

# Overhead line Fault Indicator

نمایشگرهای خطا

شبکه هوایی

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## FAULT INDICATORS OF THE FLA3.1 PRODUCT LINE

for overhead lines

### General description

The fault indicators of the FLA3.1 product line are used in medium voltage overhead line networks. The indicators of the FLA3.1 product line stand out for the great flexibility of the adjustments that can be done. Beside the basic settings of the indicator like trip current, response delay, reset time, etc., the indicators can be adapted to auto-reclosers in the network. This provides for an optimized fault indication and also allows the indication of different fault types. Permanent and temporary faults can be distinguished and indicated separately.

All indicators of the FLA3.1 product line can communicate to a remote control via a bidirectional wireless connection. In this way all settings of the indicator can be adjusted at any time without removing the indicator from the powered line. The bidirectional connection between the remote control and the fault indicators also allows to read out the present current of the monitored network with the remote control at any time.

The fault indicators of the FLA3.1 product line can be connected to the remote indication interface type RIS. This allows an easily retrofittable remote indication solution for the overhead line indicators.

### Versions

- FLA3.1: Fault detection: absolute threshold (manually set or automatically calculated)  
Indication: red signal color flag and six LEDs
- FLA3.1L: Fault detection: absolute threshold (manually set or automatically calculated)  
Indication: one ultra-bright LED
- FLA3.1V: Fault detection: a) absolute threshold (manually set or automatically calculated)  
b) di/dt fault detection algorithm  
Indication: red signal color flag and six LEDs
- FLA3.1VL: Fault detection: a) absolute threshold (manually set or automatically calculated)  
b) di/dt fault detection algorithm  
Indication: one ultra-bright LED



figure 1 - remote control type HS



figure 2 - type FLA3.1V



figure 3 - type FLA3.1VL

## Technical Data

Subject	Version	Value
trip current short-circuit (can be switched off completely)	FLA3.1 / FLA3.1V	a) Standard mode: fixed trip value 20A to 1500A (in steps of 20A) b) Automatic mode: automatically adjusted 150% to 500% (in steps of 50%) of service current
	FLA3.1L / FLA3.1VL	a) Standard mode: fixed trip value 20A to 800A (in steps of 10A) b) Automatic mode: automatically adjusted 150% to 500% (in steps of 50%) of service current
trip current earth-fault (can be switched off completely)	FLA3.1V / FLA3.1VL	a) di/dt measurement and subsequent voltage loss: di: 5A to 100A (in steps of 5A) dt: 20ms at 50Hz / 16ms at 60Hz
response delay		selectable between 40 and 300 ms (in steps of 20 ms)
voltage detection	FLA3.1VL	selectable between 20% to 90% of $U_n$ (in steps of 10%)
indication	FLA3.1 / FLA3.1V	6x LED indication, 360° visibility Flag indication, 360° visibility, red signal color
	FLA3.1L / FLA3.1VL	1x ultra-bright red LED indication with focussing lens, 360° visibility
reset of the indicator		a) by remote control b) by time: selectable from 30 min to 12 h (in steps of 30 min) c) by recovering service current: optional yes/no d) by recovering net voltage: optional yes/no
on-site function test		by remote control
dimensions		diameter: 80mm height: 184mm
protection class		IP67
housing material		ABS HI100-NP, Carbotex K20 UVR
weight	FLA3.1 / FLA3.1V	0.610kg
	FLA3.1L / FLA3.1VL	0.550kg
type tests		according to IEEE 495-2007, EN 60068-2-11 2000-02, ASTM G44-99 (2005)
operation temperature range		-20°C to +70°C
accuracy		+/- 10%
cable diameter ranges		a) 6 mm - 15 mm b) 10 mm - 28 mm c) 25 mm - 42 mm
power supply	FLA3.1 / FLA3.1V	lithium battery (LiSOCl <sub>2</sub> ) type A / 3.6V / 3600 mAh self-sustained from 20A net current upwards
	FLA3.1L / FLA3.1VL	2x lithium battery (LiSOCl <sub>2</sub> ) type A / 3.6V / 3600 mAh

Subject	Version	Value
total fault indication hours		approx. 10 years with 800 hours
flashing frequency	FLA3.1 / FLA3.1V	60 per minute (1 Hz)
	FLA3.1L / FLA3.1VL	30 per minute (0.5 Hz)
maximum operating voltage		<= 60kV
current withstand		25 kA / 170ms Sym. RMS
communication		433MHz bidirectional radio interface to remote control type HS and remote indication interface type RIS
remote indication	FLA3.1 / FLA3.1L	faults and the reset of the indicator
	FLA3.1V / FLA3.1VL	a) faults and the reset of the indicator b) current on/off events or voltage on/off events
data-logging	FLA3.1V / FLA3.1VL	logging of current read-outs and voltage status in intervals selectable from 1min to 24h (only in connection with the remote indication type RIS-FS and special built RTUs.)

## Fault detection

The fault indicators of the FLA3.1 product line are able to detect short-circuits and earth-faults. The different versions use different criteria for the detection of short-circuits and earth-faults which are described below.

### Short-circuit detection with absolute threshold

The short-circuit detection works as a fault passage detection with a fixed or automatically adjusted trip current setting. When a current exceeds the adjusted or automatically adjusted trip current and lasts longer than the adjusted response delay the indicator will detect a short-circuit (please refer to figure 4).

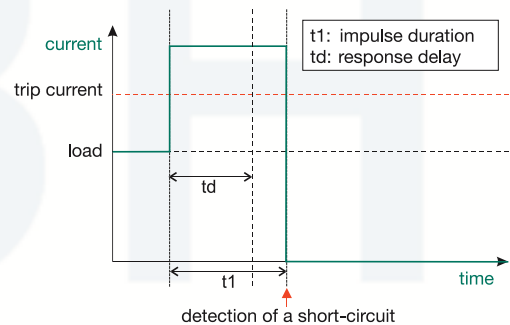


figure 4 - detection of a short-circuit

### Earth-fault detection with di/dt algorithm (only FLA3.1V and FLA3.1VL)

The earth-fault detection works with a di/dt measurement algorithm. Once the current load changes within 20ms (= dt) above a user selected value (e.g. di = 30A) and this heightened current lasts longer than 40ms the indicator will start analyzing the network voltage. If the voltage drops within one second after the heightened current was measured the indicator will detect an earth-fault (please refer to figure 5).

