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Description of the rudimentary CANopen protocol

(Version 1.3.4)

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1. Network management

After power on or after reset each component sends the CAN identifier 0x080 + Node ID and, in case of an error, with an „emergency“ message (see chapter 5). In case of no error the data length code (DLC) is 0. After the initialization the component waits in the pre opertional mode for further commands.

Identifier	DLC
0x080 + Node ID	0

Table 1.1: Standardframe after power on without error

Identifier	DLC	Byte0	Byte1
0x000	2	Command	Node ID or 0 *)

Table 1.2: Standardframe NMT

list of commands in network management

Start node: Byte0 = 0x01

After the command „start node“ the component will be in „operational mode“. Thats means, that all PDOs will send with the last set cycle time.

Stop node: Byte0 = 0x02

With this command only network mangement commads (start node, stop node) are executable.

Enter preoperational mode: Byte0 = 0x80

Reset node: Byte0 = 0x81

The component will be reset and the last set paramters (cycle time, Node ID, heartbeat cyle time) will be activ.

Reset communication: Byte0 = 0x82

Reset the communication. The last set parameters will be activ.

Note:

*) If Byte1 = 0 → broadcast

If Byte1 = Node ID → message for the selected module

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2. Bootup and heartbeat (not part of the software for the BG149)

The component sends the heartbeat messages with the information about the actual state in this mode cyclically.

Identifier	DLC	Byte0
0x700 + Node ID	1	state

Table 2.1: Standardframe heartbeat

state:

Bootup: Byte0 = 0x00

Stopped: Byte0 = 0x04

Operational: Byte0 = 0x05

Pre- Operational: Byte0 = 0x7F

3. PDO communication

Send data cyclically or on request from client to master with the following PDOs.

From client perspective :

send PDO: 0x180, 0x280, 0x380, 0x480 + Node ID (1 – 127)

receive PDO: 0x200, 0x300, 0x400, 0x500 + Node ID (1 – 127)

Note:

Only the send PDO 0x180 and the receive PDO 0x200 are used.

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4. SDO communication

The SDO communication can be used to read values and/ or to config the corresponding module. It should be noted, that always 8 byte will be transmitted (DLC = 8).

ID	DLC	Byte0	Byte1	Byte2	Byte3	Byte4	Byte5	Byte6	Byte7
Identifier	8	CMD	Index		Sub index	Data			

Tabelle 4.1: Standardframe SDO

meaning of the indentifier:
send SDOs (NMT Master): 0x600 + Node ID (Node ID: 1-127)
receive SDOs (NMT-Master): 0x580 + Node ID (Node ID: 1-127)

meaning of the command byte (CMD) in byte 0:
Master reads from Slave 0x40
Slave responds 0x42

Master writes to Slave 0x22
Slave responds 0x60

4.1 SDO error message

In case of an error during the SDO communication the module will responds with one of the SDO error messages.

ID	DLC	Byte0	Byte1	Byte2	Byte3	Byte4	Byte5	Byte6	Byte7
0x580 + Node ID	8	0x80	Index		Sub index	Error code			

Table 4.1: Standardframe in case of an error during the SDO communication

Error code	Meaning
0x0504 0001	Client / Server command unknown/ not valid
0x0601 0000	Unsupported acces to this object
0x0601 0001	Read access to this object is not supported
0x0601 0002	Write access to this object is not supported
0x0602 0000	Object does not exist in the object dictionary
0x0609 0011	Sub-Index does not exist in the object dictionary
0x0800 0000	General error
0x0800 0020	Data can not be transferred or stored to the application
0x0800 0021	Data can not be transferred or stored to the application because of local control

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0x0800 0022	Data can not be transferred or stored to the application because of the present device state
0x0800 0024	No data available

Table 4.2: Error description

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5. Emergency messages

Emergency messages indicate errors inside the component.

ID	DLC	Byte0	Byte1	Byte2	Byte3	Byte4	Byte5	Byte6	Byte7
0x080 + Node ID	3	Error Code		Error register (content 0x1001)	Not used				

Table 5.1: Standardframe emergency message

Error Code	Meaning
0x0000	Faultfree
0x5000	Hardware error
0x5010	Sensor error
0x6300	Data error

Table 5.2: Error groups

6. Rudimentary object dictionary for control units

General communication profile for all components.

