TwinCAT Motion Designer Report

BECKHOFF

Project name: Haulick RXL 500

Customer

Company:
Name:
Department:
Street:
City:
Country:
Telephone:
Email:

Application engineer

Company:	DAFRA D.O.O.
Name:	Dejan Rožič
Department:	R&D
Street:	Cesta ob železnici 3
City:	3310 Žalec
Country:	SLO
Telephone:	
Email:	

Project description

Parts manipulation from stamping tool

Exclusion

The interpretation of data contained in the report for servo axes is based on the basis data provided by you. Please check if these data are and were complete and correct before taking over of the results. The data have been entered in good faith into our software. For erroneous interpretations which are based on an incorrect or incomplete data base and subsequent product recommendations we cannot accept any liability. The calculated design of servo axes represents a non-binding recommendation. You are obliged to check whether the recommended design is suitable for your intended use.

Content

BECKHOFF

DC link: DC link 1

Axis: Axis 1

Order code	qty	Product description
AX5106-0000-02xx	1	Digital Compact Servo Drive, 1-axis module 100…480 V AC, Rated Output Current 6 A, EtherCAT Interface, OCT
Motor-gearbox-combination		The following both positions will be mounted at Beckhoff and delivered as one unit.
AM8023-xExx-0000	1	Servomotor, 400 V AC (max. 480 V AC), M_0 = 1,20 Nm, I_0 = 2,20 A, n_n = 8000 min-1
AG3210-+NP015S-MF1-10-xC1-AM803x	1	Planetary gear units, M_n = 19,00 Nm, M_b = 56,00 Nm, Backlash ≤ 8,00 arcmin, i = 10

DC link: DC link 1

Axis: Axis 1

- Motor 'AM8023-xExx-0000' is not completely configured.
- Gearbox 'AG2250-+PLE60-M01-10-xB1-AM812x' is not completely configured.
- Drive 'AX5106-0000-02xx' is not completely configured.
- No Motor cable selected for the connection of Drive 'AX5106-0000-02xx' and Motor 'AM8023-xExx-0000'.

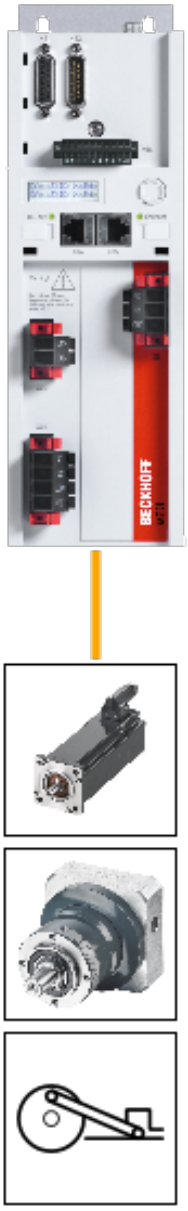
DC link: DC link 1

Power supply type	400 V AC, 3 phase
Chopper threshold	840 V
Braking resistance connection	Internal

Drive: AX5106-0000-02xx

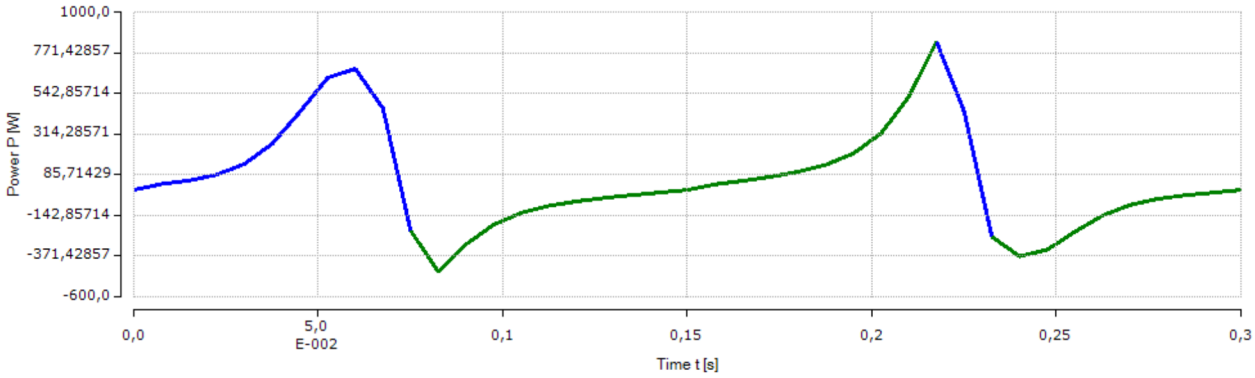
Axis: Axis 1	
Motor	AM8023-xExx-0000
Overall gear ratio	(1 * 10) ≈ 10
Max inertia	0,000127 kgm² = 1,27 kgcm²
Mean inertia	5,23E-05 kgm² = 0,523 kgcm²
Max torque	1,65 Nm
Max speed	40 rad/s = 382 rpm
Max acceleration	560 rad/s² = 32075 °/s²
Max jerk	1,03E+11 rad/s³ = 5,89E+12 °/s³