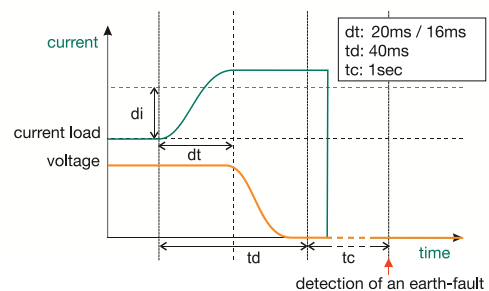


figure 5 - detection of an earth-fault

### Installation

The fault indicators of the FLA product line can be mounted while the overhead line is working. For the installation a hotstick and an insulated bucket crane (see figure 6) or a telescopic hotstick (see figure 7) can be used. All safety regulations must be regarded during installation!

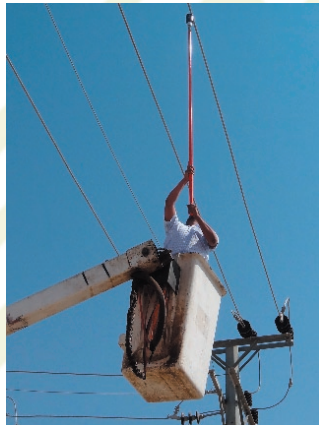


figure 6 - installation with a bucket crane



figure 7 - installation with a telescopic hotstick

To install the indicator on the line a mounting adapter (see figure 10) is required. For the installation the indicator's clip-on mechanism is opened (see figure 8) and the indicator is placed and fixed into the mounting adapter (see figure 10). The indicator can then simply be clipped onto the line.

There are different mounting adapters available for different hotstick joints. Figure 9 shows the installation of a mounting adapter with universal spline joint onto a hotstick's head.

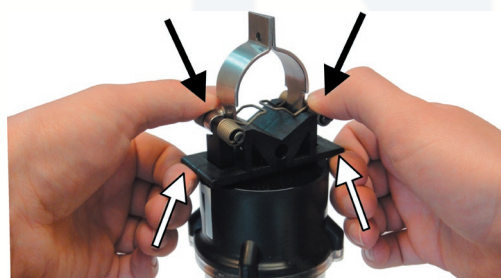


figure 8 - opening the clip-on mechanism

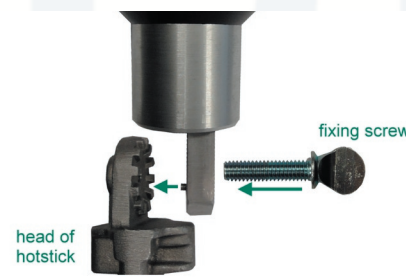


figure 9 - installing a spline joint adapter onto a hotstick



figure 10 - Mounting adapter and how to fix the indicator in the adapter

### Selection of installation sites

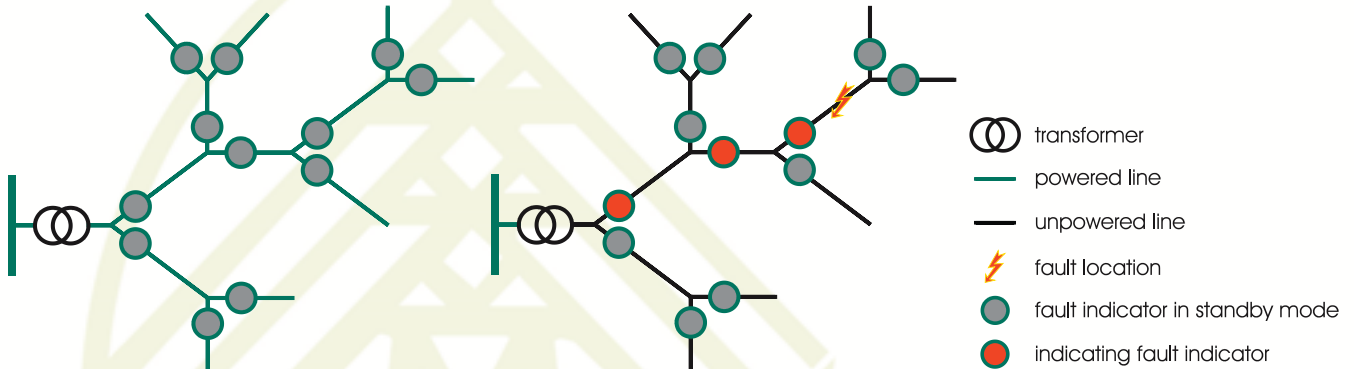


figure 11 - Finding a fault by following the indicating FLA3.1s to the fault location

A careful selection of the installation site will enhance efficiency of the fault indicators of the FLA3.1 product line. Suitable installation sites are junctions or critical points in very long lines. (See figure 12 for a suitable installation site.) Suitable installation sites enable to follow the fault current to the fault location very efficiently. Figure 11 shows how to follow the signals of indicating FLA3.1s in case of a fault.

### Selection of installation positions

The indicators of the FLA3.1 product line are robust devices but a suitable position on the line can enhance lifetime of the devices. Avoid installing the indicators in the following places:

- Positions on a cable that can get very hot. (E.g. bridges at poles that may come loose and heat up in the following.) (See figure 13.)
- Positions where the lines are bended downwards. The fields of the lines going down a pole also influence the indicators so that the accuracy is affected. (See figure 14.)



figure 12 - Suitable installation site



figure 13 - Possible hot points on a line

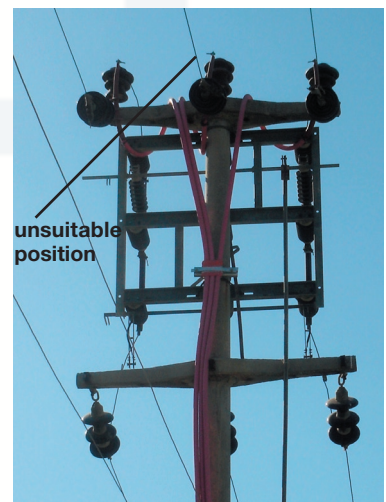


figure 14 - influences from lines

## Adaption to Auto-Reclosers

When auto-reclosers are installed in the overhead line network different types of fault may occur in the network. This depends on the successful or not successful re-energizing of the network by the auto-reclosers. The indicators of the FLA3.1 product line can be adapted to the auto-reclosers to either identify the different fault types or filter out temporary fault situations after successful re-energizing the network.

