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AIM-T500L Series Industrial Insulation Monitoring and Fault Locating Products

Installation and Operation Manual V1.7

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
1	2018.06.18	V1.0	First version
2	2019.01.15	V1.1	Modify error
3	2020.03.28	V1.2	Add overview; Revise inaccurate content; Modify the panel of ASG200 and AIL200-12. Modify address table and add fault location records.
4	2020.08.10	V1.3	Modify the power supply in the wiring diagram. Add dc input; Modify the wiring of ASG200. Added AIL200-12 operation instructions.
5	2022.02.25	V1.4	Modify the format; Add modified records; Modify technical parameters; Add ZCT information; Add operation of fault locator; Update the address table.
6	2023.03.10	V1.5	Add 161~163 to address table, match 1403 V1.04; Add reset function, and add positioning delay.
7	2024.08.20	V1.6	Add ZCT, remove ASG200 manual startup, change DO description, add application, Debugging and Fault resolution.
8	2025.01.15	V1.7	Update bottom info.
Note:			

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AIM-T500L series Industrial Insulation Monitoring and Fault Locating Products

1 Introduction

With the development of industrial science and technology, residual current poses a great threat to industrial production safety. To improve the continuity and reliability of power supply, many important production sites adopt IT distribution system (ungrounded system).

AIM-T500L series industrial insulation monitoring and fault is developed by Acrel for IT distribution system in industrial occasions such as mine, glass factory, electric furnace and test equipment, ship, metallurgical plant, chemical plant, explosion hazard site, computer center and emergency power supply. The system has rich functions, including insulation resistance monitoring, insulation fault warning, insulation fault alarm, event recording, parameter setting, communication networking, etc. When the system has grounding fault, it can give a timely alarm and accurately locate the specific circuit of the fault to remind staff to check the fault in time.

Type and Name	Picture	Introduction
AIM-T500L Insulation monitor (IMD)		AIM-T500L insulation monitor adopts advanced microcontroller technology, high integration, small size, easy to install, intelligent, digital, networking in one. wide measuring range, fast reaction speed and large allowable system leakage capacitance
ASG200 Test signal generator (TSG)		ASG200 test signal generator can start and produce test signals in time when insulation fault occurs in the monitored IT system. It can coordinate with insulation fault locator to realize insulation fault location function and send fault phase line
AIL200-12 Insulation fault locator (IFL)		AIL200-12 insulation fault locator adopts high-precision signal detection circuit, and AKH-0.66L series current transformer, detection the signal of ASG200 test signal generator, accurate location of the insulation fault loop. every locator can locate 12 loops
AKH-0.66 L series Current transformer (ZCT)		AKH-0.66L series current transformer is used in conjunction with AIL200-12 Insulation Fault Locator, the ratio is 1000: 1. The current transformer is mounted inside the cabinet by screwing directly into the cabinet, and the secondary side is led out through the wiring, which is easy to install and use.

2 Functional Characteristics

2.1 AIM-T500L Insulation Monitor

■ Suitable for AC, DC and mixed AC/DC IT systems;

■ Real-time monitoring insulation resistance, fault warning or alarm when exceeds the limit;

■ Fault location can be achieved using signal generators, fault locators, and monitoring transformers;

■ Relay alarm output, LED alarm output and other fault indication methods;

■ SOE (Sequence of Events) function, convenient for operators to view and analyze the type of faults and the time of occurrence, to determine the system operating conditions;

■ Self-check function, which can realize fault self-check of device hardware circuit;

■ Disconnect monitoring, real-time monitoring of PE/KE function grounding wire connection status;

■ RS485 interface, standard Modbus-RTU protocol;

■ CAN interface, custom protocol, used to interact with signal generator and fault locator;

■ The reset mode supports both manual and automatic methods.

2.2 ASG200 Test Signal Generator

■ Used with the AIM-T500L to generate positioning signals and inject it into the IT system;

■ Indicates the phase line where the fault is located;

■ CAN bus communication is used for data interaction with other devices.

2.3 AIL200-12 Insulation Fault Locator

■ Used with the AIM-T500L insulation monitor to locate and indicate the faulty branch;

■ Single AIL200-12 can access up to 12 circuits, up to 90 can be accessed to monitor 1080 circuits;

■ Monitor and display the status of ZCT, OPEN for no access, OK for access, SC for short-circuit;

■ CAN bus communication is used for data interaction with other devices.

2.4 AKH-0.66L series Current Transformer

■ Used with the AIL200-12 fault locator to monitor locating signals;

■ Choose between ring or rectangular shape, with a variety of sizes to choose from;

■ Selection according to the rated current of the circuit, with a ratio of 1000: 1.

3 Technical Parameters

3.1 AIM-T500L Insulation Monitor

Item		Parameter
Accessory power supply		AC 85~265V; DC100~300V
Power dissipation		< 8W
System voltage		AC 0~690V; DC 0~800V; 40~460Hz
System application		IT system (online), Other system (offline)
Insulation monitoring	Measuring range	1k~10MΩ
	Alarm range	10k~10MΩ
	Resistance accuracy	1~10k, ±1k; 10k~10M, ±10%
	system leakage capacitance	<500μF
	Response time (Ce=1μF)	<5s
Internal parameters	Measuring voltage	<50V
	Measuring current	<270μA
	Internal DC impedance	≥180kΩ

Relay output		Error, Alarm, Warning
SOE		20 records (fault type, fault value, fault time)
Alarm type		LCD, LED indicator
Communication		RS485, Modbus-RTU; CAN, custom
Impulse voltage / Pollution Level		8kV/III
EMC/ Radiation		IEC61326-2-4
Environment	Working temperature	-10 ~+65℃
	Storage temperature	-20~+70℃
	Relative humidity	<95%, without condensation
	Altitude	≤2500m

3.2 ASG200 Test Signal Generator

Item		Parameter
Accessory power supply	Voltage	AC 85~265V; DC100~300V
	Power dissipation	<7W
IT system	Voltage	AC 0~690V; DC 0~800V
Fault locating	Response time	<5s
	positing voltage	20V/5Hz
	positing current	0~10mA
	Response sensitivity	——
Internal parameters	EMC/ Radiation	IEC61326-2-4
Output	Relay output	——
Environment	Working temperature	-15~+55℃

3.3 AIL200-12 Insulation Fault Locator

Item		Parameter
Accessory power supply	Voltage	AC 85~265V; DC100~300V
	Power dissipation	<5W
IT system	Voltage	——
Fault locating	Response time	<12s
	Positing voltage	——
	Positing current	——
	Response sensitivity	>0.5mA
Internal parameters	EMC/ Radiation	IEC61326-2-4
Output	Relay output	Alarm
Environment	Working temperature	-15~+55℃

3.4 AKH-0.66L series Current Transformer

Item	Parameter	
Rated current ratio	1A: 1mA	5A: 5mA
Rated continuous thermal current	2A	10A
Rated ratio	1000: 1	
Overload multiplier	10	
Rated voltage	AC 690V	

Working frequency	50~60Hz
Accuracy grade	Grade 1 (Grade 3 with Open-ended)
Flame retardant grade	UL94-V0
Insulation resistance	>1MΩ (DC 500V)
Impulse voltage	3kV/2mA/1min/50Hz
Insulation heat resistance grade	Grade E

4 Reference Standards

■ Q/ VCL-26-2017 *IT System Insulation Monitor.*

■ IEC 61557-8 *Electrical safety in low voltage distribution systems up to 1000V a.c. and 1500V d.c. - Equipment for testing, measuring or monitoring of protective measures - Part 8: Insulation monitoring devices for IT systems.*

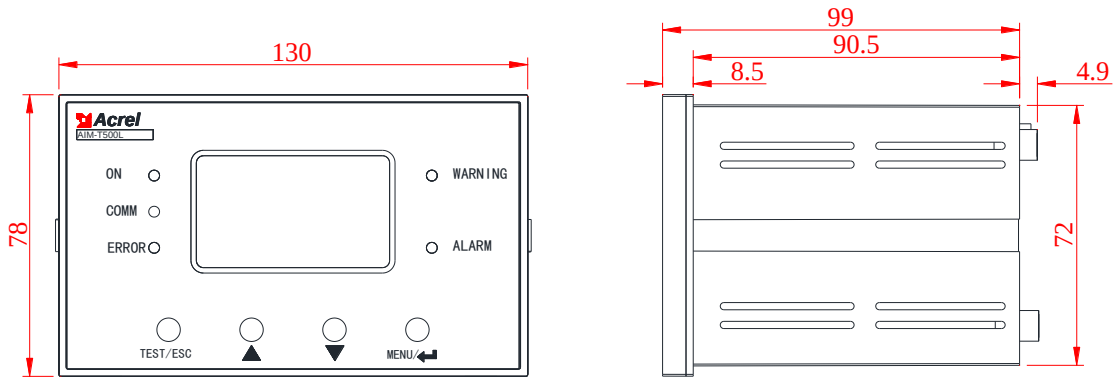
■ IEC 61557-9 *Electrical safety in low voltage distribution systems up to 1 000 V a.c. and 1 500 V d.c. - Equipment for testing, measuring or monitoring of protective measures - Part 9: Equipment for insulation fault location in IT systems.*

■ IEC 61326-2-4 *Electrical equipment for measurement, control and laboratory use - EMC requirements - Part 2-4: Particular requirements - Test configurations, operational conditions and performance criteria for insulation monitoring devices according to IEC 61557-8 and for equipment for insulation fault location according to IEC 61557-9.*

5 Installation and Connection

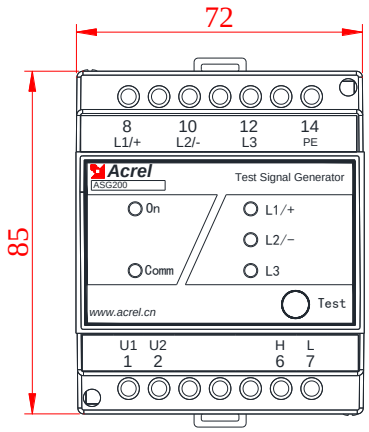
5.1 Shape and Size

AIM-T500L Insulation Monitor appearance and size are shown as follows. (unit: mm)

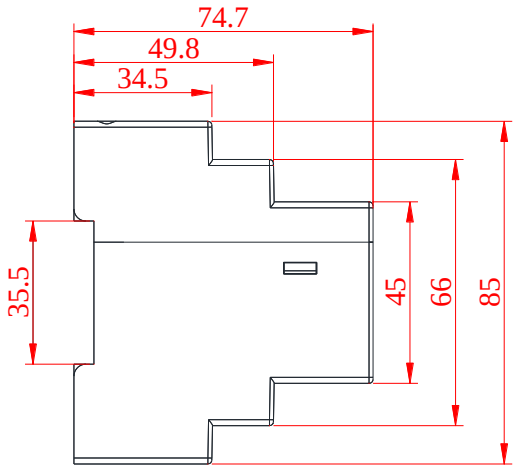


Front view　　Side view

ASG200 Test signal generator appearance is shown in the following figure. (unit: mm)