4. DC link: DC link 1

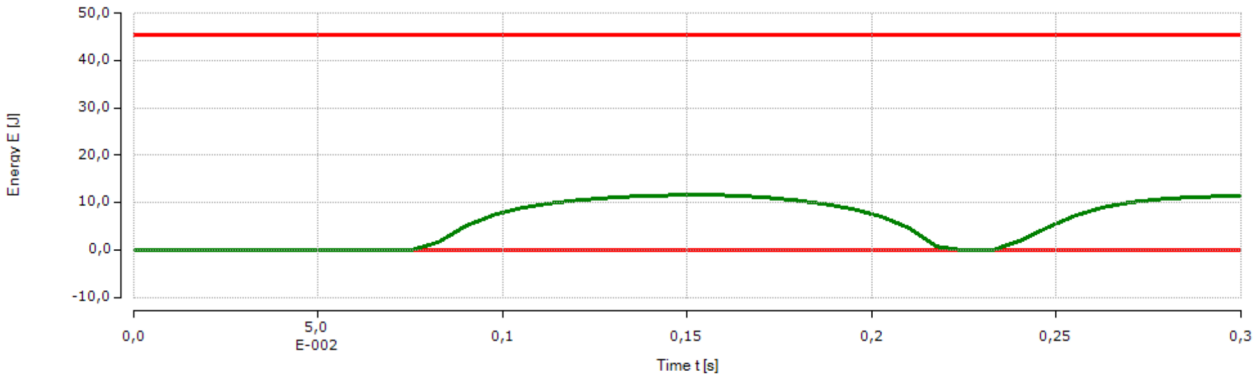


Power supply type: 400 V AC, 3 phase

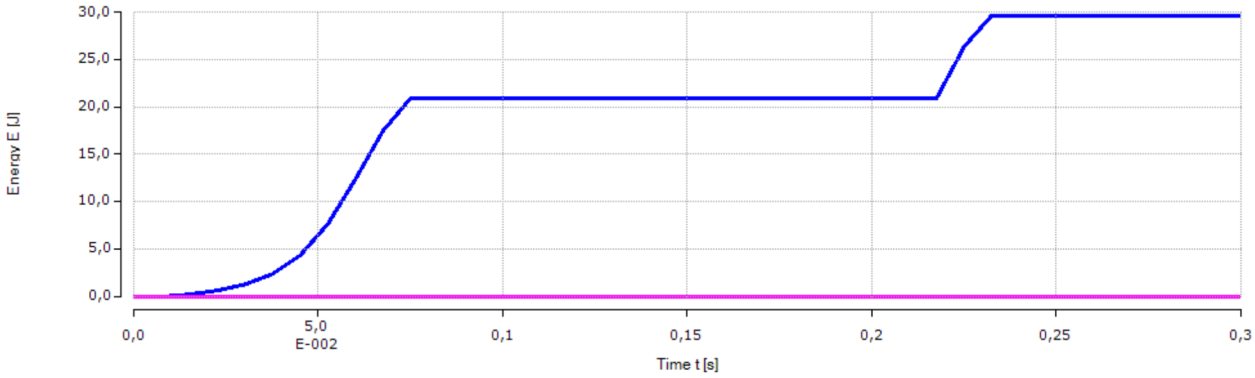
4.1. DC link power: DC link 1



Infeed module Capacitance



Boundaries capacitive energy Capacitive energy

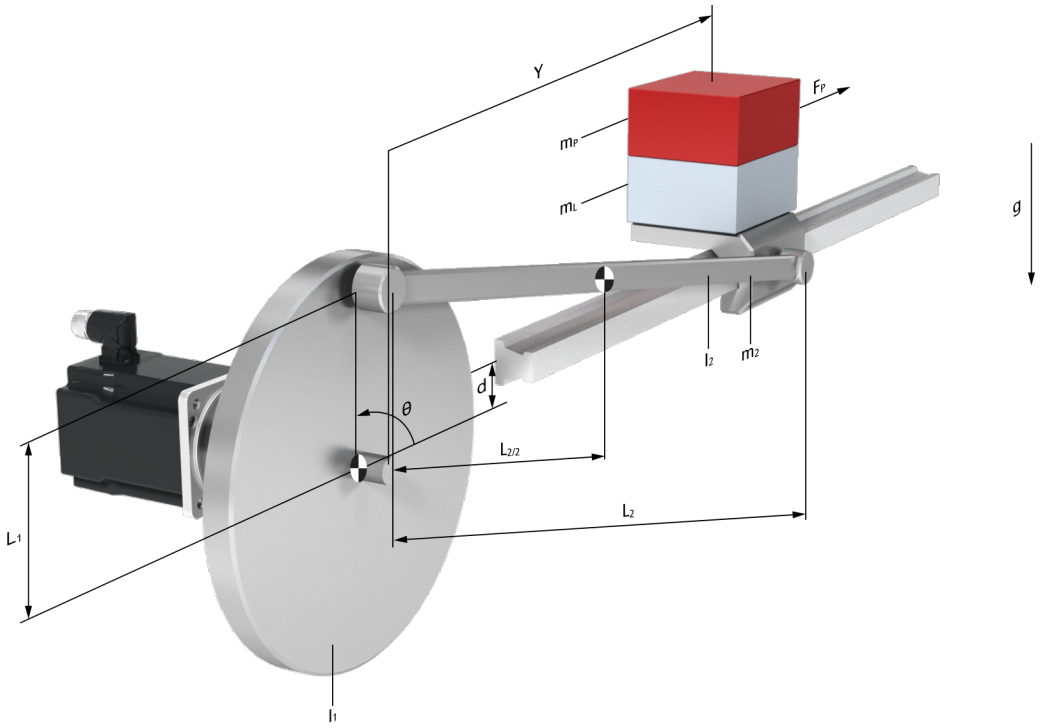


Infeed energy Bleeder energy

Nominal data	
Effective infeed power	4,57 kW
Maximal infeed power	22,9 kW
Effective braking power	150 W
Maximal braking power	2,68 kW
Max. braking power w.r.t. duty cycle	2,68 kW
Capacitance	235 µF
Storable energy	45,3 J

Application data	
Effective needed infeed power	98,9 W
Maximal needed infeed power	727 W
Infeed energy	29,7 J
Effective needed braking power	0 W
Maximal needed braking power	0 W
Brake resistance duty cycle	0
Brake energy	0 J

