Combined Earth Fault and Short Circuit Indicator

EOR-3D

▶ **Industrial housing (B01)**

1. Application

The EOR-3D combines earth fault and short circuit detection in a compact device. In particular, the advantages of different locating methods can be combined. For the first time, prioritization and thus weighting of the locating procedure is possible. The device is designed for the detection of a single discharge. By combining the methods, it is particularly suitable for substations. Of course, the advantages of the following methods can also be used directly in the transformer station.

1.1 Location method for use in compensated networks

- Transient earth fault detection using the qu2 and qui algorithms for
  - single faults
  - intermittent faults (qui)
  - fault in loops with large circul. currents (qu2)
- **Active power direction** or cos(φ) method (suitable transducers required)
- **Harmonics method** with measurement of the associated reactive power direction for a user selectable frequency
- Pulse location
- Directional or non-directional short-circuit indicator with configurable reset time

1.2 Location method for use in isolated networks

- Transient earth fault detection using the qu2 and qui algorithms for
  - single faults
  - restriking faults (qui)
  - fault in loops with large circul. currents (qu2)
- Reactive power direction or sin(φ) method
- Directional or non-directional short-circuit indicator with configurable reset time

1.3 SCADA connection

The EOR-3D offers a lot of different SCADA protocols, that can be used stand alone or in parallel. By using protocols in parallel the EOR-3D can be also used as a gateway or RTU.

Following protocols are available:

- IEC 60870-5-101 / 104
- IEC 60870-5-103 including fault log
- DNP 3.0
- IEC 61850 GOOSE
- Modbus RTU (RS232, RS485, TCP/IP)
- Modbus Master for up to 6 devices

1.4 PLC functionality

With the programming language LUA customer specific solutions can be implemented in the EOR-3D. Therefor it is also possible to share information between several EOR-3Ds via Ethernet and realize certain functions based on these shared information.

1.5 General Features

- Up to **32 GB** memory for event recorder & log book
- Extra long fault recording
- Network interface for configuration and data collection with **free software AEToolbox**
- USB 2.0 interface for quick transfer of log book and fault records
- Local connection of the devices via network
- Data acquisition with traditional **transducers** (100 V AC, 1 A / 5 A)

1.6 IT-Security (since firmware 2.0)

The EOR-3D connects **encrypted (TLSv1.2 + SFTP)** with the free parameterization software AEToolbx.

Via a user/role concept the devices can be set up **password protected**. The access via TCP (AEToolbox) and EOR-3D front panel can be configured independently.

2. Characteristics

2.1 qu2 algorithm (transient)

With the qu2 algorithm, transient earth faults can be selectively detected to a few kΩ. In the zero sequence system the healthy outputs can be considered as capacitors. To obtain a voltage shift $u_{0(t)}$, these capacitors have to be charged. This charge is created with the null current $i_{0(t)}$ and results in the charge $q_{0(t)}$. With healthy outputs this yields the equation $q_{0(t)} = C_0 \, u_{0(t)}$. When $u_{0(t)}$ is plotted on the x-axis and $q_{0(t)}$ on the y-axis of the qu-graph, this gives a straight line for healthy outputs. This behavior does not apply for faulty outputs. Figure 1 shows this behavior for a low impedance earth fault.

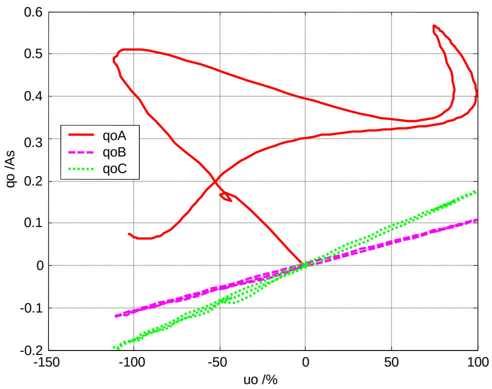


Figure 1: qu-graph for a low impedance earth fault

In parallel lines and meshed networks, circulating currents occur that can lead to an erroneous display. The improved qu2 algorithm eliminates this influence through linearization to the operating point and a downstream, non-linear filter. This algorithm is thus the first algorithm that really works in a meshed network and performs a successful, directional evaluation

This results in the following properties for the qu2 algorithm:

- Suitable for earth faults up to several kΩ
- The triggering threshold of the voltage shift u_{NE}
- The triggering current as an equivalent phase-earth capacitance
- Suppression of the earth fault in response to a selectable minimum duration of the earth fault (continuous earthing message)
- Suppression of the earth fault indication in the direction of the busbar is possible
- Reset of the indication by an external signal, automatically after a specified period or at the end of the earth fault
- For the evaluation, either the measured or calculated u_{NE} from the three phase-earth voltages can be used
- Recording of the transient events in the logbook
- Recording of the associated fault record with 10 periods of pre-event history and an adjustable post-event history length (several seconds)
- Errors due to higher-frequency signals are greatly reduced by integral evaluation
- The qu2 algorithm, in comparison with the standard transient method, uses a much larger time range for the evaluation of the fault direction

2.2 qui algorithm (restriking and intermittent earth faults)

Restriking faults occur especially in cable networks. Figure 2 shows the change in the voltage of the faulty phase and Figure 3 shows the corresponding change in the voltage shift. In the measurement, a mean value of the voltage over 10 periods is usually taken. As a result, this restriking fault is interpreted as a high-impedance fault and the failure location starts in the transmission line network, rather than in the area of the cable section. A further complication is that the usual stationary location methods, such as the cos (φ) method of stationary conditions would lead to the fault location and this non-linear method for the restriking cannot be properly evaluated. The corresponding directional indications are arbitrary and do not help with the fault location.

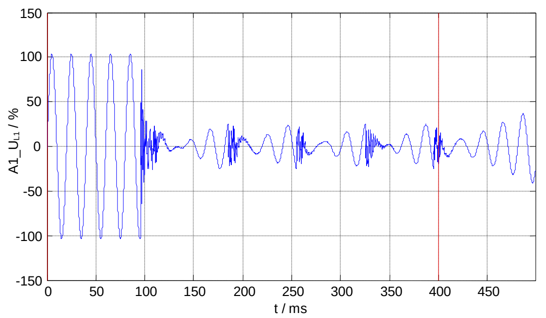


Figure 2: Voltage of the faulty conductors

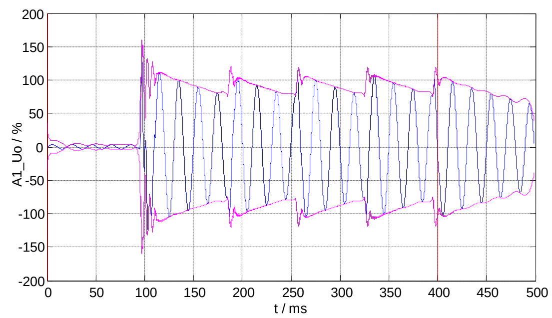


Figure 3: $u_0(t)$ with a restriking fault

The qui algorithm is based on the proven qu algorithm and is adapted to the intermittent fault only in terms of the parameter. A modified parameter set is required when, for example, the shift voltage no longer falls below the threshold value for the earth fault detection.

