CiA Draft Standard 406

Device profile for encoders

Version: 3.2

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HISTORY

Date	Changes	
1997-05-05	*Publication of Version 1.0*	
1998-05-11	*Publication of Version 2.0*	
2002-05-17	*Publication of version 3.0*	
	The version 3.0 of this specification has been re-chaptered. In addition, all object descriptions and entry descriptions have been reviewed and edited in accordance to CiA DS-301 version 4.01. In particular, all Array objects have been reviewed. Type error corrections and other editorial changes (mostly clarifications and rewordings) are not listed in detail, only changes with technical content are recorded in the following table:	
	Error behavior	Object 1029_h definitions have been added.
	TPDO	The event timer of the TPDO 1 shall be hard-wired with the cyclic timer (object 6200_h). They may be used alternatively.
		The TPDO 2 is now compliant to CiA DS-301 version 4.01 meaning that this PDO shall use 1801_h PDO communication parameter set object and $1A01_h$ PDO mapping parameter set.
	TPDO 1	This TPDO shall be transmitted when the device enters the Operational state.
	Object 6000_h	Additional parameter definition
	Object 6500_h	Additional parameter definition
	Object $65C0_h$	New object: offset values for multi-sensor device
2003-12-20	*Publication of version 3.1*	
	The version 3.1 of this specification includes besides some minor editorial clarifications the following changes:	
	Object 6000_h	Measuring direction definition included
	Object 6005_h	Sub-objects for acceleration and jerk step settings added
	Object 6008_h	High precision position value object added
	Object 6009_h	High precision preset value added
	Object 6010_h	Data type changed to Integer32
	Object 6020_h	Data type changed to Integer32
	Object 6040_h	Acceleration value object added
	Object 6050_h	Jerk value object added
	Object 6502_h	Value definition for 0 included
	Object 6510_h	Number of high precision revolutions object added
2006-12-18	*Publication of version 3.2*	
	· Detailed PDO specification	
	· Editorial changes	

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1 Scope

This document represents the CANopen device profile for incremental and absolute, linear and rotary encoders. Besides position, velocity, acceleration, and jerk output possibility complete cam functionality is covered. In addition, it is possible to handle multi-sensors through one CANopen device.

All the above mentioned devices use communication techniques, which conform to those described in the CANopen application layer and communication profile specification /CiA301/. This document should be consulted in parallel to this profile.

2 Normative references

/CiA301/ CiA 301, CANopen application layer and communication profile

3 Abbreviations and definitions

C1 Class 1

C2 Class 2

CW Clock wise

CCW Counter Clock wise

Abbreviations and definitions defined in /CiA301/ apply for this document too.

4 Operating principle

4.1 General

The purpose of encoders is to detect positions of any kind of machine tools. Encoders detect positions and transmit the position values across the CANopen network. Optionally the encoder may provide speed, acceleration, and jerk values. The encoder may receive configuration information via SDO, e.g. conversion parameters for calculating an - to the application adapted - position value. In the NMT state operational, the position value may be transmitted by synchronous PDO. Additionally, the encoders may transmit asynchronously a PDO scheduled by the elapsing of the event timer.

The CANopen device profile defines two encoder classes, a standard device class 1 (C1) and an extended device class 2 (C2). The standard device C1 specifies basic functionality, which shall be provided by each device. The C2 extended device provides a variety of features with mandatory and optional functions. The mandatory functions of both, C1 and C2, are necessary to ensure non-manufacturer specific operations of a device.

By defining mandatory device characteristics in C1, basic network and encoder operation is guaranteed. By defining extended C2, a degree of defined flexibility may be built in. By leaving ‘hooks’ for optional and manufacturer-specific functionality, the device developer will not be constrained to an out-of-date standard.

4.2 C1 encoders

C1 is the mandatory class with a basic range of functions that all encoders shall support. The C1 encoders may optionally support C2 functions, however these functions shall be implemented according to the profile.

4.3 C2 encoders

C2 encoders support all C1 functions and extended functions defined in C2.

4.4 Diagnostic area

In addition to the classes C1 and C2, there are pre-defined areas and reserved parameters for manufacturer-specific functions in this device profile.

4.5 Functional overview

The functional overview is shown in Figure 1.

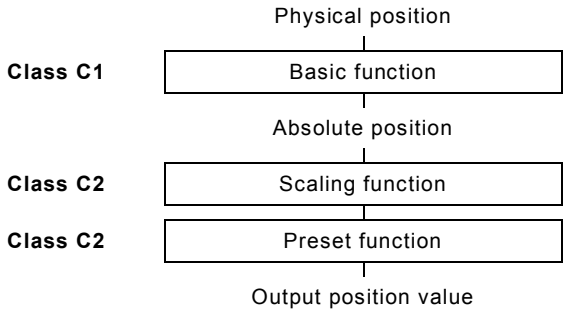


Figure 1 – Class C1 and class C2 functions

5 Error handling

5.1 General

Emergency messages are triggered by internal errors in the device and they are assigned the highest possible priority to ensure that they get access to the bus without latency. By default, the emergency messages contain the error field with pre-defined error numbers and additional information.

5.2 Error behavior

If a serious device failure is detected the module shall enter by default autonomously the pre-operational state. If object 1029_h is implemented, the device may be configured to enter alternatively the NMT stopped state or remain in the current NMT state in case of a device failure. Device failures include the following communication errors:

- Bus-off conditions of the CAN interface
- Life guarding event with the state ‘occurred’
- Heartbeat event with state ‘occurred’

Severe device errors also may be caused by device internal failures.

The value definition as well as the object description and the entry description are specified in /CiA301/.

5.3 Additional error code meanings

Additional error codes are defined in Table 1.

Table 1 – Additional error codes

Error Code	Meaning
2110_h	Input current too high
3110_h	Input voltage out of range
5100_h	Hardware memory error

6 Pre-defined communication objects

6.1 General

This chapter defines the content of pre-defined communication objects.

6.2 Object 1000_h: Device type

The object at index 1000_h describes the type of device and its functionality. It is composed of a 16-bit field, which describes the device profile that is used and a second 16-bit field, which gives information on the type of encoder.

The object structure is specified in Figure 2. The value definition is specified in Table 2 and Table 3. Object description and entry description are specified in /CiA301/.

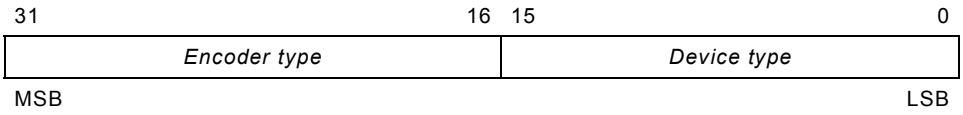


Figure 2 – Object structure

Table 2 – Value definition for device type

Value	Description
196_h	Device profile number
Other values shall be reserved.	

Table 3 – Value definition for encoder type

Value	Definition
0001_h	Single-turn absolute rotary encoder
0002_h	Multi-turn absolute rotary encoder
0003_h	Single-turn absolute rotary encoder with electronic turn-count
0004_h	Incremental rotary encoder
0005_h	Incremental rotary encoder with electronic counting
0006_h	Incremental linear encoder
0007_h	Incremental linear encoder with electronic counting
0008_h	Absolute linear encoder
0009_h	Absolute linear encoder with cyclic coding
$000A_h$	Multi-sensor encoder interface
0000_h; $000B_h$ to $FFFE_h$	Reserved

6.3 Object 1001_h: Error register

The device profile specific bit shall be reserved.

6.4 Object 1029_h: Error behaviour

This object shall indicate to which state an encoder module shall be set, in case a communication error or severe internal encoder error is detected.

The value definition, object description and entry description are specified in /CiA301/.

In addition to the specification in /CiA301/ the following sub-index may be implemented as defined in Table 4.

Table 4 – Entry description

Attribute	Value
Sub-index	02_h
Description	Internal encoder error
Entry category	rw
Access	Optional
PDO mapping	No
Value range	00_h to 02_h
Default value	00_h

NOTE If the object 1029_h is not implemented the device shall be set into the NMT state pre-operational in case a communication error is detected.

6.5 Process data objects

6.5.1 General

Two TPDOs shall be implemented in each encoder device by default. One is used for asynchronous transmission and the other one for the cyclic transmission functions.

Table 5 shows the process data mapped into TPDOs.

Table 5 – TPDO mapping

PDO number	Index/sub-index	Name/description
TPDO 1	6004 00_h	Position value (asynchronous transmission)
TPDO 2	6004 00_h	Position value (synchronous transmission)
TPDO 3	6008 00_h	High precision position value (synchronous transmission)

6.5.2 TPDO 1

This PDO transmits asynchronously the position value of the encoder. The event timer and the *cyclic timer* (object 6200_h) are hard-wired, meaning that a SDO write access will cause changes in the event timer as well as in the object 6200_h. The TPDO 1 shall be transmitted when entering the NMT operational state.

Table 6 specifies the object description of the PDO communication parameter and Table 7 specifies the associated entry description. The values are defined in /CiA301/. The sub-index 04_h is reserved for compatibility reasons and shall not be implemented.

Table 6 — Object description

Attribute	Value
Index	1800_h
Name	TPDO 1 communication parameter
Object code	Record
Data type	PDO communication parameter record
Category	Mandatory

Table 7 — Entry description

Attribute	Value
Sub-index	00_h
Description	Highest sub-index supported
Entry category	Mandatory
Access	ro
PDO mapping	No
Value range	02_h to 05_h
Default value	No
Sub-index	01_h
Description	COB-ID
Entry category	Mandatory
Access	ro
PDO mapping	No
Value range	See /CiA301/
Default value	See /CiA301/
Sub-index	02_h
Description	Transmission type
Entry category	Mandatory
Access	rw
PDO mapping	Optional
Value range	See /CiA301/
Default value	254_d
Sub-index	03_h
Description	Inhibit time
Entry category	Optional
Access	rw
PDO mapping	No
Value range	See /CiA301/
Default value	0000_h

Sub-index	05_h
Description	Event timer
Entry category	Optional
Access	rw
PDO mapping	No
Value range	See /CiA301/
Default value	0000_h

Table 8 specifies the object description of the PDO mapping parameter and Table 9 specifies the associated entry description. The values are defined in /CiA301/.

Table 8 — Object description

Attribute	Value
Index	$1A00_h$
Name	TPDO 1 mapping parameter
Object code	Record
Data type	PDO mapping parameter record
Category	Mandatory

Table 9 — Entry description

Attribute	Value
Sub-index	00_h
Description	Highest sub-index supported
Entry category	Mandatory
Access	rw (constant in NMT operational state)
PDO mapping	No
Value range	01_h
Default value	01_h
Sub-index	01_h
Description	Application object 1
Entry category	Mandatory
Access	constant
PDO mapping	No
Value range	6004 00 20_h*
Default value	6004 00 20_h*

NOTE * The default value for multi-sensor devices is 6020 01 20_h

6.5.3 TPDO 2

This PDO transmits cyclically (synchronous transmission) the position value of the encoder.

Table 10 specifies the object description of the PDO communication parameter and Table 11 specifies the associated entry description. The values are defined in /CiA301/. The sub-index 04_h is reserved for compatibility reasons and shall not be implemented.

Table 10 — Object description

Attribute	Value
Index	1801_h
Name	TPDO 2 communication parameter
Object code	Record
Data type	PDO communication parameter record
Category	Mandatory

Table 11 — Entry description

Attribute	Value
Sub-index	00_h
Description	Highest sub-index supported
Entry category	Mandatory
Access	ro
PDO mapping	No
Value range	02_h to 05_h
Default value	No
Sub-index	01_h
Description	COB-ID
Entry category	Mandatory
Access	ro
PDO mapping	No
Value range	See /CiA301/
Default value	See /CiA301/
Sub-index	02_h
Description	Transmission type
Entry category	Mandatory
Access	rw
PDO mapping	Optional
Value range	See /CiA301/
Default value	1_d
Sub-index	03_h
Description	Inhibit time
Entry category	Optional
Access	rw
PDO mapping	No
Value range	See /CiA301/
Default value	0000_h

Sub-index	05_h
Description	Event timer
Entry category	Optional
Access	rw
PDO mapping	No
Value range	See /CiA301/
Default value	0000_h

Table 12 specifies the object description of the PDO mapping parameter and Table 13 specifies the associated entry description. The values are defined in /CiA301/.

