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DYO-FF V1.0 Wall Mounted Fault Indicator User Manual

Four-Faith Corporation

Tel：+86 17750019379

Fax: +86 592-5912735

Web: en.four-faith.net

Add ：11th Floor, A-06 Area, No.370, Chengyi Street, Jimei, Xiamen, Fujian, China.

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Content

1. Introduction of Product

1.1 General

The earth-fault and short-circuit indicator type DYO-FF are used in 5~38KV cable line (underground) power distribution networks to monitor and locate earth fault and short circuit. The red LED in display unit will blink when short circuit or earth fault happens. The fault information will also be sent to SCADA system by external connection with IP Modem or RTU/FRTU.

DYO-FF indicator consists of:

1 pcs Display Unit: wall-mounted with LED indication

3 pcs Sensors: Short-circuit detection, cable connection

1 pcs Sensor: Earth-fault detection, cable connection

When the sensors detect short-circuit and earth-fault, it transmits the fault information to display unit by cable immediately. Then the LED starts to flash, and the display unit send the fault signal to SCADA system by relay output or MODBUS at the same time. The fault indicator will also be shown on the Map location or Mimic diagram of SCADA system, it helps the user to identify the faulty section quickly.

1.2 Features

Fault Indication
- ◆ Indication of transient or permanent short-circuit by ultra-bright blinking red LED.
- ◆ Indication of earth-fault by ultra-bright blinking red LED.
- ◆ Indication of Low battery alarm by ultra-bright blinking yellow LED.

Various I/O interfaces
- ◆ Provide 1 DI, support 9-38V DC wide voltage input range.
- ◆ Provide 2 DO, one for short-circuit and earth-fault alarm, the other one for Low battery alarm. It can be customized.
- ◆ Provide 1 external LED lamp interface

Dual Power Supply
- ◆ Support external 5~36V DC power supply
- ◆ Support internal 3.6V replaceable lithium battery

Multiple Reset Method
- ◆ Timing reset
- ◆ Button reset

◆ AC voltage reset

◆ DI reset

◆ Load current recovering reset

◆ Remote Reset by MODBUS

Flexible Parameter Setting Method

◆ By DIP switch

◆ By MODBUS

Stability and Reliability

◆ High-performance industrial 32bits CPU

◆ Support low power consumption mode

◆ Support hardware and software WDT

1.3 Appearance

Display Unit	Sensors 　（CTs）
3*Short-circuit LED (red)	3*Short-circuit sensors (CT) with copper cable
1*Earth-fault LED (red)	1*Earth-fault sensor (CT) with copper cable
1*Low battery alarm LED (yellow)	
1*Button	
3*PG9 cable glands	
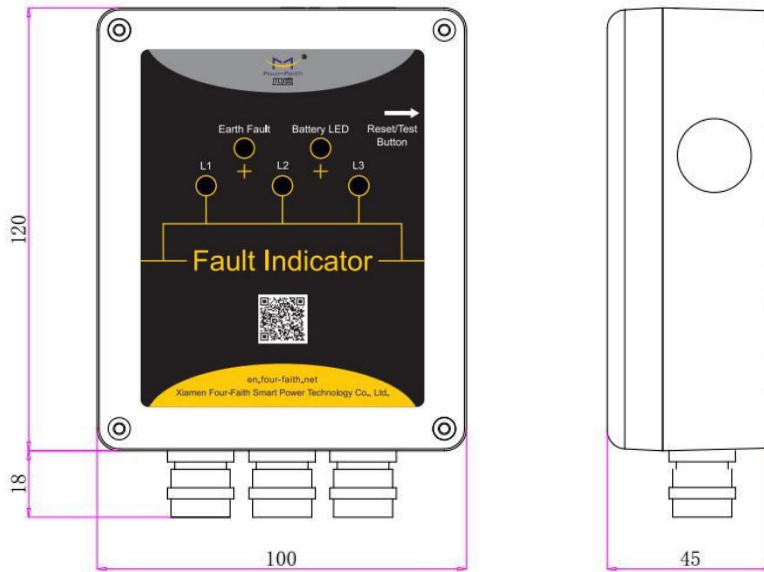
1.4 Dimension

