Operating instructions

Earth fault and short circuit indicator - EOR-3D

In DIN rail housing and industrial housing

GB

Model EOR-3D

Note:

Please note that this operating manual cannot describe the latest version of the device in all cases. For example, if you download a more recent firmware version from the internet, the following description may no longer be accurate in every point.

In this case, either contact us directly or refer to the most recent version of the operating manual, available on our website (www.a-eberle.de).

A. Eberle GmbH & Co. KG

Frankenstraße 160
D-90461 Nuremberg

Tel.: 0911 / 62 81 08 0
Fax: 0911 / 62 81 08 96
E-Mail: info@a-eberle.de
Internet: www.a-eberle.de

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1. User Guide

1.1 Warnings

Types of Warnings

Warnings are distinguished according to the type of risk through the following signal words:

→ **Danger** warns of a risk of death

→ **Warning** warns of physical injury

→ **Caution** warns of damage to property

Structure of a warning

Signal word

Nature and source of the danger

Actions to avoid the danger.

1.2 Notes

Notes on appropriate use of the device

1.3 Other Symbols

Instructions

Structure of instructions:

Guidance for an action.

Indication of an outcome, if necessary.

Lists

Structure of unnumbered lists:

- List level 1
  - List level 2

Structure of numbered lists:

1) List level 1
2) List level 1
   1. List level 2
   2. List level 2

2. Scope of Delivery/Order Codes

2.1 Scope of Delivery

- EOR-3D Hardware in housing format B01 (industrial housing) or B02 (DIN rail housing)
- Ribbon network cable for configuration using the software A.Eberle Toolbox™
- USB stick with latest operating software, firmware, manual and data sheet
- Current transformer adapter in separate housing for B01 housing format
- Operating instructions in A5 format

2.2 Order Codes

Please take the latest order codes from the latest data sheet for the EOR-3D.

3. Safety Instructions

- Follow the operating instructions
- Keep the operating instructions with the device
- Ensure that the device is operated only in perfect condition
- Never open the device
- Ensure that only qualified personnel operate the device
- Connect the device only as specified
- Ensure that the device is operated only in the original condition
- Connect the device only with recommended accessories
- Ensure that the device is not operated outside the design limits (see technical data sheet in special document)
- Ensure that the original accessories are not operated outside the design limits
- Do not use the device in environments where explosive gases, dust or fumes occur
- Clean the device only with commercially available cleaning agents

4. Technical Data

Please see the latest EOR-3D data sheet for this data. All the standards that the device conforms to are listed here.

5. Intended use

The product is intended for fixed installation and the continual measurement, monitoring and evaluation of voltages and currents.

Accordingly the voltages and currents are measured in secondary circuits.

Dependent on the transformer configuration (voltage and current) the function scope can reduce. For example as a result only earth fault detection may be possible. Please see Chapter 6for more details

6. Description

The EOR-3D is a pure earth fault and short circuit indicator. It is intended for fixed installation and continual monitoring for earth and short circuit faults in compensated, isolated or fixed earthed medium voltage networks.

The following locating procedures are implemented for earth fault location.

- qu2 procedure (transient earth fault detection)
- qui procedure (intermittent/re-igniting errors)
- cos(φ) procedure
- Harmonics procedure (250Hz & one free frequency)
- sin(φ) procedure
- Pulse locating

The following procedures are provided for short circuit detection:

- Non-directional short circuit
- Directional short circuit

7. Operation

7.1 EOR-3D hardware

There are two housing forms for the EOR-3D. The industrial version (characteristic B01) is designed for installation in a control panel cut-out of 96 mm x 48 mm. The EOR-3D in the DIN rail version (characteristic B02) is usually mounted on control panels or in switch cabinets with DIN rails. There are terminal allocation differences between the housing forms. Both versions are therefore described separately in respect of hardware.

7.1.1 Industrial housing (characteristic B01)

7.1.1.1 General view EOR-3D front side, industrial housing (B01)

1 USB interface
2 OLED colour display
3 Status LED
4 Operating keys
5 Network interface
6 Signalling LEDs
7 Reset key

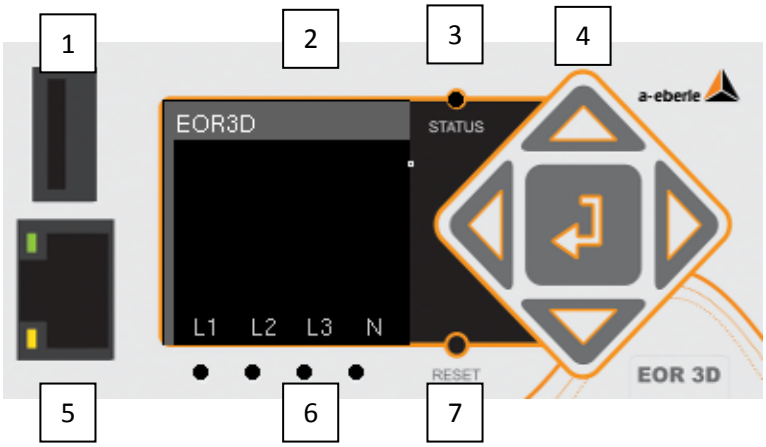


Figure 1: Front view EOR-3D - identification

7.1.1.2 General view EOR-3D rear side, industrial housing (B01)

1 X1 terminal strip binary outputs
2 X2 terminal strip power supply
3 X3 terminal strip binary inputs
4 X4 terminal strip connection voltage transformer
5 X5 terminal strip connection current transformer
6 CAN 1, CAN 2; CAN bus interface
7 RS232 or RS485 interface
8 USB2 second USB interface
9 Earth connection

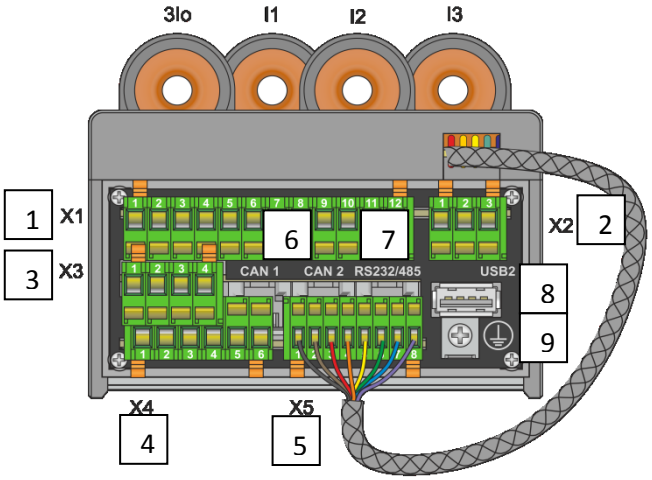


Figure 2: Rear view EOR-3D - identification

Information! The CAN bus is not currently supported by the firmware.

7.1.1.3 LED numbers

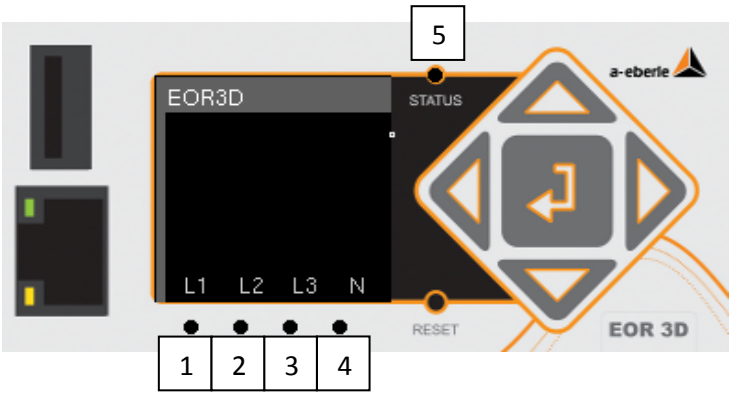


Table 1: LED numbers for settings from 1 to 5

Information! LED 5 (Status LED) is flashing if EOR-3D is active. Not to be changed.

7.1.1.4

7.1.1.5 Connection of the measurement transformers to the EOR-3D industrial housing (B01)

The EOR-3D can be connected to conventional (inductive) transformers and sensors. The appropriate analogue inputs are selected upon ordering.

In its maximum configuration, the EOR-3D has four voltage channels and 4 current channels. In this configuration three phase voltages and three phase currents plus the sequence voltage (Uen) and the zero current (3Io) can be directly connected.

For conventional transformers, the connection direction of the voltage or current transformer is indicated by the labelling of the winding sense (indicated in the figures with a point).

Information!

- For all current transformer connection drawings: P1 is positioned with its direction of installation towards the busbar
- The connection of conventional current transformers takes place via the supplied external adapter module
- The connection of conventional voltage transformers takes place directly at the terminal strip - X4.

7.1.1.6 Adapter module for current transformer connection

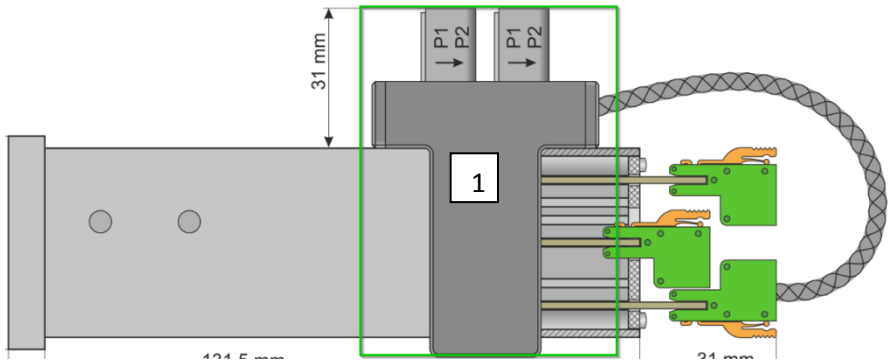


Figure 3: Side view EOR-3D (B01) with attached current transformer adapter module

1 The current transformer adapter module is used for recording or converting the secondary measurement transformer currents.

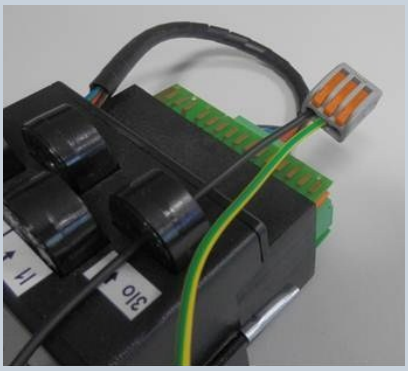
The secondary transformer lines must therefore be "threaded" through the current transformer of the adapter PCB according to the following connection diagrams.

To enable the connecting of conventional current transformers and current sensors, there are various adapter module versions.

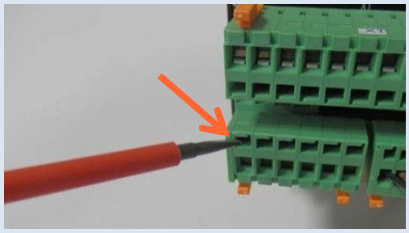
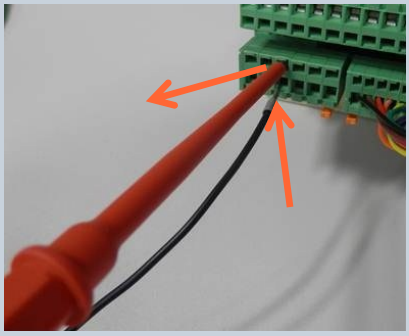
Information! Suitable adapter modules must be specified upon ordering. Under **current input configuration**, please select from the characteristics C21 to C27. The characteristics are listed in the technical datasheet.

The following example shows the connection of the summation current transformer to the EOR-3D (B01 variant). Proceed in the same way with the connection of the conductor ct.

EOR-3D (B01 variant)	Information
	Pull the secondary connecting cable (s1 or k) through the attachment transformer in the direction of the arrow.

	After pulling through the connecting cable, the transformer current circuit must be reconnected to the connection (s2 or I). This is best implemented on a separate terminal strip

This example shows the connection of the wiring on the rear side phoenix terminals, together with a voltage input.

EOR-3D (B01 variant)	Information
	Force a suitable tool (screwdriver or similar) into the top opening of the phoenix terminal to open the spring terminal.
	Insert a wire into the opened terminal. While doing so, the screwdriver must maintain the terminal open. Once the wire is fully inserted in the terminal, remove the screwdriver again to clamp the wire securely.
	Fully clamped wire

Information! To release a wire proceed in reverse order

- Slacken the locking of the sprung terminal
- Pull out the wire or lead

7.1.1.7 Connection zero sequence voltage U_{en} and total current $3I_o$

This connection of zero sequence voltage (referred to as Uen or also Uo) takes place via the so-called open delta winding.

A ring-type current transformer is used to measure 3Io.

Information! In compensated networks, ring-type current transformers mostly have transmission ratios of 100 : 1 A or 60 : 1 A.

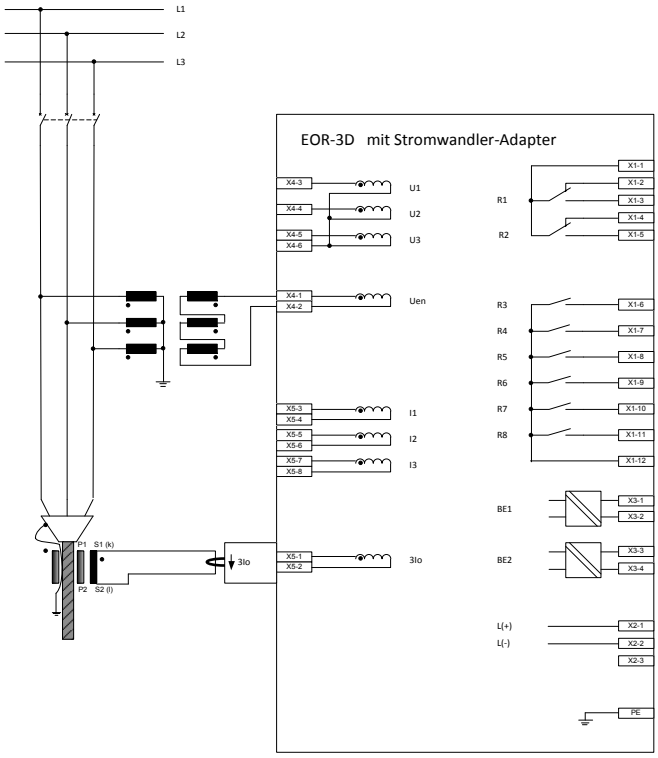


Figure 4: Connection of zero sequence voltage (Uen) and total current (3Io) to EOR-3D (B01)

Measurement input at EOR-3D used				Locating procedure applicable?						
$3I_0$	I_1 I_2 I_3	U_0	U_1 U_2 U_3	Transient: qu2	sin(φ)	cos(φ)	Highest harmonic	Pulse locating	Double earth fault	Short circuit
☑	☒	☑	☒	☑	☑	(☑)	☑	☑	☒	☒

Information! The cos(φ) procedure (wattmetric) has demanding requirements in respect of the angular error for both current **and** voltage measurement. Class 1 rating transformers would fulfil these requirements.

7.1.1.8 Connection of conductor earth voltages U_{L1}, U_{L2}, U_{L3} and the phase currents I_{L1}, I_{L2}, I_{L3}

In the following example, the phase voltage and the phase current are connected to the EOR-3D (B01). This connection variant also limits the possible locating procedures (see table)

Information! The **Calculation** of Uo and 3Io can be selected via the **Configuration** in EOR-3D. In this way particular procedures are also possible for earth fault locating.

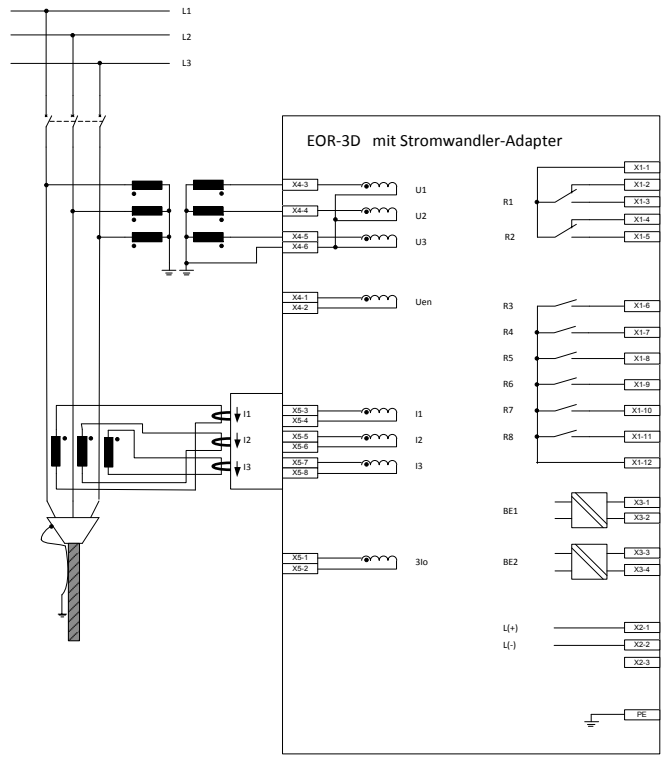


Figure 5: Connection of the phase voltages and phase currents to the EOR-3D (B01).

Measurement input at EOR-3D used				Locating procedure applicable?						
$3I_0$	I_1 I_2 I_3	U_0	U_1 U_2 U_3	Transient: qu2	sin(φ)	cos(φ)	Highest harmonic	Pulse locating	Double earth fault	Short circuit
☒	☑	☒	☑	☑	☑	☒	☒	☑	☑	☑

Information! The cos(φ) procedure (wattmetric) has demanding requirements in respect of the angular error for both current **and** voltage measurement. Dependent on the angular error harmonics can circulate between the three single phase transformers. As a result in extreme cases the incorrect direction can result at the EOR-3D. Therefore this procedure must **not** be used.

7.1.1.9 Connection to the busbar side neutral point of the current transformer

In this respect the voltage measurement is no different from that in point 0. Here the current measurement is executed so that a connection with that of the two other current transformers is combined. The sum of the three phase currents (i.e. 3Io) can consequently be measured at this "Node".

Information! Observe the direction of winding of the ct. If the transformers are installed the other way around, the direction of flow of the current is also reversed. Consequently the "threading direction" through the current transformer at the EOR-3D must also be reversed.

In **Configuration**, Uo is set to Calculate. 3Io is measured.

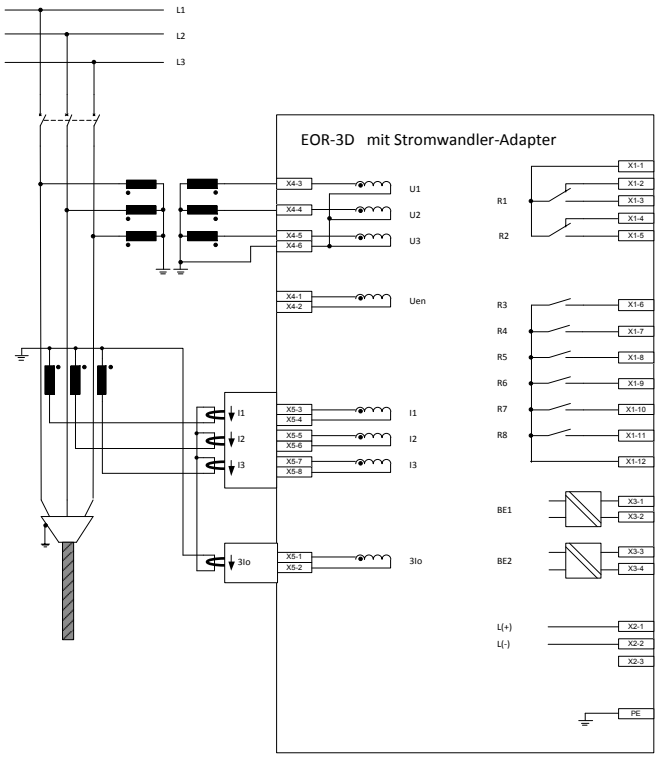


Figure 6: Connection of the phase voltages and phase currents with the neutral point in the direction of the busbar

Measurement input at EOR-3D used				Locating procedure applicable?						
				Transient: qu2	sin(φ)	cos(φ)	Highest harmon-ic	Pulse locating	Double earth fault	Short circuit
$3I_0$	I_1 I_2 I_3	U_0	U_1 U_2 U_3							
☑	☑	☒	☑	☑	☑	☒	☒	☑	☑	☑

Information! The cos(φ) procedure (wattmetric) has demanding requirements in respect of the angular error for both current **and** voltage measurement. Dependent on the angular error harmonics can circulate between the three single phase transformers. As a result in extreme cases the incorrect direction can result at the EOR-3D. Therefore this procedure must **not** be used.

7.1.1.10 Connection to the conductor side neutral point of the current transformer

In this respect the voltage measurement is no different from that in point 0. Here the current measurement is executed so that a connection with that of the two other current transformers is combined. The sum of the three phase currents (i.e. 3Io) can consequently be measured at this "Node".

Information! Observe the direction of winding of the ct. If the transformers are installed the other way around, the direction of flow of the current is also reversed. Consequently the "threading direction" through the current transformer at the EOR-3D must also be reversed.

In **Configuration**, Uo is set to Calculate. 3Io is measured.

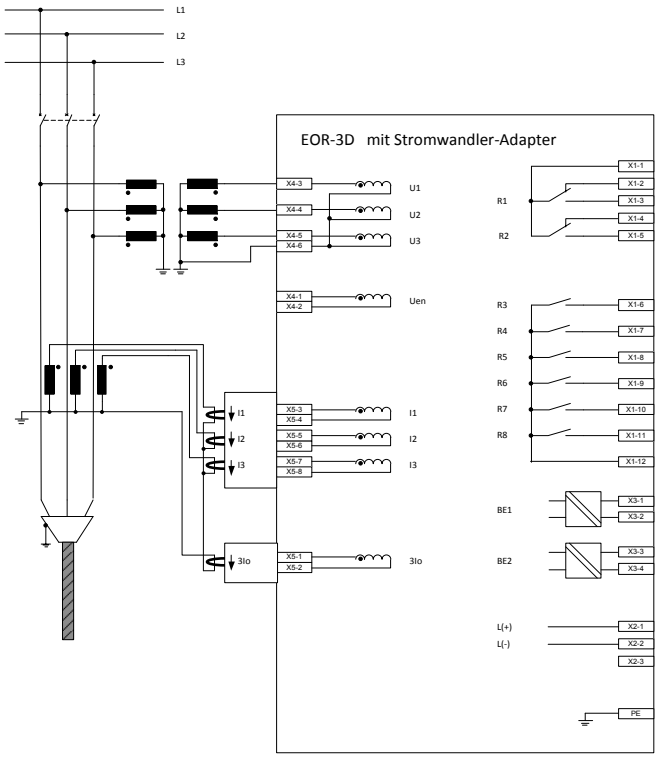


Figure 7: Connection of the phase voltages and phase currents with the neutral point in the direction of the line

Measurement input at EOR-3D used				Locating procedure applicable?						
$3I_0$	I_1 I_2 I_3	U_0	U_1 U_2 U_3	Transient: qu2	sin(φ)	cos(φ)	Highest harmo-nic	Pulse locating	Double earth fault	Short circuit
☑	☑	☒	☑	☑	☑	☒	☒	☑	☑	☑

Information! The cos(φ) procedure (wattmetric) has demanding requirements in respect of the angular error for both current **and** voltage measurement. Dependent on the angular error harmonics can circulate between the three single phase transformers. As a result in extreme cases the incorrect direction can result at the EOR-3D. Therefore these procedures must **not** be used.

7.1.1.11 Separate connection of phase voltage, phase current, zero sequence voltage and zero current

Alongside measurements for phase voltage and phase current, measurements also exist for the zero sequence voltage (Uen) and zero current (3Io).

Information! Observe the direction of winding of the ct. If the transformers are installed the other way around, the direction of flow of the current is also reversed. Consequently the "threading direction" through the current transformer at the EOR-3D must also be reversed.

In **Configuration**, Uo and 3Io are set to Calculate.

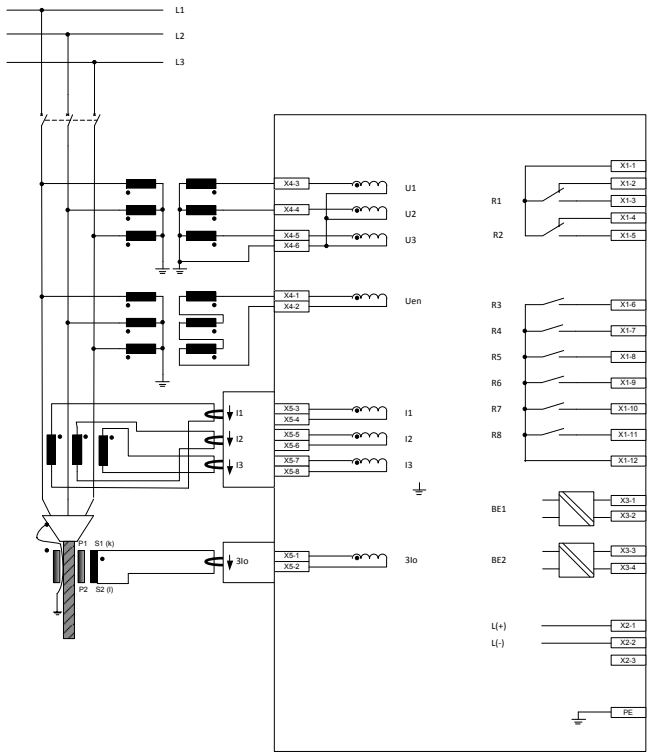


Figure 8: Connection of the phase voltages and phase currents with the neutral point in the direction of the line

Measurement input at EOR-3D used				Locating procedure applicable?						
$3I_0$	I_1 I_2 I_3	U_0	U_1 U_2 U_3	Transient: qu2	sin(φ)	cos(φ)	Highest harmo-nic	Pulse locating	Double earth fault	Short circuit
☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑

Information! In this configuration all algorithms can be selected. The condition for the cos(φ) procedure is as before good angular accuracy in respect of Uo and 3Io.

7.1.2 DIN rail housing (characteristic B02)

General view EOR-3D front side, DIN rail housing (B02)

1 USB interface
2 OLED colour display
3 Status LED
4 Operating keys
5 Network interface on the housing side
6 Signalling LEDs
7 Reset key

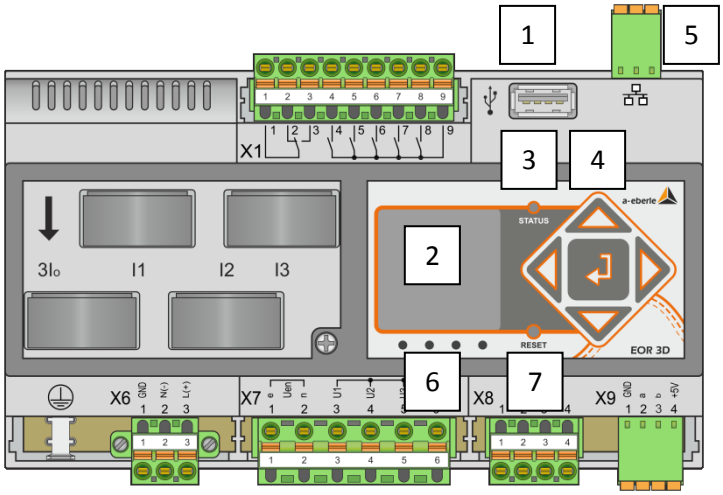
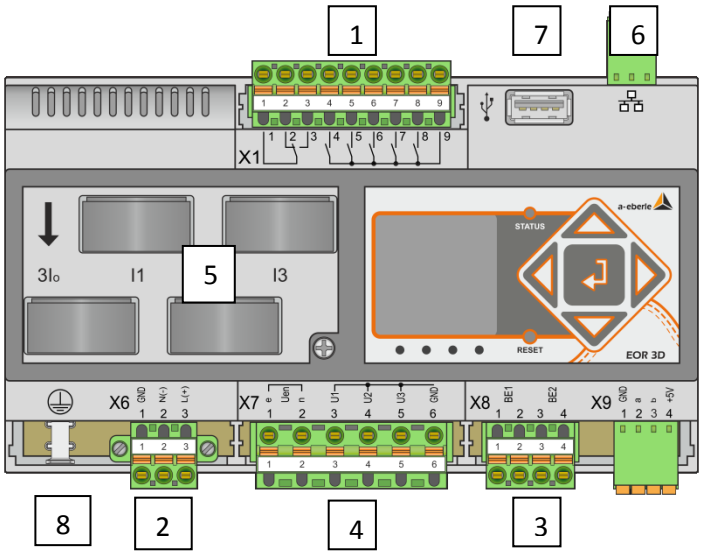


Figure 9: Front view EOR-3D - identification

7.1.2.1 General view EOR-3D terminals on the DIN rail housing (B02)

1 X1 terminal strip binary outputs
2 X6 terminal strip power supply
3 X8 terminal strip binary inputs
4 X7 terminal strip connection voltage transformer
5 Ct connection
6 CAN 1, CAN bus interface
7 RS232 or RS485 interface (optional)
8 Earth connection



Information! The CAN bus is not currently supported by the firmware!

7.1.2.2 LED numbers

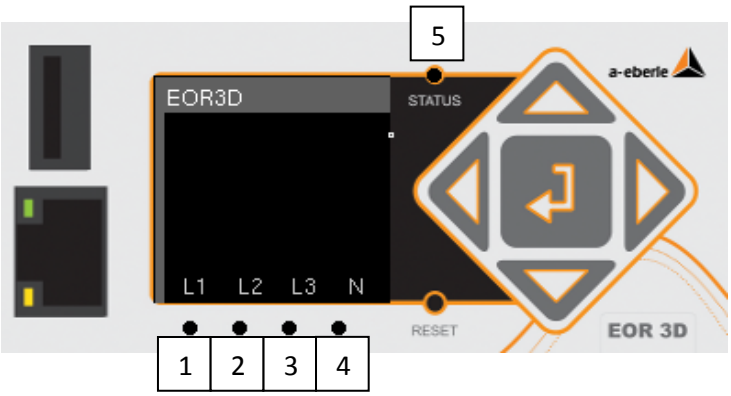


Table 2: LED numbers for settings from 1 to 5

Information! LED 5 (Status LED) is flashing if EOR-3D is active. Not to be changed.

7.1.2.3 Connection of the measurement transformers to the EOR-3D DIN rail housing (B01)

The EOR-3D can be connected to conventional (inductive) transformers and sensors. The appropriate analogue inputs are selected upon ordering.

In its maximum configuration, the EOR-3D has four voltage channels and 4 current channels. In this configuration three phase voltages and three phase currents plus the sequence voltage (Uen) and the zero current (3Io) can be directly connected.

For conventional transformers, the connection direction of the voltage or current transformer is indicated by the labelling of the winding sense (indicated in the figures with a point).

Information!

