PLC Commissioning of LinMot Servo Drives

Application Note / How-to

Latest version:
https://shop.linmot.com/E/product/0185-1120-E

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PLC Commissioning — Quick Navigation Flowchart

Use this guide to find the right chapter for your PLC, interface, and integration approach.

START: What do you need?

Are you troubleshooting or tuning an existing setup?

YES

- Troubleshooting — Ch. 22, p. 305
- Position Control Loop Tuning — p. 307
- Torque/Force Control Loop Tuning — p. 309
- Drive LED Blink Codes — Ch. 1.6, p. 21
- Drive Interface (MI) Overview — Ch. 1.3, p. 17

NO

Integration approach?
(see Overview, Ch. 2, p. 24)

LinMot Profile
Commissioning using LinMot Libraries

Which PLC / Environment?

Beckhoff TwinCAT 2 & 3 (EtherCAT / CANopen)	Ch. 3, p. 26
Siemens TIA (S7-300/1200/1500) (PROFINET / PROFIBUS)	Ch. 4, p. 33
Rockwell Automation Studio 5000 (EtherNet/IP)	Ch. 5, p. 45
B&R Automation Studio (Powerlink / CANopen)	Ch. 6, p. 54
CODESYS (based) (Various)	Ch. 7, p. 61
Mitsubishi GX Works (CC-Link IE Field Basic)	Ch. 8, p. 62
Python (PC) (EtherCAT)	Ch. 9, p. 70
Yaskawa iCube Engineer (EtherCAT CoE)	Ch. 10, p. 71

Drive Profile
Direct Integration as Std. Motion Axis

Which PLC / Environment?

Rockwell Automation (CIP Sync) (EtherNet/IP)	Ch. 11, p. 96
Siemens TIA (PROFIdrive) (PROFINET)	Ch. 12, p. 97
Beckhoff TwinCAT 2/3 (CoE DS402) (EtherCAT CoE)	Ch. 13, p. 140
Beckhoff TwinCAT 2/3 (SoE) (OUTDATED) (EtherCAT SoE)	Ch. 14, p. 170
Schneider Electric PacDrive 3 (Sercos III)	Ch. 15, p. 189
CODESYS SoftMotion (CiA402) (EtherCAT CoE)	Ch. 16, p. 204
B&R NC Motion (CiA402) (Powerlink)	Ch. 17, p. 216
B&R NC Motion (SDC interface) (Powerlink)	Ch. 18, p. 229
OMRON Sysmac Studio (CoE DS402) (EtherCAT CoE)	Ch. 19, p. 265
TRIO (CiA402) (EtherCAT)	Ch. 20, p. 292
Bosch Rexroth ctrlX (EtherCAT DS402)	Ch. 21, p. 304

Within your chapter, follow these steps

1. Motor Configuration — Sect. x.2
2. Fieldbus Connection — Sect. x.2
3. PLC Setup / I/O Mapp. — Sect. x.3
4. Verify w. LinMot-Talk — Sect. x.5
5. Homing — Sect. x.4/x.5
6. Parameter Access — various

General Information: Ch. 1 (p. 15) | Abbreviations: Ch. 1.1 (p. 15) | Available Libraries: Ch. 1.5 (p. 21) | Documentation: Ch. 1.7 (p. 22)

In case the specific PLC/Interface combination is not listed please contact our Support.
See chapter Contact & Support

Table of Contents

Table of Contents **4**
Use of This Document **12**
Version History **13**
Trademarks **14**
1 General **15**
1.1 Abbreviations *15*
1.1.1 LinMot Drive System Generations (SG) 15
1.1.2 LinMot Drive Interface Extensions 15
1.2 LinMot F Series Drives *16*
1.3 LinMot Drives with multi-interface (MI) Overview / C1250-xx replacement *17*
1.4 Device Description Files (SG5, SG6, SG7) *19*
1.5 Available LinMot Libraries *21*
1.6 Drive LED Blink Codes *21*
1.7 Documentation / User Manuals / Application Notes *22*
1.8 UPID (Unique Parameter ID) *23*
1.9 Recent Version of LinMot-Talk and Drive Firmware *23*
1.10 YouTube Video Tutorials *23*
1.11 LinMot Product Information *23*
2 Overview **24**
2.1 LinMot Profile (Commissioning using the LinMot Libraries) *24*
2.2 Drive Profiles (Direct Integration as Motion Axis using standardized Drive Profiles) *25*
3 LinMot Profile: Beckhoff TwinCAT 2&3 ..... **26**
3.1 Overview *26*
3.2 Configuration and Connection of the LinMot Drive *27*
3.2.1 Motor Configuration 27
3.2.2 XML Files 27
3.2.3 EtherCAT Connection 27
3.3 PLC Setup EtherCAT (E1450-EC-QN, E1250-EC-UC, C1x00-EC-XC-xx, -MI) *28*
3.3.1 Insert LinMot Drive as Slave 28
3.3.2 Config Module 29
3.3.3 Links to PLC Control 30
3.3.4 Check EoE settings 31
3.4 Add Additional Parameters or Variables to the Process Data *32*
3.5 Check with LinMot-Talk if the Fieldbus is running *32*
3.6 Next Steps *32*
4 LinMot Profile: Siemens TIA **33**
4.1 Overview *33*
4.2 Configuration and Connection of the LinMot Drive *34*
4.2.1 Motor configuration 34
4.2.2 GSD / GSDML files 34
4.2.3 PROFIBUS Connection 34
4.2.4 PROFINET Connection 36
4.3 PLC Setup PROFIBUS (E1430-DP-QN, E1230-DP-UC, E1130-DP-xx) *37*
4.4 PLC Setup PROFINET (E1450-PN-QN, E1250-PN-UC, C1250-PN-UC, C1150PN-UC, -MI) *39*
4.4.1 Assigning the Device Name and IP Address 41
4.5 Check with LinMot-Talk if the Fieldbus is running *44*
4.6 Next Steps *44*
5 LinMot Profile: Rockwell Automation Studio 5000 (Add-On Instructions) **45**
5.1 Overview *45*

5.2 Minimum Requirements ... *45*
5.3 Configuration and Connection of the LinMot Drive ... *46*
5.3.2 Motor Configuration ... 46
5.3.3 EtherNet/IP Connection ... 46
5.3.4 IP Address ... 47
5.4 PLC Setup EtherNet/IP ... *48*
5.4.2 FactoryTalk Linx / RSLinx Classic ... 49
5.4.3 Add a LinMot drive using EDS or AOP ... 50
5.5 Check with LinMot-Talk if the Fieldbus is running ... *53*
5.6 Next Steps ... *53*
6 LinMot Profile: B&R Automation Studio ... 54
6.1 Overview ... *54*
6.2 Configuration and Connection of the LinMot Drive ... *55*
6.2.1 Motor configuration ... 55
6.2.2 XDD File ... 55
6.2.3 Powerlink Connection ... 55
6.2.4 Node ID ... 56
6.3 Hardware Configuration ... *57*
6.3.1 Add the LinMot drive to the Powerlink network ... 57
6.3.2 Configuration ... 58
6.3.3 I/O Mapping ... 59
6.4 Parameter Access ... *60*
6.5 Add Additional Parameters or Variables to the Process Data ... *60*
6.6 Next Steps ... *60*
7 LinMot Profile: CODESYS ... 61
7.1 Overview ... *61*
8 LinMot Profile: Mitsubishi GX Works ... 62
8.1 Overview ... *62*
8.2 Configuration and Connection of the LinMot Drive ... *63*
8.2.1 Motor configuration ... 63
8.2.2 CSP+ files ... 63
8.2.3 CC Link Connection ... 63
8.2.4 IP Address ... 64
8.3 PLC Setup CC Link ... *65*
8.4 Check with LinMot-Talk if the Fieldbus is running ... *69*
8.5 Next Steps ... *69*
9 LinMot Profile: Python ... 70
9.1 Overview ... *70*
10 LinMot Profile: Yaskawa iCube Engineer ... 71
10.1 Overview ... *71*
10.2 Configuration and Connection of the LinMot Drive ... *72*
10.2.1 Motor Configuration ... 72
10.2.2 XML Files ... 72
10.2.3 EtherCAT Connection ... 72
10.3 PLC Setup EtherCAT (C125x-MI-XC-xx, F1x50-DS-UC-xx) ... *73*
10.3.1 Insert LinMot Drive as EtherCAT Device ... 73
10.3.2 Configure Module – PDO Data ... 75
10.3.3 Configure Module – Variables & Mapping ... 77
10.3.4 Configure Module – EoE Settings ... 78
10.4 Drive Configuration in LinMot-Talk ... *79*
10.4.1 Set address on Fieldbus ... 79

10.4.2 Configure Monitoring and Parmeter Channels ... 79
10.4.3 Check with LinMot-Talk if the Fieldbus is running ... 80
10.5 LinMot Yaskawa Example PLC Program ... 81
10.5.1 Overview ... 81
10.5.2 Supported Operation Modes ... 82
10.5.3 Initialize program ... 83
10.5.4 Drivers program ... 84
10.5.5 Main program and Axis Palette ... 85
10.6 LinMot Yaskawa Function Block Set ... 86
10.6.1 LM_CiA402_Power ... 86
10.6.2 LM_CiA402_Reset ... 87
10.6.3 LM_CiA402_Home ... 88
10.6.4 LM_CiA402_MoveAbsolute ... 89
10.6.5 LM_CiA402_MoveRelative ... 90
10.6.6 LM_CiA402_Halt ... 91
10.6.7 LM_CiA402_ReadAxisError ... 92
10.6.8 Error Descriptions ... 92
10.7 Cyclic Sync Torque Mode (OpMode10) ... 93
10.8 Asynchronous Parameter Access with SDO commands ... 95
11 Drive Profile: Rockwell Automation Motion (CIP Sync Motion) ... 96
11.1 Overview ... 96
12 Drive Profile: Siemens TIA, PROFIdrive ... 97
12.1 Overview ... 97
12.2 Configuration and Connection of the LinMot Drive ... 98
12.2.1 Motor Configuration ... 98
12.2.2 GSDML File ... 99
12.2.3 PROFINET Connection ... 99
12.3 PLC Setup ... 100
12.3.1 Install GSDML File(s) ... 100
12.3.2 Insert the LinMot Drive as Device (-PD Drives) ... 100
12.3.3 Insert the LinMot Drive as Device (-MI Drives) ... 101
12.3.4 Set PROFINET Name and IP Address ... 102
12.3.5 Insert and Setup a new Technology object (Linear Axis) ... 104
12.3.6 Insert and Setup a new Technology object (Rotary Axis) ... 110
12.4 Home / Set Reference ... 116
12.4.1 Active Homing for both linear and rotary motors with incremental encoders ... 116
12.4.2 Set Reference for both linear and rotary motors with absolute encoders ... 119
12.4.3 Application based example to home a LinMot Linear Axis ... 120
12.5 Parameter Access (RAM) ... 122
12.6 Add Additional Parameters / Variables to the Real-Time Channel ... 123
12.6.1 Drive Configuration ... 123
12.6.2 PLC Configuration ... 124
12.7 Telegram 750 / TDB ... 125
12.7.1 LinMot MI Drives ... 125
12.7.2 LinMot PD Drives ... 126
12.8 Using the Closed Loop Force/Torque Control Technology Function ... 130
12.8.1 Add 1 Monitoring and 2 Parameter Channels / Drive Setup ... 131
12.8.2 Scaling the Parameter and Monitoring Channels ... 133
12.8.3 Example Sequence ... 134
12.9 Tuning the Control Loops ... 136
12.9.1 Drive Control Loop ... 136

12.9.2 PLC Control Loop ... 138
12.10 Check with LinMot-Talk if the Fieldbus is running ... 139
13 Drive Profile: Beckhoff TwinCAT 2/3, CoE DS402 ... 140
13.1 Overview ... 140
13.2 Configuration and Connection of the LinMot Drive ... 141
13.2.1 Motor Configuration ... 141
13.2.2 XML File ... 142
13.2.3 EtherCAT Connection ... 142
13.3 PLC Setup ... 143
13.3.1 EtherCAT Device Description File XML ... 143
13.3.2 Scanning the EtherCAT for new Devices ... 143
13.3.3 Setting up the Process Data of the LinMot Drive ... 145
13.3.4 Check EoE settings ... 147
13.3.5 Setting up the NC Axis ... 148
13.4 Encoder Parameter Examples for Linear and Rotary Motors (Axis > Enc and Axis > Drive) ... 152
13.4.1 LinMot Linear Motors PS01 / PS10 ... 152
13.4.2 LinMot Rotary Motors RS01 / RS02 ... 153
13.4.3 LinMot Rotary Motors EC02 / GM51 / PR02 PS11 & PS31 ... 154
13.4.4 LinMot Gripper GM01 / GM5x ... 155
13.4.5 3rd Party Motors ... 156
13.5 Homing ... 157
13.5.1 Homing using the MC_Home function block and simulate a reference CAM ... 157
13.6 Visualization ... 158
13.7 Drive Reset ... 158
13.8 Asynchronous Parameter Access ... 159
13.9 Add Positive and Negative torque/force limit (0x1711) to the Process Data ... 161
13.10 Add Additional Parameters or Variables to the Process Data ... 163
13.11 Using the Closed Loop Force/Torque Control Technology Function ... 167
13.11.1 Drive Setup ... 167
13.11.2 PLC Setup ... 168
13.11.3 Example Sequence ... 169
14 Drive Profile: Beckhoff TwinCAT 2/3, SoE (Outdated) ... 170
14.1 Overview ... 170
14.2 Configuration and Connection of the LinMot Drive ... 171
14.2.1 Motor Configuration ... 171
14.2.2 XML File ... 172
14.2.3 EtherCAT Connection ... 172
14.3 PLC Setup ... 173
14.3.1 EtherCAT Device Description File XML ... 173
14.3.2 Scanning the EtherCAT for new Devices ... 173
14.3.3 Setting up the Process Data of the LinMot Drive ... 175
14.3.4 Check EoE settings ... 177
14.3.5 Setting up the NC Axis ... 178
14.4 Encoder Parameter Examples for Linear and Rotary Motors ... 180
14.4.1 Linear Motors PS01 / PS10 ... 180
14.4.2 Rotary Motors RS01 & RS02 ... 180
14.4.3 Rotary Motors EC02 ... 181
14.4.4 Other motors ... 181
14.5 Homing ... 182
14.6 Visualization ... 183
14.7 Drive Reset ... 183

14.8 Asynchronous Parameter Access *184*
14.9 Add Additional Parameters or Variables to the Process Data (MDT 1 / AT 1) *186*
15 Drive Profile: Schneider Electric PacDrive 3, FSP_DRIVE **189**
15.1 Overview *189*
15.2 Configuration and Connection of the LinMot Drive *190*
15.2.1 Motor Configuration 190
15.2.2 Sercos Connection 191
15.2.3 Sercos Address 192
15.3 PLC Setup *193*
15.3.1 General Device Properties 193
15.3.2 Add the LinMot Drive to the Sercos 194
15.3.3 Device Configuration 195
15.3.3.1 Identification 195
15.3.3.2 Motor/Mechanic using a LinMot linear motor 196
15.3.3.3 Motor/Mechanic using a LinMot Gripper GM01 / GM5x 196
15.3.3.4 Motor/Mechanic using a rotary motor 197
15.3.3.5 Realtime channel 198
15.4 Homing (Linear Motors) *199*
15.4.1 Homing using the Schneider template (FB_Home) 199
15.4.1.1 Setup 199
15.5 Parameter Access *200*
15.5.1 Supported UPID Functions via IDN Access over the Sercos Service Channel 200
15.5.2 Read RAM Parameter Example 201
15.5.3 Write RAM Parameter Example 202
15.6 Enable/Disable Drive Warnings *203*
16 Drive Profile: CODESYS SoftMotion, CiA402 ..... **204**
16.1 Overview *204*
16.2 Configuration and Connection of the LinMot Drive *205*
16.2.1 Motor Configuration 205
16.2.2 XML File 206
16.2.3 EtherCAT Connection 206
16.3 PLC Setup *207*
16.3.1 EtherCAT Device Description File XML 207
16.3.2 Add and setup the LinMot drive 207
16.3.3 Check EoE settings 209
16.4 Homing *210*
16.5 Visualization *211*
16.6 Parameter Access *212*
16.7 Add Additional Parameters or Variables to the Process Data *213*
17 Drive Profile: B&R NC Motion, CiA402 ..... **216**
17.1 Overview *216*
17.2 Preconditions to use DS402 / CiA402 ..... *217*
17.3 Supported operating modes *217*
17.4 Configuration and Connection of the LinMot Drive *218*
17.4.1 Motor Configuration 218
17.4.2 XDD File 219
17.4.3 Powerlink Connection 219
17.4.4 Node ID 219
17.5 Automation Studio Physical View *220*
17.5.1 Add the LinMot drive to the Powerlink network 220
17.5.2 Configuration 221

17.5.2.1 Linear Axis: 221
17.5.2.2 Rotary Axis PR01 or PR02 222
17.5.2.3 Rotary Axis EC02, GM51 or PR02 PS11 / PS31 222
17.5.2.4 LinMot Gripper GM01 / GM5x 222
17.6 Automation Studio Configuration View 223
17.6.1 Add axis objects 223
17.7 Homing 224
17.7.1 Linear Motor 225
17.7.2 Rotary Motor 225
17.8 Parameter access 226
17.8.1 SDO commands 226
17.9 Add Additional Parameters or Variables to the Process Data 228
18 Drive Profile: B&R NC Motion, SDC interface 229
18.1 Overview 229
18.2 Compatibility LinMot_SDC <> ACP10 ARNC0 230
18.3 Configuration and Connection of the LinMot Drive 231
18.3.1 Motor Configuration 231
18.3.2 XDD File 232
18.3.3 Powerlink Connection 232
18.3.4 Node ID 232
18.4 Short Description of the LinMot SDC interface function block 233
18.4.1 Principle of Operation 233
18.4.2 HTML Help 233
18.4.3 LM_SdcIf (Interface Function Block) 234
18.4.4 enCallType 234
18.4.5 stConfig 234
18.5 Prerequisites 235
18.6 Automation Studio Physical View 236
18.6.1 Add the LinMot drive to the Powerlink network 236
18.6.2 Configuration 237
18.6.3 I/O Mapping 238
18.6.4 Powerlink Interface and PLC Configuration 239
18.6.5 Add a B&R drive to generate all NC object specific requirements automatically 240
18.7 Automation Studio Configuration View 242
18.7.1 Setup NC Manager and NC Mapping 242
18.7.2 Add new NC Object 244
18.7.3 Add TextSystem 245
18.8 Automation Studio Logical View: Linear Motor Example 247
18.8.1 Add the example program to the project 247
18.8.2 ACOPOS Parameter Table 247
18.8.3 Init Parameter Table 248
18.8.4 Check Init Parameters of the SDC function block 249
18.8.5 Assign the example program to Cyclic #1 249
18.9 Automation Studio Logical View: Rotary Motor Example 250
18.9.1 Add the example program to the project 250
18.9.2 ACOPOS Parameter Table 251
18.9.3 Init Parameter Table 253
18.9.4 Check Init Parameters of the SDC function block 254
18.9.5 Assign the example program to Cyclic #1 254
18.10 Homing 255
18.10.1 Linear Motor 255

18.10.2 Rotary Motor 255
18.10.3 Reference Switch (mcHOME_ABS_SWITCH) 256
18.11 Test 258
18.11.1 Switch On 258
18.11.2 Homing 259
18.11.3 Error Acknowledge 259
18.12 Parameter Access 260
18.12.1 Parameter access by LMcf_ParaAccess function block 260
18.12.2 Parameter access by SDO commands 261
18.13 Add Additional Parameters or Variables to the Process Data 263
18.14 Errors (LM_SdcIf outputs) 264
18.14.1 bError 264
18.14.2 diStatusID 264
18.14.3 uiErrorCode 264
19 Drive Profile: OMRON Sysmac Studio, CoE DS402 265
19.1 Overview 265
19.2 Configuration and Connection of the LinMot Drive 266
19.2.1 Motor Configuration 266
19.2.2 XML File 267
19.2.3 EtherCAT Connection 267
19.3 PLC Setup 268
19.3.1 Install EtherCAT Device Description File XML 268
19.3.2 Define EtherCAT node address on LinMot-Device 269
19.3.2.1 Set node address by address selector on device 269
19.3.2.2 Set node address by parameter on device 270
19.3.2.3 Write node address from Sysmac Studio 271
19.3.2.4 Set node address by function block 272
19.3.3 Scanning the EtherCAT network for devices 273
19.3.4 Edit PDO mapping 274
19.3.5 Create a motion axis and link it to your physical LinMot axis 275
19.3.6 Setting up the motion axis 277
19.4 Homing procedure on Sysmac with ABS Encoder 279
19.5 Drive Based Homing (INC Encoder) 279
19.5.1 Settings on LinMot drive 279
19.5.2 Function blocks required on Sysmac 280
19.5.2.1 EC_CoESDORead 280
19.5.2.2 EC_CoESDOWrite 280
19.5.2.3 MC_ResetFollowingError 280
19.5.2.4 MC_HomeWithParameter 280
19.5.3 Homing procedure on Sysmac (motors with INC Encoder) 281
19.6 Drive reset to clear axis error 283
19.7 Control of force / torque 283
19.7.1 Limiting force or torque output in Position-Control-Mode 283
19.7.2 Control force or torque output in Torque-Control-Mode (CST Mode 10) 284
19.7.2.1 Speed Limiter for Torque/Force-Control-Mode 284
19.7.2.2 Torque/Force-Control-Mode in CST Mode 10 285
19.8 Parameter Access 287
19.8.1 PDO Access 287
19.8.2 Example for user defined PDO access 287
19.8.2.1 PDO Map 287
19.8.2.2 I/O Map 288

19.8.2.3 Scaling of mapped PDO 289
19.8.3 SDO Access 291
20 Drive Profile: TRIO, CiA402 292
20.1 Overview 292
20.2 Configuration and Connection of the LinMot Drive 293
20.2.1 Motor Configuration 293
20.2.2 XML File 294
20.2.3 EtherCAT Connection 294
20.2.4 Set the node address / station alias by address selectors on the drive 294
20.3 Controller Setup 295
20.3.1 EtherCAT Device Description File (XML) 295
20.3.2 Add and setup the LinMot drive 295
20.3.3 UNITS for Linear and Rotary Motors 300
20.4 Homing 301
20.5 Parameter Access 302
20.6 Examples 303
21 Drive Profile: Bosch Rexroth, ctrlX CORE DS402 304
21.1 Overview 304
22 Troubleshooting 305
Appendix I: Basic Position Control Loop Tuning 307
Appendix II: Basic Closed Loop Torque/Force Control Loop Tuning 309
Notes 312
Contact & Support 313

Use of This Document

This document is an Application Note / How-To to help the user connecting LinMot drives to different PLC types.

It provides guides when using function block libraries provided by NTI AG / LinMot and guides to integrate LinMot drives using standardized drive profiles.

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Drives: Various

Classification:
[x] Application Note
[ ] Installation Guide
[ ] User Manual
[ ] Documentation
[ ] LinMot internally

Version History

Version	Date	Author	Description
1V0	31/05/2017	fj	Initial Release
1V1	13/06/2017	fj	Minor corrections
1V2	10/07/2017	fj	Added chapter 16 Drive Profile: CODESYS SoftMotion, CiA402
1V3	27/03/2019	fj / mm	Added chapter 11 Drive Profile: Rockwell Automation Motion (CIP Sync Motion) Added chapter 14.4 Encoder Parameter Examples for Linear and Rotary Motors Added chapter 13 Drive Profile: Beckhoff TwinCAT 2/3, CoE DS402 Added chapter 15.3.3.4 Motor/Mechanic using a rotary motor Added chapter 18 Drive Profile: B&R NC Motion, SDC interface Updated chapter 12 Drive Profile: Siemens TIA, PROFIdrive Removed chapter OMRON with EC drives (obsolete) Various minor updates and corrections
1V4	03/06/2019	fj	Minor: added library compatibility list: chapter 18.2 Minor: fixed screenshot and description in chapter 18.13
1V5	26/02/2020	fj	Added chapter 15.4.1 Homing using the Schneider template (FB_Home) Added chapter Trademarks Various minor updates and corrections
1V6	06/08/2020	fj / mr	Updated chapter 19.1 Overview of Drive Profile: OMRON Sysmac Studio, CoE DS402 Updated chapter 12.4.3 Application based example to home a LinMot Linear Axis and created new example projects Added chapter 8 LinMot Profile: Mitsubishi Removed/Updated contact information on page 2 and the last page
1V7	13/07/2021	fj / pk	Added chapter 6 LinMot Profile: B&R Automation Studio Added chapter 7 LinMot Profile: CODESYS Added chapter 12.7 Telegram 750 / TDB Added chapter 12.8 Using the Closed Loop Force/Torque Control Technology Function Updated chapter 13 Drive Profile: Beckhoff TwinCAT 2/3, CoE DS402 for Firmware 6.10 Updated chapter 13.5 Homing: added MC_Home example Added chapter 13.11 Using the Closed Loop Force/Torque Control Technology Function Added chapter 17 Drive Profile: B&R NC Motion, CiA402 Updated chapter 19 Drive Profile: OMRON Sysmac Studio, CoE DS402 for FW 6.10 Added chapter 20 Drive Profile: TRIO, CiA402 Added chapter Appendix II: Basic Closed Loop Torque/Force Control Loop Tuning Small corrections, updates, and improvements over all document
1V8	07/09/2021	fj	Rearranged homing variants in chapter 12.4 Home / Set Reference
1V9	01/11/2021	fj	Updated/Corrected chapter 13.4
1V10	22/09/2022	fj / pk / mr	Added chapter 1.3 LinMot Drives with multi-interface (MI) Overview / C1250-xx replacement Updated chapter 12.9.1 Updated all chapters to support LinMot C125x-MI drives
1V11	03/04/2024	fj	Updated chapter 1.3 Updated chapter 5 Updated chapter 11 Various small corrections
1V12	09/06/2026	ee / ap / fj	Added Quick Navigation Flowchart Added examples for gripper (GMx1) rotary parts and new PR02 PS11 & PS31 encoders in several chapters. Added chapter 1.6 Drive LED Blink Codes Updated chapter 1.8 UPID (Unique Parameter ID) Updated chapter 5 LinMot Profile: Rockwell Automation Studio 5000 (Add-On Instructions) Added chapter 9 LinMot Profile: Python Added chapter 10 LinMot Profile: Yaskawa iCube Engineer Updated chapter 11.1 Overview Updated chapter 12.3.5 Insert and Setup a new Technology object (Linear Axis) Added chapter 13.4.4 LinMot Gripper Added chapter 21 Drive Profile: Bosch Rexroth, ctrlX CORE DS402

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Bosch Rexroth	ctrlX AUTOMATION, IndraControl, IndraMotion
3S-Smart Software Solutions GmbH	CODESYS
B&R Industrial Automation GmbH	B&R Automation Studio®, Ethernet POWERLINK®
Omron	SYSMAC®,
Profibus and Profinet International (P.I.)	Profibus®, Profinet®
Interests Group SERCOS interface e.V	SERCOS interface®
ODVA, Inc	EtherNet/IP™, CIP™, CIP Sync™
Trio Motion Technology Ltd	*Motion* Perfect
Yaskawa	*Yaskawa, ICUBE CONTROL, iCube Engineer,iCube PLC*

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1 General

1.1 Abbreviations

1.1.1 LinMot Drive System Generations (SG)

SG	Drives
SG3	Family E1100 (GP, CO, DN, DP) (LC/HC/XC)
SG4	Family B1100 (VF, PP, GP, ML) (LC/HC/XC)
SG5	Family E1200 (GP, DP, DS, EC, IP, PD, PL, PN, SC, SE, LU) Family E1400 (GP, DP, DS, EC, IP, PD, PL, PN, SC, SE, LU) (0S/1S) Family B8000-ML (GP, EC, IP, PL, PN, SC)
SG6	Family C1250 (MI, DS, EC, CM, IP, PD, PL, PN, SC, SE, LU, CC) (0S/1S) Family C1251 (MI) (2S) Family E1400V2 (GP, DP, DS, EC, IP, PD, PL, PN, SC, SE, LU) (0S/1S) Family C1400 (GP, DS, EC, IP, PD, PL, PN, SC, SE, LU) (0S/1S)
SG7	Family A1100 Family C1100 (GP, DS, EC, PD, PN, SE) (0S/1S)
SG8	Family F125x
SG9	I1050, F1050-DS-HC-0S, F1150-DS-UC-3S

1.1.2 LinMot Drive Interface Extensions

Extension	Interface
GP	General Purpose (Depends on system generation and installed FW: LinRS and/or CANopen and/or DeviceNet)
CO	CANopen (LinMot Profile)
DN	DeviceNet (LinMot Profile)
DP	PROFIBUS (LinMot Profile)
PN	PROFINET (LinMot Profile)
PD	PROFIdrive (PROFIdrive Standard Telegram 5 & 9, SIEMENS Telegram 105)
PDS	PROFISAFE (Safety Standard Telegram 30), PROFINET (LinMot Profile) & PROFIdrive (PROFIdrive Standard Telegram 5 & 9, SIEMENS Telegram 105)
EC	EtherCAT (LinMot Profile)
SE	EtherCAT SoE (Servo Drive Profile over EtherCAT)
DS	EtherCAT CoE (DS402/CiA402)
PL	Powerlink (DS402/CiA402, LinMot Profile)
IP	EtherNet/IP (LinMot Profile)
CM	EtherNet/IP (CIP Sync, LinMot Profile)
SC	Sercos III (FSP_DRIVE, FSP_IO)
CC	CC-Link IE Field Basic (LinMot Profile)
LU	LinUDP (LinMot Ethernet UDP protocol)
RS	LinRS (LinMot serial protocol for RS232, RS422, RS485)
MI	Multi Interface (PN/PD > MIPD, EC/DS > MIDS, CM > MICM, PL > MIPL, SC > MISC, CC > MICC, LU > MILU)

E.g., C1250-**DS**-XC-xS -> DS = EtherCAT CoE

1.2 LinMot F Series Drives

Preliminary information as of May 2026

From mid-2026 two new F series drives (SG9) will be available.

F1150-DS-UC-3S-000 (0150-6789)

F1050-DS-UC-0S (0150-6767)

The drives support EtherCAT (DS402 & LinMot Profile) and CANopen (LinMot Profile) as fieldbus and require **LinMot-Talk 7** for commissioning (request from support@linmot.com).

ESI (XML) file name: NTIL_DS_Drives_Vx_x_bxx.xml

The ESI (XML) is to be found in the installation directory of LinMot-Talk 7:
e.g. ..\0187-0004_SW_7V0_LinMot-Talk_7.0_Build_2026xxxx\Firmware\Interfaces\EtherCAT\XML

EDS file names: F1050.eds, F1150.eds, I1050.eds

The ESI (XML) is to be found in the installation directory of LinMot-Talk 7:
e.g. ..\0187-0004_SW_7V0_LinMot-Talk_7.0_Build_2026xxxx\Firmware\Interfaces\CanOpen\EDS

The integration steps are the same as with previous LinMot EtherCAT drives and the guides of the existing chapters can be followed.

- LinMot Profile: Beckhoff TwinCAT 2&3 (Chapter 3)
- LinMot Profile: CODESYS (Chapter 7)
- LinMot Profile: Yaskawa iCube Engineer (Chapter 10)
- Drive Profile: Beckhoff TwinCAT 2/3, CoE DS402 (Chapter 13)
- Drive Profile: CODESYS SoftMotion, CiA402 (Chapter 16)
- Drive Profile: OMRON Sysmac Studio, CoE DS402 (Chapter 19)
- Drive Profile: TRIO, CiA402 (Chapter 20)
- Drive Profile: Bosch Rexroth, ctrlX CORE DS402 (Chapter 21)

1.3 LinMot Drives with multi-interface (MI) Overview / C1250-xx replacement

The table shown on the next page gives an overview of how and if a C1250 drive with a specific interface (e.g., EC, PN, …) could be replaced by a multi-interface C125x-MI drive. (blue = C1250-MI-XC-xS, yellow = C1251-MI-XC-2S)

The C1250-MI drives can be ordered with a specific interface preinstalled by a defined article number.
Even if there is an interface preinstalled the user is free to install any supported interface during firmware installation.

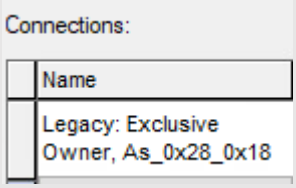
A generic C1250-MI drive is available too where no interface is preinstalled. Any supported interface can be chosen during firmware installation. Good for having in stock.

The generic versions have the following ordering information:

Item	Article no.
C1250-MI-XC-1S-000	0150-5589
C1250-MI-XC-0S-000	0150-5591
C1250-MI-XC-1S-C00 (Calibrated Measuring Amplifier)	0150-5590
C1250-MI-XC-0S-C00 (Calibrated Measuring Amplifier)	0150-5592

Attention:
The generic MI drive supports all interfaces of the C1250 series drives **except SE (SoE).**
Supported: PD, PN, DS, EC, CM, IP, PL, SC (FSP_DRIVE only), LU, CC

> -**IP** drives can be directly replaced by CM or MI when activating the “Legacy” assembly.



> -**SC** drives using the **FSP_Drive** profile can be replaced by MI drives.

> -**SC** drives using the **FSP_IO** profile can **NOT** be replaced by MI drives as FSP_IO is not supported.

Note:
For MI drives with preinstalled interface the item name is appended with -0xx / -Cxx where xx is the interface type.

E.g., C1250-MI-XC-1S-000 drive with preinstalled PD/PN interface => C1250-MI-XC-1S-0**PD**

Note:
In the PLC the device type of MI drives is shown with the interface abbreviation appended directly to MI.

E.g., C1250-MI-XC-1S-0PD (or …-000) is shown in TIA Portal as C1250-MI**PD**-XC-1S

		Drive Family				
Interface		C1250-xx-XC-0S	C1250-xx-XC-1S	**C1250-MI-XC-0S**	**C1250-MI-XC-1S**	**C1251-MI-XC-2S**
MI (generic)	***Description***			***C1250-MI-XC-0S-x00***	***C1250-MI-XC-1S-x00***	***C1251-MI-XC-2S***
	Intf Art no.					
	HW Art no. -000			0150-5591 (-000)	0150-5589 (-000)	0150-2933
	HW Art no. -C00			0150-5592 (-C00)	0150-5590 (-C00)	0150-4185
LU	***Description***	***C1250-LU-XC-0S***	***C1250-LU-XC-1S***	***C1250-MI-XC-0S-xLU***	***C1250-MI-XC-1S-xLU***	***C1251-MILU-XC-2S***
	Intf Art no.			0150-30140	0150-30160	0150-30000
	HW Art no. -000	0150-2491	0150-2492	0150-5748 (-0LU)	0150-5734 (-0LU)	0150-2933
	HW Art no. -C00	0150-4129	0150-4135	0150-5741 (-CLU)	0150-5727 (-CLU)	0150-4185
EC	***Description***	***C1250-EC-XC-0S***	***C1250-EC-XC-1S***	***C1250-MI-XC-0S-xDS***	***C1250-MI-XC-1S-xDS***	***C1251-MIDS-XC-2S***
FSoE	Intf Art no.			0150-30142	0150-30162	0150-30002
	HW Art no. -000	0150-1884	0150-2345	0150-5751 (-0DS)	0150-5737 (-0DS)	0150-2933
	HW Art no. -C00	0150-4125	0150-4126	0150-5744 (-CDS)	0150-5730 (-CDS)	0150-4185
DS	***Description***	***C1250-DS-XC-0S***	***C1250-DS-XC-1S***	***C1250-MI-XC-0S-xDS***	***C1250-MI-XC-1S-xDS***	***C1251-MIDS-XC-2S***
FSoE	Intf Art no.			0150-30142	0150-30162	0150-30002
	HW Art no. -000	0150-2415	0150-2416	0150-5751 (-0DS)	0150-5737 (-0DS)	0150-2933
	HW Art no. -C00	0150-4123	0150-4124	0150-5744 (-CDS)	0150-5730 (-CDS)	0150-4185
SE	***Description***	***C1250-SE-XC-0S***	***C1250-SE-XC-1S***			
	Intf Art no.					
	HW Art no. -000	0150-1897	0150-2350			
	HW Art no. -C00	0150-4144	0150-4145			
PL	***Description***	***C1250-PL-XC-0S***	***C1250-PL-XC-1S***	***C1250-MI-XC-0S-xPL***	***C1250-MI-XC-1S-xPL***	***C1251-MIPL-XC-2S***
	Intf Art no.			0150-30144	0150-30164	0150-30004
	HW Art no. -000	0150-1885	0150-2347	0150-5749 (-0PL)	0150-5735 (-0PL)	0150-2933
	HW Art no. -C00	0150-4138	0150-4139	0150-5742 (-CPL)	0150-5728 (-CPL)	0150-4185
PD	***Description***	***C1250-PD-XC-0S***	***C1250-PD-XC-1S***	***C1250-MI-XC-0S-xPD***	***C1250-MI-XC-1S-xPD***	***C1251-MIPD-XC-2S***
PDS	Intf Art no.			0150-30145	0150-30165	0150-31005
	HW Art no. -000	0150-2618	0150-2619	0150-5746 (-0PD)	0150-5732 (-0PD)	0150-2933
	HW Art no. -C00	0150-4136	0150-4137	0150-5739 (-CPD)	0150-5725 (-CPD)	0150-4185
PN	***Description***	***C1250-PN-XC-0S***	***C1250-PN-XC-1S***	***C1250-MI-XC-0S-xPD***	***C1250-MI-XC-1S-xPD***	***C1251-MIPD-XC-2S***
PNS	Intf Art no.			0150-30145	0150-30165	0150-31005
	HW Art no. -000	0150-1888	0150-2348	0150-5746 (-0PD)	0150-5732 (-0PD)	0150-2933
	HW Art no. -C00	0150-4140	0150-4141	0150-5739 (-CPD)	0150-5725 (-CPD)	0150-4185
IP	***Description***	***C1250-IP-XC-0S***	***C1250-IP-XC-1S***			
	Intf Art no.					
	HW Art no. -000	0150-1886	0150-2346			
	HW Art no. -C00	0150-4127	0150-4128			
CM	***Description***	***C1250-CM-XC-0S***	***C1250-CM-XC-1S***	***C1250-MI-XC-0S-xCM***	***C1250-MI-XC-1S-xCM***	***C1251-MICM-XC-2S***
	Intf Art no.			0150-30147	0150-30167	0150-30008
	HW Art no. -000	0150-2900	0150-2901	0150-5747 (-0CM)	0150-5733 (-0CM)	0150-2933
	HW Art no. -C00	0150-4121	0150-4122	0150-5740 (-CCM)	0150-5726 (-CCM)	0150-4185
SC	***Description***	***C1250-SC-XC-0S***	***C1250-SC-XC-1S***	***C1250-MI-XC-0S-xSC***	***C1250-MI-XC-1S-xSC***	***C1251-MISC-XC-2S***
FSP_DRV only!	Intf Art no.			0150-30149	0150-30169	0150-30009
	HW Art no. -000	0150-1887	0150-2349	0150-5750 (-0SC)	0150-5736 (-0SC)	0150-2933
	HW Art no. -C00	0150-4142	0150-4143	0150-5743 (-CSC)	0150-5729 (-CSC)	0150-4185
CC	***Description***	***C1250-CC-XC-0S***	***C1250-CC-XC-1S***	***C1250-MI-XC-0S-xCC***	***C1250-MI-XC-1S-xCC***	***C1251-MICC-XC-2S***
	Intf Art no.			0150-30150	0150-30170	0150-30010
	HW Art no. -000	0150-4023	0150-4024	0150-5752 (-0CC)	0150-5738 (-0CC)	0150-2933
	HW Art no. -C00	0150-4146	0150-4147	0150-5745 (-CCC)	0150-5731 (-CCC)	0150-4185

1.4 Device Description Files (SG5, SG6, SG7)

Device description files for LinMot drives can be found in the installation directory of the LinMot-Talk software in the subdirectory ..\Firmware\Interfaces\... Below a table showing the path and file name as of May 2026.

Example: If you have a **C1250-MI-XS-1S (part number 0150-5589)** and want to use PROFInet/PROFIdrive search the **"Intf. Art. No."** in the table above **-> 0150-30165.**
Therefore, take the file **GSDML-V2.45-NTI-30165-PN_PD-V1.0-20260120.xml**

File Name	Path
LinMot -MI Drives (PROFInet / PROFIdrive / PROFIsafe)	
GSDML-V2.33-NTI-30185-PN_PD-V1.0-20240807.xml	..\Firmware\Interfaces\ProfiNet_NX\GSDML_PD
GSDML-V2.33-NTI-30205-PN_PD-V1.0-20240807.xml	..\Firmware\Interfaces\ProfiNet_NX\GSDML_PD
GSDML-V2.33-NTI-31005-PN_PD-V1.0-20250611.xml	..\Firmware\Interfaces\ProfiNet_NX\GSDML_PD
GSDML-V2.33-NTI-31005-PN_PD-V1.0-20251106.xml	..\Firmware\Interfaces\ProfiNet_NX\GSDML_PD
GSDML-V2.45-NTI-30145-PN_PD-V1.0-20260120.xml	..\Firmware\Interfaces\ProfiNet_NX\GSDML_PD
GSDML-V2.45-NTI-30165-PN_PD-V1.0-20260120.xml	..\Firmware\Interfaces\ProfiNet_NX\GSDML_PD
LinMot -MI Drives (EtherCAT DS402 / LinMot Profile / FSoE)	
NTIL_CiA402_Servos_FS_V1_0ra3.xml	..\Firmware\Interfaces\EtherCat_NX\XML
NTIL_CiA402_Servos_MI_V1_0r4.xml	..\Firmware\Interfaces\EtherCat_NX\XML
LinMot -MI & -CM Drives (EtherNet/IP)	
C1250-CM-XC-0S_1V2.eds	..\Firmware\Interfaces\EtherNetIP_NX\EDS
C1250-CM-XC-1S_1V2.eds	..\Firmware\Interfaces\EtherNetIP_NX\EDS
C1250-MICM-XC-0S_1V2.eds	..\Firmware\Interfaces\EtherNetIP_NX\EDS
C1250-MICM-XC-1S_1V2.eds	..\Firmware\Interfaces\EtherNetIP_NX\EDS
C1251-MICM-XC-2S_1V2.eds	..\Firmware\Interfaces\EtherNetIP_NX\EDS
E1450-MICM-QN-0S_1V2.eds	..\Firmware\Interfaces\EtherNetIP_NX\EDS
E1450-MICM-QN-1S_1V2.eds	..\Firmware\Interfaces\EtherNetIP_NX\EDS
LinMot -MI Drives (Powerlink DS402 / LinMot Profile)	
00000156_C1250_MIPL_XC_0S_000_DS402.xdd	..\Firmware\Interfaces\Powerlink_NX\XDD\AS4
00000156_C1250_MIPL_XC_0S_C00_DS402.xdd	..\Firmware\Interfaces\Powerlink_NX\XDD\AS4
00000156_C1250_MIPL_XC_1S_000_DS402.xdd	..\Firmware\Interfaces\Powerlink_NX\XDD\AS4
00000156_C1250_MIPL_XC_1S_C00_DS402.xdd	..\Firmware\Interfaces\Powerlink_NX\XDD\AS4
00000156_E1450_MIPL_QN_0S_000_DS402.xdd	..\Firmware\Interfaces\Powerlink_NX\XDD\AS4
00000156_E1450_MIPL_QN_1S_000_DS402.xdd	..\Firmware\Interfaces\Powerlink_NX\XDD\AS4
LinMot -CO & -GP Drives (CANopen)	
A1100.eds	..\Firmware\Interfaces\CanOpen\EDS
C1100.eds	..\Firmware\Interfaces\CanOpen\EDS
E1200.eds	..\Firmware\Interfaces\CanOpen\EDS
E1400.eds	..\Firmware\Interfaces\CanOpen\EDS
LinMot -DS Drives (EtherCAT DS402)	
NTIL_CiA402_Servos_V1_9r2.xml	..\Firmware\Interfaces\EtherCAT\XML
NTIL_CiA402_SG5_Servos_V1_7r7.xml	..\Firmware\Interfaces\EtherCAT\XML
LinMot -EC Drives (EtherCAT LinMot Profile)	
NTIL_LM_Servos_V1_8_r6.xml	..\Firmware\Interfaces\EtherCAT\XML
NTIL_LM_SG5_Servos_V1_7_r4.xml	..\Firmware\Interfaces\EtherCAT\XML
LinMot -SE Drives (EtherCAT SoE)	
NTIL_SoE_Servos_V1_3r3.xml	..\Firmware\Interfaces\EtherCAT_SoE\XML
NTIL_SoE_SG5_Servos_V1_3r2.xml	..\Firmware\Interfaces\EtherCAT_SoE\XML

LinMot -IP Drives (EtherNet/IP LinMot Profile)	
024D002B06E10100.eds	..\Firmware\Interfaces\EthernetIP\EDS
024D002B06F60100.eds	..\Firmware\Interfaces\EthernetIP\EDS
024D002B075E0100.eds	..\Firmware\Interfaces\EthernetIP\EDS
024D002B092A0100.eds	..\Firmware\Interfaces\EthernetIP\EDS
024D002B09320100.eds	..\Firmware\Interfaces\EthernetIP\EDS
024D002B0A6A0100.eds	..\Firmware\Interfaces\EthernetIP\EDS
024D002B07570100.eds	..\Firmware\Interfaces\EthernetIP_ML\EDS
LinMot -PL Drives (Powerlink LinMot Profile)	
0x00000156_C1250PL.xdd	..\Firmware\Interfaces\POWERLINK\XDD\AS3
0x00000156_E1250PL.xdd	..\Firmware\Interfaces\POWERLINK\XDD\AS3
0x00000156_E1450PL.xdd	..\Firmware\Interfaces\POWERLINK\XDD\AS3
00000156_C1250PL.xdd	..\Firmware\Interfaces\POWERLINK\XDD\AS4
00000156_C1250PL_DS402.xdd	..\Firmware\Interfaces\POWERLINK\XDD\AS4
00000156_C1450PL.xdd	..\Firmware\Interfaces\POWERLINK\XDD\AS4
00000156_C1450PL_DS402.xdd	..\Firmware\Interfaces\POWERLINK\XDD\AS4
00000156_E1250PL.xdd	..\Firmware\Interfaces\POWERLINK\XDD\AS4
00000156_E1450PL.xdd	..\Firmware\Interfaces\POWERLINK\XDD\AS4
LinMot -DP Drives (Profibus LinMot Profile)	
1230092D.GSD	..\Firmware\Interfaces\Profibus\GSD_1200
1430092D.GSD	..\Firmware\Interfaces\Profibus\GSD_1400
LinMot -PN Drives (PROFInet LinMot Profile)	
GSDML-V2.33-NTI_1762-PN_IO-V1.1-20181127.xml	..\Firmware\Interfaces\ProfiNet\GSDML
GSDML-V2.33-NTI_1783-PN_IO-V1.1-20230705.xml	..\Firmware\Interfaces\ProfiNet\GSDML
GSDML-V2.33-NTI_1888-PN_IO-V1.1-20230705.xml	..\Firmware\Interfaces\ProfiNet\GSDML
GSDML-V2.33-NTI_2348-PN_IO-V1.1-20230705.xml	..\Firmware\Interfaces\ProfiNet\GSDML
GSDML-V2.33-NTI_2356-PN_IO-V1.1-20230705.xml	..\Firmware\Interfaces\ProfiNet\GSDML
GSDML-V2.33-NTI_2384-PN_IO-V1.1-20230705.xml	..\Firmware\Interfaces\ProfiNet\GSDML
GSDML-V2.33-NTI_2385-PN_IO-V1.1-20230705.xml	..\Firmware\Interfaces\ProfiNet\GSDML
GSDML-V2.33-NTI_2658-PN_IO-V1.1-20230705.xml	..\Firmware\Interfaces\ProfiNet\GSDML
LinMot -PD Drives (PROFIdrive Telegram 5/105)	
GSDML-V2.33-NTI-2616-PN_PD-V1.0-20230705.xml	..\Firmware\Interfaces\ProfiNet\GSDML_PD
GSDML-V2.33-NTI-2617-PN_PD-V1.0-20230705.xml	..\Firmware\Interfaces\ProfiNet\GSDML_PD
GSDML-V2.33-NTI-2618-PN_PD-V1.0-20230705.xml	..\Firmware\Interfaces\ProfiNet\GSDML_PD
GSDML-V2.33-NTI-2619-PN_PD-V1.0-20230705.xml	..\Firmware\Interfaces\ProfiNet\GSDML_PD
GSDML-V2.33-NTI-2621-PN_PD-V1.0-20230705.xml	..\Firmware\Interfaces\ProfiNet\GSDML_PD
GSDML-V2.33-NTI-2622-PN_PD-V1.0-20230705.xml	..\Firmware\Interfaces\ProfiNet\GSDML_PD
GSDML-V2.33-NTI-2664-PN_PD-V1.0-20230705.xml	..\Firmware\Interfaces\ProfiNet\GSDML_PD
LinMot -SC Drives (SERCOS III FSP_DRIVE & FSP_IO)	
C1250_SC_XC_0S.xml	..\Firmware\Interfaces\SERCOSIII\SDDML
C1250_SC_XC_1S.xml	..\Firmware\Interfaces\SERCOSIII\SDDML
E1250_SC_UC.xml	..\Firmware\Interfaces\SERCOSIII\SDDML
E1450_SC_QN_0S.xml	..\Firmware\Interfaces\SERCOSIII\SDDML
E1450_SC_QN_1S.xml	..\Firmware\Interfaces\SERCOSIII\SDDML

1.5 Available LinMot Libraries

LinMot provides several function block libraries for different PLCs and fieldbus systems to allow a fast and comfortable integration of LinMot drives into almost any control concept.

An overview of available LinMot libraries can be downloaded from the LinMot website:
http://www.linmot.com/support/plc-library/

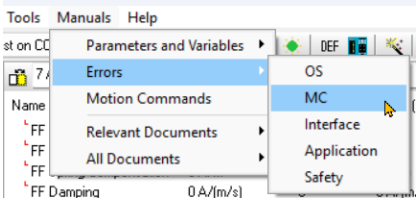
Or search for the document reference (0185-1105) in the LinMot eCatalogue:
http://shop.linmot.com

Note: The available libraries can be downloaded from: http://download.linmot.com/plc_lib/libraries
For preliminary libraries that are not available for download please contact the LinMot support team.
support@linmot.com

1.6 Drive LED Blink Codes

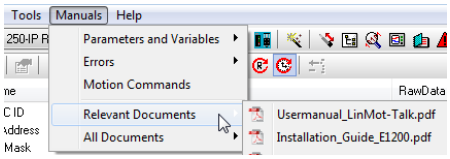
Error	Warn	EN	Description
Off	Warning	Operation Enabled	**Normal Operation:** Warnings and operation enabled are displayed.
On	● ~2 Hz 0…15× **Error Code High Nibble**	● ~2 Hz 0…15× **Error Code Low Nibble**	**Error:** The error code is shown by a blink code with “WARN” and “EN”. The error is divided into low and high nibble (4 bit). “WARN” and “EN” are blinking together. The error can be acknowledged. Example: WARN blinks 3×, EN blinks 2× → Error Code = 32h
–	● ~2 Hz 0…15× **Error Code High Nibble**	● ~2 Hz 0…15× **Error Code Low Nibble**	**Fatal Error:** The error code is shown by a blink code with “WARN” and “EN”. “WARN” and “EN” are blinking together. Fatal errors can only be acknowledged by a reset or power cycle.
● ~4 Hz	● ~2 Hz 0…15× **Error Code High Nibble**	● ~2 Hz 0…15× **Error Code Low Nibble**	**System Error:** Please reinstall firmware or contact support.
● ~0.5 Hz	Blinks ~0.5 Hz	On	**Signal Supply 24V too low:** The error and warn LEDs blink alternating if the signal supply +24 V (X4.2) is less than 18 VDC.
Off	○●●●	●○●●	**Plug & Play Communication Active:** This sequence (Warn on, then EN on, then both off) completes the sequence of the 4 states in ~1.5 s. Initializes the state when plug and play parameters are being read from the motor.
○● ~4 Hz	○● v~4 Hz	Off	**Waiting for Defaulting Parameters:** When ID (S1, S2) is set to 0xFF, the drive starts in a special mode and the Error and Warn LED blink alternating ~4 Hz. When the ID list is set to 0x00, all parameters are set to the default value. To leave this state, power down the drive and change the ID.
Off	○● ~2 Hz	○● ~2 Hz	**Defaulting Parameters Done:** When the parameters have been set to their default values (initiated via S1/S2 on power up), the Warn and EN LEDs blink together at 2 Hz. To leave this state, power down the drive.
Off	Off	Off	**Bootstrap:** The drive is in bootstrap mode if the two RT LEDs are also off (if present). Switch S5 or S4 (GP) off.

The resulting error code(s) can be found in the drive specific error lists generated within LinMot-Talk: (Manuals > Errors > …)



1.7 Documentation / User Manuals / Application Notes

Beside the documentation included in the libraries available for download, reading the following user manuals is essential to understand the communication between the PLC and the LinMot drive. The manuals are included in the LinMot-Talk software (*Menu Manuals → All Documents* or *Relevant Documents* if logged in to a drive) or can be downloaded from the LinMot eCatalogue:
http://shop.linmot.com (search by document reference)



User Manuals: General	System Generation	Document Reference
LinMot-Talk	All	0185-1059
Motion Control Software	SG3 & SG4	0185-1092
Motion Control Software	SG5 - SG7	0185-1093
User Manuals: Configuration Over Fieldbus	**System Generation**	**Document Reference**
Drive Configuration Over Fieldbus	SG3 & SG4	0185-1072 (SG3), 0185-1073 (SG4)
Drive Configuration Over Fieldbus	SG5 - SG7	0185-1074
User Manuals: Interfaces	**System Generation**	**Document Reference**
EtherCAT (LinMot Profile)	SG5 - SG7	0185-1079
EtherCAT CoE (CiA402, CANopen over EtherCAT)	SG5 - SG7	0185-1103 / 0185-1178 (-MI)
EtherCAT SoE (Servo Drive Profile over EtherCAT)	SG5 - SG7	0185-1080
PROFIBUS DP	SG3, SG5 & SG6	0185-1089
PROFINET IO	SG5 - SG7	0185-1090 / 0185-1154 (-MI)
PROFINET PROFIdrive	SG6	0185-1132 / 0185-1154 (-MI)
Sercos III (FSP_DRIVE or FSP_IO)	SG5 & SG6	0185-1091
EtherNet/IP	SG5 & SG6	0185-1081
EtherNet/IP CIP Sync	SG6	0185-1165
Powerlink	SG5 & SG6	0185-1088
CC-Link IE Field Basic	SG6 (C1250-CC-..)	0185-1171
CANopen	SG3 & SG4	0185-1075
CANopen	SG5 - SG7	0185-1076
DeviceNet	SG3 & SG4	0185-1078
LinRS (LinMot serial protocol)	SG3 - SG7	0185-1082
LinUDP (LinMot Ethernet UDP protocol) up to FW6.3	SG5 & SG6	0185-1083
LinUDP V2 (LinMot Ethernet UDP protocol) from FW6.3	SG5 & SG6	0185-1108
Application Notes		**Document Reference**
HT Config over Realtime		0185-0142-E / 0185-0142-D
HT Oscilloscope		0185-0132-E / 0185-0132-D
HT Position Loop Tuning		0185-1156-E / 0185-1156-D
HT Closed Loop Force/Torque Tuning		0185-0144-E / 0185-0144-D

1.8 UPID (Unique Parameter ID)

The value of any parameter of a LinMot drive is stored as an integer value (raw data) in the memory space of the drive. The parameter is identified through its Unique Parameter ID (UPID), which is a 16 Bit integer number.

Example from within the LinMot-Talk parameter tree:

Name	Value	Raw Data	Value (RAM)	UPID	Type	Scale	Offset	Min	Max	Default	Attr.
FF Constant Force	0 A	0	0 A	139Ch	SInt32	0.001 A	0 A	-28 A	28 A	0 A	RW

Note: Detailed information about LinMot drive parameters can be found in the user manual *Drive Configuration Over Fieldbus.* See chapter 1.7 Documentation / User Manuals

Attention ROM Access:
Intense use of writing into the ROM memory can reduce the lifetime of the drive memory!
More details can be found in the *Drive Configuration Over Fieldbus (0185-1074)* user manual
> see chapter Documentation / User Manuals

1.9 Recent Version of LinMot-Talk and Drive Firmware

The most recent LinMot-Talk version including all drive firmware, device description files and documentation can be downloaded from

either (standard):
https://linmot.com/download/linmot-talk-drive-configuration/

or (alternative link):
http://download.linmot.com/LinMot-Talk/Release/

Hint:
LinMot C1250, C1450 & E1450 series drives support configuration over several interfaces (PROFINET, EtherNet/IP, EtherCAT, Sercos III & LinUDP).

This allows to login with LinMot-Talk into the drive and change parameters, monitor the drive, import/export the drive configuration, etc.

The application note “Config over Realtime” covering this topic is available from:
0185-0142-E / 0185-0142-D

1.10 YouTube Video Tutorials

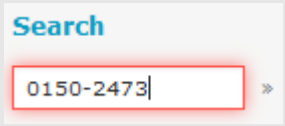
LinMot provides videos for a wide range of topics covering login, firmware installation, motor wizard, integration, and maintenance on the website.

YouTube https://linmot.com/drive-configuration/

1.11 LinMot Product Information

Datasheets, Installation Guides, Application Notes, drivers, EPlan, CAD Files and so on for LinMot products can be found in the eCataloque: https://shop.linmot.com/

Note: To find all relevant information about a product just enter the article number in the search box on https://shop.linmot.com/



2 Overview

2.1 LinMot Profile (Commissioning using the LinMot Libraries)

The following table shows working combinations of different PLC types and LinMot drives. For these combinations function block libraries and/or example projects are available. Click the link in the *See chapter* column to directly open the according chapter (if available).

PLC Type	Interface	LinMot I/F Extension	Type	Language	See chapter
Beckhoff TwinCAT 2&3	EtherCAT CANopen PROFIBUS	-EC & -MI -GP -DP	Library	ST (Structured Text)	3
Siemens Step 7 V5.5 (S7-300 and higher)	PROFINET PROFIBUS	-PN & -MI -DP	Library	AWL	4
Siemens TIA (S7-300, S7-1500)	PROFINET PROFIBUS	-PN & -MI -DP	Library	AWL	4
Siemens TIA (S7-1200, S7-1500)	PROFINET PROFIBUS	-PN & -MI -DP	Library	SCL	4
Rockwell Automation	EtherNet/IP	-IP -CM & -MI	Add-On Instructions (AOI)	LD (Ladder)	5 11
B&R	Powerlink CANopen	-PL & -MI -GP	Library	ST	6
CODESYS (based)	Various	Various	Library	ST	7
Mitsubishi	CC-Link IE Field Basic	-CC & -MI	Library	ST	8
PC (Windows & Linux)	EtherCAT	-MI	Python Script	Python	9
Yaskawa iCube Engineer	EtherCAT CoE	-MI / -DS (SG9)	Function Blocks	Structured Text	10

2.2 Drive Profiles (Direct Integration as Motion Axis using standardized Drive Profiles)

The following table shows the drive profiles supported by LinMot servo drives. Based on your PLC type the correct LinMot drive can be selected. Click the link in the *See chapter* column to directly open the according chapter (if available).

PLC Type	Interface	LinMot I/F Extension	Integration	Drive Profile	See chapter
Rockwell Automation	EtherNet/IP (CIP Sync)	-CM & -MI	As motion axis	LinMot PVA Streaming	11
Siemens (Simotion, S7-1500, …)	PROFIdrive	-PD & -MI	As axis (TO)	Standard Telegram 5 SIEMENS Telegram 105	12
Beckhoff TwinCAT 2&3	EtherCAT CoE	-DS & -MI	As axis (NC)	CoE (DS402/CiA402)	13
Beckhoff TwinCAT 2&3	EtherCAT SoE	-SE	As axis (NC)	SoE	14
Schneider Electric (PacDrive 3)	Sercos III	-SC & -MI	As axis	FSP Drive	15
CODESYS Motion	EtherCAT CoE	-DS & -MI	As axis	CoE (DS402/CiA402)	16
B&R	Powerlink CiA402	-PL & -MI	As axis	CoE (DS402/CiA402)	17
B&R	Powerlink	-PL & -MI	As SDC axis	LinMot PV Streaming	18
Omron (NJ501-1500)	EtherCAT CoE	-DS & -MI	As axis	CoE (DS402/CiA402)	19
TRIO (MC4N ECAT, P904)	EtherCAT	-DS & -MI	As axis	CoE (DS402/CiA402)	20
Bosch Rexroth (ctrlX CORE X*)	EtherCAT CoE	-MI	As axis	CoE (DS402/CiA402)	21
Bosch Rexroth (IndraControl / IndraMotion)	Sercos III	-SC & -MI	As axis	FSP Drive	Footnote [1]

[1] See Bosch Rexroth online help for GAT compact. The LinMot Sercos (-SC) drives are integrated as Sercos Drive.

3 LinMot Profile: Beckhoff TwinCAT 2&3

3.1 Overview

This chapter shows how a LinMot drive with *LinMot EtherCAT* interface (e.g., C1250-MI-XC-1S) can be integrated and setup in a Beckhoff TwinCAT environment to be used with the library provided by LinMot.
For this example, TwinCAT 2 is used. The steps are generally similar for TwinCAT 3.

Download:
The library for TwinCAT 2&3 can be downloaded from:
http://download.linmot.com/plc_lib/libraries/Beckhoff/ (named *Beckhoff_LinMot_Library_...*)

Note:
More information can be found in the library documentation (part of the above-mentioned download) and in the user manual EtherCAT (LinMot Profile) (see chapter 1.7 Documentation / User Manuals)

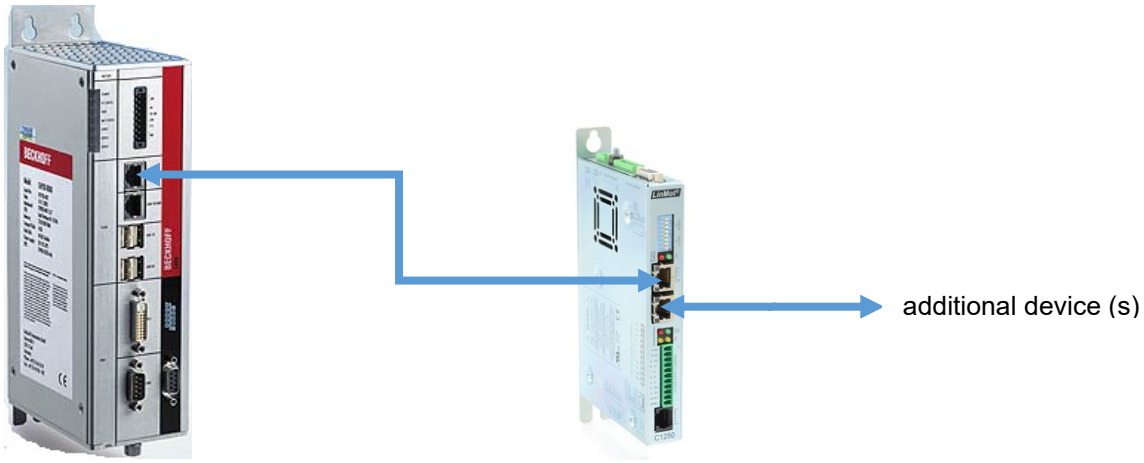


Image Source: http://www.beckhoff.com/

EtherCAT is the open real-time Ethernet network originally developed by Beckhoff. The LinMot acts as Slave in this network and is implemented with the standard ASIC ET1100 from Beckhoff.

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

3.2 Configuration and Connection of the LinMot Drive

The LinMot drive is configured using the LinMot-Talk software:
http://www.linmot.com/download/linmot-talk-drive-configuration/

3.2.1 Motor Configuration

It is assumed that the motor connected to the drive is already configured.

Use the *Motor Wizard* inside LinMot-Talk to setup the motor (Menu -> Drive -> Motor Wizard):

See Appendix I: Basic Position Control Loop Tuning

3.2.2 XML Files

Install the XML file that is part of the LinMot-Talk software/firmware you are using.
The most recent device files are always part of the newest LinMot-Talk software. They are located by default:

- EtherCAT: \\LinMot-Talk X.X Build XXXXXXXX\Firmware\Interfaces\EtherCat_Nx\XML\ **(-MI drives)**
- EtherCAT: \\LinMot-Talk X.X Build XXXXXXXX\Firmware\Interfaces\EtherCAT\XML\

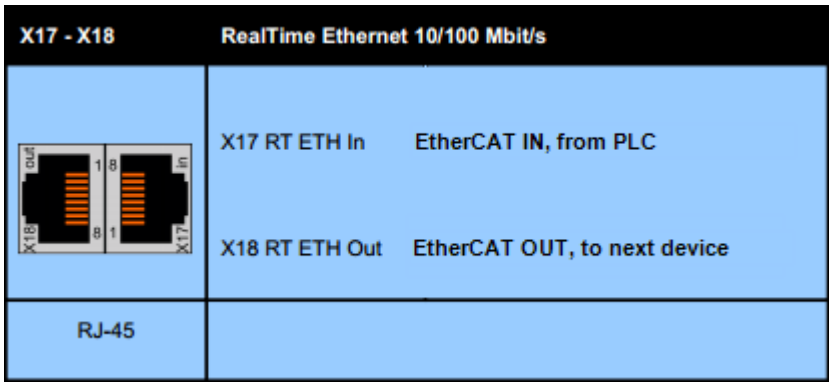
XML file names:

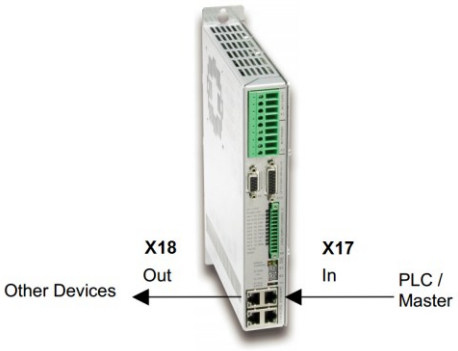
NTIL_CiA402_Servos_MI_Vx_xrx.xml	LinMot MI drives SG6
NTIL_DS_Drives_Vx_x_bxx.xml	LinMot DS drives SG9 (F Series DS)
NTIL_LM_Servos_Vx_xrx.xml	LinMot EC drives SG6-7
NTIL_LM_SG5_Servos_Vx_xrx.xml	LinMot EC drives SG5

3.2.3 EtherCAT Connection

The drive is connected to the EtherCAT network using the **X17 (IN) & X18 (OUT)** connectors.

The below pictures show the ports of an E1250-EC-UC drive.
On all other LinMot drives supporting EtherCAT the ports are named the same (X17 & X18), but they may be placed differently on the drive housing.





3.3 PLC Setup EtherCAT (E1450-EC-QN, E1250-EC-UC, C1x00-EC-XC-xx, -MI)

3.3.1 Insert LinMot Drive as Slave

The required XML files can be found in the following folder (default):

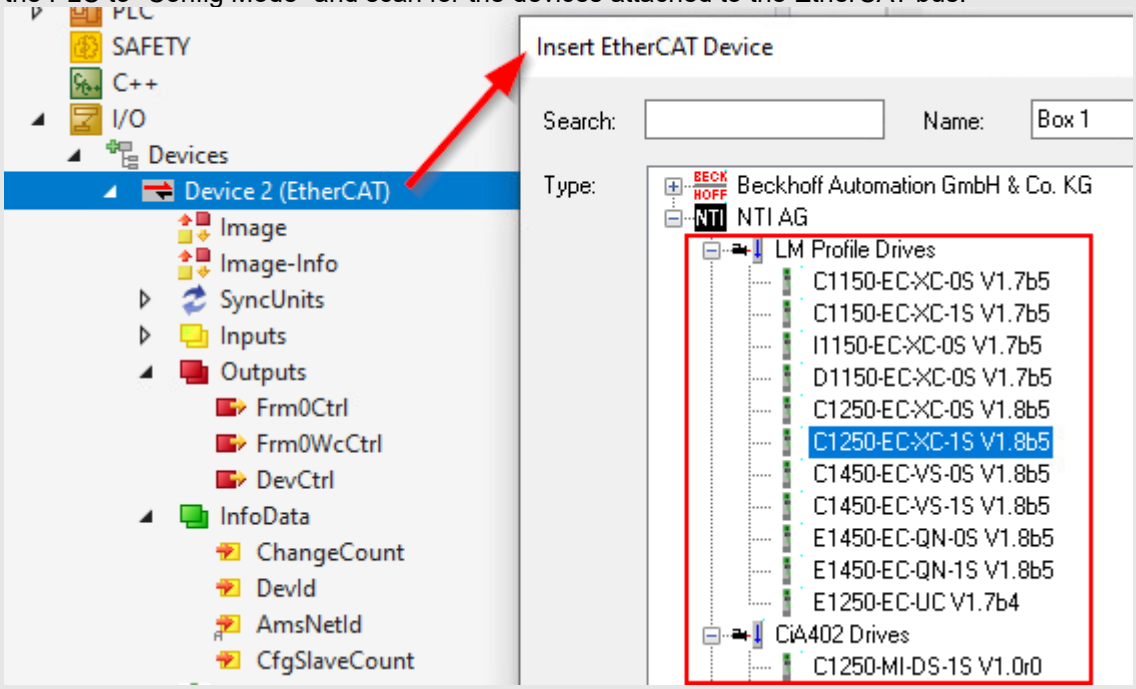
C:\Program Files\LinMot\LinMot-Talk X.X Build XXXXXXXX\Firmware\Interfaces\EtherCat_NX\XML (-MI Drives)
C:\Program Files\LinMot\LinMot-Talk X.X Build XXXXXXXX\Firmware\Interfaces\EtherCAT\XML

These files must be copied to the IO folder of TwinCAT:

- C:\TwinCAT\Io\EtherCAT\ (for TwinCAT 2)
- C:\TwinCAT\3.1\Config\Io\EtherCAT\ (for TwinCAT 3)

Note: You may have to restart the developing environment to have the new XML file to be recognized.

Insert a new device by right-click on the EtherCAT-Master and *Append Box* (figure below) or restart the PLC to “Config Mode” and scan for the devices attached to the EtherCAT bus.

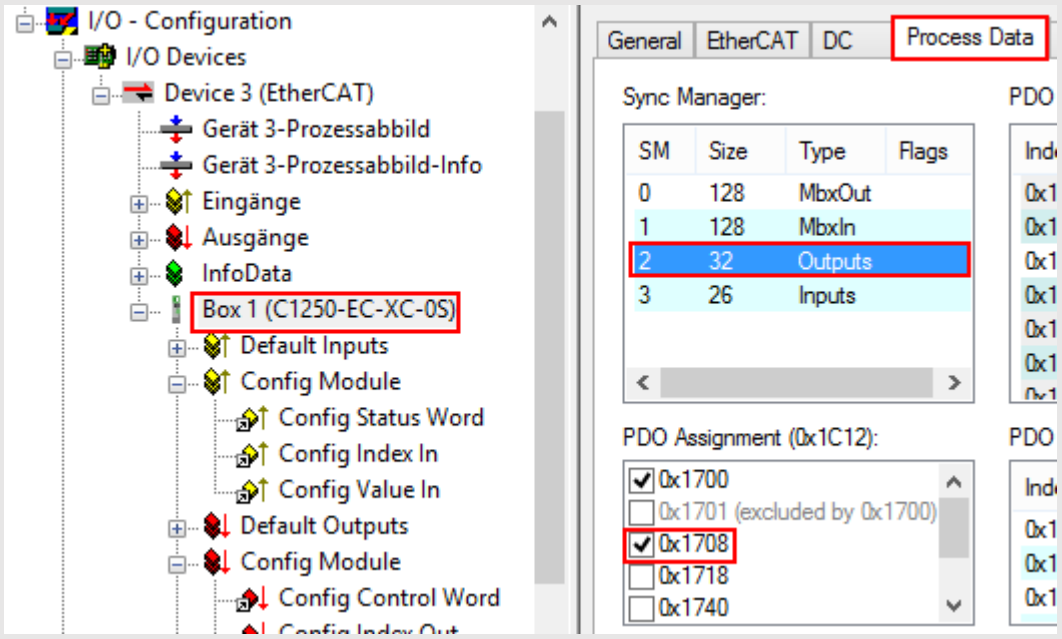


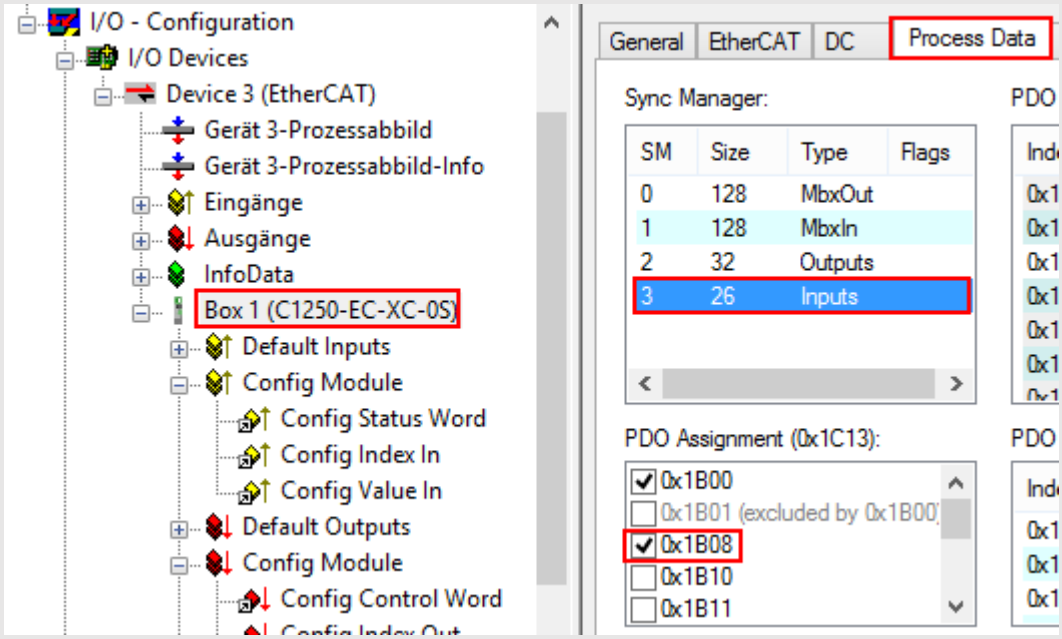
ATTENTION:
For **-MI drives** (they show up as CiA402 drives, e.g., *C1250-MIDS-1S V1.0r0*) make sure that **input PDOs 0x1B00 and 0x1B08** as well as **output PDOs 0x1700 and 0x1708** are selected.

3.3.2 Config Module

The *Config Module* provides access to parameters, curve profiles, command table and so on of a LinMot drive.

If the config function blocks of the library are used the „Config Module“ inputs and outputs (**0x1B08 & 0x1708**) must be enabled and linked as well.





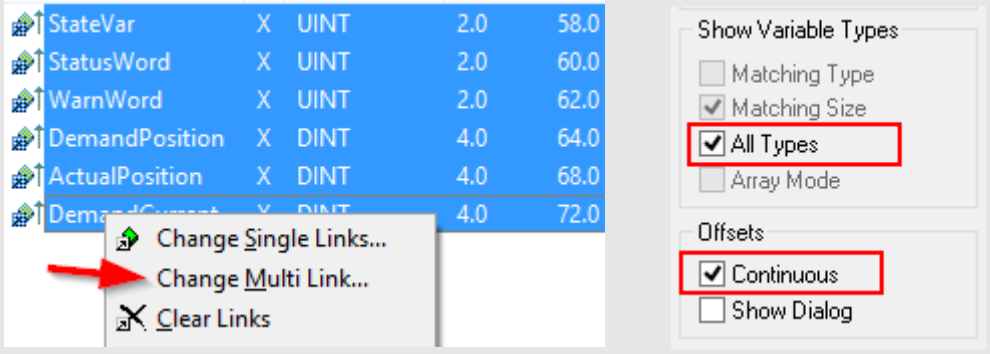
3.3.3 Links to PLC Control

To be able to link the input and output data of the LinMot drive you must create an instance of the *tstLM_Axis* data type (part of the library) in the global variables of you PLC project.

The inputs and outputs of the modules must be linked as shown below:

Name	Linked to
StateVar	StateVar . .Axis_A_Axis.DrvToPlc . Inputs . Standard . Li...
StatusWord	StatusWord . .Axis_A_Axis.DrvToPlc . Inputs . Standard ...
WarnWord	WarnWord . .Axis_A_Axis.DrvToPlc . Inputs . Standard ....
DemandPosition	ComDemandPosition . .Axis_A_Axis.DrvToPlc . Inputs ....
ActualPosition	ComActualPosition . .Axis_A_Axis.DrvToPlc . Inputs . S...
DemandCurrent	ComActualCurrent32 . .Axis_A_Axis.DrvToPlc . Inputs ....
Config Status Word	CfgStatusWord . .Axis_A_Axis.DrvToPlc . Inputs . Stand...
Config Index In	CfgIndexIn . .Axis_A_Axis.DrvToPlc . Inputs . Standard ....
Config Value In	CfgValueIn . .Axis_A_Axis.DrvToPlc . Inputs . Standard ....
Control Word	ControlWord . .Axis_A_Axis.PlcToDrv . Outputs . Stand...
Motion Command Header	MCHeader . .Axis_A_Axis.PlcToDrv . Outputs . Standar...
Motion Command Par 1	MCParaDWord_00_03 . .Axis_A_Axis.PlcToDrv . Output...
Motion Command Par 2	MCParaDWord_04_07 . .Axis_A_Axis.PlcToDrv . Output...
Motion Command Par 3	MCParaDWord_08_11 . .Axis_A_Axis.PlcToDrv . Output...
Motion Command Par 4	MCParaDWord_12_15 . .Axis_A_Axis.PlcToDrv . Output...
Motion Command Par 5	MCParaDWord_16_19 . .Axis_A_Axis.PlcToDrv . Output...
Config Control Word	CfgControlword . .Axis_A_Axis.PlcToDrv . Outputs . St...
Config Index Out	CfgIndexOut . .Axis_A_Axis.PlcToDrv . Outputs . Stand...
Config Value Out	CfgValueOut . .Axis_A_Axis.PlcToDrv . Outputs . Stand...

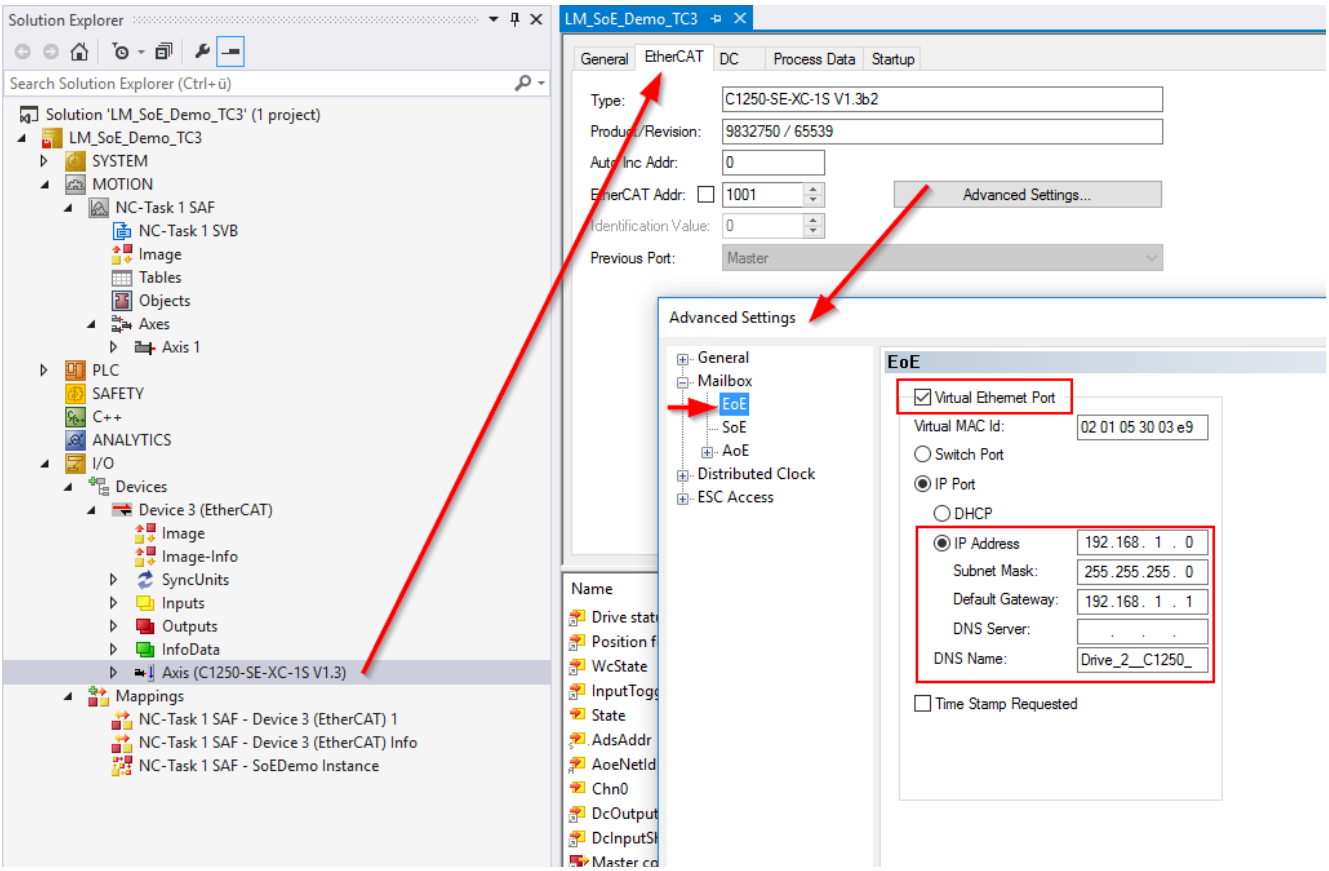
Hint:
It is possible to change multiple links at once. Just select the names you want to link > right-click > Change Multi Link. Don't forget to check "All Types" and "Continuous".



3.3.4 Check EoE settings

On supported drives (C1250-..., C1450-… & E1450-...) please check the EoE (Ethernet over EtherCAT) settings.

LinMot drives do NOT support the DHCP mode yet. A fix IP must be assigned (select *IP Address*) or the EoE feature must be completely disabled (disable Virtual Ethernet Port).



Note:
EoE can be used to login into the drive with LinMot-Talk directly over EtherCAT.
E.g., to change drive settings or for monitoring and tracing.

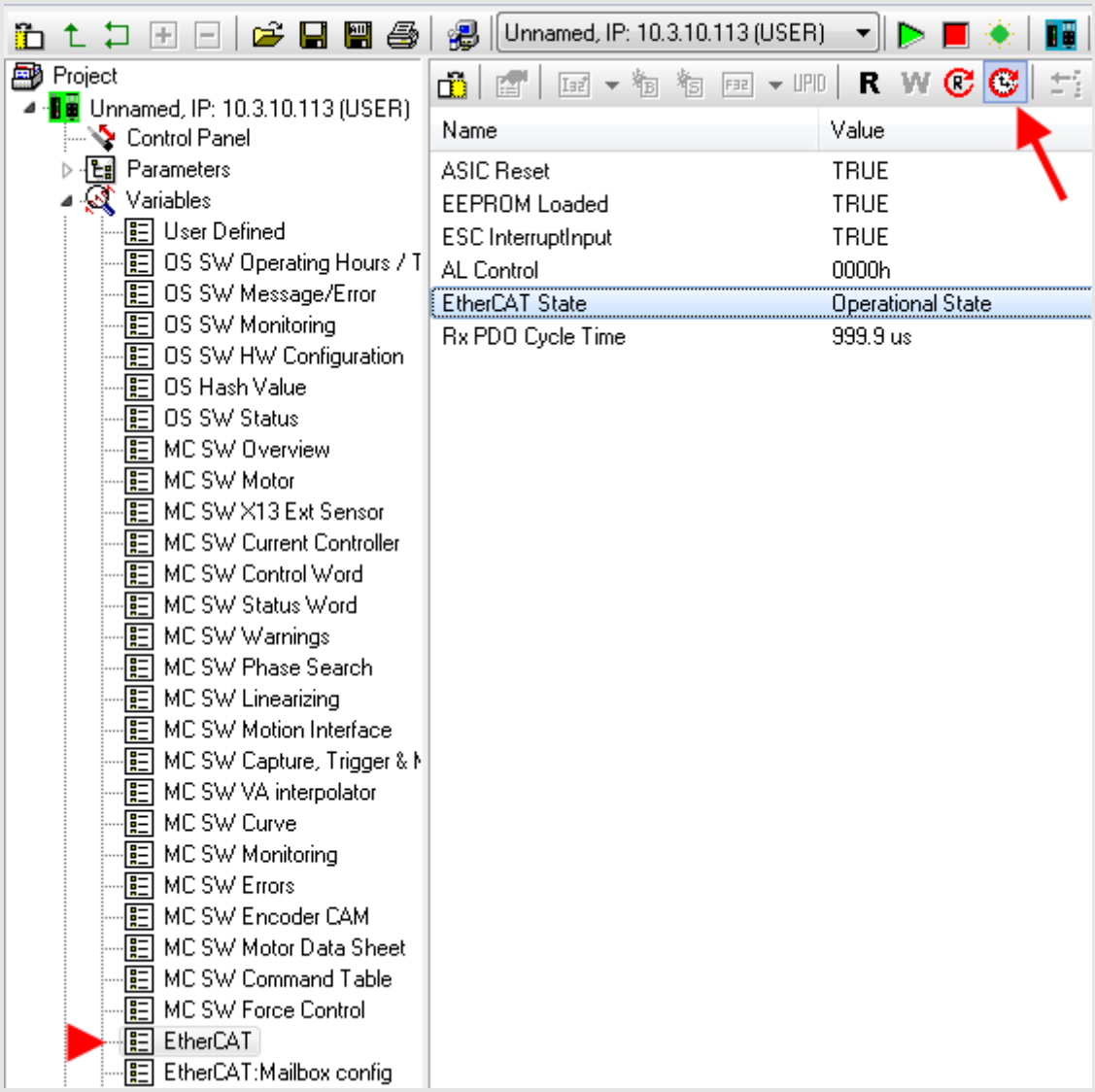
3.4 Add Additional Parameters or Variables to the Process Data

To add additional parameters or variables for read and write access to the process data please see chapter *13.10 Add Additional Parameters or Variables to the Process Data*.

3.5 Check with LinMot-Talk if the Fieldbus is running

LinMot-Talk shows the status of the fieldbus. Open the variables EtherCAT and check if the bus is running (EtherCAT State = Operational State).

Check fieldbus status:



3.6 Next Steps

Now you can start implementing your application using the function blocks and documentation from the download link in chapter **3.1 Overview.**

4 LinMot Profile: Siemens TIA

4.1 Overview

This chapter shows how a LinMot drive with either *PROFIBUS* or *PROFINET* interface (LinMot Profile) can be connected to a Siemens PLC using TIA Portal (for Step 7 the general steps are similar).

Download:
The libraries for TIA / Step 7 can be downloaded from:
http://download.linmot.com/plc_lib/libraries/Siemens/ (named *Siemens_TIA... or Siemens_Step7…*)

Note:
More information can be found in the library documentation (part of the above-mentioned download) and in the user manuals PROFINET & PROFIBUS (LinMot Profile) (see chapter 1.7 Documentation / User Manuals)

Image Source: http://automation.siemens.com/

PROFINET is an Industrial Ethernet Standard. The LinMot PROFINET drives act as PROFINET-IO slaves in this network.

PROFIBUS is a fieldbus standardized in IEC 61158. The LinMot PROFIBUS drives are PROFIBUS-DP slaves.

For further information on PROFINET / PROFIBUS please visit:
http://www.PROFIBUS.com

4.2 Configuration and Connection of the LinMot Drive

The LinMot drive is configured using the LinMot-Talk software:
http://www.linmot.com/download/linmot-talk-drive-configuration/

4.2.1 Motor configuration

It is assumed that the motor connected to the drive is already configured.

Use the *Motor Wizard* inside LinMot-Talk to setup the motor (Menu -> Drive -> Motor Wizard):

See Appendix I: Basic Position Control Loop Tuning

4.2.2 GSD / GSDML files

Install the GSD/GSDML file(s) that is part of the LinMot-Talk software/firmware you are using.
The most recent device files are always part of the newest LinMot-Talk software. They are located by default:

- PROFINET: \\LinMot-Talk X.X Build XXXXXXXX\Firmware\Interfaces\ProfiNet_Nx\GSDML_PD
  (For -MI drives)

- PROFIBUS: \\LinMot-Talk X.X Build XXXXXXXX\Firmware\Interfaces\Profibus\GSD
- PROFINET: \\LinMot-Talk X.X Build XXXXXXXX\Firmware\Interfaces\ProfiNet\GSDML

4.2.3 PROFIBUS Connection

The drive is connected to the PROFIBUS network using the X9 connector of the LinMot drive.

X9	PROFIBUS DP		
	1	Not connected	
	2	Not connected	
	3	RxD/TxD-P	
	4	CNTR-P	
	5	GND	(isolated)
	6	+5V	(isolated)
	7	Not connected	
	8	RxD/TxD-N	
	9	Not connected	
	case	Shield	
DSUB-9 (f)	Max. Baud rate: 12Mbaud		

The only setting that must be done on the drive according to the PROFIBUS interface is setting the node address. By default, it is set with the address selectors *S1 & S2* on the front of the drive.
Alternatively (not recommended) it can be set with the parameter “Node Address Parameter Value” (UPID 2076h). This requires the parameter “Node Address Selection” (UPID 206Ch) to be set to “On”.

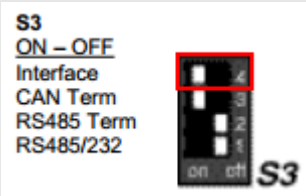
Set the node (Profibus) address using the address selectors *S1 & S2*

S1 - S2	Address Selectors		
E1100 E1200 V1	E1200 V2 E1400 C1x00		
		S1 (5 .. 8)	Bus ID High (0 ... F). Bit 5 is LSB, bit 8 MSB.
		S2 (1 .. 4)	Bus ID High (0 ... F). Bit 1 is LSB, bit 4 MSB.

The rotary switches are hexadecimal.

Attention: Do not change any other PROFIBUS interface parameters on the drive!

Attention: To activate the PROFIBUS Interface on E1130-DP-xx drives, the Dip-Switch S3.4 “Interface” at the bottom of the drive has to be set to “ON” (factory default)



Attention:
According to the PROFIBUS standard the **maximal node address is 127** (addresses 126 and 127 are reserved for special purpose and should normally not be used).

4.2.4 PROFINET Connection

The drive is connected to the PROFINET network using the **X17 (IN) & X18 (OUT)** connectors.

The below pictures show the ports of an E1250-PN-UC drive.
On all other LinMot drives supporting PROFINET the ports are named the same (X17 & X18) but they may be placed differently on the drive housing.

X17 - X18	RealTime Ethernet 10/100 Mbit/s
	X17 RT ETH In (Siemens: Port1, X1.X1) X18 RT ETH Out (Siemens: Port2, X1.X2)
RJ-45	

Attention:
The PROFINET parameters in the drive are left to default values!
The name and IP address are set using the TIA Portal, see chapter 4.4.1

4.3 PLC Setup PROFIBUS (E1430-DP-QN, E1230-DP-UC, E1130-DP-xx)

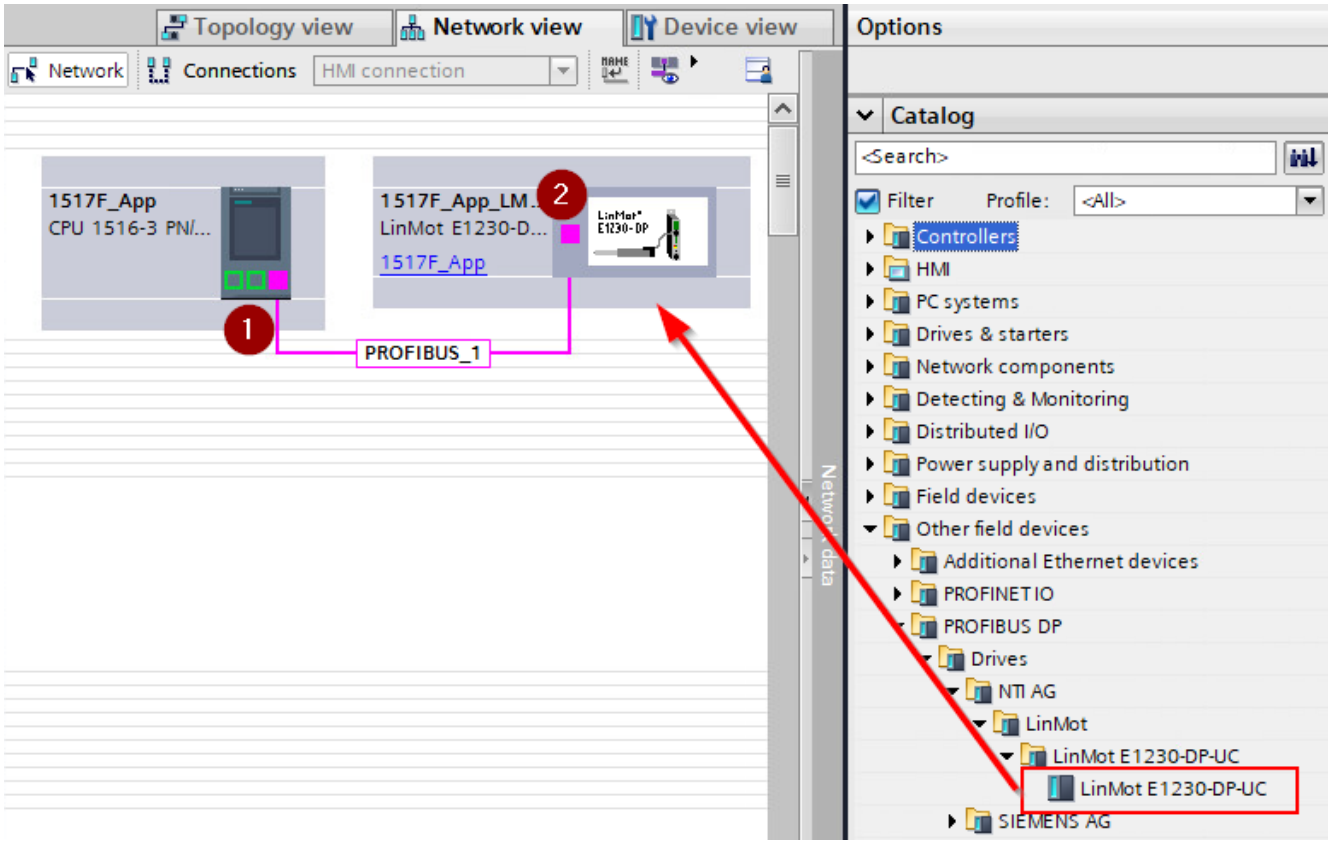
The following procedure can be used for all Siemens PLCs compatible with TIA Portal.

First, install the GSD file for the drive.
(TIA Portal → Options → Install general station description file (GSD))

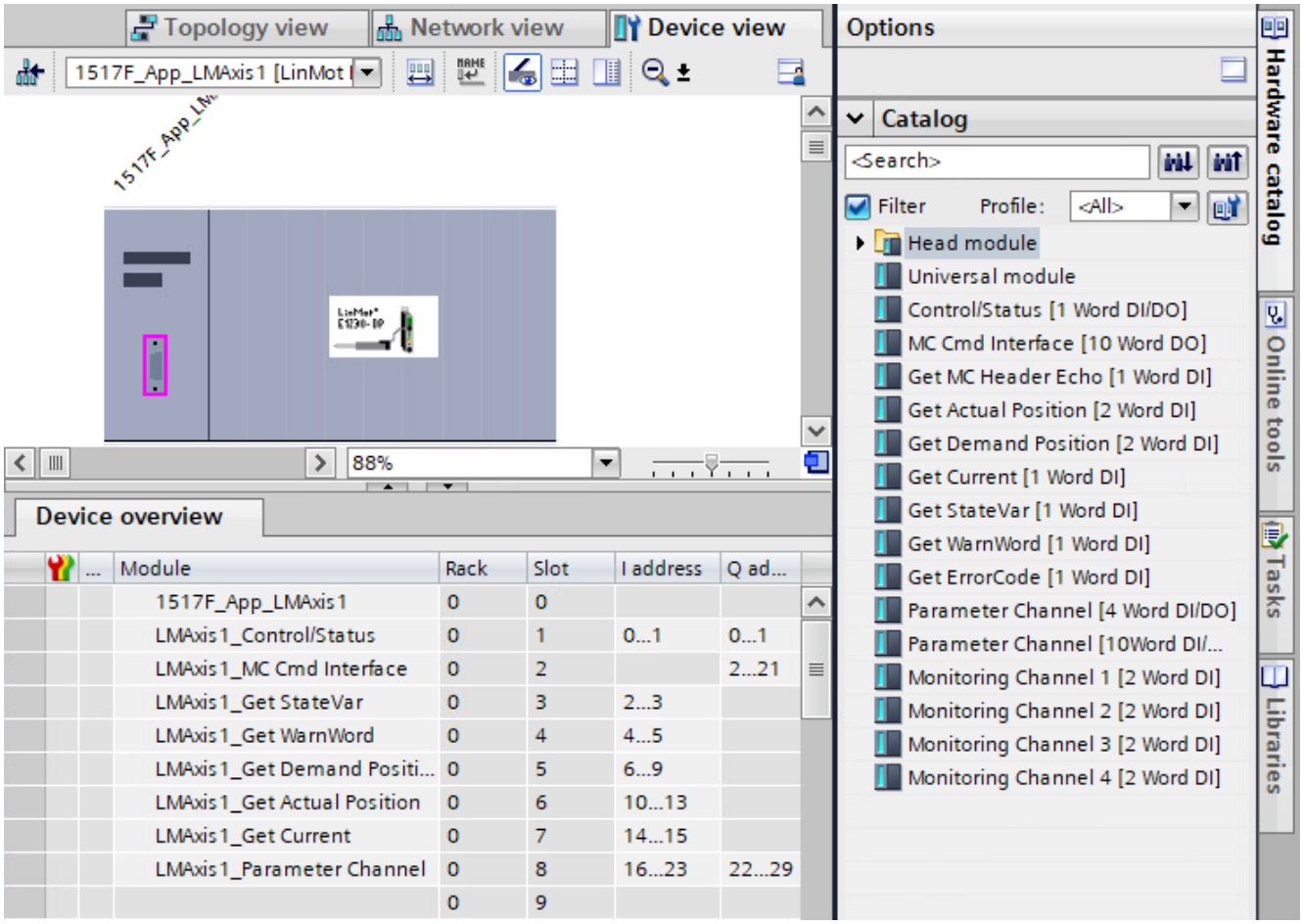
The required GSD file can be found by default in the following folder:

C:\Program Files\LinMot\LinMot-Talk X.X Build XXXXXXXX\Firmware\Interfaces\PROFIBUS\GSD

Drag and drop the desired drive from the catalogue to the network view and connect it to the Profibus network (1 & 2)



Afterwards insert the required modules into the available slots as shown in the figure below.



...	Module	Rack	Slot	I address	Q ad...
	1517F_App_LMAxis1	0	0		
	LMAxis1_Control/Status	0	1	0...1	0...1
	LMAxis1_MC Cmd Interface	0	2		2...21
	LMAxis1_Get StateVar	0	3	2...3	
	LMAxis1_Get WarnWord	0	4	4...5	
	LMAxis1_Get Demand Positi...	0	5	6...9	
	LMAxis1_Get Actual Position	0	6	10...13	
	LMAxis1_Get Current	0	7	14...15	
	LMAxis1_Parameter Channel	0	8	16...23	22...29
		0	9		

Note: Set the name and the PROFIBUS address of the device according to the requirements of your application

4.4 PLC Setup PROFINET (E1450-PN-QN, E1250-PN-UC, C1250-PN-UC, C1150PN-UC, -MI)

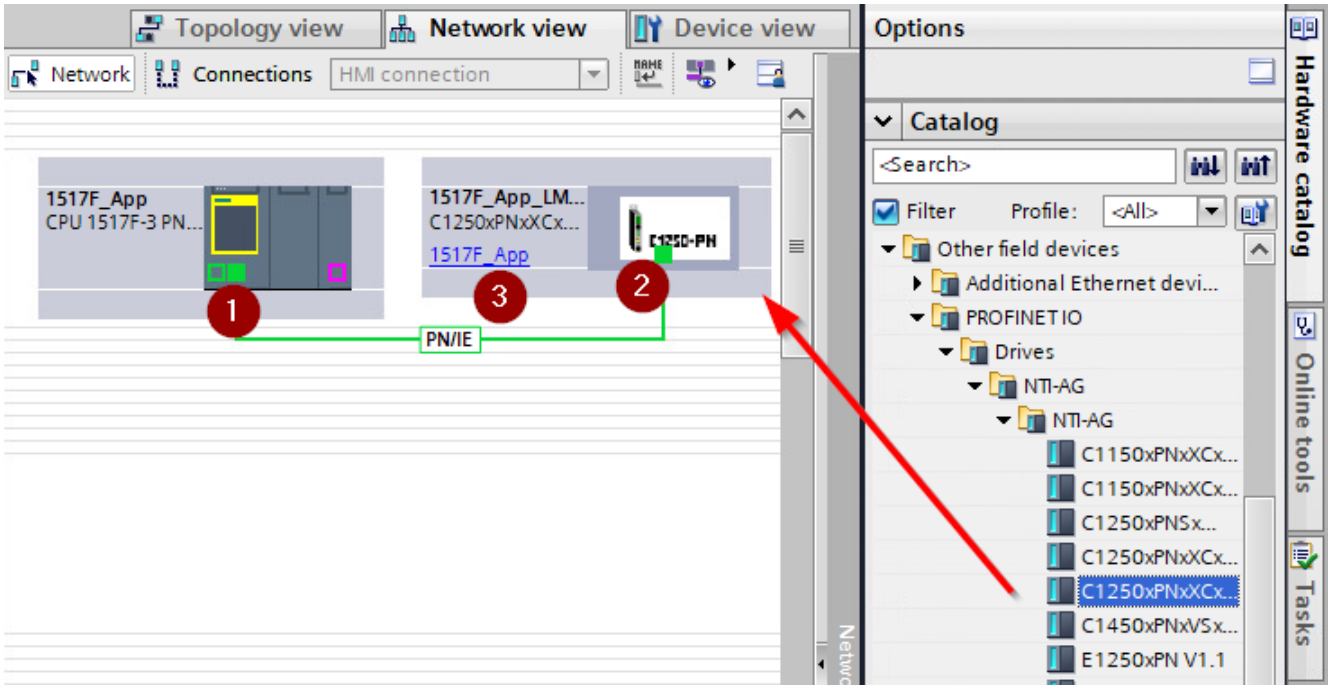
The following procedure can be used for both CPU S7-1200 and CPU S7-1500.

First, install the GSDML file for the drive.
(TIA Portal → Options → Manage general station description file (GSD))

The required GSDML file can be found by default in the following folder:

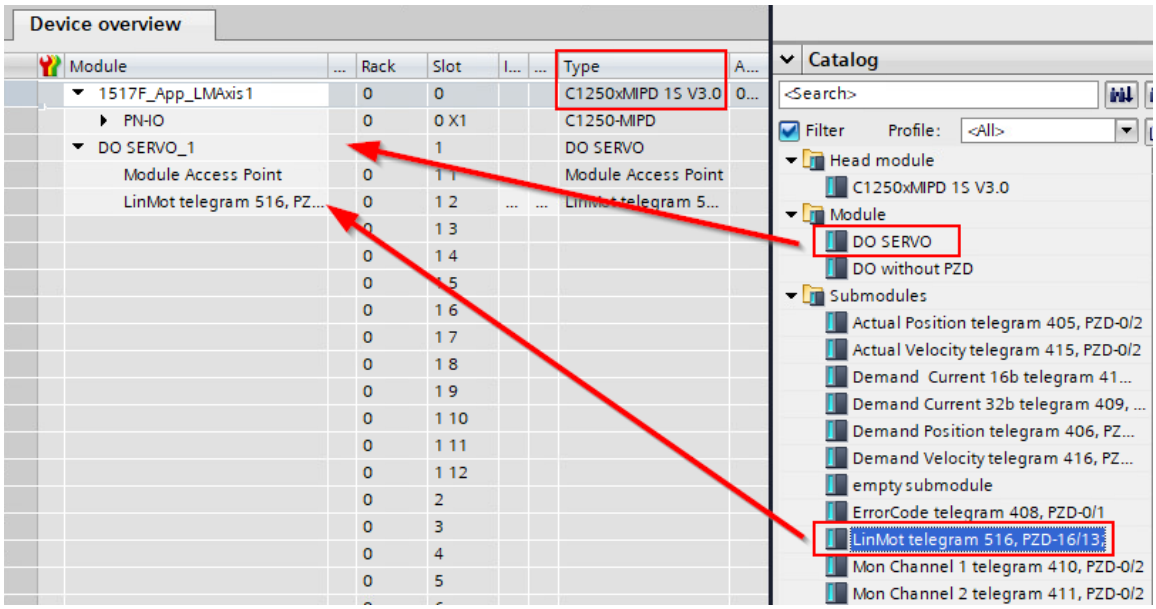
C:\Program Files\LinMot\LinMot-Talk X.X Build XXXXXXXX\Firmware\ProfiNet_Nx\GSDML_PD ***(for -MI drives)***
C:\Program Files\LinMot\LinMot-Talk X.X Build XXXXXXXX\Firmware\ProfiNet\GSDML

Drag and drop the desired drive from the catalogue to the network view, connect the drive with the PLC (draw line from 1 to 2) and assign the drive to the PLC (3).

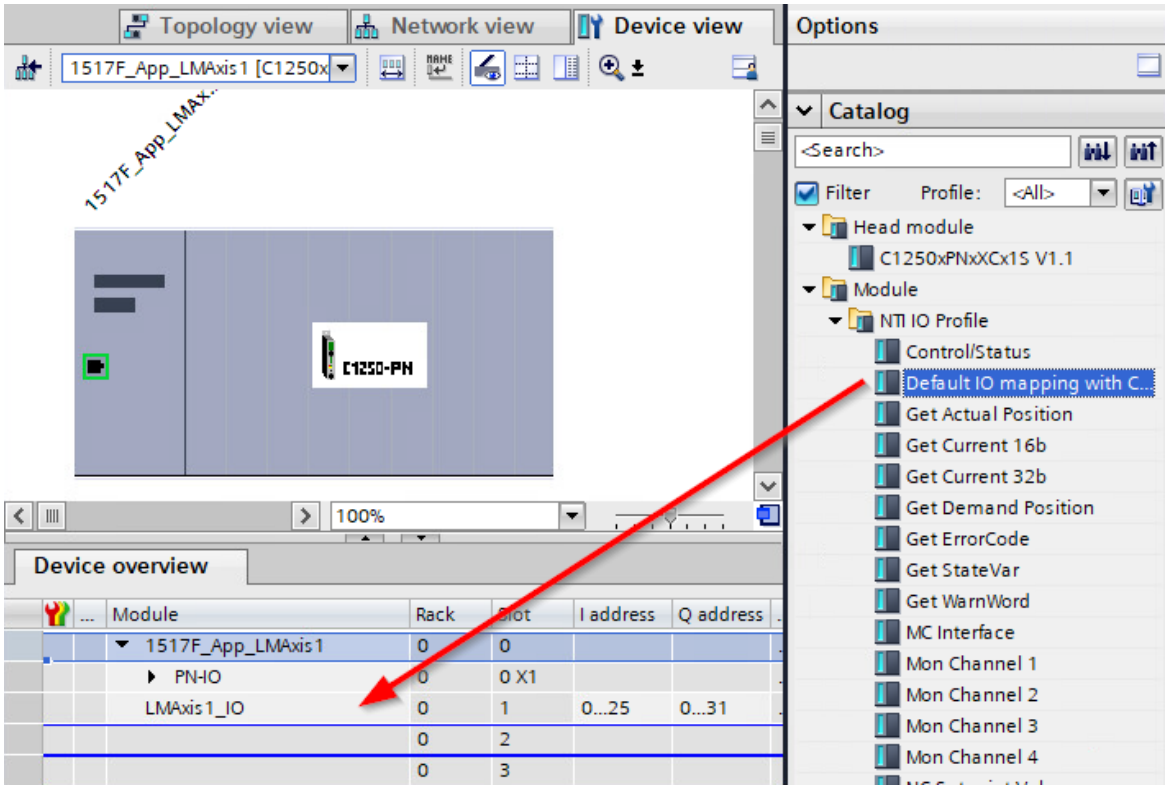


Afterwards in the Device View the module „Default IO mapping with Config“ is moved in the available slot as shown the figures below:

- **C125x-MI drive** (e.g., C1250xMIPD 1S V3.0): When adding a insert the **DO SERVO Module** first and then add the **Submodule LinMot telegram 516:**



- **LinMot -PN drive:** By default, when adding a new, this module is already present in slot 1.

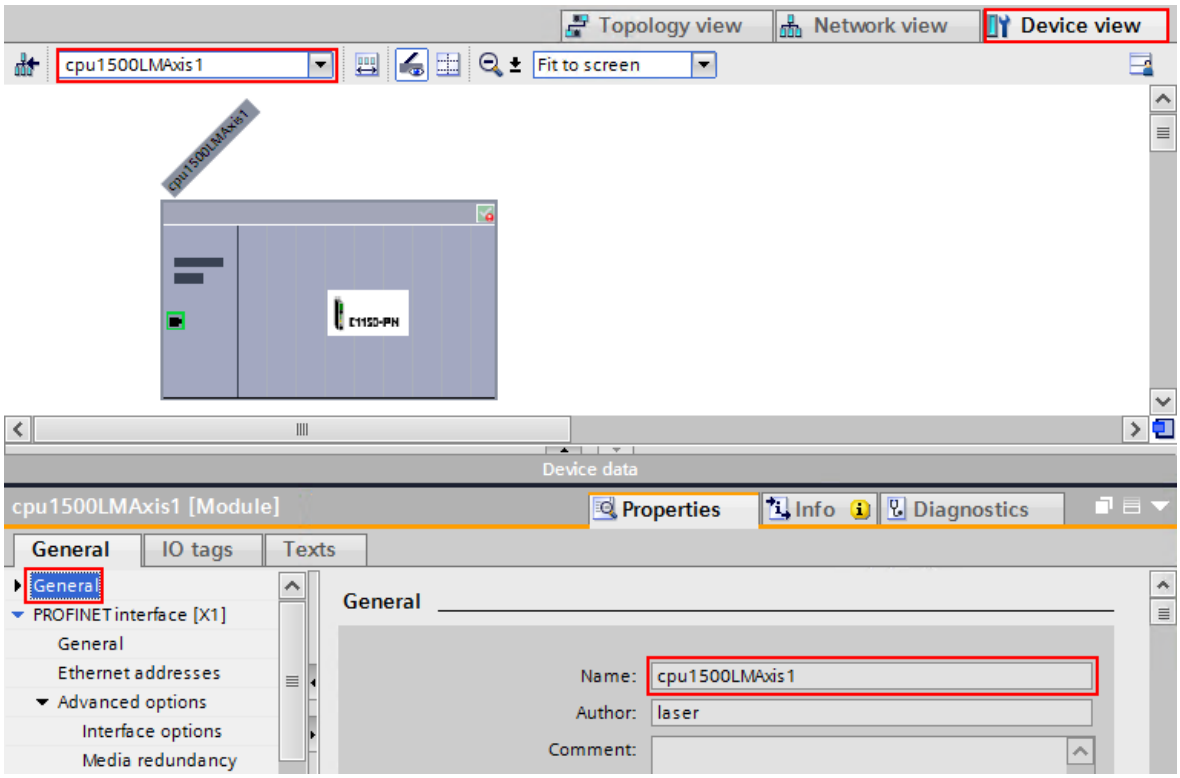


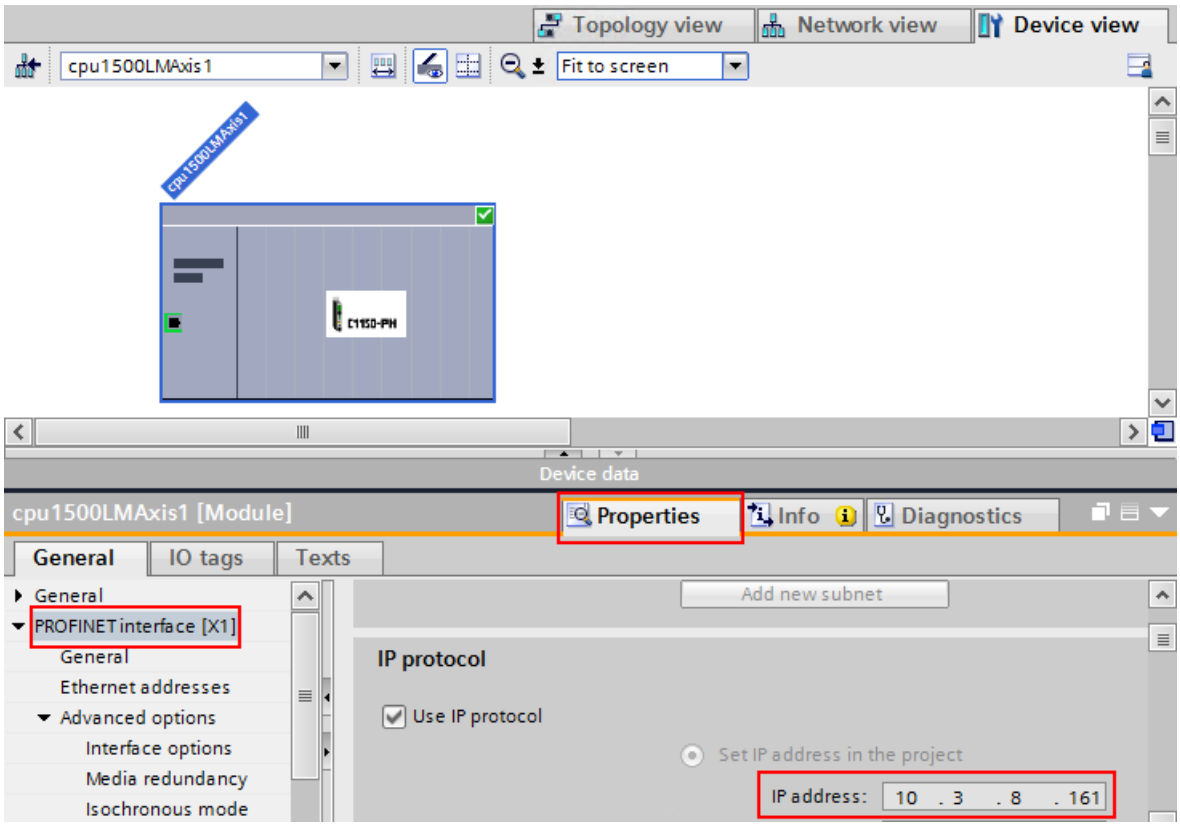
Tip:
It is possible to add up to 4 parameter and 4 monitoring channels to write or read specific parameters or variables in the process data.
Please check chapter ***12.6 Add Additional Parameters / Variables to the Real-Time Channel*** for details.

4.4.1 Assigning the Device Name and IP Address

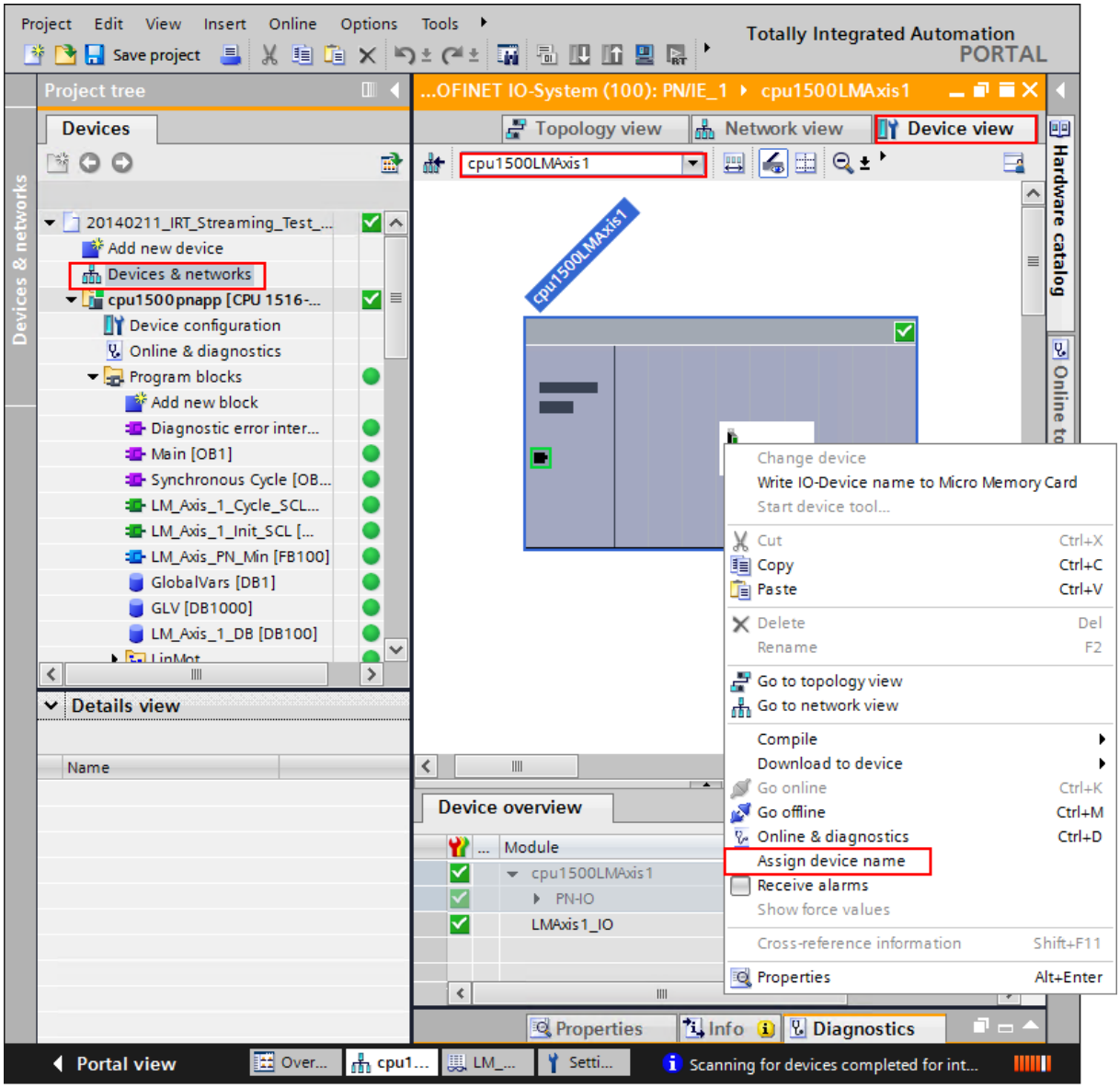
The following three steps show how to assign the PROFINET device name to the LinMot drive using TIA Portal. The IP address is assigned automatically when PROFINET starts.

1. Set the IP address and the device name in the device properties:

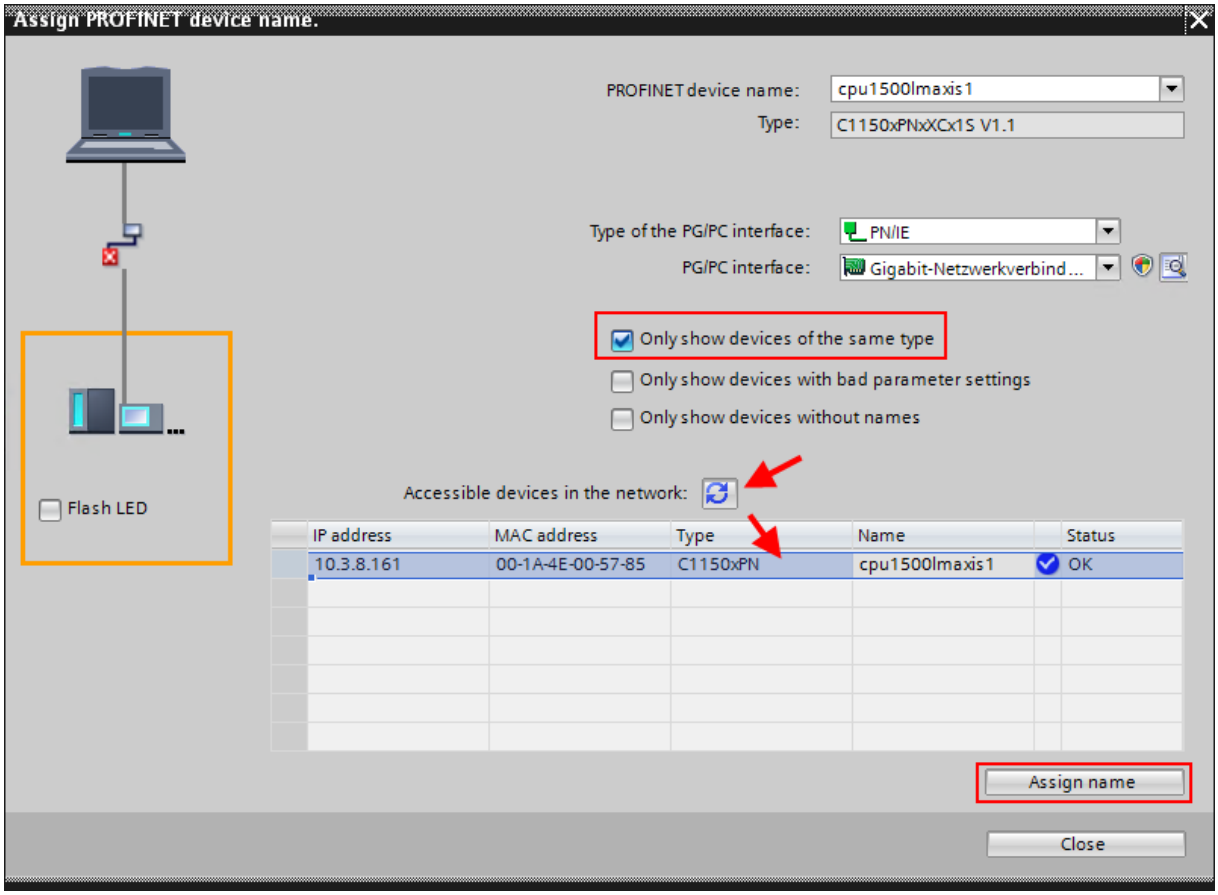




2. Choose the device you want to assign the name to (right-click on the device):



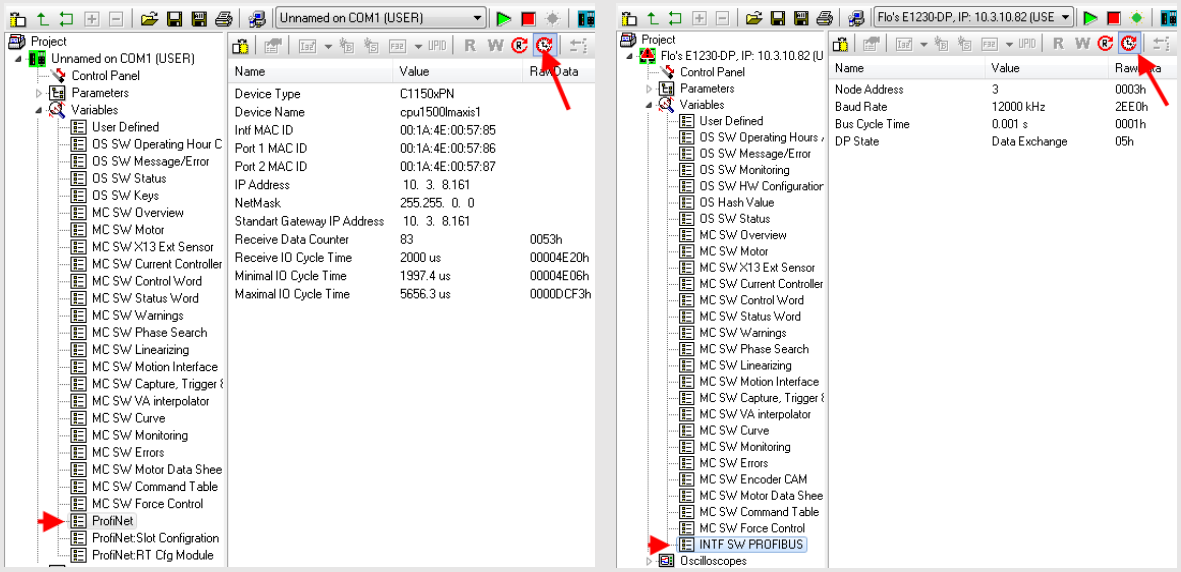
3. Search for the LinMot drive you want to name. The safest way to identify the drive is by either activating the “Flash LED” function in TIA Portal or to verify the MAC address (can be found on the housing of the drive).



4.5 Check with LinMot-Talk if the Fieldbus is running

LinMot-Talk shows the status of the fieldbus. Open the variables PROFIBUS / PROFINET and check if the Node Address / IP Address is correct.

Check fieldbus status:



If the “Receive Data Counter” is counting and there is a valid “Receive IO Cycle Time” is shown the bus is properly running.

4.6 Next Steps

Now you can start implementing your application using the function blocks and documentation from the download link in chapter **4.1 Overview.**

5 LinMot Profile: Rockwell Automation Studio 5000 (Add-On Instructions)

5.1 Overview

LinMot highly recommends -MI drives instead of -IP drives for new applications

This chapter shows how a LinMot drive with *EtherNet/IP* interface (e.g., C1250-IP-XC-0S, or C1250-MI-XC-1S) can be integrated and setup in a Rockwell Automation environment to be used with the library provided by LinMot.

Download:
A ZIP package including EDS files, Add-On Instructions, and demo projects for Rockwell Automation controllers can be downloaded from:
http://download.linmot.com/plc_lib/examples/Rockwell_CM/ (named *LinMot_Rockwell_LM_AOI_Set_2Vx...*)

Note:
More information can be found in the library documentation (part of the above-mentioned download) and in the user manual EtherNet/IP (see chapter 1.7 Documentation / User Manuals)

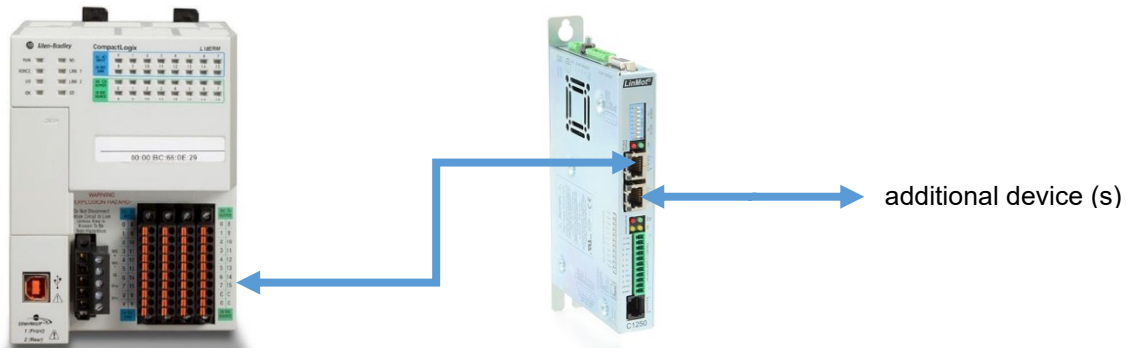


Image Source: http://www.rockwellautomation.com/

EtherNet/IP is an industrial Ethernet network that implements the Common Industrial Protocol (CIP).

For further information on EtherNet/IP please visit:
http://www.odva.org

YouTube video series (LinMot Integration – Rockwell Automation EtherNet/IP):
https://youtube.com/playlist?list=PLMSLCScLnf94pElSNCorvUf2-RpGJ8L6R

5.2 Minimum Requirements

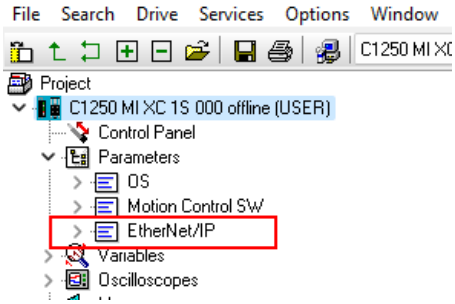
Important:
- For EDS support Rockwell Automation controller firmware revision 20.0 or higher is required.
- The AOP (Add-On Profiles) for C1250-IP-XC-xS and E1250-IP-UC drives are included in Studio 5000 Logix Designer from V31.
- Rockwell Automation changed the EDS subsystem with Studio 5000 v36 which requires new EDS files to be installed. See chapter 5.4.1.
- For additional information regarding integration of LinMot drives in Studio 5000 versions before v31 or using a Generic Ethernet Module, refer to the documentation included with the example library.

5.3 Configuration and Connection of the LinMot Drive

The LinMot drive is configured using the LinMot-Talk software:
http://www.linmot.com/download/linmot-talk-drive-configuration/

5.3.1 Ensure that the EtherNet/IP Interface is installed

Make sure that the correct interface (Ethernet/IP) is installed on the drive. This is especially the case when using MI (multi-interface) drives.
If the EtherNet/IP parameter tree is not visible, please reinstall the firmware and select the EtherNet/IP interface.



5.3.2 Motor Configuration

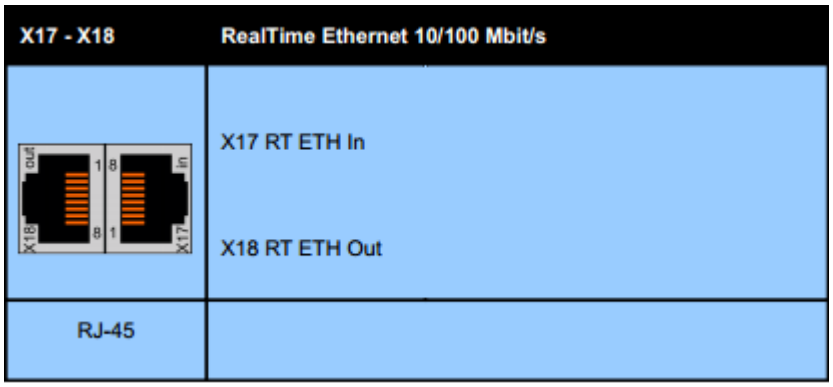
It is assumed that the motor connected to the drive is already configured.

Use the *Motor Wizard* inside LinMot-Talk to setup the motor (Menu -> Drive -> Motor Wizard):

See Appendix I: Basic Position Control Loop Tuning

5.3.3 EtherNet/IP Connection

The drive is connected to the EtherNet/IP network using the X17 & X18 connectors.



5.3.4 IP Address

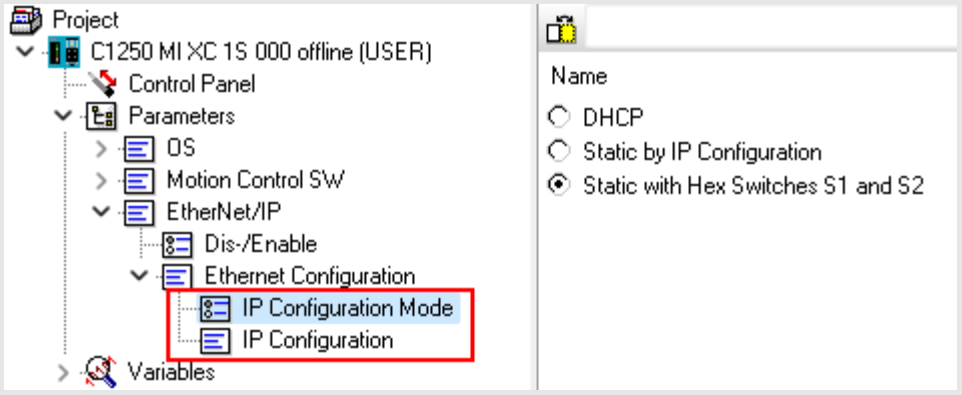
The default IP address is 192.168.001.xxx, where the last byte xxx is defined via the two address selectors *S1 & S2*. *S1* sets the high and *S2* the low digit. E.g., S1 = 5, S2 = A -> 5A (hex) = 90 (dec) -> IP = 192.168.1.**90**

Set IP address (last byte, xxx from above) by S1 & S2

S1 - S2	Address Selectors		
E1100 E1200 V1	E1200 V2 E1400 C1x00		
		S1 (5 .. 8)	Bus ID High (0 ... F). Bit 5 is LSB, bit 8 MSB.
		S2 (1 .. 4)	Bus ID High (0 ... F). Bit 1 is LSB, bit 4 MSB.

