CableTroll® 23X0

User Guide for product nr. 2310, 2320 & 2330

CableTroll®

NORTROLL
FIND FAULTS FAST

This document describes the installation and configuration of the CableTroll 23X0 fault indicator for underground cable networks

Revision no	Date	Description
1st Draft	01.09.06	
2st Draft	05.10.06	
1	10.11.06	
2	01.03.07	
3	08.05.07	
4	13.06.07	
5	12.09.07	
6	06.12.07	
7	15.01.08	(corr.of SW4 & 5 page 14)
7.1	18.01.08	• Correction of power supply options p7 • Warnings regarding illegal dip switch settings. • Updated description of battery status indication
8	16.09.08	Indication of Voltage present page §10 corrected Battery change and ext reset operation corrected
9	04.11.09	Current consumption added
10.	06.06.13	CT2315 Removed, Upper/lower dyn.range removed

© 2006 NORTROLL AS
P.O.Box 133
7601 Levanger
Norway
www.nortroll.no

Contents

1. Introduction

Ther CT 2300 comes in four different models (CT 2310, CT 2320 and 2330), two with Earth-fault indication only and two with both earth-fault and over-current indication.

The CableTroll 2300 is a fault current detector for the underground medium voltage distribution network (6-36kV). It is used to detect short circuit and/or earth faults according to the functional principles in chapter 3, and can be installed on most types of cable terminations. The CableTroll 2300 (product nr 2320 & 2330) will give separate indication for short circuit and earth faults, locally by flashing diodes, and remotely through relay contacts.

1.1 Definitions

As the terminology may differ from country to country we will throughout this presentation use the following definitions:

Short circuit fault	- Over Current or Phase to phase fault (PtP)
Earth fault	- Single phase to ground fault (PtG)

1.2 Typical Fault Situation

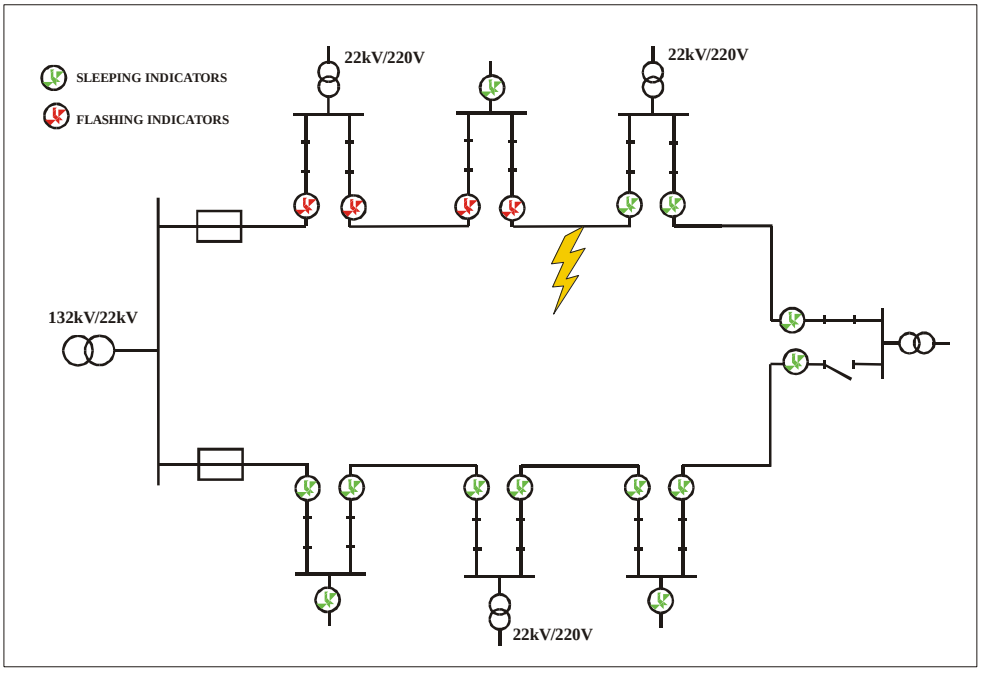
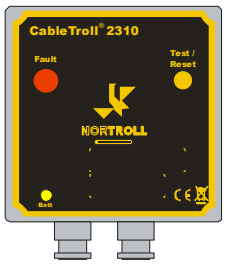


Figure 1. Fault indicator status following a fault

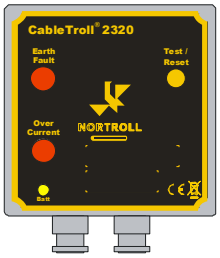
2. Technical description

2.1 General description

The indicator comprises two pcb cards mounted in a ABC enclosure with removable front cover for access to terminal blocks, battery and dip switches.



Prod. Nr 2310



Prod. Nr 2320/2330

2.2 Indication

1. CT 2310: One main high visibility red LED for earth fault indication. 1 additional smaller LED for low battery.
2. CT 2320: Two main high visibility red LEDs, one for over current fault and one for earth fault indication. 1 additional smaller LED for low battery.
3. CT 2330 Two main high visibility red LEDs, one for over current fault and one for earth fault indication. 1 additional smaller LED for low battery.

2.3 Remote contacts

Separate relay contacts (for remote signalling) for earth and short circuit faults.
The contacts are potential free and Normally Open (NO). (Norm.Closed on request) latched relay. Pulse relay may be available from factory on request.

2.4 Current Sensors/short circuit elements

Prod. Nr 2310: The indicator use one Nortroll type summing transformer and for detection of earth-faults only.

Prod. Nr 2320: The indicator use a Nortroll type summing transformer and two short-circuit elements with fibre optic cables for detection of earth-faults and short-circuit faults.

