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EtherCAT Encoders RS-25/33 RM-29/36

Manual

2 Turck Inc. | 3000 Campus Drive, Minneapolis, MN 55441 | T +1 800 544 7769 | F +1 763 553 0708 | www.turck.com



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Object 1C33h : SM 3 input parameter (read-only)32Object 2000h : System time at position reading (read-only, mappable).32Object 2004h : Raw position value (read-only, mappable).32Object 2120h : Sensor temperature value (read-only, mappable).32Object 2120h : Sensor temperature value (read-only, mappable).32Object 2121h : Temperature lower limit (read-write).32Object 2122h : Temperature upper limit (read-write).33Object 2123h : Temperature offset correction value (read-write).33Object 6000h : Operating parameters (read-write).33	Object 1C13h : TxPDO assignment (read-only)	2
Object 2000h : System time at position reading (read-only, mappable).32Object 2004h : Raw position value (read-only, mappable).32Object 2120h : Sensor temperature value (read-only, mappable).32Object 2121h : Temperature lower limit (read-write).32Object 2122h : Temperature upper limit (read-write).33Object 2123h : Temperature offset correction value (read-write).33Object 6000h : Operating parameters (read-write).33	Object 1C33h : SM 3 input parameter (read-only)	2
Object 2004h : Raw position value (read-only, mappable)32Object 2120h : Sensor temperature value (read-only, mappable)32Object 2121h : Temperature lower limit (read-write)32Object 2122h : Temperature upper limit (read-write)33Object 2123h : Temperature offset correction value (read-write)33Object 6000h : Operating parameters (read-write)33	Object 2000h : System time at position reading (read-only, mappable)	2
Object 2120h : Sensor temperature value (read-only, mappable)32Object 2121h : Temperature lower limit (read-write)32Object 2122h : Temperature upper limit (read-write)33Object 2123h : Temperature offset correction value (read-write)33Object 6000h : Operating parameters (read-write)33	Object 2004h : Raw position value (read-only, mappable)	2
Object 2121h : Temperature lower limit (read-write)32Object 2122h : Temperature upper limit (read-write)33Object 2123h : Temperature offset correction value (read-write)33Object 6000h : Operating parameters (read-write)33	Object 2120h : Sensor temperature value (read-only, mappable)	2
Object 2122h : Temperature upper limit (read-write).33Object 2123h : Temperature offset correction value (read-write).33Object 6000h : Operating parameters (read-write).33	Object 2121h : Temperature lower limit (read-write)	2
Object 2123h : Temperature offset correction value (read-write). 33 Object 6000h : Operating parameters (read-write). 33	Object 2122h : Temperature upper limit (read-write)	3
Object 6000h : Operating parameters (read-write)	Object 2123h : Temperature offset correction value (read-write)	3
	Object 6000h : Operating parameters (read-write)	3

Standard parameters	33
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Relationship of TMR and MUR	34
Object 6001h : Measuring units per revolution (MUR) (read-write)	35
Object 6002h : Total measuring range (TMR) (read-write)	35
Object 6003h : Preset (read-write)	35
Object 6004h : Position (read-only, mappable).	35
Object 6030h : Speed (read-only, mappable)	36
Object 6031h : Speed gating time (read-write)	36
Object 6400h : Work Area Status Register (read-only mappable)	36
Object 6401h : Work area low limit (read-write)	36
Object 6402h : Work area high limit (read-write)	36
Object 6501h : Single turn resolution (read-only)	36
Object 6502h : Number of distinguishable resolutions (read-only).	36
Object 6503h : Alarms (read-only)	37
Object 6504h : Supported alarms (read-only)	37
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12 References	40



1 Firmware and XML file versions

Versions of the firmware and of the XML file at the date of release of this documentation: Firmware version V3.4 visible under TwinCAT with Object 0x100A. TurckEtherCAT.xml in Version 8, visible in the file as tag <Vendor FileVersion="8">

2 Technical Details and Encoder Features

Mechanical characteristics

Shock resistance according to EN 60068-2-27:

2500 m/s2, 6ms for Singleturn 2000 m/s2, 6ms for Multiturn 100m/s2, 10.....2000 Hz

Vibration resistance according to EN 60068-2-6:

Operating temperature range

– 40.....+85 °C

Supply voltage and power consumption

10...30 VDC < 160 mA under 10 VDC < 70 mA under 24 VDC < 60 mA under 30 VDC

Hardware-characteristics

EtherCAT IO ASIC: ET1100 Auto-Negotiation Auto-Crossover Function display and diagnostics with LED's

Supported standards and protocols

CAN over EtherCAT: CoE

Implemented encoder profile

CiA 406 Work Draft Version 3.2.10 of 18 February 2011

Compliance ensured with

EN 61000-4-2:2001 EN 61000-4-3:2006 EN 61000-4-4:2005 EN 61000-4-5:2007 EN 61000-4-6:2008 EN 61000-4-7:2004

EN 61000-6-4:2007 EN 61000-6-2:2006

3 Installation

Commissioning the encoder as a part of a plant consists in five steps:

- 1. Installation of the wiring.
- 2. Installation of the supply voltage.
- 3. Installation and project implementation using TwinCAT
- 4. Setting up a communication between the encoder and TwinCAT or the control.
- 5. Start of the application

4 Installation of the wiring

The encoder has three connections, of which two are the two Ethernet ports. They are referred to as Port IN and Port OUT in this documentation.

In picture 1 below, the position of these two ports is given by arrows "PORT IN" and "PORT OUT" of the sticker. The central connector is the power supply connector, which will be described in the following chapter.



Picture 1

The two Ethernet connections are D-coded M12 sockets. The assignment of the signals to the pins is represented in picture 2 and in the following table.

Signal assignment of a D coded M12-socket



Picture 2: D-coded M12 socket of the encoder

Signal name of an M12 D-coded socket	Function	Wire color	Pin number
TD+	Transmit data +	Yellow	1
TD-	Transmit data -	Orange	3
RD+	Receive data +	White	2
RD-	Receive data -	Blue	4



Signal assignment of an RJ45 to M12 cable

M12 to RJ45 direct

Signal	M12 Pin number	RJ45 Pin number
TD+	1	1
TD-	3	2
RD+	2	3
RD-	4	6

M12 to RJ45 crossover

Signal	M12 Pin number	RJ45 Pin number
TD+	1	3
TD-	3	6
RD+	2	1
RD-	4	2

Recommended cable for EtherCAT – network wiring: M12: RSSD 441-*M M12 to RJ45 Direct: RSSD RJ45S 441-*M M12 to RJ45 Crossover: RSSD RJ45S CR 441-*M RJ45 Field Wireable: CONNECTOR, RJ45S

Caution:

Since EtherCAT is based on the Fast Ethernet technology, care must be taken so that the segments do in no case exceed a length of 100 m. For lengths exceeding 100m, switches must be connected in between.

5 Installation of the supply voltage

Picture 3 and the following table show the signal assignment for the pins of an A-coded power supply plug on the encoder.



Picture 3: A-coded M12-plug of the encoder

Signal on the M12 plug A-coded	Function	Pin number
PWR	10 – 30 V DC	1
		2
GND	OV	3
		4

Diagnostic - LEDs

The encoder is equipped with four diagnostic LED's, whose functionality is described below.



Picture 4

LED designation	Colour	Function description
L/A IN	Yellow	L/A IN is an LED of Port IN that is ON when the link is established, flickers on data transmission and is OFF otherwise.
L/A OUT	Yellow	L/A OUT is an LED of Port OUT that is ON when the link is established, flickers on data transmission and is OFF otherwise.
RUN	Green	The RUN LED shows the current status of the EtherCAT status machine, which can have the following values: Init, PreOperational, SafeOperational, Operational. These statuses are explicitly switchable within TwinCAT. Picture 5 shows the correspondence of the statuses of the status machine with the blinking codes.
ERROR	Red	Lights up in case of a failure.



Description of the RUN LED (green)

Status	Description
Init	on blinking 200 ms (ERR) off
	LED is constantly off. Neither cyclic (process data) nor acyclic (parameters) communication is possible between the master and the encoder.
Preoperational	on single flash (ERR) off
SafeOperational	The actual values are transmitted from the encoder to the master. The acyclic data communication is also
sarcoperational	operating here.
Operational	LED is constantly on. Now the cyclic data channel, which sends the encoder process data to the master, is also operating.

