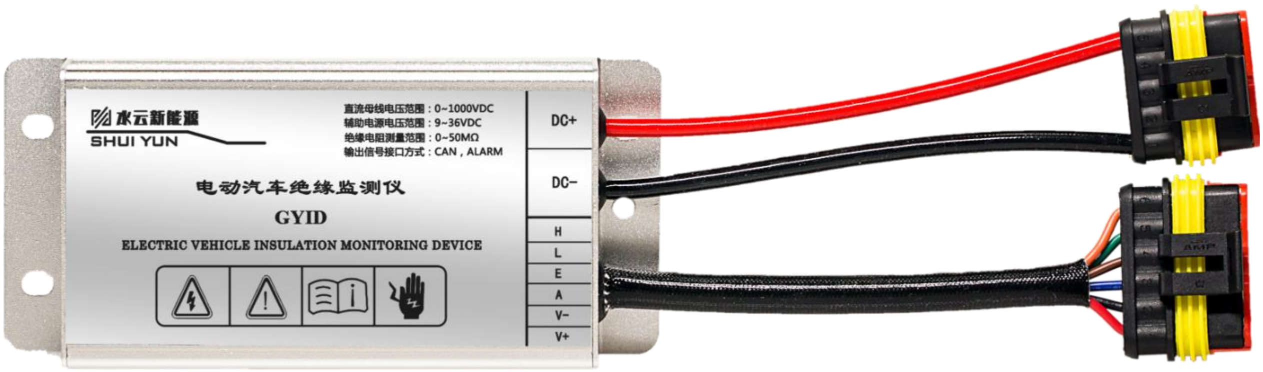
Specification of GYID Series

Electric Vehicle Insulation Monitoring Device

(EV-IMD)

GYID-10D36CAx-x

GYID-10M36CAx-x



·Edition

Products	Remarks
3rd Generation Products	✓ Products are embedded with **CAN Bootloader** function, ✓ Equivalent internal resistance between high voltage DC+, DC- : **10.2 MΩ**, ✓ Injection pulse signal : **±15 V**
2nd Generation Products	Equivalent internal resistance between high voltage DC+, DC- : 10.2 MΩ, Injection pulse signal : ±15 V
1st Generation Products	The equivalent internal resistance between DC+, DC- : 5.1 MΩ. Injection Pulse Signal : ±40 V

·Model description

GYID-□□□□□□-□

- K — Aluminum alloy package
- L — Board package
- N — Default start insulation resistance monitoring function
- J — Default stop insulation resistance monitoring function
- A — ALARM output function
- C — CAN communication
- 36 — 9 ~ 36 Vd.c. power supply
- D — Output positive and negative insulation resistance values to ground
- M — Output positive and negative ground insulation resistance parallel value
- 10 — Up to 1000 Vd.c.
- GYID — Product identification code

Notes (must be read when selecting model)

Note 1: Differences between GYID-10D36CAx-x and GYID-10M36CAx-x

The output of GYID-10D36CAx-x type is defined as $R_{ISO}+$ and $R_{ISO}-$ respectively. GYID-10M36CAx-x output "parallel value of positive and negative pole-to-ground insulation resistance", defined here as R_{ISO}.

GYID-10D36CAx-x When Battery Voltage V_{DC} (Voltage Value Between DC+, DC-of Insulation Monitor Terminal)：

① When the battery voltage $V_{DC}>$ 20 Vd.c., the output positive and negative poles of the insulation monitor are $R_{ISO}+$ and $R_{ISO}-$, respectively.

② When the battery voltage V_{DC} is greater than 0 Vd.c. and V_{DC} is less than 20 Vd.c., the output positive and negative poles of the insulation monitor are equal to the ground insulation resistance respectively, and both are equal to the parallel value of the two. Namely $R_{ISO}+ = R_{ISO}- = R_{ISO}$。

GYID-10M36CAx-x type insulation monitor normally outputs R_{ISO} of positive and negative pole-to-ground insulation resistance when the battery voltage V_{DC} ranges from 0 to 1 000 Vd.c.

