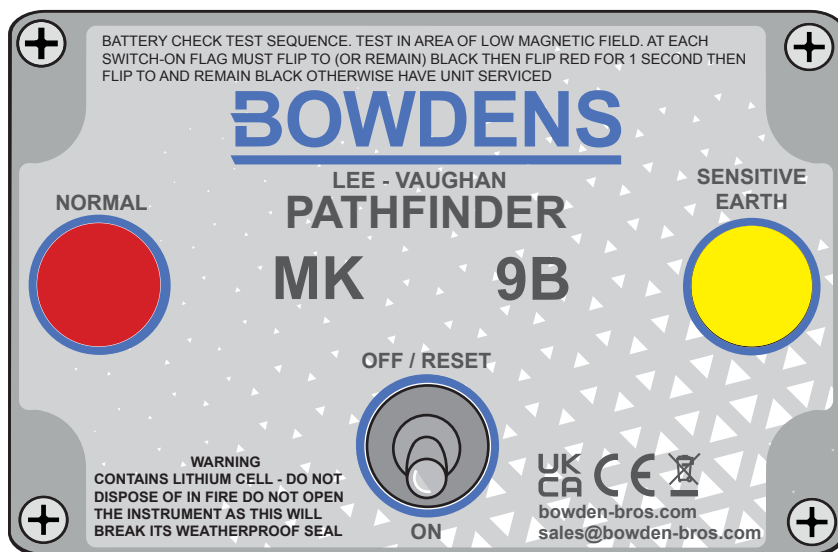


# BOWDENS

## RIGHTWAY PATHFINDER MK9B



PORTABLE EARTH FAULT INDICATOR FOR  
OVERHEAD LINE NETWORKS

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## **1.0 OVERVIEW**

The highly successful portable MK9B Pathfinder is used as a linesman or fault repair team's tool to localize either an earth fault or a phase to phase fault on an 11 or 33KV overhead line. The Portable FPI can be strapped to a clean pole at eye level and after re-energising the line, will tell the operator whether the fault is beyond that pole. With a number of units, a sometimes hard to find fault can be pin pointed very quickly. A battery test facility is built into the switch on routine. The MK9B can now detect faults as low as four Amps through to many hundreds of Amps for over current faults. It comprises of a grey Polycarbonate case with a clear front viewing panel. The unit seal is to IP67 although it is not designed to be left out for very long periods of time. An elasticated strap captured in two side mounted loops is used to hold the instrument in position on an overhead line pole. Alternatively a nylon buckle strap can be provided. The Pathfinder is not voltage dependant, and so can be used on 6.6 to 66KV lines so long as it is a radial system, and of suitable construction. It will operate on three phase or single phase, or on SWER (single wire earth return) lines. The micro-chip controlled electronics is powered by a Lithium Thionyl Chloride Battery with a service free life of up to 10 years, dependant on usage. Locations to avoid putting Pathfinder are termination poles with cables going to ground, transformer poles, tee off poles, poles in close proximity to another HV line of any voltage, poles with either LV or earth wire under-build, or any heavy magnetic influence.

