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AIM-T500L Series Industrial Insulation Monitoring and Fault Locating System

Installation and Operation Manual V1.3

Acrel Co., Ltd.

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AIM-T500L Series Industrial Insulation Monitoring and Fault Locating System

1 Introduction

With the development of industrial science and technology, residual current poses a great threat to industrial production safety. In order 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 location system is specially 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.

The products conform to the requirements of enterprise standard Q/VDCL-26-2017 *IT System Insulation Monitor*.

Type and Name	Picture	introduction
AIM-T500L insulation monitor		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		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		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-0.66L series current transformer		AKH-0.66L series current transformer is used with AIL200-12 insulation fault locator together, ratio is 1000:1. It is installed in the cabinet in the way of screw direct fixation.

2 Functional characteristics

2.1 AIM-T500L insulation monitor

1) Monitor the insulation resistance of IT system in real time, warning or alarm when the resistance exceeds the limit;

2) Relay alarm output, LED alarm output and other fault indication modes;

3) SOE function, convenient for staff to check and analyze the failure type and occurrence time, and judge the operation status of the system;

4) Self-check function, which can realize fault self-check of instrument hardware circuit;

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

6) RS485 interface, standard Modbus-RTU protocol;

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

8) Support manual/automatic reset modes;

9) Wide range of applications, suitable for AC, DC and AC-DC hybrid IT systems.

2.2 ASG200 test signal generator

1) Generate positioning signals and inject them into the ungrounded system;

2) Indicate the phase line where the fault is;

3) Manual startup positioning is supported;

4) CAN bus technology is adopted to facilitate data interaction with other devices in the system.

2.3 AIL200-12 insulation fault locator

1) Locate and indicate the loop where the fault is;

2) A single AIL200-12 can locate up to 12 loops;

3) Each IT system can be connected to a maximum of 90 locators, with a total of 1080 loops;

4) CAN bus technology is adopted to facilitate data interaction with other devices in the system.

2.4 AKH-0.66L series current transformer

1) Rated current ratio 5A:5mA, ratio 1000:1, select the appropriate aperture according to the rated current of the loop;

2) Coordinate with AIL200-12 insulation fault locator to achieve fault location.

3 Reference standards

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

3.2 IEC 61557-8:2014 *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.*

3.3 IEC 61557-9:2014 *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.*

3.4 IEC 61326-2-4:2020 RLV Redline version *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.*

4 Technical parameters

4.1 AIM-T500L insulation monitor

<table>
<tr><td rowspan="2">Accessory power supply</td><td>Voltage</td><td>AC85~265V
DC100~300V</td><td rowspan="2">Voltage range</td><td>System voltage</td><td>AC 0~690V
DC 0~800V</td></tr>
<tr><td>Power dissipation</td><td><8W</td><td>Frequency range</td><td>40~460Hz</td></tr>
<tr><td rowspan="4">Insulation monitoring</td><td>Measuring range</td><td>1k~10MΩ</td><td rowspan="4">Environment</td><td>Working temperature</td><td>-15~+55℃</td></tr>
<tr><td>Alarm range</td><td>10k~10MΩ</td><td>Storage temperature</td><td>-20~+70℃</td></tr>
<tr><td>Response time
(Ce=1μF)</td><td><5s</td><td>Relative humidity</td><td><95%, without condensation</td></tr>
<tr><td>system leakage capacitance</td><td><500μF</td><td>Altitude</td><td>≤2500m</td></tr>
<tr><td rowspan="3">Internal parameters</td><td>Measuring voltage</td><td><50V</td><td>Output</td><td>Relay output</td><td>Error, warning, Alarm</td></tr>
<tr><td>Measuring current</td><td><270μA</td><td colspan="2">Communication</td><td>RS485, Modbus-RTU
CAN, custom protocol</td></tr>
<tr><td>Internal DC impedance</td><td>≥180kΩ</td><td colspan="2">Rated impulse voltage /Pollution Level</td><td>8kV/III</td></tr>
</table>

4.2 ASG200 test signal generator

Accessory power supply	Voltage	AC 85~265V DC100~300V
	Power dissipation	<7W
IT system	Voltage	AC 220V 3AC 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℃

4.3 AIL200-12 insulation fault locator

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℃

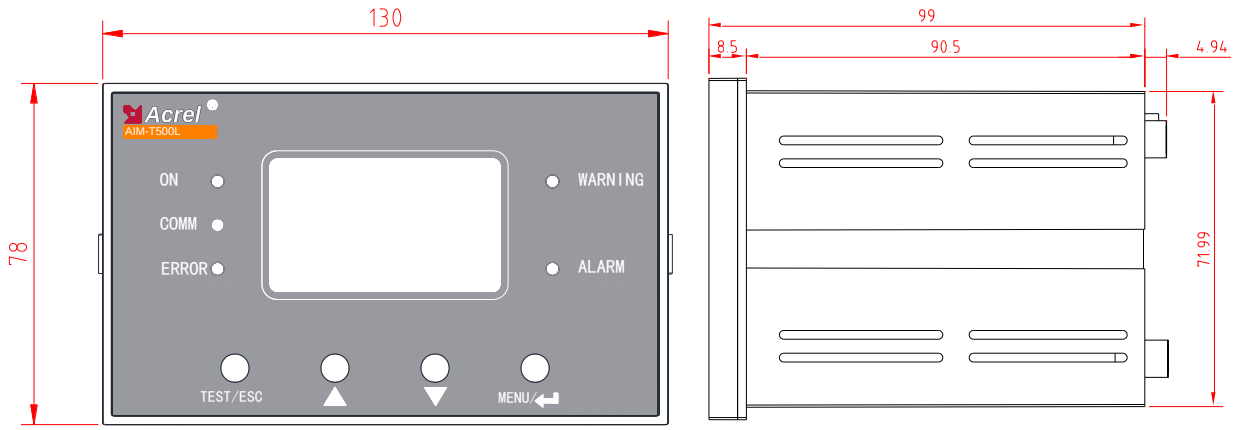
4.4 AKH-0.66L series current transformer

specifications	Rated current	Ratio	Accurate level	rated load	Overload ratio
L-45	16-100A	5A:5mA	1 level	100Ω	10
L-80	100-250A				
L-100	250-400A				
L-150	400-800A				
L-200	800-1500A				

