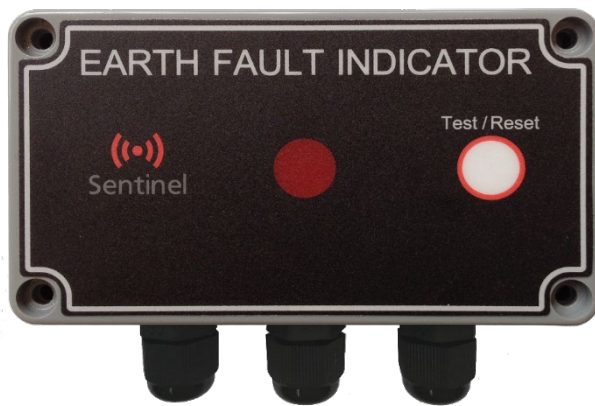


# Sentinel™ EFI-BLZ

## EARTH FAULT INDICATOR

### USER'S MANUAL



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## SAFETY

To avoid electric shock read the following carefully:

- Ensure that the current sensor is installed at earth potential on the HV cable system.
- Ensure that the current sensor is installed on the screened part of the cable system.
- Use caution during the installation and use of this product; high voltages and currents may be present in the circuit.
- This product must be used only by qualified personnel practicing applicable safety precautions.
- Wear protective clothing and gloves as required.
- Do not install this product on live conductors.
- Always de-energize circuit before installing the current sensor and indicating unit.
- Always inspect the current sensor, indicating unit and all leads for damage before using the product.
- Do not use the product if damaged.

## WARRANTY

The Sentinel™ earth fault indicator electronic hardware and software is copyright Cybertronix cc 2014.

This product is warranted to be free from defects in material and workmanship for a period of twelve months (12) from the date of shipment. Correction shall be in the form of repair or replacement of the defective items or components, freight paid by the customer both ways. Such correction shall constitute a fulfillment of all Cybertronix cc liabilities in respect to said items and components. In no event shall Cybertronix be liable for consequential damage.

No other warranties:

To the maximum extent permitted by applicable law, Cybertronix cc disclaims all other warranties, either express or implied, including but not limited to implied warranties of merchantability and fitness for a particular purpose, with respect to the Sentinel™ product and accompanying product manual. Cybertronix cc makes no representation or warranty that the product is 'error free', or meets any user's particular standards, requirements or needs.

Disclaimer :

To the maximum extent permitted by the applicable law, in no event shall Cybertronix cc be liable to the user for any special, indirect, consequential or similar damages, including any lost profits or lost data arising out of the use or inability to use the product or documentation or any other data supplied therewith even if the seller or anyone else has been advised of the possibility of such damages, or for any claim by any other party. In the event of the above limitation not applying to the user, then in no case shall the Cybertronix cc liability exceed the original purchase price of the product.

## 1. OVERVIEW

The Sentinel™ earth fault indicator (EFI) is an electronic relay used for the rapid location and isolation of earth faults on HV cable networks. The EFI can be used in radial networks or in openly operated ringed networks. The path of the fault current from the feeding point to the fault location is marked by the triggered EFI's. The defective conductor segment is located between the last EFI which has been triggered and the first EFI which is still inactive.

## 2. FEATURES

- Battery powered
- LED indication
- SCADA relay output contact
- Remote indication driver
- Split-core current sensor
- Three selectable trip levels or factory preset trip level
- 50ms minimum fault duration
- Manual test/reset facility
- IP65 environment protection
- Rugged and reliable electronics
- ISO9001 based quality assurance
- CE approved

