DC Insulation Monitor Device
IMD
(Dual channels)

GYDCG-UBCH2-LZ V5.1

Insulation monitoring device for unearthed DC systems (IT systems)DC 100 V to 1000 V
Real-time monitoring of 0 ~ 1000 Vd.c. DC voltage values
RS485 communication, Custom protocol
The ground insulation resistance of two DC systems is monitored simultaneously

1. Comprehensive Functions

Basic configuration: Insulation resistance monitoring, DC voltage monitoring, reverse DC voltage alarm.

2. Wider Power Supply Range

Compatible with 12V or 24V power supplies, operating range 10~30V.

3. Broader Insulation Monitoring Range

Capable of insulation resistance monitoring within a DC range of 100V~1000V, with a resistance monitoring range of 0KΩ~10MΩ.

4. Real-time Insulation Resistance Monitoring

Upon activation, the module continuously monitors the insulation resistance of both poles to the ground, unaffected by the symmetry of positive and negative pole insulation resistances. Monitoring data is updated in real time.

5. Higher reliability

Insulation resistance monitoring results are not affected by low-frequency fluctuations in DC voltage.

6. Greater Internal Ground Resistance

Internal ground resistance of the insulation monitoring module is 3MΩ or 600KΩ.

7. Faster Monitoring Speed, Adaptive to Ground Capacitance

Quick insulation resistance monitoring is achieved when the capacitance of both positive and negative poles to the ground does not exceed 3uF, with a monitoring period between 0.7s and 2.5s. The larger the ground capacitance, the longer the monitoring period.

8. Monitoring Accuracy

In cases of smaller ground capacitance, the monitoring error can be within 1%.

Catlog

1 General instructions

The GYDCG-UBCH2-LZ DC Insulation Monitor Device(IMD) has an insulation monitoring start/stop function. Once insulation monitoring is activated, it can real-time monitor the insulation resistance of positive and negative poles to the ground. The monitoring results are not affected by DC voltage fluctuations or the symmetry of the insulation resistance of the positive and negative poles.

• Monitors insulation resistance values of positive and negative poles to the ground in 100 ~ 1000Vd.c. floating ground DC systems;

• Resistance measurement range 0KΩ～10MΩ;

• Detects DC voltage values, range 0 ~ 1000Vd.c.;

• RS485 communication;

• DC voltage reverse connection alarm function;

• Can simultaneously monitor the ground insulation resistance of two DC systems (two DC systems share a ground), two independent control, can be monitored at the same time, non-interference.

•Dedicated to electric vehicle DC charging system.

2 Interfaces and Features

2.1 Principle and Topology

The IMD adopts bridge circuit, as shown in the figure below. Take DC1 as an example. When the IMD is deactivated, the positive and negative terminal relays K1 and K2 are disconnected, IMD does not perform resistance and voltage monitoring. Upon activating IMD, the relays K1 and K2 are closed, and starting resistance and voltage monitoring,. DC2 circuit is the same. The two channels are independently controlled. When the IMD of the two channels is deactivated, the relay K5 is disconnected, and the module is disconnected from the earth.

