IEC 60870-5-101 Protocol Description for Earthfault-Detection-Relay EOR-3D

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Distribution:

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1 IEC 60870-5-101 Protocol

This document describes the characteristics of the IEC 60870-5-101 communication protocol of EORD-3D device. EOR-3D IEC 60870-5-101 Implementation acts as controlled station definition (slave). The EOR-3D IEC 60870-5-101 Implementation is based on the EOR-3D IEC 60870-5-104 Implementation

2 IEC 60870-5-101 Physical Layer

EOR-3D devices can be connected to a IEC 60870-5-101 Network in order to communicate via RS232 or RS485.

3 IEC 60870-5-101 Link Layer

EOR-3D IEC 60870-5-101 Link Layer configuration:

- Unbalanced / Balanced
- Direction Bit (0 or 1 for balanced) (0 for unbalanced, it is not used)
  - **Direction Bit has to be different in balanced mode between Control and Monitor Station (do not forget)!**
- Address Field Length (0,1,2 for balanced 1 or 2 for unbalanced)
- Address of T101 (This is not the Station CA)

3.1 IEC 60870-5-101 Link Layer E5

The E5 sign is used, and is send on Link Test!

3.2 IEC 60870-5-101 Link Layer Timeout

The Link Layer, detects a Timeout (TR) between 20 and 10 seconds, depending on Baudrate (9600 – 115200).

4 IEC 60870-5-101 Application Layer

EOR-3D IEC 60870-5-101 Application Layer configuration:

- COT address field length
- CA address field length
- IOA address field length (take care csv configuration has to be changed when changing this)

EOR-3D IEC 60870-5-101 General configuration:

- Station CA address
- PI(Process Image) Update on small changes

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4.1 IEC 60870-5-101 Application Layer E5

The E5 sign is used, and is send if no data is available!

5 Process information in monitor direction

Following process information in monitor direction are implemented:

- <01> := Single-point information M_SP_NA_1
- <03> := Double-point information M_DP_NA_1
- <07> := Bitstring of 32 bit M_BO_NA_1
- <13> := Measured value, short floating point value M_ME_NC_1
- <30> := Single-point information with time tag M_SP_TB_1
- <31> := Double-point information with time tag M_DP_TB_1
- <33> := Bitstring of 32 bit with time tag M_BO_TB_1
- <36> := Measured value, short floating point value with time tag M_ME_TF_1

6 Process information in control direction

Following process information in control direction are implemented:

- <46> := Double command C_DC_NA_1
- <100>:= Interrogation command C_IC_NA_1
- <103>:= Clock synchronization command C_CS_NA_1