4.2. Axis: Axis 1



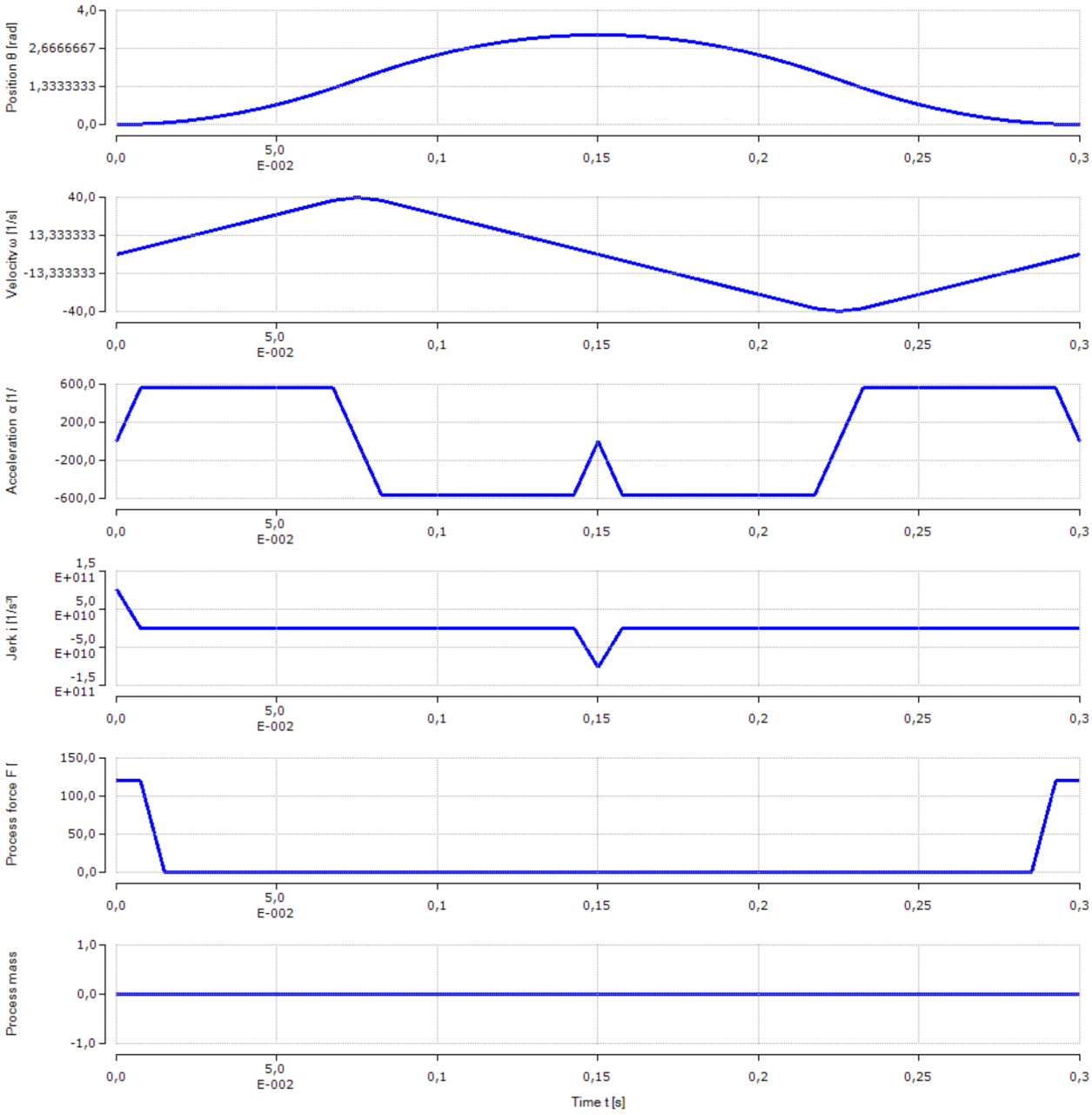
Mechanical data		
Crank length	[l_1]	50 mm
Crank inertia	[I_1]	2,05 kgmm²
Connecting rod mass	[m_2]	0,19 kg
Offset	[d]	0 mm
Efficiency	[η]	90 %

Mechanical data		
Connecting rod length	[l_2]	113 mm
Connecting rod inertia	[I_2]	0,54 kgmm²
Load mass	[m]	3,35 kg
Friction coefficient	[μ]	0,2
Idle torque	[T_{idle}]	0 Nm

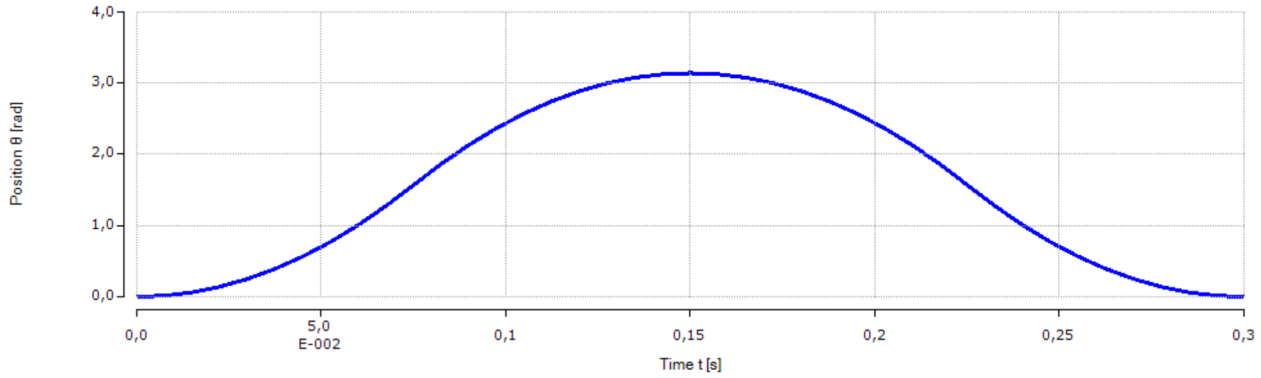
Application data		
Effective torque	[T_{eff}]	5,01 Nm
Mean speed	[ω_{avg}]	199 rpm
Mean power	[P_{eff}]	108 W
Mean inertia	[I_{eff}]	30,3 kgcm²

Application data		
Max torque	[T_{max}]	11,8 Nm
Max speed	[ω_{max}]	382 rpm
Max power	[P_{max}]	447 W
Max inertia	[I_{max}]	105 kgcm²

4.2.1. Motion profile: Axis 1



4.2.1. Motion profile: Axis 1



1. Section: Motion section (Beckhoff 7 segment)

Input parameter	
Positioning mode	Relative
Duration	0,15 s
Maximal deceleration	1 °/s²

