

Project Name: TwinCAT Motion Designer Project1

Customer

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Application Engineer

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Project Description

TwinCAT Motion Designer Project1

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.

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1. Bill of Materials

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DC Link: DC-link 0

Axis: X-Axis

Order code	qty	Product description
AX8108-0x00-0000	1	One Axis Module 8A, OCT
Motor-Gearbox-Combination	1	The following both positions will be mounted at Beckhoff and delivered as one unit.
AM8551-0G20-0000	1	Servomotor, 400 V AC (max. 480 V AC), $M_0 = 4,89 \text{ Nm}$, $I_0 = 4,75 \text{ A}$, $n_n = 5000 \text{ min}^{-1}$, Smooth Shaft, OCT 18 Bit Multiturn, No Brake
AG2210-+LP090S-MF1-7-xG1-AM805x	1	Planetary Shaft Gearbox, $M_n = 50,00 \text{ Nm}$, $M_b = 100,00 \text{ Nm}$, Backlash $\leq 8,00 \text{ arcmin}$, $i = 7$

Axis: Y-Axis

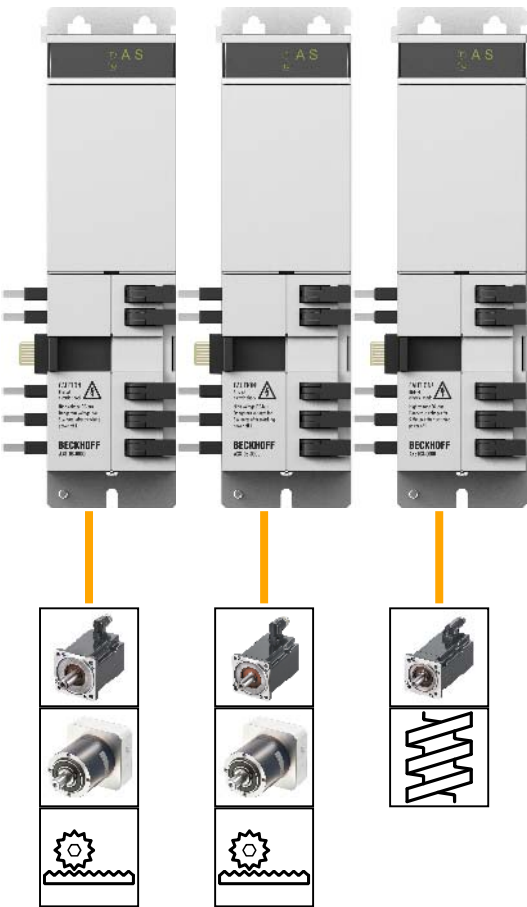
Order code	qty	Product description
AX8108-0100-0000	1	One Axis Module 8A, OCT, TwinSAFE (STO, SS1)
Motor-Gearbox-Combination	1	The following both positions will be mounted at Beckhoff and delivered as one unit.
AM8541-0E20-0000	1	Servomotor, 400 V AC (max. 480 V AC), $M_0 = 2,45 \text{ Nm}$, $I_0 = 3,00 \text{ A}$, $n_n = 6000 \text{ min}^{-1}$, Smooth Shaft, OCT 18 Bit Multiturn, No Brake
AG2210-+LP090S-MF1-7-1G1-AM804x	1	Planetary Shaft Gearbox, $M_n = 50,00 \text{ Nm}$, $M_b = 100,00 \text{ Nm}$, Backlash $\leq 8,00 \text{ arcmin}$, $i = 7$, Feather Key
ZK4800-8023-0050	1	highly flexible, drag-chain suitable cable with 5 million bending cycles, Cable Length $l = 5 \text{ m}$

Axis: Z-Axis

Order code	qty	Product description
AX8108-0100-0000	1	One Axis Module 8A, OCT, TwinSAFE (STO, SS1)
AM8033-1J21-0000	1	Servomotor, 400 V AC (max. 480 V AC), $M_0 = 3,22 \text{ Nm}$, $I_0 = 6,80 \text{ A}$, $n_n = 9000 \text{ min}^{-1}$, Feather Key, OCT 18 Bit Multiturn, Holding Brake

2. DC Link: DC-link 0

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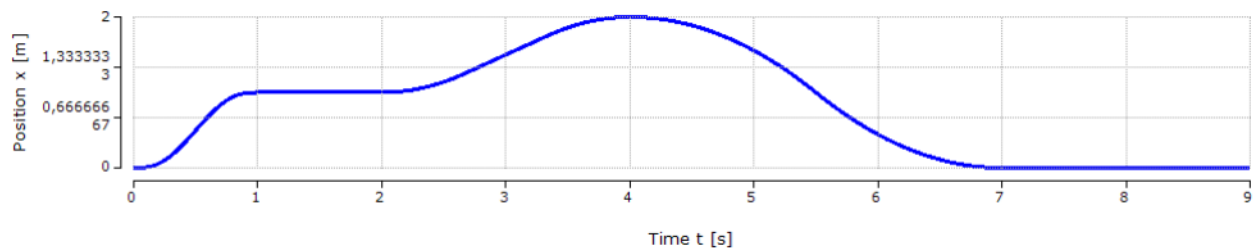


