



ADVANCED COOLING TECHNOLOGIES

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ACT-VCC Cabinet Air Conditioners



User Manual for all models



Read this manual carefully before installation and use.

Summary

This manual describes the ACT-VCC Series Air Conditioners and includes the product description, working principles, wiring diagrams, operating instructions, routine maintenance, troubleshooting, and technical specifications of the models: **VCC-1000-DC** and **VCC-3000-DC** and **VCC-2000-AC** and **VCC-5000-AC**

Table of Contents


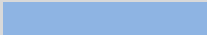
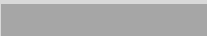

	Summary	2
1.	Instructions	3
2.	Product Overview	3
	Product Dimensions	4
	2.1 Application Notes	5
	2.2 Working Principles	6
	2.3 Product features	6
	Technical Specifications	7
	2.4 Air Circulation and Remote Mounting	8
	2.5 Operation of the Unit	9
	2.6 Condensate Handling	10
3.	Packaging and Shipping	10
4.	Unpacking and Acceptance	11
5.	Installation	11
	5.1 Physical Installation	11
	5.2 Electrical Connection	14
6.	Running and Testing	20
	6.1 Pre-operational checks	20
	6.2 Operating the Unit	20
	6.3 LED display manual	20
	6.4 LED Display Parameter setting guide:	21
7.	Maintenance and Warranty	22
	7.1 Product maintenance	22
	7.2 Service and Repair	25
8.	AC cabinet air conditioner communication protocol	27
8.	DC cabinet air conditioner communication protocol	32

1. Instructions

This manual is written for: **ACT-VCC-1000-DC**, **ACT-VCC-3000-DC**, **ACT-VCC-2000-AC**, and **ACT-VCC-5000-AC**

- Be sure to read this manual carefully before installing or operating the unit.
- To be covered by ACT's warranty and access normal warranty service, the user(s) must comply with all local and industry standards, as well as with the instructions in this User Manual.

ACT-VCC COLOR CODE KEY

ACT-VCC-1000-DC	
ACT-VCC-3000-DC	
ACT-VCC-2000-AC	
ACT-VCC-5000-AC	

2. Product Overview

The ACT-VCC Series Air Conditioners are enclosure cooling devices intended for applications where the internal air of a sealed electrical enclosure must be cooled or maintained at a particular temperature. This manual will provide an overview of the product including:

- Recommended uses
- Product nameplates
- Operating principles
- Product features
- Product composition
- Technical specifications
- Usage within a ducted design
- Control logic
- Communication protocols and user parameters
- Alarm options
- Troubleshooting

This product should be used strictly within accordance and with the relevant provisions of this manual.

Product Dimensions

Figure 2.1 Product dimensions for **ACT-VCC-1000-DC**

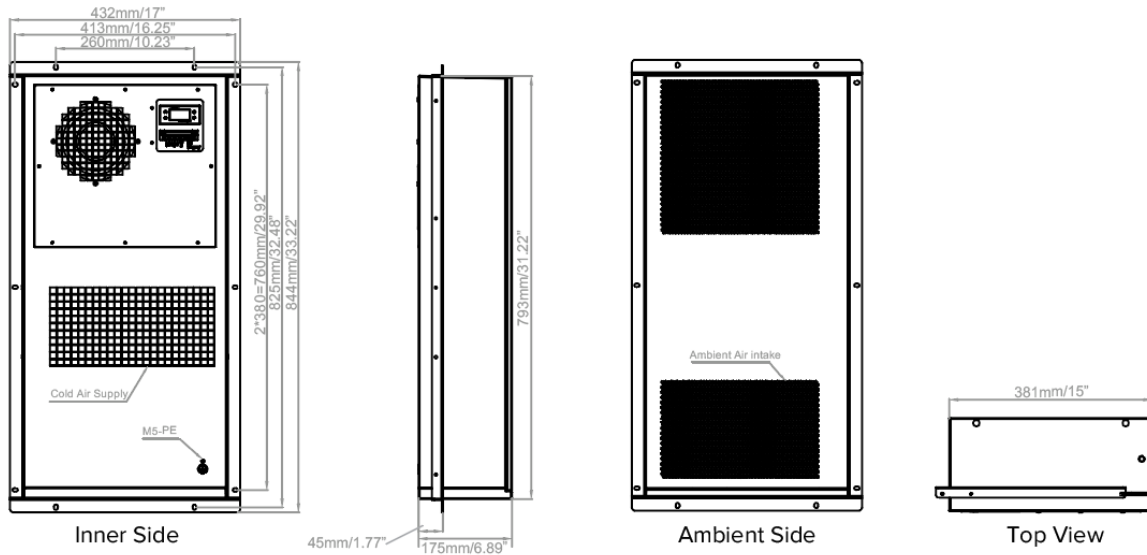


Figure 2.2 Product dimensions for **ACT-VCC-3000-DC**

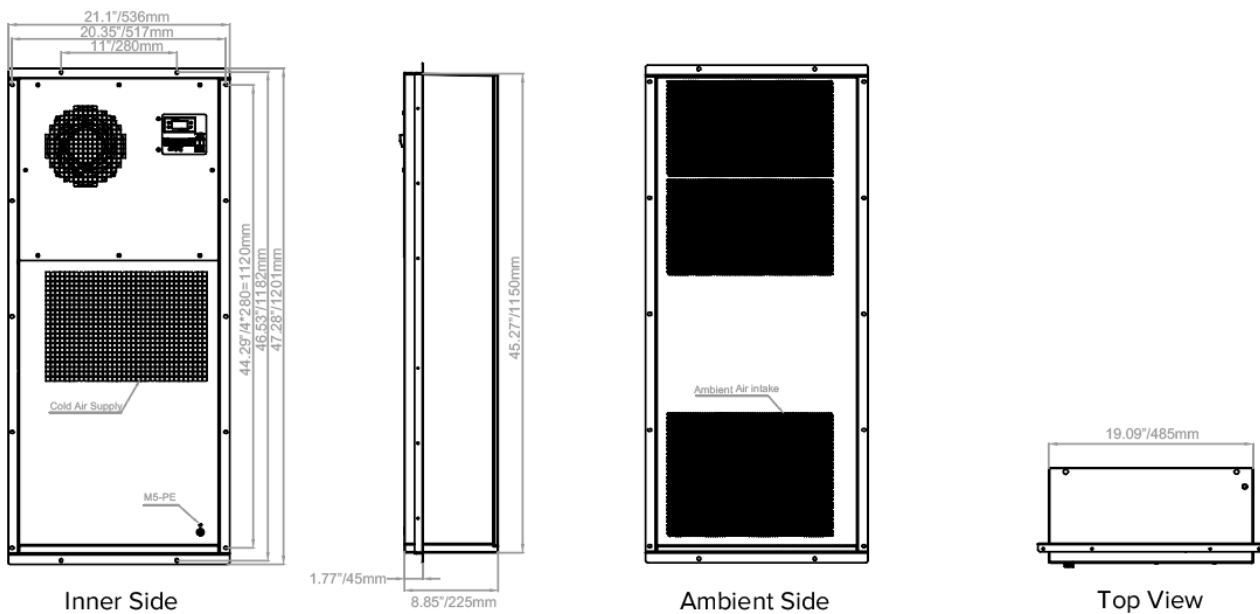
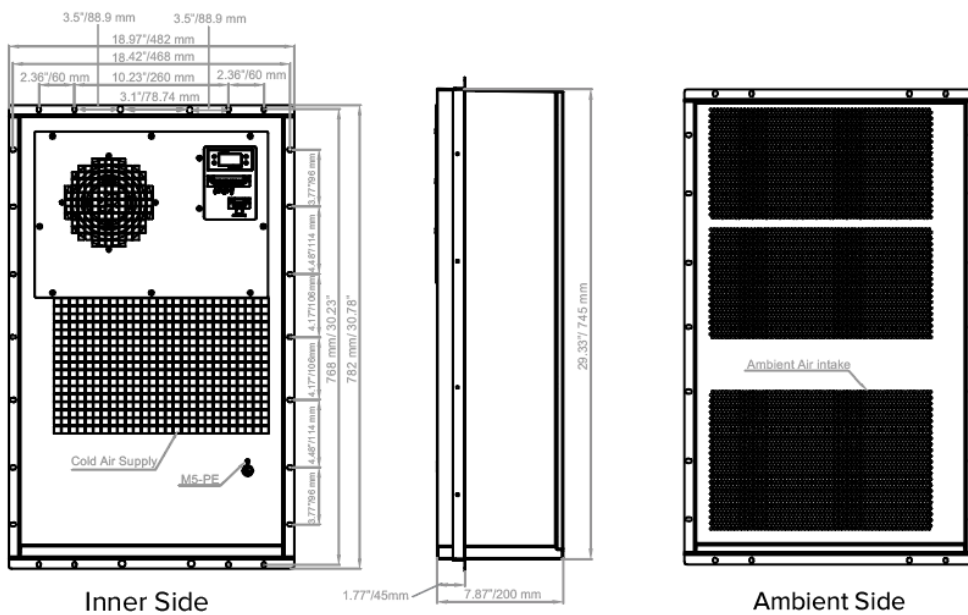
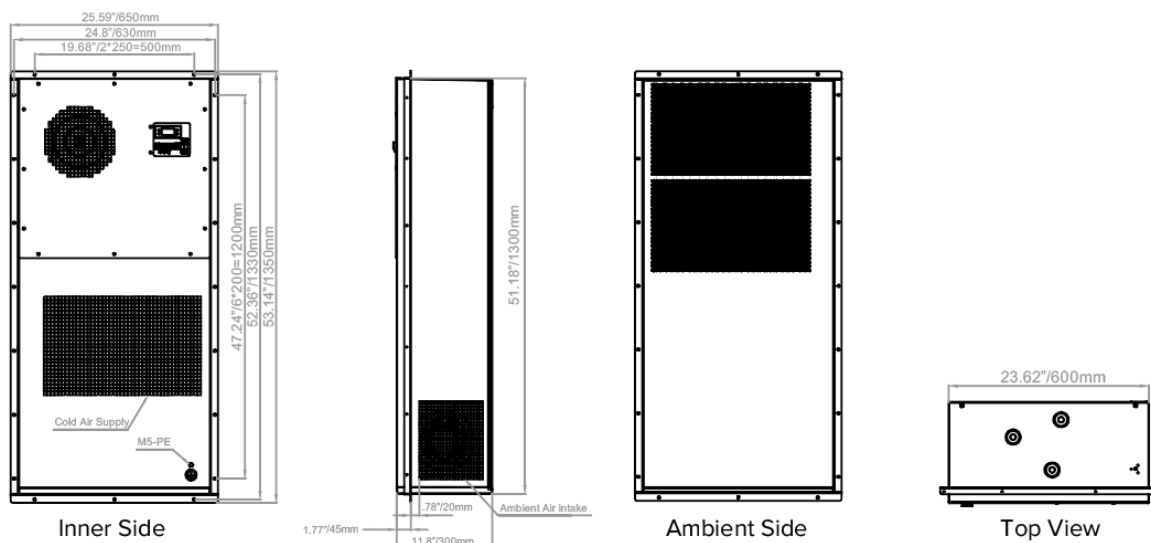


Figure 2.3 Product dimensions for **ACT-VCC-2000-AC**Figure 2.4 Product dimensions for **ACT-VCC-5000-AC**

2.1 Application Notes



Important

DC models are intended for use in industrial equipment applications that utilize a 48V DC power supply, while **AC models** are intended for use in industrial equipment applications that utilize a 230V AC power supply. The purpose of its installation is to control cabinet temperature between compressor start temp +/- Hysteresis value for compressor start/stop from Table 2.5; keeping within this range will ensure that all thermal sensors operate as intended.