- For all current transformer connection drawings: P1 is positioned with its direction of installation towards the busbar
- The connection of conventional current transformers takes place via so-called winding type transformers on the top side of the device
- The connection of conventional voltage transformers takes place directly at the terminal strip - X7

7.1.2.4 Module for current transformer connection integrated in the housing

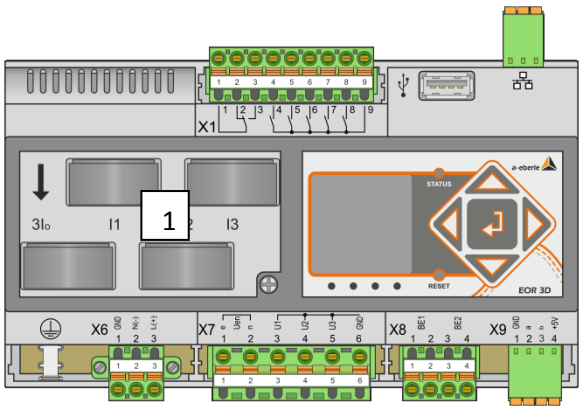


Figure 10: Plan view EOR-3D (B02) with winding type transformers for connecting of conventional current transformers

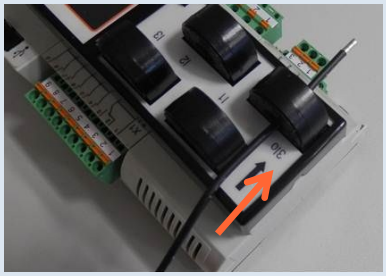
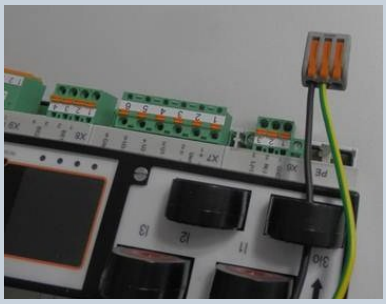
1 The current transformer adapter module is used for recording or converting the secondary measurement transformer currents.

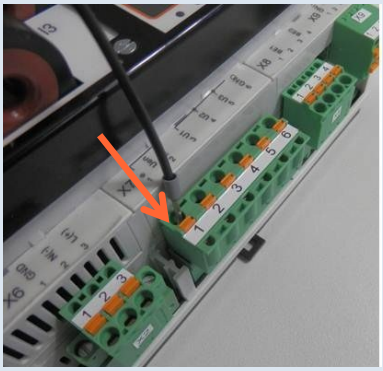
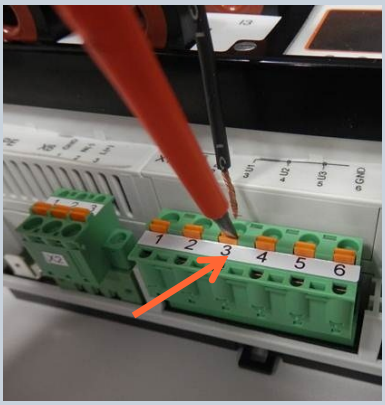
The secondary transformer lines must therefore be "threaded" through the current transformer of the adapter PCB according to the following connection diagrams.

To enable the connecting of conventional current transformers and current sensors, there are various adapter module versions.

Information! Suitable adapter modules must be specified upon ordering. Under **current input configuration**, please select from the characteristics C21 to C27. The characteristics are listed in the technical datasheet.

The following example shows the connection of the summation current transformer to the EOR-3D (B02 variant). Proceed in the same way with the connection of the conductor ct.

EOR-3D (B02 variant) current transformer connection	Information
	Pull the secondary connecting cable (s1 or k) through the attachment transformer in the direction of the arrow.
	After pulling through the connecting cable, the transformer current circuit must be reconnected to the connection (s2 or l). This is best implemented on a separate terminal strip

EOR-3D (B02 variant) voltage transformer connection	Information
	When connecting stiff wires, these must be pushed firmly into the terminal opening of the sprung terminal so that is held appropriately.
	To connect a flexible wire, the sprung terminal must first be opened using a screwdriver or similar forced in to apply pressure to the orange lock mechanism

Information! To **release** a wire proceed in reverse order

- Slacken the locking of the sprung terminal
- Pull out the wire or lead

7.1.2.5 Connection zero sequence voltage U_{en} and total current $3I_o$

This connection of zero sequence voltage (referred to as Uen or also Uo) takes place via the so-called open delta winding.

A ring-type current transformer is used to measure 3Io.

Information! In compensated networks, ring-type current transformers mostly have transmission ratios of 100 : 1 A or 60 : 1 A.

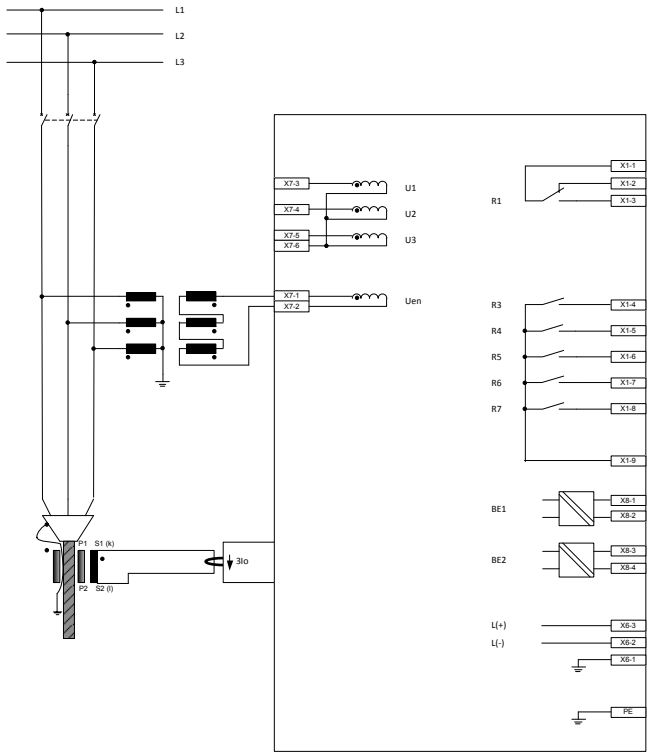


Figure 11: Connection of zero sequence voltage (Uen) and total current (3Io) to EOR-3D (B02)

Measurement input at EOR-3D used				Locating procedure applicable?						
				Transient: qu2	sin(φ)	cos(φ)	Highest harmonic	Pulse locating	Double earth fault	Short circuit
$3I_0$	I_1 I_2 I_3	U_0	U_1 U_2 U_3							
☑	☒	☑	☒	☑	☑	(☑)	☑	☑	☒	☒

Information! The cos(φ) procedure (wattmetric) has demanding requirements in respect of the angular error for both current **and** voltage measurement. Class 1 rating transformers would fulfil these requirements.

7.1.2.6 Connection of conductor earth voltages U_{L1}, U_{L2}, U_{L3} and the phase currents I_{L1}, I_{L2}, I_{L3}

In the following example, the phase voltage and the phase current are connected to the EOR-3D (B02). This connection variant also limits the possible locating procedures (see table)

Information! The **Calculation** of Uo and 3Io can be selected via the **Configuration** in EOR-3D. In this way particular procedures are also possible for earth fault locating.

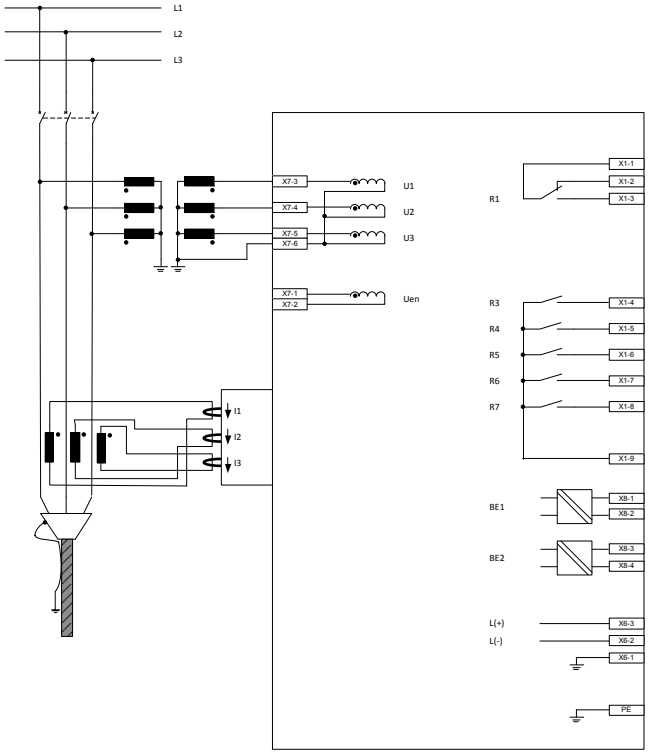


Figure 12: Connection of the phase voltages and phase currents to the EOR-3D (B02).

Measurement input at EOR-3D used				Locating procedure applicable?						
				Transient: qu2	sin(φ)	cos(φ)	Highest harmonic	Pulse locating	Double earth fault	Short circuit
$3I_0$	I_1 I_2 I_3	U_0	U_1 U_2 U_3							
☒	☑	☒	☑	☑	☑	☒	☒	☑	☑	☑

Information! The cos(φ) procedure (wattmetric) has demanding requirements in respect of the angular error for both current **and** voltage measurement. Dependent on the angular error harmonics can circulate between the three single phase transformers. As a result in extreme cases the incorrect direction can result at the EOR-3D. Therefore this procedure must **not** be used.

7.1.2.7 Connection to the busbar side neutral point of the current transformer

In this respect the voltage measurement is no different from that in point 7.1.2.6. Here the current measurement is executed so that a connection with that of the two other current transformers is combined. The sum of the three phase currents (i.e. 3Io) can consequently be measured at this "Node".

Information! Observe the direction of winding of the ct. If the transformers are installed the other way around, the direction of flow of the current is also reversed. Consequently the "threading direction" through the current transformer at the EOR-3D must also be reversed.

In **Configuration**, Uo is set to Calculate. 3Io is measured.

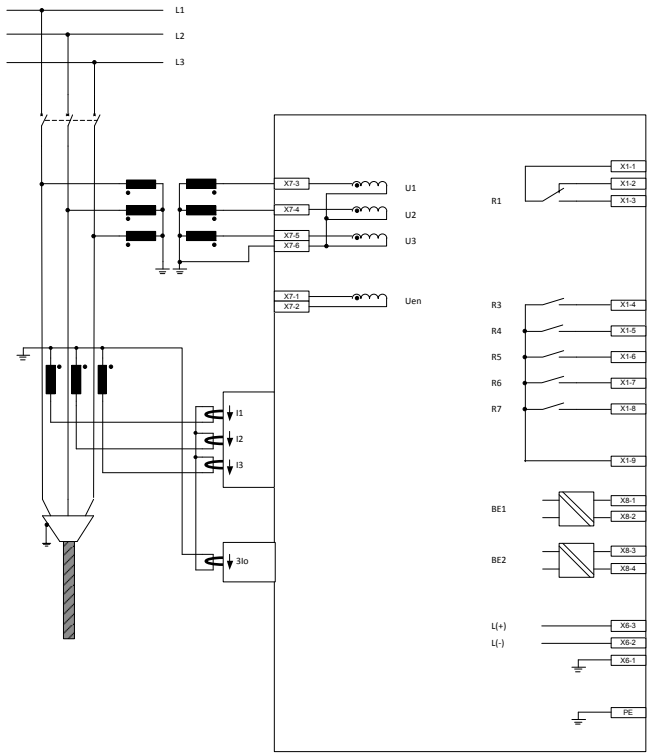


Figure 13: Connection of the phase voltages and phase currents with the neutral point in the direction of the busbar

Measurement input at EOR-3D used				Locating procedure applicable?						
$3I_0$	I_1 I_2 I_3	U_0	U_1 U_2 U_3	Transient: qu2	sin(φ)	cos(φ)	Highest harmo-nic	Pulse locating	Double earth fault	Short circuit
☑	☑	☒	☑	☑	☑	☒	☒	☑	☑	☑

Information! The cos(φ) procedure (wattmetric) has demanding requirements in respect of the angular error for both current **and** voltage measurement. Dependent on the angular error harmonics can circulate between the three single phase transformers. As a result in extreme cases the incorrect direction can result at the EOR-3D. Therefore this procedure must **not** be used.

7.1.2.8 Connection to the conductor side neutral point of the current transformer

In this respect the voltage measurement is no different from that in point 7.1.2.6. Here the current measurement is executed so that a connection with that of the two other current transformers is combined. The sum of the three phase currents (i.e. 3Io) can consequently be measured at this "Node".

Information! Observe the direction of winding of the ct. If the transformers are installed the other way around, the direction of flow of the current is also reversed. Consequently the "threading direction" through the current transformer at the EOR-3D must also be reversed.

In **Configuration**, Uo is set to Calculate. 3Io is measured.

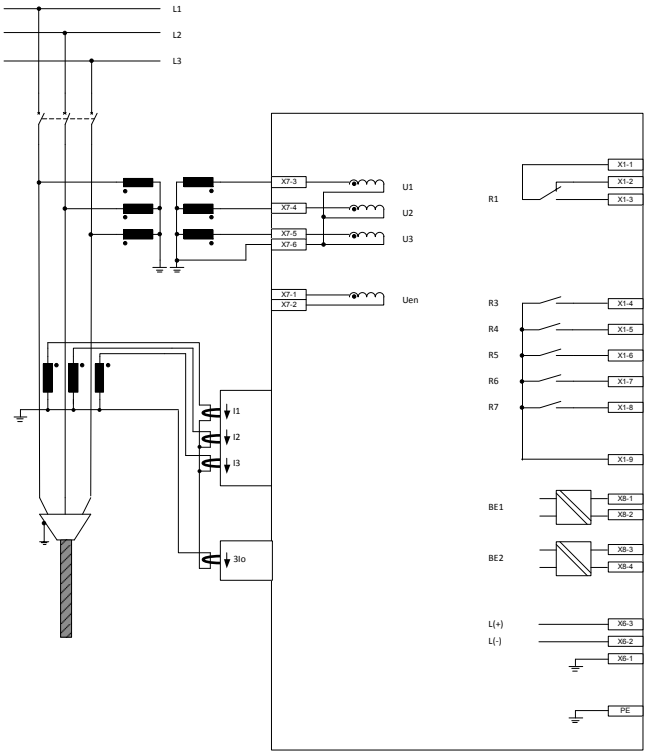


Figure 14: Connection of the phase voltages and phase currents with the neutral point in the direction of the line

Measurement input at EOR-3D used				Locating procedure applicable?						
				Transient: qu2	sin(φ)	cos(φ)	Highest harmo-nic	Pulse locating	Double earth fault	Short circuit
$3I_0$	I_1 I_2 I_3	U_0	U_1 U_2 U_3							
☑	☑	☒	☑	☑	☑	☒	☒	☑	☑	☑

Information! The cos(φ) procedure (wattmetric) has demanding requirements in respect of the angular error for both current **and** voltage measurement. Dependent on the angular error harmonics can circulate between the three single phase transformers. As a result in extreme cases the incorrect direction can result at the EOR-3D. Therefore this procedure must **not** be used.

7.1.2.9 Separate connection of phase voltage, phase current, zero sequence voltage and zero current

Alongside measurements for phase voltage and phase current, measurements also exist for the zero sequence voltage (Uen) and zero current (3Io).

Information! Observe the direction of winding of the ct. If the transformers are installed the other way around, the direction of flow of the current is also reversed. Consequently the "threading direction" through the current transformer at the EOR-3D must also be reversed.

In **Configuration**, Uo and 3Io are set to Calculate.

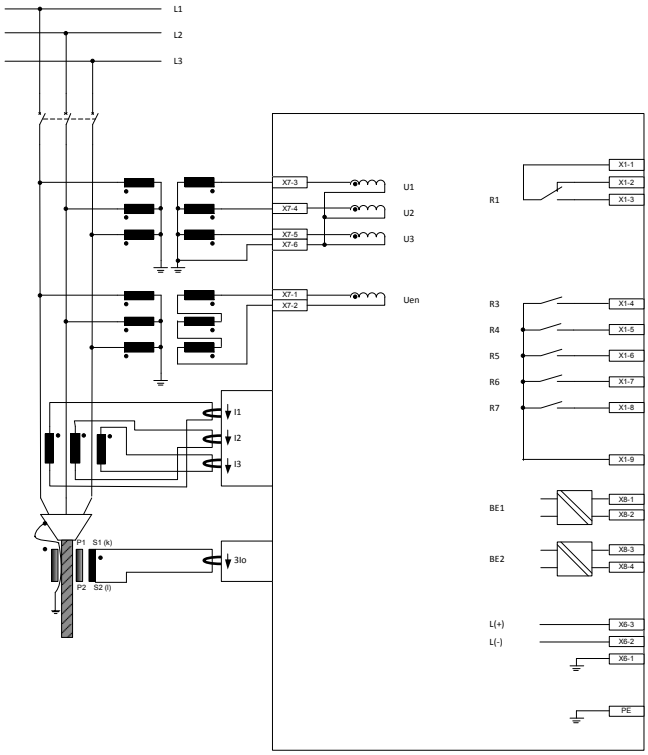


Figure 15: Connection of the phase voltages and phase currents with the neutral point in the direction of the line

Measurement input at EOR-3D used				Locating procedure applicable?						
				Transient: qu2	sin(φ)	cos(φ)	Highest harmonic	Pulse locating	Double earth fault	Short circuit
$3I_0$	I_1 I_2 I_3	U_0	U_1 U_2 U_3							
☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑

Information! In this configuration all algorithms can be selected. The condition for the cos(φ) procedure is as before good angular accuracy in respect of Uo and 3Io.

7.1.3 Connection to capacitive voltage systems

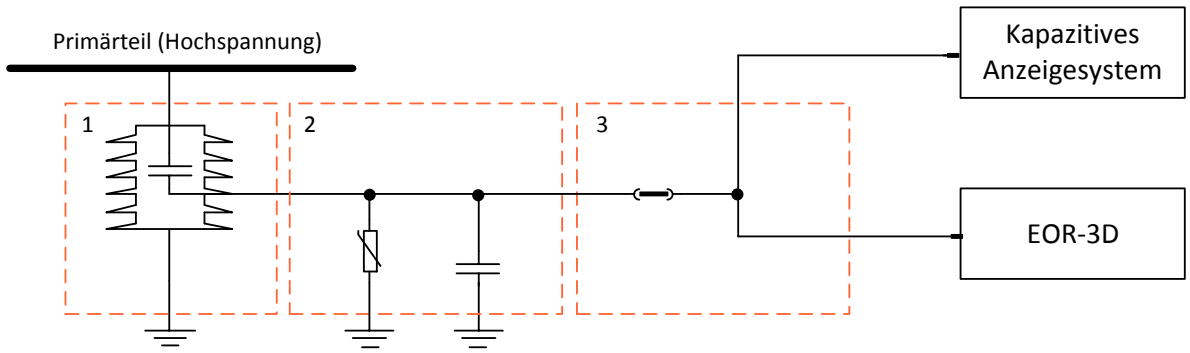
The EOR-3D likewise offers the possibility of accessing the measurement voltage of capacitive display systems.

Information! For connection to a capacitive voltage measurement, the EOR-3D must have the correct characteristic for the voltage input.

HR systems: Characteristic U24 > 40 MOhm

LR and LRM systems: Characteristic U24 > 40 MOhm,

If the EOR-3D is connected on its own to a LR or LRM system, then the characteristic U04 (2 MOhm) can also be selected (input for conventional voltage transformers)



1: Stützer mit Koppelkondensator
2: Schnittstellenkabel (Leitungskapazität) mit Überspannungsableiter
3: Adapterkabel zum parallelen Anschluss an ein kapazitives Anzeigesystem

Figure 16: Block circuit diagram for connection of the EOR-3D to capacitive voltage transformers

7.1.3.1 Selection table for capacitive voltage taps

Various capacitive systems are available for voltage measurement. These require different input impedances for the voltage input at the EOR-3D. Below you can see the voltage table with both characteristics.

	Voltage measurement using		
EOR-3D characteristic voltage input	**Inductive V transformer**	**LR/LRM system (capacitive) 2 MOhm**	**HR system (capacitive) 40 MOhm**
U04	X	X **(EOR-3D only)**	
U24		X **EOR-3D parallel** to capacitive voltmeters	X

7.1.3.2 Adapter for connecting to capacitive display systems

Various adapter cables are available for connecting to different capacitive display systems.

- Y adapter cable with 4.8mm flat pin plug

This adapter cable makes it possible to connect to capacitive voltmeter systems that have a 4.8mm flat pin socket (e.g. CAPDIS S1+/S2/IKI20a, WEGA1.2C or WEGA1.2(with flat pin socket), IVIS)

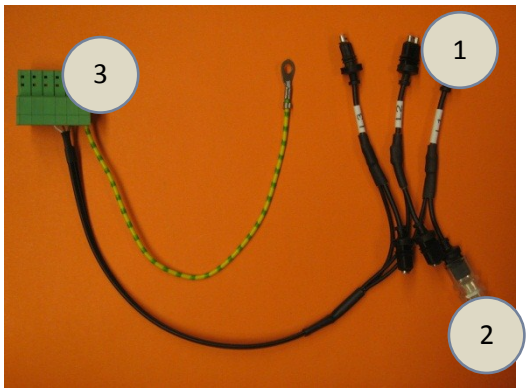


Figure 17: Y-CAPDIS adapter cable

1 Connector to the capacitive display system

2 Connector to the capacitive insulated support

3 Connector to the EOR-3D

Figure 18: Connection to a WEGA1.2C

For example Figure 2 shows the connection to a WEGA1.2C system

- WEGA connecting cable

This adapter cable provides the option of connecting to capacitive voltmeter systems that have a 4-pin AMP plug. (WEGA1.2C, WEGA1.2 (with AMP connector)

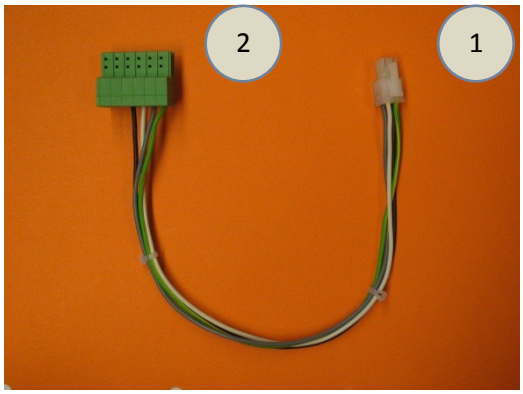


Figure 19: WEGA connecting cable

1 Connector to the capacitive display system

2 Connector to the EOR-3D

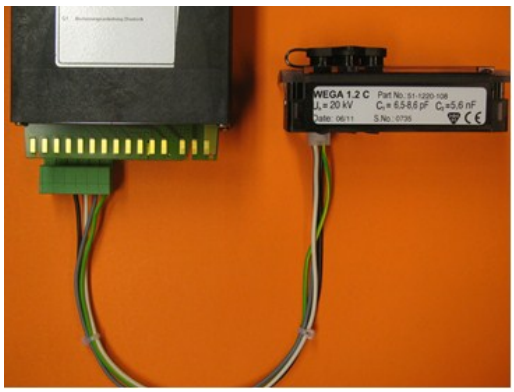


Figure 20: Connection to the WEGA1.2C

For example Figure 4 shows the connection to a WEGA1.2C system with the 4-pin AMP connector

7.2 Menu control using control keys on the device

The in-situ user interface comprises an LCD display, five function keys and 5 LED indicators as already described in 7.1.1. The figure shows the start screen.

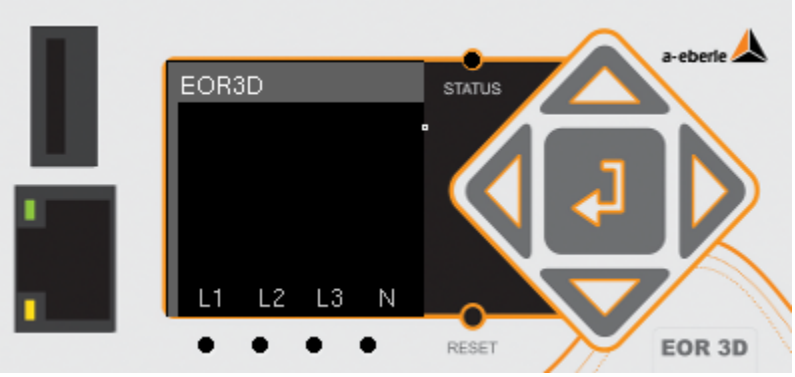


Figure 21: View of the display and user interface with the start screen

7.2.1 Brief description of the control keys

key	Description	Function
	Up / Higher	1. Move up in the menu 2. Increase parameter value
	Down / Lower	1. Move down in the menu 2. Reduce parameter value
	Left	1. Switch to previous / higher level in the menu "Back" 2. For parameters with more than one figure, move to the left (cursor)
	Right	1. Change to the next / lower level in the menu "Forward" 2. For parameters with more than one figure, move to the right (cursor)
	Return / Enter	1. Jump to the menu from the start screen 2. Selection of a particular menu item 3. Confirmation of a changed parameter
	RESET	1. Quick press → Resetting of the signals 2. Long press (> 4 seconds) → Reset of the EOR-3D

7.2.2 Menu levels

The display of all operationally relevant measurement values and configuration or servicing takes place via three subordinate menu trees. From the Setup menu tree it is possible to select all parameters and if necessary alter them. The Display item provides quick access to the current operating measurement values. The Administration tree provides various service functions.

Pressing the  key takes you from the start screen to the menu.

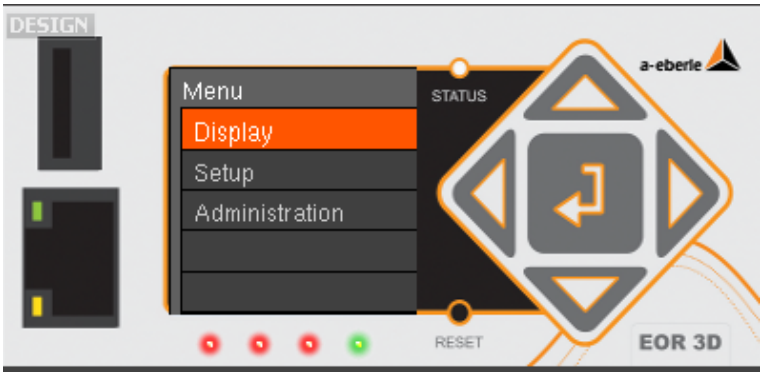


Figure 22: First menu level

The following submenus are found under the three displayed menu items:

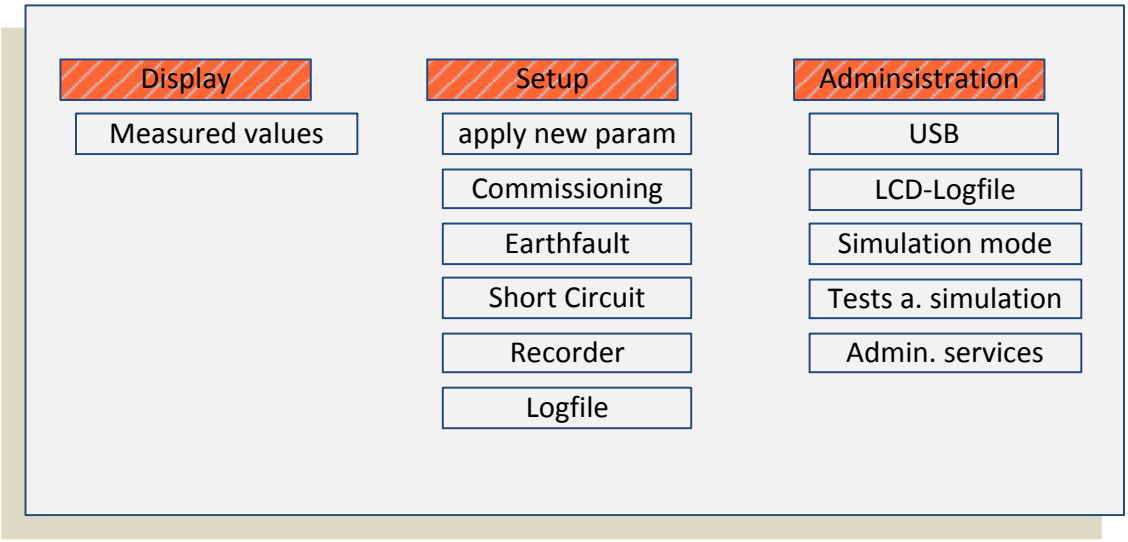
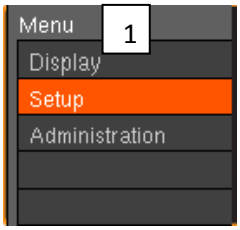


Figure 23: Menu structure

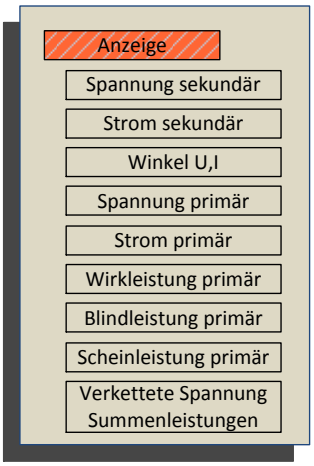
Information! Selection of the individual parameters takes place via the individual menu item. When scrolling through the menu tree, the top line of the LCD display indicates the current menu group (1).

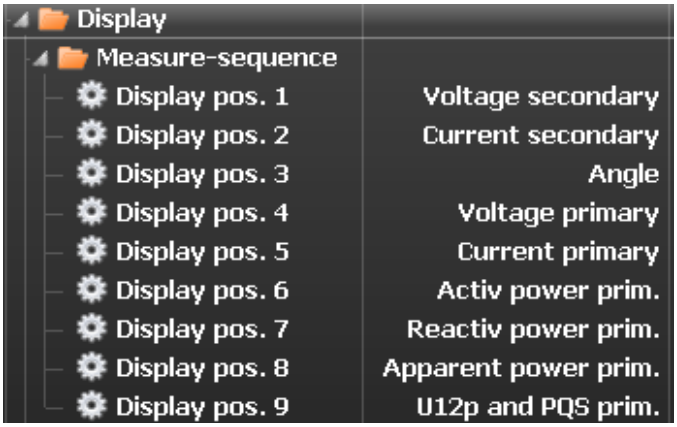
The orange highlighted menu item is selected by pressing the enter key again



7.2.3 Changing to the measurement value view

- From the start screen change to the menu as described in 7.2.2
- Select the "Display" menu item
- In the factory setting, nine pages are populated with the following measurement values





Excerpt from the software A.Eberle Toolbox™

- Example Measurement values page / position 1

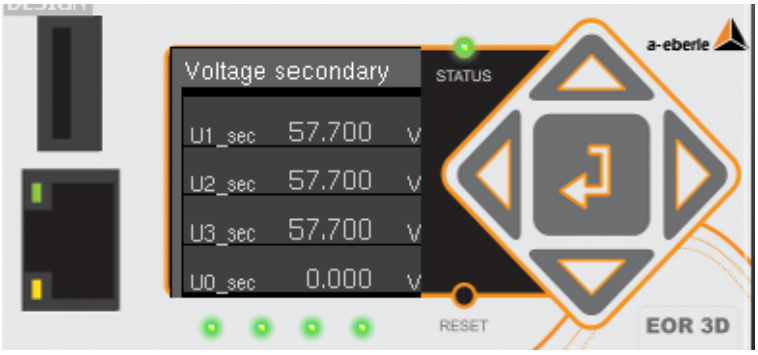


Figure 24: Display of the secondary voltages per measurement channel

7.2.3.1 Navigation in the measurement value view

Key	Description	Function
	Right	Change to the next page of the measurement value display (from pages 1 to 9)
	Left	Change to the previous page of the measurement value display (from pages 1 to 9)
	Return / Enter	Return to the first menu level

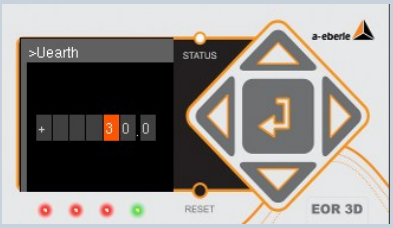
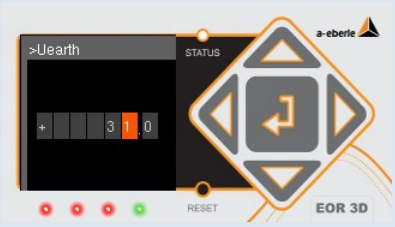
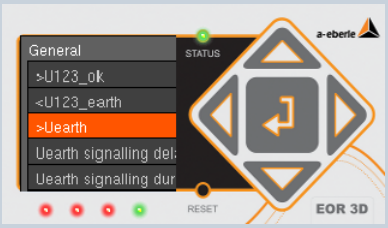
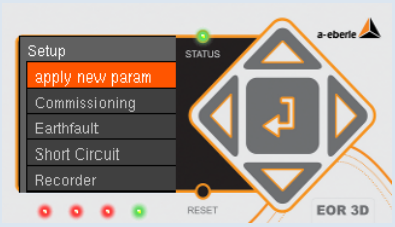
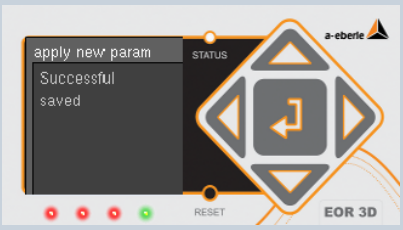
7.2.4 Changing of parameters directly on the device

All parameter can be altered directly via the user interface. There are two types of parameters:

- Pure numerical values, e.g. thresholds
- Fixed selectable values or functions

7.2.4.1 Changing numerical value parameters directly on the device

In the following example, the earth fault threshold (>Uearth) is changed from 30 to 31.