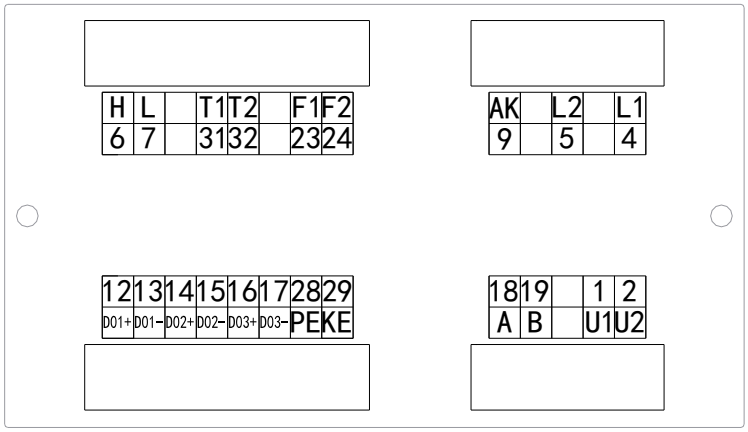
5 Installation and connection

5.1 Shape and size

5.1.1 AIM-T500L (unit: mm)

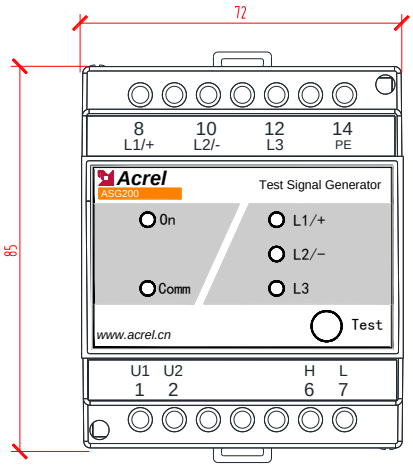


Front view Side view

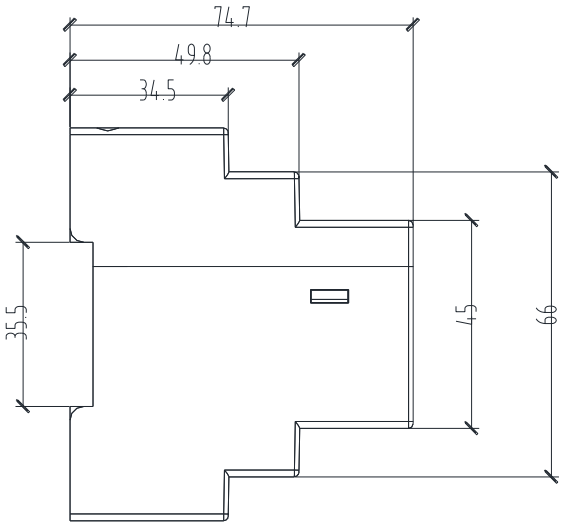


Back view

5.1.2 ASG200 (unit: mm)

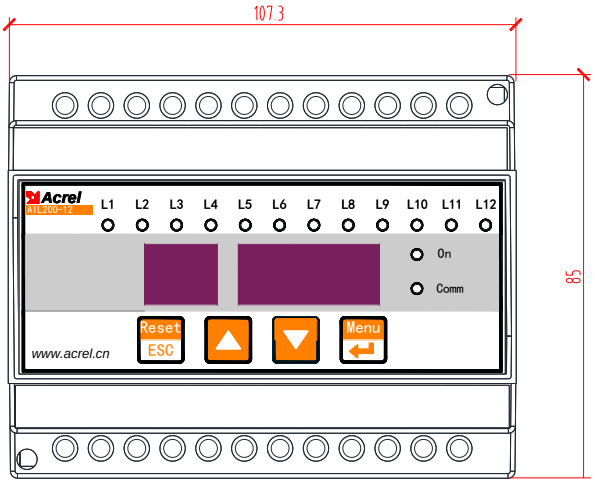


Front view

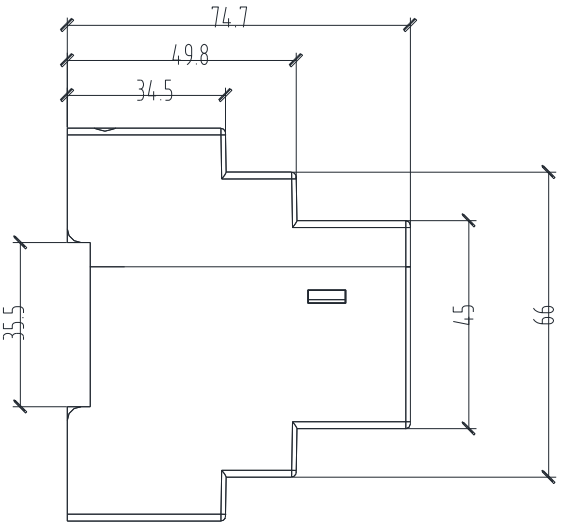


Side view

5.1.3 AIL200-12 (unit: mm)



Front view

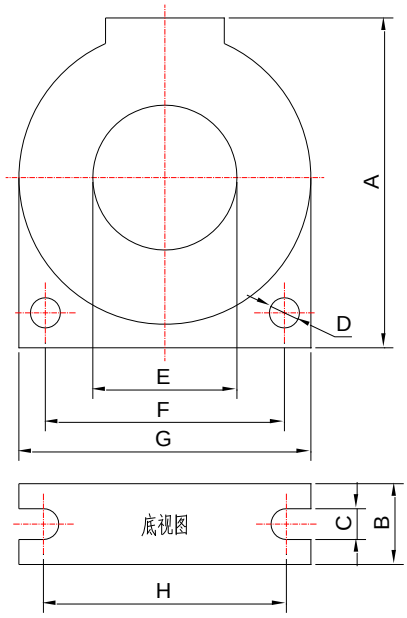


Side view

5.1.4 AKH-0.66L series current transformer

AKH-0.66L series current transformer dimension are shown in the table below:

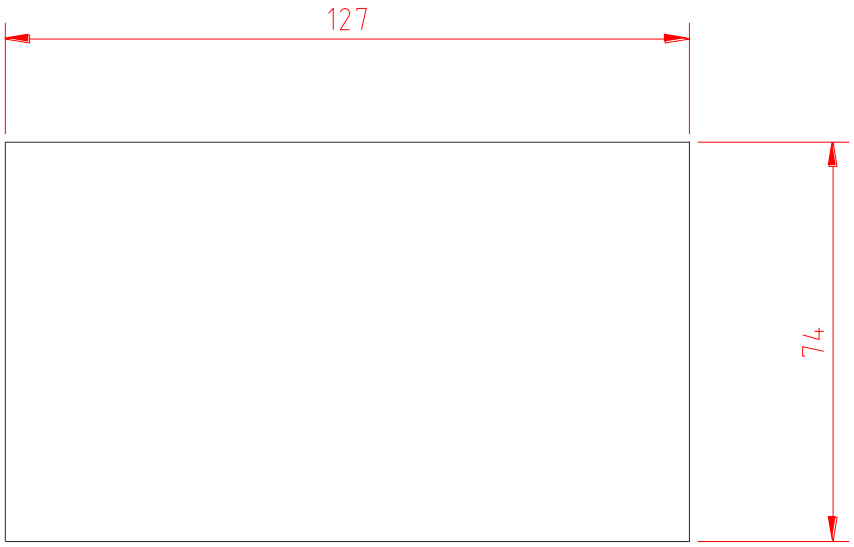
Type	Rated current	A/mm	B/mm	C/mm	D/mm	E/mm	F/mm	G/mm	H/mm	Weight
L45	16~100	74	22.5	4.5	4	45	65	75	64.5	0.18
L80	100~250	120	23	4.5	4	80	105	120	104.5	0.42
L100	250~400	140	23	4.5	4	100	124	140	123.5	0.50
L150	400~800	204	24	4.5	6	150	160	197	173.5	1.32
L200	800~1500	246	28	4.5	6	200	210	241	213.5	1.94



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 adopt DIN-35mm rail installation, they can be installed with the cabinet terminal row.

5.3 Wiring method

5.3.1 AIM-T500L wiring method

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

AK		L2		L1
9		5		4

