FI-3A9F

Overhead Fault Indicator

User Manual

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Chapter 1 Product Introduction

1.1 General

FI-3A9F fault indicator is suitable for 6-35kV power distribution overhead lines, with short-circuit fault and grounding fault detection and indication functions, and can distinguish the nature of the fault: transient faults or permanent faults, the nature of the fault could be indicated by blue light and red light respectively; the load current change can be monitored: the battery voltage could be monitored, and the low voltage warning message can be sent out when the battery voltage is lower than the fixed value; the status of the fault indicator can be monitored: act or return; the battery is replaceable (exclude the batteries, only connector models are provided).

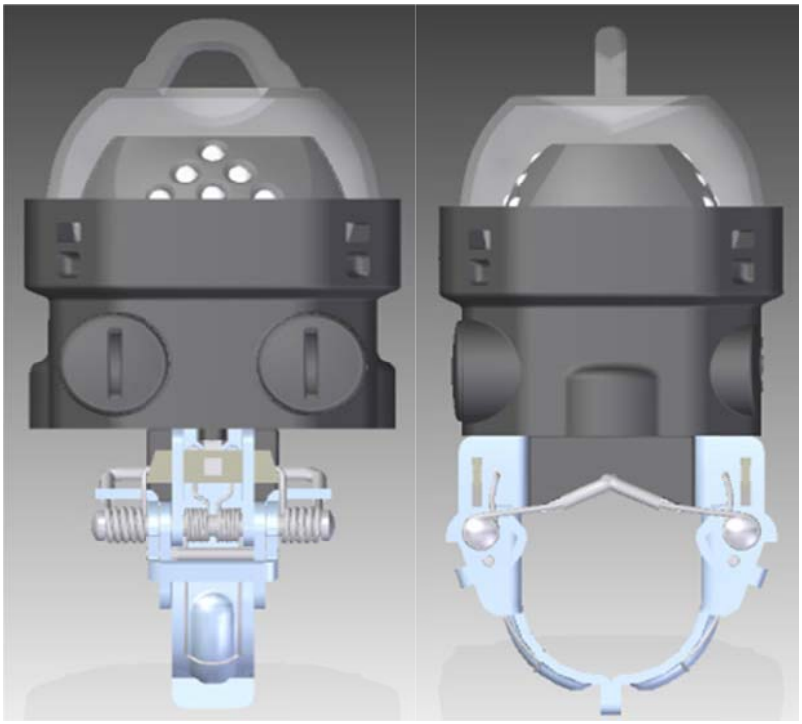


Figure 1.1 FI-3A9F Fault Indicator

The indicator has wireless data communication (optional) function, embedded wireless module, and the communication frequency is 433MHz. The indicator transmits wireless information to the sub-transmitter, and the sub-transmitter transmits to the monitoring master station via 4G/3G/2G network data communication (LTE FDD: B1, B3 , B5 , B8 ; LTE TDD: B38 , B39 , B40 , B41 ; UMTS: B1 , B8 ; GSM/GPRS/EDGE: 900/1800MHz) or to the users' mobile phone through SMS communication. The monitoring master station receives the load current (telemetry) information, and fault information (remote signaling) that are regularly uploaded by the indicator, and can automatically locate the short-circuit point according to the remote signaling information and the system topology diagram. It can shorten the power outage time and improve the reliability of power supply. The users' mobile phone only receives the fault information (remote signaling) uploaded by the indicator. The indicator could also communicate with handheld terminal. The indicator parameters could be set under the rod and the load current value could be called through the handheld terminal.

1.2 Components

FI-3A9F fault indicator consists of 9 parts, as shown below:

1. Fault indicator magnetic arm;
2. Line spring of the fault indicator;
3. Fault indicator battery compartment;
4. Fault indicator shell;
5. Fault indicator cable clamp;
6. Anti-skid block of fault indicator;

