**355**

# AMB Smart Direct-current Bus Bar Monitor

Installation and Operation Instruction V1.3

Acrel Co., Ltd.

# Declaration



The company reserves the right to modify the specifications described in this manual without prior notice.Before ordering,please consult your local agent for new specifications.

Contents

1. Overview........1

2. Product models........1

3. Technical parameters........1

4. Overall structure and dimensions........2

4.1 Overall dimensions........2

4.2 Installation instructions........6

5. Wiring instructions........7

5.1 Terminals, voltage and current connection........8

5.2 Auxiliary connections........10

6. Operation guide........11

6.1 Meaning of LED indications........11

6.2 Buzzer........11

6.3 Alarm setting........11

6.4 Centralized monitoring........11

6.5 Functions of control buttons........12

6.6 Display screens........12

6.7 Data setting on the display........13

7. Communication guide........13

7.1 General information........13

7.2 Protocol........14

7.3 Error check methods........15

7.4 Communication application........15

7.5 Communication protocol........16

8. Precautions........26

9. Diagnostics and troubleshooting of common faults........26

## 1. Overview

AMB Smart Direct-current Bus Bar Monitor is a new development to cater for smart power bus bar. It consists of a feeding detection module and a tapping detection module and integrates functions of conventional power measurements, electricity monitoring, consumption assessment and control. It also boasts the online alarm function and enables the independent off-line operation. It monitors the bus bar interface temperature in real time.

By virtue of 2 RJ45 communication ports (1 in and 1 out) and MODBUS-RTU protocol, it is easy and reliable to upload the monitoring data to the touch screen of the main controller for centralized monitoring, ensuring safe and reliable operation of the system. The smart bus bar monitor has several benefits such as flexible and convenient wiring so that it is a good substitution of the traditional centralized array cabinet.

## 2. Product models

| Model | Standard functions | Optional functions |
|---|---|---|
| AMB 100-D | Full electrical measurements of one DC circuit, 3 leakage current, 4-way temperature, 1-way humidity,4 digital inputs,2 digital outputs, discrete auxiliary power supply | /W(LORA) |
| AMB 100-D-P1 | | |
| AMB 110-D | Full electrical measurements of three DC circuits,3 leakage current, 4-way temperature , 1 humidity detection, 4 digital inputs, 2 digital outputs, discrete auxiliary power supply | |
| AMB 110-D-P1 | | |

Note 1. AMB=bus bar series; 100= for feeding cabinet; 110= for tapping cabinet; D= for direct-current system; P1= discrete auxiliary power supply

Note 2. AMB10 display is optional. There are two variants, i.e. AMB10(F) with the front port and AMB10(B&DZ) with the rear port. It shows the voltage and the current in an automatic cycle.

Note 3. For optional LORA function, an external magnetic antenna is equipped. The standard length is 2 m.

Note 4. The standard version is equipped with 1m-length harness to which maximum 3 Hall transducers are connected. The yellow wire must be used if just one Hall transducer is connected.

Note 5. For temperature sensors, there are two round-hole variants, namely 12mm-hole variant and 8mm-hole variant, and one 6mm-cylindrical variant. Each variant includes yellow, green, red and black sensors.

## 3.Technical parameters

| Technical parameters | | AMB100-D-□/AMB110-D-□ |
|---|---|---|
| Measured parameters | | Voltage, current, power, electric energy, on/off status |
| Voltage | Rated value | 48VDC, 240VDC, 336VDC |
| | Range | ±20% |
| | Overloading | 1.2 times than the rated voltage value continuously or 2 times than the rated voltage value instantaneously per second |
| Current | CT | 5V (Hall transducer) |
| | Range | |
| | Overloading | 1.2 times than the rated current value continuously or 10 times than the rated current value instantaneously per second |
| Measurement accuracy | | Voltage/current: grade 0.5; power/energy: grade 1.0 |

<table>
<tr><td colspan="2">Auxiliary power supply</td><td>AMB100/110-D(/W): triggered upon receipt of request signal<br>AMB100/110-D(/W)-P1: follow the bus bar voltage</td></tr>
<tr><td rowspan="5">Functions</td><td>Temperature detection</td><td>-20-150℃</td></tr>
<tr><td>Leakage</td><td>5VDC, 3 leakage inputs</td></tr>
<tr><td>Digital input</td><td>4 dry-contact inputs</td></tr>
<tr><td>Digital output</td><td>2 relay outputs; contact capacity: 3A/30VDC, 3A/250VDC</td></tr>
<tr><td>Communication</td><td>Via RS485/Modbus-RTU or LORA antenna</td></tr>
<tr><td colspan="2">Installation</td><td>Use DIN35mm rail</td></tr>
<tr><td colspan="2">Protection</td><td>IP20</td></tr>
<tr><td colspan="2">Pollution level</td><td>2</td></tr>
<tr><td>Environment</td><td>Temperature/ humidity/ altitude</td><td>Working temperature: -20-+60℃<br>Storage temperature: -25-+70℃<br>Relative humidity: ≤93%<br>Altitude: ≤2500m</td></tr>
<tr><td rowspan="2">Safety</td><td>Insulation</td><td>The minimum insulation resistance between all terminals and conductive components of the shell is 100MΩ.</td></tr>
<tr><td>Withstanding voltage</td><td>When a voltage of 2kV AC is applied between the voltage/ current input, relay output, RS485 port, auxiliary power supply and digital inputs, the leakage shall be less than 2mA and no breakdown or flashover shall occur in 1min..</td></tr>
<tr><td rowspan="4">Electromagnetic immunity</td><td>Electrostatic discharge immunity</td><td>Class 4</td></tr>
<tr><td>Radio frequency electromagnetic immunity</td><td>Class 3</td></tr>
<tr><td>Transient burst immunity</td><td>Class 4</td></tr>
<tr><td>Surge immunity</td><td>Class 4</td></tr>
</table>

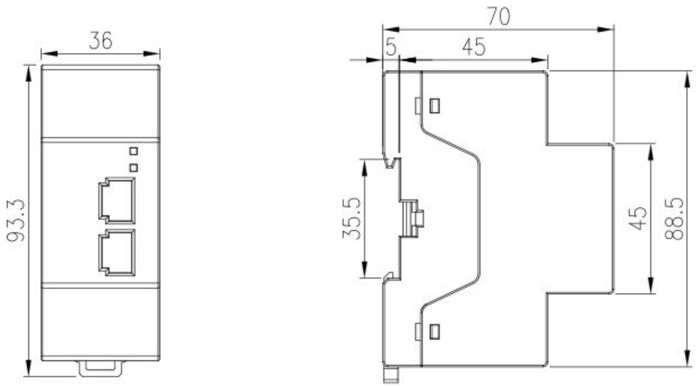
Note 1. Hall leakage transducer must be equipped with auxiliary power supply.

Note 2. The electric energy is added in 5A/5V. Operate the touch screen to view the electric energy at the primary side, if desired.

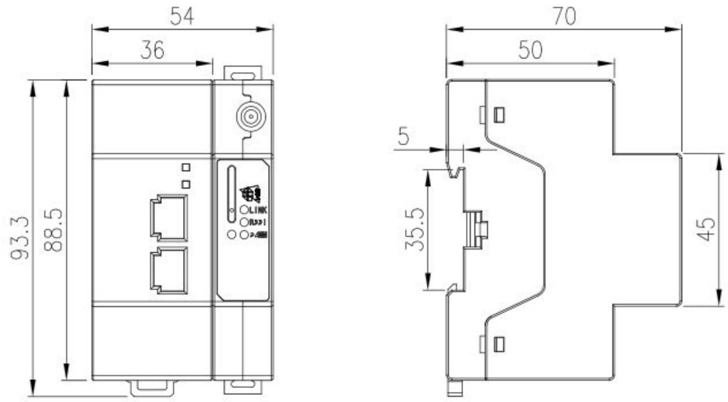
## 4. Overall structure and dimensions

4.1 Overall dimensions

1) AMB smart bus bar detection module　　　　　　　　　　　　Unit: mm




RS485/Modbus-RTU Communication



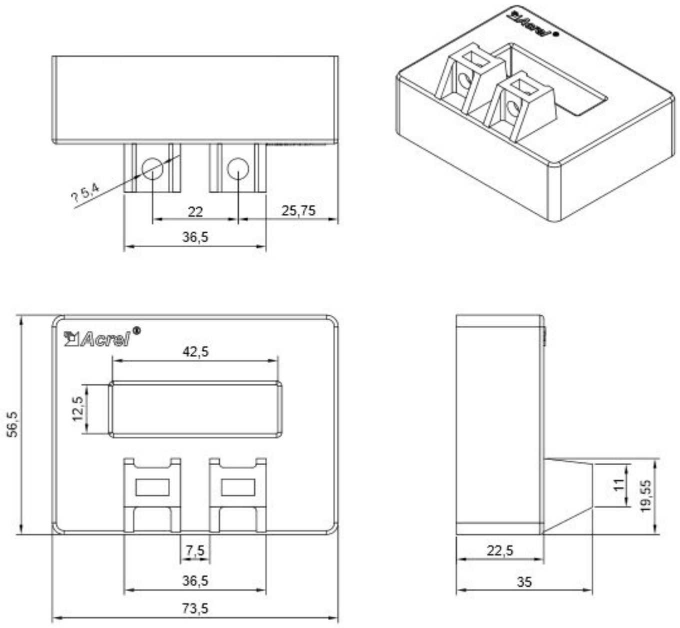

LORA Communication

Note 1. For LORA communication, the space shall be reserved for antenna.

