Grünewald

CAN-Bus

Instruction Manual

Grünewald GmbH · Oberallener Weg 7 · D-59069 Hamm

Summary

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1. General

1.1 Introduction

This section contains important information for the proper use of the CAN-Bus sensors. It was developed for the people who are trained and qualified in handling electrical equipment.

The successful and safe operation requires proper transport, storage, installation, operation and maintenance.

Ensure while operating the sensor on the applicable safety and accident prevention regulations.

When the supply of the devices with 12 V auxiliary voltage, make sure that the low voltage is safety isolated from other voltages.

It must be hardware- and software-security precautions are taken to prevent a line break does not result in undefined states in the automation devices.

For systems which can cause great damage or even personal injury due to a malfunction, safety precautions must be taken to ensure that in case of failure a safe operation condition. This can be done e.g. by limit switches, mechanical interlocks, etc...

1.2 Overview

The development of automation technology to decentralized systems with their own “intelligence” makes the communication between the components becoming increasingly important.

Industry calls for the possibility of integrating components from different manufacturers in an automation system. The solution to this problem is to network via common bus.

All these requirements are fully met by the CAN-Bus sensors of Grünewald GmbH.

The CAN-Bus field bus in sensors are standardized CAN bus concept.

The CAN-Bus sensors work with the protocol CAN-Bus sensors and controllers according to DS 404.

The Layer 2 of the ISO/OSI - model (definitions of the bits in the communication frame) is the standard CAN base frame 1bit defined identifier (2.0A).

The CAN-Bus sensors, depending on design and plug, tested to IP67 and ideal for harsh industrial applications suitable. The fast and unproblematic integration of CAN-Bus sensors in your application reduces development effort and the resulting costs. Material and labor costs are reduced to a minimum. Due to the uncomplicated installation, maintenance and replacement of components in the shortest time can be realized.

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2. Project Planning

2.1 Maximum System Expansion

To build an executable bus there must be at least a master (or superordinate system) on the bus. This master can be a PLC or a PC with an appropriate CAN card. Each CAN-Bus sensor represents an active CAN node. A bus line, each with a master of the CAN network can consist of a maximum of 127 participants.

Each participant will receive its address, which is set by special markers. The individual node can be connected (ring-wiring). The maximum bus length and baud rates are listed in the following table. The values are recommended by the CiA standard values and can be realized with the CAN-Bus sensors.

To view factory settings of this sensor please refer to section “5.3.10 Parameter Handling“.

Be sure to follow the allowable bus and stub length according to table 1

The maximum permitted total cable length and total stub length
- depends on the baud rate
- can be divided into several segments or single stitch lines.

Table 1:
Maximum total bus cable (with terminating resistor) and maximum stub length (without terminating resistor) depending on the baud rate.

Baude rate [kBit/s]	10	20	50	100	125	250	500	800	1000
Total bus length	5000 m	3000 m	1000 m	500 m	400 m	200 m	75 m	30 m	25 m
Total stub length	1360 m	875 m	350 m	175 m	140 m	70 m	35 m	20 m	17 m
Single stub length	270 m	175 m	70 m	35 m	28 m	14 m	7 m	4 m	3 m

The maximum segment cable length in Table 1 is dependent
- of the cable cross-section used
- the number of communication participants

Table 2:
Maximum segment cable lengths depends on the number of communication nodes and the cable cross-section.

Number of communication participants	Wire cross section		
	0.75 mm²	0.5 mm²	0.25 mm²
32	550 m	360 m	200 m
64	470 m	310 m	170 m
100	410 m	270 m	150 m

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- Repeaters divide the max. total cable length into segments if you need to produce longer cable lengths than are allowed in table 2.
- Repeaters require a reduction of the max. total cable length according to table 1. This is dependent on the repeater type. Per repeater, the typical reduction of the max. total cable length is approx. 30 m.
- The max. total cable length with repeaters is derived from the lengths of table 1 minus the sum of all line length reductions through a repeater.
- LBus max. = Lmax. (Table 1) - (∑ cable length shortening * numbers of repeater)
- A repeater is also recommended as a service interface for trouble-free connection during bus operation or as a calibration interface for galvanic isolation of the programming device.

3. Assembly and disassembly

For information on mounting and connection to the system take a look at the operating manual SMALL-Ex, which is included with the sensor.

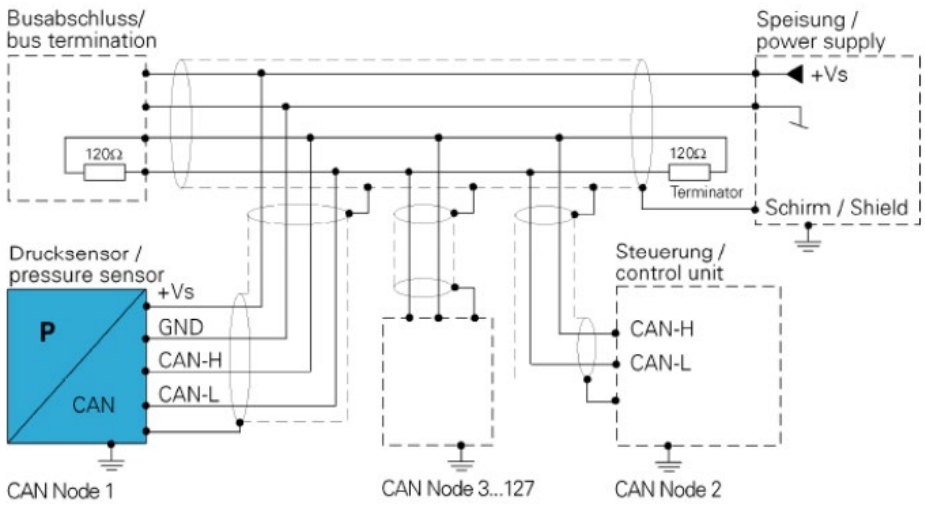
3.1 Electrical connection

Connect the sensor according to the sketch below. Please pay attention to the correct polarity. Please consider using shielded cable. The sensor housing and the cable shield must be grounded. Avoid potential differences between installation parts and measuring chains.

3.1.1 Connection assignment

1	0V supply
2	+ 12V supply
3	CAN_GND
4	CAN_High
5	CAN_Low

3.1.2 Connection sketch



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4. Connections

4.1 Potential conditions

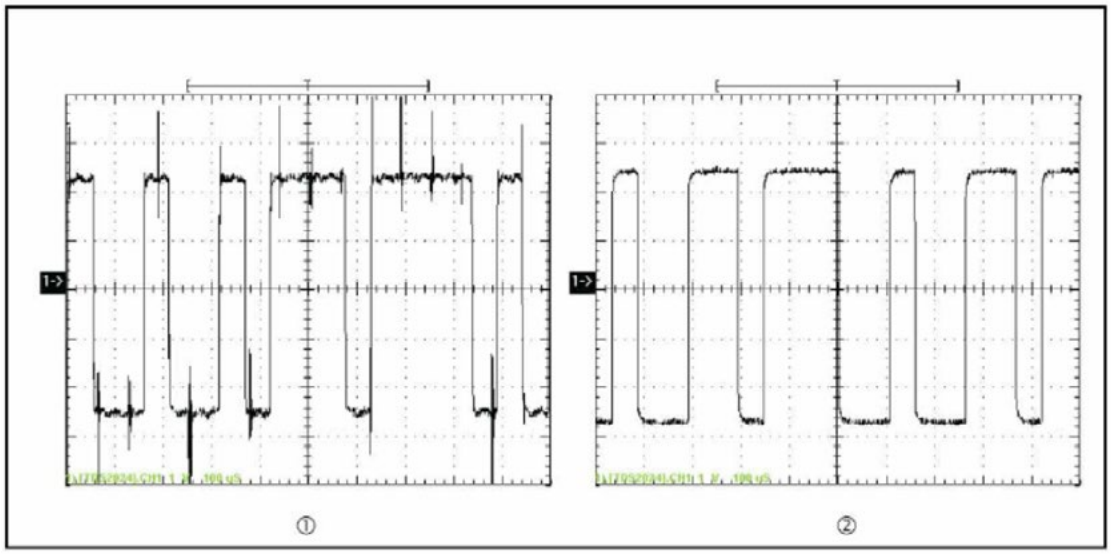
The potential relationships of a CANbus system with a CAN-Bus sensor are characterized by the following features:

- The CAN bus connection is electrically isolated from the supply terminal.
- The individual CAN-Bus sensors are not electrically isolated from the supply voltage.
- Each CAN-Bus sensor can be supplied separately.

Avoid potential differences by

- Each CAN node on the shortest possible path with the same low-earth reference potential (PE) of the machine / system connect.
- Use an equipotential line between the communication participants.
- The ground reference of the machine / system to total soil run low.

Detection of electromagnetic interference during signal oscillogram



Oscillograms of the CAN signals (1) and (2) without interference voltage (measuring points: CAN_HIGH to CAN_LOW).

Quantification of the interference measurements with a CAN Analyzer is required. Important parameters, such as the bus load or the number of error frames detected and further analyses, are performed.

4.2 EMC-compliant wiring

EMC (electromagnetic compatibility) is the ability of a device in a given electromagnetic environment to work flawlessly without even the environment in a manner not permitted to influence.

All CAN-Bus sensors meet these requirements, since all sensors are tested for compliance with the statutory limits (industry standard).

4.2.1 Grounding of inactive metal parts

All inactive metal components must be connected and low-impedance (grounding). This measure ensures that a uniform reference potential is guaranteed for all elements of the system.

The grounding of the CAN-Bus sensors occurs via the metallic threaded connection.

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4.2.2 Shielding of cables

The shield should be grounded, if possible on both sides with an EMC righteous shield connection.

4.3 Specifications of the CAN-cables

The cable that you use must match ISO 11898 to connect the nodes on the CAN bus. Therefore the lines must have the following electrical characteristics.

Specifications of CAN-cables

Total length of bus system	< 300 m	< 1000 m
Type of cable	LIYCY 2 x 2 x 0.5 mm² (shielded twisted pairs)	CYPIMF 2 x 2 x 0.5 mm² (shielded twisted pairs)
Wire resistance	< 40 Ohm/km	< 40 Ohm/km
Capacity	< 130 nF/km	< 60 nF/km
Connection	Pair 1 (white/brown): CAN_GND and +Vs Pair 2 (green/yellow): CAN_HIGH and CAN-LOW	

- Only use cables that have an extra pair for CAN-GND.
- Operation is possible only with a properly connected CAN-GND fault-free bus.

