

# AIM-D100-CA series DC Insulation Monitor

## User Manual V1.1

## **Declaration**

Please read this instruction carefully before using this product. All pictures, logos and symbols involved are owned by Acrel Co., Ltd. All or part of the content shall not be reproduced publicly without written authorization by non-company personnel.

Please read the instructions and precautions in this operation manual carefully before using this series of products. Acrel will not be responsible for personal injury or economic loss caused by ignoring the instructions in this operation manual.

The equipment is professional electrical equipment, any related operation, need to be carried out by special electrical technicians. Acrel is not responsible for personal injury or financial loss resulting from the error of non-professional personnel.

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](http://www.acrel-electric.com) or sales channels.

Modified Records

No.	Date	Version	Description
1	2023.10.20	V1.0	First version
2	2024.05.20	V1.1	Modified power supply, voltage, temperature; appearance of the size of the accuracy of 0.1; communication to increase the 06 example, registers to increase 40H, 42H, increase the time description
Notes:			

## Contents

1 Introduction .....	1
2 Model Description .....	1
3 Functional Characteristics .....	1
4 Technical Parameters .....	2
5 Installation and Connection .....	2
5.1 Shape and Size .....	2
5.2 Installation .....	3
5.3 Wiring .....	4
5.4 Wiring Diagram .....	5
5.5 Attention .....	5
6 Programming and Usage .....	6
6.1 Panel Description .....	6
6.2 LED Indicator Instructions .....	6
6.3 DIP Switch Description .....	7
7 Communication Instruction .....	7
7.1 Communication Protocol .....	7
7.2 Function Code Introduction .....	8
7.3 Register Address Table .....	9
7.4 Register Operation Description .....	11
7.5 Message Example .....	12
8 Application .....	12

# AIM-D100-CA series DC Insulation Monitor

## 1 Introduction

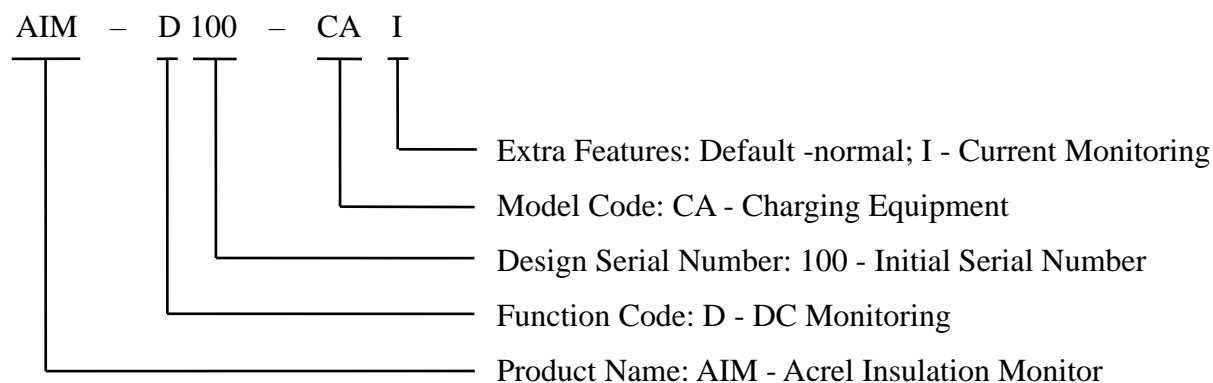


With the development of industry, many electrical equipment and factory equipment are powered by DC systems, and the positive and negative poles of the DC system are not grounded. For ungrounded (IT) power distribution systems, insulation resistance should be monitored to ensure the safe operation of the power supply system.

AIM-D100-CA series DC insulation monitor can be applied in DC system of 100~1000V, used for on-line monitoring of DC ungrounded system positive and negative pole to ground insulation resistance, when insulation resistance is lower than the set value, it will send out warning or alarm signal.

The product is mainly designed for DC 100~1000V range of electric vehicle charging device insulation monitoring, but also can be applied in energy storage DC, substation DC screen, UPS power supply system, photovoltaic DC system and other DC power grid DC system.

## 2 Model Description



### 3 Functional Characteristics

- Resistance monitoring. The product can monitor the insulation resistance of the positive and negative poles of the DC system to the ground. When the insulation resistance is lower than the set warning and alarm values, it can send out warning and alarm signals.
- Voltage monitoring. The product can monitor the voltage between the positive and negative poles of the DC system and the voltage between the positive and negative poles with respect to ground. The measurement range is 100~1000V.
- Current monitoring function. The product can monitor the current of DC system, only the AIM-D100-CAI model has this function.
- LED indication. The product panel has operation, communication, and fault LED indicators.

- Communication function. The product has RS485 interface and adopts Modbus-RTU protocol.
- Metal casing. The product adopts a metal shell and can be wall-mounted or guide rails-mounted.
- Plug-in terminals. The product adopts plug-in terminal wiring, which is convenient.

