

# **EtherCAT Connection Guide With Beckhoff TwinCAT 2**

## **Introduction**

This document shows how to use Beckhoff EtherCAT host software TwinCAT 2 to connect and control an Applied Motion Products STF EtherCAT stepper drive. By following the steps below, you will be able to use TwinCAT 2 NC controller to control the motor via STF EtherCAT drive.

Two connection methods will be introduced:

1. Using a PC as the master controller
2. Using a Beckhoff PLC as the master controller

For more advanced motion control functions, please contact Beckhoff.

## **Applies to**

Beckhoff TwinCAT 2 PC software (using Beckhoff CX2020-0112 PLC + EK1110 EtherCAT extension as example)  
STF stepper drives and compatible motors

## **Date**

June, 2018

## **Connection Guide**

Step 1 Download XML file for STFxx-EC drive from Applied Motion Products website

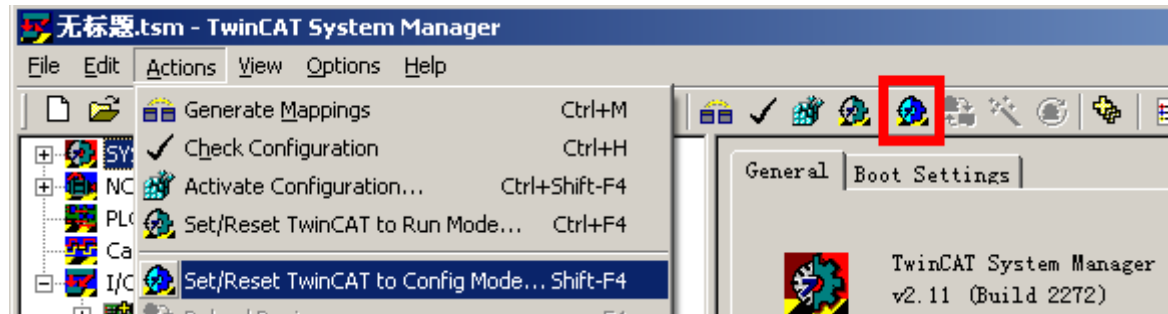
Step 2 Install Beckhoff TwinCAT 2 software

Step 3 Copy the XML file for STFxx-EC drive to TwinCAT 2 installation location, C:\TwinCAT\Io\EtherCAT

Step 4 Connect the Ethernet cable from master PC or PLC to the drive's "EtherCAT LINK IN" RJ45 port

Step 5 Apply power for drive; Apply power also for PLC if using PLC as the master controller

Step 6 Run TwinCAT 2 System Manager and set it to Config Mode

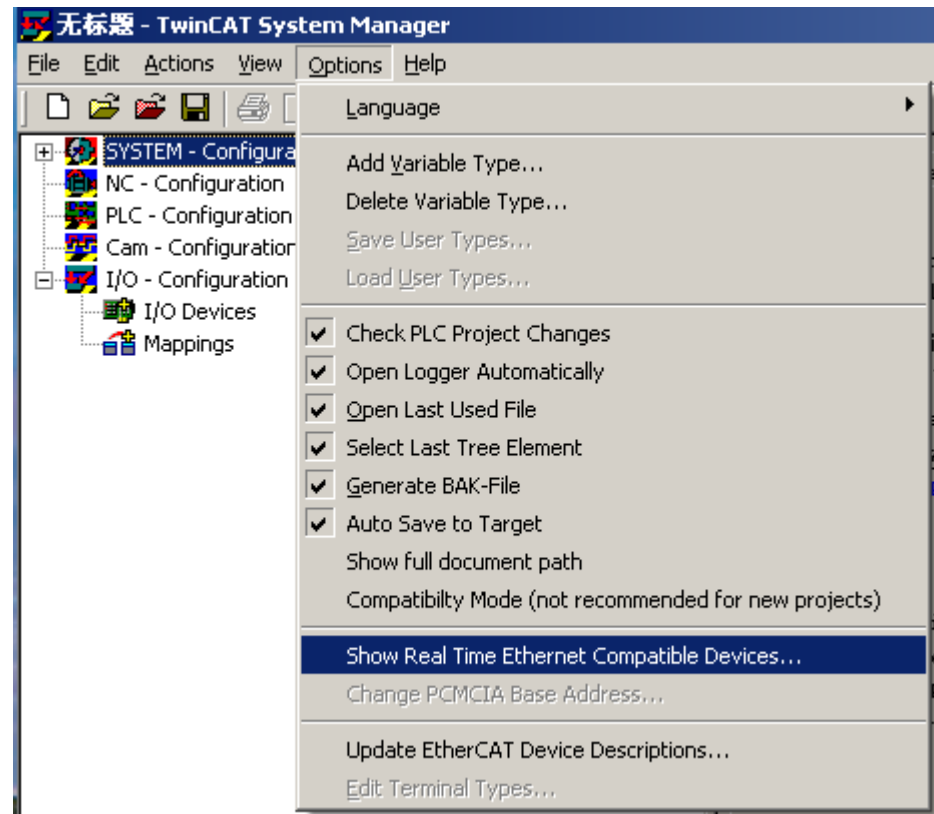


## Using a PC as the master controller

If you use a PC as the master controller, please follow these steps:

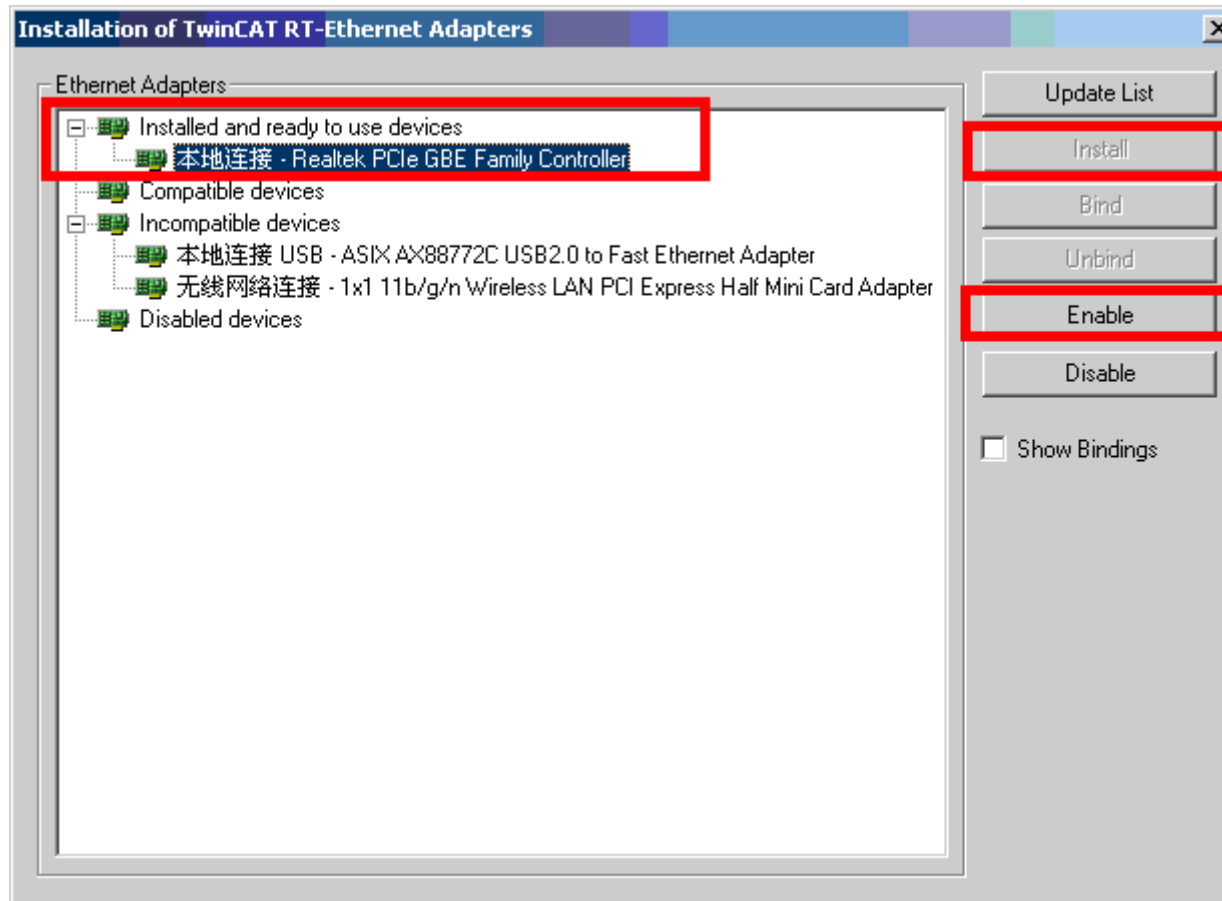
- **Install and enable the network card**

Click on **Options – Show Real Time Ethernet Compatible Devices**



## Using a PC as the master controller

Select the network card. Click on **Install**, and then click on **Enable**. If the network card is successfully installed and enabled, its name will be shown under **Installed and ready to use devices**



