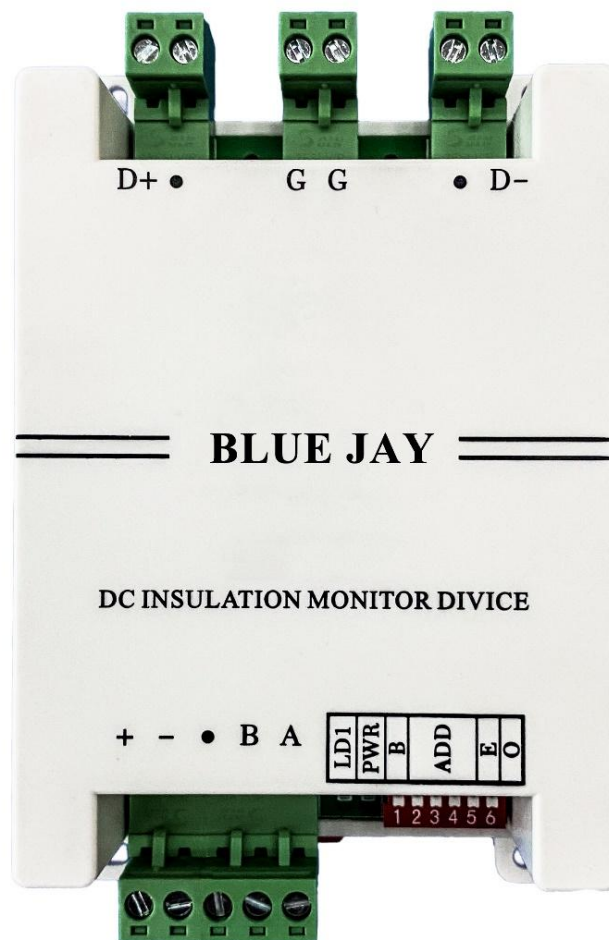


# GYDCG-UBCS1 DC Insulation Monitor

## User Manual



Version: 1.12

Revision: 2024.7

## Read me

**When you use GYDCG-UBCS1, be sure to read this user manual carefully, and be able to fully understand the implications, the correct guidance of operations in accordance with user manual, which will help you make better use of GYDCG-UBCS1, and help to solve the various problems at the scene.**

1. Before turning on the power supply, be sure that the power supply within the provisions of the instrument;
2. When installation, the current input terminal must non-open, voltage input terminals must Non-short circuit;
3. Communication terminal (RS485) is strictly prohibited to impose on high pressure;
4. Be sure the instrument wiring consistent with the internal system settings;
5. When communicating with the PC, instrument communication parameters must be consistent with the PC.



- **Please read this user manual carefully**
- **Please save this document**

## Directory

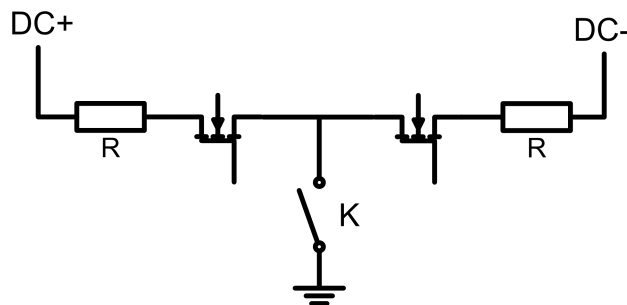
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## 1. - SUMMARIZE

GYDCG-UBCS1 is a DC insulation monitoring device based on MODBUS protocol, including DC to ground insulation impedance monitoring, DC voltage monitoring, DC voltage reverse connection alarm and other safety monitoring functions. It can be used for electric vehicle DC charging system, photovoltaic system, energy storage system, DC grid 100V~1000V. This product has the function of starting and stopping insulation monitoring. After insulation monitoring is started, the insulation resistance of positive and negative poles to ground can be monitored in real time. The monitoring result is not affected by DC voltage fluctuation, and is not affected by the symmetry of insulation resistance of positive and negative poles.