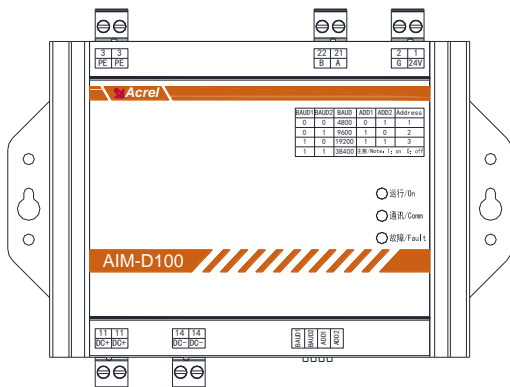
#### 4 Technical Parameters

Technical Parameter		Technical Specifications
Auxiliary power		DC 12~36V
Maximum power consumption		≤3W
Voltage monitoring	Voltage range	DC 0~1000V
	Accuracy	0.5
Current monitoring	Current monitoring	Connect with current shunt base on rated current; CAI models only
	Accuracy	5%
Insulation monitoring	Insulation resistance range	1kΩ~10MΩ
	Warning and alarm range	10kΩ~10MΩ
	Accuracy	1~10kΩ: ±1k; 10k~500k: ≤3%
	System leakage capacitance	≤5μF
	Insulation monitoring speed	500ms/cycle; 1000ms/cycle
Alarm method		LED indicator
Communication		RS485 interface, Modbus-RTU protocol
Installation		Wall-mounted installation or DIN-rail installation (plastic stent included)
Protection level		IP30
Environment	Operating temperature	-20~+60°C
	Storage temperature	-25~+75°C
	Relative humidity	<95%, without condensation
	Altitude	<2000m

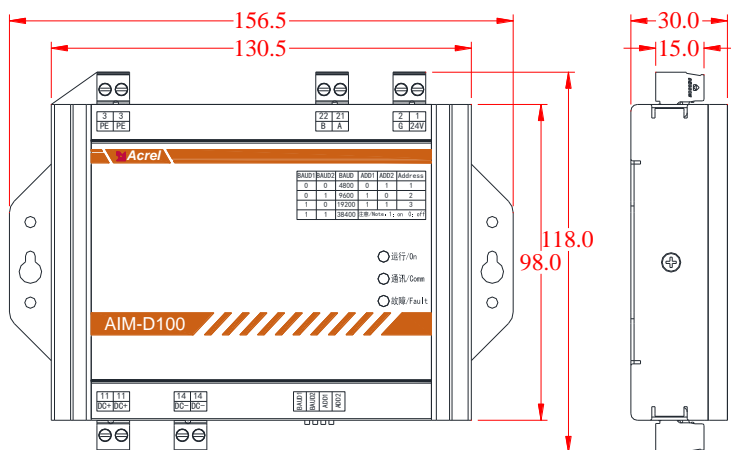
#### 5 Installation and Connection

##### 5.1 Shape and Size

The overall dimensions of the AIM-D100-CA DC Insulation Monitor are shown in the figure below.  
(Unit: mm)



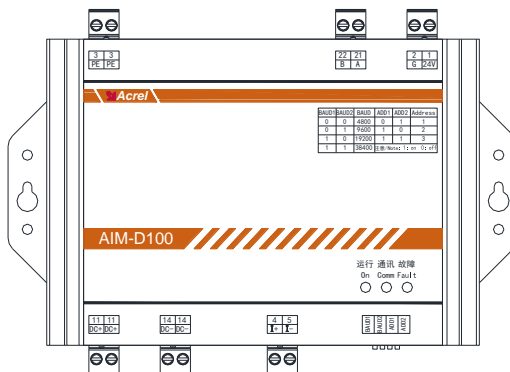
Appearance



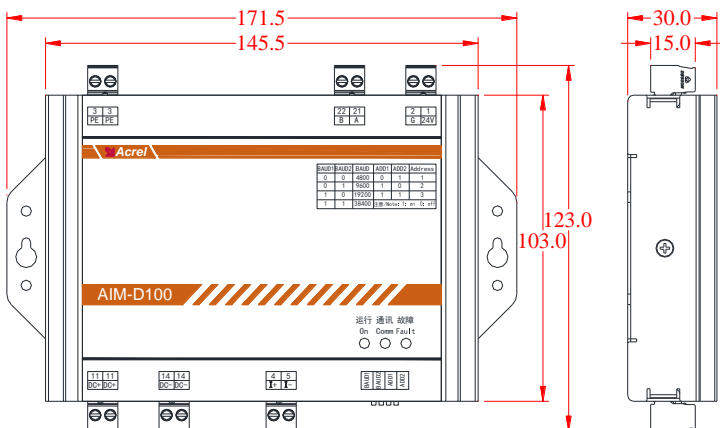
Front view

Side view

The overall dimensions of the AIM-D100-CAI DC Insulation Monitor are shown in the figure below. (Unit: mm)