This results in the following essential properties for the qui algorithm:

- Directional indication also during restriking and intermittent earth faults
- The indication tracks the fault, i.e. if the faulty segment changes while creating the open connection in the circuit to the other output, with the qui method the indication also changes
- Fault location can already be performed during the restriking error
- Fault location can already be started on the faulty cable output because there is no misinterpretation of a high-impedance fault
- The recording of the events in the log book (coming, going) is configurable
- A cyclic record of the measured values in the log book during the fault can be configured for subsequent evaluation

2.3 Reactive power direction method for isolated networks: sin(φ)

- The trigger thresholds for the voltage shift U_{NE} and the total current $3I_0$ are configurable
- For the evaluation, either the measured or calculated U_{NE} from the three phase-earth voltages can be selected. The same applies for the total current $3I_0$
- In the reactive power direction method, the requirements for the accuracy of the angle between current and voltage transformers are less
- Suppression of the earth fault indication in the direction of the busbar is possible
- The recording of the events in the log book (coming, going) is configurable
- A cyclic record of the measured values in the log book during the fault can be configured. Thus, a more detailed analysis of the fault is possible

2.4 Active power direction method for compensated networks: cos(φ)

- The trigger thresholds for the voltage shift U_{NE} and the total current $3I_0$ are configurable
- Selectable operating modes:
  - Fault tracking indication of the direction of the active power in the null system
  - Stored indication of the active residual current increase
- Reset of the indication by an external signal: automatically after a specified period or at the end of the earth fault can be selected and combined
- Suppression of the earth fault indication in the direction of the busbar is possible
- The recording of the events in the log book (coming, going) is configurable
- A cyclic record of the measured values in the log book during the fault can be parameterized for subsequent evaluation
- When using the active power direction method, the accuracy of the angle between current and voltage transformers must be monitored

2.5 Harmonics method

- The evaluation is made using the sin(φ) method, however the frequency can be freely selected
- The method can be used in both isolated and compensated networks
- The recording of the events in the log book (coming, going) is configurable
- A cyclic record of the measured values in the log book during the fault can be configured for subsequent evaluation

2.6 Pulse location

- The trigger threshold of the pulse amplitude of the total current $3I_0$ is configurable
- The stationary part of the null current is removed automatically during the recognition of the pulse pattern
- Reset of the indication by an external signal or automatically after a specified period can be selected and combined
- A simple depth positioning is possible due to the pulse location
- Symmetrical and asymmetrical pulsing can be configured

2.7 Non-directional short circuit

- Adjustable activation threshold
- Automatic indication reset after a set time or via a digital input

2.8 Directional short circuit

- Directional indication through evaluation of the phase-earth voltages
- Adjustable activation threshold
- Automatic indication reset after a set time or via a digital input
- Timing of LED and relay separately adjustable

2.9 Applicability of the methods

The following table shows the possible use of EOR-3D, depending on the placement of the Analog Input board.

Available transformers / sensors				Transient qu2	Restriking qui	sin(φ)	cos(φ)	Harmonics	Pulse	Short Circuit
I_0	$3{\cdot}I_L$	U_0	$3{\cdot}U_L$							
x									x	
x		x		x	x	x	x	x	x	
x	x								x	x
	x								x	x
	x		x	x	x	x	x	x*	x	x
	x	x		x	x	x	x	x*	x	x
	x	x	x	x	x	x	x	x*	x	x
x	x		x	x	x	x	x	x*	x	x
x	x	x		x	x	x	x	x	x	x
x	x	x	x	x	x	x	x	x	x	x

Legend of minimum requirements for class of accuracy of transducers and sensors:		
(orange)		> cl. 1
(green)		<= cl. 1
(blue)		<= cl. 0.5 + phase sensors / transducers preselected regarding error in amplitude and angle

* only applies for phase sensors/transducers, not for I_0 or U_0 sensors/transducers

2.10 SCADA connection

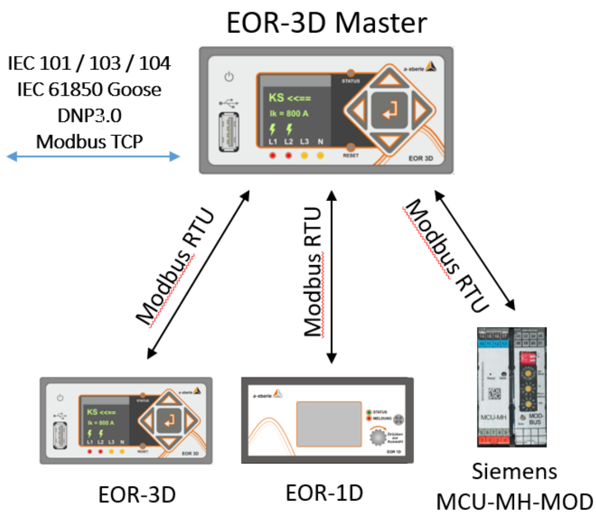
The EOR-3D offers a lot of different SCADA protocols, that can be used stand alone or in parallel. By using protocols in parallel the EOR-3D can be also used as a gateway or RTU.

Following protocols are available:

- IEC 60870-5-104
- IEC 60870-5-103 including fault log
- EC 60870-5-101
- DNP 3.0
- IEC 61850 GOOSE
- Modbus RTU (RS232, RS485, TCP/IP)
- Modbus Master for up to 6 devices

2.11 Modbus Master functionality

With help of the Modbus Master functionality the EOR-3D can connect up to 6 devices (independent from device vendor) via Modbus RTU and convert the data into another protocol. This way the EOR-3D can work as a SCADA gateway or RTU.



For switch gears, where a motor control unit (MCU) is installed for switching of circuit breakers, this way it is possible to connect MCU units via Modbus.