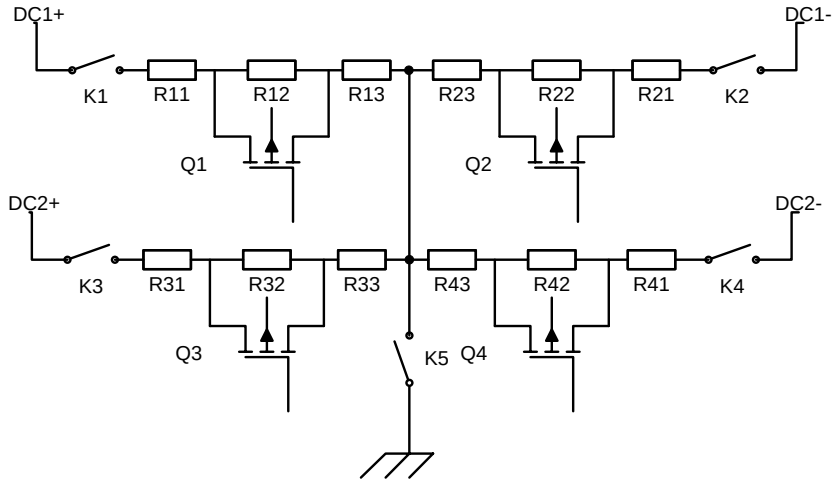

Figure 1. Schematic diagram of principle

2.2 Monitoring of the insulation resistance

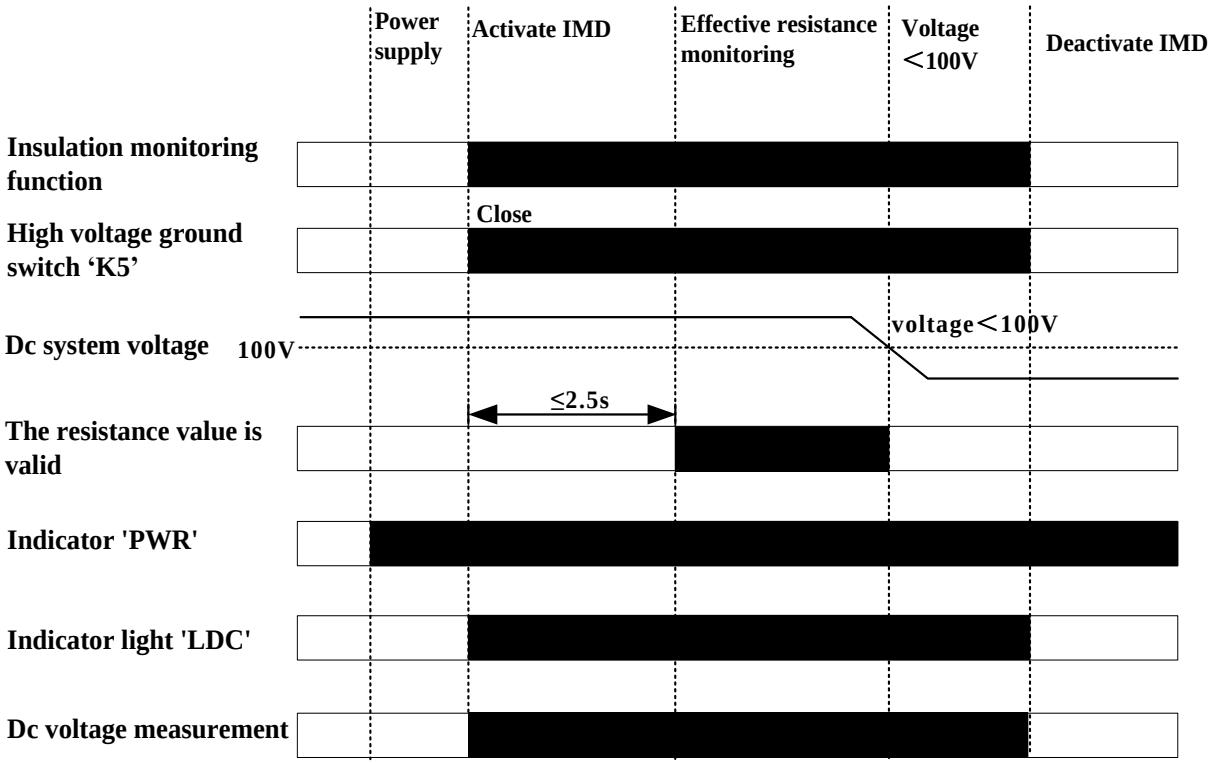

Figure 2. Sequence diagram of insulation monitoring function control

The control sequence of the insulation monitoring function is shown in the figure above.

• After the IMD is powered, the 'PWR' light turns on.

• IMD can be activated and Deactivated by writing register 0x0102.

• The current status of the IMD, whether it is activated or deactivated, can be determined by reading bit2 of the 0x001B register.