Appearance

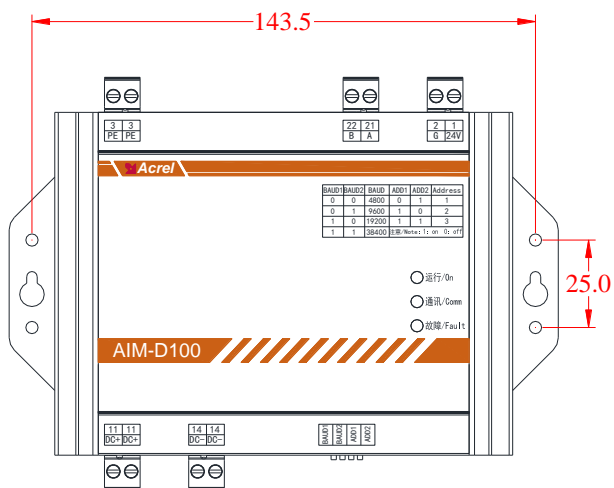


Front view

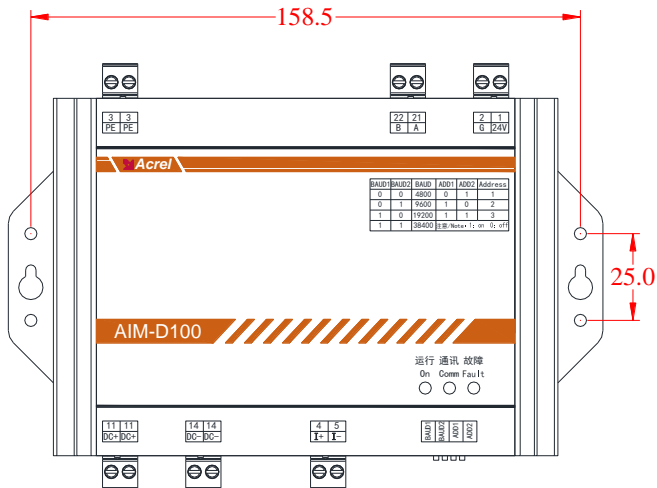
Side view

## 5.2 Installation

The AIM-D100-CA and CAI DC Insulation Monitors can be mounted in two ways. The mounting dimensions are shown below. (Unit: mm)



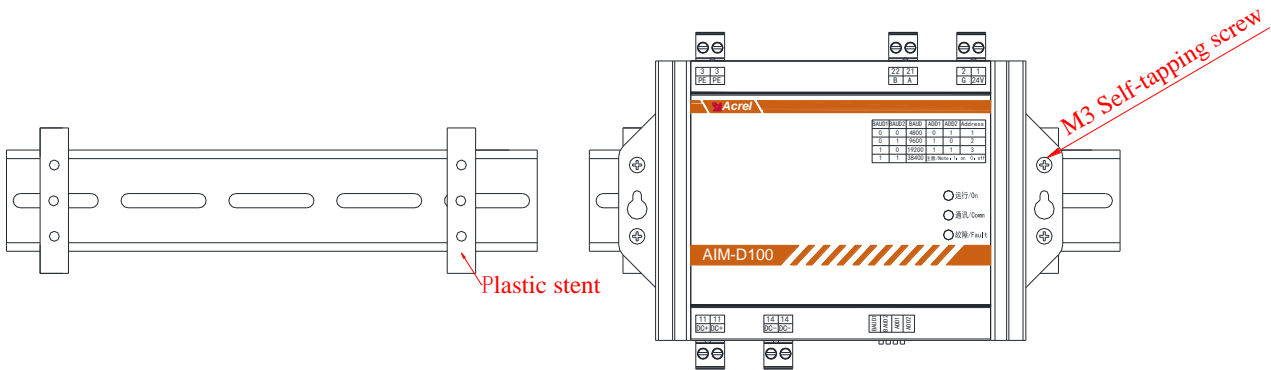
AIM-D100-CA Mounting Dimensions



AIM-D100-CAI Mounting Dimensions

First installation method: wall-mounted installation. When installing the product, use the two M3 self-tapping screws (or other screws) provided with the product to pass through the mounting holes on both sides of the instrument and fix it to the bracket in the cabinet or the galvanized metal plate.

Second installation method: guide rail installation. When installing the product, first clamp the plastic stent that comes with the product on the guide rail. Align the mounting holes on both sides of the device with the plastic stent mounting holes. Use the 4 included M3 self-tapping screws to align the mounting holes and tighten them. The guide rail installation is as follows as shown in the below.



5.3

### Wiring

AIM-D100-CA DC Insulation Monitor product wiring terminals are shown below:

1 2 24V G	3 3 PE PE	11 11 DC+ DC+	14 14 DC- DC-	21 22 A B
Power	Ground	Positive	Negative	RS485

AIM-D100-CAI DC Insulation Monitor product wiring terminals are shown below:

1 2 24V G	3 3 PE PE	4 5 I+ I-	11 11 DC+ DC+	14 14 DC- DC-	21 22 A B
Power	Ground	Current	Positive	Negative	RS485

### Description:

Terminal 1 and 2: Connect to DC 24V power supply;

Terminal 3: Connect to the on-site grounding bar, the terminals are connected inside and can be wired from either terminal;

Terminals 4 and 5: Connect with current shunt;

Terminal 11: Connect to the positive pole of the DC system, the terminals are connected inside and can be wired from either terminal;

Terminal 14: Connect to the negative pole of the DC system, the terminals are connected inside and can be wired from either terminal;

Terminal 21 and 22: RS485 interface.