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 and T2 (31, 32) are self-check terminals, which can determine whether the resistance measurement of the instrument is normal or not. This function must be used without access to the DC system. Short-connect T1 and T2, and the instrument self-test results will be displayed. F1 and F2 (23, 24) are interconnection terminals. When two sets of ungrounded systems are interconnected, the instrument connected to F1 and F2 will stop working and be separately monitored by another instrument, which is usually used for the situation of two-segment bus with busbar coupling.

AK (9) is the extension terminal, used for insulation monitoring above AC690/DC800V, see ACPD series installation and operation manual for details. L1, L2 (4, 5) are used to access the monitored IT system (three-phase or single-phase IT system without neutral line is connected to any 2 phases. For three-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).

12	13	14	15	16	17	28	29
DO1+	DO1-	DO2+	DO2-	DO3+	DO3-	PE	KE

18	19		1	2
A	B		U1	U2

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. PE and KE (28, 29) are the instrument 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 instruments, generally connected to 220V AC power supply.

5.3.2 ASG200 wiring method

1	2	3	4	5	6	7
U1	U2				H	L

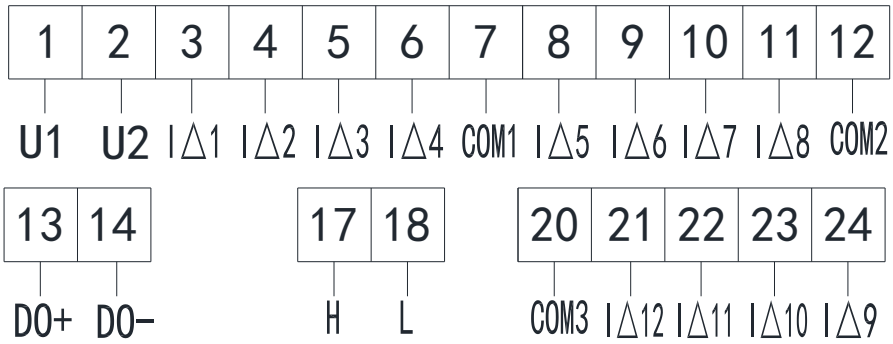
8	9	10	11	12	13	14
L1/+	L2/-			L3		PE

U1, U2 (1, 2) terminals are auxiliary power interfaces for instruments, 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 positioning system.