Input parameter	
Position	180 °
Maximal acceleration	1 °/s²
Jerk	100 rad/s³

Resulting values	
Starting position	0 °
Max speed	382 rpm
Max jerk	5,89E+12 °/s³

Resulting values	
Distance	180 °
Max acceleration	32075 °/s²
Duration	150 ms

2. Section: Motion section (Beckhoff 7 segment)

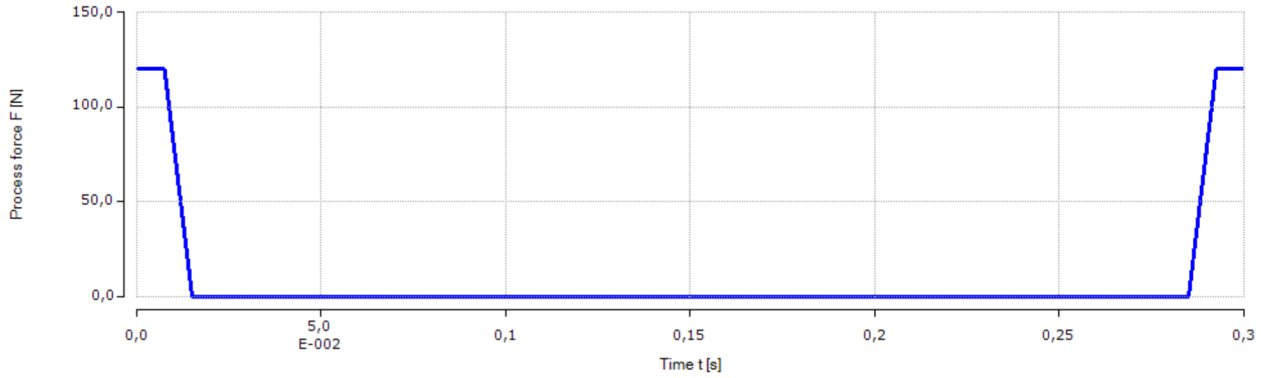
Input parameter	
Positioning mode	Absolute
Duration	0,15 s
Maximal deceleration	1 °/s²

Input parameter	
Position	0 °
Maximal acceleration	1 °/s²
Jerk	100 rad/s³

Resulting values	
Starting position	180 °
Max speed	382 rpm
Max jerk	5,89E+12 °/s³

Resulting values	
Distance	-180 °
Max acceleration	32075 °/s²
Duration	150 ms

4.2.1. Motion profile: Axis 1



1. Section: Force section (Force function section)

Input parameter	
Force	120 N

Input parameter	
Duration	0,015 s

2. Section: Force section (Force function section)

Input parameter	
Force	0 N

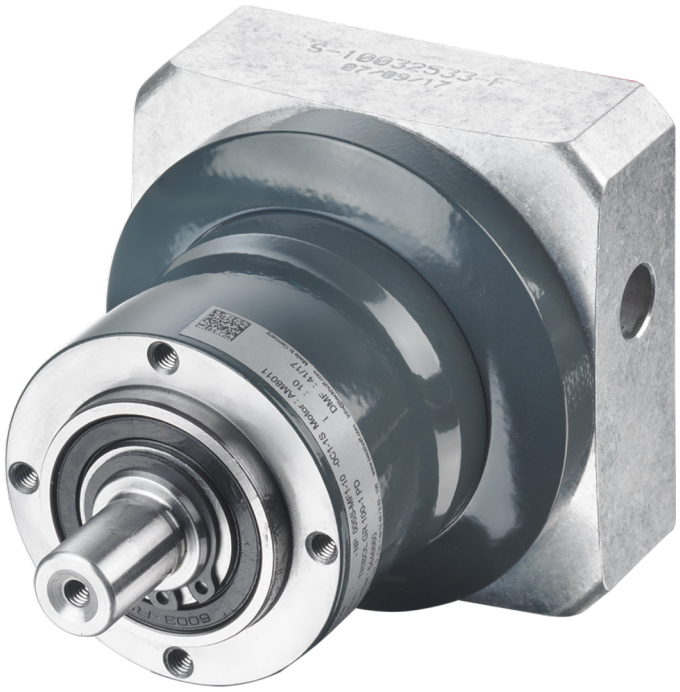
Input parameter	
Duration	0,27 s

3. Section: Force section (Force function section)

Input parameter	
Force	120 N

Input parameter	
Duration	0,015 s

4.2.2. Gearbox: Axis 1



AG3210-+NP015S-MF1-10-xC1-AM803x
Planetary gear units, M_n = 19,00 Nm, M_b = 56,00 Nm, Backlash ≤ 8,00 arcmin, i = 10
Please note: the axial and radial load on the shaft is not considered.

Nominal data		
Protection class		IP 64
Number of stages	[Z]	1
Nominal output torque	[T_{2n}]	19 Nm
Emergency output torque	[T_{2emerg}]	75 Nm
Motor side inertia	[I_1]	0,22 kgcm²
Maximal motor side speed	[ω_{1max}]	8000 rpm