Prod. Nr 2330: The indicator use two current sensors and one CT for detection of earth-faults and short-circuit faults.

2.5 Housing

Housing designed for outdoor switchgear mounting.

2.6 Glands

Two cable glands and one blinding gland is included with the indicator.

2.7 Reset options

Programmable timer
Automatic reset by voltage
Remotely by relay inputs
Manual reset by a push-button located on the front of the indicator.

2.8 Power Supply

Internal 3,6 V long life lithium battery for up to 8 years operation,
External 8-48VDC
230VAC (not available for 2310)
The battery is supplied with a ready-fitted plug.

3. Functional description

3.1 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 singular earth fault current is determined by the size of the galvanicaly 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.

IMPORTANT:

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.

In compensated networks, the earth fault detection may not be possible in certain locations depending on the degree of compensation.

3.2 CAPACITIVE DISCHARGE CURRENTS

The CableTroll 23X0 series indicators is not directional, (see CableTroll 3500 for directional) it therefore detects current without discriminating its direction. In case of an earth fault, the network capacitive energy discharges in the fault point.

It should be checked that the capacitive discharge current downstream the indicator is below preset trip level in order to avoid the indicator erroneously activating upon earth faults. If the total capacitive current exceeds the trip level, it is advisable to change the trip level or install the indicators in the branching points instead of in the main line.

The capacitive discharge of a branching point is limited by its own capacitance, while in the main line the capacitive current of all the branches downstream the indicator is added.

Underground cables have larger capacitance than overhead lines. This has to be taken into account when an overhead line feeds an underground cable and vice versa.

The following simplified formula may be used to estimate the capacitive discharge current of a line:

$$Ic = \frac{U * La}{300} + \frac{U * Lc}{K}$$

Ic = Capacitive current in A
U = Nominal voltage in kV
La = Overhead line length in km
Lc = Cable length in km
K = 10 for oil impregnated cables
5 for PEX cables
3 for PVC cables

In order to avoid that the CableTroll 2300 is activated by an earth fault downstream of the indicator, the following criterion has to be met.

$$Ic < It$$

where

Ic = capacitive current down-stream of the indicator.

It = CableTroll 23X0 programmed trip-level sensitivity.

To estimate the capacitive discharge current at any line point, you have to calculate the contribution from all the overhead lines and underground cables lengths only beyond (down-stream) that point.

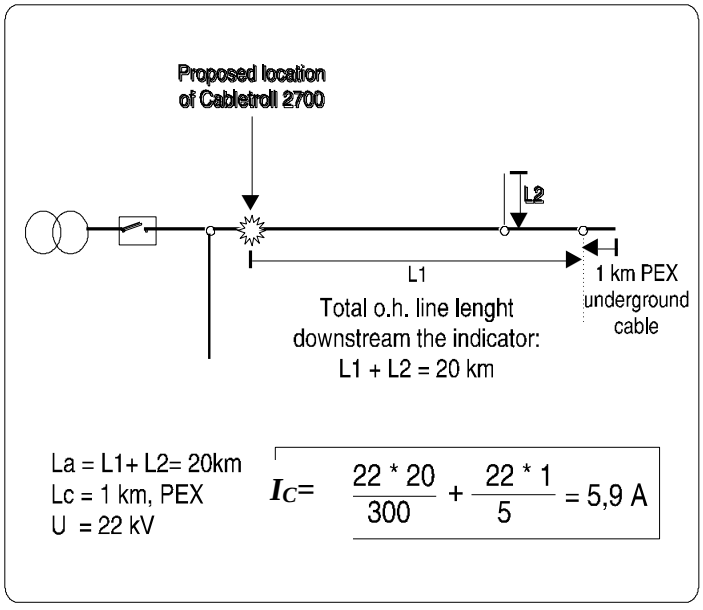


Figure 3. Capacitive discharge current calculation example

3.3 Overcurrent detection

The indicator will start to flash when a current exceeding the programmed overcurrent threshold occurs.

3.4 Earth fault detection

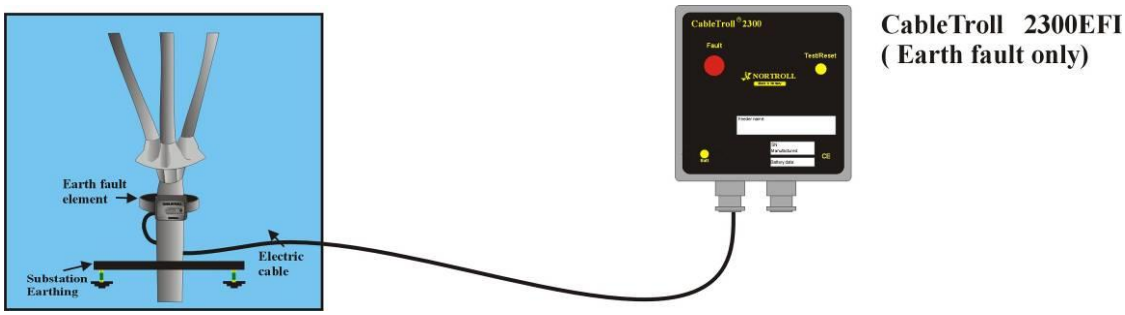
When the vectorial sum of the cable currents exceeds the trip level setting. (With no earth fault this sum is close to zero). Both transient and permanent faults are treated in the same way.

4. Application/Mounting

4.1 Earth Fault Only

The current transformer should be mounted between the end termination and the point where the cable screen is extracted. The CT may be mounted on the screened part of the cable. The screen should then be fed back through the CT to prevent earth fault currents or screen transients exceeding the trip level setting and activating the indicator erroneously.

