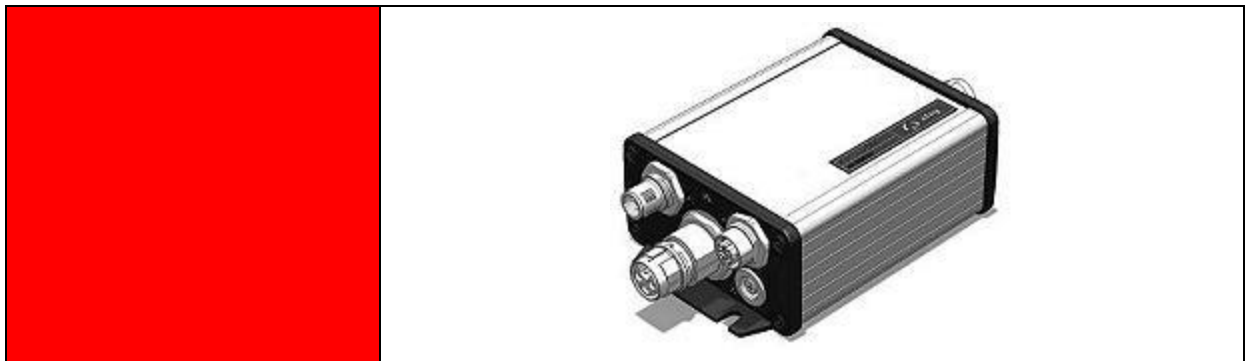


# Servo Controller

## SE-24

- **Programming example**  
**Beckhoff TwinCAT 2**





**Complementary document to the Operating Instructions**  
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This manual is a complementary document to the operating instructions and applies to:

Type	Order No.
SE-24 EtherCAT	50315436

Assembly and initial start-up may be carried out by qualified personnel only and according to these operating instructions.

Version of this documentation: SE-24 programming example Beckhoff TwinCAT 2 vers. 1.1 en.  
01.06.2022

 <b>CAUTION</b>	
	<p>As this manual is a complementary document to the operating instructions it alone is not sufficient to carry out installation and commissioning of the device.</p> <p>Please pay attention to the notes in <i>1.1 Documentation</i></p>

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## 1 General



### 1.1 Documentation

For the Servo Controllers of the SE-24 series are considerably documentations available. There are main documents and complementary documents.

**The documents contain safety instructions that must be followed**

**Main document:**

present	documentation / description
<input type="checkbox"/>	<ul style="list-style-type: none"> <li>▪ <b>SE-24 Operating Manual</b></li> </ul> <p>Description of the technical data and the functions of the device as well as notes on the plug assignment, installation and operation of the SE-24 servo controller.</p> <p>It is meant for persons who want to get familiar with the SE-24 servo controller.</p>

 <b>CAUTION</b>	
	<p><b>The operating manual is the main document and must be read by all means before installation and start-up of all devices of the SE-24 series independent of the respective model.</b></p>



## Complementary documents to the operating manual:

present	documentation / description
<input type="checkbox"/>	<ul style="list-style-type: none"> <li>SE-24 Software Manual</li> </ul> Description of the "afagTools" parameterization program.
<input type="checkbox"/>	<ul style="list-style-type: none"> <li>SE-24 IO Manual</li> </ul> Description of the I/O control of the SE-24 servo controller.
<input type="checkbox"/>	<ul style="list-style-type: none"> <li>SE-24 Profibus Manual</li> </ul> Description of the fieldbus control of the SE-24 servo controller under PROFIBUS-DP.
<input type="checkbox"/>	<ul style="list-style-type: none"> <li>SE-24 programming example Siemens S7 V5.5</li> </ul> Description to the programming example for Siemens S7 V5.5.
<input type="checkbox"/>	<ul style="list-style-type: none"> <li>SE-24 programming example Siemens TIA V12.0</li> </ul> Description to the programming example for Siemens TIA V12.0.
<input type="checkbox"/>	<ul style="list-style-type: none"> <li>SE-24 EtherCAT Manual</li> </ul> Description of the fieldbus control of the SE-24 servo controller under EtherCAT.
<input checked="" type="checkbox"/>	<ul style="list-style-type: none"> <li>SE-24 programming example Beckhoff TwinCAT 2</li> </ul> Description to the programming example for Beckhoff TwinCAT 2.
<input type="checkbox"/>	<ul style="list-style-type: none"> <li>SE-24 CANopen Manual</li> </ul> Description of the fieldbus control of the SE-24 servo controller under CANopen.

These documents are available for download on our homepage:

[www.afag.com](http://www.afag.com)

## 2 Safety instructions

 <b>CAUTION</b>	
	<p>The safety instructions in the operating manual must be followed.</p> <p>The operating manual is the main document and must be read by all means before installation and start-up of all devices of the SE-24 series independent of the respective model.</p>


### 3 Programming example for BECKHOFF TwinCAT

#### 3.1 Introduction


For the servo positioning controller SE-24, specifically for the Beckhoff PLC systems were a example configuration and a programming example written, that facilitate integration of the servo positioning controller in a PLC program with EtherCAT functionality significantly.

Example project:

Mode of operation	Example configuration	Programming example
Positioning	20140212_SE-24_Konfig.tsm	SE-24 EtherCAT.pro

NOTE	
	Download Example project under <a href="http://www.afag.com">www.afag.com</a>

A number of steps are necessary to create a functioning EtherCAT-connection. Some of these settings should or must be executed before the activation of the EtherCAT communication. This chapter provides an overview of the corresponding steps. The exact procedure is described in more detail in the following chapters.

NOTE	
	This manual is intended to provide the user with a quick introduction to the function of the inputs and outputs within the Beckhoff world. <b>This manual does not replace the „SE-24 EherCAT Manual“,but is supplementary</b>

The sample programs provided by Afag available can only be understood as such.

When using the sample programs in customer-specific applications, the user must verify that all functional and safety-relevant conditions are met.

## 4 Integration in BECKHOFF TwinCAT 2

### 4.1 Configuration

The EtherCAT master must be configured for operation of the EtherCAT network.

Definition of the participating EtherCAT slaves are an essential part of the configuration.

The properties of the EtherCAT slaves can be defined in two ways.

1. The basic properties are saved in an EEPROM of the slave, other properties are described in an XML device file.
2. All the properties are saved in an EEPROM of the slave. (This version is not supported by each manufacturer).

EtherCAT configurations become very comfortable through the use of XML device files.

With EtherCAT it is possible to execute an offline configuration and to scan the participants on an Ethernet line (online configuration).

The standard configurator (EtherCAT configurator of the company Beckhoff Automation GmbH) was used in the following example:

This configurator uses offline and online XML device files.

For the SE-24 EtherCAT servo controller the file

**"SE-24 EtherCAT\_Vx.y.xml"** is used

Copy this file into the "C:\Programs\EtherCAT Configurator\EtherCAT" directory or into the directory defined by the configurator you use.

#### 4.1.1 Configuration and commissioning aids

The following can be used as configuration and commissioning aids:

- The example configuration **"SE-24 EtherCAT Config\_Vx.y.esm"** created with the TwinCAT System Manager. This already contains the links in the PLC sample project **"SE-24\_EtherCAT\_Vx.y.pro"** and can be used directly for the commissioning of a servo controller type Afag SE-24 EtherCAT
- The box configuration **"Term 1 (SE-24 EtherCAT).tce"** exported from the example configuration.

