



# Modular Air-cooled Scroll Chiller



Unit Control

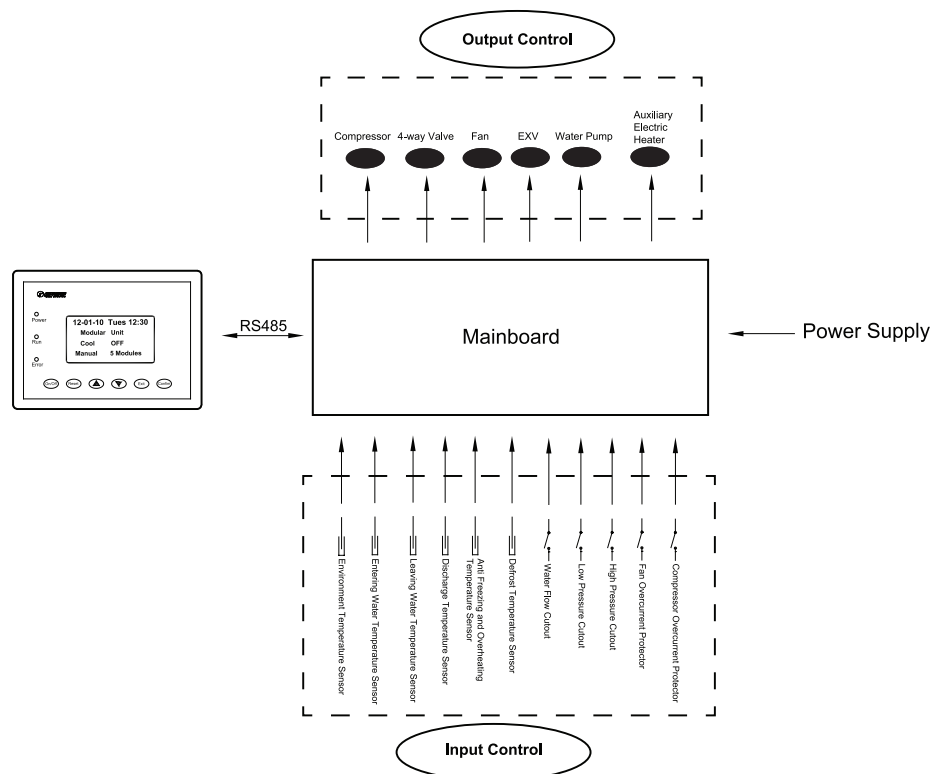
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# 1. General Control Logic