### Wiring Specification:

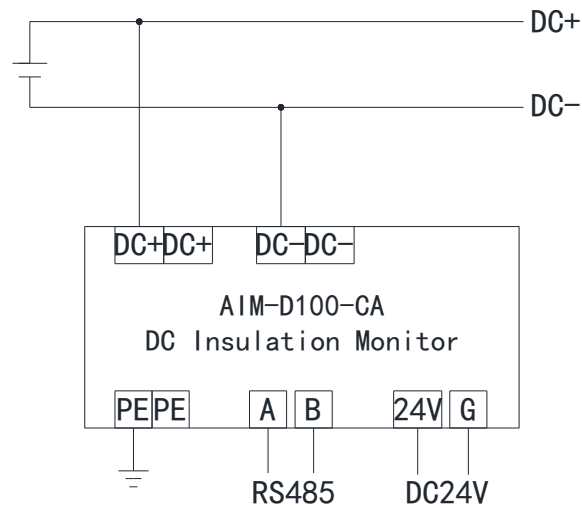
For auxiliary power supply, functional grounding, and DC system positive and negative wiring, current shunt wiring, 1.5mm<sup>2</sup> multi-core copper wires can be used. RS485 communication wiring can



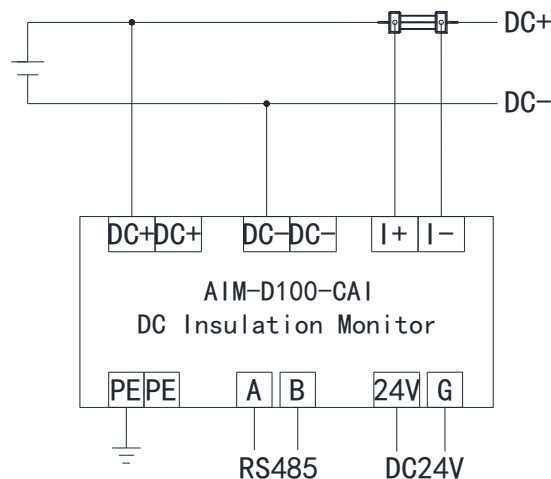
use 0.75~1.5mm<sup>2</sup> shielded twisted pair.

#### 5.4 Wiring Diagram

The AIM-D100-CA DC Insulation Monitor is wired as shown in the following schematic when monitoring the DC system:



The AIM-D100-CAI DC Insulation Monitor is wired as shown in the following schematic when monitoring the DC system:



#### 5.5 Attention

(1) When designing and installing insulation monitors, it should be noted that only one insulation monitor can be installed in a system. If multiple insulation monitors are installed in different locations of the same system, a control strategy should be used for insulation resistance monitoring.

(2) The insulation monitor can be installed in the distribution box, and the installation location is free of dripping water, corrosive chemical gases, and sedimentation substances.

(3) When wiring the insulation monitor, you should strictly follow the wiring diagram. It is best to use a pin socket connector for crimping, then insert the instrument terminal and tighten the screws to avoid abnormal operation of the instrument due to poor contact.

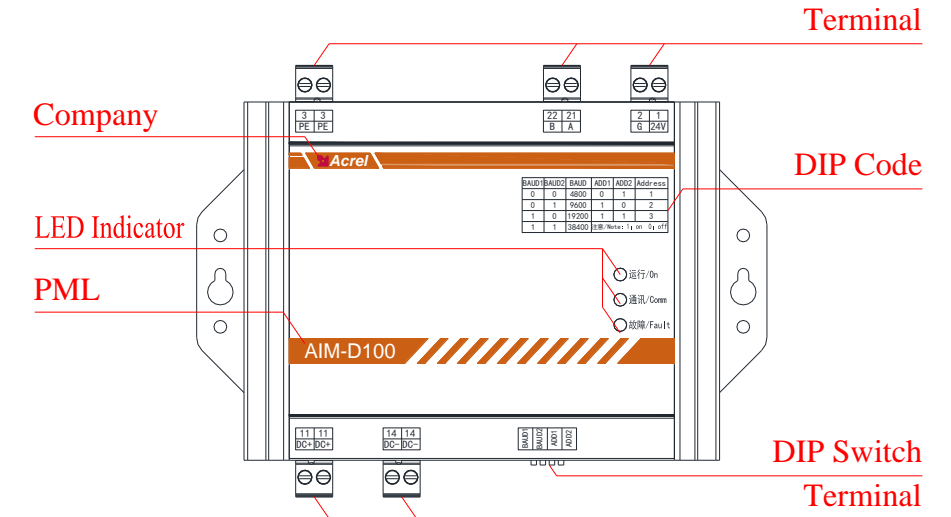
(4) The insulation monitor should be reliably connected to the DC system being monitored to ensure the effectiveness of insulation monitoring.

(5) Non-professionals are strictly prohibited from opening the product casing without authorization to avoid affecting product functions.