**This configuration can be imported directly into existing configurations.**

- The „Global\_Variables“, created in the **"SE-24\_EtherCAT\_Vx.y.pro"** example project with TwinCAT.
- The description of the example configuration and example project described on the following pages.

#### 4.1.2 Offline configuration

This option should be preferred if you carry out the configuration using the dem TwinCAT System Manager, the EtherCAT configurator or another tool which enables the box configuration file “**Term 1 (SE-24 EtherCAT).tce**” to be imported.

#### 4.1.3 Overview of the process data

If configuration is carried out manually the following details are required for the process data.

**Table 1: Overview of the process data**

PDO Name	PDO Index (hex)	Object Name	Object Index (hex)	Object Sub Index (hex)	Data type
<b>TxPdo1</b>	0x1A00	StatusWord	0x5101	0x01	INT
<b>TxPdo2</b>	0x1A01	error_nr	0x3001	0x00	INT
<b>TxPdo3</b>	0x1A02	position_value	0x3762	0x00	DINT
<b>TxPdo4</b>	0x1A03	current_value	0x3262	0x01	DINT
<b>RxPdo1</b>	0x1600	ControlWord	0x5101	0x02	INT
<b>RxPdo2</b>	0x1601	target_position	0x5102	0x01	DINT
<b>RxPdo3</b>	0x1602	velocity	0x5102	0x02	INT
<b>RxPdo4</b>	0x1603	acceleration	0x5103	0x02	INT
		deceleration	0x5104	0x01	INT
<b>RxPdo5</b>	0x1604	target_current	0x5103	0x01	INT



#### 4.1.4 Description of the offline configuration

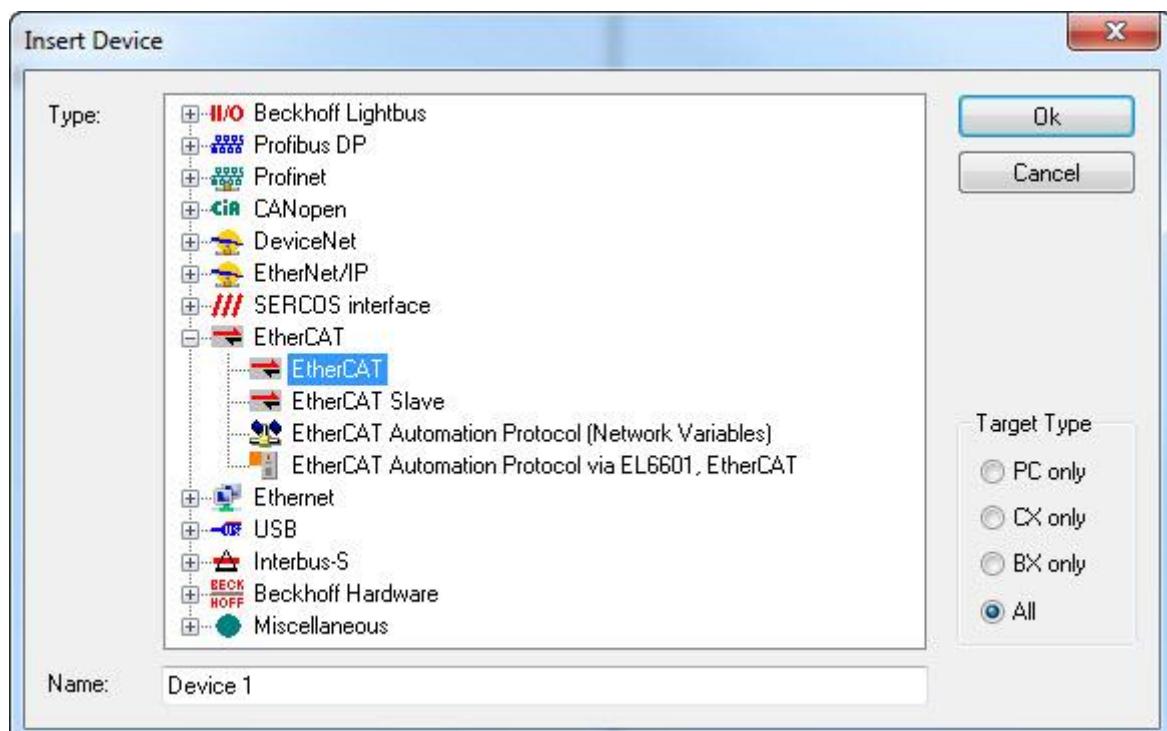
- Start the TwinCAT System Manager.



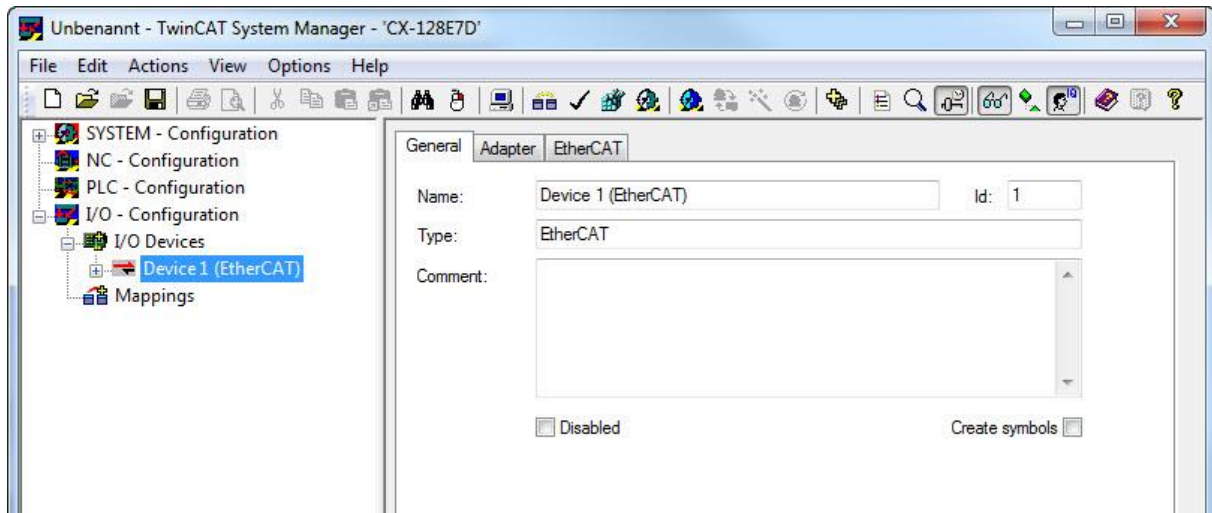
- Create a new configuration with *File/New*.



- Click right on "I/O Devices", execute "Append Device" and select the EtherCAT strand under EtherCAT.