•When the insulation monitor is activated, the DC voltage value can be monitored in real

time.

• The following conditions in Table 2 must be met for the insulation resistance values in registers 0x0012 and 0x0013 to be valid and readable. If the resistance value is >10MΩ, it displays 0xEA60, i.e., 60000; if the values in 0x0012 and 0x0013 are invalid, they display 0xFFFF, i.e., 65535..

• The user can read the insulation resistance values as soon as 0.7s~2.5s after activating the insulation monitoring function. For systems with DC ground capacitance, the IMD can adaptively monitor ground capacitances up to 3uF for each pole (The capacitance of both the positive and negative poles to the ground is each less than 3uF, with a total capacitance of less than 6uF), ensuring the monitoring time does not exceed 2.5 seconds in the presence of ground capacitance.

Table 1. Dc ground resistance monitoring

Content	Validity	Conditions	Readable Values
Insulation resistances	Valid	Conditions to be met simultaneously: 1、IMD activated; 2、0.7s~2.5s after IMD activation; 3、DC voltage ≥100V;	0x0012 for positive ground resistance RfP 0x0013 for negative ground resistance RfN Bit1 of 0x001B as "1"
	Invalid	Conditions to be met simultaneously: 1、IMD deactivated; 2、Within 0.7s~2.5s of IMD activation;; 3、DC voltage ＜100V;	0x0012 as 0xFFFF 0x0013 as 0xFFFF Bit1 of 0x001B as "0"

2.3 LED Indicator

After the IMD is powered on, the ‘PWR’ indicator turns on. When the DC channel 1 is activated, the 'LDC1' is on, and when the DC channel 2 is activated, the 'LDC2' is on.

2.4 RS485 Communication

Users can send and receive data frames via the RS485 communication port. The circuit includes a 510Ω terminal resistor, and specific operational methods can be found in '6 Communication Protocol'. Terminals A and B correspond to the A and B outputs of RS485, respectively. The internal circuit is illustrated in the diagram on the right.

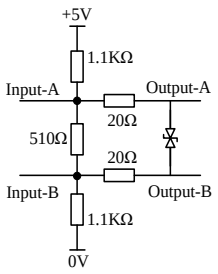

Figure 3: RS485 Internal Circuit

2.5 CONFIG Configuration

Dip switch can be used to configure the communication parity. See Figure 4

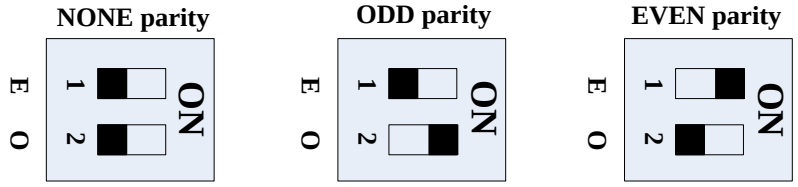

Figure 4 DIP Switch

2.6 Communication parameter initialization

Dip switch can be used to initialize communication parameters. When E and O of CONFIG are dialed to ON at the same time for at least 3 seconds, the baud rate is restored to 9600bps and the communication address is restored to 01H and 02H. The system can be initialized only once after each power on. The total number of times must be less than 1 million. See Figure 5.