### Insulation monitoring function introduction

The product can send communication frames through RS485 to turn on or off the insulation monitoring function. After the insulation monitoring function is turned on, the high-voltage grounding switch K is closed and the real-time measurement of insulation resistance is realized. After the insulation monitoring function is turned off, the high-voltage grounding switch K is disconnected. The host machine can send read command to read the insulation resistance value of positive and negative poles at any time.



The insulation resistance monitoring can be realized only when the DC voltage is between 100V and 1000V. If the insulation monitoring is off, or the DC voltage is less than 100V, or just opened for a short time, the value of Bit1 of 0x0014 is 0, then the read insulation resistance is 65535, namely 0xFFFF (invalid value). Only when the Bit1 value of 0x0014 is 1, the read insulation resistance is an effective value. The monitoring range of insulation resistance is between 1kΩ and 10MΩ. When the measured value is greater than 10MΩ, the received value is 60000, namely 0xEA60 (infinity value).

The user can turn the insulation monitoring on and off by writing the 0x0102 register, and can determine whether the current insulation monitoring is on or off by reading the Bit2 of the 0x0014 register. The opening and closing of insulation monitoring only determines whether the insulation resistance monitoring is enabled, and does not affect the DC voltage monitoring. After the product is powered, the DC voltage is continuously monitored.

After the insulation monitoring function is enabled, the product continuously monitors the insulation resistance in real time. The user can read the insulation resistance value at the earliest 1s after the function is enabled. For the presence of DC ground capacitance, the module can adaptively monitor the ground capacitance below 3uF (the positive and negative ground capacitance are respectively below 3uF, and the total capacitance is below 6uF). When the ground capacitance exists, the monitoring time is less than 2.5s.

## FEATURES

- Widely power supply range;
- Widely insulation monitoring range (100V~1000VDC);
- insulation monitoring equipment self-test;
- Adaptive capacitance to ground;
- Convenient parameter setting;
- Remote monitoring and management;
- Monitor positive and negative poles;
- Ground insulation resistance;
- Voltage reverse polarity alarm.

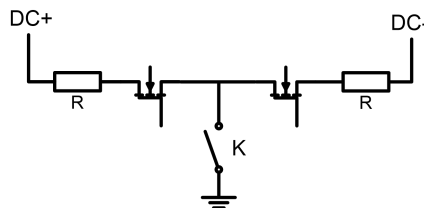
## APPLICATIONS

- Insulation resistance monitoring;
- DC voltage monitoring;
- Guarantee the safety and stability of charging;
- Improvement of the efficiency and charging quality;
- Personnel and equipment security.

## 2. - Function introduction

### 2.1. - Insulation monitoring working principle

The product can send communication frames through RS485 to turn on or off the insulation monitoring function. After the insulation monitoring function is turned on, the high-voltage grounding switch K is closed and the real-time measurement of insulation resistance is realized. After the insulation monitoring function is turned off, the high-voltage grounding switch K is disconnected. The host machine can send read command to read the insulation resistance value of positive and negative poles at any time.



### 2.2. - Insulation monitoring working mode

The insulation resistance monitoring can be realized only when the DC voltage is between 100V and 1000V.

By writing the 0x0100 register, you can select two working modes: Automatic switching bridge mode / Fixed bridge mode.

Automatic switching bridge mode means that the insulation monitor automatically switches the internal positive and negative poles to ground resistance.

As shown in Figure, [RP=3MΩ, RN=600KΩ] and [RP=600KΩ, RN=3MΩ] switch between each other. This mode monitors the insulation resistance to ground, and can read the 0x0012 and 0x0013 registers, that is, the insulation resistance values of the positive and negative poles to ground.

The positive and negative voltages to ground and negative to ground voltage are not monitored, and the 0x0015 and 0x0016 registers are invalid values (0xFFFF).