Table 12 — Object description

Attribute	Value
Index	$1A01_h$
Name	TPDO 2 mapping parameter
Object code	Record
Data type	PDO mapping parameter record
Category	Mandatory

Table 13 — Entry description

Attribute	Value
Sub-index	00_h
Description	Highest sub-index supported
Entry category	Mandatory
Access	rw (constant in NMT operational state)
PDO mapping	No
Value range	01_h
Default value	01_h
Sub-index	01_h
Description	1st application object
Entry category	Mandatory
Access	constant
PDO mapping	No
Value range	6004 00 20_h*
Default value	6004 00 20_h*

NOTE * The default value for multi-sensor devices is 6020 01 20_h

6.5.4 TPDO 3

This optional PDO shall transmit cyclically (synchronous transmission) the position value of the high precision encoder.

Table 14 specifies the object description of the PDO communication parameter and Table 15 specifies the associated entry description. The values are defined in /CiA301/. The sub-index 04_h is reserved for compatibility reasons and shall not be implemented.

Table 14 — Object description

Attribute	Value
Index	1802_h
Name	TPDO 3 communication parameter
Object code	Record
Data type	PDO communication parameter record
Category	Mandatory

Table 15 — Entry description

Attribute	Value
Sub-index	00_h
Description	Highest sub-index supported
Entry category	Mandatory
Access	ro
PDO mapping	No
Value range	02_h to 05_h
Default value	No
Sub-index	01_h
Description	COB-ID
Entry category	Mandatory
Access	ro
PDO mapping	No
Value range	See /CiA301/
Default value	See /CiA301/
Sub-index	02_h
Description	Transmission type
Entry category	Mandatory
Access	rw
PDO mapping	Optional
Value range	See /CiA301/
Default value	1_d
Sub-index	03_h
Description	Inhibit time
Entry category	Optional
Access	rw
PDO mapping	No
Value range	See /CiA301/
Default value	0000_h

Sub-index	05_h
Description	Event timer
Entry category	Optional
Access	rw
PDO mapping	No
Value range	See /CiA301/
Default value	0000_h

Table 16 specifies the object description of the PDO mapping parameter and Table 17 specifies the associated entry description. The values are defined in /CiA301/.

Table 16 — Object description

Attribute	Value
Index	$1A02_h$
Name	TPDO 3 mapping parameter
Object code	Record
Data type	PDO mapping parameter record
Category	Mandatory

Table 17 — Entry description

Attribute	Value
Sub-index	00_h
Description	Highest sub-index supported
Entry category	Mandatory
Access	rw (constant in NMT operational state)
PDO mapping	No
Value range	01_h
Default value	01_h
Sub-index	01_h
Description	Application object 1
Entry category	Mandatory
Access	constant
PDO mapping	No
Value range	6008 00 40_h
Default value	6008 00 40_h

7 Application object definitions

7.1 General

This chapter specifies the application object definitions. Each encoder shall share the dictionary entries from 6000_h to $67FF_h$.

7.2 Overview on encoder application objects

Table 18 shows the object dictionary entries for encoder parameters. ‘m’ and ‘o’ indicate, whether a function is mandatory(m) or optional(o).

Table 18 – Object dictionary entries for encoder parameters

Index	Name	C1	C2
6000_h	Operating parameters	m	m
6001_h	Measuring units per revolution	o	m
6002_h	Total measuring range in measuring units	o	m
6003_h	Preset value	o	m
6004_h	Position value	m	m
6005_h	Linear encoder measuring step settings	o	m
6010_h	Preset value for multi-sensor devices	o	m
6020_h	Position value for multi-sensor devices	m	m
6030_h	Speed value	o	c*
6200_h	Cyclic timer	o	m
6300_h	Cam state register	o	o
6301_h	Cam enable register	o	o
6302_h	Cam polarity register	o	o
6310_h	Cam 1 low limit	o	o
6311_h	Cam 2 low limit	o	o
to			
6317_h	Cam 8 low limit	o	o
6320_h	Cam 1 high limit	o	o
6321_h	Cam 2 high limit	o	o
to			
6327_h	Cam 8 high limit	o	o
6330_h	Cam 1 hysteresis	o	o
6331_h	Cam 2 hysteresis	o	o
to			
6337_h	Cam 8 hysteresis	o	o
6400_h	Area state register	o	o
6401_h	Work area low limit	o	o
6402_h	Work area high limit	o	o

NOTE * Only mandatory for multi-sensor encoders

Table 19 shows the object dictionary entries for encoder diagnostics.

Table 19 – Object dictionary entries for encoder diagnostics

Index	Name	C1	C2
6500_h	Operating status	m	m
6501_h	Single-turn resolution (rotary), Measuring step (linear)	m	m
6502_h	Number of distinguishable revolutions	m	m
6503_h	Alarms	o	c^1
6504_h	Supported alarms	o	m
6505_h	Warnings	o	c^2
6506_h	Supported warnings	o	m
6507_h	Profile and software version	o	m

6508_h	Operating time	o	m
6509_h	Offset value	o	m
$650A_h$	Module identification	o	m
$650B_h$	Serial number	o	m
$650C_h$	Offset values for multi-sensor device	o	o

NOTE [1] – if this alarm (see object 6504_h) is supported
[2] – if this warning (see object 6506_h) is supported

7.3 Encoder parameters

7.3.1 General

This chapter specifies the encoder parameter objects.

7.3.2 Object 6000_h: Operating parameters

This object shall indicate the functions for code sequence, commissioning diagnostic control and scaling function control.

Code sequence: The code sequence defines, whether increasing or decreasing position values are output, in case the encoder shaft rotates clockwise or counter clockwise as seen from the point of view of the shaft.

Commissioning diagnostic control: With the commissioning diagnostic function it is possible to check the encoder components responsible for position detection at encoder stand still.

Commissioning bit: The commissioning bit in the operating parameter initiates the commissioning diagnostic. If errors are detected it will be announced by the according alarm bits.

Scaling function control: With the scaling function the encoder numerical value is converted in software to change the physical resolution of the encoder. The *measuring units per revolution* (object 6001_h) and *total measuring range in measuring units* (object 6002_h) are the scaling parameters. The scaling function bit is set in the operating parameters. If the scaling function bit is set to zero, the scaling function is disabled.

Measuring direction: Moving away from the electrical connection (point of view shall be the mounting face) shall be regarded as forward direction.

Figure 3 specifies the object structure and Table 20 specifies the value definition.

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
msp	*msp*	*msp*	*msp*	*r*	*r*	*r*	*r*	*r*	*r*	*r*	*r*	*md*	*sfc*	*cdc*	*cs*
MSB															LSB

Figure 3 – Object structure

Table 20 – Value definition

Signal	Value	Definition
cs	0_b 1_b	Code sequence = CW (m* for C1, m* for C2) Code sequence = CCW (m* for C1, m* for C2)
cdc	0_b 1_b	Commissioning diagnostic control disabled (o for C1, o for C2) Commissioning diagnostic control enabled (o for C1, o for C2)
sfc	0_b 1_b	Scaling function control disabled (o for C1, m for C2) Scaling function control enabled (o for C1, m for C2)

Signal	Value	Definition
md	0_b 1_b	Measuring direction forward (o** for C1, o** for C2) Measuring direction backward (o** for C1, o** for C2)
r		Reserved for further use
msp	0_b 1_b	Manufacturer-specific parameter disabled (o for C1, o for C2) Manufacturer-specific parameter enabled (o for C1, o for C2)

NOTE * not for linear encoders ** not for rotary encoders

Table 21 specifies the object description, and Table 22 specifies the entry description.

Table 21 – Object description

Attribute	Value
INDEX	6000_h
Name	Operating parameters
Object code	Variable
Data type	Unsigned16
Category	See Table 18

Table 22 – Entry description

Attribute	Value
Sub-index	00_h
Access	rw
PDO mapping	No
Value range	See value definition
Default value	Manufacturer-specific

7.3.3 Object 6001_h: Measuring units per revolution

This object shall indicate the number of distinguishable steps per revolution.

Table 23 specifies the object description, and Table 24 specifies the entry description.

Table 23 – Object description

Attribute	Value
INDEX	6001_h
Name	Measuring units per revolution
Object code	Variable
Data type	Unsigned32
Category	See Table 18

Table 24– Entry description

Attribute	Value
Sub-index	00_h
Access	rw
PDO mapping	No
Value range	Unsigned32
Default value	Manufacturer-specific

7.3.4 Object 6002_h: Total measuring range in measuring units

This object shall indicate the number of distinguishable steps over the total measuring range. Table 25 specifies the object description, and Table 26 specifies the entry description.

Table 25 – Object description

Attribute	Value
INDEX	6002_h
Name	Total measuring range in measuring units
Object code	Variable
Data type	Unsigned32
Category	See Table 18

Table 26 – Entry description

Attribute	Value
Sub-index	00_h
Access	rw
PDO mapping	No
Value range	Unsigned32
Default value	Manufacturer-specific

7.3.5 Object 6003_h: Preset value

This object shall indicate the preset value for the output position value (object 6004_h).

This object supports adaptation of encoder's zero point to the mechanical zero point of the system. For multi-sensor devices and linear sensors refer to object 6010_h.

The output position value shall be set to the preset value and the offset from the position value shall be calculated and stored in the encoder.

Table 27 specifies the object description, and Table 28 specifies the entry description.

Table 27 – Object description

Attribute	Value
INDEX	6003_h
Name	Preset value
Object code	Variable
Data type	Unsigned32
Category	See Table 18

Table 28 – Entry description

Attribute	Value
Sub-index	00_h
Access	rw
PDO mapping	No
Value range	Unsigned32
Default value	Manufacturer-specific

7.3.6 Object 6004_h: Position value

This object shall provide the output position value for the communication objects 1800_h (TPDO 1) and 1801_h (TPDO 2). For multi-sensor devices refer to object 6020_h.

Table 29 specifies the object description, and Table 30 specifies the entry description.

Table 29 – Object description

Attribute	Value
INDEX	6004_h
Name	Position value
Object code	Variable
Data type	Unsigned32
Category	See Table 18

Table 30 – Entry description

Attribute	Value
Sub-index	00_h
Access	ro
PDO mapping	Optional
Value range	Unsigned32
Default value	No

7.3.7 Object 6005_h: Linear encoder measuring step settings

This object shall indicate the measuring step settings for position, speed, acceleration, and jerk for linear encoders.

The value of position step setting (sub-index 01_h) shall be given in multiples of 0.001 μm.

The value of speed step setting (sub-index 02_h) shall be given in multiples of 0.01 mm/s.

The value of acceleration step setting (sub-index 03_h) shall be given in multiples of 0.1 m/s^2.

The value of jerk step setting (sub-index 04_h) shall be given in multiples of 1 m/s^3.

Table 31 specifies the object description, and Table 32 specifies the entry description.

Table 31 – Object description

Attribute	Value
INDEX	6005_h
Name	Linear encoder measuring step settings
Object code	Array
Data type	Unsigned32
Category	See Table 18

NOTE *This object is only mandatory for linear encoders (refer to object 1000_h).