## 3. INSTALLATION

### 3.1 CURRENT SENSOR

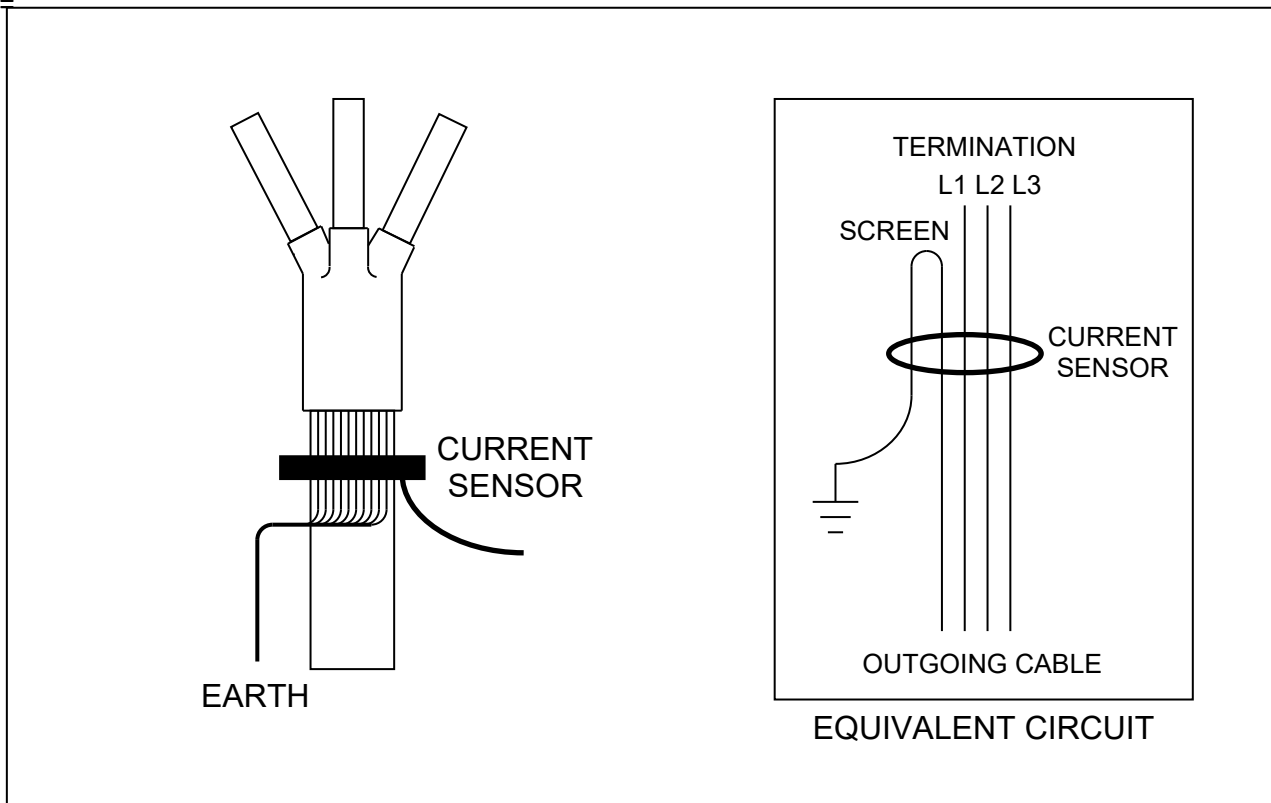
The Sentinel™ current sensor consists of a flexible steel core which is wrapped around the three-phase system to be monitored and fastened tightly in place with adjustable cable-ties. The current sensor is normally shipped fastened in a closed position. The cable-ties are released by depressing the small ratchet on the head while bending back the tail. The current sensor should not encircle the cable earthing as well. Instead, the cable earthing should bypass the current sensor.

The current sensor is available in two different sizes depending on whether it is to be applied to an installation consisting of a multi-core cable or a system comprising of three single-core cables.

