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Medical IT System Intelligent Insulation Monitoring Devices

(4-Piece Set)

Installation and Operation Manual V2.9

Acrel Co., Ltd.

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The contents of this description will be updated and amended constantly, and it is inevitable that there will be a slight discrepancy between the physical product and the description in the product function upgrading. Please refer to the physical product purchased and obtain the latest version of the description through www.acrel-electric.com or sales channels.

Modified Records

No.	Time	Versions	Reasons for revision
01	2016.01.20	V2.0	On the basis of the original insulation monitoring products, the contents of all five pieces of products are integrated to replace the instructions of each sub-product.
02	2016.10.25	V2.1	Some errors have been fixed
03	2016.11.07	V2.2	The overview added "products conform … standards"
04	2020.04.29	V2.3	Delete some discontinued accessories; Add the installation dimension of AID10 cabinet door
05	2020.06.11	V2.4	Add AID150 cabinet door installation diagram
06	2020.08.14	V2.5	Correct errors and omissions, adjust the wording
07	2021.01.20	V2.6	Update version
08	2022.02.18	V2.7	Revise mistakes and omissions, update product pictures, update typical cases, update catalogue, update current transformer content
09	2024.05.28	V2.8	Modify transformer to S type and update corresponding parameters; modify AID parameters; standardize dimensional labeling; add typical application diagrams; other errors and omissions
10	2025.01.15	V2.9	AID150 openings accurate to 0.1, Update bottom info.
Note:			

Contents

Medical IT System Insulation Monitoring Devices

1 Introduction

Medical IT systems are primarily used in critical medical 2 locations such as operating rooms, ICU/CCU intensive care units to provide safe, reliable, and continuous distribution of critical equipment in these locations. Medical insulation monitoring products are developed by Acrel according to the special requirements of insulation resistance of distribution system in medical 2 type places with many years of design experience in the power meter industry. It can be used for isolating power system in various operating rooms and intensive care units in medical places, realizing real-time monitoring of system insulation, load, isolation transformer temperature and other operating conditions, as well as remote monitoring. Products comply with the enterprise standard Q31/0114000129C013-2016 *IT System Insulation Monitor* provisions.

Insulation monitoring products of medical IT system (4-Piece set) include AITR series medical isolation transformer, AIM-M10 insulation monitor, AKH-0.66P26 current transformer and AID series (AID10, AID150) alarm and display instrument. as shown in Table 1.

Table 1 Medical IT System Insulation Monitoring Products

Model and Name	Picture	Description
AITR series Medical Isolation Transformer		AITR series isolation transformers are specialized in medical IT isolation power supply system, with low core loss, double insulation treatment between windings and electrostatic shielding screen to reduce electromagnetic interference between windings. A Pt100 temperature sensor is installed in the wire package for monitoring the transformer temperature. The whole is treated with vacuum dipping paint, which increases the mechanical strength and corrosion resistance. The product has very good temperature rise performance and very low noise.
AIM-M10 medical intelligent insulation monitor		AIM-M10 Medical Intelligent Insulation Monitor is compact and easy to install. The product integrates intelligence, digitalization and networking, and is suitable for insulation monitoring of isolated power supply systems in operating rooms, intensive care units and other medical 2 types of places.
AKH-0.66P26 current transformer		AKH-0.66P26 type current transformer and AIM-M10 insulation monitor supporting the use of the maximum measurable current of 60A, the ratio of 2000:1, the current transformer screws directly fixed in the way mounted on the inside of the cabinet, the secondary side of the shielded twisted pair of wires through the lead, easy to install and use.

AID series external alarm and display instrument	AID10		AID10 can monitor 1 AIM-M10 insulation monitor with sound and light alarms for faults such as insulation, overload, over-temperature and equipment failure. The product adopts indicator display and can be operated by keypad. The product adopts the installation method of embedding into the wall.
	AID150		AID150 can centrally monitor up to 16 sets of AIM-M10 insulation monitors with audible and visual alarms for faults such as insulation, overload, over-temperature and equipment failure. The product adopts LCD liquid crystal display and can be operated by keypad. The product can be embedded in the wall, rail, panel installation.

2 Function Features

2.1 Function Features of AITR series Medical Isolation Transformer

➢ Core component of a medical IT system for converting TN into IT system (ungrounded system);

➢ The transformation ratio between the primary and secondary windings is 1:1;

➢ Double insulation treatment is adopted between the windings, with the electrostatic shielding layer;

➢ The Pt100 temperature sensor is installed in each wire packet to monitor the temperature of the isolation transformer.

2.2 AIM-M10 Medical Intelligent Insulation Monitor

➢ Real time monitoring of IT system to ground insulation resistance, transformer load current, transformer winding temperature, and give alarm indication when fault occurs;

➢ The real-time monitoring system wire break fault, temperature sensor wire break fault and function ground wire break fault, and give alarm indication when the fault occurs;

➢ Relay output, LED indicator and other fault indication;

➢ Modbus, which communicates with external alarm and display instrument, can monitor the operation of IT system remotely;

➢ Event record (SOE), including the time and type of the alarm, is convenient for the operator to analyze the operation status of the system and eliminate the fault in time;

➢ DC24V power output function can provide power for external alarm and display instrument.

2.3 Function Features of AID10/150

➢ Remote communication function, the AID10 can monitor one insulation monitor and the AID150 can monitor up to 16 insulation monitors;

➢ The AID150 allows remote setting of the system's insulation resistance alarm values, load current alarm values and transformer temperature alarm values;

➢ The AID150 has an event logging function, which makes it easy for operators to analyze problems and eliminate faults in a timely manner, and can save up to the latest 50 records;

➢ The AID series alarm and display provides the appropriate audible and visual alarms when there is an

insulation failure, overload, high transformer temperature rise and wiring faults in the IT system and can cancel the audible alarms.

2.4 Function Features of AKH-0.66P26 Current Transformer

➢ Work with the AIM-M10 insulation monitoring instrument to measure the load current of isolation transformer;

➢ The maximum measurable current is 60A, and the transformation change ratio is 2000:1.

3 Reference Standard

■ IEC 60364-7-710 *Building electrical installations section 7-710: Requirements for special installations or locations----medical locations*

■ IEC 61557-8 *Electrical safety of low voltage distribution system below AC 1000V and DC 1500V, Test, measurement or monitoring equipment for protection test section 8: Insulation monitoring device for IT systems*

■ IEC 61557-9 *Electrical safety of low voltage distribution system below AC 1000V and DC 1500V, Test, measurement or monitoring equipment for protection test section 9: insulation fault positioning equipment for IT systems*

■ IEC 61558-1 *Safety of power transformers, power supplies, reactors and similar products section 1: General requirements and tests*

■ IEC 61558-2-15 *Safety of power transformers, power supplies and similar products section 16: Special requirements for isolation transformers for power supply in medical locations*

4 Technical Parameters

4.1 Technical Parameters of AITR series Medical Isolation Transformer

Refer to Table 2.

Table 2 Technical Parameters of AITR Series of Medical Isolation Transformer

Type	**AITR10000S**	**AITR8000S**	**AITR6300S**	**AITR5000S**	**AITR3150S**
Insulation class	F	F	F	F	F
Protection class	IP00	IP00	IP00	IP00	IP00
Power/voltage/ current					
Rated power	10000VA	8000VA	6300VA	5000VA	3150VA
Rated frequency	50~60Hz	50~60Hz	50~60Hz	50~60Hz	50~60Hz
Rated input voltage	AC230V	AC230V	AC230V	AC230V	AC230V
Rated input current	45.3A	36A	28.5A	22.5	14.2A
Rated output voltage	AC230V/115V	AC230V/115V	AC230V/115V	AC230V/115V	AC230V/115V
Rated output current	43.5A	34.7A	27.4A	21.7	13.7A
Inrush current	<12In	<12In	<12 In	<12 In	<12In
Leakage current	<500μA	<500μA	<500μA	<500μA	<500μA
No load input	1.359A	1.08A	0.855A	0.675A	0.426A

current					
No load output voltage	234V±3%	234V±3%	234V±3%	234V±3%	234V±3%
Short circuit voltage	<9.2V	<9.2V	<9.2V	<9.2V	<9.2V
General parameters					
Fuse wire	80A	63A	50A	35A	25A
Primary winding resistance	<55mΩ	<64mΩ	<80mΩ	<131 mΩ	<245mΩ
Secondary winding resistance	<45mΩ	<64mΩ	<80mΩ	<116 mΩ	<228mΩ
Iron loss	<80W	<65W	<60W	<50W	<30W
Copper loss	<450W	<345W	<277W	<255W	<175W
Efficiency	>96%	>96%	>96%	>96%	>95%
Maximum ambient temperature	<40℃	<40℃	<40℃	<40℃	<40℃
No-load temperature rise	<80K	<80K	<80K	<80K	<80K
Full load temperature rise	<40dB	<40dB	<40dB	<40dB	<40dB

4.2 Technical Parameters of AIM-M10 Medical Insulation Monitor

Refer to Table 3.

Table 3 Technical parameters of AIM-M10 insulation monitoring instrument

Auxiliary power supply	Voltage	AC220V (±10%)	Temperature measurement	Thermistor	Pt100
	Frequency	50/60Hz		Measuring range	-50~+200℃
	Power consumption	<5W		Alarm value range	0~+200℃
Insulation monitoring	Measuring range	10~999kΩ	Alarm output	Output mode	1 relay output
	Absolute percentage	0~±10%		Contact capacity	AC 250V/3A DC 30V/3A
	Alarm value	10~999kΩ	Environment	Operating temperature	-10~+55℃
	Response time	<2s		Storage temperature	-20~+70℃
	Measuring voltage	<12V		Relative humidity	<95%, non-condensate
	Measuring current	<42μA		Altitude	≤2500m
Load current	Measuring range	2.1~50A	Communication		RS485, Modbus-RTU
	Alarm value	5~50A	Rated impulse voltage/pollution degree		4KV/III
	Measuring accuracy	≤±5%	EMC/EMR		Conform to IEC 61326-2-4

4.3 Technical Parameters of AID10/150

Refer to Table 4.

Table 4 Technical parameters of AID10/150

Item		Technical parameters	
		AID10	AID150
Auxiliary power supply	Voltage	DC 24V	
	Consumption	< 0.6W	
Number of IT systems monitored		1	16
Insulation resistance alarm setting		——	10~999kΩ
Load current alarm setting		——	0~99A
Over-temperature alarm setting		——	0~200℃
Installation mode		Embedded in the wall	Embedded in wall, rail, panel
Display mode		LED indicator display	128*64 LCD display
Alarm type		Insulation fault, overload, overheat, equipment fault	
Alarm method		Sound-light alarm	
Communication mode		RS485 interface, Modbus-RTU protocol	

4.4 Technical Parameters of AKH-0.66P26 Current Transformer

Refer to Table 5.

