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AMB intelligent bus DC monitoring device

Installation and Operation Instruction V1.6

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.

Content

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
AMB100-D	Full electrical measurements of one DC circuit, 3 leakage current, 4-way temperature, 1-way humidity,4 digital inputs,2 digital outputs	/W(LORA)
AMB100-D-P1	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	
AMB110-D	Full electrical measurements of three DC circuits,3 leakage current, 4-way temperature , 1 humidity detection, 4 digital inputs, 2 digital outputs	
AMB110-D-P1	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	
AMB10	Monitor； the front network port:AMB10(F) 、 the rear network port:AMB10(B&DZ),can automatically display the voltage and current parameters	
AMB10L-72	Optional rear network port or bottom network port, can automatically cycle display voltage, current, temperature and other parameters	
AMB20	AMB20-1:accessory,used with AMB100/AMB110 for network port to network port transfer of intelligent bus staring box and plug-in box AMB20-2:accessory,used with AMB100/AMB110 for RS485 port to network port transfer of intelligent bus staring box and plug-in box AMB20-3: accessory, used with AMB100/AMB110, used for network port-to-network port transfer of intelligent bus head box and plug-in box. AMB20-4: Accessory, used with AMB100/AMB110, used for RS485 port-to-network port conversion of intelligent bus head box and plug-in box.	

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. Optional AMB10, AMB10L-72 display, automatic cycle display voltage, current parameters.

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
Auxiliary power supply		AMB100/110-D(/W): triggered upon receipt of request signal AMB100/110-D(/W)-P1: follow the bus bar voltage
Functions	Temperature detection	-20-150℃
	Leakage	5VDC, 3 leakage inputs
	Digital input	4 dry-contact inputs
	Digital output	2 relay outputs; contact capacity: 3A/30VDC, 3A/250VDC
	Communication	Via RS485/Modbus-RTU or LORA antenna
Installation		Use DIN35mm rail
Protection		IP20
Pollution level		2
Environment	Temperature/ humidity/ altitude	Working temperature: -20-+60℃ Storage temperature: -25-+70℃ Relative humidity: ≤93% Altitude: ≤2500m
Safety	Insulation	The minimum insulation resistance between all terminals and conductive components of the shell is 100MΩ.
	Withstanding voltage	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..
Electromagnetic immunity	Electrostatic discharge immunity	Class 4
	Radio frequency electromagnetic immunity	Class 3
	Transient burst immunity	Class 4
	Surge immunity	Class 4

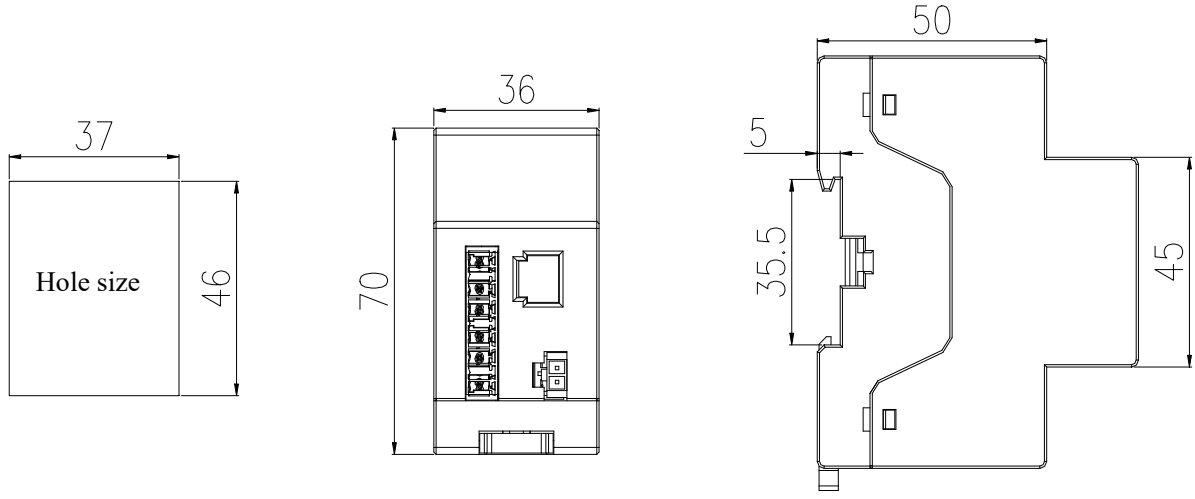
Note 1. Hall leakage transducer must be equipped with auxiliary power supply.

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.

