Motion Control Products

Application note
Using TwinCAT® with ABB motion drives

AN00203

Rev D (EN)

Use Beckhoff® TwinCAT® System Manager to configure EtherCAT® masters for control of ABB MicroFlex e190 and MotiFlex e180 servo drives

Introduction

TwinCAT software is used to configure Beckhoff PLCs and can also allow for configuration of a PC as a real time control unit. The ABB MicroFlex e190 and MotiFlex e180 motion control servo drives provide integrated EtherCAT functionality for real-time Ethernet control. A Beckhoff PLC or a PC with a suitable EtherCAT network adapter ("a soft PLC") can be used as an EtherCAT master to control one or more ABB motion drives.

This application note will cover how to use TwinCAT System Manager to define the hardware setup suitable for an ABB motion drive connected either to a PLC or a soft PLC over EtherCAT. It will also show how the TwinCAT System Manager can be used to perform moves on the drive. For the purposes of creating this document a MicroFlex e190 was used, but the principles and actions required are identical for MotiFlex e180.

Pre-requisites

You will need to have the following to work through this application note:

- Mint Workbench build 5854 or later (see new.abb.com/motion for latest downloads and support)
- A MicroFlex e190 (or MotiFlex e180) drive with build 5867.4.0 firmware or later
- A PC or laptop capable of running the TwinCAT software v2.11 or later (check out the TwinCAT website for details on system requirements).
- Either a Beckhoff PLC or a PC suitable for use as a soft PLC (check out the TwinCAT website for details on system requirements).

This application note assumes that you have already commissioned the drive. That is to say you have been through the commissioning wizard to define the motor and application settings (ensuring that the drive is setup for 'Real-time Ethernet' mode of operation and that the rotary switches are set to '00' to select EtherCAT mode for the real-time Ethernet ports) and have then auto-tuned (and fine-tuned if necessary) the control loops for the drive. Details on commissioning the drive can be found in the relevant drive installation manual.

Drive set-up and ESI file

An EtherCAT Slave Information (ESI) file contains the identity and features of the drive, and can be used by EtherCAT configuration tools such as TwinCAT to describe a device to the manager. Since build 5714.4.0 of firmware the motion drives have supported the EtherCAT EEPROM standard. This allows EtherCAT configuration tools such as TwinCAT to read an EtherCAT device's EEPROM to find all the suitable information it would normally find from an ESI file. This means that it is not essential for the ESI file to be provided to TwinCAT.

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However, the current EtherCAT EEPROM specification does not define all the ESI fields for the EEPROM. This means there are a couple of items you would find in an ESI that are not in the EEPROM:

- Distributed Clock mode
- Start-up commands

It is therefore preferable to use the available ESI file if possible.

The paragraph below details how to get an ESI file from a motion drive, this is not required for the EEPROM method. If you are going to read from the EtherCAT EEPROM you can skip to the section titled 'System manager (TwinCAT hardware setup)'.

Launch Mint Workbench and select the 'EtherCAT' icon in the toolbox (seen in the bottom left of the screen). After a few seconds the EtherCAT screen will appear. On the 'Summary' tab click the 'Save As…' button in the ESI File section. Give the file a name (it is best to include the drive's firmware version in the name somehow) and save the file to the following location:

C:\TwinCAT\IO\EtherCAT.

The TwinCAT software will need restarting if you already had TwinCAT System Manager running at this point. This is so that it can load the new ESI file for the motion drive. A different ESI file is required for each drive firmware version. If you update to a previously unused firmware version you may need to save the new ESI file to the correct location. The correct ESI file can always be uploaded from the drive being used or an offline drive project and is saved in an .xml format. The ESI files can also be downloaded from the product support page within the motion support website…

http://new.abbmotion.com/support/SupportMe/default.asp?

System manager (TwinCAT hardware setup)

If TwinCAT is installed on your PC you should see an icon in the notification area like this…

Click the icon and select 'System Manager' to launch the application (It can also be launched by going to Programs>TwinCAT System>TwinCAT System Manager).

If you have used TwinCAT System Manager before it will open up your last project, go to File>New to start a new project…

