

# ZJS-102

## DC System Insulation Monitor

### User Manual



Version:1.11

## Read me

**When you use ZJS-102 DC insulation monitoring device, 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 ZJS-102 insulation monitoring device, and help to solve the various problems at the scene.**

1. Before the meter turning on the power supply, be sure that the power supply within the provisions of the instrument;
2. Communication terminal (RS485) is strictly prohibited to impose on high pressure;
3. Be sure the instrument wiring consistent with the internal system settings;
4. When communicating with the PC, instrument communication parameters must be consistent with the PC.



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

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## 1.- SUMMARIZE

The DC system is the most important component of a high voltage industrial/utility substation. It supplies the energy to manage the protective devices and high voltage components and allows electrical faults to be safely isolated. Most high voltage substations house owns either a sealed or flooded cell battery bank.

Due to the complexity and dynamics of DC systems, DC ground faults caused by positive grounding or negative grounding are often difficult to be located. At the same time, due to the wide applications of intelligent relays and integrated automation systems, higher requirements are placed on the accuracy and safety of the DC system grounding monitoring device.

ZJS-102 DC System Insulation Monitor provides real-time online monitoring of insulation status of DC bus and branch circuit. It combined the balance bridge detection with unbalanced bridge detection two modes, to avoid the interference of distributed capacitance in the system, and also ZJS-102 can display the leakage current of each circuit in real time.

It has complete DC insulation fault monitoring functions to protect many earthing faults:

- Single-point grounding,
- Multi-point grounding,
- Busbar two-pole grounding,
- AC injection fault,
- Independent bus line DC cross fault,
- Battery loop grounding and positioning.

Device also provides Voltage equalization, Timing detection, Busbar pole voltage deviation ( $V_{\Delta}$  &  $K_{U-/U+}$ ), resistor bridge automatic calibration etc. ZJS-102 integrates transient alarm wave capture with current synchronous detection technology, and records voltage and current fault curves to realize instantaneous grounding monitoring, also have earthing fault location functions, it's an ideal solution of DC power systems safety protection.



## 2.- FEATURES AND SPECIFICATION

### 2.1.- Features

- Real-time monitoring DC system voltage, pole to ground voltage and alarm
- Real-time monitoring system insulation
- Auto record of instantaneous grounding event and wave capture
- History record can export to USB memory
- 5.0-inch touch screen display
- front panel with 6 individual alert LEDs
- Rear panel with 7 DO ports for important alarm info to PLC
- Single device supports 240 branch circuit monitor
- RS485 and Ethernet (optional) communication port
  
- **16-bit AD converter with high accuracy:**  
Conversion speed>1000 times/ sec  
Resolution> 1/50000
  
- **Adopt unique DADC structure:**  
Flexibly configure the number of slaves according to user needs  
Flexibly arrange the installation position of the slaves according to the site environment

### 2.2.- Specification

- **Monitoring range of system insulation resistance to ground:**  
Earthing alarm: 0-99.9K  
Pre-waring: 100-999.9K
  
- **Monitoring and detect range of branch insulation resistance to ground:**  
0-300K
  
- **Working voltage range:**  
Positive pole to ground: 0-300V  
Negative pole to ground: 0-300V  
System voltage: 0-300V  
AC injection voltage: 0-280V  
Busbar-II system voltage (DC cross detect): 0-300V  
Battery bank insulation fault location error:  $\pm 1$  cell
  
- **Alarm history record:**  
Record list quantities: 2000 lists  
Each record alarm list volume:  $\leq 32$  branches

**- Real-time leakage current measurement**

Screen display resolution: 0.01mA

Current sensor range: 10mA, 20mA, 50mA, 100mA optional

Each ZJS-102 port detect current volume:  $\leq 240$  branches

Each ZJS-CU collector unit connected current sensor:  $\leq 8$

**- Instant event record:**

Capture sampling ratio: 1KHz, 500Hz, 250Hz, 125Hz configurable

Record quantities: 2000

Waveforms for each instantaneous event: 8

**- Others:**

Passive digital output: 7

Fault alarm indicator: 6

Distributed capacitance range of the system: 0-200uF

Voltage monitoring error:  $\leq 0.5\%$

Communication interface: RS485, Ethernet

System voltage balance compensation bridge: 40K, 60K, 120K;

Optional AUX: 220Vac

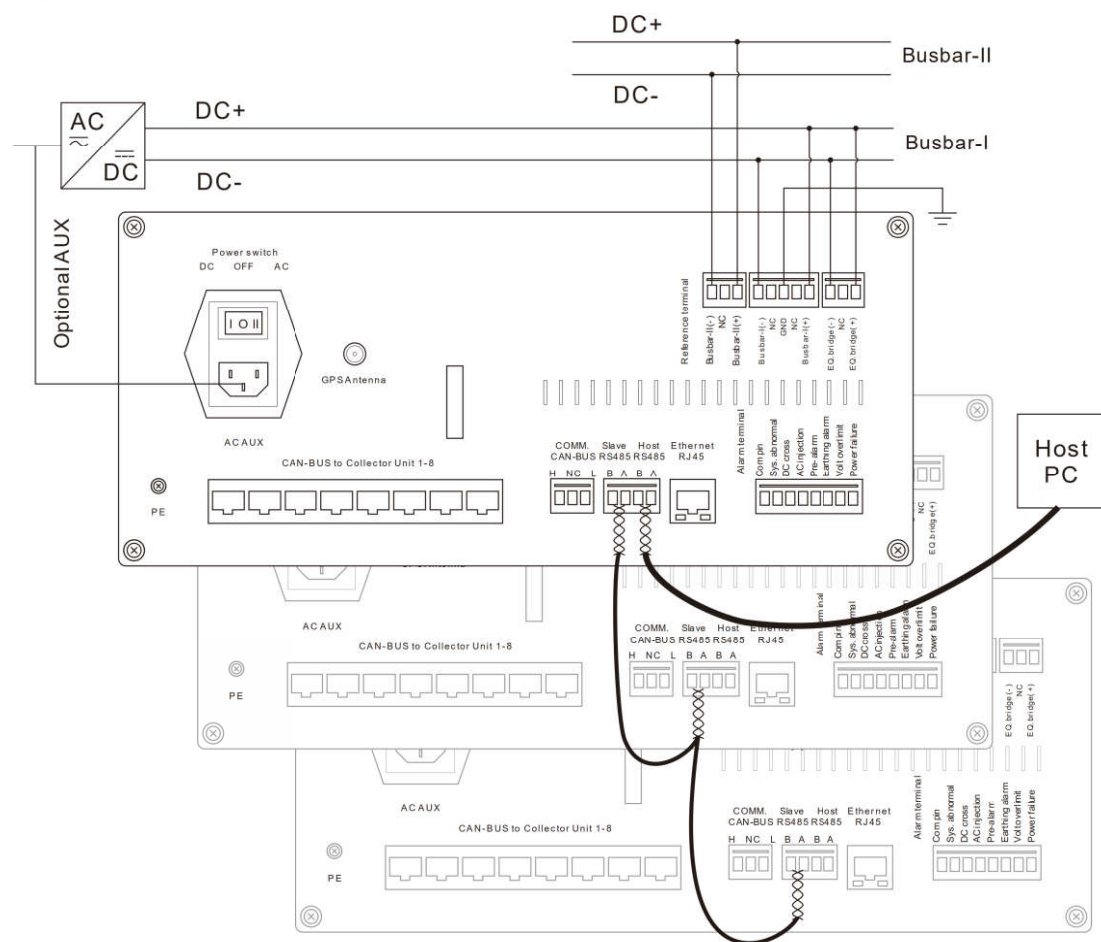
### 3.- INSTALLATION AND START-UP

#### 3.1.- Device Overall

The whole monitoring equipment consists of three parts:

|                               |          |
|-------------------------------|----------|
| Main device body              | ZJS-102  |
| Current sensor collector unit | ZJS-CU   |
| DC leakage current sensor     | ZJS-DCLC |

When monitoring DC system exceeds 240 branches, users can use multiple ZJS-102 to expand.



Typical wiring mode of ZJS-102 wiring

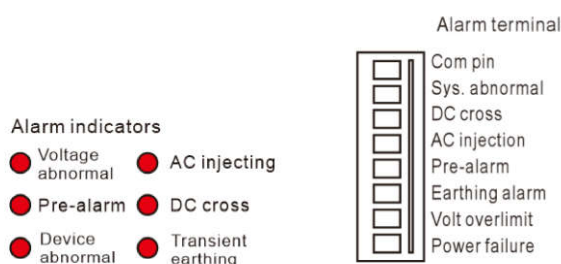
#### Notes:

1. Busbar-I must be connected; Busbar-II is connected to detect DC cross from other DC systems in the same site.
2. AC AUX is optional. ZJS-102 supports two separate power supply, and there has a switch to select. Device can draw power from Busbar-I wiring terminal if DC system is 110V or 220V rating.

- When one ZJS-102 is set as Host device in parallel with working mode, other sub-slaves need to be connected by RS485 (Slave) as typical drawing. Sub-slave device does not need to connect balance bridge terminal or Busbar-II, but it must connect Busbar-I or AUX as power supply.
- Alarm terminal is NO passive node.
- GPS port is optional, for RTC calibration and submitting station location.
- Ethernet port is optional for connecting Host PC.
- PE terminal is for enclosure grounding protection.

### 3.2.- Alarm indicators terminal defincations

ZJS-102 provides LED indicators in front panel, and NO passive node alarm output terminal in rear panel.