Table 32 – Entry description

Attribute	Value
Sub-index	00_h
Description	Highest sub-index supported
Entry category	Mandatory
Access	ro
PDO mapping	No
Value range	01_h to 04_h
Default value	No
Sub-index	01_h
Description	Position step setting
Entry category	Mandatory
Access	rw
PDO mapping	No
Value range	Unsigned32
Default value	Manufacturer-specific
Sub-index	02_h
Description	Speed step setting
Entry category	Optional
Access	rw
PDO mapping	No
Value range	Unsigned32
Default value	Manufacturer-specific
Sub-index	03_h
Description	Acceleration step setting
Entry category	Optional
Access	rw
PDO mapping	No
Value range	Unsigned32
Default value	Manufacturer-specific
Sub-index	04_h
Description	Jerk step setting
Entry category	Optional
Access	rw
PDO mapping	No
Value range	Unsigned32
Default value	Manufacturer-specific

7.3.8 Object 6008_h: High precision position value

This object may substitute the *position value* (object 6004_h) and shall provide the position value for high precision encoders. Table 33 specifies the object description, and Table 34 specifies the entry description.

Table 33 – Object description

Attribute	Value
INDEX	6008_h
Name	High precision position value
Object code	Variable
Data type	Unsigned64
Category	Optional

Table 34 – Entry description

Attribute	Value
Sub-index	00_h
Access	ro
PDO mapping	Optional
Value range	Unsigned64
Default value	No

7.3.9 Object 6009_h: High precision preset value

This object shall indicate the preset value for high precision encoders using the *high precision position value* (object 6008_h).

Table 35 specifies the object description, and Table 36 specifies the entry description.

Table 35 – Object description

Attribute	Value
INDEX	6009_h
Name	High precision preset value
Object code	Variable
Data type	Unsigned64
Category	Conditional: mandatory for C2 encoders

Table 36 – Entry description

Attribute	Value
Sub-index	00_h
Access	rw
PDO mapping	No
Value range	Unsigned64
Default value	Manufacturer-specific

7.3.10 Object 6010_h: Preset values for multi-sensor devices

This object is similar to object 6003_h and shall indicate the preset values for the output *position values for multi-sensor devices* (object 6020_h).

In sub-index 00_h the number of supported channels is defined.

The Preset function supports adaptation of the encoder's zero point to the mechanical zero point of the system.

The output position values in the sub-indices of object 6020_h are set to the sub-indices of the parameter „Preset value“ in object 6010_h, accordingly. The offset from the position value shall be calculated and stored in the encoder.

This object is only mandatory for multi-sensor encoders (object 1000_h encoder type: code 10_d).

Table 37 specifies the object description, and Table 38 specifies the entry description.

Table 37 – Object description

Attribute	Value
INDEX	6010_h
Name	Preset value for multi-sensor devices
Object code	Array
Data type	Integer32
Category	See Table 18

Table 38 – Entry description

Attribute	Value
Sub-index	00_h
Description	Highest sub-index supported
Entry category	Mandatory
Access	ro
PDO mapping	No
Value range	01_h to FE_h
Default value	No
Sub-index	01_h
Description	Preset value channel 1
Entry category	Mandatory
Access	rw
PDO mapping	No
Value range	Integer32
Default value	Manufacturer-specific
Sub-index	02_h
Description	Preset value channel 2
Entry category	Optional
Access	rw
PDO mapping	No
Value range	Integer32
Default value	Manufacturer-specific

to	
Sub-index	FE_h
Description	Preset value channel 254
Entry category	Optional
Access	rw
PDO mapping	No
Value range	Integer32
Default value	Manufacturer-specific

7.3.11 Object 6020_h: Position values for multi-sensor devices

Similar to object 6004_h this object shall indicate the output position value(s) for the communication objects 1800_h (TPDO 1) and 1801_h (TPDO 2). This object is only mandatory for multi-sensor encoders (object 1000_h encoder type: code 10_d).

Table 39 specifies the object description, and Table 40 specifies the entry description.

Table 39 – Object description

Attribute	Value
INDEX	6020_h
Name	Position value for multisensor devices
Object code	Array
Data type	Integer32
Category	See Table 18

Table 40 – Entry description

Attribute	Value
Sub-index	00_h
Description	Highest sub-index supported
Entry category	Mandatory
Access	ro
PDO mapping	No
Value range	01_h to FE_h
Default value	No
Sub-index	01_h
Description	Position value channel 1
Entry category	Mandatory
Access	rw
PDO mapping	Optional
Value range	Integer32
Default value	Manufacturer-specific

Sub-index	02_h
Description	Position value channel 2
Entry category	Optional
Access	rw
PDO mapping	Optional
Value range	Integer32
Default value	Manufacturer-specific
to	
Sub-index	FE_h
Description	Position value channel 254
Entry category	Optional
Access	rw
PDO mapping	Optional
Value range	Integer32
Default value	Manufacturer-specific

7.3.12 Object 6030_h: Speed value

This object shall provide the output speed value(s). For linear encoders the speed-measuring step is defined in object 6005_h, sub-index 02_h. The speed value for rotary encoders shall be given in multiples of measuring units per second. This object is only mandatory for multi-sensor encoders (object 1000_h encoder type: code 10_d).

Table 41 specifies the object description, and Table 42 specifies the entry description.

Table 41 – Object description

Attribute	Value
INDEX	6030_h
Name	Speed value
Object code	Array
Data type	Integer16
Category	See Table 18

Table 42 – Entry description

Attribute	Value
Sub-index	00_h
Description	Highest sub-index supported
Entry category	Mandatory
Access	ro
PDO mapping	No
Value range	01_h to FE_h
Default value	No

Sub-index	01_h
Description	Speed value channel 1
Entry category	Mandatory
Access	ro
PDO mapping	Optional
Value range	Integer16
Default value	No
Sub-index	02_h
Description	Speed value channel 2
Entry category	Optional
Access	ro
PDO mapping	Optional
Value range	Integer16
Default value	No
to	
Sub-index	FE_h
Description	Speed value channel 254
Entry category	Optional
Access	ro
PDO mapping	Optional
Value range	Integer16
Default value	No

7.3.13 Object 6040_h: Acceleration value

This object shall provide the output acceleration value(s). For linear encoders the acceleration-measuring step is defined in object 6005_h, sub-index 03_h. For rotary encoders the acceleration value shall be given in multiples of measuring units per square second.

Table 43 specifies the object description, and Table 44 specifies the entry description.

Table 43 – Object description

Attribute	Value
INDEX	6040_h
Name	Acceleration value
Object code	Array
Data type	Integer16
Category	Optional

Table 44 – Entry description

Attribute	Value
Sub-index	00_h
Description	Highest sub-index supported
Entry category	Mandatory
Access	ro
PDO mapping	No
Value range	01_h to FE_h
Default value	No
Sub-index	01_h
Description	Acceleration value channel 1
Entry category	Mandatory
Access	ro
PDO mapping	Optional
Value range	Integer16
Default value	No
Sub-index	02_h
Description	Acceleration value channel 2
Entry category	Optional
Access	ro
PDO mapping	Optional
Value range	Integer16
Default value	No
to	
Sub-index	FE_h
Description	Acceleration value channel 254
Entry category	Optional
Access	ro
PDO mapping	Optional
Value range	Integer16
Default value	No

7.3.14 Object 6050_h: Jerk value

This object shall provide the output jerk value(s). For linear encoders the jerk-measuring step is defined in object 6005_h, sub-index 04_h. Rotary encoders shall provide the jerk value in multiples of measuring units per cubic second.

Table 45 specifies the object description, and Table 46 specifies the entry description.

Table 45 – Object description

Attribute	Value
INDEX	6050_h
Name	Jerk value
Object code	Array
Data type	Integer16
Category	Optional

Table 46 – Entry description

Attribute	Value
Sub-index	00_h
Description	Highest sub-index supported
Entry category	Mandatory
Access	ro
PDO mapping	No
Value range	01_h to FE_h
Default value	No
Sub-index	01_h
Description	Jerk value channel 1
Entry category	Mandatory
Access	ro
PDO mapping	Optional
Value range	Integer16
Default value	No
Sub-index	02_h
Description	Jerk value channel 2
Entry category	Optional
Access	ro
PDO mapping	Optional
Value range	Integer16
Default value	No
to	
Sub-index	FE_h
Description	Jerk value channel 254
Entry category	Optional
Access	ro
PDO mapping	Optional
Value range	Integer16
Default value	No

7.3.15 Object 6200_h: Cyclic timer

This object shall indicate the transmission period for TPDO 1. It shall be hard-wired to the PDO's event timer meaning that a change in the event timer causes a change in object 6200_h and vice versa.

A cyclic transmission of the position value shall be set, when the cyclic timer is programmed unequal 0000_h. The values shall be given in multiples of 1 ms.

Table 47 specifies the object description, and Table 48 specifies the entry description.

Table 47 – Object description

Attribute	Value
INDEX	6200_h
Name	Cyclic timer
Object code	Variable
Data type	Unsigned16
Category	See Table 18

Table 48 – Entry description

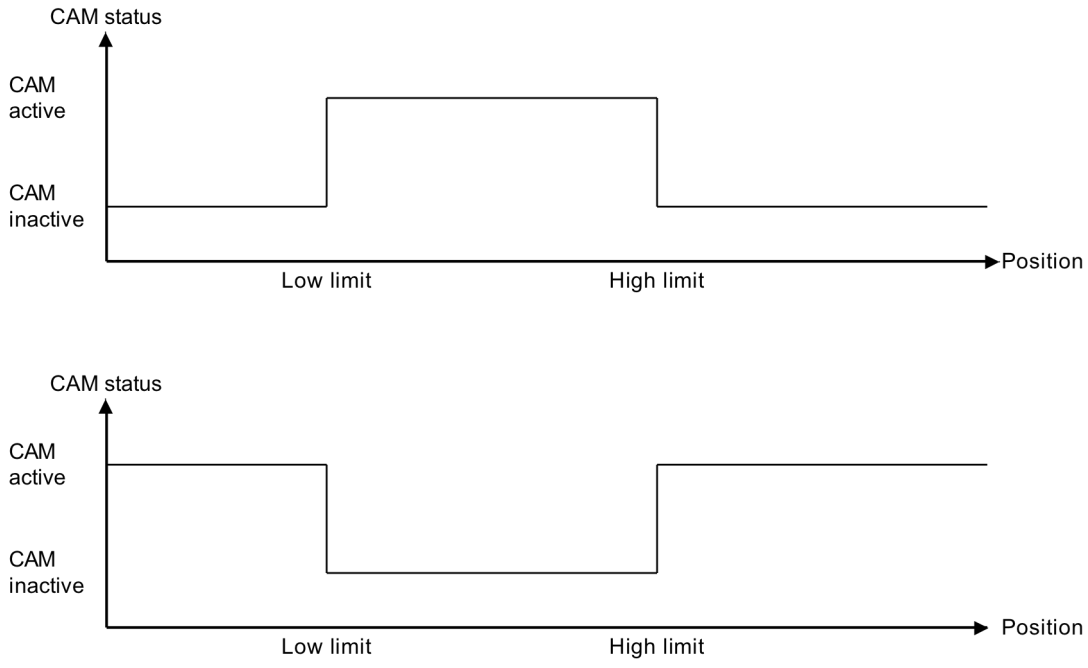
Attribute	Value
Sub-index	00_h
Access	rw
PDO mapping	No
Value range	Unsigned16
Default value	See event timer of TPDO 1

7.4 Encoder Cams

7.4.1 General

Optional up to 254 cam position channels with a maximum of 8 cams each channel may be supported by encoder devices. Each cam has parameters for the minimum switch point, the maximum switch point and setting a hysteresis to the switch points.

Figure 4 shows the possible usage of cams and switch points.