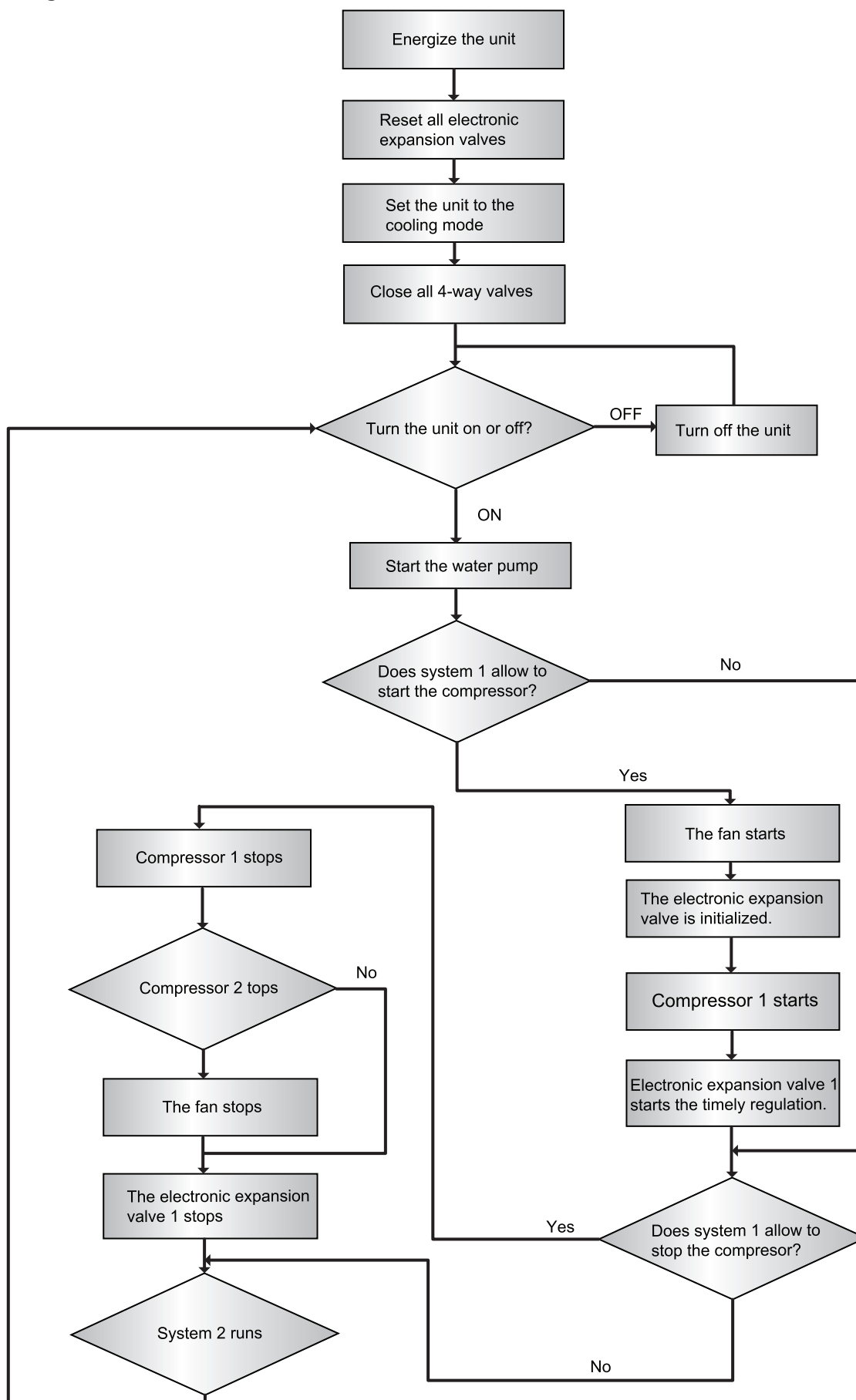
## 1.1 Schematic Diagram



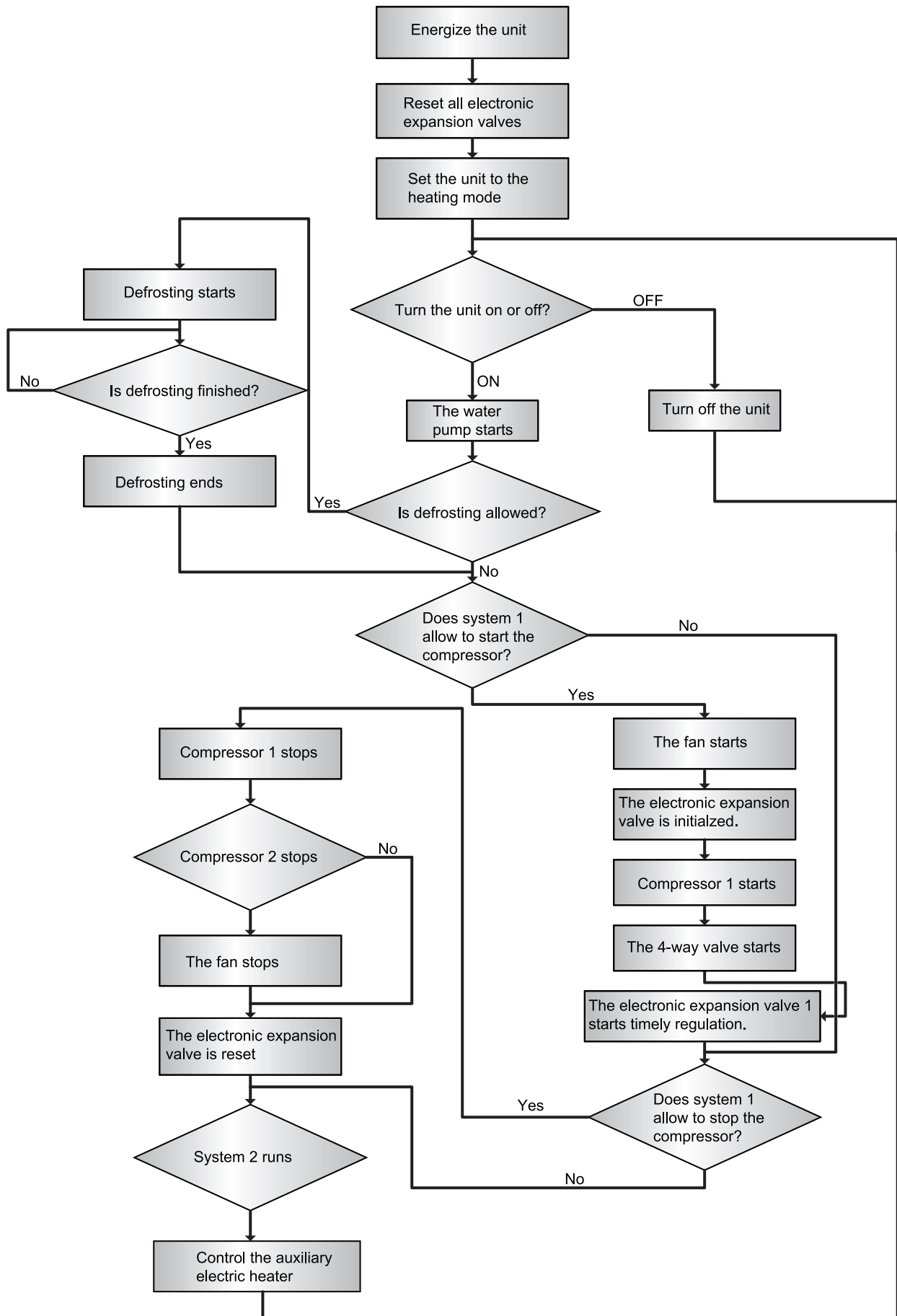
- (1). Water Flow Cutout: it is used to judge the water flow rate: when the flow rate is too low, it will trip off, and the control board will send this signal to the display and the water pump. Then, the display will tell there is an error, the water pump will stop and the unit will stop or will not start.
- (2). High/Low Pressure Cutout: it is used to judge the system pressure: when the system pressure is too high/low, it will trip off, and the control board will send this signal to the display. Then, the display will tell there is an error and the unit will stop or will not start.
- (3). Compressor Overcurrent Cutout: it is used to judge the running ampere of the compressor: when the current is too large, it will trip off and the control board will send this signal to the display. Then, the display will tell there is an error and the unit will stop or will not start.
- (4). Fan Overcurrent Cutout: it is used to judge the running ampere of the fan: when the current is too large, it will trip off and the control board will send this signal to the display. Then, the display will tell there is an error and the unit will stop or will not start.
- (5). Environment Temperature Sensor: it is used to detect the temperature of the environment where the unit is which will determine if to start or stop the fan and determine the steps of the electrostatic expansion valve when initializing. When this sensor fails, the control board will detect and send this signal to the display. Then, the display will tell there is an error and the unit will stop or will not start.
- (6). Discharge Temperature Sensor: it is used to detect the discharge temperature. When the sensed temperature is too high or this sensor fails, the control board will detect and send this signal to the display. Then, the display will tell there is an error and the unit will stop or will not start.
- (7). Entering Water Temperature Sensor: it is used to detect the temperature of the entering water which will determine if to start or stop the compressor and the auxiliary electric heater. When this sensor fails, all compressors of the unit will stop.
- (8). Defrosting Temperature Sensor: it is used to detect the temperature of the fins of the evaporator which will determine if to start defrosting. When this sensor fails, the corresponding compressor will stop.
- (9). Anti-freezing Temperature Sensor: it is used to detect the water temperature. When it fails, compressors of the unit will stop and 30 seconds later the fan also will stop.
- (10). Leaving Water Temperature Sensor: it is used to detect the leaving water temperature. When this sensor fails, compressors of the unit will stop and 30 seconds later the fan also will stop.