Furthermore it is also possible to supervise in a switch gear one feeder with an EOR-3D incl. RTU functionality and additional feeders with EOR-1Ds.

2.12 PLC functionality

With the programming language LUA customer specific solutions can be implemented in the EOR-3D. Therefor it is also possible to share information between several EOR-3Ds via Ethernet and realize certain functions based on these shared information.

Beside the serial connection via Modbus RTU there can be for example be a separate TCP/IP connection between two EOR-Ds established, without the necessity of a switch. In case of the customer specific function „cross calibration“, via a LUA background program, feeder 2 (capacitive voltage measurement cl. 3) can be periodically compared with and recalibrated by feeder 1 (resistive voltage measurement cl. 0.5).

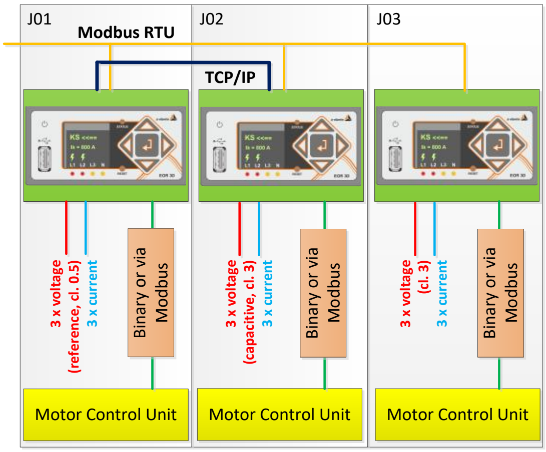


Figure 4: Cross calibration for one feeder

In case several feeders shall be cross calibrated by feeder 1, this can be realized by the additional use of a switch.

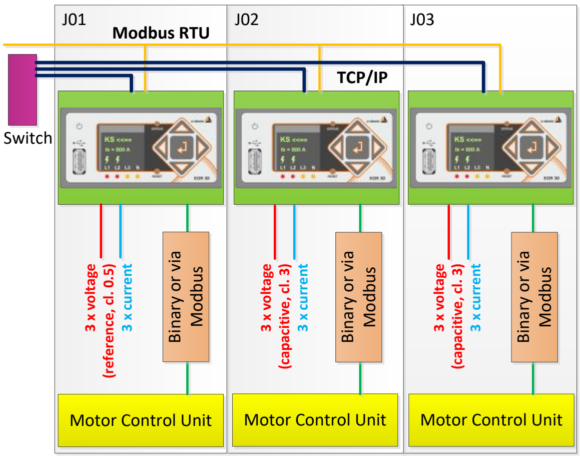


Figure 5: Cross calibration for several feeders

2.13 Fault recorder

- Recording with a sampling frequency ≥ 2 kHz
- Recording of all analogue channels, all digital inputs and relay outputs as well as all internal digital process decisions
- Due to 4 GB internal memory, very long periods can be monitored
- The recording is made in CSV format (Comma-Separated Values), and can be read directly
- The recordings can be converted using the operating software into COMTRADE format

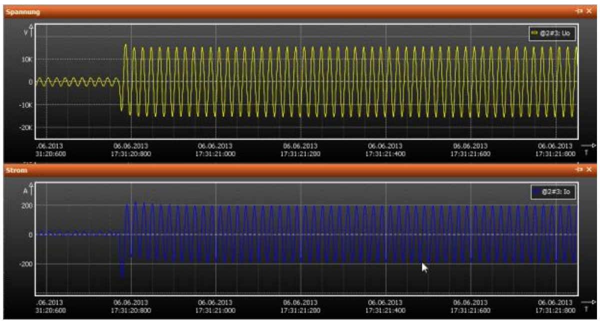


Figure 6: Fault record example Uo and Io

- The binary signals can be displayed as well

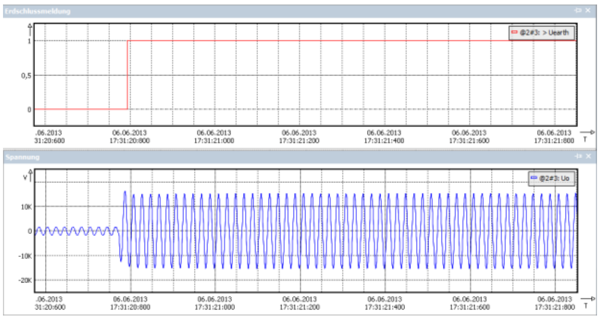
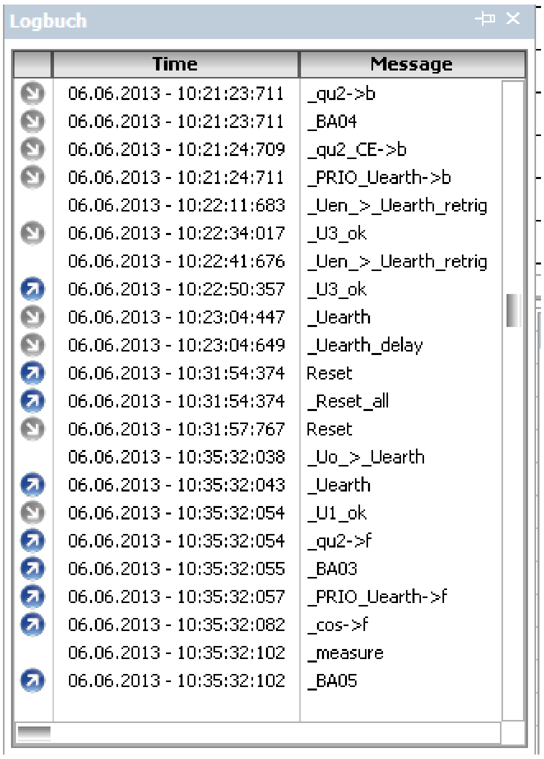


Figure 7: Fault record view incl. binary signal

- View the fault records directly in the software
- Comtrade file import via drag and drop

2.14 Log book

- Display of important signal directly at the EOR-3D
- Detailed log book recording can be read via operating software AEToolbox
- Recording in ASCII format and directly readable
- Recordable events can be configured
- Cyclic input of measurement values during the fault possible
- Results of calculations e.g. I_{CE} at the outputs
- Parameterized mapping of the relay in plain text