Table 5 Technical Parameters of AKH-0.66P26 Current Transformer

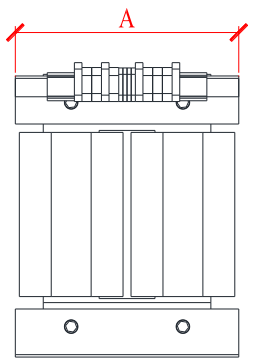
Input current	0.5mA~50A	Frequency range	0.02~10 kHz
Output current	0.025~25 mA	Loading resistance	<200Ω
Temperature coefficient	100 ppm/℃	Transient current (1s)	200A
Phase displacement	10′	Installation	Fixed with 4*10 screws
Operating temperature	-35~+70℃	Secondary wiring	Shielded twisted pair cable 2*0.3mm^2, 2m, customized
Storage temperature	-40~+75℃		
Secondary resistance range	95~120Ω	Isolation pressure	5000Vac
Accuracy	0.5%	Linearity	0.5%

5 Installation and Wiring

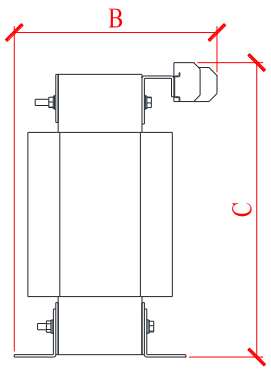
5.1 Shape and Mounting Hole Size

5.1.1 External dimensions of AITR series medical isolation transformer (unit: mm)

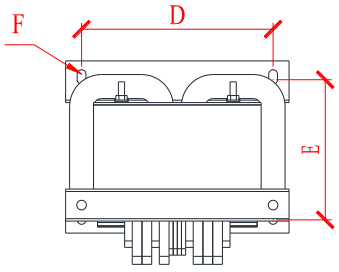
Shape and size of AITR series medical isolation transformer are shown as below and in Table 6.



Front view



Side view



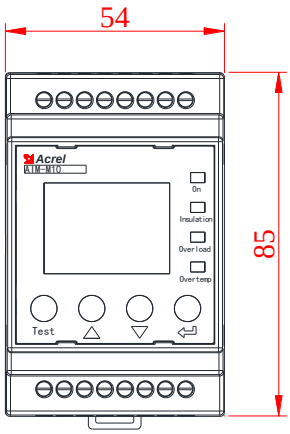
Vertical view

Table 6 External Dimensions of AITR Series Medical Isolation Transformer

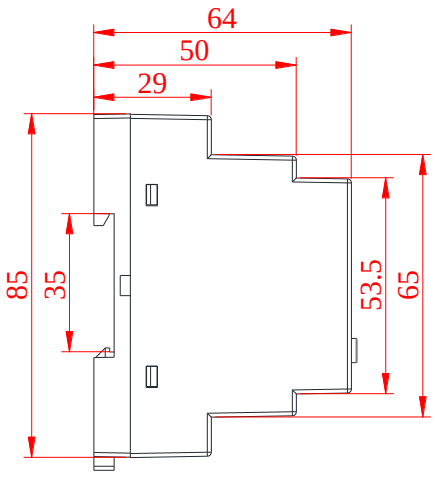
Product Type	Capacity (VA)	Overall dimension (mm)			Mounting dimension (mm)			Weight (kg)
		A	B	C	D	E	F	
AITR10000S	10000	280	236	421	240	190	11*8	86±5
AITR8000S	8000	280	236	421	240	190	11*8	79±5
AITR6300S	6300	280	221	421	240	175	11*8	69±5
AITR5000S	5000	280	211	421	240	175	11*8	62±5
AITR3150S	3150	280	211	421	240	175	11*8	49±5

Note: according to the standard, the maximum capacity of medical single-phase isolation transformer is 10kVA; Dimensions A, B, and C are the length, width, and height of the transformer; dimensions D, E, and F are the installation dimensions of the transformer; F is the mounting hole position. M8*30 screws are recommended to fix the transformer.

5.1.2 External dimensions of AIM-M10 medical insulation monitor. (unit: mm)



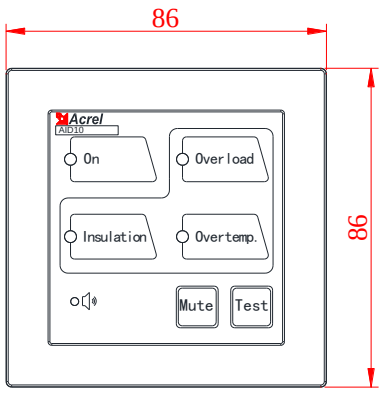
Front view



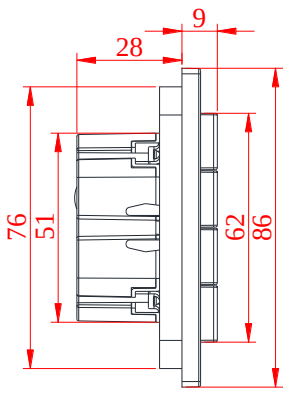
Side view

5.1.3 External dimensions of AID series (unit: mm)

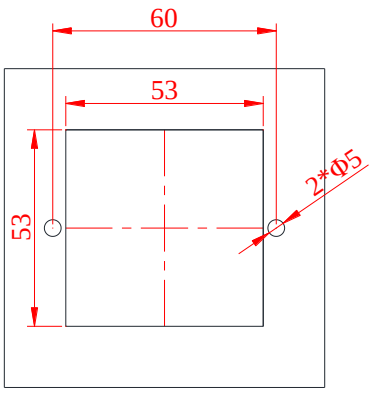
External dimensions of AID10 are shown as below.



AID10 front view

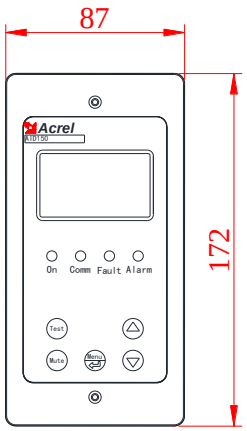


AID10 side view

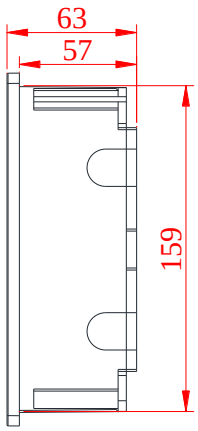


AID10 hole size

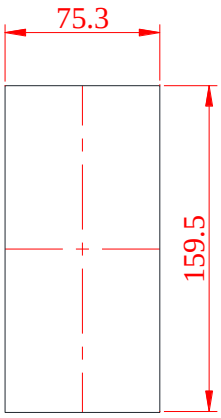
External dimensions of AID150 are shown as below.



AID150 Front view

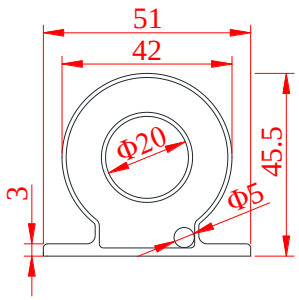


AID150 Side view

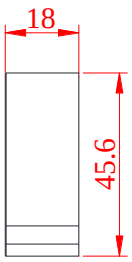


AID150 Hole size

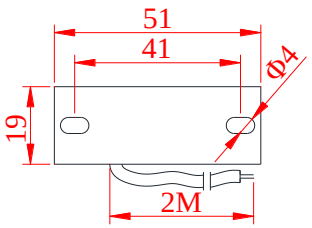
5.1.5 External dimensions of AKH-0.66P26 current transformer (unit: mm)



Front view



Side view



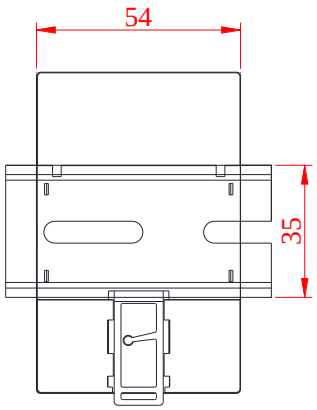
Bottom view

5.2 Installation Method

In addition to the AID series external alarm and display instrument, the M10 five-piece set insulation monitoring devices of medical IT system should be installed in the distribution cabinet (isolated power cabinet). The isolation transformer should be installed at the bottom of the distribution cabinet, fixed with supporting bolts, and cooling fan should be installed. The instrument and circuit breaker are mounted on the upper panel. If the isolation transformer is installed separately, it should be near from the AIM-M10 insulation monitor. When the AID10/150 external alarm and display instrument is used in the operating room, it can be embedded in the wall and installed next to the information panel in the operating room for the convenience of medical personnel. When AID150 is used in ICU/CCU and other intensive care units, it should be installed in the hand nurse station for the nurses on duty to check, and the RS485 communication between each insulation monitoring instrument, AID series instrument under centralized monitoring should be connected hand in hand. The wiring of the AID series external alarm and display instrument includes two 24V power lines and one RS485 communication line with 2-core shielded twisted pair. These three lines are drawn from the isolated power cabinet, and pipelines should be reserved during construction.