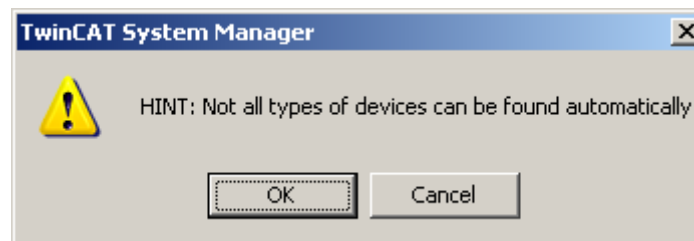
## Using a PC as the master controller

- **Scan Devices**

Right click on **I/O Devices** and then click on **Scan Devices**

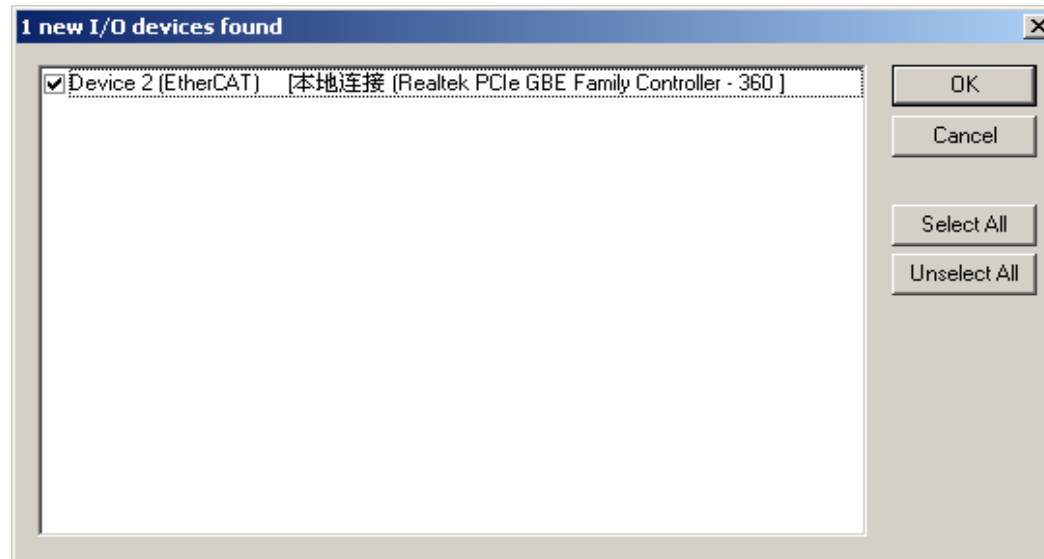


When this dialog shows, select OK

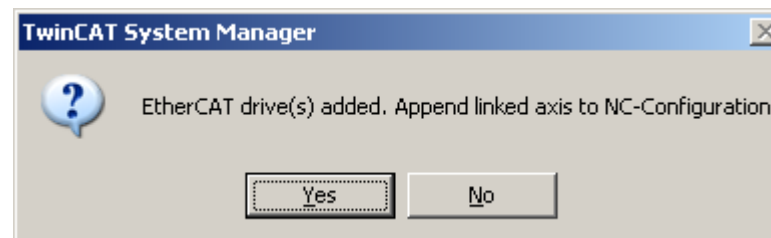
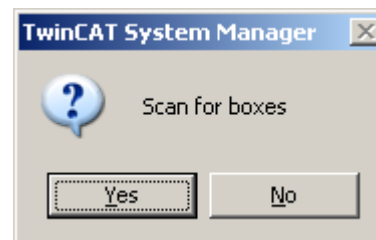


## Using a PC as the master controller

Select your network card and click on OK



When these dialogs show, select Yes to **Scan for boxes** and **Append linked axis to NC-Configuration**

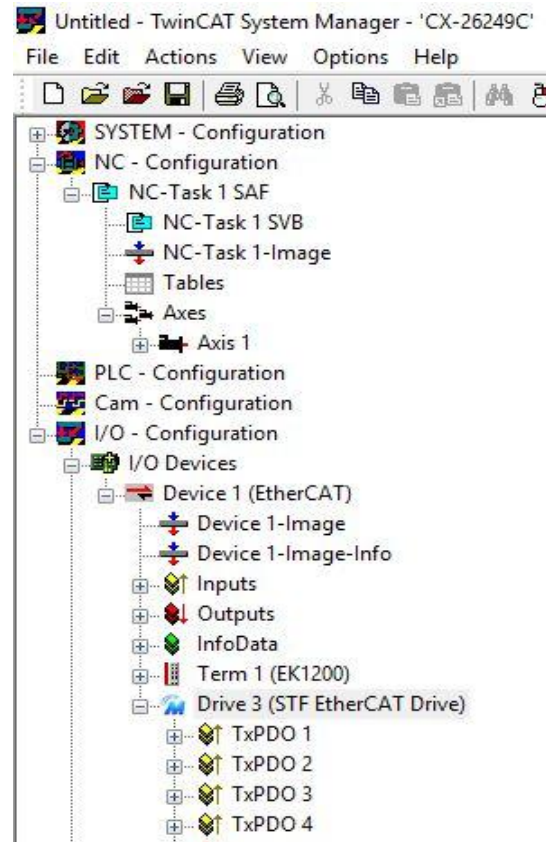


## Using a PC as the master controller

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After scan, EtherCAT drive will be shown under **I/O Devices**



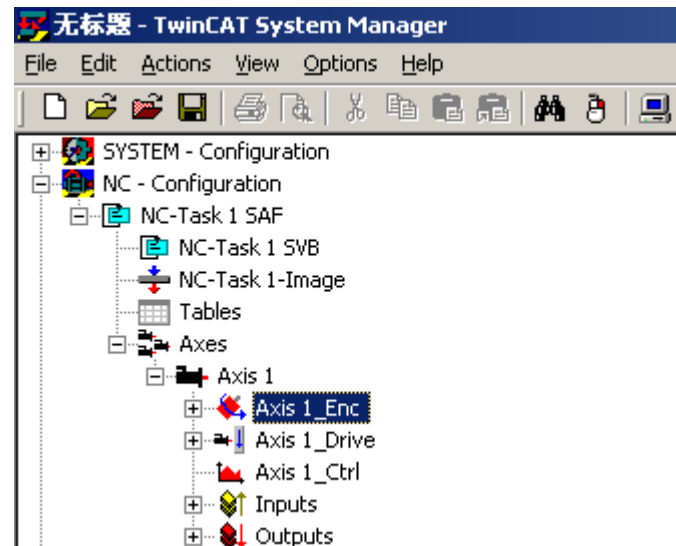
## Using a PC as the master controller

- **Parameter settings for NC - Configuration**

Click on **Axis 1\_Enc**, find **Parameter** setting tab. Set values for **Modulo Factor** and **Scaling Factor**

For all STF drive, the Electronic Gearing is set to 20000 Steps/Rev, then Scaling Factor = Modulo Factor/20000

For example, if Modulo Factor is set to 200mm, the Scaling Factor needs to be set to  $200/20000 = 0.01\text{mm}$ .



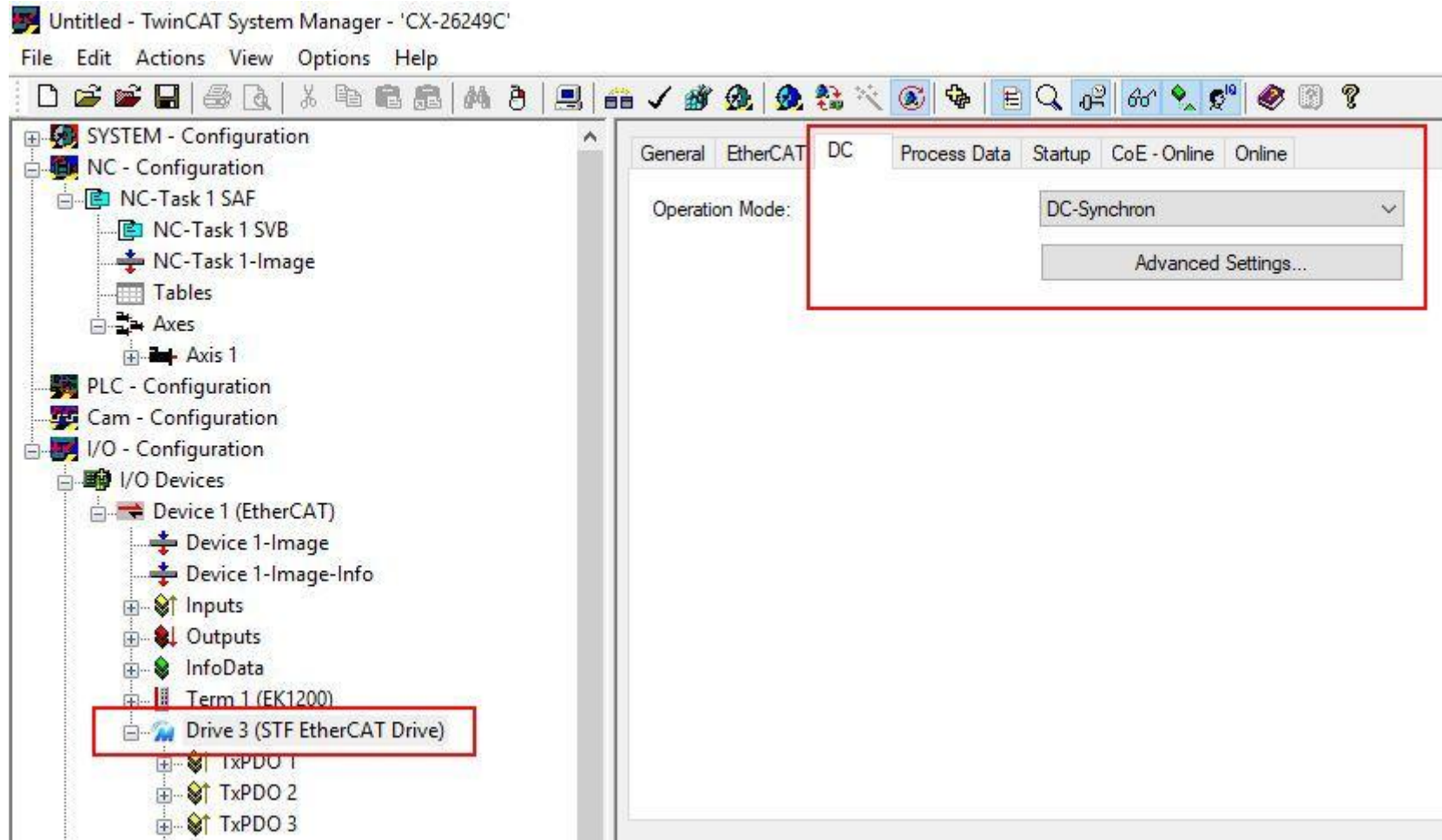
Parameter	Value	Type	Unit
<b>Encoder Evaluation:</b>			
Invert Encoder Counting Direction	FALSE	B	
Scaling Factor	0.01	F	mm/INC
Position Bias	0.0	F	mm
Modulo Factor (e.g. 360.0°)	200.0	F	mm
Tolerance Window for Modulo Start	0.0	F	mm



