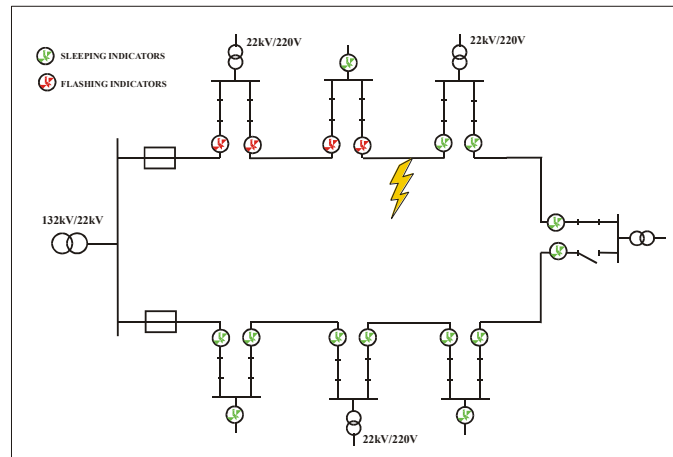


Product Catalog

Cable Fault Indicators



The CableTroll indicators are fault current detectors for the underground medium voltage distribution network (6-36kV). They are used to detect short circuit and earth faults, and can be installed on most types of cable terminations. Some units will give separate indication for short circuit and earth faults, locally by flashing diodes and remotely through separate relay contacts or additional ComTroll communication modules.



All indicators between the feeding transformer and the fault location activate.

CABLETROLL fault indicators provide fast fault localisation enabling reduction in outage times.

This represents enhanced service to the customers thereby improving the utilities image and significant reduction in the cost related to faults and outages.

Another important aspect of using fault indicators is that unnecessary operations of circuit-breakers and sectionalizers to locate faults are avoided. This way the indicators help to reduce wear and tear as reclosing cycles causes stress to the switchgear.

Fault currents in cable network

The short circuit current magnitude is mainly given by voltage level, type of transformer, primary feeding network and the distance from the feeding transformer to the fault location. A cable short circuit will normally cause a fault current in the kA-range. When short circuit appears near the end of a long line, the fault current is most likely to be of a significantly lesser value.

In networks with directly earthed neutral an earth fault is equivalent to a phase-to-earth short circuit. The current magnitude will in this case be almost equal to the fault current of a phase-to-phase short circuit. For networks that do not have a directly earthed neutral, the magnitude of the earth fault current is determined by the size of the galvanic interconnected network, the voltage level, type of cable and the neutral equipment. The magnitude of a fault current during a dual earth fault will be almost equal to a short circuit in networks that do not have a directly earthed neutral.

As the sensor principle is of the threshold type, correct use of the indicator is subject to calculations of earth fault currents and capacitive discharge currents through the sensor element (seen from the feeder). The capacitive discharge current from behind the earth fault element must not exceed the trip level setting of the indicator. The capacitive discharge current will vary between the different types of cable, and the cable supplier should be consulted about the data for your specific type in order to make the correct calculations

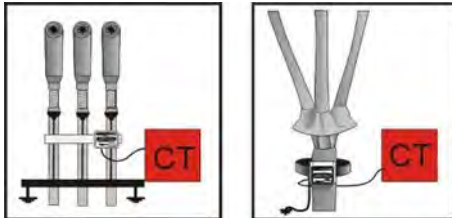
CableTroll 2310

CableTroll 2310 is an indicator for detection of earth faults (PtG) on multi-core and single core cable terminations. The unit uses NorTroll type current sensor (CT)



Programmable:	Dipswitches
Trip level PTG:	5-240A fixed & adjustable levels
Reset:	Manual, timer, automatic and remotely
Indication:	PtG and Battery monitoring
Relay output:	PTG (NO & NC)
Power:	Lithium Battery or 9 -48Vdc with battery backup
	Mains option available

Suitable Cable terminations:



CableTroll 2320

CableTroll 2320 is an indicator for detection of Earth faults (PtG) and short circuit (PtP) faults on multi-



Programmable:	Dipswitches
Trip level PtG:	5-240A, fixed & adjustable levels
Trip level PtP:	300-1000A
Reset:	Manual, timer, automatic and remotely
Indication:	Separate PtP and PtG and Battery monitoring
Relay output:	Separate PtP & PtG
Power:	Lithium Battery or 9 -48Vdc with battery backup
	Mains option available

Suitable Cable terminations:

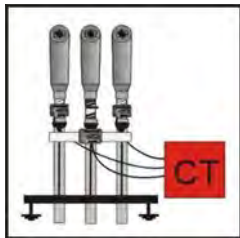


CableTroll 2330

CableTroll 2330 is an indicator for detection of earth faults (PtG) and short circuit (PtP) faults on multi and single core cable terminations. The unit uses NorTroll type current sensors



Suitable Cable terminations:



- | | |
|-----------------|---|
| Programmable: | Dipswitches |
| Trip level PtG: | 5-240A, fixed & adjustable levels |
| Trip level PtP: | 250-1000A |
| Reset: | Manual, timer, automatic and remotely |
| Indication: | Separate PtG and PtP and Battery monitoring |
| Relay output: | Separate PtG & PtP |
| Power: | Lithium Battery or 9 -48Vdc with battery backup |
| | Mains option available |

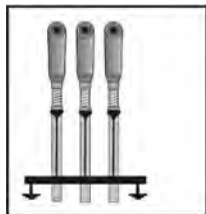
CableTroll 2350

CableTroll 2350 is an indicator for detection of PtG and PtP faults on multi and single core cables. The unit uses standard type current transformers. (40:1, 60:1 or 3x500:1)



- | | |
|-------------------|---|
| Programmable: | Dipswitches |
| Trip level PtG: | 50A |
| Trip level PtP: | 250-1000A |
| Reset: | Manual, automatic by timer and remotely |
| Indication: | Separate PtG & PtP |
| Relay output: | Common PtG & PtP |
| Power Supply | Lithium Battery |
| Internal Eventlog | |

Suitable Cable terminations:



LED-2 is a flashing unit which can be mounted outside a kiosk etc. It provides a strong flash in a rugged design and does not require additional power source

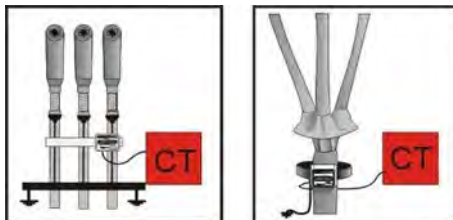
CableTroll 2410

CableTroll 2410 is an earth fault indicator for detection of PtG faults on single and multi-core cables. The unit uses NorTroll type current sensors. The housing is suitable for panel mounting in



Programmable:	Dipswitches
Trip level PTG:	6-340A fixed & variable levels
Reset:	Manual, timer and remotely
Indication:	PtG and Battery monitoring
Relay output:	PtG
Power:	Lithium Battery

Suitable Cable terminations:



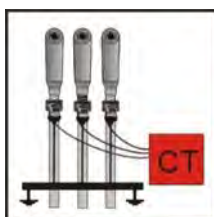
CableTroll 2440

CableTroll 2440 is an indicator for detection of PtG and PtP faults on single and multi-core cable terminations. The unit uses NorTroll type current sensors. The housing is suitable for panel mounting in RMU's.



Programmable:	Dipswitches
Trip level PTG:	20-160A
Trip level PTP:	250-1000A
Reset:	Manual, timer, remotely and automatic by return of Voltage or Current
Indication:	PtG/ PtP and VPI/CPI (Volt/Current Present Indication)
Relay output:	Common PtG- & PtP-fault and Low battery
Power:	Lithium battery

Suitable Cable terminations:



LOCAL INDICATORS

CableTroll 2600

CableTroll 2600 is an indicator for detection of PtG & PtP faults on multi-core (CT 2600M) and single-core (CT 2600S) cables. The unit uses a NorTroll type current sensor.

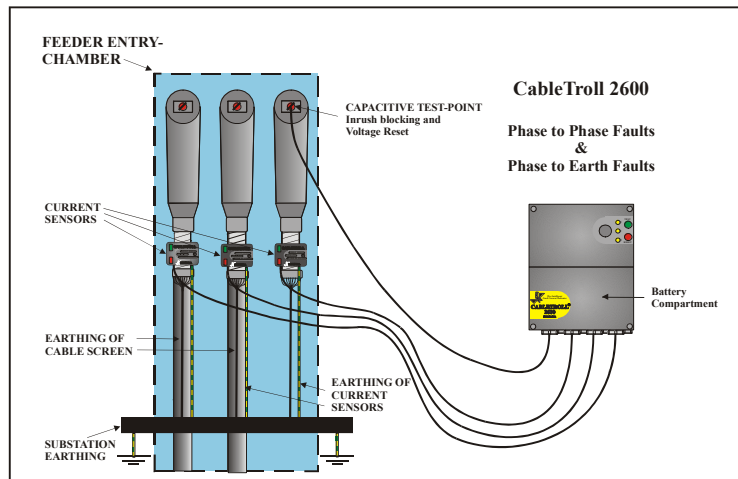
The CT2600 can be used to as a PtG indicator for up to 3 feeders.