Connect the bus terminating resistor. *IMPORTANT!*

At the physical beginning and at the physical end of the bus system each must be connected by a 120 Ohm terminating resistor.

5 CAN-Bus Protocol

5.1 General

The operating manual provides the current status of the implemented functions of the modules (described in the following chapters).

If you have further questions about the protocol, we are available at **info@gruenewald.eu**

Furthers reading:

CiA Draft Standard 404 (CAN-Bus)

Reference on:
CAN in Automation (CiA)
International Headquarters
Am Weichselgarten 26
D-91058 Erlangen
www.can-cia.org

With this CAN-Bus sensor you do not need other aids for the identification and the baud rate switch. The sensor does not need to be opened. The communication parameters can be defined and stored by the software.

CAN-Bus master information can be taken from the documentation of the used device.

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5.2 Network Management

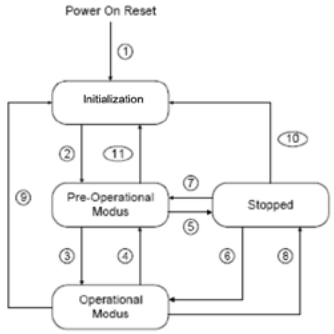
After switching on the power, the CAN-Bus sensor sends the CAN message „Boot-up Message“. This is a remote frame with no data bytes with the COB-identifier 1792d + module-ID (700H+ID).

5.2.1 Predefined Connecion Set

COB-ID = Function Code (4 bit) + Modul-ID (7 bit)

Index	COB-ID (dezimal)	COB-IB (hex)
Network Management	0	0
Sync	128	80h
Emergency	129 - 255	81h - FFh
PDO1 (tx)	385 - 511	81h - FFh
PDO3 (tx)	897 - 1023	381h - 3FFh
SDO (tx)	1409 - 1535	581h - 5FFh
SDO (rx)	1537 - 1663	601h - 67Fh
Heart beat	1793 - 1919	701h - 77Fh

5.2.2 Starting procedure



1	Connecting the supply voltage
2	Initialization after program start Send the boot-up message (see 5.2 Network Management)
3, 6	Start – Node
4, 7	Internal events
5, 8	Stop – Node
9, 10, 11	Reset – Node

Initialization
This is the state that a node passes through after power up. Within this phase is initialized in the device application and the device communication. Subsequently, the node automatically turns in the preoperational state.

Pre-Operational
In this state, the node waits for the release of the operational mode. The possibilities of communication are shown in the table below.

Operational
In this state the CAN-Bus node has full function and can independently transmit messages (PDO’s, Emgergency).

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Ways of communication trough the different modes:

	Initialization	Pre-Operational Modus	Operational Modus	Stop Modus
PDO			X	
SDO		X	X	
Sync Objects			X	
Emergency		X	X	
Boot-Up Objects	X			
Network-Management		X	X	X
Heart beat		X	X	X

5.2.3 Start Node

ID	DLC	Byte 1	Byte 2
0	2	01h	Node

Node = Module address, 0 = all nodes
The „Start Node“ command sets the node back into the operational mode.

5.2.4 Stop Node

ID	DLC	Byte 1	Byte 2
0	2	02h	Node

Node = Module address, 0 = all nodes
The „Stop Node” command sets the node back into the pre-operational mode.

5.2.5 Pre-Operational Node

ID	DLC	Byte 1	Byte 2
0	2	80h	Node

Node = Module address, 0 = all nodes

5.2.6 Reset Node

ID	DLC	Byte 1	Byte 2
0	2	81h	Node

Node = Module address, 0 = all nodes
The „Reset Node" command corresponds to a power on reset.

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5.3 supported Indexes

5.3.1 Overview

Index	Index Name	PDO mappable	Page
1000	Device profile	No	19
1001	Error Register	No	19
1003	Pre- Defined error Field	No	20
1005	Sync ID	No	23
1008	Device name	No	30
1009	Hardware Version	No	29
100A	Software Version	No	30
100C	Guard Time	No	23
100D	Livetime Faktor	No	24
1010	Save parameters	No	25
1011	Load default values	No	26
1014	Emergency Message ID	No	27
1016	User heartbeat Time	No	28
1017	Manufacturer Heartbeat Time	No	28
1018	Device Identity	No	31
1800	PDO 1 Parameter	No	33
1802	PDO 3 Parameter	No	37
1A00	PDO 1 Mapping Parameter	No	40
1A02	PDO 3 Mapping Parameter	No	43
7100	"Analog measurement value AD- Input"	No	45
6110	Sensor type	No	47
6114	Read rate analog input	No	48
6124	Analog input offset	No	48
6125	Analog input zero	No	49
6130	Calculated measurement value	Yes	49
6131	Process value unit	Yes	50
6133	Interrupt Delta value	No	54
6148	Minimum value of valid range	No	52
6149	Maximum value of valid range	No	52
6150	Sensor Status	No	53
6160	Control byte for measurement	Yes (at index 1)	54
61A0	Filter type for measurement	No	56
61A1	Filter constants for measurement	No	57
6500	Alarm 1 Input value	No	57
6508	Alarm 1 Type	No	57
6509	Alarm 1 Action	No	58
650A	Alarm 1 Size	No	58
650B	Alarm 1 Hysteresis	No	59
650E	Alarm 1 Reset	No	60
6600	Alarm 1 Status	No	60

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5.3.2 SDO-Structure

ID	DLC	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
-	8	CMC	Index	Sub Index	Data bytes				

Process	CMD	Remark
Master requests data from the slave	40h	
Slave responds	43h	(4 valid data bytes)
	47h	(3 valid data bytes)
	4Bh	(2 valid data bytes)
	4Fh	(1 valid data byte)
Master writes to the slave	23h	(4 valid data bytes)
	27h	(3 valid data bytes)
	2Bh	(2 valid data bytes)
	2Fh	(1 valid data byte)
Slave responds	60h	

For index and data bytes, the LSB is transmitted first. If ASCII transmitted characters, the characters are legibly transferred (first character first).

The range of the communication profile is located in the indexes 1000h-1FFFh and includes all the parameters that affect the CAN network. This area has the same definition in all CAN-Bus devices.

There must always be given the right CMD command so that there is no conflict with different data types.

An incorrect length of the data in the CMD command generates the error data format wrong (10 00 07 06h).

The minimum time difference between two SDO messages must not be below 20 ms. Faster SDO communication can put the device in undefined states.

5.3.3 Device profile

Index 1000h (Device Type):

ID	DLC	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
600 + ID	8	40h	00h	10h	00h	00h	00h	00h	00h

Response from the CAN-Bus sensor:

ID	DLC	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
580h + ID	8	43h	00h	10h	00h	94h	01h	02h	00h

Example:

Byte 6 + 5: 01’94h = 404d (Device profile number)

Byte 8 + 7: 00’02h (additional information, analog input)

The index 1000h can be read only.

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5.3.4 Error Register

Index 1001h (Register):

ID	DLC	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
600 + ID	8	40h	01h	10h	00h	00h	00h	00h	00h

Response from the CAN-Bus sensor:

ID	DLC	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
580h + ID	8	4Fh	01h	10h	00h	01h	00h	00h	00h

Byte 5: 1: There is one active failure.

5.3.5 Emergency History (Object 1003 Subindex 0-16)

Index 1003h: (Pre-defined Error Field)

The index 1003h stores the last 16 error messages (emergency messages) in the RAM, which have occurred during the operation.

That means the next voltage drop (or manual deletion) occurs with a data deletion. 00h is written to the subindex is 0, the record is deleted.

The index has the following structure:

Index	Sub-Index	Parameter	Length	Access
1003h	0	Number of error messages	1 byte	Read/Write
	1...16	Error messages	8 byte	Read

Sub-Index 0 (Number of recorded error messages)
The sub-index 0 can be read as follows:

ID	DLC	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
600 + ID	8	40h	03h	10h	00h	00h	00h	00h	00h

Response from the CAN-Bus sensor:

ID	DLC	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
580h + ID	8	4Fh	03h	10h	00h	aah	00	00	00

Byte 5: aa = 02h 2 error messages recorded

The Emergency messages are deleted by a 0 is written to the sub-index 0:

ID	DLC	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
600h + ID	8	2Fh	03h	10h	00h	Aa	00h	00h	00h

Response from the CAN-Bus sensor:

ID	DLC	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
580h + ID	8	60h	03h	10h	00h	aa	00h	00h	00h

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Sub-index 1...16 (Error messages):

ID	DLC	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
600h + ID	8	40h	03h	10h	00h	00h	00h	00h	00h

Byte 4: 00h last stored error message

01h – 10h earlier error messages

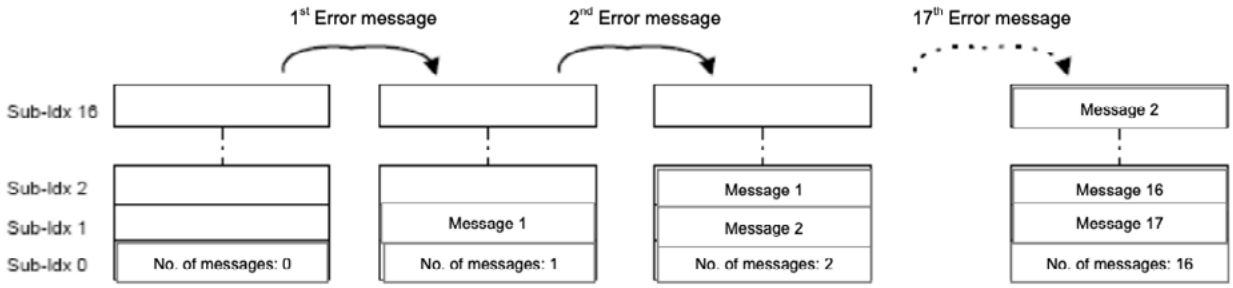
aa = index of 0 (no error) to 16 max. number of new errors - older faults will be overwritten by newer ones. A letter of 0x00 will result in the deletion of the fault memory. The error memory is stored in the RAM, so that after turning off all data will be lost.

Reponse from the CAN-Bus sensor:

ID	DLC	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
580h + ID	8	43h	03h	10h	01h	11h	F0h	81h	21h

Example „Overpressure“:
The error code is described in 5.10 Emergency Messages.