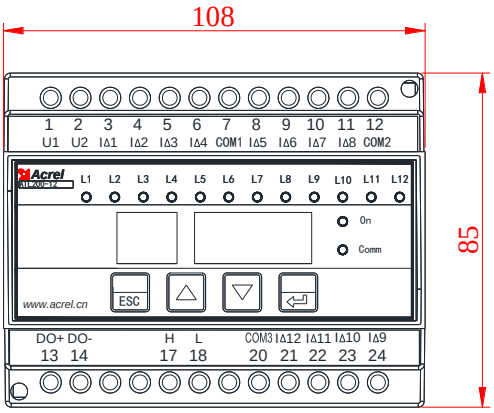


Front view

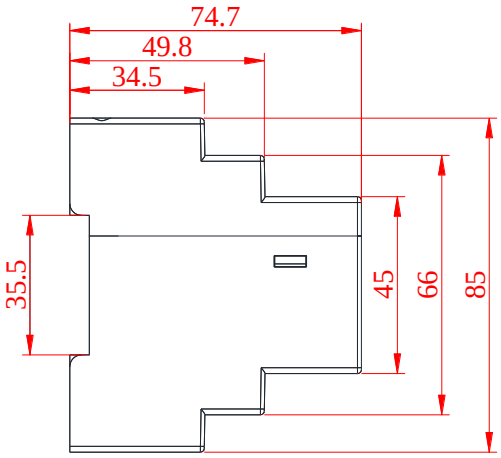


Side view

AIL200-12 Insulation fault locator appearance size as shown below. (unit: mm)



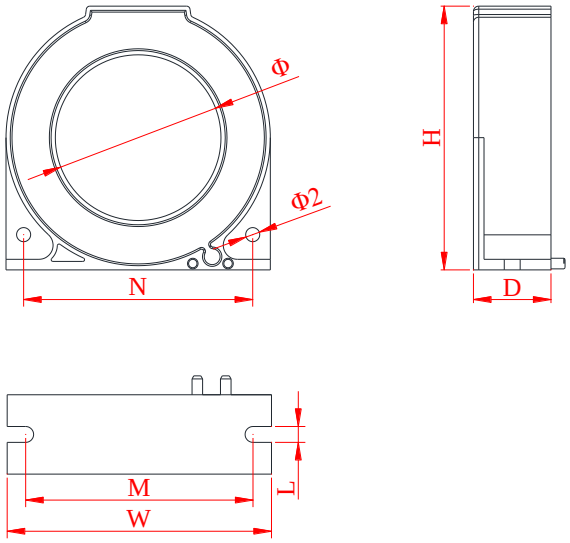
Front view



Side view

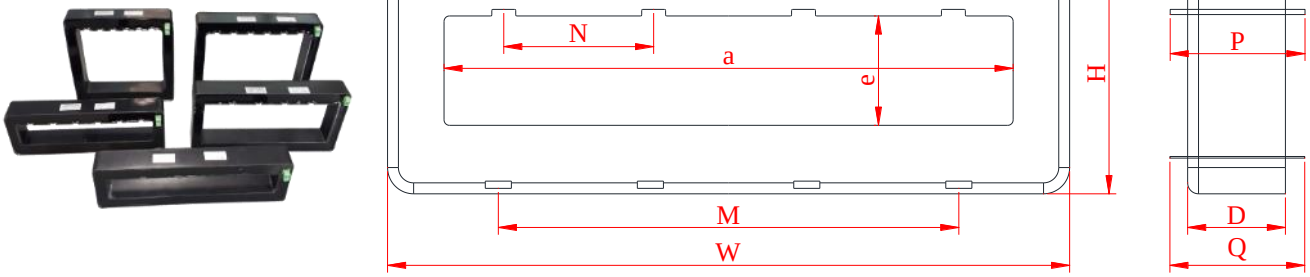
AKH-0.66 L series Current Transformers include ring, rectangular, ring shielded, rectangular shielded, open-type. Shielded type is suitable for complex power distribution environment with serious electromagnetic interference, and open-type is suitable for power distribution modification with high dismantling difficulty but not high precision requirement.

The dimensional parameters of the ring ZCT are shown in the figure and table below. (Unit: mm)



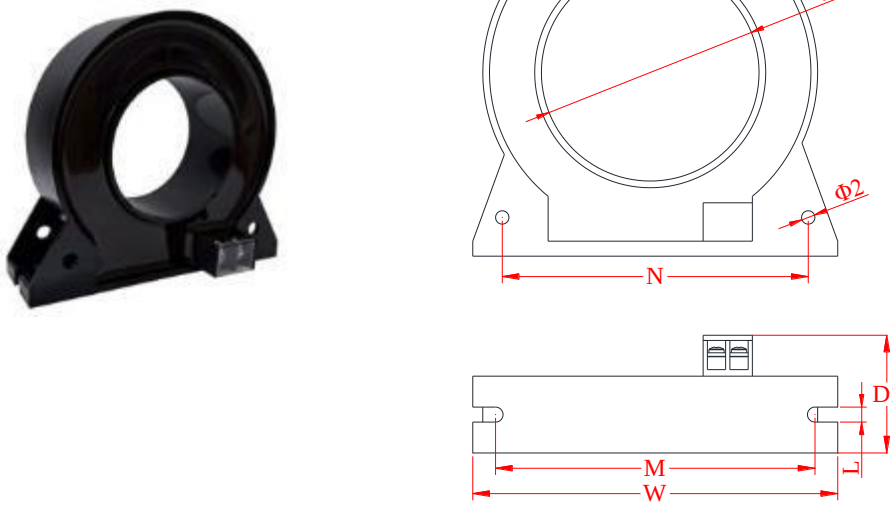
Product model	Rated current (A)	Overall dimensions (mm)			**Hole size (mm)**	Installation dimensions (mm)				Product weight (g)
		W	H	D	**Φ**	M	N	L	Φ2	
L-20	0~16	50.5	44.5	19	**20**	40.5	/	3	3	120±5
L-45	16~150	75	75	22	**46**	65	65	4.3	4	200±10
L-80	150~300	120	120	23	**81**	105	105	4.4	4	380±20
L-100	300~600	140	140	23	**100**	124	124	4.6	4	460±30

The dimensional parameters of the rectangular ZCT are shown in the figure and table. (Unit: mm)



Product model	Rated current (A)	Overall dimensions (mm)			**Hole size (mm)**		Installation dimensions (mm)				Tolerance (mm)
		W	H	D	**a**	**e**	M	N	P	Q	
L-170*30	100~200	215	84	40	**172**	**34**	86	46*3	83	57	±2
L-300*50	500~1000	352	110	45	**300**	**50**	105	70*4	49*5	83	
L-400*50	1000~1250	452	110	45	**400**	**50**	175	70*5	69*3	83	
L-500*50	1500~2000	548	102	50	**500**	**50**	/	88*5	83	/	

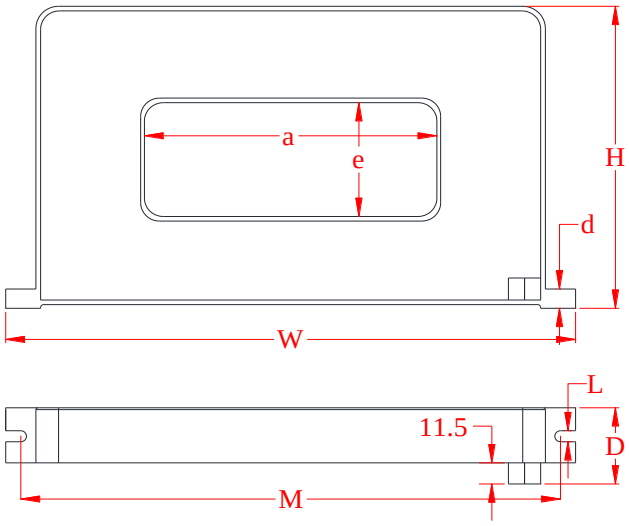
The dimensional parameters of the ring shielded ZCT are shown in the figure and table below. (Unit: mm)



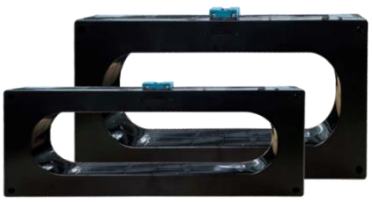
Product model	Rated current (A)	Overall dimensions (mm)			**Hole size (mm)**	Installation dimensions (mm)				Tolerance (mm)
		W	H	D	**Φ**	M	N	L	D1	

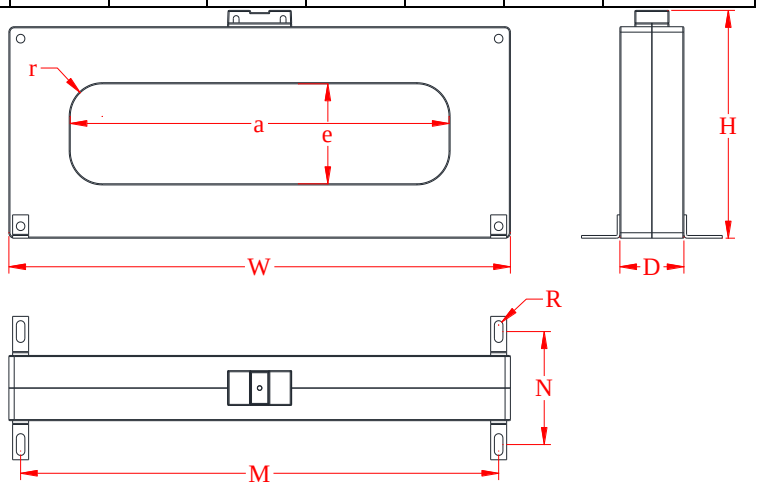
L-30(PB)	0~63	76	67	25	**30**	69	58	5	36	±2
L-45(PB)	63~160	98	86	28	**46**	87	72	5	39	
L-65(PB)	160~250	124	105	28	**65**	110	96	6	39	
L-80(PB)	250~400	140	130	32	**80**	122	106	6	43	
L-100(PB)	400~630	167	148	32	**100**	153	129	6	43	
L-120(PB)	630~800	188	172	32	**120**	170	142	6	43	
L-150(PB)	800~1000	225	206	32	**150**	205	178	6	43	

The dimensional parameters of the rectangular shielded ZCT are shown in the figure and table below. (Unit: mm)



Product model	Rated current (A)	Overall dimensions (mm)			**Hole size (mm)**		Installation dimensions (mm)			Tolerance (mm)
		W	H	D	**a**	**e**	M	L	d	
L-110*25(PB)	0~100	186	70	28	**122**	**25**	171	6	10	±2
L-140*35(PB)	100~200	214	81	28	**142**	**35**	200	6	10	
L-190*35(PB)	200~400	270	85	28	**192**	**35**	256	6	10	
L-230*45(PB)	400~600	310	95	28	**230**	**45**	295	6	10	
L-300*60(PB)	600~1000	426	127	45	**300**	**60**	396	8	15	