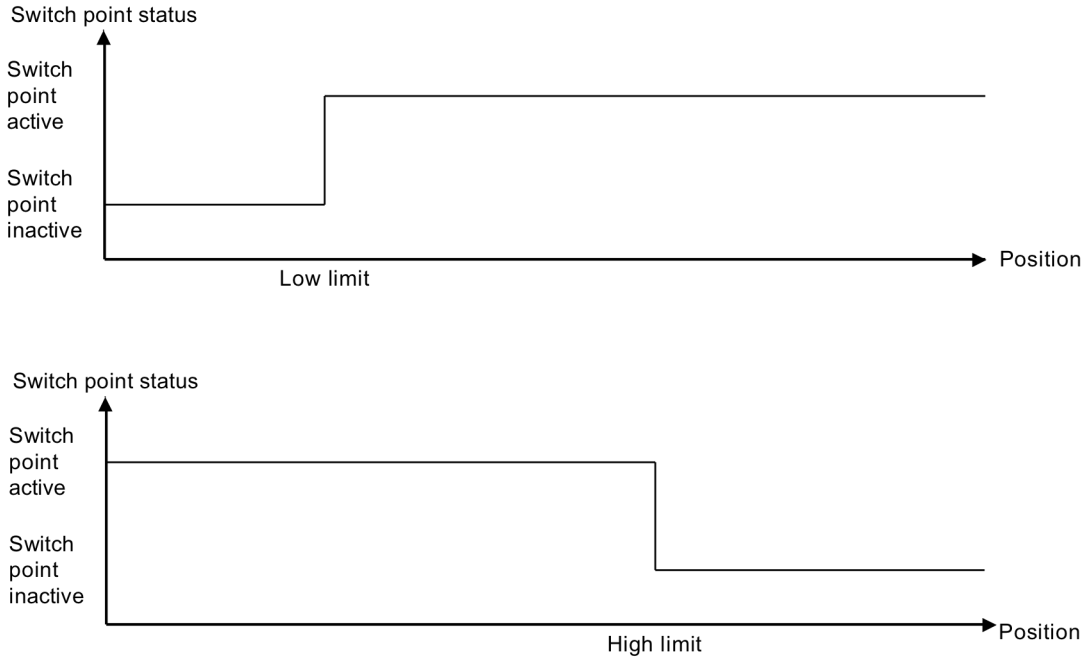


Figure 4 – Possible usage of cams and switch points

In Figure 5 the usage of hysteresis is shown.

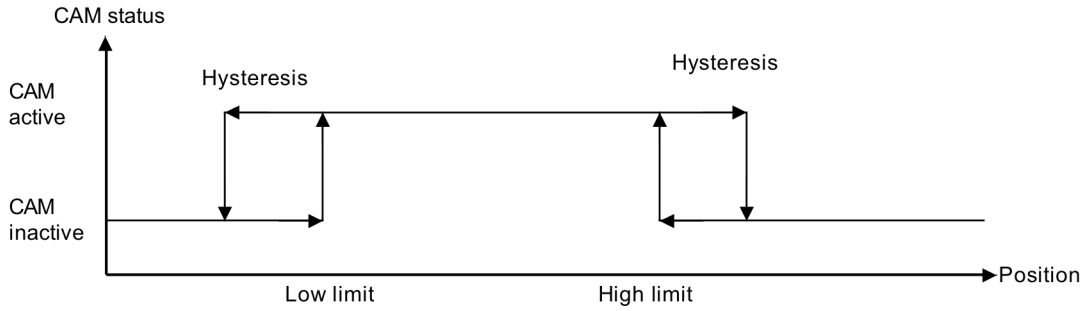


Figure 5 – Usage of hysteresis

7.4.2 Object 6300_h: Cam state register

This object shall provide the status bits of the cams in the cam channels.

If the polarity bit of a cam is set (refer to index in object 6302_h) the actual cam state will be inverted. Figure 6 specifies the object structure and Table 49 defines the values. Table 50 specifies the object description, and Table 51 specifies the entry description.

7	6	5	4	3	2	1	0
cam8	*cam7*	*cam6*	*cam5*	*cam4*	*cam3*	*cam2*	*cam1*
MSB							LSB

Figure 6 – Object structure

Table 49 – Value definition

Bit	Value	Definition
cam1 to cam8	0_b 1_b	Cam inactive Cam active

Table 50 – Object description

Attribute	Value
INDEX	6300_h
Name	Cam state register
Object code	Array
Data type	Unsigned8
Category	See Table 18

Table 51 – Entry description

Attribute	Value
Sub-index	00_h
Description	Highest sub-index supported
Entry category	Mandatory
Access	ro
PDO mapping	No
Value range	01_h to FE_h
Default value	No
Sub-index	01_h
Description	Cam state channel 1
Entry category	Mandatory
Access	ro
PDO mapping	Optional
Value range	See value definition
Default value	No
Sub-index	02_h
Description	Cam state channel 2
Entry category	Optional
Access	ro
PDO mapping	Optional
Value range	See value definition
Default value	No
to	

Sub-index	FE_h
Description	Cam state channel 254
Entry category	Optional
Access	ro
PDO mapping	Optional
Value range	See value definition
Default value	No

7.4.3 Object 6301_h: Cam enable register

This object shall indicate the cam enable register values. Each cam enable channel shall contain the calculation state for a maximum of 8 cams for one position channel.

Figure 7 specifies the object structure. Table 52 specifies the value definition. Table 53 specifies the object description, and Table 54 specifies the entry description.

7	6	5	4	3	2	1	0
cam8_en	*cam7_en*	*cam6_en*	*cam5_en*	*cam4_en*	*cam3_en*	*cam2_en*	*cam1_en*
MSB							LSB

Figure 7 – Object structure

Table 52 – Value definition

Bit	Value	Definition
cam1_en to cam8_en	0_b	Cam state of the related cam shall be set permanently to 0_b
	1_b	Cam state shall be calculated by the device

Table 53 – Object description

Attribute	Value
INDEX	6301_h
Name	Cam enable register
Object code	Array
Data type	Unsigned8
Category	See Table 18

Table 54 – Entry description

Attribute	Value
Sub-index	00_h
Description	Highest sub-index supported
Entry category	Mandatory
Access	ro
PDO mapping	No
Value range	01_h to FE_h
Default value	No

Sub-index	01_h
Description	Cam enable channel 1
Entry category	Mandatory
Access	rw
PDO mapping	Optional
Value range	See value definition
Default value	00_h
Sub-index	02_h
Description	Cam enable channel 2
Entry category	Optional
Access	rw
PDO mapping	Optional
Value range	See value definition
Default value	00_h
to	
Sub-index	FE_h
Description	Cam enable channel 254
Entry category	Optional
Access	rw
PDO mapping	Optional
Value range	See value definition
Default value	00_h

7.4.4 Object 6302_h: Cam polarity register

This object shall indicate the cam polarity register values.

Each cam polarity channel shall contain the actual polarity settings for a maximum of 8 cams for one position channel. Figure 8 specifies the object structure. Table 55 specifies the value definition.

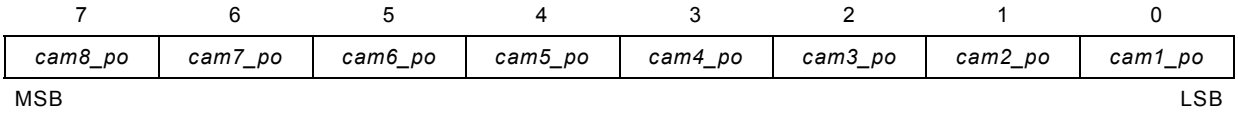


Figure 8 – Object structure

Table 55 – Value definition

Bit	Value	Definition
cam1_po to cam8_po	0_b	Cam state of the related cam shall not be inverted
	1_b	Cam state of the related cam shall be inverted

Table 56 specifies the object description, and Table 57 specifies the entry description.

Table 56 – Object description

Attribute	Value
INDEX	6302_h
Name	Cam polarity register
Object code	Array
Data type	Unsigned8
Category	See Table 18

Table 57 – Entry description

Attribute	Value
Sub-index	00_h
Description	Highest sub-index supported
Entry category	Mandatory
Access	ro
PDO mapping	No
Value range	01_h to FE_h
Default value	No
Sub-index	01_h
Description	Cam polarity channel 1
Entry category	Mandatory
Access	rw
PDO mapping	Optional
Value range	See value definition
Default value	00_h
Sub-index	02_h
Description	Cam polarity channel 2
Entry category	Optional
Access	rw
PDO mapping	Optional
Value range	See value definition
Default value	00_h
to	
Sub-index	FE_h
Description	Cam polarity channel 254
Entry category	Optional
Access	rw
PDO mapping	Optional
Value range	See value definition
Default value	00_h

7.4.5 Object 6310_h: Cam 1 low limit

The Cam 1 low limit channel shall indicate the switch point for the lower limit settings of Cam 1. Table 58 specifies the object description, and Table 59 specifies the entry description.

Table 58 – Object description

Attribute	Value
INDEX	6310_h
Name	Cam1 low limit
Object code	Array
Data type	Integer32
Category	See Table 18

Table 59 – Entry description

Attribute	Value
Sub-index	00_h
Description	Highest sub-index supported
Entry category	Mandatory
Access	ro
PDO mapping	No
Value range	01_h to FE_h
Default value	No
Sub-index	01_h
Description	Cam1 low limit channel 1
Entry category	Mandatory
Access	rw
PDO mapping	No
Value range	Integer32
Default value	Manufacturer specific
Sub-index	02_h
Description	Cam1 low limit channel 2
Entry category	Optional
Access	rw
PDO mapping	No
Value range	Integer32
Default value	Manufacturer specific
to	
Sub-index	FE_h
Description	Cam1 low limit channel 254
Entry category	Optional
Access	rw
PDO mapping	No
Value range	Integer32
Default value	Manufacturer specific

7.4.6 Object 6311_h: Cam 2 low limit

The Cam 2 low limit channel shall indicate the switch point for the lower limit settings of Cam 2. Table 60 specifies the object description, and Table 61 specifies the entry description.

Table 60 – Object description

Attribute	Value
INDEX	6311_h
Name	Cam2 low limit
Object code	Array
Data type	Integer32
Category	See Table 18

Table 61 – Entry description

Attribute	Value
Sub-index	00_h
Description	Highest sub-index supported
Entry category	Mandatory
Access	ro
PDO mapping	No
Value range	01_h to FE_h
Default value	No
Sub-index	01_h
Description	Cam2 low limit channel 1
Entry category	Mandatory
Access	rw
PDO mapping	No
Value range	Integer32
Default value	Manufacturer specific
Sub-index	02_h
Description	Cam2 low limit channel 2
Entry category	Optional
Access	rw
PDO mapping	No
Value range	Integer32
Default value	Manufacturer specific
to	
Sub-index	FE_h
Description	Cam2 low limit channel 254
Entry category	Optional
Access	rw
PDO mapping	No
Value range	Integer32
Default value	Manufacturer specific

7.4.7 Object 6312_h: Cam 3 low limit

The Cam 3 low limit channel shall indicate the switch point for the lower limit settings of Cam 3. Table 62 specifies the object description, and Table 63 specifies the entry description.

Table 62 – Object description

Attribute	Value
INDEX	6312_h
Name	Cam3 low limit
Object code	Array
Data type	Integer32
Category	See Table 18

Table 63 – Entry description

Attribute	Value
Sub-index	00_h
Description	Highest sub-index supported
Entry category	Mandatory
Access	ro
PDO mapping	No
Value range	01_h to FE_h
Default value	No
Sub-index	01_h
Description	Cam3 low limit channel 1
Entry category	Mandatory
Access	rw
PDO mapping	No
Value range	Integer32
Default value	Manufacturer specific
Sub-index	02_h
Description	Cam3 low limit channel 2
Entry category	Optional
Access	rw
PDO mapping	No
Value range	Integer32
Default value	Manufacturer specific
to	
Sub-index	FE_h
Description	Cam3 low limit channel 254
Entry category	Optional
Access	rw
PDO mapping	No
Value range	Integer32
Default value	Manufacturer specific

7.4.8 Object 6313_h: Cam 4 low limit

The Cam 4 low limit channel shall indicate the switch point for the lower limit settings of Cam 4. Table 64 specifies the object description, and Table 65 specifies the entry description.