Attention:
The switch value **S1 = S2 = 0 (factory default setting)** is a special configuration which acquires the IP address via DHCP (e.g., for use with the BOOTP-DHCP Tool from Rockwell Automation)!

Note:
To set the IP address by parameter (assign a static IP address) login to the drive using LinMot-Talk.
Parameters > EtherNet/IP > Ethernet Configuration



5.4 PLC Setup EtherNet/IP

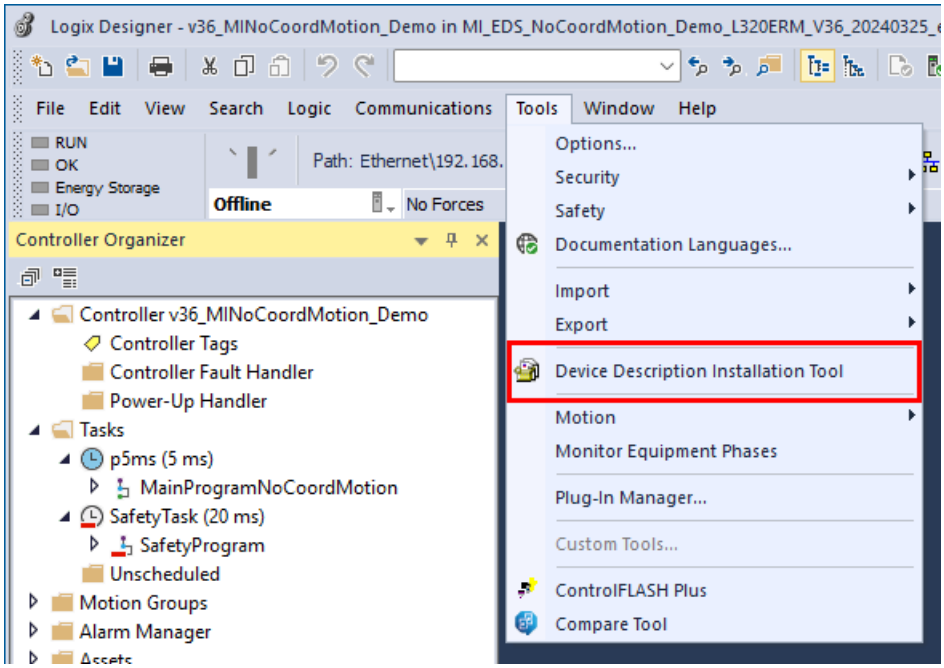
5.4.1 EDS Files (Requires Studio 5000 V20 or higher)

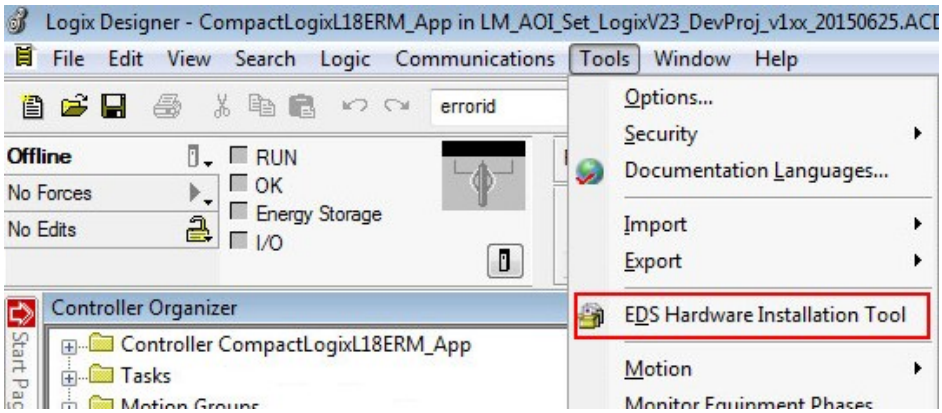
Install the EDS file that is part of the LinMot-Talk software/firmware you are using.
The most recent device files are always part of the newest LinMot-Talk software. They are located by default:

- EtherNet/IP (CM & MI): \\LinMot-Talk X.X Build XXXXXXXX\Firmware\Interfaces\EtherNetIP_NX\EDS
- EtherNet/IP (IP): \\LinMot-Talk X.X Build XXXXXXXX\Firmware\Interfaces\EtherNetIP\EDS

Add-On Profiles (AOP) for C1250-IP-XC-xS and E1250-IP-UC drives are included in Studio 5000 from V31. So no EDS file is required.

From the Tools menu in Logix Designer, choose Device Description Installation Tool or EDS Hardware Installation Tool, depending on your Logix Designer version.



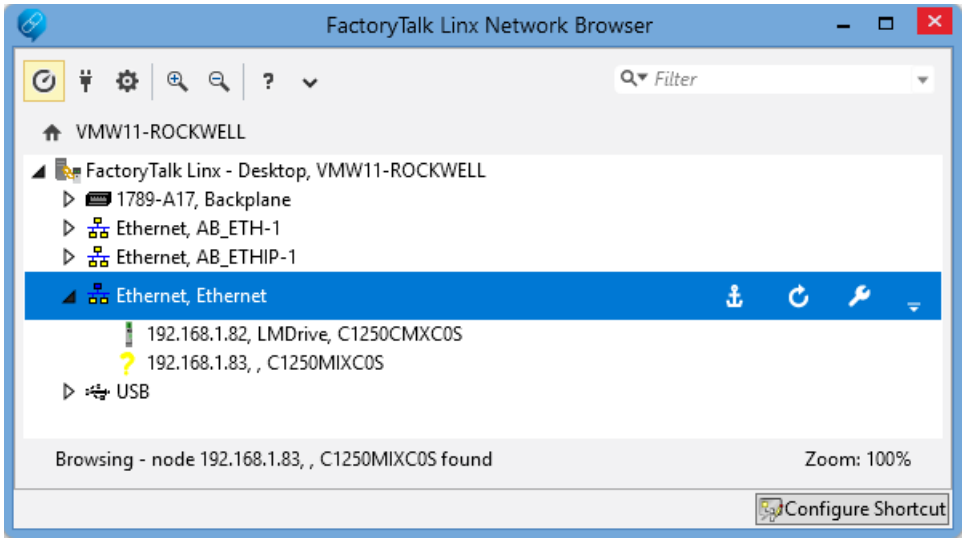


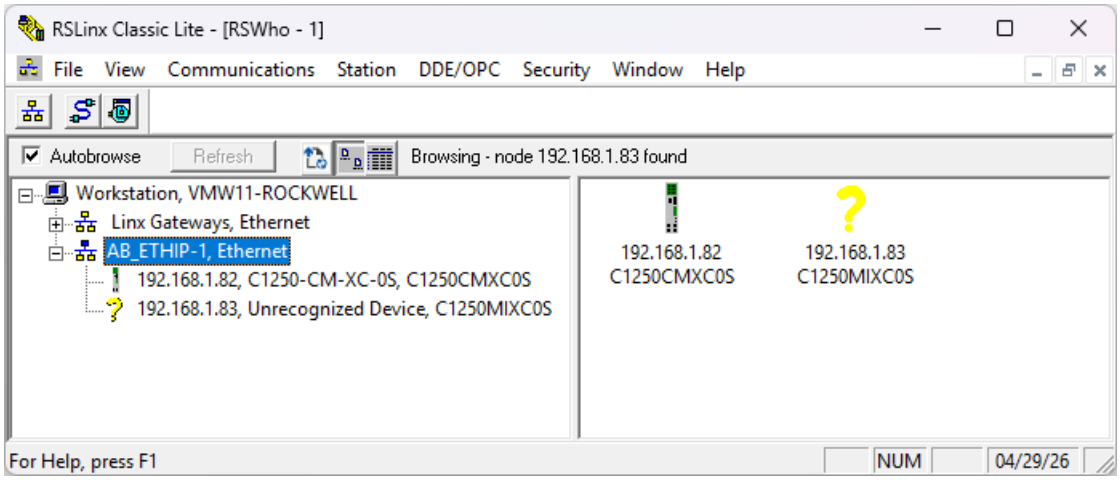
Attention:
With Studio 5000 V36 Rockwell Automation has changed the EDS subsystem which caused some EDS to stop working correctly. ***If Studio 5000 V36 or later is installed on your computer, please install the according EDS file version ending with …_1V2.eds. Also install Studio 5000 V36.01, V37.00 or later.*** See Rockwell Knowledgebase article BF30248 “Studio 5000 Logix Designer updating EDS AOP module” for more information.

5.4.2 FactoryTalk Linx / RSLinx Classic

After setting the IP address the new LinMot device should appear in FactoryTalk Linx / RSLinx Classic as “Unrecognized Device” (see IP 192.168.1.83 below).

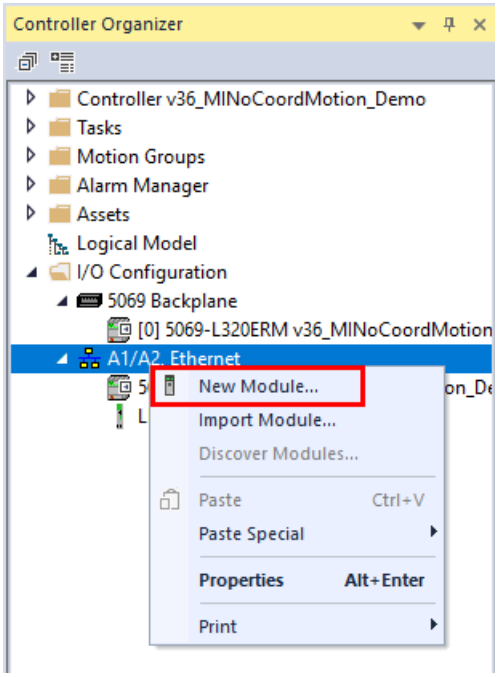
If the EDS file is installed, the LinMot drive will appear in FTLinx / RSLinx with its Device Type (see IP 192.168.1.82 below).



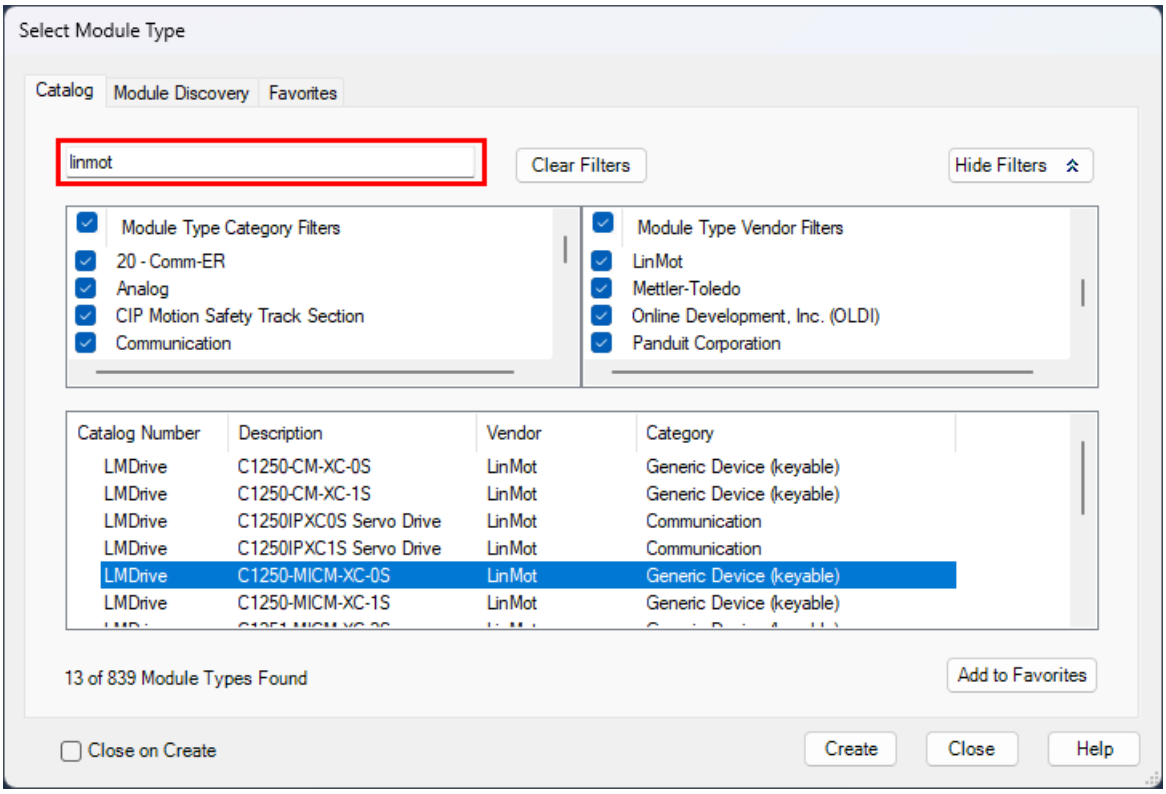


5.4.3 Add a LinMot drive using EDS or AOP

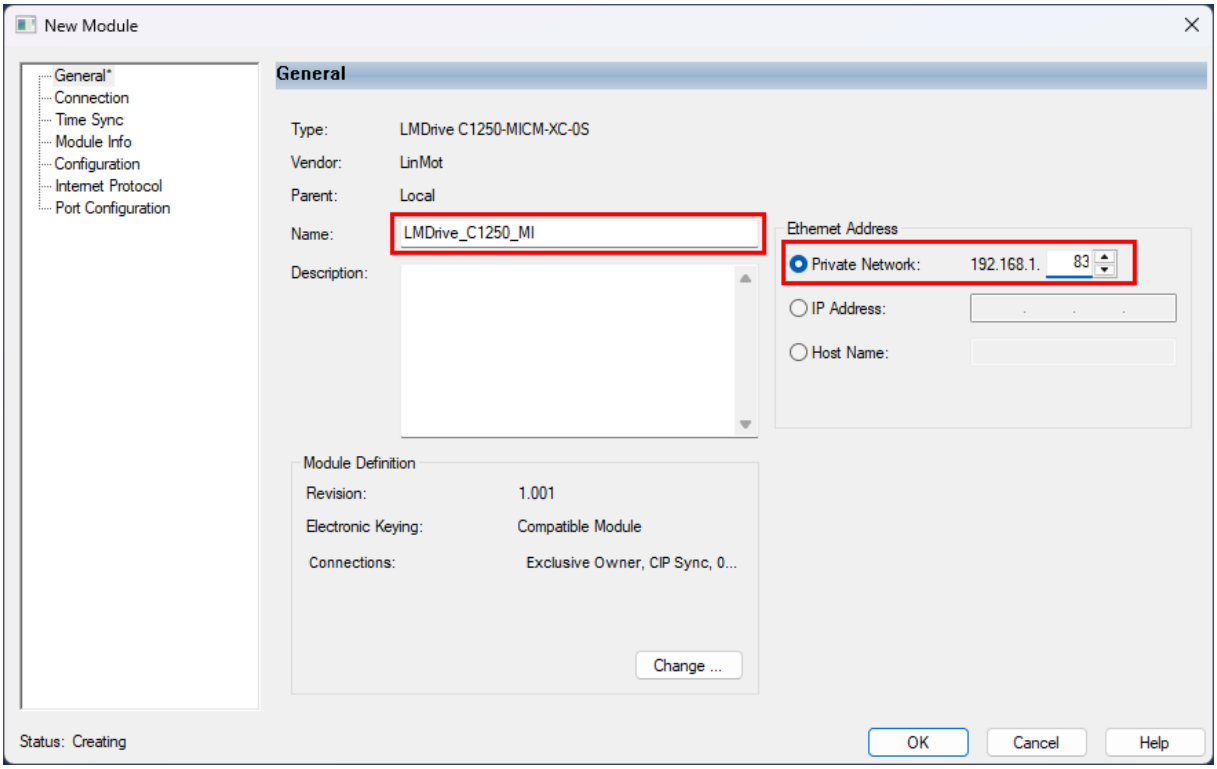
1. Add a new module by right-clicking on Ethernet in the I/O configuration:



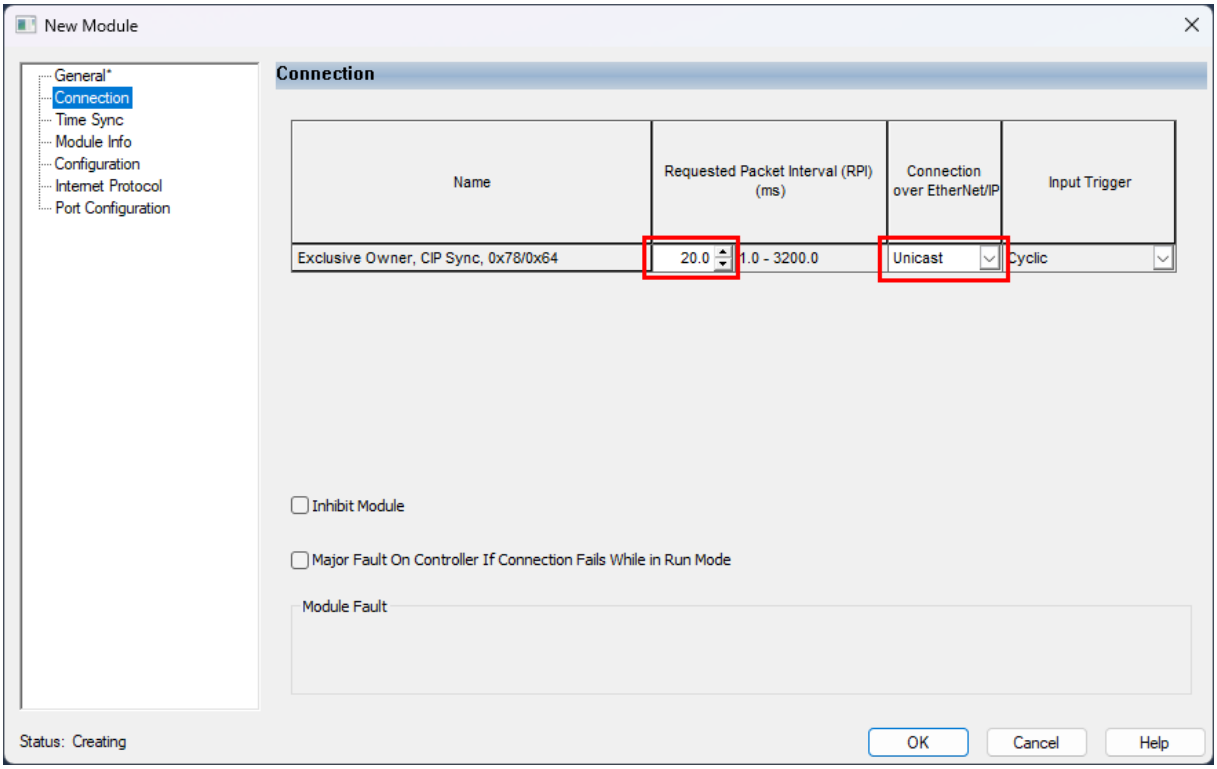
2. Select module type (catalog number *LMDrive* or vendor *LinMot* or *NTI*):



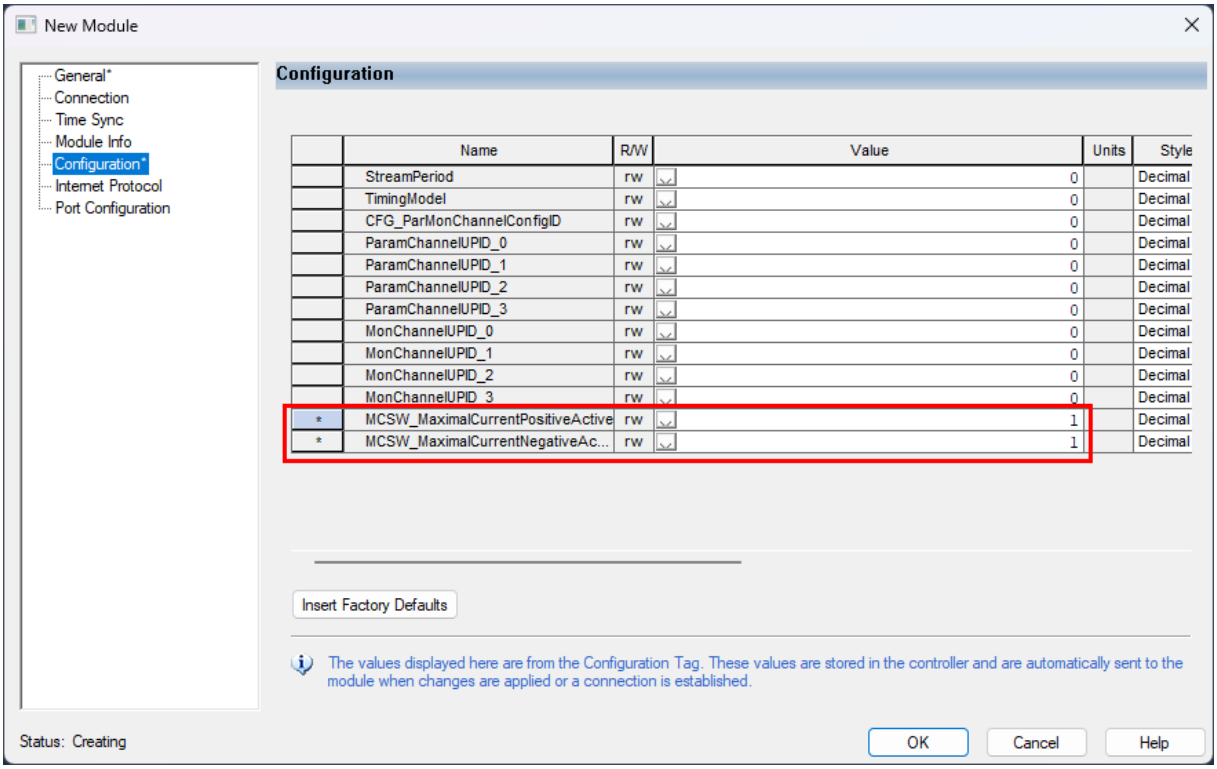
3. Set name and IP address:



4. In the Connection tab set the RPI that fits your application and check that Unicast Connection is used:



5. In the Configuration tab, set MCSW_MaximalCurrentPositive (& Negative) Active to 1.

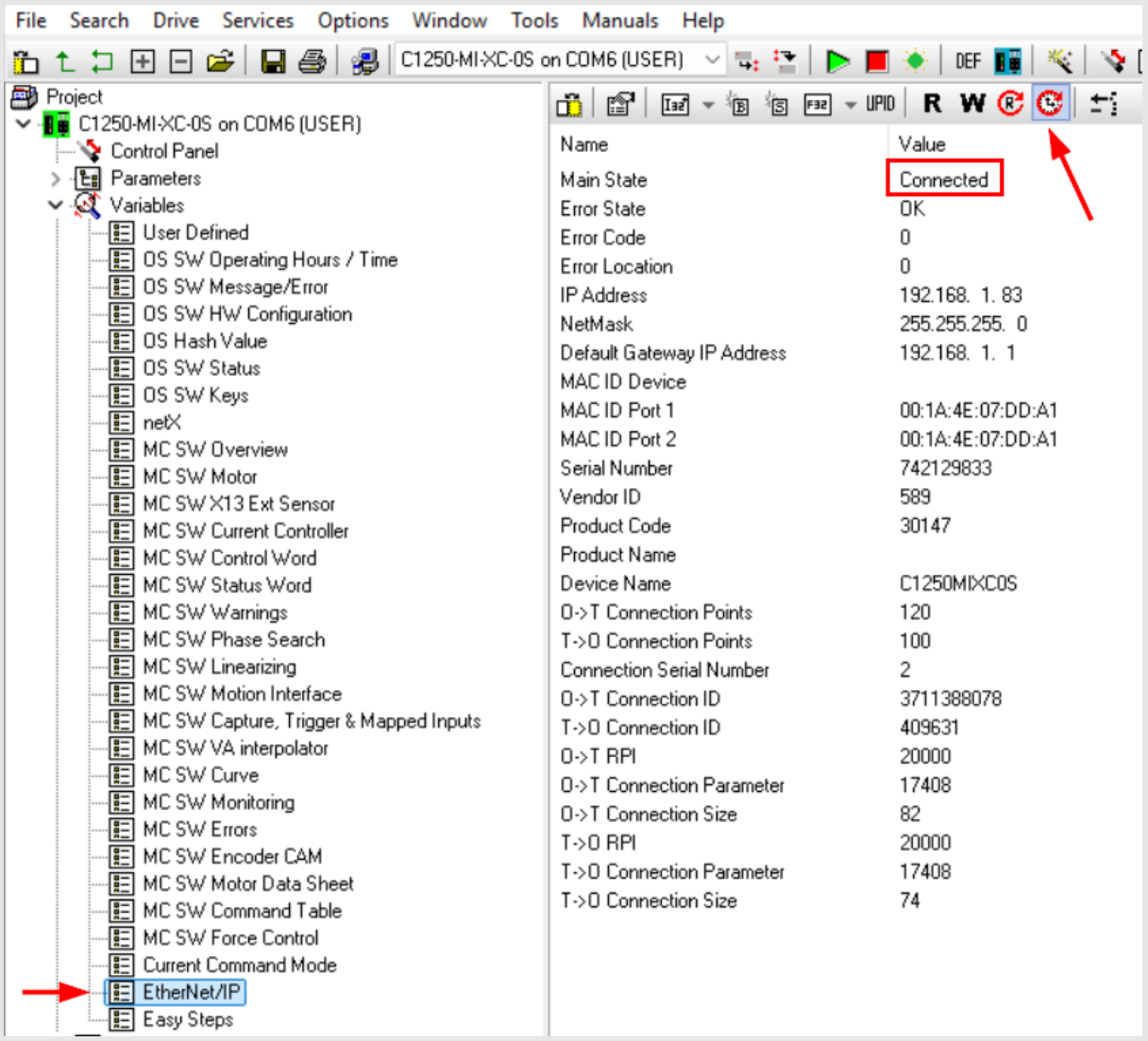


Now you can download your project to the controller and check if the connection is running, as described in chapter 5.5.

5.5 Check with LinMot-Talk if the Fieldbus is running

LinMot-Talk shows the status of the fieldbus. Open the variables *EtherNet/IP* for actual IP address, net mask or to check the connection. If logged in as service ID instead of user ID, then additional variable groups for PTP time synchronization and CIP Sync can also be accessed.

Check fieldbus status:



5.6 Next Steps

Now you can start implementing your application using the function blocks and documentation from the download link in chapter 5.1 Overview.

6 LinMot Profile: B&R Automation Studio

6.1 Overview

LinMot drives with *Powerlink* interface (e.g., C1250-MI-XC-1S) can be integrated in a B&R environment as point-to-point axis using the LinMot function block library.

Download:
Demo projects can be downloaded from:
http://download.linmot.com/plc_lib/libraries/BR/ (named *BR_AS4x_LinMot_Powerlink_noUpgrades*...)

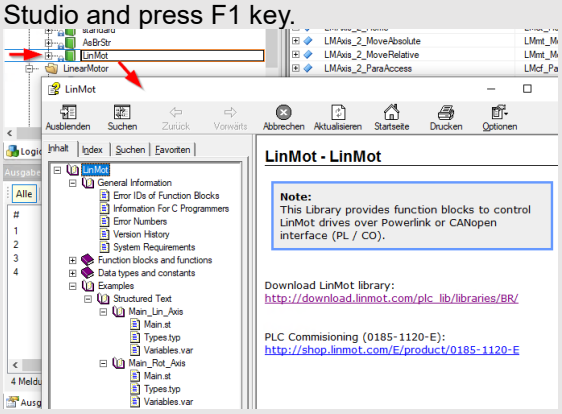
The library itself can be download from:
http://download.linmot.com/plc_lib/libraries/BR/ (named *LM_BR_Library_inclSources_*...)

> Choose the library …inclSources… to compile it on your system for your specific AS and AR versions.

For a detailed description of the library function blocks please check the Beckhoff library documentation which is part of the download in **chapter 3.1 (page 26).**

Both the Beckhoff and B&R library contain the same function blocks and are therefore identical in documentation.

The library itself contains a HTML Help that can be opened by selecting the library in Automation Studio and press F1 key.



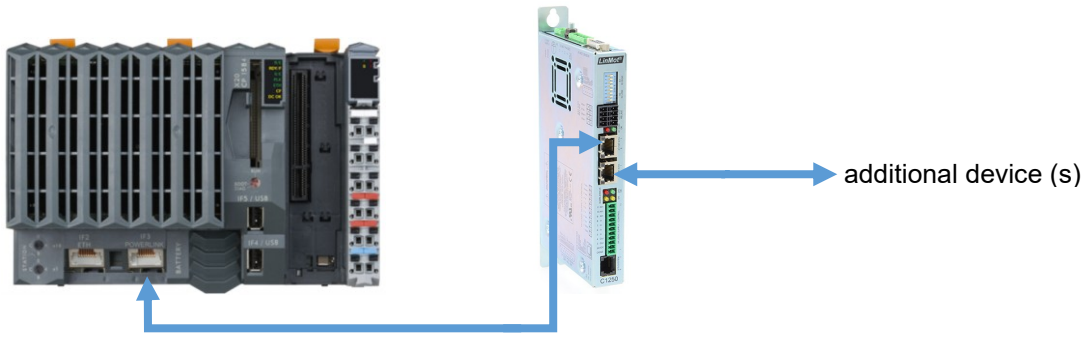


Image Source: http://www.br-automation.com/

For further information on Ethernet POWERLINK please visit: http://www.ethernet-powerlink.org

6.2 Configuration and Connection of the LinMot Drive

The LinMot drive is configured using the LinMot-Talk software:
http://www.linmot.com/download/linmot-talk-drive-configuration/

6.2.1 Motor configuration

It is assumed that the motor connected to the drive is already configured.

Use the *Motor Wizard* inside LinMot-Talk to setup the motor (Menu -> Drive -> Motor Wizard):

See Appendix I: Basic Position Control Loop Tuning

6.2.2 XDD File

Install the XDD file that is part of the LinMot-Talk software/firmware you are using.
The most recent device files are always part of the newest LinMot-Talk software.
It is located by default:

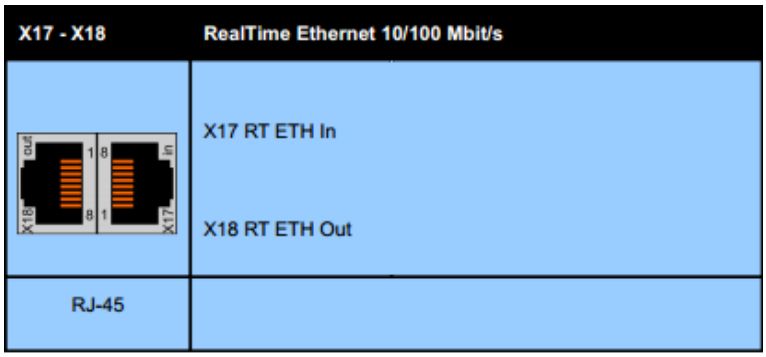
- Powerlink: \\LinMot-Talk X.X Build XXXXXXXX\Firmware\Interfaces\Powerlink_Nx\XDD **(-MI drives)**
- Powerlink: \\LinMot-Talk X.X Build XXXXXXXX\Firmware\Interfaces\Powerlink\XDD

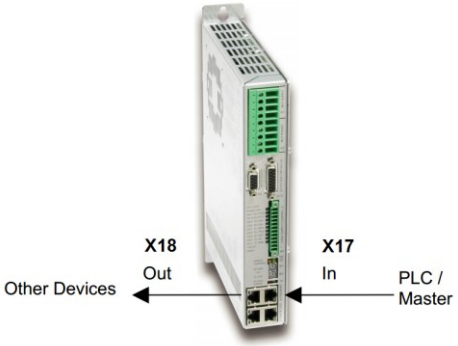
There are separate XDD files available for either AS3 or AS4.

6.2.3 Powerlink Connection

The drive is connected to the Powerlink network using the **X17 (IN) & X18 (OUT)** connectors.

The below pictures show the ports of an E1250-PL-UC drive.
On all other LinMot drives supporting Powerlink the ports are named the same (X17 & X18), but they may be placed differently on the drive housing.





6.2.4 Node ID

The Node ID of the LinMot drive is set using the hardware address selectors.

S1 - S2	Address Selectors		
E1100 E1200 V1	E1200 V2 E1400 C1x00		
		S1 (5 .. 8)	Bus ID High (0 ... F). Bit 5 is LSB, bit 8 MSB.
		S2 (1 .. 4)	Bus ID High (0 ... F). Bit 1 is LSB, bit 4 MSB.

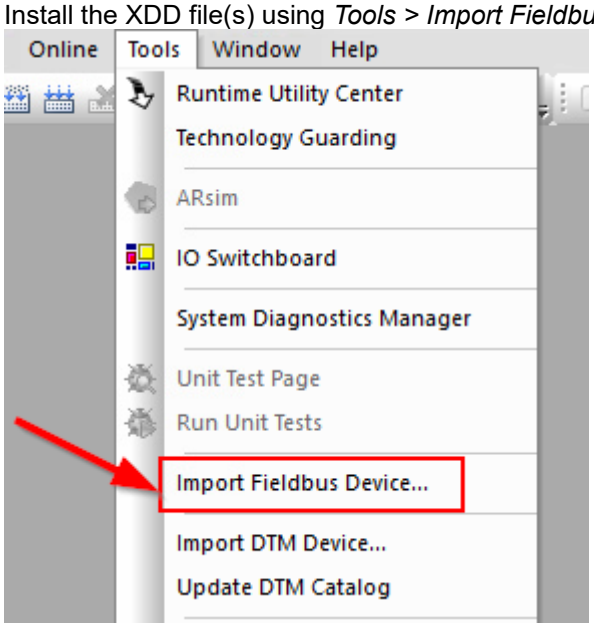
E.g.: Node ID 18 dec = 12 hex = 0001 0010 bin

=> S1 = 1 hex = 0001 bin (Dip Switch 5 = ON), S2 = 2 hex = 0010 bin (Dip Switch 2 = ON)

6.3 Hardware Configuration

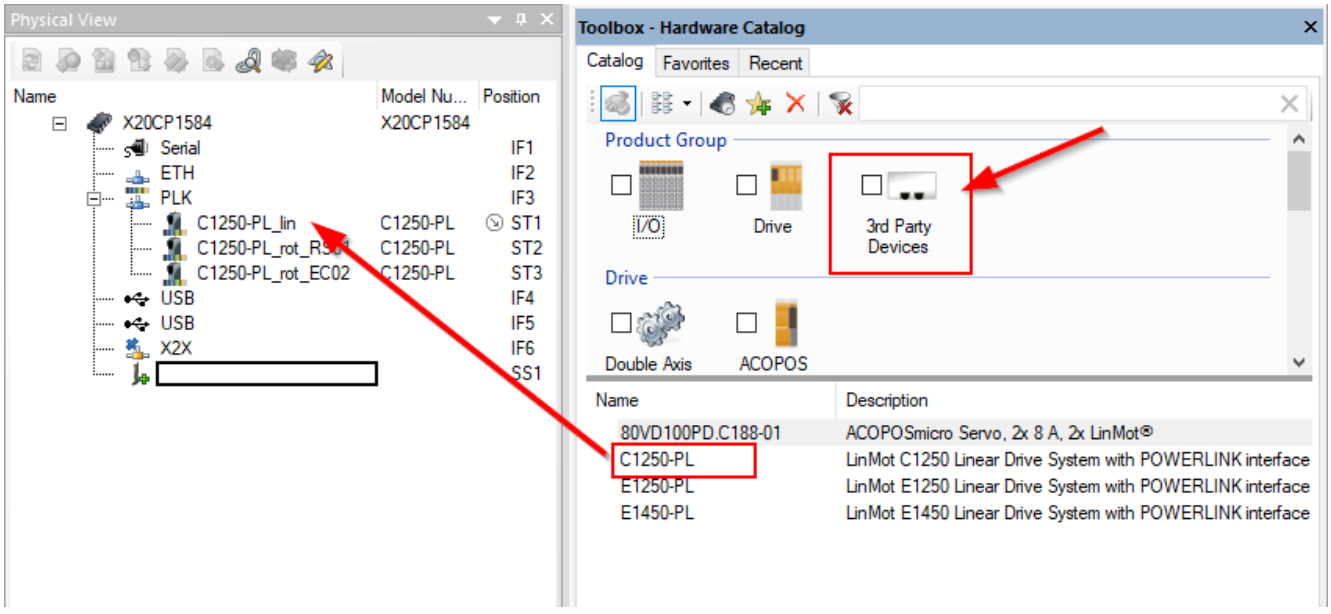
6.3.1 Add the LinMot drive to the Powerlink network

Install the XDD file(s) using *Tools* > *Import Fieldbus Device…* in Automation Studio.



The required XDD-file can be found in the following folder (default):
C:\Program Files\LinMot\LinMot-Talk X.X Build XXXXXXXX\Firmware\Interfaces\POWERLINK\XDD

In the Hardware Catalog search for the LinMot drive (e.g., C1250...) and drag&drop it onto the Powerlink interface (PLK).
Alternatively select the Product Group *3rd Party Devices* > all installed LinMot drives are shown.

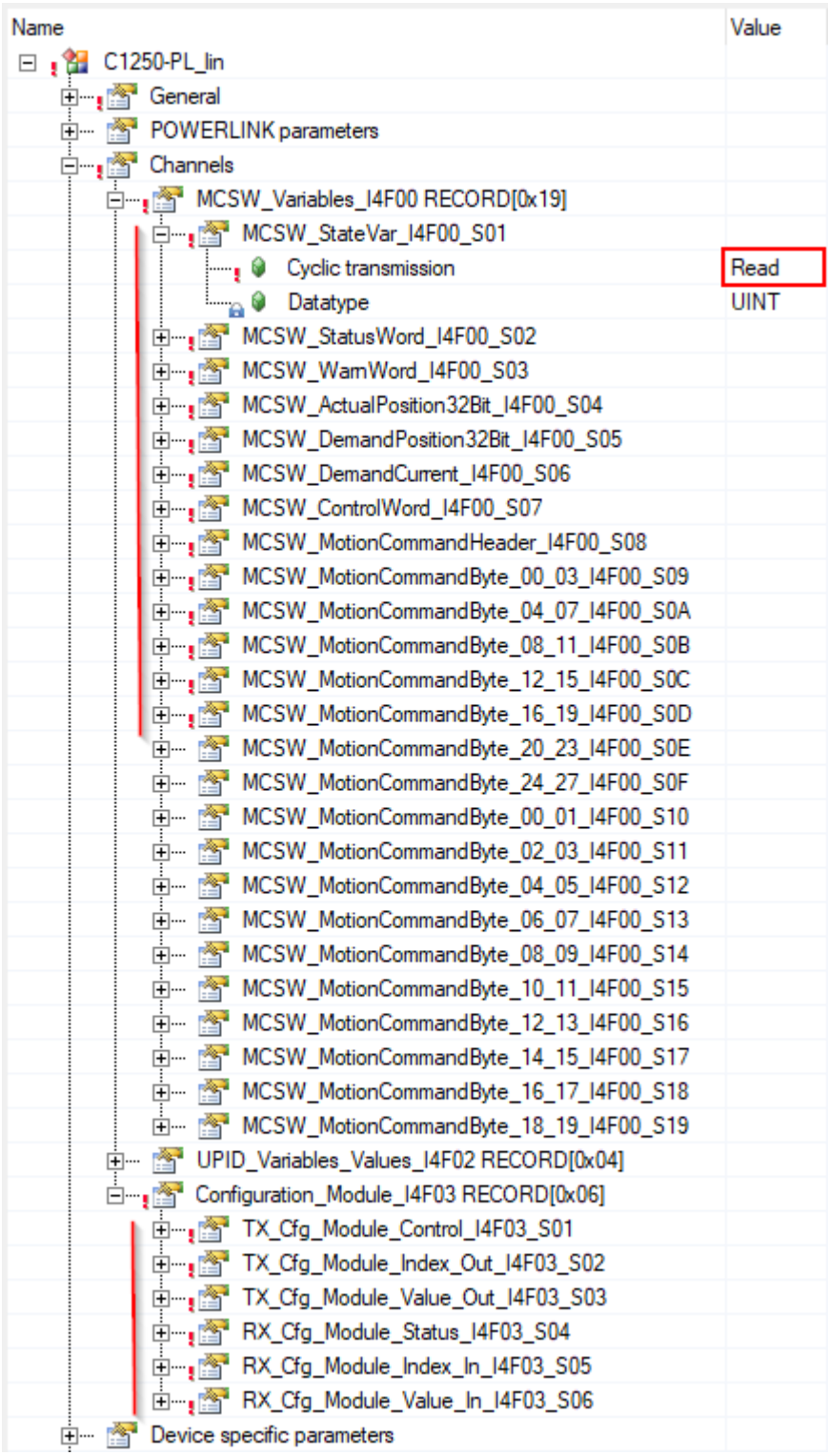


Set the Node ID according to your requirements.

6.3.2 Configuration

In the configuration of the LinMot slave module (right-click on device > *Configuration*) the following channels must be selected:

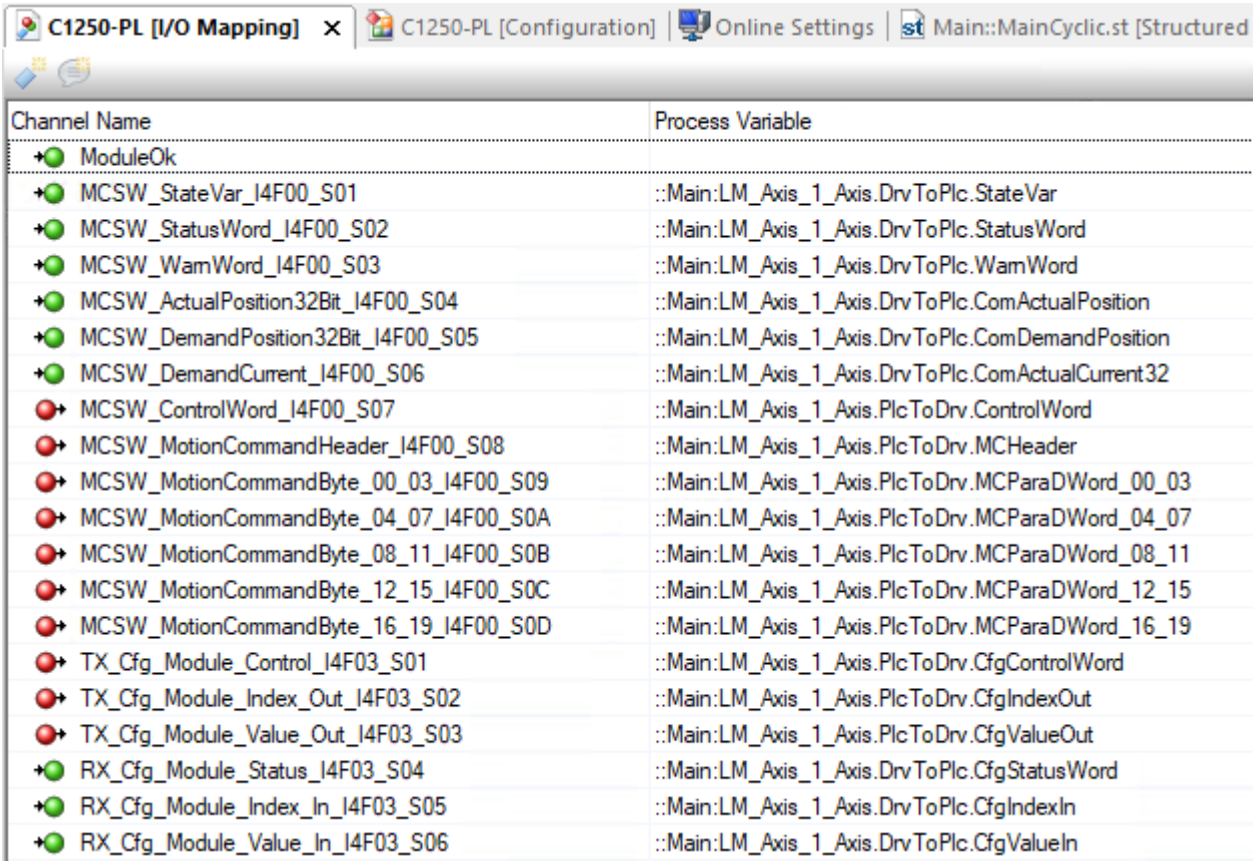
Set the **Cyclic transmission** of all channels marked with a red exclamation mark to **Read** or to **Write** respectively.



6.3.3 I/O Mapping

The inputs and outputs (right-click open I/O mapping) of the modules are mapped to the axis structure (datatype stsLM_Axis).

In the following example a variable *LM_Axis_1_Axis* of datatype *tstLM_Axis* is defined in the *Main* program.



Channel Name	Process Variable
ModuleOk	
MCSW_StateVar_I4F00_S01	::Main:LM_Axis_1_Axis.DrvToPlc.StateVar
MCSW_StatusWord_I4F00_S02	::Main:LM_Axis_1_Axis.DrvToPlc.StatusWord
MCSW_WarnWord_I4F00_S03	::Main:LM_Axis_1_Axis.DrvToPlc.WarnWord
MCSW_ActualPosition32Bit_I4F00_S04	::Main:LM_Axis_1_Axis.DrvToPlc.ComActualPosition
MCSW_DemandPosition32Bit_I4F00_S05	::Main:LM_Axis_1_Axis.DrvToPlc.ComDemandPosition
MCSW_DemandCurrent_I4F00_S06	::Main:LM_Axis_1_Axis.DrvToPlc.ComActualCurrent32
MCSW_ControlWord_I4F00_S07	::Main:LM_Axis_1_Axis.PlcToDrv.ControlWord
MCSW_MotionCommandHeader_I4F00_S08	::Main:LM_Axis_1_Axis.PlcToDrv.MCHeader
MCSW_MotionCommandByte_00_03_I4F00_S09	::Main:LM_Axis_1_Axis.PlcToDrv.MCParaDWord_00_03
MCSW_MotionCommandByte_04_07_I4F00_S0A	::Main:LM_Axis_1_Axis.PlcToDrv.MCParaDWord_04_07
MCSW_MotionCommandByte_08_11_I4F00_S0B	::Main:LM_Axis_1_Axis.PlcToDrv.MCParaDWord_08_11
MCSW_MotionCommandByte_12_15_I4F00_S0C	::Main:LM_Axis_1_Axis.PlcToDrv.MCParaDWord_12_15
MCSW_MotionCommandByte_16_19_I4F00_S0D	::Main:LM_Axis_1_Axis.PlcToDrv.MCParaDWord_16_19
TX_Cfg_Module_Control_I4F03_S01	::Main:LM_Axis_1_Axis.PlcToDrv.CfgControlWord
TX_Cfg_Module_Index_Out_I4F03_S02	::Main:LM_Axis_1_Axis.PlcToDrv.CfgIndexOut
TX_Cfg_Module_Value_Out_I4F03_S03	::Main:LM_Axis_1_Axis.PlcToDrv.CfgValueOut
RX_Cfg_Module_Status_I4F03_S04	::Main:LM_Axis_1_Axis.DrvToPlc.CfgStatusWord
RX_Cfg_Module_Index_In_I4F03_S05	::Main:LM_Axis_1_Axis.DrvToPlc.CfgIndexIn
RX_Cfg_Module_Value_In_I4F03_S06	::Main:LM_Axis_1_Axis.DrvToPlc.CfgValueIn

6.4 Parameter Access

For detailed information about accessing drive parameters please check chapter **18.12 Parameter Access (page 260)**.

6.5 Add Additional Parameters or Variables to the Process Data

To add additional parameters or variables for read and write access to the process data please see chapter **18.13 Add Additional Parameters or Variables to the Process Data (page 263)**.

6.6 Next Steps

Now you can start implementing your application using the function blocks and documentation from the download link(s) in chapter **6.1 Overview (page 54)**.

7 LinMot Profile: CODESYS

7.1 Overview

A LinMot drive with *EtherCAT (-EC, -MI)* interface (e.g., C1250-MI-XC-1S) can be integrated and setup in a CODESYS environment as I/O device using the LinMot function block library

Download:
A package including the library and example projects is available from:
http://download.linmot.com/plc_lib/libraries/CODESYS/3x/ (named *CoDeSys_3.x_LinMot_Library_...*)

For a detailed description of the library function blocks please check the Beckhoff library documentation which can be downloaded in **chapter 3.1 (page 26)**

Both the Beckhoff and CODESYS library contain the same function blocks and are therefore identical in documentation.

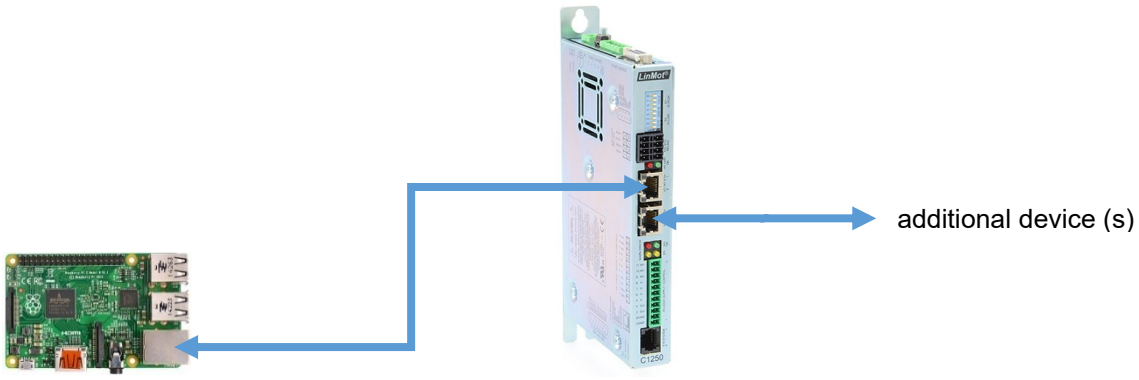


Image Source: http://www.raspberrypi.org/

EtherCAT is the real-time Ethernet network originally developed by Beckhoff. The LinMot acts as Slave in this network and is implemented with the standard ASIC ET1100 from Beckhoff.

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

8 LinMot Profile: Mitsubishi GX Works

8.1 Overview

This chapter shows how a LinMot drive with CC-Link IE Field Basic Interface (LinMot Profile) can be connected to a Mitsubishi PLC using GX Works3.

Download:
The libraries for GX Works3 including documentation can be downloaded from:
http://download.linmot.com/plc_lib/libraries/Mitsubishi/

Note:
More information can be found in the library documentation (part of the above-mentioned download) and in the user manual CC-Link IE Field Basic Interface (see chapter Documentation / User Manuals).

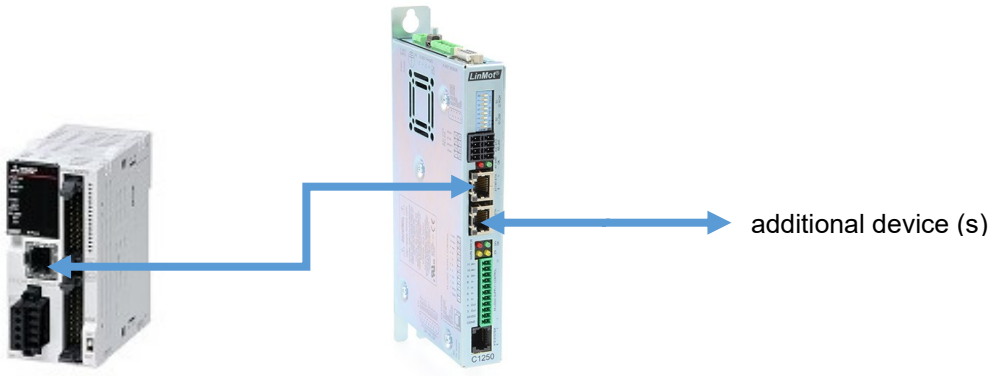


Image Source: https://www.mitsubishielectric.com

CC-Link IE Field Basic is an Industrial Ethernet Standard. The LinMot CC-Link IE Field Basic drives act as CC-Link IE Field Basic slaves in this network.

For further information on CC-Link IE Field Basic please visit:
https://www.cc-link.org/en/index.html

8.2 Configuration and Connection of the LinMot Drive

The LinMot drive is configured using the LinMot-Talk software:
http://www.linmot.com/download/linmot-talk-drive-configuration/

8.2.1 Motor configuration

It is assumed that the motor connected to the drive is already configured.

Use the *Motor Wizard* inside LinMot-Talk to setup the motor (Menu -> Drive -> Motor Wizard):

See Appendix I: Basic Position Control Loop Tuning

8.2.2 CSP+ files

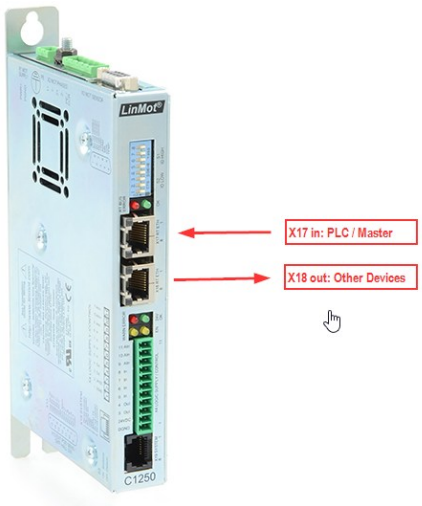
Install the CSP+ file(s) that is part of the LinMot-Talk software/firmware you are using.
The most recent device files are always part of the newest LinMot-Talk software. They are located by default:

- \\LinMot-Talk X.X Build XXXXXXXX\Firmware\Interfaces\CCLinkIEFB\CSPP

8.2.3 CC Link Connection

The drive is connected to the CC Link network using the X17 (IN) & X18 (OUT) connectors.
The below pictures show the ports of an C1250-CC drive.

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”.		

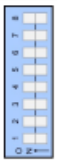


8.2.4 IP Address

The default IP address is 192.168.3.**xxx**, where the last byte xxx is defined via the two address selectors *S1 & S2*. *S1* sets the high and *S2* the low digit. E.g., S1 = 5, S2 = A -> 5A (hex) = 90 (dec) -> IP = 192.168.3.**90**

For further information about the IP address settings please check the interface manual > 0185-1171

Set IP address (last byte, **xxx** from above) by S1 & S2

	NodeID Selectors	
C12x0		
	S1 (5..8)	Station-ID High Nibble (0 ... F). Bit 5 is the LSB, bit 8 the MSB.
	S2 (1..4)	Station-ID Low Nibble (0 ... F). Bit 1 is the LSB, bit 4 the MSB. **Setting the Station-ID high & low to 0xFF initiates resetting the drive to manufacturer settings!**

8.3 PLC Setup CC Link

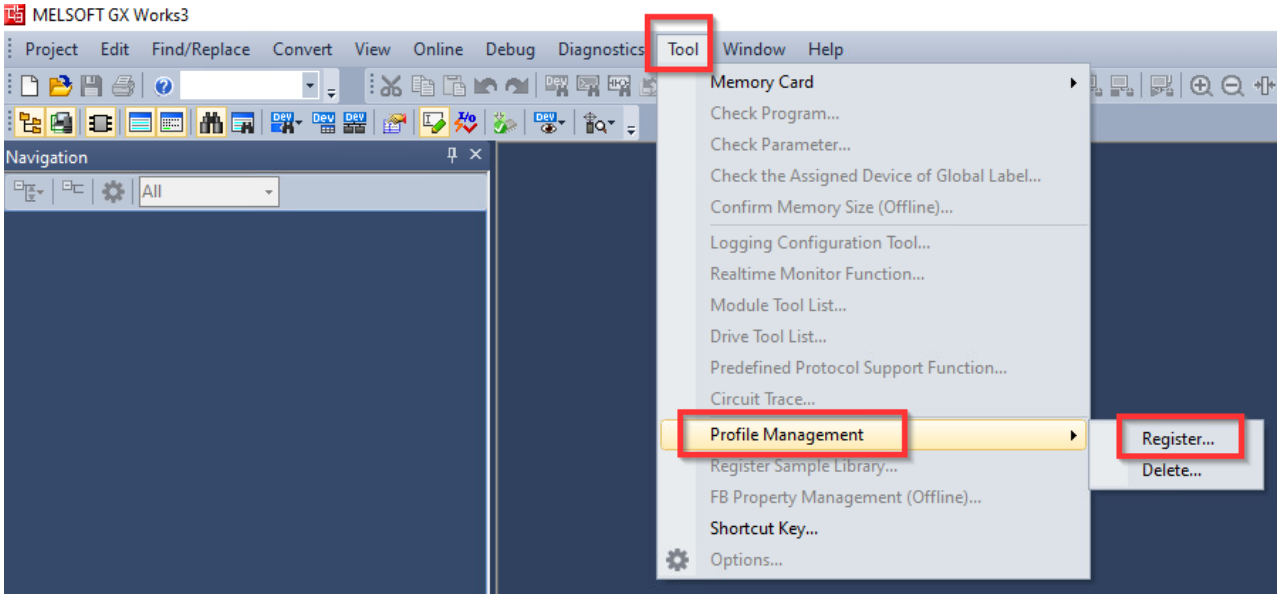
The following procedure can be used for all Mitsubishi PLCs compatible with GX Works 3.

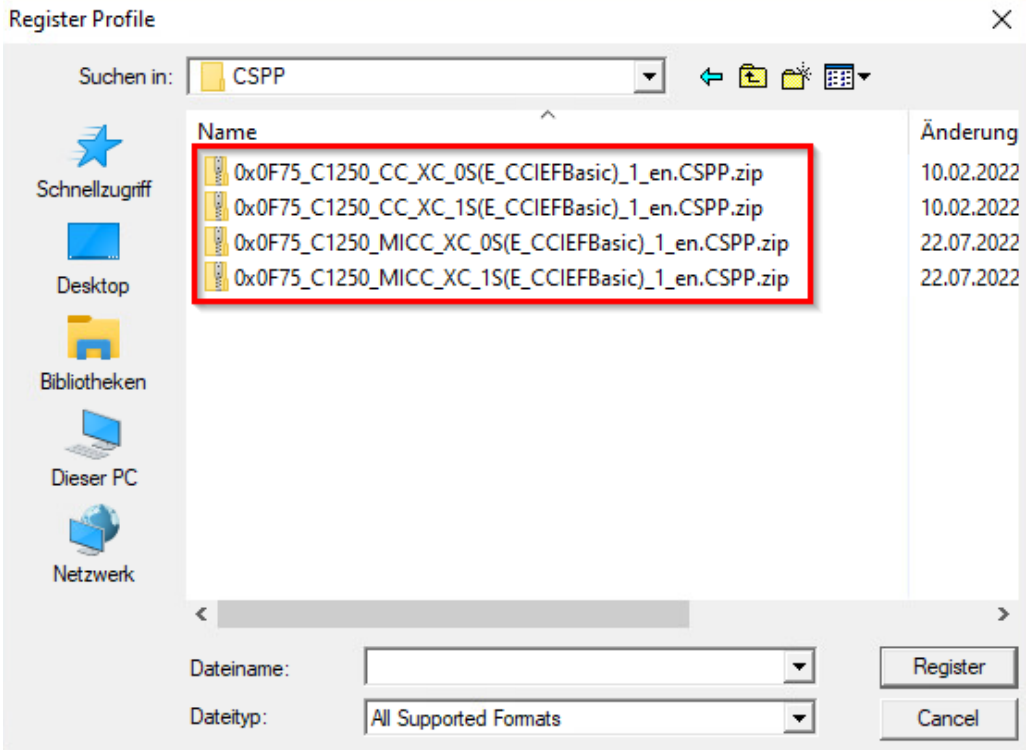
First, install the CSP+ file for the drive.
(GX Works 3 → Tool → Profile Management → Register

The required CSP+ file can be found by default in the following folder:

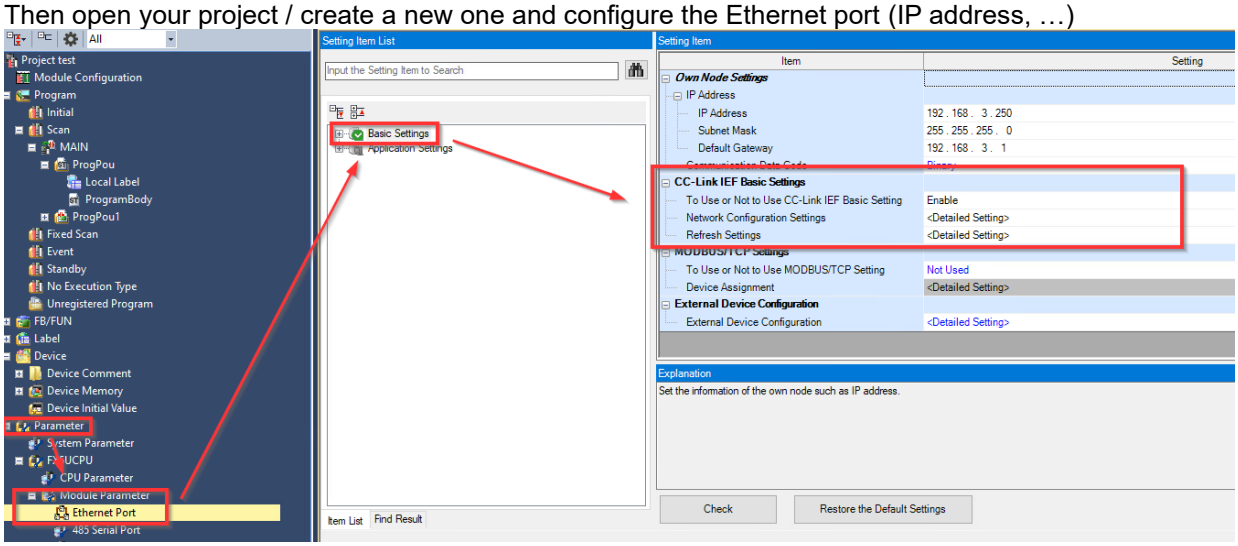
C:\Program Files\LinMot\LinMot-Talk X.X Build XXXXXXXX\Firmware\Interfaces\CCLinkIEFB\CSPP

1. First the corresponding CSPP file of the LinMot Drive must be installed. No project must be open when doing so!

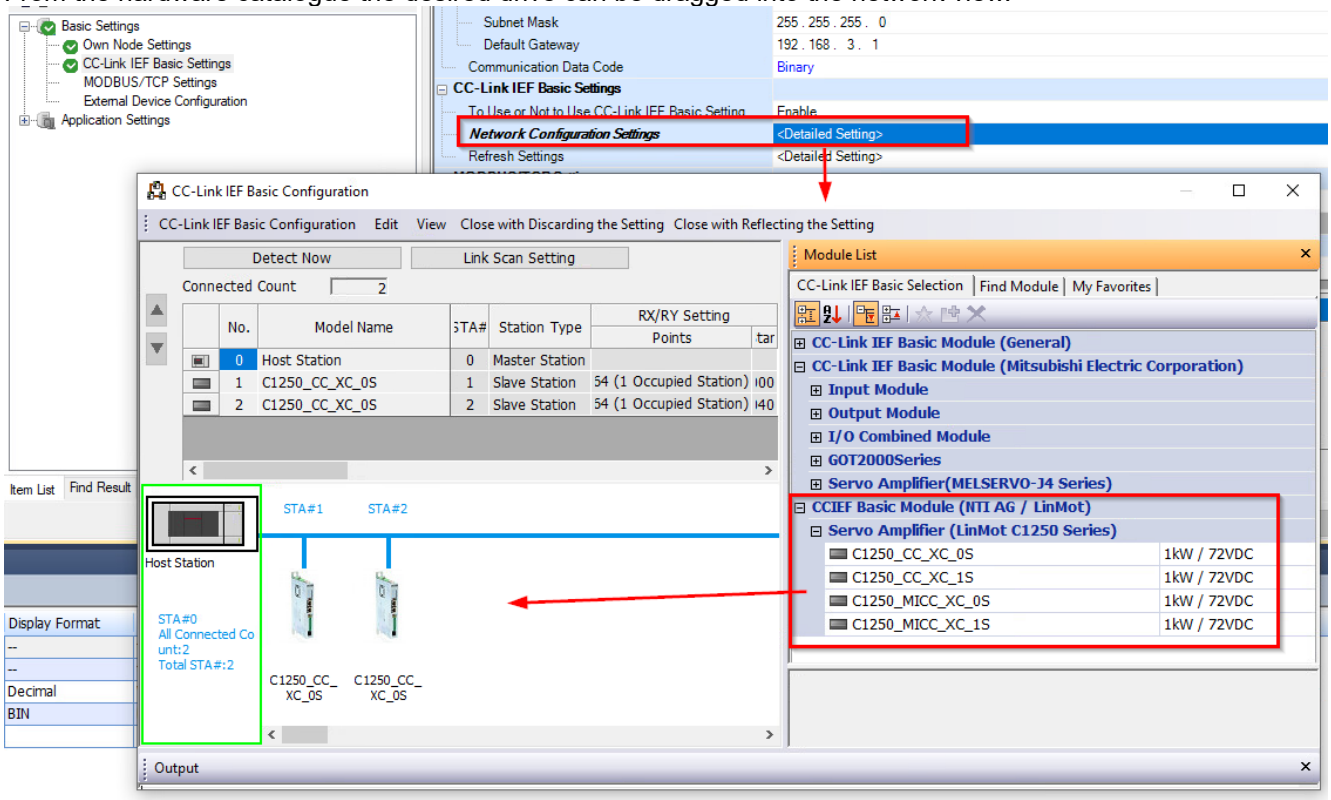




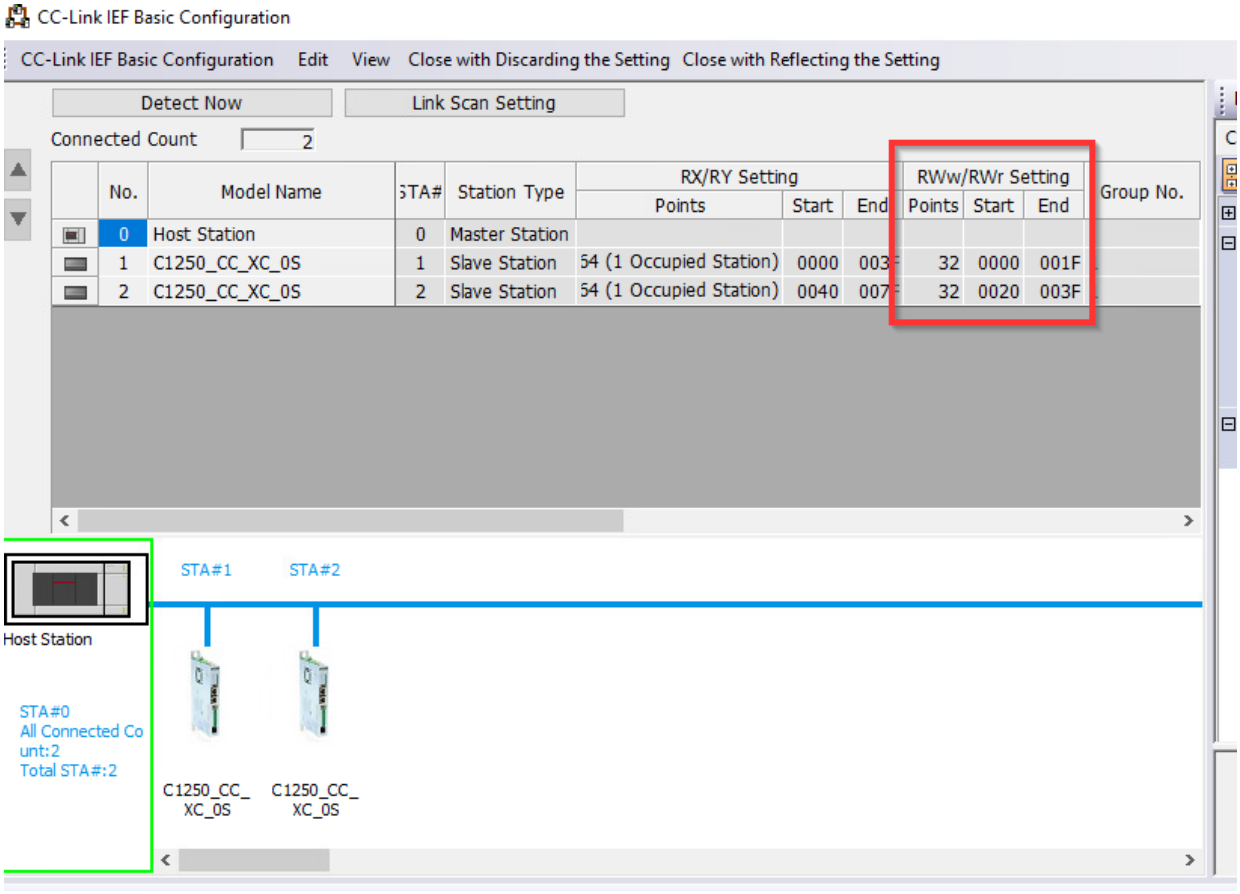
2. Then open your project / create a new one and configure the Ethernet port (IP address, …)



3. From the hardware catalogue the desired drive can be dragged into the network view.



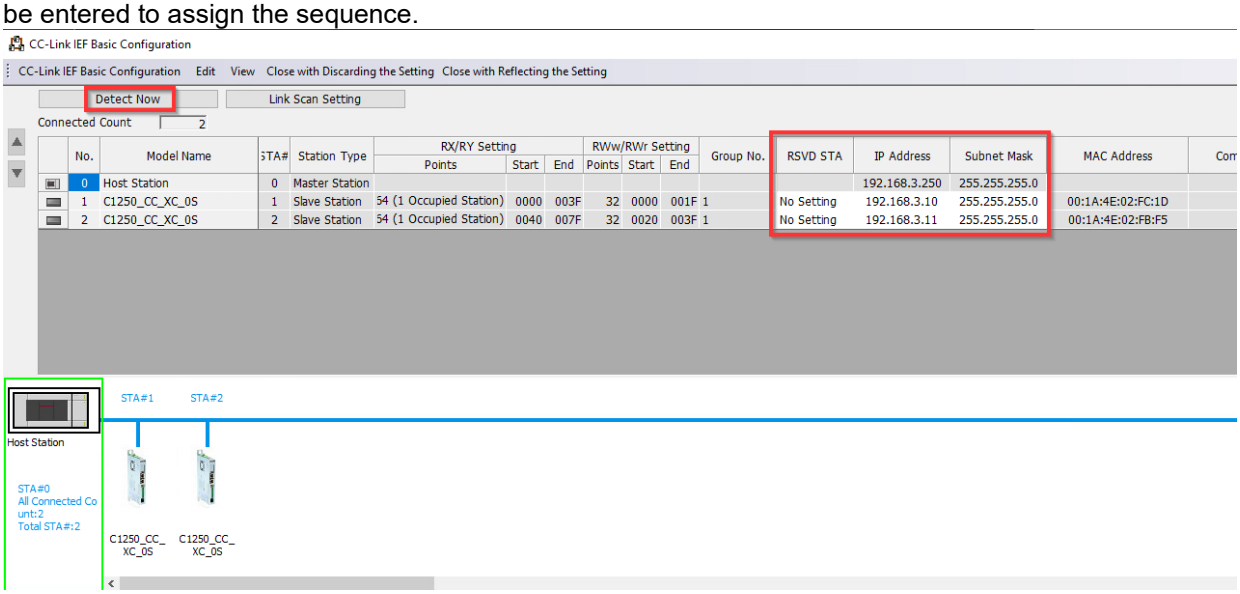
4. Afterwards the I/O data areas can be read.



Note:
Input registers W are counted hexadecimal, output registers R decimal!

Here: Read Drive 1: W0
Read Drive 2: W20
Write Drive 1: R0
Write Drive 2: R32 (1F: 31, 20: 32)

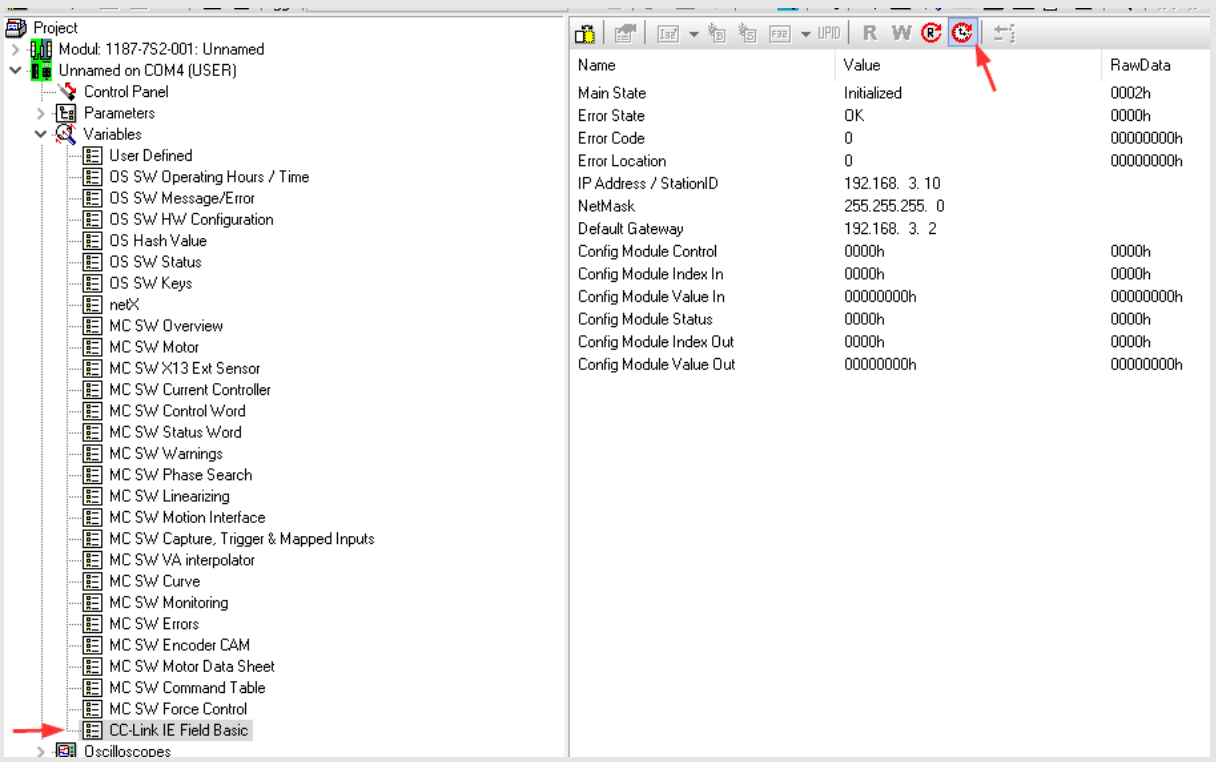
5. On the control side, the participants can then be recognized in GX3 Works via "Detect Now". The IP's can be entered to assign the sequence.



8.4 Check with LinMot-Talk if the Fieldbus is running

LinMot-Talk shows the status of the fieldbus. Open the variables CC-Link IF Field Basic and check if the IP Address is correct.

Check fieldbus status:



8.5 Next Steps

Now you can start implementing your application using the function blocks and documentation from the download link in chapter **8.1 Overview.**

9 LinMot Profile: Python

9.1 Overview

LinMot MI drives with *LinMot EtherCAT* interface installed (e.g., C1250-MI-XC-1S) can be integrated and setup with a Python EtherCAT master as motion axis.

Operating System:
The Python EtherCAT Master can run on Windows and Linux.

Download:
A ZIP package including demo projects and a detailed documentation can be found here:
https://download.linmot.com/plc_lib/libraries/Python/ (Python_EtherCAT_...)

Note:
More information and step by step guides can be found in the project documentation (part of the above-mentioned download).

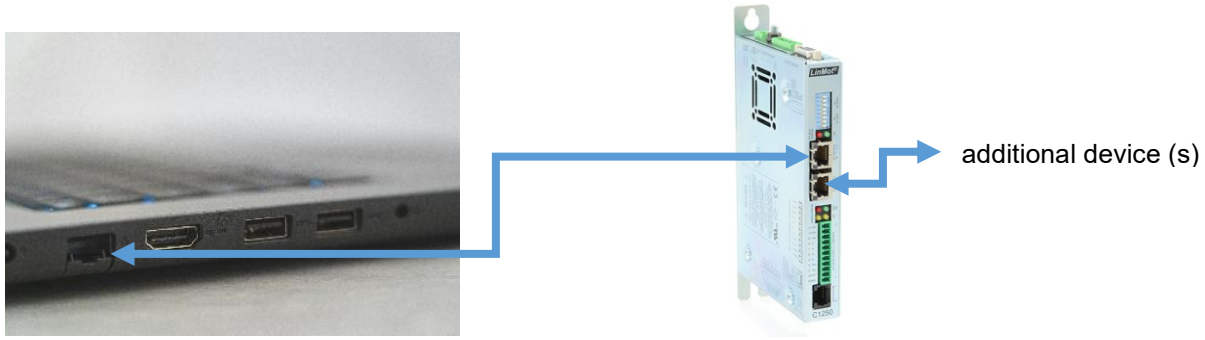


Image Source: https://www.pexels.com/photo/laptop-computer-on-white-table-4065718/

EtherCAT is a real-time Industrial Ethernet technology.

For further information on EtherCAT please visit:
https://www.ethercat.org/en/technology.html

Mandatory Prerequisites!
- Python 3.13 (64-bit) or later recommended
- LinMot drive firmware **6.14 Build 20250901 or later** recommended

10 LinMot Profile: Yaskawa iCube Engineer

10.1 Overview

This chapter shows how a LinMot drive with *LinMot EtherCAT CiA402* interface (e.g. C1250-MI-XC-0S) can be integrated and setup in a Yaskawa iCube environment.

Download:
A sample program for iCube Engineer which includes libraries for using Profile Position Mode (OpMode 1) can be downloaded from:
https://download.linmot.com/plc_lib/examples/Yaskawa/

Note: More information can be found in the user manual EtherCAT CoE (CiA 402). See chapter 1.7 Documentation / User Manuals / Application Notes

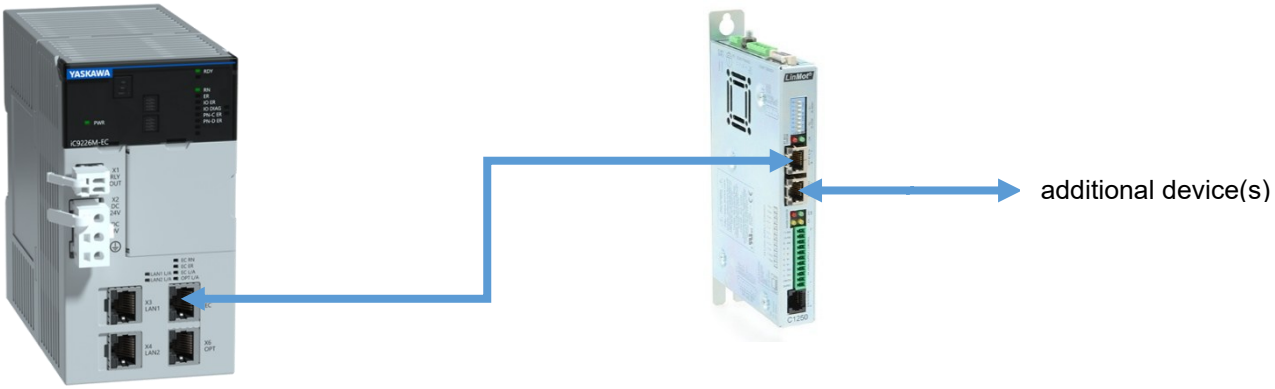


Image Source: http://www.yaskawa.com/

EtherCAT is the open real-time Ethernet network originally developed by Beckhoff. The LinMot acts as Slave in this network and is implemented with the CiA402 profile.

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

10.2 Configuration and Connection of the LinMot Drive

The LinMot drive is configured using the LinMot-Talk software:
http://www.linmot.com/download/linmot-talk-drive-configuration/

10.2.1 Motor Configuration

It is assumed that the motor connected to the drive is already configured.

Use the *Motor Wizard* inside LinMot-Talk to setup the motor (Menu -> Drive -> Motor Wizard):

See Appendix I: Basic Position Control Loop Tuning

10.2.2 XML Files

Install the XML file that is part of the LinMot-Talk software/firmware you are using.
The most recent device files are always part of the newest LinMot-Talk software. They are located by default:

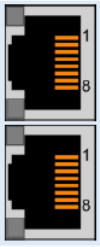
- EtherCAT: \\LinMot-Talk X.X Build XXXXXXXX\Firmware\Interfaces\EtherCAT\XML\
- EtherCAT: \\LinMot-Talk X.X Build XXXXXXXX\Firmware\Interfaces\EtherCat_Nx\XML\ (-MI drives)

XML file names:

NTIL_CiA402_Servos_MI_Vx_xrx.xml	LinMot MI drives SG6
NTIL_DS_Drives_Vx_xrx.xml	LinMot DS drives SG9

10.2.3 EtherCAT Connection

The drive is connected to the EtherCAT network using the X17 & X18 connectors. The below pictures show the ports of an C1250-MI drive. On all other LinMot drives supporting EtherCAT the ports are named the same (X17 & X18) but they may be placed differently on the drive housing.

X17 – X18	RealTime Ethernet 10/100 Mbit/s	
	X17 RT ETH In X18 RT ETH Out	Specification depends on RT Bus. Please refer to the according documentation.
RJ-45		

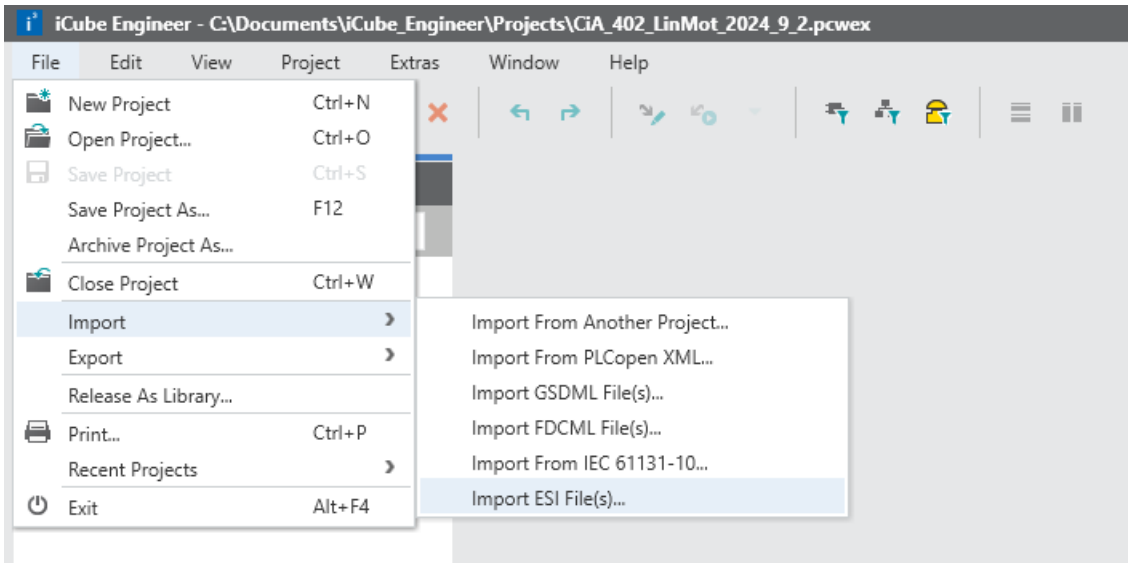
10.3 PLC Setup EtherCAT (C125x-MI-XC-xx, F1x50-DS-UC-xx)

10.3.1 Insert LinMot Drive as EtherCAT Device

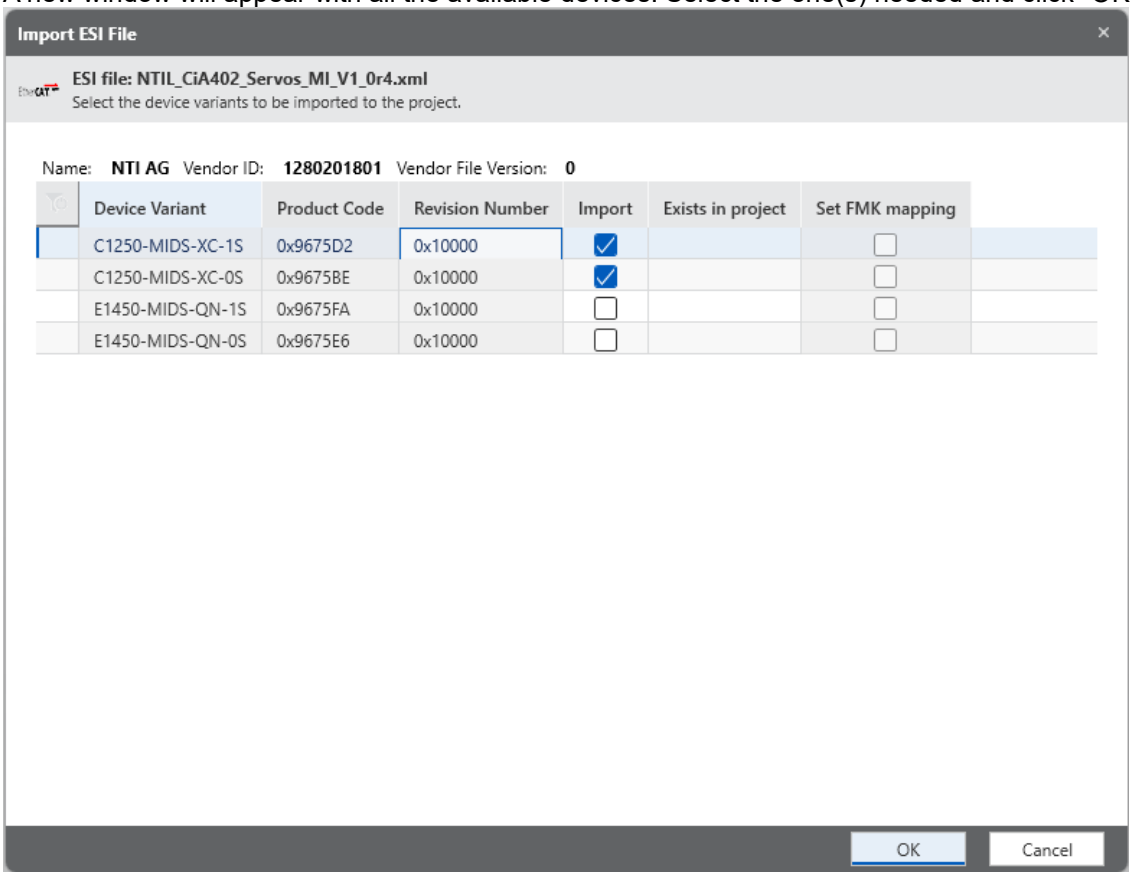
The required ESI (XML) files can be found in the following folder (default):

C:\Program Files\LinMot\LinMot-Talk X.X Build XXXXXXXX\Firmware\Interfaces\EtherCAT\XML
C:\Program Files\LinMot\LinMot-Talk X.X Build XXXXXXXX\Firmware\Interfaces\EtherCat_NX\XML (-MI Drives)

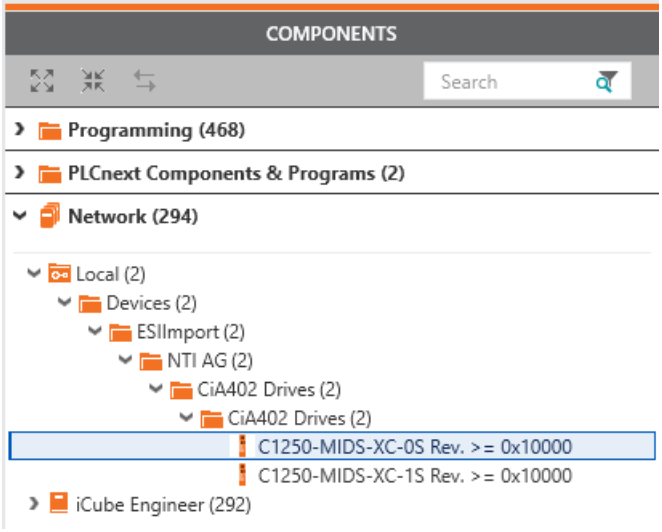
From iCubeEngineer application, add the ESI file with the device description to the project.
Go to File -> Import -> Import ESI Files(s)...
Select the appropriate one from the file explorer window, then click "Open".



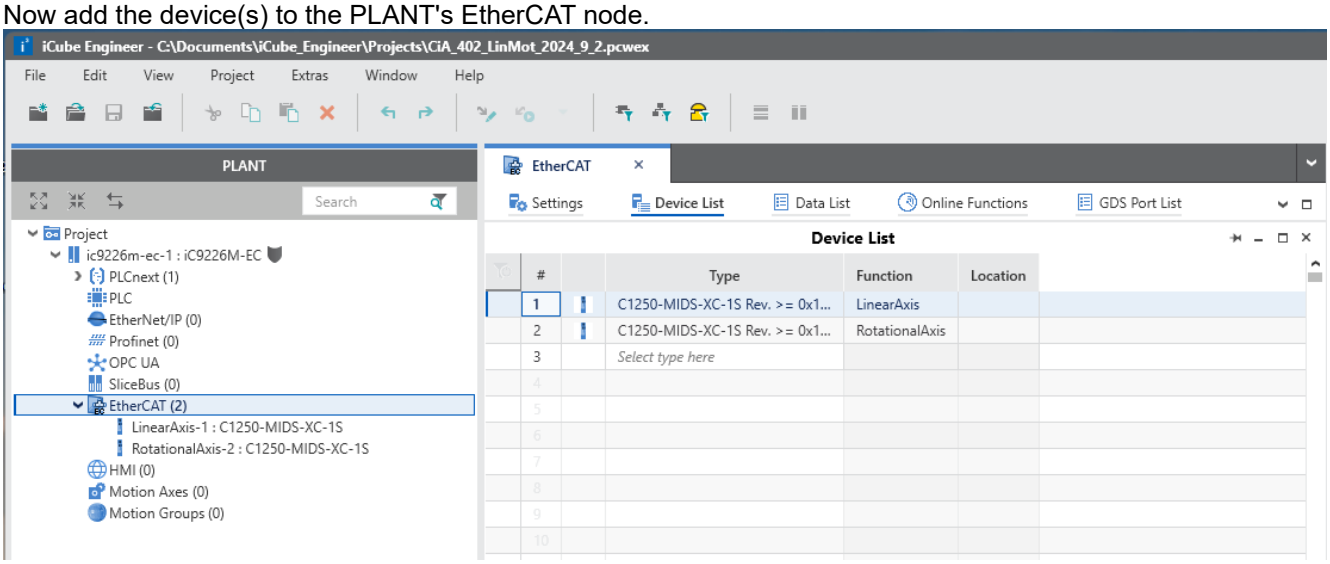
A new window will appear with all the available devices. Select the one(s) needed and click "OK".



The LinMot servo drive(s) will be added to the Local folder of the Network chapter under COMPONENTS.



Now add the device(s) to the PLANT's EtherCAT node.



10.3.2 Configure Module – PDO Data

The specific Process Data Object (PDO) mapping for a LinMot servo drive depends on project needs; therefore, the information here covers only a general case. To select the desired objects, double-click on the servo drive on the EtherCAT node, and select "PDO Data" from the device's tabs.

The default PDO Data includes:

- Input: 0x1A03 - Cyclic Mode Inputs 2
- Output: 0x1604 - Cyclic Position Velocity Torque Mode

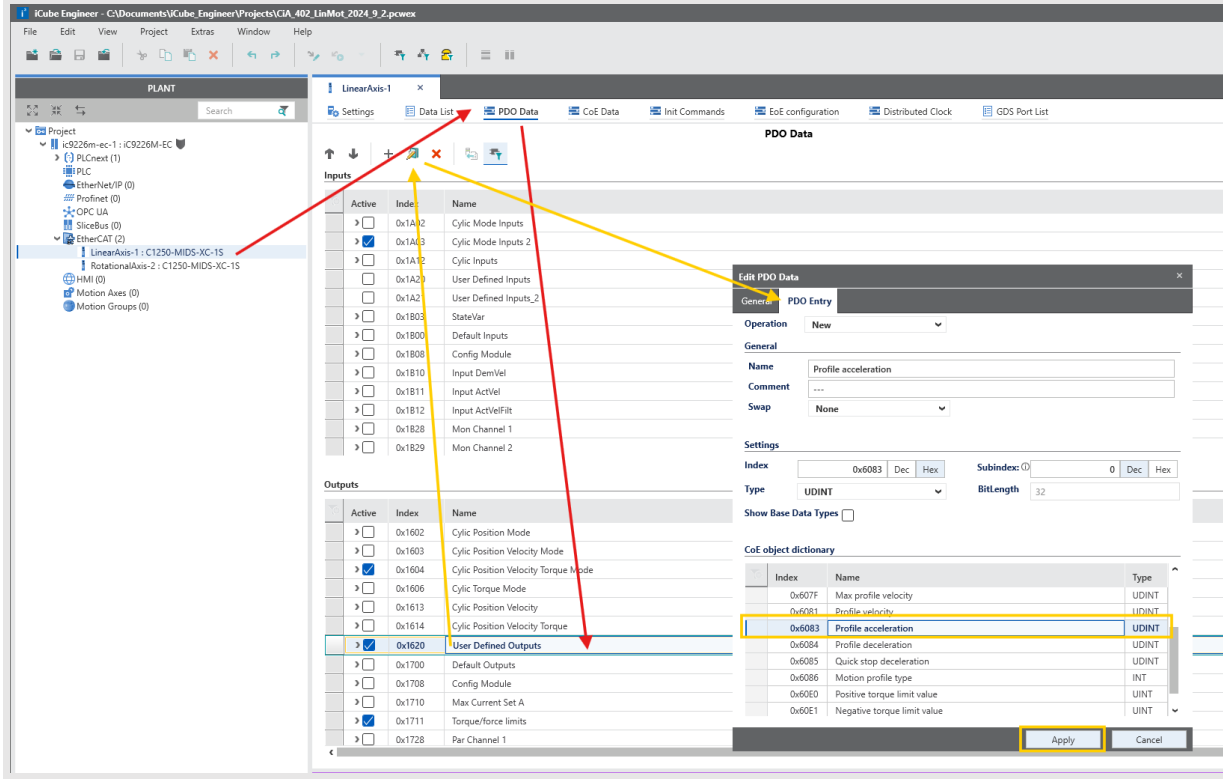
Recommended PDO Data:

- Output: 0x1711 - Torque/force limits
- Output: 0x1620 - User Defined Outputs
- 0x6083 - Profile acceleration
- 0x6084 - Profile deceleration

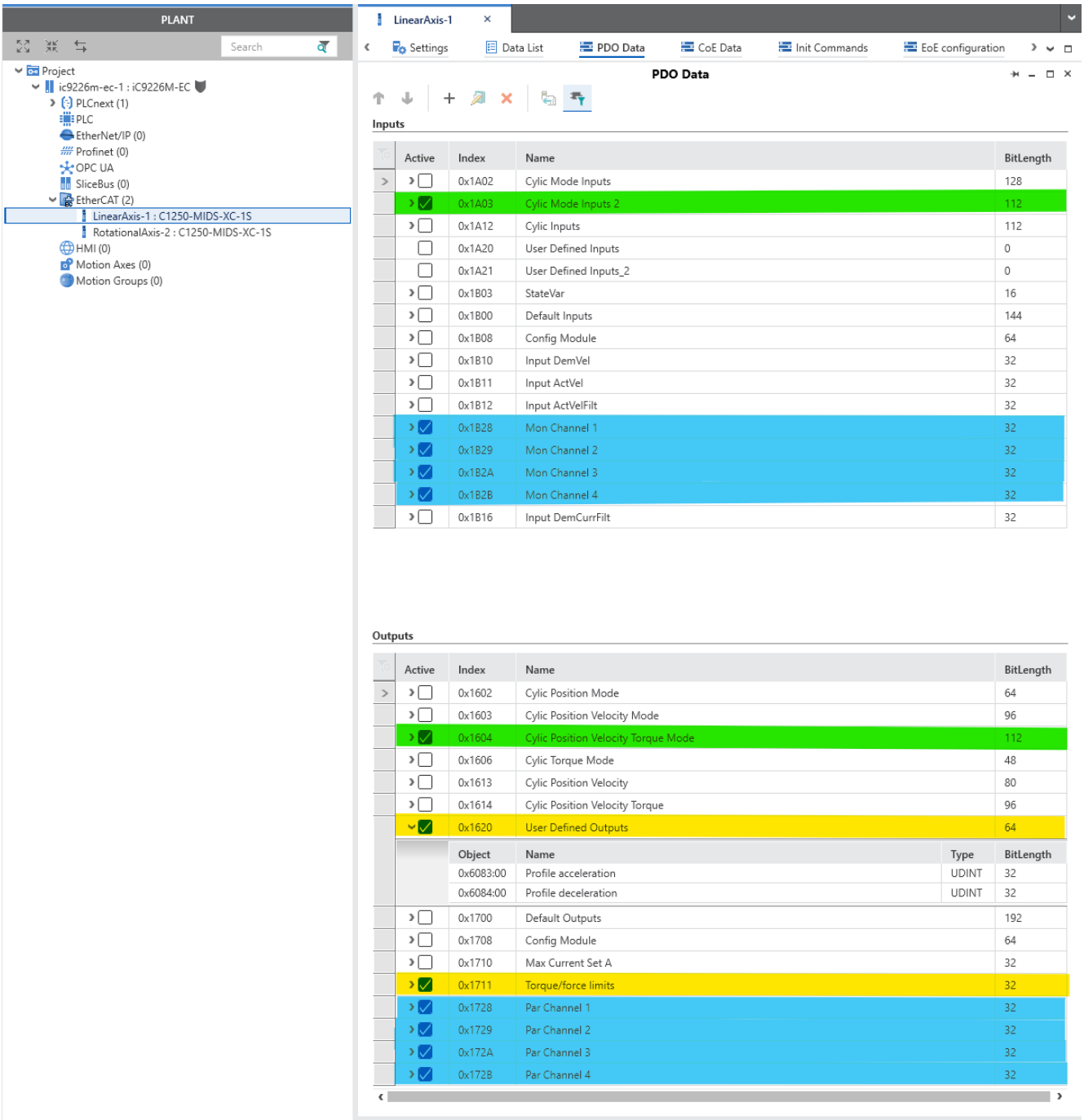
Optional PDO Data:

- Input: 0x1B28-0x1B2B - Mon Channel 1-4
- Output: 0x1728-0x172B - Par Channel 1-4

To modify the User Defined Inputs or Outputs, select the line in the PDO Data.
Then click on the Edit button, and select “PDO Entry” tab.
Choose the desired objects from the CoE object dictionary and select “Apply”.



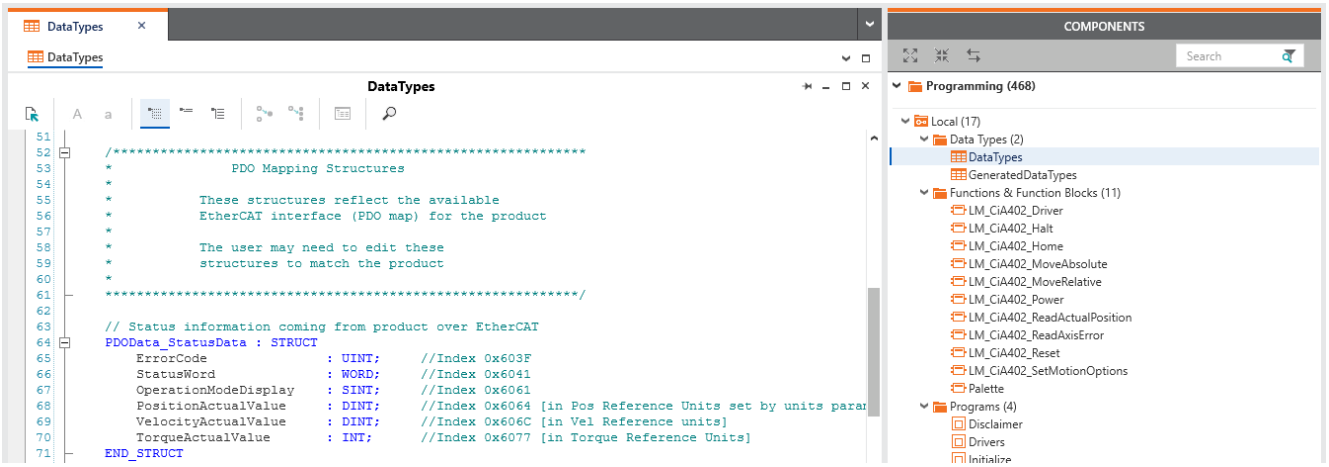
See image below for reference (Default, Recommended, Optional).
Monitoring and parameter channels can be configured via LinMot-Talk.



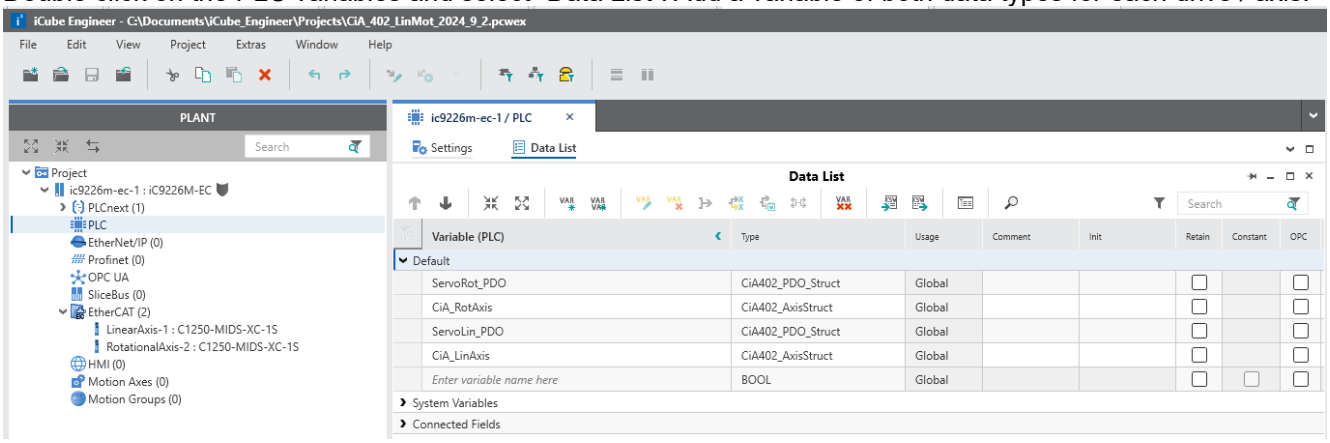
10.3.3 Configure Module – Variables & Mapping

The PDO data from the LinMot drive needs to be mapped to variables in the PLC. It is recommended to use a data type structure in the PLC that corresponds to the PDO inputs and outputs.

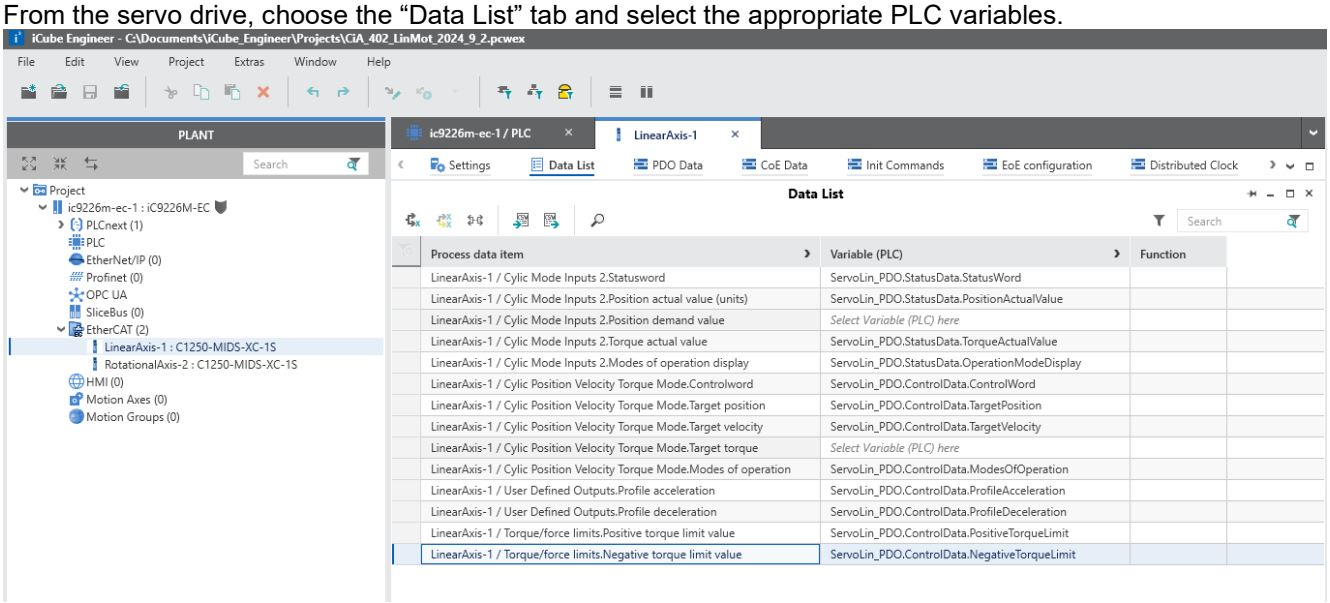
The sample program contains data type definitions for *CiA402_PDO_Struct* to map PDO inputs/outputs from the drive to a PLC tag and *CiA402_AxisStruct* for use as the internal axis tag and interface to PDO structure. Note that the axis structure is divided into standard axis information for Yaskawa (*AxisInfo*) which is only partially used and customized axis information for EtherCat drives (*AxisInfo_CiA402*).



Double click on the PLC variables and select “Data List”. Add a variable of both data types for each drive / axis.



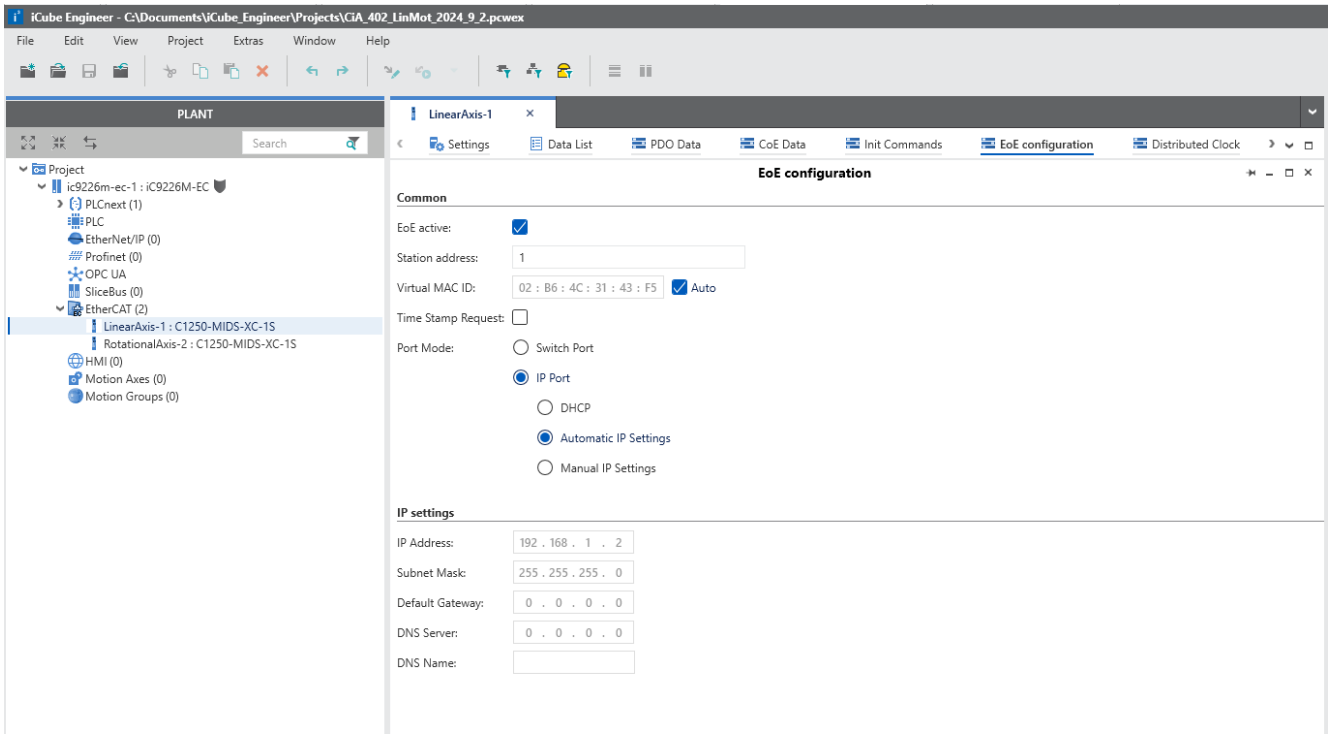
From the servo drive, choose the “Data List” tab and select the appropriate PLC variables.



10.3.4 Configure Module – EoE Settings

On supported drives (C125-…, E1450…, F1x50…), check the EoE (Ethernet over EtherCAT) settings.

LinMot drives do NOT currently support DHCP mode. A fix IP must be assigned (select “Automatic IP Settings” or “Manual IP Settings”) or the EoE feature must be disabled (“EoE active” not selected).



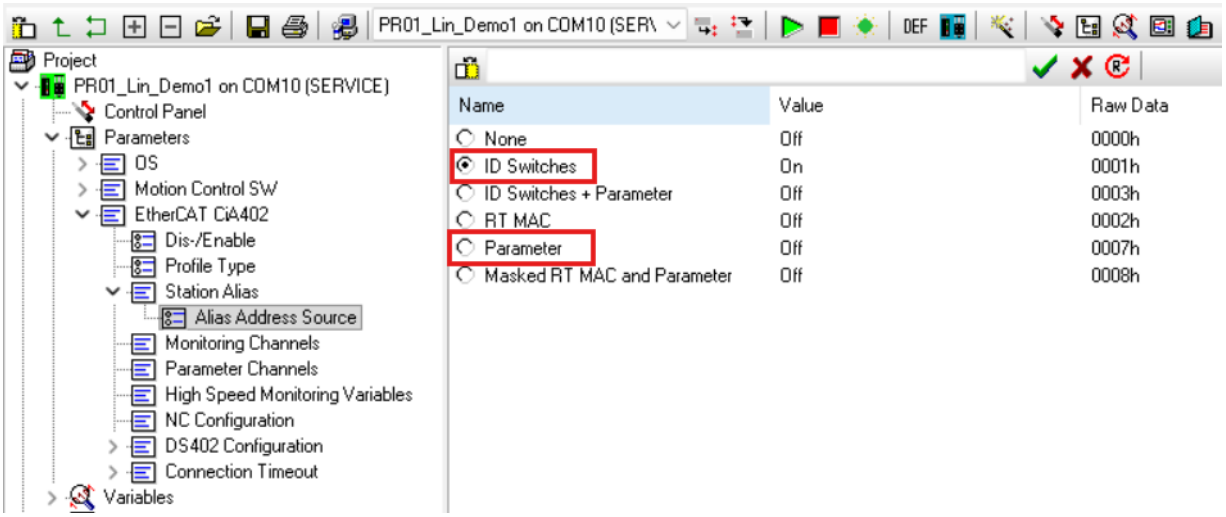
Note:
EoE can be used to login into the drive with LinMot-Talk directly over EtherCAT.
E.g., to change drive settings or for monitoring and tracing.

10.4 Drive Configuration in LinMot-Talk

10.4.1 Set address on Fieldbus

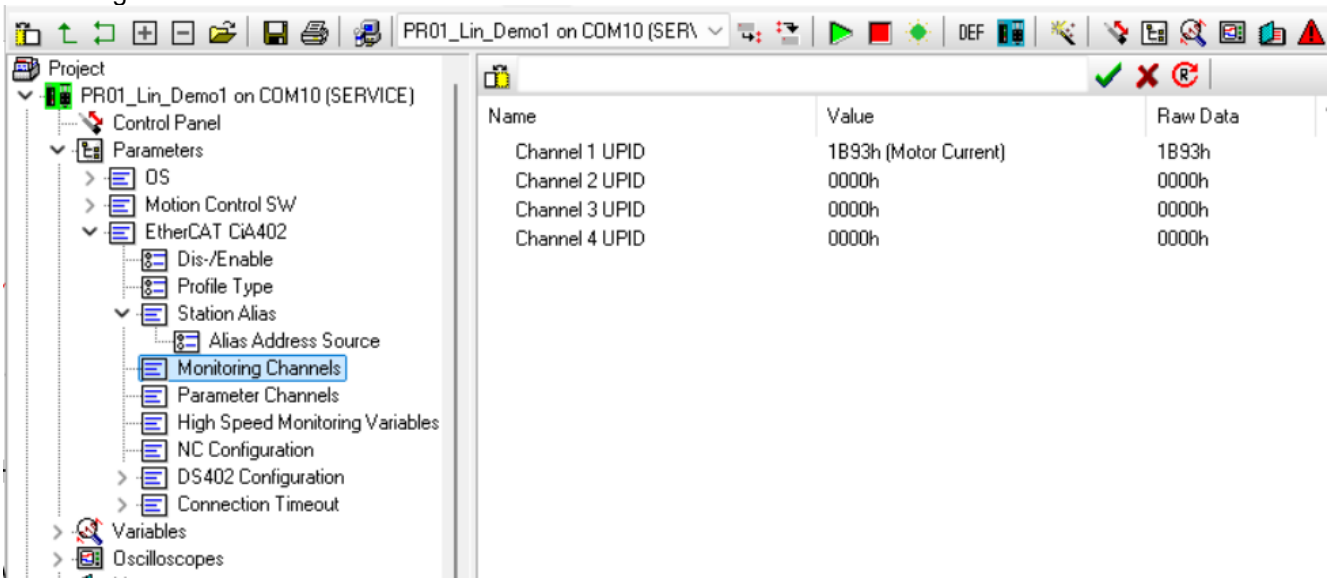
For multi-interface (MI) drives, the interface EtherCAT must be selected when installing the firmware. If the EtherCAT CiA402 parameter tree is not visible, then reinstall the firmware with the EtherCAT interface.

Set “Alias Address Source” to ID Switches or Parameter. Then configure the address either using the selector switches on the drive or with the Alias Address Parameter (UPID 2051h).



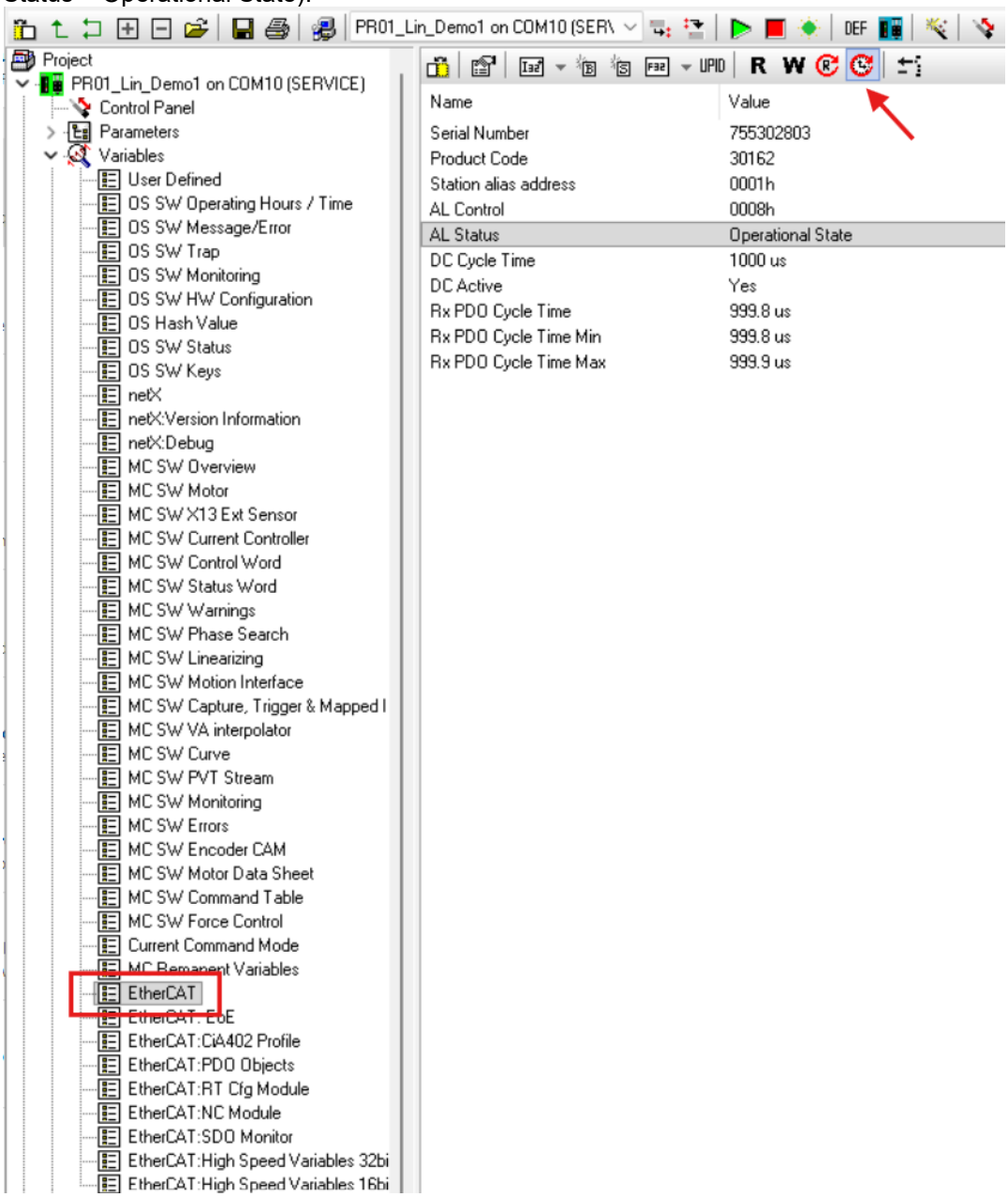
10.4.2 Configure Monitoring and Parmeter Channels

If desired up to 4 Monitoring channels and 4 Parameter channels can be configured to exchange values every fieldbus cycle with the PLC. In the example below UPID 1B93h for the motor current is configured as a monitoring channel.



10.4.3 Check with LinMot-Talk if the Fieldbus is running

LinMot-Talk shows the status of the fieldbus. Open the variables EtherCAT and check if the bus is running (AL Status = Operational State).



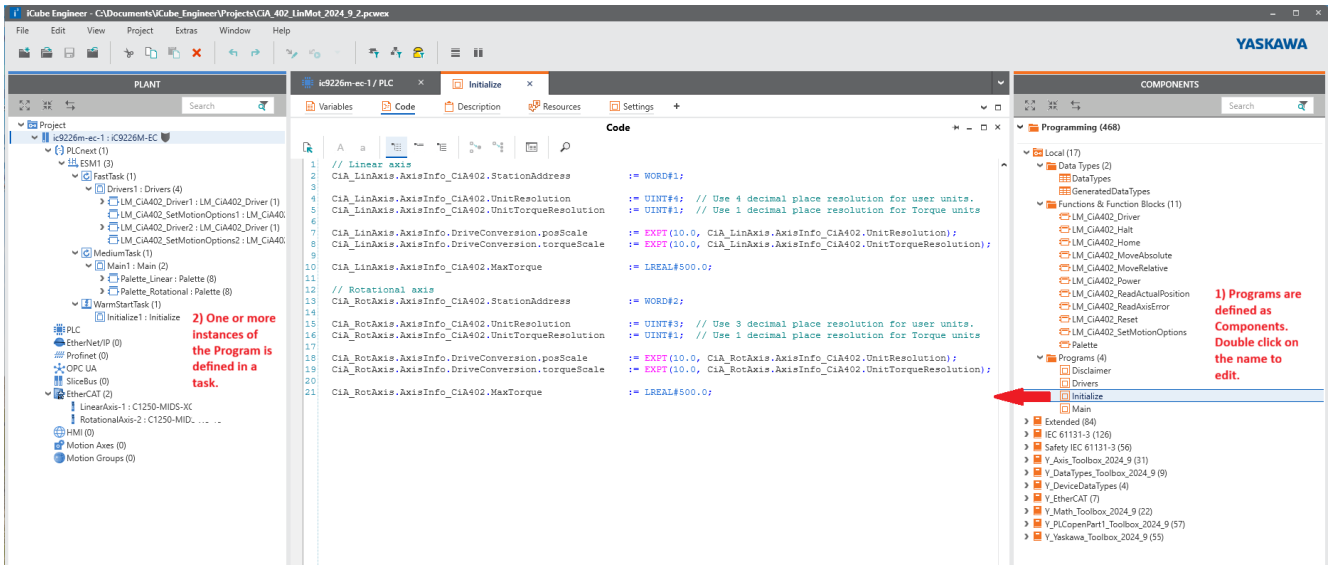
10.5 LinMot Yaskawa Example PLC Program

10.5.1 Overview

PCWEAX files are project archives, which include the necessary libraries. After making changes, it is recommended to archive the project as a complete backup, also in case the project file (.PCWEX) becomes corrupted.

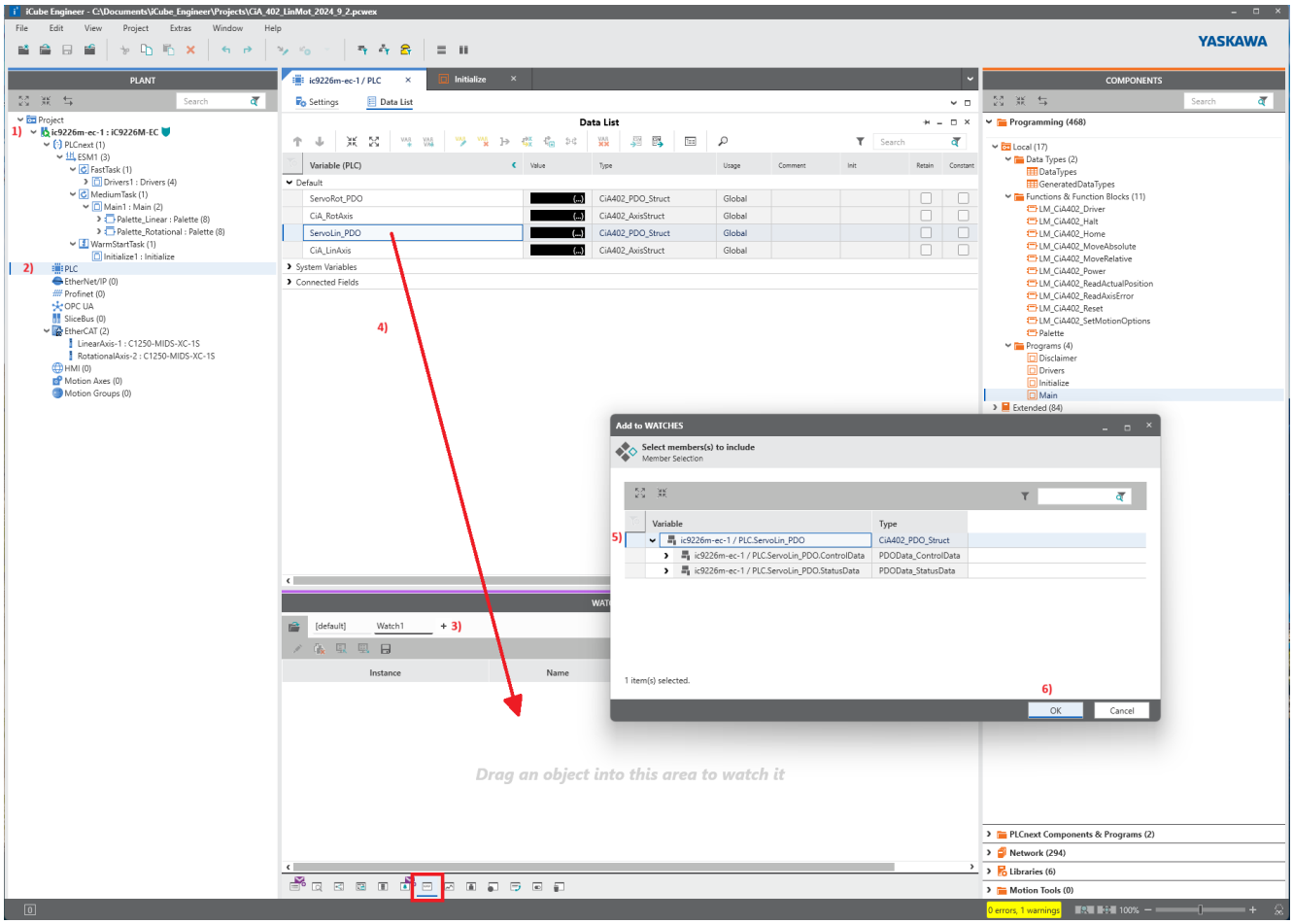
The individual programming components are defined in the COMPONENTS area on the right side. In addition to the Data Types and Function Blocks, Programs are also considered components. Double click on the definition (orange) to edit. Changes can be made when Debug mode is off or PLC is not connected.

The PLC is part of the Project in the PLANT on the left side. One or more instances of the program is defined in a task. These instances (blue) can only be viewed when connected to the PLC and Debug mode is on.



To add variables to the Watch window.

1. Check that PLC is connected and Debug mode is on. Symbol next the PLC is green circle around arrow.
2. Open the PLC variables.
3. Add a new Watch tab and rename (optional).
4. Drag variable to the watch tab.
5. In window which opens, select the members to include. Suggest selecting entire structure.
6. Click OK to complete.



10.5.2 Supported Operation Modes

This example contains function blocks which support Profile Position Mode (OpMode 1) and Homing Mode (OpMode 6). The example program and function blocks are provided by Yaskawa “as is” without any guarantee or support.

Cyclic Sync Torque Mode (OpMode10) for force control has been tested with the iCube PLC and respective LinMot modules. See chapter 10.7 for more information.
Cyclic Sync Position Mode (OpMode 8) could be implemented with a virtual axis as the master but has not been tested. Yaskawa iCube PLCs don’t currently support the use of real axes for 3rd party drives using EtherCAT DS402 drive profile.

10.5.3 Initialize program

In the Initialize program, set the Station Address, the Position Scaling and initial Max Torque for each axis.

Linear motors PS01 / PS10

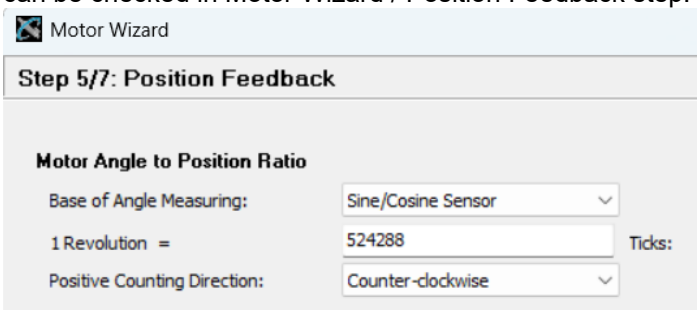
- Internal position resolution is 0.1 um
- Position scaling = 10,000 (10,000 ticks / 1 mm)

Rotary motors RS01 / RS02 (rotary part of LinMot PR01 & PR02 linear rotary motors)

- Single turn absolute encoder and by default 360,000 ticks (increments) per motor revolution
- Position scaling = 1000 (360,000 ticks / 360 deg)

Rotary motors EC02 / GM51 / PR02 PS11 & PS31

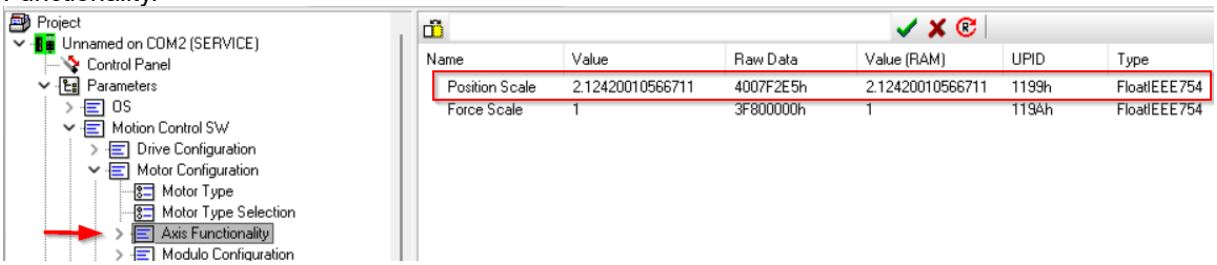
- Single turn absolute encoder and by default 524,288 (2^19) ticks (increments) per motor revolution. This can be checked in Motor Wizard / Position Feedback step.



- Position scaling = 1456.36 (524,288 ticks / 360 deg)

Gripper GM01 / GM5x

- Absolute encoder, in general. The position scaling factor must be read out from UPID 1199h for each gripper type. This parameter can be found in Motion Control SW / Motor Configuration / Axis Functionality.



- Position scaling = 4707.65 (10,000 ticks / 2.1242 mm) for this example

Max Torque = 500% corresponds to the maximum current for the motor and is the default value.

Important: Torque/force limits (index 0x1711) need to be selected in the PDO Data in order to use the Max Torque variable. Conversely if the Torque/force limits are selected in the PDO Data, then a variable must be defined and set to a value. Otherwise the value is 0 in the drive and the motor won't move.

The Max Torque variable writes the same value to the parameters for both the maximum positive torque and maximum negative torque. These maximum torque values are converted to Maximal Current Positive (UPID 12FCh RAM value) and Maximal Current Negative (UPID 13FDh RAM value) in the LinMot drive.

