LinMot®

EtherCAT®

Documentation of the EtherCAT SoE Interface of the following Drives:

- **E1250-SE-UC (E1250-EC-UC)**
- **E1450-SE-QN -0S (E1450-EC-QN-0S)**
- **E1450-SE-QN -1S (E1450-EC-QN-1S)**

EtherCAT SoE Interface

User Manual

Document version 4.3.3 / Whp, December 2013

1 SYSTEM OVERVIEW....4
1.1 References....4
1.2 Connecting In and Out....4
2 SETUP IN THE PLC....5
2.1 Copy Device Description File....5
2.2 Scan the EtherCAT slave devices....5
3 PROCESS DATA OBJECT (PDO) CONFIGURATION....9
3.1 Input PDO Modules....9
3.1.1. Default Inputs: AT 1....9
3.1.2. Input: DC bus voltage S-0-0380....9
3.1.3. Input: State Var P-1-2914....9
3.1.4. Input: X4 inputs P-1-3205....9
3.2 Output PDO Modules....10
3.2.1. Default Outputs: MDT 1....10
3.3 Typical Startup Telegrams....10
4 ASYNCHRONOUS CONFIGURATION PROTOCOL SOE....11
4.1 Generic LinMot SoE Parameter Mapping....12
5 ETHERCAT SOE PARAMETERS AND VARIABLES....13
5.1 Parameters....13
6 CONNECTING TO THE ETHERCAT NETWORK....14
6.1 Pin Assignment of the Connectors X17-X18....14
7 TWINCAT DEMO PROGRAM....15
8 POSITION DRIVE TUNING....20
9 CONTACT ADDRESSES....21

1 System overview

EtherCAT is the open real-time Ethernet network originally developed by Beckhoff. The LinMot act as Slave in this network and is implemented with the standard ASIC ET1100 from Beckhoff. With the SoE (Sercos over Ethernet) Protocol it is possible to use the Sercos functionality over the EtherCAT bus, the drive behaves as a Sercos drive.

For further information on the EtherCAT fieldbus please visit:
http://www.ethercat.org/

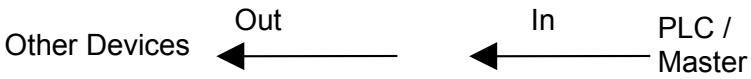
1.1 References

All user manuals are distributed with the LinMot-Talk software the newest versions can be downloaded from the LinMot homepage in the download section.

Ref	Title	Source
1	User Manual Motion Control SW	www.linmot.com
2	LinMot Drive Configuration over Fieldbus Interfaces SG5	www.linmot.com

1.2 Connecting In and Out

In the EtherCAT the cabling is directed, so In and Out is different! The right realtime RJ45 (X17) connector is the input and the left realtime RJ45 (X18) connector is the output.



2 Setup in the PLC

In the following steps the integration of a LinMot EtherCAT Sercos Servo Drive in the PLC is described. In the example a Beckhoff master PLC is used. The easiest way is the online configuration when the device is connected to the EtherCAT network.

2.1 Copy Device Description File

The LinMot Servo Drive is described with *.xml device description file distributed with the LinMot-Talk software. This file is only used when offline configuration is desired.

Copy this file to PLC so it can access it.

Example Source path of EtherCAT Device description file:

C:\Programme\LinMot\LinTalk1100 3.11 Build 20091204\Firmware\Interfaces\EtherCAT\XML\LinMot_ECAT_Servos_V1_4.xml

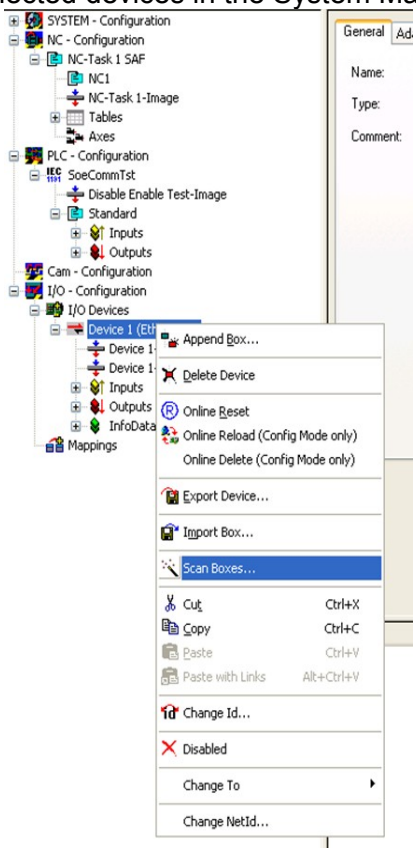
Example Destination path of EtherCAT Device description file:

C:\TwinCAT\Io\EtherCAT\LinMot_ECAT_Servos_V1_4.xml

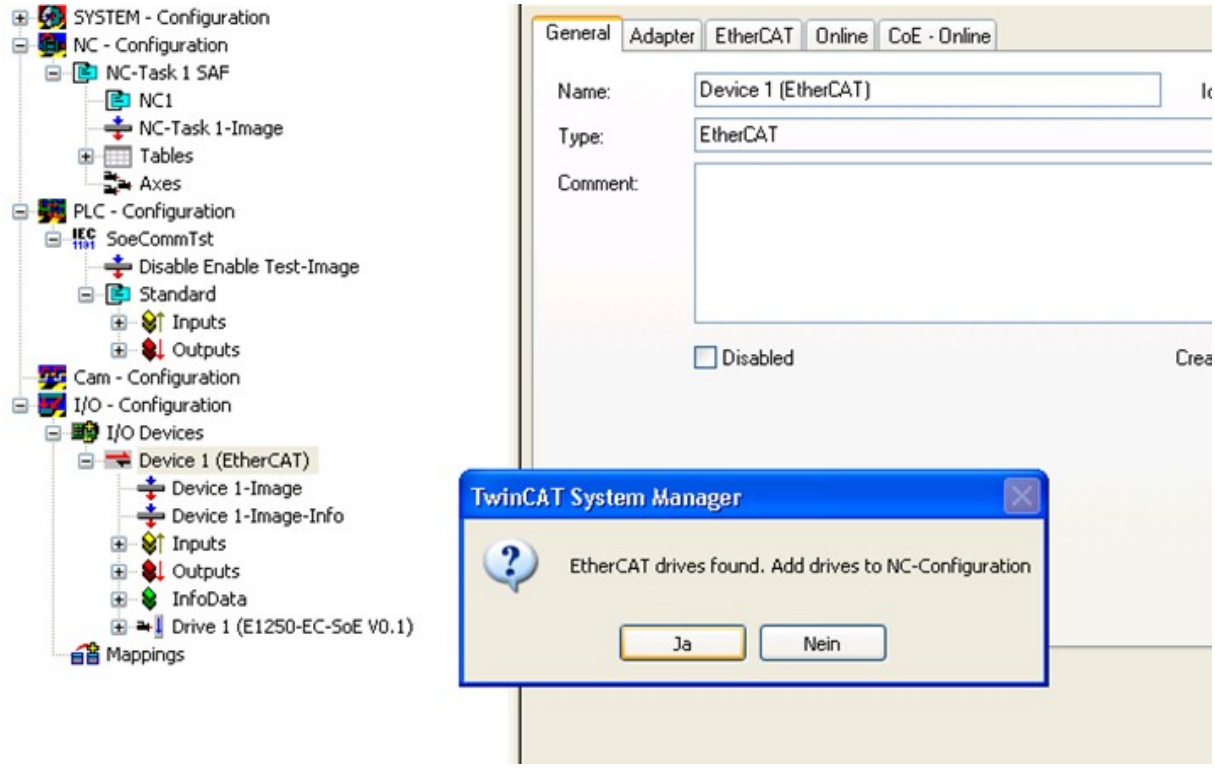
The PLC recognize the LinMot SE Servo drive even without this file, because all the relevant informations is read out from the drive if connected.

