ABSOLUTE ROTARY ENCODER WITH ETHERNET/IP INTERFACE
USER MANUAL

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General Security Advice

Important Information

Read these instructions carefully, and look at the equipment to become familiar with the device before trying to install, operate, or maintain it. The following special messages may appear throughout this documentation or on the equipment to warn of potential hazards or to call attention to information that clarifies or simplifies a procedure.

The addition of this symbol to a Danger or Warning safety label indicates that an electrical hazard exists, which will result in personal injury if the instructions are not followed.

This is the safety alert symbol. It is used to alert you to potential personal injury hazards. Obey all safety messages that follow this symbol to avoid possible injury or death.

Please Note

Electrical equipment should be serviced only by qualified trained personnel. No responsibility is assumed by manufacturer for any consequences arising out of the use of this material. This document is not intended as an instruction manual for untrained persons.

About this Manual

Trademark

EtherCAT® is registered trademark and patented technology, licensed by Beckhoff Automation GmbH, Germany.

Background

This user manual describes how to install and configure an Absolute Rotary Encoder with EtherCAT® interface. General technical data and mechanical drawings are specified in the document data sheet.

1 Safety Instructions

Do not remove the connection cap!

The absolute rotary encoder must be connected to the main signal ground over the machine chassis or by means of a separate potential compensating line.

Do not stand on the encoder!

Do not adapt the driving shaft additionally!

Avoid mechanical load!

Do not adapt the housing additionally!

2 Introduction

This manual explains how to install and configure the Absolute Rotary Encoder with EtherCAT® interface applicable for military and industrial applications with EtherCAT® protocol. The products are compliant with standard DS406 (encoder device profile) and Ethernet ETHERCAT® Communication Profile Specification CiA DS 301 V1.1.0.

2.1 General Definitions

In the following chapters general definitions are described.

2.2 Intended Usage

The absolute rotary encoder measures the physical measure and angle and revolutions and converts this into a digital position value transmitted via the EtherCAT® bus according to the EtherCAT® communication profile (CIA DS301) to other field devices. The encoder shall be connected to an EtherCAT® network according to (CIA DS301) and shall only be used for this purpose. The sensor can be used in applications like positioning tasks or length measurements. General applications could be like cranes, construction machines, lifts, packing machines etc.

2.3 Interfaces

The sensor has one EtherCAT® interface with incoming and outgoing port to support a daisy chain cable structure and supports the profile Specification CIA DS 301 V1.1.0.

2.4 Maintenance

For the device is no maintenance necessary!

2.5 Intended Time of Usage

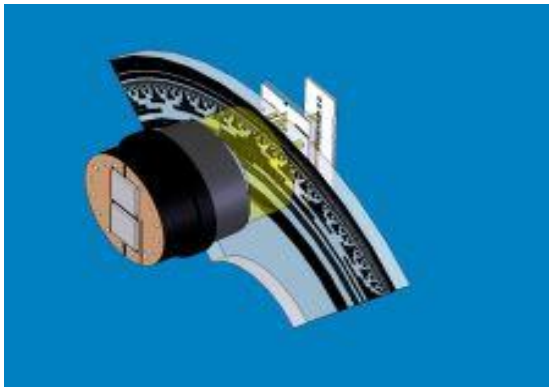
Refer to the data sheet of the Absolute Rotary Encoder.

2.6 Optical Measurement Principle

2.6.1 Overview

The absolute rotary encoders use highly integrated Opto-ASICs, providing a resolution up to 16 bits (65,536 steps) per turn. For multiturn models, the measuring range is extended by the mechanically geared code disks to as many as 16,384 (2^{14}) revolutions. These encoders are fully capable of operating in rugged industrial settings.

2.6.2 Singleturn



The measuring system in the single-turn module consists of a light source, a code disc pivoted in a precision ball bearing and an opto-electronic scanning device. A LED is used as a light source which shines through the code disc and onto the screen behind. The tracks on the code disk are evaluated by an opto-array behind the reticle. With every position another combination of slashes in the reticle is covered by the dark spots on the code disk and the light beam on the photo transistor is interrupted. That way the code on the disc is transformed into electronic signals. Fluctuations in the intensity of the light source are measured by an additional photo transistor and another electronic circuit compensates for these.

After amplification and conversion the electronic signals are available for evaluation. Single turn encoders specify the absolute position for one turn of the shaft i.e. for 360°. After one turn the measuring range is completed and starts again from the beginning.

2.6.3 Multiturn

Linear systems normally need more than one turn of a shaft. A single turn encoder is unsuitable for this type of application because of the additional requirement of the number of turns. The principle is relatively simple: Several single turn encoders are connected using a reduction gear. The first stage supplies the resolution per turn, the stages behind supply the number of turns. In the following picture you can see the gearing module with the several stages of reduction gears.

Typical Applications:

- Packing Machines
- Robots
- Printing Machines
- Theater / Moving Platforms

There are several types of encoder versions. Please refer to the datasheets to find out which is the best version for your application.

2.8 Ethernet

The present developments in the field of Industrial Ethernet are based on the vision of an integrated access of all data of a company through a uniform communication system. In higher levels of enterprise communication Ethernet is the main medium of data transfers. Combined with other IT technologies it is internationally standardized. In the long run automation engineers will benefit from the rapid technological progress in the mass markets of IT and web technologies.

Ethernet technically provides a system with higher data transfer rates than common field bus systems. TCP/IP and UDP do have a statistical access method to access the medium thereby prohibiting determined response times. Many developments are intensely done on additional real time mechanisms, e.g. EtherCAT®.

EtherCAT® 's key functional principle lies in how its nodes process Ethernet frames:
each node reads the data addressed to it and writes its data back to the frame all while the frame is moving downstream. This leads to improved bandwidth utilization (one frame per cycle is often sufficient for communication) while also eliminating the need for switches or hubs.

The unique way EtherCAT® process frames makes it the fastest Industrial Ethernet Technology; no other technology can top EtherCAT® 's bandwidth utilization or the corresponding performance.

In addition it its speed, an EtherCAT® net-work can support up to 65,535 devices without placing restrictions on their topology: line, bus, tree, star – or any combination thereof. Fast Ethernet Physics allows two devices to be up to 100m (330 ft.) apart, and greater distances are possible with the use of fiber optics. EtherCAT® also has additional features that offer further topological flexibility, such as Hot Connect and Hot Swap for devices, and added redundancy through a ring topology.

EtherCAT® is suitable for both centralized and decentralized system architectures. It can support master-slave, master-master, and slave-slave communication as well as incorporate subordinate field buses. At the factory-level, the EtherCAT® Automation Protocol has communication covered – all with the existing infrastructure.

When compared to a classic field bus system, EtherCAT® is the obvious choice: node addresses can be set automatically, there's no need for network tuning, and onboard diagnostics with fault localization make pinpointing errors a snap. Despite these advanced features, EtherCAT® is also easier to use than Industrial Ethernet: there are no switches to configure, and no complicated handling of MAC or IP addresses is required.

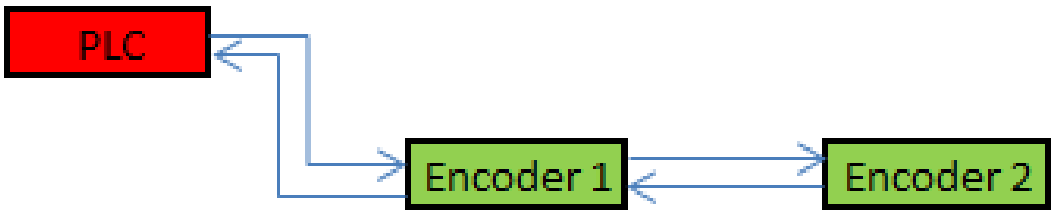
EtherCAT® also supports common internet technologies without jeopardizing the net-work's real-time capability. Its "Ethernet over EtherCAT®" protocol transports FTP, http, TCP/IP and Co.

Other functions (offset values, resolution, etc) can be configured. The absolute rotary encoder corresponds to the class 1 encoder profile (DS 406 in which the characteristics of encoder with CANopen interface are defined).

Further information is available at:
EtherCAT Technology Group
http://www.ethercat.org
A detailed description of the network in described in the following chapters.

3 Hardware Set-Up and Ethernet Connection

3.1 Network Topology



The line structure can be built up like known from standard field bus systems e.g. CANopen. The sensor can be connected to other devices by usage of “straight” or crossover network cable, because the PHY of the encoder is capable to realize Auto crossover. You need at least a cable of category Cat5e to get a data transfer rate up to 100 Mbit. To increase noise immunity only cables with foil and copper netting shield should be used (S/UTP), twisted pair, AWG26.

The symbolized structure shows a line cabling structure.

Each device can be connected together with a maximum cable length of 100m.
These requirements are specified in EtherCAT® specification. For more details visit the web site: http://www.ethercat.org

4 Connection an Absolute Encoder

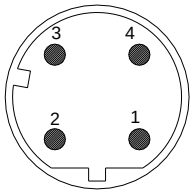
The encoder is connected by a 4 pin A-coded M12 connector for the power supply and two 4 pin, D-coded M12 connector for Ethernet.

4.1 Connector Ethernet EtherCAT®

4 pin female, D-coded

Pin Number	Signal
1	Tx +
2	Rx +
3	Tx -
4	Rx -

Sketch on encoder view

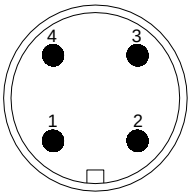


4.2 Connector Power Supply

4 pin male, A-coded

Pin Number	Signal
1	power supply (10V – 30V)
2	Reserved, not connected
3	power supply (GND)
4	Reserved, not connected

Sketch on encoder view



4.3 Ethernet Cables

RJ45 – M12 crossed

Signal	RJ45 Pin	M12 Pin	Signal
Tx+	3	2	Rx+
Tx-	6	4	Rx-
Rx+	1	1	Tx+
Rx-	2	3	Tx-

RJ45 – M12 straight

Signal	RJ45 Pin	M12 Pin	Signal
Tx+	3	1	Tx+
Tx-	6	3	Tx-
Rx+	1	2	Rx+
Rx-	2	4	Rx-

M12 – M12 crossed

Signal	M12 Pin	M12 Pin	Signal
Tx+	1	2	Rx+
Tx-	3	4	Rx-
Rx+	2	1	Tx+
Rx-	4	3	Tx-

5 Diagnostic LED's

The encoder provides on the backside of the connection cap several diagnostic LEDs. For each port there is a functional combined LED for link status and activity named "LS/DA".

Furthermore there are two LEDs to indicate the network status for EtherCAT® named "error" and "Status". The exact meaning of the LED indication is specified in the following tables.

5.1 Function of LEDs for Ports

LED	Color	Status	Description for LED = on
Link/Act IN	Green	On	LINK is active for HUB port 1
		Blinking	Activity on HUB port 1
Link/Act OUT	Green	On	LINK is active for HUB port 2
		Blinking	Activity on HUB port 2

5.2 Function of LEDs for EtherCAT®

LED	Color	Status	Description for LED
Error	Red	Off	No Error
		Blinking	Invalid Configuration
		Single Flash	Local Error
		Double Flash	Process Data Watchdog Timeout/EtherCAT® Watchdog Timeout
		Flickering	Booting Error
		On	Application Failure
Run	Green	Off	Initialization
		Blinking	Pre-Operational
		Single flash	Safe-Operational
		Flickering	Initialization or Bootstrap
		On	Operational

6 Network Configuration

A dismounting of the connection cap is not allowed! All configurations can be directly executed without opening the housing.

6.1 Install Encoders to Network

1.) Turn off the power supply for your machine
2.) Connect the Ethernet CAT5 cable with D-coded M12 connector from the PLC or the last device to the ECAD IN-Port
3.) If necessary install additional devices to the ECAD OUT-Port
4.) Connect the A-coded M12 connector for the power supply
5.) Turn on the power supply of the PLC and the devices

7 Project Integration

This integration description is an example related to Beckhoff control units with TwinCAT®. In general the user can integrate the encoder in any project tool or hardware set up using an EtherCAT® network.

Note:
- TwinCAT® needs special network cards with INTEL-Chip. See further information @ Beckhoff.
- Start TwinCAT® with Administration rights.

7.1 ESI File

A ESI file describes the properties and functions of the sensor like timings and configurable sensor parameters. By using the ESI file an easy and abstract integration of an EtherCAT® device in a project tool is realized. A detailed knowledge of EtherCAT® is not needed to configure the device.

An actual ESI file can be downloaded from the website.

The format of the ESI file is XML and is similar like an EDS file used in the CANopen world.

