch, turn the unit off immediately using the ON/OFF key on the control panel. Proceed to replace the component.

✧ **Draining water circuit**

The system may be completely drained through the cock located on the lowest side of the circuit.

c) ELECTRIC CIRCUIT

The following procedures are important:

- ✧ check electrical absorption of the unit using a current gun, and compare with ratings reported in the technical table;
- ✧ inspect and check that electrical contacts and relative terminals are tight.

EXTRAORDINARY MAINTENANCE

If the unit requires repairs, it is advisable to discharge the refrigerante from both high and low pressure sides. If refrigerante is discharged from the high pressure side alone, compressor wirings could close up, preventing equalization of pressures in the compressor. In this way, the low pressure part of the casing and the suction line could remain pressurized. In this case, if a brazing torch is applied to one of the unit's low pressure components, the pressurized mix of refrigerant and oil could be discharged from the circuit and burst into flame in contact with the torch. To prevent this risk, check that pressure has been released through both the high pressure and low pressure sides before unsoldering.



It is recommended to use the spare parts supplied or authorized by the manufacturer in case of replacement.

REFRIGERANT CIRCUIT REPAIRS

In the event of repairs to the refrigerant circuit, the following operations must be performed:

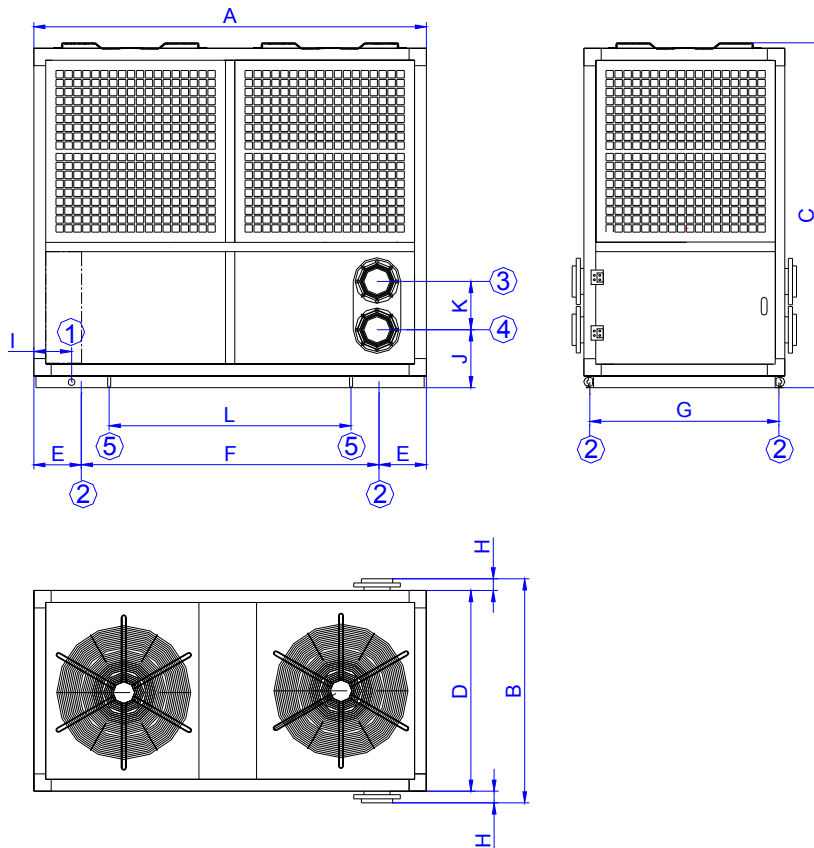
- ✧ sealing efficiency test;
- ✧ draining and drying of refrigerant circuit;
- ✧ refrigerant charge.