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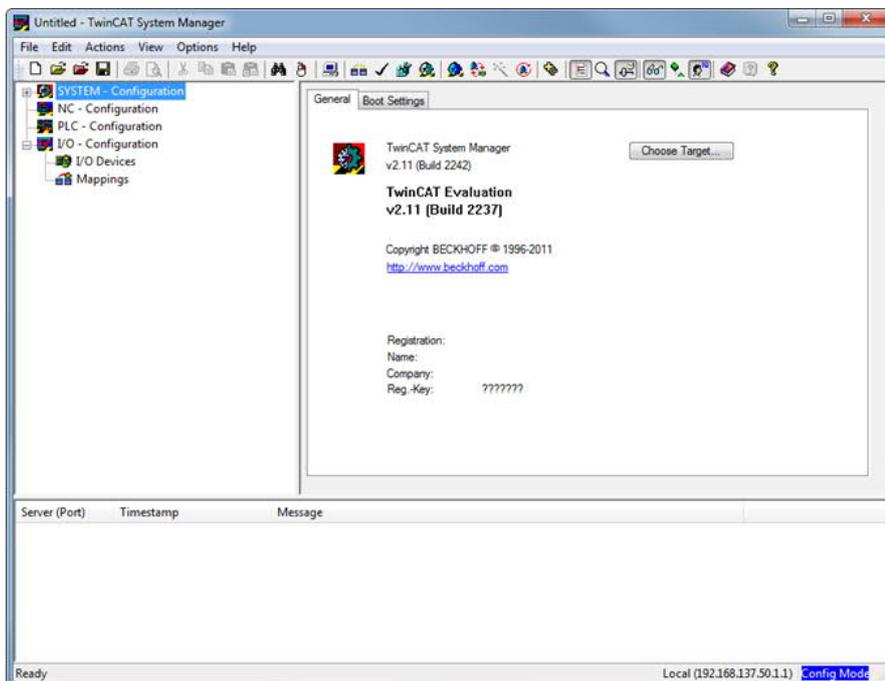
Target system

The bottom right hand corner of the screen above displays the current target system and mode of operation. Our screenshot shows that the target system is currently the local PC (plus its address) and that it is in Config mode. We will now go through how to change the target to an actual PLC, if you don't have a PLC and want to use the PC as a soft PLC then skip this next section and go to the 'I/O devices' section.

To change the target system click on the 'Choose target…' button on the 'General' tab, this will open another window which will list any existing connections that have been previously made. Click on the 'Search (Ethernet)' button on the right hand side then the 'Broadcast search' button in the top right hand corner of the next window, this will tell TwinCAT to search the network for TwinCAT compatible devices. Once the search is finished you should see a list of devices, one of these will be your PC and any others will be TwinCAT devices on the network…
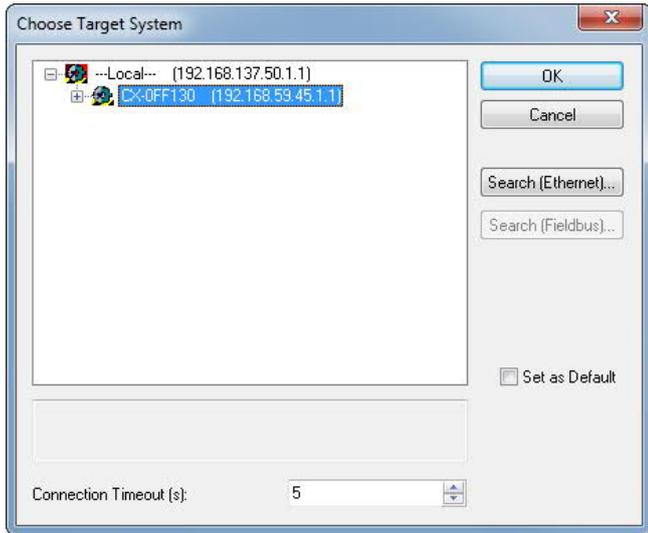
Highlight your PLC named CX-xxxxxx, the number will be the last 6 digits of the MAC-ID 1 as printed on the label of the PLC. Click the IP address button in the bottom left hand corner and then click the 'Add route' button. You will be presented with a login window, depending on your PLC operating system your login password will vary:

Operating system	User name	Password
Windows CE	Administrator	None (blank)
Windows Embedded	Administrator	'1'

After entering the login detail an 'X' should appear in the 'Connected' column next to the highlighted PLC. Click the 'Close' button and you should see your PLC listed as a target system. Highlight the PLC and click OK. You should now see the previous TwinCAT screen (above) but the info in the bottom right hand corner will indicate you are connected to the PLC in Config mode. If you have any problems with these steps please refer to the TwinCAT documentation or contact Beckhoff for technical support.

I/O devices

At this point you should have the motion drive connected to your PLC or soft PLC EtherCAT port with a suitable EtherCAT cable (EtherCAT uses a straight through type Ethernet cable). With either your soft PLC or actual PLC selected as the target system you now need to highlight 'I/O Devices' listed in the tree on the left hand side of the screen, right click on this and select 'Scan Devices'.