Warning

Manufacturer is not responsible for damage caused by operation outside of designated intended use. Warranty is void if the following instructions are not followed:

Safety and Use Instructions:

- **Transport the unit in an upright position**
- **Do not store in a high temperature, high humidity environment (<70°C, <95%).**
- **If the unit will not be in use for a long period, disconnect the main supply power**

2.2 Working Principles

- The Air Conditioner uses a standard vapor compression cycle
 - The main parts of the cooling system include: compressor, condenser, expansion valve, evaporator, internal fan, and external fan
- Principle of refrigeration: The compressor compresses warm, low-pressure vapor into hot, high-pressure vapor. This hot high-pressure vapor travels through a condenser where it dissipates heat to the environment. The high-pressure condensate then flows through an expansion valve which reduces the fluid's pressure and partially vaporizes the fluid. The expansion and partial vaporization cool the fluid (liquid and vapor mixture), which allows the remaining liquid to vaporize and cool the air flowing through the evaporator.
- The air internal to the cabinet is circulated through the evaporator to be cooled to the desired temperature
- Air outside of the cabinet flows through the condenser and is used to condense the hot vapor in the refrigeration cycle.
- Air outside of the cabinet never mixes with the air internal to the cabinet

2.3 Product features

This product is designed with all AC or DC driven components (specified by the model) such as fans and the compressor.

Air Conditioner products have the following features:

- Power supply voltage range:
 - **DC models:** 42~60 VDC
 - **AC Models:** 220-240V~/50/60Hz
- DC units can be up to 50% more efficient than comparable AC units
- DC motor speed control provides low noise operation and low energy consumption
- R134a refrigerant

Technical Specifications

Note: Parameters will be subject to the latest specification

Table 2.1 Technical Specifications for **ACT-VCC-1000-DC**

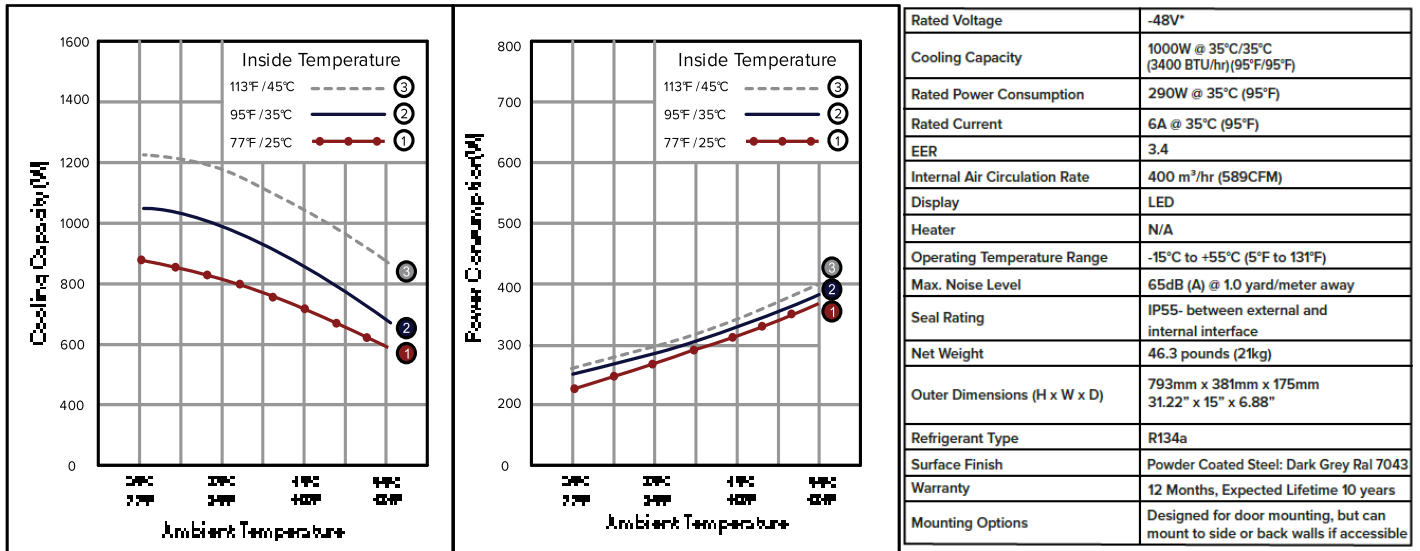


Table 2.2 Technical Specifications for **ACT-VCC-3000-DC**

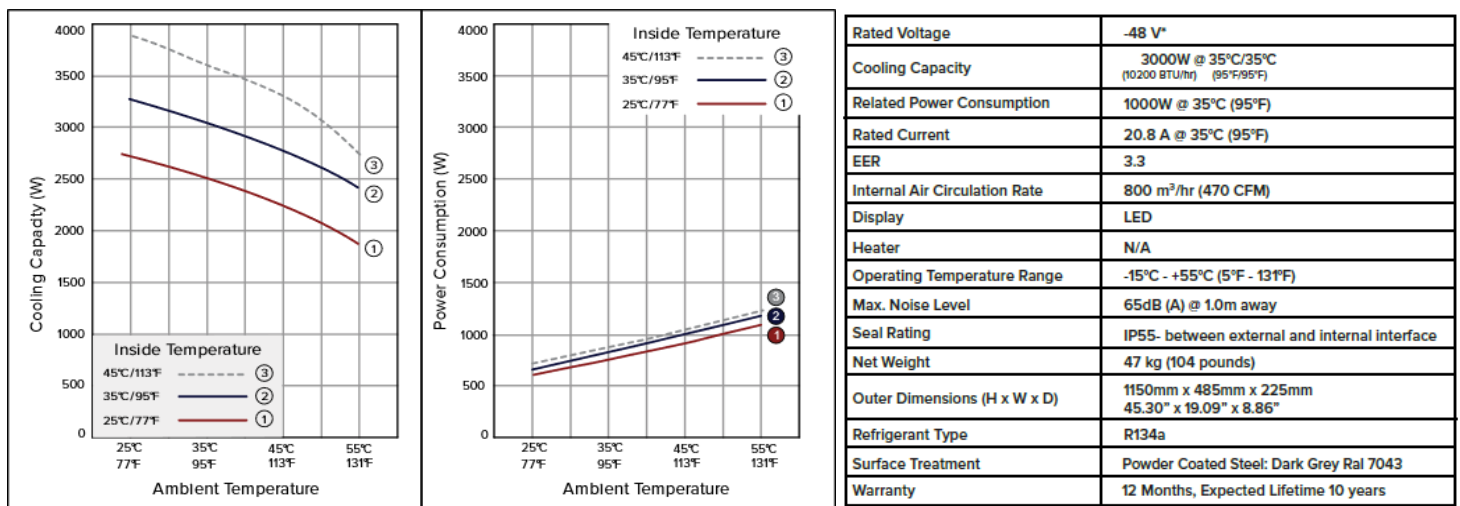


Table 2.3 Technical Specifications for **ACT-VCC-2000-AC**

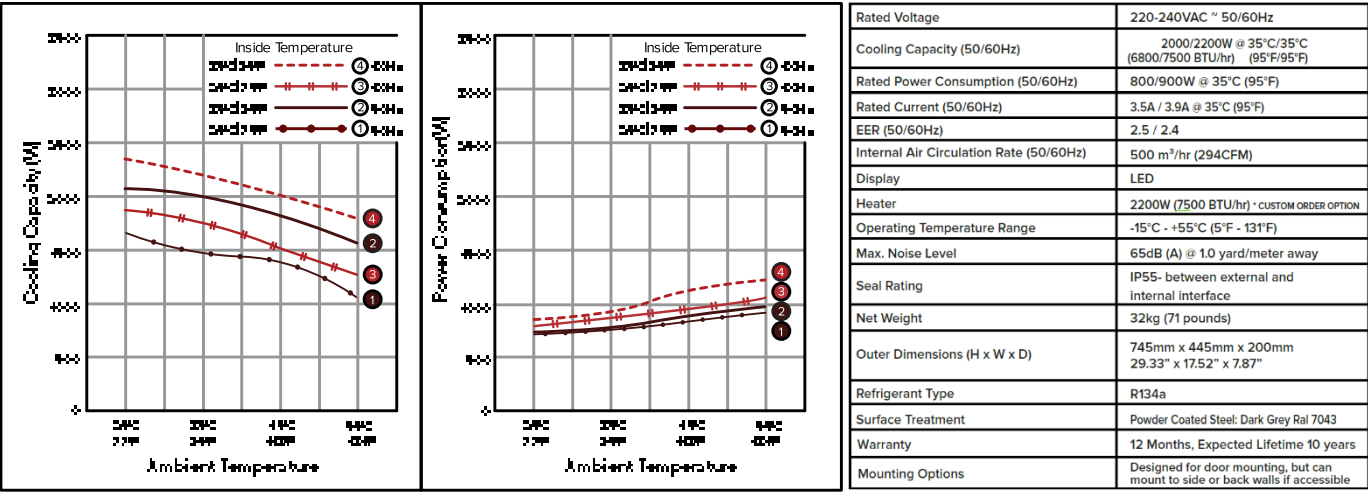
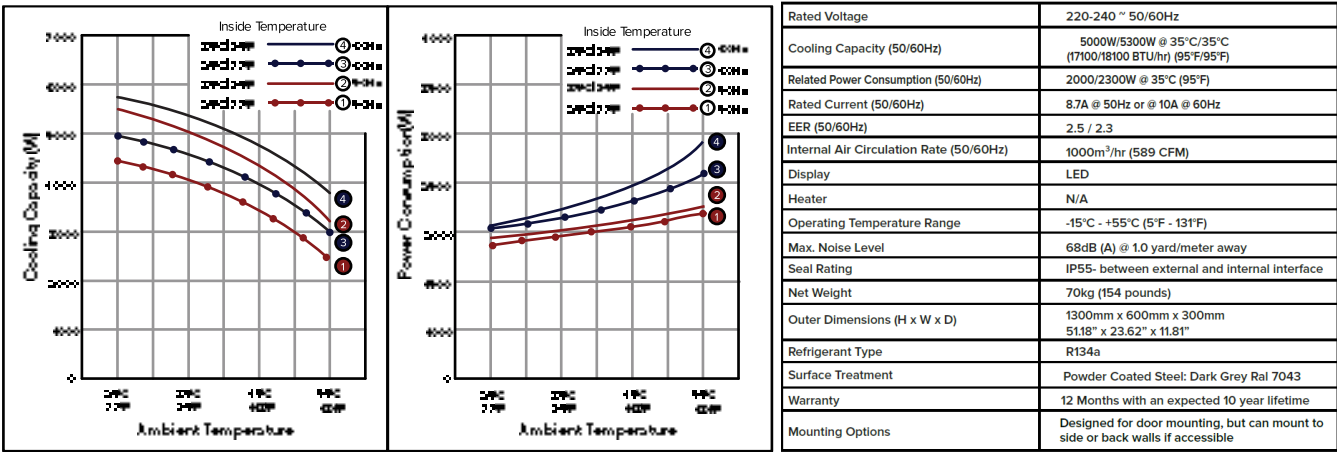