7. Transparent protective cover of fault indicator;

8. Fault indicator lock hole for assemble and unassembled;

9. Fault indicator TESTmark

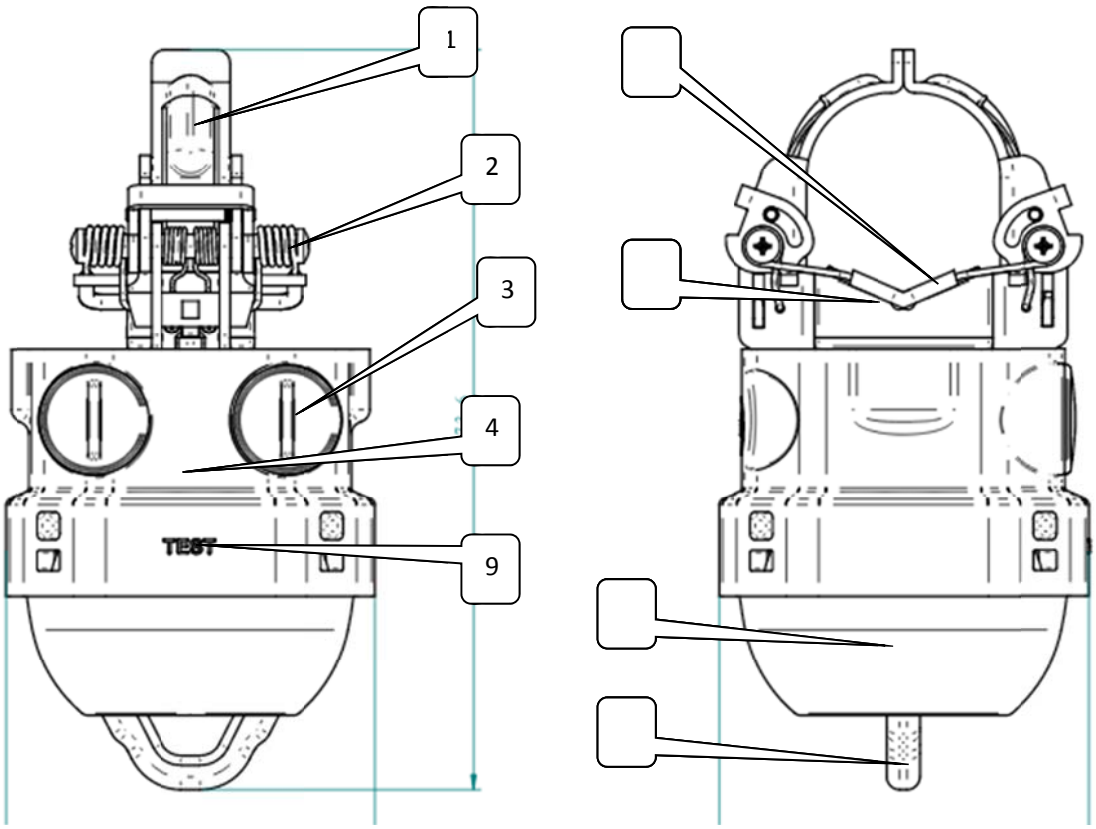


Figure 1.2 Layout of the Fault Indicator Components

1.3 Technical Parameters

1.3.1 General parameters

Measuring current range: 0～650A；

Measurement accuracy: when ≤100A: ±3A；

When > 100A: ±3% ;

Static power: < 30 uA ;

Automatic reset time: 1 ~ 1440min settable, step 1min;

Long-term withstand current: 1000A ;

Short-term withstand current: 31.5kA/2s ;

Weight (exclude the battery): 500 g ;

Size: Φ87 (MAX) ×174mm ;

Design lifetime: 8 years;

Power supply: the line inducts the current to take power; backup two 3.6V lithium batteries (self-provided by customers) for power supply, the battery is replaceable;

Failure response time: 40ms (default 40ms, 20ms products can also be provided, which need to be customized);

Minimum reclosing response time: 0.2s, automatically suppress the closing inrush current;

Reset method: timing reset (grounding fault, transient short-circuit fault); power-on reset (permanent short-circuit fault); remote control reset (via handheld terminal); magnetic reset;

Installation: power-on installation and reassemble;

Operation: epoxy casting, fully sealed structure, and long-term outdoor operation;

Anti-fall: the product could fall freely to the concrete floor from a height of 1 meter without damage.

1.3.2 System Indicators

System voltage: 6 ~ 35kV

System frequency: 50Hz (60Hz products can also be provided which need to be customized)

The maximum over-current protection delay of the substation outlet: 10s

Cable outer diameter: 8 ~ 35mm

1.3.3 Communication

Wireless communication frequency: 433MHz

Wireless communication distance: ≥20m

1.3.4 Test Standard

IEEE Std495-2007

FCC Part15.240 oct.2013

1.3.5 Environment

Ambient temperature: -40 ~ +80℃, the maximum daily temperature difference is 30℃

Relative humidity: 5 ~ 95%RH

Altitude: < 2000m

1.3.6 Anti-electromagnetic interference ability

（1） Electrostatic discharge

The indicator could withstand the ESD interference test with a severity level of IV specified in GB/T 17626.2-2006.

（2） Electrical fast transient

The indicator could withstand the rapid pulse group interference test with a severity level of IV specified in GB/T 17626.12-1998.

（3） Surge (impact)

The indicator could withstand the surge (impact) interference test with a severity level of IV specified in GB/T 17626.5-1999.