Table 64 – Object description

Attribute	Value
INDEX	6313_h
Name	Cam4 low limit
Object code	Array
Data type	Integer32
Category	See Table 18

Table 65 – Entry description

Attribute	Value
Sub-index	00_h
Description	Highest sub-index supported
Entry category	Mandatory
Access	ro
PDO mapping	No
Value range	01_h to FE_h
Default value	No
Sub-index	01_h
Description	Cam4 low limit channel 1
Entry category	Mandatory
Access	rw
PDO mapping	No
Value range	Integer32
Default value	Manufacturer specific
Sub-index	02_h
Description	Cam4 low limit channel 2
Entry category	Optional
Access	rw
PDO mapping	No
Value range	Integer32
Default value	Manufacturer specific
to	
Sub-index	FE_h
Description	Cam4 low limit channel 254
Entry category	Optional
Access	rw
PDO mapping	No
Value range	Integer32
Default value	Manufacturer specific

7.4.9 Object 6314_h: Cam 5 low limit

The Cam 5 low limit channel shall indicate the switch point for the lower limit settings of Cam 5. Table 66 specifies the object description, and Table 67 specifies the entry description.

Table 66 – Object description

Attribute	Value
INDEX	6314_h
Name	Cam5 low limit
Object code	Array
Data type	Integer32
Category	See Table 18

Table 67 – Entry description

Attribute	Value
Sub-index	00_h
Description	Highest sub-index supported
Entry category	Mandatory
Access	ro
PDO mapping	No
Value range	01_h to FE_h
Default value	No
Sub-index	01_h
Description	Cam5 low limit channel 1
Entry category	Mandatory
Access	rw
PDO mapping	No
Value range	Integer32
Default value	Manufacturer specific
Sub-index	02_h
Description	Cam5 low limit channel 2
Entry category	Optional
Access	rw
PDO mapping	No
Value range	Integer32
Default value	Manufacturer specific
to	
Sub-index	FE_h
Description	Cam5 low limit channel 254
Entry category	Optional
Access	rw
PDO mapping	No
Value range	Integer32
Default value	Manufacturer specific

7.4.10 Object 6315_h: Cam 6 low limit

The Cam 6 low limit channel shall indicate the switch point for the lower limit settings of Cam 6. Table 68 specifies the object description, and Table 69 specifies the entry description.

Table 68 – Object description

Attribute	Value
INDEX	6315_h
Name	Cam6 low limit
Object code	Array
Data type	Integer32
Category	See Table 18

Table 69 – Entry description

Attribute	Value
Sub-index	00_h
Description	Highest sub-index supported
Entry category	Mandatory
Access	ro
PDO mapping	No
Value range	01_h to FE_h
Default value	No
Sub-index	01_h
Description	Cam6 low limit channel 1
Entry category	Mandatory
Access	rw
PDO mapping	No
Value range	Integer32
Default value	Manufacturer specific
Sub-index	02_h
Description	Cam6 low limit channel 2
Entry category	Optional
Access	rw
PDO mapping	No
Value range	Integer32
Default value	Manufacturer specific
to	
Sub-index	FE_h
Description	Cam6 low limit channel 254
Entry category	Optional
Access	rw
PDO mapping	No
Value range	Integer32
Default value	Manufacturer specific

7.4.11 Object 6316_h: Cam 7 low limit

The Cam 7 low limit channel shall indicate the switch point for the lower limit settings of Cam 7. Table 70 specifies the object description, and Table 71 specifies the entry description.

Table 70 – Object description

Attribute	Value
INDEX	6316_h
Name	Cam7 low limit
Object code	Array
Data type	Integer32
Category	See Table 18

Table 71 – Entry description

Attribute	Value
Sub-index	00_h
Description	Highest sub-index supported
Entry category	Mandatory
Access	ro
PDO mapping	No
Value range	01_h to FE_h
Default value	No
Sub-index	01_h
Description	Cam7 low limit channel 1
Entry category	Mandatory
Access	rw
PDO mapping	No
Value range	Integer32
Default value	Manufacturer specific
Sub-index	02_h
Description	Cam7 low limit channel 2
Entry category	Optional
Access	rw
PDO mapping	No
Value range	Integer32
Default value	Manufacturer specific
to	
Sub-index	FE_h
Description	Cam7 low limit channel 254
Entry category	Optional
Access	rw
PDO mapping	No
Value range	Integer32
Default value	Manufacturer specific

7.4.12 Object 6317_h: Cam 8 low limit

The Cam 8 low limit channel shall indicate the switch point for the lower limit settings of Cam 8. Table 72 specifies the object description, and Table 73 specifies the entry description.

Table 72 – Object description

Attribute	Value
INDEX	6317_h
Name	Cam8 low limit
Object code	Array
Data type	Integer32
Category	See Table 18

Table 73 – Entry description

Attribute	Value
Sub-index	00_h
Description	Highest sub-index supported
Entry category	Mandatory
Access	ro
PDO mapping	No
Value range	01_h to FE_h
Default value	No
Sub-index	01_h
Description	Cam8 low limit channel 1
Entry category	Mandatory
Access	rw
PDO mapping	No
Value range	Integer32
Default value	Manufacturer specific
Sub-index	02_h
Description	Cam8 low limit channel 2
Entry category	Optional
Access	rw
PDO mapping	No
Value range	Integer32
Default value	Manufacturer specific
to	
Sub-index	FE_h
Description	Cam8 low limit channel 254
Entry category	Optional
Access	rw
PDO mapping	No
Value range	Integer32
Default value	Manufacturer specific

7.4.13 Object 6320_h: Cam 1 high limit

The Cam 1 high limit channel shall indicate the switch point for the lower limit settings of Cam 1. Table 74 specifies the object description, and Table 75 specifies the entry description.

Table 74 – Object description

Attribute	Value
INDEX	6320_h
Name	Cam 1 high limit
Object code	Array
Data type	Integer32
Category	See Table 18

Table 75 – Entry description

Attribute	Value
Sub-index	00_h
Description	Highest sub-index supported
Entry category	Mandatory
Access	ro
PDO mapping	No
Value range	01_h to FE_h
Default value	No
Sub-index	01_h
Description	Cam 1 high limit channel 1
Entry category	Mandatory
Access	rw
PDO mapping	No
Value range	Integer32
Default value	Manufacturer specific
Sub-index	02_h
Description	Cam 1 high limit channel 2
Entry category	Optional
Access	rw
PDO mapping	No
Value range	Integer32
Default value	Manufacturer specific
to	
Sub-index	FE_h
Description	Cam 1 high limit channel 254
Entry category	Optional
Access	rw
PDO mapping	No
Value range	Integer32
Default value	Manufacturer specific

7.4.14 Object 6321_h: Cam 2 high limit

The Cam 2 high limit channel shall indicate the switch point for the lower limit settings of Cam 2. Table 76 specifies the object description, and Table 77 specifies the entry description.

Table 76 – Object description

Attribute	Value
INDEX	6321_h
Name	Cam 2 high limit
Object code	Array
Data type	Integer32
Category	See Table 18

Table 77 – Entry description

Attribute	Value
Sub-index	00_h
Description	Highest sub-index supported
Entry category	Mandatory
Access	ro
PDO mapping	No
Value range	01_h to FE_h
Default value	No
Sub-index	01_h
Description	Cam 2 high limit channel 1
Entry category	Mandatory
Access	rw
PDO mapping	No
Value range	Integer32
Default value	Manufacturer specific
Sub-index	02_h
Description	Cam 2 high limit channel 2
Entry category	Optional
Access	rw
PDO mapping	No
Value range	Integer32
Default value	Manufacturer specific
to	
Sub-index	FE_h
Description	Cam 2 high limit channel 254
Entry category	Optional
Access	rw
PDO mapping	No
Value range	Integer32
Default value	Manufacturer specific

7.4.15 Object 6322_h: Cam 3 high limit

The Cam 3 high limit channel shall indicate the switch point for the lower limit settings of Cam 3. Table 78 specifies the object description, and Table 79 specifies the entry description.

Table 78 – Object description

Attribute	Value
INDEX	6322_h
Name	Cam 3 high limit
Object code	Array
Data type	Integer32
Category	See Table 18

Table 79 – Entry description

Attribute	Value
Sub-index	00_h
Description	Highest sub-index supported
Entry category	Mandatory
Access	ro
PDO mapping	No
Value range	01_h to FE_h
Default value	No
Sub-index	01_h
Description	Cam 3 high limit channel 1
Entry category	Mandatory
Access	rw
PDO mapping	No
Value range	Integer32
Default value	Manufacturer specific
Sub-index	02_h
Description	Cam 3 high limit channel 2
Entry category	Optional
Access	rw
PDO mapping	No
Value range	Integer32
Default value	Manufacturer specific
to	
Sub-index	FE_h
Description	Cam 3 high limit channel 254
Entry category	Optional
Access	rw
PDO mapping	No
Value range	Integer32
Default value	Manufacturer specific

7.4.16 Object 6323_h: Cam 4 high limit

The Cam 4 high limit channel shall indicate the switch point for the lower limit settings of Cam 4. Table 80 specifies the object description, and Table 81 specifies the entry description.

Table 80 – Object description

Attribute	Value
INDEX	6323_h
Name	Cam 4 high limit
Object code	Array
Data type	Integer32
Category	See Table 18

Table 81 – Entry description

Attribute	Value
Sub-index	00_h
Description	Highest sub-index supported
Entry category	Mandatory
Access	ro
PDO mapping	No
Value range	01_h to FE_h
Default value	No
Sub-index	01_h
Description	Cam 4 high limit channel 1
Entry category	Mandatory
Access	rw
PDO mapping	No
Value range	Integer32
Default value	Manufacturer specific
Sub-index	02_h
Description	Cam 4 high limit channel 2
Entry category	Optional
Access	rw
PDO mapping	No
Value range	Integer32
Default value	Manufacturer specific
to	
Sub-index	FE_h
Description	Cam 4 high limit channel 254
Entry category	Optional
Access	rw
PDO mapping	No
Value range	Integer32
Default value	Manufacturer specific

7.4.17 Object 6324_h: Cam 5 high limit

The Cam 5 high limit channel shall indicate the switch point for the lower limit settings of Cam 5. Table 82 specifies the object description, and Table 83 specifies the entry description.

Table 82 – Object description

Attribute	Value
INDEX	6324_h
Name	Cam 5 high limit
Object code	Array
Data type	Integer32
Category	See Table 18

Table 83 – Entry description

Attribute	Value
Sub-index	00_h
Description	Highest sub-index supported
Entry category	Mandatory
Access	ro
PDO mapping	No
Value range	01_h to FE_h
Default value	No
Sub-index	01_h
Description	Cam 5 high limit channel 1
Entry category	Mandatory
Access	rw
PDO mapping	No
Value range	Integer32
Default value	Manufacturer specific
Sub-index	02_h
Description	Cam 5 high limit channel 2
Entry category	Optional
Access	rw
PDO mapping	No
Value range	Integer32
Default value	Manufacturer specific
to	
Sub-index	FE_h
Description	Cam 5 high limit channel 254
Entry category	Optional
Access	rw
PDO mapping	No
Value range	Integer32
Default value	Manufacturer specific

7.4.18 Object 6325_h: Cam 6 high limit

The Cam 6 high limit channel shall indicate the switch point for the lower limit settings of Cam 6. Table 84 specifies the object description, and Table 85 specifies the entry description.