Product number: 2310



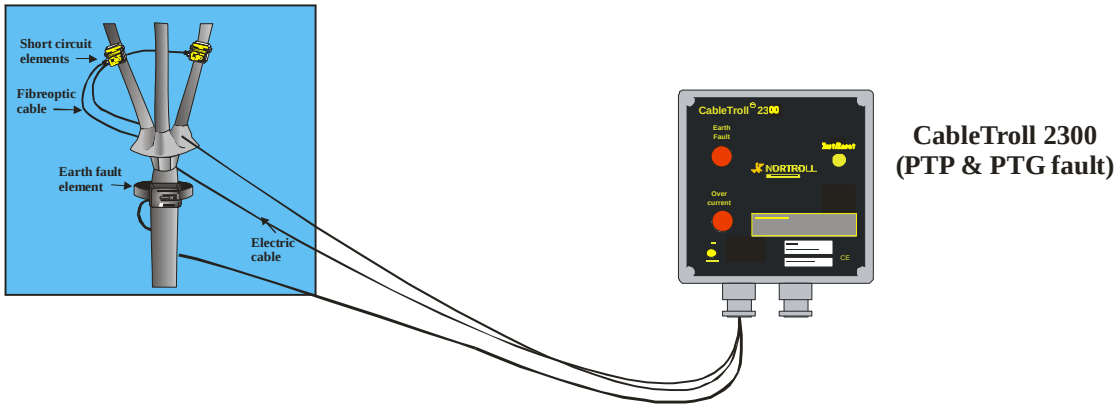
CableTroll 2300EFI (Earth fault only)

Earth fault current transformer
Mounting.

4.2 Earth Fault and Short Circuit

Two short circuit sensors with fibre optic cables and one summing transformer are required to detect both earth fault and short circuit faults.
The short circuit sensors should be mounted between the end termination and the point where the cable screen is extracted. The CT may be mounted on the screened part of the cable. The screen should then be fed back through the CT to prevent earth fault currents or screen transients exceeding the trip level setting and activating the indicator erroneously.

Product nr: 2320



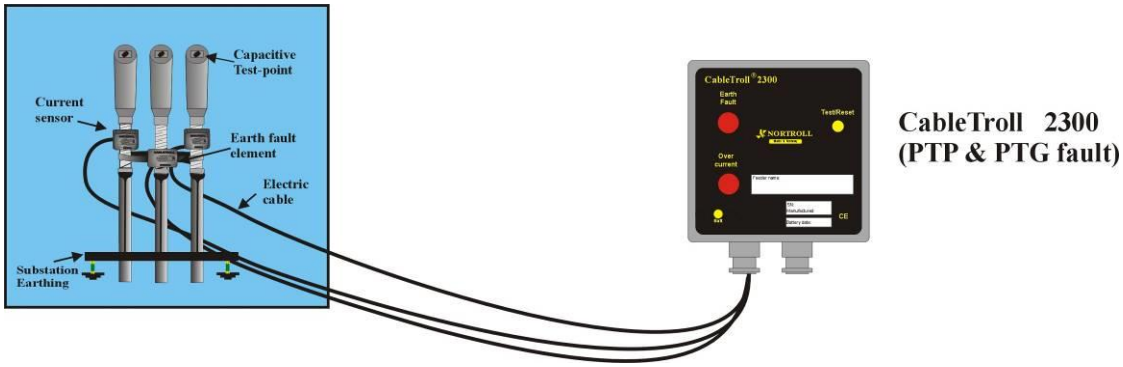
CableTroll 2300 (PTP & PTG fault)

Earth fault current transformer circuit sensors with fibre optic cables

4.3 Earth Fault and Short Circuit

Two current sensors and one summing transformer are required to detect both earth fault and short circuit faults.
The current sensors should be mounted between the end termination and the point where the cable screen is extracted. The CT may be mounted on the screened part of the cable. The screen should then be fed back through the CT to prevent earth fault currents or screen transients exceeding the trip level setting and activating the indicator erroneously.

Product nr: 2330



Earth fault current transformer and current sensor mounting.

5. Additional Indications

5.1 General

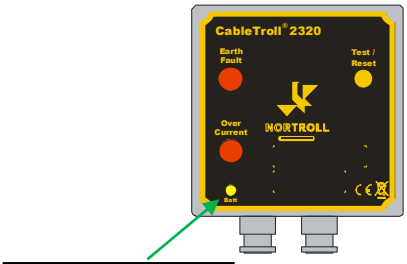
The indicator incorporates 1 additional indication functions

5.2 Low battery (Lithium battery)

When there is less than 20% capacity left on the battery, the battery LED (lower left corner) will start a red flash every 15th second.

When performing a Test or Reset, the battery LED will indicate the status of the Lithium battery.

Green flash:	OK
Red flash:	less than 20% remaining capacity.



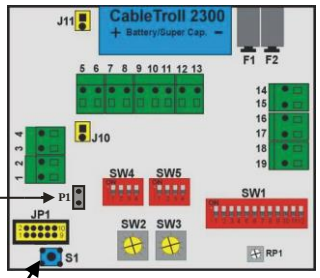
Battery LED

5.3 Resetting battery counter

When the battery has been replaced the battery counter must be reset. This is done by shorting the pins on P1 while at the same time press and release the button S1 (hard reset) located on the main PCB (lower left corner).

Successful resetting of the battery counter, will be indicated by the Battery LED; series of alternating red and green flashes.

Note: Shorting of P1 must be removed after the reset of the counter has been done, otherwise the counter will be reset each time the indicator is reset (also when Reset button on the front panel is pressed).