Note 2. An external auxiliary power supply is not required for LORA module.

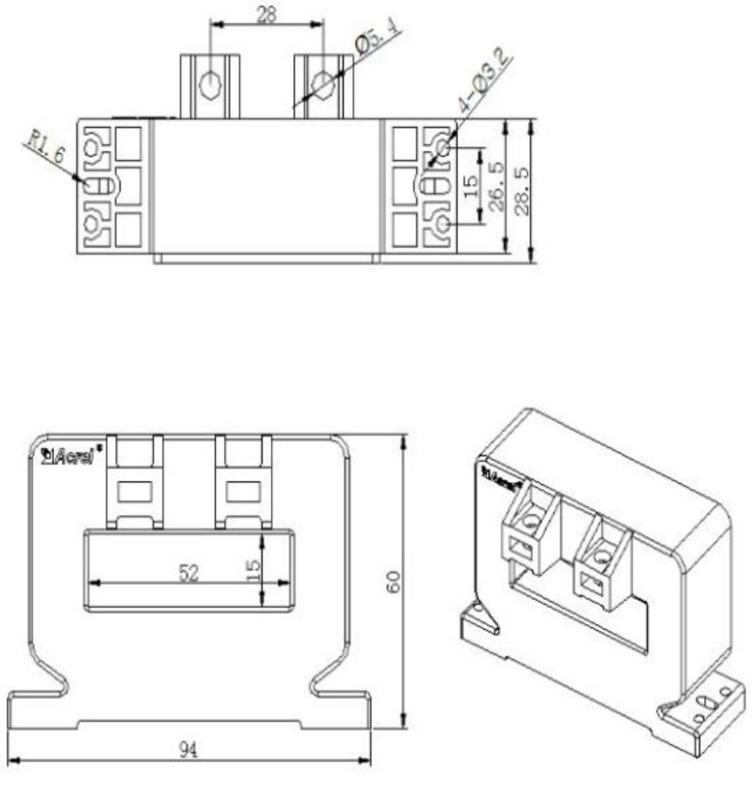
2) Hall transducer

| Monitor model | Ancillary transducer |
|---|---|
| AMB100-D | AHKC-FA 1000A/5V |
| | AHKC-F 800A/5V |
| | AHKC-F 500A/5V |
| AMB110-D | AHKC-BS 100A/5V |



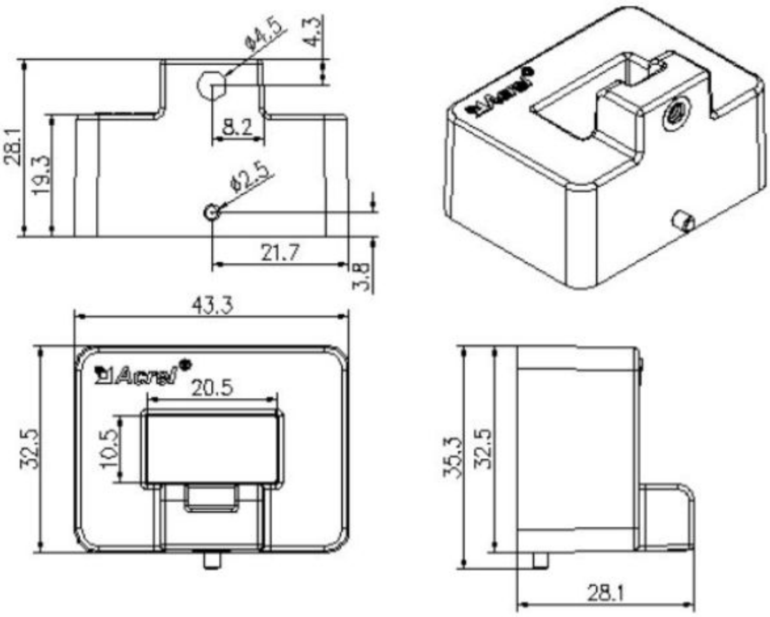

Dimensions of AHKC-F Hall transducer

Unit: mm



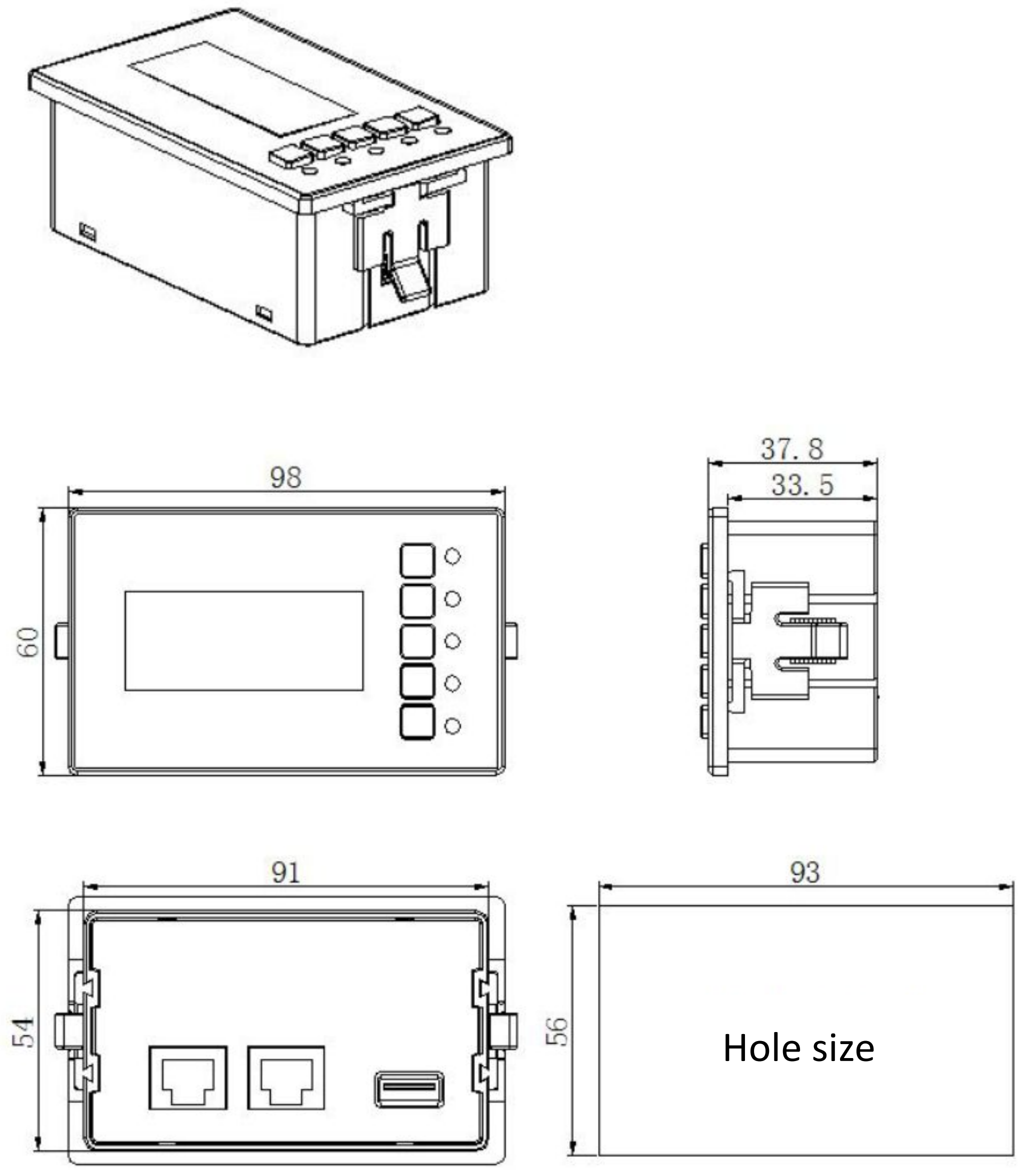

Dimensions of AHKC-FA Hall transducer

Unit: mm

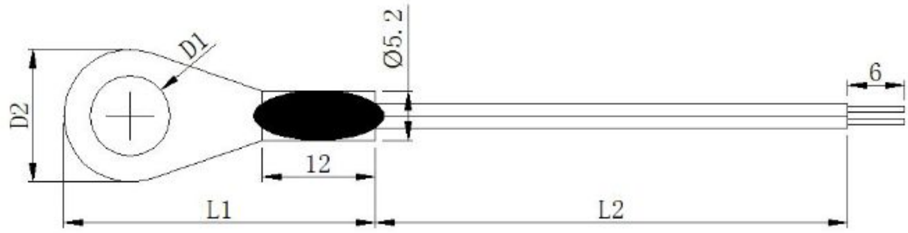


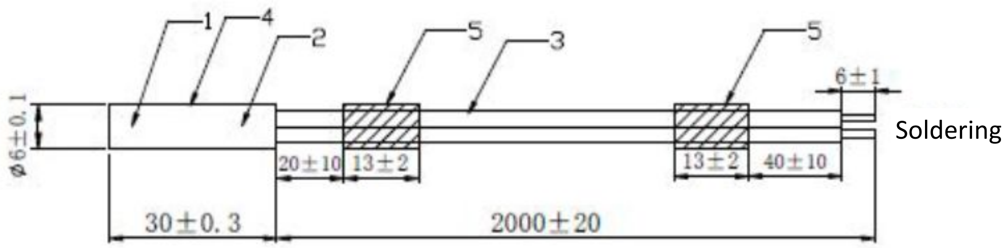

Dimensions of AHKC-BS Hall transducer

3) AMB10 display (unit: mm)



