

ЭНЕРГОМЕТРИКА
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Energom-D-102

DC System Insulation Monitor



User Manual

Version:1.0

Read me

When you use EnergoM-D-102 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 EnergoM-D-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.

Energom-D-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 Energom-D-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_{Δ} & $K_{U-/U+}$), resistor bridge automatic calibration etc. Energom-D-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 insulation resistance to ground:

- Earthing alarm: 0-50K
- Pre-waring: 50-300K

- 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: ± 1 cell

- Alarm history record:

- Record list quantities: 2000 lists
- Each record alarm list volume: ≤ 32 branches

- Real-time leakage current measurement

- Screen display resolution: 0.01mA
- Current sensor range: 10mA, 20mA, 50mA, 100mA optional
- Each EnergoM-D-102 port detect current volume: ≤ 240 branches
- Each EnergoM-D-102-CU collector unit connected current sensor: ≤ 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

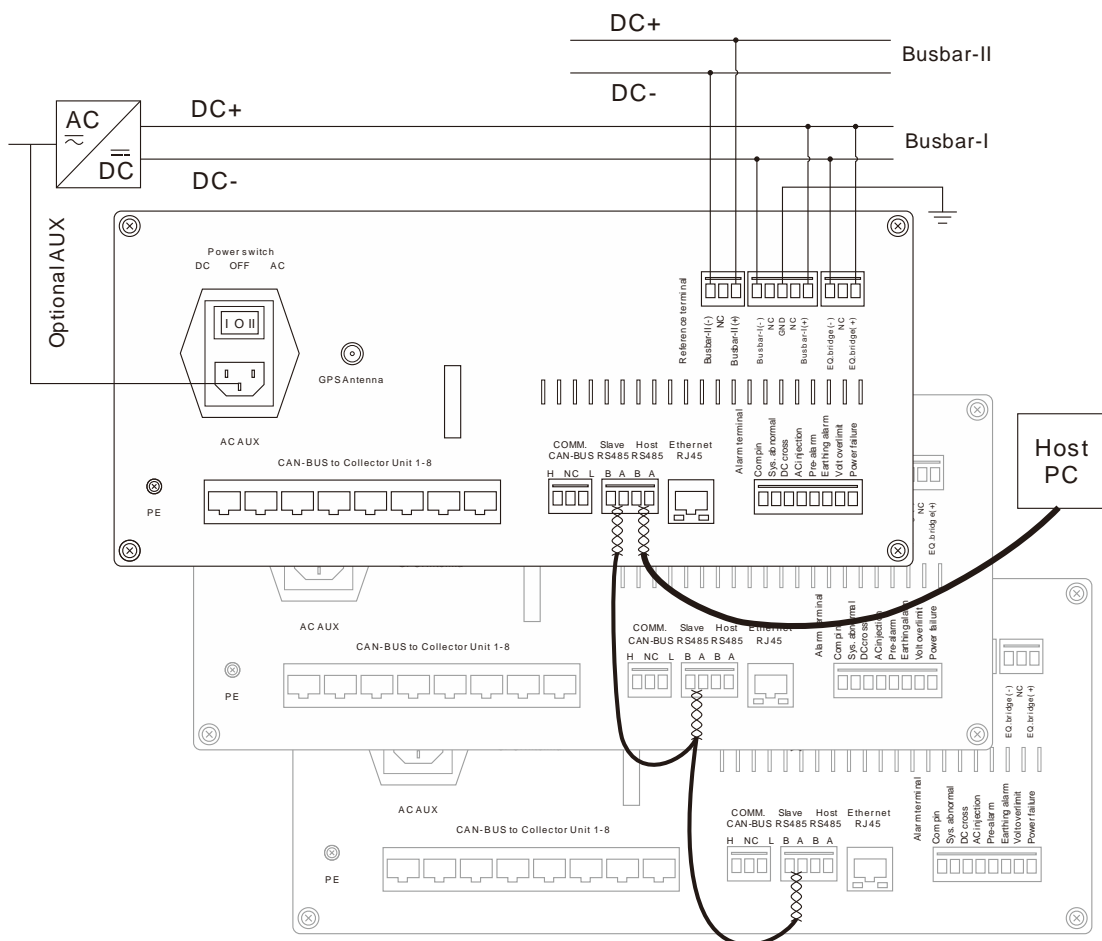
3.- INSTALLATION AND START-UP

3.1.- Device Overall

The whole monitoring equipment consists of three parts:

- Main device body EnergoM-D-102-102
- Current sensor collector unit EnergoM-D-102-CU
- DC leakage current sensor EnergoM-D-102-DCLC

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



Typical wiring mode of EnergoM-D-102 wiring

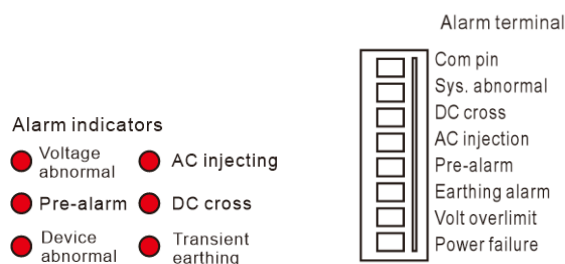
Notes:

- 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. EnergoM-D-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.

3. When one EnergoM-D-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.
4. Alarm terminal is NO passive node.
5. GPS port is optional, for RTC calibration and submitting station location.
6. Ethernet port is optional for connecting Host PC.
7. PE terminal is for enclosure grounding protection.