Note 2: Projects that can be modified or adjusted according to user needs

(1) CAN Communication Baud Rate: Default 250 kbps。

(2) Send ID: default 0x1819A1A4 (Extended frame)。

(3) CAN communication transmission cycle: Default 1s (Adjustable, but not recommended).

(4)"Level-1 Insulation Alarm"Value: Default 500 Ω/V[①] （Uint：Ω/V or kΩ，adjustable）。

(5)"Level-2 Insulation Alarm"Value: Default 1000 Ω/V （ Uint：Ω/V or kΩ，adjustable）。

(6)"Battery Overvoltage Alarm" Value: Default ∞ V (Adjustable) 。

① According to GB/T 18384.1 "Safety Requirements for Electric Vehicles - Part 1: On-board Rechargeable Energy Storage System (REESS)", the insulation resistance of battery packs containing AC circuits should not be less than 500Ω/V.

1. Brief

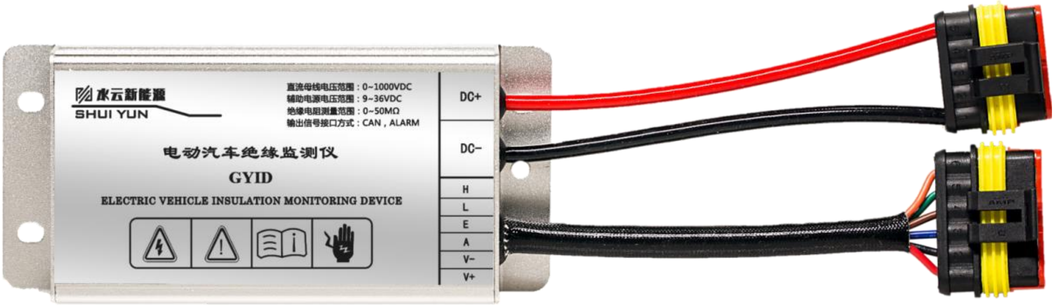


Figure 1　Product appearance

1.1 Functions and characteristics of products

- Monitoring insulation status of all internal Class B voltage (high voltage side) components in 0-1 000 Vd.c. DC Floating Ground System (IT system)[①]
- Continuous Measurement of Insulation Resistance of 0~50 MΩ
- The longest response time for measuring insulation resistance T ≤ 30 s when the system Y capacitor CY is large
- Automatically adapted to existing system Y-capacitor CY (CY ≤ 2uF)
- Measuring DC Voltage of Battery Pack
- Communication with CAN Bus Interface
- High Internal Resistance and Y Capacitor Adaptive
- Class B voltage (high voltage side) isolated from Class A voltage (low voltage side) withstands a voltage of 3 500 Vd.c. / 2 500 Va.c. (rms)
- This product is applicable to：
  - ✓ There are symmetrical or asymmetrical insulation faults in positive and negative poles of HVDC
  - ✓ Insulation failure in battery pack

1.2 Product description

GYID series insulation monitor is used to monitor the insulation resistance between high voltage components (0-1000 Vd.c.) and automobile chassis (earth) of power battery pack (pure electric or hybrid) power supply system in real time. The measuring technology used in this product can monitor the insulation faults of DC side, AC side and motor side; can simultaneously monitor the asymmetric insulation faults of positive and negative poles and symmetrical insulation faults; can monitor the internal insulation faults of battery packs and locate the fault points; can monitor under the condition of short circuit of high voltage DC side; in the case of high intensity interference, such as acceleration, deceleration, energy recovery, the insulation resistance can be reliably monitored.

Fault information (insulation fault, overvoltage, self-error, etc.) is output through CAN bus interface. The communication protocol is shown on page 7 —— "3. Communication protocol".

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① According to GB/T 18384.3 "Electric Vehicle Safety Requirements - Part 3: Personnel Electric Shock Protection", the voltage of Class B is 60 Vd.c. < V ≤ 1 500 Vd.c. or 30 Va.c. (rms) < V ≤ 1 000 Va.c. (rms) and Class A is 0 Vd.c. < V ≤60 Vd.c. or 0 Va.c. (rms) < V ≤30 Va rms. (s).