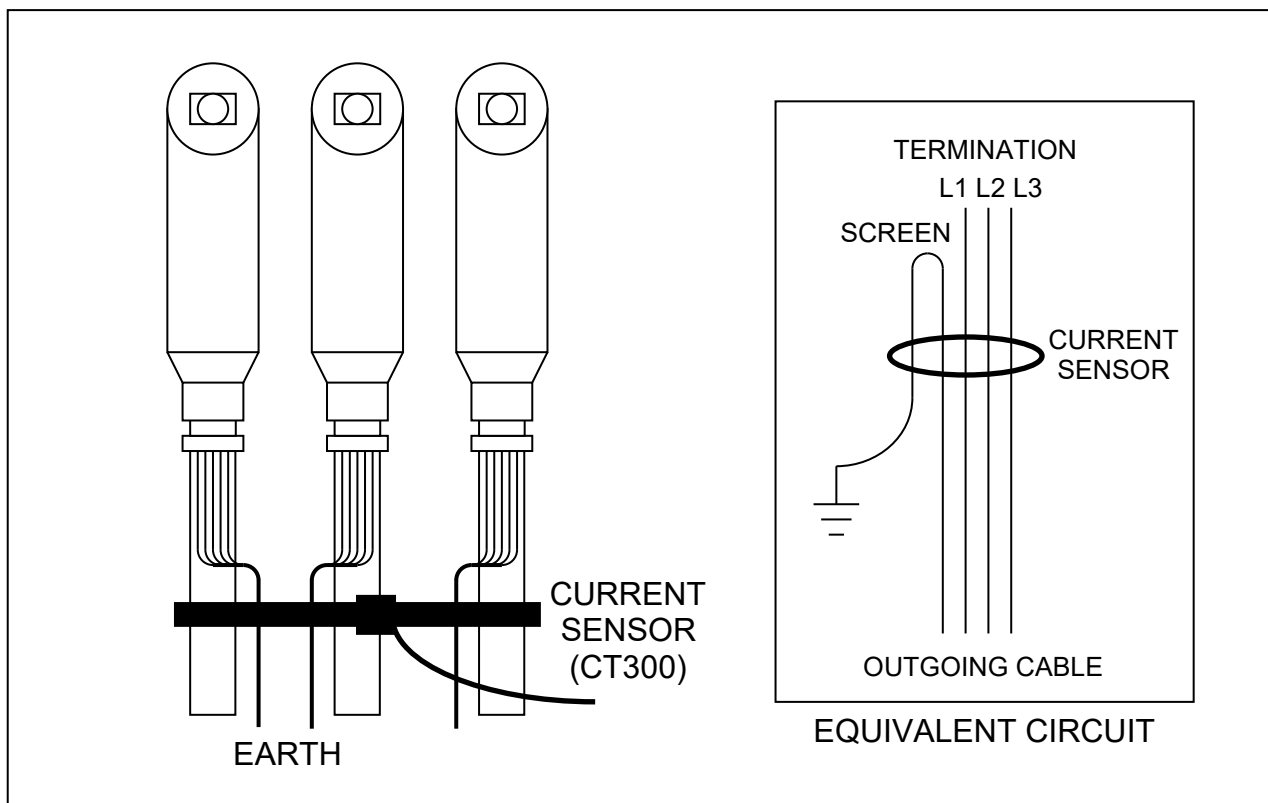
#### 3.1.1 MULTI-CORE CABLE SYSTEM

Unless ordered otherwise, the unit ships with a standard current sensor sized for application on a multi-core cable. The flexible sensor core is mounted on the screened part of the cable, below the stripback point. The core is wrapped around the cable and the cable-tie is pulled tight as far as it will go. A second cable-tie is used to hold the core firmly onto the cable. The cable screen is turned back underneath the core and then terminated to earth as shown in the Figure 1.

