

DNP 3.0 Device Profile Document and Description for Earthfault-Detection-Relay EOR-3D

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Manfred Gruber	-	Initial Version	1.0	2014-03-13
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Distribution:

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1 Introduction

This document describes the DNP 3.0 communications protocol supported by the EOR-3D. It is assumed that the reader is familiar with the DNP 3.0 protocol and its supported features.

2 Device Profile

<h3 style="margin: 0;">DNP V3.00</h3> <h4 style="margin: 0;">DEVICE PROFILE DOCUMENT</h4> <p style="margin: 0;">This document is accompanied by tables having the following headings:</p> <table style="width: 100%; border: none;"> <tr> <td style="width: 33%; border: none;">Object Group</td> <td style="width: 33%; border: none;">Request Function Codes</td> <td style="width: 33%; border: none;">Response Function Codes</td> </tr> <tr> <td style="border: none;">Object Variation</td> <td style="border: none;">Request Qualifiers</td> <td style="border: none;">Response Qualifiers</td> </tr> <tr> <td style="border: none;">Object Name</td> <td style="border: none;"></td> <td style="border: none;"></td> </tr> </table>		Object Group	Request Function Codes	Response Function Codes	Object Variation	Request Qualifiers	Response Qualifiers	Object Name		
Object Group	Request Function Codes	Response Function Codes								
Object Variation	Request Qualifiers	Response Qualifiers								
Object Name										
Vendor Name: a.eberle										
Device Name: EOR-3D										
Highest DNP Level Supported: Level 1, see 'DNP V3.00 SUBSET DEFINITIONS'. Not all functions are implemented.	Device function: <input type="checkbox"/> Master <input checked="" type="checkbox"/> Slave									
Notable objects, functions, and/or qualifiers supported in addition to the Highest DNP Levels Supported (the complete list is described in the attached table):										
<ul style="list-style-type: none"> Number of maximal FT3 frames in a telegram-fragment in monitoring direction is parameterizable from 0 to 63 (default: no frame limit). In control direction only one FT3 frame is allowed. Tap positions are transmitted as special 16-Bit Analog Input or 16-Bit Analog Change Event. Each (spontaneous) event transmission list is assignable to one specific class (class 1 to 3). Only one interrogation list is allowed (fix assigned to class 0). Function code FC22 – Assign Classes - is not supported. Response with FC129 and flag 'Functioncode not implemented'. The Analog Output Blocks are not supported in EOR-3D. In multiple Class requests the response is replied in the same order as in the multiple Class request telegram, e. g. if a multiple Class request consists of the requested Classes 1, 2 and 3 the response telegram will start with class 1. 										
Maximum Data Link Frame Size (octets): Transmitted: 280 + Header =292	Maximum Application Fragment Size (octets): Transmitted: variable (64 to 2048 octets parametrizable)									

Received: 292	Received: 1 Fragment with 1 FT3 Frame
Maximum Data Link Re-tries: <input checked="" type="checkbox"/> None <input type="checkbox"/> Fixed at _____ <input type="checkbox"/> Configurable, range ____ to ____	Maximum Application Layer Re-tries: <input type="checkbox"/> None <input checked="" type="checkbox"/> Configurable, range 0 to 255
EOR-3D requires Data Link Layer Confirmation: <input checked="" type="checkbox"/> Never <input type="checkbox"/> Always <input type="checkbox"/> Sometimes If 'Sometimes', when? _____ <input type="checkbox"/> Configurable If 'Configurable', how? _____	
EOR-3D requires Application Layer Confirmation: <input type="checkbox"/> Never <input type="checkbox"/> Always (not recommended) <input type="checkbox"/> When reporting Event Data (Slave devices only) <input type="checkbox"/> When sending multi-fragment responses (Slave devices only) <input type="checkbox"/> Sometimes If 'Sometimes', when? _____ <input checked="" type="checkbox"/> Configurable If 'Configurable', how? _____ Optionally for event data.	

Timeouts in EOR-3D while waiting for:

Data Link Confirm	<input checked="" type="checkbox"/> None <input type="checkbox"/> Fixed at _____ <input type="checkbox"/> Variable <input type="checkbox"/> Configurable
Complete Appl. Fragment	<input checked="" type="checkbox"/> None <input type="checkbox"/> Fixed at _____ <input type="checkbox"/> Variable <input type="checkbox"/> Configurable
Application Confirm	<input type="checkbox"/> None <input type="checkbox"/> Fixed at _____ <input type="checkbox"/> Variable <input checked="" type="checkbox"/> Configurable(1-65535ms)
Complete Appl. Response	<input checked="" type="checkbox"/> None <input type="checkbox"/> Fixed at _____ <input type="checkbox"/> Variable <input type="checkbox"/> Configurable
Others:	
Time-Out between select/operate	<input checked="" type="checkbox"/> Configurable(1-65535ms)
Time-Out between two serial chars (interchar)	<input checked="" type="checkbox"/> Configurable(2-1000ms)
Time till reset after COLD RESTART request confirmation	<input checked="" type="checkbox"/> Configurable(1-65535ms)