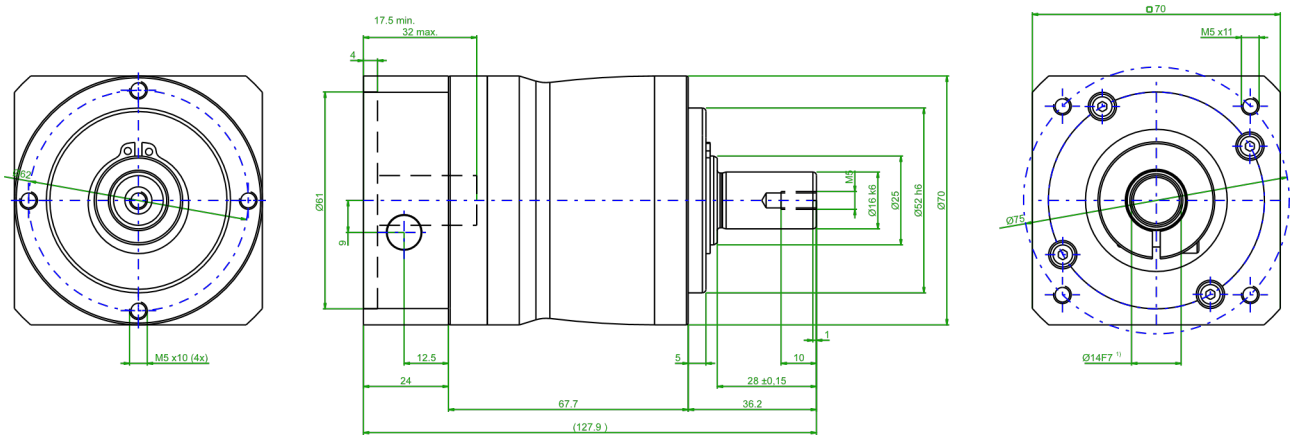
Nominal data		
Gear ratio	[i]	10
Efficiency	[η]	97 %
Maximal output torque	[T_{2max}]	56 Nm
Idle torque	[T_{012}]	0,1 Nm
Nominal motor side speed	[ω_{1nom}]	4300 rpm
Mass	[m]	1,9 kg

Application data		
Effective torque load side	[T_{eff}]	5,01 Nm
Mean speed	[ω_{avg}]	1995 rpm
Mean power	[P_{avg}]	142 W

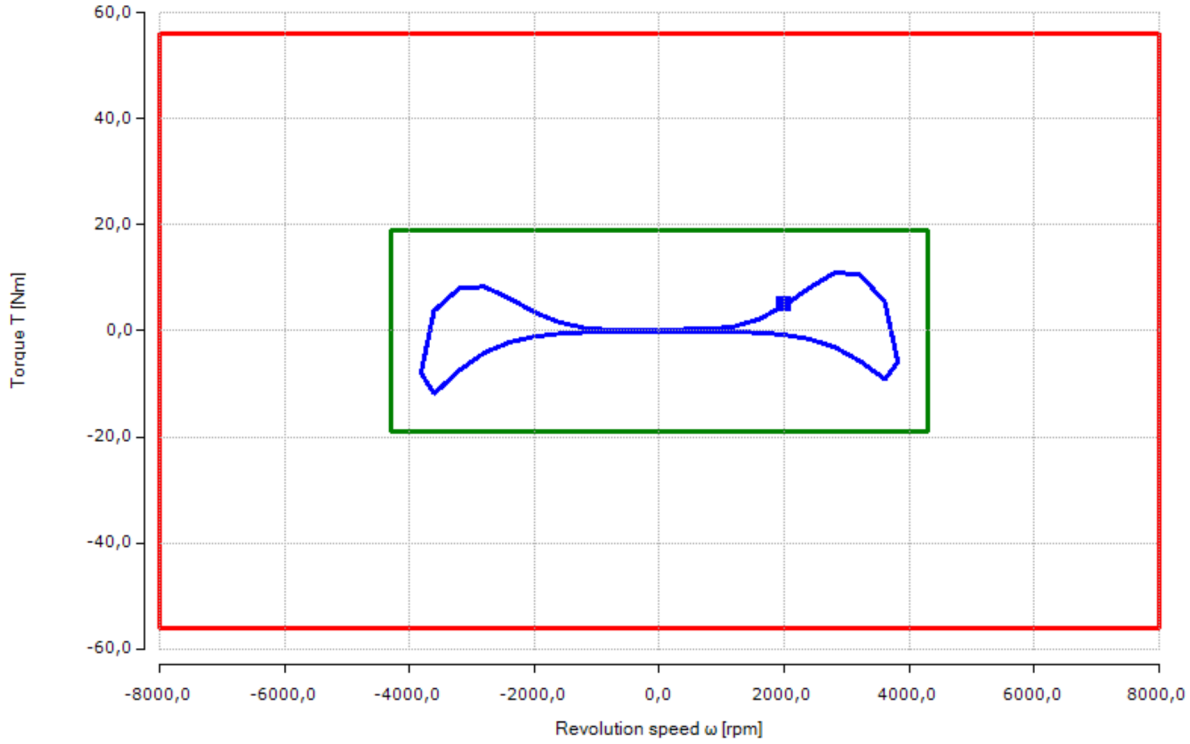
Application data		
Max torque load side	[T_{max}]	11,8 Nm
Max speed	[ω_{max}]	3816 rpm
Max power	[P_{max}]	545 W

Documentation
http://download.beckhoff.com/download/document/motion/ag3210_ba_en.pdf
Step model
http://download.beckhoff.com/download/technical_drawings/Drive_Technology/step/ag3210/ag3210-np015s-mf1-i-1c1-f3.zip

4.2.2. Gearbox: Axis 1



Dimension without tolerance ± 1 mm



Maximal limit curve
Nominal limit curve
Application curve
Effective application point

AM8023-xExx-0000
Servomotor, 400 V AC (max. 480 V AC), M_0 = 1,20 Nm, I_0 = 2,20 A, n_n = 8000 min-1
Please note: the axial and radial load on the shaft is not considered.

Nominal data		
Protection class without sealing ring		IP 54
Standstill torque	[T_0]	1,2 Nm
Rated torque @ 115 V AC	[T_{n115}]	1,15 Nm
Rated torque @ 230 V AC	[T_{n230}]	1,1 Nm
Rated torque @ 400 V AC	[T_{n400}]	1 Nm
Rated torque @ 480 V AC	[T_{n480}]	0,9 Nm
Standstill current	[I_0]	2,2 A
Torque constant	[K_e]	0,545 Nm/A
Number of pole pairs	[n_p]	3
Motor length without brake	[Y]	156 mm
Inertia with brake	[I]	0,444 kgcm²
Motor mass with brake	[m]	1,96 kg