Table 84 – Object description

Attribute	Value
INDEX	6325_h
Name	Cam 6 high limit
Object code	Array
Data type	Integer32
Category	See Table 18

Table 85 – Entry description

Attribute	Value
Sub-index	00_h
Description	Highest sub-index supported
Entry category	Mandatory
Access	ro
PDO mapping	No
Value range	01_h to FE_h
Default value	No
Sub-index	01_h
Description	Cam 6 high limit channel 1
Entry category	Mandatory
Access	rw
PDO mapping	No
Value range	Integer32
Default value	Manufacturer specific
Sub-index	02_h
Description	Cam 6 high limit channel 2
Entry category	Optional
Access	rw
PDO mapping	No
Value range	Integer32
Default value	Manufacturer specific
to	
Sub-index	FE_h
Description	Cam 6 high limit channel 254
Entry category	Optional
Access	rw
PDO mapping	No
Value range	Integer32
Default value	Manufacturer specific

7.4.19 Object 6326_h: Cam 7 high limit

The Cam 7 high limit channel shall indicate the switch point for the lower limit settings of Cam 7. Table 86 specifies the object description, and Table 87 specifies the entry description.

Table 86 – Object description

Attribute	Value
INDEX	6326_h
Name	Cam 7 high limit
Object code	Array
Data type	Integer32
Category	See Table 18

Table 87 – Entry description

Attribute	Value
Sub-index	00_h
Description	Highest sub-index supported
Entry category	Mandatory
Access	ro
PDO mapping	No
Value range	01_h to FE_h
Default value	No
Sub-index	01_h
Description	Cam 7 high limit channel 1
Entry category	Mandatory
Access	rw
PDO mapping	No
Value range	Integer32
Default value	Manufacturer specific
Sub-index	02_h
Description	Cam 7 high limit channel 2
Entry category	Optional
Access	rw
PDO mapping	No
Value range	Integer32
Default value	Manufacturer specific
to	
Sub-index	FE_h
Description	Cam 7 high limit channel 254
Entry category	Optional
Access	rw
PDO mapping	No
Value range	Integer32
Default value	Manufacturer specific

7.4.20 Object 6327_h: Cam 8 high limit

The Cam 8 high limit channel shall indicate the switch point for the lower limit settings of Cam 8. Table 88 specifies the object description, and Table 89 specifies the entry description.

Table 88 – Object description

Attribute	Value
INDEX	6327_h
Name	Cam 8 high limit
Object code	Array
Data type	Integer32
Category	See Table 18

Table 89 – Entry description

Attribute	Value
Sub-index	00_h
Description	Highest sub-index supported
Entry category	Mandatory
Access	ro
PDO mapping	No
Value range	01_h to FE_h
Default value	No
Sub-index	01_h
Description	Cam 8 high limit channel 1
Entry category	Mandatory
Access	rw
PDO mapping	No
Value range	Integer32
Default value	Manufacturer specific
Sub-index	02_h
Description	Cam 8 high limit channel 2
Entry category	Optional
Access	rw
PDO mapping	No
Value range	Integer32
Default value	Manufacturer specific
to	
Sub-index	FE_h
Description	Cam 8 high limit channel 254
Entry category	Optional
Access	rw
PDO mapping	No
Value range	Integer32
Default value	Manufacturer specific

7.4.21 Object 6330_h: Cam 1 hysteresis

The Cam 1 hysteresis channel shall indicate the delay setting of switch points for Cam 1. For illustration of the hysteresis functionality refer to Figure 5. Table 90 specifies the object description, and Table 91 specifies the entry description.

Table 90 – Object description

Attribute	Value
INDEX	6330_h
Name	Cam1 hysteresis
Object code	Array
Data type	Unsigned16
Category	See Table 18

Table 91 – Entry description

Attribute	Value
Sub-index	00_h
Description	Highest sub-index supported
Entry category	Mandatory
Access	ro
PDO mapping	No
Value range	01_h to FE_h
Default value	No
Sub-index	01_h
Description	Cam1 hysteresis channel 1
Entry category	Mandatory
Access	rw
PDO mapping	No
Value range	Unsigned16
Default value	Manufacturer specific
Sub-index	02_h
Description	Cam1 hysteresis channel 2
Entry category	Optional
Access	rw
PDO mapping	No
Value range	Unsigned16
Default value	Manufacturer specific
to	
Sub-index	FE_h
Description	Cam1 hysteresis channel 254
Entry category	Optional
Access	rw
PDO mapping	No
Value range	Unsigned16
Default value	Manufacturer specific

7.4.22 Object 6331_h: Cam 2 hysteresis

The Cam 2 hysteresis channel shall indicate the delay setting of switch points for Cam 2. For illustration of the hysteresis functionality refer to Figure 5. Table 92 specifies the object description, and Table 93 specifies the entry description.

Table 92 – Object description

Attribute	Value
INDEX	6331_h
Name	Cam2 hysteresis
Object code	Array
Data type	Unsigned16
Category	See Table 18

Table 93 – Entry description

Attribute	Value
Sub-index	00_h
Description	Highest sub-index supported
Entry category	Mandatory
Access	ro
PDO mapping	No
Value range	01_h to FE_h
Default value	No
Sub-index	01_h
Description	Cam2 hysteresis channel 1
Entry category	Mandatory
Access	rw
PDO mapping	No
Value range	Unsigned16
Default value	Manufacturer specific
Sub-index	02_h
Description	Cam2 hysteresis channel 2
Entry category	Optional
Access	rw
PDO mapping	No
Value range	Unsigned16
Default value	Manufacturer specific
to	
Sub-index	FE_h
Description	Cam2 hysteresis channel 254
Entry category	Optional
Access	rw
PDO mapping	No
Value range	Unsigned16
Default value	Manufacturer specific

7.4.23 Object 6332_h: Cam 3 hysteresis

The Cam 3 hysteresis channel shall indicate the delay setting of switch points for Cam 3. For illustration of the hysteresis functionality refer to Figure 5.

Table 94 specifies the object description, and Table 95 specifies the entry description.

Table 94 – Object description

Attribute	Value
INDEX	6332_h
Name	Cam3 hysteresis
Object code	Array
Data type	Unsigned16
Category	See Table 18

Table 95 – Entry description

Attribute	Value
Sub-index	00_h
Description	Highest sub-index supported
Entry category	Mandatory
Access	ro
PDO mapping	No
Value range	01_h to FE_h
Default value	No
Sub-index	01_h
Description	Cam3 hysteresis channel 1
Entry category	Mandatory
Access	rw
PDO mapping	No
Value range	Unsigned16
Default value	Manufacturer specific
Sub-index	02_h
Description	Cam3 hysteresis channel 2
Entry category	Optional
Access	rw
PDO mapping	No
Value range	Unsigned16
Default value	Manufacturer specific
to	
Sub-index	FE_h
Description	Cam3 hysteresis channel 254
Entry category	Optional
Access	rw
PDO mapping	No
Value range	Unsigned16
Default value	Manufacturer specific

7.4.24 Object 6333_h: Cam 4 hysteresis

The Cam 4 hysteresis channel shall indicate the delay setting of switch points for Cam 4. For illustration of the hysteresis functionality refer to Figure 5. Table 96 specifies the object description, and Table 97 specifies the entry description.

Table 96 – Object description

Attribute	Value
INDEX	6333_h
Name	Cam4 hysteresis
Object code	Array
Data type	Unsigned16
Category	See Table 18

Table 97 – Entry description

Attribute	Value
Sub-index	00_h
Description	Highest sub-index supported
Entry category	Mandatory
Access	ro
PDO mapping	No
Value range	01_h to FE_h
Default value	No
Sub-index	01_h
Description	Cam4 hysteresis channel 1
Entry category	Mandatory
Access	rw
PDO mapping	No
Value range	Unsigned16
Default value	Manufacturer specific
Sub-index	02_h
Description	Cam4 hysteresis channel 2
Entry category	Optional
Access	rw
PDO mapping	No
Value range	Unsigned16
Default value	Manufacturer specific
to	

Sub-index	FE_h
Description	Cam4 hysteresis channel 254
Entry category	Optional
Access	rw
PDO mapping	No
Value range	Unsigned16
Default value	Manufacturer specific

7.4.25 Object 6334_h: Cam 5 hysteresis

The Cam 5 hysteresis channel shall indicate the delay setting of switch points for Cam 5. For illustration of the hysteresis functionality refer to Figure 5. Table 98 specifies the object description, and Table 99 specifies the entry description.

Table 98 – Object description

Attribute	Value
INDEX	6334_h
Name	Cam5 hysteresis
Object code	Array
Data type	Unsigned16
Category	See Table 18

Table 99 – Entry description

Attribute	Value
Sub-index	00_h
Description	Highest sub-index supported
Entry category	Mandatory
Access	ro
PDO mapping	No
Value range	01_h to FE_h
Default value	No
Sub-index	01_h
Description	Cam5 hysteresis channel 1
Entry category	Mandatory
Access	rw
PDO mapping	No
Value range	Unsigned16
Default value	Manufacturer specific
Sub-index	02_h
Description	Cam5 hysteresis channel 2
Entry category	Optional
Access	rw
PDO mapping	No
Value range	Unsigned16
Default value	Manufacturer specific

to	
Sub-index	FE_h
Description	Cam5 hysteresis channel 254
Entry category	Optional
Access	rw
PDO mapping	No
Value range	Unsigned16
Default value	Manufacturer specific

7.4.26 Object 6335_h: Cam 6 hysteresis

The Cam 6 hysteresis channel shall indicate the delay setting of switch points for Cam 6. For illustration of the hysteresis functionality refer to Figure 5. Table 100 specifies the object description, and Table 101 specifies the entry description.

Table 100 – Object description

Attribute	Value
INDEX	6335_h
Name	Cam6 hysteresis
Object code	Array
Data type	Unsigned16
Category	See Table 18

Table 101 – Entry description

Attribute	Value
Sub-index	00_h
Description	Highest sub-index supported
Entry category	Mandatory
Access	ro
PDO mapping	No
Value range	01_h to FE_h
Default value	No
Sub-index	01_h
Description	Cam6 hysteresis channel 1
Entry category	Mandatory
Access	rw
PDO mapping	No
Value range	Unsigned16
Default value	Manufacturer specific

Sub-index	02_h
Description	Cam6 hysteresis channel 2
Entry category	Optional
Access	rw
PDO mapping	No
Value range	Unsigned16
Default value	Manufacturer specific
to	
Sub-index	FE_h
Description	Cam6 hysteresis channel 254
Entry category	Optional
Access	rw
PDO mapping	No
Value range	Unsigned16
Default value	Manufacturer specific

7.4.27 Object 6336_h: Cam 7 hysteresis

The Cam 7 hysteresis channel shall indicate the delay setting of switch points for Cam 7. For illustration of the hysteresis functionality refer to Figure 5. Table 102 specifies the object description, and Table 103 specifies the entry description.

Table 102 – Object description

Attribute	Value
INDEX	6336_h
Name	Cam7 hysteresis
Object code	Array
Data type	Unsigned16
Category	See Table 18

Table 103 – Entry description

Attribute	Value
Sub-index	00_h
Description	Highest sub-index supported
Entry category	Mandatory
Access	ro
PDO mapping	No
Value range	01_h to FE_h
Default value	No
Sub-index	01_h
Description	Cam7 hysteresis channel 1
Entry category	Mandatory
Access	rw
PDO mapping	No
Value range	Unsigned16
Default value	Manufacturer specific

Sub-index	02_h
Description	Cam7 hysteresis channel 2
Entry category	Optional
Access	rw
PDO mapping	No
Value range	Unsigned16
Default value	Manufacturer specific
to	
Sub-index	FE_h
Description	Cam7 hysteresis channel 254
Entry category	Optional
Access	rw
PDO mapping	No
Value range	Unsigned16
Default value	Manufacturer specific

7.4.28 Object 6337_h: Cam 8 hysteresis

The Cam 8 hysteresis channel shall indicate the delay setting of switch points for Cam 8. For illustration of the hysteresis functionality refer to Figure 5. Table 104 specifies the object description, and Table 105 specifies the entry description.