Index	Sub Index	Name/ function	Data type	Access
0x1000	0x00	Device type	Unsigned32	ro
0x1001	0x00	Error register	Unsigned8	ro
0x1002	0x00	Status register	Unsigned32	ro
0x1008	0x00	Device name	char{[4]	ro
0x1009	0x00	Hardware version	char[4]	ro
0x100A		Hersteller Software Version	char[4]	ro
0x1010		Save parameters		ro
	0x00	Highest Sub index	0x01	ro
	0x01	Save all	char[4] = {'s','a','v','e'}	ro
0x1017	0x00	Producer Heartbeat- time, 0 -- 65535 ms	Unsigned16	rw

General, specific object dictionary

Index	Sub Index	Name/ function	Data type	Access
0x2200	0x00	Cycle timer for PDOs 0ms -- 65535 ms	Unsigned16	rw
0x3200	0x00	Modify Node ID	Unsigned8	rw
0x3201	0x00	Set bit rate (default 125 Kbit/s)	Unsigned16	rw

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6.1 Rudimentary object dictionary for control unit

Error register (Index 0x1001)

Error bit 0: 1 = Overtemperature motor
Error bit 1: 1 = Temperature BG149 > 75°C
Error bit 2: not used
Error bit 3: not used
Error bit 4: not used

Status register (Index 0x1002 and index 0x3041)

Status bit 0: 1 = Gain for the start is activ
0 = Gain for the start is not activ
Status bit 1: 1 = Parameters for water
0 = Parameters for air
Status bit 2: 1 = Temperature BG149 > 75°C
0 = Temperature BG149 < 75°C
Status bit 3: 1 = Overtemperature motor
0 = No overtemperature motor
Status bit 4: 1 = Step mode is activ
0 = Speed mode
Status bit 5: not used
not used
Status bit 6: 1 = rotation CCW
0 = rotation CW
Status bit 7: not used

Command byte (Index 0x3040)

Command bit 0: 1 = start
0 = stop
Command bit 1: 1 = rotation CCW*
0 = rotation CW*
Command bit 2: not used
Command bit 3: 1 = Current control
0 = Speed regulation
Command bit 4: 1 = Control in water
0 = Control in air
Command bit 5: not used
Command bit 6: not used
Command bit 7: not used

*(CCW = CounterClockwise; CW= Clockwise)

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Transmit - PDO1 (0x180 + Node ID):

Identifier	DLC	Byte0 - Byte1	Byte2 - Byte3	Byte4	Byte5
0x180+ Node ID	6	Actual value motor frequency [Hz] *	Actual value current **	Actual command byte	Status register

Receive - PDO1 (0x200 + Node ID)

Identifier	DLC	Byte0 - Byte1	Byte2
0x200+ Node ID	3	Set value ***	Command byte

*
Actual speed [rpm] = Actual value motor frequency [Hz] * 4,81

**
Actual value current in Ampere

***
Set value depends from bit3 of the command byte, if the set value will be interpreted as motor frequency or as current.
In normal case bit3 = 0 (speed regulation) → set value = motor frequency

Object directory device profil

Index	Sub Index	Name/ function	Data type	Access
0x3010		Temperature		
	0x00	Highest Subindex	0x03	ro
	0x01	Temperature 1 [°C]	Integer16	ro
	0x02	Temperature 2 [°C]	Integer16	ro
	0x03	Temperature 3 [°C]	Integer16	ro
0x3040	0x00	Command byte	Unsigned8	rw
0x3041	0x00	Status byte	Unsigned8	ro
0x3048	0x00	Actual value motor frequency / current	Unsigned16	ro
0x304C	0x00	Set value motor frequency / current	Unsigned16	rw
0x3060	0x00	Actual value motor frequency [Hz]	Unsigned16	ro
0x3061	0x00	Actual value current [A]	Unsigned16	ro

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0x3080	0x00	Set value motor frequency [Hz]	Unsigned16	rw
0x3081	0x00	Set value current	Unsigned16	rw
0x3084		Control demand values		
	0x00	Highest Sub Index	0x04	ro
	0x01	PID output	Unsigned8	ro
	0x02	Setting curve Y	Unsigned8	ro
	0x03	PWM output	Unsigned8	ro
	0x04	PID output max limitation	Unsigned8	ro
0x30F0		Control parameters for water		
	0x00	Highest Sub Index	0x0A	ro
	0x01	PV_water	Unsigned8	
	0x02	Tn_water	Unsigned8	ro
	0x03	D_water	Unsigned8	ro
	0x04	Starts factor water	Unsigned8	ro
	0x05	PID output max limitation water	Unsigned8	ro
	0x06	PID output min limitation water	Unsigned8	ro
	0x07	Speed-dependent current limitation: m	Unsigned8	ro
	0x08	Speed-dependent current limitation: n	Unsigned8	ro
	0x09	Divisor setting curve	Unsigned8	ro
	0x0A	Offset setting curve water	Unsigned8	ro
0x30F1		Control parameters for air		
	0x00	Highest Sub Index	0x0A	ro
	0x01	PV_air	Unsigned8	
	0x02	Tn_air	Unsigned8	ro
	0x03	D_air	Unsigned8	ro
	0x04	Starts factor air	Unsigned8	ro
	0x05	PID output max limitation air	Unsigned8	
	0x06	PID output min limitation air	Unsigned8	ro
	0x07	Speed-dependent current limitation: m	Unsigned8	ro
	0x08	Speed-dependent current limitation: n	Unsigned8	ro
	0x09	Divisor setting curve	Unsigned8	ro
	0x0A	Offset setting curve air	Unsigned8	ro