Functionality:



The sensor can store the last 16 error messages. The most recent message is stored under the sub-index 1, all previous ones are shifted up one position.
If the memory is full and there is a new message, it is saved under sub-index 1 and the oldest message (sub-index 16) is pushed out of the memory.

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5.3.6 Parameter Handling

Index	Index name	PDO mappable	Page
1000	Device profile	No	19
1001	Error Register	No	19
1003	Pre- Defined error Field	No	20
1005	Sync ID	No	23
1008	Device name	No	30
1009	Hardware Version	No	29
100A	Software Version	No	30
100C	Guard Time	No	23
100D	Livetime Faktor	No	24
1010	Save parameters	No	25
1011	Load default values	No	26
1014	Emergency Message ID	No	27
1016	User heartbeat Time	No	28
1017	Manufacturer Heartbeat Time	No	28
1018	Device Identity	No	31
1800	PDO 1 Parameter	No	33
1802	PDO 3 Parameter	No	37
1A00	PDO 1 Mapping Parameter	No	40
1A02	PDO 3 Mapping Parameter	No	43
7100	"Analog measurement value AD- Input"	No	45
6110	Sensor type	No	47
6114	Read rate analog input	No	48
6124	Analog input offset	No	48
6125	Analog input zero	No	49
6130	Calculated measurement value	Yes	49
6131	Process value unit	Yes	50
6133	Interrupt Delta value	No	54
6148	Minimum value of valid range	No	52
6149	Maximum value of valid range	No	52
6150	Sensor Status	No	53
6160	Control byte for measure-ment	Yes (at index 1)	54
61A0	Filter type for measure-ment	No	56
61A1	"Filter constants for measure-ment"	No	57
6500	Alarm 1 Input value	No	57
6508	Alarm 1 Type	No	57
6509	Alarm 1 Action	No	58
650A	Alarm 1 Size	No	58
650B	Alarm 1 Hysteresis	No	59
650E	Alarm 1 Reset	No	60
6600	Alarm 1 Status	No	60

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5.3.6.1 Sync- ID Message (Object 1005, Sub-Index 0)

Index 1005h (sync- ID):

ID	DLC	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
600h + ID	8	40h	05h	10h	00h	00h	00h	00h	00h

Response from the CAN-Bus sensor in ASCII format:

ID	DLC	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
580h + ID	8	43h	05h	10h	00h	80h	00h	00h	00h

COB-ID SYNC = 0x80 (default	Ui = Bit0 ... 11 Identifier Rest = 0	80h	00h	00h	00h

Index 1005h (Sync- ID):

ID	DLC	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
600h + ID	8	23h	05h	10h	00h	gg	GG	00h	00h

Resonse from the CAN-Bus sensor for ASCII format:

ID	DLC	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
580h + ID	8	60h	05h	10h	00h	00h	00h	00h	00h

GG gg: COB_ID SYNC (0..7FFh) – sets the SYNC-ID is responsive to the sensor.

5.3.6.2 Guard Time

Index 100Ch (Guard Time):

ID	DLC	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
600h + ID	8	2Bh	0Ch	10h	00h	gg	GG	00h	00h

Response from the CAN-Bus sensor:

ID	DLC	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
580h + ID	8	60h	0Ch	10h	00h	00h	00h	00h	00h

Index 100Ch (read request):

ID	DLC	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
600h + ID	8	40h	0Ch	10h	00h	00h	00h	00h	00h

Response from the CAN-Bus sensor:

ID	DLC	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
580h + ID	8	4Bh	0Ch	10h	00h	gg	GG	00h	00h

Default- Value = 2500ms (that means GG gg = 0x09C4) (Value after power reset)

GG gg = Guardtime in ms (0x0000 ... 0xFFFF) (see note to 5.3.6.2 and 5.3.6.3)

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5.3.6.3 Livetime Factor

Index 100Dh (Livetime Factor):

ID	DLC	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
600h + ID	8	2Fh	0Dh	10h	00h	ll	00h	00h	00h

Response from the CAN-Bus sensor:

ID	DLC	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
580h + ID	8	60h	0Dh	10h	00h	00h	00h	00h	00h

Index 100Ch (read request):

ID	DLC	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
600h + ID	8	40h	0Dh	10h	00h	00h	00h	00h	00h

Response from the CAN-Bus sensor:

ID	DLC	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
580h + ID	8	4Fh	0Dh	10h	00h	LL	00h	00h	00h

Default- value = 2 (that means LL = 0x02) (value after power reset)

LL = Livetime Factor (00 ... FF)

Notes for 5.3.6.2 and 5.3.6.3:

- Guard Time [ms] * Live Time Factor = after this time has elapsed without receiving a node-guarding (see 3.) is the sensor in „pre-operational“
- The guard time is only „50ms grid“ set, that means the real value is „Real time“ until the sensor turns into „pre-operational“ in [ms] = INT (Guard Time / 50) * 50 * Live Time Factor (the result must never be 0xFFFF)
- Is the „Real Time“ (see above) = 0x0000 no „node guarding“ performed, that means the sensor never falls in the „pre-operational“ mode. (A corresponding command: „Guard Time“ and / or „Live Time Factor“ = „0“ while the sensor is in “pre-operational”, this does not turn into “operational”.)

5.3.6.4 Parameter Save

Index 1010h (Store Parameters):

With the index 1010h, the current parameters can be stored in the EEPROM. The indexes are stored in the table seen at the beginning of Chapter 5.3.6.

The saving affected by the message „save“ is sent as ASCII code on the index 1010h, Sub-index 1. The message therefore has the following structure:

ID	DLC	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
600h + ID	8	23h	10h	10h	01h	73h	61h	76h	65h

Response from the CAN-Bus sensor:

ID	DLC	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
580h + ID	8	60h	10h	10h	01h	00h	00h	00h	00h

0xdd cc bb aa = 0x65 76 61 73h („save“ in ASCII)

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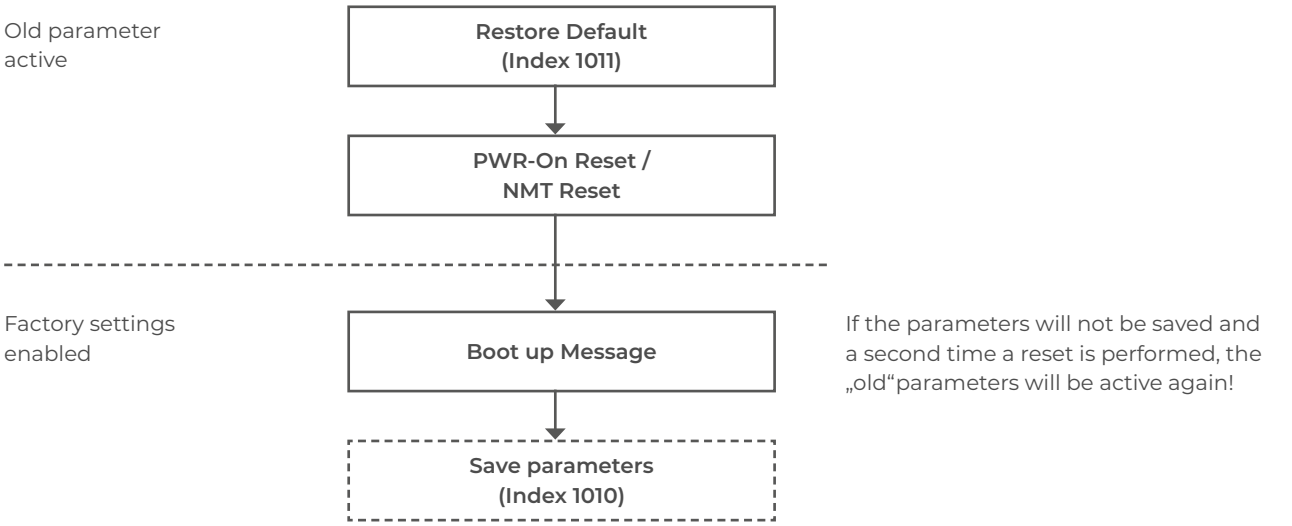
5.3.6.5 Loading default values

Index 1011h (Restore default parameters):

With the index 1011h, the factory settings can be loaded. Here, all parameters except the communication parameters (baud rate, ID) reset to the default values.

The parameters and the corresponding values can be found at the beginning of Chapter 5.3.6.

Functionality:



The loading of data is performed by the index 1011h with the message „load“ is sent in ASCII code on the sub-index 1. The message therefore has the following structure:

ID	DLC	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
600h + ID	8	23h	11h	10h	01h	6Ch	6Fh	61h	64h

Response from the CAN-Bus sensor:

ID	DLC	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
580h + ID	8	60h	11h	10h	01h	00h	00h	00h	00h

Loading the default values means that the values are loaded into RAM. If the values are retained on the next reset, the parameters must be saved with the index 1010h in the EEPROM.

0xdd cc bb aa = 0x64 61 6F 6Ch („load“ in ASCII)

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5.3.7 Emergency Message ID

Index 1014h Sub-index 0 – COB- ID EMCY – read only:

ID	DLC	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
600h + ID	8	40h	14h	10h	00h	00h	00h	00h	00h

Response from the CAN-Bus sensor:

ID	DLC	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
580h + ID	8	43h	14h	10h	00h	aa	bb	cc	dd

0xdd cc bb aa = COB-ID EMCY -> default 0x0000080 + node number

5.3.8 Heartbeat

0xdd cc bb aa = COB-ID EMCY -> default 0x0000080 + node number

ID	DLC	Byte 1
700h + ID	1	aa

aa: 00h Start up (Boot up)

04h Stop Mode

05h Operational

7Fh Pre-operational

5.3.8.1 Manufacturer Heartbeat Time

Index 1017h Sub-index 0:

ID	DLC	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
600h + ID	8	2Bh	17h	10h	00h	aa	bb	00h	00h

Response from the CAN-Bus sensor:

ID	DLC	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
580h + ID	8	60h	17h	10h	00h	00h	00h	00h	00h

Index 1017h Sub-index 0 / read:

ID	DLC	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
600h + ID	8	40h	17h	10h	00h	00h	00h	00h	00h

Response from the CAN-Bus sensor:

ID	DLC	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
580h + ID	8	4Bh	17h	10h	00h	aa	bb	00h	00h

bb aa = Heartbeat Time in ms 0xbbaa

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5.3.8.2 User Heartbeat Time

Index 1016h Sub-index 0 - Number of entries:

ID	DLC	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
600h + ID	8	40h	16h	10h	00h	00h	00h	00h	00h

