

# How to use Beckhoff AX5000 servo drive with NCT CNC controller

## Getting Started Guide



**The NCT Ltd. does not provide direct support to interface non-NCT produced EtherCAT devices (including AX5000 servo drives) with the NCT3xx CNC controller. If you have intention of using other manufacturers' EtherCAT devices, please get contact with NCT Ltd.**

This user guide’s purpose to give a step-by-step guide to set up the EtherCAT communication between a Beckhoff AX5000 servo drive and NCT 3xx CNC controller.

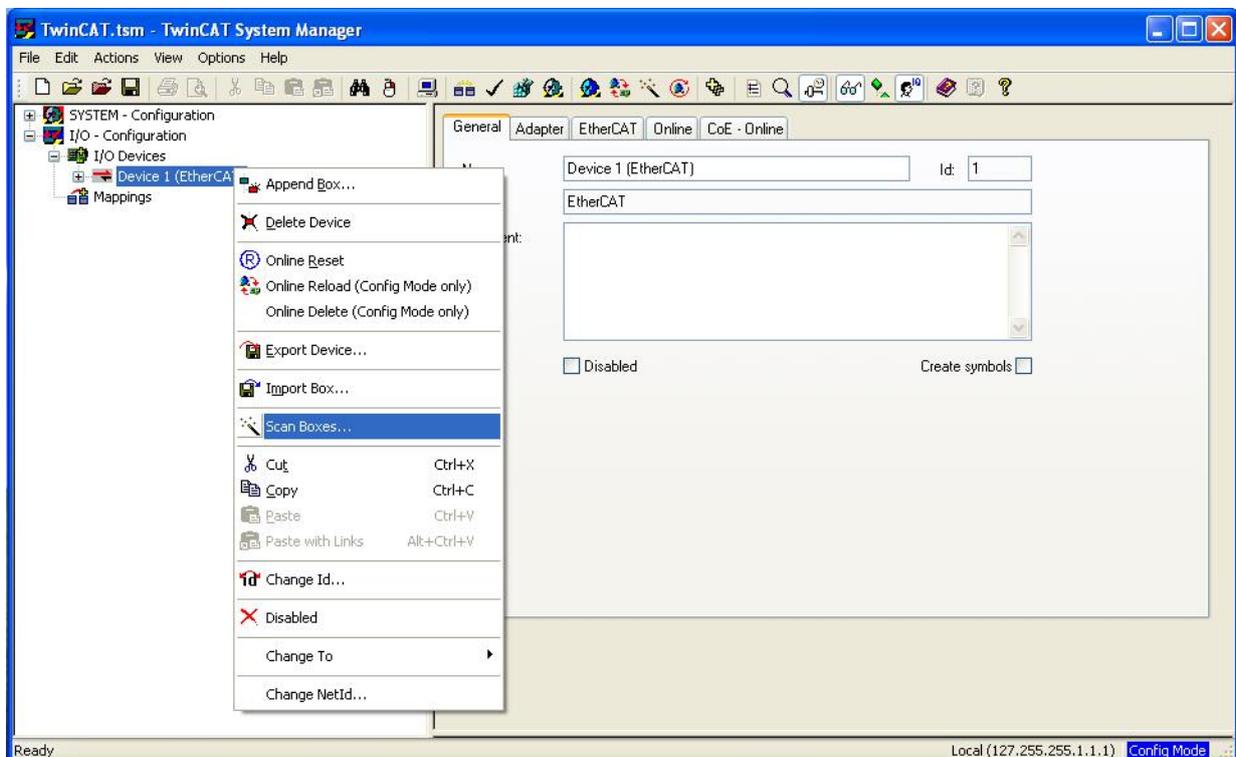
We assume basic knowledge about EtherCAT and the NCT3xx controller. The Beckhoff’s TwinCAT software contains the Drive Manager which provides a comprehensive interface to do all settings of an AX5000 servo drive. Best practice to set up a basic setting through TwinCAT’s Drive Manager, export the parameters from TwinCAT and then import these parameters into the NCT3xx CNC controller.

## 1. Provide the xml description to AX5000

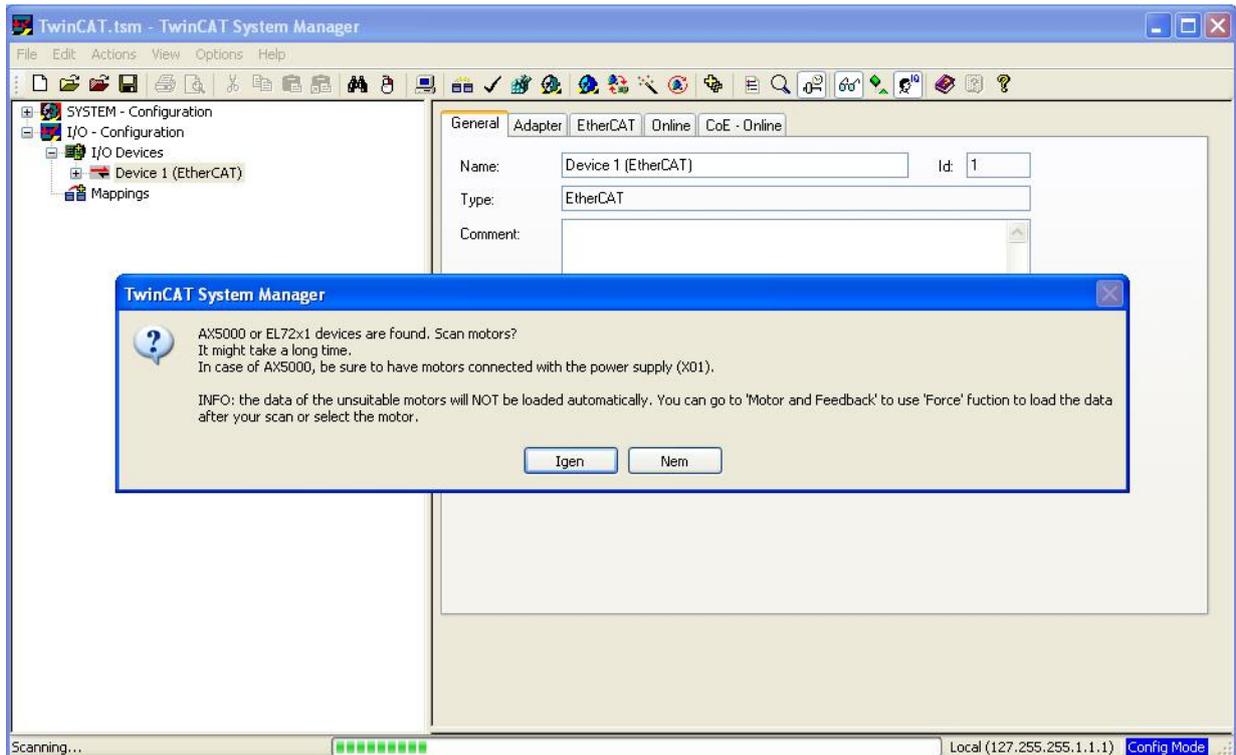
All EtherCAT devices should have a valid xml description, which is a file in xml format. You should download your AX5000’s xml description form Beckhoff homepage and copy them into the TwinCAT’s *TwinCAT\Io\EtherCAT* directory. You can copy all files what you extracted from the downloaded zip file. In case of TwinCAT3 you can use the “Update Device Descriptions (via ETG Website)...” function.

