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CANopen

This document reflects the Novotechnik sensor protocol implementation of the standard CANopen protocol. A basic knowledge of the CAN Bus is required for a proper understanding of this document. Most of the definitions made are according to the following CiA Standard specifications. For making use of all the features that these specifications offer, a knowledge about them is absolutely necessary. The sensor supports the CANopen Communication profile DS-301, V4.2.0, Encoder profile DS-406, V3.2.0 and Layer Setting Services (LSS) DS-305, V3.0.0.

1 EDS Files

For integration in a common CANopen projecting tool, electronic data sheet (*.eds) files are provided. These files can be downloaded from the Novotechnik Web Site, see Downloads/Electronic datasheets where also this document can be found.

2 Support

If you have any questions, please contact our product support at support@novotechnik.de. Electronic data sheets or user manuals for previous software versions are available on request.

3 Features

3.1 Basics based on CiA 301, V4.2.0

CAN Identifier	Standard 11 bits according to pre-defined connection set: <table border="1"> <thead> <tr> <th><u>Services</u></th> <th><u>COB-ID</u></th> </tr> </thead> <tbody> <tr> <td>NMT</td> <td>0x00</td> </tr> <tr> <td>SYNC</td> <td>0x080</td> </tr> <tr> <td>EMCY</td> <td>0x080 + Node-ID</td> </tr> <tr> <td>PDO1 (Tx)</td> <td>0x180 + Node-ID</td> </tr> <tr> <td>PDO2 (Tx)</td> <td>0x280 + Node-ID</td> </tr> <tr> <td>SDO (Rx)</td> <td>0x600 + Node-ID</td> </tr> <tr> <td>SDO (Tx)</td> <td>0x580 + Node-ID</td> </tr> </tbody> </table>	<u>Services</u>	<u>COB-ID</u>	NMT	0x00	SYNC	0x080	EMCY	0x080 + Node-ID	PDO1 (Tx)	0x180 + Node-ID	PDO2 (Tx)	0x280 + Node-ID	SDO (Rx)	0x600 + Node-ID	SDO (Tx)	0x580 + Node-ID
<u>Services</u>	<u>COB-ID</u>																
NMT	0x00																
SYNC	0x080																
EMCY	0x080 + Node-ID																
PDO1 (Tx)	0x180 + Node-ID																
PDO2 (Tx)	0x280 + Node-ID																
SDO (Rx)	0x600 + Node-ID																
SDO (Tx)	0x580 + Node-ID																
CAN Bit rates	Bit rate is defined in the ordering code: 6_7: 50 kBaud 6_5: 125 kBaud 6_4: 250 kBaud 6_3: 500 kBaud 6_2: 800 kBaud 6_1: 1000 kBaud Setting per LSS (see chapter 6 LSS / Layer Setting Service) or object 0x2001 (see chapter 7 SDO Services)																
Node-ID	Standard models 127 = 0x7F (can deviate for customized models) Setting per LSS (see chapter 6 LSS / Layer Setting Service) or object 0x2000 (see chapter 7 SDO Services)																
SYNC	Consumer																
Time Stamp	No																
Emergency Messages	Producer																
Node Guarding	Yes																
Heartbeat	Producer																
Non-volatile storage	yes																
Program Download	No																
NMT Service	Server																

3.2 Basics SDO communication

SDO communication expedited transfer	1 Server yes
segmented transfer	No
Block transfer	No

3.3 Basics PDO communication based on CiA 301, V4.2.0

PDO communication principle	Producer
TPDO's	TPDO1: Event-driven transmission - Synchronous to measurement cycle (1 ms with delay 300 µs) - Event Timer Synchronous (SYNC Object) TPDO2: Synchronous (SYNC Object)
PDO Mapping	dynamic
max. PDO Mappings per PDO	5

3.4 Basics based on CiA DS-406, V3.2

Encoder class	<input type="checkbox"/> C1 <input type="checkbox"/> C2 <input checked="" type="checkbox"/> C3
Encoder type	Absolute Rotary Multi Sensor Encoder Interface
Max. bit bandwidth of position value	32 bits
Resolution speed	0,1°/s
Encoder Cams Channels to be detected Cams per channel Polarity Hysteresis	Pos.ch1 4 invertable yes
Work Area Supervision channels	Pos.ch1

4 Object Library

4.1 Communication Profile Area based on DS 301 V4.2.0

Object description			Entry description			
Index/subindex	Name	Data Type	Access	PDO Mapping	Default value	Comment
1000	Device type	Unsigned32	const	No	0x00020196	Device profile DS406 multi-sensor encoder interface
1001	Error register	Unsigned16	RO	No	0x00	See chapter 9 <i>Error Handling</i>
1002	Manufacturer status register	Unsigned16	RO	No	0x00000000	Additional manufacturer spec. status register
1005	COB-ID SYNC	Unsigned32	RW	No	0x00000080	COB-ID SYNC message (CAN-identifier)
1008	Manufacturer device name	Visible_string	const	No	e.g. MC1-2832-A7F-614-511	Device name, see datasheet/ordering code
1009	Manufacturer hardware version	Visible_string	const	No	e.g. 40000000.00	Hardware version release
100A	Manufacturer software version	Visible_string	const	No	e.g. V 1.03.0	Software version release
100C	Guard time	Unsigned16	RW	No	0x00000000 disabled	Time base (in ms), which gives combined with 100D the time in which the response of the node guard is expected
100D	Life time factor	Unsigned8	RW	No	0x00000000 disabled	The life time factor multiplied with the guard time gives the life time for the device.
1010	Store parameter field	Unsigned32				This entry supports saving of parameters in non volatile memory. With a read access the device provides information about its saving capabilities. For saving the signature "save" (0x65766173) must be written.