2.2 Scan the EtherCAT slave devices

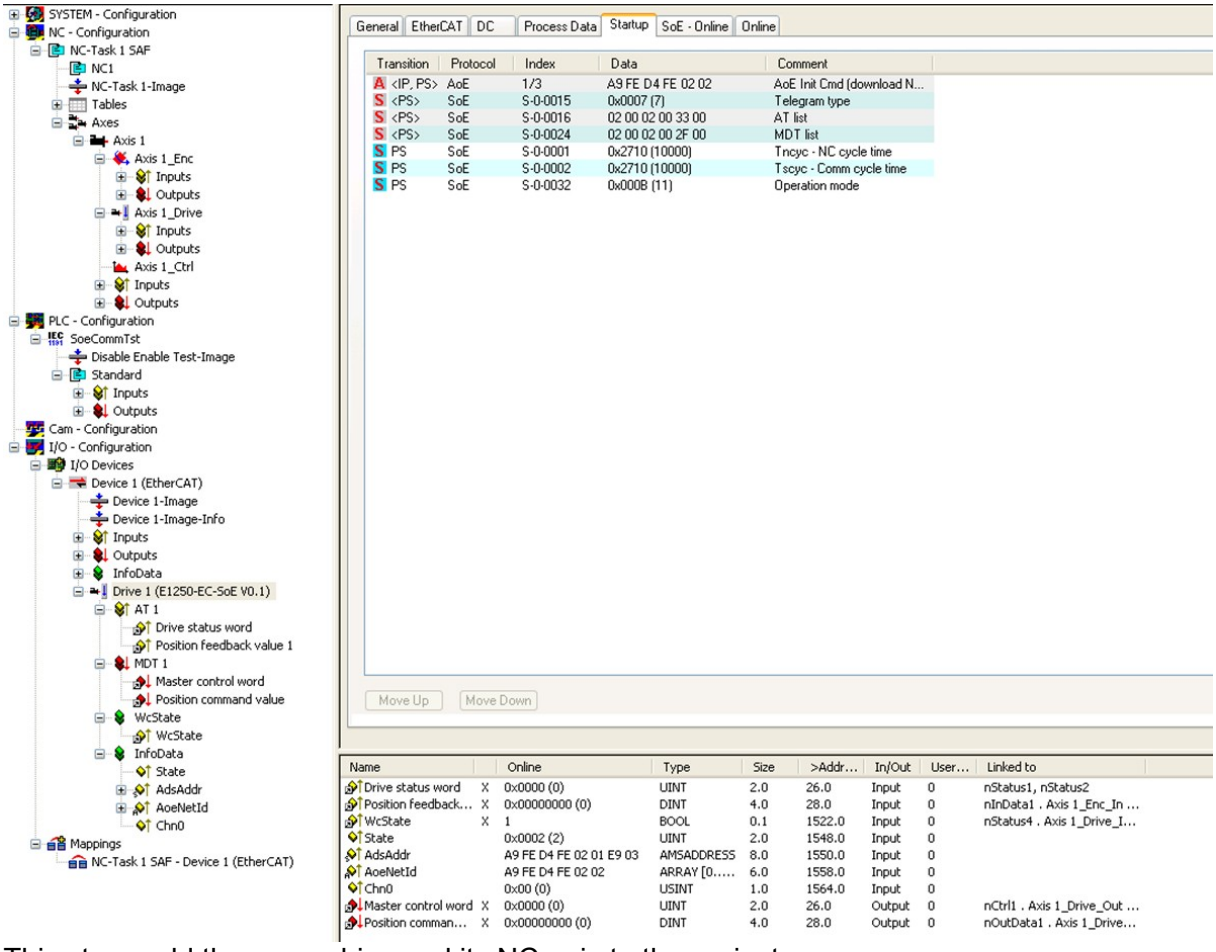
Connect the EtherCAT LinMot Servo Drive to the EtherCAT-Master and power on the signal supply. Then scan for the connected devices in the System Manager:



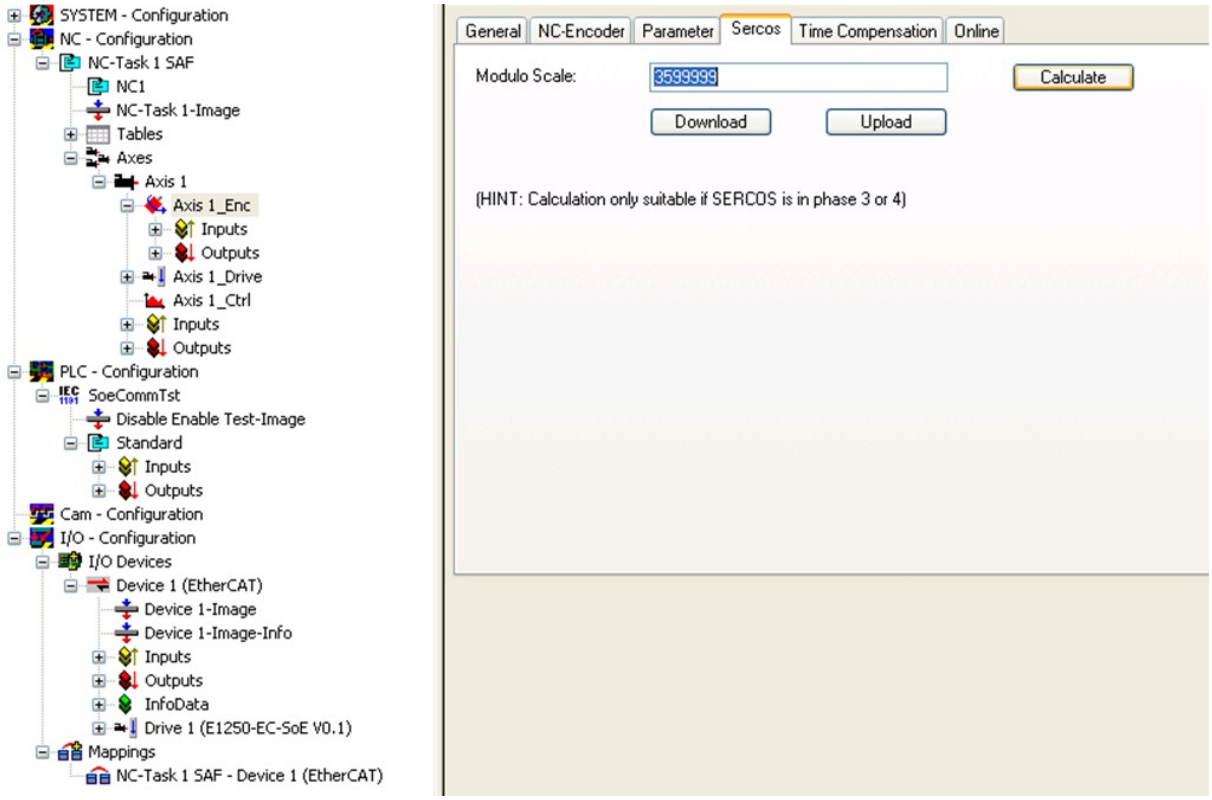
Scan for EtherCAT slave devices



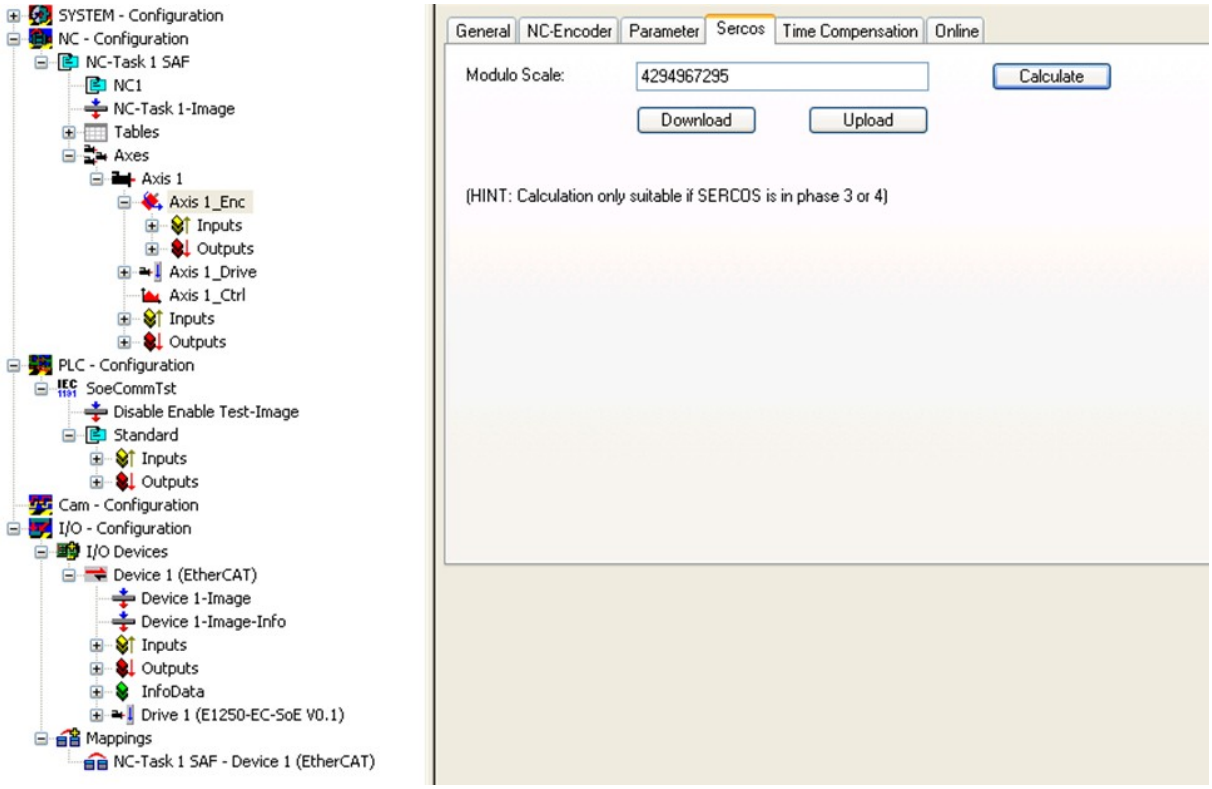
With the question Add drives to NC-configuration select yes.



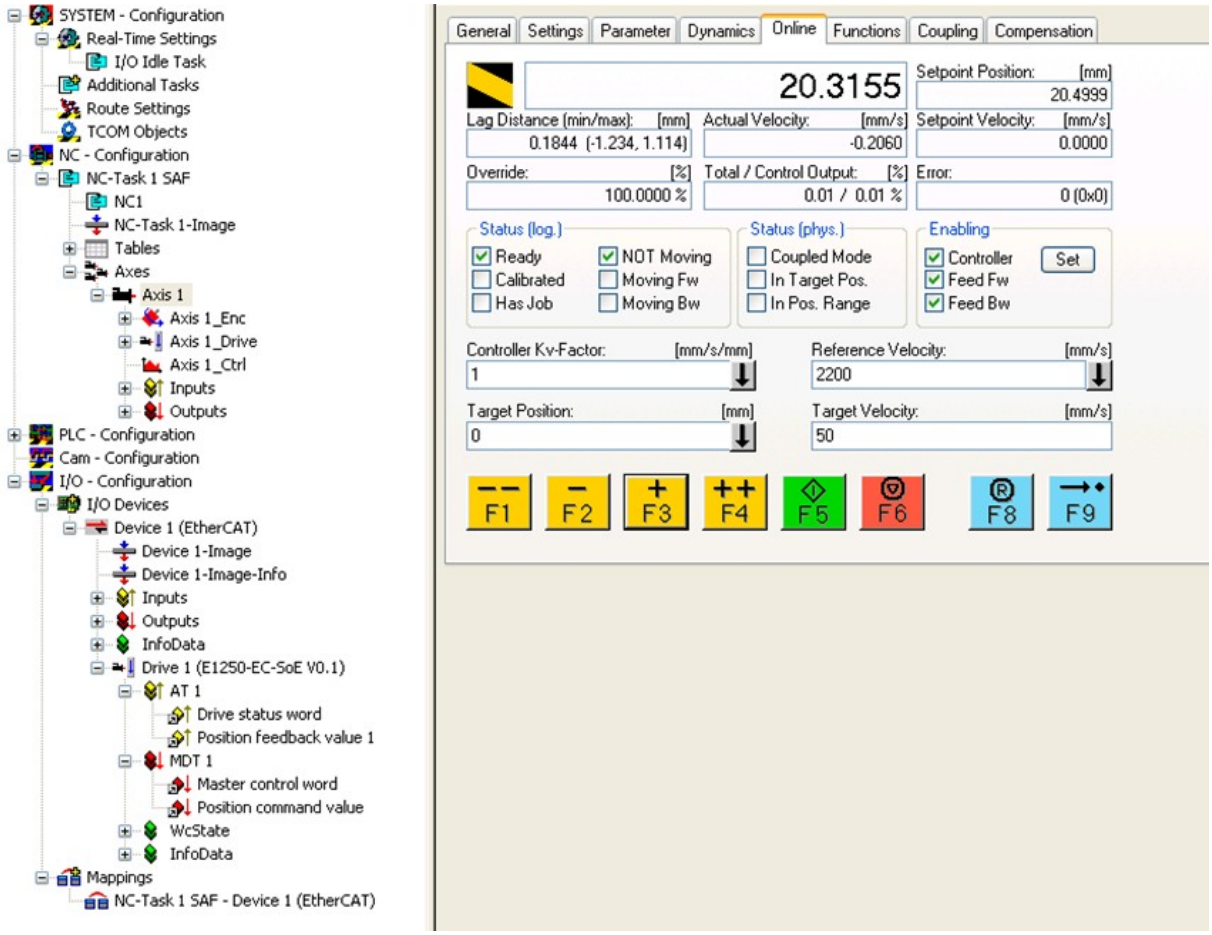
This steps add the servo drive and its NC-axis to the project.