## 2. Connect the AX5000 to the TwinCAT running PC

According the AX5000’s user guide set up and switch on the servo drive and connect the motor and the encoder too. Connect the servo drive to the TwinCAT running PC via an Ethernet cable. Scan for devices:

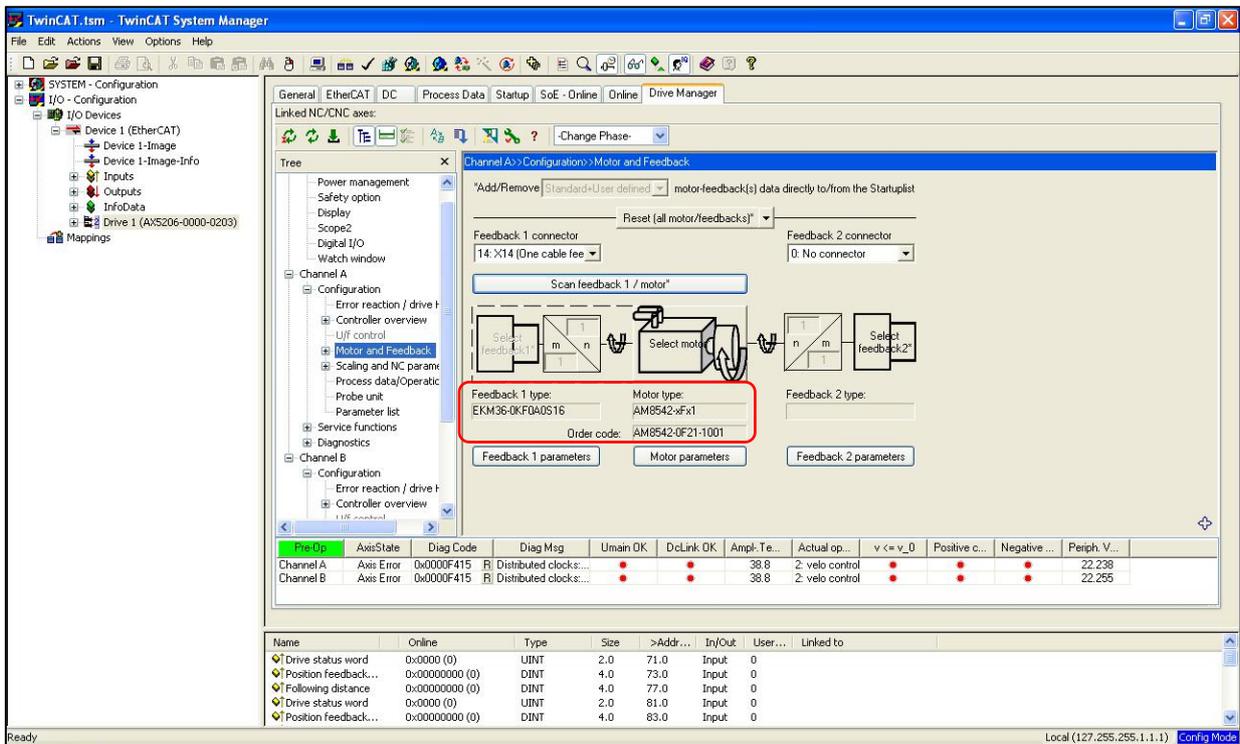
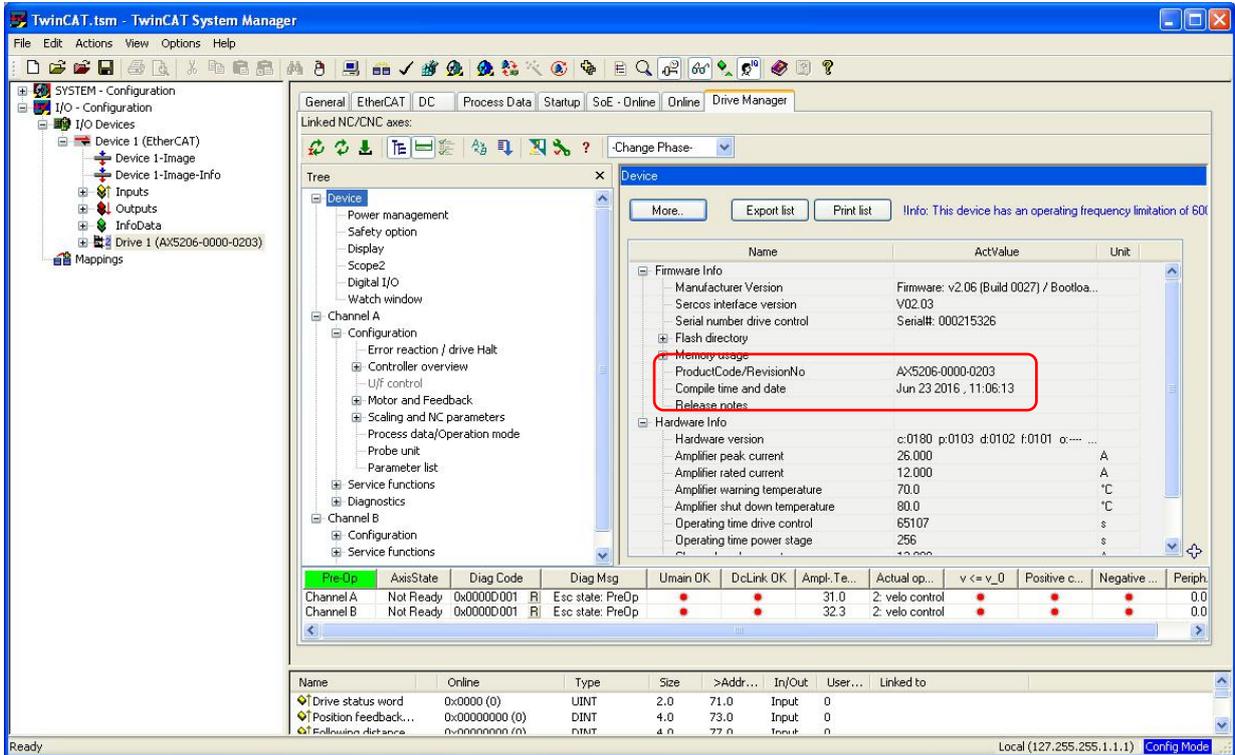