4) Temperature sensor (unit: mm)



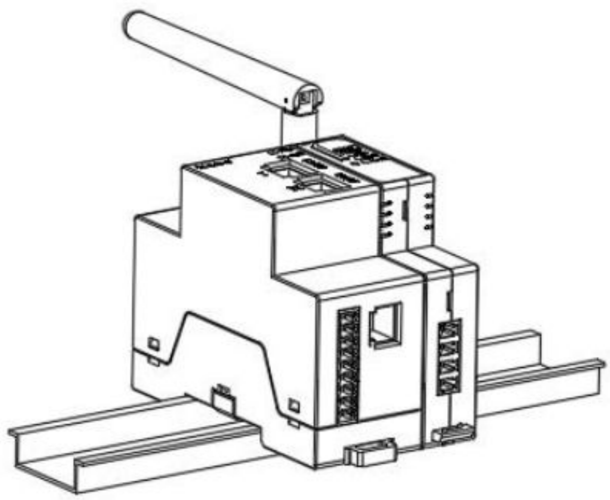




| Temperature sensor | End | | | Wire length | Suggested use |
|---|---|---|---|---|---|
| | D1 | D2 | L1 | L2 | |
| 12mm hole | 12.5 | 18 | 35 | 2000 or 4000 | With M10 and M12 screws |
| 8mm hole | 8.5 | 14 | 33 | | With M6 and M8 screws |
| 6mm diameter | 6.5 | 12 | 30 | 2000 | Insert in the connection gap |

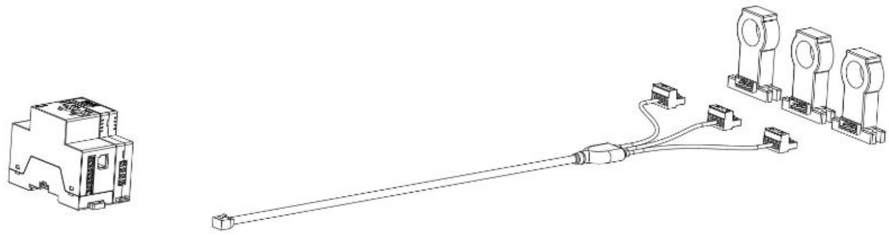
Note: For each temperature sensor variant, there are yellow, green, red and black types, corresponding to phases A, B, C and N.

4.2 Installation instructions

The AMB detection module is installed on DIN35mm rails and equipped with thru-hole Hall transducer. The side with the connector is connected to Current directly.

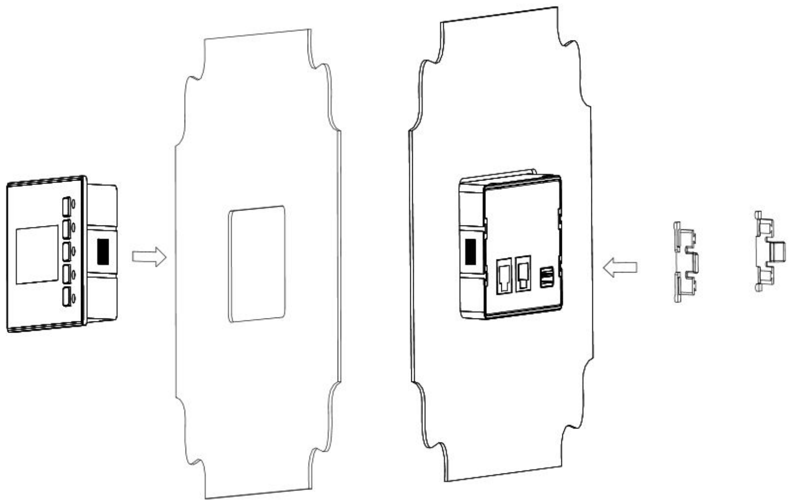


Rail-installed Type

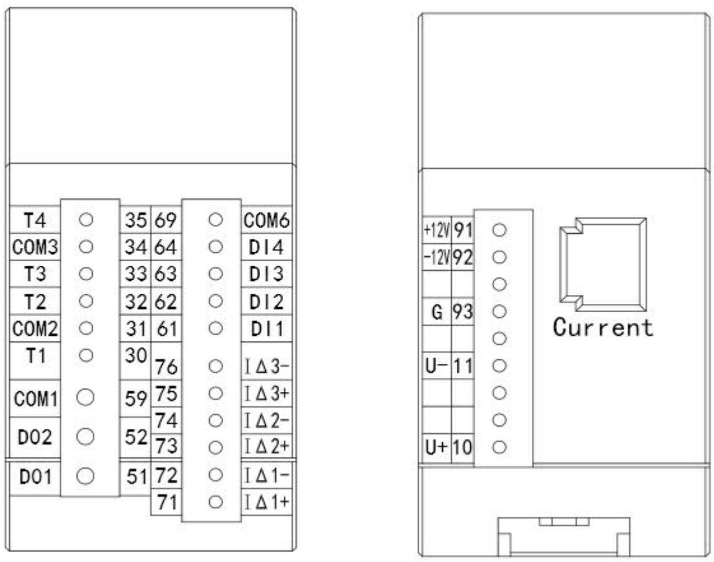


Installation of Hall Transducer

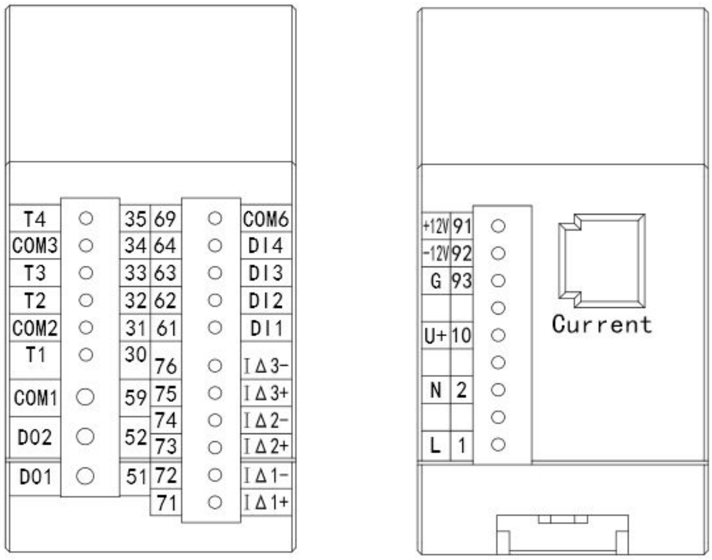
AMB display is flush-mounted. Align the display with the mounting holes, insert clips and secure the display.