## **2.0 MODEL FEATURES**

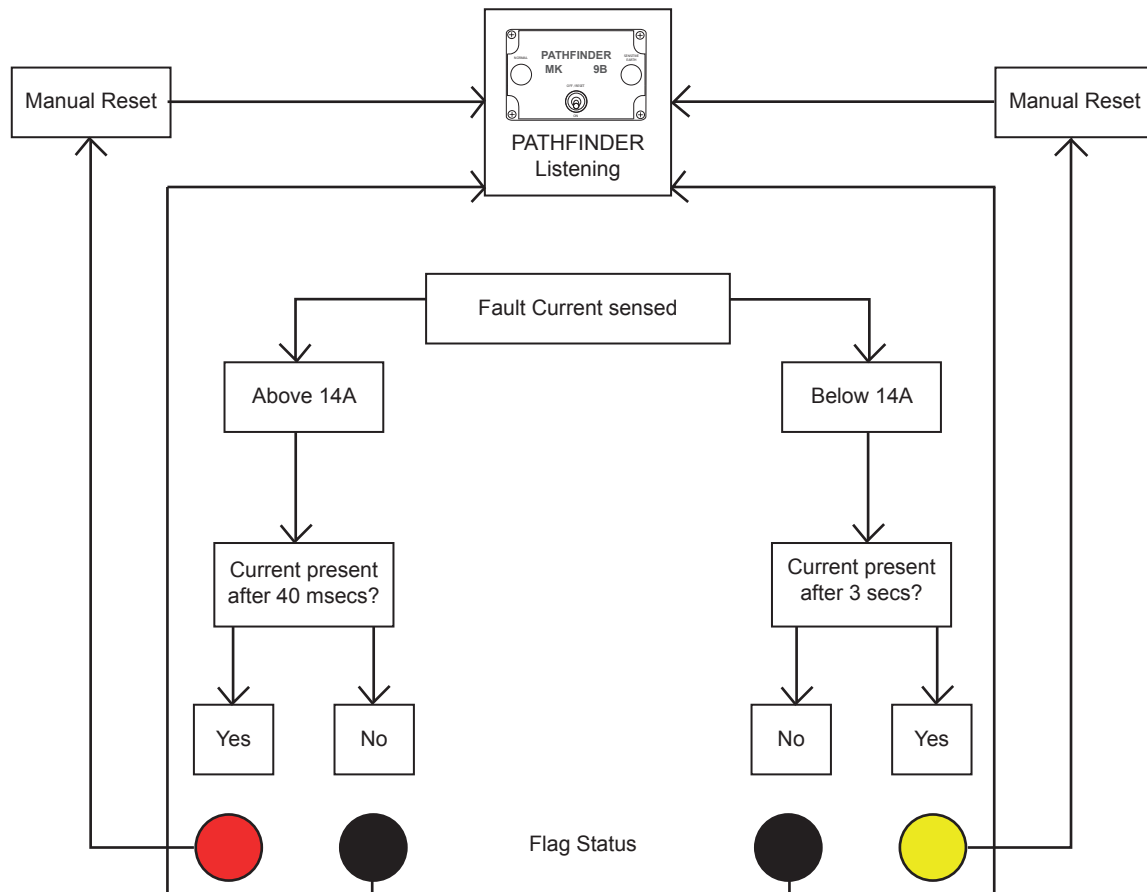
- Integral and Factory Changeable Lithium Battery - Up to 10 Years Life
- Responds to Phase/Earth and Phase/Phase Faults
- Auto Battery Test Facility
- Sensitivity Algorithm
- Identifies Permanent, Transient and Intermittent Faults
- Helps to Identify Faulty Cable sections in OHL Networks
- Helps to indicate OHL Transformer Winding Faults
- Modern PIC selection allows zero standing current when alarmed and reduced current demand when listening, with associated improvement in battery life

## **3.0 OPERATION**

### **DETECTION OF FAULT CURRENT**

The MK9B has an algorithm which behaves differently depending on whether the Pathfinder detects a fault current above or below 14 Amps. If the current detection is below 14 Amps SEF mode requires to see earth fault current between 14 and 4 Amps, (threshold set at 3.5 Amps) sustained for at least three seconds on the network to determine a fault before it will drop the right hand yellow flag. This is the SEF (Sensitive Earth Fault) mode. Earth faults or phase to phase faults greater than 14 Amps will be detected in the NORMAL mode, and will act in exactly the same way as for a MK8 Pathfinder on 'HIGH' sensitivity setting. The magnetising current inrush delay of 40msecs ensures that high current spikes within this time are not detected, and thus prevents false tripping.

For faults above the 14 Amp threshold the MK9B will indicate by dropping the left hand red flag.