The following fault types can be identified:

### Permanent faults

When a fault happens that switches off the network permanently (reclosing attempts were not successful) then the indicator will detect a permanent fault. (Please refer to figure 15.)

### Temporary faults

Temporary faults are fault situations where a fault current leads to a power failure that can be fixed by switching the network on again. (See figure 16.) This type of fault may be caused by e.g. branches of a tree that touch the line and are burnt away afterwards.

With enabled auto-recloser configuration the FLA3.1s are able to identify this kind of fault. The user can select if this type of fault should not result in indication or if this type of fault shall be indicated in a different way than permanent faults.

**Please note:** With disabled auto-recloser configuration the fault indicators will identify this type of fault as permanent fault.

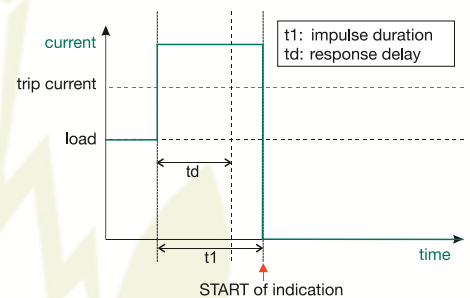


figure 15 - permanent fault

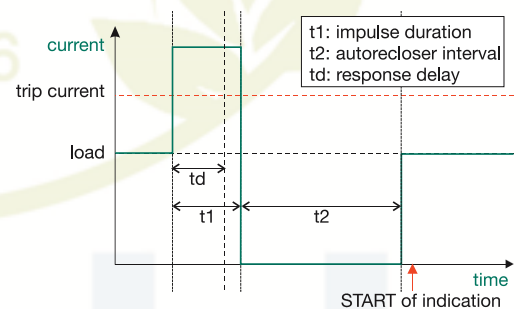


figure 16 - temporary fault

## Remote indication

The fault indicators of the FLA3.1 product line can be configured to remotely indicate faults. Some versions of the FLA3.1 product line can also remotely indicate when the voltage or current is switched on or off. Please see figure 1 for an example using the Nexus NX21 as RTU.

Upon fault detection the FLA3.1s use the short-range radio module to send a message with the fault information to a remote terminal unit (RTU) (figure 17, step 1). Inside the RTU the remote indication interface type RIS is receiving the fault indication and forwards the information to the RTU itself. The RTU will process that and will then forward the information to the iHost software (figure 17, step 2).

Upon receipt of this information iHost will store the received data into log files, will display the fault information and makes it easily accessible to authorized persons by e.g. email or SMS notifications (figure 17, step 3).

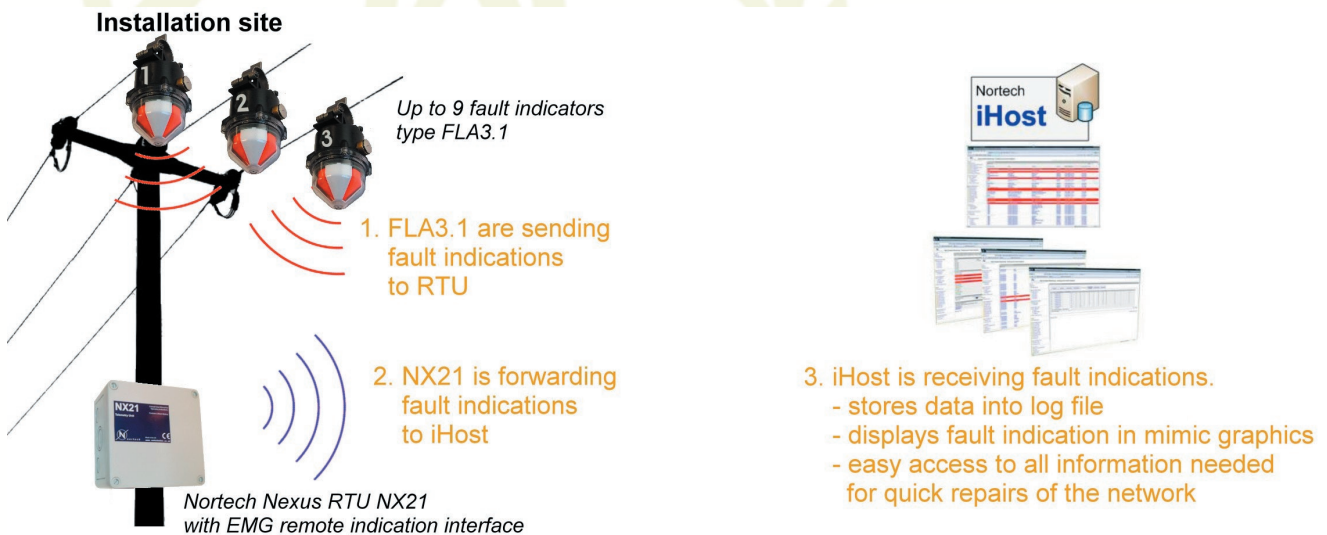


figure 17 - remote indication using the short-circuit indicators type FLA3.1 and a NX21

## iHost acting as DCU: Integration into big-scale SCADA systems

One of the advantageous features of the iHost software is that it can act as stand-alone remote monitoring system but it can also act as data concentrator unit (DCU) for big-scale SCADA systems. iHost can act as one or more virtual RTUs for the SCADA system. Supported protocols are DNP3 or IEC870.

The advantage of this architecture is that the fault indicators must not be integrated directly into the SCADA system. The usually high numbers of fault indicators make a management inside and integration into the SCADA system very expensive. So, iHost provides a more efficient and therefore cheaper way to manage and integrate the vast numbers of fault indicators.