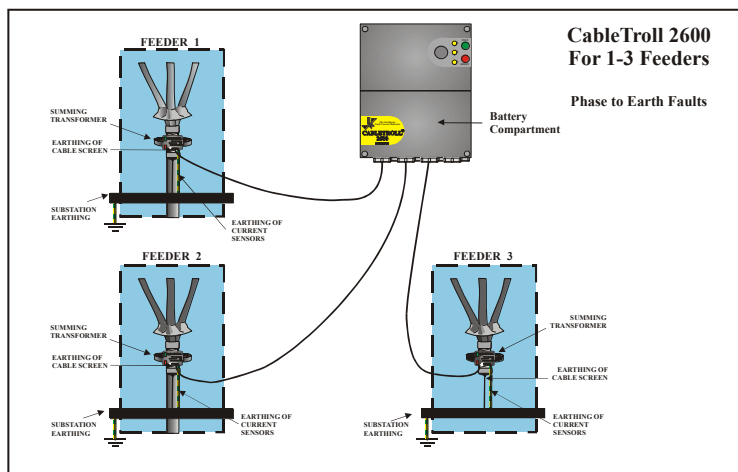
Applications:

Programmable:	Dipswitches
Trip level PtP:	200-1000A
Trip level PtG:	10- 160A
Reset:	Manual, timer, remote and automatic
Indication:	by return of Voltage or Current a) Separate PtG & PtP (S) or b) PtG for 1-3 feeders (M)
Relay output:	a) Separate PtP & PtG (S) or

T-2600 (S) Single Core:
PtG- and PtP-fault detection



CT-2600 (M) 3-core cable
PtG-fault detection on
1, 2 or 3 feeders

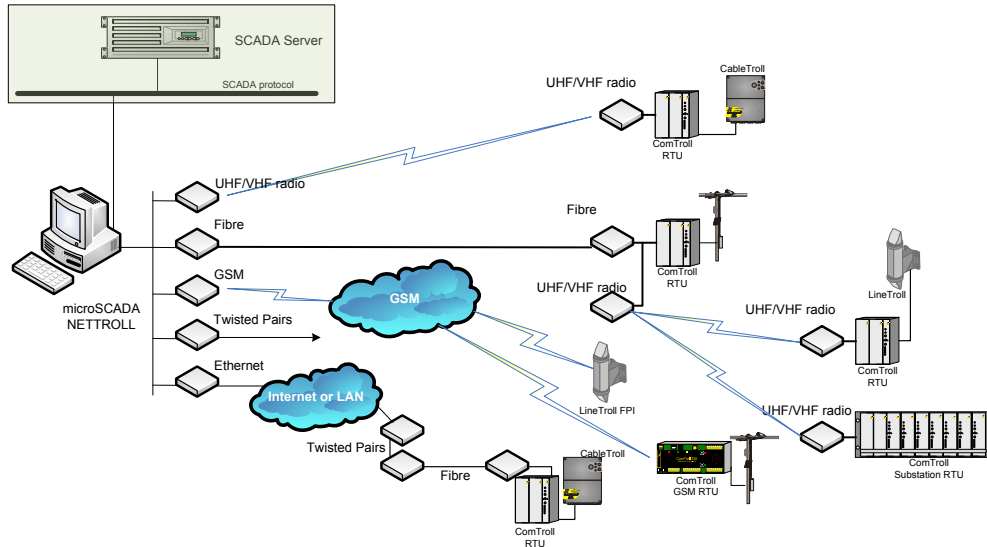


REMOTE INDICATORS

Remote Indication

All of our CableTroll fault indicators have a relay output for interfacing with equipment that can forward the alarms to a control center, SCADA system or cell-phone.

Nortroll offers a wide range of communication modules and RTUs with various communication options such as radio, GSM, fibre, Ethernet etc.



Nortroll's range of product comprises

LineTroll Product range

Fault Passage Indicators for overhead lines

CableTroll Product range

Fault Passage Indicators for cable Networks

ComTroll Product range

RTU's for substations and motorized switchgear, communication equipment for fault passage indicators and RTU's, MicroSCADA System for surveillance and control and NetTroll SCADA Gateway



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Product Catalog
**Surveillance and
automation systems**



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ComTroll SAS. Surveillance and Automation System

The electric utility industry is experiencing an increasing demand for a more efficient and cost-effective operation of the distribution network. De-regulation, increased competition, demand for better quality of supply and penalty for non-supplied energy is becoming the everyday challenge for an increasing number electricity distribution companies.

Changes in the industry have resulted in an increasing interest in distribution automation and surveillance as one means of meeting the new demands for customer satisfaction and profitability.

NorTroll's system for distribution automation called ComTroll is designed for remote control, surveillance and automation of both rural and urban distribution systems.

ComTroll is a modular system with different building-blocks allowing the utilities to tailor-make a system to meet their own demands for functionality and complexity.



NORTROLL offers:

- Fault passage indicators for cable- and overhead lines.
- Software for remote control and surveillance of the network.
- Outstations for remote operation of overhead line and underground cable switchgear.
- Interface for easy integration of the ComTroll system with other SCADA systems.
- Communication infrastructure for a wide range of media and communication protocols.

The ComTroll system is developed to identify the fault-location, isolate the faulty section and restore the healthy part of the system in a minimum of time.

Communication

The ComTroll system is based on the modern and flexible LonWorks® technology with the integrated LonTalk® protocol. The system is very suitable for use in independent as well as shared networks.

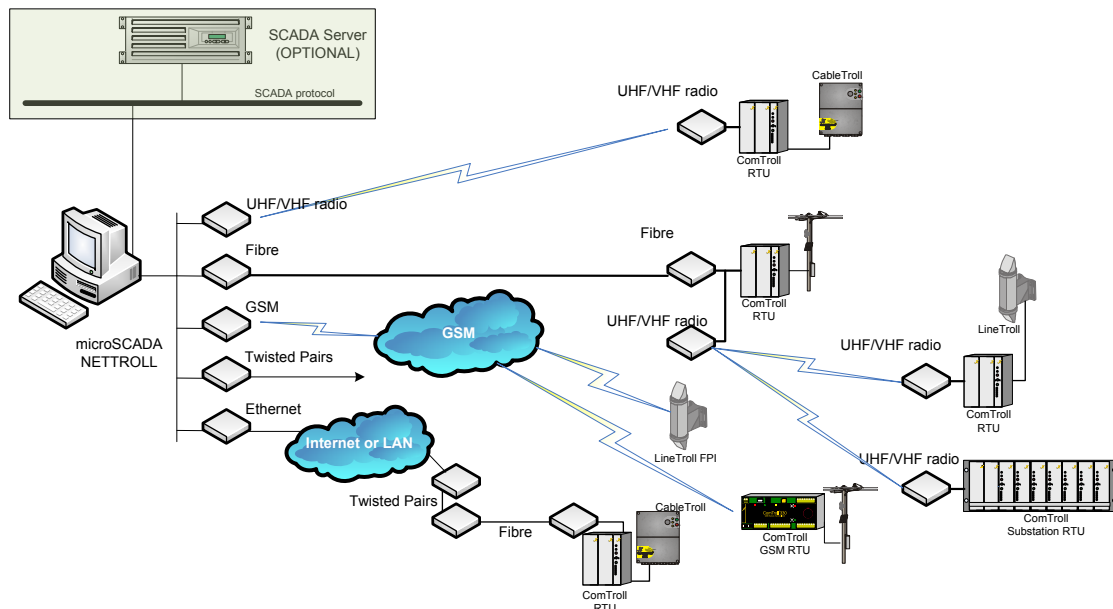
Nortroll has specialised in Radio communication (VHF/UHF) and has adapted the LonWorks technology to be used in an independent radio infrastructure, allowing the use of “store- and forward” repeaters to ensure the radio coverage to remote out-stations and indicators. The system allows for an out-station to act as a repeater for other out-stations or fault indicators.

The LonTalk protocol is media independent allowing for a wide range of media options such as radio, fibre, Ethernet and more. The LonTalk protocol benefits the power consumption as the traffic is kept in a minimum in this report-by-exception system.

This flexible communication platform opens for the use of different media within the same network.

This system can be fully integrated with a SCADA system using other protocols such as IEC60870-5-101/104 and DNP3 through a software SCADA gateway.

Nortroll also offers systems using IEC60870-5-101/104 protocol which communicates directly with existing SCADA systems on different communication media.



Low power consumption allows the outstations and repeaters to be charged from a solar-panel making it very simple and cost effective to build the radio infrastructure. This avoids the necessity for considering the cost and availability of mains power at all locations of the outstations and repeaters.

Building-blocks

The NORTROLL system consists of different building-blocks, ranging from software for monitoring and remote control of the network to outstations with integrated RTU's and fault indicators for overhead-line or underground cable. All products have been designed with the focus on high modularity and flexibility, very low current consumption, media independent communication, and integration with other SCADA systems.