If the motor is from Beckhoff too, the TwinCAT Drive Manager can read the motor type from encoder, and after device scanning immediately ask us if we want to use this function. If the motor is not from Beckhoff, but the Drive Manager's motor parameter collection (Motorpool) contains it, we can select it from this list. Now let's let the TwinCAT Drive Manager to identify the connected servo drive and the motor type.



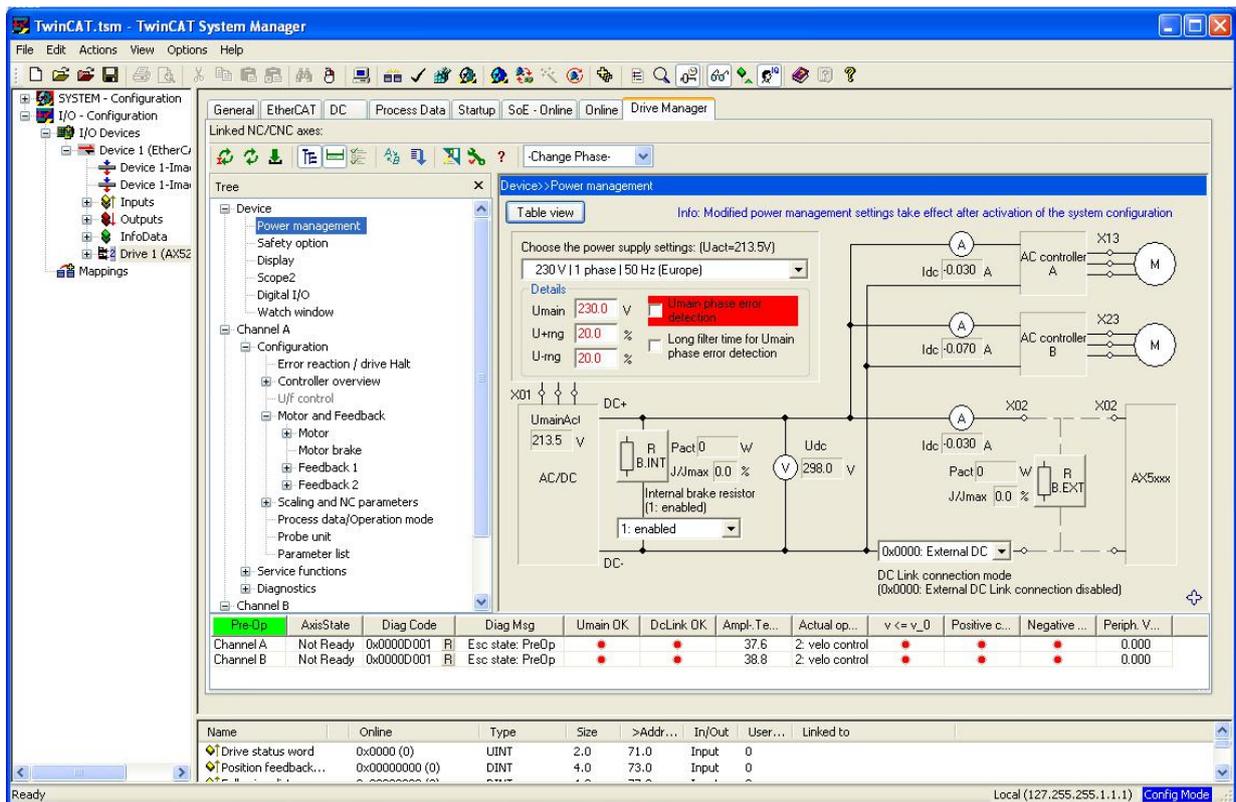
If TwinCAT has found your drive, you will see it under the “Device 1 (EtherCAT)” in the device list. After a successful identification open the Drive Manager and check the servo drive and motor type, they should be same as the drive and motor name plate. You can find the servo drive description parameters in the Drive Manager under the *Device* element. You can see the identified motor and encoder type under Channel A/B on the *Motor and feedback* tab. If the identification was not successful on this tab you can select the motor and the encoder if the Drive Manager's database contains your motor/encoder configuration.

In case of two axes servo drive (i.e. AX52xx) the TwinCAT refers Axis 1 as Channel A and Axis 2 as Channel B. Check the motor type on both channel.



