

February 2001

INTELLIGENT DIRECTIONAL FAULT-CURRENT INDICATOR FOR 6-132kV OVERHEAD LINES

- **Detects and indicates phase to ground and phase to phase (PTP) faults.**
- **Directional indication for phase to ground (PTG) faults.**
- **Insensitive to capacitive discharge currents and change of feeding direction.**
- **Internal fault counter and log.**
- **Multiple power-supply solutions.**
- **Relay output for connection to Communication devices and SCADA RTU's (Option).**



LineTroll 3500 is suitable in electricity distribution networks with resistor earthed neutral, isolated neutral as well as compensated networks (Petersen coil). State of the art technology allowing the utilities the possibility to program the operational parameters to suit their own demands for functionality and complexity.

Established in 1977, **Nortroll** has gained considerable experience within fault finding, automation and surveillance of distribution networks.

1. LINETROLL 3500 OVERVIEW

LINETROLL 3500 is used to locate short-circuit /Phase To Phase (PTP)- and earth faults/Phase To Earth (PTG) in overhead line distribution networks. LINETROLL 3500 is a 3-phase unit fully covering the different fault configurations that may occur. The indicator can be used in networks with isolated or impedance earthed neutral as well as compensated (Petersen coil) networks.

The indicators are placed at strategic locations along the line such as after branching points and sectionalisers. It mounts on the pole, 4-5 meters below the conductors, by means of screws or wrapping-bands. Live line mounting is done safely, easily and rapidly.

Upon detecting a fault on the line, the indicator gives off an intermittent red or green light-flash (LED). One LED flashing indicating an earth-fault and both LED flashing indicating an short-circuit fault. Xenon flash can be supplied as an option. The colours of the LED will also indicate direction to the fault location for earth-faults.

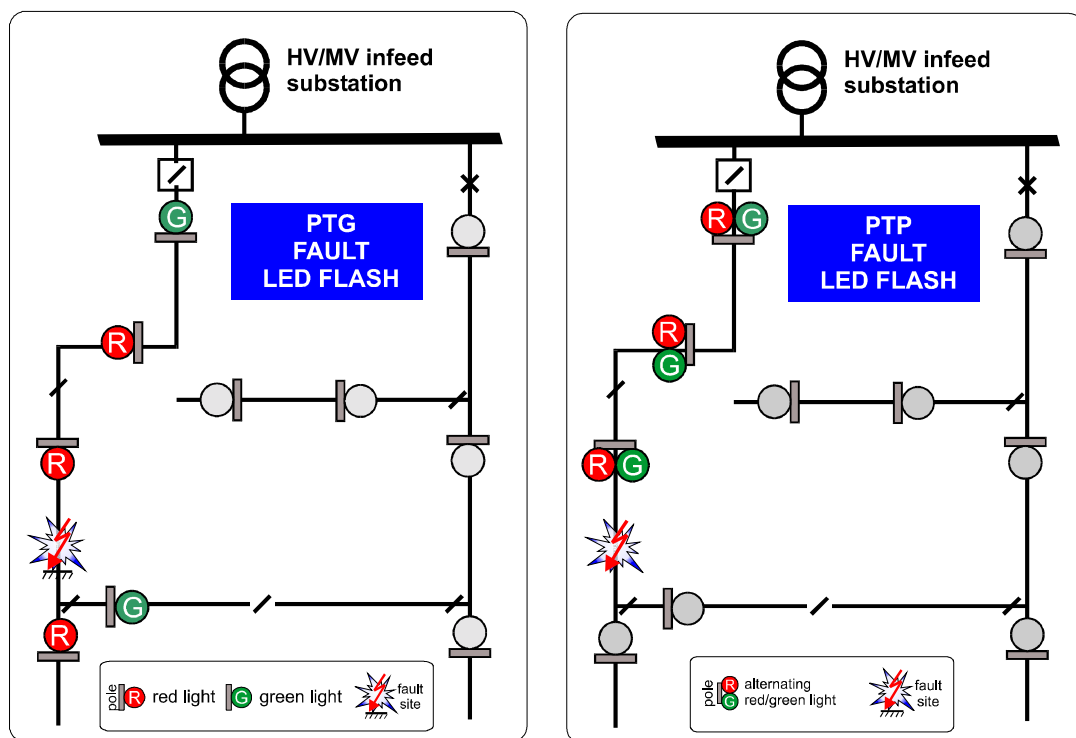


Fig. 1. Indicators during a fault situation

Upon sensing an earthfault (PTG) all indicators installed on the feeder with fault both upstream and down stream will operate. Upon sensing an short circuit fault (PTP) only indicators installed between the feeding transformer and the fault location will operate

FUNCTIONAL DESCRIPTION

LINETROLL 3500 provides fast fault location enabling reduction in outage times. This represents enhanced service to the customers thereby improving the quality of electricity-supply.

Another important aspect of using fault indicators is that unnecessary operations of circuit-breakers and sectionalisers to locate faults are avoided. This way the indicators help to reduce wear and tear as reclosing CYCLES CAUSES STRESS TO THE SWITCHGEAR.