## 5. Wiring instructions

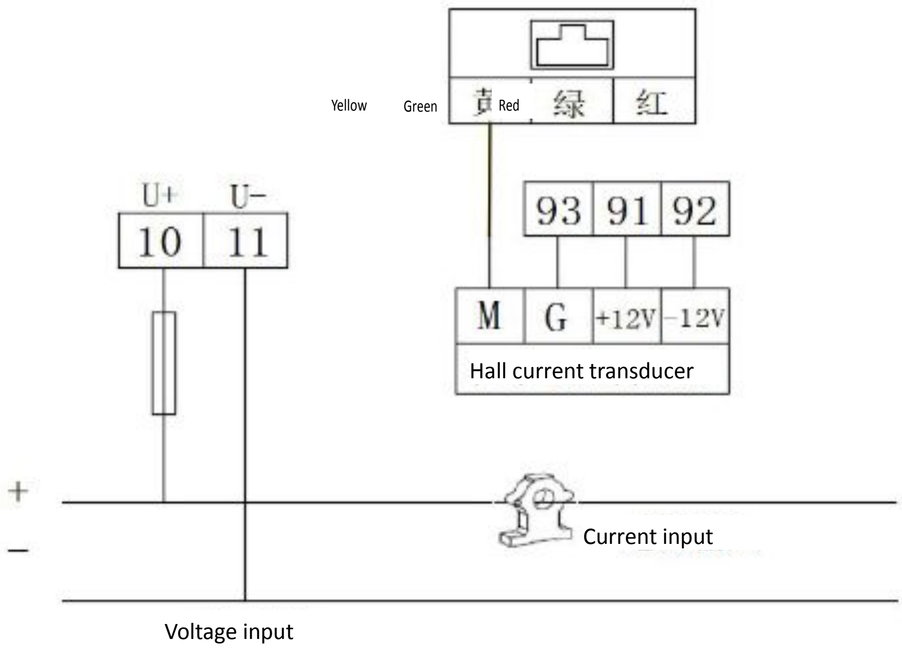



AMB1X0-D(/W) Triggered upon Receipt of Request Signal

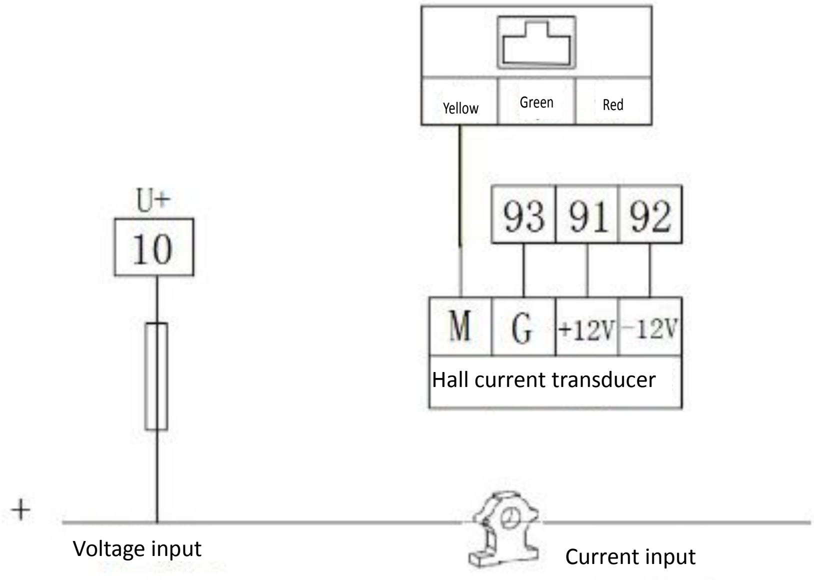



AMB1X0-D(/W)-P1 Discrete Auxiliary Power Supply

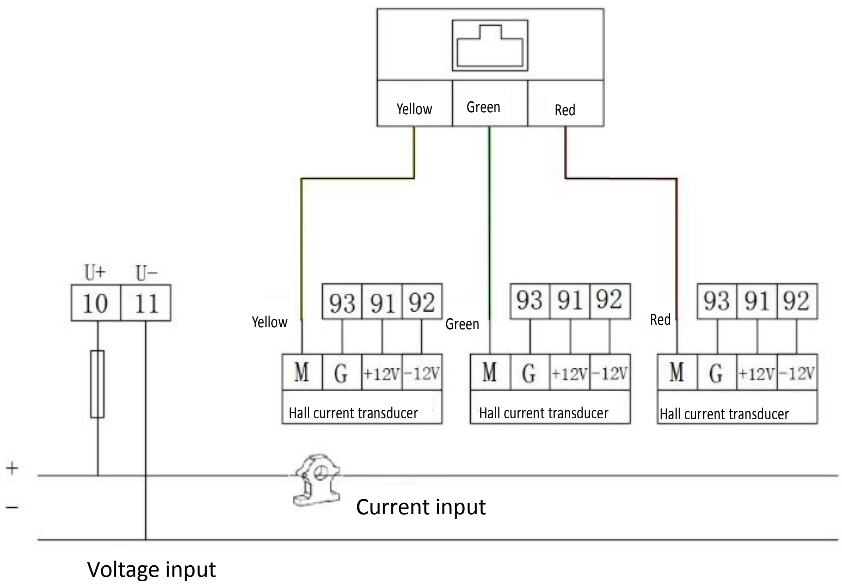
5.1 Voltage, current and transducer connection



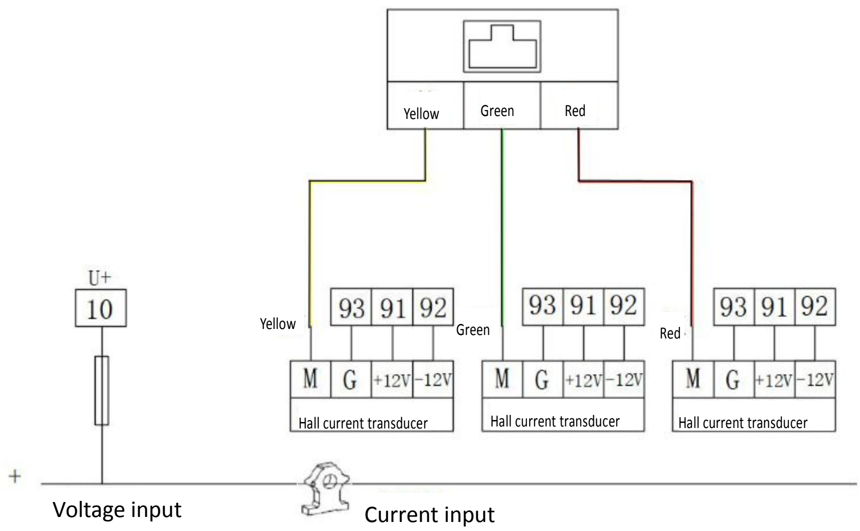

Current > 630A




Current < 630A

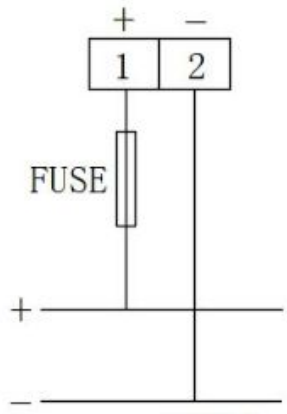



Current > 630A



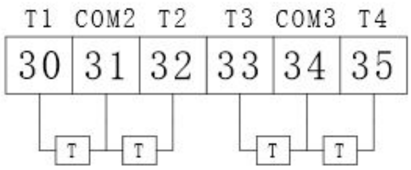

Current < 630A

5.2 Mains and auxiliary power supply connections

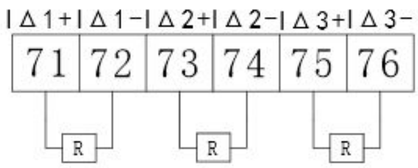



Voltage input

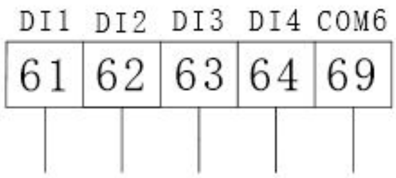
AMB1X0-D(/W)-P1 Auxiliary Power Supply



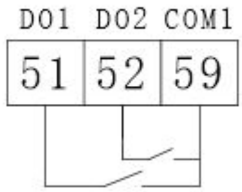

Temperature input




Leakage input




Digital input




Relay output

5.2.1 Temperature sensor connection

Temperature sensors shall be used to measure temperatures T1 to T4. They are NTC R25=50k (4150) thermistors. They send the monitoring signals for temperature between -20℃ and 150℃ and monitor the cable temperature.

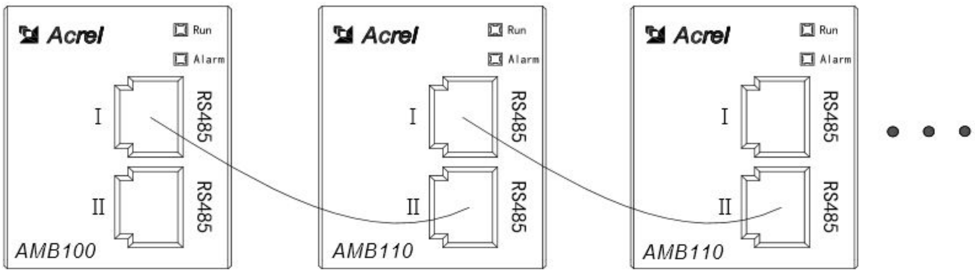
Note: Temperature sensors shall be secured firmly to prevent it from short circuiting after fall.

5.2.2 Network shielded wire connection

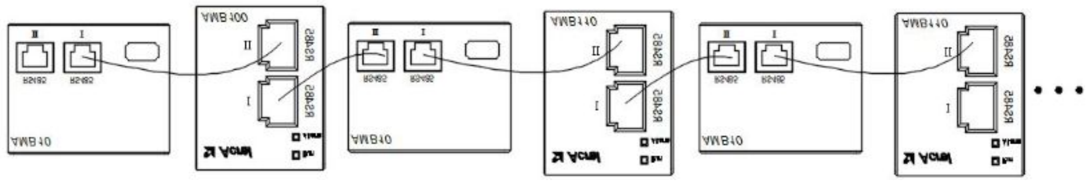
The communication port shall be connected with RJ45 network shielded wire. To connect different detection modules, it is necessary to connect RS485(I) of a module to RS485(II) of the other module. To connect a detection module with a display, RS485(II) of the module shall be connected to RS485(I) of the display. For RJ45, two wires are adequate since MODBUS-RTU protocol is applied. Keep the copper strips of connector upward. These copper strips are numbered 1 to 8 from left to right. B is presented as 1 while A is presented as 2.


RJ45 connector

Note: It is not available if LORA is activated.



Connection of Detection Modules


Connection of Detection Module with Display

## 6. Operation guide

6.1 Meaning of LED indications

On an AMB smart monitor of data center are two LEDs, Run and Alarm, indicating the monitor status. When Run turns green, it indicates that the monitor works normally. This LED flashes every 0.5 second.

When Alarm turns red, it indicates that the monitor fails. This LED flashes every 0.5 second.

6.2 Buzzer

6.2.1 Buzzer activation/ deactivation

The buzzer is activated or deactivated according to the communication parameter setting. Refer to 7.5, Communication Parameter Address List.

Set “1” to activate the buzzer and “0” to deactivate the buzzer.

The buzzer is activated by default.

6.2.2 Buzzer setting

After being activated, the buzzer alarm can be cleared according to the communication parameter setting. Refer to 7.5, Communication Parameter Address List.

Set “0x8801” to clear the current alarm. The buzzer alarm will be activated again if another alarm status occurs.

6.3 Alarm setting

AMB smart monitor boasts the online alarm function. Provide DO output and 2-stage over-current alarm by one buzzer. Enable the discrete running beyond the system. There is an on/off fault alarm (activated in 1s after the monitor is switched on or off) and an over-temperature alarm. It can also record the alarm time.

Set the specific alarm threshold according to the communication parameter setting. Refer to 7.5, Communication Parameter Address List.