Power supply type: 400 V, 3 phase

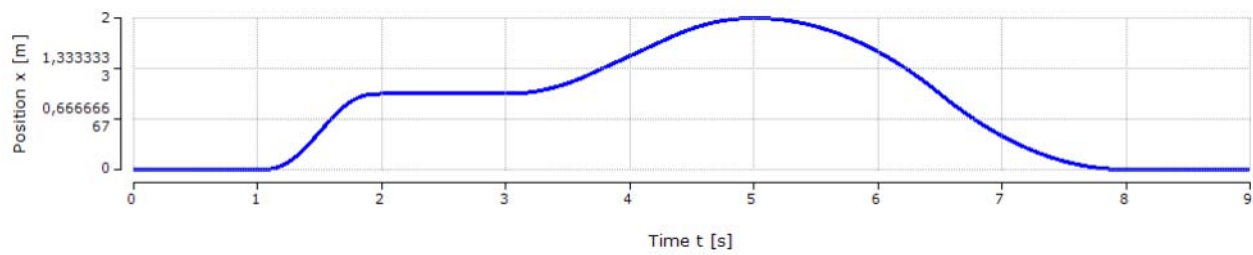
2. DC Link: DC-link 0



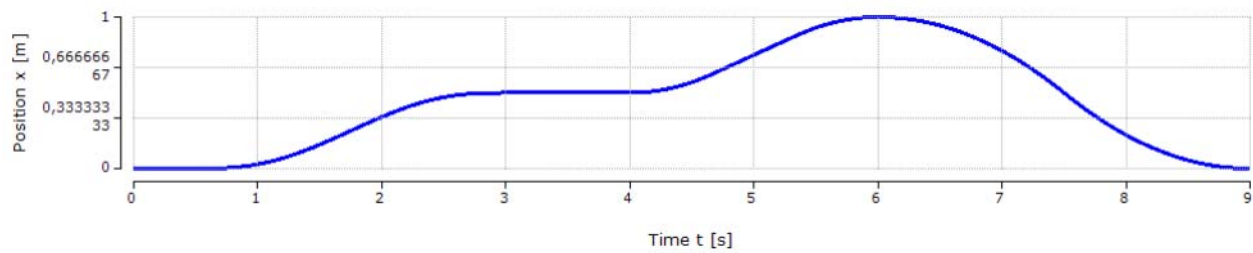
Position: X-Axis



Position: Y-Axis



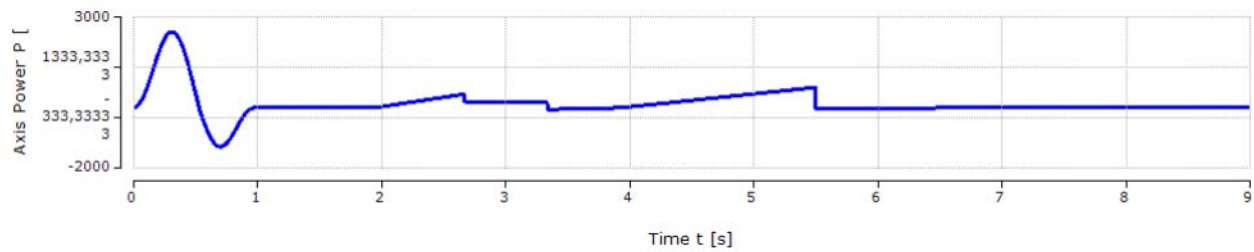
Position: Z-Axis



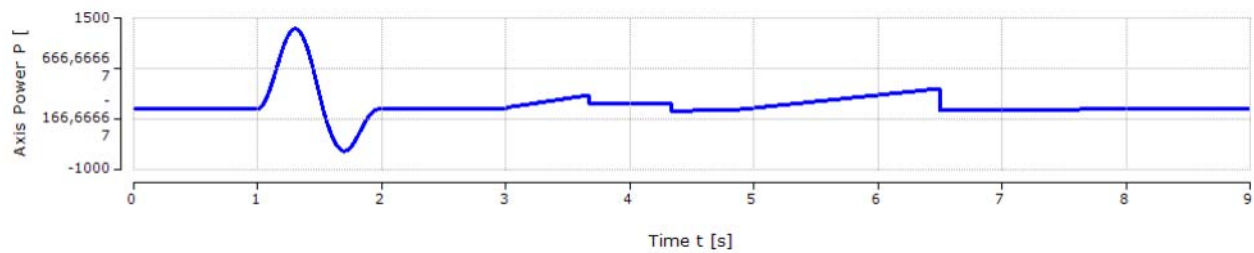
2. DC Link: DC-link 0



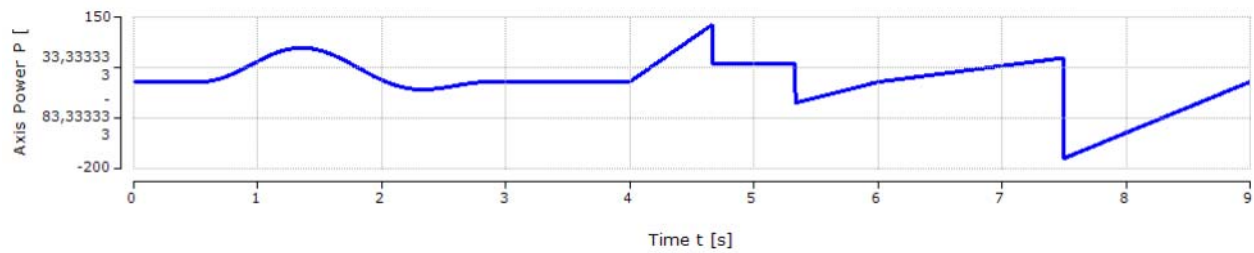
Needed Power: X-Axis



Needed Power: Y-Axis

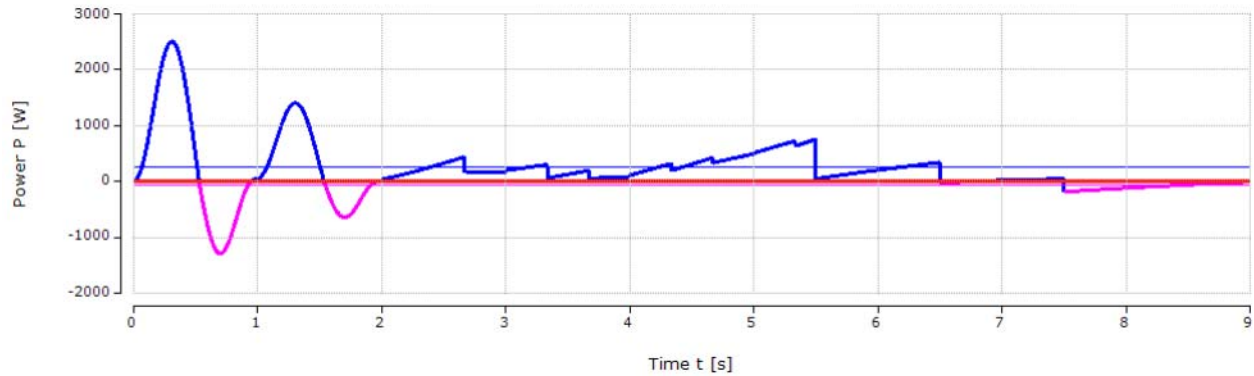