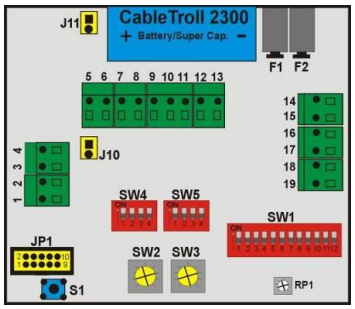
P1: Reset of battery counter

S1
'Hard Reset'

6. Connection Diagram

6.1 Main PCB

Remove 4 screws to open front cover. Front cover holds the display card that is connected by ribbon cable to the main pcb. There is no need to be disconnected to change settings.



Connection diagram 2310, 2320 and 2330

Terminal:

1:	Power (9-48VDC)	11:	Relay Short circuit fault, NO (2320 & 2330)
		11:	Relay Earth-fault (NC for 2310)
2:	GND	12:	Voltage sensor (“hot” wire if TN-net)**)
3:	Mains (230VAC)	13:	Voltage sensor (“cold” wire if TN-net)
4:	Mains (230VAC)	14:	CT 2330 Current sensor 1
5:	Ext. reset*) SC to GND)	15:	CT 2330 Current sensor 1
6:	GND	16:	CT 2330 Current sensor 2
7:	LED-2 Red (+)	17:	CT 2330 Current sensor 2
8:	LED-2 Black (-)	18:	Earth-fault element
9:	Relay common	19:	Earth-fault element
10:	Relay Earth-fault, NO (2310)		

*) Extern reset: Connect term 5 to GND. Do not apply any voltage!
**) Voltage sensor is designed for connection to Cap.outlets or a 230VAC source (10–250V)

F1: Short circuit element, fibre optic cable
F2: Short circuit element, fibre optic cable
J10: Lithium battery
J11 Super capacitor
JP1: Display card

S1: Reset button (hard reset)
RP1: Adjustable earth-fault sensitivity (5-240A)
JP1: Programming
SW2: Setting of signal length short circuit-fault
SW3: Setting of signal length earth-fault
SW4: Setting of trip level: Short Circuit (2330)
SW5: Setting of trip level: Short Circuit (2330)

Note: External DC power connection is polarized.

6.2 Display Card

The display card is mounted inside the front cover. Information regarding the connections and dip switch settings are printed on the card for quick reference on site.

7. Settings/Programming CT 2310

Settings for trip level and other parameters are done with the dip-switches on the printed circuit board.

7.1 Setting the trip level CT 2310. SWITCH BANK NR 1

The trip level is normally factory set to 40A dependent. (It depends on the length of the flexible-CT-core diameter, the trip level increases with increasing core diameter).
As the Earth Fault Indicator is of the threshold type, the trip level should be set according to your system requirements.

Continuously variable trip level:

NOTE: This should only be done when using a calibrated current generator
By means of a potentiometer the user can adjust the trip level within fault current range 5-220A.

Pre-set trip levels:

For user convenience, the fault current trip level can be set to 1 out of 8 fixed nominal values of 40A, 60A, 75A, 80A, 100A, 120A. 150A and 210A for short iron-band and 40A, 65A, 85A, 90A, 110A, 130A, 165A and 230A for long iron-band. For details, refer to table 1.

Switch number: SW 1 (0 = OFF, 1 = ON).

1	2	3	4	5	11	Trip Short iron-band	Trip Long iron-band
0	0	0	0	1	0	40A fixed trip level	45A fixed trip level
1	0	0	0	1	0	60A fixed trip level	65A fixed trip level
0	1	0	0	1	0	75A fixed trip level	85A fixed trip level
0	0	0	0	1	1	80A fixed trip level	90A fixed trip level
0	0	1	0	1	0	100A fixed trip level	110A fixed trip level
1	0	0	0	1	1	120A fixed trip level	130A fixed trip level
0	1	0	0	1	1	150A fixed trip level	165A fixed trip level
0	0	1	0	1	1	210A fixed trip level	230A fixed trip level
X	X	X	1	0	X	Infinitely variable trip level 5-220A	Infinitely variable trip level 10-240A

Table 1: Switch setting overview, trip level.

NOTE:
NORTROLLs Earth Fault Indicator and Earth Fault Element are tuned in to constitute a complete Earth Fault Current Sensing System. If any 3rd party Earth Fault Element is used the system is most likely to malfunction. The indicator may also be damaged.

The Earth Fault Element detects differences between the earth fault current (eventually compensated earth fault current) and the charge current through the element (seen from the feeding point).
This differential must exceed the trip level of the Earth Fault Indicator to give an indication.
Please observe that the trip level should be set to a value exceeding the maximum charge current from the net behind the Earth Fault Element to avoid false indications. To calculate the charge current from the network, a network analysis must be carried out.

7.3 Inrush and voltage reset.

Select Inrush and voltage reset with switch number 6.

Switch number: SW 1 (0 = OFF, 1 = ON).

6	Function
0	Voltage reset and inrush block. Disabled
1	Voltage reset and inrush block. Enabled

Table 2: Switch overview, inrush (5 sec) & voltage reset (15 sec)

IMPROTANT NOTE: SW6= OFF & SW8=ON is an illegal combination and might cause malfunctioning.

7.4 CB tripping.

Select CB (circuit breaker) tripping as start criteria with switch number 7.

Switch number: SW 1 (0 = OFF, 1 = ON).

7	Function
0	No CB trip required
1	CB trip required within 2 sec

Table 3: Switch overview, CB trip

7.5 Delayed remote indication (relay operation)

Select Immediate or delayed indication with switch number 8.