1.3 Basic principle

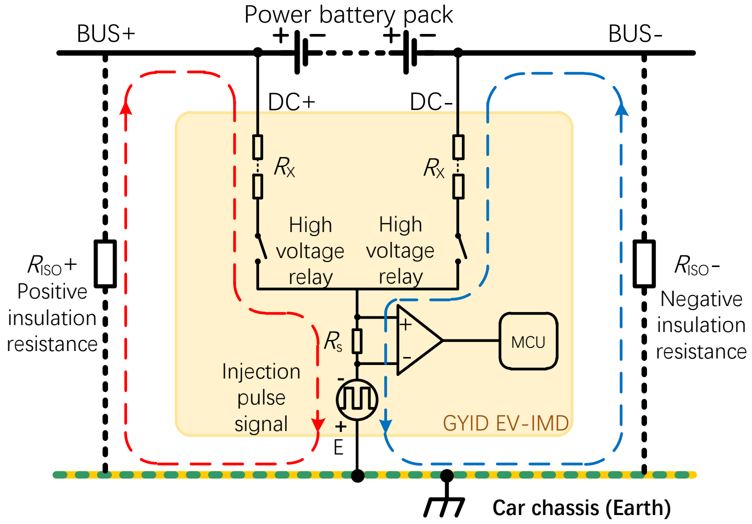
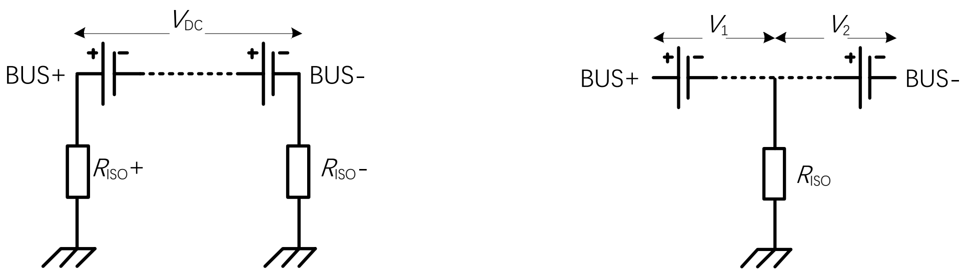


Figure 2 Principle of insulation resistance measurement

GYID series insulation monitor produces a symmetrical low-frequency AC square wave pulse signal with an amplitude of ±15 V. Pulse signal is injected between DC bus of electric vehicle battery system and vehicle chassis (earth). Pulse signal is composed of current limiting resistor series R_X , sampling resistor R_S , $R_{ISO}+$, negative resistor $R_{ISO}-$. By using the real-time sampling signal on R_S and MCU algorithm, the insulation resistance values $R_{ISO}+$, $R_{ISO}-$, R_{ISO} of the system to be measured on the chassis (earth) of the automobile can be obtained.

There are two kinds of output modes of insulation resistance: one is output positive pole and negative pole respectively for ground insulation resistance value $R_{ISO}+$ and $R_{ISO}-$ the other is output positive and negative pole to ground insulation resistance parallel value R_{ISO}. The output mode of insulation resistance is shown in Figs. 3 (a) and 3 (b).



(a) Positive and Negative (b)Parallel

Figure 3 Insulation resistance output mode

$R_{ISO}+$ and $R_{ISO}-$, respectively, refer to the value of insulation resistance of positive BUS+ to automobile chassis (earth) and negative BUS- to automobile chassis (earth), which is convenient to distinguish between positive and negative insulation faults.

The parallel value R_{ISO} of positive and negative pole-to-ground insulation resistance refers to the parallel value of all insulation resistance. Its fault grounding position is expressed by voltage V_1 and V_2:V_1 is the voltage of positive pole BUS+ to grounding point, V_2 is the voltage of grounding point to negative pole BUS-of battery, V_1+V_2 is the DC voltage value of battery. By reading V_1 data, users can easily find and determine the location of insulation failure points within the battery pack.