Sends/Executes Control Operations:

WRITE Binary Outputs	<input checked="" type="checkbox"/> Never <input type="checkbox"/> Always <input type="checkbox"/> Sometimes <input type="checkbox"/> Configurable
SELECT/OPERATE	<input type="checkbox"/> Never <input checked="" type="checkbox"/> Always <input type="checkbox"/> Sometimes <input type="checkbox"/> Configurable
DIRECT OPERATE	<input type="checkbox"/> Never <input checked="" type="checkbox"/> Always <input type="checkbox"/> Sometimes <input type="checkbox"/> Configurable
DIRECT OPERATE - NO ACK	<input checked="" type="checkbox"/> Never <input type="checkbox"/> Always <input type="checkbox"/> Sometimes <input type="checkbox"/> Configurable

Object coding:

Count > 1	<input checked="" type="checkbox"/> Never <input type="checkbox"/> Always <input type="checkbox"/> Sometimes <input type="checkbox"/> Configurable
Pulse On	<input type="checkbox"/> Never <input type="checkbox"/> Always <input type="checkbox"/> Sometimes <input checked="" type="checkbox"/> Configurable
Pulse Off	<input checked="" type="checkbox"/> Never <input type="checkbox"/> Always <input type="checkbox"/> Sometimes <input type="checkbox"/> Configurable
Latch On/Off	<input type="checkbox"/> Never <input type="checkbox"/> Always <input type="checkbox"/> Sometimes <input checked="" type="checkbox"/> Configurable
Trip/Close	<input type="checkbox"/> Never <input type="checkbox"/> Always <input type="checkbox"/> Sometimes <input checked="" type="checkbox"/> Configurable

Queue	<input checked="" type="checkbox"/> Never <input type="checkbox"/> Always <input type="checkbox"/> Sometimes <input type="checkbox"/> Configurable
Clear Queue	<input checked="" type="checkbox"/> Never <input type="checkbox"/> Always <input type="checkbox"/> Sometimes <input type="checkbox"/> Configurable

FILL OUT THE FOLLOWING ITEMS FOR SLAVE DEVICES ONLY:

Reports Binary Input Change Events when no specific variation requested:

☒ Never
☐ Only time-tagged
☐ Only non-time-tagged
☐ Configurable to send both, one or the other (attach explanation)

When no specific variation is requested the EOR-3D sends IIN only - data classes available bits are set.

Reports time-tagged Binary Input Change Events when no specific variation requested:

☒ Never
☐ Binary Input Change With Time
☐ Binary Input Change With Relative Time
☐ Configurable (attach explanation)

Sends Unsolicited Responses:

☒ Never
☐ Configurable (attach explanation)
☐ Only certain objects
☐ Sometimes (attach explanation)
☐ ENABLE/DISABLE UNSOLICITED
Function codes supported

Sends Static Data in Unsolicited Responses:

☒ Never
☐ When Device Restarts
☐ When Status Flags Change

No other options are permitted.

Default Counter Object/Variation: <input checked="" type="checkbox"/> No Counters Reported <input type="checkbox"/> Configurable (see attached tables) <input type="checkbox"/> Default Object _____ Default Variation _____ <input type="checkbox"/> Point-by-point list attached	Counters Roll Over at: <input checked="" type="checkbox"/> No Counters Reported <input type="checkbox"/> Configurable (attach explanation) <input type="checkbox"/> 16 Bits <input type="checkbox"/> 32 Bits Other Value _____ <input type="checkbox"/> Point-by-point list attached
Sends Multi-Fragment Responses: <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	

Table of Function codes:

CODE	FUNCTION	DESCRIPTION
Transfer Function Codes		
0	Confirm	Message fragment confirmation. <i>Currently used in responses.</i>
1	Read	Request specified object from RTU; respond with objects requested that are available.
2	Write	Store specified objects in Outstation; respond with status of the operation. <i>Currently used only to write TIME and DATA objects, as part of the SOE Time Synchronisation sequence. AND IIN Clear Restart-Bit.</i>
Control Function Codes		
3	Select	Select/arm output point; respond with status of selected point.
4	Operate	Operate previously selected point; respond with status of the point.
5	Direct Operate	Select and operate the specified points; respond the point status.
Transfer Function Codes		
21	Disable Unsolicited Messages	Disable spontaneous reporting; respond with status of operation. <i>Currently always respond OK, because no spontaneous respond supported.</i>
22	Assign Class	Assign specified object to a particular class; respond with status of operation. <i>Currently not implemented.</i>
Time Synchronisation Function Codes		
23	Delay Measurement	Time synchronise master and RTU; respond with status of operation. <i>Currently used together with WRITE function.</i>
Response Function Codes		
0	Confirm	Message fragment confirmation. No response to this message is required.
129	Response	Response to a request message.