Now the NC encoder has to be set to the correct value push the calulate button for this reason.



After this action the value should stand at this value (2^32).



Now the servo drive can be used with system manager NC functionality when started.

With the LinMot Talk SW also a little Demo program is distributed, where also the integration into the PLC is done, see chapter 7 for this topic.

3 Process Data Object (PDO) Configuration

The cyclic process data is configured in the master and transmitted to the slave during startup. The default mapping is documented in the tables below. The inputs and outputs correspond to the PLC point of view. For a detailed description of the exchanged data and its meaning refer to [1].
For a detailed description of the PDO data refer to [1] or have a look at the TwinCAT demo program, which is included with the LinMot-Talk software.

3.1 Input PDO Modules

3.1.1. Default Inputs: AT 1

Index	Size [Byte]	Byte Offset	Name	Data Type
S-0-0016	***6***	***-***	***Variables***	***RECORD***
S-0-0135	2	0	Sdrive status word	Uint16
S-0-0051	4	2	Position feedback value 1	Int32

Default input PDO mapping of 6 Bytes

3.1.2. Input: DC bus voltage S-0-0380

Index	Size [Byte]	Byte Offset	Name	Data Type
S-0-0380	4	0	DC bus Voltage	Int32

3.1.3. Input: State Var P-1-2914

Index	Size [Byte]	Byte Offset	Name	Data Type
P-1-2914	2	0	State Var	Uint16

3.1.4. Input: X4 inputs P-1-3205

Index	Size [Byte]	Byte Offset	Name	Data Type
P-1-3205	2	0	X4 inputs	Uint16

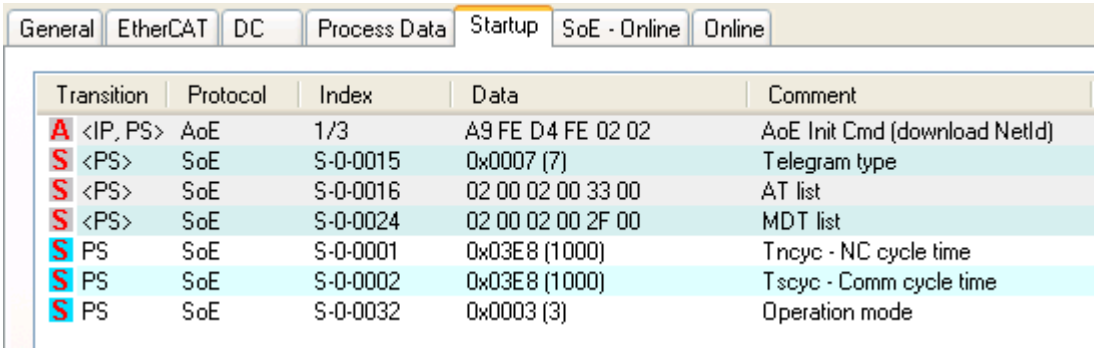
3.2 Output PDO Modules

3.2.1. Default Outputs: MDT 1

Index	Size [Byte]	Byte Offset	Name	Data TypeS-0-0024
S-0-0024	***6***	***-***	***Variables***	***RECORD***
S-0-0134	2	0	Master control word	Uint16
S-0-0047	4	2	Position command value	Int32

Default output PDO mapping of 6 Bytes

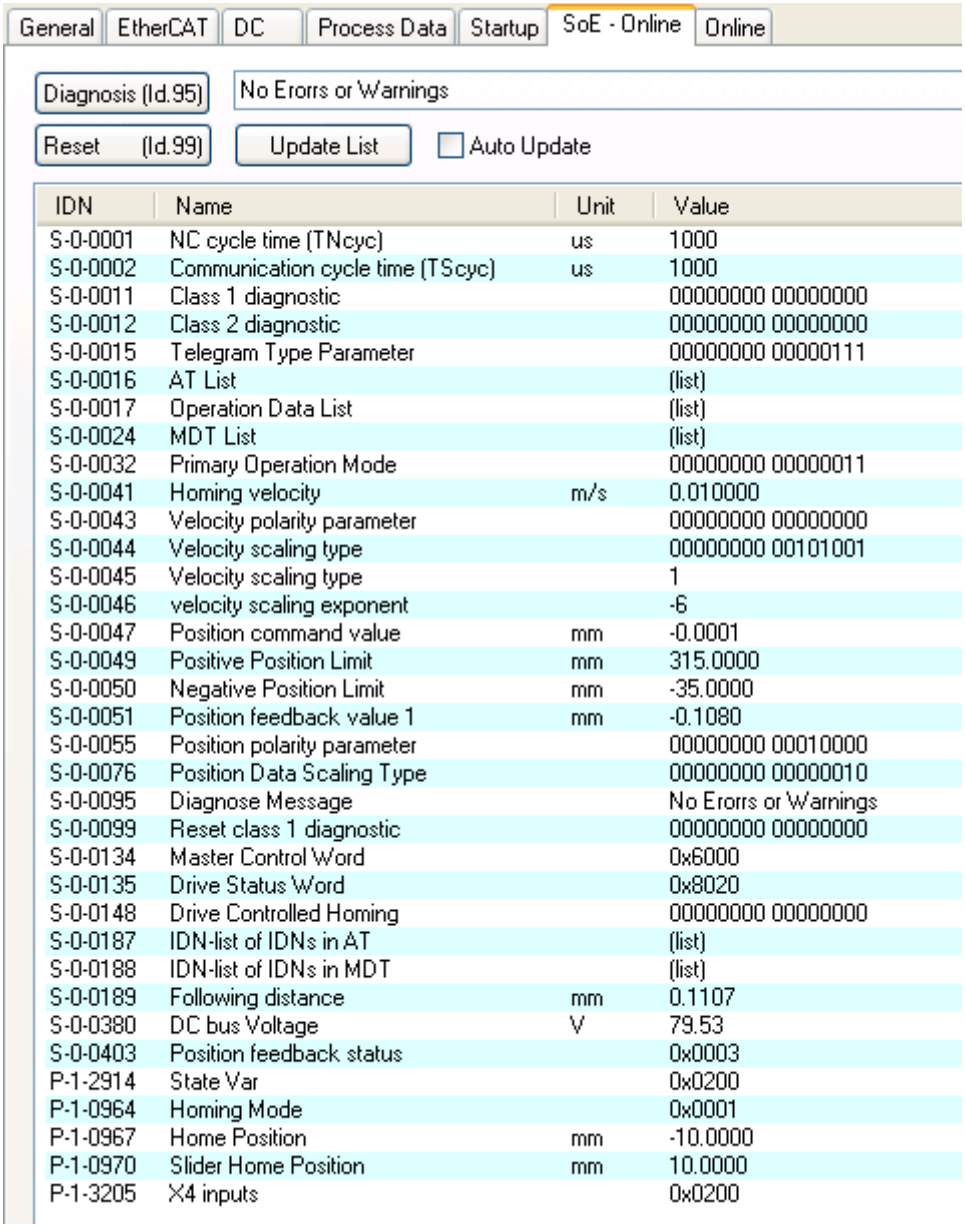
3.3 Typical Startup Telegrams



This figure shows the startup telegram list of LinMot SoE servo drive

4 Asynchronous Configuration Protocol SoE

For configuration purpose (Parameter Handling) the standard Sercos over EtherCAT SoE-Protocol is used.