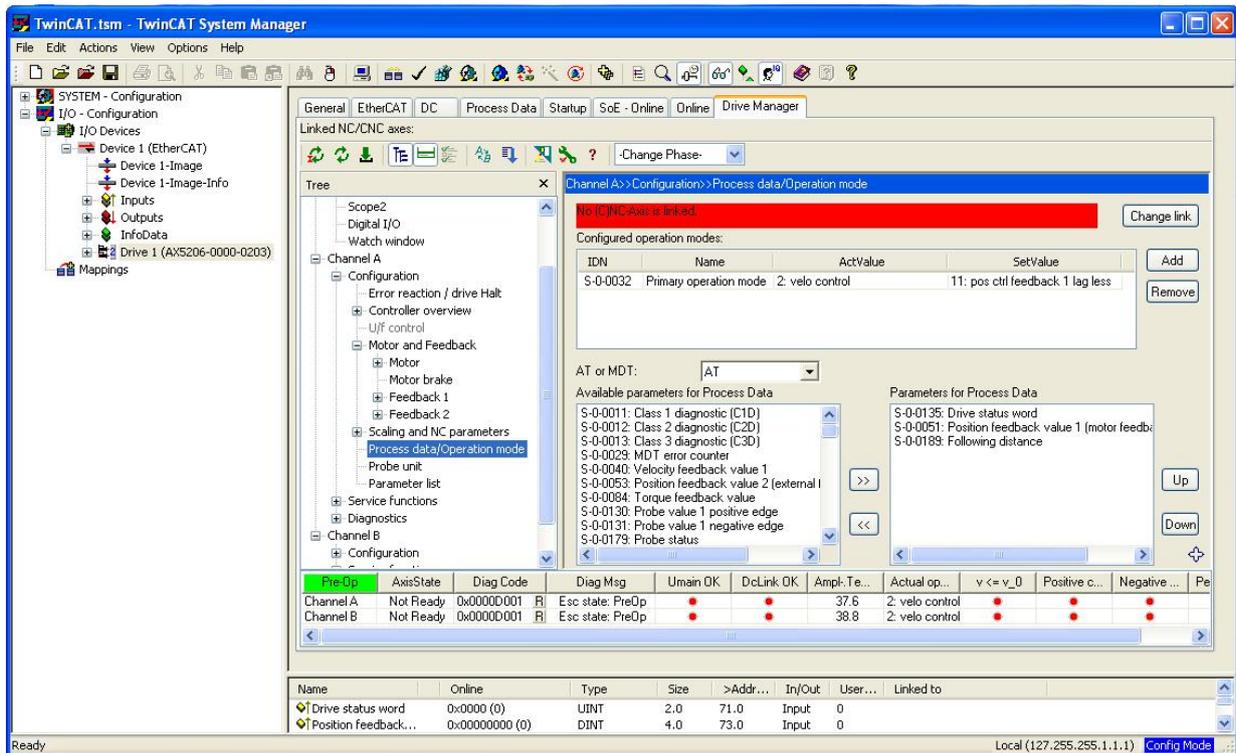
### 3. Check and set the drive parameters

You should check all the parameters and change them according to your application requirements if it is needed. You can do it by stepping one-by-one on the *Tree* items. If the drive is a two-axis servo drive, you can find the axis 1 and 2 parameters under the Channel A and Channel B.



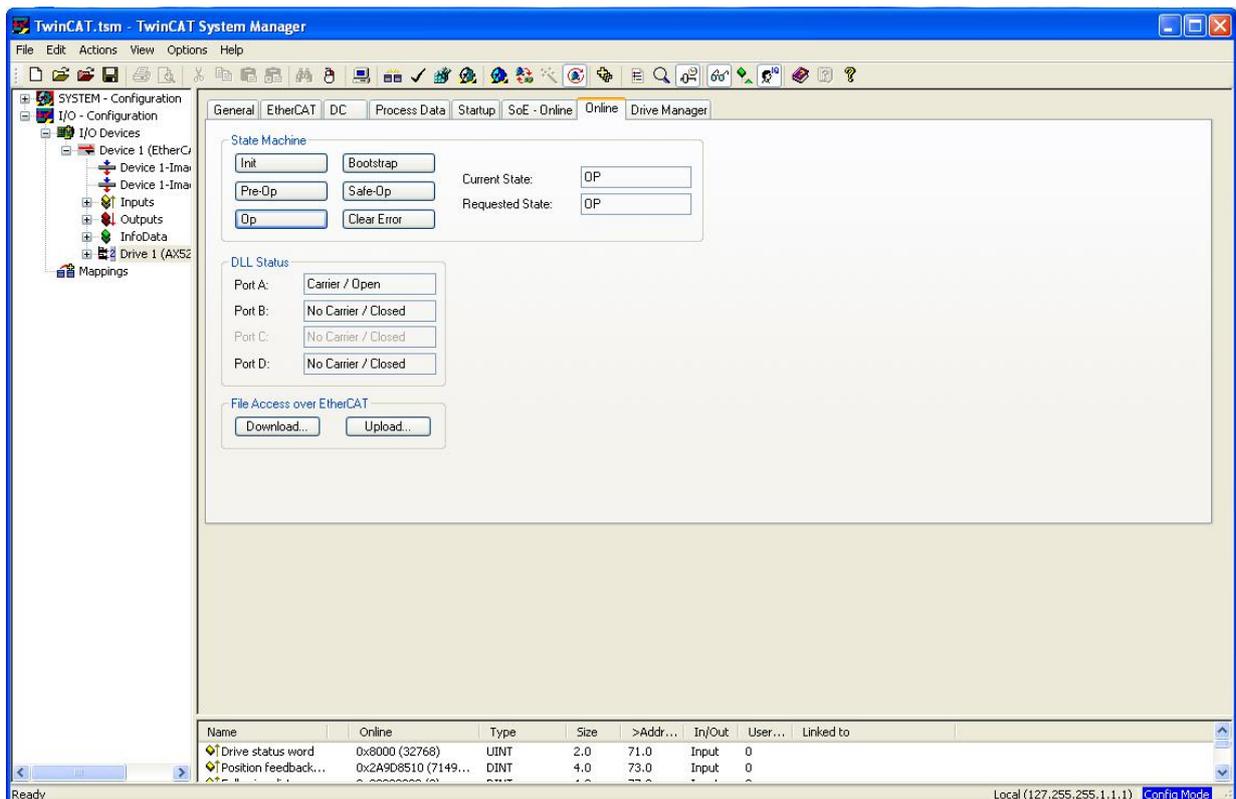
The NCT3xx CNC controller uses the drives in velocity control mode by default. We can change this under the *Channel/Configuration/ Process data/Operation mode*. Change the configured operation mode. Set the value S-0-0032 Primary operation mode parameter to 2. velo control. Select MDT and remove with << button the S-0-0047 Position command value item from the process data parameter list, and add with the >> button the S-0-0036 Velocity command value.