Click 'OK' to confirm that you realise that all devices may not be found automatically and then you should see a dialog box similar to the one shown below (the actual text in this dialog will vary depending on whether you are using a PC or a PLC)…
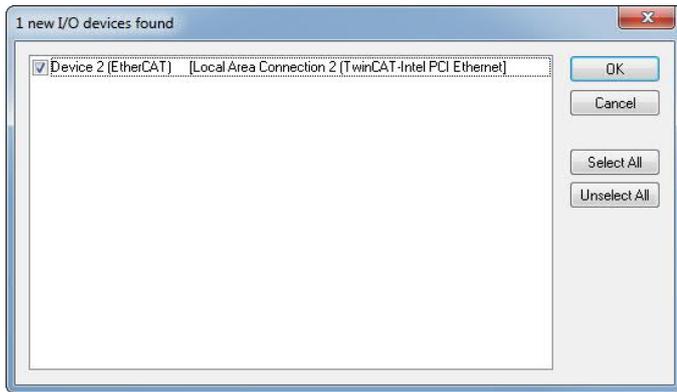
If you have any additional I/O devices on your PLC or PC / soft PLC you may see them listed here too. Ensure the correct EtherCAT device is ticked. Click 'OK' and then 'Yes' to scan for boxes. Scanning for boxes will find devices connected to the EtherCAT network.

When the ABB motion drive is found you will see a message pop-up. If you do not have the ESI file installed into TwinCAT it will look like the message shown below…


If you see this dialog click 'Yes' to read the required information from the drive EEPROM. At this point you should now see the same dialog that will appear if TwinCAT finds a device for which an ESI file is already installed…
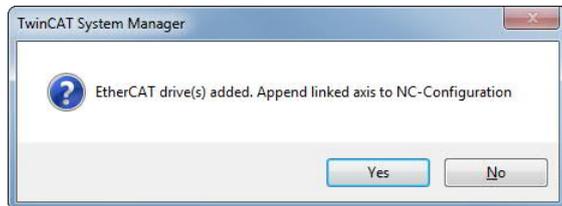

Click 'Yes' to append the axis to the NC-Configuration within TwinCAT.

You will now be asked if you wish to activate 'Free Run mode'….Click 'No'. Your TwinCAT System Manager screen should now look like the one below showing you your motion drive and an axis linked to this drive….
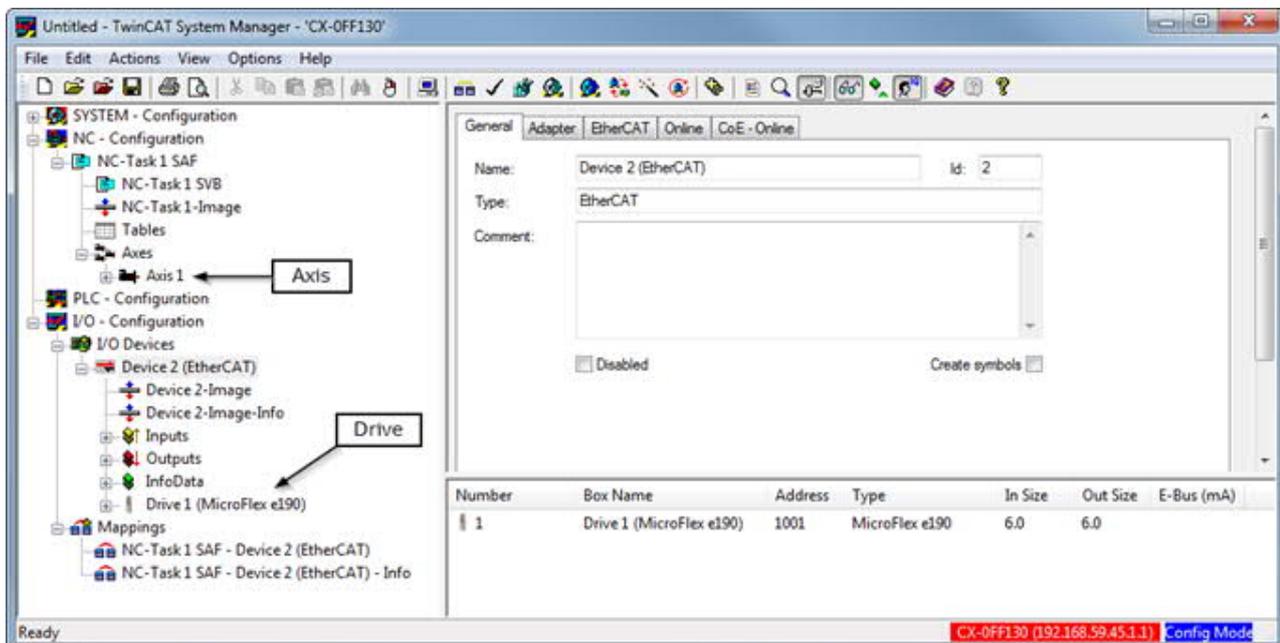
Drive settings