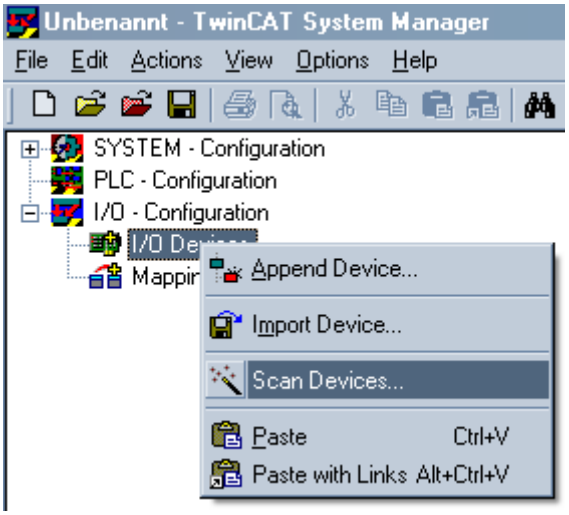
7.2 Configuration with TwinCAT® 2

7.2.1 Import the ESI file

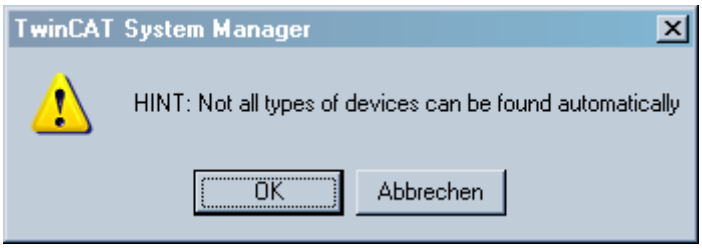
Copy the ESI file in the following directory:
…\TwinCAT\IO\Ethercat

7.2.2 Setup encoder device

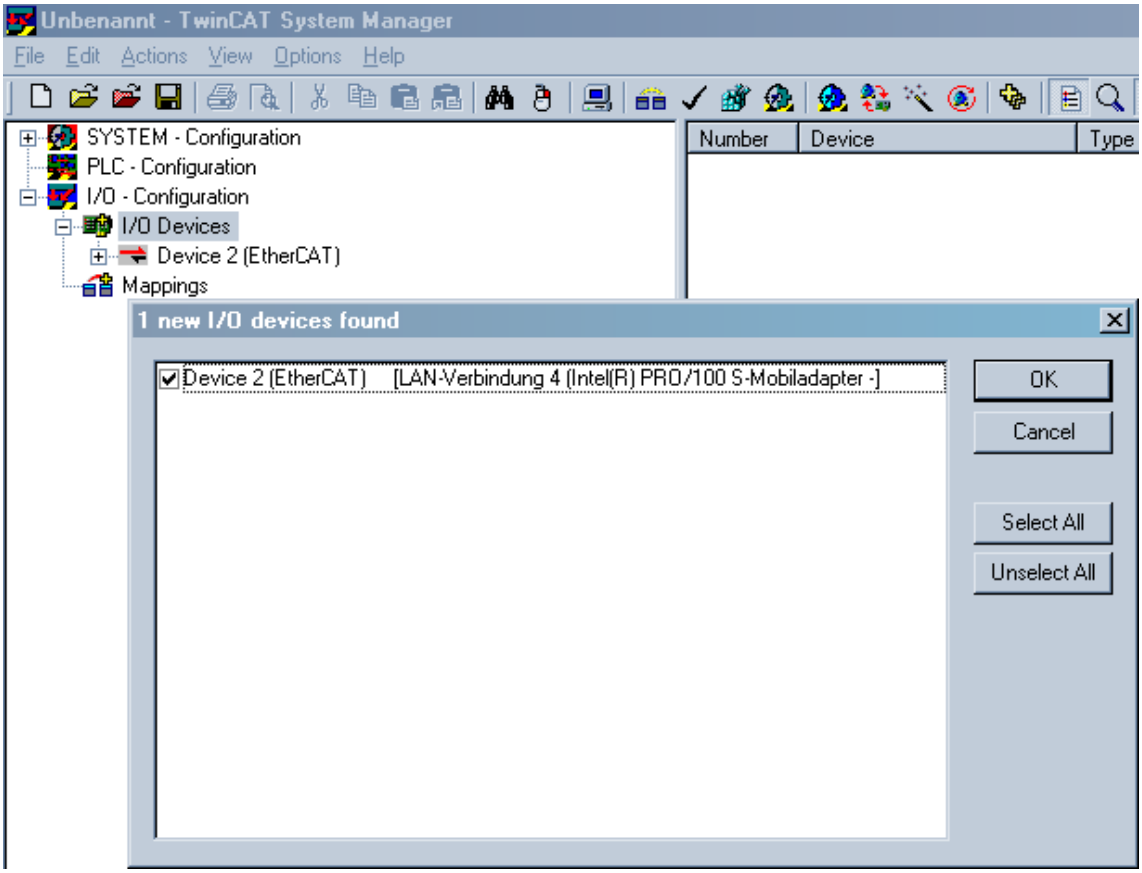
Press ***F5 key*** or click right mouse button on I/O Devices and select ***Scan Devices…***



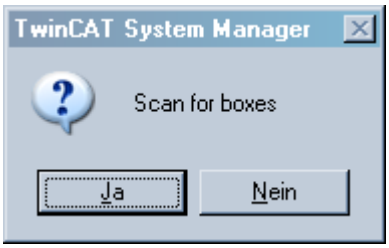
Select ***OK Button***



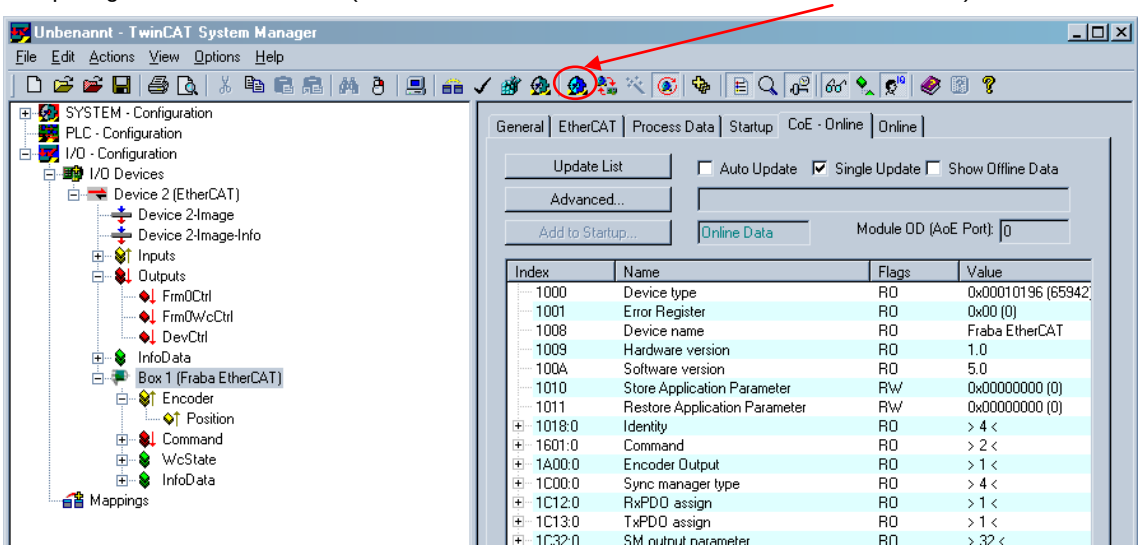
Select the network adapter where the EtherCAT® devices are connected



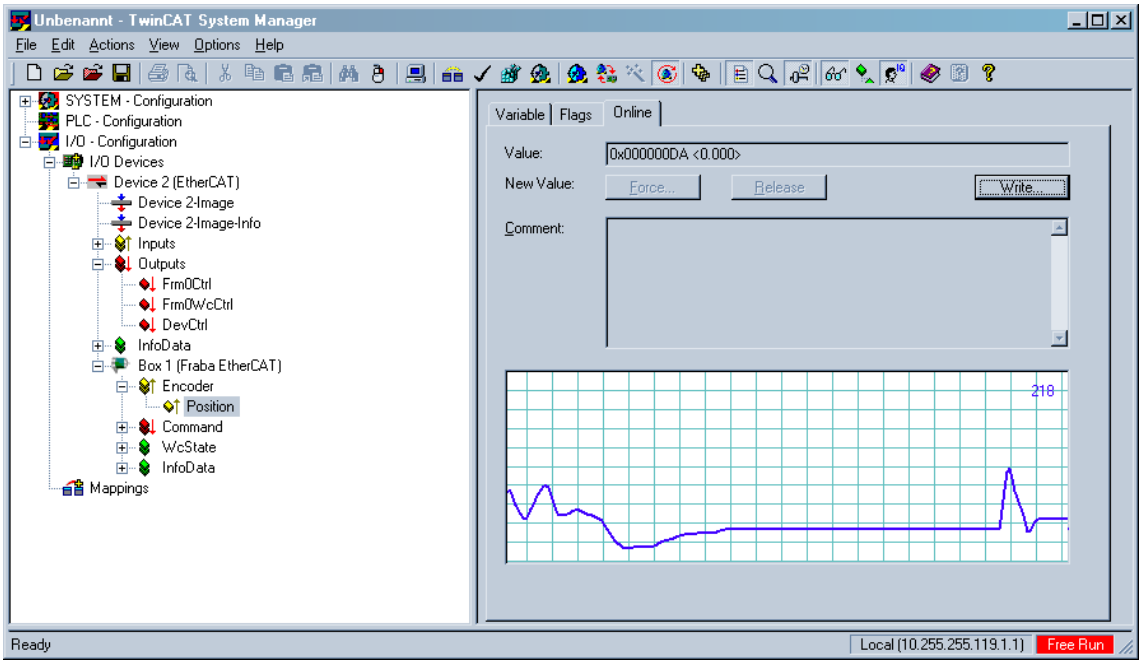
Accept to scan for boxes



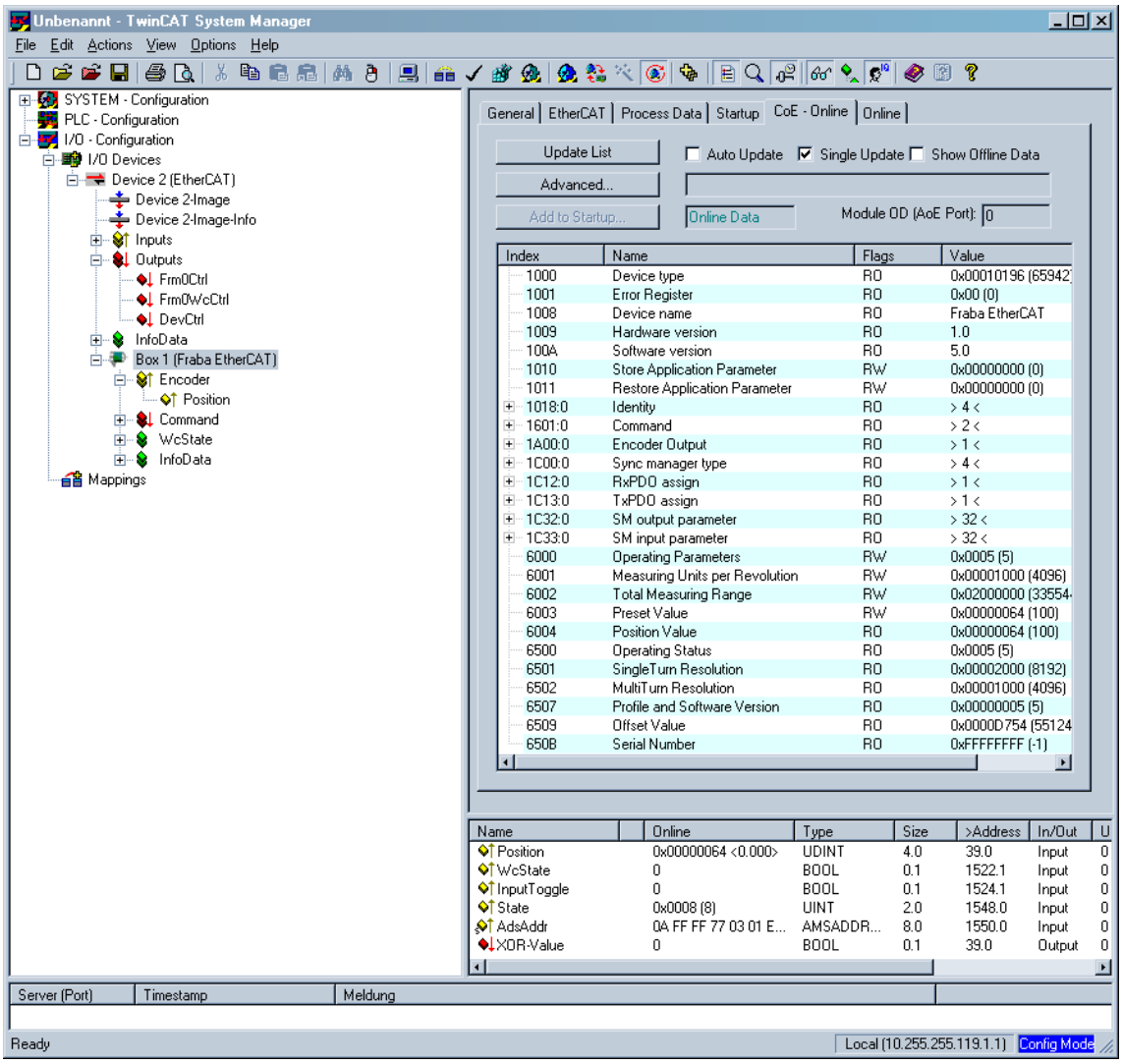
Accept to go in Free Run modus (Set/Reset TwinCAT® ***Shift+F4*** or click the marked button)



In the Free Run modus the communication between TwinCAT® and devices amount the cycle time 4ms. The position value is available i.e. the next screenshot.