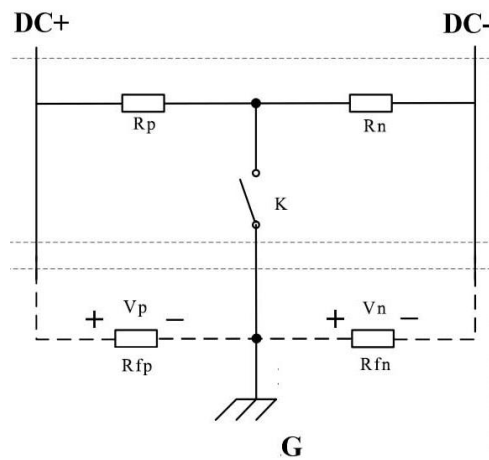
Fixed bridge mode means that the internal positive and negative pole-to-ground resistances (RP and RN) of the insulation monitor are fixed values. This mode monitors the positive and negative pole-to-ground voltages and can read the 0x0015 and 0x0016 registers, which are the positive and negative pole-to-ground voltage values., the insulation resistance of the positive and negative poles to ground is not monitored, and the 0x0012 and 0x0013 registers are invalid values

(0xFFFF). The fixed bridge mode can be realized by writing the 0x0100 register. The fixed bridge resistance is [RP=3MΩ, RN=3MΩ].

**Working mode table**

Write 0x0100	Working mode	Bridge resistor	Reading status
0x0004	Automatically switch to bridge mode	{RP=3MΩ, RN=600KΩ} and {RP=600KΩ, RN=3MΩ} switch between	Positive and negative pole-to-ground voltages VP and VN are both invalid values and display 0xFFFF.  Insulation resistance to ground RfP and RfN are both valid values
0x0000	Fixed bridge mode	RP=3MΩ, RN=3MΩ	Insulation resistance to ground RfP and RfN are both invalid values and display 0xFFFF.  Positive and negative pole-to-ground voltages VP and VN are both valid values.

After the module is powered on, it defaults to automatically switching to bridge mode. After changing the working mode, turning the insulation monitoring on and off will not change the working mode status. Users can check the current working mode by querying bit8~bit10 of the 0x0014 register.

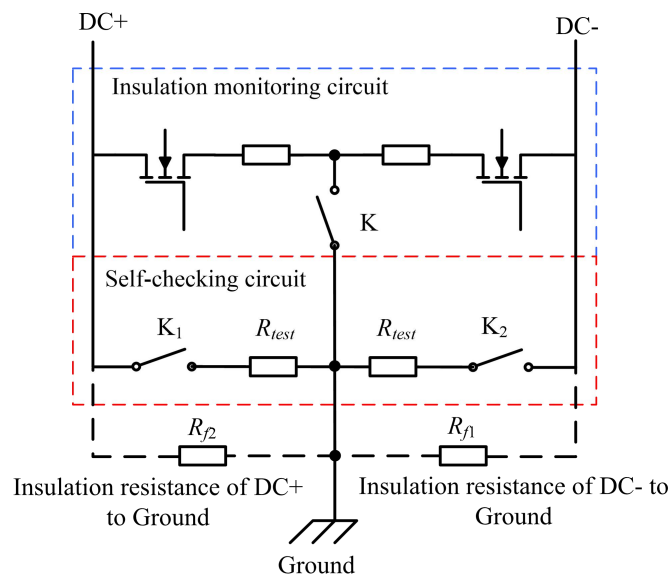


### 2.3. - Insulation monitoring internal self-test function

When the DC voltage is  $\geq 100V$  and the insulation monitoring module is turned off, the module will automatically self-test on its internal circuit (no control required) with a self-test period of 5 seconds.