3.2.- Alarm indicators terminal defincations

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

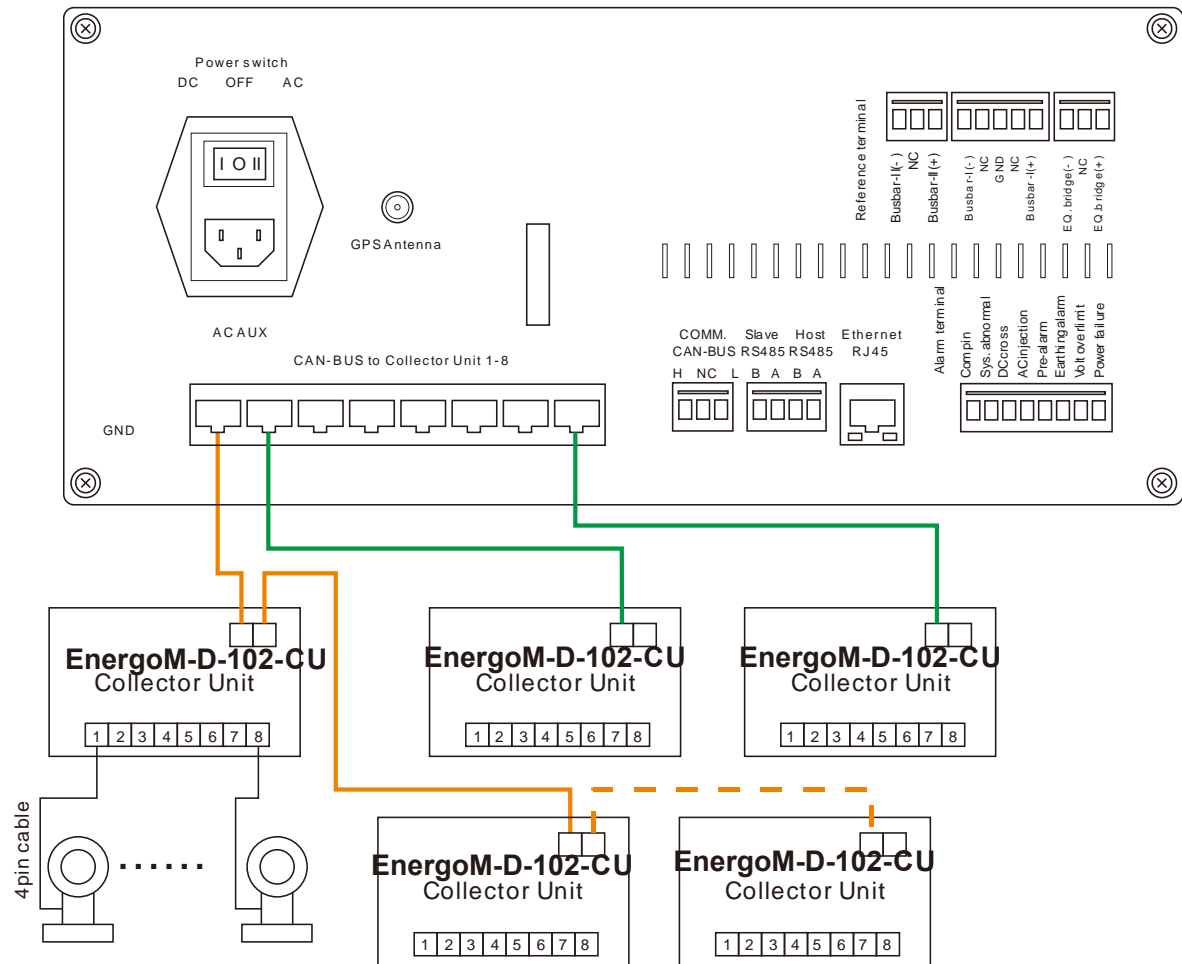


Items / Alias	Description	
Voltage abnormal Volt overlimit	Front LED Rear terminal	DC sytem voltage over upper/lower limit
AC injecting AC injection	Front LED Rear terminal	AC signal over preset limit
Pre-alarm	Front LED Rear terminal	Insulation resistance below pre-warning preset limit
Earthing alarm	Rear terminal	Insulation resistance below earthing alarm limit
DC cross	Front LED Rear terminal	Busbar-II DC voltage cross to Busbar-I or branch circuit voltage cross to each other
Device abnormal	Front LED Rear terminal	Balance bridge/unbalanced bridge fault or collector unit communication error
Transient earthing	Front LED	Associated to instant event record configution, 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 EnergoM-D-102-CU

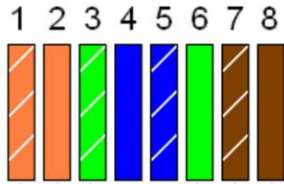
EnergoM-D-102 rear panel has 8*RJ45 ports and 1*Pin terminal for CAN-BUS connection to EnergoM-D-102 - CU. Device will automatic identify connected units, and bring highly flexibility to on-site wiring and configuration:



Typical wiring mode of single EnergoM-D-102-102

Notes:

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



3.3.2- Configuration of EnergoM-D-102-CU

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

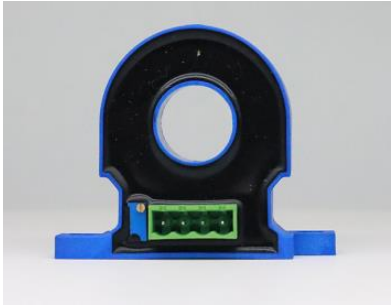
Bit 8	Bit 7	Sensor rating
0	0	10mA
0	1	20mA
1	0	50mA
1	1	100mA

Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	EnergoM-D-102-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 EnergoM-D-102-CU is 40pcs, regular less than 32pcs. If set over 40, EnergoM-D-102 will not recognize collector units. Bit6 connects a 240ohm terminal resistance for daisy chain.
2. If purchase CTs from, sensor rating default is 50mA.