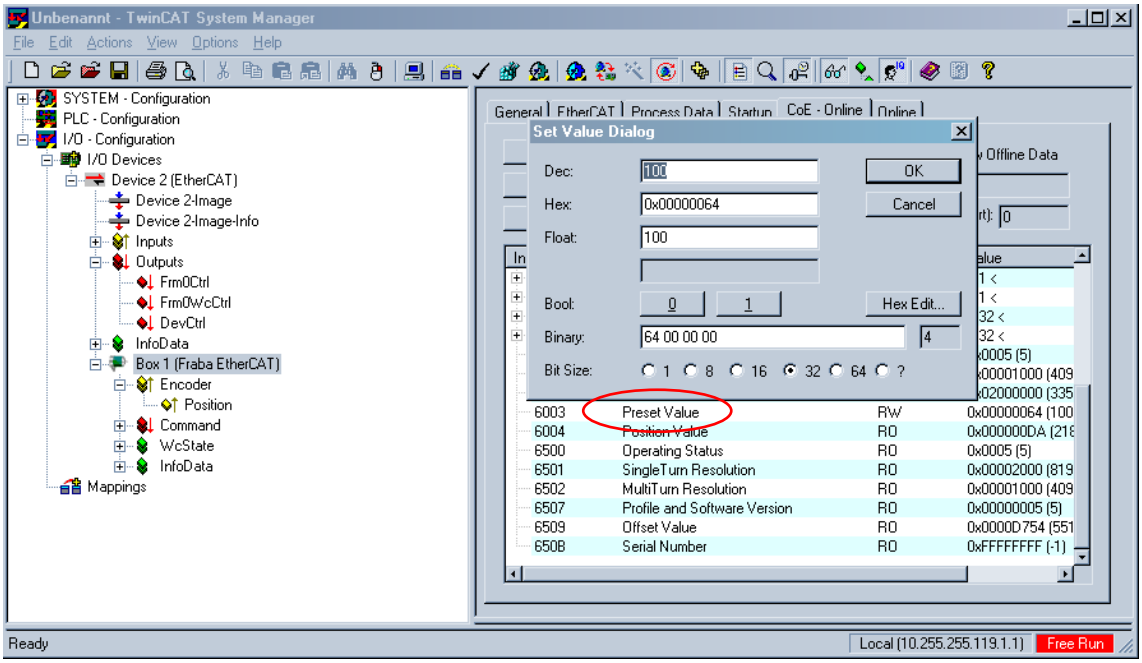


7.2.3 Objects

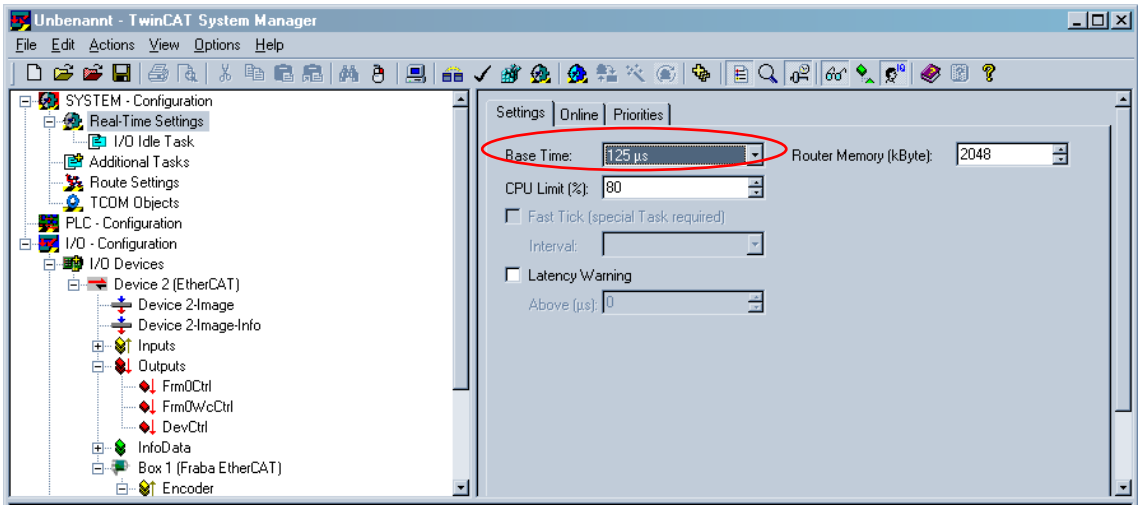

Unbenannt - TwinCAT System Manager
File Edit Actions View Options Help
SYSTEM - Configuration
PLC - Configuration
I/O - Configuration
I/O Devices
Device 2 (EtherCAT)
Device 2-Image
Device 2-Image-Info
Inputs
Outputs
Frm0Ctrl
Frm0WcCtrl
DevCtrl
InfoData
Box 1 (Fraba EtherCAT)
Encoder
Position
Command
WcState
InfoData
Mappings
General EtherCAT Process Data Startup CoE - Online Online
Update List
Auto Update
Single Update
Show Offline Data
Advanced...
Add to Startup...
Online Data
Module OD (AoE Port): 0
Index Name Flags Value
1000 Device type RO 0x00010196 (65942)
1001 Error Register RO 0x00 (0)
1008 Device name RO Fraba EtherCAT
1009 Hardware version RO 1.0
100A Software version RO 5.0
1010 Store Application Parameter RW 0x00000000 (0)
1011 Restore Application Parameter RW 0x00000000 (0)
1018:0 Identity RO > 4 <
1601:0 Command RO > 2 <
1A00:0 Encoder Output RO > 1 <
1C00:0 Sync manager type RO > 4 <
1C12:0 RxPDO assign RO > 1 <
1C13:0 TxPDO assign RO > 1 <
1C32:0 SM output parameter RO > 32 <
1C33:0 SM input parameter RO > 32 <
6000 Operating Parameters RW 0x0005 (5)
6001 Measuring Units per Revolution RW 0x00001000 (4096)
6002 Total Measuring Range RW 0x02000000 (33554
6003 Preset Value RW 0x00000064 (100)
6004 Position Value RO 0x00000064 (100)
6500 Operating Status RO 0x0005 (5)
6501 SingleTurn Resolution RO 0x00002000 (8192)
6502 MultiTurn Resolution RO 0x00001000 (4096)
6507 Profile and Software Version RO 0x00000005 (5)
6509 Offset Value RO 0x0000D754 (55124
650B Serial Number RO 0xFFFFFFFF (-1)
Name Online Type Size >Address In/Out U
Position 0x00000064 <0.000> UDINT 4.0 39.0 Input 0
WcState 0 BOOL 0.1 1522.1 Input 0
InputToggle 0 BOOL 0.1 1524.1 Input 0
State 0x0008 (8) UINT 2.0 1548.0 Input 0
AdsAddr 0A FF FF 77 03 01 E... AMSADDR... 8.0 1550.0 Input 0
XOR-Value 0 BOOL 0.1 39.0 Output 0
Server (Port) Timestamp Meldung
Ready
Local (10.255.255.119.1.1) Config Mode

7.2.4 Set Preset value

In this sample the Preset value is set to 100. Double click on Preset. After confirmation with ***OK*** the Position value switch to 100. **Note:** Set object 1010h from chapter 8 to save all parameters to the non volatile memory!

