

IPS Light Fault detector



CT



LED unit



Simply a bright product

At last there is a fault detector that also works for earth faults. A detector with higher sensitivity than traditional directional earth fault protections is now available. IPS Light consists of a MAIN unit, 3 CTs and an EXTERNAL LED unit. The LED unit is placed in the substation outer wall to be seen from a distant position. IPS Light gives a RED or GREEN light signal when the feeder is tripped persistently. If the detector has registered a short circuit or earth fault short before the the feeder is tripped, it will signal with flashing RED color and if no fault was registered it will signal with flashing GREEN color.

The faulty section is found by visual inspection along the feeder until two nearby stations show different color. After the feeder section between the "RED" and the "GREEN" substation is disconnected, the power may be restored. IPS Light is powered from ~230 VAC. When supply is available, the Ultra capacitors in the Main unit are charged to their standby voltage. When the supply disappears, IPS Light switches to a low energy state to preserve the capacitor energy for the external LED. The operation in low energy state will last for 24 hours. The replacement of batteries in favour of capacitors eliminates maintenance requirements.

The detector with protection performance

IPS Light is based on Protrol's patented earth fault algorithm PAD (Phase Asymmetry Detection). Therefore, IPS Light can offer highly sensitive and selective earth fault detection, up to 10 kOhm fault resistance⁽²⁾, in indirectly grounded networks. Note that this is achieved without measuring the zero sequence voltage. To motivate an investment a detector must be at least as good as or better than the protective relays. With this high sensitivity, IPS Light does normally not require any coordination with the feeder protection.

IPS Light is free from traditional settings which will eliminate human administration errors. The only "setting" is the selection of CTs. In most situations the exact sensitivity of the detector is not critical as long as it is more sensitive than the feeder or substation protection.

Find the faults before the relays trip the feeder

Faults with short duration may just give relay starts in the feeding substation. At repeated starts, it is likely that the fault will develop to a permanent fault. With IPS Light in the secondary substations it is possible to inspect the internal LEDs showing where to expect a future permanent fault. This gives the possibility to fault management preparations in advance or to repair the cable section before the fault lead to a power interruption.

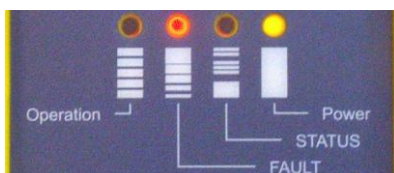


Fig. 1 The internal LEDs always show the last earth fault independent of relay trip

A well known problem in underground cable networks is arcing faults to ground. The problem is that directional relays which measure the steady state zero sequence current and voltage can lose its orientation leading to lost selectivity. Though most relay suppliers claim they can handle arcing faults, practical experiences have shown the opposite. Severe arcing earth faults may result in unselective behavior with the final result that the backup

Can it be simpler?

To be a genuine partner in the daily operation, the detector must be easy to handle and understand. IPS Light fulfills this requirement without compromising with the functionality.

protection (Delayed Neutral Voltage protection) trips the transformer. The fault is now a mayor problem for the Utility and their clients. First of all, the supply is lost for all clients connected to a primary substation. Secondly there is no information telling which feeder is faulty and thirdly one does not know where the isolation break down occurred on the feeder. Without IPS Light the only option is to reclose the transformer and wait until the fault comes back. With IPS Light in the secondary substations you will not only be able to locate the feeder; you can also point out the faulty cable section.

Maintenance Free power supply

IPS Light is intended to be placed in many secondary substations (not necessarily everyone) and therefore it is mandatory that it is practically maintenance free. To achieve this, IPS Light is equipped with Ultra Capacitors instead of batteries for the supply during loss of power. The internal electronics is energy optimized to achieve 24 hours operation time after loss of power. This time is constant and will not change during the life time of the product as the duty cycle of the flashing is adaptable. The duty cycle adaptation also makes it possible to connect 2 LED-units in series, mounted in 2 different directions, with the same operation time.

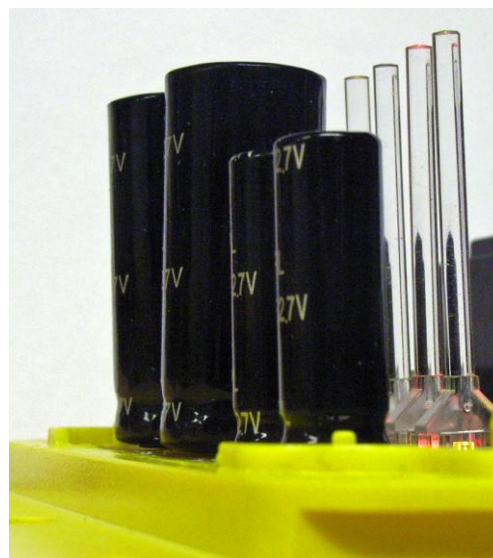


Fig. 2 Ultra capacitors are used instead of batteries

Faults resulting in trip

IPS Light in a feeder which is tripped will switch over to a low power mode and, dependant of what has been registered within the last 10 seconds, show either flashing RED external LED or GREEN external LED. If the fault did pass the substation, the LED will show RED light and if not it will show GREEN light. The internal LEDs will at the same time, for both EF and OC, flash slowly in corresponding color. This state will continue during 24 hours or until the power returns. Note that the detector is “fault pass through”. After a reconnection of the network, with different power flow, the detector will operate correctly.