Object description			Entry description			
Index/ subindex	Name	Data Type	Access	PDO Mapping	Default value	Comment
1010/1	Store parameter field	Unsigned32	RW	No	0x00000000	Save all parameters
1010/2		Unsigned32	RW	No	0x00000000	Save communication parameters
1010/3		Unsigned32	RW	No	0x00000000	Save application parameters
1010/4		Unsigned32	RW	No	0x00000000	Save user data parameters
1010/5		Unsigned32	RW	No	0x00000000	Save manufacturer defined parameters (see chapter 10 Error Objects)
1011	Restore default parameters	Unsigned32				This entry supports restoring of default parameters. With a read access the device provides information about its capabilities to restore these values. For restoring the signature "load" (0x64616f6c) must be written.
1011/1		Unsigned32	RW	No	0x00000000	Restore all default parameters
1011/2		Unsigned32	RW	No	0x00000000	Restore communication default parameters
1011/3		Unsigned32	RW	No	0x00000000	Restore application default parameters
1011/4		Unsigned32	RW	No	0x00000000	Restore user data parameters
1014	COB-ID EMCY	Unsigned32	RO	No	0x00000080 + Node-ID	COB-ID used for emergency message (Emergency Server).
1017	Producer heartbeat time	Unsigned16	RW	No	0x0000 disabled	Heartbeat time periode in ms.
1018	Identify object	Identity				General information about the device. This information is also used as the LSS address when using "switch mode selective" command
1018/1		Unsigned32	RO	No	0x0000182	Vendor ID 386 = 0x0182 (Novotechnik)
1018/2		Unsigned32	RO	No	acc. to product series	Product code: 03000 = 0x0BB8 => Multiturn series
1018/3		Unsigned32	RO	No	e.g. 0x10003	Revision number e.g. 1.3
1018/4		Unsigned32	RO	No	e.g. 123456789	Serial number see product label B/N XXXXXX/YYYY => 6+3 characters XXXXXXYYYY
1029	Error Behaviour					0: change to NMT-mode preoperational 1: no change of NMT-mode 2: change to NMT-mode stopped
1029/0		Unsigned8	RW	No	0x02	Number of entries
1029/1		Unsigned8	RW	No	0x00	Communication error
1029/2		Unsigned8	RW	No	0x00	Internal device error: measurement error (EMCY Index 0x5051 / 1 / 0 / 0)
1800	TPDO1 communication parameter	PDO_COMM_PAR				It contains the communication parameters of the current PDO the device is able to transmit.
1800/1		Unsigned32	RW	No	0x40000180 + Node ID	COB-ID of the PDO
1800/2		Unsigned8	RW	No	0xFE = 254	Transmission modes: TPDO off: 0 Event-driven transmission - Synchronous to meas. cycle: 255 - Event Timer: 254 Synchronous: 1 ... 240
1800/3		Unsigned16	RW	No	0x0000	Inhibit Time in (multiples of) 100 µs
1800/4		Unsigned8	RW	No	0x00	Compatibility entry
1800/5		Unsigned16	RW	No	0x0000 disabled	Event timer in ms Disabled: 0 Enabled: Range 1 ... 65535
1801	TPDO2 communication parameter	PDO_COMM_PAR				It contains the communication parameters of the current PDO the device is able to transmit.
1801/1		Unsigned32	RW	No	0x40000280 + Node ID	COB-ID of the PDO
1801/2		Unsigned8	RW	No	0x01	Transmission mode: TPDO off: 0 Synchronous: 1 ... 240
1801/3		Unsigned16	RW	No	0x0000	Inhibit Time in (multiples of) 100µs
1A00	TPDO1 mapping parameter	PDO_MAPPING				Contains the mapping for the PDOs the device is able to transmit
1A00/0		Unsigned8	RW	No	0x02	Number of entries
1A00/1		Unsigned32	RW	No	0x60200120	Mapping entry 1, default: Position value channel 1
1A00/2		Unsigned32	RW	No	0x60300110	Mapping entry 2, default: Speed value channel 1
1A00/3		Unsigned32	RW	No	0x00000000	Mapping entry 3
1A00/4		Unsigned32	RW	No	0x00000000	Mapping entry 4
1A00/5		Unsigned32	RW	No	0x00000000	Mapping entry 5
1A01	TPDO2 mapping parameter	PDO_MAPPING				Contains the mapping for the PDOs the device is able to transmit

Object description			Entry description			Comment
Index/ subindex	Name	Data Type	Access	PDO Mapping	Default value	
1A01/0		Unsigned8	RW	No	0x02	Number of entries
1A01/1		Unsigned32	RW	No	0x60200120	Mapping entry 1, default: Position value channel 1
1A01/2		Unsigned32	RW	No	0x60300110	Mapping entry 2, default: Speed value channel 1
1A01/3		Unsigned32	RW	No	0x00000000	Mapping entry 3
1A01/4		Unsigned32	RW	No	0x00000000	Mapping entry 4
1A01/5		Unsigned32	RW	No	0x00000000	Mapping entry 5
1F80	NMT startup	Unsigned32	RW	No	0x00000000	This object determines the startup behaviour of a device in the network. Bit 3 set: sensor starts in operational mode

4.2 Device Profile Area

Object description			Entry description			Comment
Index/ subindex	Name	Data Type	Access	PDO Mapping	Default value	
6000	Operating parameter	Unsigned8	RW	No	0x0000	This object contains the functions for code sequence (counting direction), commissioning diagnostic control and scaling function control
6001	Measuring units per revolution	Unsigned32	RW	No	0x00010000	Object sets the number of distinguishable steps per revolution (singleturn resolution)
6002	Total measuring range in measuring units	Unsigned32	RW	No	0x002C0000	Object sets the number of distinguishable steps over the total measuring range (total resolution)
6003	Preset value	Unsigned32	RW	No	0x00000000	This object supports adaption of the encoder zero point to the mechanical zero point of the system Preset value channel 1
6004	Position value	Integer32	RO	Yes	0x00000000	This object defines the output position value. Position value channel 1
600C	Position Raw Value	Unsigned32	RO	Yes	0x00000000	This object defines the output position value without scaling and preset
6030	Speed value					This object defines the output speed value
6030/0		Unsigned8	RO	No	0x01	Number of available channels
6030/1		Integer16	RO	Yes	0x0000	Speed value channel 1
6031	Speed parameter					
6031/0		Unsigned8	RO	No	0x02	Number of entries
6031/1		Unsigned8	RW	No	0x02	Speed source selector: 2: object 600C (position raw value)
6031/2		Unsigned16	RW	No	0x0001	Speed integration time. The time defines the period in which the speed values are averaged. The following values are allowed: 1, 2, 3, 6, 12, 25 ms
6300	CAM state register					defines the status bit of the cam in a cam channel. The bit value 0 means "cam inactive". The bit value 1 means "cam active". If the polarity bit of a cam is set the actual cam state will be inverted.
6300/0		Unsigned8	RO	No	0x01	Number of available channels
6300/1		Unsigned8	RO	Yes	0x00	CAM state channel 1
6301	CAM enable					This object contains the calculation state for 4 CAMs for one position channel. If the enable bit is set to 1, the CAM state will be calculated by the device. In the other case the CAM state of the related CAM will be set permanently to 0.
6301/0		Unsigned8	RO	No	0x01	Number of available channels
6301/1		Unsigned8	RW	No	0x00	CAM enable channel 1
6302	CAM polarity register					This object contains the actual polarity settings for 4 CAMs for one position channel. If the polarity bit is set to 1, the CAM state of an active CAM will signal by setting the related CAM state bit to zero. In the other case the CAM state of the related CAM will not be inverted.
6302/0		Unsigned8	RO	No	0x01	Number of available channels
6302/1		Unsigned8	RW	No	0x00	CAM polarity channel 1
6310	CAM 1 low limit					determines the lower limit of position for CAM 1
6310/0		Unsigned8	RO	No	0x01	Number of available channels
6310/1		Integer32	RW	No	0x00000000	CAM 1 low limit channel 1
6311	CAM 2 low limit					determines the lower limit of position for CAM 2
6311/0		Unsigned8	RO	No	0x01	Number of available channels
6311/1		Integer32	RW	No	0x00000000	CAM 2 low limit channel 1
6312	CAM 3 low limit					determines the lower limit of position for CAM 3
6312/0		Unsigned8	RO	No	0x01	Number of available channels
6312/1		Integer32	RW	No	0x00000000	CAM 3 low limit channel 1
6313	CAM 4 low limit					determines the lower limit of position for CAM 4
6313/0		Unsigned8	RO	No	0x01	Number of available channels