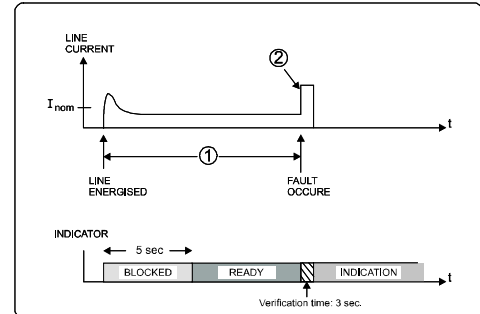


Fig. 2. Fault sequence

LINETROLL 3500's fault sensing is based on detection of the electromagnetic field below the conductors. The unit is fully self-contained, no external transformers or connections of any kind are required.

To determine whether or not the line is faulted, the indicator is looking for a specific sequence in the line conditions to happen before it starts flashing. The general sequence is as follows: (ref. fig.2)

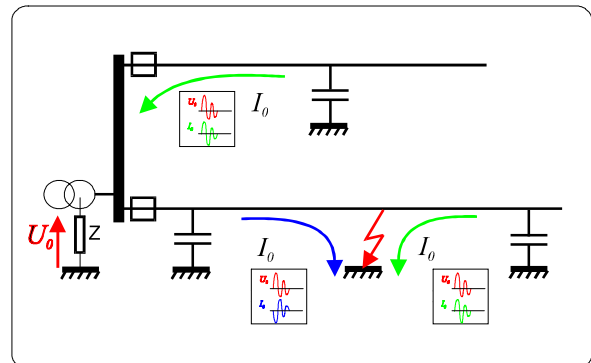
1. The line should be energised for at least 5 seconds.
2. Fault current due to PTP or PTG increasing rapidly above a pre-set value.

Sensor principle

The processor in the Indicator uses approx. 60 ms To detect the fault. It analyses the signals and looks for a de-energised line (if programmed) before starting indication. This 3 sec. period is called verification time.

For **PTP** faults the sensor will require that two conditions are satisfied:

1. Line energised for more than 5 sec.
2. current exceeding a pre-set minimum value.



For **PTG** fault the sensor will require that two conditions are satisfied:

1. Line energised for more than 5 sec. Current discharge transients exceeding a pre-set value. The indicator then makes an analyses of the current discharge transient I_0 and the residual voltage. This analyses will tell indicators whether they are located between the feeding-transformer and fault location, downstream the fault or on other feeders connected to the same bus-bar.
2. An increase of minimum 50% in the E-field set up by the residual voltage.

APPLICATION

The application of LINETROLL 3500 usually requires no previous line survey. For the best economic benefit it is recommended that the indicators are used:

- In easily accessible line points for easy monitoring of the indicator in case of fault, for instance near the road. It is advisable to take binoculars.
- Before and after line points difficult to reach (mountains, woods, etc.) to quickly locate the fault.
- Next to line branching points, to easily locate the damaged branch. When installing indicators at such points, the use of indicators in every branch is recommended in order to provide complete information in the event of fault. Not doing so may cause confusion since there may be an indication in a branch due to a non-permanent fault while another branch without indicator may be faulty yet considered healthy.
- Near line points with sectionalisers to rapidly pinpoint and isolate the fault to facilitate rapid reconnection the healthy sections.
- In connection with remotely controlled outstations where the indicator can be connected to an RTU giving the SCADA operators immediate information of the fault location.

LINETROLL 3500 Connected to an RTU:

The LT 3500 can be equipped with an internal relay-card, situated in indicator bracket, giving the possibility of four different relay-output's to an RTU.

The different output signals can be:

- Transient Fault in red direction
- Transient Fault in green direction
- Permanent Fault in red direction
- Permanent Fault in green direction

The relay-card also has an input for external reset from the RTU

The LT 3500 can in this application, instead of batteries, be powered with an external DC (10-24VDC) from the RTU.

LINETROLL 3500 is suitable in:

- 6-132kV distribution networks.
- Isolated-neutral networks.
- Compensated networks (Petersen-coil).
- Resistance-earthed-neutral networks.
- Single and 3-phase network

LT 3500 TECHNICAL SPECIFICATIONS

BLOCKING TIME FOR INRUSH:

5 seconds

INDICATION CRITERIA PTG FAULT

- 1) Line energised for more than 5 seconds
- followed by a
- 2) Fault current (50Hz) exceeding a preset value within 60 ms.

INDICATION CRITERIA PTG FAULT

- 1) Line energised for more than 5 seconds
- followed by a
- 2) Fault current transient exceeding a preset value within 60ms.
- 3) 50% increase in the E-field set up by the residual voltage

REQUIRED FAULT DURATION:

Minimum 60 ms

INDICATION:

- 1) Indication by high intensity LED (1Hz);
- two colours, RED and GREEN.
- 2) Future optional Xenon gas flashes, 0.2 Joules per flash every 5 sec., and

The LED flashes for the elapse of the timer, until voltage is restored (if voltage reset is set to ON or until the indicator is reset manually by a magnet.

RESET:

- 1) Voltage reset, delayed 5sec. or disabled.
- 2) Timer reset:
LED factory set to 6 hours. (The number of hours can be changed by Nortroll personnel)
- 3) Manual reset by internal magnet.

CURRENT CONSUMPTION:

Non-activated: 400 uA

IR activated: 500 uA

Flash activated: 10 mA

RELAY ACTIVATED

80MA