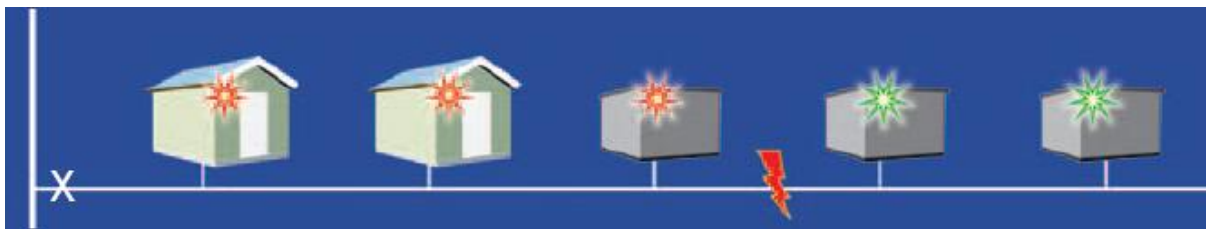


Fig. 3 Shows how the external LED information helps finding where the fault is located

Faults not resulting in trip

If an earth fault is detected and trip occurs within 10 seconds, the earth fault current amplitude will be evaluated ($3I_0 > 0.9 \text{ A}$ at CT ratio 150/1). If this requirement is fulfilled, the internal red LED is turned on. It will flash during 24 hours, but with decreasing duty cycle in its flashing. After 24 hours the red LED is switched off and the green LED starts flashing with 1 flash (1 day after the fault was detected) up to 7 green flashes (7 days after the fault) with a pause between each flash sequence. After 7 days (i.e. 1+7 days after the fault) the green LED will switch to a solid green light. If the fault returns or a new fault is detected, the procedure above will be repeated and if the power disappears, shortly after the detection, the external RED LED also starts to flash.

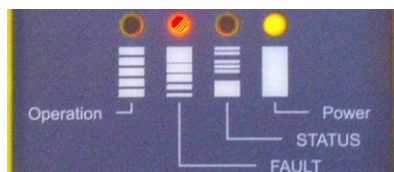


Fig. 4 The first 24 hours after an earth fault the FAULT LED flash with decreasing intensity

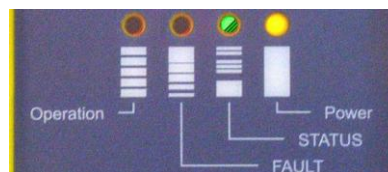


Fig. 5 Day 1 to 7 the STATUS LED flash with a pulse sequence representing the number of days since the fault

IPS Light in new and existing substations

In new substations IPS Light can be preinstalled in the factory with solid current transformers. When erecting the substation at site, the CT can be thread on to the cable before the cable termination is arranged. Finally the external LED unit should be mounted in an Ø27-28 mm hole in the wall, located for best external visibility. The LED unit is easily fitted with the associated screw nut and seal.



Fig.6 Solid and split core CTs.

In existing substations the split core CTs are preferred as the cable does not have to be disconnected.

Options

IPS Light with potential free closing contact intended for connection to local RTU or PLC equipment. In remote controlled substations IPS Light is delivered with a closing contact only. The contact is closed when "fault pass through" is detected. It is selectable to have closing for all detected faults or just faults together with power loss (default).



Fig. 7 IPS Light with closing contact

Relay unit with a closing contact for "fault pass through" detection together with feeder trip. The relay unit is delayed in order not to give false alarms when a LED test is performed.



Fig. 8 Relay unit connected to the LED unit cable when both electrical and optical signaling is required

A protective cover for protection against unintentional contact with the external terminals is available.

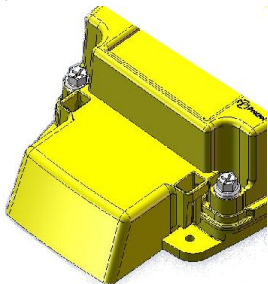


Fig. 9 Protective cover

Technical specifications

General data

Physical dimension:	125 x 195 x 60 mm.
Length with protective cover:	220 mm.
Environment temperature:	-40 to +70 °C.
Power supply:	230 VAC +/-15%.
Power consumption:	~ 1.2 W.
Operation after trip:	24 hours.
Life time Ultra capacitors:	>20 years ⁽³⁾
LED unit light emission:	~800 mcd
Current transformers:	150/1..300/1 A, 2.5 VA

Electromagnetic compatibility (EMC)

Standards:	EN61000-6-2 - Immunity
	EN61000-6-4 - Emission class B
	EN61000-6-5 - Installation in medium voltage switchgears
	EN60068-2- Climatic tests

Tests according to: EN61000-4-2, -3, -4, -5, -6, -12
EN60068-2-1, -2, -30

Detector settings

Over current

Basic setting: 130% of rated current ⁽¹⁾

Earth fault

Basic setting: ~0.5 A residual current ⁽²⁾

Environment

Electronic production is performed according to the ROHS directive.

Housing made in recyclable ABS/PC plastic.

(1) Rated current is the CT primary current.

(2) At 10 kV and a neutral point resistor of 5 A or more, earth faults with up to 10 kOhm fault resistance are detected. At 20 kV the sensitivity is ~20 kOhm. Other ratio of the CTs will change the sensitivity. CTs with 300/1 A will give a sensitivity of 5 kOhm at 10 kV.

(3) The life time is calculated from manufacturer information as a function of operation voltage and temperature.