Object description			Entry description			
Index/ subindex	Name	Data Type	Access	PDO Mapping	Default value	Comment
6313/1	CAM 1 high limit	Integer32	RW	No	0x00000000	CAM 4 low limit channel 1
6320						determines the higher limit of position for CAM 1
6320/0		Unsigned8	RO	No	0x1	Number of available channels
6320/1		Integer32	RW	No	0x002BFFFF	CAM 1 high limit channel 1
6321	CAM 2 high limit					determines the higher limit of position for CAM 2
6321/0		Unsigned8	RO	No	0x01	Number of available channels
6321/1		Integer32	RW	No	0x002BFFFF	CAM 2 high limit channel 1
6322	CAM 3 high limit					determines the higher limit of position for CAM 3
6322/0		Unsigned8	RO	No	0x01	Number of available channels
6322/1		Integer32	RW	No	0x002BFFFF	CAM 3 high limit channel 1
6323	CAM 4 high limit					determines the higher limit of position for CAM 4
6323/0		Unsigned8	RO	No	0x01	Number of available channels
6323/1		Integer32	RW	No	0x002BFFFF	CAM 4 high limit channel 1
6330	CAM 1 hysteresis					This object contains the delay setting of switch points for CAM 1
6330/0		Unsigned8	RO	No	0x01	Number of available channels
6330/1		Unsigned16	RW	No	0x0000	CAM 1 hysteresis channel 1
6331	CAM 2 hysteresis					This object contains the delay setting of switch points for CAM 2
6331/0		Unsigned8	RO	No	0x01	Number of available channels
6331/1		Unsigned16	RW	No	0x0000	CAM 2 hysteresis channel 1
6332	CAM 3 hysteresis					This object contains the delay setting of switch points for CAM 3
6332/0		Unsigned8	RO	No	0x01	Number of available channels
6332/1		Unsigned16	RW	No	0x0000	CAM 3 hysteresis channel 1
6333	CAM 4 hysteresis					This object contains the delay setting of switch points for CAM 4
6333/0		Unsigned8	RO	No	0x01	Number of available channels
6333/1		Unsigned16	RW	No	0x0000	CAM 4 hysteresis channel 1
6400	Work area state register					This object contains the actual area status of the encoder position. Bit meaning 0 out of range 1 range overflow 2 range underflow
6400/0		Unsigned8	RO	No	0x01	Number of available work areas
6400/1		Unsigned8	RO	Yes	0x00000000	Work area state channel 1
6401	Work area low limit					This object contains the lower limit of the work area
6401/0		Unsigned8	RO	No	0x01	Number of available work areas
6401/1		Integer32	RW	No	0x00000000	Low limit work area 1
6402	Work area high limit					This object contains the higher limit of the work area
6402/0		Unsigned8	RO	No	0x01	Number of available channels
6402/1		Integer32	RW	No	0x002BFFFF	High limit work area 1
6500	Operating status	Unsigned16	RO	No	0x0000	This gives information on encoder internal programmed parameters.
6501	Measuring units per resolution	Unsigned32	RO	No	0x00010000	This object gives the number of steps per revolution that are output for the absolute singleturn position value.
6502	Number of distinguishable revolutions	Unsigned16	RO	No	0x002C	This object contains the number of distinguishable revolutions that the multiturn-encoder can output. e.g. Multiturn with 44 revolutions
6503	Alarms	Unsigned16	RO	Yes	0x0000	This object shows, which alarm is active
6504	Supported alarms	Unsigned16	RO	No	0xC002	This object informs on alarms supported by the encoder
6505	Warnings	Unsigned16	RO	Yes	0x0000	This object reports warnings.
6506	Supported warnings	Unsigned16	RO	No	0xC05C	This object informs on warnings supported by the encoder
6507	Profile and software version	Unsigned32	RO	No	e.g. 0x01020302	This object reports the versions: byte 3-2: software version byte 1-0: profile version
6508	Operating Time	Unsigned32	RO	No	-	See object 0x2320/3
6509	Offset Value	Integer32	RO	No	0x00000000	Offset-value, calculated from position and preset.
650A	Modul Identification					
650A/0		Unsigned8	RO	No	0x03	Number of entries
650A/1		Integer32	RO	No	0x00000000	Manufacturer offset value
650A/2		Integer32	RO	No	0x00000000	Manufacturer min position value
650A/3		Integer32	RO	No	0x002BFFFF	Manufacturer max position value
650B	Serial Number	Unsigned32	RO	No	e.g. 0x01020302	See Index1018/4.
650D	Absolut accuracy	Unsigned8	RO	No	0x10	Real 16-bit resolution of sensor-element
650E	Device Capability	Unsigned16	RO	No	0x0003	Encoder Class C3 without safety support, no high-resolution and no manufacturer-specific capability.

4.3 Manufacturer specific Area

Object description			Entry description			
Index/ subindex	Name	Data Type	Access	PDO Mapping	Default value	Comment
2000	Node-ID	Unsigned8	RW	No	0x7F	Node-ID of the sensor Range 1...127
2001	CAN bit rate	Unsigned16	RW	No	as defined by ordering code	CAN bit rate of the sensor in kbit/s
2002	Temperature	Integer16	RO	Yes	-	Condition monitoring data "Temperature" in 0.1°C. The sensor records the sensor-internal temperature, which is always higher than the actual ambient temperature.
2003	Supply voltage	Unsigned16	RO	Yes	-	Condition monitoring data "Voltage" in 0.1 VDC
2010	Filter position and speed					
2010/0		Unsigned8	RO	No	0x02	Number of available channels
2010/1		Unsigned8	RW	No	0x00	Filter position, average within 2 ⁿ positions, range 0x00 ... 0x07
2010/2		Unsigned8	RW	No	0x03	Filter speed, range 0x00 .. 0x08
2100	Position Error Reset	Bool	W	No	0x01	Precondition: The sensor is turned back into the measurement range. The front end of the device is reset to delete the position values "Out of Range (+)" and "Out of Range (-)". No communication stop or restart.
2101	Power management	Bool	W	No	0x01	The front end of a device is switched off to eliminate disruptive influences on the environment or to reduce power consumption. Switch on must be done via Power-on or by Appli- cation-Reset.
2104	EMCY behaviour	Unsigned8	RW	No	0x00 = all events active	If diagnostic functions in the application cause problems, messages like warnings and errors can be suppressed. 0 = all events active 1 = info warnings suppressed 2 = info and warnings suppressed 3 = info and warnings and errors suppressed Hard errors rises always! => see list on 9.1
Condition Monitoring – Commands/Settings						
2300	Settings and Reset commands					Reset commands for condition monitoring features and setting of maintenance time.
2300/0		Unsigned8	RO	No	0x06	Number of available entries
2300/1		Bool	W	No	0x01	Reset Maintenance: Reset of all statistic data for condition monitoring which are related to maintenance.
2300/2		Bool	W	No	0x01	Reset Lot Size: The lot size counter is reset to zero.
2300/3		Bool	W	No	0x01	Reset Temperature Minimum: Stored minimum temperature value is reset to zero.
2300/4		Bool	W	No	0x01	Reset Temperature Maximum: Stored maximum temperature value is reset to zero.
2300/5		Bool	W	No	0x01	Reset Voltage Minimum: Stored minimum voltage value is reset to zero
2300/6	Bool	W	No	0x01	Reset Voltage Maximum: Stored maximum voltage value is reset to zero	
230A	Time between Maintenance	Unsigned32	RW	No	0x0000FFFF= 65535h	User-settable value for time between maintenance in [h] 0x00000000 = deactivated
Condition Monitoring – Boot Cycle Counter						
2310	Boot Cycles Counter					Condition monitoring data "Boot Cycles"
2310/0		Unsigned8	RO	No	0x02	Number of available entries
2310/1		Unsigned32	RO	No	-	Boot-cycles since maintenance
2310/2		Unsigned32	RO	No	-	Boot-cycles Total over operational life
Condition Monitoring – Operating Time Counter						
2320	Operating Time Counter		RO	No		Condition monitoring data "Operating Time"
2320/0		Unsigned8	RO	No	0x03	Number of available entries
2320/1		Unsigned32	RO	No	-	Time Power-on: Operating time since power-on
2320/2		Unsigned32	RO	No	-	Time since Maintenance: Operating time since maintenance
2320/3		Unsigned32	RO	No	-	Operating time total over operational life
232A	Time Counter Unit	Unsigned16	RO	No	6 [min]	Unit of operational time: 0.1h
Condition Monitoring – Lot Size Counter						
2330	Lot Size Counter					The lot size counter is incremented as soon as a status change of the switching point occurs accord- ing to the parameterization (lotConfig) of the selected CAMs (rising: off => on, falling: on => off).
2330/0		Unsigned8	RO	No	0x04	Number of available entries
2330/1		Unsigned32	RO	No	-	Lot size since power-on
2330/2		Unsigned32	RO	Yes	-	Lot size since reset
2330/3		Unsigned32	RO	No	-	Lot size since maintenance

