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NTG-3000

Transducer

Description of Protocol for Data Transmission via Ethernet and PROFIBUS

Document Version 3.10
Software Version 3.7

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Versions / Revisions:

Document version	Creation date	Author	Description
3.1	2012-08-24	P. Compensis	Description for Software Version 3.1
3.2	2012-09-17	P. Compensis	Description for Software Version 3.2, Sections 4, 5, 6
3.3	2012-10-16	P. Compensis	Identification of high and low bytes Distinction between modes 2 and 2+
3.4	2012-10-18	P. Compensis	Adaptation of GSD file names
3.5	2013-02-22	P. Compensis	Changes of SW-Version 3.3: Parameters TA und „Faktor fcomp“ removed. Transmission of the measured frequency as pu-value. New filter structures for for filtered fcomp and P
3.6	2013-03-08	P. Compensis	Addition to the description of settings/parameters via PROFIBUS.
3.7	2013-09-03	C. Aggou	Adding the inertia of the synchronous machine to the configuration data Adding the bit of the advanced phase-failure-detection to the error-byte
3.8	25.11.2013	C. Aggou	Adding the option-byte to activate/deactivate the filters
3.9	2013-12-16	P. Compensis	Various small corrections
3.10	2014-04-16	P. Compensis	New Software Version

1 Note

This document describes the protocol structure for **Software Version 3.3**.

2 Ethernet

Depending on the selected mode (see Section 7.3), the transducer sends either the measured values or the calculated values for all channels to target IP address **192.168.1.100** cyclically in a UDP packet.

The cycle time can be defined via PROFIBUS (see Section 7).

The following cycle times are selected as standard:

Mode 1: 100 µs
Mode 2: 500 µs

3 PROFIBUS

All of the measured values can also be queried via PROFIBUS as an alternative to transmission via Ethernet. The transducer can be accessed under **slave address 1**.

The data that can be queried via PROFIBUS also depend on the mode (see Section 4).

3.1 GSD files

Three different GSD files are provided for the transducer. The selection of the correct GSD file depends on the selected mode (see Section 7.3).

GSD file name	**Mode** (see Section 7.3)	**"Model_Name"** (in GSD file)
NTG1.gsd	1	"NTG-3000 Mode 1"
NTG2.gsd	2	"NTG-3000 Mode 2"
NTGd.gsd	2+	"NTG-3000 Mode 2+"

4 Data structure

The data transmitted with each UDP packet and the data queried via PROFIBUS are identical in structure. The structure, which varies according to the selected mode, is described below.

4.1 Data structure in mode 1 ("raw data mode")

Byte	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**
Priority	LSB	MSB	LSB	MSB	LSB	MSB	LSB	MSB	LSB	MSB	LSB	MSB	LSB	MSB	LSB	MSB	LSB	MSB			LSB	MSB
Data	U1		U2		U3		I1		I2		I3		DC1		DC2		DC3		CB	EB	Info	

LSB: Least significant byte MSB Most significant byte

The first byte (LSB, index=0) is transmitted first in the case of Ethernet transmission.

Channel	**Measuring range**	**Data type**
U1	-120...120 V	Integer (16-bit)
U2	-120...120 V	Integer (16-bit)
U3	-120...120 V	Integer (16-bit)
I1	-5...5 A // -1...1 A	Integer (16-bit)
I2	-5...5 A // -1...1 A	Integer (16-bit)
I3	-5...5 A // -1...1 A	Integer (16-bit)
DC1	0...20 mA	Unsigned integer (16-bit)
DC2	0...20 mA	Unsigned integer (16-bit)
DC3	0...10 V	Unsigned integer (16-bit)
CB	Configuration byte	See Section 5 (8-bit)
EB	Error byte	See Section 6 (8-bit)
Info	Optional additional information	(16-bit)

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4.2 Data structure in mode 2 (“Calculation mode”)

Byte	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
Priority	LSB			MSB	LSB			MSB	LSB			MSB	LSB	MSB	LSB	MSB
Data	I_{rms}				U_{rms}				P				DC1		DC2	

16	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**	**26**	**27**	**28**	**29**
LSB	MSB			LSB	MSB	LSB			MSB	LSB			MSB
DC3		CB	EB	Info		Q				S			

30	**31**	**32**	**33**	**34**	**34**	**36**	**37**	**38**	**39**	**40**	**41**	**42**	**43**	**44**	**45**	**46**
LSB			MSB	LSB			MSB	LSB			MSB		LSB			MSB
cos φ				F				f_{comp}				FS	$f_{comp\ filtered}$			

47	**48**	**49**	**50**
LSB			MSB
$P_{filtered}$			

51	**52**	**53**	**54**	**55**	**56**	**57**	**58**	**59**	**60**	**61**	**62**	**63**	**64**	**65**	**66**
LSB			MSB	LSB			MSB	LSB			MSB	LSB			MSB
I_a *[1]				I_b *[1]				U_a *[1]				U_b *[1]			