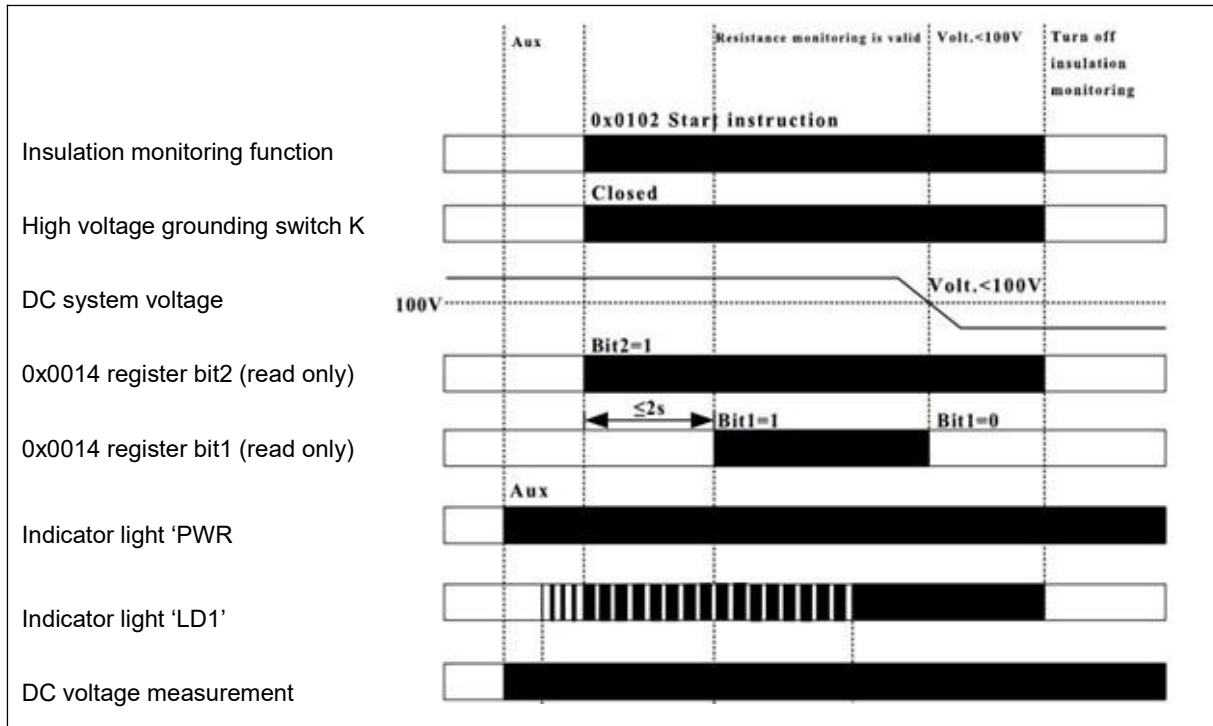
When the sampled value of the monitored bridge voltage matches the bridge resistance value, it means that the self-test is passed.

By reading Bit4 of the 0x0014 register can judge the self-test whether is passed or not. passed self-test is "1"; not passed is "0". If the self-test results are not updated, the last result will remain unchanged.





## 2.4. - Insulation resistance monitoring function



### Insulation monitoring function control sequence

- After the product is powered on, the 'PWR' light turns on and the DC voltage is continuously monitored.
- Insulation monitoring can be turned on and off by writing to the 0x0102 register.
- You can determine whether the current insulation monitoring is on or off by reading bit2 of the 0x0014 register.
- After sending the opening command to the module, the grounding switch K is closed and the 'LD1' light is on; after sending the closing command to the module, the grounding switch K is open and the 'LD1' light is on.
- The conditions for the effective DC-to-ground insulation resistance in Table 2 below must be met. The insulation resistance values of 0x0012 and 0x0013 are valid values. The resistance values of 0x0012 and 0x0013 can be read; if the resistance value is  $> 10M\Omega$ , 0xEA60 is displayed, which is 60000; if The values of 0x0012 and 0x0013 are invalid values, that is, 0xFFFF is displayed, which is 65535.
- Users can read the insulation resistance value as soon as 0.7s~2s after turning on the insulation monitoring function. For the presence of DC capacitance to ground, the module can adaptively monitor ground capacitance below 3uF (the positive and negative capacitances to

ground are below 3uF respectively, and the total capacitance is below 6uF). When there is capacitance to ground, the monitoring time does not exceed 2s.