（4） Power frequency magnetic field

The indicator could withstand the power frequency magnetic field interference test with a severity level of III specified in GB/T 17626.8-2006.

Chapter 2 Installation and Disassembly

2.1 Dimensions

The fault indicator has excellent windproof shell.

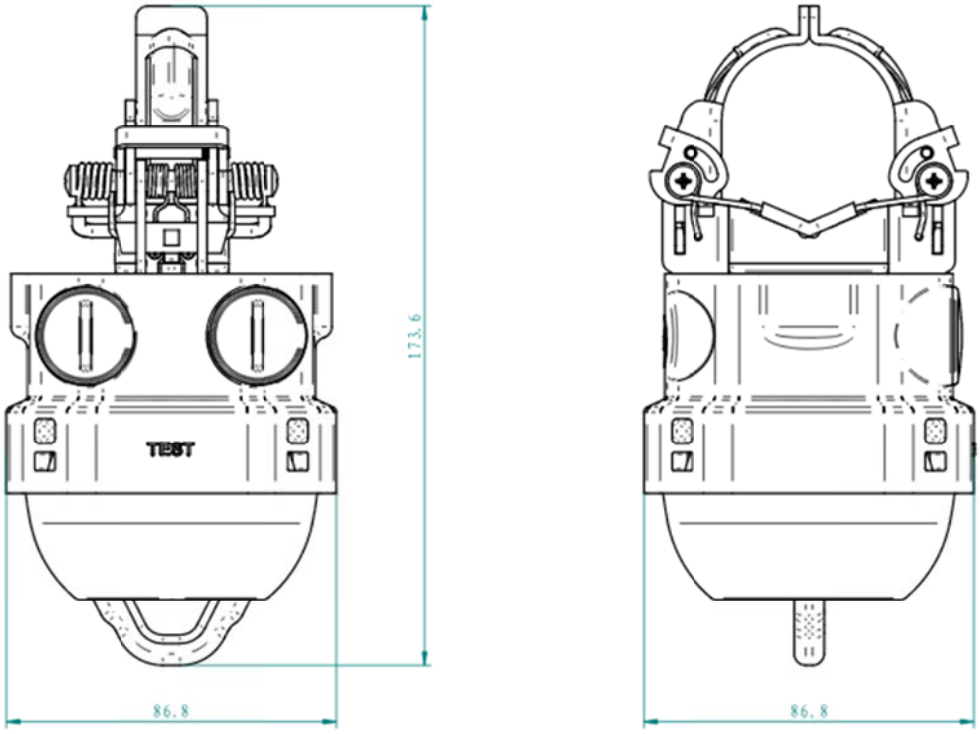


Figure 2.1 Product Appearance and Dimensions

2.2 Simulate Failure and Reset

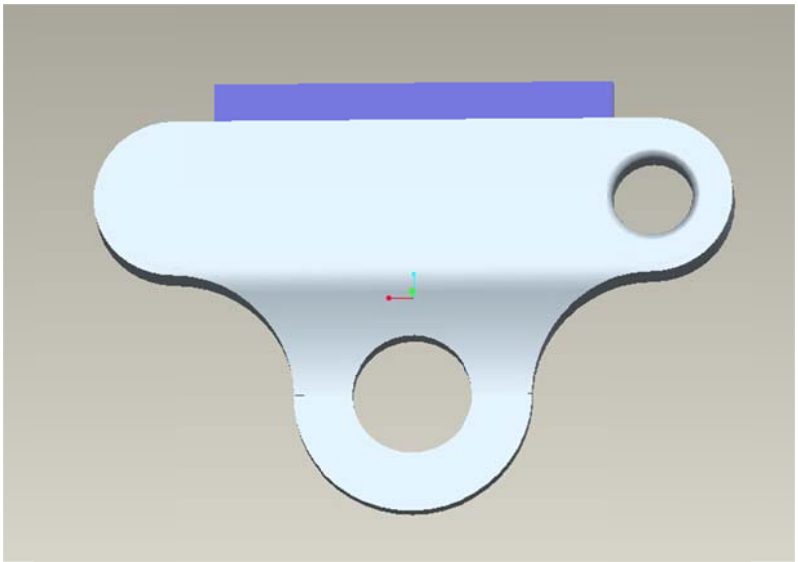


Figure 2.2 Magnets and Battery Cover Removal Tool

The magnet tool (as shown in Figure 2.2) can be used to manually simulate the action of fault indicator and reset test.

Simulated failure: place the magnet test tool at the TEST position of the fault indicator (the distance ＜2cm) for longer than 1.2s and less than 5s. The fault indicator receives the simulated action test signal, and the indicator light of the fault indicator flashes cyclically and the fault information is sent.