Click on the drive in the left hand window and select the EtherCAT tab in the right hand window. Now select the 'Advanced Settings' button which will open the window shown below.
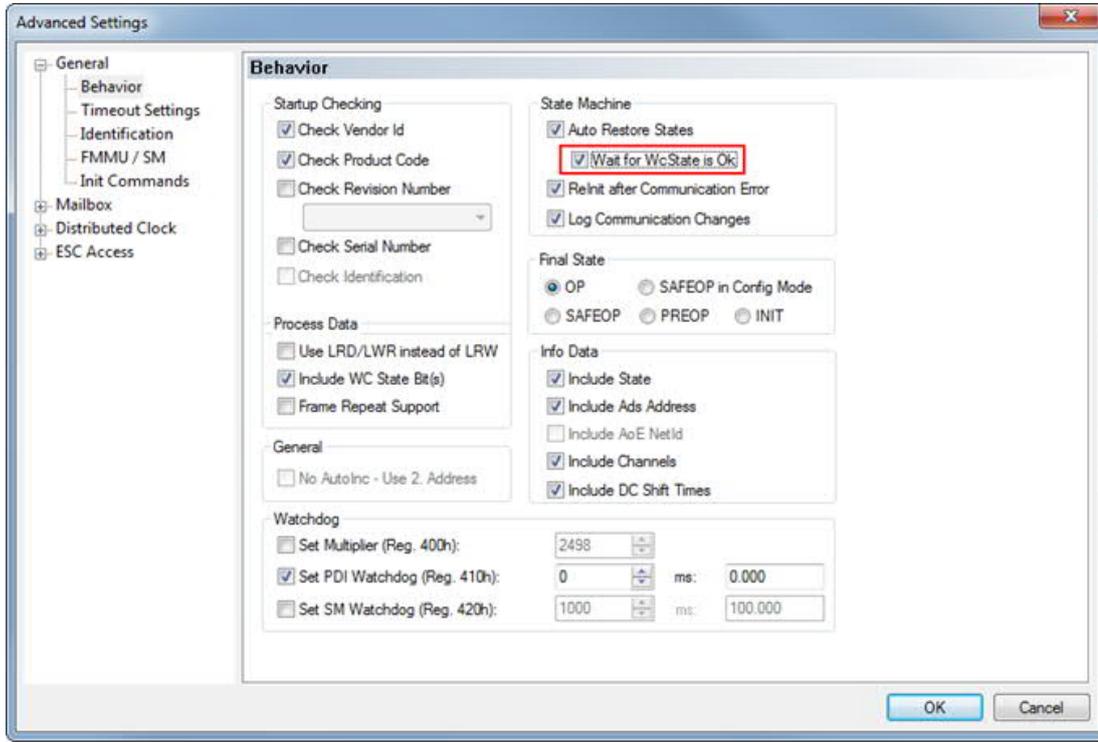

Make sure the 'Wait for WcState is Ok' box is ticked in the top right hand corner section labeled 'State Machine'.

While in this same 'Advanced Settings' screen if you are using the EEPROM mode (i.e. you have not installed an ESI file) then you will need to make some additional changes. If you are using an ESI file please skip ahead to the section titled 'Axis settings'.