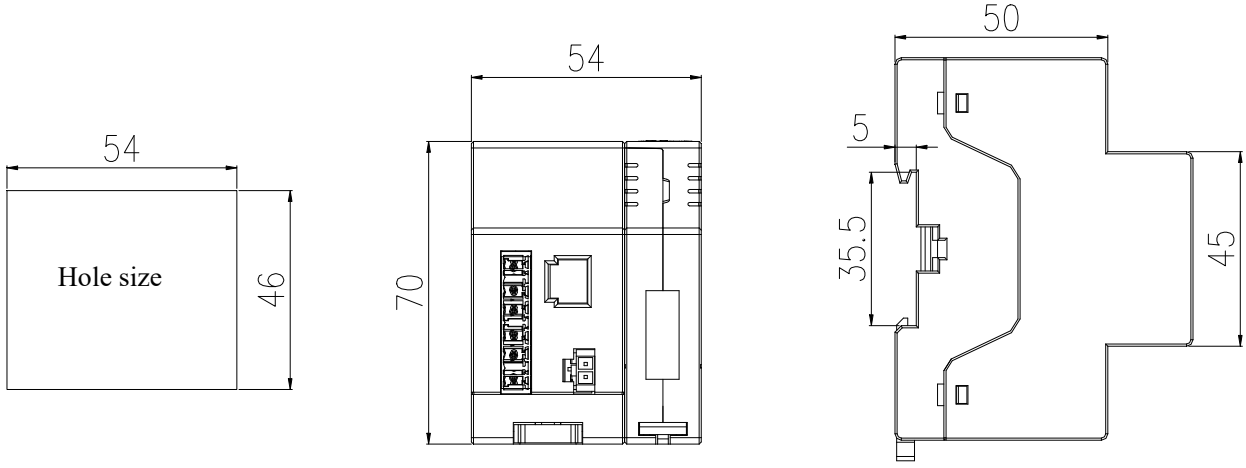
4. Overall structure and dimensions

4.1 Overall dimensions

1) AMB smart bus bar detection module Unit: mm



RS485/Modbus-RTU Communication



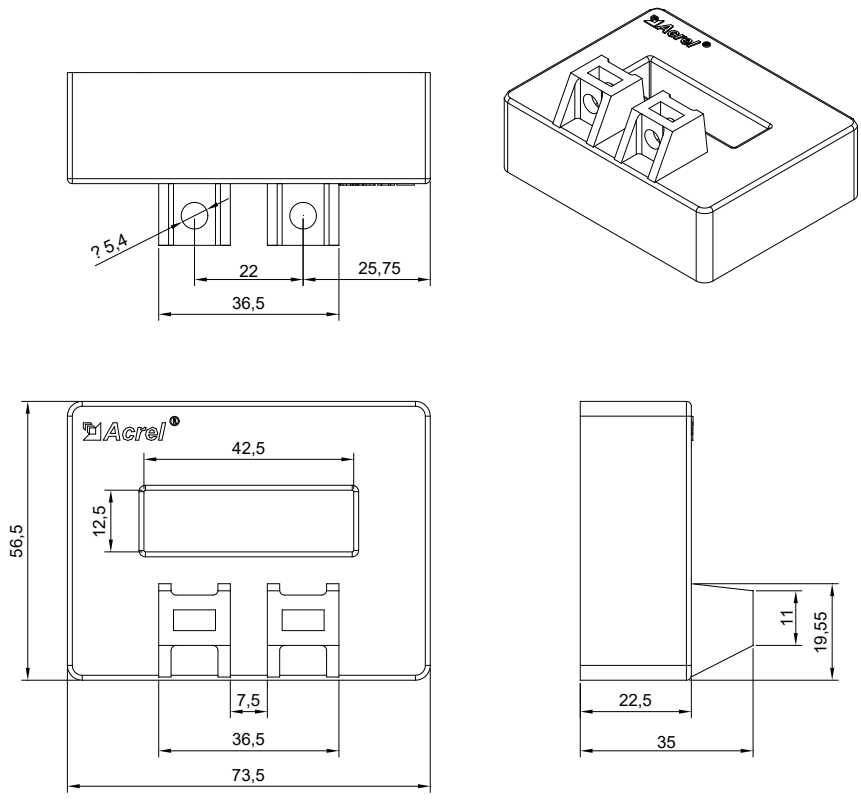
LORA Communication

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

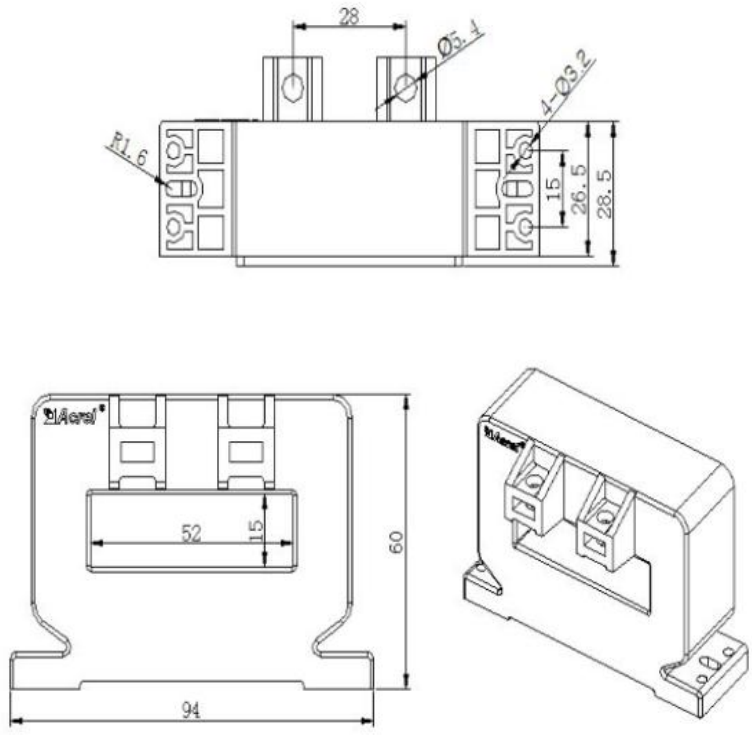
Note 2. An external auxiliary power supply is not required for LORA module.

2) Hall transducer Unit: mm

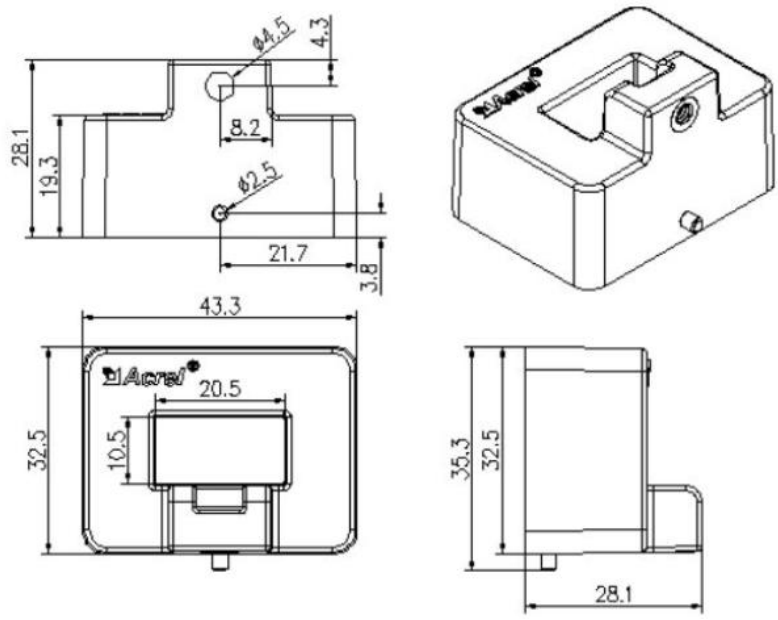
Monitor model	Ancillary transducer
AMB100-D(-P1)	AHKC-FA 1000A/5V
	AHKC-F 800A/5V
	AHKC-F 500A/5V
AMB100-D(-P1)	AHKC-BS 100A/5V



