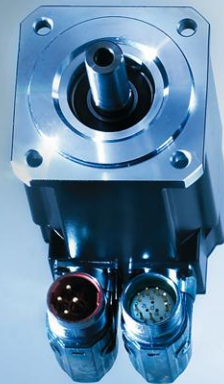
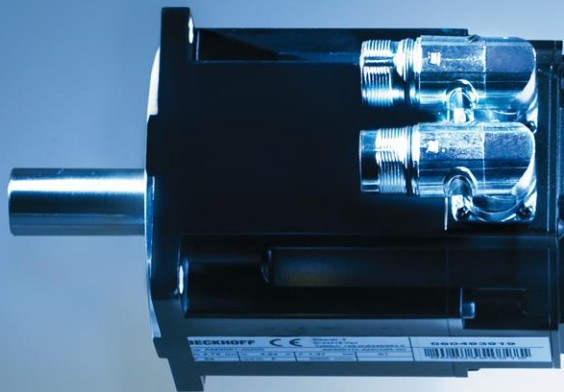




AX5000 – Motion control for high dynamic positioning

www.infoPLC.net





AX5000 | Digital Compact Servo Drive

EtherCAT 





AX5000 | Technical highlights

- high-speed capture inputs 11µs or 20µs
- wide voltage range 100 ... 480 V AC
- integrated mains filter
- integration of safety functions (optional)
 - restart lock
 - TwinSAFE: intelligent safety functions for Motion Control *in prep.*
- compact design for simple control cabinet installation (for 300 mm depth)
- AX-Bridge – the quick connection system for power supply, DC link and control voltage
- variable cooling concept (fanless, forced cooling, cold plate)



AX5000 | EtherCAT optimized

EtherCAT – high performance system communication in drive control

- Short cycle time and synchrony
- EtherCAT working drives
- High precision synchrony by Distributed-Clocks
- Highspeed-Latch with Time-Stamp, e.g. “print mark control outer web”
- Ultra-High speed- Communication update time:
 - 100 drives in 100 μ s
 - 1000 shared I/Os in 30 μ s
- High speed- control algorithm
 - Current controller up to 31,25 μ s cycle time for high dynamic iron less linear motor control *in prep.*
 - Speed controller in 125 μ s
 - Position controller in 250 μ s
- Clear line topology, flexible sideline
- Easy wiring by standard cable
- Easy to scan
 - Link brake detecting and finding
 - Protocol, hardware and the Topologies make it possible to detect the individual quality of each link



AX51xx | 1-channel Servo Drive

**1-axis Servo Drive for motors
up to 12 A rated current**





AX51xx | Technical data

Technical data	AX5101	AX5103	AX5106	AX5112	AX5118	AX5125
Rated output current	1 x 1 A	1 x 3 A	1 x 6 A	1 x 12 A	1 x 18 A	1 x 25 A
Rated supply voltage	1 x 100 ... 3 x 480 VAC +/- 10 %					
DC link voltage	125... 790 VDC					
Peak output current ⁽¹⁾	4,5 A	7,5 A	13 A	26 A	63 A	70 A
Rated connected load for S1-operation	1,2 kVA	2,5 kVA	5 kVA	10 kVA	15 kVA	20,8 kVA
Continuous braking power ⁽²⁾	50 W	50 W	150 W	extern	extern	extern
max. braking power ⁽²⁾	2,8 kW					

⁽¹⁾ I_{rms} for max. 7 s

⁽²⁾ internal brake resistor



AX52xx | 2-channel Servo Drive

2-axis Servo Drive for two motors with a total current up to 12 A.





AX52xx | Technical data

Technical data	AX5201	AX5203	AX5206
Rated output current	2 x 1.5 A	2 x 3 A	2 x 6 A
Rated supply voltage	1 x 100 ... 3 x 480 VAC +/- 10 %		
DC link voltage	125 ... 790 VDC		
Peak output current ⁽¹⁾	7,5 A	12 A	26 A
Rated connected load for S1-operation	2,5 kVA	5 kVA	10 kVA
Continuous braking power ⁽²⁾	50 W	150 W	50 W
max. braking power ⁽²⁾	2,8 kW		

⁽¹⁾ I_{rms} for max. 7 s

⁽²⁾ Internal brake resistor



AX5000 | Cycle times and clock frequencies

Different cycle times for various application requirements

- 31.25 μs current control loop for high dynamic linear motors *in prep.*
- 4 kHz frequency for minimum power dissipation

EtherCAT (minimum)	Position loop	Speed loop	Current loop	IGBT switching	Motor cable
31.25 μs	125 μs	125 μs	31.25 μs	16 kHz	32 kHz
62.5 μs	125 μs	125 μs	62.5 μs	8 kHz	16 kHz
62.5 μs	125 μs	125 μs	125 μs	4 kHz	8 kHz



AX5xxx | Features

Motor feedback:
Sin/Cos 1 Vss, TTL, single- od.
multi-turn EnDat, Hiperface,
BiSS

Motor feedback:
Resolver

**8 digital I/Os, e.g. enable,
limit switch, capture input,
error message**

EtherCAT system bus

**DC power supply/
DC link**

**Power supply
100 V AC 480 V AC**

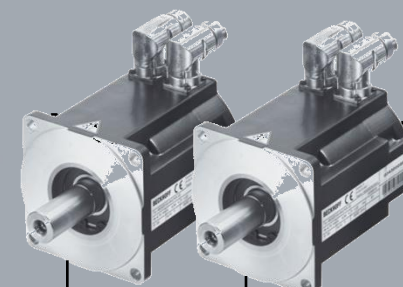
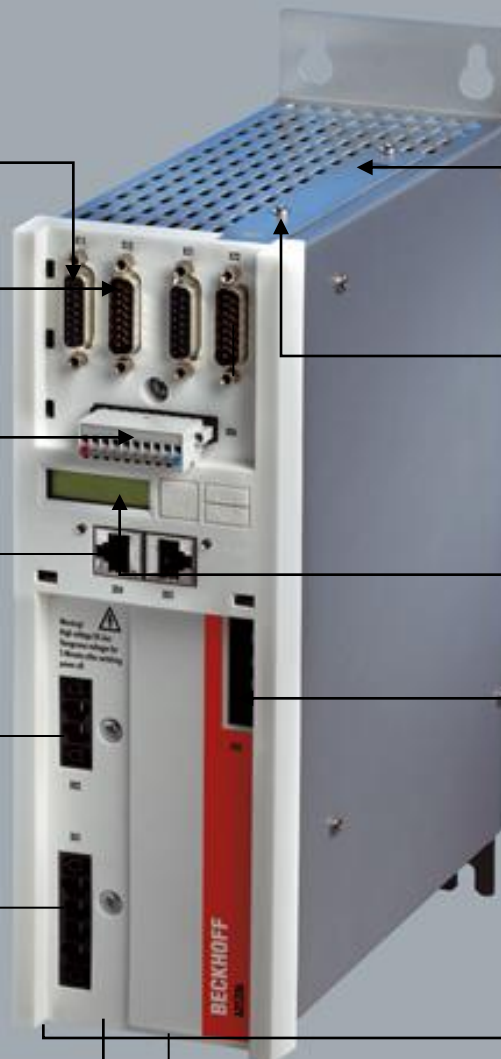
**Brake control/motor
temperature monitoring**

**Optional slot for inter-
face boards, e. g.
additional feedback**

**Optional slot for re-
start lock or optional
TwinSAFE safety
cards**

**Status display, e. g.
axis identifier or
error message**

**24 V DC control and
braking voltage**



Motor circuits



X06: Digitale I/Os

X06: Digitale I/Os

I/O-Steckverbinder ohne LEDs

ZS4500-2006

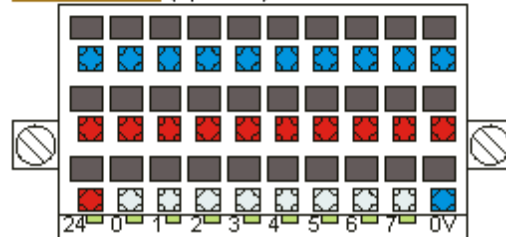


I/O-Steckverbinder mit LEDs

ZS4500-2007 (optional)



ZS4500-2008 (optional)



Terminal	Signal	Factory setting	
		AX51xx	AX52xx
24	Output 24V DC !!!		
0	Input 1	Enable	Enable Achse 1
1	Input 2	P-Stop	
2	Input 3	N-Stop	
3	Input 4		
4	Input 5		
5	Input 6	Capture	Capture Axis 1
6	Input 7	Capture	Capture Axis 2
7	Input 8 or Output	Error	
0V	Ground/DC 0V		



AX5000 | Digital inputs



Number:
7 inputs/
1 I/O per device

Functions:

- limit switches pos./neg.
- Enable
- amplifier lock with stator short cut braking
- Capture (2x)

Reaction time:
11 μ s



AX5xxx | Communication



- **Highspeed-EtherCAT- as system bus
SERCOS-Profile IEC61491 for Servo drives implemented**
- **Other field bus by external Gateways**



AX5xxx | Options

Optional slots for interface boards:

- safety for Motion Control
- additional feedback interface, e.g. SSI
- I/Os (capture, etc.)
- customer specific interface boards

(Slot 1)

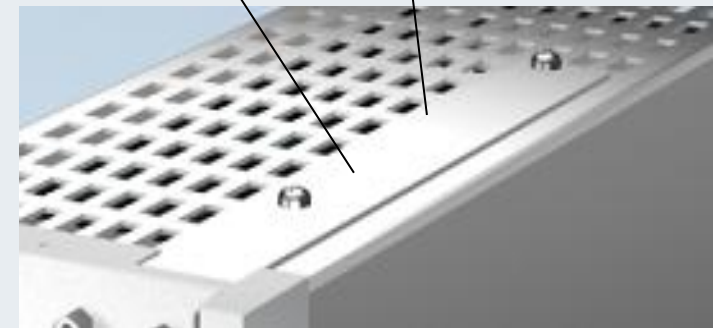
(Slot 2)

(Slot 2)

(Slot 2)

Slot 1

Slot 2





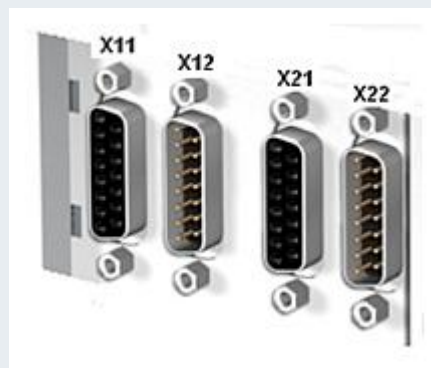
AX5000 | Multi feedback interface

- all common feedback systems on-board – no additional interface necessary
 - Resolver
 - TTL encoder
 - Sinus wave 1 Vpp
 - EnDAT, single and multi turn
 - Hiperface, single und multi turn
 - BiSS, single und multi turn
- support of electronic motor name plates

in prep.,

in prep.,

in prep.,





Multi-Feedback-Interface

Pin	Signal: high resolution Feedback		
	EnDAT/Biss	Hiperface	Sinus/ Cosinus 1Vss
1	Cos B+	Cos B+	Cos B+
2	GND UP_5V	GND UP_9V	GND UP_5V
3	SIN A+	SIN A+	SIN A+
4	UP_5V	n.c.	UP_5V
5	DX+ (Data)	DX+ (Data)	n.c.
6	n.c.	UP_9V	n.c.
7	REF N-	UP_9V	REF N-
8	CLK+ (Clock)	n.c.	n.c.
9	REFCOS B-	REFCOS B-	REFCOS B-
10	GND_Sense	n.c.	GND_Sense
11	REFSIN A-	REFSIN A-	REFSIN A-
12	UP_5V_Sense	n.c.	UP_5V_Sense
13	DX- (Data)	DX- (Data)	n.c.
14	N+	N+	N+
15	CLK- (Clock)	n.c.	n.c.



X03: 24 VDC Supply

Control voltage supply by connector X3. The 24V supply has two lines, in this way brake and control supply can be handled separately. In case of unused Up please connect Up-Us. By connecting motor holding brake please pay attention on voltage tolerance.



Klemmstelle	Signal
Up	24 VDC -0 / +15% : Peripherie (z.B. sep. Bremseinspeisung)
Us	24 VDC +/-15% : Systemversorgung / Steuerspannung
GND	GND



Main power

X01: Power input-

from single phase 100 VAC up to 3-phase 480 VAC. In case of single phase supply connect phase to L1 and N to L3.

Terminal	Connection	
	3-phase	1-phase
L1	Phase L1	Phase L1
L2	Phase L2	n.c.
L3/ N	Phase L3	Neutral wire
PE	Protective earth	Protective earth





X13 (A), X23 (B): Motor terminal



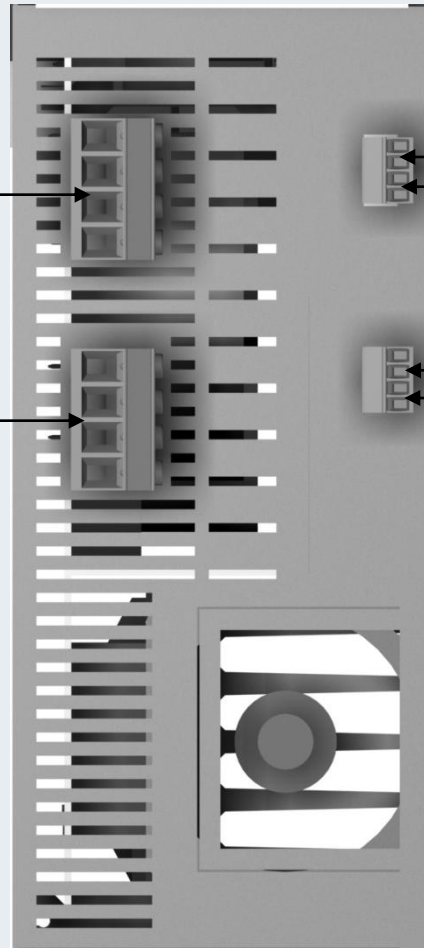
Terminal	Signal
U	Motor U
V	Motor V
W	Motor W
PE	Schutzleiter
Shield	Shield



AX5000 | Motor terminal

Motor output (Ch1)

Motor output (Ch2)



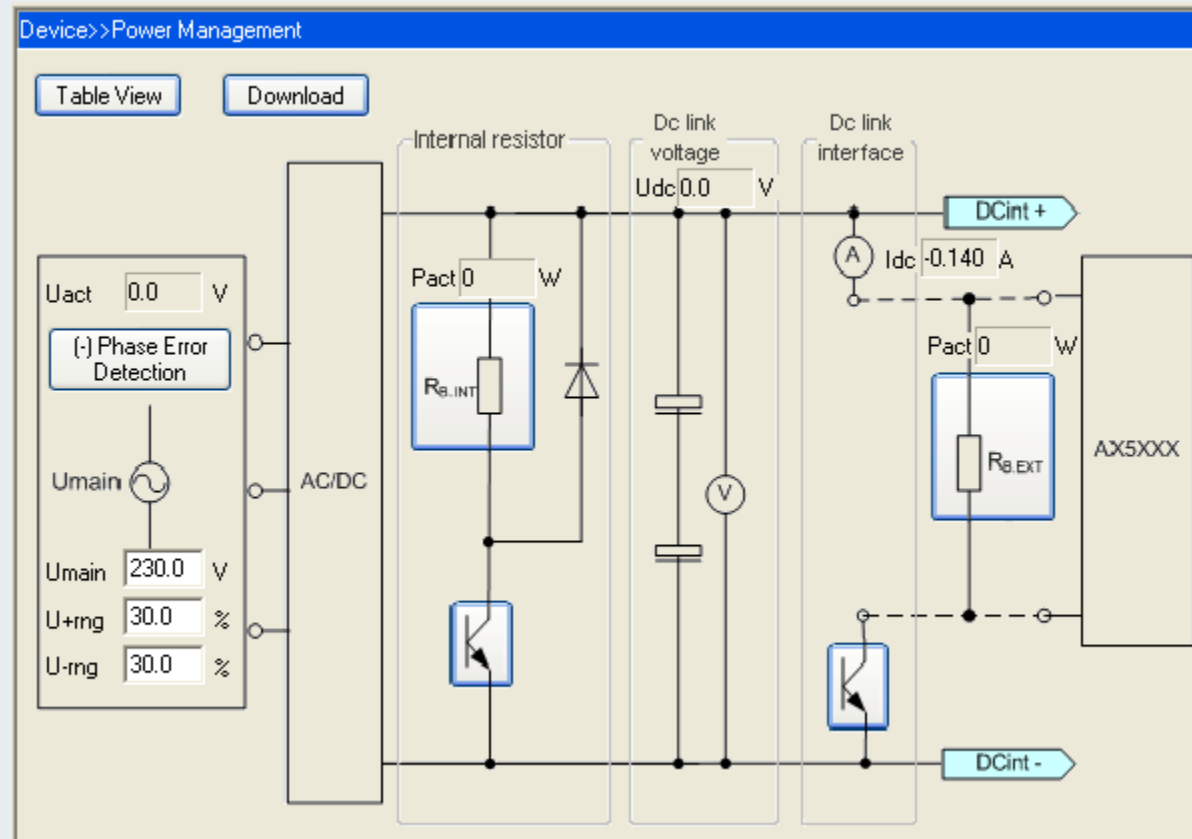
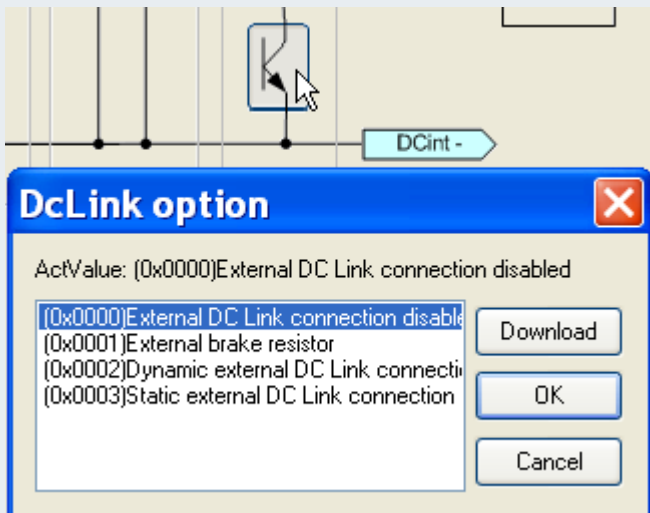
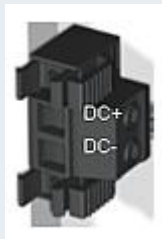
Output (Ch1): mechanical brake
Input (Ch1): motor temperature

Output (Ch2): mechanical brake
Input (Ch2): motor temperature



X02: DC Link Bus/ Zwischenkreis

By terminal X2, DC bus coupling or direct DC power supply is possible.





AX5000 | Active DC link

- DC link automatically connected only for regenerative energy flow
- short circuit proof DC link connection
- distributed braking by using all connected braking resistors
- external chopper module for high regenerative energy *in prep.*



AX5000 | Variable cooling concept

- max. operation temperature: 50°C
- fanless operation up to 2 x 3 A or 1 x 6 A
- temperature controlled forced cooling, starting at 2 x 6 A or 1 x 12 A
- internal air flow channel separated from electronic parts, by thus no contamination
- **Cold Plate** *in prep.*
 - plane back plane for cold plate assembly
 - thereby realisation of protection class IP 65



AX5xxx | System modules

AX5001 | DC link expansion *in prep.*

- brake energy can be stored and reused for next acceleration process
- short-circuit proof
- can be combined with multi-axis systems through AX-Bridge
- EtherCAT interface for parameterisation and diagnosis

AX5020 | Brake module *in prep.*

- with internal 250 W braking resistor and active cooling
- integrated brake chopper for external braking resistor up to 6 kW
- EtherCAT interface for parameterisation and diagnosis

AX5040 | Energy recovery module *in prep.*

- mains inverter for feeding brake energy back into the supply network
- EtherCAT interface for parameterisation and diagnosis



AX59xx | AX-Bridge quick connection system

AX5911

- connection module with power rail system for multi-axis systems
- current carrying capacity up to 85 A according to UL/cSA
- simple, wireless connection



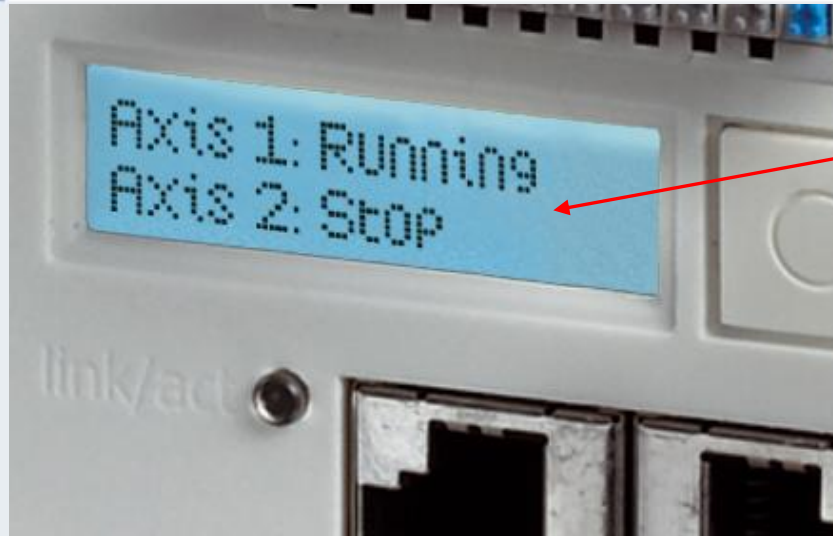
Connection module AX5901

AX5901

- Connection: supply or DC-link voltage and 24 V DC for control



AX5000 | Status display



2 rows x 16 characters
with backlight

Advantages:

- comfortable device diagnosis and maintenance
- axis identifier for two channel devices
- display of axis status and errors, also without EtherCAT communication
- error messages as plain text



SERCOS-Profile for servo drives

To bring the motion control to an existing standard the SERCOS – Profile IEC 61491 was implemented.

This offer the user an easy and optimal setup.

Sercos S- and P- Parameter:

This SERCOS profile differs two main groups of parameter.

The standard parameter e.g. :

S-0-0001 \Rightarrow NC \Rightarrow Cycle time (TNcyc)

Product specific parameter e.g. :

P-0-0001 \Rightarrow Switching frequency of the IGBT module



The storage concept

Compared to the AX2000 the modified drive parameter are not stored inside the Drive, there is only the default setup as part of the Drive firmware.

e.g. by changing the parameter „Motor“ the new setup has to be add to the „Startup List“.

After „saving“ the „Startup List“ and “Activate configuration” it becomes a part of the System Manager file .tsm and will be handled from the system manager.