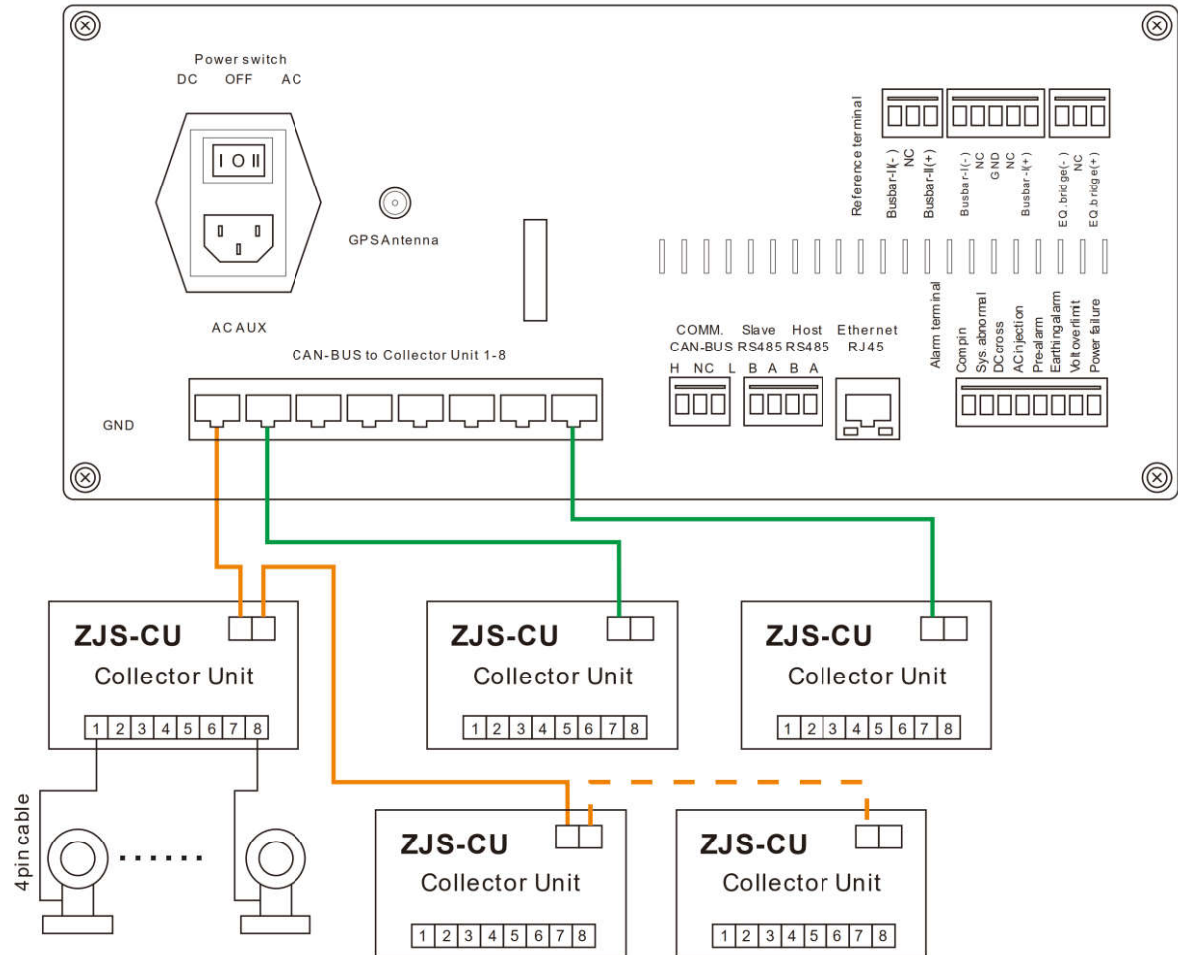


| Items / Alias      | Description   |                                                                                                                                                                                   |
|--------------------|---------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Voltage abnormal   | Front LED     | DC sytem voltage over upper/lower limit                                                                                                                                           |
| Volt overlimit     | Rear terminal |                                                                                                                                                                                   |
| AC injecting       | Front LED     | AC signal over preset limit                                                                                                                                                       |
| AC injection       | Rear terminal |                                                                                                                                                                                   |
| Pre-alarm          | Front LED     | Insulation resistance below pre-warning preset limit                                                                                                                              |
|                    | Rear terminal |                                                                                                                                                                                   |
| Earthing alarm     | Rear terminal | Insulation resistance below earthing alarm limit                                                                                                                                  |
| DC cross           | Front LED     | Busbar-II DC voltage cross to Busbar-I or branch circuit voltage cross to each other                                                                                              |
|                    | Rear terminal |                                                                                                                                                                                   |
| Device abnormal    | Front LED     | Balance bridge/unbalanced bridge fault or collector unit communication error                                                                                                      |
|                    | Rear terminal |                                                                                                                                                                                   |
| Transient earthing | Front LED     | Associated to instant event record configuration, under the transient earthing condition, indicator ON, after checking details in Other Func. screen indicator will reset to OFF. |
| Power failure      | Rear terminal | Device loss power, front Power ON indicator will be OFF.                                                                                                                          |

### 3.3.- Collector unit wiring and configuration

#### 3.3.1- Wiring of ZJS-CU

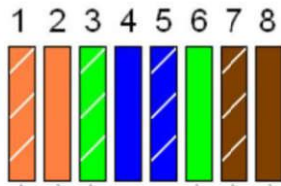
ZJS-102 rear panel has 8\*RJ45 ports and 1\*Pin terminal for CAN-BUS connection to ZJS-CU. Device will automatic identify connected units, and bring highly flexibility to on-site wiring and configuration:



Typical wiring mode of single ZJS-102

#### Notes:

1. ZJS-102 supports mixed Start link (green) and Daisy chain link (Orange) mode. ZJS-CU has 2\*RJ45 ports, and also it can connect with other collector units, or connect with ZJS-102. Two ports have the same rating, and do not need to distinguish between primary and secondary in wiring.
2. ZJS-CU supports hot swap. Connected ZJS-CU should be less than 30pcs and must be set different ID.
3. Cable header for 8pin RJ45 port uses T568B connection in both terminal:



### 3.3.2- Configuration of ZJS-CU

There are 8 pin DIP switch for configuration, low 6 bit to set ID, follow 8421 coding. High 2 bit for sensor rating:

| Bit 8 | Bit 7 | Sensor rating |
|-------|-------|---------------|
| 0     | 0     | 10mA          |
| 0     | 1     | 20mA          |
| 1     | 0     | 50mA          |
| 1     | 1     | 100mA         |

| Bit 6 | Bit 5 | Bit 4 | Bit 3 | Bit 2 | Bit 1 | ZJS-CU ID |
|-------|-------|-------|-------|-------|-------|-----------|
| 0     | 0     | 0     | 0     | 0     | 0     | 1         |
| 0     | 0     | 0     | 0     | 0     | 1     | 2         |
| 0     | 0     | 0     | 0     | 1     | 0     | 3         |
| ..... |       |       |       |       |       |           |
| 1     | 1     | 1     | 1     | 1     | 1     | 64        |

#### Notes:

1. Maximum connection ZJS-CU is 40pcs, regular less than 32pcs. If set over 40, ZJS-102 will not recognize collector units. Bit6 connects a 240ohm terminal resistance for daisy chain.
2. If purchase CTs from Blue Jay, sensor rating default is 50mA.

Each ZJS-CU can connect 8pcs current sensors. Current sensor has 4 pin terminal, so clients need to prepare suitable length of 4 cores/8 cores cable to connect with ZJS-CU, and its terminal port in ZJS-CU is RJ48, terminal definition is as shown:

| Sensor                                                                              | Wire definition | Description   | RJ45 on ZJS-CU |
|-------------------------------------------------------------------------------------|-----------------|---------------|----------------|
|  | /               | Blank         | 1              |
|                                                                                     | +               | 12V +         | 2              |
|                                                                                     | /               | Blank         | 3              |
|                                                                                     | -               | 12V -         | 4              |
|                                                                                     | /               | Blank         | 5              |
|                                                                                     | M               | Signal output | 6              |
|                                                                                     | /               | Blank         | 7              |
|                                                                                     | G               | Signal GND    | 8              |

## 4.- Detection LOGIC & FUNCTIONS

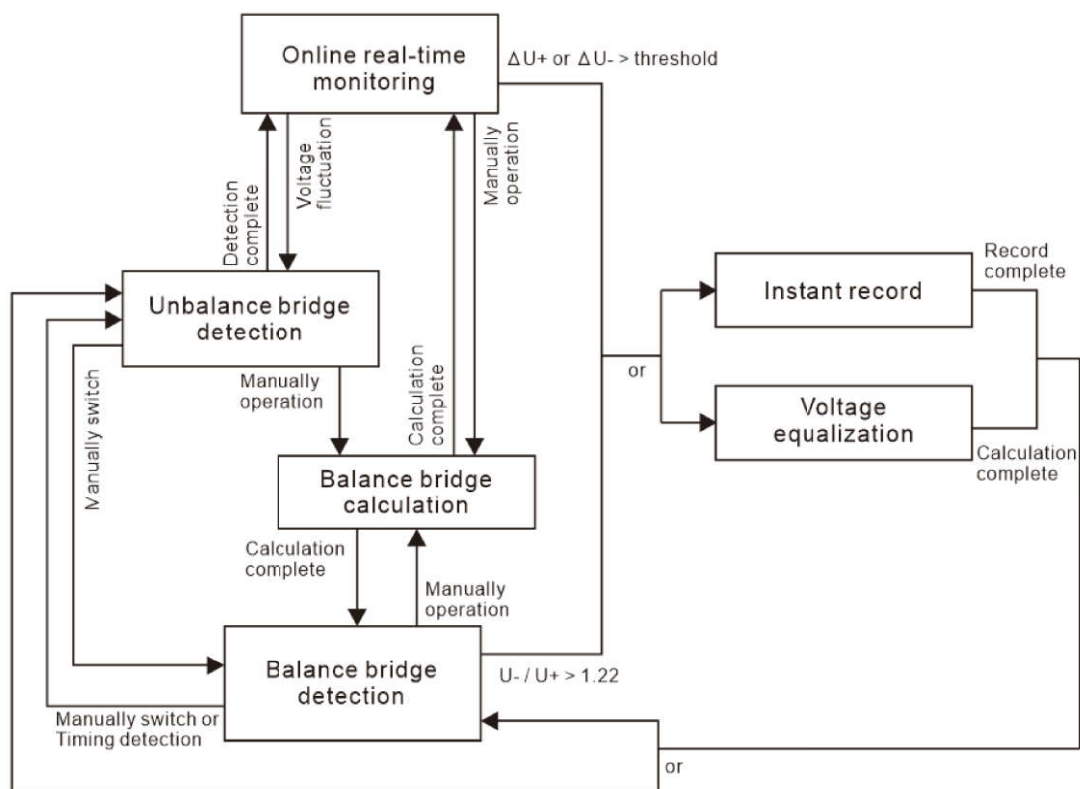
### 4.1.- Device Detection Logic

The device has two types of insulation detection mode: Balance bridge detection mode (Balance bridge) and Unbalanced bridge detection mode. They can manually switch to another mode.

Balance bridge detection mode calculates the equivalent resistance from  $U_+$  and  $U_-$ , then calculates the equivalent resistance of each branch circuit based on  $I_{branch}$  from current sensor connected by ZJS-CU.

Unbalanced bridge detection mode: the device calculates actual system  $IR_+$  and  $IR_-$  by activating the internal unbalanced bridge, then calculates  $(R_{branch+})$  and  $(R_{branch-})$  based on  $\Delta I_{branch}$  of current sensor connected by ZJS-CU.

ZJS-102 also provides balance bridge calculation, voltage equalization, instant earth detection (Instant graph record) and online real-time monitoring.



Simplified diagram of device working and switching logic



## 4.2.- Functions description

### 4.2.1.- Online real-time monitoring

Real-time monitoring DC system Busbar to ground voltage, including the following:

|                                                          |               |
|----------------------------------------------------------|---------------|
| DC System voltage                                        | $U_{DC}$      |
| Positive pole to ground voltage                          | $U_{+}$       |
| Negative pole to ground voltage                          | $U_{-}$       |
| Positive to ground resistance                            | $IR_{+}$      |
| Negative to ground resistance                            | $IR_{-}$      |
| Positive and negative ground voltage difference          | $U_{\Delta}$  |
| Distributed capacity of DC system                        | $C_{distri}$  |
| Real-time leakage current of each branch leakage current | $I_{Obranch}$ |

**Note:** Real-time monitoring parameters on screen will be shown in different pages, please refer to [Chapter 5](#) for more details.

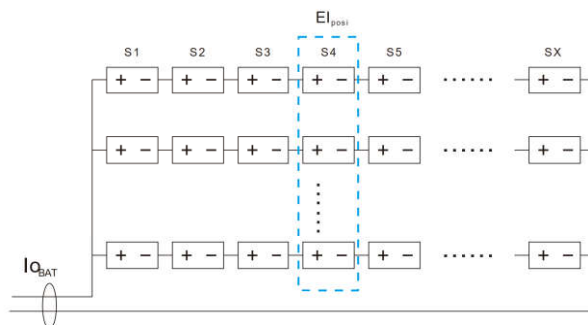
### 4.2.2.- Branch circuit pre-warning and insulation alarm

ZJS-102 collects all the characteristic parameters of each branch circuit in DC systems, through intelligently pattern matching technology to analyze and judge whether devices earthing or not.