Dimensions of AHKC-F Hall transducer

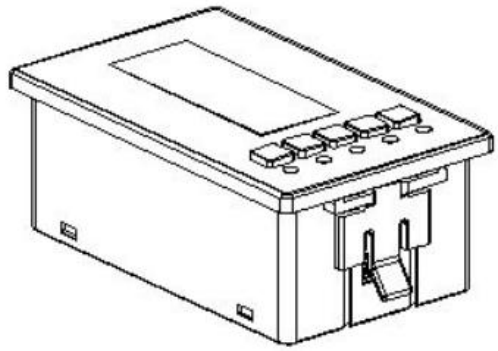


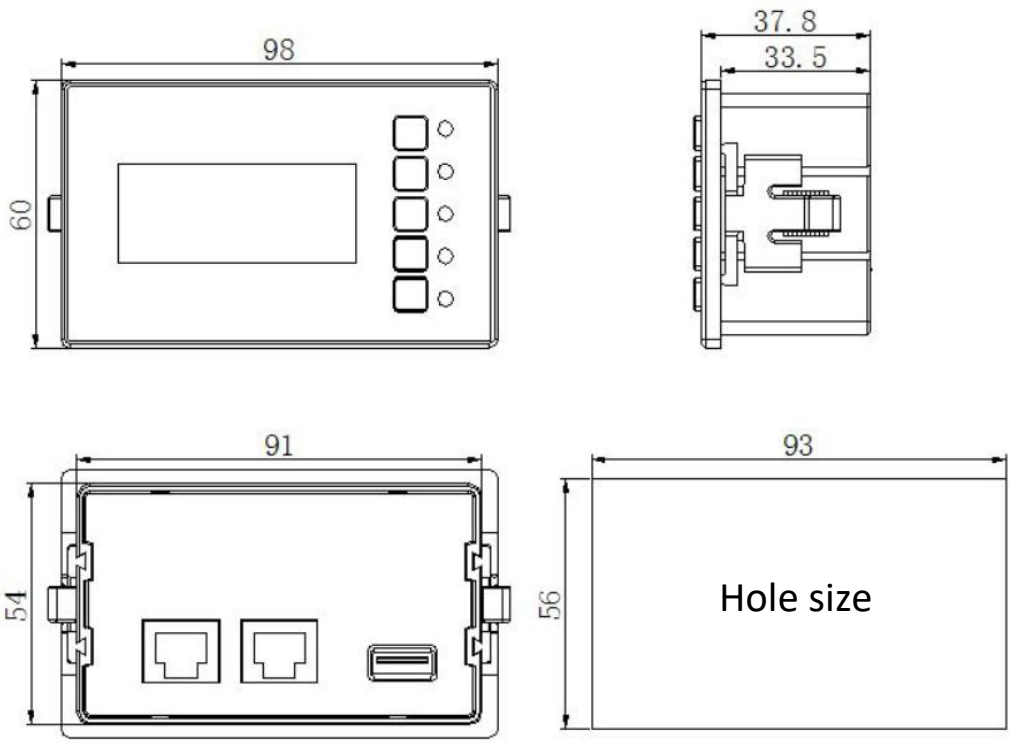
Dimensions of AHKC-FA Hall transducer



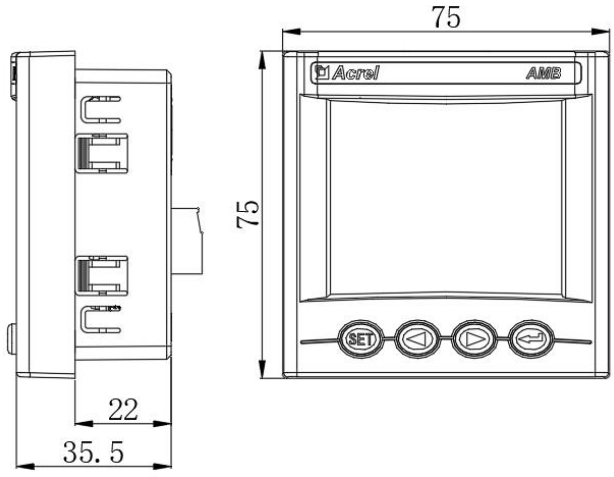
Dimensions of AHKC-BS Hall transducer

3) AMB10 display (unit: mm)

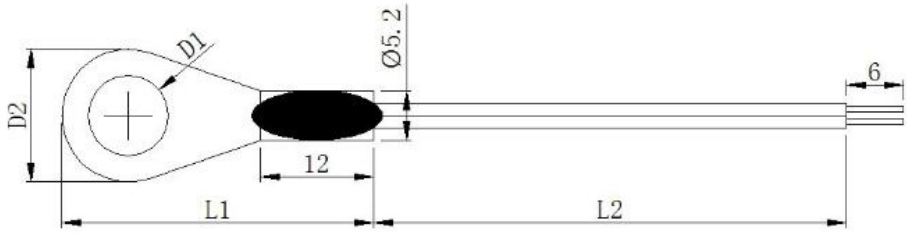


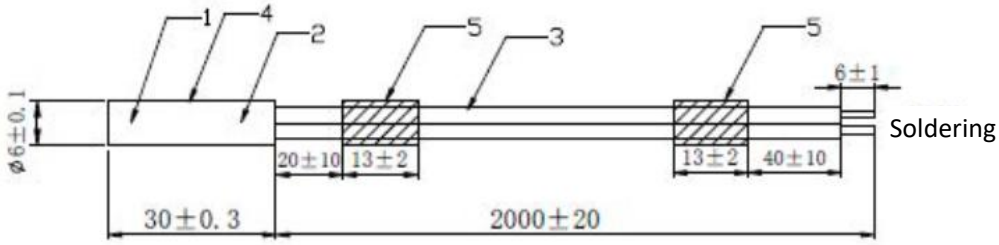


AMB10L-72 display device



4) Temperature sensor (unit: mm)

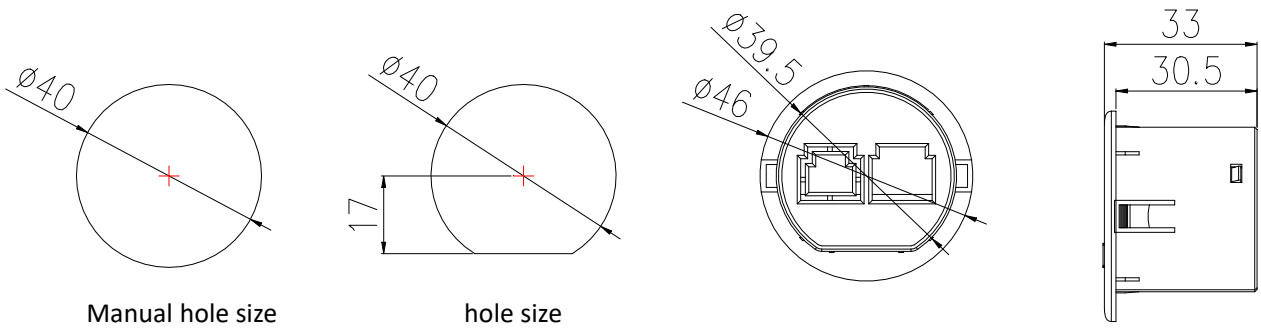


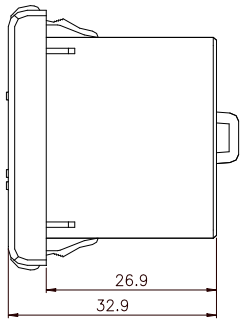


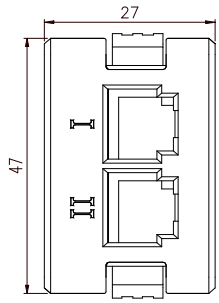
Temperature sensor	End			Wire length	Suggested use
	D1	D2	L1	L2	
12mm hole	12.5	18	35	2000 or 4000	With M10 and M12 screws
8mm hole	8.5	14	33		With M6 and M8 screws
6mm diameter	6.5	12	30	2000	Insert in the connection gap

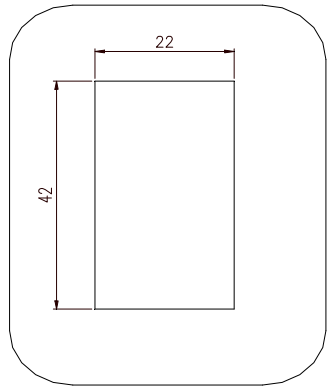
Note: For each temperature sensor variant, there are yellow, green, red and black types, corresponding to phases A, B, C and N.