Each EnergoM-D-102-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 EnergoM-D-102-CU, and its terminal port in ZJS-CU is RJ48, terminal definition is as shown:

Sensor	Wire definition	Description	RJ45 on EnergoM-D-102-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

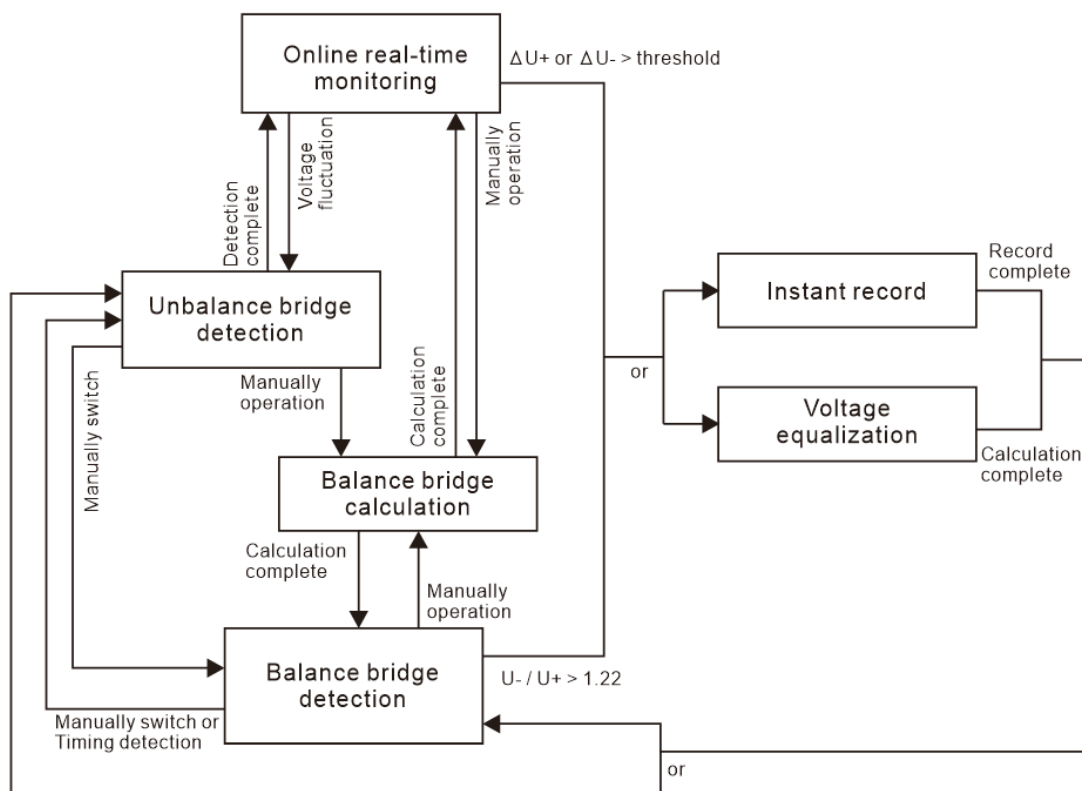
4.1.- Device Detection Logic

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 EnergoM-D-102-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 ΔI_{branch} of current sensor connected by EnergoM-D-102-CU.

EnergoM-D-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_{Δ}
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.

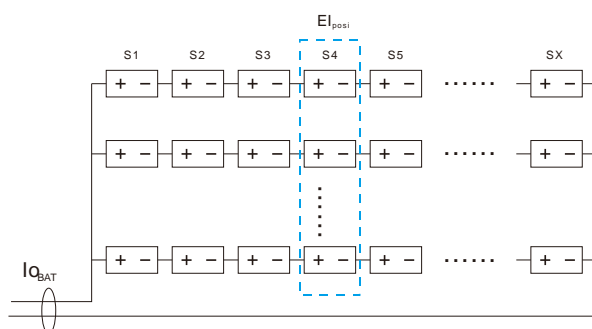
4.2.2.- Branch circuit pre-warning and insulation alarm

Energom-D-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

Energom-D-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 ($E_{I_{posi}}$).



In multiple series & parallel BAT bank, Energom-D-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_- , I_{R+} and I_{R-} , U_{AC} (AC injection)

Max 32 insulation failed branch $I_{R_{branch+}}$ and $I_{R_{branch-}}$

Notes:

1. If set Battery bank parameters, device can calculate $E_{I_{posi}}$ 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, EnergoM-D-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.

IR+	Positive pole to ground insulation resistance
IR-	Negative pole to ground insulation resistance
IR _{BAR}	Battery bank branch insulation resistance
Battery EI _{posi}	Battery bank earth insulation fault location
C _{distri}	Distributed capacity of DC system
Pre-waning	Number of pre-warning triggered
Earth alarm	Number of earth alarm triggered


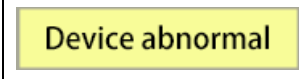
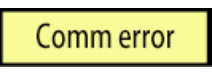
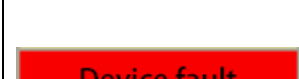
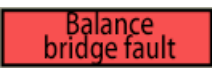

5.1.2- DC system and device status

Center area will show the DC Power System status (abbr. DC sys.) and EnergoM-D-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_{DC} in range	U _{DC} in pre-set upper / lower range
	U_{AC} in range	U _{AC} 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 EnergoM-D-102 to EnergoM-D-102-CU in the normal status
	Unbalance bridge normal	Unbalanced bridge in the normal status
	I_o in range	Leakage current under pre-set threshold
DC sys. abnormal	Insulation drop	IR is lower than preset pre-warning threshlod
	Voltage Unbalance	K _{U-JU+} or U Δ over preset threshold
DC sys. fault	Earthing alarm	Earth fault alarm
	AC injection	U _{AC} is over pre-set threshold
	DC crossed	Insulation fault Busbar-I to Busbar-II, there are DC crossed two DC systems
	U_{DC} overlimit	U _{DC} over upper / lower limit

Energom-D-102 device status have 3 status indicators as the following:

	/	Device in the normal status
		There exists communication error from Energom-D-102 to Energom-D-102-CU
		/
		/

5.1.3- Other icons

		Indicate device working mode, can be set in Other Func. page, details refer to Chapter 5.7
		Voltage auto equalization function, details refer to Chapter 4.2.6
		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. 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.)