Read the specific alarm status according to the communication parameter setting. Refer to the column “Alarm status” in 7.5, Communication Parameter Address List.

6.4 Centralized monitoring

Centrally acquire and monitor the data of 80-tap tapping cabinet. Acquire and show the electric parameters of each tap. Upload all acquired data to the power environment monitoring system.

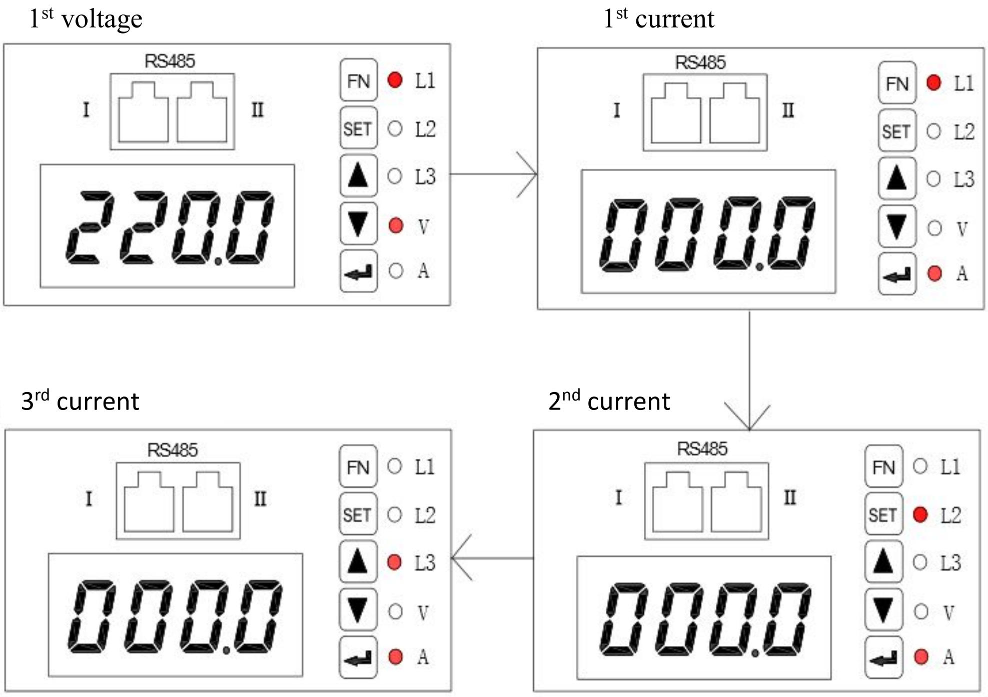
Furthermore, monitor the temperature at the bus bar connection in a real-time manner. By virtue of 2 RJ45 communication connectors (1 in and 1 out) and MODBUS-RTU protocol, it is easy and secure to upload the monitored data to the main controller and the background system, ensuring the safe and reliable running of the system.

6.5 Functions of control buttons

| Symbol | Designation | Functions |
|---|---|---|
| FN | FN | Unavailable |
| SET | SET | Select a function, switch over to another function or save the selected function, or back to the last menu |
| ▲ | Up | Submenu parameters - |
| ▼ | Down | Submenu parameters + |
| ↵ | Enter | Enter the next menu or confirm the selection |

6.6 Display screens

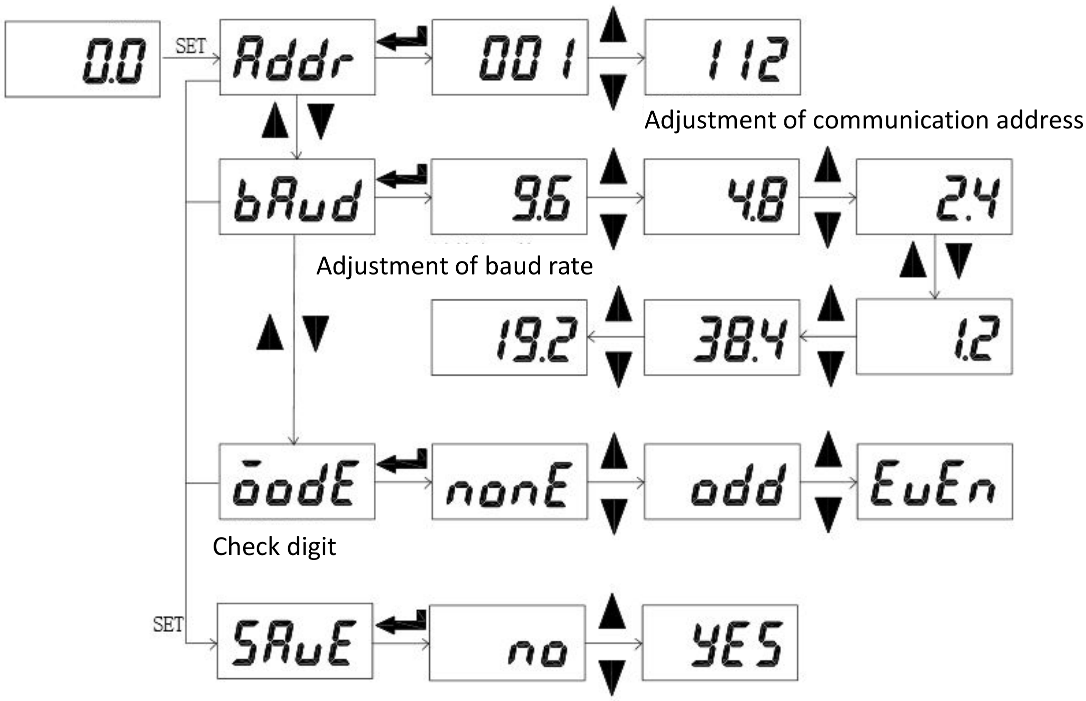
Measurement screens. After being powered, the display will show the voltage and the current in an automatic cycle. These screens change in the following order:




For this direct-current instrument, there are one voltage and three currents. L1, L2 and L3 correspond to the currents. The current is 0A by default if not being matched.

Control screens.

Voltage/ current screens.




To adjust the communication address, press SET under any item on the screen, enter “Addr” and then press ↵ and ▲ or ▼. To adjust the baud rate, press ↵ to return to “Addr” and then press ▲ or ▼. To look over the check digit, press ↵ to return to “Baud rate” and then press ▲ or ▼. Press SET to enter “Save”. Press ↵ to enter “NO”. Press ▲ or ▼ to enter “YES”. Press ↵ to return to the main screen. For adjustment of the communication address, press ▼ to adjust unit parameters and ▲ for switchover of various parameters.

6.7 Data setting on the display

Following menus can be set on display screens:

| Function screen | Description |
| --- | --- |
| Addr | RS485 communication address |
| bAUd | RS485 and RS645 communication baud rate |
| nodE | RS485 and RS645 communication modes<br>(no parity, odd parity, even parity) |
| 13bb | Software No. |
| 1.00 | Software version |

## 7. Communication guide

7.1 General information

AMB smart monitor implements Modbus-RTU protocol “9600, 8, 1, n”. “9600” is the baud rate by default and can be changed to 2400, 4800, 19200 or others via communication. Refer to 7.5, Communication Parameter

Address List. “8” indicates 8 data bits. “n” indicates no parity. “1” indicates one stop bit.

Error check: CRC16 (cyclic redundancy check)

7.2 Protocol

AMB smart direct-current monitor employs the communication protocol that defines the data sequence meaning of address digit, function digit and check digit in details. They are necessary for specific data exchange. According to this protocol, one communication line connects a master unit and slave units (half-duplex). It means that signals are transmitted in two opposite directions of a communication line. Signals from the master unit are transmitted to an exclusively-addressed terminal unit (slave) and then responses are transmitted from the terminal unit back to the master unit in the opposite direction. When reaching the addressed terminal unit, a data frame will enter it through a simple “port”. In this unit, the envelope of the data frame (data header) is removed and the contained data is read. If there is no error, the request of data will be executed. Then the terminal unit will generate and input its data into the removed envelope and return the data frame to the sender. The response data returned contains: the address of terminal slave unit (Address), the function executed (Function), requested data generated from the function (Data) and a CRC check digit (Check). If there is any error, no response will be made or an error indication frame will be returned.

7.2.1 Data frame format

| Address | Function | Data | Check |
|---|---|---|---|
| 8-Bits | 8-Bits | Nx8-Bits | 16-Bits |

7.2.2 Address field

A data frame starts from address field that consists of one byte (8-Bits, 8 binary codes). It is from 0 to 255 in decimal, in which 1 to 247 is used in our system and the rest is reserved. It indicates the address of a terminal unit that user designates to receive the data from the master unit. The address of each terminal unit of one bus must be exclusive. Except for the addressed terminal unit, other terminal units will not respond to an inquiry containing its address. When the terminal unit returns a response, the master unit will identify it according to the slave address contained in the response signal.

7.2.3 Function field

The function field indicates the function to be executed by the addressed terminal unit. The following list gives all function codes used by AMB series as well as the meaning and role.

| Code (hexadecimal system) | Meaning | Behavior |
|---|---|---|
| 03H | Read the holding register | Acquire the current binary value from one or several holding registers |
| 16H | Preset multiple registers | Load a specific binary value into a series of holding registers |

7.2.4 Data field

The data field contains the data that is required for a terminal unit to execute a specific function or acquired by a terminal unit in response to inquiries. The data may be values, parameter addresses or set values.