Initialize

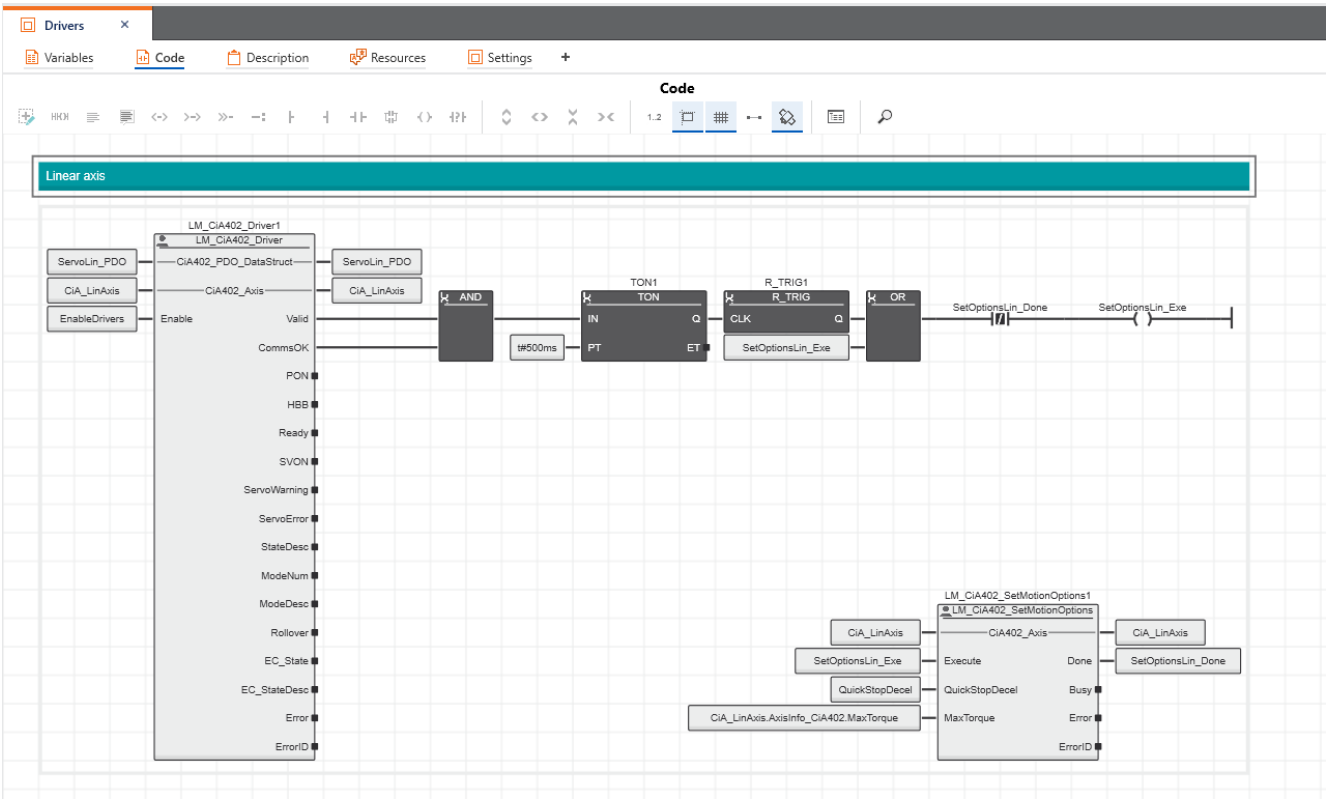
Variables | Code | Description | Resources | Settings

Code

```
// Linear axis - example linear motors PS01 / PS10
CiA_LinAxis.AxisInfo_CiA402.StationAddress          := WORD#1;

CiA_LinAxis.AxisInfo.DriveConversion.posScale       := LREAL#10000.0;   // Position scaling =  10,000 ticks / 1 mm
CiA_LinAxis.AxisInfo.DriveConversion.torqueScale    := LREAL#10.0;      // Torque scaling = 10

CiA_LinAxis.AxisInfo_CiA402.MaxTorque               := LREAL#500.0;     // Max torque = 500% corresponds to max. torque/force of motor


// Linear axis - example for gripper GM01 / GM5x
//CiA_LinAxis.AxisInfo.DriveConversion.posScale       := LREAL#4707.65;   // Position scaling =  10,000 ticks / 2.1242 mm
//CiA_LinAxis.AxisInfo.DriveConversion.torqueScale    := LREAL#10.0;      // Torque scaling = 10

//CiA_LinAxis.AxisInfo_CiA402.MaxTorque               := LREAL#500.0;     // Max torque = 500% corresponds to max. torque/force of motor



// Rotational axis - example rotary motors RS01 / RS02 (rotary part of LinMot PR01 & PR02 linear rotary motors)
CiA_RotAxis.AxisInfo_CiA402.StationAddress          := WORD#2;

CiA_RotAxis.AxisInfo.DriveConversion.posScale       := LREAL#1000.0;    // Position scaling =  360,000 ticks / 360 deg
CiA_RotAxis.AxisInfo.DriveConversion.torqueScale    := LREAL#10.0;      // Torque scaling = 10

CiA_RotAxis.AxisInfo_CiA402.MaxTorque               := LREAL#500.0;     // Max torque = 500% corresponds to max. torque/force of motor


// Rotational axis - example rotary motors EC02 / GM51 / PR02 PS11 & PS31
// CiA_RotAxis.AxisInfo.DriveConversion.posScale       := LREAL#1456.36;   // Position scaling =  524,288 ticks / 360 deg
// CiA_RotAxis.AxisInfo.DriveConversion.torqueScale    := LREAL#10.0;      // Torque scaling = 10

// CiA_RotAxis.AxisInfo_CiA402.MaxTorque               := LREAL#500.0;     // Max torque = 500% corresponds to max. torque/force of motor
```

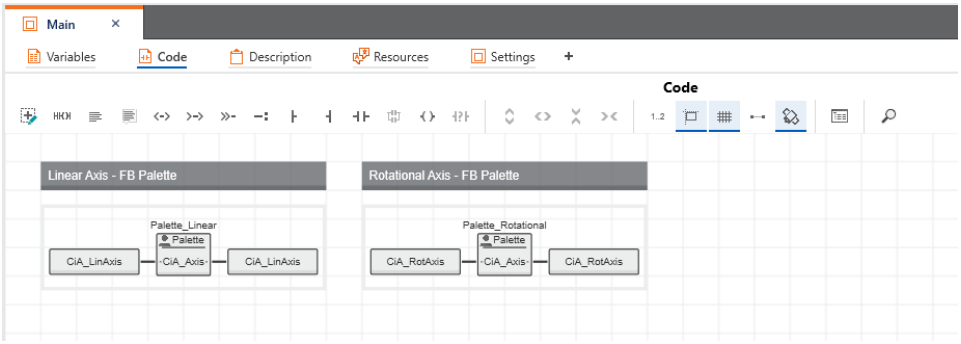
10.5.4 Drivers program

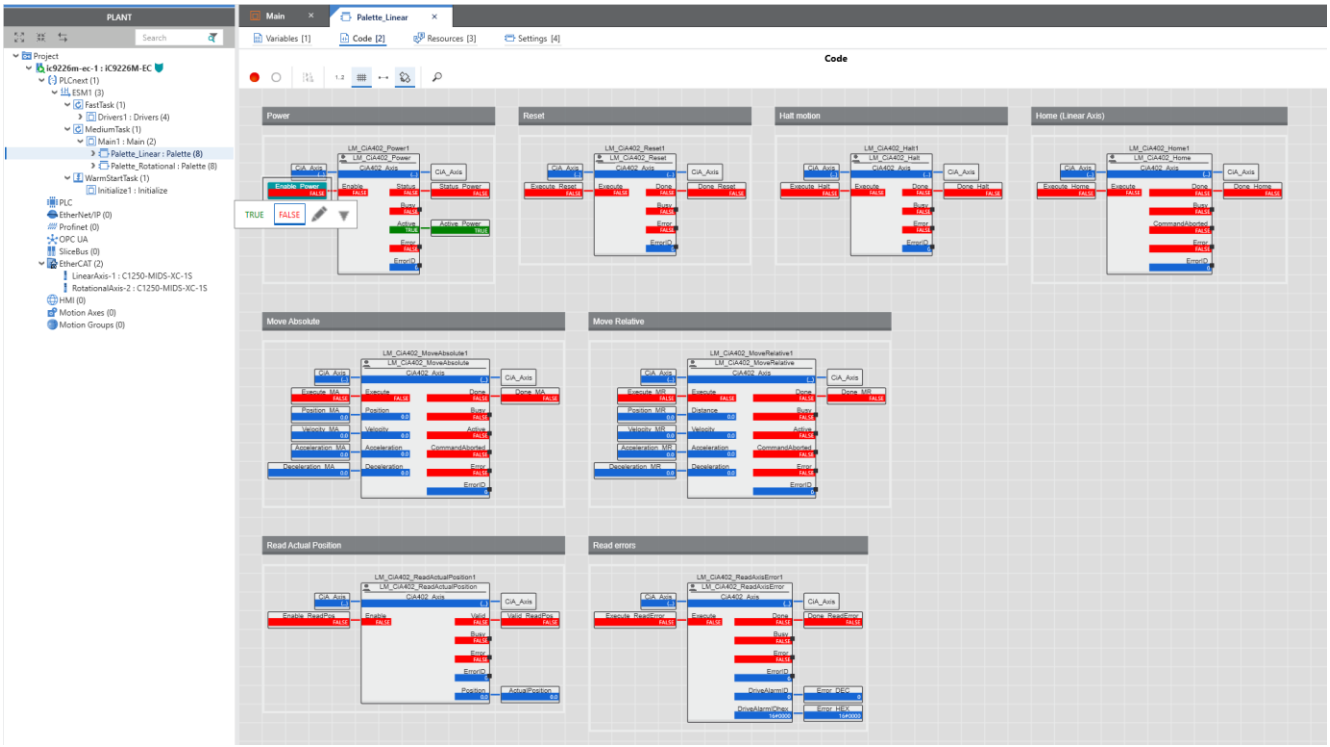
In the Drivers program, the PDO tag for interfacing with the LinMot drive (*ServoLin_PDO* in example below) internal axis tag for programming motion commands (*CIA_LinAxis*) are connected together with function block *LM_CiA402_Driver*. Function block *LM_CiA402_SetMotionOptions* initializes values when the drive communication is established.



10.5.5 Main program and Axis Palette

In the Main program, each axis is connected to the Palette function, which is a collection of the function blocks available for the LinMot axes. For test purposes, the individual function blocks can be enabled and the input variables changed as desired.





10.6 LinMot Yaskawa Function Block Set

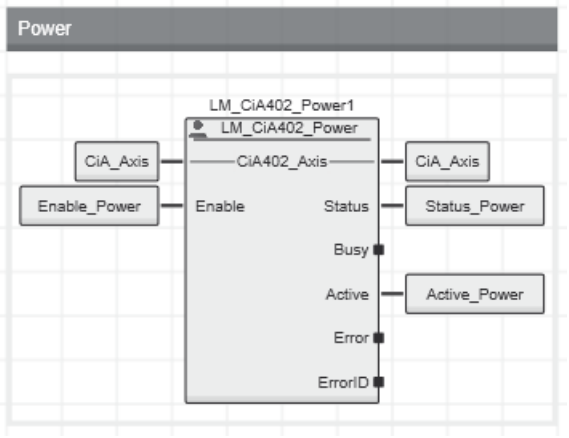
Axis Control:
- LM_CiA402_Power
- LM_CiA402_Reset
- LM_CiA402_Home

Axis Move:
- LM_CiA402_Halt
- LM_CiA402_MoveAbsolute
- LM_CiA402_MoveRelative

Axis Status:
- LM_CiA402_ReadAxisError

10.6.1 LM_CiA402_Power

The LM_CiA402_Power function block enables or disables the axis.

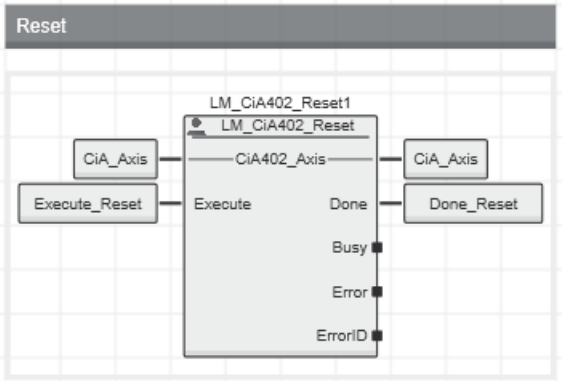


Inputs		
Name	**Data type**	**Description**
CiA402_Axis	CIA402_AXISSTRUCT	Axis reference (InOut)
Enable	BOOL	Enable / disable axis

Outputs		
Name	**Data type**	**Description**
Status	BOOL	Axis enable status
Busy	BOOL	Command active
Active	BOOL	No error
Error	BOOL	Error in function block
ErrorID	UINT	Error ID (see chapter 10.6.8 Error Descriptions)

10.6.2 LM_CiA402_Reset

The LM_CiA402_Reset function block resets axis faults.

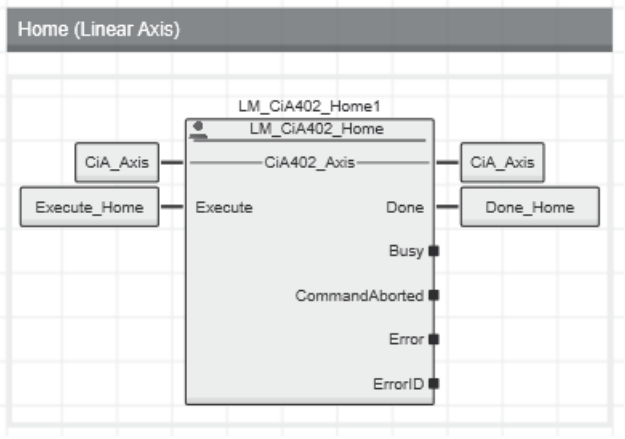


Inputs		
Name	**Data type**	**Description**
CiA402_Axis	CIA402_AXISSTRUCT	Axis reference (InOut)
Execute	BOOL	Execute command (rising edge)

Outputs		
Name	**Data type**	**Description**
Done	BOOL	Command done / Fault reset
Busy	BOOL	Command active
Error	BOOL	Error in function block
ErrorID	UINT	Error ID (see chapter 10.6.8 Error Descriptions)

10.6.3 LM_CiA402_Home

The LM_CiA402_Home function block executes the homing sequence setup in the drive (Motor Wizard).

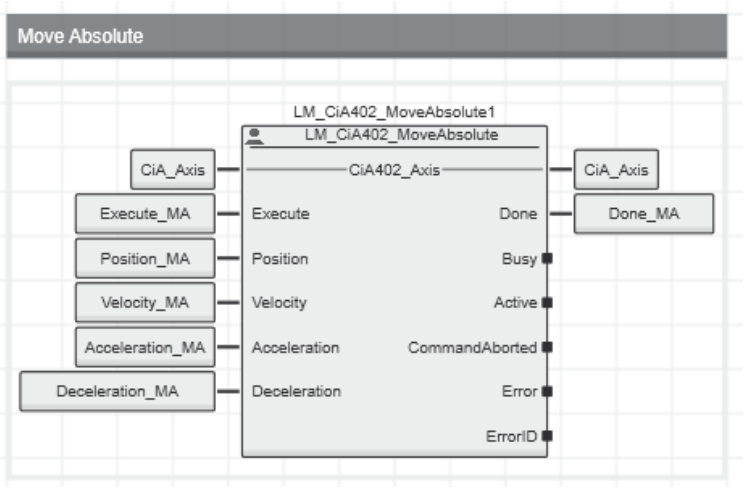


Inputs		
Name	**Data type**	**Description**
CiA402_Axis	CIA402_AXISSTRUCT	Axis reference (InOut)
Execute	BOOL	Execute command (rising edge)

Outputs		
Name	**Data type**	**Description**
Done	BOOL	Command done / Homing completed
Busy	BOOL	Command active
CommandAborted	BOOL	Command was aborted by another command during execution
Error	BOOL	Error in function block
ErrorID	UINT	Error ID (see chapter 10.6.8 Error Descriptions)

10.6.4 LM_CiA402_MoveAbsolute

The LM_CiA402_MoveAbsolute function block executes an absolute move to the requested position with the set maximal velocity, acceleration and deceleration.



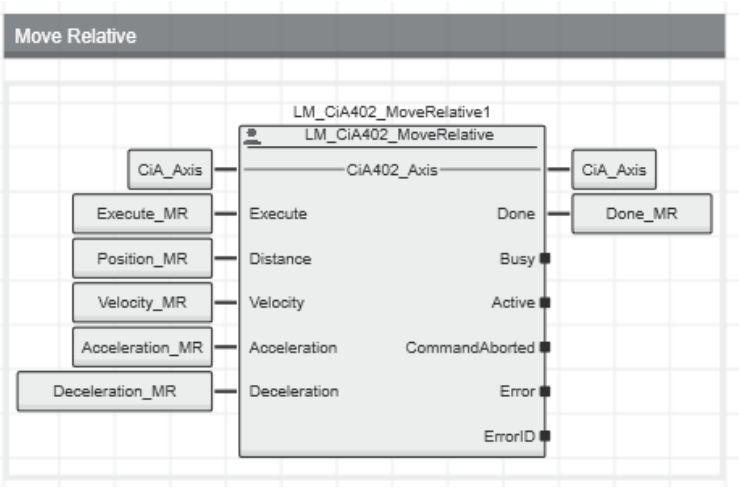
Inputs		
Name	**Data type**	**Description**
CiA402_Axis	CIA402_AXISSTRUCT	Axis reference (InOut)
Execute	BOOL	Execute command (rising edge)
Position	REAL	Target position in [Units]
Velocity	REAL	Max. velocity in [Units/s]
Acceleration	REAL	Acceleration in [Units/s^2]
Deceleration	REAL	Deceleration in [Units/s^2]

Outputs		
Name	**Data type**	**Description**
Done	BOOL	Command done / Fault reset
Busy	BOOL	Command active
Active	BOOL	Command active
CommandAborted	BOOL	Command was aborted by another command during execution
Error	BOOL	Error in function block
ErrorID	UINT	Error ID (see chapter 10.6.8 Error Descriptions)

Note: Profile acceleration (index 0x6083) and profile deceleration (index 0x6084) need to be added to the User Defined Outputs in the PDO Data. Otherwise the acceleration and deceleration defined in UPIDs 1727h and 1728h will be used for the move.

10.6.5 LM_CiA402_MoveRelative

The LM_CiA402_MoveRelative function block executes a relative move by the requested distance with the set maximal velocity, acceleration and deceleration.



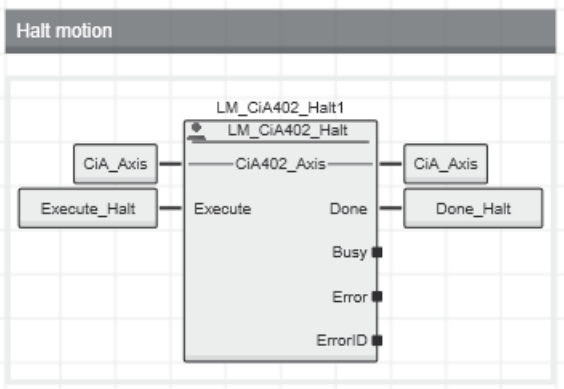
Inputs		
Name	**Data type**	**Description**
CiA402_Axis	CIA402_AXISSTRUCT	Axis reference (InOut)
Execute	BOOL	Execute command (rising edge)
Distance	REAL	Position increment in [Units]
Velocity	REAL	Max. velocity in [Units/s]
Acceleration	REAL	Acceleration in [Units/s^2]
Deceleration	REAL	Deceleration in [Units/s^2]

Outputs		
Name	**Data type**	**Description**
Done	BOOL	Command done / Fault reset
Busy	BOOL	Command active
Active	BOOL	Command active
CommandAborted	BOOL	Command was aborted by another command during execution
Error	BOOL	Error in function block
ErrorID	UINT	Error ID (see chapter 10.6.8 Error Descriptions)

Note: Profile acceleration (index 0x6083h) and profile deceleration (index 0x6084h) need to be added to the User Defined Outputs in the PDO Data. Otherwise the acceleration and deceleration defined in UPIDs 1727h and 1728h will be used for the move.

10.6.6 LM_CiA402_Halt

The LM_CiA402_Halt function block stops the axis while a move is in progress. See note.



Inputs		
Name	**Data type**	**Description**
CiA402_Axis	CIA402_AXISSTRUCT	Axis reference (InOut)
Execute	BOOL	Execute command (rising edge)

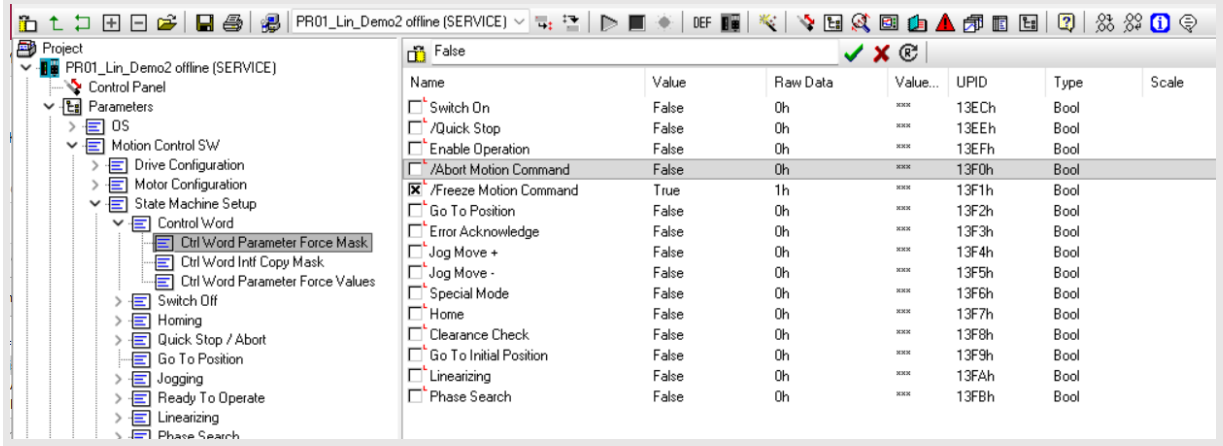
Outputs		
Name	**Data type**	**Description**
Done	BOOL	Command done / Homing completed
Busy	BOOL	Command active
Error	BOOL	Error in function block
ErrorID	UINT	Error ID (see section 10.6.8 Error Descriptions)

Note: The LM_CiA402_Halt function block sets the Halt bit = 0 in the Control Word (index 0x6040). The desired function in the drive must be enabled using CtrlWord Parameter Force Mask (UPID 13F0h & 13F1h).

For LinMot-Talk v6.15, LinMot-Talk v7.00 and later, either the Abort or Freeze function can be enabled.

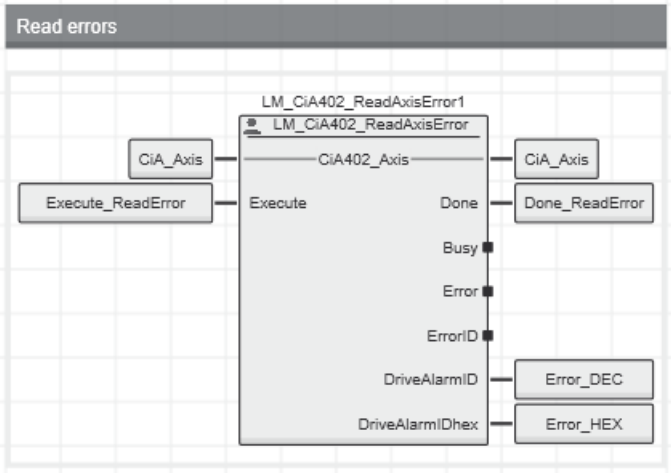
For LinMot-Talk v6.14 and earlier only Freeze function is possible. If the move should be aborted, then after executing the Halt, then a relative move with distance = 0 should be executed.

In the example below, the Abort is enabled and Freeze is forced by parameter. So when the LM_CiA402_Halt function block is executed, the drive will abort the currently active move.



10.6.7 LM_CiA402_ReadAxisError

The LM_CiA402_ReadAxisError function block reads the error code from the drive. Typically this function block is executed when the Fault bit is active in the Status word to determine the exact error code.



Inputs		
Name	**Data type**	**Description**
CiA402_Axis	CIA402_AXISSTRUCT	Axis reference (InOut)
Execute	BOOL	Execute command (rising edge)

Outputs		
Name	**Data type**	**Description**
Done	BOOL	Command done / Homing completed
Busy	BOOL	Command active
Error	BOOL	Error in function block
ErrorID	UINT	Error ID (see section 10.6.8 Error Descriptions)
DriveAlarmID	UNIT	Error code from drive (dec), see section 1.6 for drive error code information
DriveAlarmIDhex	WORD	Error code from drive (hex)

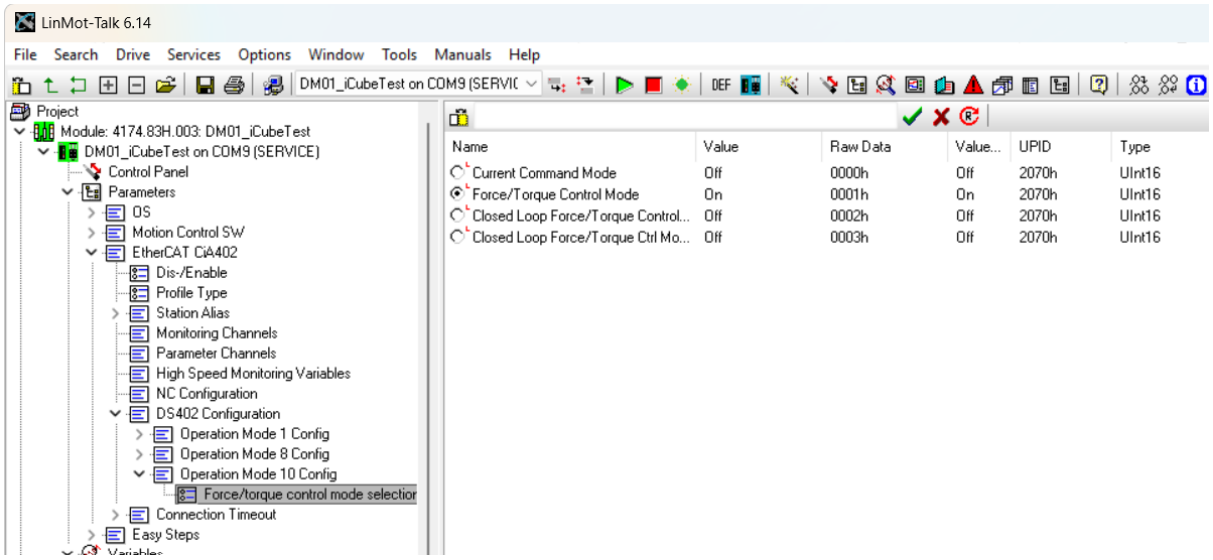
10.6.8 Error Descriptions

The error IDs of LM_CiA402 function blocks are as follows:

Error ID (dec)	Error text	Description
0101	Drive error	LinMot drive has a fault. Check error code from drive.
0102	State error	Axis is not in the expected state. - Check axis is enabled before executing home or move command.
0103 0104	Motion error Home MoveAbsolute or MoveRelative	Requested motion is not allowed. - Check homing not in progress. - Check no Halt command is active. - Check no other motion command is active.
0105	Input error	Function block input out of range. - Check block inputs don't exceed range of variable type - Check velocity, acceleration and deceleration not equal zero.
0106	Timeout error	Function block has timed out. - In case of Reset command, fault or warning is still active. Check error code from LinMot drive.
4414	Bus error	Network communication to drive is disrupted. Check fieldbus connection.
Other	Read error from ReadAxisError	Read error from Y_EC_COE_SdoRead function block. Check Yaskawa function block documentation.

10.7 Cyclic Sync Torque Mode (OpMode10)

This mode supports both open and closed loop Force / Torque control. The control mode is selected in the drive using UPID 2070h, whereby closed loop control is only possible with force / torque sensor in the motor and TF Force Control key installed in the drive.



To use this mode, enable the servo drive (Control Word = bin 0000 0000 0000 1111 / dec 15) and set the operation mode to 10. Set the target torque to the desired value. The scale for force/torque values is 10, so to set the limit to 100%, the positive and negative torque limit should be set to 1000.

Note:
The maximum Torque/force Limit value is **5000 (500.0%)** and corresponds to the **maximal Current** of the connected motor. The value **1000 (100.0%)** corresponds approximately to the **nominal Current** of the motor.

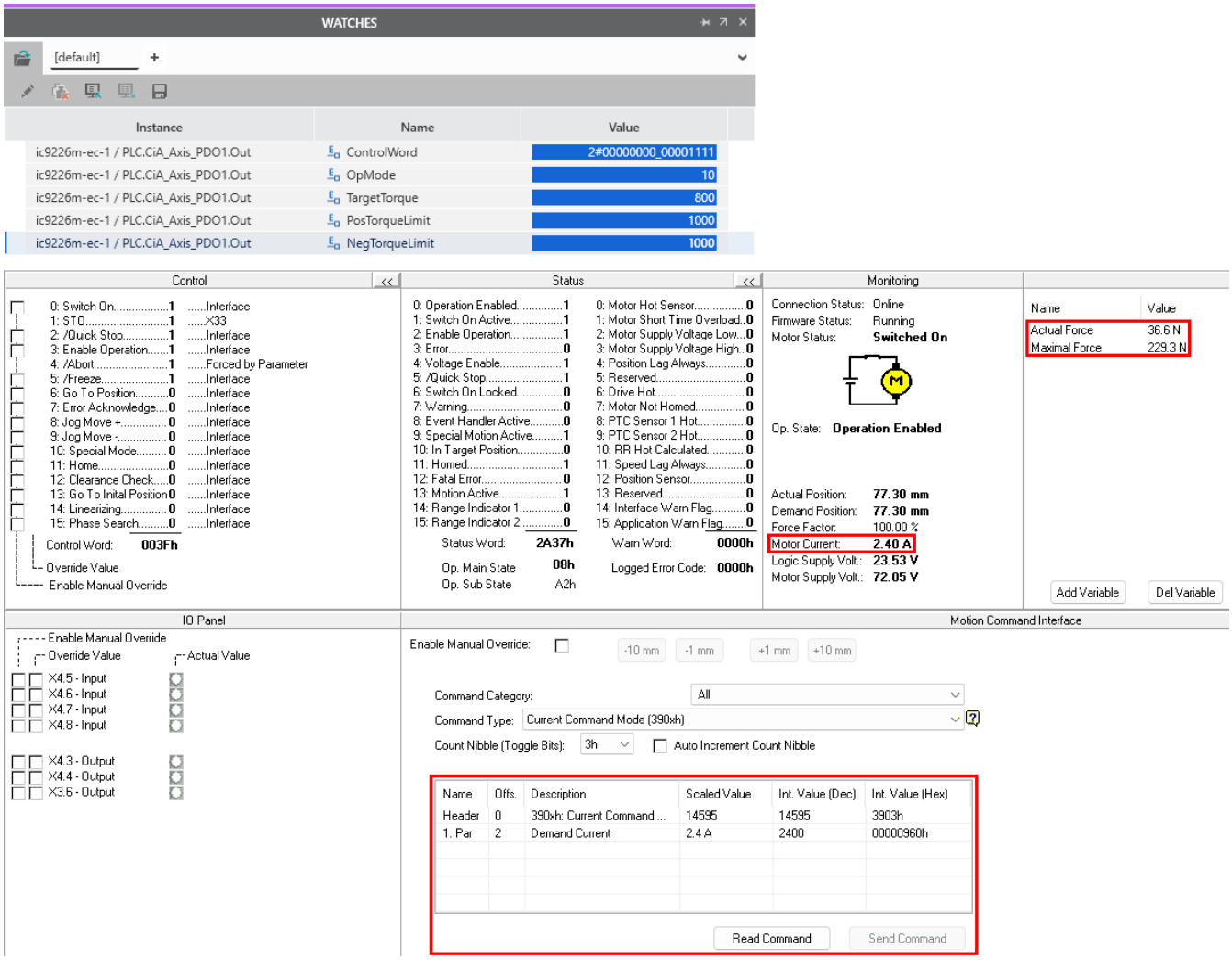
Example 1:

Torque/Force Limit Positive:	**1000 (100.0%)**
Motor Maximal Current:	15.0 A
= Max. Current Positive:	3.0 A

Example 2:

Torque/Force Limit Negative:	**5000 (500.0%)**
Motor Maximal Current:	15.0 A
= Max. Current Negative:	15.0 A

The image below shows an example of a linear motor with a maximum force of 229.3 N and a maximum current of 15 A. Setting the target torque to 80% results in a force of 36.69 N (229.3 N * 80 / 500) and a current of 2.4 A (15 A * 80 / 500).



10.8 Asynchronous Parameter Access with SDO commands

Parameters of the LinMot drive can be accessed using the Yaskawa function blocks *Y_EC_COE_SdoRead* and *Y_EC_COE_SdoWrite* which are part of the *Y_EtherCAT* library.

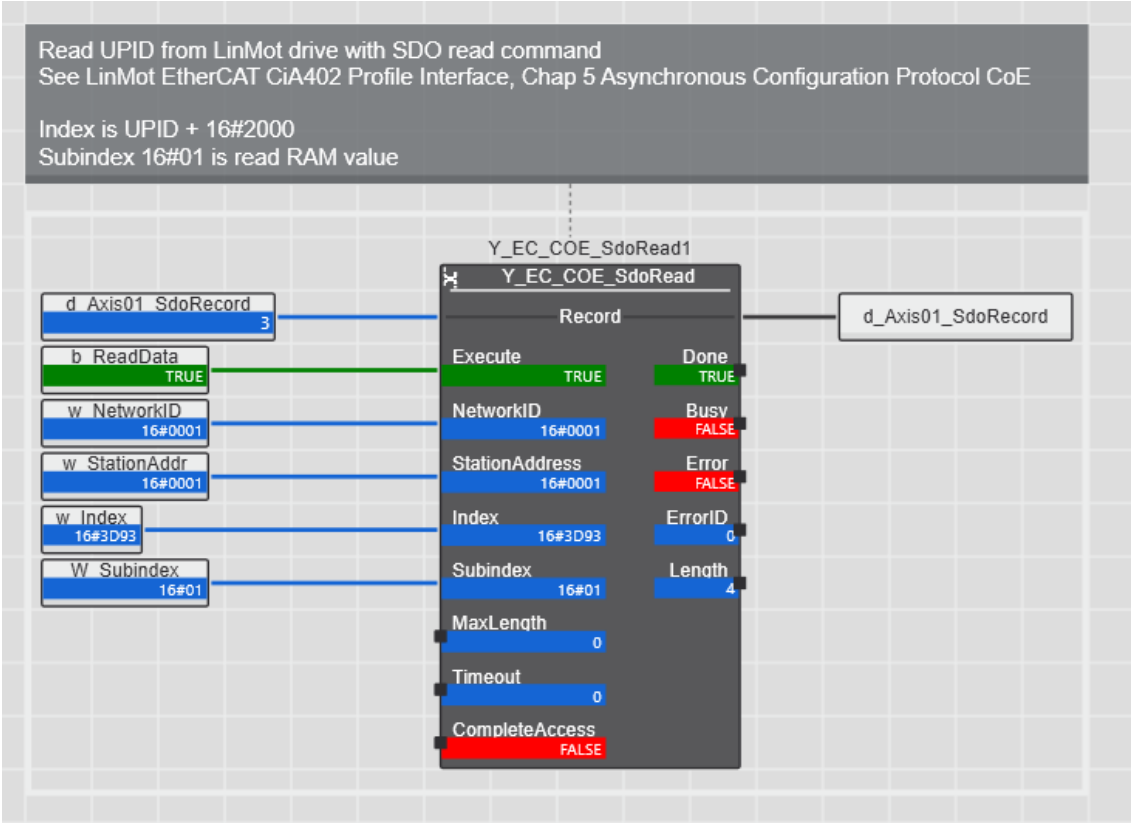
More information about these function blocks can be found in the iCube Engineer online help.
https://www.icubecontrol.com/help.html

More Information about reading and writing parameters (UPIDs) on the LinMot drive can be found in the respective EtherCAT CiA402 Profile Interface Manual, in the chapter titled “Asynchronous Configuration Protocol CoE”. Search for the drive on http://shop.linmot.com and look in the section with Software documentation.

The important parameters and suggested values for *Y_EC_COE_SdoRead* and *Y_EC_COE_SdoWrite* are listed below.

Name	Data type	Description
Record	DINT	Variable for data which is read (InOut)
Execute	BOOL	Execute command (rising edge)
NetworkID	WORD	Network ID of EtherCAT master, default = 1
StationAddress	WORD	EtherCAT station address of the LinMot drive
Index	WORD	UPID + 2000h
Subindex	WORD	01h is subindex to read/write RAM value, for other SDO services see list in chapter 13.8 for Beckhoff TwinCAT
MaxLength	UDINT	Max number of bytes to be read. Value of 0 causes size of Record data type to be used, i.e. 4 bytes
Timeout	UINT	Timeout value in ms. A value of 0 will be treated as default 5000ms.
Complete Access	BOOL	Defines whether to read/write only a single sub-index or entire object. Use value = FALSE

The example below uses *Y_EC_COE_SdoRead* to read the value of the Error Code (UPID 1D93h).



11 Drive Profile: Rockwell Automation Motion (CIP Sync Motion)

11.1 Overview

LinMot drives with *LinMot EtherNet/IP CIP Sync* interface installed (e.g., C1250-CM-XC-1S or C1250-MI-XC-1S) can be integrated and setup in a Rockwell Automation environment as a motion axis.

Download:
A ZIP package including EDS files, demo projects and detailed documentation can be found here:
http://download.linmot.com/plc_lib/examples/Rockwell_CM/ (LinMot_Rockwell_AOI_Set_2Vx...)

Note:
More information and step by step guides can be found in the project documentation (part of the above-mentioned download) and in the user manual Ethernet/IP (0185-1165, see chapter 1.7 Documentation / User Manuals)

EDS Files:
EDS files for **-CM** and **-MI** drives located by default:
\\LinMot-Talk X.X Build XXXXXXXX\Firmware\Interfaces\EtherNetIP_NX\EDS

Image Source: http://www.rockwellautomation.com/

EtherNet/IP is an industrial Ethernet network that implements the Common Industrial Protocol (CIP).

For further information on EtherNet/IP please visit:
http://www.odva.org

YouTube video series (LinMot Integration – Rockwell Automation CIP Sync):
https://youtube.com/playlist?list=PLMSLCScLnf95PmjyZv8sl6zuHKhci8uln

!!! Mandatory Prerequisites !!!
- Rockwell Automation controller revision must be **V30 or later for coordinated motion**
- Minimum Rockwell Automation controller revision **for no coordinated motion is V20**
- LinMot drive firmware **6.12 Build 20230803 or later**

Attention:
With Studio 5000 V36 Rockwell Automation has changed the EDS subsystem which caused some EDS to stop working correctly. ***If Studio 5000 V36 or later is installed on your computer, please install the according EDS file version ending with …_1V2.eds. Also install Studio 5000 V36.01, V37.00 or later.*** See Rockwell Knowledgebase article BF30248 “Studio 5000 Logix Designer updating EDS AOP module” for more information.

12 Drive Profile: Siemens TIA, PROFIdrive

12.1 Overview

This chapter shows how a LinMot drive with *PROFIdrive* interface (e.g., a C1250-MI-XC-1S) can be integrated and setup in SIEMENS TIA Portal using SIEMENS Telegram 105. For this example, TIA 15 and a S7-1517F-3 PN/DP is used.

Download:
An example project can be downloaded from:
http://download.linmot.com/plc_lib/examples/Siemens_PD/

Components used:

- LinMot C1250-PD-XC-1S-000 (article number 0150-2619) with firmware 6.10 Build 20210521
- CPU 1517F-3 PN/DP (article number 6ES7 517-3FP00-0AB0) with firmware V 2.6.1
- TIA Portal V15.1 Update 4

Image Source: https://mall.industry.siemens.com

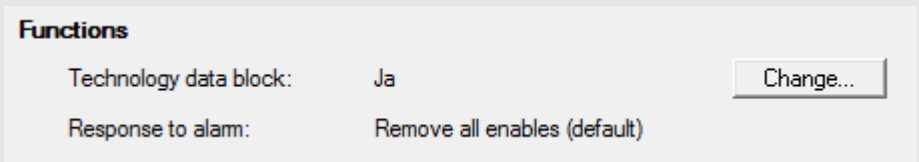
PROFINET is an open real-time Ethernet network
The LinMot drive acts as slave in this network and is implemented with the TPS1 chip from Renesas.

For further information on PROFINET and the PROFIdrive fieldbus protocols please visit:
http://www.profibus.com/

YouTube video series (LinMot Integration – Siemens PROFIdrive):
https://youtube.com/playlist?list=PLMSLCScLnf97_39VIYddSsIm57rr-N0su

Attention:
SIEMENS Telegram 105 requires firmware 2.0 and higher installed in the S7-1500 CPU. Some older S7-1500 hardware revisions do not support firmware 2.0. In that case use Standard Telegram 5.

Note:
From firmware 6.6 Build 20170522 the LinMot drive supports the SIEMENS Technology data block:



12.2 Configuration and Connection of the LinMot Drive

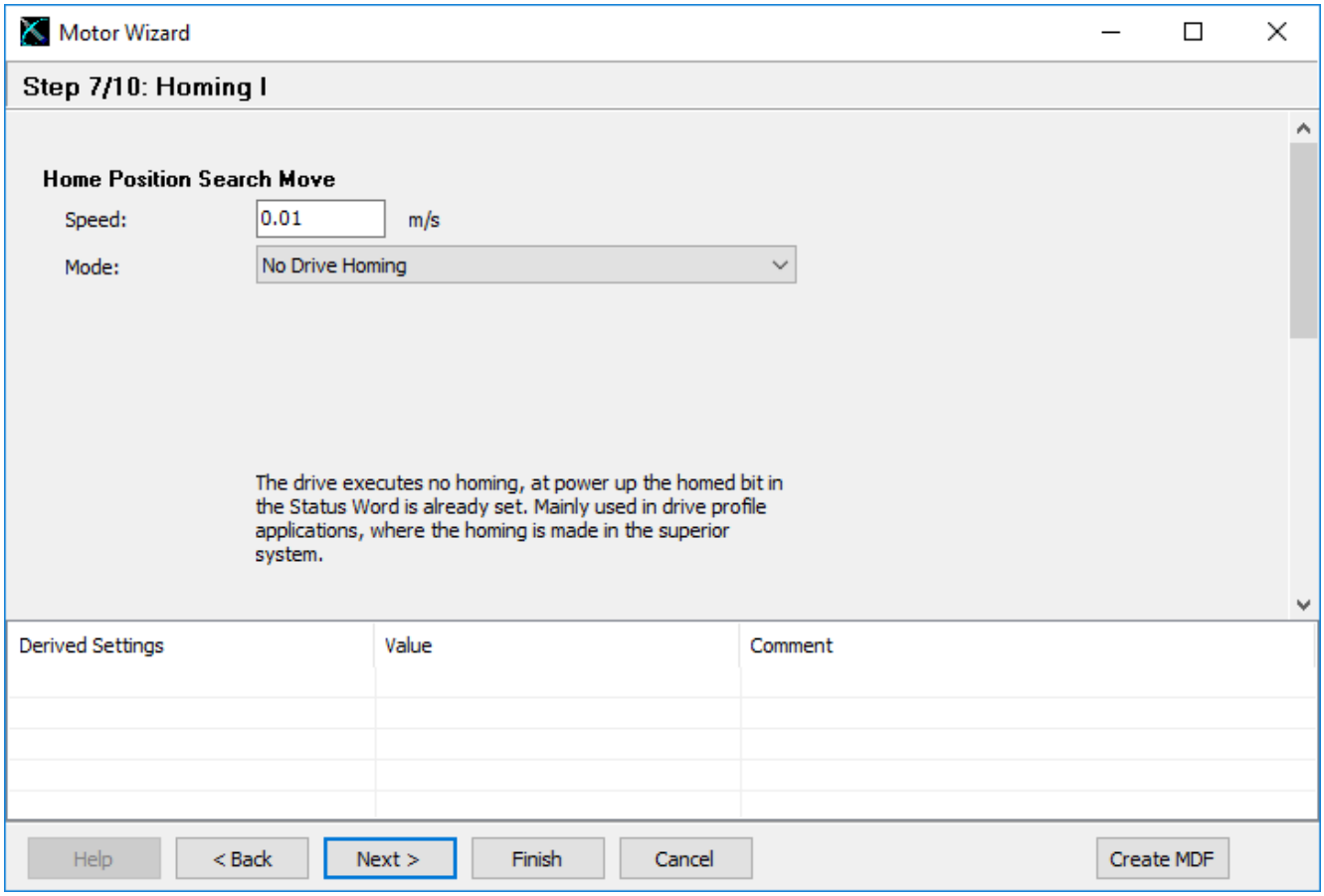
The LinMot drive is configured using the LinMot-Talk software:
http://www.linmot.com/download/linmot-talk-drive-configuration/

12.2.1 Motor Configuration

It is assumed that the motor connected to the drive is already configured.

Use the *Motor Wizard* inside LinMot-Talk to setup the motor (Menu -> Drive -> Motor Wizard):

Make sure that you select “No Drive Homing” in the Motor Wizard as with SIEMENS Telegram 105 the homing of the axis is done in the PLC.



See Appendix I: Basic Position Control Loop Tuning

12.2.2 GSDML File

Install the GSDML file that is part of the LinMot-Talk software/firmware you are using.
The most recent device files are always part of the newest LinMot-Talk software. They are located by default:

- PROFIdrive: \\LinMot-Talk X.X Build XXXXXXXX\Firmware\Interfaces\ProfiNet_Nx\GSDML_PD
  (-MI drives)
- PROFIdrive: \\LinMot-Talk X.X Build XXXXXXXX\Firmware\Interfaces\ProfiNet\GSDML_PD

12.2.3 PROFINET Connection

The drive is connected to the PROFINET network using the X17 (Port1, IN) & X18 (Port 2, OUT) connectors.

X17 – X18	RealTime Ethernet 10/100 Mbit/s	
	X17 RT ETH In	SIEMENS: Port 1, X1.X1
	X18 RT ETH Out	SIEMENS: Port 2, X1.X2
RJ-45		

12.3 PLC Setup

12.3.1 Install GSDML File(s)

The GSDML files for the drives are located by default in the LinMot-Talk installation path:

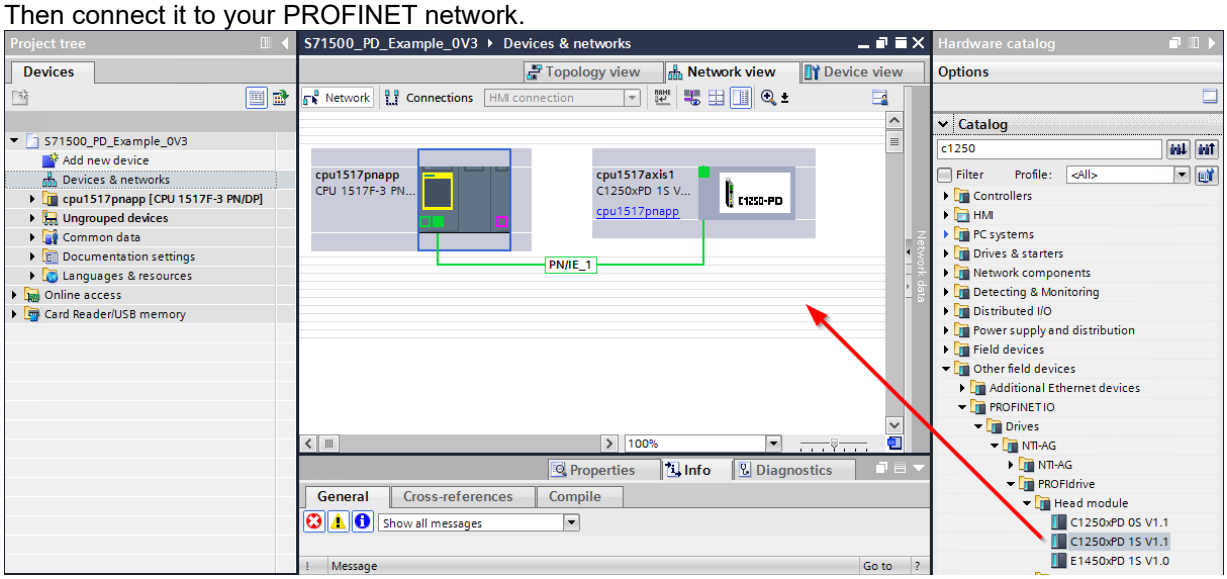
C:\Program Files (x86)\LinMot\LinMot-Talk …\Firmware\Interfaces\ProfiNet_Nx\GSDML_PD (-MI Drives)

C:\Program Files (x86)\LinMot\LinMot-Talk …\Firmware\Interfaces\ProfiNet\GSDML_PD (-PD Drives)

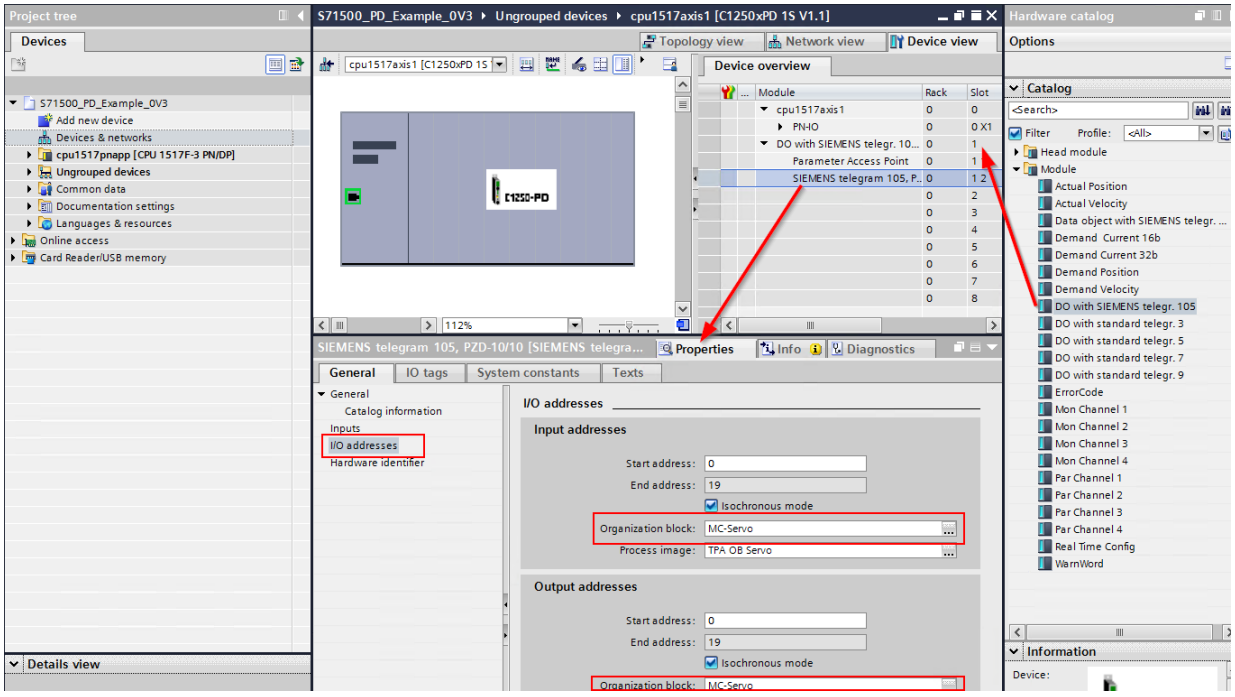
In TIA Portal select in the menu bar “Options > Manage general station description files (GSD)” and navigate to the directory you have put the GSDML file(s) in.

12.3.2 Insert the LinMot Drive as Device (-PD Drives)

Select the LinMot C1250-PD-XC-1S drive from the catalogue and drag&drop it to the network view.
Then connect it to your PROFINET network.



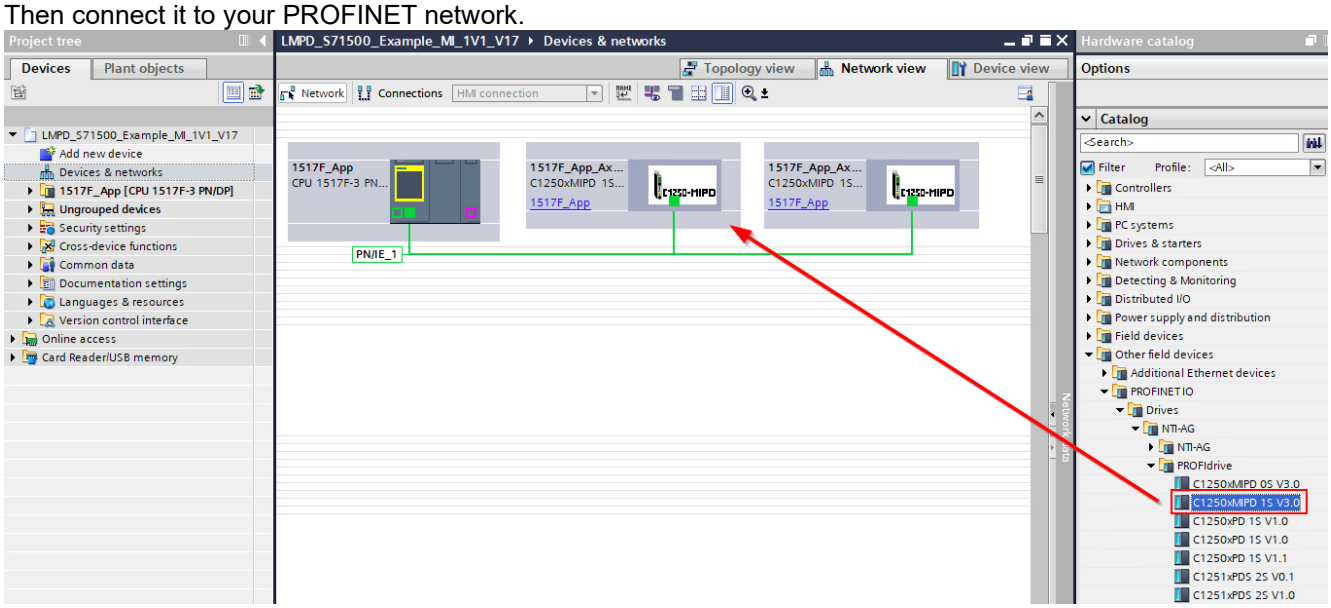
Add the SIEMENS Telegram 105 module in the device view to slot 1 and select the MC-Servo OB under I/O addresses:



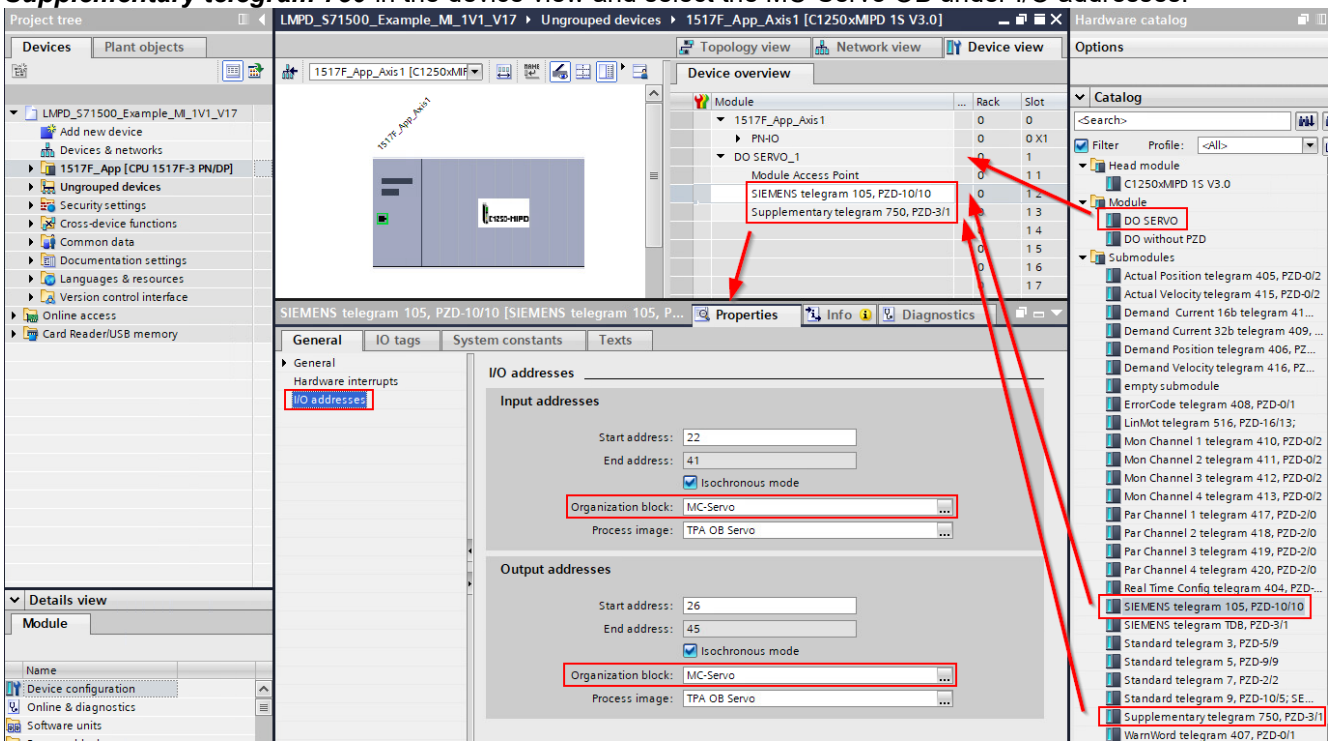
12.3.3 Insert the LinMot Drive as Device (-MI Drives)

Select the LinMot C1250-MI-XC-1S (C1250xMIPD 1S V3.0) drive from the catalogue and drag&drop it to the network view.

Then connect it to your PROFINET network.

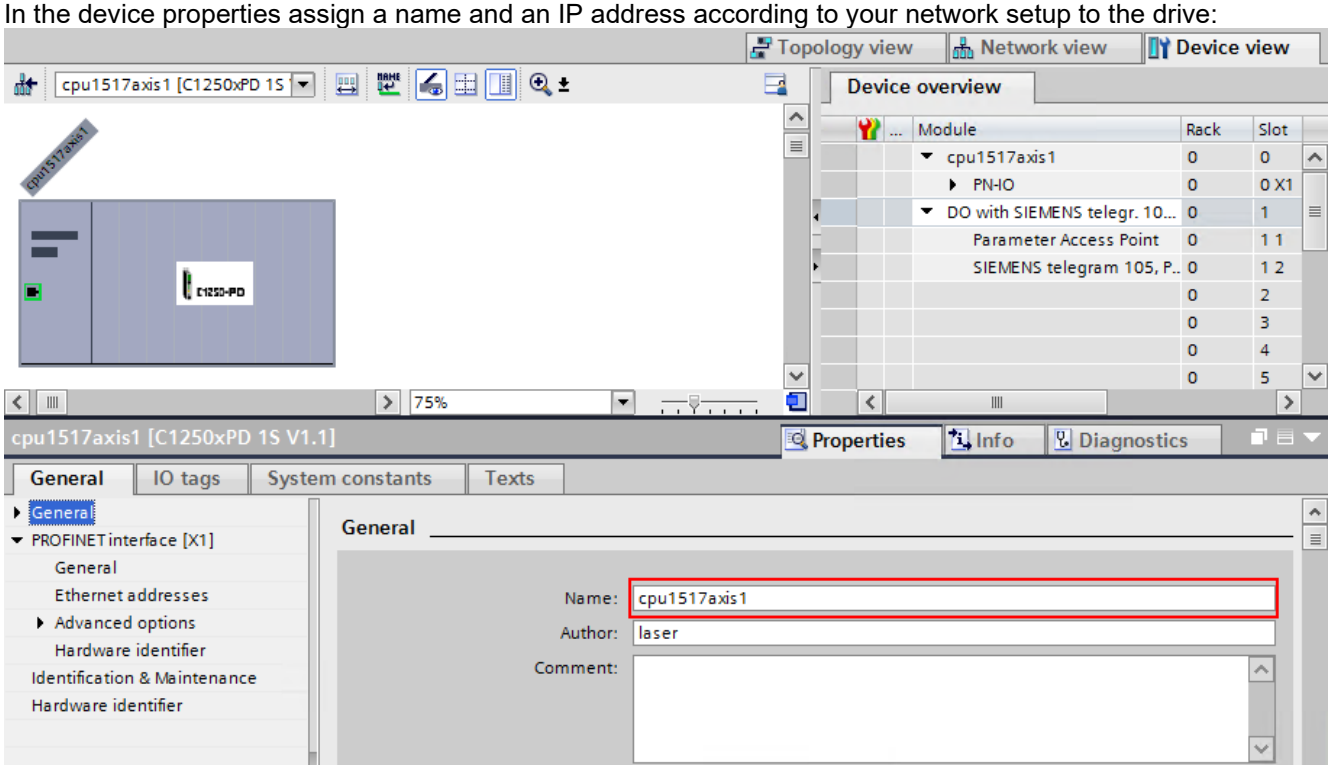


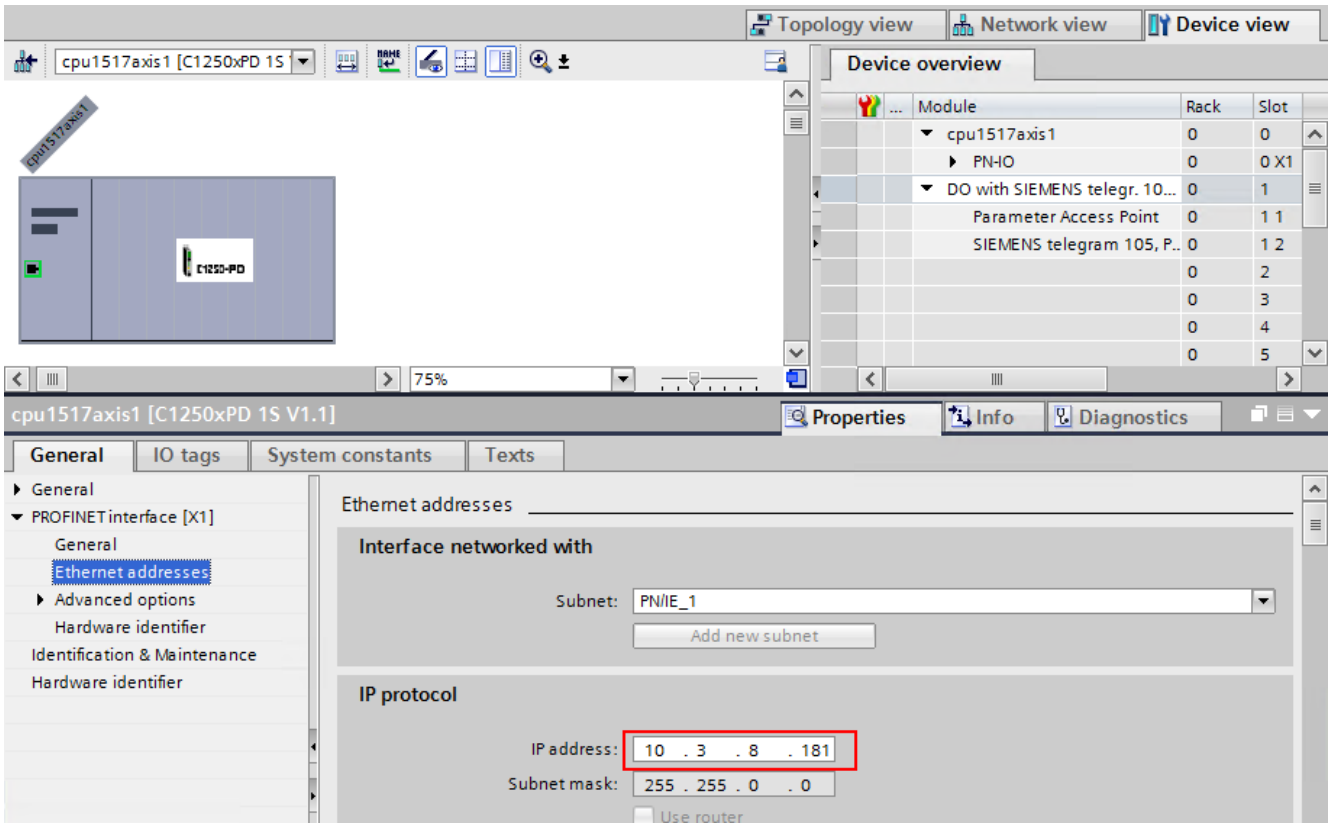
Add the ***DO Servo Module*** and afterwards the submodule ***SIEMENS telegram 105*** and optionally ***Supplementary telegram 750*** in the device view and select the MC-Servo OB under I/O addresses:



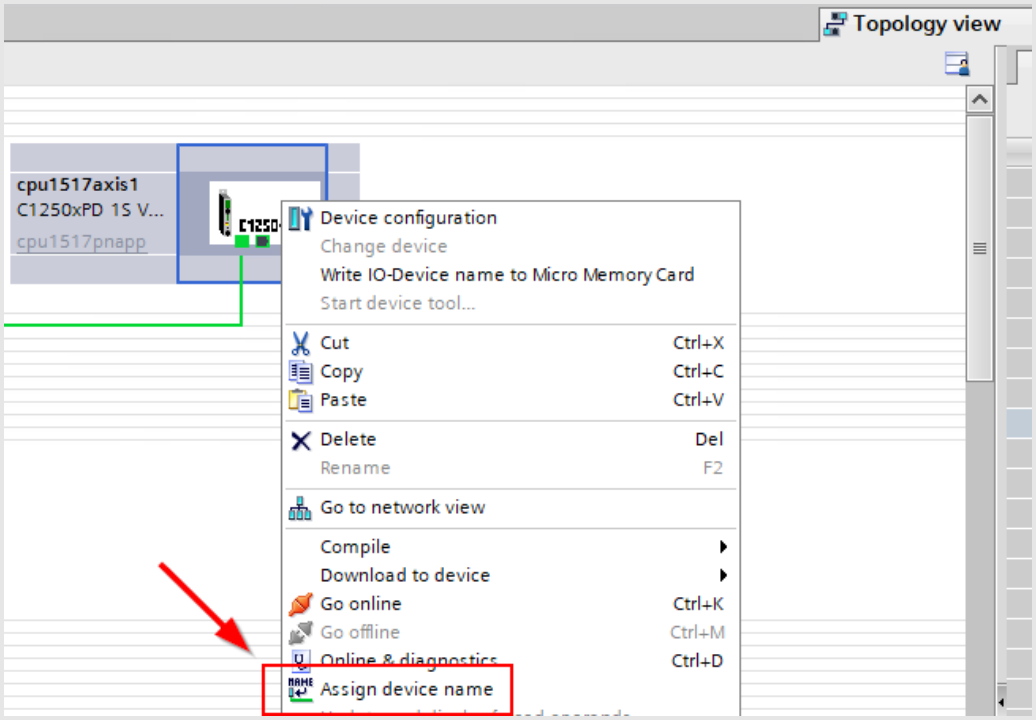
12.3.4 Set PROFINET Name and IP Address

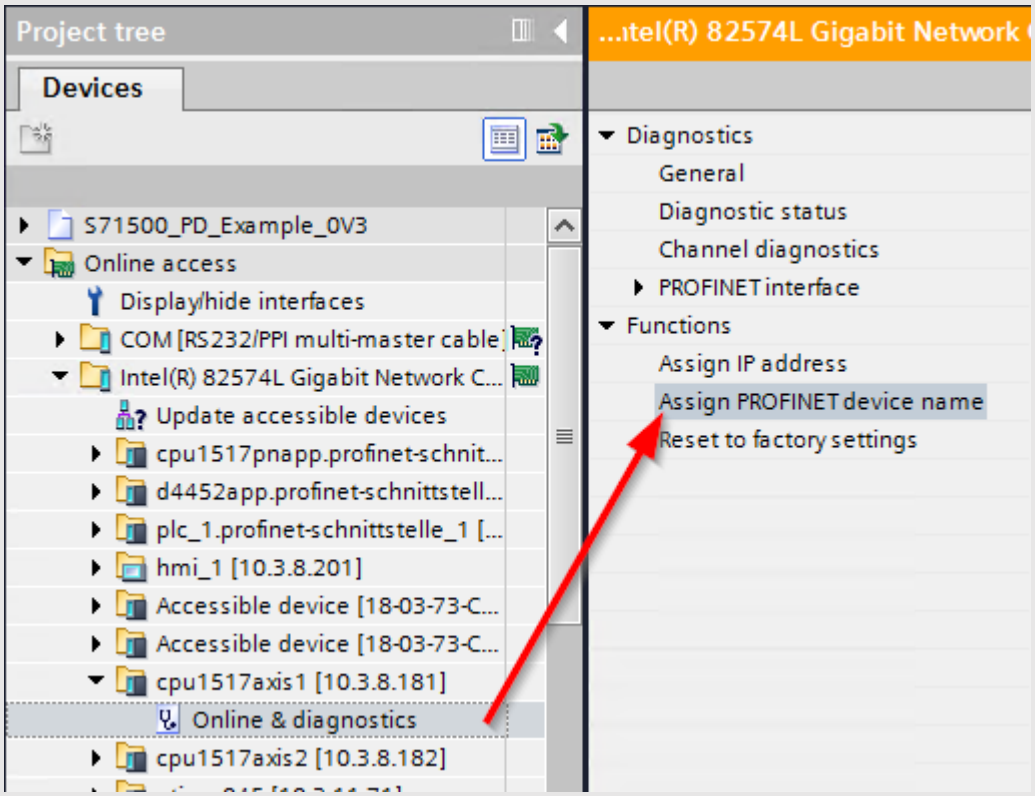
In the device properties assign a name and an IP address according to your network setup to the drive:





Note:
If the PROFINET device name is not assigned automatically you can either right-click the device in the topology view and select “Assign device name” or in the project tree under “Online access”.

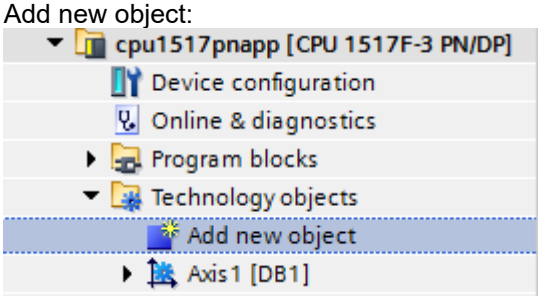




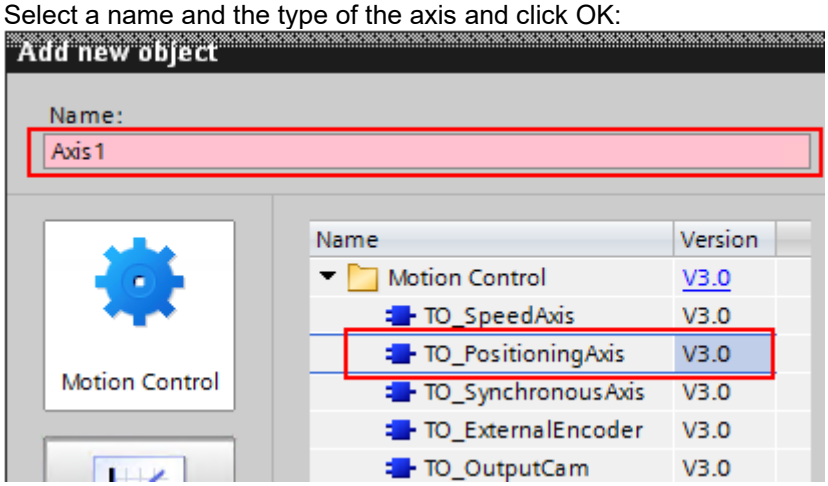
Normally the PROFINET name and IP address are assigned automatically to the devices if the topology is defined.

12.3.5 Insert and Setup a new Technology object (Linear Axis)

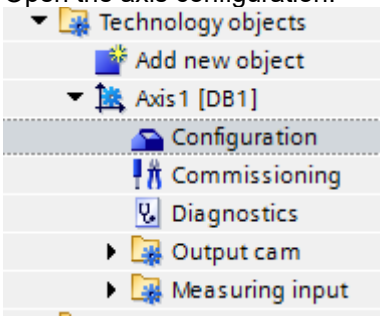
1. Add new object:



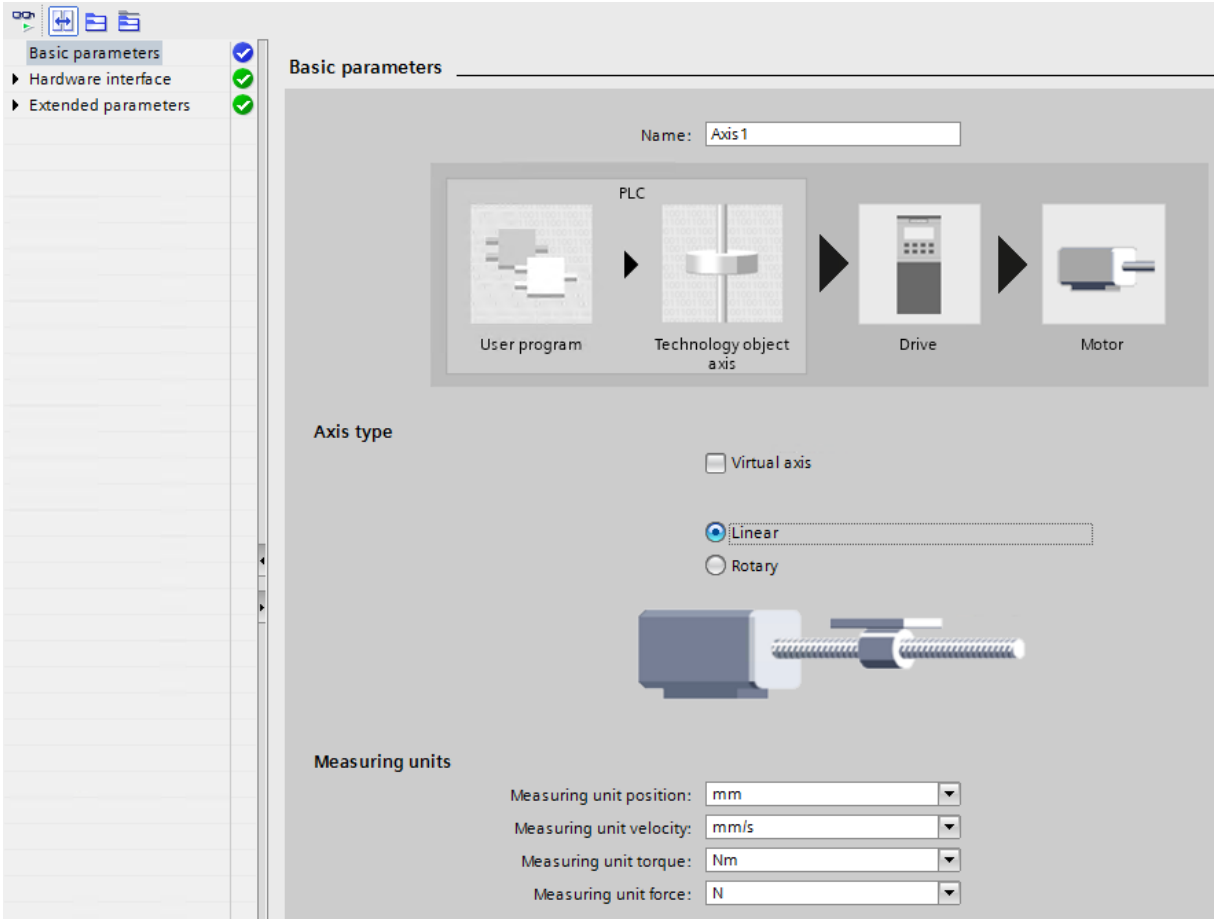
2. Select a name and the type of the axis and click OK:



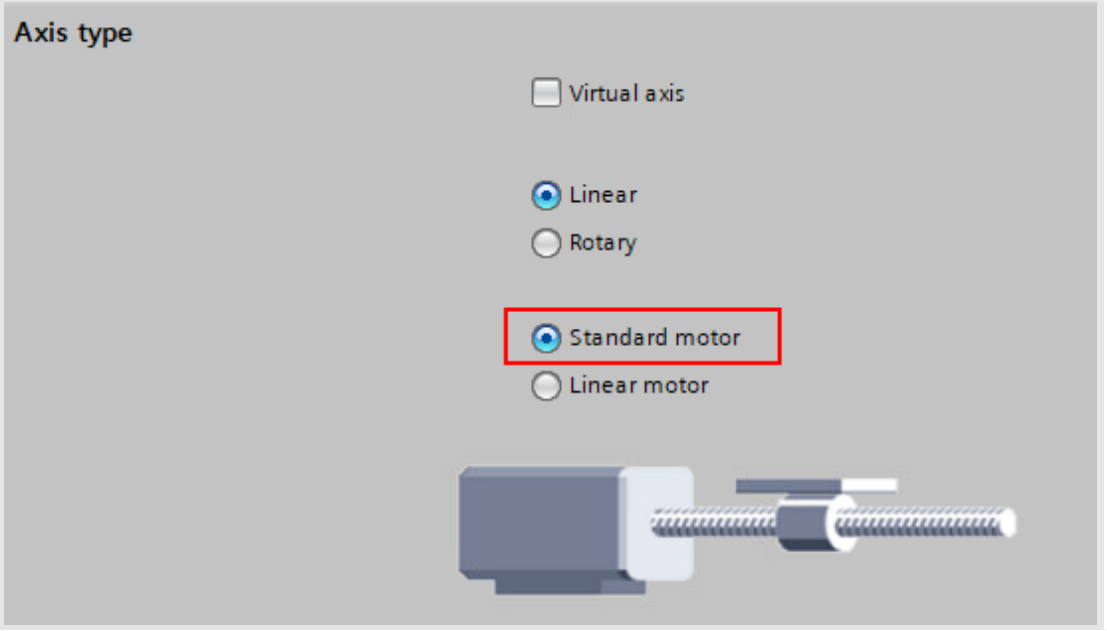
3. Open the axis configuration:



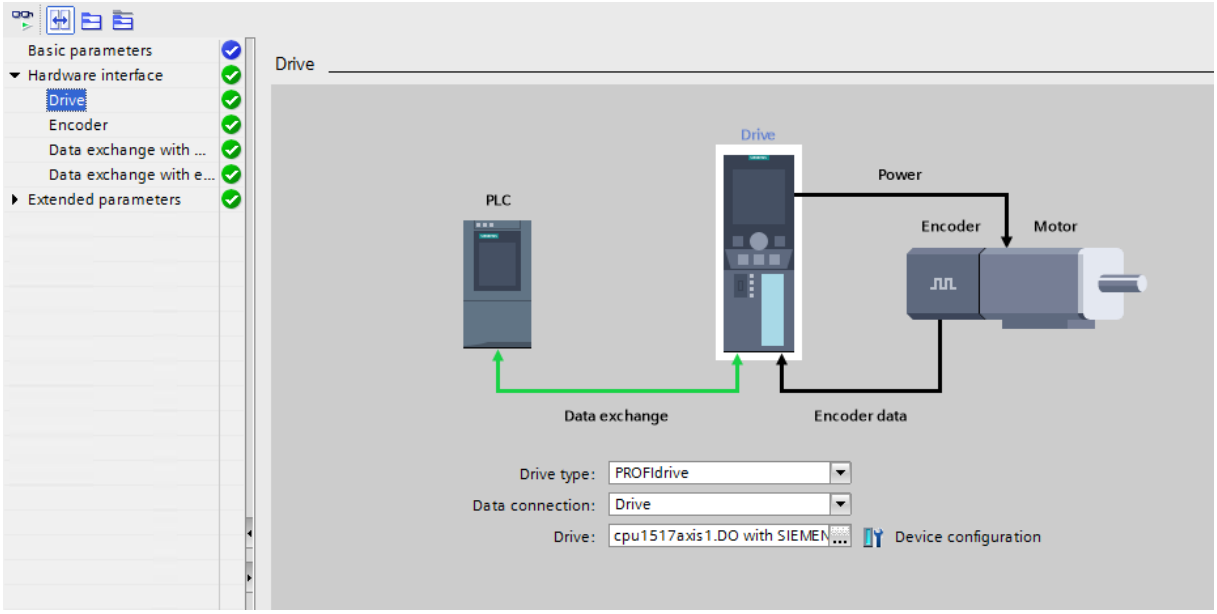
4. Basic Parameters:



Note:
From TO version V6.0 there is a new option to select “Standard motor” or “Linear motor”.
Choose “Standard motor”

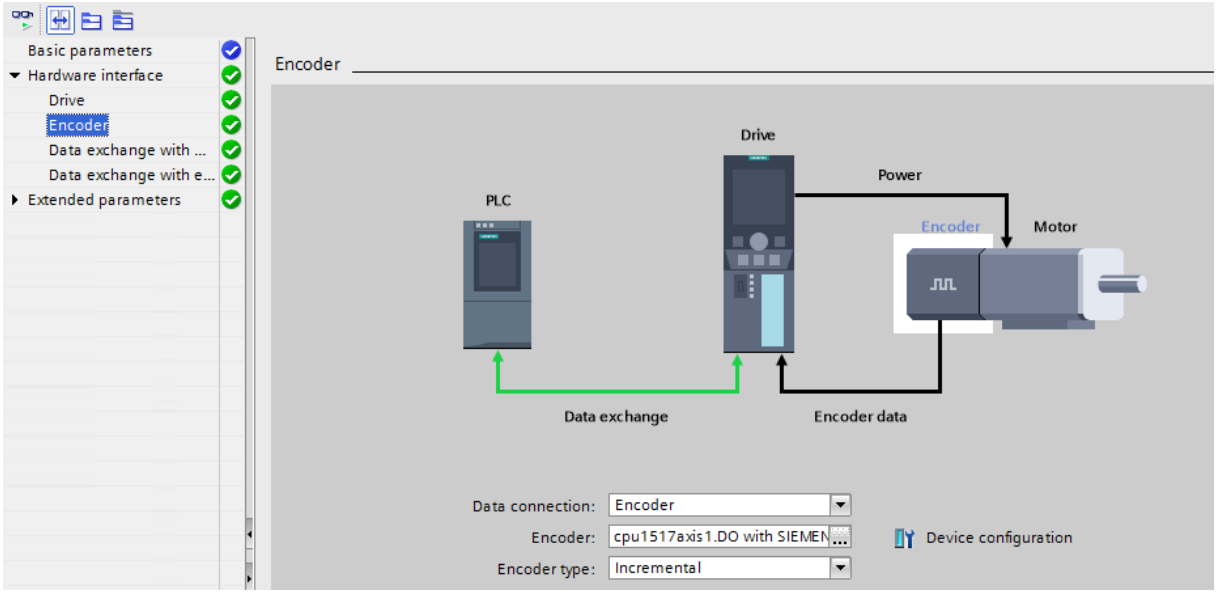


5. Hardware Interface > Drive:



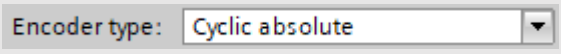
Note:
Make sure the correct drive is selected.

6. Hardware Interface > Encoder:



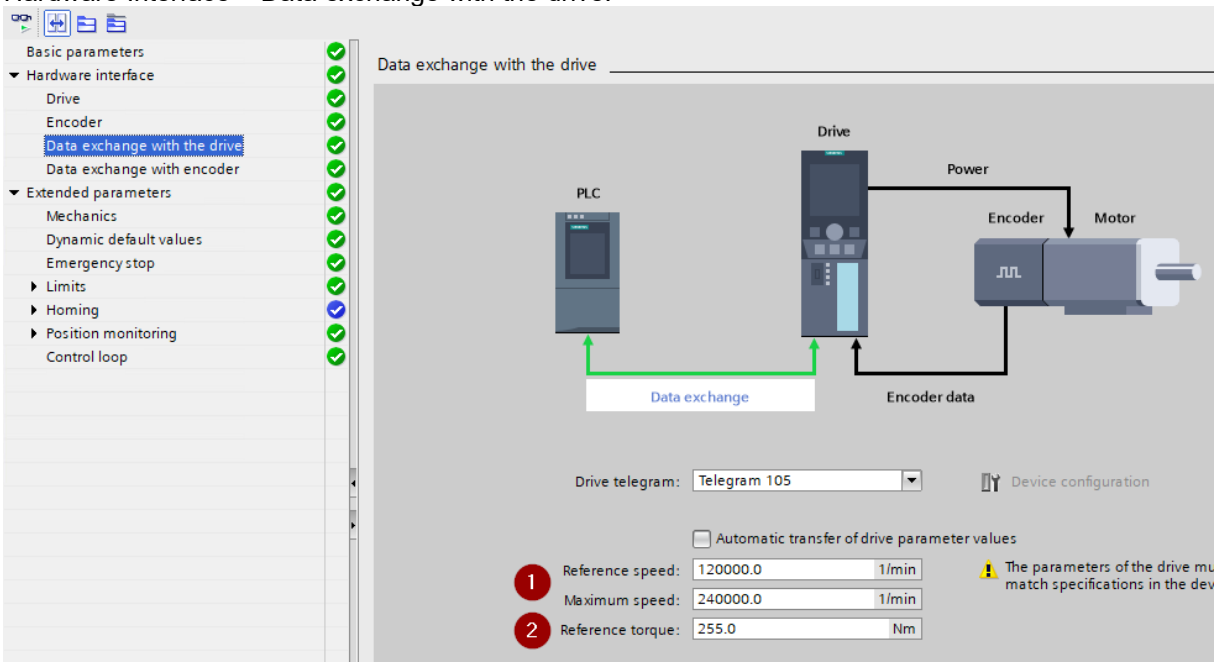
Set Encoder type to *"Incremental"*

Note:
If an absolute encoder is connected to the LinMot drive, select "Cyclic absolute" as Encoder Type.

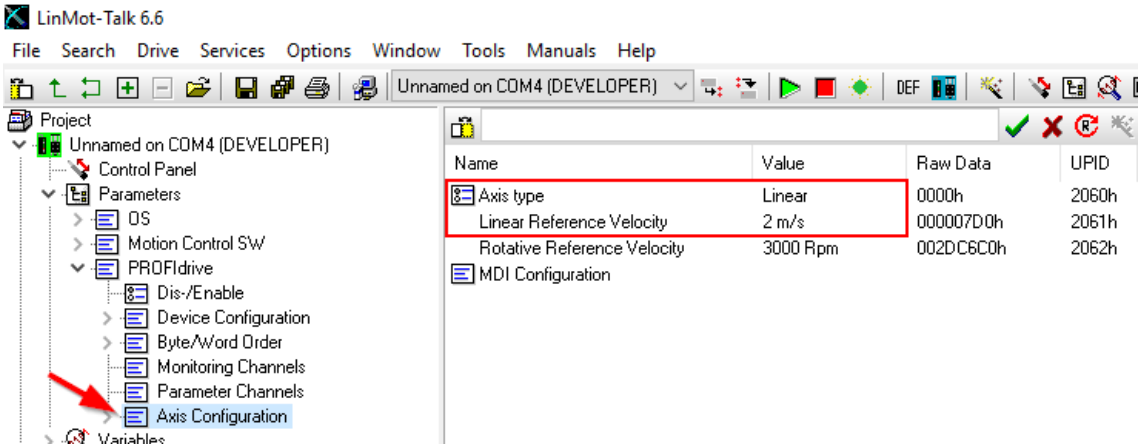


Please also check the note in chapter 12.4.3 Application based example to home a LinMot Linear Axis**!**

7. Hardware Interface > Data exchange with the drive:

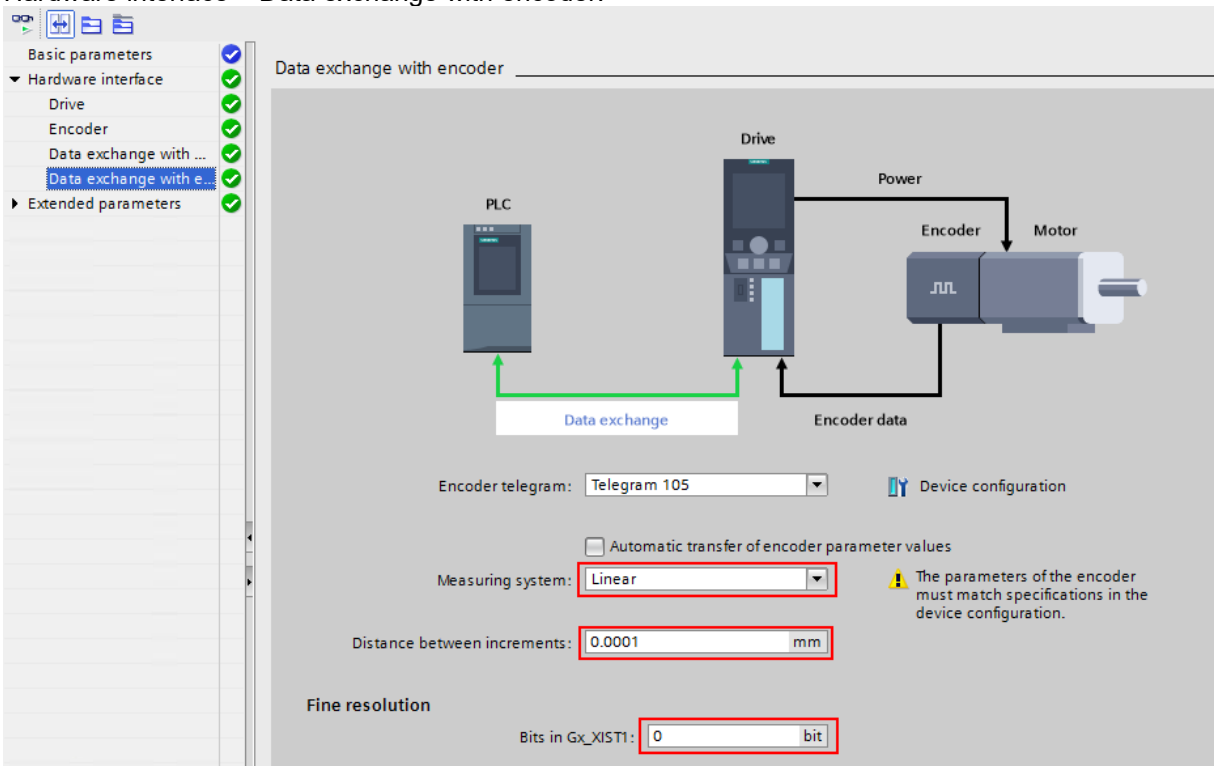


1: Set the reference speed according to the setting within the drive.
E.g., drive: 2 m/s => 2000 mm/s * 60 = 120’000 1/min



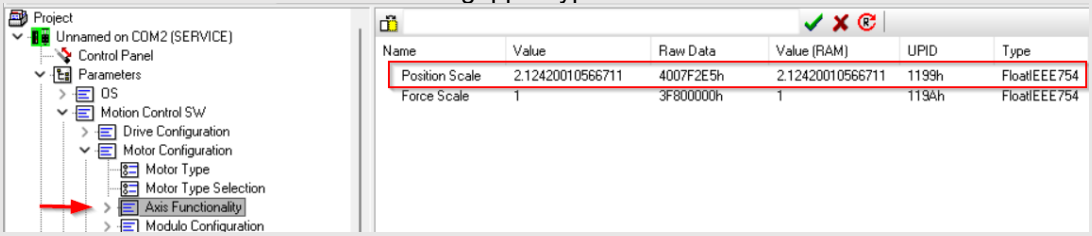
2: Set to the maximum force of the motor.
This value can be found in the data sheet of the connected motor (*Max. Force @72VDC*).
The motor in this example has 255 N peak force.

8. Hardware interface > Data exchange with encoder:



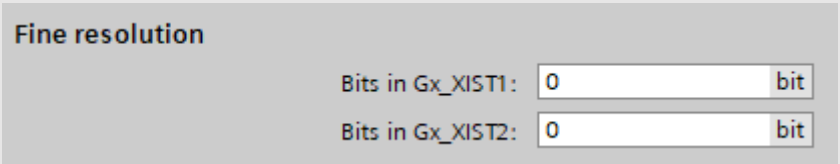
The internal resolution of the LinMot drive is 0.1um.

Note for GM01 / GM5x Gripper:
The LinMot grippers have in general an absolute encoder. The position scaling factor must be read out from UPID 1199h for each gripper type:



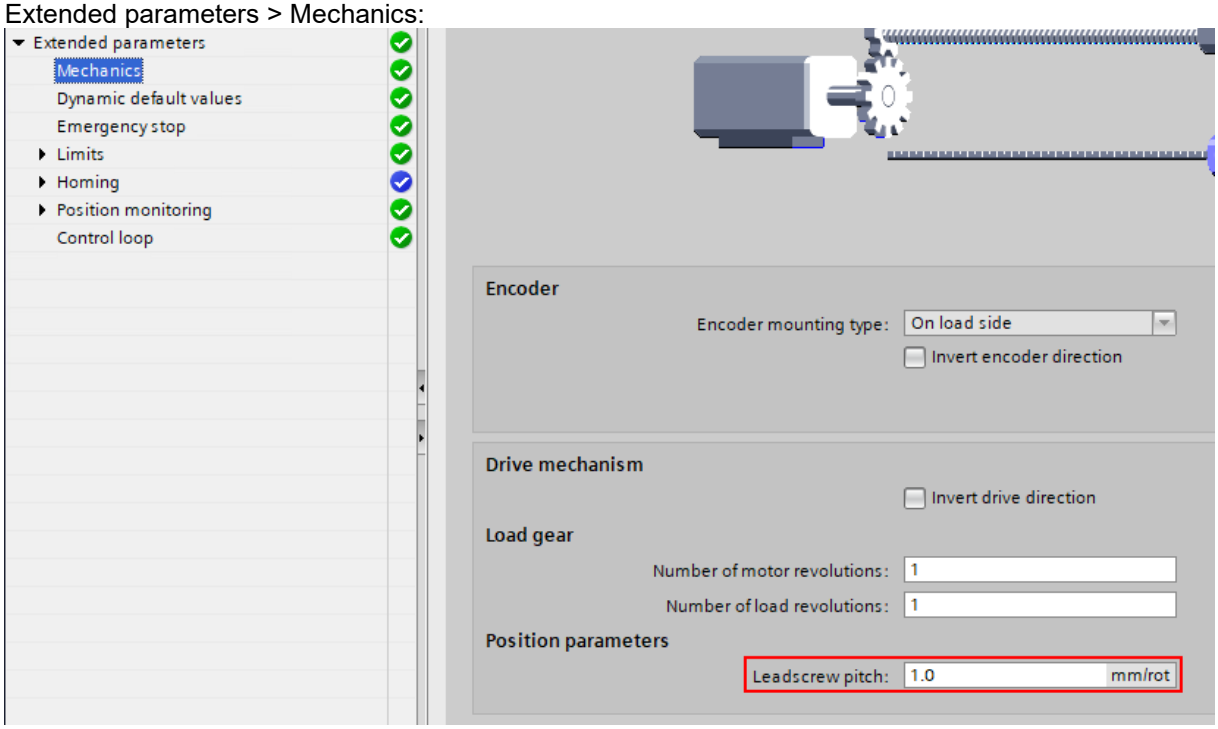
In this case the *Distance between increments* must be set to **0.00021240010**… (= 2.124…* 1mm / 10’000 Increments)

Note:
If an absolute encoder is connected to the LinMot drive and setup in *Hardware Interface* > *Encoder,* then set the fine resolution for both *Gx_XIST1* and *Gx_XIST2* to **0 bit**.



Please also check the note in chapter 12.4.3 Application based example to home a LinMot Linear Axis**!**

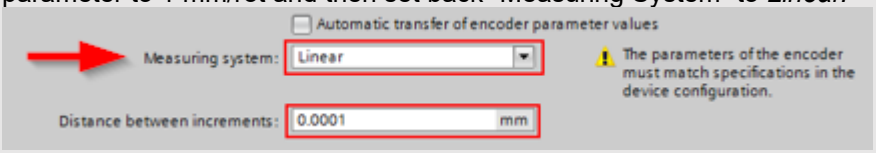
9. Extended parameters > Mechanics:



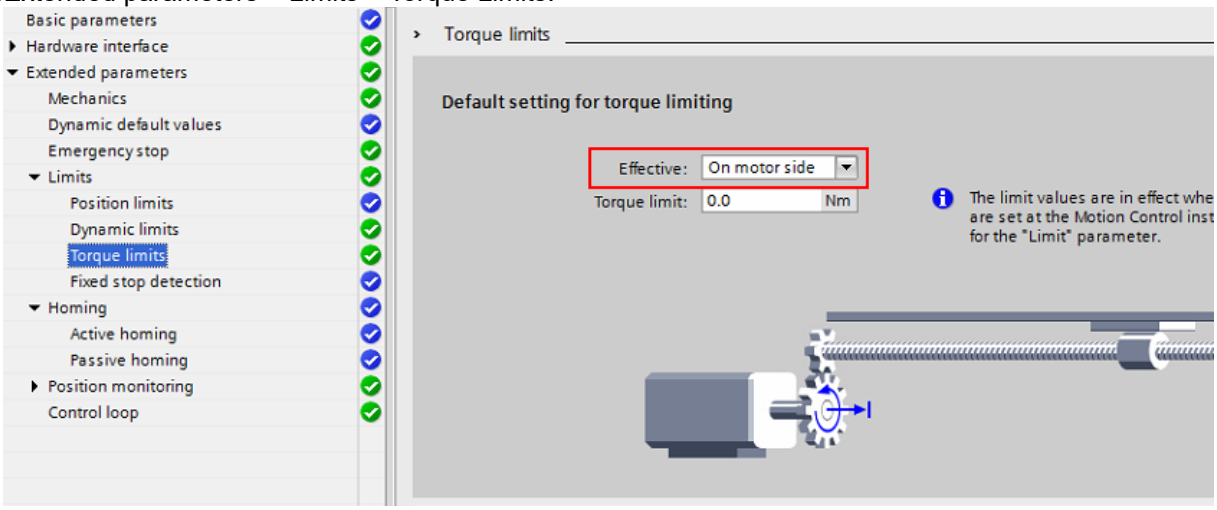
Make sure the Leadscrew pitch is set to 1 mm/rot.

Attention TIA16:
In TIA16 this parameter is not shown any more if the “Measuring system” is set to *Linear*. This seems to be a bug in TIA16 as the original value (10mm/rot) is taken anyway.

Workaround: Set in **Step 8. above** the “Measuring System” to *Rotary*, change the parameter to 1 mm/rot and then set back “Measuring System” to *Linear.*



10. Extended parameters > Limits > Torque Limits:

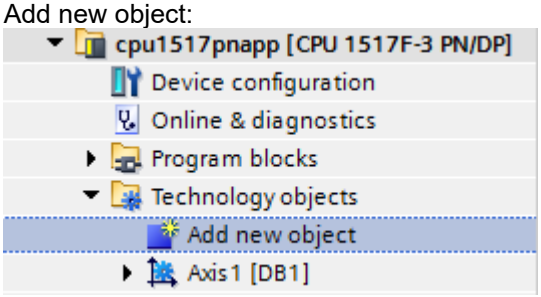


Set Effective to *On motor side.*

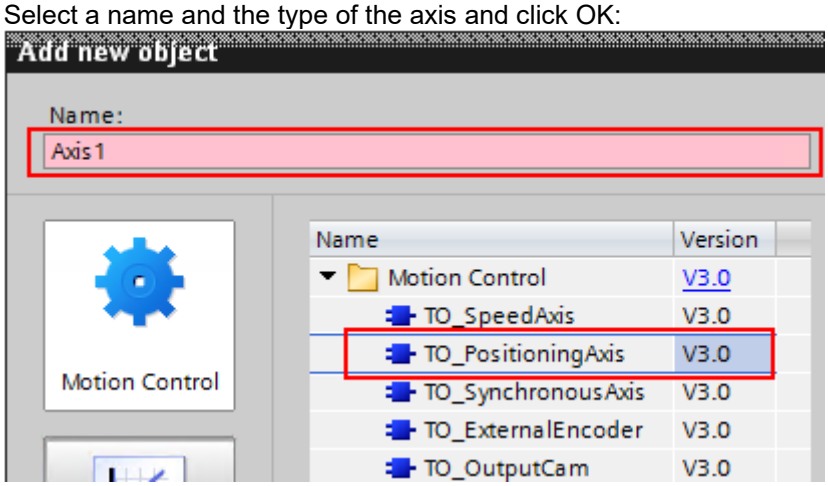
12.3.6 Insert and Setup a new Technology object (Rotary Axis)

In this example we setup a RS01-52x40 motor (rotary part of a LinMot PR01-52x40…)

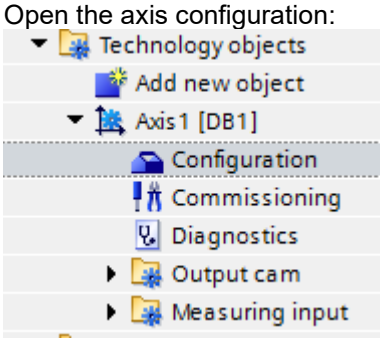
1. Add new object:



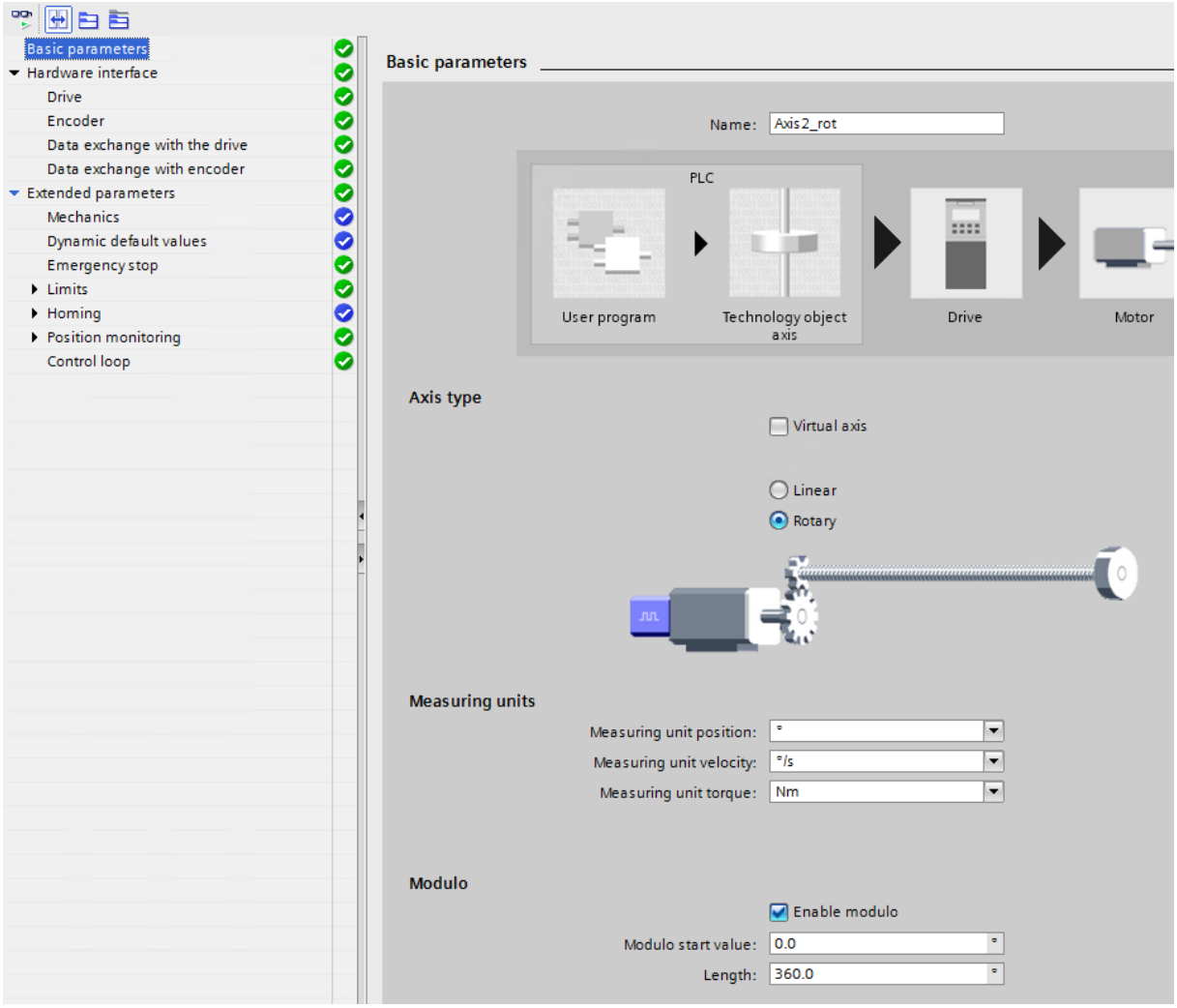
2. Select a name and the type of the axis and click OK:



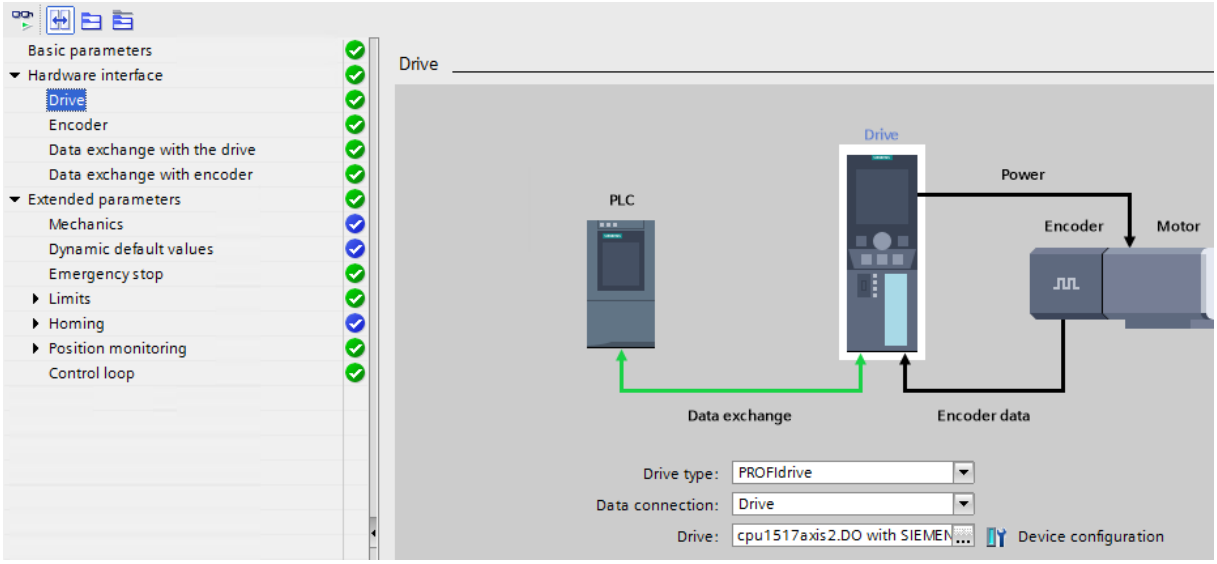
3. Open the axis configuration:



4. Basic Parameters:

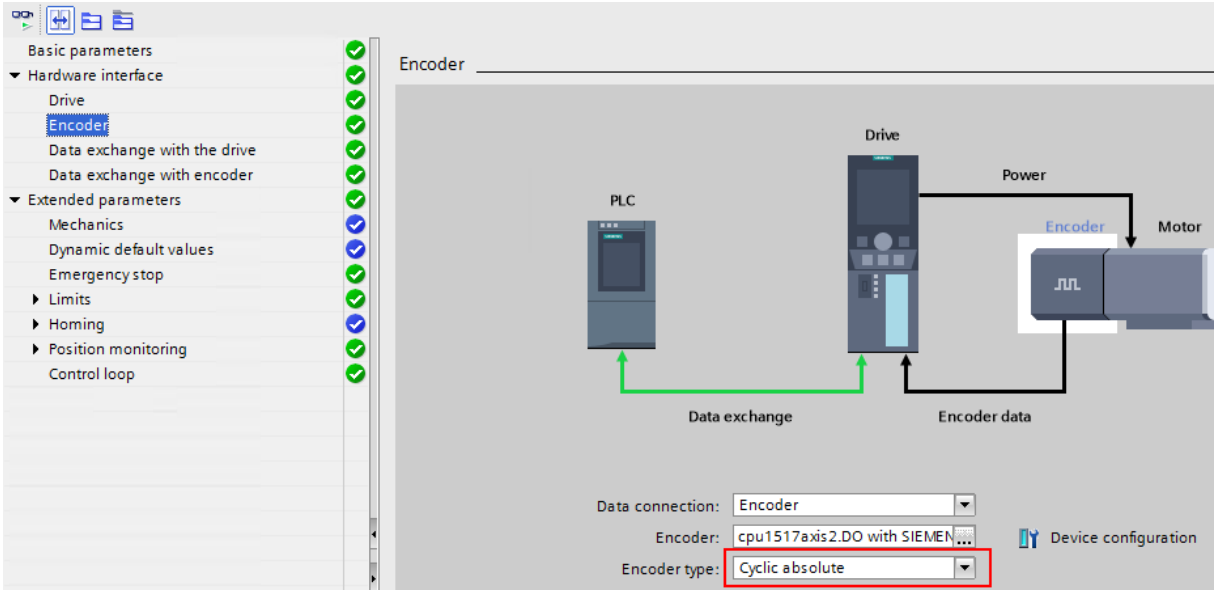


5. Hardware Interface > Drive:



Note:
Make sure the correct drive is selected.

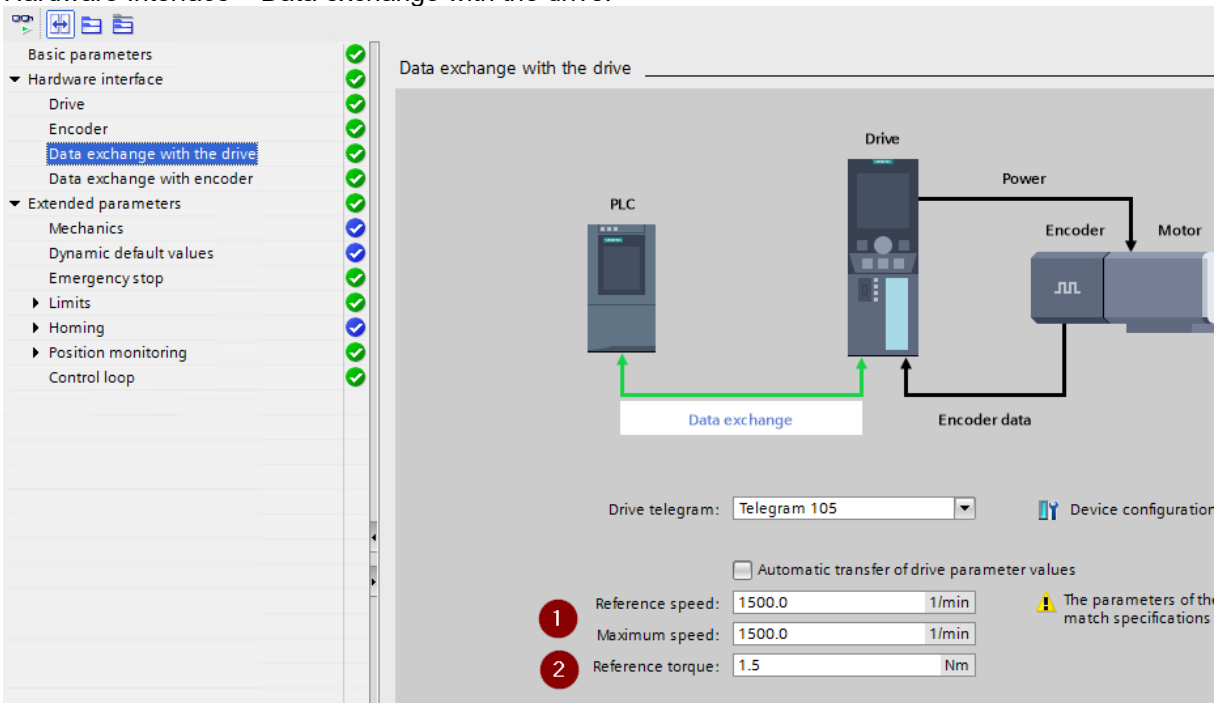
6. Hardware Interface > Encoder:



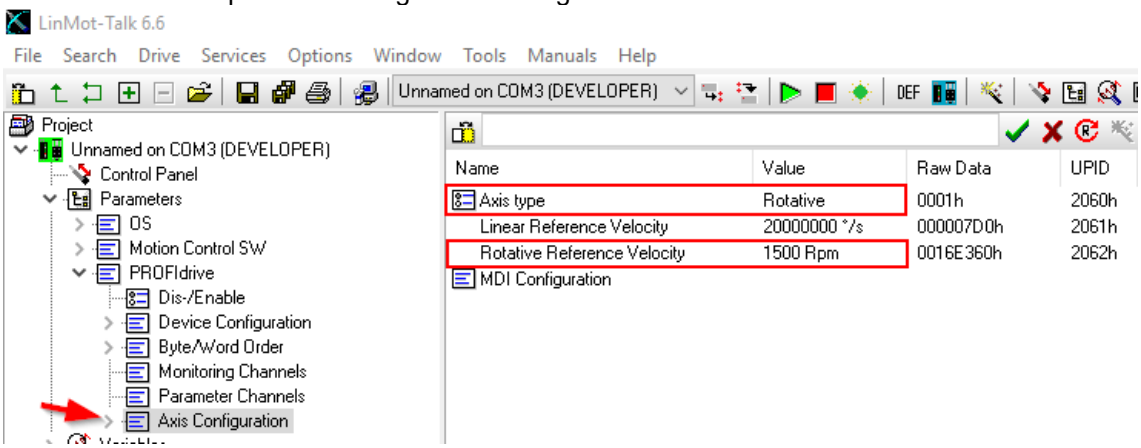
The used RS01-52x40 motor (rotary part of a LinMot PR01-52x40…) has single turn absolute encoder feedback.

Therefore select “Cyclic absolute” as encoder type.

7. Hardware Interface > Data exchange with the drive:

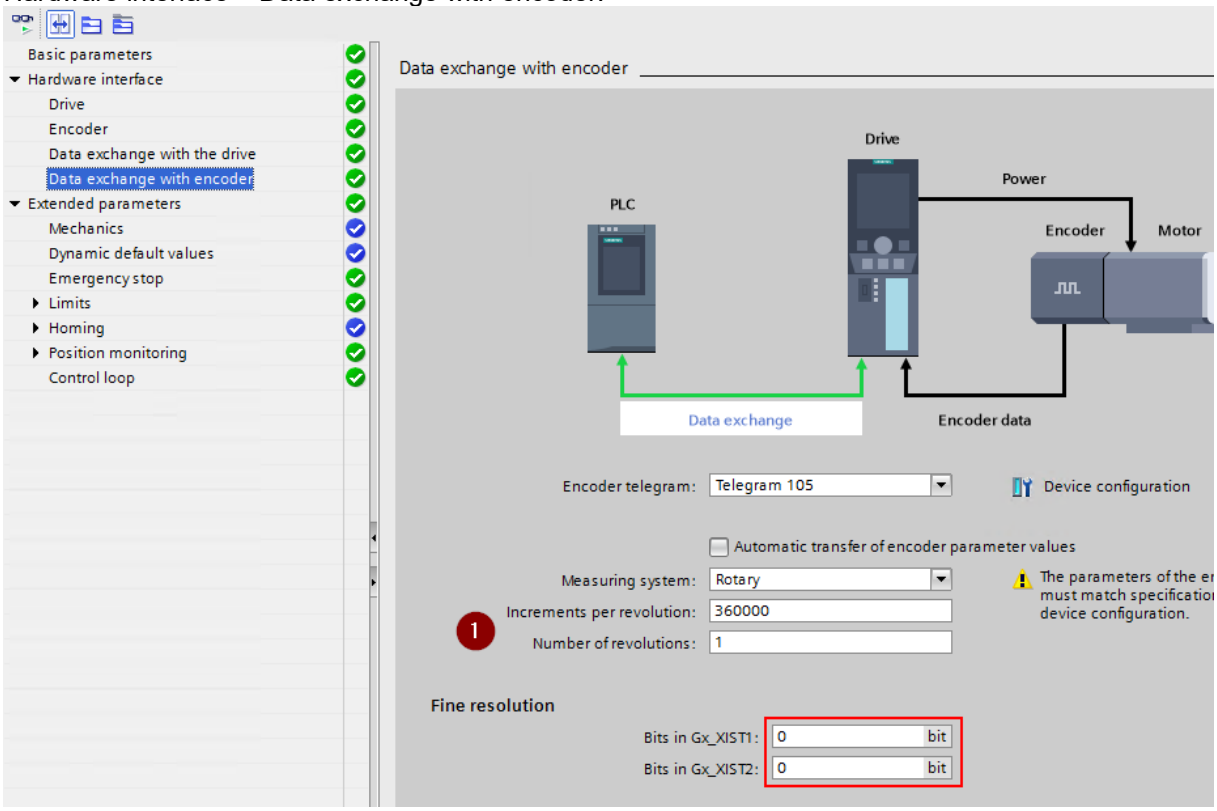


1: Set the reference speed according to the settings within the drive:



2: Set to the maximum torque of the motor according to the datasheet. The motor in this example has 1.5 Nm peak torque.

8. Hardware interface > Data exchange with encoder:



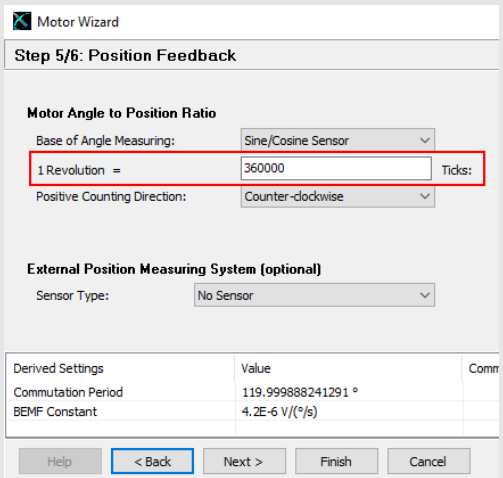
1: The used RS01-52x40 motor (rotary part of a LinMot PR01-52x40…) has a single turn absolute encoder feedback.
Set the increments according to the settings within the LinMot-Talk Motor Wizard (default 36mm / 360'000 ticks). By default, this motor has 360'000 ticks per revolution.

Note:
Following an overview of LinMot rotary motors showing encoder type and increments per revolution.

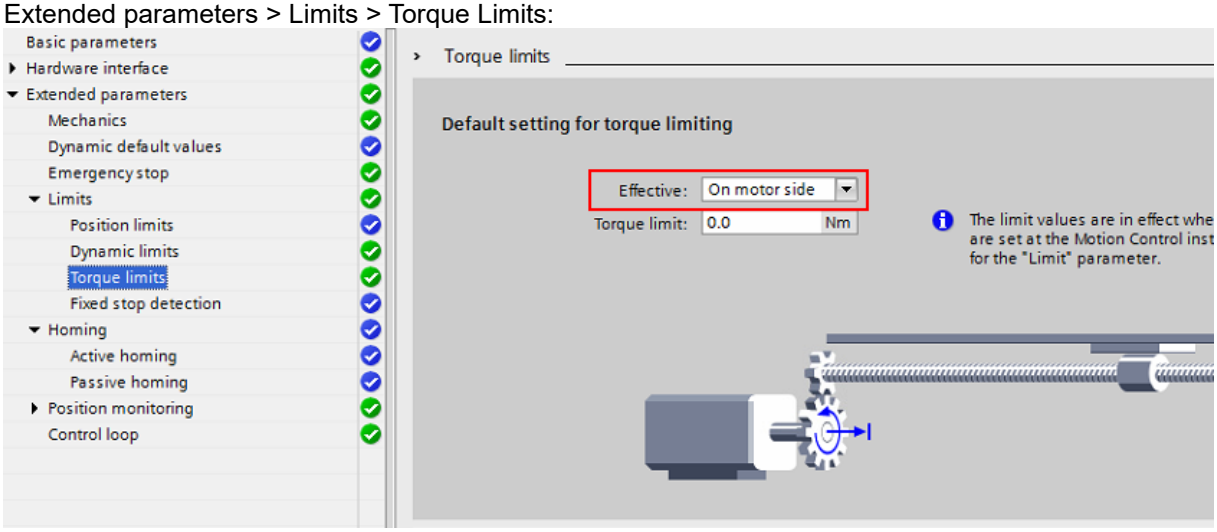
RS01:
- cyclic absolute (single turn), **360'000** increments per revolution

EC02, GM51, PR02 PS11 & PS31:
- cyclic absolute (single turn), **524'288** increments per revolution

LinMot supports a wide range of rotary motor. Just check the motor wizard for how many ticks per revolution the used motor has.



9. Extended parameters > Limits > Torque Limits:

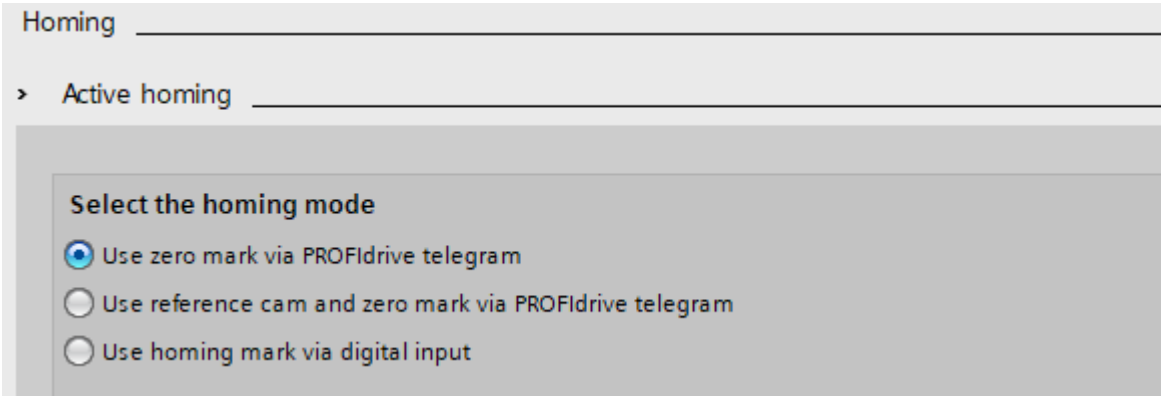


Set Effective to “*On motor side”.*

12.4 Home / Set Reference

12.4.1 Active Homing for both linear and rotary motors with incremental encoders

From firmware 6.8 Build 20190315 and later it is possible to use a zero mark via PROFIdrive telegram to execute an active homing using the MC_Home function block of SIEMENS.

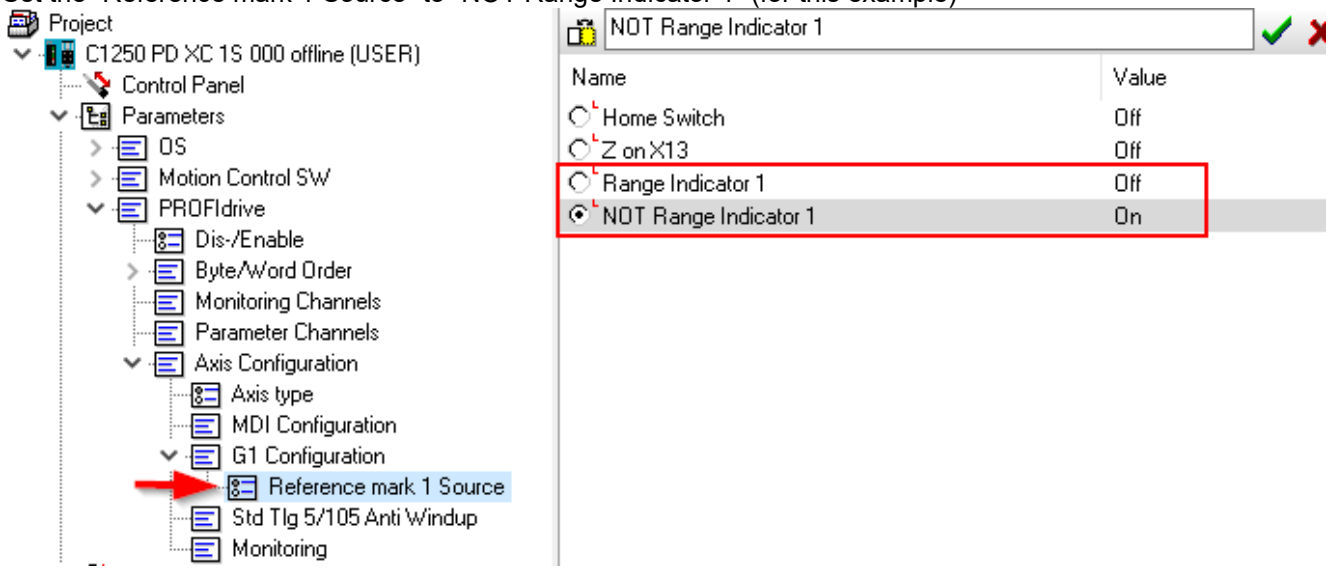


On the following pages there are two examples showing the setup in the LinMot drive using the LinMot-Talk software.

Example 1: Generating the zero-mark using the Range Indicator 1 functionality of the LinMot drive. The current of the motor should be monitored to detect the hard stop. As soon as the motor current exceeds a set limit the zero mark is generated.

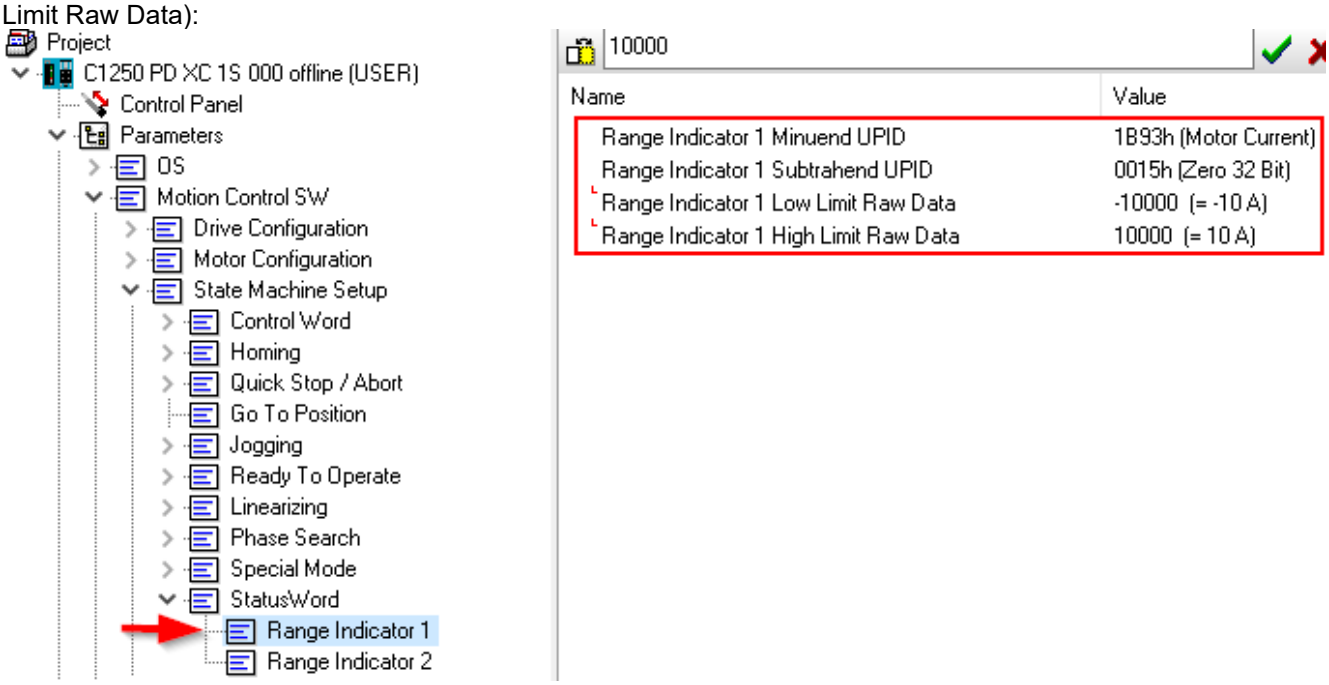
From firmware **6.9 Build xxxxxxx**x the Range Indicator 1 can be used to generate the zero mark via PROFIdrive telegram.

Set the “Reference mark 1 Source” to “NOT Range Indicator 1” (for this example)



As example the motor current or difference position can be used to generate the zero mark.

The *Range Indicator 1* can be setup here (Choose UPID 1B93h as Minuend UPID and set the Low and High Limit Raw Data):

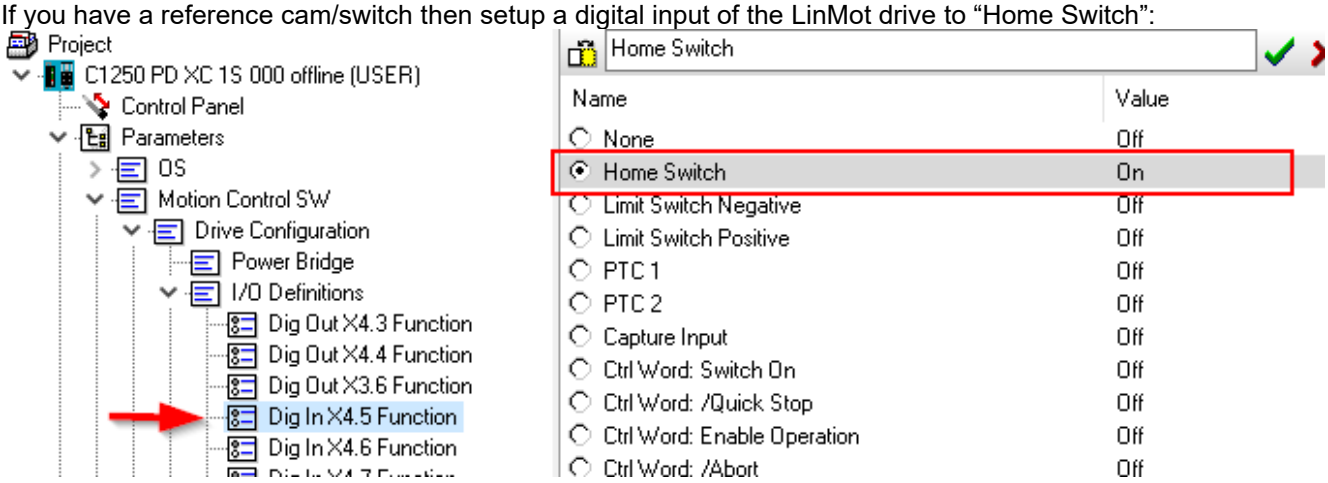


In this case the Range Indicator 1 Bit is set when the Demand Current is between -10A and 10A. Therefore, the zero mark will be generated when the motor current is >10A or <-10A.

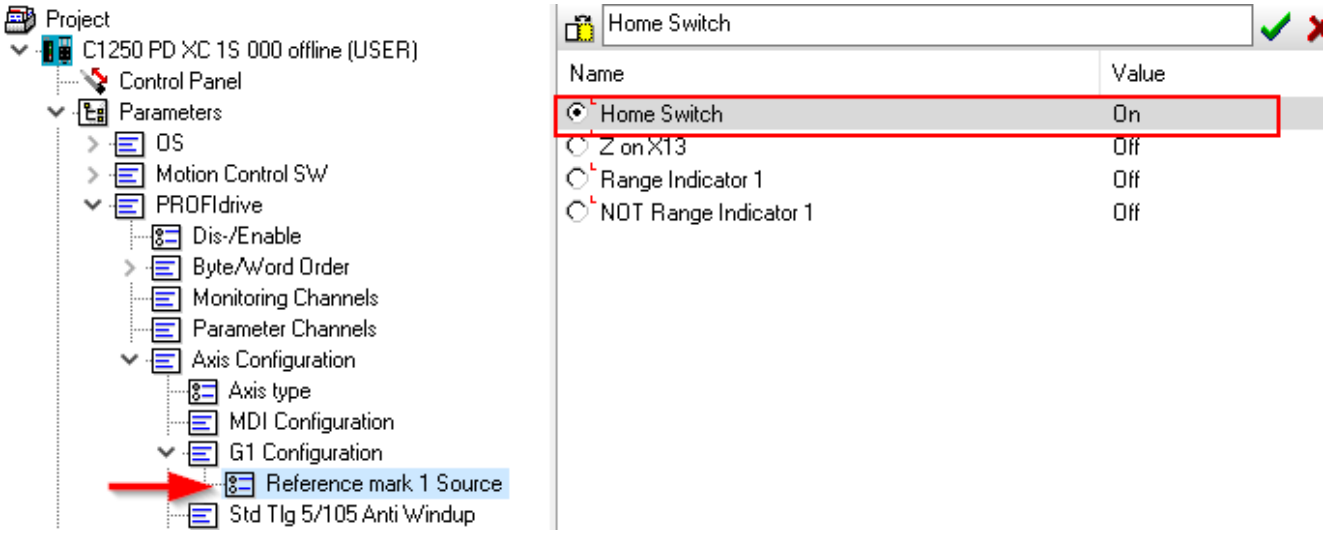
The **active homing** itself can then be executed using the **MC_HOME** function block with **mode 3 or 5**.

Example 2: Generating the zero-mark using a Home Switch (external 24V DC signal connected to the drive)

If you have a reference cam/switch then setup a digital input of the LinMot drive to “Home Switch”:



Set “Reference mark 1 Source” to “Home Switch”:



The **active homing** itself can then be executed using the **MC_HOME** function block with **mode 3 or 5**.

12.4.2 Set Reference for both linear and rotary motors with absolute encoders

As the rotary motor used in this example has a single turn absolute encoder it is only required to set the reference flag of the axis. This is also valid for linear axes with absolute encoders too (please check the note below).

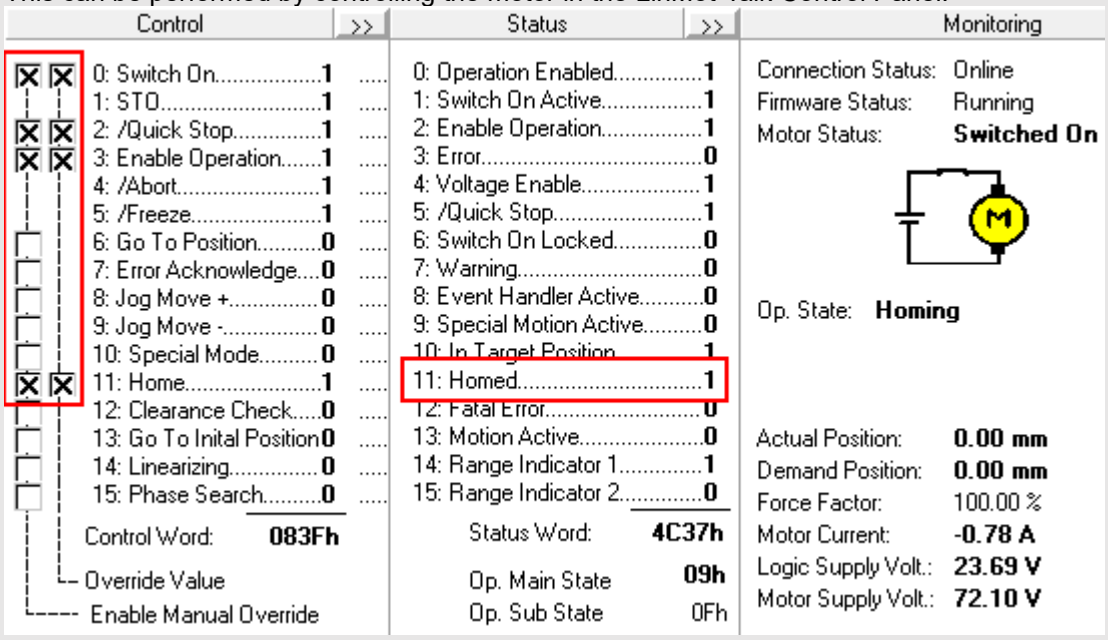
This can be done using the function block **MC_HOME with mode 6** (Absolut encoder adjustment (relative)) and Position = 0.0.