Dimension: 100mm x 120mm x 45mm (W*H*D) (exclusive cable gland)

1.5 Specifications

Electrical Parameters

Applicable Voltage Level	5~38KV
Applicable Current Level	0 ≤ I ≤ 600A
Maximum Fault Current	1200A
Short-circuit Trip Current (Phase to Phase)	150A/360A/450A/625A, default 150A，adjustable by DIP switch or MODBUS，Support customization
Short-circuit Response Delay Time	50ms/100ms/150ms/200ms, default 50ms，adjustable by DIP switch or MODBUS，Support customization
Earth-fault Trip Current (Phase to Ground)	40A/80A/120A/160A, default 40A，adjustable by DIP switch or MODBUS，Support customization
Earth-fault Response Delay Time	50ms/100ms/150ms/200ms, default 50ms，adjustable by DIP switch or MODBUS，Support customization
Short-time Withstand Current	31.5kA/ 2s

Power Supply

Internal Battery	3.6V, lithium battery, type AA
External Power Source	5-36V DC (Optional)

Interface

Serial Port	● 1 RS485 ● Data bits: 8 ● Stop bits: 1 ● Parity: none ● Baud Rate: 9600 bits/s
I/O	1*DI：9-38V DC input 2*DO：Maximum switching voltage 250VAC/30VDC Maximum switching current 5A 1*external LED lamp interface
AC Input	1*AC220-240V voltage recovery interface

Reset

Timing Reset（transient short-circuit and earth-fault）	2min(for test), 12h, 24h, 48h, adjustable by DIP switch
Button Reset（transient/ permanent short-circuit and earth-fault）	Manual by push-button
DI Reset（transient and permanent short-circuit、earth-fault）	By 9-38V DC wide voltage input
AC Voltage Reset（permanent short-circuit）	By AC220-240V recovery
Load Current Reset（permanent short-circuit）	By load current (>15A)
MODBUS Reset（transient and permanent short-circuit、earth-fault）	By communication

Protection Level

Display Unit	IP54
Sensor (CT)	IP68

Environmental Limits

Environment Temperature	-40°C to +70°C
Relative Humidity	≤95%RH
Altitude	≤4000m

2. Installation Introduction

2.1 General

The fault indicator must be installed correctly to make it work properly.

2.2 Packing List

Name	Quantity	Notes
Display Unit	1	
Short-Circuit Sensor (CT) with Copper Cable	3	
Earth Fault Sensor (CT) with Copper Cable	1	
Power Adapter	1	optional
Certification Card	1	
Maintenance Card	1	

2.3 Installation and Wiring

2.3.1 Installation of the Sensors

1) Installation of Earth Fault Sensor, the Max. diameter is 110mm
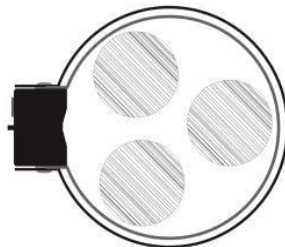
Cable tie is provided to fix the cable line.

Cable Tie, sensor can be fixed to the cable
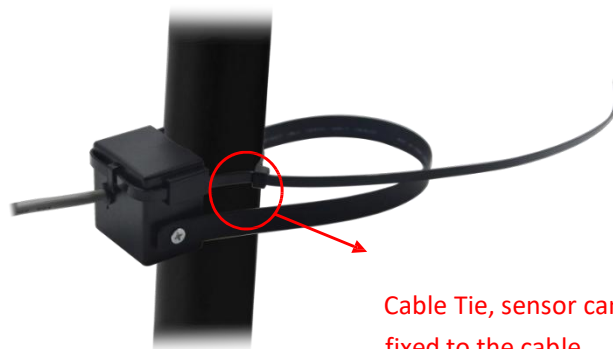
2) Installation of Short-circuit Sensor, the Max. diameter is 40mm