# THE PURPOSE OF DIFFERENT IDENTIFICATION CODES OF FAULT INDICATORS OF THE FLA3.1 PRODUCT LINE

## for overhead lines

### Introduction

The fault indicators of the FLA3.1 product line, e.g. the type FLA3.1 or the type FLA3.1VL, can be fully configured and read out by the remote control type HS. Therefore a bidirectional short range radio communication is used. This paper describes what should be considered when installing FLA3.1 indicators at one installation site.

**Please note:** The pictures below show the fault indicator type FLA3.1 as an example. This document and the pictures can be applied to all indicators of the FLA3.1 product line in the same way.

### Correct installation

Usually more than one indicator is used at one installation site. To address the FLA3.1 indicators with the remote control the indicators have identification codes (IDs). The ID of an FLA3.1 indicator is printed on the outside of the housing. (Please see figures 1 and 2.)

Figure 3 shows the correct installation. Only indicators with unique IDs should be installed at one site. With this installation each indicator can be addressed by the remote control. The user of the remote control can be sure that the command that he is sending is received by only one FLA3.1 indicator. And more importantly he can be sure that the response that he will receive from the indicator is from one specific device.

### Wrong installation

As soon as there are FLA3.1 indicators with duplicate IDs installed at one site the indicators can not be addressed individually. In the example in figure 4, there are two indicators with ID2 installed. E.g., when the user would like to read out the service current from ID2 he can not be sure from which indicator he is receiving the values.

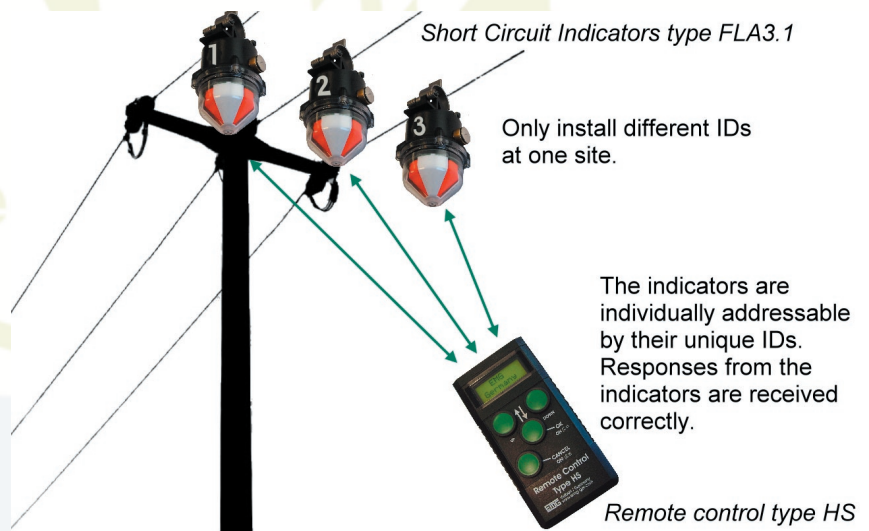


figure 3 - Correct installation

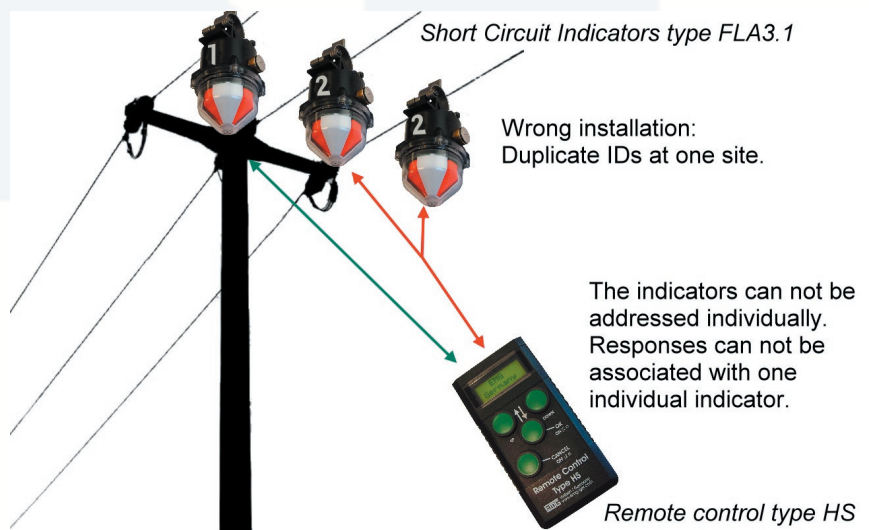


figure 4 - Wrong installation



figure 1 - FLA3.1 with ID 1



figure 2 - FLA3.1VL with ID 5

# Ground Fault Indicator

Reg : 10346  
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# EARTH-FAULT AND SHORT-CIRCUIT INDICATOR TYPE **EKS3.2**

panel-mounted

## General description

The earth-fault and short-circuit indicator can be used in radial networks with one input and open-ring networks which are solidly earthed or low resistance-earthed. The connections between the short-circuit sensors and accordingly the earth-fault sensors to the display unit are done by cable. All sensors must be mounted on screened cables. The sensors are divisible and can be retrofitted on the cable. The display device is powered by an exchangeable lithium battery.