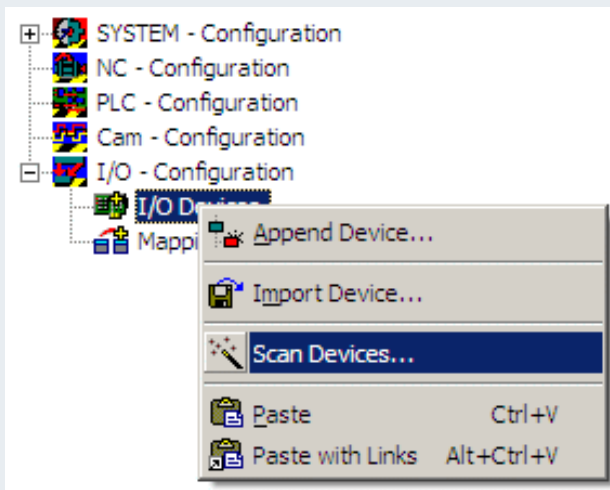


Drives linking – First motion

Requirements:

- Control voltage: 24 VDC
- EtherCAT- master connection
- TwinCAT Config Mode

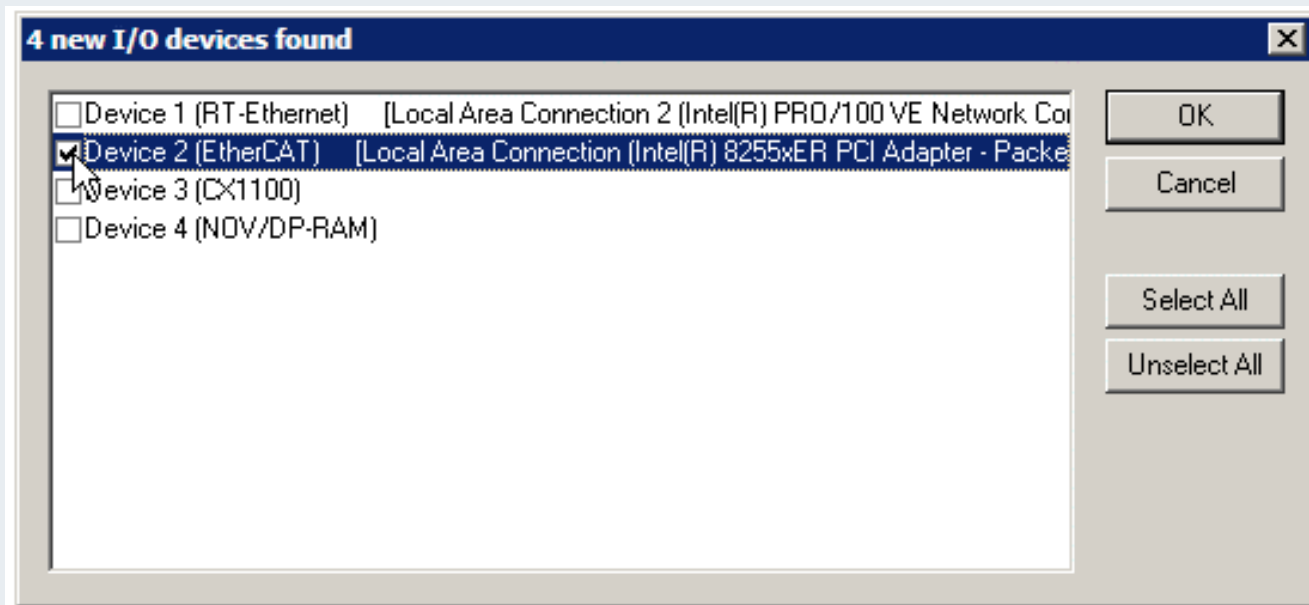
The first step is to scan the bus for EtherCAT devices:





Drives linking – First motion

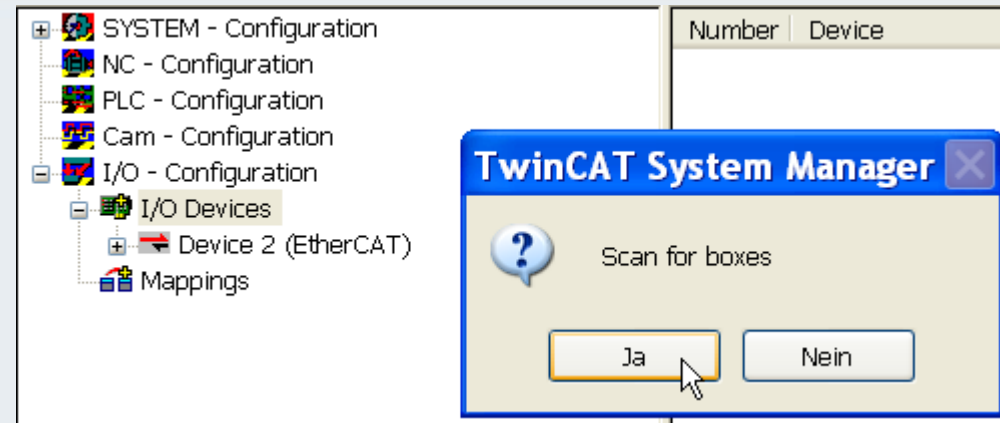
Select the EtherCAT-Interface



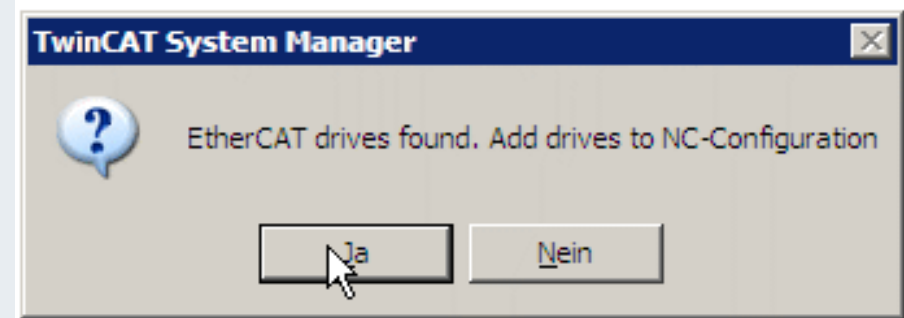


Drives linking – First motion

- Scan for boxes



- Add the Drives to the NC



- No “Free Run”

Ja = Yes

Nein = No

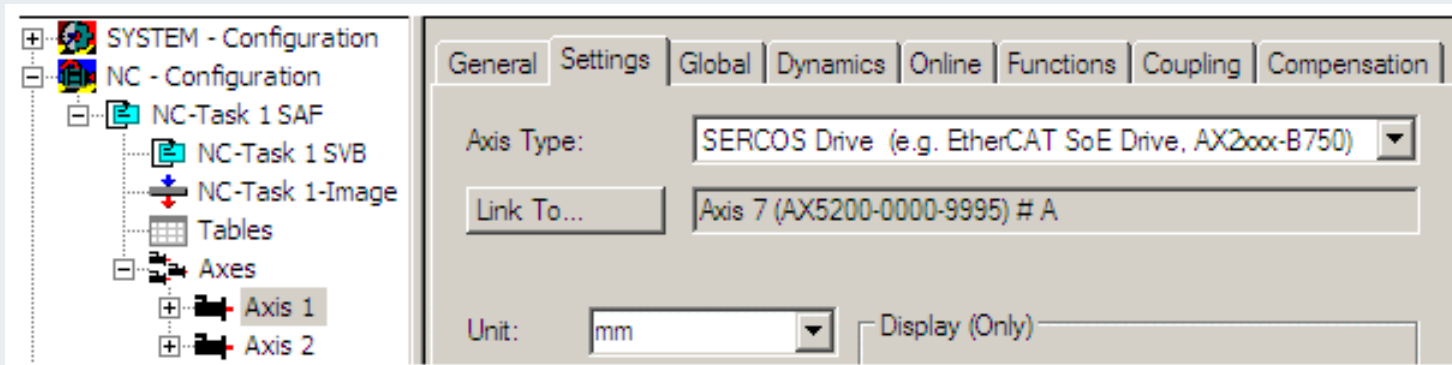




Drives linking – First motion

Tap "Settings"

All detected Axis are displayed under NC- Configuration.
The AX5000 is shown as “SERCOS Drive”.
The communication profile is SoE (Sercos over EtherCAT).



Drives linking – First motion

The TC Drive Manager.

The TC Drive Manager gives all the resources to handle the drive setup and the parameter. By the menu tree you have access to device and drive data's. In case of twin axis like AX52xx axis data's selectable as canal A and channel B.

Setup in the
„Power Management“
U+rng
U-rng
Disable „Phase Error Detection“
Press „Download“

The screenshot displays the TC Drive Manager software interface. On the left is a 'Tree' view showing the navigation structure:

- Device
 - Device Info
 - Power Management**
 - Display
 - Scope
 - Watch Window
- Channel A
 - Parameter
 - Controller Overview
 - Motor and Feedback
 - Process Data/Operation Mode
 - Digital I/O
 - Parameter List
 - Scalings
 - Operation
 - Diagnostics
- Channel B
 - Parameter
 - Operation
 - Diagnostics

The main window shows the 'Device >> Power Management' configuration. It includes a 'Table View' and a 'Download' button. The configuration area displays various parameters and a schematic diagram of the drive's power electronics.

Parameters shown:

- Uact: 212.1 V
- (+) Phase Error Detection
- Umain: 230.0 V
- U+rng: 25.0 %
- U-rng: 25.0 %
- Udc: 293.0 V
- Idc: 0.050 A

The schematic diagram illustrates the internal resistor (R_{INT}), the DC link voltage (U_{dc}), the DC link interface, and the external resistor (R_{EXT}) connected to the AX5XXX drive. It also shows the AC/DC converter and the DC link interface with DCInt+ and DCInt- terminals.

A dialog box titled 'Power Management con...' is open, showing the current state: 'ActValue: 1: UmainPhaseErrorDetection enabled'. It provides options to 'Enable UmainPhaseErrorDetection' or 'Disable UmainPhaseErrorDetection', with 'Download', 'OK', and 'Cancel' buttons.

Drives linking – First motion

Scan motor and feedback.

After this steps motor and Feedback type is shown

Tree

- Device
 - Device Info
 - Power Management
 - Display
 - Scope
 - Watch Window
- Channel A
 - Parameter
 - Controller Overview
 - Motor and Feedback
 - Motor
 - Feedback 1

Channel A>>Parameter>>Motor and Feedback

Reset (All) *Add parameters directly to the Startuplist: All data

Feedback 1 connector: 3: X11 (Front, Encoder) Feedback 2 connector: 0: No connector

Scan motor and feedback 1 Scan feedback 2

Feedback 1 type: Motor type: Feedback 2 type:

Channel A>>Parameter>>Motor and Feedback

Reset (All) *Add parameters directly to the Startuplist: All data

Feedback 1 connector: 3: X11 (Front, Encoder) Feedback 2 connector: 0: No connector

Scan motor and feedback 1 Scan feedback 2

Feedback 1 type: Heng#AD36-0019AF.0XB10 Motor type: AM3021-0C30 Feedback 2 type:

Feedback 1 Parameters Motor Parameters Feedback 2 Parameters

Scan motor and feedback

Scan motor and feedback 1... OK

Try with feedback Scan-Heng#BiSS...
-->Motor type AM3021-0C30 is found in the databank.

Constraints for Motor type A...

- ☒ Current ctrl cycle time (P-0-0002): 62 us
Nominal main voltage (P-0-0201): 90~230 V
- ☐ Current ctrl cycle time (P-0-0002): 125 us
Nominal main voltage (P-0-0201): 90~230 V

OK Cancel

Drives linking – First motion

Unter „Motor and Feedback“ wird der angeschlossene Motor aus der Motordatenbank gewählt.

The screenshot displays the Beckhoff TwinCAT configuration environment. On the left, a 'Tree' pane shows the project structure with 'Channel A' expanded, and 'Parameter' > 'Motor and Feedback 1' selected. The main workspace shows the 'Channel A >> Parameter >> Motor and Feedback 1' configuration window. This window contains a 'Reset' button, a 'Download' button, and a diagram illustrating the motor and feedback selection process: a 'Select Motor' button points to a box with '1' in the top-left, 'n' in the bottom-left, and 'm' in the top-right, which then points to a 'Select Feedback' button. Overlaid on this is a 'Select a motor. (SchemaVersion.1.0)' dialog box. The dialog shows a tree view of motor types: Synchronous Motors (Rotational, BECKHOFF, Default, AM302x) and Asynchronous Motors (Linear). The 'AM3021-0C41 (ver.1.0.1)' motor is selected. On the right side of the dialog, there are 'OK' and 'Cancel' buttons, and a section titled 'Append Startup directly?' with three radio button options: 'No', 'Standard', and 'Standard + Userdefined'. The 'Standard + Userdefined' option is selected, indicated by a mouse cursor.

Drives linking – First motion

The upper part of the Startup List shows default and changed parameters / IDNs.

The lower part shows all the IDNs modified by the TcDriveManager.

Add this by „Accept All“ and „OK“ to the Startup List.

And “Activate configuration”

Startup List

IDNs already in Startup list (count: 51)

Index	Name	Set Value	Unit
S-0-0015	Telegram type	00000000 00000111	
S-0-0016	Configuration list of AT	Edit list... (disabled)	
S-0-0024	Configuration list of MDT	Edit list... (disabled)	
S-0-0001	Control unit cycle time (TNcyc)	2000	us
S-0-0002	Communication cycle time (tSync)	2000	us
S-0-0032	Primary operation mode	2: velo control	
P-0-0053	Configured motor type	AM3021-0C30	
P-0-0054	Configured drive type	AX5203-0000-####	
S-0-0109	Motor peak current	6.300	A
S-0-0111	Motor continuous stall current	1.580	A
S-0-0113	Maximum motor speed	8000	rpm
P-0-0051	Number of pole pairs/pole pair distance	3	
P-0-0055	Motor EMF	19.5	V
P-0-0165	Commutation offset calibration parameter		
P-0-0057	Electrical commutation offset	270.00	deg
P-0-0060	Motor brake		
P-0-0066	Electric motor model		

IDNs modified by TcDriveManager

Index	Name	Set Value	Unit
S-0-0001	Control unit cycle time (TNcyc)	500	us
S-0-0002	Communication cycle time (tSync)	500	us
S-0-0091	Bipolar velocity limit value	7599	rpm
S-0-0100	Velocity loop proportional gain	0.300	A/(ra..
S-0-0101	Velocity loop integral action time	6.0	ms
S-0-0106	Current loop proportional gain 1	58.0	V/A
S-0-0107	Current control loop integral action time 1	0.5	ms
S-0-0109	Motor peak current	6.300	A
S-0-0111	Motor continuous stall current	1.580	A

Buttons: En-/Disable, Delete, Add, Clean up, Export List, Import List, OK, Cancel, Accept, Accept All

Drives linking – First motion

The image displays two screenshots of the Beckhoff NC Configuration software interface, showing the configuration for Axis 1.

Top Screenshot: The "Sercos" tab is selected. The "Modulo Scale" is set to 4294967295. The "Calculate" button is highlighted with a mouse cursor. Below the input field, there are "Download" and "Upload" buttons. A hint message states: "(HINT: Calculation only suitable if SERCOS is in phase 3 or 4)".

Bottom Screenshot: The "Sercos" tab is selected. The "Output Scale" is set to 1.02398817080127. The "Calculate" button is highlighted with a mouse cursor. Below the input field, there are "Download" and "Upload" buttons. A hint message states: "(Output Scale' is only needed if drive in 'Velocity' operation mode!) (HINT: Calculation only suitable if SERCOS is in phase 3 or 4)".

The final is to „Calculate“ and „Download“ the scaling.

Drives linking – First motion

SYSTEM - Configuration

- NC - Configuration
 - NC-Task 1 SAF
 - NC-Task 1 SVB
 - NC-Task 1-Prozessabbild
 - Tables
 - Achsen
 - Achse 1
 - Achse 1_Enc
 - Achse 1_Drive
 - Achse 1_Ctrl
 - Eingänge
 - Ausgänge
 - Achse 2
- PLC - Configuration
- Cam - Configuration
- I/O - Configuration
 - I/O Devices
 - Gerät 2 (EtherCAT)
 - Gerät 2-Prozessabbild
 - Gerät 2-Prozessabbild

General Settings

374.0435

Setpoint Position: [mm] 374.0403

Lag Distance (min/max): [mm] -0.0032 (-1.373, 1.628)

Actual Velocity: [mm/s] 0.0130

Setpoint Velocity: [mm/s] 0.0000

Override: [%] 100.0000 %

Total / Control Output: [%] -0.00 / -0.00 %

Error: 0 (0x0)

Status (log.)

- ☒ Ready
- ☒ NOT Moving
- ☐ Calibrated
- ☐ Moving Fw
- ☐ Has Job
- ☐ Moving Bw

Status (phys.)

- ☐ Coupled Mode
- ☐ In Target Pos.
- ☐ In Pos. Range

Enabling

- ☒ Controller
- ☒ Feed Fw
- ☒ Feed Bw

Controller Kv-Factor: [mm/s/mm] 1

Reference Velocity: [mm/s] 2200

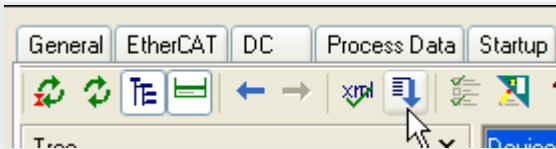
Target Position: [mm] 0

Target Velocity: [mm/s] 0

Buttons: F1, F2, F3, F4, F5, F6, F8, F9

Now the first move is possible !

Setup saving in three steps: 1. in „Startup List“



Startup List

IDNs already in Startup list

IDN	Tra...	Order	Name	Set Value	Unit
S-0-0015	PS	000	Telegram type	00000000 00000111	
S-0-0016	PS	001	Konfigurationsliste der AT	Edit list... (disabled)	
S-0-0024	PS	004	Konfigurations-Liste der MDT	Edit list... (disabled)	
S-0-0001	PS	006	NC-Zykluszeit (TNcyc)	2000	us
S-0-0002	PS	007	Kommunikations-Zykluszeit (tSync)	2000	us
S-0-0032	PS	008	Hauptbetriebsart	11: pos ctrl feedback 1...	
P-0-0167	PS	010	Motor and feedback connection check parameter		
P-0-0201	PS	011	Nominal main voltage	230.0	V
P-0-0202	PS	012	Main voltage positive tolerance range	30.0	%
P-0-0203	PS	013	Main voltage negative tolerance range	30.0	%
P-0-0204	PS	014	Power Management control word		
S-0-0091	PS	015	Bipolarer Geschwindigkeitsgrenzwert	7599	rpm
S-0-0100	PS	016	Drehzahlregler-Proportionalverstärkung	0.200	A/(ra...
S-0-0101	PS	017	Velocity loop integral action time	6.0	ms
S-0-0201	PS	018	Motor warning temperature	80.0	°C
P-0-0062	PS	019	Thermal motor model		
P-0-0165	PS	020	Commutation offset calibration parameter		
P-0-0003	PS	020	Configured motor type	440001 0000	

Channel: A

Buttons: Transition, En-/Disable, Move, Add, Delete, Clean up, Export List, Import List, OK, Cancel

IDNs modified by TcDriveManager

☐ Show only the difference

IDN	Name	Set Value	Unit
S-0-0001	NC-Zykluszeit (TNcyc)	2000	us
S-0-0002	Kommunikations-Zykluszeit (tSync)	2000	us
S-0-0032	Hauptbetriebsart	11: pos ctrl feedback 1...	
S-0-0091	Bipolarer Geschwindigkeitsgrenzwert	7599	rpm
S-0-0100	Drehzahlregler-Proportionalverstärkung	0.200	A/(ra...
S-0-0101	Velocity loop integral action time	6.0	ms
S-0-0104	Position loop Kv-factor	4.00	
S-0-0106	Current loop proportional gain 1	58.0	V/A

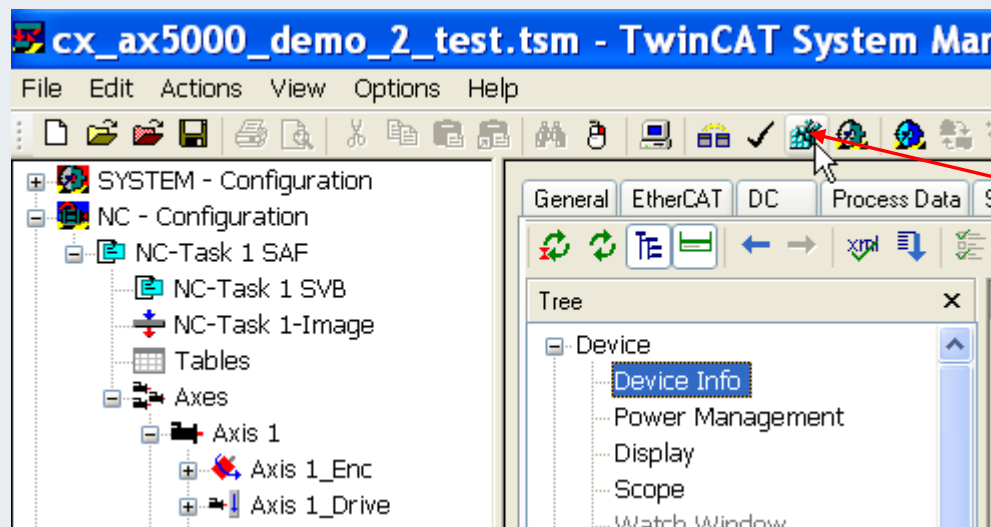
Buttons: Accept, Accept All

1. "Accept All"

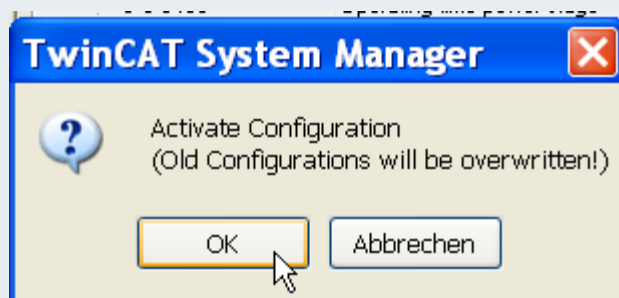
2. "OK"



Setup saving in three steps: 2., „Activate configuration“

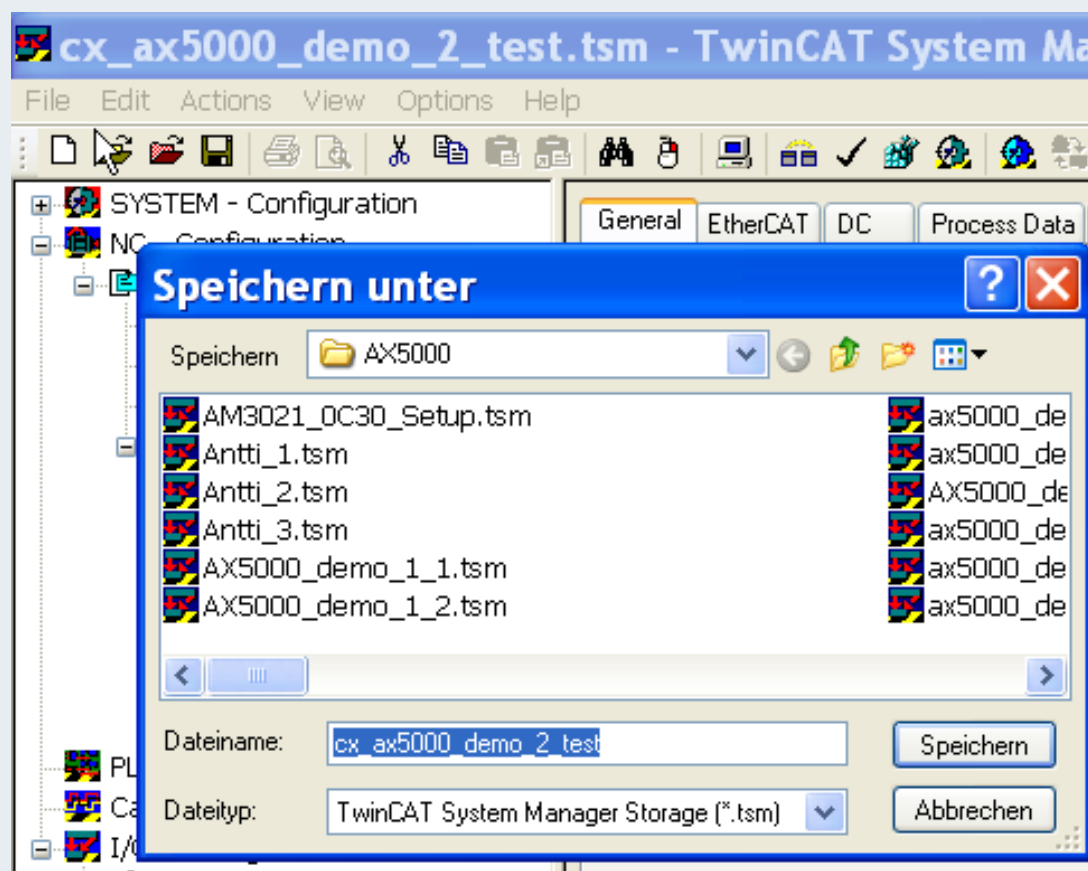


Activate configuration





Setup saving in three steps: 3. in TSM file



Drive tuning preparations

The screenshot shows the Beckhoff NC configuration software interface. On the left is a tree view of the system configuration, including NC-Task 1 SAF, NC-Task 1 SVB, NC-Task 1-Image, Tables, Axes (Axis 1, Axis 2), SPS - Konfiguration, Nocken - Konfiguration, E/A - Konfiguration, and Device 2 (EtherCAT). The main window displays the 'Kopplung' (Coupling) tab, specifically the 'Global' sub-tab. A table of parameters is shown, with 'Setpoint Generator Type' selected and its dropdown menu open, showing '7 Phases' and '7 Phases optimized' (highlighted by a red arrow). Other parameters include speed limits, acceleration, and deceleration values.

Funktionen		Kopplung		Kompensation	
Allgemein		Einstellungen		Dynamik	
		Global		Online	
Maximale erlaubte Geschwindigkeit	F	2000.0	mm/s		
Geschwindigkeit Hand Max (Fast)	F	300.0	mm/s		
Geschwindigkeit Hand Min (Slow)	F	100.0	mm/s		
Geschwind. Ref.fahrt in pos. Richtung	F	30.0	mm/s		
Geschwind. Ref.fahrt in neg. Richtung	F	30.0	mm/s		
Pulsweite in positiver Richtung (Jog-Betrieb)	F	5.0	mm		
Pulsweite in negativer Richtung (Jog-Betrieb)	F	5.0	mm		
Beschleunigung	F	1500.0	mm/s ²		
Verzögerung	F	1500.0	mm/s ²		
Ruck	F	2250.0	mm/s ³		
Override Typ	E	Reduziert (iteriert)			
Setpoint Generator Type	r	7 Phases			
NCI: Eilganggeschwindigkeit (G0)	F	0.0	mm		
NCI: Geschw. Sprung Faktor	F	0.0	mm		
NCI: Toleranzkugel Hilfsachse	F	0.0	mm		
NCI: Max. Positionsabweichung, Hilfsachse	F	0.0	mm		
BETRIEBSART: Min-Endlagenüberwachung	B	FALSE			
- Software Endlage Min	F	0.0	mm		
BETRIEBSART: Max-Endlagenüberwachung	B	FALSE			
- Software Endlage Max	F	0.0	mm		
BETRIEBSART: Schleppüberwachung Position	B	TRUE			
Maximaler Schleppabstand Position	F	5.0	mm		

Setup preparations for speed controller tuning:

Very short ramps (< 20ms) are possible by this option of "Setpoint Generator Type".