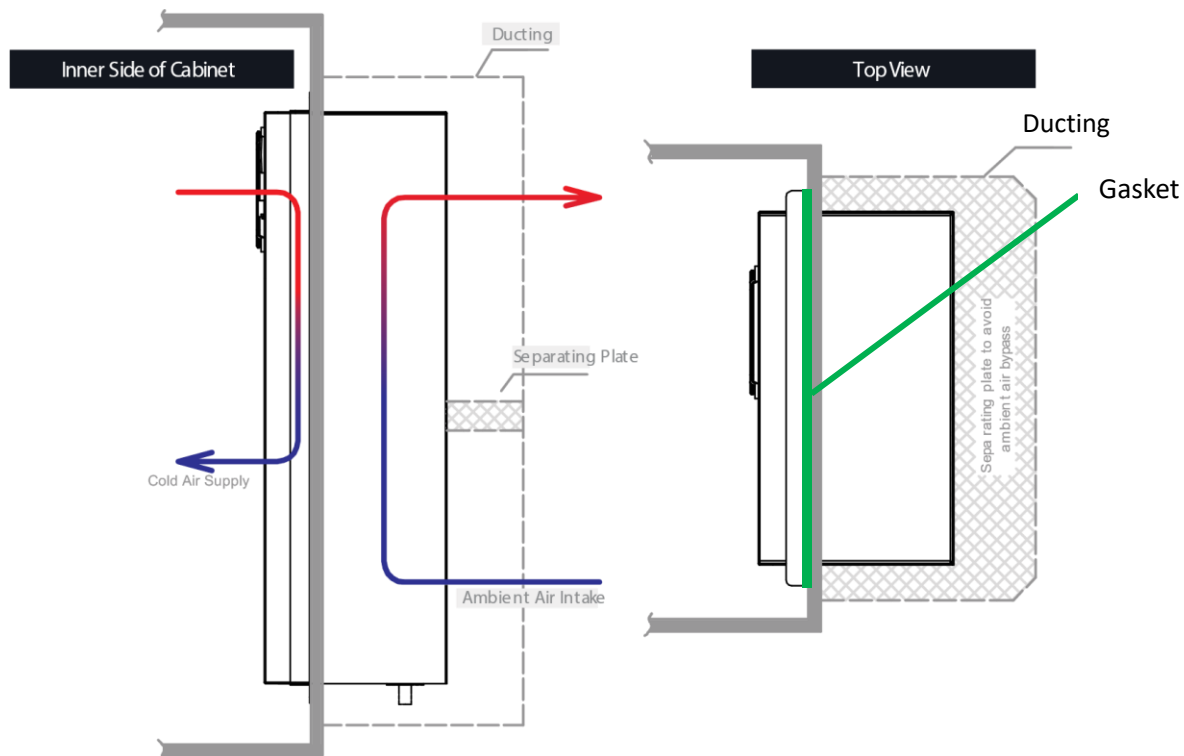
Table 2.4 Technical Specifications for **ACT-VCC-5000-AC**



2.4 Air Circulation and Remote Mounting

Internal circulation and external circulation of the air is shown in Figure 2.5. Ducting and a separating plate are not required for enclosure mounting applications. If the unit is to be mounted remotely to cool an enclosure, ductwork and a separating plate must be used as shown in Figure 2.5. Ductwork should be made as short as possible to minimize the impact on the performance of the unit. Any additional pressure drop incurred by the fans will reduce the performance of the unit. Be prepared to oversize the cooling unit accordingly. Any grills or filters added to the unit or to accompanying ductwork will also result in reduced potential cooling from the unit.

Figure 2.5: Cabinet air circulation



2.5 Operation of the Unit

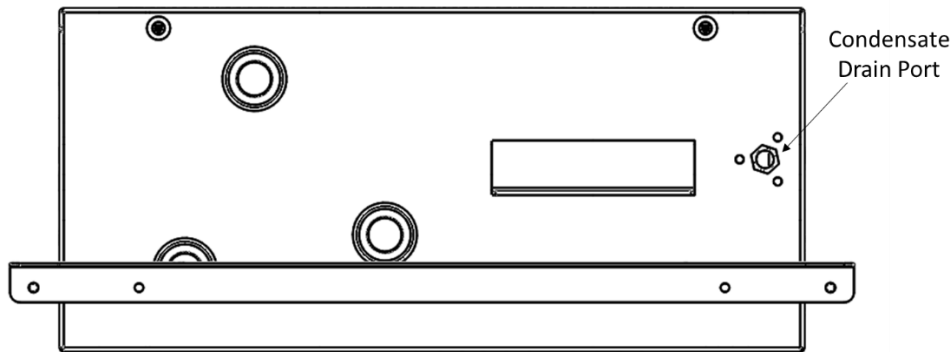
When the unit is turned on, it will perform a self-test before starting standard operation. If any faults are detected during the self-test, the system goes into the 'fault' mode; an alarm will be triggered and an error code will be shown on the LED display to alert the user (error code information and troubleshooting found in section 7.1.4). If there is no fault after the self-test process, the system will automatically begin normal operation.

- The self-test procedure is as follows:
 1. Test of the internal fan;
 2. Test of the internal temperature sensor;
 3. Test of the external fan;
 4. Test of the compressor.
- The normal operating mode includes standby mode and active cooling mode:
 - Standby mode: If the air temperature is lower than the air conditioner set point, the unit will remain in a standby mode, where only the internal fan runs at its lowest speed.
 - Active Cooling mode: If the air temperature is greater than the setpoint temperature, the unit will run on normal cooling mode to achieve the setpoint temperature.
 - Heating mode (Optional and for AC models only): If the air temperature is lower than the Heater start set temperature, the product runs on normal heating mode

2.6 Condensate Handling

During normal operation in a humid environment, the unit may produce condensate on the evaporator coil inside of the casing. A condensate drain port is provided on the bottom of the unit as shown in Figure 2.6. Condensate will naturally flow out of this port under normal operating conditions. If it is not permissible for certain applications for water to drain directly out of this port, a fitting is provided for connection of an appropriately sized drain tube to relocate condensate to an available drain. Most applications will produce less than 150 mL/hr of condensate and drain tubes should be sized accordingly.

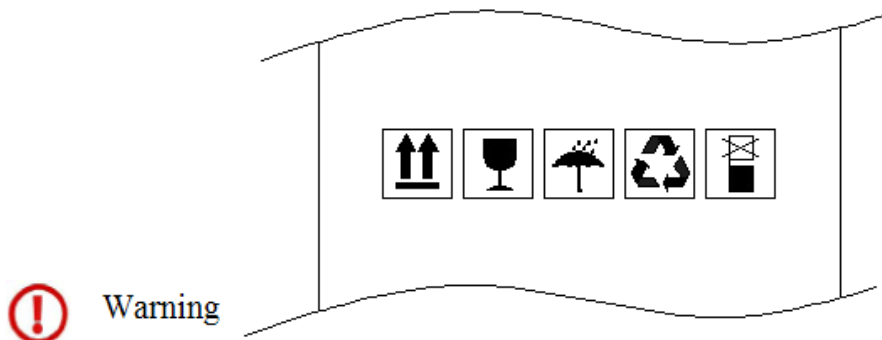
Figure 2.6: Bottom View of unit, showing Condensate drain port



3. Packaging and Shipping

- The Air Conditioner should be packaged in a wooden crate, as in figure 4.1 with foam protection surrounding the unit.
 - 1 pcs/ box or 10 pcs / pallet for ACT-VCC-1000-DC
 - 1 pcs/ box or 6 pcs / pallet for ACT-VCC-3000-DC or ACT-VCC-2000-AC
 - 1 pcs/ box or 3 pcs / pallet for ACT-VCC-5000-AC
- When transporting this Air Conditioner, please pay attention to the following:

Figure 3.1 Packaging marking



- During Handling or transport, the Air Conditioner must be upright. Do not place flat or tilted.
- The Air Conditioner is a precision instrument and should be handled with care. Any secondary shipping must be capable of protecting the unit from damage.

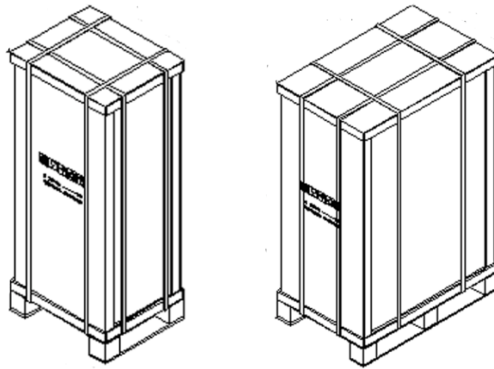
4. Unpacking and Acceptance

- Make sure the package is upright as shown in Figure 4.1 before you open the package,

Figure 4.1 packaging



Warning



- Please check that the packing straps are unbroken and that the wooden box is undamaged, not deformed or wet.
- Use scissors or a knife to dismantle the packing belt, then open the wooden box.
- After opening the package, please check the contents against the packing list.

5. Installation

5.1 Physical Installation

Please follow the below diagram, figure, and instructions for installation:

Notes:

* Included gasket should be installed between the unit and internal surface of the cabinet.