Advanced detection methods can automatically eliminate distractions like charging pulse interference, voltage fluctuation Interference etc. Measurement range is up to 300Kohm, and devices can provide pre-warning and earthing alarm two level insulation classifications.

### 4.2.3.- Battery bank insulation monitoring

ZJS-102 can define a certain branch as BAT circuit. If this circuit have faults, faults will be displayed on screen as “BAT/Battery”, and also the device can calculate fault location of cell number ( $EI_{posi}$ ).



In multiple series & parallel BAT bank, ZJS-102 only can locate the node number from first position cell, as the left drawing.



#### 4.2.4.- Instant graph record

Device can set 1KHz, 500Hz, 250Hz and 125Hz sampling frequencies to capture transient earth fault graph.

Each record provides 8 curves:

- 1\*Positive pole to GND voltage waveforms
- 1\*Negative pole to GND voltage waveforms
- 6\* transient earthing branch current waveforms

##### Notes:

1. Not every transient earth fault has 6 current waveforms captured, which is maximum record capacity in one record data.
2. In record data, calculate the maximum, minimum and peak values of each curve for the users' reference and tracking faults after transient earth event.

#### 4.2.5.- History record

EEPROM will record maximum 2000 list alarm fault, and record includes:

Timestamp of fault

Fault type

Fault branch quantities

$U_{DC}$ ,  $U_+$  and  $U_-$ ,  $IR_+$  and  $IR_-$ ,  $U_{AC}$  (AC injection)

Max 32 insulation failed branch  $IR_{branch+}$  and  $IR_{branch-}$

##### Notes:

1. If set Battery bank parameters, device can calculate  $EI_{posi}$  for quick troubleshooting.
2. Users can export log file to USB.

#### 4.2.6.- Voltage equalization

If deviation ratio  $K_{U-/U+}$  of over a preset value, ZJS-102 can use internal compensation bridge to equalization busbar voltage to balance status.

##### Notes:

1.  $K_{U-/U+}$  default value is 1.22, mainly represents the ratio of positive and negative insulation voltage imbalance.
2. Only in System setting page, set "Voltage equalization" in **ON** can active this function.

5.- SCREEN INTERFACE

ZJS-102 has the 5.0-inch touch screen, which all operations and data will be displayed on this interface.

5.1.- System Information (System Info.)

After power ON and welcome screen, it will show DC Power System parameters and device status etc. If no operation in other screen over 90sec, the device will automatically switch to this screen.

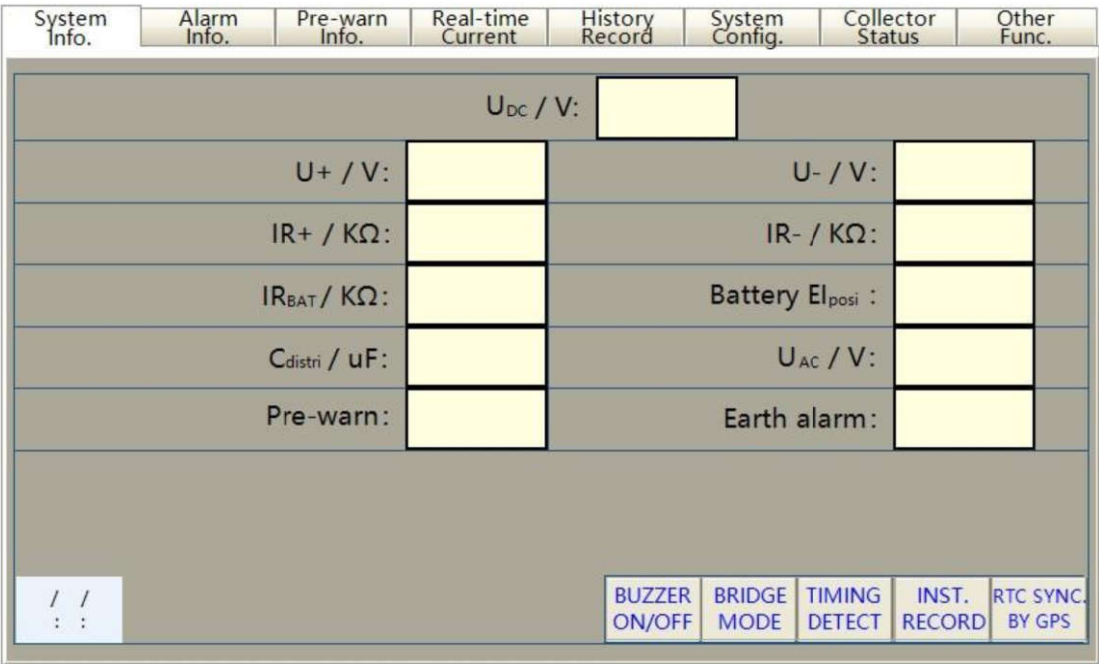


Figure 1 DC system whole screen

5.1.1- Real-time monitoring value display

|               |  |                  |
|---------------|--|------------------|
| UDC / V:      |  |                  |
| U+ / V:       |  | U- / V:          |
| IR+ / KΩ:     |  | IR- / KΩ:        |
| IRBAT / KΩ:   |  | Battery Elposi : |
| Cdistri / uF: |  | UAC / V:         |
| Pre-warn:     |  | Earth alarm:     |

- UDC
- DC System voltage
- U+
- Positive pole to ground voltage
- U-
- Negative pole to ground voltage

|                            |                                               |
|----------------------------|-----------------------------------------------|
| IR+                        | Positive pole to ground insulation resistance |
| IR-                        | Negative pole to ground insulation resistance |
| IR <sub>BAR</sub>          | Battery bank branch insulation resistance     |
| Battery EI <sub>posi</sub> | Battery bank earth insulation fault location  |
| C <sub>distrib</sub>       | Distributed capacity of DC system             |
| Pre-warning                | Number of pre-warning triggered               |
| Earth alarm                | Number of earth alarm triggered               |

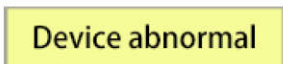
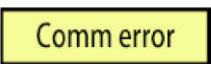
### 5.1.2- DC system and device status

Center area will show the DC Power System status (abbr. DC sys.) and ZJS-102 device status (abbr. Device).

DC Power System have 3 status indicators as the following:

|                  |                           |                                                                               |
|------------------|---------------------------|-------------------------------------------------------------------------------|
| DC sys. normal   | DC Insulated              | Busbar-I and Busbar-II insulated                                              |
|                  | U <sub>DC</sub> in range  | U <sub>DC</sub> in pre-set upper / lower range                                |
|                  | U <sub>AC</sub> in range  | U <sub>AC</sub> under pre-set threshold, AC and DC circuit in good insulation |
|                  | IR in range               | Insulation resistance in pre-set range                                        |
|                  | Balance bridge normal     | Balance bridge in the normal status                                           |
|                  | Comm normal               | Communication from ZJS-102 to ZJS-CU in the normal status                     |
|                  | Unbalance bridge normal   | Unbalanced bridge in the normal status                                        |
|                  | I <sub>o</sub> in range   | Leakage current under pre-set threshold                                       |
| DC sys. abnormal | Insulation drop           | IR is lower than preset pre-warning threshold                                 |
|                  | Voltage Unbalance         | K <sub>U-/U+</sub> or U <sub>Δ</sub> over preset threshold                    |
| DC sys. fault    | Earthing alarm            | Earth fault alarm                                                             |
|                  | AC injection              | U <sub>AC</sub> is over pre-set threshold                                     |
|                  | DC crossed                | Insulation fault Busbar-I to Busbar-II, there are DC crossed two DC systems   |
|                  | U <sub>DC</sub> overlimit | U <sub>DC</sub> over upper / lower limit                                      |

ZJS-102 device status have 3 status indicators as the following:

|                                                                                   |                                                                                   |                                                         |
|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|---------------------------------------------------------|
|  | /                                                                                 | Device in the normal status                             |
|  |  | There exists communication error from ZJS-102 to ZJS-CU |
|  |  | /                                                       |
|                                                                                   |  | /                                                       |

### 5.1.3- Other icons

|                                                                                                                                                                         |                                                                                                                                  |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------|
|       | Indicate device working mode, can be set in <b>Other Func.</b> page, details refer to <a href="#">Chapter 5.7</a>                |
|       | Voltage auto equalization function, details refer to <a href="#">Chapter 4.2.6</a>                                               |
|     | Buzzer with alarm triggered                                                                                                      |
|   | Balance bridge detection mode or Unbalanced bridge detection mode                                                                |
|   | Timing detection function (device automatic switch to balance bridge detection regularly)                                        |
|   | Instant record function                                                                                                          |
|   | Only be valid when select the GPS function                                                                                       |
|                                                                                      | Balance bridge detection mode: 4 icons are displayed cyclically.<br>Unbalanced bridge detection mode: 4 icons are displayed once |
|                                                                                      | Real-time monitoring                                                                                                             |
|                                                                                      | Device in instant record                                                                                                         |
|                                                                                      | Device in voltage equalization                                                                                                   |
|   | /                                                                                                                                |

## 5.2.- Alarm Information (Alarm Info. & Pre-warning Info.)

ZJS-102 provides two level alarms. In pre-warn the device can alert users to notice insulation drop in DC system, while alarm trig is to remind users of earthing fault. These two screens also show insulation resistance value at which a fault event occurs, and branch No. can help to locate the earthing fault position in troubleshooting.

| System Info. | Alarm Info. | Pre-warn Info. | Real-time Current | History Record | System Config. | Collector Status | Other Func. |
|--------------|-------------|----------------|-------------------|----------------|----------------|------------------|-------------|
| Branch No.   | Alarm type  | IR+ / KΩ       |                   | IR- / KΩ       |                |                  |             |
|              |             |                |                   |                |                |                  |             |
|              |             |                |                   |                |                |                  |             |
|              |             |                |                   |                |                |                  |             |
|              |             |                |                   |                |                |                  |             |
|              |             |                |                   |                |                |                  |             |
|              |             |                |                   |                |                |                  |             |
|              |             |                |                   |                |                |                  |             |
|              |             |                |                   |                |                |                  |             |
|              |             |                |                   |                |                |                  |             |
| Total        |             | Lists Total    |                   | Page Present   |                | Page             |             |
|              |             |                |                   | Previous       | Next           |                  |             |

Figure 2 Alarm Info.

[illegible]

Figure 3 Pre-warn Info.