Drive tuning preparations

SYSTEM - Configuration

- NC - Configuration
 - NC-Task 1 SAF
 - NC-Task 1 SVB
 - NC-Task 1-Image
 - Tables
 - Axes
 - Axis 1
 - Axis 1_Enc
 - Inputs
 - Outputs
 - Axis 1_Drive
 - Axis 1_Ctrl
 - Inputs
 - Outputs
 - Axis 2
 - PLC - Configuration
 - Cam - Configuration
 - I/O - Configuration

General NC-Encoder **Global** Incremental Sercos Online

ENCODER-Mode	E 'POSVELO'
Invert Encoder Counting Direction	B FALSE
Scaling Factor	F 0.0000095367432 mm/INC
Position Bias	F 0.0 mm
Modulo Factor (e.g. 360.0°)	F 360.0 mm
- Tolerance Window for Modulo Start	F 0.0 mm
ENABLE: Min Soft Position Limit	B FALSE
- Software Position Limit Min	F 0.0 mm
ENABLE: Max Soft Position Limit	B FALSE
- Software Position Limit Max	F 0.0 mm
Filter Time for Actual Position (P-T1)	F 0.0 s
Filter Time for Actual Velocity (P-T1)	* F 0.0 s
Filter Time for Actual Acceleration (P-T1)	F 0.1 s
Encoder Mask (Maximal Value)	r D 0xFFFFFFFF
ENABLE: Actual Position Correction	B FALSE
Filter Time Actual Position Correction (P-T1)	F 0.0 s
Reference System	E 'INC'

Download Upload Select All

Set "Filter Time Actual Velocity (P-T1)" to 0.



Drive tuning preparations

SYSTEM - Configuration

- NC - Configuration
 - NC-Task 1 SAF
 - NC-Task 1 SVB
 - NC-Task 1-Image
 - Tables
 - Axes
 - Axis 1
 - Axis 1_Enc
 - Inputs
 - Outputs
 - Axis 1_Drive
 - Axis 1_Ctrl
 - Inputs
 - Outputs
 - Axis 2
 - PLC - Configuration
 - Cam - Configuration
 - I/O - Configuration

General Settings Global Dynamics Online Functions Coupling Compensation

☒ Indirect by Acceleration Time

Maximum Velocity (V_{max}): 2000 mm/s

Acceleration Time: 0.01 s

Deceleration Time: ☒ as above 0.01 s

Acceleration Characteristic: smooth stiff

Deceleration Characteristic: smooth stiff

$a(t)$:

$v(t)$:

☐ Direct

Acceleration: 202000 mm/s²

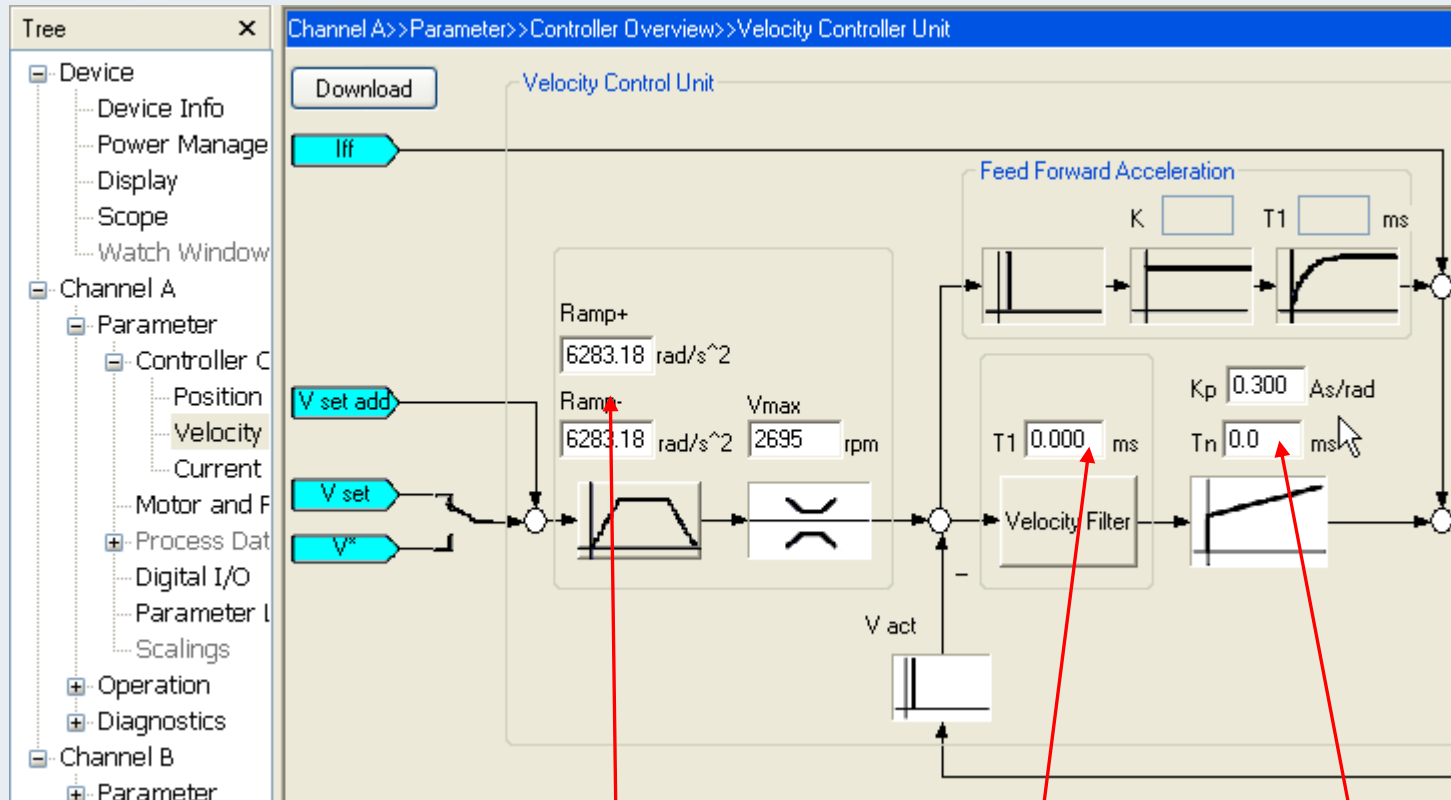
Deceleration: ☒ as above 202000 mm/s²

Jerk: 2.0402e+009 mm/s³

Download Upload

Selection of short ACC and DEC ramps and nearly no Jerk limitation.

Drive tuning preparations



Selection of short Ramp+ and Ramp- . Switch off tachometer filter and integral part.



Drive tuning preparations

Allgemein | EtherCAT | DC | **Prozessdaten** | Startup | SoE - Online | Online | Configuration

Sync Manager:

SM	Size	Type	Flags
0	128	MbxOut	
1	128	MbxIn	
2	12	Outputs	
3	14	Inputs	

PDO Liste:

Index	Size	Name	Flags	SM	SU
S-0-0016...	8.0	AT 1	M	3	0
S-0-0016...	6.0	AT 2	M	3	0
S-0-0024...	6.0	MDT 1	M	2	0
S-0-0024...	6.0	MDT 2	M	2	0

PDO Zuordnung (SM 2):

- ☒ S-0-0024 (A)
- ☒ S-0-0024 (B)

PDO Inhalt (S-0-0016 (A)):

Index	Size	Offs	Name	Type	Default
S-0-0135	2.0	0.0	Drive status word	UINT	
S-0-0051	4.0	2.0	Position feedback 1 value	DINT	
S-0-0084	2.0	6.0	Torque feedback value	INT	
		8.0			

For „Step response“ estimation we have to map the actual current (Torque feedback value) into the Process data's.

Drive tuning preparations

The screenshot displays the Beckhoff TwinCAT configuration interface. On the left, the project tree is expanded to 'I/O Devices' > 'Device 2 (EtherCAT)' > 'Axis 8 (AX5203-0000-0005)' > 'AT 1', where 'Torque feedback value' is highlighted. A red arrow points from this selection to the text below. The right pane shows the 'Online' tab for this variable, with a 'Value' field set to '0x0000 (0)', a 'New Value' field with 'Force...' and 'Release' buttons, and a 'Write...' button. A 'Comment' text area is also present. Below these fields is a large grid area, likely for monitoring or visualization.

The actual current is a part of the Process Data.

Drive tuning preparations

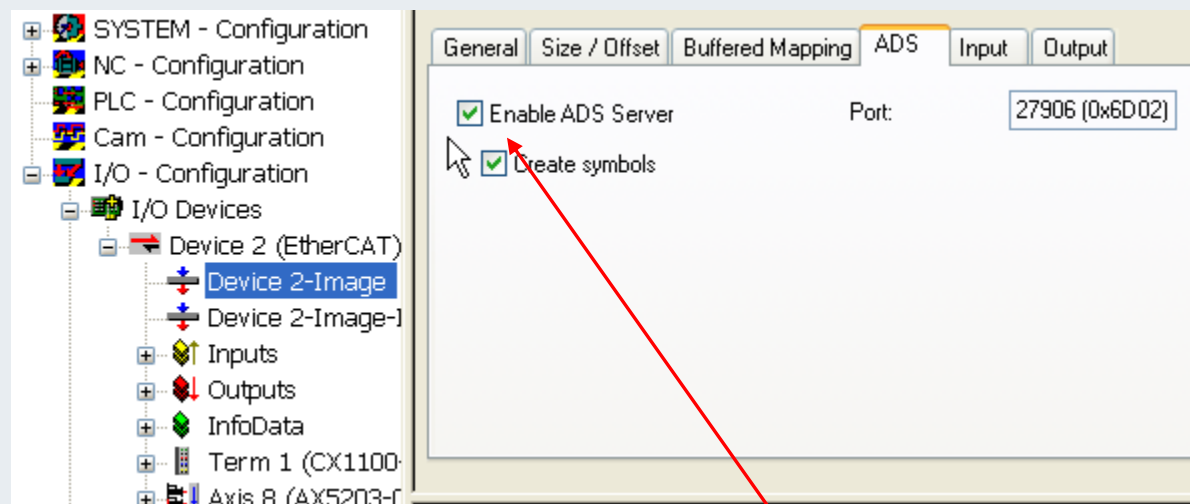
The screenshot shows the 'Online' tab of the Beckhoff NC Configuration software. The left sidebar displays the system configuration tree, including 'SYSTEM - Configuration', 'NC - Configuration', 'NC-Task 1 SAF', 'NC-Task 1 SVB', 'NC-Task 1-Image', 'Tables', 'Axes', 'Axis 1', 'Axis 1_Enc', 'Axis 1_Drive', 'Axis 1_Ctrl', 'Axis 2', 'PLC - Configuration', 'Cam - Configuration', and 'I/O - Configuration'. The main window shows the 'Online' tab for 'Axis 1'. The 'Controller Kv-Factor' is set to 0, and the 'Reference Velocity' is set to 2200. A red arrow points to the 'Controller Kv-Factor' field.

General	Settings	Global	Dynamics	Online	Functions	Coupling	Compensation
<p>Position 1.7339</p> <p>Setpoint Position: [mm] 0.0000</p> <p>Lag Distance (min/max): [mm] 0.0000 (0.000, 0.000)</p> <p>Actual Velocity: [mm/s] -0.0000</p> <p>Setpoint Velocity: [mm/s] 0.0000</p> <p>Override: [%] 0.0000 %</p> <p>Total / Control Output: [%] 0.00 / 0.00 %</p> <p>Error: 0 (0x0)</p>							
<p>Status (log.)</p> <p><input type="checkbox"/> Ready <input checked="" type="checkbox"/> NOT Moving</p> <p><input type="checkbox"/> Calibrated <input type="checkbox"/> Moving Fw</p> <p><input type="checkbox"/> Has Job <input type="checkbox"/> Moving Bw</p> <p>Status (phys.)</p> <p><input type="checkbox"/> Coupled Mode</p> <p><input type="checkbox"/> In Target Pos.</p> <p><input type="checkbox"/> In Pos. Range</p> <p>Enabling</p> <p><input type="checkbox"/> Controller <input type="checkbox"/> Feed Fw <input type="checkbox"/> Feed Bw</p> <p>Set</p>							
<p>Controller Kv-Factor: [mm/s/mm] 0</p> <p>Reference Velocity: [mm/s] 2200</p> <p>Target Position: [mm] 0</p> <p>Target Velocity: [mm/s] 0</p>							
<p>F1 F2 F3 F4 F5 F6 F8 F9</p>							

Switch off the position controller Kv=0



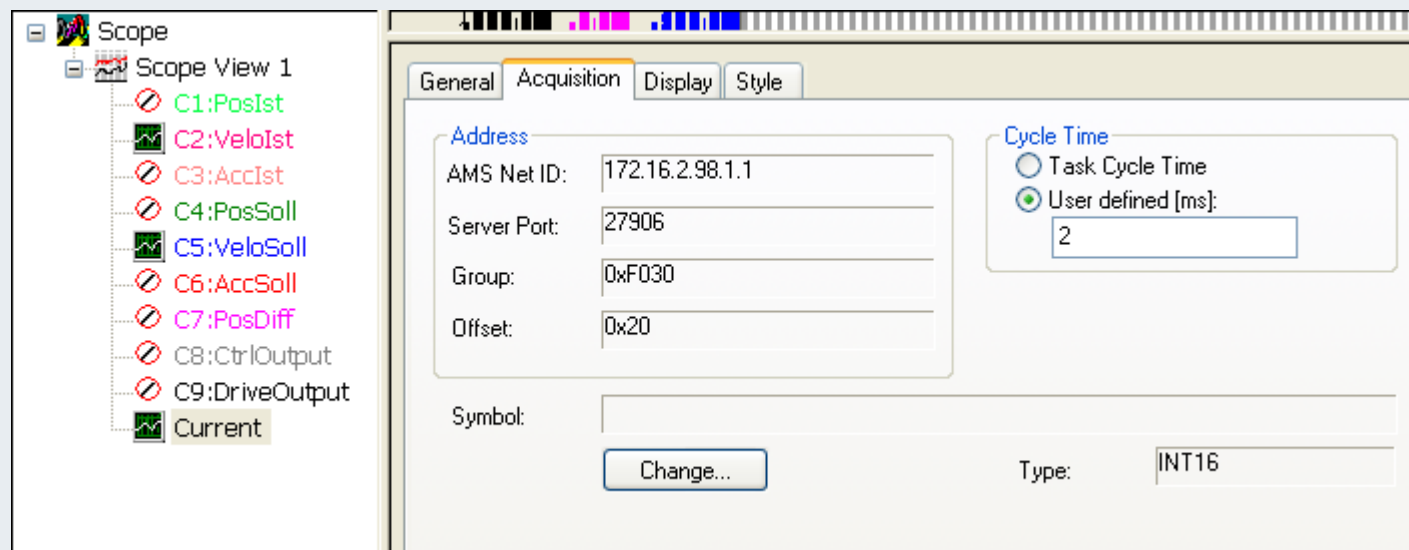
Drive tuning preparations



Scope view preparations



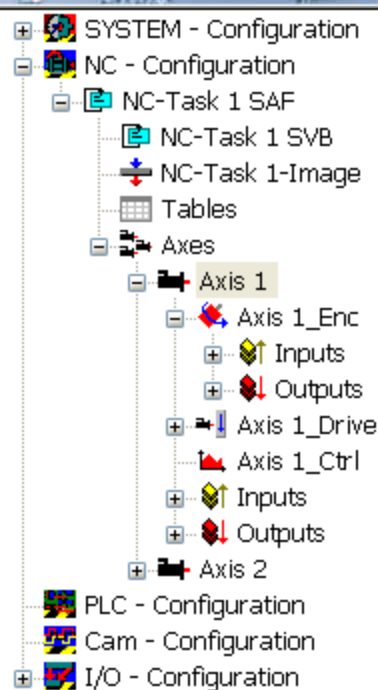
Drive tuning preparations



Basic „Scope View“ selection by „Achse1.scp“.

Add current to Scope.

Drive tuning



General Settings Global Dynamics Online **Functions** Coupling Compensation

1.7339 Setpoint Position: [mm] 0.0000

Extended Start

Start Mode: Reversing Sequence [Start] [Stop]

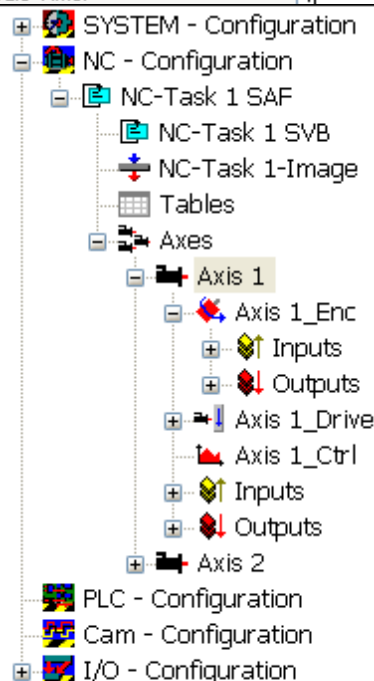
Target Position1: 100 [mm]

Target Velocity: 100 [mm/s]

Target Position2: 0 [mm]

Idle Time: 1 s

Up from Build 1316 the reversing sequence is possible as pure speed



General Settings Global Dynamics Online **Functions** Coupling Compensation

1.7339 Setpoint Position: [mm] 0.0000

Extended Start

Start Mode: Velo Step Sequence [Start] [Stop]

Target Velocity1: 100 [mm/s]

Target Velocity2: -100 [mm/s]

Driving Time: 1 s

Idle Time: 1 s

No Of Cycles: 2 0, 1, 2...

Raw Drive Output

Output Mode: Percent [Start] [Stop]

Output Value: 0 [%]

Set Actual Position

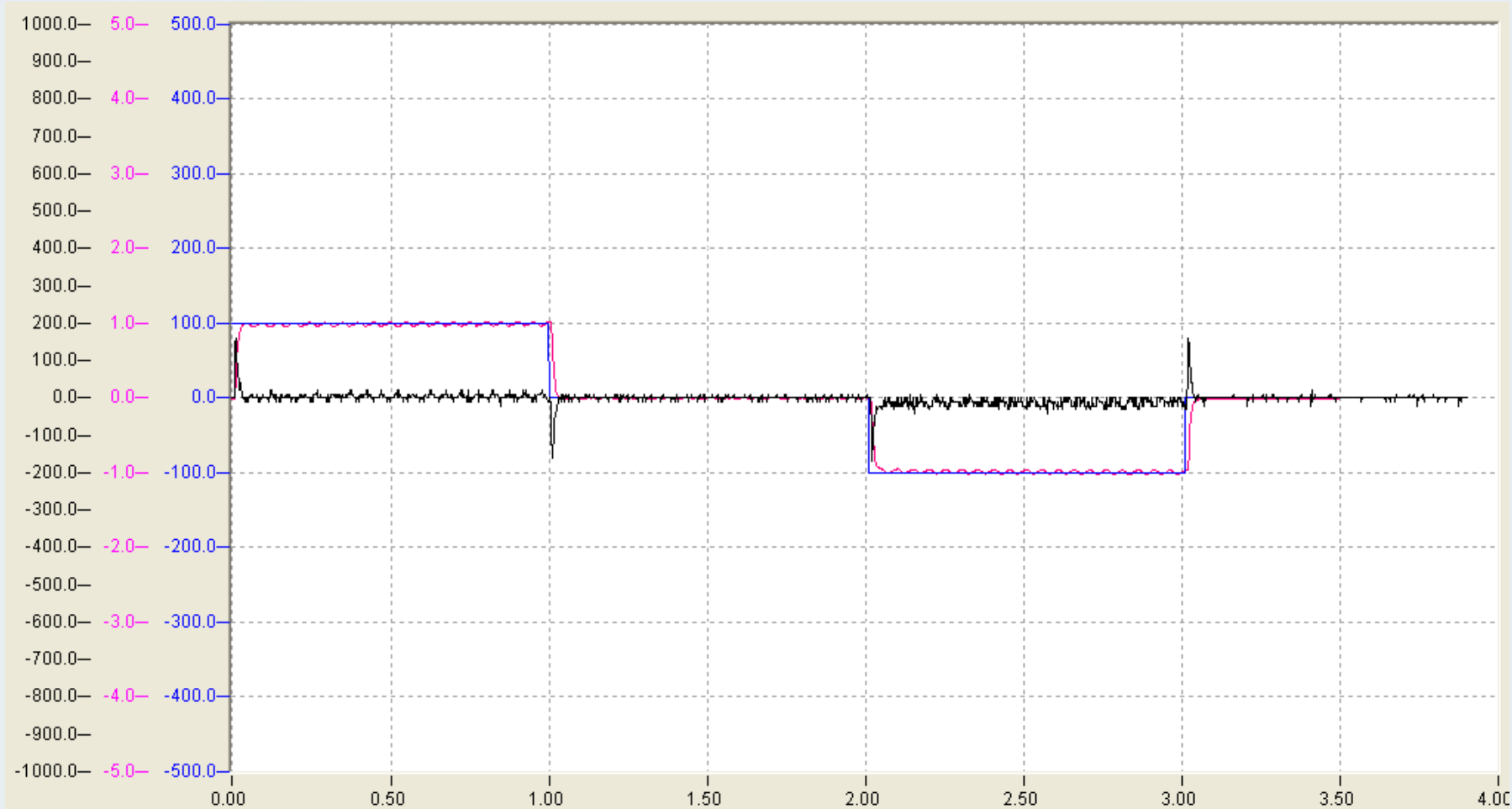
Absolute [Start] [Set]

Set Target Position

Absolute [Start] [Set]



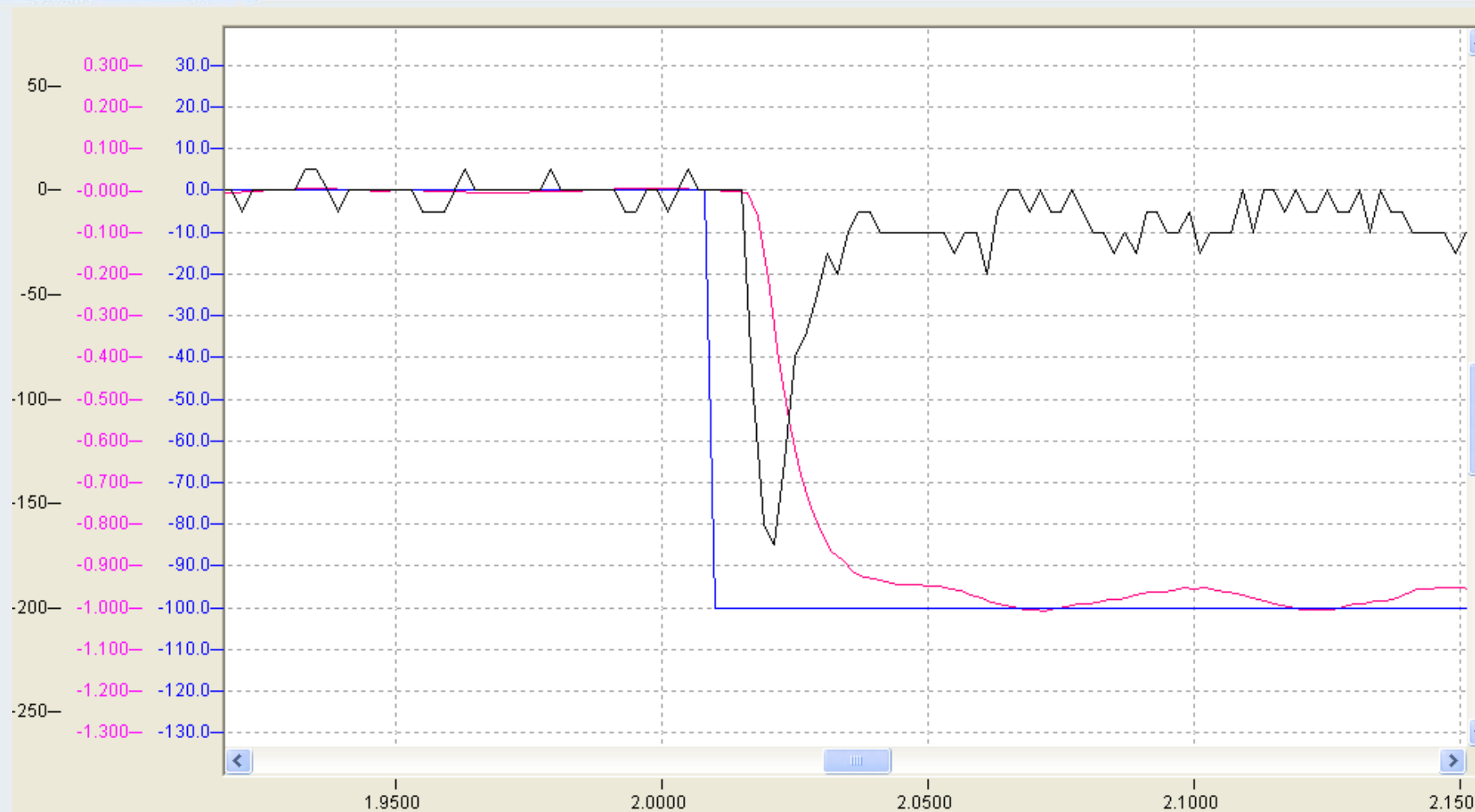
Drive tuning – Speed-controller “step response”