## Using a PC as the master controller

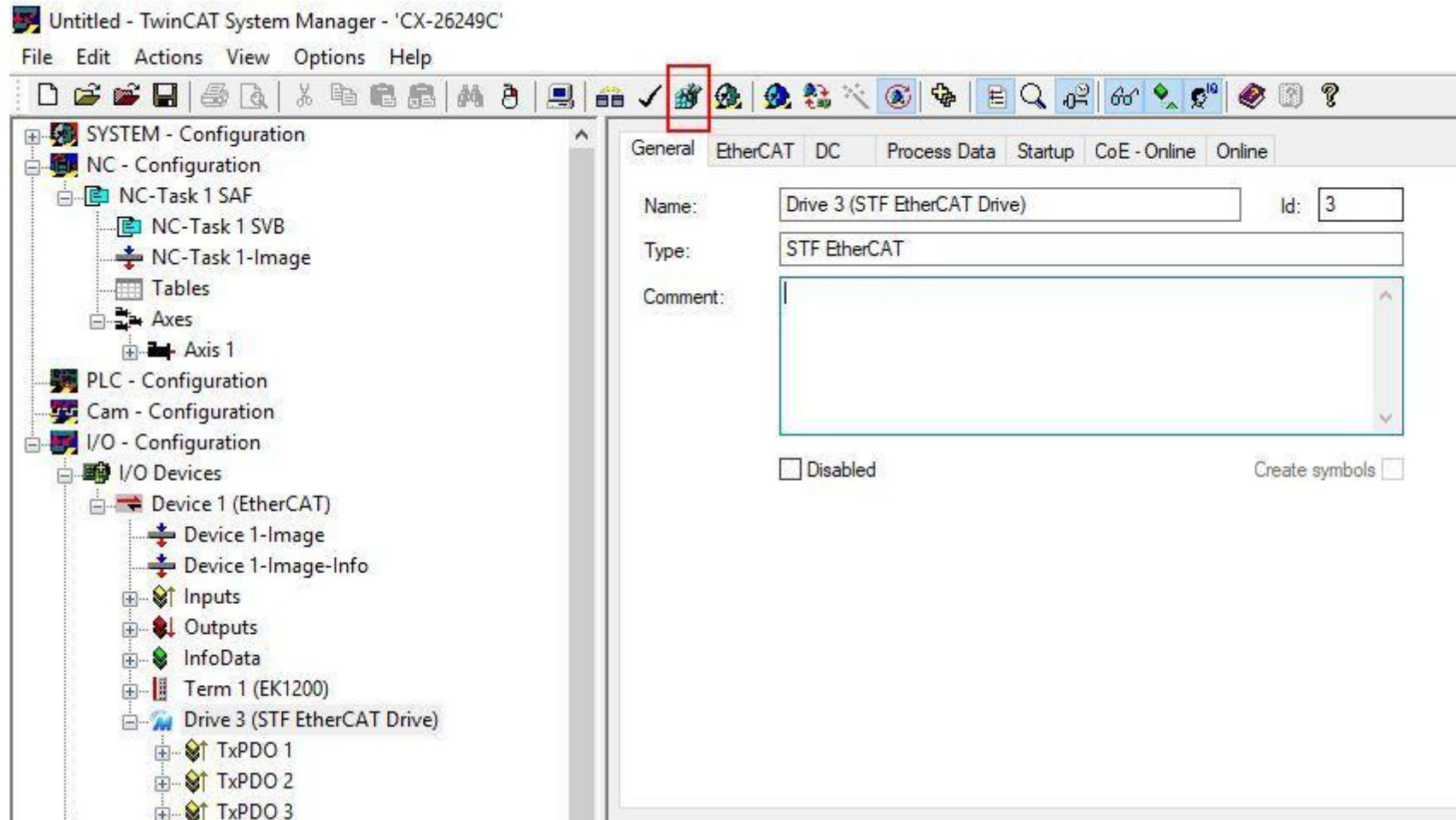
- **Parameter settings for drive**

Select drive and find **DC** setting tab. Set **Operation Mode** to DC-Synchron



## Using a PC as the master controller

Click on **Activate Configuration** under **Actions** to activate configuration and change TwinCAT to Run Mode

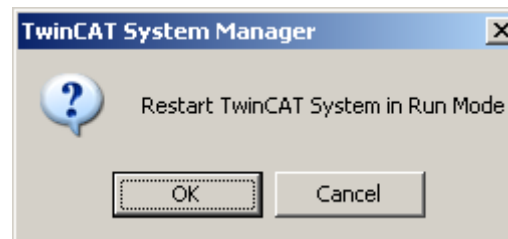
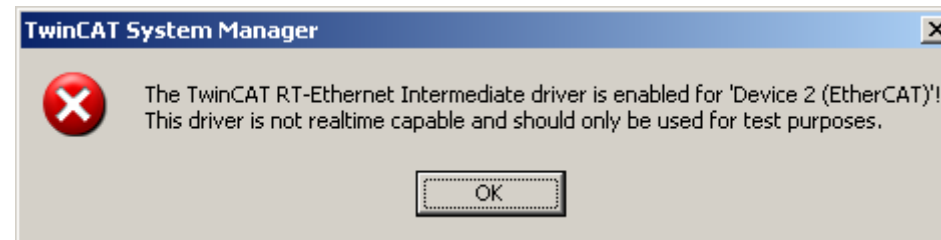
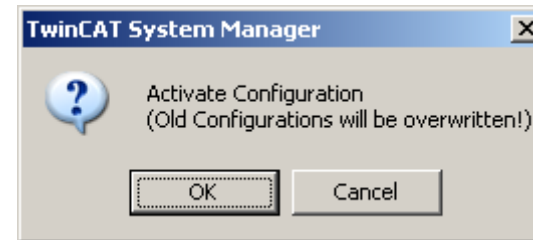
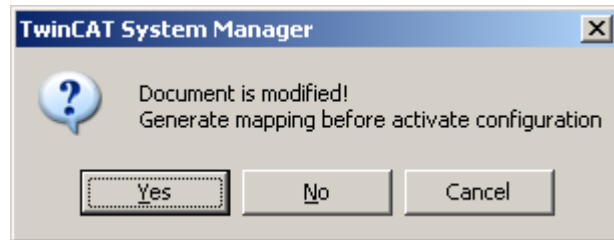


The screenshot displays the TwinCAT System Manager interface. The left pane shows a hierarchical tree structure under 'SYSTEM - Configuration'. The 'I/O - Configuration' folder is expanded to show 'I/O Devices', which includes 'Device 1 (EtherCAT)'. Under 'Device 1 (EtherCAT)', 'Drive 3 (STF EtherCAT Drive)' is selected. The right pane shows the configuration details for 'Drive 3 (STF EtherCAT Drive)'. The 'Name' field is 'Drive 3 (STF EtherCAT Drive)' and the 'Id' is '3'. The 'Type' is 'STF EtherCAT'. The 'Comment' field is empty. There are checkboxes for 'Disabled' and 'Create symbols'. The 'Actions' menu is visible at the top, and the 'Activate Configuration' icon is highlighted with a red box.