Logbuch

Time	Message
06.06.2013 - 10:21:23:711	_qu2->b
06.06.2013 - 10:21:23:711	_BA04
06.06.2013 - 10:21:24:709	_qu2_CE->b
06.06.2013 - 10:21:24:711	_PRIO_Uearth->b
06.06.2013 - 10:22:11:683	_Uen_>_Uearth_retrig
06.06.2013 - 10:22:34:017	_U3_ok
06.06.2013 - 10:22:41:676	_Uen_>_Uearth_retrig
06.06.2013 - 10:22:50:357	_U3_ok
06.06.2013 - 10:23:04:447	_Uearth
06.06.2013 - 10:23:04:649	_Uearth_delay
06.06.2013 - 10:31:54:374	Reset
06.06.2013 - 10:31:54:374	_Reset_all
06.06.2013 - 10:31:57:767	Reset
06.06.2013 - 10:35:32:038	_Uo_>_Uearth
06.06.2013 - 10:35:32:043	_Uearth
06.06.2013 - 10:35:32:054	_U1_ok
06.06.2013 - 10:35:32:054	_qu2->f
06.06.2013 - 10:35:32:055	_BA03
06.06.2013 - 10:35:32:057	_PRIO_Uearth->f
06.06.2013 - 10:35:32:082	_cos->f
06.06.2013 - 10:35:32:102	_measure
06.06.2013 - 10:35:32:102	_BA05

Figure 8: EOR-3D Logfile

2.15 Data logger

- Recording of measured operating values with adjustable sampling period
- The following are recorded: U, I, P, Q, S, 50 Hz

2.16 Digital inputs can be used as analogue voltage measurement

The digital inputs are configured as additional analog inputs.

- The digital inputs can be used for additional voltage measurements
- The trigger thresholds are adjustable by software

2.17 Digital outputs (relay)

- Signals can be inverted by software
- Multiple signals can be combined by software (OR-operation, invertible)
- 2 relays with changeover contacts; monostable
- 6 relays with normally open contacts; bistable

2.18 Hardware architecture

The hardware architecture of the EOR-3D B01 industrial housing is the following:

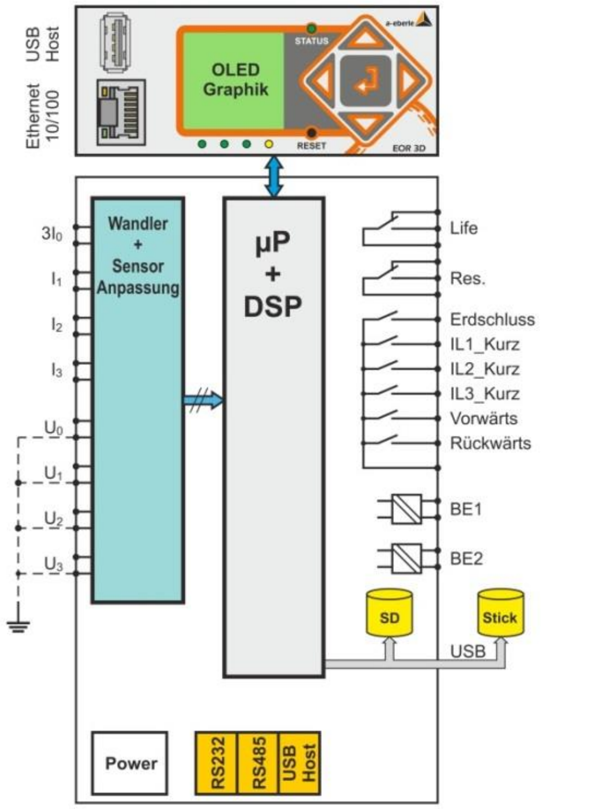


Figure 9: Hardware architecture of the EOR-3D industrial housing

3. Application software AE-Toolbox

The following functions are available in the application software.

3.1 Configuring of EOR-3Ds

- Communication via TCP/IP
- System configuration
- Comparison of the parameterization and creation of difference lists
- Activation of the various earth fault and short circuit detection methods
- Setting the trigger levels
- Configuration of the signalling (LEDs, relays and combined signalling)
- Configuration of the EOR-3D's display sequence
- Configuration of the integrated SCADA

3.2 Support for easy commissioning

- Online service page
- Digital input and output testing
- Simulation of all input, output functions and analogue values for simple SCADA commissioning
- Display of all measurements:
  - U, I, P, Q, S, φ
  - 50 Hz and harmonics
- Graphic display of the measured values in a vector diagram

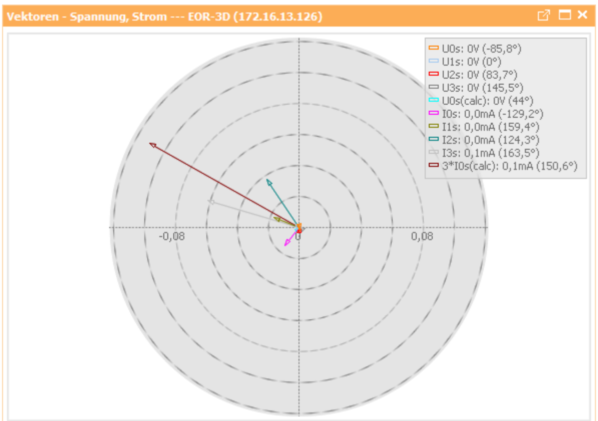


Figure 10: Vector diagram of the measurement values

- Primary examination of the direction of the power transformer in a healthy network with earth fault compensation during normal operation. This test requires no additional accessories.

3.3 IT-Security / User management

Since firmware 2.0 of EOR-3D the parameterization software AEToolbox communicates **encrypted** with the devices (AEToolbox >= 2.0 necessary).

Via a user/role concept the devices can be set up **password protected**. The access via TCP (AEToolbox) and EOR-3D front panel can be configured independently.

The activation and configuration of the user/role concept is done in AEToolbx on the tab "User Management". For the access via TCP the following roles are available:

- User (read only)
- Operator (read+write)
- Admin (r+w and security relevant parameters)

The user name and password are freely chooseable for TCP connections. It's also possible to define several users in the same role.

For the access via panel of EOR-3D only the users and roles User and Operator are available. The password is a four digit numeric code.

Single users can also explicitly be locked. This way it is possible to have e.g. read only access to the EOR-3D panels or to lock the panel completely.