Action reset: After the fault indicator acts, place the magnet test tool at the TEST position of the fault indicator (the distance ＜2cm) for longer than 1.2s and less than 5s. When the fault indicator light goes out, the reset signal action is completed.

2.3 Installation Location

Figure 2.3 Picture of Installation Location

The following principles should be followed when installing the fault indicator:

1) The distance between the fault indicator and the telegraph pole should not exceed 2 meters ;

2) The distance between the fault indicator and the telegraph pole is not less than 1 meter ;

3) The distance between the fault indicator and the wire fitting is not less than 0.6 meters ;

In order to better monitor overhead line faults, the installation of fault indicators should generally follow the rules below:

1) Installed at the exit of the substation line: it can identify the fault inside or outside the station, and the fault line selection;

2) Installed in the middle section of the main trunk line of the long line: for the overhead long line 1-2km, the fault indicator section can be used to reduce the scope of the fault section:

3) Installed at important branches of the line: For the branch lines whose length is over 3km or branch lines that bear important loads, the fault indicator could be used to indicate the line fault branch;

4) Installed at the junction of the cable line and the overhead line: it can distinguish whether the fault is in the cable section;

2.4 Assemble and disassemble tools

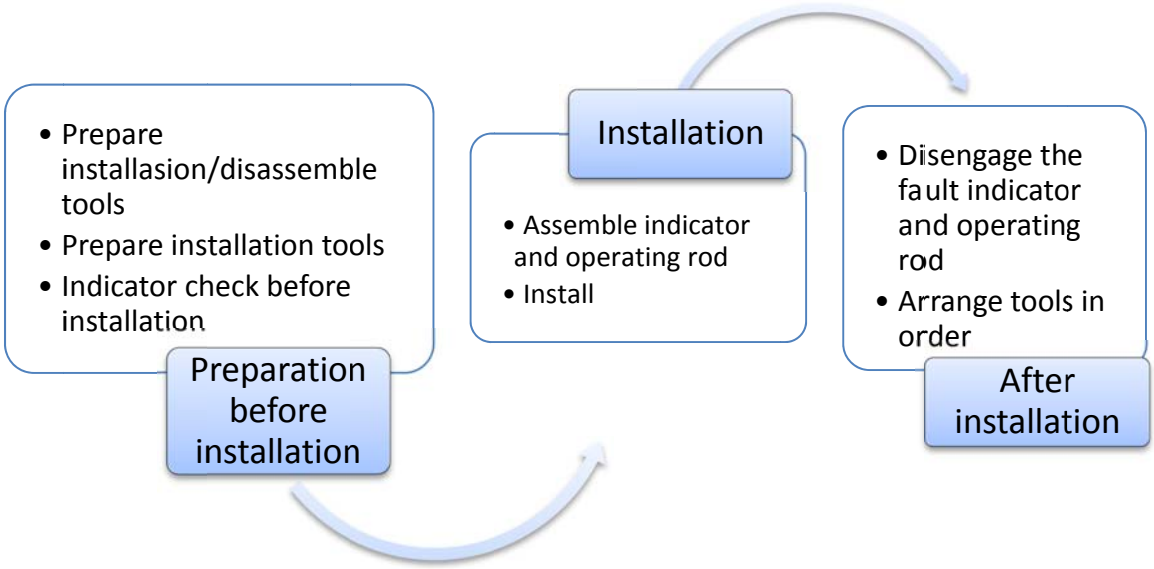
- Insulated operating rods can be divided according to the length: 3 meters, 4 meters, 5 meters, 6 meters, 8 meters, 10 meters

- Insulated operating rods can be divided according to the voltage levels: 10KV，35KV.
- Insulated operating rod material: Insulated operating rods are generally 2 types: glass fiber reinforced plastic epoxy hand-rolled rods and mechanical pultruded rods. The two types of insulated rods have their own advantages: the hand-rolled rod has greater tension, but the longitudinal strength is less than that of the mechanical pultruded rods. The mechanical pultruded rod has high strength, but the transverse tension is less than that of the hand-rolled rod.
- The color of the insulated operating rods: the snap-on insulated operating rods generally use yellow insulated rods, the telescopic insulated operating rods generally use upper red and lower yellow colors, and the red part is slip resistant.