Screw, sensor can be fixed to the cable
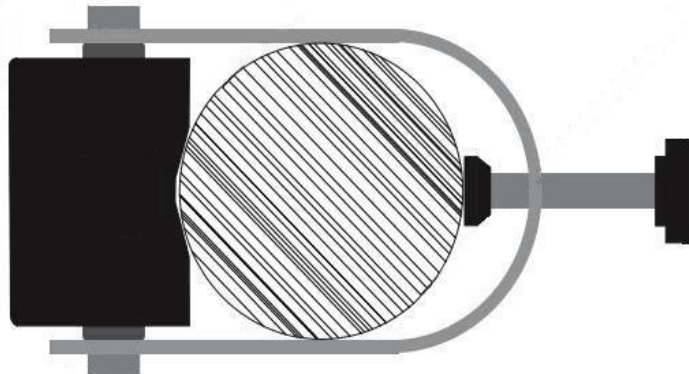
2.3.2 Installation of the Display Unit

1) **Step1:** unscrew the A-1, A-2, A-3 and A-4 screws, then remove the front panel from display unit
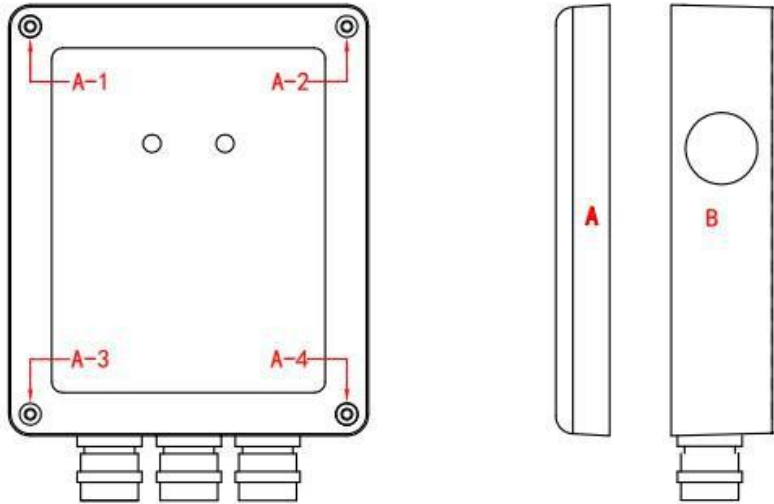
A: front panel of display unit

B: back cover of display unit

A-1, A-2, A-3, A-4: screws to fixe the panel and cover

2) **Step 2:** using 2*M4 screw to fixed the back cover on the wall
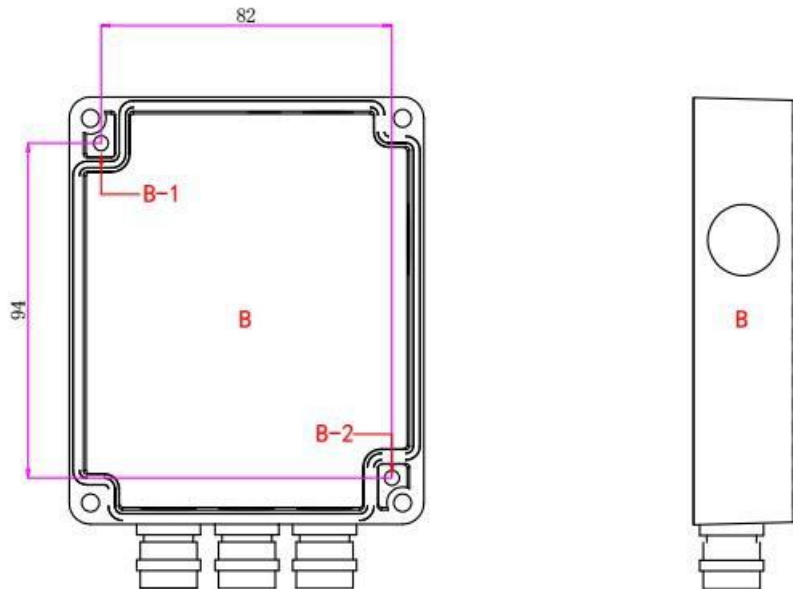
B-1, B-2: wall mounted screw hole

3) **Step 3:** Wiring and close the front panel again.