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 instrument functional earthing terminal and shall be connected to the field equipotential earthing terminal row.

5.3.3 AIL200-12 wiring method

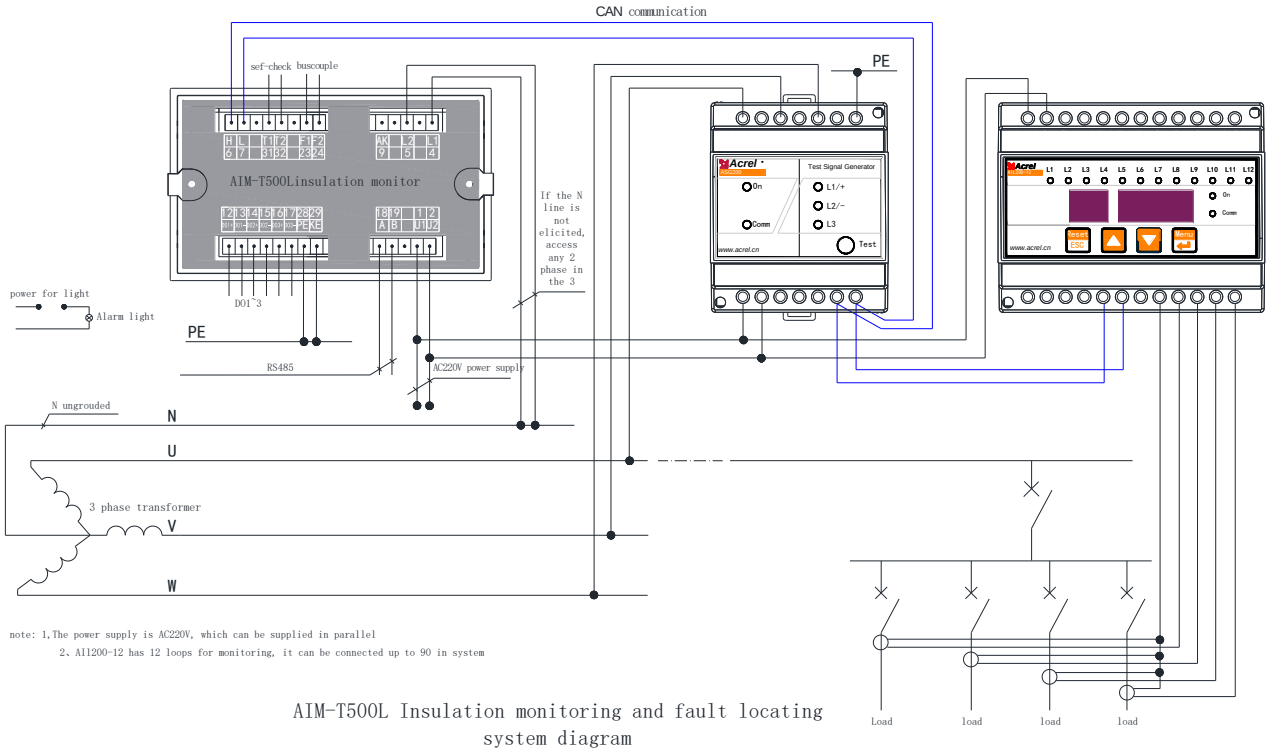


U1, U2 (1, 2) terminals are auxiliary power interfaces, generally connected to 220V AC power supply. I△1~I△4 (3, 4, 5, 6) respectively access 1~4 loop residual current transformer. COM1 (7) access other side with 1~4 loop of residual current transformer. I△5~I△8 (8, 9, 10, 11) respectively access 5~8 loop residual current transformer. COM2 (12) access other side with 5~8 loop of residual current transformer.

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 location system. 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.

5.4 Typical application

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



AIM-T500L Insulation monitoring and fault locating system diagram

5.5 Matters needing attention

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

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

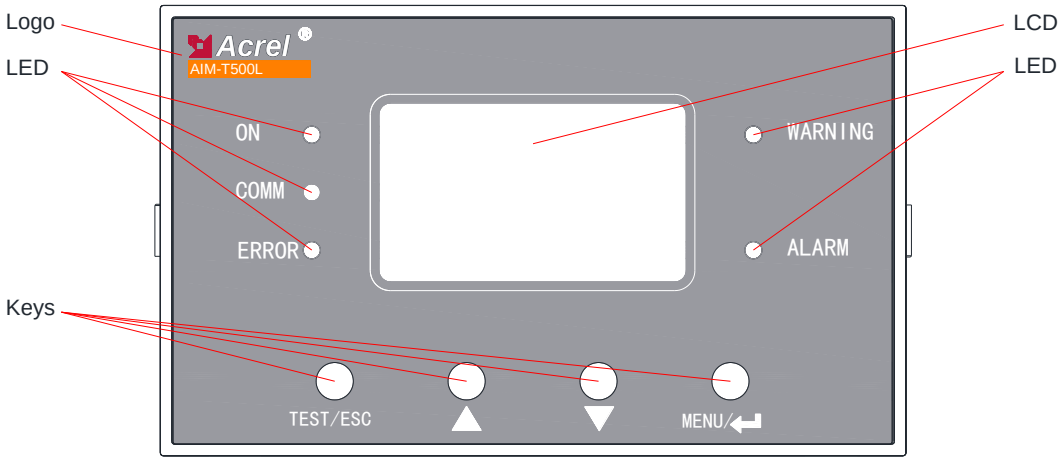
3) It is recommended to use shielded twisted pair wire when CONNECTING AIM-T500L to the upper computer system. Each core section should be no less than 1.0mm2, connected to A and B respectively, and the communication wire should be kept away from strong electric cables or other strong electric field environment when wiring. Suggest the end insulation monitor of matching resistor in parallel between A and B terminals, recommended value for 120Ω; 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.