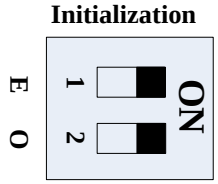

Figure 5. Initial configuration of communication parameters

3 Wiring Diagram

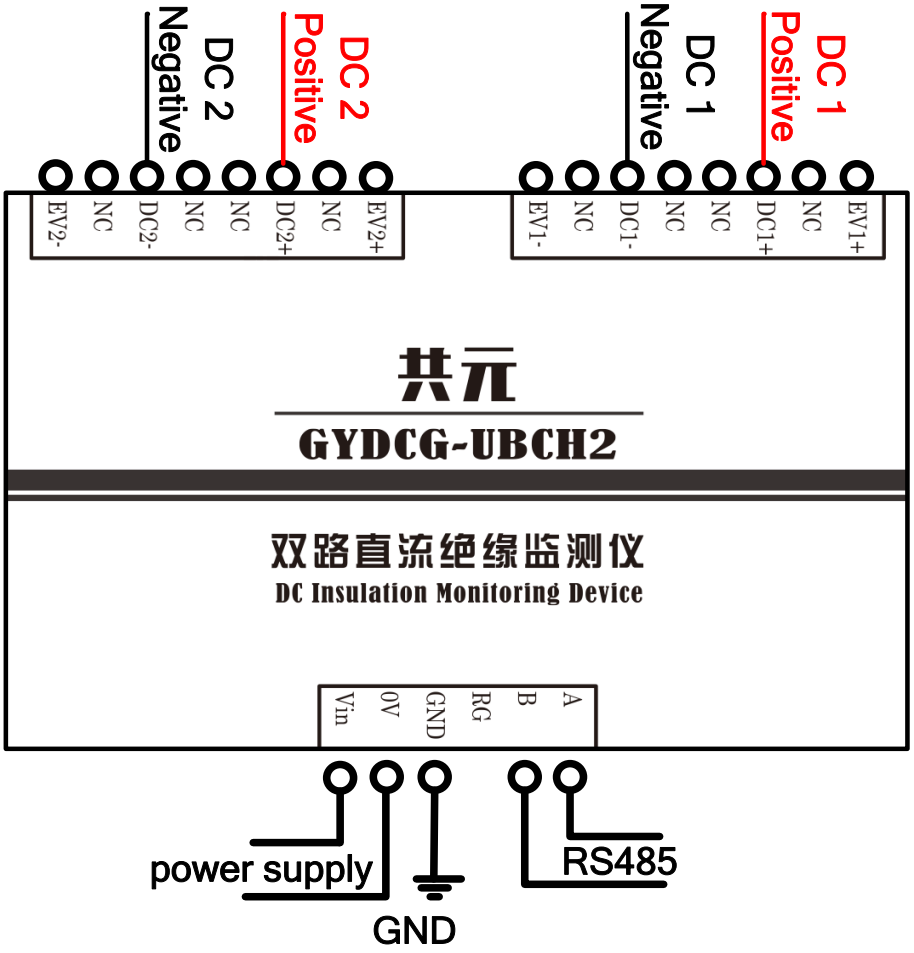

Figure 6. Wiring Diagram

The name of the interface	Connection mode	note
DC1+	DC 1 positive pole	
DC1-	DC 1 negative pole	
DC2+	DC 2 positive pole	
DC2-	DC 2 negative pole	
Vin	Positive pole of power supply	10-30VDC
0V	Negative pole of power supply	
GND	GND	
A	485A	
B	485B	

4 Dimensions and mounting

The IMD can be installed using either DIN rail or Screw mounting. The rail conforms to a standard width of 35mm. The external dimensions are as shown in the diagram below: (unit: mm)