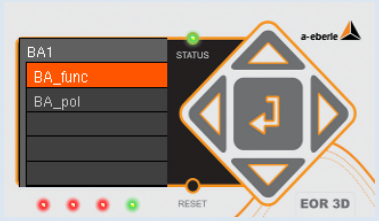
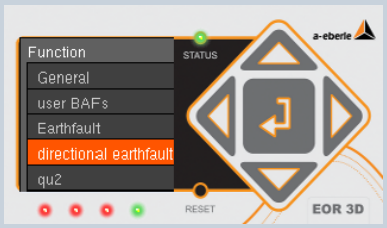
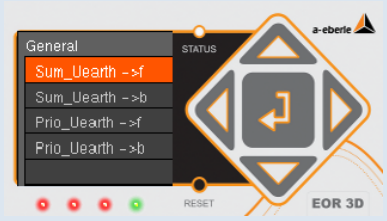
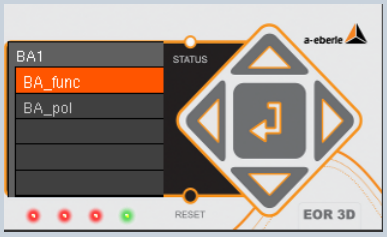
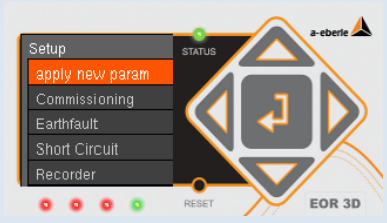
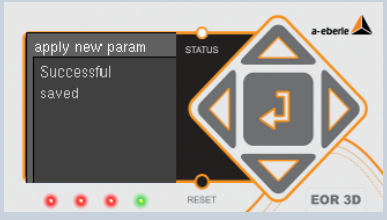
Operating step	Keys	Display view
1) Press the keys to select the desired parameter that is to be changed		
2) Pressing the input keys moves the cursor to the desired position		
3) The "Up" / "Down" keys are pressed to set the desired value		
4) Pressing the "Enter" key confirms the value		
5) Then the function "Accept param" must be selected in the menu tree		
6) This selection must be confirmed with the "Enter" key. This finally saves the changed parameter		

Information! Changed parameters must always additionally be confirmed with "Apply new param" (Accept parameter)

7.2.4.2 Changing function value parameters directly on the device

In the following example, the output function for Binary output 1 (Relay 1) is selected.

<Setup> <Commissioning> <HW Config> <BOs> <BA1> <BA_func>

Operating step	Keys	Display view
1) Press the keys to select the desired parameter that is to be changed **Ex.** Binary output 1 (BA1)		
2) The "Up" / "Down" keys are pressed to select the desired value **Ex**. The directional earth fault signal should be applied to Binary output 1 → "Directional earth f.		
3) Pressing "Enter" takes you to the submenu. If there are further selection options for this value, they are displayed here **Ex.** Sum_Uerd→L (Total signal earth fault line direction)		
4) Pressing the "Enter" key assigns the selected function to the binary output. You are returned to the previous menu		
5) Then the function "apply new param" must be selected in the menu tree		
6) This selection must be confirmed with the "Enter" key. This finally saves the changed parameter		

7.2.5 Displaying the log book on the display (LCD log book)

The EOR-3D also provides the function of outputting a reduced log book directly to the display. This log book is called the LCD log book, because for space reasons it cannot replace the log book in the device.

Information! Only locating signals are entered in the LCD log book (earth fault and short circuit). System messages (e.g. status) are stored in the internal logbook, which is read using the software.

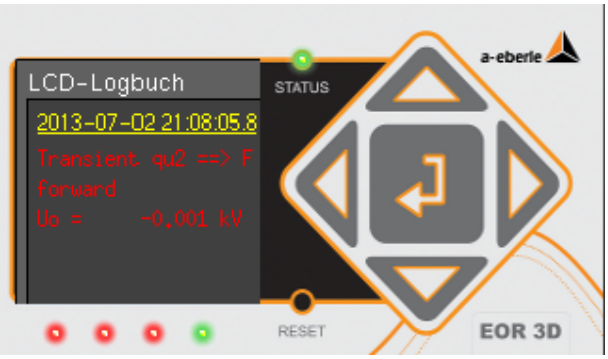
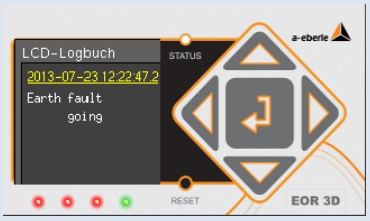
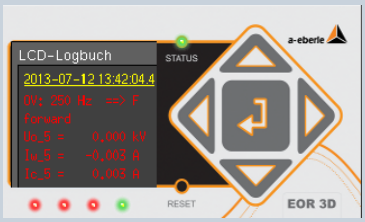
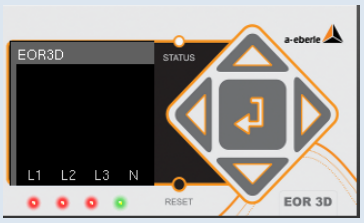


Figure 25: LCD log book in the EOR-3D

Operating step	Keys	Display view
1) From the start screen you access the LCD log book directly by pressing the "Up" key		
2) By pressing the "Up" / "Down" keys you can scroll through the log book		
3) Pressing the "Left" key returns you to the start screen		

Information!

- Faults in line direction **==> Forward** are entered in **red**
- Faults in busbar direction **<== Backward** are entered in **green**
- **Non-directional** indications (short circuit or pulse locating) are entered in **yellow**

7.2.6 Display indicators

Alongside measurement values first information about a fault is also output to the display when a fault occurs (earth fault or short circuit). In this respect the display view contains information with the value of the fault current (mean value) and, where possible through the locating procedure used, directional information as well. A selective indication of the conductor affected is signalled by a corresponding lightning symbol above the phase in question.

The duration of the indication is controlled by the parameter ***LED signal extension***.

Here a differentiation must be made between earth fault and short circuit. Likewise the following time parameters apply:

Information!
Earth fault: LED-Uerd – signal extension Chapter (9.3.1)
Short circuit: LED – signal extension Chapter (**Fehler! Verweisquelle konnte nicht gefunden werden.**)

For continuous indications, the screen is overwritten by the next fault. The display can be reset either by pressing the reset key or through a binary input function.

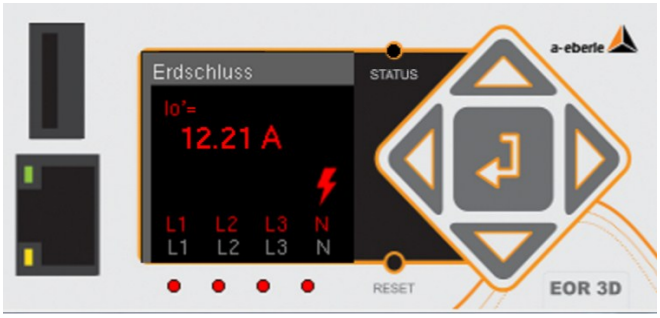


Figure 26: Earth fault display in the line direction

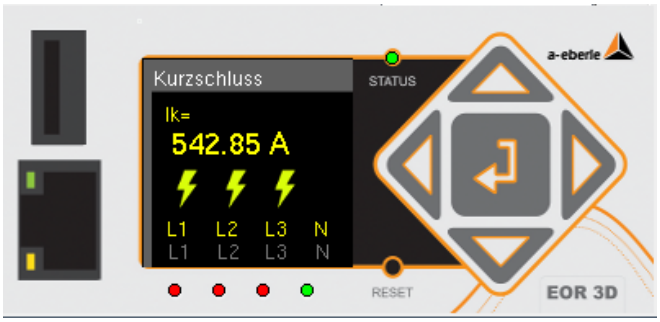


Figure 27: Non-directional short circuit display (3-pole)

Information!

- Faults in line direction **==> Forward** are entered in **red**
- Faults in busbar direction **<== Backward** are entered in **green**
- **Non-directional** indications (short circuit or pulse locating) are entered in **yellow**

8. Configuration software A.Eberle Toolbox™

The supplied A.Eberle Toolbox™ is used for configuration and commissioning of the EOR-3D. The A.Eberle Toolbox™ also supports other devices supplied by A.Eberle. Consequently complex functions can be implemented using the software

8.1 Software installation

Hardware requirements (minimum)

Intel or AMD dual core CPU

Graphics card with at least 256 MB RAM, screen resolution 1280 x 800 or higher recommended

1 GB RAM

Network connection 100 MBit/s

Supported operating systems

Microsoft® Windows® XP, SP3 (32-bit)

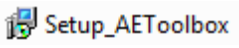
Microsoft® Windows® Vista (32-bit and 64-bit*)

Microsoft® Windows® 7 (32-bit and 64-bit*)

Microsoft® Windows® 8 (32-bit and 64-bit*)

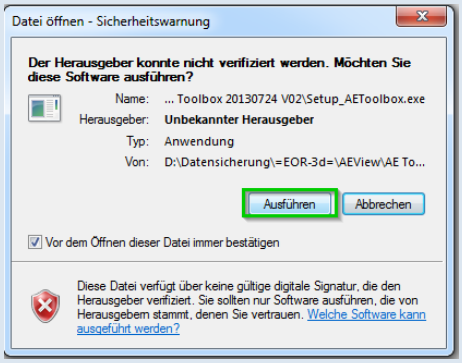
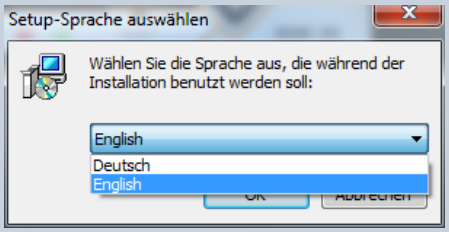
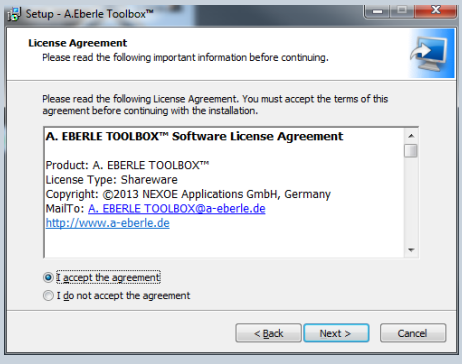
*On a 64 bit operating system, the application runs in 32-bit mode

The software must be installed on the control computer. As necessary, administrator rights are required to install the software on your PC / laptop. If you have any questions in this respect, consult your IT department.

Run 

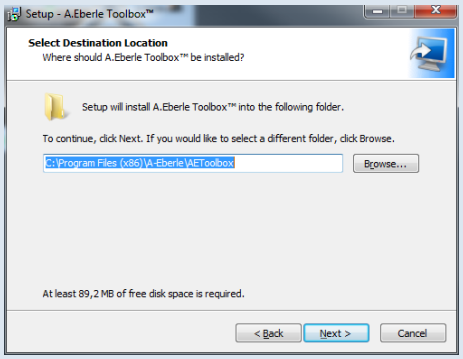
.

By way of example, installation is shown under Windows 7.

Installation step	Window in Windows
1. Confirm safety warning	
2. Selecting the setup language ● German ● English	
3. Start the setup by pressing "Next"	
4. Accept the licence conditions	

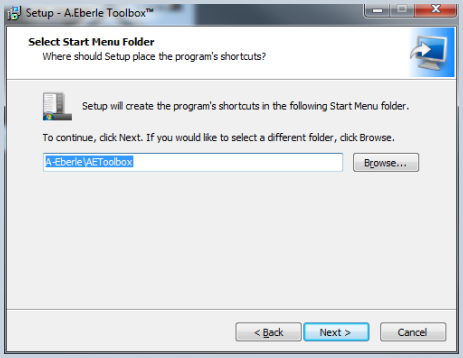
5. Select the installation path for the A.Eberle Toolbox™

If no selection is made, the software is installed in the default folder A-Eberle under Programs



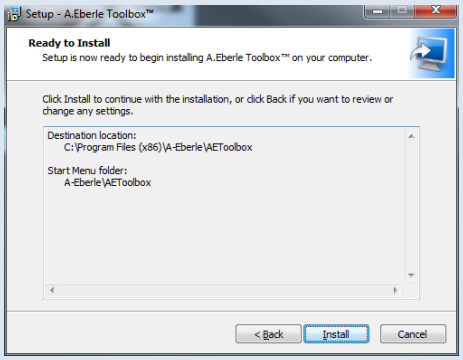
6. Select the Name for the Shortcut in the Windows Start Menu

Default:: A-Eberle\AEToolbox

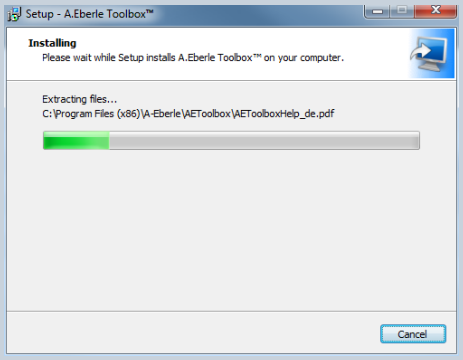


7. Confirm once more installation in the selected locations

➔ Continue by clicking "Install"



8. Installation progress is indicated



9. By checking "Display AE-Toolbox.exe" you start the software directly by clicking "Finish"	
10. Start screen of the A.Eberle Toolbox™	
11. Installation is successfully completed	You can now start configuration using the software

8.2 A.Eberle Toolbox™ general settings

In the default setting, the A.Eberle Toolbox™ is installed in the German **language**. The **layout** is kept black. Both can be changed under the File menu item.

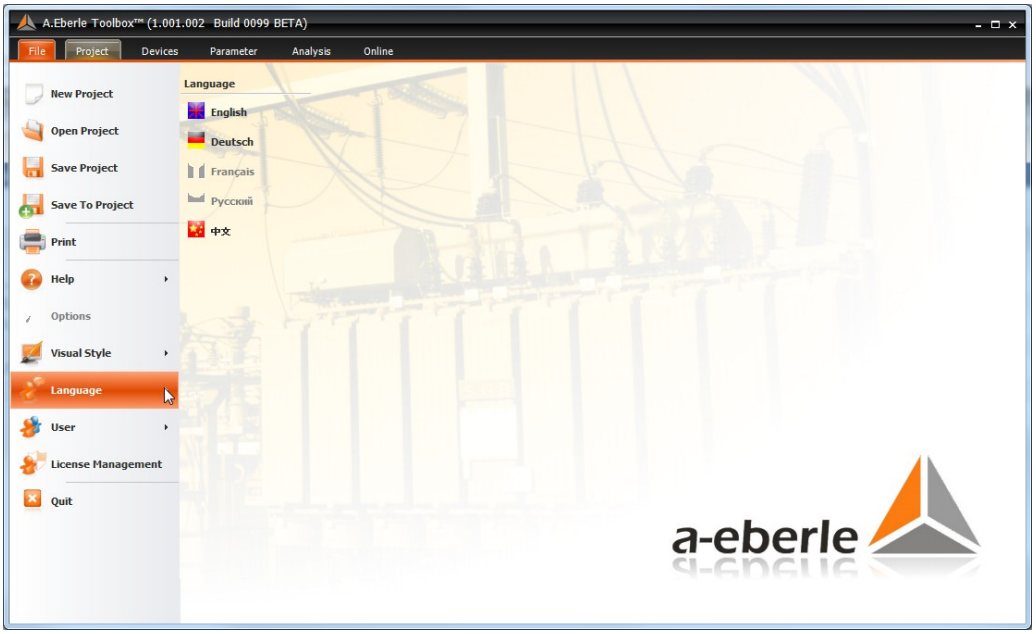


Figure 28: Changing the language and view of the general settings

The software has two user levels. During installation the "User" user level is used. User administration likewise comes under the Menu shown above. There is a difference between User and Advanced.

User rights	USER	ADVANCED
Configuration	☑	☑
Changing communication settings	☑	☑
Firmware update	☑	☑
Loading control system parameters	☑	☑
Displaying and converting fault records	☑	☑
Matching online page layout	☒	☑

8.3 Calling online help for A.Eberle Toolbox™

Information! A.Eberle Toolbox™ has an integral **Online help** system.

Calling the **online help by pressing F1**:

When you are over a particular area of the A.Eberle Toolbox™ GUI with the mouse cursor, press F1. You receive the help text for this area

Online help example for the Connecting wizard

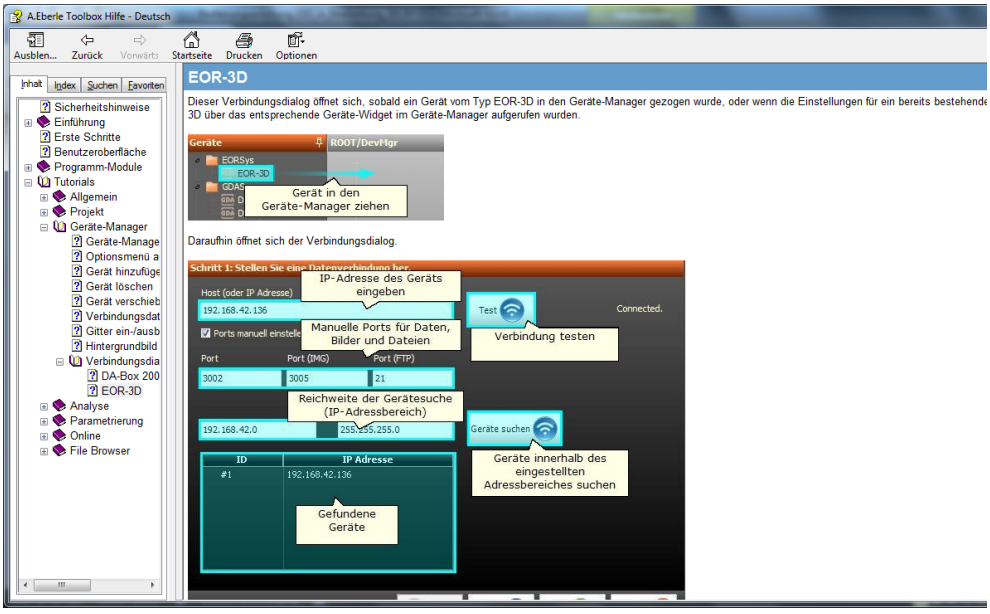
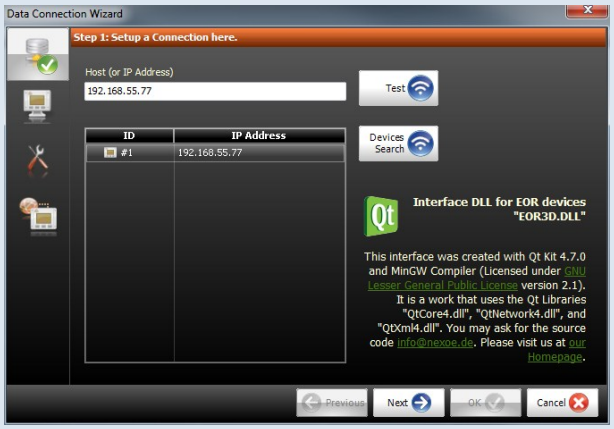
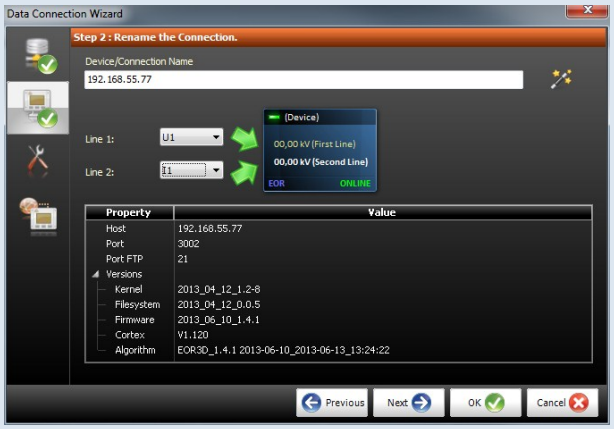
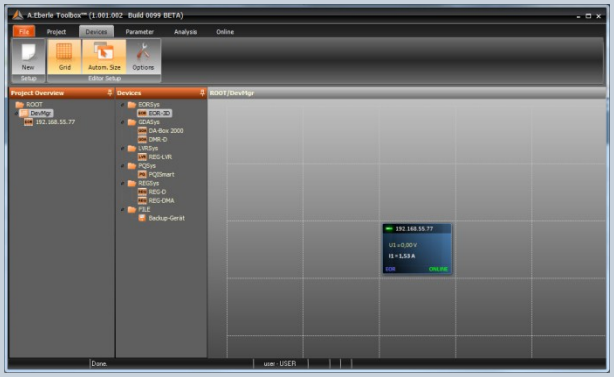


Figure 29: Online help of the A.Eberle Toolbox using F1

8.4 Creating the EOR-3D device in the A.Eberle Toolbox™

If you are using the A.Eberle Toolbox™ for the first time, an EOR-3D must be created as a device. This makes it possible for you to exploit the full scope of the operating software.

Operating steps	Screenshot	Comments
1. Create a network connection between your PC and the EOR-3D		If no network connection is created, then after the first steps the parameters are made available offline in the software
2. Creating a device To do this, select the item "Create device: EOR-3D"		Currently the software is for configuration of the EOR-3D. Dependent of the licence, other devices (REG-D, DA-Box 2000) can also be operated with it
3. The wizard for creating a device starts		If your PC and the EOR-3D are located in the same subnetwork area and IP address range, you can use the function:  .Otherwise enter the IP address set in the EOR-3D in the top field.
	The Connecting wizard **always** remains in the foreground even if you change to another program. The wizard must be stopped by clicking "Cancel".	

4. Follow the steps in the wizard.		The wizard settings can be adapted later. In this view measurement values can be selected that should always be displayed. Moreover the firmware version can be seen at a glance.
5. Click "OK" to exit the wizard at this point. You enter the project view		For general functions such as how to move, delete or create devices via the GUI, please see the online help of the operating software.

8.5 The three levels for a device: PARAM, ONLINE, DATA

After you have created a device, then within the operating software you go from the device GUI in to the three levels PARAM, ONLINE and DATA.

Information! This operating philosophy is essentially the same for all devices supplied by A.Eberle. The devices of other product families can easily be identified by their different colours.

Figure 30: Device view enlarged with display of the menus PARAM, ONLINE and DATA

Figure 31: Detail view of a device GUI

You access the sub items PARAM, ONLINE and DATA from this GUI

Menu	Explanation
	Jumps to the configuration menu item
	Jumps to the menu item for displaying online values. ● Measurement values as numerical values and in a dial display ● Statuses of the binary inputs and outputs ● Device log books, including log book export into Excel
	Jumps to the data transfer menu item. All the fault records in the device are shown in a list. The fault records also contain binary traces

8.5.1 Parameter view in the PARAM level

Select PARAM in the software GUI

Figure 32: Jump to parameter view.

Information! To simplify configuration the "**General**" item is inserted in the parameter tree. Here you must make a pre-selection to reduce the number of subsequent parameters.

This simplifies an initial configuration.

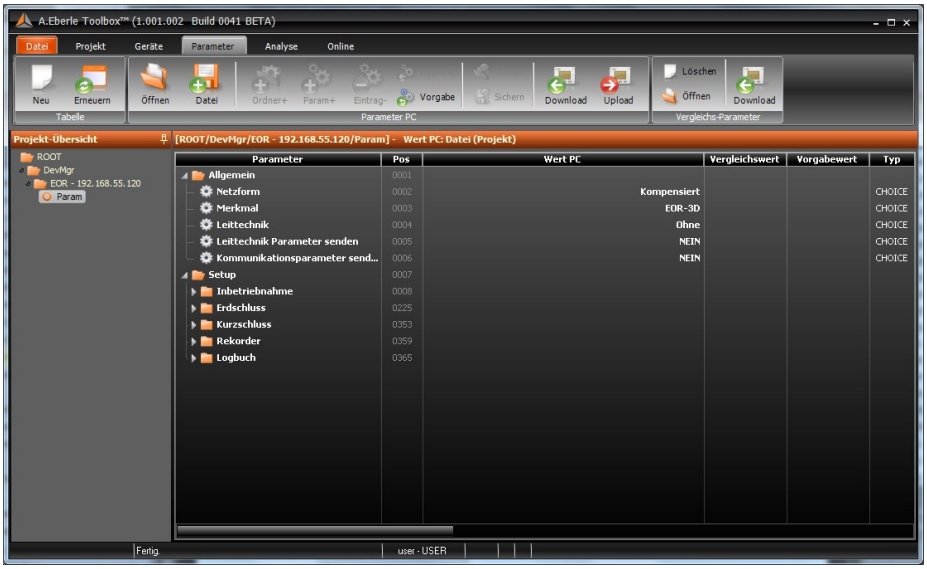


Figure 33: Parameter view under the menu item PARM

8.5.1.1 Operation using the PARAM view

The parameter view is designed in the form of a Windows-type Explorer. Individual folders contain the parameters that are assigned to the folder.

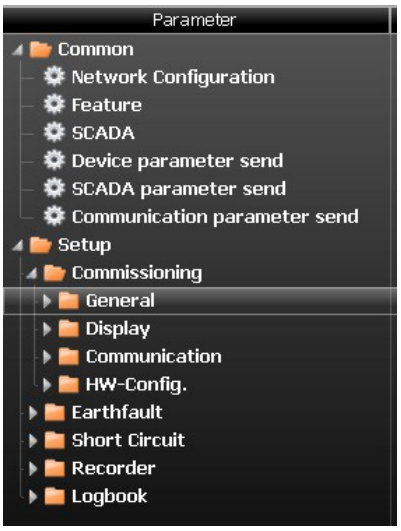
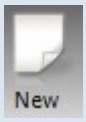
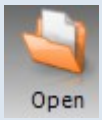
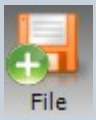
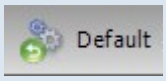
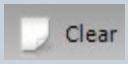
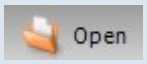
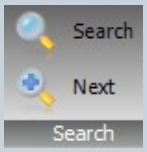


Figure 34: Tree structure of the Parameter menu (example)

Information! To begin with the Parameter page displays the default parameters. In this way it is also possible to carry out an offline configuration. As soon as the parameters have been loaded from the EOR-3D for the first time, the device view of the parameter file is automatically adapted! You see exactly what is present in the device.

Figure 35: Menu bar in the Parameter view

The functions of the menu bar for the parameter view are as follows:

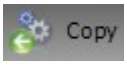
Menu	Menu group	Description	Information
	Table	Adds a new parameter file to the device	Several parameter sets can be saved under each device (each device connection)
	Table	Updates the table in Parameter view	
	Parameter PC	Opens a parameter file that is already saved on the PC	
	Parameter PC	Saves the parameter file on the local PC	
	Parameter PC	Transfers the standard parameters for this value from the column "Default value" to the current parameter set	Multiple parameters can be simultaneously highlighted. The default values are then accepted for the highlighted parameters. Applies also for the entire folder
	Parameter PC	Loads the parameters from the device into the PC	
	Parameter PC	Loads the parameters from the PC into the device	The parameter comparison between PC and device is output again as an intermediate step.
	Comparison parameters	Delete the current comparison values from the column "Comparison value"	
	Comparison parameters	Opens an already saved parameter set and carries out the comparison with the already loaded parameter file	
	Comparison parameters	Loads the parameters from the device for comparison only	The currently opened parameters are retained.
	Parameter search	Used to find a particular parameter in the folder tree	

8.5.1.2 Parameter comparison

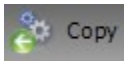
Information! The comparison function displays the parameter differences in the column "Comparison value". These comparison values can be accepted.

As described in 8.5.1.1, various parameter comparison forms are possible

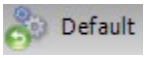
- File with file
- File with device
- Device with device

After a completed Comparison, the function 

appears in the menu bar. This is used to accept the comparison value.

Caution! 

accepts the comparison values.



accepts the default values from the default file!

If comparison values are to be accepted, "Copy" **must** be used

Information!  identifies **different parameters**

 identifies the same parameters

The example shows the parameter comparison. The parameter folder is also displayed in which the differences are saved. This simplifies the locating of differences in the parameter sets.

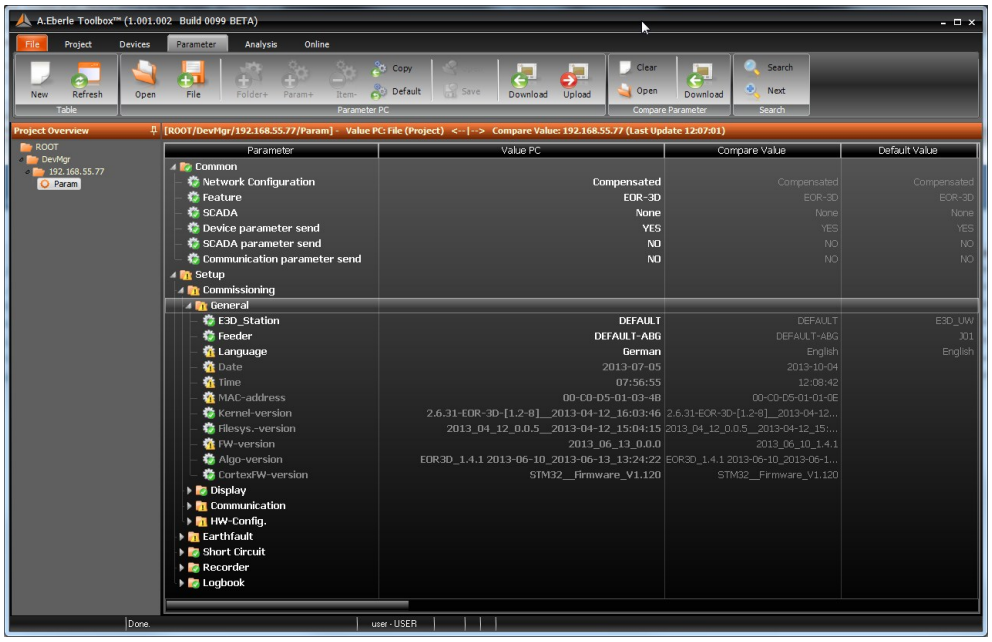


Figure 36: View after parameter comparison

A comparison is also carried out in advance when sending parameters. A wizard appears with a comparison table.