Energom-D-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.																																												
<table border="1"> <thead> <tr> <th>Branch No.</th> <th>Alarm type</th> <th>IR+ / KΩ</th> <th>IR- / KΩ</th> </tr> </thead> <tbody> <tr><td> </td><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td><td> </td></tr> </tbody> </table>								Branch No.	Alarm type	IR+ / KΩ	IR- / KΩ																																								
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Figure 2 Alarm Info.

System Info.	Alarm Info.	Pre-warn Info.	Real-time Current	History Record	System Config.	Collector Status	Other Func.																																												
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Figure 3 Pre-warn Info.

Alarm type will show one of the following 6 icons:

Earthing fault	Combined Branch No. can know a certain location that earthing fault
BAT earthing	Battery branch earthing fault
AC injection	Combined Branch No. users can know a certain location that AC injection into Busbar-I
DC cross	Combined Branch No. users can know a certain location that Busbar-II DC cross with Busbar-I
Insulation drop	IR lower than preset pre-warning threshlod
BAT branch fault	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.																																																						
<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr style="background-color: #d9d9d9;"> <th style="padding: 5px;">Branch No.</th> <th style="padding: 5px;">Leakage current /mA</th> <th style="padding: 5px;">Branch No.</th> <th style="padding: 5px;">Leakage current /mA</th> <th style="padding: 5px;">Branch No.</th> <th style="padding: 5px;">Leakage current /mA</th> </tr> </thead> <tbody> <tr><td> </td><td> </td><td> </td><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td><td> </td><td> </td><td> </td></tr> </tbody> </table>								Branch No.	Leakage current /mA	Branch No.	Leakage current /mA	Branch No.	Leakage current /mA																																																
Branch No.	Leakage current /mA	Branch No.	Leakage current /mA	Branch No.	Leakage current /mA																																																								
<div style="display: flex; justify-content: space-between; align-items: center;"> Clear All Total <input style="width: 40px;" type="text"/> Lists Total <input style="width: 40px;" type="text"/> Page Present <input style="width: 40px;" type="text"/> Page <input style="width: 40px;" type="text"/> Previous Next </div>																																																													

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.

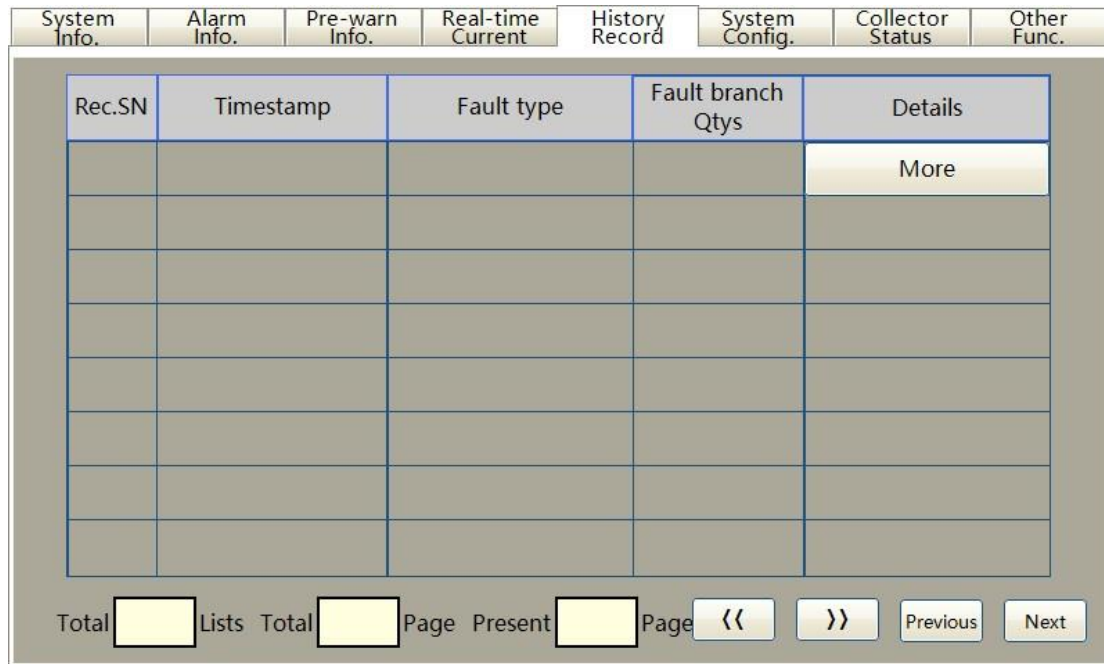


Figure 4 History record abstract

Fault type will show one of the following 8 icons:

Earthing fault	/
U_{DC} overlimit	U _{DC} 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 _{U-U+} or UΔ 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).

System Info.	Alarm Info.	Pre-warn Info.	Real-time Current	History Record	System Config.	Collector Status	Other Func.
--------------	-------------	----------------	-------------------	----------------	----------------	------------------	-------------

RTC Fault type

Branch Qtys DC cross loop style BAT insulation status KΩ Cell





U_{DC} : U₊ : U₋ : IR₊ : IR₋ : U_{AC} :

Branch No.	R+/KΩ	R-/KΩ	Branch No.	R+/KΩ	R-/KΩ	Branch No.	R+/KΩ	R-/KΩ	Branch No.	R+/KΩ	R-/KΩ


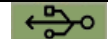
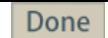
Export log Exit Previous Record SN: Next

Figure 5 History record details

DC cross loop style shows DC cross fault style:

	Positive of Busbar-I and Positive of Busbar-II connected
	Negative of Busbar-I and Negative of Busbar-II connected
	Positive of Busbar-I and Negative of Busbar-II connected
	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.
		$U_{DC-U} / V:$	<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"/>		reboot:	<input type="text"/>	
		$R_{balance} /$	<input type="text"/>		ation:	<input type="text"/>	
		$K_{U-/U+}$ threshold	<input type="text"/>		etting:	<input type="text"/>	Enter
		U_{Δ} threshold / V:	<input type="text"/>		Auto-calculate Rbalance:	<input type="text"/>	Enter
		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"/>	Enter
		U_{Δ} threshold / V:	<input type="text"/>		Auto-calculate Rbalance:	<input type="text"/>	Enter
		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 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 _Δ	System Voltage Unbalanced degree , $U_{\Delta} = (U+) - (U-) $	Display voltage deviation @ (U+) - (U-) > threshold value
Io	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 Chapter 4.2.3
BAT branch No.	Define branch No. of battery bank. Note: Set 0 to let EnergoM-D-102 ignore BAT, EI _{posi} function will be disabled.
Timing detect interval	Set automatic detection interval for unbalanced bridge. Note: Set this interval also need active <input type="checkbox"/> Timing detect ON in system page by clicking it.
Bridge stabilization delay	Wait for the unbalanced bridge stable after connect to DC system. The larger the value, the longer the waiting time
Device MODBUS Addr.	Communication address of present EnergoM-D-102 to host PC/PLC
Auto-reset after reboot	Enable this function, current sensor will automatic reset to zero if detect Io<10mA after reboot. Note: In Real-time current page, click <input type="button" value="Clear All"/> to manually reset.
Voltage equalization	Enable this function, if deviation ratio K _{U-/U+} of over a preset value, EnergoM-D-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 <input type="button" value="Start"/> button, R _{balance} will automatic reset by device internal calculation.

5.6.- Collector Status Screen

In this page users can see all the connected EnergoM-D-102-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	

There are 3 status of collector unit:

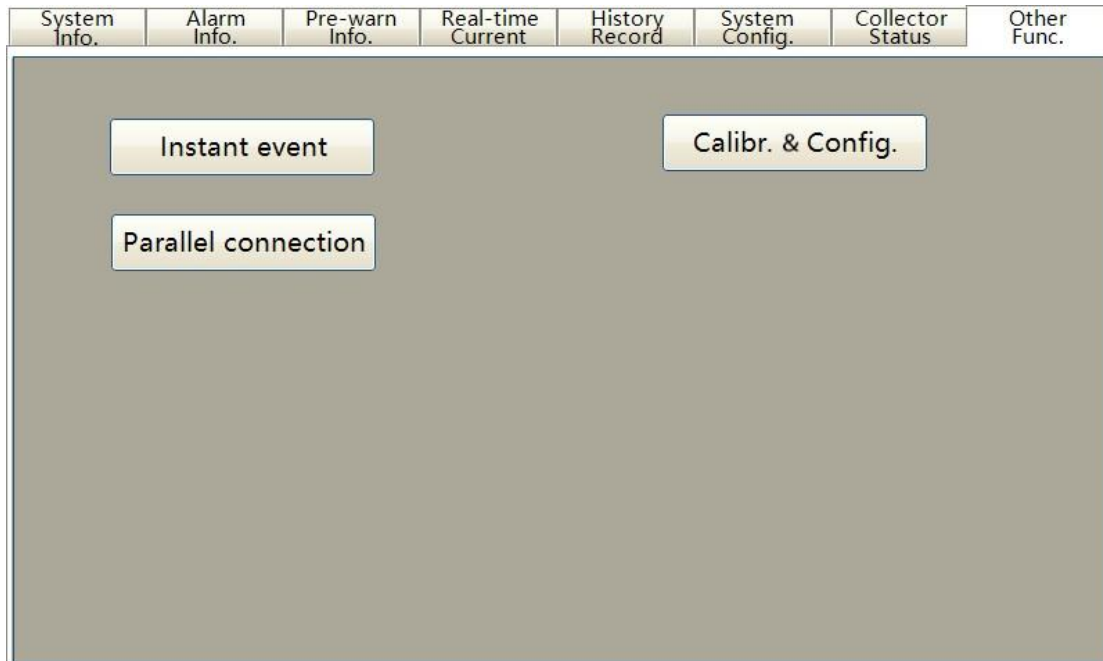
None	Unconnected
Connected	Connected
Disconnect	Communication interrupted

Notes:

1. For EnergoM-D-102-CU Disconnect, users can click Remove disconnected collector to turn the Disconnect into None status.
2. Collector ID is setting by DIP switch on EnergoM-D-102-CU, please refer Chapter 3.3.2.