Response from the CAN-Bus sensor:

ID	DLC	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
580h + ID	8	4Fh	16h	10h	00	01h	00h	00h	00h

Index 1016h Sub-index 1 - Node-ID and Heartbeat-Time:

ID	DLC	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
600h + ID	8	23h	16h	10h	01h	aa	bb	cc	00

Response from the CAN-Bus sensor:

ID	DLC	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
580h + ID	8	60h	16h	10h	01h	00h	00h	00h	00h

Index 1016h Sub-index 1 - Node-ID and Heartbeat-Time / read:

ID	DLC	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
600h + ID	8	40h	16h	10h	01h	00h	00h	00h	00h

Response from the CAN-Bus sensor:

ID	DLC	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
580h + ID	8	43h	16h	10h	01h	aa	bb	cc	00h

bb aa = Heartbeat Time in ms 0xbbaa

cc = Node- ID for Heartbeat Time

5.3.9 Versions

5.3.9.1 Hardware

Index 1009h (Manufacturer Hardware Version):

ID	DLC	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
600h + ID	8	40h	09h	10h	00h	00h	00h	00h	00h

Response from the CAN-Bus sensor in ASCII format:

ID	DLC	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
580h + ID	8	43h	09h	10h	00h	30h	32h	31h	30h

Response from the CAN-Bus sensor in ASCII format:

Hardware-version V:	String = "01.20"	'0'	'2'	'1'	'0'

Example Hardware Version 1.20:

Byte 5 – 8: 31'2E'32'30h „1.20“ in ASCII format

The index 1009h can only be read.

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5.3.9.2 Software

Index 100Ah (Hersteller Software Version):

ID	DLC	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
600h + ID	8	40h	0Ah	10h	00h	00h	00h	00h	00h

Respone from the CAN-Bus sensor in ASCII format:

ID	DLC	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
580h + ID	8	43h	0Ah	10h	00h	30h	32h	31h	30h

Software-version V:	String = "01.20"	'0'	'2'	'1'	'0'

Example Software Version 1.20:

Byte 5 – 8: 31'2E'32'30h „1.20“ in ASCII format

The index 100Ah can only be read.

5.3.10 Device Description

Index 1008h (Device Description):

ID	DLC	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
600h + ID	8	40h	08h	10h	00h	00h	00h	00h	00h

Response from the CAN-Bus sensor in ASCII format:

ID	DLC	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
580h + ID	8	43h	08h	10h	00h	30h	32h	31h	47h

Device =	String = " "	'0'	'2'	'1'	'G'

The index 1008h can only be read.

5.3.11 Device Identity

Index 1018h: (Identity Object)

The index 1018h contains general information about the device.

The index has the following structure:

Device =	Sub-Index	'0'	Length	Access
1018h	0	Number of sub-indexes	1 Byte	Read
	1	Vendor-ID	4 Byte	Read
	2	Product Code	4 Byte	Read
	3	Revision number	4 Byte	Read
	4	Serial number	4 Byte	Read

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Sub-index 0 (Number of sub-indexes):

ID	DLC	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
600h + ID	8	40h	18h	10h	00h	00	00	00	00

Response from the CAN-Bus sensor:

ID	DLC	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
580h + ID	8	4Fh	18h	10h	00h	04h	00h	00h	00h

Sub-index 1 (Vendor-ID):

ID	DLC	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
600h + ID	8	40h	18h	10h	01h	00h	00h	00h	00h

Response from the CAN-Bus sensor:

ID	DLC	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
580h + ID	8	4Bh	18h	10h	01h	90h	02h	00h	00h

Byte 5 – 8: 00’00’02’90h (LSB first) ⟶ company Grünewald GmbH

Sub-index 2 (Product Code):

ID	DLC	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
600h + ID	8	40h	18h	10h	02h	00h	00h	00h	00h

Response from the CAN-Bus sensor:

ID	DLC	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
580h + ID	8	43h	18h	10h	02h	aa	bb	cc	dd

0xdd cc bb aa represents the product code.

Sub-index 3 (Revision number)

ID	DLC	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
600h + ID	8	40h	18h	10h	03h	00h	00h	00h	00h

Response from the CAN-Bus sensor:

ID	DLC	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
580h + ID	8	4Bh	18h	10h	03h	aa	bb	cc	dd

0xdd cc bb aa represents the revision number.

Sub-index 4 (Serial number)

ID	DLC	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
600h + ID	8	40h	18h	10h	04h	00h	00h	00h	00h

Response from the CAN-Bus sensor:

ID	DLC	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
580h + ID	8	43h	18h	10h	04h	aa	bb	cc	dd

0xdd cc bb aa represents the Serial number. The index 1018h can only be read.

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5.4 PDO-Communication

Via the communication by PDO (Process Data Objects) it is possible to query certain values of the CAN-Bus sensor in a simple and fast way. In the sensor, a variable PDO mapping is realized (cf. Chapter 5.8.3 – 5.8.4). The parameters sent as well as the condition for sending a PDO can be defined by the user.

The PDO can be triggered by a sync message, according to a run-time event or when a delta value is exceeded.

Communication via PDOs is possible only in the operational mode of the sensor. An RTR on the 0x1800 or 0x1802 is not supported.

5.4.1 Send PDO 1

Index 1800h (Transmit PDO Communication Parameter):
About the index 1800h the settings are made to work with the transmit PDOs. PDOs are only processed in the operational mode of the device. The PDO must be enabled.

The PDOs should be requested no faster than the corresponding measured rate.
(10 measurements / second) > 100 ms

The index 1800h has the following structure:

Subindex	Parameter	Length	Access
00h	Number of the highest sub-index	1 Byte	Read access only
01h	ID of the PDO 1 (COB-ID)	4 Bytes	Read / Write access
02h	Type of programm (Transmission Type)	1 Byte	Read / Write access
03h	Inhibit TIme in 100us	2 Byte	Read / Write access
05h	Event Time in ms	2 Bytes	Read / Write access

Index 1800h Sub-index 0 - Number of entries:

ID	DLC	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
600h + ID	8	40h	00h	18h	00h	00h	00h	00h	00h

Response of the CAN-Bus sensor:

ID	DLC	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
580h + ID	8	4Fh	00h	18h	00h	05h	00h	00h	00h

Index 1800h Sub-index 1 - ID-TPDO1:

ID	DLC	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
600h + ID	8	23h	00h	18h	01h	aa	bb	00h	dd

Response of the CAN-Bus sensor:

ID	DLC	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
580h + ID	8	60h	00h	18h	01h	00h	00h	00h	00h

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Index 1800h Sub-index 1 - ID-TPDO1 / read:

ID	DLC	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
600h + ID	8	40h	00h	18h	01h	00h	00h	00h	00h

Response from the CAN-Bus sensor:

ID	DLC	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
580h + ID	8	43h	00h	18h	01h	aa	bb	00h	dd

0xbbaa = 180h + node number
0xdd = 40h -> TPDO 1 active, no RTR
0xdd = C0h -> TPDO 1 inactive, no RTR

Index 1800h Sub-index 2 Transmission type- TPDO1:

ID	DLC	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
600h + ID	8	2Fh	00h	18h	02h	aa	00h	00h	00h

Response from the CAN-Bus sensor:

ID	DLC	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
580h + ID	8	60h	00h	18h	02h	00h	00h	00h	00h

Index 1800h Sub-index 2 - ID-TPDO1 / read

ID	DLC	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
600h + ID	8	40h	00h	18h	02h	00h	00h	00h	00h

Response from the CAN-Bus sensor:

ID	DLC	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
580h + ID	8	4Fh	00h	18h	02h	aa	00h	00h	00h

0xaa = Transmission type

Transmission type = 01h ... F0h -> TPDO 1 is triggered at every nth SYNC-pulse

Transmission type = FEh -> TPDO 1 is triggered with every change greater AI interrupt delta PV (6133h) and the end of the inhibit time.

Transmission type = FFh -> TPDO 1 is triggered after the event time.

Index 1800h Sub-index 3 - Inhibit Time:

ID	DLC	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
600h + ID	8	2Bh	00h	18h	03h	tt	TT	00h	00h

Response from the CAN-Bus sensor:

ID	DLC	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
580h + ID	8	60h	00h	18h	03h	00h	00h	00h	00h

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Index 1800h Sub-index 3 - ID-TPDO1 / read:

ID	DLC	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
600h + ID	8	40h	00h	18h	03h	00h	00h	00h	00h

Response ferom the CAN-Bus sensor:

ID	DLC	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
580h + ID	8	4Bh	00h	18h	03h	tt	TT	00h	00h

0xTT tt = Inhibit Time in 100 µsec grid (1 = 100 µsec.) 0x01F4 ... 0xFFFF 50 ... 6550 ms.

Object 1800 for TPDO 1 (Send PDO)

- The „Inhibit Time“ is the minimum time interval between the transmission of the same TPDO. (That means if a digital and/or analog input channel will change several times within this period, the corresponding TPDO will not be sent more frequently.)
- The „Inhibit Time“ can be set only in the „50ms grid“, that means the real value is: "Real Inhibit Time“ = INT(0xTTtt/500) * 50[ms] A “Real Inhibit Time” of 0 is not allowed.

Default Value = 500 ms (that means TT tt = 0x1388) (value after power reset)

Index 1800h Sub-index 4 – Reserved

Index 1800h Sub-index 5 – Event Timer:

ID	DLC	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
600h + ID	8	2Bh	00h	18h	05h	tt	TT	00h	00h

Response from the CAN-Bus sensor:

ID	DLC	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
580h + ID	8	60h	00h	18h	05h	00h	00h	00h	00h

Index 1800h Sub-index 5 Event Timer / read:

ID	DLC	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
600h + ID	8	40h	00h	18h	05h	00h	00h	00h	00h

Response from the CAN-Bus sensor:

ID	DLC	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
580h + ID	8	4Bh	00h	18h	05h	tt	TT	00h	00h

TT tt = Event Timer in 1ms grid 0x0000 ... 0xFFFF <-> 0 ... 65535ms.

Default Value = 1000 (value after power reset)

Too small values do not make any effect because the bus is too heavily loaded and the readings may not be updated yet (see the beginning of this chapter).