Needed Power: Z-Axis

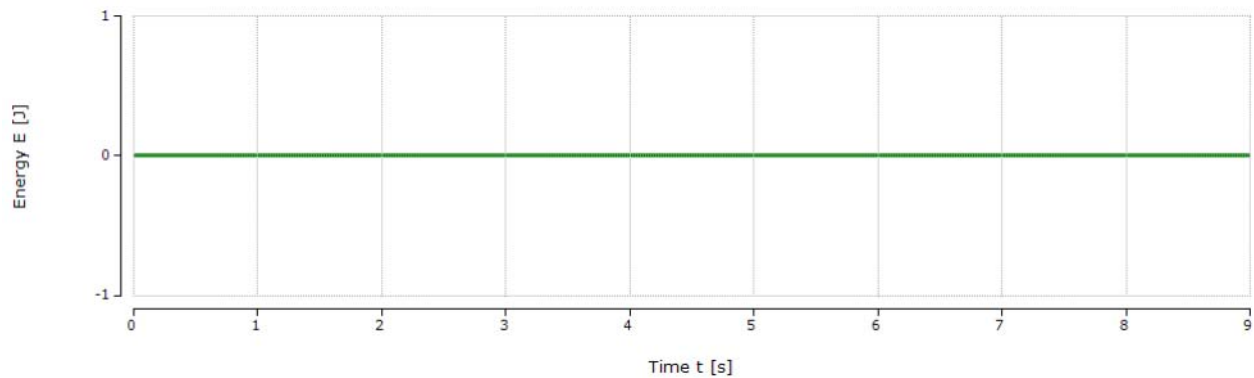


2. DC Link: DC-link 0

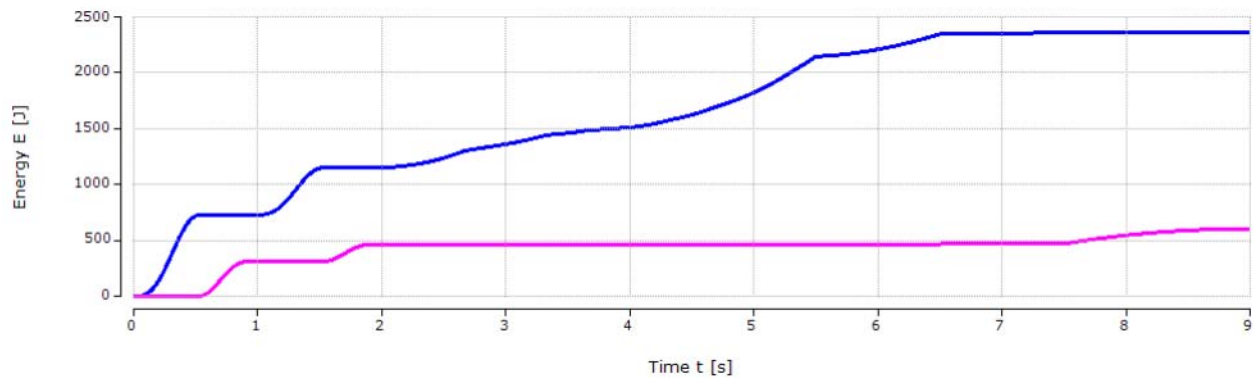
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■ Infeed Module ■ Bleeder Module ■ Allowed Effective Infeed Power ■ Allowed Maximal Infeed Power
■ Effective Infeed Power ■ Allowed Effective Bleeder Power ■ Allowed Maximal Bleeder Power
■ Effective Bleeder Power