3.4 Fault analysis

- Log book download and display
- Time synchronization of multiple log books
- Presentation of the events in digital traces
- Download of the recorded fault records
- Conversion of fault records into COMTRADE format
- Events in the fault record as binary traces

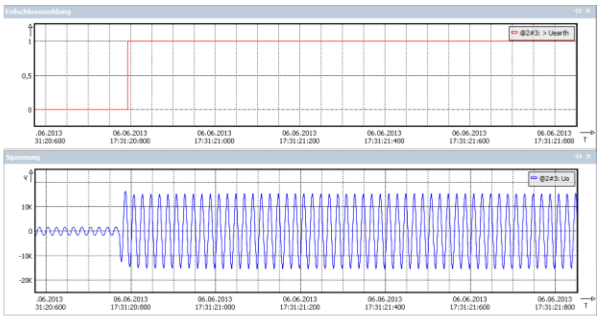


Figure 11: Fault record view incl. binary signal

3.5 AEToolbox projects for single devices and device pools

The software AEToolbox is project based. Each project can be saved as a project file in *.aepx format. But it is also possible to export single parameter setups or online pages.

Per project it is possible to have only one device or several devices in one device pool included. Furthermore it is possible to have several device pools and other A.Eberle devices included, e.g. REG-DP(A)s.

A detailed manual of the different functions of AEToolbox is available within the AEToolbox installation or on the A.Eberle homepage within the download center.

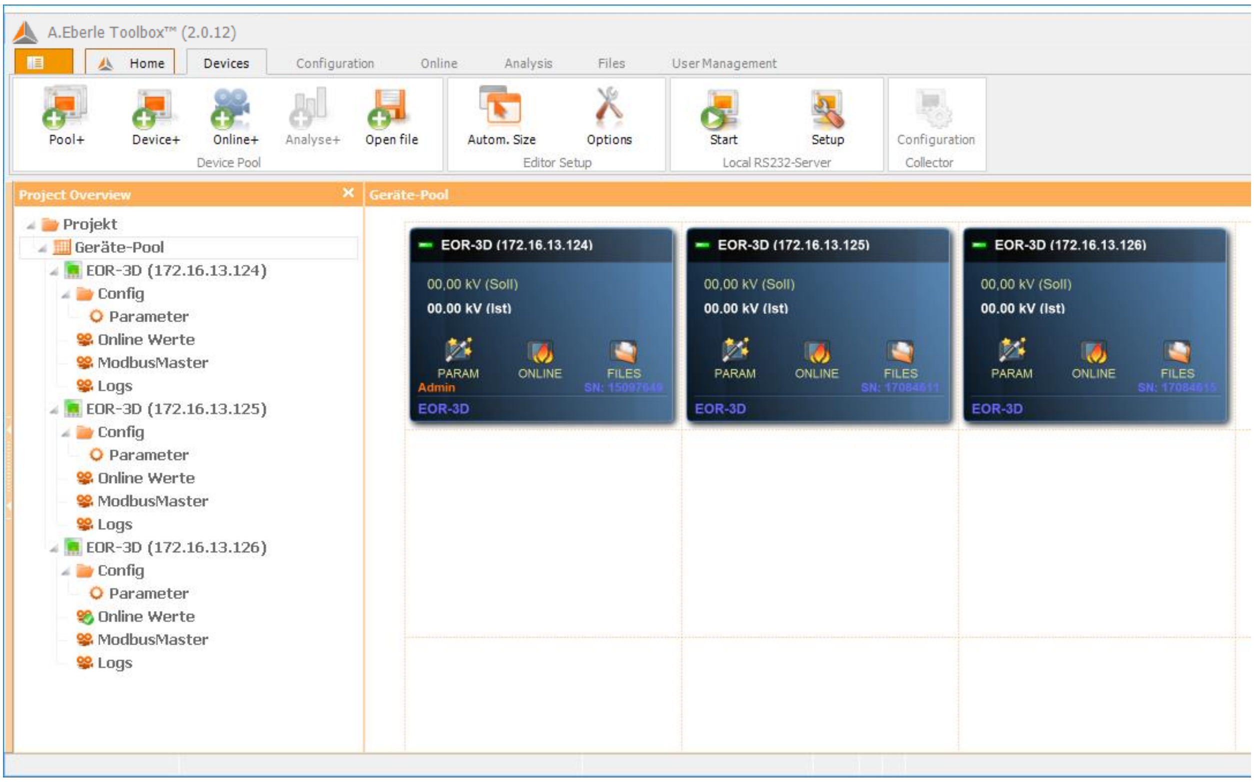


Figure 12: programming software AEToolbox

4. Technical specifications

4.1 Regulations and standards

IEC61010-1
IEC61010-2-030
EN55022
IEC61000-6-5

CE

4.2 AC voltage input U04

Measuring voltage	0.1 V ... 120 V
Shape of the curve	Sine
Frequency range of the fundamental wave	45....50....60....65 Hz
Internal consumption	≤ Unom2 / 1 MΩ
Overload capacity	Unom *1.2

4.3 AC voltage input U24

Measuring voltage	0.1 V ... 120 V
Shape of the curve	Sine
Frequency range of the fundamental wave	45....50....60....65 Hz
Internal consumption	≤ Unom2 / 30 MΩ
Overload capacity	Unom *1.2

4.4 AC current input C21 / C25

Measuring current	1 A / 5 A
Shape of the curve	Sinus
Frequency range	45....50....60....65 Hz
Internal consumption	≤ 0,01 VA
Overload capacity	5 A * 4,0

4.5 Supply voltage

Charac-teristic	Voltage range	Power
H1:	AC: 110..230..277 V (50/60 Hz) DC: 120..220..300 V	4,2 VA
H2:	DC: 20..24..48..75 V protect. against polarity reversal	3,8 VA
H3:	DC: 38..48..60..110..160 V Protect. against polarity reversal	3,9 VA

4.6 Digital inputs

Inputs BI1 ... BI2

Input voltage	AC/DC 40 V...260 V
Shape of the curve, permissible	Rectangular, sinusoidal
H - Level	Programmable
L - Level	Programmable
AC Filter	Programmable
Wobble hold-off	Programmable
Signal frequency fs	DC ≤ fs ≤ 60 Hz
Input resistance	≥ 100 kΩ
Potential isolation	Optocoupler

4.7 Digital outputs (signal relay)

max. switching frequency	≤ 1 Hz
Potential isolation	Isolated from all device-internal potentials
Contact load	AC 250 V, 30 W (cosφ =1.0) DC 220 V, 30 W
Switching operations	> 10^6 electrical
BO1, BO2	Relay with changeover contacts, monostable
BO3 ... BO8	bistable relay