When the MK9B is in position the following instructions must be followed:

Switch on the instrument. This action automatically checks the battery. If it is healthy, both flags will flip from black to red/yellow for about one second and back to black again so long as you are not standing in an area of high electro-magnetic field (in close proximity to a PC or fluorescent lights). This indicates that the unit is ready to sense fault current. This testing must be carried out in an area of low field strength i.e. not near a transformer or a motor that will cause the instrument to indicate red. Any other behaviour on the part of the flag shows that the instrument is not serviceable.

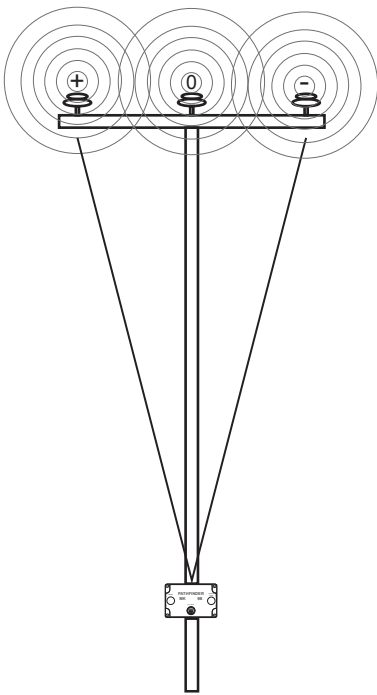
The MK9B should be mounted on a clean, intermediate pole symmetrically below the line conductors and about five metres below the lowest conductor. An elasticated strap or nylon buckle strap is provided to wrap around the pole and hook over metal hoops on either side of the instrument case. Alternatively, the MK9B can be laid on a convenient hedgerow or held by an operator below the line.

For either mode the threshold is calculated with the instrument mounted five metres below the conductors. At this height the geometrical displacement of the phase conductors becomes insignificant, as does any small load imbalance, and so the instrument will respond in the same manner under different line configurations. To ensure the correct response, it is NOT recommended that the instrument be moved further up the pole. The MK9B can be deployed on part of the network known to be faulty following the trip of the source circuit breaker or PMAR. Covering the route of main line and spur lines, when the source supply is restored those units under the path of the fault current will indicate, and those not under the fault path will not.

Once the area of search is narrowed down, the MK9B's can be re-deployed to further reduce the area of search. This applies to even a single pole which may have a cracked insulator, something that is very difficult to find other than by inspection.

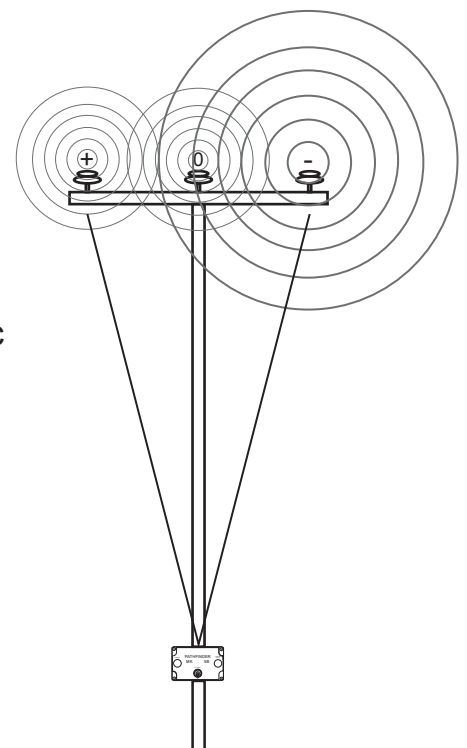
Pathfinders may be left out on a live network to chase a transient fault, and will respond when the fault occurs, leaving the flags tripped on those instruments under the fault path, until reset manually. Pathfinders are sensitive to the electro-magnetic field generated by the fault condition in the overhead line. Anything that might interfere with the integrity of that field must be avoided, so the MK9B should NOT be mounted on poles with transformers or with auto re-closers installed. Be aware of influences from other HV or LV lines in the vicinity which may distort the field. Pathfinders can be re-deployed again to narrow down the area of the search.