■ Boundaries Capacitive Energy ■ Capacitive Energy

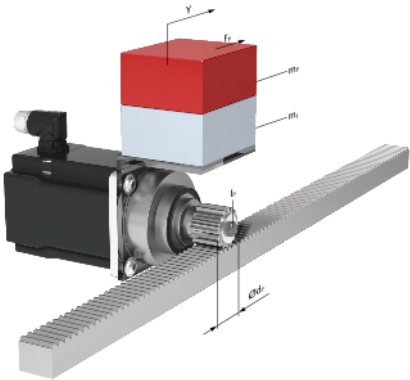


■ Infeed Energy ■ Bleeder Energy

Nominal Data	
Effective Infeed Power	0 W
Maximal Infeed Power	0 W
Effective Braking Power	0 W
Maximal Braking Power	0 W

Application Data	
Effective Needed Infeed Power	262,89 W
Maximal Needed Infeed Power	2506,41 W
Effective Needed Braking Power	67,03 W
Maximal Needed Braking Power	1288,86 W

2.1. Axis: X-Axis

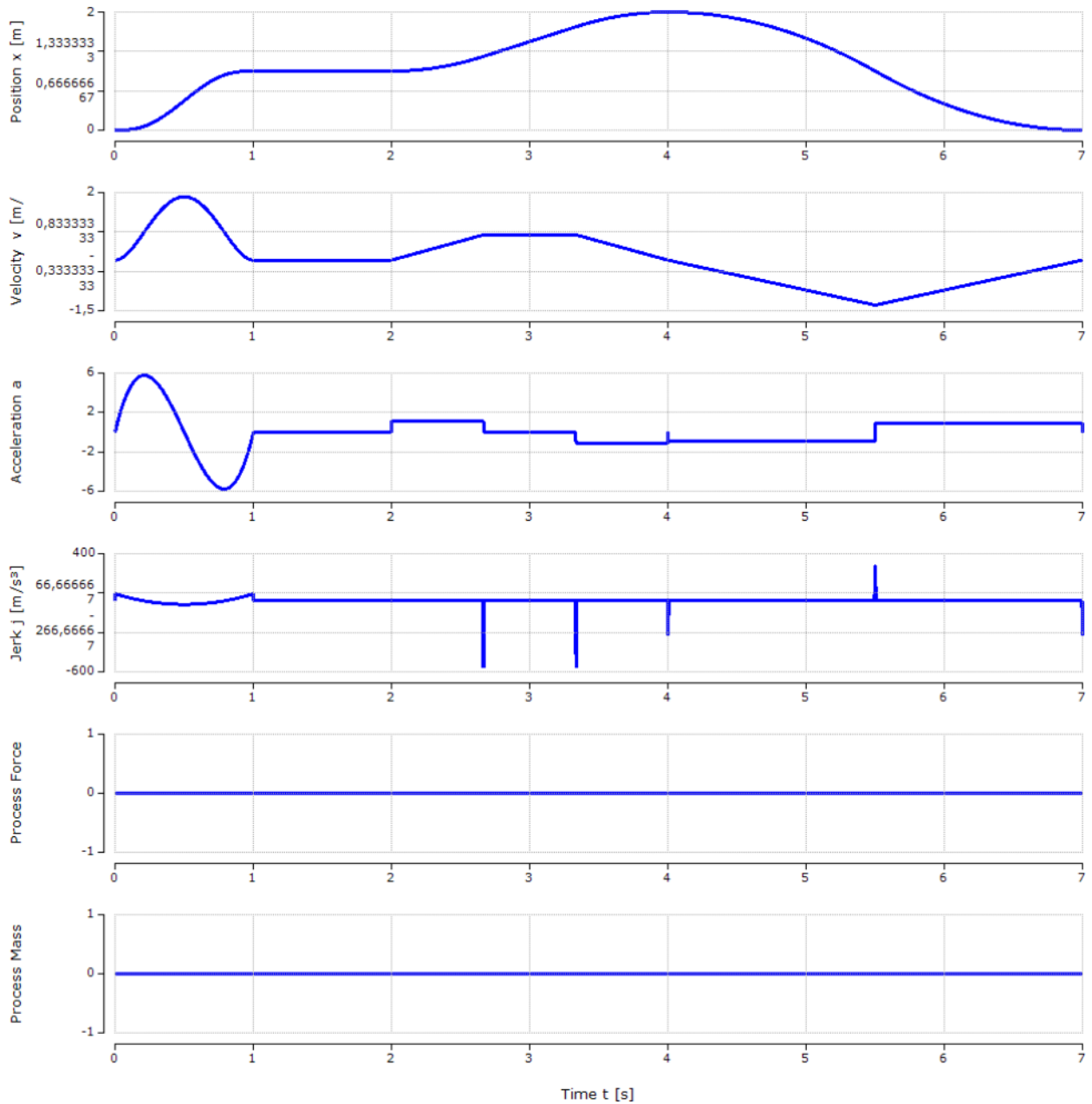


Mechanical Data		
Pitch Circle Diameter	$[\phi_{d_p}]$	63,66 mm
Load Mass	$[m_L]$	200 kg
Efficiency	$[\eta]$	0,90