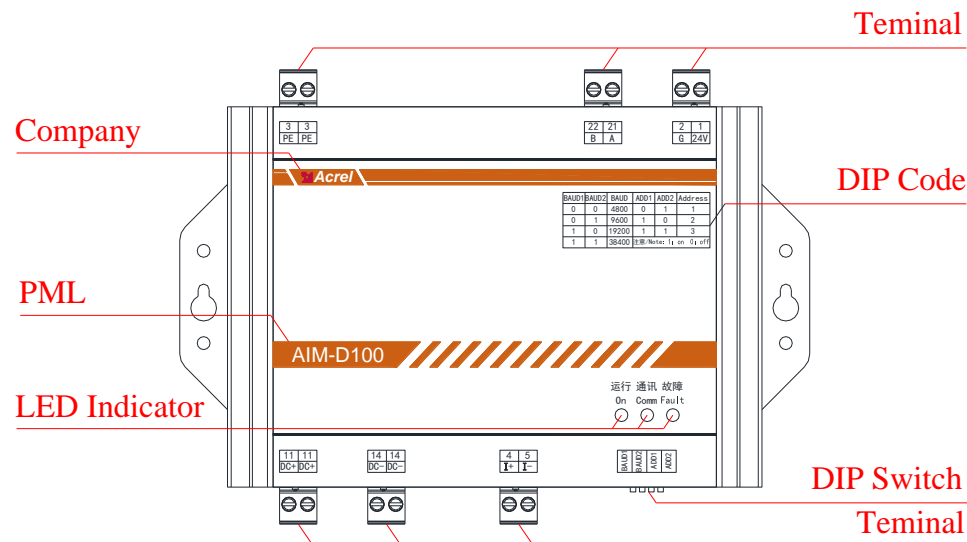
6 Programming and Usage

6.1 Panel Description

The AIM-D100-CA panel description is shown below:



The AIM-D100-CAI panel description is shown below:



6.2 LED Indicator Instructions

Indicator	Function Description
On	When the instrument is running normally, the indicator light flashes with a flashing frequency of approximately once per second.
Comm	When there is no data communication, the indicator light is off. When there is data communication, the indicator light flashes.
Fault	The indicator light flashes when an insulation fault occurs and is always on when an insulation fault occurs.

## 6.3 DIP Switch Description

AIM-D100-CA series Insulation Monitor is equipped with a 4-digit dipswitch at the lower row of terminals, and the functions corresponding to each set of dial codes are shown in the table below:

BAUD1	BAUD2	Baud rate	ADD1	ADD2	Address
0	0	4800	0	0	——
0	1	9600	0	1	1
1	0	19200	1	0	2
1	1	38400	1	1	3
Notes: 1: on    0: off					

The combination of BAUD1 and BAUD2 DIP switch: used to set the baud rate of RS485 communication. The factory default value is 10.

The combination of ADD1~ADD2 DIP switch: used to set the address of the instrument's RS485 communication. the default is 01.

## 7 Communication Instruction

### 7.1 Communication Protocol

The RS485 interface of the instrument adopts the Modbus-RTU communication protocol. The protocol defines the address, function code, data, check code, etc. in detail, which is a necessary content to complete the data exchange between the host and the slave.

#### 7.1.1 Transmission method

Information transmission is asynchronous and in bytes. The communication information transmitted between the host and the slave is in an 11-bit format, including 1 start bit, 8 data bits (the smallest significant bit is sent first), and no Parity bit, 1 stop bit (N-8-1).

#### 7.1.2 Information frame format

Address Code	Function Code	Data Zone	CRC check code
1Byte	1 Byte	n Byte	2 Byte

**Address code:** The device address code is at the beginning of the data frame and consists of one byte (8-bit binary code), ranging from 0 to 255 in decimal. The device can set the address to 1 to 247. These bits identify the address of the user-specified end device that will receive data from the connected host. The address of each terminal device must be unique, and only the addressed terminal will respond to a query containing this address. When the terminal sends back a response, the slave address data in the response tells the host which terminal it is communicating with.

**Function code:** The function code indicates what function the addressed terminal performs.

Function Code	Definition	Explanation
03H/04H	Read data register	Get the current binary value
06H	write single registers	Set binary values to single registers

10H	Write multiple registers	Set binary values to multiple registers
-----	--------------------------	---

Data zone: The data area contains the data required by the terminal to perform specific functions or the data collected when the terminal responds to queries. The content of these data may be numerical values, reference addresses or setting values. For example: the function code tells the terminal to read a register, and the data zone needs to indicate which register to start from and how much data to read. The embedded address and data vary according to the type and content between slaves.。

CRC check code: The error check (CRC) field occupies two bytes and contains a 16-bit binary value. The CRC value is calculated by the transmitting device and then appended to the data frame. The receiving device recalculates the CRC value when receiving the data and then compares it with the value in the received CRC field. If the two values are not equal, it occurs. mistake.

## 7.2 Function Code Introduction

### 7.2.1 Function code 03H or 04H: read register

This function allows users to obtain data and system parameters collected and recorded by the device. There is no limit to the number of data requested by the host at one time, but it cannot exceed the defined address range.