4) The output of AIM-T500L relay does not carry power, and the external alarm (or warning light) shall be equipped with additional independent power supply.

6 Program and Usage

6.1 AIM-T500L insulation monitor

6.1.1 Display Panel



6.1.2 LED

5 LED indicators are used to indicate the status of the insulation monitor:

"ON": when the device is in normal, the indicator light flashes at a frequency of about once per second.

"COMM": when the device has communication data to send and receive, the indicator light flashes.

"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 self-check/return, up/down, menu/Enter.

Keys	keys function
TEST/ESC	In non-programming mode, it is used to start the self-check function; In programming mode, for exit.
Up button, Down button	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

1. 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 "up key" or "down key" to enter the event record query interface, and turn the page by "up key" or "down key" to query the last 20 fault records in turn. Article 1 is the most recent record and article 20 is the oldest record.

(3) Instrument self-test. Press the "Self-test" 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 instrument functions normally.

2. Parameter setting

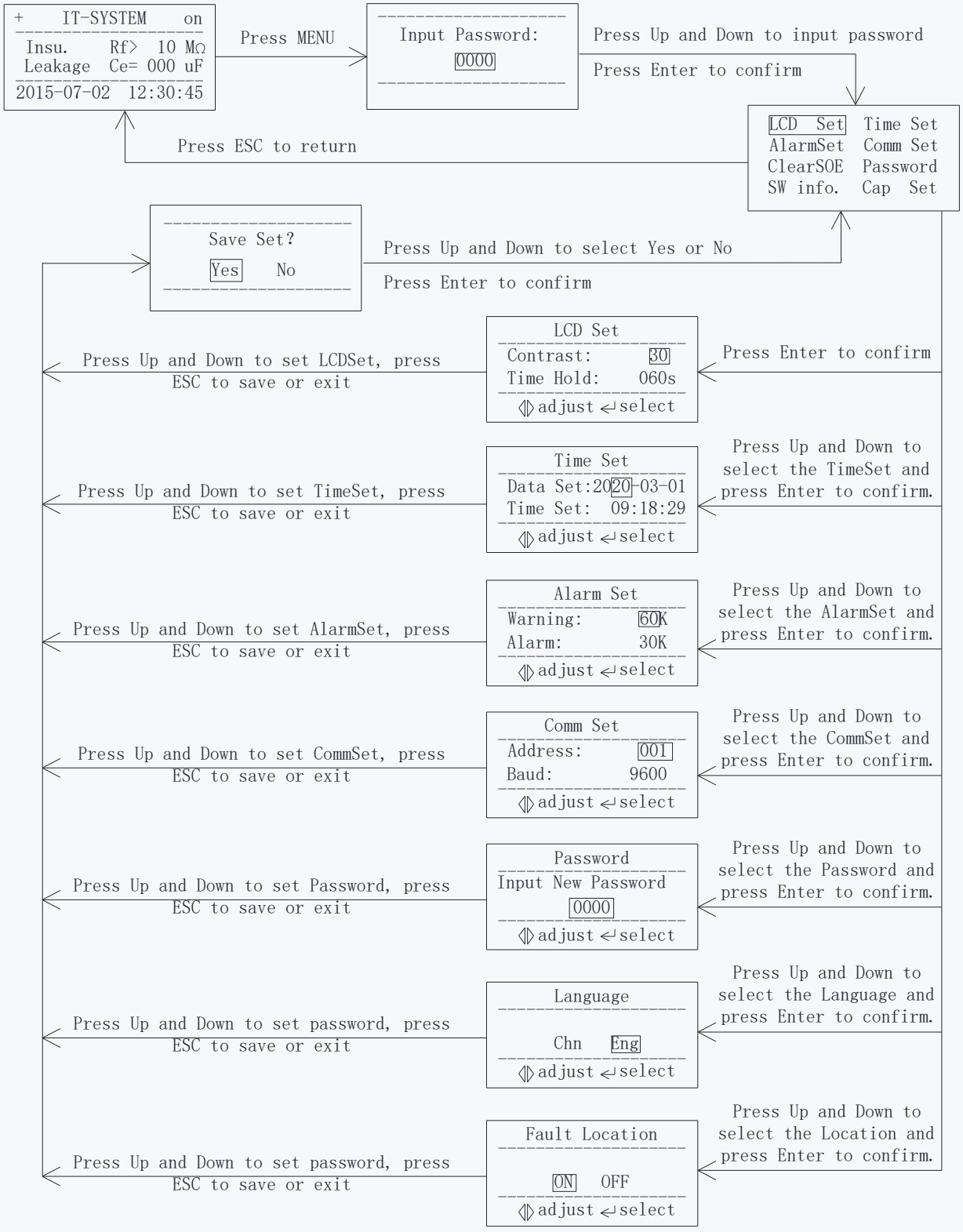
(1) Enter the menu

Under normal operation, press "Enter" to enter the password entry page. Set the number size by "up" and "down". After entering the correct password, press "Enter" to enter the menu. Otherwise, "Password error" will be displayed and return automatically after 1s.

(2) Password setting

After entering the menu, select the option "Password setting", press "up" and "down" to reset the system password (long press is supported). Press the "Return" key to exit. At this time, you can choose whether to save

the setting or not. Press the "Enter" key to confirm and exit. Operation examples are as follows:



(3) Alarm setting

Alarm setting is to set the insulation warning value and the size of insulation alarm value of the system. It belongs to the menu of the same level as "password setting", and the entry steps are the same. The default alarm value is 60K and the alarm value is 30KΩ.