TROUBLESHOOTING CHECKLIST

Inconvenience:	Suggested action
1-HIGH DISCHARGE PRESSURE	
Insufficient cooling air at air side heat exchanger	Check for adequate service spaces or obstruction in the coils
Fan not running	Check fan operation
Excessive coolant gas charge	Discharge excess
2-LOW DISCHARGE PRESSURE	
Insufficient coolant gas charge	① Find and repair leak ② Recharge
Mechanical problems in the compressor	Replace compressor
3-HIGH SUCTION PRESSURE	
Excessive thermal load	Check system sizing, possible inflation or insulation problems
Irregular expansion valve operation	Check expansion valve operation
Mechanical problems in compressor	Replace compressor
4.LOW SUCTION PRESSURE	
Insufficient coolant gas charge	① Find and repair leak ② Recharge
Filter partially clogged(looks frosted)	Replace filter
Irregular expansion valve operation	Check expansion valve operation
Air present in water circuit	Bleed air from hydraulic system
Insufficient water flow rate	Check water pump operation
5- COMPRESSOR WILL NOT START	
Alarm in microprocessor board	Identify alarm and correct condition
No power, switch off	Switch on
Thermal-protection cut-out tripped due to overload	① Reset switch ② Check unit at start-up
No refrigeration request from user with correct operation setting	Check wait for refrigeration request
Operation setting too high	Check and correct setting if necessary
Defective contactor	Replace contactor
Electrical fault in compressor motor	Check for short circuit
6-COMPRESSOR BUZZING SOUND	
Incorrect power supply voltage	Check power supply, identify cause
Compressor contactor malfunction	Replace contactor
Mechanical problems in compressor	Replace compressor
7-COMPRESSOR INTERMITTENT OPERATION	
Low pressure switch malfunction	Check pressure switch settings and operation
Insufficient coolant gas charge	① Find and repair leak ② Recharge
Refrigerant line filter clogged(looks frosted)	Replace filter
Irregular expansion valve operation	Check expansion valve operation
8-COMPRESSOR STOPS	
High pressure switch malfunction	Check pressure switch operation and setting
Insufficient cooling air at air side heat exchanger	① Check for adequate service spaces or obstruction in the coils ② Check correct fan operation
Ambient temperature too high	Check operation limits
Excessive coolant gas charge	Discharge excess
9-COMPRESSOR NOISY OPERATION-VIBRATIONS	
Compressor is pumping liquid, excessive increase of coolant gas fluid in crankcase	① Check expansion valve operation ② Check overheating ③ Correct overheating, replace expansion valve if necessary
Mechanical problems in compressor	Replace compressor
Unit operating at extreme conditions of use	Check operation limits
10-COMPRESSOR CONTINUOUS OPERATION	
Excessive thermal load	Check system sizing, possible infiltration or insulation problems
Operation setting too low for cooling cycle (or too high for heating cycle)	Check setting and correct if necessary
Insufficient coolant gas charge	① Check for and repair leaks ② Recharge
Refrigerant line filter clogged(looks frosted)	Replace filter
Control board malfunction	Replace board
Irregular expansion valve operation	Check expansion valve operation
Compressor contactor malfunction	Replace contactor
Poor fined coil ventilation	① Check for adequate service spaces or fined coil obstructions ③ Check fan operation
11-FAN WILL NOT START; STARTS AND STOPS	
Contactors burnt out	Replace contactor
Thermal protection tripped	① Check for short circuit ② Replace motor
12-WATER PUMP WILL NOT START	
No power to pumping unit	Check electrical connections
No signal from control board	Check control board
Pump jammed	Repair pump
Pump motor malfunction	Replace pump

