LineTroll®

LineTroll® R110C

GSM communication unit for LineTroll 110EμR phase-mounted fault indicator

User Manual

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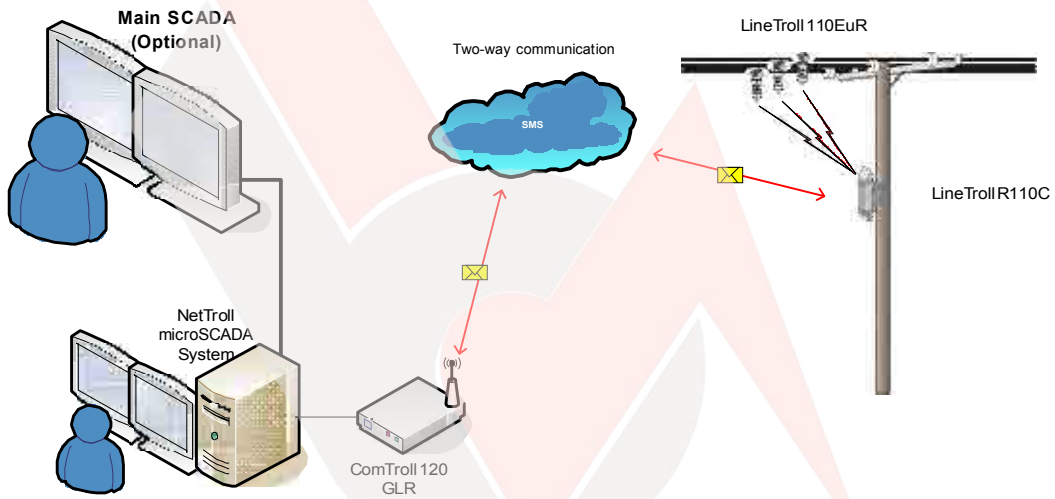
System overview

The LineTroll R110C is a pole mounted device for communication between NetTroll microSCADA System and LineTroll 110EµR fault passage indicators.

LineTroll R110C uses a 2.4GHZ, ISM band radio to communicate with up to 9 fault indicators in the range of up to 40m. The alarm messages from the fault indicators are transported to the SCADA system using Short Message Service (SMS) through the GSM network.



The LineTroll R110C can be described as a data-collector for fault indicators and will in this document also be referred to as «*Collector*».

Available versions

The LineTroll R110C comes with a built-in SMS modem as standard. Alternative models are:

Relay output option:

This version has no GSM modem. Instead alarms can be sent using any third party RTU through a relay interface.
The functionality is the same as for all other versions. The relay card has one relay output (NO) for the following messages/alarms:

- ✓ Permanent Fault
- ✓ Transient Fault
- ✓ Loss of voltage
- ✓ Low Battery in indicators
- ✓ Low Battery in Collector
- ✓ Faulty communication with indicator(s)

GPRS /DNP3 Option

The on-board SMS modem is exchanged with a GPRS module with DNP3 protocol for direct connection to SCADA systems. This modem has also SMS messaging where GPRS is made difficult do to network limitations.

The collector itself has the same functionalities as described in this document.

Details about usage, setup and commissioning is found in separate documentation for the GPRS/DNP3 modem.

LineTroll R110C can:

- ✓ Forward fault alarms from the phase-mounted indicators:
  - Transient Fault
  - Permanent Fault
  - Loss of voltage
  - Low Battery warning from Indicators
- ✓ Configure, test and reset indicators from either NetTroll FDP or a handheld unit (FDP-20).
- ✓ Continuously monitor communication link between the collector and all indicators and report errors.
- ✓ Monitor signal level and report Low Battery Warning in the Collector.

Technical description

LineTroll R110C can be setup to communicate with 3, 6 or 9 indicators within the communication range. This opens for the possibility to mount fault indicators on parallel feeders or in poles with multiple circuits using only one Collector. It will also give a cost-effective setup in T-off's and branches.

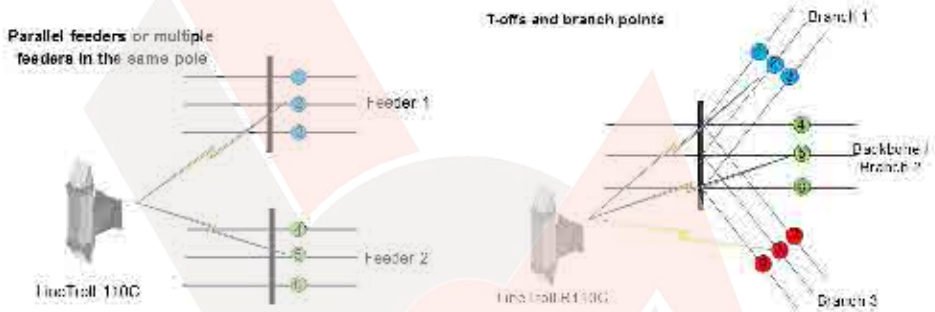


Figure 2,

Configuration and setup

Settings in LineTroll 110Eμr fault indicator

The LineTroll 110Eμr fault indicator has two settings to be made:

a) Operational settings with DIP-switch
b) Address setting with rotary switch

The operational setting is done with a DIP switch with 8 positions as shown in the below table.