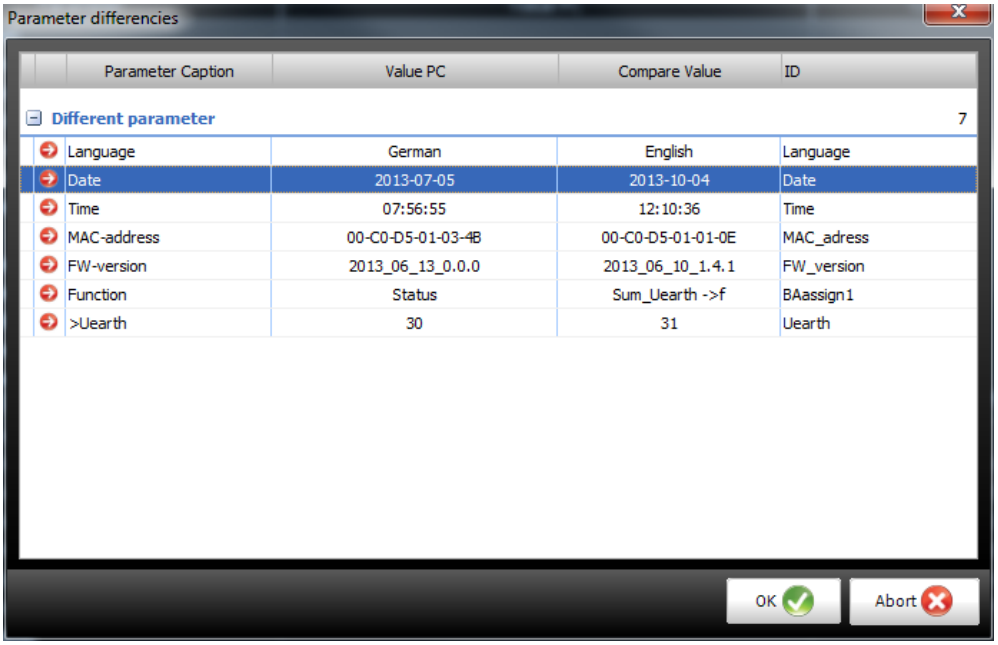


Figure 37: Parameter comparison upon parameter upload

The comparison value can be seen directly for each parameter which differs.

Information! If the parameter is selected in the table, the software jumps directly to this position in the background.

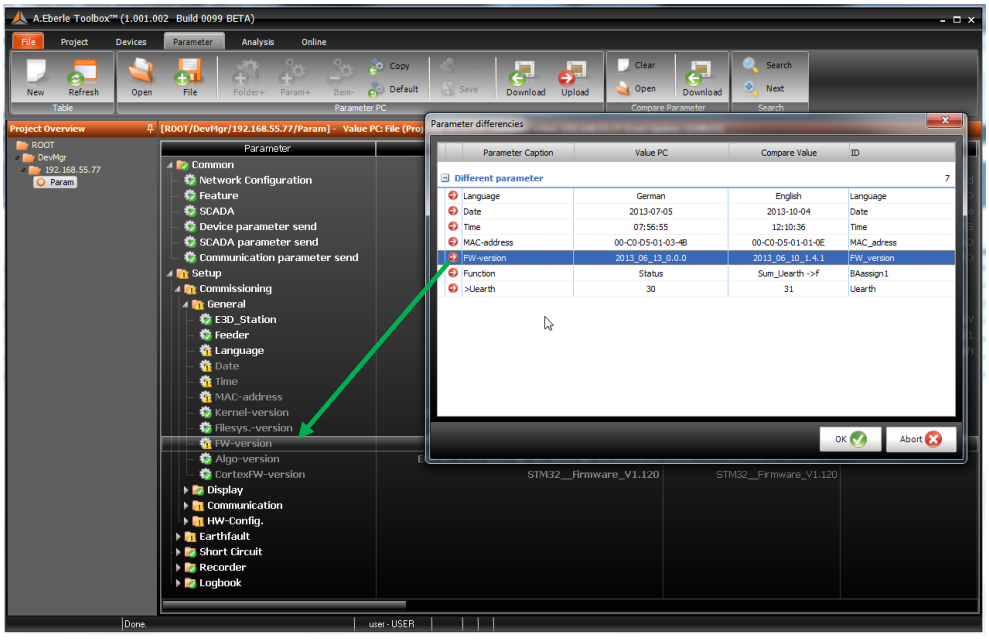


Figure 38: Parameter comparison upon uploading to the device with difference display and direct display in the parameter view

The symbols in the parameter comparison have the following meaning:

Comparison symbol	Meaning	
	Different parameters	These parameters are changed upon transfer to the device
	Non-transferred parameters	Through the preselection, the software prevents transfer of certain parameters
	Incorrect parameter	This parameter is not available on the device. Causes: • Incorrect parameter set • Older firmware on the EOR-3D that does not support the parameter

8.5.2 The online view is the ONLINE level for the EOR-3D

Figure 39: Jump to online view.

The online view is used to display the measurement values and statuses of binary inputs and outputs directly. Moreover, the log books, which are also present in the device are likewise displayed.

Information! The Online View display is a predefined view. If desired, this can be adjusted in "Advanced" mode.

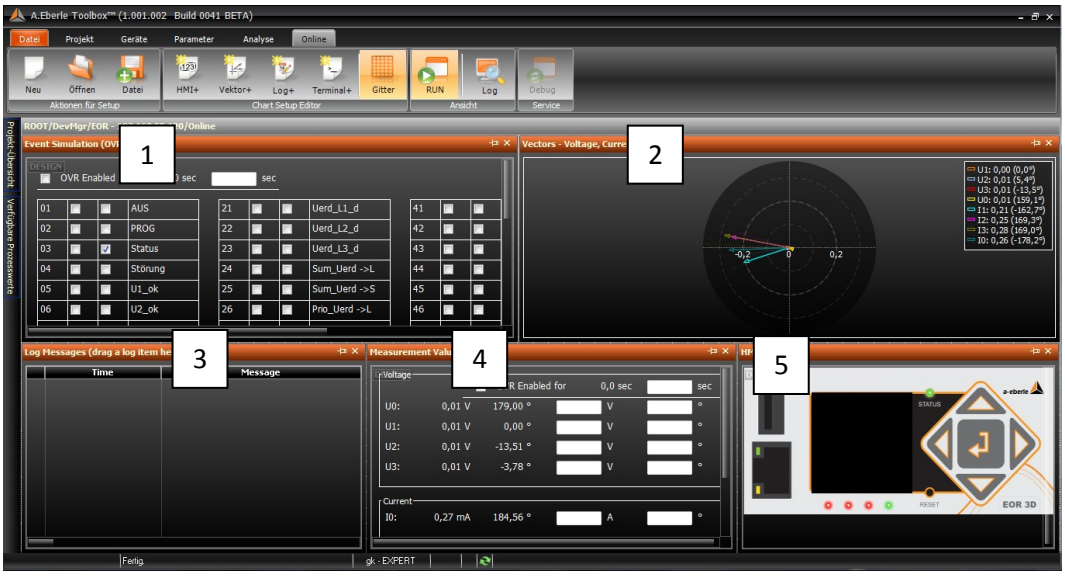


Figure 40: Default setting for the Online Page

The Online Page has the following options

Window	Function	
1. Events Output functions	The statuses of the output functions can be read directly The values can also be immediately simulated using the OVR (override) function	Simulation for testing control system connections via relays as well as div. protocols is thereby possible
2. Vector	The four voltage and current measurement values are displayed as vectors / pointers. Other vectors can likewise be inserted in the image using drag and drop.	Double clicking the window opens the menu for the window. Pointers can be hidden.
3. Log book		
4. Measurement values	Here measurement values are displayed directly in terms of a value and phase as secondary values. You can override the values for measurement value simulation in the control system direction using the OVR function.	The overriding of measurement values must be actively reset. Otherwise it is stopped after 250 seconds (default).
5. Panel EOR-3D	This function is used for operation of the EOR-3D as if you were directly in-situ	This makes remote maintenance of devices extremely easy

Information! Double clicking the window frame increases its size to the maximum view. Double clicking again resets it to the original position.

This simplifies the display of events, the log book and vectors. Dependent on your screen resolution, different scales can result.

8.5.3 DATA - Upload fault records from the EOR-3D, the file browser

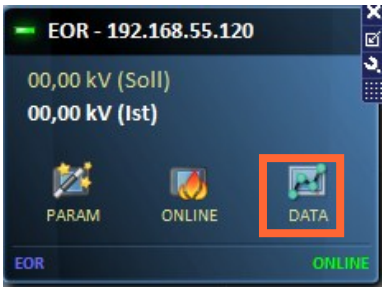


Figure 41: Jump to the data view for uploading the fault records

From the DATA menu you can upload the fault records from the EOR-3D

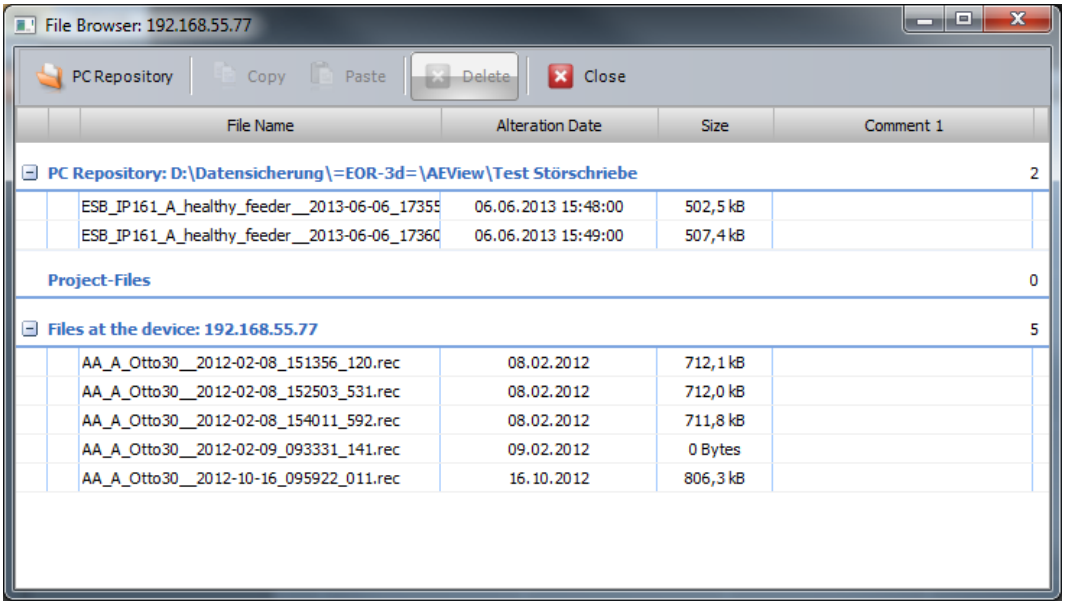


Figure 42: View of the file browser for an EOR-3D

Information! For more information about operating the file browser, see the online help of the A.Eberle Toolbox™ by pressing F1.

In this way all fault records that are present in the EOR-3D can be transferred.

The following file handling is possible

- Allocate files directly to a project (substation or device)
- Allocate files to a common backup folder for all devices from a particular area
- Delete fault records directly on the EOR-3D
- Several files or all can be selected simultaneously

Information! The recorders, which have been directly saved under "Project" are shown immediately in the Device Manager under the EOR-3D.

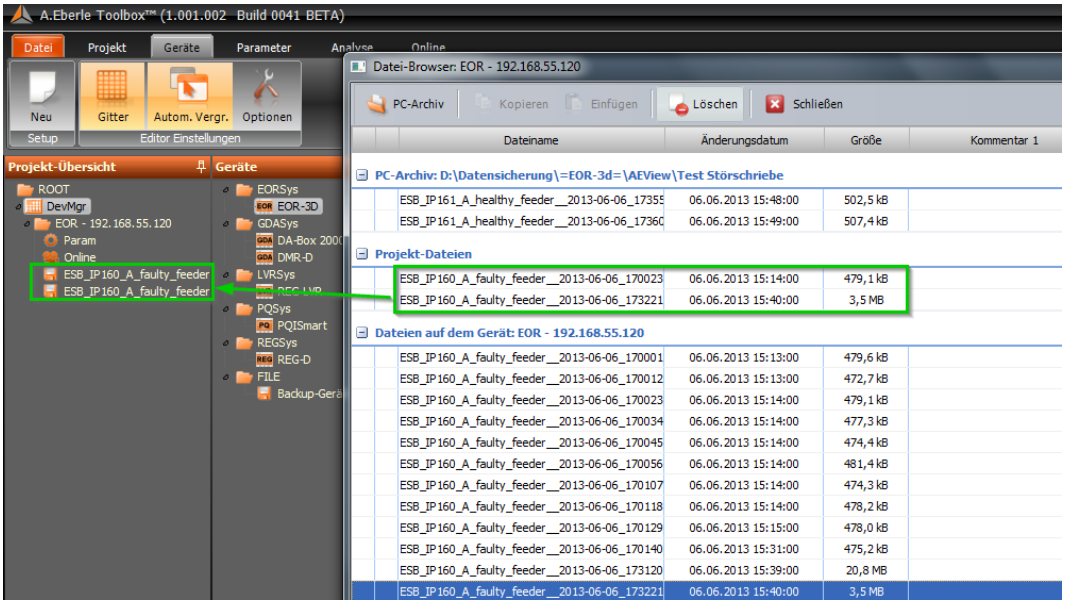


Figure 43: Retrieving fault records for an EOR-3D in the menu view

8.5.3.1 Displaying fault records from the EOR-3D

After uploading the data it can be found under Project / Device.

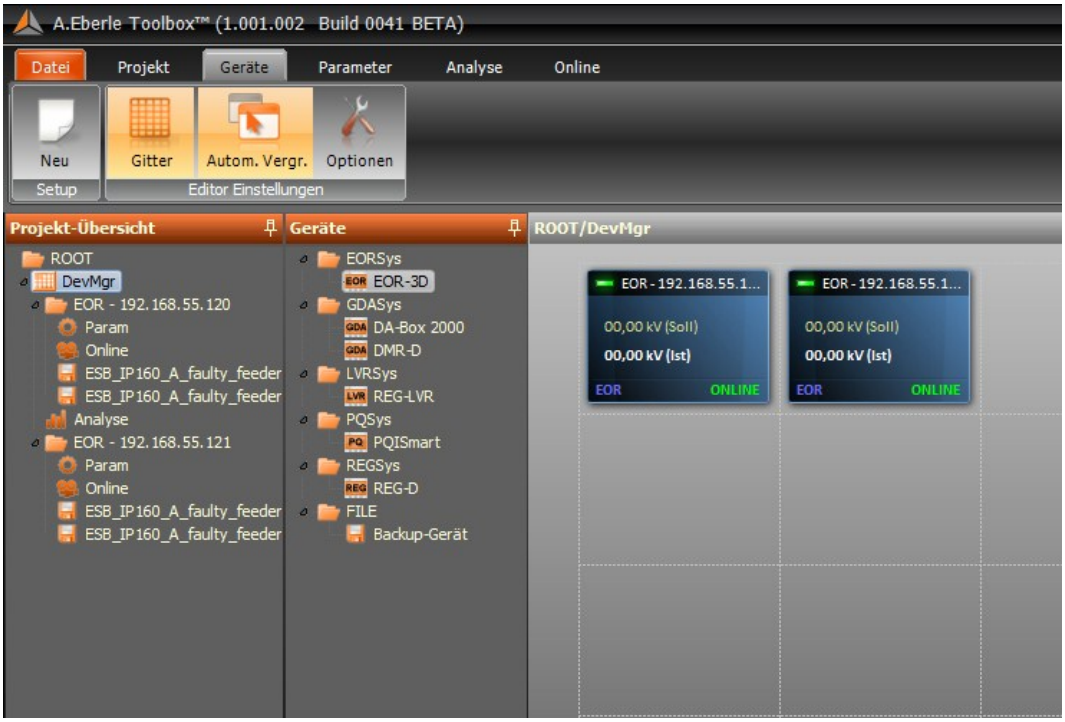


Figure 44: Two devices in a project with assigned fault records

The fault records have been uploaded from the devices? Then you can see them under the item "Analysis".

The view with the fault records and three charts opens in which measurement values can be saved by dragging and dropping.

Figure 45: Analysis start screen

Information! To improve clarity, abbreviation characters are used for the device connections.

- @ stands for the device - number 1 is always used for the first connection
- # stands for the number of a fault record within a device - number 1 is always used for the first available fault record for a device

E.g.: @2#2 = Device 2 Fault record no. 2

Clicking the connection show the list of fault records for this device.

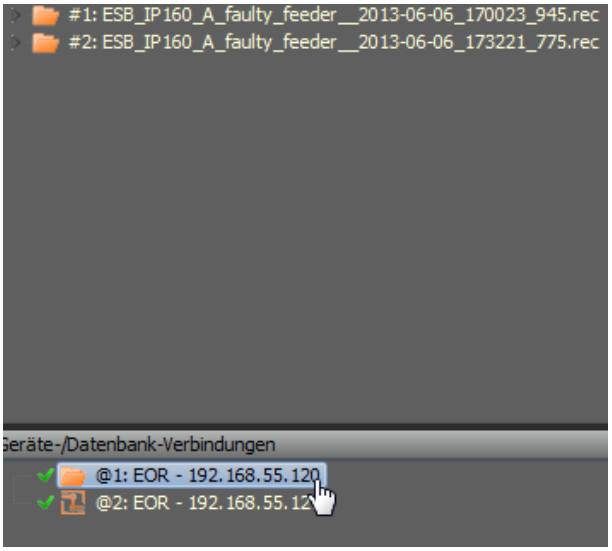


Figure 46: Connection / device 1 with 2 fault records

Now you can open the folder containing the fault records. The contained measurement values and binary traces are likewise visible as a folder.

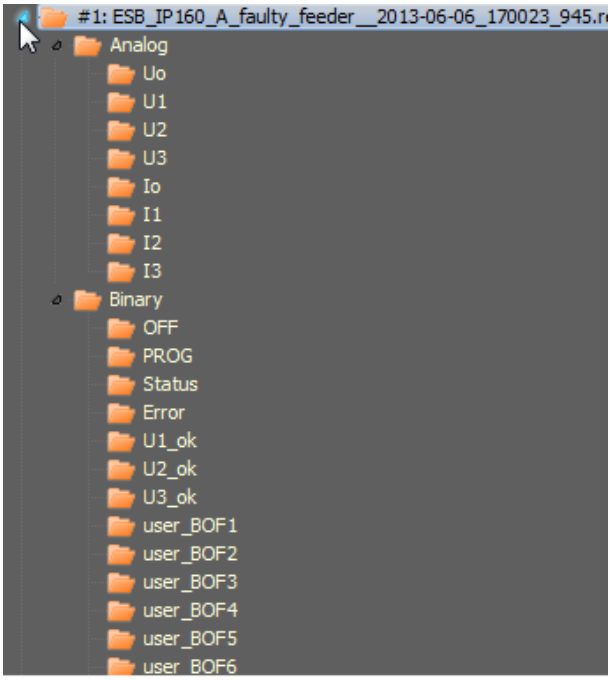


Figure 47: Available data from the selected fault record

Now you can drag and drop the measurement values and binary traces into the charts

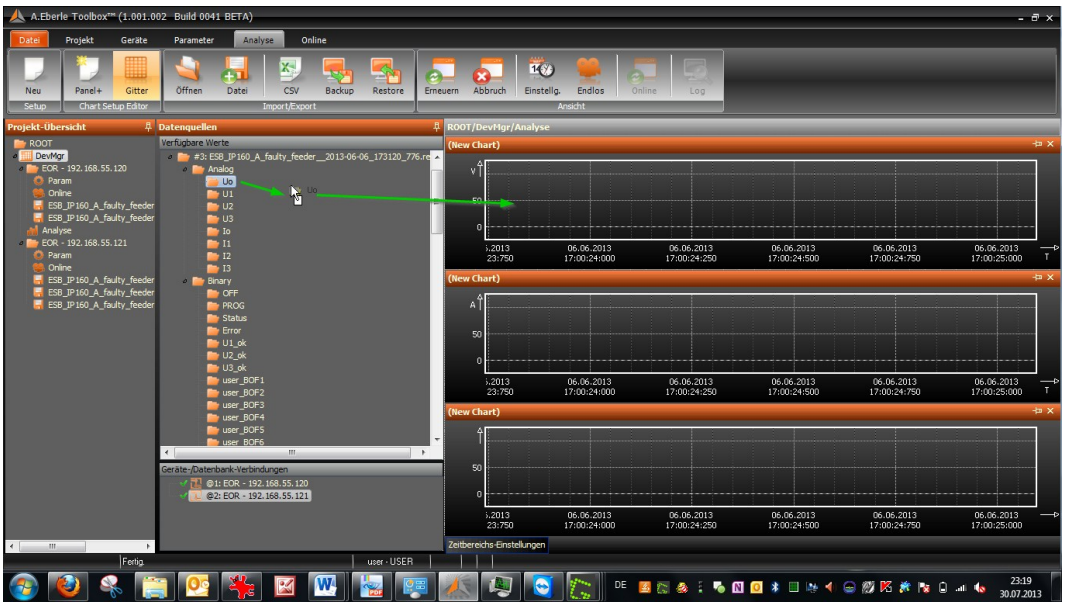


Figure 48: Drag and drop with one measurement value

The measurement values are displayed for the complete time that was recorded. The example shows a very long fault record with Uo, the earth fault signal from the EOR-3D and the current Io.

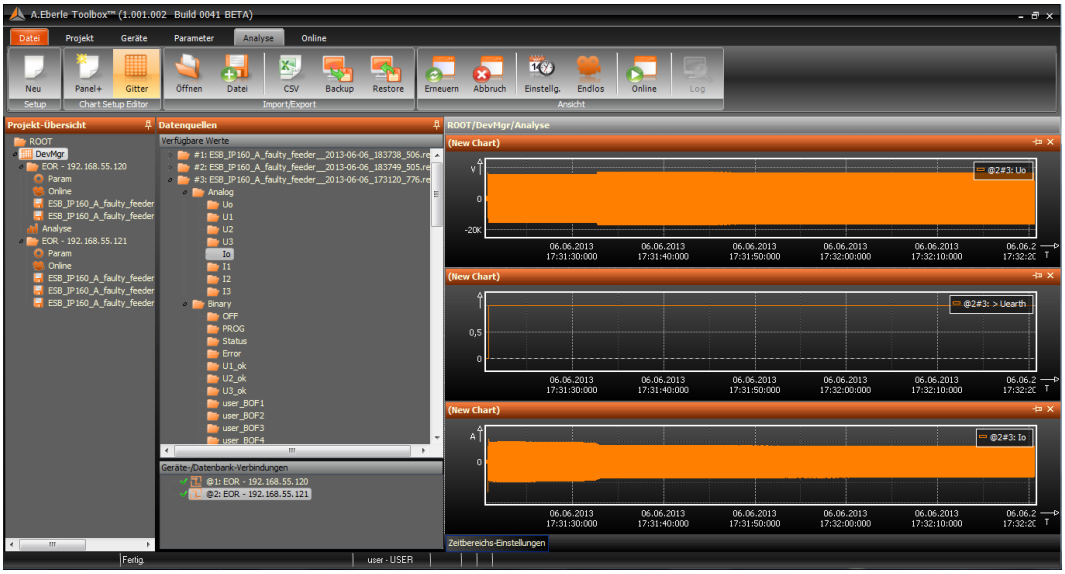


Figure 49: Fault record over the entire recording duration

The fault record can now be processed

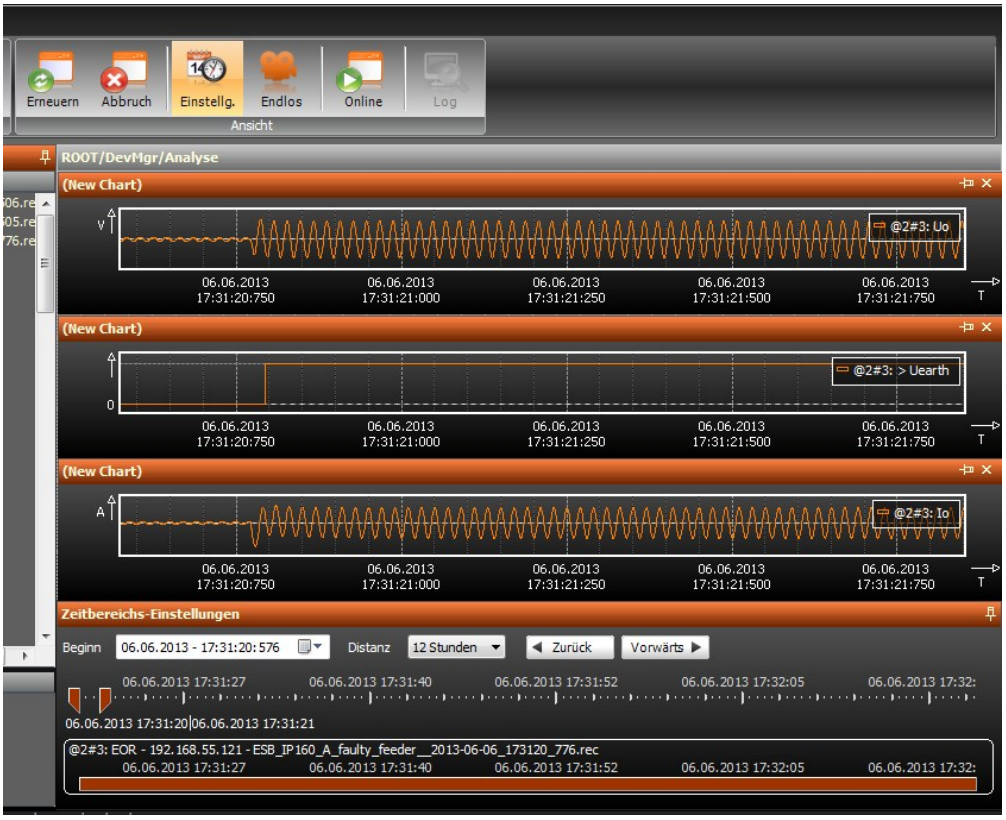


Figure 50: Time range for the first zoom

Using the cursor needles the time range can be roughly set. As a result the sinusoidal values can be seen immediately. Likewise you can see the status change of the binary trace for the earth fault signal from 0 to 1.

Information! The number of charts can be freely selected. For more details about operation of the Analysis view, press F1 to use the online help of the A.Eberle Toolbox™.

8.5.3.2 Simultaneous display and comparison of several fault records (optional licence)

The A.Eberle Toolbox™ has an option for displaying several fault records from different devices.

- Compare fault records from different periods with each other
- Overlay measurement values directly using the capture function
- Backup the data into a file including set zooms and time ranges

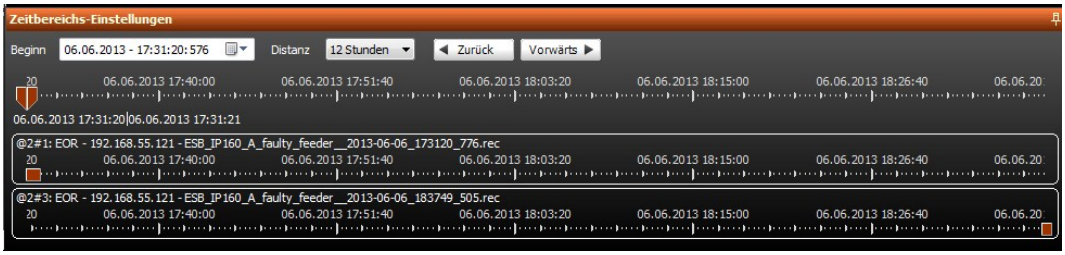


Figure 51: Time range for 2 fault records

By simple shifting of the time axis for the second fault record, the data can be compared with each other.

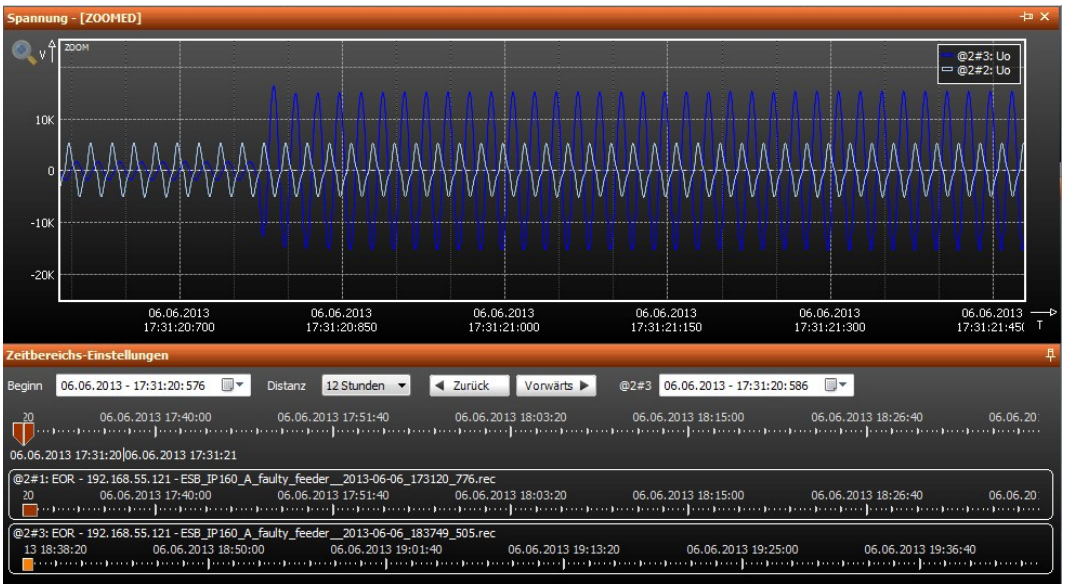


Figure 52: Time range shifted for fault record 2

Information! The modified time range is identified by a lighter colour. The change to the time range is easily reset by simply double clicking on the time range axis of the shifted fault record.

8.6 Commissioning of an EOR-3D using the A.Eberle Toolbox™

Carry out the following steps in the specified sequence

Checklist	Carried out?	Chapter
Is the wiring completely connected?	● Auxiliary voltage connected ● Measuring signals (voltage, current) connected ● Binary inputs and outputs connected ● If available, the control system interface is connected	7
Have you created the connection between your PC and the EOR-3D using a crossed network cable?	● Crossed network cable (ribbon cable), supplied with the EOR-3D, is connected	
Have you installed the A.Eberle Toolbox™?	● A.Eberle Toolbox installed on your PC	8.1
Has an EOR-3D been created in the software?	● An EOR-3D was created as a device after the installation	1.1
All questions answered YES?	● Then we can kick-off	

Information! For the following steps you can leave the EOR-3D with the default settings. However it must be adapted to the transformer factors for a first function.

8.6.1 Setting the IP address directly at the EOR-3D

It is easier to set the IP address for communication with the PC directly at the EOR-3D.