4.8 Limit-value monitoring

Limit values	programmable
Response times	programmable
Alarm indicators	programmable: LED; Display

4.9 Reference conditions

Reference temperature	23°C ± 1 K
Input quantities	U_E = 90...110 V
Auxiliary voltage	H = Hn ± 10%
Frequency	50 Hz...60 Hz with AC
Other	IEC 60688 - Part 1

4.10 Climatic conditions

Operation	-20 °C...+50 °C
Transport and storage	-25 °C...+65 °C
Relative humidity	5 %..95 % non-condensing
Altitude	Up to 2000 meters

4.11 Measurement value recording

non-volatile	≤ 32 GB

4.12 Weight

EOR-3D B01 with C21 adapter	0,60 kg

4.13 Electrical safety

Degree of protection	IP 30
Protection class	I
Degree of pollution	2
Measurement category	III/150 V
Measurement category	II/300 V
Overvoltage category	II

Operating voltages

50 V	120 V	230 V
COMs USB Ethernet	Voltage inputs	Auxiliary voltage digital inputs relay outputs

4.14 Electromagnetic compatibility

Interference emissions

Limit class A according to IEC 61000-6-4

Disturbance immunity

Electrostatic discharge Air discharge: Contact discharge:	according to IEC 61000-4-2 8 kV 4 kV
Electromagnetic fields 80 - 2000 MHz:	according to IEC 61000-4-3 10 V/m
Fast transient Interference (bursts) Supply voltage: Data connections: Measurement inputs:	according to IEC 61000-4-4 2 kV 1 kV 4 kV
Conduc. interference 0.15 - 80 MHz:	according to IEC 61000-4-6 10 Veff
50 Hz magnetic field	according to EN 61000-4-8 100 A/m

4.15 Indicator dimensions

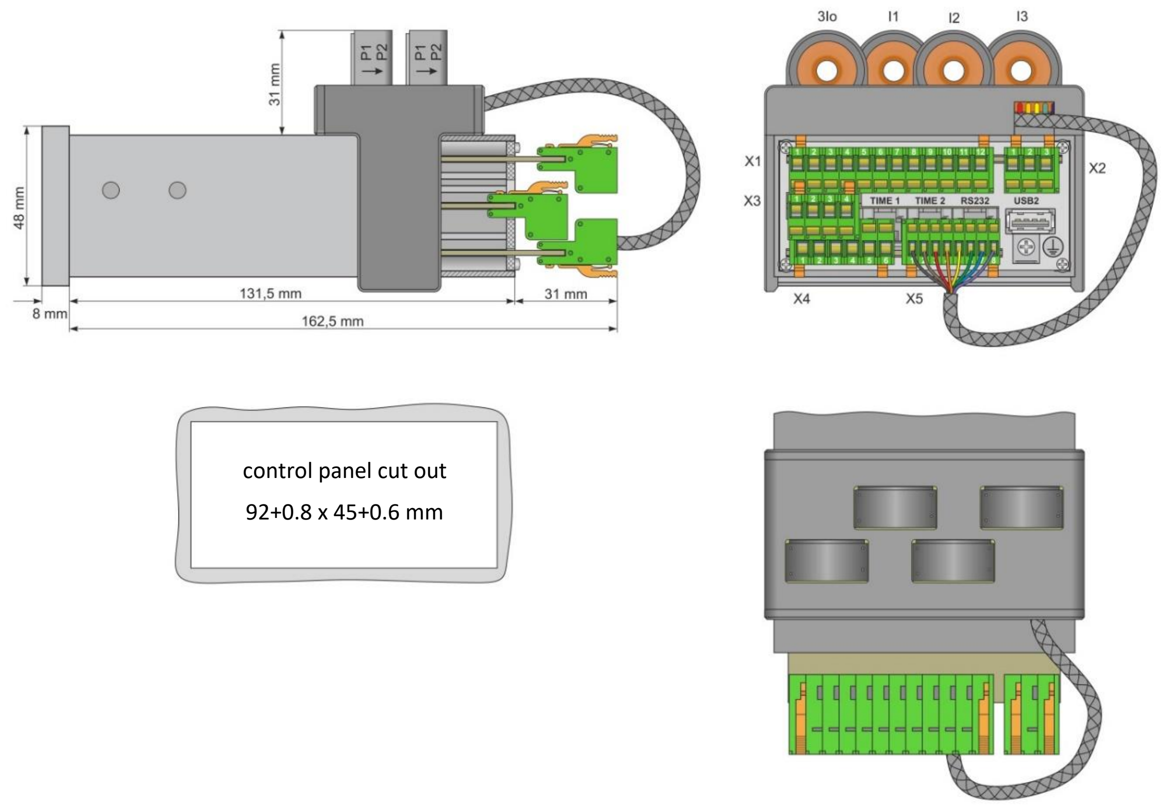
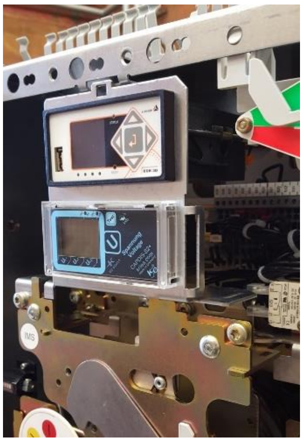


Figure 13: EOR-3D industrial housing dimensions and top view with conventional transformer

4.16 Installation location in compact switch gears

⚠ **WARNING!**

Compact switchgear stations: Installation in low voltage compartment mandatory, in case relays shall be used for switching commands or other security relevant commands!



The installation of the EOR-3D B01 housing in compact switchgear stations is permitted directly in the switchgear panel only, cf. figure on the right, in case the relays are not used for switching commands of the motor control unit or other security relevant commands. The switchgear panel's load break switch is partially not decoupled from the switch gear panel's predefined control panel cut out, whereby very high forces act on an installed device at that place. Because there are bipolar relays used in the EOR-3D B01, it can not be ruled out, that during a load breaker's switching operation the relays are shortly influenced, in case the EOR-3D B01 is installed directly in the switchgear panel.

⚠ **WARNING!**

Compact switchgear stations: Switching commands and other security relevant commands allowed as double commands only!

Depending on the installation location of the EOR-3D B01 in compact switch gear stations, during a switching operation in the own or near switch field high acceleration forces can affect the device. Due to the acceleration forces closed relay contact might open for a short time.