IDN	Name	Unit	Value
S-0-0001	NC cycle time (TNcyc)	us	1000
S-0-0002	Communication cycle time (TScyc)	us	1000
S-0-0011	Class 1 diagnostic		00000000 00000000
S-0-0012	Class 2 diagnostic		00000000 00000000
S-0-0015	Telegram Type Parameter		00000000 00000111
S-0-0016	AT List		(list)
S-0-0017	Operation Data List		(list)
S-0-0024	MDT List		(list)
S-0-0032	Primary Operation Mode		00000000 00000011
S-0-0041	Homing velocity	m/s	0.010000
S-0-0043	Velocity polarity parameter		00000000 00000000
S-0-0044	Velocity scaling type		00000000 00101001
S-0-0045	Velocity scaling type		1
S-0-0046	velocity scaling exponent		-6
S-0-0047	Position command value	mm	-0.0001
S-0-0049	Positive Position Limit	mm	315.0000
S-0-0050	Negative Position Limit	mm	-35.0000
S-0-0051	Position feedback value 1	mm	-0.1080
S-0-0055	Position polarity parameter		00000000 00010000
S-0-0076	Position Data Scaling Type		00000000 00000010
S-0-0095	Diagnose Message		No Erorrs or Warnings
S-0-0099	Reset class 1 diagnostic		00000000 00000000
S-0-0134	Master Control Word		0x6000
S-0-0135	Drive Status Word		0x8020
S-0-0148	Drive Controlled Homing		00000000 00000000
S-0-0187	IDN-list of IDNs in AT		(list)
S-0-0188	IDN-list of IDNs in MDT		(list)
S-0-0189	Following distance	mm	0.1107
S-0-0380	DC bus Voltage	V	79.53
S-0-0403	Position feedback status		0x0003
P-1-2914	State Var		0x0200
P-1-0964	Homing Mode		0x0001
P-1-0967	Home Position	mm	-10.0000
P-1-0970	Slider Home Position	mm	10.0000
P-1-3205	X4 inputs		0x0200

LinMot Object Dictionary

4.1 Generic LinMot SoE Parameter Mapping

Apart from the above described parameters with the LinMot servo drives, there exists a generic parameter mapping of the LinMot parameters by UPID to the SoE parameter index by adding the UPID to 0x8000h. Reading and writing the value accesses the RAM value of the UPID. Writing to the default value accesses the ROM value of the UPID.

5 EtherCAT SoE Parameters and Variables

5.1 Parameters

The EtherCAT SoE Interface has an additional parameter tree branch (Parameters → EtherCAT SoE), which can be configured with the distributed LinMot-Talk software.
With these parameters, the EtherCAT interface can be enabled or disabled.
The LinMot-Talk software can be downloaded from http://www.linmot.com under the section download, software & manuals.

EtherCAT Dis-/Enable

With the Dis-/Enable parameter the LinMot Servo Drive can be run without the Ethernet EtherCAT Interface going online. So in a first step the system can be configured and run without any bus connection.

ETHERCAT\ Dis-/Enable	
Disable	Servo Drive runs without ETHERCAT SoE.
Enable	Servo Drive runs with ETHERCAT SoE connection.

IMPORTANT: If the ETHERCAT Interface is disabled, the integrated ETHERCAT-ASIC rests in reset state! No messages will be sent to other devices connected to the ETHERCAT-Network via the E1250 or E1450 drive.

6 Connecting to the EtherCAT Network

6.1 Pin Assignment of the Connectors X17-X18

The ETHERCAT connector is a standard RJ45 female connector with a pin assignment as defined by EIA/TIA T568B:

X17 – X18	ETHERCAT Connector		
	Pin	**Wire color code**	**Assignment 100BASE-TX**
	1	WHT/ORG	Rx+
	2	ORG	Rx-
	3	WHT/GRN	Tx+
	4	BLU	-
	5	WHT/BLU	-
	6	GRN	Tx-
	7	WHT/BRN	-
	8	BRN	-
	case	-	-
RJ-45	Use standard patch cables (twisted pair, S/UTP, AWG26) for wiring. This type of cable is usually referred to as a “Cat5e-Cable”.		

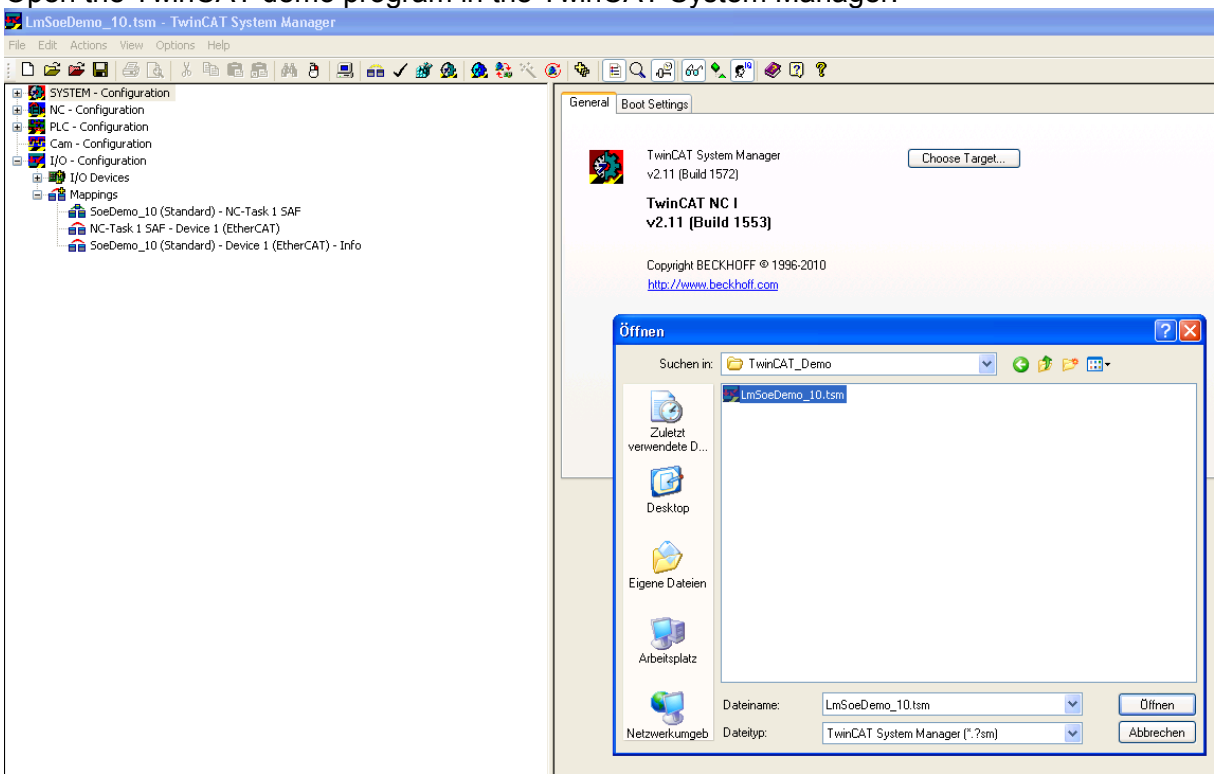
7 TwinCAT Demo Program

With the LinMot-Talk software a TwinCAT demo program is included as start point for new LinMot users, to get familiar with the concepts that stands behind LinMot motion SW. For getting started with this demo program connect a LinMot EtherCAT Servo Drive directly to the master. Wire the signal supply (24V DC) and the motor power supply. Wire also the “Safety Voltage Enable” on X4.12 to 24V. Then connect the motor to the servo power on the signal supply and configure the motor with the help of the LinMot-Talk software.