## 1.2 Operation Flowchart

### 1.2.1 Cooling



### 1.2.2 Heating



## 2. Control Logic

### 2.1 Cooling Control

#### 2.1.1 Control to the Compressor

(1). "First On, First Off"

"First On, First Off"/"First Off, First On" control indicates the numbered compressor which is started/stopped firstly will then be stopped/started firstly.

(2). Temperature Drop/Rise Rate Control

The water temperature range control assisted by the temperature drop/rise rate control is capable of precisely adapting the load change of the terminal units and avoiding remarkable water temperature fluctuation.

#### 2.1.2 Freeze Protection

For each single module, when the anti-freezing temperature or the leaving water temperature is lower than the limit value, freeze protection will work and this module stops; when the anti-freezing temperature and the leaving water temperature go higher than the normal value, freeze protection will quit; when the anti-freezing temperature and the leaving water temperature are between the limit value and the normal value, the module is protected again freeze.

#### 2.1.3 Shutdown

Shutdown manually or timely: in this case, the compressor and the auxiliary electric heater stop firstly, then the electronic expansion valve initializes, and then the 4-way valve is de-energized, and lastly the water pump stops.

Shutdown when reaching the set point: in this case, the compressor stops firstly, and then the fan stops and the electronic expansion valve initializes. However, the 4-way valve keeps its state unchanged and the water pump keeps running.

Shutdown due to errors: in this case, the compressor stops firstly, and then the fan stops (except that the fan is malfunctioning), and the electronic expansion valve initializes. However, the 4-way valve keeps its state unchanged and the water pump keeps running.

### 2.2 Heating Control

#### 2.2.1 Control on the Compressor

It is the same as that in selection 2.1.1.

#### 2.2.2 Over-temperature Protection

For each single module, when the over-temperature is higher than the limit value, over-temperature protection will work; when the over-temperature goes lower than the normal value, over-temperature protection will quit; when the over-temperature is between the limit value and the normal value, the module is still protected again over-temperature.

#### 2.2.3 Control on the Auxiliary Electric Heater

When the auxiliary electric heater is enabled through the wired controller, it will work in accordance with the change of the entering water temperature.

When the flow switch and the entering water temperature sensors work normally, any other error can be ignored.

When the auxiliary electric heater is disabled through the wired controller, the auxiliary electric heater will stop working.

When all entering water temperature sensors malfunction, the auxiliary electric heater will stop working.

When any flow switch malfunctions, the auxiliary electric heater will stop working.

When the unit is under over-temperature protection but the auxiliary electric heater is not allowed to stop, the auxiliary electric heater will keep working until the entering water temperature reaches the set point.

#### 2.2.4 Shutdown

Shutdown manually or timely: in this case, the compressor and the auxiliary electric heater stop firstly, then the electronic expansion valve initializes, and then the 4-way valve is de-energized, and lastly the water pump stops.

Shutdown when reaching the set point: in this case, the compressor stops firstly, and then the fan stops and the electronic expansion valve initializes. However, the 4-way valve keeps its state unchanged and the water pump keeps running.

Shutdown due to errors: in this case, the compressor stops firstly, and then the fan stops (except that the fan is malfunctioning), and the electronic expansion valve initializes. However, the 4-way valve keeps its state unchanged and the water pump keeps running.

## 2.3 Freeze Protection

Under the OFF state at any mode (except the manual defrosting mode), when the freeze protection is activated through the wired controller, the unit will be protected again freeze. Free protection is factory defaulted to be ON.

When the module is in the freeze protection, its compressor will work as per the on/off setting and also the principle of "Six-minute On, Three-minute Off".

## 2.4 Control to the Compressor

All compressors run as per the principle of "First On, First Off" and "First Off, First On". See section 2.1 and section 2.2.

## 2.5 Control to the Fan

The fan starts earlier than the compressor upon startup, and stops later than the compressor upon shutdown. During defrosting, the fan and the 4-way valve stops. After defrosting they start again.

## 2.6 Control the 4-way Valve

The 4-way valve is stopped at the cooling mode. At the heating mode, it will start after the compressor runs. During defrosting it stops and then starts again after defrosting. It will stop later than the compressor upon shutdown.

## 2.7 Control to the Water Pump

When any module is required to run (incl. manual startup, timely startup, startup again freeze), water pumps of all module starts. Then, when one module reaches the set point and is shut down, water pumps of all modules keep running; when one module is shut down manually or timely, its water pump keeps running and will stop only after all modules are shut down; when one module malfunctions and is shutdown, its water pump keeps running.

## 2.8 Control to the Electronic Expansion Valve

The electronic expansion valve initialize when the wired controller is emerged for the first time. After the compressor has been started, the electronic expansion valve starts to adjust its opening angle.

## 2.9 Protection

### 2.9.1 Recoverable Protection

#### ◆ Compressor 1/2 low pressure protection

When it is detected the low-pressure switch of compressor 1 (compressor 2) is opened compressor 1 (compressor 2) will be shut down immediately.

Meanwhile the indicating LED will light on and the error information will be displayed among the error log which must be manually cleared for normal operation of next time.

#### ◆ Compressor 1/2 high discharge protection

When it is detected in three consecutive seconds that the discharge temperature of compressor 1 (compressor 2) exceeds the set point, compressor 1 (compressor 2) will be shut down immediately but the fan will still run for some time.