2. Product parameters

2.1 Connector definition

(a) Class B Voltage (High Voltage Side) Connector

(b) Class A Voltage (Low Voltage Side) Connector

Figure 4 Connector definition

Connector pin definition

Voltage grade	Number/Color	Name	Wiring instructions
Class B voltage (High voltage side)	V red	DC+	Connect to Battery Positive BUS+
	I black	DC-	Connect to Battery Negative BUS-
Class A voltage (low voltage side)	⑥ orange	H	Connect to CAN Bus H Port
	⑤ green	L	Connect to CAN Bus L Port
	④ brown	E	Connect the chassis of the car (earth)
	③ blue	A	Alarm output terminal (suspended if not required)
	② black	V-	Connect to auxiliary power supply negative
	① red	V+	Connect to auxiliary power supply positive

Connector and Fittings Model (AMP SUPERSEAL 1.5 Series)

Category	5-pin connector (Class B voltage)		6-pin connector (Class A voltage)	
Connector type	EV-IMD: Hole	Needle	EV-IMD: Hole	Needle
Connector model	AMP282089-1	AMP282107-1	AMP282090-1	AMP282108-1
Internal metal terminal	AMP282110-1	AMP282109-1	AMP282110-1	AMP282109-1
Waterproof plugging	AMP281934-2	AMP281934-2	AMP281934-2	AMP281934-2
Blind blocking	AMP282081-1	AMP282081-1	×	×

2.2 Technical specifications

Parameter	Condition		Typical value
Insulation resistance output mode	GYID-10D36CAx-x	Bus voltage 20～1000 Vd.c.	output R_{ISO}+ and R_{ISO}-
		Bus voltage 0 ~ 20 Vd.c.	compulsory $R_{ISO}+ = R_{ISO}- = R_{ISO}$
	GYID-10M36CAx-x	Bus voltage 0 ~ 1 000 Vd.c.	output R_{ISO}
Bus voltage measurement range			0～1 000 Vd.c.
Bus voltage measurement accuracy			1 %
Power supply range of auxiliary power supply			9～36 Vd.c.
Input power			≤ 2W
Insulation resistance measurement range			0 ~ 50 MΩ
Insulation resistance measurement accuracy ①	0～100 kΩ, C_Y≤2μF, Bus voltage stability		±12 kΩ
	100 kΩ~1 MΩ, C_Y≤2μF, Bus voltage stability		±10 %
	1 MΩ~50 MΩ, C_Y =0μF, Bus voltage stability		±10 %
Insulation resistance measurement response time	R_{ISO}≥500 kΩ, C_Y =0μF, Bus voltage stability		4 s
	R_{ISO}<500 kΩ, C_Y =0μF, Bus voltage stability		5 s
	R_{ISO}=1 MΩ, C_Y =1μF, Bus voltage stability		8 s
	R_{ISO}=1 MΩ, C_Y =2μF, Bus voltage stability		12 s
DC equivalent internal resistance	Power on		10.2 MΩ
Amplitude of injection pulse signal			±15 V
Injection pulse signal frequency	It is related to the size of Y capacitor C_Y and insulation resistance R_{ISO}.		self-adaption
High to low voltage withstanding voltage			3 500 Vd.c. 2 500 Va.c.(rms)
CAN to high voltage withstanding voltage			3 500 Vd.c. 2 500 Va.c.(rms)
Working temperature			-40 ℃ ～+ 85 ℃
Storage temperature			-40 ℃ ～+ 85 ℃
Protection level			IP55

① C_Y is the system-to-ground Y capacitor.

2.3 Application introduction

2.3.1 Typical application

GYID series insulation monitor can be used in electric vehicle and hybrid electric vehicle, backup battery system, power grid energy storage and other occasions. Typical applications of GYID series insulation monitor for electric vehicles are shown in Fig. 5.