**FIGURE 1: CURRENT SENSOR MOUNTED ON MULTI-CORE CABLE SYSTEM**



**FIGURE 2: CURRENT SENSOR MOUNTED ON SINGLE-CORE CABLE SYSTEM**



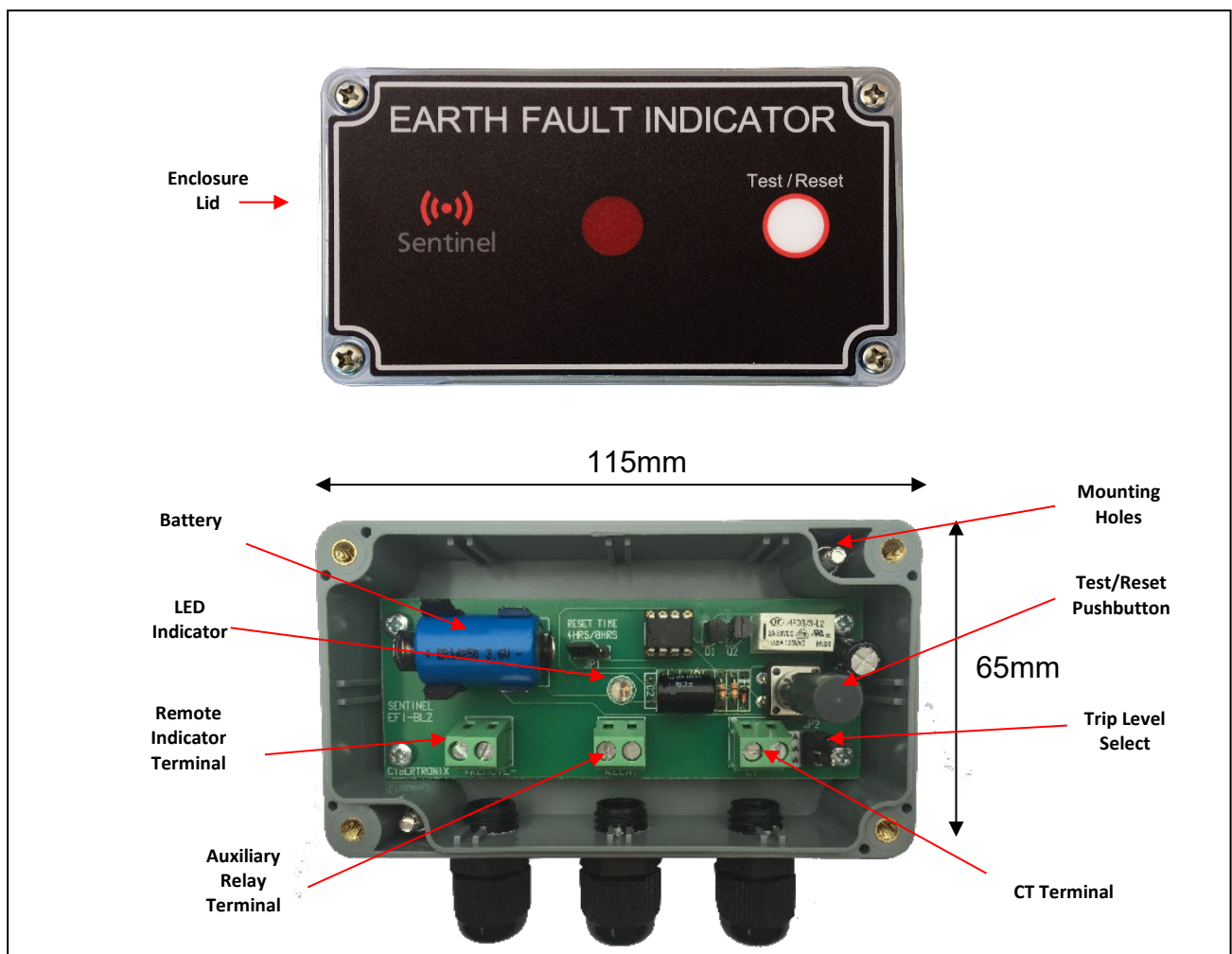
### 3.1.2 SINGLE-CORE CABLE SYSTEM

A larger current sensor (CT300) is available for application on single core cable systems. These systems usually consist of three single-core cables spaced in a row, side-by-side. The flexible sensor core is wrapped tightly around all three cables forming a rectangular oval, and fastened in place with cable-ties. Care should be taken to ensure that the core is mounted on the screened part of the cable. The screen of all three conductors should be turned back underneath the core and then terminated to earth as shown in Figure 2.

### 3.2 INDICATING UNIT

The Sentinel™ indicating unit is normally flush mounted onto a vertical surface. When the cover is removed, mounting holes are exposed for use in bolting the indicating unit to a surface. The current sensor and other accessories are electrically connected to the indicating unit by feeding the leads through cable glands on the indicating unit and connecting them to two-way screw terminals mounted inside the indicating unit enclosure. With the cover and cable glands tightened firmly the enclosure provides IP65 protection.