Description of the ERR LED (red)

Picture 5

The two pictures below illustrate graphically the definition of the ERR-LED in "flickering" and "double flash" statuses. These pictures are followed by a table which describes the behaviour of the ERROR-LED according to the situation.



ERR LED Status	Failure designation	Description	Example
On	Failure display caused by a failure on the microcontroller of the application	Communication error or critical application error. It a bit is set in Object 0x1001 (error register), the ERR LED is switched to permanently On.	Position error, Temperature limit value exceeded, Commissioning error, Watchdog of the process data interface between the microcontroller and the EtherCAT slave
Double Flash	Process data or EtherCAT watchdog timeout	An application watchdog timeout occurred	Sync Manager Watchdog timeout
Single Flash	Local error	The slave changed the Eth- erCAT status autonomously because of a local error	Device changes its EtherCAT status from Operational to SafeOperationalError because of a synchronisation error.
Blinking	Invalid configuration	General configuration error	Error leading to the fact that the master cannot modify a status change because of invalid register values or an invalid hardware configuration.
Flickering	Boot error	Boot error detected, even if INIT status has been reached.	Check sum error in the Flash of the microcontrol- ler.
Off	No failure		

6 Installation and project implementation with TwinCAT

Hardware-requirements

Important: Absolutely make sure that the PC on which you install TwinCAT includes an Ethernet chipset (LAN controller) that appears on the attached list "Network controllers supported by Beckhoff's Software Ethernet Driver". This is a necessary prerequisite for the communication between TwinCAT and the EtherCAT device.

System requirements for TwinCAT installation:

WinXP (32 bits) or Win7 (32 bits). Please note that TwinCAT cannot be installed under the 64 bits version of Win7.

Important: Install TwinCAT imperatively in version v2.11 Build 2226 and higher! TwinCAT is stored on the DVD supplied with the encoder in this version. It is to be installed as follows.

Start file tcat_2110_2226.exe with a double click and select the language of the InstallShield as shown in picture 6.

TwinCAT - InstallShield Wi	zard	
Wählen Sie eine Setup-Spr Wählen Sie die Sprache für die aufgeführten Auswahl aus.	ache aus e Installation aus der unten	
	Deutsch Englisch	
InstallShield	< <u>Z</u> urück <u>W</u> eiter >	Abbrechen

Picture 6

The CAN bus termination must be set by software on Object 2102h.

Since the CAN signals are represented on the bus as differential levels, the CAN line is comparatively insensitive to interference (EMI). Interferences always affect both lines, and therefore they almost do not modify the differential level.



Accept the license terms.

TwinCAT Setup		X
License Agreement Please read the following licen	se agreement carefully.	
	 Software Usage Agreement for Beckholf Software Products \$1 Subject Matter of this Agreement 1 Licensor grants Licensee a non-transferable, non-exclusive right to use the data processing applications specified in Appendix 1 hereto (hereinafter called "Software") under the conditions specified hereinafter. (2) The Software shall be delivered to Licensee on machine-readable recording media as specified in Appendix 1, on which it is recorded as an object program in an executable status. One copy of the user documentation shall be part of the application and it shall be delivered to Licensee in printed form, or also on a machine-readable recording medium or online. The form the user documentation is delivered in is specified in Appendix 1. The Software and the documentation are hereinafter called "License Materials". (3) Data (files, data base materials) recorded on the machine readable recording media which is part of the Software shall fall under the cinemes Materials. (4) The License Materials shall also include new editions or supplements to the License Materials which Licensor shall let License have during the life of the agreement, and that is ordinarily not free of a cocept the terms of the license agreement 	Print
InstallShield	< <u>B</u> ack <u>N</u> ext >	Cancel

Picture 7

Input a name and the name of your company. Leave the Serial Number empty. This example installs the 30-day demo version.

TwinCAT Setup		×
Customer Information Please enter your information.		
	If you have no valid registration key, press "next". You can install a 30 days version and register later. User Name: Company Name: Serial Number:	
Instal IShield	< <u>B</u> ack <u>N</u> ext >	Cancel

Picture 8

Select the Installation Level as shown in picture 9.

winCAT Setup
Select Installation Level
You can choose one of the following product levels:
O TwinCAT CP - Driver for Control Panels.
O TwinCAT IO - I/O Driver
TwinCAT PLC - IEC 61131-3 PLC System
TwinCAT NC PTP - PTP Motion Control.
O TwinCAT NC I - Interpolation
stallShield
< Back Next > Cancel

Picture 9

Select the 30-day demo version of the installation.

TwinCAT Setup	
Select Installation Type	
You can choose one of the following installation types:	
⊙ 30 days demo version	
Register now via phone or internet.	
O further information	
InstallShield Kack	Next > Cancel

Picture 10



Select the components to be installed as shown in picture 11 hereafter.

TwinCAT Setup			X
Select Features Select the features setup will install.			
	Select the features you want to inst.	all, and deselect the featu 212 K	ures you do not want to install.
	TwinCAT Scope view TwinCAT Can Server TwinCAT EDS and GSD Files TwinCAT Remote Manager TwinCAT Drive Manager TwinCAT BACnet/IP	0 K 2916 K 0 K 76864 K 0 K	
			Change
	Space Required on C: Space Available on C:	235824 K 10341184 K	
InstallShield	< <u>B</u> ack	<u>N</u> ext >	Cancel

Picture 11

Select the installation folder as shown in picture 12.

TwinCAT Setup		×
Choose Destination Location Select folder where setup will insta	all files.	
	Setup will install TwinCAT in the following folder. To install to this folder, click Next. To install to a different folder, click Browse and select another folder. —Destination Folder	
	C:\TwinCAT Browse	
InstallShield	< <u>B</u> ack Next> Cancel	

Picture 12

Select the program group name as shown in picture 13.

TwinCAT Setup		X
Select Program Folder Please select a program folder.		
	Setup will add program icons to the Program Folder listed below. You may type a new folder name, or select one from the existing folders list. Click Next to continue.	
	Program Folder: TwinCAT System	
	Existing Folders: Renesas Electronics e2studio Renesas Electronics Tools Siemens Automation SISTEMA SolidWorks 2011 Spiele StarUML	
	Tera Term TortoiseSVN TRACE32 Trend Micro Client-Server Security Agent TwinCAT System	
InstallShield	< <u>B</u> ack <u>N</u> ext > Cancel]

Picture13

Reboot your computer. This will make the TwinCAT installation usable.

TwinCAT Setup	
	InstallShield Wizard Complete Setup has completed installing TwinCAT
	 Yes, I want to restart my computer now. No, I will restart my computer later. Click Finish to exit TwinCAT setup.
InstallShield	< Back Finish Cancel

Picture 14



Commissioning the encoder

The DVD supplied with the EtherCAT encoder contains the EtherCAT slave information file (ESI) in XML form. Its name is "TurckEtherCAT.xml", and it must be installed in the TwinCAT installation folder.

Copying the ESI file

Once you have installed TwinCAT in C:\TwinCAT, you have to copy the file TurckEtherCAT.xml in the folder C:\TwinCAT\lo\ EtherCAT\.

Configuration of the TwinCAT System Manager

Start the TwinCAT System Manager in the program group or in the Quick Start bar.



The first start requires more time, since the System Manager analyses all XML files in the installation folder. The progress can be followed on the progress bar in the left lower corner of the System Manager window.

The graphic front end of the TwinCAT-System Managers corresponds to picture 16 hereafter.



Picture 16

As shown in picture 17, click with the right mouse key the "I/O Devices" line and select in the displayed menu the "Append Device..." item.