(4) Communication Settings

Communication Settings can modify the communication address and baud rate, with the upper computer communication, default address is 1, and baud rate is 9600.

(5) Setting of other information

The insulation monitor also includes "time setting", "LCD setting", "capacitance setting", "language setting", "fault location" and other functions, which are all set by default by factory. If you need to modify the parameter Settings, refer to the above operation, we will not repeat the example here.

(6) Clear the record

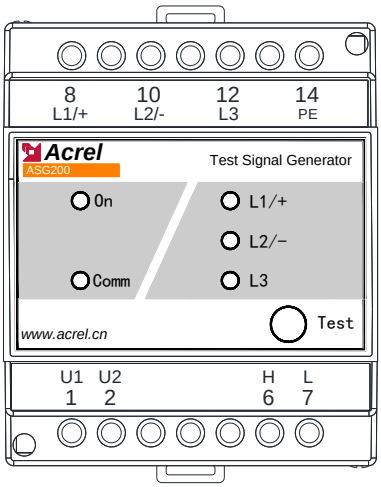
This function is used to clear SOE in the meter.

(7) Software information

This feature is used to view software version information.

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;

"On": when the device is in normal operation, the indicator light flashes at a frequency of about 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;

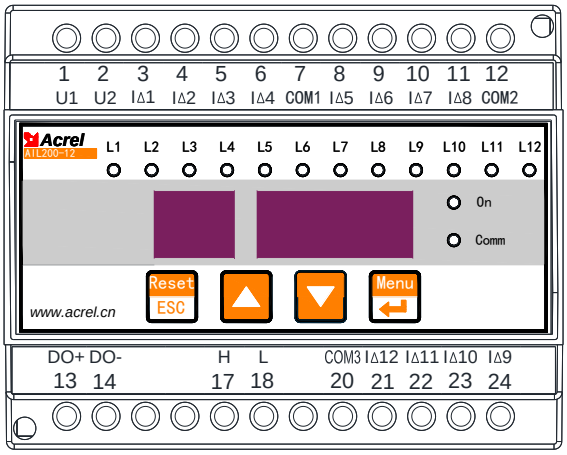
"L3": when insulation fault occurs in Phase C, the indicator light will be on.

6.2.3 keys function

The ASG200 test signal generator has only one "start" button, which can be used to manually start fault location. After manual starting, the signal generator interacts with the insulation monitor and the fault locator, the instrument communication light flashes, and the interface of the insulation monitor shows that manual fault location is started. If the system insulation is in normal condition, the insulation monitor will return to normal after re-measuring.

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:

"On": when the device is in normal operation, the indicator light flashes at a frequency of about once per second.

"Comm": when the device has communication data to send and receive, the indicator light flashes.

"L1~L12": the corresponding indicator light will be on in case of short circuit and broken line of any loop transformer from L1 to L12 and insulation fault.

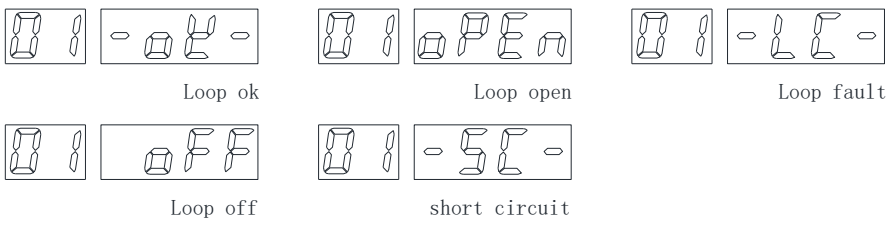
6.3.3 keys function

There are four keys in the device, namely “RESET/ESC”, “up/down”, “MENU/Enter.”

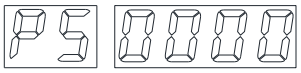
Keys	Function
RESET/ESC	In non-programming mode, used to return to the superior menu; In programming mode, used to exit the current operation; Long press for device reset function.
Up button, down button	In non-programming mode, used for menu switching and password entering; In programming mode, used 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 Instruction

The user interface displays the status of 12 loops, which can be viewed by pressing the up or down key. The corresponding characters represent the following meanings:



Press "Ok" to enter the password input interface. The default password is 0001. Press "OK" to enter the setting interface.



Password

set passsword　　set address　　set loop　　version

If you need to change the Settings, press ok and the character flashes to indicate that you can edit. Users can change the default password; The address setting range is 1~90; The circuit can be set to open or close. If the circuit is not connected to the transformer, the circuit can be closed manually. Software versions are used to distinguish programs. The interface for loop modification is as follows:

loop off　　loop on

After modifying the default Settings, press the return key to enter the "save or Not" interface. Press the up or down key to select whether to save the modified Settings.

not save　　yes save

If only one fault locator is connected in the system, confirm the connected transformer circuit, manually close the unconnected circuit, and default to other parameters. If multiple fault locator is connected in the system, confirm the transformer circuit connected by each fault locator, and manually close the circuit that is not connected; The address of each fault locator is set to distinguish different fault locators. After setting modification, exit the setting, select confirm to save, and the fault locator will run automatically.