## Using a PC as the master controller

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When these dialogs show, select Yes or OK for all

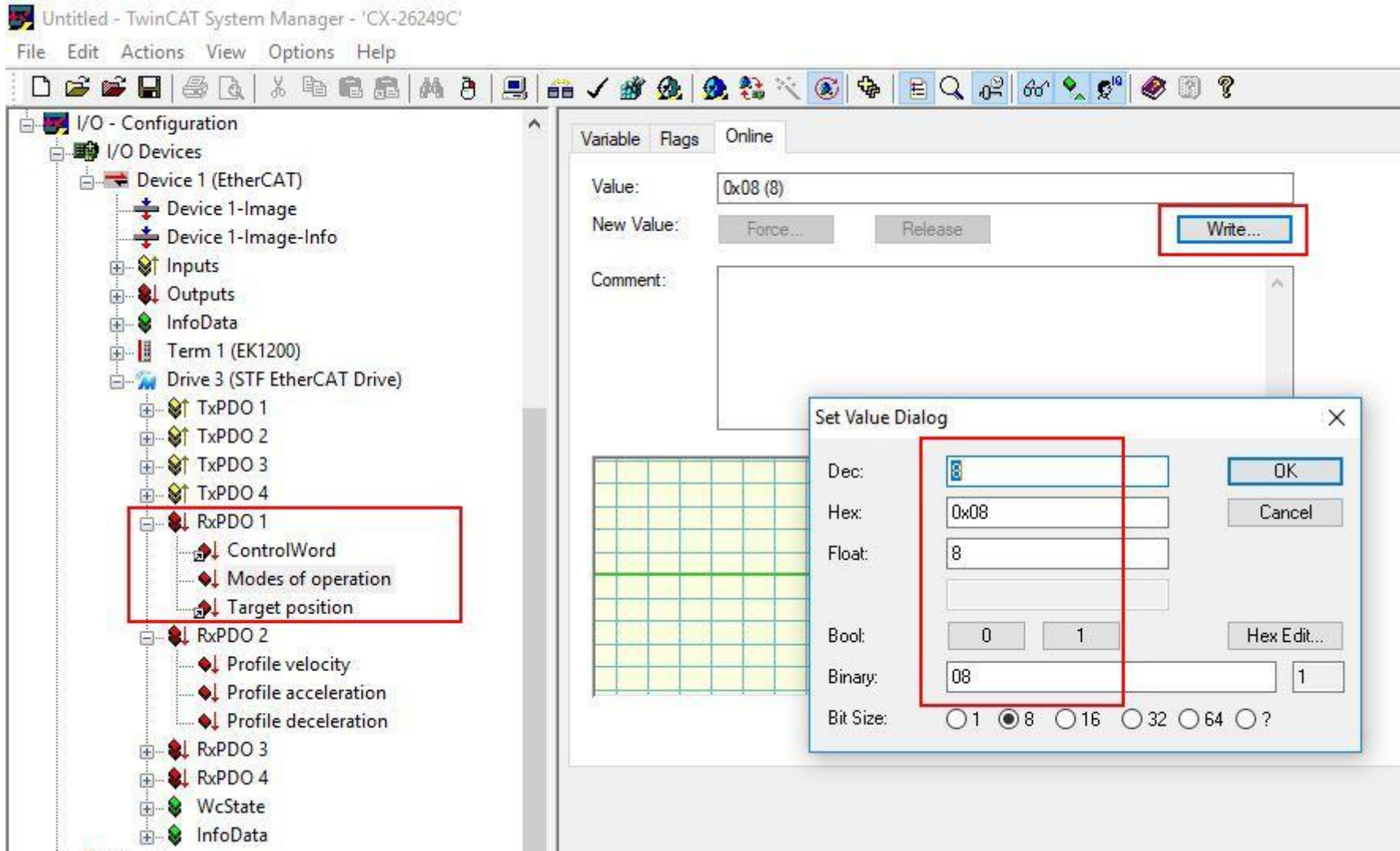


TwinCAT is now in Run Mode.

## Using a PC as the master controller

- **Set the drive's modes of operation to 8 (CSP mode)**

Select **Modes of operation** under **RxPDO 1**. Find **Online** tab, and click on **Write**. In the pop up window, set value to 8.

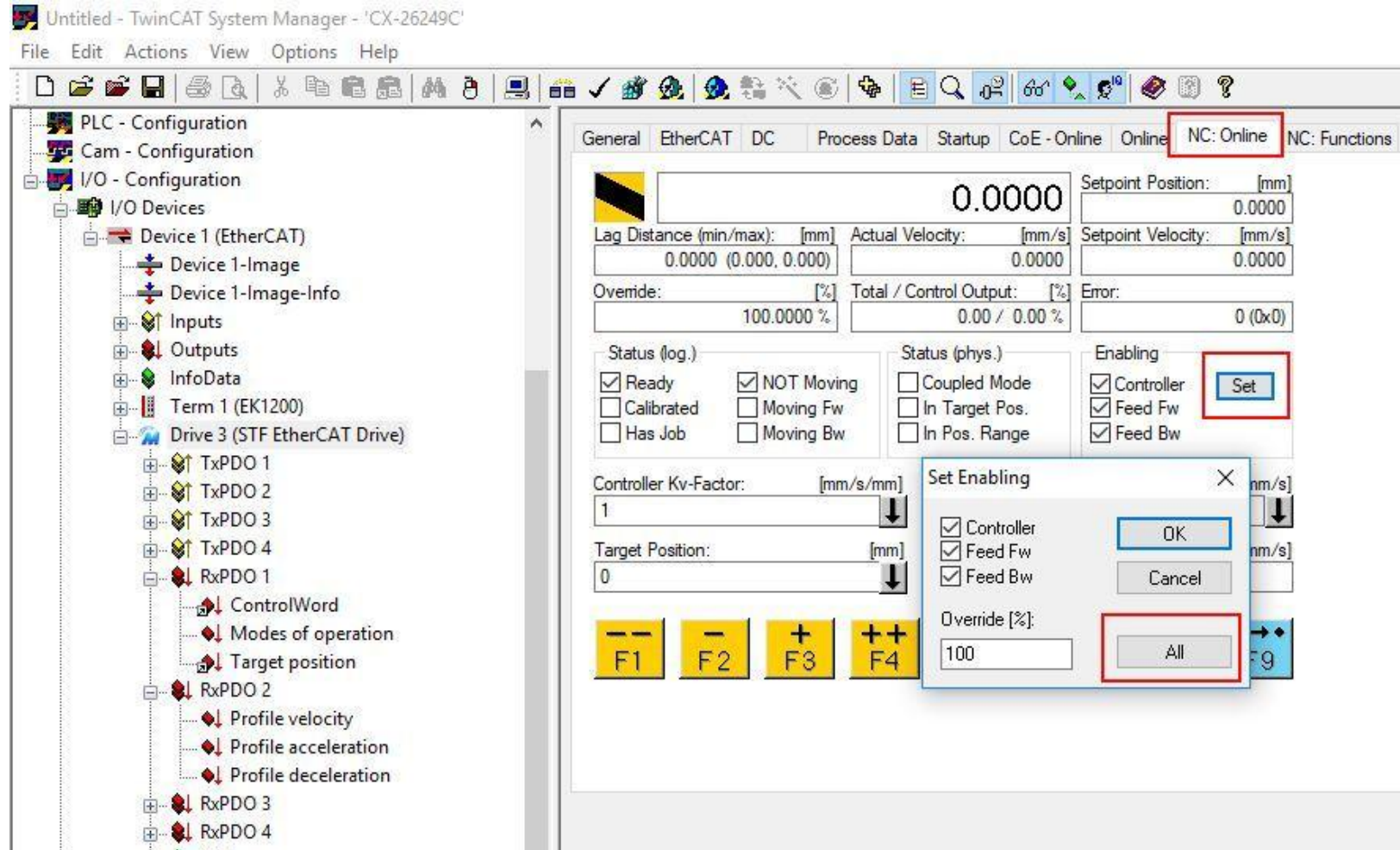


The screenshot shows the TwinCAT System Manager interface. On the left, the I/O Configuration tree is expanded to show 'RxPDO 1' with its sub-items: 'ControlWord', 'Modes of operation', and 'Target position'. The 'Modes of operation' item is highlighted with a red box. On the right, the 'Online' tab is active, showing the 'Value' field set to '0x08 (8)'. The 'Write...' button is highlighted with a red box. A 'Set Value Dialog' window is open in the foreground, showing the 'Dec' field set to '8', the 'Hex' field set to '0x08', and the 'Bit Size' field set to '8'. The 'OK' button is highlighted with a blue box.

## Using a PC as the master controller

- **Enable the motor**

Select the drive and find **NC: Online** tab. Click on **Set**. In the pop up window, click on **ALL**



When the motor is successfully enabled, the LED on the drive will show that the motor has been switched to enabled status.