$T_n = 0$ $K_p = 0,2$



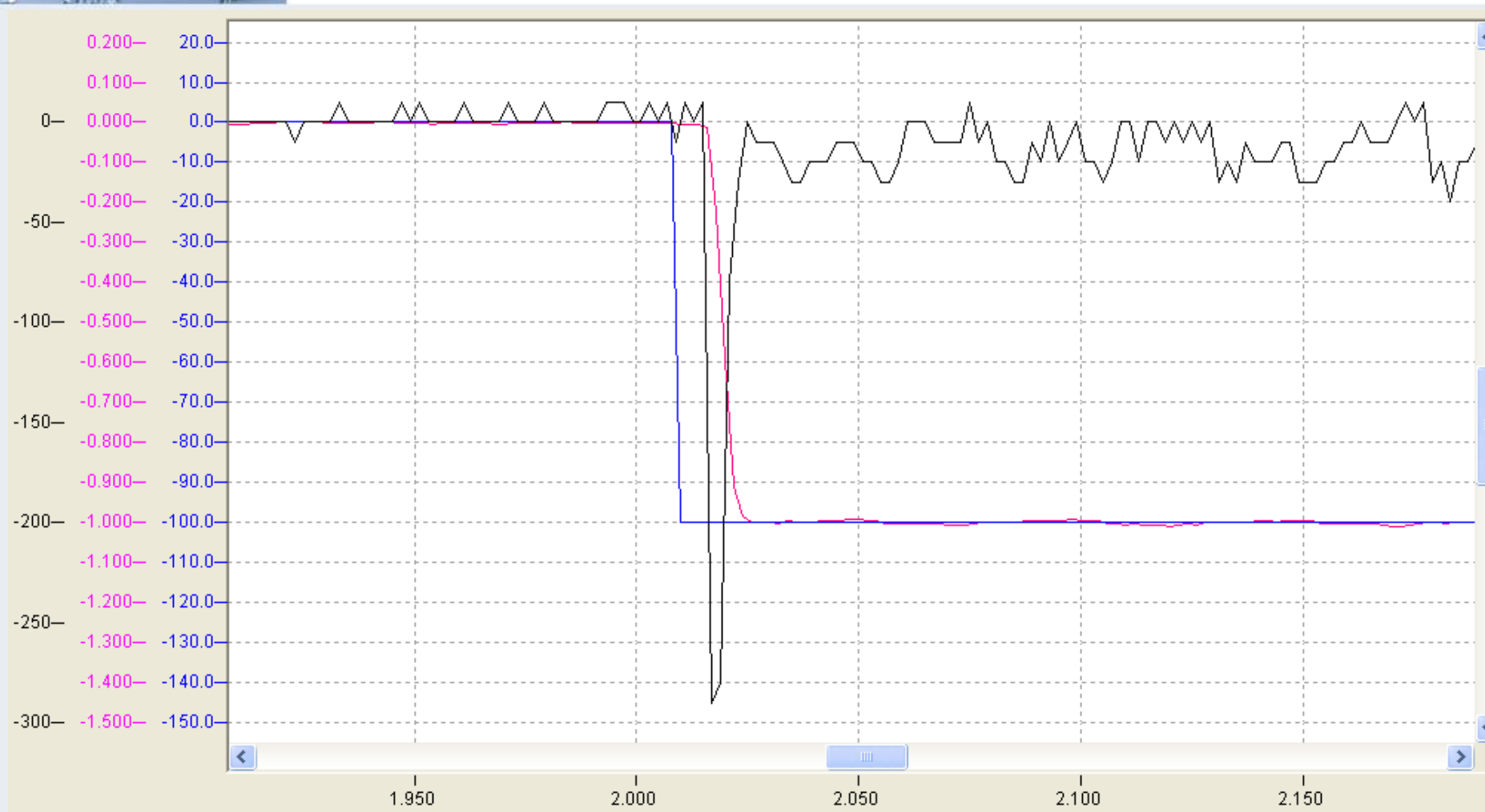
Drive tuning – Speed-controller “step response”



$T_n = 0$ $K_p = 0,2$



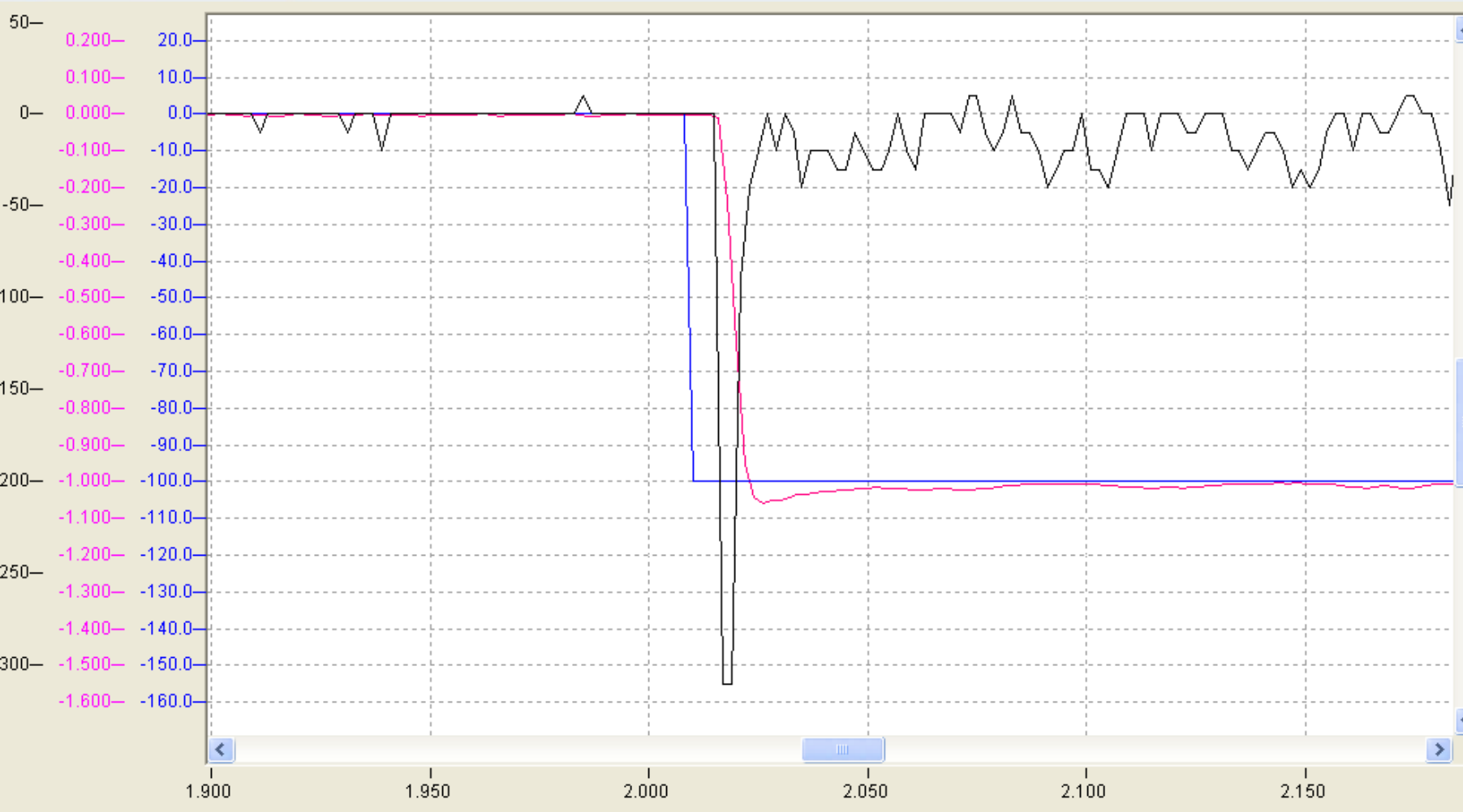
Drive tuning – Speed-controller “step response”



$T_n = 0$ $K_p = 1,0$



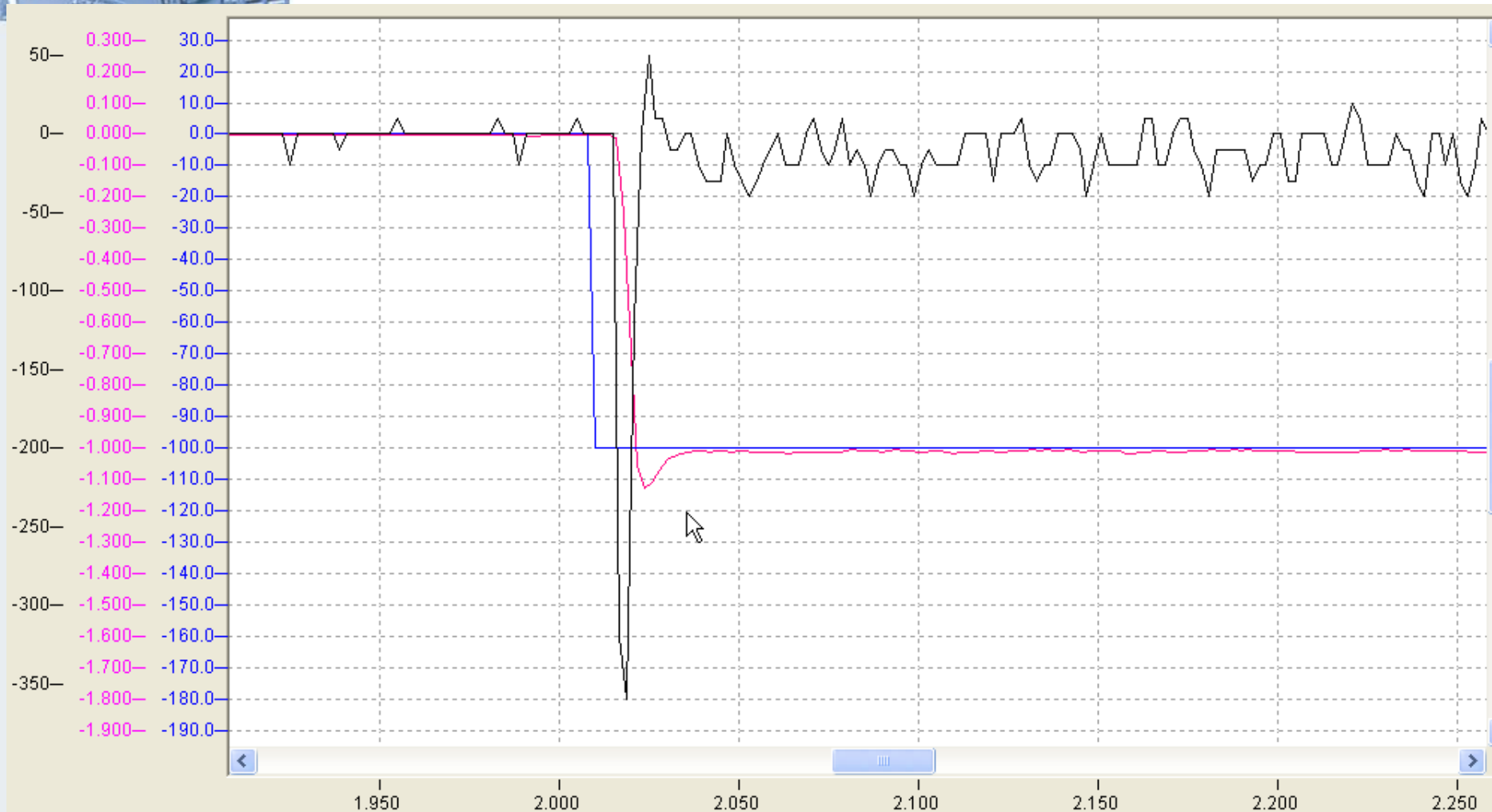
Drive tuning – Speed-controller “step response”



$T_n = 20$ $K_p = 1,0$



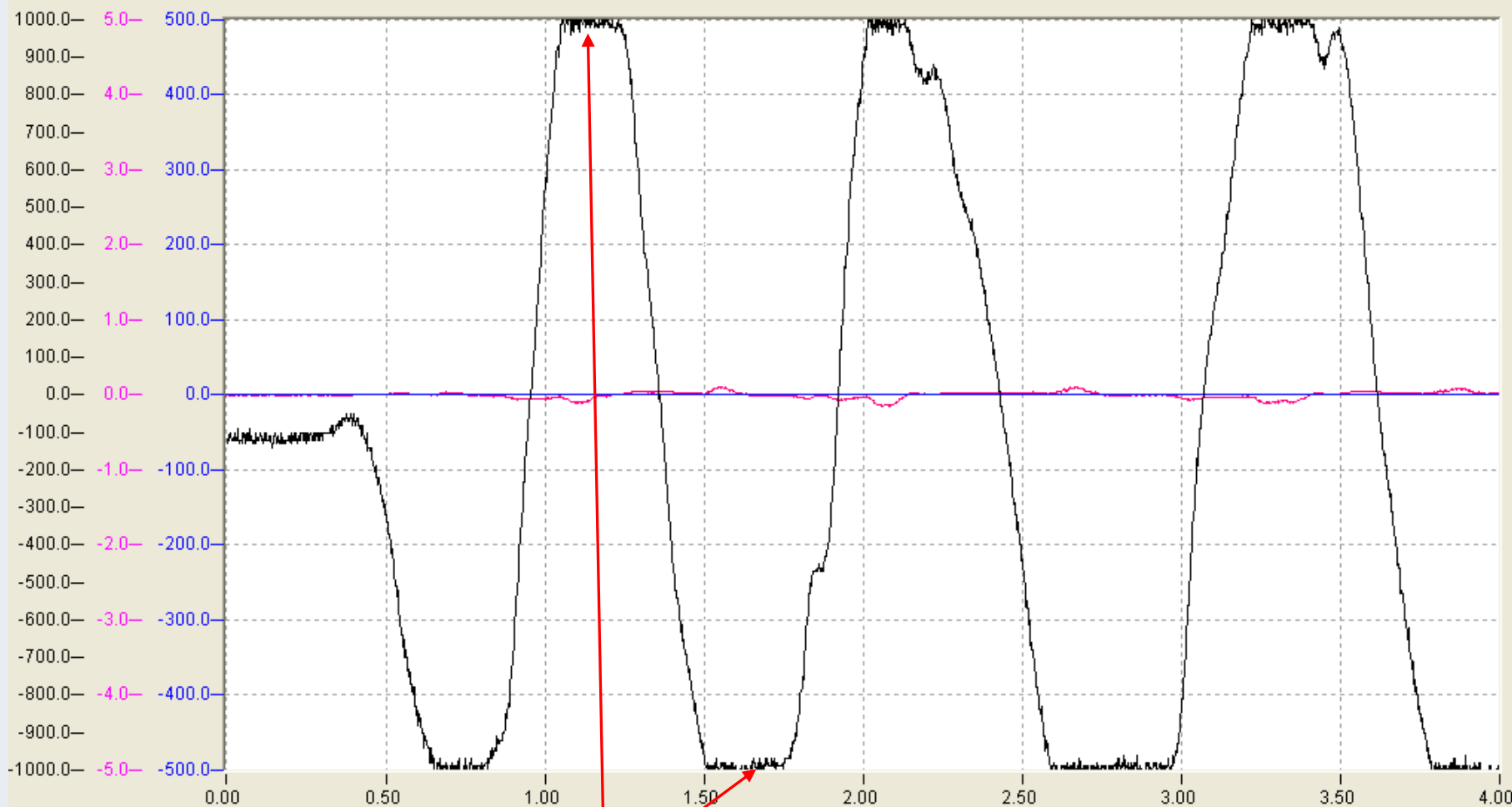
Drive tuning – Speed-controller “step response”



$T_n = 5$ $K_p = 1,0$



Drive tuning – Speed-controller “step response”



During the step response keep the current away from saturation.



Drive tuning – Speed-controller “step response”

-Summary of speed controller tuning:

- Switch off all filter and T_n .
- Raise up K_p to the final point without overshoot
- Raise T_n up to 10-20 % overshoot.
- Activate filter according requirements.



Drive tuning – Position-controller

The position controller

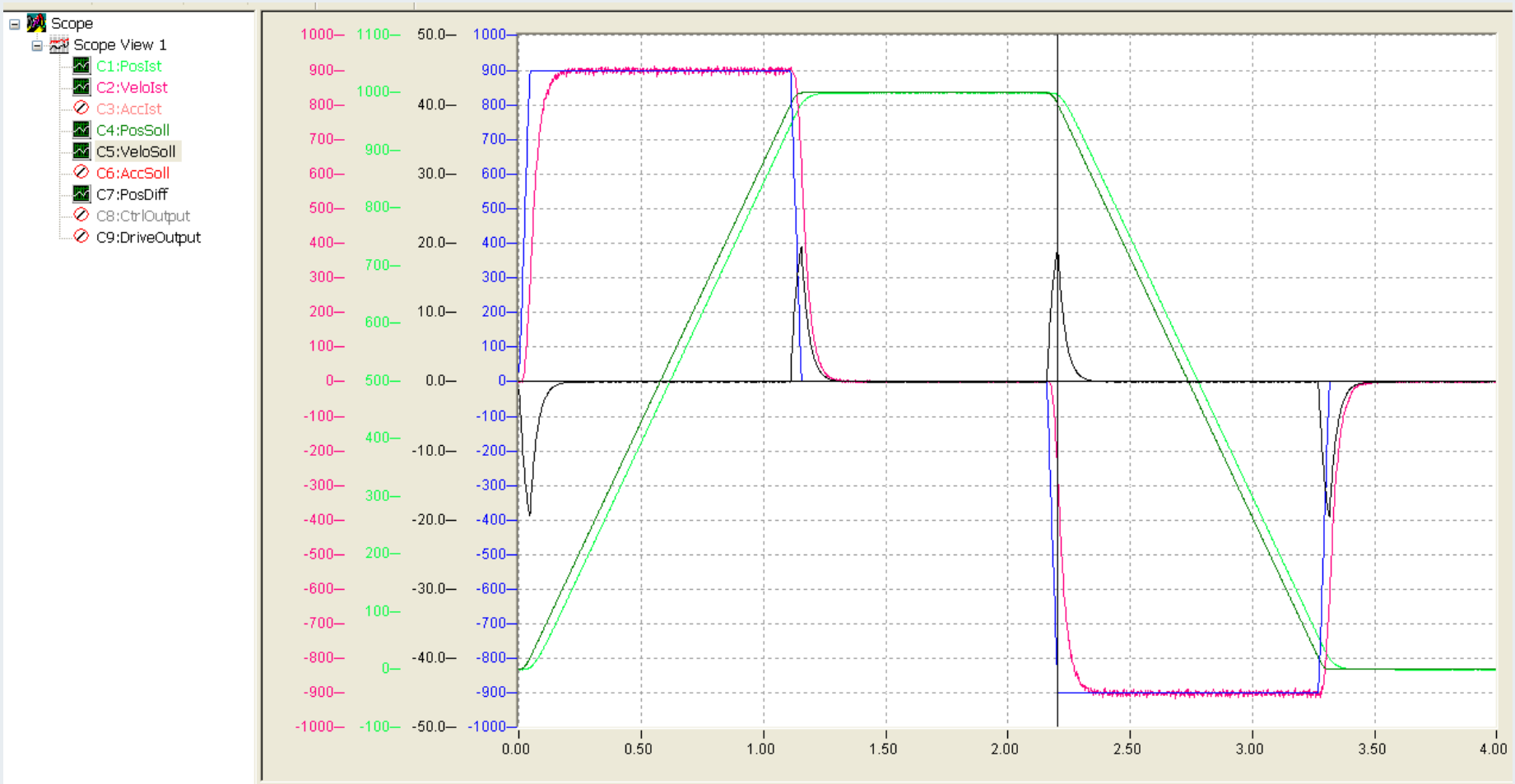
The position controller gain should be scaled to reach less following error and specified saddling time.

This procedure can be watched by „TwinCat Scop View”.

The System Manager generates the position setpoint.