Alarm type will show one of the following 6 icons:

|                         |                                                                                                  |
|-------------------------|--------------------------------------------------------------------------------------------------|
| <b>Earthing fault</b>   | Combined Branch No. can know a certain location that earthing fault                              |
| <b>BAT earthing</b>     | Battery branch earthing fault                                                                    |
| <b>AC injection</b>     | Combined Branch No. users can know a certain location that AC injection into Busbar-I            |
| <b>DC cross</b>         | Combined Branch No. users can know a certain location that Busbar-II DC cross with Busbar-I      |
| <b>Insulation drop</b>  | IR lower than preset pre-warning threshlod                                                       |
| <b>BAT branch fault</b> | Battery branch IR lower than preset pre-warning threshlod, only be valid when set BAT branch No. |

### 5.3.- Real-time Current Screen

This screen displays the real-time leakage current value of each branch.

| System Info. | Alarm Info.         | Pre-warn Info. | Real-time Current   | History Record | System Config.      | Collector Status | Other Func.   |
|--------------|---------------------|----------------|---------------------|----------------|---------------------|------------------|---------------|
| Branch No.   | Leakage current /mA | Branch No.     | Leakage current /mA | Branch No.     | Leakage current /mA |                  |               |
|              |                     |                |                     |                |                     |                  |               |
|              |                     |                |                     |                |                     |                  |               |
|              |                     |                |                     |                |                     |                  |               |
|              |                     |                |                     |                |                     |                  |               |
|              |                     |                |                     |                |                     |                  |               |
|              |                     |                |                     |                |                     |                  |               |
|              |                     |                |                     |                |                     |                  |               |
|              |                     |                |                     |                |                     |                  |               |
| Clear All    | Total               | Lists          | Total               | Page           | Present             | Page             | Previous Next |

**Note:** If click **Clear All**, the device will force to reset leakage current value to zero, and after 5-10sec the sensor data will be measured again.



## 5.4.- History Record Screen

History record consists of abstract and details these two pages. Record maximum can storage 1000 lists in the internal memory.

| System Info. | Alarm Info. | Pre-warn Info. | Real-time Current | History Record | System Config. | Collector Status | Other Func.         |
|--------------|-------------|----------------|-------------------|----------------|----------------|------------------|---------------------|
| Rec.SN       | Timestamp   | Fault type     | Fault branch Qtys | Details        |                |                  |                     |
|              |             |                |                   | More           |                |                  |                     |
|              |             |                |                   |                |                |                  |                     |
|              |             |                |                   |                |                |                  |                     |
|              |             |                |                   |                |                |                  |                     |
|              |             |                |                   |                |                |                  |                     |
|              |             |                |                   |                |                |                  |                     |
|              |             |                |                   |                |                |                  |                     |
|              |             |                |                   |                |                |                  |                     |
| Total        |             | Lists Total    |                   | Page Present   |                | Page             | << >> Previous Next |

Figure 4 History record abstract

Fault type will show one of the following 8 icons:

|                           |                                                                                                     |
|---------------------------|-----------------------------------------------------------------------------------------------------|
| Earthing fault            | /                                                                                                   |
| U <sub>DC</sub> overlimit | U <sub>DC</sub> is over upper / lower limit                                                         |
| BAT earthing              | Battery branch earthing fault                                                                       |
| AC injection              | AC injection into Busbar-I                                                                          |
| DC cross                  | Busbar-II DC cross with Busbar-I                                                                    |
| Insulation drop           | IR is lower than preset pre-warning threshlod                                                       |
| Voltage Unbalance         | K <sub>U</sub> -/U <sub>+</sub> or U <sub>Δ</sub> is over preset threshold                          |
| BAT branch fault          | Battery branch IR is lower than preset pre-warning threshlod, only be valid when set BAT branch No. |

Click **More** can enter details information sub-page, and users can view a certain pieces of fault details information. Each history record contains up to 32 branch fault information (if less than 32 branches fault, there will filled with **256** to Branch No. and **999.9** to R+, R- as placeholder).

[illegible]

Figure 5 History record details

DC cross loop style shows DC cross fault style:

|                   |                                                          |
|-------------------|----------------------------------------------------------|
| <b>+</b> <b>+</b> | Positive of Busbar-I and Positive of Busbar-II connected |
| <b>-</b> <b>-</b> | Negative of Busbar-I and Negative of Busbar-II connected |
| <b>+</b> <b>-</b> | Positive of Busbar-I and Negative of Busbar-II connected |
| <b>-</b> <b>+</b> | Negative of Busbar-I and Positive of Busbar-II connected |

Users can export the present page data by plugging into USB flash disk. Plug into a USB, and then click **Export log**. After showing the **Done** icon, users can remove USB.

|                                                                                     |                           |
|-------------------------------------------------------------------------------------|---------------------------|
|  | USB removed               |
|  | USB plugged               |
|  | Export operation finished |



5.5.- System Configuration (System Config.)

The following picture is password protection parameter configuration screen. Users can enter the default password **5555** to enter the setting page:

| System Info.                | Alarm Info. | Pre-warn Info.       | Real-time Current | History Record                                                       | System Config. | Collector Status     | Other Func. |
|-----------------------------|-------------|----------------------|-------------------|----------------------------------------------------------------------|----------------|----------------------|-------------|
|                             |             |                      |                   | <div>Password</div> <div><input type="text"/></div> <div>Enter</div> |                |                      |             |
| $U_{DC-U} / V:$             |             | <input type="text"/> |                   | Series connection cell qtys. in BAT:                                 |                | <input type="text"/> |             |
| $U_{DC-L} / V:$             |             | <input type="text"/> |                   | BAT branch No.:                                                      |                | <input type="text"/> |             |
| $U_{AC} / V:$               |             | <input type="text"/> |                   | Timing detect interval/Hour:                                         |                | <input type="text"/> |             |
| $I_{R_{system}} /$          |             | <input type="text"/> |                   | y/sec:                                                               |                | <input type="text"/> |             |
| $I_{R_{branch}} /$          |             | <input type="text"/> |                   | Addr:                                                                |                | <input type="text"/> |             |
| $I_{R_{pre-warning}} /$     |             | <input type="text"/> |                   | eboot:                                                               |                | <input type="text"/> |             |
| $R_{balance} /$             |             | <input type="text"/> |                   | ation:                                                               |                | <input type="text"/> |             |
| $K_{U-/U+}$ threshold       |             | <input type="text"/> |                   | etting:                                                              |                | <input type="text"/> |             |
| $U_{\Delta}$ threshold / V: |             | <input type="text"/> |                   | Auto-calculate Rbalance :                                            |                | <input type="text"/> |             |
| $I_o$ threshold / mA:       |             | <input type="text"/> |                   |                                                                      |                |                      |             |

| System Info.                     | Alarm Info. | Pre-warn Info.       | Real-time Current | History Record                       | System Config. | Collector Status     | Other Func. |
|----------------------------------|-------------|----------------------|-------------------|--------------------------------------|----------------|----------------------|-------------|
| $U_{DC-U} / V:$                  |             | <input type="text"/> |                   | Series connection cell qtys. in BAT: |                | <input type="text"/> |             |
| $U_{DC-L} / V:$                  |             | <input type="text"/> |                   | BAT branch No.:                      |                | <input type="text"/> |             |
| $U_{AC} / V:$                    |             | <input type="text"/> |                   | Timing detect interval/Hour:         |                | <input type="text"/> |             |
| $I_{R_{system}} / K\Omega:$      |             | <input type="text"/> |                   | Bridge stabilization delay/sec:      |                | <input type="text"/> |             |
| $I_{R_{branch}} / K\Omega:$      |             | <input type="text"/> |                   | Device MODBUS Addr:                  |                | <input type="text"/> |             |
| $I_{R_{pre-warning}} / K\Omega:$ |             | <input type="text"/> |                   | Auto-reset after reboot:             |                | <input type="text"/> |             |
| $R_{balance} / K\Omega:$         |             | <input type="text"/> |                   | Voltage equalization:                |                | <input type="text"/> |             |
| $K_{U-/U+}$ threshold / V:       |             | <input type="text"/> |                   | RTC setting:                         |                | <input type="text"/> |             |
| $U_{\Delta}$ threshold / V:      |             | <input type="text"/> |                   | Auto-calculate Rbalance :            |                | <input type="text"/> |             |
| $I_o$ threshold / mA:            |             | <input type="text"/> |                   |                                      |                |                      |             |

|                    |                                                                 |                                                                                                        |
|--------------------|-----------------------------------------------------------------|--------------------------------------------------------------------------------------------------------|
| $U_{DC-U}$         | System voltage $U_{DC}$ upper limit                             | Alarm @ system voltage is > setting value                                                              |
| $U_{DC-L}$         | System voltage $U_{DC}$ lower limit                             | Alarm @ system voltage < setting value                                                                 |
| $U_{AC}$           | AC injection alarm threshold                                    | Alarm @ AC injection voltage > setting value                                                           |
| $IR_{system}$      | DC system insulation resistance threshold                       | Alarm @ system earthing < setting value                                                                |
| $IR_{branch}$      | Branch circuit insulation resistance threshold                  | Display @ branch earthing < setting value                                                              |
| $IR_{pre-warning}$ | Pre warning insulation resistance                               | Alarm @ system ground resistance < setting value<br>Display @ branch ground resistance < setting value |
| $R_{balance}$      | Balance bridge resistance                                       | Manually set the system balance bridge resistance value                                                |
| $K_{U-/U+}$        | System Voltage Unbalanced degree, $K_{U-/U+} = [(U-) / (U+)]$ , | Display voltage deviation @ $(U-) / (U+) >$ threshold value, default alarm threshold 1.22              |
| $U_{\Delta}$       | System Voltage Unbalanced degree, $U_{\Delta} =  (U+) - (U-) $  | Display voltage deviation @ $ (U+) - (U-)  >$ threshold value                                          |
| $I_o$              | Leakage current limit                                           | Abnormal current @ branch current > threshold value                                                    |

|                                    |                                                                                                                                                                                                      |
|------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Series connection cell qty. in BAT | Set this value to enable $EI_{posi}$ detect function, please refer to <a href="#">Chapter 4.2.3</a>                                                                                                  |
| BAT branch No.                     | Define branch No. of battery bank.<br><b>Note:</b> Set <b>0</b> to let ZJS-102 ignore BAT, $EI_{posi}$ function will be disabled.                                                                    |
| Timing detect interval             | Set automatic detection interval for unbalanced bridge.<br><b>Note:</b> Set this interval also need active <a href="#">Timing detect ON</a> in system page by clicking it.                           |
| Bridge stabilization delay         | Wait for the unbalanced bridge stable after connect to DC system.<br>The larger the value, the longer the waiting time                                                                               |
| Device MODBUS Addr.                | Communication address of present ZJS-102 to host PC/PLC                                                                                                                                              |
| Auto-reset after reboot            | Enable this function, current sensor will automatic reset to zero if detect $I_o < 10mA$ after reboot.<br><b>Note:</b> In Real-time current page, click <a href="#">Clear All</a> to manually reset. |
| Voltage equalization               | Enable this function, if deviation ratio $K_{U-/U+}$ of over a preset value, ZJS-102 can use internal compensation bridge to equalization busbar voltage to balance status.                          |
| RTC setting                        | Enter RTC setting screen                                                                                                                                                                             |
| Auto-calculate $R_{balance}$       | After clicking <a href="#">Start</a> button, $R_{balance}$ will automatic reset by device internal calculation.                                                                                      |

## 5.6.- Collector Status Screen

In this page users can see all the connected ZJS-CU status, and this page displays the connection status of each collector.