## Features and Options

- Permanent earth-faults: Indication of permanent earth-faults by double blinking of the earth-fault LED.
- 2nd short-circuit pass-through: Indication of a second short-circuit passing through by double blinking of the respective short-circuit LED.
- Separate response delays: The response delay for short-circuits and earth-faults can be adjusted individually.
- Optional two relays: The indicator can be equipped with two remote contact relays to indicate earth-faults and short-circuits separately.
- Optional reset input: For reset by recovering auxiliary voltage supply (V DC or V AC)
- Optional sensor reset: Sensor reset on recovering net current
- Optional power supplies: 10-110 V DC or 110 / 230 V AC power supply with optional lithium backup battery

## External connectors

- Connector 1 - 2: short-circuit sensor L1
- Connector 3 - 4: short-circuit sensor L2
- Connector 5 - 6: short-circuit sensor L3
- Connector 7 - 8: earth-fault sensor
- Connector 9 - 10: external blinking lamp (Type BL3.1+BL4.1)
- Connector 10 - 11: Remote reset input
- Connector 13 - 15: SCADA change-over contact (please refer to figure 1)

### Optional two relays:

- Connector 12- 13: SCADA remote contact for short-circuit
- Connector 14- 15: SCADA remote contact for earth-fault

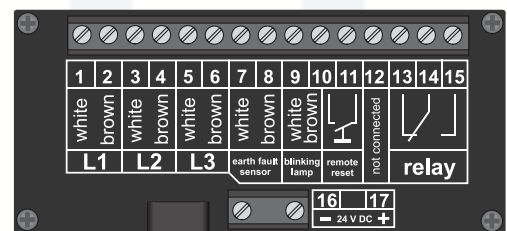


figure 1 - Connectors one relay version

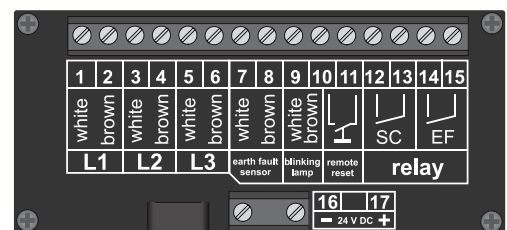
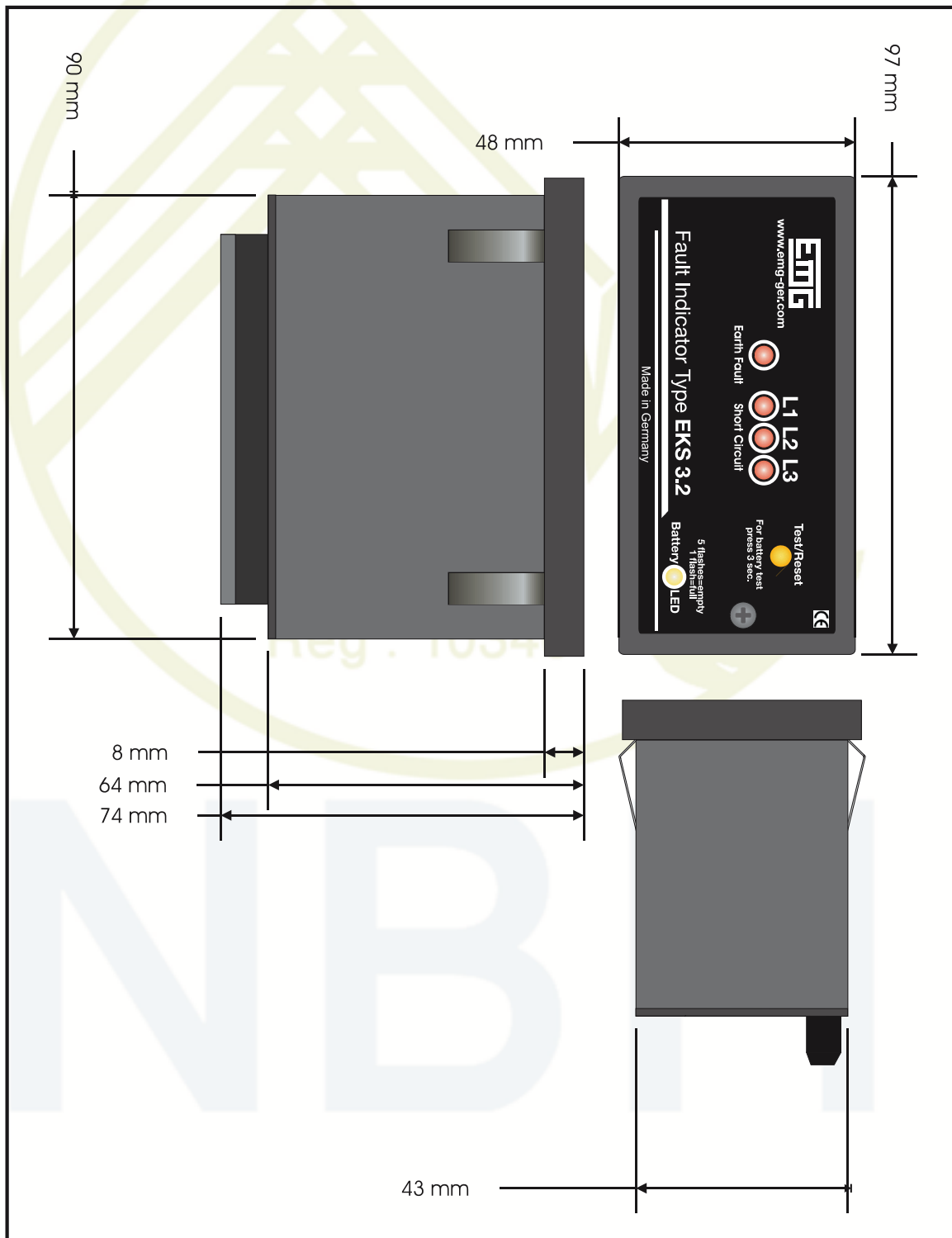