Drive tuning – Position-controller

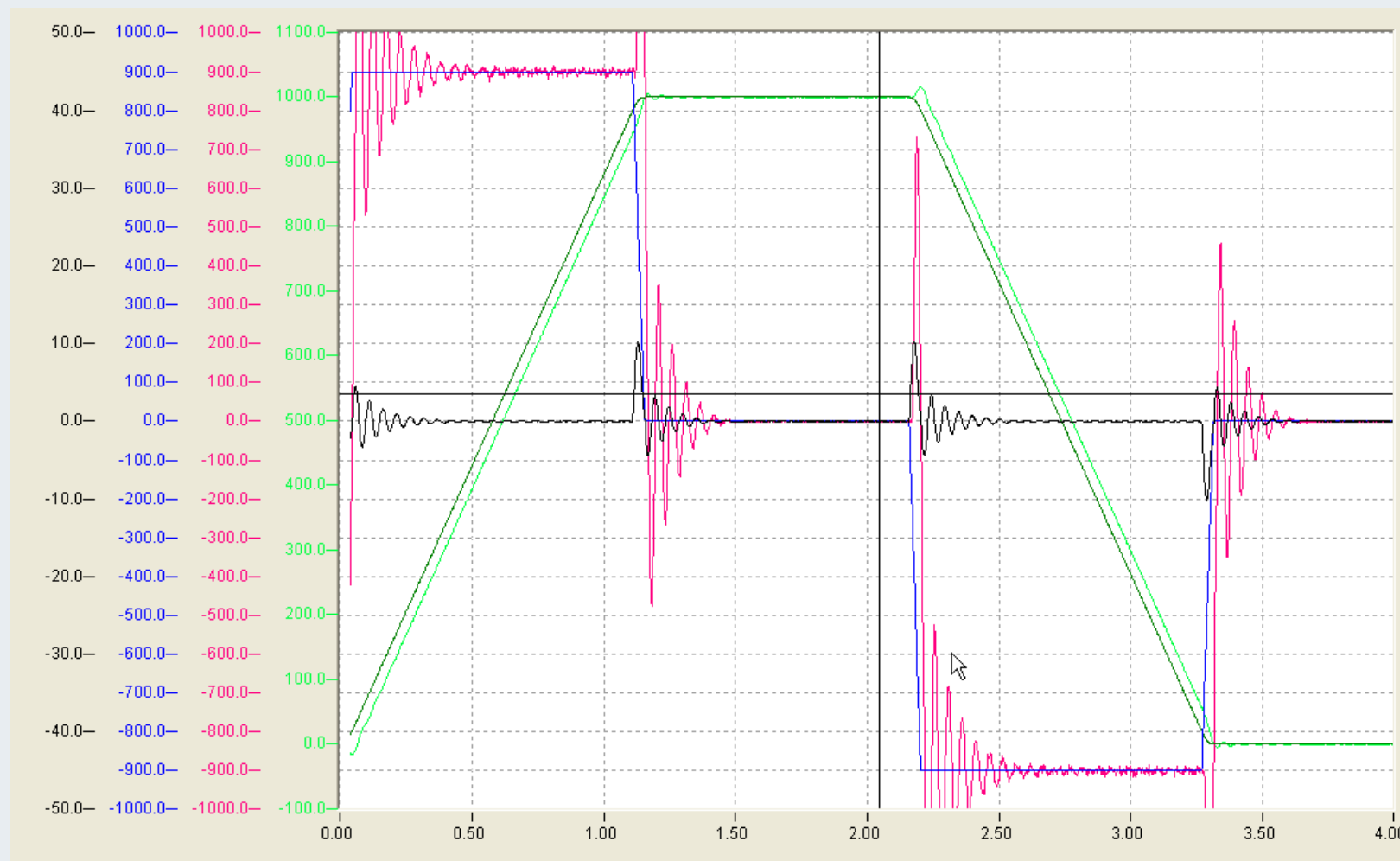
Right scaling of KV





Drive tuning – Position-controller

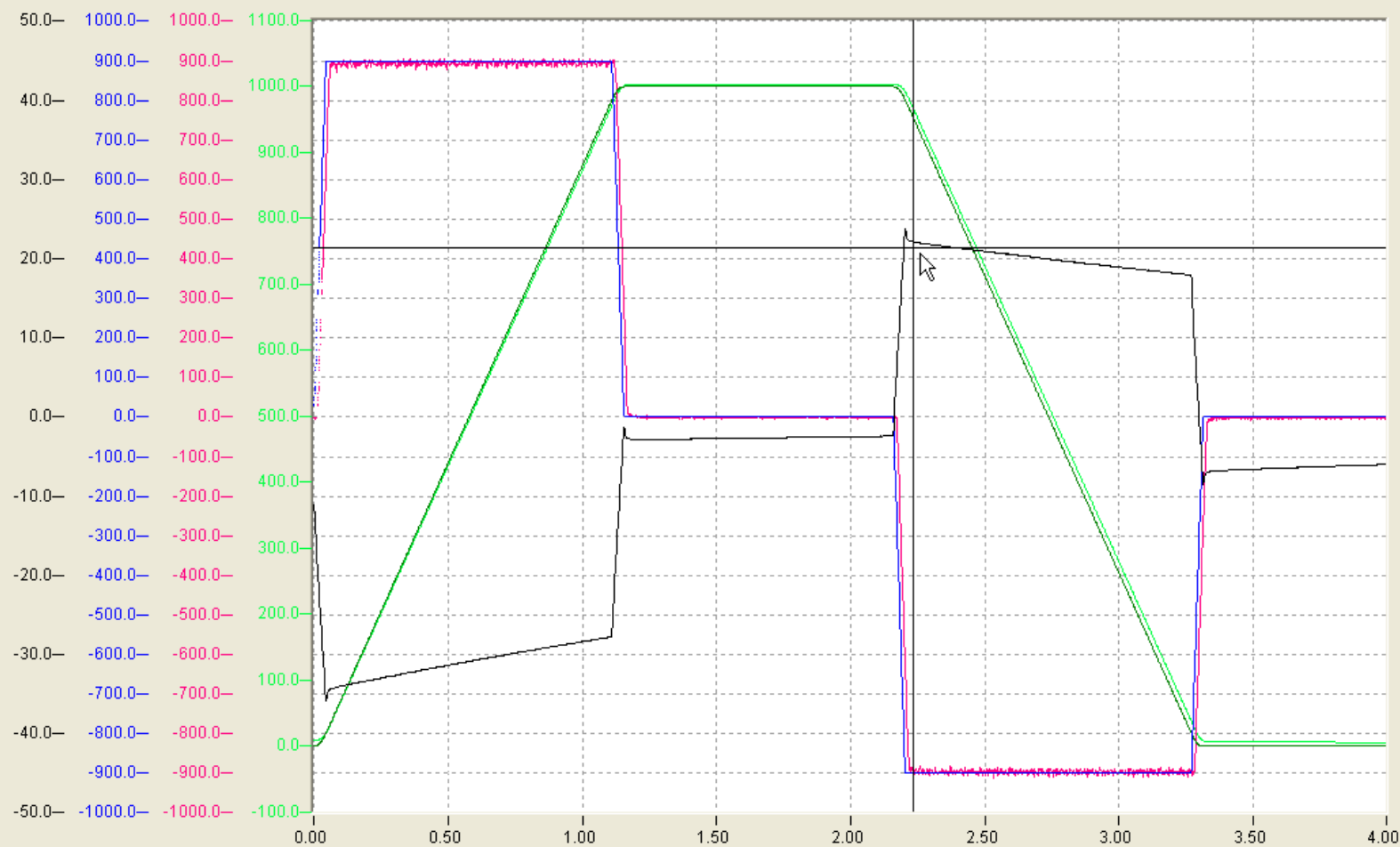
KV to high



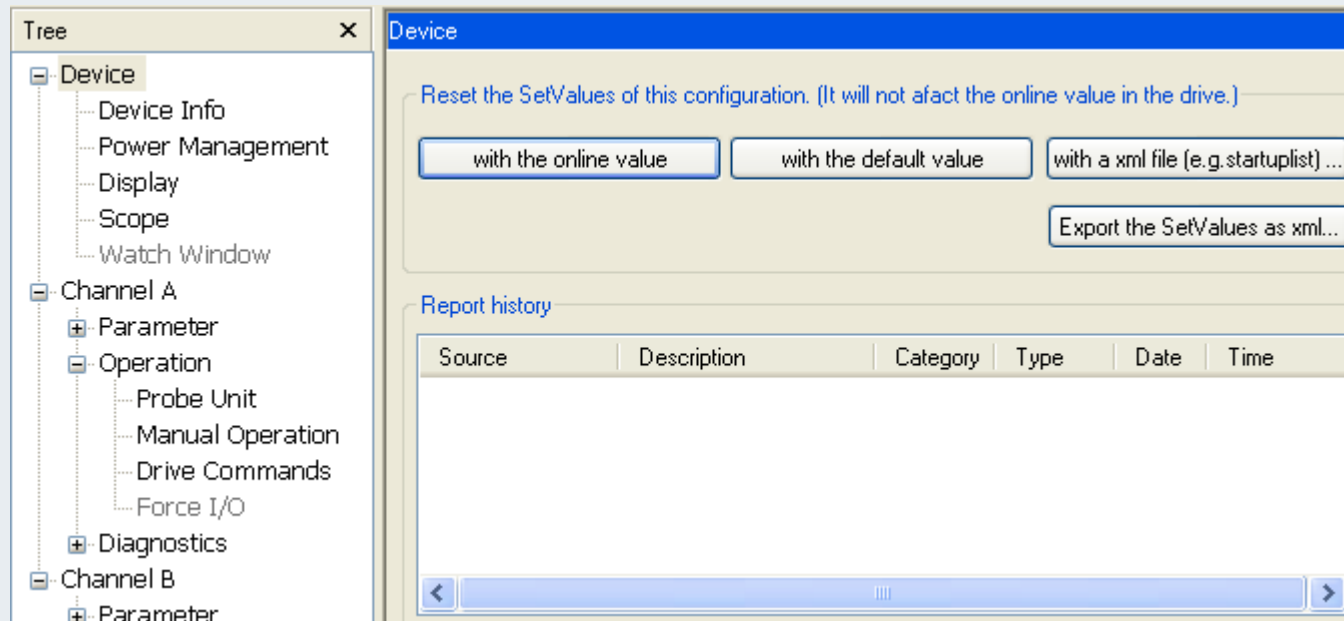


Drive tuning – Position-controller

KV to low



Device- Funktionen



Parameter handling of the AX5xx: Reset

Device- Info

Tree

- Device
 - Device Info
 - Power Management
 - Display
 - Scope
 - Watch Window
- Channel A
 - Parameter
 - Controller Overview
 - Position Control
 - Velocity Control
 - Current Control
 - Motor and Feedback
 - Process Data/Operation
 - Digital I/O
 - Parameter List
 - Scalings
 - Operation
 - Diagnostics
- Channel B

Device>>Device Info

More.. Export list Print list

IDN	Name	Act Value	Unit
Firmware Info			
S-0-0030	Hersteller-Version	Firmware: v1.00 (Build 0004) / Bootloader: v1.01 (Build 0002)	
S-0-0143	Sercos interface version	V02.03	
P-0-0324	ProductCode/RevisionNo	AX5206-0000-0003	
P-0-0325	Compile time and date	Mar 30 2007, 08:22:48	
P-0-0326	Release notes		
Hardware Info			
S-0-0031	Hardware-Version	c:0001 p:0000 d:0001 f:0100 o:---- s:----	
S-0-0110	Amplifier peak current	13.000	A
S-0-0112	Amplifier rated current	12.000	A
S-0-0200	Amplifier warning temperature	70.0	°C
S-0-0203	Amplifier shut down temperature	80.0	°C
S-0-0435	Operating time drive control	1674755	s
S-0-0436	Operating time power stage	215080	s
P-0-0090	Channel peak current	13.000	A
P-0-0091	Channel rated current	9.000	A

Drive "Firmware" - 0 = released 9 = test version

Hardware Version c= control - board; p = power-; d = driver-; f = frond-; o = option; s = safety

Device- Info

IDN	Name	Act Value	Unit
Firmware Info			
S-0-0030	Hersteller-Version	Firmware: v1.00 (Build 0004) / Bootloader: v1.01 (Build 0002)	
S-0-0143	Sercos interface version	V02.03	
P-0-0324	ProductCode/RevisionNo	AX5206-0000-0003	
P-0-0325	Compile time and date	Mar 30 2007 , 08:22:48	
P-0-0326	Release notes		
Hardware Info			
S-0-0031	Hardware-Version	c:0001 p:0000 d:0001 f:0100 o:---- s:----	
S-0-0110	Amplifier peak current	13.000	A
S-0-0112	Amplifier rated current	12.000	A
S-0-0200	Amplifier warning temperature	70.0	°C
S-0-0203	Amplifier shut down temperature	80.0	°C
S-0-0435	Operating time drive control	1674755	s
S-0-0436	Operating time power stage	215080	s
P-0-0090	Channel peak current	13.000	A
P-0-0091	Channel rated current	9.000	A

Export function for device info



Device- Info

IDN;Name;ActValue;SetValue;Unit

Firmware Info;;;;

S-0-0030;Hersteller-Version;Firmware: v1.01 (Build 0002) / Bootloader: v1.01 (Build 0002);;

S-0-0143;Sercos interface version;V02.03;;

P-0-0324;ProductCode/RevisionNo;AX5203-0000-0006;;

P-0-0325;Compile time and date;Sep 27 2007 , 12:36:48;;

P-0-0326;Release notes;;;;

Hardware Info;;;;

S-0-0031;Hardware-Version;c:0001 p:0001 d:0001 f:0100 o:---- s:----;;

S-0-0110;Amplifier peak current;12.000;;A

S-0-0112;Amplifier rated current;6.000;;A

S-0-0200;Amplifier warning temperature;70.0;;°C

S-0-0203;Amplifier shut down temperature;80.0;;°C

S-0-0435;Operating time drive control;854046;;s

S-0-0436;Operating time power stage;45888;;s

P-0-0090;Channel peak current;12.000;;A

P-0-0091;Channel rated current;6.000;;A



Power- Management

Device >> Power Management

Table View Download

Uact 204.4 V

(-) Phase Error Detection

Umain 230.0 V

Uring 30.0 %

Uring 30.0 %

AC/DC

Internal resistor

Pact0 W

R_{INT}

Dc link voltage Udc 290.0 V

Dc link interface

Idc -0.150 A

DCInt +

Pact0 W

R_{EXT}

AX5XXX

DCInt -

Power Management con...

ActValue: 0: UmainPhaseErrorDetection disabled

☐ Enable UmainPhaseErrorDetection

☒ Disable UmainPhaseErrorDetection

Download OK Cancel

Power Management con...

ActValue: 1: enabled

☒ Enable Internal brake resistor

☐ Disable Internal brake resistor

Download OK Cancel

Internal brake resistor parameter (P-0-...

Resistance 100 Ohm

Continuous Power 300 W

Maximum energy for 1 second 3000 J

Maximum energy for 0.1 second 350 J

Maximum single peak energy 100 J

reserved

Download OK Cancel

External brake resistor parameter (P-0-...

Resistance 0 Ohm

Continuous Power 0 W

Maximum energy for 1 second 0 J

Maximum energy for 0.1 second 0 J

Maximum single peak energy 0 J

reserved

(ActValue =)

Download OK Cancel

DcLink option

ActValue: 0x0000: External DC Link connection disabled

0x0000: External DC Link connection disabled

0x0001: External brake resistor

0x0002: Dynamic external DC Link connection

0x0003: Static external DC Link connection

Download OK Cancel



Power- Management in „Table View“

Device>>Power Management

Graphic View Download

IDN	Name	Act Value	Set Value	Unit
... S-0-0380	DC bus voltage	280.0		V
... S-0-0381	DC bus current	-0.080		A
... P-0-0200	Actual main voltage peak value	284.0		V
... P-0-0201	Nominal main voltage	230.0	230.0	V
... P-0-0202	Main voltage positive tolerance range	30.0	30.0	%
... P-0-0203	Main voltage negative tolerance range	30.0	30.0	%
+ P-0-0204	Power Management control word			
+ P-0-0205	Power Management status word			
+ P-0-0206	Power management switching thresholds			
+ P-0-0207	Internal brake resistor parameter			
+ P-0-0208	External brake resistor parameter			
... P-0-0209	Actual power internal brake resistor	0		W
... P-0-0210	Actual power external brake resistor	0		W
... P-0-0211	Warning level: Actual power internal brake resistor	100	100	W
... P-0-0212	Warning level: Actual power external brake resistor	500	500	W
... P-0-0213	External DC link current	0.040		A
... P-0-0214	DC Link connection mode	0x0000: External DC Li...	0x0000: External DC Li...	
... P-0-0215	Actual Periphery Voltage	26.688		V

Display

Tree

- Device
 - Device Info
 - Power Management
 - Display
 - Scope
 - Watch Window
- Channel A
- Channel B

Device>>Display

Download

Display value line 1:
(16)Actual ESC state

Display value line 2:
(14)Dc-Link voltage in V

(-1)Off
(0)Current mainloop time in us
(1)Min mainloop time in us
(2)Max mainloop time in us
(6)Current control interrupt CPU time in us
(7)Min control interrupt CPU time in us
(8)Max control interrupt CPU time in us
(9)System time
(10)Operation time high word
(11)Operation time low words
(12)IGBT temperature in C
(13)Main voltage in V
(14)Dc-Link voltage in V
(15)Dc-Link current in A
(16)Actual ESC state
(20)Actual Position
(23)Actual Velocity
(25)Actual Current
(26)Actual d-axis current
(27)Control word
(28)AxisState
(29)Operation time high word
(30)Operation time low word
(31)Encoder temperature
(40)Setpoint Position
(41)Setpoint Velocity
(42)Setpoint ext. Torque
(43)Setpoint int. Torque
(44)Setpoint Current
(45)Setpoint d-axis current

Op	AxisState	Error Id	Umain OK	DcLink OK	Ampl. Te...	Ac
Channel A	Control Sect...	ED43: U...	R		31.9	(2)w
Channel B	Control Sect...	ED43: U...	R		33.2	(2)w

Different display modes are possible

Default setting:

Display value line 1:
16: Actual ESC state

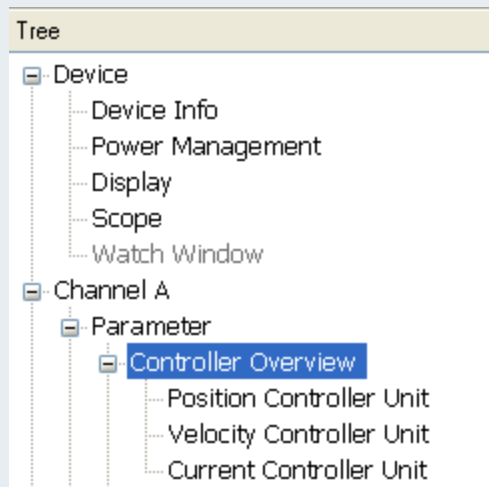
Display value line 2:
14: Dc-Link voltage in V



Parameter

- Controller Overview

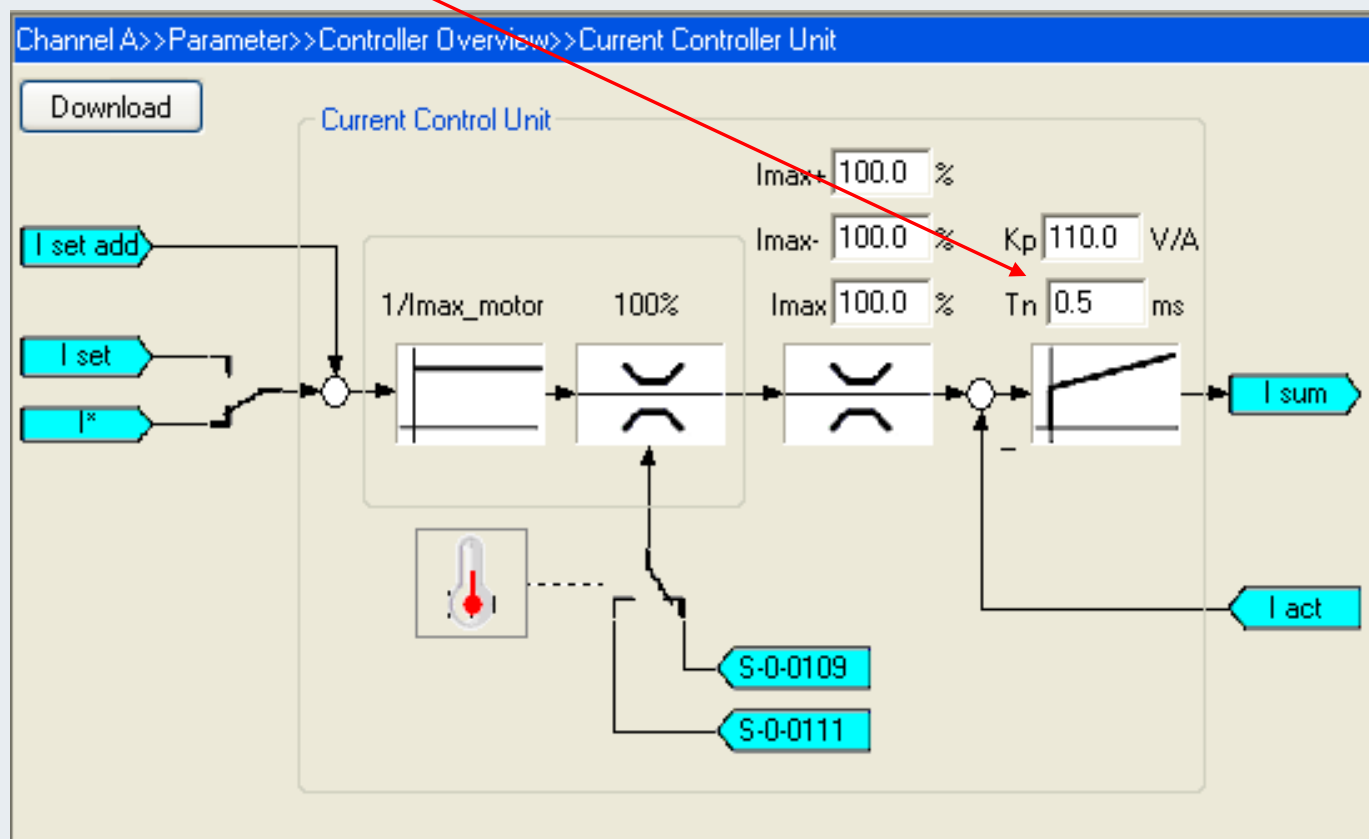
The setup of each controller goes from the “inside” (Current Controller) to the “outside” (Position Controller).





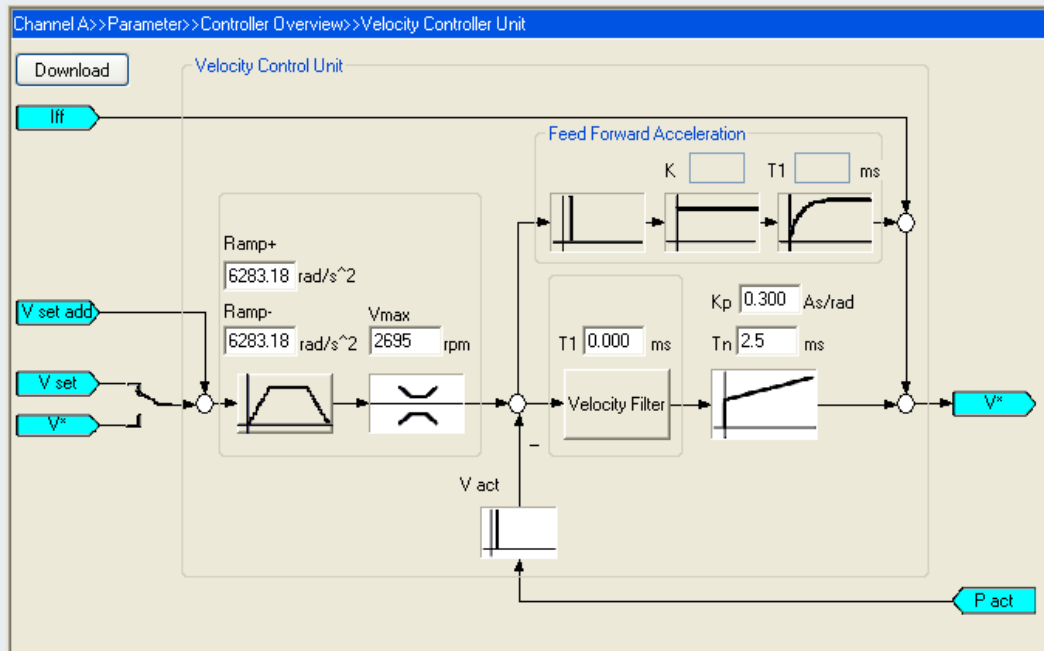
Current Controller Unit

Kp and Tn of the current controller are set by the Motor default parameters.





Velocity Controller Unit



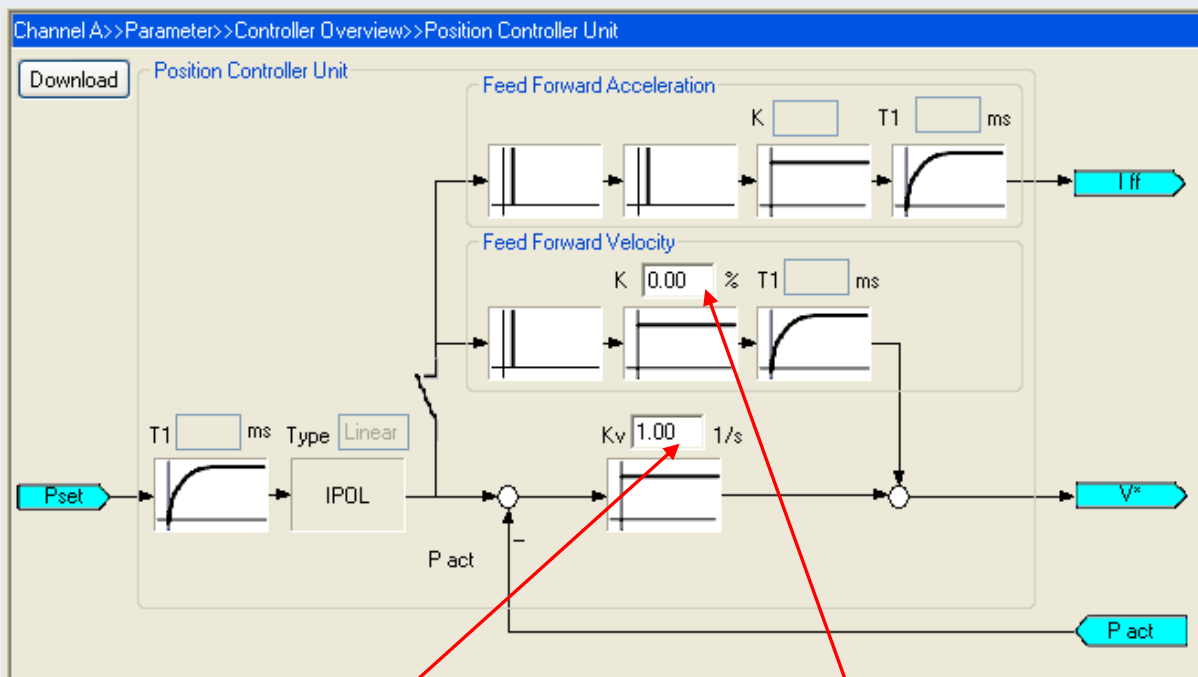
The scaling “rad” is fix.