📴 Unbenannt.tsm - TwinCAT System Man	nager	
File Edit Actions View Options Help		
! D 🚅 📽 🖬 🚭 🖪 🎝 🖪 🖬 🖬 🛤	🚧 ð 黒 📾 🗸 🌋 🧟 🍓 🎨 🌾 🚳 🖹 🔍 🖓 🚳 😒 🔊	8
SYSTEM - Configuration Real-Time Settings Real-Time Settings Real-Time Settings Route Settings TOO Hobjects PLC - Configuration TOO - Configuration Map Map Map Map Scan Device Scan Devices Scan Devices Scan Devices Paste with Links Alt+Ctrl+V	Number Device Type	
	Local (134.3.3.66.1.1) Config	; Mode

Picture 17

In the window that then opens, select menu "EtherCAT", submenu "EtherCAT", as shown in picture 18, and click on Ok.

Insert Devi	ice	
Туре:	II/O Beckhoff Lightbus II/O Beckhoff Lightbus Profibus DP II/O Excellent II/O CANopen II/O DeviceNet / Ethernet I/P II/O SERCOS interface II/O SERCOS interface II/O EtherCAT II/O EtherCAT II/O EtherCAT II/O EtherCAT Slave II/O EtherCAT Automation Protocol (Network Variables) II/O EtherCAT Automation Protocol via EL6601, EtherCAT II/O Ethernet <	Ok Cancel
Name:	Device 1	

Picture 18



Click with the right mouse button on the newly displayed menu item "Device 1 (EtherCAT)" and select the submenu "Append Box...".

📴 Unbenannt.tsm - TwinCAT System Man	ager	
File Edit Actions View Options Help		
i D 📽 📽 🖬 🥌 🗛 🕺 🖪 🛤	M 8 🔜 🗃	e 🗸 🏙 👧 👧 🗞 🔨 🔕 🖶 E 🔍 🖓 60 🔍 🕵 🧶 🛙 🔋
SYSTEM - Configuration Real-Time Settings I/O Idle Task Additional Tasks Configuration I/O Configuration I/O - Configuration I/	General Adapt Name: Type: Comment:	ter EtherCAT Online CoE - Online Device 1 (EtherCAT) Id: 1 EtherCAT Id: 1 Disabled Create symbols Id:
Ready		Local (134.3.3.66.1.1) Config Mode

Picture 19

In the window that then opens, select Turck Encoder as shown in the picture below.

Insert Eth	nerCAT Device					
Search:		Name:	Box 1	Multiple:	1 🗘	ОК
Туре:	Turck GmbH	oder				Cancel
	Extended Information		Show Hidden Devid	ces	C Sho	w Sub Groups

Picture 20

The System Manager window should now look as follows:

🗾 Unbenannt.tsm - TwinCAT System Ma	anager	
File Edit Actions View Options Help		
: D 🛎 📽 日 🍜 🖪 👗 🛍 🖻 🔒	🛯 👭 ð 💻 📾 🗸 🏄 🧟 🧶 🗞 🔨 🚳 🖹 🔍 🖓 🚳 🔍 🕵 🧇	8
SYSTEM - Configuration Real-Time Settings I/O Idle Task Koute Settings I/O Configuration I/O Configuration I/O Configuration I/O Devices I/O Device 1-Image Device 1-Image-Info Device 1-Image-Info I/O Devices I/O Device 1-Image-Info I/O Device 1-Image-Info I	General EtherCAT DC Process Data Startup CoE Online Name: Box 1 (Turck_encoder_RS_RM) Id: 1 Type: Turck Encoder Comment: Id: 1 Disabled Create symbols Id: Id:	
Ready	Local (134.3.3.66.1.1)	Config Mode

Picture 21

Configuration of the network board

As shown in picture 22, select the menu "Device 1 (EtherCAT)" and select, in the right-hand area, the tab "Adapter".

📑 Unbenannt.tsm - TwinCAT System Mai	nager	
File Edit Actions View Options Help		
i D 📽 📽 🖬 🥔 🗛 🕺 🛍 🛱 🔒	🚧 ð 🔜 🐽 🗸 🌋 🏡 🏡 🗞 🔨 🚳 🖹 🔍 🖓 🚳 👷 🥙	1) ?
SYSTEM - Configuration Real-Time Settings Additional Task Configuration TCOM Objects PLC - Configuration FI/O - Configuration FI/O - Configuration FI/O Devices Device 1 (EtherCAT) Device 1-Image Device 1-Image Device 1-Image Device 1-Image Moute Source 1-Image Moute Source 1-Image Moute Source 1-Image Mappings Mappings	General Adapter EtherCAT Online CoE - Online	
кеаду	Local (134.3.3.66.1.1)	ioning mode

Picture 22

Click on the button "Compatible Devices...", which opens the following window (picture 23). It shows on the first line the adapters that are installed and ready-to-use for TwinCAT ("Installed and ready to use devices"). In this example, no ready-to-use adapter is available yet.

The second line, with its sub-items shows all TwinCAT-compatible adapters of the PC, from which one or several may be selected for the installation of the TwinCAT real time extension.



The third line shows all incompatible adapters. These adapters are not suitable for use with TwinCAT. The fourth line shows all adapters that have already been operated successfully, but have been disabled.

Installation of TwinCAT RT-Ethernet Adapters	
Ethernet Adapters	Update List
Installed and ready to use devices Gramma Compatible devices	Install
Intel - TwinCAT-Intel PCI Ethernet Adapter #2 PCIcard - TwinCAT-Intel PCI Ethernet Adapter Incompatible devices Disobled devices	Bind
	Unbind
	Enable
	Disable
	Show Bindings

Picture 23

Select at least one adapter from the category of the compatible adapters and click on the "Install" button. The adapters are now displayed as sub-items of the installed and ready-to-use adapters. See picture 24.

statiation of twines t Kt-Ethernet staupters	
Ethernet Adapters	Update List
Installed and ready to use devices Installed and ready to use devices Installed and ready to use devices	Install
PCIcard - TwinCAT-Intel PCI Ethernet Adapter	Bind
B Compatible devices	
Incompatible devices	Unbind
	Enable
	Disable
	Show bindings

Picture 24

If, due to an update of the TwinCAT Software, there is already a disabled adapter, select it and click on "Enable". This adapter then also appears in the category of the installed and ready-to-use adapters.

Now close the window and click on the "Search..." button. A selection window opens, allowing selecting an adapter for the future TwinCAT communication with the encoder. In the present example, the "PCIcard" adapter has been selected (picture 25).

Important!

If no input is displayed in the dialogue box of picture 25, even though the installation of a network card according to picture 24 was completed successfully, this network card is not suitable for operation with TwinCAT.

Device Found At	
(none) PCIcard (TwinCAT-Intel PCI Ethernet Adapter - Paketplaner-Miniport) Intel (Intel(R) PR0/100 VE Network Connection #2 - Paketplaner-Minip	OK Cancel
	⊙ Unused ○ All
	Help



The "Adapter" tab finally corresponds to this selection of picture 26

📅 Unbenannt.tsm - TwinCAT System Manager	
File Edit Actions View Options Help	
- D 😅 📽 🖬 🚳 🖪 🖇 🙃 📾 📾 🤌 🤌 🔜 📾 🗸 🏙 🎯 🗶 🎯 🏀 🗮 🚱	1 옷 🔊 🥔 👔 💡
SYSTEM - Configuration Image: System - Configuration	aner-Minip D) t evices
Keady Local (1	39.3.3.66.1.1) Config Mode

Picture 26



Configuration of the DC operating mode (Distributed Clocks)

In the System Configuration, select the submenu "Real-Time Settings" as shown in the picture below and set the "Base time" to 500µs.

🗾 Unbenannt.tsm - TwinCAT System Man	lager	
File Edit Actions View Options Help		
: D 📽 📽 🖬 🚑 🗛 🗴 🖻 🖬 🔒	🗰 ð 🔜 📾 🗸 🏄 👧 🧶 🎨 🔧 🚳 🖶 🔍 🖓 🚳 🔍 📌 🧶	9 ?
 SYSTEM - Configuration Real-Time Settings I/O Idle Task Additional Tasks Route Settings TCOM Objects PLC - Configuration I/O Devices I/O Configuration I/O Device 1 (EtherCAT) Device 1-Image Device 1-Image Device 1-Image InfoData Box 1 (Turck_encoder_RS_RM) Mappings 	Settings Online Priorities Base Time: 500 µs CPU Limit (%): 80 Fast Tick (special Task required) Interval: Latency Warning Above (µs): 0	
Ready	Local (134.3.3.66.1.1)	onfig Mode

Picture 27

As shown in picture 28, select now the menu "Additional Tasks" with the right mouse button and select the submenu item "Append Task..". Click OK in the dialogue box that is then displayed.