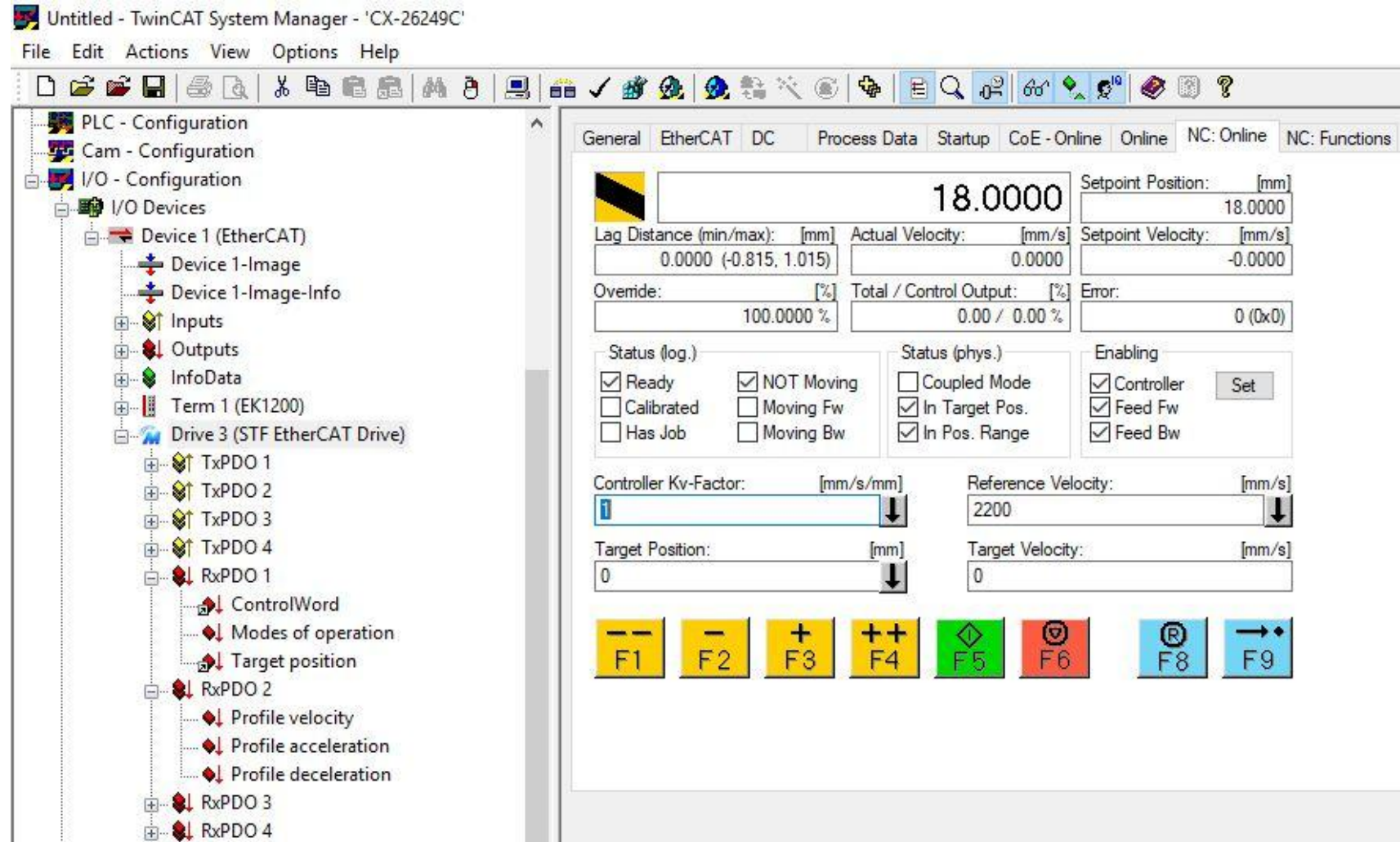
## Using a PC as the master controller

Then you can click on different buttons under the tabs shown below to control the motor.

NC: Online tab

Untitled - TwinCAT System Manager - 'CX-26249C'

File Edit Actions View Options Help



The screenshot displays the TwinCAT System Manager interface. On the left, a tree view shows the configuration hierarchy: PLC - Configuration, Cam - Configuration, I/O - Configuration, and I/O Devices. Under I/O Devices, 'Device 1 (EtherCAT)' is expanded to show its parameters, including TxPDOs, RxPDOs, and motion control settings. The main window shows the 'NC: Online' tab for 'Device 1 (EtherCAT)'. The interface includes a menu bar, a toolbar, and a main control area with the following elements:

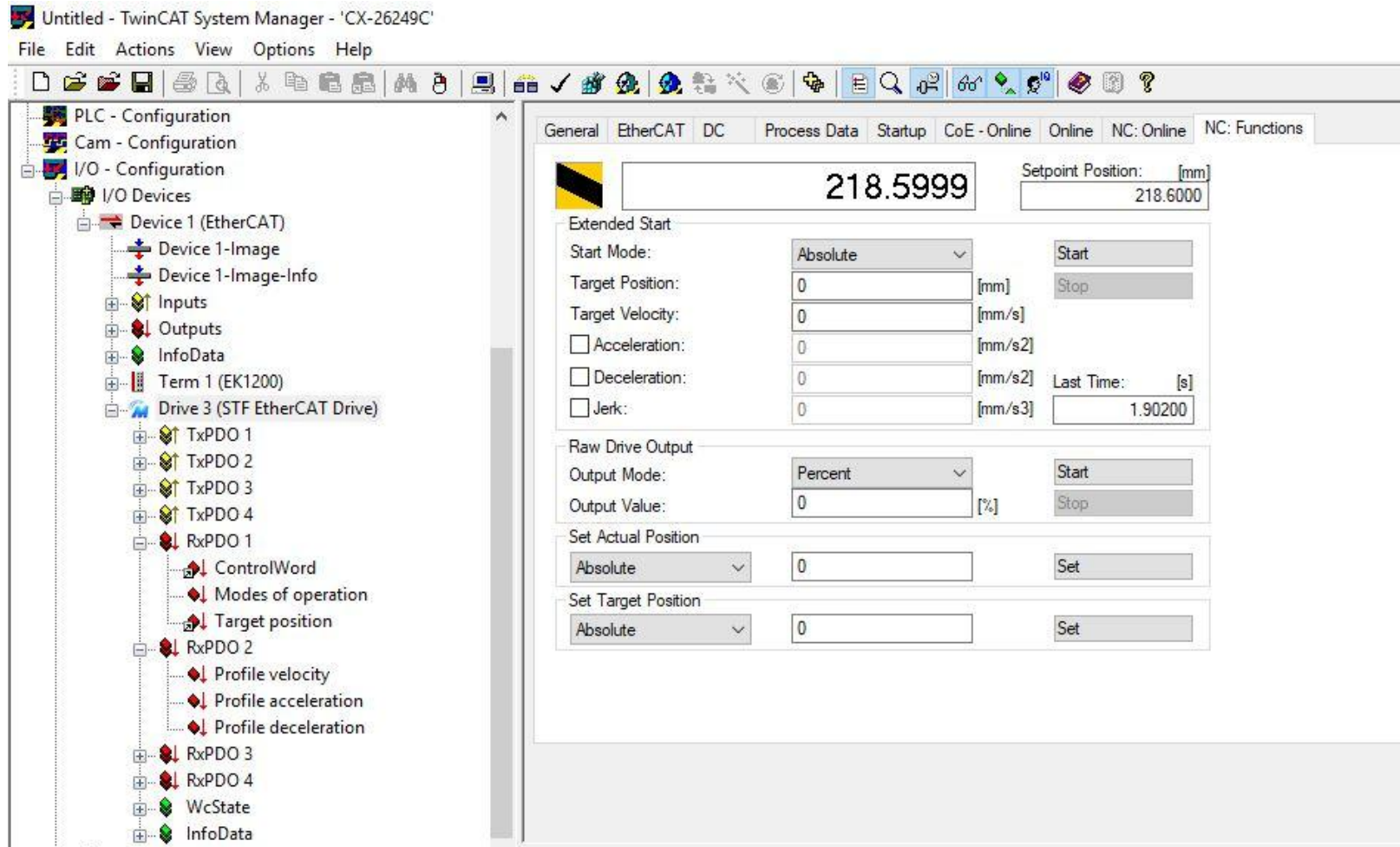
- General Tab:** Displays the current position as 18.0000 mm. Other parameters include Lag Distance (0.0000 mm), Actual Velocity (0.0000 mm/s), Setpoint Position (18.0000 mm), Setpoint Velocity (-0.0000 mm/s), Override (100.0000%), Total / Control Output (0.00 / 0.00%), and Error (0 (0x0)).
- Status (log.):** Includes checkboxes for Ready (checked), Calibrated (unchecked), Has Job (unchecked), NOT Moving (checked), Moving Fw (unchecked), and Moving Bw (unchecked).
- Status (phys.):** Includes checkboxes for Coupled Mode (unchecked), In Target Pos. (checked), and In Pos. Range (checked).
- Enabling:** Includes checkboxes for Controller (checked), Feed Fw (checked), and Feed Bw (checked), along with a 'Set' button.
- Controller Kv-Factor:** Set to 1 mm/s/mm.
- Reference Velocity:** Set to 2200 mm/s.
- Target Position:** Set to 0 mm.
- Target Velocity:** Set to 0 mm/s.
- Control Buttons:** A row of function buttons labeled F1 through F9, with F5 highlighted in green.

## Using a PC as the master controller

NC: Function tab

Untitled - TwinCAT System Manager - 'CX-26249C'

File Edit Actions View Options Help



PLC - Configuration  
Cam - Configuration  
I/O - Configuration  
I/O Devices  
Device 1 (EtherCAT)  
Device 1-Image  
Device 1-Image-Info  
Inputs  
Outputs  
InfoData  
Term 1 (EK1200)  
Drive 3 (STF EtherCAT Drive)  
TxPDO 1  
TxPDO 2  
TxPDO 3  
TxPDO 4  
RxPDO 1  
ControlWord  
Modes of operation  
Target position  
RxPDO 2  
Profile velocity  
Profile acceleration  
Profile deceleration  
RxPDO 3  
RxPDO 4  
WcState  
InfoData

General EtherCAT DC Process Data Startup CoE - Online Online NC: Online NC: Functions

218.5999 Setpoint Position: [mm] 218.6000

Extended Start  
Start Mode: Absolute [v] Start  
Target Position: 0 [mm] Stop  
Target Velocity: 0 [mm/s]  
 Acceleration: 0 [mm/s<sup>2</sup>]  
 Deceleration: 0 [mm/s<sup>2</sup>] Last Time: [s]  
 Jerk: 0 [mm/s<sup>3</sup>] 1.90200