The perigon is 2π radian or 360 degree; That is:

$$1 \text{ rad} = \frac{360^\circ}{2\pi} = \frac{180^\circ}{\pi} \approx 57,29577951^\circ$$

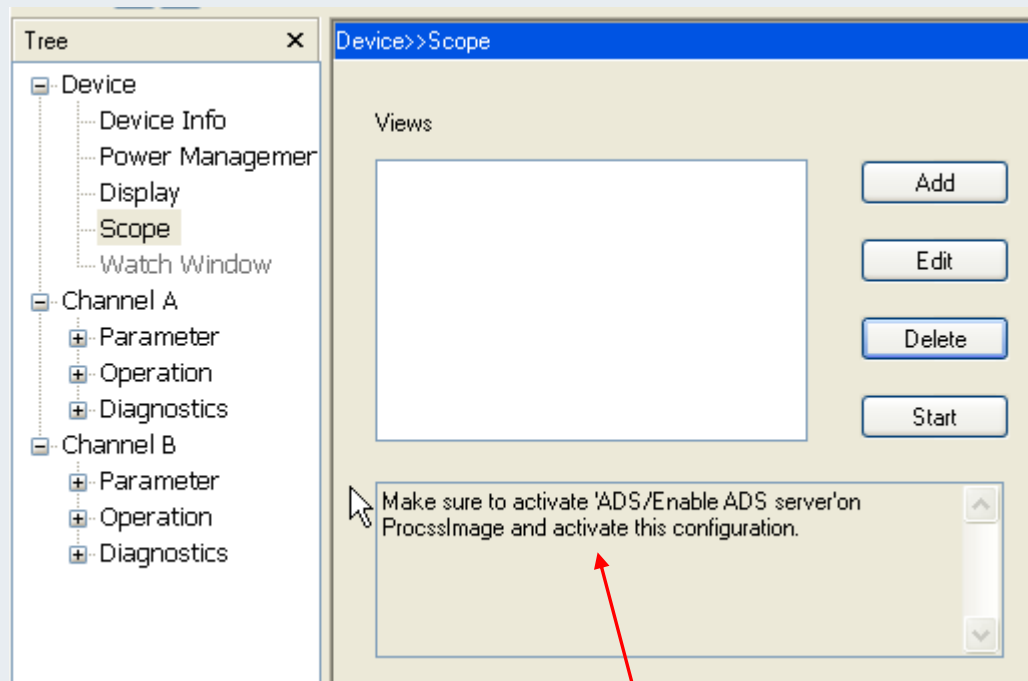


Position Controller Unit



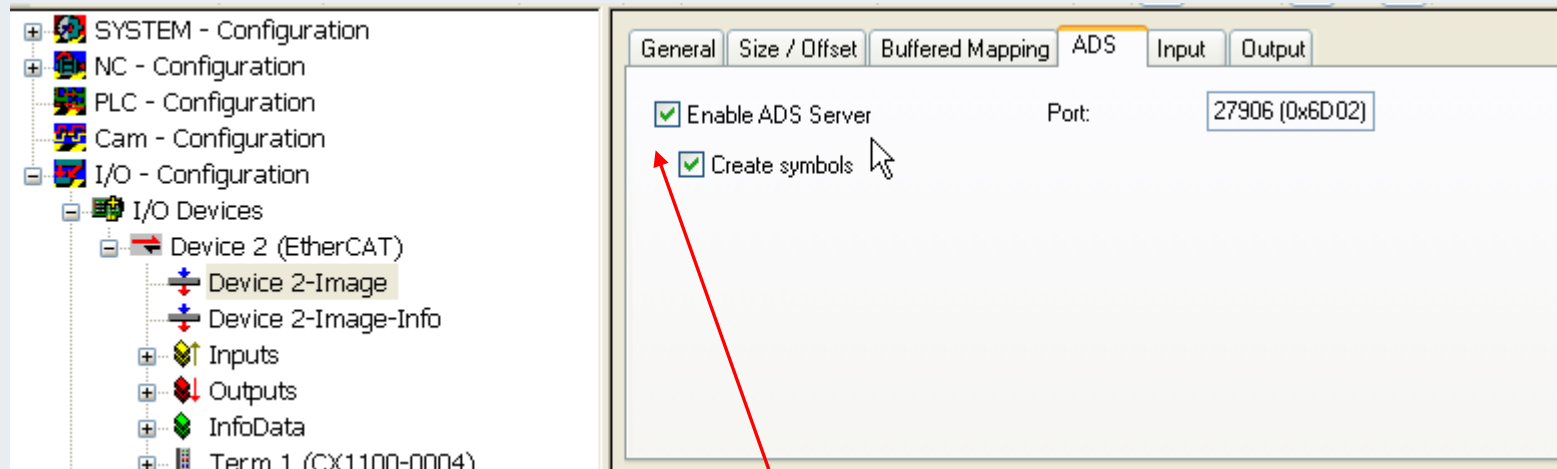
“Proportional gain” and “Velocity Feed Forward” in the position controller

Scope



Important note to do - scope function-

Scope



For the scope function please select: “Enable ADS Server” and “Create symbols”.

Motor and Feedback

Tree

- Device
 - Device Info
 - Power Management
 - Display
 - Scope
 - Watch Window
- Channel A
 - Parameter
 - Controller Overview
 - Position Controller
 - Velocity Controller
 - Current Controller
 - Motor and Feedback
 - Motor
 - Feedback 1
 - Feedback 2

Channel A>>Parameter>>Motor and Feedback

Reset (All) *Add parameters directly to the Startuplist: No

Feedback 1 connector: 3: X11 (Front, Encoder) Feedback 2 connector: 0: No connector

Scan motor and feedback 1 Scan feedback 2

Feedback 1 type: Heng#AD36-0019AF.0XB10 Motor type: AM3021-0C30 Feedback 2 type:

Feedback 1 Parameters Motor Parameters Feedback 2 Parameters

13 Feedback options

Tree

- Device
 - Device Info
 - Power Management
 - Display
 - Scope
 - Watch Window
- Channel A
 - Parameter
 - Controller Overview
 - Position Controller
 - Velocity Controller
 - Current Controller
 - Motor and Feedback
 - Motor
 - Feedback 1
 - Feedback 2

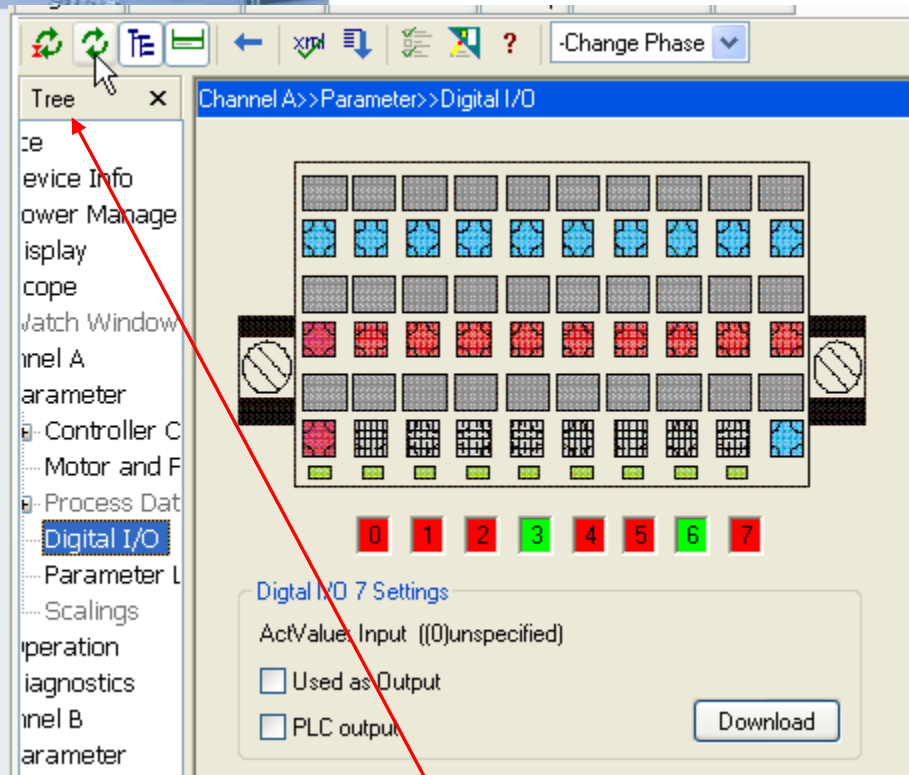
Channel A>>Parameter>>Motor and Feedback>>Motor

Type AM3021-0C30 Download selected items

Parameter list:

IDN	Name	Act Value	Set Value	Unit
S-0-0091	Bipolar velocity limit value	7599	7599	rpm
S-0-0100	Velocity loop proportional gain	0.200	0.200	A/(ra...
S-0-0101	Velocity loop integral action time	6.0	6.0	ms
S-0-0106	Current loop proportional gain 1	58.0	58.0	V/A
S-0-0107	Current control loop integral action time 1	0.5	0.5	ms
S-0-0109	Motor peak current	6.300	6.300	A
S-0-0111	Motor continuous stall current	1.580	1.580	A
S-0-0113	Maximum motor speed	8000	8000	rpm
S-0-0136	Positive acceleration limit value	6283.18	6283.18	rad/s^2
S-0-0137	Negative acceleration limit value	6283.18	6283.18	rad/s^2

Digital I/O Link



After running „Update IDN`s“ the input online state is displayed.

Digital I/O Link

By the folder „Process data“ e.g. the I/O state can be add.
 Maximum is: 12 input words and 20 output words by 62,5 µsec.
 One Word = 2Byte

Software interface showing the configuration of Digital I/O Link (PDO) settings.

Sync Manager:

SM	Size	Type	Flags
0	128	MbxOut	
1	128	MbxIn	
2	12	Outputs	
3	12	Inputs	

PDO Liste:

Index	Size	Name
S-0-0016...	6.0	AT 1
S-0-0016...	6.0	AT 2
S-0-0024...	6.0	MDT 1
S-0-0024...	6.0	MDT 2

PDO Zuordnung (SM 2):

- ☒ S-0-0024 (A)
- ☒ S-0-0024 (B)

PDO Inhalt (S-0-0016 (A)):

Index	Size	Offs	Na
S-0-0135	2.0	0.0	Driv
S-0-0051	4.0	2.0	Pos
		6.0	

PDO Eintrag Bearbeiten

Name: Digital inputs, state

Index (hex): 8321 33569

Sub Index: 0

Datentyp: WORD

Bit Länge: 16

From Dictionary:

- S-0-0011 - Class 1 diagnostic (C1D)
- S-0-0040 - Velocity feedback value 1
- S-0-0084 - Torque feedback value
- S-0-0130 - Probe value 1 positive edge
- S-0-0131 - Probe value 1 negative edge
- S-0-0189 - Following distance
- S-0-0347 - Velocity error
- S-0-0380 - DC bus voltage
- S-0-0381 - DC bus current
- P-0-0252 - Probe 1 logic state
- P-0-0801 - Digital inputs, state
- P-0-1002 - Debug pointer 1 value
- P-0-1005 - Debug pointer 2 value
- P-0-1008 - Feedback debug pointer 1 value
- P-0-1011 - Feedback debug pointer 2 value



Digital I/O Link

Now „Digital inputs, state“ is a part of AT1.

Name	Online	Typ	Größe	>Adr...	Ein/...	Us
Drive status word	X 0x8000 (32768)	UINT	2.0	26.0	Eing...	0
Position feedback 1 value	X 0x000074FE (29...)	DINT	4.0	28.0	Eing...	0
Digital inputs, state	0x0088 (136)	WORD	2.0	32.0	Eing...	0

- SYSTEM - Configuration
- NC - Configuration
- PLC - Configuration
- Cam - Configuration
- I/O - Configuration
 - I/O Devices
 - Device 2 (EtherCAT)
 - Device 2-Image
 - Device 2-Image-Info
 - Inputs
 - Outputs
 - InfoData
 - Term 1 (CX1100-0004)
 - Axis 8 (AX5203-0000-0005)
 - AT 1
 - Drive status word
 - Position feedback 1 value
 - Digital inputs, state
 - AT 2
 - MDT 1
 - MDT 2
 - WcState

Variable

Flags

Online

Value:

0x0000 (0)

New Value:

Force...

Release

Write...

Comment:

Parameter List

By the „Parameter List“ there is access to the axis parameter.

Two forms are possible.

Show in groups:

Channel A >> Parameter >> Parameter List

Download Upload All Visible

IDN	Name	Act Value	Set Value	Unit	Default
+	Axis Management				
+	Communication				
+	Current Control Loop				
+	Debug				
+	Diagnostics				
+	Digital In / Out				
+	Feedback				
+	Firmware Info				
+	Hardware Info				
+	Motor				
+	Other				
+	Position Control Loop				
+	Power Management				
+	Probe unit				
+	Procedure Commands				
+	Realtime ctrl and status bits				
+	Scaling				
+	Velocity Control Loop				

- Min value
- Max value
- Default value
- ✓ Show in group
- Export list



Parameter List

Or IDN listed.

Tree

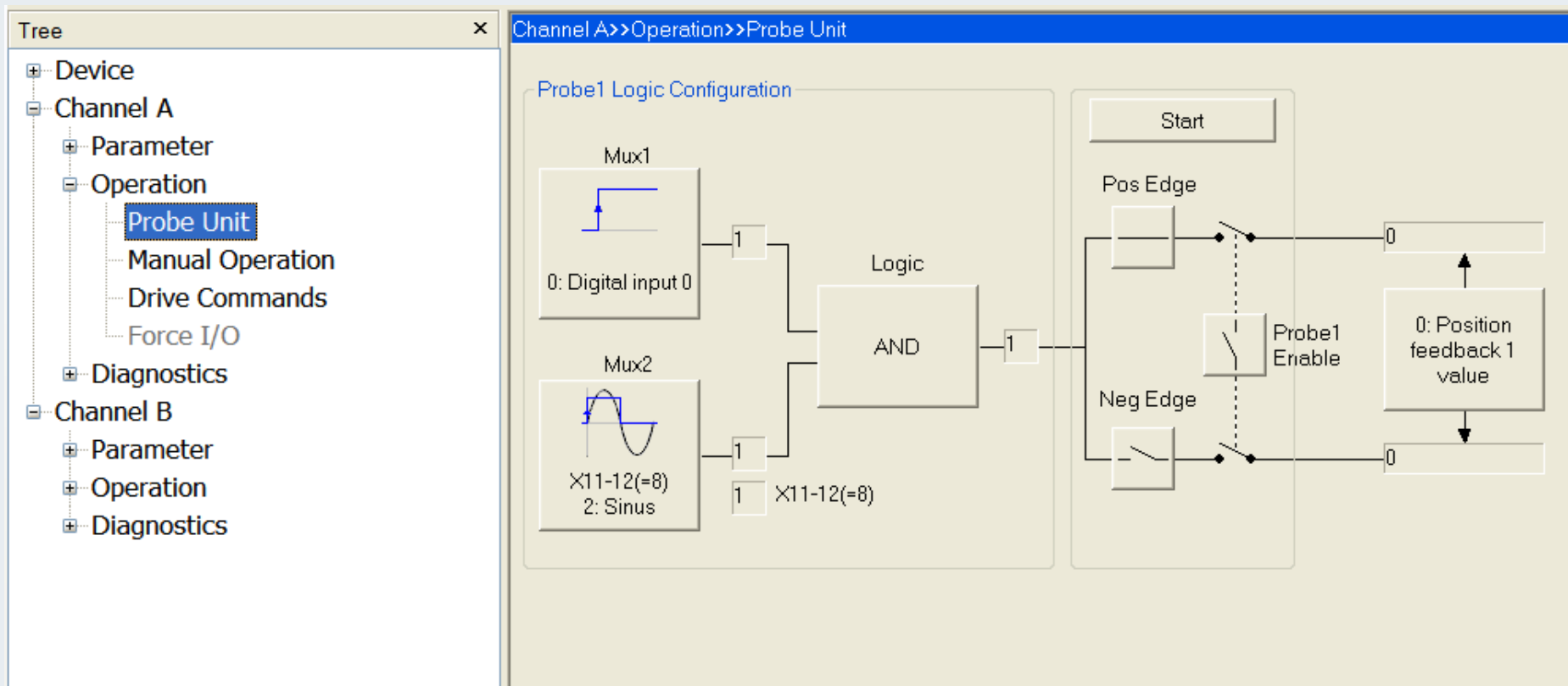
- + Device
 - Channel A
 - Parameter
 - + Controller Overview
 - + Motor and Feedback
 - + Process Data/Operation
 - Digital I/O
 - Parameter List**
 - Scalings
 - + Operation
 - + Diagnostics
 - Channel B

Channel A >> Parameter >> Parameter List

Download
Upload All Visible

IDN	Name	Act Value	Set Value	Unit
S-0-0001	Control unit cycle time (TNcyc)		2000	us
S-0-0002	Communication cycle time (tSync)		2000	us
+ S-0-0011	Class 1 diagnostic (C1D)			
S-0-0012	Class 2 diagnostic (C2D)			
S-0-0015	Telegram type		00000000 00000111	
S-0-0016	Configuration list of AT		Edit list... (disabled)	
S-0-0017	IDN-list of all operation data			
S-0-0018	IDN-list of operation data for CP2			
S-0-0019	IDN-list of operation data for CP3			
S-0-0020	IDN-list of operation data for CP4			
S-0-0021	IDN-list of invalid operation data for CP2			
S-0-0022	IDN-list of invalid operation data for CP3			
S-0-0024	Configuration list of MDT		Edit list... (disabled)	
S-0-0025	IDN-list of all procedure commands			
S-0-0029	MDT error counter			
S-0-0030	Manufacturer Version			
S-0-0031	Hardware version			
S-0-0032	Primary operation mode	2: velo control	11: pos ctrl feedback 1...	
S-0-0033	Secondary operation mode 1		0: no mode of operation	

Probe Unit - Operation



The Probe Unit gives the possibility to select different latch and “Homing” alternatives.

Probe Unit - Operation, Position Latch

In case of „position latch“ the Probe Unit can configured in that way:

The screenshot shows the Beckhoff configuration software interface. On the left is a 'Tree' view with the following structure:

- Device
 - Device Info
 - Power Management
 - Display
 - Scope
 - Watch Window
- Channel A
 - Parameter
 - Operation
 - Probe Unit
 - Manual Operation
 - Drive Commands
 - Force I/O
 - Diagnostics
- Channel B
 - Parameter
 - Operation
 - Diagnostics

The main window is titled 'Channel A >> Operation >> Probe Unit'. It displays a logic configuration diagram for 'Probe1'. The diagram includes a 'Mux1' block with a signal selection dropdown set to '0: Digital input 0'. The output of 'Mux1' is connected to a 'Logic' block. The 'Logic' block is connected to a 'Pos Edge' block, which is then connected to a 'Probe1' block. The 'Probe1' block has an output labeled '0: Position'. A 'Start' button is also visible in the diagram.

A modal dialog titled 'Probe 1 logic configuration (P-0-0251): Mux 1' is open. It contains the following sections:

- Signal selection:** ActValue: 0: Digital input 0. A list of digital inputs (0-7) is shown, with '0: Digital input 0' selected.
- Output negation:** ActValue: 0: off. Two radio buttons are present: 'High active' (selected) and 'Low active'.
- Now:** A signal trace showing a rising edge.
- Preview:** A signal trace showing a rising edge.
- Buttons:** Download, OK, and Cancel.



Probe Unit - Operation, Position Latch

Multiplexer selection

Tree

- Device
 - Device Info
 - Power Management
 - Display
 - Scope
 - Watch Window
- Channel A
 - Parameter
 - Operation
 - Probe Unit
 - Manual Oper
 - Drive Comm
 - Force I/O
 - Diagnostics
- Channel B
 - Parameter
 - Operation
 - Diagnostics

Channel A >> Operation >> Probe Unit

Probe1 Logic Configuration

Mux1

0: Digital input 0

Mux2

Logic

Start

Pos Edge

Neg Edge

Probe1 Enable

0: Position feedback 1 value

Probe 1 logic configuration (P-0-0251): Logic

Logic operation

ActValue: 0: Mux 1

Output negation

ActValue: 0: off

☒ High active

☐ Low active

0: Mux 1

1: Mux 2

2: Mux 1 AND Mux 2

3: Mux 1 AND rising edge Mux2

4: reserved

5: Mux 1 OR Mux 2

Download

OK

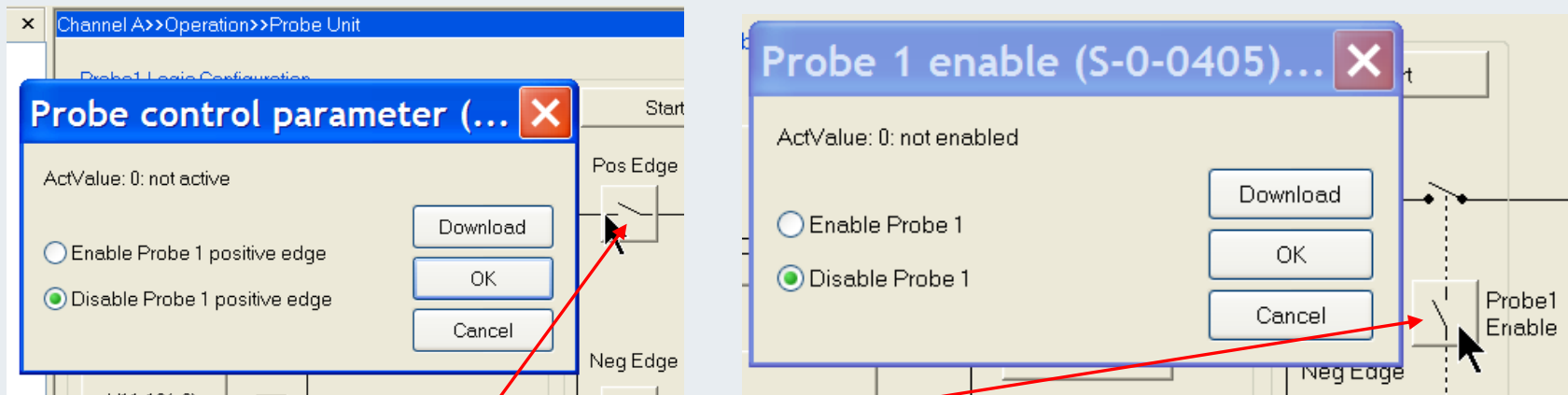
Cancel

Op AxisState Er

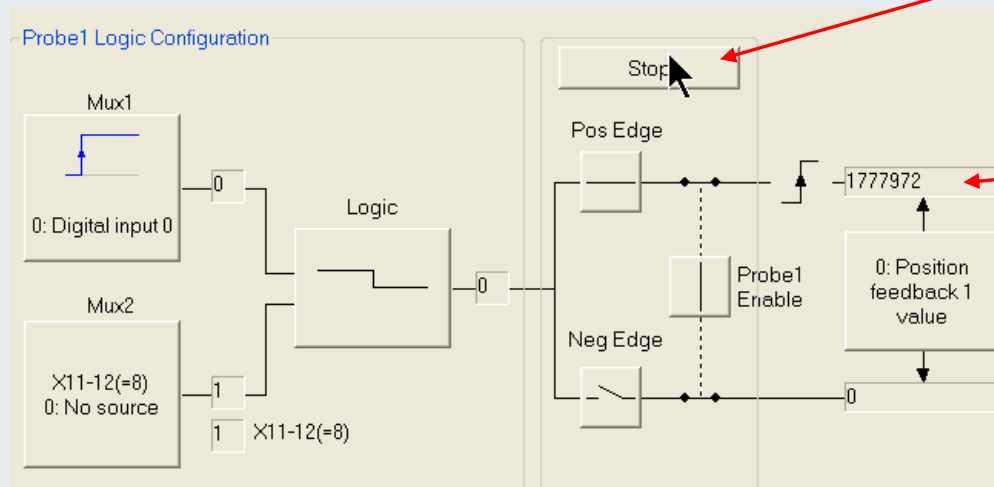
Channel A Drive Re... D01

Channel B Axis Error F70

Probe Unit - Operation, Position Latch



Select „Probe control“ and „Probe 1 enable“, now the latch start/start is possible.



The latched value is displayed here.

Probe Unit - Operation, Position Latch

Add latched value to „Process data's“

The screenshot shows the Beckhoff Configuration Manager interface. On the left, the 'I/O Configuration' tree is expanded, showing 'Device 2 (EtherCAT)' and its sub-items. The 'Probe value 1 positive edge' is highlighted in blue. A red arrow points from the text 'Add latched value to „Process data's“' to this item. On the right, the 'Online' tab of the 'Variable' window is active. It shows the 'Value' field with the hexadecimal value '0x43568000 (1129742336)'. Below the 'Value' field are buttons for 'Force...', 'Release', and 'Write...'. A 'Comment' field is also present. At the bottom, a grid displays the value '1129742336' in blue text.



Probe Unit - Operation, “Homing”

Reference Movement

It is possible to do Homing by TwinCat using the Probe-Unit of AX5000. The probe unit configuration should be done in the “Startup List”, it is also possible during axis operation.

So that TwinCat is able to control the probe-unit by IDN S-0-0405 and S-0-0406 it has to mapp into the real-time-control and status bit 2. This is done by the IDN S-0-0303 and S-0-0307 entry.