There is no automatic saving of the set PDO parameter, but 1010h of the index. (see 5.3.6.4)

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5.4.2 Send PDO 3

The index 1802h has the following structure:

Subindex	Parameter	Length	Access
00h	Number of the highest sub-index	1 Byte	Read access only
01h	ID of the PDO 3 (COB-ID)	4 Bytes	Read / Write access
02h	Type of programm (Transmission Type)	1 Byte	Read / Write access
03h	Inhibit TIme in 100us	2 Byte	Read / Write access
05h	Event Time in ms	2 Bytes	Read / Write access

Index 1802h Sub-index 0 - Number of entries:

ID	DLC	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
600h + ID	8	40h	02h	18h	00h	00h	00h	00h	00h

Response of the CAN-Bus sensor:

ID	DLC	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
580h + ID	8	4Fh	00h	18h	00h	05h	00h	00h	00h

Index 1802h Sub-index 1 - ID-TPDO3:

ID	DLC	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
600h + ID	8	23h	02h	18h	01h	aah	bbh	00h	ddh

Response of the CAN-Bus sensor:

ID	DLC	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
580h + ID	8	60h	02h	18h	01h	00h	00h	00h	00h

Index 1802h Sub-index 1 - ID-TPDO3 / read:

ID	DLC	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
600h + ID	8	40h	02h	18h	01h	00h	00h	00h	00h

Response from the CAN-Bus sensor:

ID	DLC	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
580h + ID	8	43h	02h	18h	01h	aa	bb	00h	dd

0xbbaa = 180h + node number

0xdd = 40h -> TPDO 3 active, no RTR

0xdd = C0h -> TPDO 3 inactive, no RTR

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Index 1802h Sub-index 2 Transmission type- TPDO3:

ID	DLC	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
600h + ID	8	2Fh	02h	18h	02h	aa	00h	00h	dd

Response from the CAN-Bus sensor:

ID	DLC	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
580h + ID	8	60h	02h	18h	02h	00h	00h	00h	00h

Index 1802h Sub-index 2 - ID-TPDO3 / read

ID	DLC	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
600h + ID	8	40h	02h	18h	02h	00h	00h	00h	00h

Response from the CAN-Bus sensor:

ID	DLC	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
580h + ID	8	4Fh	02h	18h	02h	aa	00h	00h	dd

0xaa = Transmission type

Transmission type = 01h ... F0h -> TPDO 3 is triggered at every nth SYNC-pulse
Transmission type = FEh -> TPDO 3 is triggered with every change greater AI interrupt delta PV (6133h) and the end of the inhibit time.
Transmission type = FFh -> TPDO 3 is triggered after the event time.

Index 1802h Sub-index 3 - Inhibit Time:

ID	DLC	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
600h + ID	8	2Bh	02h	18h	03h	tt	TT	00h	00h

Response from the CAN-Bus sensor:

ID	DLC	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
580h + ID	8	60h	02h	18h	03h	00h	00h	00h	00h

Index 1802h Sub-index 3 - ID-TPDO3 / read:

ID	DLC	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
600h + ID	8	40h	02h	18h	03h	00h	00h	00h	00h

Response ferom the CAN-Bus sensor:

ID	DLC	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
580h + ID	8	4Bh	02h	18h	03h	tt	TT	00h	00h

TT tt = Inhibit Time in 100 µsec Grid (1 = 100 µsec) 0x01F4 ... 0xFFFF 50 ...6550 ms.
Object 1802 for TPDO 3 (Send PDO)

- The „Inhibit Time“ is the minimum time interval between the transmission of the same TPDO. (That means if a digital and/or analog input channel will change several times within this period, the corresponding TPDO will not be sent more frequently.)
- The „Inhibit Time“ can be set only in the „50ms grid“, which means the real value is: "Real Inhibit Time“ = INT(0xTTtt/500) * 50[ms] A “Real Inhibit Time” of 0 is not allowed.

Default Value = 500ms (that means TT tt = 0x1388) (value after power reset)

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Index 1802h Sub-index 4 – Reserved

Index 1802h Sub-index 5 – Event Timer:

ID	DLC	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
600h + ID	8	2Bh	02h	18h	05h	tt	TT	00h	00h

Response from the CAN-Bus sensor:

ID	DLC	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
580h + ID	8	60h	02h	18h	05h	00h	00h	00h	00h

Index 1802h Sub-index 5 – Event Timer / read:

ID	DLC	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
600h + ID	8	40h	02h	18h	05h	00h	00h	00h	00h

Response from the CAN-Bus sensor:

ID	DLC	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
580h + ID	8	4Bh	02h	18h	05h	tt	TT	00h	00h

TT tt = Event Timer in 1ms grid 0x0000 ... 0xFFFF <-> 0 ... 65535ms.

Default Value = 1000 (value after power reset)

Too small values do not have any effect, because the bus is too heavily loaded and the readings may not be updated yet (see beginning of this chapter).

The saving of the set PDO parameter is not automatic, but 1010h of the index. (see 5.3.6.4)

5.4.3 PDO 1 Mapping Parameter

Index 1A00h Sub-index 0 - Number of mapped objects:

ID	DLC	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
600h + ID	8	40h	00h	1Ah	00h	00h	00h	00h	00h

Response from the CAN-Bus sensor:

ID	DLC	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
580h + ID	8	4Fh	00h	1Ah	00h	aa	00h	00h	00h

Index 1A00h Sub-index 0 - Number of mapped objects:

ID	DLC	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
600h + ID	8	40h	00h	1Ah	00h	00h	00h	00h	00h

Response from the CAN-Bus sensor:

ID	DLC	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
580h + ID	8	4Fh	00h	1Ah	00h	aa	00h	00h	00h

0xaa: Number of mapped objects in PDO1

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Index 1A00h Sub-index 1 – ID- TPDO3:

ID	DLC	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
600h + ID	8	40h	00h	1Ah	00h	00h	00h	00h	00h

Response from the CAN-Bus sensor:

ID	DLC	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
580h + ID	8	4Fh	00h	1Ah	00h	aa	00h	00h	00h

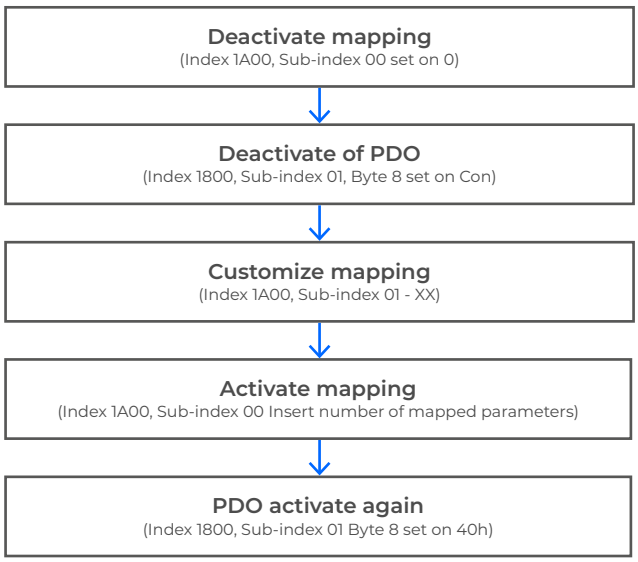
Index 1A00h (Transmit PDO 1 Mapping Parameter):

About the index 1A00h the mapping of the transmit PDO 1 can be determined.

The index 1A00h has the following structure:

Sub-index	Parameter	Length	Access
00h	Number of mapped objects in PDO 1	1 Byte	Read / Write access
01h	First mapped object in PDO 1	4 Bytes	Read / Write access
02h - 04h	2nd to 4th mapped object in PDO 1	4 Bytes	Read / Write access

Procedure for setting the mapping:



The transmit PDO 1 has a size of 8 bytes, which can be freely configured by the user.

Can be selected from the following objects:

Index	Sub-Index	Parameter	Length
6130h	01h	Process value 1 (pressure value)	4 Bytes
6130h*	02h	Process value 2 (temperature value)	4 Bytes
6131h	01h	Unit process value 1	4 Byte
6131h*	02h	Unit process value 2	4 Byte
6600h	01h	Alarm 1 Status	1 Byte

*available only for sensors with two process values (temperature compensating pressure measurement)

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Mapping of the PDO 1 via SDO-command:

ID	DLC	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
600h + ID	8	23h	00h	1Ah	01h	20h	01h	30h	61h

Example PDO 1 with process value 1:

Byte 4:	01h	1st mapped object in PDO 1
	02h – 04h	2nd to 4th mapped object in PDO 1 (Attention only 8 byte)
Byte 5:	20h	32 bit data length of the mapped object
Byte 6:	01h	Sub-Index 01
Byte 7 – 8:	30’71h	6130 → mapped index

Response from the CAN-Bus sensor:

ID	DLC	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
580h + ID	8	60h	00h	1Ah	01h	00h	00h	00h	00h

Structure of the message when sending the PDO 1:

ID	DLC	Byte 1	Byte 2*	Byte 3*	Byte 4*	Byte 5*	Byte 6*	Byte 7*	Byte 8*
180h + ID	4	68h	10						

*Byte are sent only if they are mapped in the index 1A00.

Example PDO 1 with process value 4200:

DLC:	2	2 follow bytes sent	
Byte 1 – 2:	68’10h	10’68h (LSB first) →	4200
Byte 3 – 8:		will not be send	

5.4.4 PDO 3 Mapping Parameter

Index 1A02h Sub-index 0 – Number of mapped objects:

ID	DLC	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
600h + ID	8	40h	02h	1Ah	00h	00h	00h	00h	00h

Response from the CAN-Bus sensor:

ID	DLC	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
580h + ID	8	4Fh	02h	1Ah	00h	aa	00h	00h	00h

Index 1A02h Sub-index 0 – Changing the number of mapped objects:

ID	DLC	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
600h + ID	8	2Fh	02h	1Ah	00h	aa	00h	00h	dd

Response from the CAN-Bus sensor:

ID	DLC	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
580h + ID	8	60h	02h	10h	00h	00h	00h	00h	00h

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Index 1A02h Sub-index 1 – ID- TPDO3:

ID	DLC	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
600h + ID	8	40h	02h	1Ah	00h	00h	00h	00h	00h

Response from the CAN-Bus sensor:

ID	DLC	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
580h + ID	8	4Fh	02h	1Ah	00h	aa	00h	00h	00h

Index 1A02h (Transmit PDO 3 Mapping Parameter):

About the index 1A02h the mapping of the transmit PDO 3 can be determined.