When the function field requests a terminal unit to read a register, for example, the data field shall indicate the first register and the size of data to read. Content of the embedded address and the data depends on the type and the slave unit.

7.2.5 Error check (Check) field

The check field employs CRC16 check and enables both master unit and terminal unit to check transmission errors. When being transmitted from one unit to another unit, a set of data may change partly because of electrical noise or other interferences. In such case, the error check ensures that neither master unit nor slave unit responds to such change, improving the system safety, reliability and efficiency.

7.3 Error check methods

The error check (CRC) field occupies two bytes and contains one 16-bits binary value. A CRC value is calculated in the transmitting unit and loaded to the data frame. After receiving the data, the receiving unit will make a calculation again and compare the calculated CRC value with the received one. If they are different, it indicates that there is an error.

For CRC calculation, preset 1 at all bits of a 16-bits register and then operate 8 bits of each byte in the data frame and the current value of the register continuously. It is only 8 data bits of each byte to participate in CRC generation. The start bit, stop bit or parity bit, if any used, will not have an influence on CRC. After such 8 bits and the register content are operated by XOR for CRC generation, move the result to the lower bits and fill the higher bits with 0. Shift out and detect the lowest bit (LSB). If the lowest bit is 1, operate the register and a preset fixed value (0A001H) by XOR. If it is 0, no processing is required. Repeat these steps until all of eight bits shift. After the last bit ($8^{th}$ bit) of the current byte shifts, operate the next 8-bits byte and the current register value by XOR and implement the shifting of such 8 bits as before. CRC value is finally generated after all bytes in the data frame are processed.

CRC generation process:

1. Preset a 16-bits register to be 0FFFFH (1 at all bits) and name it CRC register.
2. Operate 8 bits of the first byte in the data frame and lower bits of CRC register by XOR and return the result to CRC register.
3. Move CRC register right by one bit. Fill the highest bit with 0. Shift out and detect the lowest bit.
4. If the lowest bit is 0, repeat step 3 (further movement). If the lowest bit is 1, operate the register and a preset fixed value (0A001H) by XOR.
5. Repeat steps 3 and 4 until eight movements complete. By then, all of 8 bits are processed.
6. Repeat steps 2 to 5 for the next 8 bits until all bytes are processed.
7. The final CRC register value is CRC value.

In addition, CRC value can be calculated by looking up table. This method is mainly characterized by quick calculation. However, a big memory is required. Please consult relevant data for more details.

7.4 Communication application

All examples in this section are basically in the following form (hexadecimal data).

| Addr | Fun | Data start | | Data # of | | CRC16 | |
|---|---|---|---|---|---|---|---|
| | | reg Hi | reg Lo | reg Hi | reg Lo | Lo | Hi |
| 01H | 03H | 00H | 00H | 00H | 06H | C5H | C8H |
| Address | Function code | Data start address | | Number of data read | | Cyclic redundancy check digit | |

7.4.1 Data reading

Example 1. Read the phase-A voltage

| | |
|---|---|
| Inquiry data frame | 01 03 00 30 00 02 65 cb |
| Return data frame | 01 03 04 43 5c 00 00 2f a5 |

Keys:

01: slave address

03: function code

04: hexadecimal system. It is 4 in decimal. Indicate that 4-bytes data is followed.

2f a5: cyclic redundancy check digit

Data processing method:

If the data is integral, such as 08 98 for hi-voltage alarm, convert the data into a decimal value in the following formula: (8*256+9*16+8)/10.

If the data is floating, such as 43 5c 00 00 for phase-A voltage, convert the data into a decimal value by using the floating conversion tool.

Read other information inquiry frame in the same way. For information address, please refer to 7.5, Communication Parameter Addresses of Single-phase Meter.

7.4.2 Data writing

Example 1. Edit the meter address

| | |
|---|---|
| Read-in data frame | 01 10 00 00 00 01 02 00 05 66 53 (address changed to 5) |
| Return data frame | 01 10 00 00 00 01 01 c9 (fail, no data frame returned) |

Example 2. Control the buzzer alarm function

| | |
|---|---|
| Read-in data frame | 01 10 00 27 00 01 02 00 00 A0 87 (buzzer alarm deactivated)<br>01 10 00 27 00 01 02 00 01 61 47 (buzzer alarm activated) |
| Return data frame | 01 10 00 28 00 01 81 c1 (fail, no data frame returned) |

7.5 Communication protocol

| Address | Address in decimal | Content | Data type | Bytes | Read/write | Remark |
|---|---|---|---|---|---|---|
| 0 | 0 | Address | uint16_t | 2 | R/W | 1-247 |
| 1 | 1 | Baud rate | uint16_t | 2 | R/W | 0:1200; 1: 2400; 2:4800; 3:9600 4:19200; 5:38400 |
| 2 | 2 | Check method | uint16_t | 2 | R/W | 0:8 N 1; 1:8 E 1; 2:8 0 1; 3:8 N 2 |
| 3 | 3 | Wiring method | uint16_t | 2 | R/W | Reserved |
| 4 | 4 | Voltage ratio | uint16_t | 2 | R/W | |
| 5 | 5 | Current ratio | uint16_t | 2 | R/W | Ratio of Hall transducer |
| 6 | 6 | Over-voltage alarm on/off | uint16_t | 2 | R/W | 0: off; 1: on |
| 7 | 7 | Over-voltage alarm setting | uint16_t | 2 | R/W | V |
| 8 | 8 | Under-voltage alarm on/off | uint16_t | 2 | R/W | 0: off; 1: on |
| 9 | 9 | Under-voltage alarm setting | uint16_t | 2 | R/W | V |
| A | 10 | Stage-1 over-current alarm on/off | uint16_t | 2 | R/W | 0: off; 1: on |
| B | 11 | Stage-1 over-current alarm setting | uint16_t | 2 | R/W | 0.1A |
| C | 12 | Stage-1 under-current alarm on/off | uint16_t | 2 | R/W | 0: off; 1: on |
| D | 13 | Stage-1 under-current alarm setting | uint16_t | 2 | R/W | 0.1A |

| | | | | | | |
|---|---|---|---|---|---|---|
| E | 14 | Stage-2 over-current alarm on/off | uint16_t | 2 | R/W | 0: off; 1: on |
| F | 15 | Stage-2 over-current alarm setting | uint16_t | 2 | R/W | 0.1A |
| 10 | 16 | Stage-2 under-current alarm on/off | uint16_t | 2 | R/W | 0: off; 1: on |
| 11 | 17 | Stage-2 under-current alarm setting | uint16_t | 2 | R/W | 0.1A |
| 12 | 18 | Over-power alarm on/off | uint16_t | 2 | R/W | 0: off; 1: on |
| 13 | 19 | Over-power alarm setting | uint16_t | 2 | R/W | 0.1kW |
| 14-17 | 20-23 | Reserved | | | | |
| 18 | 24 | Over-temperature alarm on/off | uint16_t | 2 | R/W | 0: off; 1: on |
| 19 | 25 | Over-temperature alarm setting | int16_t | 2 | R/W | 0.1°C |
| 1A | 26 | Under-temperature alarm on/off | uint16_t | 2 | R/W | 0: off; 1: on |
| 1B | 27 | Under-temperature alarm setting | int16_t | 2 | R/W | 0.1°C |
| 1C | 28 | Humidity alarm on/off | uint16_t | 2 | R/W | 0: off; 1: on |
| 1D | 29 | Humidity alarm setting | uint16_t | 2 | R/W | 0.10% |
| 1E | 30 | Leakage alarm on/off | uint16_t | 2 | R/W | 0: off; 1: on |
| 1F | 31 | Leakage alarm setting | uint16_t | 2 | R/W | 1mA |
| 20-23 | 32-35 | Reserved | | | | |
| 24 | 36 | Alarm delay time | uint16_t | 2 | R/W | 0.1S |
| 25 | 37 | Relay type | uint16_t | 2 | R/W | 0: remote control; 1: alarm |
| 26 | 38 | Digital input filtering | uint16_t | 2 | R/W | Number is written |
| 27 | 39 | Buzzer on/off | uint16_t | 2 | R/W | 0: off; 1: on |
| 28 | 40 | D01 | uint16_t | 2 | R/W | 0: open; 1: closed |
| 29 | 41 | D02 | uint16_t | 2 | R/W | 0: open; 1: closed |
| 2A | 42 | Buzzer alarm cleared | uint16_t | 2 | R/W | 0x8801 |
| 2B | 43 | Data cleared | uint16_t | 2 | R/W | 0x6601: energy |