figure 2 - Connectors two relay version

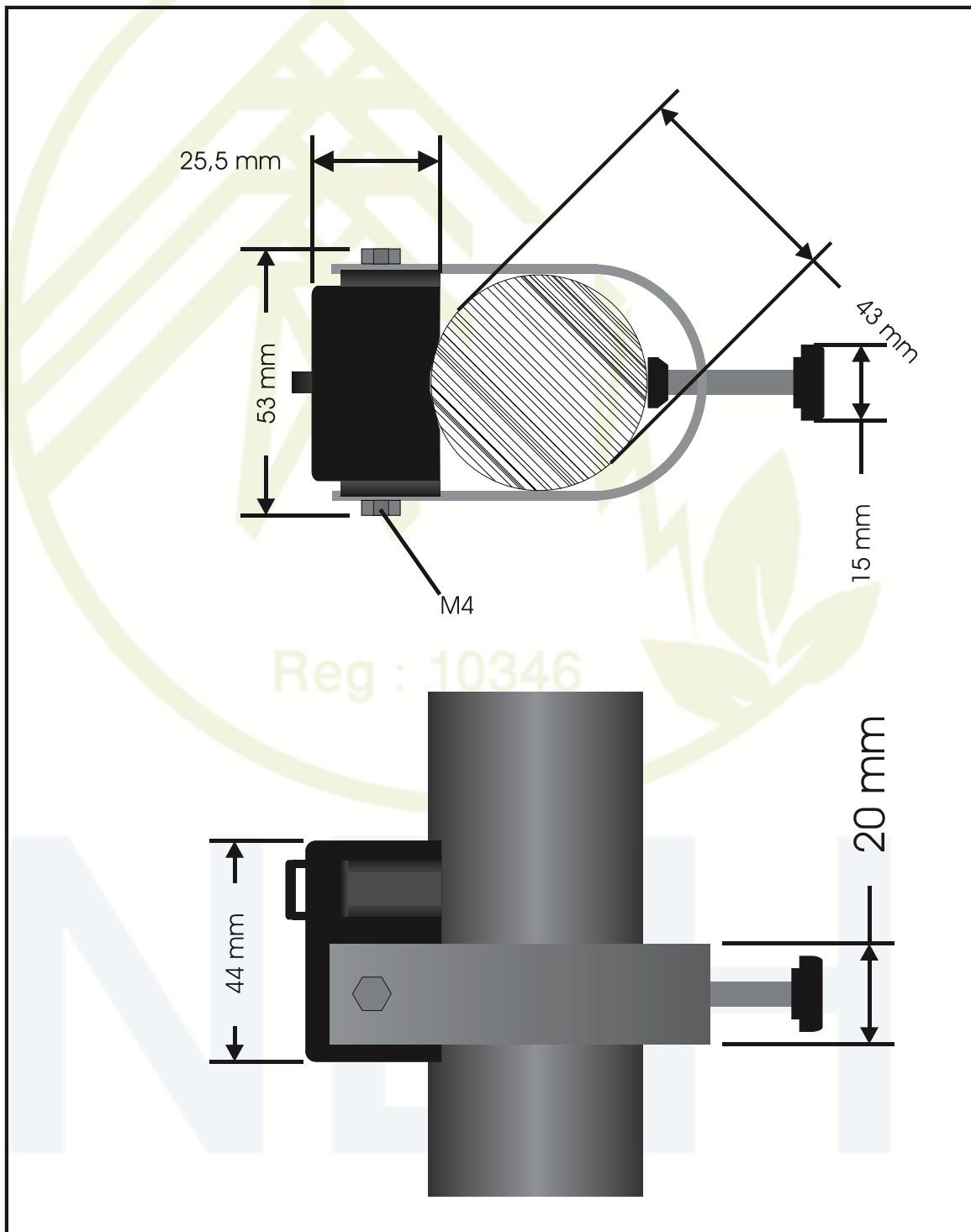
## General Data


Subject	Value
short-circuit current (phase to phase)	adjustable: 200 / 400 / 600 / 800 / 1000 * A ( $\pm 10\%$ )
earth-fault current (phase to ground)	adjustable: 10 / 20 / 40 / 60 / 80 / 100 * A ( $\pm 10\%$ )
response delay short-circuit	adjustable: 40 / 60 / 80 / 160 * ms
response delay earth-fault	adjustable: 40 / 60 / 80 / 160 * ms
indication unit	suitable for panel installation
indication of a) short-circuit b) earth-fault c) battery	a) one red LED for each phase b) one red LED for earth-fault c) one yellow LED
reset of the indicator	a) manual by push-button b) connection for a potential-free remote reset c) time*: 1 / 2 / 4 / 8 ( $\pm 1\%$ ) hours after fault Optional: d) self-acting after recovering of 230 V AC Optional: e) sensor reset after recovering net current
on site function test a) function test b) battery test	by push-button a) the button has to be pressed for 1 second b) the button has to be pressed for 3 seconds
dimensions: indication unit	(WxHxD) 97 mm x 48 mm x 74 mm (dimensions of the cut out: 92+0.8 x 45+0.6 mm / IEC 61554 / DIN43700)
Protection class: indication unit	IP40
Protection class: sensors	IP67
internal type test	according to IEEE 495-2007
operation temperature range	-25°C to +70°C
power supply	lithium battery (LiSOCl <sub>2</sub> ) type AA / 3.6V / 2600 mAh Optional: 10-110 V DC ** Optional: 110 / 230 V AC ** **) can be ordered with lithium backup battery type AA / 3.6V / 2600 mAh
SCADA contact	1x change-over contact Optional: 2x NO (separate earth-fault and short-circuit indication) permanent / wipe contact (100ms) (can be selected on site by a dip switch) max. 230 V AC / max. 2 A / max. 30 W
short-circuit sensor (CT)	three short circuit sensors type SK (current transformers for single-core cable) diameter: 22-42* mm connection cable length: 3* m (copper cable)
earth-fault sensor (CT)	one earth-fault sensor type SE (current transformers for a three-core cable) diameter: 80-100* mm connection cable length: 3* m (copper cable)