Terminal block definition description:
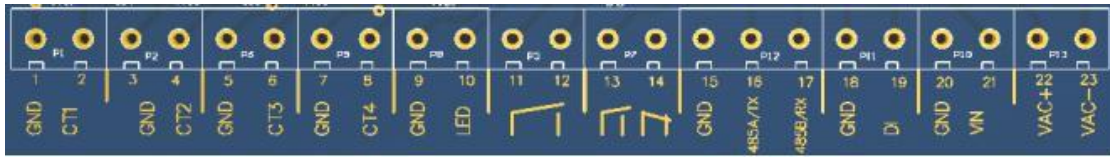
PIN	Interface name	Explanation
1-2	GND-CT1	Phase A short circuit sensor (CT), not need to distinguish positive or negative
3-4	GND-CT2	Phase B short circuit sensor (CT), not need to distinguish positive or negative
5-6	GND-CT3	Phase C short circuit sensor (CT), not need to distinguish positive or negative
7-8	GND-CT4	Earth fault sensor (CT), not need to distinguish positive or negative
9-10	LED-GND	External LED lamp
11-12	DO 1	Digital output 1 (Relay output)，Earth-fault and Short-circuit alarm
13-14	DO 2	Digital output 2 (Relay output)，Low battery alarm
15-16-17	GND-A-B	RS485, A for RS485+, B for RS485-
18-19	GND-DI	Digital input 1, 9-38VDC , DI for positive, GND for negative
20-21	GND-VIN	DC power, 5-36V , VIN for positive, GND for negative
22-23	VAC-VAC	AC220-240V, not need to distinguish positive or negative

(Note: 3 PG9 cable glands are the same, cables can go through any PG9 cable glands)

3. Commissioning

3.1 Parameter Setting

J2.1	J2.2	J2.3	J2.4	J3.1	J3.2	J3.3	J3.4	J4.1	J4.2	J4.3	J4.4	
				OFF	OFF							Earth-fault trip current:40A
				OFF	ON							Earth-fault trip current:80A
				ON	OFF							Earth-fault trip current:120A
				ON	ON							Earth-fault trip current:160A
						OFF	OFF					Earth-fault response delay time :50ms
						OFF	ON					Earth-fault response delay time :100ms
						ON	OFF					Earth-fault response delay time :150ms
						ON	ON					Earth-fault response delay time :200ms
OFF	OFF											Short-circuit trip current:150A
OFF	ON											Short-circuit trip current:360A
ON	OFF											Short-circuit trip current:450A
ON	ON											Short-circuit trip current:625A
		OFF	OFF									Short-circuit response delay time :50ms
		OFF	ON									Short-circuit response delay time :100ms
		ON	OFF									Short-circuit response delay time :150ms
		ON	ON									Short-circuit response delay time :200ms
								OFF	OFF			Reset time:2Min
								OFF	ON			Reset time:12hour
								ON	OFF			Reset time:24hour
								ON	ON			Reset time:48hour
										ON		**Remote Setting**
										OFF		**DIP Setting**
											ON	**Communication ON**
											OFF	**Communication OFF**

Note: after change the DIP setting, the reset button must be pushed twice, so that the new setting can take effect.