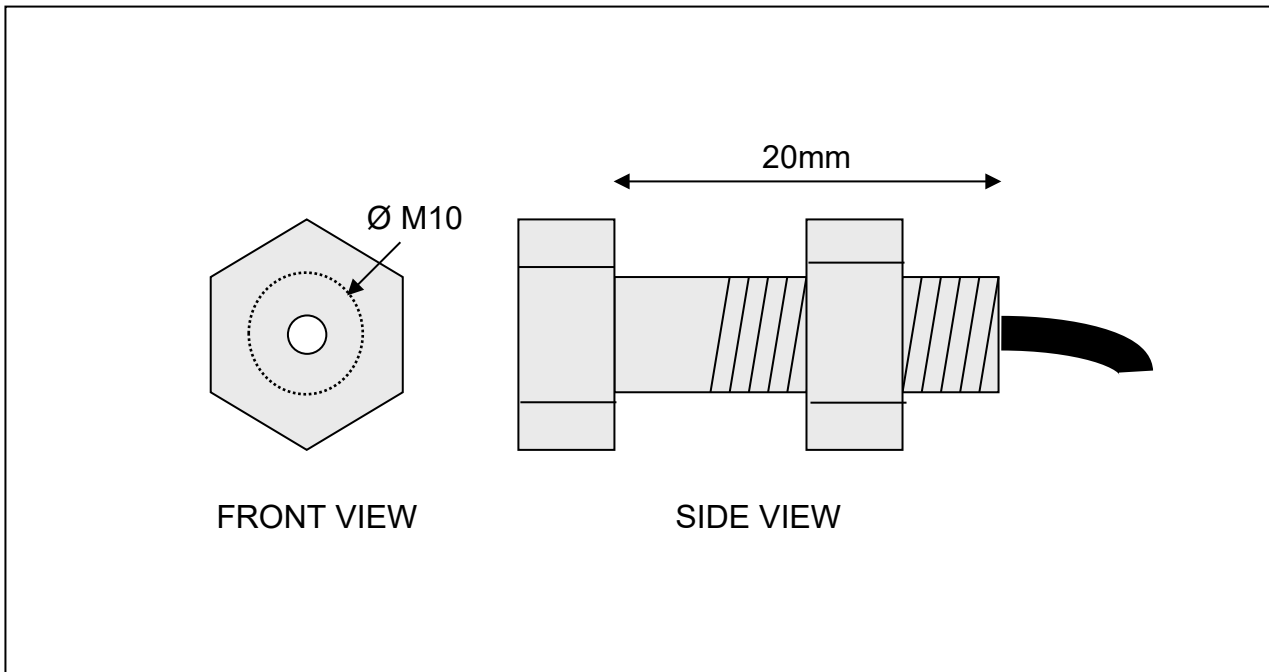
**FIGURE 3: INDICATING UNIT SHOWING TERMINALS AND MOUNTING HOLES**



## REMOTE INDICATOR

A remote indicator can be ordered separately or ordered pre-installed. The remote indicator is designed to be mounted through a hole in the switchgear enclosure so that it is visible from the outside. The remote indicator mirrors the flash rate and duration of the primary LED indicator of the main indicating unit.

**FIGURE 4: REMOTE INDICATOR**



## 4. OPERATION

### 4.1 CURRENT SENSOR

The Sentinel™ current sensor comprises of a flexible iron-core belt with a pickup coil. The belt is fitted around the three-phase cable system being monitored and works on the core-balance current sensing method. Under normal conditions the magnetic flux from the three phase currents summates to zero and the pickup coil generates no voltage output. When an earth fault occurs the summation flux is non-zero and a voltage proportional to the magnitude of the earth fault is generated. The current sensor has no exposed metal parts and is completely encapsulated and corrosion proof.