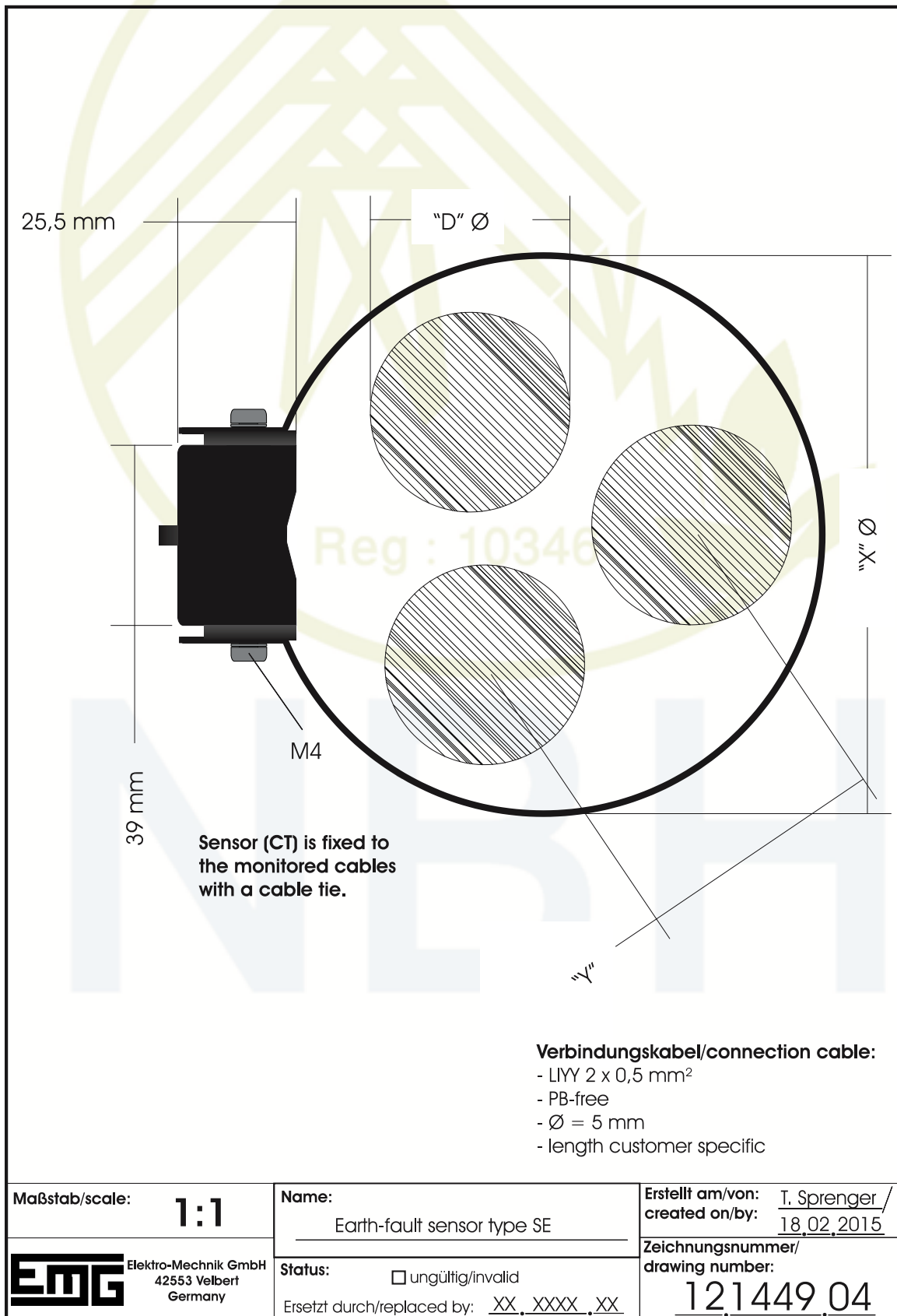
\*PLEASE NOTE: other values can be ordered



<b>Maßstab/scale:</b> <span style="font-size: 2em;">1:1</span>	<b>Name:</b> Indication unit type EKS3.2	<b>Erstellt am/von:</b> D. Kusserow/ <b>created on/by:</b> 26.08.2011
 Elektro-Mechanik GmbH 42553 Velbert Germany	<b>Status:</b> <input type="checkbox"/> ungültig/invalid Ersetzt durch/replaced by: XX.XXXX.XX	<b>Zeichnungsnummer/</b> <b>drawing number:</b> <span style="font-size: 1.5em;">22.1529.01</span>



Maßstab/scale: <b>1:1</b>	Name: Short-circuit sensor type SK	Erstellt am/von: T. Sprenger / created on/by: 18.02.2015
 Elektro-Mechnik GmbH 42553 Velbert Germany	Status: <input type="checkbox"/> ungültig/invalid Ersetzt durch/replaced by: XX.XXXX.XX	Zeichnungsnummer/ drawing number: <b>121469.02</b>



# Voltage Indicator

نمایشگر ولتاژ

فازمتر 20KV



## VOLTAGE INDICATOR TYPE EL

### General description

The voltage detector type EL is used in medium voltage networks to determine the voltage presence. The voltage detector is manufactured and tested according to the requirements of IEC 61243-1 (DIN VDE 0681 Part 411). It does not need any auxiliary power and has a self-testing device. It is constructed as single unit.

The voltage detector consists of an indication device with a M8 external screw thread, on which the different test electrodes can be screwed. For the transport, the size of the voltage detector can be reduced by twisting off the extension and fixing it in the opposite direction (length for transportation: 616 mm).

To protect the unit, a transportation bag is available. The voltage detector type EL is available for 6 kV, 10 kV, 15 kV or 20 kV.