LSB: Least significant byte MSB Most significant byte

*[1] Only in mode 2+ (see Section 7.3)

Value	Description	Measuring range/Scaling	Data type
I_{rms}	rms value for current	*[2]	float32
U_{rms}	rms value for voltage	*[2]	float32
P	rms value for active power	*[2]	float32
DC1		0...20 mA	Unsigned integer, 2 bytes
DC2		0...20 mA	Unsigned integer, 2 bytes
DC3		0...10 V	Unsigned integer, 2 bytes
CB	Configuration byte	–	See Section 5
EB	Error byte	–	See Section 6
Info	Optional additional information	–	2 bytes
Q	rms value for reactive power	*[2]	float32
S	rms value for apparent power	*[2]	float32
cos φ	Power factor	-1 ... +1	float32
F	Frequency	As pu-value *3	float32
f_{comp}	Compensated frequency		float32

<table>
<tr><th>Value</th><th>Description</th><th>Measuring range/Scaling</th><th>Data type</th></tr>
<tr><td>FS</td><td>Status of calculation for compensated frequency</td><td><table><tr><th>Bit 1</th><th>Bit 0</th><th>Description</th></tr><tr><td>0</td><td>0</td><td>No fault</td></tr><tr><td>X</td><td>1</td><td>Fault in fcomp formation</td></tr><tr><td>1</td><td>X</td><td>Downward violation of fcomp threshold</td></tr></table>X: Bit status: 0 or 1</td><td>Byte (8 bits)</td></tr>
<tr><td>$f_{comp\ filtered}$</td><td>Filtered compensated frequency *4</td><td></td><td>float32</td></tr>
<tr><td>$P_{filtered}$</td><td>Filtered active power *4</td><td></td><td>float32</td></tr>
<tr><td>I_a*1</td><td>Alpha component, current</td><td>*2</td><td>float32</td></tr>
<tr><td>I_b*1</td><td>Beta component, current</td><td>*2</td><td>float32</td></tr>
<tr><td>U_a*1</td><td>Alpha component, voltage</td><td>*2</td><td>float32</td></tr>
<tr><td>U_b*1</td><td>Beta component, voltage</td><td>*2</td><td>float32</td></tr>
</table>

*1 Only in mode 2+ (see Section 7.3)
*2 Depends on selected factors (see Section 7)
*3 Depends on selected parameter f0 (nominal frequency, see Section 7)
*4 Description of filters see NTG-3000 operating instructions, section “Filter”.

5 Configuration byte (CB)

In addition to the acquired measured values, a byte containing details of the current system configuration is transmitted during every send procedure. The bit assignments are as follows in this case:

<table>
<tr><th>Bit</th><th>Function</th><th>Assignment</th></tr>
<tr><td>0</td><td>DC signals (currents)</td><td>0: 0...20 mA
1: 4...20 mA</td></tr>
<tr><td>1</td><td>Current measuring ranges</td><td>0: 1 A
1: 5 A</td></tr>
<tr><td>3…2</td><td>Reserved</td><td></td></tr>
<tr><td>5 .. 4</td><td>Mode</td><td><table><tr><th>Bit 5</th><th>Bit 4</th><th>Description</th></tr><tr><td>0</td><td>0</td><td>Mode 1</td></tr><tr><td>0</td><td>1</td><td>Mode 2</td></tr><tr><td>1</td><td>1</td><td>Mode 2 (without debug data)</td></tr></table></td></tr>
<tr><td>6</td><td>Reserved</td><td></td></tr>
<tr><td>7</td><td>Alive bit</td><td>0/1 toggle, on every updated data block transmission</td></tr>
</table>

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6 Error byte (EB)

Bit	Error	Description	Error type
0	PROFIBUS error	Error in the PROFIBUS communication (connection, protocol)	0: No error 1: Error
1	Voltage phase failure	Phase failure (determined by the sum of the three voltage phases, see *NTG-3000 operating instructions*)	0: No error 1: Error
2	Advanced Voltage phase failure	Phase failure (determined by comparison of the three voltage phases, see *NTG-3000 operating instructions*)	0: No error 1: Error
3	EEPROM error	Error reading or writing the EEPROM	0: No error 1: Error
4	Program error	An unexpected error occurred during program execution	0: No error 1: Error
5	Invalid configuration	Error in the configuration	0: Valid configuration 1: Invalid configuration
6	Incorrect calibration values	Error reading or setting the calibration values	0: No error 1: Incorrect calibration values
7	Reserved		

7 Settings via PROFIBUS

The following values can be defined via PROFIBUS:

Value	Description	Data type
Command byte	*The other values are only accepted and stored permanently in the transducer EEPROM if the command byte is **0x5A**.*	unsigned char (8-bit)
Factor I	Factor for converting phase currents at the transducer inputs to actual current	float32
Factor U	Factor for converting phase voltages at the transducer inputs to actual voltage	float32
Sampling time factor	Sampling time and transmission time via Ethernet (see Section 7.2)	unsigned char (8-bit)
Factor H	Inertia of the turbo generator (for calculation the min/max-values of the "rate-of-change-filter")	float32
XQ	Main inductance of transverse axis in "pu" (for calculation of compensated frequency)	float32
Options Byte	Various functions can be enabled / disabled via this byte	unsigned char (8 Bit)
Reserved		24 Bit
f0	Rated frequency in Hz (inter alia for calculation of compensated frequency and to normalize the measured frequency)	float32
Scalar product threshold	If the scalar product value falls below this threshold when calculating the compensated frequency (f_{comp}), the most recent valid fcomp value is transmitted and the bit identifier "downward violation of fcomp threshold" (see Section 4.2) is set.	float32
F1 b_0	Filter constants for parameterization of the first filter level. For filtering the compensated frequency ($f_{comp\ filtered}$) **and** for filtering rms active power ($P_{filtered}$). (see NTG-3000 operating instructions, Section „Filter").	float32
F1 b_1		float32
F1 b_2		float32
F1 a_0		float32
F1 a_1		float32
F2 b_0	Filter constants for parameterization of the second filter level. For filtering the compensated frequency ($f_{comp\ filtered}$) **and** for filtering rms active power ($P_{filtered}$). (see NTG-3000 operating instructions, Section „Filter").	float32
F2 b_1		float32
F2 b_2		float32
F2 a_0		float32
F2 a_1		float32

Attention:
The other values are only accepted and stored permanently in the transducer EEPROM if the command byte is **0x5A** (edge triggered pulse).

Note:
The calculated rms values are multiplied by the assigned factors in each case.

7.1 Structure of setting data via PROFIBUS

Byte	0	1	2	3	4	5	6	7	8	9	10	11	12	13
Priority		LSB			MSB	LSB			MSB		LSB			MSB
Data	Command	Factor I				Factor U				Sampling time	Reserve			

14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29
LSB			MSB					LSB			MSB	LSB			MSB
XQ				Options-Byte	Reserved			F0				Scalar product threshold			

30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49
LSB			MSB	LSB			MSB	LSB			MSB	LSB			MSB	LSB			MSB
$FS1\_b_0$				$FS1\_b_1$				$FS1\_b_2$				$FS1\_a_0$				$FS1\_a_1$			

50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69
LSB			MSB	LSB			MSB	LSB			MSB	LSB			MSB	LSB			MSB
$FS2\_b_0$				$FS2\_b_1$				$FS2\_b_2$				$FS2\_a_0$				$FS2\_a_1$			

LSB: Least significant byte
MSB: Most significant byte
FS: Filter level

7.2 Setting of sampling time via PROFIBUS

An 8-bit integer value is provided (sampling time factor) for setting the sampling time and the transmission time via Ethernet. The sampling time is calculated from the value as follows:

Mode 1: sampling time = 100 µs * ("sampling time factor" + 1)
Mode 2: sampling time = 500 µs * ("sampling time factor" + 1)

Permitted values for "sampling time factor": 0 ... 254

The sampling time configured in this way is also used for calculation of the compensated frequency (fcomp).

7.3 Options Byte

Various functions can be enabled or disabled via the options-byte.

Bit	Function	Assignment
0	Disable input filter	0: The analog input filter is **enabled**, the advanced phase failure detection and the rate-of-change limiter are **disabled** 1: The analog input filter is **disabled**, the advanced phase failure detection and the rate-of-change limiter are **enabled**
1...7	Reserved	-

8 Mode selection

The mode is selected using the 16-position rotary switch:

	Currents:		**DC signals**		**Mode**	**3-phase (I1, I2, I3)** **2-phase (I1, I3)**
Setting	1 A	5 A	0...20 mA	4...20 mA		
+0	X		X		2 (without debug data)	3-phase
1	X			X	2 (without debug data)	
2		X	X		2 (without debug data)	
3		X		X	2 (without debug data)	
4	X		X		2+ (with debug data)	
5	X			X	2+ (with debug data)	
6		X	X		2+ (with debug data)	
7		X		X	2+ (with debug data)	
8	X		X		1	
9	X			X	1	
A		X	X		1	
B		X		X	1	
C	X		X		2 (without debug data)	2-phase
D	X			X	2 (without debug data)	
E		X	X		2 (without debug data)	
F		X		X	2 (without debug data)	

8.1.1 Power, system and error LEDs

STATUS LED (green)	ERROR LED (red)	
ON	OFF	Normal operation
1 Hz	OFF	System startup (for approx. 2 seconds) or during initialization of an Ethernet link
2 Hz	5 Hz	PROFIBUS error
5 Hz	ON	Unexpected, serious error
OFF	ON	EEPROM error
ON	ON	Incorrect calibration values
ON	2 Hz	Invalid rotary switch setting = invalid configuration

1 Hz: LED flashes at 1 Hz   2 Hz: LED flashes at 2 Hz   5 Hz: LED flashes at 5 Hz

The POWER LED is lit when the supply voltage is connected.