### DC to ground resistance/voltage monitoring

Measured value	Valid/invalid	Conition	Readable
DC to ground insulation resistance value	Valid	<b>Need to meet both:</b> 1. Send the instruction to turn on insulation monitoring to 0x0102; 2. 0.7s~2s after turning on the module; 3. DC voltage $\geq 100V$ ; 4. Set to automatically switch to bridge mode;	0x0012 is the positive to ground resistance RfP 0x0013 is the positive to ground resistance RfN Bit1 of 0x0014 is "1"
	Invalid	<b>Meet any of the following:</b> 1. Send the turn off insulation monitoring command to 0x0102; 2. Turn on the module within 0.7s~2s; 3. DC voltage $< 100V$ ; 4. Set to fixed bridge mode;	0x0012 is 0xFFFF 0x0013 is 0xFFFF Bit1 of 0x0014 is "0"
DC to ground voltage value	Valid	<b>Need to meet both:</b> 1. Turn on fixed bridge mode to 0x0100; 2. Send the instruction to turn on insulation monitoring to 0x0102;	0x0015 is the positive to ground voltage VP 0x0016 is the negative ground voltage VN Bit8~bit10 of 0x0014 is "000"
	Invalid	<b>Meet any of the following:</b> 1. Turn on automatic switching bridge mode to 0x0100; 2. Send the shutdown insulation monitoring command to 0x0102	0x0015 is 0xFFFF 0x0016 is 0xFFFF Bit8~bit10 of 0x0014 is "100"

## 2.5. - LED indicator

After the module is powered on, the PWR indicator is on.



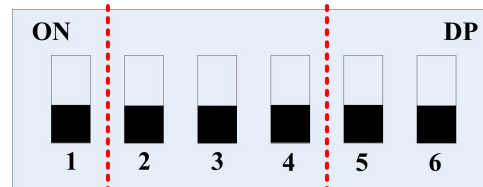
'LD1' light logic	
Insulation monitoring function is ON, and the self-test function is OFF	'LD1 lights Normally ON
Insulation monitoring function is ON, and the self-test function is ON	'LD1' is ON for 1.5 seconds and OFF for 0.5 seconds
Insulation monitoring function is OFF, self-test function is ON	'LD1' is ON for 0.5 seconds and OFF for 1.5 seconds
Insulation monitoring function is OFF, and the self-test function is OFF	'LD1 lights Normally OFF

## 2.6. - Communication parameter configuration bit

Baud rate	Address	Parity check
1: 19200bps	000: 00H	00: NONE
0: 9600bps	001: 01H	01: ODD
	010: 02H	10: EVEN
	011: 03H	
	100: 04H	
	101: 05H	
	110: 06H	
	111: 07H	

### DIP switches used to configure

**Bit 1:** set the baud rate;  
**Bits 2-4:** set communication address;  
**Bits 5-6:** set parity check;  
**"ON":** direction means set to "1".



### 3. - TECHNICAL PARAMETERS

#### Basic parameters

Parameter	Value		
Power supply	10-30VDC, Power 3w		
DC voltage range	100V~1000V		
DC voltage measurement accuracy	≤2V+0.3%		
Insulation resistance measurement range	1KΩ~10MΩ (DC System voltage:100V~1000V)		
	<b>C<sub>Y</sub> range      Resistance range      Accuracy</b>		
Insulation monitoring accuracy (When :DC voltage:100V-1000V)	0~0.8μF	≤60kΩ 60kΩ<R≤1MΩ	≤3kΩ ≤5%
	0.8μF ~3μF	≤60kΩ 60kΩ<R≤1MΩ	≤6kΩ ≤20%
Insulation resistance value update time after turning on	After insulation monitoring is turned on, the time until the effective resistance value can be read for the first time	0.7s~2s	
Insulation resistance value update time	Switch the insulation resistance until the module can read the switched insulation resistance value.	0.5s~3s	
Insulation monitoring function switching times		50*10 <sup>5</sup> times	
Off-line pressure test		<2mA	
Standard		IEC 61851-23 (2014-03):2014-11	
Humidity		85%	
Storage temperature		- 55°C ~90°C	
Operating temperature		- 40°C ~75°C	

Notes:

1.When facing the ground insulation resistance  $R_{ISO+}$  and negative insulation resistance to ground  $R_{ISO-}$ , The difference is too large, Multiplier of difference>5 times,  $R_{ISO+}$  and  $R_{ISO-}$  Large resistors may not be typical values.

2.C<sub>Y</sub> Refers to the positive and negative Y capacitance values of the system bus to ground.