Raw Drive Output  
Output Mode: Percent [v] Start  
Output Value: 0 [%] Stop

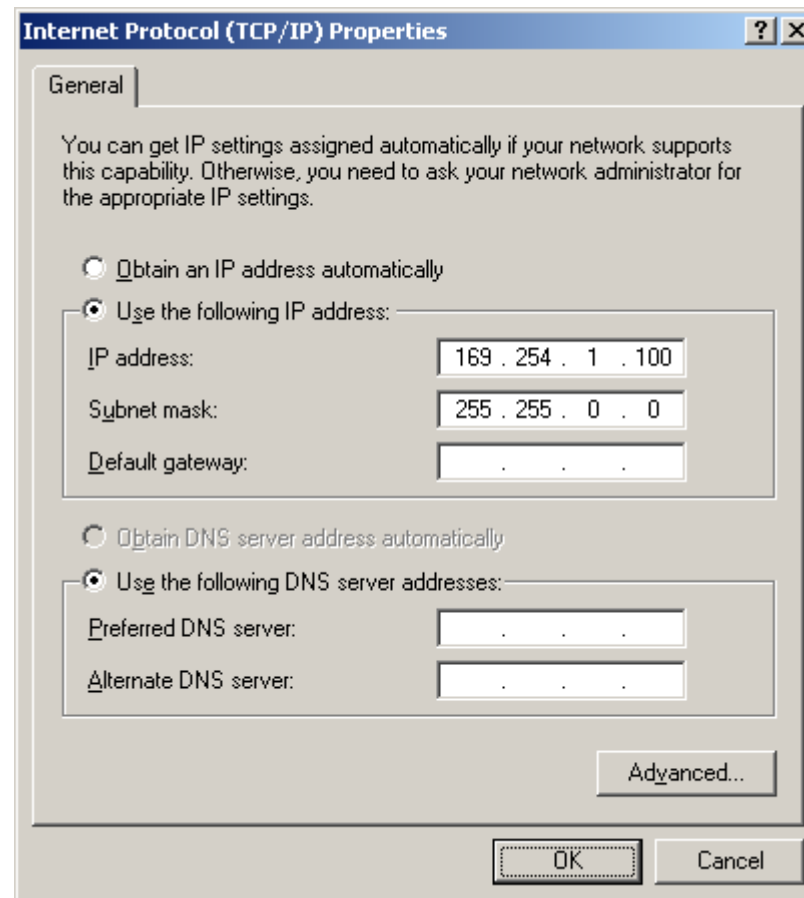
Set Actual Position  
Absolute [v] 0 Set

Set Target Position  
Absolute [v] 0 Set

If you use a Beckhoff PLC as the master controller, please follow these steps:

- **IP Setting**

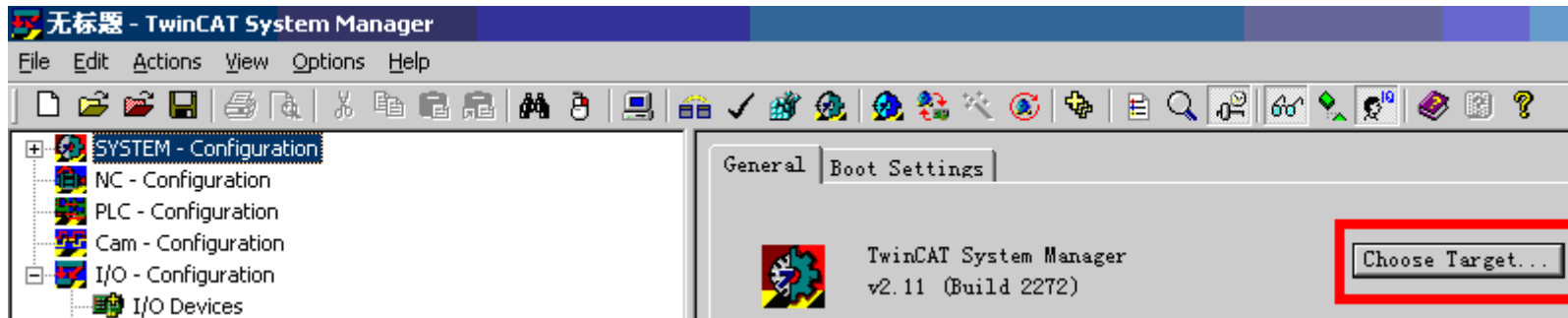
The IP address of Beckhoff PLC is usually 169.254.X.X, and the subnet mask is 255.255.0.0. You need to set the PC's IP address in the same subnet of Beckhoff PLC. For example, set PC's IP address to 169.254.1.100 and subnet mask to 255.255.0.0



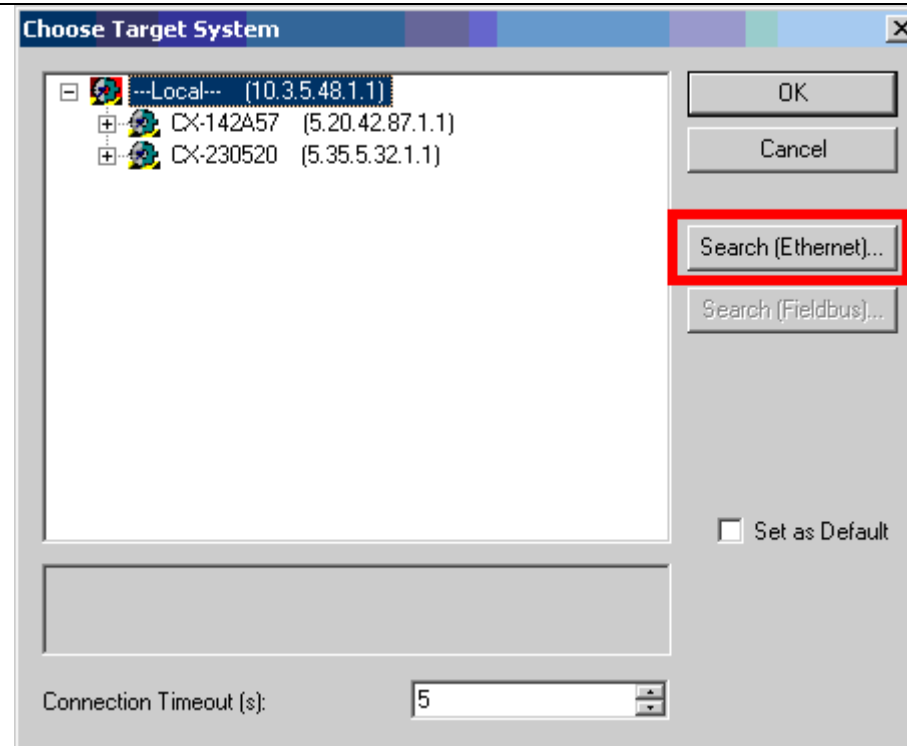


- **Search and connect to PLC**

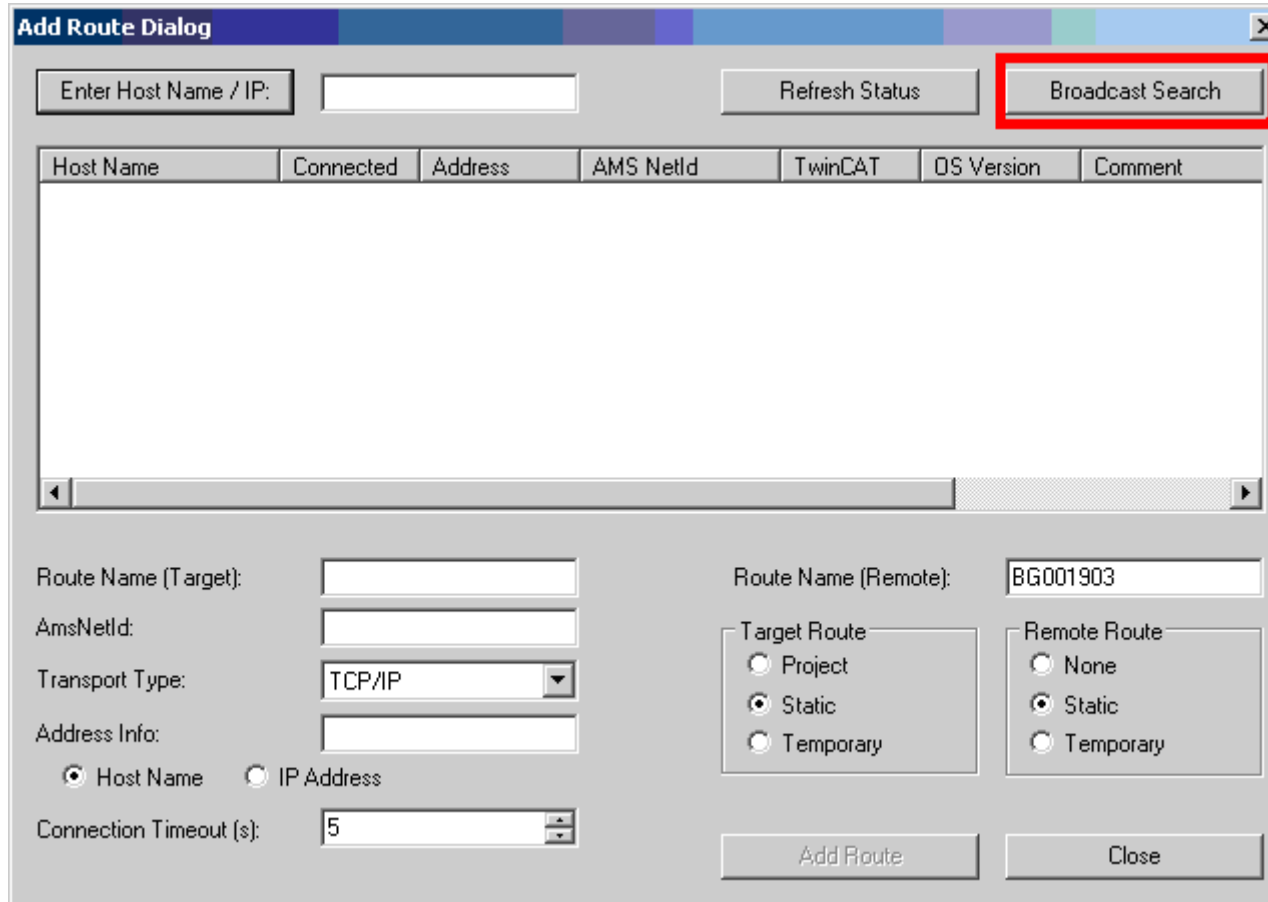
Select **SYSTEM – Configuration** and find **General** tab. Click on **Choose Target**



In the pop up window, Click on **Search (Ethernet)**



Click on [Broadcast Search](#)



**Add Route Dialog**

Enter Host Name / IP:  Refresh Status **Broadcast Search**

Host Name	Connected	Address	AMS NetId	TwinCAT	OS Version	Comment
-----------	-----------	---------	-----------	---------	------------	---------

Route Name (Target):

AmsNetId:

Transport Type:

Address Info:

Host Name  IP Address

Connection Timeout (s):

Route Name (Remote):

Target Route

Project

Static

Temporary

Remote Route

None

Static

Temporary

Add Route Close

When the host PLC is found, it will be shown in below window.