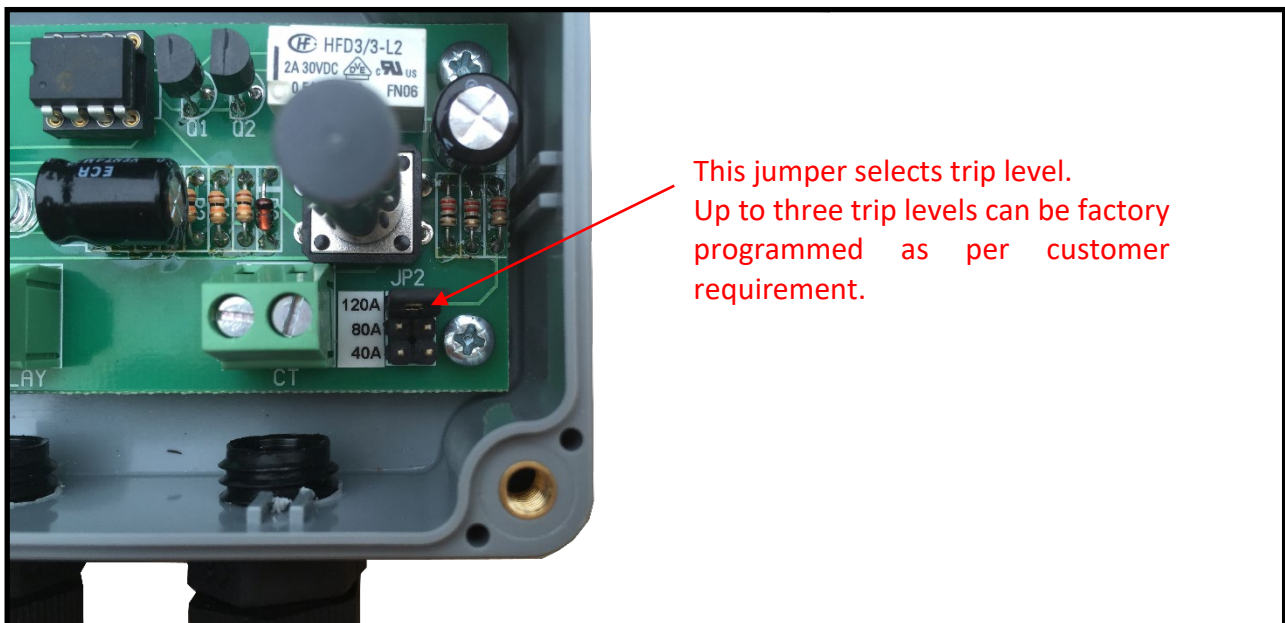
### 4.2 INDICATING UNIT

The primary indication on the EFI-BLZ is a light-emitting-diode (LED). The LED will flash at approximately 1Hz when the EFI is in a tripped state and remain extinguished when the EFI is in a reset state.

The indicating unit continuously monitors the output signal from the current sensor. The current sensor transmits a voltage which is proportional to the measured current. For primary currents in excess of the trip level the current sensor saturates and a limiting circuit inside the indicating unit clamps the output voltage to below 10V even for high fault currents. When an imbalance is detected, onboard circuitry analyses the fault current. The magnitude and duration of the half cycles of fault current are measured. Current spikes and glitches are ignored. As soon as valid fault current has been detected, the Sentinel™ triggers and enters a tripped state.

The indicating unit is powered from a long-life lithium battery. The unit will reset from an on-board timer after 4 hours or 8 hours (selectable via jumper) of LED flashing.

**FIGURE 5: TRIP LEVEL SELECTION**



#### 4.2.1 SCADA RELAY

An on-board relay provides a potential-free, normally-open contact for additional signaling to SCADA. A 2-way screw terminal is provided on-board to which the user can connect a signaling cable. A reset will latch the relay into the reset position (open). A tripped state will latch the relay into a tripped position (closed).

#### 4.2.2 REMOTE INDICATOR

An optional remote indicator can be ordered pre-installed or ordered separately. A 2-way screw terminal is provided on-board for connection of the remote indicator. It provides flashing LED indication at some distance from the main indicating unit. During a tripped state the unit will flash



at a rate of about 1Hz. The remote indicator is weather-proof and is housed inside a brass bolt which also makes it vandal-proof.

#### 4.2.3 MANUAL TEST

A test/reset pushbutton is accessible on the front panel of the indicating unit. The pushbutton only activates after being depressed for three seconds. This manual test/reset feature can both trip and reset the EFI, as well as test the battery. After being manually tripped, the unit will automatically reset after 60 seconds to prevent inadvertent wastage of the battery.