The following example reads data from the 00 25H register from the slave at address 01.

Host send		Sent information	Slave return		Returned information
Address code		01H	Address code		01H
Function code		03H	Function code		03H
Starting address	High byte	00H	Byte count		02H
	Low byte	25H	Register data	High byte	1FH
Register count	High byte	00H		Low byte	68H
	Low byte	01H	CRC check code	Low byte	B1H
CRC check code	Low byte	95H		High byte	9AH
	High byte	C1H			

The slave returns a read result of 0x1F68H, decimal 8040, indicating a system voltage of 804V.

### 7.2.2 Function code 06H: Write single registers

Function code 06H allows the user to change the contents of a single register without going outside the defined address range.

The following example writes 0xEF EF data to the 0034H register of the slave at address 01.

Host send		Sent information	Slave return		Returned information
Address Code		01H	Address Code		01H
Function Code		06H	Function Code		06H

Register address	High byte	00H
	Low byte	34H
Data to be written	High byte	EFH
	Low byte	EFH
CRC check code	Low byte	C5H
	High byte	B8H

Register address	High byte	00H
	Low byte	34H
Data to be written	High byte	EFH
	Low byte	EFH
CRC check code	Low byte	C5H
	High byte	B8H

The host writes 0xEFEF to 00 34H to indicate that the insulation alarm switch is turned on.

### 6.2.3 Function Code 10H: Write Multiple Registers

Function code 10H allows the user to change the contents of multiple registers without going outside the defined address range.

The following example writes 0xFEFE, 0x0064, 0x0032 to the 0034H~0036H registers of the slave at address 01.

Host send		Sent information
Address Code		01H
Function Code		10H
Starting address	High byte	00H
	Low byte	34H
Register count	High byte	00H
	Low byte	03H
Register count		06H
0004H Data to be written	High byte	FEH
	Low byte	FEH
0005H Data to be written	High byte	00H
	Low byte	64H
0006H Data to be written	High byte	00H
	Low byte	32H
CRC check code	Low byte	5BH
	High byte	AAH

Slave return		Returned information
Address Code		01H
Function code		10H
Starting address	High byte	00H
	Low byte	34H
Register count	High byte	00H
	Low byte	03H
CRC check code	Low byte	C1H
	High byte	C6H

The host writes 0xFEFE, 0x0064, 0x00 32H to 00 34H~00 36H to indicate that the insulation alarm switch is turned on, setting warning value of 100kΩ and alarm value of 50kΩ.

**Note: The above data is for reference only. Please refer to the address table for register definitions.**

### 7.3 Register Address Table

No.	Address	Parameter	Read /Write	Value range	Data Types
-----	---------	-----------	-------------	-------------	------------

0	00H	Reserved	R		UINT16
1	01H	address	R	1~63 (default 1)	UINT16
2	02H	Baud rate	R	0~3: 4800, 9600, 19200, 38400 (Unit: bps) (default 1)	UINT16
3~11	03H~0BH	Reserved	R		UINT16*9
12	0CH	Software number	R		UINT16
13	0DH	Software version	R		UINT16
14~31	0EH~1FH	Reserved	R		UINT16*18
32	20H	Fault type	R	bit15: 1 DC+ and DC- connected reversely; 0 is normal bit14~bit6: Reserved bit5: 1 negative pole insulation fault warning; 0 is normal bit4: 1 negative pole insulation fault alarm; 0 is normal bit3: 1 positive pole insulation fault warning; 0 is normal bit2: 1 positive pole insulation fault alarm; 0 is normal bit1~bit0: Reserved 00 18 means 0000 0000 0001 1000	UINT16
33	21H	Positive pole insulation resistance	R	Unit: kΩ; Ratio is 1 For example, 10000, the resistance is 10MΩ	UINT16
34	22H	Negative pole insulation resistance	R		UINT16
35	23H	Positive pole voltage to ground	R	Unit: V; Ratio is 0.1 For example, 4567, the voltage is 4567*0.1=456.7V	UINT16
36	24H	Negative pole voltage to ground	R		UINT16
37	25H	System voltage	R		UINT16
38	26H	System current	R	Unit: A; Ratio (0.01). Value is 2500 (mV), current ratio (4000), current is 2500*0.01*4000=100000mA=100A	UINT16
39~51	27H~33H	Reserved	R		UINT16*13
52	34H	Insulation alarm switch	R/W	0xFEFE is on (default is on) 0xEFEF is off	UINT16
53	35H	Positive pole insulation resistance warning value	R/W	10~10000kΩ (default 100)	UINT16
54	36H	Positive pole insulation resistance alarm value	R/W	10~10000kΩ (default 50)	UINT16
55	37H	Negative pole insulation resistance warning value	R/W	10~10000kΩ (default 100)	UINT16
56	38H	Negative pole insulation resistance alarm value	R/W	10~10000kΩ (default 50)	UINT16

57~62	39H~3EH	Reserved	R		UINT16*6
63	3FH	Insulation monitor speed	R/W	0: 500ms/cycle; 1: 1000ms/cycle	UINT16
64	40H	Insulation monitor trigger mode	R/W	0x01: Cycle 0x10: Communication (default 10)	UINT16
65	41H	Capacitor delay time	R/W	0~60000ms (default 0)	UINT16
66	42H	Resistances monitor delay time	R/W	5~500s (default 5s)	UINT16

## 7.4 Register Operation Description

### 7.4.1 Trigger Insulation Monitoring

0x40H is the insulation monitoring trigger form, there are three main types: cycle trigger, communication trigger, cycle and communication trigger, default cycle trigger.