Picture 28

In the dialogue window of Task 2, select now all settings as shown in picture 29.

D 📽 📽 🖬 🍜 🖪 🗡 Þ. R. S.	🛤 ð 🗏 📾 🗸 🌌 👧 🧶 🗞 🔨 🤅	5 🐄 E Q 02 66 🔍 🕫 🧶 🗿 🤋
Image: System - Configuration Image: Real-Time Settings Image: Real-Time Settings Image: Task 2-Image Image: TotM Objects Image: TotM Objects	Task Online Name: Task 2 Auto stat Auto Priority Management Priority: 1 Cycle ticks: 20 Start tick (modulo): 0 Separate input update Pre ticks: Warning by exceeding Message box Comment:	Port: 301 Options I/O at task begin Disable Create symbols Include external symbols Extern sync

Picture 29

Select now the menu item "Box 1 (Turck_encoder_RS_RM)" and select the "DC" tab. Select the Operation Mode Distributed Clocks (picture 30).

Ele Edit Actions View Ontions Help	anager							
	1 AA 👌 🔜 🙃	🗸 谢 👧 🗶 👯	<u>ه ج</u> (6 🖗 🗉	Q 0 ⁶	R 66 🎗	© ® 🧶 🛙	8
SYSTEM - Configuration	General EtherCAT	DC Process Da	ita Start	up CoE - Or tributed Clock Advar	nline Onli s nced Settir	ne		
COM Objects PLC - Configuration	Name At Desition under	Туре	Size	>Addr	In/Out	User	Linked to	
COM Objects PLC - Configuration I/O Devices Device 1 (EtherCAT) Device 1-Image Device 1-Image-Info Device 1-Image-Info Device 1-Image Device 1-Image Device 1-Image Device 1-Image-Info Device 1-Image Device 1-Image-Info Device 1	♦ WeState ♦ InputTogle ♦ State ♦ AdsAddr ♦ InetId[0] ♦ InetId[1] ♦ InetId[2] ♦ InetId[3] ♦ InetId[3] ♦ InetId[4] ♦ InetId[5] ♦ Iport ♥ DecloputShift ♥ DecloputShift	BOOL BOOL UINT AMSADDRESS ARRAY [0 USINT USINT USINT USINT USINT USINT UINT DINT	0.1 0.1 2.0 8.0 1.0 1.0 1.0 1.0 1.0 1.0 1.0 2.0 4.0 4.0	1522.3 1524.3 1548.0 1550.0 1550.0 1551.0 1551.0 1553.0 1554.0 1555.0 1556.0 1556.0 1556.0	Input Input Input Input Input Input Input Input Input Input Input Input Input	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0		
Ready]					Local (134	.3.3.66.1.1)	Config Mode



Click the "Advanced settings…" button and check whether the settings correspond to picture 31. In particular the SYNC 0 Cycle Time should be 62.500 µs or more. The cycle time of 62.5 µs may only be used if no other process data than the position is to be transmitted. In other words, with the 62.5 µs cycle time, only one of Object 0x6004 or 0x2004 may be mapped, but not both.

Important!

The duration of the transmission, and thus the duration of the DC cycle, depends on the number of mapped bytes. If the DC cycle time is too short, there will be a communication break. Therefore, be sure to observe Annex "DC cycle times".



As shown in picture 30, the System Manager is in the Configuration mode. This is indicated by the "Config Mode" message in the blue field in the lower right corner.

Advanced Settings			
Distributed Clock	stributed Clock		
	Cyclic Mode Operation Mode: ✓ Enable SYNC 0 Cycle Time (µs): ③ Sync Unit Cycle /1 ③ User Defined 62. ✓ Enable SYNC 0	Distributed Clocks Sync Unit Cycle (µs): 1000 Shift Time (µs): User Defined 0 + SYNC0 Cycle × 0 ♥ 0 Based on Input Reference + = 0	
	SYNC Unit Cycle SYNC 0 Cycle × 1 Enable SYNC 1 Use as potential Reference Clo	Cycle Time (µs): 62.500	

Picture 31

Representation of the process data in variables in TwinCAT

As shown in picture 32, select with the right mouse button the "Inputs" item and select the submenu item "Insert Variable...".



Picture 32

In the dialogue window that is displayed then, see following picture, select a variable of the UINT32 type. The value of the encoder position will be reproduced in this variable. If necessary, input a suitable comment at the location provided to that purpose and click on OK

Insert Variabl	9		
General Name: Comment:	Var 34 Multiple:	1	OK Cancel
Start Address:	Byte: 0 📚 Bit:	0	
∼ Variable Type	UINT24 INT24 UINT8ARR3 BYTE_ARRAY_0_2 FLOAT UINT32 INT32 Test	3.0 A 3.0 3.0 4.0 4.0 4.0 4.0 4.0 4.0	Sort by ○ Name ④ Size ○ Type

Picture 33

Select now the variable "Var 34" and click on the "Connect..." button. Select now the "Position value" of the encoder and click on the OK button (picture 34).

Attach Variable Var 34 (Input)	
 I/O - Configuration I/O Devices Device 1 (EtherCAT) Box 1 (Turck_encoder_RS_RM) Position value > 18 71.0, UINT32 [4.0] DeOutputShift > 1B 1558.0, INT32 [4.0] DeInputShift > 1B 1562.0, INT32 [4.0] 	Show Variables Unused Used and unused Exclude disabled Exclude other Devices Exclude same Image Show Tooltips Show Variable Types Matching Type Matching Size All Types Array Mode Offsets Continuous Show Dialog Variable Name Hand over Take over Cancel OK

Picture 34



7 Setting up a communication between the encoder and TwinCAT

Now the encoder is to be put in communication with the PC via the network card that has been configured for TwinCAT.

Caution!

If you selected a star topology and thus use only one port of the encoder, imperatively connect the encoder via Port IN. This is an indispensable prerequisite for the good operation of an EtherCAT device. As shown in the following picture, Port IN corresponds to Port0 of the ET1100, which represents the EtherCAT slave controller of the encoder. Port OUT of the encoder corresponds to Port1 of the ET1100.



Switch the supply voltage of the encoder on.

In case of a trouble-free start-up of the encoder firmware, the red LED only lights up for a short period. Then the yellow LED of the port connecting the encoder to TwinCAT / to the control switches to permanently on.

Activate now the DC mode of TwinCAT with the "Actions" menu, submenu "Activate Configuration…". Answer the following dialogues with "Yes".



Picture 35

And confirm the two following dialogues with OK.

TwinCAT System Manager			
Activate Configuration (Old Configurations will be overwritten!)			
OK Cancel			
Picture 36			
TwinCAT System Manager			
TwinCAT System Manager			
TwinCAT System Manager 🔀 Restart TwinCAT System in Run Mode OK Cancel			

If all conditions for the Operational Mode are met, TwinCAT switches to the Real-Time display and shows the position value. This value is highlighted with a red rectangle in the next picture 38. In the present example, the position has the value 4317.