Implementation Table:

Obj.	Var.	OBJECT Description	Requests to EOR-3D		Response of EOR-3D	
			Func Codes (dec)	Qual Codes (hex)	Func Codes (dec)	Qual Codes (hex)
01	01	Binary Input (Single-Bit)	1	*)	129	01
01	02	Binary Input with Status	1	*)	129	27
02	01	Binary Input Change without Time	1	*)	129	27
02	02	Binary Input Change with Time	1	*)	129	27
02	03	Binary Input Change with Relative Time	1	*)	129, IIN = 2/1	-
12	01	Control Relay Output Block	3,4,5	*)	129	mirrored
30	00	Analog Input – All Variations	1	*)	129	27
30	01	32-Bit Analog Input with Flags	1	*)	129	27
30	02	16-Bit Analog Input with Flags	1	*)	129	27
30	05	Short Float Analog Input with Flags	1	*)	129	27
32	01	Analog Change Event	1	*)	Switch to Class 2- Request	-
32	02	16-Bit Analog Change Event without Time	1	*)	129	27
32	03	32-Bit Analog Change Event with Time	1	*)	129	27
32	05	Short Float Change Event without Time	1	*)	Switch to Class 2- Request	-
32	07	Short Float Change Event with Time	1	*)	129	27
50	01	Time and Date	2	*)	129	-
52	02	Time Delay Fine (Delay Measurement)	23	-	129	-
60	01	Class 0 Data	1	*)	129	01,27
60	02	Class 1 Data	1	*)	129	27
60	03	Class 2 Data	1	*)	129	27
60	04	Class 3 Data	1	*)	129	27
80	01	Internal Indications	1	*)	129, IIN = 2/1	-
			2	00 IIN = 1/7		

- telegram contains no qualifier code

*) 06, 07, 08, 16, 17, 18, 26, 27, 28

IIN = 1/7: Internal Indication Byte 1, index 7 (Device restart)

IIN = 2/1: Internal Indication Byte 2, index 1 (Requested object unknown)

Flags in DNP3 user data

The following table shows the relation between internal information qualifier and DNP3 flags in DNP3 user data:

Information type	Flags DNP3 telegram objects supported by EO-3D
Binary inputs (SPIs)	Online Communication lost Local forced data *
Analog	Online Communication lost Local forced data * Over-range
Tap positions (transmitted as analogs)	Online Communication lost Local forced data *

* : no difference between local and remote forced data possible, therefore always local is assumed

Valid error responses

A EOR-3D device may respond to Master requests as described in following Table if there is an error in the request.

Response	IIN bit	Meaning
FUNCTION UNKNOWN	0	means „My implementation level does not support this function (on objects of this group and variation)“.
OBJECT UNKNOWN	1	means either „My implementation level does not support this group and variation of object“, or for <i>static</i> objects, „I have no objects with this group and variation“. Cannot be used as a response for event objects if the request is defined for the level. In that case, the Slave must send a Null Response (see below).
Null Response (no IIN bits set, but no objects of the specified type returned)	n/a	means „No point range was specified, and I have no objects of this type“. Primarily used in response to event data polls. Can be used instead of OBJECT UNKNOWN for static objects if no range was specified.

3 Default EOR-3D Configuration

The EOR-3D is shipped from the factory with the DNP objects defined in the csv file eor3d_dnp3_target.csv.

3.1 DNP 3.0 EOR-3D Toolbox configuration

- DNP3 active (disable – DNP 3.0 is disabled / enable – DNP 3.0 is enabled)
--> On a changed from 0 to 1 the DNP 3.0 slave get it new configuration.
- DNP3 device
--> Ethernet_UDP, Ethernet_TCP, RS485 COM2, RS232 COM1
- TCP/UDP port
--> Port for Ethernet_UDP, Ethernet_TCP
--> Ignored on RS485 COM2, RS232 COM1
- Central Station IP
--> Authorized IP address from central station
--> Ignored on RS485 COM2, RS232 COM1
- Link address
--> Link address of EOR-3D
- Link address master
--> Link address of central station
- Timeout Application Confirm
- Time-Out between select/operate