Switch number: SW 1 (0 = OFF, 1 = ON).

8	Function
0	Immediate remote indication.
1	Delayed remote indication **(ref dip#12)**

Table 4: Switch overview, Delayed indication

IMPROTANT NOTE: SW6= OFF & SW8=ON is an illegal combination and might cause malfunctioning.

7.6 Timer reset.

Switch number: SW 1 (0 = OFF, 1 = ON).

9	10	Reset time
0	0	2 hours
1	0	6 hours
0	1	12 hours
1	1	24 hours

Table 5: Switch overview, reset time settings.

7.7 Delay Relay operation

Switch number: SW 1 (0 = OFF, 1 = ON).

12	Delay Relay operation (ref dip#8)
0	10 sec
1	70 sec

Table 7: Switch overview, delay relay operation

8. Settings/Programming CT 2320

Settings for trip level and other parameters are done with the dip-switches on the printed circuit board.

SWITCH BANK NR 1

8.1 Setting the trip level.

The trip level is normally factory set to 40A dependent. (It depends on the length of the flexible-CT-core diameter, the trip level increases with increasing core diameter).
As the Earth Fault Indicator is of the threshold type, the trip level should be set according to your system requirements.

Continuously variable trip level:

NOTE: This should only be done when using a calibrated current generator
By means of a potentiometer the user can adjust the trip level within fault current range 5-220A

Pre-set trip levels:

For user convenience, the fault current trip level can be set to 1 out of 8 fixed nominal values of 40A, 60A, 75A, 80A, 100A, 120A. 150A and 220A for short iron-band and 45A, 65A, 85A, 90A, 110A, 130A, 165A and 230A for long iron-band.. For details, refer to table 1.

Switch number: SW 1 (0 = OFF, 1 = ON).

1	2	3	4	5	11	Trip Short iron-band	Trip Long iron-band
0	0	0	0	1	0	40A fixed trip level	45A fixed trip level
1	0	0	0	1	0	60A fixed trip level	65A fixed trip level
0	1	0	0	1	0	75A fixed trip level	85A fixed trip level
0	0	0	0	1	1	80A fixed trip level	90A fixed trip level
0	0	1	0	1	0	100A fixed trip level	110A fixed trip level
1	0	0	0	1	1	120A fixed trip level	130A fixed trip level
0	1	0	0	1	1	150A fixed trip level	165A fixed trip level
0	0	1	0	1	1	210A fixed trip level	230A fixed trip level
X	X	X	1	0	X	Infinitely variable trip level 5-220A	Infinitely variable trip level 5-240A

Table 1: Switch setting overview, trip level.

NOTE:
NORTROLLs Earth Fault Indicator and Earth Fault Element are tuned in to constitute a complete Earth Fault Current Sensing System. If any 3rd party Earth Fault Element is used the system is most likely to malfunction. The indicator may also be damaged.

The Earth Fault Element detects differences between the earth fault current (eventually compensated earth fault current) and the charge current through the element (seen from the feeding point).
This differential must exceed the trip level of the Earth Fault Indicator to give an indication.
Please observe that the trip level should be set to a value exceeding the maximum charge current from the net behind the Earth Fault Element to avoid false indications. To calculate the charge current from the network, a network analysis must be carried out.

8.2 Inrush and voltage reset.

Select Inrush and voltage reset with switch number 6.

Switch number: SW 1 (0 = OFF, 1 = ON).

6	Function
0	Voltage reset and inrush block. Disabled
1	Voltage reset and inrush block. Enabled

Table 2: Switch overview, inrush (5 sec) & voltage reset (15 sec)

IMPROTANT NOTE: SW6= OFF & SW8=ON is an illegal combination and might cause malfunctioning.

8.3 CB tripping.

Select CB (circuit breaker) tripping as start criteria with switch number 7.

Switch number: SW 1 (0 = OFF, 1 = ON).

7	Function
0	No CB trip required
1	CB trip required within 2 sec

Table 3: Switch overview, CB trip

8.4 Delayed remote indication (relay operation)

Select Immediate or delayed indication with switch number 8.

Switch number: SW 1 (0 = OFF, 1 = ON).

8	Function
0	Immediate remote indication.
1	Delayed remote indication **(ref dip#12)**

Table 4: Switch overview, Delayed indication

IMPROTANT NOTE: SW6= OFF & SW8=ON is an illegal combination and might cause malfunctioning.

8.5 Timer reset.

Switch number: SW 1 (0 = OFF, 1 = ON).

9	10	Reset time
0	0	2 hours
1	0	6 hours
0	1	12 hours
1	1	24 hours

Table 5: Switch overview, reset time settings.

8.6 Delay Relay operation

Switch number: SW 1 (0 = OFF, 1 = ON).

12	Delay Relay operation (ref dip#8)
0	10 sec
1	70 sec

Table 7: Switch overview, delay relay operation

8.7 Setting phase-phase fault signal delay.

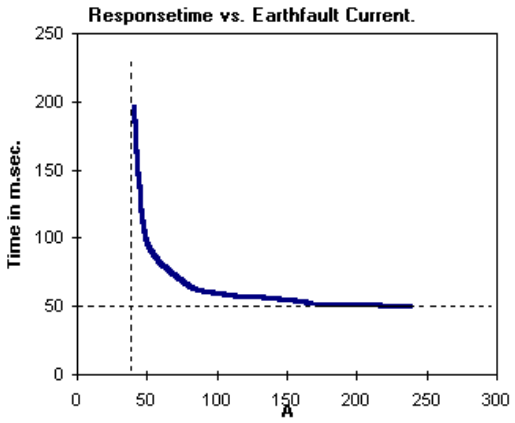
Switch number: SW 2 0 = Off, 1 = ON

SW2	Programmed time in ms.
0	50 ms.
1	100 ms.
2	150 ms.
3	200 ms.
4	250 ms.
5	300 ms.
6	350 ms.
7	400 ms.