As previously mentioned, when using EEPROM mode this currently misses the Distributed Clock settings and start-up commands.
To enable the Distributed Clock select Distributed Clock in the tree on the left of your already open Advanced Settings window. Tick the two boxes highlighted below and click OK.
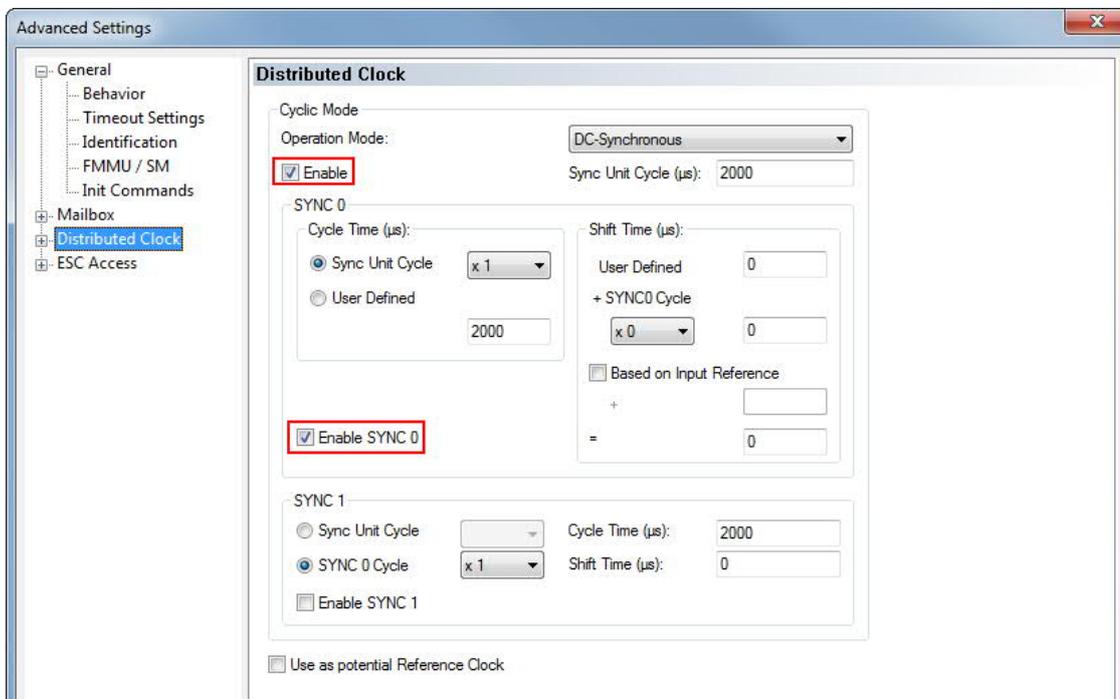
To enter start-up commands select the drive in the device tree and then go to the 'Startup' tab. Click the 'New' button at the bottom of the top right pane and enter the information shown below
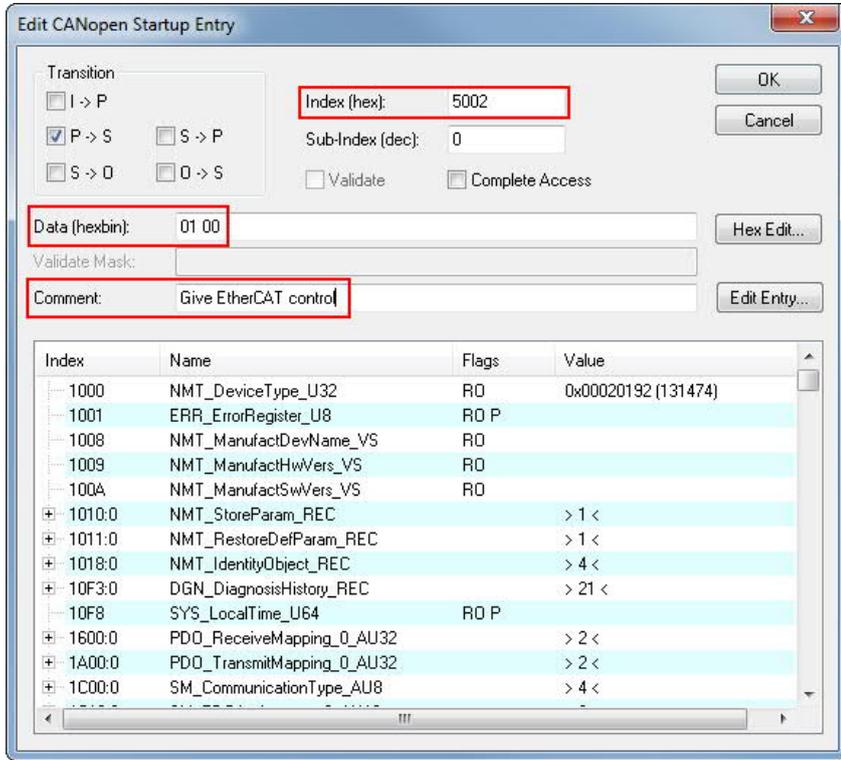
In the example above we have entered:

Index (hex): 5002
Data (hexbin): 01 00
Comment: Give EtherCAT control

Repeat this process to add a second start-up command using:

Index (hex): 6060
Data (hexbin): 08
Comment: Cyclic Synchronous Position

The startup command list will now have two additional entries

Axis settings
The next things to configure are the axis settings including scale factors and user units.
Click on 'Axis 1' and then select the 'Settings' tab from the window on the right. Select the user units required, the default is mm, mm/s, etc. Next expand 'Axis 1' by clicking on the + symbol and click on 'Axis 1_Enc', then select the 'Parameter' tab in the window on the right…
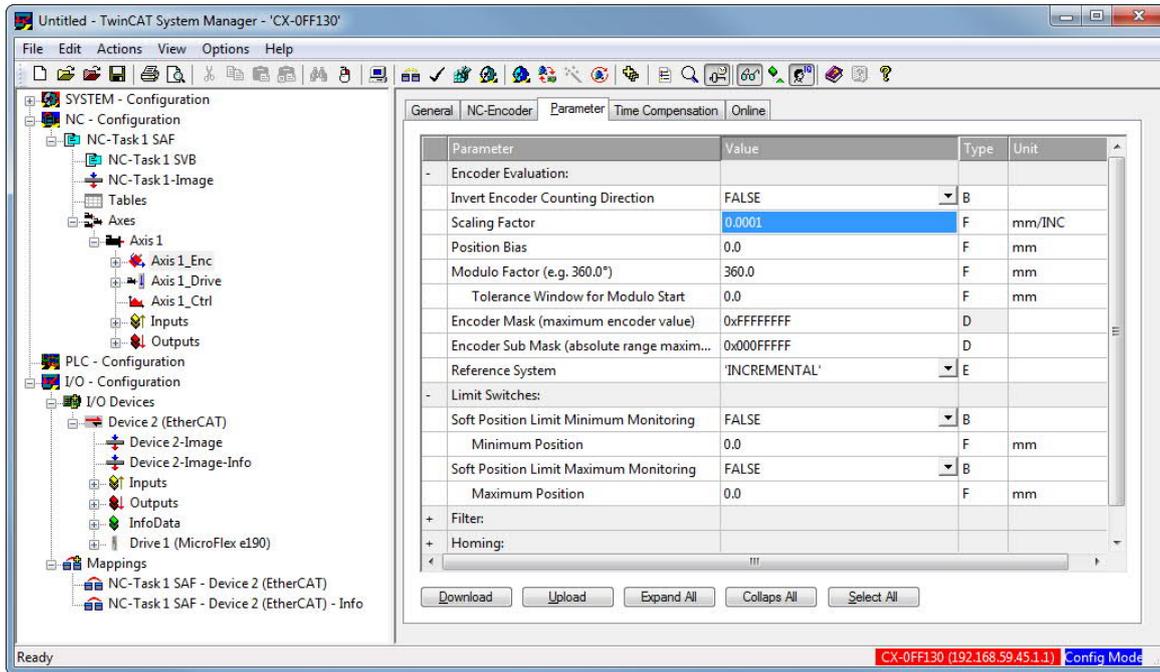
Enter the correct scale factor for your axis. For example if you have a 2,500 line (10,000 counts/rev) encoder on your motor connected to a 5:1 gearbox with a pulley on the output that moves a conveyor 200mm for one rev of the pulley your scale factor will be:

200 mm **/** (5 x 10,000 cts/rev) = <u>0.004</u> mm/count (or mm/INC)

Also, on this same screen, you need to set 'Encoder Sub Mask (absolute range maximum value)' to 0xFFFFFFFF. This tells TwinCAT that the drive can handle 32bit absolute positioning.

Now click on 'Axis 1' and select the 'Parameter' tab in the window on the right. Under the 'Velocities' section of the list you can enter suitable speed values for the axis. 'Reference velocity' is used when performing a position type move. The fast and slow manual velocities are used to set the speed for the fast and slow jog buttons (we will see these later).
The 'Dynamics' section allows you to set accel and decel rates…

Parameter	Value	Unit
Velocities:		
Reference Velocity	2200.0	mm/s
Maximum Velocity	2000.0	mm/s
Manual Velocity (Fast)	600.0	mm/s
Manual Velocity (Slow)	100.0	mm/s
Calibration Velocity (towards plc cam)	30.0	mm/s
Calibration Velocity (off plc cam)	30.0	mm/s
Jog Increment (Forward)	5.0	mm
Jog Increment (Backward)	5.0	mm
Dynamics:		
Acceleration	1500.0	mm/s2
Deceleration	1500.0	mm/s2
Jerk	2250.0	mm/s3
Fast Axis Stop Signal Type (optional)	'OFF (default)'	
Fast Acceleration (optional)	0.0	mm/s2
Fast Deceleration (optional)	0.0	mm/s2
Fast Jerk (optional)	0.0	mm/s3

Cycle time

The final setting we need to consider is the EtherCAT cycle time, this is set using two different parameters. The first parameter can be set by expanding the 'SYSTEM – Configuration' branch of the tree on the left and then highlighting 'Real-Time Settings'.
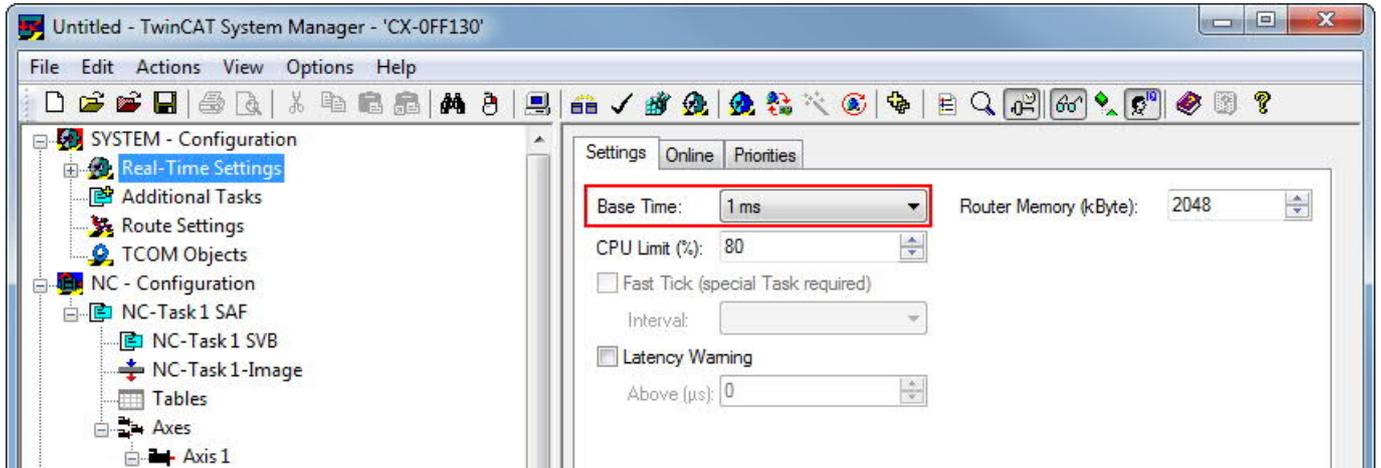