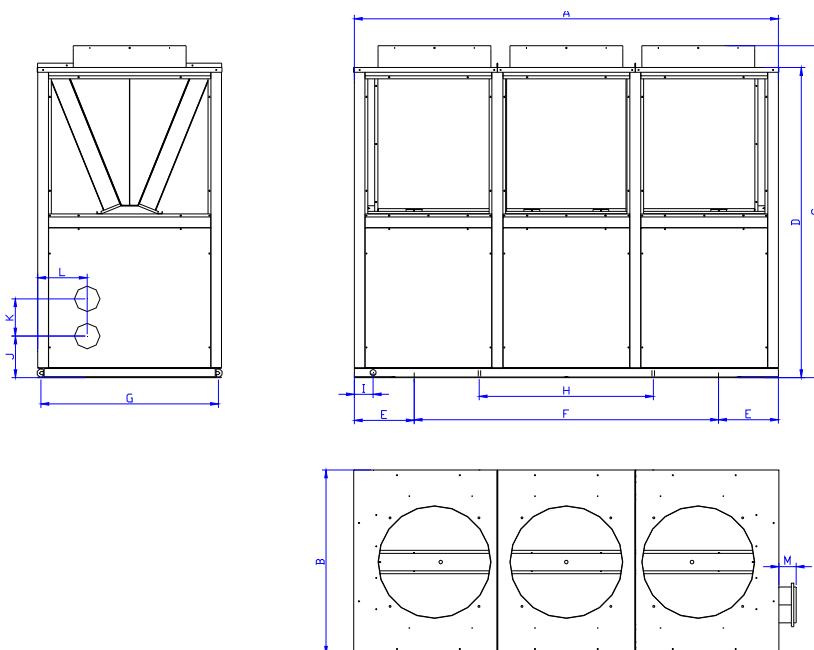
OVERALL DIMENSION

Two systems 60kW with tube in tube heat exchanger



A	2090
B	1200
C	1900
D	1060
E	245
F	1600
G	1020
H	70
I	205
J	240
K	260
L	1300
(1)	Power supply cable inlet $\varnothing 40$
(2)	Mounting hole $\varnothing 18$
(3)	Water outlet DN125
(4)	Water inlet DN125
(5)	Lift handler hole $\varnothing 18$

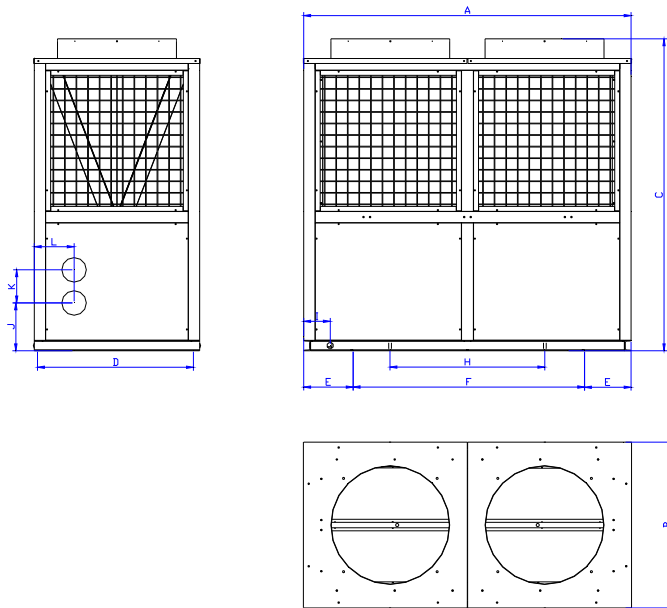
Two systems 80 100kW with tube in tube heat exchanger



	80kW	100kW
A	2400	2700
B	1170	1170
C	2000	2000
D	1860	1860
E	400	500
F	1600	1700
G	1130	1130
H	1120	1120
I	120	120
J	248	248
K	250	250
L	360	360
M	100	100
(1)	Mounting hole $\varnothing 18$	
(2)	Lift handler hole $\varnothing 18$	
(3)	Water outlet DN65/80	
(4)	Water inlet DN65/80	