NetTroll and NetDraw

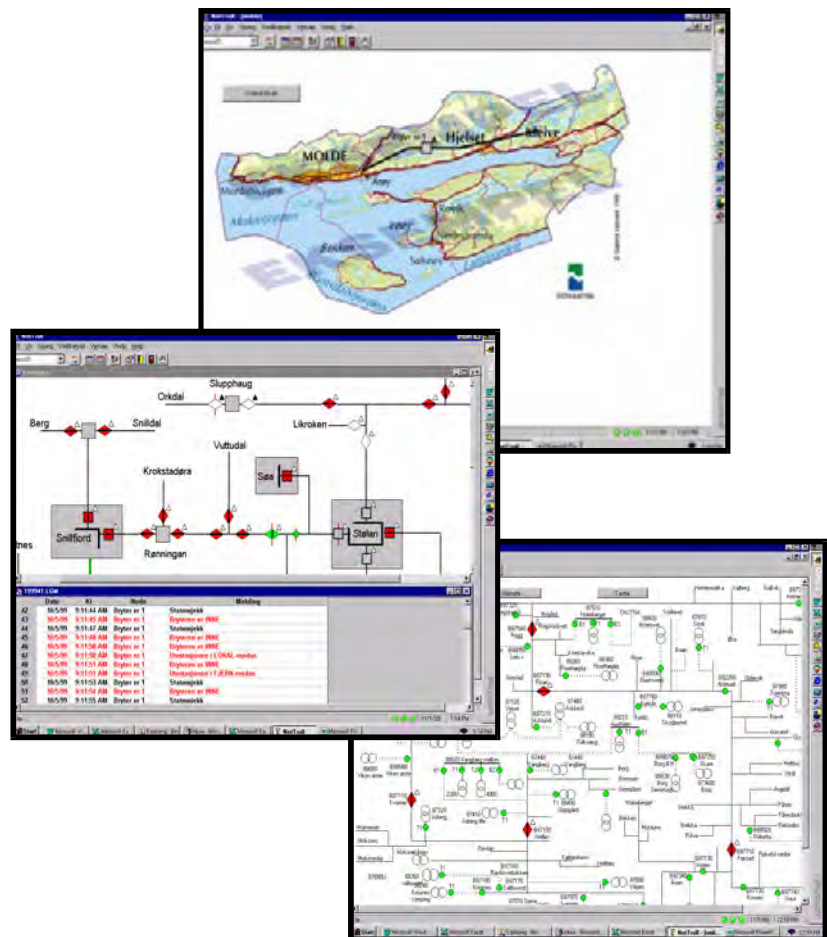
NetTroll is a micro SCADA system for remote operation of switchgear, monitoring of indicators and switch-gear status and collection of other useful digital and analog data for effective operation and maintenance of the distribution network.

NetTroll and NetDraw

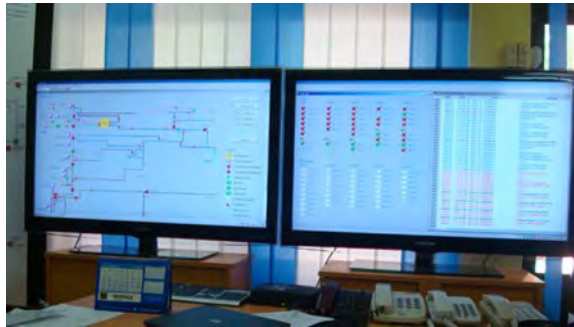
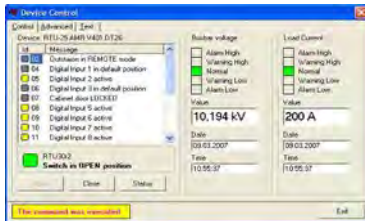
NetTroll is a micro SCADA system for remote operation of switchgear, monitoring of indicators and switch-gear status and collection of other useful digital and analog data for effective operation and maintenance of the distribution network.

NetTroll Features:

- Runs on a standard Windows PC platform.
- Easy installation and configuration.
- Easy-to-use operator interface.
- User defined logs for monitoring of specific events.
- Advanced Alarm Management
- Built-in Conditional Actions Module (CAM)
- Ideally suited for monitoring and control of report-by-exception fault passage indicators and RTU's.
- Secure password protected user levels.
- Advanced graphical features.
- Built-in bitmap editor for creating user defined symbols.
- Device specific message properties.
- Unlimited number of devices can be installed.
- Easy Master SCADA integration with a wide range of SCADA protocols.



NetDraw is a drawing editor for NetTroll and gives the user full control of the screen graphics. Symbols for outstations and indicators can be chosen from the symbol library or can be designed by the user (bit-maps). Device independent properties can be set to give any message a special meaning and importance level.



NetAlert

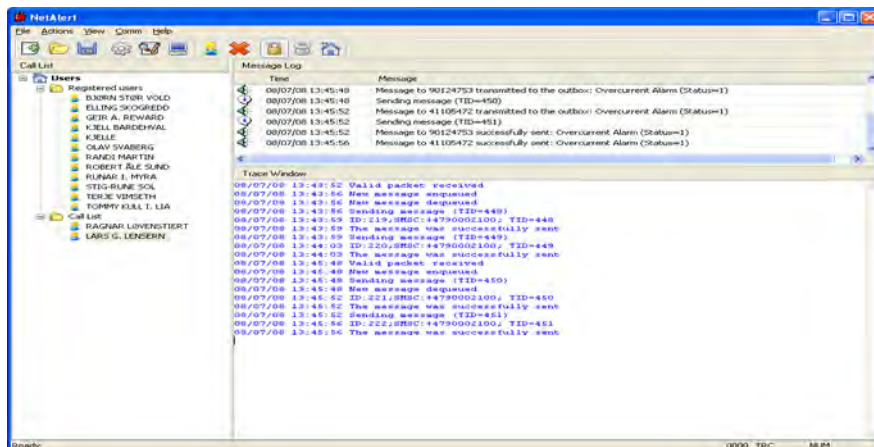
NetAlert is a supplementary program to NetTroll 4.

NetAlert sends SMS alarms to one or more pre-defined users set up in one or several call lists.

Alarms in NetTroll can be grouped and different group messages can be forwarded to different recipients.

It is also possible to forward alarms from specific devices to specific recipients defining the same message from different devices into the same group.

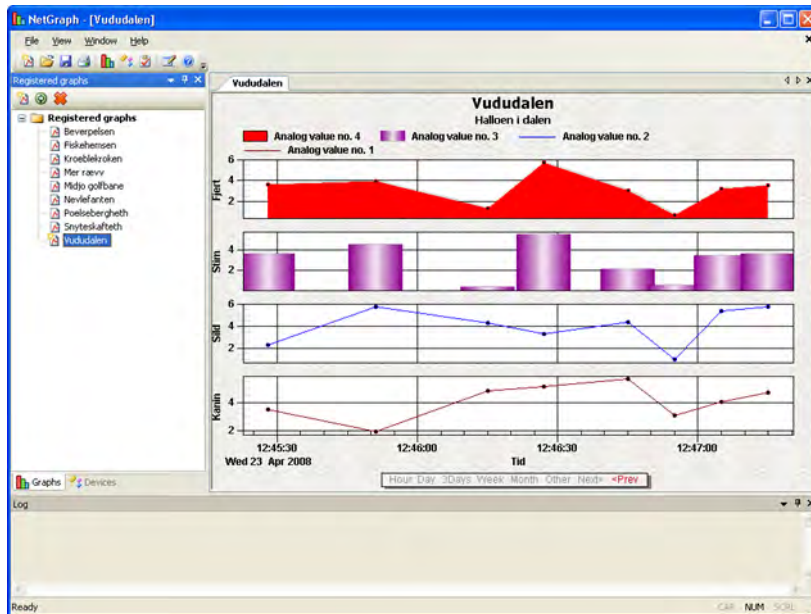
The SMS recipients receive will contain the same alarm string as defined for the actual message in NetTroll. It also contains date, time and the outstation name.



NetGraph

NetGraph is a program to graphically present analog values from outstations. (Trend curves).

Immediately when a message has arrived in NetTroll the trend curve for the particularly value will be updated and stored. This program works in parallel with NetTroll and all the incoming analog data will also be stored and presented in NetTroll simultaneously.



ComTroll Outstations

ComTroll Outstations can be equipped with a variety of RTU's. From the compact ComTroll 155 offering a simple low-cost solution for operation of one switch (Nortroll actuator, LBS, ABS etc) as well as being a repeater for other stations to the more advanced rack based ComTroll 230.

ComTroll 230 (RTU-30 / RTU-30i) offers various numbers of I/O's, digital, analog and serial interface and can be built on customer specific requirements. ComTroll 230T (RTU-30t) includes a GPS unit that provides a highly accurate time reference on events that occurs in the RTU.

ComTroll 230S (RTU-30s) is equipped with an EIA-232/EIA-485 port which can be connected to up to 15 external Modbus RTU devices such as relay protection, switchgear, power quality devices etc.

OUTSTATIONS

ComTroll 220 Actuator for OH line switches
COMTROLL 220A1 is a linear motordrive unit suitable for the operation of Medium Voltage Overhead Line Switches with a vertical manoeuvring rod.

Due to its adjustable stroke length and high linear force, COMTROLL 220A1 is suitable for most types of switches available on the market.

COMTROLL 220A1 has an integrated spring mechanism allowing for high speed closing. (Live line closing option).

COMTROLL 220A1 is equipped with motor protection fuses, and a local operation module with terminals for remote control options. The actuator can be manually operated in case of a power failure.