Meanwhile the indicating LED will light on and the error information will be displayed among the error log which must be manually cleared for normal operation of next time.

### **2.9.2 Irrecoverable Protection**

#### ◆ Compressor 1/2 high pressure or over-current protection

When it is detected that the high pressure switch of compressor 1 (or compressor 2) is open, compressor 1 (or compressor 2) will be shut down but the fan will still last for some time.

Meanwhile the indicating LED will light on and the error information will be displayed among the error log which must be manually cleared for normal operation of next time.

#### ◆ Fan 1/2 over-current protection

When any fan is over-current, this module unit will be shut down automatically. Meanwhile, the error information will be displayed among the error log which must be manually cleared for normal operation of next time.

#### ◆ Flow switch protection

When a single module unit detect that the flow switch is closed (under normal condition, it keeps open), it will be shut down automatically.

When all modules are shut down because of flow switch protection, the water pump will stop.

#### ◆ Communication protection

When a single module unit fails to receive any signal from the wired controller, it will be shut down automatically and then the water pump will stop.

#### ◆ Phase loss/reversal protection

When phase loss/reversal occurs, the power supply to the main board will be cut off.



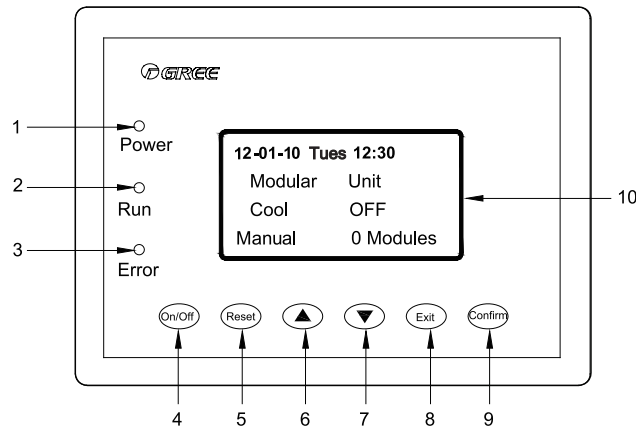
### 3. Controller

#### 3.1 Control Panel

This control panel, especially designed for D series modular air-cooled chillers, is capable of controlling and displaying each running parameter of the chiller and being integrated into the remote monitoring system.

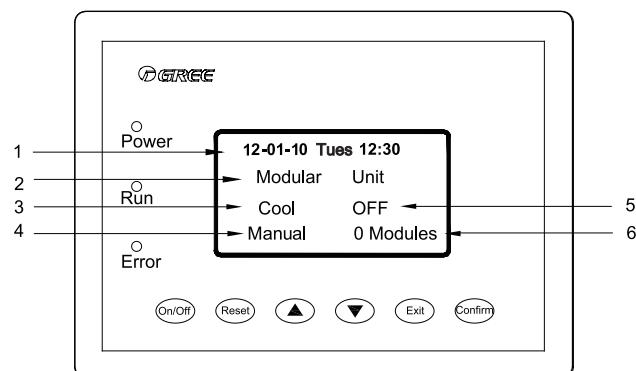
##### 3.1.1 Press Buttons and Icons on the Homepage

###### (1). Press Buttons



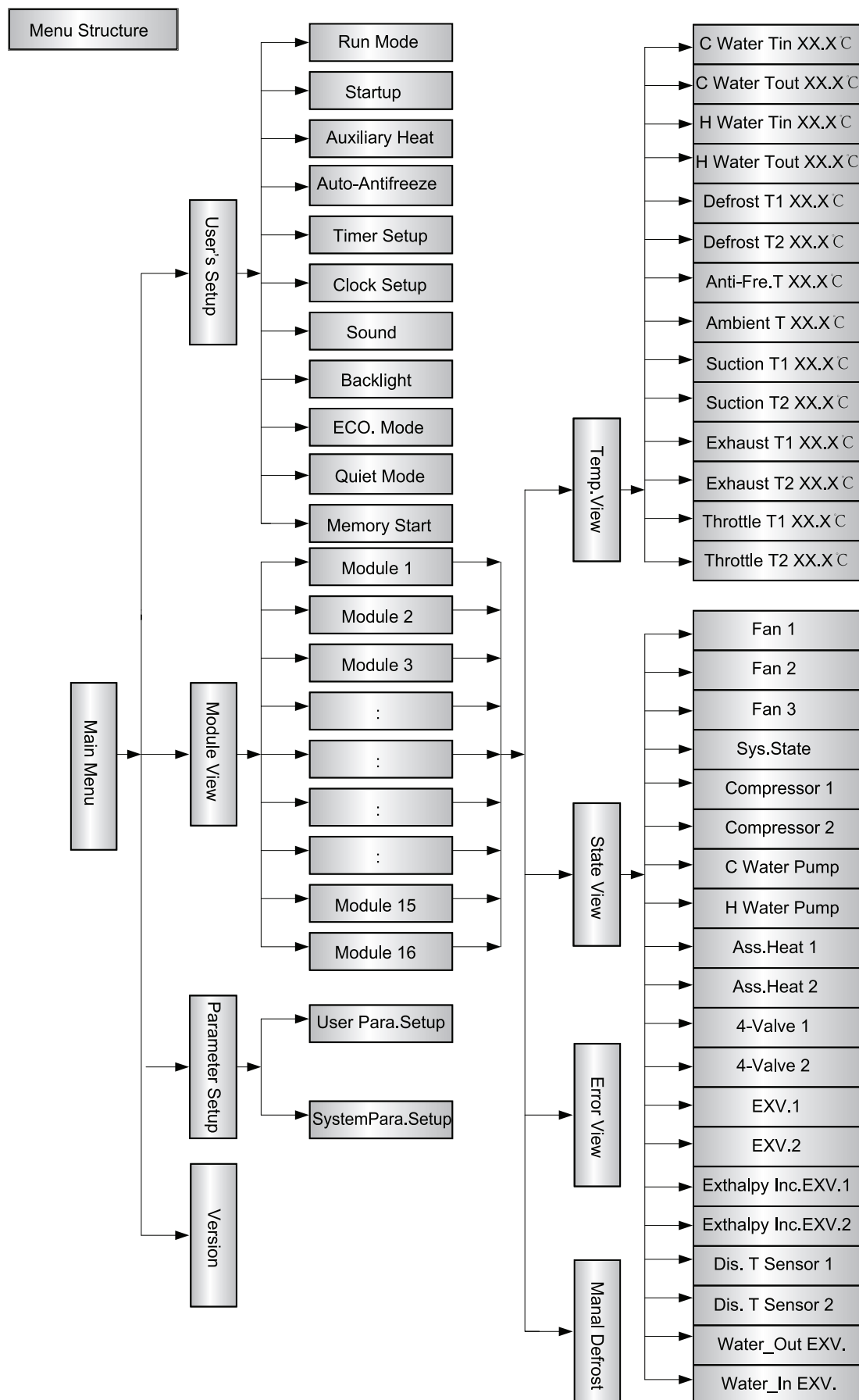
NO.	Name	Function description
1	Power indicator(red)	the indicator is on when the Wired Controller is powered on, or otherwise it is off.
2	Run indicator(green)	the indicator is on when the Wired Controller is started, or otherwise it is off.
3	Error indicator(red)	The indicator is on when the unit is at fault, or otherwise it is off.
4	On/Off button	For controlling unit conversion between start and stop, press the button (for 3 seconds) in stop state to start the unit and press the button (for 3 seconds) in operation state to stop the unit.
5	Reset button	Press the button to clear fault and relieve the air discharge temperature sensor locking.
6	Up selection button	in menu selection, press the button to move the cursor upward or leftward; and in data modification mode, press the button to increase the value.
7	Down selection button	In menu selection, press the button to move the cursor downward or rightward; and in data modification mode, press the button to decrease the value.
8	Exit button	Press the button to go back to the previous menu.
9	Confirm button	In menu selection, press the button to confirm the selected item; and in data modification mode, press the button to confirm the parameter and move the cursor.
10	LCD	Information display zone.