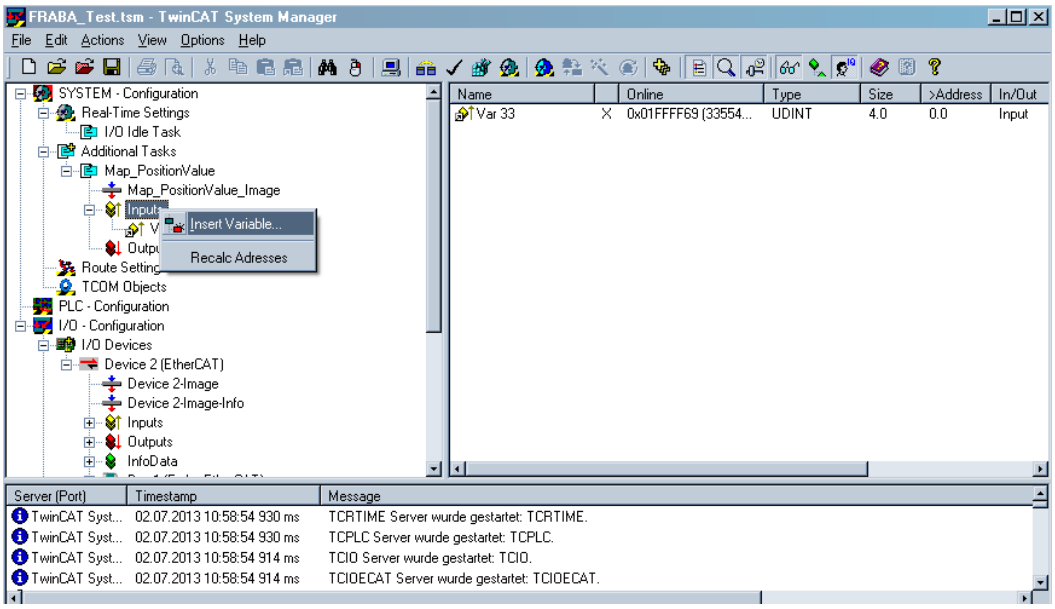


7.2.5 Set Base Time for Real-time mode

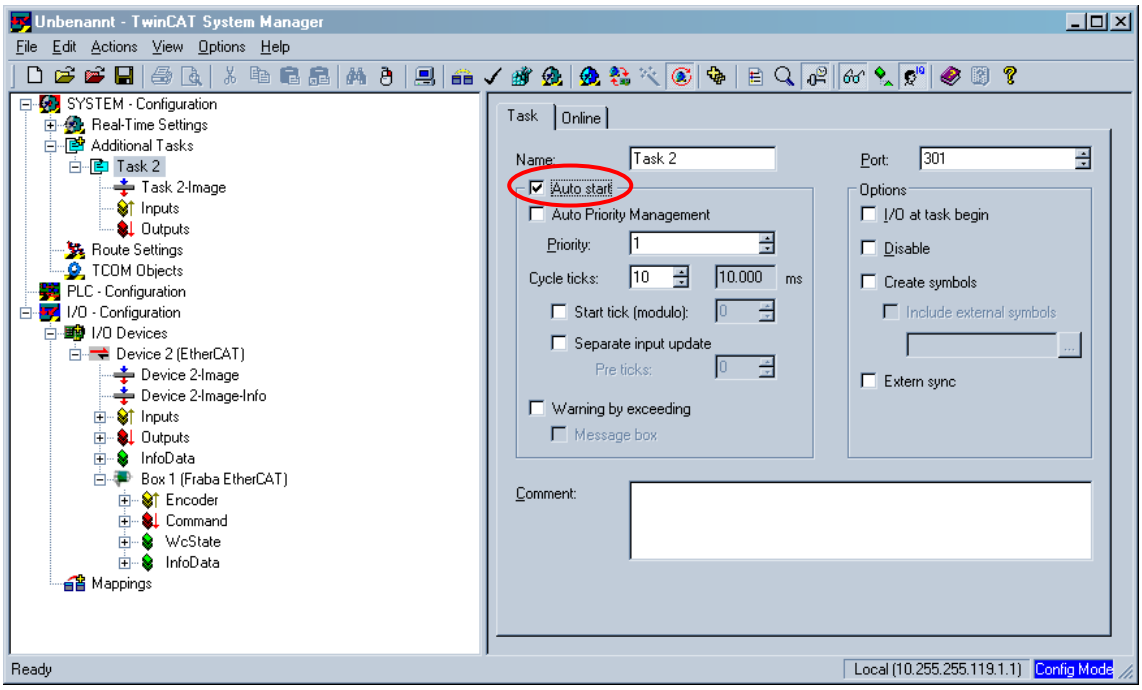


7.2.6 Mapping of parameters

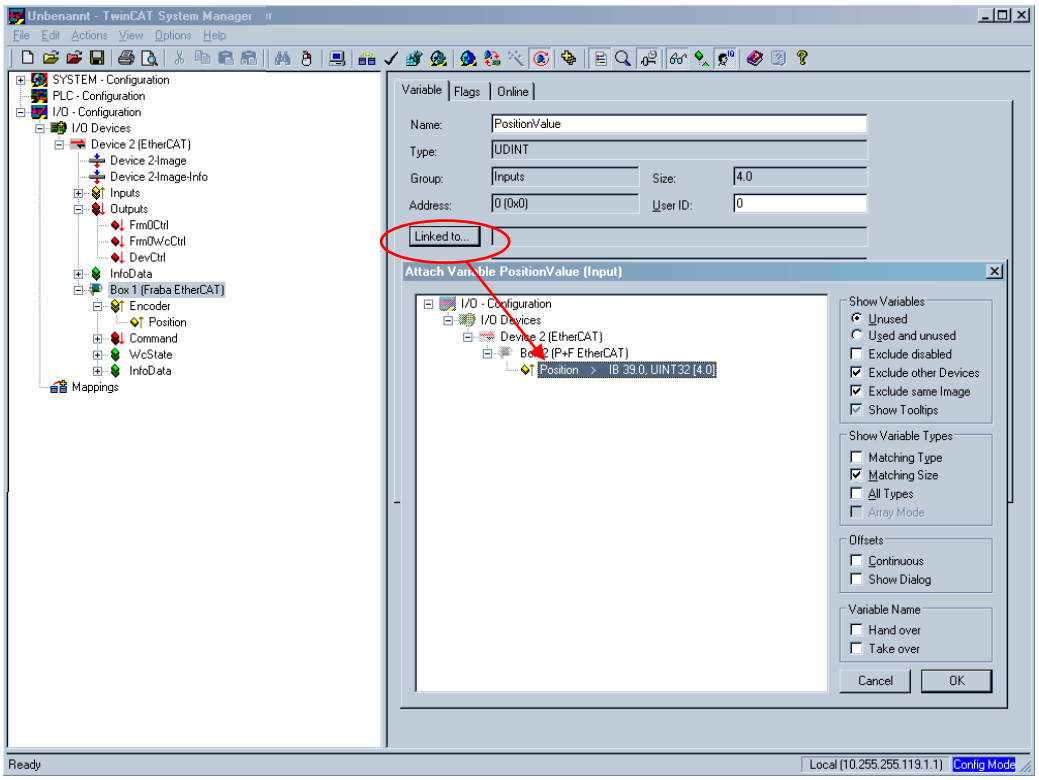
If no external EtherCAT®-Master is in use (only Laptop as Master) then an additional task is necessary. After right mouse click on Inputs it is possible to insert a variable.



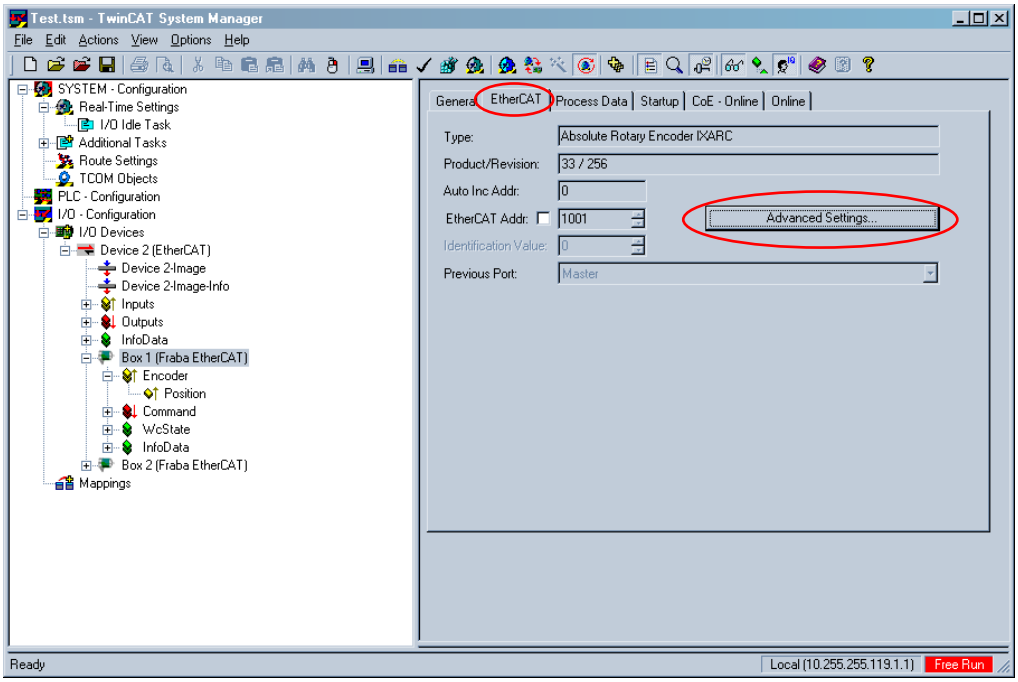
Set Checkbox for Auto start to get back position values

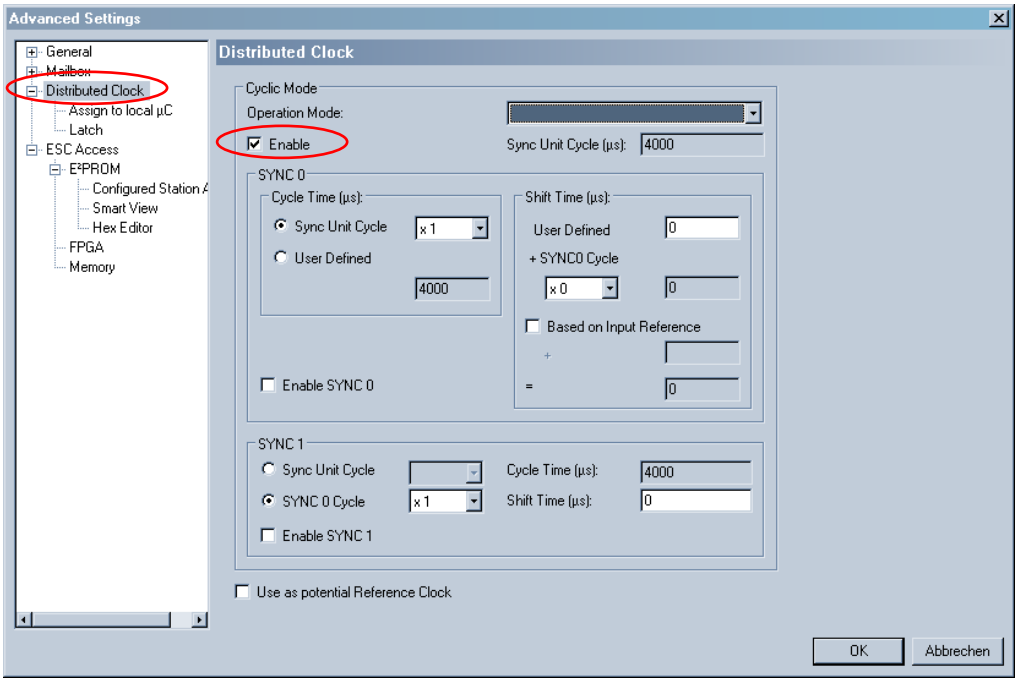


Go in Set/Reset TwinCAT® in Run Mode (***CTRL+F4***)



7.2.7 Distributed Clocks

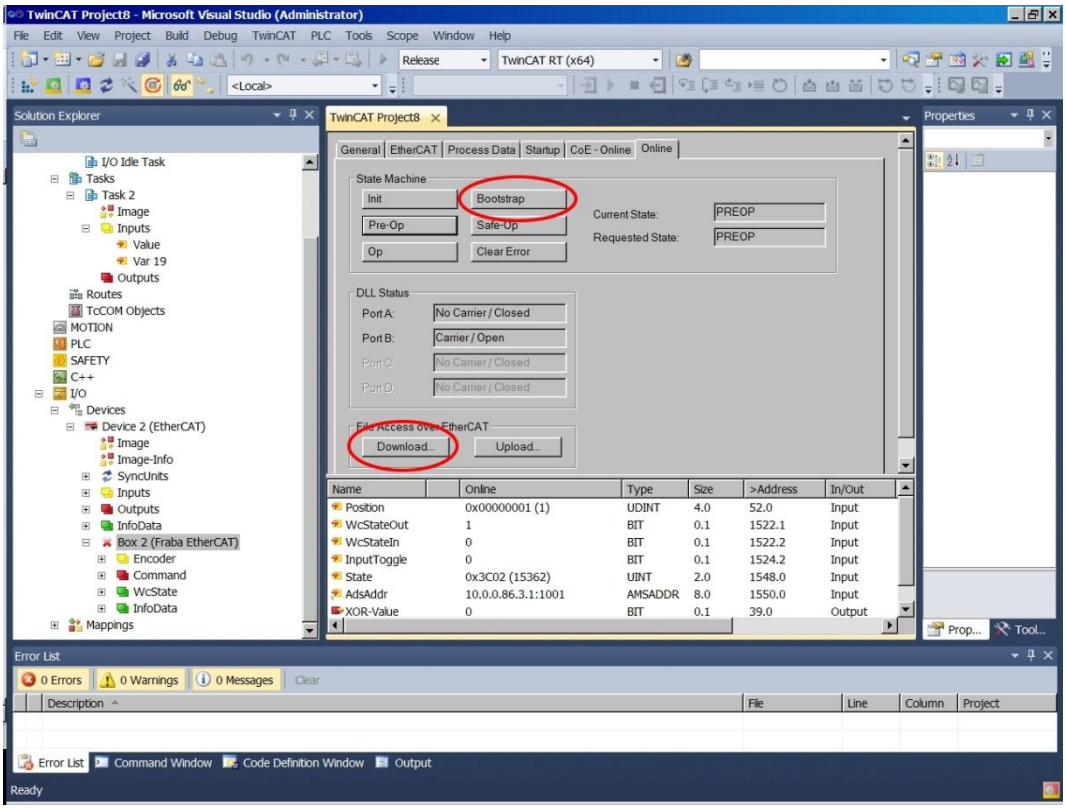




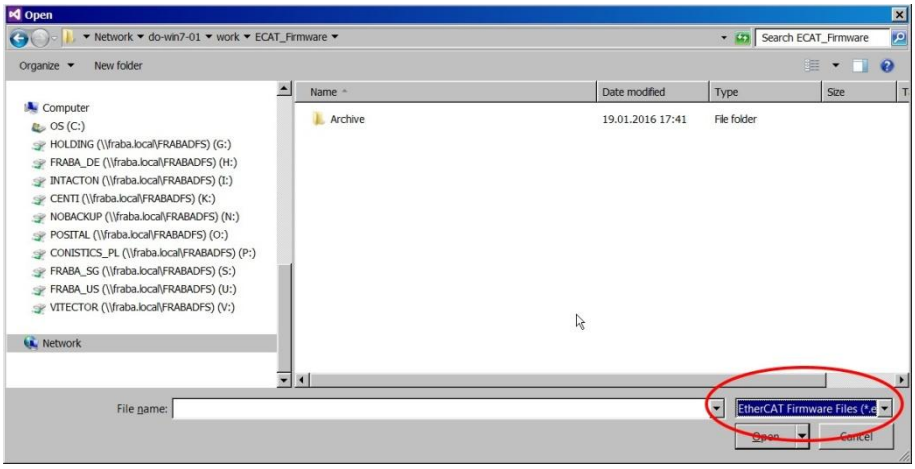
7.2.8 Remote Firmware Update

Execute remote firmware update always in “TwinCAT config mode”.

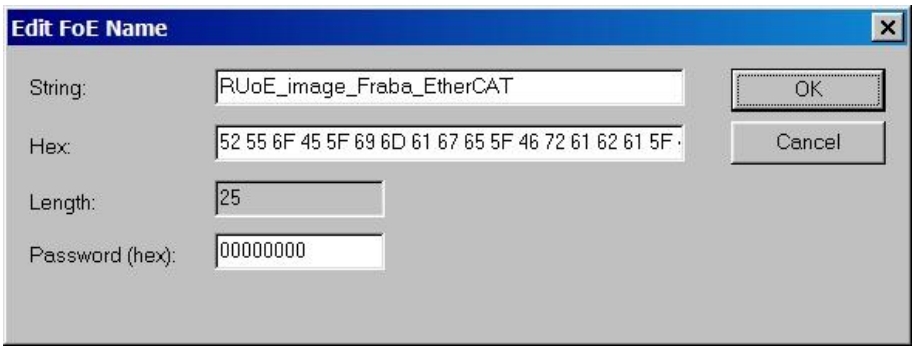
1) Set encoder state machine to bootstrap mode. Click “Download”.