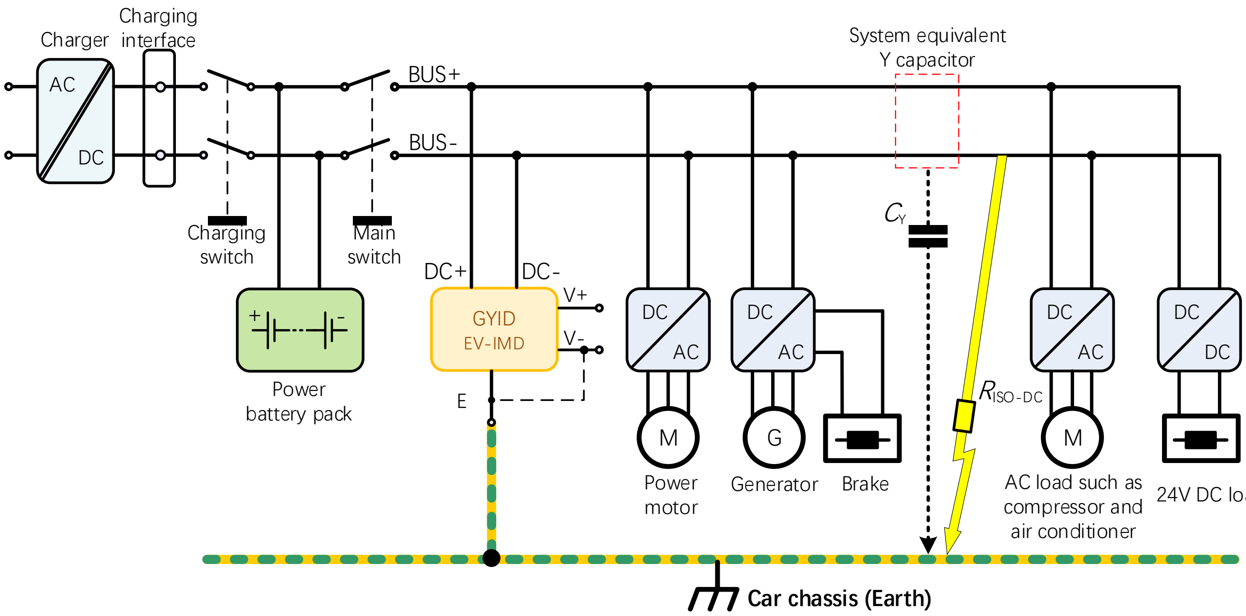


Figure 5 Typical applications of electric vehicles

2.3.2 CAN communication circuit

The CAN communication circuit of GYID series insulation monitor is connected with a terminal resistance of 120Ω, as shown in Fig.6 .

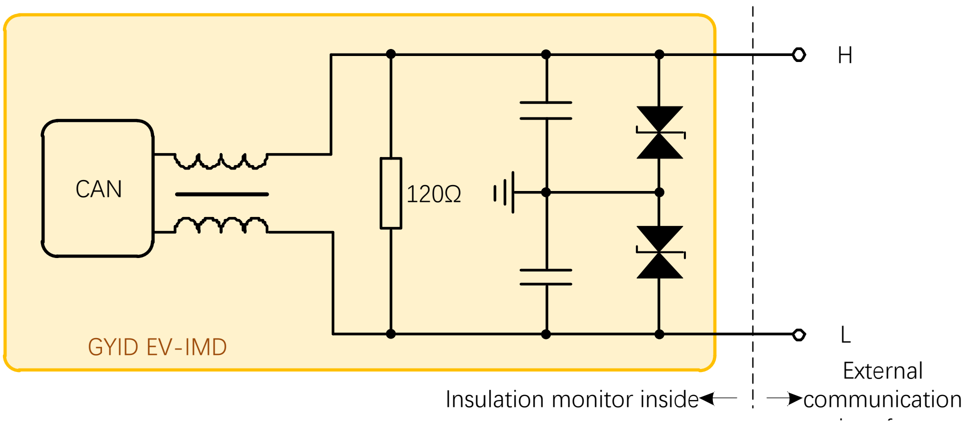


Figure 6 CAN communication circuit

2.3.3 Wiring indication for actual vehicle application

The connection mode of GYID series insulation monitor in actual vehicle application is shown in Fig. 7.