5） AMB20 adapter（Unit：mm）





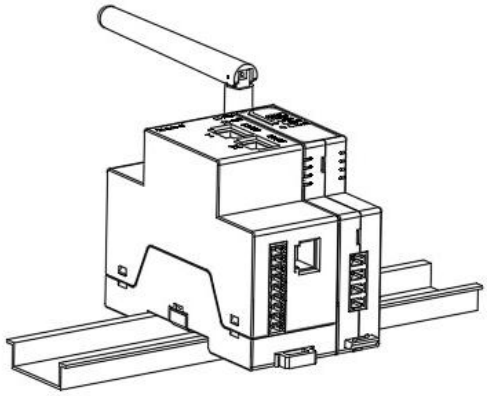




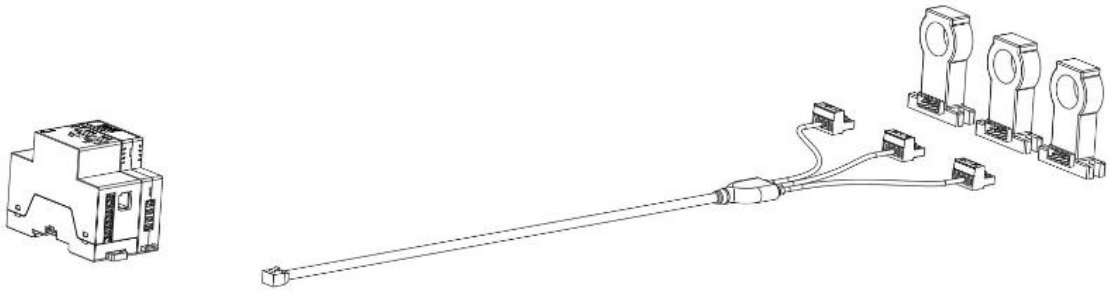
hole size

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.

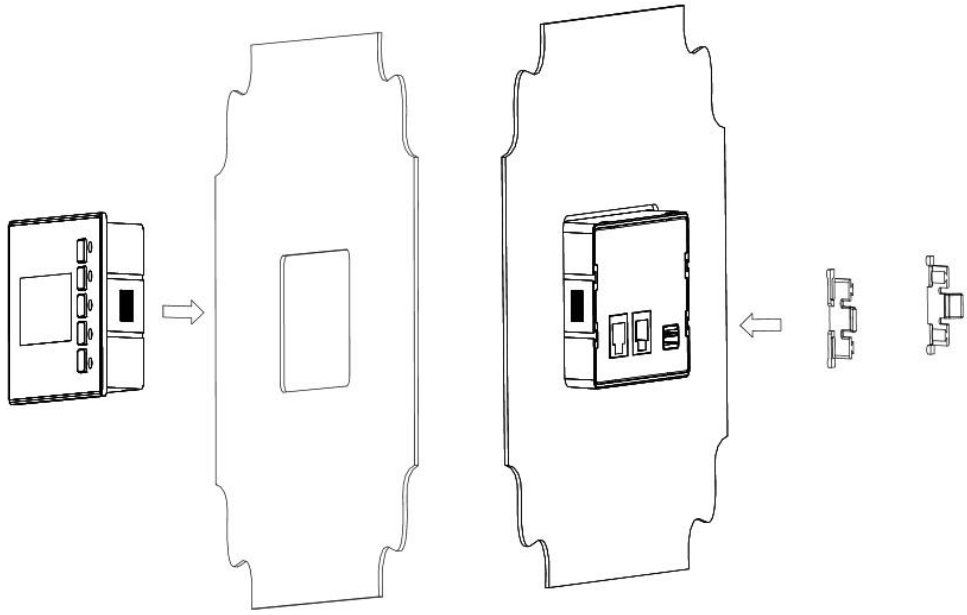


Rail-installed Type

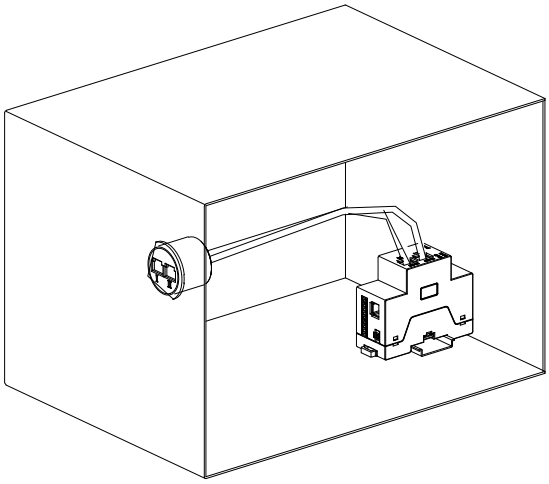


Installation of Hall Transducer

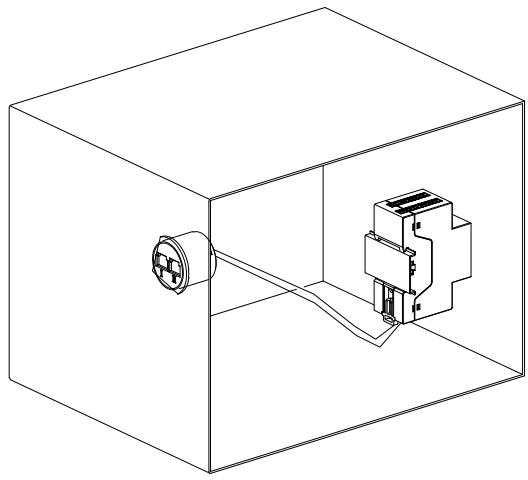
AMB display is flush-mounted. Align the display with the mounting holes, insert clips and secure the display.



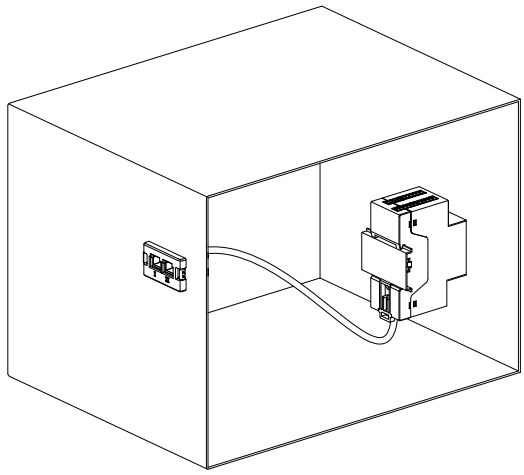
AMB20 adapter module is connected with the instrument through network cable.