Note:
Please check the SIEMENS Information System for more information about the Motion Control function blocks.

Note for linear absolute encoders:

1. If a linear motor with absolute encoder is used, then first a homing in the drive must be completed once to set the absolute encoder offset in the drive. (e.g., use homing mode “Mechanical Stop Negative Search” > UPID 13C4h [set back to “No Drive Homing” when completed!]).

This can be performed by controlling the motor in the LinMot-Talk Control Panel:



2. After that the absolute encoder adjustment in the PLC must be performed **ONCE** using mode 6 or 7 of the function block MC_Home (check SIEMENS Information System):
Mode 6: Absolute encoder adjustment (relative)
Mode 7: Absolute encoder adjustment (absolute)

This will cause the PLC to store the calculated absolute value offset retentively in the CPU.
(<TO>.StatusSensor[n].AbsEncoderOffset)

***ATTENTION**: If the Actual Position in the Control Panel of LinMot-Talk is showing a negative value when using the MC_Home it is recommended to use mode 7 (absolute) and **set the input Position to the value of the Actual Position in the Control Panel.** Then the correct offset (negative) is stored in the PLC.*

12.4.3 Application based example to home a LinMot Linear Axis

If for any reason the active homing procedure as explained in chapter 12.4.1 can't be used it is also possible to do the homing application based.

Using the torque limiting functionality (MC_TORQUELIMITING) of SIEMENS Telegram 105 it is possible to make a referencing to a mechanical stop with a desired force limit.

If the hard stop should be detected when the motor reaches the set force limit then check for "InLimitation" in state 5 of the following example, or if the hard stop should be detected by the position lag (*"Axis1".Clamping.FollowingErrorDeviation*) then use "InClamping".

The next page shows how an application-based homing can be performed.

Following a very basic example homing routine that is also part of the example project:

```
CASE "GVL".iHomeState OF
    0:  //Idle
        IF "GVL".bHomeExecute THEN
            "GVL".iHomeState := 1;
        END_IF;

    1:  //Check motor powered
        IF "MC_POWER_Axis1".Status THEN
            "GVL".iHomeState := 2;
        ELSE
            "MC_POWER_Axis1".Enable := TRUE;
        END_IF;

    2:  //Enable Torque Limiting and start moving direction hard stop
        IF NOT "MC_TORQUELIMITING_Axis1".Busy THEN
            "MC_TORQUELIMITING_Axis1".Mode := 1; //Detect hard stop
            "MC_TORQUELIMITING_Axis1".Limit := 100; //Motor force limit in Newton [N]
            "MC_TORQUELIMITING_Axis1".Enable := TRUE; //Enable Torque Limiting
            "Axis1".Clamping.FollowingErrorDeviation := 0.5; //Set clamping detection window [mm]
            "Axis1".Clamping.PositionTolerance := 0.3; //Set clamping position tolerance [mm]
        END_IF;

        "MC_MOVEVELOCITY_Axis1".Velocity := -10; //Velocity to find the hard stop. Values <10mm/s!
        "MC_MOVEVELOCITY_Axis1".Execute := TRUE;

        IF "MC_MOVEVELOCITY_Axis1".Busy THEN
            "GVL".iHomeState := 3;
        END_IF;

    3: // Check axis in limitation & clamping (wait MoveVelocity aborted) and set axis reference
        IF "MC_TORQUELIMITING_Axis1".InLimitation AND "MC_MOVEVELOCITY_Axis1".CommandAborted THEN
            // Set reference position
            "MC_HOME_Axis1".Mode := 0; //Set absolute reference
            "MC_HOME_Axis1".Position := -2.0; //Reference position
            "MC_HOME_Axis1".Execute := TRUE;
        END_IF;

        IF "MC_HOME_Axis1".Done THEN
            "MC_HOME_Axis1".Execute := FALSE;
            "GVL".iHomeState := 5;
        END_IF;

    5:  //Move away from hard stop
        "MC_MOVEABSOLUTE_Axis1".Position := 0.0; //Move to 0 position
        "MC_MOVEABSOLUTE_Axis1".Execute := TRUE;
        "MC_MOVEABSOLUTE_Axis1".Velocity := 1; //Slow velocity
        IF "MC_MOVEABSOLUTE_Axis1".Done THEN
            "MC_MOVEABSOLUTE_Axis1".Execute := FALSE;
            "GVL".iHomeState := 10;
        END_IF;

    10: //Clean up
        "MC_MOVEABSOLUTE_Axis1".Execute := FALSE;
        "MC_MOVEABSOLUTE_Axis1".Velocity := -1;
        "MC_HALT_Axis1".Execute := FALSE;
        "MC_HOME_Axis1".Execute := FALSE;
        "MC_MOVEVELOCITY_Axis1".Execute := FALSE;
        "MC_TORQUELIMITING_Axis1".Enable := FALSE;

        "GVL".bHomeExecute := FALSE;
        "GVL".iHomeState := 0;

    ELSE
        ;
END_CASE;
```

12.5 Parameter Access (RAM)

Read/Write access to the RAM value of LinMot drive parameters/variables can be done using the SIEMENS function block “SINA-PARA” (FB286) from the library “DriveLib_S71500” that is installed with SINAMICS Startdrive.

The RAM and ROM values of the drive parameters can be accessed by their parameter number (UPID) added with an offset of 0x2000 (UPID+0x2000).

More information about accessing parameters can be found on the SIEMENS support page:
https://support.industry.siemens.com (Entry ID: 99412590)

Example:

Read the value of the parameter Maximal Current (UPID 16#13A6):

Name: Maximal Current
UPID: 16#13A6 = 5030
Type: SInt32 = DINT
Scale: 0.001 A

> .ParaNo = 1 (read 1 parameter)
> .sxParameter[1].siParaNo = 16#2000 + 16#13A6 = 16#33A6 = 13222

Name	...	Display format	Monitor value	Modify value		Comment
"SINA_PARA_Axis1".Start		Bool	TRUE	TRUE	☑ ⚠	
"SINA_PARA_Axis1".ReadWrite		Bool	FALSE	FALSE	☑ ⚠	
"SINA_PARA_Axis1".ParaNo		DEC+/-	1	1	☑ ⚠	
"SINA_PARA_Axis1".AxisNo		Hex	16#00		☐	
"SINA_PARA_Axis1".hardwareId		DEC	267		☐	
"SINA_PARA_Axis1".Done		Bool	TRUE		☐	
"SINA_PARA_Axis1".Busy		Bool	FALSE		☐	
"SINA_PARA_Axis1".Error		Bool	FALSE		☐	
"SINA_PARA_Axis1".ErrorId		Hex	16#0000_0000		☐	
"SINA_PARA_Axis1".sxParameter[1].sdValue		DEC+/-	7000	0	☑ ⚠	
"SINA_PARA_Axis1".sxParameter[1].siIndex		DEC+/-	0		☐	
"SINA_PARA_Axis1".sxParameter[1].siParaNo		DEC+/-	13222	13222	☑ ⚠	// 16#2000 + UPID = 16#33A6 = 13222
"SINA_PARA_Axis1".sxParameter[1].srValue		Floating-point nu...	0.0		☐	
"SINA_PARA_Axis1".sxParameter[1].swErrorNo		Hex	16#0000		☐	
"SINA_PARA_Axis1".sxParameter[1].syFormat		Hex	16#07		☐	

Set .Start TRUE.
As soon as Done becomes TRUE the read data is shown in .sxParameter[1].sdValue

Supported Services:

Request ID	Description
0x01	Request Parameter, reads the RAM value of the parameter
0x02	Change parameter, changes the RAM value of the parameter
With modified SINA_PARA only:	
0x41	*Read ROM value of parameter, only valid with value attribute*
0x42	*Write ROM value of parameter, only valid with the value attribute*

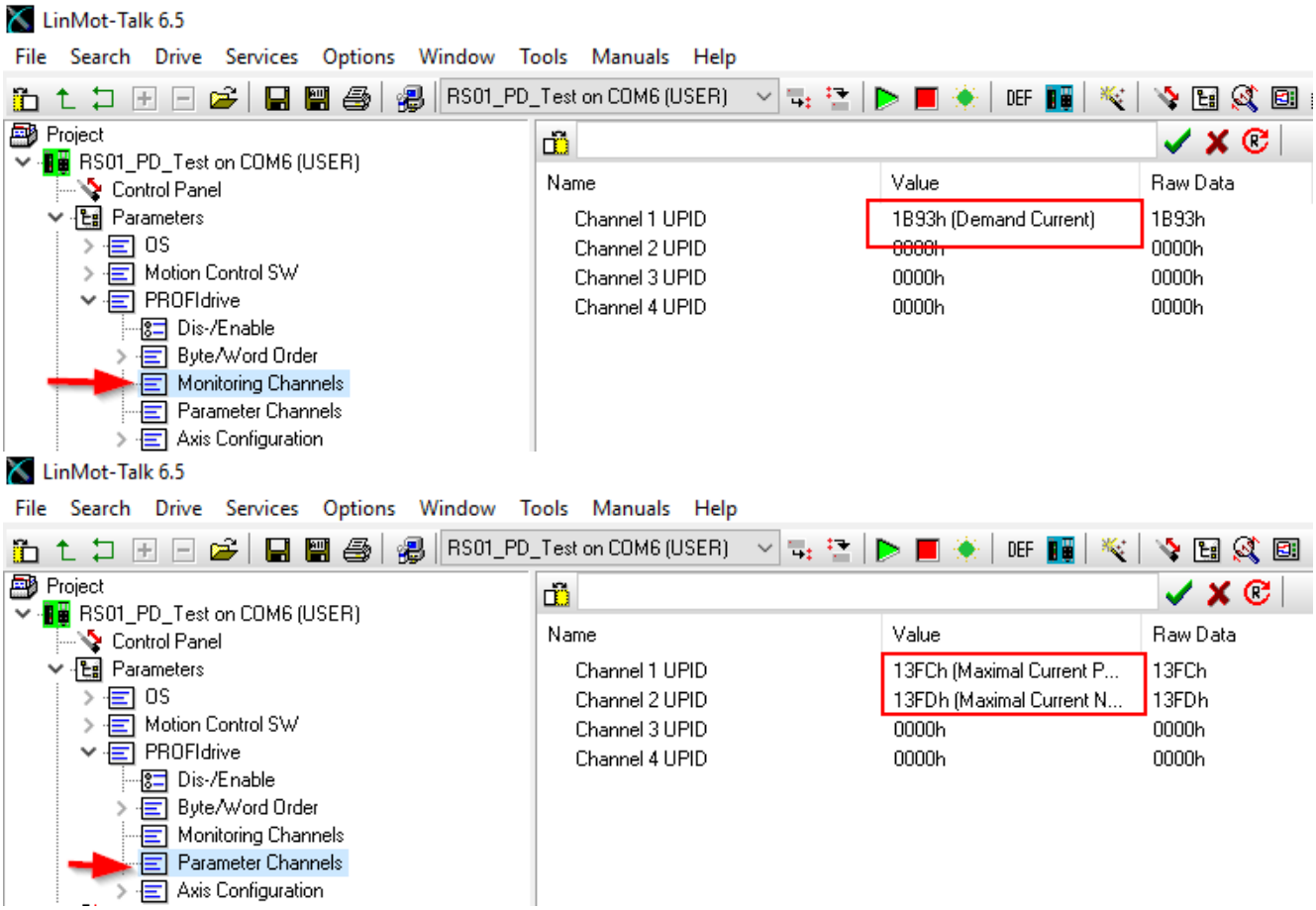
12.6 Add Additional Parameters / Variables to the Real-Time Channel

It is possible to add additional parameters or variables of the drive to the real-time channel to allow read and write access (RAM). There are 4 channels from the Drive to the PLC (32Bit each, Mon Channel 1-4) and 4 channels from the PLC to the Drive (32Bit each, Par Channel 1-4) available.

12.6.1 Drive Configuration

In LinMot-Talk the UPID (parameter/variable address) is entered in the particular channel.

As example in Monitoring Channel 1 the UPID *1B93h (Demand Current)* and in Parameter Channel 1 & 2 the UPID *13FCh (Maximal Current Positive)* and *13FDh (Maximal Current Negative)* are entered.

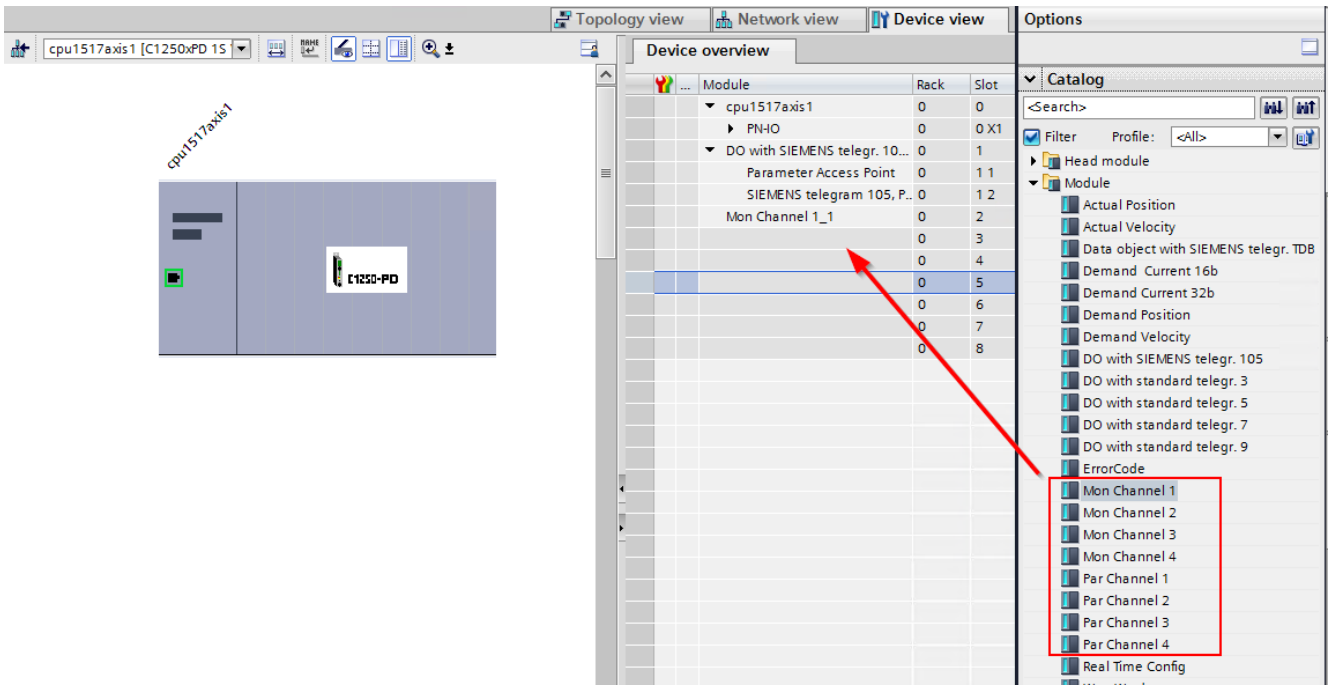


Attention:
The above used parameters are thought to be an example only and should not be used if SIEMENS telegram 105 is used.

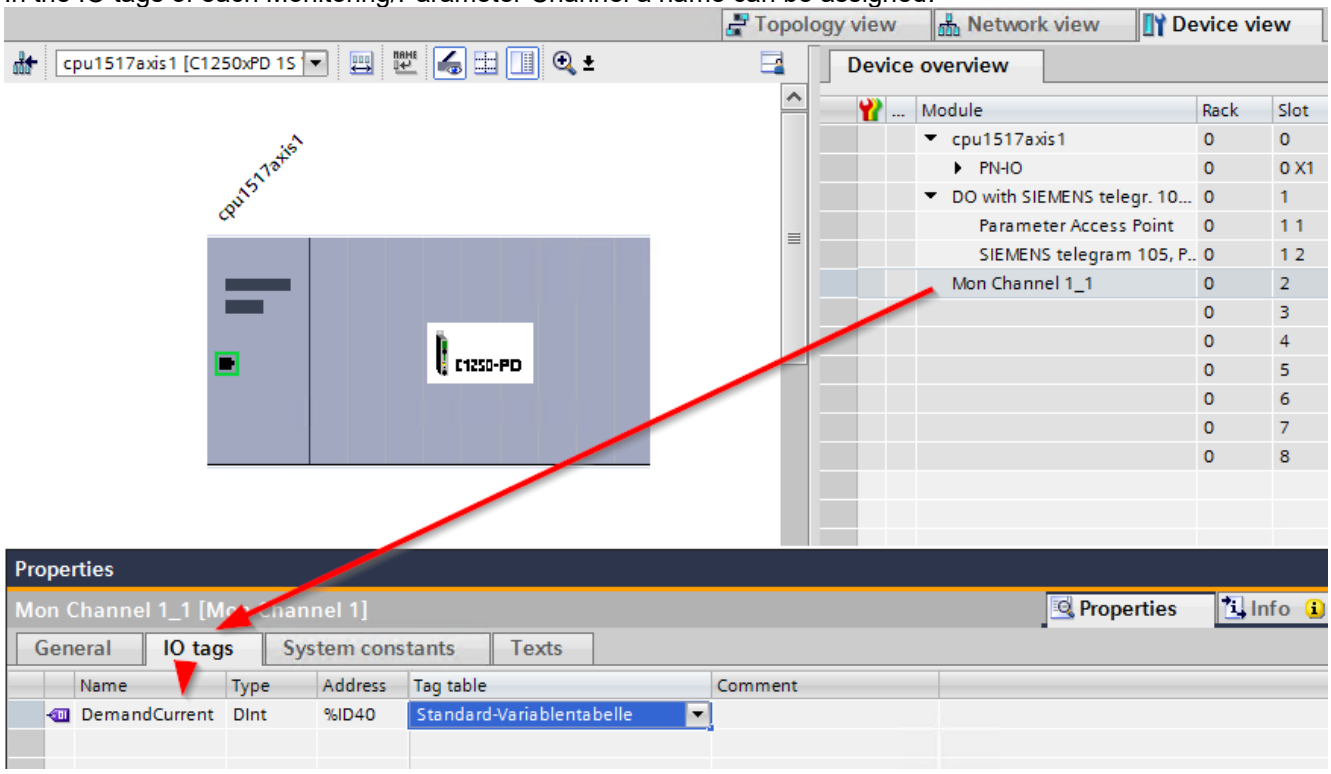
If the parameters in Parameter Channel 1 & 2 have a value of 0 the motor cannot move as they limit the maximal allowed positive and negative motor current in the drive.

12.6.2 PLC Configuration

In the HW Config drag&drop the desired modules from the catalogue to the slots of the drive:



In the IO tags of each Monitoring/Parameter Channel a name can be assigned:



Note:
On SIEMENS PLCs, the double words are transmitted in big endian organization. Therefore, it is required to swap the high and the low word.
This can be done by using the function ROR().
E.g. *DemandCurrent:=**ROR**(DemandCurrent,16);*

12.7 Telegram 750 / TDB

It is possible to add telegram 750 for additional torque/force functionality using a data block.

12.7.1 LinMot MI Drives

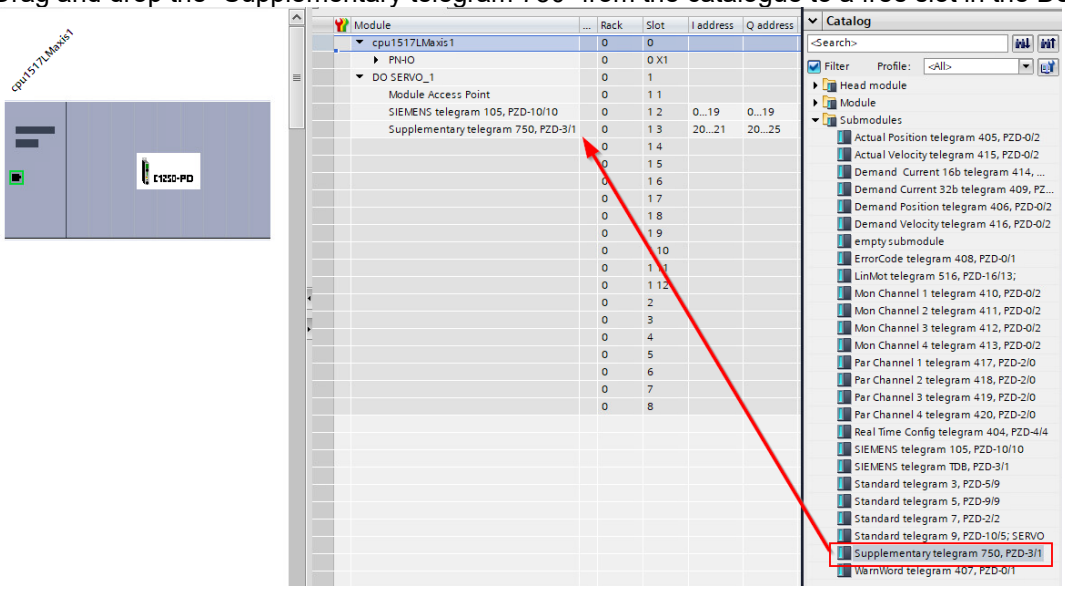
Using LinMot MI drives the telegram 750 can be / is directly connected to the TO configuration.

Telegram 750 is a supplementary telegram for torque/force control containing the following data:

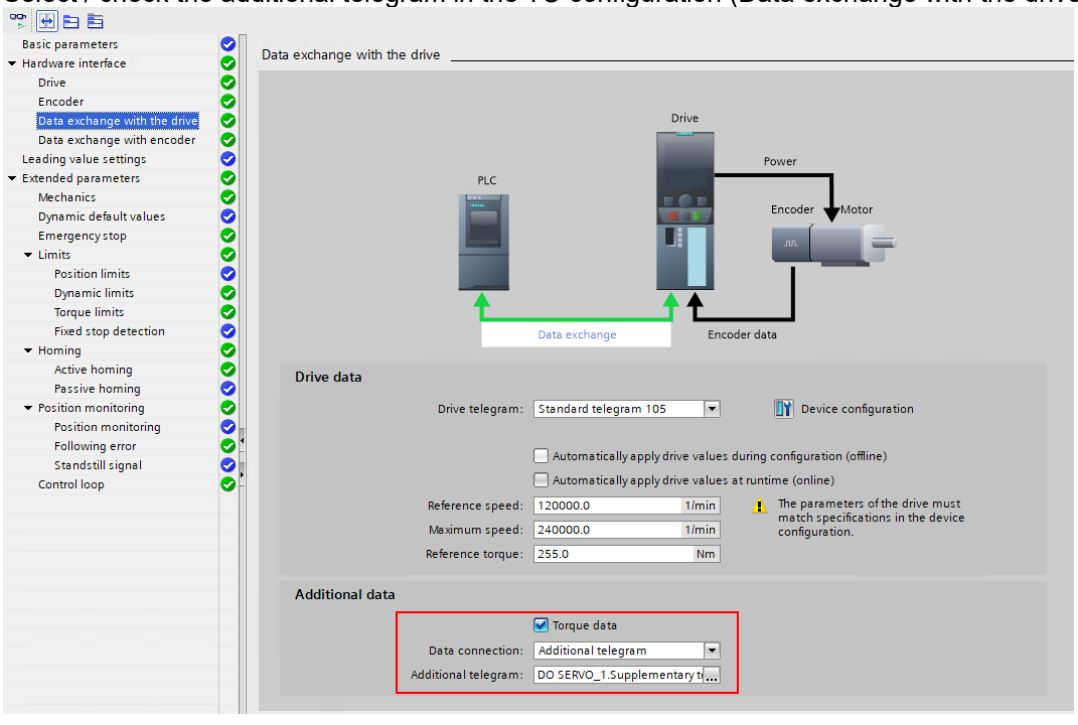
- The PLC sends the additive torque/force (M_ADD) as well as the positive and negative torque/force limit (M_LIMIT_POS, M_LIMIT_NEG) to the drive.
- The drive sends the actual torque/force (M_ACT) to the PLC.

PZD01	PZD02	PZD03
M_ADD	M_LIMIT_POS	M_LIMIT_NEG
M_ACT	---	

1. Drag and drop the “Supplementary telegram 750” from the catalogue to a free slot in the Device view:



2. Select / check the additional telegram in the TO configuration (Data exchange with the drive):



12.7.2 LinMot PD Drives

Using LinMot PD drives the telegram 750 can be used by following these instructions.

Telegram 750 is a supplementary telegram for torque/force control containing the following data:

- The PLC sends the additive torque/force (M_ADD) as well as the positive and negative torque/force limit (M_LIMIT_POS, M_LIMIT_NEG) to the drive.
- The drive sends the actual torque/force (M_ACT) to the PLC.

Axis1_TorqueData	PD_TEL750
Input	PD_TEL750_IN
ActualTorque	Word
Output	PD_TEL750_OUT
AdditiveTorque	Word
UpperTorqueLimit	Word
LowerTorqueLimit	Word

PZD01	PZD02	PZD03
M_ADD	M_LIMIT_POS	M_LIMIT_NEG
M_ACT	---	

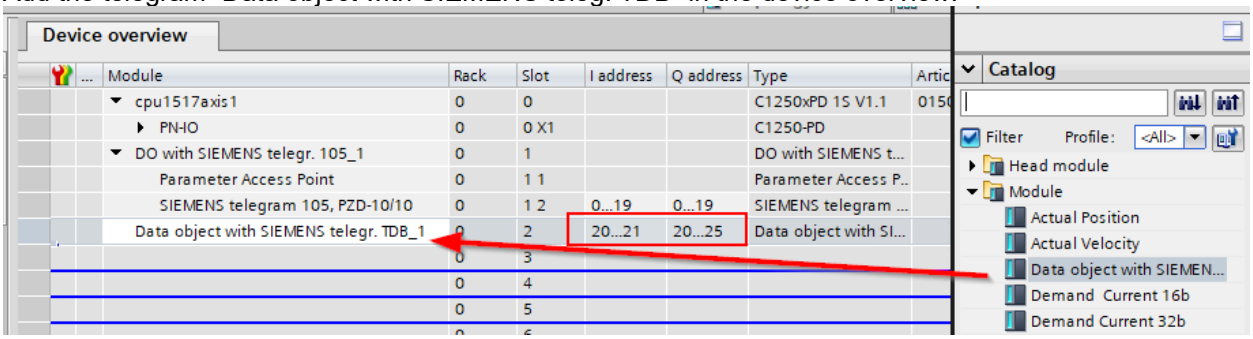
Note:
The data types **PD_TEL750**, **PD_TEL750_IN** and **PD_TEL750_OUT** are automatically added to the project when you set them in the Data type column (they don't show up in the dropdown list).
Do not create your own data types.

Note:
The additional torque (**M_Add)** is calculated with **UPID 0x119E (maximal Motor Current) and written to UPID 0x139C or 0x13B0** depending on which control parameter set is active.
The additional torque is standardized by 4000h. The unit of **M_Add** is N (or Nm if rotary).
Value at **UPID 0x139C/0x13B0 = M_Add * maximal Motor Current / 4000h**

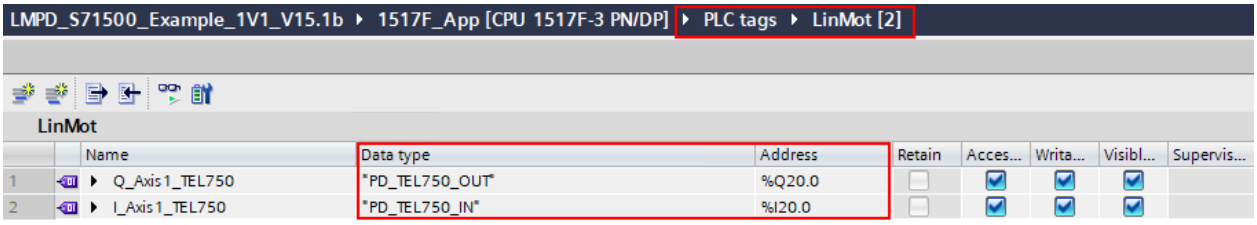
The torque limits B+ and B- are also calculated with **UPID 0x119E (maximal Motor Current) and written to UPID 0x13FC/0x13FD or 0x13FE/0x13FF** depending on which control parameter set is active.
The unit of (B+) pos torque Limit and (B-) neg torque Limit are N (or Nm if rotary).
Value at **UPID 0x13FC/0x13FE = (B+) pos torque Limit * maximal Motor Current / 4000h**
Value at **UPID 0x13FD0/x13FF = -(B-) neg torque Limit * maximal Motor Current / 4000h**

M_act is the standardised actual torque/ force.
For linear motor, **M_act = Motor Actual Force (UPID 0x1BFF) / Motor Maximim Force (UPID 0x1BB0)* 0x4000**. The unit is N.
For rotary motor, **M_act = Motor Actual Torque (UPID 0x1BBF) / Motor Maximim Torque (UPID 0x1BBE) * 0x4000**. The unit is Nm.

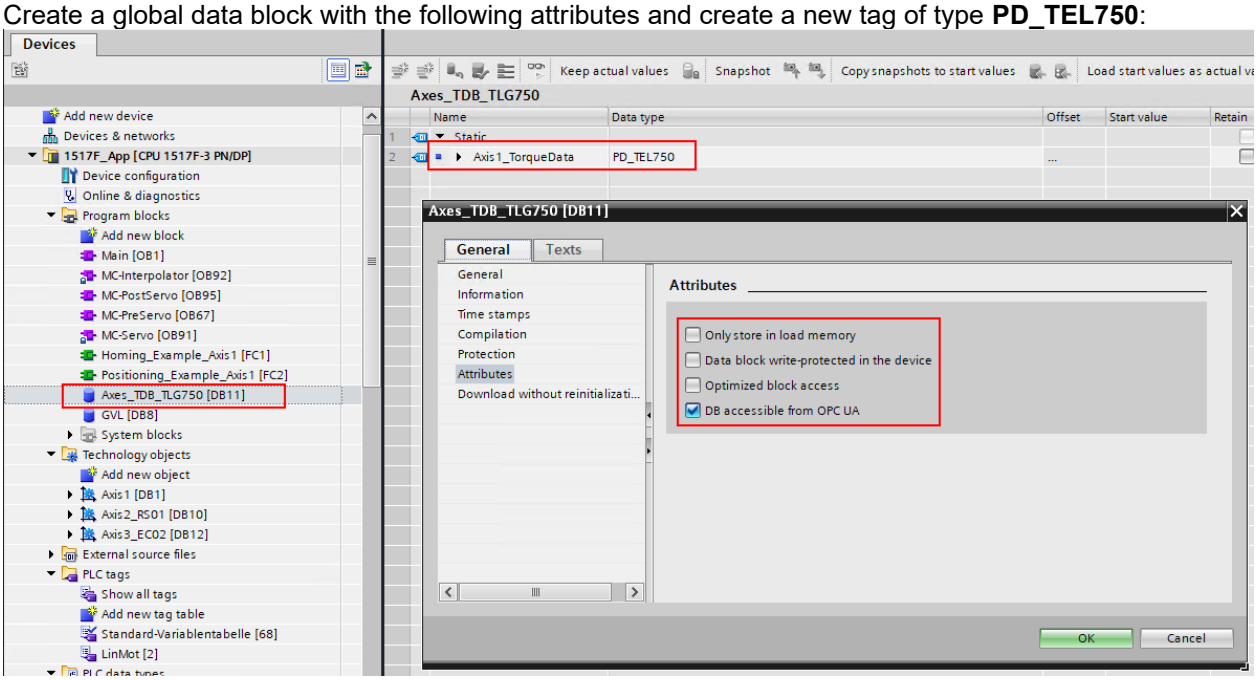
1. Add the telegram “Data object with SIEMENS teleg. TDB” in the device overview:



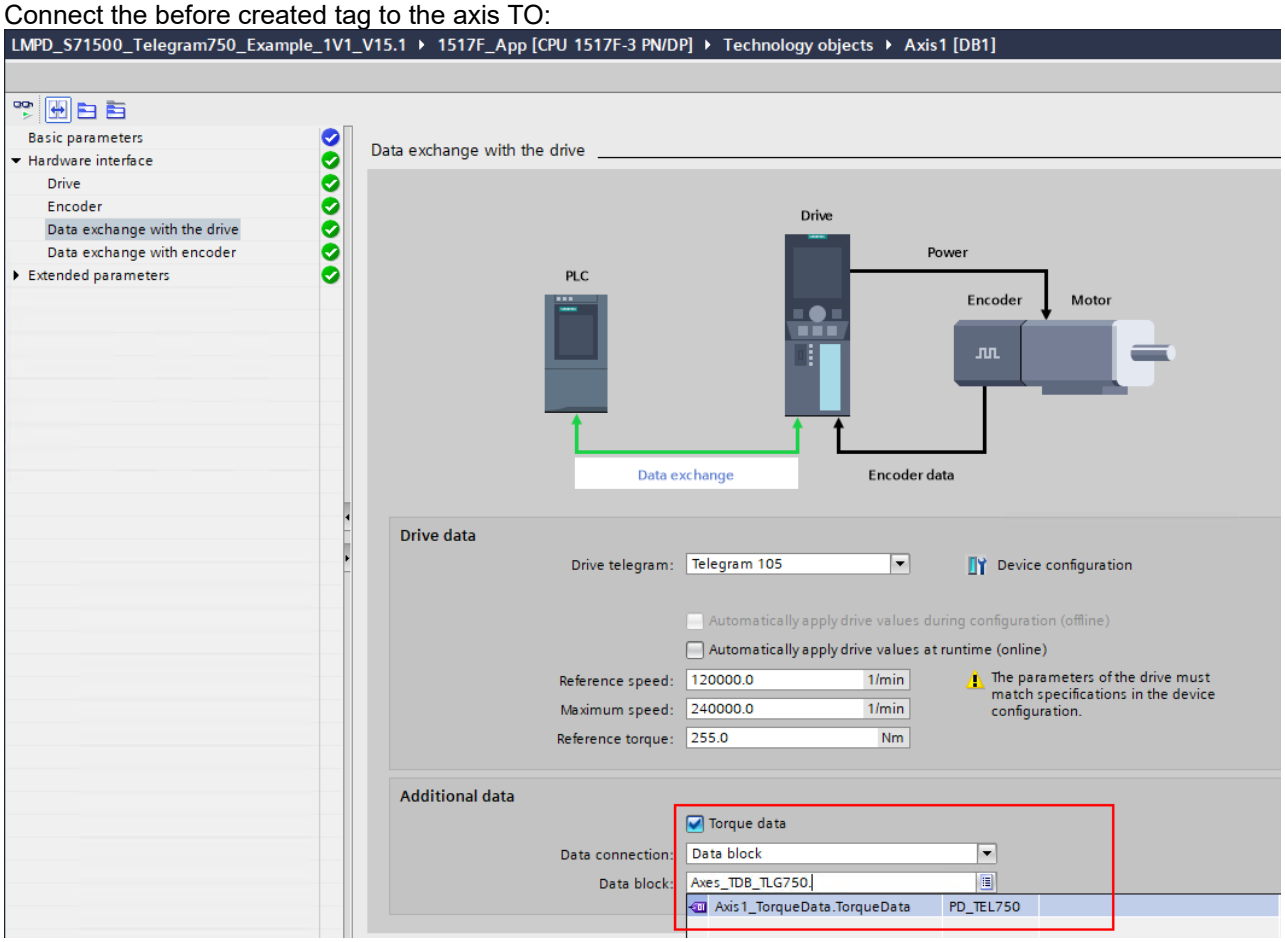
2. Add two tags in the PLC tags of type **PD_TEL750_IN** and **PD_TEL750_OUT** and assign the addresses from above:



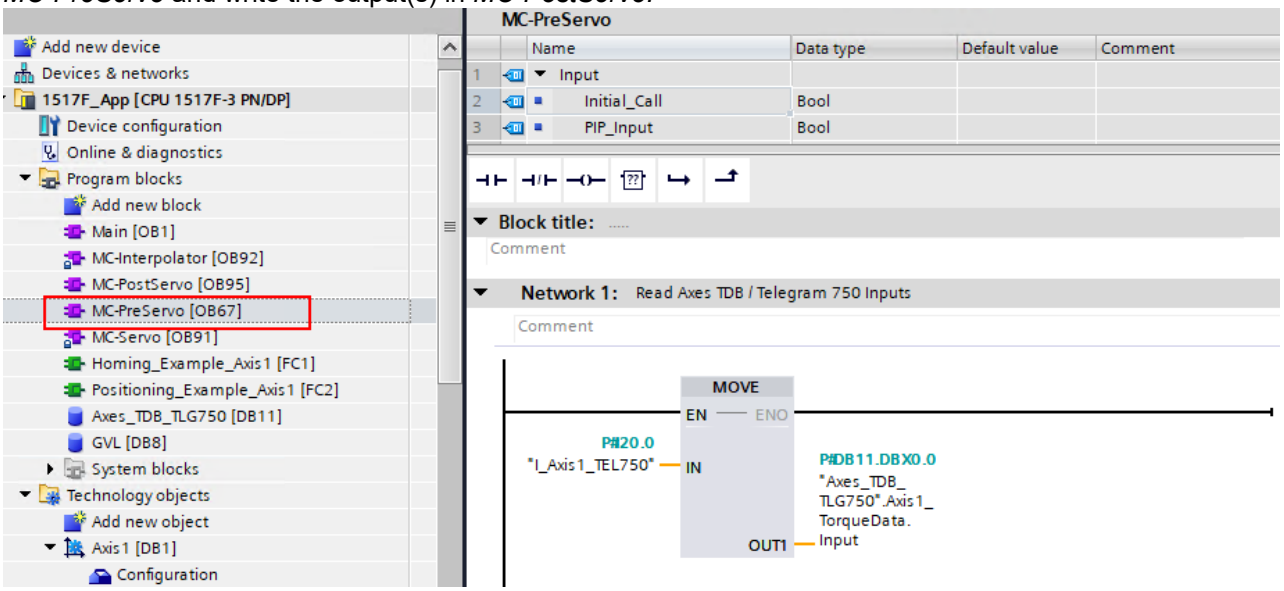
3. Create a global data block with the following attributes and create a new tag of type **PD_TEL750**:

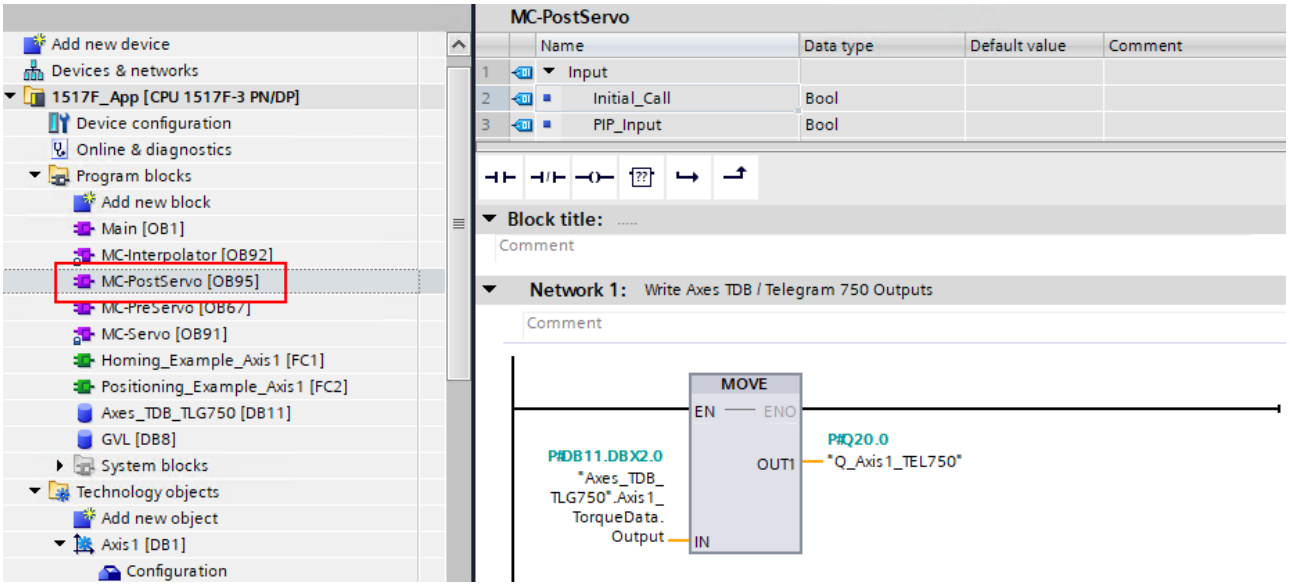


4. Connect the before created tag to the axis TO:



5. Add the organization blocks *MC-PreServo* and *MC-PostServo* to your program blocks. Read the input in *MC-PreServo* and write the output(s) in *MC-PostServo:*





12.8 Using the Closed Loop Force/Torque Control Technology Function

This chapter shows a way to switch from using Telegram 5/105 with a TO Axis to the closed loop force/torque control run mode inside the LinMot drive and vice versa.

This chapter does not cover the general setup of force/torque sensor and the according control loop parameters.

Attention:
To use closed loop force/torque control the technology function **TF-Force Control** (0150-2503) is required. Check the manual for more information: https://shop.linmot.com/E/product/0150-2503

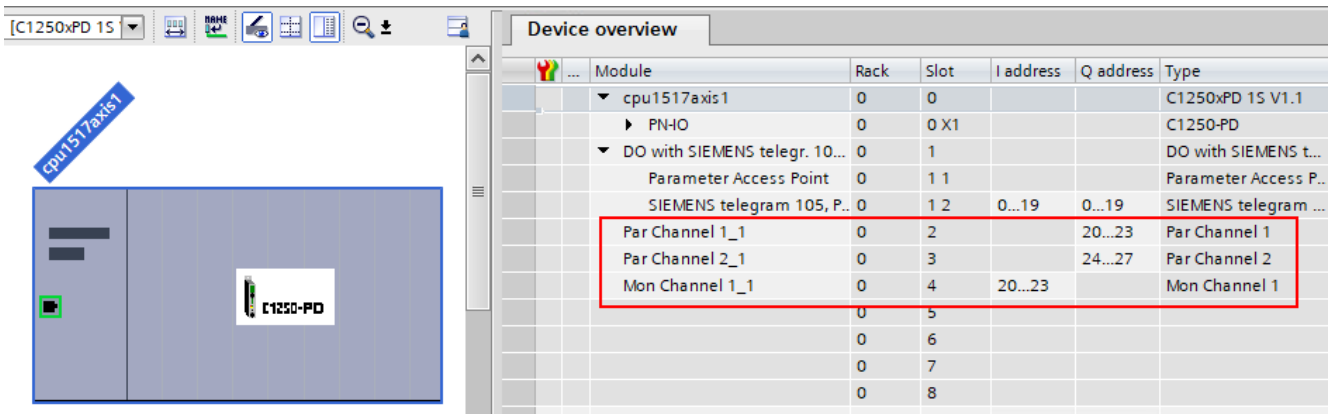
Attention:
Drive firmware **6.10 Build 20210521 or later** is required.

Note:
This example was done using the rotary part of a LinMot PR02 Linear Rotary Module with torque sensor. Nevertheless, the same principle is applicable for linear motors with force sensors.

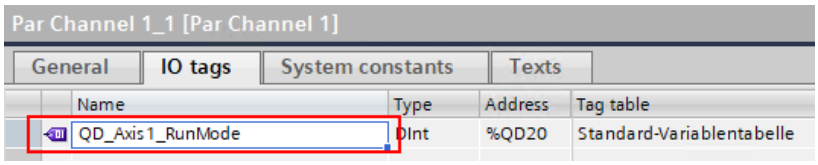
See Appendix II: Basic Closed Loop Torque/Force Control Loop Tuning

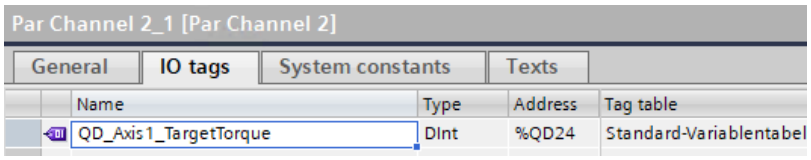
12.8.1 Add 1 Monitoring and 2 Parameter Channels / Drive Setup

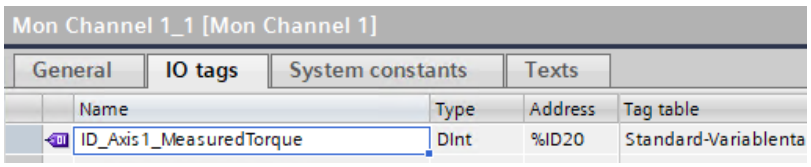
1. In the TIA Portal in the Device overview add the following modules from the catalogue:



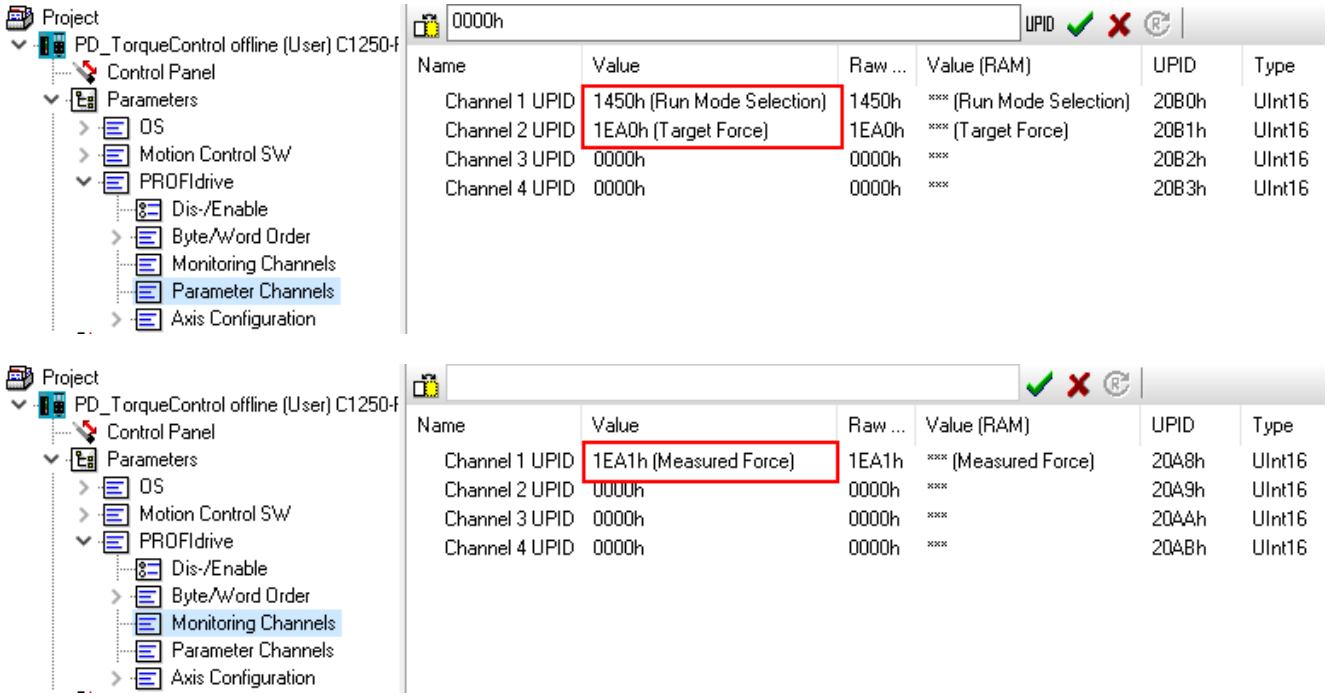
2. Assign a tag name in their properties to use them in your program:



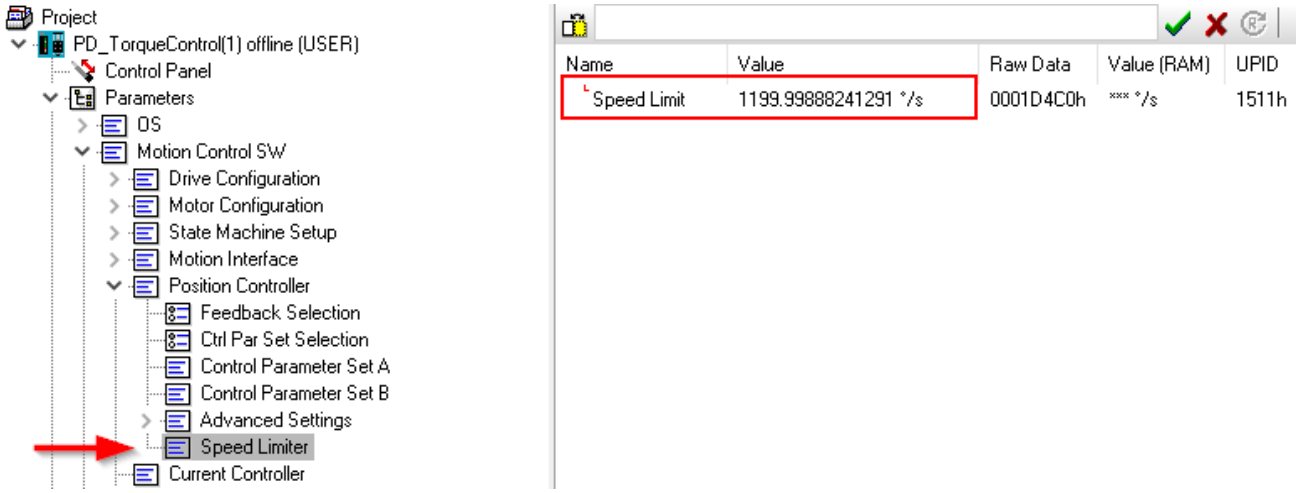




3. Setup the UPIDs for the channels withing the drive using the LinMot-Talk software:



4. Enable a Speed Limit to avoid too fast moves in closed loop force/torque control:



Attention:
Setting the speed limiter too low can influence the process control significantly. Set it as high as possible and as low as required by the process.

12.8.2 Scaling the Parameter and Monitoring Channels

The *Axis1_TargetTorque* and *Axis1_MeasuredTorque* tags can be scaled and rotated to Nm. This is done at the beginning (monitoring) and the end (parameter) of the program block (here in OB1).

Network 1: Read Axis 1 Monitoring Channels

Comment

```
1  // Torque scaling is 0.000572957795113082 Nm for the used rotary motor (PR02 with 360000 ticks per motor revolution)
2  "Axis1_MeasuredTorque" := INT_TO_REAL((ROR(IN := "ID_Axis1_MeasuredTorque", N:=16))) * 0.000572957795113082;
3
```

Network 7: Write Axis 1 Parameter Channels

Comment

```
1  // Torque scaling is 0.000572957795113082 Nm for the used rotary motor (PR02 with 360000 ticks per motor revolution)
2  "QD_Axis1_TargetTorque" := ROR(IN := REAL_TO_DINT("Axis1_TargetTorque" / 0.000572957795113082), N := 16);
3
4  // "Axis1_RunModeSelection" allows switching the drive run mode
5  // 1    = Motion Command Interface [normal operation with telegram 5/105
6  // 14   = Closed Loop Force Control [only visble in LinMot-Talk when logged in as "Service"]
7  "QD_Axis1_RunMode" := ROR(IN := "Axis1_RunModeSelection", N := 16);
```

12.8.3 Example Sequence

The following state machine is an example how the mode can be changed **from *controlled by the TO (technology object)*** to ***closed loop force/torque control inside the drive*** and back.
In this example the axis is controlling a rotary motor.

```
//************************************************************************
// LinMot Drive Based Torque Control Demo
// - Switch from Telegram 5/105 DSC to closed loop force control and back
//************************************************************************
//

CASE "GVL".iTCtrlState OF
    0:  // Idle
        // *******************************************
        IF "GVL".bTCtrlExecute THEN
            "Axis1_TargetTorque" := 0;
            "Axis1_RunModeSelection" := 1; // Positioning Mode (Drive Run Mode 1, Telegram 5 / 105)
            "GVL".iTCtrlState := "GVL".iTCtrlState + 1;
        END_IF;

    1:  // Move Velocity to disable position-controlled mode and position monitoring
        // *******************************************
        "MC_MOVEVELOCITY_Axis1".Execute := TRUE;
        "MC_MOVEVELOCITY_Axis1".Velocity := 120;
        "MC_MOVEVELOCITY_Axis1".PositionControlled := FALSE; //Important: Disable position
        controlled. Otherwise, there will be jumps when switching back

        IF "MC_MOVEVELOCITY_Axis1".InVelocity AND "Axis1_MeasuredTorque" > 0.15 THEN // Check actual
         torque to switch
            "MC_MOVEVELOCITY_Axis1".Execute := FALSE;

            // Change to drive based Torque Control and set target torque
            // *******************************************
            "Axis1_TargetTorque" := 0.2; // Target Torque 0.2 Nm
            "Axis1_RunModeSelection" := 14; // Torque Control Mode (Drive Run Mode 14)

            "GVL".iTCtrlState := "GVL".iTCtrlState + 1;
        END_IF;

    2:  // Check target torque reached
        // *******************************************
        IF "Axis1_MeasuredTorque" >= "Axis1_TargetTorque" - 0.02
           // AND ABS(IN := "Axis1_RS02".ActualSpeed) < 2
        THEN
            // Halt axis
            // *******************************************
            "MC_HALT_Axis1".Execute := TRUE;
            "GVL".iTCtrlState := "GVL".iTCtrlState + 1;
        END_IF;

    3:  // Check axis halted
        // *******************************************
        IF "MC_HALT_Axis1".Done THEN
            "MC_HALT_Axis1".Execute := FALSE;

            // Reset axis to position control mode (Telegram 5/105)
            // *******************************************
            "Axis1_RunModeSelection" := 1; // Positioning Mode (Drive Run Mode 1, Telegram 5 / 105)

            // Decrement Actual Position a little
            // *******************************************
            "MC_MOVEABSOLUTE_Axis1".Position := "Axis1_RS02".ActualPosition - 0.1; // Increment
            Actual Position
            "MC_MOVEABSOLUTE_Axis1".Velocity := 3600; //
            "MC_MOVEABSOLUTE_Axis1".Acceleration := 72000; //
            "MC_MOVEABSOLUTE_Axis1".Deceleration := 72000; //
            "MC_MOVEABSOLUTE_Axis1".Direction := 3; // Shortest way!!!
            "MC_MOVEABSOLUTE_Axis1".Execute := TRUE;

            "GVL".iTCtrlState := "GVL".iTCtrlState + 1;
        END_IF;
```

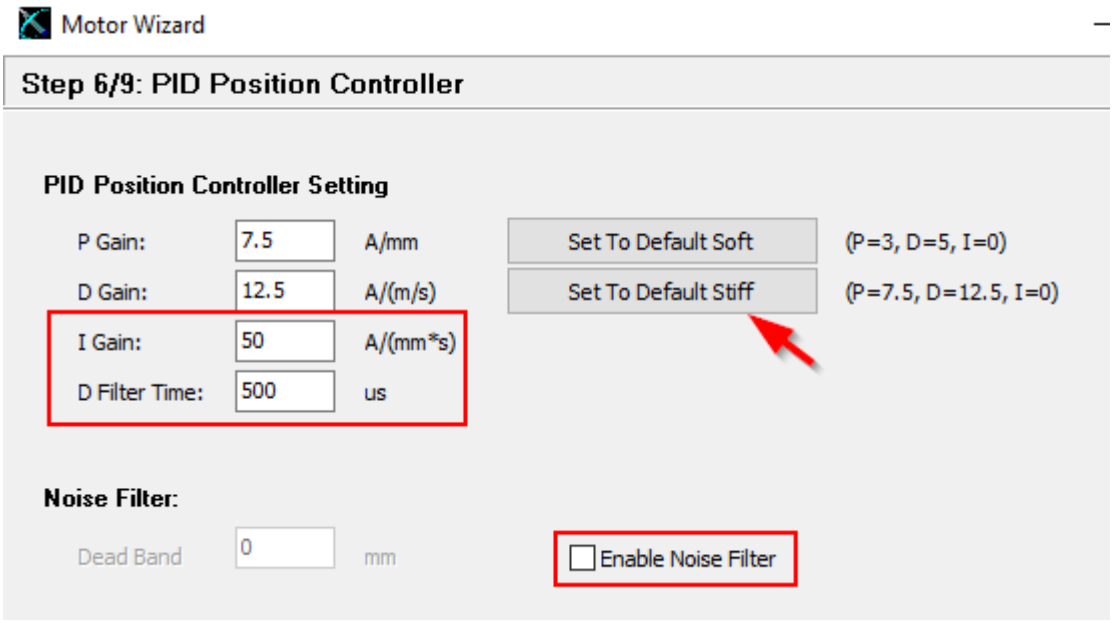
```
    4:  // Wait move absolute done
        // ********************************************
        IF "MC_MOVEABSOLUTE_Axis1".Done THEN
            // Clean up
            // ********************************************
            "MC_MOVEABSOLUTE_Axis1".Execute := FALSE;
            "MC_MOVEVELOCITY_Axis1".Execute := FALSE;
            "MC_HALT_Axis1".Execute := FALSE;

            "Axis1_TargetTorque" := 0;
            "Axis1_RunModeSelection" := 1; // Positioning Mode (Drive Run Mode 1, Telegram 5 / 105)

            "GVL".bTCtrlExecute := FALSE;

            "GVL".iTCtrlState := 0; // Cycle completed
        END_IF;


    100:// Reset
        // ********************************************
        "MC_MOVEABSOLUTE_Axis1".Execute := FALSE;
        "MC_MOVEVELOCITY_Axis1".Execute := FALSE;
        "MC_HALT_Axis1".Execute := FALSE;

        "Axis1_TargetTorque" := 0;
        "Axis1_RunModeSelection" := 1; // Positioning Mode (Drive Run Mode 1, Telegram 5 / 105)

        "GVL".bTCtrlExecute := FALSE;

        "GVL".iTCtrlState := 0;
    ELSE
        ;
END_CASE;
```

12.9 Tuning the Control Loops

12.9.1 Drive Control Loop

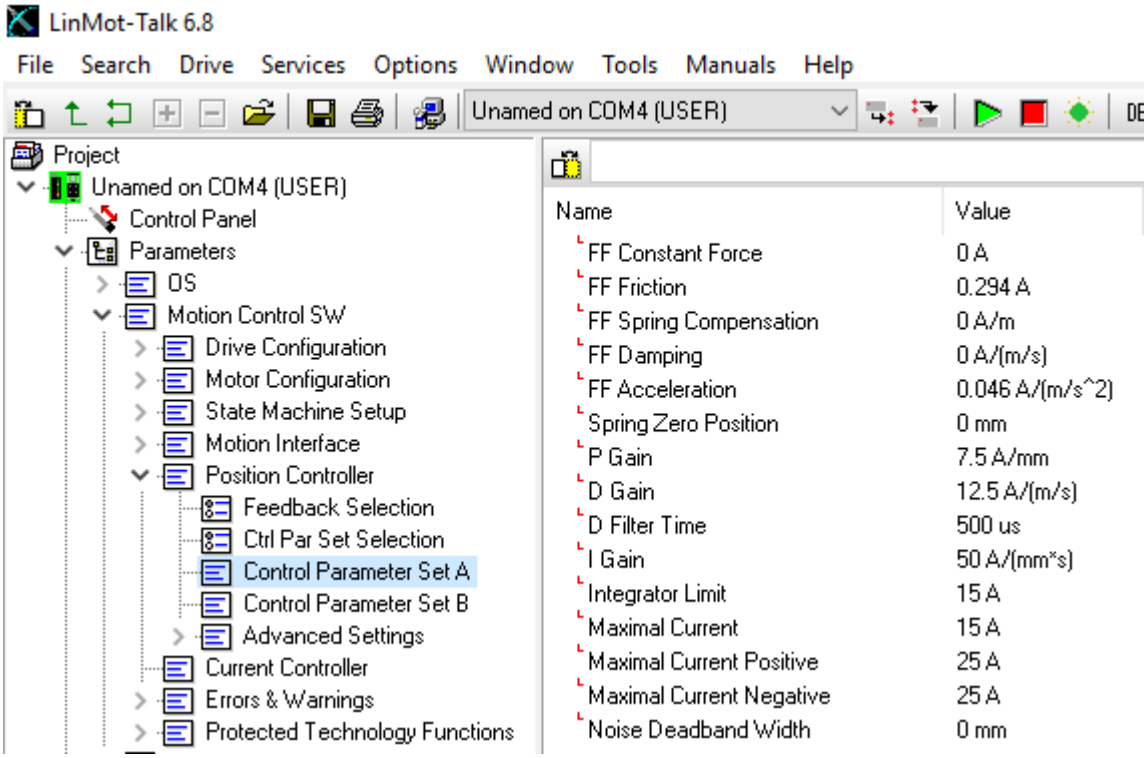
To start tuning use the **default stiff** settings in the Motor Wizard within LinMot-Talk (motor depending).

In case the motor becomes too loud and vibrates reduce the P and D Gains.



- Make sure the “Enable Noise Filter” is unchecked.
- Set the D Filter Time to 250-500us.
- Set the I Gain to 20-50 A/(mm*s).

After finishing the motor wizard and restarting the drive, the control loop parameters can be tuned in the *Control Parameter Set A* (mainly P, D and I Gains):



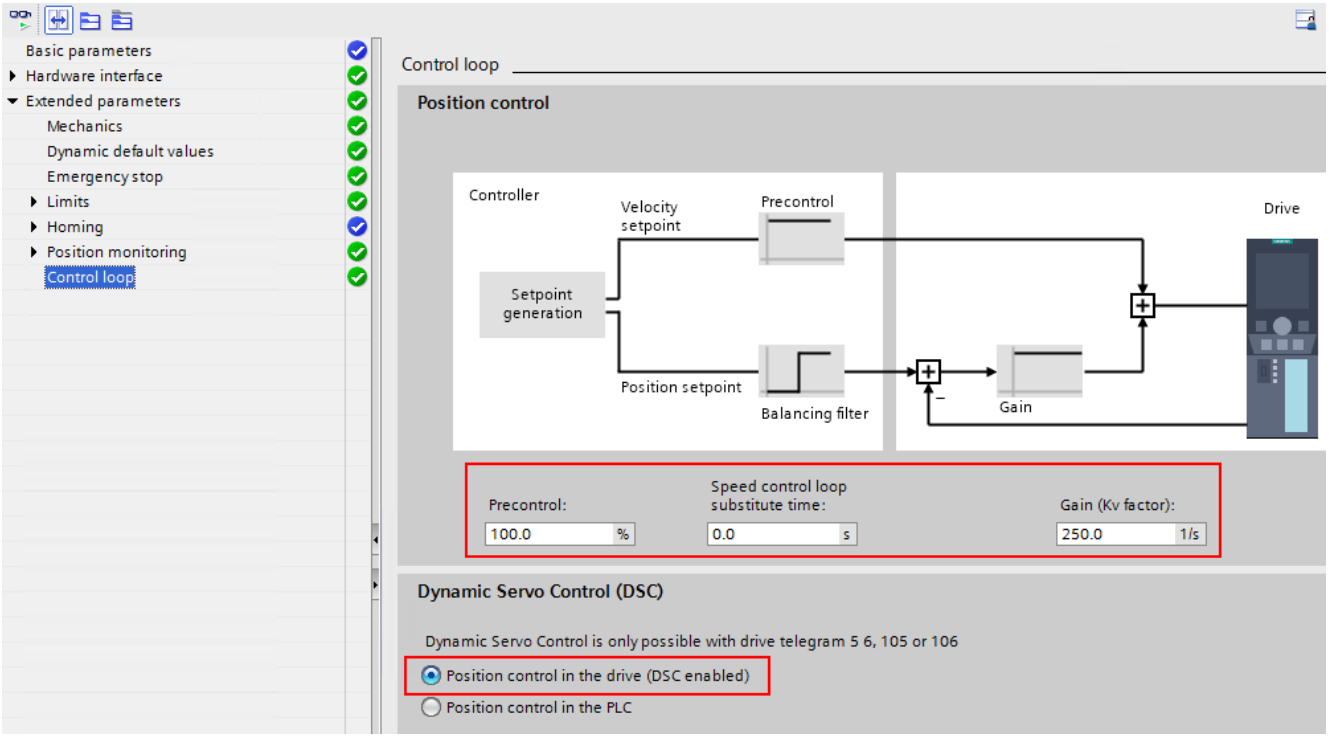
Up to firmware 6.6 Build 20170410 the I Gain in the Control Parameters Set A of the LinMot drive must be set to 0 (zero).

From firmware 6.6 Build 20170522 the I-Gain must be set to an appropriate value to exactly reach the end position.

Also check chapter Appendix I: Basic Position Control Loop Tuning

12.9.2 PLC Control Loop

Within the technology object configuration set the Gain (Kv factor) to 100.
From this value increase until you reach the required stiffness and accuracy.



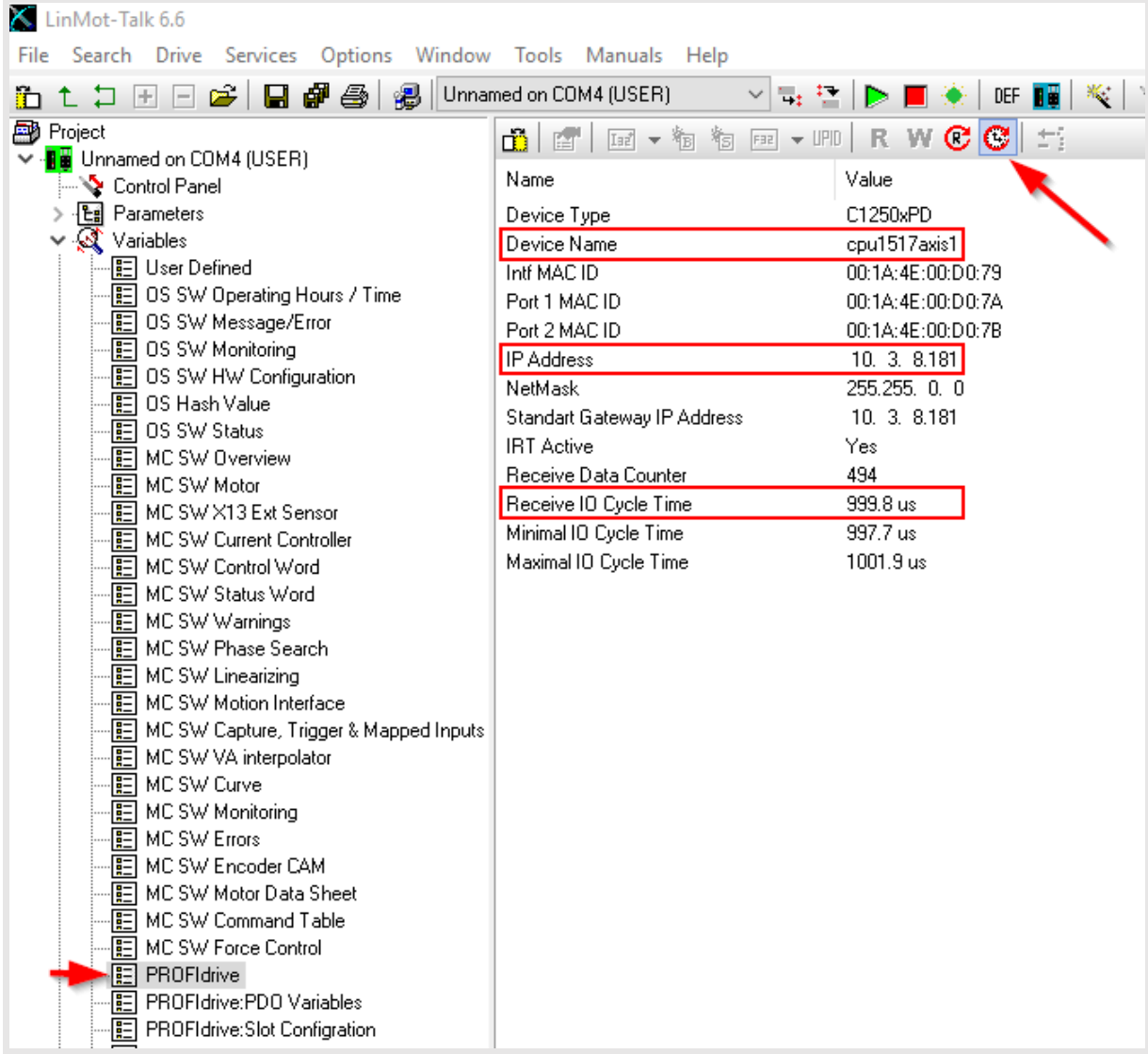
Make sure DSC is enabled.

Now you are ready to enable the motor and start some movements to optimize the control parameters in both the drive and the PLC.

12.10 Check with LinMot-Talk if the Fieldbus is running

LinMot-Talk shows the status of the fieldbus. Open the variables *PROFIdrive* and check if the Node Address / IP Address is correct.

Check fieldbus status:



13 Drive Profile: Beckhoff TwinCAT 2/3, CoE DS402

13.1 Overview

This chapter shows how a LinMot drive with *DS402 (CoE) / CiA402* interface (e.g., C1250-MI-XC-1S) can be integrated and setup in a Beckhoff TwinCAT environment.
For this example, TwinCAT 3 is used. The steps are generally similar for TwinCAT 2.

Attention:
Drive firmware **6.10 Build 20210521 or later** is required to use all the functionality shown in this chapter.

Download:
Example projects can be downloaded from:
http://download.linmot.com/plc_lib/examples/Beckhoff_CoE/ (named *LM_CoE_Demo_TCx_...*)

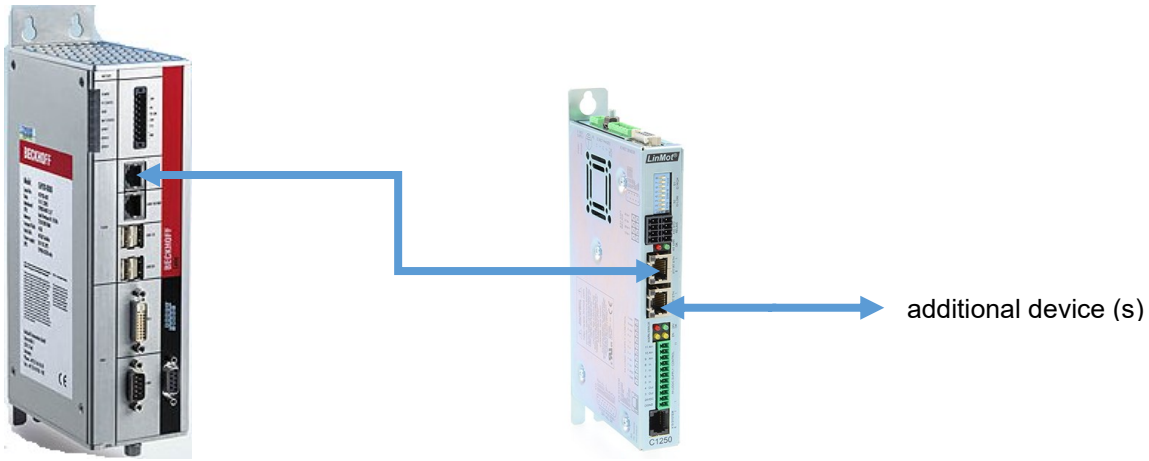


Image Source: http://www.beckhoff.com/

EtherCAT is the real-time Ethernet network originally developed by Beckhoff. The LinMot acts as Slave in this network and is implemented with the netX from Hilscher (MI Drives) or the standard ASIC ET1100 from Beckhoff (DS Drives).

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

Note:
In this chapter the following Modes of Operation of the DS402 / CiA402 profile are used:
6 = homing mode
8 = cyclic synchronous position (csp)
10= cyclic synchronous torque (cst)

The modes are switched by setting object 6060h (Mode of operation) to the according value.
The drive shows the active mode in object 6061h (Mode of operation display).

13.2 Configuration and Connection of the LinMot Drive

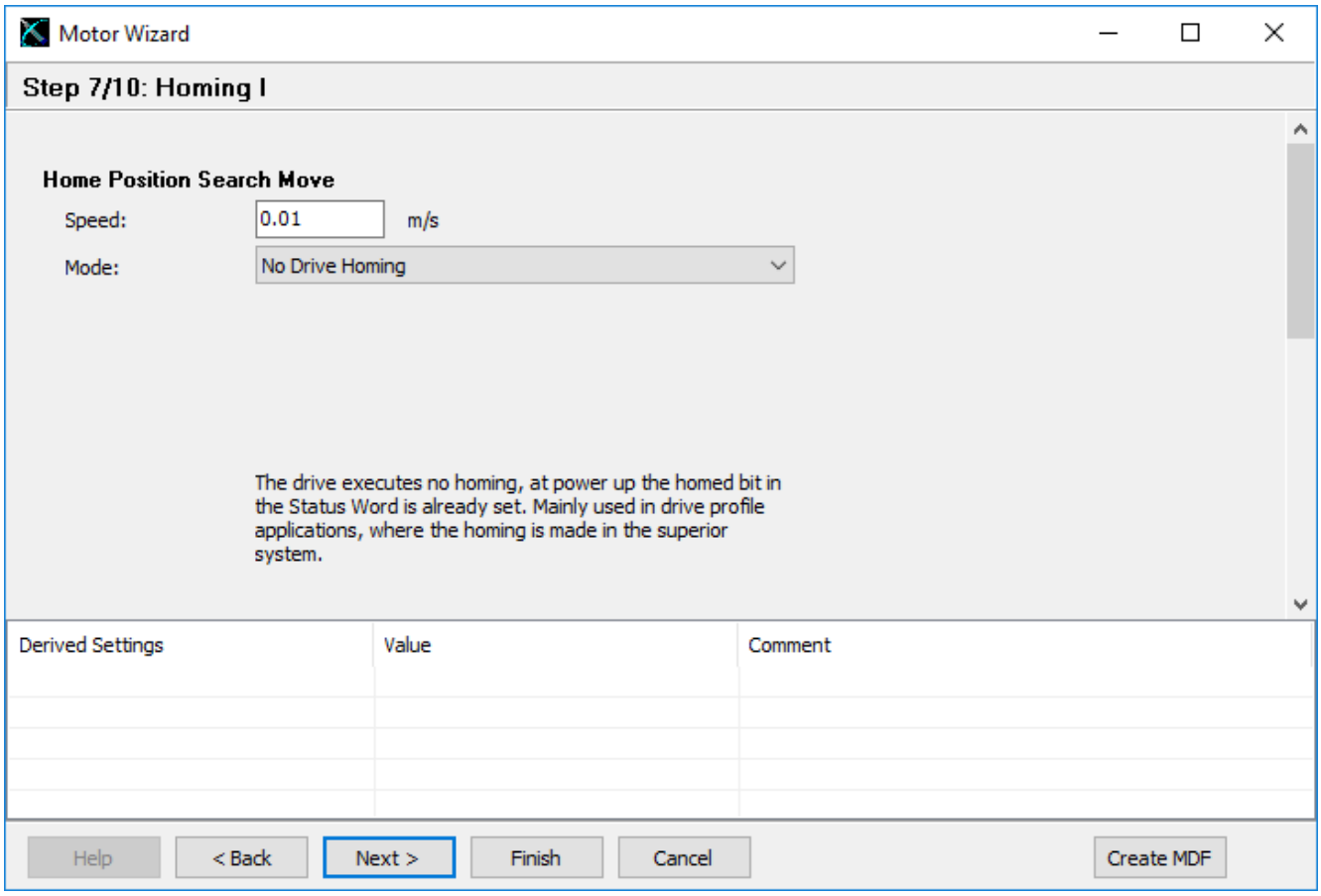
The LinMot drive is configured using the LinMot-Talk software:
http://www.linmot.com/download/linmot-talk-drive-configuration/

13.2.1 Motor Configuration

It is assumed that the motor connected to the drive is already configured.

Use the *Motor Wizard* inside LinMot-Talk to setup the motor (Menu -> Drive -> Motor Wizard):

Make sure that you select “No Drive Homing” in the Motor Wizard as the homing of the axis is done in the PLC.



See Appendix I: Basic Position Control Loop Tuning

13.2.2 XML File

Install the XML file that is part of the LinMot-Talk software/firmware you are using.
The most recent device files are always part of the newest LinMot-Talk software. They are located by default:

- *EtherCAT CoE: \\LinMot-Talk X.X Build XXXXXXXX\Firmware\Interfaces\EtherCat_Nx\XML* ***(-MI drives)***
- *EtherCAT CoE: \\LinMot-Talk X.X Build XXXXXXXX\Firmware\Interfaces\EtherCAT\XML*

XML file names:

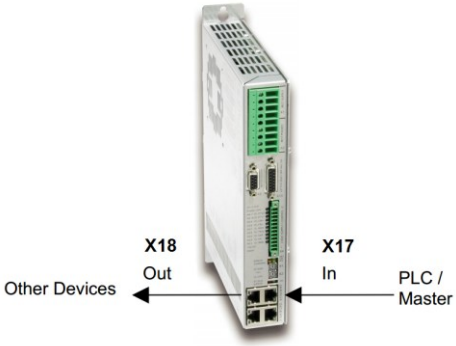
NTIL_CiA402_Servos_MI_Vx_xrx.xml	LinMot MI drives
NTIL_DS_Drives_Vx_x_bxx.xml	LinMot DS drives SG9 (F Series DS)
NTIL_CiA402_Servos_Vx_xrx.xml	LinMot DS drives SG6-7
NTIL_CiA402_SG5_Servos_Vx_xrx.xml	LinMot DS drives SG5

13.2.3 EtherCAT Connection

The drive is connected to the EtherCAT network using the **X17 (IN) & X18 (OUT)** connectors.

The below pictures show the ports of an E1250-DS-UC drive.
On all other LinMot drives supporting EtherCAT CoE the ports are named the same (X17 & X18) but they may be placed differently on the drive housing.

X17 - X18	RealTime Ethernet 10/100 Mbit/s	
	X17 RT ETH In	(Beckhoff: EtherCAT IN, from PLC)
	X18 RT ETH Out	(Beckhoff: EtherCAT OUT, to next device)
RJ-45		



13.3 PLC Setup

13.3.1 EtherCAT Device Description File XML

The EtherCAT device description file (XML) is located by default in the LinMot-Talk installation path:

C:\Program Files (x86)\LinMot\LinMot-Talk X.X Build XXXXXXXX\Firmware\Interfaces\EtherCat_Nx\XML
C:\Program Files (x86)\LinMot\LinMot-Talk X.X Build XXXXXXXX\Firmware\Interfaces\EtherCAT\XML

Copy the required file to your local TwinCAT installation path:

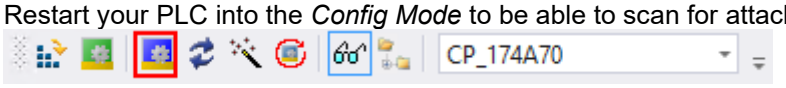
- C:\TwinCAT\Io\EtherCAT\ (for TwinCAT 2)
- C:\TwinCAT\3.1\Config\Io\EtherCAT\ (for TwinCAT 3)

Note: You may have to restart the developing environment to have the new XML file to be recognized.

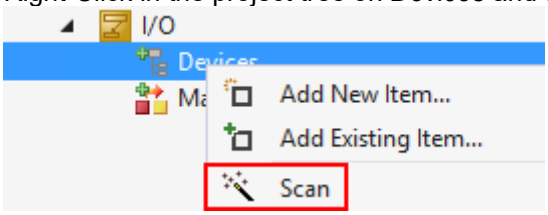
13.3.2 Scanning the EtherCAT for new Devices

Follow these steps to add the LinMot drive to your Beckhoff PLC.

1. Restart your PLC into the *Config Mode* to be able to scan for attached devices.

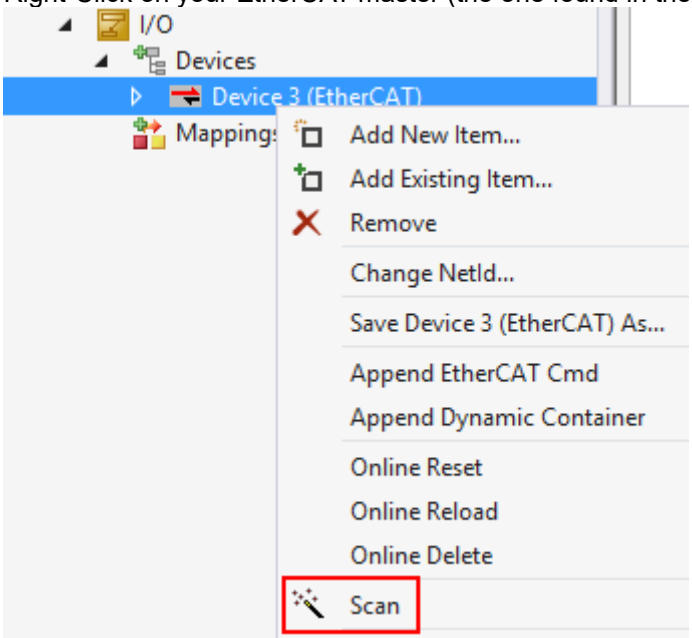


2. Right-Click in the project tree on *Devices* and select *Scan*

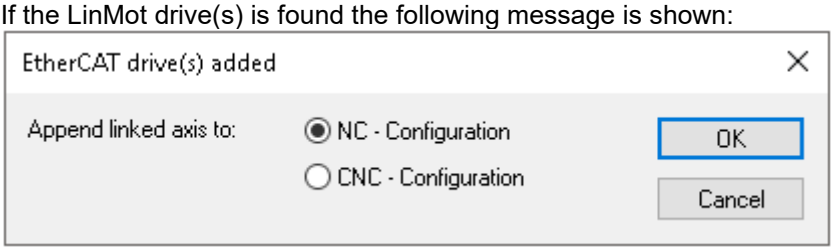


Select and insert the found EtherCAT master (e.g., *Device 3 (EtherCAT)*).
You can now directly scan for boxes. If you select yes, then skip the next step.

3. Right-Click on your EtherCAT master (the one found in the previous step) and select *Scan*

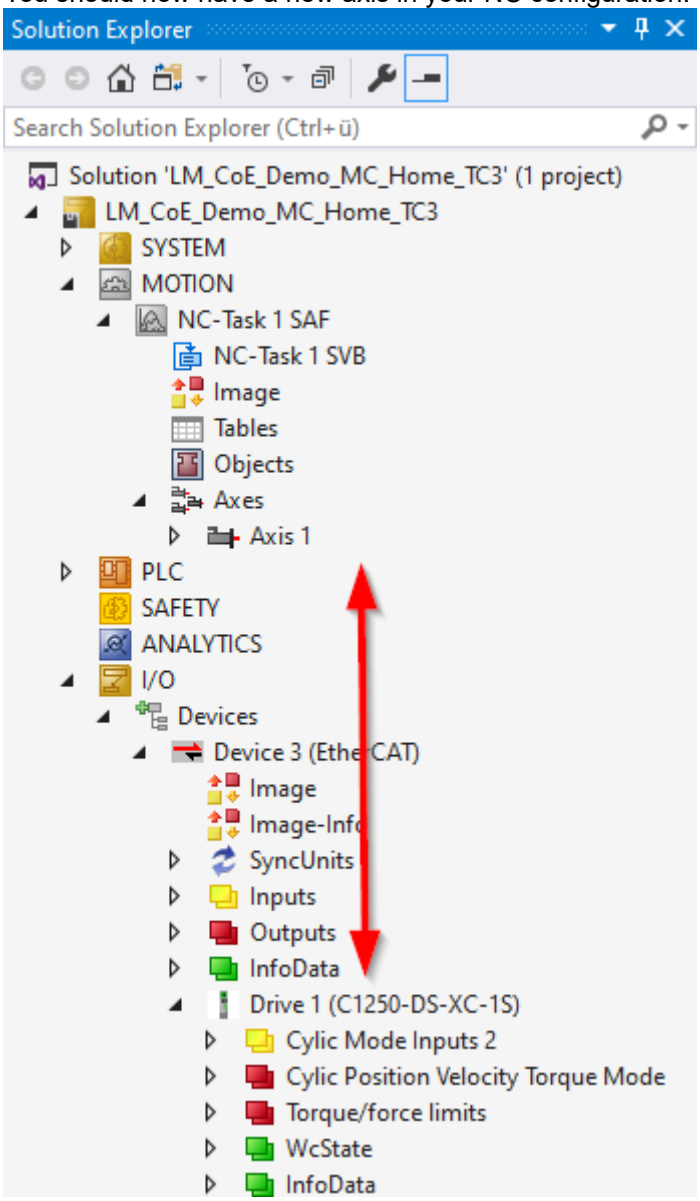


4. If the LinMot drive(s) is found the following message is shown:



Select OK

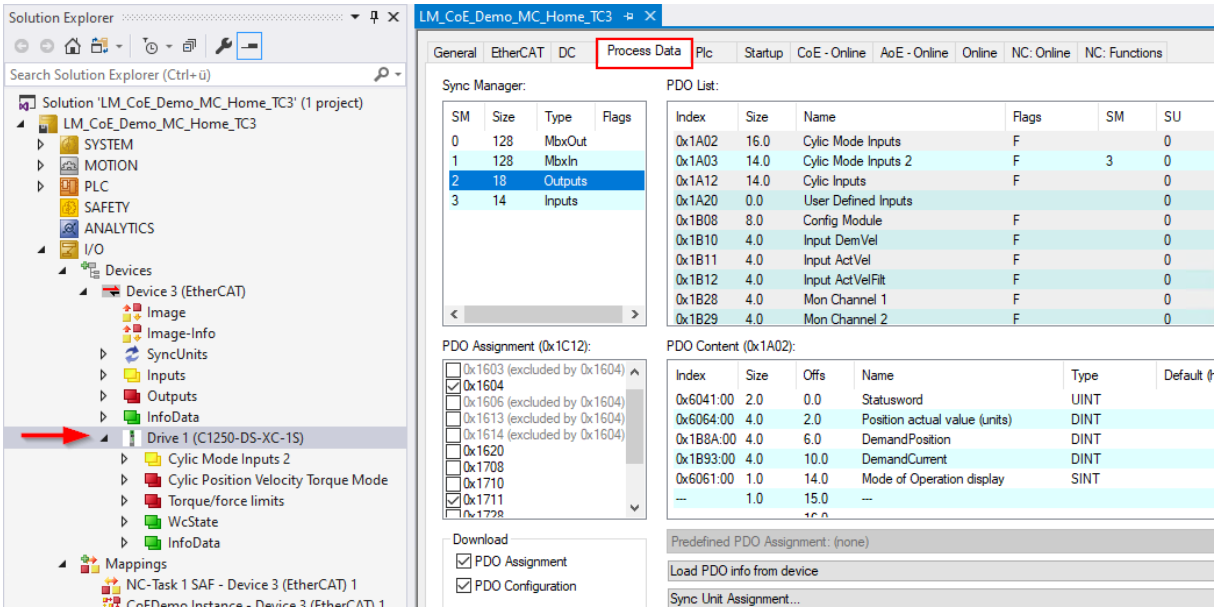
5. You should now have a new axis in your NC configuration:



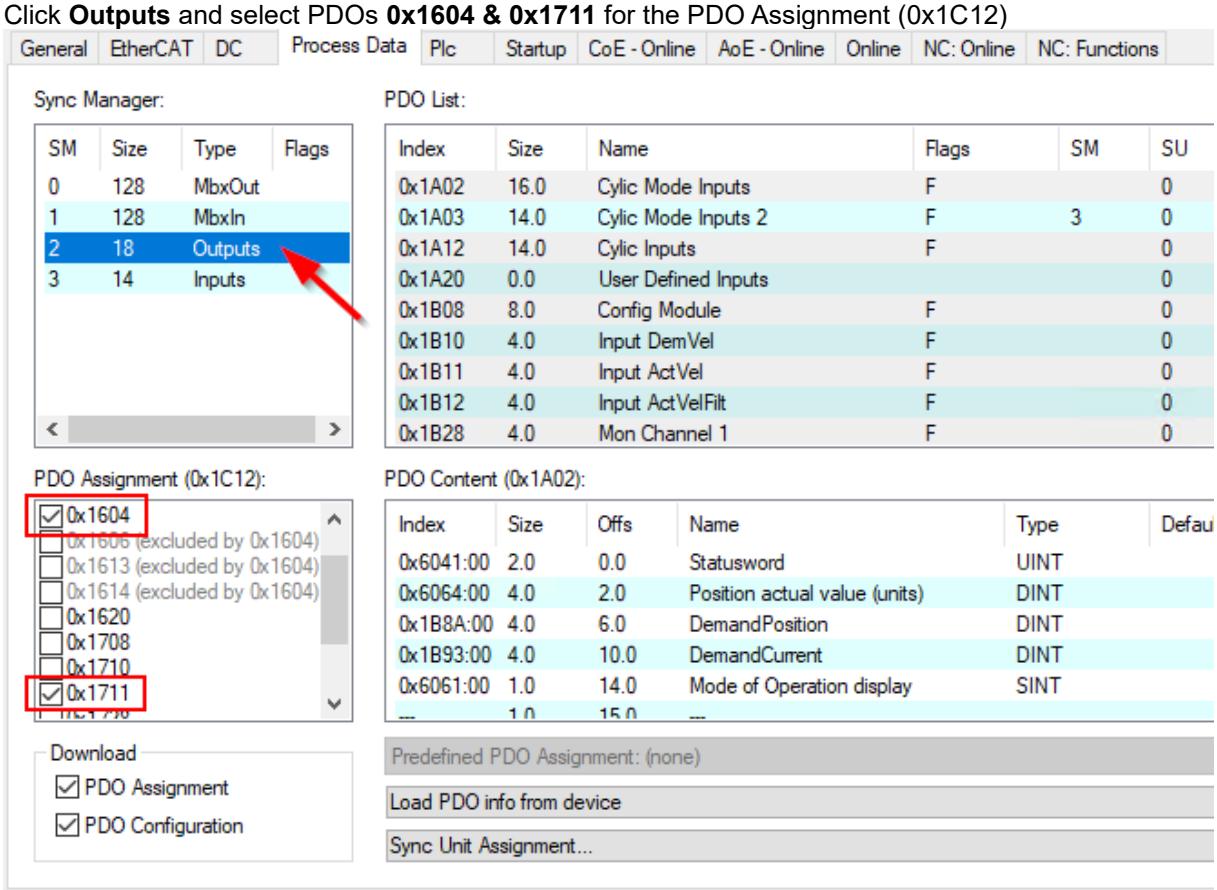
In the next chapter the configuration of the process data of the LinMot drive is shown

13.3.3 Setting up the Process Data of the LinMot Drive

1. Move to the tab *Process Data*

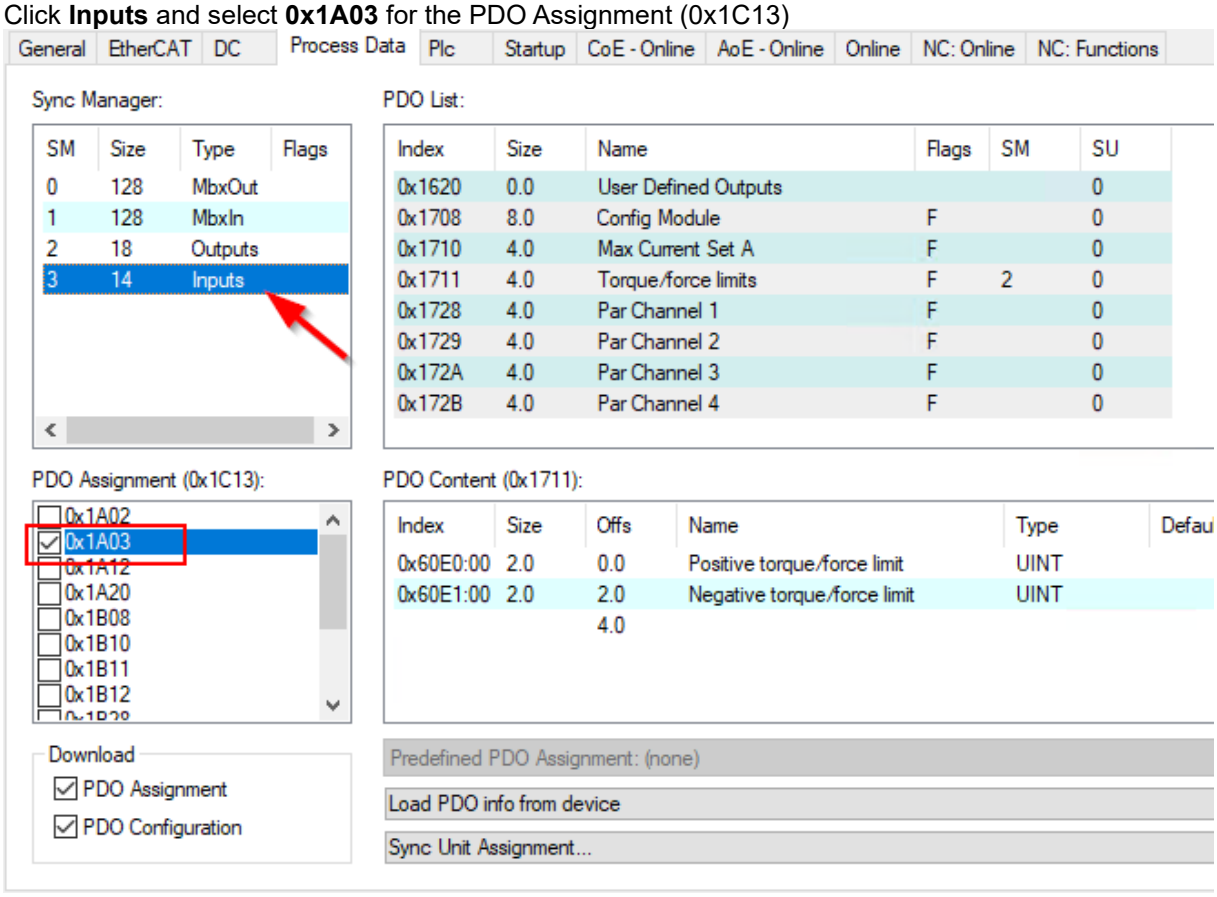


2. Click **Outputs** and select PDOs **0x1604 & 0x1711** for the PDO Assignment (0x1C12)



0x1604 = Cyclic Position Velocity Torque Mode
0x1711 = Torque/Force Limits (optional)

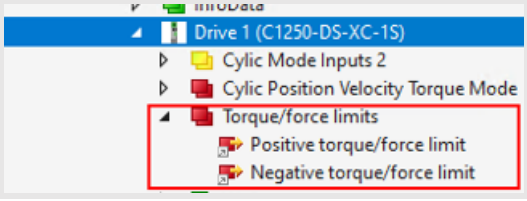
3. Click **Inputs** and select **0x1A03** for the PDO Assignment (0x1C13)



The mapping of drive and NC axis should look as follows:

Name	Type	Size	In/Out	Linked to
Statusword	UINT	2.0	Input	nState1, nState2
Position actual value (units)	DINT	4.0	Input	nDataIn1 . In . Inputs . Enc . Axis 1 . Axis 1 . Axes . NC-Task 1 SAF
Position demand value	DINT	4.0	Input	
Torque actual value	INT	2.0	Input	nDataIn3[0] . nDataIn3 . In . Inputs . Drive . Axis 1 . Axis 1 . Axes . NC-Task 1 SAF
Mode of Operation display	SINT	1.0	Input	nState5 . In . Inputs . Drive . Axis 1 . Axis 1 . Axes . NC-Task 1 SAF
WcState	BIT	0.1	Input	nState4, nState4
InputToggle	BIT	0.1	Input	nState4, nState4
State	UINT	2.0	Input	
AdsAddr	AMSADDR	8.0	Input	
AoeNetId	AMSNETID	6.0	Input	
Chn0	USINT	1.0	Input	
DcOutputShift	DINT	4.0	Input	nDcOutputTime . In . Inputs . Drive . Axis 1 . Axis 1 . Axes . NC-Task 1 SAF
DcInputShift	DINT	4.0	Input	nDcInputTime . In . Inputs . Enc . Axis 1 . Axis 1 . Axes . NC-Task 1 SAF
Controlword	UINT	2.0	Output	nCtrl1, nCtrl2
Target position	DINT	4.0	Output	nDataOut1 . Out . Outputs . Drive . Axis 1 . Axis 1 . Axes . NC-Task 1 SAF
Target velocity	DINT	4.0	Output	nDataOut2 . Out . Outputs . Drive . Axis 1 . Axis 1 . Axes . NC-Task 1 SAF
Target torque	INT	2.0	Output	nDataOut4[0] . nDataOut4 . Out . Outputs . Drive . Axis 1 . Axis 1 . Axes . NC-Task 1 SAF
Mode of Operation	SINT	1.0	Output	nCtrl5 . Out . Outputs . Drive . Axis 1 . Axis 1 . Axes . NC-Task 1 SAF
Positive torque/force limit	UINT	2.0	Output	GVL.iAxisTorqueLimitPos[1] . GVL.iAxisTorqueLimitPos . PlcTask Outputs . CoEDemo Instance . CoEDemo
Negative torque/force limit	UINT	2.0	Output	GVL.iAxisTorqueLimitNeg[1] . GVL.iAxisTorqueLimitNeg . PlcTask Outputs . CoEDemo Instance . CoEDemo

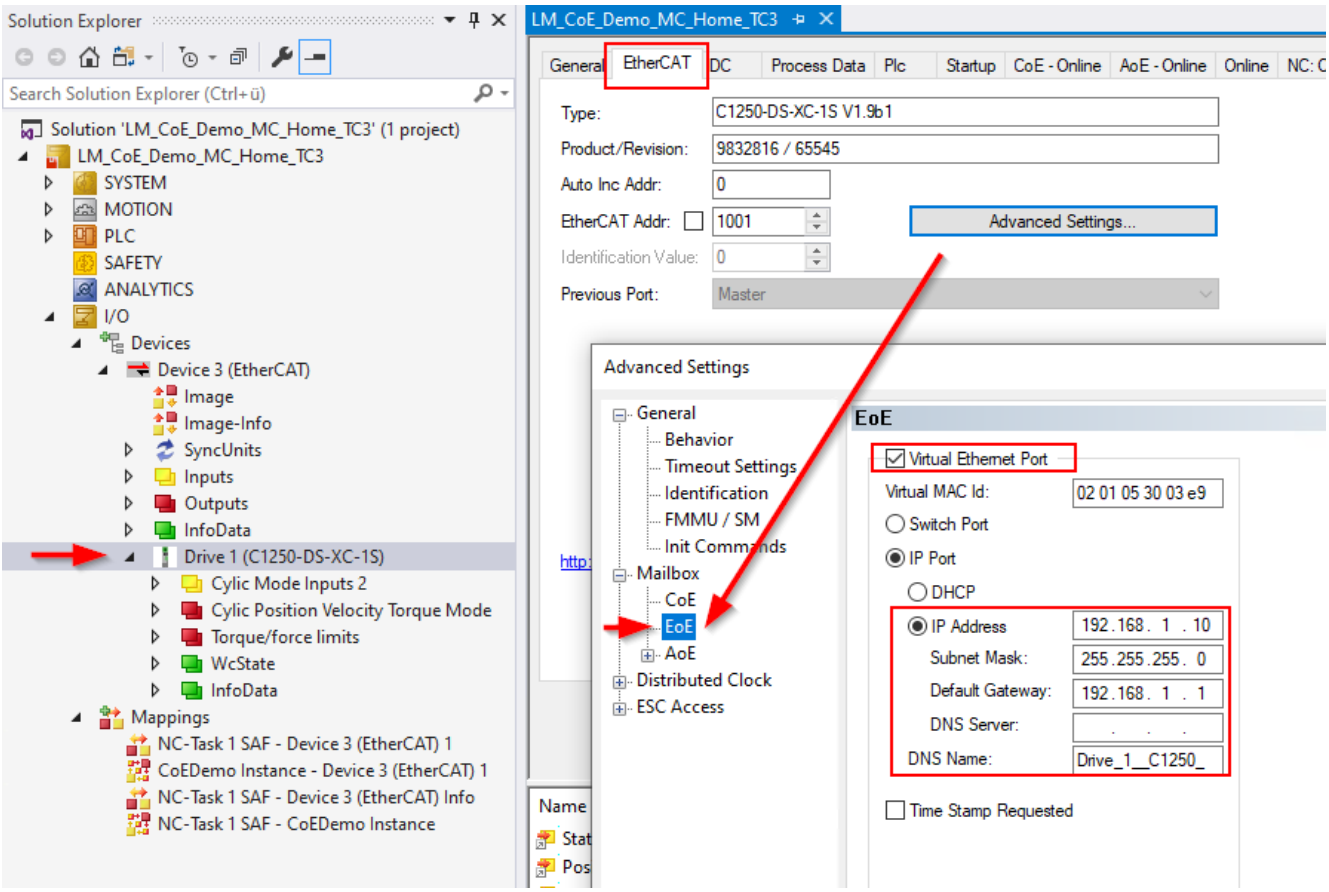
!!! Attention !!!:
At this point the positive and negative force/torque limits must be mapped/linked as shown above. Otherwise, the motor current will be set to 0 when activating the project and it won't be possible to move.



13.3.4 Check EoE settings

On supported drives (C1250-..., C1450-… & E1450-...) please check the **EoE** (Ethernet over EtherCAT) settings.

LinMot drives do NOT support the DHCP mode yet. A fix IP must be assigned (select *IP Address*) or the EoE feature must be completely disabled (disable Virtual Ethernet Port).

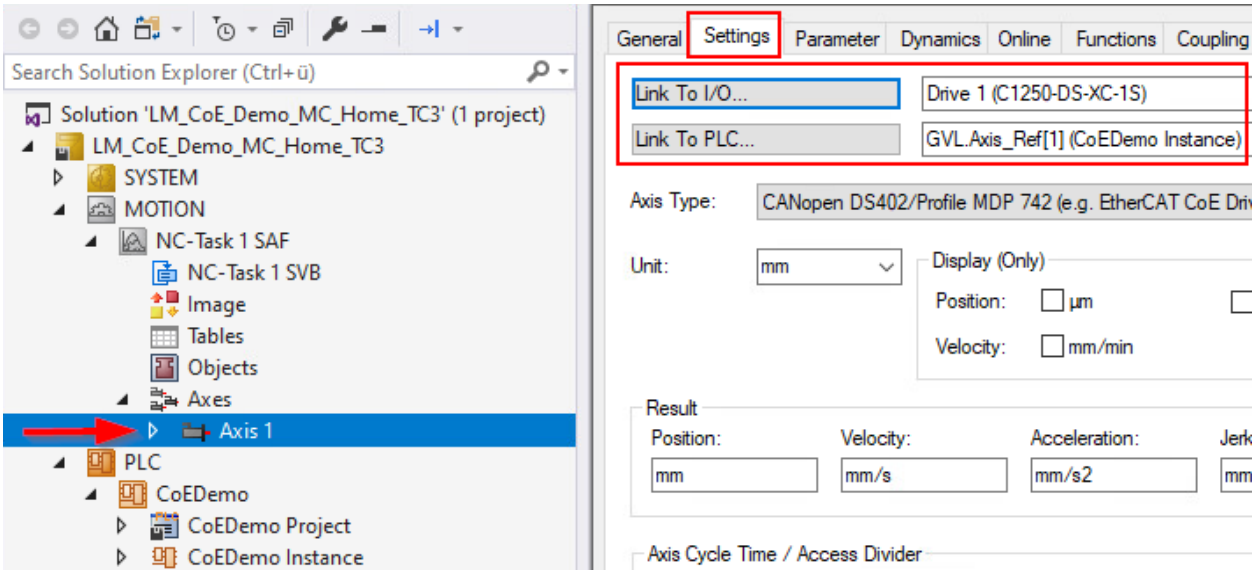


Note:
EoE can be used to login into the drive with LinMot-Talk directly over EtherCAT.
E.g., to change drive settings or for monitoring and tracing.

13.3.5 Setting up the NC Axis

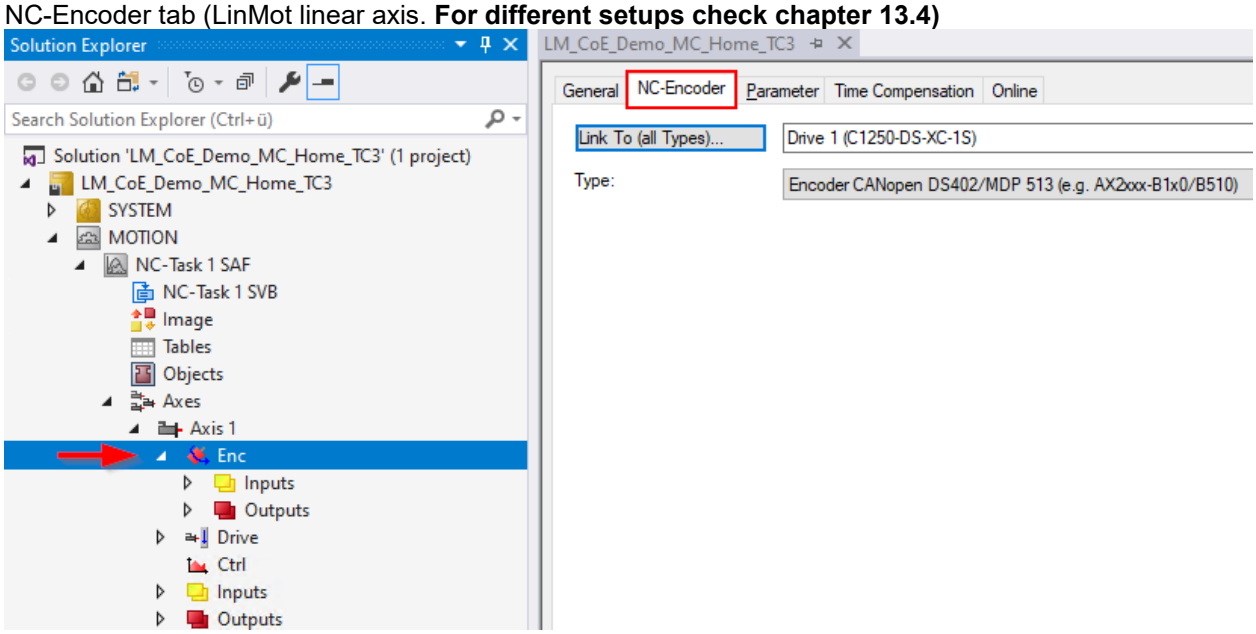
The following steps show how to basically setup the NC axis (red framed = mandatory).

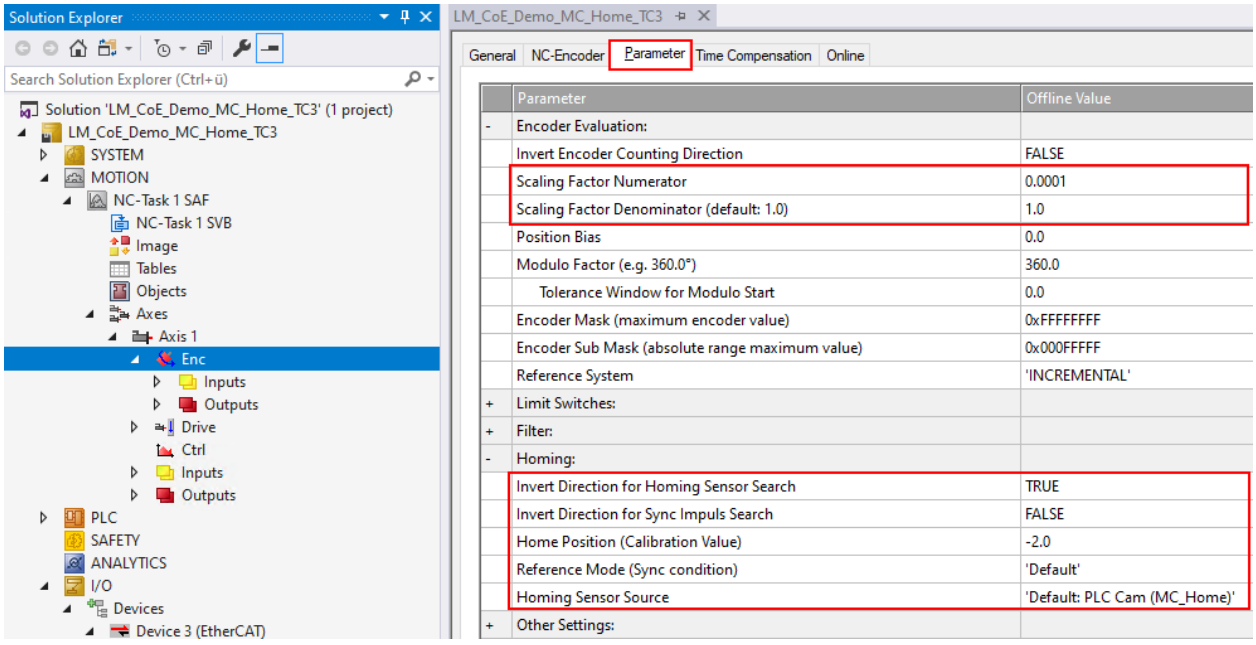
1. **Axis Drive and AXIS_REF:** Make sure the correct drive and AXIS_REF are selected under “Settings” > “Link To I/O…” and “Link To PLC..”



2. **Axis Encoder:** Setup the axis encoder as shown. Make sure the correct drive is selected “Link To (all….).

NC-Encoder tab (LinMot linear axis. **For different setups check chapter 13.4)**





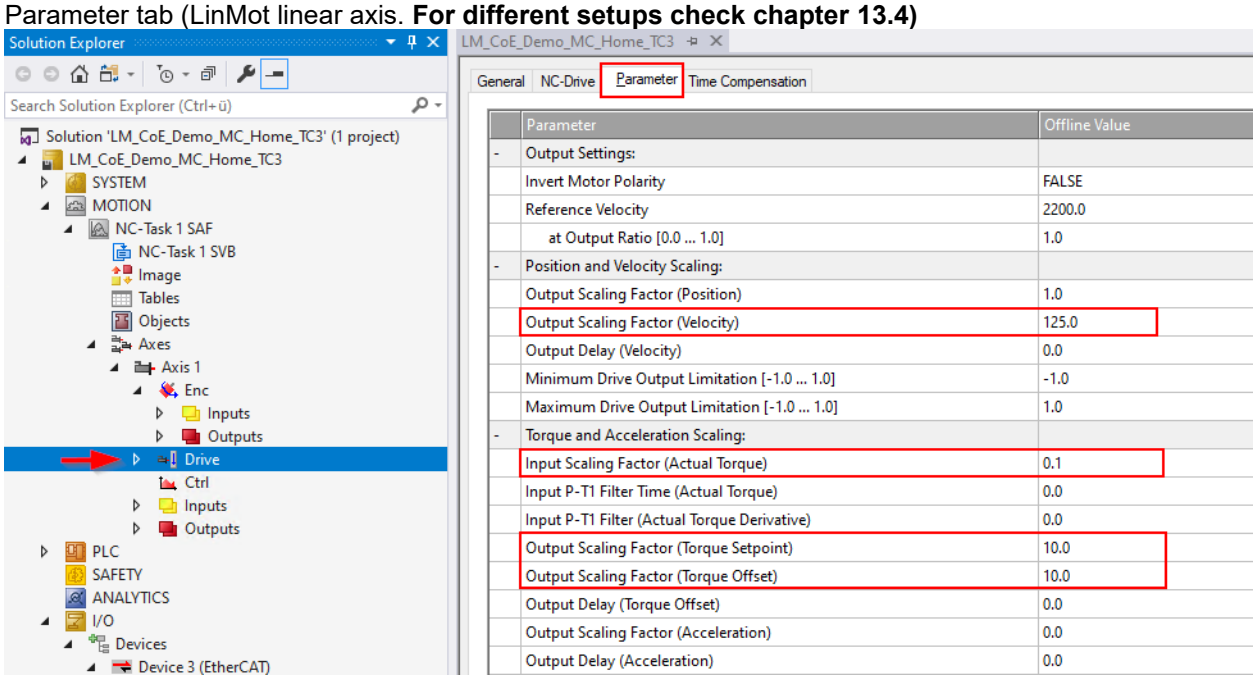
Depending on what Homing sequence you prefer you can setup some of the Homing parameters here.

Note:
To minimize the following error caused by communication delay it is recommended to enable “Time Compensation”. The below settings are a good starting point.

Parameter	Offline Value
Time Compensation Mode Encoder	'ON (with velocity)'
IO Time is absolute	FALSE
Encoder Delay in Cycles	3
Additional Encoder Delay	500

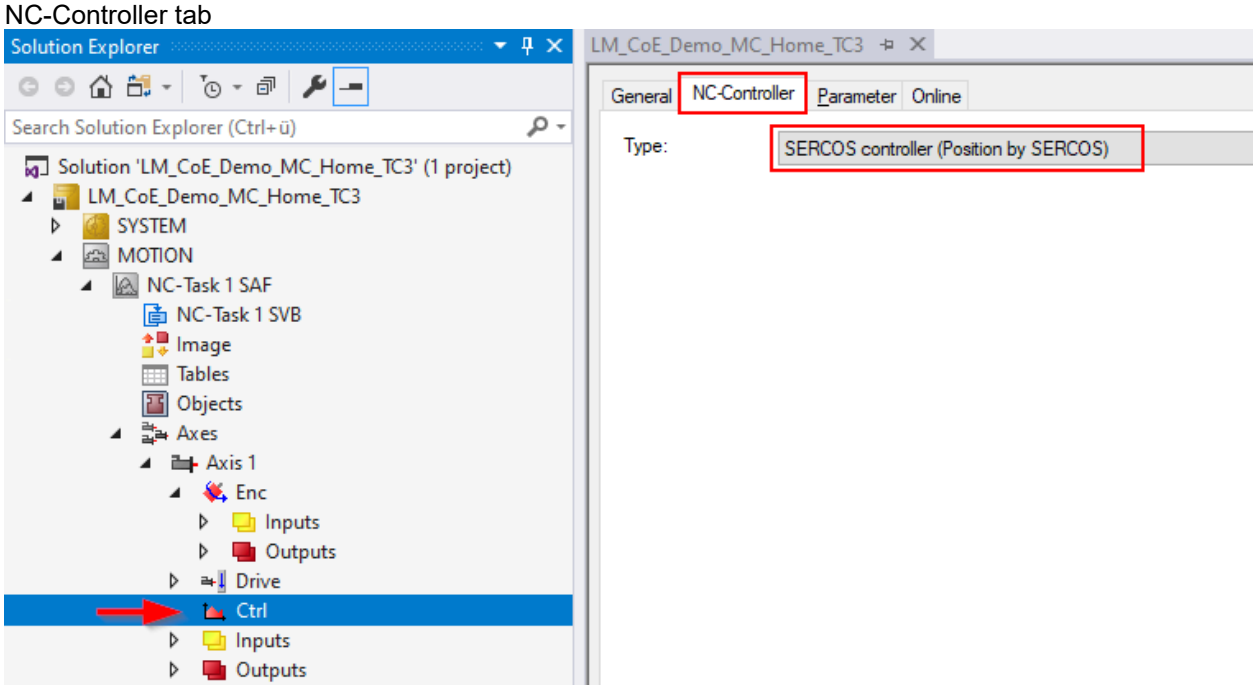
3. **Axis Drive:** Setup the drive as shown (red framed = mandatory)

   Parameter tab (LinMot linear axis. **For different setups check chapter 13.4)**

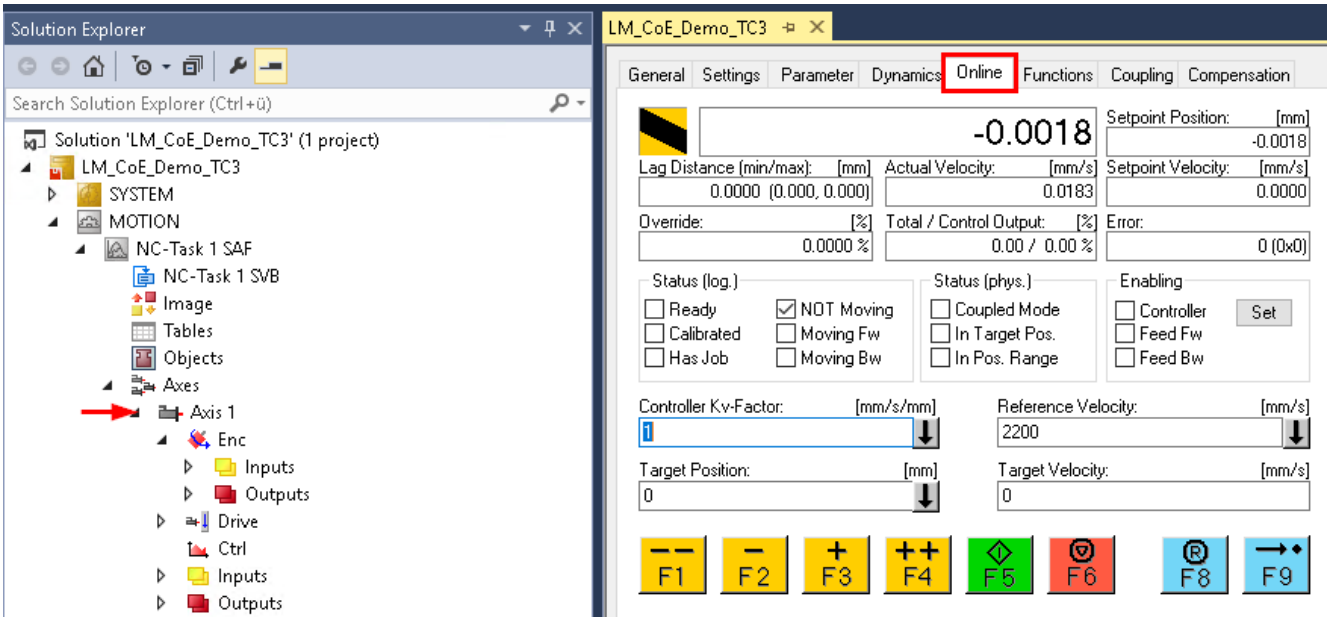


4. **Axis Ctrl:** Set Type as SERCOS controller

   NC-Controller tab



You are now ready to activate the configuration of the PLC and to enable and move the axis in the Online tab of the NC axis



13.4 Encoder Parameter Examples for Linear and Rotary Motors (Axis > Enc and Axis > Drive)

13.4.1 LinMot Linear Motors PS01 / PS10

The internal position resolution of the LinMot drive is 0.1um for linear motors.

Therefore, the following parameters must be set accordingly:

- *Scaling Factor Numerator* must be set to **0.0001** (=1mm / 10'000 Increments)
- *Scaling Factor Denominator* is left to **1.0**

Encoder tab:

General | NC-Encoder | Parameter | Time Compensation | Online

	Parameter	Offline Value
-	Encoder Evaluation:	
	Invert Encoder Counting Direction	FALSE
	Scaling Factor Numerator	0.0001
	Scaling Factor Denominator (default: 1.0)	1.0
	Position Bias	0.0
	Modulo Factor (e.g. 360.0°)	360.0
	Tolerance Window for Modulo Start	0.0
	Encoder Mask (maximum encoder value)	0xFFFFFFFF
	Encoder Sub Mask (absolute range maximum value)	0x000FFFFF
	Reference System	'INCREMENTAL'

Drive tab:

General | NC-Drive | Parameter | Time Compensation

	Parameter	Offline Value
-	Output Settings:	
	Invert Motor Polarity	FALSE
	Reference Velocity	4000.0
	at Output Ratio [0.0 ... 1.0]	1.0
-	Position and Velocity Scaling:	
	Output Scaling Factor (Position)	1.0
	Output Scaling Factor (Velocity)	125.0
	Output Delay (Velocity)	0.0
	Minimum Drive Output Limitation [-1.0 ... 1.0]	-1.0
	Maximum Drive Output Limitation [-1.0 ... 1.0]	1.0
-	Torque and Acceleration Scaling:	
	Input Scaling Factor (Actual Torque)	0.1
	Input P-T1 Filter Time (Actual Torque)	0.0
	Input P-T1 Filter (Actual Torque Derivative)	0.0
	Output Scaling Factor (Torque Setpoint)	10.0
	Output Scaling Factor (Torque Offset)	10.0
	Output Delay (Torque Offset)	0.0
	Output Scaling Factor (Acceleration)	0.0
	Output Delay (Acceleration)	0.0

13.4.2 LinMot Rotary Motors RS01 / RS02

The LinMot RS01 motors (rotary part of LinMot PR01 & PR02 linear rotary motors) have a single turn absolute encoder and by default 360'000 Ticks (Increments) per motor revolution.

Therefore, the following parameters must be set accordingly:

- *Scaling Factor Numerator* must be set to **0.001** (=360° / 360'000 Increments)
- *Scaling Factor Denominator* is left to **1.0**

Encoder tab:

General | NC-Encoder | Parameter | Sercos | Time Compensation | Online

	Parameter	Offline Value
-	Encoder Evaluation:	
	Invert Encoder Counting Direction	FALSE
	Scaling Factor Numerator	0.001
	Scaling Factor Denominator (default: 1.0)	1.0
	Position Bias	0.0
	Modulo Factor (e.g. 360.0°)	360.0
	Tolerance Window for Modulo Start	0.0
	Encoder Mask (maximum encoder value)	0xFFFFFFFF
	Encoder Sub Mask (absolute range maximum value)	0x00057E40
	Reference System	'ABSOLUTE SINGLETURN RANGE (with single overflow)'

Set the **Reference System** according to your application needs. When 'ABSOLUTE SINGLETURN RANGE (with single overflow)' is used as above then also the **Soft Position Limits** values must be set and enabled.

Drive tab:

General | NC-Drive | Parameter | Time Compensation

	Parameter	Offline Value
-	Output Settings:	
	Invert Motor Polarity	FALSE
	Reference Velocity	7200.0
	at Output Ratio [0.0 ... 1.0]	1.0
-	Position and Velocity Scaling:	
	Output Scaling Factor (Position)	1.0
	Output Scaling Factor (Velocity)	42.91538516558186
	Output Delay (Velocity)	0.0
	Minimum Drive Output Limitation [-1.0 ... 1.0]	-1.0
	Maximum Drive Output Limitation [-1.0 ... 1.0]	1.0
-	Torque and Acceleration Scaling:	
	Input Scaling Factor (Actual Torque)	0.1
	Input P-T1 Filter Time (Actual Torque)	0.0
	Input P-T1 Filter (Actual Torque Derivative)	0.0
	Output Scaling Factor (Torque Setpoint)	10.0
	Output Scaling Factor (Torque Offset)	10.0
	Output Delay (Torque Offset)	0.0

The *Output Scaling Factor (Velocity)* depends on the selected *Encoder Sub Mask*.

Scaling = **125** * **360000** (16#00057E40) / **1048575** (16#000FFFFF) = **42.9153851655818610972033474000 43**

13.4.3 LinMot Rotary Motors EC02 / GM51 / PR02 PS11 & PS31

The LinMot motors name in the title have a single turn absolute encoder and by default 524'288 (2^19) Ticks (Increments) per motor revolution.

Therefore, the following parameters must be set accordingly:
- *Scaling Factor Numerator* must be set to **0.006866455078125** (=360° / 524'288 Increments * 10)
- *Scaling Factor Denominator* is set to **10.0** (=1.0 * 10)

Factor 10 is required to have the full resolution in the *Scaling Factor Numerator*

Encoder tab:

General | NC-Encoder | Parameter | Sercos | Time Compensation | Online

	Parameter	Offline Value
-	Encoder Evaluation:	
	Invert Encoder Counting Direction	FALSE
	Scaling Factor Numerator	0.006866455078125
	Scaling Factor Denominator (default: 1.0)	10.0
	Position Bias	0.0
	Modulo Factor (e.g. 360.0°)	360.0
	Tolerance Window for Modulo Start	0.0
	Encoder Mask (maximum encoder value)	0xFFFFFFFF
	Encoder Sub Mask (absolute range maximum value)	0x00080000
	Reference System	'ABSOLUTE SINGLETURN RANGE (with single overflow)'

Set the **Reference System** according to your application needs. When 'ABSOLUTE SINGLETURN RANGE (with single overflow)' is used as above then also the **Soft Position Limits** values must be set and enabled.

Drive tab:

General | NC-Drive | Parameter | Time Compensation

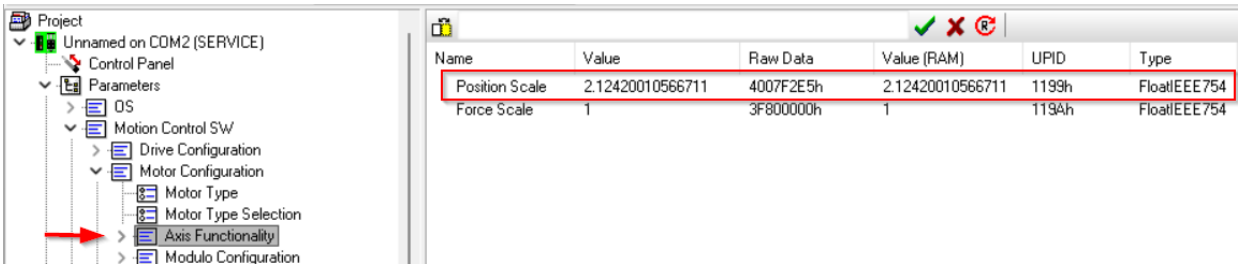
	Parameter	Offline Value
-	Output Settings:	
	Invert Motor Polarity	FALSE
	Reference Velocity	7200.0
	at Output Ratio [0.0 ... 1.0]	1.0
-	Position and Velocity Scaling:	
	Output Scaling Factor (Position)	1.0
	Output Scaling Factor (Velocity)	62.500059604701619
	Output Delay (Velocity)	0.0
	Minimum Drive Output Limitation [-1.0 ... 1.0]	-1.0
	Maximum Drive Output Limitation [-1.0 ... 1.0]	1.0
-	Torque and Acceleration Scaling:	
	Input Scaling Factor (Actual Torque)	0.1
	Input P-T1 Filter Time (Actual Torque)	0.0
	Input P-T1 Filter (Actual Torque Derivative)	0.0
	Output Scaling Factor (Torque Setpoint)	10.0
	Output Scaling Factor (Torque Offset)	10.0
	Output Delay (Torque Offset)	0.0
	Output Scaling Factor (Acceleration)	0.0
	Output Delay (Acceleration)	0.0

The *Output Scaling Factor (Velocity)* depends on the selected *Encoder Sub Mask*.

Scaling = **125** * **524288** (16#00080000) / **1048575** (16#000FFFFF) = **62.500059604701618863695968337983**

13.4.4 LinMot Gripper GM01 / GM5x

The LinMot grippers have in general an absolute encoder. The position scaling factor has to be read out from UPID 1199h for each gripper type:



Therefore, the following parameters must be set accordingly:

- *Scaling Factor Numerator* must be set to **0.00021240010…** (= 2.124…* 1mm / 10'000 Increments)
- *Scaling Factor Denominator* is left to **1.0**

Encoder tab:

General | NC-Encoder | Parameter | Time Compensation | Online

	Parameter	Offline Value
-	Encoder Evaluation:	
	Invert Encoder Counting Direction	FALSE
	Scaling Factor Numerator	0.000212420010567
	Scaling Factor Denominator (default: 1.0)	1.0
	Position Bias	0.0
	Modulo Factor (e.g. 360.0°)	360.0
	Tolerance Window for Modulo Start	0.0
	Encoder Mask (maximum encoder value)	0xFFFFFFFF
	Encoder Sub Mask (absolute range maximum value)	0x000FFFFF
	Reference System	'ABSOLUTE'

Drive Tab

General | NC-Drive | Parameter | Time Compensation

	Parameter	Offline Value
-	Output Settings:	
	Invert Motor Polarity	FALSE
	Reference Velocity	4000.0
	at Output Ratio [0.0 ... 1.0]	1.0
-	Position and Velocity Scaling:	
	Output Scaling Factor (Position)	1.0
	Output Scaling Factor (Velocity)	125.0
	Output Delay (Velocity)	0.0
	Minimum Drive Output Limitation [-1.0 ... 1.0]	-1.0
	Maximum Drive Output Limitation [-1.0 ... 1.0]	1.0
-	Torque and Acceleration Scaling:	
	Input Scaling Factor (Actual Torque)	0.1
	Input P-T1 Filter Time (Actual Torque)	0.0
	Input P-T1 Filter (Actual Torque Derivative)	0.0
	Output Scaling Factor (Torque Setpoint)	10.0
	Output Scaling Factor (Torque Offset)	10.0
	Output Delay (Torque Offset)	0.0
	Output Scaling Factor (Acceleration)	0.0
	Output Delay (Acceleration)	0.0

13.4.5 3rd Party Motors

For other motors, the principle is the same to calculate the Numerator, Denominator, and other encoder parameters as well as the Output Scaling Factor (Velocity)

13.5 Homing

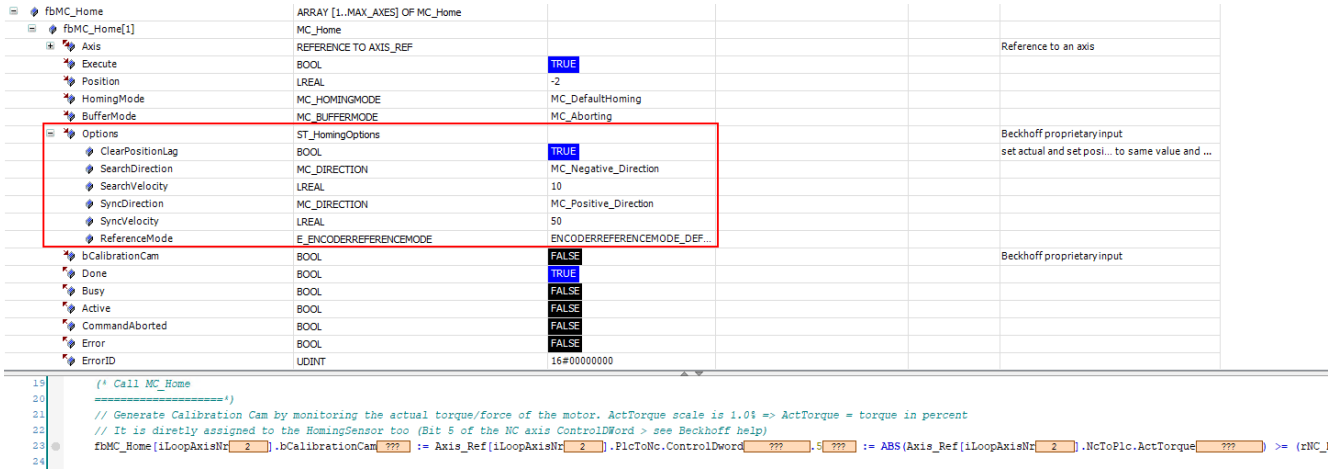
13.5.1 Homing using the MC_Home function block and simulate a reference CAM

The MC_Home function block does not support a block search yet. Nevertheless, it is possible to simulate a calibration cam by a certain force/torque value of the motor.

Attention:
To have the ActualTorque feedback in percent (500% = max. torque/force of the motor) at least firmware **6.10 Build 20210521 or later** is required.

The MC_Home function block *Options* in this example are set to start the search direction negative with 10 unit/s, clear position lag and move away from the calibration cam in positive direction with 50 unit/s.

The calibration cam is set TRUE when the actual motor torque/force is bigger than the set limit in variable rNC_HomeTorqueLimit (500% = max. motor torque/force).

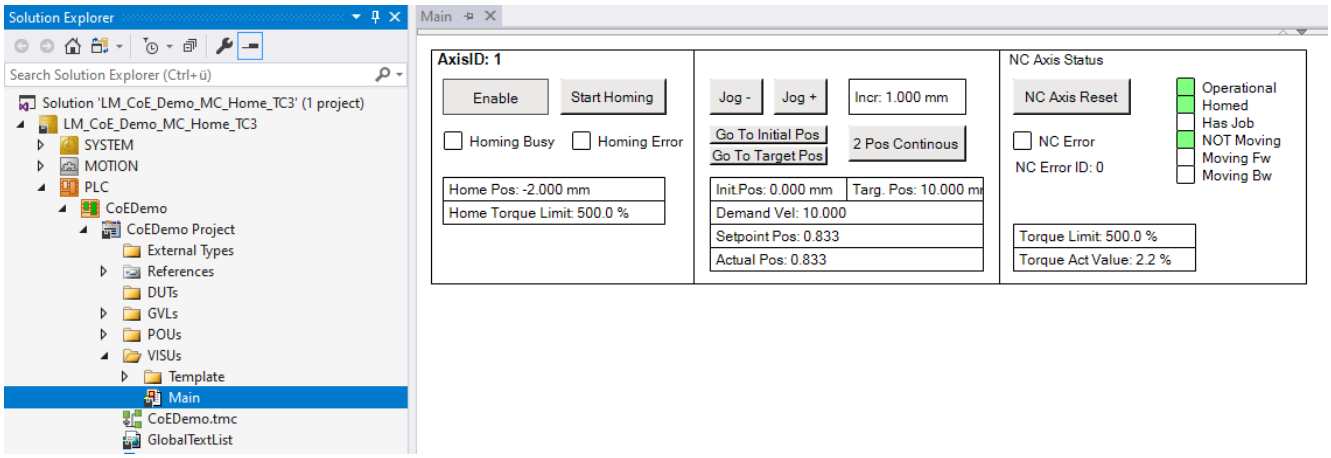


The actual torque is visible in the AXIS_REF structure (***AXIS_REF.NcToPlc.ActTorque***).