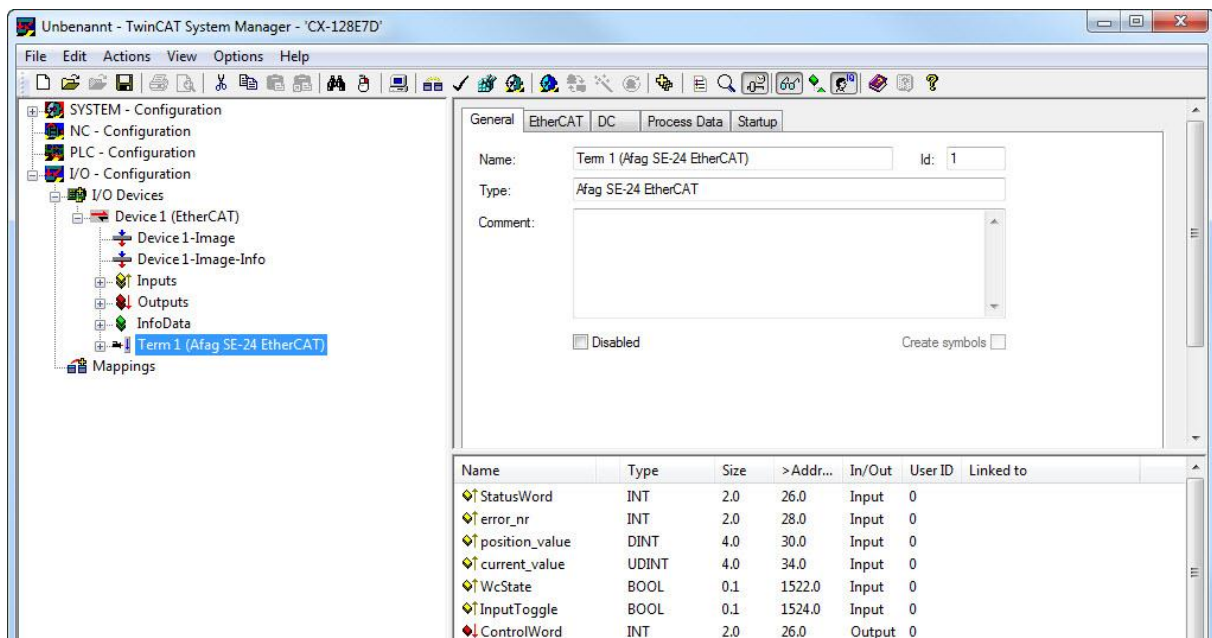


- The EtherCAT master is now recorded as “Device 1”.



#### 4.1.4.1 Import Box

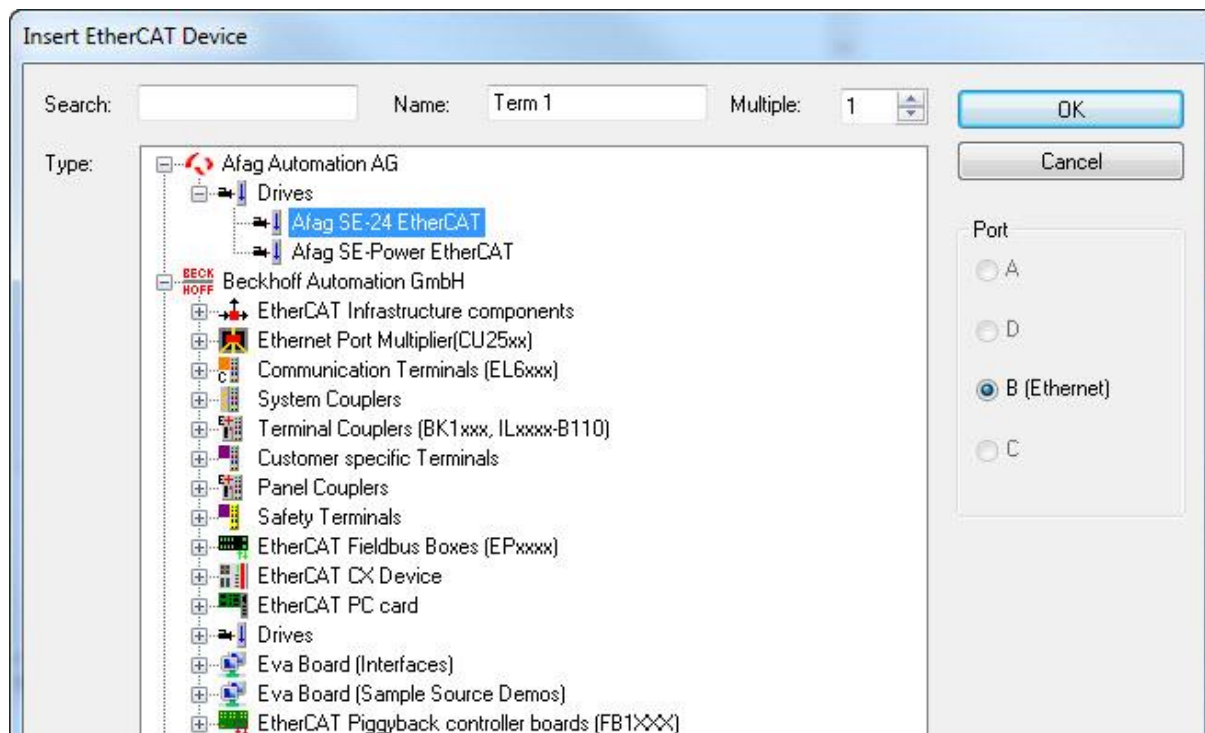
- If you have the “**Term 1 (SE-24 EtherCAT).tce**” file, execute “Box Import” (right click on Device 1 EtherCAT) and select the “**Term 1 (SE-24 EtherCAT).tce**” file as the box to be imported. The controller is then inserted as a fully parameterized slave. In this case, you can skip the next chapter *4.1.4.2 Create a configuration manually*.



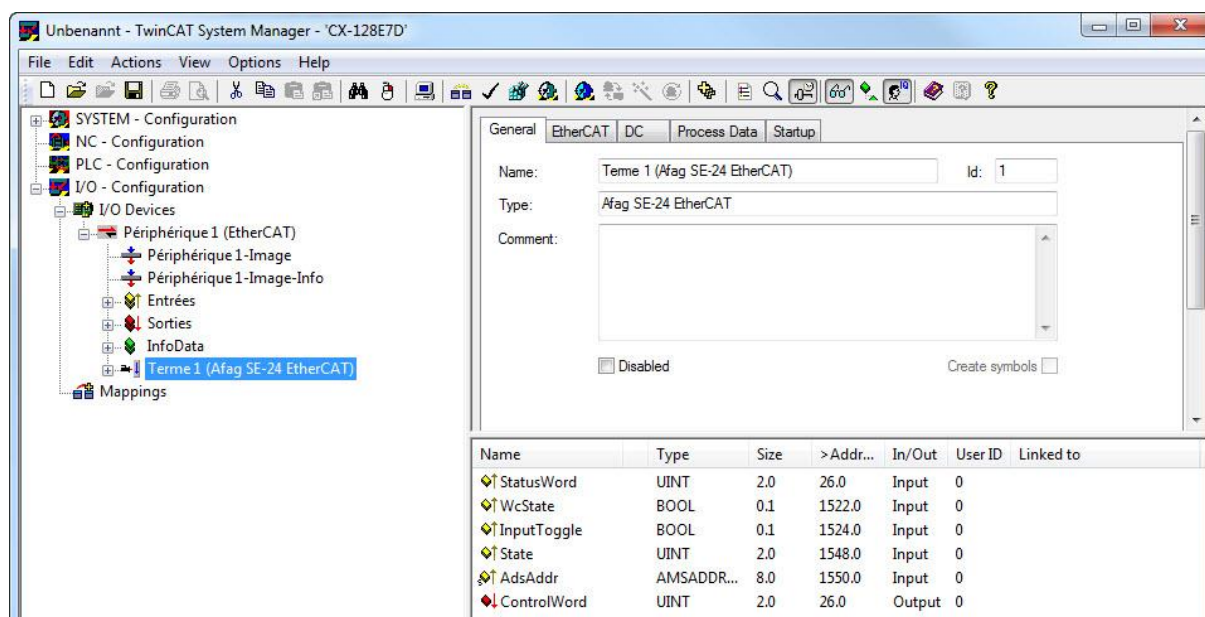
#### 4.1.4.2 Create a configuration manually

If you have the “**Term 1 (SE-24 EtherCAT).tce**” file not, or you have to do the configuration manually by an other reason, continue with the following steps.