Note:
0=OFF
1=ON

Bit/DIPsw		Value	Function
1	0		Di/dt sensing (6 – 60A)
	1		Threshold sensing (250 – 750A) (+ 120A di/dt)
2 and 3	3	2	
	0	0	6A di/dt / 250A Thresh.
	1	0	12A di/dt / 500A Thresh.
	0	1	25A di/dt / 750A Thresh.
	1	1	60A di/dt / 120 di/dt
4	0		Start criteria I (current)
	1		Start criteria V (Voltage)
5 and 6	6	5	
	0	0	Timer reset 2h
	1	0	Timer reset 6h
	0	1	Timer reset 12h
	1	1	Timer reset 24h
7	0		Auto reset off
	1		Auto reset on
8	0		Not allow remote programming
	1		Remote programming

DIP setting of the indicator

Setting the addresses of each indicator is done by the rotary switch on the indicator board. In installations with 3 indicators (one for each phase) the addresses must be set to 1, 2 and 3.
In installations with more than 3 indicators (6 or 9) it is important that address 1, 2, 3 are mounted on the same t-off/feeder, address 4, 5, 6 is mounted on each phase on the next feeder and so on. See figure 2.

Inserting the SIM card

To find the type of subscription that is most economic and suitable for your system, please contact your local network service provider.
We do not recommend using prepaid subscriptions. We also recommend disabling voice communication on the SIM cards and only use SMS services.

All PIN codes must be deactivated before installation. Most service providers offer SIM-cards where the PIN codes are deactivated when you receive them.

Insert the SIM-card as shown in the picture to the left. The batteries should be disconnected when inserting the SIM card.

Remove the top-cap of the Collectors housing to access:

- ✓ SIM card socket
- ✓ Programming contact (J3)
- ✓ Activation button (S1)
- ✓ Address settings (SW1)

Operational parameters

Most of the parameters LineTroll R110C uses to operate correctly are set as default values in the firmware. However, some parameters *must* be set such as the telephone numbers the Collector shall send its messages/alarms to, parameters the indicators need to pick up faults correctly and some radio link parameters.

The configuration parameters can be divided into three categories:

- ✓ GSM Parameters
- ✓ Indicator Parameters
- ✓ Radio link Parameters

Some parameters can be sent as SMS to the collector, other parameters require special programming tools. The different programming/configuration options are listed below:

<u>GSM parameters</u>

NetTroll	Sending SMS through the ComTroll 120 GLR
Cell-phone	Sending SMS using a standard cell-phone
NetTroll FDP	Either by serial cable connected to the Collector or by a standard GSM modem connected to the computer through a serial port.
FDP-20	Handheld Field Device Programmer. Use a short-range radio to communicate with the Collector.

<u>Indicator parameters</u>

NetTroll	Sending SMS through the ComTroll 120 GLR
Cell-phone	Sending SMS using a standard cell-phone
NetTroll FDP	Either by serial cable connected to the Collector or by a standard GSM modem connected to the computer through a serial port.

FDP-20	Handheld Field Device Programmer. Use a short-range radio to communicate with the Collector.

Radio Link parameters

NetTroll FDP	Either by serial cable connected to the Collector or by a standard GSM modem connected to the computer through a serial port.
FDP-20	Handheld Field Device Programmer. Use a short-range radio to communicate with the Collector.

All parameters can be sent to the collector and indicators from the control center even when the indicator is installed in the field. Before the FDP-20 handheld programming unit can be used, all parameters must first be uploaded to the FDP-20 either from another indicator or from NetTroll FDP program.

Communication between Collector and Indicators

LineTroll 110EµR fault indicators continuously monitor the status of the line and store the status in a variable. To save battery power, the radio unit in the indicator is switched on and off in intervals.

The Collector sends a status request to each of the indicators every 15 seconds (can be configured). The status request also gives information to the indicators when the next status request will be sent to maximize the performance/power consumption ratio.
When the indicator receives a status request from the Collector, the indicator sends its current status. If this status is changed since the previous status request, the collector will dependent upon several factors send the message in an SMS or wait for further status changes to happen. See the operation chapter for details. When the collector receives an alarm message from the indicator, the status request is sent in shorter intervals to increase response-time.

The messages the indicator can send to the Collector are;

- ✓ Status OK
- ✓ Loss of voltage
- ✓ Transient fault
- ✓ Permanent fault
- ✓ Low battery warning

Status OK

This message is sent when the indicator hasn't detected any fault current and the indicator detects an energized line. This status is also sent when the line is energized after a fault.