** M5 bolts and nuts should be torqued toin*lb/.....N*m

Figure 5.1 Installation diagram

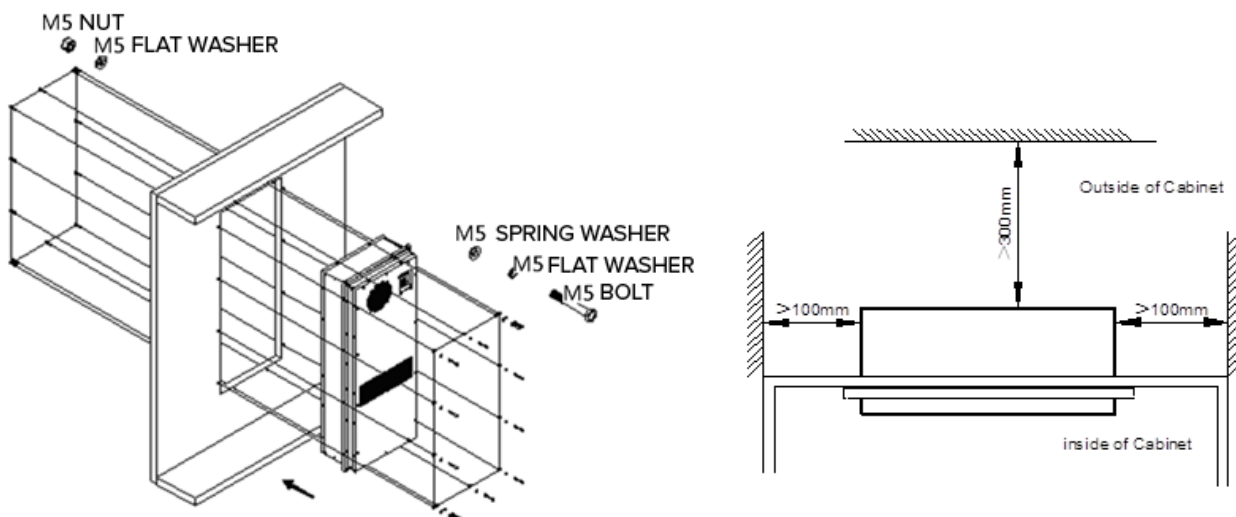
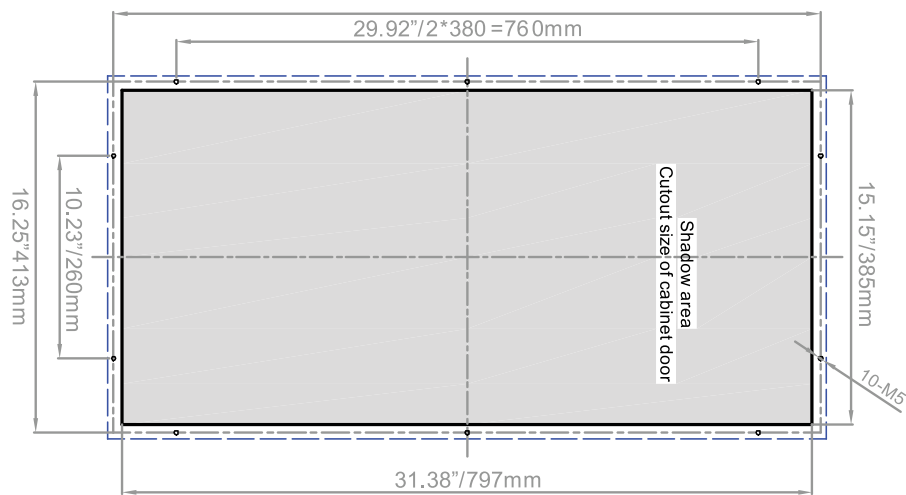
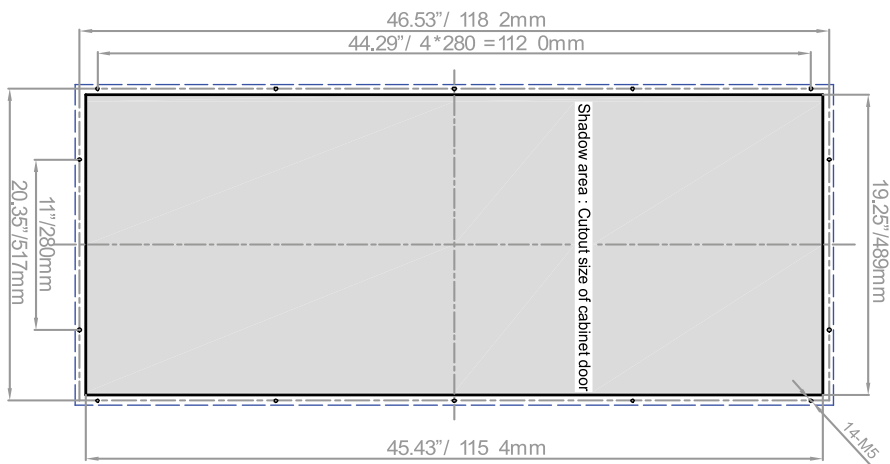


Figure 5.2 Dimensions for cut-out in enclosure door for the **ACT-VCC-1000-DC**Figure 5.3 Dimensions for cut-out in enclosure door for the **ACT-VCC-3000-DC**Figure 5.4 Dimensions for cut-out in enclosure door for the **ACT-VCC-2000-AC**

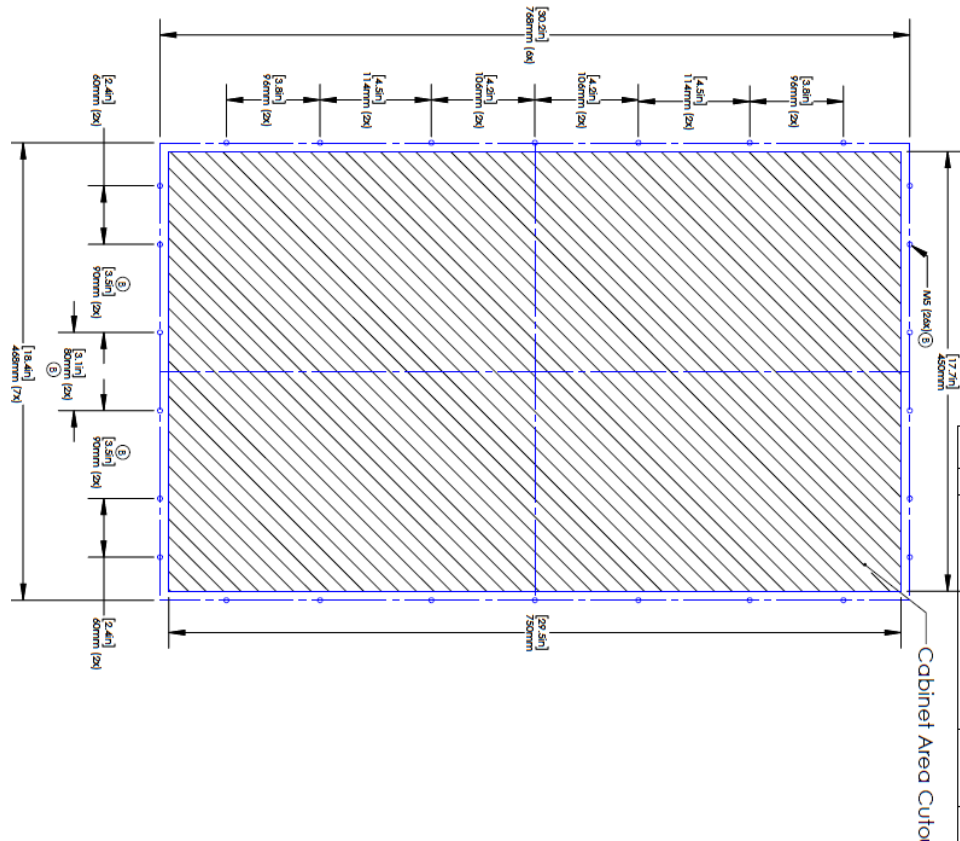
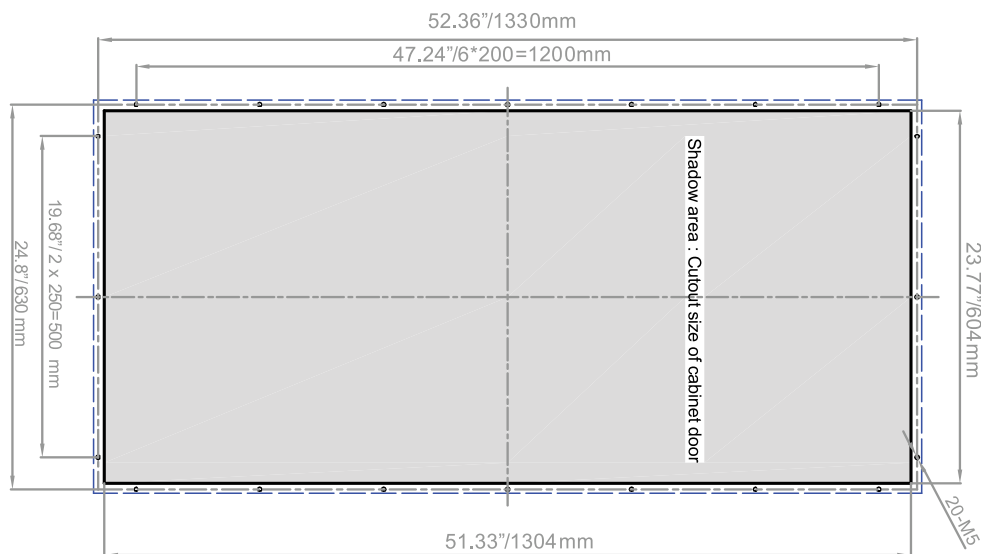


Figure 5.5 Dimensions for cut-out in enclosure door for the **ACT-VCC-5000-AC**



Installation steps:

1. Mark the cabinet with the cut-out dimensions according to Figure 5.2 – 5.5 depending on model
2. Cut out the shaded area
3. Remove the product from the shipping crate with care
4. Install the Air Conditioner on the cabinet as shown in Figure 5.1

5. The mechanical portion of the installation is now finished. Adhere to the “Install Checklist.”

Current documentation, cut out templates, DXF and Step files can also be found on our website at <https://www.1-act.com/enclosure-cooling/resources/enclosure-cooling-dxf-and-step-files/>

Install Checklist



Important

- ✓ The ambient air must be under 55°C, and the humidity under 95%.
- ✓ Make sure that the product is installed within 3° of plumb level, relative to the vertical direction
- ✓ Make sure that the cabinet is well-sealed (using the supplied gasket)
- ✓ Do not turn the unit on immediately after finishing the installation; the unit must remain standing vertically for more than 30 minutes before being turned on to allow the compressor oil to drain back to the compressor.
- ✓ Complete wiring according to section 5.2 and perform pre-operational checks found in section 6.1 before turning on the unit.

5.2 Electrical Connection

**** Before powering on the air conditioner, electrical wiring should be completed (only) by a skilled technician ****

The power supply must be in accordance with the technical specifications of the unit. Power supply cable sizes and circuit breaker sizes are recommended below in Table 5.1 for DC models and 5.2 for AC models.

Table 5.1: Wiring Requirements for DC Models

MODEL	ACT-VCC-1000-DC	ACT-VCC-3000-DC
Power supply	- 48 VDC* (GND/RTN: positive, -48: negative)	- 48 VDC* (GND/RTN: positive, -48: negative)
Power supply range	-42 VDC ~ - 60 VDC.	-42 VDC ~ - 60 VDC.
DC power supply source capacity	≥15Amps @ 48VDC	≥30Amps @ 48VDC
Main power supply cable size	≥14AWG (UL 1015)	≥10AWG (UL 1015)
Voltage loss along power supply cable from the power source to the unit	≤1.0V	≤1.0V
Circuit breaker size	≥15 Amps	≥30 Amps

Table 5.2: Wiring Requirements for AC Models

MODEL	ACT-VCC-2000-AC	ACT-VCC-5000-AC
Power supply	220-240V~/50/60Hz	220-240V~/50/60Hz
AC power supply source capacity	≥10Amps @ 230VAC	≥15Amps @ 230VAC
Main power supply cable size	≥14AWG (UL 1015)	≥12AWG (UL 1015)
Voltage loss along power supply cable from power source to unit	NA	NA
Circuit breaker size	≥10Amps	≥15Amps

Notes:

- A circuit breaker is required before connecting the power supply, refer to the above table for size
- All wires must be properly torqued to the relevant terminals
- All national wiring regulations and local electrical codes should be followed, based upon installation location.