We do not need to make further process data settings, because these settings are not part of the exported parameters and we should do the PDO setting on the NCT controller again. If the drive is a two-channel drive, you should do this setting on both channels.

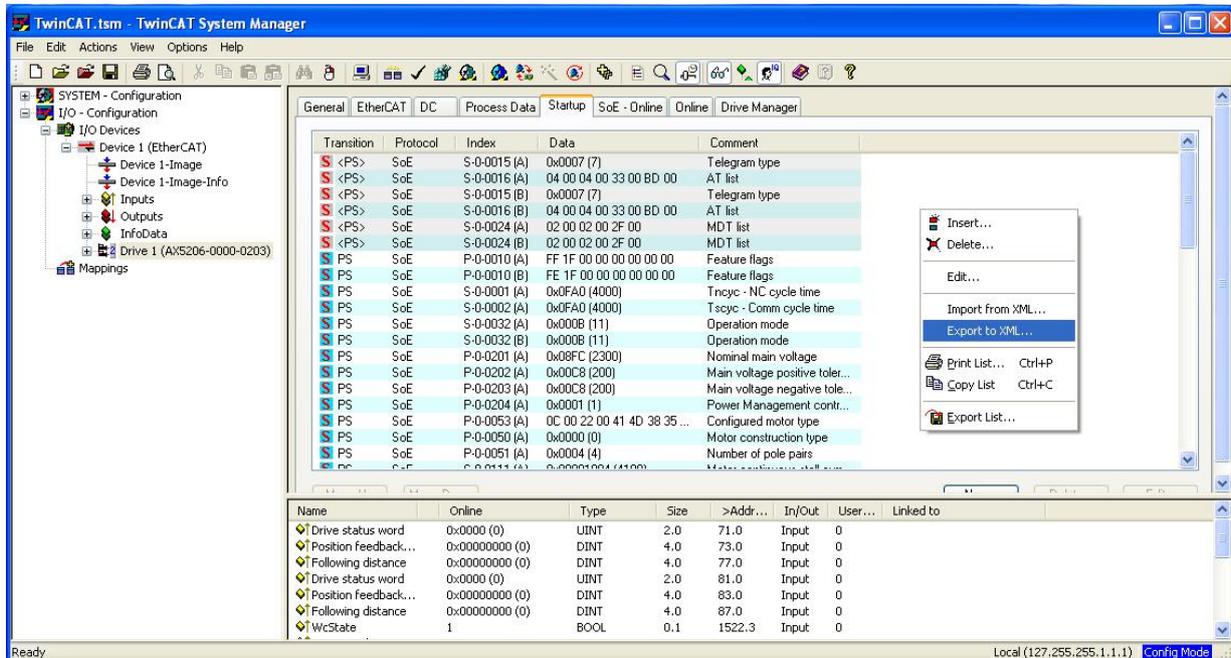


#### 4. Check and export parameters

We check if the drive accepts the parameters. Switch on the Freerun mode, select the Online tab and change the EtherCAT state to Op.



If the drive changed its state to Op (there is Op in the Current state box) we can export the parameters. Select the Startup tab, right click and choose “Export to xml...”. If the drive is a two axes drive the exported parameter list will contain both axis’ parameters.