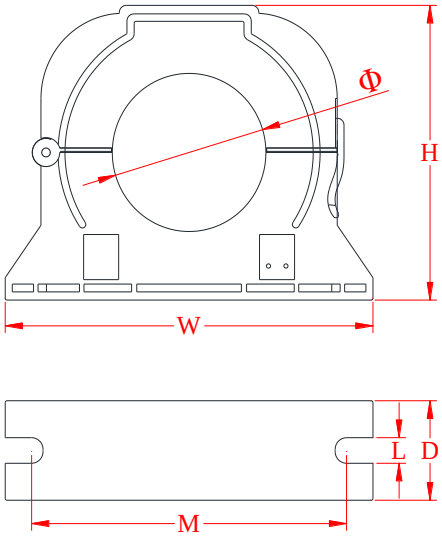




Product model	Rated current (A)	Overall dimensions (mm)	**Hole size (mm)**	Installation dimensions (mm)	Tolerance (mm)

		W	H	D	**a**	**e**	**r**	M	N	R	
L-400*120(PB)	1000~1250	504	243	60	**400**	**120**	**50**	472	112	4	±2
L-500*160(PB)	1500~2000	612	291	60	**500**	**160**	**70**	580	112	4	

The dimensional parameters of the open-type ZCT are shown below and in the table. (Unit: mm)

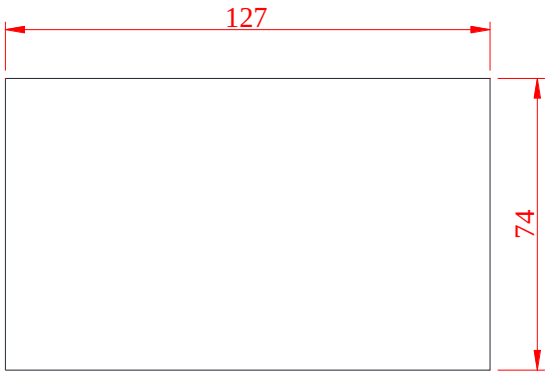


Product model	Rated current (A)	Overall dimensions (mm)			**Hole size (mm)**	Installation dimensions (mm)		Tolerance (mm)
		W	H	D	**Φ**	M	L	
L30KN	0~63	85.5	65	23.6	**30**	69.5	7.5	±1
L45KN	63~160	107	83.5	28	**45**	91.5	7.5	
L65KN	160~250	126.5	103.5	28	**65**	107	7.5	
L80KN	250~400	139	118.5	28	**80**	120.5	7.5	
L100KN	400~630	160.5	138.5	28	**100**	142.5	7.5	

Note: The current transformer with corresponding specifications should be selected according to the rated current of the circuit and the thickness of the wire. (If you have special requirements on the shape and range of the transformer, contact us)

5.2 Installation Method

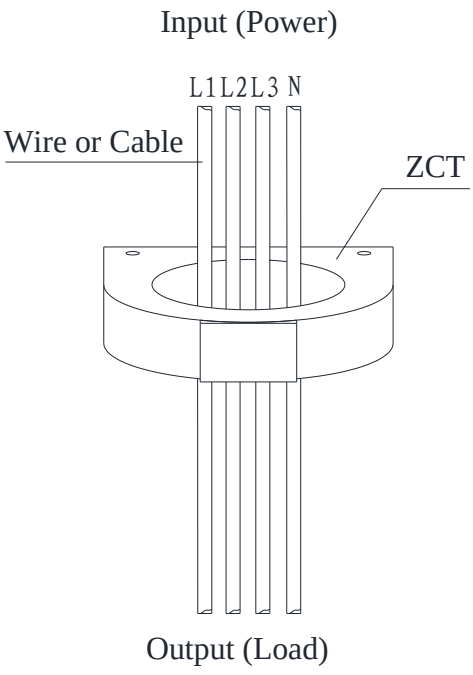
AIM-T500L insulation monitor adopts embedded installation (which can be installed in the distribution cabinet), the size of the opening hole is as follows:



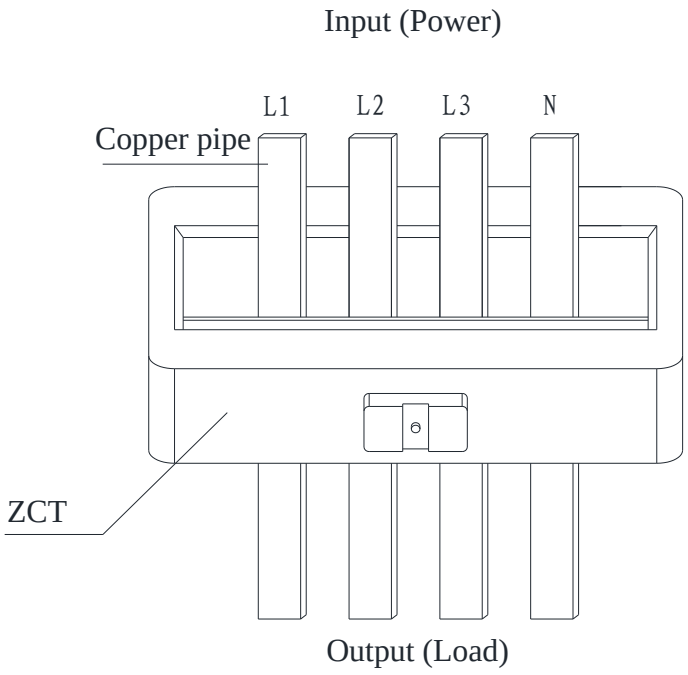
AGS200 test signal generator and AIL200-12 insulation fault locator are installed on a 35mm standard

guide rail and can be installed on the terminal block in the power distribution cabinet. The installation result is shown below:

The AKH-0.66L series current transformers are available in two shapes, toroidal and rectangular. The toroidal transformer is suitable for wire and cable installation, and the rectangular transformer is suitable for copper row installation. The transformer should be installed in a straight section of the cable or copper row, the cable or copper row in the center of the transformer. PE wire can not be penetrated into the transformer, the same group of multi-core cable should be placed on the outside of the transformer PE wire. Transformer lead wiring should be 0.75~1.5mm^2 shielded twisted pair connection, should not be too long, to the same fault locator transformer installation location of no more than 3 cabinets.



Cable passing through the ZCT diagram



Copper pipe passing through the ZCT diagram

5.3 Wiring Method

AIM-T500L wiring method

H	L		T1	T2		F1	F2
6	7		31	32		23	24

CAN comm Test Lock

AK		L2		L1
9		5		4

Expand IT System

H, L (6, 7) are CAN communication terminals, which are used to communicate with the signal generator and fault locator of the fault positioning system. T1, T2 (31, 32) are self-check terminals,

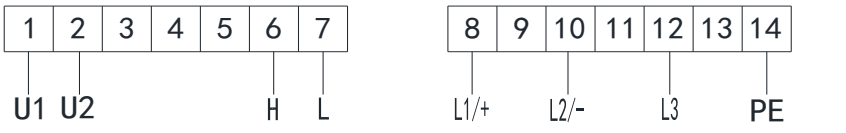
which can determine whether the resistance measurement of the device is normal or not. This function must be used without access to the DC system. Connect T1 and T2, self-test results will be displayed, pushbutton or rotary switch can be connected for external manual self-test. F1, F2 (23, 24) are latching terminals, when two sets of ungrounded systems are connected through the switch, the meter with F1, F2 shorted will stop working, and will be monitored separately by another meter, commonly used in the case of two busbars with a busbar, you can connect the normally open auxiliary contacts of the busbar switch to F1, F2, and when the busbar switch is closed, the F1, F2 is shorted, and the corresponding meter quits monitoring, displaying " measure shut down!!!", and cannot be operated.

AK (9) is the extension terminal, used for insulation monitoring above AC690 or DC800V (without fault locating), see "ACPD series … installation and operation manual" for details. L1, L2 (4, 5) are used to access the monitored IT system (3-phase or single-phase IT system without neutral line is connected to any 2 phases. For 3-phase IT systems with neutral lines, L1 and L2 are connected to the neutral line, in a single-phase DC system, L1 is connected to the positive pole and L2 to the negative pole).

Relay output Grounding 485 comm Power

DO1 (12, 13), DO2 (14, 15) and DO3 (16, 17) are the outputs of three sets of relays, which normally correspond to the outputs of error alarm, fault alarm and fault warning respectively. Device wiring error or hardware error, DO1 action. Device insulation warning, DO3 action. Device insulation alarm, DO2 and DO3 action. PE and KE (28, 29) are the device functional grounding terminals, which shall be connected to the field equipotential grounding terminal row respectively. A, B (18, 19) are the Interfaces A and B of RS485 respectively for communication with the upper computer. U1, U2 (1, 2) terminals are auxiliary power interfaces for devices, generally connected to 220V AC power supply.

ASG200 wiring method



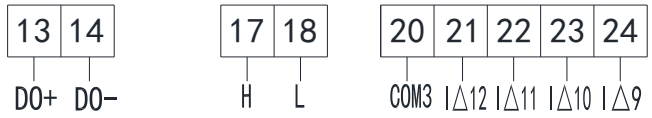
Power CAN comm IT System Grounding

U1, U2 (1, 2) terminals are auxiliary power interfaces for devices, generally connected to AC220V power supply. H, L (6, 7) are CAN communication terminals used for communicating with insulation monitors and fault locator of fault locating products.

L1/+, L2/-, L3 (8, 9, 10) are used for access to monitored IT system (three-phase IT system access to three-phase, single-phase IT system access to L1, L2; For single-phase DC systems, L1/+ is connected to the positive pole and L2/- is connected to the negative pole). PE (14) is the device functional earthing terminal and shall be connected to the field equipotential earthing terminal row.