📑 Unbenannt.tsm - TwinCAT System Ma	nager								
File Edit Actions View Options Help									
i D 🚅 📽 🖬 🍜 🖪 🕉 🖻 🛱 🖧	M ð 🗏 🙃 🗸	💣 🙆 🙆 💱 🔨	s 🗣 🖹	Q @	66 🔦 😒	9 🤣 🛙) ?		
SYSTEM - Configuration	General EtherCAT D	Process Data Star	tup CoE - Onlin	e Online					
I/O Idle Task	Operation Mode:	Di	stributed Clocks		~				
🗐 📴 Task 2			Advance	ad Sattings		ו			
Task 2-Image			Advance	su settings		J			
The second seco									
Qutputs									~
Route Settings	Name	Online	Туре	Size	>Addr	In/Out	User	Linked to	
PLC - Configuration	分 Position value X	0x000007C5 (1989)	UDINT	4.0	71.0	Input	0	Var 34 . Inputs .	Task 2
E TIO - Configuration	V westate	0	BOOL	0.1	1522.3	Input	0		
I/O Devices	♦↑ InputToggle	0	BOOL	0.1	1524.3	Input	0		
E = Device 1 (EtherCAT)	♦↑ State	0x0008 (8)	UINT	2.0	1548.0	Input	0		
Device 1-Image	🔊 AdsAddr	86 03 03 42 02 01 E	AMSADDRESS	8.0	1550.0	Input	0		
	A netId	86 03 03 42 02 01	ARRAY [0	6.0	1550.0	Input	0		
	♦Î netId[0]	0x86 (134)	USINT	1.0	1550.0	Input	0		
	♦TnetId[1]	0x03 (3)	USINT	1.0	1551.0	Input	0		
	♦ netId[2]	0x03 (3)	USINT	1.0	1552.0	Input	0		
Thropata	♥[netId[3]	0x42 (66)	USINT	1.0	1553.0	Input	0		
E-Box 1 (Turck_encoder_RS_RM)	♥[netId[4]	0×02 (2)	USINT	1.0	1554.0	Input	0		
	♦ netId[5]	0×01 (1)	USINT	1.0	1555.0	Input	0		
Iask 2 - Device 1 (EtherCAT)	♦ port	0x03E9 (1001)	UINT	2.0	1556.0	Input	0		
	DcOutputShift	UXUUU4BC1C (3103	DINT	4.0	1558.0	Input	U		
	♥ DcInputShift	0x0019C864 (1689	DINT	4.0	1562.0	Input	0		
Server (Port) Timestamo	Message								~
TwinCAT Such 02.12.2012 15:54:50 455 mg	COM Server TrEverHear	any used another tak						1	
TwinCAT Syst 03.12.2012 15:54:50 655 ms	COM Server ToEventLog	ger wird gestartet!							
TwinCAT Syst 03.12.2012 15:54:49 140 MS	TCPLC Server wurde ges	tartet: TCPLC.							
TwinCAT Syster 03 12 2012 15:54:49 124 ms	TCIO Server wurde ges	artet: TCIO							
TwinCAT System: 03.12.2012 13.34.49 124 ms	TCIOECAT Server wurde	aestartet: TCIOECAT.							~
Ready							Local (13	34.3.3.66.1.1)	RTime 2% 📑

Picture 38

The yellow LED of the associated ports is now blinking. The green RUN LED is permanently on.



8 Encoder configuration

The following picture 41 shows an example of the SDO's and PDO's supported by the encoder. The objects are based on the CiA CANopen profile for encoders in Version 3.2.10 of 18 February 2011 and will be explained subsequently.

The display shown in picture 39 is obtained reading the SDO/PDO information of the encoder with the "Advanced…" button, see picture 40.

Unbenannt.tsm - TwinCAT System Manager								
File Edit Actions View Options Hel	lp							
1 🗅 📂 📽 🔲 🚑 🔃 X 🖻	8842	🔍 🔐 🗸 🗰 👧 🏨 😫	× @ & [e Q 🔏 & 🔍 🕫 🥔	2 ?			
SYSTEM - Configuration								
Real-Time Settings	General EtherC	AT DC Process Data Startup	CoE - Online Onl	ine				
📕 I/O Idle Task			_					
🖃 📑 Additional Tasks	Update	List 🔽 Auto Update 🔽 S	ingle Update 🔄 S	how Offline Data				
🖃 📴 Task 2	Advanc	ed All Objects	All Objects					
📫 Task 2-Image			Madula OD (Aal	E Borth: 0				
🖃 💱 Inputs	Add to Sta	Unline Data						
Var 34	Index	Name	Flags	Value				
Route Settings	1000	Device tune	BO	0v00020196 (131478)				
Q TCOM Objects	1001	Error register	R0 P	0x00 (0)				
PLC - Configuration	1008	Device name	RO	Kuebler Sendix Encoder				
J 📝 I/O - Configuration	1009	Hardware version	RO	V01.03				
🚍 🎒 I/O Devices	100A	Software version	RO	V2.9				
🖃 🗮 Device 1 (EtherCAT)	E 1010:0	Store parameters	RU Pu/	> 1 <				
🕂 Device 1-Image	E 1011:0	Bestore parameters	BO	> 2 4				
Device 1-Image-Inf	1011:0	1 Restore user parameter values	BW	0x00000000 (0)				
Inputs	1011:0	2 Restore factory default values	BW	0x00000000 (0)				
	Ē~ 1018:0	Identity	RO	> 4 <				
Box 1 /Turck opport	1018:0	1 VendorID Destatust and	RO	0x00000013 (19)				
	1018:0	2 Product code	HU BO	0x08688112 (1483256082)				
Task 2 - Device 1 (Ether	1018:0	4 Serial number	BO	0x00010007 (60043) 0x42EE1807 (1122900742)				
	1100	EtherCAT address	RO	0x03E9 (1001)				
		TxPDO 1 Normal PDO mapping	BW1	>1<				
	E 1C00:0	Sync manager type	RO	> 4 <				
	1000:0	1 SubIndex 001	RO	0x01 (1)				
	1000:0	2 SubIndex 002	RO	0x02 (2)				
	1000:0	3 Subindex UU3 4 Cublindex 004	RU	UXUU (U)				
	E-10120	4 Subindex 004 ByPDO assign	RW1	0x04 (4)				
	E-1013:0	TxPD0 assign	BW1	>1<				
	- 1C13:0	1 SubIndex 001		0x1A00 (6656)				
	. E 1C33:0	SM input parameter	RO	> 32 <				
	2000	System time at position reading	R0 P	0xE0C3B5ED (-524044819)				
	2004	Raw position value	ROP	0x0FFB3E2A (268123690)				
	2120	Sensor temperature value ["L]	RU P	24				
	2121	Temperature upper limit [*C]	BW	-40				
	2123	Temperature offset correction value	BW	0x65 (101)				
	6000	Operating parameters	BW	0x0006 (6)				
	6001	Measuring units per revolution	RW	0x00002000 (8192)				
	6002	Total measuring range	BW	0x00002000 (8192)				
	6003	Preset value	RW	0x00000000 (0)				
	6004	Position value Speed	RUP	0x000007C5(1989)				
	6030-0	1 Speed value	ROP	0				
	Ē~ 6031:0	Speed gating time in ms	RO	>3<				
	6031:0	1 Gating time in ms	BW	0x03E8 (1000)				
	6031:0	2 Multiplier value	RW	0x0001 (1)				
	6031:0	3 Divider value	BW	0x0001 (1)				
	E 6400:0	Area state register	RO	> 2 <				
	6400:0	Work area state channel 1 Work area state channel 2	ROP	UXUU (U) 0500 (0)				
	E- 6401:0	Work area low limit	BO	> 2 <				
	6401:0	1 Work area low limit channel 1	BW	0x00000000 (0)				
	6401:0	2 Work area low limit channel 2	RW	0x00000000 (0)	V			
	<			-	2			
ŕ	News		-	sadde to to a lar	1 (and and a			
	Name	Unline Typ	ie Size	Zi o Tanto C	Linked to			
	Position value	X UXUUUUU7C5 (1989) UDI	NI 4.0	/1.U Input 0	Var 34 . I			
	<				>			
Server (Port) Timestamp Message								
TwinCAT Syst 03.12.2012 15:54:50	0.655 ms COM 9	erver TcEventLogger wird gestartet						
TwinCAT Syst 03.12.2012 15:54:49	9140 ms TCRTI	ME Server wurde gestartet: TCRTIMF.						
TwinCAT Syst 03.12.2012 15:54:49	9 124 ms TCPLC	Server wurde gestartet: TCPLC.						
J.				1	DT			
ady				Local (134.3.3.66.1.1)	R1me 2%			

Picture 39

Advanced Settings		
Dictionary	Dictionary	
	Online - via SDD Information Offline - from Device Description	Device OD Module OD (via AoE port)
	All Objects Mappable Objects (RxPDO) Mappable Objects (TxPDO) Backup Objects Settings Objects	
	Offline - via EDS File	Browse
		OK Abbrechen

Picture 40

Object 1000_b : Device type (read-only)

Displays the following for the Turck encoders range 0x00010196 for Singleturn encoders or 0x00020196 for Multiturn encoders

Object 1001_h: Error register (read-only, mappable)

This is the Error Register of the encoder. If an error occurs, it will be displayed, in case of a temperature overshoot or undershoot, directly in bit 3 with the help of this register. Bit 0 (generic error) is also always set in this case. Therefore, the global error code is 0x09 in case of an unpermissible temperature over /undershoot. In addition, an EMERGENCY message is emitted with code 0x4200.