AMB20-1 installation diagram

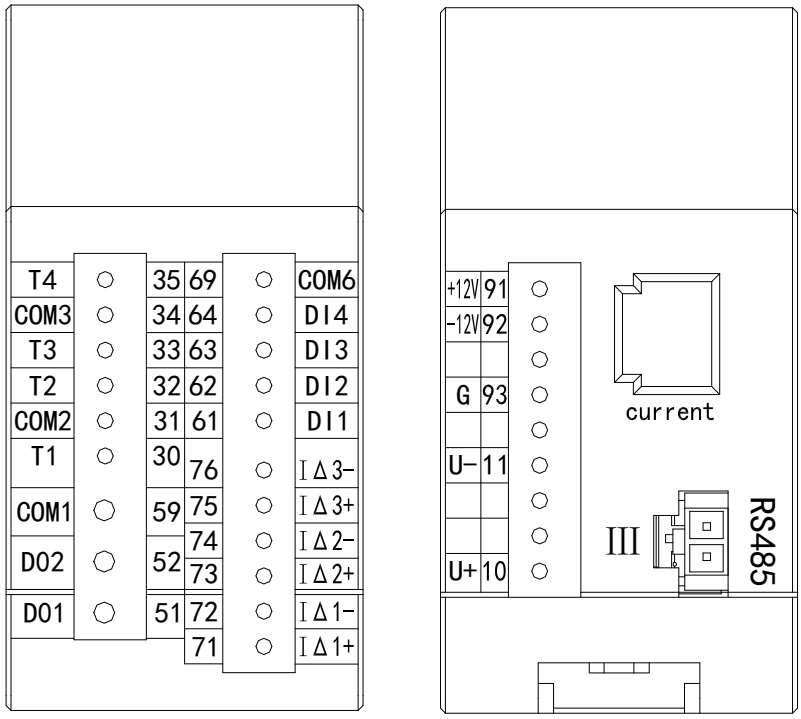


AMB20-2 installation diagram

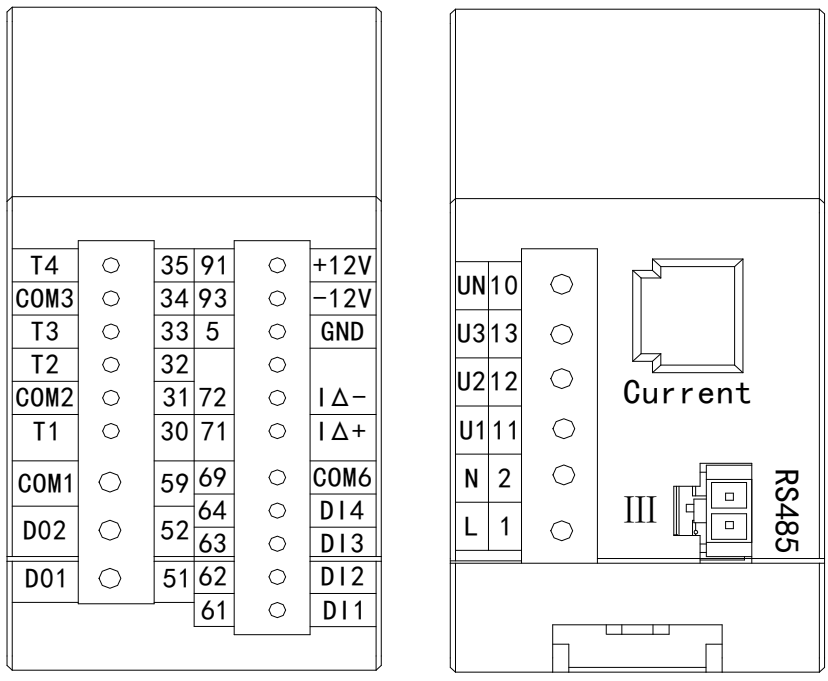


AMB20-3/AMB20-4 installation diagram

5. Wiring instructions

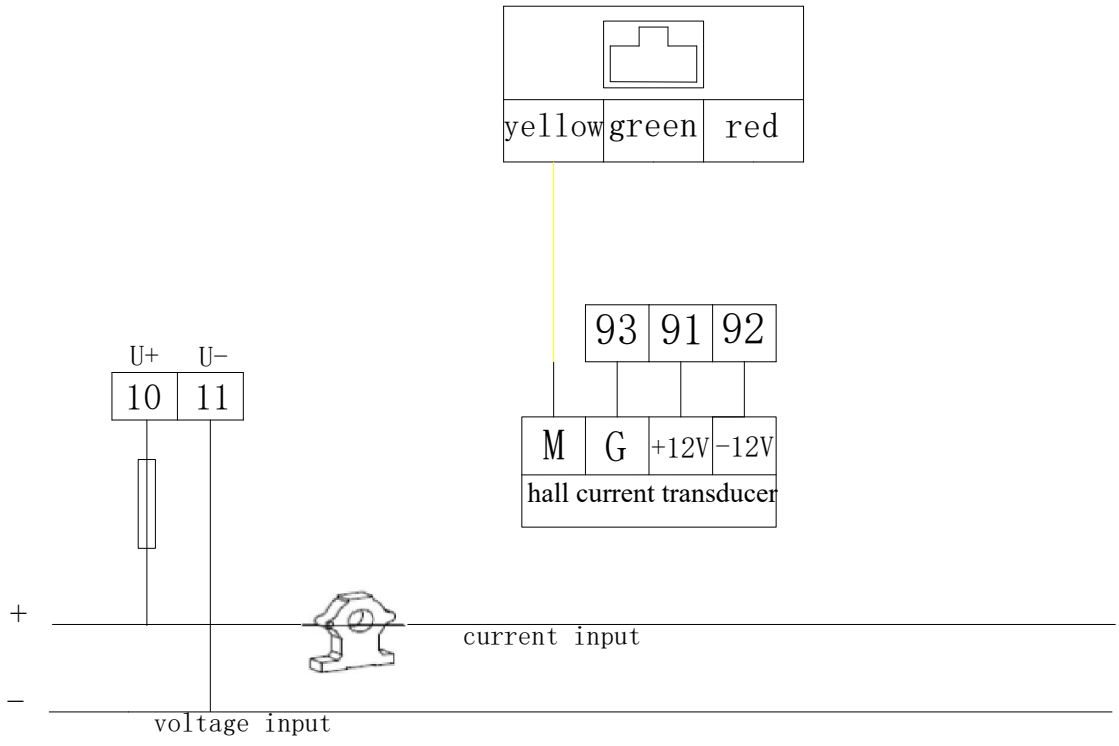


AMB1X0-D(/W) Triggered upon Receipt of Request Signal

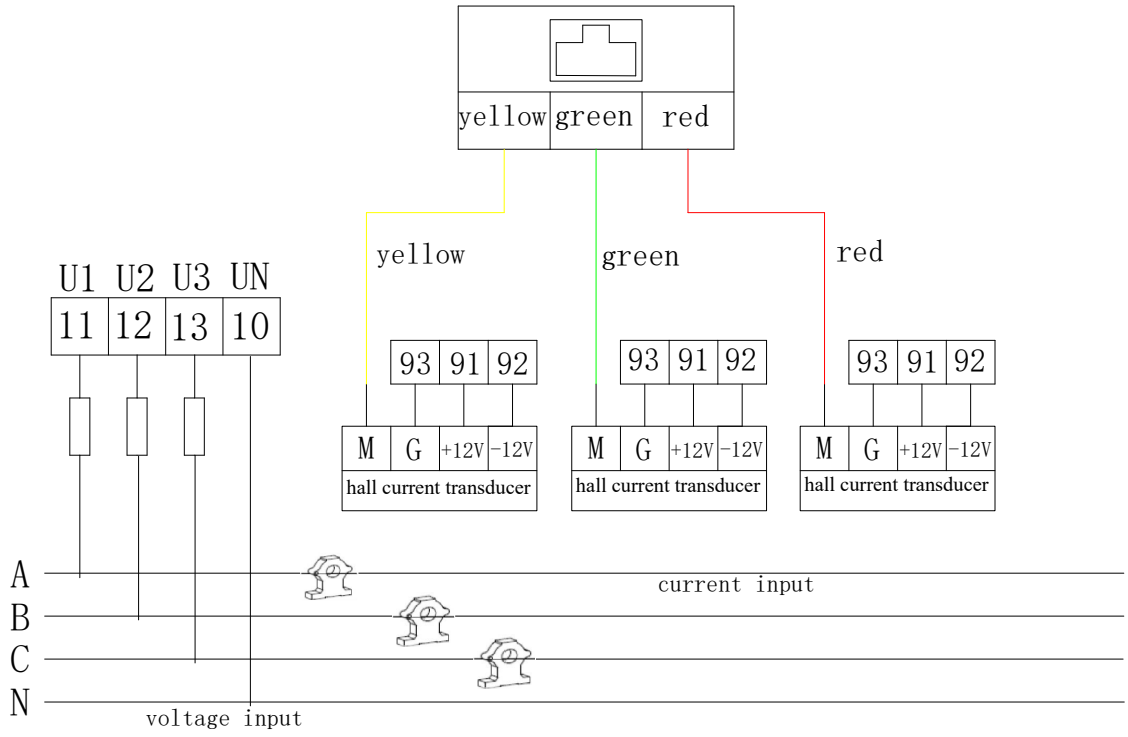


AMB1X0-D(/W)-P1 Discrete Auxiliary Power Supply

5.1 Voltage, current and transducer connection

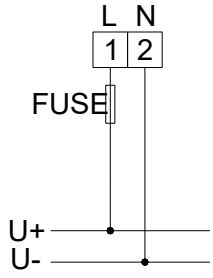


AMB1X0-D(/W) Triggered upon Receipt of Request Signal

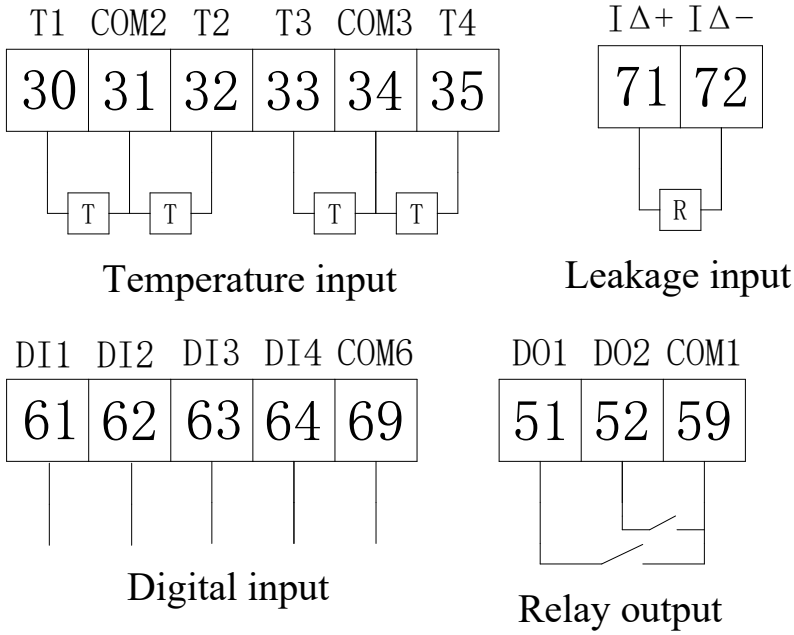


AMB1X0-D(/W)-P1 Discrete Auxiliary Power Supply