AIL200-12 wiring method

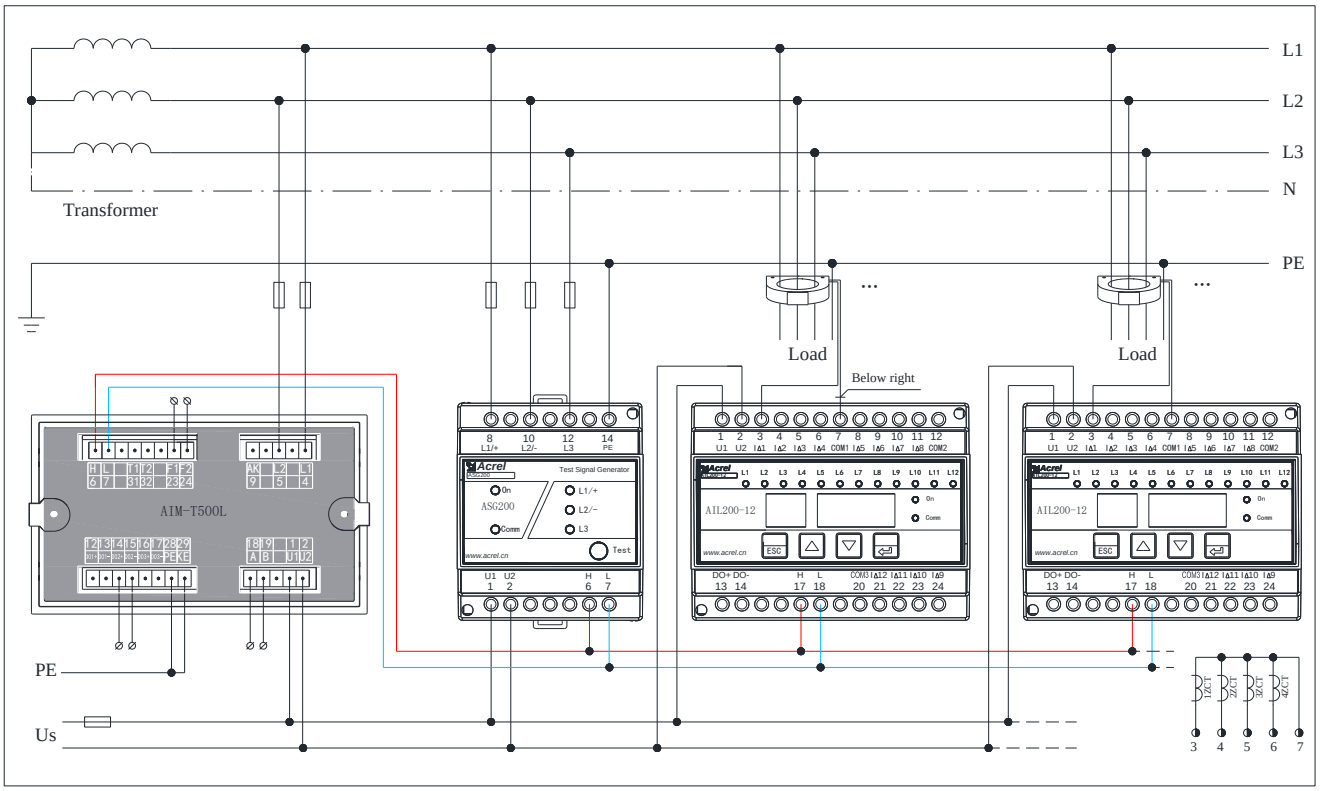
U1, U2 (1, 2) terminals are auxiliary power interfaces, generally connected to 220V AC power supply. I△1~I△4 (3, 4, 5, 6) respectively access 1~4 loop residual current transformer. COM1 (7) access other side with 1~4 loop of residual current transformer. I△5~I△8 (8, 9, 10, 11) respectively access 5~8 loop residual current transformer. COM2 (12) access other side with 5~8 loop of residual current transformer, transformer access without positive or negative polarity.



DO+, DO- (13, 14) is relay output, corresponding to fault alarm output, as long as there is any alarm signal along the loops, be closed. H, L (17, 18) is CAN communication terminal used to interact with insulation monitor and signal generator of the fault locating products. I△9~I△12 (24, 23, 22, 21) respectively access 9~12 loop residual current transformer. COM3 (20) access other side with 9~ 12 loop of residual current transformer, transformer access without positive or negative polarity.

5.4 Typical Application

AIM-T500L series industrial insulation monitoring and fault locating products typical application wiring method is as follow:



Wiring instructions:

(1) IT system usually does not lead to the N line, ITn system specifically refers to lead to the N line;

(2) The auxiliary power supply of the devices can be AC220V or DC110V, and it is desirable to use independent circuit power supply;

(3) Each AIL200-12 can access a maximum of 12 transformers, more than 12 circuits can be increased AIL200-12, a maximum of 90. The transformers should be connected in sequence, and the COM terminal should be connected by parallel terminals. All phase wires except PE wire are threaded into the transformer, and if there is N, they are threaded together.

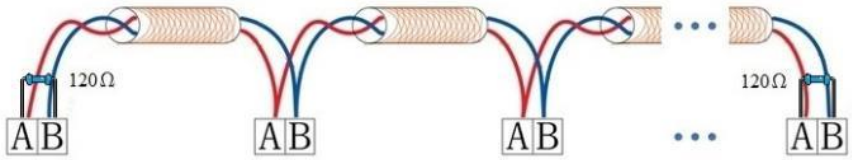
(4) The DO output of AIM-T500L and AIL200-12 adopts passive dry node output, and external independent power supply is required to access the alarm.

5.5 Matters Needing Attention

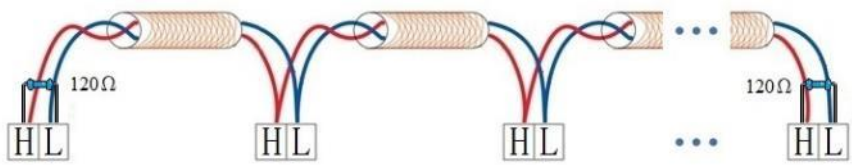
(1) Wiring shall be conducted according to the wiring diagram. It is better to press and connect the wires with the needle-type sleeve joint, then insert the corresponding terminals of the device and tighten the screws to avoid abnormal operation of the device due to poor contact.

(2) AIM-T500L has two communication interfaces, and the first one is RS485 interface with Modbus-RTU protocol. When connected to the system, a bus can connect up to 128 devices. The second is the CAN interface, which uses a custom protocol for the data interaction between each component of the insulation fault locating products. The CAN address of AIM-T500L defaults to 1, ASG200 and AIL200-12 only have one CAN communication interface, the CAN address of ASG200 defaults to 1, and the CAN address of AIL200-12 defaults to 1, and it can be set 1~90.

(3) It is recommended to use shielded twisted pair wire when connecting AIM-T500L to the upper computer system. Each core section should be no less than 1.0mm^2, connected to A and B respectively, and the communication wire should be kept away from strong electric cables or other strong electric field environment when wiring. Suggest the end insulation monitor of matching resistor in parallel between A and B terminals, recommended value for 120Ω, the wiring is shown below:



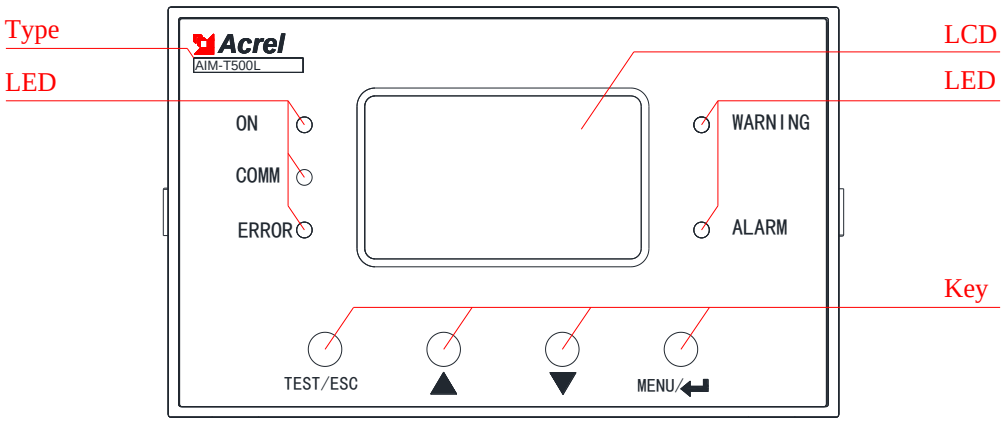
Insulation fault location system CAN communication interface connection, pay attention to the connection H and L, the distance is longer than the suggested in head and tail end parallel matching resistance and recommended value for 120Ω, the wiring is shown below:



6 Program and Usage

6.1 AIM-T500L Insulation Monitor

6.1.1 Display Panel



6.1.2 LED Indicators

LED Indicators	Functional Description
ON	When the device is normal, the indicator light flashes once per second
COMM	When the device has communication data to send and receive, the indicator light flashes When the device CAN interface communication data sending and receiving, the indicator light blinks 3 times
ERROR	When the device PE, KE broken line, indicator light flashing
WARNING	When the monitored insulation resistance value is less than the warning value, the warning indicator flashes
ALARM	When the monitored insulation resistance value is less than the alarm value, the warning and alarm indicator light flashes

6.1.3 Keys Function

There are four keys in the device, which are "TEST/ESC", "▲", "▼", "MENU/↵".

Keys	Function Description
TEST/ESC	In non-programming mode, it is used to start the self-check function; In programming mode, for exit.
▲ ▼	In non-programming mode, it is used to view and browse fault records; In programming mode, used to increase or decrease values.
MENU/↵	In non-programming mode, used to enter programming mode; In programming mode, for validation.

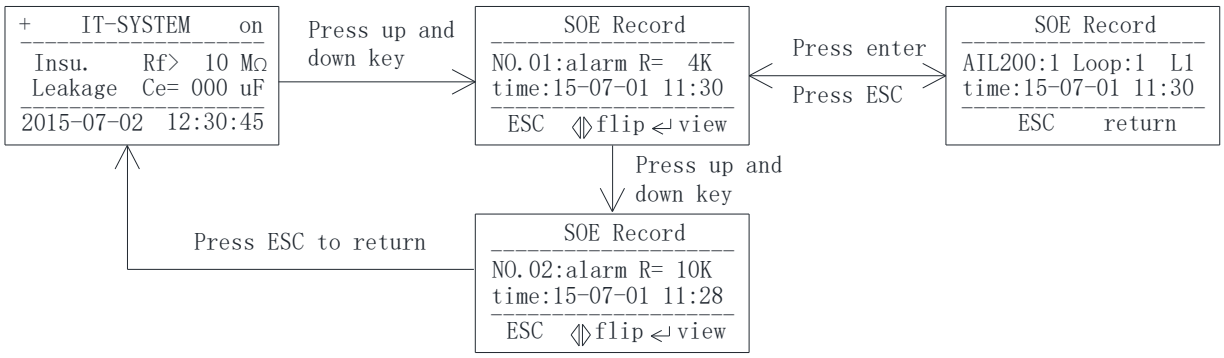
6.1.4 Keys Operation

Button operation on the main interface

(1) Boot into the main interface by default. If no other keystrokes are performed, the system enters the main interface and runs. The main interface displays the insulation resistance, leakage capacitance, and current system time.

(2) Check the alarm record. In the main interface, press "▲" or "▼" to enter the event record query interface, and turn the page by "▲" or "▼" to query the last 20 fault records in turn. Article 1 is the most recent record and article 20 is the oldest record.

(3) Device self-test. Press the "TEST/ESC" key and the monitor will start the self-test program to simulate insulation failures and system errors. 5 LED lights are on at the same time and the relay is closed. The self-test result will be displayed after 2s to check whether the device functions normally.



Parameter setting

(1) Enter the menu. If the system runs normally, press "MENU/↵ " to enter the password input page. Use the "▲" and "▼" keys to change the password. Enter the correct password and press "MENU/↵ " to enter the menu. Otherwise, "Password" will be displayed.