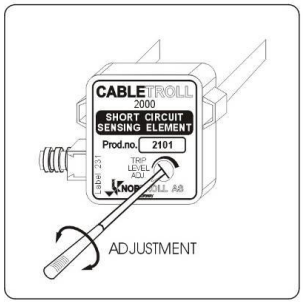
8.9 Setting earth fault signal delay.

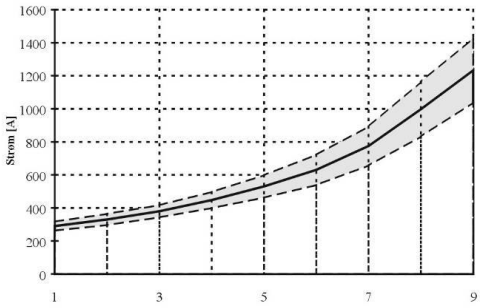
Switch number: SW 3 0 = Off, 1 = ON

SW3	Programmed time in ms.
0	50 ms.
1	100 ms.
2	200 ms.
3	400 ms.
4	800 ms.
5	1200 ms.
6	1600 ms.
7	2000 ms.



8.10 Setting Short circuit trip-level.

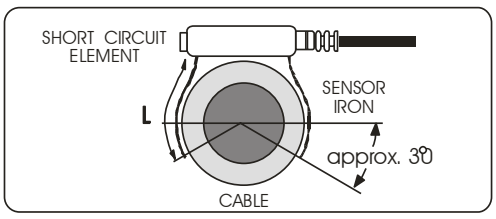




For mounting of the Earth-fault element and the short circuit elements see: Mounting instruction.

8.11 Cutting the short circuit element irons

Measured diameter (mm)	Length L (mm)	
	Rubber hose (LKGD)	PEX cable and OTIA
10-20	-	14
21-25	-	19
26-30	-	22
31-35	30	27
36-40	31	32
41-45	41	36
46-50	47	41



The element irons must be cut according to the drawing/table above to achieve correct trip level for short circuit faults.

9. Settings/Programming CT 2330

Settings for trip level and other parameters are done with the dip-switches on the printed circuit board.

SWITCH BANK NR 1

9.1 Setting the trip level.

The trip level is normally factory set to 40A dependent. (It depends on the length of the flexible-CT-core diameter, the trip level increases with increasing core diameter).
As the Earth Fault Indicator is of the threshold type, the trip level should be set according to your system requirements.

Continuously variable trip level:

NOTE: This should only be done when using a calibrated current generator
By means of a potentiometer the user can adjust the trip level within fault current range 5-220A.

Pre-set trip levels:

For user convenience, the fault current trip level can be set to 1 out of 4 fixed nominal values of 40A, 60A, 75A, 80A, 100A, 120A. 150 and 220A for short iron-band and 45A, 65A, 85A, 90A, 110A, 130A, 165A and 230A for long iron-bandd.. For details, refer to table 1.

Switch number: SW 1 (0 = OFF, 1 = ON).

1	2	3	4	5	11	Trip Short iron-band	Trip Long iron-band
0	0	0	0	1	0	40A fixed trip level	45A fixed trip level
1	0	0	0	1	0	60A fixed trip level	65A fixed trip level
0	1	0	0	1	0	75A fixed trip level	85A fixed trip level
0	0	0	0	1	1	80A fixed trip level	90A fixed trip level
0	0	1	0	1	0	100A fixed trip level	110A fixed trip level
1	0	0	0	1	1	120A fixed trip level	130A fixed trip level
0	1	0	0	1	1	150A fixed trip level	165A fixed trip level
0	0	1	0	1	1	210A fixed trip level	230A fixed trip level
X	X	X	1	0	X	Infinitely variable trip level 5-220A	Infinitely variable trip level 5-240A

Table 1: Switch setting overview, trip level.

NOTE:
NORTROLLs Earth Fault Indicator and Earth Fault Element are tuned in to constitute a complete Earth Fault Current Sensing System. If any 3rd party Earth Fault Element is used the system is most likely to malfunction. The indicator may also be damaged.

The Earth Fault Element detects differences between the earth fault current (eventually compensated earth fault current) and the charge current through the element (seen from the feeding point).
This differential must exceed the trip level of the Earth Fault Indicator to give an indication.
Please observe that the trip level should be set to a value exceeding the maximum charge current from the net behind the Earth Fault Element to avoid false indications. To calculate the charge current from the network, a network analysis must be carried out.

9.2 Inrush and voltage reset.

Select Inrush and voltage reset with switch number 6.

Switch number: SW 1 (0 = OFF, 1 = ON).

6	Function
0	Voltage reset and inrush block. Disabled
1	Voltage reset and inrush block. Enabled

Table 2: Switch overview, inrush (5 sec) & voltage reset (15 sec)

IMPROTANT NOTE: SW6= OFF & SW8=ON is an illegal combination and might cause malfunctioning.

9.3 CB tripping.

Select CB (circuit breaker) tripping as start criteria with switch number 7.

Switch number: SW 1 (0 = OFF, 1 = ON).

7	Function
0	No CB trip required
1	CB trip required within 2 sec

Table 3: Switch overview, CB trip

9.4 Delayed remote indication (relay operation)

Select Immediate or delayed indication with switch number 8.

Switch number: SW 1 (0 = OFF, 1 = ON).