DIP setting positions are shown as below:
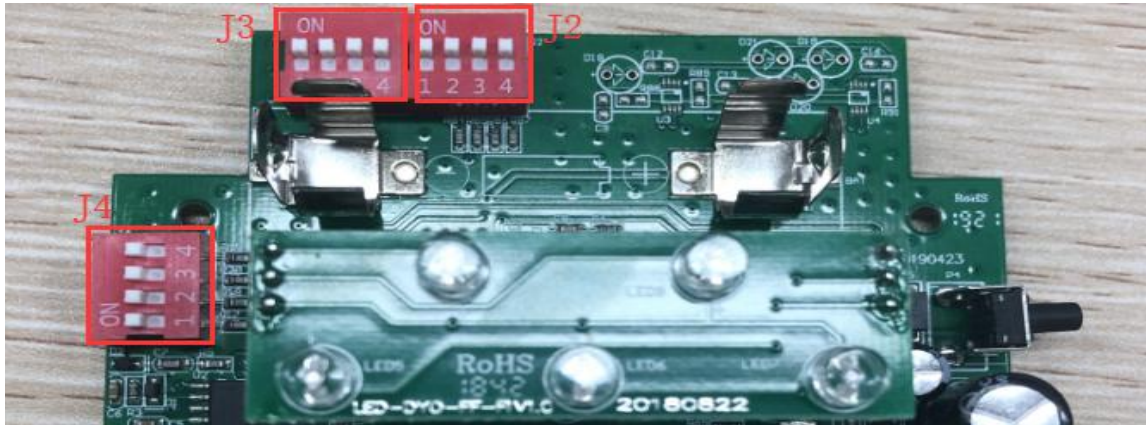
3.2 Fault Test

When detecting fault, the display unit will indicate the fault by both LED blinking and relay output at the same time. The LED will stop blinking and the relay will come back when fulfill one of the following conditions (depends on different fault type)

- Push the button manually
- after reset time
- AC220-240V voltage recovery (Optional)
- DI signal reset (Optional)
- Load Current recovering (Optional)
- Communications by MODBUS (Optional)

3.2.1 Earth-fault Test Step

1) Wiring

remove front panel of the display unit, connect the Earth fault sensor (CT) to terminal 7 and 8, please refer to "2.3.2 Installation of the Display Unit" for more information of cable connection
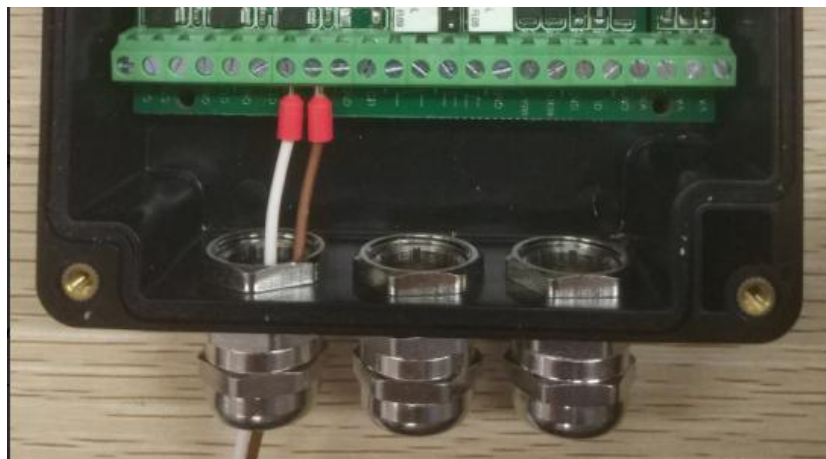
2) Install the earth-fault sensor (CT) to the cable

Install the earth-fault sensor (CT) to the cable with the help of cable tie, **the sensor must be close to the line**,

3) Set the parameter

set the DIP switch in order to select the earth fault trip current and reset time, please see **"3.1**

parameter setting" for more details

For example: the setting below means that the earth fault trip current is 40A, earth fault response
delay time is 50ms and the auto reset time is 2 minutes

J2.1	J2.2	J2.3	J2.4	J3.1	J3.2	J3.3	J3.4	J4.1	J4.2	J4.3	J4.4	value
--	--	--	--		OFF	OFF	OFF	OFF	OFF	--	ON	Earth-fault trip current:40A Earth fault response delay time :50ms Reset time:2 minutes

4) Simulate the earth-fault

add the current more than 40A (e.g.: 50A), and the duration time must greater than 40ms (e.g.:
100ms) when the earth-fault happen, Earth-fault LED (red) will start to blink, and DO1 (relay 1,
terminal 11-12, NO) will close and keep until reset

5) Reset

push the button manually: push the button one

time after reset time, e.g.: 12hours

DI signal reset, e.g.: DC12V input

MODBUS reset, e.g.: send the MODBUS message
After reset, Earth-fault LED (red) will stop blinking, and DO1 will open again.