###### (2). Display Icons on the Homepage



No.	Icon	Description
1	Time	It indicates the current time.
2	Unit name	It indicates the unit name.
3	Running mode	It indicates the running mode (cooling, heating or manual defrosting)
4	On/Off mode	It indicate the on/off mode, manual or timing)
5	Running status	It indicates the running status, on or off.
6	Module quantity	It indicates how many modules this system is consisted of. ( max. 16)

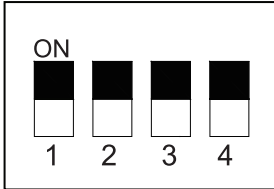
## 3.1.2 Menu Structure of Controller



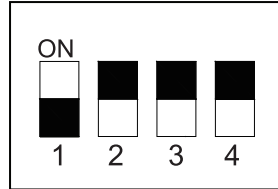
### 3.2 Setup of DIP Switches on the Mainboard

Four-bit DIP switches are used for indicating hardware address (1 ~ 16) of modules, with module No. displayed alternately on the panel as Module 1, Module 2, ....., Module 16. DIP switches 1, 2, 3 and 4 are binary code, with 1 for the lowest bit and 4 for the highest bit. See the figures below for more details. (Caution: DIP switches can be set only when the power supply is cut off):

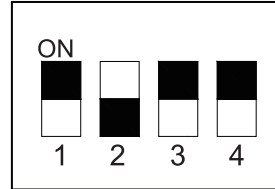
Module1



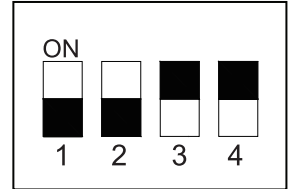
Module2



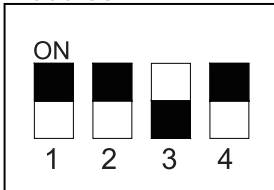
Module3



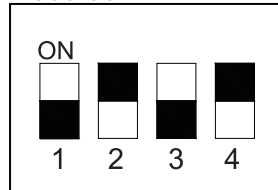
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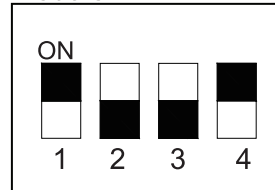
Module5