250µs is the minimum cycle time for the ABB motion drives so this would be the minimum base time. For our example we have set a base time of 1ms. We can now go to the second setting used for the EtherCAT cycle time, expand 'NC – Configuration' and highlight 'NC-Task 1 SAF' in the tree on the left. In the window on the right you should see a box allowing you to set 'Cycle ticks' and next to this the cycle time. In the screen shot below we have set 'Cycle ticks' to 2 making our cycle time 2ms (1ms base time x 2 cycle ticks).
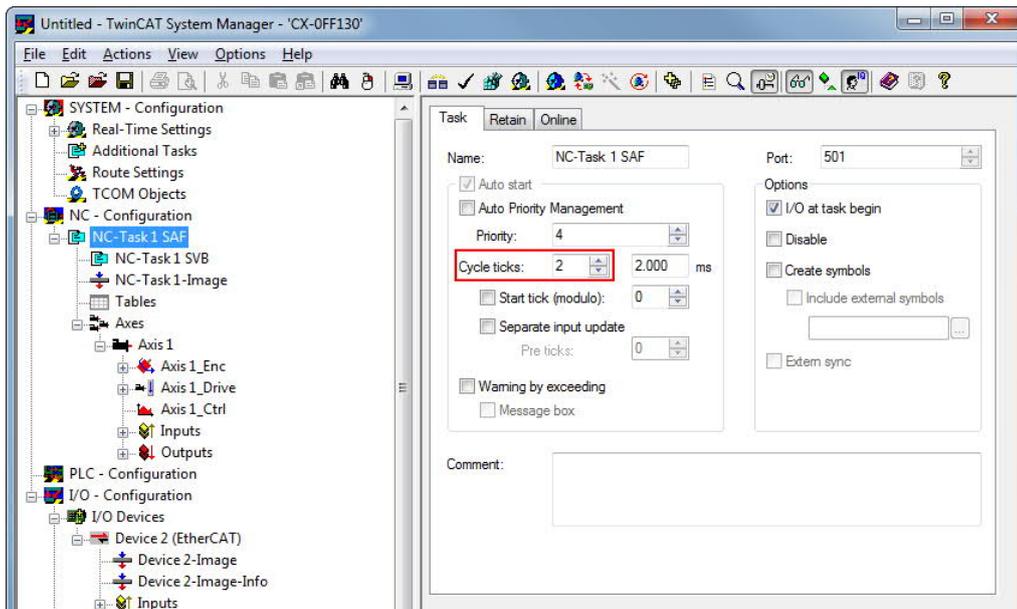
Note that the EtherCAT cycle time must be a binary multiple of 250µs (250µs, 500µs, 1ms, 2ms, 4ms, 8ms, etc…)

Activate configuration

Once all these settings are correct we need to activate the configuration. This requires that we click 3 buttons:
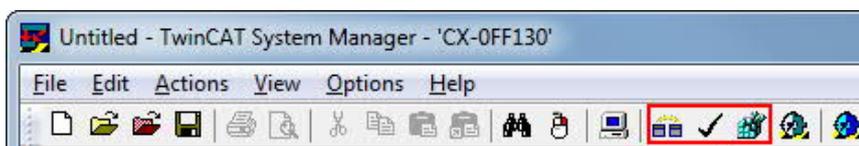

From left to right we click 'Generate mappings', then 'Check configuration' and finally assuming no errors occurred after the previous two button presses click 'Activate configuration'. After clicking 'Activate configuration' you will see a window asking you to confirm you want to activate the configuration as old configurations will be overwritten, click 'OK'. You will then get another

window asking if you want to restart TwinCAT in Run Mode, click 'OK' to do this. The box in the bottom right hand corner of TwinCAT should turn green and read 'RTime n%' or 'Running' to indicate that TwinCAT is now in run mode.