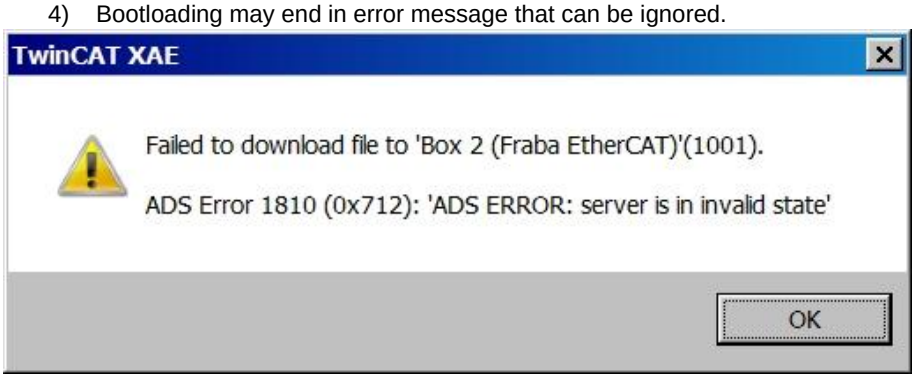
2) Select in the drop menu all file name extensions (*.*).



3) Select correct firmware version to be updated and enter the Password.



4) Bootloading may end in error message that can be ignored.



7.3 Configuration with TwinCAT® 3

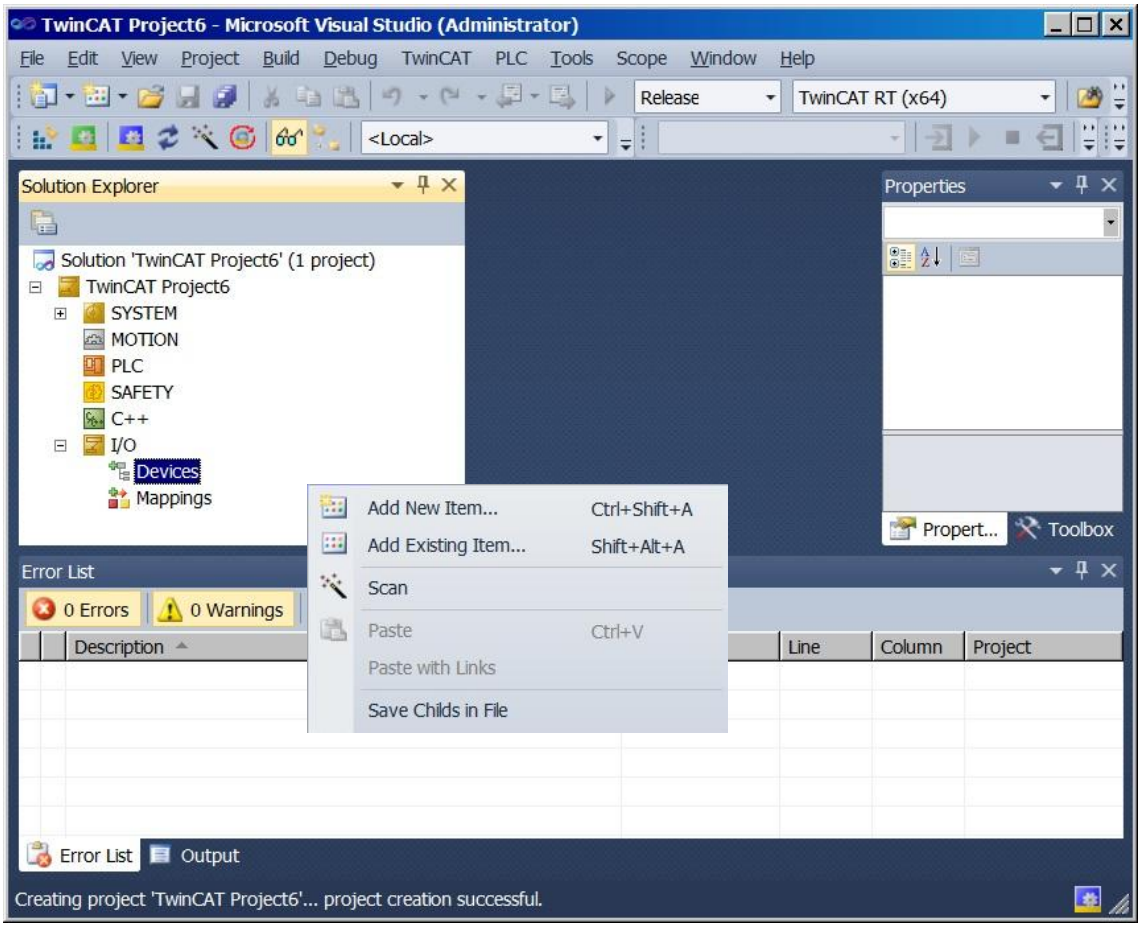
7.3.1 Import the ESI file

Copy the ESI file in the following directory:

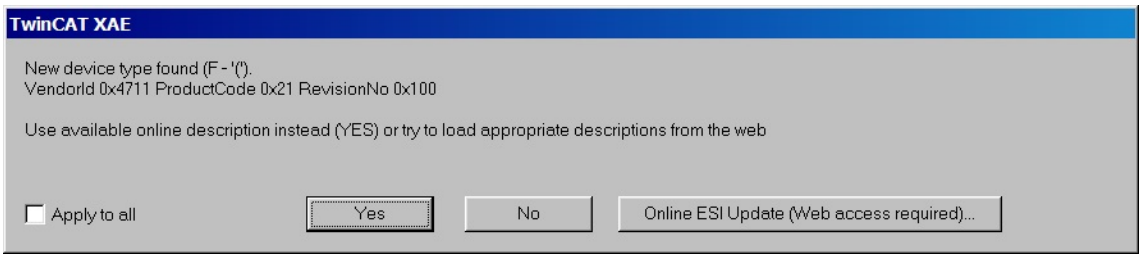
…\TwinCAT\3.1\Config\Io\EtherCAT

7.3.2 Create project

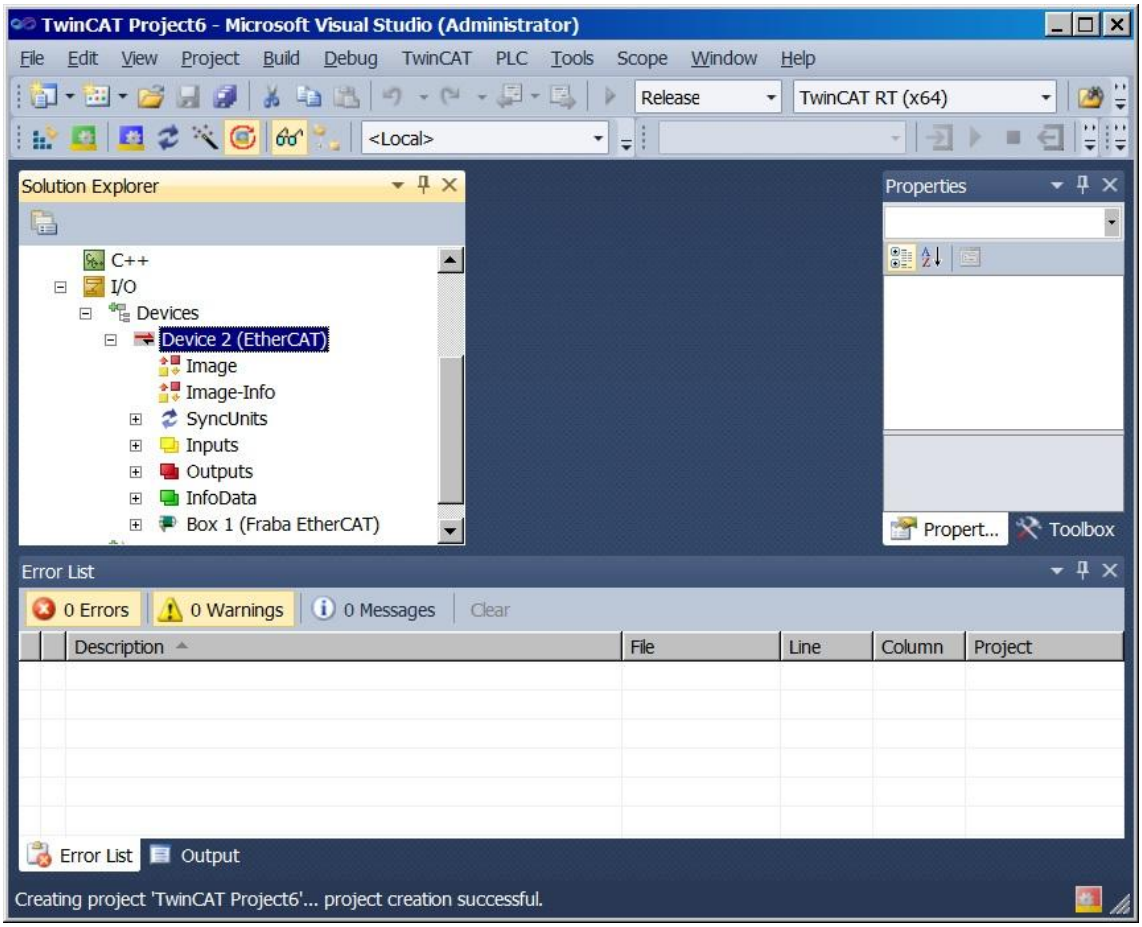
Add New Item under Devices



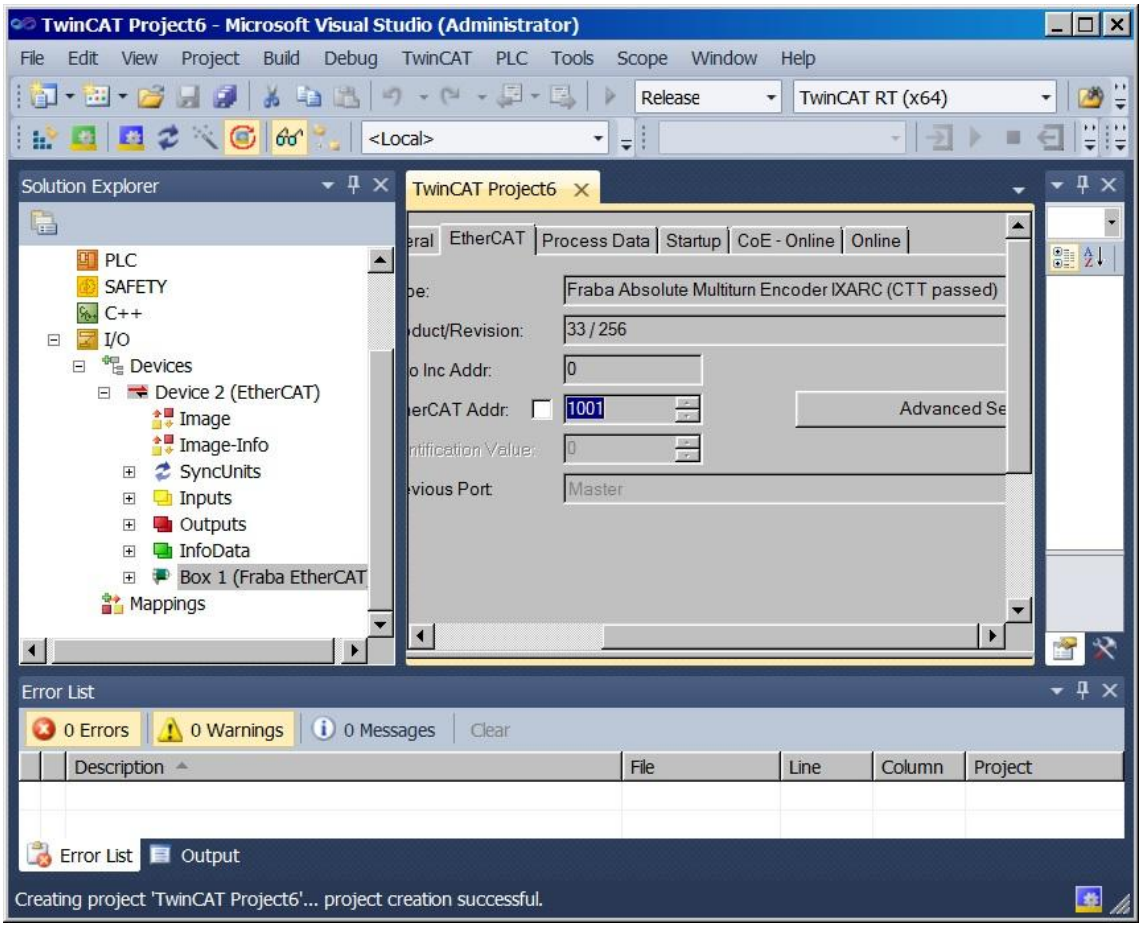
If ESI-File was not installed you get the following message:



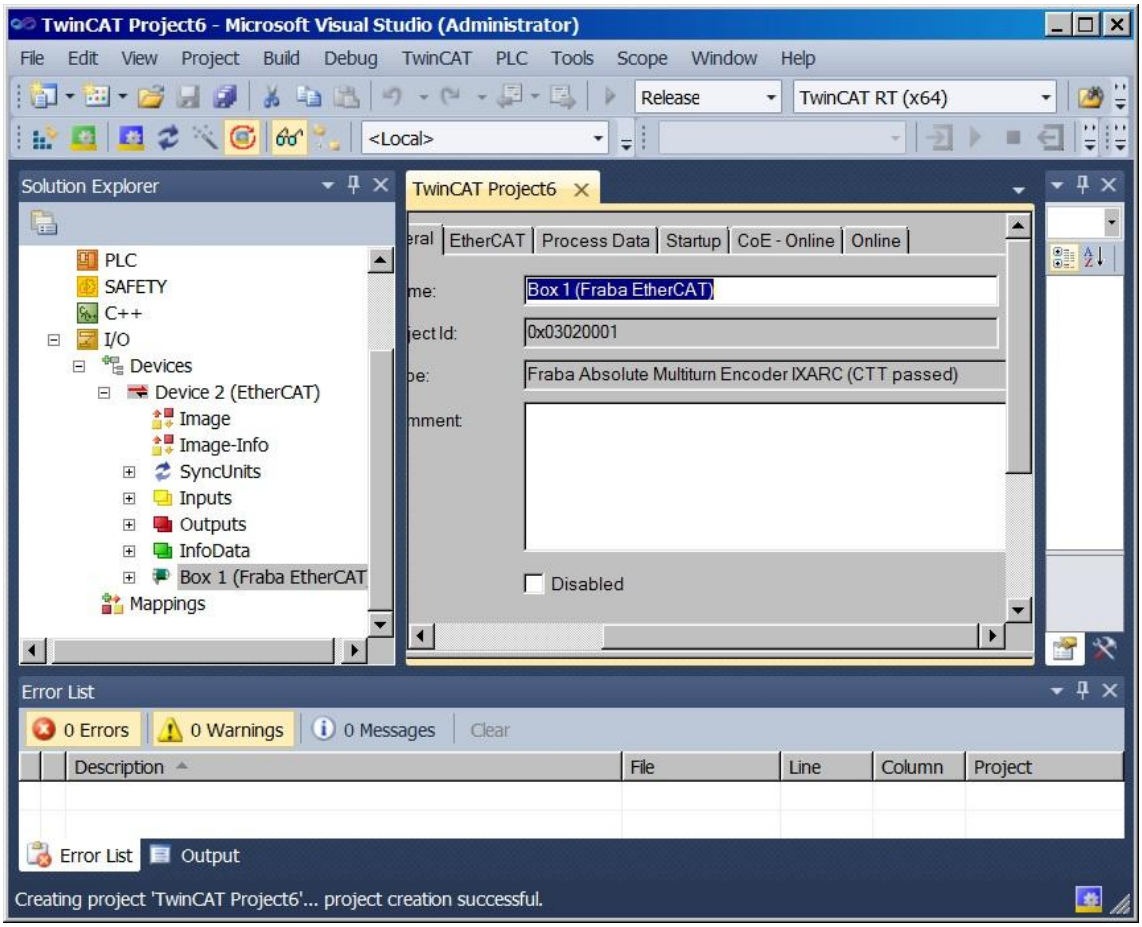
The encoder is available under the EtherCAT® Device (network card) as Box under InfoData (see encoder icon).



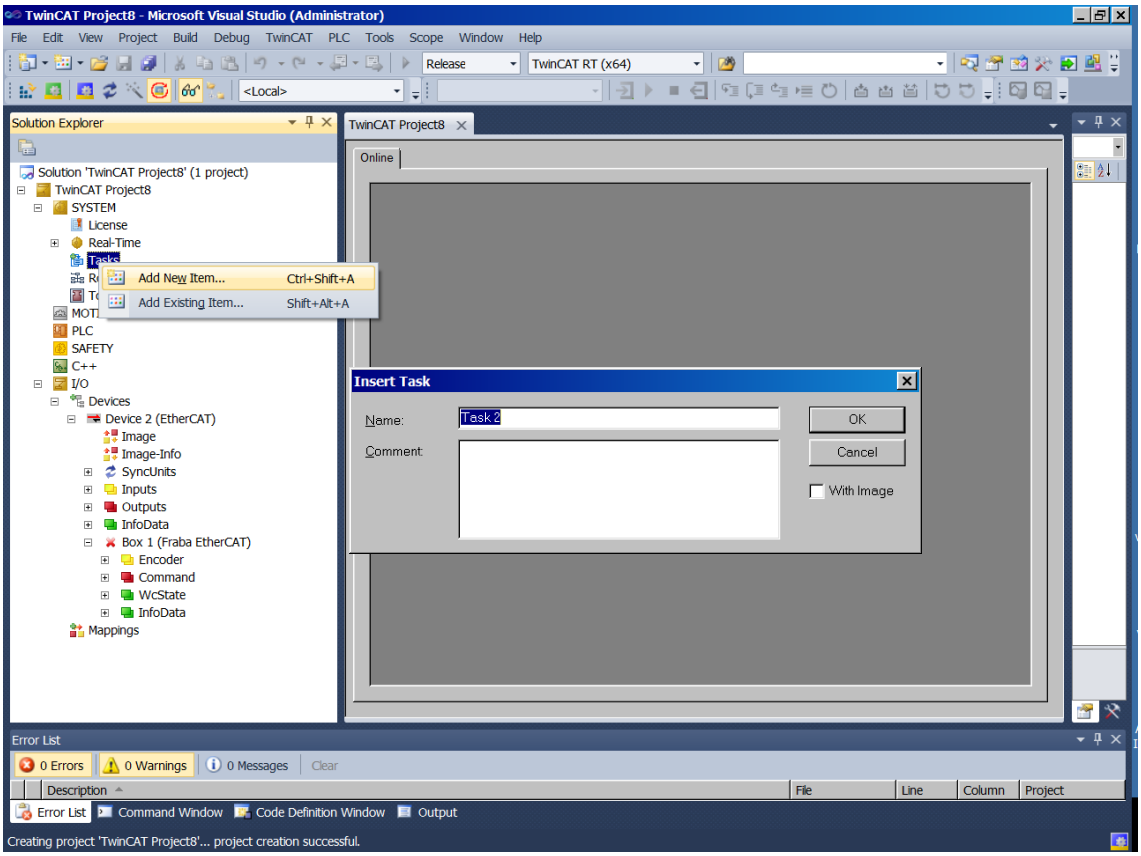
Under the tabs is it possible to set the different configurations.



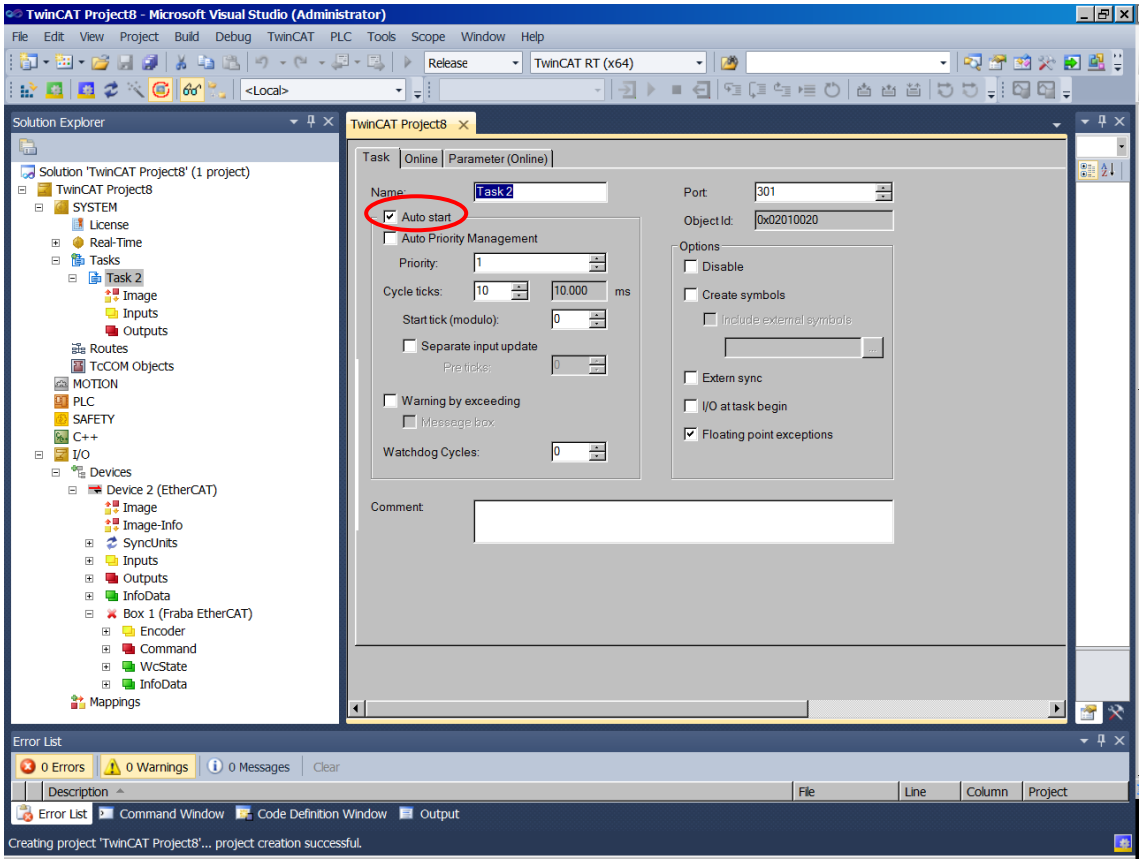
Change the device to an explicit name.



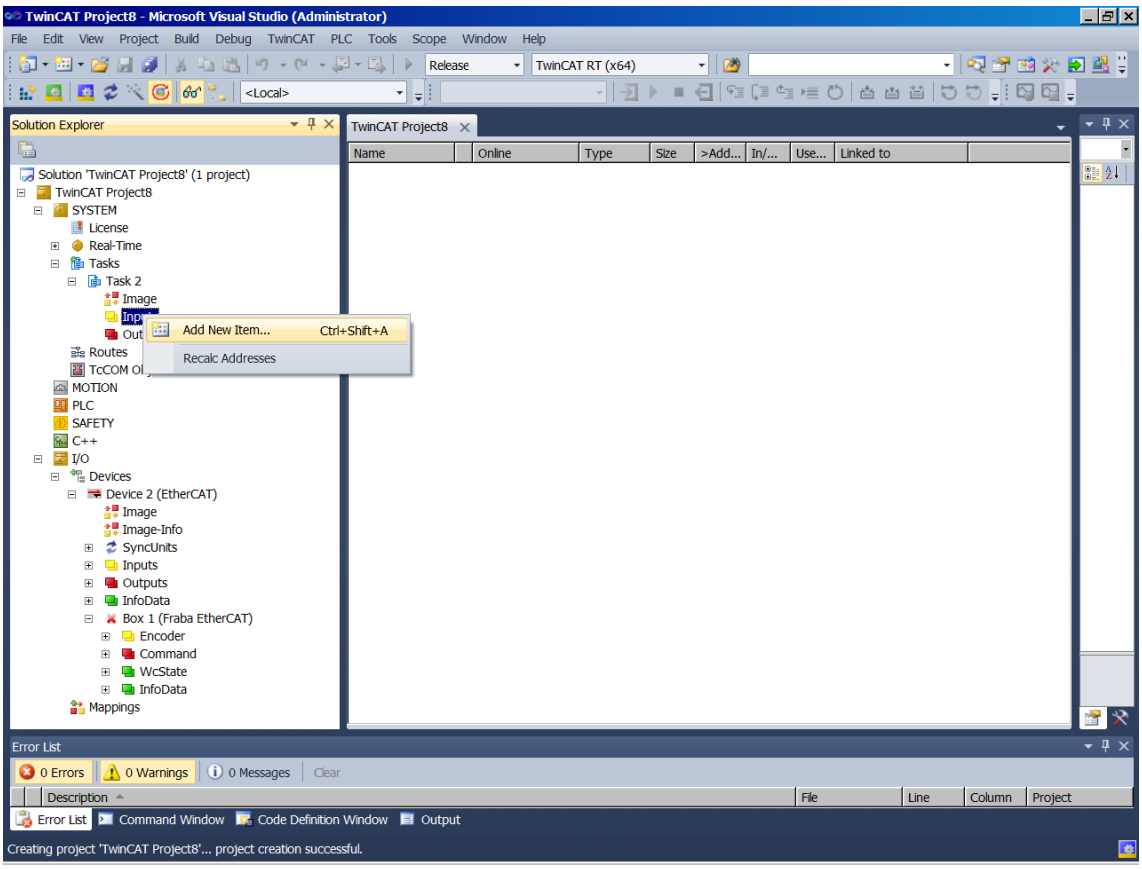
If no external EtherCAT®-Master is in use (only Laptop as Master) then an additional task is necessary. After right mouse click on Inputs it is possible to insert a variable.