To go from the start menu to the menu item in the EOR-3D:

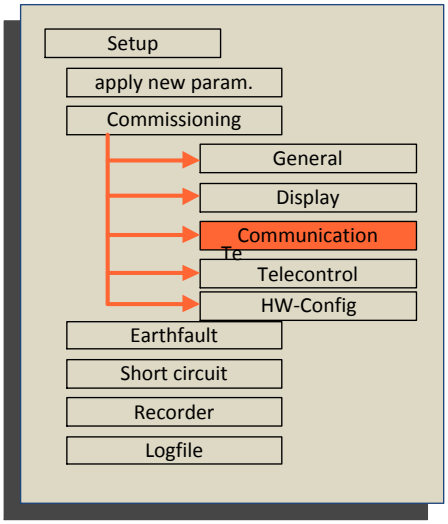
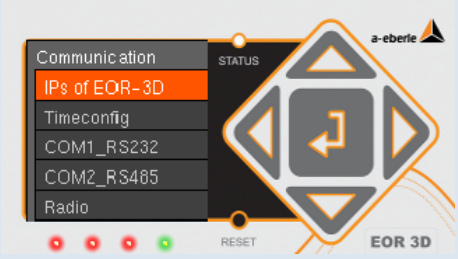
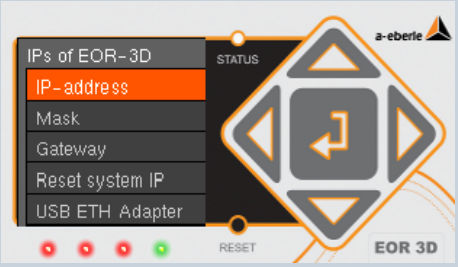
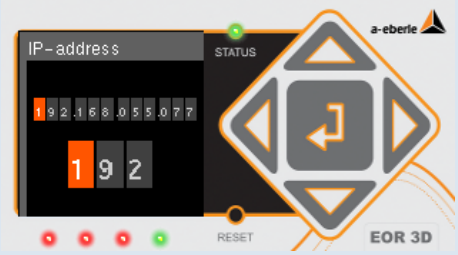
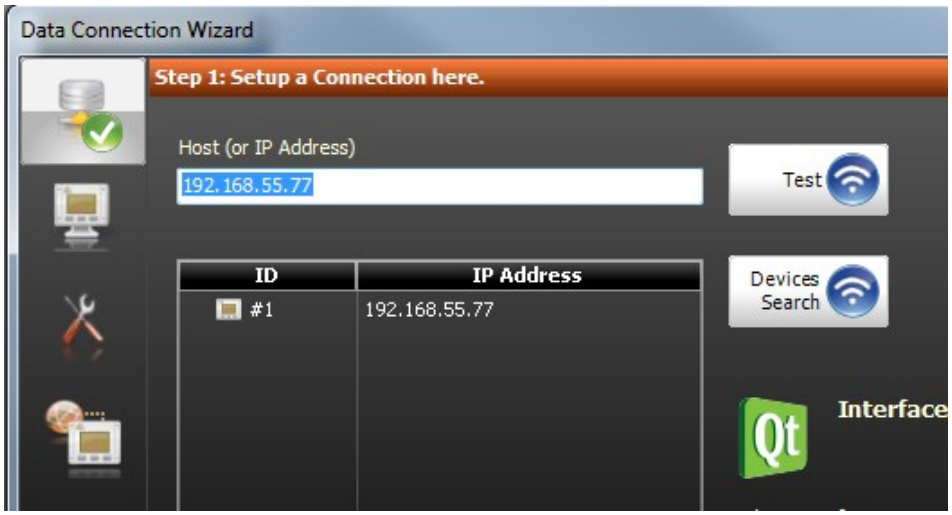


Figure 53: Menu item "Communication" in the EOR-3D

Display on the EOR-3D	Information
	
	
	Change the IP address accordingly.  Changing of parameters with numerical values is described under 7.2.4.1
Proceed with the subnet mask in a similar manner	

Information! With an existing connection, you can search for the EOR-3D using the software in the network.



You can see the device (or several devices) in the list of the connecting wizard

Information! You access the connecting wizard by creating a device (1.1)

If a device is already created, you can similarly access the connecting wizard by double clicking the device name (default name is the IP address).

8.6.2 Simplification of the parameter GUI by preselection

You can reduce the extent of the Parameter view. This is undertaken under the item "General" in the Parameter view of the software.

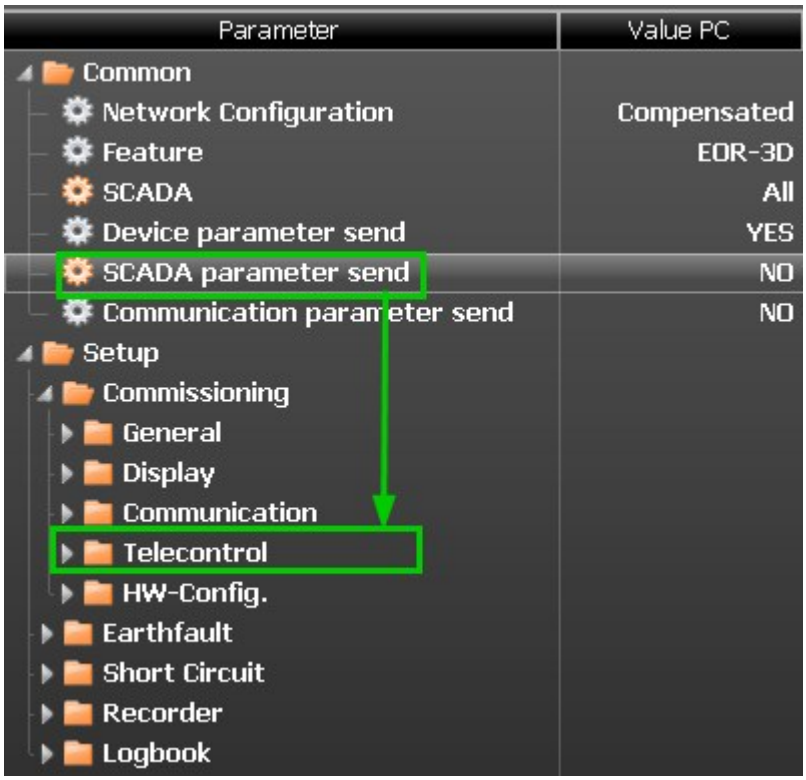


Figure 54: General settings for the Parameter view

The preselection under "General" gives you the advantage of no longer having to enter certain parameters.

The following function is hidden behind the individual items

General	Selection option	Function	
Network configuration	• Compensated • Isolated • Solidly earthed	Here you can make a preselection for the locating procedures that make sense with your network configuration	Dependent on the network configuration, unsuitable locating procedures are hidden. These procedure are actively set to OFF in the background
Characteristic	• EOR-3D • EWR22	Used as a simplification when replacing EWR22 devices **Please use EOR-3D as the default**	EWR22: The parameters are reduced in scope so that they match the scope of the EWR22. Hidden and actively set to OFF are: • current channels 1 to 3 as only Io is used • All short circuit parameters • All parameters for stationary locating procedures • The selection option for connecting to sensors
Control system	• None • IEC 60870-5-101 • IEC 60870-5-103 • IEC 60870-5-104 • MODBUS • All	Preselection of the control system connection used	All non-preselected protocols are actively set to OFF. **WARNING: Control system protocols require a licence. The function can be run in the software independently of the device licence.**
Send parameters	• NO • YES	You can prevent the sending of parameters with NO	Relates to all parameters excluding the control system and communication E.g. if only COM ports are to be adjusted
Send control system parameters	• NO • YES	You can prevent the sending of control system parameters with NO	Relates to the parameters in the control system folder
Send communication parameters	• NO • YES	You can prevent the sending of communication parameters with NO	Relates to the parameters in the communication folder

8.6.3 Configuring transformer factors

After preselection, please enter the transformer factors under "General" (0).

The transformer factor must be set for each measuring channel for the connected current and voltage transformers.

Caution! The calculation and also the entry of thresholds for the individual procedures is based on primary values. Consequently the transformer factor must be set.

The settings of the transformer factor can be found under menu item HW_config (hardware configuration)

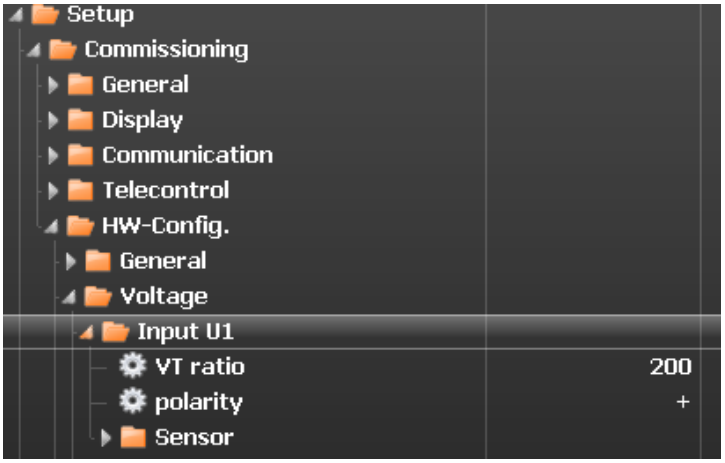


Figure 55: Menu item for setting transformer factors

- Set voltage transformer factors

knu
E.g.: Entry of the voltage transformer transformation ratio e.g. $\frac{20000}{\sqrt{3}}V / \frac{100}{\sqrt{3}}V$ -> knu = 200

- Set current transformer factors

kni
Entry of the current transformer transformation ratio The transformation ratio is defined as the ratio or primary to secondary current. e.g. $\frac{100A}{1A}$ -> kni = 100

Information! The "Sensor" menu item need not be considered for conventional transformers (inductive transformers)!

8.6.4 Sending the first parameters to the EOR-3D

You have carried out the initial steps under 0? Then you can now send the parameters using the A.Eberle Toolbox™ to the EOR-3D.

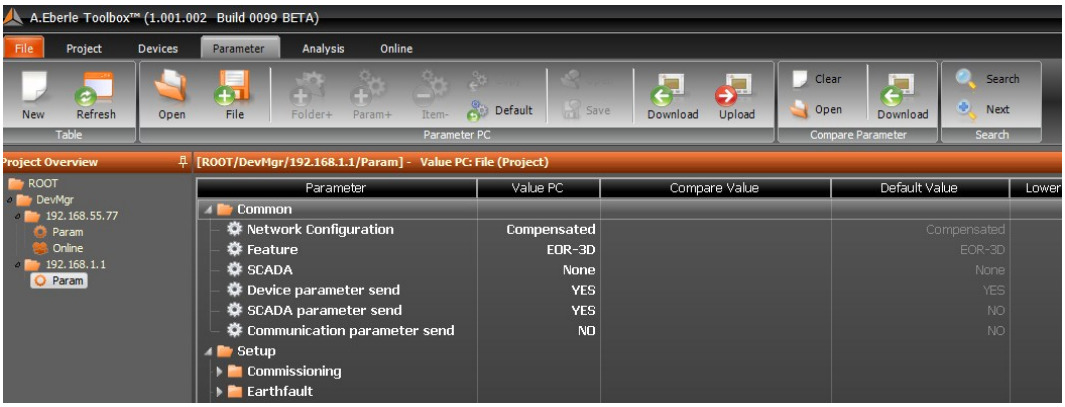


Figure 56: Starting parameter upload to the device

The Upload button is contained in the menu bar. First a comparison of the actual parameters with the parameters in the device is displayed.

Information! An explanation of the parameter comparison can be found under 0.

9. Settings / Parameter detail view

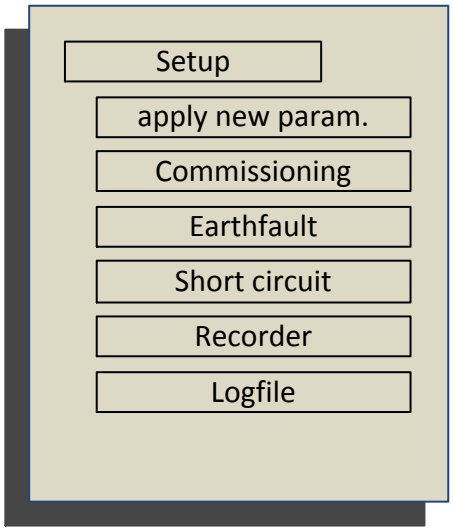
This chapter describes the function of each individual parameter.

9.1 Setup

The EOR-3D must be matched to the system in question through appropriate settings. The following section provides a description of the parameters, likewise tips are given for determining the setting data. The parameter sequence corresponds to the arrangement in the menu tree and in the configuration software A.Eberle Toolbox™.

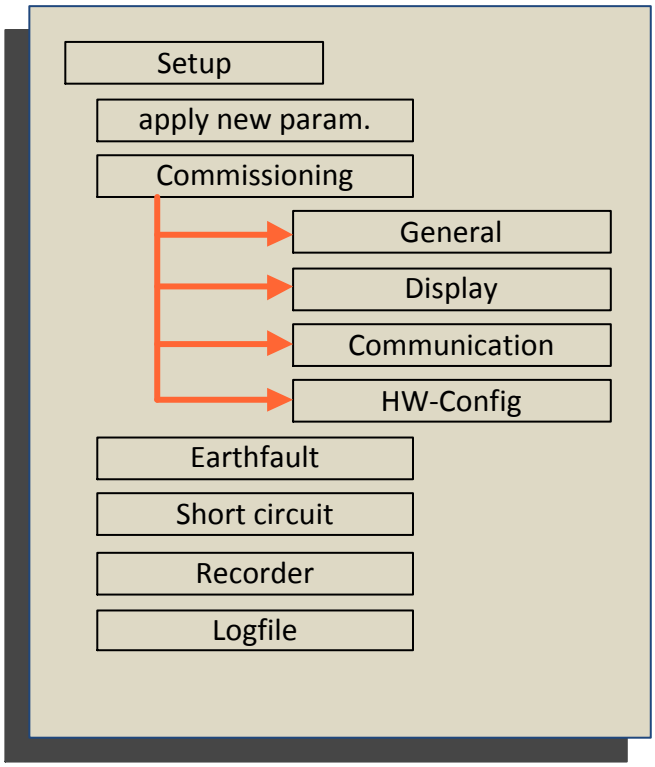
Below the parameters are described as they occur in the configuration software environment.

The following function groups are again found in the "Setup" menu tree:

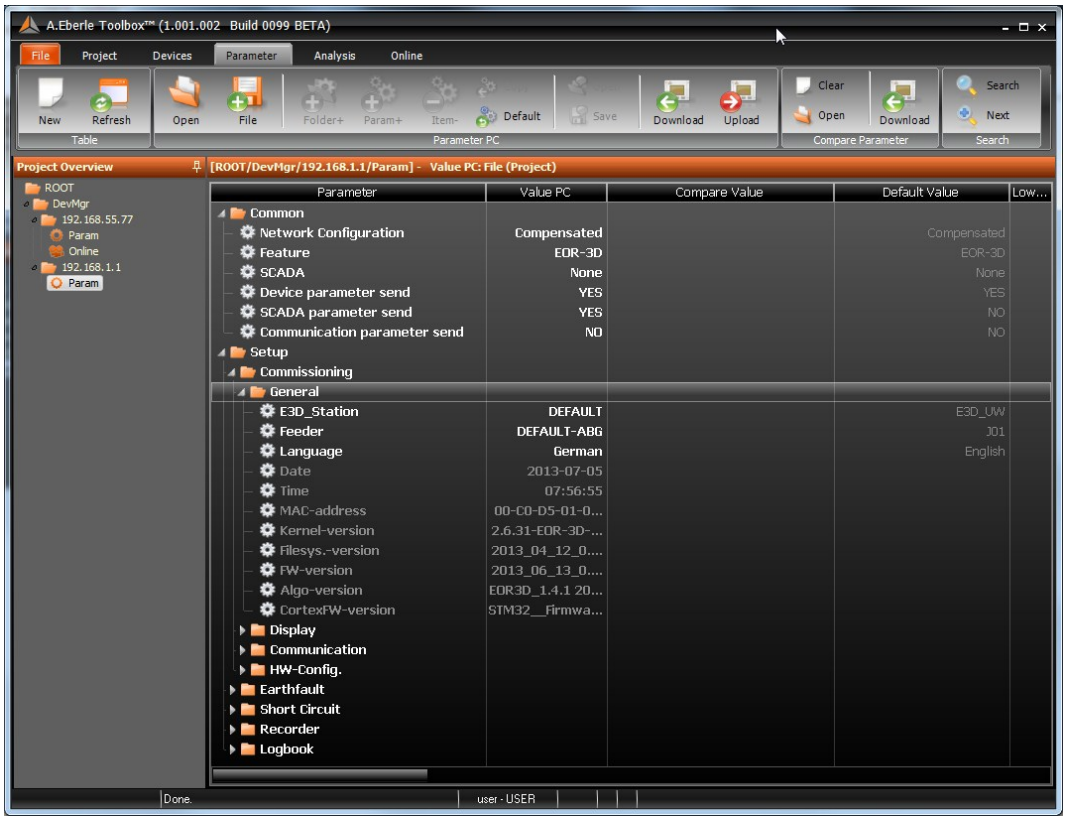


9.2 Commissioning menu

The function group "Commissioning" includes general settings as well as the configuration of the communication settings and the hardware inputs and outputs.



9.2.1 General menu



E3D_Station
Specification of a station name is possible (Warning: only use Windows-conformant characters. Maximum 40 characters)
Output
An output identifier can be entered in this field. For example this can be the Field identifier (e.g. J01)
Language
Here it is possible to switch the device operating language between German and English

Hardware information from the EOR-3D (cannot be changed)
Date
Time
MAC-Address
Kernel-Version
Filesys.-Version
FW-Version
Algo-Version
CortexFW-Version

9.2.2 Display

Under the Display menu item are found the settings that affect the displaying of measurement values. The LED texts can also be adjusted here

Figure 57: Parameter view MV sequence

MV sequence

Here the sequence of the measurement value pages in the device display view can be freely defined, if less measurement value pages than the maximum available number are to be displayed. Then for the following measurement value pages the respective preceding measurement value set must be selected.

If the MV sequence is configured as in Figure 58: , then only positions 1 - 3 are shown in the device display.

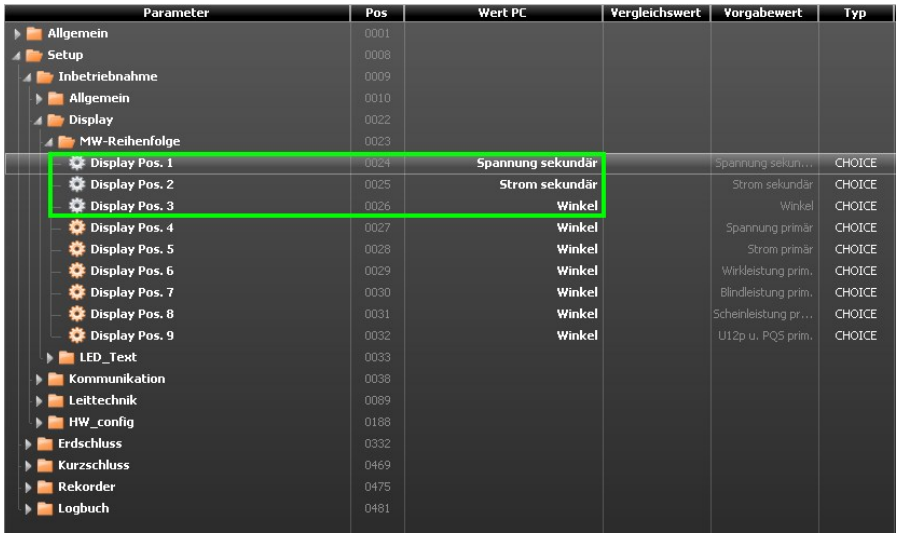


Figure 58: Measurement value display configuration

LED_Text

This adjustment option allows a freely configurable text to be entered for the 4 LEDs in the display. The text must not exceed 4 lowercase letters or 3 uppercase letters

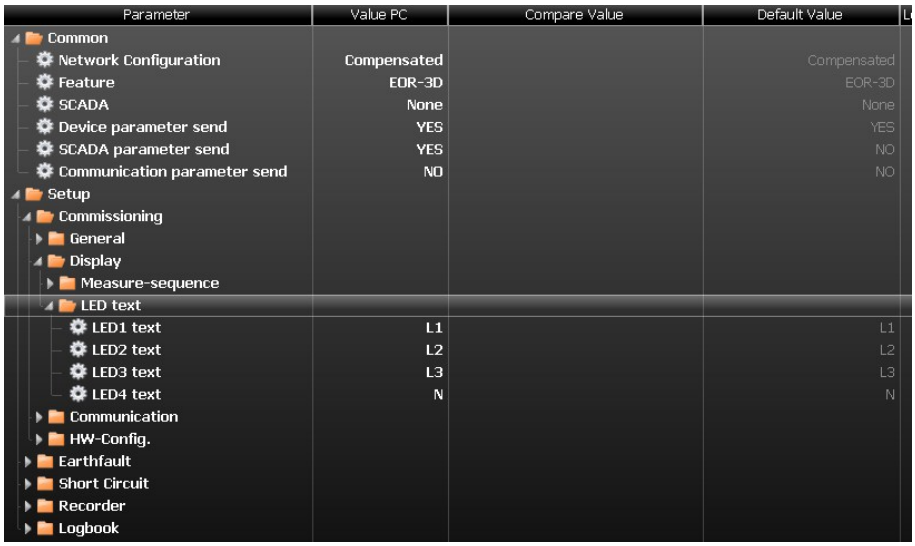


Figure 59: Configuration of LED texts

9.2.3 Communication

The communication settings for the EOR-3D are made under this menu item. This relates to the PC connection settings and the two COM ports.

9.2.3.1 IP configuration

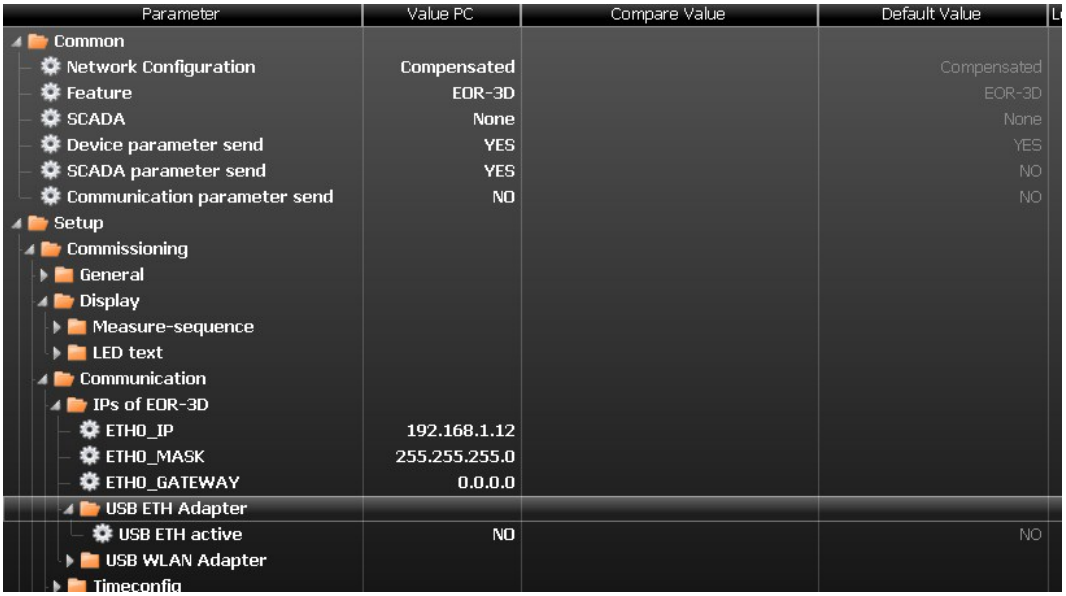


Figure 60: EOR-3D IP configuration

- **EOR-3D IPs**

  Configuration of the Ethernet interfaces on the device or a connectable Wi-Fi adapter for the EOR-3D are undertaken under this menu item.

ETH0_IP (network interface directly on the EOR-3D)
Setting of the IP address for front network interface port
ETH0_MASK
Configuration of the subnet mask
ETH0_GATEWAY
Configuration of an ETH gateway

- **USB on network adapter (USB ETH Adapter)**

  This menu item contains a setting for the optional Ethernet interface. This second ETH port is activated via the USB ETH adapter.

USB ETH active
Activation of the additional Ethernet port
USB ETH IP
IP configuration of the additional Ethernet port
ETH1_IP
Configuration of the additional IP address
ETH1 MASK
Configuration of the subnet mask
ETH1_GATEWAY
Configuration of an ETH gateway

Figure 61: USB Wi-Fi adapter configuration

USB Wi-Fi (WLAN) adapter

Using a Wi-Fi stick connected to the USB port, a connection can be created over a Wi-Fi network.

WLAN active
Activation of Wi-Fi mode
WLAN IP
IP configuration of the Wi-Fi interface
WLAN0_IP
Configuration of the IP address
WLAN0_ MASK
Configuration of the subnet mask
WLAN0_GATEWAY
Configuration of an ETH gateway
ESSID
Allocation of a network name (Service Set Identifier ≙ SSID)
WLAN Rate
Setting of a transfer rate 11M or 54M. If Auto is selected, the transfer rate is automatically identified

AdHoc configuration

If a Wi-Fi stick is used on the EOR-3D then with it, a simple AdHoc network can be set up (direct network communication between the devices).

AdHoc Channel
AdHoc channel setting. This must be identical in the PC and device
AdHoc WEP Key
WEP encryption for the network.

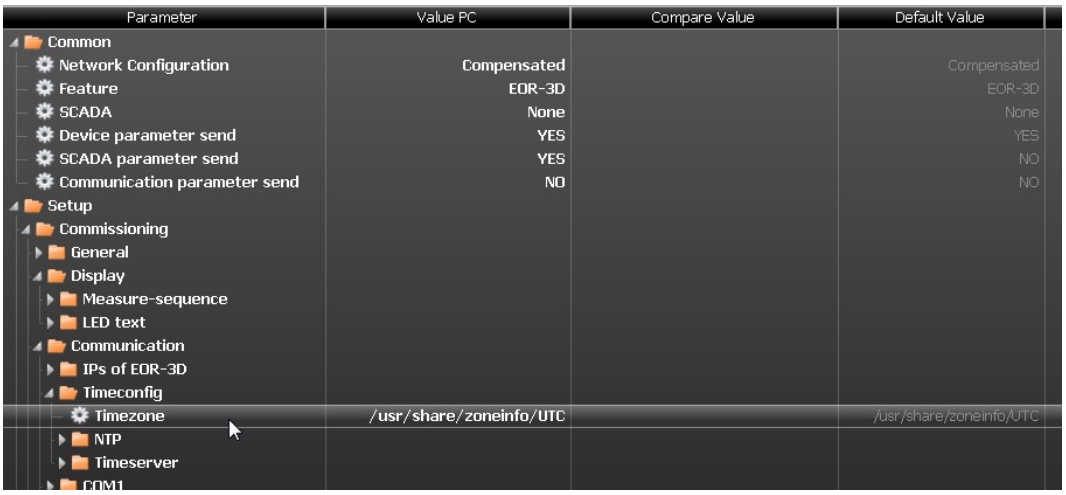
Information! The Off setting means that no encryption is used.

INFRASTR./ADHOC
This parameter is permanently set to the value ADHOC and cannot be changed

9.2.3.2 Time configuration (time synchronisation of the EOR-3D)

This menu item contains a setting for time synchronisation for the EOR-3D.

Information! Time zone setting in the EOR-3D takes place using Linux Syntax. I.e. the entry is made in plain text.



- **Time zone**

  Time zone setting in which the EOR-3D is used

  Below typical parameters are shown for various time zones

Information! You can find the complete list of time zones under
http://en.wikipedia.org/wiki/List_of_tz_database_time_zones

Time zone	UTC offset	UTC DST offset (daylight saving time)	Parameter (setting)
UTC	+00:00	+00:00	**/usr/share/zoneinfo/UTC (default value)**
Europe/Dublin	+00:00	+01:00	/usr/share/zoneinfo/Europe/Dublin
Europe/Berlin	+01:00	+02:00	/usr/share/zoneinfo/Europe/Berlin
Africa/Johannesburg	+02:00	+02:00	/usr/share/zoneinfo/Africa/Johannesburg
Europe/Helsinki	+02:00	+03:00	/usr/share/zoneinfo/Europe/Helsinki
Asia/Qatar	+03:00	+03:00	/usr/share/zoneinfo/Asia/Qatar
Iran	+03:30	+04:30	/usr/share/zoneinfo/Iran
Europe/Moscow	+04:00	+04:00	/usr/share/zoneinfo/Europe/Moscow
Asia/Dubai	+04:00	+05:00	/usr/share/zoneinfo/Asia/Dubai
Asia/Kabul	+04:30	+04:30	/usr/share/zoneinfo/Asia/Kabul
Asia/Tashkent	+05:00	+05:00	/usr/share/zoneinfo/Asia/Tashkent
Antarctica/Davis	+05:00	+07:00	/usr/share/zoneinfo/Antarctica/Davis
Asia/Kolkata	+05:30	+05:30	/usr/share/zoneinfo/Asia/Kolkata
Asia/Kathmandu	+05:45	+05:45	/usr/share/zoneinfo/Asia/Kathmandu
Asia/Dhaka	+06:00	+06:00	/usr/share/zoneinfo/Asia/Dhaka
Asia/Rangoon	+06:30	+06:30	/usr/share/zoneinfo/Asia/Rangoon
Iran	+03:30	+04:30	/usr/share/zoneinfo/Iran
Europe/Moscow	+04:00	+04:00	/usr/share/zoneinfo/Europe/Moscow
Asia/Dubai	+04:00	+05:00	/usr/share/zoneinfo/Asia/Dubai
Asia/Kabul	+04:30	+04:30	/usr/share/zoneinfo/Asia/Kabul
Asia/Tashkent	+05:00	+05:00	/usr/share/zoneinfo/Asia/Tashkent
Antarctica/Davis	+05:00	+07:00	/usr/share/zoneinfo/Antarctica/Davis
Asia/Kolkata	+05:30	+05:30	/usr/share/zoneinfo/Asia/Kolkata
Asia/Kathmandu	+05:45	+05:45	/usr/share/zoneinfo/Asia/Kathmandu

Time zone	UTC offset	UTC DST offset (daylight saving time)	Parameter (setting)
Asia/Dhaka	+06:00	+06:00	/usr/share/zoneinfo/Asia/Dhaka
Asia/Rangoon	+06:30	+06:30	/usr/share/zoneinfo/Asia/Rangoon
Asia/Bangkok	+07:00	+07:00	/usr/share/zoneinfo/Asia/Bangkok
Australia/West	+08:00	+08:00	/usr/share/zoneinfo/Australia/West
Australia/Eucla	+08:45	+08:45	/usr/share/zoneinfo/Australia/Eucla
Japan	+09:00	+09:00	/usr/share/zoneinfo/Japan
Australia/North	+09:30	+09:30	/usr/share/zoneinfo/Australia/North
Australia/South	+09:30	+10:30	/usr/share/zoneinfo/Australia/South
Australia/Queensland	+10:00	+10:00	/usr/share/zoneinfo/Australia/Queensland
Australia/Sydney	+10:00	+11:00	/usr/share/zoneinfo/Australia/Sydney
Australia/LHI	+10:30	+11:00	/usr/share/zoneinfo/Australia/LHI
Antarctica/Casey	+11:00	+08:00	/usr/share/zoneinfo/Antarctica/Casey
Pacific/Kosrae	+11:00	+11:00	/usr/share/zoneinfo/Pacific/Kosrae
Pacific/Norfolk	+11:30	+11:30	/usr/share/zoneinfo/Pacific/Norfolk
Pacific/Wake	+12:00	+12:00	/usr/share/zoneinfo/Pacific/Wake
New Zealand	+12:00	+13:00	/usr/share/zoneinfo/NZ
Pacific/Chatham	+12:45	+13:45	/usr/share/zoneinfo/NZ-CHAT
Pacific/Enderbury	+13:00	+13:00	/usr/share/zoneinfo/Pacific/Enderbury
Pacific/Apia	+13:00	+14:00	/usr/share/zoneinfo/Pacific/Apia
Pacific/Kiritimati	+14:00	+14:00	/usr/share/zoneinfo/Pacific/Kiritimati
Atlantic/Cape_Verde	-01:00	-01:00	/usr/share/zoneinfo/Atlantic/Cape_Verde
Atlantic/Azores	-01:00	+00:00	/usr/share/zoneinfo/Atlantic/Azores
Atlantic/South_Georgia	-02:00	-02:00	/usr/share/zoneinfo/Atlantic/South_Georgia
America/Buenos_Aires	-03:00	-03:00	/usr/share/zoneinfo/America/Buenos_Aires
America/Montevideo	-03:00	-02:00	/usr/share/zoneinfo/America/Montevideo

Time zone	UTC offset	UTC DST offset (daylight saving time)	Parameter (setting)
America/Puerto_Rico	-04:00	-04:00	/usr/share/zoneinfo/America/Puerto_Rico
Atlantic/Bermuda	-04:00	-03:00	/usr/share/zoneinfo/Atlantic/Bermuda
America/Cayman	-05:00	-05:00	/usr/share/zoneinfo/America/Cayman
America/Eastern Time	-05:00	-04:00	/usr/share/zoneinfo/EST
America/Regina	-06:00	-06:00	/usr/share/zoneinfo/America/Regina
US/Central	-06:00	-05:00	/usr/share/zoneinfo/US/Central
Mountain Standard Time	-07:00	-07:00	/usr/share/zoneinfo/MST
Canada/Mountain	-07:00	-06:00	/usr/share/zoneinfo/Canada/Mountain
Pacific/Pitcairn	-08:00	-08:00	/usr/share/zoneinfo/Pacific/Pitcairn
Pacific Time	-08:00	-07:00	/usr/share/zoneinfo/US/Pacific
Pacific/Gambier	-09:00	-09:00	/usr/share/zoneinfo/Pacific/Gambier
US/Alaska	-09:00	-08:00	/usr/share/zoneinfo/US/Alaska
Pacific/Marquesas	-09:30	-09:30	/usr/share/zoneinfo/Pacific/Marquesas
Hawaii Time Zone	-10:00	-10:00	/usr/share/zoneinfo/HST
America/Adak	-10:00	-09:00	/usr/share/zoneinfo/America/Adak
Pacific/Midway	-11:00	-11:00	/usr/share/zoneinfo/Pacific/Midway

NTP (NTP time synchronisation)

The EOR-3D supports time synchronisation over NTP(***N***etwork ***T***ime ***P***rotocol). Up to two NTP servers can be configured.