Note:
For more details check the example project (link in chapter 13.1 Overview)

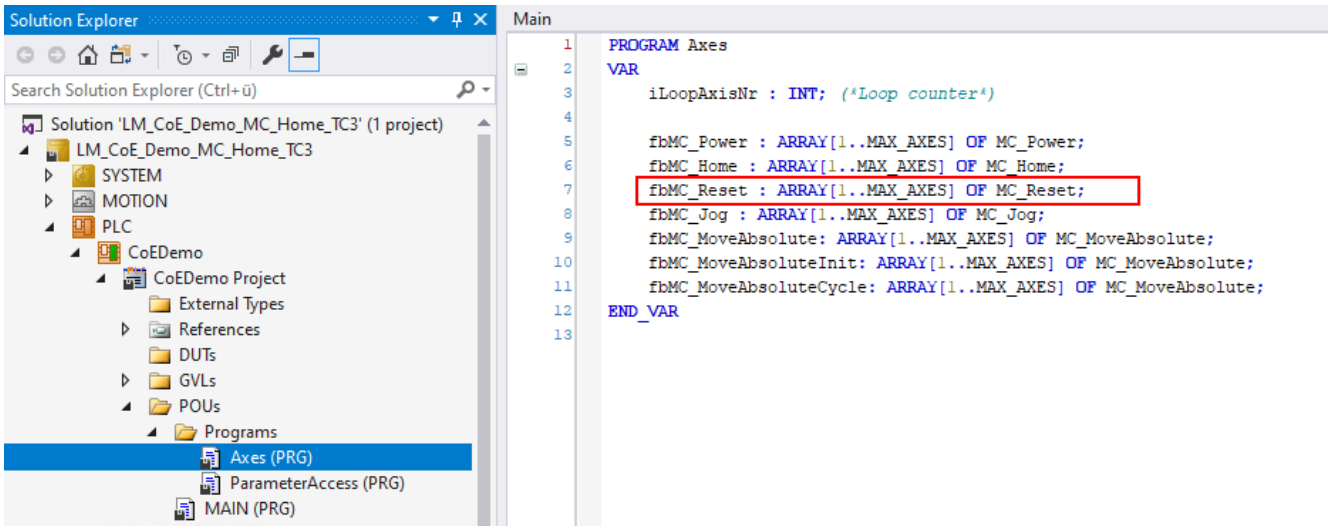
13.6 Visualization

The example project contains a visualization to control the NC axis (including the mentioned homing method in the chapter 13.5.1):



13.7 Drive Reset

To acknowledge an error of a CoE drive the function block *MC_Reset* must be used on TwinCAT systems. This function block is part of the Beckhoff library *TC2_MC2 (TwinCAT 3) / MC (TwinCAT 2)*.



13.8 Asynchronous Parameter Access

Parameters of the LinMot drive can be accessed using the Beckhoff function block *FB_EcCoESdoRead* and *FB_EcCoESdoWrite* which are part of the *Tc2_EtherCAT (TwinCAT 3) / EtherCAT (TwinCAT 2)* library.

More information about this function blocks can be found in the Beckhoff Information System: http://infosys.beckhoff.com (search for *FB_EcCoESdoRead & FB_EcCoESdoWrite).*

Example calls of this function blocks can be found in the example project.

```
PROGRAM ParameterAccess
VAR
    iLoopAxisNr :INT; (*Loop counter*)

    fbGetAxisAmsAddr : ARRAY[1..MAX_AXES] OF FB_GetAxisAmsAddr; (* Get the NetID and the Port of the drive linked to the NC axis by AxisID *)

    CoERead     :ARRAY[1..MAX_AXES] OF FB_EcCoESdoRead;
    CoEWrite    :ARRAY[1..MAX_AXES] OF FB_EcCoESdoWrite;

    UPID        :ARRAY[1..MAX_AXES] OF WORD;
    SubIndex    :ARRAY[1..MAX_AXES] OF BYTE;
    DataIN      :ARRAY[1..MAX_AXES] OF DINT;
    DataOUT     :ARRAY[1..MAX_AXES] OF DINT;
END_VAR
```

```

    (* Read parameter
    ============================================================*)
    CoERead[iLoopAxisNr](
        sNetId:=g_aDrive_AmsAddr[iLoopAxisNr].netId,
        nSlaveAddr:=g_aDrive_AmsAddr[iLoopAxisNr].port,
        nIndex:= 16#2000 + UPID[iLoopAxisNr],
        nSubIndex:= SubIndex[iLoopAxisNr], (*e.g. 16#01 = Access RAM Value*)
        pDstBuf:= ADR(DataIN[iLoopAxisNr]),
        cbBufLen:= SIZEOF(DataIN[iLoopAxisNr]),
        bExecute:= ,
        tTimeout:= ,
        bBusy=> ,
        bError=> ,
        nErrId=> );

    (* Write parameter
    ============================================================*)
    CoEWrite[iLoopAxisNr](
        sNetId:=g_aDrive_AmsAddr[iLoopAxisNr].netId,
        nSlaveAddr:=g_aDrive_AmsAddr[iLoopAxisNr].port,
        nIndex:= 16#2000 + UPID[iLoopAxisNr],
        nSubIndex:= SubIndex[iLoopAxisNr], (*e.g. 16#01 = Access RAM Value*)
        pSrcBuf:= ADR(DataOUT[iLoopAxisNr]),
        cbBufLen:= SIZEOF(DataOUT[iLoopAxisNr]),
        bExecute:= ,
        tTimeout:= ,
        bBusy=> ,
        bError=> ,
        nErrId=> );
```

sNetID, nSlaveAddr: AmsNetID & port of the drive.
These can be read using the function block *FB_GetAxisAmsAddr* which is part of the Beckhoff library *Tc2_NC (TwinCAT 3) / TcNC (TwinCAT 2)*.

nDriveNo: NC axis ID

nIndex: Parameter address to be accessed = **16#2000** + UPID
(E.g., Maximal Current (UPID 16#13A6) ▶ **nIndex** = 16#2000 + 16#13A6 = 16#33A6)

nSubIndex: The following commands can be performed
(See user manual 0185-1103 for more information > search on http://shop.linmot.com)

SDO Service	Index	SubIndex	Description
Read	2000h+UPID	0x01	Parameter UPID read RAM value
Write	2000h+UPID	0x01	Parameter UPID write RAM value
Read	2000h+UPID	0x02	Parameter UPID read ROM value
Write	2000h+UPID	0x02	Parameter UPID write ROM value
Read	2000h+UPID	0x03	Parameter UPID read minimal value
Read	2000h+UPID	0x04	Parameter UPID read maximal value
Read	2000h+UPID	0x05	Parameter UPID read default value
Write	2000h+UPID	0x06	Parameter UPID write RAM and ROM value
Write	2000h	0x07	Parameter Default OS SW instance
Write	2000h	0x08	Parameter Default MC SW instance
Write	2000h	0x09	Parameter Default Intf SW instance
Write	2000h	0x0A	Parameter Default Appl SW instance
Write	2000h	0x0B	Reset device

pDstBuf, pSrcBuf: Address to the variable containing the value to be read / written (must be of size 4 Bytes!)

cbBufLen: Size of the variable of the value to be read / written (must be of size 4 Bytes!)

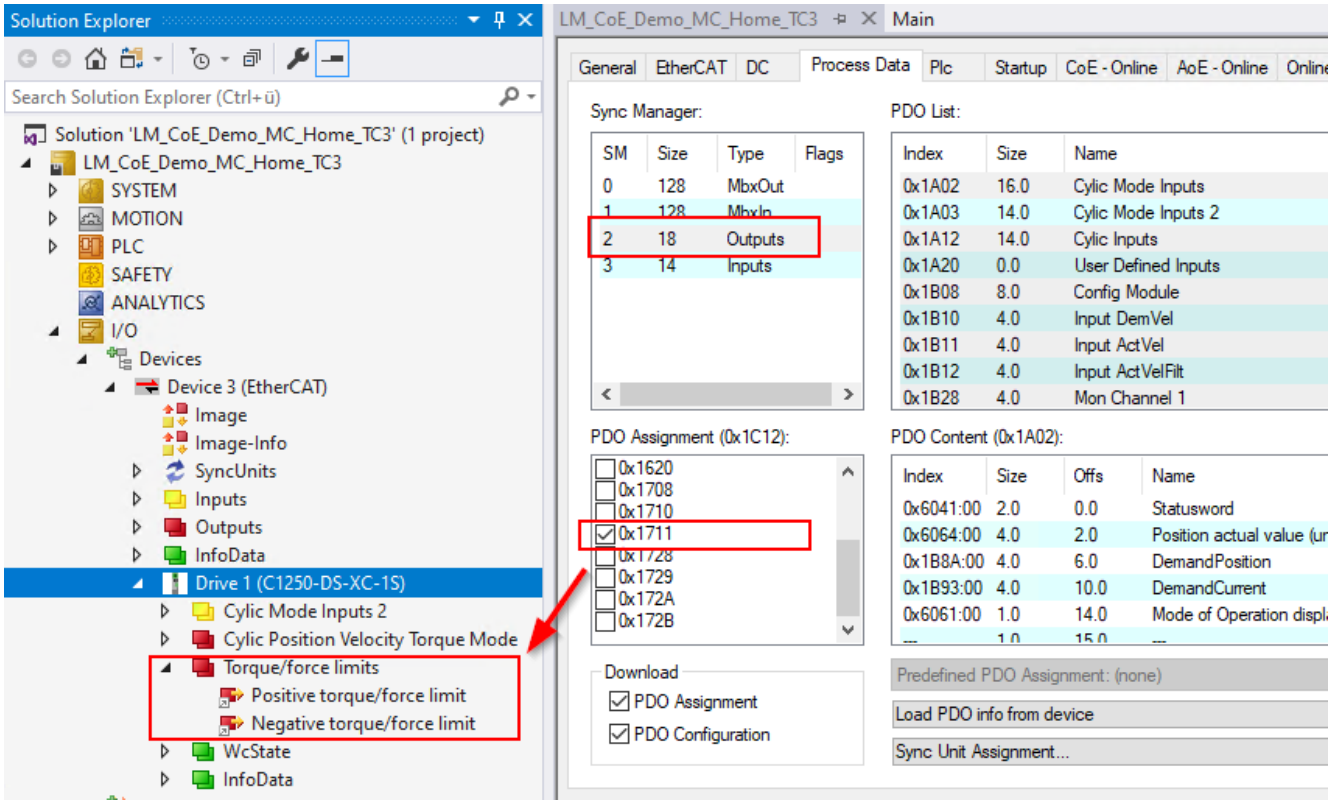
Attention ROM Access:
Intense use of writing into the ROM memory can reduce the lifetime of the drive memory!
More details can be found in the *Drive Configuration Over Fieldbus (0185-1074)* user manual
> see chapter Documentation / User Manuals

Note:
Use *FB_EcCoESdoRead & FB_EcCoESdoWrite* from Beckhoff to access drive parameters.

For every access (read or write) the length of the variable connected to pDstBuf/pSrcBuf must be of **size 4 Bytes** (e.g., datatypes DWORD, DINT, UDINT).
If you access a parameter/variable of a different size (e.g., INT, SINT, …) then make a typecast afterwards.

13.9 Add Positive and Negative torque/force limit (0x1711) to the Process Data

It is possible to add additional Process Data to PDO for cyclical write access. The additional Output *Torque/force Limits* (0x60E0 & 0x60E1) control the *Maximal Current Positive (UPID 13FCh)* and the *Maximal Current Negative (UPID 13FDh)* of the drive cyclically by adding the PDO 0x1711 in the PDO Assignment.



Note:
The maximum Torque/force Limit value is **5000 (500.0%)** and corresponds to the **maximal Current** of the connected motor. The value **1000 (100.0%)** corresponds approximately to the **nominal Current** of the motor.

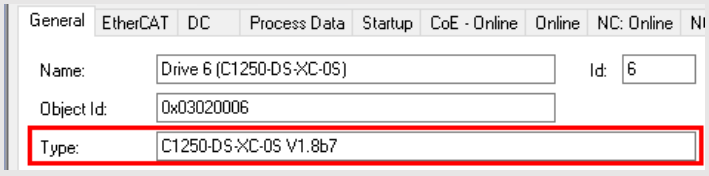
Example 1:

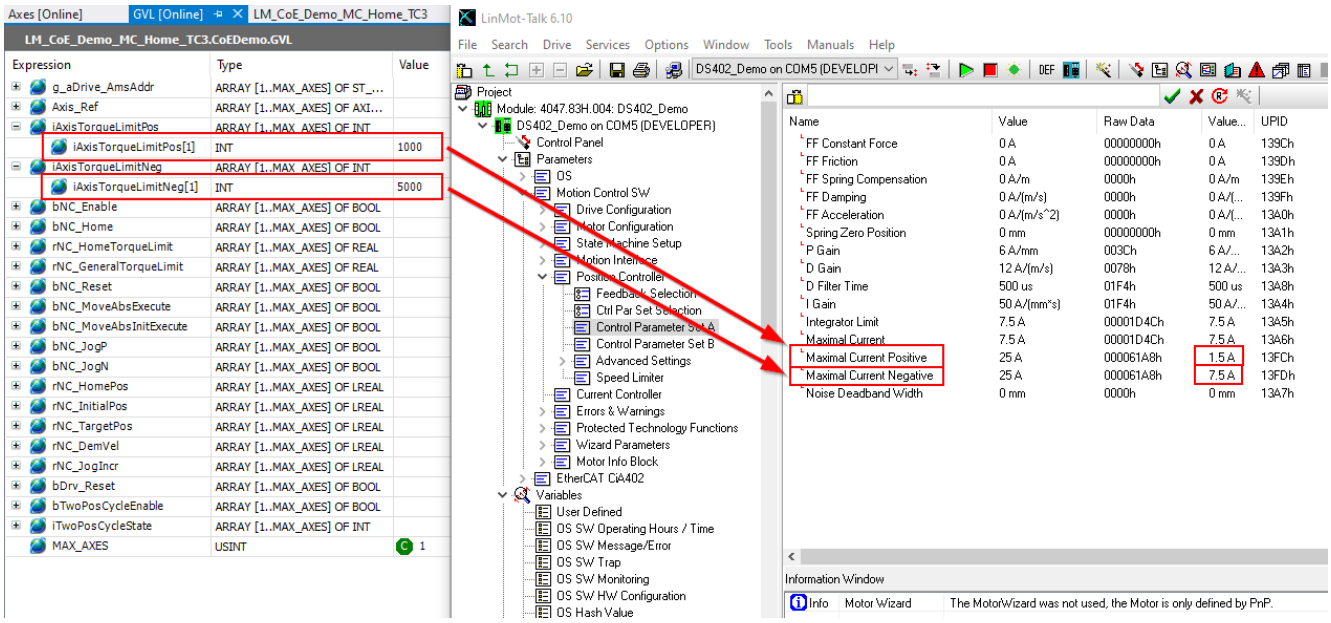
Torque/Force Limit Positive:	**1000 (100.0%)**
Motor Maximal Current:	7.5 A
= Max. Current Positive:	1.5 A

Example 2:

Torque/Force Limit Negative:	**5000 (500.0%)**
Motor Maximal Current:	7.5 A
= Max. Current Negative:	7.5 A

Note:
Torque/force Limit value is supported from xml version V1.8b7 with Firmware Build 6.8 Build 20190315 and newer.



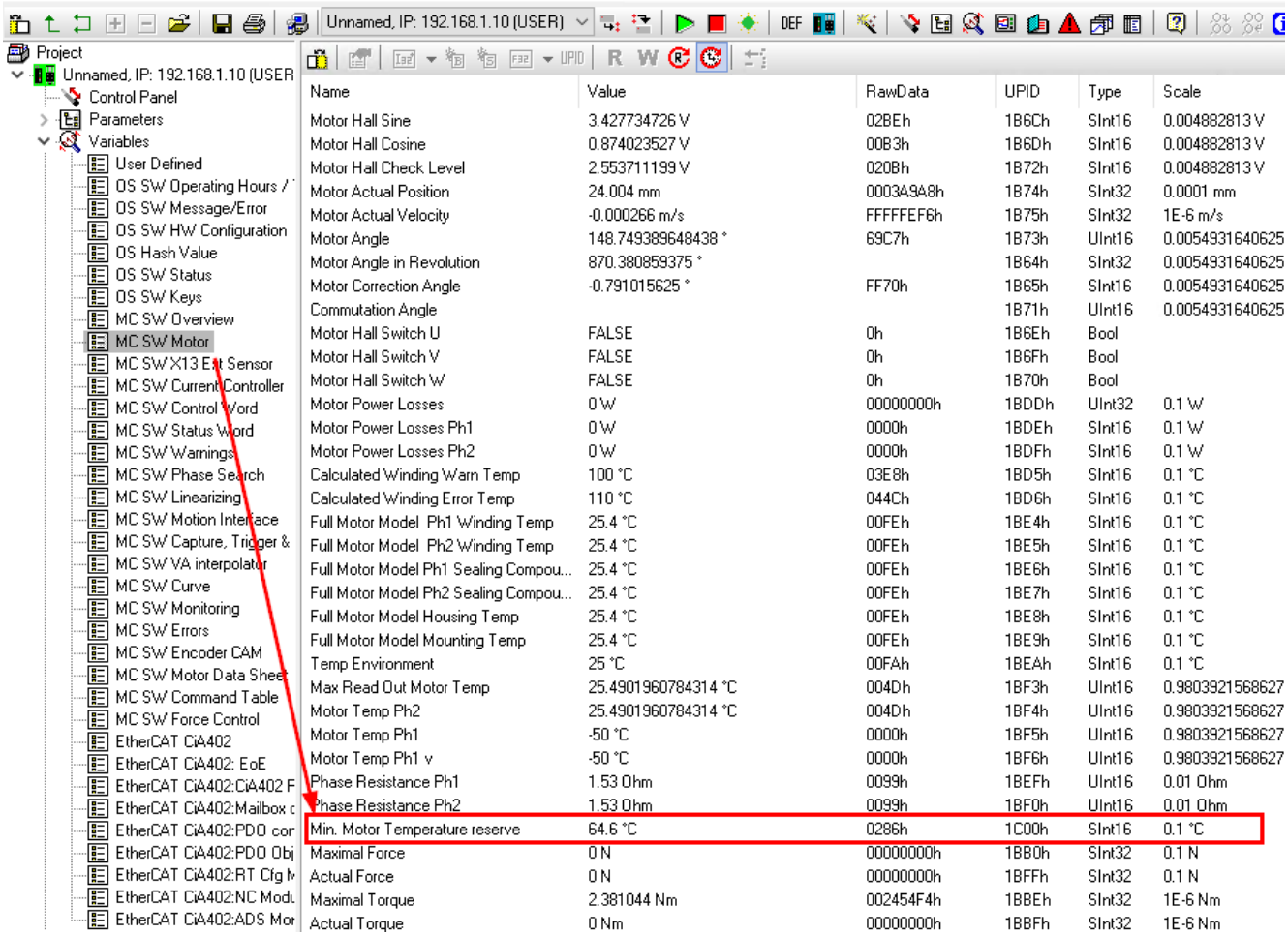


Attention:
Make sure, that the torque/force limit is not 0. Otherwise, the motor cannot move with a current of 0A.

13.10 Add Additional Parameters or Variables to the Process Data

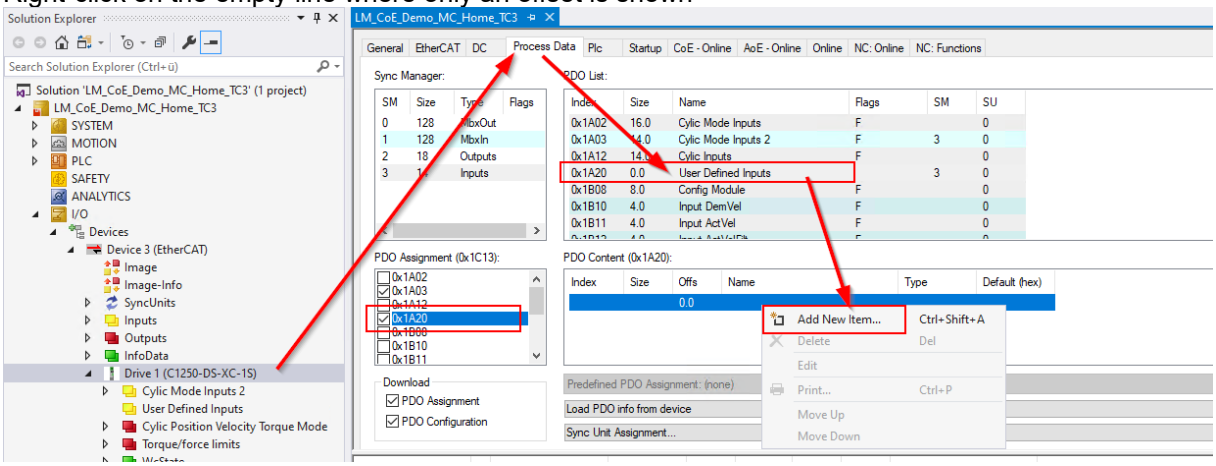
It is possible to add additional parameters or variables of the drive to PDO for cyclical write or read access.

Example 1: Read the *Min. Motor Temperature reserve (UPID 1C00h)* of the drive cyclically by adding it into the User Defined Inputs (0x1A20):

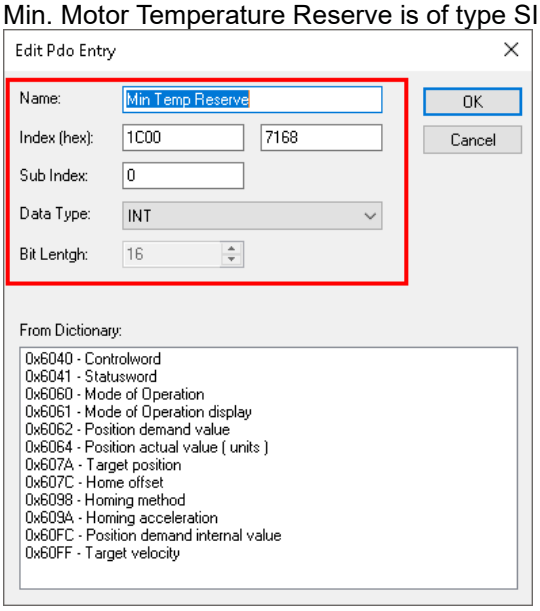


Name: Min. Motor Temperature reserve
UPID: 1C00h
Type: Sint16 = INT
Scale: 0.1 °C

1. In the Process Data select *0x1A20 User Defined Inputs* from the PDO List.
2. Right-click on the empty line where only an offset is shown

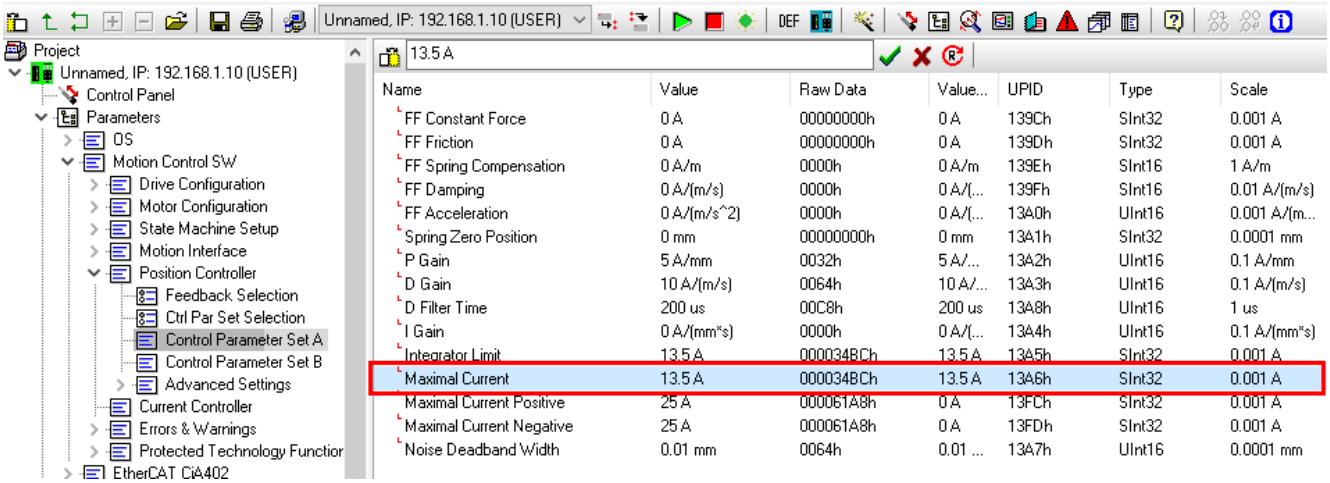


3. In the *Edit PDO Entry* window enter the name, the UPID as *Index* and set the *Data Type* to INT (as the Min. Motor Temperature Reserve is of type SINT16)



4. Click OK to finish

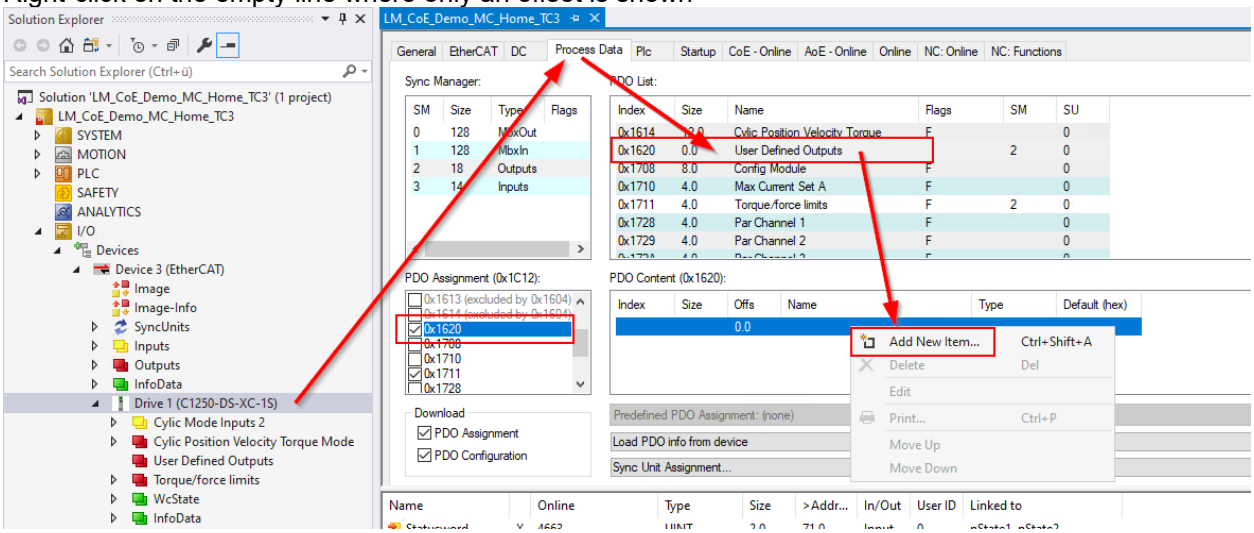
Example 2: Write the *Maximal Current (UPID 13A6h)* of the drive cyclically by adding it into the User Defined Outputs (0x1620):



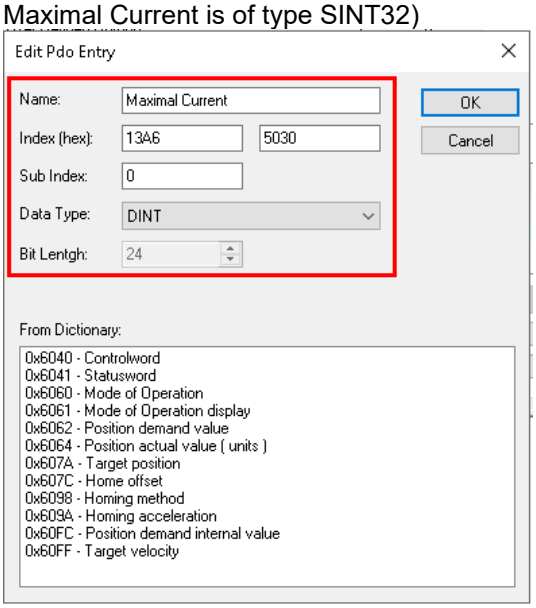
Name: Maximal Current
UPID: 13A6h
Type: SInt32 = DINT
Scale: 0.001 A

1. In the Process Data select 0x1620 *User Defined Outputs* from the PDO List.

2. Right-click on the empty line where only an offset is shown

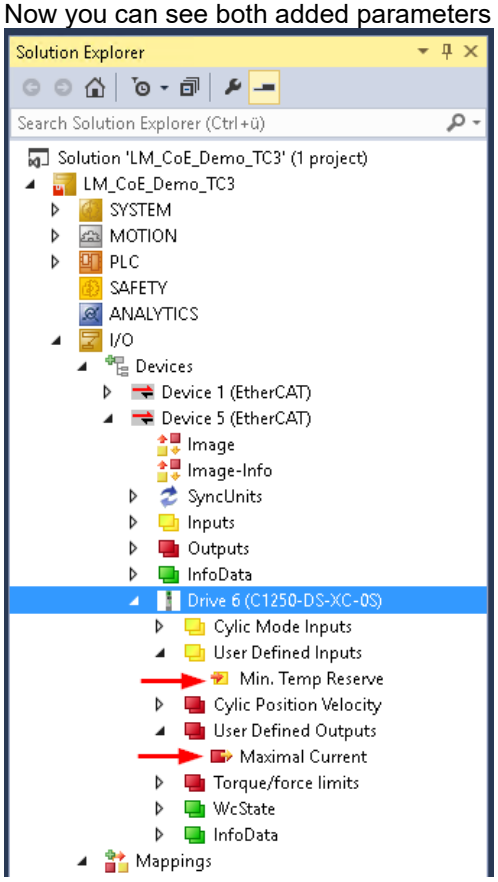


3. In the *Edit PDO Entry* window enter the name, the UPID as *Index* and set the *Data Type* to DINT (as the Maximal Current is of type SINT32)



4. Click OK to finish

Now you can see both added parameters in the solution tree and link them:



Definitions in the GVL (Global Variable List):

```
iMotorSensorTemp    AT %I*  :ARRAY[1..MAX_AXES] OF INT;
uiMaximalCurrent    AT %Q* :ARRAY[1..MAX_AXES] OF DINT := [MAX_AXES(1000)]; (*1A*)
uiForceLimitPos     AT %Q* :ARRAY[1..MAX_AXES] OF UINT := [MAX_AXES(5000)]; (*500$*)
uiForceLimitNeg     AT %Q* :ARRAY[1..MAX_AXES] OF UINT := [MAX_AXES(5000)]; (*500$*)
```

13.11 Using the Closed Loop Force/Torque Control Technology Function

This chapter shows an application example of how the technology function *closed loop force/torque control* inside the LinMot drive can be used.

This chapter does not cover the general setup of force/torque sensor and the according control loop parameters. Please check the according documentation.

Attention:
To use closed loop force/torque control the technology function **TF-Force Control** (0150-2503) is required. Check the manual for more information: https://shop.linmot.com/E/product/0150-2503

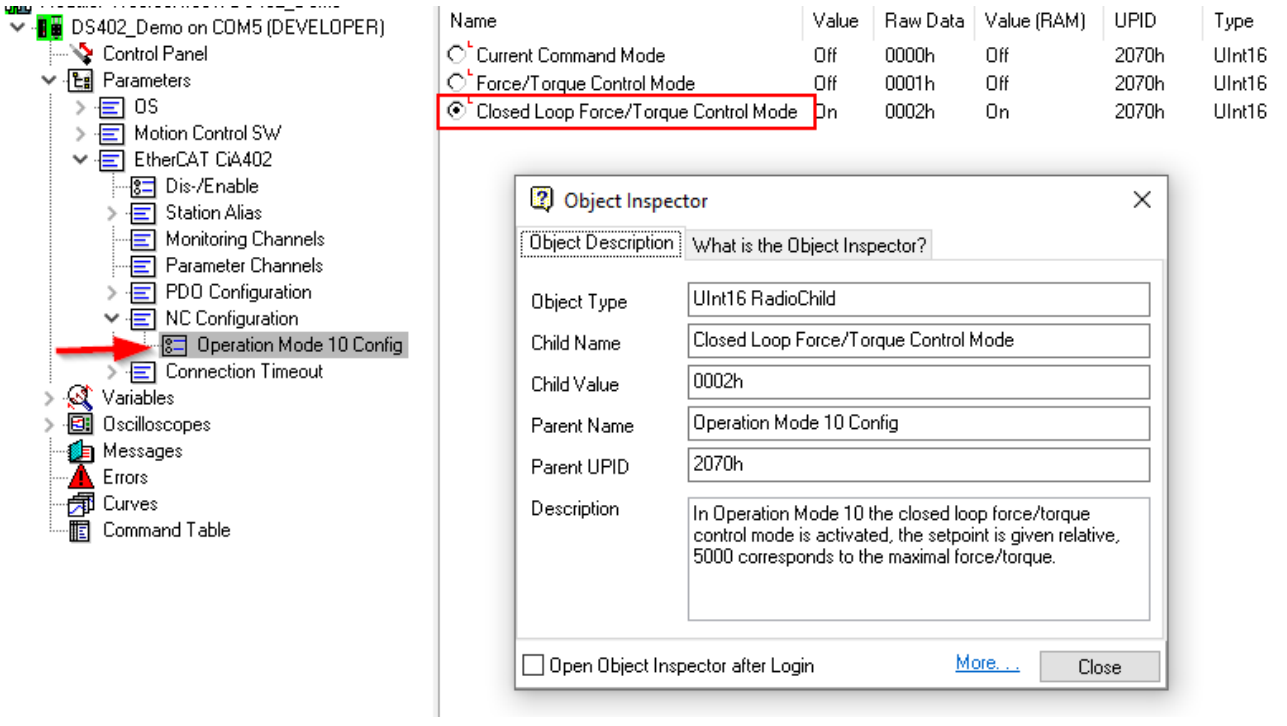
Attention:
Drive firmware **6.10 Build 20210521 or later** is required.

Note:
This example was done using the rotary part of a LinMot PR02 Linear Rotary Module with torque sensor. Nevertheless, the same principle is applicable for linear motors with force sensors.

See Appendix II: Basic Closed Loop Torque/Force Control Loop Tuning

13.11.1 Drive Setup

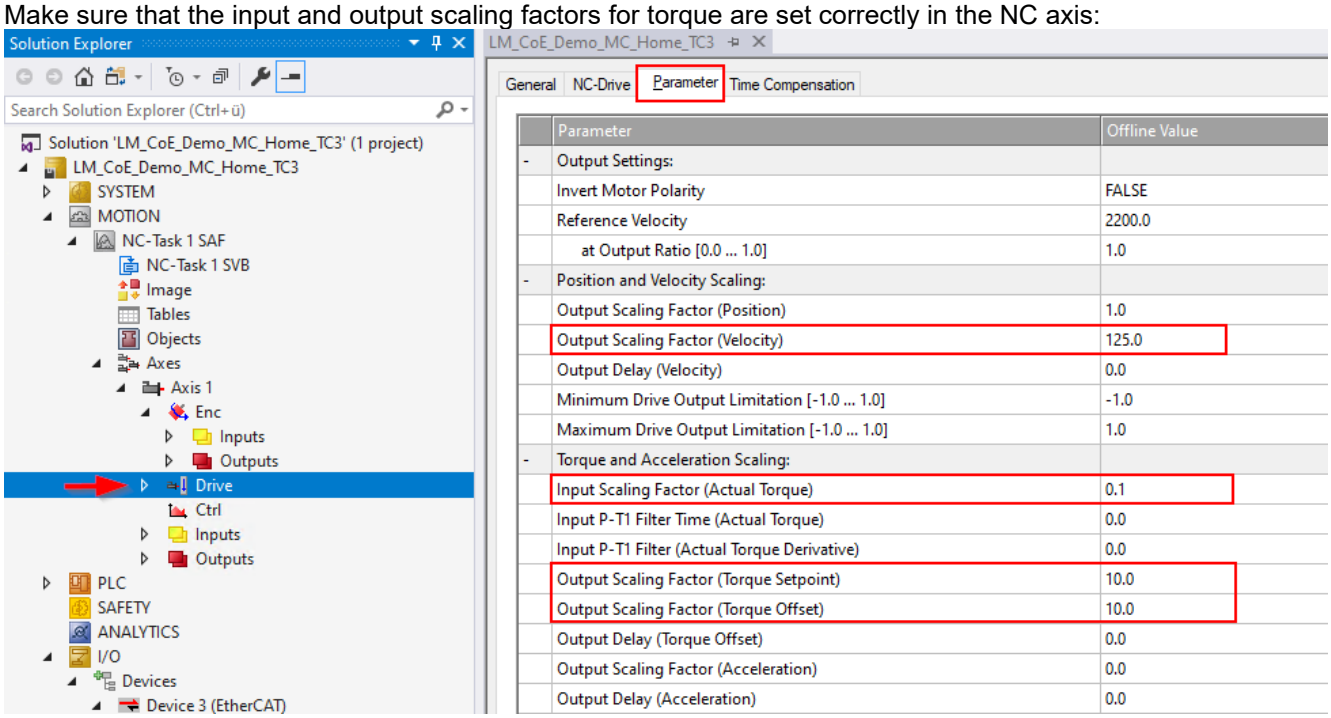
To enable the closed loop/force control in *Mode of Operation 10 (CST)* UPID 2070h must be set to “Closed Loop Force/Torque Control Mode”:



Note:
If an open loop force/torque control is enough for the application (less accurate and influenced by mechanical properties) one can also us “Force/Torque Control Mode” which sets the requested current.

13.11.2 PLC Setup

Make sure that the input and output scaling factors for torque are set correctly in the NC axis:



	Parameter	Offline Value
-	Output Settings:	
	Invert Motor Polarity	FALSE
	Reference Velocity	2200.0
	at Output Ratio [0.0 ... 1.0]	1.0
-	Position and Velocity Scaling:	
	Output Scaling Factor (Position)	1.0
	Output Scaling Factor (Velocity)	125.0
	Output Delay (Velocity)	0.0
	Minimum Drive Output Limitation [-1.0 ... 1.0]	-1.0
	Maximum Drive Output Limitation [-1.0 ... 1.0]	1.0
-	Torque and Acceleration Scaling:	
	Input Scaling Factor (Actual Torque)	0.1
	Input P-T1 Filter Time (Actual Torque)	0.0
	Input P-T1 Filter (Actual Torque Derivative)	0.0
	Output Scaling Factor (Torque Setpoint)	10.0
	Output Scaling Factor (Torque Offset)	10.0
	Output Delay (Torque Offset)	0.0
	Output Scaling Factor (Acceleration)	0.0
	Output Delay (Acceleration)	0.0

Note:
The torque unit is in 0.1 percent [%].
Decimal 5000 reflects 500% = motor maximal torque/force.
Torque Actual value (object 0x6077) and Target torque (object 0x6071) are used to read and write the torque/force of the motor in percent.

Therefore, the input scaling factor must be 0.1 and the output scaling factor must be 10.

Attention:
This example requires the drive PDOs setup as shown in chapter 13.3.3.

13.11.3 Example Sequence

The example project from chapter 13.1 contains an example sequence ***TorqueForceControlDemo*** following that shows how a closed loop force control process could look like.

In the example the axis is controlling a rotary motor.

Attention:
This example should not directly be used as it is shown!
Please adapt it to your machine and error handling concept.

Tested using:
- TwinCAT target version **V3.1 Build 4024.32**
- LinMot C1250-DS-XC-1S drive with **Firmware 6.11 Build 20220628**

```
PROGRAM TorqueForceControlDemo
VAR
    fbMC_TorqueControl      :MC_TorqueControl;
    fbMC_MoveAbsolute       :MC_MoveAbsolute;
    fbMC_MoveVelocity       :MC_MoveVelocity;
    fbMC_Halt               :MC_Halt;
    fbMC_Reset              :MC_Reset;

    rTargetTorque           :REAL := 100.0; // 100.0 % target torque/force (+/-500.0 % = maximal torque/force of the motor)
    rLimitTorque            :REAL := 70.0; // 70.0 % torque/force limit to switch to torque/force control
    rSearchSpeed            :REAL := 10.0; // 10 Units
    rSearchAccDec           :REAL := 100.0; // 100 Units
    rFastSpeed              :REAL := 4000.0; // 4000 Units
    rFastAccDec             :REAL := 5000.0; // 5000 Units
    rStopDec                :REAL := 50000.0; // 50000 Units
    rDistance               :REAL := 0.05; // 0.05 Units, Distance to move away from target after process completed
    rSmoothJerk             :REAL := 1000000.0; //
    rStopJerk               :REAL := 10000.0; //

    State                   :INT; // State machine
    Execute                 :BOOL; // Start process

    Error                   :BOOL; // Error flag
    ErrorId                 :UDINT; // Error code
    ErrorState              :INT; // State Error happened

    Axis                    :Axis_Ref;

    ExecuteOffTrigger       :F_TRIG;
END_VAR
```

```
// Read inputs
// ***********************************************
Axis := Axis_Ref[1]; // Assign axis (1 in this example)

//*************************************************************************************************************************************************
// DEMO
//*************************************************************************************************************************************************
// LinMot Drive Based Torque/Force Control Demo
// - Switches mode of operation to 10 (CST, TorqueControl) by using MC_TorqueControl (tc2_mc2 3.3.48.0)
// - Inside the drive set parameter UPID 2070h to the desired mode:
//      Force/Torque Mode (1): without force/torque cell
//      Closed Loop Force/Torque Control Mode (2): closed loop force control inside the drive with force/torque cell feedback
//
// ATTENTION: Make sure to enable the Speed Limiter in the drive (UPID 1511h) before starting with tests
//
// ATTENTION: This example is provided by NTI AG / LinMot free of charge with no warranty for updates.
// Also, LinMot accepts no liability for damages that may be caused by using this example
//
// This is only an example! A proper implementation on the users machine may differ completely.
```

14 Drive Profile: Beckhoff TwinCAT 2/3, SoE (Outdated)

Important Note:

For new applications with Beckhoff PLCs LinMot recommends using LinMot drives with **CoE (DS402/CiA402)** interface.

See chapter **13 Drive Profile: Beckhoff TwinCAT 2/3, CoE DS402**

14.1 Overview

This chapter shows how a LinMot drive with *Servo Drive Profile over EtherCAT (SoE)* interface (e.g., C1250-SE-XC-1S) can be integrated and setup in a Beckhoff TwinCAT environment.
For this example, TwinCAT 3 is used. The steps are generally similar for TwinCAT 2.

Download:
Example projects can be downloaded from:
http://download.linmot.com/plc_lib/examples/Beckhoff_SoE/ (named *LM_SoE_Demo_TCx_...*)

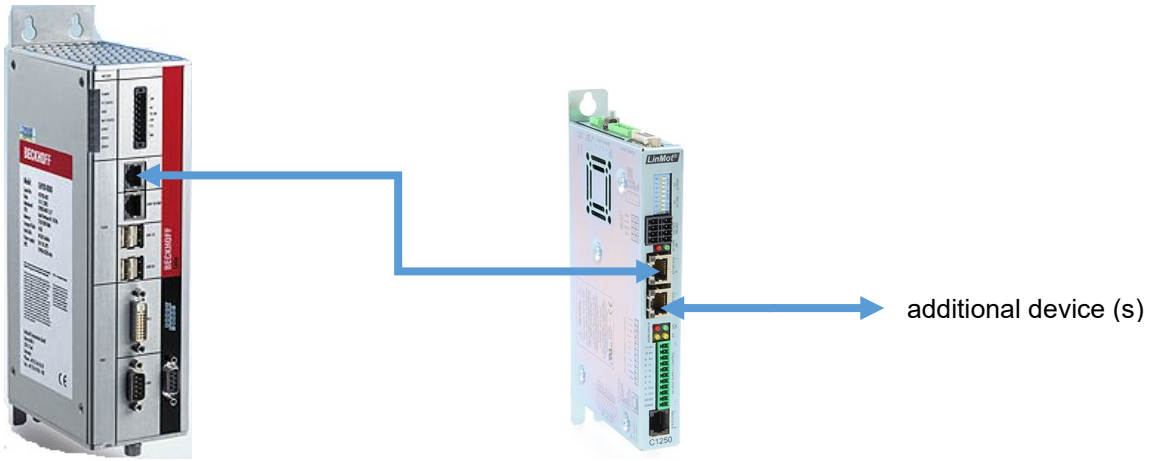


Image Source: http://www.beckhoff.com/

EtherCAT is the real-time Ethernet network originally developed by Beckhoff. The LinMot acts as Slave in this network and is implemented with the standard ASIC ET1100 from Beckhoff.

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

14.2 Configuration and Connection of the LinMot Drive

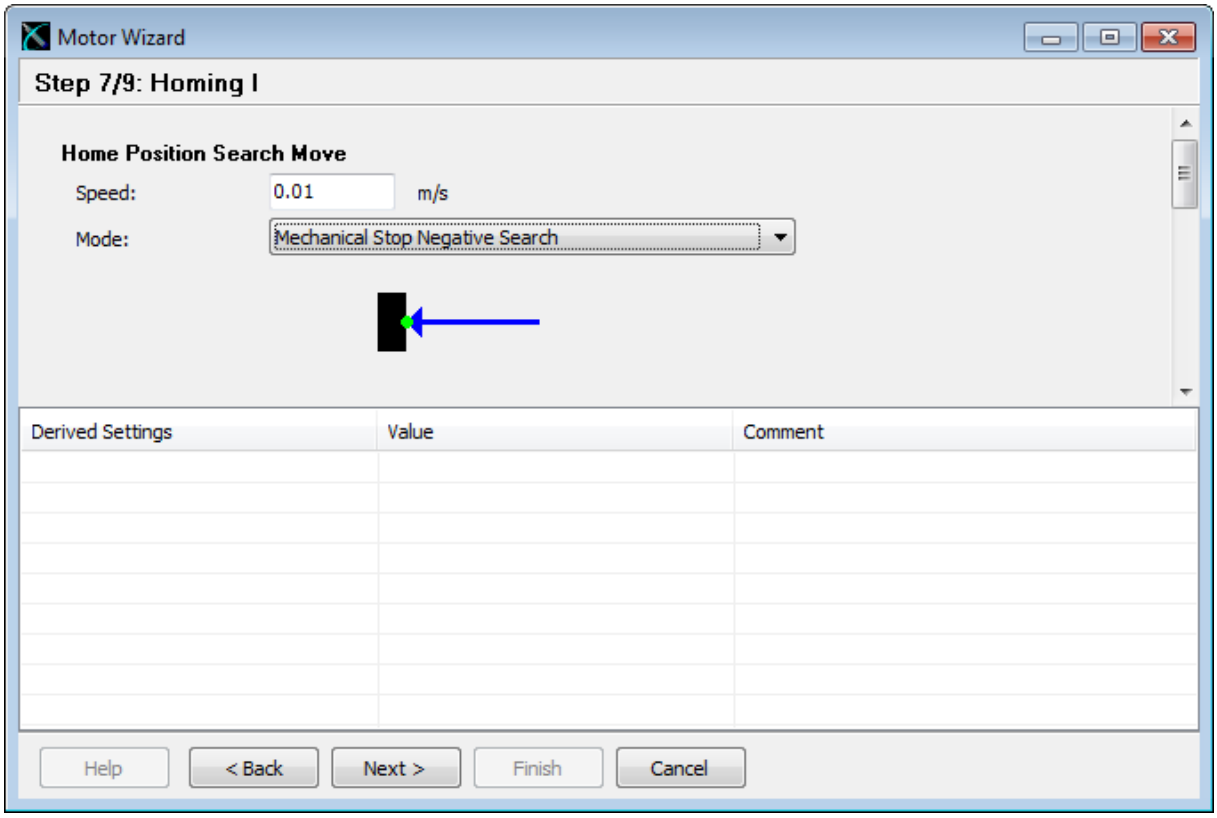
The LinMot drive is configured using the LinMot-Talk software:
http://www.linmot.com/download/linmot-talk-drive-configuration/

14.2.1 Motor Configuration

It is assumed that the motor connected to the drive is already configured.

Use the *Motor Wizard* inside LinMot-Talk to setup the motor (Menu -> Drive -> Motor Wizard):

Make sure that you select a homing mode in the Motor Wizard as with the SoE interface a drive-based homing is possible (e.g. *Mechanical Stop Negative Search*):



See Appendix I: Basic Position Control Loop Tuning

14.2.2 XML File

Install the XMLfile that is part of the LinMot-Talk software/firmware you are using.
The most recent device files are always part of the newest LinMot-Talk software. They are located by default:

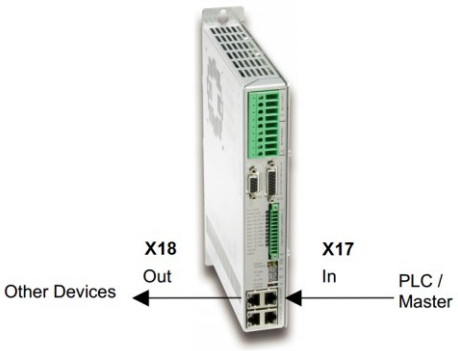
- EtherCAT SoE: \\LinMot-Talk X.X Build XXXXXXXX\Firmware\Interfaces\EtherCAT_SoE\XML

14.2.3 EtherCAT Connection

The drive is connected to the EtherCAT network using the **X17 (IN) & X18 (OUT)** connectors.

The below pictures show the ports of an E1250-SE-UC drive.
On all other LinMot drives supporting EtherCAT SoE the ports are named the same (X17 & X18) but they may be placed differently on the drive housing.

X17 - X18	RealTime Ethernet 10/100 Mbit/s	
	X17 RT ETH In	(Beckhoff: EtherCAT IN, from PLC)
	X18 RT ETH Out	(Beckhoff: EtherCAT OUT, to next device)
RJ-45		



14.3 PLC Setup

14.3.1 EtherCAT Device Description File XML

The EtherCAT device description file (XML) is located by default in the LinMot-Talk installation path:
C:\Program Files (x86)\LinMot\LinMot-Talk X.X Build XXXXXXXX\Firmware\Interfaces\EtherCAT_SoE\XML

Copy this file to your local TwinCAT installation path:

- C:\TwinCAT\Io\EtherCAT\ (for TwinCAT 2)
- C:\TwinCAT\3.1\Config\Io\EtherCAT (for TwinCAT 3)

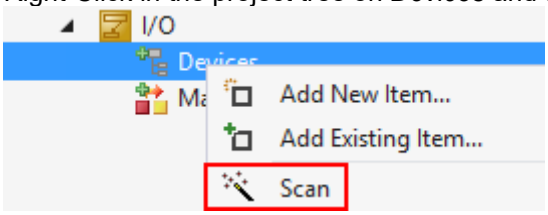
Note: You may have to restart the developing environment to have the new XML file to be recognized.

14.3.2 Scanning the EtherCAT for new Devices

Follow these steps to add the LinMot drive to your Beckhoff PLC.

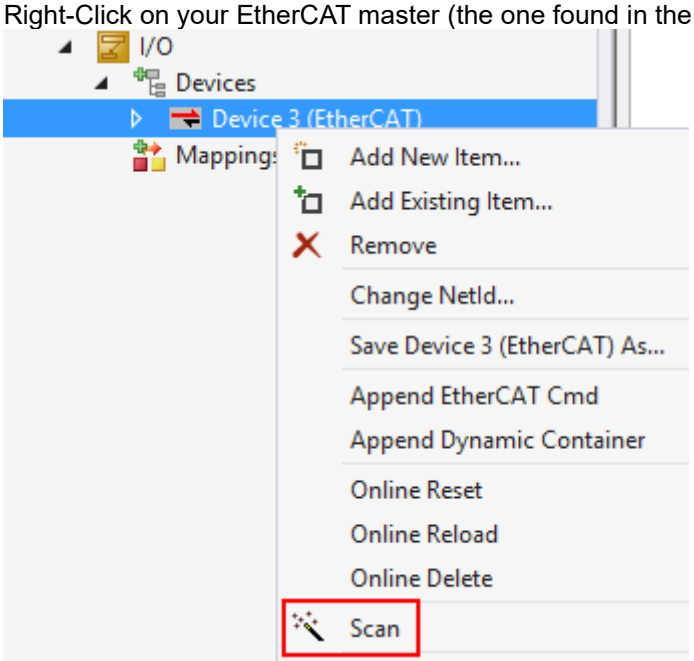
1. Restart your PLC into the *Config Mode* to be able to scan for attached devices.

2. Right-Click in the project tree on *Devices* and select *Scan*

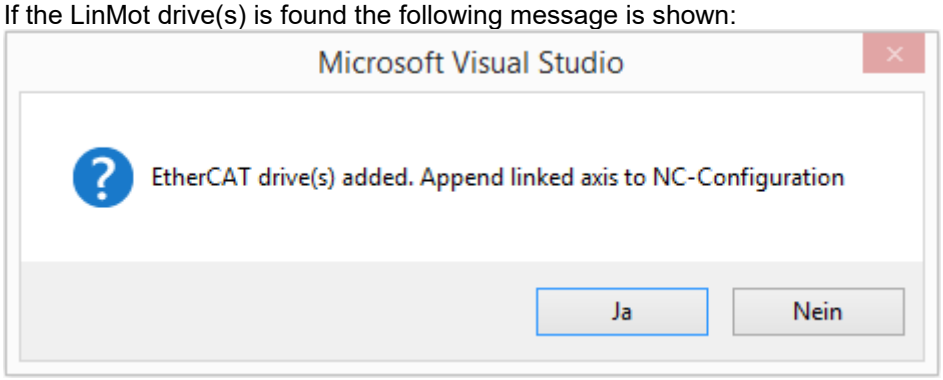


Select and insert the found EtherCAT master (e.g. *Device 3 (EtherCAT)*).
You can now directly scan for boxes. If you select yes, then skip the next step.

3. Right-Click on your EtherCAT master (the one found in the previous step) and select *Scan*

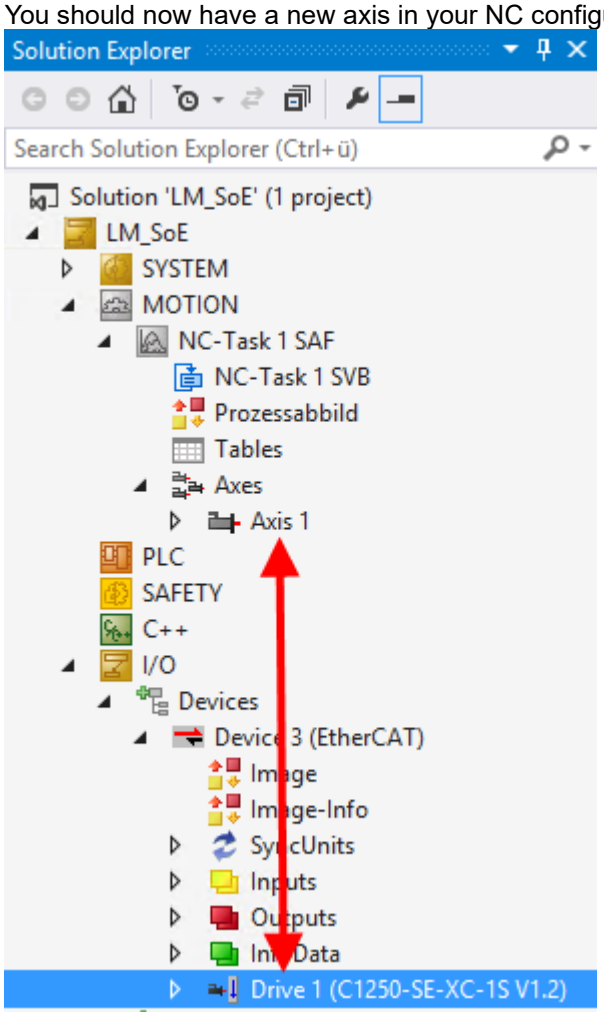


4. If the LinMot drive(s) is found the following message is shown:



Select Yes (Ja)

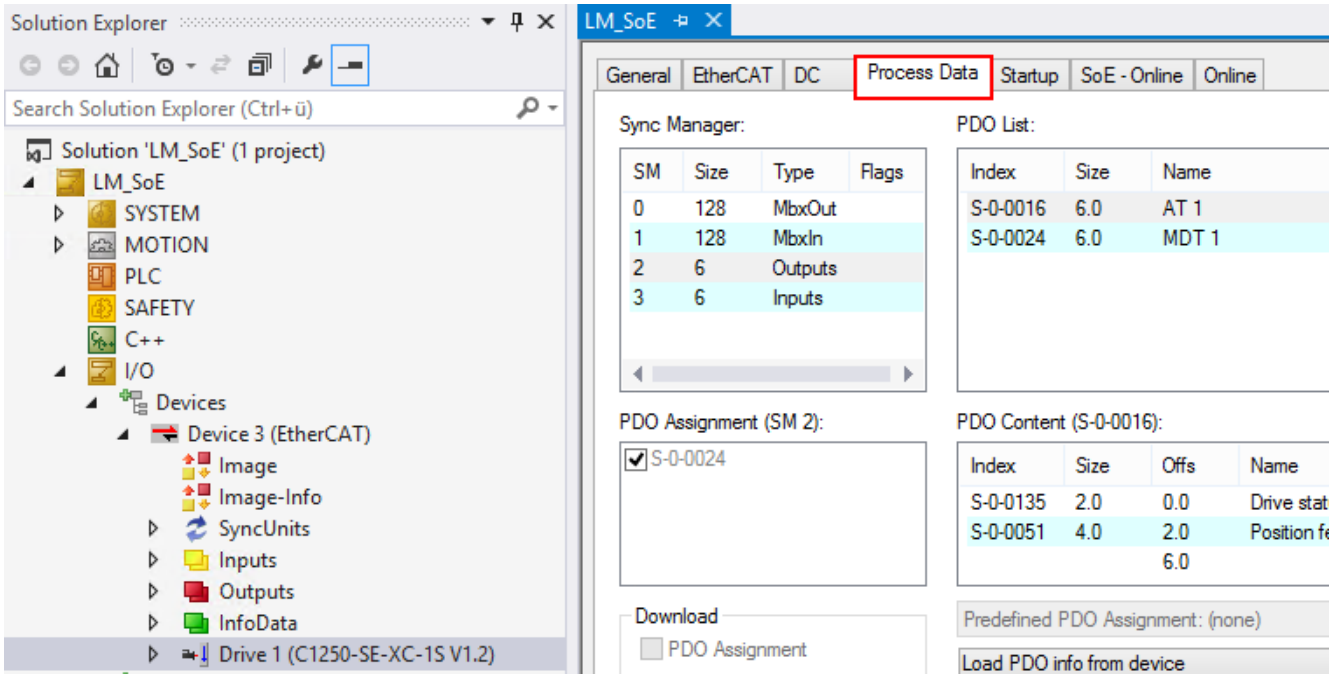
5. You should now have a new axis in your NC configuration:



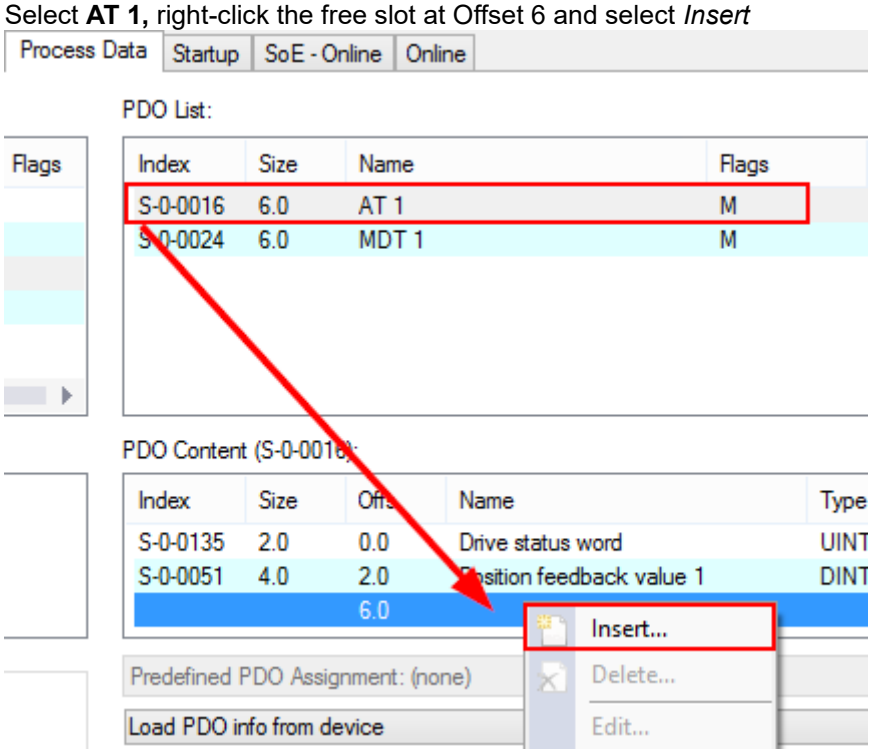
In the next chapter the configuration of the process data of the LinMot drive is shown

14.3.3 Setting up the Process Data of the LinMot Drive

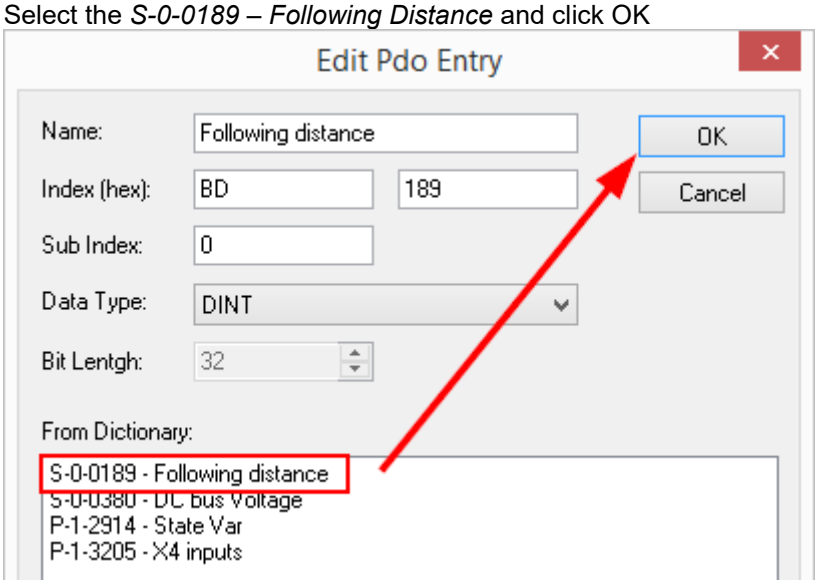
1. Move to the tab *Process Data*



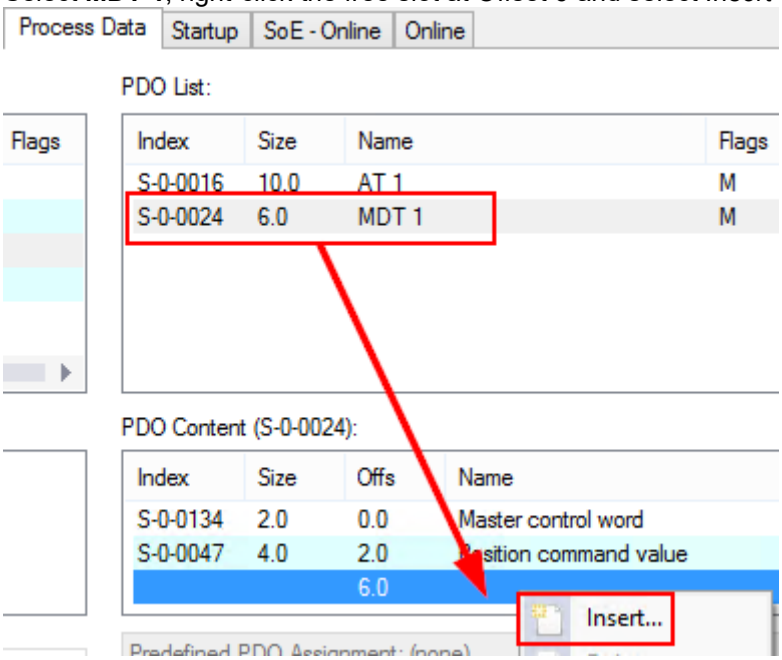
2. Select **AT 1,** right-click the free slot at Offset 6 and select *Insert*



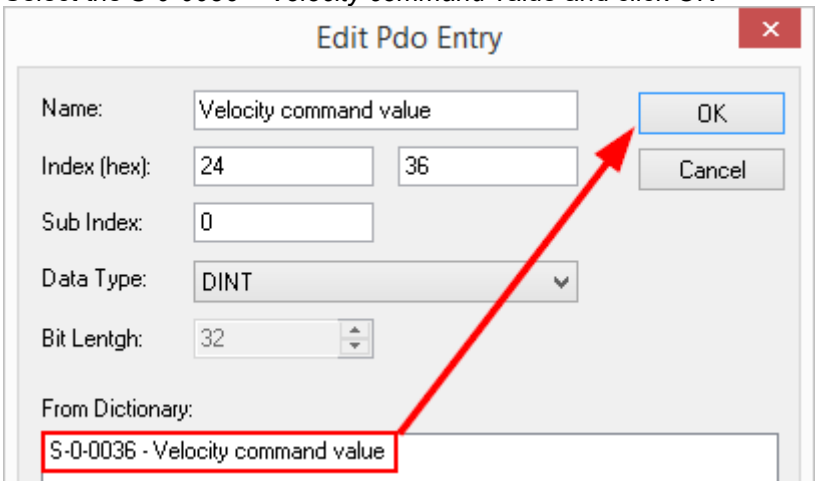
3. Select the *S-0-0189 – Following Distance* and click OK



4. Select **MDT 1**, right-click the free slot at Offset 6 and select *Insert*



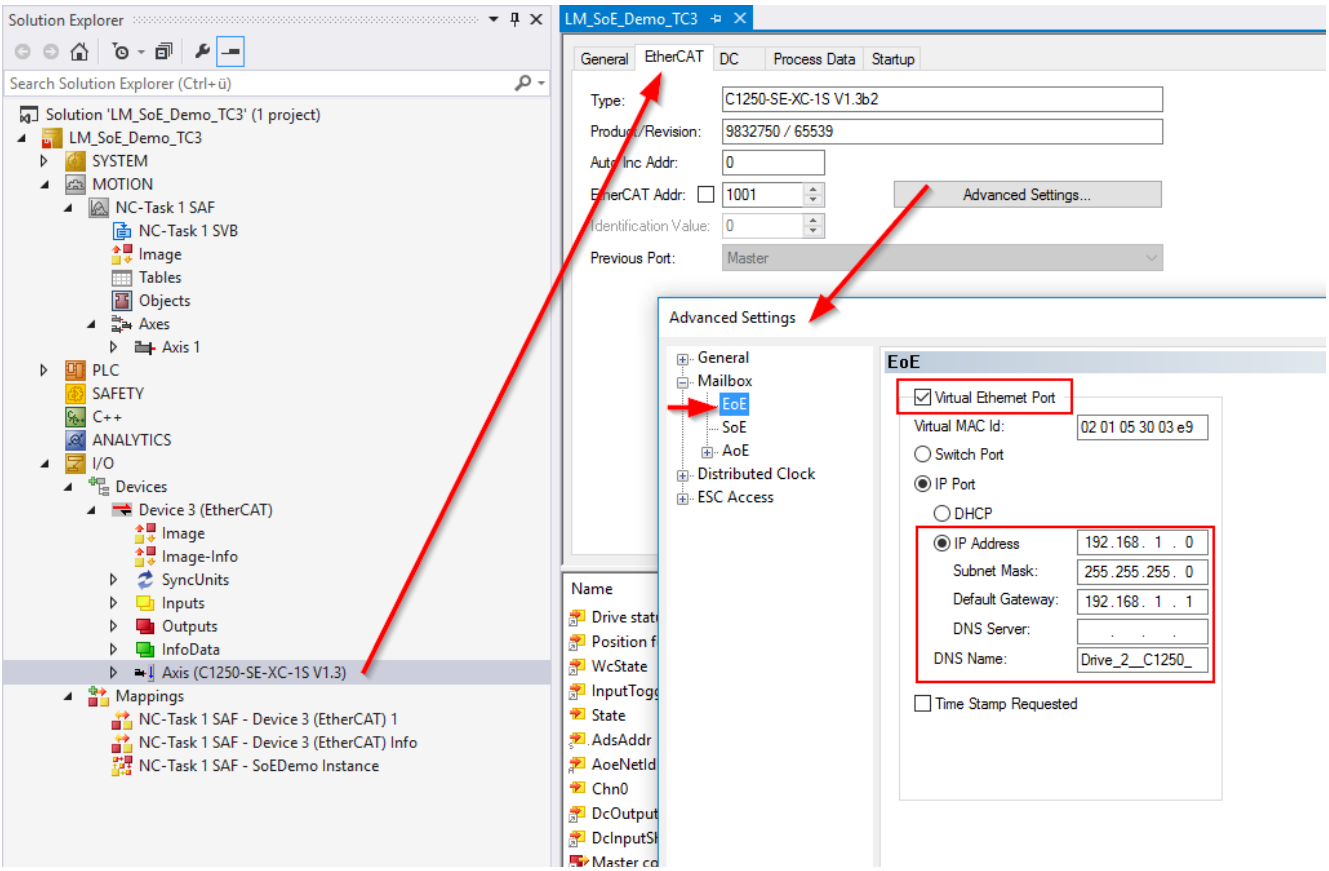
5. Select the *S-0-0036 – Velocity command* value and click OK



14.3.4 Check EoE settings

On supported drives (C1250-..., C1450-… & E1450-...) please check the EoE (Ethernet over EtherCAT) settings.

LinMot drives do NOT support the DHCP mode yet. A fix IP must be assigned (select *IP Address*) or the EoE feature must be completely disabled (disable Virtual Ethernet Port).



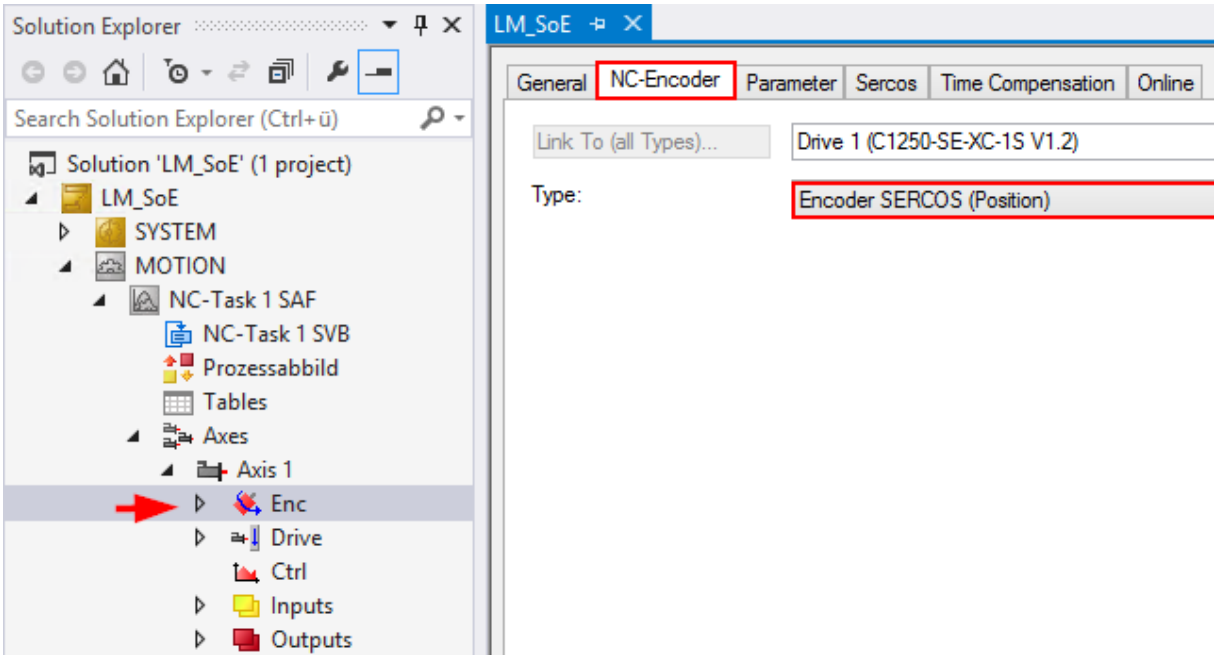
Note:
EoE can be used to login into the drive with LinMot-Talk directly over EtherCAT.
E.g. to change drive settings or for monitoring and tracing.

14.3.5 Setting up the NC Axis

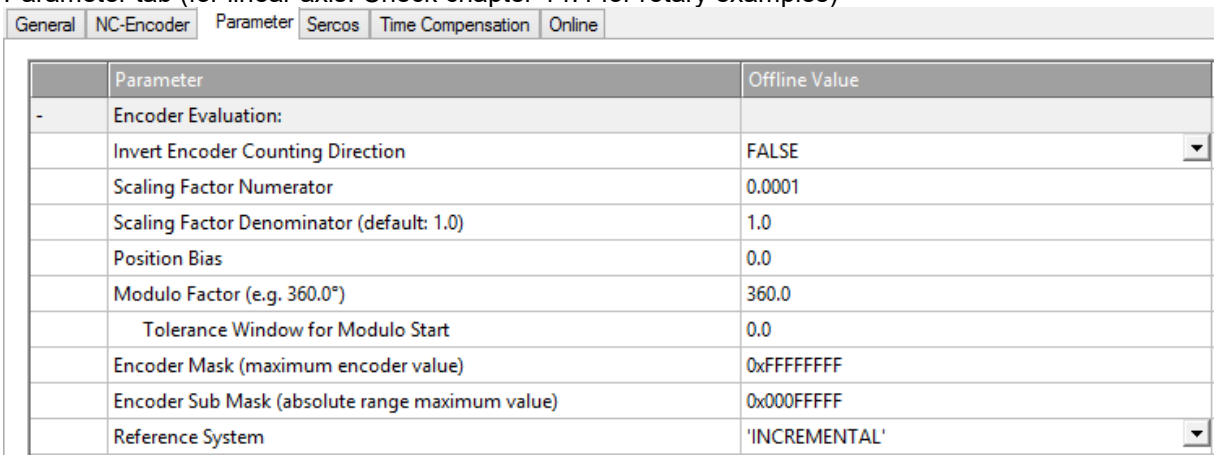
The following steps show how to basically setup the NC axis.

1. **Axis Encoder:** Setup the axis encoder as shown:

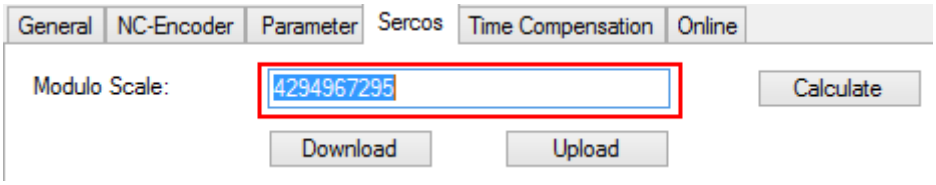
NC-Encoder tab



Parameter tab (for linear axis. Check chapter 14.4 for rotary examples)

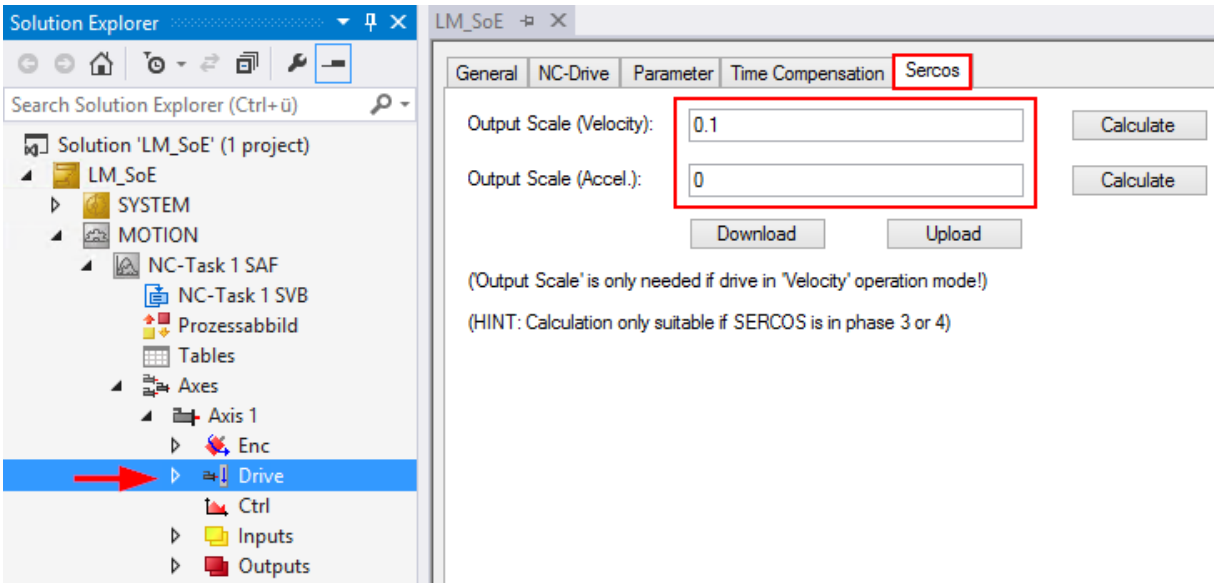


Sercos tab



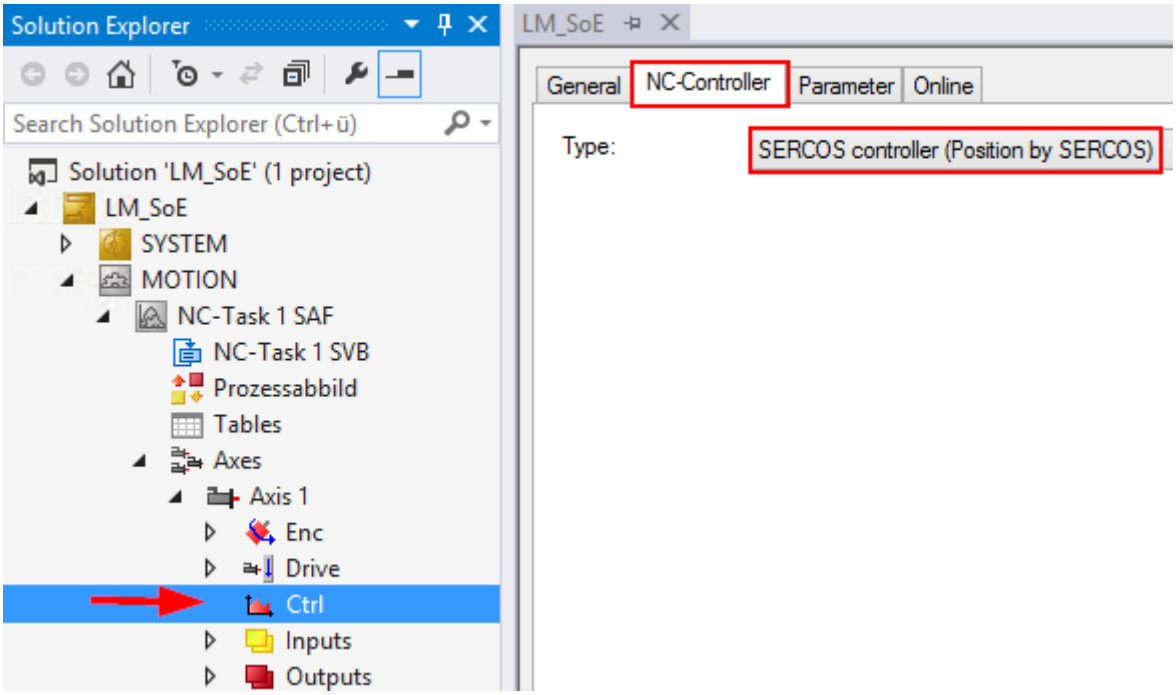
2. **Axis Drive:** Setup the drive as shown:

Sercos tab



3. **Axis Controller:** Setup the controller as shown:

NC-Controller tab



4. You're now ready to activate the configuration of the PLC and to enable and move the axis in the Online tab of the NC axis.

14.4 Encoder Parameter Examples for Linear and Rotary Motors

14.4.1 Linear Motors PS01 / PS10

The internal position resolution of the LinMot drive is 0.1um for linear motors.

Therefore the following parameters must be set accordingly:
- *Scaling Factor Numerator* must be set to **0.0001** (=1mm / 10'000 Increments)
- *Scaling Factor Denominator* is left to **1.0**

General | NC-Encoder | Parameter | Sercos | Time Compensation | Online

	Parameter	Offline Value
-	Encoder Evaluation:	
	Invert Encoder Counting Direction	FALSE
	Scaling Factor Numerator	0.0001
	Scaling Factor Denominator (default: 1.0)	1.0
	Position Bias	0.0
	Modulo Factor (e.g. 360.0°)	360.0
	Tolerance Window for Modulo Start	0.0
	Encoder Mask (maximum encoder value)	0xFFFFFFFF
	Encoder Sub Mask (absolute range maximum value)	0x000FFFFF
	Reference System	'INCREMENTAL'

14.4.2 Rotary Motors RS01 & RS02

The LinMot RS01 motors (rotary part of LinMot PR01 & PR02 linear rotary motors) have a single turn absolute encoder and by default 360'000 Ticks (Increments) per motor revolution.

Therefore the following parameters must be set accordingly:
- *Scaling Factor Numerator* must be set to **0.001** (=360° / 360'000 Increments)
- *Scaling Factor Denominator* is left to **1.0**

General | NC-Encoder | Parameter | Sercos | Time Compensation | Online

	Parameter	Offline Value
-	Encoder Evaluation:	
	Invert Encoder Counting Direction	FALSE
	Scaling Factor Numerator	0.001
	Scaling Factor Denominator (default: 1.0)	1.0
	Position Bias	0.0
	Modulo Factor (e.g. 360.0°)	360.0
	Tolerance Window for Modulo Start	0.0
	Encoder Mask (maximum encoder value)	0xFFFFFFFF
	Encoder Sub Mask (absolute range maximum value)	0x00057E40
	Reference System	'ABSOLUTE SINGLETURN RANGE (with single overflow)'

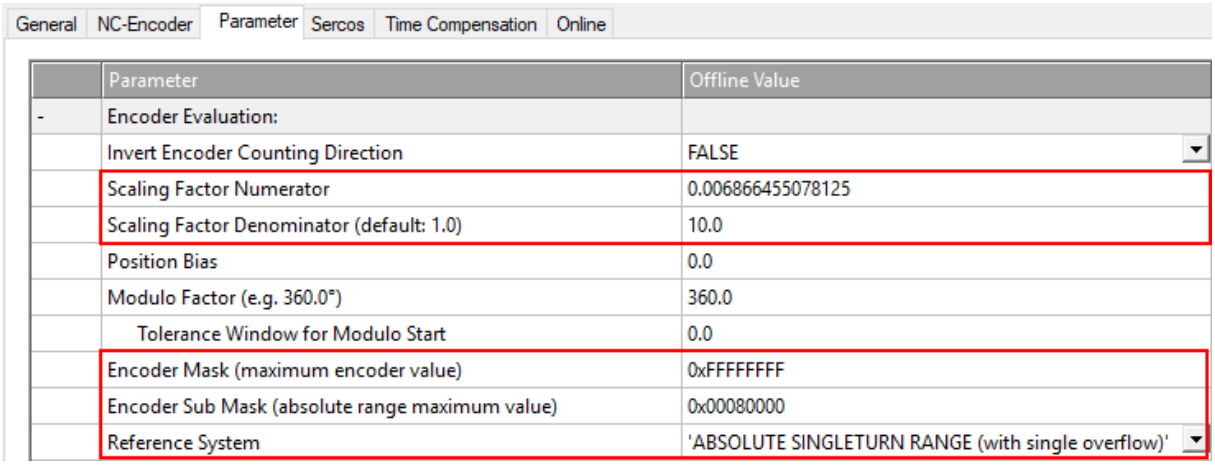
14.4.3 Rotary Motors EC02

The LinMot EC02 motors have a single turn absolute encoder and by default 524’288 (2^19) Ticks (Increments) per motor revolution.

Therefore the following parameters must be set accordingly:

- *Scaling Factor Numerator* must be set to **0.006866455078125**
  (=360° / 524’288 Increments * 10)
- *Scaling Factor Denominator* is set to **10.0** (=1.0 * 10)

Factor 10 is required to have the full resolution in the *Scaling Factor Numerator*



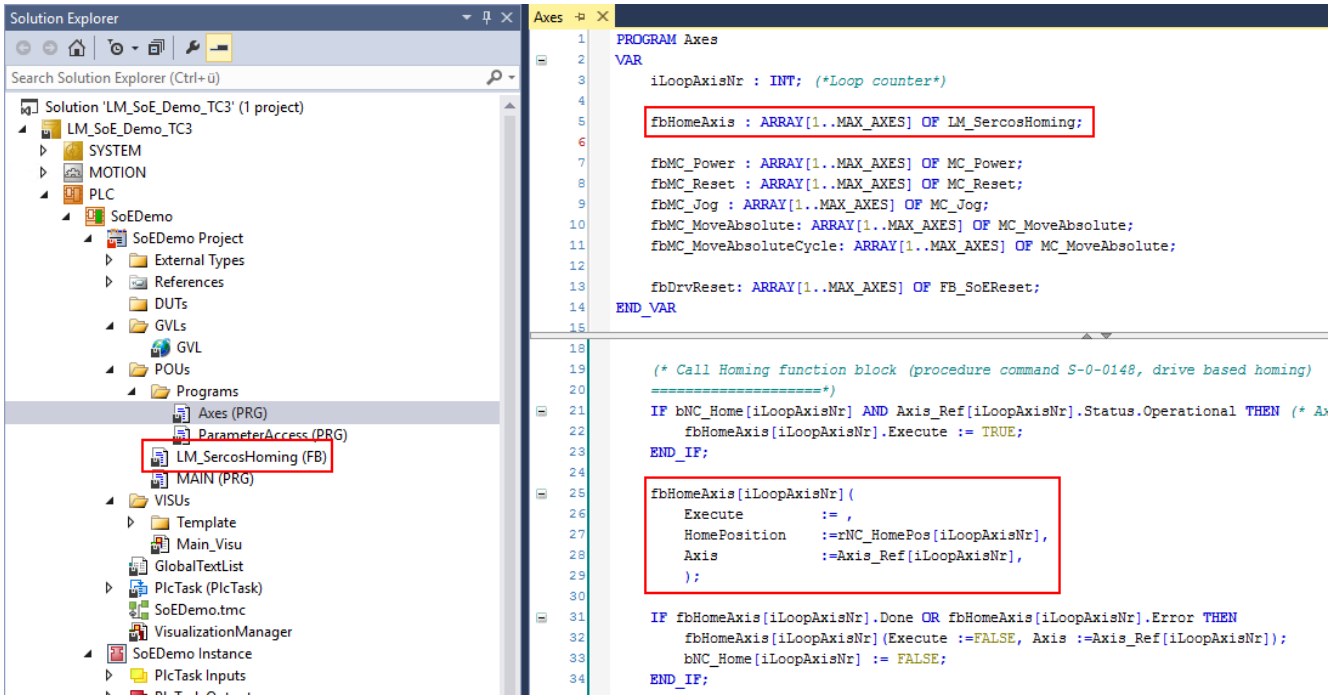
14.4.4 Other motors

For other motors the principle is the same to calculate the Numerator, Denominator and other encoder parameters.

14.5 Homing

To home the axis, the drive-controlled homing procedure command (IDN S-0-0148) can be used.

The example project (see chapter 14.1 Overview) contains a function block (LM_SercosHoming) to do the drive-controlled homing.



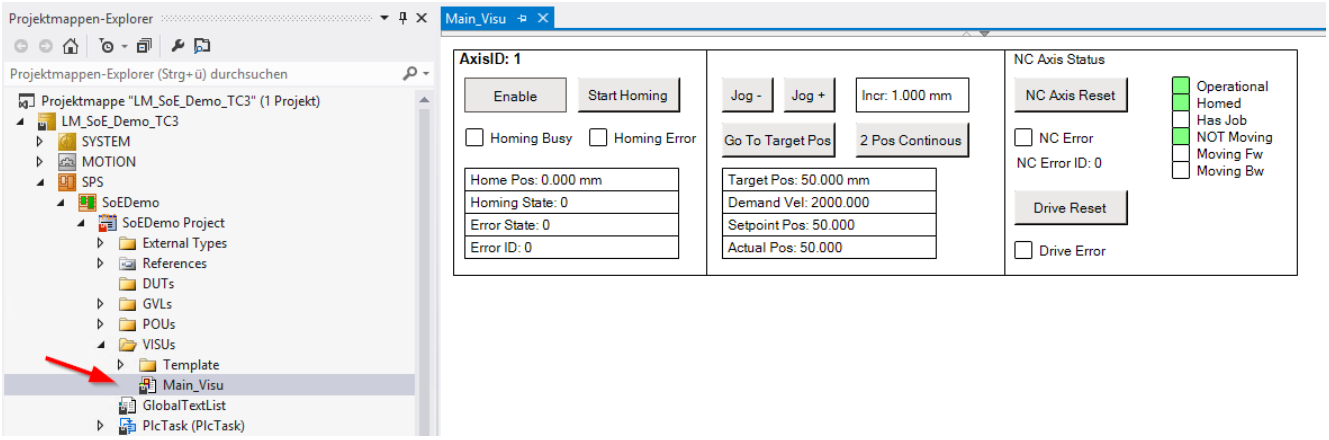
Inputs of the function block:

HomePosition	Position the NC axis actual position is set to after homing is done
Axis	Axis reference of the NC axis

The LM_SercosHoming is using the function block *FB_GetAxisAMsAddr* which is part of the Beckhoff library *Tc2_NC (TwinCAT 3) / TcNC (TwinCAT 2)*.

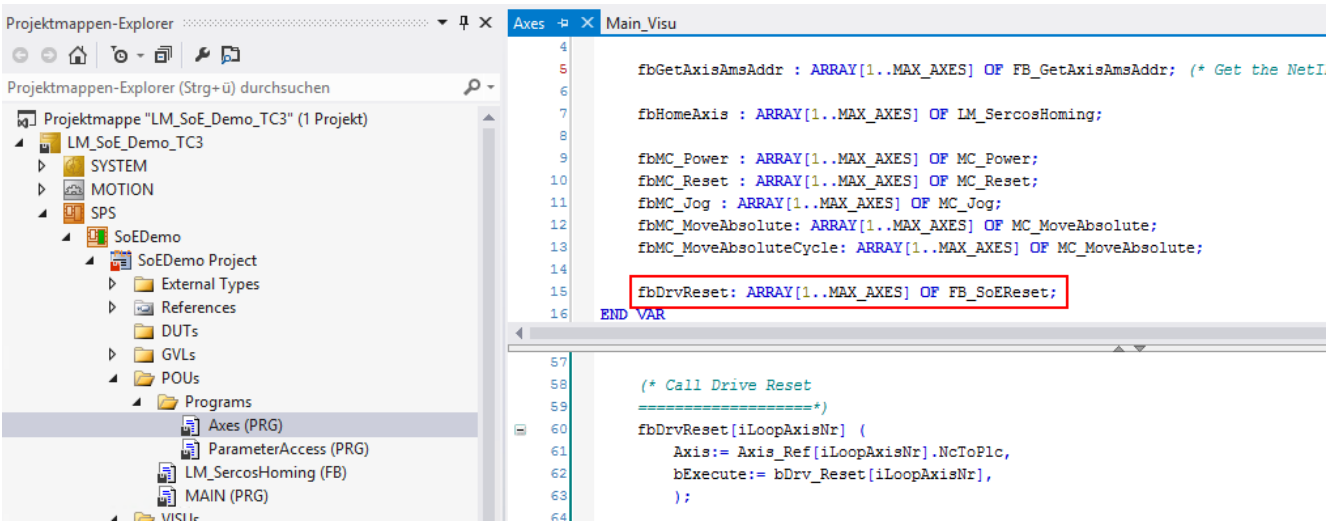
14.6 Visualization

The example project contains a visualization to control the NC axis (including the mentioned homing function block in the chapter before):



14.7 Drive Reset

To acknowledge an error of a SoE drive the function block *FB_SoEReset* must be used on TwinCAT systems. This function block is part of the Beckhoff library *Tc2_NcDrive (TwinCAT 3) / TcMC2Drive (TwinCAT 2)*.



Note:
Use FB_SoEReset from Beckhoff to reset drive errors.

14.8 Asynchronous Parameter Access

Parameters of the LinMot drive can be accessed using the Beckhoff function block *FB_EcSoeRead* and *FB_EcSoeWrite* which are part of the *Tc2_EtherCAT (TwinCAT 3) / EtherCAT (TwinCAT 2)* library.

More information about this function blocks can be found in the Beckhoff Information System: http://infosys.beckhoff.com (search for *FB_EcSoeRead & FB_EcSoeWrite*

Example calls of this function blocks can be found in the example project (see chapter 14.1)

MAIN | ParameterAccess | Library Manager | Axes | Main

```
PROGRAM ParameterAccess
VAR
    iLoopAxisNr :INT; (*Loop counter*)

    SoERead     :ARRAY[1..MAX_AXES] OF FB_EcSoERead;
    SoEWrite    :ARRAY[1..MAX_AXES] OF FB_EcSoEWrite;

    UPID        :ARRAY[1..MAX_AXES] OF WORD;

    DataIN      :ARRAY[1..MAX_AXES] OF DINT;
    DataOUT     :ARRAY[1..MAX_AXES] OF DINT;
END VAR
```

```
FOR iLoopAxisNr := 1 TO MAX_AXES DO (*Call the following function blocks per axis*)

SoERead[iLoopAxisNr](
    sNetId:=F_CreateAmsNetId(g_aAmsAddr[iLoopAxisNr].netId),
    nSlaveAddr:=g_aAmsAddr[iLoopAxisNr].port,
    nIdn:= 16#8000 + UPID[iLoopAxisNr],
    nElement:= 16#40, (*Value*)
    nDriveNo:= DWORD_TO_BYTE(Axis_Ref[iLoopAxisNr].NcToPlc.AxisId),
    bCommand:= ,
    pDstBuf:= ADR(DataIN[iLoopAxisNr]),
    cbBufLen:= SIZEOF(DataIN[iLoopAxisNr]),
    bExecute:= ,
    tTimeout:= ,
    bBusy=> ,
    bError=> ,
    nErrId=> );

SoEWrite[iLoopAxisNr](
    sNetId:=F_CreateAmsNetId(g_aAmsAddr[iLoopAxisNr].netId),
    nSlaveAddr:=g_aAmsAddr[iLoopAxisNr].port,
    nIdn:=16#8000 + UPID[iLoopAxisNr],
    nElement:=16#40, (*Value*)
    nDriveNo:= DWORD_TO_BYTE(Axis_Ref[iLoopAxisNr].NcToPlc.AxisId),
    bCommand:= ,
    pSrcBuf:= ADR(DataOUT[iLoopAxisNr]),
    cbBufLen:= SIZEOF(DataOUT[iLoopAxisNr]),
    bExecute:= ,
    tTimeout:= ,
    bBusy=> ,
    bError=> ,
    nErrId=> );
```

sNetID, nSlaveAddr: AmsNetID & port of the drive.
These can be read using the function block *FB_GetAxisAmsAddr* which is part of the Beckhoff library *Tc2_NC (TwinCAT 3) / TcNC (TwinCAT 2)*.

nDriveNo: NC axis ID

nIdn: Parameter address to be accessed = **16#8000** + UPID
(E.g., Maximal Current (UPID 16#13A6) ▶ **nIdn** = 16#8000 + 16#13A6 = 16#93A6)

nElement: Element of the parameter to be accessed. The following values are allowed

Value	Description
0x01	Data Status
0x02	Name (read only)
0x04	Attribute
0x08	Unit
0x10	Minimum
0x20	Maximum
0x40	**Value**
0x80	Default

Reading and writing the value (nElement := 16#40) accesses the **RAM** value of the UPID.
Writing to the default value (nElement := 16#80) accesses the **ROM** value of the UPID.

pDstBuf, pSrcBuf: Address to the variable containing the value to be read / written (must be of size 4 Bytes!)

cbBufLen: Size of the variable of the value to be read / written (must be of size 4 Bytes!)

Attention ROM Access:
Intense use of writing into the ROM memory can reduce the life-time of the drive memory!
More details can be found in the *Drive Configuration Over Fieldbus (0185-1074)* user manual
> see chapter Documentation / User Manuals

Note:
Use *FB_EcSoeRead* and *FB_EcSoeWrite* from Beckhoff to access drive parameters.

Advanced: Stop / Start MC_SW and reboot drive
The parameter UPID 2080 allows:
1. stopping the MC_SW for flash access or to setup the drive from the PLC
2. starting the MS_SW after flash access and to load changed ROM values to RAM
3. reset the drive.

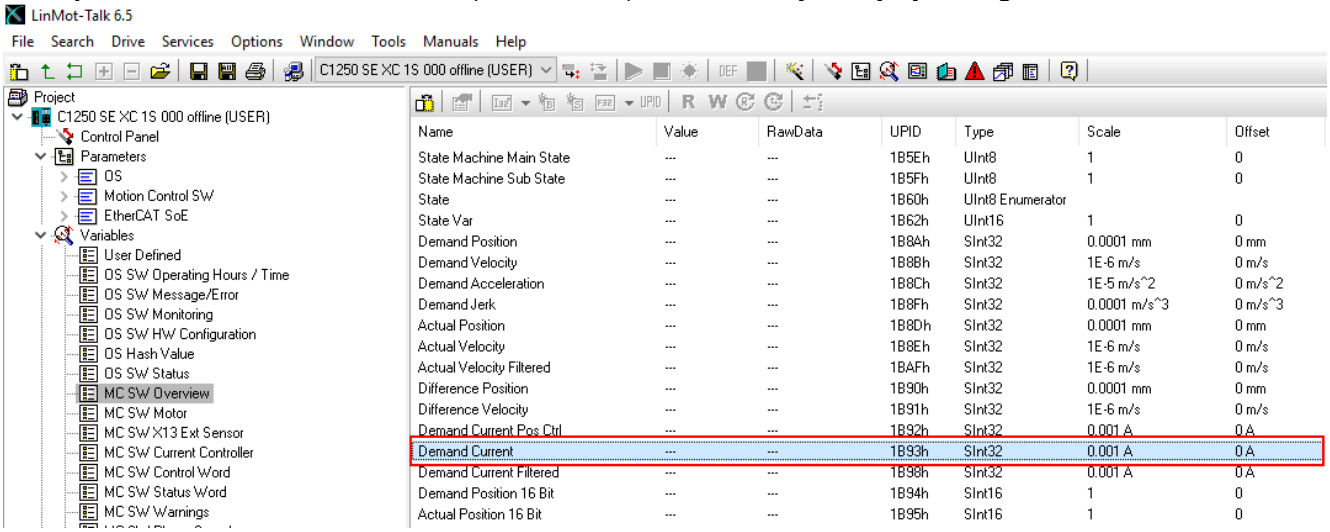
Write to RAM (nElement 0x40) and value 0 -> Stop MC_SW
Write to RAM (nElement 0x40) and value 1 -> Start MC_SW
Write to ROM (nElemen 0x80) and value 1 -> Reboot drive

For every access (read or write) the length of the variable connected to pDstBuf/pSrcBuf must be of **size 4 Bytes** (e.g., datatypes DWORD, DINT, UDINT).
If you access a parameter/variable of a different size (e.g., INT, SINT, …) then make a typecast afterwards.

14.9 Add Additional Parameters or Variables to the Process Data (MDT 1 / AT 1)

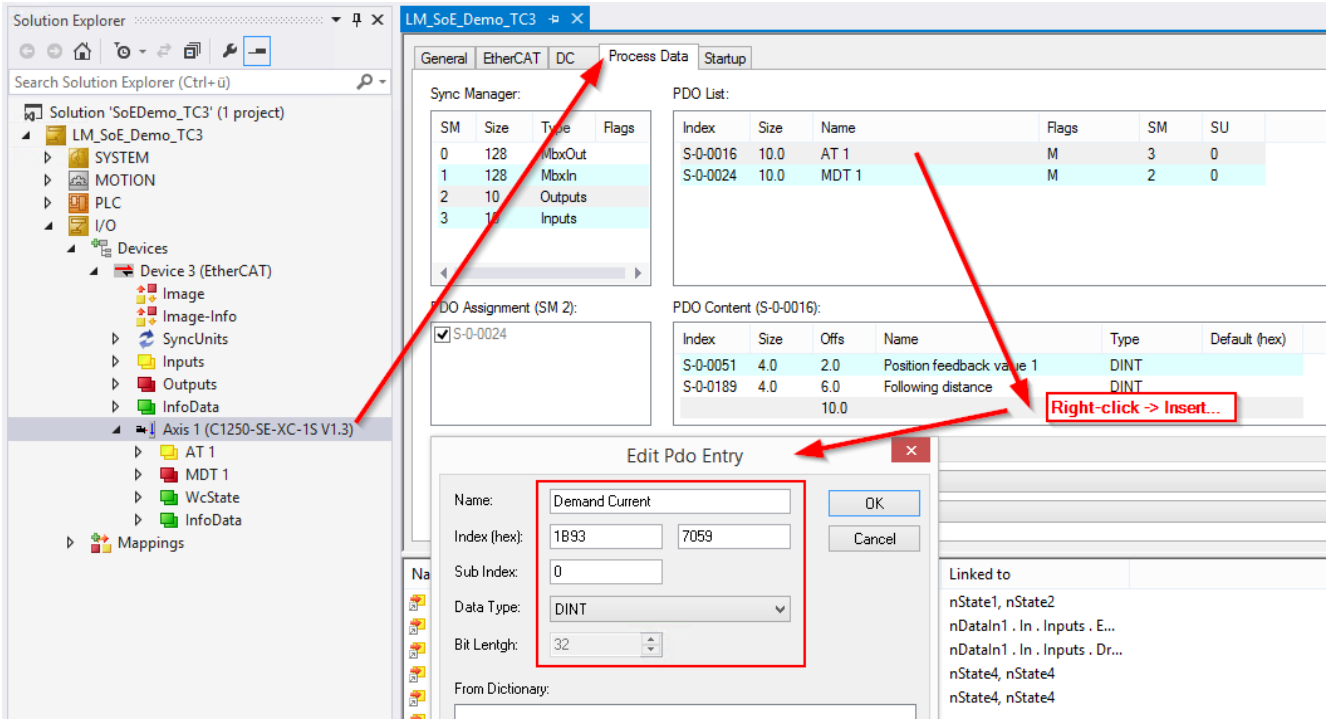
It is possible to add additional parameters or variables of the drive to PDO for cyclical write or read access.

Example 1: Read the *Demand Current (UPID 1B93h)* of the drive cyclically by adding it to AT 1:

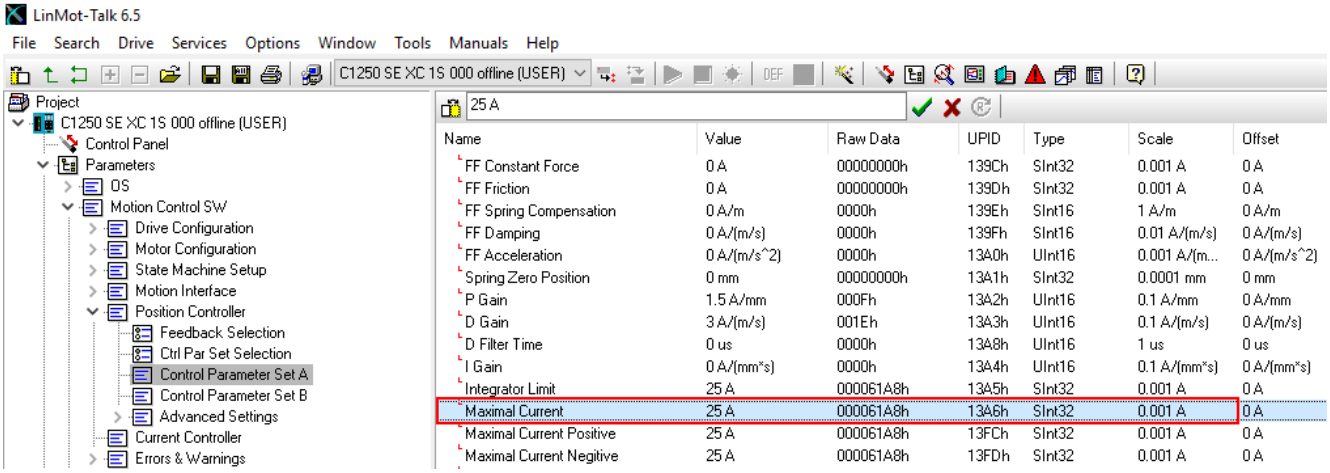


Name: Demand Current
UPID: 1B93h
Type: SInt32 = DINT
Scale: 0.001 A

1. In the Process Data select *AT 1* from the PDO List.
2. Right-click on the empty line where only an offset is shown
3. In the *Edit PDO Entry* window enter the name, the UPID as *Index* and set the *Data Type* to DINT (as the Demand Current is of type SINT32)
4. Click OK to finish

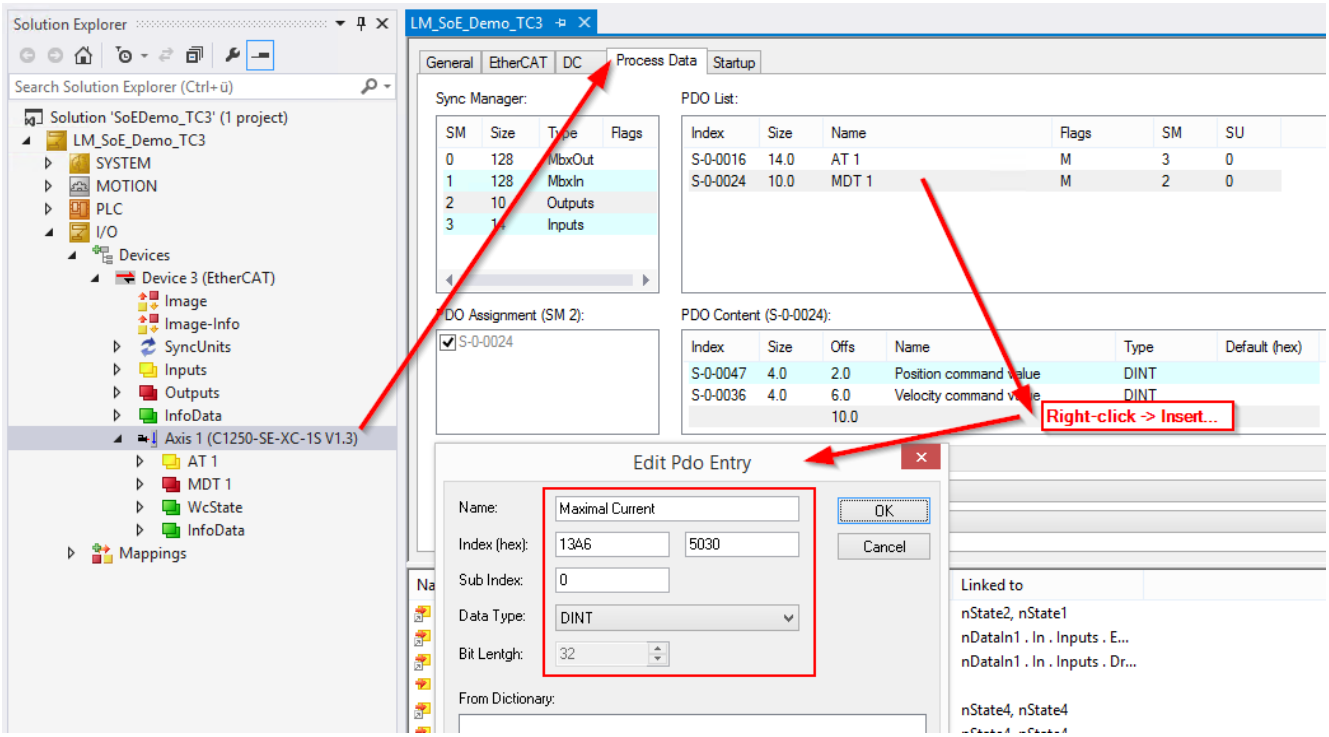


Example 2: Write the *Maximal Current (UPID 13A6h)* of the drive cyclically by adding it to MDT 1:

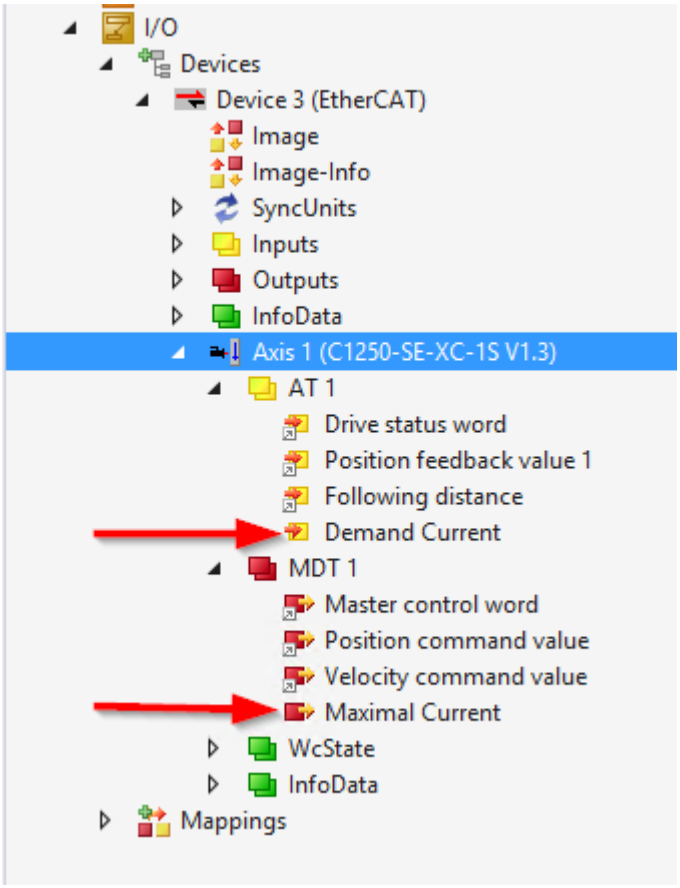


Name: Maximal Current
UPID: 13A6h
Type: SInt32 = DINT
Scale: 0.001 A

1. In the Process Data select *MDT 1* from the PDO List.
2. Right-click on the empty line where only an offset is shown
3. In the *Edit PDO Entry* window enter the name, the UPID as *Index* and set the *Data Type* to DINT (as the Maximal Current is of type SINT32)
4. Click OK to finish



Now you can see both added parameters in the solution tree and link them:



15 Drive Profile: Schneider Electric PacDrive 3, FSP_DRIVE

15.1 Overview

This chapter shows how a LinMot drive with SERCOS (FSP_DRIVE) interface (e.g., C1250-SC-XC-1S) can be integrated and setup in a Schneider Electric PacDrive environment.

Download:
An example project can be downloaded from (The example is based on the QuickMotionProgramming example from Schneider Electric):
http://download.linmot.com/plc_lib/examples/Schneider (named *LMC_LinMot_AxisModule_Example_...*)

Components used:

- LinMot C1250-SC-XC-0S-000 (article number 0150-1887) with firmware 6.8 Build 20191003
- LMC 400C with firmware V01.56.21.13
- SoMachine Motion Logic Builder V4.41 (V4.4 SP1)

Image Source: http://www.schneider-electric.com/

Sercos is an open IEC standard universal bus for Ethernet-based real-time communication.

For further information on sercos please visit:
http://www.sercos.org/

15.2 Configuration and Connection of the LinMot Drive

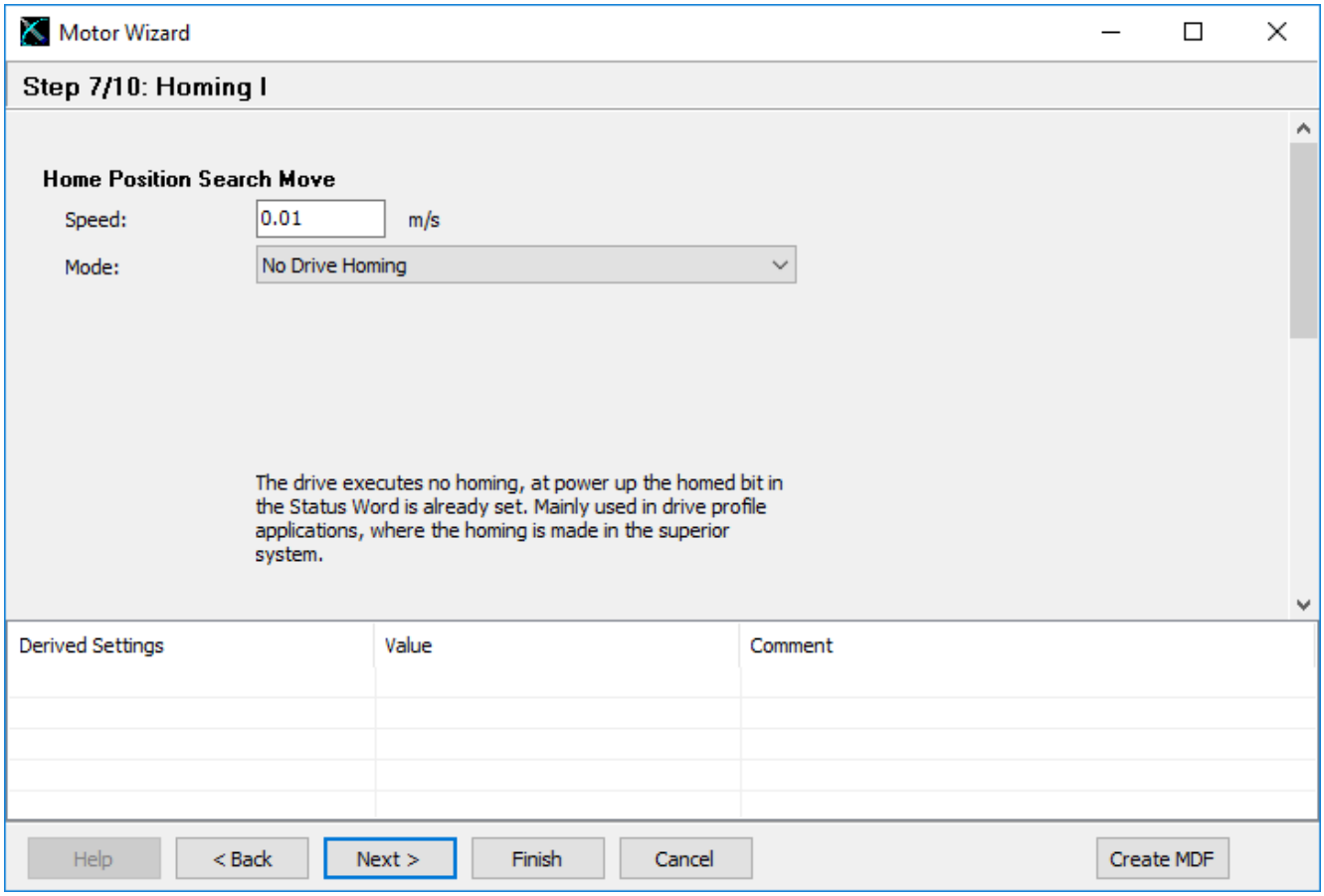
The LinMot drive is configured using the LinMot-Talk software:
http://www.linmot.com/download/linmot-talk-drive-configuration/

15.2.1 Motor Configuration

It is assumed that the motor connected to the drive is already configured.

Use the *Motor Wizard* inside LinMot-Talk to setup the motor (Menu -> Drive -> Motor Wizard):

Make sure that you select “No Drive Homing” in the Motor Wizard as the homing of the axis is done in the PLC.

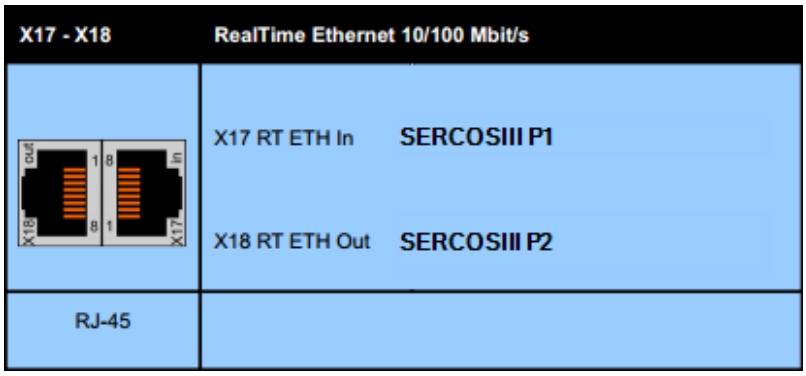


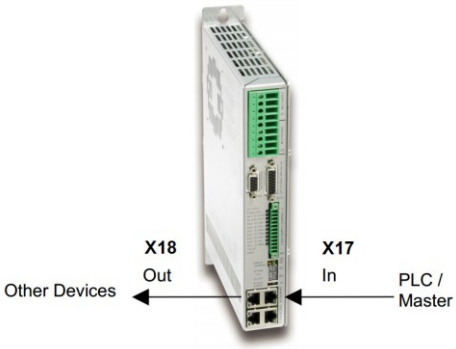
See Appendix I: Basic Position Control Loop Tuning

15.2.2 Sercos Connection

The drive is connected to the sercos network using the **X17 (IN) & X18 (OUT)** connectors.

The below pictures show the ports of an E1250-SC-UC drive.
On all other LinMot drives supporting sercos the ports are named the same (X17 & X18) but they may be placed differently on the drive housing.





15.2.3 Sercos Address

The sercos address is set via the two ID-switches S1 and S2, where S1 sets the high digit and S2 the low digit. The address can have a value between 1 (01h) and 255 (FFh).

Set the sercos address by S1 & S2

S1 - S2	Address Selectors		
E1100 E1200 V1	E1200 V2 E1400 C1x00		
		S1 (5 .. 8)	Bus ID High (0 ... F). Bit 5 is LSB, bit 8 MSB.
		S2 (1 .. 4)	Bus ID High (0 ... F). Bit 1 is LSB, bit 4 MSB.

Note:
The sercos address has no use with some identification modes like topology-based addressing. If both address selectors are set to 0, the topology address is used as the sercos address when topology-based addressing is configured in the PLC.

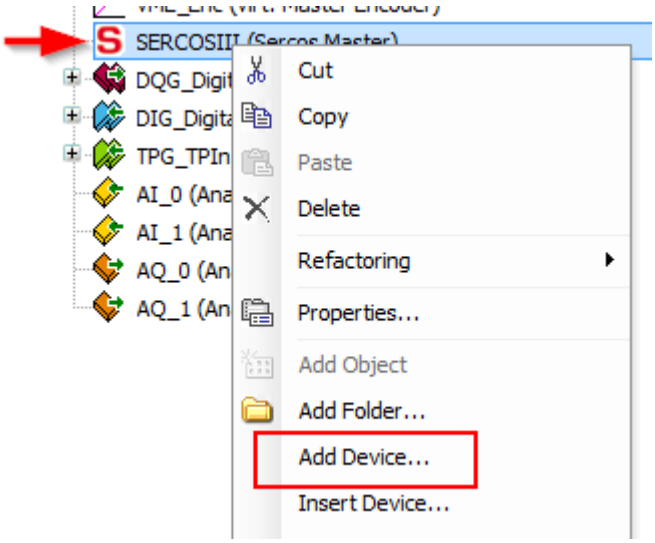
15.3 PLC Setup

15.3.1 General Device Properties

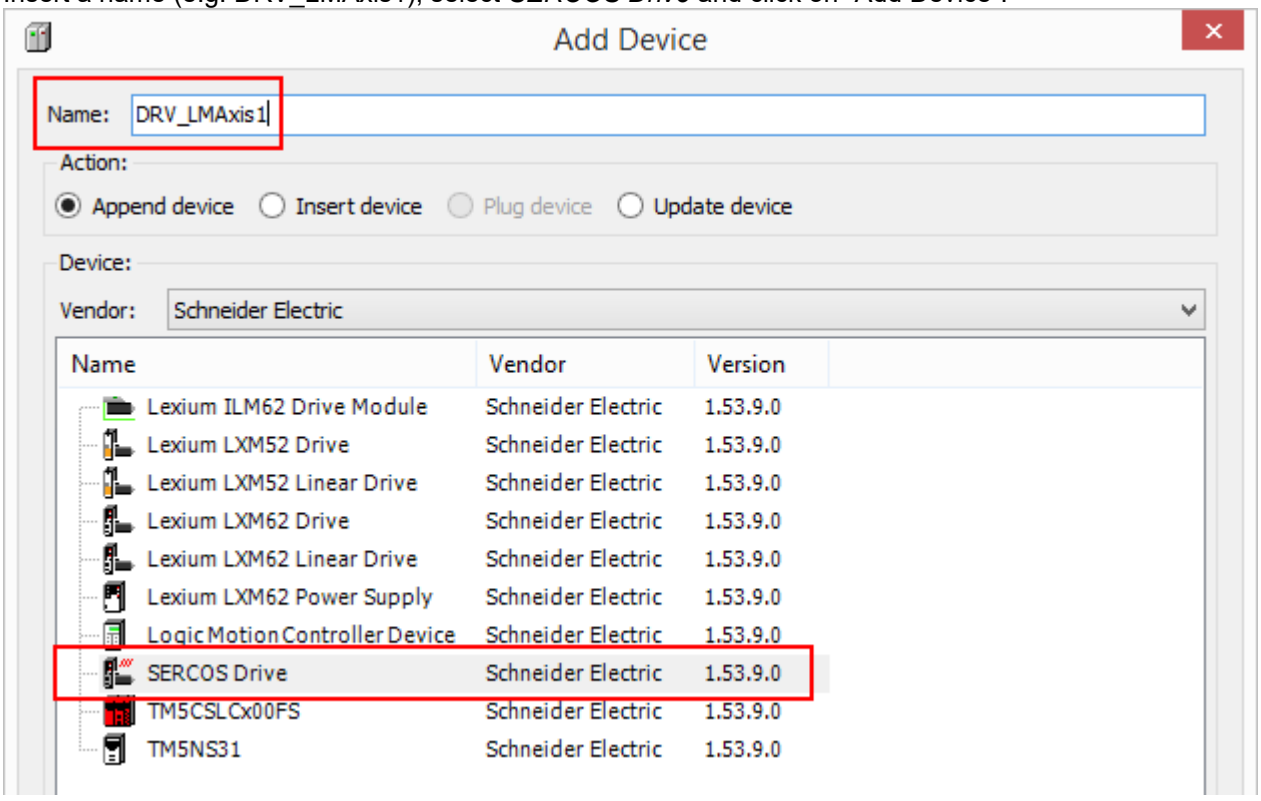
Device Properties	Value	
sercos generation	Third generation	
sercos version	SC: sercos III V1.1.2; MI: sercos III V1.3.2	
Hot-Plug support	only on MI-devices	
SERCON100 image version	V2.11 (SC only)	
Supported profiles and telegram types	E1x50-SC-xx-xx, C1x50-SC-xx-xx	FSP_DRIVE, FSP_IO
	C1x50-MI-xx-xx, C1251-MI-XC-2S	FSP_DRIVE
	B8050-ML-SC, MB8050-ML-SC	FSP_IO
Minimal sercos cycle time	250 µs	
Vendor Device ID	'0150-1764' (E1250-SC-UC) '0150-1785' (E1450-SC-QN-0S) '0150-2357' (E1450-SC-QN-1S) '0150-1881' (B8050-ML-SC) '0150-2032' (MB8050-ML-SC) '0150-1887' (C1250-SC-XC-0S-000, C1250-SC-XC-0S-C00) '0150-2349' (C1250-SC-XC-1S-000, C1250-SC-XC-1S-C00) '0150-30149' (C1250-MI-XC-0S-000, C1250-MI-XC-0S-C00) '0150-30169' (C1250-MI-XC-1S-000, C1250-MI-XC-1S-C00) '0150-30009' (C1251-MI-XC-2S-000, C1251-MI-XC-2S-C00)	
Vendor Code	342 (0156h)	

15.3.2 Add the LinMot Drive to the Sercos

Right-click on SERCOSIII (Sercos Master) and select *Add Device*:



Insert a name (e.g. DRV_LMAxis1), select *SERCOS Drive* and click on “Add Device”:



Double-click on the new added device to open the configuration.

15.3.3 Device Configuration

15.3.3.1 Identification

All identification modes are support (SerialNumberController (0), SerialNumberMotor (1), TopologyAddress (2), ApplicationTyp (3) and SercosAddress (4)).

Following an example setup where the device is identified by *TopologyAddress (2)*
ConfiguredTopologyAddress: **1** (As it is the first device in the ring in this project)
VendorCode: **342**
VendorDeviceID: **'0150-2349'** (LinMot C1250-SC-XC-1S-000, for others check chapter 15.3.1)

Parameter	Type	Value	Default Value
Identification			
Name	STRING(40)	''	''
WorkingMode	Enumeration of DINT	real / 1	virtual / 0
WorkingState	Enumeration of DINT	virtual / 0	virtual / 0
IdentifyDevice	Enumeration of BOOL	off / 0	off / 0
IdentificationMode	Enumeration of DINT	TopologyAddress / 2	TopologyAddress / 2
ConfiguredTopologyAddress	UINT(1..512)	1	1
TopologyAddress	UINT		
ConfiguredApplicationType	STRING(40)	''	''
ApplicationType	STRING(40)	''	''
ConfiguredSercosAddress	UINT(1..512)	100	100
SercosAddress	UINT(1..299)	1	1
ConfiguredSerialNumber	STRING(80)	''	''
ConfiguredSerialNumberMotor	STRING(20)	''	''
ConfiguredVendorCode	WORD	342	0
VendorCode	WORD		
ConfiguredVendorDeviceId	STRING(80)	'0150-2349'	'SercDrv'
VendorDeviceId	STRING(80)	''	''

15.3.3.2 Motor/Mechanic using a LinMot linear motor

As unit millimeter [mm] is used.

The MaxRPM parameter limits the maximal possible velocity to around 1m/s when using 1.0 as *FeedConstant*.

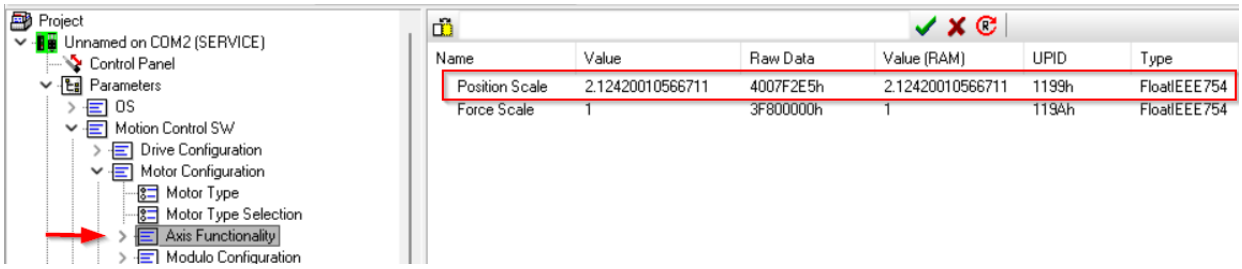
Therefore, the *FeedConstant* is set to **1'000** and the *FeedbackResolution* to **10'000'000**.

Parameter	Value	Unit
GearIn	1	-
GearOut	1	-
Direction	right	-
FeedConstant	1'000	[Units/Revolution]
FeedbackResolution	10'000'000	[Increments]
MaxRPM	See below	[1/min]
ModuloValue	0	[Increments]
J total	Leave on default or set as required	[kg*cm^2]
Torque Constant	Leave on default or set as required	[0,001*Nm/A]

MaxRPM:
Max. Speed (@72VDC, see motor datasheet): e.g., 5.2 [m/s] * 60 => 312 [m/min]
Input value for MaxRPM: 312 [m/min]

15.3.3.3 Motor/Mechanic using a LinMot Gripper GM01 / GM5x

The LinMot grippers have in general an absolute encoder. The position scaling factor has to be read out from UPID 1199h for each gripper type:



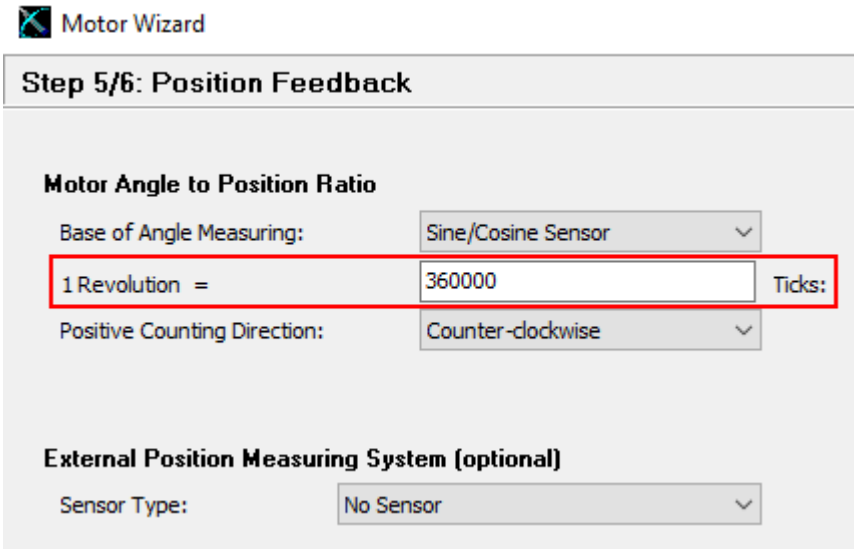
As unit millimetre [mm] is used.

Therefore, the following parameters must be set to 10'000'000 * the position scaling factor = **21'242'000** for this gripper type:

Parameter	Value	Unit
GearIn	1	-
GearOut	1	-
Direction	right	-
FeedConstant	1'000	[Units/Revolution]
FeedbackResolution	**21'242'000**	[Increments]
MaxRPM	See above	[1/min]
ModuloValue	0	[Increments]
J total	Leave on default or set as required	[kg*cm^2]
Torque Constant	Leave on default or set as required	[0,001*Nm/A]

15.3.3.4 Motor/Mechanic using a rotary motor

As unit degree [°] is used. As rotary motor, the *FeedbackResolution* depends on the settings done within the LinMot-Talk Motor Wizard. It must be set to the same value as Ticks per revolution in the Motor Wizard.



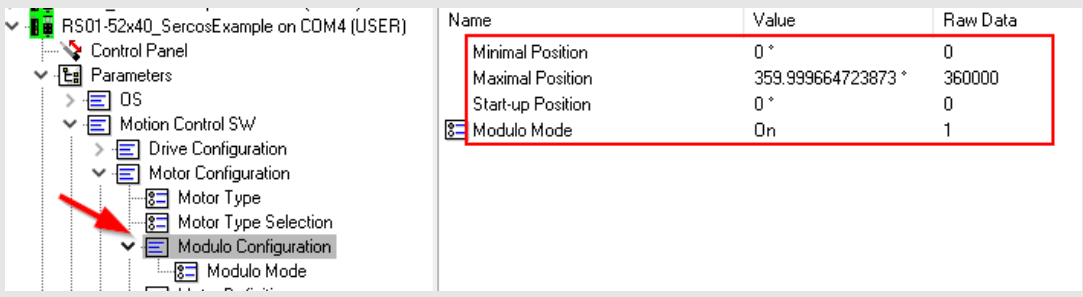
For a LinMot **RS01** (rotary part of the linear rotary motor PR01) the *FeedbackResolution* is **360'000**.
For a LinMot **EC02, GM51 or PR02 PS11 / PS31** the *FeedbackResolution* is **524'288**.

If the motor should be used as modulo axis (1 revolution) the *ModuloValue* must be set accordingly (same as *FeedbackResolution*).