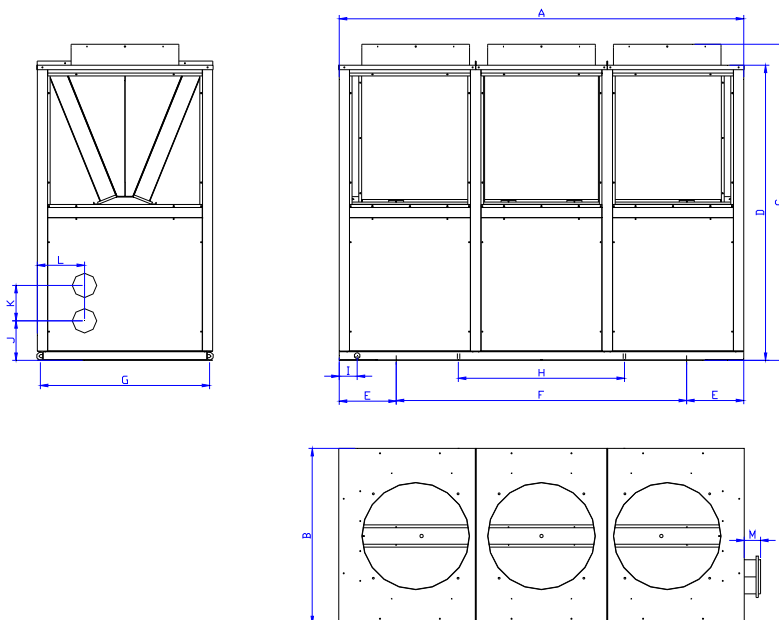
OVERALL DIMENSION

Four systems 60kW with tube in tube heat exchanger



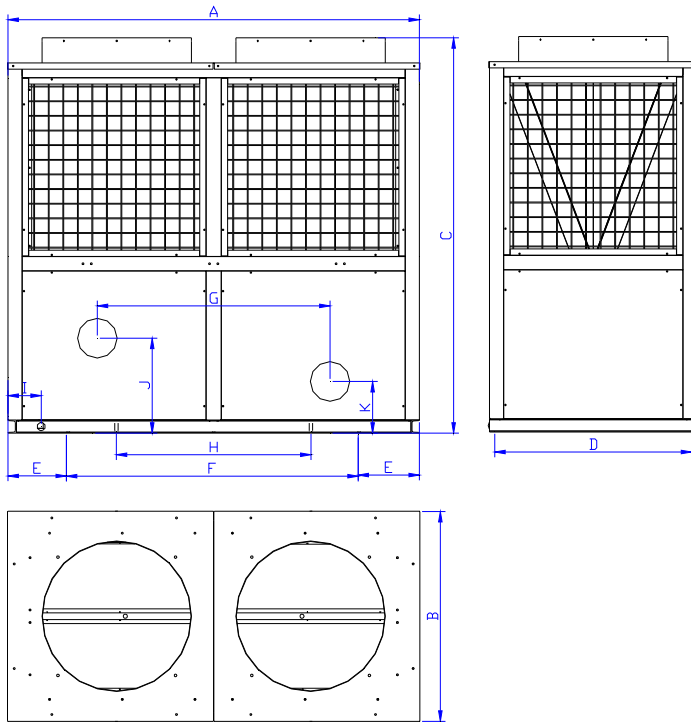
A	1980
B	1000
C	1900
D	960
E	290
F	1400
G	1120
H	940
I	120
J	243
K	210
L	364
(1)	Power supply cable inlet $\varnothing 40$
(2)	Mounting hole $\varnothing 18$
(3)	Water outlet DN65
(4)	Water inlet DN65
(5)	Lift handler hole $\varnothing 18$