3.2.2 Short Circuit Test Step

1) Wiring

remove front panel of the display unit, connect the 3 Short Circuit sensors (CT) to terminal 1
and 6, please refer to **"2.3.2 Installation of the Display Unit**〞 for more information of cable
connection

2) **Install the short circuit sensor (CT) to the cable**

Install the short circuit sensors (CT) to the cable, **the sensors must be close to the line**.

3) **Set the parameter**

set the DIP switch in order to select the short circuit trip current and reset time, please see **"3.1 parameter setting"** for more details

For example: the setting below means that short circuit trip current is 150A，short circuit response delay time is 50ms and the auto reset time is 2 minutes

J2.1	J2.2	J2.3	J2.4	J3.1	J3.2	J3.3	J3.4	J4.1	J4.2	J4.3	J4.4	值
OFF	OFF	OFF	OFF	--	--	--	--	OFF	OFF	--	ON	Earth-fault trip current:150A Short-circuit response delay time: 50ms Reset time:2 minutes

4) **Simulate the transient short-circuit**
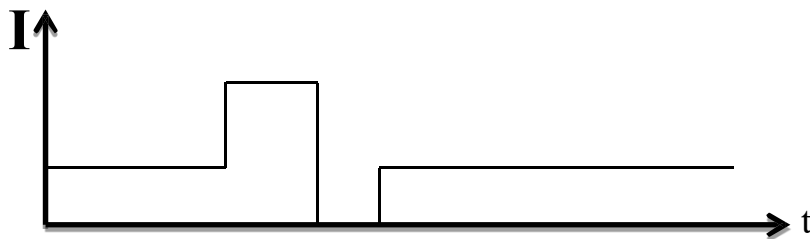
Set the current sequence as below:

- normal load current: 30A, last for 10 seconds
- short-circuit current: 300A, last for 0.04 seconds
- normal outage current: 0A, last for 0.2 seconds
- normal load current: 30A, last for 10 seconds

when the transient short circuit happen, all 3 short circuit LEDs (red) will start to blink, and DO1 (relay 1, terminal 11-12, NO) will close and keep until reset

5) **Transient short-circuit Reset**

　　push the button manually: push the button one
　　time after reset time, e.g.:12hours
　　DI signal reset, e.g.: DC12V input
　　MODBUS reset, e.g.: send the MODBUS message
　　After reset, Short circuit LEDs (red) will stop blinking, and DO1 will open again.

6) **Simulate the permanent short-circuit**

Set the current sequence like below:

- normal load current: 30A, last for 10 seconds
- short-circuit current: 300A, last for 0.04 seconds

when the transient short circuit happen, all 3 short circuit LEDs (red) will start to blinking, and DO1 (relay 1, terminal 11-12, NO) will close and keep until reset

7) **Permanent short-circuit Reset**

　　push the button manually: push the button one time
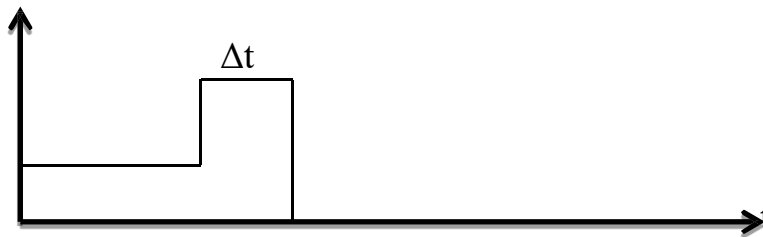　　DI signal reset, e.g.: DC12V input
　　Load current recovery, e.g.: >15A load current
　　MODBUS reset, e.g.: send the MODBUS message
　　AC220V reset, e.g.: AC220V-240V voltage input
　　After reset, Short circuit LEDs (red) will stop blinking, and DO1 will open again.

3.3 Low Battery Alarm Test

When battery voltage is less than 3V, the display unit will indicate the fault by LED flashing (yellow). The LED will stop blinking after a new battery is replaced.