  The appearance is shown as below:

Figure 2.4 Insulated Operating Rod

2.5 Installation Process and Method



The operation process is as following:

Step 1: Check the indicator before installation

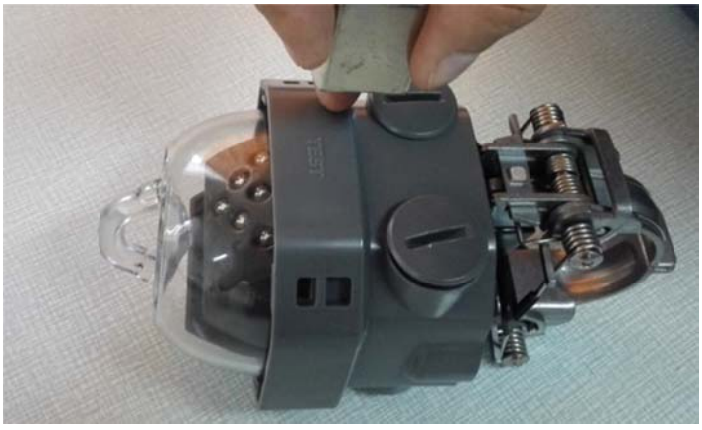


Figure 2.5 Installation Picture 1

Step 2: Open indicator magnetic arm

Figure 2.6 Installation Picture 2

Step 3: Connect the operating rod

Figure 2.7 Installation Picture 3

Step 4: The fault indicator and the operating rod are connected

Figure 2.8 Installation Picture 4

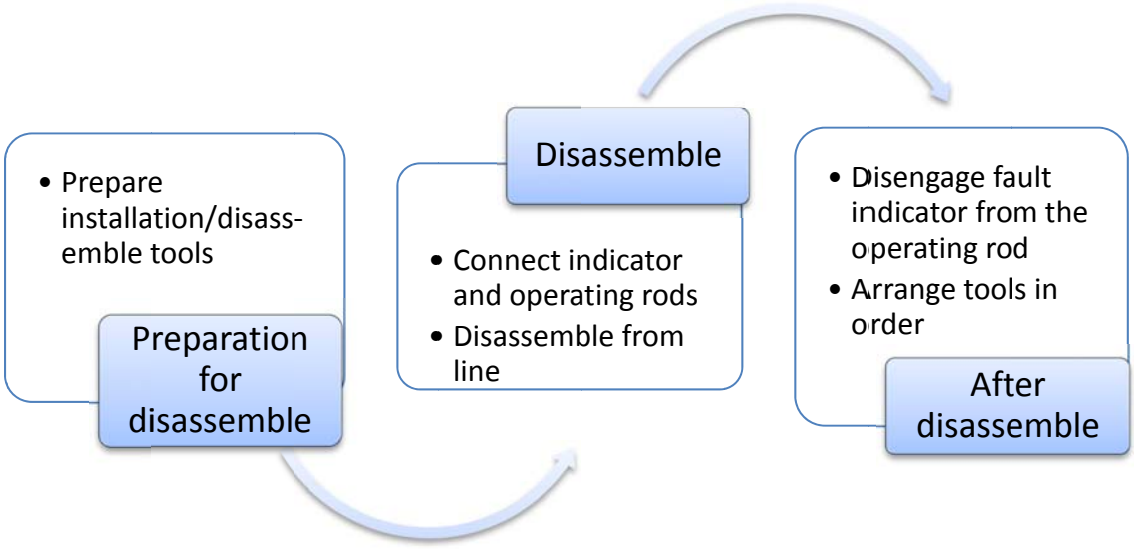
Step 4: Install on the cable (conductor trace line)

Figure 2.9 Installation Picture 5

Step 5: Remove the operating rod

Figure 2.10 Installation Picture 6

2.6 Disassemble process and method



The operation process is as following

Step 1: Prepare the installation/disassemble tool

Figure 2.11 Disassemble Picture 1

Step 2: Connect the indicator

Figure 2.12 Disassemble Picture 2

Step 3: The operating rod and the fault indicator are connected

Figure 2.13 Disassemble Picture 3

Step 4: Pull down the operating rod firmly

Figure 2.14 Disassemble Picture 4

Step 5: Separate the indicator from the cable (conductor trace line)

Figure 2.15 Disassemble Picture 5

Step 6: Remove the indicator from the operating rod

Figure 2.16 Disassemble Picture 6

Chapter 3 Operation Principles

3.1 Principle of Short-circuit Faults

When a short-circuit fault occurs in the power system, a characteristic of the line current change is that the current is varying rapidly. Another feature is that in a short time interval after the occurrence of a short-circuit fault, under the control of the relay protection device, the fault current of the high-voltage line will be cut off by the outlet circuit breaker and the line current will drop to zero, as shown below:

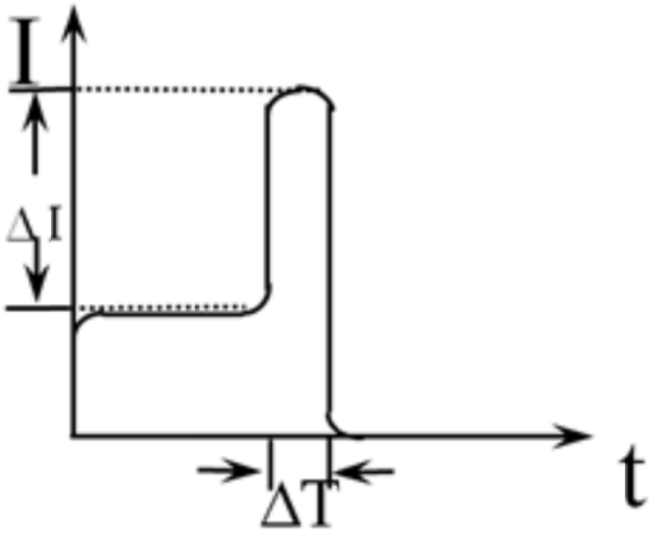


Figure 3.1 Waveform of short-circuit fault

Mutation criterion:

a) When the line detects voltage or current greater than 3A, charge it for 15s first, during which the device is in a locked state.

b) Detection of current mutation. After charging for 15s, the device will detect current mutation. When the mutation is greater than the set value of the mutation, and the mutation is greater than 0.5 times the load current, and

the duration is greater than 40ms, the device will perform line power failure detection. The indicator can be configured with 3 current settings and 3 time settings. The larger the Iset, the smaller the Tset, as shown in the following table:

Item	Set value of current (A)	Set value of time (ms)
Mutation section I	IsetI	TsetI
Mutation section II	IsetII	TsetII
Mutation section III	IsetIII	TsetIII

The current setting value and time setting value are preset according to the superior protection configuration. The default IsetI、IsetII、IsetIII are respectively: 400、260、170A ; The default TsetI、TsetII、TsetIII are respectively: 25、80、180ms.

c) Zero detection: The voltage and current are detected to be zero within 10s from the start of the fault.

d) Provide fault remote signal and local indication signal (red indicator light flashes).

3.2 Grounding Fault Principle (with signal source)

When a grounding fault occurs in the power system, the signal source identifies which phase has grounding fault, and applies a characteristic pulse current signal on the line (as shown in the figure below). After the fault indicator detects this signal, it reports the grounding fault and sends out a local indication, so as to realize the fault locating.

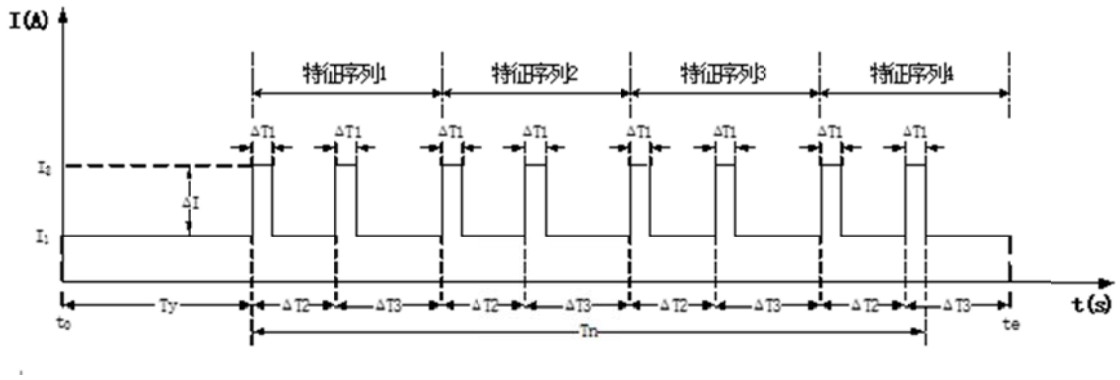


Figure 3.2 Grounding Fault Pulse Current Diagram

a) When the line detects voltage or current greater than 3A, charge it for 15s first, during which the device is in a locked state.

b) When the electric field is detected drop, after charging for 15s, the device will detect the electric field drop. When the drop ratio is greater than the set value, the device will perform the characteristic pulse current signal detection. The indicator can be configured with pulse timeΔT1, pulse periodΔT2 and ΔT3.

c) Detection and calculation: It's the effective pulse if the pulse current amplitude and time width meet the requirements of the set value, and the number of statistical effective pulses is ≥6。

d) Provide fault remote signal and local indication signal (blue indicator light flashes).

3.3 Fault Type and Low Battery Indication

Fault can be divided into short-circuit faults and grounding faults. The short-circuit faults can be divided into transient faults and permanent faults.