**Other parameters**

<b>Pressure point</b>	<b>Maximum voltage rating</b>	<b>Time</b>
DC+/DC- To GND	4200VDC/3000VAC	≤1min
Power supply +/- To GND	3500VDC/2500VAC	≤1min
RS485 A/B To GND	3500VDC/2500VAC	≤1min
DC+/DC- To Power supply +/-	4200VDC/3000VAC	≤1min
DC+/DC- TO A/B	4200VDC/3000VAC	≤1min

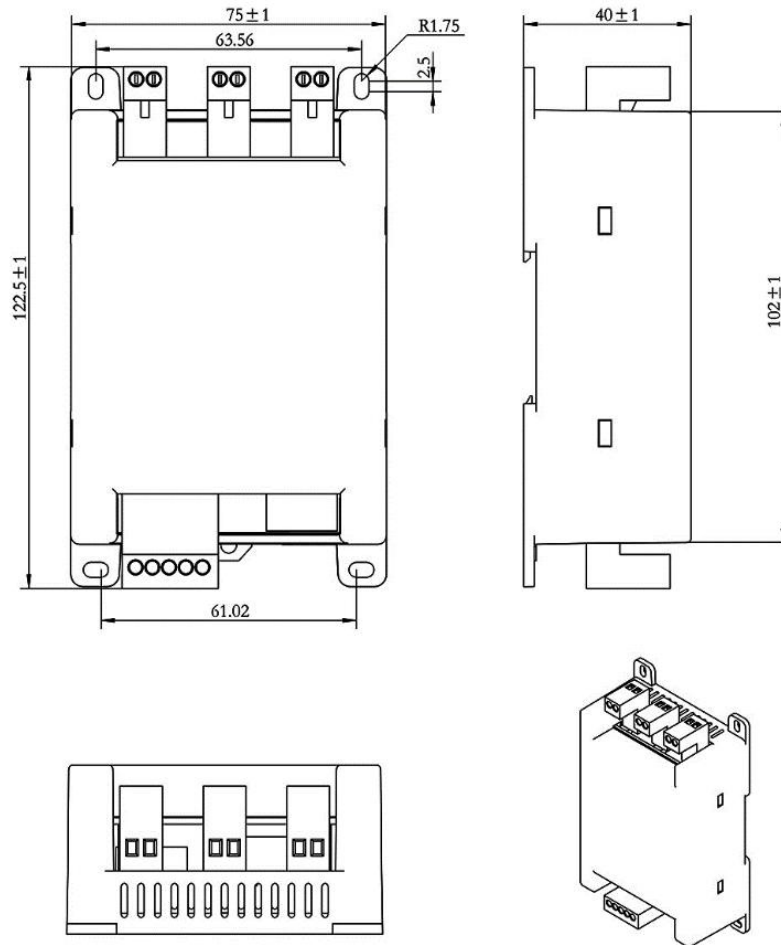
**Note:**

The power supply side (+/-), RS485(A/B), and Ground(G) should be isolated from each other

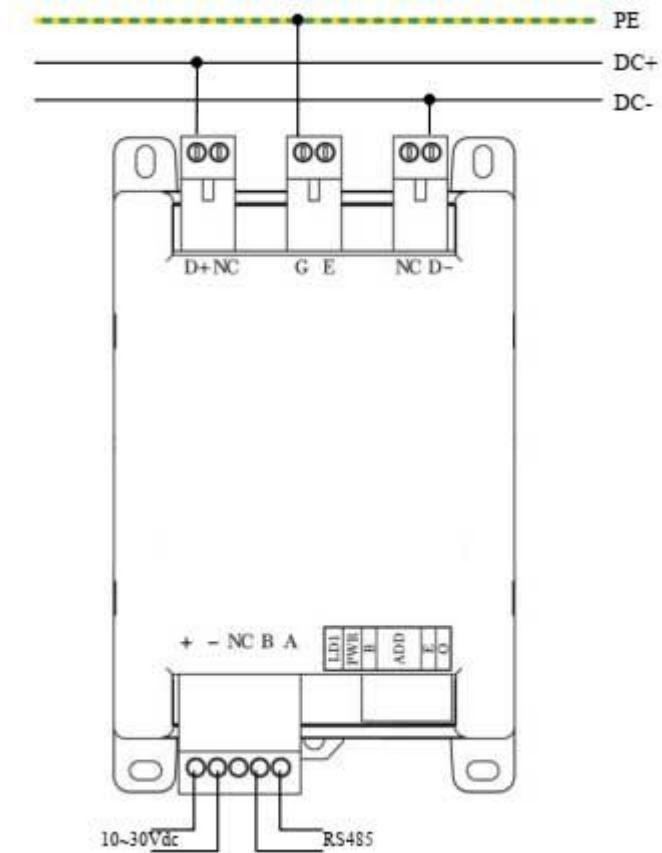
## 4. - INSTALLATION AND STAR UP

### 4.1. - Mounting

GYDCG-UBCS1 module can be installed by rail or screw. Guide rails use standard width of 35mm. Overall dimensions are shown in Figure 1 below: (Unit: mm)