COMTROLL 220A1 can be operated by Nortroll's VHF radio controlled RTU Nortroll's GSM operated RTU (ComTroll 333 RTU)

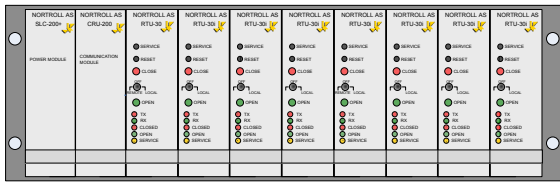
Other supplier's RTU systems



Solar Charged version and Mains Charged versions are available dependent upon the type of communication module and RTU



ComTroll 230



ComTroll 230 is a series of outstations for operation of already motorised switchgear such as reclosers and ground mounted actuator driven switchgear. One 19" Rack Frame can be fitted with 8 RTU cards. I/O's can be utilized individually although the normal setup is one RTU pr switch. For stations or cabinets with limited space, a 10.5" Rack Frame can be supplied leaving enough space for 3 RTU cards including power supply and various communication modules. The ComTroll 230 can be fitted with different RTU cards with different features and protocols to tailor the application in each case.

ComTroll 155

ComTroll 155 RTU is a compact device with RTU, modem, radio and DC/DC charger all built in to one unit. A version designed for fibre networks is also available. The ComTroll 155 RTU can be used for remote control of one actuator or one motorised switch. The ComTroll 155 can be supplied with a cabinet for outdoor mounting.



ComTroll Repeater

The ComTroll stand alone repeater is based on the same hardware as the ComTroll 155 RTU/ICU.

The repeater can be configured to route signals to specific address ranges keeping the radio traffic to a minimum for maximum throughput.

Any Nortroll RTU can be configured as a combined repeater extending the radio coverage to outstations further out in the network.

ComTroll RTU Options

	ComTroll 155 RTU	ComTroll 155 ICU	RTU-26	RTU-30	RTU-30i	RTU-30s	RTU-30t
Digital Inputs	7	9	8	8	8	N/A	8
Digital Outputs	4	5	6	6	6	N/A	6
Analog Inputs	0	0	3	4	4	N/A	4
Serial port (MODBUS RTU)	No	No	No	No	No	Yes	No
IEC870-5-101 Protocol	Through gateway	Trough gateway	Trough gateway	Trough gateway	Trough gateway	Yes	Trough gateway
Time Stamped Events (External GPS)	No	No	No	No	No	Optional	Yes
Solar Charging Option	Yes	Yes	Yes	Yes	Yes	Yes	No
Switchgear Control Appl.	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Communication Media	UHF/VHF Radio	UHF/VHF Radio	Selectable	Selectable	Selectable	Selectable	Selectable
Local/Remote control	Local & Remote	Remote	Local & Remote	Local & Remote	Local & Remote	Local & Remote	Local & Remote
Form factor	Stand-alone. 300x201x65 [mm]	Stand-alone. 300x201x65 [mm]	10,5" / 19" rack-frame, single height	10,5" / 19" rack-frame, single height	10,5" / 19" rack-frame, single height	10,5" / 19" rack-frame, single height	10,5" / 19" rack-frame, single height

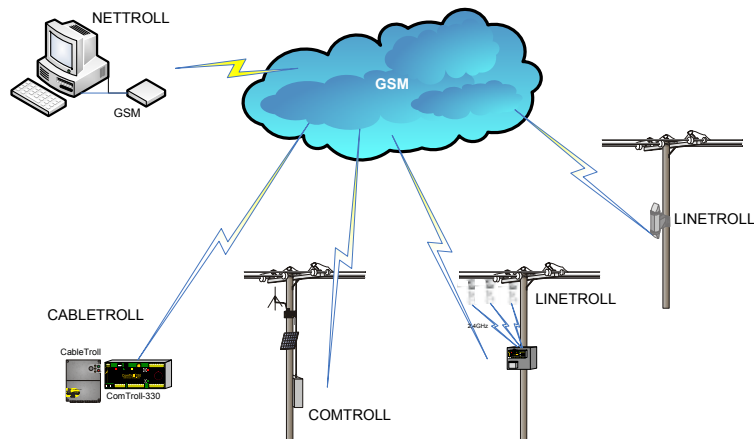


ComTroll GSM Remote Terminal Units

Nortroll offers a complete system for **Remote Indication and – control** using GSM as the communication carrier. In fault indicator systems, SMS is the most commonly used media to transfer the alarms to the central unit.

GPRS solutions for fault indicators are also available. Control systems have to establish a CSD or GPRS connection before any control can be executed. The GPRS system can also connect to any SCADA system directly running the IEC870-101-5-104 protocol.

The GSM based system can be integrated into NetTroll in the same way as equipment using other communication media.



ComTroll 330 RTU

ComTroll 330 RTU's primary function is to monitor and control overhead line and cable switch-gears. It reports any alarm to a central control system by sending SMS text message or by a GSM Data (CSD) connection. Critical messages as switchgear position are always sent by CSD. Secondary alarms can be set up by the user to either use SMS or CSD. If the CSD connection fails, the unit tries to re-connect three times. If the CSD connection still fails a SMS is sent to ensure all alarms or events are received by the central unit.

During the design of this product, NorTroll has put all efforts into making an RTU with lowest possible power consumption, allowing the unit to work for a long period during loss of charging. It is designed to facilitate solar panel charging and for operation in the most demanding climatic environment.

ComTroll 330 RTU is available in a version where the GSM modem is replaced with an Ethernet port. (ComTroll 333 RTU Ethernet) The protocol used is IEC60870-5-104 which means it can be installed in most SCADA system without the need for a SCADA gateway.



Additional analog- and digital I/O's can be added using the ComTroll 333 Slave unit. The slave unit has 4 analog, 8 digital inputs and 8 relay outputs and is connected to the 333RTU by a serial port.

ComTroll 333 ICU

(Indicator Communication Unit) communicates with the NetTroll micro SCADA system through SMS.

The unit can be used as a general communication module for NorTroll's fault passage indicators as well as third parties equipment though its 8 digital inputs, 4 analogs and 4 relay outputs. (8 relays optional). The units also have a serial port for serial connection to third parties equipment. (EIA 485)



The ComTroll 333 ICU is especially suitable together with the ComTroll 115C QuickLink Collector.

ComTroll 115C communicates with up to 9 LineTroll 110EµR phase –mounted fault passage indicator with a 2.4GHz radio link.



ComTroll 120 GLM

ComTroll 120 GLM's primary function is to monitor NorTroll's overhead line fault indicators and report any initiated alarms to a central control system by sending a SMS.

The GLM offers a wide range of functions that will maximize the benefits of using fault indicators. It is no longer necessary to patrol the lines to find where the fault is located, leading to a better deployment of staff and reducing the time that customers are without supply. The unit has been designed for ultra low power consumption so that the ComTroll 120 GLM can be powered from one or two 3,6V Lithium batteries with maintenance free operation for many years. The ComTroll 120 GLM is placed in the same housing as the fault indicator itself and no additional cabinets or external devices are necessary.





ComTroll 120 GLM can also be used as a GSM/SMS interface for fault indicators for cable networks. (CableTroll). In this application the GSM module is placed in an outdoor weather-proof enclosure and can be powered by two Lithium batteries.

The SMS unit can be connected to up to 4 CableTroll (or third parties) fault indicators.

NetTroll SCADA Gateway

The NetTroll SCADA Gateway is supplementary software to NetTroll. It runs on the NetTroll PC and will be set up as a slave RTU seen from the SCADA side.

This means all indications and alarms will appear on the main SCADA system. Controls and commands will also be executed from the SCADA terminals.

All NorTroll field devices can communicate with the SCADA through one or more gateways. Where a utility has several regional offices, one Gateway could be placed in each regional office and connect to the main centralized SCADA centre through the SCADA communication system. This facilitated "local" terminals where personnel can be given different levels or permissions to operate or only monitor the status of their local network.

The number of devices that can communicate through one gateway is unlimited.

AutoTroll Feeder and Network Automation.

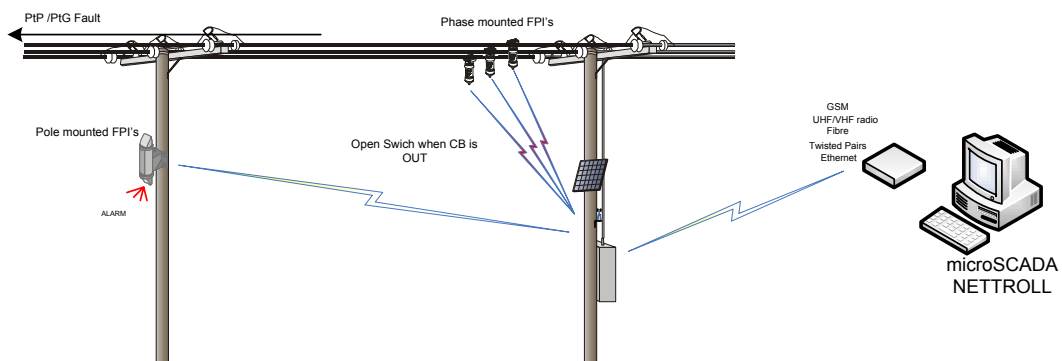
The AutoTroll concept has been developed to further maximise the value of the ComTroll system. Automatic disconnection of a faulty feeder or a reconfiguration of the network without the need for operator intervention will further reduce the outage-time and restore power to the healthy part of the system in less than a minute. The total time to restore power is dependent on the complexity and the number of outstation involved in an automation scheme.