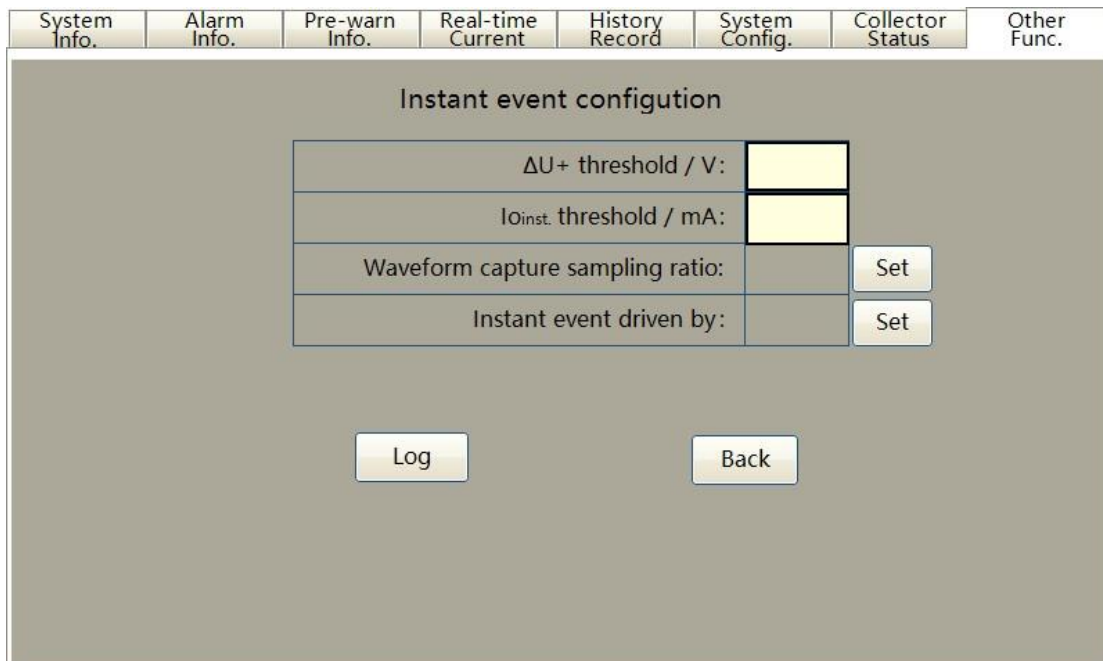
5.7.- Other Functions (Other Func.)

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 $\Delta U+$ Example: set $\Delta U+ = 5$, If $U+ > 115V$ or $U+ < 105V$, EnergoM-D-102 will consider happen instant event.
$I_{Oinst.}$	Leakage current threshold that trigger start-up instant record	Record event @ Detected insulation current $I_{Oinst.}$

Waveform capture sampling ratio	<input type="radio"/> 1KHz <input type="radio"/> 500Hz <input type="radio"/> 250Hz <input type="radio"/> 125Hz
Instant event driven by	<input type="radio"/> $I_{Oinst.}$ <input type="radio"/> $\Delta U_{inst.}$

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.
--------------	-------------	----------------	-------------------	----------------	----------------	------------------	-------------

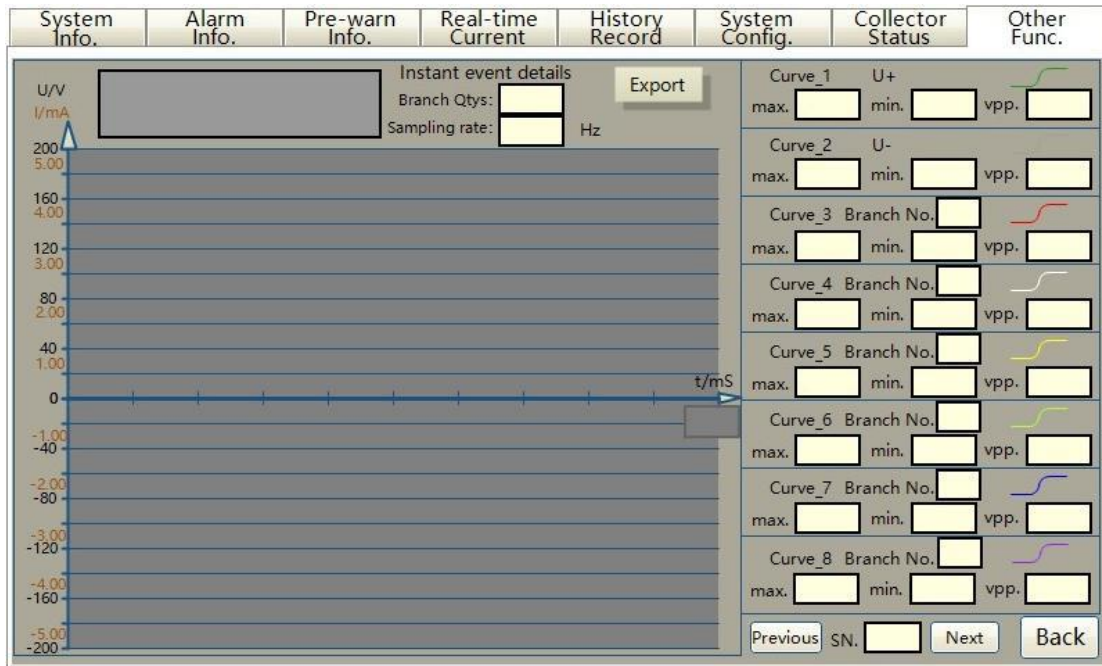
Instant event record

Record SN.	Timestamp	Branch Qtys	Details
			More

Total Lists Total Page Present Page

EnergoM-D-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.


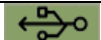
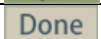
2 waveforms for DC system voltage, related to $\Delta U+$

6 waveforms for branch leakage current, related to $I_{o_{inst}}$.

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

- max. Maximum value in instant event
- mini. Maximum value in instant event
- vpp. $||\max.| - |\min.|$

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

System Info.	Alarm Info.	Pre-warn Info.	Real-time Current	History Record	System Config.	Collector Status	Other Func.
--------------	-------------	----------------	-------------------	----------------	----------------	------------------	-------------