Optional (For **ACT-VCC-2000-AC** only):

1000W Heater: Power Supply	220-240 V~
-----------------------------------	------------

Safety Reminders to note before running the product:

- ✓ Don't touch the product with wet hands
- ✓ Disconnect power to the unit before carrying out cleaning, maintenance, or disassembly
- ✓ Don't touch the inlet and outlet of the unit with fingers or tools, to avoid damaging the machinery
- ✓ If the unit is functioning abnormally (such as abnormal sounds, smoking, not cooling), turn the unit off immediately and schedule a professional inspection.

Figure 5.6 System wiring diagram for the ACT-VCC-1000-DC

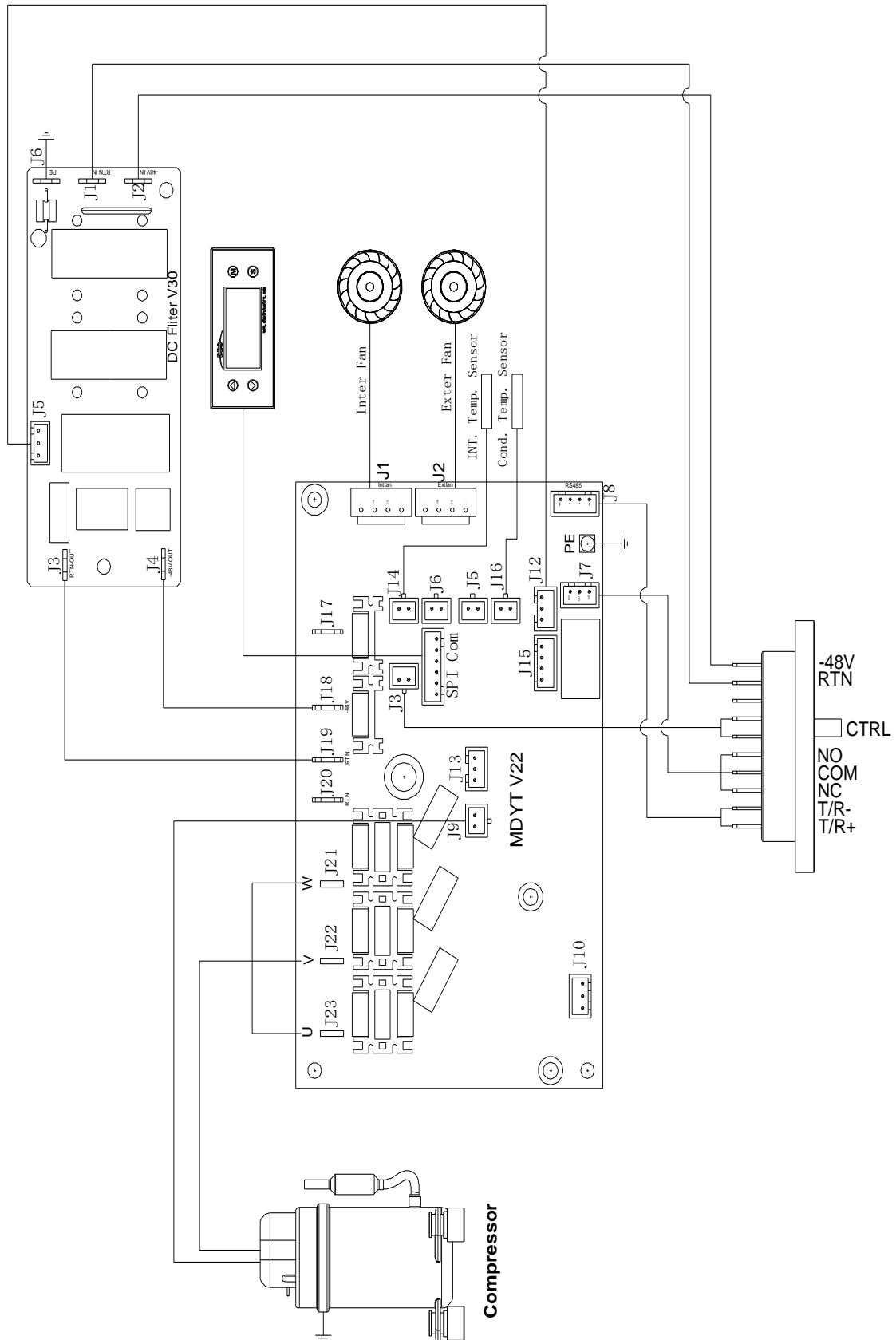


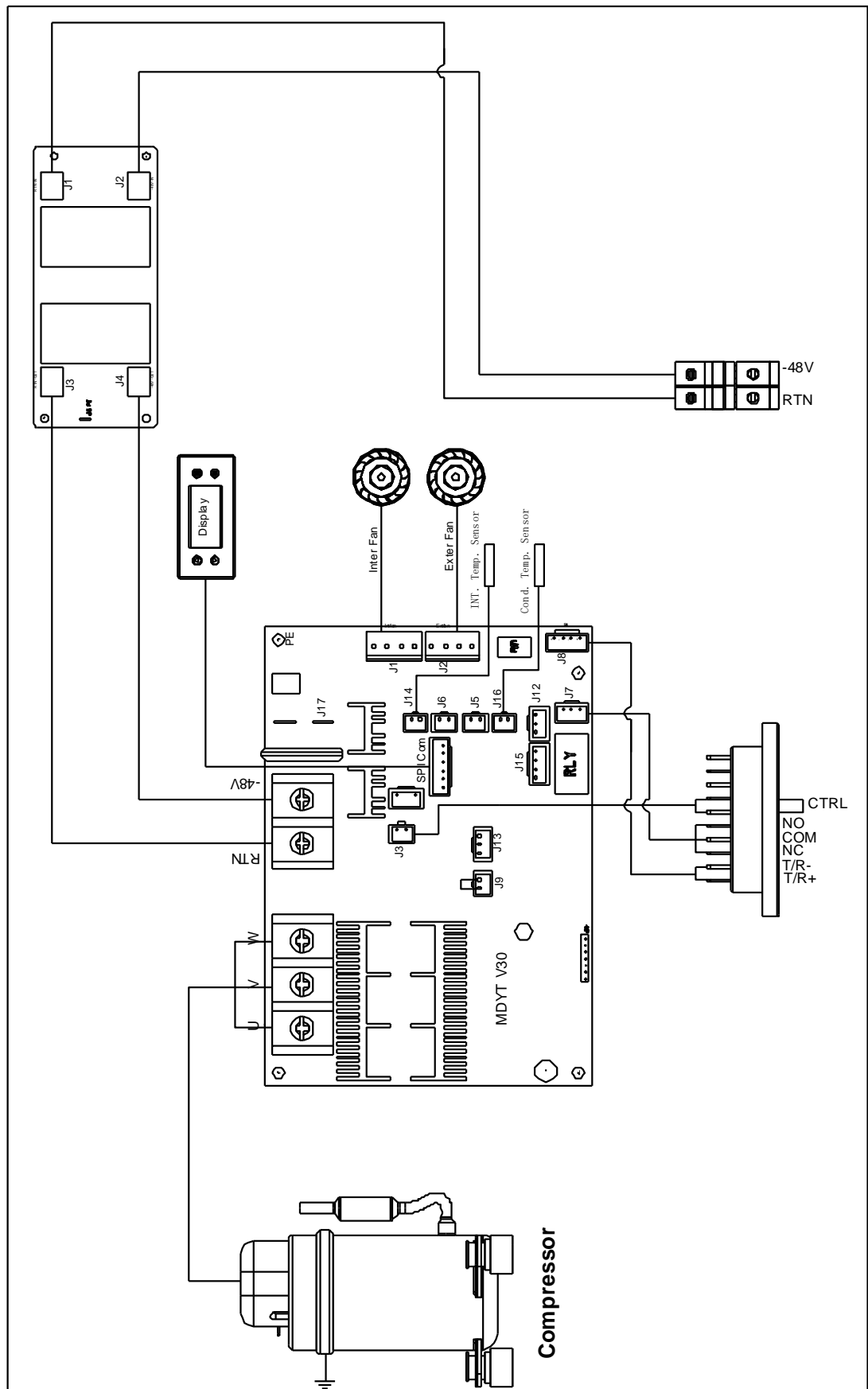
Figure 5.7 System wiring diagram for the **ACT-VCC-3000-DC**