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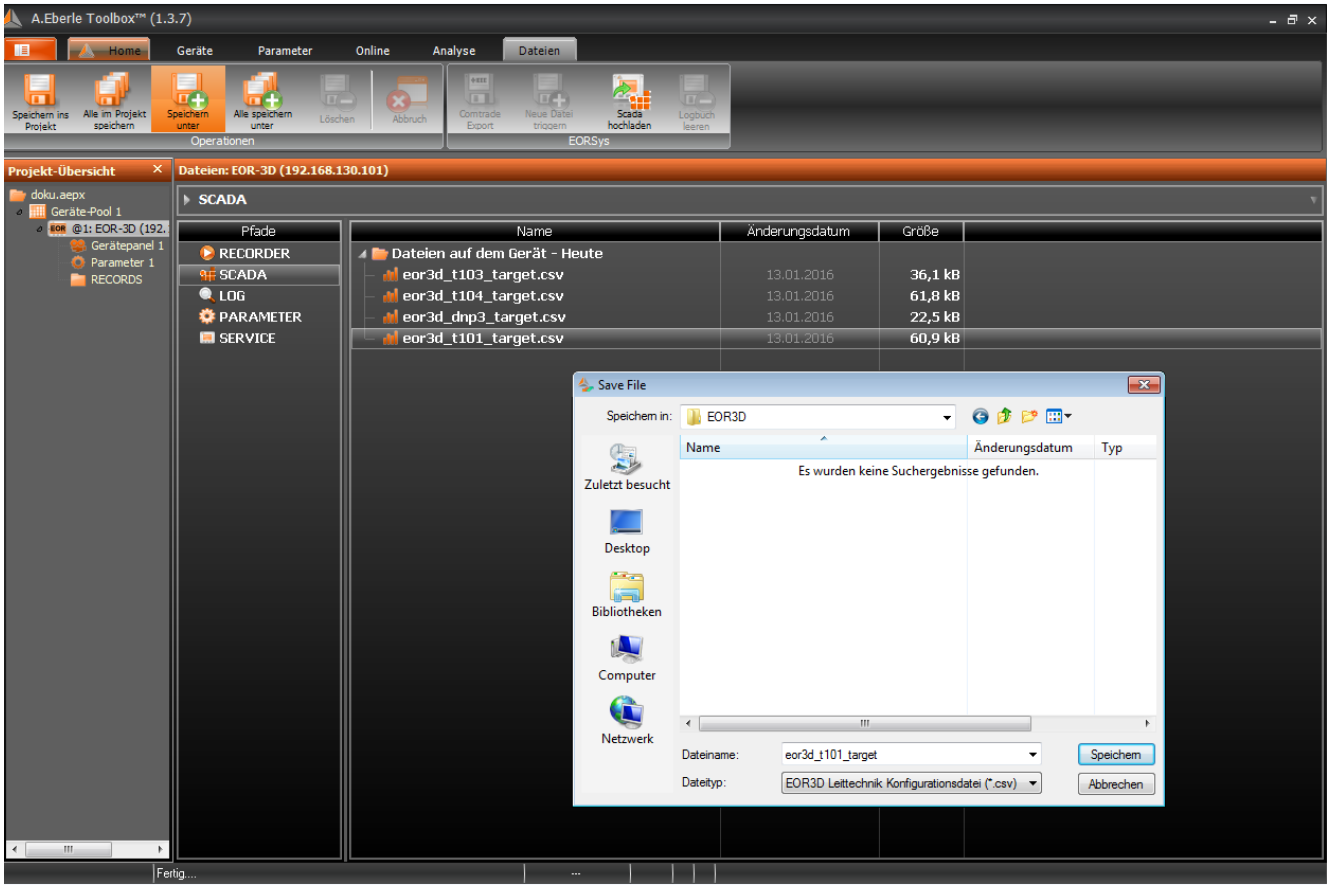
7 CSV configuration of the IEC 60870-5-101 slave

The EOR-3D IEC 60870-5-101 slave can be configured through a csv file on the target. On start up of the system the configuration csv file will be loaded and the IEC 60870-5-101 slave is operational. This file has to be placed in the directory ftp/appfs/eor3dapp1/param on the target (this is the directory where also other EOR-3D configurations can be found). It can be transferred to the EOR-3D with the Toolbox.

After changing the file, it has to be saved and **has also to be saved** as **MSDOS CSV** file. Then the CSV file has to be transferred to the target via the Toolbox with Upload Scada to the param directory (Normal ftp/appfs/eor3dapp1/param).