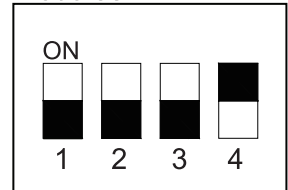
Module6



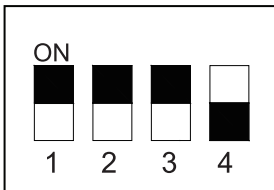
Module7



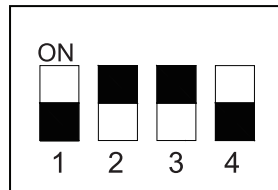
Module8



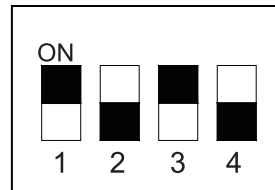
Module9



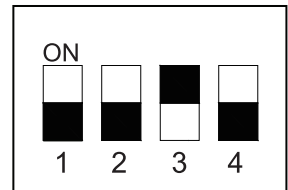
Module10



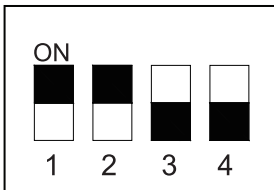
Module11



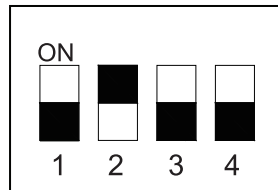
Module12



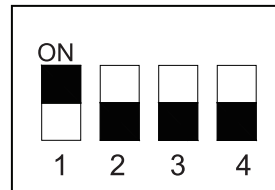
Module13



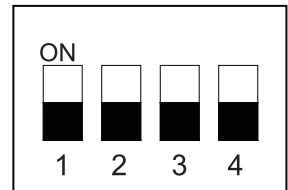
Module14



Module15



Module16



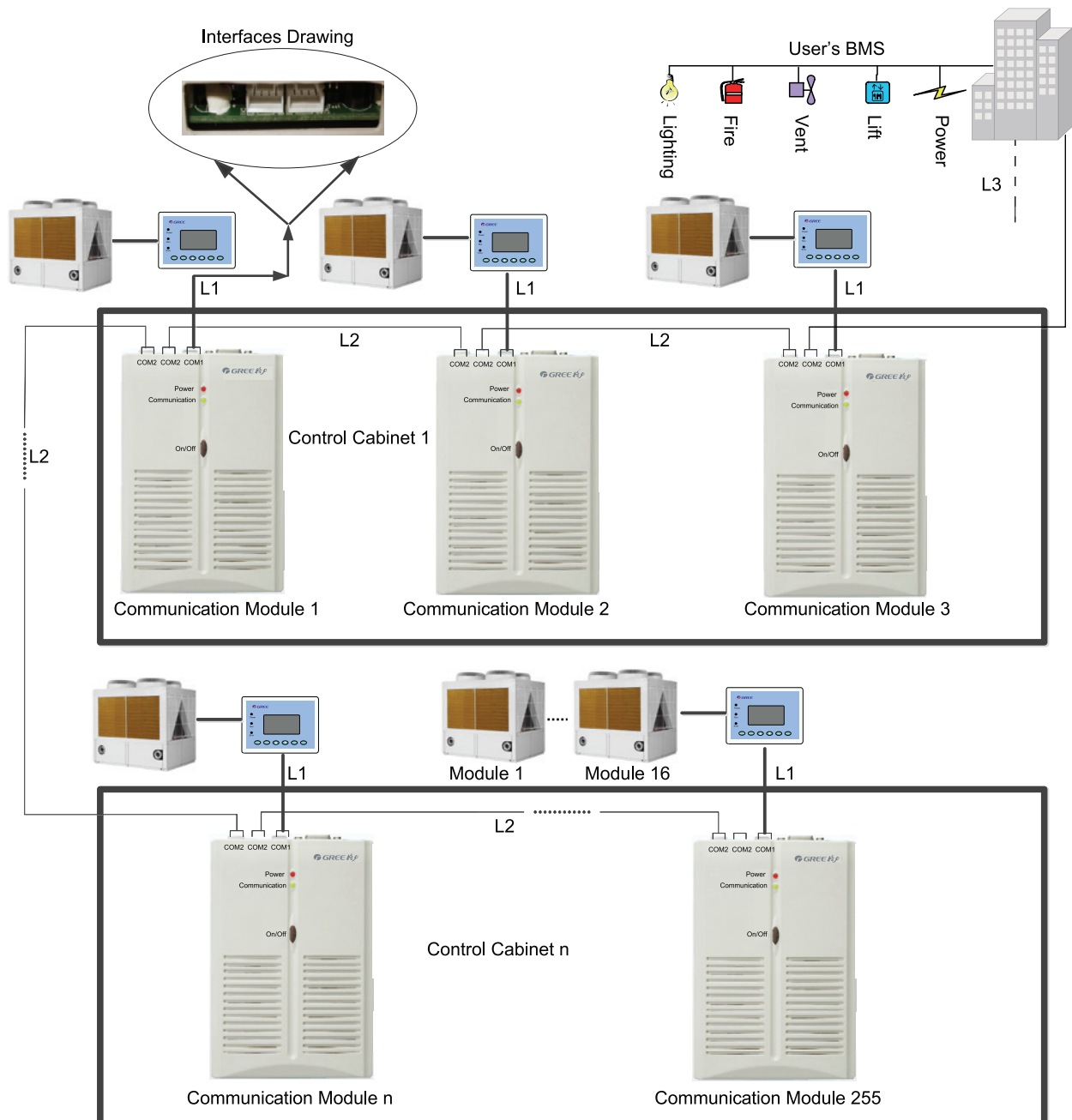
## 4. Long-distance Monitoring/BMS Interface

### 4.1 Brief Introduction

#### 4.1.1 General

This long-distance monitoring system allows users through a computer to remotely monitor up to 255 D series modular (heat pump) chillers, including turning on/off the units, setting parameters, giving alarms for malfunctions, which is an efficient tool for management of intelligent air conditioning systems for modern buildings.

#### 4.1.2 Net Topological Diagram



Note: the air conditioning system as shown in the figure above consists of up to 16 single units depending on the actual demand of the project.

### 4.1.3 Communication Lines

S=Standard, O=Field Supplied, P=Optional

Line Code	Description	Class
L1	A pair of category-5 twisted pairs, one RJ-11 connectors for the communication module, another connector for the communication port on the display board.	s
L2	A pair of category-5 twisted pairs, two RJ-11 connectors	s
L3	A pair of category-5 twisted pairs, one RJ-11 connectors, another connector for BMS port.	o

### 4.1.4 Description to the Topological Diagram

From the topological diagram above, the long-distance monitoring system consists of 3 parts:

The first part is the BMS and the converter used to convert RS232 signals from the BMS into RS485 signals of the long-distance monitoring network.

The second part refers to the communication network, that is, the communication lines and the connected hardware.

The third part is the communication module responsible for the data exchange between the air conditioning system and the monitoring PC, which is an important link for the whole network. Each communication module has an address set through an 8-position DIP switch. This same address is not allowed to be repeated in a system. For the sake of easy installation and future service, all communication modules are installed together in the central control cabinet.