Object description			Entry description			
Index/ subindex	Name	Data Type	Access	PDO Mapping	Default value	Comment
2330/4		Unsigned32	RO	No	-	Lot size Total over operational life
233A	Lot Size Config	Unsigned8	RW	No	0x00 = Lot counter off	Parameterization of selected CAMs: 0: Lot counter off 1: Rising CAM 1 (off => on) 2: Falling CAM 1 (on => off) 3: Rising CAM 2 (off => on) 4: Falling CAM 2 (on => off)
Condition Monitoring – Odometer						
2340	Odometer					Performed movements/angle changes in turns
2340/0		Unsigned8	RO	No	0x03	Number of available entries
2340/1		Unsigned32	RO	No	-	Odometer since power-on
2340/2		Unsigned32	RO	No	-	Odometer since maintenance
2340/3		Unsigned32	RO	No	-	Odometer Total over operational life
234A	Odometer Unit	Unsigned16	RO	No	-	Odometer Unit (turns)
Condition Monitoring – Temperature						
2350	Temperature					Condition monitoring data "Temperature" in 0.1°C. The sensor records the sensor-internal temperature, which is always higher than the actual ambient temperature.
2350/0		Unsigned8	RO	No	0x09	Number of available entries
2350/1		Integer16	RO	No	-	Temperature live: Current sensor internal temperature
2350/2		Integer16	RO	No	-	Temp. Power-on Minimum: Min. sensor internal temp. since power-on
2350/3		Integer16	RO	No	-	Temp. Power-on Maximum: Max. sensor internal temp. since power-on
2350/4		Integer16	RO	No	-	Temp. since Reset Minimum: Min. sensor internal temp. since reset
2350/5		Integer16	RO	No	-	Temp. since Reset Maximum: Max. sensor internal temp. since reset
2350/6		Integer16	RO	No	-	Temp. s. Maintenance Minimum: Min. sensor internal temperature since maintenance
2350/7		Integer16	RO	No	-	Temp. s. Maintenance Maximum: Max. sensor internal temperature since maintenance
2350/8		Integer16	RO	No	-	Temperature Minimum Total: Min. sensor internal temperature over operational life
2350/9		Integer16	RO	No	-	Temperature Maximum Total: Max. sensor internal temperature over operational life
235A	Temperature		-	-		User-settable warning thresholds in 0.1°C
235A/0	Thresholds (user-set)	Unsigned8	RO	No	0x02	Number of available entries
235A/1		Integer16	RW	No	as specified in data sheet	Temperature Warning Minimum: User-set threshold of min. operating temperature (limit temp. see data sheet)
235A/2		Integer16	RW	No	as specified in data sheet	Temperature Warning Maximum: User-set threshold of max. operating temperature (limit temp. see data sheet)
235B	Temperature		-	-		Factory-set warning thresholds in 0.1°C
235B/0	Thresholds (factory-set)	Unsigned8	RO	No	0x02	Number of available entries
235B/1		Integer16	RO	No	as specified in data sheet	Temp. Threshold Minimum: Factory-set threshold of min. operating temperature accord. to data sheet
235B/2		Integer16	RO	No	as specified in data sheet	Temp. Threshold Maximum: Factory -set threshold of max. operating temperature acc. to data sheet
Condition Monitoring – Supply Voltage						
2360	Voltage		-	-		Condition monitoring data "Voltage" in 0.1 VDC
2360/0		Unsigned8	RO	No	0x09	Number of available entries
2360/1		Unsigned16	RO	No	-	Voltage live: Current operating voltage
2360/2		Unsigned16	RO	No	-	Minimum voltage since power-on
2360/3		Unsigned16	RO	No	-	Maximum voltage since power-on
2360/4		Unsigned16	RO	No	-	Minimum voltage since reset
2360/5		Unsigned16	RO	No	-	Maximum voltage since reset
2360/6		Unsigned16	RO	No	-	Minimum voltage since maintenance
2360/7		Unsigned16	RO	No	-	Maximum voltage since maintenance
2360/8		Unsigned16	RO	No	-	Min. voltage total over operational life
2360/9		Unsigned16	RO	No	-	Max. voltage total over operational life
236A	Voltage Thresholds		-	-		User-settable warning thresholds in 0.1 VDC
236A/0	(user-set)	Unsigned8	RO	No	0x02	Number of available entries
236A/1		Unsigned16	RW	No	as specified in data sheet	Voltage Warning Minimum: User-set threshold of min. operating voltage (limit voltage see data sheet)
236A/2		Unsigned16	RW	No	as specified in data sheet	Voltage Warning Maximum: User-set threshold of max. operating voltage (limit voltage see data sheet)

Object description			Entry description			
Index/ subindex	Name	Data Type	Access	PDO Mapping	Default value	Comment
236B	Voltage Thresholds (factory-set)		-	-		Factory-set warning thresholds in 0.1 VDC
236B/0		Unsigned8	RO	No	0x02	Number of available entries
236B/1		Unsigned16	RO	No	as specified in data sheet	Voltage Threshold Minimum: Factory-set threshold of min. operating voltage acc. to data sheet
236B/2		Unsigned16	RO	No	as specified in data sheet	Voltage Threshold Maximum: Factory-set threshold of max. operating voltage acc. to data sheet

5 Explanations to Object Library

5.1 Object 0x2010/1 Position Filter

The behavior of the position output filter can be adjusted for smoothing the signal noise of the output signal.