Four systems 80kW 100kW with tube in tube heat exchanger



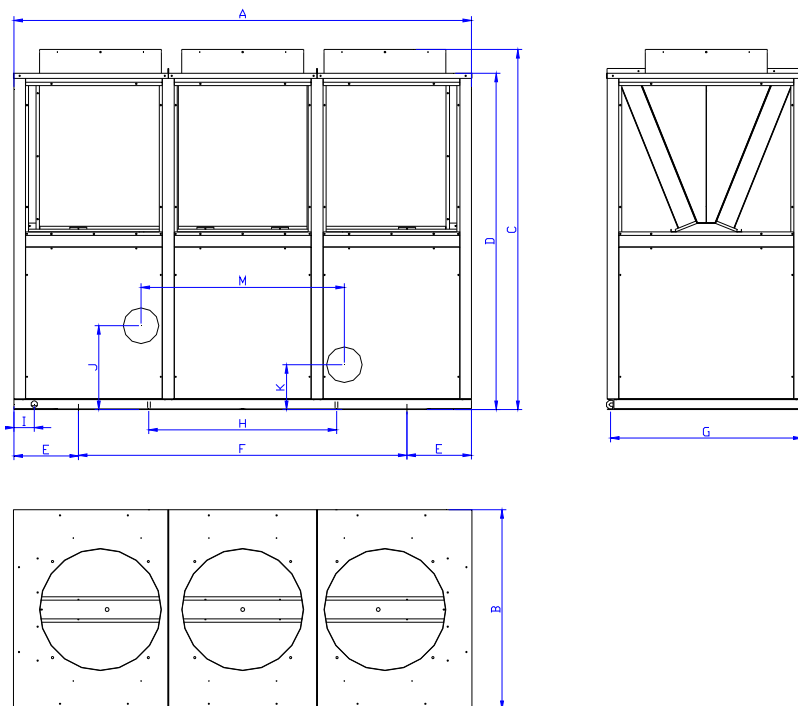
	80kW	100kW
A	2400	2700
B	1170	1170
C	2000	2000
D	1860	1860
E	400	500
F	1600	1700
G	1130	1130
H	1120	1120
I	120	120
J	248	248
K	250	250
L	360	360
M	100	100
(1)	Mounting hole $\varnothing 18$	
(2)	Lift handler hole $\varnothing 18$	
(3)	Water outlet DN65/80	
(4)	Water inlet DN65/80	