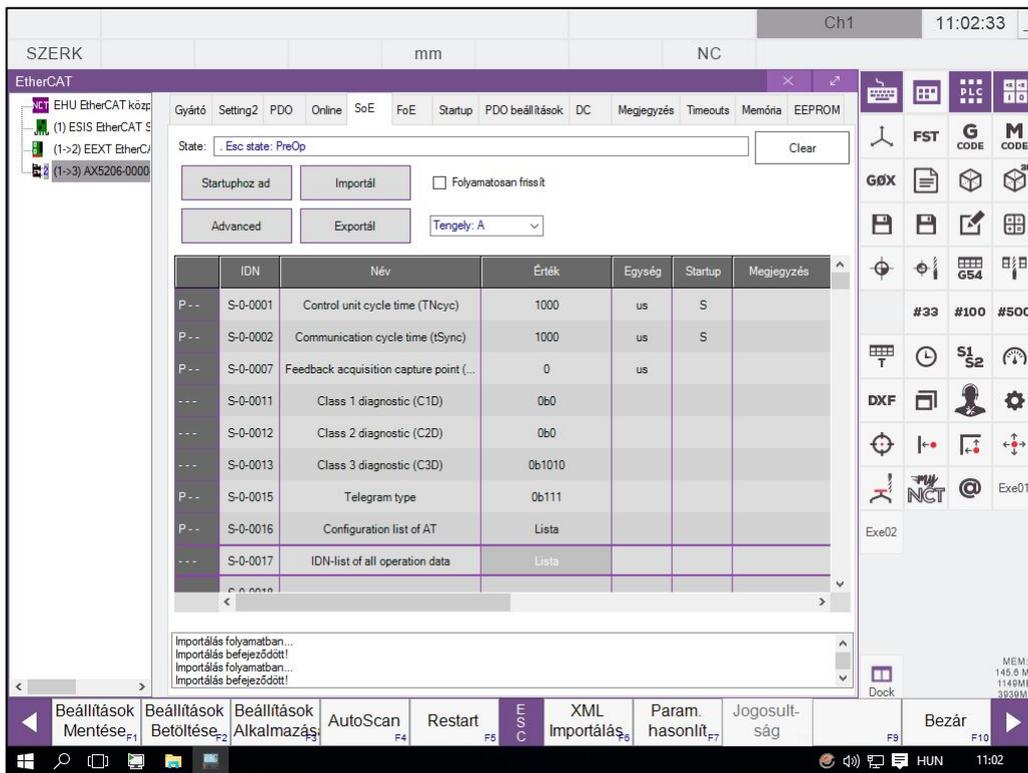


## 5. Set up the AX5000 on NCT3xx controller

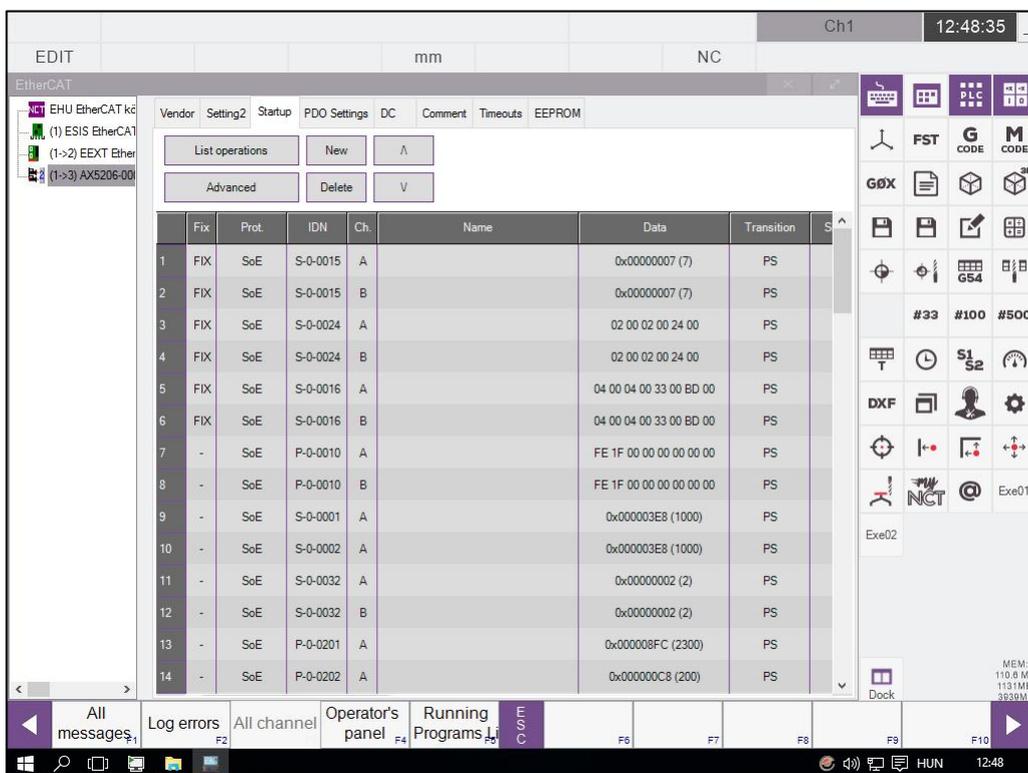
Copy the AX5000’ xml description to NCT3xx controller. Open the EtherCAT window from Softkey strip (Service->ECAT Config), and use the EtherCAT window’s XML Import function. You need import only the Beckhoff AX5xxx.xml file, no other files needed.

Switch on and connect the AX5000 servo drive to the NCT3xx controller with an EtherCAT cable. After pressing AutoScan the drive should show up in the device list with an icon and with a correct device name. On the Online tab you should see the device is in PreOp state. Select the SoE tab and you can see the drive parameters. The tab contains on the top a *State* line which shows the current state of the drive or an error message in case of error. At the end of this line there is the *Clear* button which performs an error clear. In case of two axes drive you will see the axis selector, where you can choose which axis’ parameters want to see.

To import the parameters click on Import button, and select All files (\*.\*) to see the TwinCAT parameter list file, which has xml extension, and open the previously exported xml file. The import process should go without any error. If you have a two axes drive first select channel A import the file, then select channel B and import the same file, because only parameters are imported which are related to the currently selected axis. In case of error check first the TwinCAT2StartupXML.xsd file, it should be in the Config/XML directory and needed to process the TwinCAT xml format.



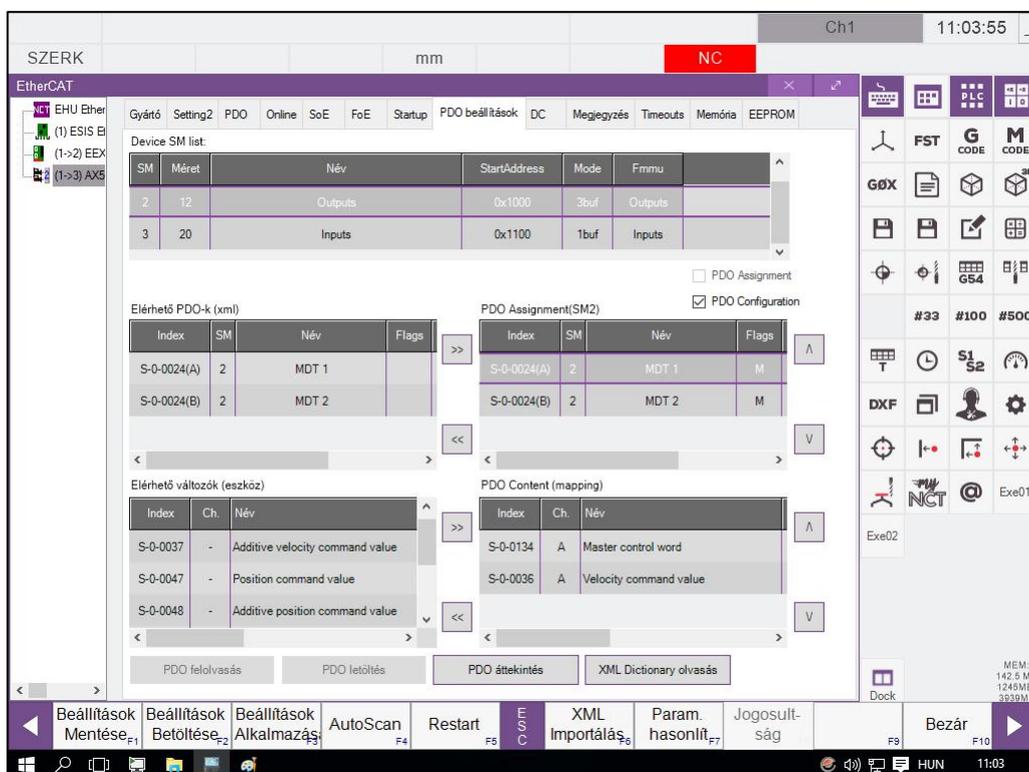
After importing parameters open the Startup tab, and you should see the newly imported parameters with their values. In case of two axes drive you should see the parameters both from channel A and B.