**Add Route Dialog** [X]

Enter Host Name / IP:  Refresh Status Broadcast Search

Host Name	Connected	Address	AMS NetId	TwinCAT	OS Version	Comment
CX-230520	X	169.254.19...	5.35.5.32.1.1	2.11.2249	Win CE (7.0)	

Route Name (Target):  Route Name (Remote):

AmsNetId:

Transport Type:

Address Info:

Host Name  IP Address

Connection Timeout (s):

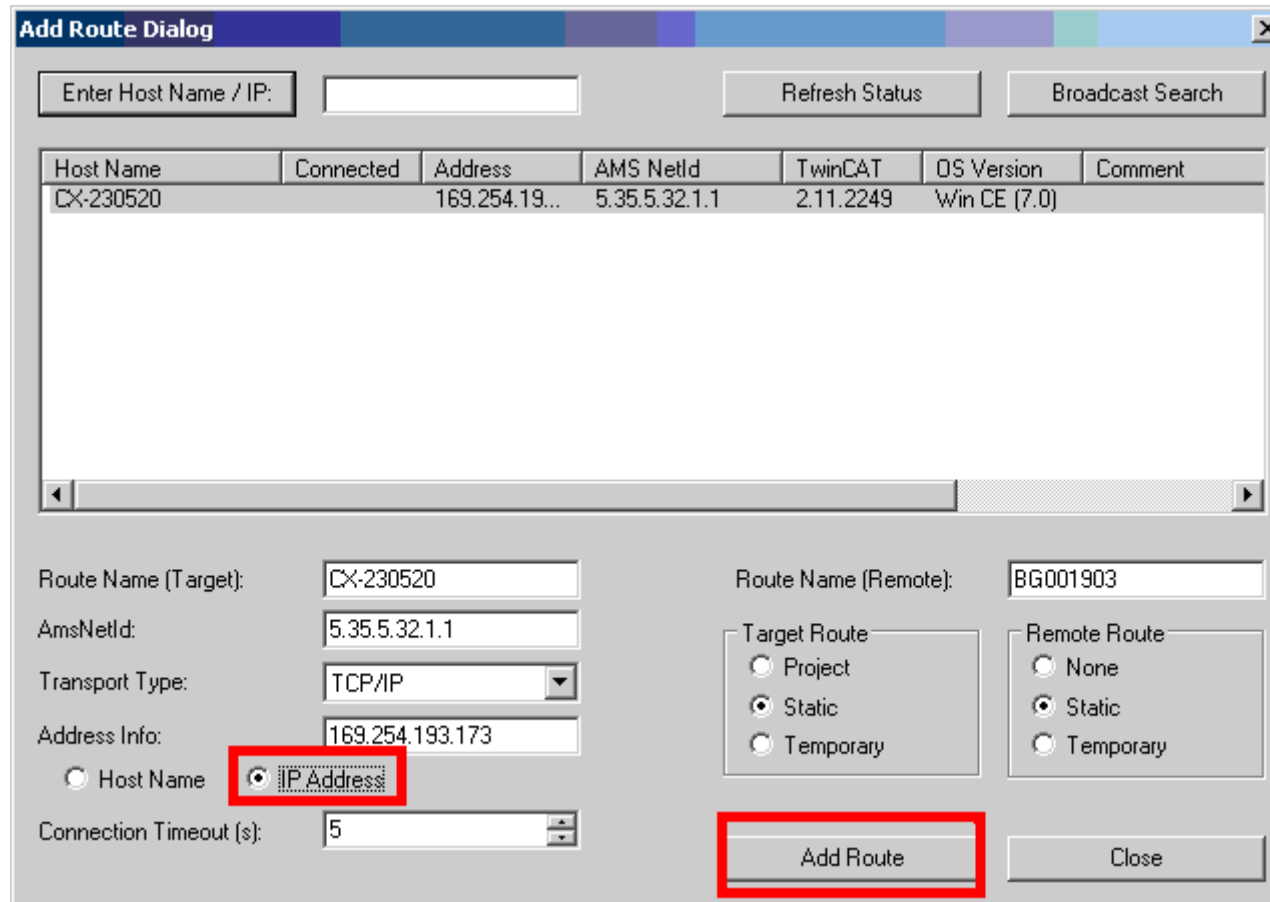
Target Route:  Project  Static  Temporary

Remote Route:  None  Static  Temporary

Add Route Close

When **Connected** column is empty, the PLC is not connected. If the PLC is connected, there will be an X under **Connected**

Select the host PLC. Select **IP Address** and click on **Add Route**



Host Name	Connected	Address	AMS NetId	TwinCAT	OS Version	Comment
CX-230520	Connected	169.254.19...	5.35.5.32.1.1	2.11.2249	Win CE (7.0)	

Route Name (Target):

Route Name (Remote):

AmsNetId:

Transport Type:

Address Info:

Host Name  IP Address

Connection Timeout (s):

Target Route:  
 Project  
 Static  
 Temporary

Remote Route:  
 None  
 Static  
 Temporary

Enter User name and password

Factory default: for Windows XP/WIN7, User name: Administrator, Password: 1; For Windows CE, password is blank



The image shows a 'Logon Information' dialog box with a blue title bar. It contains a key icon and the text 'Enter a user name and password that is valid for the remote system.' Below this are two input fields: 'User name:' with 'Administrator' entered and 'Password:' which is empty. At the bottom are 'OK' and 'Cancel' buttons.

When the PLC is successfully connected, there will be an X under **Connected**

**Add Route Dialog** [X]

Enter Host Name / IP:  Refresh Status Broadcast Search

Host Name	Connected	Address	AMS NetId	TwinCAT	OS Version	Comment
CX-230520	X	169.254.193.173	5.35.5.32.1.1	2.11.2249	Win CE (7.0)	

Route Name (Target):  Route Name (Remote):

AmsNetId:

Transport Type:

Address Info:

Host Name  IP Address

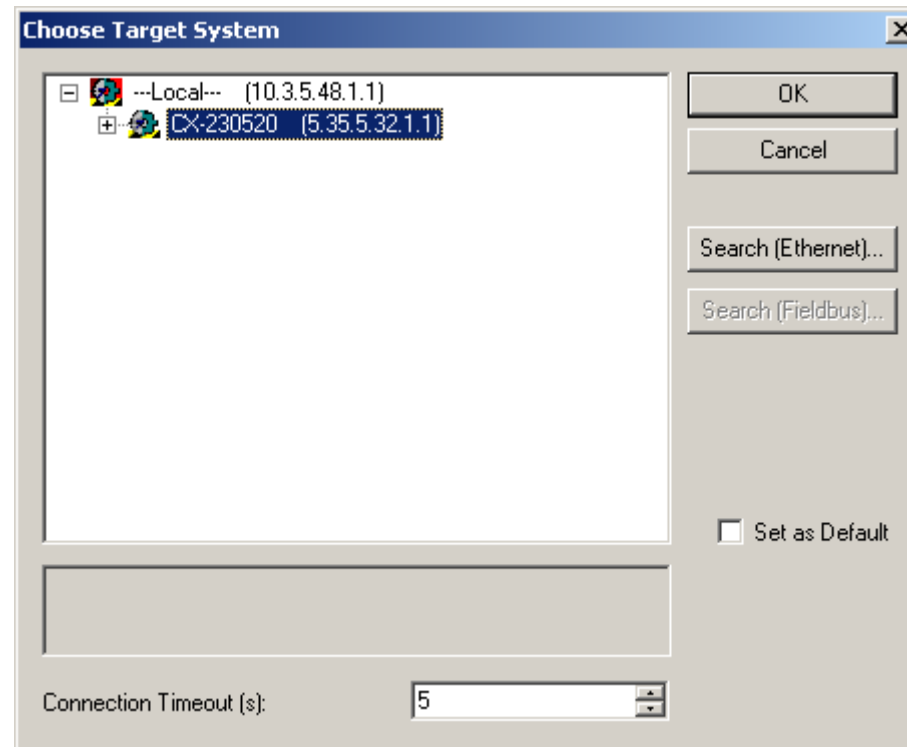
Connection Timeout (s):