60kW Shell and tube is optional

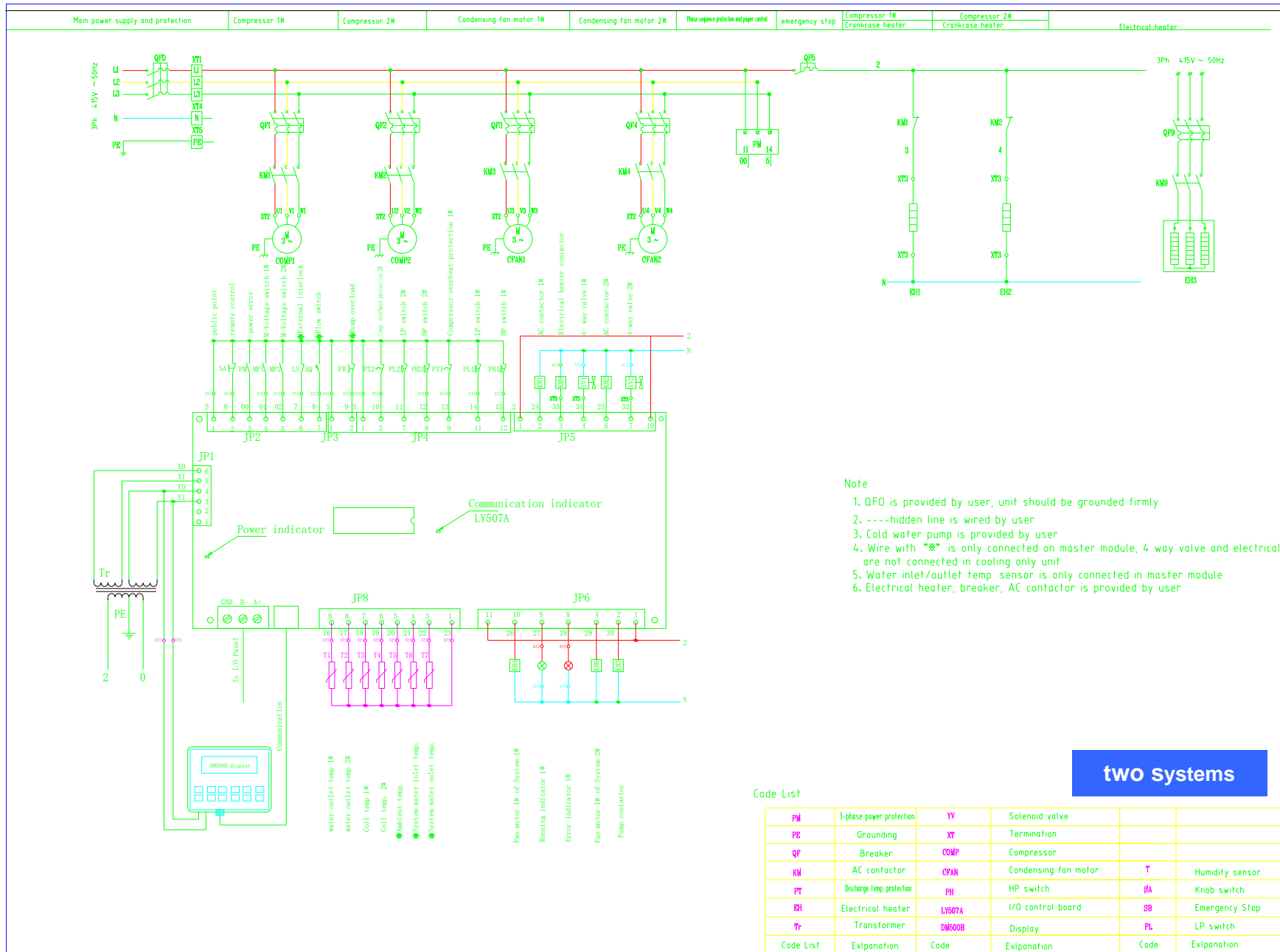


	Two systems	Four systems
A	1980	1980
B	1000	1000
C	1900	1900
D	960	960
E	290	290
F	1400	1400
G	1120	1120
H	940	940
I	120	120
J	454	454
K	247	247
(1)	Power supply cable inlet Ø40	
(2)	Mounting hole Ø18	
(3)	Water outlet DN65	
(4)	Water inlet DN65	
(5)	Lift handler hole Ø18	

80kW 100kW Shell and tube is optional



systems	80kW		100kW	
	2	4	2	4
A	2400	2400	2700	2700
B	1170	1170	1170	1170
C	2000	2000	2000	2000
D	1860	1860	1860	1860
E	400	400	500	500
F	1600	1600	1700	1700
G	1130	1130	1130	1130
H	1120	1120	1120	1120
I	120	120	120	120
J	494	494	494	494
K	264	264	264	264
M	1200	1200	1200	1200
(1)	Power supply cable inlet			
(2)	Mounting hole Ø18			
(3)	Water outlet DN65/80			
(4)	Water inlet DN65/80			
(5)	Lift handler hole Ø18			