Table 104 – Object description

Attribute	Value
INDEX	6337_h
Name	Cam8 hysteresis
Object code	Array
Data type	Unsigned16
Category	See Table 18

Table 105 – Entry description

Attribute	Value
Sub-index	00_h
Description	Highest sub-index supported
Entry category	Mandatory
Access	ro
PDO mapping	No
Value range	01_h to FE_h
Default value	No

Sub-index	01_h
Description	Cam8 hysteresis channel 1
Entry category	Mandatory
Access	rw
PDO mapping	No
Value range	Unsigned16
Default value	Manufacturer specific
Sub-index	02_h
Description	Cam8 hysteresis channel 2
Entry category	Optional
Access	rw
PDO mapping	No
Value range	Unsigned16
Default value	Manufacturer specific
to	
Sub-index	FE_h
Description	Cam8 hysteresis channel 254
Entry category	Optional
Access	rw
PDO mapping	No
Value range	Unsigned16
Default value	Manufacturer specific

7.5 Work area supervision

7.5.1 General

Some encoders define a so-called user defined working area. The actual work area information with work area low limit and work area high limit may be stored in objects (6401_h and 6402_h), respectively. This way, the *area state register* (object 6400_h) may also be used as software limit switches.

7.5.2 Object 6400_h: Area state register

The object shall provide the actual area status of the encoder position. Figure 9 specifies the object structure and Table 106 specifies the value definition.

7	6	5	4	3	2	1	0
r	*r*	*r*	*r*	*r*	*range underflow*	*range overflow*	*out of range*

MSB LSB

Figure 9 – Object structure

Table 106 – Value definition

Signal	Value	Definition
out of range	0_b 1_b	Position between low and high limit Position out of range (refer to module identification object, $650A_h$) is reached
range overflow	0_b	No range overflow Position is lower than the position value set in

Signal	Value	Definition
	1_b	object 6402_h „work area low limit“
range underflow	0_b 1_b	No range underflow Position is higher than the position value set in object 6401_h „work area high limit“
r	0_b	Reserved

Table 107 specifies the object description, and Table 108 specifies the entry description.

Table 107 – Object description

Attribute	Value
INDEX	6400_h
Name	Area state register
Object code	Array
Data type	Unsigned8
Category	See Table 18

Table 108 – Entry description

Attribute	Value
Sub-index	00_h
Description	Highest sub-index supported
Entry category	Mandatory
Access	ro
PDO mapping	No
Value range	01_h to FE_h
Default value	No
Sub-index	01_h
Description	Work area state channel 1
Entry category	Mandatory
Access	ro
PDO mapping	Optional
Value range	See value definition
Default value	No
Sub-index	02_h
Description	Work area state channel 2
Entry category	Optional
Access	ro
PDO mapping	Optional
Value range	See value definition
Default value	No
to	

Sub-index	FE_h
Description	Work area state channel 254
Entry category	Optional
Access	ro
PDO mapping	Optional
Value range	See value definition
Default value	No

7.5.3 Object 6401_h: Work area low limit

This object shall indicate the position value, at which bit 2 of the according work area state channel in object 6400_h shall flag the underflow of the related work area.

Table 109 specifies the object description, and Table 110 specifies the entry description.

Table 109 – Object description

Attribute	Value
INDEX	6401_h
Name	Work area low limit
Object code	Array
Data type	Integer32
Category	See Table 18

Table 110 – Entry description

Attribute	Value
Sub-index	00_h
Description	Highest sub-index supported
Entry category	Mandatory
Access	ro
PDO mapping	No
Value range	01_h to FE_h
Default value	No
Sub-index	01_h
Description	Work area low limit channel 1
Entry category	Mandatory
Access	rw
PDO mapping	No
Value range	Integer32
Default value	Manufacturer specific

Sub-index	02_h
Description	Work area low limit channel 2
Entry category	Optional
Access	rw
PDO mapping	No
Value range	Integer32
Default value	Manufacturer specific
to	
Sub-index	FE_h
Description	Work area low limit channel 254
Entry category	Optional
Access	rw
PDO mapping	No
Value range	Integer32
Default value	Manufacturer specific

7.5.4 Object 6402_h: Work area high limit

This object shall indicate the position value, at which bit 1 of the according work area state channel in object 6400_h shall flag the overflow of the related work area.

Table 111 specifies the object description, and Table 112 specifies the entry description.

Table 111 – Object description

Attribute	Value
INDEX	6402_h
Name	Work area high limit
Object code	Array
Data type	Integer32
Category	See Table 18

Table 112 – Entry description

Attribute	Value
Sub-index	00_h
Description	Highest sub-index supported
Entry category	Mandatory
Access	ro
PDO mapping	No
Value range	01_h to FE_h
Default value	No

Sub-index	01_h
Description	Work area high limit channel 1
Entry category	Mandatory
Access	rw
PDO mapping	No
Value range	Integer32
Default value	Manufacturer specific
Sub-index	02_h
Description	Work area high limit channel 2
Entry category	Optional
Access	rw
PDO mapping	No
Value range	Integer32
Default value	Manufacturer specific
to	
Sub-index	FE_h
Description	Work area high limit channel 254
Entry category	Optional
Access	rw
PDO mapping	No
Value range	Integer32
Default value	Manufacturer specific

7.6 Encoder diagnostics

7.6.1 General

All encoder diagnostics are read from securely stored parameters.

7.6.2 Object 6500_h: Operating status

This object shall provide the operating status of the encoder. It gives information on encoder internal programmed parameters. Figure 10 specifies the object structure and Table 113 specifies the value definition.

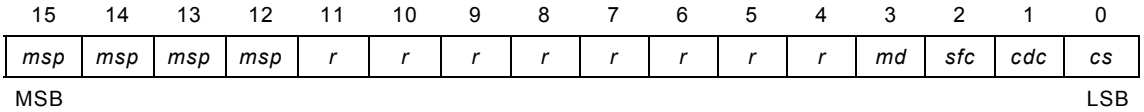


Figure 10 – Object structure

Table 113 – Value definition

Signal	Value	Definition
cs	0_b 1_b	Code sequence = CW (m* for C1, m* for C2) Code sequence = CCW (m* for C1, m* for C2)
cdc	0_b 1_b	Commissioning diagnostic control not supported (o for C1, o for C2) Commissioning diagnostic control supported (o for C1, o for C2)
sfc	0_b 1_b	Scaling function control disabled (o for C1, m for C2) Scaling function control enabled (o for C1, m for C2)

Signal	Value	Definition
md	0_b 1_b	Measuring direction forward (o** for C1, o** for C2) Measuring direction reward (o** for C1, o** for C2)
r		Reserved for further use
msp	0_b 1_b	Manufacturer-specific function disabled (o for C1, o for C2) Manufacturer-specific function enabled (o for C1, o for C2)

NOTE * not for linear encoders ** not for rotary encoders

Table 114 specifies the object description, and Table 115 specifies the entry description.

Table 114 – Object description

Attribute	Value
INDEX	6500_h
Name	Operating status
Object code	Variable
Data type	Unsigned16
Category	See Table 19

Table 115 – Entry description

Attribute	Value
Sub-index	00_h
Access	ro
PDO mapping	No
Value range	See value definition
Default value	No

7.6.3 Object 6501_h: Single-turn resolution and Measuring step

This object shall be interpreted in dependence of the encoder type.

For rotary or angle encoders this object shall provide the number of measuring steps per revolution that are output for the absolute single-turn position value. The maximum single-turn resolution shall be 2^{32}.

For linear encoders this object shall provide the measuring step that is output by the encoder. The measuring step is given in multiples of 0.001 μm (1 nm).

Table 116 specifies the object description, and [1)] Object name for rotary encoders [2)] Object name for linear encoders

Table 117 specifies the entry description.

Table 116 – Object description

Attribute	Value
INDEX	6501_h
Name	Single-turn resolution[1)] Measuring step[2)]
Object code	Variable
Data type	Unsigned32
Category	See Table 19

[1)] Object name for rotary encoders [2)] Object name for linear encoders

Table 117 – Entry description

Attribute	Value
Sub-index	00_h
Access	ro
PDO mapping	No
Value range	Unsigned32
Default value	No

7.6.4 Object 6502_h: Number of distinguishable revolutions

This object shall provide the number of distinguishable revolutions that the encoder may output. For a multi-turn encoder the number of distinguishable revolutions and the single-turn resolution shall give the measuring range according to the formula below.

Measuring range = Number of distinguishable revolutions x single-turn resolution

Table 118 specifies the value definition. Table 119 specifies the object description and Table 120 specifies the entry description.

Table 118 – Value definition

Value	Definition
0_d	High-resolution object (6510_h) is used
1_d to $65,536_d$	Range for distinguishable revolutions

Table 119 – Object description

Attribute	Value
INDEX	6502_h
Name	Number of distinguishable revolutions
Object code	Variable
Data type	Unsigned16
Category	See Table 19

Table 120 – Entry description

Attribute	Value
Sub-index	00_h
Access	ro
PDO mapping	No
Value range	See value definition
Default value	No

7.6.5 Object 6503_h: Alarms

Additionally to the emergency messages in /CiA301/, this object shall provide further alarm messages. An alarm shall be set if a malfunction in the encoder could lead to incorrect position value. If an alarm occurs, the according bit shall indicate the alarm til the alarm is cleared and the encoder is able to provide an accurate position value. Figure 11 specifies the object structure and Table 121 specifies the value definition. Table 122 specifies the object description, and Table 123 specifies the entry description.

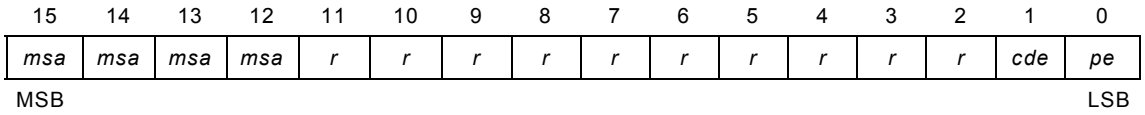


Figure 11 – Object structure

Table 121 – Value definition

Signal	Value	Definition
pe	0_b 1_b	No position error (o for C1, o for C2) Position error (o for C1, o for C2)
cde	0_b 1_b	Commissioning diagnostic OK (o for C1, o for C2) Commissioning diagnostic error (o for C1, o for C2)
r		Reserved for further use
msa	0_b 1_b	Manufacturer-specific alarm disabled (o for C1, o for C2) Manufacturer-specific alarm enabled (o for C1, o for C2)

Table 122 – Object description

Attribute	Value
INDEX	6503_h
Name	Alarms
Object code	Variable
Data type	Unsigned16
Category	See Table 19

Table 123 – Entry description

Attribute	Value
Sub-index	00_h
Access	ro
PDO mapping	Optional
Value range	See value definition
Default value	No

7.6.6 Object 6504_h: Supported alarms

This object shall provide the information on supported alarms by the encoder. This object is mandatory for C2 encoders. If this object is implemented, at least one alarm shall be supported. Figure 12 specifies the object structure and Table 124 specifies the value definition. Table 125 specifies the object description, and Table 126 specifies the entry description.