8	Function
0	Immediate remote indication.
1	Delayed remote indication **(ref dip#12**)

Table 4: Switch overview, Delayed indication

IMPROTANT NOTE: SW6= OFF & SW8=ON is an illegal combination and might cause malfunctioning.

9.5 Timer reset.

Switch number: SW 1 (0 = OFF, 1 = ON).

9	10	Reset time
0	0	2 hours
1	0	6 hours
0	1	12 hours
1	1	24 hours

Table 5: Switch overview, reset time settings.

9.6 Delay Relay operation

Switch number: SW 1 (0 = OFF, 1 = ON).

12	Delay Relay operation (ref dip#8)
0	10 sec
1	70 sec

Table 7: Switch overview, delay relay operation

9.7 Setting phase-phase fault signal delay.

Switch number: SW 2 0 = Off, 1 = ON

SW2	Programmed time in ms.
0	50 ms.
1	100 ms.
2	150 ms.
3	200 ms.
4	250 ms.
5	300 ms.
6	350 ms.
7	400 ms.

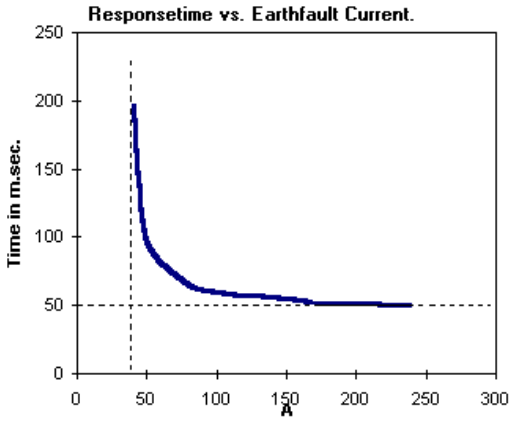
Table 8: Switch overview, signal delay.

9.8 Setting earth fault signal delay.

Switch number: SW 3 0 = Off, 1 = ON

SW3	Programmed time in ms.
0	50 ms.
1	100 ms.
2	200 ms.
3	400 ms.
4	800 ms.
5	1200 ms.
6	1600 ms.
7	2000 ms.

Table 9: Switch overview, signal delay.



9.9 Setting Short circuit trip-level.

Switch number: SW 4 & 5 (0 = OFF, 1 = ON).

1	2	3	4	Trip Short iron-band
1	0	0	0	250A
0	1	0	0	500A
0	0	1	0	750A
0	0	0	1	1000A

Table 10: Switch setting overview, trip level.

NB: Switch 4 & 5 to be programmed identically (Trip level short circuit fault)

10. Test and Reset Button

10.1 Test:

If TEST/RESET is pressed

- and released within 1 sec: All LEDs will flash in a sequence

- more than 1 s:

The indicator will do a voltage input check from Cap-test point or any other voltage source:

- Voltage NOT present: Earth-fault LED flashes rapidly in burst 
- Voltage present: Earth-fault LED illuminates constant. 

- more > 5 s:
The out-put relay(s) will close in a sequence

10.2 Reset

Release the Test/Reset button: The indicator will perform a reset. All LED's will indicate with a flash.

10.3 Battery test.

See section 5, page 13.

10.4 Remote reset

The indicator can be reset from a SCADA RTU by shorting terminal 5 (Ext.reset) to term 6 (GND)

11. Battery Change

11.1 General

The internal battery should be changed every 8 years/1500 hours or if BATT (LED) is illuminated yellow when pressing the test button. If so battery must be changed immediately.

11.2 To replace the battery

1. Remove front cover. (There is no need to disconnect the lead connected to the display card.)
2. Snip the two battery retainer cable ties.
3. Disconnect battery terminal plug.
4. Remove battery.
5. Fit new battery into place and secure using a new cable ties.
6. Plug in connector to main PCB.
7. Reset battery counter (ref section 5.3)

12. Technical specifications

APPLICATION AREA:		Indoor or outdoor cable distribution network. Network voltage range: 6-36 kV.
EARTH FAULT ELEM.:		Description: Summing current transformer (CT)
	Mounting:	On single-core and multi-core cable within the diameter range up to 100mm, with extended flexible CT core up to 650mm circumference.
	Housing material:	Polyethylene.
SHORT CIRCUIT SENSORS:		Two short circuit elements with fibre optic cables (prod. Nr 2320) Two threshold type current sensors (prod nr 2330) Housing material: Polyethylene
INDICATOR:		
	Application:	Short circuit and/or Earth fault indication for multi and single core underground cables. MV– voltage Network
	Grounding system:	Isolated, resistor and solidly grounded
	Trip level PTG fault:	Earth fault range: 5-220A (→ 240 with long iron band)
	Trip level PTP fault:	Prod nr 2320: Short circuit fault range: 350-1200A Prod nr 2330: Short circuit fault range: 250-1000A in 250A Increments
	Duration:	50 msec, configurable 50 – 400/2000msec) for SC/EF
	Inrush blocking:	5 sec.
	Reset	Automatic, By return of voltage 10-230VAC
	Timer:	2, 6, 12, or 24 hours. *
	Manual:	Reset button
	Remote:	Closed contact
	Indication:	Red LED's for short circuit and/or earth-fault Low battery when < 80% capacity left
	External indic.	LED-2
	Flashing freq:	Powered by ext DC/AC: 1 Hz (duty cycle 5%), Powered by Internal battery/supercap:0,3Hz (dutycycle:1,7%)
	Remote:	2 dry relay contacts (NO) (2310 both NC and NC available) (NC for 2320 and 2330 on request only) Contact ratings: Maximum switching current: 2A Maximum switching voltage: 125Vdc, 250Vac Maximum switching capacity: 30W, 62.5VA
	Power supply:	1 Lithium Cell A size 3 Ah Lithium Battery change if powred by battery: Every 1500 hours flashing/ up to 10 years Lithium battery as backup: Up to 10 years Super capacitor – optional back-up
	Current consumption:	Idle: < 30uA Indication: 450uA (Internal LED + ext LED-2) 210uA Internal LED only External 8 - 48 V DC or 230VAC
	Ambient temp range:	- 40º to +74ºC
	Housing:	Polycarbonate, UV stablized
	Dimension:	Main unit: 121x123x60mm (exclusive cable glands) Packaging box: 326x200x66mm
	Weight:	2310:0,97kg / 2320:1,12kg / 2330:1,68kg including sensors and packaging.
Degree of protection:		IP54 (limited by the cable glands)