You should change some parameters before you enable the drive. First set the AX5000's S-0-0001 *Control unit cycle time (TNcyc)* and S-0-0002 *Communication cycle time (tScyc)* parameters to the the NCT3xx controller cycle time. For example if the controllers cycle time 1ms, you should set these parameters to 1000, which is the cycle time in microsec.

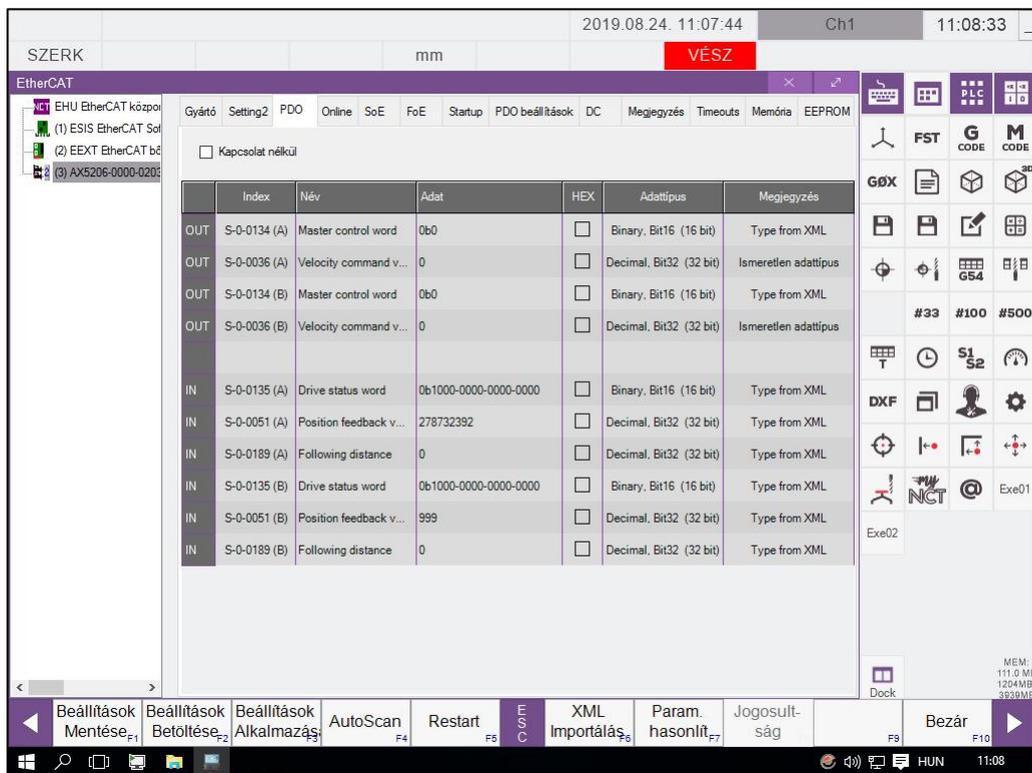
You can change the parameter values either on Startup tab or on SoE tab, because the SoE parameter modifications will change the value on startup too (if the parameter is already on startup). In case of two axes servo drive be sure that the S-0-0001 and S-0-0002 parameters are only once on startup list and they are assigned to channel A. Check the S-0-0032 *Primary operation mode* parameter, it's value SHOULD be 2 (velocity control mode), if your drive is a two axes drive check this parameter on both channel.

According to the selected velocity operation mode, you should change the process data settings too, because these settings are not part of the parameter list which was exported from TwinCAT. Switch to PDO Settings tab, select Outputs form the Device SM list, after that select MDT and remove with << button the S-0-0047 *Position command value* item from the process data parameter list, and add with the >> button the S-0-0036 *Velocity command value*. If the drive is a two channel drive you will see in PDO Assignment list MDT1 and MDT2 and should do this setting on both channel.



Check drive EtherCAT state on Online tab, it should be in PreOp state and NoError. Check the drive errors on SoE tab, and try to clear the error if there is any. If you have a two axes drive the State line always shows the selected axis' state, and the Clear button will perform the error clear on the selected axis as well.

Now you can press Set Config on the softkey and check if the drive reaches the Operational (OP) state. In case of initialization error check the error box on the Online tab. If it contains ErrorSOE value, you can see the parameters which value are incorrect or inconsistent on the S-0-0021 *IDN-list of invalid operation data for CP2*. The State line on SoE tab and the drive's display could give you information about the cause of the error.