Feeder Automation.

Input from a **LineTroll** or **CableTroll** fault passage indicator to a Nortroll RTU can locally initiate opening of a switch. The output from the indicator can be delayed to make sure that the outstation receives the command to open the switch after the indicator has verified that there is a permanent fault on the feeder. Alternatively, voltage sensors can be used to detect voltage presence before the operation is carried out.

The outstation will then open the switch when the line is de-energised before the delayed re-closing appears. When the delayed re-closing appears the faulted feeder or branch will have been disconnected and the healthy part of the feeder will be restored.

This system is a very good alternative to an Auto-Recloser system.



Both phase mounted fault passage indicators and pole mounted indicators can be used to detect the PtG or PtP faults and report this to the receiver in the switchgear cabinet.

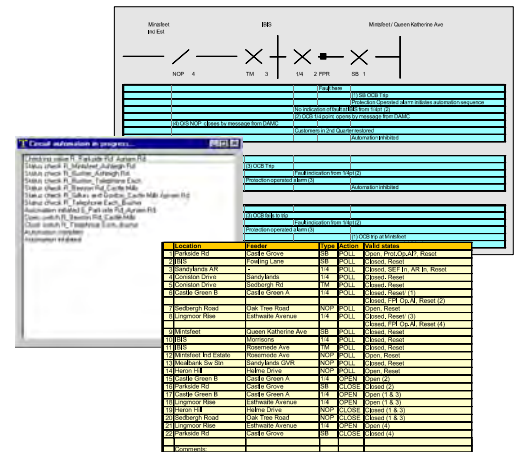
Network automation

An automated sequence can be programmed in the AutoTroll module within the NetTroll micro SCADA software (Optional). A sequence can include a various number of outstations even from different feeders.

Different events in the network or RTU I/O states can be set as a **Trigger** or an **Inhibitor** for an automated sequence. Triggers and inhibitors are set up in a step-table describing what commands should be executed when a specified event occur.

When the specified event (trigger) occurs the AutoTroll system will start a sequence of opening and closing switches according to the step-table specified for the sequence. The automatic sequence will isolate the faulty section and reconfigure the network unless an inhibitor prevent the sequence being executed.

The AutoTroll feeder and network automation can be used in a standalone Nortroll system or in systems where the Nortroll outstations are integrated into other SCADA systems.



Nortroll's range of product comprises

LineTroll Product range

Fault Passage Indicators for overhead lines

CableTroll Product range

Fault Passage Indicators for cable Networks

ComTroll Product range

RTU's for substations and motorized switchgear, communication equipment for fault passage indicators and RTU's, MicroSCADA System for surveillance and control and NetTroll SCADA Gateway

This document does not contain all of Nortrolls products within the ComTroll range, but lists our main products for SMARTER NETWORK MANAGEMENT in distribution networks. For more information please contact your local NORTROLL representative or get more information on our web site www.nortroll.com



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Product Catalog

**Fault Passage Indicators to locate
short circuit and earth faults**

Improve customer satisfaction

Customer satisfaction is often difficult to measure. So one of the key figures used to indicate the performance of a distribution network is SAIDI. SAIDI (System Average Interruption Duration Index) is often measured and monitored every month or as a sum over one year.

SAIDI gives the average outage duration that any customer would experience and is the sum of two factors:

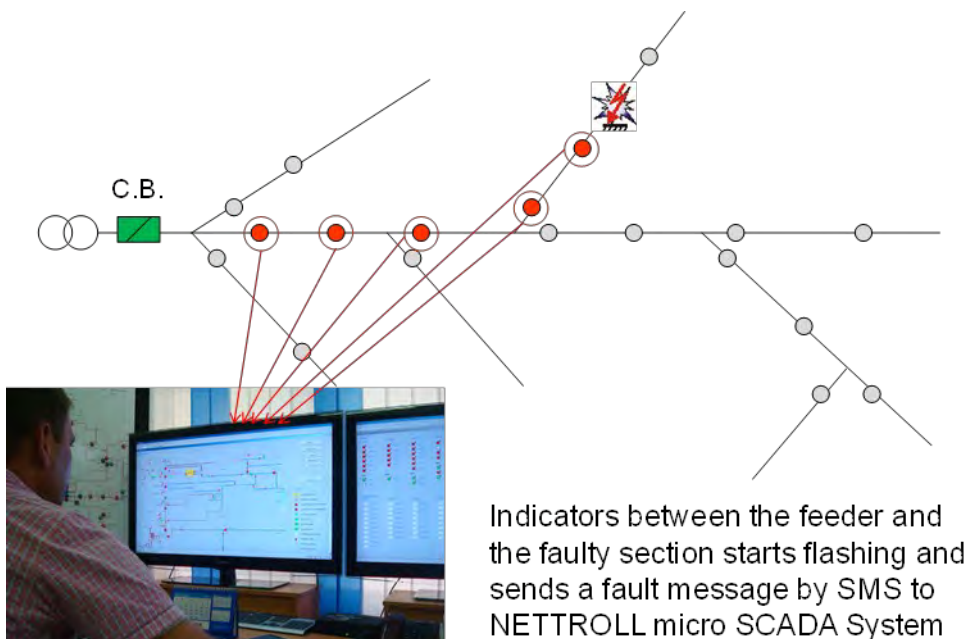
The time it takes to find the fault

The time it takes to repair the fault.

It is the time to find the fault that often drives the SAIDI in a negative direction. Distribution feeders normally have sectionalizing switches throughout the network. However, sectionalizing can only start when the faulty location is known. It is therefore outmost important to know where the fault is as quickly as possible. Using local indicators will reduce the fault finding time, because the patrolling down the healthy feeders are avoided.

Using fault indicators with communication will reduce fault finding time to the absolute minimum. Immediately after the fault is detected, all indicators in the faulty path will send an alarm message to the operation room. The operator will immediately see where the faulty section is and can start sectionalizing.

Using NORTROLL's remote control system for sectionalizing of the network will reduce SAIDI further, as customer on the healthy part of the feeder will have the energy restored within minutes rather than hours.



The use of fault indicators will also give other benefits which is also important for a utility:

Response time can be reduced without increased staff

Call-out time is reduced -> Reduced costs

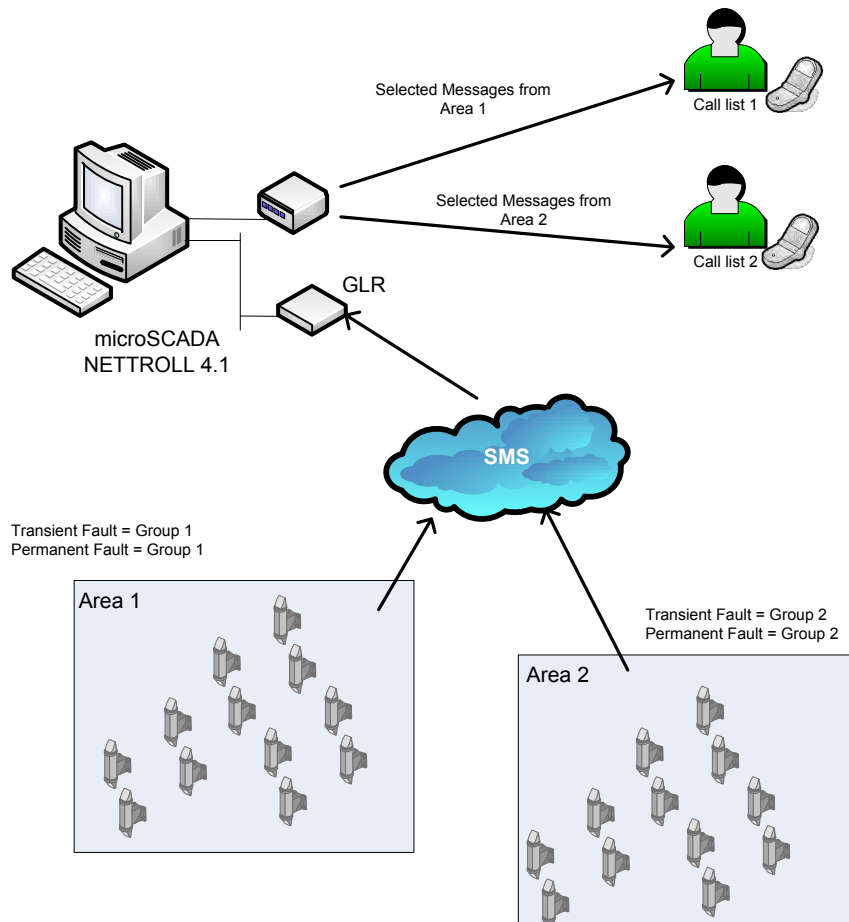
Improved safety for staff

Increased revenues due to more delivered energy

Improved Shareholder value by cost reductions

An effective deployment of staff is also important to reduce the effect of a fault in the distribution network.

Alarms sent from indicators with communication can be routed to the right person immediately based on information about where in the network the indicators are located and the person which is responsible for that particular area.