Configuration of real-time-control- and status-bit: ↯

Probe Unit - Operation, "Homing"

Add IDN S-0-0303 und IDN S-0-0307 to "Startup List"

Startup List

IDNs already in Startup list

Index	Name	Set Value	Unit
S-0-0015	Telegram type	00000000 00000111	
S-0-0016	Configuration list of AT	Edit list... (disabled)	
S-0-0024	Configuration list of MDT	Edit list... (disabled)	
S-0-0001	Control unit cycle time (TN _{cyc})	2000	us
S-0-0002	Communication cycle time (t _{sync})	2000	us
S-0-0032	Primary operation mode	2: velo control	
P-0-0167	Motor and feedback connection check parameter		

Channel: A

Position back value (0-0051)

En-/Disable

Delete

Add

Add Parameter to Startuplist

IDN	Name	Act Value	Set Value	Unit
S-0-0206	Drive on delay time	100	100	ms
S-0-0207	Drive off delay time	150	150	ms
S-0-0273	Maximum drive off delay time	10000	10000	ms
S-0-0295	Drive enable delay time	0	0	ms
S-0-0296	Velocity feed forward gain	100.00	100.00	%
S-0-0301	Allocation of real-time control bit 1	S-0-0000	S-0-0000	
S-0-0303	Allocation of real-time control bit 2	S-0-0000	S-0-0000	
S-0-0305	Allocation of real-time status bit 1	S-0-0000	S-0-0000	
S-0-0307	Allocation of real-time status bit 2	S-0-0000	S-0-0000	
S-0-0372	Drive Halt acceleration bipolar	6283.18	6283.18	rad/s ²

OK

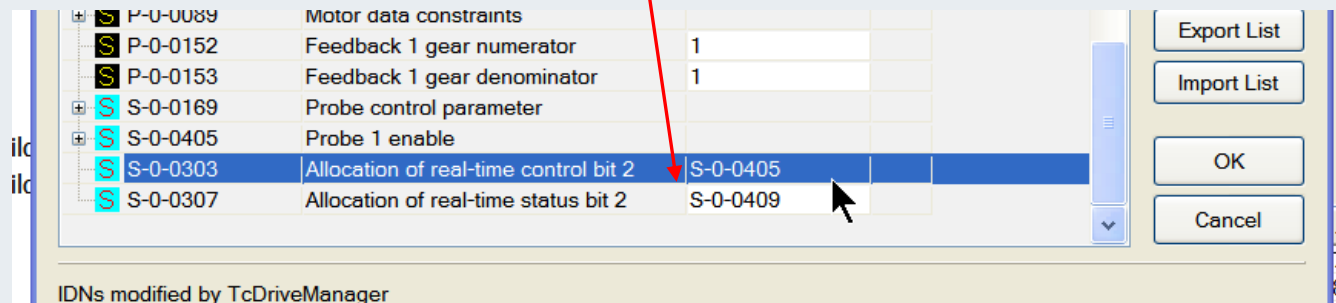
Cancel



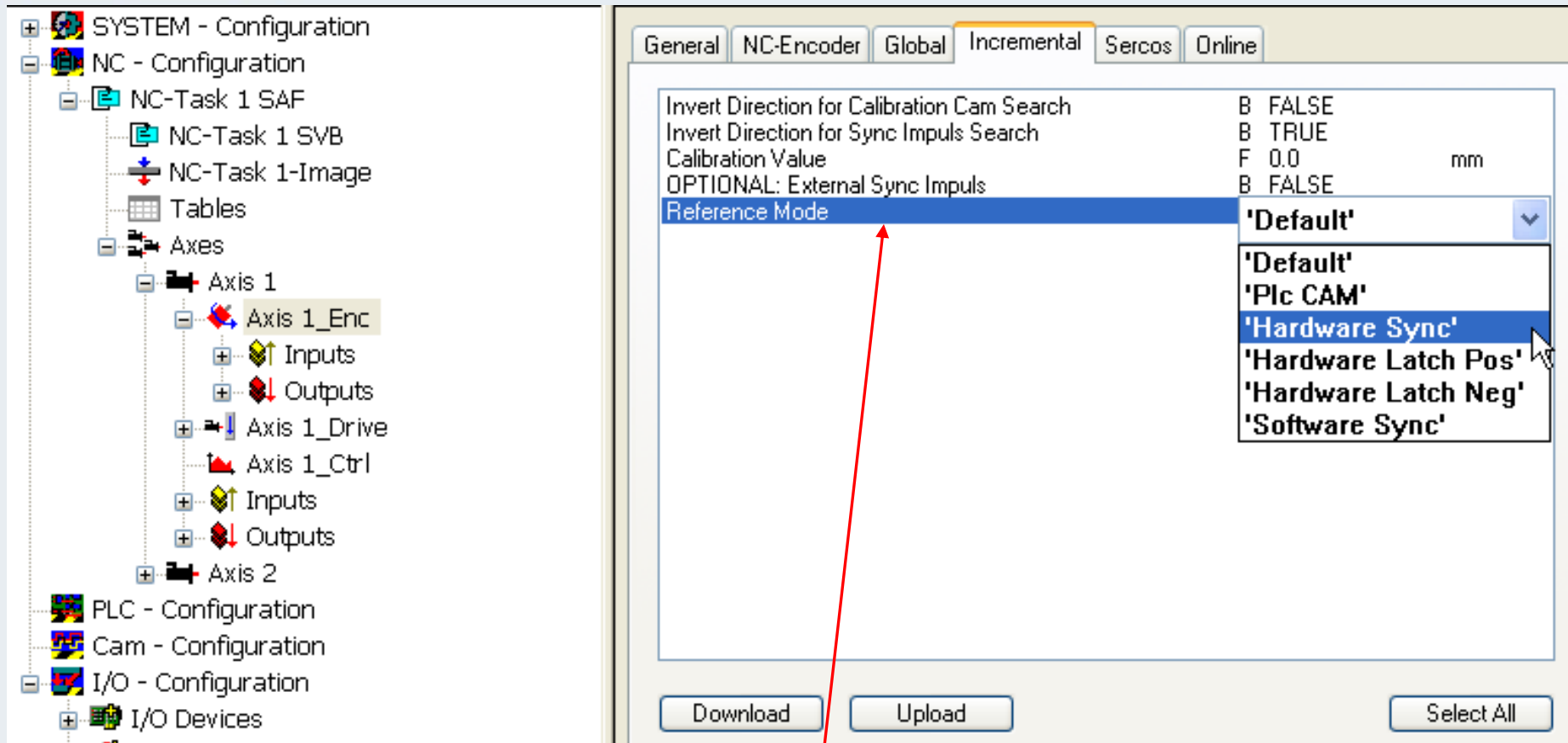
Probe Unit - Operation, “Homing”

The latched drive position is stored in IDN S-0-0130 “Probe value 1 positive edge” or in IDN S-0-0131 „Probe value 1 negative edge. One of this selected value is cyclic (by the AT-Telegram) assigned to the NC.

Configuration of S-0-0303 and S-0-0307 with:



Probe Unit - Operation, "Homing"



The screenshot displays the Beckhoff NC Configuration software interface. On the left, a tree view shows the system configuration, including NC-Task 1 SAF, NC-Task 1 SVB, NC-Task 1-Image, Tables, Axes, and Axis 1. The 'Axis 1' folder is expanded, showing 'Axis 1_Enc' and its sub-items: Inputs, Outputs, Axis 1_Drive, Axis 1_Ctrl, and another set of Inputs and Outputs. The 'Axis 1_Enc' folder is selected, and the 'Reference Mode' dropdown menu is open, showing options: 'Default', 'Plc CAM', 'Hardware Sync', 'Hardware Latch Pos', 'Hardware Latch Neg', and 'Software Sync'. A red arrow points from the text 'Selection of Reference Mode' below the screenshot to the 'Reference Mode' dropdown menu. The main window shows the 'Incremental' tab selected, with parameters for 'Invert Direction for Calibration Cam Search' (B FALSE), 'Invert Direction for Sync Impuls Search' (B TRUE), 'Calibration Value' (F 0.0 mm), and 'OPTIONAL: External Sync Impuls' (B FALSE). The 'Reference Mode' is currently set to 'Default'.

Parameter	Value	Unit
Invert Direction for Calibration Cam Search	B FALSE	
Invert Direction for Sync Impuls Search	B TRUE	
Calibration Value	F 0.0	mm
OPTIONAL: External Sync Impuls	B FALSE	

Reference Mode: 'Default' (dropdown menu open showing: 'Default', 'Plc CAM', 'Hardware Sync', 'Hardware Latch Pos', 'Hardware Latch Neg', 'Software Sync')

Buttons: Download, Upload, Select All

Selection of Reference Mode

Probe Unit - Operation, "Homing"

Tree

- Device
 - Device Info
 - Power Management
 - Display
 - Scope
 - Watch Window
- Channel A
 - Parameter
 - Operation
 - Probe Unit
 - Manual Operation
 - Drive Commands
 - Diagnostics
- Channel B
 - Parameter
 - Operation
 - Diagnostics

Channel A >> Operation >> Probe Unit

Probe1 Logic Configuration

Probe 1 logic configuration (P-0-0251): Mux 2

Signal selection
ActValue: 0: Digital input 0

- 0: Digital input 0
- 1: Digital input 1
- 2: Digital input 2
- 3: Digital input 3
- 4: Digital input 4
- 5: Digital input 5
- 6: Digital input 6
- 7: Digital input 7
- 8: Referencesignal Feedback**

Output negation
ActValue: 0: off

☒ High active
☐ Low active

Now **Preview**

Download **OK** **Cancel**

Op	AxisState	
Channel A	Drive Ready	D0
Channel B	Drive Ready	D0

Probe Unit - Operation, "Homing"

The screenshot shows the Beckhoff HW Config software interface. On the left is a 'Tree' view with the following structure:

- Device
 - Device Info
 - Power Management
 - Display
 - Scope
 - Watch Window
- Channel A
 - Parameter
 - Axis Management
 - Controller Overview
 - Motor and Feedback
 - Motor
 - Feedback 1**
 - Feedback 2
 - Process Data/Operatic

The main window displays the configuration for 'Channel A >> Parameter >> Motor and Feedback >> Feedback 1'. The 'Type' is set to 'Heng#AD36-0019AF.0XB10'. A 'Download selected items' button is in the top right.

Below the title bar, it says 'Reference signal at 3: X11 (Front, Encoder, Channel A):'. A diagram shows a sine wave input to a comparator (triangle symbol). The comparator's output is connected to a 'Feedback Reference Signal' block. A 'Threshold voltage' is set to '0 mV'.

To the right of the diagram is a list of options:

- 0: No source
- 1: Zero index
- 2: Sinus
- 3: Cosinus
- 4: UVW

Below this is a 'Parameter list' table:

IDN	Name	Act Value	S
P-0-0150	Feedback 1 type		
P-0-0154	Feedback 1 reference signal		

1: Feedback „Zero index“ detection.

2,3 Sin/Cos zero detection

4: Digital commutation for linear motors i.prep.



Probe Unit - Operation, "Homing"

The screenshot shows the TwinCAT software interface. On the left is a configuration tree with the following structure:

- SYSTEM - Konfiguration
 - NC - Konfiguration
 - NC-Task 1 SAF
 - NC-Task 1 SVB
 - NC-Task 1-Image
 - Tables
 - Axes
 - Axis 1
 - Axis 1_Enc
 - Axis 1_Drive
 - Axis 1_Ctrl
 - Inputs
 - Axis 1_FromPlc
 - nDeCtrlDWord
 - nOverride
 - nAxisModeReq
 - nAxisModeDWord
 - fAxisModeLReal
 - fActPosCorrection
 - fExtSetPos
 - fExtSetVelo
 - fExtSetAcc

In the center, the 'Set Value Dialog' box is open, showing the following fields:

- Wert: 0x00000007 (7)
- Neuer Wert: Force... (button), Aufheben (button), Schreiben... (button)
- Kommentar: (text area)
- Dec: 7
- Hex: 0x00000007
- Float: 7
- Bool: 0 (button), 1 (button)
- Binär: 07 00 00 00
- Bitgröße: 1, 8, 16, 32 (selected), 64, ?

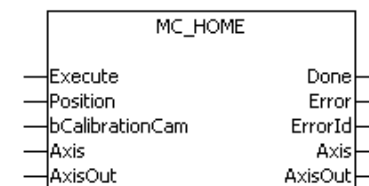
Buttons in the dialog include OK, Abbruch, and Hex Edit... A grid on the right shows the value 7 in the first cell.

Change direction by Bit 5; Input Hex 27.

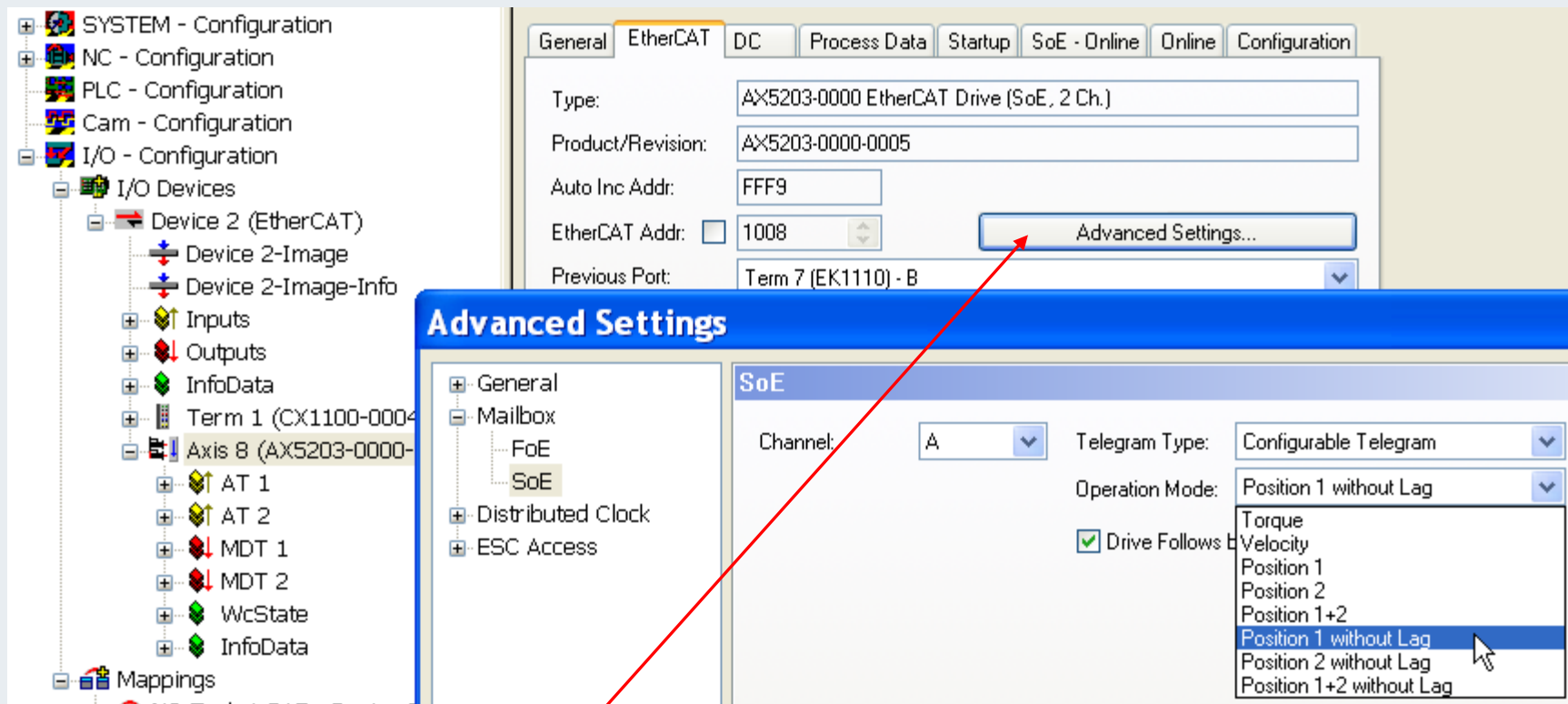
Handled by „bCalibrationCam“ in MC_HOME.

TwinCAT PLC Library: MC

FUNCTION_BLOCK MC_Home



AX5000 Position controller



Activated by "Advanced Settings". After this setting the "Position Controller" is done by the AX5000.

Channel current configuration

Startup List

IDNs already in Startup list

Index	Name	Set Value	U...
S-0-0204	Motor shut down temperature	140.0	°C
P-0-0061	Motor temperature sensor type	0: Motor wire: Te...	
P-0-0167	Motor and feedback connection chec...		
S-0-0106	Current loop proportional gain 1	45.0	V/A
S-0-0107	Current control loop integral action ti...	0.6	ms
S-0-0100	Drehzahlregler-Proportionalverstärku...	0.300	A/(r...
S-0-0101	Velocity loop integral action time	5.0	ms
P-0-0052	Time limitation for peak current	3000	ms
P-0-0056	Max motor speed with max torque	4658	rpm
P-0-0092	Configured channel peak current	3.160	A
P-0-0093	Configured channel current	1.580	A
S-0-0091	Bipolarer Geschwindigkeitsgrenzwert	7599	rpm
P-0-0089	Motor data constraints		
P-0-0152	Feedback 1 gear numerator	1	
P-0-0153	Feedback 1 gear denominator	1	
S-0-0169	Probe control parameter		
S-0-0405	Probe 1 enable		
S-0-0303	Allocation of real-time control bit 2	S-0-0405	

Channel

A

En-/Disable

Delete

Add

Clean up

Export List

Import List

OK

Cancel



S-0-0033-55 Secondary operation mode

Tree x Channel A>>Parameter>>Parameter List

Download Upload All Visible

IDN	Name	Act Value	Set Value	Unit
S-0-0031	Hardware version			
S-0-0032	Primary operation mode	2: velo control	11: pos ctrl feedback 1...	
S-0-0033	Secondary operation mode 1		0: no mode of operation	
S-0-0034	Secondary operation mode 2		0: no mode of operation	
S-0-0035	Secondary operation mode 3		1: torque control	
S-0-0036	Velocity command value		11: pos ctrl feedback 1	inc/(1...
S-0-0040	Velocity feedback value 1		12: pos ctrl feedback 2	inc/(1...
S-0-0043	Velocity polarity parameter		2: velo control	
S-0-0044	Velocity data scaling type		3: pos ctrl feedback 1	
S-0-0045	Velocity data scaling factor		4: pos ctrl feedback 2	
S-0-0046	Velocity data scaling exponent			
S-0-0047	Position command value			inc
S-0-0051	Position feedback value 1 (motor feedback)			inc
S-0-0053	Position feedback value 2 (external feedback)			inc
S-0-0055	Position polarity parameters			

Left Tree:

- Device
 - Device Info
 - Power Management
 - Display
 - Scope
 - Watch Window
- Channel A
 - Parameter
 - Controller Overview
 - Motor and Feedback
 - Process Data/Operation
 - Digital I/O
 - Parameter List
 - Scalings
 - Operation
 - Diagnostics
- Channel B

Secondary operation modes are selectable by the Controlword!

Disable device channel

Tree

- Device
 - Device Info
 - Power Management
 - Display
 - Scope
 - Watch Window
- Channel A
 - Parameter
 - Controller Overview
 - Motor and Feedback
 - Process Data/Operation
 - Digital I/O
 - Parameter List
 - Scalings
 - Operation

Channel A>>Parameter>>Parameter List

Download Upload All Visible

IDN	Name	Act Value	Set Value	U...
S-0-0410	Probe 1 negative latched			
S-0-0429	Emergency Stop Deceleration		6283.18	rad/...
S-0-0435	Operating time drive control			s
S-0-0436	Operating time power stage			s
P-0-0001	Switching frequency of the IGBT mod...		8.000	kHz
P-0-0002	Current ctrl cycle time		62	us
P-0-0003	Velocity ctrl cycle time		125	us
P-0-0004	Position ctrl cycle time		250	us
P-0-0007	Sync1 to device input copy			us
P-0-0008	Sync1 to device output copy			us
P-0-0009	Synchronisation mode			
P-0-0040	Disable device channel		0	
P-0-0050	Motor construction type			
P-0-0051	Number of pole pairs/pole pair distance		3	
P-0-0052	Time limitation for peak current		3000	ms

e.g. to use only channel 2 feedback

Error reaction

Tree

- Device
 - Device Info
 - Power Management
 - Display
 - Scope
 - Watch Window
- Channel A
 - Parameter
 - Controller Overview
 - Motor and Feedback
 - Process Data/Operation
 - Digital I/O
 - Parameter List**
 - Scalings
 - Operation

Channel A>>Parameter>>Parameter List

Download Upload All Visible

IDN	Name	Act Value	Set Value	U...
P-0-0311	PLL ctrl error	46.2		ns
P-0-0312	PCB temperature	43.8		°C
P-0-0320	Software versions			
P-0-0322	Device component hardware Id's			
P-0-0324	ProductCode/RevisionNo	AX5203-0000-0004		
P-0-0325	Compile time and date	May 16 2007 , 08:16:32		
P-0-0326	Release notes			
P-0-0350	Error reaction control word			
	Error reaction (BitSize 4, OffSet 0)	0: a) Torque off	0	
P-0-0351	Error reaction delay time	0.00		s
P-0-0400	Hardware enable configuration			
P-0-0401	Position limit switch configuration			
P-0-0402	Ready to operate configuration			
P-0-0451	Current controller settings			
P-0-0452	Current controller control word			

0: a) Torque off
1: a) Ramp b) Torque off
2: a) Ramp b) Shorted coil
3: a) Ramp b) Shorted coil

What should happen after error detection.

Hardware Enable

Tree

- Device
 - Device Info
 - Power Management
 - Display
 - Scope
 - Watch Window
- Channel A
 - Parameter
 - Controller Overview
 - Motor and Feedback
 - Process Data/Operation
 - Digital I/O
 - Parameter List**
 - Scalings
 - Operation
 - Probe Unit

Channel A >> Parameter >> Parameter List

Download Upload All Visible

IDN	Name	Act Value	Set Value	U...
P-0-0311	PLL ctrl error	-59.4		ns
P-0-0312	PCB temperature	44.0		°C
+ P-0-0320	Software versions			
+ P-0-0322	Device component hardware Id's			
P-0-0324	ProductCode/RevisionNo	AX5203-0000-0004		
P-0-0325	Compile time and date	May 16 2007 , 08:16:32		
P-0-0326	Release notes			
- P-0-0350	Error reaction control word			
	Error reaction (BitSize 4,Offset 0)	0: a) Torque off	0	
P-0-0351	Error reaction delay time	0.00	0.00	s
- P-0-0400	Hardware enable configuration			
	Configuration (BitSize 2,Offset 0)	0: No hardware enable	0	
	rsvd (BitSize 1,Offset 2)	0	0: No hardware enable	
	Input number (BitSize 5,Offset 3)	0: Digital input 0	1: High active	
	rsvd (BitSize 8,Offset 8)	0	0	
+ P-0-0401	Position limit switch configuration			

Limit switch configuration

Tree

- Device
 - Channel A
 - Parameter
 - Controller Overview
 - Motor and Feedback 1
 - Process Data/Operation
 - Digital I/O
 - Parameter List**
 - Scalings
 - Operation
 - Diagnostics
 - Channel B

Channel A>>Parameter>>Parameter List

Download Upload All Visible

IDN	Name	Act Value	Set Value	U...
P-0-0350	Error reaction control word			
P-0-0351	Error reaction delay time	0.00	0.00	s
P-0-0400	Hardware enable configuration			
P-0-0401	Position limit switch configuration			
	Positive limit switch (BitSize 16, OffSet...			
	Configuration (BitSize 3, OffSet 0)	0: No limit switch	0	
	Limit switch reaction (BitSize 3, OffSet...	0: E-Stop with a C1D ...	0: No limit switch 1: Normally closed 2: Normally open	
	rsvd (BitSize 2, OffSet 6)	0		
	Input number (BitSize 8, OffSet 8)	0: Digital input 0		
	Negative limit switch (BitSize 16, OffS...			
P-0-0402	Ready to operate configuration			

RTO (BTB) Function

Tree

- Device
 - Channel A
 - Parameter
 - Controller Overview
 - Motor and Feedback 1
 - Process Data/Operation
 - Digital I/O
 - Parameter List**
 - Scalings
 - Operation
 - Diagnostics
 - Channel B
 - Parameter
 - Operation
 - Diagnostics

Channel A>>Parameter>>Parameter List

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IDN	Name	Act Value	Set Value	U...
P-0-0350	Error reaction control word			
P-0-0351	Error reaction delay time	0.00	0.00	s
P-0-0400	Hardware enable configuration			
P-0-0401	Position limit switch configuration			
P-0-0402	Ready to operate configuration			
	Ready to operate output (BitSize 8,OffSet 0)			
	Configuration (BitSize 3,Offset 0)	0: No RTO output	0	
	Output number (BitSize 5,Offset 3)	0	0: No RTO output 1: High active	
	Ready to operate input (BitSize 8,Offset 0)			
P-0-0451	Current controller settings			
P-0-0452	Current controller control word			
P-0-0453	Current controller status word			
P-0-0502	Velocity controller control word			
P-0-0503	Velocity controller status word			
P-0-0511	Velocity controller PT1 filter time	0.000	0.000	ms
P-0-0552	Position controller control word			

Display Motor working load by P-0-0063

Tree

- Device
 - Device Info
 - Power Management
 - Display
 - Scope
 - Watch Window
- Channel A
 - Parameter
 - Controller Overview
 - Motor and Feedback 1
 - Process Data/Operatic
 - Digital I/O
 - Parameter List
 - Scalings
 - Operation