In case of a position error or a "Commissioning diagnostic" error, bit 0, "generic error", and Bit 5, "device profile specific error", are set in this register. Object 0x6503 indicates whether a position error or a "Commissioning diagnostic" error occurred. Refer to the description of Object 0x6503 in the following pages and to Reference [2].

Important!

Since reading the temperature is a not insignificant operation as concerns time, the temperature, in the case of the DC mode, is only read continuously from the ASIC if the temperatures belongs to the process data. In other words, if Object 0x2120 is mapped. When the DC mode is activated, but Object 0x2120 is not mapped, Object 0x2120 shows the correct temperature value immediately after switching on, but this value is not updated any more in the Operational status! Therefore, a possibly occurring temperature error will not be displayed in Object 1001. In the case of the FreeRun mode, the temperature is updated with every bus cycle.

Object 1008, : Device name (read-only)

Has the constant value "Turck Encoder".

Object 1009_b: Hardware version (read-only)

Has the constant value V01.03.

Object 100A_b : Software version (read-only)

Has a constant value Va.b, a and b representing respectively the numerical values of the major and minor firmware version.



Object 1010_b: Store parameters (readWrite)

Sub-index 1 of this object allows the persistent storage of the following user parameters in the non-volatile memory of the encoder:

- •1A00
- 6000
- 6001
- 6002
- 6003
- 6031
- 6401
- 6402

Therefore, these values are available even after a reset, without requiring a new download from the control. A double-click on the TwinCAT line "Save all parameters" opens the following dialogue box. After the input of value 0x65766173, which represents the Hex signature of the word "save" according to ISO 8859, the encoder stores the values.

Set Value Di	alog	×					
Dec:	1702257011	ОК					
Hex:	0x65766173	Cancel					
Float:	1702257011						
Bool:	0 1	Hex Edit					
Binary:	73 61 76 65	4					
Bit Size:	○1 ○8 ○16 ⊙32	○64 ○?					



Object 1011_h: Restore parameters (readWrite)

Sub-index 1 of this object allows activating all user parameters with the values stored in the non-volatile memory. Which parameters belong to the user parameters is described in Object 1010. A double-click on the line "Restore all parameters" opens a dialogue box as shown in picture 42. After the input of value 0x64616F6C, which represents the Hex signature of the word "load" according to ISO 8859, all user parameters are replaced with those stored in the non-volatile memory. To take the values over in TwinCAT, the configuration must be activated.

Set Value D	ialog	
Dec:	1684107116	ОК
Hex:	0x64616F6C	Cancel
Float:	1684107116	
Bool:	0 1	Hex Edit
Binary:	6C 6F 61 64	4
Bit Size:	○1 ○8 ○16 ⊙32	○ 64 ○ ?

Picture 42

Sub-index 2 is similar to sub-index 1: a double-click on the line "Restore factory default values" activates the so-called Factory Values. In this case, the user parameters receive the values that have been determined at the time of the production of the encoder. Also in this case, the values are taken over in TwinCAT only after having activated the configuration.

Object 1018h : Identity (read-only)

Object 1018 has four indexes, which are all read-only:

Vendor ID

This is the Vendor ID belonging to the Turck Group, which is registered with the EtherCAT Technology Group.

Product code

This value represents the Turck-specific order code of the encoder.

Revision

This value represents the revision of the EtherCAT encoder in general and is always 0x00010007.

Serial Number

This value represents the unique serial number of the encoder. Each serial number applies to only one encoder.

Object 1100h : EtherCAT address (read-only)

Object 1100 indicates the EtherCAT address of the encoder. In the specific case of TwinCAT, this is the address that has been set in the dialogue window of picture 43.

📴 Unbenannt.tsm - TwinCAT System Manag	jer -					
File Edit Actions View Options Help						
D 🖆 📽 🖬 🍜 🖪 X 🖻 🖬 🛃 A	8 🗏 🙃 🗸	💣 🏡 💁 🖄 🏵	🗣 🖹 Q	J ² 66∕ �	. 5 ° 🔌 🔞	?
SYSTEM - Configuration Real-Time Settings B I/O Idle Task C Task 2 Task 2- Task	General EtherCAT Type: Product/Revision: Auto Inc Addr: EtherCAT Addr: Identification Value: Previous Port:	DC Process Data Star Kuebler Sendix Encoder 1483256082 / 65543 0 1001 0 Master	tup CoE - Onlin	nced Settings		
Task 2 - Device 1 (EtherCAT)	Name	Online	Туре	Size >	Addr In/Out	User. 📥
		X 0x00007C5 (1989) 0 1 0x0008 (8) 86 03 03 42 02 01 E 86 03 03 42 02 01	UDINT BOOL BOOL UINT AMSADDRESS ARRAY [0	4.0 71 0.1 15 0.1 15 2.0 15 8.0 15 6.0 15	.0 Input 22.3 Input 24.3 Input 48.0 Input 50.0 Input 50.0 Input	
Ready				Local (134.3	3.3.66.1.1) RTir	ne 2% 🔡

Picture 43

Object 1A00h : TxPDO 1 Normal PDO mapping (read-write)

This object allows selecting the data that is to be transmitted during runtime as process data. This data can be for example input in the "Process Data" tab of the TwinCAT manager, as shown in picture 44.

To that purpose, click on the last item of the list with the right mouse button and select menu item "Insert…". This opens a dialogue window, see picture 45, that allows selecting the single objects and placing them in the desired order.



ync M	anager:			PDO	List:				
SM	Size	Туре	Flags	Inc	lex	Size	Name		1
0	246	MbxOut		0x1	A00	4.0	Encoder output		
2	246	Outpute							
3	4	Innuts							
<			>	<					
< DO A:	ssignmen	t (0x1C13):	>	PDO	Conten	(0x1A00):	0%- Norra		3
< ℃O A: ✓ 0x1.	ssignmen A00	uu t (0x1C13):	>	PD0	Conten lex	t (0x1A00): Size	Offs Name	e value	3
< DO A: ✔ 0x1.	ssignmen A00	t (0x1C13):	>	PD0	Conten lex :004:00	t (0x1A00): Size 4.0	Offs Name	value	
CO As	ssignmen A00	uu t (0x1C13):	>	PD0	Conten lex 004:00	t (0x1A00): Size	Offs Name Offs Device Insert Delete	value	1
< DO As 2 0x1.	ssignmen A00	## t (0x1C13):	>	PDO Inc	Conten Jex 1004:00	t (0x1A00): Size 4.0	Offs Name Offs Destin Insert Delete Edit	- value	<u>:</u>
< ℃O A: ▼ 0x1.	ssignmen AOO	till t (0x1C13):		PDO Inc	Conten lex 004:00	t (0x1A00): Size	Offs Name Delete Edit	value	<u>_</u>
< ℃ A: ▼ 0x1.	ssignmen A00	t (0x1C13):		PDO Inc	Conten Jex 004:00	(0x1A00): Size 4.0	Offs Name Delete Edit Move Up Move Down	value	
DO A	asignmen A00	(0x1C13):		PDO Inc Oxe	Conteni dex 004:00	t (0x1A00): Size 4.0	Offs Name Insert Delete Edit Move Up Move Down		6
DO A	ssignmen A00 Iload D0 Assig	(0x1C13):		PDO Inc Oxe Prec	Conteni lex 004:00	t (0x1A00): Size 4.0	Offs Name Insert Delete Edit Move Up Move Down		

Picture 44

Important! For the DC mode, observe Annex "DC cycle times". The cycle time to be set increases with every additional process data byte. Independently of the operating mode of the encoder, DC or FreeRun, a maximum of seven objects may be inserted for mapping.