### 3.1 SENSING ELECTRO-MAGNETIC FIELD



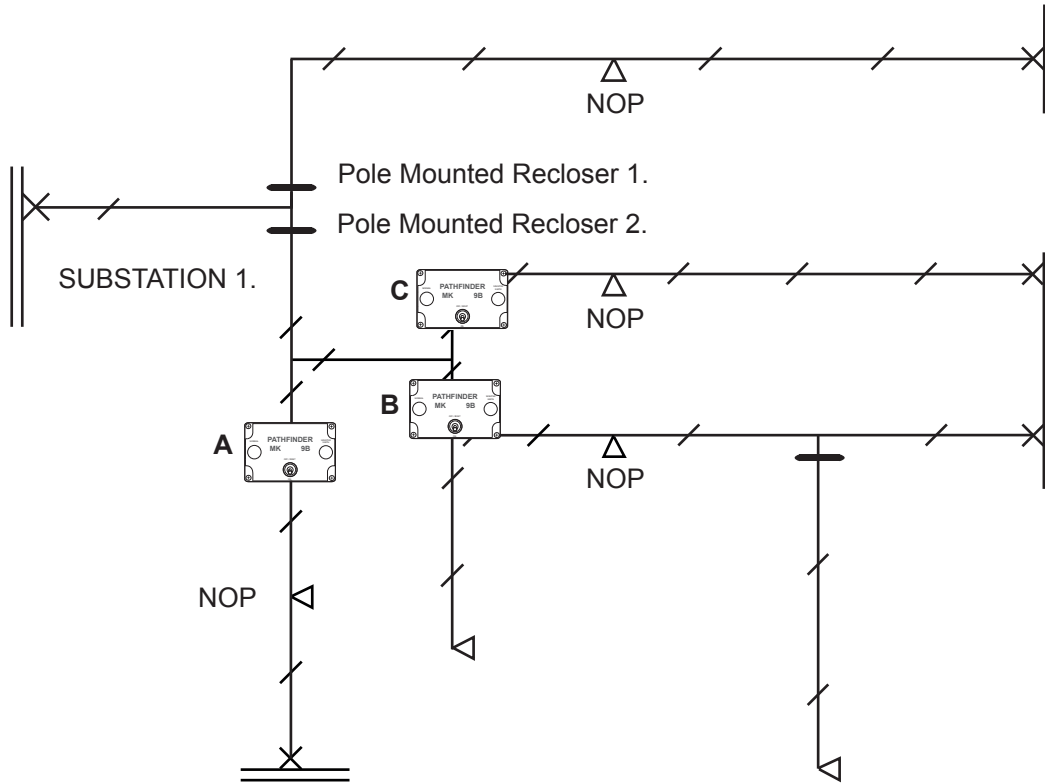
On an HV overhead line each conductor will radiate an electro-magnetic field. Due to the phase separation one field will be in a positive direction, the other in a negative direction, and the third at zero. Therefore the field will be balanced, only the load imbalance on the phases giving rise to any residual field. As we move away from the line the physical separation of the conductors becomes less of an influence and at ground level, about five metres from the conductors the residual field is insignificant.

If an earth fault occurs on one conductor it has a strong effect on the electro-magnetic field which can be detected by the MK9B fault passage indicator. If a phase to phase fault occurs the fault current values may be higher, but the electro-magnetic influence is less than for an earth fault. However, we rotate the detection coil to 30° from the horizontal in Pathfinder which increases its response to the phase to phase fault, whilst retaining almost the same response to earth faults.