5.2 Mains and auxiliary power supply connections



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



5.2.1 Temperature sensor connection

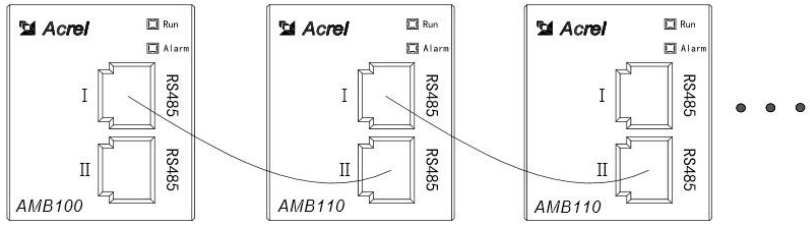
Temperature sensors shall be used to measure temperatures T1 to T4. They are NTC R25=50k (4150) thermistors. They send the monitoring signals for temperature between -20℃ and 150℃ and monitor the cable temperature.

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

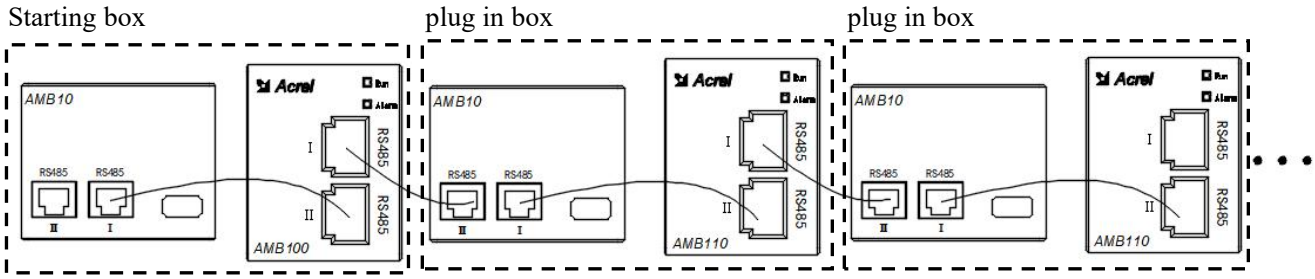
5.2.2 Network shielded wire connection

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.