| System Info. | Alarm Info. | Pre-warn Info. | Real-time Current | History Record | System Config. | Collector Status | Other Func. |
|--------------|-------------|----------------|-------------------|----------------|----------------|------------------|-------------|
| Collector ID | Status      | Collector ID   | Status            | Collector ID   | Status         | Collector ID     | Status      |
| 1            |             | 11             |                   | 21             |                | 31               |             |
| 2            |             | 12             |                   | 22             |                | 32               |             |
| 3            |             | 13             |                   | 23             |                | 33               |             |
| 4            |             | 14             |                   | 24             |                | 34               |             |
| 5            |             | 15             |                   | 25             |                | 35               |             |
| 6            |             | 16             |                   | 26             |                | 36               |             |
| 7            |             | 17             |                   | 27             |                | 37               |             |
| 8            |             | 18             |                   | 28             |                | 38               |             |
| 9            |             | 19             |                   | 29             |                | 39               |             |
| 10           |             | 20             |                   | 30             |                | 40               |             |

Remove disconnected collector

There are 3 status of collector unit:

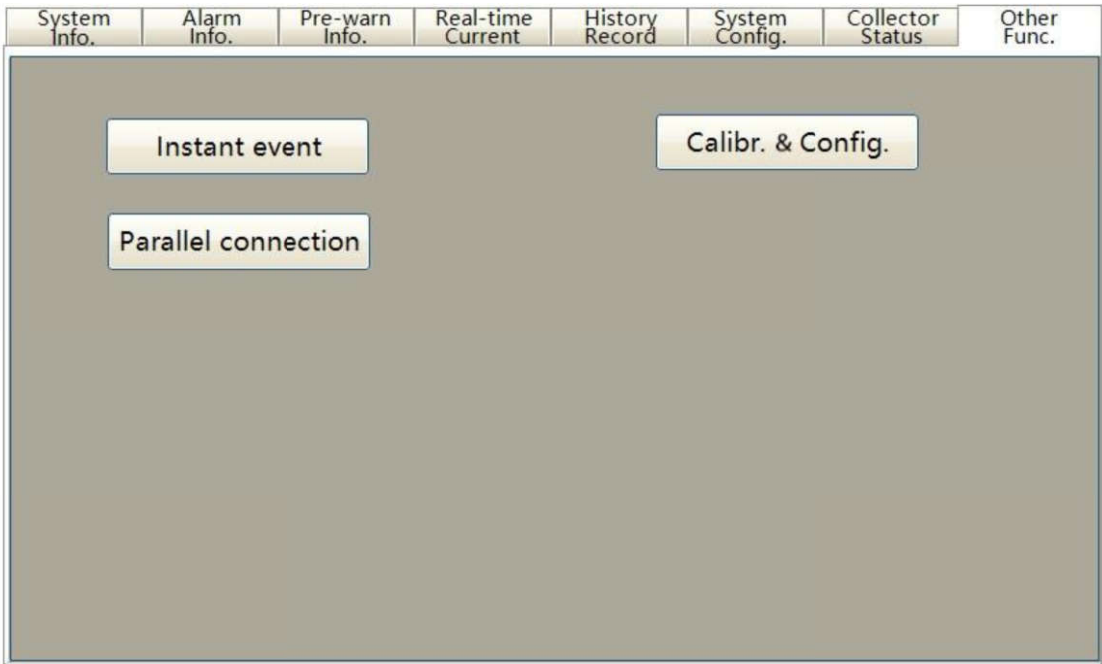
|            |                           |
|------------|---------------------------|
| None       | Unconnected               |
| Connected  | Connected                 |
| Disconnect | Communication interrupted |

### Notes:

1. For ZJS-CU Disconnect, users can click [Remove disconnected collector](#) to turn the Disconnect into None status.
2. Collector ID is setting by DIP switch on ZJS-CU, please refer [Chapter 3.3.2.](#)

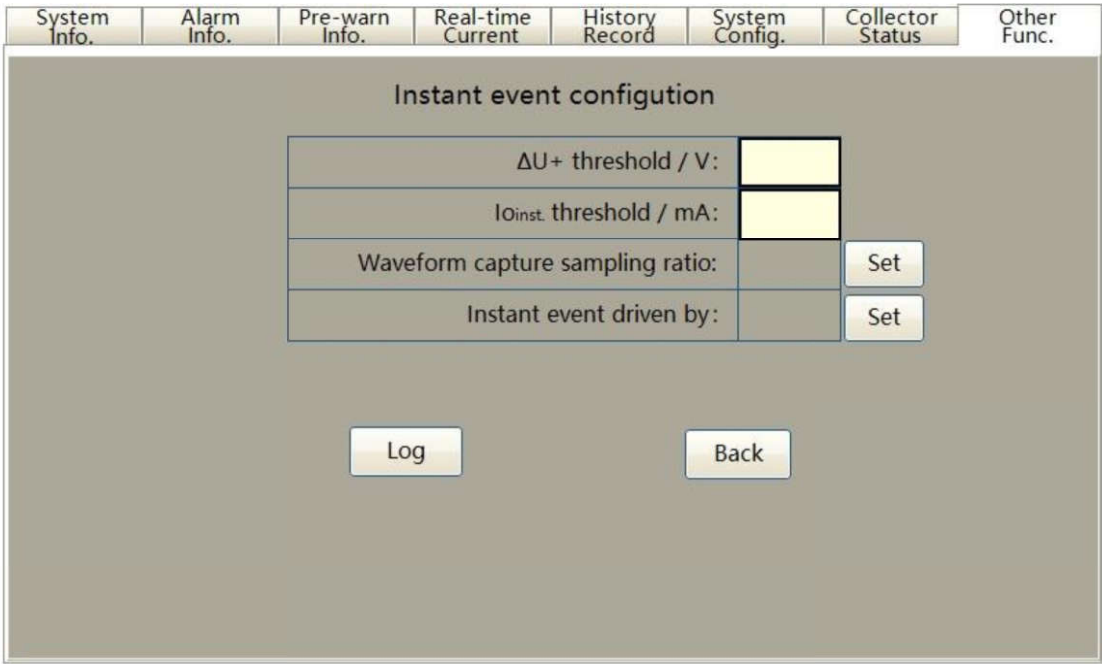
5.7.- Other Functions (Other Func.)

Other functions include the following three sub-pages:



5.7.1- Instant event

Click Instant event on the other func. page to enter the page, where relevant parameters can be set. The content of the setting page is as shown:



|              |                                                             |                                                                                                                                                                                |
|--------------|-------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| $\Delta U+$  | U+ shift value                                              | Record event @ pole to ground voltage shift > $\Delta U+$<br><b>Example:</b> set $\Delta U+ = 5$ , If $U+ > 115V$ or $U+ < 105V$ , ZJS-102 will consider happen instant event. |
| $I_{Oinst.}$ | Leakage current threshold that trig start-up instant record | Record event @ Detected insulation current < $I_{Oinst.}$                                                                                                                      |

|                                 |                                                                                                                                                    |
|---------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------|
| Waveform capture sampling ratio | <input type="button" value="1KHz"/> <input type="button" value="500Hz"/> <input type="button" value="250Hz"/> <input type="button" value="125Hz"/> |
| Instant event driven by         | <input type="button" value="I&lt;sub&gt;Oinst.&lt;/sub&gt;"/> <input type="button" value="Δ U&lt;sub&gt;inst.&lt;/sub&gt;"/>                       |

**Notes:**

- Device have default waveform deeps 480, set the different ratio:
 

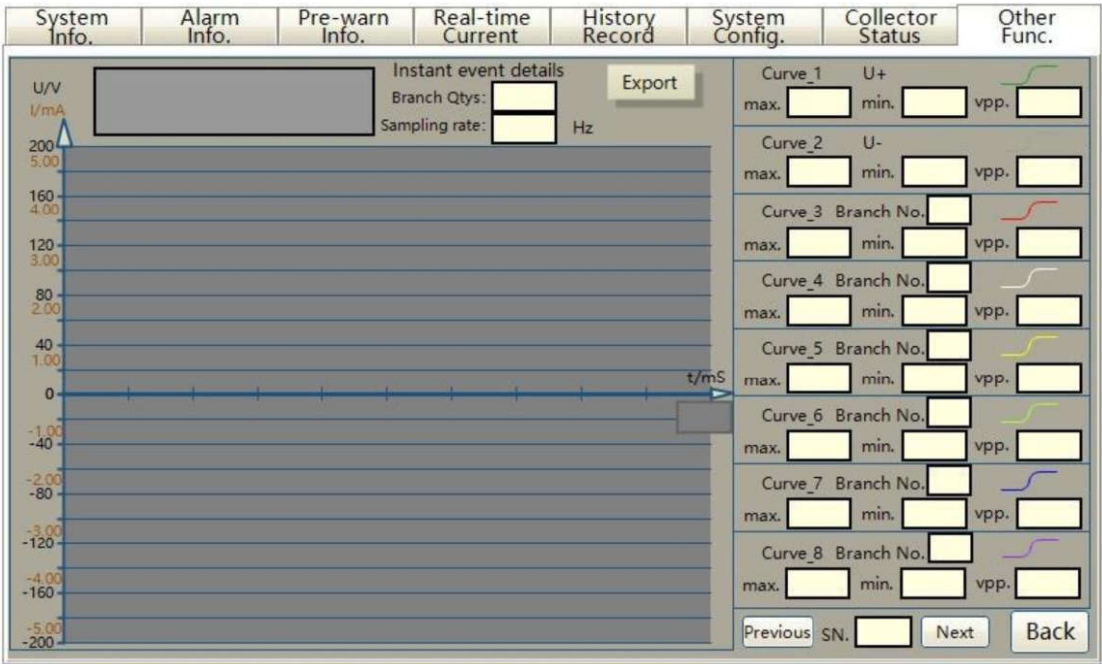
|       |                 |
|-------|-----------------|
| 1KHz  | 480ms waveform  |
| 500Hz | 960ms waveform  |
| 250Hz | 1920ms waveform |
| 125Hz | 3840ms waveform |
- Instant record only can be triggered when the DC power system in the normal status and exceeds 10 seconds.

Click [Log](#) and users can see the record page of instant event:

| System Info.                | Alarm Info.          | Pre-warn Info. | Real-time Current    | History Record | System Config.       | Collector Status | Other Func.                                                                                                                                   |
|-----------------------------|----------------------|----------------|----------------------|----------------|----------------------|------------------|-----------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Instant event record</b> |                      |                |                      |                |                      |                  |                                                                                                                                               |
| Record SN.                  | Timestamp            |                | Branch Qtys          | Details        |                      |                  |                                                                                                                                               |
|                             |                      |                |                      | More           |                      |                  |                                                                                                                                               |
|                             |                      |                |                      |                |                      |                  |                                                                                                                                               |
|                             |                      |                |                      |                |                      |                  |                                                                                                                                               |
|                             |                      |                |                      |                |                      |                  |                                                                                                                                               |
|                             |                      |                |                      |                |                      |                  |                                                                                                                                               |
|                             |                      |                |                      |                |                      |                  |                                                                                                                                               |
|                             |                      |                |                      |                |                      |                  |                                                                                                                                               |
|                             |                      |                |                      |                |                      |                  |                                                                                                                                               |
|                             |                      |                |                      |                |                      |                  |                                                                                                                                               |
| Total                       | <input type="text"/> | Lists Total    | <input type="text"/> | Page Present   | <input type="text"/> | Page             | <input type="button" value="«"/> <input type="button" value="»"/> <input type="button" value="Previous"/> <input type="button" value="Next"/> |

ZJS-102 can maximum storage 2000 lists record of instant event, each record has timestamp, fault branch quantities number.

Click **More** and users can view the detailed information of the record as shown below:



This page can show maximum 8 curves for investigation after instant event.