Edit Pdo Ent	гу	×
Name:		ОК
Index (hex):	0 0	Cancel
Sub Index:	0	
Data Type:	(none) 💌	
Bit Lentgh:	1	
From Dictionar	y:	
0x1001 - Error 0x2000 - Syst 0x2004 - Raw 0x2120 - Sen: 0x6004 - Posis 0x6030:01 - S 0x6400:01 - V 0x6400:02 - V 0x6505 - War	register em time at position reading position value sor temperature value [°C] tion value peed value Vork area state channel 1 Vork area state channel 2 nings	

Picture 45

Object 1C00_h : Sync Manager type (read-only)

Object 1C00 indicates the assignment of the type to the respective Sync Manager. According to [3], the type assignment for the Sync Manager is selected as follows:

Sync Manager 0: 1 Mailbox receive (Master to Slave) Sync Manager 1: 2 Mailbox send (Slave to Master) Sync Manager 2: 0 Disabled since the encoder has no output process data Sync Manager 3: 4 Input process data (Slave to Master)

Object 1C12_h: RxPDO assignment (read-only)

Since the encoder has no output process data, there is no assignment to a RxPDO object.

Object 1C13_h: **TxPDO assignment (read-only)**

Assignment of the encoder process data takes place through Object 0x1A00.

Object 1C33_h: SM 3 input parameter (read-only)

Object 1C33 has only Read-Only sub-indexes. This information is only for information purposes. It allows in particular:

• reading the synchronisation type in DC mode in sub-index 1. E.g. 2 represents "DC SYNC0 synchronized with AL Event".

• checking the cycle time in sub-index 2.

• reading the minimum cycle time in sub-index 5.

Object 2000_h:System time at position reading (read-only, mappable)

This object represents the system time at the moment when the position is generated in the encoder.

Object 2004, : Raw position value (read-only, mappable)

This object allows evaluating the raw position data. The raw data depends only on the physical resolution of the sensor; it is independent of the scaling operations.

Object 2120_h : Sensor temperature value (read-only, mappable)

The sensor includes an ASIC whose component is a temperature sensor. It allows displaying the internal temperature of the encoder sensor. Object 0x2120 indicates the temperature in °C.

Important!

Since reading the temperature is a significant operation as concerns time, the temperature, in the case of the DC mode, is only read continuously from the ASIC and checked for exceeding the allowed range if the temperature belongs to the process data. In other words, if Object 0x2120 is mapped.

When the DC mode is activated, but Object 0x2120 is not mapped, Object 0x2120 shows the correct temperature value immediately after switching on, but this value is not updated any more in the Operational status, and it is not checked for exceeding the allowed range!

In the case of the FreeRun mode, the temperature is updated and checked for exceeding the allowed range with every bus cycle.

Object 2121, : Temperature lower limit (read-write)

The sensor includes an ASIC whose component is a temperature sensor. It allows displaying the internal temperature of the encoder sensor. This object allows setting the lower temperature limit; an alarm is triggered if it is undershot. This alarm is signalled through Object 1001 (Error Register) and by a corresponding Emergency Message. The value is given in °C. The values allowed for this object are in the range of -45 °C to +90°C.

Important!

This value is set using the same ASIC interface that is used for reading the position. Therefore, an interruption of the bus cycle time of 250 ms will take place in DC mode. Ideally this value should be set in PreOperational mode.



Object 2122, : Temperature upper limit (read-write)

The sensor includes an ASIC whose component is a temperature sensor. It allows displaying the internal temperature of the encoder sensor. This object allows setting the upper temperature limit; an alarm is triggered if it is overshot. This alarm is signalled through Object 1001 (Error Register) and by a corresponding Emergency Message. The values allowed for this object are in the range of -45 °C to +90°C.

Important!

This value is set using the same ASIC interface that is used for reading the position. Therefore, an interruption of the bus cycle time of 250 ms will take place in DC mode. Ideally this value should be set in PreOperational mode.

Object 2123, : Temperature offset correction value (read-write)

This object allows offsetting the temperature sensor so that Object 2120 displays the value 64 (decimal) for a temperature of 0°C.

Important!

This value is set using the same ASIC interface that is used for reading the position. Therefore, an interruption of the bus cycle time of 250 ms will take place in DC mode.

Object 6000, : Operating parameters (read-write)

In compliance with Reference [1], this object is defined as follows:

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
nbr	su1	su0	-	-	-	-	-	-	-	-	-	-	sfc	cdc	CS

Important!

This value is set using the same ASIC interface that is used for reading the position. Therefore, an interruption of the bus cycle time of 250 ms will take place in DC mode.

Standard parameters:

cs = 0 = COM (clock wise). Reference view: on the encoder shaft side

cs = 1 = Code sequence = CCW (counter clock wise)

cdc = 0 = ^ Commissioning diagnostic control disabled

- cdc = 1 = ^ Commissioning diagnostic control enabled
- sfc = 0 = Scaling function control disabled $sfc = 1 = \hat{S}caling function control enabled$

Manufacturer-specific parameters:

su0 und $su1 = ^ Speed Unit.$

su1	su0	Speed unit
0	0	Rounds per minute (default)
0	1	Steps per 10 ms
1	0	Steps per 100 ms
1	1	Steps per second

 $nbr = 0 = \hat{D}$ Binary Ratio of TMR (Total Measuring Range) to MUR (Measuring Units per Revolution)

nbr = 1 = Non Binary Ratio of TMR to MUR

Relationship of TMR and MUR

TMR = Total Measuring Range MUR = Measuring Units per Revolution

The single and multiturn units of the Turck encoders operate independently of each other. According to the resolution of the disc or to the interpolator, the bits used for the resolution can always be incremented or decremented only bit by bit. This also applies to the multiturn gear.

This fact affects the selectable values of MUR and TMR

The TMR value must be chosen so that either this value itself or a multiple of this value corresponds to the total measuring range and is a binary multiple of MUR.

The total measuring range is defined as the product of the singleturn resolution g_ST (e.g. 65536 corresponding to 16 bits) and the multiturn resolution g_MT (e.g. 4096 corresponding to 12 bits).

If TMR is a binary multiple of MUR, the position value evolves without error at the end of the range, where an overflow from the maximum position to zero takes place, as shown in the picture below.

The second picture shows the case when TMR is not a binary multiple of MUR. An error appears at the end of the range.



A binary multiple is therefore defined as

TMR=MUR/2^k and in special cases TMR=g_ST/2^k where k=0, 71, 72, ..., 7`

If k is positive, TMR is a binary multiple of MUR

If k=0, TMR = MUR

If k is negative, MUR is a multiple of TMR. Figuratively speaking: the "saw teeth" in the pictures above then exist k times within one revolution.



Therefore the following boundary conditions must be met for MUR und TMR:

• The MUR value is only accepted during the SDO download if it fulfils the following criterion: 0, MUR # g_ST and MUR must an addition be a multible of 2, thus: MUR = g_ST/2n where 0 # n #`

• The TMR value of an encoder without multiturn stage is only accepted during the SDO download if it fulfills the following criterion:

0 , TMR # g_ST and TMR must be a multiple of 2, thus: TMR = MUR/2k and in special cases TMR = g_ST/2k where k = 0, 71, 72, ..., 7

• For an encoder with a multiturn stage, the following condition for the TMR value must be met so that it can be accepted for SDO download:

0 , TMR # MUR*g_MT, in special cases 0 , TMR # g_ST*g_MT and TMR must be a multiple of 2, thus: TMR = MUR*g_MT/2k where k = 0, 71, 72, ..., 7`

Important!

The check of the binary relationship of TMR with respect to MUR can be switched on and off with the bit "nbr" in Object 6000. The default value of this bit is zero, which enables the check. If the bit has the value one, the check during SDO download is disabled, allowing to load any value for MUR and TMR.

Before bit "nbr" is disabled, the values for MUR (Object 6001) and TMR (Object 6002) should be se so that they fulfill the "Binary" criterion. Otherwise, they will be set automatically to default values.

Object 6001, : Measuring units per revolution (MUR) (read-write)

This object indicates the number of distinguishable steps per revolution. The description of Object 6000 is to be observed. Depending on the bit "nbr" in Object 6000, a check of the boundary conditions for MUR and TMR is performed. If this check is performed, in the case of an error, the value is rejected and a corresponding SDO Download Abort-message is sent.