## 4.2 Hardware Introduction

### 4.2.1 Parts List

S=Standard, O=Field Supplied, P=Optional

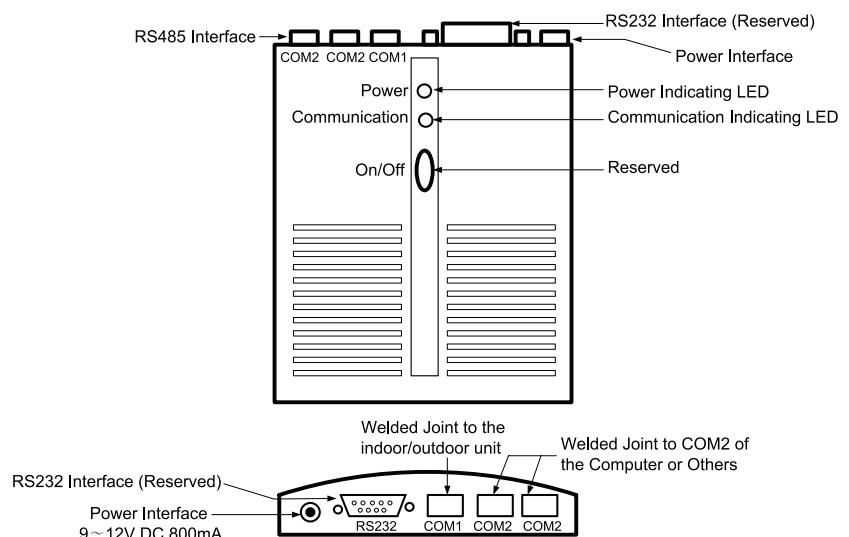
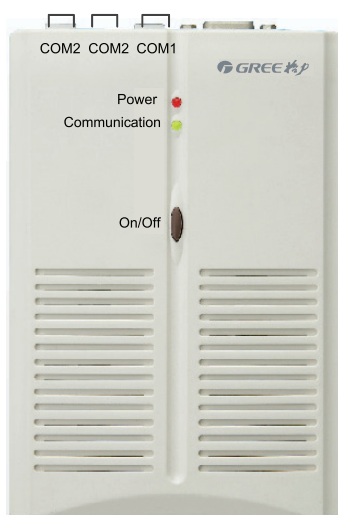
Name	Model	Material Code	Class	Remarks
Communication Module	ME30-28/E(M)	MC200022	S	It can be integrated into the BMS system with RS485 interface which supports Modbus RTU. Main parts: communication module, transformer, connection line, User's Manual.
Optoelectronic Isolated Repeater	RS485-W	EN02200010	P	A repeater is required every 800m communication distance or every 30 communication modules.
Optoelectronic Isolated Converter	GD02	EN02200020	P	It is required for RS232
Central Control Cabinet	\	\	O	

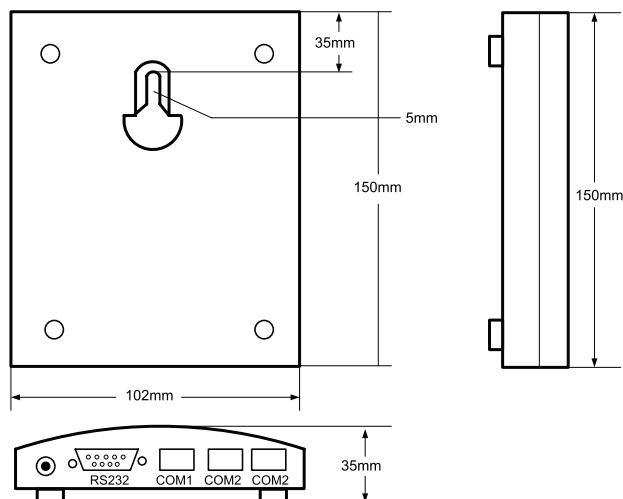
### 4.2.2 Communication Module ME30-28/E(M)

#### 4.2.2.1 Functional Introduction

The communication module is intended to bridge the computer and the air conditioning system for data conversion and transmission.

#### 4.2.2.2 Appearance





#### 4.2.2.3 Precaution for Installation

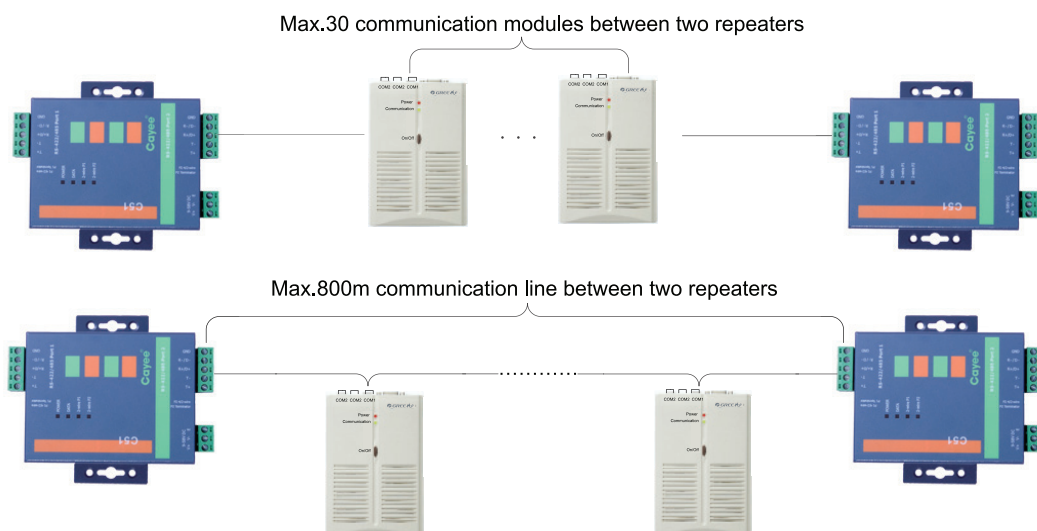
- ◆ Be sure the correct adapter is used, otherwise the communication module would fail or even be damaged.
- ◆ Be sure each communication module has a unique address, otherwise communication would fail.
- ◆ Be sure the communication line is plugged into the correct port, otherwise communication would fail.
- ◆ Do not place the communication module where there is direct sunlight or it is high-temperature and damp, but instead put all of them in the central control cabinet.