Cycle trigger form, timed monitoring, monitoring time 500ms or 1000ms once, after monitoring update register data, after a polling delay (0x42H), continue to trigger monitoring. After a polling delay (0x42H), the monitoring will continue to be triggered. The host communication reads 0x20H~0x24H register data, and the instrument returns the latest data in the register.

Communication trigger form, polling delay (0x42H) is invalid, insulation monitoring in standby mode. Host communication read 0x20H~0x24H register data, the instrument triggers a monitoring, monitoring time 500ms or 1000ms once, monitoring register data refresh and return data, monitoring time repeated reading data is invalid, not monitoring can not return data. It is recommended that the interval between two readings when communication is triggered is more than 2500ms, and the timeout time is more than 1500ms.

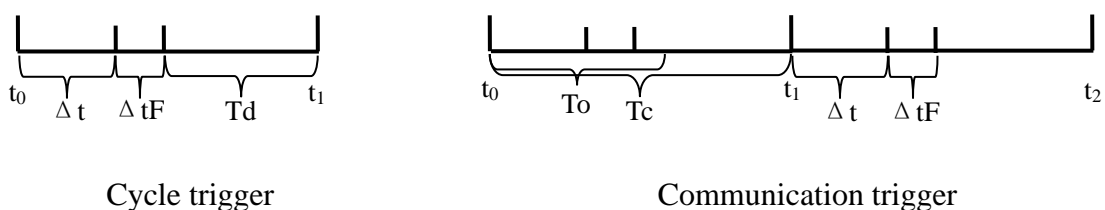
### 7.4.2 Insulation Monitoring Speed

0x3FH is the insulation monitoring resistance time, and the insulation monitoring period can be set to 500ms or 1000ms. The accuracy of 500ms is slightly worse.

### 7.4.3 Delay Time of Insulation Monitoring Capacitor

0x41H is the insulation monitoring capacitance time. When the system capacitance is  $>5\mu\text{F}$ , the insulation resistance monitoring has a long response time and the insulation monitoring accuracy deteriorates. You can set the insulation monitoring capacitance time to 1000ms/10 $\mu\text{F}$  and increase the monitoring time to stabilize the insulation measurement and eliminate the influence of capacitance.

The cycle trigger defines polling delay as  $T_d$ , insulation monitoring resistance time as  $\Delta t$ , insulation monitoring capacitance time as  $\Delta t_F$ ; the communication trigger defines reading interval time as  $T_c$ , and timeout as  $T_o$ . The time correspondence is shown in the following figure:



## 7.5 Message Example

### 7.5.1 Read the insulation monitoring status

Host Send: 01 03 00 20 00 05 84 03

Slave Response: 01 03 0A 00 18 00 64 00 0A 11 94 01 C2 F7 A0

Data Analysis: 00 18 represents the fault type, the binary system is 0000 0000 0001 1000, the fault is positive insulation fault warning, negative insulation fault alarm; 00 64 represents the positive pole to ground insulation resistance, 100kΩ; 00 0A represents the negative pole to ground insulation resistance, 10kΩ; 11 94 represents the positive electrode to ground voltage,  $4540/10=454.0V$ ; 01 C2 represents the negative electrode to ground voltage,  $450/10=45.0V$ .

### 7.5.2 Read the system voltage status

Host Send: 01 03 00 25 00 01 95 C1

Slave Response: 01 03 02 1F 68 B1 9A

Data Analysis: 1F 68 represents the system voltage,  $8040/10=804V$ .

### 7.5.3 Set Alarm Parameters

The alarm switch is turned on by default, the positive and negative insulation fault warning values default to 100kΩ, and the positive and negative insulation fault alarm values default to 50kΩ. No changes are required without special requirements. If you need to change, please refer to the following example.

(1) Turn on the alarm switch

Host Send: 01 06 00 34 FE FE 09 E4

Slave Response: 01 06 00 34 FE FE 09 E4

(2) Turn off the alarm switch

Host Send: 01 06 00 34 EF EF C5 B8

Slave Response: 01 06 00 34 EF EF C5 B8

(3) Alarm threshold setting

Host send: 01 10 00 35 00 04 08 00 64 00 32 00 64 00 32 26 3E

Slave response: 01 10 00 35 00 04 D1 C4

Data analysis: 00 64 means setting the positive insulation fault alarm value to 100kΩ; 00 32 means setting the positive insulation fault alarm value to 50kΩ; 00 64 means setting the negative insulation fault alarm value to 100kΩ; 00 32 means setting the negative insulation fault alarm value to 50kΩ.