Figure 5.8 System wiring diagram for the **ACT-VCC-2000-AC**

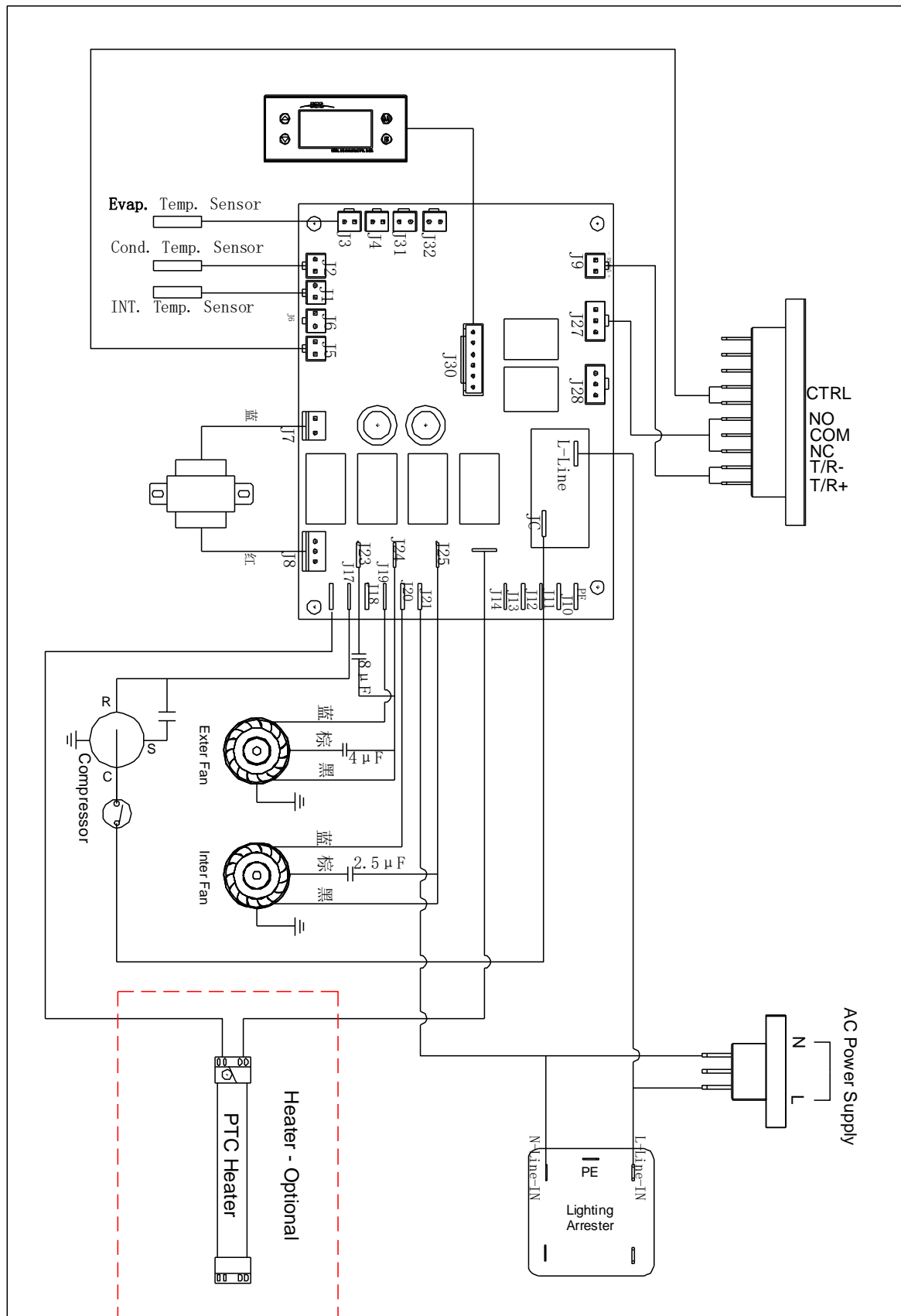
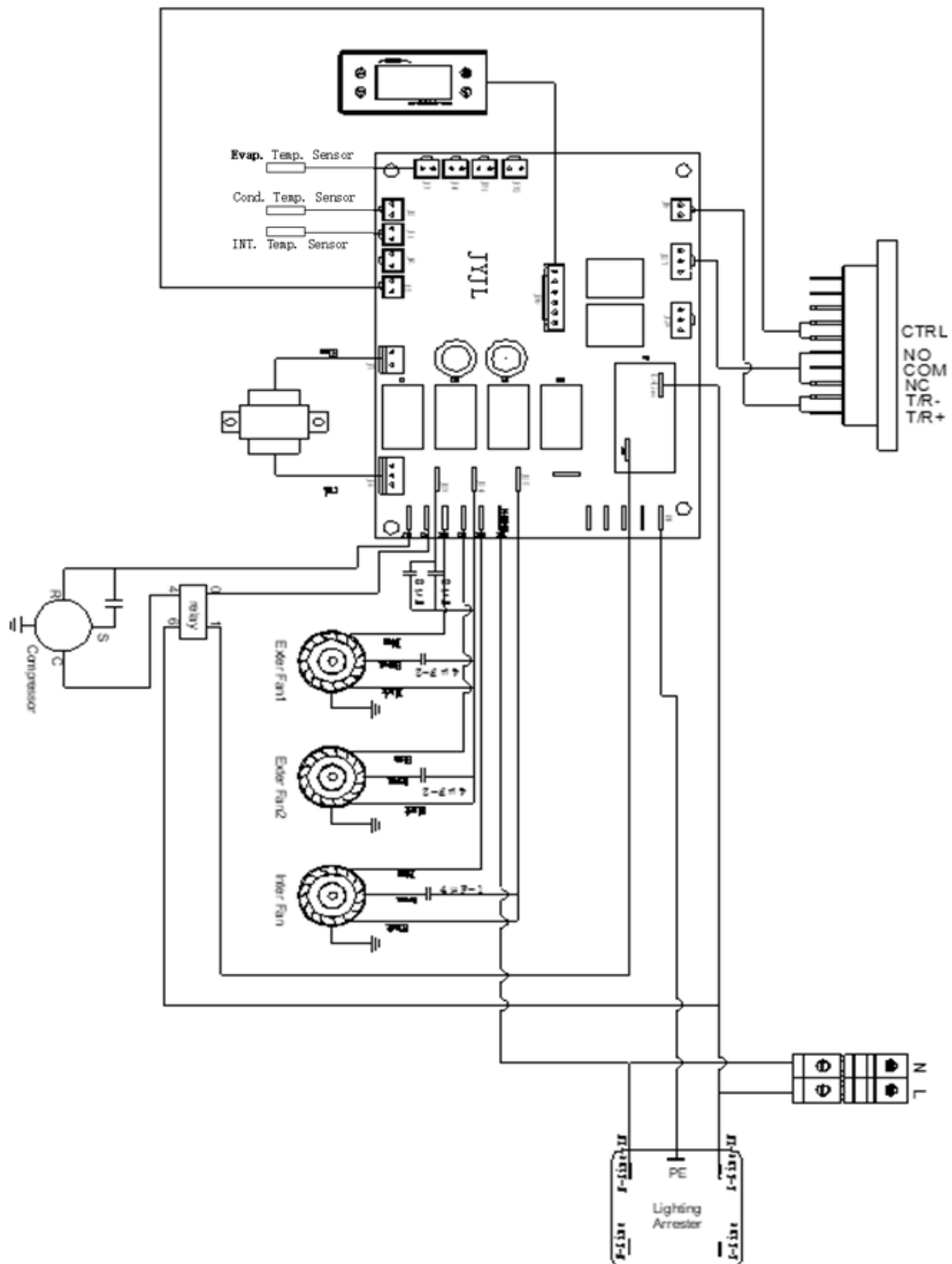


Figure 5.9 System wiring diagram for the **ACT-VCC-5000-AC**

6. Running and Testing

6.1 Pre-operational checks

After Air Conditioner is installed and the electrical connection is completed, please complete the following checklist:

Table 6.1 Pre-operational checks

Steps	✓	Checking items
1		Ensure all screws are torqued to appropriate values
2		Ensure that there is enough space around the internal and external air ducts of the air conditioner. Per Figure 5.1
3		Ensure that the power line connects to the right polarity; Alarm signal cables are connected correctly
4		Use a multimeter to check the supply voltage, that the power supply voltage is normal and consistent with the requirements on the nameplate.

6.2 Operating the Unit

Apply power to the unit. The product will first run a self-test program, and then the unit will run normally. (Self-test: Refer to “Section 2.6: Operation”)

- If there is any trouble during the self-test, the alarm will be triggered: the LED Display will flash with alarm error codes, Refer to “Table:7.7 Error Code meanings”
- If there is no fault after the self-test process, the system will go into normal operation automatically. (Normal mode: includes standby operation and active cooling mode)



Warning

When the Air Conditioner is running, if there is abnormal noise or vibration, turn the power off.

6.3 LED display manual

The interface of the LED display is shown in Figure 6.2

Figure 6.1 LED Display:

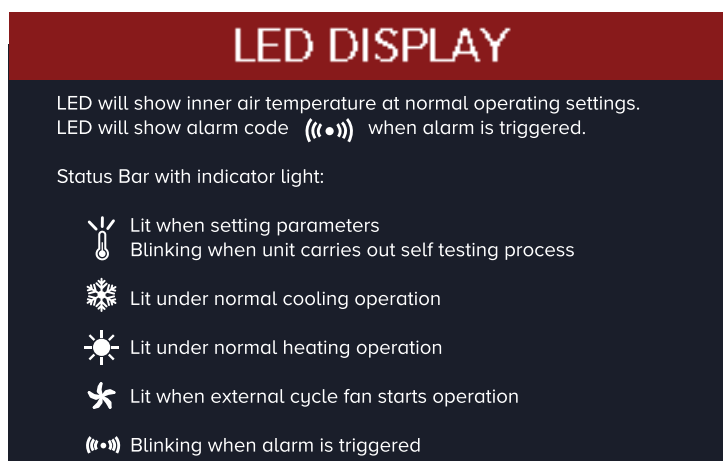











Figure 6.2 LED Display faceplate



Table 6.2 Definition of the symbols

Indicator Icon	Definition	Is lit	Is blinking
	Parameter setting	Under setting status	Self-test status
	*Heating status	*Heater is running	*Heater has failed when  off
	Cooling	Compressor is running	Compressor has failed when  off
	External fan	External fan is running	External fan has failed when  off
	---	---	---
	Alarm / Warning	Alarm / Warning	---
*Not all options are available for all units			

*Please see section 7.1.4 for information on error code messages and troubleshooting

6.4 LED Display Parameter setting guide:

Table 6.3: Parameter setting range

Items code	Item name	Default Value	Value Range	Unit
P01	Communication address for master/slave unit setting	1 - slave unit	1 – slave unit; 2 – master unit,	/
P02	Compressor starting temperature	35	18~50	°C
P03	Hysteresis value for compressor start/stop	5	1~5	°C
P04	High-temperature alarming value	58	35~100	°C
P05	Low temperature alarming value	-42 (-10*)	-42~25	°C
P06	Heater starting temperature value*	5	-45~15	°C
P07	Hysteresis value for heating start/stop*	10	5~20	°C
P08	External input signal type definition	2	0: disable; 1: NO type; 2: NC type	
P09	Master/Slave function definition	0	0 – disable 1 - enable	
P10	Master/slave switching period for each unit	12 hours	0~72 hours	
P97	Return to factory setting	/	Pressing the “S” key will return the product to default factory	

*Heating functions are optional and not included on all units.

The above parameters can be accessed through RS485 communication if necessary. For questions, please contact ACT's sales staff at 717-295-6061.

Setting Display Parameters:

Press the "M" key for 5 seconds, causing the system to enter into parameter setting mode. The display will show the "Pxx" code: see table 6.3.

- Use arrow "▲ ▼" keys to choose the desired item.
- Press the "S" button to select. The display will show the selected item's current parameter values; use arrow "▲ ▼" keys to adjust the value and press the "S" button to lock in that value.
 - At this time, a four-digit password input interface will be shown as "0000"; please key in the customer default password **"1234"** and use the "S" key to confirm each digit. Once the correct password is entered, the system will save the new parameter value and display code "End", then return to normal display status automatically.

Note:

- While in the parameter setting mode, press the "M" key to exit..
- If no key is touched within 30 seconds, the system will return to normal mode automatically.

7. Maintenance and Warranty

7.1 Product maintenance

7.1.1 Tools needed

Table 7.1 Maintenance tools

Number	Tools
1	Multimeter
2	Phillips screwdriver
3	Slotted screwdriver

7.1.2 Spare parts list

Table 7.2 Spare parts list for the **ACT-VCC-1000-DC**

No.	Spare part PN	Spare part name	Spare part model	Quantity
1	31.002	Internal Fan	175 DC FAN	1
2	31.002	External Fan	175 DC FAN	1
3	41.013	Main Control Board	MDYT V22	1

Table 7.3 Spare parts list for the **ACT-VCC-3000-DC**

No.	Spare part PN	Spare part name	Spare part model	Quantity
1	31.001	Internal/external fan	225DC FAN	2
3	41.011	Main control board	MDYT V30	1

Table 7.4 Spare parts list for the **ACT-VCC-2000 AC**

No.	Spare part PN	Spare part name	Spare part model	Quantity
1	31.051	Internal Fan	190 AC FAN	1
2	31.052	External Fan	225 AC FAN	1
3	41.019	Main Control Board	JYJL V20	1

Table 7.5 Spare parts list for the **ACT-VCC-5000 AC**

No.	Spare part PN	Spare part name	Spare part model	Quantity
1	31.052	Internal Fan	225 AC FAN	1
2	31.052	External Fan	225 AC FAN	2
3	41.019	Main Control Board	JYJL V20	1

7.1.3 Routine Maintenance

Table 7.6 Routine maintenance

NUM	Check items	Check methods	Solution
1	Power line attachment	<ol style="list-style-type: none"> 1. Turn off the supply power 2. Tug on the power line with moderate force and check whether the line is loosening from its terminals 3. Tighten the screws on the power cord terminals with a screwdriver, watch whether the screw is tightening or stripped 	If a power line is loose or loosening, retorque the attachment terminals or replace the cable if damaged.
2	Voltage Stability	Use the multimeter to measure the Air Conditioner input voltage, in order to gauge whether the voltage is within normal range.	If the voltage is not within the normal range, please turn off the power supply immediately. Do not power-on the Air Conditioner until the supply voltage within normal range.
3	Attachment bolt torque	Check the torque on all attachment bolts to ensure that the unit is still secured to the enclosure properly.	Retorque any bolts as required.
4	Cooling	Power on the switch and check whether the self-test is correct. If it is correct, then the monitor will display compressor current as self-test program.	While self-testing, if there is abnormal noise or vibration, please cut power off immediately and notify a professional to inspect. If alarm triggers while self-testing, please troubleshoot, see Table 7.5.
5	Fan Dust Accumulation	Check for dust build-up around the fan blades on both the internal and external fans.	If significant dust has accumulated, use compressed air to blow dust off of fan blades until clean.