If the battery is removed, the yellow LED will start to blink for a while, when the display unit is not connected to external DC power. The LED will blink all the time when the display unit is connected to external DC power and the voltage is less than 3V.

3.4 Self-check Test

When display unit is on the normal status (no fault or alarm), push the button, all 5 LEDs will blink, DO1/DO2 will close, after push the button again, the 5 LEDs will stop blinking and DO1/DO2 will open again.

3.5 Connecting to RTU (SCADA)

DO1: connect to RTU by 2 wires, when short-circuit happen, it will turn from open to close
DO2: connect to RTU by 2 wires, when earth-fault happen, it will turn from open to close
DI: connect to RTU by 2 wires, 9-38VDC signal will be sent by RTU to reset the display unit

3.6 Communication

3.6.1 Communication Parameter

Serial parameter: RS485, baud rate 9600, none parity, 8 data bits, 1 stop bits
Default address: 1
Protocol: Modbus RTU

Note: When using communication function, the external DC adapter is absolutely necessary

3.6.2 Modbus Register

Register	Length (word)	Data	Data Type	Read/ Write	Factor
0x00	2	Phase A Load Current	Int32	R	0.1
0x02	2	Phase B Load Current	Int32	R	0.1
0x04	2	Phase C Load Current	Int32	R	0.1
0x06	2	Earth-Fault Current	Int32	R	0.1
0x08	2	Battery Voltage	Int32	R	0.01
0x0A	2	Temperature	Int32	R	1
0x0C	2	Phase A permanent short circuit fault	Int32	R	1
0x0E	2	Phase B permanent short-circuit fault	Int32	R	1
0x10	2	Phase C permanent short-circuit fault	Int32	R	1
0x12	2	Phase A transient short-circuit fault	Int32	R	1
0x14	2	Phase B transient short-circuit fault	Int32	R	1
0x16	2	Phase C transient short-circuit fault	Int32	R	1
0x18	2	Earth-fault alarm	Int32	R	1
0x1A	2	Low battery alarm	Int32	R	1
0x1C(28)	2	signal input	Int32	R	1
0x1E(30)	2	AC220	Int32	R	1
0x20(32))	2	Version	Int32	R	1

Note: The gray part （0x0118(280) - 0x017A(378) is just for internal R&D test.

	Length (word)	Data	Data Type	Read/ Write	Factor
0x0100(256)	2	Reset time	Int32	R/W	1
0x0102(258)	2	Short-circuit trip current	Int32	R/W	0.1
0x0104(260)	2	Short-circuit time	Int32	R/W	1
0x0106(262)	2	Earth-fault trip current	Int32	R/W	0.1
0x0108(264)	2	Earth-fault time	Int32	R/W	1
0x010A(266)	2	Charging time	Int32	R/W	0.1
0x010C(268)	2	Maximum failure time	Int32	R/W	1
0x010E(270)	2	Flow setting	Int32	R/W	0.1
0x0110(272)	2	No flow duration setting	Int32	R/W	1
0x0112(274)	2	Address	Int32	R/W	1
0x0118(280)	1	IA Segmentation coefficient 1	Uint16	R/W	1
0x0125(293)	1	IA Segmentation coefficient 14	Uint16	R/W	1

0x012C(300)	1	IB Segmentation coefficient 1	Uint16	R/W	1
		…….			
0x0139(313)	1	IB Segmentation coefficient 14	Uint16	R/W	1
0x0140(320)	1	IC Segmentation coefficient 1	Uint16	R/W	1
		…….			
0x014D(333)	1	IC Segmentation coefficient 20	Uint16	R/W	1
0x0154(340)	1	I0 Segmentation coefficient 1	Uint16	R/W	1
		…….			
0x0159(359)	1	I0 Segmentation coefficient 6	Uint16	R/W	1
0x0172(370)	2	Automatic calibration of three-phase current	Uint16	W	0x85
0x017A(378)	2	Automatic calibration of earth-fault current	Uint16	W	0x85
0x0180(384)	2	Remote reset	Int32	W	0x85
0x0188(392)	2	Remote restart	Int32	W	0x85
0x0190(400)	2	Clearing factor	Int32	W	0x85
0x01A0(416)	2	Online upgrade	Int32	W	0x85