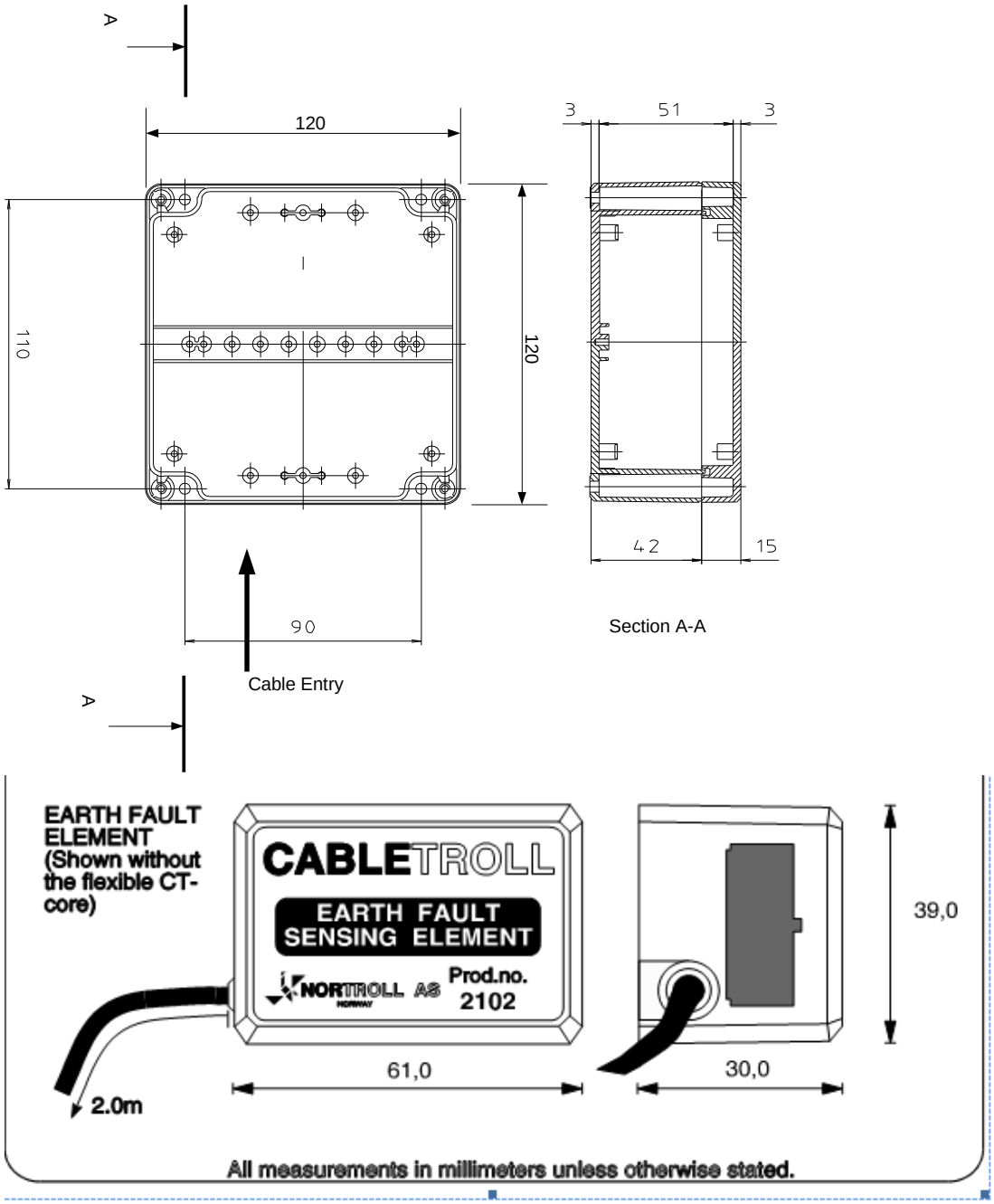
Note *: All triplevels, timers etc. are selectable and programmable by microswitches.

13 Dimensions

13.1 Housing

Overall dimensions 121 x 123 x 60 mm

4 x 4.2mm Mounting holes on 90 x 110 mm centres as shown below.



14. Ordering Information

Product nr: 2310:	CableTroll 2310 EFI Earth fault (only) indicator, Lithium battery
Product nr: 2320:	CableTroll 2320 Earth fault and Short circuit fault indicator with short circuit elements and fibre optic cables, Lithium battery
Product nr: 2321:	CableTroll 2320 Earth fault and Short circuit fault indicator with short circuit elements and fibre optic cables, Super capacitor.
Product nr: 2330:	CableTroll 2330 Earth fault and Short circuit fault indicator, Lithium battery
Product nr: 2331:	CableTroll 2330 Earth fault and Short circuit fault indicator, Super capacitor.