Channel A>>Parameter>>Parameter List

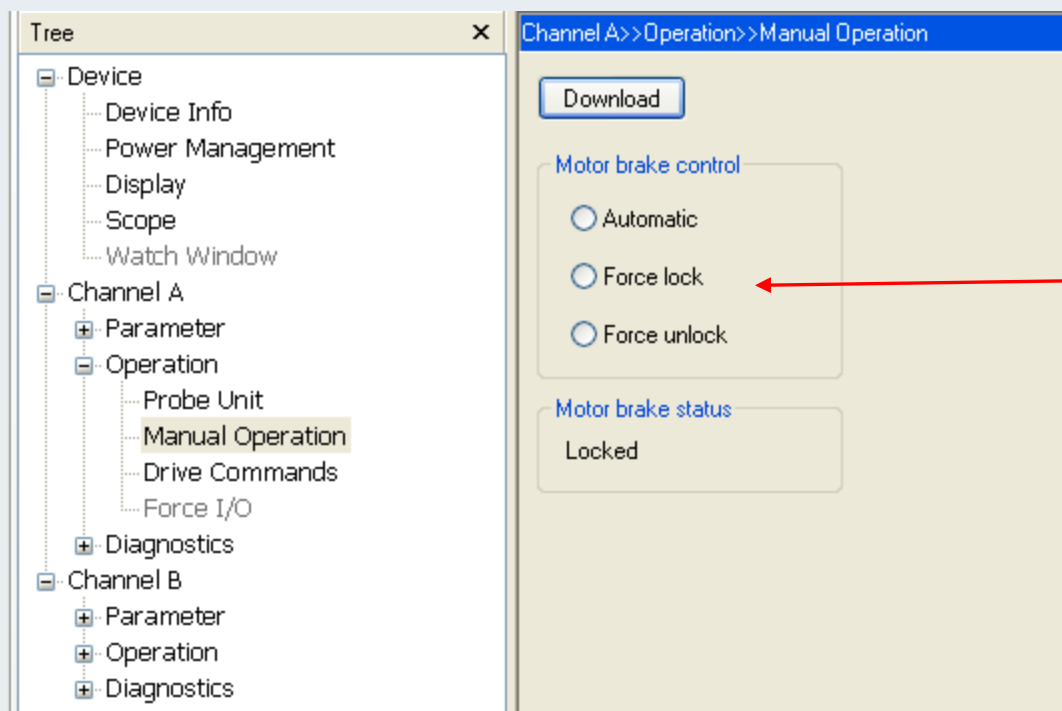
Download Upload All Visible

IDN	Name	Act Value	Set Value	Unit
P-0-0055	Motor EMF	54.5		V
P-0-0056	Max motor speed with max torque	1576		rpm
P-0-0057	Electrical commutation offset	270.00		deg
P-0-0058	Mechanical commutation offset	90.00		deg
P-0-0059	Motor brake current monitoring level	0.000		A
P-0-0060	Motor brake			
P-0-0061	Motor temperature sensor type	0: Motor wire: Tempera...		
P-0-0062	Thermal motor model			
P-0-0063	Thermal motor utilisation	0		%
P-0-0064	Actual Motorbrake current	0.000		A
P-0-0065	Actual temperature sensor resistance	414		Ohm
P-0-0066	Electric motor model			
P-0-0067	Motor winding: Dielectric strength	1200.0		V
P-0-0068	Thermal overload factor (motor winding)			

This function has to be enabled by IDN P-0-0062 (Reaction =1)



Manual Operation



Brake operations



Drive Commands

e.g. Motor feedback connection check

Channel A>>Operation>>Drive Commands

Command IDNs

P-0-0166: Motor and feedback connection check (pc)
 S-0-0099: Setze Klasse 1 Diagnose zurück (pc)
 S-0-0170: Probing cycle procedure command (pc)
 P-0-0160: Calibrate commutation offset (pc)
 P-0-0161: Feedback 1: Save position offset (pc)
 P-0-0162: Feedback 1: Save digital name plate (pc)
 P-0-0163: Scan feedback 1 (pc)
 P-0-0166: Motor and feedback connection check (pc)
 P-0-0192: Feedback 2: Save digital name plate (pc)
 P-0-0193: Scan feedback 2 (pc)
 P-0-0901: Save Factory Settings (pc)
 P-0-0902: Current calibration (pc)
 P-0-0904: Save Device component hardware Id's (pc)
 P-0-0905: Clear error history (pc)
 P-0-0906: Reset operation times (pc)
 P-0-1022: Debug command

Tree

- Device
 - Device Info
 - Power Management
 - Display
 - Scope
 - Watch Window
- Channel A
 - Parameter
 - Operation
 - Probe Unit
 - Manual Operation
 - Drive Commands
 - Force I/O
- Diagnostics
- Channel B
 - Parameter
 - Operation
 - Diagnostics

Channel A>>Operation>>Drive Commands

Command IDNs

P-0-0166: Motor and feedback connection check (pc)

Start

Motor and feedback connection check parameter (P-0-0167)

Name	Act Value	Set Value	Unit
eMode (BitSize 16,Offset 0)	0: Rotating vector	0: Rotating vector	
Current level (BitSize 16,Offset 16)	50.0	50.0	%
Moving distance (BitSize 16,Offset 32)	0	0	deg/p...
Velocity (BitSize 16,Offset 48)	0	0	deg/(...
rsvd (BitSize 16,Offset 64)	0	0	
rsvd (BitSize 16,Offset 80)	0	0	
Results (BitSize 64,Offset 96)			
EqualDirections (BitSize 16,Offset 0)	0: No	0: No	
Commutation position difference (BitSize 16,Offset 16)	0.00	0.00	deg
rsvd (BitSize 16,Offset 32)	0	0	
rsvd (BitSize 16,Offset 48)	0	0	

Download

Upload

Diagnostics and error history

Tree

- Device
 - Device Info
 - Power Managemen
 - Display
 - Scope
 - Watch Window
- Channel A
 - Parameter
 - Operation
 - Probe Unit
 - Manual Operat
 - Drive Comman
 - Force I/O
 - Diagnostics**
 - IDN-Debugger
- Channel B
 - Parameter

Channel A >> Diagnostics

Diagnostics

Message: D012: DriveRdy

Reset

List:

ErrorCode	ErrorMessage

Error history

ErrorTime	ErrorCode	ErrorMessage	
132h 50m 28s	0x0000FD11	Periphery voltage too low.	?
125h 30m 44s	0x0000FC03	Control voltage error: undervoltage	?
124h 1m 19s	0x0000FD11	Periphery voltage too low.	?
123h 6m 56s	0x0000FD07	Motor overtemperature shut down.	?
123h 6m 9s	0x0000FD04	Periphery voltage missing.	?
123h 6m 9s	0x0000FD11	Periphery voltage too low.	?



IDN-Debugger

Direct IDN access

Channel A>>Diagnostics>>IDN-Debugger

IDN

S S-0-0100 < > Read

S-0-0100

Value: ☐ r ☐ w 0.300

USHORT

NotList

Name: ☐ r 32 32 Velocity loop proportional gain

Attribute: ☐ r 51445761

P4	P3	P2	Dec	Type	C	Len	Factor
0	0	0	3	1	0	1	1

Unit: ☐ r 10 10 A/(rad/s)

Min: ☐ r 0.000

Max: ☐ r 10.000

DataState: ☐ r

Default: ☐ r 0.100

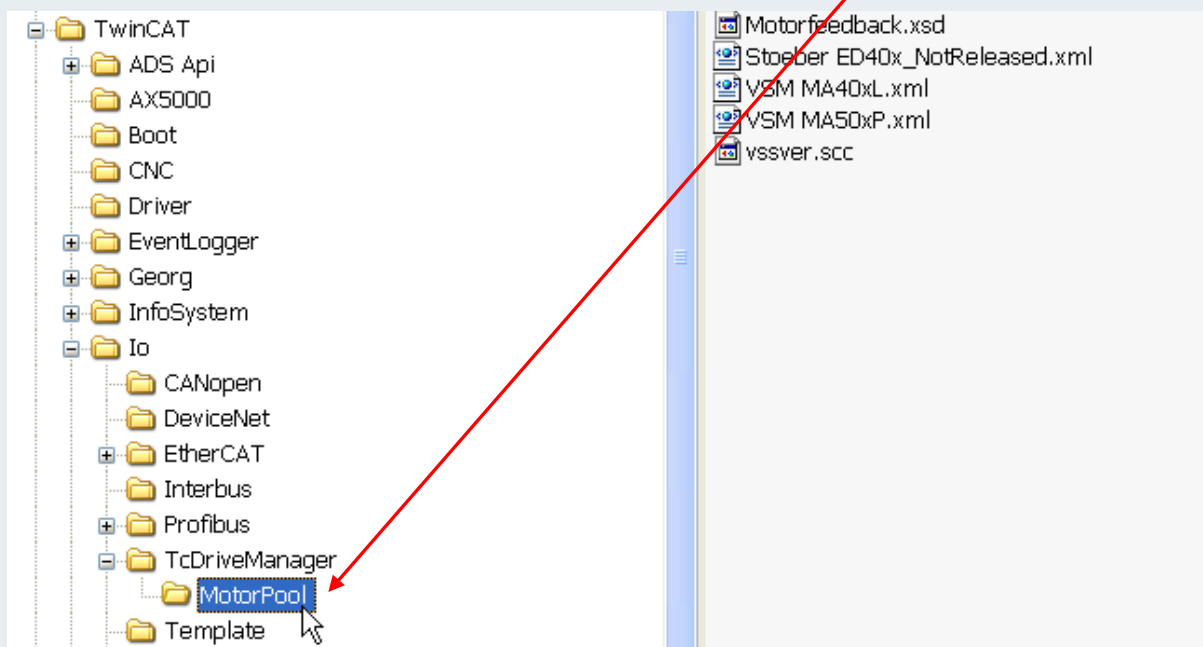
Error

Clear



XML handling

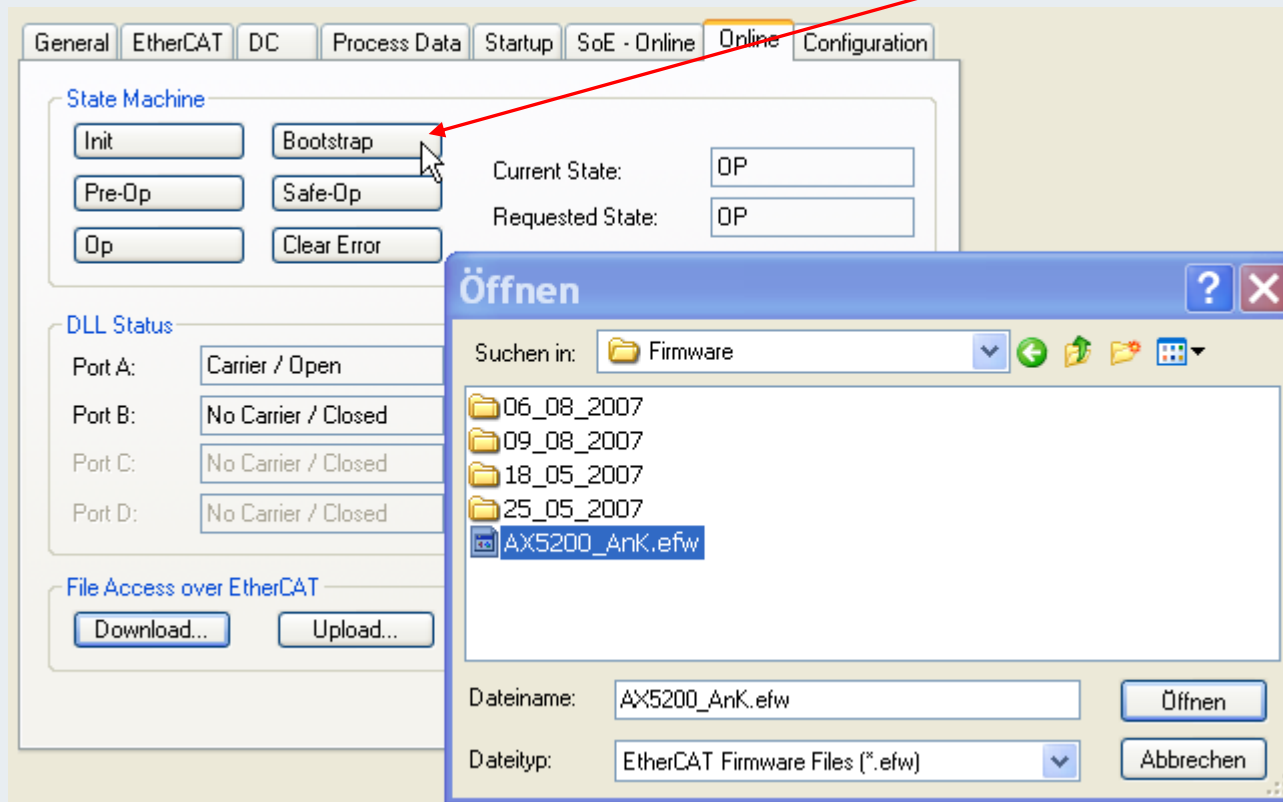
Location of motor default parameter file (motor.xml).





Softwareupdate

To load a new firmware (xxx.efw file), please bring drive into „Bootstrap“ mode.



Feedback setup

Steps to do a feedback formatting:

Read Feedback type string by "Copy" from P150 in „Parameter List“ e.g. Heng#AD36-0019AF.0XBI0

Channel A >> Parameter >> Parameter List

Download Upload All Visible

IDN	Name	Act Value	Set Value	Unit
+	Axis Management			
+	Communication			
+	Current Control Loop			
+	Debug			
+	Diagnostics			
+	Digital In / Out			
-	Feedback			
S-0-0124	Standstill window	5.0	5.0	rpm
S-0-0256	Multiplication factor 1	2048		
S-0-0257	Multiplication factor 2	0		
P-0-0150	Feedback 1 type			
	Manufacturer (BitSize 16,Offset 0)	1: Hengstler	1: Hengstler	
	Feedback type (BitSize 16,Offset 16)	0: Rotational feedback	0: Rotational feedback	
	Feedback type string (BitSize 240,Offset 32)	Heng#AD36-0019AF.0...	Heng#AD36-0019AF.0XBI0	
	reserved (BitSize 16,Offset 272)	1	0	
+	Power settings (BitSize 32,Offset 288)			
+	Process channel (BitSize 96,Offset 320)			
+	Parameter channel (BitSize 640,Offset 416)			
+	Manufacturer limits settings (BitSize 32,Offset 1056)			
P-0-0151	Scanned feedback 1 type			



Feedback setup

Pun P162 in „Drive Command“ and select “Name plate type” Beckhoff SM

Tree

- Device
 - Device Info
 - Power Management
 - Display
 - Scope
 - Watch Window
- Channel A
 - Parameter
 - Controller Overview
 - Position Control
 - Velocity Control
 - Current Control
 - Motor and Feedback
 - Process Data/Operation
 - Digital I/O
 - Parameter List
 - Scalings
 - Operation
 - Probe Unit
 - Manual Operation
 - Drive Commands
 - Force I/O

Channel A >> Operation >> Drive Commands

Command IDNs

P-0-0162: Feedback 1: Save digital name plate (pc) Start

Digital motor name plate (P-0-0098)

Name	Act Value	Set Value	Unit
Name plate type (BitSize 16,Offset 0)	1: Beckhoff SM		
rsvd (BitSize 16,Offset 16)	0	0: No 1: Beckhoff SM	
Data (BitSize 992,Offset 32)			
+ Beckhoff (BitSize 992,Offset 0)			
+ generic (BitSize 992,Offset 0)			

Download
Upload

Feedback setup

Tree

- Device
 - Device Info
 - Power Manager
 - Display
 - Scope
 - Watch Window
- Channel A
 - Parameter
 - Operation
 - Probe Unit
 - Manual Operat
 - Drive Command
 - Force I/O
 - Diagnostics
- Channel B
 - Parameter
 - Operation
 - Diagnostics

Channel A >> Operation >> Drive Commands

Command IDNs

P-0-0162: Feedback 1: Save digital name plate (pc)

Digital motor name plate (P-0-0098)

Name	Act Value	Set Value	Unit
rsvd (BitSize 16,Offset 16)	0		
Data (BitSize 992,Offset 32)			
Beckhoff (BitSize 992,Offset 0)			
Motorparameter (BitSize 896,Offset 0)			
Id part 1 (BitSize 32,Offset 0)	1113940843	1113940843	
Id part 2 (BitSize 32,Offset 32)	1752131174	1752131174	
Version No. (BitSize 16,Offset 64)	2	2	
Motor vendor (BitSize 16,Offset 80)	65535	65535	
Serial number (BitSize 32,Offset 96)	71071728	71071728	
Motor type (BitSize 240,Offset 128)	AMAM3021-0C30	AM3021-0C30	
Feedback type (BitSize 240,Offset 160)	Heng#AD36-0019AF.0	Heng#AD36-0019AF.0	
reserved (BitSize 16,Offset 608)	0	0	
Add motor parameter description [... 0: No additional motorp...	0: No additional motorp...	0: No additional motorp...	
reserved (BitSize 96,Offset 768)	0	0	
reserved (BitSize 16,Offset 864)	0	0	

Please give the password (S-...)

OK Cancel

Maximum speed (BitSize 16,Offset 16)

Cos phi (BitSize 16,Offset 32)

Maximum feedback speed (BitSize 16,Offset 48)

reserved (BitSize 96,Offset 64)

reserved (BitSize 16,Offset 80)

Checksum (BitSize 16,Offset 96)

Commutation adjustment (BitSize 16,Offset 112)

Succeeded.

Give "Feedback type" by Paste, than -Motor vendor-, -Serial Number- and -Motor type- and save by the sequence:

- Download – Password (AX5000) – Download - Start -

Attention! Wait for status message „Executing“ und „Succeeded“

Feedback setup

Tree

- Device
 - Device Info
 - Power Management
 - Display
 - Scope
 - Watch Window
- Channel A
 - Parameter
 - Operation
 - Probe Unit
 - Manual Operat
 - Drive Command
 - Force I/O
 - Diagnostics
- Channel B

Channel A >> Operation >> Drive Commands

Command IDNs

P-0-0161: Feedback 1: Save position offset [pc] Start

Digital motor name plate (P-0-0098)

Name	Act Value	Set Value	Unit
Name plate type (BitSize 16, Offset 0)	1: Beckhoff SM		
rsvd (BitSize 16, Offset 16)	0		
Data (BitSize 992, Offset 32)			
Beckhoff (BitSize 992, Offset 0)			
Motorparameter (BitSize 896, Offset 0)			
Commutation adjustment (BitSize 96, Offset 0)			
Position offset (BitSize 32, Offset 0)	0.00	1.00	deg
Number of adjustments (BitSize 16, Offset 0)	0	0	
reserved (BitSize 32, Offset 48)			
Checksum (BitSize 16, Offset 80)	0	0	
generic (BitSize 992, Offset 0)			

Download Upload

Give any angle in P161

And save by the sequence: - Download – Password – Download - Start -

Feedback setup

Channel A >> Operation >> Drive Commands

Command IDNs
P-0-0161: Feedback 1: Save position offset (pc) Start

Digital motor name plate (P-0-0098)

Name	Act Value	Set Value	Unit
Name plate type (BitSize 16,Offset 0)	1: Beckhoff SM		
rsvd (BitSize 16,Offset 16)	0		
Data (BitSize 992,Offset 32)			
Beckhoff (BitSize 992,Offset 0)			
Motorparameter (BitSize 896,Offset 0)			
Commutation adjustment (BitSize 96,Offset 0)			
Position offset (BitSize 32,Offset 0)	1.00	1.00	deg
Number of adjustments (BitSize 16,Offset 48)	1	0	
reserved (BitSize 32,Offset 48)			
Checksum (BitSize 16,Offset 80)	101	0	
generic (BitSize 992,Offset 0)			

Download Upload

Increment this counter by 1

And save by the sequence: - Download – Password – Download - Start -



Feedback setup

Tree

- Device
 - Device Info
 - Power Managem
 - Display
 - Scope
 - Watch Window
- Channel A
 - Parameter
 - Operation
 - Probe Unit
 - Manual Operat
 - Drive Comman
 - Force I/O
 - Diagnostics

Channel A>>Operation>>Drive Commands

Command IDNs

P-0-0160: Calibrate commutation offset (pc)

Start

Commutation offset calibration parameter (P-0-0165)

Name	Act Value	Set Value	Unit
eMode (BitSize 16,Offset 0)	0: Static current vector	0: Static current vector	
Current level (BitSize 16,Offset 16)	50.0	50.0	%
Duration (BitSize 16,Offset 32)	3000	3000	ms
Current vector angle (BitSize 16,Offset 48)	180.00	180.00	deg

Download

Upload

Run P160 by pressing “Downenload” and “Start”
to bring the rotor in the adjustment position.

Feedback setup

Tree

- Device
 - Device Info
 - Power Manageme
 - Display
 - Scope
 - Watch Window
- Channel A
 - Parameter
 - Controller Over
 - Motor and Fee
 - Process Data/C
 - Digital I/O
 - Parameter List
 - Scalings
 - Operation
 - Probe Unit
 - Manual Operat
 - Drive Comman
 - Force I/O
 - Diagnostics
- Channel B
 - Parameter
 - Operation
 - Diagnostics

Channel A >> Parameter >> Parameter List

Download Upload All Visible

IDN	Name	Act Value	Set Value	Unit
+	Hardware Info			
-	Motor			
...	S-0-0109 Motor peak current	6.300	6.300	A
...	S-0-0111 Motor continuous stall current	1.580	1.580	A
...	S-0-0113 Maximum motor speed	8000	8000	rpm
...	S-0-0201 Motor warning temperature	80.0	80.0	°C
...	S-0-0204 Motor shut down temperature	140.0	140.0	°C
...	S-0-0206 Drive on delay time	100	100	ms
...	S-0-0207 Drive off delay time	150	150	ms
...	S-0-0273 Maximum drive off delay time	10000	10000	ms
...	S-0-0295 Drive enable delay time	0	0	ms
...	S-0-0383 Motor temperature	0.0		°C
...	S-0-0429 Emergency Stop Deceleration	6283.18	6283.18	rad/s ²
+	P-0-0050 Motor construction type			
...	P-0-0051 Number of pole pairs/pole pair distance	3	3	
...	P-0-0052 Time limitation for peak current	3000	3000	ms
...	P-0-0053 Configured motor type	AM3021-0C30	AM3021-0C30	
...	P-0-0054 Configured drive type	AX5206-0000-####	AX5206-0000-####	
...	P-0-0055 Motor EMF	19.5	19.5	V
...	P-0-0056 Max motor speed with max torque	4658	4658	rpm
...	P-0-0057 Electrical commutation offset	270.00	270.00	deg
...	P-0-0058 Mechanical commutation offset	240.20	90.00	deg
...	P-0-0059 Motor brake current monitoring level	0.000	0.000	A

Read the „Act Value“ of „Mechanical commutation offset“ from P58

Feedback setup

Tree

- Device
 - Device Info
 - Power Manageme
 - Display
 - Scope
 - Watch Window
- Channel A
 - Parameter
 - Controller Over
 - Motor and Fee
 - Process Data/C
 - Digital I/O
 - Parameter List
 - Scalings
 - Operation
 - Probe Unit
 - Manual Operat
 - Drive Comman
 - Force I/O

Channel A >> Operation >> Drive Commands

Command IDNs

P-0-0161: Feedback 1: Save position offset (pc)

Digital motor name plate (P-0-0098)

Name	Act Value	Set Value	Unit
Name plate type (BitSize 16,Offset 0)	1: Beckhoff SM		
rsvd (BitSize 16,Offset 16)	0		
Data (BitSize 992,Offset 32)			
Beckhoff (BitSize 992,Offset 0)			
Motorparameter (BitSize 896,Offset 0)			
Commutation adjustment (BitSize 96,Offset 0)			
Position offset (BitSize 32,Offset 0)	240.20	240.20	deg
Number of adjustments (BitSize 16,Offset 16)	0	0	
reserved (BitSize 32,Offset 48)			
Checksum (BitSize 16,Offset 80)	0	0	
generic (BitSize 992,Offset 0)			

Start

Download

Upload

Give this angle (240,2) in P161 and save by the sequence:

- Download – Password – Download - Start -

Feedback setup

The screenshot shows the Beckhoff Configuration Manager software interface. The 'Configuration' tab is active. The left sidebar shows a tree structure with 'Channel A' expanded, and 'Operation' selected. The main area displays the 'Operation' settings for 'Channel A'. A context menu is open over the 'Operation' settings, showing options: '-Change Phase', '-Change Phase-Clear Error', 'Init', 'Pre-Op', 'Bootstrap', 'Safe-Op', and 'Op'. A mouse cursor is pointing at 'Bootstrap'. Below the menu, a table shows the 'Act Value' for various parameters.

Name	Act Value
Name plate type (BitSize 16,Offset 0)	1: Beckhoff SM
rsvd (BitSize 16,Offset 16)	0
Data (BitSize 992,Offset 32)	

Restart by the sequence: „Bootstrap“ than „Op“



Programming example

Move Axis 1 and 2 by giving analog setpoint.

```

0001 VAR_GLOBAL
0002   Ax_to_Plc AT%I*: ARRAY[1..2] OF NCTOPLC_AXLESTRUCT;
0003   Plc_To_Ax AT%Q*: ARRAY[1..2] OF PLCTONC_AXLESTRUCT;
0004   bEnable AT%I*: BOOL; (* Input Digital1 Enable and Disable Axis 1+2 *)
0005   bMove AT%I*: BOOL; (* Input Digital2 start move *)
0006   bReset AT%I*: BOOL; (* Input Digital 3, Reset, Stop Move; double click change axis *)
0007   bRefCam AT%I*: BOOL; (* Reference Cam *)
0008
0009   bReady AT%Q*: ARRAY[1..2] OF BOOL;
0010   bError AT%Q*: BOOL;
0011   bAxisCalibr AT%Q*: BOOL;
0012   rAbsPos AT %I*: INT; (* Analog in 1 ; Position *)
0013   rVelo AT %I*: INT; (* Analog in 2 ; Velocity *)
0014   SetAnalogOut AT %Q*: WORD; (* Set 10 V *)
0015 END_VAR
0016

```



The Final

Thank you for your attention.