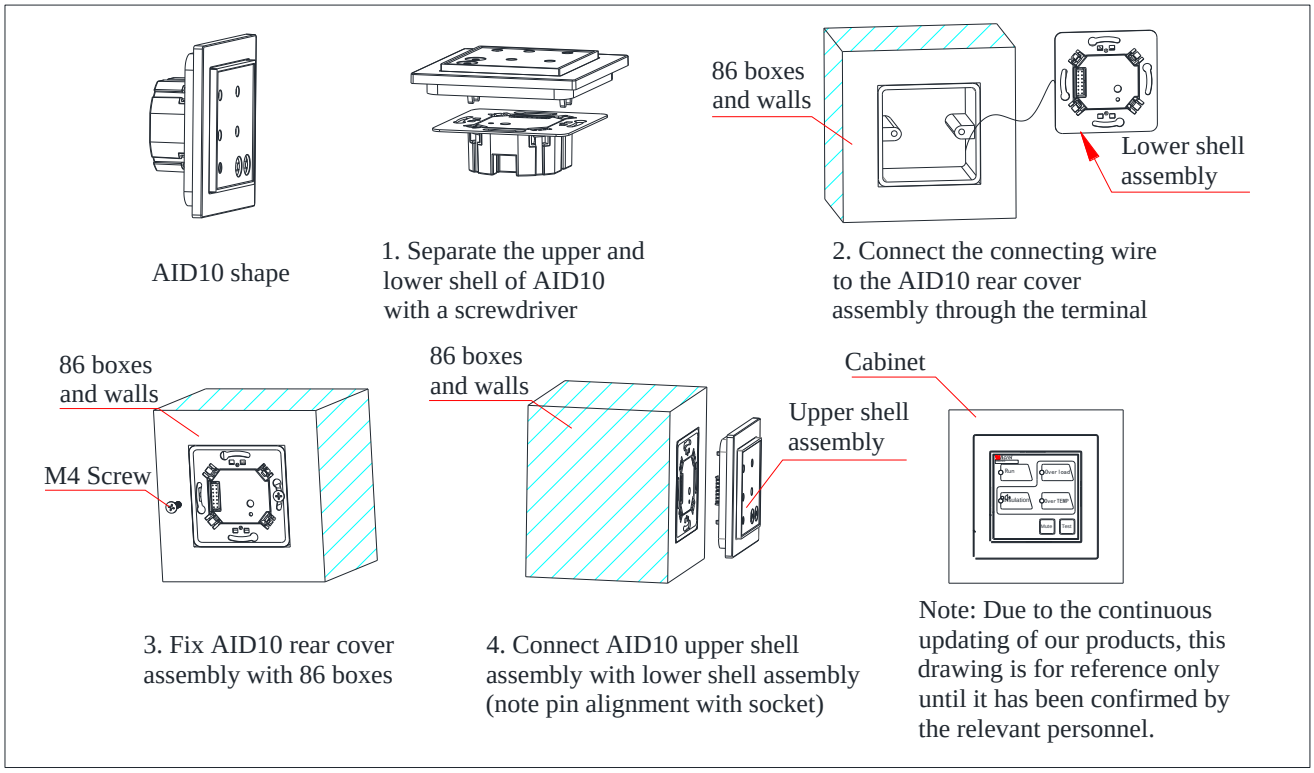
5.2.1 Installation mode of AIM-M10 medical insulation monitor

AIM-M10 insulation monitor adopts the installation method of the guide rail, and the fixation mode is the clip buckle type, as shown in the following figure:



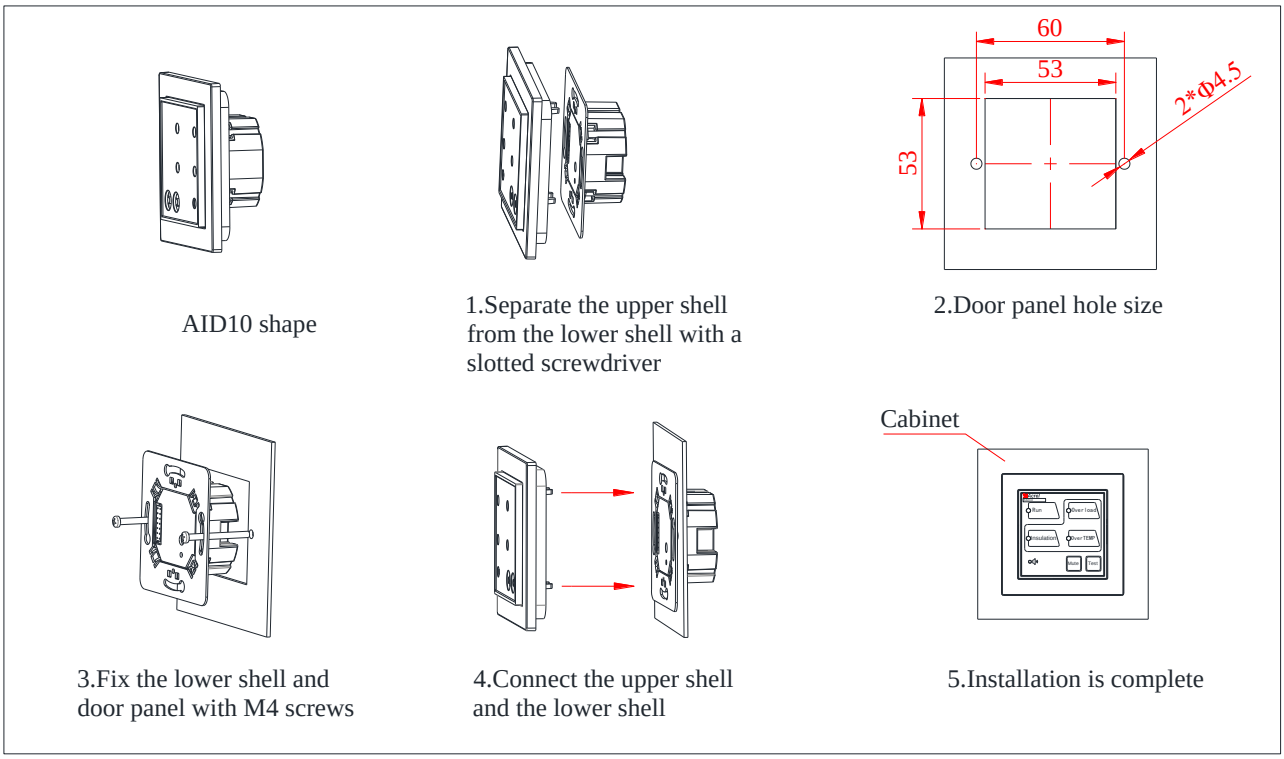
5.2.2 Installation mode of AID series alarm and display instrument

(1) If AID10 is embedded into the wall, the standard 86*86 mounting hole shall be reserved. The installation diagram is as follows:

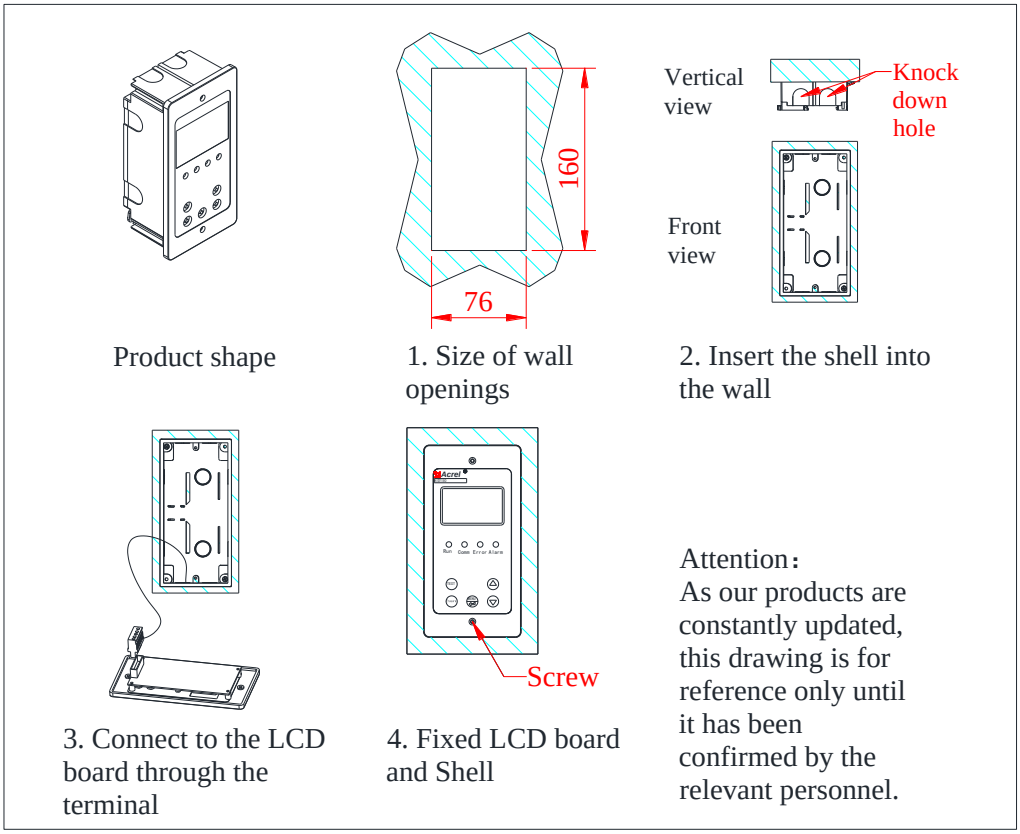


When decorating, first place in the right wall openings, and then isolated power cabinet lead (2 power cable with 1.5mm^2 cables and 1 shielded twisted-pair cable with 1.5mm^2 cable) introducing the receiving terminal, the shell knocked down hole near the line, then embedding external alarm and display the shell wall and internal fixation, the terminal to circuit board corresponding terminals on the front cover, Install the panel on the housing and fix it with the supplied tapping screws.

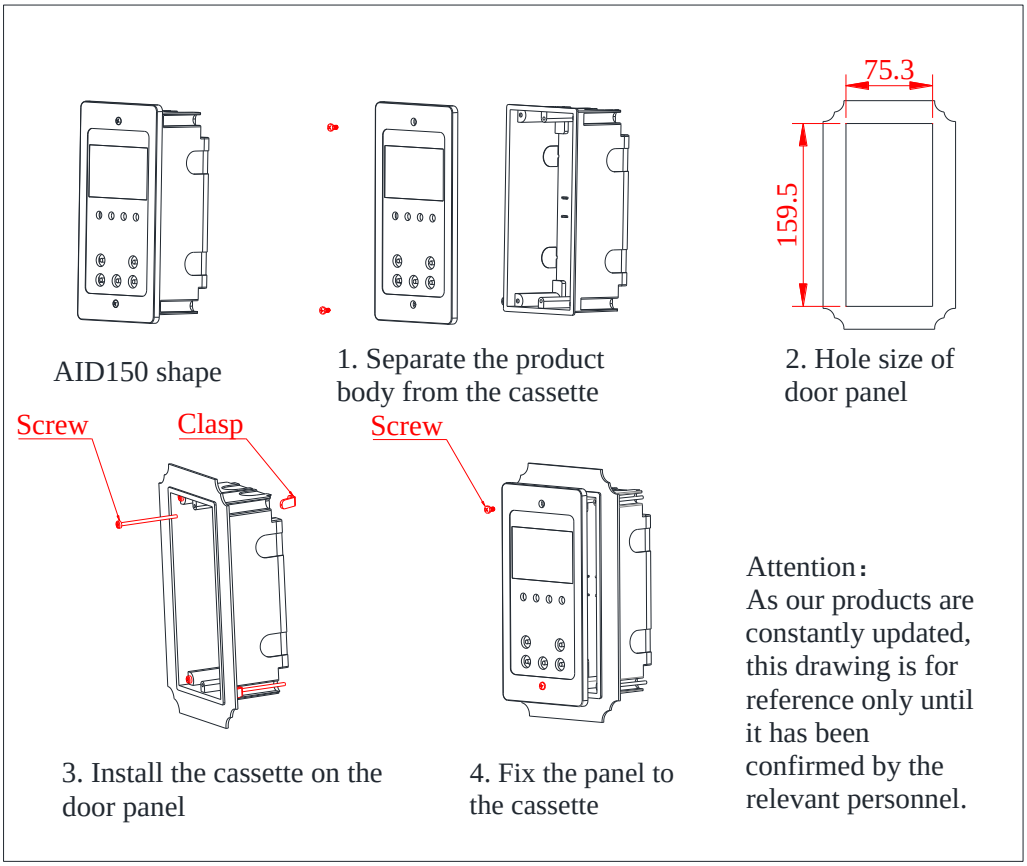
(2) If AID10 is installed by opening the cabinet door, the installation diagram is as follows:



(3) If the AID150 centralized alarm and display instrument is embedded in the wall, the installation schematic is shown below:



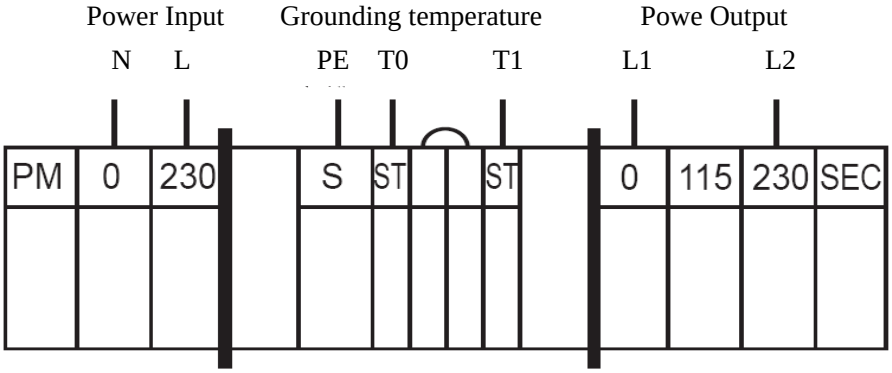
(4) If the AID150 external alarm and display instrument is installed by opening the cabinet door, the installation diagram is as follows:



5.3 Wiring Method

5.3.1 Wiring mode of AITR series medical isolation transformer

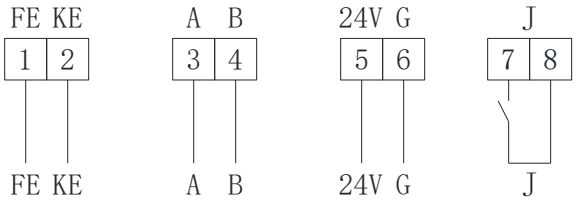
The input terminals at the transformer terminal blocks are labeled with "PM", in which two terminals 0 and 230 are connected to the input 220V single-phase AC. The output terminals are labeled with "SEC", in which the output voltage of two terminals 0 and 230 is AC 220V and is connected to external field load. The S terminal is connected to the PE bus bar on the spot (or the equipotential terminal line). Two ST terminals are temperature sensor interfaces, which are respectively connected to the 17 and 18 terminals of AIM-M10 insulation monitoring instrument.



Note: The wirings of input and output terminals of the isolation transformer should select the copper wires matching the line diameter based on the isolation transformer rated input and output current (refer to tables in section 5.4). S terminal wiring can select 2*4mm^2 yellow-green wire. The wiring of two ST terminals can select 2*1.5mm^2 shielded twisted pairs, and the wiring should not be too long.

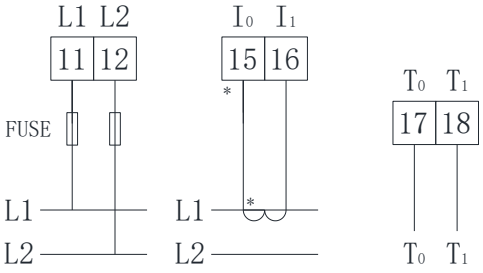
5.3.2 Wiring mode of AIM-M10

Lower row terminals: FE, KE (1,2) are connected to the field equipotential grounding terminal block as instrument functional grounding. A, B (3,4) are communication terminals connected with external alarm and display device. +24V, 0V (5,6) are DC power output to supply power for alarm and display instrument. J (7,8) are output of over temperature alarm relay (used to control cooling fan).



Grounding Communication 24V output Relay output

Upper terminal: L1, L2 (11, 12) are connected with monitored IT system. I0, I1 (15, 16) are signal input of current transformer AKH-0.66P26. T0, T1 (17, 18) are signal input of temperature sensor.



IT System Current Temperature

Notes:

(1) The wirings connecting the 11 and 12 terminals of the insulation monitor can select 2*1.5mm^2 copper wires, and the FE and KE terminals corresponding to the 1 and 2 can select 2*4mm^2 yellow-green wires (grounding wires). relay output are the dry nodes, which need additional power supply during the control of external load. For example, J1 controls AC 220V cooling fan, then the AC 220V power supply is needed, and the wiring line type should be determined according to the load current.

(2) 2*1.5mm^2 shielded twisted pair cable can be selected for current transformer signal line corresponding to terminals 15 and 16, temperature signal line corresponding to terminals 17 and 18, RS485 communication line corresponding to terminals 3 and 4. The COM port for communication does not need wiring.

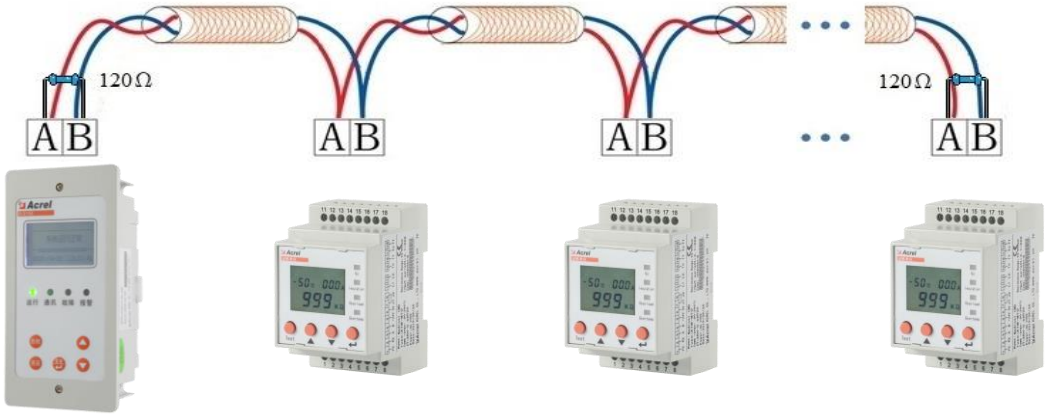
5.2.3 Wiring mode of AID10/150 centralized alarm and display instrument

The terminals of the power supply correspond to the positive pole and ground of the 24V DC power module respectively. A and B are connected with A and B in the lower terminal of AIM-M10.

The wiring diagram is shown in the following figure.

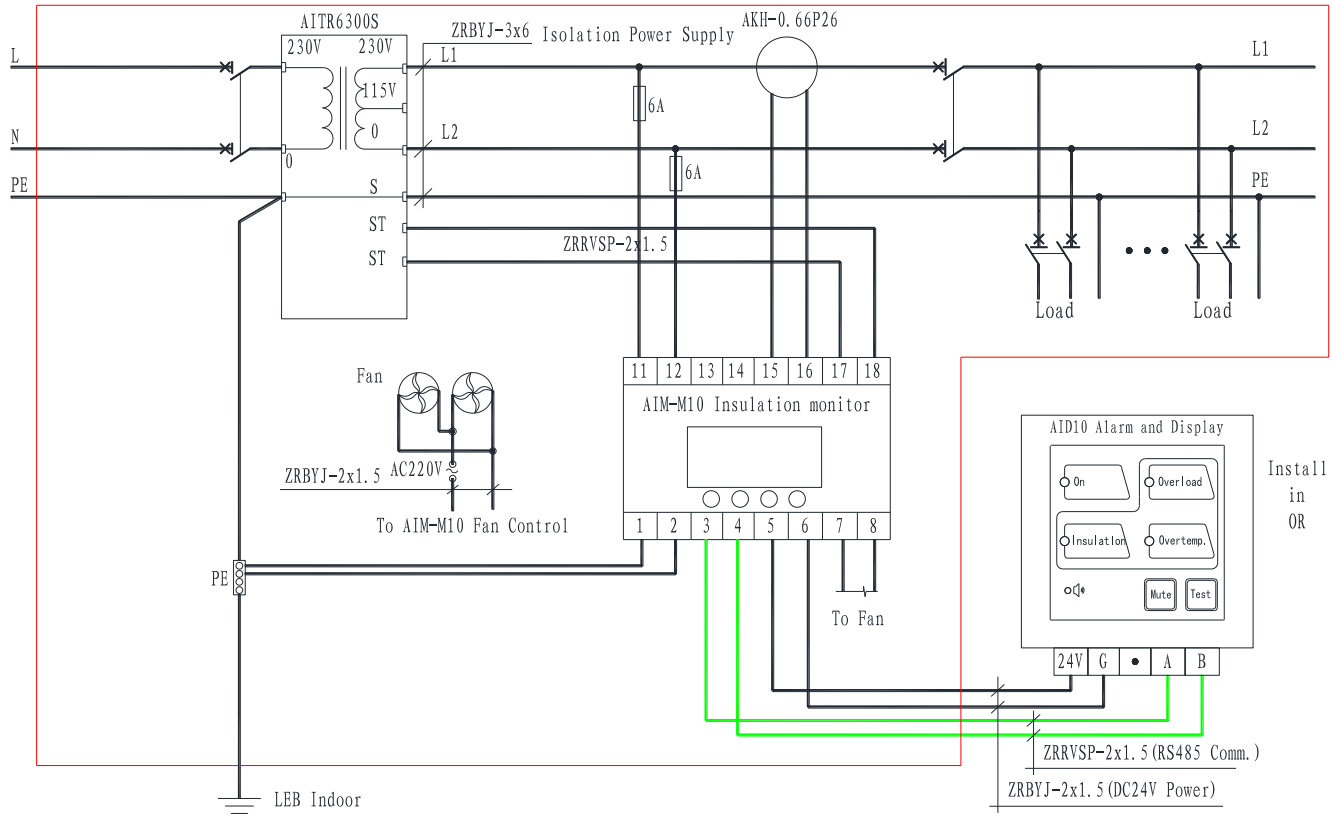
Power RS485

When an AID150 is required to access multiple AIM-M10 Medical Intelligent Insulation Monitors, all instrument communication A and B communication terminals should be connected by hand, and if the communication distance is too long or the communication is abnormal, a 120Ω matching resistor should be accessed in parallel at the first and the last ends of the communication, as shown in the following figure:



The 24V power supply can be connected by multiple copper wires of 2*1.5mm^2, and the RS485 communication terminal can be connected by shielded twisted pair of 2*1.5mm^2.