Functional description

LineTroll fault Passage Indicators are used to locate short-circuit- (PtP) and earth faults (PtG) in over-head line distribution networks. LineTroll product line will fully cover the different fault configurations that may occur.

The indicators are placed at strategic locations along the line such as after branching points and sectionalizers.

Live line installation makes installation safe, easy and rapid.

Upon detecting a fault on the line, the indicator gives off an intermittent LED and/or Xenon type flashing.

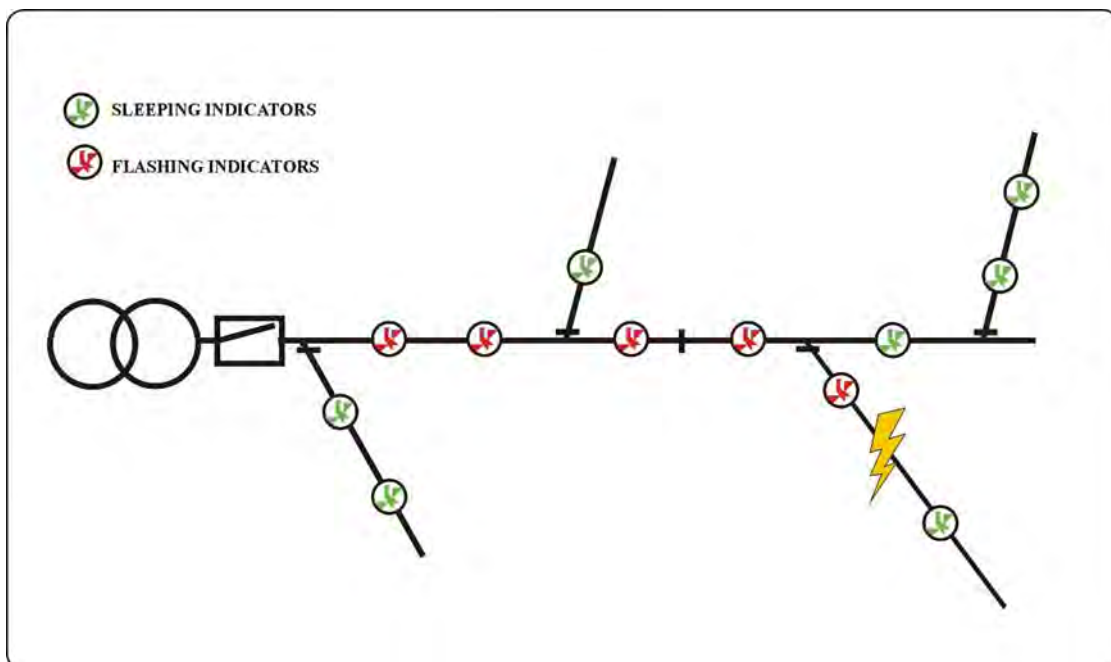


Fig 1: Indicator flashing pattern in a fault situation

All indicators installed between the feeding substation and the fault will operate when a fault occurs. The indicators placed behind the fault and on the T-offs remain idle.

LineTroll fault indicators provide fast fault localisation enabling reduction in outage times.

This represents enhanced service to the customers thereby improving the utilities image and significant reduction in the cost related to faults and outages.

Another important aspect of using fault indicators is that unnecessary operations of circuit-breakers and sectionalizers to locate faults are avoided. This way the indicators help to reduce wear and tear as reclosing cycles causes stress to the switchgear.

Detection principle

LineTroll fault Passage Indicators fault sensing is based on detection of the electromagnetic field below the conductors.

The units are fully self-contained; - no external transformers or connections of any kind are required.

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

1. The line should be energised for a period of time, normally 5 seconds. (Inrush Blocking)
2. The line current should increase rapidly above the value set by the user (the nominal trip level).
3. The line should be de-energised. (Configurable)

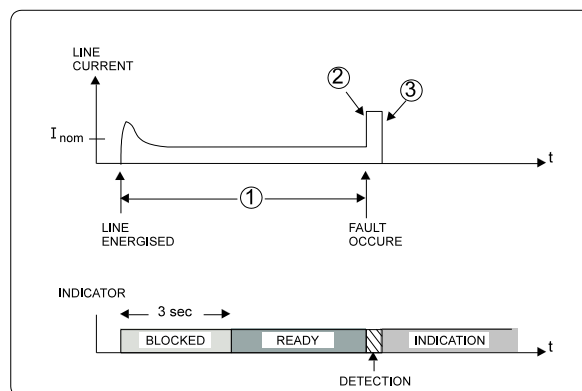


Fig. 2. Fault sequence

The user may program the criteria for operation to suit the local requirement by manipulating a bank of micro-switches inside the indicator. On some models this can be done remotely from the control center or by a hand-held unit from the ground.

The current flowing in the lines generates a magnetic field (B-field) which is constantly measured by the indicators.

The measured B-field is applied to an adaptive dB/dt detector.

This detector automatically adjusts to the normal conditions on the line. Slow variations in load current will not affect the detector.

A fault current will cause a rapid increase in the B-field. The detector in the indicator will detect this increase and respond accordingly.

The detector will now require that two conditions are satisfied:

1. The relative increase is greater than a certain level.
2. The absolute increase is greater than a pre-set value.

The second condition is the trip-level that can be set by the user to different values.

Where should indicators be installed and what model should be used

Installation of a fault indicator usually requires a line survey to ensure that the best use of it may be obtained.

Several factors should be considered, such as fault frequency, type of customers, the number of customers, accessibility etc.

For the best economic benefit it is recommended that the indicators are used in easily accessible line points, before and after line segments difficult to access. A general rule of thumb could be to install indicators on each T-off as well as in the main feeder. A combination of local- and remote indicators could also be a good solution in some networks.

Phase mounted indicators can be used in all different pole- and network configurations.

Pole mounted indicators have some limitations to where to install them. If a parallel line runs nearby, if the pole has multiple feeders or the earth-wire is located between the indicator and the three phases, pole mounted indicators cannot be used. Pole mounted indicators requires a pole as "clean" as possible.

It is a significant difference between the benefit of using fault indicators with communication option compared to indicators with a local flash. Nortroll's system for remote indication benefits from an effective communication system which allows powering from long-life batteries without any external charging.

Indicators with communication with a central monitoring system (or SCADA) reduce the fault-finding time down to driving time to the faulty section.



Phase Mounted Indicators



Pole Mounted Indicator

LineTroll 110E μ

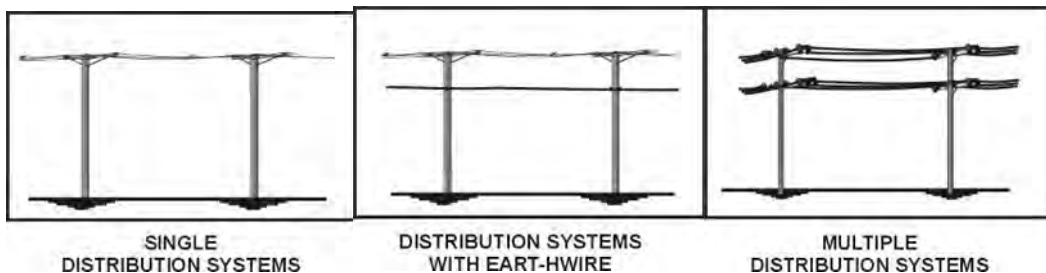
Distribution Networks (6-69kV)

LineTroll 110E μ is a conductor mounted indicator for detection of PtG and PtP faults in overhead line networks. The indicator is powered by replaceable long-life lithium batteries which have a life expectancy of 10-15 years. It provides a 360 degree visibility for indication both for transient faults and permanent faults.



Programmable:	Dipswitches
Threshold level:	250-1000A
Trip level Di/Dt:	6-60A (120A)
Reset:	Manual, timer & automatic by return of voltage or current
Fault Indication:	
Permanent:	Super-intensive Red LED with strobe effect
	Transient: Green LED
Low Battery:	Yellow LED
Mounting:	Live-line mounting with hotstick

LineTroll 110E μ can be used in line systems/configuration as shown below:



LineTroll 110T μ

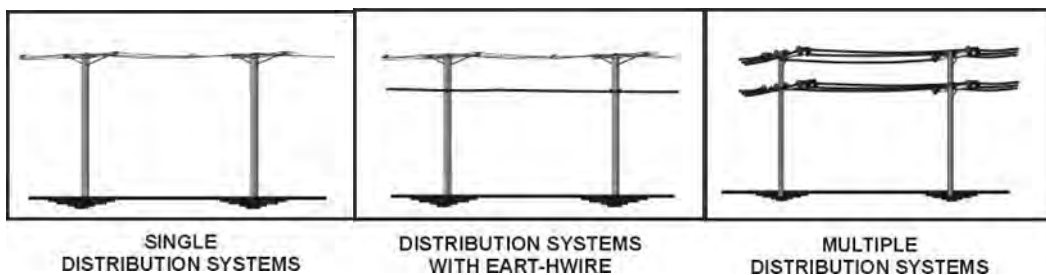
Transmission Networks (66-132kV)

LineTroll 110T μ is a conductor mounted indicator for detection of PtG and PtP faults in overhead line networks. The indicator is powered by replaceable long-life lithium batteries which have a life expectancy of 10-15 years. It provides a 360 degree visibility for indication both for transient faults and permanent faults.