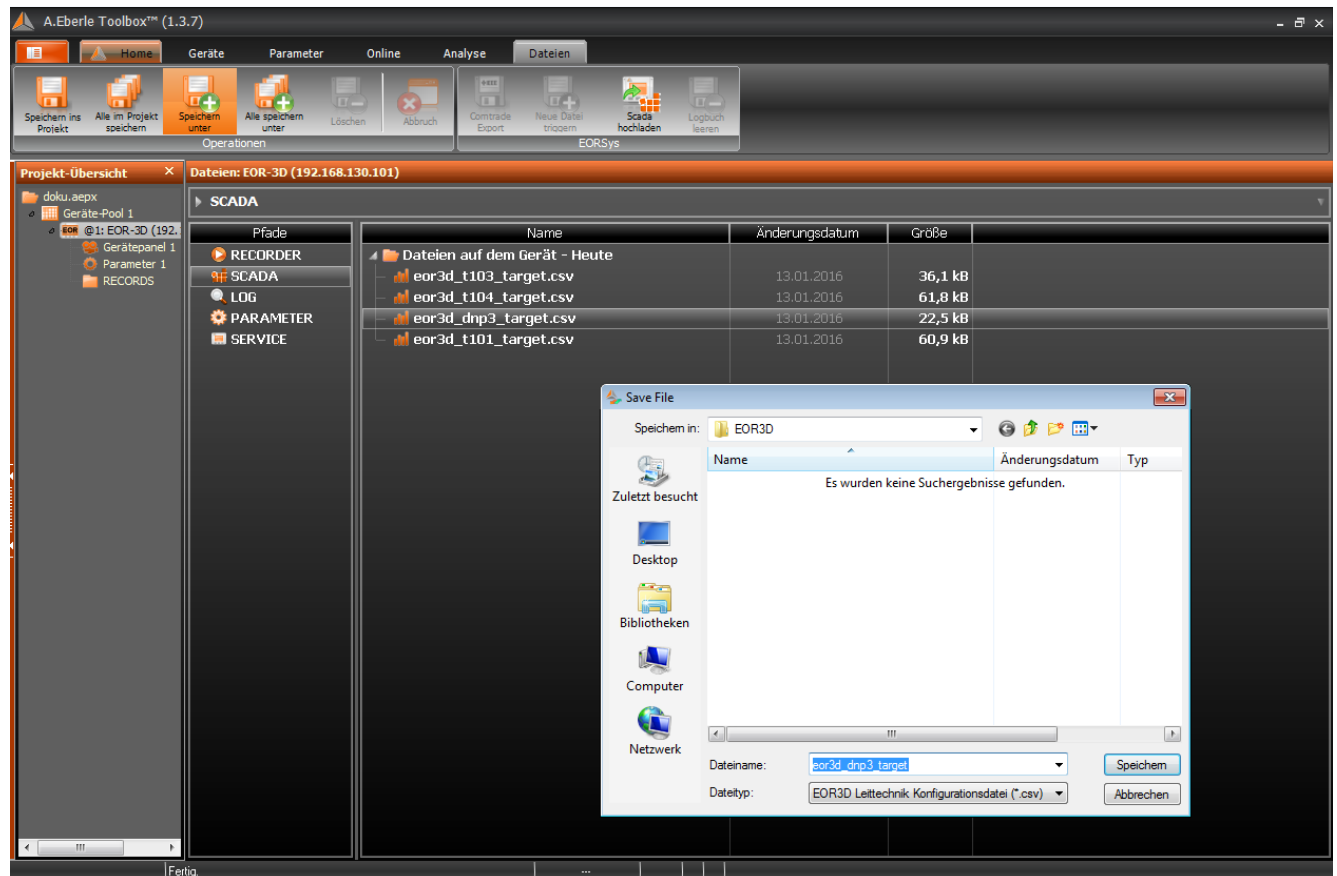
- Time-Out between two serial chars (interchar)
- Time till reset after COLD RESTART request confirmation

3.2 Customizing the DNP 3.0 - CSV configuration

The EOR-3D DNP3.0 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 DNP3.0 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 its ftp tool.

The default eor3d_dnp30_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
- Change the csv file for you needs with a editor or Microsoft Excel
- Save the file as eor3d_dnp3_target.csv (MSDOS File format when using excel)
- Upload the file to the target



Picture 1: Toolbox download

3.3 Customizing the DNP 3.0 Configuration

Settings scheme overview

The following overview shows the possibilities of settings the data points available. Each data point can be addressed as static and/or event object.

Object types	Static		Event		Event		Event		Event		Event		Event class
	Object	Var	Object	Var	Object	Var	Object	Var	Object	Var	Object	Var	
Binary Input	01 01	01 02	02	01	02	02	02	03	-	-	-	-	1-3
Binary Output	12	01	-	-	-	-	-	-	-	-	-	-	-
Analog Input	30 30 30	01 02 05	32	01	32	02	32	03	32	05	32	07	1-3

3.4 BI (Binary Input) – Hardware differences

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