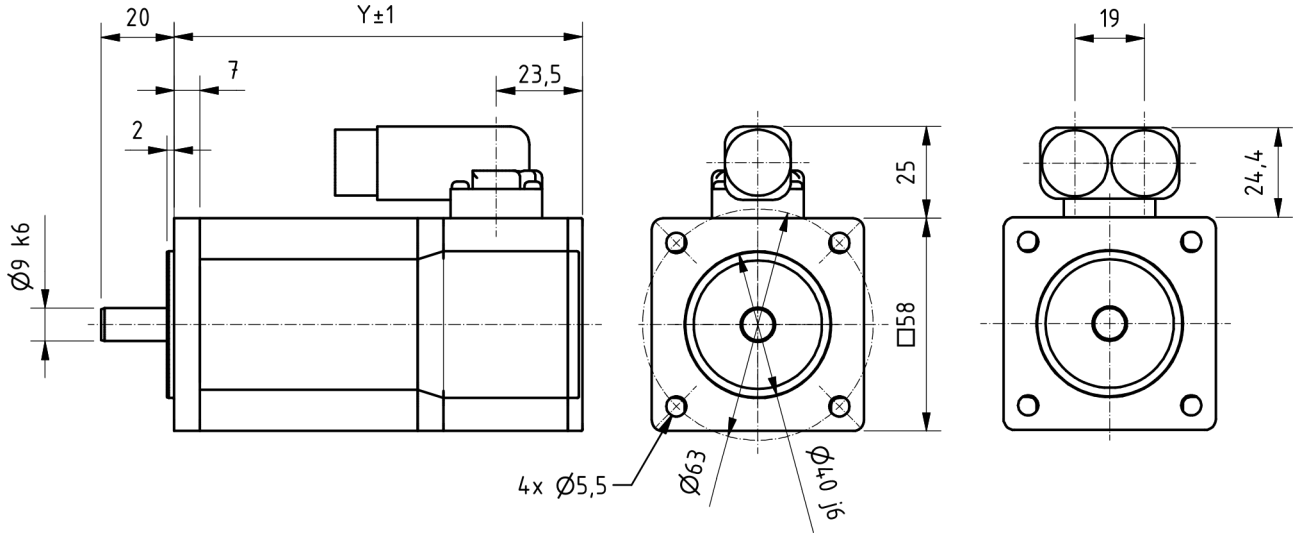
Nominal data		
Protection class with sealing ring		IP 65
Max torque	[T_{max}]	6,36 Nm
Rated speed @ 115 V AC	[ω_{n115}]	2000 rpm
Rated speed @ 230 V AC	[ω_{n230}]	4500 rpm
Rated speed @ 400 V AC	[ω_{n400}]	8000 rpm
Rated speed @ 480 V AC	[ω_{n480}]	9000 rpm
Peak current	[I_{max}]	11,4 A
Voltage constant	[K_v]	43 mV/rpm
Inertia without brake	[I]	0,373 kgcm²
Motor mass without brake	[m]	1,7 kg
Motor length with brake	[Y]	190 mm
Holding brake torque	[T_{brake}]	2 Nm

Application data		
Effective torque	[T_{eff}]	0,799 Nm
Mean speed	[ω_{avg}]	1995 rpm
Mean power	[P_{avg}]	215 W
Mean inertia ratio	[λ_{avg}]	1,4

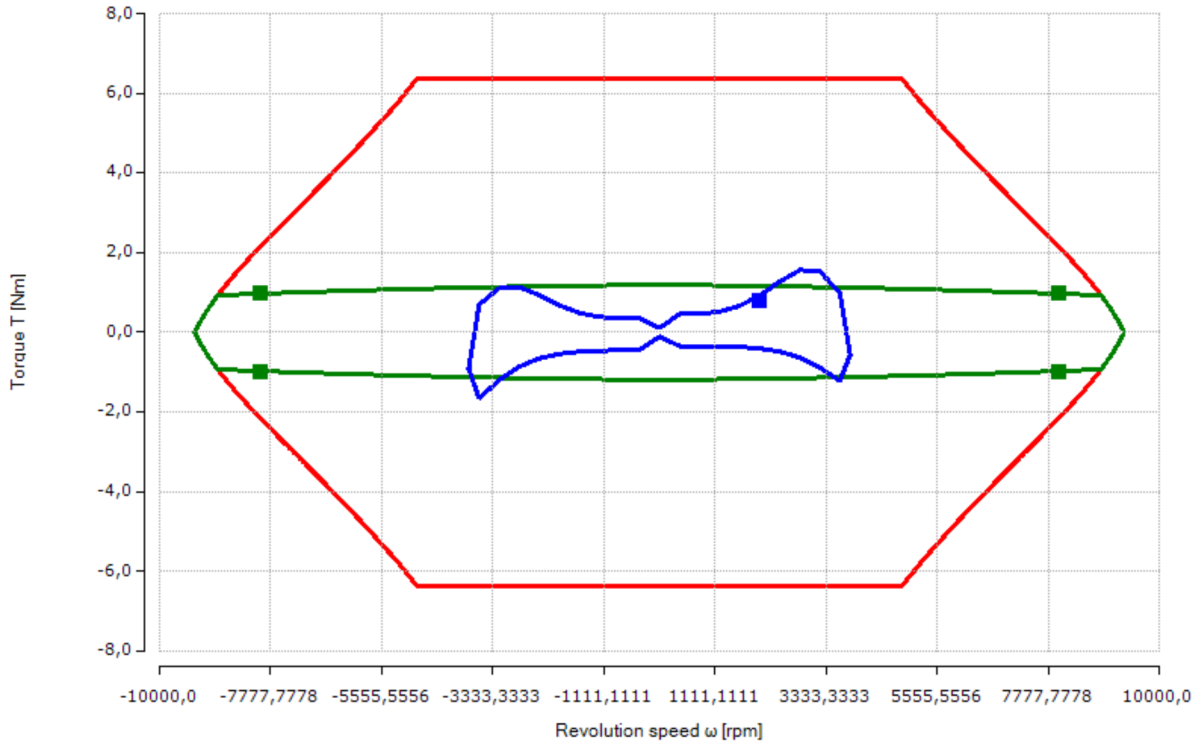
Application data		
Max torque	[T_{max}]	1,65 Nm
Max speed	[ω_{max}]	3816 rpm
Max power	[P_{max}]	833 W
Max inertia ratio	[λ_{max}]	3,41