Example for a LinMot **RS01** motor as modulo axis without gearbox:

Parameter	Value	Unit
GearIn	1	-
GearOut	1	-
Direction	right	-
FeedConstant	360.0	[Units/Revolution]
FeedbackResolution	360'000	[Increments]
MaxRPM	Take from motor datasheet	[1/min]
ModuloValue	0	[Increments]
J total	Leave on default or set as required	[kg*cm^2]
Torque Constant	Leave on default or set as required	[0,001*Nm/A]

Attention:
From drive firmware 6.9 it is possible to use the motor in modulo mode. The modulo mode must be enabled and setup in drive. Make sure that the *ModuloValue* in the PLC is set to the same value as the RawData of *Maximal Position* in the drive. E.g.: 360'000.



15.3.3.5 Realtime channel

Following the recommended configuration of the real-time channel.

If the Realtime channel is configured with a list of IDNs the LinMot StatusWord, StateVar, the velocity feedback (S-0-0040), torque/force feedback (S-0-0084) and the effective current (S-0-0389) can also be mapped directly as part of the real-time process data.

In this example in the MDT also the **Bipolar torque limit** value (S-0-0092) is mapped. It allows to limit the maximum force/torque in percent (scale = 0.1%, > value = 0 to 1000).

Parameter	Value
TelegramType	7
PrimaryOperationMode	3
ConfigurationListAT	'S-0-0051.0.0;P-0-0100.0.0;P-0-0101.0.0;S-0-0040.0.0;S-0-0084.0.0;S-0-0389.0.0'
ConfigurationListATLength	9
PositionFeedbackValueOffset	0
ConfigurationListMDT	'S-0-0047.0.0;S-0-0092.0.0'
ConfigurationListMDTLength	3
PositionCommandValueOffset	0

Echtzeitkanal		
TelegramType	UINT(0..7)	7
PrimaryOperationMode	UINT	3
ConfigurationListAT	STRING(254)	'S-0-0051.0.0;P-0-0100.0.0;P-0-0101.0.0;S-0-0040.0.0;S-0-0084.0.0;S-0-0389.0.0'
ConfigurationListATLength	UINT(0..750)	9
PositionFeedbackValueOffset	UINT(0..748)	0
ConfigurationListMDT	STRING(254)	'S-0-0047.0.0;S-0-0092.0.0'
ConfigurationListMDTLength	UINT(0..750)	3
PositionCommandValueOffset	UINT(0..748)	0

Attention:
The order of the list's objects and its content must be exactly as stated in the table above to work properly.

Make sure the Bipolar torque limit value is not 0 or the motor cannot move.

Note:
Writing to the MDT from the PLC program (e.g., to write the Bipolar torque limit) could be done as follows:

```
39      // Bipolar Torque Limit (S-0-0092)
40      pBipolarLimit           : POINTER TO UINT;
41      rBipolarLimit           : REAL := 100.0; // in percent;
```

```
17  // ******************************************************************************
18  // Set Bipolar torque limit (S-0-0092) in MDT
19  // ATTENTION: Only valid with ConfigurationListMDT = 'S-0-0047.0.0;S-0-0092.0.0'
20  // - Bipolar torque limit has scaling 0.1% percent (100% = maximal force / torque of motor)
21  // - for other ConfigurationListMDT the address offset(s) must be adapted accordingly
22  // ******************************************************************************
23
24  pBipolarLimit := (DRV_LMAxis1.MDTAdr + 4); // Byte offset is 4
25  pBipolarLimit^ := REAL_TO_UINT(rBipolarLimit * 10);
26
```

15.4 Homing (Linear Motors)

15.4.1 Homing using the Schneider template (FB_Home)

As homing mode *NegDirectionPosEdgeSensor* is used in this example project. As sensor the tracking deviation is evaluated. The axis moves in negative direction until it reaches the mechanical stop, and the tracking deviation increases. At a certain value this triggers *i_xSensor*.

15.4.1.1 Setup

Set the homing mode:

```
55  AXM.FC_SetHomeMode( i_etModeVirtualDrive    := PDL.ET_HomeMode.SetPosAxisAndLogEncoderPosition,
56                      i_etModeRealDrive       := PDL.ET_HomeMode.NegDirectionPosEdgeSensor,
57                      iq_stAxisModuleItf      := stAxisInterface,
58                      q_etDiag                => etDiag,
59                      q_etDiagExt             => etDiagExtAXM,
60                      q_sMsg                  =>  );
```

Setup the homing mode Sensor:

```
72  (* Possible modes for homing mode Sensor:
73      PDL.ET_HomeMode.PosDirectionPosEdgeSensor
74      PDL.ET_HomeMode.NegDirectionPosEdgeSensor
75      PDL.ET_HomeMode.NegDirectionNegEdgeSensor
76      PDL.ET_HomeMode.PosDirectionNegEdgeSensor
77  *)
78  stAxisInterface.stHome.stSensor.i_lrHomePosition        := 0.0;       (* Position at the end of homing in units *)
79  stAxisInterface.stHome.stSensor.i_lrVel                 := 5.0;       (* Homing ceiling velocity in units/s *)
80  stAxisInterface.stHome.stSensor.i_lrAcc                 := 1000.0;    (* Homing acceleration in units/s^2 *)
81  stAxisInterface.stHome.stSensor.i_lrDec                 := 1000.0;    (* Homing deceleration in units/s^2 *)
82  stAxisInterface.stHome.stSensor.i_lrJerk                := 10000.0;   (* Homing jerk in units/s^3 *)
83  stAxisInterface.stHome.stSensor.i_lrOffset              := 10.0;      (* Offset from home signal in units *)
84  stAxisInterface.stHome.stSensor.i_lrMaxTravel           := 720.0;     (* Max. travel for referencing by normal input *)
85  stAxisInterface.stHome.stSensor.i_xRotativeSystem       := FALSE;     (* Rotative system true or false for referencing by norm
86  stAxisInterface.stHome.stSensor.i_xSensor               := FALSE;     (* Input for home signal. Can be a signal from a control
```

Make sure to keep the velocity *i_lrVel* low for best accuracy and set *i_lrOffset* to move away from the mechanical stop afterwards.

In a cyclic task trigger *i_xSensor*. E.g., as follows:

```
38  // ******************************************************************************
39  // Sensor for homing
40  //
41  // Can be used with homing modes:
42  //      PDL.ET_HomeMode.PosDirectionPosEdgeSensor
43  //      PDL.ET_HomeMode.NegDirectionPosEdgeSensor
44  //
45  // Recommended solution:
46  // - set i_xSensor if the tracking deviation reaches a certain level (2mm in this example)
47  // - keep the search velocity (stAxisInterface.stHome.stSensor.i_lrVel) low to get accurate results. Best below 5-10mm/s
48  //
49  // Alternative (probably less accurate):
50  // - If iTorque feedback (in 0.1% of the motors maximal force/torque) is 100% the sensor becomes TRUE
51  // - As limit by default 100% (1000) is used. The user is free to use other limits.
52  // ******************************************************************************
53
54  stAxisInterface.stHome.stSensor.i_xSensor := (ABS(DRV_LMAxis1.TrackingDeviation) >= 2); // Trig sensor on tracking deviation level (2mm in this example)
55
```

15.5 Parameter Access

Every parameter and variable in a LinMot system has its own UPID (Unique Parameter ID).
Every UPID is mapped to its own manufacturer specific IDN to access it via the sercos service channel.

UPIDs are mapped according to the following table:

UPID	IDN (dec)	IDN (hex)
0xHBLB	P-Y-0000.HBdec.LBdec	0xHBLB0000 + (0x00008000 + 0x0000Y000)

HB: High Byte (hexadecimal), HBdec: High Byte (decimal)
LB: Low Byte (hexadecimal), LBdec: Low Byte (decimal)

Y = 0: RAM value of a UPID is accessed
Y = 1: ROM value of a UPID is accessed
Y = 2: RAM and ROM value of a UPID is accessed (only applicable when writing UPIDs)

(Note: Not every UPID has a RAM and a ROM Value)

Example:
Access RAM value (Y=0) of UPID 0x13A6 (Maximal Current of Control Parameter Set A)
UPID = 0x13A6
IDN (dec) = P-0-0000.19.166
IDN (hex) = 0x13A60000 + (0x00008000 + 0x00000000) = **0x13A68000**

15.5.1 Supported UPID Functions via IDN Access over the Sercos Service Channel

Use Schneider functions *FC_SercosReadServiceData & FC_SercosWriteServiceData* (see Schneider help)

UPID Access	Data Service Type (i_wType)
Read UPID value (RAM or ROM value)	5 (read/write user data)
Write UPID value (RAM and/or ROM value)	5 (read/write user data)
Get minimum value of UPID	3 (read/write min. value)
Get maximum value of UPID	4 (read/write max. value)

Attention ROM Access:
Intense use of writing into the ROM memory can reduce the lifetime of the drive memory!
More details can be found in the *Drive Configuration Over Fieldbus (0185-1074)* user manual
> see chapter Documentation / User Manuals

Advanced:
By writing anything to **IDN P-0-0099 (hex: 16#00008063)** a drive reboot can be performed (e.g., to load and activate written ROM parameters).
Attention: The Sercos line/ring will be interrupted until the drive has completed the reboot.

15.5.2 Read RAM Parameter Example

To read the RAM value of a LinMot parameter the function *FC_SercosReadServiceData* (see Schneider help) can be used.

```
PROGRAM SR_Main
VAR
	bStartReadIDN: BOOL := 0;
	diRetVAL: DINT;
	i_stAxisId := DRV_SercDrv.stLogicalAddress;
	wIDN: DWORD := 16#1BF38000; // UPID 1BF3h (Max Read Out Motor Temp, Offset = -50, Scale =
	0.9803…°C)
	dwIDNDataIN: DWORD ; // read data value
	wNumBytetoRead: WORD:= 4; // read 4 bytes of data
	uiReadDataLen: UINT; // actual length of read data
	uiMaxReadDataLen: UINT; // actual maximum length of read data (i.e. max possible length of a string)

END_VAR

...
// ReadIDN
IF bStartReadIDN THEN

	RetVAL:=FC_SercosReadServiceData(
		i_stAxisId,
		wIDN,
		5,
		ADR(dwIDNDataIN),
		wNumBytetoRead,
		uiReadDataLen,
		uiMaxReadDataLen);

	StartReadIDN := 0;

END_IF
…
```

15.5.3 Write RAM Parameter Example

To write the RAM value of a LinMot parameter the function *FC_SercosWriteServiceData* (see Schneider help) can be used.

```
PROGRAM SR_Main
VAR
	bStartWriteIDN: BOOL := 0;
	diRetVAL: DINT;
	i_stAxisId := DRV_SercDrv.stLogicalAddress;
	wIDN: DWORD := 16#13A58000; // UPID 13A5h (Integrator Limit)
	dwIDNDataOUT: DWORD := 3000; // Set Integrator Limit to 3A (Scale 0.1 mA)
	wNumBytetoWrite: WORD := 4; // Write 4 bytes of data

END_VAR
...
// WriteIDN
IF bStartWriteIDN THEN  // If StartWriteIDN = TRUE parameter will be read

	RetVAL:=FC_SercosWriteServiceData(
		i_stAxisId,
		wIDN,
		5,
		ADR(dwIDNDataOUT),
		wNumBytetoWrite);

	bStartWriteIDN := 0;
END_IF
…
```

15.6 Enable/Disable Drive Warnings

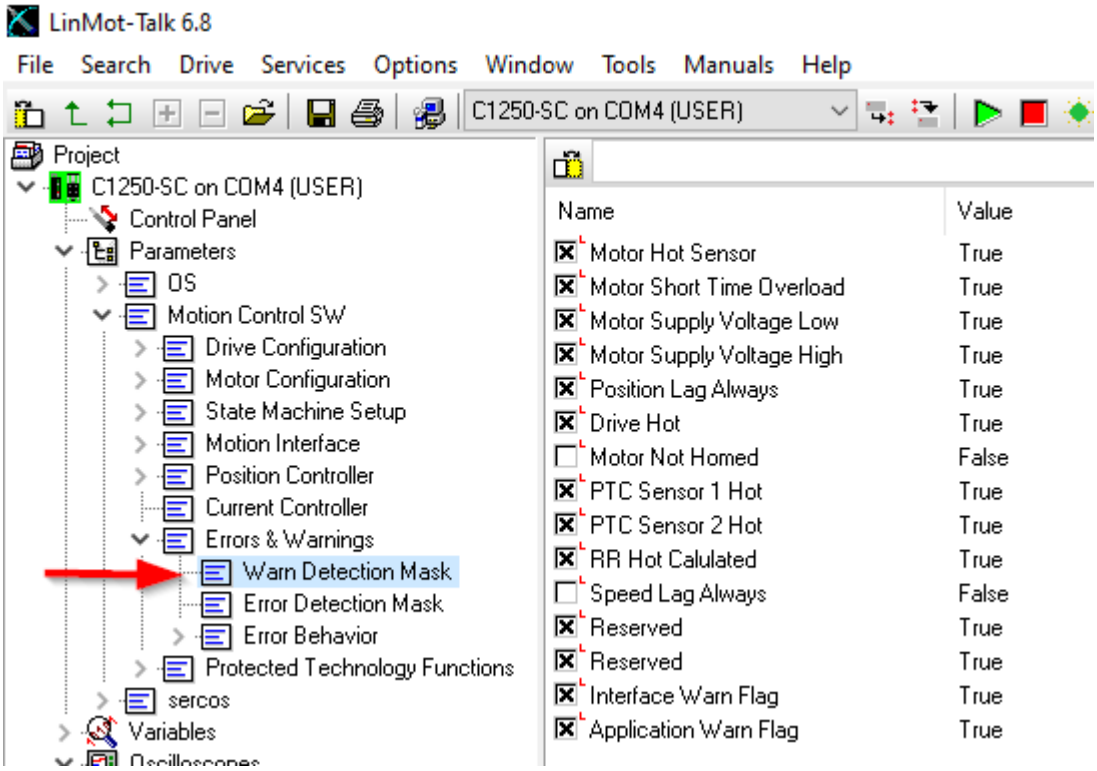
By default, any SERCOS Slave C2D warning (8165) or SERCOS C2Dman.specific warning (8166) will cause the PLC to stop the axes. The LinMot drive can generate several warnings *Motor Not Homed*, *Speed Lag Always* and so on.

To avoid this behaviour on the Schneider PLC, these diagnostic messages can be deactivated using *FC_DiagConfigSet2* (see Schneider help for more information).

In the example project (see 15.1 Overview) in the *Init_Action* of the program *SR_MainMaschine* the two diagnostic codes 8165 and 8166 are set to diagnostic class 1:

```
IF (SystemConfiguration.G_ifSercos.State = 4) THEN
    //Warnings, see help
    diResultDiagConfigSet8165 := FC_DiagConfigSet2(i_diDiagCode:= 8165, i_diDiagClass:= 1, i_stLogAddr:= SERCDRV_TYPE, i_diDiagSubClass:= 1);
    diResultDiagConfigSet8166 := FC_DiagConfigSet2(i_diDiagCode:= 8166, i_diDiagClass:= 1, i_stLogAddr:= SERCDRV_TYPE, i_diDiagSubClass:= 1);

    xInitDone :=  TRUE;
END_IF
```

Otherwise it is also possible to disable warnings on the drive side:



Attention:
Be aware that some of the warnings of a LinMot drive can indicate an upcoming error. So, make sure you have good reasons to disable warnings on the drive, e.g., *Motor Hot Sensor* or *Drive Hot.*

16 Drive Profile: CODESYS SoftMotion, CiA402

16.1 Overview

This chapter shows how a LinMot drive with *DS402 (CoE) / CiA402* interface (e.g., C1250-DS-XC-1S) can be integrated and setup in a CODESYS SoftMotion environment (on a Raspberry Pi 2).

Download:
Example projects can be downloaded from:
http://download.linmot.com/plc_lib/examples/CODESYS_DS (named *LM_DS_Demo_CODESYS_RaspPi...*)

Components used:

- LinMot C1250-DS-XC-1S-000 (article number 0150-2416) with firmware 6.6 Build 20170522
- Raspberry Pi 2, Model B, target system version 3.5.10.20
- CODESYS Control for Raspberry PI 3.5.10.20 Package
- CODESYS V3.5 SP10 Patch 3

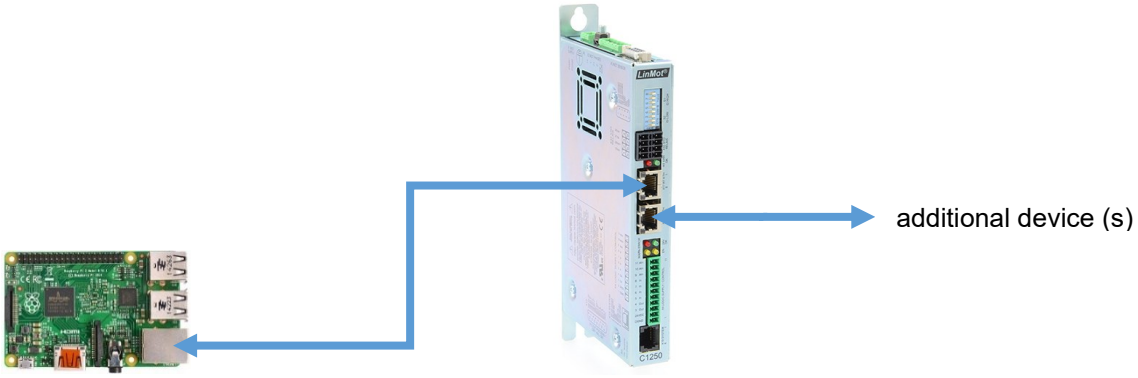


Image Source: http://www.raspberrypi.org/

EtherCAT is the real-time Ethernet network originally developed by Beckhoff. The LinMot acts as Slave in this network and is implemented with the netX from Hilscher (MI Drives) or the standard ASIC ET1100 from Beckhoff (DS Drives).

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

16.2 Configuration and Connection of the LinMot Drive

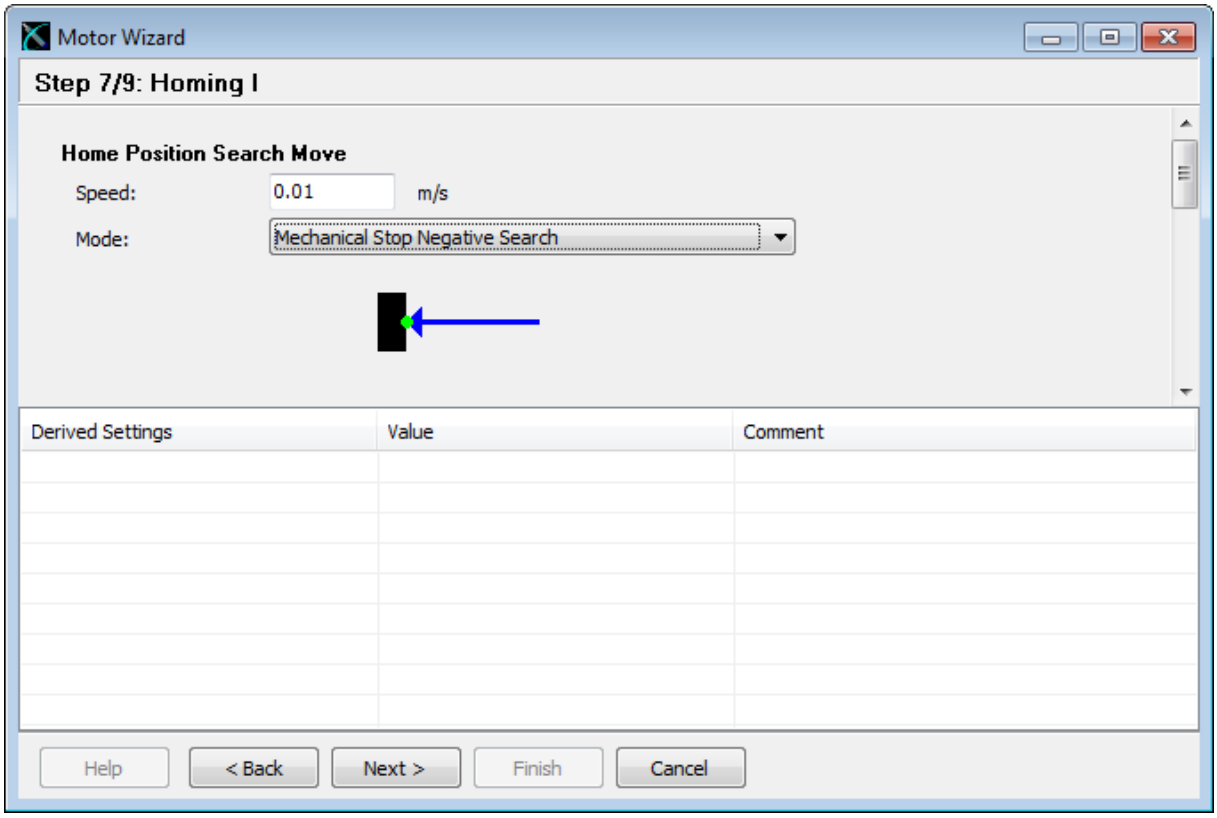
The LinMot drive is configured using the LinMot-Talk software:
http://www.linmot.com/download/linmot-talk-drive-configuration/

16.2.1 Motor Configuration

It is assumed that the motor connected to the drive is already configured.

Use the *Motor Wizard* inside LinMot-Talk to setup the motor (Menu -> Drive -> Motor Wizard):

Make sure that you select a homing mode in the Motor Wizard as with the DS (DS402 / CiA402) interface a drive-based homing is possible (e.g. *Mechanical Stop Negative Search*):



See Appendix I: Basic Position Control Loop Tuning

16.2.2 XML File

Install the XML file that is part of the LinMot-Talk software/firmware you are using.
The most recent device files are always part of the newest LinMot-Talk software. They are located by default:

- EtherCAT CoE: \\LinMot-Talk X.X Build XXXXXXXX\Firmware\Interfaces\EtherCat_Nx\XML\ **(-MI drives)**
- EtherCAT CoE: \\LinMot-Talk X.X Build XXXXXXXX\Firmware\Interfaces\EtherCAT\XML\

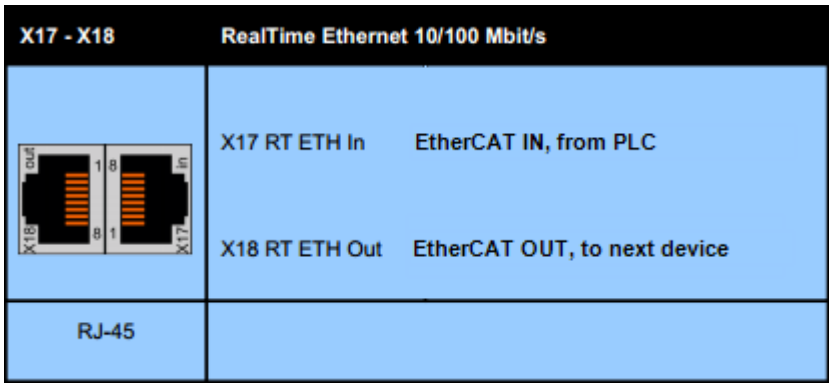
XML file names:

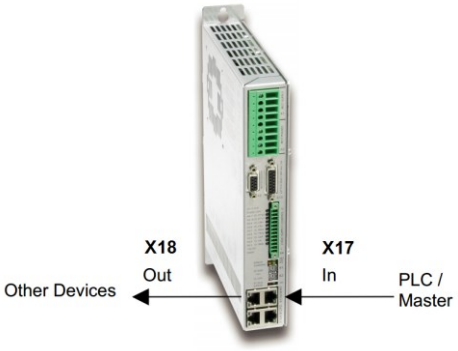
NTIL_CiA402_Servos_MI_Vx_xrx.xml	LinMot MI drives
NTIL_DS_Drives_Vx_x_bxx.xml	LinMot DS drives SG9 (F Series DS)
NTIL_CiA402_Servos_Vx_xrx.xml	LinMot DS drives SG6-7
NTIL_CiA402_SG5_Servos_Vx_xrx.xml	LinMot DS drives SG5

16.2.3 EtherCAT Connection

The drive is connected to the EtherCAT network using the **X17 (IN) & X18 (OUT)** connectors.

The below pictures show the ports of an E1250-DS-UC drive.
On all other LinMot drives supporting EtherCAT DS the ports are named the same (X17 & X18) but they may be placed differently on the drive housing.





16.3 PLC Setup

16.3.1 EtherCAT Device Description File XML

The EtherCAT device description file (XML) is located by default in the LinMot-Talk installation path:
C:\Program Files (x86)\LinMot\LinMot-Talk X.X Build XXXXXXXX\Firmware\Interfaces\EtherCat_Nx\XML
C:\Program Files (x86)\LinMot\LinMot-Talk X.X Build XXXXXXXX\Firmware\Interfaces\EtherCAT\XML

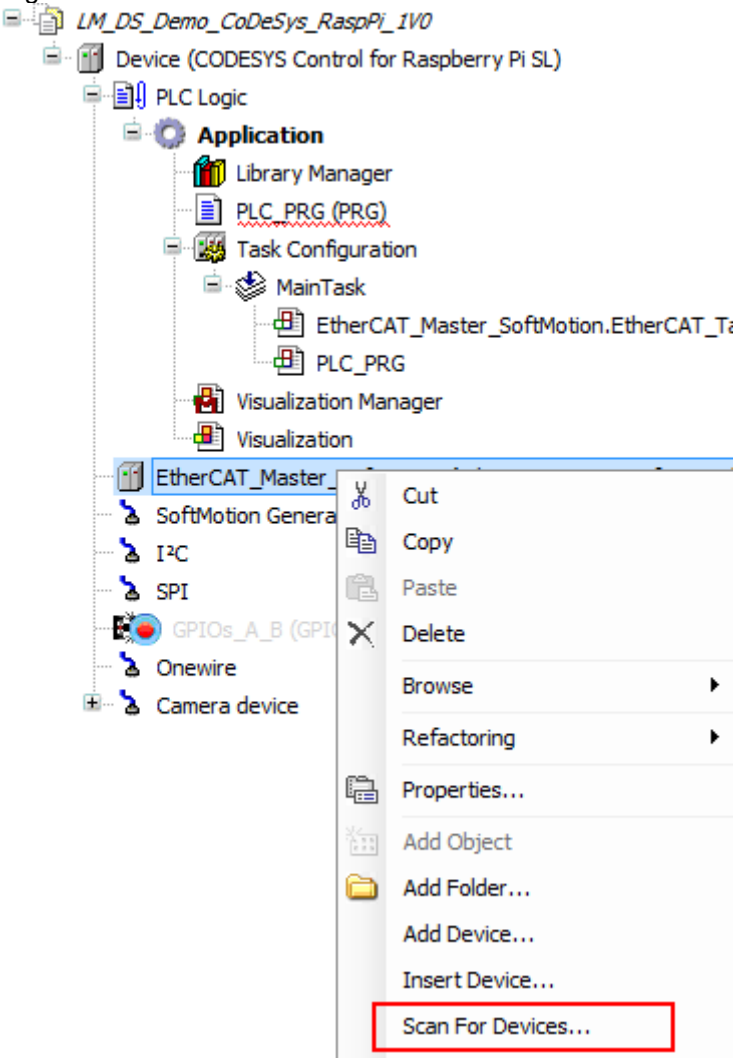
Install the XML in CODESYS by selecting “Tools > Device Repository”.

16.3.2 Add and setup the LinMot drive

Follow these steps to add the LinMot drive to your CODESYS project.

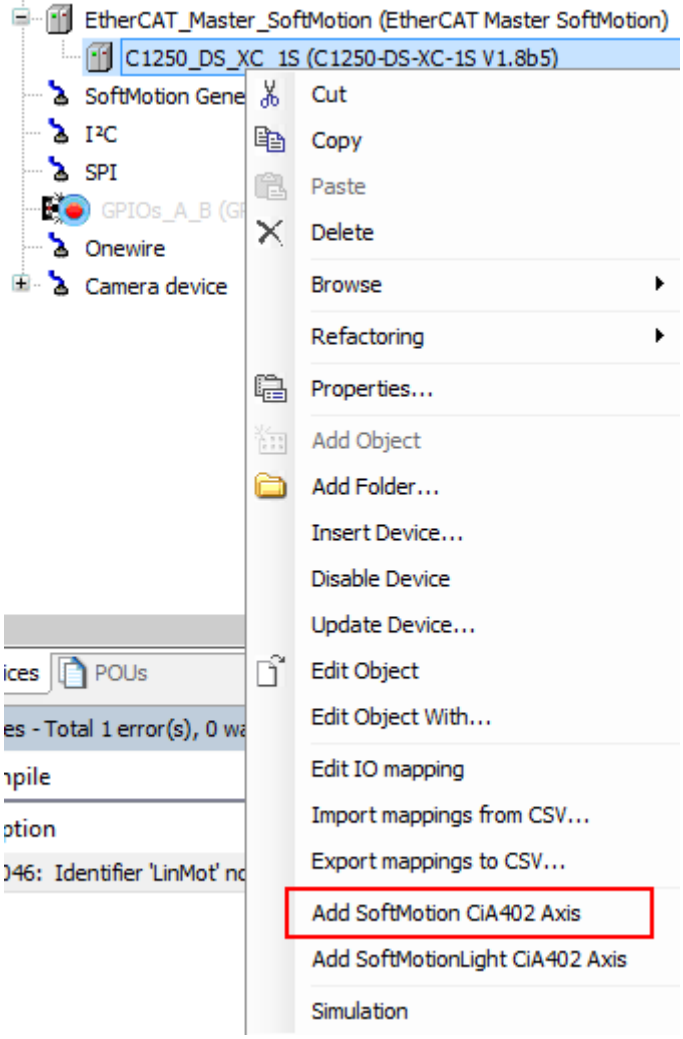
1. If not already existing add an *EtherCAT Master SoftMotion* by right-click on the PLC and select *Add Device…*

2. Right-Click on the *EtherCAT Master SoftMotion* and select Scan for Devices…



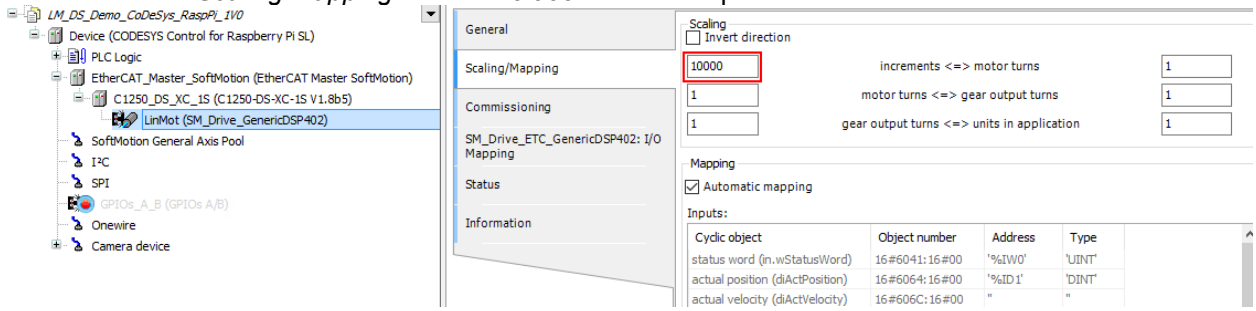
In the following window select Copy All Devices to Project

3. Right-Click on the added drive (e.g. C1250_DS_XS_1S…) and select *Add SoftMotion CiA402 Axis*



Select Ok in the following pop up.

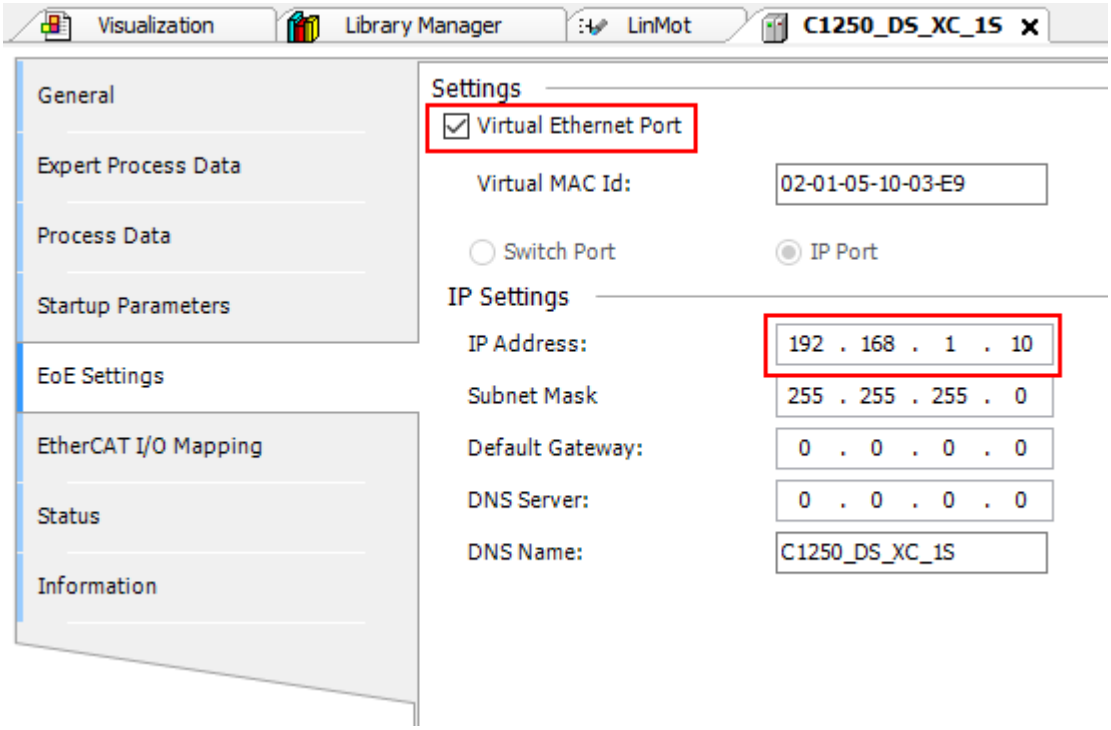
4. Move to the tab *Scaling/Mapping* and set 10’000 increments per 1 motor turn



You are now ready to use the axis.

16.3.3 Check EoE settings

On supported drives (C1250-..., C1450-… & E1450-...) please check the EoE (Ethernet over EtherCAT) settings.
You can enable the *Virtual Ethernet Port* and assign an IP to be able to login over EtherCAT into the drive using LinMot-Talk.



Be aware that the PLC must route the requests from LinMot-Talk over Ethernet to the EtherCAT network.

Note:
EoE can be used to login into the drive with LinMot-Talk directly over EtherCAT.
E.g., to change drive settings or for monitoring and tracing.
If not required, this feature can be disabled.

LinMot drives do NOT support the DHCP mode yet. A fix IP must be assigned or the EoE feature must be completely disabled (disable Virtual Ethernet Port).

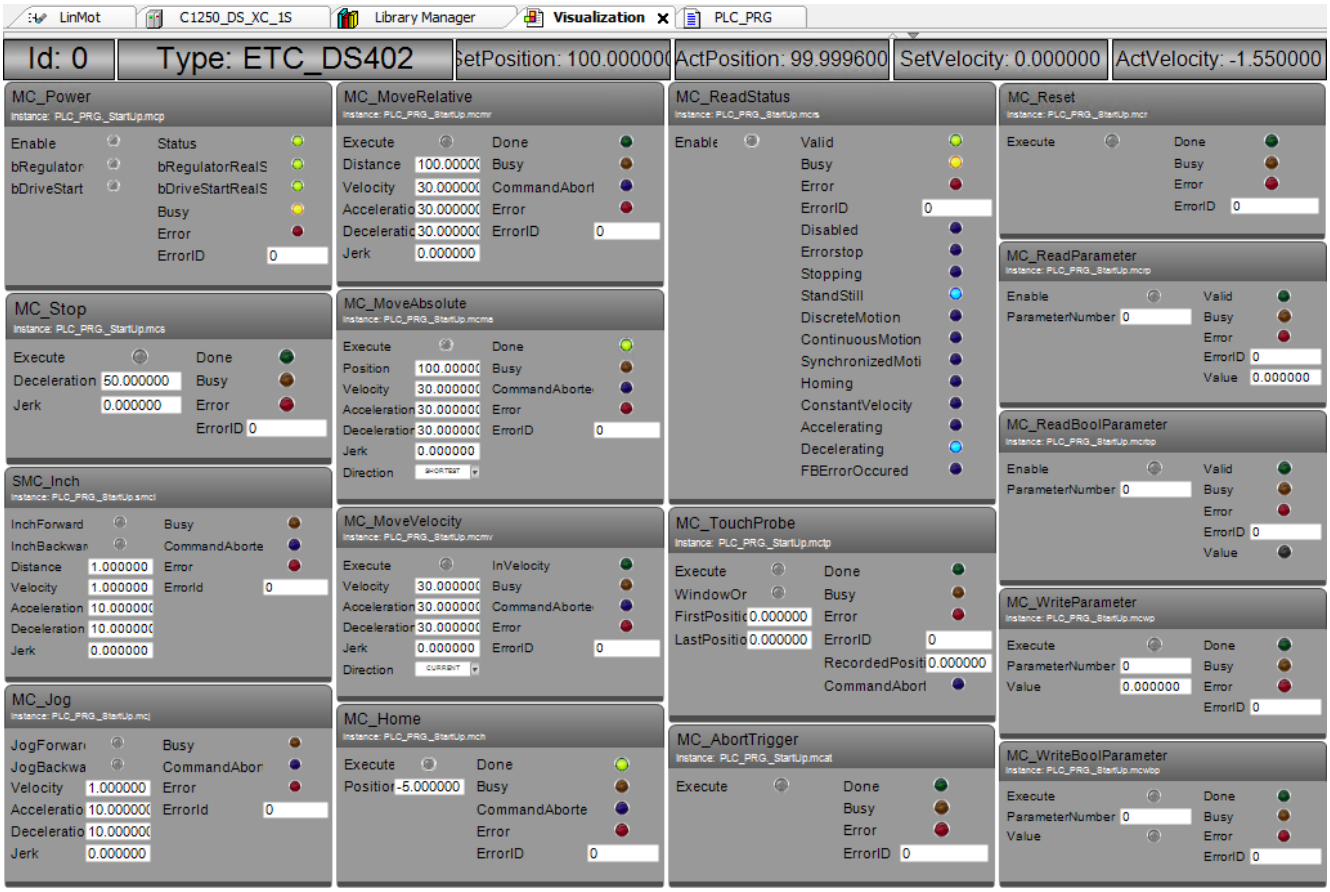
16.4 Homing

To home the axis using the drive-controlled homing procedure the function block MC_Home (library SM3_Basic) can be used.

Executing this function block will start the homing procedure defined with the Motor Wizard of LinMot-Talk (e.g., Mechanical Stop Negative Search). The Position input of the function block defines the home position of the axis, e.g., the mechanical stop.

16.5 Visualization

In the example project the VISU_NEW_SMC_StartupDrive (SM3_Basic) template is used



16.6 Parameter Access

Parameters can be modified using their UPIDs (Unique Parameter ID) via CoE.
To use a UPID command the function blocks MC_ReadParameter and MC_WriteParameter can be used.

The Sub-Index specifies the command which is performed

SDO Service	Index	SubIndex	Description
Read	2000h+UPID	0x01	Parameter UPID read RAM value
Write	2000h+UPID	0x01	Parameter UPID write RAM value
Read	2000h+UPID	0x02	Parameter UPID read ROM value
Write	2000h+UPID	0x02	Parameter UPID write ROM value
Read	2000h+UPID	0x03	Parameter UPID read minimal value
Read	2000h+UPID	0x04	Parameter UPID read maximal value
Read	2000h+UPID	0x05	Parameter UPID read default value
Write	2000h+UPID	0x06	Parameter UPID write RAM and ROM value
Write	2000h	0x07	Parameter Default OS SW instance
Write	2000h	0x08	Parameter Default MC SW instance
Write	2000h	0x09	Parameter Default Intf SW instance
Write	2000h	0x0A	Parameter Default Appl SW instance
Write	2000h	0x0B	Reset device

Attention ROM Access:
Intense use of writing into the ROM memory can reduce the lifetime of the drive memory!
More details can be found in the *Drive Configuration Over Fieldbus (0185-1074)* user manual
> see chapter Documentation / User Manuals

The input *ParameterNumber* of the MC_... function blocks must be of type DINT and contains the data length the index and the subindex.

E.g., *ParameterNumber* := -DWORD_TO_DINT(SHL(USINT_TO_DWORD(usiDataLength), 24) +
SHL(UINT_TO_DWORD(uiIndex), 8) + usiSubIndex);

```
PROGRAM PLC_PRG
VAR
    _StartUp: SM3_Basic.SMC_StartupDrive;

    //Parameter Access
    MC_ReadParameter1:  MC_Readparameter;
    MC_WriteParameter1: MC_Writeparameter;
    usiDataLength: USINT := 4; // Length 4 Bytes
    uiIndex: UINT; //= 16#2000 + UPID number of the LinMot parameter. E.g. UPID 16#13a6 => Index := 16#2000 + 16#13a6 = 16#33a6
    usisubIndex: USINT := 1; // 1 = RAM Value, 2 = ROM Value, further information in the drive interface manual
END_VAR
```

```
// SM3_Basic StartupDrive
_StartUp(Axis:= LinMot);

// Parameter Access
MC_ReadParameter1.ParameterNumber := -DWORD_TO_DINT(SHL(USINT_TO_DWORD(usiDataLength), 24) + SHL(UINT_TO_DWORD(uiIndex), 8) + usisubIndex);
MC_WriteParameter1.ParameterNumber := -DWORD_TO_DINT(SHL(USINT_TO_DWORD(usiDataLength), 24) + SHL(UINT_TO_DWORD(uiIndex), 8) + usisubIndex);

MC_ReadParameter1(Axis:=LinMot);
MC_WriteParameter1(Axis:=LinMot);
```

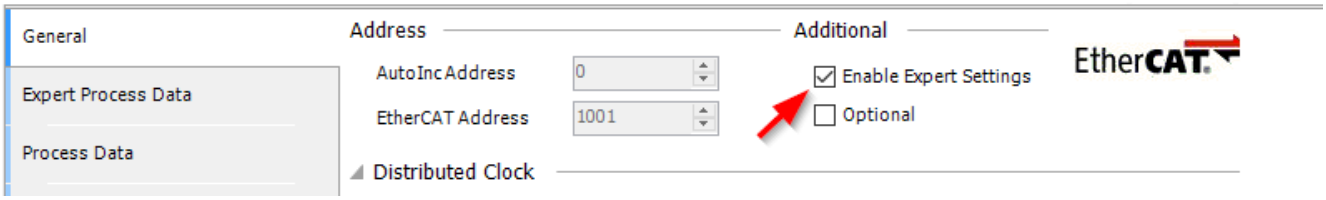
Example:

To write 1A to the RAM value of the parameter Maximal Current:

Name:	**Maximal Current**	DataLength = **4**
UPID:	**13A6h**	Index **= 16#2000 + 16#13a6 = 16#33a6**
Type:	**SInt32 = DINT**	SubIndex **= 1**
Scale:	**0.001 A**	Value **= 1A / 0.001A (scale) = 1'000**

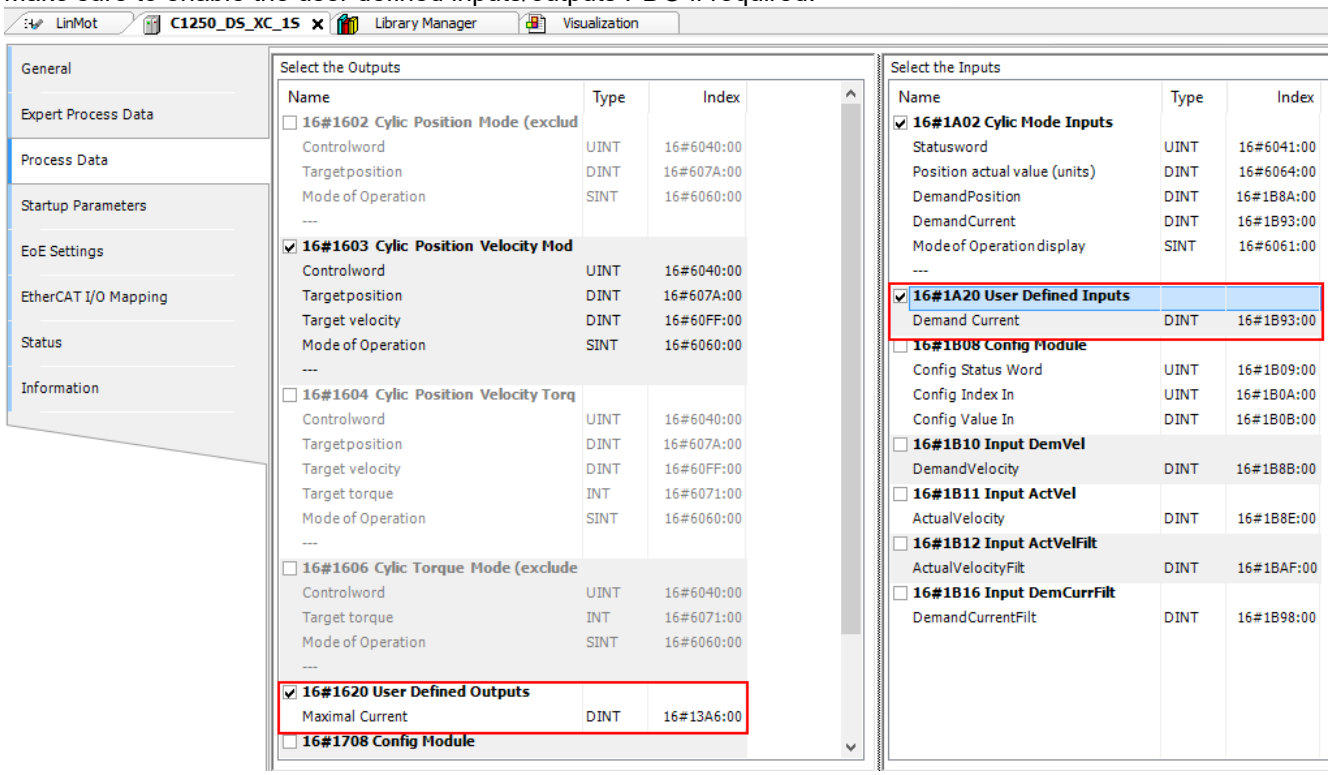
16.7 Add Additional Parameters or Variables to the Process Data

To be able to modify the Process Data make sure to enable the expert settings:

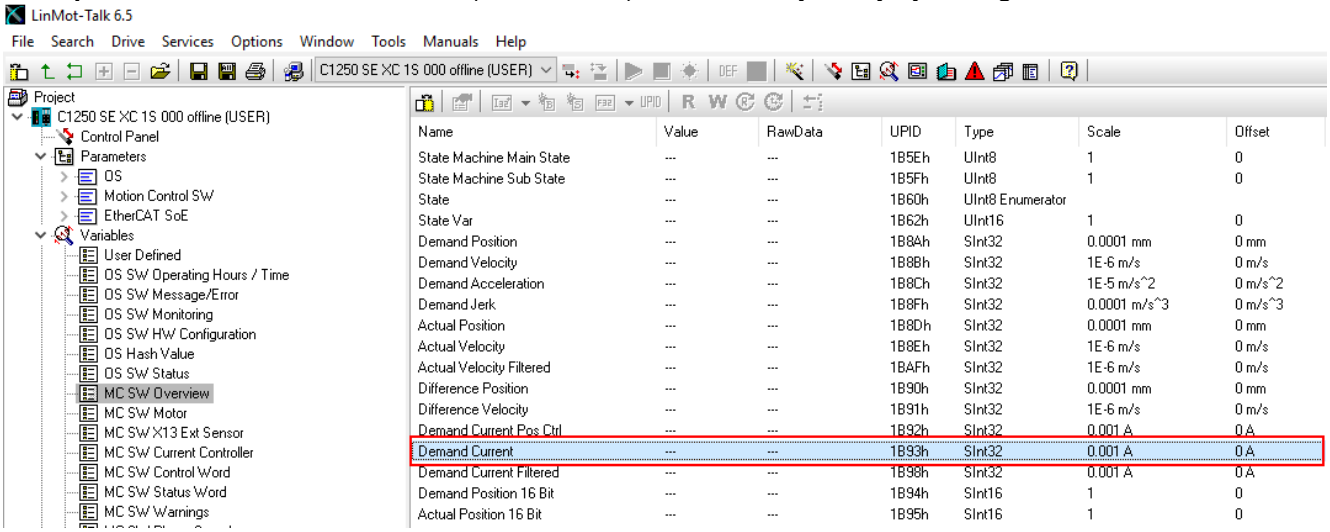


It is possible to add additional parameters or variables of the drive to the Process data PDO for cyclical write or read access.

Make sure to enable the user defined inputs/outputs PDO if required:

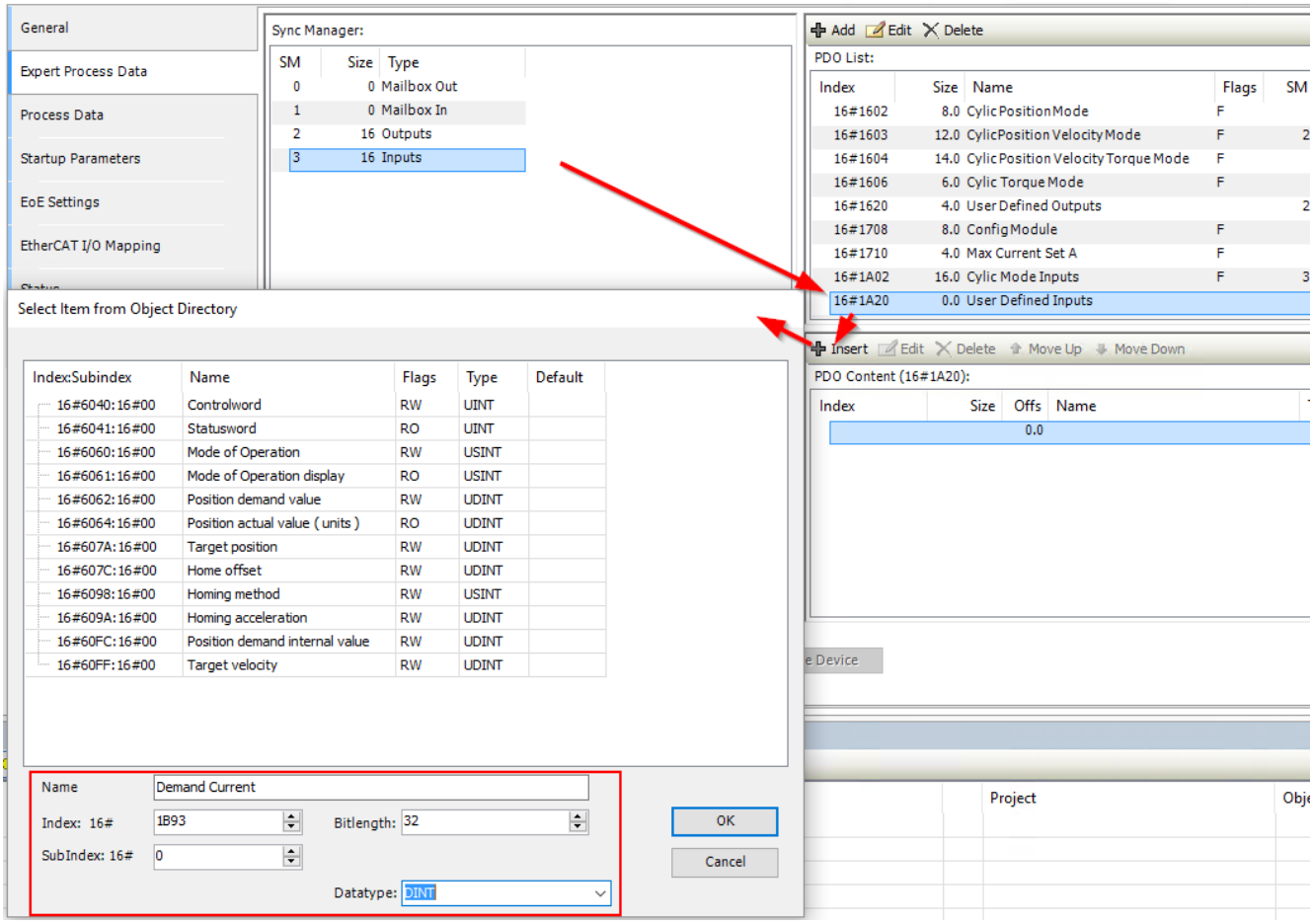


Example 1: Read the *Demand Current (UPID 1B93h)* of the drive cyclically by adding it to AT 1:

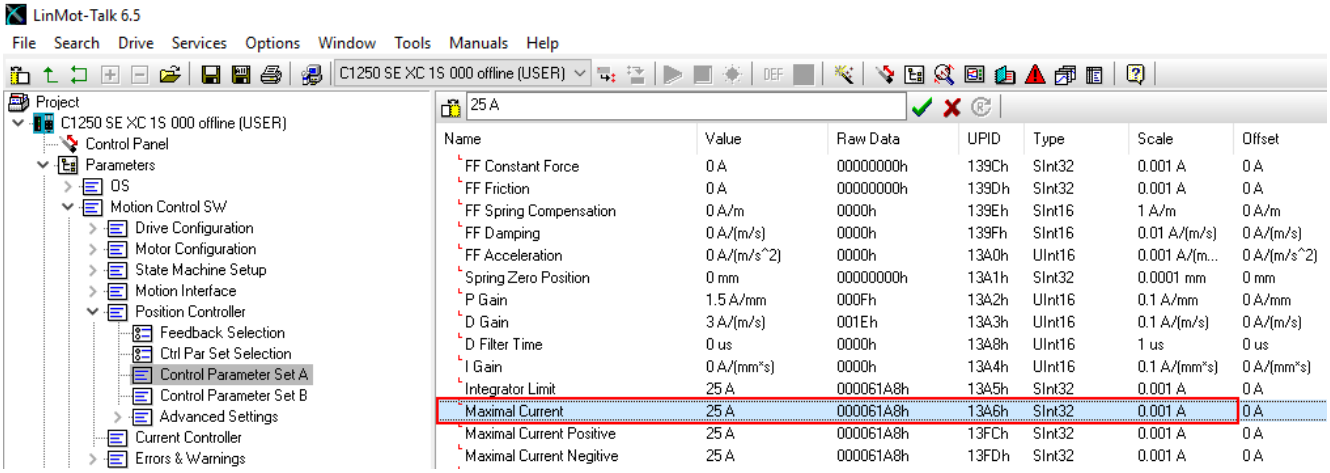


Name: Demand Current
UPID: 1B93h
Type: SInt32 = DINT
Scale: 0.001 A

1. In the Expert Process Data select *User Defined Inputs* from the PDO List.
2. Press the *Insert* button
3. In the *Select Item From Object Dictionary* window enter the name, the UPID as *Index* and set the *Datatype* to DINT (as the Demand Current is of type SINT32)
4. Click OK to finish

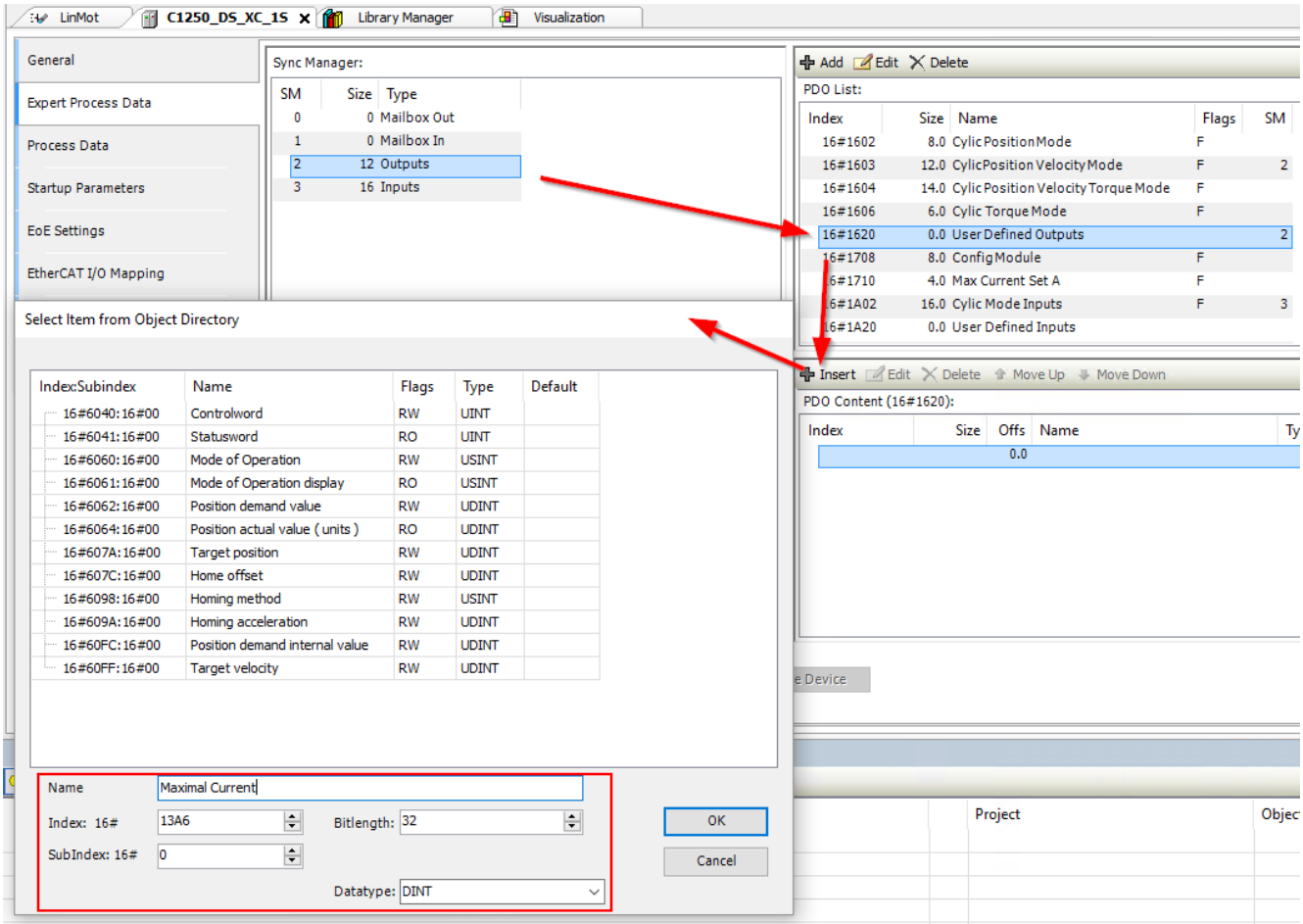


Example 2: Write the *Maximal Current (UPID 13A6h)* of the drive cyclically by adding it to the process data:



Name: Maximal Current
UPID: 13A6h
Type: SInt32 = DINT
Scale: 0.001 A

1. In the Expert Process Data select *User Defined Outputs* from the PDO List.
2. Click the *Insert* button
3. In the *Select Item From Object Dictionary* window enter the name, the UPID as *Index* and set the *Datatype* to DINT (as the Maximal Current is of type SINT32)
4. Click OK to finish



17 Drive Profile: B&R NC Motion, CiA402

17.1 Overview

This chapter shows how a LinMot drive with *Powerlink* interface (e.g., C1250-PL-XC-1S) can be integrated and setup in a B&R environment as DS402 motion axis (CiA402).

Download:
The demo project can be downloaded from:
http://download.linmot.com/plc_lib/examples/BR/DS402 (named *LM_DS402_Demo_AS4...*)

Components used:

- LinMot C1250-PL-XC-1S-000 (article number 0150-1885)
  Firmware 6.10 Build 20210521
- B&R X20CP1584 (1.9.0.0)
- Automation Studio V 4.9.2.46 SP#, Automation Runtime C4.90, mapp Motion **5.12.3**

Attention:
Drive firmware **6.10 Build 20210521 or later** is required to use the DS402 / CiA402 functionality

In the *B&R Help Explorer* check chapter ***McDS402Ax*** for more details about the DS402 / CiA402 integration of 3rd party drives.
Press Ctrl + G to open by Guid: **5935c8d1-cc4a-43f2-aead-783ff4f9f6fc**

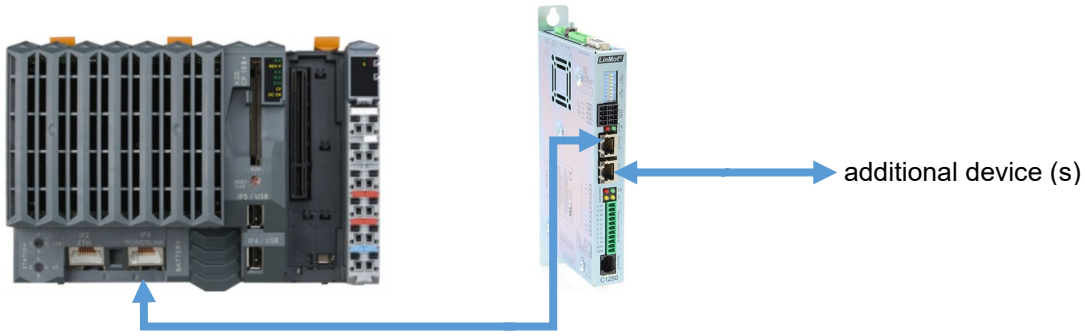


Image Source: http://www.br-automation.com/

The LinMot POWERLINK devices are Ethernet POWERLINK CNs (Controlled Nodes) with the following parameters (according to EPSG-DS-301-V1.1.0):

Device Properties	Value
Minimal POWERLINK cycle time	250 µs
Size of isochronous transmit buffer (maximal size of isochronous frames)	64 Byte
Size of isochronous receive buffer (maximal size of isochronous frames)	64 Byte
Overall buffer size available for isochronous data	128 Byte
PReq to PRes latency (CN isochronous reaction time)	~ 1 µs
SoA to ASnd latency (CN asynchronous reaction time)	~ 1 µs
Maximum asynchronous MTU	300 Byte
Ability to support multiplexed isochronous access	No
Asynchronous SDO transfer method (UDP/IP and/or POWERLINK ASnd)	POWERLINK ASnd only

For further information on Ethernet POWERLINK please visit: http://www.ethernet-powerlink.org

17.2 Preconditions to use DS402 / CiA402

- Only SG6 devices are supported (C1250, C1251, C1450 & E1450)
- Drive firmware must be 6.10 Build 20210521 or later (latest build recommended)
- Use of “00000156_xxxxxPL_DS402.xdd” as device description file when configuring the drive in the PLC

Attention:
After adding the axes, it is recommended to rebuild the project and to **restart both the PLC and drives** to have a proper start-up. Ignoring this may prevent being able to power on the axis.

17.3 Supported operating modes

- Mode 1: Profile Position Mode (pp)
- Mode 3: Profile Velocity Mode (pv)
- Mode 6: Homing Mode (hm)
- Mode 7: Interpolated Position Mode (ip)
- Mode 8: Cyclic synchronous position mode (csp)
- Mode 9: Cyclic synchronous velocity mode (csv)

17.4 Configuration and Connection of the LinMot Drive

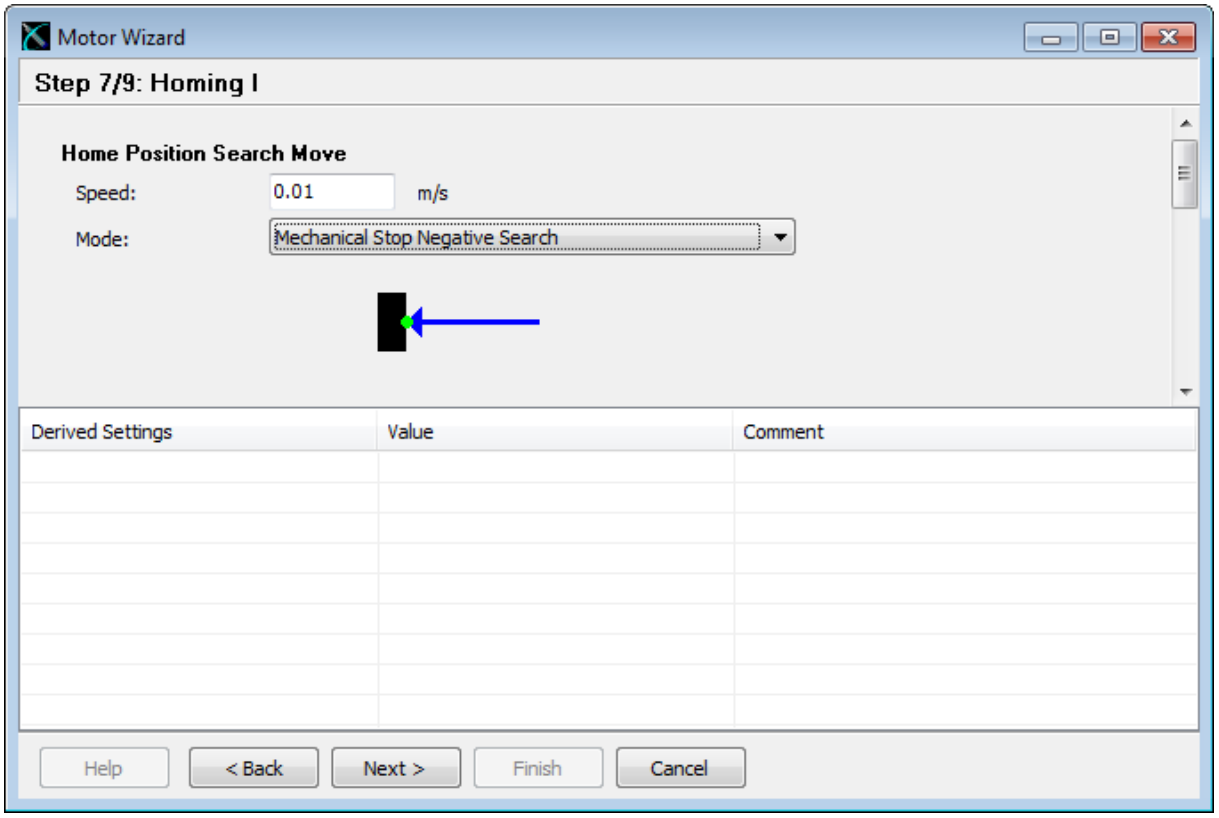
The LinMot drive is configured using the LinMot-Talk software:
http://www.linmot.com/download/linmot-talk-drive-configuration/

17.4.1 Motor Configuration

It is assumed that the motor connected to the drive is already configured.

Use the *Motor Wizard* inside LinMot-Talk to setup the motor (Menu -> Drive -> Motor Wizard):

Make sure that you select a homing mode in the Motor Wizard if you want to use the drive-based homing as described in chapter 17.7 Homing



See Appendix I: Basic Position Control Loop Tuning

17.4.2 XDD File

Install the XDD file that is part of the LinMot-Talk software/firmware you are using.
The most recent device files are always part of the newest LinMot-Talk software.
It is located by default:

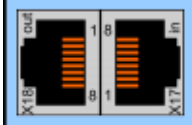
- Powerlink: \\LinMot-Talk X.X Build XXXXXXXX\Firmware\Interfaces\Powerlink_Nx\XDD\AS4 **(-MI drives)**
- Powerlink: \\LinMot-Talk X.X Build XXXXXXXX\Firmware\Interfaces\Powerlink\XDD\AS4

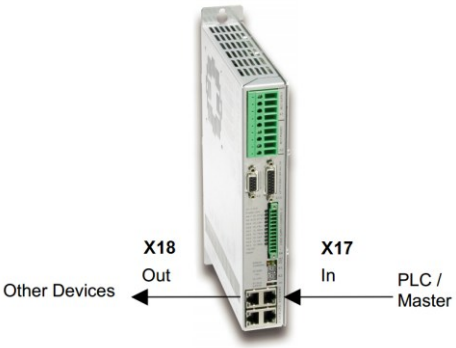
e.g., *00000156_C1250PL_DS402.xdd*

17.4.3 Powerlink Connection

The drive is connected to the Powerlink network using the **X17 (IN) & X18 (OUT)** connectors.

The below pictures show the ports of an E1250-PL-UC drive.
On all other LinMot drives supporting Powerlink the ports are named the same (X17 & X18), but they may be placed differently on the drive housing.

X17 - X18	RealTime Ethernet 10/100 Mbit/s
	X17 RT ETH In X18 RT ETH Out
RJ-45	



17.4.4 Node ID

The Node ID of the LinMot drive is set using the hardware address selectors.

S1 - S2	Address Selectors		
E1100 E1200 V1	E1200 V2 E1400 C1x00		
		S1 (5 .. 8)	Bus ID High (0 ... F). Bit 5 is LSB, bit 8 MSB.
		S2 (1 .. 4)	Bus ID High (0 ... F). Bit 1 is LSB, bit 4 MSB.

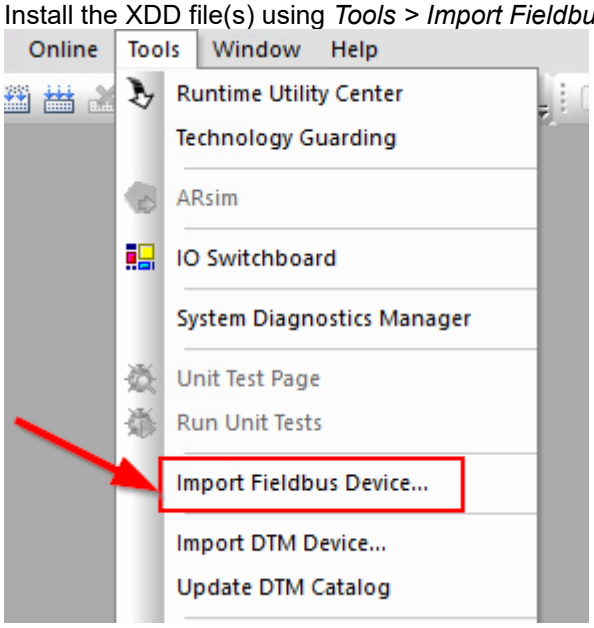
E.g.: Node ID 18 dec = 12 hex = 0001 0010 bin

=> S1 = 1 hex = 0001 bin (Dip Switch 5 = ON), S2 = 2 hex = 0010 bin (Dip Switch 2 = ON)

17.5 Automation Studio Physical View

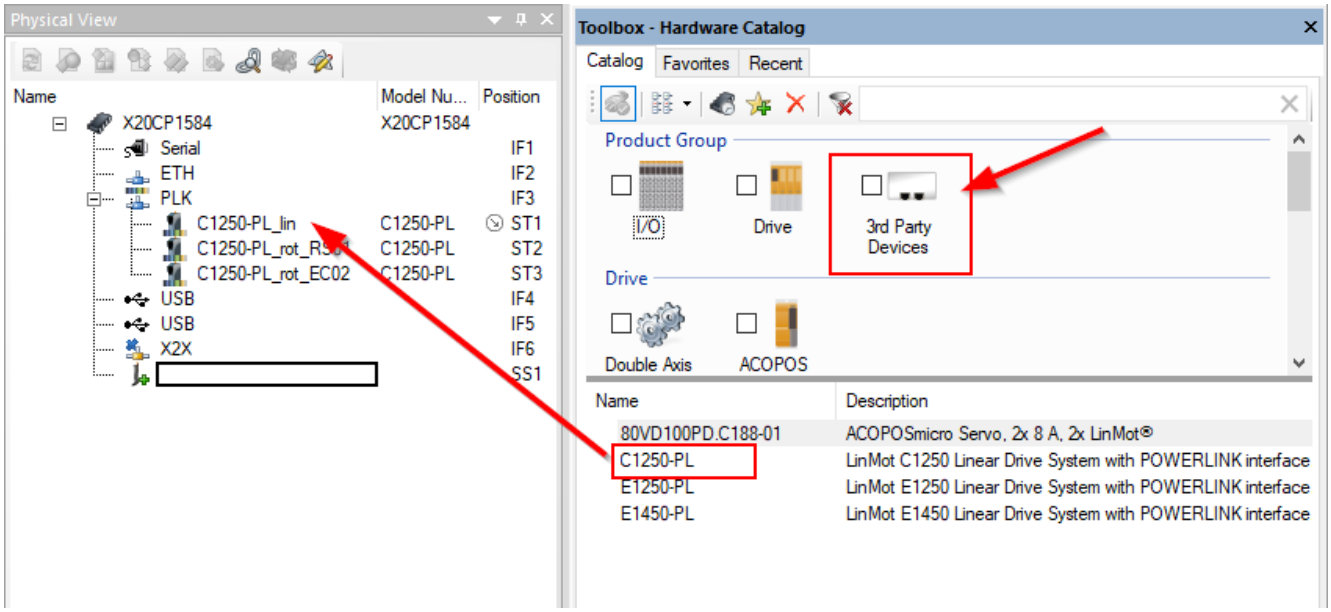
17.5.1 Add the LinMot drive to the Powerlink network

Install the XDD file(s) using *Tools* > *Import Fieldbus Device…* in Automation Studio.



The required XDD-file can be found in the following folder (default):
C:\Program Files\LinMot\LinMot-Talk X.X Build XXXXXXXX\Firmware\Interfaces\POWERLINK\XDD\AS4
C:\Program Files\LinMot\LinMot-Talk X.X Build XXXXXXXX\Firmware\Interfaces\Powerlink_Nx\XDD\AS4

In the Hardware Catalog search for the LinMot drive (e.g., C1250...) and drag&drop it onto the Powerlink interface (PLK).
Alternatively select the Product Group *3rd Party Devices* > all installed LinMot drives are shown.

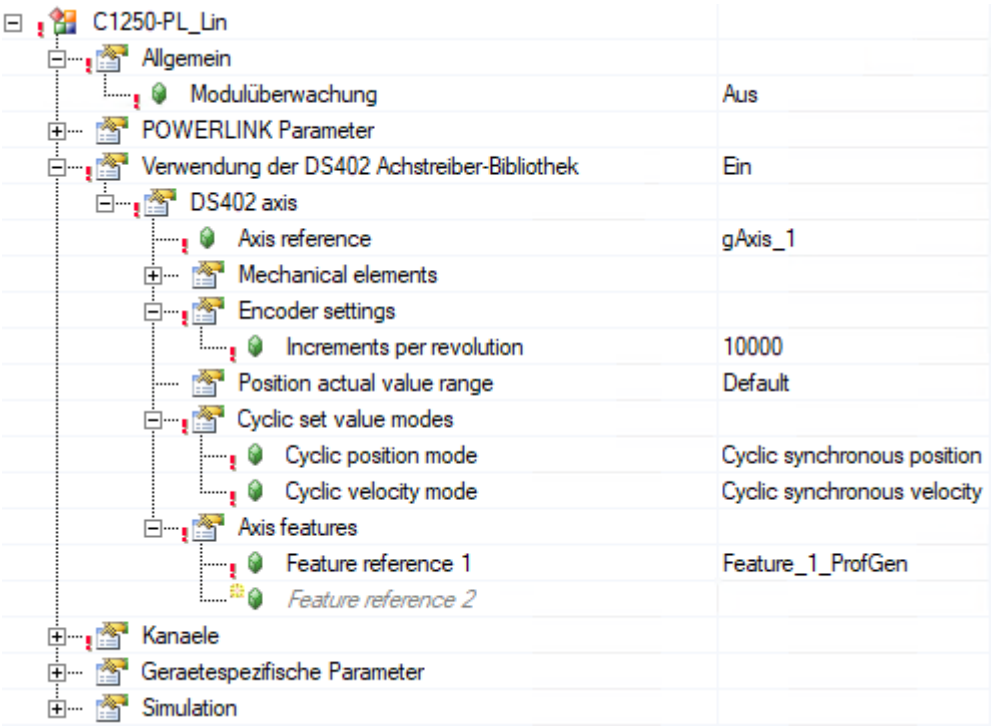


Set the Node ID according to your requirements.

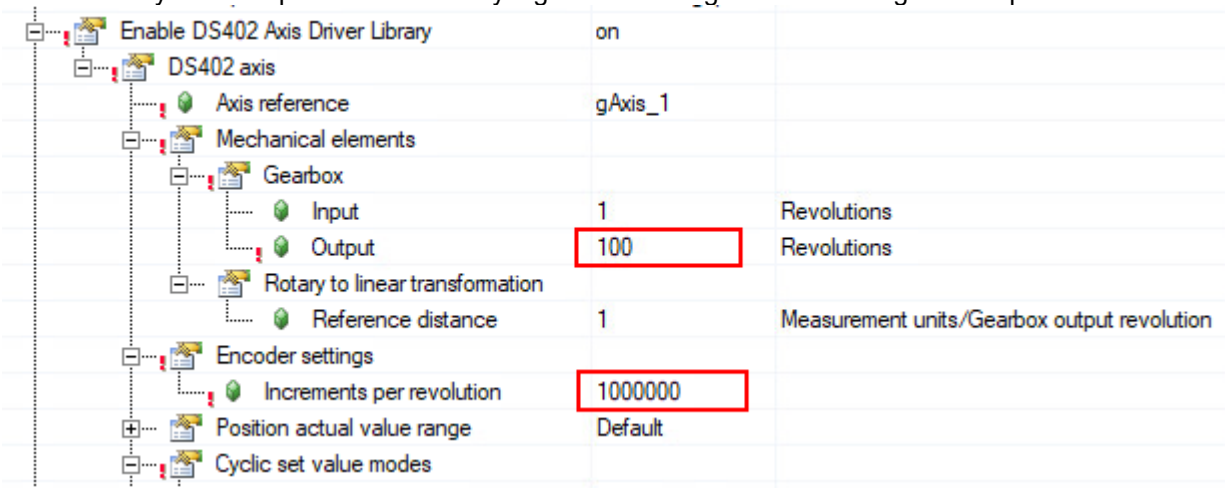
17.5.2 Configuration

In the configuration of the LinMot slave module (right-click on device > *Configuration*) the following setting must be done. Attention: The “Axis reference” can only be set when the axis is already defined (see 17.6.1)

17.5.2.1 Linear Axis:



In case the dynamic requirements are very high the following encoder settings will help



17.5.2.2 Rotary Axis PR01 or PR02

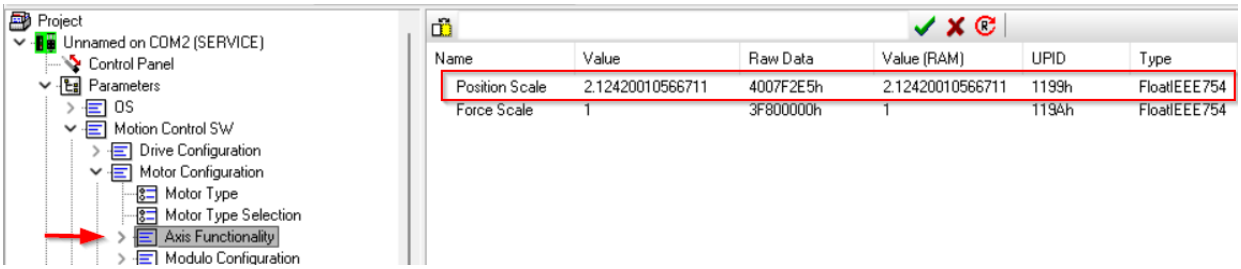
C1250-PL_Rot	
Allgemein	
Modulüberwachung	Aus
POWERLINK Parameter	
Verwendung der DS402 Achstreiber-Bibliothek	Ein
DS402 axis	
Axis reference	gAxis_2
Mechanical elements	
Encoder settings	
Increments per revolution	360000
Position actual value range	Default
Cyclic set value modes	
Cyclic position mode	Cyclic synchronous position
Cyclic velocity mode	Cyclic synchronous velocity
Axis features	
Feature reference 1	Feature_1_ProfGen
Feature reference 2	
Kanaele	
Geraetespezifische Parameter	
Simulation	

17.5.2.3 Rotary Axis EC02, GM51 or PR02 PS11 / PS31

Check the picture from the previous chapter and set the parameter *"Increments per revolution"* to **524'288**.

17.5.2.4 LinMot Gripper GM01 / GM5x

The LinMot grippers have in general an absolute encoder. The position scaling factor must be read out from UPID 1199h for each gripper type:



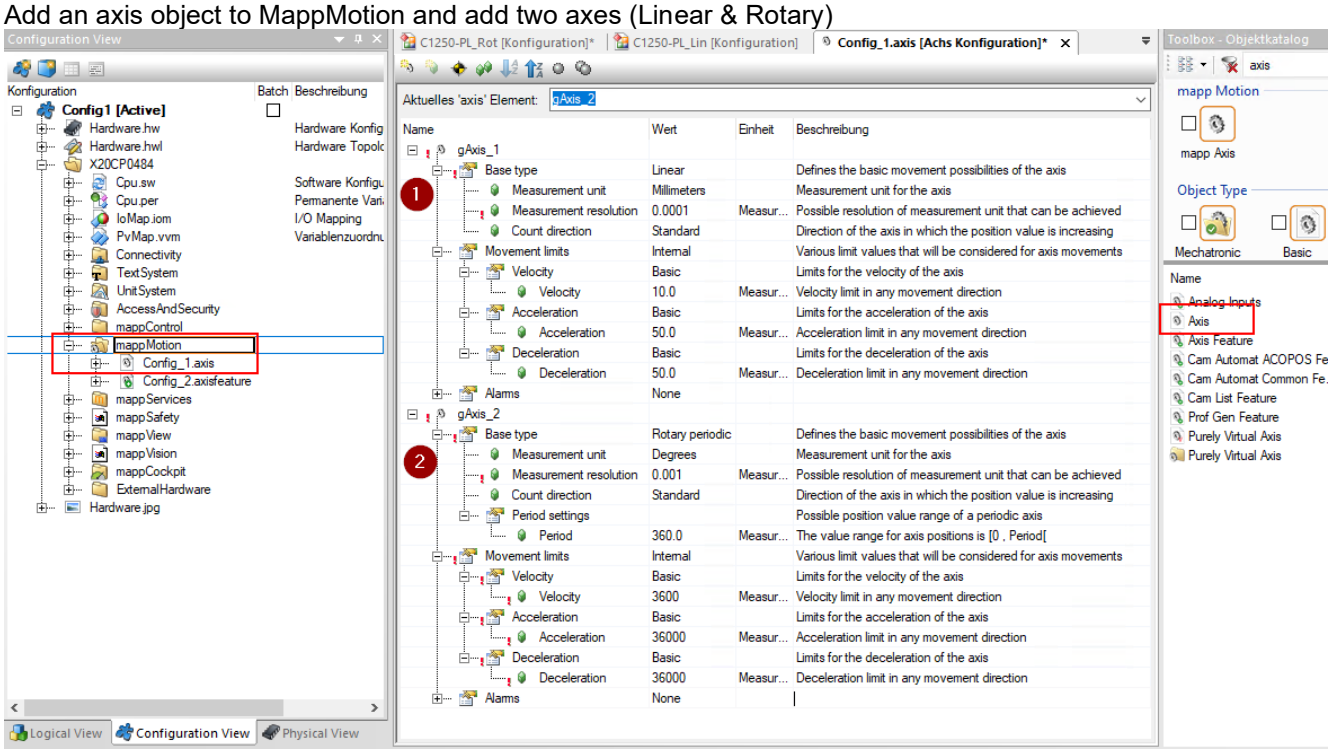
Check the picture from the previous chapter and set the parameter *"Increments per revolution"* for this gripper type to **21'242**.

Note:
In these examples the feature "*Feature_ProfGen*" is used. It is only required if CNC, CAM, or other synchronized motion is used.

17.6 Automation Studio Configuration View

17.6.1 Add axis objects

Add an axis object to MappMotion and add two axes (Linear & Rotary)



Note:
A **LinMot linear motor (includes grippers)** has an internal position resolution of 0.1 um. Therefore the “Measurement resolution” for the unit Millimetres [mm] is **0.0001**.

A **LinMot PR01/PR02 rotary motor** has by default 360’000 ticks/increments per motor revolution. Therefore, for the “Measurement resolution” for the unit Degrees [°] is 360 / 360’000 = **0.001**.

17.7 Homing

Within the DS402 / CiA402 profile a drive based / manufacturer specific homing is possible. To setup the homing the function block *MC_BR_InitHome_DS402Ax* is used.

Only manufacturer specific homing modes are supported.

When using the MC_BR_InitHome_DS402Ax function block, set "DriveSpecificHoming" to "mcSWITCH_ON". "DriveSpecificHomingModeMode" configures the HomingMode like the UPID 13C4h does:

Name	Value	Raw Data
Actual Position	Off	0000h
Mechanical Stop Negative Search	On	0001h
Mechanical Stop Positive Search	Off	0002h
Limit Switch Negative	Off	000Eh
Limit Switch Positive	Off	000Fh
Home Switch Negative	Off	0003h
Home Switch Positive	Off	0010h
Home Switch And Mechanical Stop Negative	Off	0004h
Home Switch And Mechanical Stop Positive	Off	0005h
Home Switch And Limit Switch Negative	Off	0006h
Home Switch And Limit Switch Positive	Off	0007h
Index On X13 And Mechanical Stop Negative	Off	0008h
Index On X13 And Mechanical Stop Positive	Off	0009h
Index On X13 And Limit Switch Negative	Off	000Ah
Index On X13 And Limit Switch Positive	Off	000Bh
Index On X13 Negative Search	Off	000Ch
Index On X13 Positive Search	Off	000Dh
No Drive Homing	Off	0011h

Select the homing mode you have setup with the Motor Wizard of LinMot-Talk.

Position offset, velocity and acceleration should also be configured to the users' needs.

17.7.1 Linear Motor

A possible setup for homing mode “Mechanical Stop Negative Search” when the drive-based homing should be modified could look as follows.
Just uncomment all *MC_BR_InitHome…* and the *MC_Home_0.HomingMode* lines.

The code as it is shown below is directly executing the homing sequence as it is setup within the Motor Wizard of LinMot-Talk.

```
PROGRAM _INIT

    gAxis_1; // Touch PV

    // MC_BR_InitHome_DS402Ax initialisations
    // This is only required if one doesn't want to use Homing Mode setup in the drive
    //  MC_BR_InitHome_DS402Ax_0.Axis := ADR(gAxis_1);
    //  MC_BR_InitHome_DS402Ax_0.HomingParameters.DriveSpecificHoming := mcSWITCH_ON;
    //  MC_BR_InitHome_DS402Ax_0.HomingParameters.DriveSpecificHomingMode := 1; // Homing Mode "Mechanical Stop Negative Search"
    //  MC_BR_InitHome_DS402Ax_0.HomingParameters.Position := -10;
    //  MC_BR_InitHome_DS402Ax_0.HomingParameters.StartVelocity := 10; // 10 mm/s
    //  MC_BR_InitHome_DS402Ax_0.HomingParameters.HomingVelocity := 10; // 10 mm/s
    //  MC_BR_InitHome_DS402Ax_0.HomingParameters.Acceleration := 100;

    // MC_Power initialisations
    MC_Power_0.Axis := ADR(gAxis_1);

    // MC_Home initialisations
    MC_Home_0.Axis := ADR(gAxis_1);
    MC_Home_0.HomingMode := mcHOMING_DEFAULT;
    //MC_Home_0.HomingMode := mcHOMING_INIT; // This is only required if one doesn't want to use Homing Mode setup in the drive
```

17.7.2 Rotary Motor

LinMot rotary motors (RS01 & EC02) have a single turn absolute encoder.
Therefore, as homing mode *ncHOME_OFFSET* can be used.

Note:
It is recommended to home axes with absolute encoders first before switching the motor on.

17.8 Parameter access

17.8.1 SDO commands

For SDO access the B&R library *AsEPL* is required.
Function blocks: *EplSDORead() & EplSDOWrite()*

The Index specifies the LinMot parameter (UPID) to be addressed. It is UPID + 16#2000.
The Sub-Index specifies the command which is performed

Index	Sub-Index	Description	Access Type
2000h -5FFFh		LinMot Parameter Commands	
UPID Commands			
	01h	RAM Value of UPID	Read & Write
	02h	ROM Value of UPID	Read & Write
	03h	Min Value of UPID	Read Only
	04h	Max Value of UPID	Read Only
	05h	Default Value of UPID	Read Only
	06h	RAM / ROM Write of UPID	Write Only
System Commands			
	07h	Set ROM to default (OS)	Write Only
	08h	Set ROM to default (MC)	Write Only
	09h	Set ROM to default (Interface)	Write Only
	0Ah	Set ROM to default (Application)	Write Only
	0Bh	Reset drive	Write Only
	35h	Stop MC and APPL Software	Write Only
	36h	Start MC and APPL Software	Write Only

Attention ROM Access:
Intense use of writing into the ROM memory can reduce the lifetime of the drive memory!
More details can be found in the *Drive Configuration Over Fieldbus (0185-1074)* user manual
> see chapter Documentation / User Manuals

Possible variable declaration:

instLMAxis01_SdoWrite	EplSDOWrite
instLMAxis01_SdoRead	EplSDORead
udiDataWrite	UDINT
udiDataRead	UDINT

Possible function block calls where IF3 is the Powerlink interface:

```
// SDO read
instLMAxis01_SdoRead(pDevice:=ADR('IF3'), pData:=ADR(udiDataRead));

// SDO write
instLMAxis01_SdoWrite(pDevice:=ADR('IF3'), pData:=ADR(udiDataWrite));
```

Example read parameter:

Read the RAM value of the parameter Maximal Current:

Name: Maximal Current
UPID: 16#13A6
Type: SInt32 = DINT = 4 Bytes
Scale: 0.001 A

pDevice := pointer to POWERLINK interface, e.g., ADR('IF3')
node := **1** (Node ID of the LinMot drive)
index := **13222 = 16#33a6** = 16#2000 + 16#13a6
subindex := **1** (access RAM value)
pData := pointer to data buffer, e.g., ADR(udiDataRead)
datalen := **4** (always 4 Bytes! Even if the parameter to read is less)

instLMAxis01_SdoRead	EplSDORead	local		
enable	BOOL			TRUE
pDevice	UDINT			69733729
node	USINT			1
index	UINT			13222
subindex	USINT			1
pData	UDINT			69735842
datalen	UDINT			4
status	UINT			65535
errorinfo	UDINT			16#0000_0000
readlen	UDINT			4
intern	EPL_I_TYPE			
udiDataRead	UDINT	local		15000

Example write parameter:

Write 1A to the RAM value of the parameter Maximal Current:

Name: Maximal Current
UPID: 16#13A6
Type: SInt32 = DINT = 4 Bytes
Scale: 0.001 A > value to be sent = 1'000

pDevice := pointer to POWERLINK interface, e.g., ADR('IF3')
node := **1** (Node ID of the LinMot drive)
index := **13222 = 16#33a6** = 16#2000 + 16#13a6
subindex := **1** (access RAM value)
pData := pointer to data buffer, e.g., ADR(udiDataWrite)
datalen := **4** (always 4 Bytes! Even if the parameter to read is less)

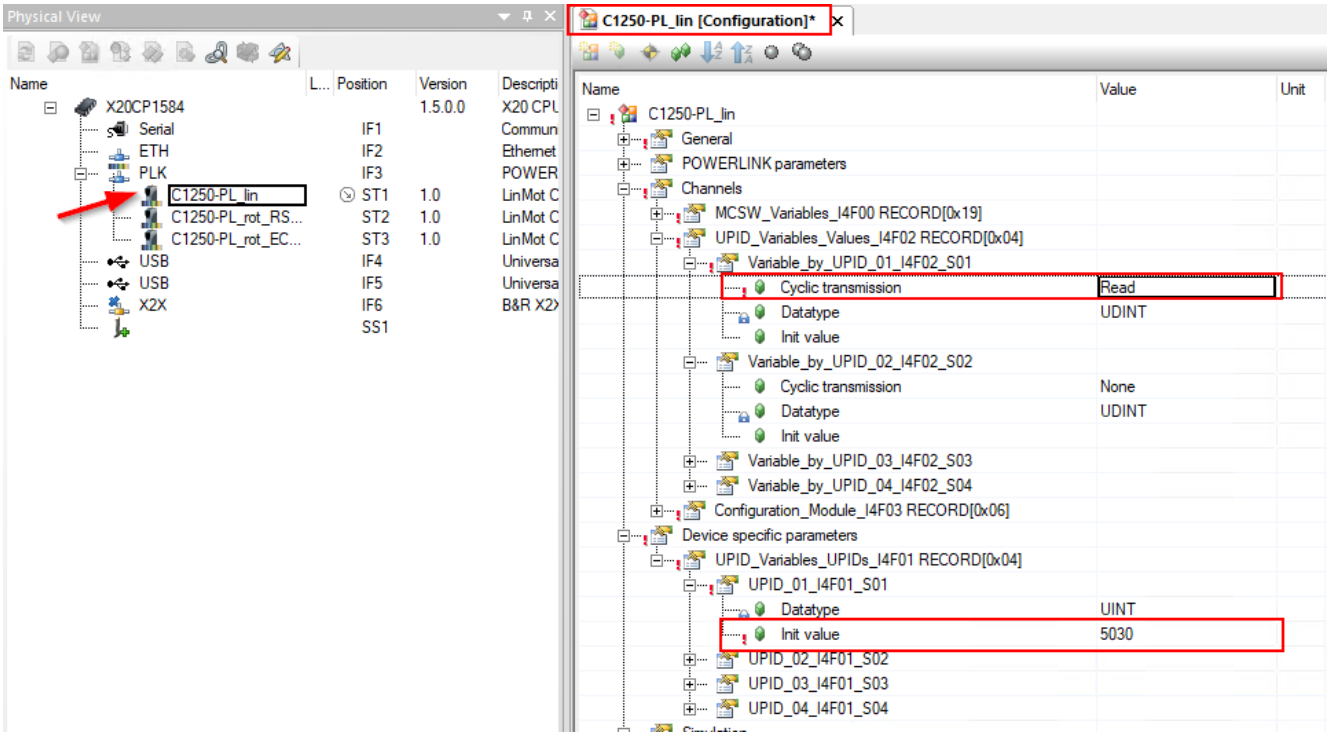
instLMAxis01_SdoWrite	EplSDOWrite	local		
enable	BOOL			TRUE
pDevice	UDINT			69733783
node	USINT			1
index	UINT			13222
subindex	USINT			1
pData	UDINT			69735838
datalen	UDINT			4
status	UINT			65535
errorinfo	UDINT			0
intern	EPL_I_TYPE			
udiDataWrite	UDINT	local		1000

17.9 Add Additional Parameters or Variables to the Process Data

It is possible to add up to 4 parameters or variables to the cyclic PDO of the drive. This allows fast read/write access.

Right-click on the drive and select *Configuration*.

- Set the ***Cyclic transmission*** to either *Read* (for read access from the drive) or *Write* (for write access to the drive) in the “Channels”.
- As ***Init value*** in the “Device specific parameters” set the UPID number (e.g., Maximal Current has UPID 16#13A6 > 5030 decimal) of the parameter you want to access.



Afterwards you can assign a PV in the I/O configuration of the device.

18 Drive Profile: B&R NC Motion, SDC interface

18.1 Overview

This chapter shows how a LinMot drive with *Powerlink* interface (e.g., C1250-PL-XC-1S) can be integrated and setup in a B&R environment as motion axis (ACP10 > SDC > LinMot).

Download:
The demo project can be downloaded from:
http://download.linmot.com/plc_lib/libraries/BR/SDC/ (named *LM_SDC_Demo_...*)

The general library for LinMot drives is available from:
http://download.linmot.com/plc_lib/libraries/BR/ (v2.10.0 or later required)

Components used:

- LinMot C1250-PL-XC-1S-000 (article number 0150-1885)
  Firmware 6.7 Build 20190311 & 6.8 Build 20190315
- B&R X20CP1584
- Automation Studio V 4.3.8.58 SP#, Automation Runtime G4.34, ACP10 ARNC0 **5.2.1**
- Automation Studio V 4.4.6.71 SP#, Automation Runtime C4.45, ACP10 ARNC0 **5.4.1**

In the *B&R Help Explorer* check chapter *ACP10SDC* for more details about SDC.
It contains all important information about requirements and setup of SDC NC objects.

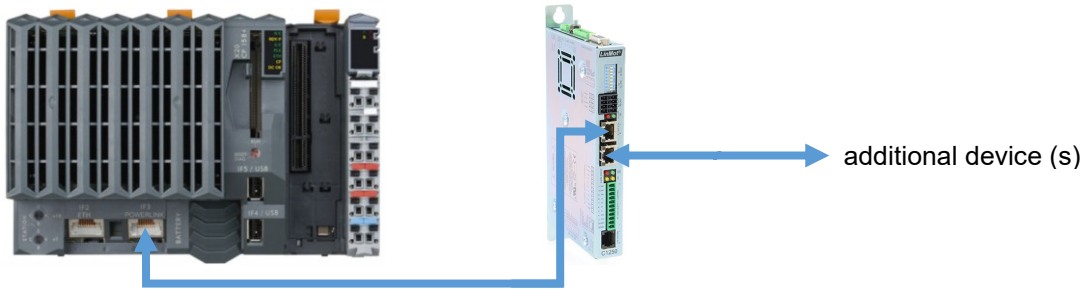


Image Source: http://www.br-automation.com/

The LinMot POWERLINK devices are Ethernet POWERLINK CNs (Controlled Nodes) with the following parameters (according to EPSG-DS-301-V1.1.0):

Device Properties	Value
Minimal POWERLINK cycle time	200 µs
Size of isochronous transmit buffer (maximal size of isochronous frames)	64 Byte
Size of isochronous receive buffer (maximal size of isochronous frames)	64 Byte
Overall buffer size available for isochronous data	128 Byte
PReq to PRes latency (CN isochronous reaction time)	~ 1 µs
SoA to ASnd latency (CN asynchronous reaction time)	~ 1 µs
Maximum asynchronous MTU	300 Byte
Ability to support multiplexed isochronous access	No
Asynchronous SDO transfer method (UDP/IP and/or POWERLINK ASnd)	POWERLINK ASnd only

For further information on Ethernet POWERLINK please visit:
http://www.ethernet-powerlink.org

18.2 Compatibility LinMot_SDC <> ACP10 ARNC0

The following table lists the dependencies of the LinMot_SDC library.

LinMot_SDC	< compatible with >	ACP10 ARNC0
1.00.1	<->	5.2.0 to 5.2.9
1.00.2	<->	5.4.0 to 5.4.9

18.3 Configuration and Connection of the LinMot Drive

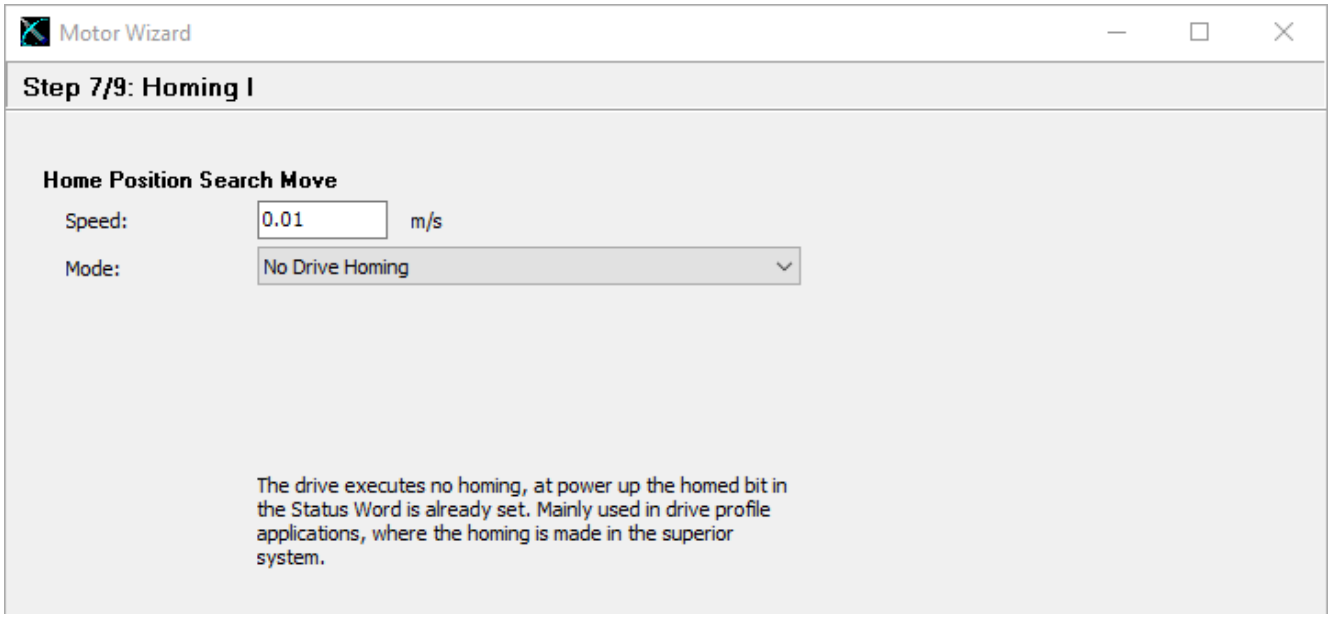
The LinMot drive is configured using the LinMot-Talk software:
http://www.linmot.com/download/linmot-talk-drive-configuration/

18.3.1 Motor Configuration

It is assumed that the motor connected to the drive is already configured.

Use the *Motor Wizard* inside LinMot-Talk to setup the motor (Menu -> Drive -> Motor Wizard):

Make sure that you select “No Drive Homing” as homing mode in the Motor Wizard as with the SDC interface the motor is homed within the PLC.



See Appendix I: Basic Position Control Loop Tuning

18.3.2 XDD File

Install the XDD file that is part of the LinMot-Talk software/firmware you are using.
The most recent device files are always part of the newest LinMot-Talk software.
It is located by default:

- Powerlink: \\LinMot-Talk X.X Build XXXXXXXX\Firmware\Interfaces\Powerlink_Nx\XDD **(-MI drives)**
- Powerlink: \\LinMot-Talk X.X Build XXXXXXXX\Firmware\Interfaces\Powerlink\XDD

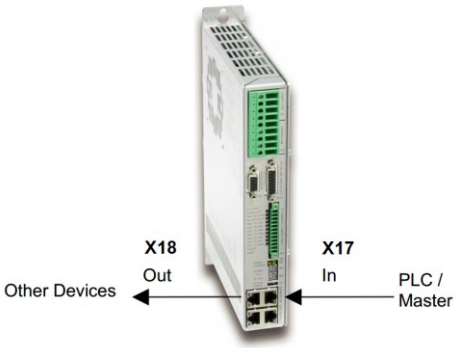
There are separate XDD files available for either AS3 or AS4.

18.3.3 Powerlink Connection

The drive is connected to the Powerlink network using the **X17 (IN) & X18 (OUT)** connectors.

The below pictures show the ports of an E1250-PL-UC drive.
On all other LinMot drives supporting Powerlink the ports are named the same (X17 & X18) but they may be placed differently on the drive housing.

X17 - X18	RealTime Ethernet 10/100 Mbit/s
	X17 RT ETH In X18 RT ETH Out
RJ-45	



18.3.4 Node ID

The Node ID of the LinMot drive is set using the hardware address selectors.

S1 - S2	Address Selectors		
E1100 E1200 V1	E1200 V2 E1400 C1x00		
		S1 (5 .. 8)	Bus ID High (0 ... F). Bit 5 is LSB, bit 8 MSB.
		S2 (1 .. 4)	Bus ID High (0 ... F). Bit 1 is LSB, bit 4 MSB.

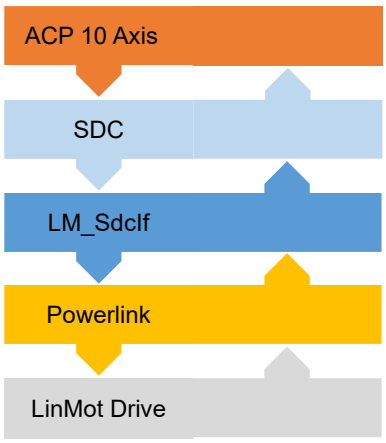
E.g.: Node ID 18 dec = 12 hex = 0001 0010 bin

=> S1 = 1 hex = 0001 bin (Dip Switch 5 = ON), S2 = 2 hex = 0010 bin (Dip Switch 2 = ON)

18.4 Short Description of the LinMot SDC interface function block

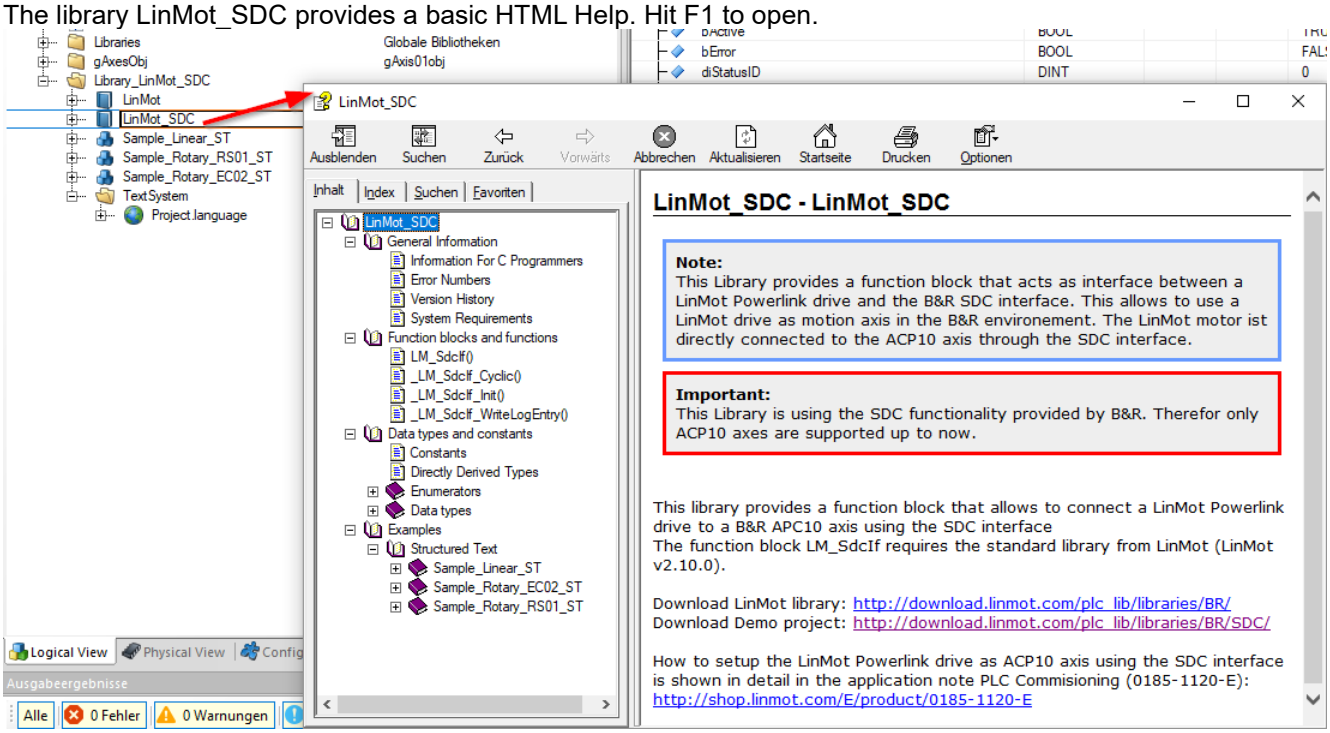
18.4.1 Principle of Operation

The *LM_SdcIf* function block acts as interface between the LinMot drive and the B&R SDC (Smart Device Controller) interface. On top of the SDC interface the ACP10 Manager is located that manages the ACP10 axes.



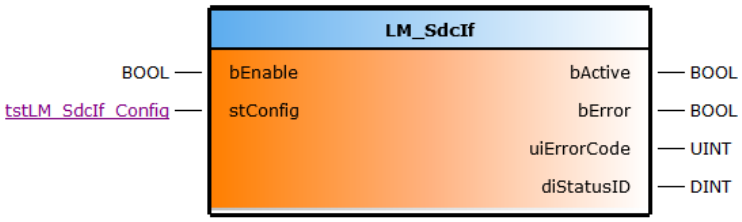
18.4.2 HTML Help

The library LinMot_SDC provides a basic HTML Help. Hit F1 to open.



18.4.3 LM_SdcIf (Interface Function Block)

This is the function block that acts as interface between SDC and LinMot drive.



18.4.4 enCallType

The function block LM_SdcIf has two call types.

- enLM_SDCIF_CALLTYPE_INIT (value 1):
  With this type the function block LM_SdcIf is called in the Init section of the PLC program to setup all required internal variables

- enLM_SDCIF_CALLTYPE_CYCLE (value 2):
  With this type the function block LM_SdcIf is called in the cyclic section of the PLC program. This is the normal operation mode.

18.4.5 stConfig

This structure contains the parameters required for a proper operation of the LM_SdcIf function block.

Name	Data Type	Default Value	Description	
pszLogName	UDINT	0	Log name to be used / created. Set 0 if not logger should be used / created	
pszAxisName	UDINT	0	ACP10 axis name.	
pszSDCHWName	UDINT	0	Name of SDC HW without **_HW**	*Name of SDC HW*
pszSDCDrvIf32Name	*UDINT*	*0*	*Name of SDC Drv32If* **(Attention: max length of string is 34 characters!)**	
pszSDCEncIf32Name	*UDINT*	*0*	*Name of SDC Enc32If* **(Attention: max length of string is 34 characters!)**	
pszSDCDiDoIf32Name	*UDINT*	*0*	*Name of SDC DiDoIf* **(Attention: max length of string is 34 characters!)**	
pszSDCLmName	*UDINT*	*0*	*Name of LinMot tstLM_LinMot*	
udiSM_SCALE_LOAD_MOTREV	UDINT	1	Same as used in the ACOPOS Parameter Table	
udiSM_SCALE_LOAD_UNITS	UDINT	10000	Same as used in the ACOPOS Parameter Table	
udiSM_SCALE_STEP	UDINT	10000	Same as used in the ACOPOS Parameter Table	
diResReductionFactor	DINT	10	Resolution reduction (Default 10 for LinMot linear motors. Use 1 for other motors)	
diEncReductionFactor	DINT	10	Encoder reduction (Default 10 for LinMot linear motors. Use 1 for other motors)	
tEnableDelay	TIME	T#10ms	Delay velocity calculation during enable	

Note:
The default values of the parameters in the table with blue background color are set to be used with a LinMot linear motor. This default values and the settings done in chapter 18.8 result in 1um per Unit and 10um actual position resolution.

Attention:
The orange parameters in italic font are optional. In the examples of this manual they are not used. In this manual, the names of the individual SDC components are derived from *pszSDCHWName* as shown in chapter 18.5 point 3.
Nevertheless, it is possible to set unique names for each SDC component and the LinMot axis type (tstLM_axis) and assign them to the parameters above (orange).

18.5 Prerequisites

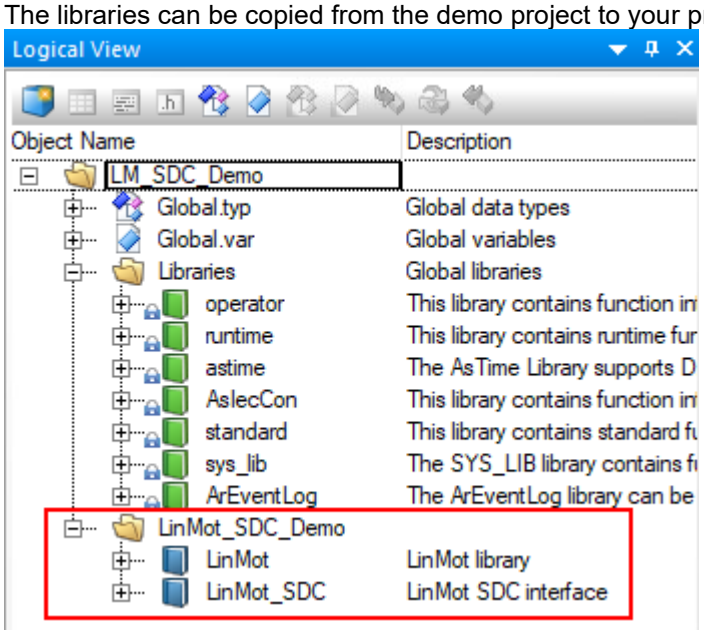
Attention:
There are some prerequisites that must be fulfilled before the following chapters can be successfully completed.

1. The project you are using must already have the PLC type setup. Otherwise please follow the B&R wizard for creating a new project

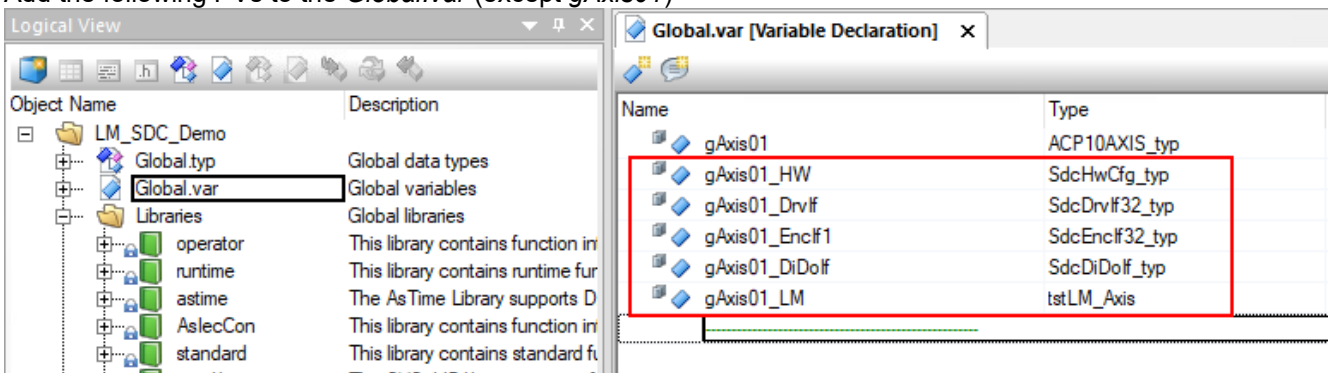
2. The libraries from LinMot (*LinMot* v2.10.0 or later & *LinMot_SDC*) must be installed in the project.
   Check compatibility with ACP10 ARNC0 in **chapter 18.2 Compatibility LinMot_SDC <> ACP10 ARNC0**

   You may want to create a separate package for testing (E.g., LinMot_SDC_Demo).

   The libraries can be copied from the demo project to your project:



3. Add the following PVs to the *Global.var* (except *gAxis01*)



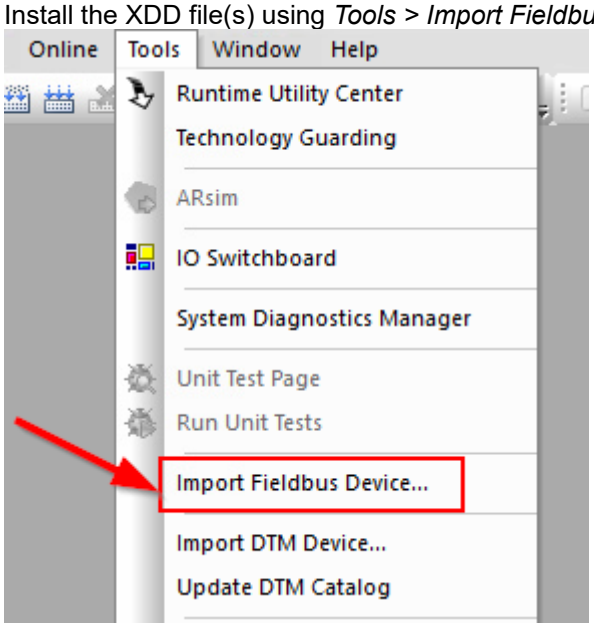
Attention:
Don't add the PV ***gAxis01*** (ACP10Axis_typ) yet. It will be added in chapter 18.6.5.

Attention:
The names of the PVs are very important! As shown above the PVs beside the ACP10AXIS (gAxis01) must be named *xxx_HW, xxx_DrvIf, xxx_EncIf1, xxx_DiDoIf, xxx_LM* where xxx is always the same for the same axis (e.g., *gAxis01*).

18.6 Automation Studio Physical View

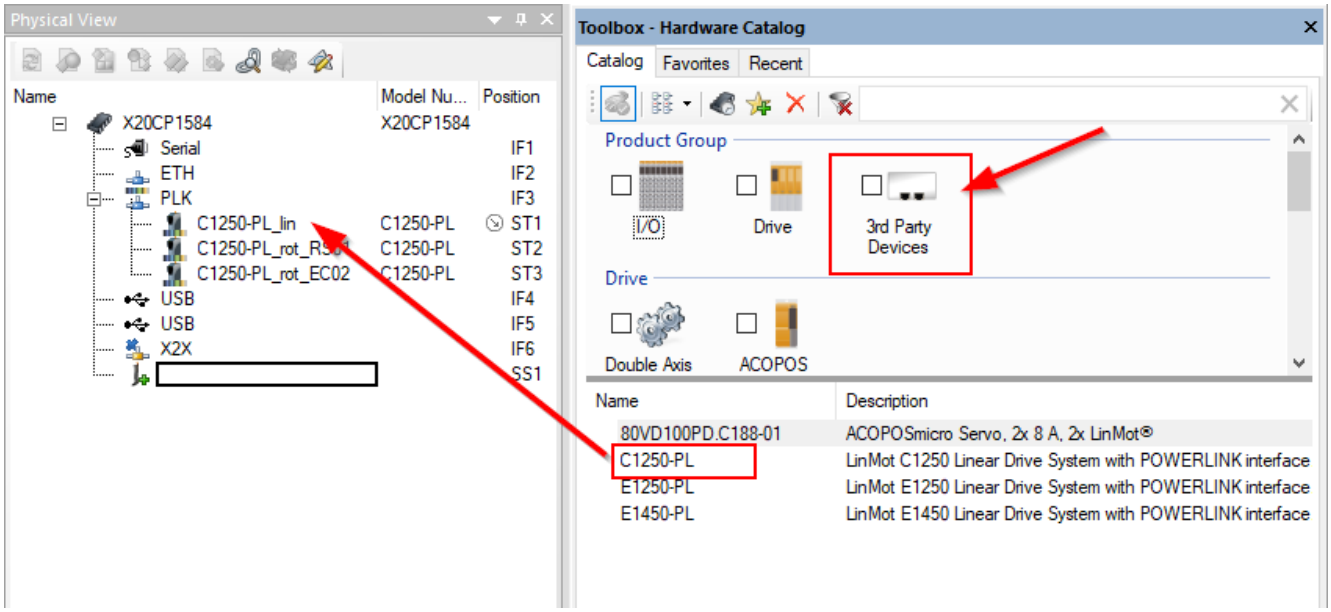
18.6.1 Add the LinMot drive to the Powerlink network

Install the XDD file(s) using *Tools* > *Import Fieldbus Device…* in Automation Studio.



The required XDD-file can be found in the following folder (default):
C:\Program Files\LinMot\LinMot-Talk X.X Build XXXXXXXX\Firmware\Interfaces\POWERLINK\XDD
C:\Program Files\LinMot\LinMot-Talk X.X Build XXXXXXXX\Firmware\Interfaces\Powerlink_Nx\XDD

In the Hardware Catalog search for the LinMot drive (e.g., C1250...) and drag&drop it onto the Powerlink interface (PLK).
Alternatively select the Product Group *3rd Party Devices* > all installed LinMot drives are shown.

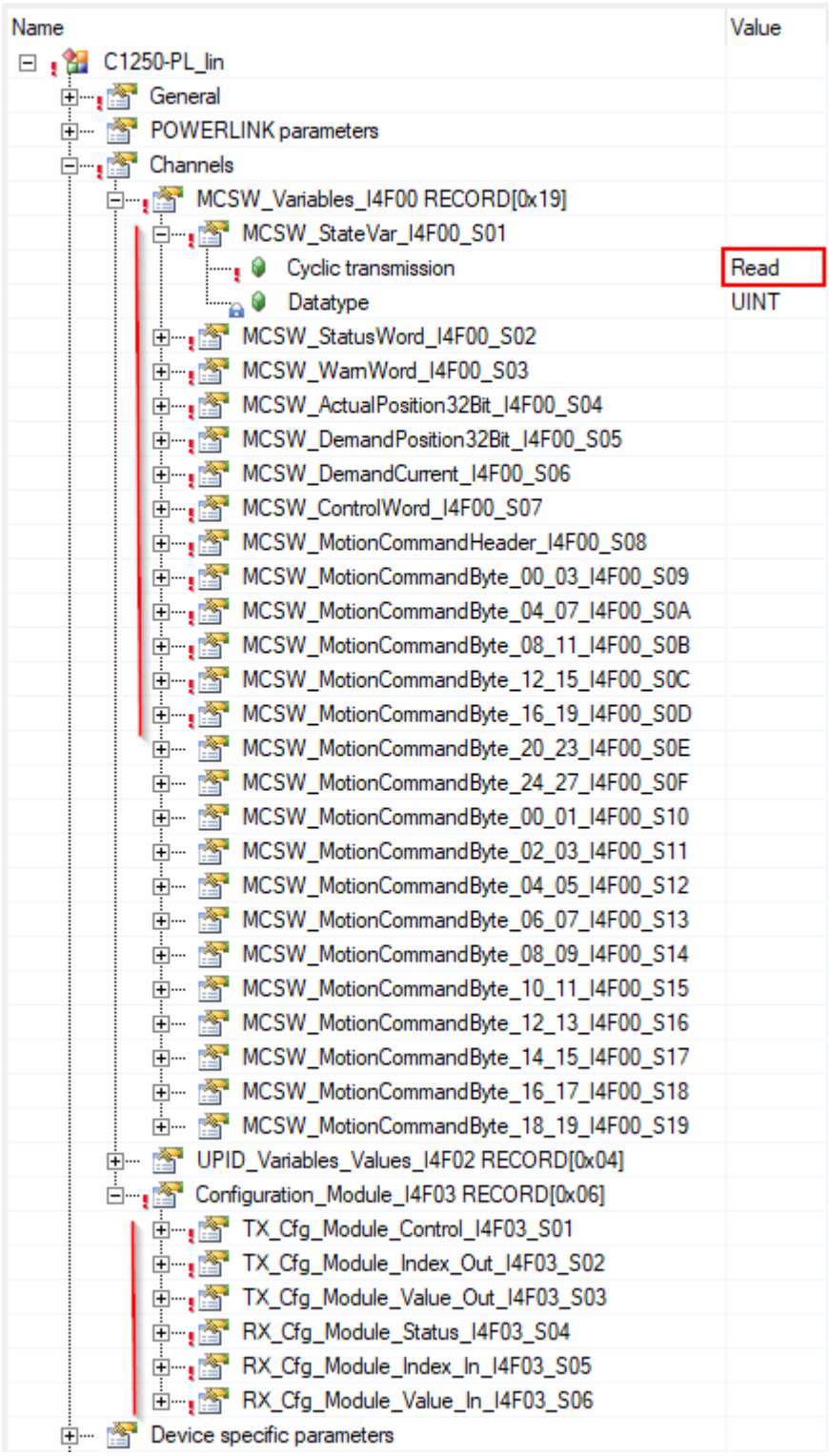


Set the Node ID according to your requirements.

18.6.2 Configuration

In the configuration of the LinMot slave module (right-click on device > *Configuration*) the following channels must be selected:

Set the **Cyclic transmission** of all channels marked with a red exclamation mark to **Read** or to **Write** respectively.



18.6.3 I/O Mapping

Right-click on the device and open *I/O mapping.* The inputs and outputs of the modules are mapped to the axis structure (datatype tstLM_Axis).

In the actual example the used PV *gAxis01_LM* is defined in the *Global.var* as data type *tstLM_Axis:*

Global.var [Variable Declaration]

Name	Type
gAxis01	ACP10AXIS_typ
gAxis01_HW	SdcHwCfg_typ
gAxis01_DrvIf	SdcDrvIf32_typ
gAxis01_EncIf1	SdcEncIf32_typ
gAxis01_DiDoIf	SdcDiDoIf_typ
gAxis01_LM	tstLM_Axis

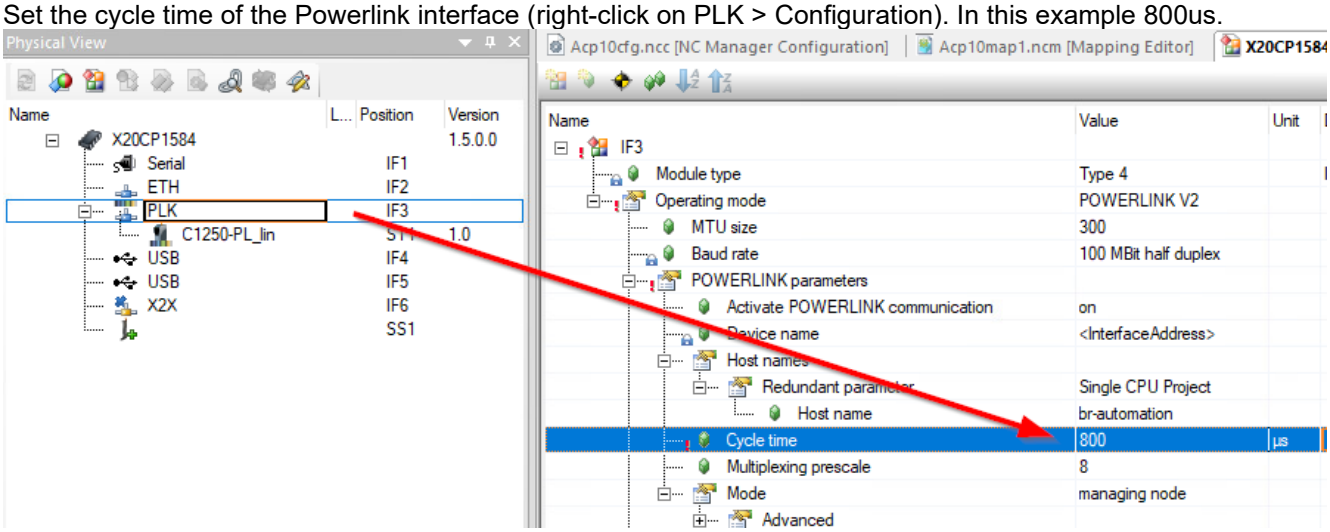
Map the channels to the process variables as shown below

Global.var [Variable Declaration] | C1250-PL_lin [I/O Mapping]

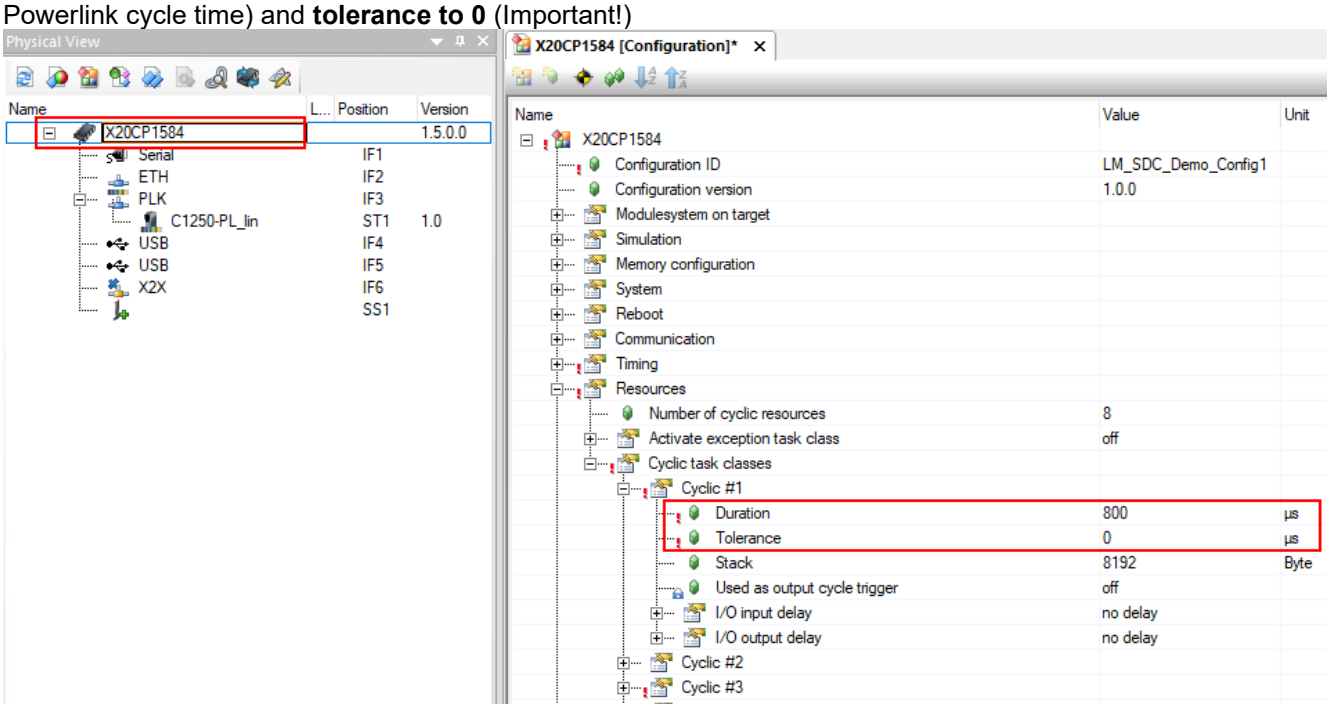
Channel Name	Process Variable	Data Type
ModuleOk		BOOL
MCSW_StateVar_I4F00_S01	::gAxis01_LM.DrvToPlc.StateVar	UINT
MCSW_StatusWord_I4F00_S02	::gAxis01_LM.DrvToPlc.StatusWord	UINT
MCSW_WarnWord_I4F00_S03	::gAxis01_LM.DrvToPlc.WarnWord	UINT
MCSW_ActualPosition32Bit_I4F00_S04	::gAxis01_LM.DrvToPlc.ComActualPosition	DINT
MCSW_DemandPosition32Bit_I4F00_S05	::gAxis01_LM.DrvToPlc.ComDemandPosition	DINT
MCSW_DemandCurrent_I4F00_S06	::gAxis01_LM.DrvToPlc.ComActualCurrent32	DINT
MCSW_ControlWord_I4F00_S07	::gAxis01_LM.PlcToDrv.ControlWord	UINT
MCSW_MotionCommandHeader_I4F00_S08	::gAxis01_LM.PlcToDrv.MCHeader	UINT
MCSW_MotionCommandByte_00_03_I4F00_S09	::gAxis01_LM.PlcToDrv.MCParaDWord_00_03	UDINT
MCSW_MotionCommandByte_04_07_I4F00_S0A	::gAxis01_LM.PlcToDrv.MCParaDWord_04_07	UDINT
MCSW_MotionCommandByte_08_11_I4F00_S0B	::gAxis01_LM.PlcToDrv.MCParaDWord_08_11	UDINT
MCSW_MotionCommandByte_12_15_I4F00_S0C	::gAxis01_LM.PlcToDrv.MCParaDWord_12_15	UDINT
MCSW_MotionCommandByte_16_19_I4F00_S0D	::gAxis01_LM.PlcToDrv.MCParaDWord_16_19	UDINT
TX_Cfg_Module_Control_I4F03_S01	::gAxis01_LM.PlcToDrv.CfgControlWord	UINT
TX_Cfg_Module_Index_Out_I4F03_S02	::gAxis01_LM.PlcToDrv.CfgIndexOut	UINT
TX_Cfg_Module_Value_Out_I4F03_S03	::gAxis01_LM.PlcToDrv.CfgValueOut	UDINT
RX_Cfg_Module_Status_I4F03_S04	::gAxis01_LM.DrvToPlc.CfgStatusWord	UINT
RX_Cfg_Module_Index_In_I4F03_S05	::gAxis01_LM.DrvToPlc.CfgIndexIn	UINT
RX_Cfg_Module_Value_In_I4F03_S06	::gAxis01_LM.DrvToPlc.CfgValueIn	UDINT

18.6.4 Powerlink Interface and PLC Configuration

Set the cycle time of the Powerlink interface (right-click on PLK > Configuration). In this example 800us.



In the PLC configuration (right-click on X20CP1584 > Configuration) set Cyclic #1 **duration to 800us** (same as Powerlink cycle time) and **tolerance to 0** (Important!)

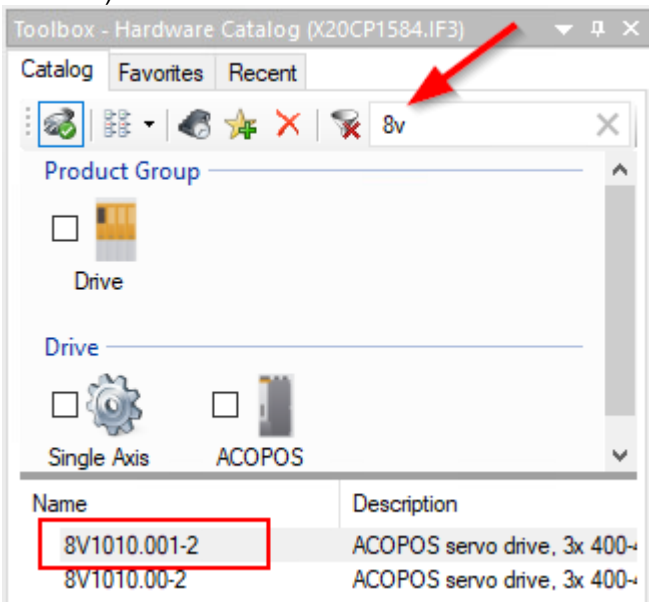


Note:
Other cycle times are possible too. Just make sure that Cyclic #1 *Duration* and Powerlink *Cycle Time* are set the same (e.g. 2000us).