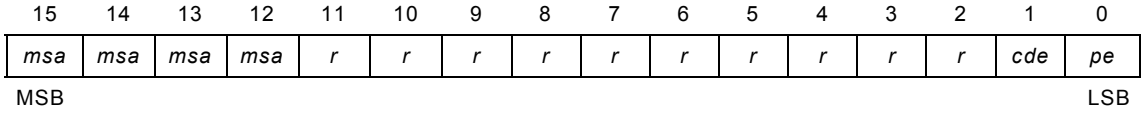


Figure 12 – Object structure

Table 124 – Value definition

Signal	Value	Definition
pe	0_b 1_b	Position error not supported Position error supported

Signal	Value	Definition
cde	0_b 1_b	Commissioning diagnostic error not supported Commissioning diagnostic error supported
r		Reserved for further use
msa	0_b 1_b	Manufacturer-specific alarm not supported Manufacturer-specific alarm supported

Table 125 – Object description

Attribute	Value
INDEX	6504_h
Name	Supported alarms
Object code	Variable
Data type	Unsigned16
Category	See Table 19

Table 126 – Entry description

Attribute	Value
Sub-index	00_h
Access	ro
PDO mapping	No
Value range	See value definition
Default value	No

7.6.7 Object 6505_h: Warnings

This object shall provide the warnings. Warnings indicate that tolerance for certain internal parameters of the encoder have been exceeded. In contrast to alarm and emergency messages warnings do not imply incorrect position values. All warnings shall be cleared if the tolerances are again within normal parameters. For the operating time limit warning (bit 3) the warning shall be only set again after a power-on sequence.

Figure 13 specifies the object structure and Table 127 specifies the value definition. Table 128 specifies the object description, and Table 129 specifies the entry description.

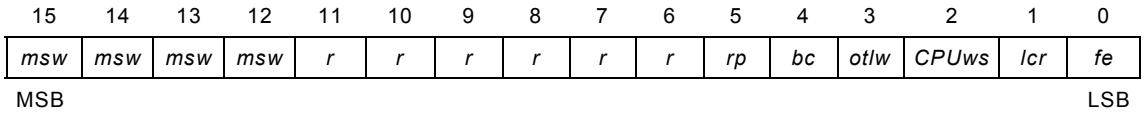


Figure 13 – Object structure

Table 127 – Value definition

Signal	Value	Definition
fe	0_b 1_b	Frequency not exceeded (o for C1, o for C2) Frequency exceeded (o for C1, o for C2)
lcr	0_b 1_b	Light control reserve not reached (o for C1, o for C2) Light control reserve reached (o for C1, o for C2)
CPUws	0_b 1_b	CPU watchdog status is OK (o for C1, o for C2) CPU watchdog status reset generated (o for C1, o for C2)
otlw	0_b 1_b	No operating time limit warning (o for C1, o for C2) Operating time limit warning (o for C1, o for C2)
bc	0_b 1_b	Battery charge OK (o for C1, o for C2) Battery charge too low (o for C1, o for C2)

Signal	Value	Definition
rp	0_b 1_b	Reference point reached (o for C1, o for C2) Reference point not reached (o for C1, o for C2)
r		Reserved for further use
msw	0_b 1_b	No manufacturer specific warning (o for C1, o for C2) Manufacturer-specific warning (o for C1, o for C2)

Table 128 – Object description

Attribute	Value
INDEX	6505_h
Name	Warnings
Object code	Variable
Data type	Unsigned16
Category	See Table 19

Table 129 – Entry description

Attribute	Value
Sub-index	00_h
Access	ro
PDO mapping	Optional
Value range	See value definition
Default value	No

7.6.8 Object 6506_h: Supported warnings

This object shall provide the information on supported warnings by the encoder. This object is mandatory for C2 encoders. If this object is implemented, at least one warning shall be supported.

Figure 14 specifies the object structure and Table 130 specifies the value definition. Table 131 specifies the object description, and Table 132 specifies the entry description.

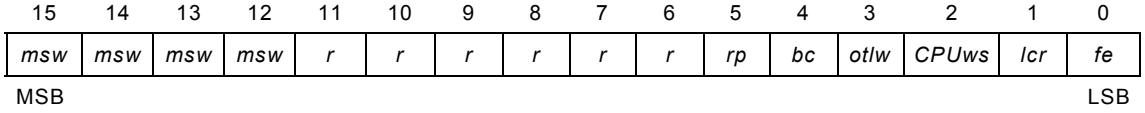


Figure 14 – Object structure

Table 130 – Value definition

Signal	Value	Definition
fe	0_b 1_b	Frequency exceeded warning not supported Frequency exceeded warning supported
lcr	0_b 1_b	Light control reserve warning not supported Light control reserve warning supported
CPUws	0_b 1_b	CPU watchdog status warning not supported CPU watchdog status warning supported
otlw	0_b 1_b	Operating time limit warning not supported Operating time limit warning supported
bc	0_b 1_b	Battery charge warning not supported Battery charge warning supported
rp	0_b 1_b	Reference point warning not supported Reference point warning supported

Signal	Value	Definition
r		Reserved for further use
msw	0_b 1_b	No manufacturer specific warning not supported Manufacturer-specific warning supported

Table 131 – Object description

Attribute	Value
INDEX	6506_h
Name	Supported warnings
Object code	Variable
Data type	Unsigned16
Category	See Table 19

Table 132 – Entry description

Attribute	Value
Sub-index	00_h
Access	ro
PDO mapping	No
Value range	See value definition
Default value	No

7.6.9 Object 6507_h: Profile and software version

This object shall provide the implemented encoder device profile version and the manufacturer-specific software version. Figure 15 specifies the object structure. Table 133 shows the value explanation. The software version is implemented in the encoder. It is combined to a revision number and an index. Table 134 specifies the object description, and Table 135 specifies the entry description.

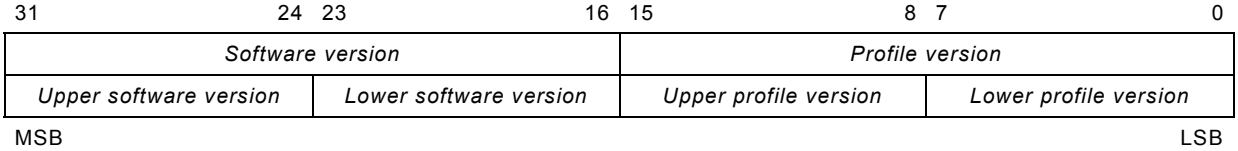


Figure 15 – Object structure

Table 133 – Value explanation

Field	Binary code (example)	Hexadecimal (example)	Meaning
Upper profile version	00000011	03_h	The Profile version is 3.1
Lower profile version	00000001	01_h	
Upper software version	00000001	01_h	The Software version is 1.40
Lower software version	01000000	40_h	

Table 134 – Object description

Attribute	Value
INDEX	6507_h
Name	Profile and software version
Object code	Variable
Data type	Unsigned32
Category	See Table 19

Table 135 – Entry description

Attribute	Value
Sub-index	00_h
Access	ro
PDO mapping	No
Value range	Unsigned32
Default value	No

7.6.10 Object 6508_h: Operating time

This object shall provide the operating time. The operating time monitor stores the operating time for the encoder in operating hours. The operating time is stored in the encoder non-volatile memory as long as the encoder is power supplied. The value shall be given in multiples of 0.1 hours per bit.

If the operating time function is not used the operating time value shall be set to FFFF $FFFF_h$ by the encoder manufacturer.

Table 136 specifies the object description, and Table 137 specifies the entry description.

Table 136 – Object description

Attribute	Value
INDEX	6508_h
Name	Operating time
Object code	Variable
Data type	Unsigned32
Category	See Table 19

Table 137 – Entry description

Attribute	Value
Sub-index	00_h
Access	ro
PDO mapping	No
Value range	Unsigned32
Default value	No

7.6.11 Object 6509_h: Offset value

This object shall provide the offset value. The offset value is calculated by the preset function and shifts the position value with the calculated value. The offset value is stored and may be read from the encoder.

Table 138 specifies the object description, and Table 139 specifies the entry description.

Table 138 – Object description

Attribute	Value
INDEX	6509_h
Name	Offset value
Object code	Variable
Data type	Integer32
Category	See Table 19

Table 139 – Entry description

Attribute	Value
Sub-index	00_h
Access	ro
PDO mapping	No
Value range	Integer32
Default value	No

7.6.12 Object $650A_h$: Module identification

This object shall provide the manufacturer-specific offset value, the manufacturer-specific minimum and maximum position value.

In sub-index 01_h, the offset value shall be stored. This value gives information on the shift of the zero point in the number of positions from the physical zero point of the encoder disk.

In sub-index 02_h and 03_h the minimum and maximum position value shall be stored, respectively.

All three values shall be given in number of steps according to the basic resolution of the encoder and are located in write protected memory area only changeable by the encoder manufacturer.

Table 140 specifies the object description, and Table 141 specifies the entry description.

Table 140 – Object description

Attribute	Value
INDEX	$650A_h$
Name	Module identification
Object code	Array
Data type	Integer32
Category	See Table 19

Table 141 – Entry description

Attribute	Value
Sub-index	00_h
Description	Highest sub-index supported
Entry category	Mandatory
Access	ro
PDO mapping	No
Value range	01_h to 03_h
Default value	No
Sub-index	01_h
Description	Manufacturer offset value
Entry category	Mandatory
Access	ro
PDO mapping	No
Value range	Integer32
Default value	0_h
Sub-index	02_h
Description	Manufacturer min position value
Entry category	Optional
Access	ro
PDO mapping	No
Value range	Integer32
Default value	No
Sub-index	03_h
Description	Manufacturer max position value
Entry category	Optional
Access	ro
PDO mapping	No
Value range	Integer32
Default value	No

7.6.13 Object $650B_h$: Serial number

This object shall provide the encoder serial number. This object shall be hard-wired to object 1018_h sub-index 04_h. If the parameter serial number is not used the value shall be set to maximum value FFFF $FFFF_h$ by the encoder manufacturer and object 1018_h sub-index 04_h shall not be implemented.

Table 142 specifies the object description, and Table 143 specifies the entry description.

Table 142 – Object description

Attribute	Value
INDEX	$650B_h$
Name	Serial number
Object code	Variable
Data type	Unsigned32
Category	See Table 19

Table 143 – Entry description

Attribute	Value
Sub-index	00_h
Access	ro
PDO mapping	No
Value range	Unsigned32
Default value	No

7.6.14 Object $650C_h$: Offset values for multi-sensor devices

This object shall provide the offset values for multi-sensor devices and is similar to object 6509_h. The offset value shall be calculated by the preset function in object 6010_h and shifts the position value with calculated value. The offset value is stored and can be read from the encoder for diagnostics. This object is only optional for multi-sensor encoders (encoder type code 10_d in object 1000_h).

Table 144 specifies the object description, and Table 145 specifies the entry description.

Table 144 – Object description

Attribute	Value
INDEX	$650C_h$
Name	Offset value for multi-sensor device
Object code	Array
Data type	Integer32
Category	See Table 19

Table 145 – Entry description

Attribute	Value
Sub-index	00_h
Description	Highest sub-index supported
Entry category	Mandatory
Access	ro
PDO mapping	No
Value range	01_h to FE_h
Default value	No

Sub-index	01_h
Description	Offset value channel 1
Entry category	Mandatory
Access	ro
PDO mapping	No
Value range	Integer32
Default value	No
Sub-index	02_h
Description	Offset value channel 2
Entry category	Optional
Access	ro
PDO mapping	No
Value range	Integer32
Default value	No
to	
Sub-index	FE_h
Description	Offset value channel 254
Entry category	Optional
Access	ro
PDO mapping	No
Value range	Integer32
Default value	No

7.7 Object 6510_h: Number of high precision revolutions

This object shall provide the distinguishable revolutions for *high precision position values* (object 6008_h).

Table 146 specifies the object description, and Table 147 specifies the entry description.

Table 146 – Object description

Attribute	Value
INDEX	6510_h
Name	Number of high precision revolutions
Object code	Variable
Data type	Unsigned40
Category	Mandatory

Table 147 – Entry description

Attribute	Value
Sub-index	00_h
Access	ro
PDO mapping	No
Value range	00 0000 0001_h to FF FFFF $FFFF_h$
Default value	No

7.7.1 Object $67FF_h$: Device type

This object shall describe the first logical device in a multiple device module according to /CiA301/.