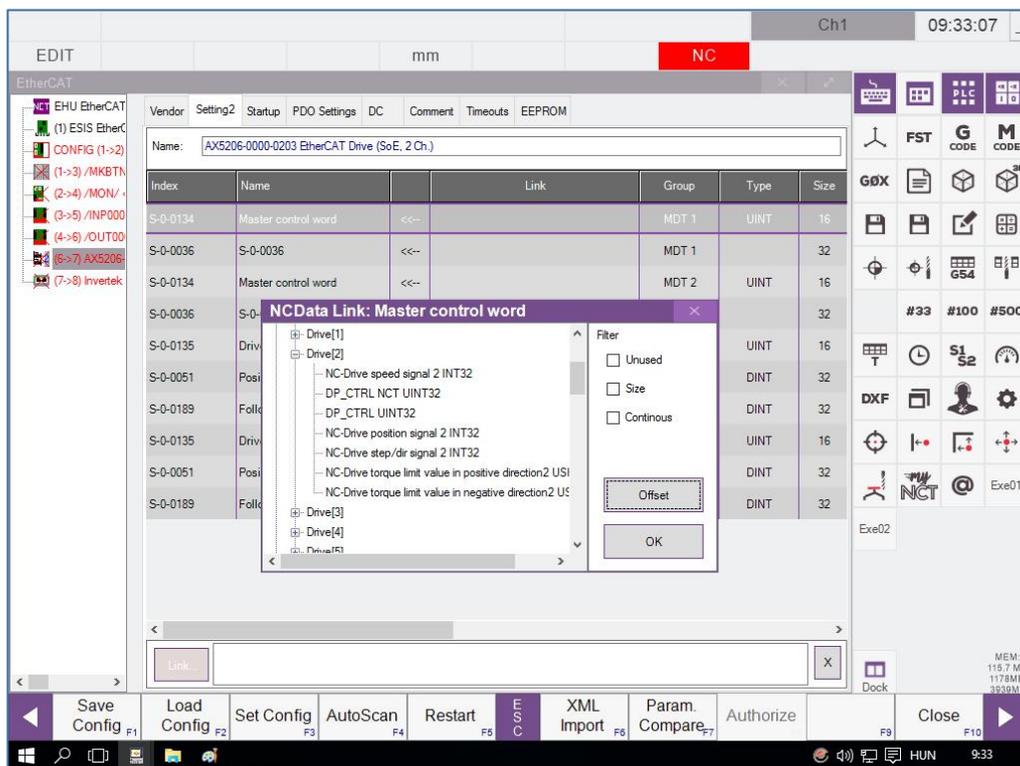
If the drive reached the Operational state, switch to PDO tab and you can see all the process data variables with their values which are refreshed cyclically. Now the basic properties of the drive and motor are checkable (value of the *Drive status word*; is the *Position feedback value* counting if the motor shaft is rotated manually, etc.). In case of two axes drive the process data IDNs ending with "(A)" and "(B)" are related to axis 1 and axis 2, respectively.

At this point you have the option to enable the drive manually through the S-0-0134 *Master control word* and the give speed set value through the S-0-0036 *Velocity command value*. The output PDO variables of the EtherCAT devices on the PDO tab are write protected by default, so you should

switch the drive to Offline mode on PDO tab. The Offline mode detaches the drive's output PDO variables from the NC/PLC, so you can write the drive PDO variables directly. The Offline mode enables you to check the communication and basic functions without the NC/PLC, but because of safety reasons in general not recommended to use it.

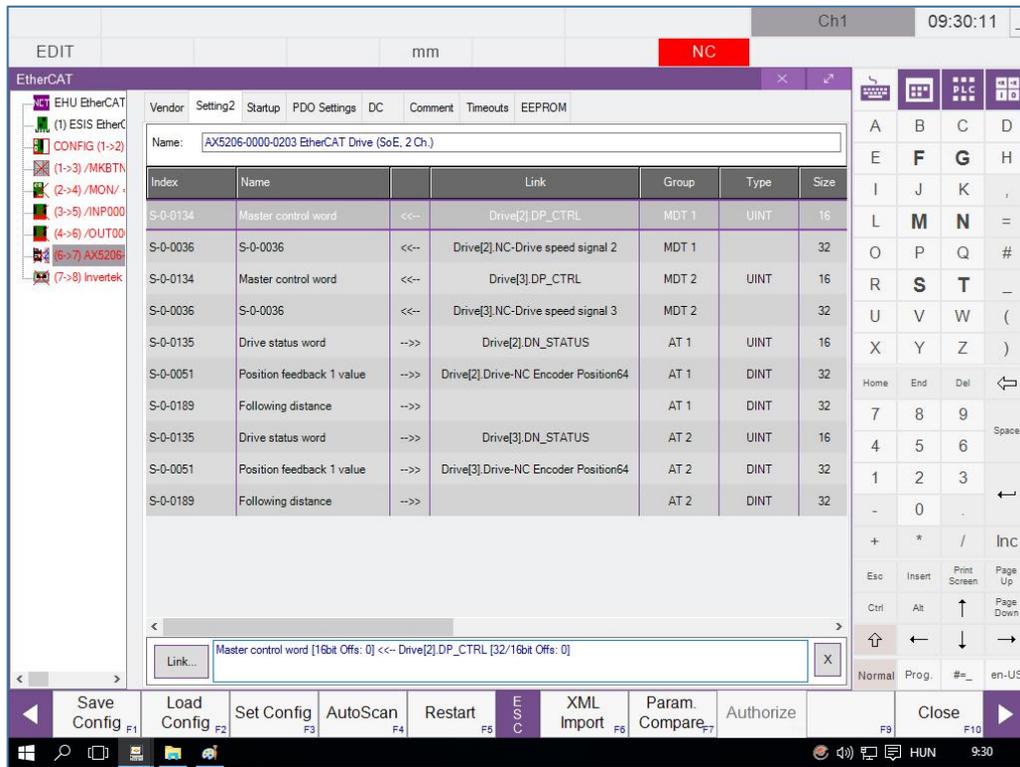
If you decide to move the motor in Offline mode, be very careful because there is no NC/PLC protection, and the motor will move according to value what you give on the PDO tab. In this case always be sure about the motor is firmly fixed, can rotate freely and you can safely disconnect the drive's main power supply if needed!

You can map these process data variables to NC and PLC symbols by means of Settings2 tab. On the Settings2 tab you can see all the input and output process data variables of the drive. Select a variable, click on Link button and select the symbol what you want to assign to the PDO variable.



If there is length mismatch between the drive's PDO variable and the CNC symbol, the mapping will be denied and the *Offset* window will appear, where you can adjust the length and bit offset properties of the assignment. You can delete the connection between drive variable and the NC symbol by the X button.

The picture above shows an example mapping of a Beckhoff AX5206 two channel servo drive, where the PDO variables of channel A are assigned to NC drive 2 and the variables of channel B are assigned to NC drive 3



In this user guide we showed how can you import the base parameters form TwinCAT into the NCT3xx CNC controller and set up the EtherCAT communication between the controller and the AX5000 servo drive.