5.4 Typical Wiring Diagram



More information:

(1) The connection line diameter of the input and output of the isolation transformer should match the rated current of the isolation transformer, or it can be selected according to the following table:

Isolation transformer type	Selected line diameter
AITR3150S	3*4 mm^2
AITR5000S/AITR6300S	3*6 mm^2
AITR8000S/AITR10000S	3*10 mm^2

(2) AIM-M10 insulation monitor terminals 11, 12 for auxiliary power and IT system insulation monitoring, can be connected to the back end of the medical single-phase isolation transformer, it is appropriate to series 6A rated fuse protection. AIM-M10 insulation monitor terminals 1, 2 for the grounding terminal, should be used for two independent grounding wires were connected to the site of the equipotential terminal block (or isolation of the power supply cabinet within the grounding terminal block).

(3) AIM-M10 insulation monitor 15, 16 terminals for current monitoring, access to AKH-0.66P26 current transformer, the transformer only need to pass through the medical single-phase isolation transformer secondary side of the output of the L1, L2 any of the two lines can be, can not be worn at the same time into the two wires. Current transformer lead wiring into the corresponding terminal, the shield is not grounded.

(4) AIM-M10 insulation monitor 17, 18 terminals for temperature monitoring, access to the temperature sensor, the transformer internal temperature sensor leads to the ST terminal.

(5) AIM-M10 insulation monitor 7, 8 terminals for the over-temperature alarm relay, access to the fan requires external power supply, when multiple transformers are centrally installed in an isolated power cabinet, multiple fans should be connected into a parallel control by multiple insulation monitors, that is, each 1 insulation monitor can start and stop all the fans.

(6) AIM-M10 insulation monitor 5 and 6 terminals are DC 24V output terminals, which can provide power to AID10/150.

(7) AIM-M10 insulation monitor terminal 3 and 4 are RS485 communication terminals for communication with AID10/150, AID10 can be connected to 1 AIM-M10, AID150 can be connected to up to 16 AIM-M10, AID10 can be mounted on the wall of the operating room, AID150 can be mounted on the door of the cabinet, the wall of the operating room, or the wall of the nurses' station. The AID10 can be mounted on the operating room wall and the AID150 can be mounted on the cabinet door, operating room wall or nurse station wall.

5.5 Considerations

(1) Medical IT system insulation monitoring and fault locating seven pieces of products should be centrally installed in the isolation power cabinet except for AID series. If the field space is too limited to apply the isolation power cabinet, the isolation transformer can be installed separately, but should not be too far away from the insulation monitor and the field load.

(2) The installation of wiring should strictly follow the wiring diagrams, which should preferably use

the pressure connection with the needle-type fittings, and then insert into the corresponding terminal of the instrument and tighten the screws to avoid the abnormal work conditions of instrument caused by loose connection.

(3) The grounding wire of the instrument and the transformer shall be reliably connected with the equipotential terminals in the field. When applying the isolation power cabinet, it should be connected to the grounding terminals in the isolation power supply cabinet, and then to the equipotential terminals in the field.

(4) The current input of AIM-M10 medical insulation monitoring instrument should use a matching AKH-0.66P26 type current transformer. It is recommended to use pressure connection with U-type indenters during wiring operation, and then connect to the CT terminal. Do not directly use the bare head connection, for the considerations of reliable connection and easy disassembly. Before removing the wiring, the CT primary circuits must be cut off or the secondary circuits must be short connection.

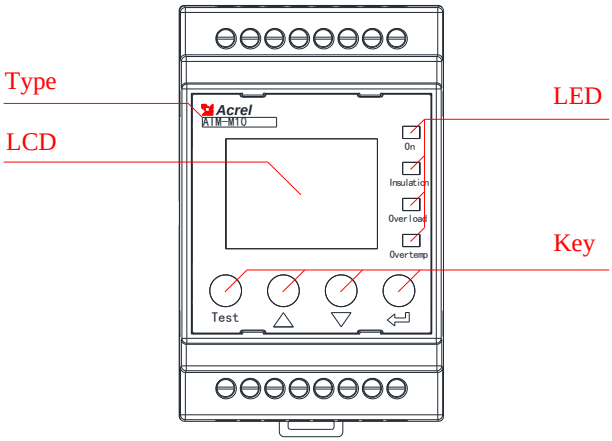
(5) Special reminder:

Any isolation transformer will have an impact current when it starts up, and too large impact current may cause the circuit breaker at primary side of the transformer difficult to disconnect or shut down. Therefore, for medical IT systems composed of medical isolation transformers and insulation monitoring products, in the selection of inlet circuit breaker of the isolation transformer, it is recommended to choose the circuit breakers only with short circuit protection but without overload protection according to GB requirements. If choosing the circuit breaker with overload protection, the circuit breaker should conform to the C and D tripping curves of GB14048.2-2008, and the rated current of the circuit breaker should be determined according to the capacity of the isolation transformer as follows: 10kVA-63A, 8kVA-50A, 6.3kVA-40A, 5kVA-40A, 3.15kVA-20A.If the circuit breaker selection is not in accordance with the above requirements, the company shall not be liable for any medical malpractice caused by the closure difficulty of the circuit breaker or the disconnection of the circuit breaker during operation.

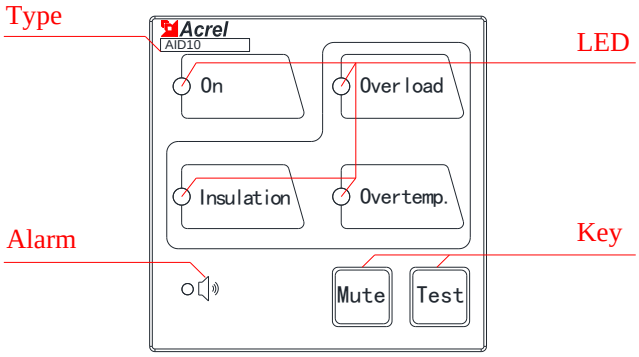
6 Programming and Application

6.1 Panel Description

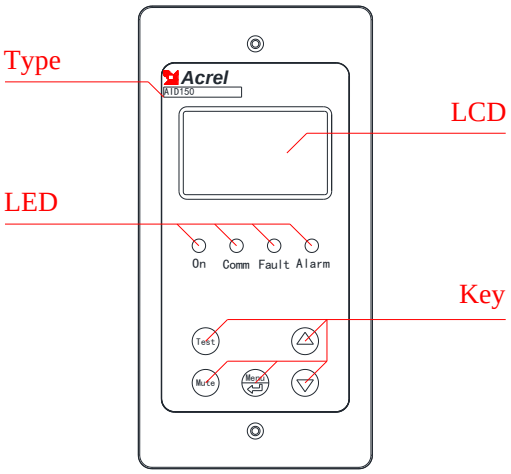
(1) AIM-M10 Insulated Monitor Panel



(2) AID10 External Alarm and Display Panel



(3) AID150 External Alarm and Display Panel



6.2 LED Indicator Instructions

6.2.1 AIM-M10

Indicator	Instructions
On	When the instrument operation is normal, the indicator light flashes, with the flashing frequency of about one time per second.
Insulation	When the insulation resistance exceeds the alarm value, or when the LL/FK is disconnected, the indicator light flashes to alarm.
Overload	When load current exceeds the total load current of transformer, the indicator light flashes to alarm.
Overtemp.	When testing transformer temperature exceeds the alarm value, or when the temperature sensor wiring is disconnected, the indicator light flashes to alarm.

6.2.2 AID10

Indicator	Instructions
On	When the device is in normal operation, the indicator flashes, and the flickering frequency is about once a second.
Insulation	When the insulation resistance exceeds the alarm value, the indicator light flashes to alarm.
Overload	When load current exceeds the total load current of transformer, the indicator light flashes to alarm.
Overtemp.	When testing transformer temperature exceeds the alarm value, the indicator light flashes to alarm.

6.2.3 AID150

Indicator	Instructions
On	When the device is in normal operation, the indicator flashes, and the flickering frequency is about once a second.
Comm	Indicate the status of device communication, when there is data communication, the indicator light flashes.
Fault	When AIM series monitor detect disconnection failure, indicator flashes alarm.
Alarm	When AIM-M series monitor exceed threshold alarm, indicator flashing alarm.

6.3 Button Function Descriptions

6.3.1 AIM-M10

AIM-M10 has four buttons in total, "Test" button, "▲" button, "▼" button, and "↵" button.

Key	Function
"Test" button	In operation state, used to start the self-test function of instrument.
"▲" button "▼" button	In non-programming mode, used to view the fault records. In programming mode, used to increase or decrease the values, or to change the protection action status.
"↵" button	In non-programming mode, press this button to enter the programming mode; In programming mode, used as the Enter button.

6.3.2 AID10

AID10 has two buttons in total, "Mute" button and "Test" button.

Key	Functions
"Mute" button	When there is alarm, press this button to eliminate the alarm sound.
"Test " button	Used to start the self-test function of instrument.

6.3.3 AID150

AID150 has five buttons in total, "Test" button, "Mute" button, "▲" button, "▼" button, and "Menu/↵" button,

Key	Functions
"Test" button	In non-programming mode, used to start the self-test function of instrument.

"Mute" button	When there is alarm, press this button to eliminate the alarm sound.
"▲" button "▼" button	In programming mode, used to increase or decrease the value.
" Menu/↵ " button	In non-programming mode, press this button to enter the programming mode; In programming mode, used as the Enter button.

6.4 Button Operation Descriptions

6.4.1 AIM-M10 Insulation Monitor in Non-programming Mode

(1) Enter operation mode. The default mode of startup is operation mode. The main interface displays temperature value, insulation resistance value, load rate and current system time.