Sub Transmission lines:	66-132KV
Programmable:	Dipswitches
Threshold level:	500 or 1000A
Trip level Di/Dt:	500 or 1000A
Reset:	Manual, timer & automatic by return of voltage or current
Fault Indication:	
Permanent:	Super-intensive Red LED with strobe effect
Transient:	Green LED
Low Battery:	Yellow LED
Mounting:	Live-line mounting with hotstick

LineTroll 110T μ can be used in line systems/configuration as shown below:



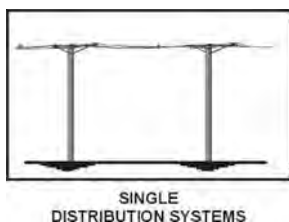
LineTroll 111K

LineTroll 111K is a cost effective pole mounted indicator for detection of PtG and PtP faults in 6-69kV overhead line networks. The unit mounts 3-5m below the conductors and monitors all three phases. The indicator is powered by replaceable long-life lithium batteries which have a life expectancy of 10-15 years. It provides a 360 degree visibility for indication both for transient faults and permanent faults.



Programmable:	By dipswitches
PtG Faults thresholds:	4-50A
PtP Faults Di/dt:	100% relative increase in I_{Load}
Reset:	Manual, timer & automatic on return of voltage.
Fault Indication:	
Permanent:	Two Super-intensive LEDs with strobe effect
Transient:	Red LED
Low Battery:	Yellow LED
Mounting:	Live-line mounting with strap-bands or screws
Poles:	Lattice Towers, concrete and wooden poles

LineTroll 111K can be used in line systems/configuration as shown below:



LineTroll 3100K

LineTroll 3100K is a pole mounted indicator for detection of PtG and PtP faults in 6-66kV overhead line networks. LT 3100K have a special Software-algorithm for Load Current Compensation (LCC) in order to maintain the PtG-sensitivity independent of the Load Current. This will make this indicator more sensitive for low PtG fault currents compared to traditional fault indicators.



Programmable:	Dipswitches
Trip level PtG:	4-50A (2,5-50A on request)
Trip level PtP:	100/200% rel increase I_{Load}
LCC:	Yes
Reset:	Manual, timer & automatic by return of voltage
Indication:	
Permanent faults	Super-intensive Red LED with strobe effect
Transient faults	Green LED
Low Battery	Yellow LED
Outputs:	Separate outputs for permanent and transient alarms as well as Low Battery Warning for connection to various communication modules.
Mounting:	By strap-bands or screws
Poles:	Lattice towers, concrete, steel and wooden poles

LineTroll 3100K can be used in line systems/configuration as shown below:



SINGLE
DISTRIBUTION SYSTEMS



LineTroll 3100T

The LineTroll 3100T is a pole mounted fault indicator used to locate short-circuit and earth faults in overhead line transmission networks. LineTroll 3100T is a 3-phase unit fully covering the different fault configurations that may occur.

contacts or additional ComTroll communication modules.



Programmable:	Dipswitches
Trip level PtG:	Threshold: 150 – 390A (3,3 – 8,7uT)
Trip level PtP:	Threshold: 320 – 3.200 A or 100/200% relative increase
Reset:	Manual, timer & automatic by return of voltage
Indication:	LED, separate indication of permanent & transient fault
Relay output.	Permanent PtG/PtP fault Loss of Voltage
Event Log	Can be downloaded to PC.

LineTroll 3100T can be used in line systems/configuration as shown below:



SINGLE
DISTRIBUTION SYSTEMS

LineTroll 3500 (Directional Fault –Indicator) (Compensated neutral/Petersen coil)

LineTroll 3500 is a pole mounted indicator for detection of PtG and PtP faults in 6- 69kV overhead line networks. Optional communication modules are available.



Indication:	Directional for PtG; Up-/down-streams Fault Passage Indication for PtP (bi-directional)
Reset:	Manual, timer & automatic by return of voltage
Indication:	Green and Red LED's dependent upon the direction of the fault (PtG)
Relay output.	Separate for PtP and PtG fault
Event Log:	Download by IR-hand-held unit
Communication:	Short range radio or GSM for SCADA-integration. (Optional)

Please note that installation of LineTroll 3500 requires an evaluation of the network and neutral grounding system to be carried out.

Suitable Line systems/configuration:



SINGLE
DISTRIBUTION SYSTEMS



LineTroll 110EμR

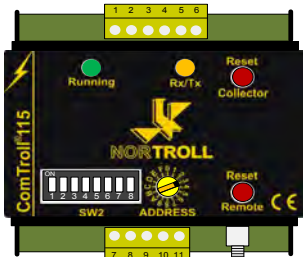
Distribution Networks (6-69kV)

LineTroll 110EμR is a conductor mounted indicator for detection of PtG and PtP faults in overhead line networks. The indicator is powered by replaceable long-life lithium batteries which have a life expectancy of 10-15 years. It provides a 360 degree visibility for indication both for transient faults and permanent faults.

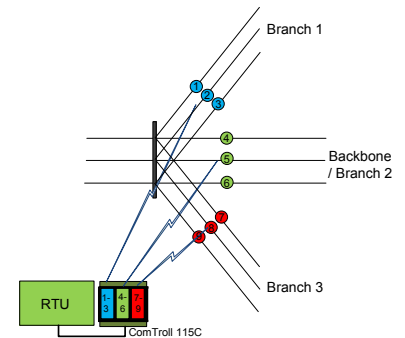
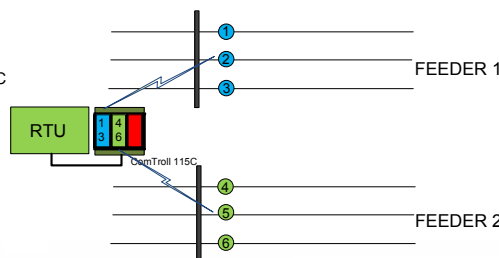
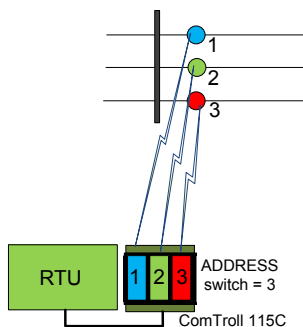


The indicator unit has the same detection/sensing principles as the local indicator LineTroll 110Eμ. The difference is that it is equipped with a built-in 2.4GHZ radio device which can communicate with a receiver located in a cabinet on the pole.

The receiver, **ComTroll 115C** has a general digital interface which can be connected to any Nortroll- or third parties RTU for communication to a SCADA system.



ComTroll 115C monitors up to 9 LineTroll 110EμR indicators in the range of maximum 40m line-of-sight. A configuration with three indicators (one for each phase) and one the "collector" will receive information about the phase(s) the fault



LineTroll 3100K GSM

LineTroll 3100K is a pole mounted indicator for detection of PtG and PtP faults in 6-66kV overhead line networks. LT 3100K have a special Software-algorithm for Load Current Compensation (LCC) in order to maintain the PtG-sensitivity independent of the Load Current. This will make this indicator more sensitive for low PtG fault currents compared to traditional fault indicators.

The indicator is a standard LineTroll 3100K, where a GSM modem is installed in the mounting bracket. It is therefore not necessary with any external boxed or connections.

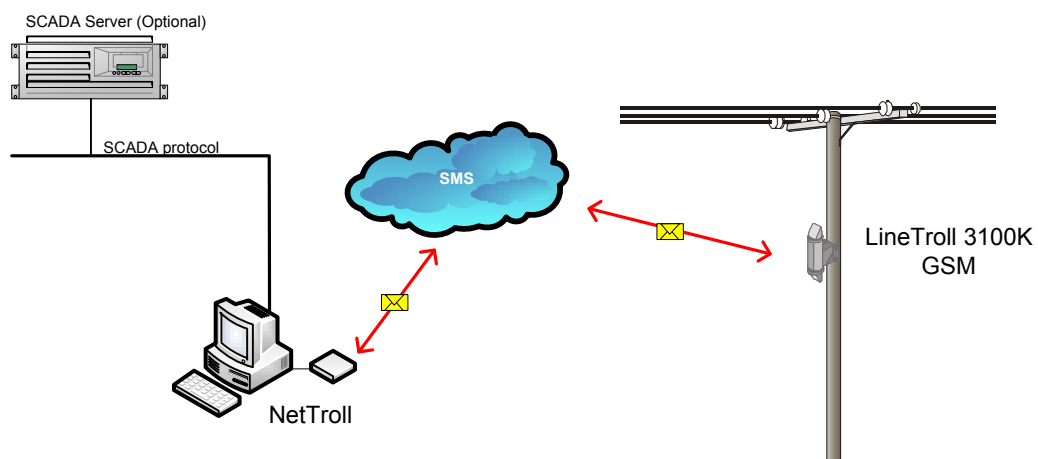


The GSM modem is normally powered down and will only be active when the indicator detects a fault condition. In addition it wakes up in configurable time intervals to send heartbeat message and check if a message is sent to it from the central unit.

The GSM modem sends alarms by SMS. This facilitates battery operation and the unit can be installed in areas with weak signal levels in the GSM network.