- Select the inserted EtherCAT device “Device 1” and execute “Append Box” (right click). Expand the window which opens to the “Afac Automation AG” group and the “Drives” subgroup and select the device “SE-24 EtherCAT”.

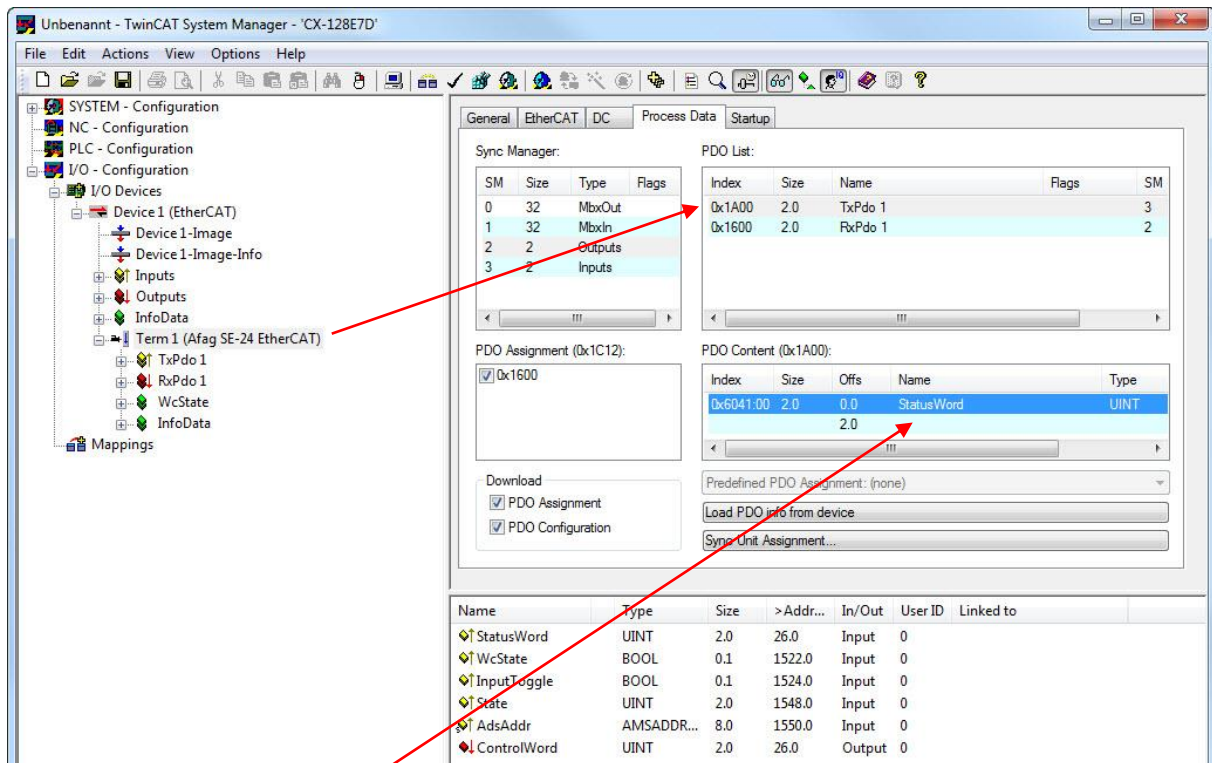


- The device is now connected to the EtherCAT strand.

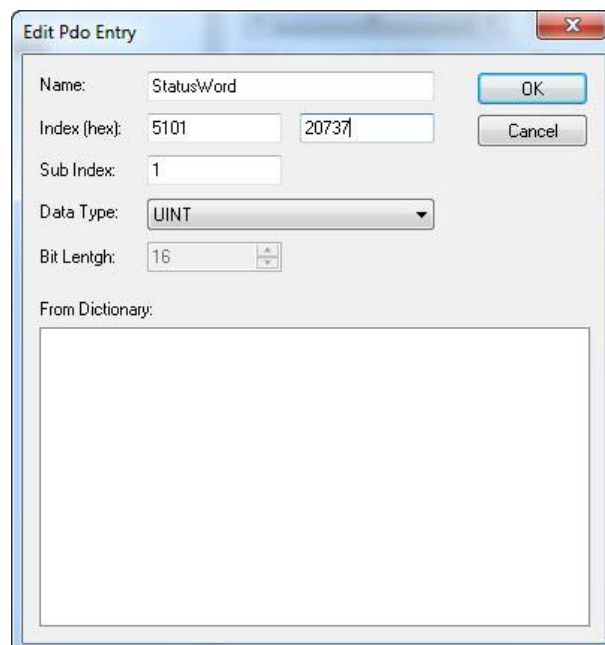


There now follows the setting of process data

- Select the "Therm 1 (SE-24 EtherCAT)" device, click the "Process Data" tab and click on the PDO named "TxPdo 1" in the "PDO list".

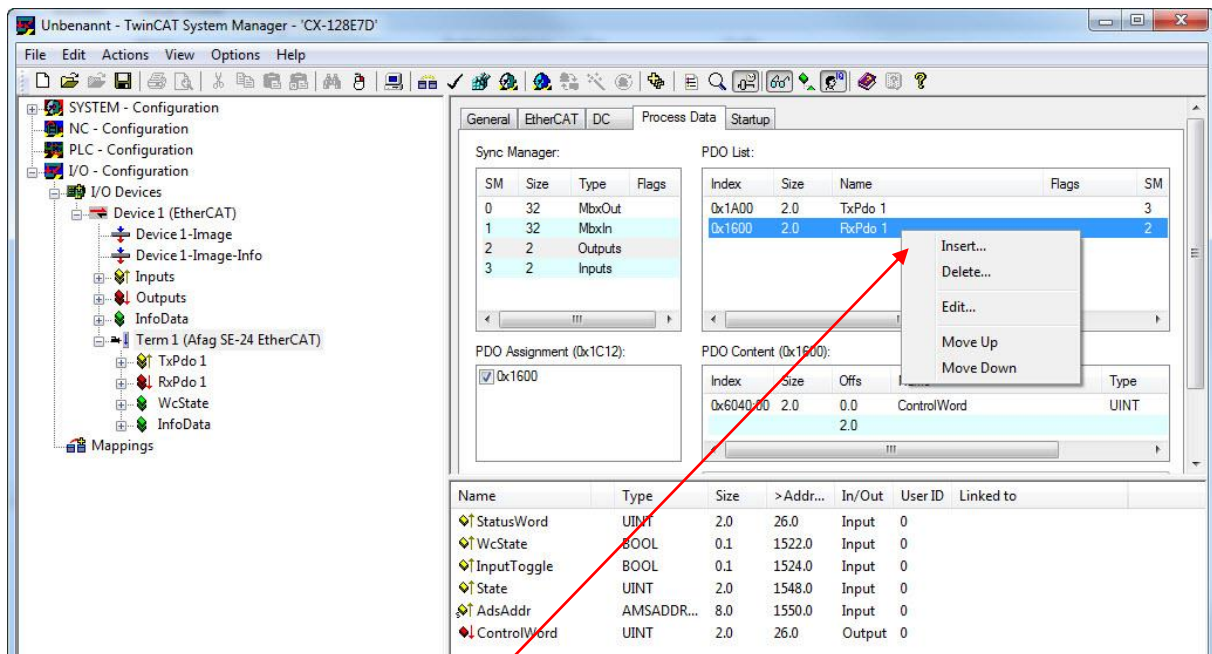


- Open the "StatusWord" entry in the "PDO Content" box.