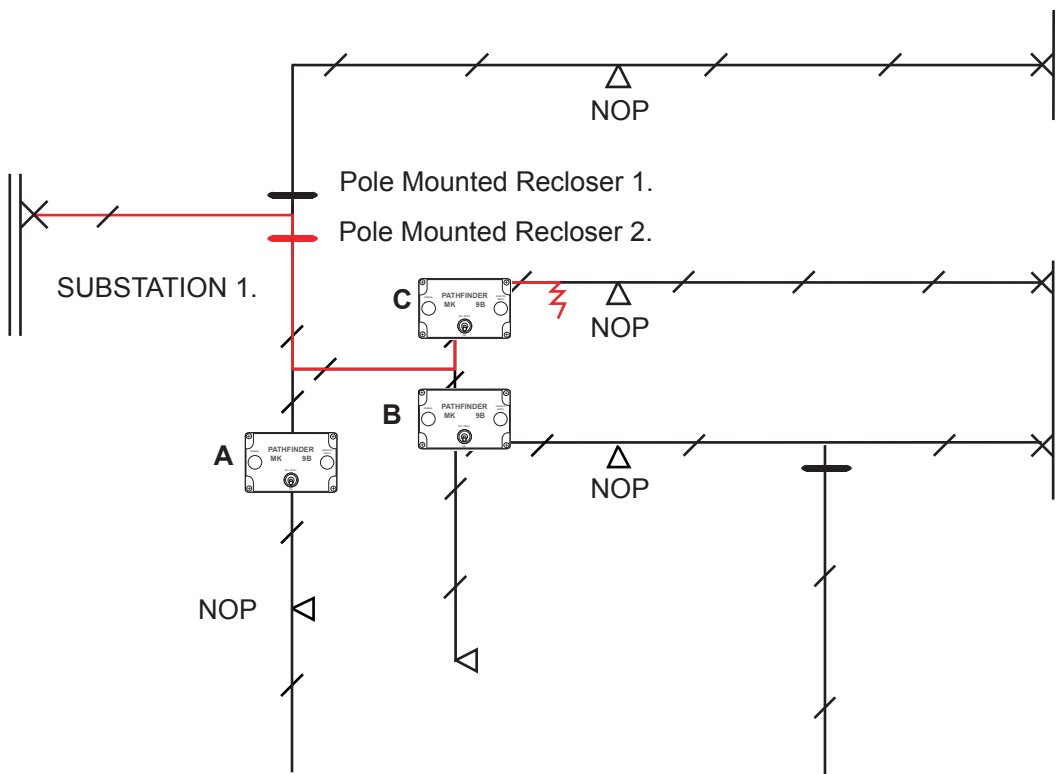


### 3.2 FAULT FINDING

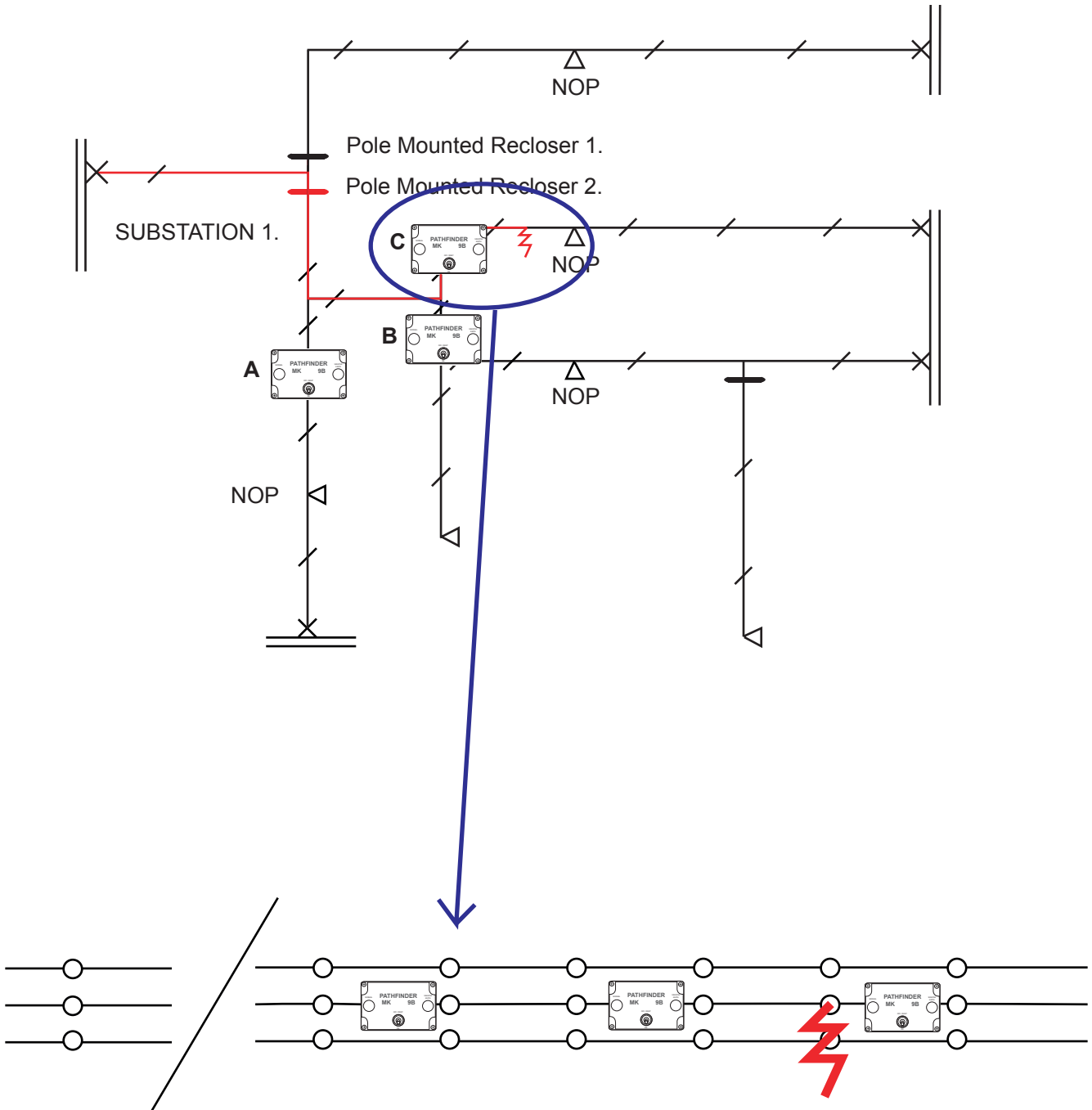
On an overhead HV network we are getting repetitive tripping at PMAR 2. MK9B Pathfinders are deployed at points A, B & C to find out which leg of the network has the transient fault.



When the fault occurs PMAR 2 trips. The MK9B at C flags. The instruments at A and B do not trip. We know that the fault lies between the MK9B at C and the Normally Open Point (NOP).



Trying to locate a fault due to a cracked insulator can be very difficult. The MK9B's can be re-deployed down the main line a few poles apart to divide the network up into the smallest sections.



## **4.0 POWER SUPPLY**

The MK9B is powered from a SAFT LS14500 Lithium cell rated at 2.6 Ah. The battery calculations support a ten year life under normal usage, operating within the temperature range - 10°C to +60°. During a service, the battery, which is soldered onto the PCB, will be changed if necessary, the unit re-calibrated, and the enclosure re-sealed to ensure a full IP67 rating. It is very important that the instrument is switched off after every field outing to prevent shortening its life.

## **5.0 ROUTINE TESTING**

Functional testing is carried out on 100% of all manufactured units before shipping.

### **5.1 TESTING AT PNDC (Strathclyde University)**

Testing on the overhead line network at Power Networks Demonstration Centre Cumbernauld with Strathclyde University has proven the principal of detection of low value faults, and just as importantly the stability of instruments not to trip when located downstream of a fault.

## **6.0 SPECIFICATION**

Dimensions: 120 x 80 x 55mm

Weight: 356 gms

Mounting: Hand-held or attached to pole with an elastic strap, or nylon buckle strap.

Enclosure: Polycarbonate sealed to IP67

Trip Level: NORMAL: >14 Amps SEF: > 4 Amps AND < 14 Amps

Battery/Longevity: SAFT LS14500 - Up to 10 years under normal usage

Trip Delay: Nominal 40msecs +/- 15%

Reset: Manual with ON/OFF switch

Battery Test: With ON/OFF routine.

Temperature Range: -10°C to +60°

Usage: Up to 10 years life under normal usage