Filter	Noise [°]	Cutoff frequency [Hz]
0 (default)	0,03	-
1	0,02	5000
2	0,015	2500
3	0,01	1250
4	0,0075	625
5	0,005	312,5
6	0,00375	156,25
7	0,02	78,125

5.2 Object 0x2010/2 Speed filter and Object 0x6031/2 Speed Integration Time

The behavior of the speed output filter can be adjusted for smoothing the signal noise of the output signal either by 0x6031/2 speed integration time or 0x2010/2 speed filter. When setting one of the two objects, the other one is automatically set to the corresponding value.

0x6031/2 Speed integration time [ms]	0x2010/2 Speed filter	Noise [°/s]	Cutoff frequency [Hz]	Max. rotation speed [U/s]
0	0 / 1	26,51	62,5	1250
1 (default)	2 / 3 (default)	3,31	26,0	156,3
2	4	1,66	15,1	78,1
3	5	0,83	8,7	39,1
6	6	0,41	4,6	19,5
12	7	0,21	2,4	9,8
25	8	0,1	1,2	4,9

5.3 Object 0x6000 Operating Parameter

This object contains the function for the **counting direction**.

The counting direction clockwise (cw) or counterclockwise (ccw) is defined whether the signal values are rising or falling when sensor shaft or position marker is rotated cw (view on the position marker or shaft).

Bit 0 = 0: counting direction cw

Bit 0 = 1: counting direction ccw

This object contains the function for the **commissioning diagnostic control**.

The commissioning diagnostic control bit initiates the commissioning diagnostics. The alarm bit in object 0x6503 indicates detected errors. It is possible to check the encoder components responsible for position detection at encoder stand still with the commissioning diagnostics.

Bit 1 = 0: commissioning diagnostic control disable

Bit 1 = 1: commissioning diagnostic control enable

This object also includes the **switching on and off of the scaling function**, which is required to change the sensor resolution.

Bit 2 = 0: scaling on (further scaling is done by objects 0x6001 or 0x6002)

Bit 2 = 1: scaling off

5.4 Object 0x6001 Measuring Step per Revolution

This object sets the number of distinguishable steps per revolution.

Writing is only possible if scaling (0x6000 / Bit 2) is on. Changes of this object also changes object 0x6002.

The default value 0x10000 (16 bits) is the maximum step size per revolution. The resolution can only be reduced.

5.5 Object 0x6002 Total Measuring Range in measuring units

This object sets the number of distinguishable steps over the total measuring range. Writing is only possible if scaling (0x6000 / Bit 2) is on. Changes of this objects also changes object 0x6001.

The default value 0x2C0000 is the maximum total step size. This can only be reduced.

5.6 Object 0x6300 CAM State Register

Encoder CAMs are used to indicate if a position falls below or exceeds a defined value.

CAM active: the current position value is between the higher and lower CAM-limit
 CAM inactive: the current position value is not between the higher and lower CAM-limit.

The values for low limit (0x631x) and high limit (0x632x) regard the values for preset (0x6010) and measuring units per resolution (0x6001). The value of hysteresis (0x633x) is added in direction of motion.

Note: The CAM high limit value can have a lower value than the CAM low limit

A change in CAM state causes an EMCY message.
 The CAM state objects (0x6300) are able to be mapped to the TPDOs.

5.7 Object 0x6400 Work Area

It is possible for encoders to define a so-called user defined working area.
 The main purpose for a work area is to get a high-priority information (via EMCY message) when the transducer's position leaves its predefined working area.
 The actual work area information with work area low limit and work area high limit may be stored in object 0x6401 and 0x6402. This way, the area state object (0x6400) may also be used as software limit switches.

5.7.1 Work Area State

Condition	State register 0x6400
Position < Work Area Low Limit Position >= Work Area Low Limit	Bit 2 = 1 Bit 2 = 0
Position > Work Area High Limit Position <= Work Area High Limit	Bit 1 = 1 Bit 1 = 0
Position <= Min Position Value or Position >= Max Position Value otherwise (see Index 0x650A/2 and /3)	Bit 0 = 1 Bit 0 = 0

The values for low limit (0x6401) and high limit (0x6402) regard the values for preset (0x6010) and scaling (0x6501, 0x6502).

A change in work area state causes an EMCY message.
 The work area state objects (0x6400) are able to be mapped to the TPDOs.

5.8 Condition Monitoring Data

The statistics data for temperature, supply voltage, operating time, boot cycle, lot size and odometer ("history recorder") are not cleared by any system command according to chapter 4.3 *Manufacturer specific Area*, object 0x2300.
 Exceptions are all condition monitoring data with the suffix "Power-on" that have been recorded since switching on. These are set to "0" by power-cycle (power off/on).

6 LSS / Layer Setting Service

To configure the sensor via the LSS (according CiA DS-305) the sensor is handled as a server, the PLC must have a LSS manager functionality.

A LSS-message is composed as follows:

COB-ID	DLC	Command	Byte0	Byte1	Byte2	Byte3	Byte4	Byte5	Byte6
--------	-----	---------	-------	-------	-------	-------	-------	-------	-------

This applies to the COB-ID:

- LSS-Manager ⇒ LSS-Server: 2021 (0x7E5)
- LSS-Server ⇒ LSS- Manager: 2020 (0x7E4)

LSS can only be used when the encoder is in the stopped status or pre-operational status.
 The NMT command for setting the encoder in stopped status is:

COB-ID	DLC	Command	Byte0	Byte1	Byte2	Byte3	Byte4	Byte5	Byte6
0x7E5	8	0x04	0x00	0x00	0x00	0x00	0x00	0x00	0x00

To program via LSS the sensor has to be switched to LSS configuration state.
 There are two possible ways to do so:

- **Switch Mode Selective:**
only the addressed CANopen device is switched to the LSS configuration state

LSS requires data content in the following objects:

Example:

Vendor-ID (see index 1018/1) 0x0182 LSS-Command 0x40
 Product code (see index 1018/2) 0x0BB8 LSS-Command 0x41

After receiving the identification objects, the encoder answers with LSS-Command **0x44**.

COB-ID	DLC	Rx /Tx	Command	Byte0	Byte1	Byte2	Byte3	Byte4	Byte5	Byte6
0x7E5	8	Rx	0x40	0x82	0x01	0x00	0x00	0x00	0x00	0x00
0x7E5	8	Rx	0x41	0xE0	0x0B	0x00	0x00	0x00	0x00	0x00
0x7E5	8	Rx	0x42	0x03	0x00	0x01	0x00	0x00	0x00	0x00
0x7E5	8	Rx	0x43	0x78	0x56	0x34	0x12	0x00	0x00	0x00
0x7E4	8	Tx	0x44	0x00	0x00	0x00	0x00	0x00	0x00	0x00

- **Switch Mode Global:** all CANopen devices supporting LSS are switched to the LSS configuration state

COB-ID	DLC	Rx/ Tx	Command	Byte0	Byte1	Byte2	Byte3	Byte4	Byte5	Byte6
0x7E5	8	Rx	0x04	0x01	0x00	0x00	0x00	0x00	0x00	0x00

When the CAN devices are in configuration state the Node-ID and/or the bit rate can be changed.