Performing moves

Now that we are in run mode we can try and move the axis. To do this we can use the online tab, click on Axis 1 listed in the tree on the left then select the 'Online' tab in the window on the right…
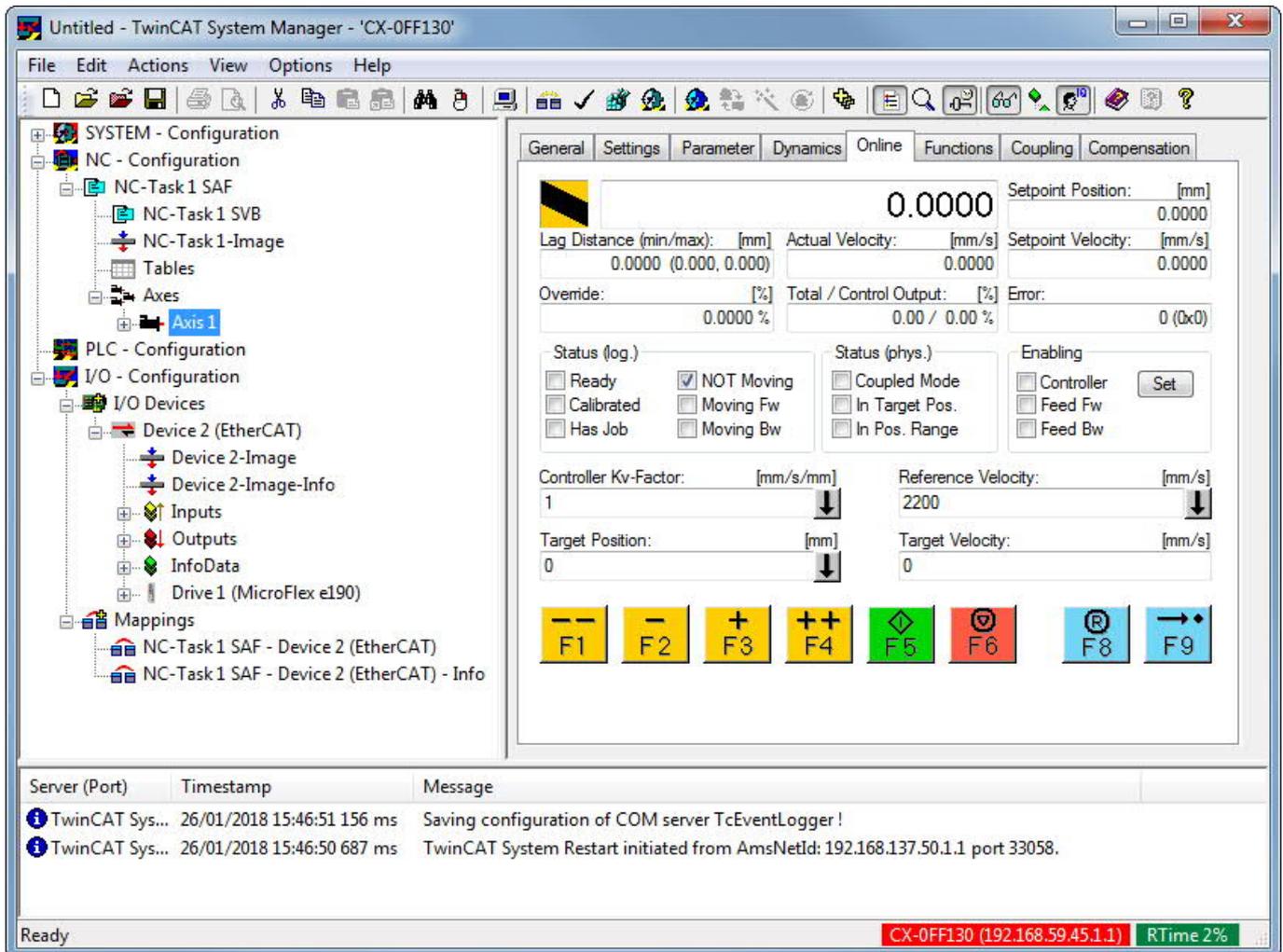
Note – Please ensure you have tuned the drive using Mint Workbench before you try to use TwinCAT to move the motor.

The large number at the top is the position of the axis in user units. If you rotate the shaft of the motor by hand you should see this number count up/down.

To enable the axis click the 'Set' button on the right hand side in the 'Enabling' section. A window will appear with some tick boxes, click the 'All' button to enable them all. The drive should now be enabled and we can use the yellow coloured buttons along the bottom to jog the axis. We set the fast and slow manual velocities previously that control the speed of these jog buttons, a single +/- (F3/F2) indicates the slow jog either forward or back and the double ++/-- (F4/F1) indicates a fast jog. ◇/F5 and ⊚/F6 are go and stop buttons respectively -these are used in conjunction with the target position and target velocity boxes to move to a given position at a given velocity.

®/F8 is the reset button and can be used to clear errors on the drive.

➝•/F9 is used to perform a homing sequence. Please refer to the TwinCAT documentation for details on available homing methods.

The next tab along is called 'Functions' and allows you to perform repeated moves, reversing sequences, sinusoidal motion, etc. More detail on these functions is available in the TwinCAT documentation.

PLC program

PLC programs are written using another of the TwinCAT tools called 'PLC Control'. This can be started by right clicking on the TwinCAT icon in the system tray. Please refer to the TwinCAT documentation for details on writing PLC programs. Once you have a PLC program you can append it to a TwinCAT System Manager project by right clicking on 'PLC – Configuration' in the tree on the left and selecting 'Append PLC project'. Once you have appended a PLC program to the project you can then link PLC variables to PLC I/O or data. Further details on appending PLC programs can be found in the TwinCAT documentation.

Contact Us

For more information please contact your
local ABB representative or one of the following:

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