Picture 1: Toolbox Download

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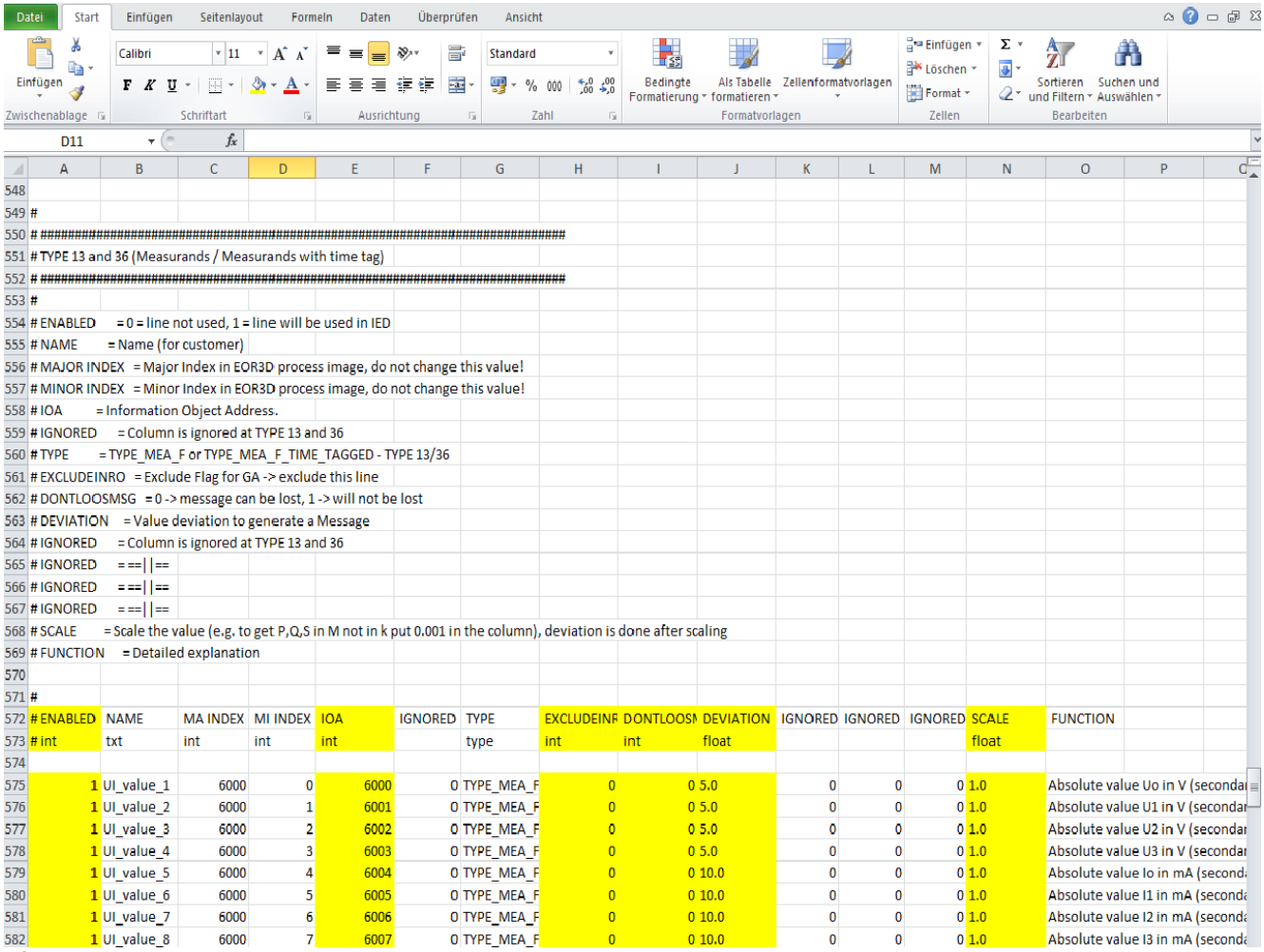
7.1 Detailed CSV configuration (Step by step)

The default eor3d_t101_target.csv file has the explanation for every possible configuration included. Please look direct in the file for changes. Normal step by step configuration would be:

- Download the csv file from the device with the Toolbox
- Change the csv file for you needs with a editor or Microsoft Excel
- Save the file as eor3d_t101_target.csv (MSDOS File format when using excel)
- Upload the file to the target with Upload Scada from Toolbox