2 waveforms for DC system voltage, related to  $\Delta U+$

6 waveforms for branch leakage current, related to  $I_{o\text{inst}}$ .

Each curve uses different color to identity, as is shown above.

max.        Maximum value in instant event  
mini.      Maximum value in instant event  
vpp.        $||\text{max.}| - |\text{mini.}||$

Users can export the present page data by plugging into USB flash disk. Plug into a USB, and then click **Export log**. After showing the **Done** icon, users can remove USB.

|                                                                                     |                           |
|-------------------------------------------------------------------------------------|---------------------------|
|  | USB removed               |
|  | USB plugged               |
|  | Export operation finished |



5.7.2- Calibration and configuration (Calibr. & Config.)

Click **Calibr. & Config.** On the “Other Func.” page, users enter the default password **6666** and then can enter the setting page:

System Info.

Alarm Info.

Pre-warn Info.

Real-time Current

History Record

System Config.

Collector Status

Other Func.

Calibration & Configuration

Password

Enter

System Info.

Alarm Info.

Pre-warn Info.

Real-time Current

History Record

System Config.

Collector Status

Other Func.

Calibration & Configuration

Voltage calibration

| Items           | Disp./V | Real./V | Operate   |
|-----------------|---------|---------|-----------|
| I_U+            |         |         | Calibrate |
| I_U-            |         |         | Calibrate |
| II_U+           |         |         | Calibrate |
| U <sub>AC</sub> |         |         | Calibrate |
| BB_U+           |         |         | Calibrate |
| BB_U-           |         |         | Calibrate |
| UB_U+           |         |         | Calibrate |
| UB_U-           |         |         | Calibrate |

Current calibration

| Items           | Branch No. | Operate   |
|-----------------|------------|-----------|
| Zero point Cal. |            | Calibrate |
| Compensate Cal. |            | Calibrate |

Notes:  
Branch No. enter 500 for calibrate all sensor or only calibrated designated sensor

Record erase

|                      |       |
|----------------------|-------|
| history record       | Erase |
| instant event record | Erase |

Configuration

|                     |     |
|---------------------|-----|
| Device mode         | Set |
| Host baud           | Set |
| Slave baud          | Set |
| Comm. protocol      | Set |
| IRM mode            | Set |
| Unbalance bridge/KΩ |     |
| Elposi caculate     |     |
| Io low cut/mA       |     |
| Collector qtys      |     |

Back

Load Default



## Voltage calibration

|                 |                                                                                                                                                                                                                                                                                                                |
|-----------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| I_U+            | Busbar-I position voltage                                                                                                                                                                                                                                                                                      |
| I_U-            | Busbar-I negative voltage                                                                                                                                                                                                                                                                                      |
| II_U+           | Busbar-II position voltage                                                                                                                                                                                                                                                                                     |
| U <sub>AC</sub> | Detected AC injection voltage                                                                                                                                                                                                                                                                                  |
| BB_U+           | To judgment balance bridge status, in normal condition:<br>BB_U+ = I_U+, BB_U- = I_U-.<br><br>If bridge fault, the voltage may loss or large offset of pole voltage. Users can enter a suitable value to calibrate.                                                                                            |
| BB_U-           |                                                                                                                                                                                                                                                                                                                |
| UB_U+           | To judgment balance bridge status, in the normal condition:<br>UB_U+ = 0, UB_U- = 0,<br>After switching to the unbalanced bridge detection mode:<br>UB_U+ = I_U+, UB_U- = I_U-,<br>If bridge fault, the voltage may loss or enlarge the offset of pole voltage. Users can enter a suitable value to calibrate. |
| UB_U-           |                                                                                                                                                                                                                                                                                                                |

### Notes:

1. The device only can calibrate when Display voltage and real detect voltage is over 5V.
2. If enter 999.9 in Real./V box, the Disp./V will reset to 0.

## Current calibration

|                 |                                                                                                                                                                                                                                        |
|-----------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Zero point Cal. | Set measurement Io of certain branch to 0, based on ZJS-102 zero point.<br><b>Note:</b> Generally use this calibration mode to check real drift value of the sensor measurement value.                                                 |
| Compensate Cal. | Set measurement Io as 0 point in certain branch, based on output signal level.<br><b>Note:</b> If there exists zero drift of current sensor, or branch has constant acceptable leakage current, the device can calibrate as this mode. |

### Notes:

1. Branch No. enter 500 to calibrate all sensor
2. Branch No. enter 1-240 to calibrate the designated sensor

## Configuration

|             |                                                                                                                                                                         |                                                                 |
|-------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------|
| Device mode |   | Set present device work as Host or Slave in parallel connection |
| Host baud   |                                                                                                                                                                         | Set Modbus baud rate                                            |

|                |            |        |                                                                                                     |
|----------------|------------|--------|-----------------------------------------------------------------------------------------------------|
| Slave baud     | 2400       | 4800   |                                                                                                     |
|                | 9600       | 115200 |                                                                                                     |
| Comm. protocol | Modbus RTU |        | Standard RS485 Modbus communication protocol                                                        |
|                | XJ         |        | Communication protocol of XJ ELECTRIC CO.,LTD in China, website: xjec.com                           |
|                | ATX        |        | Communication protocol of Shenzhen Auto Electric Power Plant Co., Ltd. in China, website: atc-a.com |
| IRM mode       | Real time  |        | Real-time monitoring branch circuit insulation resistance                                           |
|                | Fault Only |        | Calculate branch circuit insulation resistance only in earthing fault                               |

|                              |                                                                                                                                                                                  |
|------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Unbalanced bridge            | Default 120KΩ @ 110V/ 220V DC system<br><b>Note:</b> Change this value will lead to deviation when calculate system insulation resistance under unbalanced bridge detection mode |
| El <sub>posi</sub> calculate | If cannot install CT on BAT branch, "BAT branch No." = 0<br>Set value = 0 to disable BAT earthing fault detect;<br>Set value = 1 to enable BAT earthing fault detect;            |
|                              | If install CT on BAT branch, and correct set "BAT branch No."<br>Set value = 0 for connect CT core size < 40mm;<br>Set value = 1 for connect CT core size > 40mm;                |
| Io low cut                   | In balance bridge detection mode, ZJS-102 calculate insulation resistance @ branch current > threshold value                                                                     |
|                              | In unbalanced bridge detection mode, ZJS-102 calculate insulation resistance @ branch current > 50% threshold value                                                              |

**Note:** El<sub>posi</sub> calculation is based on internal logic algorithm, and there is no need to modify without Blue Jay's technical support.

### 5.7.3- Parallel connection

Click [Parallel connection](#) in the "Other Func." page, and users can enter the following page:

| System Info.                        | Alarm Info. | Pre-warn Info. | Real-time Current | History Record | System Config. | Collector Status | Other Func. |
|-------------------------------------|-------------|----------------|-------------------|----------------|----------------|------------------|-------------|
| <b>Parallel connection overall</b>  |             |                |                   |                |                |                  |             |
| Slave ID                            | Status      | Detail         | Slave ID          | Status         | Detail         |                  |             |
| 1                                   |             | More           | 9                 |                | More           |                  |             |
| 2                                   |             | More           | 10                |                | More           |                  |             |
| 3                                   |             | More           | 11                |                | More           |                  |             |
| 4                                   |             | More           | 12                |                | More           |                  |             |
| 5                                   |             | More           | 13                |                | More           |                  |             |
| 6                                   |             | More           | 14                |                | More           |                  |             |
| 7                                   |             | More           | 15                |                | More           |                  |             |
| 8                                   |             | More           | 16                |                | More           |                  |             |
| <input type="button" value="Back"/> |             |                |                   |                |                |                  |             |

There are 2 status of collector unit:

|           |             |
|-----------|-------------|
| None      | Unconnected |
| Connected | Connected   |

#### Notes:

1. Connection please refer to [Chapter 3.3.1.](#)
2. Users should set device working mode correctly in [Chapter 5.7.2.](#)

Click **More** and users can view the details of slave device as shown below:

| System Info.                                                                                                                                                                                 | Alarm Info. | Pre-warn Info.        | Real-time Current | History Record        | System Config. | Collector Status | Other Func. |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------|-----------------------|-------------------|-----------------------|----------------|------------------|-------------|
| <div> <div>Parell Slave ID <input type="text"/></div> <div>MODBUS Addr. <input type="text"/></div> <div>Auto polling <input type="text"/></div> <div>Set <input type="button"/></div> </div> |             |                       |                   |                       |                |                  |             |
| U <sub>DC</sub> / V:                                                                                                                                                                         |             | U <sub>+</sub> / V:   |                   | U <sub>-</sub> / V:   |                |                  |             |
| U <sub>AC</sub> / V:                                                                                                                                                                         |             | IR <sub>+</sub> / KΩ: |                   | IR <sub>-</sub> / KΩ: |                |                  |             |
| Overlimit                                                                                                                                                                                    |             | Insulation            |                   | AC isolation          |                |                  |             |
| Deviated                                                                                                                                                                                     |             | Earthing              |                   | DC isolation          |                |                  |             |
| Branch NO.                                                                                                                                                                                   | R+/KΩ       | R-/KΩ                 | Branch NO.        | R+/KΩ                 | R-/KΩ          | Branch NO.       | R+/KΩ       |
|                                                                                                                                                                                              |             |                       |                   |                       |                |                  |             |
|                                                                                                                                                                                              |             |                       |                   |                       |                |                  |             |
|                                                                                                                                                                                              |             |                       |                   |                       |                |                  |             |
|                                                                                                                                                                                              |             |                       |                   |                       |                |                  |             |
| <input type="button" value="Back"/>                                                                                                                                                          |             |                       |                   |                       |                |                  |             |

|                       |                           |                                                                                                     |
|-----------------------|---------------------------|-----------------------------------------------------------------------------------------------------|
| Auto polling          | ON                        | Set ON for enable auto polling data from slave. If set OFF, this page will no value display         |
|                       | OFF                       |                                                                                                     |
| Overlimit & Deviated  | U <sub>DC</sub> in range  | System voltage is normal                                                                            |
|                       | Voltage Unbalance         | Voltage derivation                                                                                  |
|                       | U <sub>DC</sub> overlimit | System voltage is out of limit                                                                      |
| Insulation & Earthing | IR in range               | Insulation resistance in pre-set range                                                              |
|                       | Insulation drop           | IR is lower than preset pre-warning threshlod                                                       |
|                       | Earthing alarm            | Earth fault alarm                                                                                   |
|                       | BAT branch fault          | Battery branch IR is lower than preset pre-warning threshlod, only be valid when set BAT branch No. |
|                       | BAT earthing              | Battery branch earthing fault                                                                       |
| AC isolation          | U <sub>AC</sub> in range  | U <sub>AC</sub> under pre-set threshold, AC and DC circuit in good insulation                       |
|                       | AC injection              | U <sub>AC</sub> over pre-set threshold                                                              |
| DC isolation          | DC Insulated              | Busbar-I and Busbar-II insulated                                                                    |
|                       | DC crossed                | Insulation fault Busbar-I to Busbar-II, there are DC crossed two DC systems                         |

## 6.- RS485 COMMUNICATION

### Physical port:

ZJS-102 has 2pin 5.08mm size terminal block header for RS485 port in rear panel. It is suggested that the composition of the RS-485 cabling is with a meshed screen cable (3 wire), also users can use 2 wire cabling for different applications, its diameter of not less than 0.5mm<sup>2</sup>, Maximum 2.5mm<sup>2</sup> (AWG20...12)

### Notes:

1. Host RS485 for communication with host PC. Slave RS485 connects with multiple ZJS-102 as daisy chain to expand measurement capacity, typical wiring please refer to [Chapter 3.3.1](#).
2. For communication with Host PC or PLC, users can choose RS-485 to RS-232 converter or RS485 to USB adapter.
3. For expanding the number of devices (max 16pcs) in the communication network, a signal repeater can be used.
4. Baud rate can be optional 2400/4800/9600/115200, setting please refer to [Chapter 5.7.2](#). Users must restart the device to take effect of Baud rate modify.