(2) LCD Settings. After entering the menu, select "LCD Set" and press "▲" and "▼" to adjust the LCD contrast and LCD backlight time. After the modification is complete, press "TEST/ESC" to exit. At this time, you can choose whether to save the setting and press "MENU/↵ " to confirm and exit.

(3) Security Settings. After entering the menu, select "AlarmSet", press "▲" and "▼" to modify the warning and alarm value, and press "TEST/ESC" to exit. After modification, press "TEST/ESC" key to exit, at this time, you can choose whether to save the settings, press "MENU/↵ " key to confirm and exit.

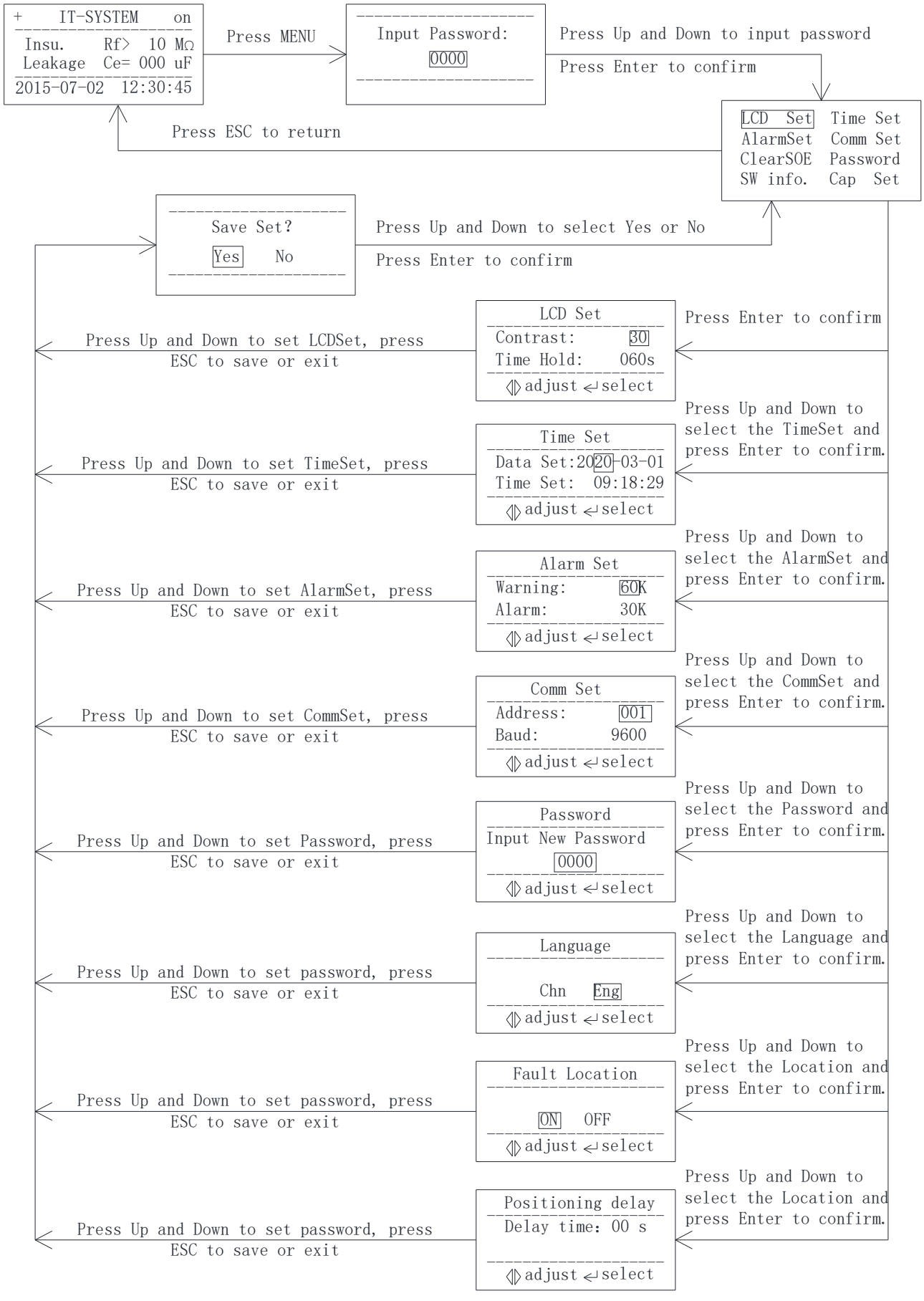
Insulation resistance lower limit alarm, when the insulation resistance is less than the set value, the device sends out the over limit signal. The warning value is greater than the alarm value, the default warning value is 60k and the default alarm value is 30k.

The warning value and alarm value can be set according to the default setting or can be changed according to the actual needs of the site. Under normal environment, the warning value can be set according to the principle of 1MΩ/1kV (i.e. 1kΩ/1V). Under humid and saline environment, the warning value can be set according to the principle of 0.5MΩ/1kV (i.e. 0.5kΩ/1V). The early warning value should not be less than 100Ω/1V. e.g. 0.4kV distribution system insulation can set the early warning value to 400kΩ, and it is recommended to set it to 500kΩ. The alarm value is 30k by default, and the setting interval is from 10 to 30k, and the insulation fault localization can only locate the single-phase insulation faults within 30k (Leakage or phase-to-phase short-circuit faults caused by multi-phase insulation failures can cause leakage protection switches or circuit breakers to trip for protection).

(4) Communication Settings. After entering the menu, select "Comm Set", press "▲" and "▼" to modify the communication address and baud rate, the default address is 1, baud rate is 9600, and the internal default parameter is N-8-1, i.e. no parity, 8 data bits, 1 stop bit, which can not be changed. After the modification is completed, press "TEST/ESC" key to select exit, at this time, you can choose whether to save the settings, press "MENU/↵ " key to confirm and exit.

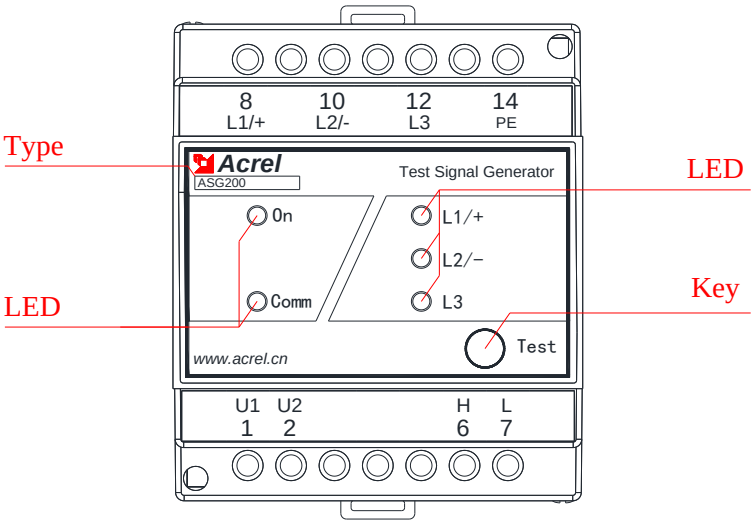
(5) Setting of other information. The insulation monitor also provides functions such as Time setting, Capacitance setting, Language setting, and Fault Location, which are set by default before delivery. If

the fault locating function is required, keep it enabled. If you need to modify parameter Settings, refer to the preceding operations.



6.2 ASG200 Test Signal Generator

6.2.1 Display Panel



6.2.2 LED

5 LED indicators are used to indicate the current status of ASG200 test signal generator.

LED indicators	Function Description
On	When the device is normal, the indicator light flashes once per second
Comm	When the device has communication data to send and receive, the indicator light flashes
L1/+	When insulation fault occurs in Phase A or L+, the indicator light will be on
L2/-	When insulation fault occurs in B phase or L-, the indicator light will be on
L3	When insulation fault occurs in Phase C, the indicator light will be on

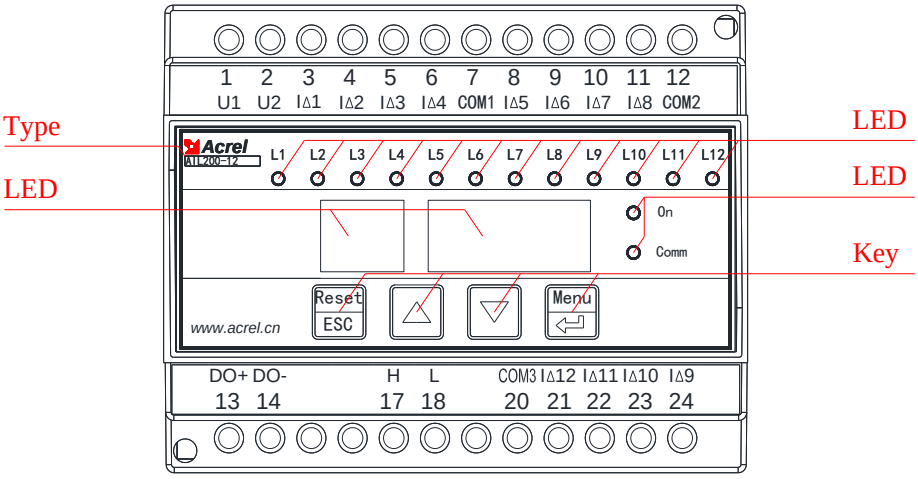
ASG200 confirms the faulty phase line by judging the voltage of the phase line to ground, lights up the corresponding LED and injects a signal. In ITn system, if the N line is grounded, the signal generator lights up the L1~3 LEDs in sequence and injects a signal. If the faulty phase line cannot be determined, L1, L2 and L3 will all be lit.

6.2.3 Keys Function

Key	Function Description
Start	Reserved for factory commissioning. Short press, manually start fault location, insulation monitor simulates alarm, signal generator and fault locator simulate work, communication light flashes three times, can be used to check the CAN communication bus connection status. the IT system insulation is normal, insulation monitor displays locating failure, and then returns to normal status. Long press, signal generator restart reset.

6.3 AIL200-12 Insulation Fault Locator

6.3.1 Display Panel



6.3.2 LED

14 LED indicators are used to indicate the current status of AIL200-12 insulation fault locator.

LED indicators	Function Description
On	when the device is normal, the indicator light flashes once per second
Comm	When the device CAN interface communication data sending and receiving, the indicator light blinks three times
L1~L12	If the ZCT of any circuit from L1 to L12 is short-circuited, disconnected, or has an insulation fault, the corresponding indicator light will be illuminated.

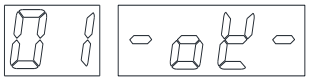
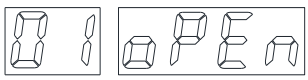
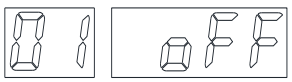
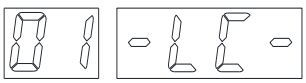
6.3.3 Keys Function

There are four keys in the device, namely " RESET/ESC ", "▲", "▼", " MENU/↵ ".