Documentation
http://download.beckhoff.com/download/document/motion/am8000_am8500_ba_en.pdf
Step model
http://download.beckhoff.com/download/technical_drawings/Drive_Technology/step/AM80xx/AM8023-xx00_STP.zip

4.2.3. Motor: Axis 1



general tolerances according to DIN ISO 2768 mK



- Voltage boundary curve @ 400 V AC
- S1 characteristic curve
- Nominal point @ 400 V AC
- Application curve
- Effective application point

AX5106-0000-02xx
Digital Compact Servo Drive, 1-axis module 100…480 V AC, Rated Output Current 6 A, EtherCAT Interface, OCT

Nominal data	
Minimal rated supply voltage 1-	18 V
Rated input current 1-	6,6 A
Minimal rated supply voltage 1~	100 V
Rated input current 1~	6,6 A
Minimal rated supply voltage 3~	100 V
Rated input current 3~	6,6 A
Number of channels	1
Channel peak current	13 A
Rated braking power Internal	150 W
Peak braking power Internal 10 % duty cycle	611 W
Peak braking power Internal 40 % duty cycle	267 W
Rated braking power External	6 kW
max DC link voltage	845 V

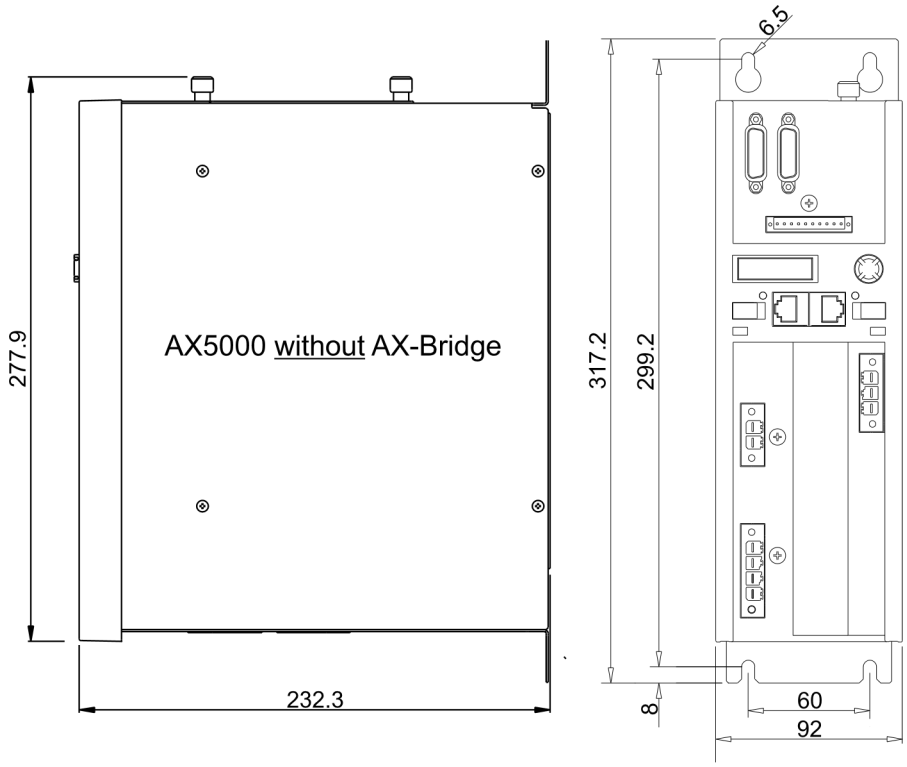
Nominal data	
Maximal rated supply voltage 1-	700 V
Maximal input current 1-	33 A
Maximal rated supply voltage 1~	240 V
Maximal input current 1~	33 A
Maximal rated supply voltage 3~	480 V
Maximal input current 3~	33 A
Channel nominal current	6 A
Capacitance	235 µF
Peak braking power Internal 1 % duty cycle	2,68 kW
Peak braking power Internal 20 % duty cycle	375 W
Peak braking power Internal 100 % duty cycle	150 W
Peak braking power External	15 kW

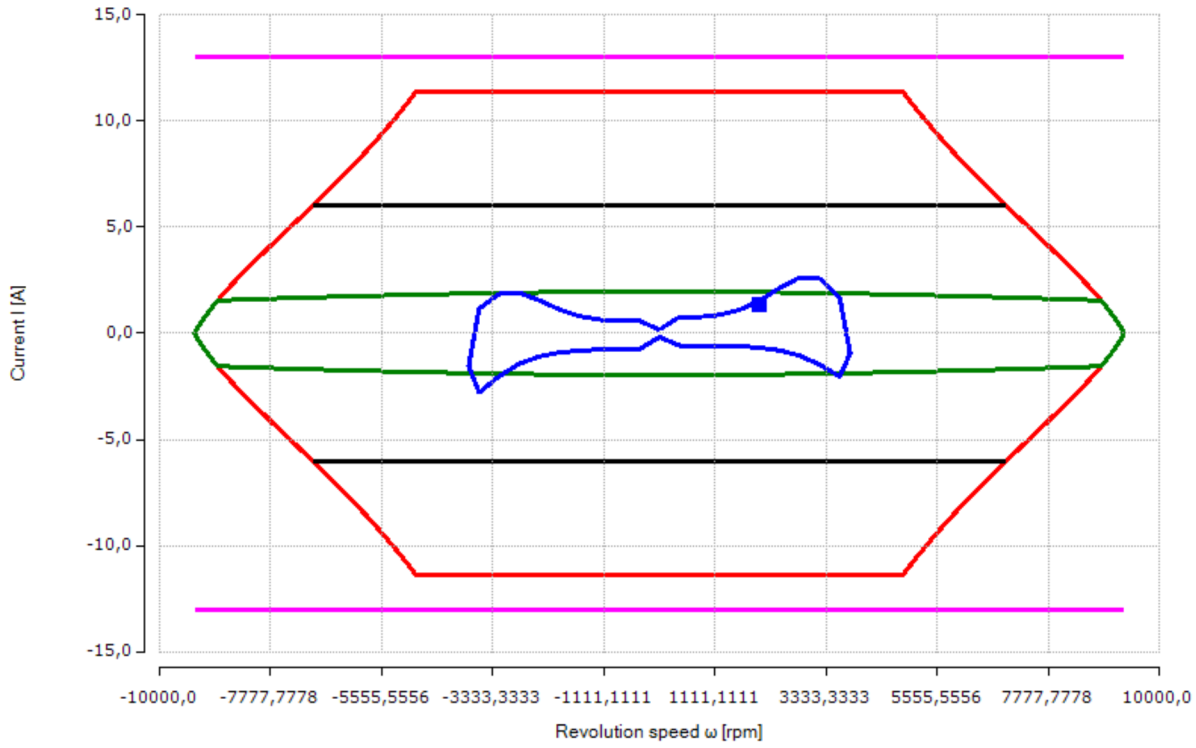
Application data		
Device nominal current	[I_{d_eff}]	1,33 A
Device average power	[P_{d_avg}]	215 W