Alarm code and Processing method

During normal operation, the LED displays the return air temperature leaving the air conditioner. An alarm signal will alert the user to an error and the alarm code error message will be displayed alternately with the return air temperature. Alarm codes are as follows:

Table: 7.7 Error Code meanings *

*Note: This is the full list of codes. Not all codes apply to each model.

Error Code	Code Definition
E01	Internal fan No.1 fault warning
E02	Internal fan No.2 fault warning
E03	External fan No.1 fault warning
E04	External fan No.2 fault warning
E05	Compression fault warning
E06	Communication fault warning
E07	High-temperature warning
E08	Low-temperature warning
E09	DC Power overvoltage warning
E10	DC Power undervoltage warning
E11	Refrigerant circuit pressure is too high warning
E12	Refrigerant circuit pressure is too low warning
E13*	Heater current overload warning
E14*	Heater current too low warning
E15	Return air temperature sensor fail warning
E16	Condenser air temperature sensor fail warning
E17	Ambient air temperature sensor fail warning
E18	Control signal input: on / off dry-switch type
E21	AC voltage too high warning
E22	AC voltage too low warning
E23	Compressor Current Overload warning
E24	Compressor Current Underload warning
E25	Communication Loss warning for master/slave pairs
E26	Evaporator temperature sensor fail alarming
E27	Evaporator freeze-up alarming
E28	Refrigerant leakage alarming

Table 7.8 Alarm information

Code Name	Principle	Troubleshooting Method
E15: Return air temperature sensor alarm	Return air temperature sensor has a short circuit or open circuit.	Check whether the return air temperature sensor wire has been damaged or if a short circuit or open circuit is present.
E24: Compressor current is too low	Compressor current is not within the normal range.	1. Check whether the compressor power line is loose 2. Compressor fault, contact professional maintenance or ACT
E23: Compressor over-current	Compressor current is not within the normal range.	1. Check whether the condenser is dirty or blocked 2. Compressor fault: contact professional maintenance or ACT
E01 & E02: Internal fan alarm	The internal fan current is not within the normal range.	Check whether the internal fan electrical connections are loose.
E03 & E04: External fan alarm	The external fan current is not within the normal range.	Check whether the external fan electrical connections are loose.
E07: High-temperature alarm	The cabinet temperature is higher than the set point.	Reduce electrical power in cabinet and open the cabinet door until the alarm stops.
E09 or E21: Supply voltage overload	The compressor current is not within the normal range.	Turn off the power supply immediately. Use a multimeter to measure the voltage, do not power-on the switch until the power supply is within the normal range.

7.1.4 Other fault analysis and processing

Table 7.9 other fault analysis and processing

Fault state	Analysis of the reasons	Solutions
Powered-on unit but the cabinet temperature is too high and the Air Conditioner is not working	1. Power failure or no power 2. The cooling set temperature is higher than the cabinet temperature 3. System fault	1. Check the power supply and the electric circuit 2. Set cooling temperature setpoint according to needs 3. Contact ACT
The Air Conditioner is running but the cooling effect is not adequate	1. The cooling capacity of the Air Conditioner is not matched to the thermal load. 2. The ambient temperature is too high 3. Other system faults	1. Add additional air conditioner to match load, or select a properly sized unit for the thermal load 2. Ensure the machine is used in the correct range 3. Contact ACT
The Air Conditioner is stopping suddenly, and the electrical system is normal	1. The cabinet temperature is greater than, or equal to, the cooling set temperature. 2. Other system faults	1. Set cooling temperature setpoint according to needs 2. Contact ACT

7.2 Service and Repair

Disclaimer

The warranty is limited to the delivered product(s) and ACT is not responsible for any loss that may be derived by equipment failure.

Warranty period: 1-year limited warranty

Warranty Section from ACT's PURCHASE ORDER TERMS AND CONDITIONS

- **Buyer's Property.** All drawings, tools, fixtures, materials and other items supplied or paid for by Buyer shall be and remain the property of Buyer. All such items shall be used only in the performance of work under this Order unless Buyer consents otherwise in writing. Seller shall have the obligation to maintain any and all property furnished by Buyer to Seller and shall be responsible for all loss or damage to said property except for normal wear and tear.
- **Warranty.** Seller warrants that all Goods furnished under this Order shall conform to all specifications and appropriate standards, will be new, and will be free from defects in material or workmanship. Seller warrants that all Goods furnished hereunder will be merchantable, and will be safe and appropriate for the purpose for which Goods of that kind are normally used. If Seller knows or has reason to know the particular purpose for which Buyer intends to use the Goods, Seller warrants that such Goods will be fit for such particular purpose. Inspection, test, acceptance or use of Goods furnished hereunder shall not affect Seller's obligations under this warranty, and such warranty shall survive inspection, test, acceptance and use. Seller's warranty shall run to Buyer, its successors, assigns and customers, and users of products sold by Buyer. Seller agrees to replace or correct defects of any Goods not conforming to the foregoing warranty promptly, without expense to Buyer, when notified of such nonconformity by Buyer, provided that Buyer elects to provide Seller with an opportunity to do so. In the event of failure of Seller to correct defects in or replace nonconforming Goods, Buyer, after reasonable notice to Seller, may make such corrections or replace such Goods and charge Seller for the costs incurred by Buyer in doing so. Seller shall be liable for and save Buyer harmless from any loss, damage, or expense whatsoever that Buyer may suffer from a breach of these warranties.
- **Inspection and Acceptance.** All Goods are subject to Buyer's inspection, testing and approval, both at Seller's facility and Buyer's point of destination. Buyer reserves the right to reject and refuse acceptance of any Goods which do not comply with all the terms of this Order. Acceptance, payment, use, or resale of Goods by Buyer shall not release Seller of any of Seller's obligations, representations, or warranties hereunder. Payment for any Goods shall not be deemed an acceptance hereof.

Please see ACT's current full Terms & Conditions: <https://www.1-act.com/termsandconditions/>

Questions or Comments?

ACT Quality Department: quality@1-act.com or call 717-295-6061 to reach the Sales staff for assistance on custom orders.



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8. AC cabinet air conditioner communication protocol

No.	Version	Document	Author	Date
1	1.0	Initial Document	Chris	2018-09-15
2				
3				

Contents

Contents	0
Summarization	1
Valid Function Code	1
Valid Error Code	2
Data Type	2
Data Index	3
MODBUS Coil Data Points List	3
MODBUS Discrete Input Data Points List.....	3
MODBUS Input Register Data Points List.....	4
MODBUS Holding Register Data Points List	4

Summarization

The communication of the combined unit supports MODBUS protocol, the MODBUS protocol defines a simple protocol data unit (PDU) independent of the underlying communication layers. Please refer to <http://www.modbus.org> to find the detail.

The data frame mode is: RTU mode, data bits is 8, none parity, stop bit is 1, CRC check, baudrate is 9600bps. The max. waiting time of response is 50ms.

Valid Function Code

This system support function code as following:

Function Code	Definition	Description
01 (0x01)	Read Coils	This function code is used to read from 1 to 2000 contiguous status of coils in a remote device.
02 (0x02)	Read Discrete Inputs	This function code is used to read from 1 to 2000 contiguous status of discrete inputs in a remote device.
03 (0x03)	Read Holding Registers	This function code is used to read the contents of a contiguous block of holding registers in a remote device.
04 (0x04)	Read Input Registers	This function code is used to read from 1 to approx. 125 contiguous input registers in a remote device.
05 (0x05)	Write Single Coil	This function code is used to write a single output to either ON or OFF in a remote device.
06 (0x06)	Write Single Register	This function code is used to write a single holding register in a remote device.
16 (0x10)	Write Multiple Registers	This function code is used to write a block of contiguous registers in a remote device.

Valid Error Code

This system support error code as following:

Error Code	Definition	Description
01 (0x01)	Invalid function code	The function code is invalid.
02 (0x02)	Invalid data address	The data address is invalid.
03 (0x03)	Invalid date	The data is invalid.
04 (0x04)	Slave fail	The slave fails while executing the request.
12 (0x0C)	CRC check error	CRC check error

Data Type

The data has two types: bit data and word data. The bit data include discrete input data that is read-only and coil data that is readable and writable. The word data include input register that is read-only and holding register that is readable and writable.