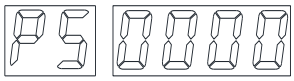
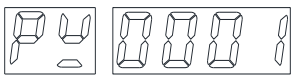
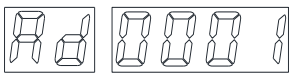
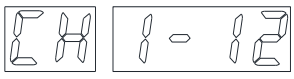
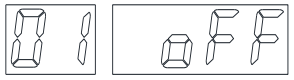
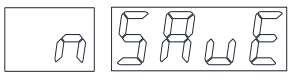
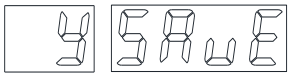
Keys	Function Description
RESET/ESC	In non-programming mode, used to return to the superior menu; In programming mode, used to exit the current operation; Long press for device reset.
▲ ▼	In non-programming mode, used for menu switching and password entering; In programming mode, used for change values and switching states.
MENU/↵	In non-programming mode, press the button to enter the programming mode; In programming mode, when enter confirm or select the key to use.

6.3.4 Operation Description

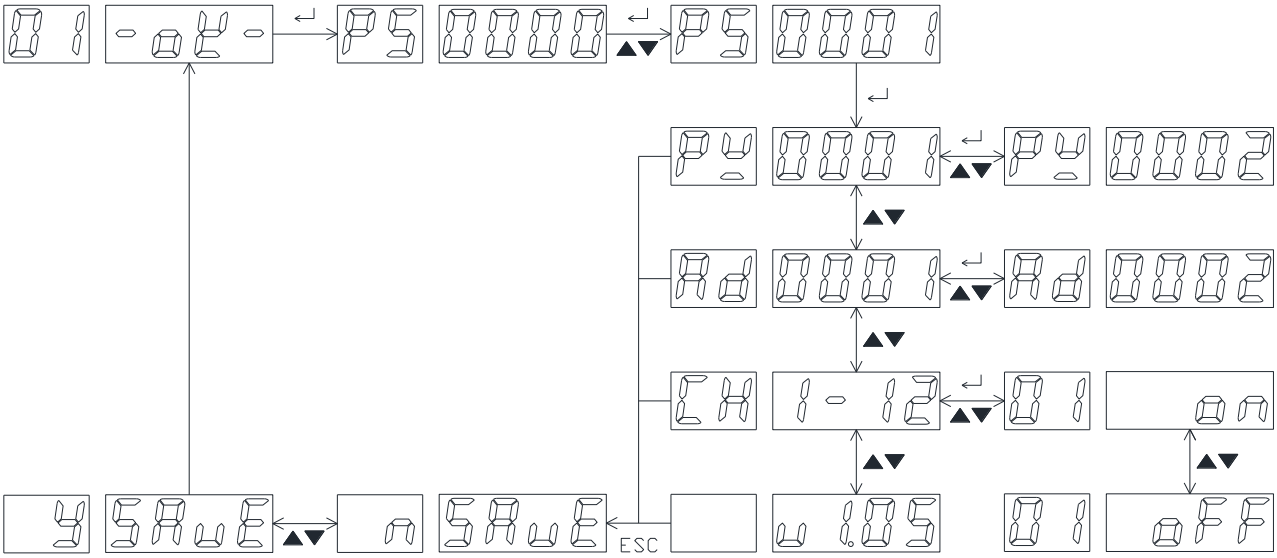
The user interface displays the status of 12 loops. press "▲" or "▼" to view the status. The corresponding characters are described as follows:

Symbol	Symbol description
	01 -OK-, for 01 ZCT loop normally connected, normal state
	01 OPEN, for 01 ZCT loop break line, abnormal state
	01 -SC-, for 01 ZCT loop short circuit, abnormal state
	01 OFF, for 01 ZCT loop channel is closed, normal state
	01 -LC-, for 01 ZCT loop fault, fault state

To modify the settings, press OK and enter the password to enter the settings. The blinking character indicates that you can modify the settings. You can change the default password. The default password is 0001. The value ranges of address from 1 to 90. The default address is 1. The loop can be set to open or close. If the loop is not connected to the transformer, the loop can be manually closed. After modifying the settings, press the Back key to enter the screen for saving the settings. Press the up or down key to select whether to save the settings. After confirming the saving, return to the main screen.

	PS 0000, for password interface, the default password is 0001
	PW 0000, for password modify, it can be set
	Ad 0001, for CAN address, it can be set 1~90
	CH 1-12, for 12 channel set, it can be set ON or OFF
	01 On, for channel is open, the default is all of 12 channels are open, the channel without ZCT can be set closed
	01 OFF, for channel is closed, the channel with ZCT can be set open
	n SAVE, for setting is invalid
	y SAVE, for setting is valid

The specific key operation process is shown in the figure below:



If only one fault locator is connected to the system, manually close the loop that is not connected, and other parameters default. If multiple fault locators are connected to the system, confirm the transformer circuit connected to each fault locator and manually close the unconnected circuit; Set the address of each fault locator to distinguish different fault locators. After the Settings are modified, exit the settings, and select confirm to save. The fault locator will run automatically.

7 Communication Instruction

7.1 Modbus-RTU Communication Protocol

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

7.2 Introduction to Function Code

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

This function allows to acquire the data by equipment and the system parameters. The number of data requested by hosts has no limit, but cannot exceed the defined address 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	00H
	Low byte	50H
CRC check code	Low byte	B8H
	High byte	78H

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 registers	High byte	00H
	Low byte	03H
Number of registers		06H
0004H data	High byte	09H
	Low byte	0CH
0005H data	High byte	01H
	Low byte	05H

The slave computer returns		Return message
Address code		01H
Function code		10H
Start address	High byte	00H
	Low byte	04H
Number of registers	High byte	00H
	Low byte	03H
CRC check code	Low byte	C1H
	High byte	C9H

0006H data	High byte	0CH
	Low byte	00H
CRC check code	Low byte	A3H
	High byte	30H

Note: The above data is for reference only, see address table for register definition

7.3 Address Table of AIM-T500L

No.	Address	Parameter		Read/ write	Value range	Data Type
0	0000H	Passwords		R	0000~9999 (default 0000)	UINT16
1	0001H high	Address		R	1~247 (default 1)	UINT16
	0001H low	Baud rate		R	0~3: 4800, 9600, 19200, 38400 (unit bps) (default 9600)	
2	0002H high	Contrast ratio		R	15~60 (default 30)	UINT16
	0002H low	Display time		R	15~250 (unit: second) (default 60, 15 light)	
3	0003H high	Year		R/W	0~99, hexadecimal to decimal +2000	UINT16
	0003H low	Month		R/W	1~12	
4	0004H high	Day		R/W	1~31	UINT16
	0004H low	Warning mark		R	0: none 1: warning 2: warning and alarm	
5	0005H high	Hour		R/W	0~23	UINT16
	0005H low	Minute		R/W	0~59	
6	0006H high	Second		R/W	0~59	UINT16
	0006H low	Data stable		R	0 or 1 (0 invalid, 1 stable)	
7	0007H high	Warning value high		R/W	60~4999 (unit: kΩ) (default: 60)	UINT16
	0007H low	Warning value low				
8	0008H high	Alarm value high		R/W	10~4999 (unit: kΩ) (default: 30)	UINT16
	0008H low	Alarm value low				
9	0009H high	Resistance high		R	1~10001 (unit kΩ)	UINT16
	0009H low	Resistance low				
10	000AH	SN (high 16-bits)		R	The sequence number is a 32-bit integer number (Default: 0000000000)	UINT32
11	000BH	SN (low 16-bits)				
12	000CH	Reserved		R		UINT16
13	000DH	Leakage capacity		R	0~500 (unit: μF)	UINT16
14	000EH high	broken line		R	0: none 4:PE/KE broken line	UINT16
	000EH low	Current period			2~500 (unit second)	
15	000FH high	Whether access system		R	0: no access system 1: access system	UINT16
	000FH low	Reserved				
16	0010H high	SOE1	Info.	R	The sequence number of incident record	UINT16
	0010H low			R	SOE1 code: 0~2 0: normal 1: warning 2: alarm	
17	0011H		Resistance	R	SOE1 insulation resistance	UINT16
18	0012H high		Year	R	SOE1 time -year	UINT16
	0012H low		Month	R	SOE1 time -month	

19	0013H high		Day	R	SOE1 time -day	UINT16
	0013H low		Hour	R	SOE1 time -hour	
20	0014H high		Minute	R	SOE1 time -minute	UINT16
	0014H low		Second	R	SOE1 time -second	
21~115	0015H~0073H	The remaining 19 SOE are recorded in this part of the space, and the rules and formats are the same as the first.				UINT16*95
116~119	0074H~0077H	Reserved		R		UINT16*4
120	0078H high	SOE1	Number	R	The sequence number of incident record: 0~19	UINT16
	0078H low		Locator	R	Locator address of record 1: 1~90	
121	0079H high		Fault loop	R	Locator fault loop of record 1: 1~12	UINT16
	0079H low		Fault line	R	Fault line of record 1: 01: A 02: B 03: C 04: N	
122~159	007AH~009FH	The remaining 19 SOE are fault locating recorded in this part of the space, and the rules and formats are the same as the first.				UINT16*38
160	00A0H high	Resistance high		R	1~10001 (unit: kΩ)	UINT16
	00A0H low	Resistance low		R		
161	00A1H high	Locator address		R	Locator sequence of record 1: 1~90	UINT16
	00A1H low	Fault loop		R	Locator fault loop of record 1: 1~12	
162	00A2H high	Warning mark		R	0: none 1: warning 2: warning and alarm	UINT16
	00A2H low	Reserved		R		

8 Typical Applications

Generally, checking something insulation or insulation level, refers to offline (without power), phase-to-phase insulation, phase-to-ground insulation, winding to shell insulation, winding to ground insulation. Conventional practice is to use megohmmeter (hand-cranked or digital meter) on the phase-to-phase, phase-to-ground insulation test, when the test results do not meet the standard, the implementation of corrective measures.

Insulation monitoring of IT systems refers to online monitoring of the overall system insulation to ground and the first metallic ground fault. A stand-alone IT system generally uses one insulation monitor, and multiple insulation monitors working simultaneously can cause signal interference problems.