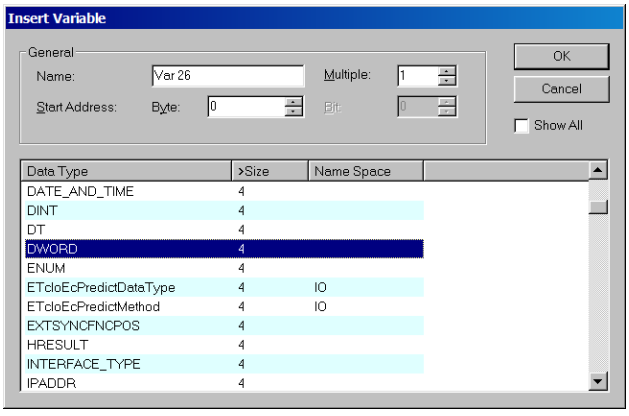


Activate Auto start

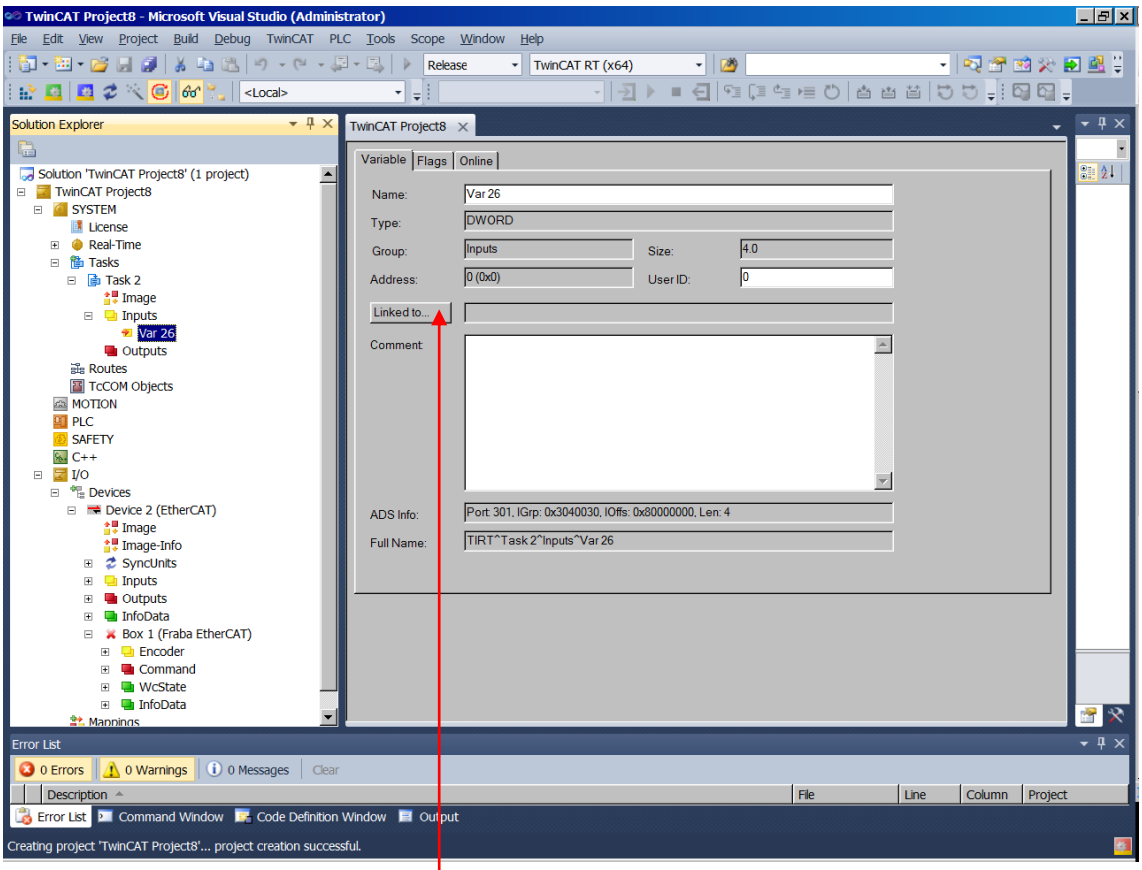


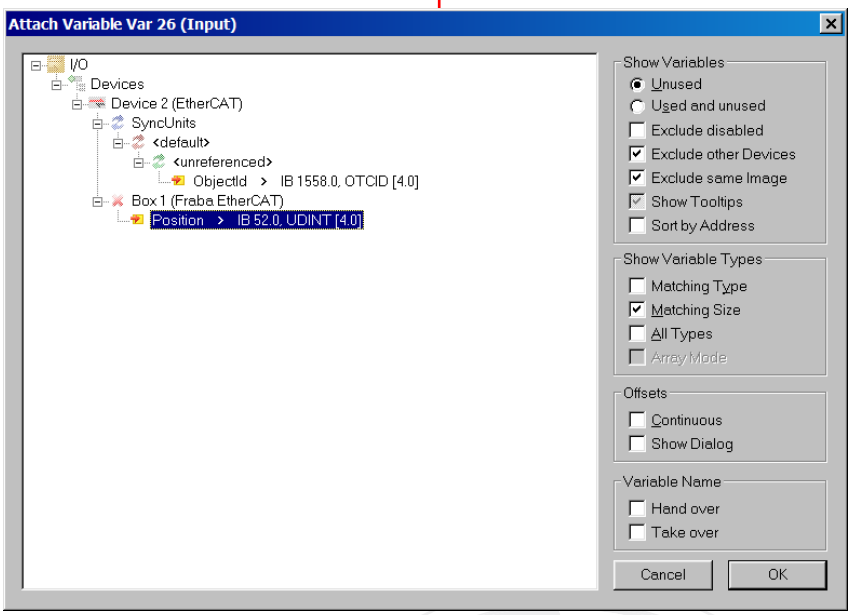
Add New Item under Input and set the attributes

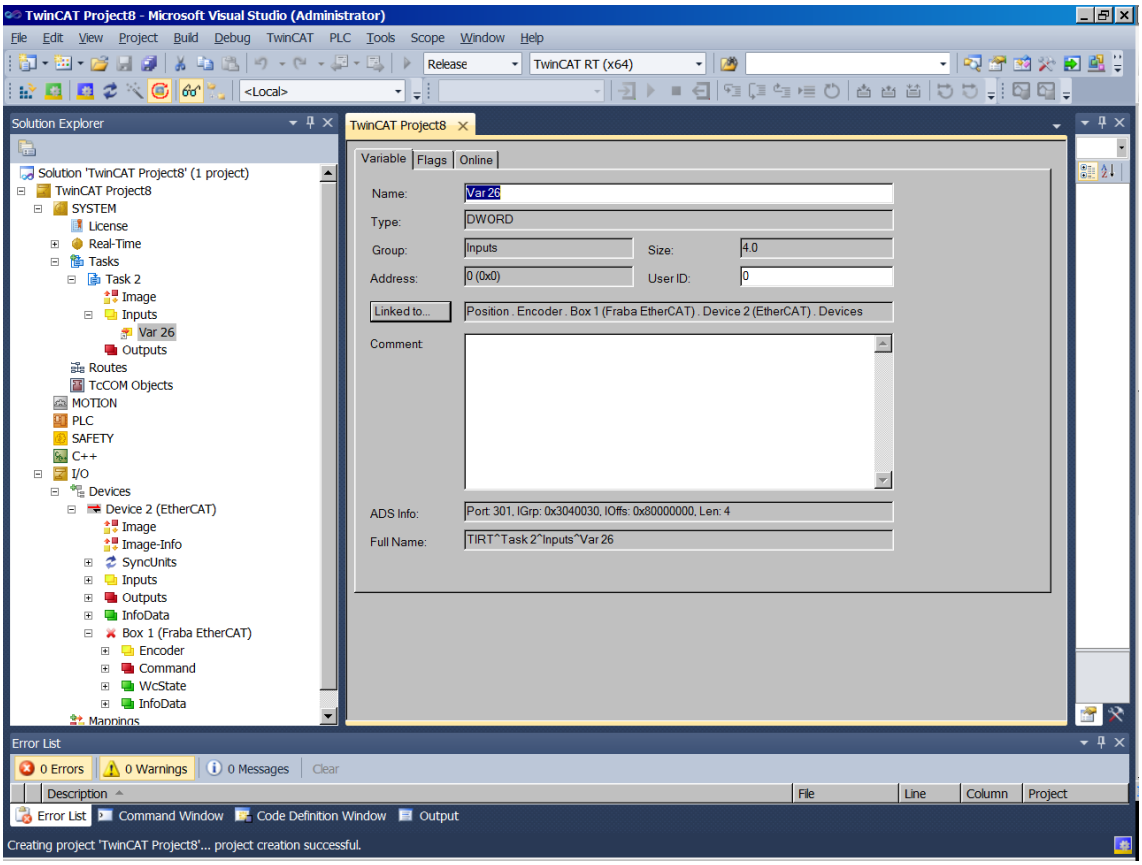




Attach the necessary variable

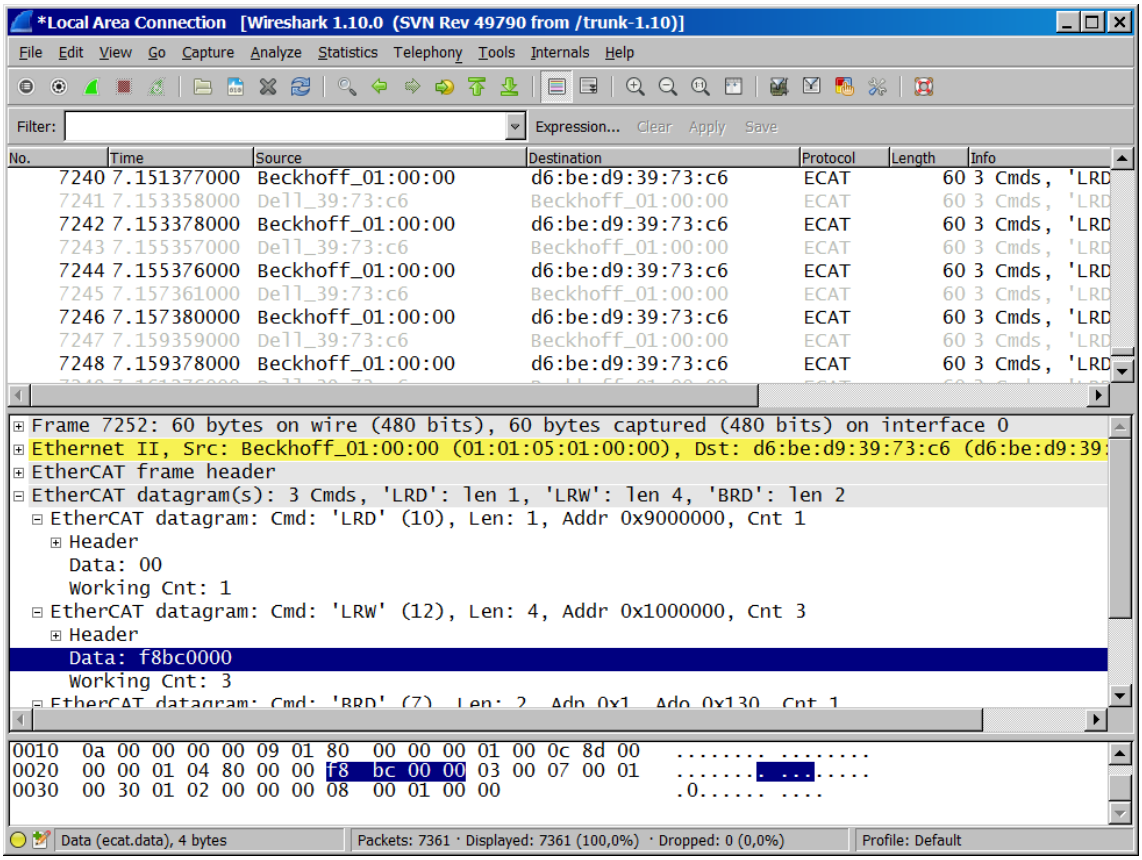





TwinCAT Project8 - Microsoft Visual Studio (Administrator)
File Edit View Project Build Debug TwinCAT PLC Tools Scope Window Help
Release
TwinCAT RT (x64)
<Local>
Solution Explorer
Solution 'TwinCAT Project8' (1 project)
TwinCAT Project8
SYSTEM
License
Real-Time
Tasks
Task 2
Image
Inputs
Var 26
Outputs
Routes
TcCOM Objects
MOTION
PLC
SAFETY
C++
I/O
Devices
Device 2 (EtherCAT)
Image
Image-Info
SyncUnits
Inputs
Outputs
InfoData
Box 1 (Fraba EtherCAT)
Encoder
Command
WcState
InfoData
Mappings
TwinCAT Project8
Variable Flags Online
Name: Var 26
Type: DWORD
Group: Inputs
Size: 4.0
Address: 0 (0x0)
User ID: 0
Linked to...
Position . Encoder . Box 1 (Fraba EtherCAT) . Device 2 (EtherCAT) . Devices
Comment:
ADS Info: Port: 301, IGrp: 0x3040030, IOffs: 0x80000000, Len: 4
Full Name: TIRT^Task 2^Inputs^Var 26
Error List
0 Errors 0 Warnings 0 Messages Clear
Description File Line Column Project
Error List Command Window Code Definition Window Output
Creating project 'TwinCAT Project8'... project creation successful.