Calibration & Configuration

Voltage calibration	Current calibration	Configuration																																																																																				
<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th>Items</th> <th>Disp./V</th> <th>Real./V</th> <th>Operate</th> </tr> </thead> <tbody> <tr><td>I_U+</td><td></td><td></td><td>Calibrate</td></tr> <tr><td>I_U-</td><td></td><td></td><td>Calibrate</td></tr> <tr><td>II_U+</td><td></td><td></td><td>Calibrate</td></tr> <tr><td>UAc</td><td></td><td></td><td>Calibrate</td></tr> <tr><td>BB_U+</td><td></td><td></td><td>Calibrate</td></tr> <tr><td>BB_U-</td><td></td><td></td><td>Calibrate</td></tr> <tr><td>UB_U+</td><td></td><td></td><td>Calibrate</td></tr> <tr><td>UB_U-</td><td></td><td></td><td>Calibrate</td></tr> </tbody> </table>	Items	Disp./V	Real./V	Operate	I_U+			Calibrate	I_U-			Calibrate	II_U+			Calibrate	UAc			Calibrate	BB_U+			Calibrate	BB_U-			Calibrate	UB_U+			Calibrate	UB_U-			Calibrate	<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th>Items</th> <th>Branch No.</th> <th>Operate</th> </tr> </thead> <tbody> <tr><td>Zero point Cal.</td><td></td><td>Calibrate</td></tr> <tr><td>Compensate Cal.</td><td></td><td>Calibrate</td></tr> <tr> <td colspan="3" style="font-size: small;">Notes: Branch No. enter 500 for calibrate all sensor or only calibrated designated sensor</td> </tr> <tr> <th colspan="3" style="text-align: center;">Record erase</th> </tr> <tr> <td style="text-align: center;">history record</td> <td></td> <td style="text-align: center;">Erase</td> </tr> <tr> <td style="text-align: center;">instant event record</td> <td></td> <td style="text-align: center;">Erase</td> </tr> </tbody> </table>	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	<table border="1" style="width: 100%; border-collapse: collapse;"> <tbody> <tr><td>Device mode</td><td></td><td style="text-align: center;">Set</td></tr> <tr><td>Host baud</td><td></td><td style="text-align: center;">Set</td></tr> <tr><td>Slave baud</td><td></td><td style="text-align: center;">Set</td></tr> <tr><td>Comm. protocol</td><td></td><td style="text-align: center;">Set</td></tr> <tr><td>IRM mode</td><td></td><td style="text-align: center;">Set</td></tr> <tr><td>Unbalance bridge/KΩ</td><td></td><td></td></tr> <tr><td>El_{posi} caculate</td><td></td><td></td></tr> <tr><td>Io low cut/mA</td><td></td><td></td></tr> <tr><td>Collector qtys</td><td></td><td></td></tr> </tbody> </table>	Device mode		Set	Host baud		Set	Slave baud		Set	Comm. protocol		Set	IRM mode		Set	Unbalance bridge/KΩ			El _{posi} caculate			Io low cut/mA			Collector qtys		
Items	Disp./V	Real./V	Operate																																																																																			
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Collector qtys																																																																																						

Voltage calibration

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

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 I ₀ of certain branch to 0, based on EnergoM-D-102 zero point. Note: Generally use this calibration mode to check real drift value of the sensor
Compensate Cal.	Set measurement I ₀ as 0 point in certain branch, based on output signal level. Note: 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	<input type="checkbox"/> Host <input type="checkbox"/> Slave	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 120K Ω @ 110V/ 220V DC system Note: Change this value will lead to deviation when calculate system insulation resistance under unbalanced bridge detection mode
EI _{posi} calculate	If cannot install CT on BAT branch, "BAT branch No." = 0 Set value = 0 to disable BAT earthing fault detect; Set value = 1 to enable BAT earthing fault detect;
	If install CT on BAT branch, and correct set "BAT branch No." Set value = 0 for connect CT core size < 40mm; Set value = 1 for connect CT core size > 40mm;
Io low cut	In balance bridge detection mode, EnergoM-D-102 calculate insulation resistance @ branch current > threshold value
	In unbalanced bridge detection mode, EnergoM-D-102 calculate insulation resistance @ branch current > 50% threshold value

Note: EI_{posi} calculation is based on internal logic algorithm, and there is no need to modify without 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.
Parallel connection overall							
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:

<input type="button" value="None"/>	Unconnected
<input checked="" type="button" value="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 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.				
Parell Slave ID <input type="text"/>		Auto polling <input type="button" value="Set"/>									
MODBUS Addr. <input type="text"/>											
U _{DC} / V:		U ₊ / V:		U ₋ / V:							
U _{AC} / V:		IR ₊ / KΩ:		IR ₋ / 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	R-/KΩ	Branch NO.	R+/KΩ	R-/KΩ
<input type="button" value="Back"/>											

Auto polling	<div style="background-color: green; color: white; padding: 2px; text-align: center;">ON</div> <div style="background-color: gray; color: black; padding: 2px; text-align: center;">OFF</div>	Set ON for enable auto polling data from slave. If set OFF, this page will no value display
Overlimit & Deviated	<div style="background-color: green; color: white; padding: 2px; text-align: center;">U_{DC} in range</div>	System voltage is normal
	<div style="background-color: yellow; color: black; padding: 2px; text-align: center;">Voltage Unbalance</div>	Voltage derivation
	<div style="background-color: red; color: white; padding: 2px; text-align: center;">U_{DC} overlimit</div>	System voltage is out of limit
Insulation & Earthing	<div style="background-color: green; color: white; padding: 2px; text-align: center;">IR in range</div>	Insulation resistance in pre-set range
	<div style="background-color: yellow; color: black; padding: 2px; text-align: center;">Insulation drop</div>	IR is lower than preset pre-warning threshlod
	<div style="background-color: red; color: white; padding: 2px; text-align: center;">Earthing alarm</div>	Earth fault alarm
	<div style="background-color: yellow; color: black; padding: 2px; text-align: center;">BAT branch fault</div>	Battery branch IR is lower than preset pre-warning threshlod, only be valid when set BAT branch No.
	<div style="background-color: red; color: white; padding: 2px; text-align: center;">BAT earthing</div>	Battery branch earthing fault
AC isolation	<div style="background-color: green; color: white; padding: 2px; text-align: center;">U_{AC} in range</div>	U _{AC} under pre-set threshold, AC and DC circuit in good insulation
	<div style="background-color: red; color: white; padding: 2px; text-align: center;">AC injection</div>	U _{AC} over pre-set threshold
DC isolation	<div style="background-color: green; color: white; padding: 2px; text-align: center;">DC Insulated</div>	Busbar-I and Busbar-II insulated
	<div style="background-color: red; color: white; padding: 2px; text-align: center;">DC crossed</div>	Insulation fault Busbar-I to Busbar-II, there are DC crossed two DC systems