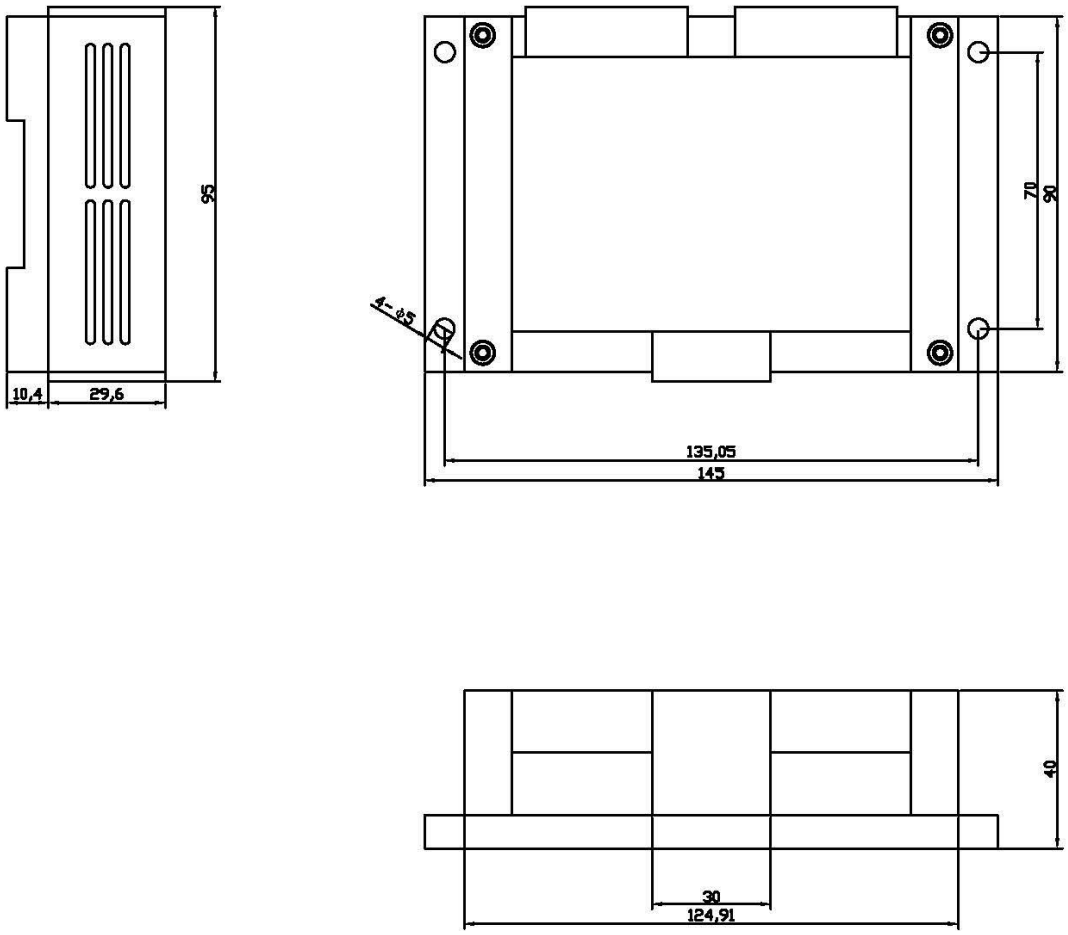

Figure 7. Dimensional Diagram

5 Electrical Parameters

Table 2. Electrical parameters

Parameter	**Conditions**	**Typical values**
DC System Voltage Measurement Range		0~1000VDC
DC System Voltage Measurement Accuracy	0~400Vd.c.	≤2V
	400~1000 Vd.c	≤0.5%
Auxiliary Power Supply Range		10~30Vdc
Auxiliary Power Supply Power Consumption		≤6W
Insulation Resistance Measurement Range	Dc system voltage 100V~1000V	0KΩ~10MΩ

Insulation Monitoring Accuracy①	DC range	C_Y② Range	Resistance range	Accuracy
	100V~1000V	0~0.8μF	≤60kΩ	≤3KΩ
			60 kΩ ~ 1MΩ	≤5%
		0.8μF~3μF	≤60kΩ	≤6KΩ
			60 kΩ ~ 1MΩ	≤20%
Time to Update Insulation Resistance Value after Activation	Time from insulation monitoring activation to the first valid resistance value			0.7s~2s
Insulation Resistance Value Update Time	Time from switching insulation resistance to the module reading the new insulation resistance value			0.5s~3s
The IMD Counts the Number of Times the Ground Switch K is Turned On				20×10^5 times
Storage Temperature				-55℃~90℃
Operating Temperature				-40℃~75℃
Altitude				≤3500m
Operating Humidity				≤90%

①When the positive-to-ground insulation resistance R_{fP} and the negative-to-ground insulation resistance R_{fN} differ significantly, by more than 5 times, the higher resistance value of R_{fP} or R_{fN} may not meet the typical value.

②C_Y refers to the capacitance values of the system bus positive and negative to ground.