Therefor switching commands and other security relevant commands via relay contacts of the EOR-3D B01 have to be executed as double commands, i.e. by two in parallel wired relays, that both have to change their state for a successful command from BAx=1 & BAy=0 to BAx=0 & BAy=1.

4.17 Connection scheme for conventional transducers

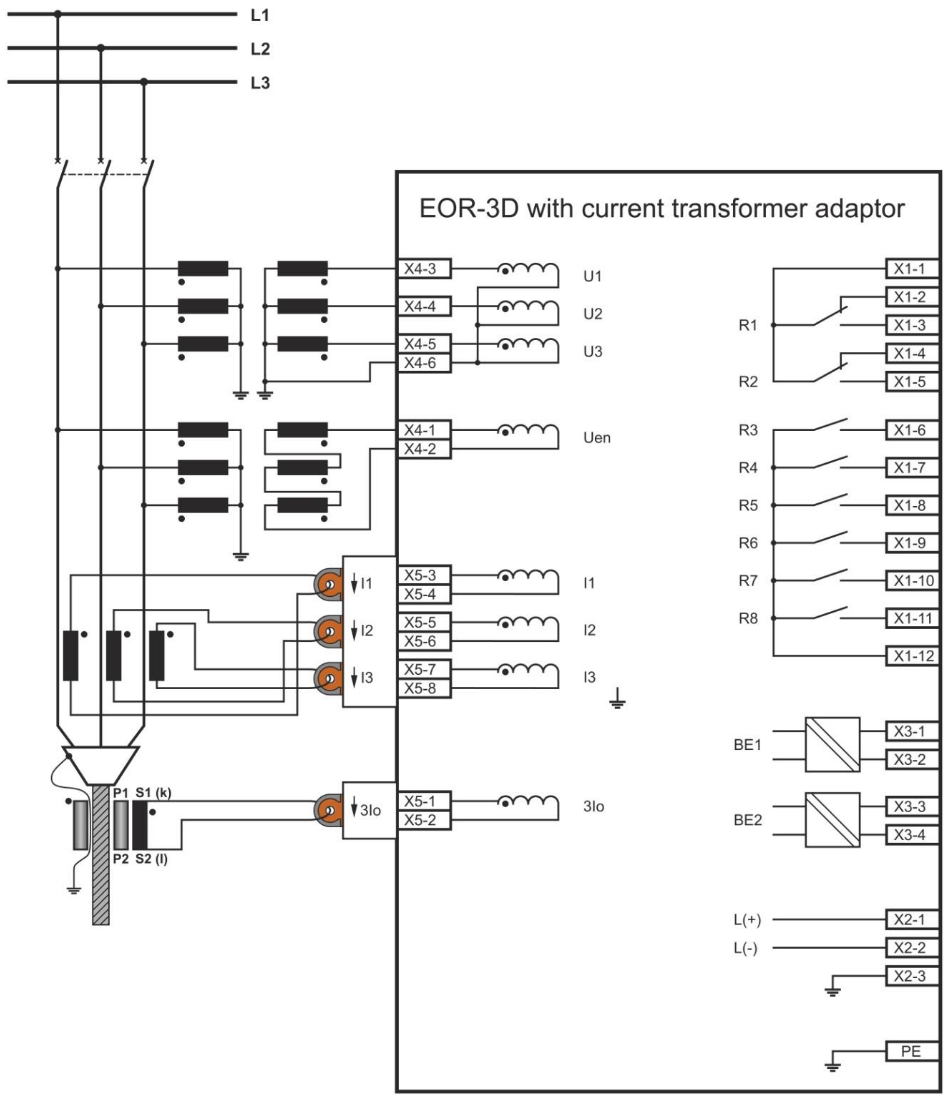


Figure 14: EOR-3D in industrial housing for use with conventional transducers

5. EOR-3D accessories

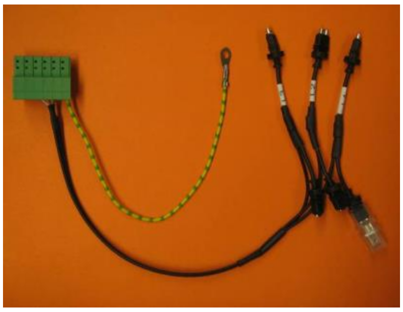
5.1 Housing adaptor for DIN rail mounting

With help of the housing adaptors the EOR-3D B01 can be prepared for DIN rail mounting. Therefor at the back end of the device two appropriate housing adaptors are required. (article number: 564.0490)

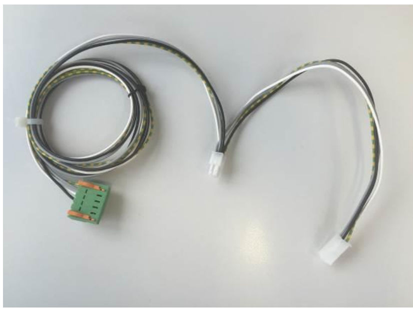
Installation depth until DIN rail front edge: 187 mm

5.2 Adapter cables

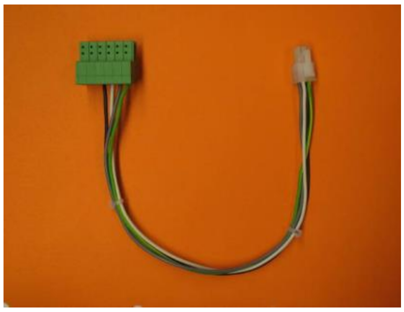
There are different adapter cables for connection of capacitive or resistive dividers up to 100V for the combination with the measurement inputs card U24 available.



Y-adapter cable for WEGA and CAPDIS (flat connector) article number: 582.8004.xx



Y-connection cable for WEGA and Capdis (4 pin connector) article number: 582.8002.xx.02

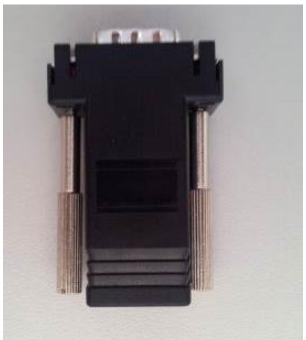


Connection cable for WEGA and CAPDIS (4 pin socket) article number: 582.8002.xx

5.3 Communication adapters

The EOR-3D firmware supports the driver of the USB-Ethernet adapter (article number 111.9075) natively. The adapter can be connected at the front or rear USB interface to configure an Ethernet-network (e.g. for T104 SCADA or for parameterization via software AEToolbox)

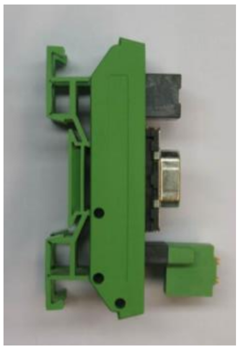
Further more fort he EOR-3D B01 there are different adapters available, in case RS232 or RS485 shall be used. The adapters are normally chosen via order code R and this way already included in scope of delivery.