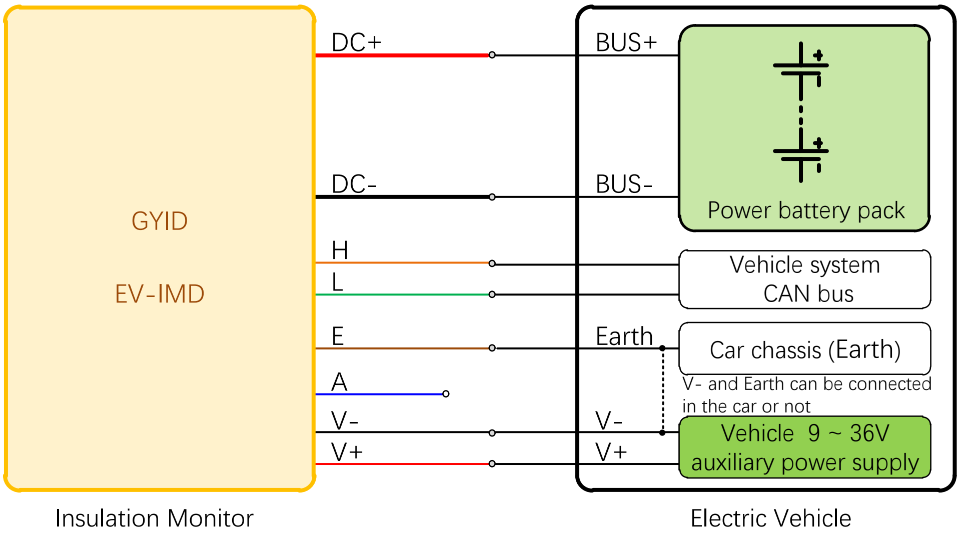


Figure 7 The actual on-board application wiring diagram

2.3.4 ALARM circuit

The ALARM function of GYID series insulation monitor consists of optocoupler output. The negative end of the output of the optocoupler device in the insulation monitor has been connected with the negative end of the auxiliary power supply in the insulation monitor. Therefore, when the ALARM function is selected, users need to connect a resistor R and alarm indicator LED in series between the "A" port and the "V+" port to form a circuit, and ensure that the maximum current of the circuit does not exceed 100 mA. The connection mode is shown in Fig.8 .

After the user completes the wiring according to Fig.8 , when the detected insulation resistance value satisfies the alarm point which is less than or equal to the set of "Level-1 Insulation Alarm", the optocoupler circuit is connected. At this time, the "A" port is connected to the negative "V-" of the auxiliary power supply through the optocoupler inside the insulation monitor. Cooperate with external circuit to achieve the purpose of alarming through LED.

Note: If the ALARM function is not required, the "A" port on the insulation monitor can be suspended.

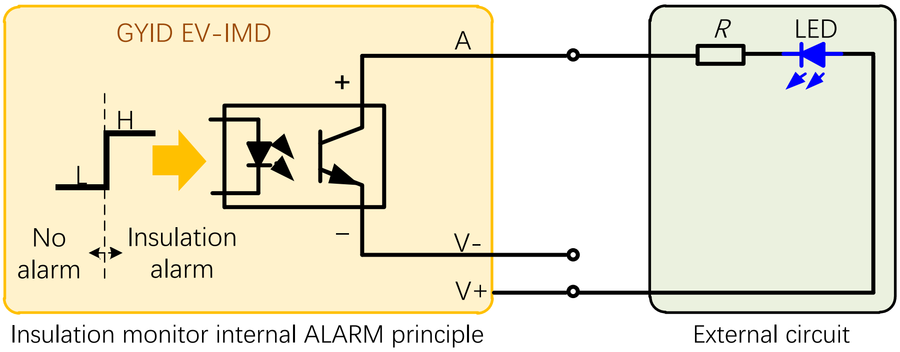


Figure 8 ALARM circuit connection

3. Communication protocol

3.1 Communication parameters

Project	Parameter	Remarks
Receiving ID	0x1819A1A5 (Extended frame)	(1) Turn on insulation resistance monitoring function command: 00 01 02 03 04 05 06 07 (2) Turn off insulation resistance monitoring function command: 07 06 05 04 03 02 01 00 **Default: 0x1819A1A5，adjustable**
Receiving cycle	10 ms	
Send ID	0x1819A1A4(Extended frame)	**Default: 0x1819A1A4，adjustable**
Sending cycle	1 s	**Default: 1s，adjustable**
Baud rate	250 kbps	**Default: 250 kbps，adjustable**