The following alarms are sent from the indicator:

- Transient Fault Alarm
- Permanent Fault Alarm
- Low Battery Warning
- Heartbeat (communication/health-check)



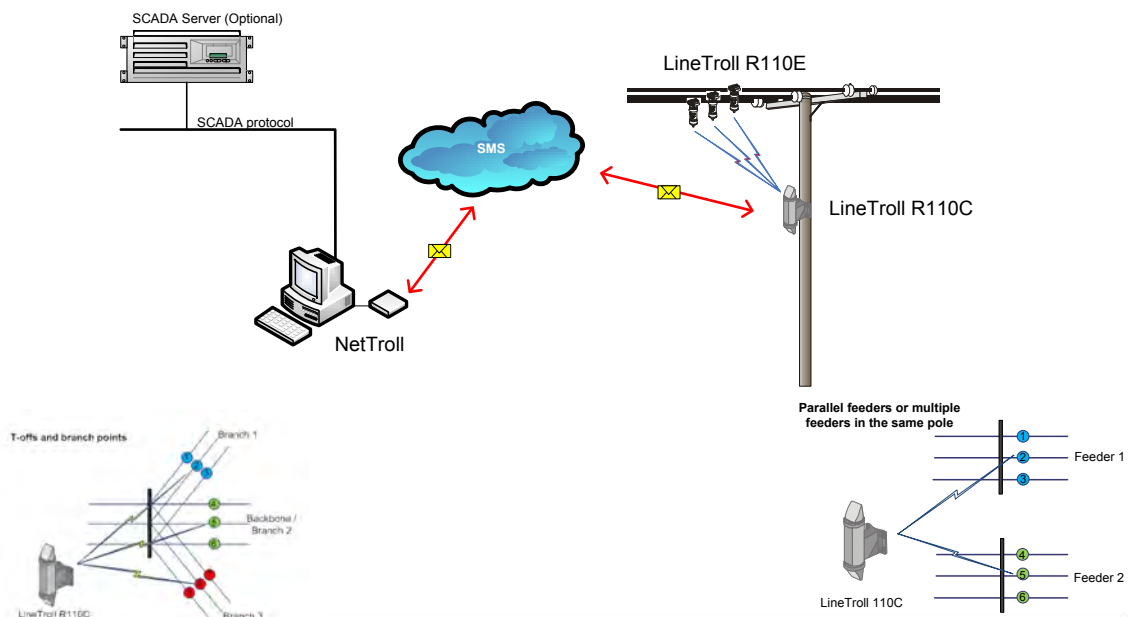
LineTroll R110E RIS

The LineTroll R110E Remote Indicator System uses phase mounted fault indicator LineTroll R110E and the pole mounted SMS sending device LineTroll R110C. The system is designed for 6-66kV distribution networks but will also be available in a version for transmission networks up to 138kV.



The fault indicator use a 2.4GHz ISM band short-range radio to communicate with the collector mounted on the pole. The collector communicates with up to 9 fault indicators. Both the indicators and the collector are powered by long-life lithium batteries for long and maintenance free operation.

All settings and configuration can be done remotely from the central unit. It is also possible to use a handheld configuration device to program the collector and the fault indicators.



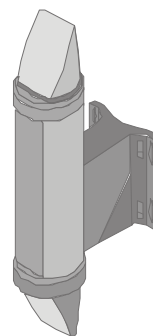
LineTroll R110E

Features include:

- Remotely programmable operating parameters.
 - From NetTroll
 - From NetTroll FDP (stand-alone configuration utility software)
 - Hand-held unit, FDP-20
- Integrated addressable short-range radio.
- High visibility for local indication
 - RED Strobe flash for permanent faults
 - Green LED for transient faults
 - Yellow LED for Low Battery Warning
- Usable on all Medium Voltage distribution networks 6-69KV.
- Usable on multi circuit systems.
- Voltage or current as start criteria (programmable)
- Inrush Blocking
- Resistant to tough weather conditions.
- Live-line mounting with standard clamp stick
- Line diameters up to 36mm

LineTroll R110C sends the following alarms/messages to the receiver:

- Status OK (no faults and line energized)
- Transient Fault Alarm
- Permanent Fault Alarm
- Loss of Voltage (line de-energized)
- Low Battery Warning form Indicators
- Low Battery Warning from Collector unit
- Communication lost with indicator(s)
- Heartbeat message (health check)



Accessories

KBN-4

Mounting tool for LineTroll 110E/ 110Em/ 110Eµr and R110E.

The KBN-4 can be used with a standard hot-stick as shown in the picture.

The KBN-4 have a built-in magnet for Test/reset of the indicator.

It is however possible to mount/dismount the Indicators without the KBN-4, using a “grip-all-clamp” hot-stick.



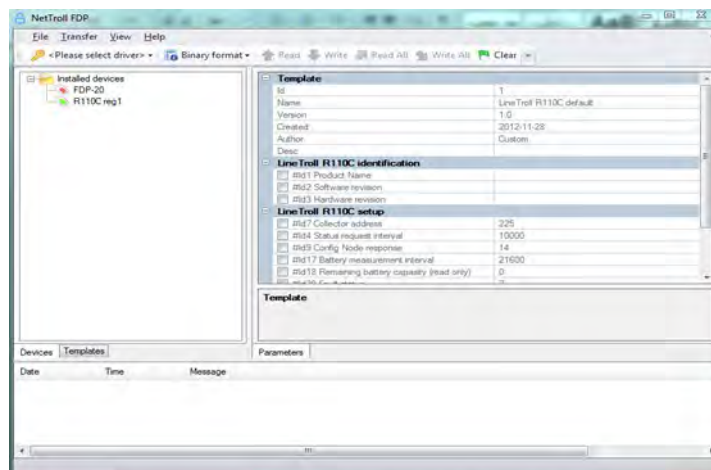
FDP-20



The FDP-20 hand-held configuration tool is a field programming device where up to 8 different configurations can be stored. It can also be used to download up to 8 different configuration settings in already installed devices.

Uploading parameters to FDP-20 is done by connecting it to a PC with USB-cable running NetTroll FDP configuration utility.

NetTroll FDP configuration utility can also be used to send configuration settings directly to indicators in the field from the control center.



NetTroll

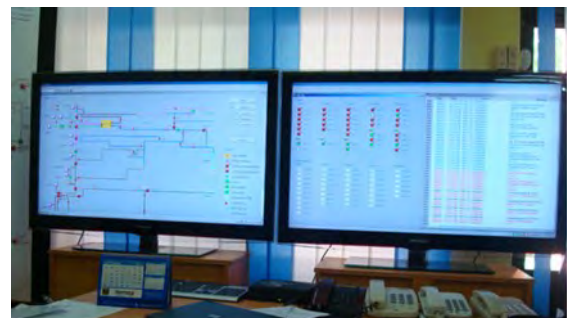
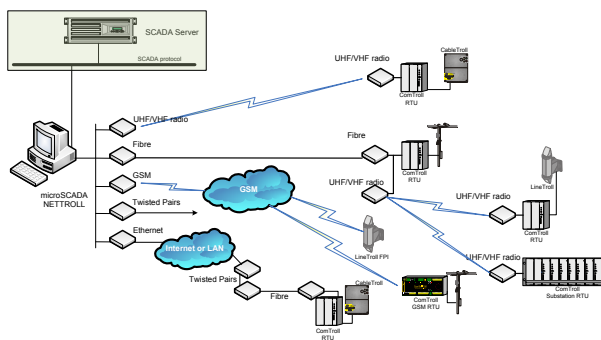
In a remote indication system, it is necessary to have a monitoring system where alarms and indications can be logged and presented in a single line diagram, network diagram or in a geographical map etc.

NetTroll microSCADA system is a program especially designed for all of NorTrolls field devices with communication.



Features

- Runs on a standard Windows PC platform.
- Easy installation and configuration.
- Easy-to-use operator interface.
- User defined logs for monitoring of specific events.
- Advanced Alarm Management
- Built-in Conditional Actions Module (CAM)
- Ideally suited for monitoring and control of report-by-exception fault passage indicators and RTU's.
- Secure password protected user levels.
- Advanced graphical features.
- Built-in bitmap editor for creating user defined symbols.
- Device specific message properties.
- Unlimited number of devices can be Installed.
- Easy Master SCADA integration with a wide range of SCADA protocols.



NetAlert is a supplementary software that can be installed together with NetTroll.

Messages defined as an alarm

(e.g. permanent fault) will be forwarded by SMS to one or more recipients based on where the alarm comes from.

Nortroll AS has since the foundation in 1977, offered a wide range of products aiming to improve the distribution network reliability by means of effective fault localization and remote sectionalising in case of a fault.

Nortroll's range of product comprises

LineTroll Product range	Fault Passage Indicators for overhead lines
CableTroll Product range	Fault Passage Indicators for cable Networks
ComTroll Product range	RTU's for substations and motorized switchgear, communication equipment for fault passage indicators and RTU's, MicroSCADA System for surveillance and control and NetTroll SCADA Gateway

This catalogue does not contain all of Nortrolls products, but lists our main products for SMARTER NETWORK MANAGEMENT in overhead line networks.
For further information go to our web-site www.nortroll.no or contact your local sales representative or NORTROLL AS.



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