6.1 Configuration of Node-ID

The Node-ID can be programmed with the LSS-Command **0x11**

N ID: new Node-ID in the range of 1...127
 Err Code: 0: protocol successfully completed / 1: Node-ID out of range

COB-ID	DLC	Rx/ Tx	Command	Byte0	Byte1	Byte2	Byte3	Byte4	Byte5	Byte6
0x7E5	8	Rx	0x11	N ID	0x00	0x00	0x00	0x00	0x00	0x00
0x7E4	8	Tx	0x11	Err Code	0x00	0x00	0x00	0x00	0x00	0x00

Change of Node-ID will cause:

- Automatic alteration of COB-ID's for SDO1, EMCY and Heartbeat and TPDOs.
- Non-volatile Node-ID storage through „Store Configuration“ in the LSS mode configuration.

6.2 Configuration of Bit Rate

The Bit Rate can be programmed with LSS-Command **0x13**

Table Index: 0x06: 50 kBaud
 0x04: 125 kBaud
 0x03: 250 kBaud
 0x02: 500 kBaud
 0x01: 800 kBaud
 0x00: 1000 kBaud
 Err Code: 0: protocol successfully completed 1: Bit timing not supported

COB-ID	DLC	Rx/ Tx	Command	Byte0	Byte1	Byte2	Byte3	Byte4	Byte5	Byte6
0x7E5	8	Rx	0x13	0x00	Table Index	0x00	0x00	0x00	0x00	0x00
0x7E4	8	Tx	0x13	Err Code	0x00	0x00	0x00	0x00	0x00	0x00

Change of Bit rate will cause:

- The bit rate gets active
- Non-volatile CAN bit rate storage through „Store Configuration“ in the LSS mode configuration

6.3 Store Configuration Data

The LSS configuration data (Node-ID and Bit Rate) are stored to the non-volatile memory of the sensor using LSS-Command **0x17**

Err Code: 0: protocol successfully completed 2: storage media access error

COB-ID	DLC	Rx/Tx	Command	Byte0	Byte1	Byte2	Byte3	Byte4	Byte5	Byte6
0x7E5	8	Rx	0x17	0x00	0x00	0x00	0x00	0x00	0x00	0x00
0x7E4	8	Tx	0x17	Err Code	0x00	0x00	0x00	0x00	0x00	0x00

7 SDO Services

Service Data Objects SDO (according to CiA DS 301) manage the parameter data exchange, e.g. the non-cyclical execution of the preset function.

Parameters of device object library (object index/subindex see chapter 4 *Object Library*) can be read, written or stored by means of SDO.

7.1 SDO Download

The SDO download service is used to configure the parameters.

Command 0x2_: 0x22 write command, parameter to encoder
 0x23 write command, 4 Byte parameter to encoder
 0x27 write command, 3 Byte parameter to encoder
 0x2B write command, 2 Byte parameter to encoder
 0x2F write command, 1 Byte parameter to encoder
 Command 0x60: confirmation: parameter received

COB-ID	DLC	Rx/Tx	Command	Byte0	Byte1	Byte2	Byte3	Byte4	Byte5	Byte6
0x600+Node-ID	8	Rx	0x2_	Index		Sub-index	Data LSB	Data	Data	Data MSB
0x580+Node-ID	8	Tx	0x60	Index		Sub-index	0x00	0x00	0x00	0x00

Example: object index 0x1010 subindex 01 "store all parameters"

0x600+Node-ID	8	Rx	0x23	0x10	0x10	0x01	0x73	0x61	0x76	0x65
0x580+Node-ID	8	Tx	0x60	0x10	0x10	0x01	0x00	0x00	0x00	0x00

Example: object index 0x1011 subindex 01 "restore all parameters"

0x600+Node-ID	8	Rx	0x23	0x11	0x10	0x01	0x6C	0x6F	0x61	0x64
0x580+Node-ID	8	Tx	0x60	0x11	0x10	0x01	0x00	0x00	0x00	0x00

Example: object index 0x2000 "set new node-ID" with 0x40

0x600+Node-ID	8	Rx	0x2F	0x00	0x20	0x00	0x40	0x00	0x00	0x00
0x580+Node-ID	8	Tx	0x60	0x00	0x20	0x00	0x00	0x00	0x00	0x00

NODE-ID

Using writing to object 0x2000, non-volatile storage has to be done by writing the "save"-signature (0x65766173) on - object 0x1010/4

These changes will become effective after a communication restart or a power up.

Changing the Node-ID will affect all COB-IDs according to the "predefined connection set".

Example: COB-ID TPDO1 = 0x180 + (Node-ID)

BIT-RATE

Using writing to object 0x2001; non-volatile storage has to be done by writing the "save"-signature (0x65766173) on - object 0x1010/4

These changes will become effective after a communication restart or a power up.

7.2 SDO Upload

The SDO upload service is used to read the parameters.

Command 0x40: read command, parameters from encoder
 Command 0x4_: 0x42 read command, unspecified size, parameter from encoder
 0x43 read command, 4 Byte parameter from encoder
 0x47 read command, 3 Byte parameter from encoder
 0x4B read command, 2 Byte parameter from encoder
 0x4F read command, 1 Byte parameter from encoder

COB-ID	DLC	Rx/Tx	Command	Byte0	Byte1	Byte2	Byte3	Byte4	Byte5	Byte6
0x600+Node-ID	8	Rx	0x40	Index		Subindex	0x00	0x00	0x00	0x00
0x580+Node-ID	8	Tx	0x4_	Index		Subindex	Data LSB	Data	Data	Data MSB

7.3 SDO Abort

If the SDO download or SDO upload service fails for any reason, the sensor responds with a SDO abort protocol.

Abort Code: 0x06090011 subindex does not exist
 0x06090030 value exceeded
 0x06020000 object does not exist
 0x06010001 object is write only
 0x06010002 object is read only
 0x06060000 access error
 0x08000020 data transport error
 0x08000000 general error
 0x08000022 wrong state

COB-ID	DLC	Rx/Tx	Command	Byte0	Byte1	Byte2	Byte3	Byte4	Byte5	Byte6
0x580+Node-ID	8	Tx	0x80	Index		Sub-index	Abort code			

8 Process Data PDO

Process Data Objects (according CiA DS 301) manage the process data exchange, f.e the cyclical transmission of the position value. The process data exchange with the CANopen PDOs is a very slim process without protocol overhead.

8.1 PDO Default Setting

2 Transmit PDOs (TPDO) with each max. 8 bytes are provided:

0x1800 TPDO1: default: Event-driven (changeable to synchronous)

0x1801 TPDO2: default: synchronous

8.2 PDO Parameter Setting

The contents of the encoder-specific TPDOs can be configured by variable mapping according to customer's requirements. This mapping has to be performed for the encoder as well as for the receiver. The PDO is limited to a maximum size of 8 bytes and 5 mappings per each PDO.

Mappable objects		
Index/Subindex	Entry	Byte
0x6004	Position value	4
0x600C	Position raw value	4
0x6030/1	Speed value ch. 1	2
0x6300/1	CAM state ch. 1	1
0x6400/1	Work area ch. 1	1
0x6503	Alarms	2
0x6505	Warnings	2
0x2002	Temperature	2
0x2003	Supply Voltage	2
0x2330/2	Lot size since reset	4

Step 1: For changing of mapping, the sensor must be in properational mode and the MSB of PDO COB-ID has to be set to 1 to deactivate it.