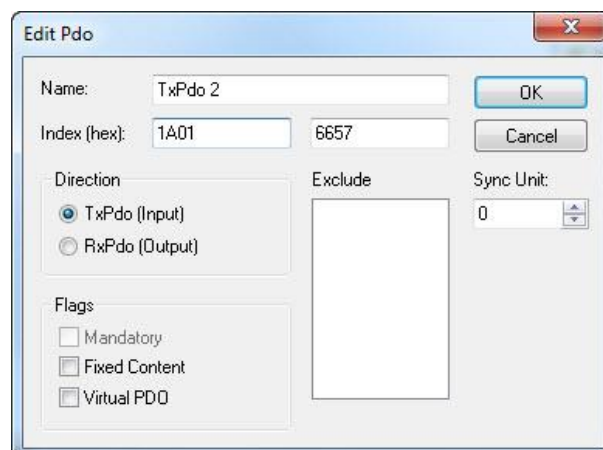


- Input the index, the sub-index and the data type for the "StatusWord" object according to *Table 1: Overview of the process data*.

- Insert a new PDO before the PDO named “RxPdo 1”.



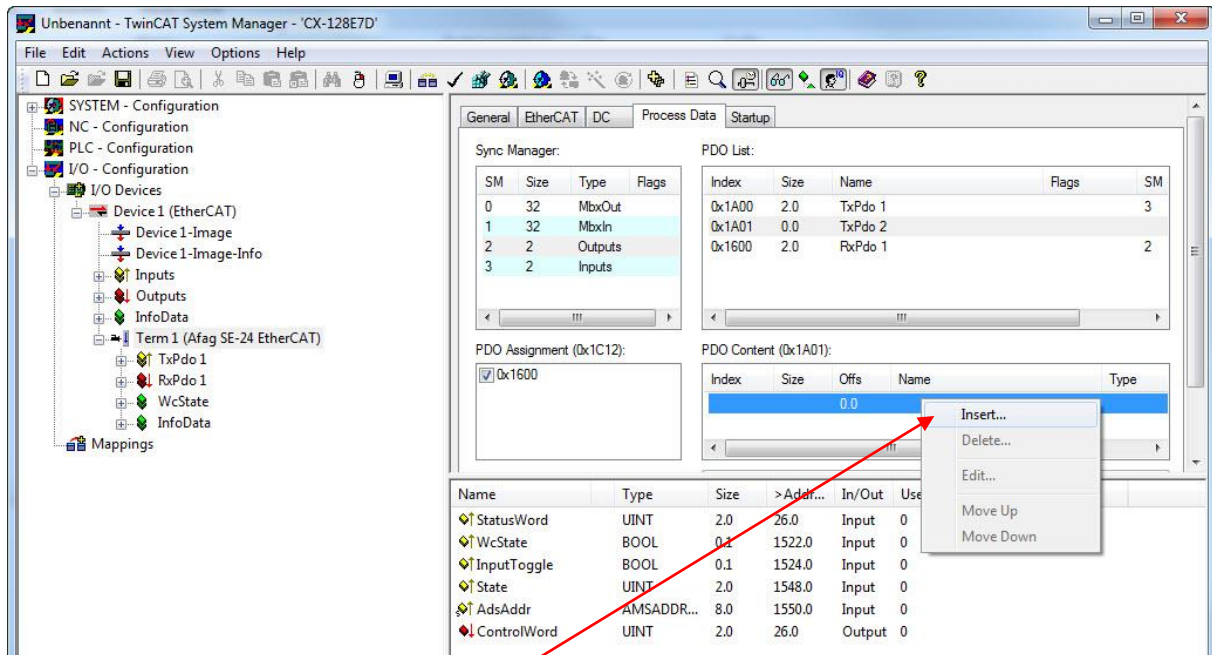
- Highlight the PDO named “RxPdo 1” and right-click the option “Insert...”.



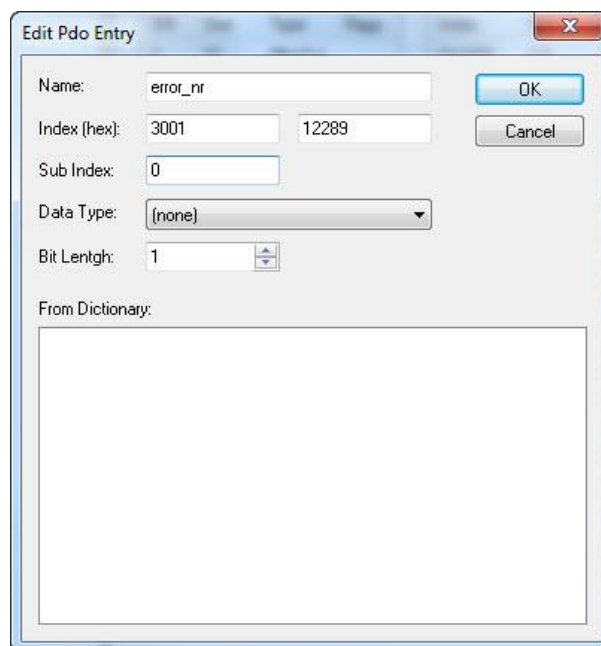
- Enter the name “TxPdo 2” for the new PDO.
- Enter the index according to *Table 1: Overview of the process data*.
- Ensure that “TxPdo (Input)” was selected in the “Direction” box.



- Add the corresponding object to the TxPdo 2.