Object 6002, : Total measuring range (TMR) (read-write)

This object indicates the number of distinguishable steps up to the overflow from the maximum value to zero. The description of Object 6000 is to be observed also here. Depending on the bit "nbr" in Object 6000, a check of the boundary conditions for MUR and TMR is performed. If this check is performed, in the case of an error, the value is rejected and a corresponding SDO Download Abort-message is sent.

Object 6003_h : Preset (read-write)

This object allows initializing the position value as it is displayed by Object 6004. This value is given in the scaled unit, which is also used to display Object 6004. The maximum value that can be input corresponds to the TMR value, and thus to the value of Object 6002.

Important!

This value is set using the same ASIC interface that is used for reading the position. Therefore, an interruption of the bus cycle time of 250 ms will take place in DC mode.

Object 6004_h: **Position (read-only, mappable)**

This object supplies, depending on the value of Object 0x6000, the scaled or unscaled position.

It must be noted that this value always loses its validity when objects are activated, which use the same interface to access to the position ASIC. These objects are marked as such and described in this list.

Object 6030_h: Speed (read-only, mappable)

This object supplies, depending on the value of Object 0x6000, the speed in the following units:

- Revolutions per minute (RPM)
- Steps per second
- Steps per 100ms
- Steps per 10ms

Object 6031_h: Speed gating time (read-write)

In compliance with Reference [1], this object defines the time interval to be considered for the calculation of the speed.

Subindex 0

Defines the maximum supported sub-index, which has in this case always the value three.

Subindex 1 (Time Value T)

Defines the base time for the gating time. The true value of the gating time results from the combination of subindexes 1, 2 and 3.

Subindex 2 (Multiplier Value M)

The value of sub-index 1 is multiplied by the value of this sub-index.

Subindex 3 (Divider Value D)

The value of sub-index 1 is divided by the value of this sub-index.

Therefore, the gating time G is the result of: G = T * M / D

Caution!

Maximum permitted gating time is 2 seconds.

If the SDO download value exceeds this value, the encoder reacts with an SDO Download Abort message: "Value of parameter too high". This takes place regardless of the sub-index that eventually caused the overflow.

Object 6400_b : Work Area Status Register (read-only mappable)

Sub-indexes 1 and 2 give two values, with which the current position of the encoder can be evaluated with respect to predefined work areas. See also reference [1] on that subject. Both work areas are set with the help of Objects 0x6401 and 0x6402.

Object 6401, : Work area low limit (read-write)

Defines the lower limit value of both areas for the representation by Object 6400.

Object 6402_h: Work area high limit (read-write)

Defines the upper limit value of both areas for the representation by Object 6400.

Object 6501_h: Single turn resolution (read-only)

This Object indicates the singleturn resolution of an encoder. In the case of the Turck sensor, this is usually the value 65536, which corresponds to 16 bits.

Object 6502_b: Number of distinguishable resolutions (read-only)

In the case of a multiturn encoder, this is the multiturn resolution. The Turck sensor has a 12 bits multiturn stage and thus a value of 4096. If the multiturn stage is missing, this object displays the value 1.



Object 6503_h : Alarms (read-only)

This object informs about the occurrence of the following errors on the encoder:

- Position error: "pe"
- Commissioning diagnostic error: "cde"

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
-	-	-	-	-	-	-	-	-	-	-	-	-	-	cde	pe

Object 6504_h: Supported alarms (read-only)

This object indicates which error cases are to be signalled externally, and thus in Object 0x6503. These are the Position errors and the Commissioning diagnostic.

Object 6505, : Warnings (read-only)

This object signals the following warnings of the encoder:

· Light control reserve reached: "lcr"

• Speed range exceeded: "sr". This bit is set for 9000 RPM.

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
-	-	-	-	-	-	-	-	-	sr	-	-	-	-	lcr	-

Object 6506_h: Supported warnings (read-only)

This object indicates which warnings are to be signalled externally, and thus in Object 0x6505. These are two warnings: Light control reserve reached and Speed range exceeded.

Object 6507_h: Profile and software version (read-only)

Similarly to Object 0x1A00, the software version is represented in the two upper nibbles. If the software version is V4.5, the value of this object is 0x04050302, where the two lower nibbles 0x0302 represent the CANopen profile version, that is to say 3.2.

Object 6509_h: Offset value (read-only)

The offset value is updated when switching on and later every time the Preset value (Object 0x6003) is activated.

9 Annex: DC cycle times

Number of transmitted bytes	Transmission time in μs
4 as Object 0x6004 with scaled position	55 or 107 depending on cleared or set NBR-Bit in object 0x6000.
5 as 0x6004 and 0x1001	63
10 as 0x6004 (Scaled position), 0x6505 (Warnings), 0x2000 (System time)	76 or 128 depending on cleared or set NBR-Bit in object 0x6000.

10 Annex:

11 Network controllers supported by Beckhoff's Software Ethernet Driver

Intel Fast Ethernet Controllers (Vendor ID: 0x8086)

Device ID	Description
0x1029	82559
0x1030	82559
0x1031	82801CAM
0x1032	82801CAM
0x1033	82801CAM
0x1034	82801CAM
0x1038	82801CAM
0x1039	82801CAM
0x103A	82801DB
0x103B	82801DB
0x103C	82801DB
0x103D	82801DB
0x103E	82801DB
0x1050	82801EB/ER
0x1051	82801EB/ER
0x1052	82801EB/ER
0x1053	82801EB/ER
0x1054	82801EB/ER
0x1055	82801EB/ER
0x1056	82801EB/ER
0x1057	82801EB/ER
0x1059	82551QM
0x1064	82801EB/ER
0x1067	Intel PRO/100
0x1068	82562
0x1069	Intel PRO/100
0x106A	Intel PRO/100
0x106B	Intel PRO/100
0x1094	Intel PRO/100
0x1209	8255xER/IT
0x1229	82557/8/9/0/1
0x1249	82559ER
0x1259	82801E
0x245D	82801E
0x27DC	Intel PRO/100



Intel Gigabit Ethernet Controllers (Vendor ID: 0x8086)

Device ID	Description
0x1000	82542
0x1001	82543GC
0x1004	82543GC
0x1008	82544EI
0x1009	82544EI
0x100C	82544EI
0x100D	82544GC
0x100E	82540EM
0x100F	82545EM
0x1010	82546EB
0x1011	82545EM
0x1012	82546FB
0x1013	82541FI
0x1014	82541FR
0x1015	82540EM
0x1016	82540EP
0x1017	82540EP
0x1018	82541EI
0v1010	82547EI
0x1012	82547EI
0v101D	82546EB
0x101E	82540EP
0x1076	82545GM
0x1020	82545GM
0x1027	82545GM
0x1020	82545GM
0x1049	82566DM
0x104A	82566DC
0x104D	82560V
0x104C	82566MC
0x104D	82500MC
0x104L	0237 ILD
0x1040	02371LD 92571ER
0x1000	8237 ILD 82547EI
0x1075	02547LI
0x1070	0234101 02547EI
0x1077	02347EI
0x1070	82541LR
0x1079	02340ED
0x107A	02040ED
0x107D	02040ED
0x107C	02041GI
0x107D	02572EI
0X107E	82372EI
UX10/F	82572EI
0x108A	82546GB
0X108B	82573E
0x108C	825/3E
UX1090	80003ES2LAN
UX1098	80003ES2LAN
UX1099	82546GB
UX109A	825/3L
0x10A4	82571EB
UX10A7	825/5

0x10A9	82575
0x10B5	82546GB
0x10B9	82572EI
0x10BA	80003ES2LAN
0x10BB	80003ES2LAN
0x10BC	82571EB
0x10C4	82562GT
0x10C5	82562G
0x10C9	82576
0x10D3	82574L

12 References

- [1] CANopen device profile for encoders. CiA 406 Work Draft. Version 3.2.10
- [2] CANopen Application Layer Communication Profile. CiA Draft Standard 301.
- [3] EtherCAT Specification Part 6. Application Layer protocol specification.



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