7 Address table

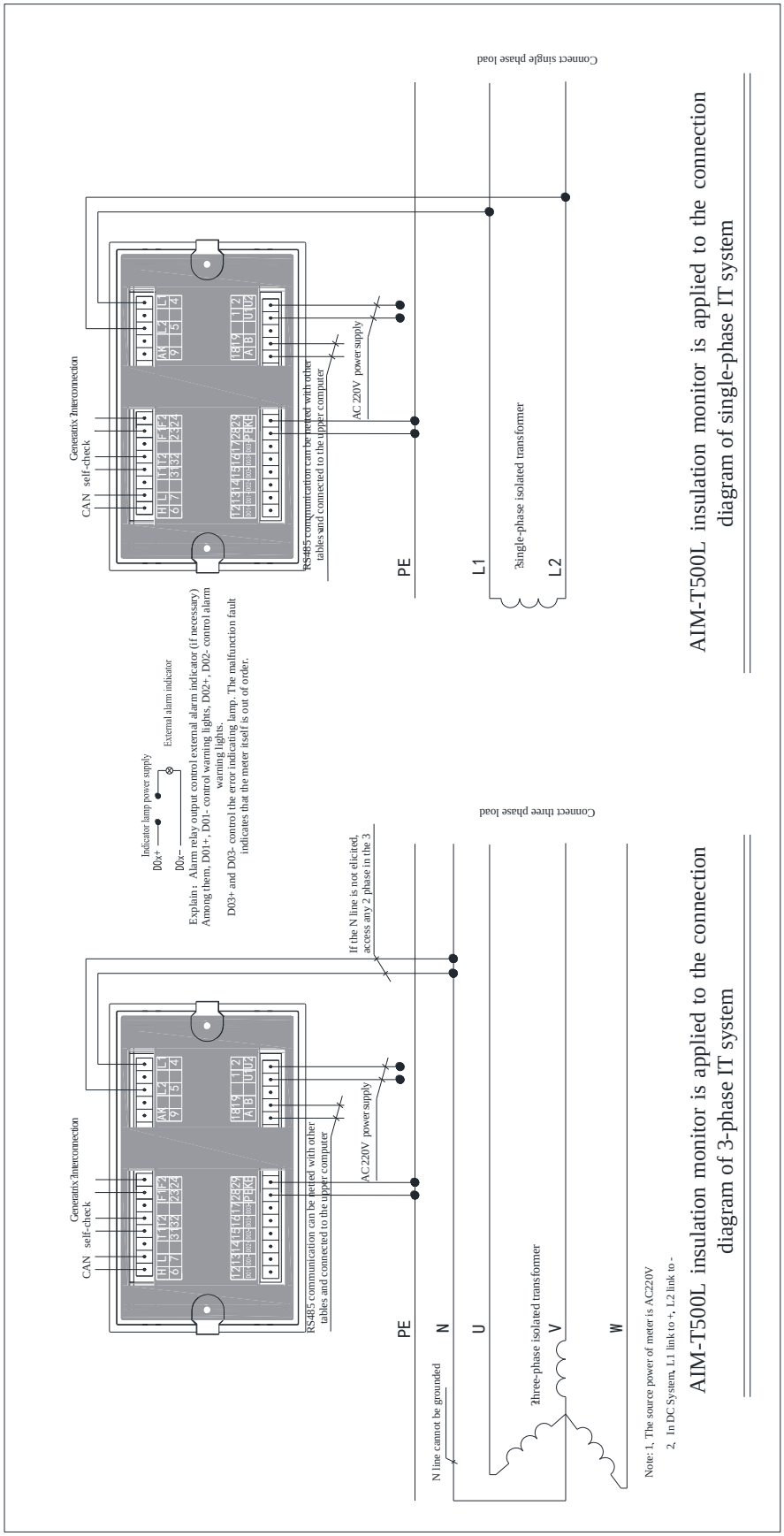
AIM-T500L Modbus-RTU protocol communication address table is as follows:

Number	Address	Parameter	Read/write	range	Word
1	0000H	Passwords	R	0000-9999 (default:0000)	1
2	0001H high byte	Address	R	1~247 (default:1)	1
	0001H low byte	baud rate	R	0~3: 4800, 9600, 19200, 38400 (unit: bps) (default: 9600)	
3	0002H high byte	Contrast ratio	R	15-60 (default: 30)	1
	0002H low byte	Display time	R	15~250 (unit: second) (default: 60,15light)	
4	0003H high byte	year	R/W	0~99 (unit: year) (default: 0)	1
	0003H low byte	month	R/W	1~12 (unit: month) (default: 1)	
5	0004H high byte	day	R/W	0~31 (unit: day) (default：1)	1
	0004H low byte	warning mark	R	0: no 1: warning 2: warning and alarm	
6	0005H high byte	hour	R/W	0~23 (unit: hour) (default: 0)	1
	0005H low byte	minute	R/W	0~59 (unit: minute) (default: 0)	