Application data		
Device peak current	[I_{d_max}]	2,78 A
Device peak power	[P_{d_max}]	833 W

Documentation
http://download.beckhoff.com/download/document/motion/ax5000_startup_en.pdf
Step model
http://download.beckhoff.com/download/technical_drawings/Drive_Technology/step/AX5000/AX51xx_STP.zip
EPLAN Macros
http://www.beckhoff.de/default.asp?forms/eplan_macros/default.aspx?lg=de

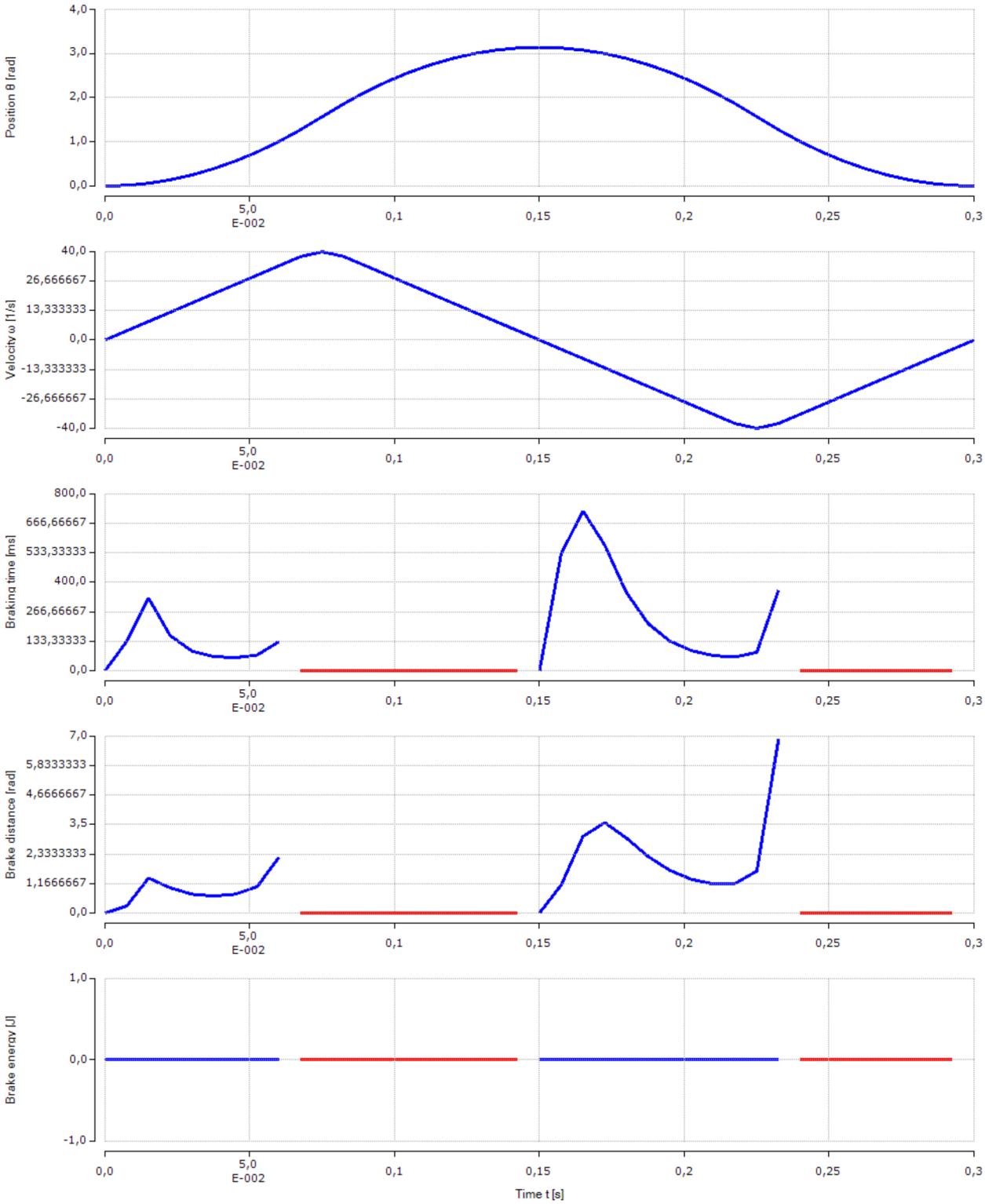
4.2.4. Drive: Axis 1





- Voltage boundary curve
- Drive peak current
- S1 characteristic curve motor
- Application curve
- Drive nominal current
- Effective application point

4.2.5. Emergency brake investigation: Axis 1



Emergency brake Emergency brake not possible

Resulting values		
Emergency braking torque	[T_b]	0 Nm
Maximal braking distance load shaft	[θ_{bShaft}]	1,1 rev
Braking time	[t_b]	1 s

Resulting values		
Maximal braking distance load	[θ_b]	8,63 °
Maximal braking distance motor	[θ_{bMot}]	11 rev
Maximal braking energy	[E_b]	1 J