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 Display function

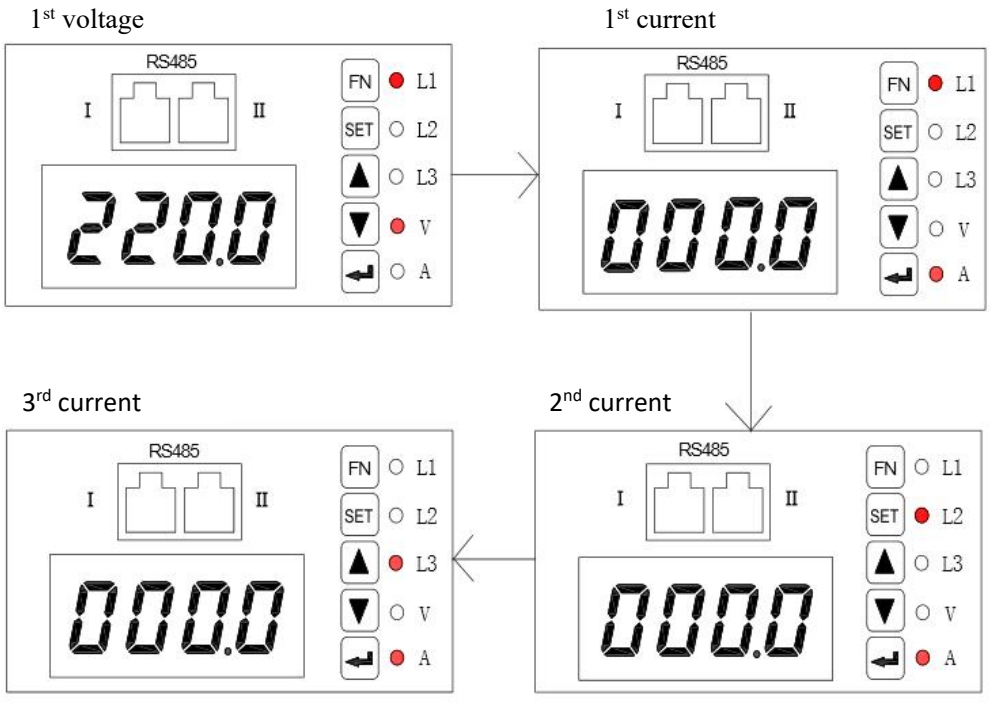
6.5.1 AMB10 display device

(1)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

(2)Display screens

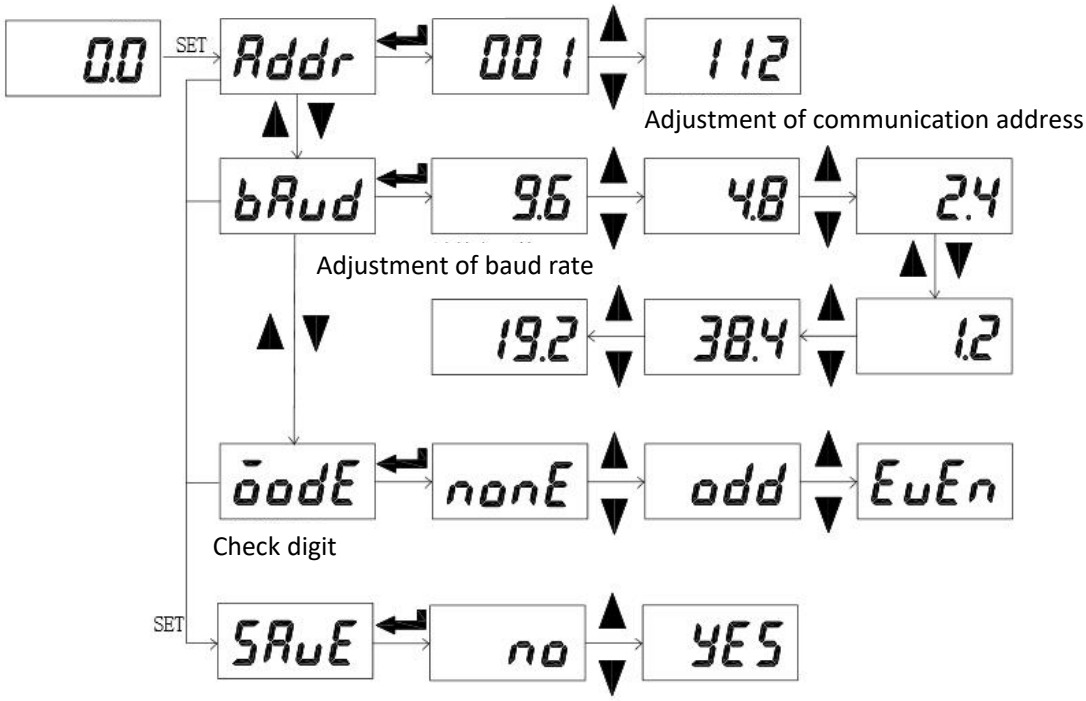
Measurement screens. After being powered, the display will show the voltage and the current in an automatic cycle. These screens change in the following order:



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.

(3) 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 (no parity, odd parity, even parity)
1366	Software No.
1.00	Software version

6.5.2 AMB10L-72 display device

(1)Functions of control buttons

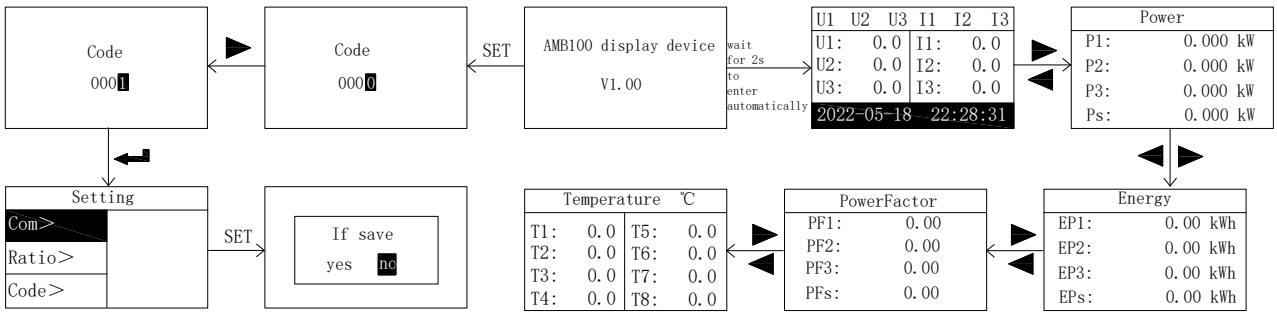
Symbol	Designation	Functions
SET	SET	Select a function, switch over to another function or save the

		selected function, or back to the last menu
◀	Left	Submenu parameters -
▶	Right	Submenu parameters +
↵	Enter	Enter the next menu or confirm the selection

(2)AMB10L-72 Key operation interface

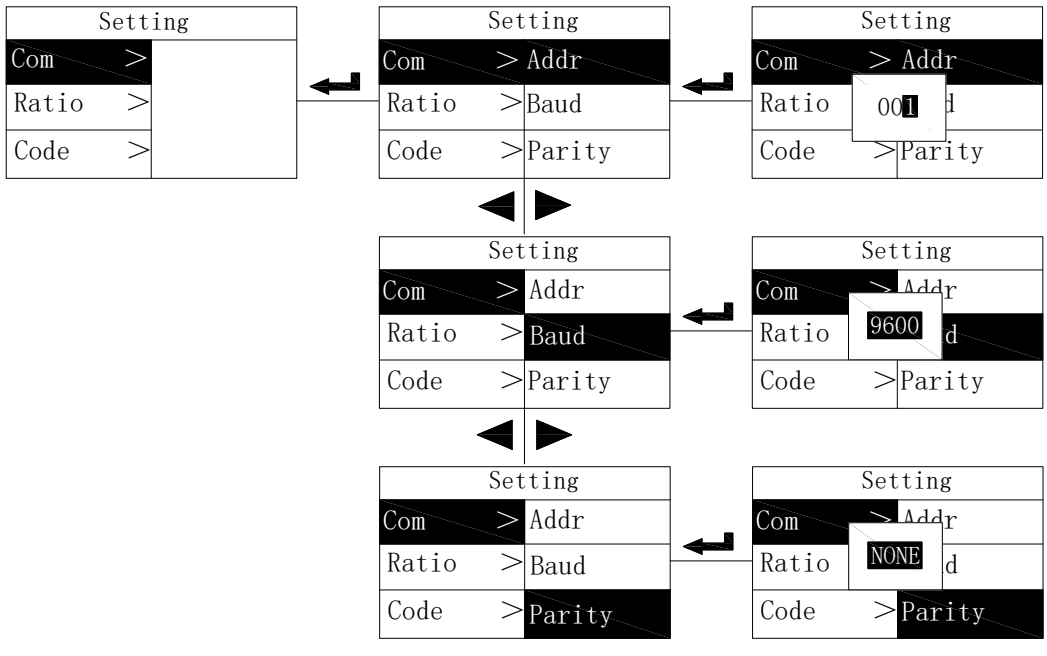
Operating Instructions on the Startup Interface

After power-on, the startup interface displays AMB100 display device; 1) After the startup interface waits for 2 seconds, it will automatically enter the voltage and current parameter interface (when U1, U2, U3, I1, I2, and I3 are displayed as black characters on a white background, it means that there are Voltage, current), press the Left and Right keys to switch to parameter interfaces such as active power, active energy, power factor, temperature, etc.; 2) Press the SET key to enter the password input interface when starting the interface, and press the Right key to enter the password "0001" to enter the parameter setting interface (Parameter setting options include communication setting, ratio setting, password setting, backlight time, home page setting), press the Enter key to enter each interface to set parameters; press the SET key to choose whether to save the dat.