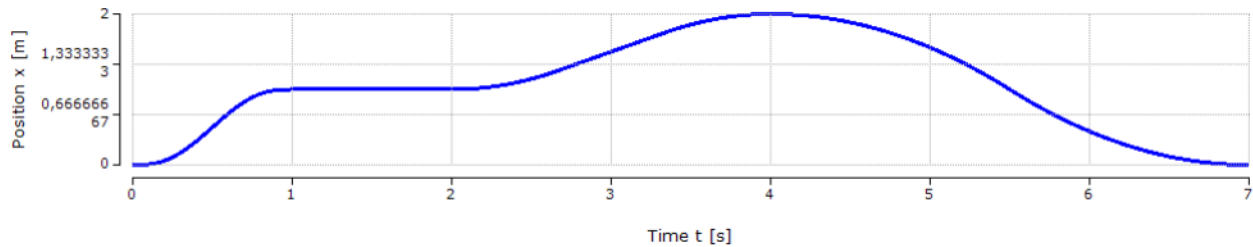
Mechanical Data		
Pinion Inertia	$[I_P]$	10 kgcm ²
Friction Coefficient	$[\mu]$	0,10

2.1. Axis: X-Axis

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2.1. Axis: X-Axis



1. Section: TrajectorySection (VDI Section)

Input Parameter	
Positioning Mode	Relative
Position	1000 mm

Resulting Values	
Max speed	1,88 m/s
Max jerk	60 m/s ³

Input Parameter	
Type	m of 5th degree
Duration	1 s

Resulting Values	
Max acceleration	5,77 m/s ²

2. Section: TrajectorySection (Rest)

Input Parameter	
Duration	1 s

Resulting Values	
Max speed	0 m/s
Max jerk	0 m/s ³

Resulting Values	
Max acceleration	0 m/s ²

3. Section: TrajectorySection (Third Rule)

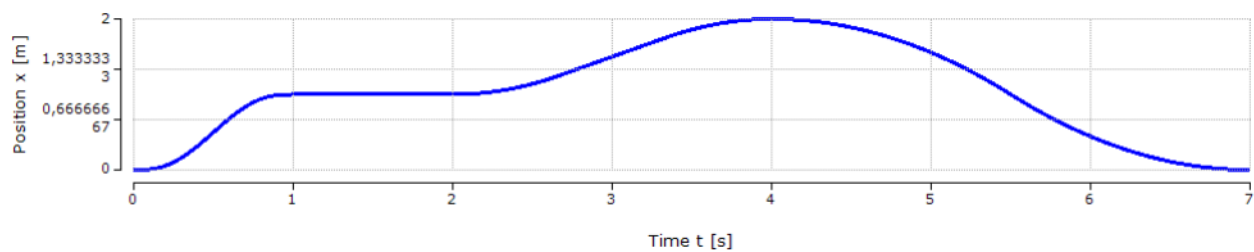
Input Parameter	
Positioning Mode	Relative
Duration	2 s

Resulting Values	
Max speed	0,75 m/s
Max jerk	+unendlich m/s ³

Input Parameter	
Position	1000 mm

Resulting Values	
Max acceleration	1,13 m/s ²

2.1. Axis: X-Axis



4. Section: TrajectorySection (Half Rule)

Input Parameter	
Positioning Mode	Absolute
Duration	3 s

Resulting Values	
Max speed	1,33 m/s
Max jerk	+unendlich m/s ³

Input Parameter	
Position	0 mm

Resulting Values	
Max acceleration	0,89 m/s ²

2.1. Axis: X-Axis

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AG2210-+LP090S-MF1-7-xG1-AM805x

Planetary Shaft Gearbox, $M_n = 50,00 \text{ Nm}$, $M_b = 100,00 \text{ Nm}$, Backlash $\leq 8,00 \text{ arcmin}$, $i = 7$

Nominal Data		
Gear Ratio	$[i]$	7
Efficiency	$[\eta]$	0,97
Maximal Output Torque	$[T_{2\max}]$	100 Nm
Nominal Motor Side Speed	$[\omega_{1\text{nom}}]$	3400 rpm
Motor Side Inertia	$[I_1]$	1,47 kgcm ²

Application Data		
Effective torque	$[T_{\text{eff}}]$	2,01 Nm
Mean speed	$[\omega_{\text{avg}}]$	1200,00 rpm
Mean power	$[P_{\text{avg}}]$	209,87 W

Nominal Data		
Number of Stages	$[Z]$	1
Nominal Output Torque	$[T_{2n}]$	50 Nm
Emergency Output Torque	$[T_{2\text{emerg}}]$	190 Nm
Maximal Motor Side Speed	$[\omega_{1\max}]$	6000,00 rpm