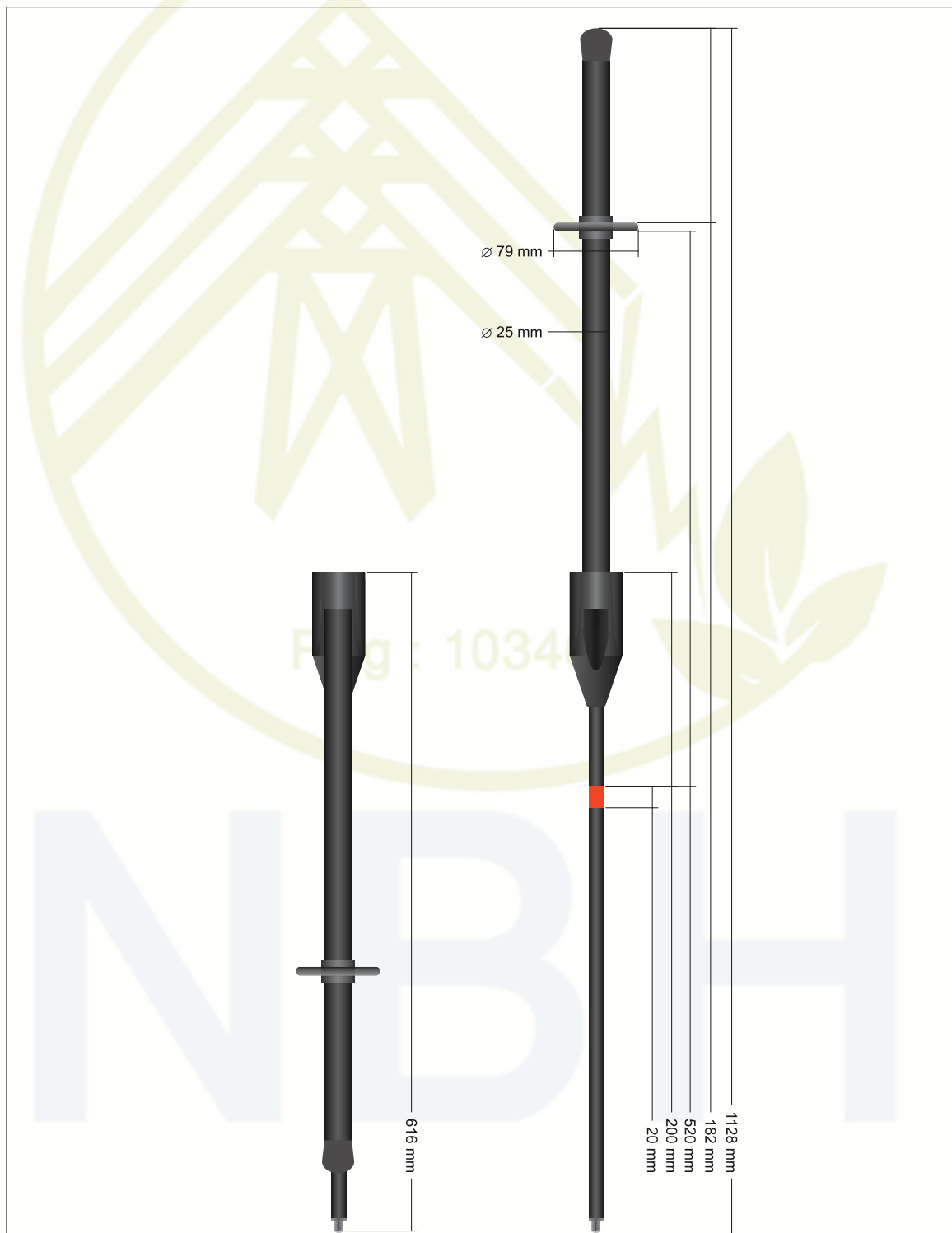
figure 1 - transport condition




figure 2 - ready for operation

### General Data

Subject	Value
applied standard	IEC 61243-1 (DIN VDE 0681 Part 411)
rated voltage	6 kV / 10 kV / 15 kV / 20 kV
frequency	50 Hz
protection class	IP65
area of application	indoor
indication of voltage	blinking LEDs
visibility	visible at 1000lux (+/- 10%) with standard light A according to CIE 15.2
blinking frequency	min. 60 times per minute
self-test	by push-button
power supply	not necessary
dimensions	length in operating condition: 1128 mm length in transport condition: 616 mm
operation temperature range	-25°C to +70°C
operating voltage	testing voltage
a) in-phase interference field	a) $0,45 \times U_N$ - indication "voltage present"
b) out of phase interference field	a) $0,60 \times U_N$ - indication "voltage not present"
c) separate source voltage	a) $0,10 \times U_N$ - indication "voltage not present"
material	
a) housing	a) ABS GF 20%
b) tube	b) epoxy tube WT912
weight	0.550 kg



<b>Maßstab/scale:</b> <p style="font-size: 2em; font-weight: bold;">1:1</p>	<b>Name:</b> Voltage detector type EL	<b>Erstellt am/von:</b> D. Kusserow/ <b>created on/by:</b> 20.06.2012
	<b>Status:</b> <input type="checkbox"/> ungültig/invalid Ersetzt durch/replaced by: XX, XXXX, XX	<b>Zeichnungsnummer/                  drawing number:</b> <p style="font-size: 1.5em; font-weight: bold;">321652.00</p>

# Voltage Indicator

نمایشگر ولتاژ

Reg : 10346

نمایشگرهای تابلویی

## PRODUCT RANGE – VOLTAGE

VOLTAGE INDICATOR  
TYPE WM

- according to IEC 61243-5
- part of an HR voltage detection system
- rated voltage range:  
between 5 kV and 36 kV
- fits into a panel cut-out  
complying to DIN EN 61 554
- can be adapted to  
bushings and insulators
- connection cables and  
insulators available



## VOLTAGE INDICATOR

### TYPE WM

panel-mounted

#### General description

This capacitive voltage module is an element of the HR voltage detection system and is used in medium voltage switchgears. The voltage detector module is tested and manufactured according to the requirements of IEC 61243-5.

The indication of the voltage is displayed permanently with one flashing LED for each phase. The test sockets for phase comparing are gold plated and protected by a hinged flag. The capacitive module has to be adapted to the capacitive bushing or the insulator, in which the module is used. The voltage indicators type WM do not require any power supply.



Subject	Value
Area of application	HR-Systems
Applied standard	IEC 61243-5
Indication of voltage	The presence of voltage is indicated permanently by blinking LEDs.
Test sockets	Gold-plated, for phase comparison Protected by a hinged flag
Well-defined, non-ambiguous indication	The non-ambiguous indication of present voltage is assured by the standard IEC 61243-5
Temperature range	-25° C to +65° C
Maintenance tests	The maintenance test has to be done according to standard IEC 61243-5 chapter 5.26
dimensions	(WxHxD) 114 mm x 49 mm x 39 mm (dimensions of the cut out: 92 <sup>+0.8</sup> x 45 <sup>+0.6</sup> mm / IEC 61554 / DIN43700)
Protection class	IP54
Fixing	self-cutting tapping screw 3,9mm x 9,5mm

#### PLEASE NOTE

The capacitive voltage ledge type WM has to be adapted to the bushing / capacitive insulator. The capacity of the bushing / capacitive insulator must be specified for the calculation of the balancing capacitor.