PDO	Object	COB-ID for active PDO	COB-ID for disabled PDO (MSB set to 1)
1	0x1800	0x40000xxx	0xC0000xxx
2	0x1801	0x40000xxx	0xC0000xxx

Step 2: Clearing entries in mapping table of PDO1 (PDO2) => subindex 0x0 of object 1A00 (1A01) has to be set to 0x00.

Step 3: Mapping of objects into PDO

Example:

A PDO shall be mapped in a way that the "current position" and the "current speed" are transmitted in one PDO.

Mapping #1 "current position":

object 0x1A00/1

size: 32 bits = 4 byte => 0x20

position value = object 0x6020/1

COB-ID	DLC	Rx/Tx	Command	destination object			size	source object			
				Byte0 (object)	Byte1 (object)	Byte2 (subindex)	Byte3	Byte4 (subindex)	Byte5 (object)	Byte6 (object)	
0x600+Node-ID	8	Rx	0x23	0x00	0x1A	0x01	0x20	0x01	0x20	0x60	

Mapping #2 "current speed":

object 0x1A00/2 size: 16 bit = 2 byte => 0x10 speed value = object 0x6030/1

COB-ID	DLC	Rx/Tx	Command	destination object			size	source object		
				Byte0 (object)	Byte1 (object)	Byte2 (subindex)	Byte3	Byte4 (subindex)	Byte5 (object)	Byte6 (object)
0x600+Node-ID	8	Rx	0x23	0x00	0x1A	0x02	0x10	0x01	0x30	0x60

Step 4: Setting entries in mapping table => subindex 0x00 of object 1A00 has to be set to the numbers of mapping entries (e.g. 0x03)

Step 5: For re-activating the PDO, the MSB of PDO COB-ID has to be set to 0.

PDO	Object	COB-ID for disabled PDO	COB-ID for enabled PDO (MSB cleared)
1	0x1800	0xC0000xxx	0x40000xxx
2	0x1801	0xC0000xxx	0x40000xxx

Note:

TPDO1 value for Event Timer must always be higher than the value for Inhibit Time (except for value 0).

Failed sending of TPDOs can occur if:

- more TPDOs shall be sent than the CANbus may accept due to insufficient CAN bit rate compared to TPDO/Event Timer
- excessive bus load or unfavourable setting of COB-ID in the CANopen network prevents TPDO sending
- Object 0x1800/5- event timer- is set to 0.

9 Error Handling

Depending on the type of error occurred, the sensor will react accordingly:

Error Class	Error	Error Message from Sensor
Protocol error	SDO protocol error, corrupted data received via SDO	Abort SDO Transfer*
	PDO protocol error, corrupted data received via PDO	Not relevant, sensor does support TPDOs only
Communication error	CAN bus off CAN error passive CAN overrun CAN buffer overflow	EMCY message**
Process error	Position or sensor error	EMCY message**, position value is set to 0x7FF0 (beyond measuring range), speed value is set to 0x0000
	Data error	Abort SDO Transfer* or EMCY message**
Change of state	According to CAMs and Work Areas	EMCY Message**

* according to DS-301, see chapter 7 SDO Services

** details see chapter 9.1 Emergency Messages

9.1 Emergency Messages

COB-ID EMCY	DLC	Rx/Tx	Byte0	Byte1	Byte2	Byte3	Byte4	Byte5	Byte6	Byte7
0x80+Node-ID	8	Tx	See next table							

COB-ID EMCY in object 0x1014.

Error-Register in object 0x1001.

Error-Code	Error-Register					
Byte 0,1	Byte 2	Byte 3	Byte 7-4	Description	Level	
0x0000	0	0	0	Sensor Error resetted, no error	Hard	
0x1000	1	0	0	Unknown Error, position value 0x7FFFFFFC	Hard	
0x3100	1	0	0	Supply Voltage Fault	Error	
0x3100	1	1	0	Supply Voltage overrun, Voltage Threshold Max. exceeded (thres- hold is factory-set)	Warn	
0x3100	1	2	0	Supply Voltage underrun, Voltage Threshold Min. exceeded (thres- hold is factory-set)	Warn	

Error-Code	Error-Register				
Byte 0,1	Byte 2	Byte 3	Byte 7-4	Description	Level
0x4210	1	1	0	Temperature overrun, Temperature Threshold Max. exceeded (threshold is factory-set)	Warn
0x4210	1	2	0	Temperature underrun, Temperature Threshold Min. exceeded (threshold is factory-set)	Warn
0x5000	1	0	0	Device Hardware Fault, position value 0x7FFFFFFC <u>Cause:</u> An internal error bit is set. The current process values stay in the object directory; the CAM and work area states stay unchanged. If the internal error bit is reset to 0, an EMCY with 0x0000 is sent.	Hard
0x5000	0	0	0	LifeGuarding Error	Info
0x5000	0	1	0	Maintenance required (operating time limit)	Info
0x5000	1	2	0	Hardware ASIC Fault, position value 0x7FFFFFFC	Hard
0x5000	2	0	0	Memory lost	Hard
0x5051	0	0	0	Valid position	
0x5051	1	0	0	Measurement error, position value 0x7FFFFFFC	Error
0x5051	1	1	0	Position overflow error "Out of range (+)", position value 0x7FFFFFF8, Reset via Position Error Reset (see 4.3 Index 0x2100). <u>Cause:</u> An internal error bit is set. If the internal error bit is reset to 0, an EMCY with 0x0000 (valid position) is sent.	Error
0x5051	1	2	0	Position underflow error "Out of range (-)", position value 0x80000008, Reset via Position Error Reset (see 4.3 Index 0x2100). <u>Cause:</u> An internal error bit is set. If the internal error bit is reset to 0, an EMCY with 0x0000 (valid position) is sent.	Error
0x5051	2	1	0	Position overflow warning, position value 0x7FFFFFF8	Warn
0x5051	2	2	0	Position underflow warning, position value 0x80000008	Warn
0x6000	1	0	0	Device Software Fault, position value 0x7FFFFFFC	Hard
0x6000	2	0	0	Insufficient Event Timer Value <u>Cause:</u> CAN bit rate has been set to a low value and an insufficient Event Timer value has been set for TPDO1 accordingly. <u>Reaction:</u> TPDO1 sending will occur partially.	Hard
0x8110	1	0	0	CAN Controller Overflow , CAN Overrun <u>Cause:</u> data buffers of CAN controller are still holding data and cannot accept new entries. Data is being lost. <u>Reaction:</u> none	Hard
0x8110	2	0	0	CAN Buffer Overflow <u>Cause:</u> data buffers of CANopen library are still holding data and cannot accept new entries. Data is being lost. <u>Reaction:</u> none	Hard
0x8120	0	0	0	CAN Error Passive <u>Cause:</u> CAN controller has detected communication errors and is reporting error passive. <u>Reaction:</u> none	Hard
0x8140	0	0	0	CAN Recovered From Bus-Off <u>Cause:</u> CAN controller registered too many sending errors. CAN communication could be restored afterwards. <u>Reaction:</u> none	Hard
0x9080	1	0	CAM	Encoder CAM <u>Cause:</u> the state of CAM / channel has changed. State is coded according to 0x6300. CAM: Byte 4: bits of changed CAM channel 1-4 Byte 7: status bits of CAM channel 1-4 <u>Reaction:</u> none	Warn

Error-Code Byte 0,1	Error-Register Byte 2	Byte 3	Byte 7-4	Description	Level
0x9090	1	0	state	Work Areas <u>Cause:</u> the state of Work Area / chan. has changed. State is coded according to 0x6400. state: status bits in Byte 7 0: Valid Work Area 1: WorkArea underflow 2: WorkArea overflow <u>Reaction:</u> none	Warn

10 Error Objects

10.1 Manufacturer-specific Status

The object 0x1002 shows the sensor status bit code and is used for internal process control purposes. For servicing this information can be requested via SDO (see chapter 7 *SDO Services*).