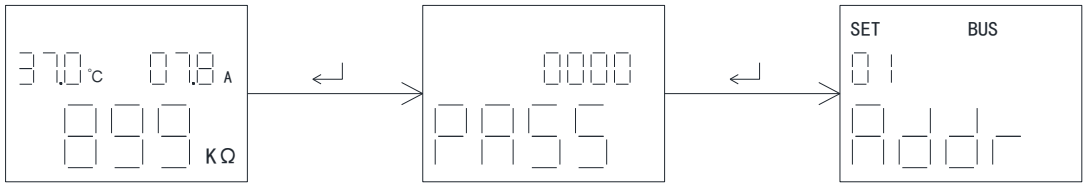
(2) View the alarm record. In the main interface, press the "▲" or "▼" to enter the "fault record query" interface. Press the " ↵ " button to confirm, and then you can turn the page through the "▼" or "▲" to query the condition of each fault record in turn. The first record is the latest record and the tenth record is the oldest record.

(3) Instrument self check. Press the "Test" key, the monitor will start the self-test program to simulate overload fault, insulation fault and over temperature fault. In order to detect and judge whether the main fault is normal or not. If the monitor can detect the above three kinds of faults, it indicates that the instrument function is normal.

6.4.2 AIM-M10 Insulation Monitor in Programming Mode

(1) Enter programming mode

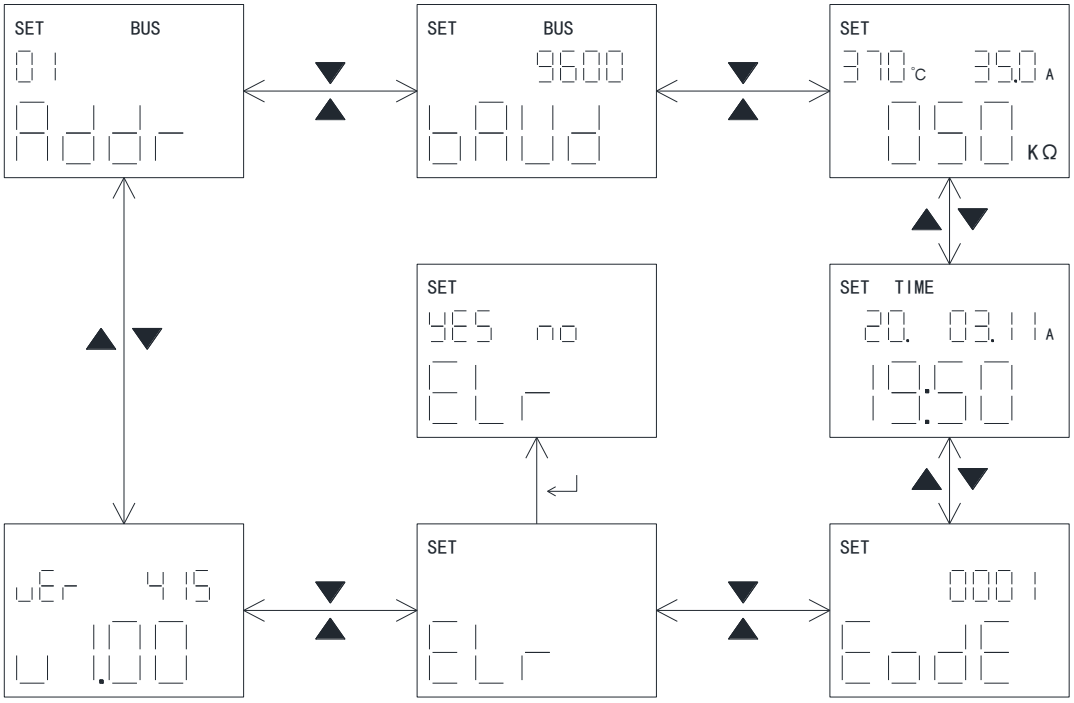
In normal operation, press Enter to enter the password input page of programming mode. Increase the number by "▲" and decrease it by "▼". After inputting the correct password, press " ↵ " to enter the programming mode.



(2) In programming mode, the instrument parameters are set

After entering the programming mode, press "▲" or "▼" to view each parameter interface.

In the programming mode, press the " ↵ " key, the parameter will flash, and the parameter can be modified by "▲" and "▼". When there are multiple parameters in the interface, such as alarm value setting interface and time setting interface, when the parameter flashes, "▲" is used to select the parameter and "▼" is used to modify the parameter value. Press " ↵ " again to exit the parameter modification mode and browse the menu.



(3) Exit programming mode

In the programming mode, enter the "save parameter" page through the "Test" key, select "yes" and "no" by "▲" and "▼", and the flashing indicates the selection. Press the "↵" key to save the parameters or not, exit the programming mode and enter the operation mode.

6.4.3 AID10 Alarm and Display Key Operation

(1) After AID10 and AIM-M10 are connected through RS485 communication, the On light flashes, indicating that the communication is normal. If the operation lamp is normally on, it means the communication is abnormal.

(2) When AID10 detects the fault mark issued by AIM-M10, the corresponding indicator light flashes, and the buzzer rings. Press the Mute key to turn off the buzzer.

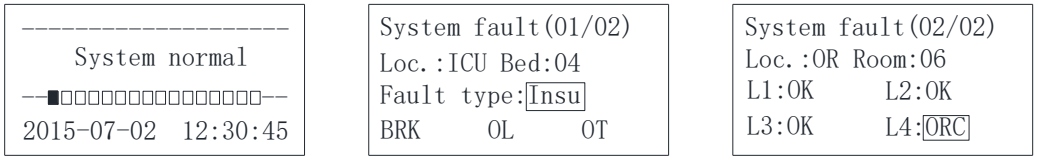
(3) When the system is running normally, press the Test key to start the AIM-M10 insulation monitor self-test.

6.4.4 AID150 Alarm and Display Key Operation

(1) Description of the operating interface

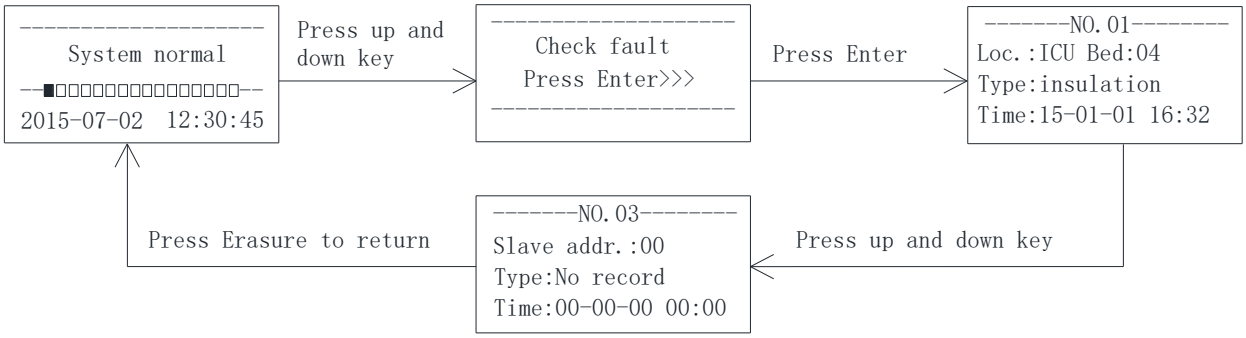
After the system is powered on, if there is no fault alarm, AID150 shows the normal operation interface as shown in the following figure. The black boxes in the figure indicate that the corresponding address serial number is connected to the instrument communication, and the black boxes indicate that there is no instrument connection, or that the communication is not connected. When the insulation

monitors or residual current monitor detects the fault, AID150 displays the corresponding alarm interface and sends out the corresponding sound and light alarm.



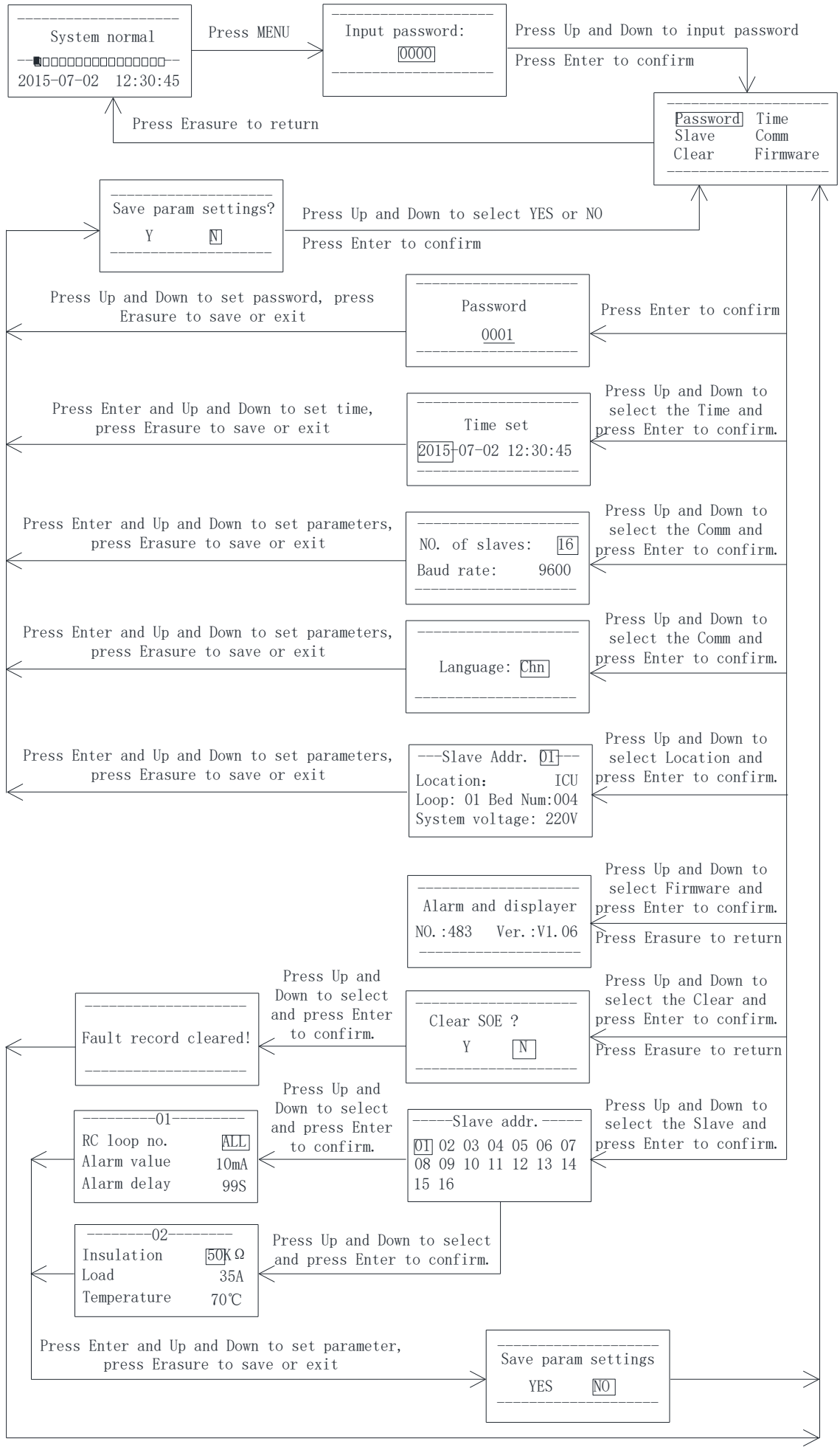
Normal system fault indication（AIM-M10） fault indication（AIM-R100）

(2) Fault record viewing interface operations and descriptions



(3) Programming Interface Operation and Explanation

The operation method and process are shown in the following flow chart.