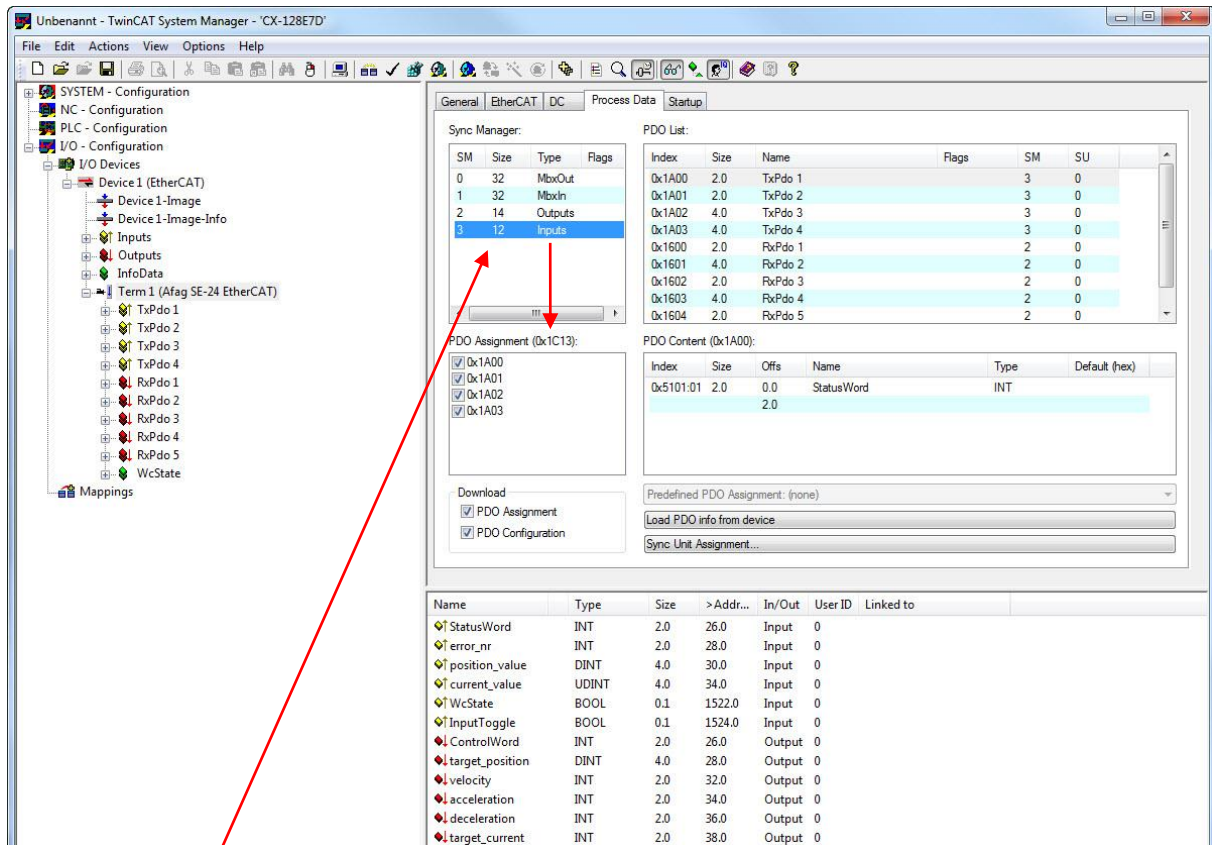


- Select the corresponding PDO and open the empty entry under “PDO Content” (right-click the option “Insert...”).



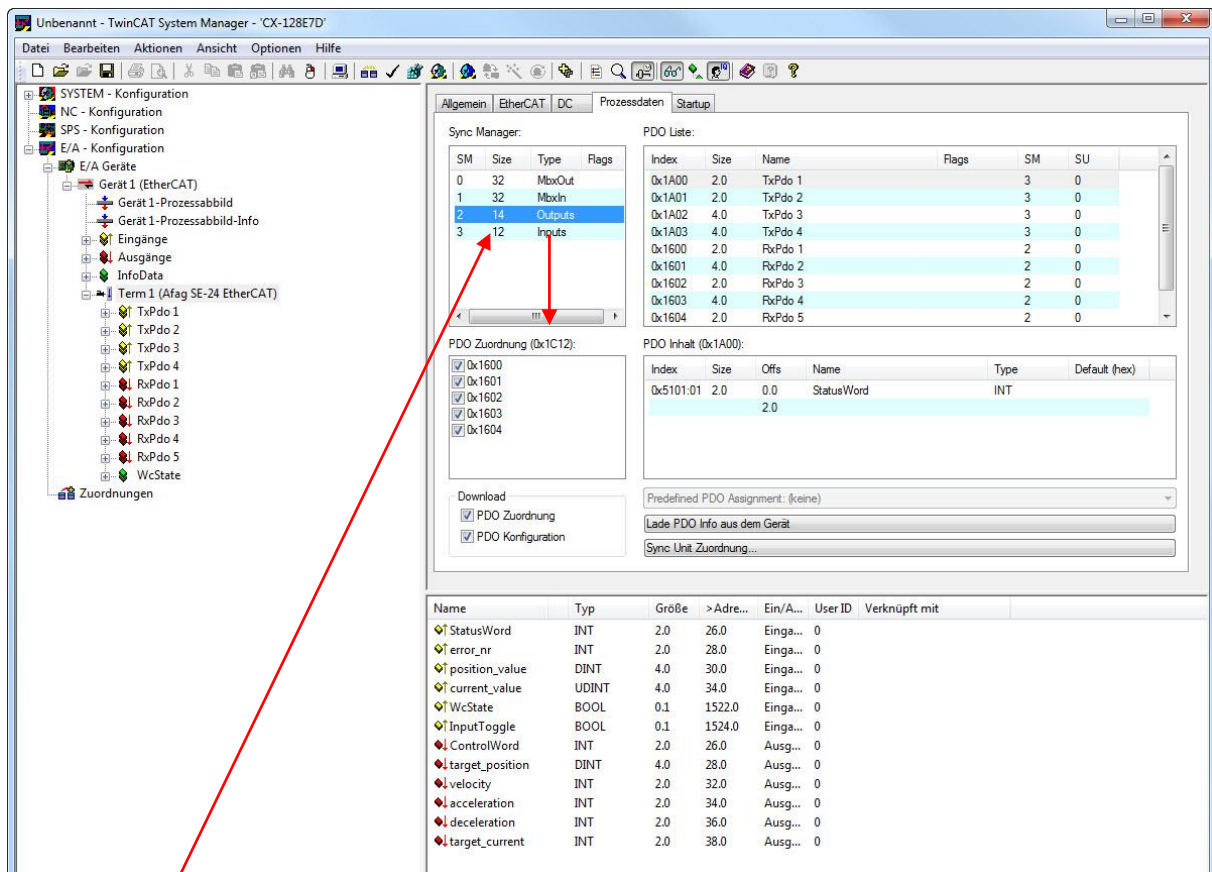
- Input the index, the sub-index and the data type for the “error\_nr” object according to *Table 1: Overview of the process data*.

- Repeat these steps until all objects according to *Table 1: Overview of the process data* have been configured.
- The two objects “acceleration” and “deceleration” must be input for the RxPdo 4.
- Make sure that all configured PDOs, the input and the output are active.



- Select the “Inputs” option in the “Sync Manager” box and activate all PDOs in the “PDO Assignment” box.

- Carry out the same steps for the outputs.



The screenshot shows the TwinCAT System Manager interface for 'Unbenannt - TwinCAT System Manager - 'CX-128E7D''. The left sidebar shows the project tree with 'Gerät 1 (EtherCAT)' selected. The main window has tabs for 'Allgemein', 'EtherCAT', 'DC', 'Prozessdaten', and 'Startup'. The 'EtherCAT' tab is active, showing the 'Sync Manager' and 'PDO List' sections.