After the indicator detects a short-circuit fault, the red indicator light starts to flash. At

this time, the default is a transient fault. From the indicator action, the line load current will be detected again after 7s. If the load current does not meet the power-on condition, it is judged as permanent fault and upload permanent fault message; if the load current meets the power-on condition, it's judged as the transient fault and a transient fault message is uploaded. When the transient short-circuit fault time reaches the reset timing time, it will automatically reset; when the permanent short-circuit fault time reaches the reset timing time or when the power-on time reaches the power-on reset time, it'll automatically reset.

After the indicator detects the grounding fault, the blue indicator light starts to flash and the grounding fault message is uploaded. After the grounding fault time reaches the reset timing time, it'll automatically reset.

The indicator regularly detects its own battery voltage. When the battery voltage is lower than the set value and the duration reaches the set value, the yellow indicator light starts to flash and the low-voltage alarm message is uploaded. After the battery is replaced, the alarm is automatically cleared.

Chapter 4 Typical Action Test

4.1 Typical Action Test Items

Before the indicator is installed, it's recommended to perform a typical action test to eliminate the operation faults caused by the transportation. The typical action test waveform is shown below. The fault indicator should act correctly and reset according to the reset method in 2.2. At this time, it can be determined that the fault indicator is operating normally.

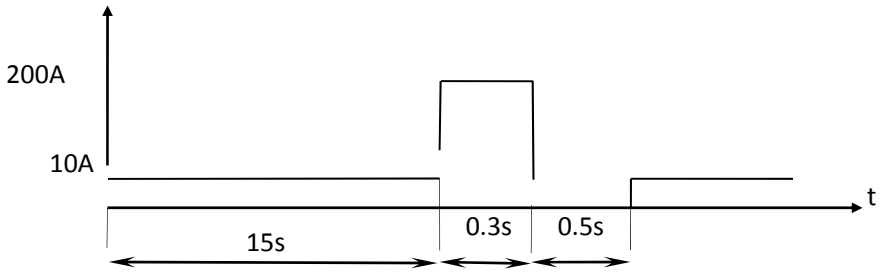


Figure 4.1 Waveform of the Typical Action Test

Chapter 5 Parameter Configuration

5.1 Function Cast and Cancel Configuration Items

No.	Items	Configuration	Remarks
1	Turn off the permanent fault and power-on reset	Cast/Cancel	Factory default configuration “cancel”
2	Short-circuit judgment without charging	Cast/Cancel	Factory default configuration “cancel”
3	Grounding fault power-on reset	Cast/Cancel	Factory default configuration “cancel”

If you need to disable permanent fault power-on reset, turn on “Turn off permanent fault power-on reset”; If it’s necessary to detect short-circuit faults immediately after power-on, turn on “short-circuit judgment without charging”; if you need to enable grounding fault power-on reset, turn on “grounding fault power-on reset”.

5.2 Telemetry Configuration Items

No.	Items	Measure Range	Measurement Accuracy	Remarks

1	Load current	0～650A	±3A（load current≤100A）; ±3%（load current>100A）	Test Environment Room temperature: 25℃
2	Battery voltage	2～3.7V	±2%	

5.3 Set Value Parameters Configuration

No.	Items	Parameters Range	Set	Default value
1	Current mutation set value	100-400A	1A	170A、260A、400A
2	Maximum faults duration	2-9.9s	0.1s	9.9s
3	Charging time set value	10-6000s	1s	10s
4	Indicator flashing frequency	50ms/5s	Can not Be changed	
5	Transient faults timing reset time	1-1440min	1	1440min
6	Permanent fault timing reset time	1-1440min	1	1440min
7	Permanent fault power-on	5-6000s	1s	30s

	reset time			
8	Transient fault judgment load current delay time	5-6000s	1s	7s

5.4 Remote Test

The indicator can be simply tested through the handheld terminal to test whether the short-circuit and grounding fault indicator lights work, and then reset the faults via remote control.

No.	Test Items
1	Remote control indicator light test
2	Remote reset
3	Simulate faults

Chapter 6 Maintenance

6.1 Battery Features

6.1.1 Product category and product model (connector models are provided, and the battery is self-provided by customers)

Category	Model	Battery Connector
Lithium battery	3.6V Lithium battery(recommend ER14505)	MOLEX brand 510050200 connector

6.1.2 Precautions for use

Use

The batteries should be qualified products, neat and tidy, with correct positive and negative markings, no deformation, no rust, no leakage and etc.

Storage

Please store in a clean, dry and cool environment.