NTP active	Setting
Activates the receipt of time data via the NTP protocol and the network interface on the EOR-3D	YES **NO (default)**

NTP1	Setting
IP address of NTP server 1	E.g.: 192.168.55.120
NTP2	**Setting**
IP address of NTP server 2	E.g.: 192.168.1.120

Timeserver

Information! The EOR-3D can also transmit its own time to other EOR-3Ds. Therefore timeservers can be used.

Likewise here is where the internal switching between summer / winter time is set

Timeserver active	Setting
Activation of the time server The following parameters are only now active, including active summer / winter time switching	YES (default) NO
HW RTC Som./Wint.	
Automatic changeover of the internal clock to summer or winter time	YES (default) NO
DCF77 time receiver (RS232)	
A DCF77 receiver can be connected to the EOR-3D. It is connected via the RS232 port	YES NO (default)
REG-DP Sender	
The EOR-3D can send a time signal to an A-Eberle device	

REG-DP Sender

Information! The EOR-3D can send a time signal to an A-Eberle device with E-LAN **or** a serial port. In this way the device can likewise be time-synchronised.

REG-DP Time Port	Setting
The time signal can be output via the serial ports. • In the case of a 2-wire connection to **E-LAN** the parameter must be set to **RS484 COM2**. • If **RS232 COM1** is selected, the send format must be changed to **DCF77**. The corresponding COM port on the device receiving the time signal must be set similarly.	**OFF (default)** RS485 COM2 RS232 COM1
Sender Pause	
Pulse adjustable in mm:ss; how often the signal is to be sent	**00:01 (default)** (corresponds to 1 s)
Send Format	
Format in which the time signal is to be sent to the receiver • Selection **REG-DP**, if the time signal is to be sent by E-LAN and consequently **RS485** • Selection **DCF77**, if the time signal is to be sent via **RS232** in DCF format	**REG-DP (default)** DCF77
REG-DP time send.	
Should the time signal be sent YES / NO	YES **NO (default)**

9.2.3.3 Configuration of the COM ports

The RS232 or RS485 interfaces are configured under this menu item.

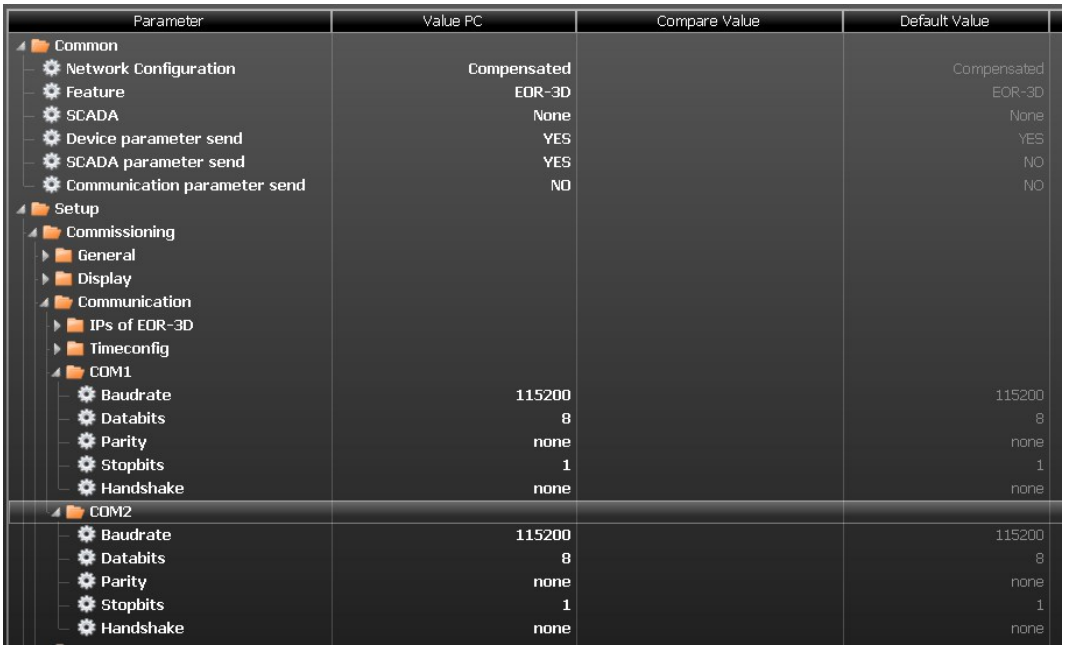


Figure 62: Configuring the COM ports

COM1 RS232
Communication settings for the RS232 interface
Baud rate
Baud rate for the RS232 interface 115200, 57600, 38400, 19200, 9600
Data bits
Number of data bits 7 or 8
Parity
Parity setting: none, odd, even
Stop bits
Stop bit setting 1, 1.5 or 2
Handshake
Handshake setting: none, XON/XOFF (software), RTS/CTS (hardware)

COM2 RS485
Communication settings for the RS232 interface
Baud rate
Baud rate for the RS485 interface 115200, 57600, 38400, 19200, 9600
Data bits
Number of data bits 7 or 8
Parity
Parity setting: none, odd, even
Stop bits
Stop bit setting 1, 1.5 or 2
Handshake
Handshake setting: none, XON/XOFF (software), RTS/CTS (hardware)

9.2.4 Control system

The menu item "Control system" contains the settings for the control system protocol for the EOR-3D. The following protocols are available to the user:

- Modbus
- IEC60870-5-101
- IEC60870-5-103
- IEC60870-5-104

Information! The control system protocols are linked to a licence key

Figure 63: Configuration of the control system profiles

9.2.4.1 Modbus protocol

Modbus
Modbus protocol settings
Modbus active
Activation of the Modbus protocol
TCP/IP port
TCP/IP port setting
Slave-ID
Slave ID setting
Protocol
This option is used to specify over which physical interface the protocol is transferred. TCP/IP, RTU RS485, RTU RS232
Memory retention time
Memory retention time setting
Offset Read
This option is used to change the offsets of the read registers of the Modbus protocol
Offset_Write
This option is used to change the offsets of the write registers of the Modbus protocol

9.2.4.2 IEC60870-5-101 protocol

IEC60870-5-101 protocol
IEC60870-5-101 protocol settings
T101 active
Activation of the T101 protocol
T101 interface
This option is used to specify over which physical interface the protocol is transferred. OFF, RS485, RS232
T101 Station CA
Station address setting for the T101 protocol
T101 PI (Process Image) update
This parameter can be used to deactivate the deviation set it the control system file (.csv).

▶ **T101 Config**

- T101 App.Layer

T101 COT Fieldl.
Setting for the Cause of Transmission (COT) field length: Selection: 1 / 2
T101 CA Fieldl.
Setting for the ASDU field length: Selection: 1 / 2
T101 IOA Fieldl.
Address length of the Information Object Address (IOA) Selection: 1/2/3

. **Information**! If the IOA address is changed, the corresponding csv file (data point list) must also be changed

- T101 Link Layer

T101 Sym./Unsym.
The type of data transfer is selected here: Unbalanced (unsymmetric), Balanced (symmetric)
T101 Dir Bit
This parameter is used to set the Direction Bit: 0: Balanced and unbalanced 1: Balanced
T101 Addr Fieldl.
This parameter is used to set the address field length. 0: Balanced 1: Balanced and unbalanced 2: Balanced and unbalanced
T101 Addr.
T101 address setting

9.2.4.3 IEC60870-5-103 protocol

IEC60870-5-103 protocol
IIEC60870-5-103 protocol settings
T103 active
Activation of the T103 protocol
T103 interface
This option is used to specify over which physical interface the protocol is transferred. OFF, RS485, RS232
T103 Station CA
Station address setting for the T103 protocol
T103 PI (Process Image) update
This parameter can be used to deactivate the deviation set it the control system file (.csv).

9.2.4.4 IEC60870-5-104 protocol

IEC60870-5-104 protocol
IIEC60870-5-104 protocol settings
T104 active
Activation of the T104 protocol
T104 Eth.(SYS/USB)
This option is used to specify over which Ethernet interface the protocol is transferred. System Ethernet USB Ethernet
T104 Station CA
Station address setting for the T104 protocol
T104 TCP/IP Port
TCP/IP setting for the interface
T104 PI update
This parameter can be used to deactivate the deviation set it the control system file (.csv).
T104 IP Bind
When using a redundancy, this parameter must be set
T104 permitted IP
Setting of a T104 Client IP address

T104 Timeo.Parameter

This parameter set contains specific parameters for the T104 protocol (link layer).

t0
This parameter determines how long the control centre waits for a connection
t1
This parameter determines how long the sender waits for an acknowledgement
t2
The telegram is acknowledged by the receiver no later than after this set time.
t3
After the configured time a test telegram is sent, provided there is no data traffic.
k
This parameter determines the maximum number of telegrams the sender transmits until it waits for the acknowledgement.
w
This parameter determines after how many telegrams the receiver sends an acknowledgement.

Information!

In the IEC60870-5-104 protocol, these parameters represent standard values, therefore they should not be altered.

- **T104 Redundancy 1 – 4**

  The EOR-3D can have up to 4 configurable slaves

  The parameters are identical for slaves 1 - 4.

Red. IP address
Permissible IP address for the respective redundancy. If an IP address is set to 0.0.0.0, then it causes a search in all networks.
Red. Mask
Subnetwork mask for one redundancy (slave)
Red. Gateway
Gateway IP address for one redundancy (slave)
Red.permitted IP
Permitted client IP address
Red. TCP/IP Port
TCP/IP port for the redundancy (slave)
Red. 1 active
Activates the redundancy
Debug output
Activates a debug output for the control system
CS log book
Enters the debug outputs in a separate log book

9.2.5 HW_config

You can find the settings for the current and voltage channels under the menu tree of the hardware configuration (HW_config). Moreover, the configuration of the binary inputs, relay outputs and LEDs is undertaken here.

Also user-defined output functions, so-called uBAFs can be created here.

9.2.5.1 General

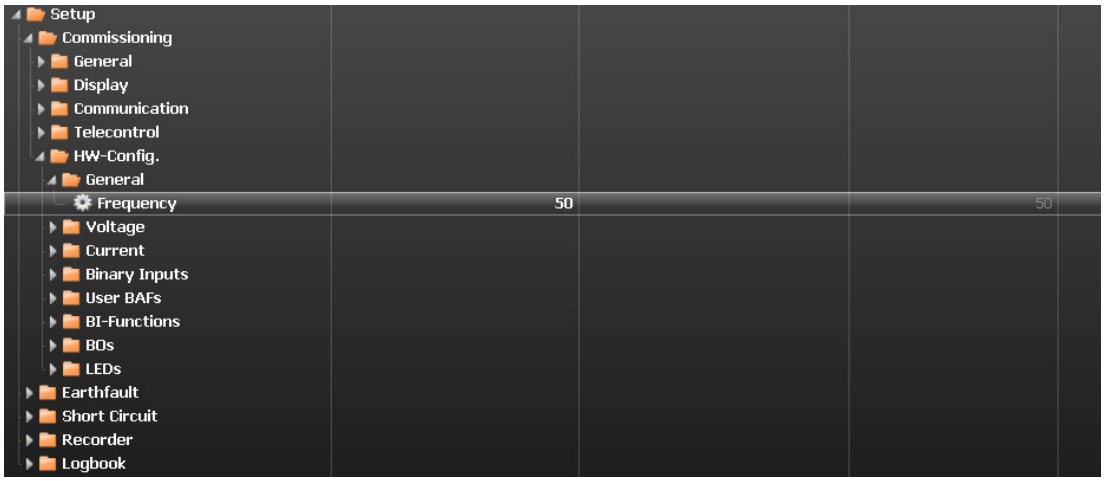


Figure 64: Hardware configuration menu tree

Frequency
Setting of the network rated frequency 50Hz 16.7Hz (not currently used)

9.2.5.2 Voltage

The 4 voltage inputs can be configured under this menu tree.

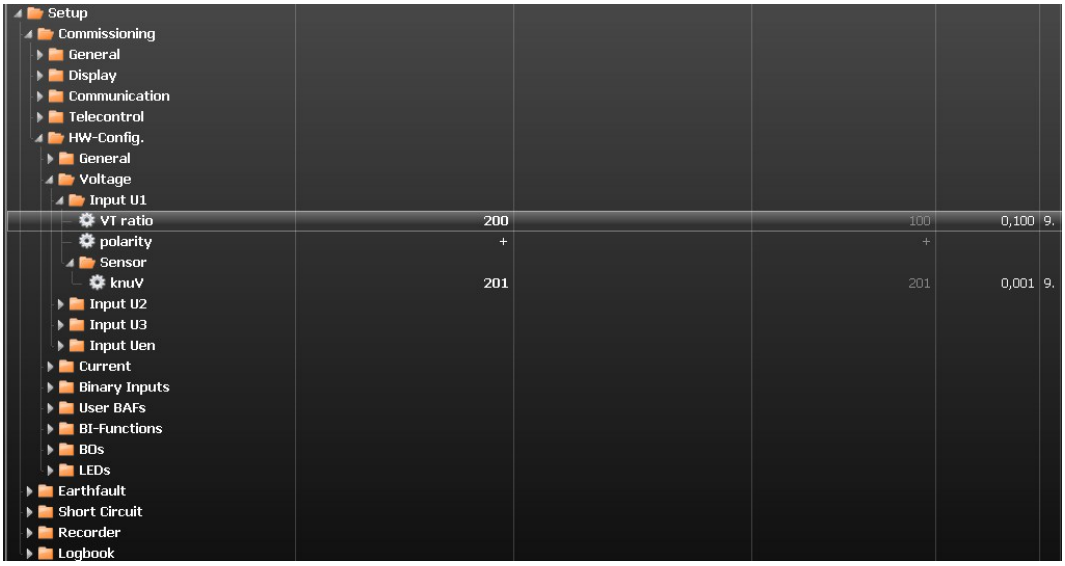


Figure 65: Configuration of the voltage inputs

- **Voltage input U1**

Configuration of voltage channel U1 (channels U2, U3 and Uen are configured accordingly)

knu
Entry of the voltage transformer transformation ratio e.g. $\frac{20000}{\sqrt{3}}V / \frac{100}{\sqrt{3}}V$ -> knu = 200

Polarity
This setting is used to reverse the polarity of the voltage transformer input. This corresponds to a rotation of the signal through 180°

Calculate Uen
If this parameter is activated, then the zero sequence voltage is calculated from the three connected conductor-earth voltages

Information! Note, this parameter is only valid for the Uen input

- **Sensor**

This menu item is used compensate the voltage with capacitive voltage taps.

knuV
System parameter should only be adapted when using capacitive voltage taps.

9.2.5.3 Current

The 4 current inputs can be configured under this menu item.

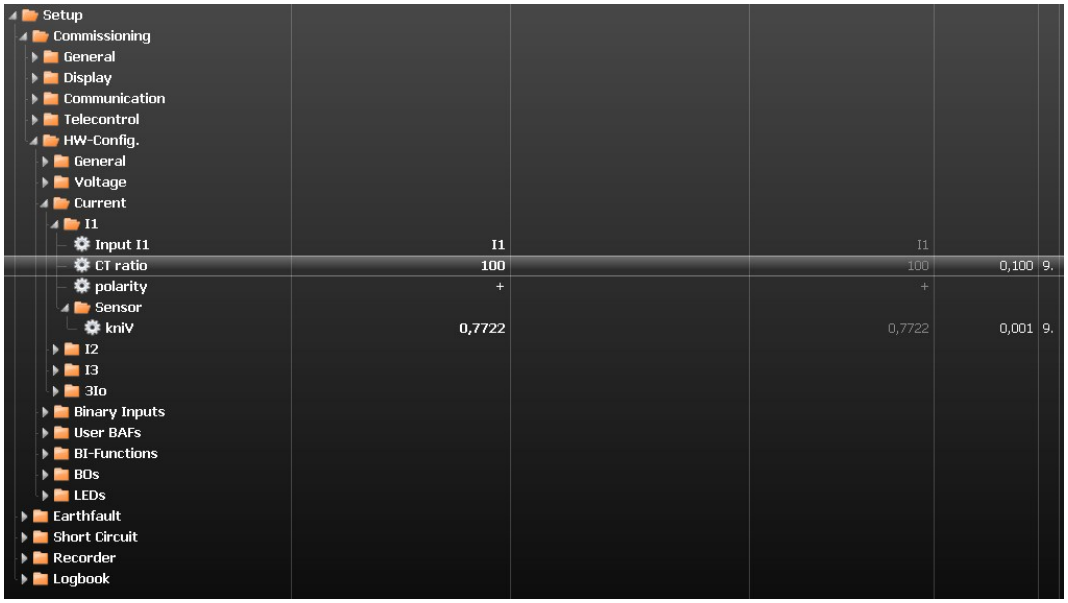


Figure 66: Configuration of the current inputs

- **Current input I1**

Configuration of current channel I1 (channels UI2, I3 and 3Io are configured accordingly)

kni
Entry of the current transformer transformation ratio The transformation ratio is defined as the ratio or primary to secondary current. e.g. $\frac{100A}{1A}$ -> kni = 100

Polarity
This setting is used to reverse the polarity of the current transformer input. This corresponds to a rotation of the signal through 180°

Calculate 3Io
If this parameter is activated, then the total current is calculated from the three connected phase currents

Information! Note, this parameter is only valid for the 3Io input

- **Sensor**

This menu item is used to compensate the current transformer adapter PCB or current sensors can be matched.

kniV

System parameters should only be matched in individual cases.

9.2.5.4 Binary inputs (BI 1 and BI 2)

This menu item is used to configure the threshold values of binary inputs 1 and 2. Using the on and off thresholds a hysteresis threshold can be set.

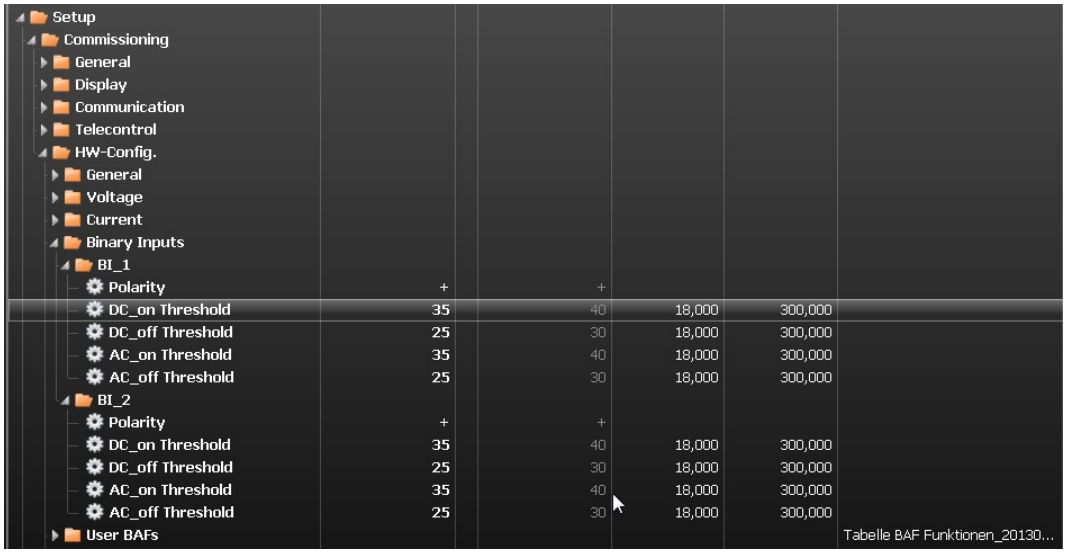


Figure 67: Switching thresholds of the binary inputs

Polarity
This setting can be used to change the polarity of the binary inputs: + : with active voltage - : without active voltage

DC_on threshold
DC voltage switch on threshold
DC_off threshold
DC voltage switch off threshold
AC_on threshold
AC voltage switch off threshold
AC_off threshold
AC voltage switch off threshold

9.2.6 User-defined output functions (uBAFs)

So-called user BAFs are user defined output functions. Several so-called output functions can be created on one so-called user BAF

Information! If a user BAF has been populated with several output functions, it is always an OR relation (disjunction) of these output functions. The linking of output functions is implemented here using a semicolon ";"

Configuration takes place using the numbers of the binary output function. You can find these in the table in Chapter 9.2.8 directly in the first column.

Information! A help file is also created in the A.Eberle Toolbox™ standard file with information about the UserBAFs and their configuration.

Figure 68: Link to the help file for configuring the userBAFs

The following aid opens:

Kombination mehrere Ausgangsfunktionen auf eine userBAF werden mit ; getrennt

Die Eingabe erfolgt als Zahlenwert

Beispiel	
Index	**Bedeutung**
5;6;7	U1_ok ODER U2_ok ODER U3_ok

Index	Funktion
1	AUS
2	PROG
3	Status
4	Störung
5	U1_ok
6	U2_ok
7	U3_ok
8	user_BAF1
9	user_BAF2
10	user_BAF3
11	user_BAF4
12	user_BAF5
13	user_BAF6
14	user_BAF7
15	user_BAF8
16	>Uerd
17	>Uerd_delay
18	Uerd_L1
19	Uerd_L2
20	Uerd_L3
21	Uerd_L1_d
22	Uerd_L2_d
23	Uerd_L3_d
24	Sum_Uerd ->L
25	Sum_Uerd ->S
26	Prio_Uerd ->L
27	Prio_Uerd ->S
28	qu2 ->L
29	qu2 ->S
30	qu2_DE ->L
31	qu2_DE ->S
32	qui ->L
33	qui ->S
34	cos ->L
35	cos ->S
36	sin ->L
37	sin ->S
38	c_s ->L
39	c_s ->S
40	OV_250 ->L

Index	Funktion
41	OV_250 ->S
42	OV_fx1 ->L
43	OV_fx1 ->S
44	OV_fx2+ ->L
45	OV_fx2+ ->S
46	OV_fx2- ->L
47	OV_fx2- ->S
48	Puls_50
49	Puls_50c
50	Puls_50c ->L
51	Puls_50c ->S
52	Puls50 LED
53	Puls_HPCI_50
54	Puls_HPCI_50 ->L
55	Puls_HPCI_50 ->S
56	Puls_HPCI_fx
57	>I
58	>I1
59	>I2
60	>I3
61	>>I
62	>>I1
63	>>I2
64	>>I3
65	>I ->
66	>I1 ->
67	>I2 ->
68	>I3 ->
69	>>I ->
70	>>I1 ->
71	>>I2 ->
72	>>I3 ->
73	>I ->S
74	>I1 ->S
75	>I2 ->S
76	>I3 ->S
77	>>I ->S
78	>>I1 ->S
79	>>I2 ->S
80	>>I3 ->S

Figure 69: Help file for userBAFs in A.Eberle Toolbox™

9.2.7 Binary input functions (BE functions)

Information! Functions are listed here (e.g. Reset all). They can be assigned to a binary input.

If more than one function is assigned to a binary input, the binary input status is used for each of the functions.

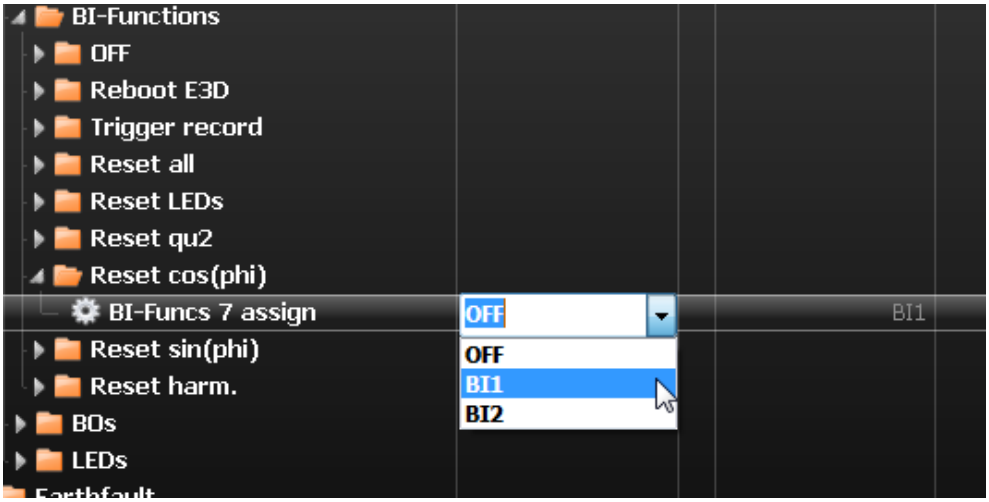


Figure 70: Assignment of a binary input function to a binary input

Binary input function	Description
OFF	No function
Reboot E3D	Restart EOR-3D
Start recording	Triggers **fault recording** via a binary input that is linked with this function.
Reset all	Reset all signals on the EOR-3D ● Location signals via the control system ● LED signals ● Indicators in the display
Reset LEDs	Resetting of ● LED indicators ● Indicators in the display
Reset qu2	Resets the signal from the transient procedure (qu2)
Reset cos(phi)	Resets the signal from the wattmetric procedure (cos(phi))
Reset sin(phi)	Resetting of the signal from the sin(phi) procedure
Reset OV	Resets the signal from the harmonic procedure (OV) here OV_250 and OV_fx1

9.2.8 Binary outputs (BOs)

The binary outputs (BOs) of the EOR-3D can be freely configured using the so-called output functions.

Caution! Please note that the number of binary outputs differs between the industrial housing (B01) and the DIN rails housing (B02) of the EOR-3D.

In the DIN rail device, BA2 and BA8 are missing! For the hardware details, please see the latest datasheet and Chapter 7.1.

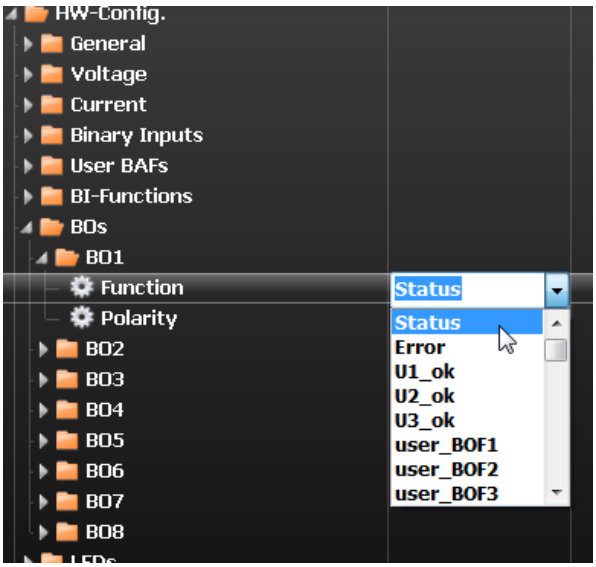


Figure 71: Selecting the output function for the binary output

Information! The output function can be **inverted** using the "**Polarity**" parameter

A so-called **user_BAF** must be used for **multiple assignment** of a binary output to different output functions. The configuration is described in 9.2.6.

The output functions are listed in the following table with a code designation. Next to this is an explanation.