**Sync Manager:**

SM	Size	Type	Flags
0	32	MboxOut	
1	32	MboxIn	
2	14	Outputs	
3	12	Inputs	

**PDO List:**

Index	Size	Name	Flags	SM	SU
0x1A00	2.0	TxPdo 1		3	0
0x1A01	2.0	TxPdo 2		3	0
0x1A02	4.0	TxPdo 3		3	0
0x1A03	4.0	TxPdo 4		3	0
0x1600	2.0	RxPdo 1		2	0
0x1601	4.0	RxPdo 2		2	0
0x1602	2.0	RxPdo 3		2	0
0x1603	4.0	RxPdo 4		2	0
0x1604	2.0	RxPdo 5		2	0

**PDO Zuordnung (0x1C12):**

- ☒ 0x1600
- ☒ 0x1601
- ☒ 0x1602
- ☒ 0x1603
- ☒ 0x1604

**PDO Inhalt (0x1A00):**

Index	Size	Offs	Name	Type	Default (hex)
0x5101:01	2.0	0.0	StatusWord	INT	
	2.0				

**Download:**

- ☒ PDO Zuordnung
- ☒ PDO Konfiguration

**Predefined PDO Assignment: (keine)**

**Sync Unit Zuordnung...**

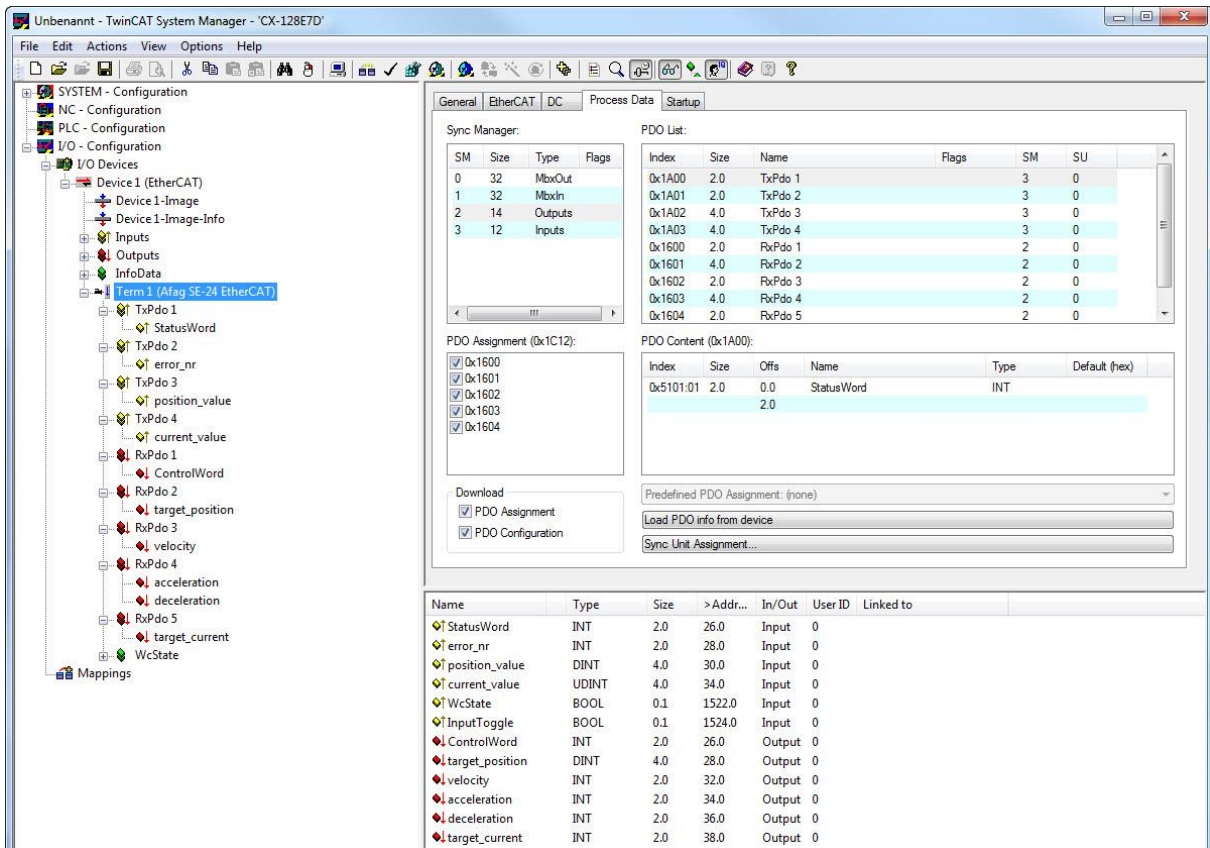
**Variables Table:**

Name	Typ	Größe	> Adre...	Ein/A...	User ID	Verknüpft mit
StatusWord	INT	2.0	26.0	Einga...	0	
error_nr	INT	2.0	28.0	Einga...	0	
position_value	DINT	4.0	30.0	Einga...	0	
current_value	UDINT	4.0	34.0	Einga...	0	
WcState	BOOL	0.1	1522.0	Einga...	0	
InputToggle	BOOL	0.1	1524.0	Einga...	0	
ControlWord	INT	2.0	26.0	Ausg...	0	
target_position	DINT	4.0	28.0	Ausg...	0	
velocity	INT	2.0	32.0	Ausg...	0	
acceleration	INT	2.0	34.0	Ausg...	0	
deceleration	INT	2.0	36.0	Ausg...	0	
target_current	INT	2.0	38.0	Ausg...	0	

- Select the “Outputs” option in the “Sync Manager” box and activate all PDOs in the “PDO Assignment” box.



The configuration should look as follows when you expand all PDOs:



The screenshot shows the TwinCAT System Manager interface. The left pane displays the configuration tree for 'Unbenannt - TwinCAT System Manager - 'CX-128E7D''. The 'I/O Devices' section is expanded, showing 'Device 1 (EtherCAT)' and its sub-components. The 'Term 1 (Afag SE-24 EtherCAT)' is selected, showing its internal components like 'TxPdo 1' through 'TxPdo 5' and 'RxPdo 1' through 'RxPdo 5'. The right pane shows the 'Startup' tab with the 'PDO List' and 'PDO Assignment' sections.

**PDO List:**

Index	Size	Name	Flags	SM	SU
0x1A00	2.0	TxPdo 1		3	0
0x1A01	2.0	TxPdo 2		3	0
0x1A02	4.0	TxPdo 3		3	0
0x1A03	4.0	TxPdo 4		3	0
0x1600	2.0	RxPdo 1		2	0
0x1601	4.0	RxPdo 2		2	0
0x1602	2.0	RxPdo 3		2	0
0x1603	4.0	RxPdo 4		2	0
0x1604	2.0	RxPdo 5		2	0