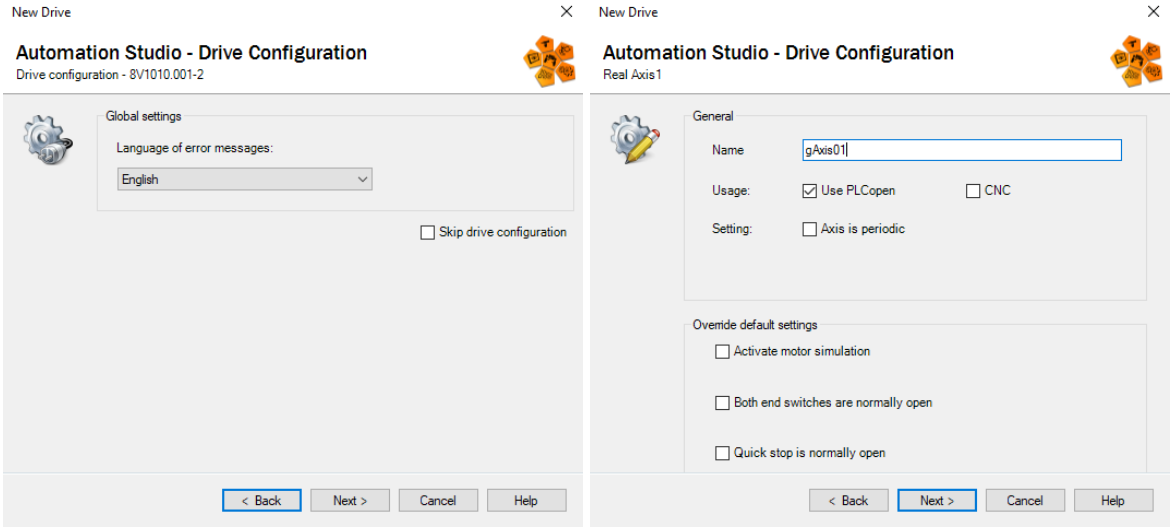
18.6.5 Add a B&R drive to generate all NC object specific requirements automatically

In the *B&R Help Explorer* check chapter *ACP10SDC > Using the Drive Configuration wizard*.
It explains how to add the required components.
As alternative it is also possible to do all steps manually as described in the B&R Help Explorer.

1. Search for 8V1010.001-2 in the *Hardware Catalog* and then double-click (or drag&drop on the Powerlink interface)

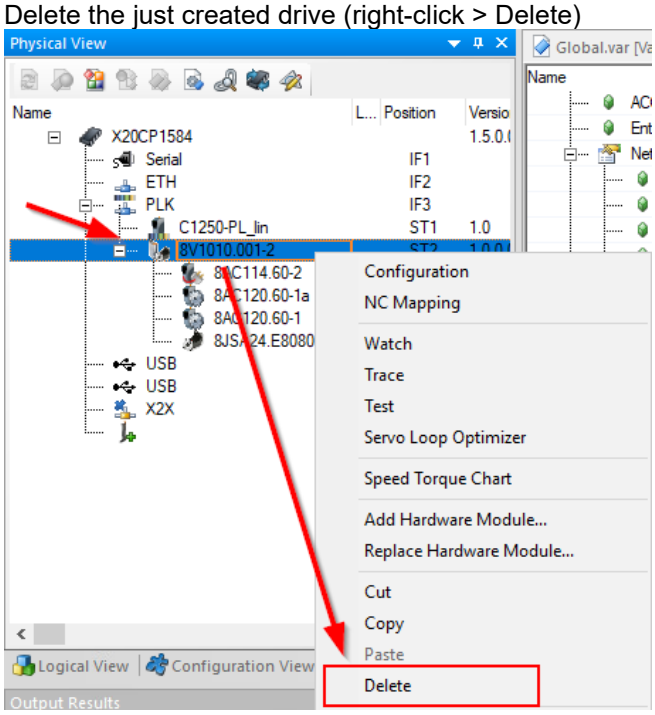


2. Click through the Drive Configuration Wizard without changing anything until *Global Settings*. Then select the language, set a name for the axis (gAxis01 in this example) and click Finish at the end.



Now all required libraries for NC objects are added to the project. Also, the *NC manager configuration* and the *NC mapping* are created.

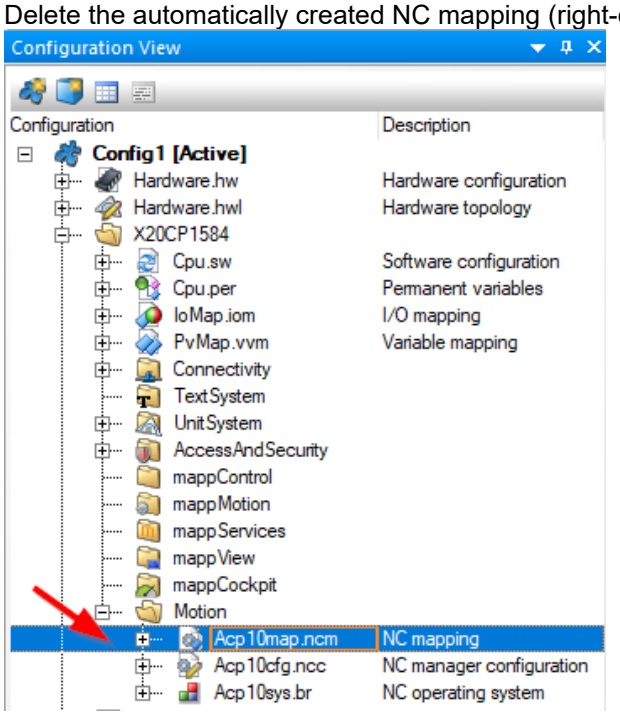
3. Delete the just created drive (right-click > Delete)



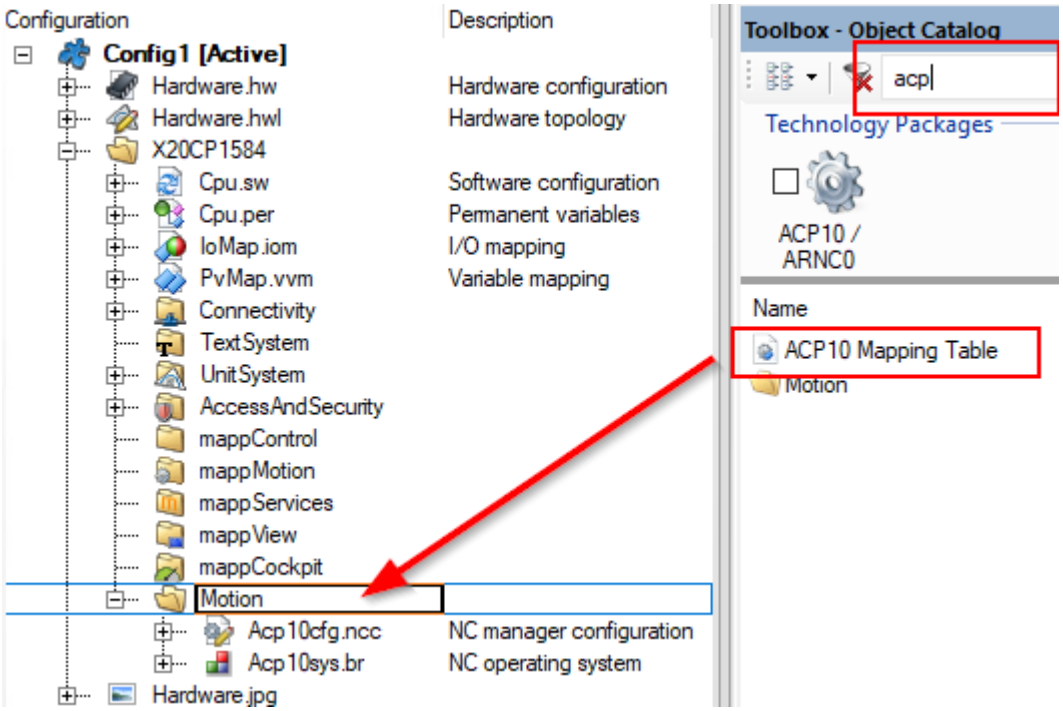
18.7 Automation Studio Configuration View

18.7.1 Setup NC Manager and NC Mapping

Delete the automatically created NC mapping (right-click > Delete)

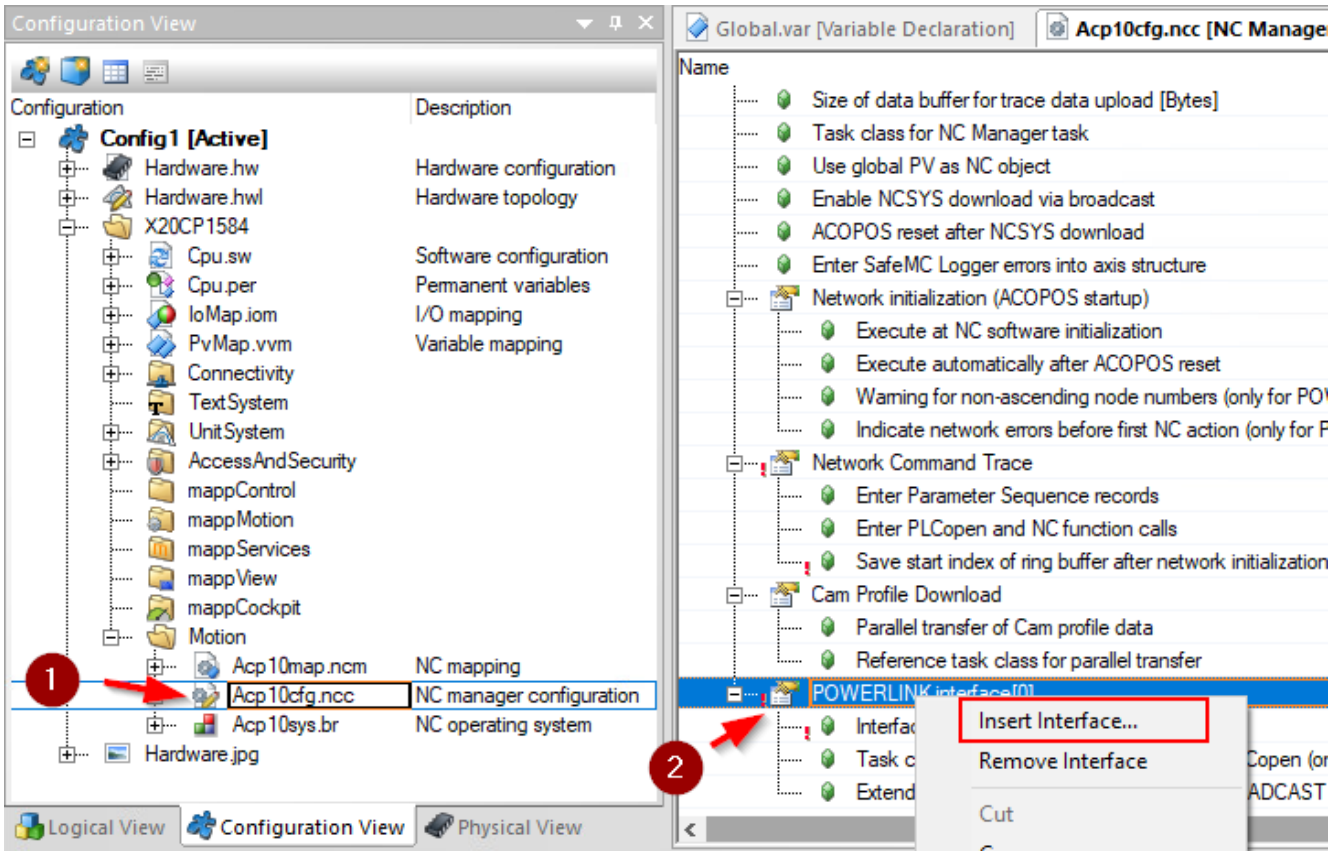


Add a new NC mapping by drag&drop *ACP10 Mapping Table* from the Toolbox – Object Catalog

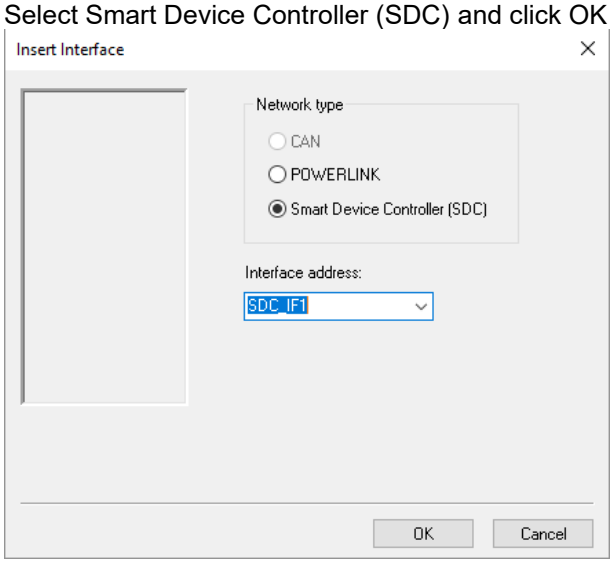


Attention:
Assign a name that is different to *Acp10map.ncm* or you will later not be able to add a new NC object. E.g.name it *Acp10map1.ncm*

Double-click on the NC manager configuration. Then right-click on the POWERLINK interface (or anywhere else in the NC manager configuration) and select “Insert Interface”

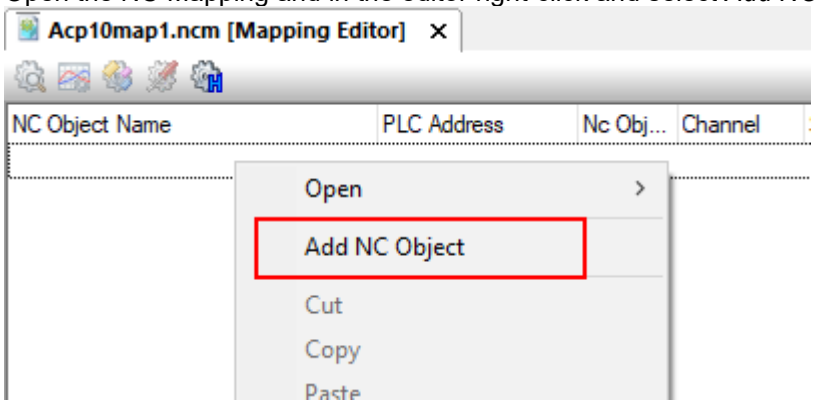


Select Smart Device Controller (SDC) and click OK



18.7.2 Add new NC Object

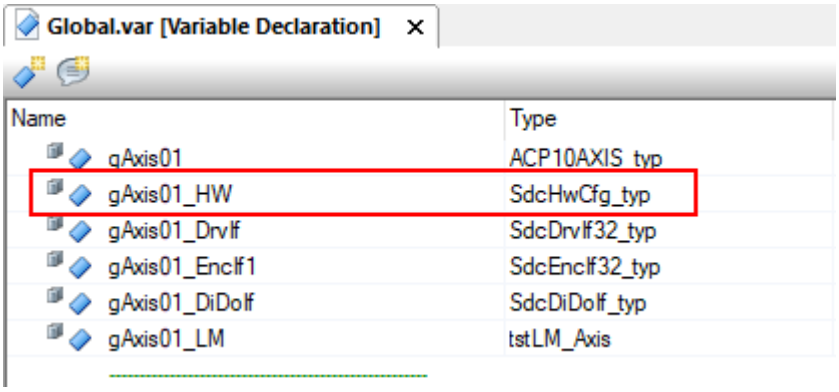
Open the NC Mapping and in the editor right-click and select *Add NC Object*



In the new empty line enter the following data:

NC Object Name	PLC Address	Nc Object Type	Channel	Simulation	NC INIT Parameter	ACOPOS Parameter	Additional Data
gAxis01	SDC_IF1.ST1	ncAXIS	1	Off	gAxis01i	gAxis01a	SDC_AX_HwPv="gAxis01_HW"

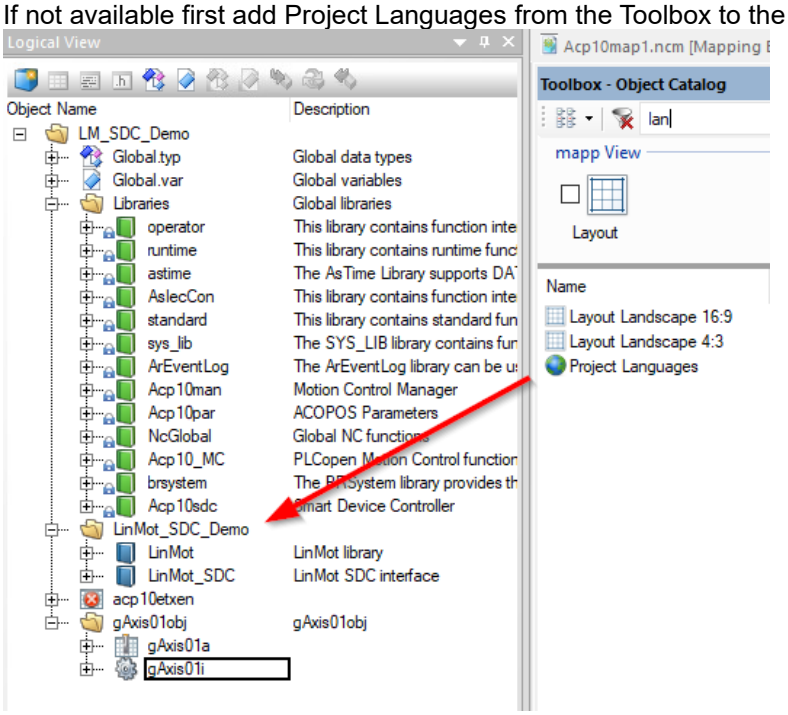
NC Object Name: Name of the ACP10Axis in Global.var. In this example *gAxis01*
PLC Address: Select the SDC interface, e.g. SDC_IF1.STx (Where x is a number. Here 1)
Nc Object Type: ncAxis
Channel: 1
Simulation: Off
NC INIT Parameter: Init Parameter table for this axis. In this example *gAxis01i*
ACOPOS Parameter: ACOPOS Parameter table for this axis. In this example *gAxis01a*
Additional Data: Name of SDC HW PV. In this example *gAxis01_HW* as defined in *Global.var*



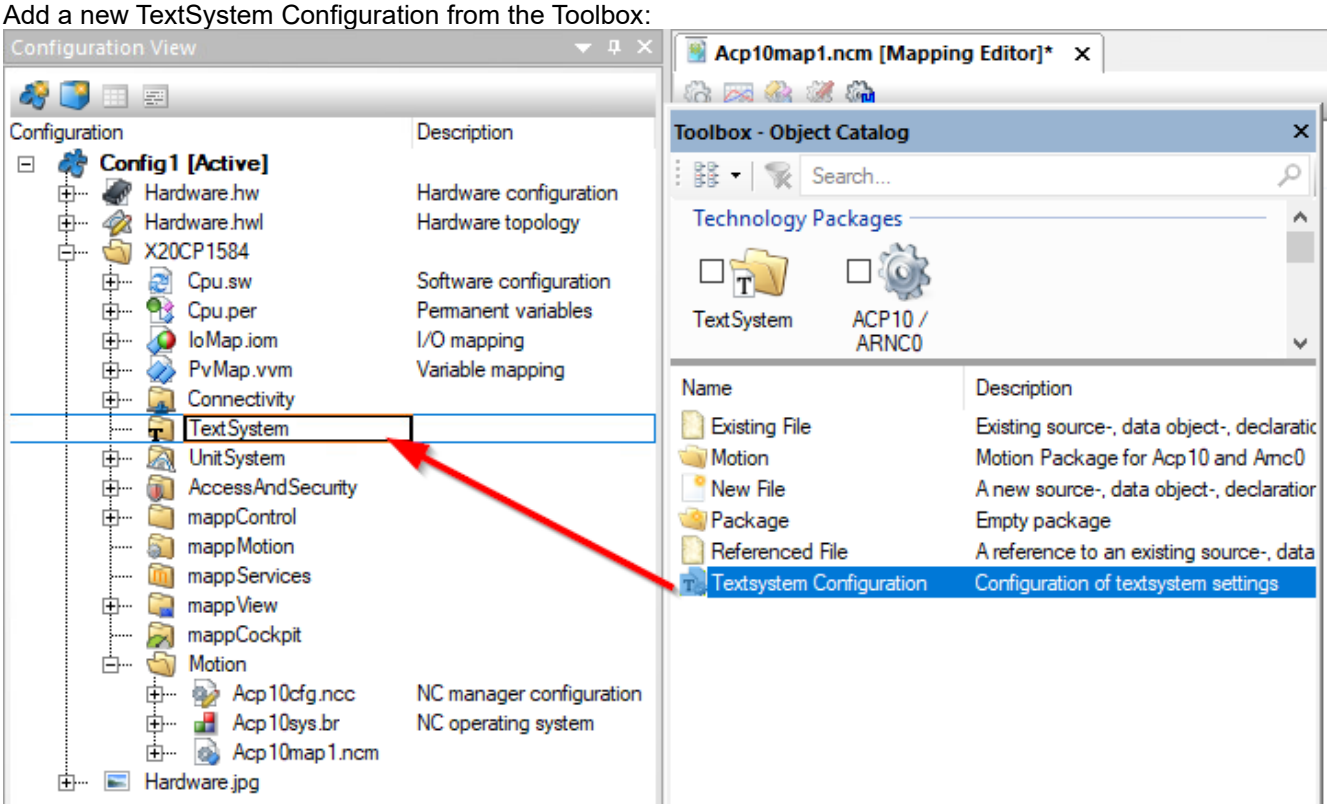
18.7.3 Add TextSystem

Note:
If you don't want to use the logger functionality this chapter can be skipped.

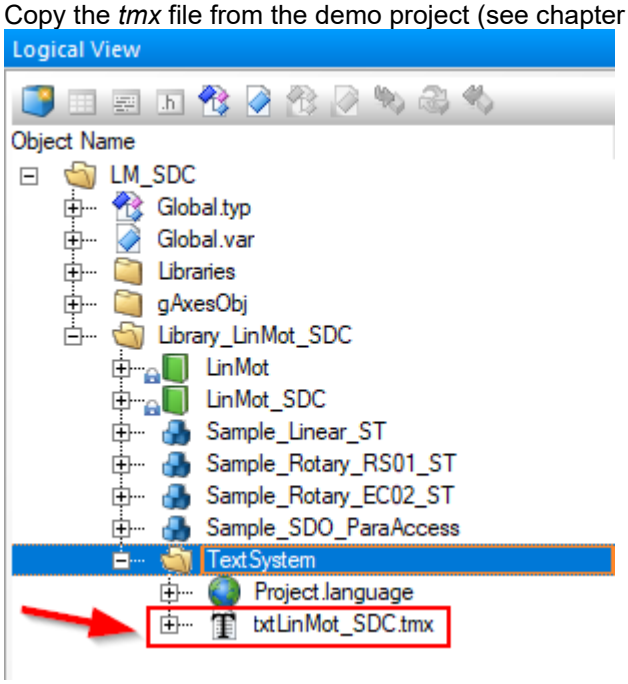
If not available first add Project Languages from the Toolbox to the project (in Logical View) and set it up:



Add a new TextSystem Configuration from the Toolbox:



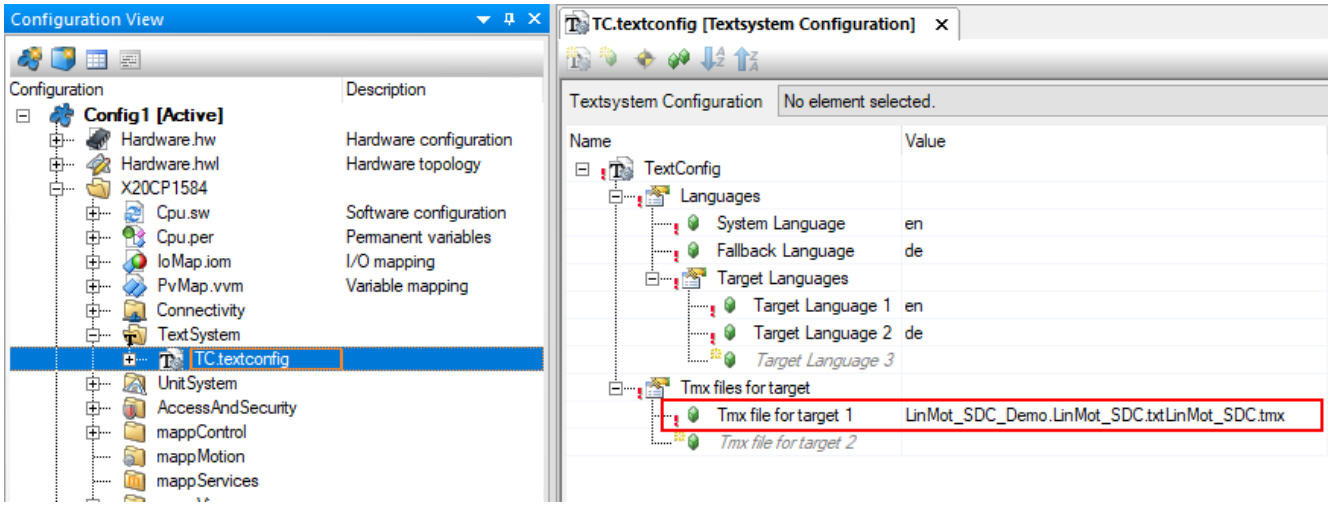
Copy the *tmx* file from the demo project (see chapter 18.1) to your project:



Open the TextSystem Configuration and set it up by selecting the *.tmx file just copied.

To do so right-click on “Tmx file for target 1” and select *Add New Dynamic Node*.

Click in the empty Value field and choose *xxx.LinMot_SDC.txtLinMot_SDC.tmx*



18.8 Automation Studio Logical View: Linear Motor Example

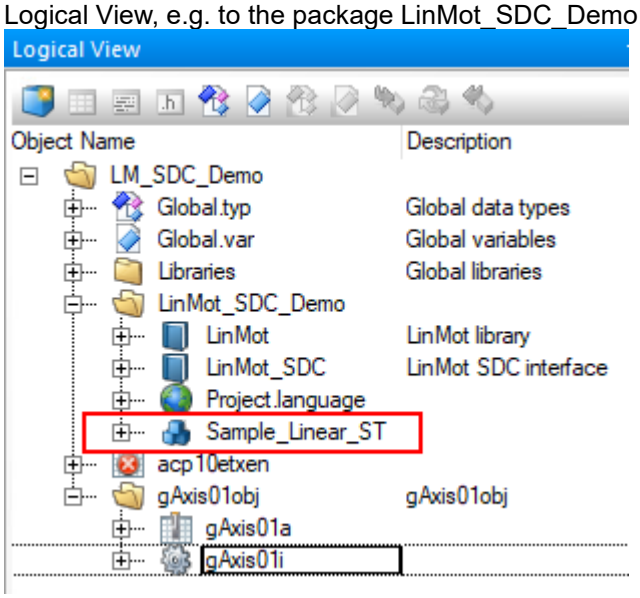
This chapter shows the integration of a LinMot linear motor.

By default, a LinMot linear drive has a maximum resolution of 0.1um of the actual and demand positions. The SDC encoder interface has the limitation that it must be able to check two times per task/Powerlink cycle the actual encoder value of the motor. With 10'000 Units per motor revolution (=1mm) and a task/Powerlink cycle time of 800us this limits the maximum reachable velocity to around 400mm/s which is slow for a LinMot linear motor.

Therefore, the resolution is changed to 1um by setting the SCALE_ENC_INCR and the parameter *diEncReductionFactor* of the LinMot SDC interface function block accordingly. This allows maximum velocities of up to 4'000 mm/s which is enough for most applications.

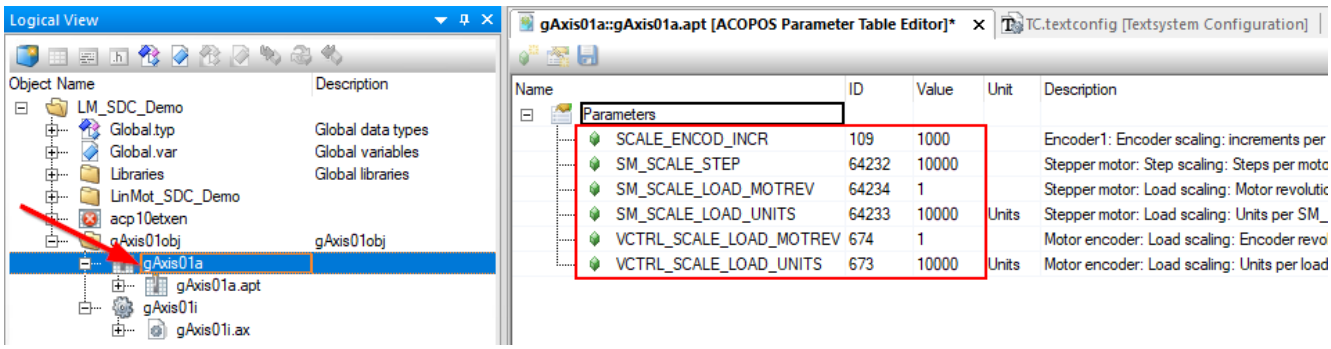
18.8.1 Add the example program to the project

Copy the sample program *Sample_Linear_ST* from the demo project (see chapter 18.1) and past it to the Logical View, e.g. to the package LinMot_SDC_Demo:



18.8.2 ACOPOS Parameter Table

For a LinMot linear motor the parameters must be set exactly as shown below. This will result in a resolution of 1um per Unit.



18.8.3 Init Parameter Table

Set all digital input active levels to *ncACTIV_HI*.
Set *Units* in *Encoder_if* to 10000 (> 1um per Unit with LinMot linear motor)
Set *t_predict* and *t_total* to 5 times Powerlink cycle time each > 800us * 5 = 0.004 s

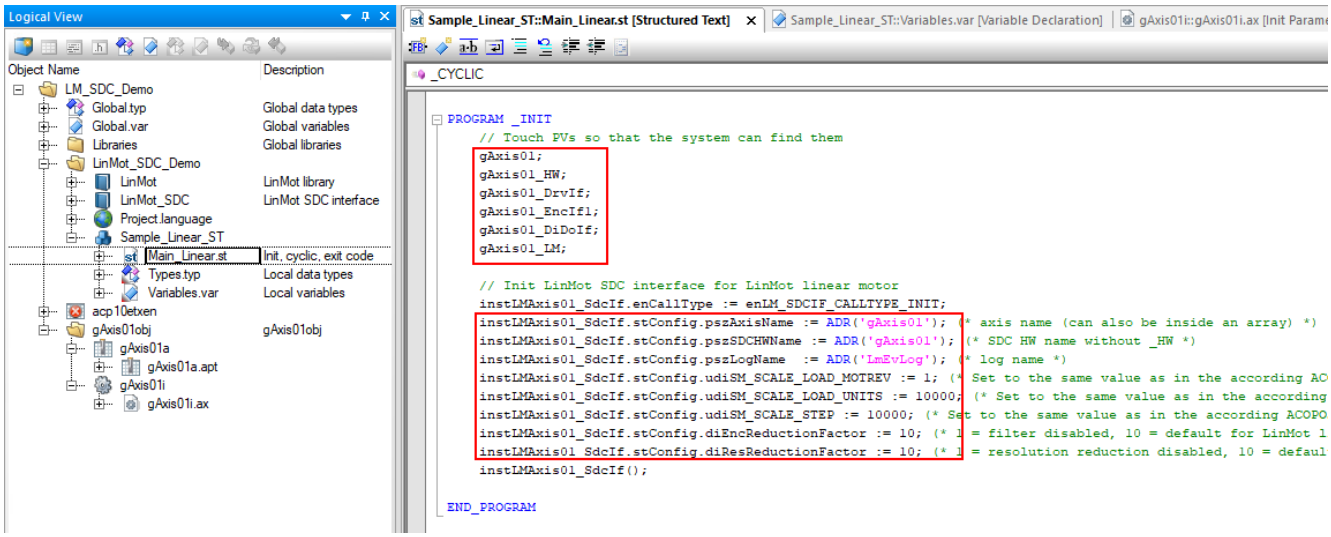
Name	Value	Unit	Description
ACP10AXIS_typ			
dig_in			Digital Inputs
level			Active Input Level
reference	ncACTIV_HI		Reference switch
pos_hw_end	ncACTIV_HI		Positive HW end switch
neg_hw_end	ncACTIV_HI		Negative HW end switch
trigger1	ncACTIV_HI		Trigger1
trigger2	ncACTIV_HI		Trigger2
encoder_if			Encoder Interface
parameter			Parameters
count_dir	ncSTANDARD		Count direction
scaling			Scaling
load			Load
units	10000	Units	Units at the load
rev_motor	1		Motor revolutions
limit			Limit value
controller			Controller
mode	ncPOSITION		Mode
position			Position Controller
kv	50	1/s	Proportional amplification
tn	0	s	Integral action time
t_predict	0.004	s	Prediction time
t_total	0.004	s	Total time
p_max	1.0e30	Units/s	Maximum proportional action
i_max	0	Units/s	Maximum integral action

As the limits depend on the application and the motor type used it is recommended to start with some moderate values.

limit			Limit value
parameter			Parameters
v_pos	1000000.0	Units/s	Speed in positive direction
v_neg	1000000.0	Units/s	Speed in negative direction
a1_pos	5000000.0	Units/s²	Acceleration in positive direction
a2_pos	5000000.0	Units/s²	Deceleration in positive direction
a1_neg	5000000.0	Units/s²	Acceleration in negative direction
a2_neg	5000000.0	Units/s²	Deceleration in negative direction
t_jolt	0	s	Jolt time
t_in_pos	0	s	Settling time before message 'In Position'
pos_sw_end	2000000000	Units	Positive SW end
neg_sw_end	-2000000000	Units	Negative SW end
ds_warning	2000.0	Units	Lag error limit for display of a warning
ds_stop	5000.0	Units	Lag error limit for stop of a movement
a_stop	1.0e30	Units/s²	Acceleration limit for stop of a movement
dv_stop	0	1/s	Speed error limit for stop of a movement
dv_stop_mode	ncOFF		Mode for speed error monitoring

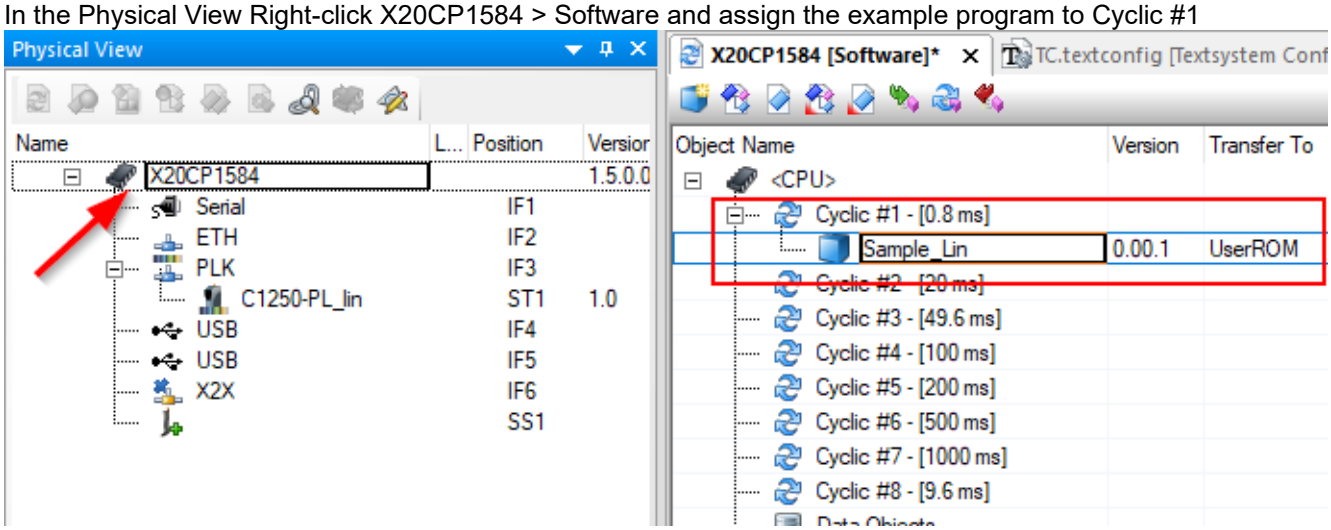
18.8.4 Check Init Parameters of the SDC function block

Open Main_Linear.st and check if the axis, SDCHW and log names as well as the other parameters in stConfig are set correctly.



18.8.5 Assign the example program to Cyclic #1

In the Physical View Right-click X20CP1584 > Software and assign the example program to Cyclic #1



18.9 Automation Studio Logical View: Rotary Motor Example

This chapter shows the integration of a rotary motor. In this example a RS01 (rotary part of a LinMot PR01 linear rotary motor).

To add a second axis, repeat chapter 18.6 and 18.7 and use another name, e.g. *gAxis02*.

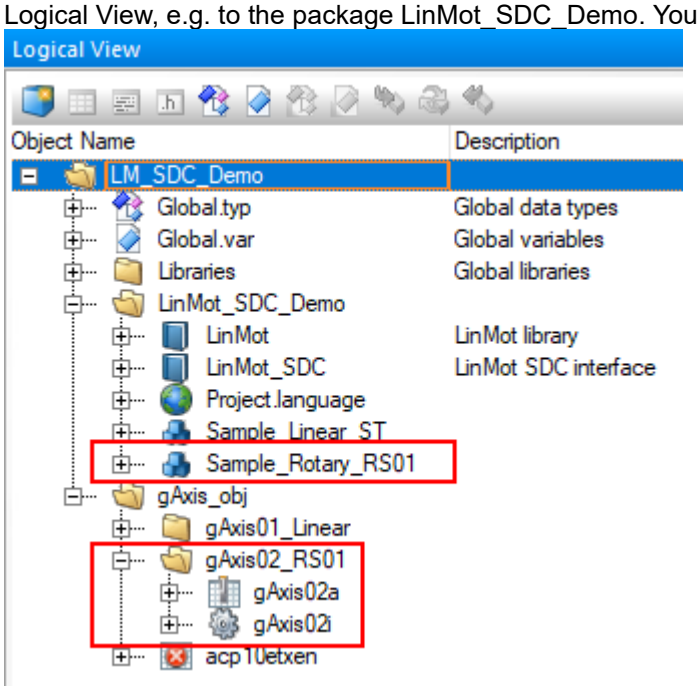
The mapping table with more axes may look as follows:

Global.typ [Data Type Declaration] | **Acp10map1.ncm [Mapping Editor]*** ×

NC Object Name	PLC Address	Nc Object Type	Channel	Simulation	NC INIT Parameter	ACOPOS Parameter	Additional Data
gAxis01	SDC_IF1.ST1	ncAXIS	1	Off	gAxis01i	gAxis01a	SDC_AX_HwPv="gAxis01_HW"
gAxis02	SDC_IF1.ST2	ncAXIS	1	Off	gAxis02i	gAxis02a	SDC_AX_HwPv="gAxis02_HW"

18.9.1 Add the example program to the project

Copy the sample program *Sample_Rotary_RS01* from the demo project (see chapter 18.1) and paste it to the Logical View, e.g. to the package LinMot_SDC_Demo. You may also want to copy the axes objects:



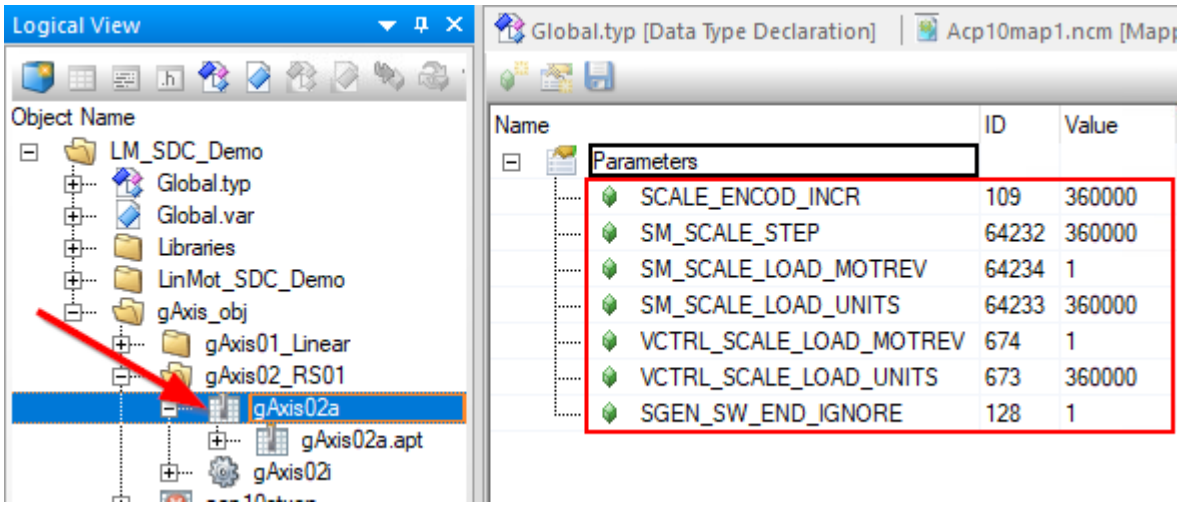
18.9.2 ACOPOS Parameter Table

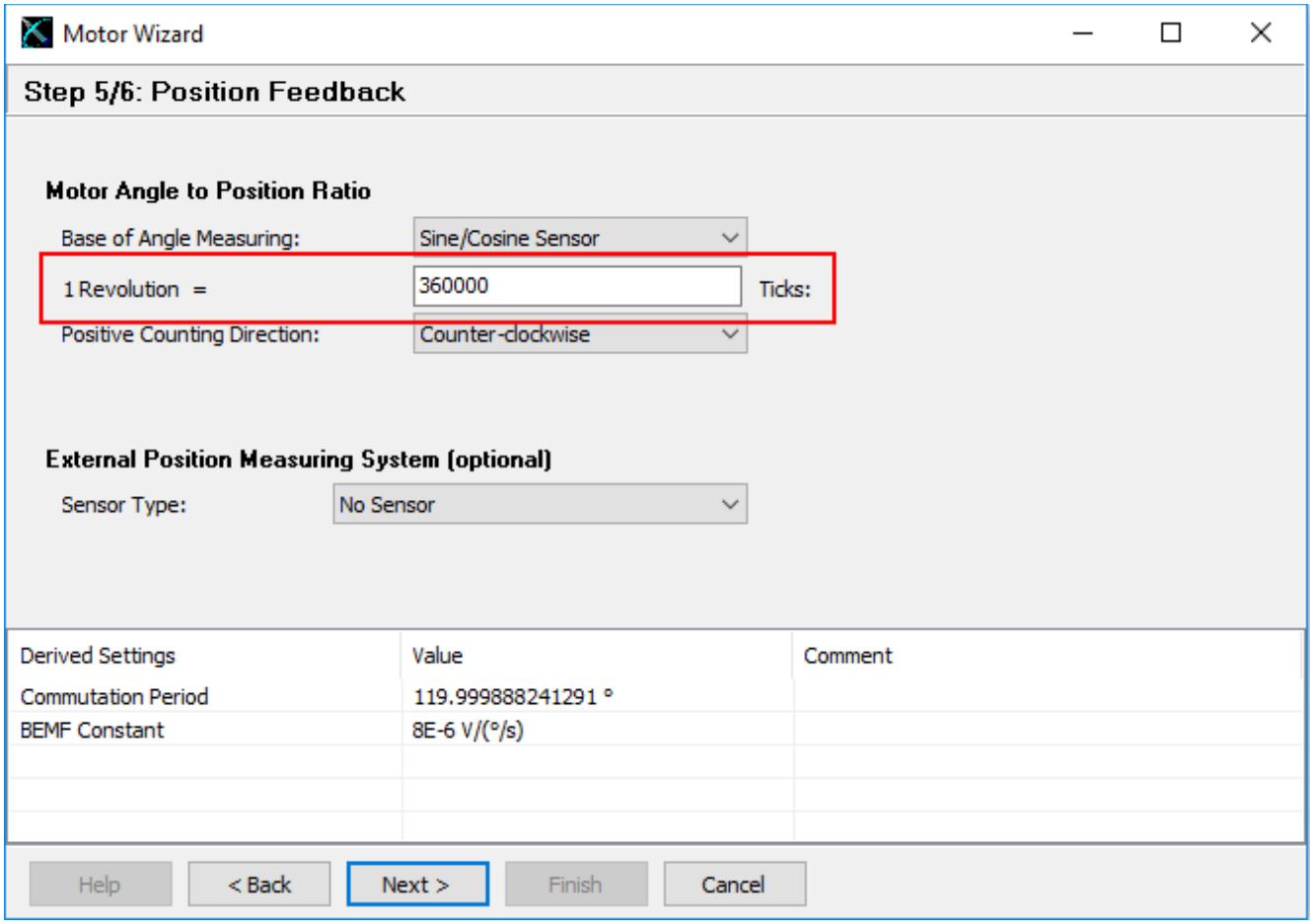
For a rotary motor the parameters must be set in relation to the settings on the LinMot drive.

The following examples will result in a resolution of **0.001 degree** per Unit.

The parameters ***SCALE_ENCOD_INCR*** and ***SM_SCALE_STEP*** must be set to the number of ticks shown in the LinMot-Talk motor wizard.

Example 1: RS01 motor

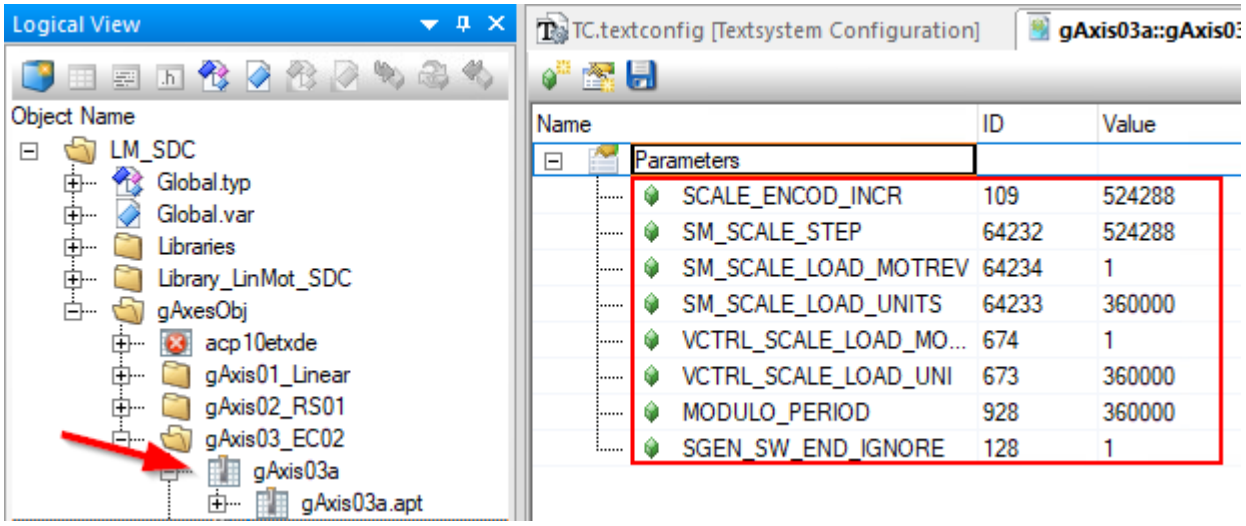


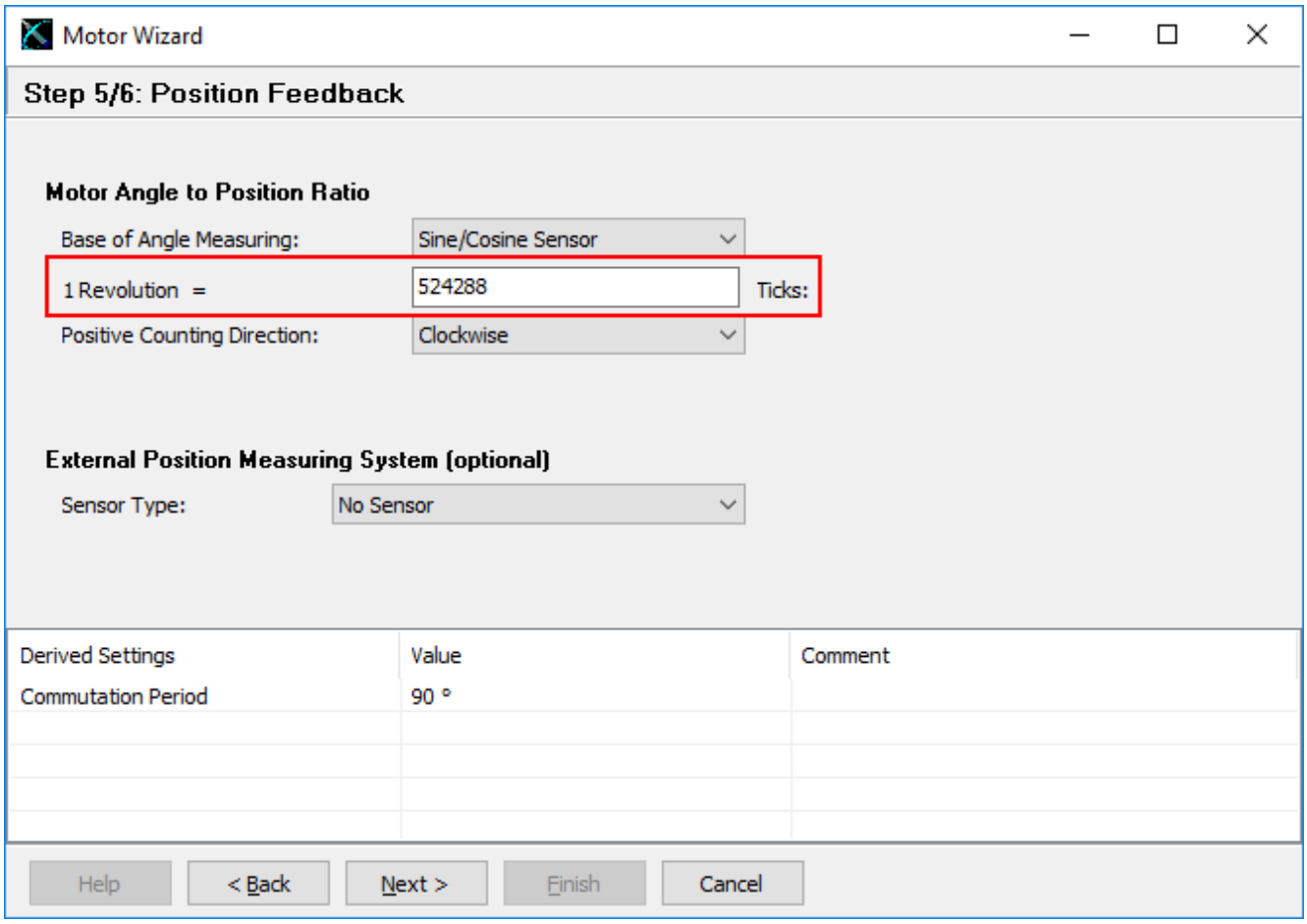


Example 2: EC02 motor

This motor has 524288 ticks per motor revolution. For this reason, the parameters ***SCALE_ENCOD_INCR*** and ***SM_SCALE_STEP*** must be set to 524288.

The unit is the same as before: 0.001 degree





18.9.3 Init Parameter Table

Set all digital input active levels to *ncACTIV_HI*.
Set *Units* in *Encoder_if* to 360000 (> 0.001 degree per Unit)
Set *t_predict* and *t_total* to 5 times Powerlink cycle time each > 800us * 5 = 0.004 s

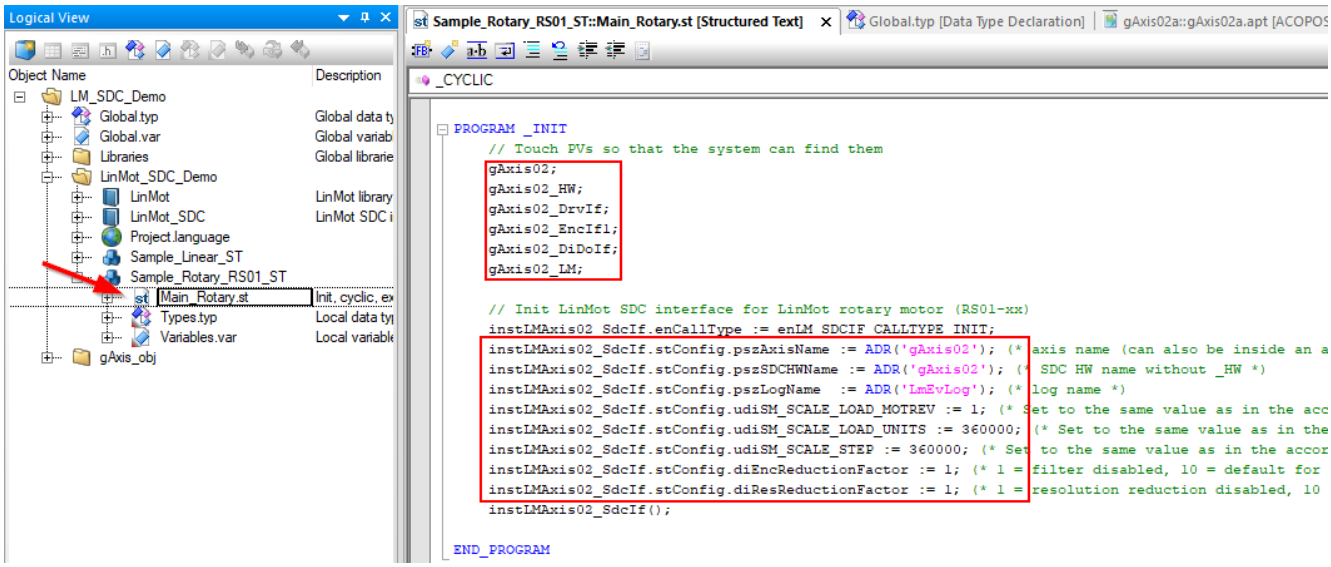
Name	Value	Unit	Description
ACP10AXIS_typ			
dig_in			Digital Inputs
level			Active Input Level
reference	ncACTIV_HI		Reference switch
pos_hw_end	ncACTIV_HI		Positive HW end switch
neg_hw_end	ncACTIV_HI		Negative HW end switch
trigger1	ncACTIV_HI		Trigger1
trigger2	ncACTIV_HI		Trigger2
encoder_if			Encoder Interface
parameter			Parameters
count_dir	ncSTANDARD		Count direction
scaling			Scaling
load			Load
units	360000	Units	Units at the load
rev_motor	1		Motor revolutions
limit			Limit value
controller			Controller
mode	ncPOSITION		Mode
position			Position Controller
kv	0.0	1/s	Proportional amplification
tn	0.0	s	Integral action time
t_predict	0.004	s	Prediction time
t_total	0.004	s	Total time
p_max	0.0	Units/s	Maximum proportional action
i_max	0.0	Units/s	Maximum integral action

As the limits depend on the application and the motor type used it is recommended to start with some moderate values.

Name	Value	Unit	Description
limit			Limit value
parameter			Parameters
v_pos	3600000.0	Units/s	Speed in positive direction
v_neg	3600000.0	Units/s	Speed in positive direction
a1_pos	7200000.0	Units/s²	Acceleration in positive direction
a2_pos	7200000.0	Units/s²	Deceleration in positive direction
a1_neg	7200000.0	Units/s²	Acceleration in negative direction
a2_neg	7200000.0	Units/s²	Deceleration in negative direction
t_jolt	0.0	s	Jolt time
t_in_pos	0.0	s	Settling time before message "In Position"
pos_sw_end	2000000000	Units	Positive SW end
neg_sw_end	-2000000000	Units	Negative SW end
ds_warning	10000.0	Units	Lag error limit for display of a warning
ds_stop	20000.0	Units	Lag error limit for stop of a movement
a_stop	1.0E+09	Units/s²	Acceleration limit for stop of a movement
dv_stop	0.0	1/s	Speed error limit for stop of a movement
dv_stop_mode	ncOFF		Mode for speed error monitoring

18.9.4 Check Init Parameters of the SDC function block

Open Main_Linear.st and check if the axis, SDCHW and log names as well as the other parameters in stConfig are set correctly.

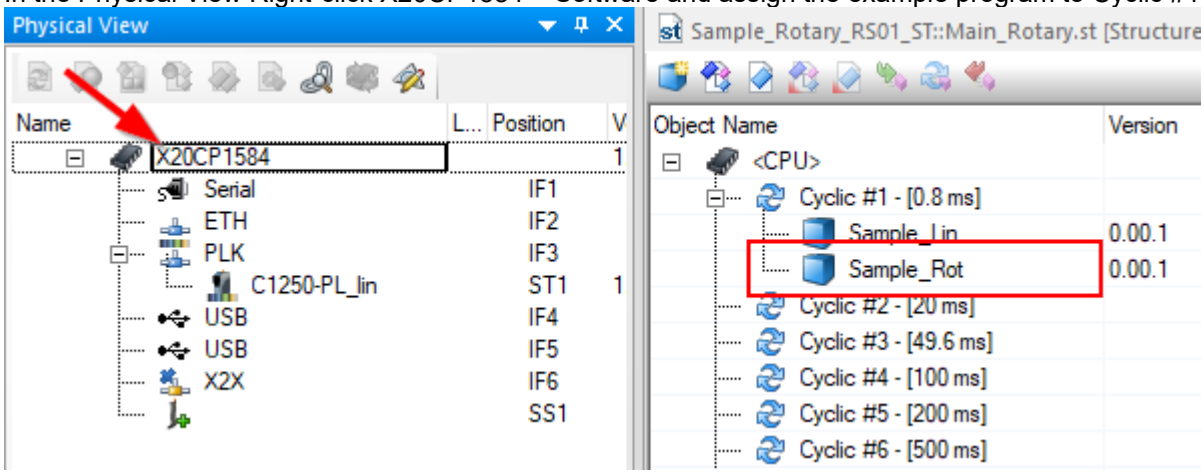


Attention:
The parameter ***SM_SCALE_STEP*** must be set as shown in chapter 18.9.2.

For a LinMot RS01 rotary motor the parameter ***SM_SCALE_STEP*** is set to 360000.
For a LinMot EC02 rotary motor the parameter ***SM_SCALE_STEP*** is set to 524288.
For any other motor please check the Position Feedback in the LinMot-Talk Motor Wizard.

18.9.5 Assign the example program to Cyclic #1

In the Physical View Right-click X20CP1584 > Software and assign the example program to Cyclic #1



18.10 Homing

18.10.1 Linear Motor

A possible setup for homing mode ncBlock_DS:

move			Movement
stop			Stop Movement
homing			Homing procedure
parameter			Parameters
s	-1000	Units	Reference position
v_switch	5000.0	Units/s	Speed for searching the reference switch
v_trigger	5000.0	Units/s	Trigger Speed
a	50000.0	Units/s²	Acceleration
mode	ncBLOCK_DS		Mode
edge_sw	ncPOSITIVE		Edge of reference switch
start_dir	ncNEGATIVE		Start direction
trigg_dir	ncPOSITIVE		Trigger direction
ref_pulse	ncOFF		Reference pulse
fix_dir	ncOFF		Fixed direction
tr_s_block	1.0	Rev.	Distance for blocking the activation of 'triggering reference pulse'
torque_lim	0.0	Nm	Torque limit for homing on block
ds_block	1000.0	Units	Lag error for block detection
ds_stop	2000.0	Units	Lag error for stop of a movement

18.10.2 Rotary Motor

LinMot rotary motors (RS01 & EC02) have a single turn absolute encoder.
Therefore, as homing mode *ncHOME_OFFSET* can be used.

move			Movement
mode	ncOFF		Mode
detail	ncOFF		Detail
stop			Stop Movement
homing			Homing procedure
init	ncTRUE		Homing procedure initialized
status			Status
parameter			Parameters
s	0	Units	Reference position
v_switch	5000	Units/s	Speed for searching the reference switch
v_trigger	5000	Units/s	Trigger Speed
a	50000	Units/s²	Acceleration
mode	ncHOME_OFFSET		Mode
edge_sw	ncPOSITIVE		Edge of reference switch
start_dir	ncNEGATIVE		Start direction
trigg_dir	ncPOSITIVE		Trigger direction
ref_pulse	ncOFF		Reference pulse
fix_dir	ncOFF		Fixed direction
tr_s_block	0.1	Rev.	Distance for blocking the activation of 'triggering reference pulse'
torque_lim	0	Nm	Torque limit for homing on block
ds_block	1000	Units	Lag error for block detection
ds_stop	2000	Units	Lag error for stop of a movement

Note:
It is recommended to home axes with absolute encoders first before switching the motor on.

18.10.3 Reference Switch (mcHOME_ABS_SWITCH)

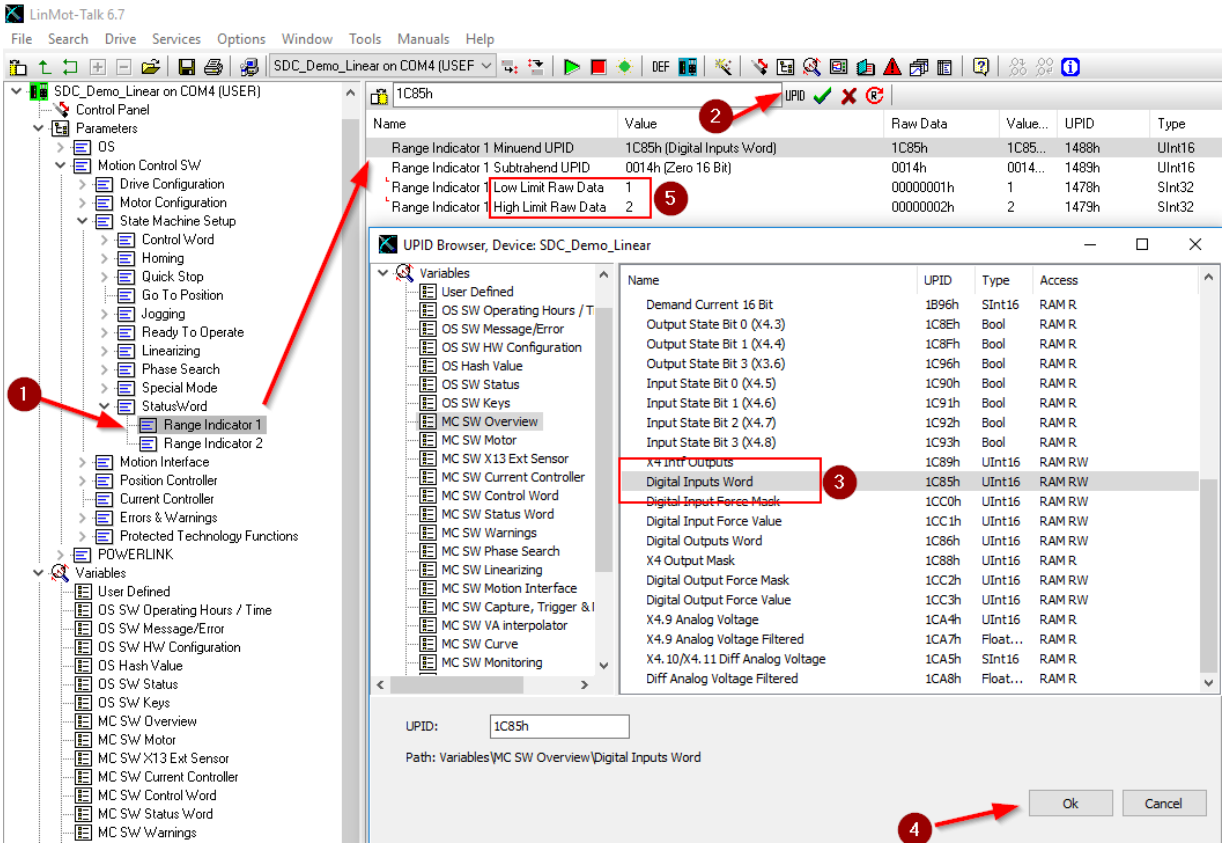
Attention:
Up to **LinMot drive firmware 6.7** this mode works only when on the drive only the digital input X4.5 is used. If any other input on X4 is set or used for other functions, then this method does not work with this firmware.

Attention:
From **LinMot drive firmware 6.8 Build 20190315** this method works too with boolean parameters. E.g. for X4.5 set the parameter *Range Indicator 1 Minuend UPID* to *1C90h* (Inputs State Bit 0 (X4.5)) instead of *1C85h*. See screenshot below.

It is possible to connect a hardware switch to the LinMot drives X4 inputs (e.g. X4.5). The state of the digital input is then passed through to *iReference* of the SDC DI/DO Interface.

Setup the reference switch in the LinMot drive:

- For LinMot drive firmware 6.7:



- For LinMot drive firmware 6.8 Build 20190315 and newer replace the value in *Range Indicator 1 Minuend UPID* to *1C90h* (Inputs State Bit 0 (X4.5)) instead of *1C85h*

As example we want to use the following homing mode
(see B&R Automation Studio Help > search for mcHOME_ABS_SWITCH):

```
edge_sw = ncNEGATIVE
trigg_dir = ncPOSITIVE
fix_dir = ncOFF
```

Possible setup of the homing mode:

homing			Homing procedure
init	ncTRUE		Homing procedure initialized
status			Status
parameter			Parameters
s	0	Units	Reference position
v_switch	1000	Units/s	Speed for searching the reference switch
v_trigger	5000	Units/s	Trigger Speed
a	50000	Units/s²	Acceleration
mode	ncABS_SWITCH		Mode
edge_sw	ncNEGATIVE		Edge of reference switch
start_dir	ncNEGATIVE		Start direction
trigg_dir	ncPOSITIVE		Trigger direction
ref_pulse	ncOFF		Reference pulse
fix_dir	ncOFF		Fixed direction
tr_s_block	1	Rev.	Distance for blocking the activation of 'triggering reference pulse'
torque_lim	0	Nm	Torque limit for homing on block
ds_block	1000	Units	Lag error for block detection
ds_stop	2000	Units	Lag error for stop of a movement

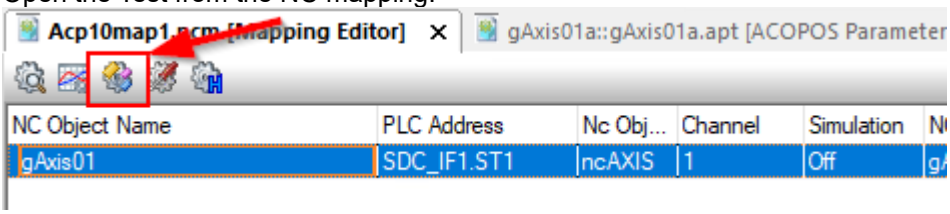
18.11 Test

After the LinMot drive is integrated as shown in the chapters before, the project can be compiled and downloaded to the PLC.

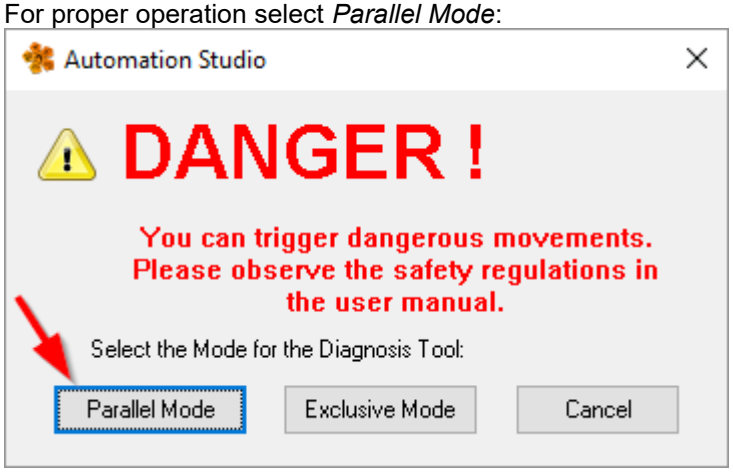
Attention:
It is recommended to rebuild the project and to **restart both the PLC and drives** to have a proper start-up. Ignoring this may prevent being able to power on the axis.

For testing purposes, the Test tool in Automation Studio can be used.

Open the Test from the NC mapping:

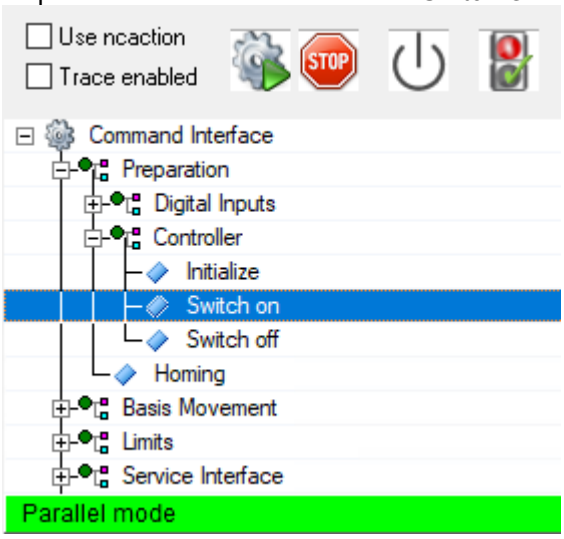


For proper operation select *Parallel Mode*:



18.11.1 Switch On

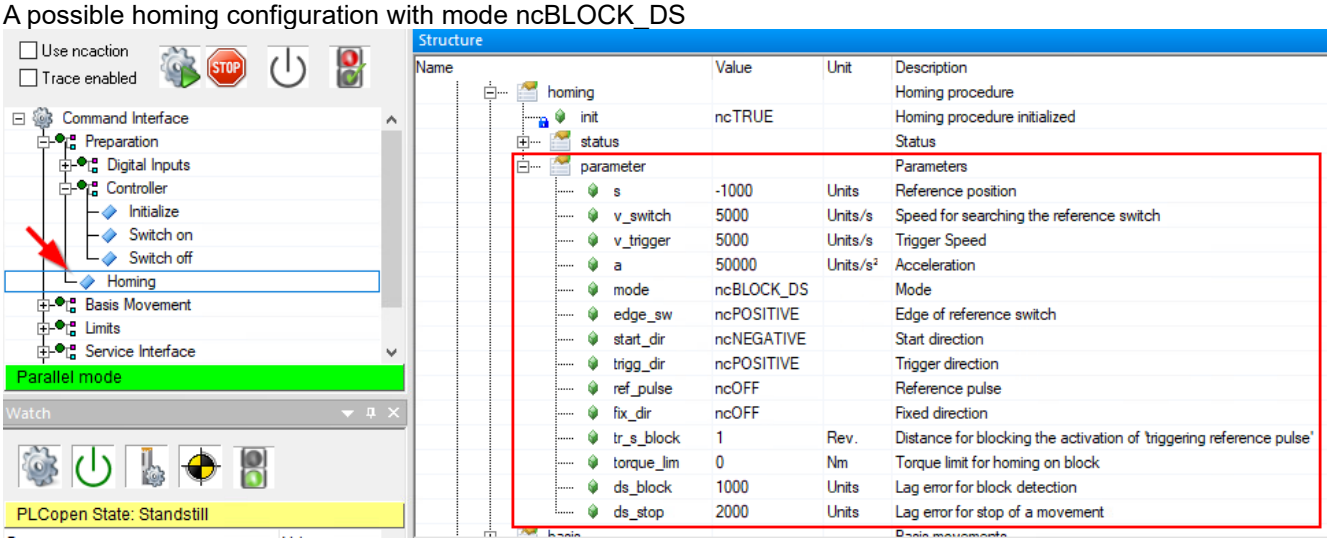
To power on the motor execute the *Switch On* command:



18.11.2 Homing

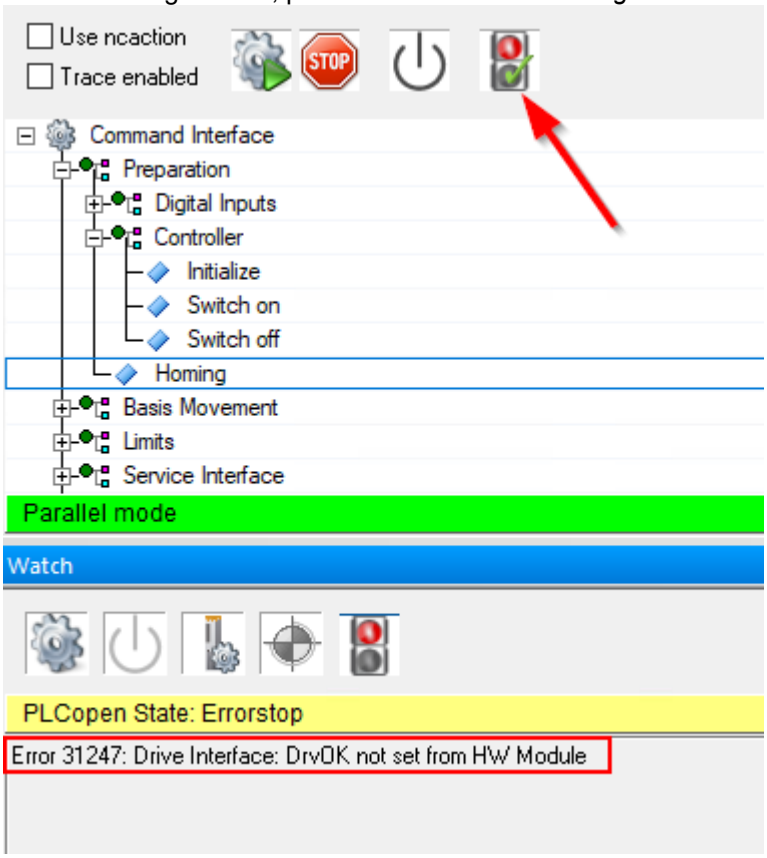
To home the axis (in this example a linear motor to hard stop) use the Homing command.

A possible homing configuration with mode ncBLOCK_DS



18.11.3 Error Acknowledge

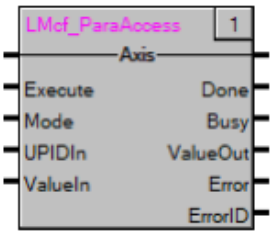
To acknowledge errors, press the button *Acknowledge Error* as long as an error is shown in the Watch:



18.12 Parameter Access

18.12.1 Parameter access by LMcf_ParaAccess function block

Every parameter and variable in a LinMot system has its own UPID (Unique Parameter ID).
Read and write access is possible using the LMcf_ParaAccess function block from the library LinMot.



Supported Modes		
Value	Used Inputs	Description
0	UPIDIn	Read ROM Value of Parameter by UPID
1	UPIDIn	Read RAM Value of Parameter by UPID
2	UPIDIn, ValueIn	Write ROM Value of Parameter by UPID
3	UPIDIn, ValueIn	Write RAM Value of Parameter by UPID
4	UPIDIn, ValueIn	Write RAM and ROM Value of Parameter by U
5	UPIDIn	Get minimal Value of Parameter by UPID
6	UPIDIn	Get maximal Value of Parameter by UPID
7	UPIDIn	Get default Value of Parameter by UPID

Attention ROM Access:
Intense use of writing into the ROM memory can reduce the life-time of the drive memory!
More details can be found in the *Drive Configuration Over Fieldbus (0185-1074)* user manual
> see chapter Documentation / User Manuals

Note:
Further documentation about this function block can be found in the LinMot library manual.
See chapter 18.1.

18.12.2 Parameter access by SDO commands

Alternatively, also access by SDO is possible. For SDO access the B&R library *AsEPL* is required.
Function blocks: *EplSDORead() & EplSDOWrite()*

The Index specifies the LinMot parameter (UPID) to address. It is UPID + 16#2000.
The Sub-Index specifies the command which is performed

Index	Sub-Index	Description	Access Type
2000h -5FFFh		LinMot Parameter Commands	
UPID Commands			
	01h	RAM Value of UPID	Read & Write
	02h	ROM Value of UPID	Read & Write
	03h	Min Value of UPID	Read Only
	04h	Max Value of UPID	Read Only
	05h	Default Value of UPID	Read Only
	06h	RAM / ROM Write of UPID	Write Only
System Commands			
	07h	Set ROM to default (OS)	Write Only
	08h	Set ROM to default (MC)	Write Only
	09h	Set ROM to default (Interface)	Write Only
	0Ah	Set ROM to default (Application)	Write Only
	0Bh	Reset drive	Write Only
	35h	Stop MC and APPL Software	Write Only
	36h	Start MC and APPL Software	Write Only

Attention ROM Access:
Intense use of writing into the ROM memory can reduce the life-time of the drive memory!
More details can be found in the *Drive Configuration Over Fieldbus (0185-1074)* user manual
> see chapter Documentation / User Manuals

Possible variable declaration:

instLMAxis01_SdoWrite	EplSDOWrite
instLMAxis01_SdoRead	EplSDORead
udiDataWrite	UDINT
udiDataRead	UDINT

Possible function block calls where IF3 is the Powerlink interface:

```
// SDO read
instLMAxis01_SdoRead(pDevice:=ADR('IF3'), pData:=ADR(udiDataRead));

// SDO write
instLMAxis01_SdoWrite(pDevice:=ADR('IF3'), pData:=ADR(udiDataWrite));
```

Example read parameter:

Read the RAM value of the parameter Maximal Current:

Name: Maximal Current
UPID: 13A6h
Type: SInt32 = DINT = 4 Bytes
Scale: 0.001 A

pDevice := pointer to POWERLINK interface, e.g. ADR('IF3')
node := **1** (Node ID of the LinMot drive)
index := **13222 = 16#33a6** = 16#2000 + 16#13a6
subindex := **1** (access RAM value)
pData := pointer to data buffer, e.g. ADR(udiDataRead)
datalen := **4** (always 4 Bytes! Even if the parameter to read is less)

instLMAxis01_SdoRead	EplSDORead	local		
enable	BOOL			TRUE
pDevice	UDINT			69733729
node	USINT			1
index	UINT			13222
subindex	USINT			1
pData	UDINT			69735842
datalen	UDINT			4
status	UINT			65535
errorinfo	UDINT			16#0000_0000
readlen	UDINT			4
intern	EPL_I_TYPE			
udiDataRead	UDINT	local		15000

Example write parameter:

Write 1A to the RAM value of the parameter Maximal Current:

Name: Maximal Current
UPID: 13A6h
Type: SInt32 = DINT = 4 Bytes
Scale: 0.001 A > value to be sent = 1'000

pDevice := pointer to POWERLINK interface, e.g. ADR('IF3')
node := **1** (Node ID of the LinMot drive)
index := **13222 = 16#33a6** = 16#2000 + 16#13a6
subindex := **1** (access RAM value)
pData := pointer to data buffer, e.g. ADR(udiDataWrite)
datalen := **4** (always 4 Bytes! Even if the parameter to read is less)

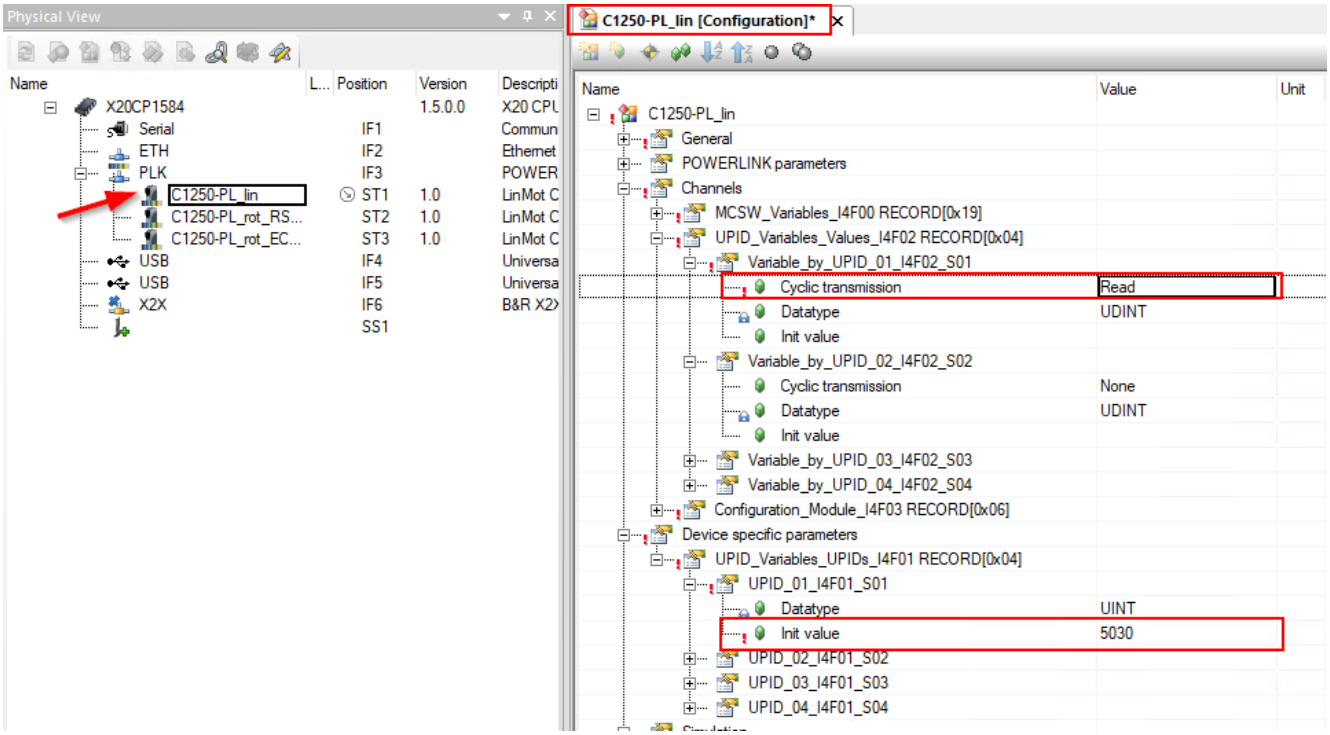
instLMAxis01_SdoWrite	EplSDOWrite	local		
enable	BOOL			TRUE
pDevice	UDINT			69733783
node	USINT			1
index	UINT			13222
subindex	USINT			1
pData	UDINT			69735838
datalen	UDINT			4
status	UINT			65535
errorinfo	UDINT			0
intern	EPL_I_TYPE			
udiDataWrite	UDINT	local		1000

18.13 Add Additional Parameters or Variables to the Process Data

It is possible to add up to 4 parameters or variables to the cyclic PDO of the drive. This allows fast read/write access.

Right-click on the drive and select *Configuration*.

- Set the ***Cyclic transmission*** to either *Read* (for read access from the drive) or *Write* (for write access to the drive) in the “Channels”.
- As ***Init value*** in the “Device specific parameters” set the UPID number (e.g. Maximal Current has UPID 16#13A6 > 5030 decimal) of the parameter you want to access.



Afterwards you can assign a PV in the I/O configuration of the device.

18.14 Errors (LM_SdcIf outputs)

18.14.1 bError

This output indicates that an error occurred either in the *LM_SdcIf* function block itself, in the used libraries (LinMot, Sys_Lib or ArEventLog) or in the LinMot drive. The source is shown by the *diStatusID* output.

18.14.2 diStatusID

diStatusID shows the actual status of the LM_SdcIf function block. The following values are valid.

Parameter	Value	Description
enLM_SDCIF_ERR_OK	0	No Event ID: No error
enLM_SDCIF_INF_FUB_ENABLE_FALSE	1610612736	Function block not enabled
enLM_SDCIF_WRN_LIB_LINMOT	-1610612736	Library LinMot: Warning
enLM_SDCIF_ERR_LIB_CONFIG_AXNAME	-536870912	Object at parameter "pszAxisName" or "pszSDCHWName" not found or null. Or PV names (pszSDC...) too long (>34 characters)
enLM_SDCIF_ERR_LIB_SYS_LIB	-536870911	Library Sys_Lib: Error
enLM_SDCIF_ERR_LIB_LINMOT	-536870910	Library LinMot: Error
enLM_SDCIF_ERR_LIB_AREVENTLOG	-536870909	Library ArEventLog: Error

18.14.3 uiErrorCode

If the LinMot drive has an error this is indicated by:

- diStatusID value of -536870910 (enLM_SDCIF_ERR_LIB_LINMOT)
- uiErrorCode output greater than 0 (zero)

A list of possible uiErrorCode values can be found in either the MS_SW manual or within LinMot-Talk (Menu > Manuals > Errors > MC Layer).

It is possible to read the error message (English only) as STRING using the function block *LMcf_GetErrorText* from the library LinMot.

inst_LMGetErrorText	LMcf_GetErrorTxt	
Execute	BOOL	TRUE
ErrorCode	UINT	11
Done	BOOL	TRUE
Busy	BOOL	FALSE
ErrorText	STRING[80]	'Err: Pos Lag Always Too Big'
Error	BOOL	FALSE
ErrorID	UINT	0
Axis	UDINT	65872452

Note:
Further documentation about this function block can be found in the LinMot library manual.
See chapter 18.1.

19 Drive Profile: OMRON Sysmac Studio, CoE DS402

19.1 Overview

This chapter shows how LinMot drives with *DS402 (CoE) / CiA402* interface (e.g., C1250-DS-XC-1S) can be integrated and setup in an OMRON N-Series (NJ, NX, NY) environment.

For this example, ***Sysmac Studio V1.50*** and ***LinMot-Talk V6.11*** were used.

Download:
Example projects can be downloaded from:
http://download.linmot.com/plc_lib/examples/Omron_DS/ (named: *prjLinMotDS402_fwV6.10_Nx1.smc2)*

Image Source: http://www.omron.com/

EtherCAT is the real-time Ethernet network originally developed by Beckhoff. The LinMot drives acts as slaves in this network and are implemented with either the standard ASIC ET1100 from Beckhoff or Hilscher NETX.

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

Note:
In this chapter the following Modes of Operation of the DS402 / CiA402 profile are used:
6 = homing mode
8 = cyclic synchronous position (csp)
10= cyclic synchronous torque (cst)

The modes are switched by setting object 6060h (Mode of operation) to the according value.
The drive shows the active mode in object 6061h (Mode of operation display).

19.2 Configuration and Connection of the LinMot Drive

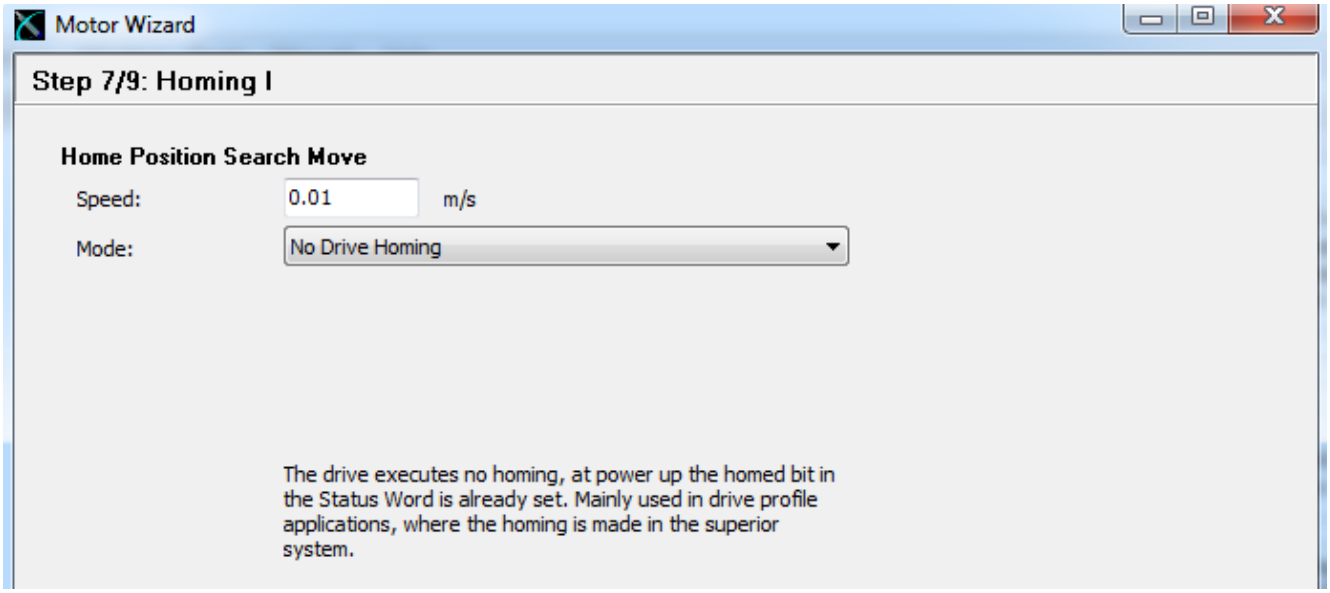
The LinMot drive is configured using the LinMot-Talk software:
http://www.linmot.com/download/linmot-talk-drive-configuration/

19.2.1 Motor Configuration

It is assumed that the motor connected to the drive is already configured.

Use the *Motor Wizard* inside LinMot-Talk to setup the motor (Menu -> Drive -> Motor Wizard):

Only select a homing mode in the Motor Wizard in case of a drive-based homing (e.g., *Mechanical Stop Negative Search*). Otherwise, *No Drive Homing* must be selected.



See Appendix I: Basic Position Control Loop Tuning

For ***Drive Based Homing*** please refer to chapter ***19.5***

19.2.2 XML File

Install the XML file that is part of the LinMot-Talk software/firmware you are using.
The most recent device files are always part of the newest LinMot-Talk software. They are located by default:

- EtherCAT CoE: \\LinMot-Talk X.X Build XXXXXXXX\Firmware\Interfaces\EtherCat_Nx\XML\ **(-MI drives)**
- EtherCAT CoE: \\LinMot-Talk X.X Build XXXXXXXX\Firmware\Interfaces\EtherCAT\XML\
-

XML file names:

NTIL_CiA402_Servos_MI_Vx_xrx.xml	LinMot MI drives
NTIL_DS_Drives_Vx_x_bxx.xml	LinMot DS drives SG9 (F Series DS)
NTIL_CiA402_Servos_Vx_xrx.xml	LinMot DS drives SG6-7
NTIL_CiA402_SG5_Servos_Vx_xrx.xml	LinMot DS drives SG5

19.2.3 EtherCAT Connection

The drive is connected to the EtherCAT network using the **X17 (IN) & X18 (OUT)** connectors.

The below pictures show the ports of an E1250-DS-UC drive.
On all other LinMot drives supporting EtherCAT DS402 / CiA402 the ports are named the same (X17 & X18), but they may be placed differently on the drive housing.

X17 - X18	RealTime Ethernet 10/100 Mbit/s
	X17 RT ETH In **(OMRON: EtherCAT IN, from PLC)**
	X18 RT ETH Out **(OMRON: EtherCAT OUT, to next device)**
RJ-45	

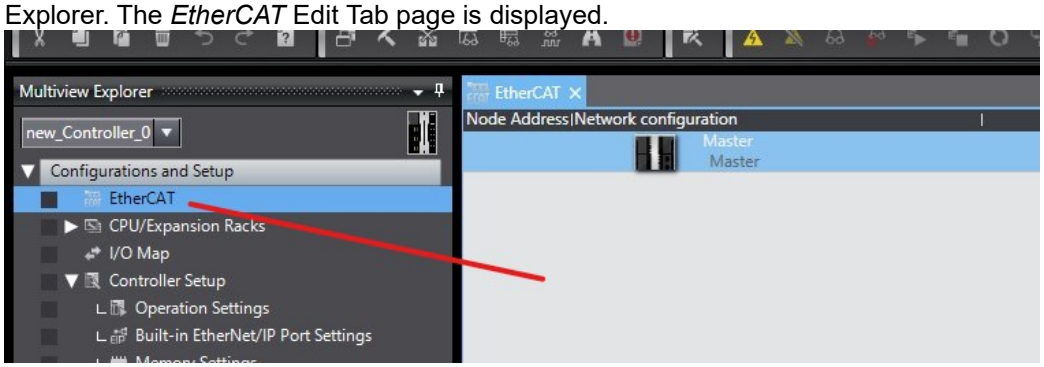
19.3 PLC Setup

19.3.1 Install EtherCAT Device Description File XML

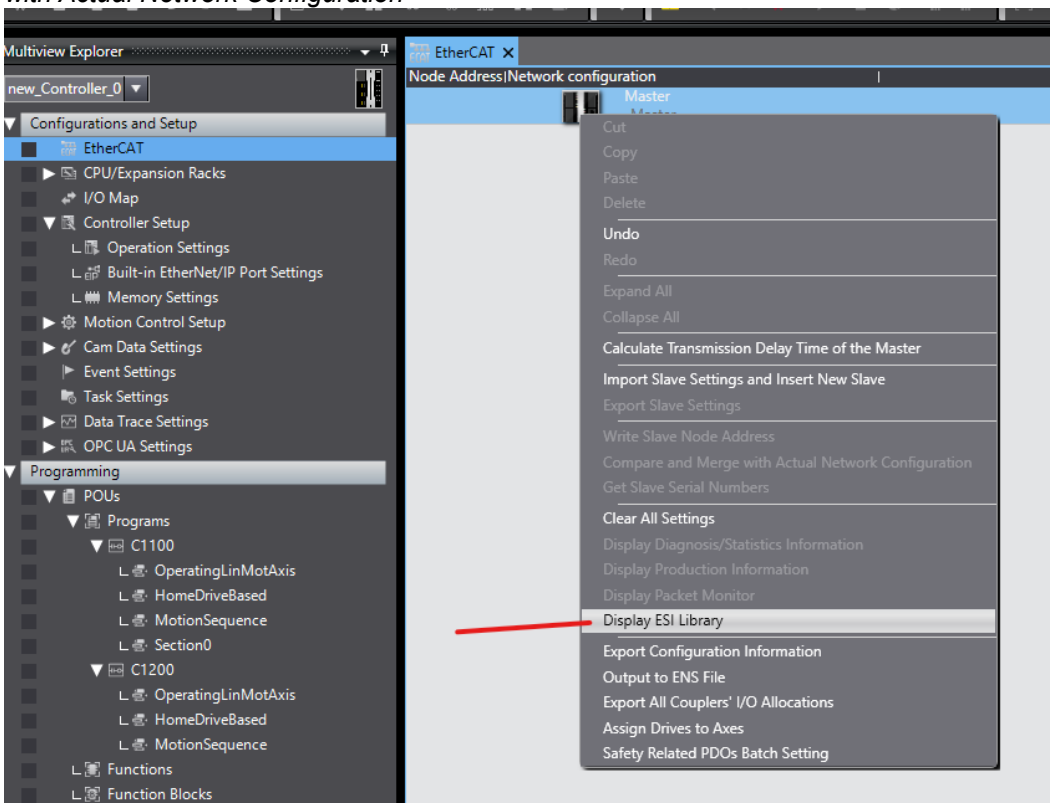
Find the most recent *ESI* file as described in chapter ***19.2.2 XML File***.

Install this file as follows:

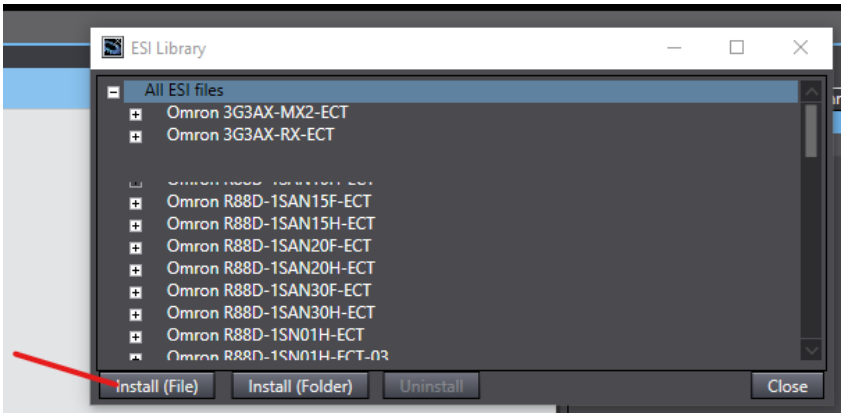
1. When *Offline* with the PLC, double-click *EtherCAT* under *Configuration and Setup* in the Multiview Explorer. The *EtherCAT* Edit Tab page is displayed.

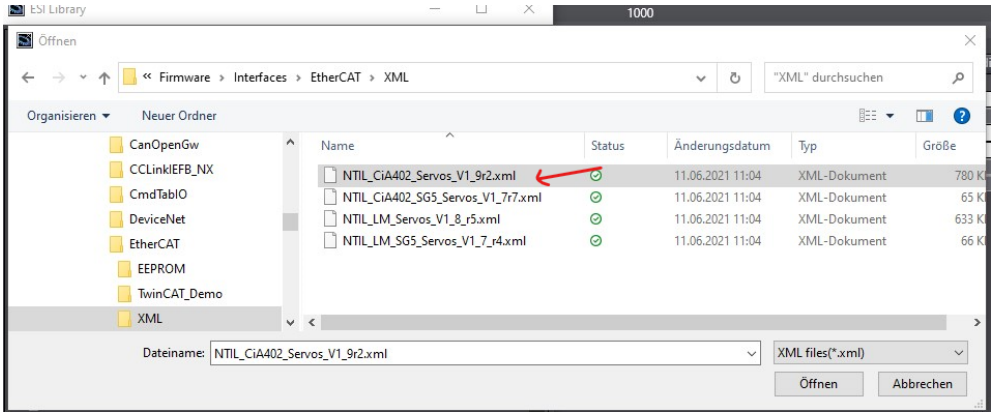


2. Scan EtherCAT network by right-click *Master* in the *Network configuration* and select *Compare and Merge with Actual Network Configuration*



3. Install XML file





19.3.2 Define EtherCAT node address on LinMot-Device

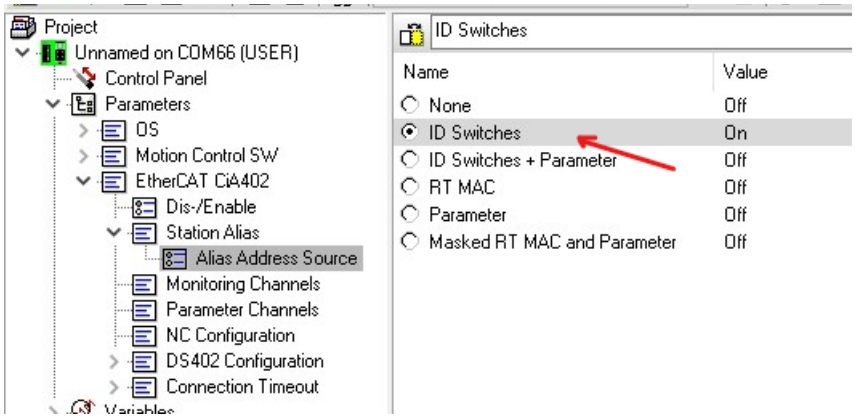
The accepted address range depends on the used PLC.
NJ, NX1: 1...192
NX7/NY: 1...512

OMRON does not support implicit addressing. But ***Node address "0"*** can be addressed by Sysmac Studio or with additional function blocks in the user program.

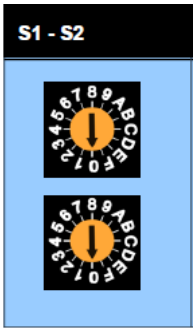
19.3.2.1 Set node address by address selector on device

This is the most popular way, because it is user-friendly to maintenance people.

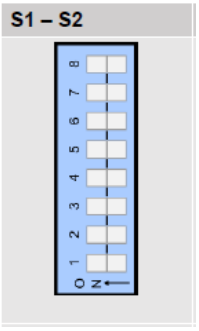
1. Select *ID Switches*



2. Depending on the LinMot-Drive the address selector is designed as Hex- or DIP-Switch.



Hex-Switch

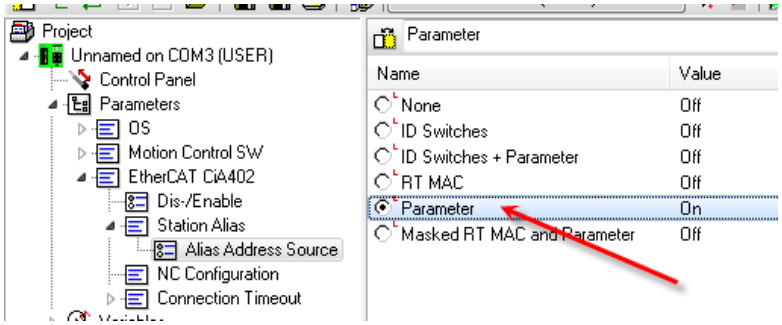


DIP-Switch

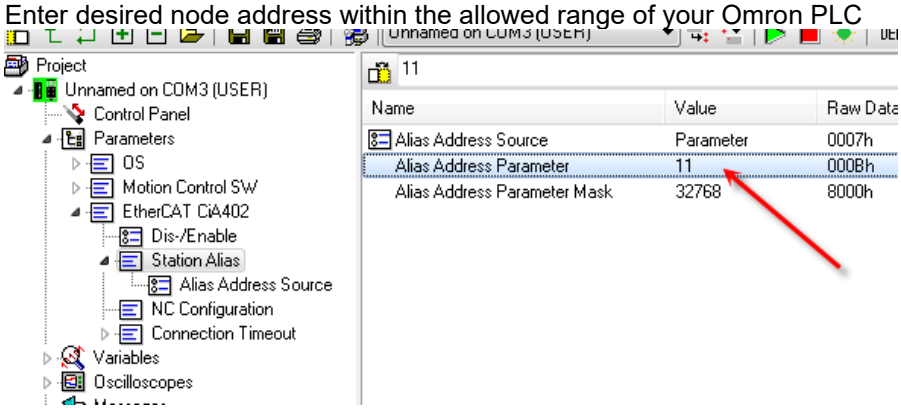
19.3.2.2 Set node address by parameter on device

The node address can be defined by parameter.

3. Select *Parameter*



4. Enter desired node address within the allowed range of your Omron PLC

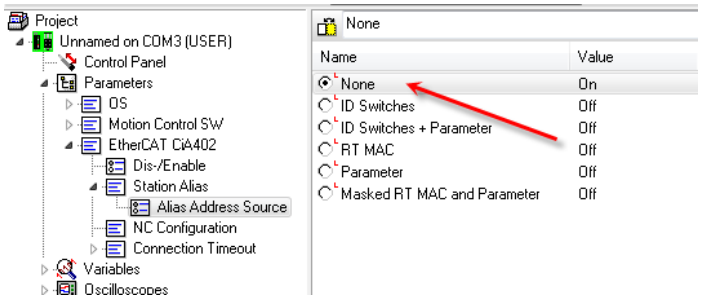


19.3.2.3 Write node address from Sysmac Studio

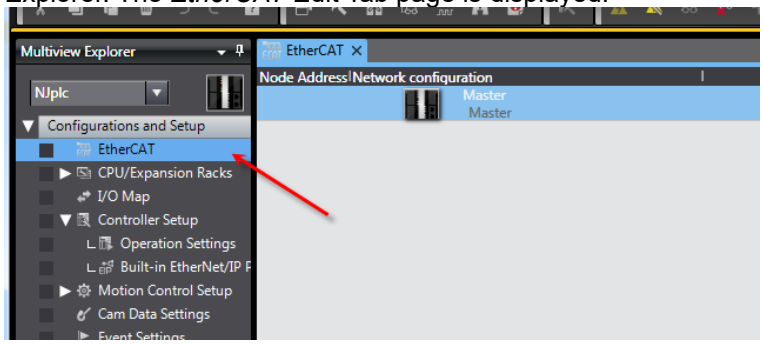
The node address can be written to the slave from *Sysmac Studio* (OMRON Software license required!).

This feature is currently not supported for **-MI** Drives

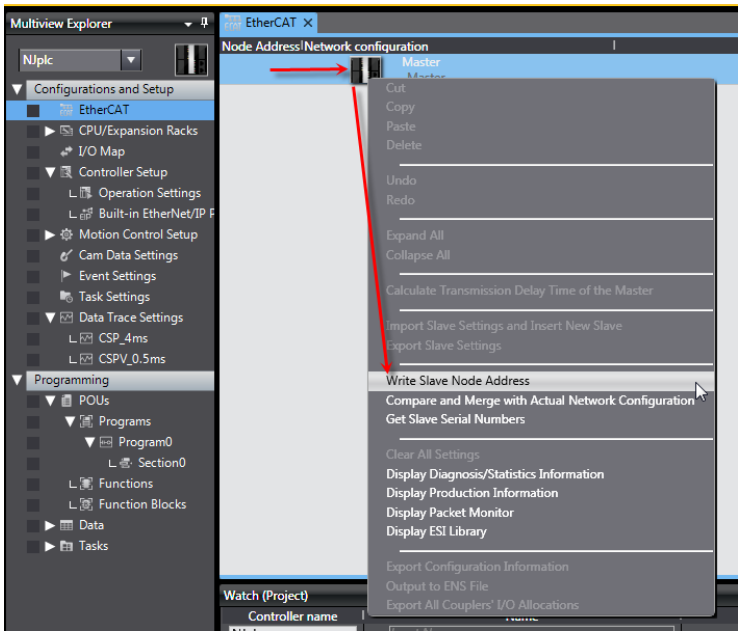
1. Select *None* and reboot drive



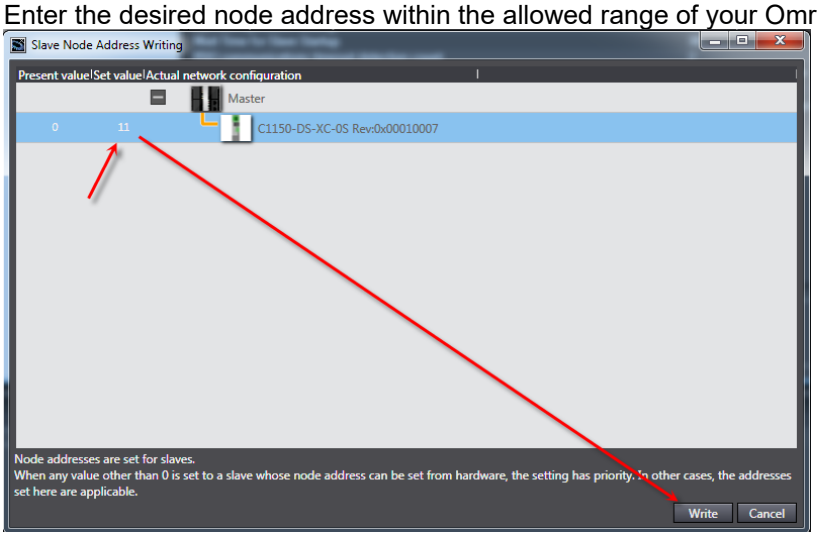
2. When *Online* with the PLC double-click *EtherCAT* under *Configuration and Setup* in the Multiview Explorer. The *EtherCAT* Edit Tab page is displayed.



3. Open the writing-tool by right-click *Master* in the *Network configuration* and select *Write Slave Node Address*



4. Enter the desired node address within the allowed range of your Omron PLC and reboot drive.

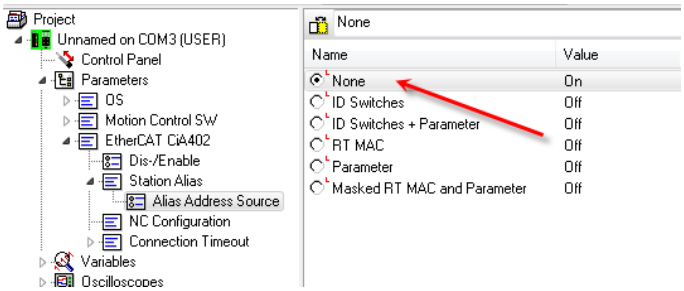


19.3.2.4 Set node address by function block

This feature is currently not supported for **-MI** Drives

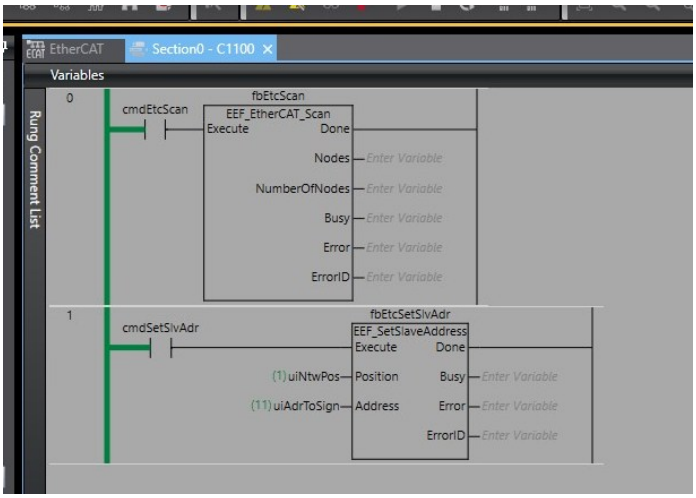
Omron supports a library with extended functions for EtherCAT: EthercatExtendedFunctions.slr

1. Select *None* and reboot drive



2. Use function block ***EEF_SlaveAddress*** to set a node address to the desired drive and reboot the drive.

   You may use function block *EEE_EtherCAT_Scan* to check the EtherCAT network before and after writing a slave address.

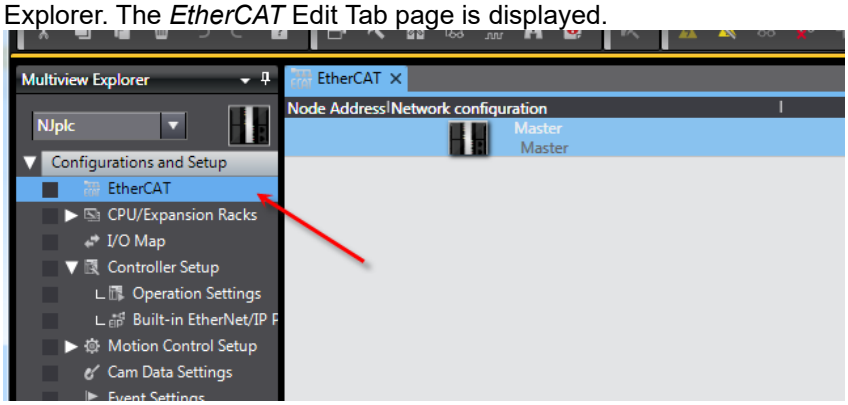


The OMRON library *EthercatExtendedFunctions.slr* can be requested by your local Omron support. It is an additional Library made by Omron ATC in Barcelona.

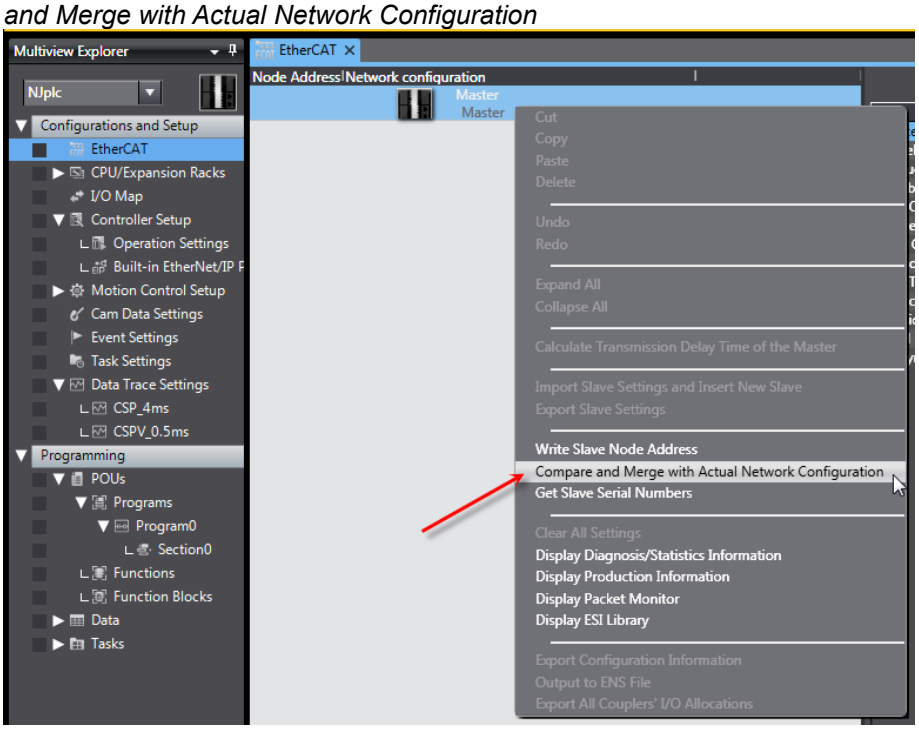
19.3.3 Scanning the EtherCAT network for devices

Follow these steps to add LinMot drives to your OMRON PLC.

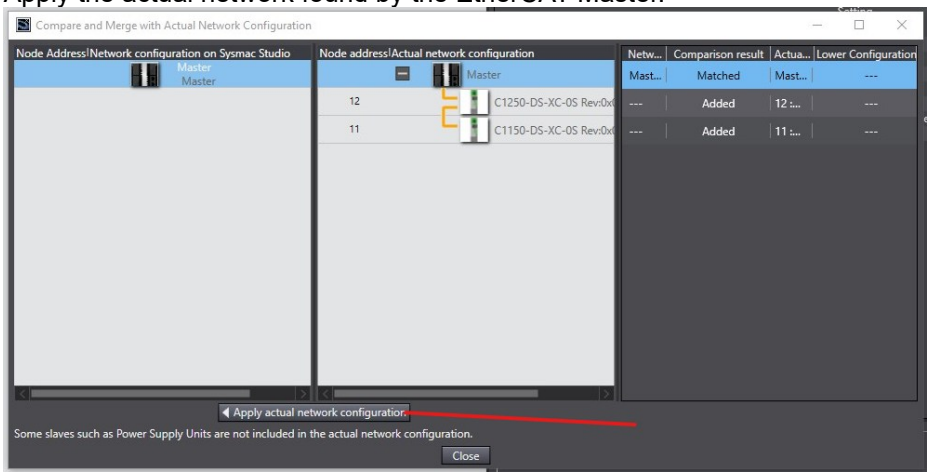
1. When *Online* with the PLC double-click *EtherCAT* under *Configuration and Setup* in the Multiview Explorer. The *EtherCAT* Edit Tab page is displayed.



2. Scan the EtherCAT network by right-click on the *Master* in the *Network configuration* and select *Compare and Merge with Actual Network Configuration*



3. Apply the actual network found by the EtherCAT Master.



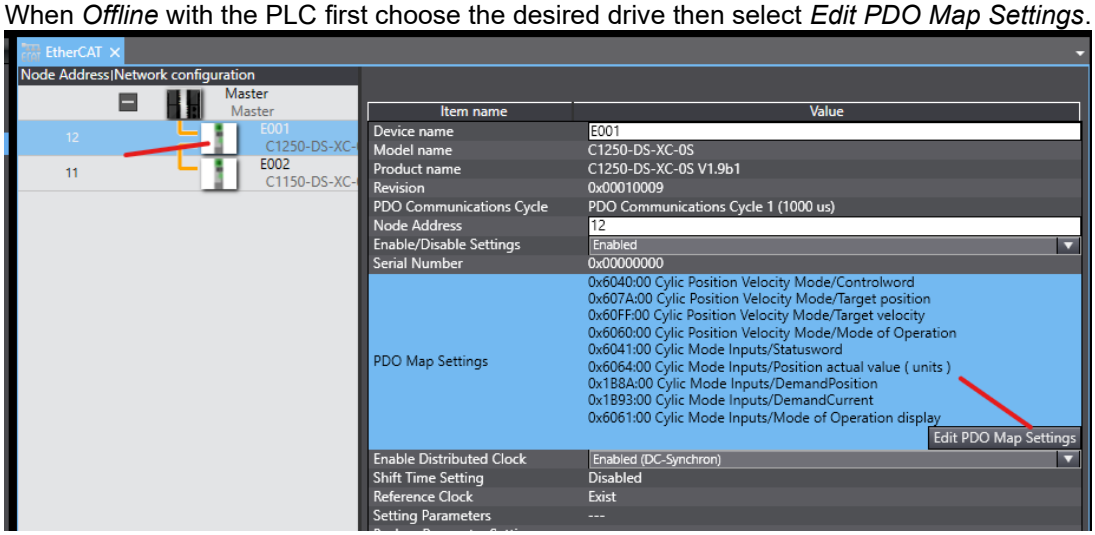
19.3.4 Edit PDO mapping

The following steps show how to setup the PDO mapping.

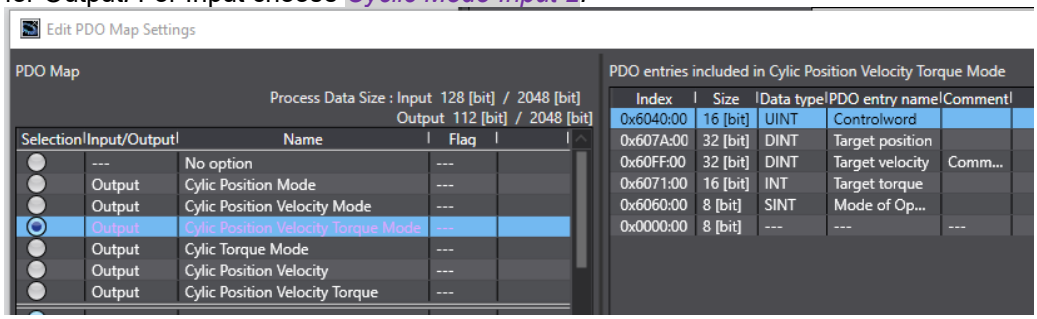
For standard (minimal) functionality, no change of the PDO mapping is required.

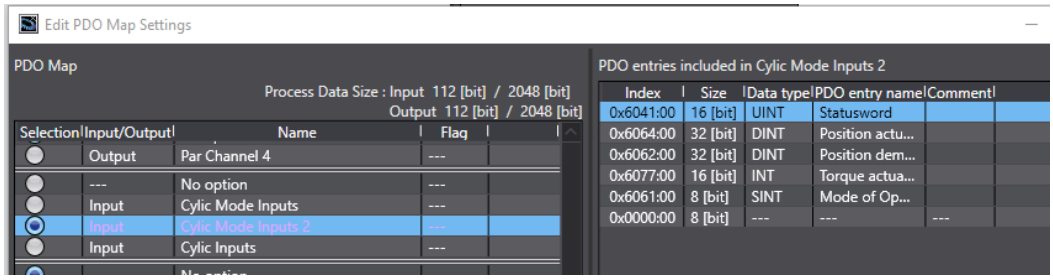
The less PDO's are mapped the less bandwidth is required - and therefore the performance of EtherCAT fieldbus will be higher.

1. Open PDO Map Dialog:
   When *Offline* with the PLC first choose the desired drive then select *Edit PDO Map Settings*.



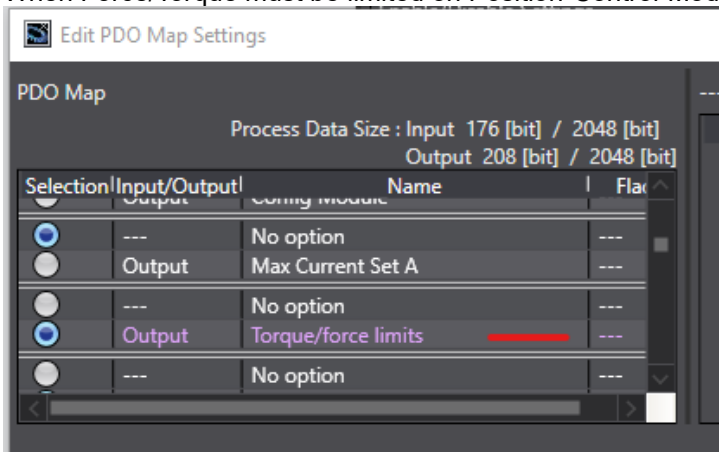
2. For full functionality (Position- AND Force/Torque-Control) choose *Cyclic Position Velocity Torque Mode* for Output. For Input choose *Cyclic Mode Input 2*.





3. For cyclic PDO transmission of any drive value/parameter choose *Par Channel X* for Output and *Mon Channel X* for Input.
   Please refer to chapter 19.8.1 for more information.

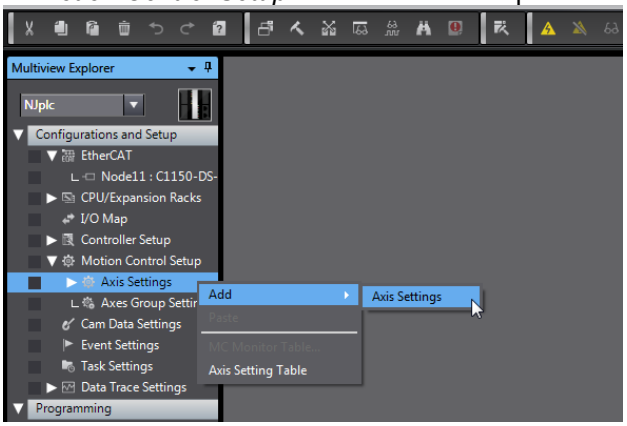
4. When Force/Torque must be limited on Position-Control-Mode, choose in addition *Torque/Force limits*.



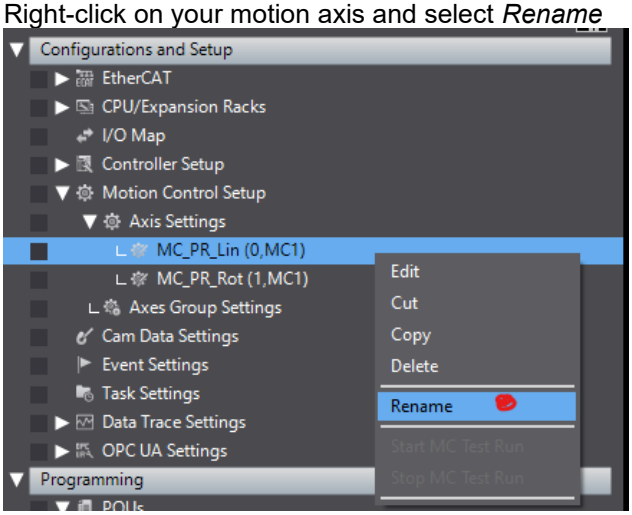
19.3.5 Create a motion axis and link it to your physical LinMot axis

Follow these steps to use the LinMot axis as a motion axis on your OMRON PLC.

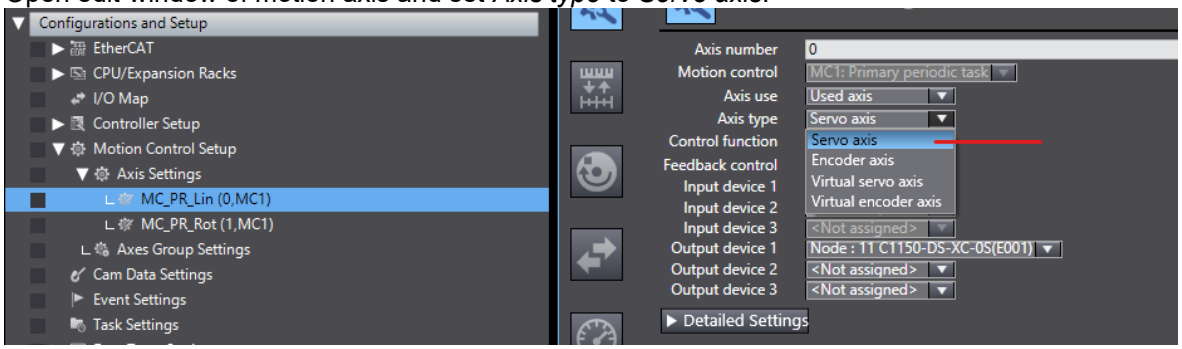
5. Create a motion axis:
   When *Offline* with the PLC right-click *Axis Setting → Add → Axis Setting* under *Configuration and Setup → Motion Control Setup* in the Multiview Explorer.



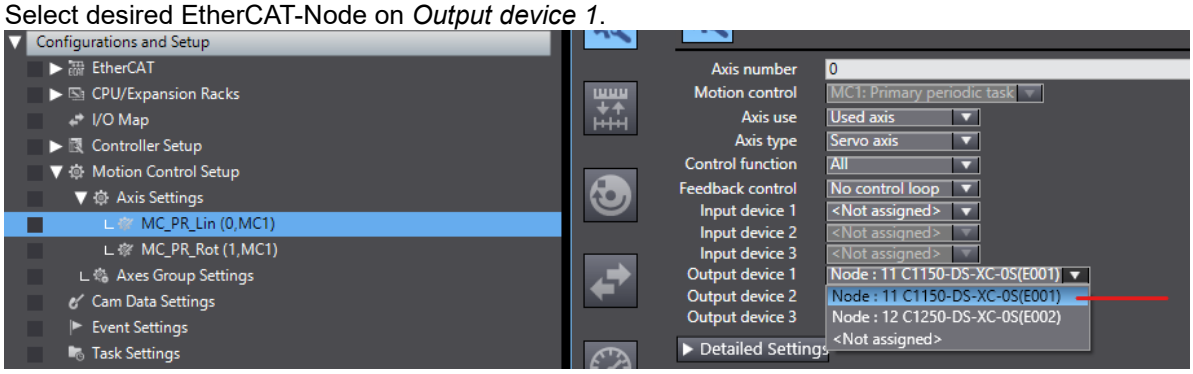
6. First assign a meaningful name to the axis.
   Right-click on your motion axis and select *Rename*



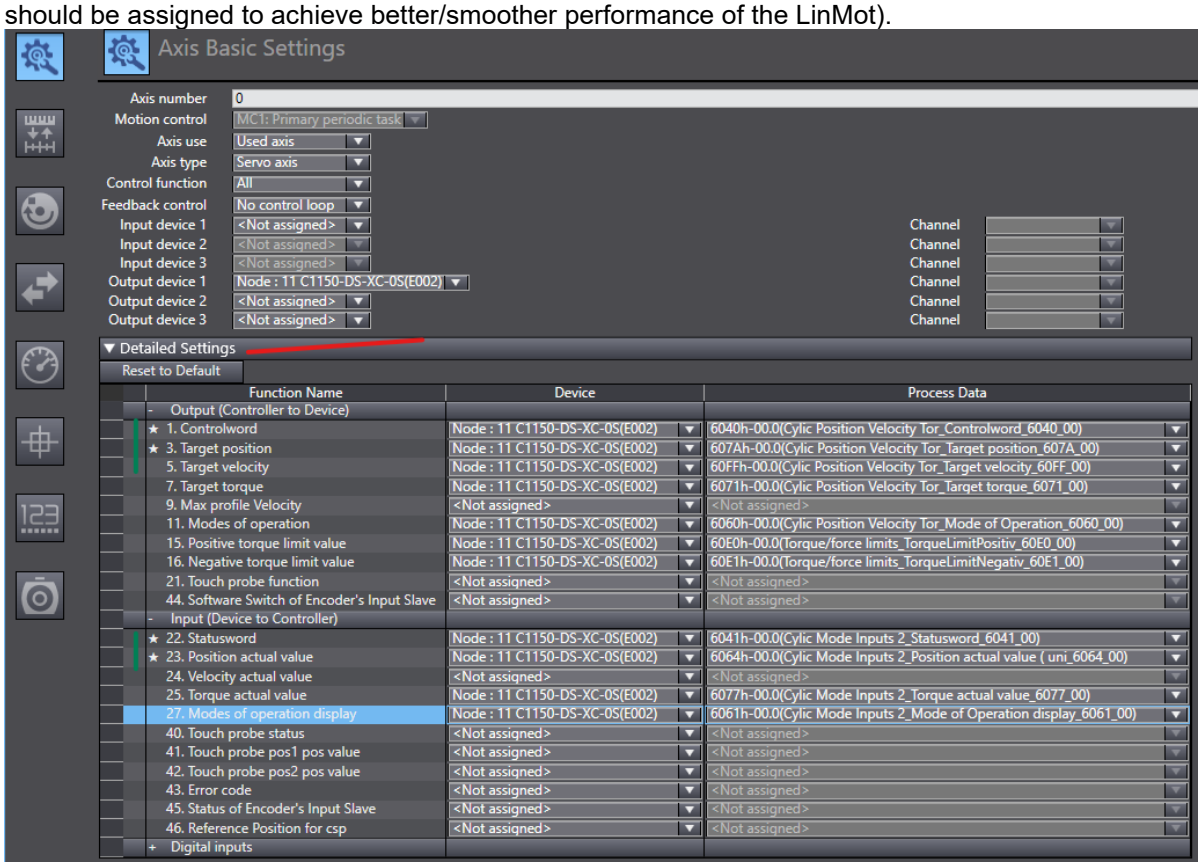
7. Set axis type.
   Open edit-window of motion axis and set *Axis type* to *Servo axis*.



8. Link physical axis to the motion axis:
   Select desired EtherCAT-Node on *Output device 1*.



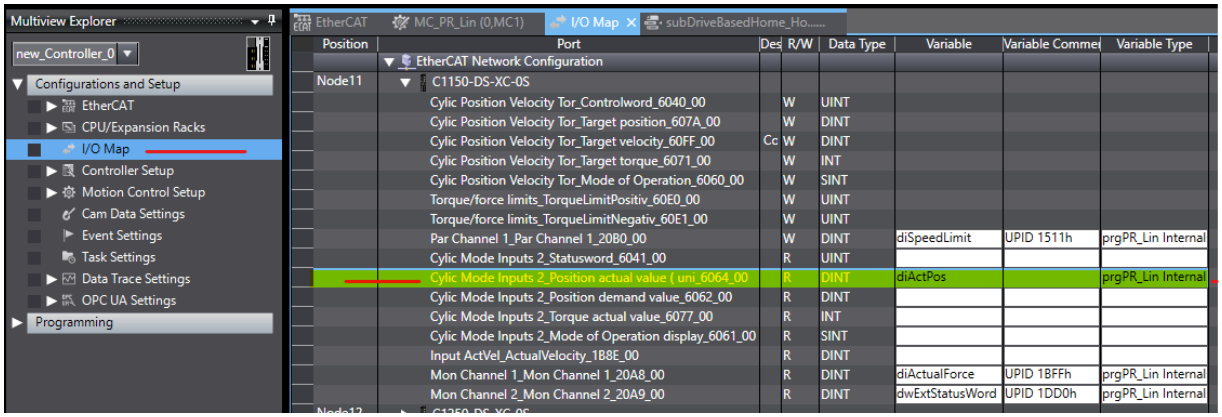
9. Assign PDO's of the axis
   Select *Detailed Settings* and assign Out- and Inputs as shown below.
   (Entries marked with a star are the minimal entries required from Sysmac. In addition, *Target velocity* should be assigned to achieve better/smoother performance of the LinMot).



10. OPTIONAL: When using drive-based-homing, assign the Actual-Position of Drive in the PDO mapping to synchronise it with the position value of the Motion-Axis on PLC.

    Open *Configuration and Setup → I/O MAP* in the Multiview Explorer. Select desired node and assign PDO 6064h as shown below.

    For detail description refer to chapter 19.5 (drive-based-homing).

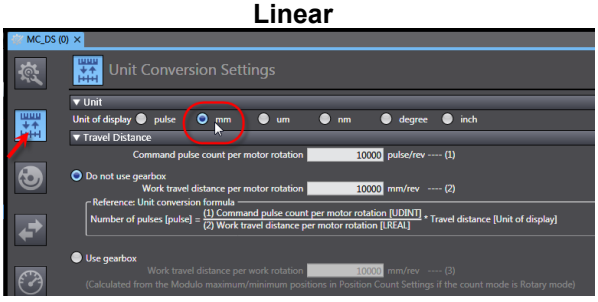


19.3.6 Setting up the motion axis

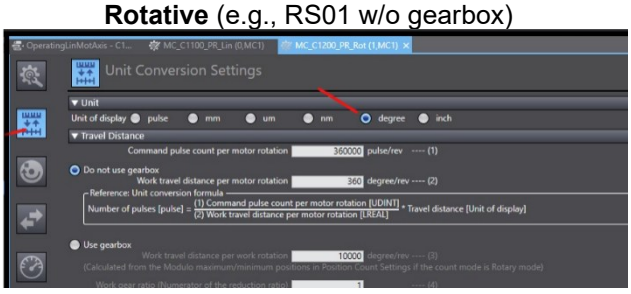
The following steps show how to basically setup the motion axis.