The index 1A02h has the following structure:

Sub-Index	Parameter	Länge	Zugriff
00h	Number of mapped objects in PDO 3	1 Byte	Read / Write access
01h	First of mapped objects in PDO 3	4 Bytes	Read / Write access
02h - 04h	2nd to 4th mapped object in PDO 3	4 Bytes	Read / Write access

The transmit PDO 3 has a size of 8 bytes that can be freely configured by the user.

Can be selected from the following objects:

Index	Sub-Index	Parameter	Length
6130h	01h	Process value 1 (pressure value)	4 Bytes
6130h*	02h	Process value 2 (temperature value)	4 Bytes
6131h	01h	Unit process value 1	4 Byte
6131h*	02h	Unit process value 2	4 Byte
6600h	01h	Alarm 1 Status	1 Byte

*available only for sensors with two process values (temperature compensating pressure measurement)

Mapping of the PDO 3 via SDO-command:

ID	DLC	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
600h + ID	8	23h	02h	1Ah	01h	20h	02h	30h	61h

Example PDO 3 with process value 1:

Byte 4:	01h	1st mapped object in PDO 3	
	02h – 04h	2nd to 4th mapped object in PDO 3 (Attention only 8 byte)	
Byte 5:	20h	32 bit data length of the mapped object	
Byte 6:	02h	Sub-Index 03	
Byte 7 – 8:	30'71h	6130	mapped index

Response from the CAN-Bus sensor:

ID	DLC	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
580h + ID	8	60h	02h	1Ah	01h	00h	00h	00h	00h

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Structure of the message when sending the PDO 3:

ID	DLC	Byte 1	Byte 2*	Byte 3*	Byte 4*	Byte 5*	Byte 6*	Byte 7*	Byte 8*
280h + ID	4	48h	0Dh						

*Byte are sent only if they are mapped in the index 1A01.

Example PDO 3 with data value 3400:

DLC: 2 2 follow bytes sent

Byte 1 – 2: 48’ 0Dh 0D’48h (LSB first) 3400

Byte 3 – 8: will not be sent

5.5 Analog measurement value AD - Input (uncorrected)

Index 7100h Sub-index 0 – Number of entries:

ID	DLC	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
600h + ID	8	40h	00h	71h	00h	00h	00h	00h	00h

Response from the CAN-Bus sensor:

ID	DLC	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
580h + ID	8	4Fh	00h	71h	00h	01h	00h	00h	00h

Index 7100h Sub-index 1 – AD- value pressure / temperature:

ID	DLC	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
600h + ID	8	40h	00h	71h	01h	00h	00h	00h	00h

Response from the CAN-Bus sensor:

ID	DLC	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
580h + ID	8	4Bh	00h	71h	01h	aa	bb	00h	00h

AD_value pressure / temperature as INTEGER16 number

AD_value 0xbbaa

Index 7100h Sub-index 2 – AD- value temperature (available only for pressure with temperature compensation):

ID	DLC	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
600h + ID	8	40h	00h	71h	02h	00h	00h	00h	00h

Response from the CAN-Bus sensor:

ID	DLC	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
580h + ID	8	4Bh	00h	71h	02h	aa	bb	00h	00h

AD_value temperature as INTEGER16 number

AD_value 0xbbaa

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5.6 Device specific indices

Setting and querying the sensor-specific values. The following indexes are supported:

Index	Description
6110h	Sensor type
6112h	Operating mode
6114h	Read rate analog input
6124h	Analog input Offset
6125h	Analog input zero
6130h	Analog input measuring value
6131h	Process value unit
6133h	Interrupt Delta- value
6148h	Analog value intial value
6149h	Analog value end value
6150h	Status of measurement

5.6.1 Sensor type

Index 6110h (Sensor Type):

Sub index 1:

ID	DLC	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
600h + ID	8	40h	10h	61h	01h	01h	00h	00h	00h

Response from the CAN-Bus sensor:

ID	DLC	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
580h + ID	8	4Bh	10h	61h	01h	aa	bb	00h	00h

Type as Unsigned int 16- Zahl

Type = 0xbbaa

Byte 5: 5Ah Pressure

Byte 5: 64h Temperature

The index 6110h can only be read.

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5.6.2 Read rate analog input

Index 6114h (Read rate):

Sub-index 1 channel pressure / temperature:

Upon delivery, the sensor is always in normal mode. The mode can be read as follow:

ID	DLC	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
600h + ID	8	40h	14h	61h	01h	00h	00h	00h	00h

Response from the CAN-Bus sensor:

ID	DLC	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
580h + ID	8	43h	14h	61h	01h	aa	bb	cc	dd

0xddccbbaa = read rate pressure / temperature in ms as Unsigned32 number

Sub-index 2 channel pressure / temperature (available only for pressure with temperature compensation N/T):

Upon delivery, the sensor is always in normal mode. The mode can be read as follow:

ID	DLC	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
600h + ID	8	40h	14h	61h	02h	00h	00h	00h	00h

Response from the CAN-Bus sensor:

ID	DLC	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
580h + ID	8	43h	14h	61h	02h	aa	bb	cc	dd

0xddccbbaa = read rate temperature in ms as Unsigned32 number

5.6.3 Analog input offset

Index 6124h (Analog input offset):

Sub-index 1 channel pressure / temperature:

ID	DLC	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
600h + ID	8	40h	24h	61h	01h	00h	00h	00h	00h

Response from the CAN-Bus sensor:

ID	DLC	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
580h + ID	8	43h	24h	61h	01h	aa	bb	cc	dd

0xddccbbaa = Offset pressure / temperature as Float32 number (as absolute value of the process size)

Sub-index 2 channel pressure / temperature (available only for pressure with temperature compensation N/T):

ID	DLC	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
600h + ID	8	40h	24h	61h	02h	00h	00h	00h	00h

Response from the CAN-Bus sensor:

ID	DLC	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
580h + ID	8	43h	24h	61h	02h	aa	bb	cc	dd

0xddccbbaa = Offset temperature as Float32 number (as absolute value of the process size)

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5.6.4 Analog input zero

Index 6125h (Analog input zero):

Sub-index 1 channel pressure / temperature:

ID	DLC	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
600h + ID	8	23h	25h	61h	01h	aa	bb	cc	dd

Response from the CAN-Bus sensor:

ID	DLC	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
580h + ID	8	60h	25h	61h	01h	00	00	00	00

0xddccbbaa = 0x6F72657A („zero“ in ASCII)

5.6.5 Query of the process value

Index 6130h (Input Process Value):

Sub-Index	Parameter	Length	Access
00h	Number of Sub-Indexes	1 Byte	Read access only
01h	Query process value 1	4 Bytes	Read access only
02h*	Query process value 2	4 Bytes	Read access only

*available only for sensors with two process values (temperature compensating pressure measurement)

The measured value can be read as follows:

ID	DLC	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
600h + ID	8	40h	30h	61h	01h	00h	00h	00h	00h

Response from the CAN-Bus sensor:

ID	DLC	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
580h + ID	8	4Bh	30h	61h	01h	71h	0Fh	00h	41h

Byte 4: 01h Sub-Index1 (Status Process value 1)

02h Sub-Index2 (Status Process value 2)

Byte 5 + 6 + 7 + 8: 41'00'0F'71h → 71'0F'00'41h (LSB first)
+ unit (6131) = 8.003770 bar

The process value is specified in the IEEE float format.
The index 6130 can only be read.

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5.6.6 Process value units

Index 6131h (Physical Unit Process Value):

Sub-Index	Parameter	Length	Access
00h	Number of Sub-Indexes	1 Byte	Read access only
01h	Query process value 1	4 Bytes	Read access only
02h*	Query process value 2	4 Bytes	Read access only

*available only for sensors with two process values (temperature compensating pressure measurement)

Sub-index 1: The physical process unit of the CAN-Bus sensor can be read as follows:

ID	DLC	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
600h + ID	8	40h	31h	61h	01h	00h	00h	00h	00h

Response from the CAN-Bus sensor:

ID	DLC	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
580h + ID	8	43h	31h	61h	01h	00h	bb	cc	dd

0xddccbbaa = Prefix SI Numerator / SI Denumerator acc. DS303 part 2 V1.04

Byte 4:	01h	Sub-Index1 (Unit process value 1)	
	02h	Sub-Index2 (Unit process value 2)	
Byte 5 – 8:	00’00’4E’FDh	0xFD’4E’00’00 (LSB first)	→ Unit “mbar”
	00’00’4E’00h	0x00’4E’00’00 (LSB first)	→ Unit “bar”
	00’00’A2’03h	0x03’A2’00’00 (LSB first)	→ Unit “mWs“
	00’00’A2’00h	0x00’A2’00’00 (LSB first)	→ Unit “mmWs”
	00’00’22’00h	0x00’22’00’00 (LSB first)	→ Unit “Pa”
	00’00’A2’03h	0x03’A2’00’00 (LSB first)	→ Unit “kPa“
	00’00’22’06h	0x06’22’00’00 (LSB first)	→ Unit “MPa”
	00'58'02'04h	0x04'02'58'00 (LSB first)	→ Unit “Kg/cm²”
	00’00’AB’00h	0x00’AB’00’00 (LSB first)	→ Unit “psi”
	00’00’A3’03h	0x03’A3’00’00 (LSB first)	→ Unit “mmHg“
	00’00’A4’00h	0x00’A4’00’00 (LSB first)	→ Unit “atm”
	00’2D’00’00h	0x00’2D’00’00 (LSB first)	→ Unit “°C”
	00’00’AC’00h	0x00’AC’00’00 (LSB first)	→ Unit “°F”
	00’00’01’00h	0x00’01’00’00 (LSB first)	→ Unit “m“
	00’00’01’FDh	0xFD’01’00’00 (LSB first)	→ Unit “mm”
	00’00’21’00h	0x00’21’00’00 (LSB first)	→ Unit “N”
	00’00’4C’00h	0x00’4C’00’00 (LSB first)	→ Unit “t”
	00'47'00'00h	0x00'00'47'00 (LSB first)	→ Unit “l/min“
	00'00'21'00h	0x00'21'00'00 (LSB first)	→ Unit “rpm“
	00'00'20'00h	0x00'20'00'00 (LSB first)	→ Unit “Hz“
	00'48'59'00h	0x00'59'48'00 (LSB first)	→ Unit “m³/h“
	00'47'44'00h	0x00'44'47'00 (LSB first)	→ Unit “l/min“

nits of the process values are dependent on sensor type and not adjustable by the user. The index 6131h can only be read.