**PDO Assignment (0x1C12):**

Index	Size	Offs	Name	Type	Default (hex)
0x5101:01	2.0	0.0	StatusWord	INT	2.0

**Download:**

- ☒ PDO Assignment
- ☒ PDO Configuration

**Sync Unit Assignment...**

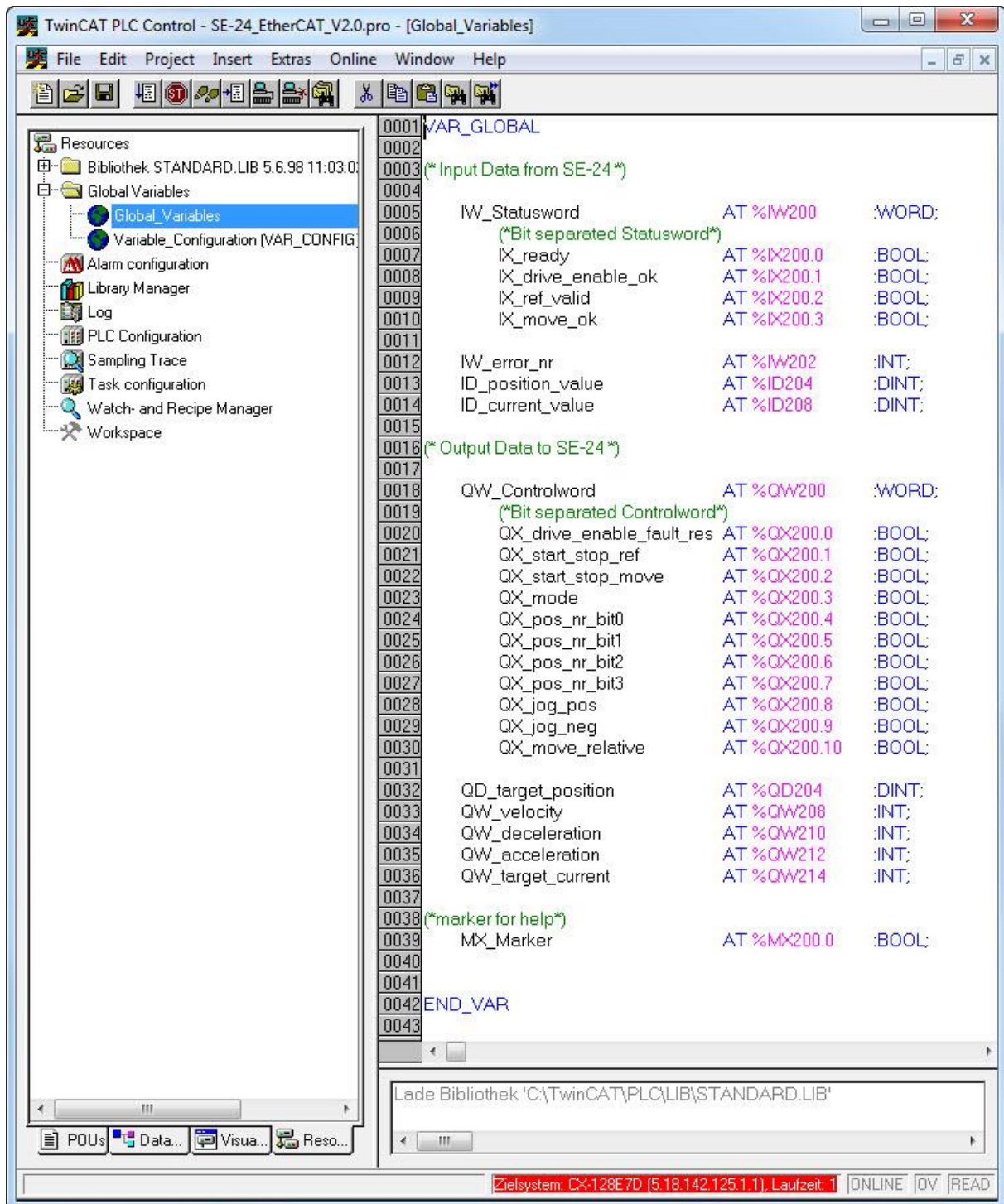
**Table:**

Name	Type	Size	> Addr...	In/Out	User ID	Linked to
StatusWord	INT	2.0	26.0	Input	0	
error_nr	INT	2.0	28.0	Input	0	
position_value	DINT	4.0	30.0	Input	0	
current_value	UDINT	4.0	34.0	Input	0	
WcState	BOOL	0.1	1522.0	Input	0	
InputToggle	BOOL	0.1	1524.0	Input	0	
ControlWord	INT	2.0	26.0	Output	0	
target_position	DINT	4.0	28.0	Output	0	
velocity	INT	2.0	32.0	Output	0	
acceleration	INT	2.0	34.0	Output	0	
deceleration	INT	2.0	36.0	Output	0	
target_current	INT	2.0	38.0	Output	0	

You can save the complete configuration as an \*.esm-file or only export the box as a \*.tce-file.

## 4.2 PLC Project

The PLC project contains no actual user program, but the relevant variables which for the commissioning and operation required by a servo controller of the type SE-24 EtherCAT.



TwinCAT PLC Control - SE-24\_EtherCAT\_V2.0.pro - [Global\_Variables]

File Edit Project Insert Extras Online Window Help

Resources

- Bibliothek STANDARD.LIB 5.6.98 11:03:0
- Global Variables
  - Global\_Variables
  - Variable\_Configuration (VAR\_CONFIG)
- Alarm configuration
- Library Manager
- Log
- PLC Configuration
- Sampling Trace
- Task configuration
- Watch- and Recipe Manager
- Workspace

0001 VAR\_GLOBAL

0002

0003 (\* Input Data from SE-24 \*)

0004

0005 IW\_Statusword AT %IW200 :WORD;

0006 (\*Bit separated Statusword\*)

0007 IX\_ready AT %IX200.0 :BOOL;

0008 IX\_drive\_enable\_ok AT %IX200.1 :BOOL;

0009 IX\_ref\_valid AT %IX200.2 :BOOL;

0010 IX\_move\_ok AT %IX200.3 :BOOL;

0011

0012 IW\_error\_nr AT %IW202 :INT;

0013 ID\_position\_value AT %ID204 :DINT;

0014 ID\_current\_value AT %ID208 :DINT;

0015

0016 (\* Output Data to SE-24 \*)

0017

0018 QW\_Controlword AT %QW200 :WORD;

0019 (\*Bit separated Controlword\*)

0020 QX\_drive\_enable\_fault\_res AT %QX200.0 :BOOL;

0021 QX\_start\_stop\_ref AT %QX200.1 :BOOL;

0022 QX\_start\_stop\_move AT %QX200.2 :BOOL;

0023 QX\_mode AT %QX200.3 :BOOL;

0024 QX\_pos\_nr\_bit0 AT %QX200.4 :BOOL;

0025 QX\_pos\_nr\_bit1 AT %QX200.5 :BOOL;

0026 QX\_pos\_nr\_bit2 AT %QX200.6 :BOOL;

0027 QX\_pos\_nr\_bit3 AT %QX200.7 :BOOL;

0028 QX\_jog\_pos AT %QX200.8 :BOOL;

0029 QX\_jog\_neg AT %QX200.9 :BOOL;

0030 QX\_move\_relative AT %QX200.10 :BOOL;

0031

0032 QD\_target\_position AT %QD204 :DINT;

0033 QW\_velocity AT %QW208 :INT;

0034 QW\_deceleration AT %QW210 :INT;

0035 QW\_acceleration AT %QW212 :INT;

0036 QW\_target\_current AT %QW214 :INT;

0037

0038 (\*marker for help\*)

0039 MX\_Marker AT %MX200.0 :BOOL;

0040

0041

0042 END\_VAR

0043

Lade Bibliothek 'C:\TwinCAT\PLC\LIB\STANDARD.LIB'

Zielsystem: CX-128E7D (5.18.142.125.1.1), Laufzeit: 1 | ONLINE | OV | READ





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