#### 4.2.3 Optoelectronic Isolated Repeaters

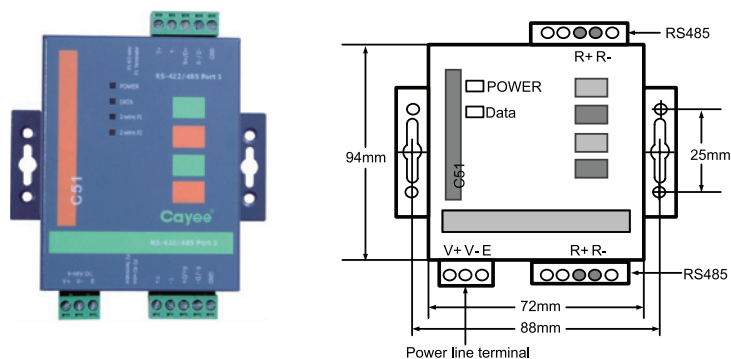
##### 4.2.3.1 Functional Introduction

The repeater is applied to keep signals integrated and from attenuation when the distance between two nodes in the communication network is beyond 800m.

The repeater is applied to keep signal integrated and transmitted normally when more than 30 nodes exist in the communication network. Generally, a converter supports up to 32 nodes.



##### 4.2.3.2 Appearance



#### 4.2.3.3 Precautions for Installation

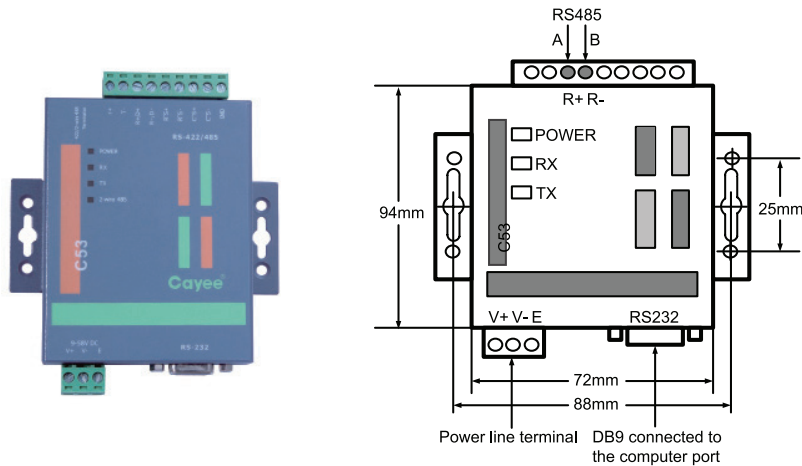
- ◆ It shall be installed inside the door and not subject to collision, direct sunlight and rain water. Installation inside the monitor room is preferred.
- ◆ The OEM device shall be used and the use of the substitute from other manufacturer or of other model is prohibited.
- ◆ The separate power supply is required as well as enough 220V sockets.

#### 4.2.4 Optoelectronic Isolated Converter

##### 4.2.4.1 Functional Introduction

It is intended to convert the RS232 signals from the computer serial ports to RS485 signals from the bus and vice versa.

##### 4.2.4.2 Appearance



#### 4.2.4.3 Precautions for Installation

- ◆ It shall be installed inside the door and not subject to collision, direct sunlight and rain water. Installation inside the monitor room is preferred.
- ◆ The OEM device shall be used and the use of the substitute from other manufacturer or of other model is prohibited.
- ◆ The separate power supply is required as well as enough 220V sockets.

### 4.3 Model Selection Instructions

#### 4.3.1 Rules for Model Selection

##### 4.3.1.1 Supply Scope

S=Standard, O=Field Supplied, P=Optional

Supply Scope	Model	Class	Remarks
Communication Module Kit	ME30-28/E(M)	S	It can be integrated into the BMS system with RS485 interface which supports Modbus RTU. Main parts: communication module, transformer, connection line, User's Manual.
Optoelectronic Isolated Repeater	EN02200010	P	A repeater is required every 800m communication distance or every 30 communication modules.
category-5 twisted pairs	\	O	Its length depends on the actual demand.
Optoelectronic Isolated Converter	EN02200020	P	It is required only for the RS232 interface.

##### 4.3.1.2 Selection Solution

Model	Long-distance Monitoring Kit	Optoelectronic Isolated Repeaters
All D series modular (heat pumps) chillers	One monitoring kit is required for each unit.	A repeater is required every 800m communication distance or every 30 communication modules.

### 4.3.2 Examples of Model Selection

#### 4.3.2.1 Example 1

This project consists of one LSQWRF65M/D-M and one communication module. The communication distance between the monitoring computer and the unit is within 800m. The BMS interface is RS232 and one converter is required.

Name	Code	Quantity
The Unit LSQWRF65M/D-M	\	1
Communication Module ME30-28/E(M)	MC200022	1
Optoelectronic Isolated Converter	EN02200020	1

#### 4.3.2.2 Example 2

This project consists of three groups LSQWRF65M/D-M, two groups concluding 16 and the three concluding 3. One repeater is required for somewhere the communication distance is over 800m. The BMS interface is RS485.

Name	Code	Quantity
The Unit LSQWRF65M/D-M	\	16+16+3
Communication Module ME30-28/E(M)	MC200022	3
Optoelectronic Isolated Repeater	EN02200010	1

#### 4.3.2.3 Example 3

This project consists of 35 LSQWRF65M/D-M and two repeaters are required, one for somewhere the communication distance is beyond 800m, and the other for the quantity of chillers which is over 30.

Name	Code	Quantity
The Unit LSQWRF65M/D-M	\	35
Communication Module ME30-28/E(M)	MC200022	35
Optoelectronic Isolated Repeater	EN02200010	2



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