Sub-index 2: channel temperature (only with pressure with temperature compensation available):

ID	DLC	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
600h + ID	8	40h	31h	61h	02h	00h	00h	00h	00h

Response from the CAN-Bus sensor:

ID	DLC	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
580h + ID	8	43h	31h	61h	02h	00h	bb	cc	dd

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5.6.7 Analog input minimum value range

Index 6148h (AI Span Start):

Sub-Index	Parameter	Length	Access
00h	Number of Sub-Indexes	1 Byte	Read access only
01h	Process value 1	4 Bytes	Read / Write access
02h*	Process value 2	4 Bytes	Read / Write access

Response from the CAN-Bus sensor:

ID	DLC	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
580h + ID	8	43h	48h	61h	01h	aa	bb	cc	dd

And this information can be amended as follows:

ID	DLC	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
600h + ID	8	23h	48h	61h	01h	aa	bb	Cc	dd

Response from the CAN-Bus sensor:

ID	DLC	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
580h + ID	8	60h	48h	61h	01h	00h	00h	00h	00h

0xaa bb cc dd: the current analog minimum value 32-bit floating point number.

5.6.8 Analog input maximum value range

Index 6149h (DAI Span end):

Sub-Index	Parameter	Length	Access
00h	Number of Sub-Indexes	1 Byte	Read access only
01h	Process value 1	4 Bytes	Read / Write access
02h*	Process value 2	4 Bytes	Read / Write access

*available only for sensors with two process values (temperature compensating pressure measurement)

Response from the CAN-Bus sensor:

ID	DLC	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
580h + ID	8	43h	49h	61h	01h	aa	bb	cc	dd

And this information can be amended as follows:

ID	DLC	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
600h + ID	8	23h	49h	61h	01h	aa	bb	Cc	dd

Response from the CAN-Bus sensor:

ID	DLC	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
580h + ID	8	60h	49h	61h	01h	00h	00h	00h	00h

0xaa bb cc dd: the current analog minimum value 32-bit floating point number.

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5.6.9 Status of the measurement

Index 6150h (Status):

Sub-Index	Parameter	Length	Access
00h	Number of Sub-Indexes	1 Byte	Read access only
01h	Status of the measurement Process value 1	4 Bytes	Read / Write access
02h*	Status of the measurement Process value 2	4 Bytes	Read / Write access

*available only for sensors with two process values (temperature measurement): S&T types

Status of the CAN-Bus sensor can be read as follows:

ID	DLC	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
600h + ID	8	40h	50h	61h	01h	00h	00h	00h	00h

Response from the CAN-Bus sensor:

ID	DLC	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
580h + ID	8	4Fh	50h	61h	01h	00h	00h	00h	00h

Byte 4:	01h	Sub-Index1 (Status process value 1)
	02h	Sub-Index2 (Status process value 2)
Byte 5:	00h	measurement value currently
	02h	value too high
	04h	value too low
	01h:	for temperature measurement: measurement value currently
	03h:	for temperature measurement: sensor break
	05h:	for temperature measurement: sensor short circuit

The index 6150h can only be read.

5.6.10 Control of the measurement

Index 6160h (Status):

Sub-Index	Parameter	Length	Access
00h	Number of Sub-Indexes	1 Byte	Read access only
01h	Status of the measurement Process value 1	4 Bytes	Read / Write access
02h*	Status of the measurement Process value 2	4 Bytes	Read / Write access

*available only for sensors with two process values (temperature compensating pressure measurement)

Status of the CAN-Bus sensor can be read as follows:

ID	DLC	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
600h + ID	8	40h	60h	61h	01h	00h	00h	00h	00h

Response from the CAN-Bus sensor:

ID	DLC	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
580h + ID	8	4Fh	60h	61h	01h	aa	00h	00h	00h

0xaa:	0x01:	the corresponding measurement is in progress
	0x00:	the measurement is not running

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ID	DLC	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
600h + ID	8	2Fh	60h	61h	01h	aa	00h	00h	00h

Response from the CAN-Bus sensor:

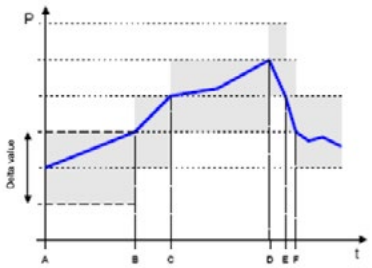
ID	DLC	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
580h + ID	8	60h	60h	61h	01h	00h	00h	00h	00h

0xaa: 0x02: start the corresponding measurement
other: the measurement does not stop

5.6.11 Interrupt Delta-Value

After activating the delta function is sent when the defined threshold, the current process value is exceeded over a PDO and set the threshold again. The next time you exceed or fall below the threshold, a PDO is sent again.

(Threshold = instantaneous process value +/- delta value)



A: Activation of the delta-function via PDO transmission type

B-F: Process value is transmitted via PDO, threshold value is reset

P: Process value

t: Time

Index 6133h (Interrupt Delta Input Process Value):

About the index 6133 the delta value can be read and written.

Sub-Index	Parameter	Length	Access
00h	Number of Sub-Indexes	1 Byte	Read access only
01h	Delta value for process value 1	4 Bytes	Read / Write access
02h*	Delta value for process value 2	4 Bytes	Read / Write access

*available only for sensors with two process values (pressure with temperature compensation): N/T types
The delta function will be activated or deactivated via the transmission type of PDO1 (Index 1800h) and PDO3 (Index 1802h).

The delta value can be changed as follows:

ID	DLC	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
600h + ID	8	40h	33h	61h	01h	00h	00h	00h	00h

Example „Delta value of 8.003770Bar“:
Byte 4: 01h Sub-Index 01 → Delta value for PDO1
Byte 5 + 6 + 7 + 8: 41'00'0F''71h → 71'0F'00'41h (LSB first)
+ Unit (6131) = 8.003770 bar

Response from the CAN-Bus sensor:

ID	DLC	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
580h + ID	8	60h	60h	61h	01h	00h	00h	00h	00h

0xddccbbaa = Delta pressure / temperature as IEEE float number (as absolute value of the process size) If the value is 0.0 written to the index 6133, the delta value function is turned off.

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5.6.12 Filter Type for measurement value

Index 61A0h (Filter Type measurement):
Sub-index 1 channel pressure / temperature:

ID	DLC	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
600h + ID	8	40h	A0h	61h	01h	00h	00h	00h	00h

Response from the CAN-Bus sensor:

ID	DLC	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
580h + ID	8	4Fh	A0h	61h	01h	aa	00h	00h	00h

0xaa = Filter Type
Filter Type = 0 -> No Filter
Filter Type = 1 -> Moving average
Value(n) = Value(n-1) + (Input – Value (n-1)) / Filter constant
Filter Type = 2 -> arithmetic mean
Value = Sum (n to n-1) Input / Filter constant

5.6.13 Filter constant for measurement

Index 61A1h (Filter constant for measurement):
Sub-index 1 channel pressure / temperature:

ID	DLC	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
600h + ID	8	40h	A1h	61h	01h	00h	00h	00h	00h

Response from the CAN-Bus sensor:

ID	DLC	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
580h + ID	8	4Fh	A1h	61h	01h	aa	00h	00h	00h

0xaa = Filter constant

5.7 Alarm 1 input value

Index 6500h (Alarm 1 input value):
Contain the measured value for the alarm monitoring.
Sub-index 1 channel pressure / temperature:

ID	DLC	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
600h + ID	8	40h	00h	65h	01h	00h	00h	00h	00h

Response from the CAN-Bus sensor:

ID	DLC	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
580h + ID	8	43h	00h	65h	01h	aa	bb	cc	dd

0xddccbbaa = pressure / temperature as Float32 number (as absolute value of the process size)

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5.7.1 Alarm 1 Type

Index 6508h (Alarm 1 Type):
Contain the type of error for the alarm monitoring.
Sub-index 1 channel pressure / temperature:

ID	DLC	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
600h + ID	8	40h	08h	65h	01h	00h	00h	00h	00h

Response from the CAN-Bus sensor:

ID	DLC	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
580h + ID	8	4Fh	08h	65h	01h	aa	00h	00h	00h

0xaa = Fault
Fault = 0 -> No alarm function
Fault = 1 -> sensor error
Fault = 2 -> equal to or above level
Fault = 3 -> lower Level
Fault = 6 -> measured value inside the limits (alarm hysteresis)
Fault = 7 -> measured value outside the limits (alarm hysteresis)

5.7.2 Alarm 1 reaction

Index 6509h (Alarm 1 reaction):
Contain the type of behavior to respond to an alarm that has occurred.
Sub-index 1 channel pressure / temperature:

ID	DLC	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
600h + ID	8	40h	09h	65h	01h	00	00	00	00

Response from the CAN-Bus sensor:

ID	DLC	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
580h + ID	8	4Bh	09h	65h	01h	aa	bb	00	00

0xaa = be executed behavior
Fault bit0 = 1 -> Sending an emergency message
Fault bit1 = 1 -> device internal alarm (will not be observed as the internal errors are processed)
Fault bit2 = 1 -> Send TPD = 3 when the alarm occurs again
Fault bit3 = 1 -> Send TPD = 3 when the alarm is eliminated

5.7.3 Alarm 1 size

Index 650Ah (Alarm 1 size):
Contain the benchmark as a reference to trigger the alarm.
Sub-index 1 channel pressure / temperature:

ID	DLC	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
600h + ID	8	40h	0Ah	65h	01h	00	00	00	00

Response from the CAN-Bus sensor:

ID	DLC	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
580h + ID	8	43h	0Ah	65h	01h	aa	bb	cc	dd

0xddccbbaa = Level as Float32- number as a reference for the alarm level (as absolute value of the process size)

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5.7.4 Alarm 1 Hysteresis

Index 650Bh (Alarm 1 Hysteresis):
Contain the size of the window / hysteresis for the alarm size
Sub-index 1 channel pressure / temperature:

ID	DLC	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
600h + ID	8	40h	0Bh	65h	01h	00h	00h	00h	00h

Response from the CAN-Bus sensor:

ID	DLC	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
580h + ID	8	43h	0Bh	65h	01h	aa	bb	cc	dd

0xddccbbaa = Hysteresis as Float32- number (as absolute value of the process size)

5.7.5 Alarm 1 Reset

Index 650Eh (Alarm 1 Reset):
Contain the reset for the triggered alarm
Sub-index 1 channel pressure / temperature:

ID	DLC	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
600h + ID	8	2Fh	0Eh	65h	01h	aa	00	00	00

Response from the CAN-Bus sensor:

ID	DLC	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
580h + ID	8	60h	0Eh	65h	01h	00	00	00	00

0xaa = 1 -> Deletes the triggered alarm

5.7.6 Alarm 1 Status

Index 6600h (Alarm 1 Status):
Contain the current status of the currently active alarm.
Sub-index 1 channel pressure / temperature:

ID	DLC	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
600h + ID	8	2Fh	00h	66h	01h	aa	00	00	00

Response from the CAN-Bus sensor:

ID	DLC	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
580h + ID	8	60h	00h	66h	01h	00	00	00	00

0xaa = 0x00 -> Alarm 1 is currently not triggered
0xaa = 0x01 -> Alarm 1 is currently triggered

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5.8 SDO-error messages

For wrong access to an index, you receive an error message in response. An error message has the following structure:

ID	DLC	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
580h + ID	8	80h	Index		Sub-Index	Additional Code		Error Code	Error Code

The ID of the message and the index and sub-index refers to the message that caused an error...