#### 4.2.4 BATTERY SUPPLY

The Sentinel™ EFI-BLZ is powered by a replaceable, long-life, ½AA, 3.6V lithium battery. The battery has a shelf-life which easily exceeds 10 years. During normal operation the quiescent current if the device is so low that it approaches the self-discharge rate of the battery. Significant current is only consumed when the device trips for an earth fault. Even then the power consumption is very economical and the device yields more than 1000 flashing hours. The state of the battery can easily be checked by manually testing the unit. If the battery is still healthy then the device will initially flash rapidly (10 Hz) for a couple of seconds and then commence to flash at its normal rate (1 Hz). If the battery requires replacement then on activation of the test facility, the indicating unit will only flash at its normal indication rate (1 Hz) or not at all. The device is protected against battery reverse polarity.

Complete battery technical details can be found under the Specification section.

## 5. TESTING

The Sentinel™ EFI can be fully tested by injecting test current through the current sensor. A test procedure is suggested below.

1. Inject a current with a magnitude which is 20% below the selected trip level for 1 second. The device should not trip.
2. Inject a current with a magnitude which is 20% above the selected trip level for at least 50 ms. The device should trip.
3. The device will reset after 4 hours or 8 hours (selectable) or can be manually reset.

## 6. SPECIFICATIONS

Network voltage range:	1-36kV
Trip current:	50A ±10A
Minimum fault duration:	2.5 cycles (50ms @ 50Hz / 40ms @ 60Hz)
Fault current withstand:	25kA for 1s
Primary indication:	LED, flash rate 1Hz nominal
Timer reset:	4 or 8 hours selectable
Manual test/reset:	Front pushbutton initiates trip/reset
Operating temperature:	-20°C to 70°C

### Enclosure

-dimensions	115mm × 65mm × 40m
-material	ABS, grey
-mounting	Flush-mounting, two M4 holes
-degree of protection	IP65
-cable gland size:	M12; cable diameter range 3-6.5mm
-mass:	250g

### Current sensor

-standard size:	100mm diameter
-large size (CT300):	300mm × 100mm rectangular oval
-material:	Insulated silicon steel
-mounting:	releasable cable-ties
-lead length:	3m
-lead type:	2-core, 0.5mm <sup>2</sup> , doubly insulated
-mass:	250g

### Auxiliary relay

-type:	Latching, N/O on reset
-rating:	220Vdc, 250Vac, 2A

### Remote indicator

-dimensions:	M10 Hex Bolt 20mm long
-material:	Brass
-mounting:	Self-mounting through single M12 Hole
-lead length:	2m
-lead type:	2-core, 0.5mm <sup>2</sup> , doubly insulated
-degree of protection	IP65
-indication method	LED, flash rate 1Hz nominal
-mass	200g

**Battery**

-type:	3.6 V, ½AA, lithium battery
-specification:	Model ER14250 or similar
-international size refs:	½AA, 1/2R6, 1/2UM-3
-capacity:	1200mAH
-open circuit voltage:	3.7 V
-quiescent current:	<5 µA
-flashing current:	<0.8 mA
-shelf life:	>10 years
-flashing life:	>1000 flashing hours (>500 hours with remote indicator)
-temperature effects:	no adverse effects -55° C to +85° C
-supplier:	RS, Arrow Altech, Electrocomp
-alternate manufacturer:	SAFT, Tadiran

**7. ORDERING**

<b>ORDER NO:</b>	<b>DESCRIPTION:</b>
EFI-BLZ	Sentinel™ EFI: - Battery powered - LED indication - SCADA relay output - Remote indication driver - 50A default trip level
EFI-BLZ-S	Sentinel™ EFI with selectable trip levels (specify)
EFI-BLZ-CT300	Sentinel™ EFI with larger current sensor (CT-300) instead of standard size
EFI-BLZ-R	Sentinel™ EFI with remote indicator preinstalled (R)
EFI-BLZ-R-CT300	Sentinel™ EFI with remote indicator (R) and large current sensor (CT-300)
REMOTE	Sentinel™ remote indicator - LED Flashing - Brass bolt housing

**NOTE:**

- The remote indicator is an optional component and must be specified (-R) if required.
- The EFI unit does not ship with any leads for the auxiliary relay output.
- The unused cable-glands ship with a rubber stopper inserted to maintain sealing integrity.
- The EFI unit ships in a brown corrugated cardboard box.