6.- RS485 COMMUNICATION

Physical port:

Energom-D-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 0.5mm², Maximum 2.5mm²(AWG20...12)

Notes:

1. Host RS485 for communication with host PC. Slave RS485 connects with multiple Energom-D-1022 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:

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

6.2. - MODBUS FUNCTIONS:

Code	Meaning	Description
FUNCTION 03	Reading of n Words	<i>This function permits to read multiple register</i>
FUNCTION 10	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, EnergoM-D-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) Unit: 0.1V
0x0001	U ₊	int	1	Busbar-I positive pole to ground voltage Unit: 0.1V(signal)
0x0002	U ₋	int	1	Busbar-I negative pole to ground voltage Unit: 0.1V
0x0003	IR ₊	int	1	Busbar-I positive pole to ground Insulation resistance Unit: 0.1KΩ
0x0004	IR ₋	int	1	Busbar-I negative pole to ground Insulation resistance Unit: 0.1KΩ
0x0005	IR _{BAT}	int	1	Branch of Battery bank Insulation resistance Unit: 0.1KΩ
0x0006	E _{Iposi}	int	1	BAT earthing location, calculate series connection cell node from positive pole
0x0007	U _{AC}	int	1	AC injection voltage Unit: 0.01V
0x0008	DC system status	int	1	Low Bit 0~7 used for indicate status, 0 for regular normal status, 1 for different alert info: Bit0 Pre-waring of DC system insulation fail Bit1 DC system pole to ground voltage deviation (U _d =U ₋ /U ₊) over limit Bit2 Pre-waring of BAT branch insulation fail Bit3 DC system voltage U _{DC} over upper limit or lower limit Bit4 Earthing fault alarm Bit5 Busbar-I and Busbar-II occur DC cross situation Bit6 AC injection status (U _{AC}) over preset value Bit7 Earthing alarm of BAT branch insulation fail

0x0009	Instantaneous recording status	int	1	low Bit 0 used for indicate status, 0 for regular normal status, 1 for different alert info: Bit0 Generated a new instant record
0x000a	Device status	int	1	Low Bit 0~4 used for indicate status, 0 for regular normal status, 1 for different alert info: Bit0 Balance bridge failure Bit1 Unbalanced bridge failure Bit2 Collector unit (CU) communication disconnect Bit3 Leakage current (I _o) overlimit
0x000b	Earthing fault #1	int	1	Branch No. of earthing fault
0x000c	IR+ of #1	int	1	Positive pole to ground Insulation resistance Unit: 0.1KΩ
0x000d	IR- of #1	int	1	Negative pole to ground Insulation resistance 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 Unit: 0.1KΩ
0x0010	IR- of #2	int	1	Negative pole to ground Insulation resistance 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 Unit: 0.1KΩ
0x003a	IR- of #16	int	1	Negative pole to ground Insulation resistance Unit: 0.1KΩ
0x0100- 0x013a	Energom-D-102Sub-salve #1	int	59	Refer to 0x0000-0x003a
0x0200- 0x023a	Energom- D-102 Sub- salve #2	int	59	Refer to 0x0000-0x003a
...
0x1000- 0x103a	Energom-D-102 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
		int	1	
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 Unit 0.1K Ω
0x0056	$R_{balance}$	int	1	Unit 0.1K Ω
0x0057	$K_{U-/U+}$	int	1	Calculate formula = $(U-) / (U+)$ Unit 0.01
0x0058	U_{Δ}	int	1	Calculate formula = $ (U+) - (U-) $ Unit 0.1V
0x0059	I_o	int	1	Leakage current threshold 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 1 for enable
0x0060	Voltage equalization	int	1	0 for disable 1 for enable
0x0061	Detection mode	int	1	0 for balance bridge 1 for Unbalanced bridge
0x0062	Balance bridge timing switch to Unbalanced bridge	int	1	0 for disable 1 for enable

Note: Only can R/W host device parameter in parallel connection of multiple EnergoM-D-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 63 BE 00

Details meaning as is shown:

U _{DC}	08 A0	220.8V
U ₊	04 50	110.4V
U ₋	FB B0	-110.4V
IR ₊	27 0F	999.9KΩ
IR ₋	27 0F	999.9 KΩ
IR _{BAT}	27 0F	999.9 KΩ
E _{Iposi}	00 00	0
U _{AC}	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 ₊ of #1	FF FF	Placeholder, no earthing fault
IR ₋ 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 9F B8 00

Details meaning as is shown:

U _{DC}	08 97	219.9V
U+	02 71	-157.4V
U-	F9 DA	6396.2V
IR+	00 C5	19.7KΩ
IR-	27 0F	999.9 KΩ
IR _{BAT}	27 0F	999.9 KΩ
E _{Iposi}	00 00	0
U _{AC}	00 00	0.00V
DC system status	00 12	BIN 00010010: -. DC system pole to ground voltage deviation (U _d =U-/U+) over limit. -. 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+ of #1	00 C6	19.8 KΩ
IR- of #1	27 0F	999.9 KΩ
Earthing fault #2	00 05	Branch No.5 earthing fault
IR+ of #2	00 CA	20.2 KΩ
IR- of #2	27 0F	999.9 KΩ
Earthing fault #3	00 08	Branch No.8 earthing fault
IR+ of #3	00 C9	20.1 KΩ
IR- of #3	27 0F	999.9 KΩ
Earthing fault #4	FF FF	Placeholder, no earthing fault
IR+ of #4	FF FF	Placeholder, no earthing fault
IR- 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, EnergoM-D-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.