Loss of voltage

This message is sent if the indicator detects a de-energized line without any fault current detected. (This feature id default switched OFF but can be switched ON)

Transient fault

When the indicator has detected a transient fault, the indicator will send this message to the Collector.

Permanent fault

Permanent fault is sent when the indicators have defined the fault to be permanent.

Low battery warning

This message will be sent from the indicator when the remaining capacity of the battery is less than a specific level. (Default set to 20%) This message can only be reset by resetting the battery counter in the indicator after changing batteries. See manual for LineTroll 110Eμr for how to reset the battery counter.

Communication between Collector and the central unit

The central unit is normally the NetTroll micro SCADA software or a SCADA Gateway connected to any SCADA system. Regardless of the type of central used, the ComTroll 120 GLR must be connected as the receiver of the messages from the GSM Network. The Collector can also communicate with a standard cell-phone, e.g. for testing and configuration of the GSM parameters.

It is important to notice that the GSM modem in the Collector is normally switched OFF. It will only wake up on the following events:

- ✓ One or more indicators have reported an alarm
- ✓ Polling
- ✓ Heartbeat
- ✓ After power-up (connecting the batteries)
- ✓ Pressing the manual activation button on the Collector
- ✓ Twisting the bottom lens to TEST or RESET

Status message definition

Whenever the indicator sends an alarm, status or a response to a status request, the format of the message is always the same (With GPS the string is with 24, without the string is with 5) as follows:

Alarm/Status	3 5 Status1 Status2 Analog1 Analog2 1 Tx
Alarm/Status	3 24 Status1 Status2 Analog1 Analog2 Timestamp 1 Tx

Analog1: RSSI: Signal strength on the GSM network. The value returned is a value between 0 – 31, were 0 equals -113dBm and 31 equals -51dBm.

Analog2: Battery voltage. (raw value)

$$(\text{Vbatt} = \frac{2*\text{Analog2}}{4095} * 3\text{V})$$

X: Always '1'

Timestamp: YYMMDDHHMMSSss (ss ~ millisecond)

Tx: A number between 1 and 9 used as a message identifier.

Status1 and Status 2:
These variables give the decimal value representing two 16-bits variables as shown below:

Status1 (16 bit)																**Status2 (16 bit)**															
X	LBC	LBI	MHB	T	T9	T8	T7	T6	T5	T4	T3	T2	T1	S9	S9	S8	S8	S7	S7	S6	S6	S5	S5	S4	S4	S3	S3	S2	S2	S1	S1
X	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

The different bits have the following meaning:

LBC: '1' = Low battery warning for the Collector

LBI: '1' = Low battery warning for one or more indicator

MHB: '1' = Missing heartbeat message. Means one or more indicator have lost communication with the Collector.

T: Test bit Collector. Set to '1' when the Collector is manually activated by the pushbutton. The pushbutton must be pressed for more than 3 seconds to send the test bit. If it is pressed shorter time no test bit will be sent.

T1-T9: Test bit Indicators. Set to '1' when the indicators are activated by a TEST command from NetTroll or by twisting the bottom lens into TEST position.
(T1= indicator 1, T2= indicator 2… T9= indicator 9)

S1-S9: Two-bit status received from the indicators
'00' Status OK
'01' Loss of Voltage
'10' Transient Fault
'11' Permanent Fault

(S1=Status from indicator 1 and so on)

The prefix 3 5 (or 3 24) will always appear in the front of the alarm/status message.

Examples: Alarm / Status messages from LineTroll 110 C with 3 indicators:

3 24 0 0 30 2222 15061507105000 1 4

0 0: Means that ALL three indicators send STATUS OK (No alarms, voltage present). No other alarms either.
30: Means the signal level. (Very good signal)
2222: is the battery voltage (=3.26 v), see formula above.
15061507105000: is the time stamp for the event. (It is date 2015/06/15 hour 07:10 and 50 Seconds and 00 msec)
1: Is always 1
4: TX number.

3 24 28 0 30 2222 15061507095000 1 3

In the string above we see that the STATUS1 variable has changed from 0 to 28:
28 dec = 011100 binary; If you put this into the STATUS1 frame you will see that T1, T2, T3 bits are '1', which is the OK response to a TEST command.

After permanent fault: 3 24 0 63 30 2222 150615075950000 1 3

Above you see STATUS1 is '0' and STATUS2 is '63'
63 dec = 0111111 binary; S1 = the message from indicator 1, S2= indicator 2 and S3= indicator 3.
'11' in S1 means indicator 1 sends permanent fault. The other bits are also '1' so all three indicators send permanent fault.

After return the current/voltage: 3 24 0 0 29 2222 150615081020500 1 4

0 0 = status all OK as described above.