548															
549	#														
550	# ##														
551	# TYPE 13 and 36 (Measurands / Measurands with time tag)														
552	# ##														
553	#														
554	# ENABLED = 0 = line not used, 1 = line will be used in IED														
555	# NAME = Name (for customer)														
556	# MAJOR INDEX = Major Index in EOR3D process image, do not change this value!														
557	# MINOR INDEX = Minor Index in EOR3D process image, do not change this value!														
558	# IOA = Information Object Address.														
559	# IGNORED = Column is ignored at TYPE 13 and 36														
560	# TYPE = TYPE_MEA_F or TYPE_MEA_F_TIME_TAGGED - TYPE 13/36														
561	# EXCLUDEINRO = Exclude Flag for GA -> exclude this line														
562	# DONTLOOSMSG = 0 -> message can be lost, 1 -> will not be lost														
563	# DEVIATION = Value deviation to generate a Message														
564	# IGNORED = Column is ignored at TYPE 13 and 36														
565	# IGNORED = ==||==														
566	# IGNORED = ==||==														
567	# IGNORED = ==||==														
568	# SCALE = Scale the value (e.g. to get P,Q,S in M not in k put 0.001 in the column), deviation is done after scaling														
569	# FUNCTION = Detailed explanation														
570															
571	#														
572	# ENABLED	NAME	MA INDEX	MI INDEX	IOA	IGNORED	TYPE	EXCLUDEINF	DONTLOOSM	DEVIATION	IGNORED	IGNORED	IGNORED	SCALE	FUNCTION
573	# int	txt	int	int	int		type	int	int	float				float	
574															
575	1	UI_value_1	6000	0	6000	0	TYPE_MEA_F	0	0	5.0	0	0	0	1.0	Absolute value Uo in V (secondar
576	1	UI_value_2	6000	1	6001	0	TYPE_MEA_F	0	0	5.0	0	0	0	1.0	Absolute value U1 in V (secondar
577	1	UI_value_3	6000	2	6002	0	TYPE_MEA_F	0	0	5.0	0	0	0	1.0	Absolute value U2 in V (secondar
578	1	UI_value_4	6000	3	6003	0	TYPE_MEA_F	0	0	5.0	0	0	0	1.0	Absolute value U3 in V (secondar
579	1	UI_value_5	6000	4	6004	0	TYPE_MEA_F	0	0	10.0	0	0	0	1.0	Absolute value Io in mA (second
580	1	UI_value_6	6000	5	6005	0	TYPE_MEA_F	0	0	10.0	0	0	0	1.0	Absolute value I1 in mA (second
581	1	UI_value_7	6000	6	6006	0	TYPE_MEA_F	0	0	10.0	0	0	0	1.0	Absolute value I2 in mA (second
582	1	UI_value_8	6000	7	6007	0	TYPE_MEA_F	0	0	10.0	0	0	0	1.0	Absolute value I3 in mA (second

Picture 2: csv Demo

7.1.1 Monitor Direction

7.1.1.1 Single-point inf. / with time tag (1,30)

Standard SPI information with time tag or not are included. Please take a look in the csv file which events can be configured.

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7.1.1.2 Double-point inf. / with time tag (3,31)

Standard DPI information with time tag or not are included. Please take a look in the csv file which events can be configured.

7.1.1.3 Bitstring of 32 bit inf. / with time tag (7,33)

Standard Bitstring information with time tag or not are included. Please take a look in the csv file which events can be configured.

With Bitstring a compact version of all (BI, BIF, BO, BOF, LED) are transferred at once (SPI or DPI compact to one value).

7.1.1.4 Short floating point value / with time tag (13,36)

Standard spontaneous measurements with or without time tag are included. Please take a look in the csv file which events can be configured.

7.1.2 Control Direction

7.1.2.1 Double-point command (46)

Standard DPI commands are included. Please take a look in the csv file which commands can be configured.

IEC 60870-5-101 commands are atomic! Only send next command when you got ACTON+ and ACTTERM or ACTON-, it is not allowed to send more commands at once. If it is needed or wanted to send more commands in a list make sure that a delay of 250ms is between every command!

After a successful command a return information caused by a remote command (COT=11) is send on this instance and on every redundant instance!

7.1.2.2 Interrogation command (100)

The standard interrogation command of IEC 60870-5-101 is included. All configured elements from the csv file can be read through this command.

7.1.2.3 Time Sync (103)

The standard time sync of IEC 60870-5-101 is included. The system time and the real time clock gets set.