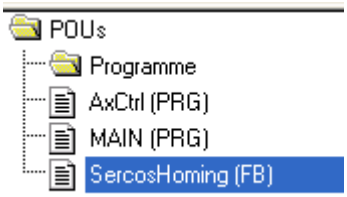
The demo program files are saved under the path:

C:\Program Files\LINMOT\LinMot-Talk 4 Build 20100616\Firmware\Interfaces\EtherCAT_SoE\TwinCAT_Demo\

Open the TwinCAT demo program in the TwinCAT System Manager:

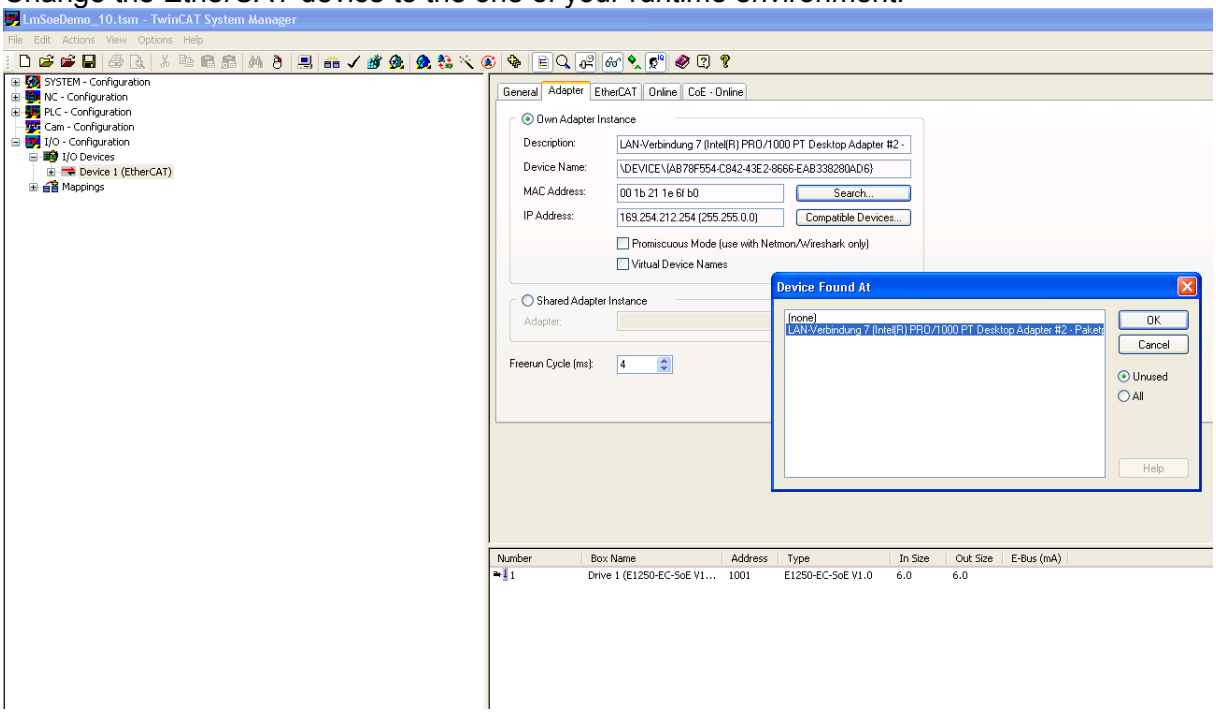


The main issue of the distributed demo, is to show, how the with LinMot motors needed drive based homing procedure can be done. The demo program has following program parts:

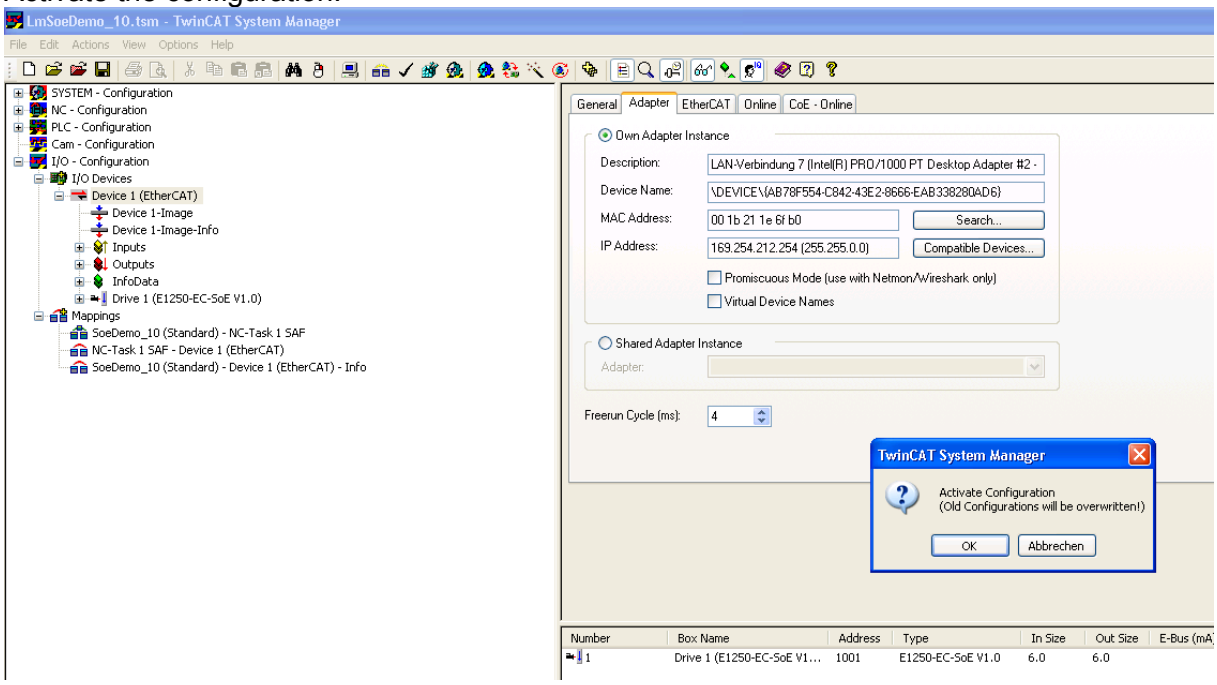


In the FB SercosHoming the drive based homing is done. The AxCtrl program handles the user inputs of the HOMING_PANEL visualization.