The error messages can have the following contents:

Error Class	Error Code	Additional Code	Meaning
05h	04h	00'01h	Client / Server command is not valid or unknown
06h	01h	00'01h	Only write access is possible
06h	01h	00'02h	Only read access is possible
06h	02h	00'00h	Index does not exist
06h	07h	00'10h	Data type does not match, lenth of service parameter does not match
06h	09h	00'11h	Sub-index does not exist
06h	09h	00'30h	Exceeded value range of the parameter
06h	04h	00'43h	General parameter incompatibility reason -> DLC at SDO !=8
06h	04h	00'42h	TPDO is too long
06h	04h	00'41h	Object is not provided for TPDO

5.9 Sync ID

Index 1005h (COB-ID SYNC message):

When the index 1A00h Sub-index 2 was set accordingly the sync generation at sensor is turned off and only PDO messages will be sent.

In the index 1005h the ID can be queried for the sync messages. If a sync message with the following ID is on the bus, then a PDO is triggered (see PDO communication).

The ID can be read as follows:

ID	DLC	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
600h + ID	8	40h	05h	10h	00h	0	0	0	0

Response from the CAN-Bus sensor:

ID	DLC	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
580h + ID	8	43h	05h	10h	00h	80h	00h	00h	00h

The ID is set to 80h. This ensures the sync messages high priority on the CAN bus.

The index 1005h can only be read.

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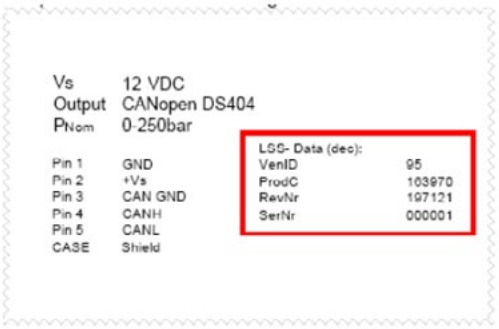
5.10 LSS (Layer Setting Services)

5.10.1 Printed LSS-Data on sensor

To use the LSS functionality, LSS data are needed which clearly identify the sensor. These data are printed on each sensor.

Example for a sensor label with LSS data:



The LSS data are shown on the decimal number system.

Inscription:	**Description:**
VenID	Vendor- ID
ProdC	Product- Code
RevNr	Revisions- Number
SerNr	Serial- Number

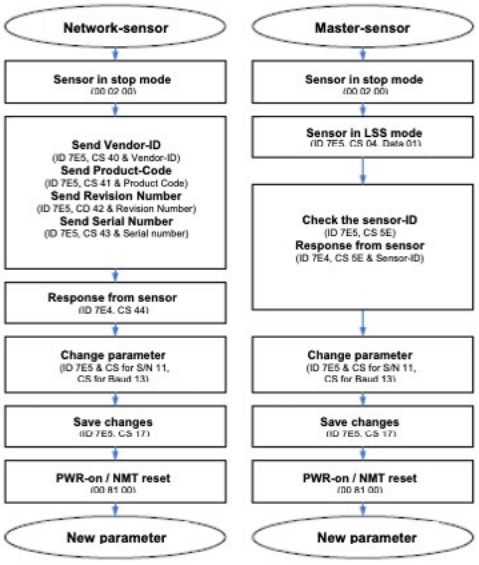
5.10.2 Response of the sensor on LSS

There are two ways to address a sensor with LSS. The LSS service is for a sensor in an existing network, as well as support for a sensor with a 1:1 master. In both cases, bring the bus to the Stop mode.

To bring the BUS in the stop mode:

ID	DLC	Byte1	Byte2
0	2	02h	00h

The desired sensor can now be switched in the configuration mode on different paths. (Direct connection Master – Sensor or Sensor - Network)



5.10.3 Direct connection configuration mode (Master-Sensor)

To use LSS you must have the sensor in the LSS configuration mode.

With the following command the sensor can be switched into the LSS configuration mode:

ID	DLC	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
7E5	8	04h	01h	00h	00h	00h	00h	00h	00h

To check whether the sensor has changed into configuration mode, the currently selected ID is queried:

ID	DLC	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
7E5	8	5Eh	00h	00h	00h	00h	00h	00h	00h

Response from the CAN-Bus sensor:

ID	DLC	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
7E4	8	5Eh	01h	00h	00h	00h	00h	00h	00h

Example “ID 1“

Byte 2: 01h adressed sensor is ID 1

If sensor does not respond it does not support LSS or the baud rate is incorrect. For a safe respond the service must be tested with all supported baud rates.

5.10.4 Configuration mode of one sensor in network

With following command the sensor can be recognized:

Transmission of vendor-ID:

ID	DLC	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
7E5	8	40h	90h	02h	00h	00h	00h	00h	00h

Vendor-ID:

Byte 1: 40h System-byte Vendor-ID

Byte 2 – 5: 90’02’00’00h 00’00’02’90h (LSB first) → company Grünewald GmbH

Transmission of Product-Code:

ID	DLC	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
7E5	8	41h	E6h	53h	02h	00h	00h	00h	00h

Product-Code:

Byte 1: 41h Systembyte Product-Code

Byte 2 – 5: E6’53’02’00h 00’02’53’E6 (LSB first) → 152550 in decimal

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Transmission of revision number:

ID	DLC	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
7E5	8	42h	02h	01h	01h	00h	00h	00h	00h

Revision-number:

Byte 1:	42h	Systembyte revision-number	
Byte 2 – 5:	7B'00'00'00h	00'00'00'7B (LSB first) →	0000007Bh (123; V1.23)

Transmission of serial number:

ID	DLC	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
7E5	8	43h	7Bh	00h	00h	00h	00h	00h	00h

Serial number:

Byte 1:	43h	Systembyte serial number	
Byte 2 – 5:	7B'00'00'00h	00'00'00'7B →	(LSB first) 123

Response from the CAN-Bus Sensor:

ID	DLC	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
7E4	8	44h	00h	00h	00h	00h	00h	00h	00h

With this answer the sensor confirms the recognition. Now the ID and the baud rate of the sensor can be changed.

5.10.5 Adjustment of the ID and the baud rate

Adjustment of ID:

ID	DLC	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
7E5	8	11h	01h	00h	00h	00h	00h	00h	00h

Example ID = 1:

Byte 2:	01h	ID = 1

Response from the CAN-Bus sensor:

ID	DLC	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
7E4	8	11h	00h	00h	00h	00h	00h	00h	00h

Byte 2:	00h	ID was switched successfully
	01h	ID out of valid range
	FFh	specific failure

Adjustment of baud rate:

ID	DLC	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
7E5	8	13h	00h	04h	00h	00h	00h	00h	00h

Example baud rate = 125kBaud:

Byte 2:	00h	CiA baud rate table
Byte 3:	04h	4 = 125kBau

Baud rates:

0 = 1Mbaud	3 = 250kBaud	7 = 20kBaud
1 = 800kBaud	4 = 125kBaud	8 = 10kBaud
2 = 500kBaud	6 = 50kBaud	

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Response from the CAN-Bus sensor:

ID	DLC	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
7E4	8	13	00h	00h	00h	00h	00h	00h	00h

Byte 2: 00h ID was successfully switched
01h ID out of valid range
FFh specific failure

5.10.6 Save the changes

In order to apply the changes they has to be saved.

Save the LSS changes:

ID	DLC	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
7E5	8	17h	00h	00h	00h	00h	00h	00h	00h

Response from the CAN-Bus sensor:

ID	DLC	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
7E4	8	17h	00h	00h	00h	00h	00h	00h	00h

Byte 2: 00h ID was successfully switched
01h ID out of valid range
FFh specific failure

The changes will take effect after a reset.

5.11 Error messages (Emergency Messages)

Emergency messages are sent automatically in case of failure of the sensor. The first occurrence of an error, an error message is sent. If the reason for the error is corrected or the error no longer exists, an appropriate error message will also be sent. The last 16 error messages are stored in the emergency history (see 5.3.9).

The error messages are structured as follows:

ID	DLC	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
80h + ID	8	Emergency Error Code		Error Register	Vendor specific error code				

The following error codes are supproted:

Emergency error code 0xbbaa	Vendor-specific error code 0xddcc	Desciption
00 00h	0h	No rerro is still present
50 10h	1h	EEPROM error
50 10h	2h	Internal Bus error
50 10h	3h	RAM error
F0 11h	21h	Exceeded max. pressure
F0 11h	22h	Below min. pressure
F0 11h	31h	Exceeded allowable temperature
F0 11h	32h	Below allowable temperature

Index 1014h (COB-ID Emergency Object):

In this index, the value is retained in case of failure. Using this ID, the error message can be assigned to a sensor.

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Query the ID of the emergency message of a sensor. The ID can be read as follows:

ID	DLC	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
600h+ ID	8	40h	14h	10h	00h	00h	00h	00h	00h

Response from the CAN-Bus sensor:

ID	DLC	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
580g + ID	8	43h	14h	10h	00h	aa	bb	cc	dd

0xdd cc bb aa: COB_ID EMCY.

Example „ID 1“:

Byte 5 81h ID = 80h + Node ID

The index 1014h can only be read.

5.12 Revision history

V2.10 Manual before software version 2.00 & revision number 30200H
V3.XX Manual to software from version 2.00 & revision number 30200H
Check the communication and rectify the commands.
Implementing changes for software version 2.00
- LSS service
- dynamic PDO mapping
- 2nd process value (temperature)

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