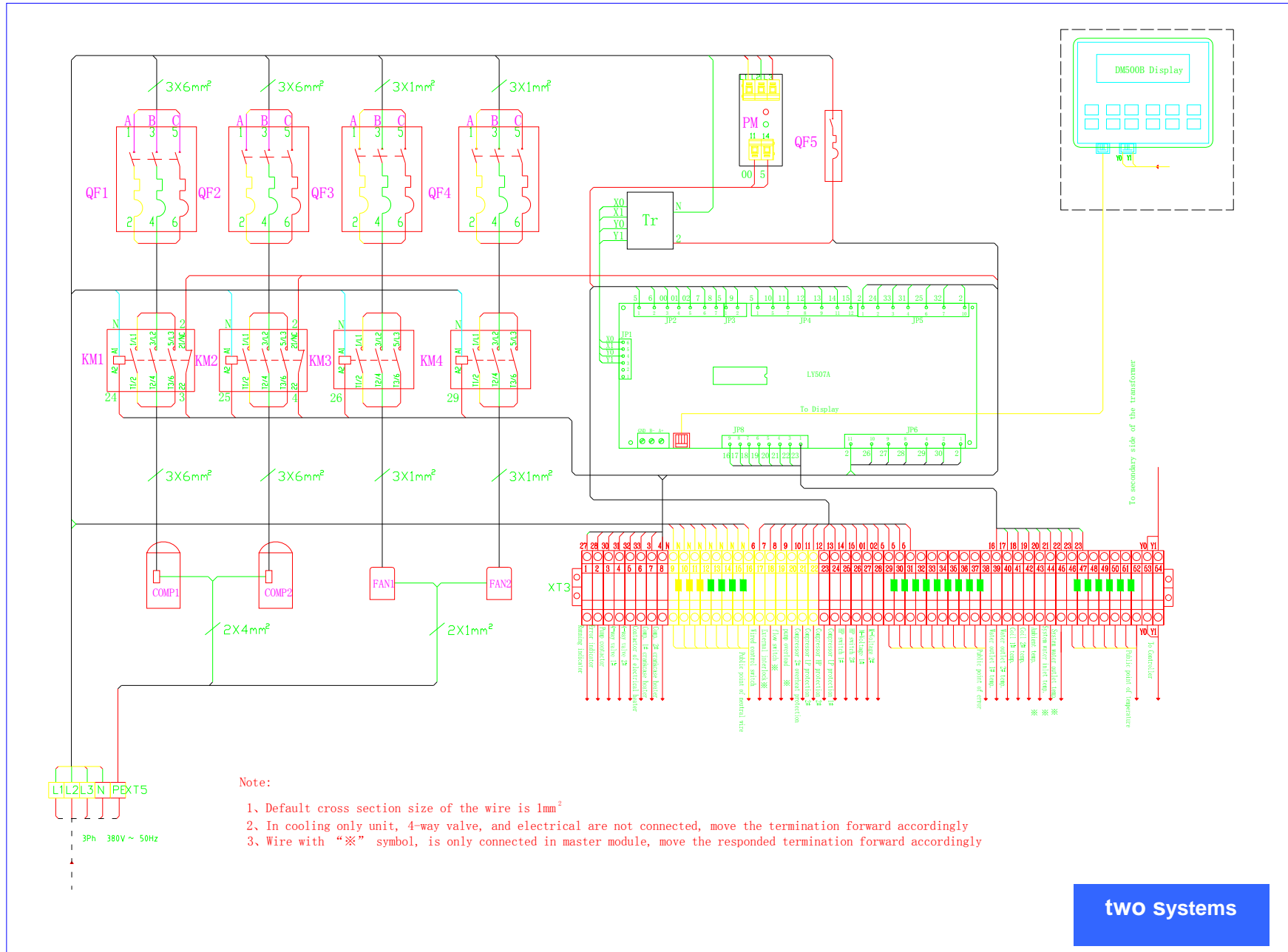


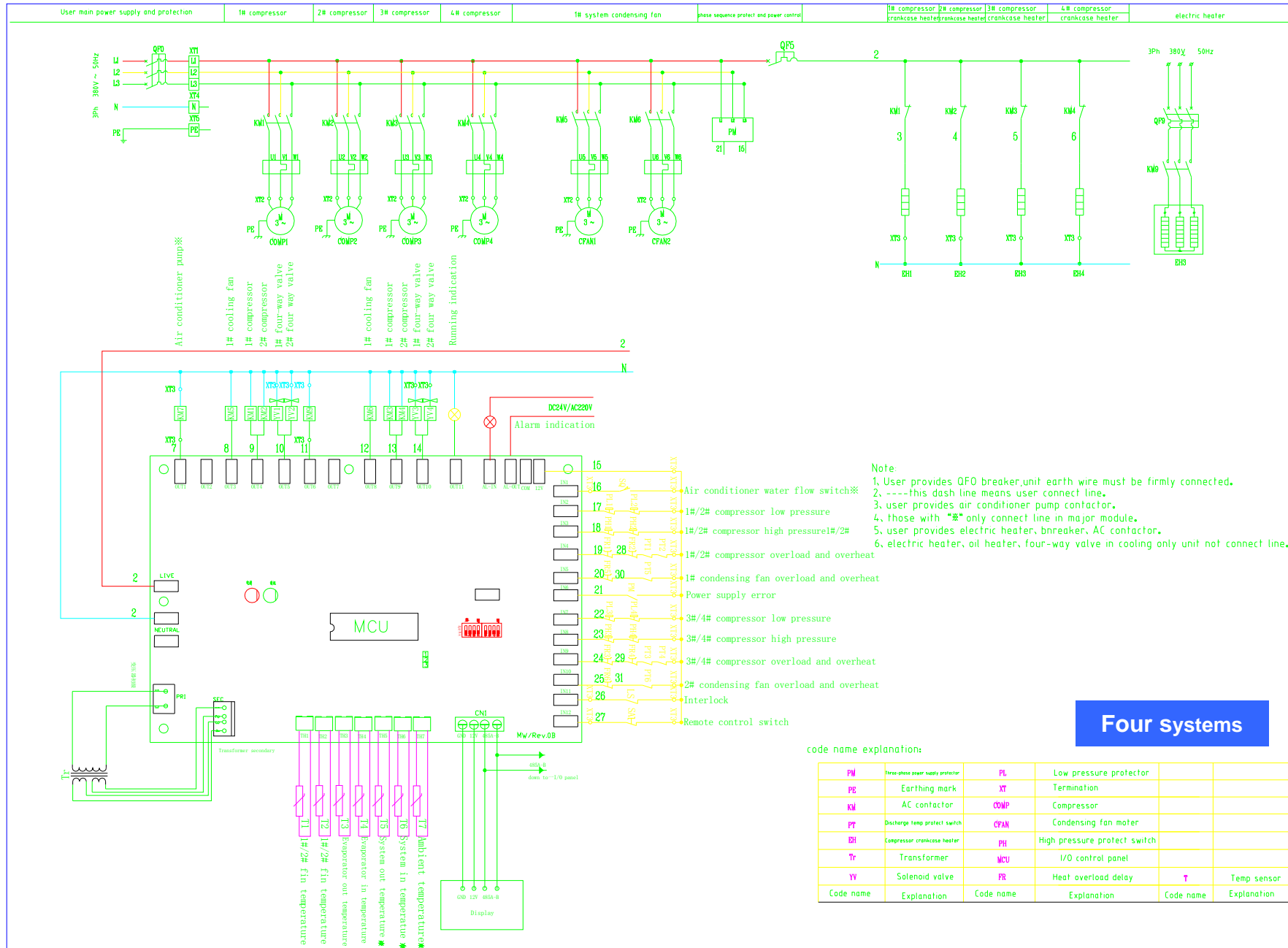
- Note:
1. QF0 is provided by user, unit should be grounded firmly
 2. ---hidden line is wired by user
 3. Cold water pump is provided by user
 4. Wire with "*" is only connected on master module, 4 way valve and electrical are not connected in cooling only unit
 5. Water inlet/outlet temp sensor is only connected in master module
 6. Electrical heater, breaker, AC contactor is provided by user

two systems

Code List

PM	3-phase power protection	YV	Solenoid valve		
PE	Grounding	XT	Termination		
QF	Breaker	COMP	Compressor		
KM	AC contactor	CFAN	Condensing fan motor	T	Humidity sensor
PT	Discharge temp protection	PH	HP switch	SA	Knob switch
EH	Electrical heater	LY507A	I/O control board	SB	Emergency Stop
Tr	Transformer	DM600B	Display	PL	LP switch
Code List	Explanation	Code	Explanation	Code	Explanation





- Note:
1. User provides QF0 breaker, unit earth wire must be firmly connected.
 2. ---this dash line means user connect line.
 3. user provides air conditioner pump contactor.
 4. those with "*" only connect line in major module.
 5. user provides electric heater, breaker, AC contactor.
 6. electric heater, oil heater, four-way valve in cooling only unit not connect line.