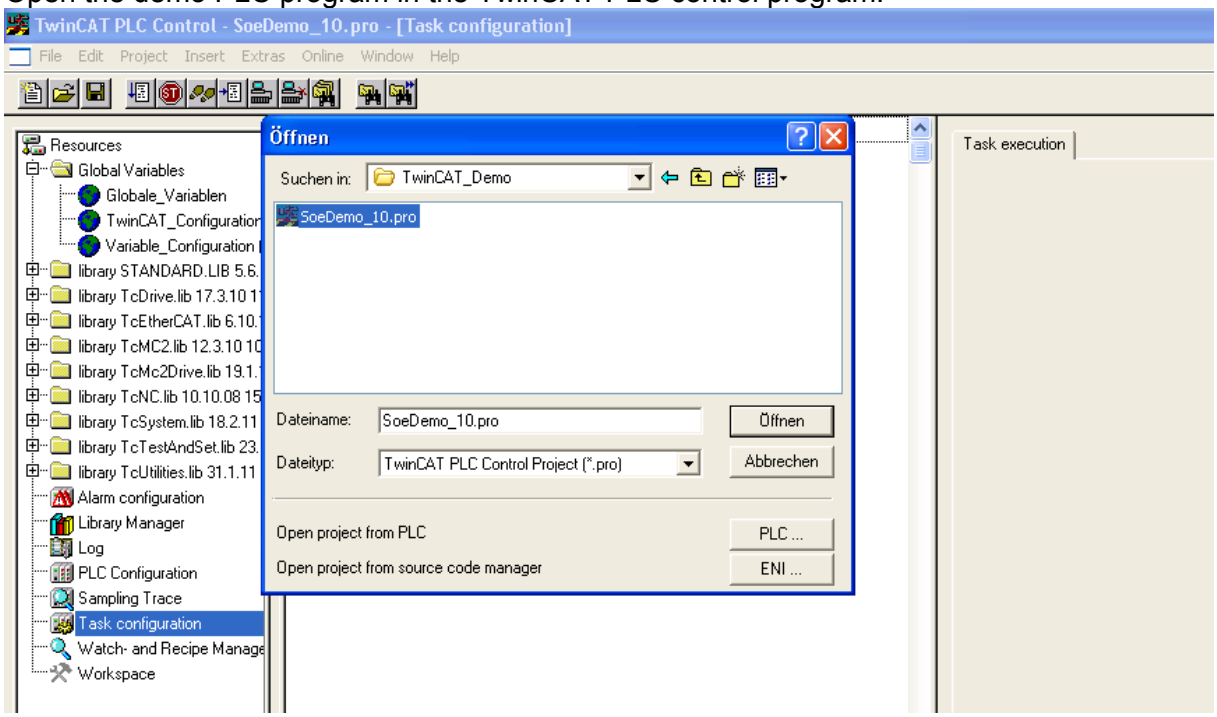
Change the EtherCAT device to the one of your runtime environment:



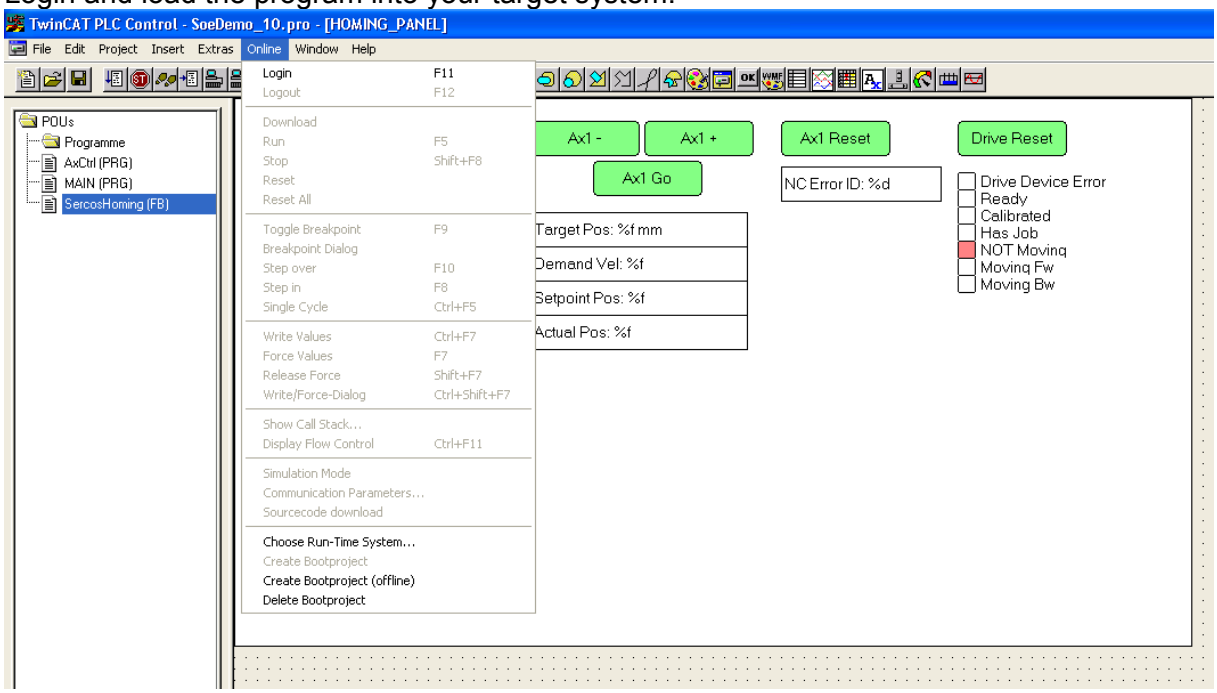
Activate the configuration:



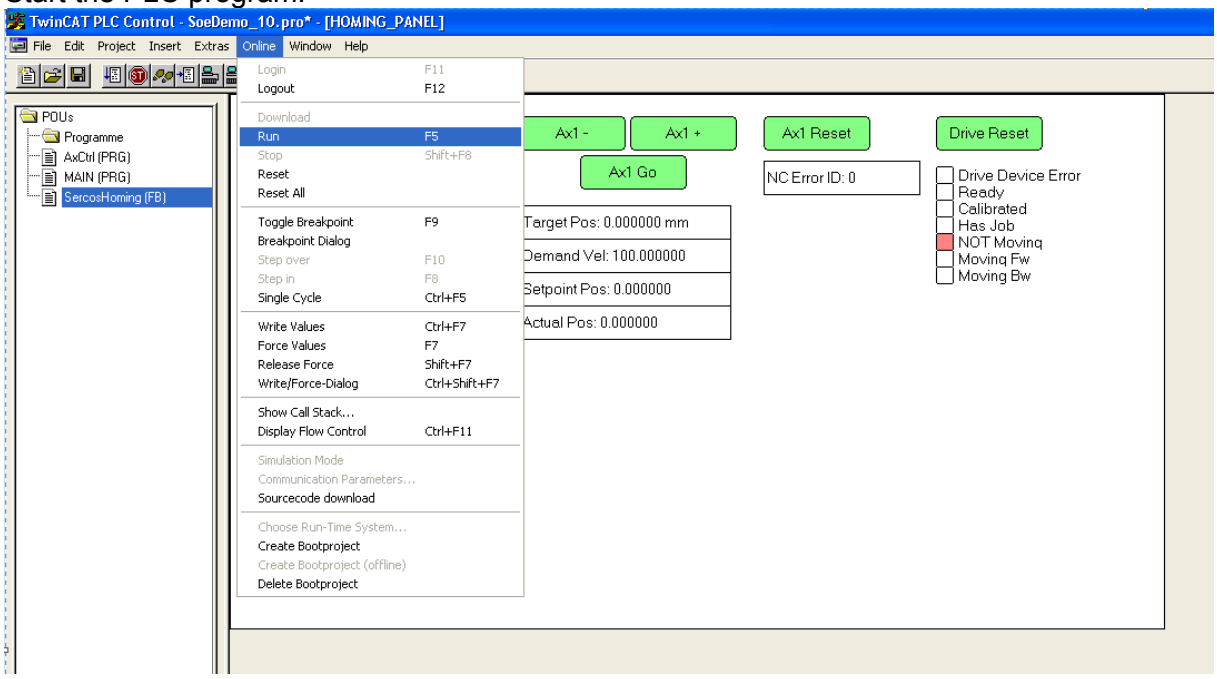
Open the demo PLC program in the TwinCAT PLC control program:



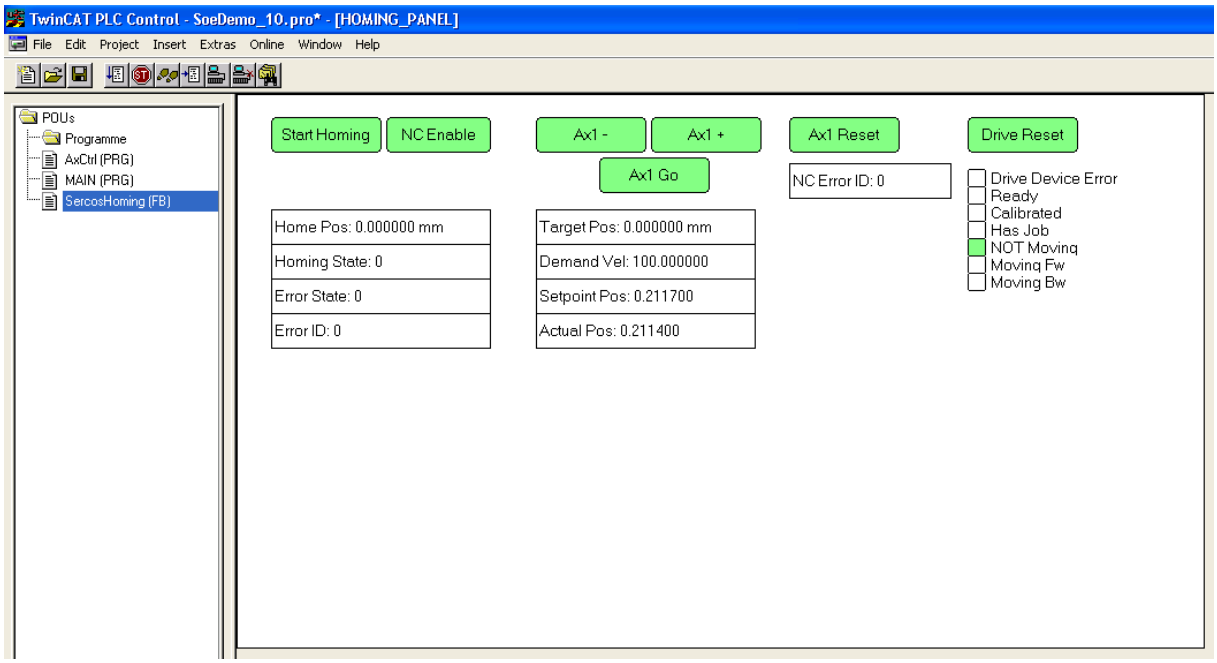
Login and load the program into your target system:



Start the PLC program:



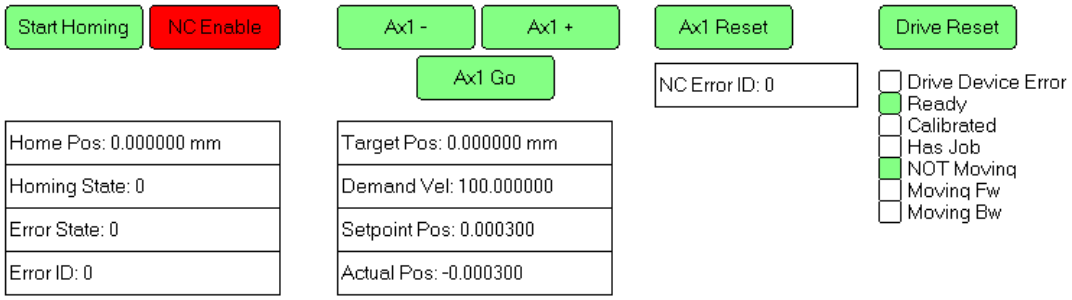
Change to the Visualisation Control panel view:



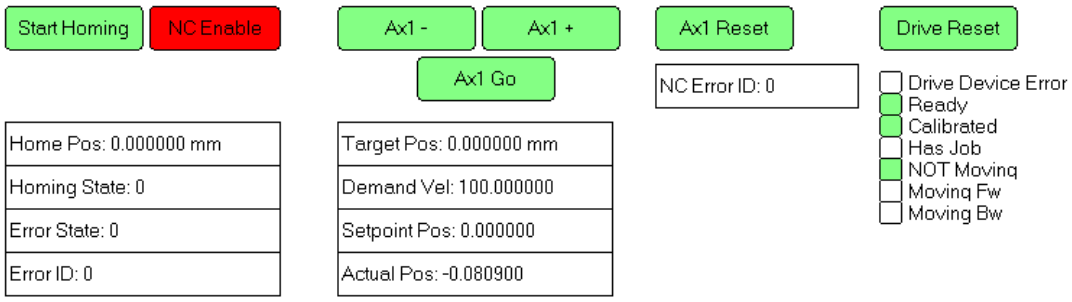
Buttons:

- NC Enable (Dis-/Enable position control on servo drive and enable NC)
- Start Homing, starts the drive based homing procedure (released when finished)
- Ax-/ Ax+, command manual motion of NC
- Ax1, Go Point to Point NC motion to Target Position
- Ax1 Reset, Reset the NC if NC error
- Drive Reset, Reset the errors on the drive

Enable the Axis with the button “NC Enable” now “Ready” should be highlighted:



Push the homing button is released when finished now “Calibrated” should be highlighted:



Now the drive is ready for normal NC operation. Tests can be done with manual or point to point motions with the demo program.

8 Position Drive Tuning

It is possible that, depending on the cycle time, a quiet noisy motion is generated, this because of the twice derivation of the position signal to generate the acceleration value. In this case, it is recommended to set the position controller value “FF Acceleration” (UPID 0x13A0 and 0x13B4) to zero.

9 Contact Addresses

SWITZERLAND

NTI AG / LinMot
Haerdlistr. 15
CH-8957 Spreitenbach

Sales and Administration: +41-(0)56-419 91 91
office@linmot.com

Tech. Support: +41-(0)56-544 71 00
support@linmot.com

Tech. Support (Skype) : skype:support.linmot

Fax: +41-(0)56-419 91 92
Web: http://www.linmot.com

USA

LinMot, Inc.
204 E Morrissey Dr.
Elkhorn, WI 53121

Sales and Administration: 877-546-3270
262-743-2555

Tech. Support: 877-804-0718
262-743-1284

Fax: 800-463-8708
262-723-6688

E-Mail: us-sales@linmot.com
Web: http://www.linmot-usa.com

Please visit http://www.linmot.com to find the distributor nearest to you.

Smart solutions are…