● Off-line withstand voltage test <2mA：

Table 3. Withstand pressure test

Voltage Application Point		Level	Test Time
D+/D- TO GND	DC voltage positive and negative to the earth	4200VDC/3000VAC	⩽1min
+/- TO GND	The power supply is positive and negative to the earth	4200VDC/3000VAC	⩽1min
A/B TO GND	The RS485 port connects to the ground	4200VDC/3000VAC	⩽1min
DC+/DC- TO +/-	Dc voltage positive and negative poles to supply positive and negative poles	4200VDC/3000VAC	⩽1min
DC+/DC- TO A/B	The positive and negative DC voltage pairs the RS485 port	4200VDC/3000VAC	⩽1min

Note: The power supply side, RS485, and G should be isolated from each other.

6 Communication Protocol

This IMD provides a Modbus protocol interface, utilizing Modbus 0x03/0x06 commands. with 1 stop bit and 8 data bits. The time interval between each byte in the transmitted frame must not exceed 20ms; otherwise, the frame will be reset.

The module operates in slave mode.

Read Operation: Function code 0x03: Read Holding Registers (can read multiple register addresses at once)

Request Command	Response Command
BYTE[0] Device Address	BYTE[0] Device Address
BYTE[1] Function Code 0x03	BYTE[1] Function Code 0x03
BYTE[2] Register Start Address High Byte	BYTE[2] Register Byte Length
BYTE[3] Register Start Address Low Byte	BYTE[3] Register High Byte
BYTE[4] Register Length High Byte	BYTE[4] Register Low Byte
BYTE[5] Register Length Low Byte	BYTE[5] Register High Byte
BYTE[6] CRC Check Low Bit	… …
BYTE[7] CRC Check High Bit	BYTE[n] CRC Check Low Bit
	BYTE[n+1] CRC Check High Bit

Write Operation: Function code 0x06 - Write Single Register (can set only one register address at a time)

Request Command	Response Command
BYTE[0] Device Address	BYTE[0] Device Address
BYTE[1] Function Code 0x06	BYTE[1] Function Code 0x06
BYTE[2] Register Address High Byte	BYTE[2] Register Byte Length
BYTE[3] Register Address Low Byte	BYTE[3] Register High Byte
BYTE[4] Register Parameter High Byte	BYTE[4] Register Low Byte
BYTE[5] Register Parameter Low Byte	BYTE[5] CRC Check Low Bit
BYTE[6] CRC Check Low Bit	BYTE[6] CRC Check High Bit
BYTE[7] CRC Check High Bit	

■CRC-16 Algorithm (RS485):

Generates a check data based on the CRC polynomial rule, with the result added to the command as a check code.

Polynomial: X^16+X^15+X^2+1

1. Set the CRC register and initialize it to 0Xffff.
2. XOR the first 8-bit character of the data with the lower 8 bits of the 16-bit CRC register, and store the result in the CRC register.
3. Shift the CRC register right by one bit. MSB is replaced with 0, and the LSB is shifted out and checked.
4. If the LSB is 0, repeat step 3; if the LSB is 1, XOR the CRC register with the polynomial code.
5. Repeat steps 3 and 4 until all 8 shifts are completed. This completes the processing of one 8-bit data