### Caution:

Communication terminal (RS232/ RS485 or Ethernet) is strictly prohibited to impose on high voltage!

**6.1. - Modbus RTU Frame Format:**

|                         |               |                                                                                                               |
|-------------------------|---------------|---------------------------------------------------------------------------------------------------------------|
| <b>Address code</b>     | <b>1 BYTE</b> | <i>Device ID (Slave address) <b>1-254</b></i>                                                                 |
| <b>Function code</b>    | <b>1 BYTE</b> | <i>Indicates the function codes like read register / coils / inputs etc.<br/>Starting Register, high byte</i> |
| <b>Data code</b>        | <b>4 BYTE</b> | <i>Starting Register, low byte<br/>Number of registers, high byte<br/>Number of registers, low byte</i>       |
| <b>Error Check code</b> | <b>2 BYTE</b> | <i>Cyclical Redundancy Check<br/>( <b>CRC</b> )</i>                                                           |

**6.2. - MODBUS FUNCTIONS:**

| <b>Code</b>        | <b>Meaning</b>         | <b>Description</b>                                     |
|--------------------|------------------------|--------------------------------------------------------|
| <b>FUNCTION 03</b> | Reading of n Words     | <i>This function permits to read multiple register</i> |
| <b>FUNCTION 10</b> | Preset Single register | <i>Used for RTC reset</i>                              |

**Notes:**

1. Response data is Big-endian (AB CD)
2. All parameters are two complement value.
3. If the host sends wrong inquire command or the process is error, ZJS-102 will have no response.

### 6.3. - Register map

#### 6.3.1- Regular parameter, read only by 03 code

Device provides DC power system real-time monitoring data, device status and insulation resistance value where the branch occurs insulation failure.

| Register | Data             | Byte mode |   | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
|----------|------------------|-----------|---|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 0x0000   | $U_{DC}$         | int       | 1 | DC power system voltage (Busbar-I)<br>Unit: 0.1V                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| 0x0001   | $U_{+}$          | int       | 1 | Busbar-I positive pole to ground voltage<br>Unit: 0.1V(signal )                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| 0x0002   | $U_{-}$          | int       | 1 | Busbar-I negative pole to ground voltage<br>Unit: 0.1V                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| 0x0003   | $IR_{+}$         | int       | 1 | Busbar-I positive pole to ground Insulation resistance<br>Unit: 0.1K $\Omega$                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| 0x0004   | $IR_{-}$         | int       | 1 | Busbar-I negative pole to ground Insulation resistance<br>Unit: 0.1K $\Omega$                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| 0x0005   | $IR_{BAT}$       | int       | 1 | Branch of Battery bank Insulation resistance<br>Unit: 0.1K $\Omega$                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| 0x0006   | $EI_{posi}$      | int       | 1 | BAT earthing location, calculate series connection cell node from positive pole                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| 0x0007   | $U_{AC}$         | int       | 1 | AC injection voltage<br>Unit: 0.01V                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| 0x0008   | DC system status | int       | 1 | Low Bit 0~7 used for indicate status,<br>0 for regular normal status,<br>1 for different alert info:<br><b>Bit0</b> Pre-waring of DC system insulation fail<br><b>Bit1</b> DC system pole to ground voltage deviation ( $U_d=U_{-}/U_{+}$ ) over limit<br><b>Bit2</b> Pre-waring of BAT branch insulation fail<br><b>Bit3</b> DC system voltage UDC over upper limit or lower limit<br><b>Bit4</b> Earthing fault alarm<br><b>Bit5</b> Busbar-I and Busbar-II occur DC cross situation<br><b>Bit6</b> AC injection status ( $U_{AC}$ ) over preset value<br><b>Bit7</b> Earthing alarm of BAT branch insulation fail |



|                   |                                |     |     |                                                                                                                                                                                                                                                                                               |
|-------------------|--------------------------------|-----|-----|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 0x0009            | Instantaneous recording status | int | 1   | low Bit 0 used for indicate status,<br>0 for regular normal status,<br>1 for different alert info:<br><b>Bit0</b> Generated a new instant record                                                                                                                                              |
| 0x000a            | Device status                  | int | 1   | Low Bit 0~4 used for indicate status,<br>0 for regular normal status,<br>1 for different alert info:<br><b>Bit0</b> Balance bridge failure<br><b>Bit1</b> Unbalanced bridge failure<br><b>Bit2</b> Collector unit (CU) communication disconnect<br><b>Bit3</b> Leakage current (Io) overlimit |
| 0x000b            | Earthing fault #1              | int | 1   | Branch No. of earthing fault                                                                                                                                                                                                                                                                  |
| 0x000c            | IR+ of #1                      | int | 1   | Positive pole to ground Insulation resistance<br>Unit: 0.1KΩ                                                                                                                                                                                                                                  |
| 0x000d            | IR- of #1                      | int | 1   | Negative pole to ground Insulation resistance<br>Unit: 0.1KΩ                                                                                                                                                                                                                                  |
| 0x000e            | Earthing fault #2              | int | 1   | Branch No. of earthing fault                                                                                                                                                                                                                                                                  |
| 0x000f            | IR+ of #2                      | int | 1   | Positive pole to ground Insulation resistance<br>Unit: 0.1KΩ                                                                                                                                                                                                                                  |
| 0x0010            | IR- of #2                      | int | 1   | Negative pole to ground Insulation resistance<br>Unit: 0.1KΩ                                                                                                                                                                                                                                  |
| ...               | ...                            | /   | /   | /                                                                                                                                                                                                                                                                                             |
| 0x0038            | Earthing fault #16             | int | 1   | Branch No. of earthing fault                                                                                                                                                                                                                                                                  |
| 0x0039            | IR+ of #16                     | int | 1   | Positive pole to ground Insulation resistance<br>Unit: 0.1KΩ                                                                                                                                                                                                                                  |
| 0x003a            | IR- of #16                     | int | 1   | Negative pole to ground Insulation resistance<br>Unit: 0.1KΩ                                                                                                                                                                                                                                  |
| 0x0100-<br>0x013a | ZJS-102<br>Sub-salve #1        | int | 59  | Refer to 0x0000-0x003a                                                                                                                                                                                                                                                                        |
| 0x0200-<br>0x023a | ZJS-102<br>Sub-salve #2        | int | 59  | Refer to 0x0000-0x003a                                                                                                                                                                                                                                                                        |
| ...               | ...                            | ... | ... | ...                                                                                                                                                                                                                                                                                           |
| 0x1000-<br>0x103a | ZJS-102<br>Sub-salve #16       | int | 59  | Refer to 0x0000-0x003a                                                                                                                                                                                                                                                                        |

**Notes:**

1. If no Earthing fault, the IR value register and branch No. register will be filled FF as placeholder.
2. Polling data must be less than 59 register. If over this limit, RS485 will have no response from device

### 6.3.2- Configuration parameter, read by 03 code, write by 06 code

| Register | Data                                              | Byte mode |   | Description                                             |
|----------|---------------------------------------------------|-----------|---|---------------------------------------------------------|
| 0x0050   | $U_{DC-U}$                                        | int       | 1 | Upper limit of $U_{DC}$                                 |
| 0x0051   | $U_{DC-L}$                                        | int       | 1 | Lower limit of $U_{DC}$                                 |
| 0x0052   | $U_{AC}$                                          | int       | 1 | AC injection alarm threshold                            |
| 0x0053   | $IR_{system}$                                     | int       | 1 | DC insulation resistance threshold                      |
| 0x0054   | $IR_{branch}$                                     | int       | 1 | Branch circuit insulation resistance threshold          |
| 0x0055   | $IR_{pre-warning}$                                | int       | 1 | Pre-warning insulation resistance<br>Unit 0.1K $\Omega$ |
| 0x0056   | $R_{balance}$                                     | int       | 1 | Unit 0.1K $\Omega$                                      |
| 0x0057   | $K_{U-/U+}$                                       | int       | 1 | Calculate formula = $(U-) / (U+)$<br>Unit 0.01          |
| 0x0058   | $U_{\Delta}$                                      | int       | 1 | Calculate formula = $  (U+) - (U-)  $<br>Unit 0.1V      |
| 0x0059   | $I_o$                                             | int       | 1 | Leakage current threshold<br>Unit 0.1mA                 |
| 0x005a   | Location of BAT earthing fault                    | int       | 1 | Set battery bank series connection quantities           |
| 0x005b   | BAT branch No.                                    | int       | 1 | Definition of battery bank branch No.                   |
| 0x005c   | Unbalanced bridge detection interval              | int       | 1 | Unit: Hour                                              |
| 0x005d   | Unbalanced bridge detection delay                 | int       | 1 | Unit: sec                                               |
| 0x005e   | Device MODBUS address                             | int       | 1 | Range: 1-254                                            |
| 0x005e   | Auto calibration                                  | int       | 1 | 0 for disable<br>1 for enable                           |
| 0x0060   | Voltage equalization                              | int       | 1 | 0 for disable<br>1 for enable                           |
| 0x0061   | Detection mode                                    | int       | 1 | 0 for balance bridge<br>1 for Unbalanced bridge         |
| 0x0062   | Balance bridge timing switch to Unbalanced bridge | int       | 1 | 0 for disable<br>1 for enable                           |

**Note:** Only can R/W host device parameter in parallel connection of multiple ZJS-102.

### 6.3.3- Examples of regular parameter and configuration parameter

Device ID 16, ready all regular parameter, sends inquire command:

10 03 00 00 00 3B 07 58

#### Device response round\_1:

10 03 76 08 A0 04 50 FB B0 27 0F 27 0F 27 0F 00 00 00 0A 00 00 00 00 00 00 FF FF  
 FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF  
 FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF  
 FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF  
 FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF  
 FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF 63 BE 00

Details meaning as is shown:

|                                |       |                                                                   |
|--------------------------------|-------|-------------------------------------------------------------------|
| U <sub>DC</sub>                | 08 A0 | 220.8V                                                            |
| U <sub>+</sub>                 | 04 50 | 110.4V                                                            |
| U <sub>-</sub>                 | FB B0 | -110.4V                                                           |
| IR <sub>+</sub>                | 27 0F | 999.9KΩ                                                           |
| IR <sub>-</sub>                | 27 0F | 999.9 KΩ                                                          |
| IR <sub>BAT</sub>              | 27 0F | 999.9 KΩ                                                          |
| EI <sub>posi</sub>             | 00 00 | 0                                                                 |
| U <sub>AC</sub>                | 00 0A | 0.10V                                                             |
| DC system status               | 00 00 | Regular normal status, no alarm                                   |
| Instantaneous recording status | 00 00 | Regular normal status, no record generated                        |
| Device status                  | 00 00 | Regular normal status, no failure                                 |
| Earthing fault #1              | FF FF | Placeholder, no earthing fault                                    |
| IR <sub>+</sub> of #1          | FF FF | Placeholder, no earthing fault                                    |
| IR <sub>-</sub> of #1          | FF FF | Placeholder, no earthing fault                                    |
| .....                          |       | ...                                                               |
| CRC                            | 63 BE | Cyclical Redundancy Check                                         |
| Special placeholder            | 00    | Integrity of the data and not affect the judgment, can be ignored |