Data Index

Data address of the controller register follows MODBUS communication protocol, which start from 0 and the maximum address is 65535. But any address is not defined in the controller, if the master request data at undefined address, the controller will return error. The corresponding data as follows:

MODBUS Coil Data Points List

Network Control Property	Read or Write	Data Type	Address	Description
Machine state	R/W	Coil	0	1=Run, 0=Stop
Internal fan state	R	Coil	1	1=Run, 0=Stop
External fan state	R	Coil	2	1=Run, 0=Stop
Compressor state	R	Coil	3	1=Run, 0=Stop
Heater state	R	Coil	4	1=Run, 0=Stop
Hydrogen discharging state	R/W	Coil	5	1=Run, 0=Stop

MODBUS Discrete Input Data Points List

Network Control Property	Read or Write	Data Type	Address	Description
Return air temp. sensor fault	R	Discrete Input	0	1=Alarm ,0=No Alarm
Evaporator temp. sensor fault	R	Discrete Input	1	1=Alarm ,0=No Alarm
Condenser temp. sensor fault	R	Discrete Input	2	1=Alarm ,0=No Alarm
High system pressure alarm	R	Discrete Input	13	1=Alarm ,0=No Alarm
Cabinet inside high temperature	R	Discrete Input	15	1=Alarm ,0=No Alarm
Alarm				
Cabinet inside low temperature alarm	R	Discrete Input	16	1=Alarm ,0=No Alarm
Evaporator frozen alarm	R	Discrete Input	23	1=Alarm ,0=No Alarm
Refrigerant leakage alarm	R	Discrete Input	24	1=Alarm ,0=No Alarm

MODBUS Input Register Data Points List

Network Control Property	Read or Write	Data Type	Address	Description
Indoor return air temperature	R	Input Register	0	Register value = Temp. Value *10
Evaporator temperature	R	Input Register	1	Register value = Temp. Value *10
Condenser temperature	R	Input Register	2	Register value = Temp. Value *10

MODBUS Holding Register Data Points List

Network Control Property	Read or Write	Data Type	Address	Range
Device communication address	R/W	Holding Register	0	1~255
Compressor starting temperature	R/W	Holding Register	1	20°C~50°C
Compressor return difference temperature	R/W	Holding Register	2	2°C~15°C
Cabinet inside high temperature limit	R/W	Holding Register	3	35°C~70°C
Cabinet inside low temperature limit	R/W	Holding Register	4	-42°C~15°C
Heater starting temperature	R/W	Holding Register	5	-40°C~25°C
Heater return difference temperature	R/W	Holding Register	6	1°C~15°C

1. Temperature converting formula:

Actual temperature (°C) = (Register value)/10;

For example: The register data is 200, then the actual temperature = 200/10 = 20°C

9. DC Cabinet air conditioner communication protocol

No.	Version	Content	Author	Date
1	V1.0	Init document		2019-04-21
2				
3				

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Contents

1. Introduction.....	1
2. Application Layer	1
2.1 Transmission Mode	1
2.2 Function Code	1
2.3 Error Code	2
3. Coil Register.....	3
3.1 Communication format	3
3.2 Data List.....	3
4. Discrete Input Register	4
4.1 Communication format	4
4.2 Data List.....	4
5. Input Register	5
5.1 Communication format	5
5.2 Data List.....	6
6. Holding Register	6
6.1 Communication Format.....	6
6.1.1 Read Register	6

6.1.2 Write Single Register.....	7
6.1.3 Write Multiple Registers	8
6.2 Register List	8
7. Write Single Coil	8
7.1 Communication Format.....	8
7.2 Register List	9

1. Introduction

This document describes the protocol for command control and data exchange between air conditioner and monitoring module. The prescribed functions mainly include:

- 1> The host computer obtains the relevant information of air conditioner by sending the read command;
- 2> The host computer sets related parameters and action control by writing commands.

2. Application Layer

2.1 Transmission Mode

Standard MODBUS RTU communication protocol is adopted Communication baud rate is 9600, 8 data bits, 1 stop bit, no parity bit.

2.2 Function Code

This protocol supports the following function codes:

Command Code	Description
0x01	Read coils
0x02	Read discrete inputs
0x03	Read holding registers

0x04	Read input register
0x10	Write multiple holding registers
0x06	Write single holding register

2.3 Error Code

Error Code	Definition	Meaning
0x01	Illegal function	The function code received in the query is not an allowable action for the server(or slave).
0x02	Illegal data address	The data address received in the query is not an allowable address for the device.
0x03	Illegal data value	A value contained in the query data field is not an allowable value for device.
0x04	Slave device failure	An unrecoverable error occurred while the device was attempting to perform the requested action.
0x06	Slave device busy	Device is engaged in processing a long-duration program command
0x0C	CRC check failure	CRC check failure

The slave exception response format is as follows:

No.	0	1	2	3	4
Definition	ADDR	CMD +128	Error Code	LSB	MSB
Description	Address	Command+128	Error Code	CRC check	

3. Coil Register

3.1 Communication format

Format of data sent by master

No.	0	1	2	3	4	5	6	7
Definition	ADDR	0x01	MSB	LSB	MSB	LSB	LSB	MSB
Description	Address	Command	Start register address		Register number		CRC check	

Format of the normal response data from slave

No.	0	1	2	3	4	...	L+2	L+3	L+4
Definition	ADDR	0x01	Length	Data1	Data2	...	DataL	LSB	MSB
Description	Address	Command	Number of sent bytes: L	Register data bits				CRC check	

If n is a multiple of 8: $L=n/8$

If n is not a multiple of 8: $L=n/8+1$

3.2 Data List

No.	Parameter	Address	Data type	Note
1	Internal fan state	0x0000	Bit	1:Runing 0:Stop
2	External fan state	0x0002	Bit	1:Runing 0:Stop
3	Cooing state	0x0004	Bit	1:Runing 0:Stop
4	Heating state	0x0005	Bit	1:Runing 0:Stop
5	Self-check state	0x000B	Bit	1:Runing 0:Stop
6	Machine state	0x000C	Bit	1:Runing 0:Stop

4. Discrete Input Register

4.1 Communication format

Format of data sent by master

No.	0	1	2	3	4	5	6	7
Definition	ADDR	0x02	MSB	LSB	MSB	LSB	LSB	MSB
Description	Address	Command	Start register addr.		Register number: n		CRC check	

Format of the normal response data from slave

No.	0	1	2	3	4	...	L+2	L+3	L+4
Definition	ADDR	0x02	Length	Data1	Data2	...	DataL	LSB	MSB
Description	Address	Command	Number of sent bytes: L	Register data bits				CRC check	

If n is a multiple of 8: $L=n/8$

If n is not a multiple of 8: $L=n/8+1$

4.2 Data List

No.	Parameter	Address	Data type	Note
1	Internal fan alarm	0x0000	Bit	1: alarm; 0: normal
2	External fan alarm	0x0002	Bit	1: alarm; 0: normal
3	Compressor fault	0x0004	Bit	1: alarm; 0: normal
4	Heater overload alarm	0x0008	Bit	1: alarm; 0: normal
5	Heater underload alarm	0x0009	Bit	1: alarm; 0: normal
6	Return air temp. sensor fault	0x000A	Bit	1: alarm; 0: normal

7	Condenser temp. sensor fault	0x000B	Bit	1: alarm; 0: normal
8	High DC voltage alarm	0x000C	Bit	1: alarm; 0: normal
9	Low DC voltage alarm	0x000D	Bit	1: alarm; 0: normal
10	Inside high temperature alarm	0x000E	Bit	1: alarm; 0: normal
11	Inside low temperature alarm	0x000F	Bit	1: alarm; 0: normal
12	High pressure alarm	0x0010	Bit	1: alarm; 0: normal
13	Door alarm	0x0012	Bit	1: alarm; 0: normal
14	Water alarm	0x0013	Bit	1: alarm; 0: normal
15	Smoke alarm	0x0014	Bit	1: alarm; 0: normal

5. Input Register

5.1 Communication format

Format of data sent by master

No.	0	1	2	3	4	5	6	7
Definition	ADDR	0x04	MSB	LSB	MSB	LSB	LSB	MSB
Description	Address	Command	Start register addr.		Register number: n		CRC check	

Format of the normal response data from slave

No.	0	1	2	3	4	5	6	...	L+1	L+2	L+3	L+4
Definition	ADDR	0x04	Length	MS B	LS B	MS B	LS B	...	MS B	LS B	LS B	MS B
Description	Address	Command	Number of sent bytes: $L=n*2$	Register 1		Register 2		...	Register n		CRC check	

5.2 Data List

No.	Parameter	Unit	Address	Data type	Note
1	Internal fan speed	RPM	0x0000	2 bytes unsigned integer	Data=Actual value
2	External fan speed	RPM	0x0002	2 bytes unsigned integer	Data=Actual value
3	Return air temperature	°C	0x0004	2 bytes signed integer	Data=Actual value*10
4	DC power voltage	V	0x0006	2 bytes unsigned integer	Data=Actual value*10
5	Heater current	A	0x000A	2 bytes unsigned integer	Data=Actual value*100
6	Condenser temperature	°C	0x000D	2 bytes signed integer	Data=Actual value*10

6. Holding Register

6.1 Communication Format

6.1.1 Read Register

Format of data sent by master

No.	0	1	2	3	4	5	6	7
Definition	ADDR	0x03	MSB	LSB	MSB	LSB	LSB	MSB
Description	Address	Command	Start register addr.		Register number n		CRC check	

Format of the normal response data from slave

No.	0	1	2	3	4	...	L+1	L+2	L+3	L+4
Definition	ADDR	0x03	Length	MS B	LS B	...	MS B	LS B	LS B	MS B
Description	Address	Command	Send number $L=n*2$	Register 1		...	Register n		CRC	

6.1.2 Write Single Register

Format of data sent by master

No.	0	1	2	3	4	5	6	7
Definition	ADDR	0x06	MSB	LSB	MSB	LSB	LSB	MSB
Description	Address	Command	Register address		Data		CRC check	

Format of the normal response data from slave

No.	0	1	2	3	4	5	6	7
Definition	ADDR	0x06	MSB	LSB	MSB	LSB	LSB	MSB
Description	Address	Command	Register address		Data		CRC check	

6.1.3 Write Multiple Registers

Format of data sent by master

No.	0	1	2	3	4	5	6	7	8	...	L+5	L+6	L+7	L+8
Definition	ADDR	0x10	MS B	LS B	MS B	LS B	Length	MS B	LS B	...	MS B	LS B	LS B	MS B
Description	Address	Com man d	Start register address	Number: n		L = n*2 Send number	Register 1		...	Register n		CRC check		

Format of the normal response data from slave

No.	0	1	2	3	4	5	6	7
Definition	ADDR	0x10	MSB	LSB	MSB	LSB	LSB	MSB
Description	Address	Command	Start register address		Register number		CRC check	

6.2 Register List

No.	Parameter	Unit	Address	Data type	Note
1	Heater starting temperature	°C	0x0016	2 bytes signed integer	Data=Actual value*10
2	Heater stop return difference temperature	°C	0x0017	2 bytes signed integer	Data=Actual value*10
3	Communication address	/	0x001B	2 bytes unsigned integer	Data=Actual value
4	Cabinet inside high temperature limit	°C	0x001C	2 bytes signed integer	Data=Actual value*10
5	Cabinet inside low temperature limit	°C	0x001D	2 bytes signed integer	Data=Actual value*10
6	Door alarm option	/	0x0025	2 bytes unsigned integer	0-Diable;1-NO;2-NC
7	High DC voltage alarm value	V	0x0026	2 bytes unsigned integer	Data=Actual value*10
8	Low DC voltage alarm value	V	0x0027	2 bytes unsigned integer	Data=Actual value*10
9	Compressor starting temperature	°C	0x0028	2 bytes signed integer	Data=Actual value*10
10	Compressor stop return difference temperature	°C	0x0029	2 bytes signed integer	Data=Actual value*10

7. Write Single Coil

7.1 Communication Format

Format of data sent by master

No.	0	1	2	3	4	5	6	7
Definition	ADDR	0x05	MSB	LSB	MSB	LSB	LSB	MSB
Description	Address	Command	Register address		Data		CRC check	

Format of the normal response data from slave

No.	0	1	2	3	4	5	6	7
Definition	ADDR	0x05	MSB	LSB	MSB	LSB	LSB	MSB
Description	Address	Command	Register address		Data		CRC check	

7.2 Register List

No.	Parameter	Data	Address	Date type
1	Remote turn on/off air conditioner	0xFF00 ON 0x0000 OFF	0x000C	2 bytes unsigned integer
2	Restore default	0xFF00	0x0014	2 bytes unsigned integer