3.2 Data definition

Byte	Bit	Definition	
Byte 0	7	1：Insulation resistance monitoring function already started. 0：Insulation resistance monitoring function already stopped.	
	6	1：Output R_{ISO}+ and R_{ISO}- 0：Output R_{ISO}	
	5 4	10：R_{ISO}+ > R_{ISO}- 01：R_{ISO}+ < R_{ISO}- 00：R_{ISO}+ = R_{ISO}-	
	3	Reserved(Default 0)	
	2	1：Battery Overvoltage Alarm **(Default: ∞V , adjustable)** 0：No Battery Overvoltage Alarm	
	1	1：Level-2 Insulation Alarm **(Default: 1 000Ω/V , adjustable)** 0：No Level-2 Insulation Alarm	
	0	1：Level-1 Insulation Alarm **(Default: 500Ω/V , adjustable)**[①] 0：No Level-1 Insulation Alarm	
Byte 1~7		**GYID-10D36CAx-x(output R_{ISO}+ and R_{ISO}-)**	**GYID-10M36CAx-x (output R_{ISO})**
Byte 1		R_{ISO}+ High byte **/Unit kΩ**	R_{ISO} High byte**/Unit kΩ**
Byte 2		R_{ISO}+ Low byte	R_{ISO} Low byte
Byte 3		Battery Voltage V_{DC} High byte[②]**/Unit 0.1V**	
Byte 4		Battery Voltage V_{DC} Low byte	
Byte 5		R_{ISO}- High byte**/Unit kΩ**	Grounding position V_1 High byte**/Unit 0.1V**
Byte 6		R_{ISO}- Low byte	Grounding position V_1 Low byte
Byte 7		Counting / 00~FF(HEX) cycle, plus 1 for each transmission cycle	

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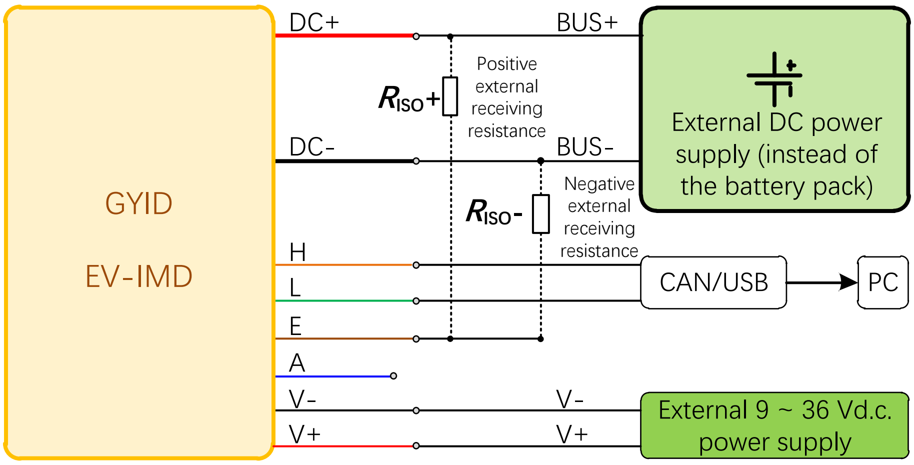
① To type GYID-10D36CAx-x ,the insulation alarm value equals min[R_{ISO}+,R_{ISO}-].To type GYID-10M36CAx-x , it equals R_{ISO} .

② The data converted from two bytes of battery voltage V_{DC} to decimal contains one decimal point. Example: The two-byte data of battery voltage V_{DC} is 04D2 (HEX), and the data converted into decimal system is 1234, then the battery voltage V_{DC} = 123.4 V.