Bit	Definition (if bit value = 1)
0-1	NMT Condition of Sensor: 0: initialisation 1: pro-operational 2: operational 3: stopped
2	Temperature overrun (user-set threshold)
3	Temperature underrun (user-set threshold)
4	Temperature overrun (factory-set threshold)
5	Temperature underrun (factory-set threshold)
6	Supply Voltage overrun (user-set threshold)
7	Supply Voltage underrun (user-set threshold)
8	Supply Voltage overrun (factory-set threshold)
9	Supply Voltage underrun (factory-set threshold)
10	Position overrange Info: issued in the last revolution before the upper limit
11	Position underrange Info: issued in the last revolution before the lower limit
12	Position overrange Error: position value 0x7FFFFFF8, Reset via Position Error Reset (see 4.3 Index 0x2100)
13	Position underrange Error: position value 0x80000008, Reset via Position Error Reset (see 4.3 Index 0x2100)
14	CAN Controller Overflow
15	CAN Buffer Overflow
16	CAN Error Passive
17	CAN Bus-Off
18	CAN Bus-Off Timer started
19	Speed out of range
20	Position overrange Warning: position value 0x7FFFFFF8
21	Position underrange Warning: position value 0x80000008
22	Measurement Fault
23	TPDO Event Timer Value insufficient for set CAN bit rate
24	Lifeguarding Error
25	Maintenance required
26	Valid Position
27	Software Fault
28	Unknown Error
29	Memory lost

Bit	Definition (if bit value = 1)
30	Supply Voltage Fault
31	Device Hardware Fault

10.2 Alarms

Interpretation of object 0x6503:

Bit	Definition (if bit value = 1)
0	Measurement error, position value 0x7FFFFFFC
1	Unknown Error or Device Hardware Fault or Hardware ASIC Fault or Device Software Fault or Memory lost, position value 0x7FFFFFFC
12	Position underflow error, position value 0x80000008
13	Position overflow error, position value 0x7FFFFFF8

10.3 Warnings

Interpretation of object 0x6505:

Bit	Definition (if bit value = 1)
2	CPU Watchdog Reset
3	Maintenance required (operating time limit)
4	Supply Voltage Fault
6	Speed Range Limit
12	Position underflow warning, position value 0x80000008
13	Position overflow warning, position value 0x7FFFFFF8

11 Non-Volatile Storage and Data Restoration

Default values for all data objects are stored in the non-volatile program memory.
 Data encryption to the non-volatile memory is only admitted in the pre-operational status.

• Storage via LSS

Data must be stored through the LSS Service Configuration/Store while in LSS Configuration Mode (see chapter 6 LSS / Layer Setting Service).

• Storage via SDO Object 0x1010

Data is stored in the non-volatile memory during encryption of object 0x1010 subindex 1/2/3/4 with „save“ signature (0x65766173).

Note: The signature „save“ must not be sent to object 0x1010 subindex 5, otherwise a possible custom configuration is overwritten!

• Load via SDO Object 0x1011

Encryption of object 0x1011 subindex 1/2/3/4 with the signature „load“ (0x64616F6C) will upload data from the non-volatile memory.

• Deletion and Restoration to Default via SDO Object 0x1010

Additionally to the functionality defined in CiA standard DS-301, CANopen library offers the possibility to delete data in the non-volatile memory.

Delete process is initiated by sending the signature „kill“ (0x6C6C696B) to object 0x1010 subindex 1/2/3/4.

By sending the signature „kill“ to object 0x1010 subindex 1/2/3/4, default settings are being restored (see chapter 7 SDO Services). In case of custom factory programmed parameters like node-ID, averaging, bit rate etc., these will be retained.

Object 0x1010 Object 0x1011	Subindex /1 All	Subindex /2 Communication	Subindex /3 Application	Subindex /4 User data
COB-ID Sync				
Guard Time	X	X		
Life Time Factor	X	X		
Heartbeat Timer	X	X		
Error Behaviour	X	X		
TPDO COB-ID	D	X		
TPDO Trans Typ	X	X		
TPDO Inhibit Time	X	X		
TPDO Event Timer	X	X		
TPDO Mapping	X	X		
NMT Startup	X	X		
Node-ID				X
Bit Rate				X
Filter	X	X		
EMCY Behaviour	X	X		
I40: Warning Levels Temperature min & max	X	X		
I40: Warning Levels Supply Voltage min & max	X	X		
I40: Lot Size Config	X	X		
I40: Time Between Maintenance	X	X		
Operating Parameters	X		X	
Measurement units per Revolution	X		X	
Total Measurement Range	X		X	
Preset Value	X		X	
CAM Enable	X		X	
CAM Polarity	X		X	
CAM Low Limit	X		X	
CAM High Limit	X		X	
CAM Hysteresis	X		X	
Work Area Low Limit	X		X	
Work Area High Limit	X		X	

X: data saved or restored
 D: data set to default value

12 Abbreviations

CAN	Controller Area Network
ch	channel
COB-ID	Communication Object Identifier
const	constant parameter, only readable
DLC	Data Length Code
DS	Draft Standard
EMCY	Emergency Service
NMT	Network-Management: service element for initialization and error handling
PDO	Process Data Object
Pos	Position (value)
RO	read only, parameter can change
RW	read/write
Rx	Novotechnik sensor is consumer of the CAN data frame
SDO	Service Data Object
SYNC	Synchronisation message
TPDO	Transmit Process Data Object
Tx	Novotechnik sensor is producer of the CAN data frame

13 Document Changes

Revision	Changes	Date	Who
V00	First edition	01.09.23	VM/mm
V01	4.3 Time counter unit 0x232A: 0,1 h instead of 1 h 4.3 Position error reset object 0x2100: Out of Range (+) and Out of Range (-) instead of 0xtbd 5.5 Description of speed integration time added 8.2 Mappable objects PDO: Lot size added	13.01.25	VM/mm
V02	4.3 0x2010/0: data type added, 0x2010/1 position filter: description aded, default value added, 0x2010/2 speed filter: default values corrected 5.1 0x2010/1 Position filters added (table) 5.2 Speed filters: description and table for object 0x2010/2 added, 5.2 new chapter number: object 0x6031 speed integration time was formerly in chapter 5.5 6.2 Configuration of Bit Rate: correction of telegram description	21.01.25	VM/mm
V03	4.1 Object 1018/2 Product code:03000 = 0x0BB8 instead of 03029 = 0x0BD5 => series MZ1-2200, 03001 = 0x0BB9 => series MC1-2800, 03004 = 0x0BBC => series MB1-3600 6 LSS: 03000 = 0x0BB8 instead of 0x0BD5/0x0BB9 /0x0BBC 10.3 Typo: Speed range instead of speed ange	30.09.25	VM/mm