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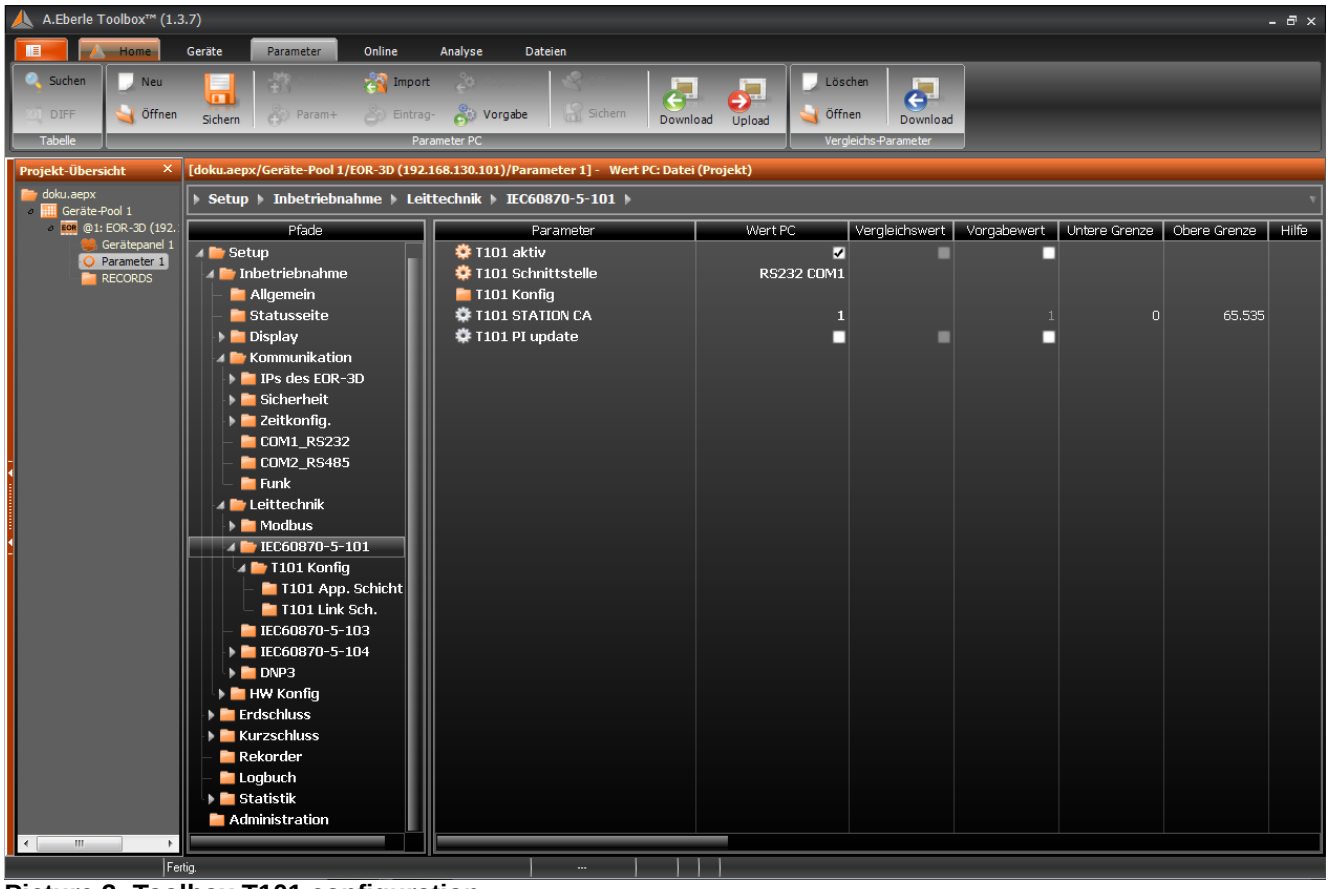
8 IEC 60870-5-101 EOR-3D Toolbox configuration

- T101 active (disable - all configuration data 0 / enable update data)

  --> On a changed from 0 to 1 the IEC 60870-5-101 slave gets it new configuration.
- T101 Station CA
- T101 PI Update (Update PI Image IEC 60870-5-101 Slave on small changes, normal disabled)
- See also Link Layer and Application Layer configuration at Point 3 and 4



Picture 3: Toolbox T101 configuration

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8.1 Process Image Update

On normal operation the EOR-3D IEC 60870-5-101 slave process image is only updated if an event is send. If the configuration with csv file has deviation configured events are only send if enough deviation occurs. It can be configured that the internal process image also gets updated if not enough deviation occurs. Normal higher level systems check the slave of correctness if the event has the same date like the general interrogation. So this configuration is default turned off. It can be switched that the general interrogation always sends the most actual data.

9 BI (Binary Input) – Hardware differences

BE3 to BE6 is only available on EOR-3D compact Hardware Version!

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