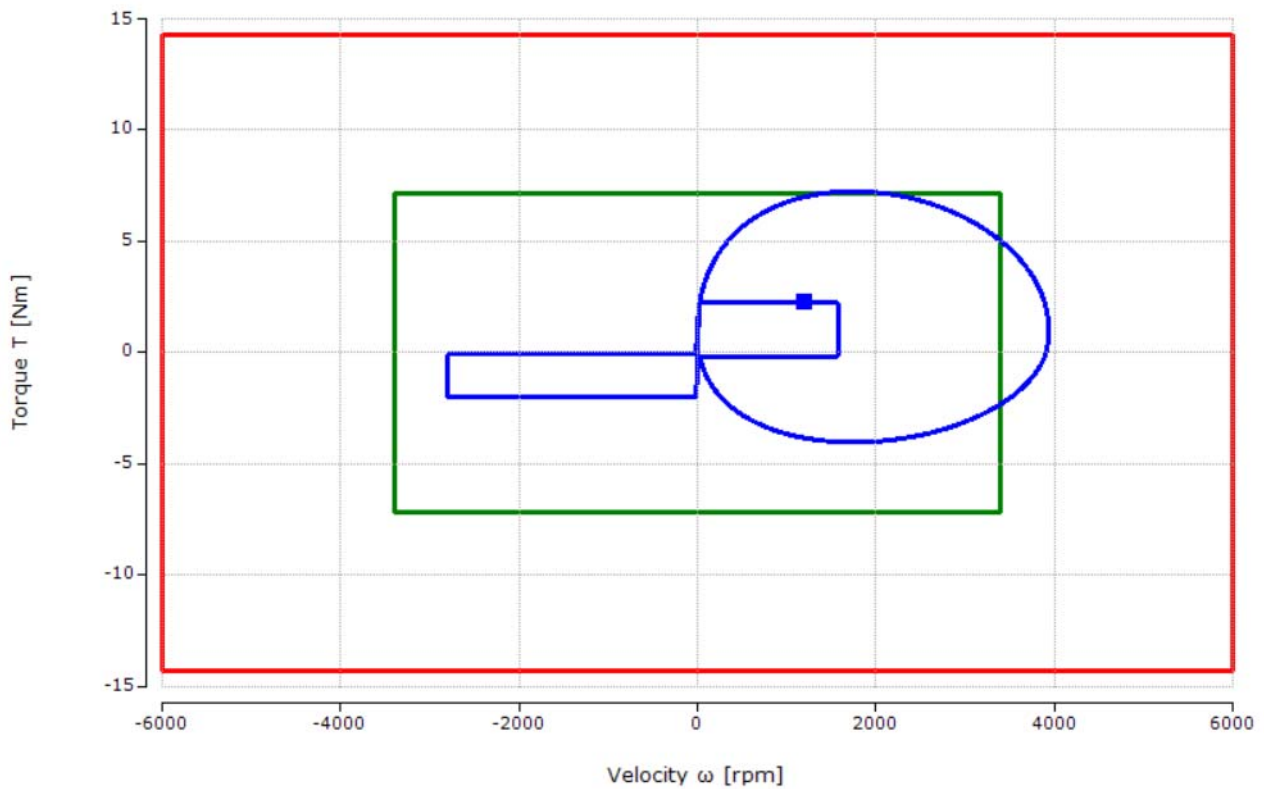
Application Data		
Max torque	$[T_{\max}]$	7,25 Nm
Max speed	$[\omega_{\max}]$	3937,50 rpm
Max power	$[P_{\max}]$	1903,82 W

Documentation

http://download.beckhoff.com/download/document/motion/ag2210_ag2300_ba_de.pdf

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Ansicht von links / View from left



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TcMotionDesigner 0.1.1.0
21.10.2016
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2.1. Axis: X-Axis

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AM8551-0G20-0000

Servomotor, 400 V AC (max. 480 V AC), $M_0 = 4,89 \text{ Nm}$, $I_0 = 4,75 \text{ A}$, $n_n = 5000 \text{ min}^{-1}$, Smooth Shaft, OCT 18 Bit Multiturn, No Brake

Nennwerte		
Standstill Torque	$[T_0]$	4,89 Nm
Rated Torque @ 115 V AC	$[T_{n115}]$	4,80 Nm
Rated Torque @ 230 V AC	$[T_{n230}]$	4,65 Nm
Rated Torque @ 400 V AC	$[T_{n400}]$	4,40 Nm
Rated Torque @ 480 V AC	$[T_{n480}]$	4,30 Nm
Standstill Current	$[I_0]$	4,75 A
Torque Constant	$[K_e]$	1,03 Nm/A
Number of Pole Pairs	$[n_p]$	4
Motor Length	$[Y]$	216,50 mm

Applikationskennwerte		
Effective torque	$[T_{eff}]$	2,33 Nm
Mean speed	$[\omega_{avg}]$	1200,00 rpm
Mean power	$[P_{avg}]$	269,79 W
Mean inertia ratio	$[\lambda_{avg}]$	4,54