Output function number	Binary output function (BAF) (parameter name)	
01	OFF	
02	PROG	Not currently used
03	Status	Status signal (live contact)
04	Failure	Fault signal
05	U1_ok	Earth conduction voltage U_{L1E} OK Measurement value is above the set threshold >U123_ok

Output function number	Binary output function (BAF) (parameter name)	ℹ
06	U2_ok	Earth conduction voltage U_{L2E} OK Measurement value is above the set threshold >U123_ok
07	U3_ok	Earth conduction voltage U_{L3E} OK Measurement value is above the set threshold >U123_ok
08	user_BAF1	User defined output function 1
09	user_BAF2	User defined output function 2
10	user_BAF3	User defined output function 3
11	user_BAF4	User defined output function 4
12	user_BAF5	User defined output function 5
13	user_BAF6	User defined output function 6
14	user_BAF7	User defined output function 7
15	user_BAF8	User defined output function 8
16	>Uerd	Earth fault threshold >Uerd exceeded
17	>Uerd_delay	Earth fault threshold >Uerd exceeded; delayed signal
18	Uerd_L1	Earth fault in L1 phase
19	Uerd_L2	Earth fault in L2 phase
20	Uerd_L3	Earth fault in L3 phase
21	Uerd_L1_d	Earth fault in L1 phase; delayed
22	Uerd_L2_d	Earth fault in L2 phase; delayed
23	Uerd_L3_d	Earth fault in L3 phase; delayed
24	Sum_Uerd ->L	Not currently used
25	Sum_Uerd ->S	Not currently used

Output function number	Binary output function (BAF) (parameter name)	
26	Prio_Uerd ->L	Prioritised forward earth fault signal
27	Prio_Uerd ->S	Prioritised backward earth fault signal
28	qu2 ->L	Forward earth fault transient
29	qu2 ->S	Backward earth fault transient
30	qu2_DE ->L	Earth fault transient with changeover to continuous earth fault (DE) forward
31	qu2_DE ->S	Earth fault transient with changeover to continuous earth fault (DE) backward
32	qui ->L	Intermittent forward earth fault
33	qui ->S	Intermittent backward earth fault
34	cos ->L	Cos(phi) (active power direction) forward
35	cos ->S	Cos(phi) (active power direction) backward
36	sin ->L	Sin(phi) (reactive power direction) forward
37	sin ->S	Sin(phi) (reactive power direction) backward
38	c_s ->L	Not currently used
39	c_s ->S	Not currently used
40	OV_250 ->L	Harmonic procedure 250Hz forward
41	OV_250 ->S	Harmonic procedure 250Hz backward
42	OV_fx1 ->L	Harmonic procedure free frequency 1 forward
43	OV_fx1 ->S	Harmonic procedure free frequency 1 backward

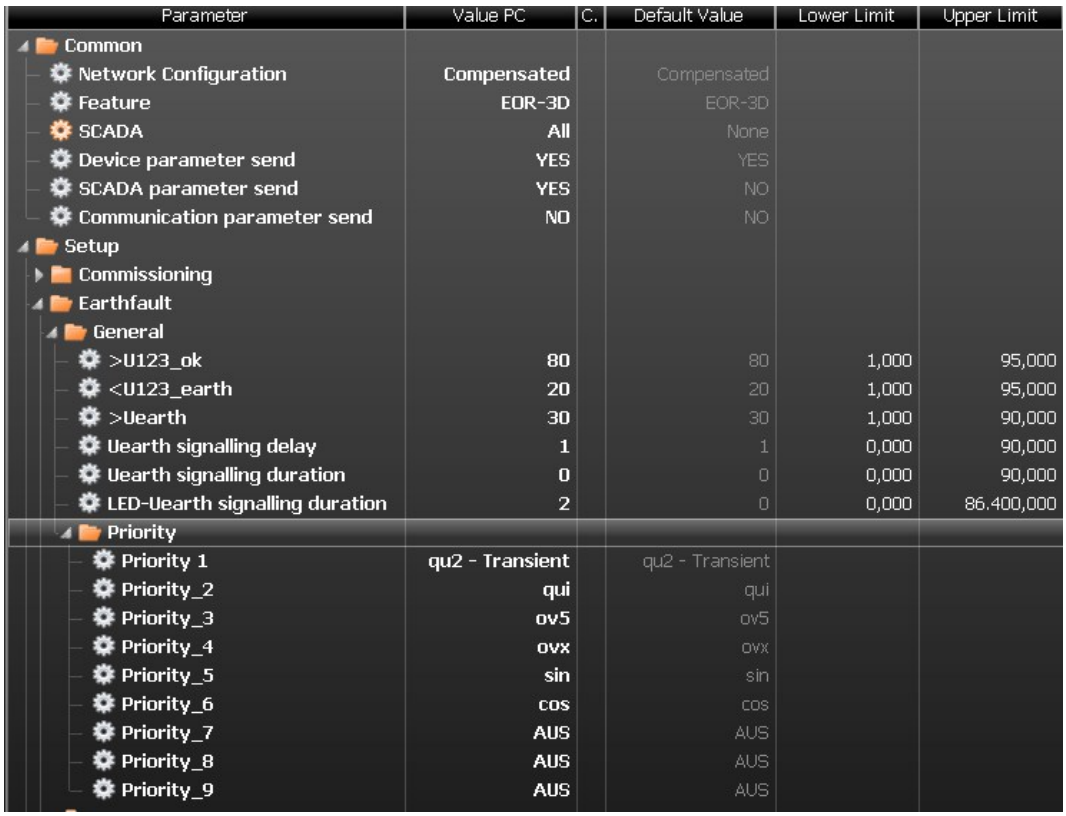
Output function number	Binary output function (BAF) (parameter name)	ℹ
44	OV_fx2+ ->L	Not currently used
45	OV_fx2+ ->S	Not currently used
46	OV_fx2- ->L	Not currently used
47	OV_fx2- ->S	Not currently used
48	Puls_50	Pulse locating signal
49	Puls_50c	Not currently used
50	Puls_50c->L	Not currently used
51	Puls_50c ->S	Not currently used
52	Puls50 LED	Pulse locating signal LED indicator
53	Puls_HPCI_50	Not currently used
54	Puls_HPCI_50 ->L	Not currently used
55	Puls_HPCI_50 ->S	Not currently used
56	Puls_HPCI_fx	Not currently used
57	>I	Central fault signal non-directional short circuit
58	>I1	Non-directional short circuit phase L1
59	>I2	Non-directional short circuit phase L2
60	>I3	Non-directional short circuit phase L3
61	>>I	Not currently used
62	>>I1	Not currently used
63	>>I2	Not currently used
64	>>I3	Not currently used
65	>I ->L	Central fault signal forward short circuit
66	>I1 ->L	Forward short circuit phase L1

Output function number	Binary output function (BAF) (parameter name)	
67	>I2 ->L	Forward short circuit phase L2
68	>I3 ->L	Forward short circuit phase L3
69	>>I ->L	Not currently used
70	>>I1 ->L	Not currently used
71	>>I2 ->L	Not currently used
72	>>I3 ->L	Not currently used
73	>I ->S	Central fault signal backward short circuit
74	>I1 ->S	Backward short circuit phase L1
75	>I2 ->S	Backward short circuit phase L2
76	>I3 ->S	Backward short circuit phase L3
77	>>I ->S	Not currently used
78	>>I1 ->S	Not currently used
79	>>I2 ->S	Not currently used
80	>>I3 ->S	Not currently used
81	Ferro Res.	Not currently used

9.3 Earth fault

Configuration of the entire earth fault locating procedure is undertaken under this menu tree.

9.3.1 General



Parameter	Value PC	C.	Default Value	Lower Limit	Upper Limit
Common					
Network Configuration	Compensated		Compensated		
Feature	EOR-3D		EOR-3D		
SCADA	All		None		
Device parameter send	YES		YES		
SCADA parameter send	YES		NO		
Communication parameter send	NO		NO		
Setup					
Commissioning					
Earthfault					
General					
>U123_ok	80		80	1,000	95,000
<U123_earth	20		20	1,000	95,000
>Uearth	30		30	1,000	90,000
Uearth signalling delay	1		1	0,000	90,000
Uearth signalling duration	0		0	0,000	90,000
LED-Uearth signalling duration	2		0	0,000	86.400,000
Priority					
Priority 1	qu2 - Transient		qu2 - Transient		
Priority_2	qui		qui		
Priority_3	ov5		ov5		
Priority_4	ovx		ovx		
Priority_5	sin		sin		
Priority_6	cos		cos		
Priority_7	AUS		AUS		
Priority_8	AUS		AUS		
Priority_9	AUS		AUS		

>U123_ok

Using this the three conductor-earth voltagesL1, L2, L3 can be monitored for an adjustable threshold. If the threshold is exceeded, a signal >U123_ok is issued.

<U123_erd

Using this the three conductor-earth voltagesL1, L2, L3 can be monitored for an adjustable threshold. If the threshold is undershot, a signal <U123_erd is issued.

>Uerd

Using this the three conductor-earth voltagesL1, L2, L3 can be monitored for an adjustable threshold. If the threshold is exceeded, a signal >U123_ok is issued.

<U123_erd

Using this the three conductor-earth voltagesL1, L2, L3 can be monitored for an adjustable threshold. If the threshold is undershot, a signal <U123_erd is issued.

>Uerd
This parameter is used to set the earth fault threshold. If the threshold is overshot, evaluation of the earth fault locating procedure is enabled. This parameter applies universally to all earth fault locating procedures.
Uerd - signalling delay
This adjustable time is used to delay the issuing of the general earth fault signal Uerd.
Uerd - signalling extension
The output (relay, control system) of the general earth fault signal is extended by the adjustable time.
LED-Uerd - signalling extension
If the Uerd signal is shunted to an LED, then the time set here applies for a signal extension

- **Priority**

  The priority of the individual earth fault locating procedures can be set here. This means that only the earth fault locating procedure that is activated with the maximum priority can output a signal. The signals

  - Prio_Uerd->L (line direction)
  - Prio_Uerd->S (busbar direction)

  are provided for this prioritisation.

9.3.2 qu2 (earth fault transient)

9.3.2.1 Functional Description

The qu2 procedure (earth fault transient) evaluates the charging process of the two fault-free conductors in the earth fault occurrence.

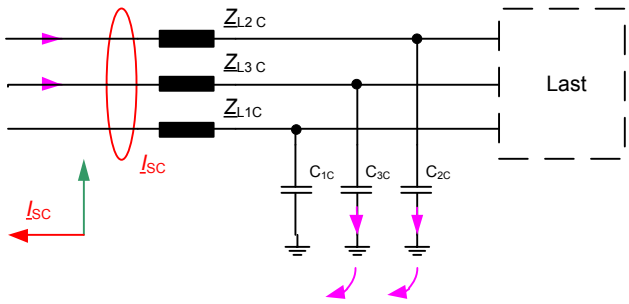


Figure 72: Charging process fault-free output

The curve of the zero sequence voltage can be described in a simplified manner by the following equation: $u_0(t) = \frac{1}{C}\int_o^t i_o(\tau)d\tau$. Here it can be seen that a voltage can only be generated if a current flows across the conductor-earth capacitance. As a result a current flows that leads the voltage by 90°. The integral of the current can here be interpreted as the accumulated charge q. Consequently in the fault-free output, the voltage is proportional to the charge. If uo and q are now plotted against each other in a graph, the result for a fault-free output is always a straight line with a positive gradient.

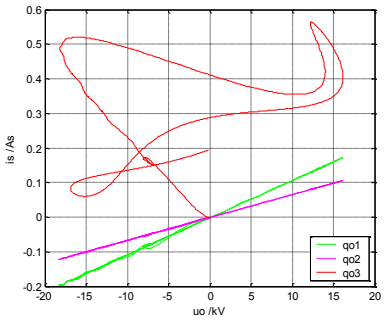


Figure 73: Direction determination qu2 procedure

For the faulty output, there is, dependent on the fault resistance, a straight line with a negative gradient or the direction determination occurs based on the rotation (corresponds to the surface area or curvature of the curve)

Fault-free output:	Straight line with positive gradient
Faulty output:	Straight line with negative gradient or rotation

9.3.2.2 Setting instructions

Parameter descript for the qu2 procedure (earth fault transient)

Transient active
Activation of the qu2 procedure
Ice min
If the zero sequence voltage has exceeded the threshold value, then a minimum current must also flow before the device generates a signal. This parameter is used to specify the minimum value for the fault-free residual network (primary value). The trigger value can be estimated from the undeleted earth fault current: $I_{ce,min} = I_{CE} \cdot 0.05$
Rot./Grad.
The ratio Rotation / Gradient (Rot./Grad.) is determined when the rotation or the gradient is used for direction evaluation. Here if Rot./Grad. < set value then the gradient is used to determine the direction.
Continuous earth fault. after
If the zero sequence voltage remains greater than the triggering threshold for longer than the set time, then this is detected as a continuous earth fault. Accordingly the signal qu2_DE is then output.

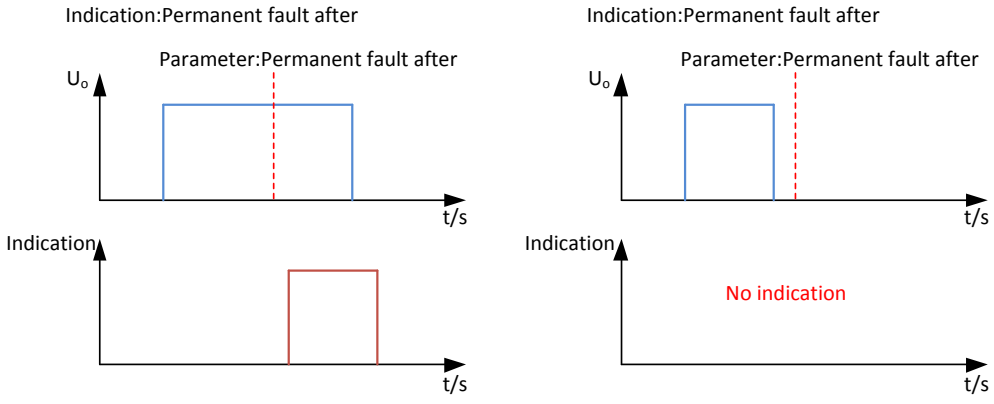


Figure 74: Earth fault transient signal with a continuous earth fault

Signal extension
The earth fault transient signal is automatically reset after the set time has elapsed. Applies for binary outputs and LT signals.
LED signal extension
If the earth fault transient signal is configured to an LED, then the LED indicator is automatically reset after the set time has elapsed.

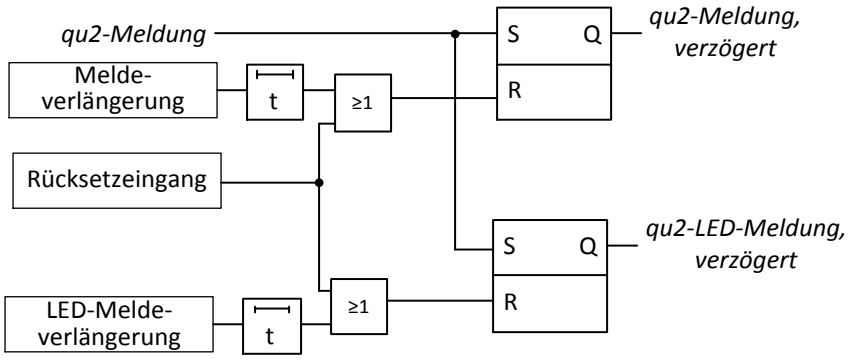


Figure 75: Signal extension qu2

Information! A setting of 0s in the signal extension or LED signal extension causes a continuous signal with the qu2 procedure

Type of signal
This parameter specifies whether the qu2 signal is ● Retriggerable (the latest qu2 signal is always output) or ● Not retriggerable (first qu2 signal is saved until active resetting of the signal)
LCD_log active
This parameter enables entry of qu2 results in the LCD log book. (Output via the display)

9.3.2.3 Parameter

Parameter	Adjustment option	Presetting
Transient active	▶ **Yes** ▶ **No**	Yes
Ice min	0 to 3000A	5A
Rot./Grad.	0 to 360	50
DE active	▶ **Yes** ▶ **No**	Yes
Continuous earth fault. after	0 to 60 s	1 s
Signal extension	0 to 90 s 0 ≙ Hold signal	2s
LED signal extension	0 to 86400 s 0 ≙ Hold signal	2s
Type of signal	▶ **retriggerable** ▶ **not retriggerable**	retriggerable
LCD-log active	▶ **yes** ▶ **no**	yes

9.3.3 qui - re-igniting earth fault detection

9.3.3.1 Functional Description

In the qui procedure, the transient process is used for the re-igniting fault. It is essential that the zero sequence voltage no longer exceeds the trigger threshold. The increase in the zero sequence voltage due to the re-igniting represents only a fraction of the maximum zero sequence voltage. In this procedure there is also a correct display, if during the re-igniting fault network switching occurs; here the earth fault indication tracks the fault.

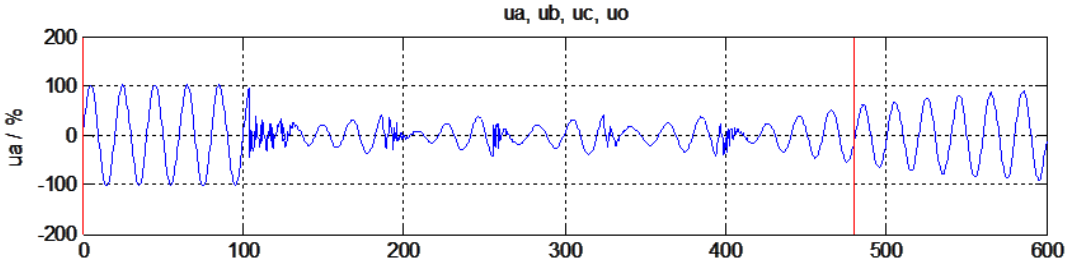


Figure 76: Conductor-earth voltage U_{L1}

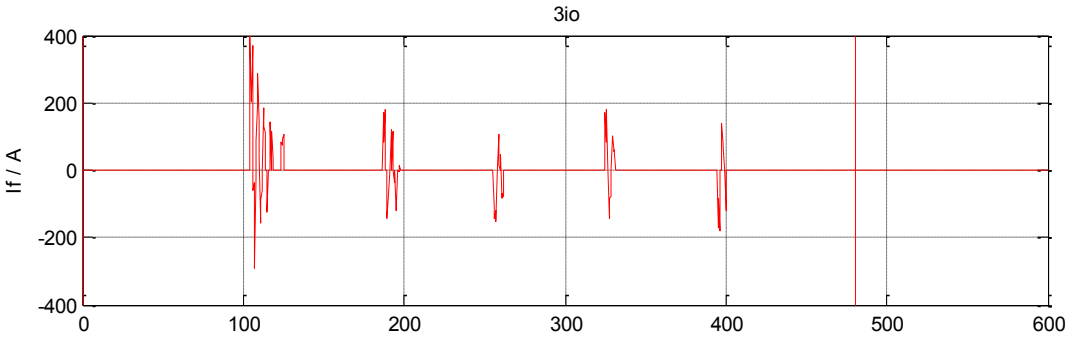


Figure 77: Fault current

Figure 76: show the behaviour of a re-igniting fault. The conductor-earth voltage UL1 is none-zero during the entire earth fault. The fault current itself is attenuated a few milliseconds after the current zero crossing. The network under consideration here is a compensated network, consequently the conductor-earth voltage UL1 increases only very slowly. During this increase, the conductor-earth voltage increases to a value of 2 - 6 kV, until a re-ignition recreates the fault path. The voltage upon re-igniting depends on various parameters and is not constant even during the earth fault.

Measurement value recording in network conductor systems normally determine a voltage mean value over 200 - 1000 ms. Consequently a re-igniting fault cannot be detected. This fault type would thus always be detected as a high-resistance, stationary earth fault.

9.3.3.2 Setting instructions

Parameter description for the qui procedure

qui active
Activating the qui procedure (intermittent earth fault)
Threshold dUo
With an intermittent earth fault, the zero sequence voltage must change by at least this adjustable threshold. Figure 78:

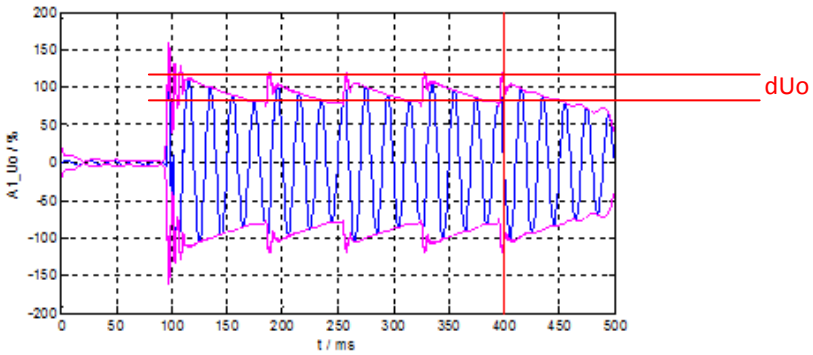


Figure 78: dUo threshold

Ice min.
Minimum current so that a direction decision or signal can be issued.
Monitoring window
The number of igniting pulses is determined in the monitoring window. The number of igniting pulses must be reached for a direction indication.
Number of re-ignitions
Number of igniting pulses that must be reached for a direction decision.
Signal extension
The qui signal is automatically reset after the set time has elapsed. Applies for binary outputs and LT signals
LED signal extension
If the qui signal is configured to an LED, then the LED indicator is automatically reset after the set time has elapsed.
LCD_log active
This parameter enables entry of qui results in the LCD log book.

- **Cyclical log**

  The cyclical log book entry is only active in earth fault cases, when a measurement value set is recorded in the log book according to the configured time interval.

Cyclical log
Activates the cyclical log book entry
Time interval
Configurable time interval for the cyclical log book entry.

9.3.3.3 Parameter

Parameter	Adjustment option	Presetting
qui active	▶ **Yes** ▶ **No**	Yes
Threshold dUo	0 to 150%	15%
Ice min.	0 to 300A	5A
Monitoring window	200 to 1000ms	400ms
Number of re-ignitions	2 to 1000	2
Signal extension	0 to 90 s	2s
LED signal extension	0 to 86400 s	2s
LCD-log active	▶ **yes** ▶ **no**	yes
Cyclical log	▶ **Yes** ▶ **No**	Yes
Time interval	1 to 1000s	60s

9.3.4 Harmonic procedure OV_250Hz, OV_fx1

9.3.4.1 Functional Description

In the EOR-3D, the harmonic procedure firstly evaluates the 5th harmonic (OV_250Hz), while on the other hand two parameter sets (OV_fx1, OV_fx2) are available for a free frequency. In this procedure, stationary earth fault conditions are prerequisite.

When monitoring the 5th harmonic, a compensated network can, as a first approximation, be considered as an isolated network, because the impedance of the electrical coil is increased by a factor of 5 ($X_{ESP}=\omega L_{ESP}$). Consequently the reactive power procedure can be used for earth fault locating or direction determination. The disadvantage is that the 250Hz zero sequence voltage does not underlie the 100% value rather time of day load fluctuations. This can be avoided through the feeding in of defined frequencies (e.g. ripple control installation).

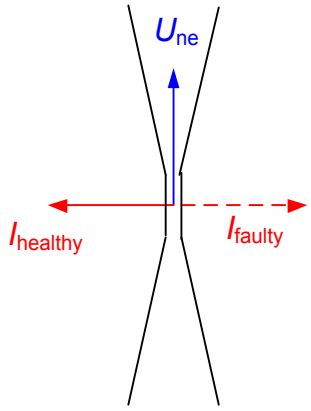


Figure 79: Direction determination procedure (OV_250,OV_fx1)

Information! Text Text
OV_250Hz and OV_fx1 are identical in their function. The difference is that in the OV_fx1 procedure the frequency is freely selectable.

9.3.4.2 Setting instructions

- Parameter description for the harmonic procedure for the 5th harmonic

Harm_250Hz active
Activates the harmonic procedure for the 5th harmonic
Ice min.
Minimum current so that a direction decision or signal can be issued. Caution, refers to the current of the 5th harmonic. The following formula can be used as a basis for estimating the minimum current: $I_{fx} = I_{CE} \frac{f_{fx}}{f_{50hz}} \frac{U_{fx}}{U_{50}} U_{erd}$ I_{CE}: capacitive network earth fault current at 50 Hz f_{fx}: Frequency of the harmonic in Hz $\frac{U_{fx}}{U_{50}}$: Ratio of harmonic voltage to fundamental (conductor-conductor)
Min. angle
Minimum angle that must be exceeded to ensure an indication is output. This parameter is used to allow for angular errors of the current and voltage transformers.
Measurement cycles
The same earth fault direction must always be specified for the specified number of measurement cycles.
Signal delay
The harmonic signal is only output once the set time has elapsed.
Signal extension
The harmonic signal is automatically reset after the set time has elapsed. Applies for binary outputs and LT signals
LED signal extension
If the harmonic signal is configured to an LED, then the LED indicator is automatically reset after the set time has elapsed.
LCD_log active
This parameter enables entry of qui results in the LCD log book.

- **Cyclical log**

  The cyclical log book entry is only active in earth fault cases, when a measurement value set is recorded in the log book according to the configured time interval.

Cyclical log
Activates the cyclical log book entry
Time interval
Configurable time interval for the cyclical log book entry.

9.3.4.3 Parameter

Parameter	Adjustment option	Presetting
Harm_250Hz active	▶ **Yes** ▶ **No**	No
Ice min.	0 to 3000A	1A
Min. angle	0 to 180°	5°
Measurement cycles	0 to 10	3
Signal delay	0 to 90 s	0s
Signal extension	0 to 90 s	0s
LED signal extension	0 to 86400 s	2s
LCD-log active	▶ **yes** ▶ **no**	yes
Cyclical log	▶ **Yes** ▶ **No**	Yes
Time interval	1 to 1000s	60s

9.3.5 Harmonic procedure with free frequency OV_fx1

9.3.5.1 Setting instructions

- Parameter description for the harmonic procedure with free frequency OV_fx1.

OV_fx1 active
Activates the harmonic procedure for a free frequency.
fx1
This parameter is used to set the frequency to be detected.
Ice min.
Minimum current so that a direction decision or signal can be issued. Caution, refers to the current of the 5th harmonic. The following formula can be used as a basis for estimating the minimum current: $I_{fx} = I_{CE} \frac{f_{fx}}{f_{50hz}} \frac{U_{\mathrm{fx}}}{U_{50}} U_{erd}$ I_{CE}: capacitive network earth fault current at 50 Hz f_{fx}: Frequency of the harmonic in Hz $\frac{U_{fx}}{U_{50}}$: Ratio of harmonic voltage to fundamental (conductor-conductor)
Min. angle
Minimum angle that must be exceeded to ensure an indication is output. This parameter is used to allow for angular errors of the current and voltage transformers.
Measurement cycles
The same earth fault direction must always be specified for the specified number of measurement cycles.
Signal delay
The harmonic signal is only output once the set time has elapsed.
Signal extension
The harmonic signal is automatically reset after the set time has elapsed. Applies for binary outputs and LT signals

LED signal extension
If the harmonic signal is configured to an LED, then the LED indicator is automatically reset after the set time has elapsed.
LCD_log active
This parameter enables entry of qui results in the LCD log book.

- **Cyclical log**

  The cyclical log book entry is only active in earth fault cases, when a measurement value set is recorded in the log book according to the configured time interval.

Cyclical log
Activates the cyclical log book entry
Time interval
Configurable time interval for the cyclical log book entry.

9.3.5.2 Parameter

Parameter	Adjustment option	Presetting
OV fx1 active	▶ **Yes** ▶ **No**	No
fx1	0 to 500Hz	217Hz
Ice min.	0 to 3000A	1A
Min. angle	0 to 180°	5°
Measurement cycles	0 to 10	3
Signal delay	0 to 90 s	0s
Signal extension	0 to 90 s	0s
LED signal extension	0 to 86400 s	2s
LCD-log active	▶ **yes** ▶ **no**	yes
Cyclical log	▶ **Yes** ▶ **No**	Yes
Time interval	1 to 1000s	60s

9.3.6 Wattmetric Cos(phi) procedure

9.3.6.1 Functional Description

In the cos(phi) procedure, the measured total current Io is extrapolated to form the zero sequence voltage Uo. Then the active component is calculated from the total current. Here the direction of this active current is decisive for signalling the earth fault in the forward or backward direction.

In this procedure it also important that the measurement values Io and Uo are accurately measured. This is primarily dependent on the angular accuracy of the current and voltage transformers.

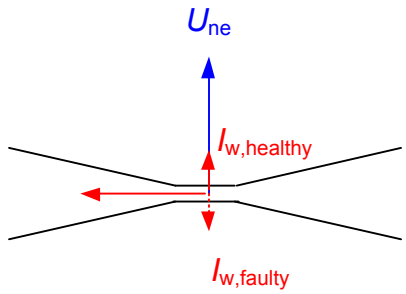


Figure 80: Direction determination cos(phi) procedure

9.3.6.2 Setting instructions

- Parameter description for the cos(phi) procedure

Cos(phi) active
Activates the cos(phi) procedure
Iw min
Minimum resistive fraction of the total current at the output. Here the trigger value can be estimated using the following formula: Rule of thumb: $I_{w,min} = 0.25 \cdot 0.03 \cdot I_{CE,Netz}$ The total active component of the network can initially be estimated as 3% v. $I_{CE,Netw}$, or e.g. read directly from the electrical coil controller. The trigger value is then determined by multiplying with a safety factor (f_A=25%).

Min. angle
Minimum angle that must be exceeded to ensure an indication is output. This parameter is used to allow for angular errors of the current and voltage transformers. Example: I_{CE} = 100A → I_W = 3A With an angular error of 2° this gives an apparent active current of 1.7A. This means that outputs with large, capacitive fractions can lead to incorrect displays because of angular errors.
Measurement cycles
The same earth fault direction must always be specified for the specified number of measurement cycles.
Save active
This parameter causes saving of the wattmetric signal. This means that if an earth fault now switches to other outputs without earth fault interruption (switching action), then the output which no longer has an earth fault is still indicated. The signals remain until resetting.
Signal delay
The cos(phi) signal is only output once the set time has elapsed.
Signal extension
The cos(phi) signal is automatically reset after the set time has elapsed. Applies for binary outputs and LT signals
LED signal extension
If the cos(phi) signal is configured to an LED, then the LED indicator is automatically reset after the set time has elapsed.
LCD_log active
This parameter enables entry of cos(phi) signals in the LCD log book.

- **Cyclical log**

  The cyclical log book entry is only active in earth fault cases, when a measurement value set is recorded in the log book according to the configured time interval.

Cyclical log
Activates the cyclical log book entry
Time interval
Configurable time interval for the cyclical log book entry.

9.3.6.3 Parameter

Parameter	Adjustment option	Presetting
Cos(phi) active	▶ **Yes** ▶ **No**	Yes
Iw min	0 to 1000A	1A
Min. angle	0 to 90°	2°
Measurement cycles	0 to 10	3
Save active	▶ **Yes** ▶ **No**	No
Signal delay	0 to 90 s	0s
Signal extension	0 to 90 s	0s
LED signal extension	0 to 86400 s	2s
LCD-log active	▶ **yes** ▶ **no**	yes
Cyclical log	▶ **Yes** ▶ **No**	Yes
Time interval	1 to 1000s	60s

9.3.7 Sin(phi) procedure for isolated networks

9.3.7.1 Functional Description

This procedure is favoured for use in isolated networks. Here the sin(phi) procedure evaluates the fundamental of the zero sequence voltage and total current. In this procedure, stationary conditions are prerequisite.

In the isolated network there are, due to the high capacitive currents, unique conditions for measuring the direction of the fault. The advantage of this procedure is that the angular accuracy requirement for the current and voltage transformers is low. For a direction decision here only a 90° decision is made.

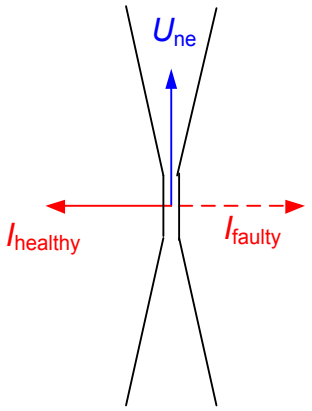


Figure 81: Direction evaluation sin(phi) - procedure

9.3.7.2 Setting instructions

- Parameter description for the sin(phi) procedure

sin(phi) active
Activates the sin(phi) procedure
Ib min
Minimum current of the fundamental so that a direction decision or signal can be issued. This value relates to the total, capacitive network earth fault current. Rule of thumb: $Ib_{min} = 0.05 \cdot I_{CE,Netz}$

Min. angle
Minimum angle that must be exceeded to ensure an indication is output. This parameter is used to allow for angular errors of the current and voltage transformers.
Measurement cycles
The same earth fault direction must always be specified for the specified number of measurement cycles.
Signal delay
The sin(phi) signal is only output once the set time has elapsed.
Signal extension
The sin(phi) signal is automatically reset after the set time has elapsed. Applies for binary outputs and LT signals
LED signal extension
If the sin(phi) signal is configured to an LED, then the LED indicator is automatically reset after the set time has elapsed.
LCD_log active
This parameter enables entry of sin(phi) signals in the LCD log book.

- **Cyclical log**

  The cyclical log book entry is only active in earth fault cases, when a measurement value set is recorded in the log book according to the configured time interval.

Cyclical log
Activates the cyclical log book entry
Time interval
Configurable time interval for the cyclical log book entry.

9.3.7.3 Parameter

Parameter	Adjustment option	Presetting
Sin(phi) active	▶ **Yes** ▶ **No**	No
Ib min	0 to 1000A	5A
Min. angle	0 to 90°	5°
Measurement cycles	0 to 10	3
Signal delay	0 to 90 s	0s
Signal extension	0 to 90 s	0s
LED signal extension	0 to 86400 s	2s
LCD-log active	▶ **yes** ▶ **no**	yes
Cyclical log	▶ **Yes** ▶ **No**	Yes
Time interval	1 to 1000s	60s

9.3.8 Pulse locating

9.3.8.1 Functional Description

A pulsing current is produced by a clock system, which usually is on the power auxiliary winding of the Petersen coil, that can only be measured up to the fault location. By toggling capacitors, there is a current change towards full compensation. In this way, the total current at the faulty output is reduced and increased at the fault-free outputs.