1. Set axis unit:
   Choose *Unit Conversion Settings* in the Edit-Window of your axis and set *Unit* to “mm”.

Linear



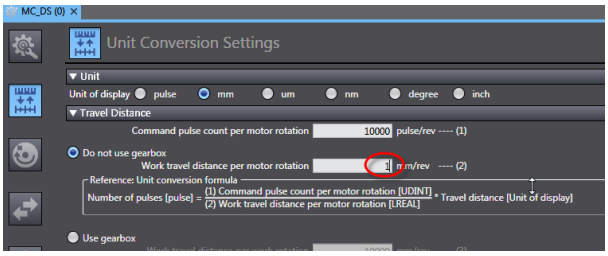
Rotative (e.g., RS01 w/o gearbox)



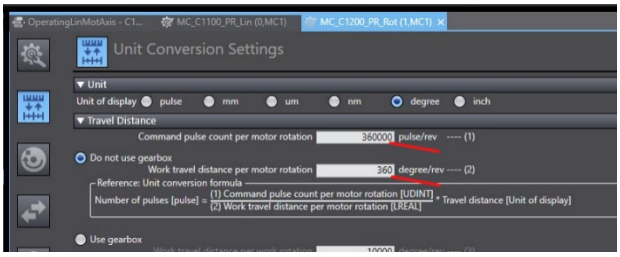
2. Set axis scaling:
   Set *Travel Distance* to standard value *10’000:1* [Ticks/mm] on linear axis or *360’000:360* [Ticks/rotation] on rotary axis.

For rotary motors, choose your desired work travel distance according to your mechanical system (gearbox, belt transmission, pinion etc.)

Linear

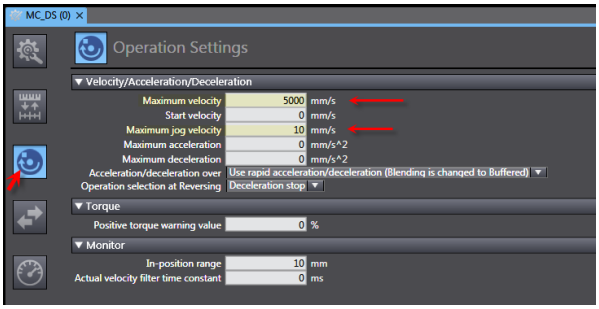


Rotative (e.g., RS01 w/o gearbox)

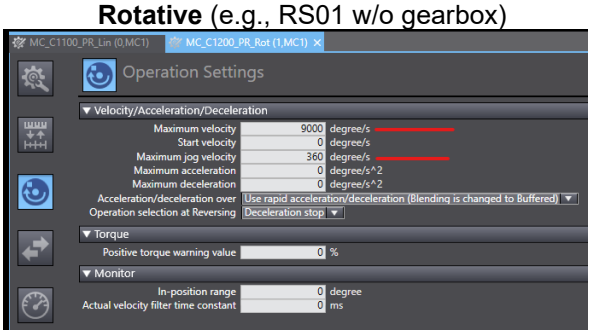


3. Set axis velocity limits:
   Choose *Operation Settings* and set your desired values at least into *Velocity* fields.

Linear



Rotative (e.g., RS01 w/o gearbox)

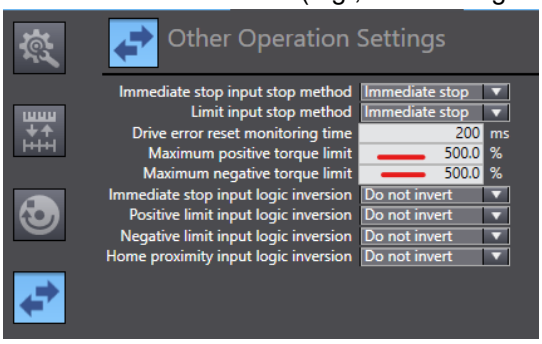


4. Set axis torque limits:
   In case force/torque must be limited in Position-Control-Mode, set torque limit to **500.0%**.
   Use motion instruction ***MC_SetTorqueLimit*** to limit force/torque of your motor.

Maximal value (equals to 500.0%) can be read out of motor:
LinMot-Talk / Variables / MC SW Motor / Maximal Force
Maximal Torque

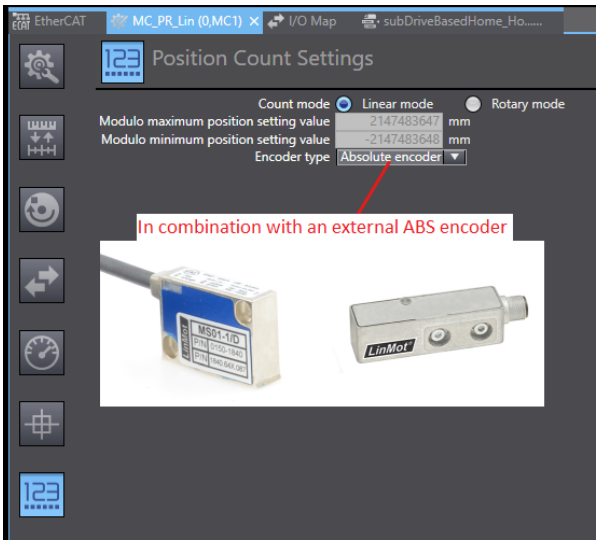
→ Max. value is defined by each individual motor and may vary slightly from datasheet.

Linear and/or **Rotative** (e.g., RS01 w/o gear)

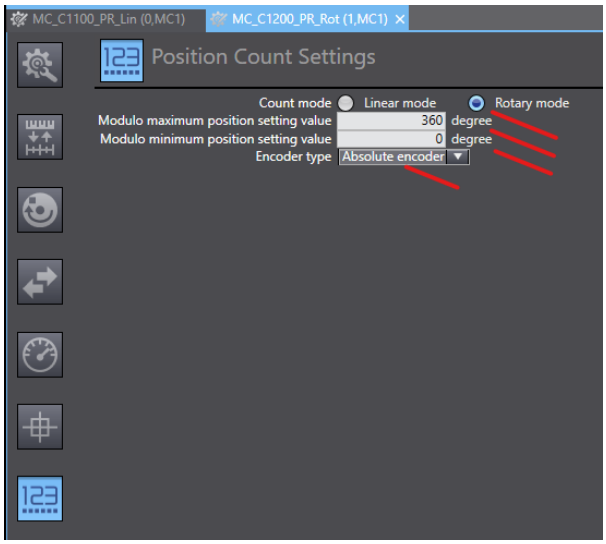


5. Configure ABS encoder and Modulo:
   In case of using a LinMot rotary motor (with single turn ABS encoder) or an external ABS encoder for linear motors, *Absolute encoder* must be selected. To use modulo functionality, select *Rotary mode*.

Linear with external ABS encoder



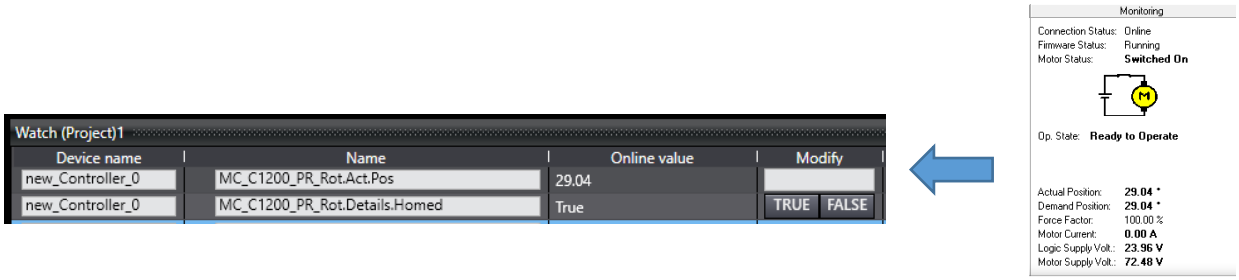
Rotative (e.g., RS01 w/o gearbox)



6. Transfer program to your PLC:
   Go Online and *Transfer*

19.4 Homing procedure on Sysmac with ABS Encoder

When using ABS encoder, there is no need for any homing procedure.



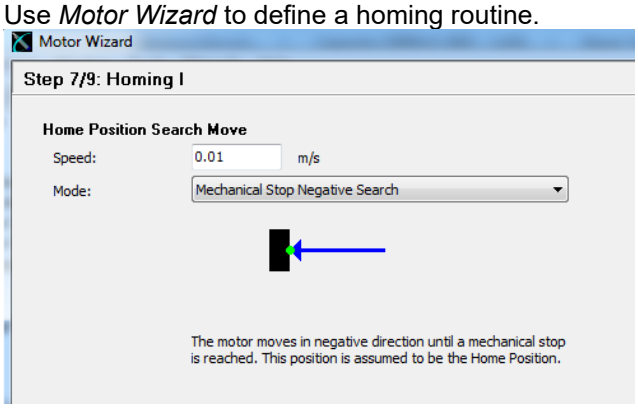
19.5 Drive Based Homing (INC Encoder)

In general, the easiest way to home a linear motor is to use homing routines predefined in the servo drive.

19.5.1 Settings on LinMot drive

The following setting are required on the drive.

1. Use *Motor Wizard* to define a homing routine.



19.5.2 Function blocks required on Sysmac

To operate a drive-based homing the following function blocks are used.

19.5.2.1 EC_CoESDORead

With this function block, the status word of the physical LinMot axis will be read.

Variables to declare:

	Data type	Value
Function block	EC_CoESDORead	
SDO Parameter	_sSDO_ACCESS	Index := 16#3D51, Subindex := 1
Read Data	ARRAY[0..3] OF WORD	Located in [0]

19.5.2.2 EC_CoESDOWrite

With this function block, the homing procedure will be executed and stopped.

Variables to declare:

	Data type	Value
Function block	EC_CoESDOWrite	
SDO Parameter	_sSDO_ACCESS	Index := 16#33F7, Subindex := 1 Index := 16#341F, Subindex := 1
Write Data	WORD	16#0 (FALSE) or 16#1 (TRUE)
Write Data Size	UINT	2 (Bytes to write)

19.5.2.3 MC_ResetFollowingError

With this function block, the position lag on the motion axis will be reset.

Variables to declare:

	Data type	Initial Value
Function block	MC_ResetFollowingError	

19.5.2.4 MC_HomeWithParameter

With this function block, the PLC motion axis will be homed.

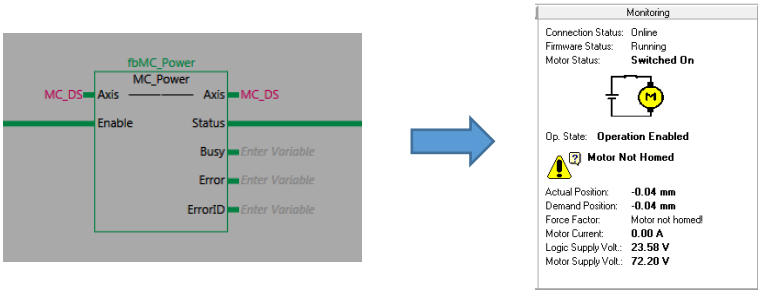
Variables to declare:

	Data type	Initial Value
Function block	MC_HomeWithParameter	
Homing Parameter	_sHOMING_REF	(HomingMode := _mcHomePreset) others irrelevant

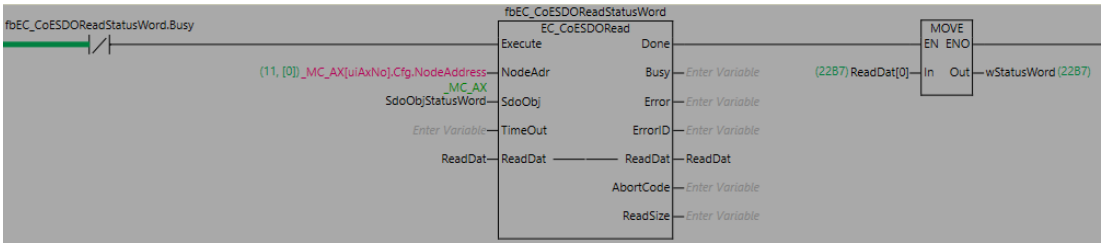
19.5.3 Homing procedure on Sysmac (motors with INC Encoder)

This section describes the *Drive Based Homing* sequence.

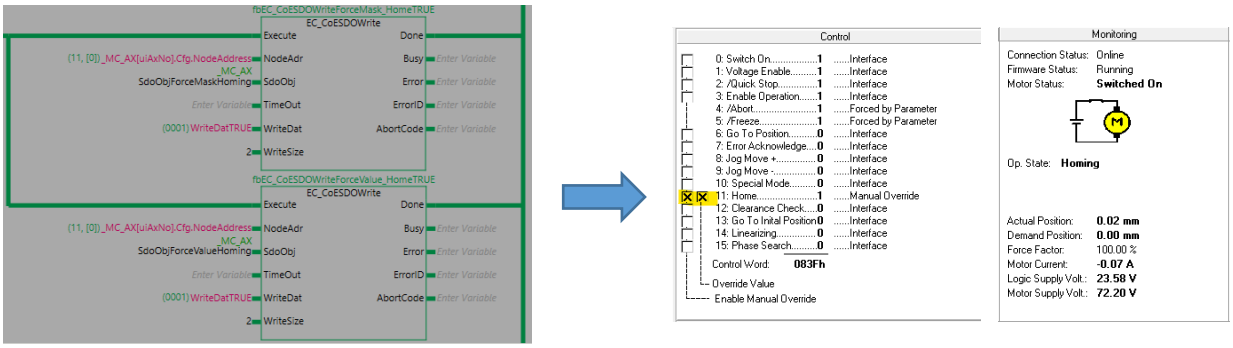
1. Use MC_Power instruction to make axis ready to operate.



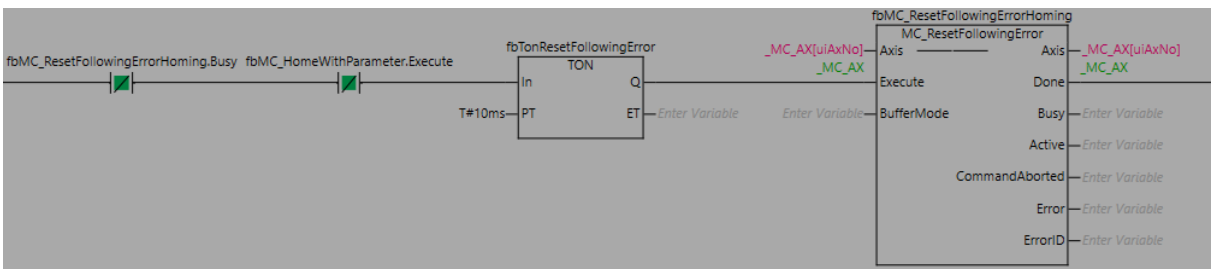
2. Read Status-Word of LinMot drive while homing to check Homed Bit.



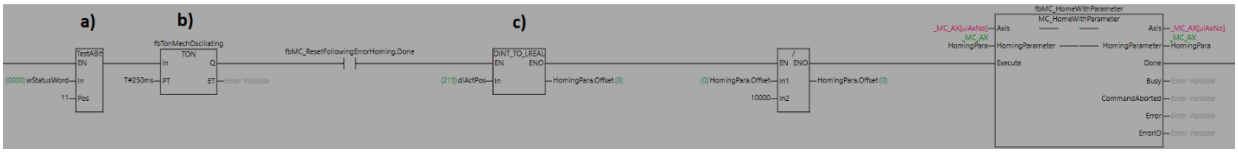
3. Execute homing by setting the *Home* within the *Control Word* to TRUE.

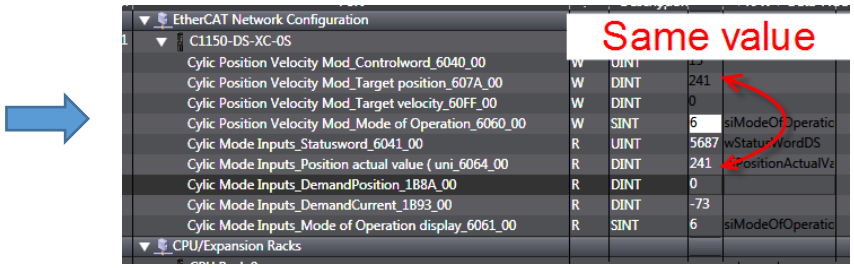


4. Clear the following-error of motion axis during *Drive Based Homing* otherwise malfunction can occur (e.g., when homing long stroke).
   It must be cleared, because Sysmac does not update the axis position during *Drive Based Homing*.

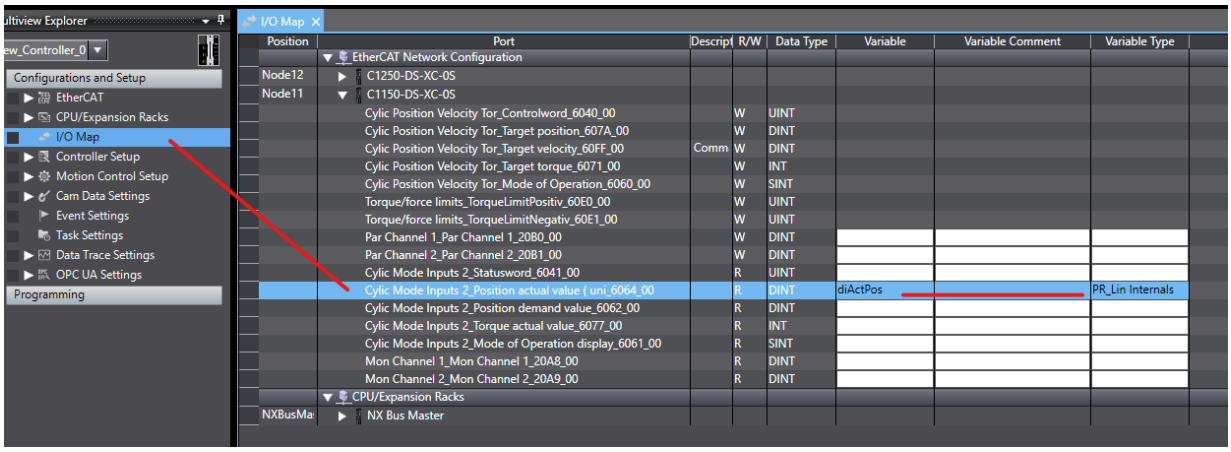


5. a) Observe Homed Bit in Status-Word of LinMot drive.
   b) When axis is homed, may wait a short time, until the axis does not oscillate due mechanical construction.
   c) Use Actual-Position[i] of LinMot drive as offset for MC_Homing on PLC.

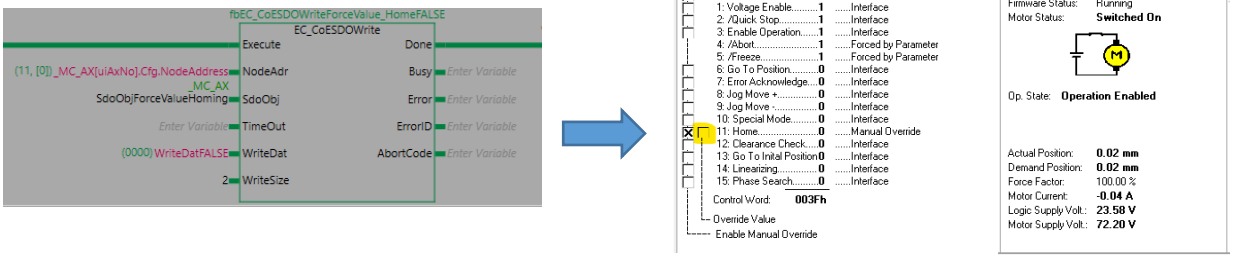




[i] Map a variable in I/O Map to have Actual-Position available. Also refer to chapter 19.3.5 10)

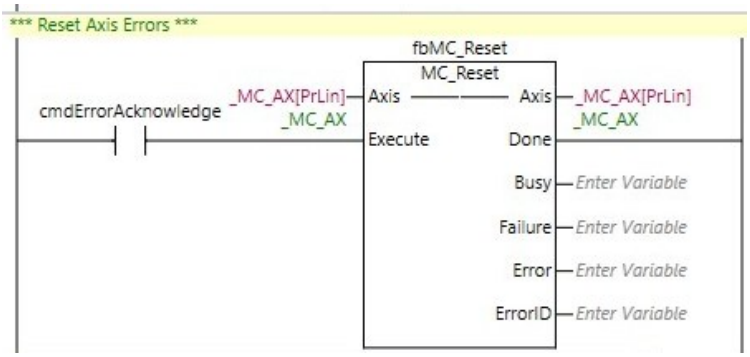


6. Reset homing by setting the *Home* within the *Control Word* to FALSE.



19.6 Drive reset to clear axis error

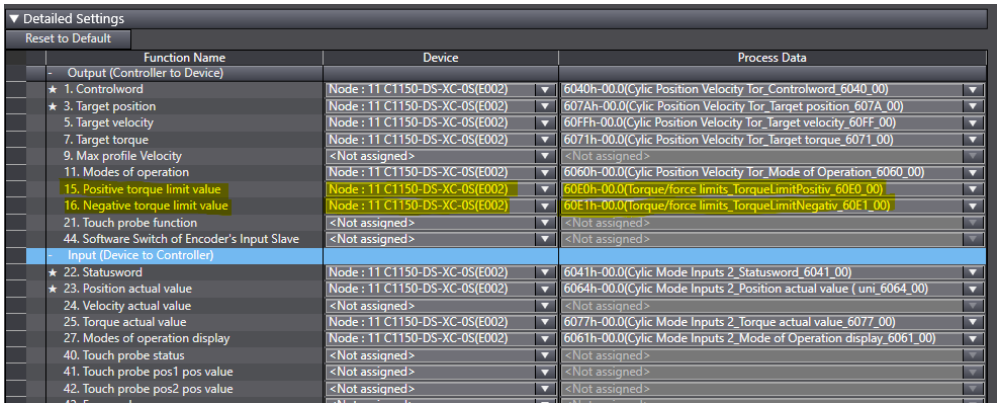
To acknowledge an error of a DS402 / CiA402 drive, use the standard motion instruction ***MC_Reset***.

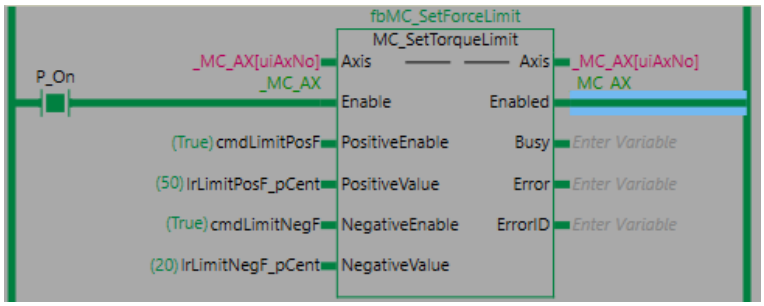


19.7 Control of force / torque

19.7.1 Limiting force or torque output in Position-Control-Mode

To limit output torque/force of a DS402 / CiA402 servo drive, use standard motion instruction ***MC_SetTorqueLimit***. Please make sure, the necessary PDOs are mapped.

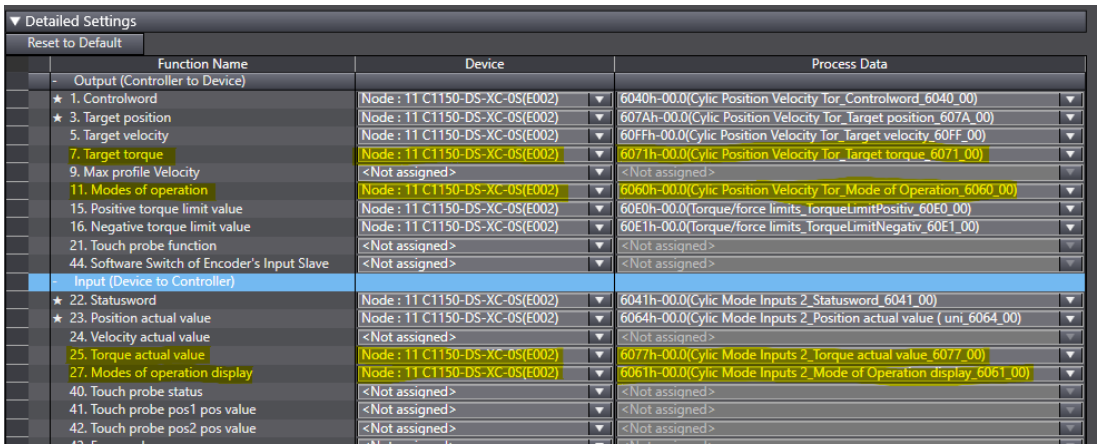


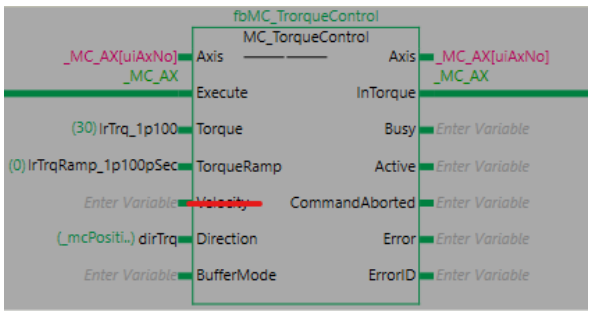


Value 500.0% equals to max. force or torque.

19.7.2 Control force or torque output in Torque-Control-Mode (CST Mode 10)

To control output torque/force of a DS402 servo drive, use standard motion instruction ***MC_TorqueControl***.
Please make sure, necessary PDOs are mapped, and parameter settings on drive are done correctly.



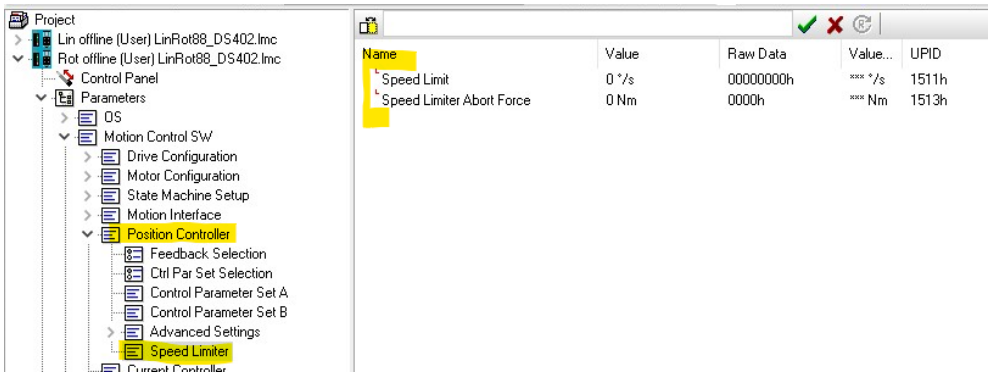


Torque 500.0% equals to max. force or torque.

The Velocity input of MC_TorqueControl is currently not supported for LinMot drives.
Use the Speed Limiter instead

19.7.2.1 Speed Limiter for Torque/Force-Control-Mode

To prevent overspeed while controlling force or torque, use the Speed Limiter.

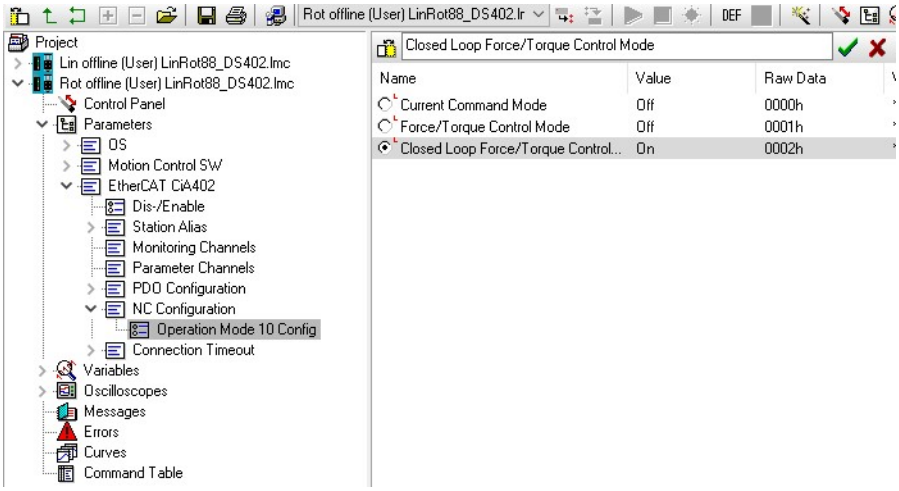


When the motor speed reaches *Speed Limit*, the drive switches to Position-Controlled-Mode.
The selected Control parameter Set (A or B) will become active!

Switching from Force/Torque- to Position-Mode and vice versa while the motor is moving, will always cause a bumpy behaviour.
Smoother reaction can be achieved by adjusting PID values of the corresponding control loops.

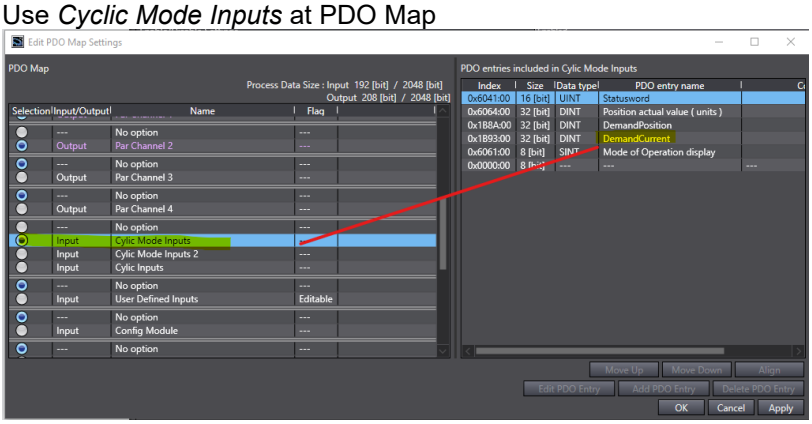
19.7.2.2 Torque/Force-Control-Mode in CST Mode 10

If using an additional force or torque sensor, Closed-Loop Control Mode must be selected on drive.



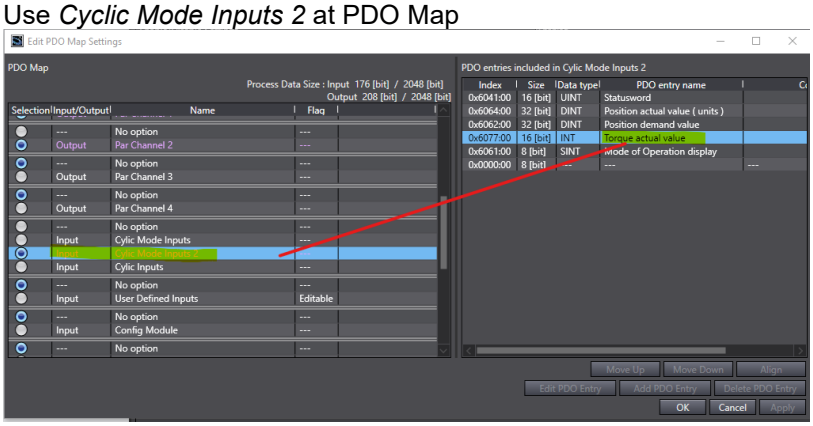
0000h: Current Command Mode
This mode is only for reverse compatibility with FW older than V6.10!

Use *Cyclic Mode Inputs* at PDO Map



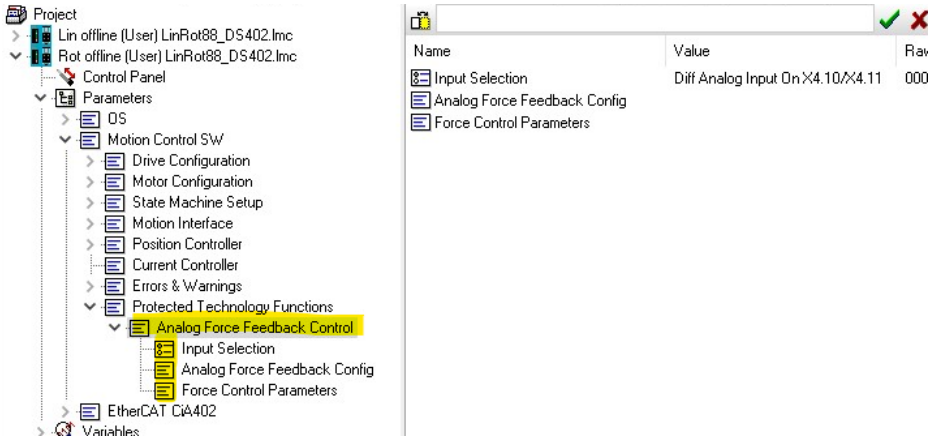
0001h: Force/Torque Control Mode
This mode corresponds to DS402.

Use *Cyclic Mode Inputs 2* at PDO Map



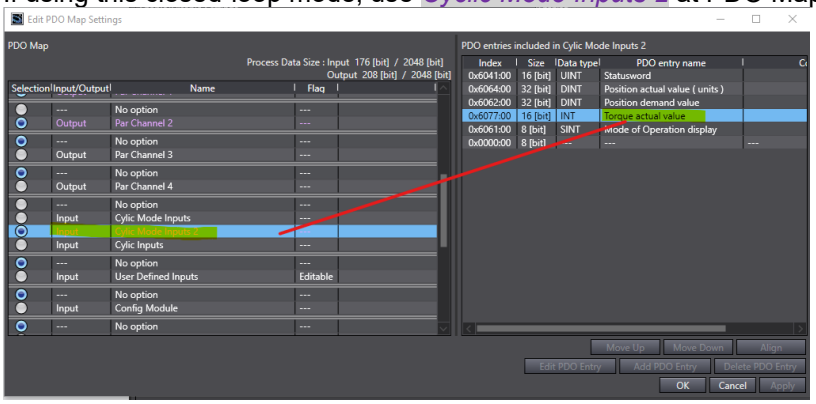
0002h: Closed-Loop Force/Torque Control Mode
In addition to *0001h: Force/Torque Control Mode*, this mode requires TF-Force Control (Technology Function).
LinMot-Article: 0150-2503

It is used in combination with an external torque or force sensor such as TS01 or TS02 on a PR-module.
These sensors must be wired directly to the drive.



Make sure all parameters in Analog Force Feedback Control are set correctly.

If using this closed-loop mode, use *Cyclic Mode Inputs 2* at PDO Map.



19.8 Parameter Access

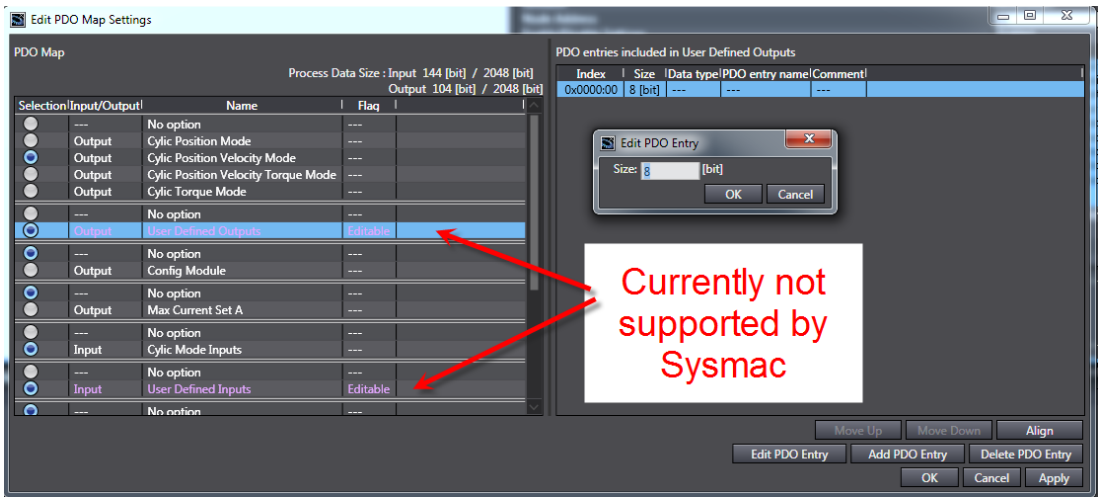
19.8.1 PDO Access

For cyclical write or read access of any parameter or variables, up to 4 channels each can be used.

OMRON does not support *User Defined In- or Outputs* for PDO. Please use up to 4 Parameter and Monitoring Channel each instead.
If no real-time access is required, use SDO for reading or writing values/parameters.

➔ Use parameter channels for cyclical write access.

➔ Use monitoring channels for cyclical read access.

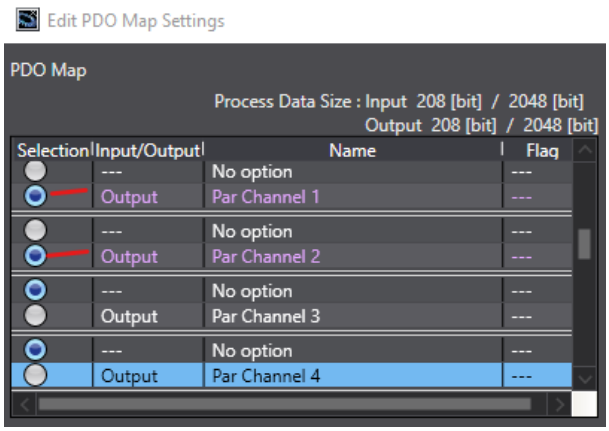


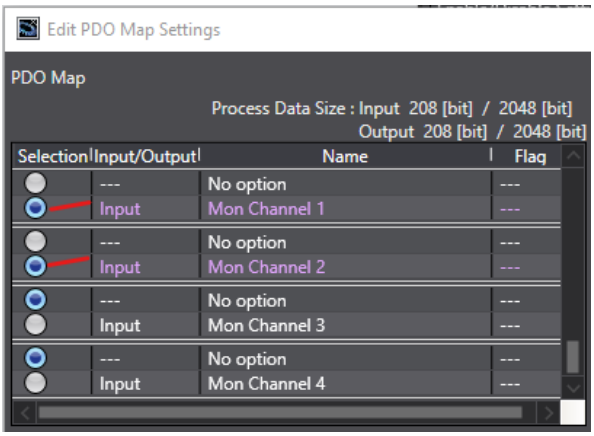
19.8.2 Example for user defined PDO access

In this example two channels each are used for a PR02-module (rotary motor for torque control).

19.8.2.1 PDO Map

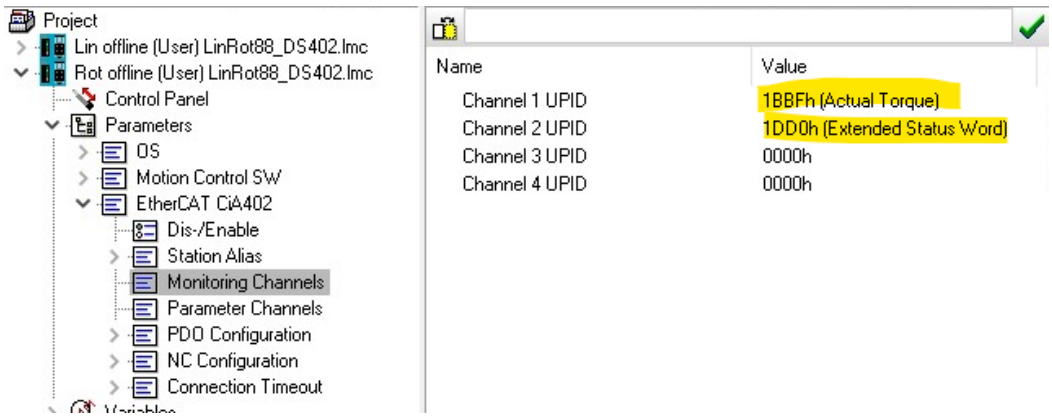
Use *Edit PDO Map Settings* at desired EtherCAT node.



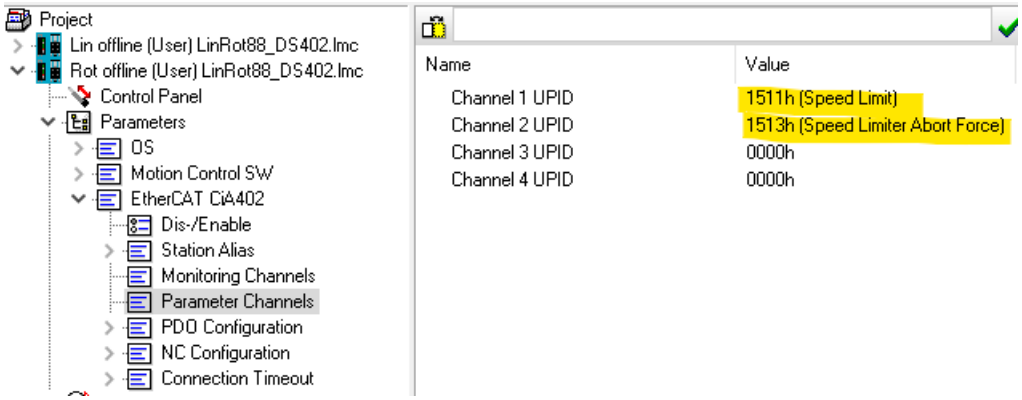


19.8.2.2 I/O Map

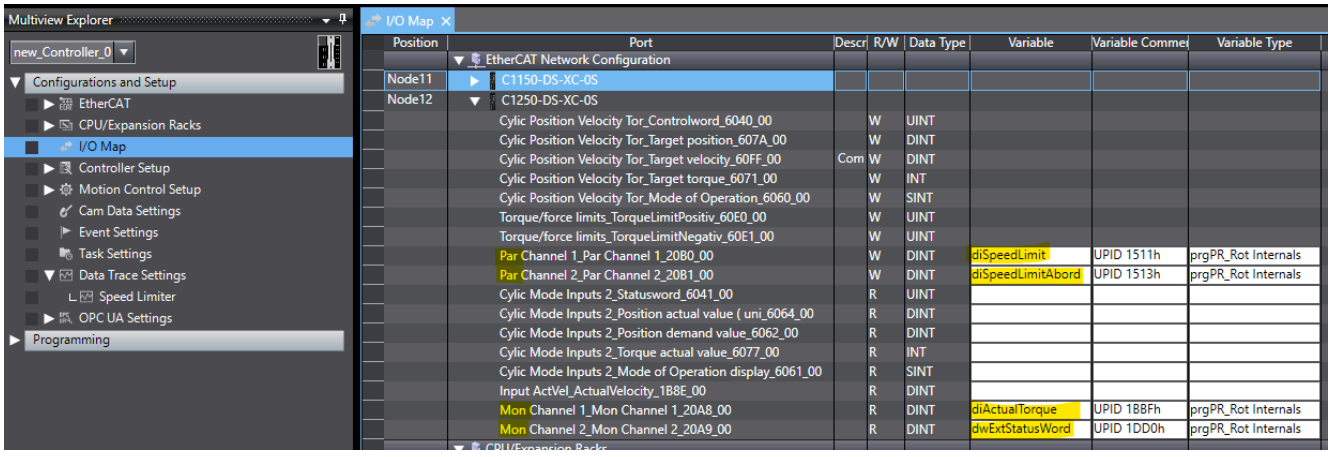
On the drive assign UPID *Actual Torque* to and *Extended Status Word* to the **Monitoring** Channels



And to the **Parameter** Channels assign UPID of *Speed Limit* and *Speed Limiter Abord Force*.



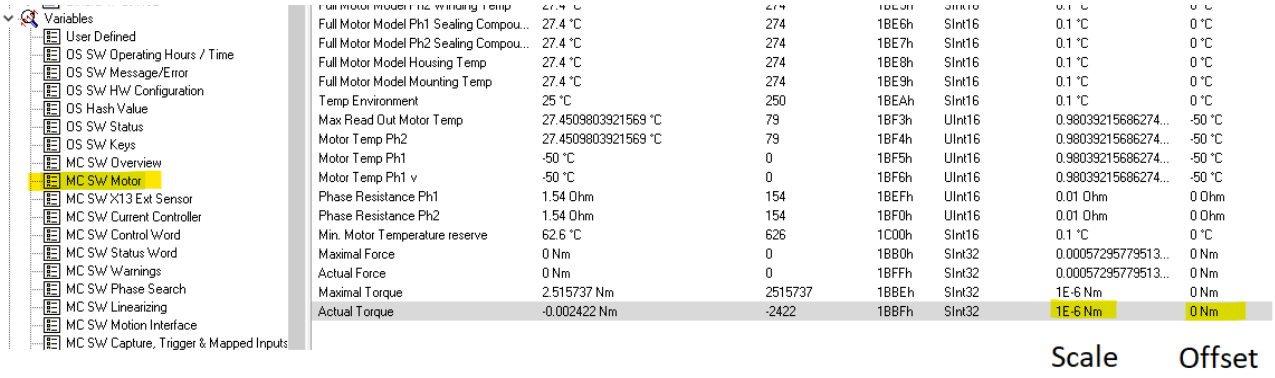
On Sysmac assign a DINT or a DWORD to the selected PDO channels.

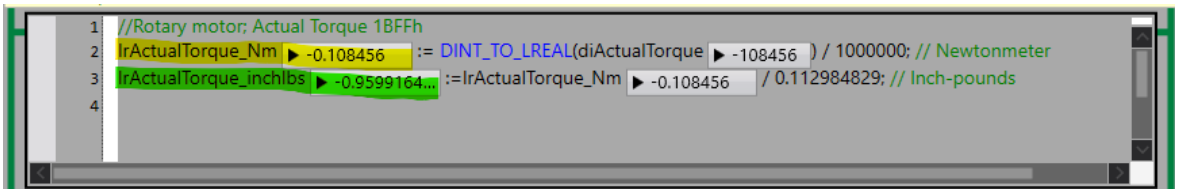


19.8.2.3 Scaling of mapped PDO

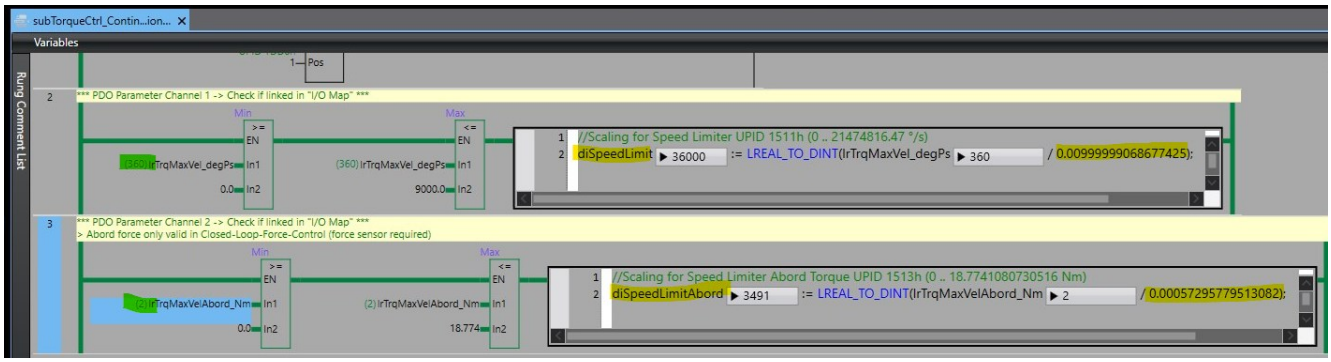
Check scale and offset of all used UPIDs and recalculate them on Sysmac

Example *Actual Torque:*

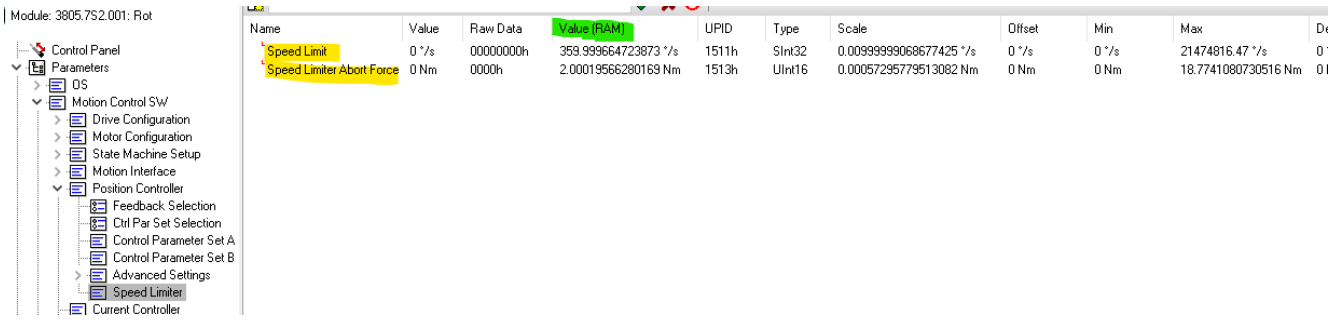




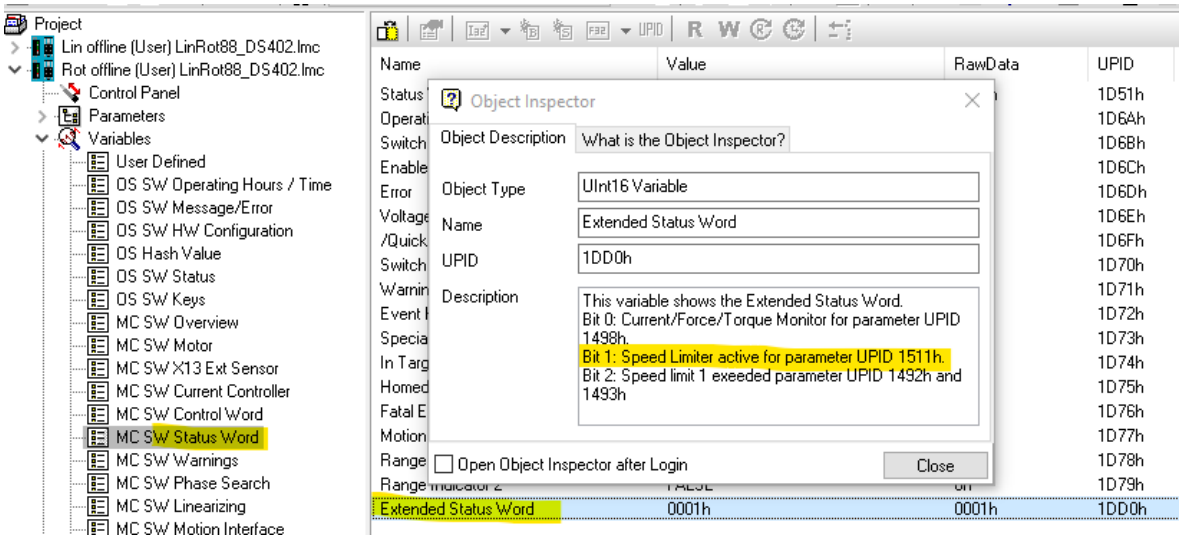
Example *Speed Limit* and *Speed Limit Abort Force:*



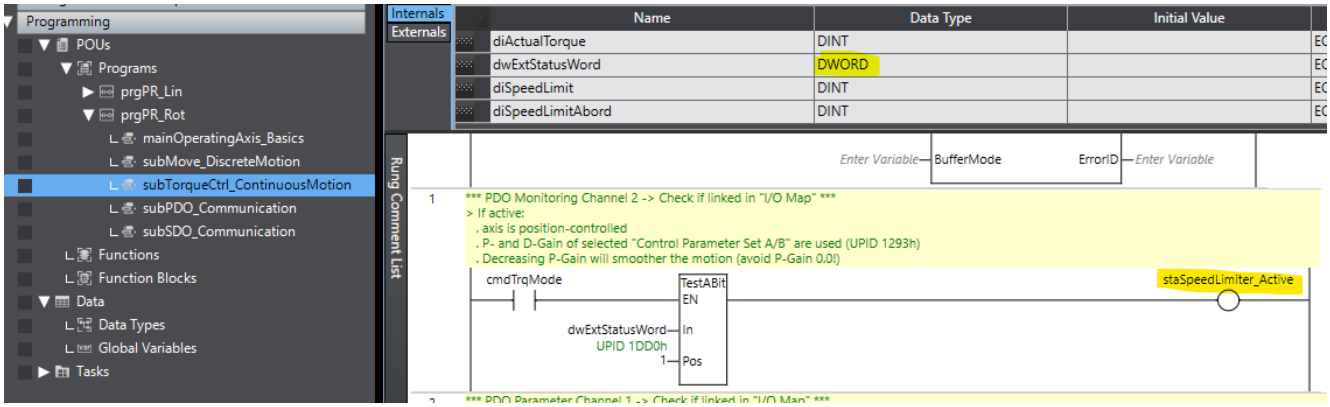
➔ Check the value of the parameter always in RAM



Example *Speed Limiter Active:*



➔ For Bit variables DWORD instead of DINT can be used to make masking easier.

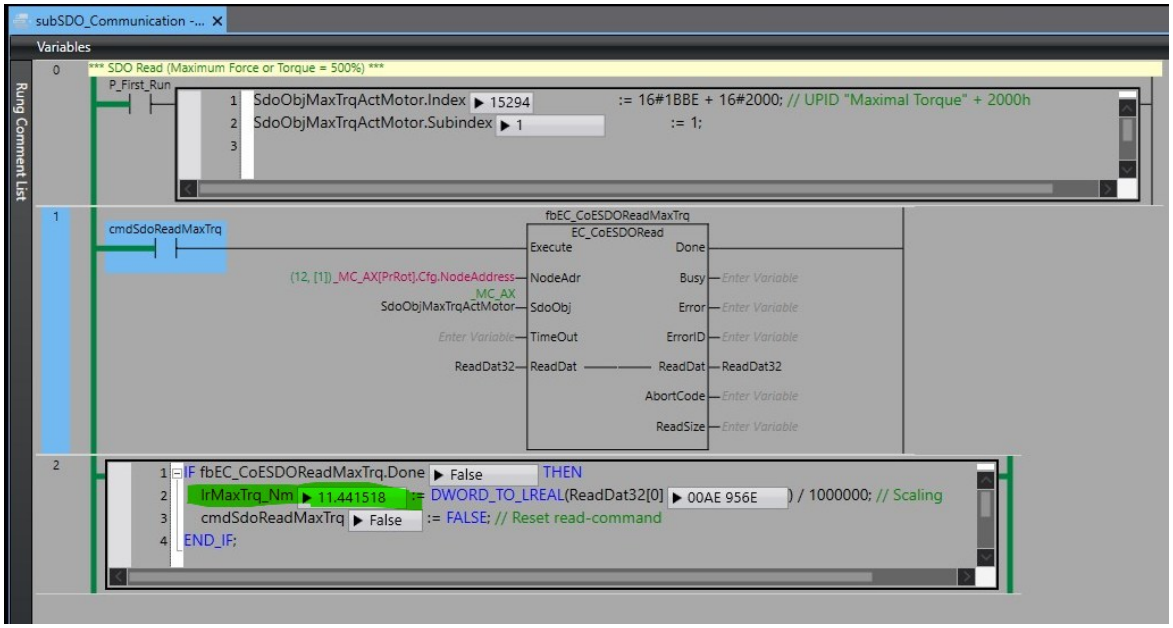


19.8.3 SDO Access

Parameters of the LinMot drive can be accessed using the Omron function block *EC_CoESDORead* and *EC_CoESDOWrite* which are part of Sysmac library.

More information about this function blocks can be found in the *Instructions Reference Manual (W502)* from Omron:
https://industrial.omron.eu/en/home (search for *W502)*

Example calls of this function blocks can be found in the example project (see chapter 19.1).



NodeAdr: EtherCAT-Slave node address

SdoObj.Index: Parameter address to be accessed = **16#2000** + UPID

SdoObj.Subindex: Parameter memory area to be accessed.
01: Read and write the **RAM** value of the UPID.
02: Read and write the **ROM** value of the UPID.

Attention ROM Access:
Intense use of writing into the ROM memory can reduce the lifetime of the drive memory!
More details can be found in the *Drive Configuration Over Fieldbus (0185-1074)* user manual
> see chapter Documentation / User Manuals

Note:
Use *EC_CoESDORead* and *EC_CoESDOWrite* from Omron to access drive parameters.

Advanced: Stop / Start MC and Application SW and reboot drive
The SDO-index 16#2000 allows

1. Stopping the MC and Appl SW for flash access or to setup the drive from the PLC
2. Starting the MC and Appl SW after flash access and to load changed ROM values to RAM,
3. Rebooting the drive (warm start).

Subindex 16#35 ▶ Stop MC and Application SW
Subindex 16#36 ▶ Start MC and Application SW
Subindex 16#0B ▶ Reboot drive

20 Drive Profile: TRIO, CiA402

20.1 Overview

This chapter shows how a LinMot drive with *DS402 (CoE) / CiA402* interface (e.g., C1250-DS-XC-1S) can be integrated and setup as axis in a TRIO motion controller.

Download:
An example project can be downloaded from:
http://download.linmot.com/plc_lib/examples/TRIO (named *LM_TRIO_DS_Demo...*)

Attention:
Drive firmware **6.10 Build 20210521 or later** is required to use all the functionality shown in this chapter.

Components used:

- LinMot C1250-DS-XC-1S-000 (article number 0150-2416) with firmware 6.10 Build 20210521
- TRIO MC4N ECAT (P904) v2.0309
- Motion Perfect v5.1.1

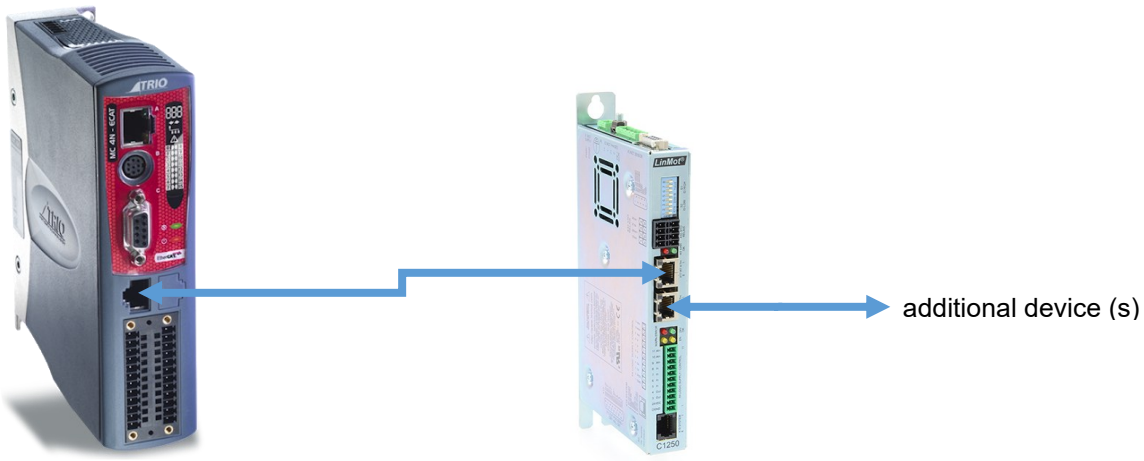


Image Source: http://www.triomotion.uk/

EtherCAT is the real-time Ethernet network originally developed by Beckhoff. The LinMot acts as Slave in this network and is implemented with the standard ASIC ET1100 from Beckhoff.

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

20.2 Configuration and Connection of the LinMot Drive

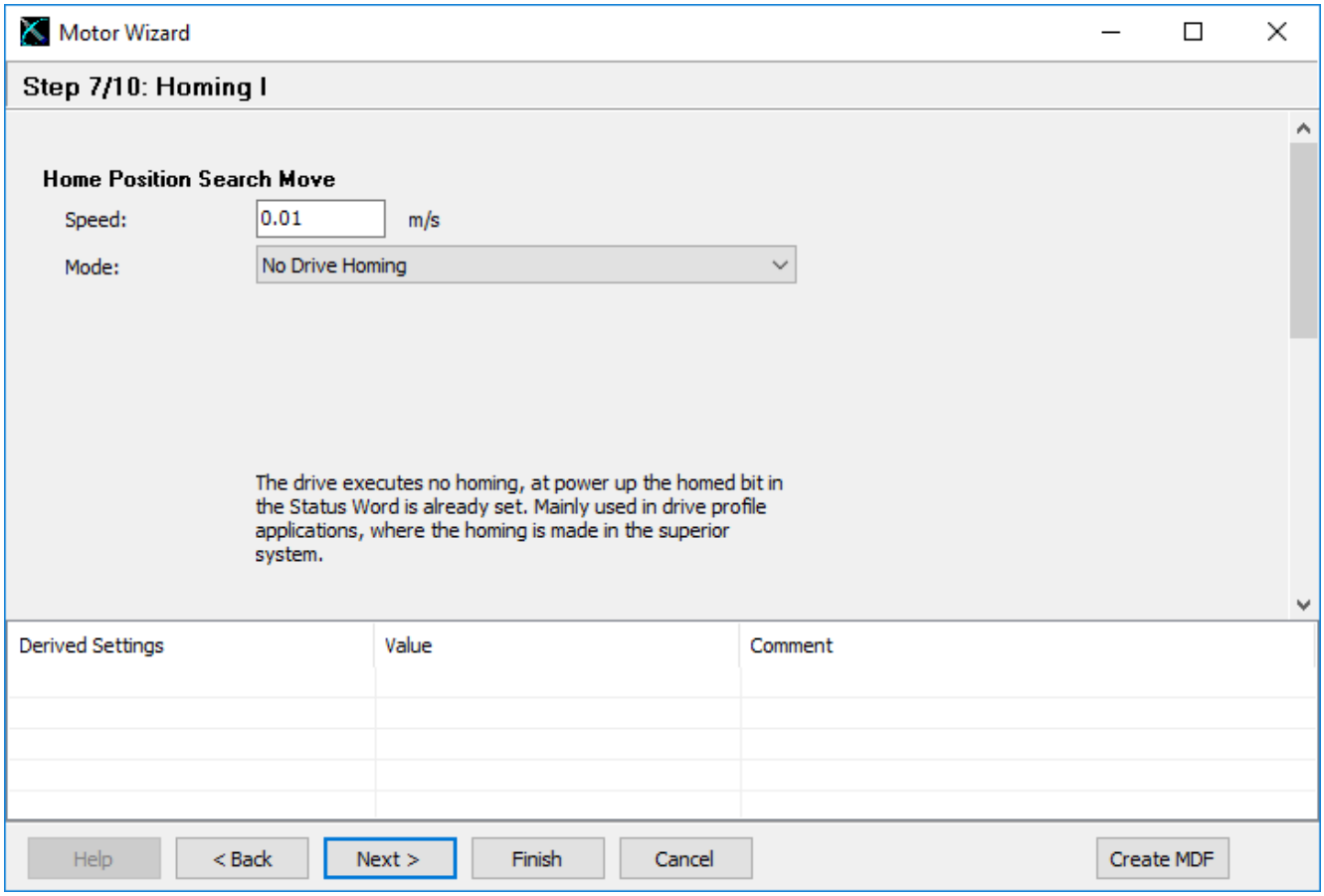
The LinMot drive is configured using the LinMot-Talk software:
http://www.linmot.com/download/linmot-talk-drive-configuration/

20.2.1 Motor Configuration

It is assumed that the motor connected to the drive is already configured.

Use the *Motor Wizard* inside LinMot-Talk to setup the motor (Menu -> Drive -> Motor Wizard):

Make sure that you select “No Drive Homing” in the Motor Wizard as with TRIO the homing of the axis is done in the PLC (DS402 mode of operation 6 is not yet supported).



See Appendix I: Basic Position Control Loop Tuning

20.2.2 XML File

Install the XML file that is part of the LinMot-Talk software/firmware you are using.
The most recent device files are always part of the newest LinMot-Talk software. They are located by default:

- EtherCAT CoE: \\LinMot-Talk X.X Build XXXXXXXX\Firmware\Interfaces\EtherCat_Nx\XML\ **(-MI drives)**
- EtherCAT CoE: \\LinMot-Talk X.X Build XXXXXXXX\Firmware\Interfaces\EtherCAT\XML\

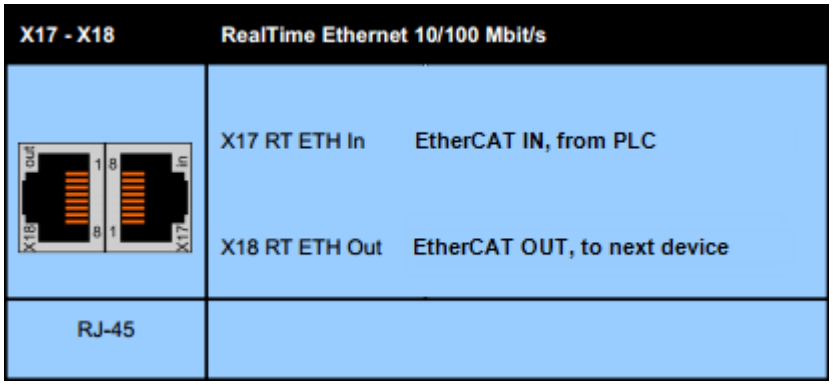
XML file names:

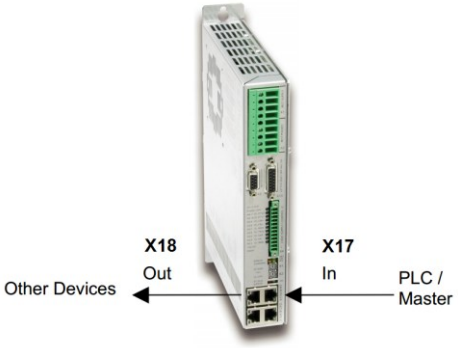
NTIL_CiA402_Servos_MI_Vx_xrx.xml	LinMot MI drives
NTIL_DS_Drives_Vx_x_bxx.xml	LinMot DS drives SG9 (F Series DS)
NTIL_CiA402_Servos_Vx_xrx.xml	LinMot DS drives SG6-7
NTIL_CiA402_SG5_Servos_Vx_xrx.xml	LinMot DS drives SG5

20.2.3 EtherCAT Connection

The drive is connected to the EtherCAT network using the **X17 (IN) & X18 (OUT)** connectors.

The below pictures show the ports of an E1250-DS-UC drive.
On all other LinMot drives supporting EtherCAT DS the ports are named the same (X17 & X18), but they may be placed differently on the drive housing.

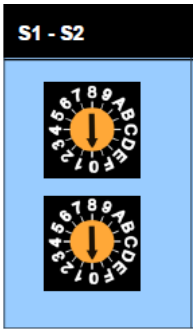




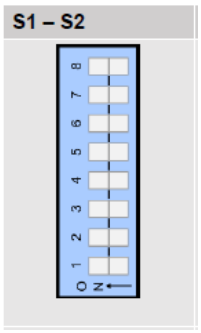
20.2.4 Set the node address / station alias by address selectors on the drive

This is the most popular way, because it is user-friendly to maintenance people.

Depending on the LinMot-Drive the address selectors are designed as Hex- or DIP-Switches.



Hex-Switches



DIP-Switches

20.3 Controller Setup

20.3.1 EtherCAT Device Description File (XML)

The EtherCAT device description file (XML) is located by default in the LinMot-Talk installation path:

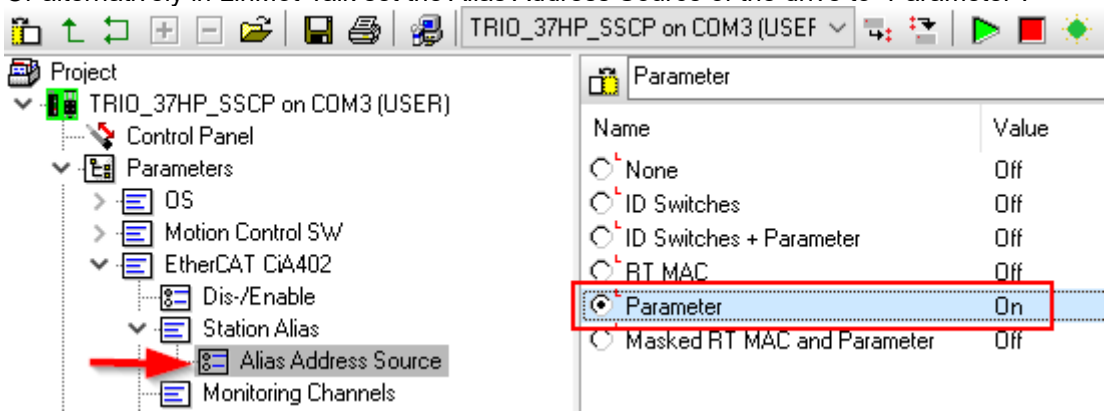
C:\Program Files (x86)\LinMot\LinMot-Talk X.X Build XXXXXXXX\Firmware\Interfaces\EtherCat_Nx\XML
C:\Program Files (x86)\LinMot\LinMot-Talk X.X Build XXXXXXXX\Firmware\Interfaces\EtherCAT\XML

20.3.2 Add and setup the LinMot drive

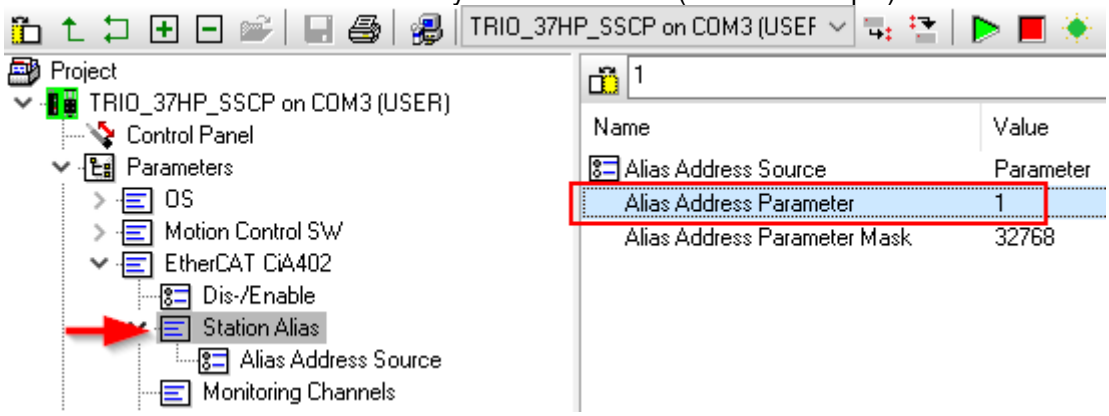
Follow these steps to add the LinMot drive to your Motion Perfect project.

1. Set the node address / station alias address of the LinMot drive to 1 for this example using the S1&S2 address selectors on the drive (if available > check chapter 20.2.4)

   Or alternatively in LinMot-Talk set the Alias Address Source of the drive to “Parameter”:

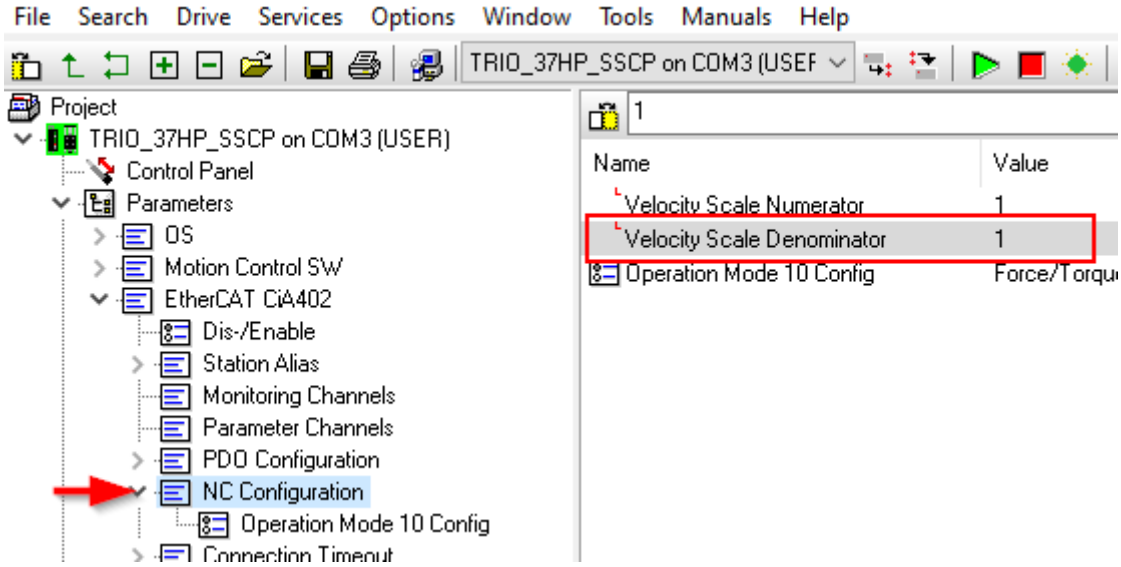


   And the “Alias Address Parameter” to your desired value (1 in this example):

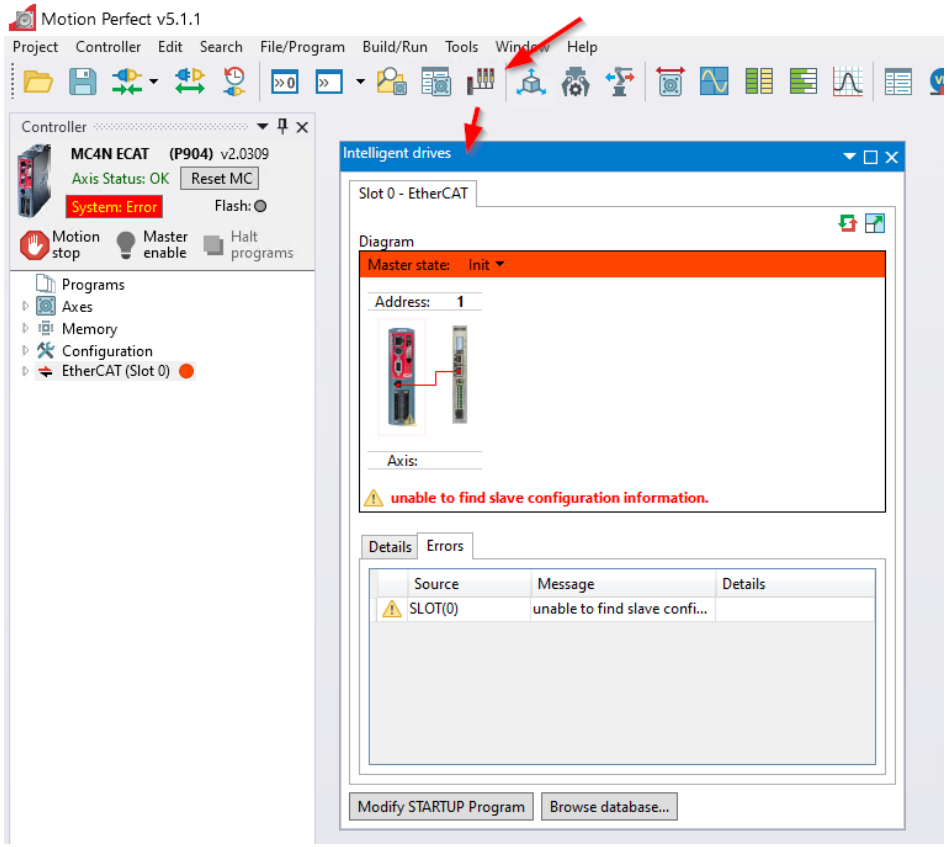


Attention: A drive reboot is required to activate the address after a change!

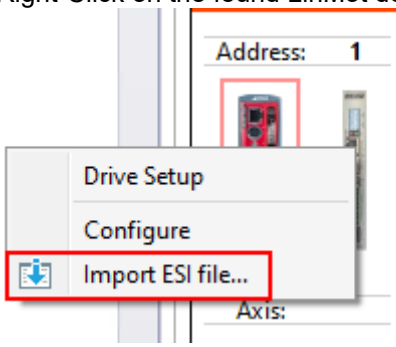
2. Set the “Velocity Scale Denominator” to **1**:



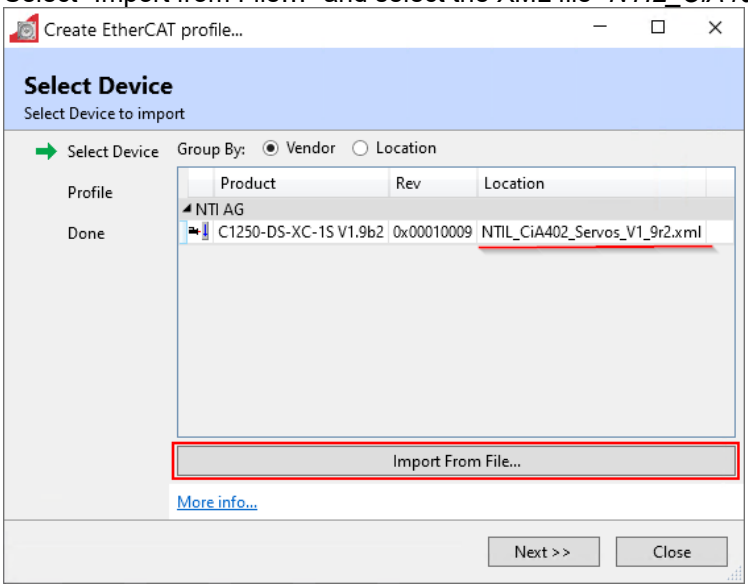
3. Open the “Intelligent drives” window:



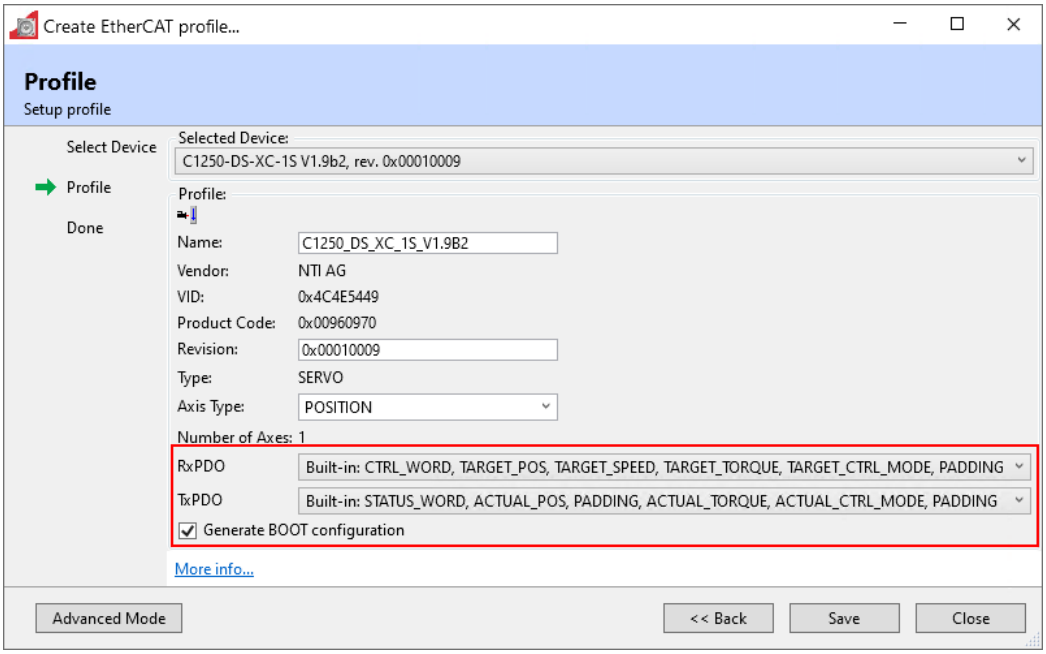
4. Right-Click on the found LinMot device (Address 1 in this case) and select *“Import ESI file…”*:



5. Select “Import from File…” and select the XML file “*NTIL_CiA402_Servos_...*”:

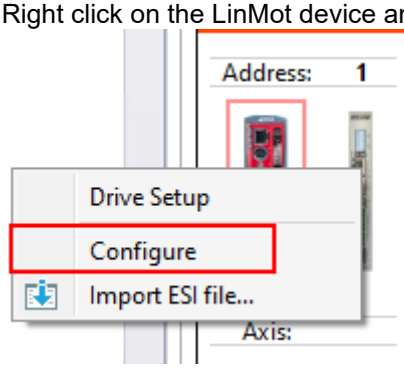


6. Choose the following **RxPDO** and **TxPDO** mappings, activate “Generate BOOT configuration” and click “Save”:

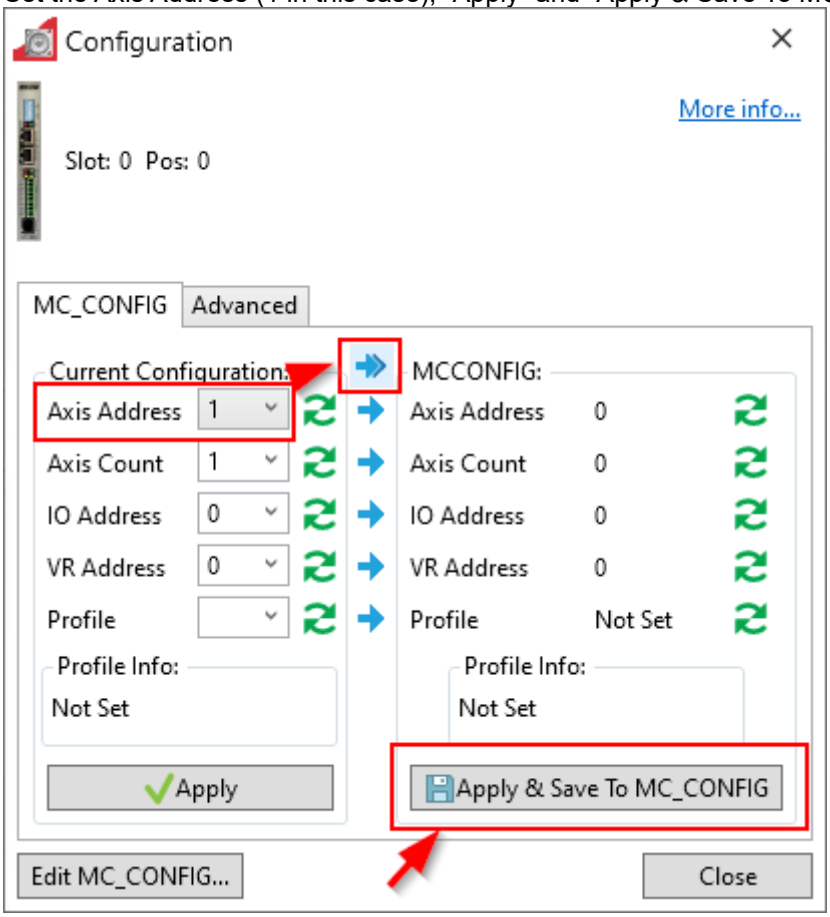


Close the window after successfully creating the EC_EXTEND file.

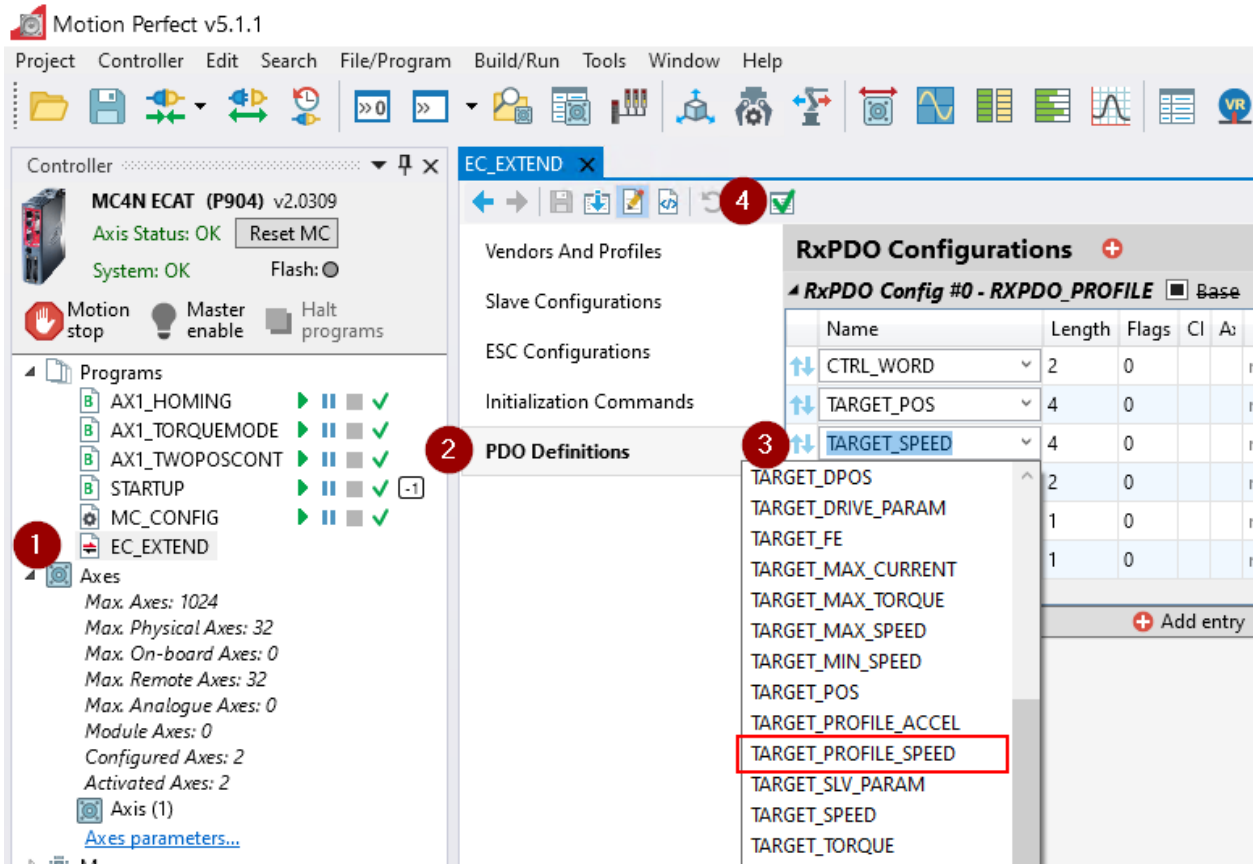
7. Right click on the LinMot device and select “Configure”:



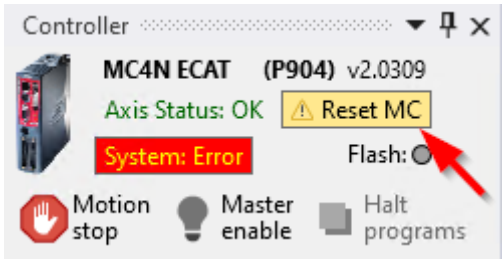
8. Set the Axis Address (1 in this case), “Apply” and “Apply & Save To MC_CONFIG”:



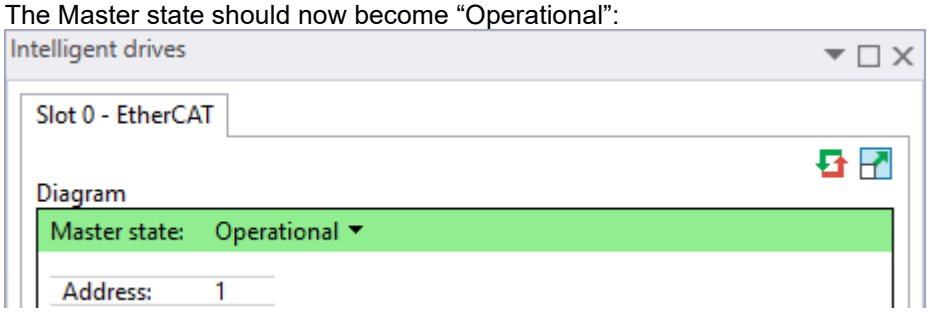
9. Open the EC_EXTEND file, click to enable editing, and assign the **TARGET_PROFILE_SPEED** instead of TARGET_SPEED in the RxPDO to have a smoother motion behaviour of the axis:



10. Reset the controller:



The Master state should now become “Operational”:



20.3.3 UNITS for Linear and Rotary Motors

To define the application units (mm, degrees, …) the drive parameters UNITS and ENCODER_RATIO can be used.

Motor Type	Type	Application units	Counts per Rev	UNITS	ENCODER_RATIO
LinMot PS01 / PS02	Linear	Millimetres [mm]	10'000	10000	-
LinMot GM01 / GM5x Gripper	Linear	Millimetres [mm]	21'242**	10000	-
LinMot RS01 (PR01 & PR02)	Rotary	Degrees [°]	360'000	1000	-
LinMot EC02	Rotary	Degrees [°]	524'288	1456*	(524160,524288)*
LinMot GM51 Gripper	Rotary	Degrees [°]	524'288	1456*	(524160,524288)*
LinMot PR02 (PS11 & PS31)	Rotary	Degrees [°]	524'288	1456*	(524160,524288)*

***ENCODER_RATIO example for a EC02 motor (From the TrioBASIC help):**

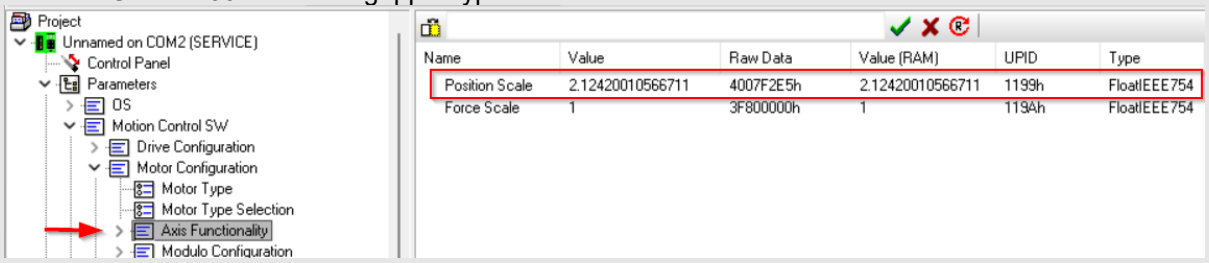
Counts per rev: 524'288
Units per rev: 360 [°]

The highest value that is less than **524288** yet divides into **360** should be chosen. This is **524160** (524160 / **1456** = 360). This reduces the resolution from 0.00068664… to 0.00068681… degrees but enables you to program easily in degrees.

Therefore set the drive parameters as follows:

```
'LinMot EC02 with 524288 counts per motor rev.
ENCODER_RATIO(524160,524288)
UNITS = 1456 'AXIS calibrated IN degrees
```

****Note:**
The LinMot grippers have in general an absolute encoder. The position scaling factor must be read out from UPID 1199h for each gripper type:



For this gripper type the Counts per Rev are 2.124200... * 10'000 = **21'242**.

20.4 Homing

There are several ways to home an axis.

The example project from chapter **20.1 Overview** contains a program called “AX1_Homing” that uses the DATUM and DEFPOS functions to implement a homing sequence to detect a hard stop.

```
'================================================================================
'Application based homing procedure (detect hard stop in negative direction)
'
'================================================================================

'Variables / Parameters
torque_limit = 2500 '=250.0% > Force/Torque Limit in 0.1% for hard stop detection,
'5000 = 500% = maximal force/torque of connected motor

home_position = 0.0 'Position that is set at hard stop
init_position = 10.0 'Position the axis moves to after detection

fe_limit_backup = 0.0 'Backup variable for FE_LIMIT


'Base: Axis 1
'================================================================================
BASE(1)

UNITS = 10000 'Set motor units. 10000inc = 1mm
'REP_DIST AXIS(axisx) = 360 ' make position modulo 0..360° for rotary axis

```

Note:
This is an application side homing sequence as TRIO does not support the DS402 drive-controlled homing mode (Mode of Operation 6) yet.

20.5 Parameter Access

Parameters can be modified using their UPIDs (Unique Parameter ID) via CoE.
To use a SDO service the **CO_READ_AXIS** and **CO_WRITE_AXIS** functions can be used (See TRIO Basic Help).

Syntax:

- **CO_READ_AXIS**(axis_number, index, subindex ,type [,vr_number])
- **CO_WRITE_AXIS**(axis_number, index, subindex, type, vr_number [,value])

The sub-index specifies the command which is performed

SDO Service	CANopen Object index	CANopen Object sub-index	Description
Read	2000h+UPID	0x01	Parameter UPID read RAM value
Write	2000h+UPID	0x01	Parameter UPID write RAM value
Read	2000h+UPID	0x02	Parameter UPID read ROM value
Write	2000h+UPID	0x02	Parameter UPID write ROM value
Read	2000h+UPID	0x03	Parameter UPID read minimal value
Read	2000h+UPID	0x04	Parameter UPID read maximal value
Read	2000h+UPID	0x05	Parameter UPID read default value
Write	2000h+UPID	0x06	Parameter UPID write RAM and ROM value
Write	2000h	0x07	Parameter Default OS SW instance
Write	2000h	0x08	Parameter Default MC SW instance
Write	2000h	0x09	Parameter Default Intf SW instance
Write	2000h	0x0A	Parameter Default Appl SW instance
Write	2000h	0x0B	Reset device

Attention ROM Access:
Intense use of writing into the ROM memory can reduce the lifetime of the drive memory!
More details can be found in the *Drive Configuration Over Fieldbus (0185-1074)* user manual
> see chapter Documentation / User Manuals

Example Write:

To write 1A to the RAM value of the parameter Maximal Current:

Name:	**Maximal Current**	Index	**= 16#2000 + 16#13a6 = 16#33a6**
UPID:	**13A6h**	Sub-index	**= 1**
Type:	**SInt32 = DINT = 4**	Value	**= 1A / 0.001A (scale) = 1'000**
Scale:	**0.001 A**		

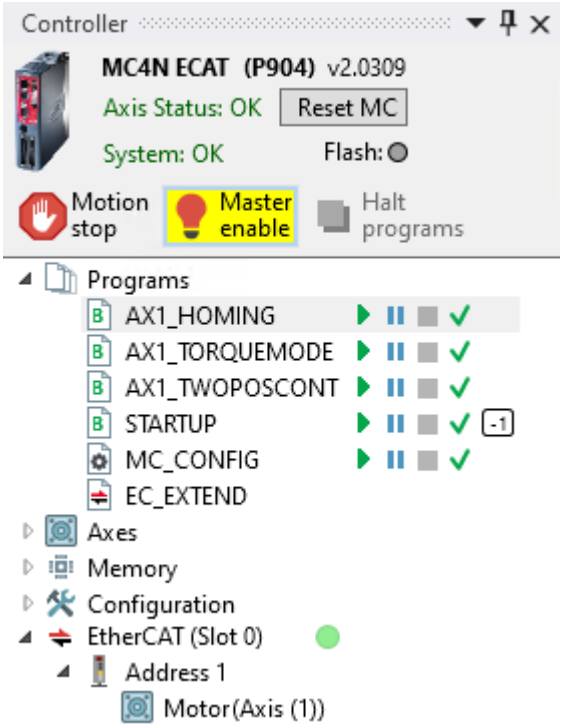
```
VR(200) = 1000 'Set Maximal Current UPID 13A6h to 1A = 1'000
CO_WRITE_AXIS(BASE, $33a6, 1, 4, 200)
```

Example Read:

```
'Read UPID 13A6 Maximal Current in Control Parameter Set A of the drive
CO_READ_AXIS(BASE, $33a6, 1 ,4 ,200)
motor_max_current_set_a = VR(200)
```

20.6 Examples

The example project from chapter **20.1 Overview** also contains programs to show a simple positioning cycle and a torque mode sequence.



Just set the correct BASE for the axis you want to use the program with:

```
'Base: Axis 1
'================================================================================
BASE(1)
```

21 Drive Profile: Bosch Rexroth, ctrlX CORE DS402

21.1 Overview

LinMot drives with *DS402 (CoE) / CiA402* interface (e.g., C1250-DS-XC-1S) can be integrated and setup as axis in a ctrlX CORE X* environment.

For a detailed description and integration guide please visit the ctrlX AUTOMATION How-to here:
Interface LinMot C1250-MI-XC-1S Drive with ctrlX CORE via EtherCAT

Used Hardware

- ctrlX CORE X*-Serie
- LinMot CoE / DS402 Drive (e.g.C1250-MI-XC-1S-000)

Versions Used and Required Software

- ctrlX PLC Engineering v3.6.2+
- ctrlX I/O Engineering v3.6.2+
- LinMot-Talk 6.14 Drive Configuration Software -> Download
- ctrlX Apps from ctrlX OS Store:
  - ctrlX OS - EtherCAT Master v3.6.0+
  - ctrlX OS - Motion v3.6.1+
  - ctrlX OS - PLC v3.6.2+

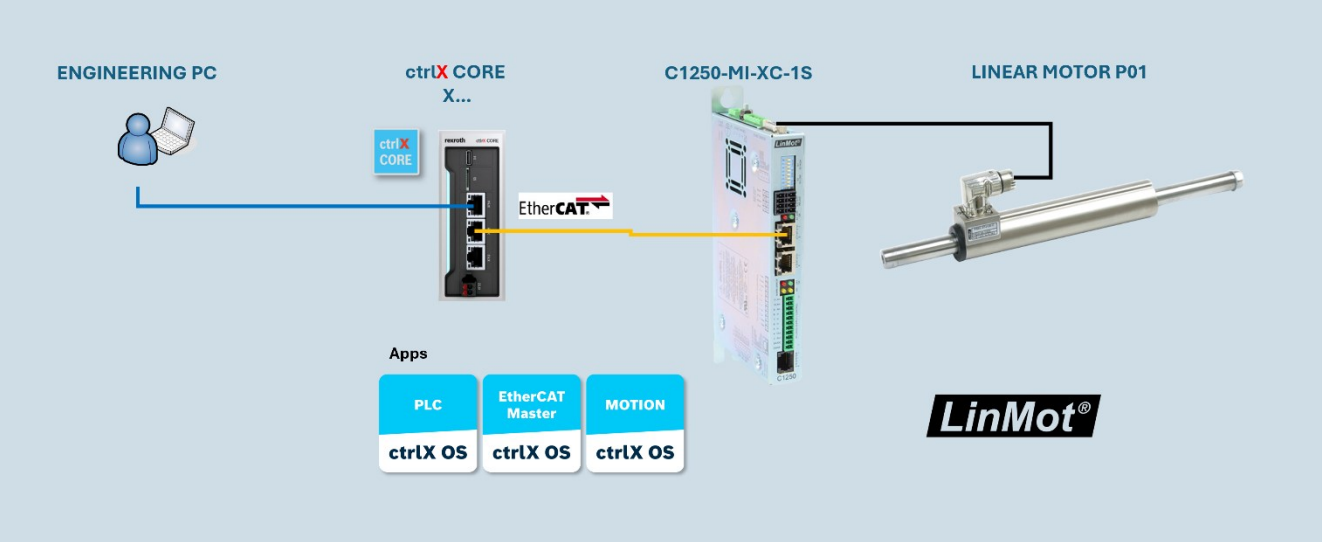


Image Source: Interface LinMot C1250-MI-XC-1S Drive with ctrlX CORE via EtherCAT

EtherCAT is the real-time Ethernet network originally developed by Beckhoff. The LinMot acts as Slave in this network and is implemented with the standard ASIC ET1100 from Beckhoff.

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

22 Troubleshooting

The following points should be checked if there are any troubles getting the LinMot drive to connect to the fieldbus or using the LinMot PLC libraries and drive profile examples.

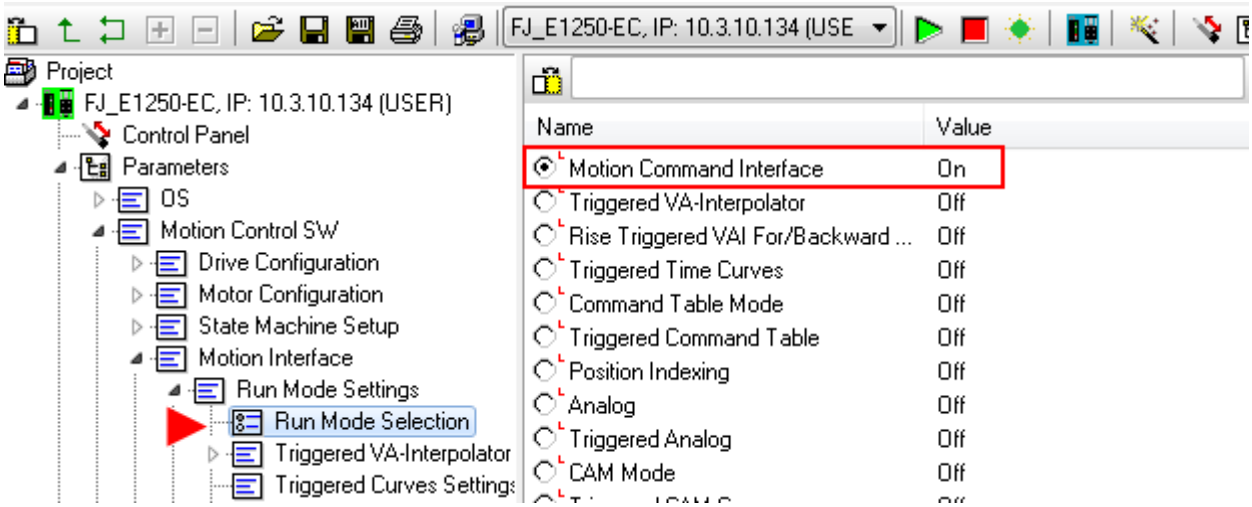
- Is the **fieldbus** connected to the **correct connector** of the LinMot drive?
  E.g., for EtherCAT or PROFINET X17 must be used as input (PLC → X17, X18 → next device)

- Is the **address** of the LinMot drive set correctly? (Node address, MAC ID, IP, device name, …)
  → Check the fieldbus variables inside LinMot-Talk

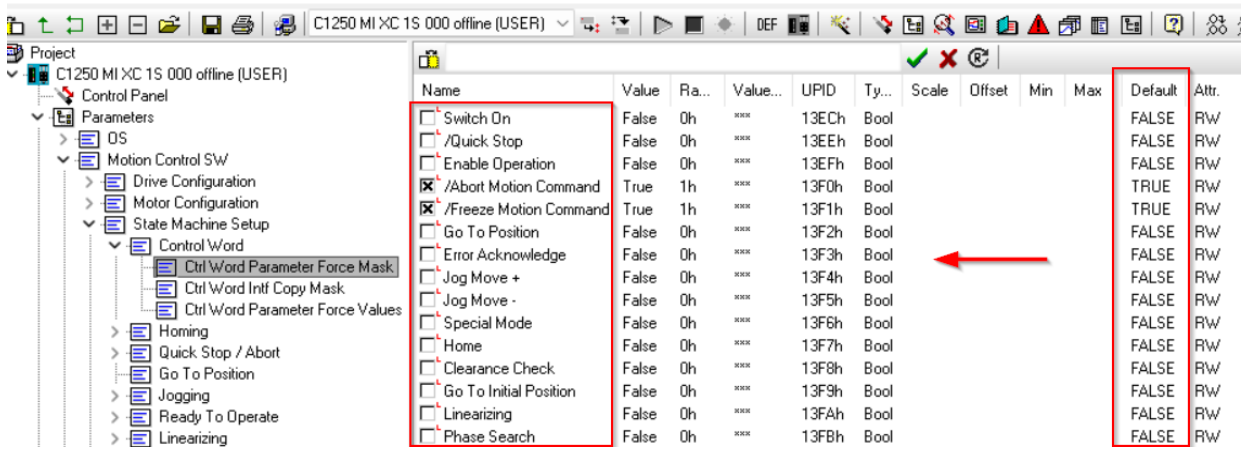
- Are all **interface parameters** on the drive set to the specified values of the library documentation?
  → Check with LinMot-Talk → Parameters → Interface

  By default, the LinMot libraries use factory default interface parameters on the LinMot drive.
  Except CANopen and LinRS/LinUDP.

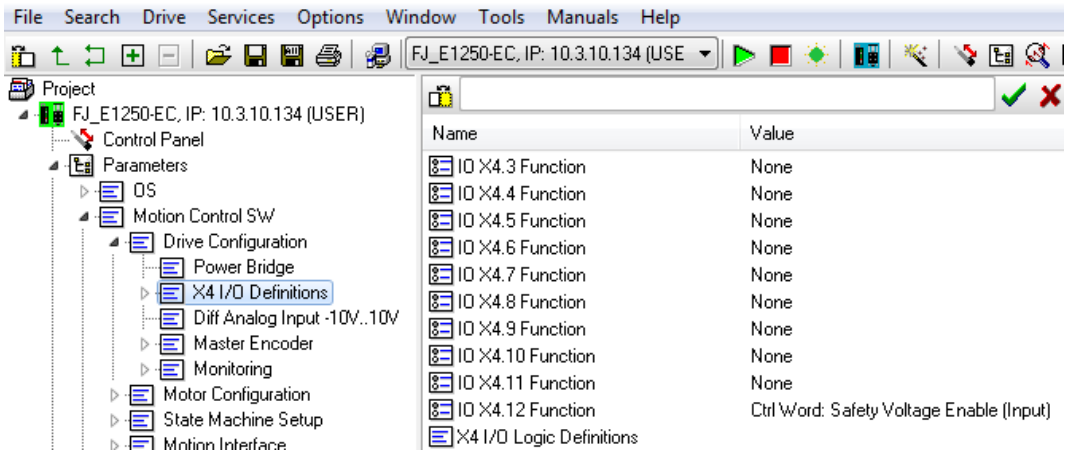
- Is the **run mode** of the drive set to “Motion Command Interface”?



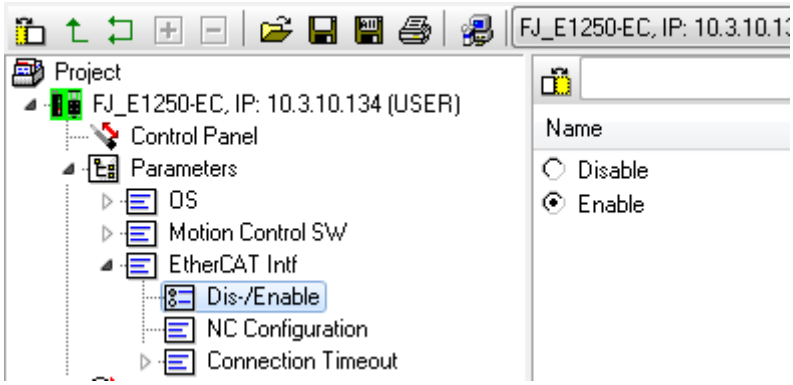
- Are the **Control Word bit force masks** set to default values?



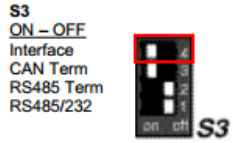
- Are there any **digital inputs on X4** configured that are controlled by the PLC?
  Check if the I/O are set correctly by the PLC or try to use the default settings and check if it works:



- Is the **interface enabled**?



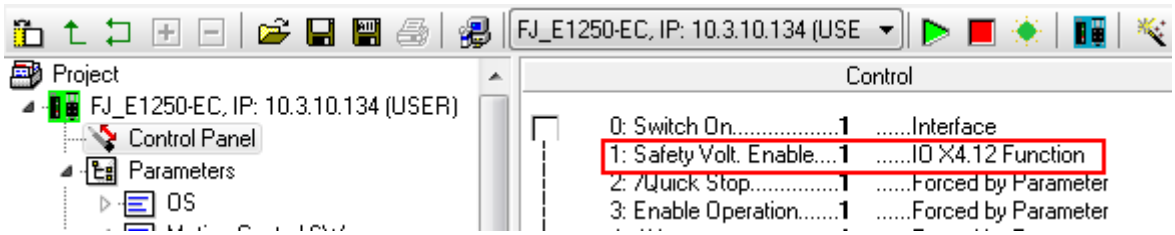
On E1100 series drives check if the **interface dip switch** is set to ON:



- In case of doubt, use a **clean configuration** of the LinMot drive.
  1. Install / reinstall the firmware or set the drive to factory settings using LinMot-Talk
  2. Set up the motor using the motor wizard
  3. Set the fieldbus specific parameters (e.g., node address, IP, …)

  Now check again if the problem still exists

- Are the **safety inputs powered** before trying to switch on the motor?
  - Is the X4.12 input powered with 24V DC (SVE input on series E1100 and E1200 drives)?
  - Are the safety relays X33 powered (drives with -1S option)?
  - Are the safety inputs X4.9/X4.10 (STO inputs channels) powered (drives with -3S option)?



Appendix I: Basic Position Control Loop Tuning

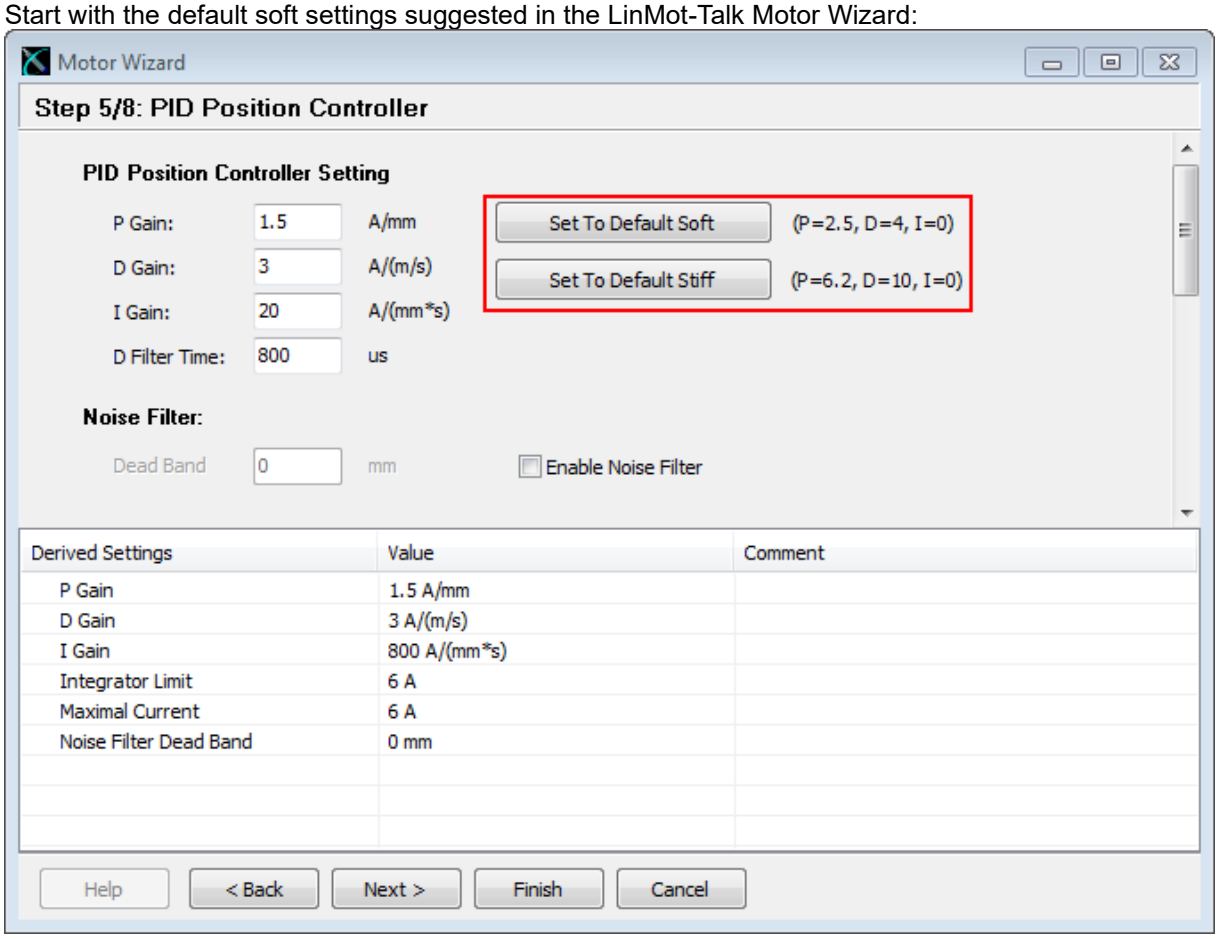
Tuning the position loop of a LinMot drive depends a lot on the application the motor is used for.

Hint: Further documentation

See application note about **position loop tuning**: 0185-1156 (EN / DE).
See application note about using the **LinMot oscilloscope**: 0185-0132 (EN / DE).

A basic setup of the position loop parameters could look as follows.

1. Start with the default soft settings suggested in the LinMot-Talk Motor Wizard:



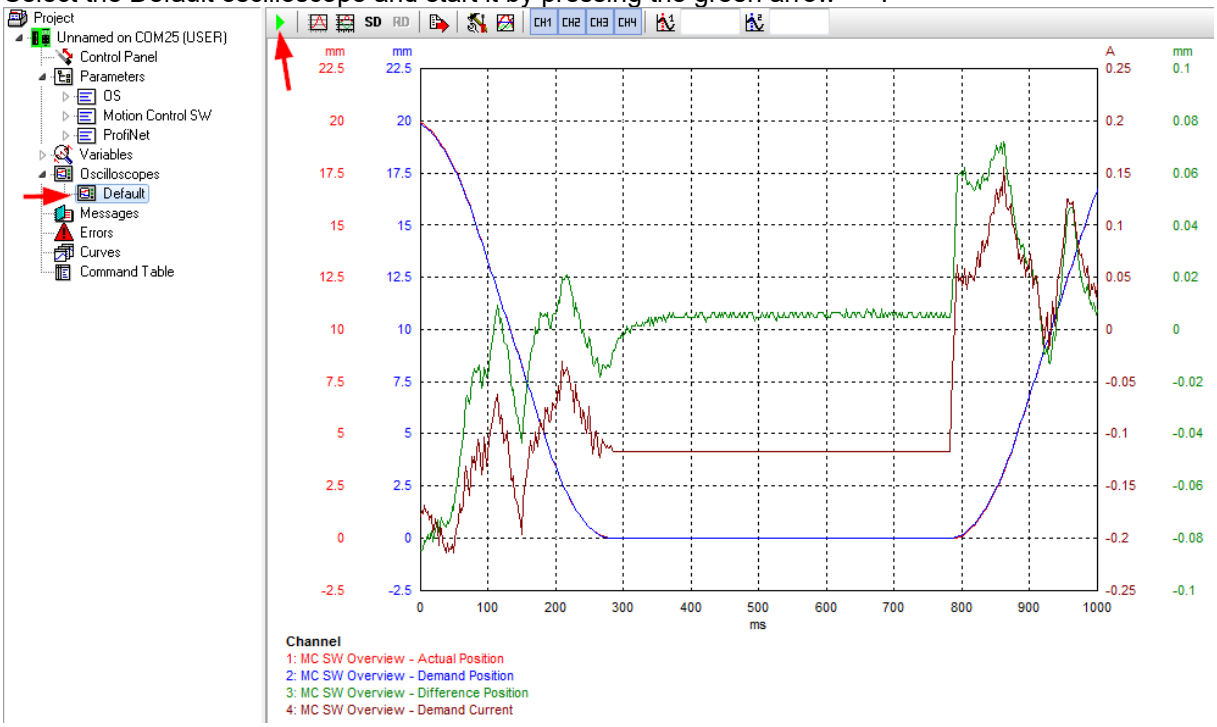
If the motor is mounted vertically or if a high accuracy at the target position is required set the *I Gain* of the position controller to a value between 20 to 50 A/(mm*s).

To reduce noise of the motor it is recommended to set the *D Filter Time* to 500us (C1200, C1100) or 800us (E1100, E1200)

It is highly recommended to disable the *Dead Band,* especially if a Drive Profile is used or in vertical applications. Uncheck *Enable Noise Filter*.

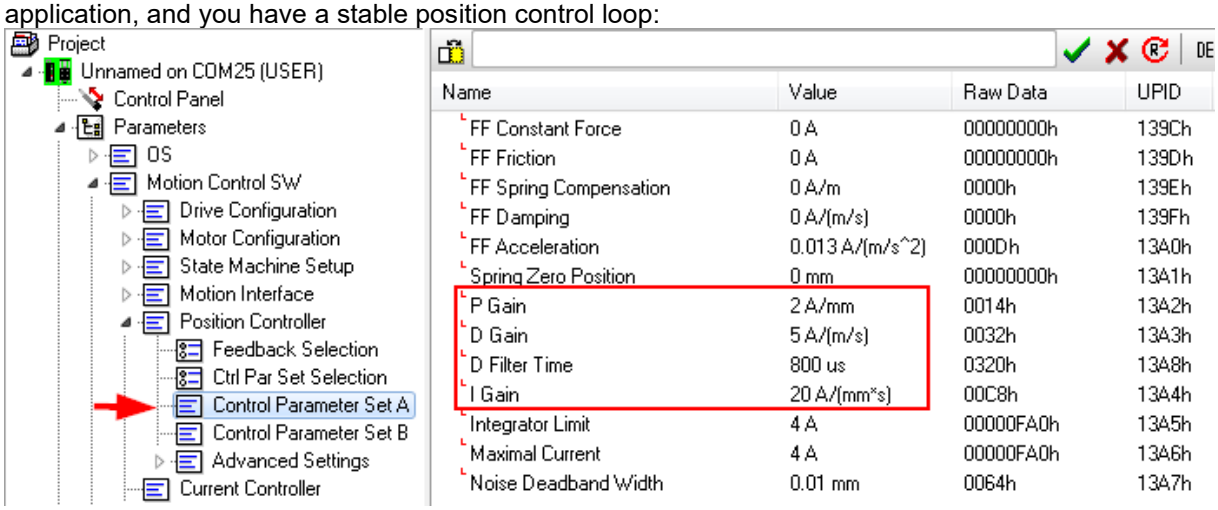
2. After finishing the Motor Wizard, rebooting the drive firmware, enabling, and homing the motor you can start moving the motor. With the built-in oscilloscope in LinMot-Talk you can trace the movement of the motor.

   Select the Default oscilloscope and start it by pressing the green arrow .



   The green channel shows the *Difference Position* (Position Error) you may want to minimize.

3. Slowly increase the P, D and I Gains in the Control Parameter Set A until the accuracy fits your application, and you have a stable position control loop:



Attention:
When controlling the LinMot drive using a drive profile (e.g., SoE, CiA402, FSP_Drive, …) and velocity or acceleration jumps occur then try to set **all** FF … parameters (except *FF Constant Force*) in *Control Parameter Set A* to 0 (zero).

Appendix II: Basic Closed Loop Torque/Force Control Loop Tuning

Tuning the closed loop torque/force control loop of a LinMot drive depends a lot on the application the motor is used for.

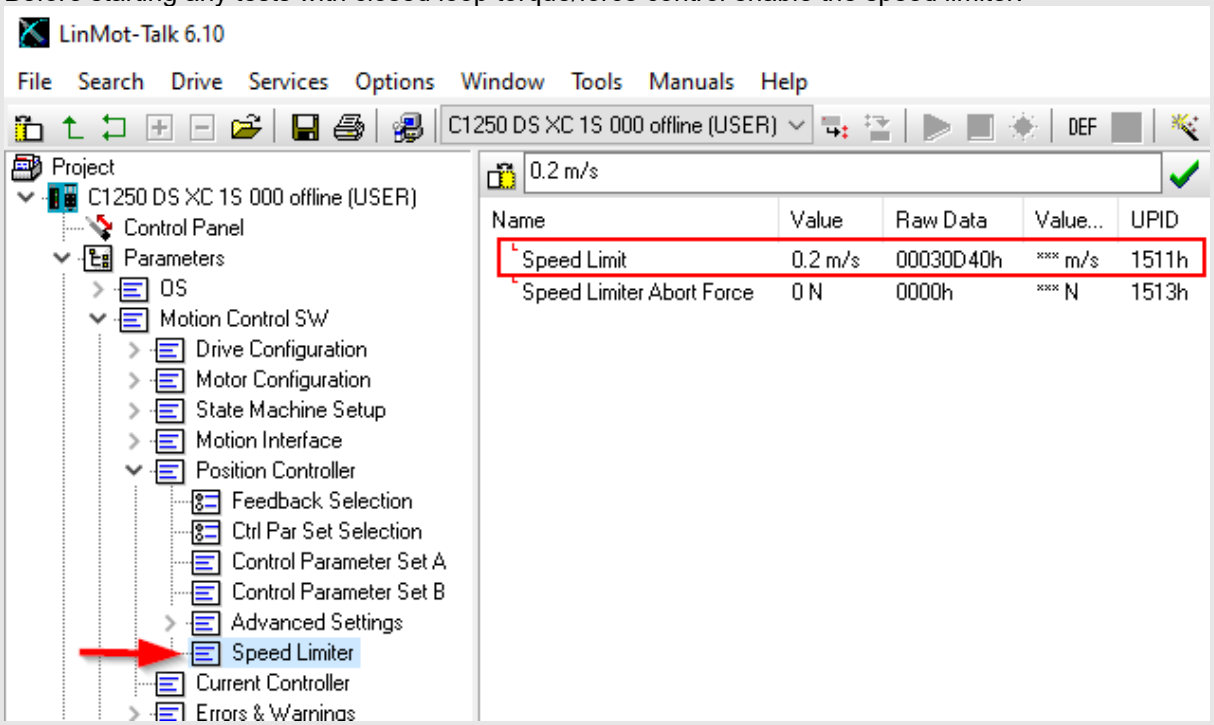
Attention:
To use closed loop force/torque control the technology function **TF-Force Control** (0150-2503) is required. Check the manual for more information: 0150-2503

Attention:
An application note about how to setup, tune and use closed loop torque/force control is available with document reference 0185-0144 (EN / DE).

Please follow that document to properly setup your system. This chapter here is thought to give a rough overview of where the parameters and variables related to closed loop torque/force control can be found.

Not following the above-mentioned document may lead to sever damage of your system.

Attention:
Before starting any tests with closed loop torque/force control enable the speed limiter!



Set it as high as possible and as low as the application requires.
This will help to protect you mechanics and sensors.

A basic setup of the torque/force control loop could look as follows:

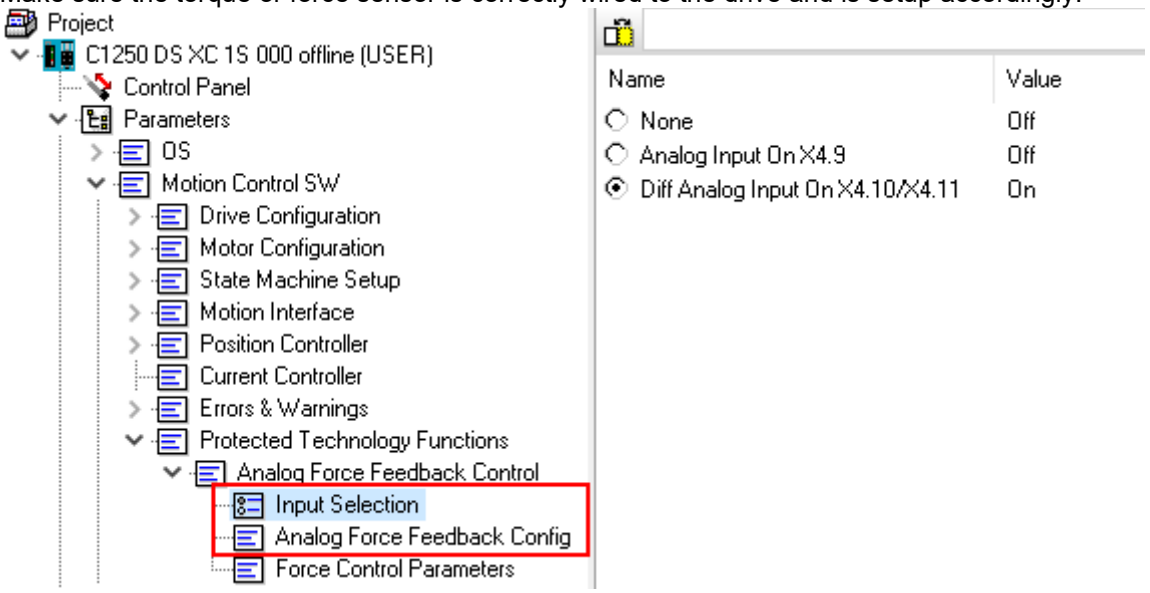
1. Enable and set the Speed Limiter as shown above
2. Make sure the *TF Force Control* license is activated (Drive > Set Access Code):

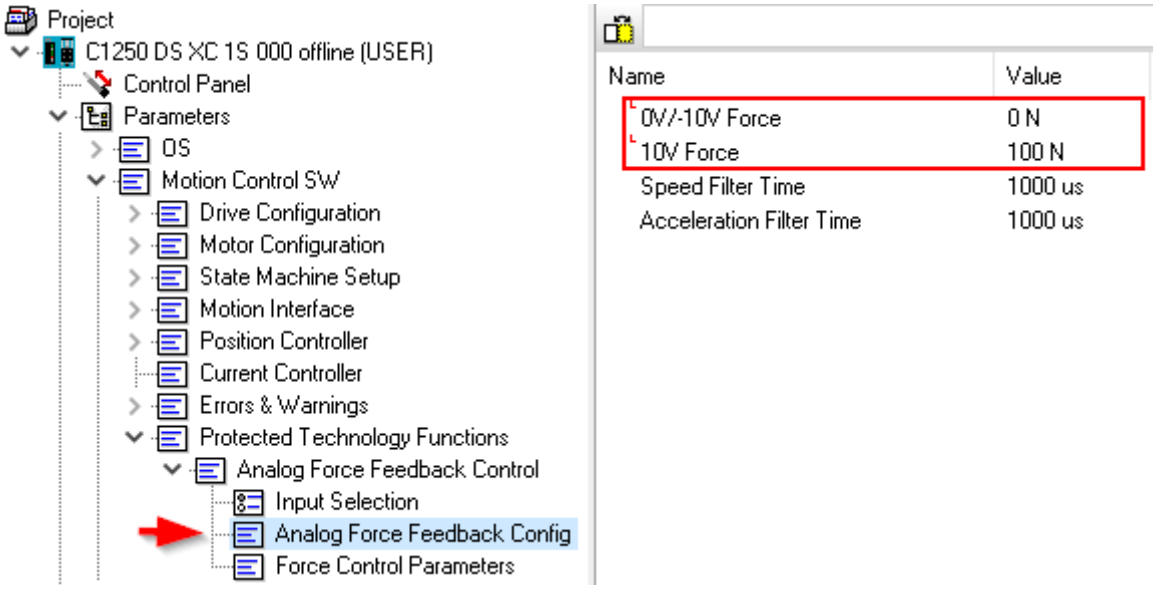
   Set Access Code

   Active Keys:

Name	Value	Access Code
Key1	5A93h - TF Force Control	2BFD82D9h
Key2	0000h - No Key	

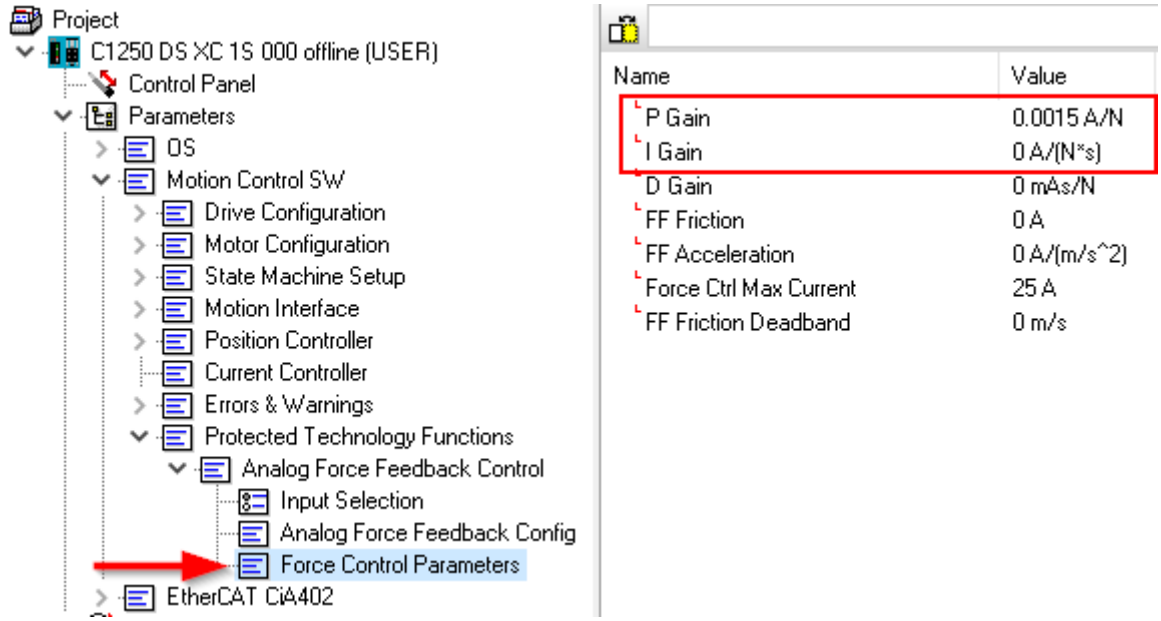
   If it is not activated, please check the manual 0150-2503
3. Make sure the torque or force sensor is correctly wired to the drive and is setup accordingly:



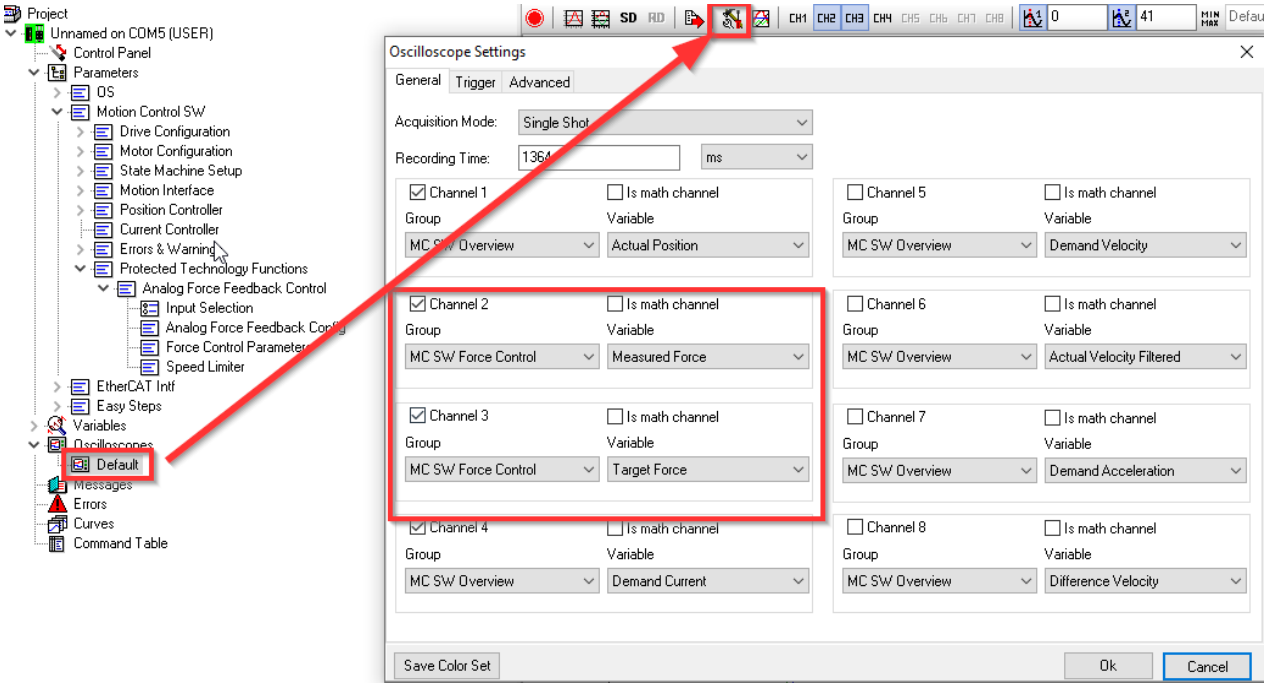


4. Start tuning the control loop. In most applications it is enough to increase only slowly the I Gain.

   For linear motors (linear system of units) you can use 0.5 A/(N*s) as the step size for the I Gain, for rotary motors (rotary system of units) you can use 50 to 100 A/(Nm*s) as the step size.



5. Setup and start an oscilloscope (see manual 0185-0132 (EN / DE)) that contains the target and measured torque/force and start your process.



6. Check the result and repeat steps 4 and 5 until you reach the required control quality.

Notes

Contact & Support

Europe / Asia Headquarters

NTI AG - LinMot & MagSpring
Bodenaeckerstrasse 2
CH-8957 Spreitenbach
Switzerland

Sales / Administration:	+41 56 419 91 91 office@linmot.com
Tech. Support:	+41 56 544 71 00 support@linmot.com
	+49 201 858940 10 support@linmot.de
Web:	https://www.linmot.com

North / South America Headquarters

LinMot USA Inc.
N1922 State Road 120, Unit 1
Lake Geneva, WI 53147
USA

Sales / Administration:	262.743.2555 usasales@linmot.com
Tech. Support:	262.743.2555 usasupport@linmot.com
Web:	https://www.linmot.com

Visit https://www.linmot.com/contact to find a distributor next to you.

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