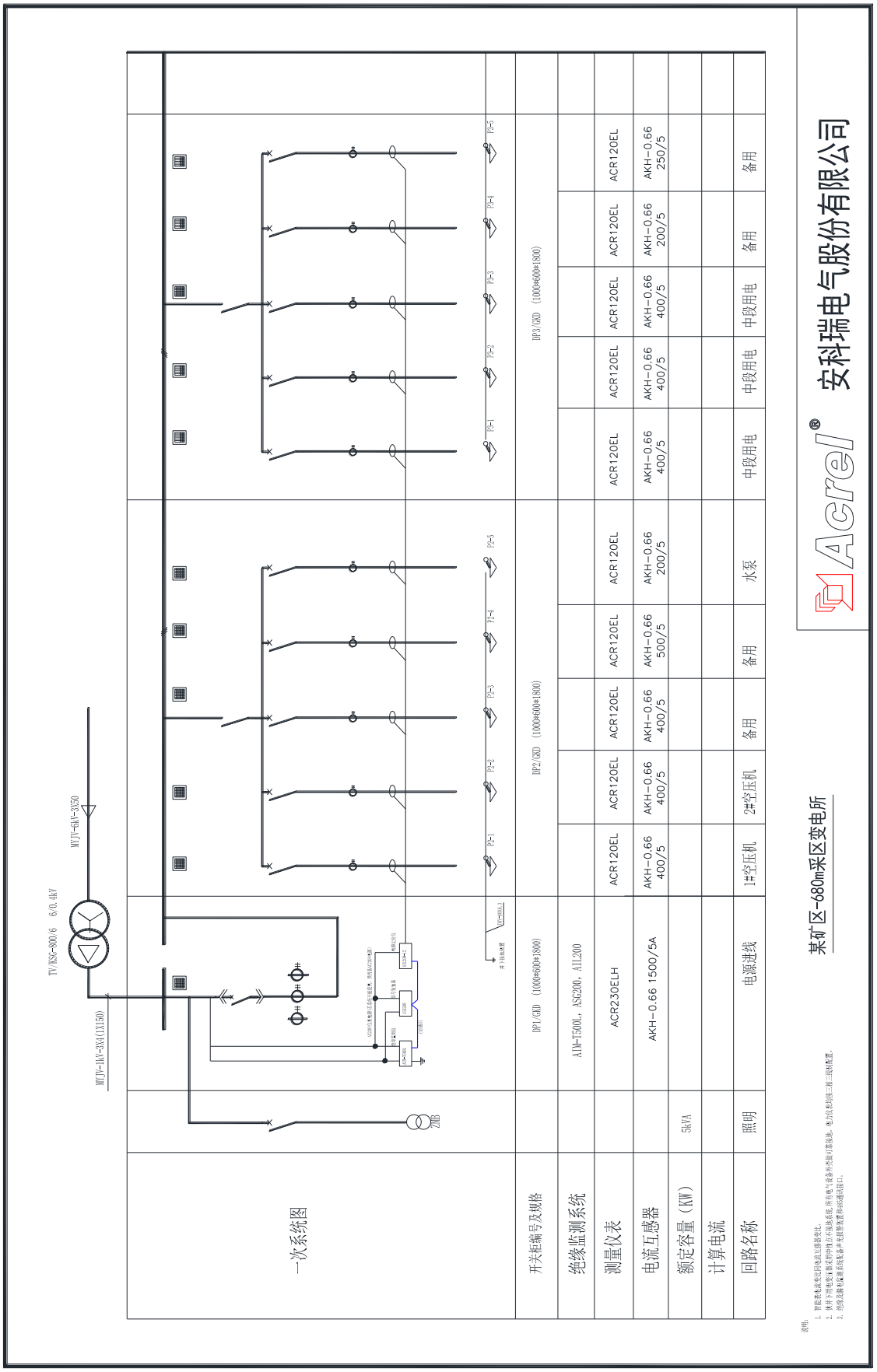
7	0006H high byte	second	R/W	0~59 (unit: second) (default:0)	1
	0006H low byte	data stable	R	0 or 1 (0 invalid, 1 stable)	
8	0007H high byte	warning (high 8 bits)	R/W	60~4999 (unit: kΩ) (default: 60)	1
	0007H low byte	warning (low 8 bits)			
9	0008H high byte	Alarm (high 8 bits)	R/W	10~4999 (unit: kΩ) (default: 38)	1
	0008H low byte	Alarm (low 8 bits)			
10	0009H high byte	insulation resistance value (high 8 bits)	R	1~10001 (unit: kΩ)	1
	0009H low byte	insulation resistance value (low 8 bits)			
11	000AH	SN (high 16 bits)	R	default：0000000000	1
12	000BH	SN (low 16 bits)			1
13	000CH	reserve			1
14	000DH	leakage capacity	R	0~500 (unit: μF)	1
15	000EH high byte	Broken-line symbol	R	0: no 4:PE/KE broken line	1
	000EH low byte	current period		2~500 (unit: s)	
16	000FH high byte	access system	R	0: no access system 1: access system	1
	000FH low byte	reserve			
17	0010H high byte	SOE 1 STA1	R	The sequence number of incident record	1
	0010H low byte		R	Incident1content: 0~20: a fault free record 1: early warning2: alarm	
18	0011H	SOE 1 insulation resistance value	R	incident 1 insulation resistance value 0~early warning set value (default: 0~50) (unit: kΩ)	1
19	0012H high byte	SOE 1 Year1	R	incident 1 time -year	1
	0012H low byte	SOE 1 Month1	R	incident 1 time -month	
20	0013H high byte	SOE 1 Day1	R	incident 1 time -day	1
	0013H low byte	SOE 1 Hour1	R	incident 1 time -hour	
21	0014H high byte	SOE 1 Minute1	R	incident 1 time -minute	1
	0014H low byte	SOE 1 Second1	R	incident 1 time -second	
22-116	0015H~0073H	The remaining 19 events are recorded in this part of the space, and the rules and formats are the same as the first.			95
117~120	0074H~0077H	reserve			4
121	0078H high byte	Fault location record 1 Number	R	The sequence number of incident record: 0~19	1
	0078H low byte	Fault location record 1 Locator	R	Locator sequence of record 1: 0~90	
122	0079H high byte	Fault location record 1 Fault loop	R	Locator fault loop of record 1: 1~12	1
	0079H low byte	Fault location record 1 Fault line	R	Fault line of record 1: 01: A 02: B 03: C 04: N	
123~160	007AH~009FH	The remaining 19 events are fault locating recorded in this part of the space, and the rules and formats are the same as the first.			38

8 Typical application

8.1 AIM-T500L typical wiring method



8.2 AIM-T500L series fault location system application diagram



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