3.6.3 Communication Message Examples

1)   Read Measured Values

short circuit sensors add 30A, earth-fault sensors add 30A, insert battery

Send: 01 03 00 00 00 0C 45 CF

Receive: 01 03 18 00 00 01 45 00 00 01 45 00 00 01 47 00 00 01 2F 00 00 01 5B 00 00 00 19 ED 10

Data Decoded:

01 45: 325, multiple 0.1, Phase A load current is 32.5A

01 45: 325, multiple 0.1, Phase B load current is 32.4A

01 47: 327, multiple 0.1, Phase C load current is 32.7A

01 2F: 303, multiple 0.1, Earth-fault current is 30.3A

01 5B: 347, multiple 0.01, Battery voltage is 3.47V

00 19: 25, multiple 1, Temperature of CPU is 25℃

2)   Read Digital Values

No simulate any alarm

Send: 01 03 00 00 00 06 C5 C8

Receive: 01 03 0C 00 00 00 00 00 00 00 00 00 00 00 00 93 70

Data Decoded:

All data is 0

simulate Short circuit permanent fault and earth-fault, remove the battery

Send: 01 03 00 0C 00 10 84 05

Receive: 01 03 20 00 00 00 01 00 00 00 01 00 00 00 01 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 01 00 00 00 01 88 DD

Data Decoded:

00 00 00 01 00 00 00 01 00 00 00 01: Phase A B C permanent fault

00 00 00 00 00 00 00 00 00 00 00 00: Phase A B C no permanent fault

```
00 00 00 01: earth-fault
00 00 00 01: low battery alarm
```

3) **Read Temperature and Version**

```
Send: 01 03 00 0A 00 02 E4 09
Receive: 01 03 04 00 00 00 18 FA 39
```

Data Decoded:

```
00 18: 24, multiple 1, temperature of CPU is 24℃
```

4） **Read version**

```
Send: 01 03 00 20 00 02 C5 C1
Receive: 01 03 04 00 00 00 6F BA 1F
```

Data Decoded:

```
01 6F: 111, multiple 0.01, Version is 1.11
```

5) **Read Setting Values**

```
Send: 01 03 01 00 00 14 44 39
Receive: 01 03 28 00 00 00 78 00 00 05 DC 00 00 00 32 00 00 01
90 00 00 00 32 00 00 00 32 00 00 00 03 00 00 00 96 00 00 00 03
00 00 00 01 AB 93
```

Data Decoded:

```
00 00 00 78: 120,multiple 1, Reset time 120 seconds (2minutes)
00 00 05 DC: 1500,multiple 0.1, Short circuit trip current 150A
00 00 00 32: 50,multiple 1, Short-circuit response delay 50ms
00 00 01 90: 400,multiple 0.1, Earth fault trip current 40A
00 00 00 32: 50,multiple 1, Earth-fault response delay 50ms
00 00 00 32 00 00 00 03 00 00 00 96 00 00 00 03: no need to decode
00 00 00 01:1,multiple 1, Address 1
```

6) **Setting Value**

Set the short-circuit trip current to 625A, the register is 102

```
Send: 01 10 01 02 00 02 04 00 00 18 6A F5 C9
Receive: 01 10 01 02 00 02 F4 E1
```

Read the short-circuit trip current, the setting is successful

```
Send: 01 03 01 02 00 02 64 37
Receive: 01 03 04 00 00 18 6A 70 1C
```

7) **Remote Testing**

After sending the message, the 5 LEDs in display unit are all blinking once

```
Send: 01 10 01 88 00 02 04 00 6F 00 55 07 DB
Receive: 00
```

8) **Remote Reset**

After sending the message, the fault indications (LEDs blinking) are stopped

```
Send: 01 10 01 80 00 02 04 00 6F 00 55 06 7D
Receive: 01 10 01 80 00 02 DC 41
```