Nennwerte		
Max torque	$[T_{max}]$	17,80 Nm
Rated Speed @ 115 V AC	$[\omega_{n115}]$	1200 rpm
Rated Speed @ 230 V AC	$[\omega_{n230}]$	2700 rpm
Rated Speed @ 400 V AC	$[\omega_{n400}]$	5000 rpm
Rated Speed @ 480 V AC	$[\omega_{n480}]$	5700,00 rpm
Peak Current	$[I_{max}]$	20,90 A
Voltage Constant	$[K_v]$	73,00 mV/rpm
Rotor Moment of Inertia	$[J]$	9,48 kgcm ²

Applikationskennwerte		
Max torque	$[T_{max}]$	8,46 Nm
Max speed	$[\omega_{max}]$	3937,50 rpm
Max power	$[P_{max}]$	2506,35 W
Max inertia ratio	$[\lambda_{max}]$	4,54

Documentation

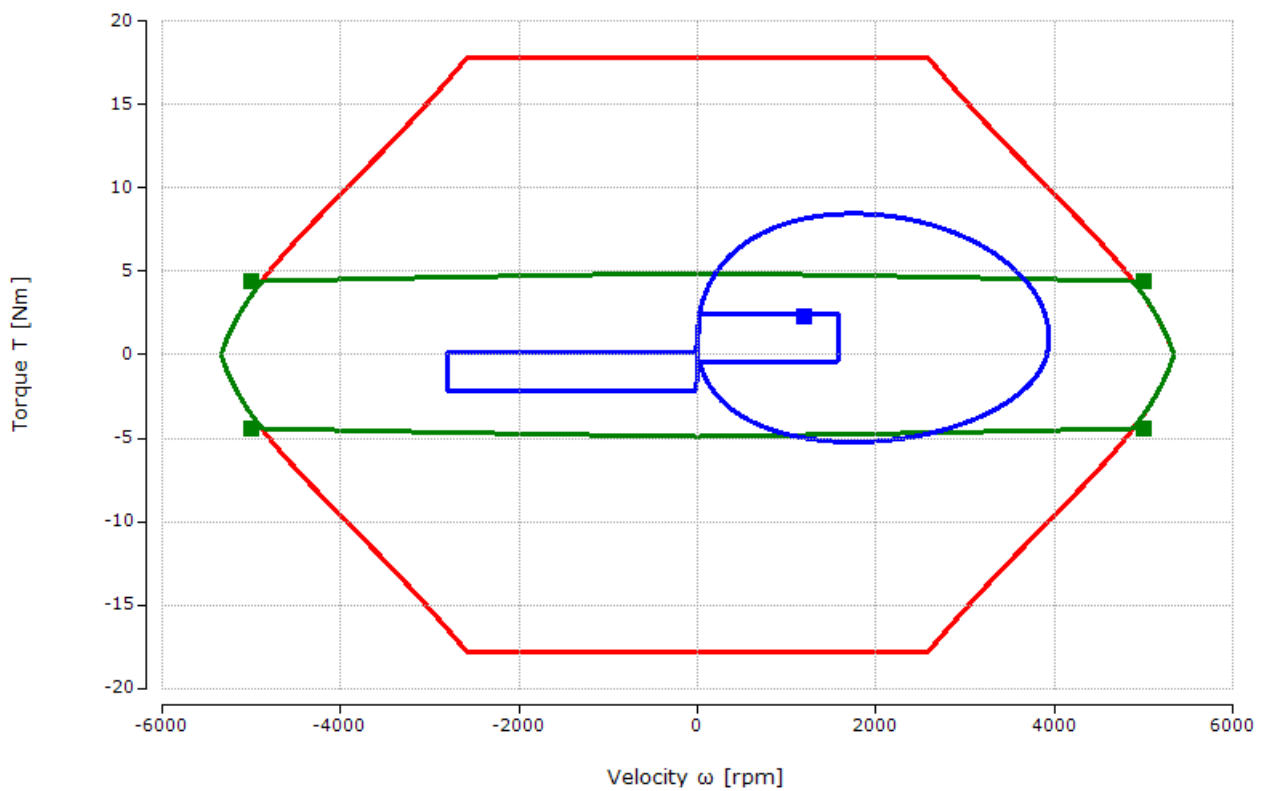
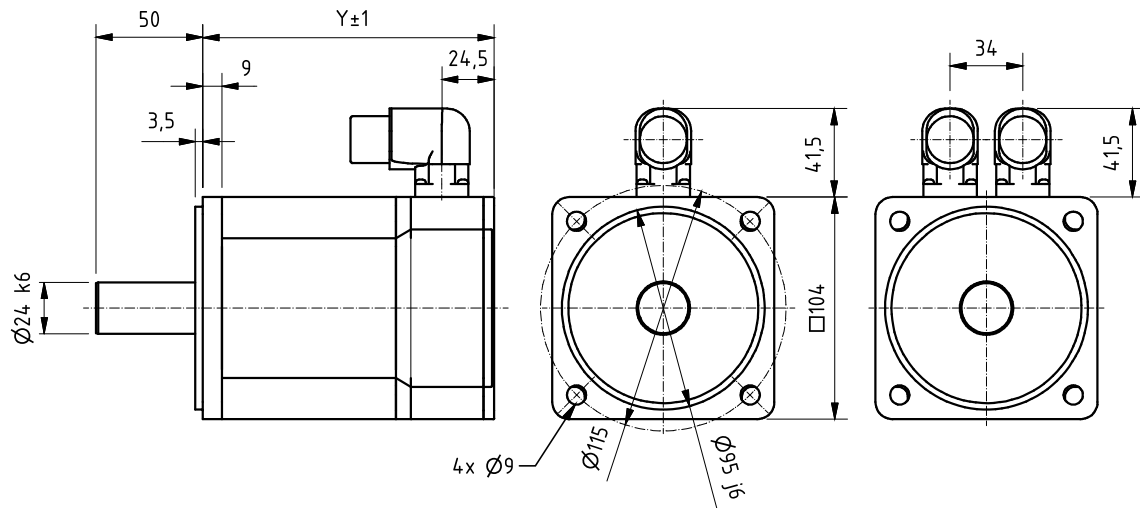
http://download.beckhoff.com/download/Document/Drives/AM8000_AM8500_BA_de.pdf