Target Route:  Project  Static  Temporary

Remote Route:  None  Static  Temporary

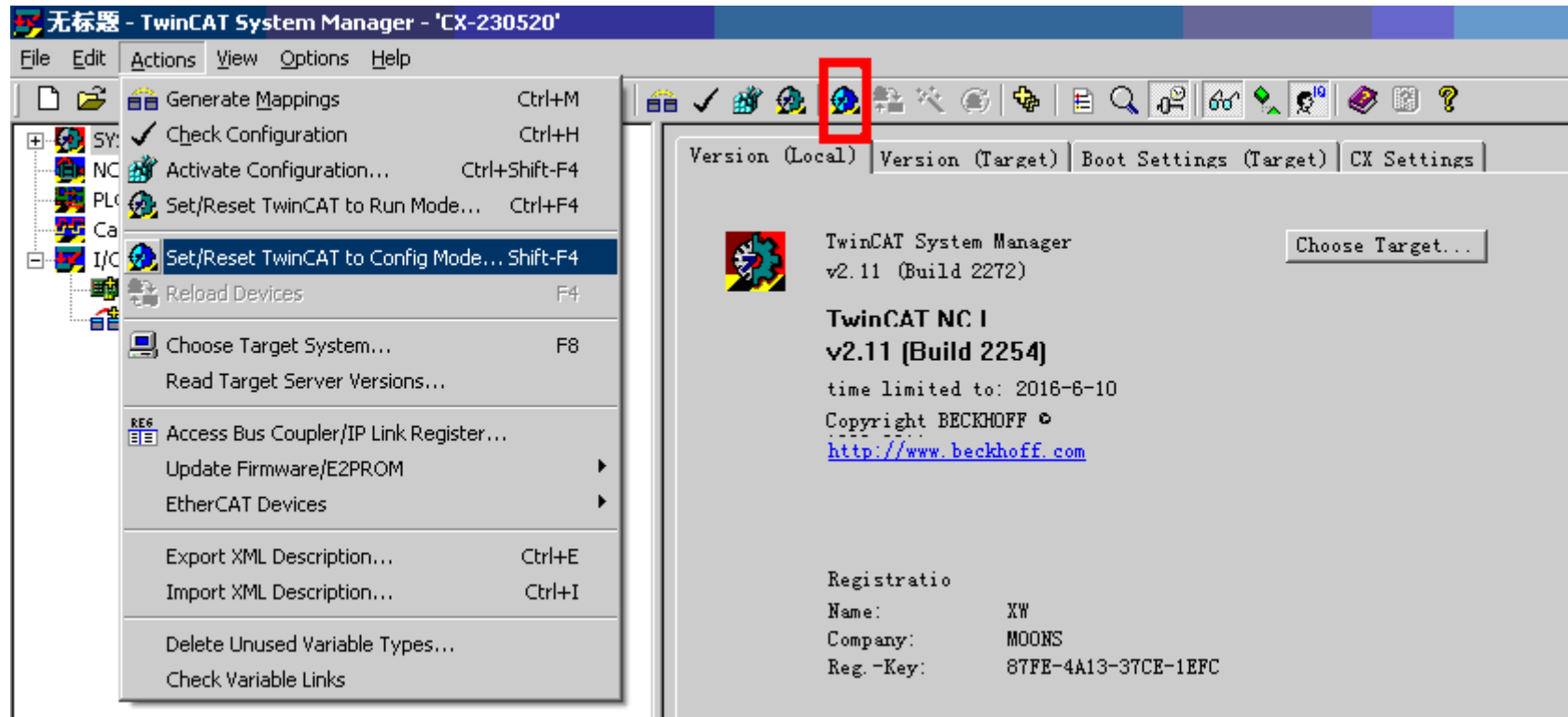
Add Route Close

Click on **Close** and go back to previous window. The connected PLC will be shown in the list. Select the PLC and click on OK.



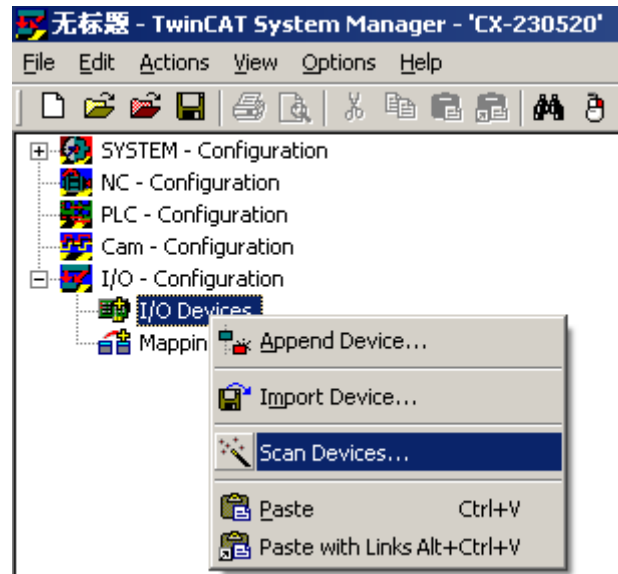


Click on **Set/Reset TwinCAT to Config Mode** under **Actions** to change TwinCAT to Config Mode.

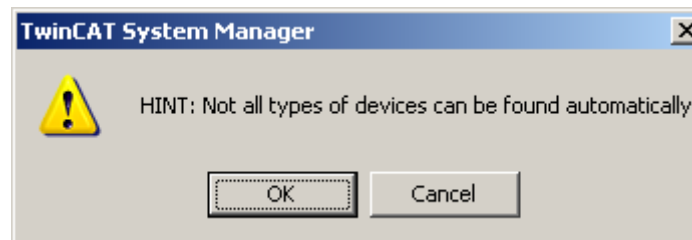


- **Scan Devices**

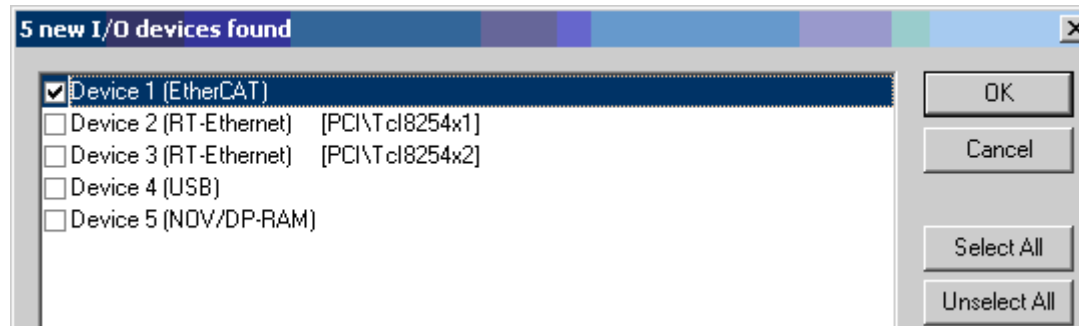
Right click on **I/O Devices** and then click on **Scan Devices**



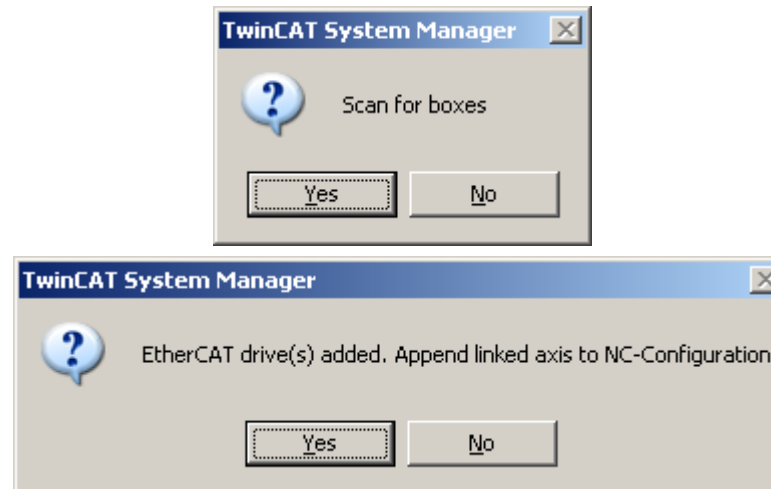
When this dialog shows, select OK



After I/O device is found, select **EtherCAT** only and click on OK



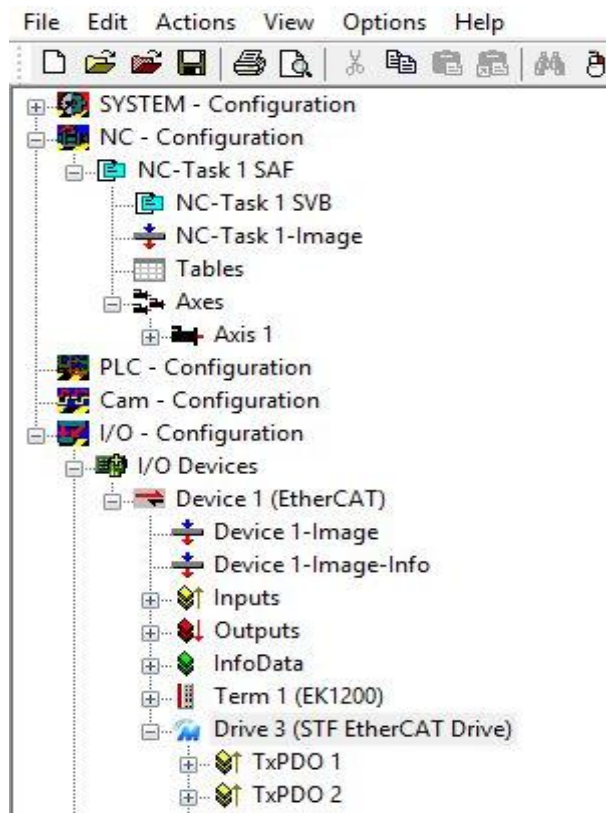
When these dialogs show, select Yes to **Scan for boxes** and **Append linked axis to NC-Configuration**



When this dialog shows, select Yes to **Activate Free Run**



After scan, EtherCAT drive will be shown under **I/O Devices**



The rest of the steps are the same as the previous section, starting from “Parameter settings for NC – Configuration” on page 8.