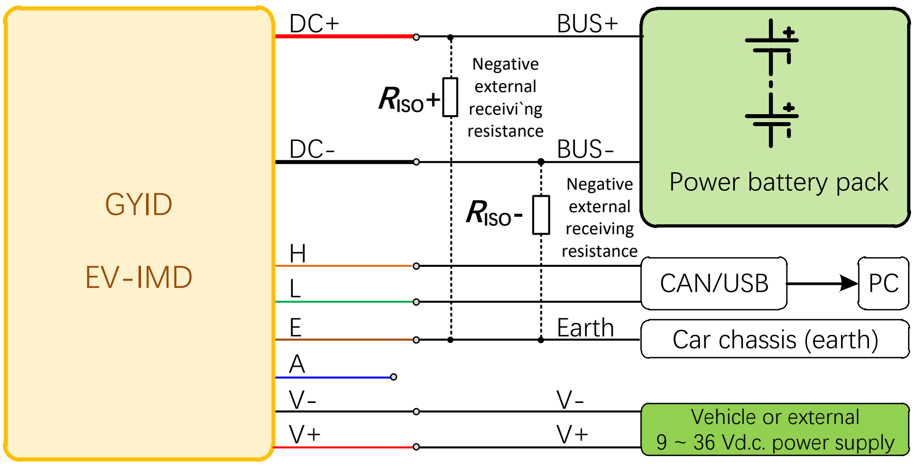
4. Simulated test method

Before the actual vehicle application, users can simulate and test the insulation monitor, including two cases: "Simple simulation test" and "Vehicle simulation test". In both tests, the user is required to prepare one or two resistors with fixed resistance values, and test them according to the method provided in the following table and Fig.9 .

Testing situation	Test method
Simple simulation test①	According to the wiring of Fig. 9 (a), Connect BUS+、BUS- to E by R_{ISO}+、 R_{ISO}- at the same time or alone.
Vehicle simulation test	According to the wiring of Fig. 9 (b), Connect BUS+、BUS- to E by R_{ISO}+、 R_{ISO}- at the same time or alone . E must be the chassis (earth).



(a) Simple simulation test wiring schematic



(b) Vehicle simulation test wiring schematic

Figure 9 Simulation test wiring schematic

① In simulation test , if the battery voltage is 0V , DC+ and DC- must be connected together , or an electrolytic capacitor(C > 10uF) between DC+ and DC- is needed.

5. Indicator definition

GYID series insulation monitor has a LED indicator, which can judge the state of the device under test (DUT) according to the display mode of LED indicator.

State of the DUT	Display mode of LED indicator	Remarks
Running normally (No Alarm)	Flash 1 time, stop 1s	
Level 1 Insulation Alarm	Continuous flashing	**Default 500 Ω/V，adjustable**
Level 2 Insulation Alarm	Flash 2 times, stop 1s	**Default 1000 Ω/V，adjustable**
Battery Overvoltage Alarm	Flash 3 times, stop 1s	**Default ∞ V，adjustable**

6. Structure size

Structure size is shown in Fig. 10 in mm.

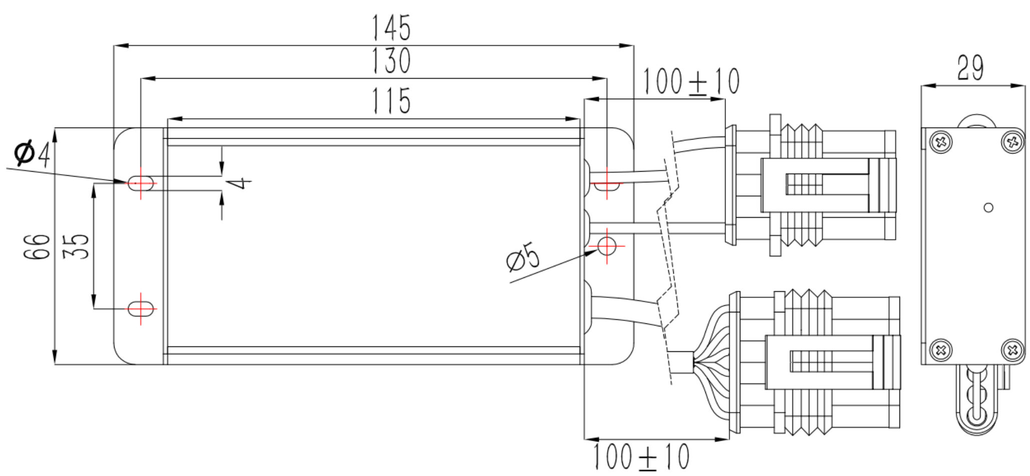


Figure 10 Structure size