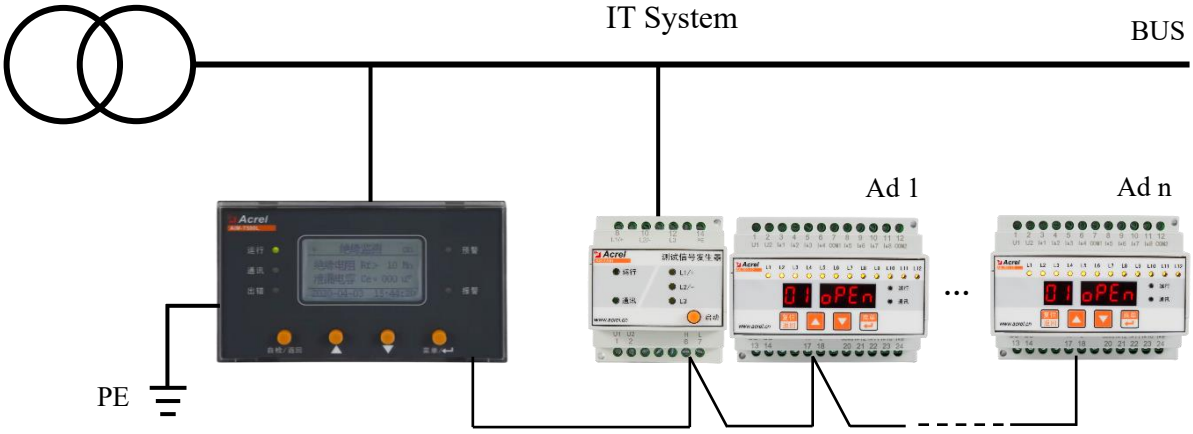
TN-S distribution system does not use the insulation monitor, to determine whether the insulation is damaged using residual current monitoring products, if the feeder circuit residual current is large, the insulation may be damaged or single-phase non-metallic grounding, residual current monitoring products refer to the RCM and RCD information. The insulation monitor can be used off-line (power failure) to monitor the insulation of the phase line to ground or the insulation of the motor winding to the shell and ground. The method of use is like the megohmmeter, but the monitoring signal is different.

The insulation monitor monitors the insulation condition of the entire IT system to ground. When an insulation fault occurs, the insulation monitor sends out an alarm signal, the signal generator and fault locator are activated, the signal generator determines the faulty phase line and injects a test signal, the fault locator detects the faulty circuit through the transformer, and after the positioning is completed, the

insulation monitor displays the positioning results, including the address of the fault locator, the faulty circuit and the faulty phase line.

8.1 Insulation monitoring and fault locating in Single Busbar

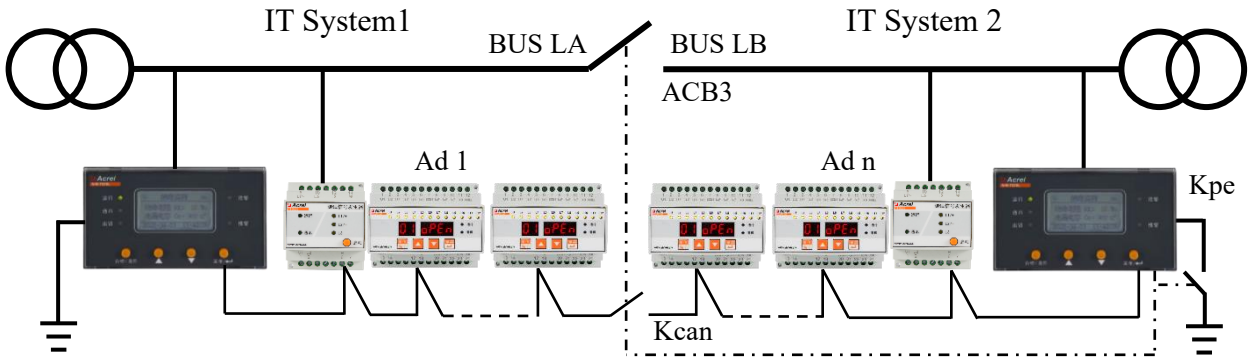
In a stand-alone IT system, a set of insulation monitoring fault location products are set up.



AIM-T500L insulation monitor and ASG200 signal generator are connected to the system. n AIL200-12 monitors multiple circuits, and CAN interfaces between all the devices are connected hand-in-hand through shielded twisted pair cables to form a bus.

8.2 Insulation monitoring and fault locating in Double Busbar

In the IT system of double busbar segmentation, a set of insulation monitoring fault location products are set up in LA section and LB section respectively, using ACB3 auxiliary contact status connection F1 and F2 to control LB section insulation monitor, and recommended to control the ground and CAN bus connection at the same time to complete the insulation monitoring fault location.

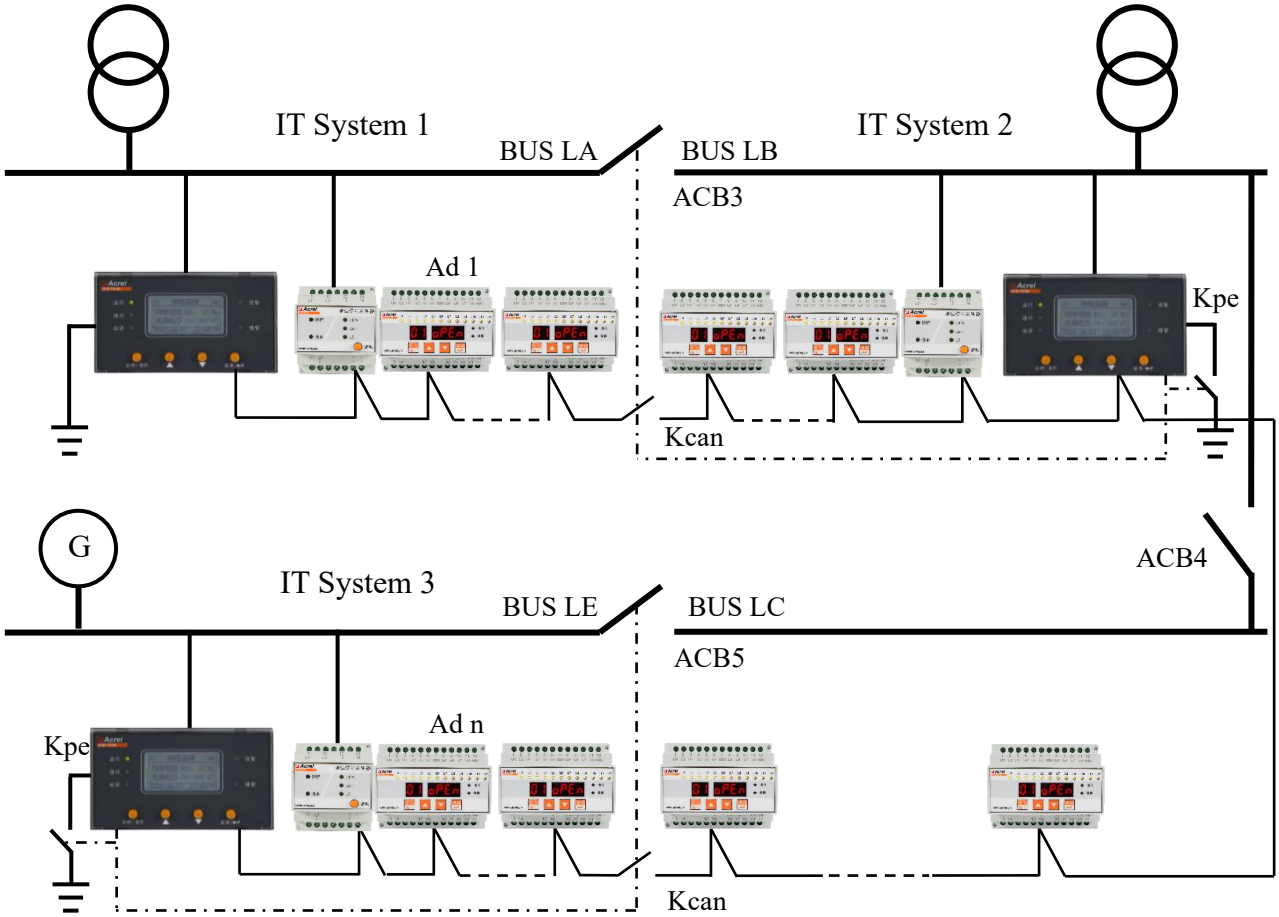


When ACB3 is disconnected, LA section and LB section operate independently, at this time, Kpe is closed, Kcan is disconnected, LB section insulation monitors F1 and F2 are disconnected, and the two insulation monitoring fault localization operate independently.

When ACB3 is closed, LA and LB section run together, at this time, Kpe is disconnected, LB section insulation monitors F1 and F2 are closed to enter the blocking state and exit the monitoring, Kcan be closed, LA section connects all the meters and monitors all the circuits of LA section and LB section.

8.3 Insulation monitoring and fault locating in Multi-Busbar

In a multi-busbar segmented IT system, a set of insulation monitoring fault location products is set up for LA, LB and LE segments respectively, and LC has no independent operating conditions and is not set up with insulation monitor. Use ACB3 and ACB5 auxiliary contact status connection F1 and F2 to control LB and LE section insulation monitor, and it is recommended to control LB and LE section ground and CAN bus connection at the same time to complete insulation monitoring fault location.



When ACB3 is disconnected, LA section and LB section run independently, at this time, LB section Kpe is closed, Kcan is disconnected, the two insulation monitoring fault localization run independently; ACB4 and ACB5 are closed, at this time, LE section Kpe is disconnected, LE section insulation monitor F1 and F2 are closed to enter into blocking state, exit monitoring, Kcan is closed, LB section connects all devices of LC and LE to Monitor all circuits of LB, LC and LE.

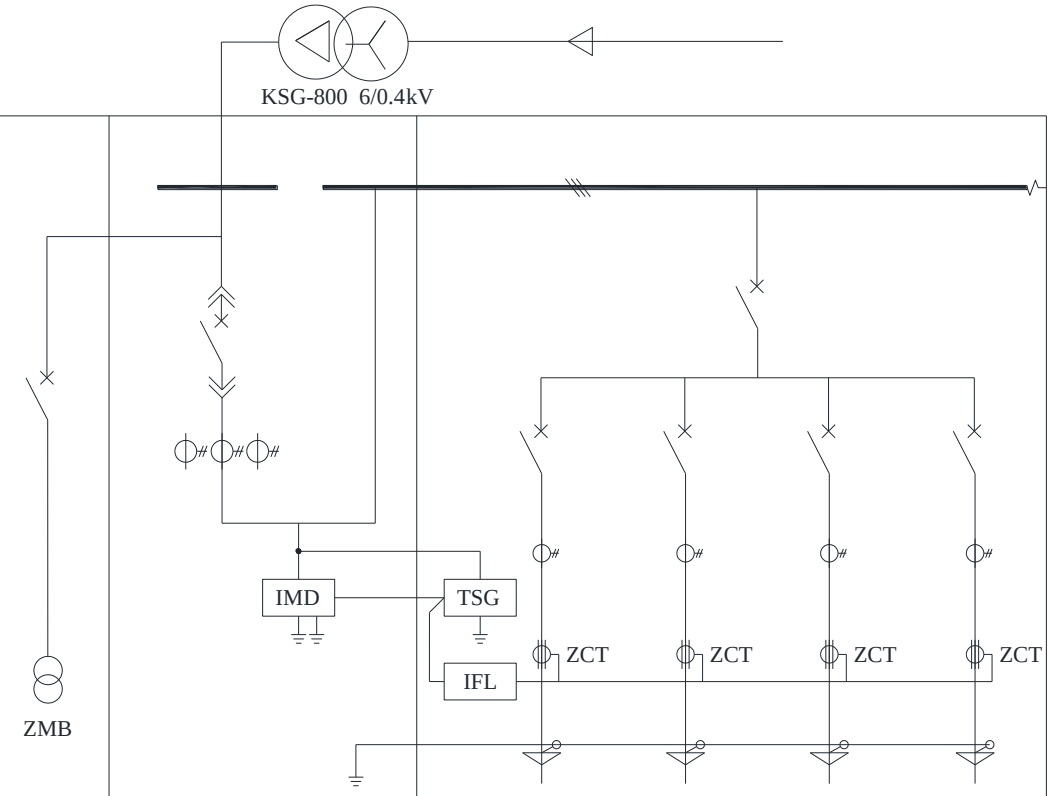
When ACB3 is closed, LA and LB section run together, at this time, LB section Kpe is disconnected, LB section insulation monitor F1 and F2 are closed to enter into blocking state, exit monitoring, Kcan is closed; ACB4 and ACB5 are closed, at this time, LE section Kpe is disconnected, LE section insulation monitor F1 and F2 are closed to enter into blocking state, exit monitoring, Kcan is closed, LA section insulation Kcan close, LA section insulation monitor monitor LA, LB, LC, LE all circuits.