## 4.2. - Terminal definition



Terminal	Connection mode	Definition
D+	Positive pole of DC	DC interface
D-	Negative pole of DC	
A	RS485-A	Communication
B	RS485-B	
+	Positive pole of power supply	10-30VDC
-	Negative pole of power supply	
G	System ground wire	
E	Earth or chassis	
NC	Backup	

## 5. - COMMUNICATION INTERFACE

### 5.1. - Connection for RS485

Users can send and receive data frames through the RS485 communication port. The circuit is equipped with 510Ω terminal resistance. For details, see 6 Communication Protocol. Terminals A and B correspond to RS485 outputs A and B respectively.

### 5.2. - Communication Protocol

GYDCG-UBCS1 use standard Modbus RTU protocol, using Modbus RTU **0x03/0x06** command; Baud rate, communication address, parity check mode, can be set by DIP switch, stop bit 1, data bit 8. The interval between each byte in the sent frame must not exceed 20ms; otherwise, the frame will be cleared. This module works in slave mode.

#### Modbus RTU Frame Format:

<b>Address code</b>	<b>1 BYTE</b>	Slave device address <b>1-247</b>
<b>Function code</b>	<b>1 BYTE</b>	Indicates the function codes like read coils / inputs
<b>Data code</b>	<b>4 BYTE</b>	Starting address, high byte Starting address, low byte Length of registers, high byte Length of registers, low byte
<b>Error Check code</b>	<b>2 BYTE</b>	Cyclical redundancy check ( <b>CRC</b> )

#### MODBUS FUNCTIONS:

Code	Meaning	Description
<b>FUNCTION 03</b>	Read hold register	This function permits to read all the electrical parameters
<b>FUNCTION 06</b>	Write single register	This function permits to write a value into a single holding register.



### 5.3. - Register Map

Function	Register	Data	Description
0x03	0x0010	DC bus voltage	Unit 0.1V, 16-bits <b>01 03 00 10 00 01 85 CF</b>
	0x0012	Insulation resistance of DC+ to Ground	Unit KΩ, take an integer <b>01 03 00 12 00 01 24 0F</b> (0xFFFF: invalid value; 0xEA60: resistance value greater than 10MΩ)
	0x0013	Insulation resistance of DC- to Ground	Unit KΩ, take an integer <b>01 03 00 13 00 01 75 CF</b> (0xFFFF: invalid value; 0xEA60: resistance value greater than 10MΩ)
	0x0014	Status bit	Refer to: <a href="#">chapter 5.3.1</a> <b>01 03 00 14 00 01 C4 0E</b>
	0x0015	Positive pole to ground voltage value	Unit 0.1V, take an integer <b>01 03 00 15 00 01 95 CE</b>
	0x0016	Negative pole to ground voltage value	Unit 0.1V, take an integer <b>01 03 00 16 00 01 65 CE</b>
	0x001A	Read version number	0x5202 <b>01 03 00 1A 00 01 A5 CD</b>
0x06	0x0102	Insulation monitoring control	Turn on insulation monitoring function <b>01 06 01 02 00 11 E9 FA</b>
			Turn off insulation monitoring function <b>01 06 01 02 00 00 29 F6</b>
	0x0100	Automatically switch to bridge mode	Positive bridge resistance and negative bridge resistance switch each other <b>01 06 01 00 00 04 89 F5</b>
Fixed bridge mode		Positive bridge resistance is 3MΩ, negative bridge resistance is 3MΩ <b>01 06 01 00 00 00 88 36</b>	
0xFF	0x66	Host reads the slave address	Example: Host inquiry: <b>FF 66 A5 AA 2B</b> Slave response: <b>FF 66 01 AB 90</b> The slave address is <b>0x01</b>