System normal
2015-07-02 12:30:45
Press MENU
Input password:
0000
Press Up and Down to input password
Press Enter to confirm
Password Time
Slave Comm
Clear Firmware
Press Erasure to return
Save param settings?
Y N
Press Up and Down to select YES or NO
Press Enter to confirm
Password
0001
Press Enter to confirm
Press Up and Down to set password, press Erasure to save or exit
Time set
2015-07-02 12:30:45
Press Up and Down to select the Time and press Enter to confirm.
Press Enter and Up and Down to set time, press Erasure to save or exit
NO. of slaves: 16
Baud rate: 9600
Press Up and Down to select the Comm and press Enter to confirm.
Press Enter and Up and Down to set parameters, press Erasure to save or exit
Language: Chn
Press Up and Down to select the Comm and press Enter to confirm.
Press Enter and Up and Down to set parameters, press Erasure to save or exit
---Slave Addr. 01---
Location: ICU
Loop: 01 Bed Num:004
System voltage: 220V
Press Up and Down to select Location and press Enter to confirm.
Press Enter and Up and Down to set parameters, press Erasure to save or exit
Alarm and displayer
NO.:483 Ver.:V1.06
Press Up and Down to select Firmware and press Enter to confirm.
Press Erasure to return
Fault record cleared!
Press Up and Down to select and press Enter to confirm.
Clear SOE ?
Y N
Press Up and Down to select the Clear and press Enter to confirm.
Press Erasure to return
---------01---------
RC loop no. ALL
Alarm value 10mA
Alarm delay 99S
Press Up and Down to select and press Enter to confirm.
-----Slave addr.-----
01 02 03 04 05 06 07
08 09 10 11 12 13 14
15 16
Press Up and Down to select the Slave and press Enter to confirm.
--------02--------
Insulation 50KΩ
Load 35A
Temperature 70℃
Press Up and Down to select and press Enter to confirm.
Press Enter and Up and Down to set parameter, press Erasure to save or exit
Save param settings
YES NO

7 Communication Protocol

7.1 Modbus-RTU Communication Protocol

Meter RS485 interface adopts Modbus-RTU communication protocol, which defines the address, function code, data, check code in detail. It is the necessary content to complete the data exchange between the host and slave machine.

7.2 Introduction of Function Code

7.2.1 Function code 03H or 04H: Read the registers

This function allows the user to acquire the data collected and recorded by device and the system parameters. The number of data requested by hosts has no limit, but cannot exceed the range.

The following example shows how to read a measured insulation resistance value from No.01 slave computer, with the address of the value of 0008H.

The host computer sends		Send message
Address code		01H
Function code		03H
Start address	High byte	00H
	Low byte	08H
Number of registers	High byte	00H
	Low byte	01H
CRC check code	Low byte	05H
	High byte	C8H

The slave computer returns		Return message
Address code		01H
Function code		03H
Bytes		02H
Register data	High byte	03H
	Low byte	E7H
CRC check code	Low byte	F8H
	High byte	FEH

The read result is 0x03E7H. The value is 999 in decimal notation, indicating that the insulation resistance is 999kΩ.

7.2.2 Function code 10H: Write the registers

The function code 10H allows the user to change the contents of multiple registers, which can write the time and date in this meter. The host can write up to 16 (32 bytes) data at a time.

The following example shows a preset address of 01 with an installation date and time of 12:00, Friday, December 1, 2009.

The host computer sends		Send message
Address code		01H
Function code		10H
Start address	High byte	00H
	Low byte	04H
Number of	High byte	00H

The slave computer returns		Return message
Address code		01H
Function code		10H
Start address	High byte	00H
	Low byte	04H
Number of	High byte	00H

registers	Low byte	03H
Number of registers		06H
0004H data	High byte	09H
	Low byte	0CH
0005H data	High byte	01H
	Low byte	05H
0006H data	High byte	0CH
	Low byte	00H
CRC check code	Low byte	A3H
	High byte	30H

registers	Low byte	03H
CRC check code	Low byte	C1H
	High byte	C9H

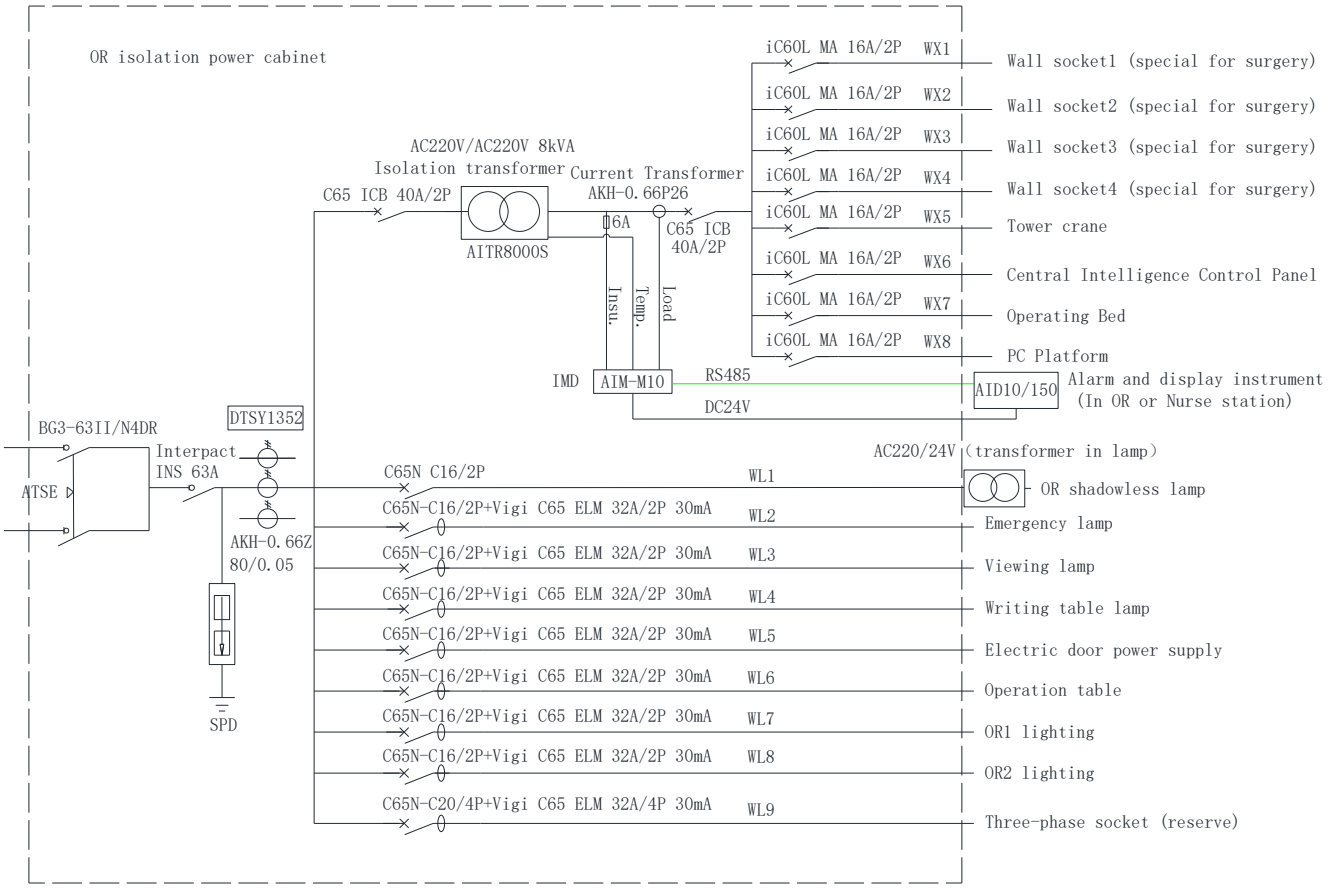
7.3 AIM-M10 Parameter Address Table

No.	Address	Parameter	Read-Write	Value Range	Data Type
0	0000H	Password	R/W	0000~9999 (Default 0001)	UINT16
1	0001H high	RS485 address	R/W	1~247 (Default 1)	UINT16
	0001H low	RS485 Baud	R/W	1~3: 4800, 9600, 19200 (unit bps) (Default 2)	
2	0002H	Reserved			UINT16
3	0003H	Reserved			UINT16
4	0004H high	Year	R/W	1~99	UINT16
	0004H low	Month	R/W	1~12	
5	0005H high	Day	R/W	1~31	UINT16
	0005H low	Week	R/W	1~7	
6	0006H high	Hour	R/W	0~23	UINT16
	0006H low	Minute	R/W	0~59	
7	0007H high	Second	R/W	0~59	UINT16
	0007H low	Reserved			
8	0008H	Insulation resistance	R/W	10~999 (Unit is kΩ)	UINT16
9	0009H	Load current	R/W	0~500 (Unit is 0.1A)	UINT16
10	000AH	Transformer temperature	R/W	-50~200 (Unit is℃)	INT16
11	000BH high	Reserved			UINT16