| | | | | | | |
|---|---|---|---|---|---|---|
| | | | | | | cleared<br>0x6602: demand record cleared<br>0x6603: energy record cleared<br>0x6801:1st-channel zeroed<br>0x6802:2nd -channel zeroed<br>0x6803:3rd -channel zeroed<br>0x68ff:All channels zeroed |
| 2C | 44 | Year | uint16_t | 2 | R/W | |
| 2D | 45 | Month | uint16_t | 2 | R/W | |
| 2E | 46 | Day | uint16_t | 2 | R/W | |
| 2F | 47 | Hour | uint16_t | 2 | R/W | |
| 30 | 48 | Minute | uint16_t | 2 | R/W | |
| 31 | 49 | Second | uint16_t | 2 | R/W | |
| 32 | 50 | DI1 alarm on/off | uint16_t | 2 | R/W | 0: off; 1: on |
| 33 | 51 | DI2 alarm on/off | uint16_t | 2 | R/W | 0: off; 1: on |
| 34 | 52 | DI3 alarm on/off | uint16_t | 2 | R/W | 0: off; 1: on |
| 35 | 53 | DI4 alarm on/off | uint16_t | 2 | R/W | 0: off; 1: on |
| 36 | 54 | DI1 on/off status | uint16_t | 2 | R/W | 0: NO; 1: NC |
| 37 | 55 | DI2 on/off status | uint16_t | 2 | R/W | 0: NO; 1: NC |
| 38 | 56 | DI3 on/off status | uint16_t | 2 | R/W | 0: NO; 1: NC |
| 39 | 57 | DI4 on/off status | uint16_t | 2 | R/W | 0: NO; 1: NC |
| 3A | 58 | Open-phase alarm on/off | uint16_t | 2 | R/W | Reserved |
| 3B | 59 | Phase-sequence alarm on/off | uint16_t | 2 | R/W | Reserved |
| 3C | 60 | Open-phase voltage setting | uint16_t | 2 | R/W | Reserved |
| 3D | 61 | Cabinet over-temperature alarm on/off | uint16_t | 2 | R/W | 0: off; 1: on |
| 3E | 62 | Cabinet over-temperature alarm setting | uint16_t | 2 | R/W | 0.1°C |
| 3F | 63 | Cabinet under-temperature alarm on/off | uint16_t | 2 | R/W | 0: off; 1: on |
| 40 | 64 | Cabinet under-temperature alarm setting | uint16_t | 2 | R/W | 0.1°C |

| | | | | | | |
|---|---|---|---|---|---|---|
| 41 | 65 | Active switching alarm 1 on/off | uint16_t | 2 | R/W | 0: off; 1: on |
| 42 | 66 | Active switching alarm 2 on/off | uint16_t | 2 | R/W | 0: off; 1: on |
| 43 | 67 | Active switching alarm 3 on/off | uint16_t | 2 | R/W | 0: off; 1: on |
| 44 | 68 | Active switching alarm 1 setting | uint16_t | 2 | R/W | V |
| 45 | 69 | Active switching alarm 2 setting | uint16_t | 2 | R/W | V |
| 46 | 70 | Active switching alarm 3 setting | uint16_t | 2 | R/W | V |
| 47-4F | 71-79 | Reserved | | | | |
| 50 | 80 | Bus bar voltage | float | 4 | R | V |
| 51 | 81 | | | | | |
| 52 | 82 | Bus bar voltage | float | 4 | R | V |
| 53 | 83 | | | | | |
| 54 | 84 | Bus bar voltage | float | 4 | R | V |
| 55 | 85 | | | | | |
| 56-5F | 86-95 | Reserved | | | | |
| 60 | 96 | 1st-channel current | float | 4 | R | A |
| 61 | 97 | | | | | |
| 62 | 98 | 2nd-channel current | float | 4 | R | A |
| 63 | 99 | | | | | |
| 64 | 100 | 3rd-channel current | float | 4 | R | A |
| 65 | 101 | | | | | |
| 66 | 102 | 1st-channel leakage | float | 4 | R | A |
| 67 | 103 | | | | | |
| 68 | 104 | 2nd-channel leakage | float | 4 | R | mA |
| 69 | 105 | | | | | |
| 6A | 106 | 3rd-channel leakage | float | 4 | R | A |
| 6B | 107 | | | | | |
| 6C | 108 | 1st-channel power | float | 4 | R | W |
| 6D | 109 | | | | | |
| 6E | 110 | 2nd-channel power | float | 4 | R | W |
| 6F | 111 | | | | | |
| 70 | 112 | 3rd-channel power | float | 4 | R | W |
| 71 | 113 | | | | | |
| 72-8B | 114-139 | Reserved | | | | |
| 8C | 140 | 1st-channel electric energy | uint32_t | 4 | R | 0.01kWh |
| 8D | 141 | | | | | |
| 8E | 142 | 2nd-channel electric energy | uint32_t | 4 | R | 0.01kWh |
| 8F | 143 | | | | | |
| 90 | 144 | 3rd-channel | uint32_t | 4 | R | 0.01kWh |

| | | | | | | |
|---|---|---|---|---|---|---|
| 91 | 145 | electric energy | | | | |
| 92-A1 | 146-161 | Reserved | | | | |
| A2 | 162 | 1st-channel temperature | int16_t | 2 | R | 0.1°C |
| A3 | 163 | 2nd-channel temperature | int16_t | 2 | R | 0.1°C |
| A4 | 164 | 3rd-channel temperature | int16_t | 2 | R | 0.1°C |
| A5 | 165 | 4th-channel temperature | int16_t | 2 | R | 0.1°C |
| A6-A9 | 166 | Reserved | | | | |
| AA | 170 | Cabinet humidity | uint16_t | 2 | R | 0.10% |
| AB | 171 | Cabinet temperature | int16_t | 2 | R | 0.1°C |
| AC | 172 | Digital input 1 | uint16_t | 2 | R | |
| AD | 173 | Digital input 2 | uint16_t | 2 | R | |
| AE | 174 | Digital input 3 | uint16_t | 2 | R | |
| AF | 175 | Digital input 4 | uint16_t | 2 | R | |
| B0 | 176 | Alarm status 1 | uint16_t | 2 | R | |
| B1 | 177 | Alarm status 2 | uint16_t | 2 | R | |
| B2 | 178 | Alarm status 3 | uint16_t | 2 | R | |
| B3 | 179 | Alarm status 4 | uint16_t | 2 | R | |
| B4 | 180 | Active DI1 | uint16_t | 2 | R | |
| B5 | 181 | Active DI2 | uint16_t | 2 | R | |
| B6 | 182 | Active DI3 | uint16_t | 2 | R | |
| B7-BD | 183-189 | Reserved | | | | |
| BE | 190 | Maximum voltage demand | float | 4 | R | V |
| BF | 191 | | | | | |
| C0 | 192 | Time: year/month | uint16_t | 2 | R | |
| C1 | 193 | Day/hour | uint16_t | 2 | R | |
| C2 | 194 | Minute/ Second | uint16_t | 2 | R | |
| C3-CC | 195-204 | Reserved | | | | |
| CD | 205 | Maximum 1st-channel current demand | float | 4 | R | A |
| CE | 206 | | | | | |
| CF | 207 | Time: year/month | uint16_t | 2 | R | |
| D0 | 208 | Day/hour | uint16_t | 2 | R | |
| D1 | 209 | Minute/ Second | uint16_t | 2 | R | |
| D2 | 210 | Maximum phase-B current demand (2nd-channel current) | float | 4 | R | A |
| D3 | 211 | | | | | |
| D4 | 212 | Time: year/month | uint16_t | 2 | R | |

| | | | | | | |
|---|---|---|---|---|---|---|
| D5 | 213 | Day/hour | uint16_t | 2 | R | |
| D6 | 214 | Minute/ Second | uint16_t | 2 | R | |
| D7 | 215 | Maximum phase-C current demand (3rd-channel current) | float | 4 | R | A |
| D8 | 216 | | | | | |
| D9 | 217 | Time: year/month | uint16_t | 2 | R | |
| DA | 218 | Day/hour | uint16_t | 2 | R | |
| DB | 219 | Minute/ Second | uint16_t | 2 | R | |
| DC | 220 | Maximum phase-A active demand (1st-channel power) | float | 4 | R | W |
| DD | 221 | | | | | |
| DE | 222 | Time: year/month | uint16_t | 2 | R | |
| DF | 223 | Day/hour | uint16_t | 2 | R | |
| E0 | 224 | Minute/ Second | uint16_t | 2 | R | |
| E1 | 225 | Maximum phase-B active demand (2nd-channel power) | float | 4 | R | W |
| E2 | 226 | | | | | |
| E3 | 227 | Time: year/month | uint16_t | 2 | R | |
| E4 | 228 | Day/hour | uint16_t | 2 | R | |
| E5 | 229 | Minute/ Second | uint16_t | 2 | R | |
| E6 | 230 | Maximum phase-C active demand (3rd-channel power) | float | 4 | R | W |
| E7 | 231 | | | | | |
| E8 | 232 | Time: year/month | uint16_t | 2 | R | |
| E9 | 233 | Day/hour | uint16_t | 2 | R | |
| EA | 234 | Minute/ Second | uint16_t | 2 | R | |
| EB-EF | 235-239 | Reserved | | | | |
| F0-F1 | | Phase-A energy of this month | uint32_t | 4 | R | 0.01kWh |
| F2-F3 | | Phase-B energy of this month | uint32_t | 4 | R | 0.01kWh |
| F4-F5 | | Phase-C energy of this month | uint32_t | 4 | R | 0.01kWh |
| F6-F7 | | Phase-A energy of last month | uint32_t | 4 | R | 0.01kWh |
| F8-F9 | | Phase-B energy of last month | uint32_t | 4 | R | 0.01kWh |