6.2 Change of the Batteries

Step 1: open the battery compartment cover

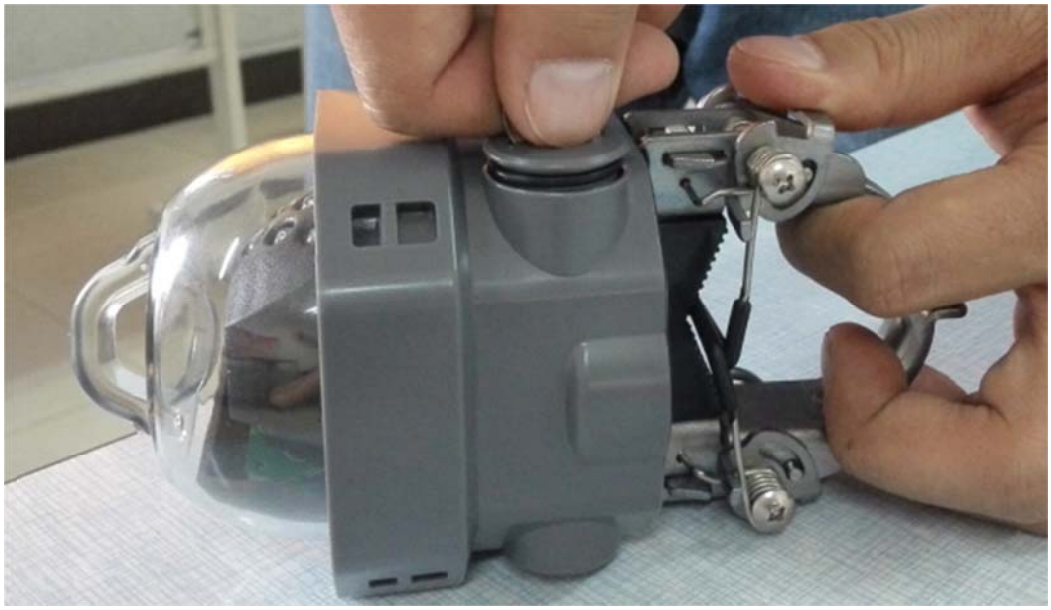


Figure 6.1 Battery Maintenance Picture 1

Step 2: pinch the battery traction strap or battery lead

Figure 6.2 Battery Maintenance Picture 2

Step 3: Remove the battery from the battery compartment

Figure 6.3 Battery Maintenance Picture 3

Step 4: Unplug the battery connector

Figure 6.4 Battery Maintenance Picture 4

Step 5: put into the battery

When put into the battery, if the battery has a traction strap, the battery traction strap should face the entrance of the battery compartment. If there's no battery traction strap, the battery lead should face the entrance of the battery compartment for convenient replacement in future.

Figure 6.5 Battery Maintenance Picture 5

Step 6: Tighten the battery compartment cover

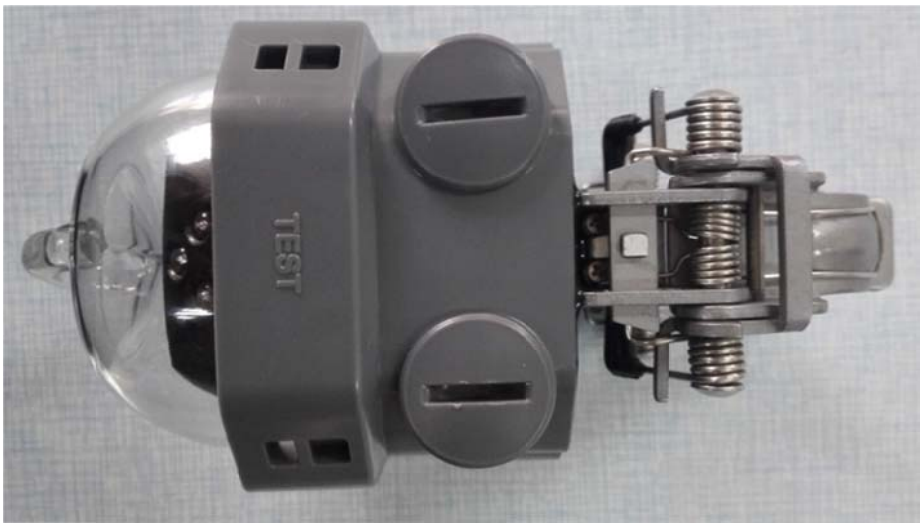


Figure 6.6 Battery Maintenance Picture 6

Chapter 7 Common Fault Analysis and Treatment

7.1 Common faults and cause analysis

No.	Faults	Possible causes
1	The indicator is not operating normally-the fault indicator cannot flash normally	The battery life is exceeded, the battery is weak or no electricity
		The internal components of the indicator were damaged due to transportation and lightning strikes.
2	Indicator communication is not good	The battery life is exceeded, the battery is weak or no electricity
		The internal components of the indicator were damaged due to transportation and lightning strikes.

7.2 Technical Support

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