Table 4: Register Address Definitions

Code	Add	Content	Send Example (Address 01/02)	Remarks
03 Read Register	0x0010	Bus voltage	01 03 00 10 00 01 85 CF 02 03 00 10 00 01 85 FC	Unit 0.1V, voltage between positive and negative bus
	0x0012	Positive Pole-to-Ground Insulation Resistance	01 03 00 12 00 01 24 0F 02 03 00 12 00 01 24 3C	Unit KΩ, rounded to the nearest integer(0xFFFF indicates invalid value; 0xEA60 indicates resistance >10MΩ)
	0x0013	Negative Pole-to-Ground Insulation Resistance	01 03 00 13 00 01 75 CF 02 03 00 13 00 01 75 FC	
	0x001B	Status Bits	01 03 00 1B 00 01 F4 0D 02 03 00 1B 00 01 F4 3E	See Table 5 below
06 Write Register	0x0102	Activate Insulation Monitoring	01 06 01 02 00 11 E9 FA 02 06 01 02 00 12 A9 C8	Activate 1 insulation monitoring Activate 2 insulation monitoring
		Deactivate Insulation Monitoring	01 06 01 02 00 00 29 F6 02 06 01 02 00 00 29 C5	Deactivate 1 insulation monitoring Deactivate 2 insulation monitoring
	0x0103	Change the address	01 06 01 03 00 02 F9 F7 02 06 01 03 00 03 38 04	01 Change the address to 02 02 Change the address to 03 (Power ON the 2-bit DIP switch to the ON position to change.)
	0x0104	Change the baud rate	01 06 01 04 00 01 08 37 01 06 01 04 00 11 09 FB	Change the baud rate to 9600; Change the baud rate to 19200 (Power ON the DIP switch to the ON position to modify)
0xFF	0x 66	Master Broadcast Read Slave Address	Master sends FF 66 A5 AA 2B Slave replies FF 66 add CRClo CRCHi add is the slave's communication address	Example of slave reply: FF 66 01 02 50 7E The slave addresses are 0x01 and 0x02

Table 5. 0x001B Register Bit Definitions

Register ADD	Bit	Read/ Write	Definition	
0x001B	bit15~bit11	Blank	Blank	
	bit7	R	Bus Voltage Reverse Connection Alarm	0: No reverse connection of DC voltage or reverse voltage <150V
				1：Reverse DC voltage ⩾150V
	bit2	R	Insulation Monitoring Function Status	0: IMD Deactivate, Ground switch K is disconnected

				1: IMD Activate, Ground switch K closed
	bit1	R	Insulation Resistance Monitoring Validity	0: Insulation resistance monitoring incomplete, resistance value invalid
				1: Insulation resistance monitoring valid, resistance value can be read
	bit0	Blank		

Examples:

1、Activate IMD：01 06 01 02 00 11 E9 FA

Return frame：01 06 02 00 11 78 84

2、Deactivate IMD：01 06 01 02 00 00 29 F6

Return frame：01 06 02 00 00 B8 88

3、Read Bus Voltage and Positive/Negative Pole-to-Ground Resistances

(Read 4 registers)：01 03 00 10 00 04 45 CC

Return frame：01 03 08 03 E8 02 58 EA 60 02 58 A9 7F

Reading DC voltage 0x03E8 (100V), reading positive pole insulation resistance 0xEA60 (infinitely large), reading negative pole insulation resistance 0X0258 (600KΩ).

4、Read Status Bits：01 03 00 1B 00 01 F4 0D

Return frame：01 03 02 00 06 38 46

0x0006=0000 0000 0000 0110. Bit7 = 0 indicates no reverse connection of bus voltage, Bit2 = 1 insulation monitoring function is activated, Bit1 = 1 insulation resistance value is valid.

7 Contact Us

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8 Product Iteration and Document Revision

Date	Document Version	Product Version	Status/Changes
2017/12	©2017V1	V1.0	Final Version
2019/04	©2019V1	V2.0	Suitable for DC 250~850VDC, add car side voltage monitoring function (optional)
2019/11	©2019V2	V3.0	Suitable for DC 200~1000VDC
2021/6	©2021V1	V4.0	Optimize insulation resistance monitoring speed and accuracy Power supply range for 10-30V.d.c Module beautification
2022/10	©2022V5	V5.0	Optimize the reliability of insulation resistance detection with low frequency fluctuation of DC voltage Optimize the detection speed and accuracy in the presence of capacitance to earth Optimize RS485 communication reliability Module LED light changed to patch Change the high voltage side terminal of GYDCG-UBCH2 model to 4P Change the address baud rate. Set the DIP switch to 'ON' before powering on the system.
2023/11	©2023V1	V5.1	Optimize resistance measurement accuracy when DC voltage > 950V