**5.3.1.- 0x0014 Register bit definition**

Bit	Definition	
bit15~bit11	Null	Null
bit10:bit9: bit 8	Present working mode	000: Fixed bridge mode
		100: Automatically switch to bridge mode (default)
bit7	Bus voltage reverse connection alarm	0: There is no reverse connection of DC voltage or the reverse connection voltage is less than 100V
		1: DC reverse voltage is greater than 100V
bit4	Self-test result bit	1: Self-test passed
		0: Self-test not passed or invalid
bit2	Insulation monitoring function turned on or off	0: Insulation monitoring function turned off and the grounding switch K is disconnected.
		1: Insulation monitoring function turned on and the grounding switch K is closed.
bit1	Insulation resistance monitoring valid or invalid	0: Insulation resistance monitoring has not been completed, and the resistance value is an invalid value.
		1: Insulation resistance monitoring is valid and the resistance value can be read
bit0	Null	Null

## 5.4. - Command samples

### 5.4.1 - Read Command (Function x 03)

**Sample 1** Read the DC bus voltage and positive and negative insulation resistance to the ground(read 4 registers)

**Host inquiry:**

01 03 00 10 00 04 45 CC

**Slave response:**

01 03 08 07 D0 02 58 EA 60 02 58 11 4F

**Means that:**

Read the DC voltage 0X07D0 (200V),  
The positive insulation resistance 0XEA60 (infinite),  
The negative insulation resistance 0X0258 (600KΩ).

**Notes:**

Only when the DC voltage is between 100V~1000V, Insulation resistance monitoring can be realized. If DC voltage is low than 100V, or it is turned on within a short time, the insulation resistance read is 0xFFFF (means invalid number).

If the read insulation resistance value is a valid number, the insulation resistance value monitoring range is between 1KΩ~10MΩ. When the measured value is greater than 10MΩ, the value received by the communication is 0xEA60 (means infinity).

**Sample 2** Read IO status

**Host inquiry:**

01 03 00 14 00 01 C4 0E

**Slave response:**

01 03 02 00 94 B9 EB

**Means that:** 0x0094=0000 0000 1001 0100,

Bit10: Bit9: Bit8=000 represents fixed bridge mode, positive bridge resistance is 3MΩ, negative bridge resistance is 3MΩ,  
Bit7=1 represents bus voltage reverse connection,  
Bit2=1 insulation monitoring function is ON,  
Bit1=0 insulation resistance value is invalid,  
Bit4=1 self-test passed and set to "1".

#### 5.4.2 -Write Command (Function x 06)

**Sample 1** Turn on insulation monitoring:

**Host inquiry:**

01 06 01 02 00 11 E9 FA

**Slave response:**

01 06 01 02 00 11 E9 FA

**Sample 2** Turn off insulation monitoring:

**Host inquiry:**

01 06 01 02 00 00 29 F6

**Slave response:**

01 06 01 02 00 00 29 F6

## 6. - SAFETY CONSIDERATIONS



All installation specification described at the previous chapters named:  
**INSTALLATION AND STARTUP, INSTALLATION MODES and SPECIFICATIONS.**

Please note that with the instrument powered on, the terminals could be dangerous to touching and cover opening actions or elements removal may allow accessing dangerous parts. This instrument is factory-shipped at proper operation condition.

- ◆ The device must have a professional installation and maintenance
- ◆ Any operation of the device, you must cut off the input signal and power;

## 7. - MAINTENANCE

The GYDCG-UBCS1 does not require any special maintenance. No adjustment, maintenance or repairing action should be done when the instrument is open and powered on, should those actions are essential, high-qualified operators must perform them.

Before any adjustment, replacement, maintenance or repairing operation is carried out, the instrument must be disconnected from any power supply source.

When any protection failure is suspected to exist, the instrument must be immediately put out of service. The instrument's design allows a quick replacement in case of any failure.

For any inquiry about the instrument performance or any failure,  
contact to Blue Jay's technical service.

*Blue Jay - After-sales service*

E-mail: [tech@cqbluejay.com](mailto:tech@cqbluejay.com)