**Device response round\_2:**

10 03 76 08 97 02 71 F9 DA 00 C5 27 0F 27 0F 00 00 00 00 00 12 00 00 00 00 00 01 00  
 C6 27 0F 00 05 00 CA 27 0F 00 08 00 C9 27 0F FF FF FF FF FF FF FF FF FF FF FF  
 FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF  
 FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF  
 FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF 9F B8 00

Details meaning as is shown:

|                                |       |                                                                                                                                                          |
|--------------------------------|-------|----------------------------------------------------------------------------------------------------------------------------------------------------------|
| U <sub>DC</sub>                | 08 97 | 219.9V                                                                                                                                                   |
| U <sub>+</sub>                 | 02 71 | -157.4V                                                                                                                                                  |
| U <sub>-</sub>                 | F9 DA | 6396.2V                                                                                                                                                  |
| IR <sub>+</sub>                | 00 C5 | 19.7KΩ                                                                                                                                                   |
| IR <sub>-</sub>                | 27 0F | 999.9 KΩ                                                                                                                                                 |
| IR <sub>BAT</sub>              | 27 0F | 999.9 KΩ                                                                                                                                                 |
| EI <sub>posi</sub>             | 00 00 | 0                                                                                                                                                        |
| U <sub>AC</sub>                | 00 00 | 0.00V                                                                                                                                                    |
| DC system status               | 00 12 | BIN 00010010:<br>-. DC system pole to ground voltage deviation (U <sub>d</sub> =U <sub>-</sub> /U <sub>+</sub> ) over limit.<br>-. Earthing fault alarm. |
| Instantaneous recording status | 00 00 | Regular normal status, no record generated                                                                                                               |
| Device status                  | 00 00 | Regular normal status, no failure                                                                                                                        |
| Earthing fault #1              | 00 01 | Branch No.1 earthing fault                                                                                                                               |
| IR <sub>+</sub> of #1          | 00 C6 | 19.8 KΩ                                                                                                                                                  |
| IR <sub>-</sub> of #1          | 27 0F | 999.9 KΩ                                                                                                                                                 |
| Earthing fault #2              | 00 05 | Branch No.5 earthing fault                                                                                                                               |
| IR <sub>+</sub> of #2          | 00 CA | 20.2 KΩ                                                                                                                                                  |
| IR <sub>-</sub> of #2          | 27 0F | 999.9 KΩ                                                                                                                                                 |
| Earthing fault #3              | 00 08 | Branch No.8 earthing fault                                                                                                                               |
| IR <sub>+</sub> of #3          | 00 C9 | 20.1 KΩ                                                                                                                                                  |
| IR <sub>-</sub> of #3          | 27 0F | 999.9 KΩ                                                                                                                                                 |
| Earthing fault #4              | FF FF | Placeholder, no earthing fault                                                                                                                           |
| IR <sub>+</sub> of #4          | FF FF | Placeholder, no earthing fault                                                                                                                           |
| IR <sub>-</sub> of #4          | FF FF | Placeholder, no earthing fault                                                                                                                           |
| .....                          |       | ...                                                                                                                                                      |

|             |       |                                                                   |
|-------------|-------|-------------------------------------------------------------------|
| CRC         | 9F B8 | Cyclical Redundancy Check                                         |
| Placeholder | 00    | Integrity of the data and not affect the judgment, can be ignored |

#### 6.4.- RTC synchronization, write by 16 code

Send write command:

FF 10 08 07 E6 09 1A 0C 38 DE A8 16 56

|       |                         |
|-------|-------------------------|
| FF    | Broadcast in MODBUS     |
| 10    | Write by 16 code        |
| 08    | Data with 8 byte length |
| 07 E6 | 2022 year               |
| 09    | 09 month                |
| 1A    | 26 date                 |
| 0C    | 12 Hours                |
| 38    | 56 minutes              |
| DE A8 | 57000 millisecond       |
| 16 56 | CRC                     |

**Note:** In RTC synchronization operation, ZJS-102 does not give response. Please check the screen to confirm whether operate successfully or not.

## 6.5.- Appendix: calculation of CRC

CRC (Cyclical Redundancy Check) is composed of two bytes, the generation function as shown:

### 1.- CRC calculation function

WORD ModbusCRC(BYTE \* buf, int len)

```
{
    BYTE  hi, lo, idx;
    WORD  crc;

    hi = 0xff;
    lo = 0xff;

    while(len--)
    {
        idx = lo ^ *buf++;
        lo = hi ^ gpbtCRCLo[idx];
        hi = gpbtCRCHi[idx];
    }

    crc = hi;
    crc <<= 8;
    crc += lo;

    return crc;
}
```

### 2.- CRC table

High byte:

BYTE gpbtCRCLo[] =

```
{
    0x00,0xc1,0x81,0x40,0x01,0xc0,0x80,0x41,0x01,0xc0,
    0x80,0x41,0x00,0xc1,0x81,0x40,0x01,0xc0,0x80,0x41,
    0x00,0xc1,0x81,0x40,0x00,0xc1,0x81,0x40,0x01,0xc0,
    0x80,0x41,0x01,0xc0,0x80,0x41,0x00,0xc1,0x81,0x40,
```



```

0x00,0xc1,0x81,0x40,0x01,0xc0,0x80,0x41,0x00,0xc1,
0x81,0x40,0x01,0xc0,0x80,0x41,0x01,0xc0,0x80,0x41,
0x00,0xc1,0x81,0x40,0x01,0xc0,0x80,0x41,0x00,0xc1,
0x81,0x40,0x00,0xc1,0x81,0x40,0x01,0xc0,0x80,0x41,
0x00,0xc1,0x81,0x40,0x01,0xc0,0x80,0x41,0x01,0xc0,
0x80,0x41,0x00,0xc1,0x81,0x40,0x00,0xc1,0x81,0x40,
0x01,0xc0,0x80,0x41,0x01,0xc0,0x80,0x41,0x00,0xc1,
0x81,0x40,0x01,0xc0,0x80,0x41,0x00,0xc1,0x81,0x40,
0x00,0xc1,0x81,0x40,0x01,0xc0,0x80,0x41,0x01,0xc0,
0x80,0x41,0x00,0xc1,0x81,0x40,0x00,0xc1,0x81,0x40,
0x01,0xc0,0x80,0x41,0x00,0xc1,0x81,0x40,0x01,0xc0,
0x80,0x41,0x01,0xc0,0x80,0x41,0x00,0xc1,0x81,0x40,
0x00,0xc1,0x81,0x40,0x01,0xc0,0x80,0x41,0x01,0xc0,
0x80,0x41,0x00,0xc1,0x81,0x40,0x01,0xc0,0x80,0x41,
0x00,0xc1,0x81,0x40,0x00,0xc1,0x81,0x40,0x01,0xc0,
0x80,0x41,0x00,0xc1,0x81,0x40,0x01,0xc0,0x80,0x41,
0x01,0xc0,0x80,0x41,0x00,0xc1,0x81,0x40,0x01,0xc0,
0x80,0x41,0x00,0xc1,0x81,0x40,0x00,0xc1,0x81,0x40,
0x01,0xc0,0x80,0x41,0x01,0xc0,0x80,0x41,0x00,0xc1,
0x81,0x40,0x00,0xc1,0x81,0x40,0x01,0xc0,0x80,0x41,
0x00,0xc1,0x81,0x40,0x01,0xc0,0x80,0x41,0x01,0xc0,
0x80,0x41,0x00,0xc1,0x81,0x40
};

```

Low Byte :

```

BYTE gpbtCRCHI[] = {
    0x00,0xc0,0xc1,0x01,0xc3,0x03,0x02,0xc2,0xc6,0x06,
    0x07,0xc7,0x05,0xc5,0xc4,0x04,0xcc,0x0c,0x0d,0xcd,
    0x0f,0xcf,0xce,0x0e,0x0a,0xca,0xcb,0x0b,0xc9,0x09,
    0x08,0xc8,0xd8,0x18,0x19,0xd9,0x1b,0xdb,0xda,0x1a,
    0x1e,0xde,0xdf,0x1f,0xdd,0x1d,0x1c,0xdc,0x14,0xd4,
    0xd5,0x15,0xd7,0x17,0x16,0xd6,0xd2,0x12,0x13,0xd3,
    0x11,0xd1,0xd0,0x10,0xf0,0x30,0x31,0xf1,0x33,0xf3,
    0xf2,0x32,0x36,0xf6,0xf7,0x37,0xf5,0x35,0x34,0xf4,
    0x3c,0xfc,0xfd,0x3d,0xff,0x3f,0x3e,0xfe,0xfa,0x3a,

```

```

0x3b,0xfb,0x39,0xf9,0xf8,0x38,0x28,0xe8,0xe9,0x29,
0xeb,0x2b,0x2a,0xea,0xee,0x2e,0x2f,0xef,0x2d,0xed,
0xec,0x2c,0xe4,0x24,0x25,0xe5,0x27,0xe7,0xe6,0x26,
0x22,0xe2,0xe3,0x23,0xe1,0x21,0x20,0xe0,0xa0,0x60,
0x61,0xa1,0x63,0xa3,0xa2,0x62,0x66,0xa6,0xa7,0x67,
0xa5,0x65,0x64,0xa4,0x6c,0xac,0xad,0x6d,0xaf,0x6f,
0x6e,0xae,0xaa,0x6a,0x6b,0xab,0x69,0xa9,0xa8,0x68,
0x78,0xb8,0xb9,0x79,0xbb,0x7b,0x7a,0xba,0xbe,0x7e,
0x7f,0xbf,0x7d,0xbd,0xbc,0x7c,0xb4,0x74,0x75,0xb5,
0x77,0xb7,0xb6,0x76,0x72,0xb2,0xb3,0x73,0xb1,0x71,
0x70,0xb0,0x50,0x90,0x91,0x51,0x93,0x53,0x52,0x92,
0x96,0x56,0x57,0x97,0x55,0x95,0x94,0x54,0x9c,0x5c,
0x5d,0x9d,0x5f,0x9f,0x9e,0x5e,0x5a,0x9a,0x9b,0x5b,
0x99,0x59,0x58,0x98,0x88,0x48,0x49,0x89,0x4b,0x8b,
0x8a,0x4a,0x4e,0x8e,0x8f,0x4f,0x8d,0x4d,0x4c,0x8c,
0x44,0x84,0x85,0x45,0x87,0x47,0x46,0x86,0x82,0x42,
0x43,0x83,0x41,0x81,0x80,0x40
};

```

## **7.- ORDER INFORMATION**

1. Customers need to provide rated voltage in the DC system.
2. Customers should provide circuit number which is need to monitor in the DC system, or required digital sensors.
3. If need to connect with other systems, customers should provide communication protocol of access.
4. Better to provide operation mode if there are two DC Busbar running.
5. In order to easily install the Host, customers need to provide the outline structure drawing of DC panel.