During pulse locating a capacitor is switched on at a neutral point with a frequency of approximately 0.5Hz. This detuning changes the zero current through the neutral point. With low resistance faults, this current can only flow through the fault location. The voltage of the fault-free conductors relative to earth remains constant, so that the capacitive currents at the fault-free outputs also remain constant. Changing of the zero current with a 0.5Hz rhythm can thus only be measured in the earth fault afflicted output.

With high resistance earth faults, a coupling to the fault-free outputs is created. By changing the current across the fault location the impedance Z_f changes as a result; the zero sequence voltage Une and consequently also the voltage relative to earth in the fault-free conductors also change. This results in the capacitive current to earth in the fault-free conductors also changing. Because of this relationship, with symmetrical pulsing and high-resistance earth faults, it is not possible to differentiate between faulty and good conductors.

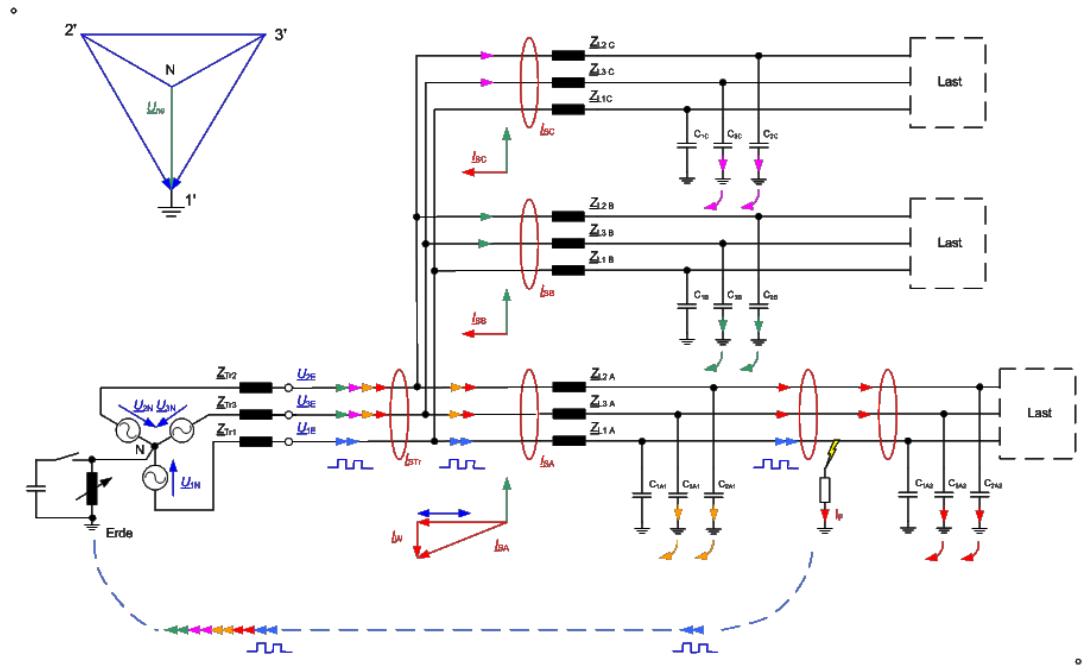


Figure 82: Pulse locating principle

Help is provided by asymmetric pulsing. In this type of pulsing, the capacitor is switched on for 1 second and off for 1.5 seconds (pulse interval ratio 1:1.5). This pattern can be repeated as often as necessary. It can easily be shown that with over-compensation the resulting

current changes in the fault-free output are the inverse of the change in the faulty output. Consequently, even for high-resistance transition resistances in the faulty conductor, a criterion for differentiating between the faulty and fault-free conductors exists.

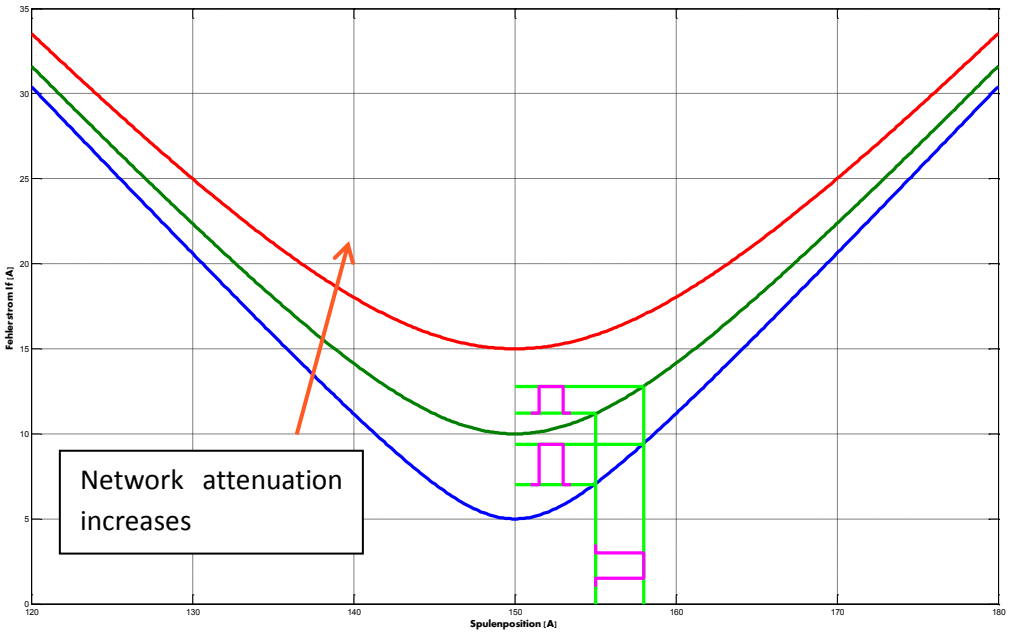


Figure 83: Timing pulse with different attenuation ≙ I_w

Figure 83: Clarifies again the influence of attenuation on the transferred pulse current. It can be seen that with increasing attenuation (V-curve becomes flatter) the transferred pulse becomes smaller. Consequently it is essential that when using pulse locating, appropriate detuning is selected.

9.3.8.2 Setting instructions

- Parameter description for the pulse locating procedure

Pulse 50hz active
Activates the pulse locating procedure
Pulse Uen active
Evaluation of the pulse locating even without the zero sequence voltage being connected. This enables depth locating even in substations without voltage measurement.
Pulse T_on
Switch on time of the detuning capacitor

Pulse T_off
Cycle time interval. The detuning capacitor is switched off during this time
Pulse min
This parameter, together with the pulse window, determines the sensitivity of the pulse locating procedure. A ratio values is obtained from the two values which can be applied to the know cycle current. e.g. Pulse min = 3 Pulse window = 5 $\rightarrow \frac{3}{5} = 0.6$
Pulse window
The device searches in the immediately preceding seconds (moving monitoring window) for the pulse pattern.

Information! The pulse locating procedure does **not** evaluate any current pulses! (A spectrum is evaluated)

Signal extension
The pulse locating signal is automatically reset after the set time has elapsed. Applies for binary outputs and LT signals
LCD_log active
This parameter enables entry of pulse locating signals in the LCD log book.
Minimum dIe
This parameter is used to specify the necessary minimum current change of the pulse pattern

Information! The value is derived from earth fault engineering. As part of this activity, the cycle power must be matched to the network size.

- **Cyclical log**

  The cyclical log book entry is only active in earth fault cases, when a measurement value set is recorded in the log book according to the configured time interval.

Cyclical log
Activates the cyclical log book entry
Time interval
Configurable time interval for the cyclical log book entry.

9.3.8.3 Parameter

Parameter	Adjustment option	Presetting
Pulse 50Hz active	▶ **Yes** ▶ **No**	No
Pulse Uen active	▶ **Yes** ▶ **No**	No
Pulse T_on	0 to 10 s	1 s
Pulse T_off	0 to 10 s	15 s
Pulse min	0 to 10	3
Pulse window	0 to 10	5
Signal extension	0 to 86400 s	0s
LCD-log active	▶ **yes** ▶ **no**	yes
Cyclical log	▶ **Yes** ▶ **No**	Yes
Time interval	1 to 1000s	60s

9.4 Short circuit; over current indication

The EOR-3D provides directional and non-directional (default) short circuit indication (over current).

Information! Die directional short circuit / overcurrent indication is a software feature and can be ordered

9.4.1 non directional over current indication

9.4.1.1 Description

The non-directional short circuit indication is based on phase current levels.

It is possible to parameterize two levels for a definite time over current indication. $I_{>}$ and $I_{>>}$ and the corresponding time delays $t_{>}$ and $t_{>>}$ can be adjusted.

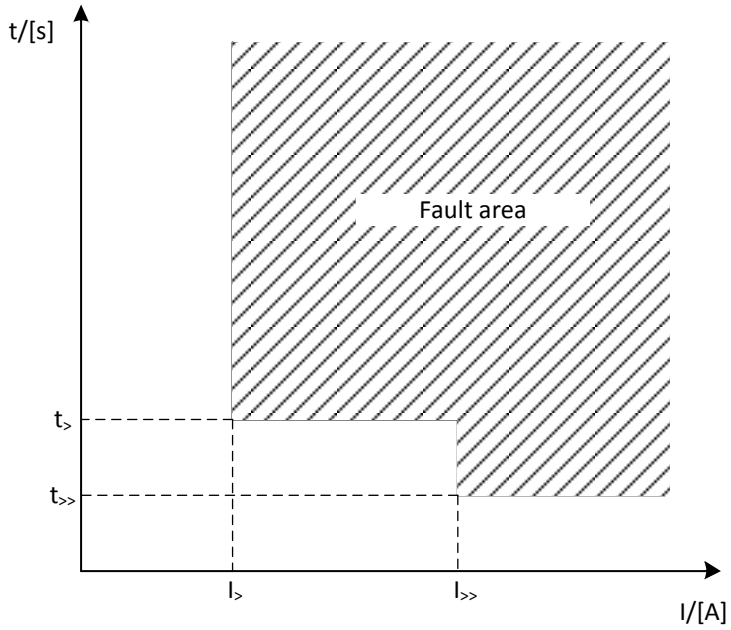


Table 3: Definite time over current indication levels EOR-3D

9.4.1.2 Remarks for the settings

Following each parameter is described

Short circuit
Parameterization non-directional over current indication
SC active
Activates the non-directional over current indication
Signalling duration
The short circuit indication can be extended by this time duration. Counts for binary outputs and remote protocoll indications.
LED-signalling duration
The LED indication time refers to the optical indication on the device. It's related to the LED and the flash indication on the display.

▶ **I> (1. Definite level)**

$I_>$ active
Activates the first level
I_k min 1
Current trigger value. Set as primary value.
T min.1
Time delay for I>. If I_kmin 1 is exceeded the EOR-3D will indicate after the set time delay.

▶ **I>> (2. Definite level)**

$I_>$ active
Activates the second level
I_k min 2
Current trigger value. Set as primary value.
T min.2
Time delay for I>>. If I_kmin 2 is exceeded the EOR-3D will indicate after the set time delay.

The trigger level for the indication should be set with a security factor higher than the maximum load current. The lowest possible over current (short circuit current) must be taken into consideration on the other hand.

Information! To the message delay, the **inherent time** of the EOR-3D must be added. It is **40 ms** typically!

9.4.1.3 Settings

Setting	Adjustment option	Default setting
SC active	▶ **YES** ▶ NO	YES
Signalling duration	0 to 86400s	15 s
LED-signalling duration	0 to 86400s	15s
I> active	▶ **YES** ▶ NO	YES
I_k min 1	10 to 10000A	200A
T min.1	0.2 to 2s	0.2s
I>> active	▶ **YES** ▶ NO	YES
I_k min 2	10 bis 10000A	400A
T min.2	0.02 bis 2s	0.04s

9.4.2 Directional over current indication

The settings for the current limits are the same as for the non-directional overcurrent indication.

The directional overcurrent indication is an order feature.

Information! For the directional overcurrent indication, the measurement of the three phase voltages is mandatory.

SC directional
Activates the directional overcurrent evaluation

9.4.2.1 Settings

SC directional active	▶ **YES** ▶ **NO**	YES

9.5 Recorder

Under the Recorder menu item, there are setting options for fault recording.

Figure 84: Fault recorder settings

Pretrigger in Per.
This parameter specifies how many periods (n*20ms) prior to the trigger event (history) are displayed in the fault record.
Posttrigger in ms
Recording duration of the fault record
Retrigger in ms
This parameter is used to trigger a new trigger event (fault record) during a fault. This setting indicates at what intervals the renewed fault recording is triggered.
Regtrigger-duration in ms
This parameter indicates the recording duration of a fault record that has been triggered by a retrigger.
Max. number of fault records
Specifies the maximum number of fault records that can be saved on the SD card

9.5.1 Parameter

Parameter	Adjustment option	Presetting
Pretrigger in Per.	1 to 11	5
Posttrigger in ms	1 to 100,000 ms	3000 ms
Retrigger in ms	1 10,000 ms	-1ms

Information! Text Text
The -1ms entry for this parameter deactivates the retrigger function

Max. no. of fault records	1 to 10000	1000

9.6 Log book

Figure 85: Log book settings

System time check
Parameter not currently used
Time change inp.
Enables entry of time changes, which have been received via the control system or time signal (DCF77) in the log book.
LED event inp.
This parameter can be used to decide whether in addition to the normal signals of the locating procedure the LED signals are also entered in the log book.

9.6.1 Parameter

Parameter	Adjustment option	Presetting
System time check	Parameter not currently used	Parameter not currently used
Time change inp.	▶ **Yes** ▶ **No**	No
LED event inp.	▶ **Yes** ▶ **No**	No

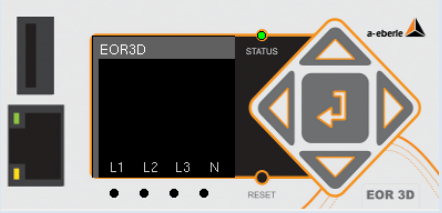
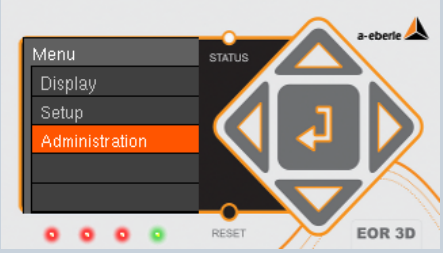
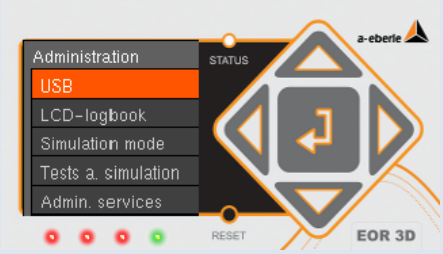
9.7 Data transfer via USB stick

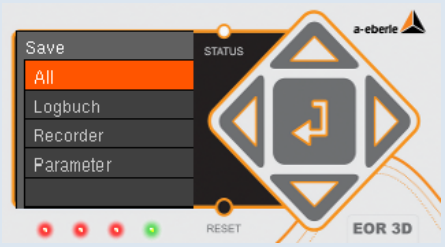
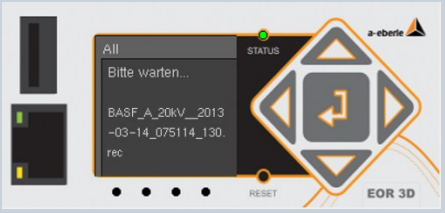
The EOR-3D also o of transferring data via the USB stick (parameters, log files and fault records). The following files can be transferred:

- Log book
- Recorder (fault record)
- Parameter files (ini)

Either all three categories or each category can be transferred individually.

The procedure for this is as follows:

Display	Information
	Plug the empty USB stick into the USB port Press the -key twice in a row
	Select Administration and confirm by pressing the -key
	Select USB and confirm by pressing the -key
	Select save and confirm by pressing the -key

	Select All and confirm by pressing the  -key
	Transfer starts
	Downloading of all files was successful or is completed

10. Signal list (control system)

The following protocols are currently available for signals from the EOR-3D to the control system:

- MODBUS
- IEC 60870-5-101
- IEC 60870-5-103 with fault record data transfer
- IEC 60870-5-104
- DNP 3.0 (upon request)
- Other protocols upon request

Information! The control system connection is made directly from the EOR-3D. No external device is necessary.

The following signals, commands and measurement values are available:

Binary output function (BAF) (parameter name)	
OFF	
PROG	Not currently used
Status	Status signal (live contact)
Failure	Fault signal
U1_ok	Earth conduction voltage U_{L1E} OK Measurement value is above the set threshold >U123_ok
U2_ok	Earth conduction voltage U_{L2E} OK Measurement value is above the set threshold >U123_ok
U3_ok	Earth conduction voltage U_{L3E} OK Measurement value is above the set threshold >U123_ok
user_BAF1	User defined output function 1
user_BAF2	User defined output function 2
user_BAF3	User defined output function 3
user_BAF4	User defined output function 4
user_BAF5	User defined output function 5
user_BAF6	User defined output function 6
user_BAF7	User defined output function 7

Binary output function (BAF) (parameter name)	
user_BAF8	User defined output function 8
>Uerd	Earth fault threshold >Uerd exceeded
>Uerd_delay	Earth fault threshold >Uerd exceeded; delayed signal
Uerd_L1	Earth fault in L1 phase
Uerd_L2	Earth fault in L2 phase
Uerd_L3	Earth fault in L3 phase
Uerd_L1_d	Earth fault in L1 phase; delayed
Uerd_L2_d	Earth fault in L2 phase; delayed
Uerd_L3_d	Earth fault in L3 phase; delayed
Sum_Uerd ->L	Not currently supported
Sum_Uerd ->S	Not currently supported
Prio_Uerd ->L	Prioritised forward earth fault signal
Prio_Uerd ->S	Prioritised backward earth fault signal
qu2 ->L	Forward earth fault transient
qu2 ->S	Backward earth fault transient
qu2_DE ->L	Earth fault transient with changeover to continuous earth fault (DE) forward
qu2_DE ->S	Earth fault transient with changeover to continuous earth fault (DE) backward
qui ->L	Intermittent forward earth fault
qui ->S	Intermittent backward earth fault
cos ->L	Cos(phi) (active power direction) forward
cos ->S	Cos(phi) (active power direction) backward
sin ->L	Sin(phi) (reactive power direction) forward
sin ->S	Sin(phi) (reactive power direction) backward
c_s ->L	Not currently supported
c_s ->S	Not currently supported

Binary output function (BAF) (parameter name)	
OV_250 ->L	Harmonic procedure 250Hz forward
OV_250 ->S	Harmonic procedure 250Hz backward
OV_fx1 ->L	Harmonic procedure free frequency 1 forward
OV_fx1 ->S	Harmonic procedure free frequency 1 backward
OV_fx2+ ->L	Not currently supported
OV_fx2+ ->S	Not currently supported
OV_fx2- ->L	Not currently supported
OV_fx2- ->S	Not currently supported
Puls_50	Pulse locating signal
Puls_50c	Not currently supported
Puls_50c->L	Not currently supported
Puls_50c ->S	Not currently supported
Puls50 LED	
Puls_HPCI_50	Not currently used
Puls_HPCI_50 ->L	Not currently used
Puls_HPCI_50 ->S	Not currently used
Puls_HPCI_fx	Not currently used
>I	Central fault signal non-directional short circuit
>I1	Non-directional short circuit phase L1
>I2	Non-directional short circuit phase L2
>I3	Non-directional short circuit phase L3
>>I	Not currently used
>>I1	Not currently used
>>I2	Not currently used
>>I3	Not currently used
>I ->L	Central fault signal forward short circuit

Binary output function (BAF) (parameter name)	
>I1 ->L	Forward short circuit phase L1
>I2 ->L	Forward short circuit phase L2
>I3 ->L	Forward short circuit phase L3
>>I ->L	Not currently used
>>I1 ->L	Not currently used
>>I2 ->L	Not currently used
>>I3 ->L	Not currently used
>I ->S	Central fault signal backward short circuit
>I1 ->S	Backward short circuit phase L1
>I2 ->S	Backward short circuit phase L2
>I3 ->S	Backward short circuit phase L3
>>I ->S	Not currently used
>>I1 ->S	Not currently used
>>I2 ->S	Not currently used
>>I3 ->S	Not currently used
Ferro Res.	Not currently used

Binary input function	
OFF	No function
Reboot E3D	Restart EOR-3D
Start recording	Triggers **fault recording** via a binary input that is linked with this function.
Reset all	Reset all signals on the EOR-3D ● Location signals via the control system ● LED signals ● Indicators in the display
Reset LEDs	Resetting of ● LED indicators ● Indicators in the display
Reset qu2	Resets the signal from the transient procedure (qu2)
Reset cos(phi)	Resets the signal from the wattmetric procedure (cos(phi))
Reset sin(phi)	Resetting of the signal from the sin(phi) procedure
Reset OV	Resets the signal from the harmonic procedure (OV) here OV_250 and OV_fx1

Measurement values	
UI_value_1	Absolute value Uo in V (secondary)
UI_value_2	Absolute value U1 in V (secondary)
UI_value_3	Absolute value U2 in V (secondary)
UI_value_4	Absolute value U3 in V (secondary)
UI_value_5	Absolute value Io in mA (secondary)
UI_value_6	Absolute value I1 in mA (secondary)
UI_value_7	Absolute value I2 in mA (secondary)
UI_value_8	Absolute value I3 in mA (secondary)
UI_angle_1	Angle Uo in degrees, phase angle Uo
UI_angle_2	Angle U1 in degrees, phase angle U1 (L1_N)
UI_angle_3	Angle U2 in degrees, phase angle U2 (L2_N)
UI_angle_4	Angle U3 in degrees, phase angle U3 (L3_N)
UI_angle_5	Angle Io in degrees, phase angle Io
UI_angle_6	Angle I1 in degrees, phase angle I1
UI_angle_7	Angle I2 in degrees, phase angle I2
UI_angle_8	Angle I3 in degrees, phase angle I3
UI_d_angle_1	**Angle (Uo_Io) in degree / angle between Uo and Io**
UI_d_angle_2	**Angle (U1_I1) in degree / angle between U1 and I1**
UI_d_angle_3	**Angle (U2_I2) in degree / angle between U2 and I2**
UI_d_angle_4	**Angle (U3_I3) in degree / angle between U3 and I3**
Up_1	Absolute value Uo in kV (primary) / primary value Uo
Up_2	Absolute value U1 in kV (primary) / primary value U1
Up_3	Absolute value U2 in kV (primary) / primary value U2
Up_4	Absolute value U3 in kV (primary) / primary value U3
U12p_0	Absolute value(U12) / U12 value

Measurement values	
U12p_r_0	Active component U12 / real part voltage U12
U12p_i_0	Reactive component U12 / imaginary part voltage U12
wU12_0	Angle U12
P_1	Active power Zero sequence component Po in kW
P_2	Active power Phase_1 P1 in kW
P_3	Active power Phase_2 P2 in kW
P_4	Active power Phase_3 P3 in kW
Q_1	Reactive power Zero sequence component Qo in kVar
Q_2	Reactive power Phase_1 Q1 in kVar
Q_3	Reactive power Phase_2 Q2 in kVar
Q_4	Reactive power Phase_3 Q3 in kVar
S_1	Apparent power Zero sequence component So in kVA
S_2	Apparent power Phase_1 S1 in kVA
S_3	Apparent power Phase_2 S2 in kVA
S_4	Apparent power Phase_3 S3 in kVA
Pg_0	Total active power (P1+P2+P3) in kW
Qg_0	Total reactive power (Q1+Q2+Q3) in kVar
Sg_0	Total apparent power (S1+S2+S3) in kVA

11. Battery replacement

Information! A back-up battery is fitted in the EOR-3D. This is only used for the internal clock (RTC). The parameters, fault records and calibration data of the EOR-3D are saved in a **non-volatile memory**.

With **no** power supply, the time is maintained for at least 10 years.

12. Firmware

12.1 EOR-3D firmware update

There are two options for carrying out an EOR-3D firmware update. Using the software A.Eberle Toolbox™ or directly using a USB stick, which has been loaded in the office with the so-called Update Matrix ready for the update.

When is a firmware update worthwhile?

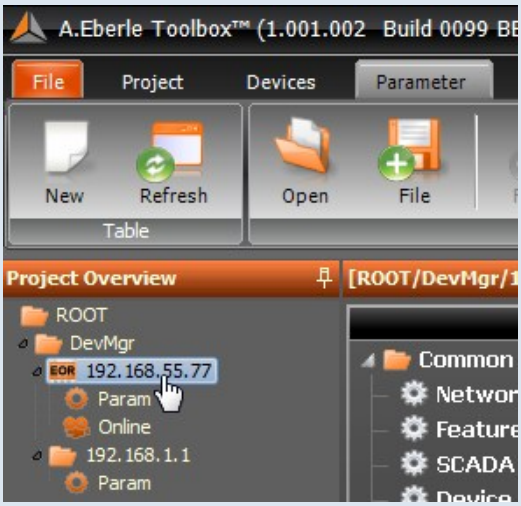
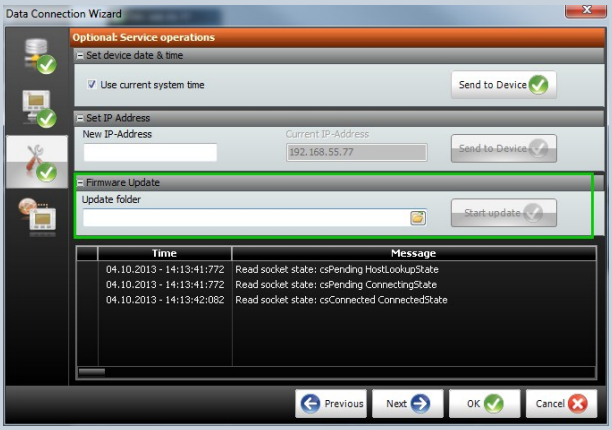
- If new algorithms are available for earth fault or short circuit detection.
- If new protocols are available for the control system connection
- The device firmware is more than 3 years old

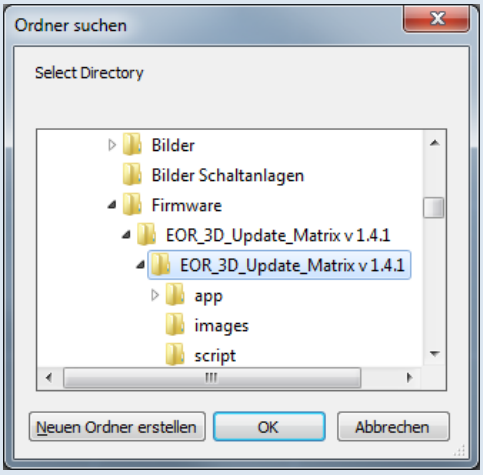
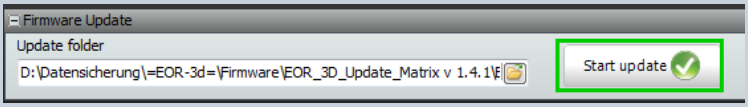
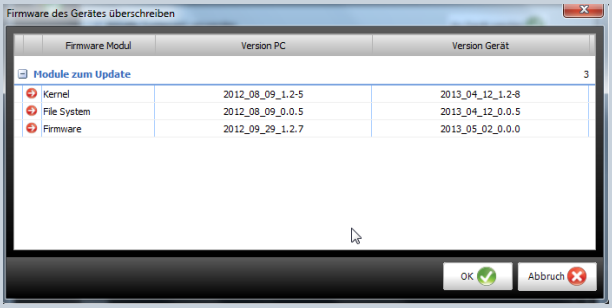
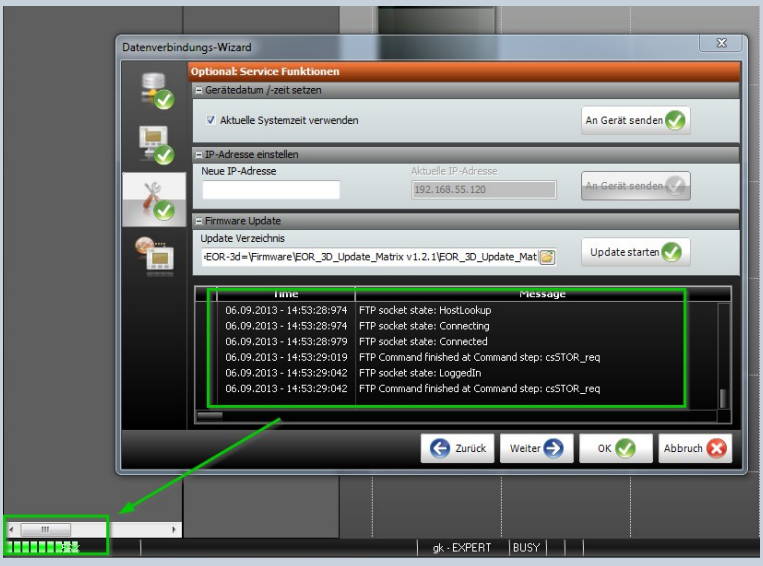
Information! You can query the current firmware version using the Connecting wizard.

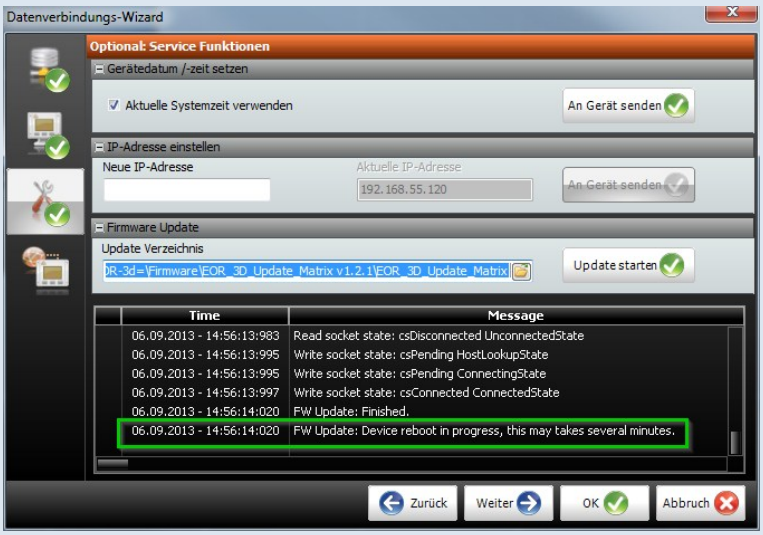
12.1.1 Firmware update via A.Eberle Toolbox™

A firmware update can also be executed via the A.Eberle Toolbox. The following steps are necessary for the update.

- Ensure that a connection exists between the PC and the EOR-3D via a network cable
- Check that the firmware that you want to download is up-to-date. Go to our website www.a-eberle.de under the download area

Step	A.Eberle Toolbox Screen
1. Select the EOR-3D from the project list by **double clicking**. The connection wizard opens	
2. In the connection wizard, select the option **Firmware update**	

Step	A.Eberle Toolbox Screen
3. Select the folder on your PC, where the firmware (Update Matrix) is saved.	
4. Now you can start the update.	
A comparison appears indicating the differences between the firmware in the device and the update file	
5. Starting of the update must be confirmed	OK → Start update Abort → Cancel update
6. Update progress can be monitored in the log window and the progress bar	

Step	A.Eberle Toolbox Screen
Once the update is complete, the EOR-3D automatically restarts. This may take a few minutes	
7. After the update the EOR-3D is performing a reboot	

Information! There are three modules in the EOR-3D firmware. Kernel, file system and firmware. When updating, a comparison is always carried out to determine in which module there are differences. **Only** the **differences** are updated.

- If the firmware module in the device and the update file are identical → no update
- If the firmware module in the device and the update file are different → Update

A. Eberle GmbH & Co. KG

Frankenstr. 160
D-90461 Nueremberg

Tel.: +49 (0) 911 / 62 81 08-0
Fax: +49-(0)911-62 81 08 96
E-mail: info@a-eberle.de

http://www.a-eberle.de

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