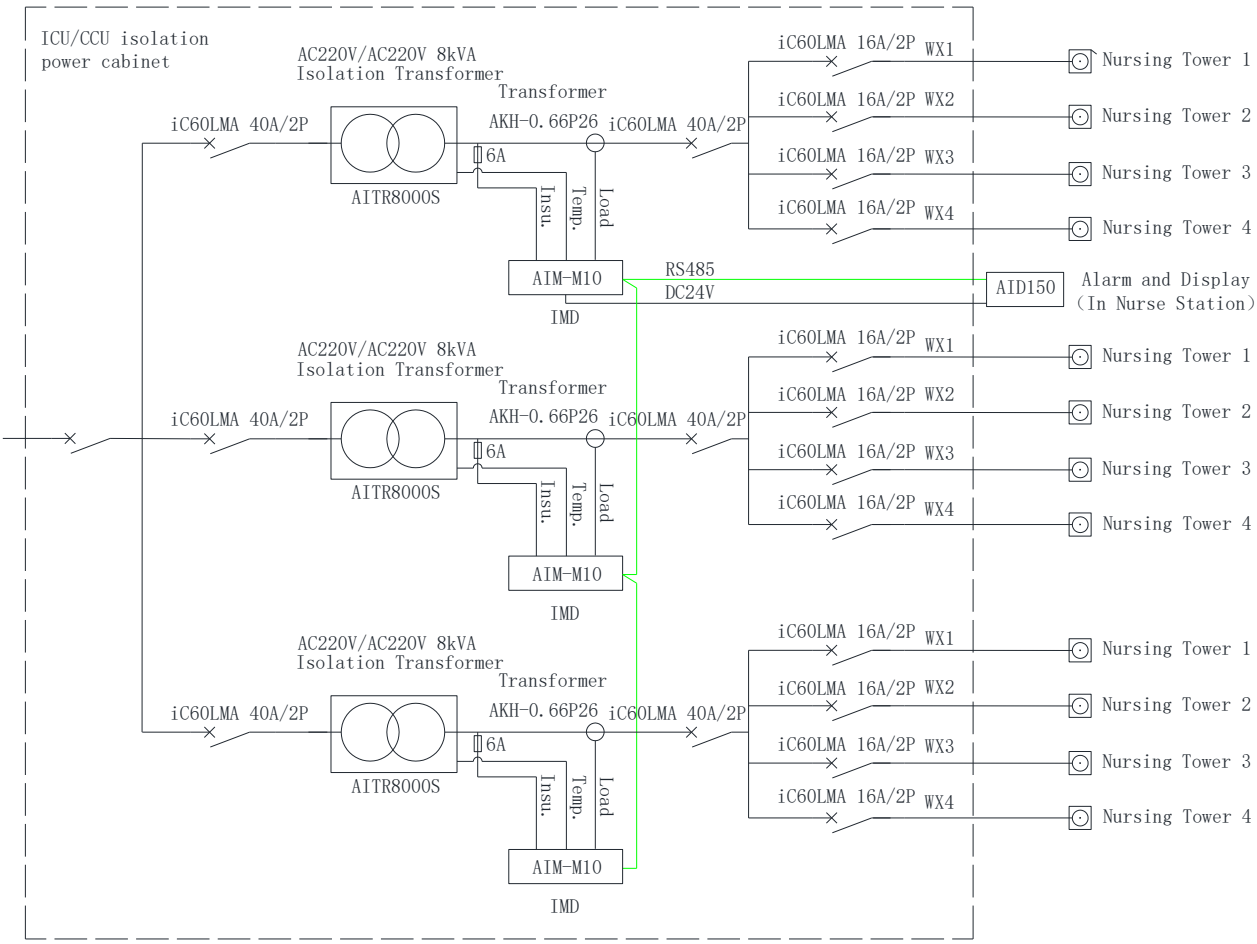
	000BH low	Fault type		R	bit7~bit6: Reserved bit5: 0 normal; 1 Temperature sensor disconnection bit4: 0 normal; 1 PE or KE disconnection fault bit3: Reserved bit2: 0 normal; 1 Transformer overheat fault Bit1: 0 normal; 1 Overload fault Bit0: 0 normal; 1 Insulation resistance fault e.g. 00 01 means 0000 0000 0000 0001, insulation fault	
12~15	000CH~ 000FH	Reserved				UINT16 *4
16	0010H	Insulation resistance set value		R/W	10~999 (Unit kΩ) (default 50)	UINT16
17	0011H	Load current set value		R/W	14, 18, 22, 28, 35, 45 (Unit A) (default 35)	UINT16
18	0012H	Transformer temperature set value		R/W	0~200 (Unit ℃) (default 70)	UINT16
19~23	0013H~ 0017H	Reserved				UINT16 *5
24	0018H high	SOE1	Reserved			UINT16
	0018H low		Info.	R	SOE type: 0~6 0: No fault record 1: Insulation fault 2: Overload fault 3: Over temperature fault 4: LL disconnection 5: PK disconnection 6: TC disconnection	
25	0019H high		Year	R	SOE1 time - year	UINT16
	0019H low		Moth	R	SOE1 time - month	
26	001AH high		Day	R	SOE1 time - day	UINT16
	001AH low		Hour	R	SOE1 time - hour	
27	001BH high		Minute	R	SOE1 time - minute	UINT16
	001BH low		Second	R	SOE1 time - second	
28~63	001CH~ 003FH	Store the other 9 SOEs in the same format as the first one				UINT16 *36

8 Typical Applications

The Application of medical IT system intelligent insulation monitoring product M10 five-piece set in the operating room power distribution is shown in the following figure.



The application such as ICU/CCU is shown in the following figure.



9 Power On and Debugging Instructions

9.1 Wiring Check

For each set of IT system, the wiring check should be conducted before power on, mainly checking whether there is wrong, missed or short connection. The examination can be conducted sequentially in the following order according to the wiring diagrams shown in section 5.4 of this manual:

(1) Check whether each four-piece set constitutes an independent IT distribution system, and ensure that the current, resistance and temperature signals monitored by each insulation monitor are connected to the same isolation transformer and its IT system.

(2) Check the AIM-M10 DC power output. Whether the 5 and 6 (+ 24 V, G) of the 24V output end are respectively reliably connected with the 24 V and G terminals of the AID series external display device, and the positive and negative poles are correct.

(3) Check whether the 15 (I0) and 16(I1) terminals of AIM-M10 in each system are reliably connected to the terminals of the transformer AKH-0.66P26 socketed to the secondary side of the corresponding isolation transformer, and are not grounded. The transformer only passes one of the two lines of the output terminals of the isolation transformer.

(4) Check whether 17 (T0) and 18 (T1) terminals of AIM-M10 in each system are connected with the two ST terminals of isolation transformer and connected reliably.

(5) Check whether the terminals 11 (L1) and 12 (L2) of AIM-M10 in each set of systems are reliably connected with the two wires of IT system (i.e. output end of secondary side of isolation transformer).

(6) Check whether the 1 (FE) and 2 (KE) terminals of AIM-M10 in each system are connected to the field equipotential terminal block with wires, and whether the S terminal of the isolation transformer is also reliably connected with the equipotential terminal block.

(7) Check whether terminals 3 (A) and 4 (B) of RS485 communication of AIM-M10 instrument in each system are connected with terminals a and B of AID series external alarm display instrument in a hand-in-hand manner, and the positive and negative are correct.

(8) If each isolation transformer has a cooling fan, check whether the power control of the cooling fan is connected to the 7 and 8 terminals of AIM-M10 in the system.

9.2 Common Faults and Eliminations

Make sure the wirings are correct and power on the system. Then check whether each meter is abnormal, and whether there is a fault alarm in AIM-M10. For common problems, the causes can be determined and the faults can be eliminated according to the phenomenon of each instrument and the fault types:

Model and Name	Fault phenomenon	Possible causes and troubleshooting
AIM-M10 Insulation	LCD display: FK disconnection, and the	1 and 2 terminals of AIM-M10 are not reliably connected to the equipotential terminals. Check the wirings and make sure they are

Monitor	insulation indicator.	reliably connected.
	LCD display: TC disconnection fault, and the overheat indicator.	17 and 18 terminals of AIM-M10 are not reliably connected to the two ST terminals of the isolation transformer. Check the wirings and make sure they are reliably connected.
	LCD display: insulation fault, and the insulation indicator.	At least one of the two lines in the IT system at the secondary side of the isolation transformer has a grounding fault, after elimination it can be restored to normal.
	The device is not lit.	The 220V power supply of AIM-M10 is not connected well. Check the wirings of 11 and 12 terminals and make sure they are reliably connected.
AID series Alarm and Display Device	The device is not lit.	The 24V power supply is not connected well. Check the wirings of 24V and G terminals and rewire.
	Communication indicator does not flash	(1)If the slave address of AIM-M10 is not set to the default 1, or the slave Baud is not set to the default 9600, it needs to be set as the default value. (2)If the communication line with AIM-M10 in the system is not well connected, check the communication line and confirm whether the matching resistance is connected properly.

Note: If the above faults occur, interrupt the power to troubleshoot, and adjust the wirings until everything is normal.

9.3 Settings and Debugging

(1) Acrel medical IT products need to enter a password when entering the menu settings, and the initial password for medical IT products is 0001.

(2) Rated current setting. After the system is powered on, set the AIM-M10 load current alarm value according to the capacity of the isolation transformer. The corresponding relations between alarm current and isolation transformer capacity are: 45A---10kVA, 35A---8kVA, 28A---6.3kVA, 14A---3.15kVA. After you set up, follow the process step by step to exit and save the setting parameters. The default alarm current value of the instrument is 35A, if the matching transformer is 8kVA, then this parameter does not need to be set 1.

(3) Communication parameter setting. To realize the centralized monitoring function of multiple sets of insulation monitors through the centralized alarm and display AID150, it is necessary to set the slave addresses of each AIM-M10 in turn (the master address is used to communicate with the upper computer, if there is no upper computer, it is not necessary to set it), and then the communication between the instruments should be connected hand in hand. After setting, the head and end of the communication bus relate to a matching resistor of 120Ω (the resistance must be added, otherwise communication may not be possible). AID150 does not need to set RS485 communication address. When using AID10 type external alarm and display instrument to monitor a set of AIM-M10 insulation monitor, the slave address of the insulation monitor should be 1, and the slave baud rate should be 9600, otherwise it can not communicate.

(4) System number setting. When AID150 is connected to N insulation monitors, it is necessary to set the "number of systems" in the AID150 settings to N. When the number of insulation monitors is more than 16, AID150 should be increased for network monitoring.

(5) Communication view and debugging. After setting the address and the number of systems to view the communication status, AID150 running interface can display access to the communication status of the insulation detector, if it shows "□", it means that the corresponding address communication failure, if it shows "■", it means that the corresponding address communication success, if the communication failure, you need to check the communication bus. If the communication fails, you need to check the connection of the communication bus. If multiple insulation monitors cannot communicate, you can connect matching resistors in parallel at the first end of the communication bus.

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