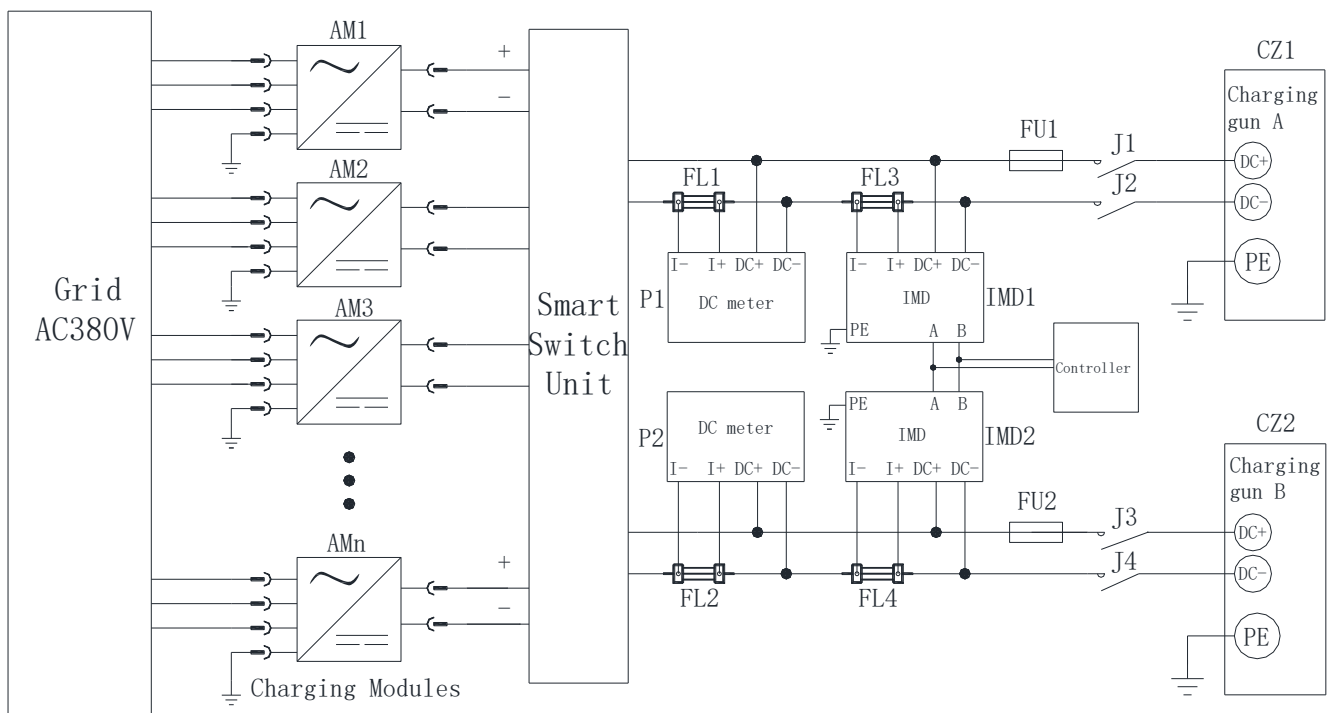
## 8 Application

Electric vehicle charging device generally consists of cabinet, several AC to DC charging modules, intelligent switching unit, measuring instrument, controller, contactor, charging gun and so on.





The following figure shows an example of the application of AIM-D100-CAI DC Insulation Monitor in an electric vehicle DC charging unit.



The example is a two-gun 120kW DC charging post. The intelligent switching unit controls the charging module, the meter measures the current, the insulation monitor measures the insulation voltage, the insulation resistance, and the insulation monitor is controlled by the controller. When the charging pile is in use, when charging gun A or B is used alone, the controller issues a command to control the corresponding IMD1 or IMD2 insulation monitor; when charging guns A and B are used at the same time, the controller issues a command to control the IMD1 insulation monitor for insulation monitoring. If it is a single gun DC charging device, only one insulation monitor needs to be installed and controlled by the controller. Generally only one insulation monitor needs to be installed for a stand-alone DC system to avoid interference. The safety, stability and reliability of the DC charging system is guaranteed by the coordinated work of the controller and the insulation monitor.

Headquarters: Acrel Co., LTD.

Address: No.253 Yulv Road Jiading District, Shanghai, China

TEL.: 0086-21-69158338 0086-21-69156052 0086-21-59156392 0086-21-69156971

Fax: 0086-21-69158303

Web-site: [www.acrel-electric.com](http://www.acrel-electric.com)

mail: [ACREL008@vip.163.com](mailto:ACREL008@vip.163.com)

Postcode: 201801

Manufacturer: Jiangsu Acrel Electrical Manufacturing Co., LTD.

Address: No.5 Dongmeng Road, Dongmeng industrial Park, Nanzha Street, Jiangyin City, Jiangsu Province, China

TEL: 0086-510-86179966

Fax: 0086-510-86179975

Web-site: [www.jsacrel.com](http://www.jsacrel.com)

Postcode: 214405

E-mail: [sales@email.acrel.cn](mailto:sales@email.acrel.cn)