7.4 Diagnostic

If problems occur it is possible to conduct diagnosis with standard Ethernet tools like Wireshark (http://www.wireshark.org). It is one tool of many available on the market which can be used, because EtherCAT® is using standard Ethernet frames. With this tool an interpretation of Ethernet frames according to EtherCAT® is possible. Just the right filter “ECAT” has to be selected and the user has a powerful tool. In case of problems it is recommended to log a trace for own analysis or send this log to manufacturer for further evaluation purposes. Anyhow our experience is, that this tool has also restrictions at very low EtherCAT® cycles and that you cannot trust time stamps and the order of logged telegrams. In those cases contact Beckhoff for support.



8 Communication Profile

The CANopen communication profiles have been overtaken for the EtherCAT® protocol to minimize integration effort for the customer. This means for encoders, that communication parameters are corresponding to the profile DS301 V4.02. In the following table the supported parameters are listed:

Object	Description	Data type	Access type
1010h	Store application parameter	Unsigned 32	r / w
1011h	Restore application parameter	Unsigned 32	r / w

Object 1010h: Store application parameter

This object shall save all parameters to the non volatile memory.

Subindex	Description	Data Type	Default Value	Access
0h	Store all parameters	Unsigned 32	65766173h	rw

To save the parameters to non volatile memory the access signature 65766173h has to be sent to the corresponding subindex of the device.

Object 1011h: Restore application parameter to manufacture default value

This object shall restore parameters 6000-6003 to the default values and store to the non volatile memory.

Subindex	Description	Data Type	Default Value	Access
0h	Restore parameters 6000-6003	Unsigned 32	64616F6Ch	rw

To restore the parameters to non volatile memory the access signature 64616F6Ch has to be sent to the corresponding subindex of the device.

9 Encoder Profile

The CANopen Device profiles have been overtaken for the EtherCAT® protocol to minimize integration effort for the customer. This means for encoders, that device parameters are corresponding to the profile DS406. In the following table the supported parameters are listed:

Object	Description	Data type	Access type
6000h	Operating Parameters	Unsigned 16	r / w
6001h	Measuring units per revolution	Unsigned 32	r / w
6002h	Total measuring range in measuring units	Unsigned 32	r / w
6003h	Preset value	Unsigned 32	r / w
6004h	Position Value	Unsigned 32	r / w
6500h	Operating status	Unsigned 16	r
6501h	Single-turn resolution	Unsigned 32	r
6502h	Number of distinguishable revolutions	Unsigned 32	r
6507h	Profile and Software Version	Unsigned 32	r
6509h	Offset Value	Unsigned 32	r
650Bh	Serial Number (fits to Identity Object 1018h)	Unsigned 32	r

Object 6000h: Operating parameters

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

Subindex	Description	Data Type	Default Value	Access
0h	Operating Parameter	Unsigned 16	4h	rw

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.

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 6001h) and total measuring range in measuring units (object 6002h) 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.
Set object 1010h from chapter 8 to save all parameters to the non volatile memory!

Bit structure for the operating parameters

Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Use	MS	MS	MS	MS	R	R	R	R	R	R	R	R	MD	SFC	CD	CS

Table Description:
MS: Manufacturer Specific Function (not available)
R: Reserved for future use
MD: Measuring direction (not available)
SFC: Scaling function (0 = disable, 1 = enable)
CD: Commissioning diagnostic control (not available)
CS: Code sequence (0 = CW, 1 = CCW)

Object 6001h: Measuring units per revolution

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

Subindex	Description	Data Type	Default Value	Access
0h	Measuring units per revolution	Unsigned 32	See type shield	rw

Attention: The ESI file has as default value 2000 hex. This value has to be adapted in the project tool to the specific encoder value. Please refer to the type shield for the type key and data sheet.
Set object 1010h from chapter 8 to save all parameters to the non volatile memory!

Object 6002h: Total measuring range in measuring units

This object shall indicate the number of distinguishable steps over the total measuring range.

Subindex	Description	Data Type	Default Value	Access
0h	Total measuring steps	Unsigned 32	see type shield	rw

Attention: The ESI file has as default value 1000 hex. This value has to be adapted in the project tool to the specific encoder value. Please refer to the type shield for the type key and data sheet.
Set object 1010h from chapter 8 to save all parameters to the non volatile memory!

Object 6003h: Preset value

This object indicates the preset value for the output position value. The encoder output position can be set to a desired value: Preset value. Set object 1010h from chapter 8 to save all parameters to the non volatile memory!

Subindex	Description	Data Type	Default Value	Access
0h	Preset Value	Unsigned 32	0h	rw

Object 6004h: Position value

This object contains the process value of the encoder.

Subindex	Description	Data Type	Default Value	Access
0h	Process Value	Unsigned 32	–	romap

Object 6500h: Operating status

This object shall provide the operating status of the encoder. It gives information on encoder internal programmed parameters.

Subindex	Description	Data Type	Default Value	Access
0h	Operating status	Unsigned 16	4	ro

Object 6501h: Single-turn resolution

The object contains the physical measuring steps per revolution of the absolute rotary encoder.
A value written in object 6001h must be lower than defined in 6501.

Subindex	Description	Data Type	Default Value	Access
0h	Single Turn Resolution	Unsigned 32	see type shield	ro

Object 6502h: Number of distinguishable revolutions

This object contains number of revolutions of the absolute rotary encoder.

A value written in object 6002h must be lower than defined as the multiplication of object 6501h and 6502h. Object 6002h <= 6501h * 6502h.

Subindex	Description	Data Type	Default Value	Access
0h	Number of Revolutions	Unsigned 16	see type shield	ro

Object 6507h: Profile and software version

This object provides the implemented encoder device profile version and the manufacturer-specific software version.

Subindex	Description	Data Type	Default Value	Access
0h	Profile and Software Version	Unsigned 32	xxyy0302h	ro

The value is divided into the profile version part and the Software version part. Each part is divided in upper version and lower version.

MSB LSB

Software Version xx.yy		Profile Version 3.2	
Upper Software Version	Lower Software Version	Upper Software Version	Lower Software Version
xx	yy	xx	yy

Object 6509h: Offset value

This object contains the offset value. It is been calculated by the preset function and shifts the physical position value with the desired value.

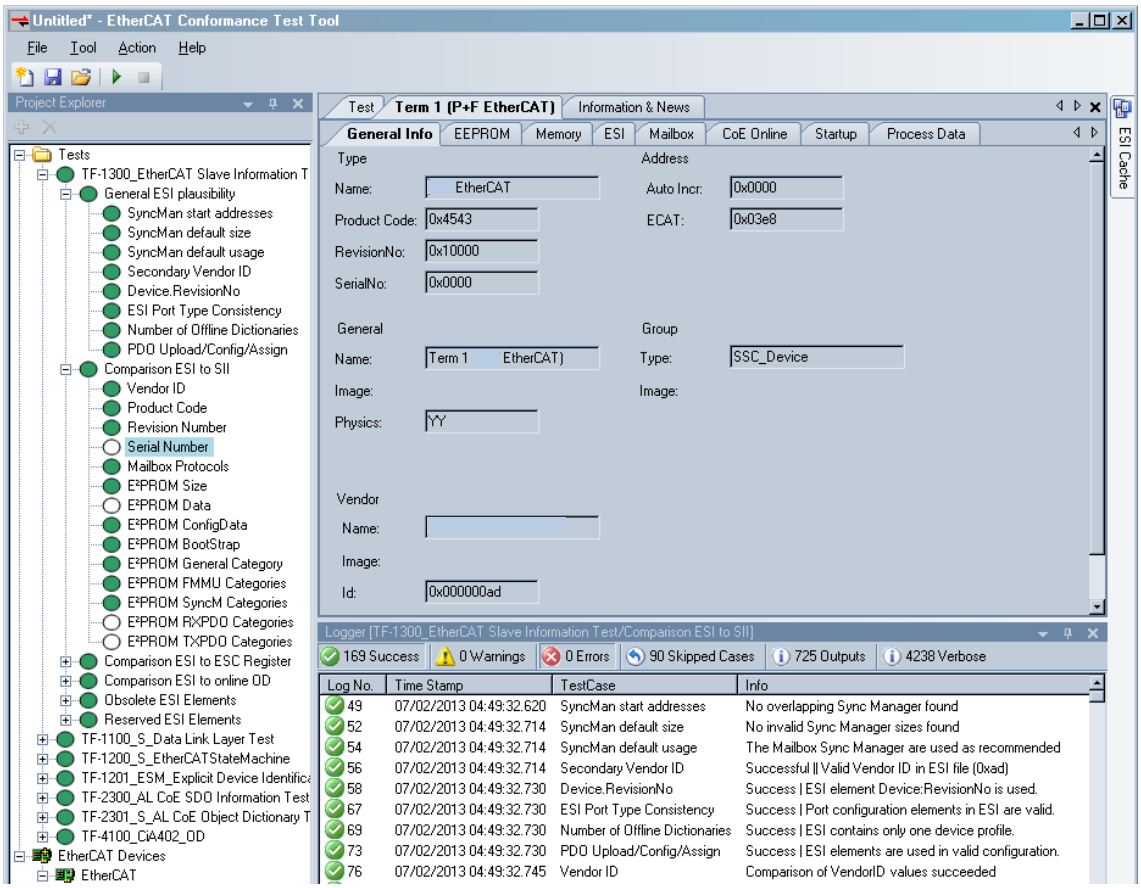
Subindex	Description	Data Type	Default Value	Access
0h	Offset value	Integer 32	–	ro

Object 650Bh: Serial number

This object contains the serial number of the device. The serial number is identical with the value in object 1018h subindex 4h.

Subindex	Description	Data Type	Default Value	Access
0h	Serial Number	Unsigned 32	See type sign	ro

10 Conformance Test



11 Glossary

Terms	Description
10 Base T	Transmission line with 10 Mbit data transmission rate
100 Base T	Transmission line with 100 Mbit data transmission rate
APV	Absolute Position Value.
ASCII	American Standard Code for Information Interchange ASCII describes as code the correlation from digital integers to a normal font described character.
Batch file	Script program for MS-DOS
Baud rate	Transmission rate; it display the transmission bits per second
Binary	Numeric system with value 0 or 1.
Byte	8-bit unit of data = 1 byte.
CAN	Controller Area Network or CAN multiplexing network.
CANopen	Application layer of an industrial network based on the CAN bus.
CAT5	Terminations for transmission rates up to 100 Mbit.
CCW	Counter-clockwise
CiA	CAN In Automation, organization of manufacturers and users of devices that operate on the CAN bus.
CoE	CANopen over EtherCAT®
CRC	The cyclic redundancy check is a method from the information technology to control a checksum for data, to reduce errors by the transmission.
CW	Clockwise
DC	Distributed Clocks
EEPROM	Electrically Erasable Programmable Read-only Memory
EMC	Electromagnetic compatibility, there are rules to verifying devices.
ESC	EtherCAT® Slave Controller
ESI	EtherCAT® Slave Information, electronic data sheet based on XML
ETG	EtherCAT® Technology Group
EtherCAT®	EtherCAT® is registered trademark and patented technology, licensed by Beckhoff Automation GmbH, Germany
Ethernet	Ethernet is a computer network technology based on frames.
FAQ	Frequently Asked Questions
Fast Ethernet	Transmission technology with 100 Mbit transmission rate.
Flash	Internal memory, saved data will be available after power down.
IP-Protocol	The Internet Protocol is widespread in computer networks. It is the implementation of the internet layer of the TCP/IP-model
Mbit	Transmission rate or baud rate, million bits per second
OSI-Model	The Open System Interconnection reference model is an open layer model for the organization of a communication.
PCV	Process Value

PDO	Communication object, with a high priority for sending process data.
PLC	Programmable Logic Controller
PV	Preset Value: Configuration value
RO	Read Only: Parameter that is only accessible in read mode.
ROMAP	Read Only MAPable: Parameter that can be polled by the PDO.
RW	Read/Write: Parameter that can be accessed in read or write mode.
SDO	Communication object, with a low priority for messaging (configuration, error handling, diagnostics). Slave Bus node that sends data at the request of the master. The encoders are always slaves.
TCP	The Transmission Control Protocol is a connection orientated transmission protocol, in a network.
TwinCAT®	Configuration tool for Beckhoff controllers
WO	Write Only: Parameter that is only accessible in write mode.

12 Additional information

www.ethercat.org
ETG.1000, 2 … 6: Layer protocol & service definitions
ETG.1020, EtherCAT Guidelines and Protocol Enhancements
ETG.1300, EtherCAT Indicator & Labeling specification (as per IEC 61784-2)
ETG.2000, EtherCAT Slave Information
ETG.2200, EtherCAT Slave Implementation Guide
CiA DS-301, CANopen communication profile
CiA DS-406, Profile Encoder for CANopen

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