| | | | | | | |
|---|---|---|---|---|---|---|
| FA-FB | | Phase-C energy of last month | uint32_t | 4 | R | 0.01kWh |
| FC-FD | | Phase-A energy of last two months | uint32_t | 4 | R | 0.01kWh |
| FE-FF | | Phase-B energy of last two months | uint32_t | 4 | R | 0.01kWh |
| 100-101 | | Phase-C energy of last two months | uint32_t | 4 | R | 0.01kWh |
| 102-103 | | Phase-A energy of last three months | uint32_t | 4 | R | 0.01kWh |
| 104-105 | | Phase-B energy of last three months | uint32_t | 4 | R | 0.01kWh |
| 106-107 | | Phase-C energy of last three months | uint32_t | 4 | R | 0.01kWh |
| 108-109 | | Phase-A energy of last four months | uint32_t | 4 | R | 0.01kWh |
| 10A-10B | | Phase-B energy of last four months | uint32_t | 4 | R | 0.01kWh |
| 10C-10D | | Phase-C energy of last four months | uint32_t | 4 | R | 0.01kWh |
| 10E-10F | | Phase-A energy of last five months | uint32_t | 4 | R | 0.01kWh |
| 110-111 | | Phase-B energy of last five months | uint32_t | 4 | R | 0.01kWh |
| 112-113 | | Phase-C energy of last five months | uint32_t | 4 | R | 0.01kWh |
| 114-115 | | Phase-A energy of last six months | uint32_t | 4 | R | 0.01kWh |
| 116-117 | | Phase-B energy of last six months | uint32_t | 4 | R | 0.01kWh |
| 118-119 | | Phase-C energy of last six months | uint32_t | 4 | R | 0.01kWh |
| 11A-11 | | Phase-A energy | uint32_t | 4 | R | 0.01kWh |

| | | | | | | |
|---|---|---|---|---|---|---|
| B | | of last seven months | | | | |
| 11C-11D | | Phase-B energy of last seven months | uint32_t | 4 | R | 0.01kWh |
| 11E-11F | | Phase-C energy of last seven months | uint32_t | 4 | R | 0.01kWh |
| 120-121 | | Phase-A energy of last eight months | uint32_t | 4 | R | 0.01kWh |
| 122-123 | | Phase-B energy of last eight months | uint32_t | 4 | R | 0.01kWh |
| 124-125 | | Phase-C energy of last eight months | uint32_t | 4 | R | 0.01kWh |
| 126-127 | | Phase-A energy of last nine months | uint32_t | 4 | R | 0.01kWh |
| 128-129 | | Phase-B energy of last nine months | uint32_t | 4 | R | 0.01kWh |
| 12A-12B | | Phase-C energy of last nine months | uint32_t | 4 | R | 0.01kWh |
| 12C-12D | | Phase-A energy of last ten months | uint32_t | 4 | R | 0.01kWh |
| 12E-12F | | Phase-B energy of last ten months | uint32_t | 4 | R | 0.01kWh |
| 130-131 | | Phase-C energy of last ten months | uint32_t | 4 | R | 0.01kWh |
| 132-133 | | Phase-A energy of last eleven months | uint32_t | 4 | R | 0.01kWh |
| 134-135 | | Phase-B energy of last eleven months | uint32_t | 4 | R | 0.01kWh |
| 136-137 | | Phase-C energy of last eleven months | uint32_t | 4 | R | 0.01kWh |
| 138-139 | | Phase-A energy of last twelve months | uint32_t | 4 | R | 0.01kWh |
| 13A-13 | | Phase-B energy | uint32_t | 4 | R | 0.01kWh |

| | | | | | | |
|---|---|---|---|---|---|---|
| B | | of last twelve months | | | | |
| 13C-13D | | Phase-C energy of last twelve months | uint32_t | 4 | R | 0.01kWh |
| 13E-13F | | Phase-A energy of this year | uint32_t | 4 | R | 0.01kWh |
| 140-141 | | Phase-B energy of this year | uint32_t | 4 | R | 0.01kWh |
| 142-143 | | Phase-C energy of this year | uint32_t | 4 | R | 0.01kWh |
| 144-145 | | Phase-A energy of last year | uint32_t | 4 | R | 0.01kWh |
| 146-147 | | Phase-B energy of last year | uint32_t | 4 | R | 0.01kWh |
| 148-149 | | Phase-C energy of last year | uint32_t | 4 | R | 0.01kWh |

Remark: Actual energy value= energy reading * current ratio

| | | |
|---|---|---|
| Alarm status 1 | bit0 | Phase-A over-voltage alarm |
| | bit1 | Phase-B over-voltage alarm |
| | bit2 | Phase-C over-voltage alarm |
| | bit3 | Phase-A under-voltage alarm |
| | bit4 | Phase-B under-voltage alarm |
| | bit5 | Phase-C under-voltage alarm |
| | bit6 | Voltage open-phase alarm (none) |
| | bit7 | Phase-A stage-1 over-current alarm |
| | bit8 | Phase-B stage-1 over-current alarm |
| | bit9 | Phase-C stage-1 over-current alarm |
| | bit10 | Phase-A stage-2 over-current alarm |
| | bit11 | Phase-B stage-2 over-current alarm |
| | bit12 | Phase-C stage-2 over-current alarm |
| | bit13 | Phase-A stage-1 under-current alarm |
| | bit14 | Phase-B stage-1 under-current alarm |
| | bit15 | Phase-C stage-1 under-current alarm |

| | | |
|---|---|---|
| Alarm status 2 | bit0 | Phase-A stage-2 under-current alarm |
| | bit1 | Phase-B stage-2 under-current alarm |
| | bit2 | Phase-C stage-2 under-current alarm |
| | bit3 | Phase-A over-power alarm |
| | bit4 | Phase-B over-power alarm |
| | bit5 | Phase-C over-power alarm |
| | bit6 | Total over-power alarm (none) |
| | bit7 | Humidity alarm |
| | bit8 | Leakage 1 alarm |
| | bit9 | Null-ground potential difference alarm |

| | | |
|---|---|---|
| | bit10 | Neutral current alarm |
| | bit11 | Phase sequence alarm |
| | bit12 | Digital input 1 alarm |
| | bit13 | Digital input 2 alarm |
| | bit14 | Cabinet over-temperature alarm |
| | bit15 | Cabinet under-temperature alarm |

| | | |
|---|---|---|
| Alarm status 3 | bit0 | 1st-channel over-temperature alarm |
| | bit1 | 2nd-channel over-temperature alarm |
| | bit2 | 3rd- channel over-temperature alarm |
| | bit3 | 4th- channel over-temperature alarm |
| | bit4 | 5th- channel over-temperature alarm (none) |
| | bit5 | 6th- channel over-temperature alarm (none) |
| | bit6 | 7th- channel over-temperature alarm (none) |
| | bit7 | 8th- channel over-temperature alarm (none) |
| | bit8 | 1st-channel under-temperature alarm |
| | bit9 | 2nd-channel under -temperature alarm |
| | bit10 | 3rd- channel under -temperature alarm |
| | bit11 | 4th- channel under -temperature alarm |
| | bit12 | 5th- channel under -temperature alarm (none) |
| | bit13 | 6th- channel under -temperature alarm (none) |
| | bit14 | 7th- channel under -temperature alarm (none) |
| | bit15 | 8th- channel under -temperature alarm (none) |

| | | |
|---|---|---|
| Alarm status 4 | bit0 | Digital input 3 alarm |
| | bit1 | Digital input 4 alarm |
| | bit2 | Active DI1 alarm |
| | bit3 | Active DI2 alarm |
| | bit4 | Active DI3 alarm |
| | bit5 | Leakage 2 alarm |
| | bit6 | Leakage 3 alarm |
| | bit7 | |
| | bit8 | |
| | bit9 | |
| | bit10 | |
| | bit11 | |
| | bit12 | |
| | bit13 | |
| | bit14 | |
| | bit15 | |

## 8. Precautions

8.1 The monitor shall be installed at a place without direct exposure to rain, snow, corrosive gases or violent vibration.

8.2 The monitor shall be installed with the surrounding temperature between -20℃ and +60℃.

8.3 The monitor shall be installed with the surrounding relative humidity not exceeding 95%.

## 9. Diagnostics and troubleshooting of common faults

9.1 Incorrect measurements

* Check if the voltage and current connection is correct.

9.2 Correct voltage and current measurements and incorrect power measurement

*Check if the direction of current is correct.

* Check if each current circuit corresponds to the correct phase.

9.3 Communication failure

* Check if the communication connection is normal.
* Check if terminals A and B are connected oppositely.
* Check if the address setting and the communication baud rate are correct.
* Check the communication of one monitor in a series of monitors with communication failure

Headquarters： Acrel Co.,LTD.
Address： No.253 Yulv Road Jiading District,Shanghai,China
TEL.： 0086-21-69158338 0086-21-69156052 0086-21-59156392 0086-21-69156971
Fax： 0086-21-69158303
Web-site： www.acrel-electric.com
E-mail： ACREL008@vip.163.com
Postcode： 201801

Manufacturer： Jiangsu Acrel Electrical Manufacturing Co.,LTD.
Address： No.5 Dongmeng Road,Dongmeng industrial Park,Nanzha Street,Jiangyin City,Jiangsu Province,China
TEL./Fax： 0086-510-86179970
Web-site： www.jsacrel.com
Postcode： 214405
E-mail： JY-ACREL001@vip.163.com

Revision history

| Date | Old version | New version | Revision |
|---|---|---|---|
| 20/04/27 | | V1.0 | 1. 1st issue |
| | V1.0 | V1.1 | 1. Update the outline drawing of AMB10 display<br>2. Correct some errors in the text<br>3. Add operation instructions of AMB10 display |
| 20/11/10 | V1.1 | V1.2 | 1. Add the outline drawing of temperature sensor<br>2. Revise the outline drawing of Hall transducer<br>3. Add the P1 model and transformer model<br>4. Delete the data center and small typeface |
| 20/12/23 | V1.2 | V1.3 | 1. Revise the description of 6mm-diameter cylindrical temperature sensor |