When the G (diesel generator) start power supply, ACB5 disconnect, LE section alone, at this time, LE section Kpe closed, Kcan disconnect, LA section insulation monitor alone (case 1); ACB5 closed, at

this time, LE section Kpe closed, Kcan closed, LE section insulation monitor to monitor the LE and LC section (case 2); ACB5, ACB4, ACB3 all ACB5, ACB4, ACB3 are all closed, generator temporary power supply, at this time, LB and LE section Kpe is disconnected, the corresponding insulation monitor F1, F2 is closed to enter the blocking state, and quit monitoring, two Kcan are all closed, and LA section insulation monitor monitors all the circuits (case 3).

8.4 Insulation monitoring and fault locating Design Examples

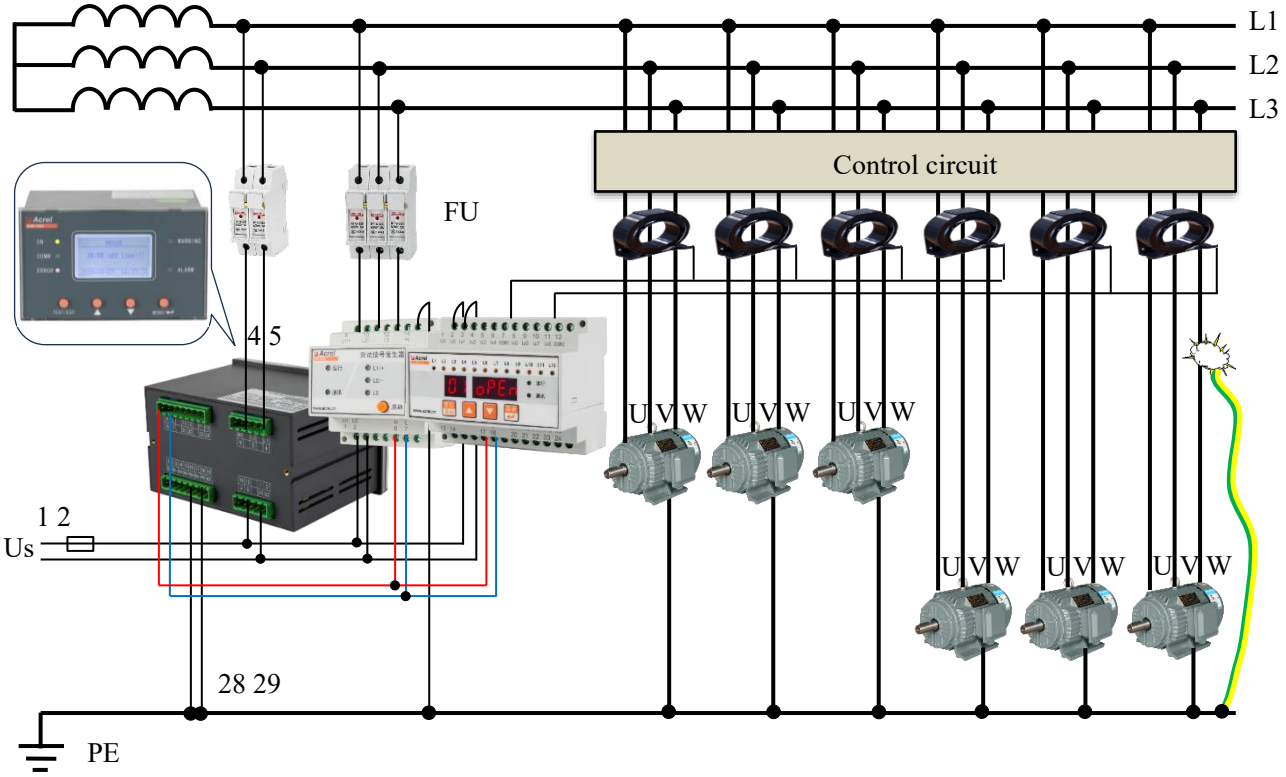
In IT systems, insulation monitors (IMD) are set up at the incoming cabinet locations, signal generators (TSG) and fault locators (IFL) are set up at the outgoing cabinet locations, and monitoring transformers (ZCT) are set up for each outgoing circuit. Each IFL can be connected to a maximum of 12 ZCT, and the IFL setup does not exceed three feeder cabinets. The IMD, TSG and IFL are connected via CAN bus to form a set of insulation monitoring and fault location products.

Primary system diagram						
Switchgear No. and Specification		DP1/GKD (1000*600*1800)	DP2/GKD (1000*600*1800)			
Insulation monitoring systems		AIM-T500L	ASG200，AIL200 AKH-0.66 L-100	AKH-0.66 L-100	AKH-0.66 L-100	AKH-0.66 L-100
Measuring meter		APM820	APM520	APM520	APM520	APM520
CT		AKH-0.66 1500/5A	AKH-0.66 400/5	AKH-0.66 400/5	AKH-0.66 400/5	AKH-0.66 400/5
Rated capacity（KW）	5kVA					
Calculated current						
Circuit name	Lights	Power feed	1# Air compressor	2# Air compressor	Spare	Spare

9 Debugging Instructions

Confirm that the product is wired correctly. If the wiring is incorrect, the measurement results will be affected.

Check insulation monitor, signal generator, fault locator wiring. Confirm that 1 and 2 of all devices are connected to the auxiliary power supply, 4 and 5 of insulation monitors are connected to the monitored distribution system, and 28 and 29 are grounded reliably; 8, 10 and 12 of signal generators are connected to the monitored system, and 14 are grounded reliably; 3 to 12 and 20 to 24 of fault locators are connected to the mutual transformer according to the actual situation, and the circuits that are not connected to the system are set to be closed through the pushbuttons. Insulation monitor's 6,7, signal generator's 6,7 and fault locator's 17,18 are connected into a bus according to the hand in hand method, when the distance is longer, the first and the last end of the bus are connected in parallel with a 120Ω matching resistor.



The insulation is in good condition, the insulation monitor shows >10MΩ, and the test signal generator and fault locator have only the operation lamps flashing.

If it is necessary to do a simulation of each fault circuit, you can use a 2mm^2 wire to simulate a ground fault on the circuit that is connected to the transformer, the grounding point should be at the back end of the transformer, or if the grounding point is at the top end of the transformer, you need to pass the grounding wire through the transformer when simulating. When simulating, you can first connect the grounding point, and then the other end is hooked up to the busbar or outlet screw lap point.

First, the insulation monitor detects whether the insulation of the system is normal, when the insulation value is lower than the alarm value, the insulation monitor sends out commands, the signal generator

and fault locator start to work, and the devices on the CAN bus can receive the information, and the "Comm" light of the device that receives the information will flash three times. If the "Comm" light does not flash, check whether the bus is disconnected or reversed. If the physical connection is normal, the first and last ends need to access the 120Ω matching resistor.

Then, the signal generator detects the faulty phase line and sends a signal when it detects it, and the corresponding phase line indicator on the panel will light up, and the lighting time lasts up to 15 seconds. If the three indicator lights keep flashing, it means the fault status is abnormal or the meter is damaged. In general, if the single-phase metallic grounding, the voltage of this phase line to ground should be ≤ 5V, you can use a multimeter to measure the voltage to confirm whether the system voltage is normal.

Finally, the fault locator detects the circuit, and when the transformer of the fault circuit passes the fault current, the fault locator shows the fault circuit. If the fault point circuit is not equipped with a monitoring transformer, it cannot be located and additional transformers are required; if the fault point is at the front of the transformer, additional transformers are required.

Keep single-phase ground fault during simulation, wait for the insulation monitor to report the fault phase line and fault circuit before lifting the fault, and the fault location time is ≤20s. If fails, the insulation monitor restarts the fault localization after 45s. After the fault is lifted, wait for a few seconds, the insulation monitor monitors that the system is normal and then return to normal, the signal generator and fault locator reset. After all resets the next circuit ground fault can be simulated.

10 Fault Resolution

After ensuring that the wiring is correct, turn on the device auxiliary power. Check whether each device is normal, for common problems, determine the cause and resolution according table below.

No.	Failure problem	Fault causes and resolution
1	LCD and LED indicators do not light up	Check whether the meter power supply is normal, the power supply is normal, then replace the meter
2	Insulation monitor display: PE/KE disconnection	Check whether the device 28, 29 terminals are reliably grounded, short 28, 29 is normal, short abnormalities, then replace the meter
3	Insulation monitor display: fault location is in progress and displays location failure	(1) communication abnormalities. Check the CAN communication connection, and check the insulation monitor alarm, signal generator and fault locator communication light is blinking three times, the connection error is changed, the connection is correct can not be communicated, the first end, the end of the parallel 120Ω resistor; (2) The point of failure has no transformer or is at the front end of the transformer. If the fault is simulated, the simulated point of failure is placed at the back end of the transformer. If the actual fault is present, it is necessary to manually troubleshoot the insulation fault; (3) Alarm value > 30k. modify the alarm value to 30k; (4) Multi-phase non-metallic grounding. Signal generator L1~L3 is flashing constantly, and the system voltage to ground is greater than 80V. Manual troubleshooting of insulation faults is required.

4	Signal generator L1~L3 LED lamp flashing	If the insulation monitor shows: fault is locating, and the system voltage to ground are greater than 80V, the device is normal, you need to manually troubleshoot insulation faults; if the insulation monitor does not alarm, you need to replace the signal generator
5	Fault locator display: xx OPEN	Check that the xx circuit transformer is reliably connected
6	Fault locator display: xx -SC-	Check that the xx circuit transformer is not shorted.

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