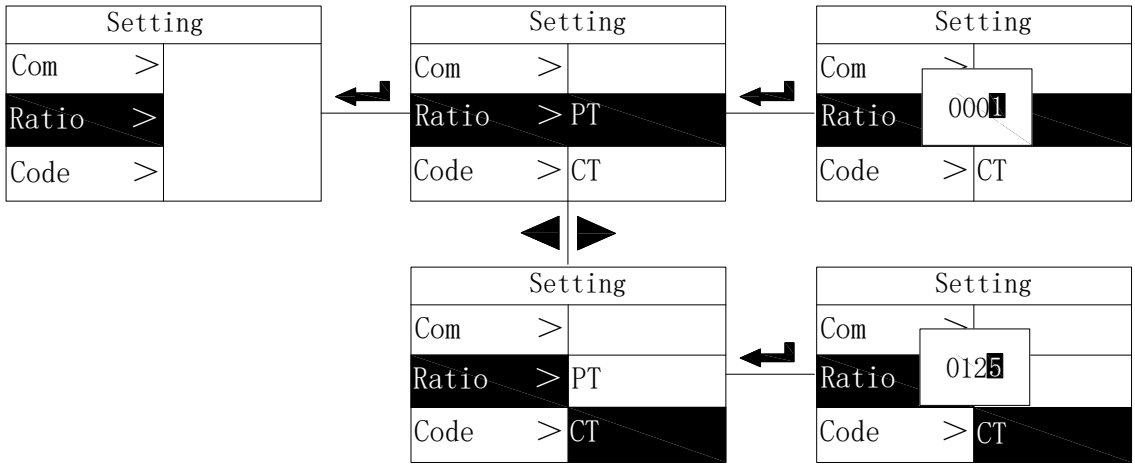
Communication parameter setting

Enter the parameter setting interface, the cursor stops at the communication setting by default, press the enter key to see the address, baud rate, check digit three categories, and then press the enter key to pop up various parameter interfaces that can be set; press the left and right keys to Switch the settings of address, baud rate and check digit. The address can be set to 1-247; the baud rate can be set to 1200, 2400, 4800, 9600, 19200, 38400, 57600, 115200; the parity bit can be set to EVEN (even parity), ODD (odd parity), NONE (no checksum).



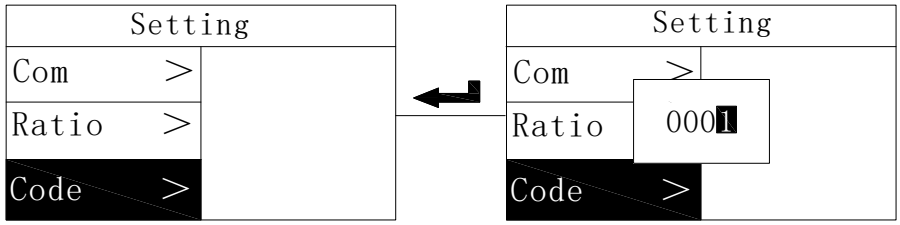
Ratio parameter setting

Press the left or right button to move the cursor to the transformation ratio setting, press the Enter key to see the voltage transformation ratio and current transformation ratio, and then press the Enter key to pop up various settable parameters. The voltage and current transformation ratio can be set according to the specifications of the transformer.



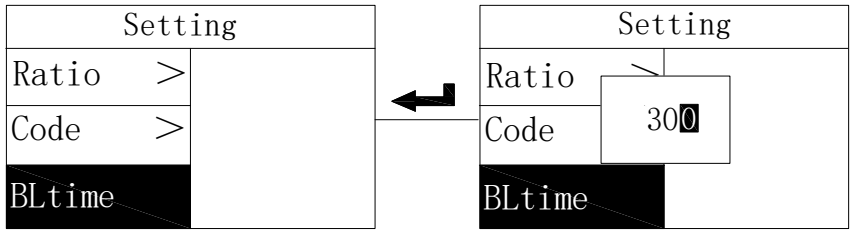
Password setting

Press the left or right key to move the cursor to the password setting, press the Enter key to enter the password setting interface, and the password can be set to 1-9999.



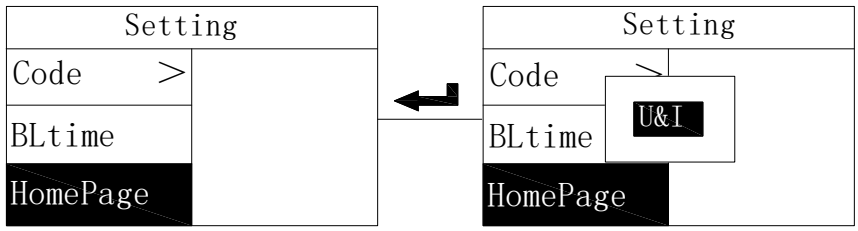
Backlight time setting

Press the left or right button to move the cursor to the backlight time, press the Enter key to enter the backlight time setting, the backlight time can be set from 0 to 300s, "0" means always on.



Home page settings

Press the left or right key to move the cursor to the home page setting, press the Enter key to set the home page, the default is the voltage and current parameter interface, press the left and right keys to switch to power, electric energy, power factor, temperature, wheel display (wheel display refers to The home page, power, electric energy, power factor, temperature and other parameter interfaces are automatically switched within the same time interval).



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) 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 0x6602: demand record cleared 0x6603: energy record cleared 0x6801:1st-channel zeroed 0x6802:2nd -channel zeroed 0x6803:3rd -channel zeroed 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	uint16_t	2	R/W	0.1°C

		under-temperature alarm setting				
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	uint32_t	4	R	0.01kWh

8F	143	energy				
90	144	3rd-channel electric energy	uint32_t	4	R	0.01kWh
91	145					
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	uint32_t	4	R	0.01kWh

		last three months				
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-11B		Phase-A energy of last seven months	uint32_t	4	R	0.01kWh
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-13B		Phase-B energy of last twelve months	uint32_t	4	R	0.01kWh
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

Revision history

Date	Old version	New version	Revision
20.4.27		V1.0	1.1st issue
	V1.0	V1.1	1.Update the outline drawing of AMB10 display 2.Correct some errors in the text 3.Add operation instructions of AMB10 display
20.11.10	V1.1	V1.2	1.Add the outline drawing of temperature sensor 2.Revise the outline drawing of Hall transducer 3.Add the P1 model and transformer model 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
2021.5.18	V1.3	V1.4	1.Change AMB1X0 size diagram，add the content of AMB20 bus transfer module
2022.4.21	V1.4	V1.5	1.Modify the independent wiring diagram(one-way voltage is changed to three-way voltage)；Modify terminal blocks 2.Hall sensor model AMB100-D/AMB110-D changed to AMB100-D(-P1)/AMB110-D(-P1)
2023.1.13	V1.5	V1.6	1. Added content of AMB10L-72 display device 2. Add AMB20-3/AMB20-4 adapter module related content

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