RS232 adapter on 9 pol. SubD-ML (order code R1)

RS232 adapter for DIN rail (art.no.: 119.8900.25)

RS485 adapter on 3 pol. bus connector (order code R2)



RS232 and RS485 adapter for DIN rail (order code R3)

5.4 Current transducers with low nominal load

Phase current transformer für load current and short circuit detection ELEQ TQ50 (Inside-Ø: 42mm, rated burden 0,5 VA)

Transducer type	Length of cable	Article no.
250/1 A (cl.1)	5,0 m	330.1502
300/1 A (cl.1)	5,0 m	330.1503
400/1 A (cl.0,5)	5,0 m	330.1504
500/1 A (cl.0,5)	5,0 m	330.1505
600/1 A (cl.0,5)	5,0 m	330.1506

6. Order specifications

For determining the order details:

- Only one unit can be ordered for codes with the same capital letter.
- When a code's capital letter is followed only by zeros, the code may be omitted.

Characteristic	CODE
Earth fault detection and short circuit indicator - EOR-3D	EOR-3D
• >= 4 GB internal memory	
• with two programmable inputs (digital, analog)	
• USB host for USB stick, USB⇔Ethernet, USB modem	
• Ethernet 10/100 MBits/s	
• Log book and fault recorder for easy fault analysis	
• Clock for logbook and fault recorder protected by SuperCap and battery	
• including PC software and Ethernet cable	
Model	
• Industrial housing 96 x 48 x 165 mm	B01
• with programmable relay (6 x bistable contacts, 2x changeover contacts)	
Supply voltage	
• external AC 110 ... <u>230</u> ... 277 V / DC 120 ... 220 ... 300 V	H1
• external DC 20 ... <u>24</u> ... 48 ... 75 V	H2
• external DC 38 ... <u>48</u> ... <u>60</u> ... <u>110</u> ... 160 V	H3
Firmware	
• Standard: qu2,qui, cos(φ), sin(φ), sin(φ)_cos(φ), harm_250, harm_fx, Puls_50, non-directional short circuit, P, Q, S, transformer direction test	S000
• in addition: directional short circuit	S010
Communication	
• without	T000
• Modbus Master	Incl.
• Modbus RTU RS232/RS485, 2-wire	T005
• Modbus TCP/IP	T006
• IEC60870-5-103 with fault recorder supply	T103
• IEC60870-5-101	T101
• IEC60870-5-104	T104
• DNP 3.0 RS485	T007
• DNP 3.0 TCP/IP	T008
• IEC 61850 GOOSE	T009
Current input configuration (not comprising sensors or instrument transformers)	
• Adaptor for 4 x current transformer for 1 A / 5 A (1 x $3I_0$, 3 x I_{Lx})	C21
• Adaptor for 1 x current transformer (1 x 3I0) **EWR22 replacement**	C25
Voltage input configuration (not comprising sensors or instrument transformers)	
• 4 x voltage transformers 100 V (2 MΩ) for classical inductive transformers	U04
• 4 x voltage transformers 100 V (40 MΩ) for HR- and LR-systems	U24
Serial Interface	
• without	R0
• 1 x RS232 adapter, incl. 30cm connection cable plus 9 pol. SubD-ML adapter	R1
• 1 x RS485 adapter, incl. 30cm connection cable plus 3 pol. bus connector	R2
• 1 x RS232 and 1 x RS485 adapter on DIN-rail unit, incl. 30cm con. cable	R3

Characteristic	CODE
Operating instructions	
• without	G0
• German	G1
• English	G2

ACCESSORIES	article number
Housing adaptor for DIN rail mounting (2 pcs.) (see also chapter 5.1)	564.0490
Adapter cables (see also chapter 5.3)	
• Y-adapter cable for WEGA and CAPDIS (flat connector)	
○ length of connection cable 0.3 m	582.8004.03
○ length of connection cable 1.5 m	582.8004.15
• Y-connection cable for WEGA and CAPDIS (4 pin connector)	
○ length of connection cable 0.5 m	582.8002.05.02
○ length of connection cable 1.0 m	582.8002.10.02
○ length of connection cable 1.5 m	582.8002.15.02
• Connection cable for WEGA and. CAPDIS (4 pin socket)	
○ length of connection cable 0.3 m	582.8002.03
○ length of connection cable 0.5 m	582.8002.05
○ length of connection cable 1.0 m	582.8002.10
○ length of connection cable 1.5 m	582.8002.15
Communication adapters (see also chapter 5.3)	
• USB-Ethernet Adapter (USB to Ethernet conversion. For connecting to the front or rear USB-interface of the EOR-3D to configure an Ethernet-network (e.g. for T104 SCADA)	111.9075
• 1 x RS232 adapter, incl. 30 cm connection cable plus 9 pol. SubD-ML adapter (corresponds to order code R1)	119.8900.23
• 1 x RS232 adatper on DIN-rail unit, incl. 30 cm connection cable (DIN rail alternative for adapter 119.8900.23 of order code R1)	119.8900.25
• 1 x RS485 adapter, incl. 30 cm connection cable plus 3 pol. Bus connector (corresponds to order code R2)	119.8900.00
• 1 x RS232 and 1 x RS485 adapter on DIN-rail unit, incl. 30 cm con. cable (corresponds to order code R3)	119.8900.22
Current transducers with low nominal load (see also chapter 5.4)	
• Phase current transformer für load current and short circuit detection ELEQ TQ50 (Inside-Ø: 42mm, rated burden 0.5 VA)	
○ ELEQ TQ50 250/1 A (cl.1), length of connection cable 5.0 m	330.1502
○ ELEQ TQ50 300/1 A (cl.1), length of connection cable 5.0 m	330.1503
○ **ELEQ TQ50 400/1 A (cl.0.5), length of connection cable 5.0 m**	**330.1504**
○ ELEQ TQ50 500/1 A (cl.0.5), length of connection cable 5.0 m	330.1505
○ ELEQ TQ50 600/1 A (cl.0.5), length of connection cable 5.0 m	330.1506

Notes

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