Step Model

http://download.beckhoff.com/download/Technical_Drawings/Drive_Technology/step/AM85xx/AM8551-xx11_STP.zip

2.1. Axis: X-Axis

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2.1. Axis: X-Axis



AX8108-0x00-0000

One Axis Module 8A, OCT

Nominal Data	
Number of Channels	1
Maximal Output Current	20 A

Nominal Data	
Rated Output Current	8 A

Documentation

http://download.beckhoff.com/download/document/motion/ax8000_startup_de.pdf

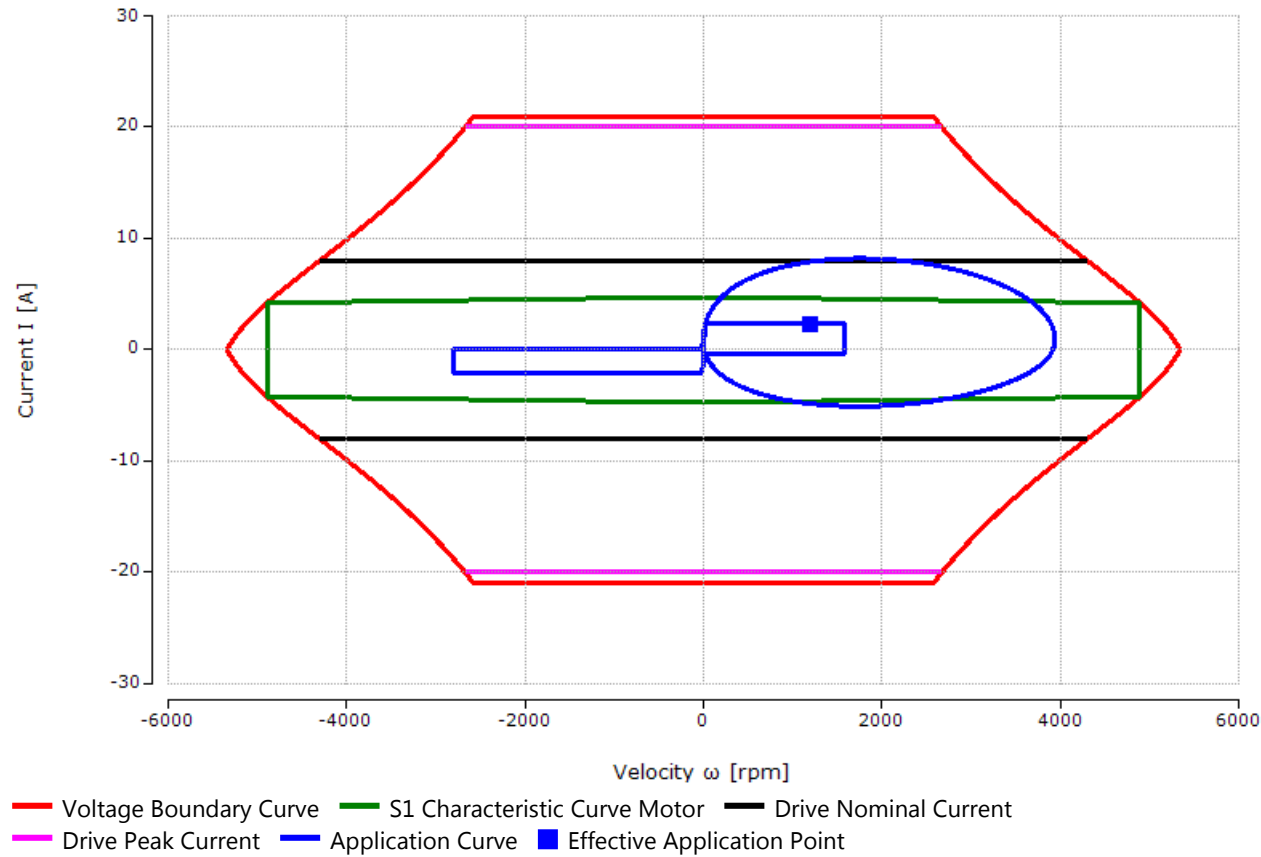
Step Model

http://download.beckhoff.com/download/Technical_Drawings/Drive_Technology/step/AX8000/ax8108_ax8118_ax8206_str

EPLAN-Macros

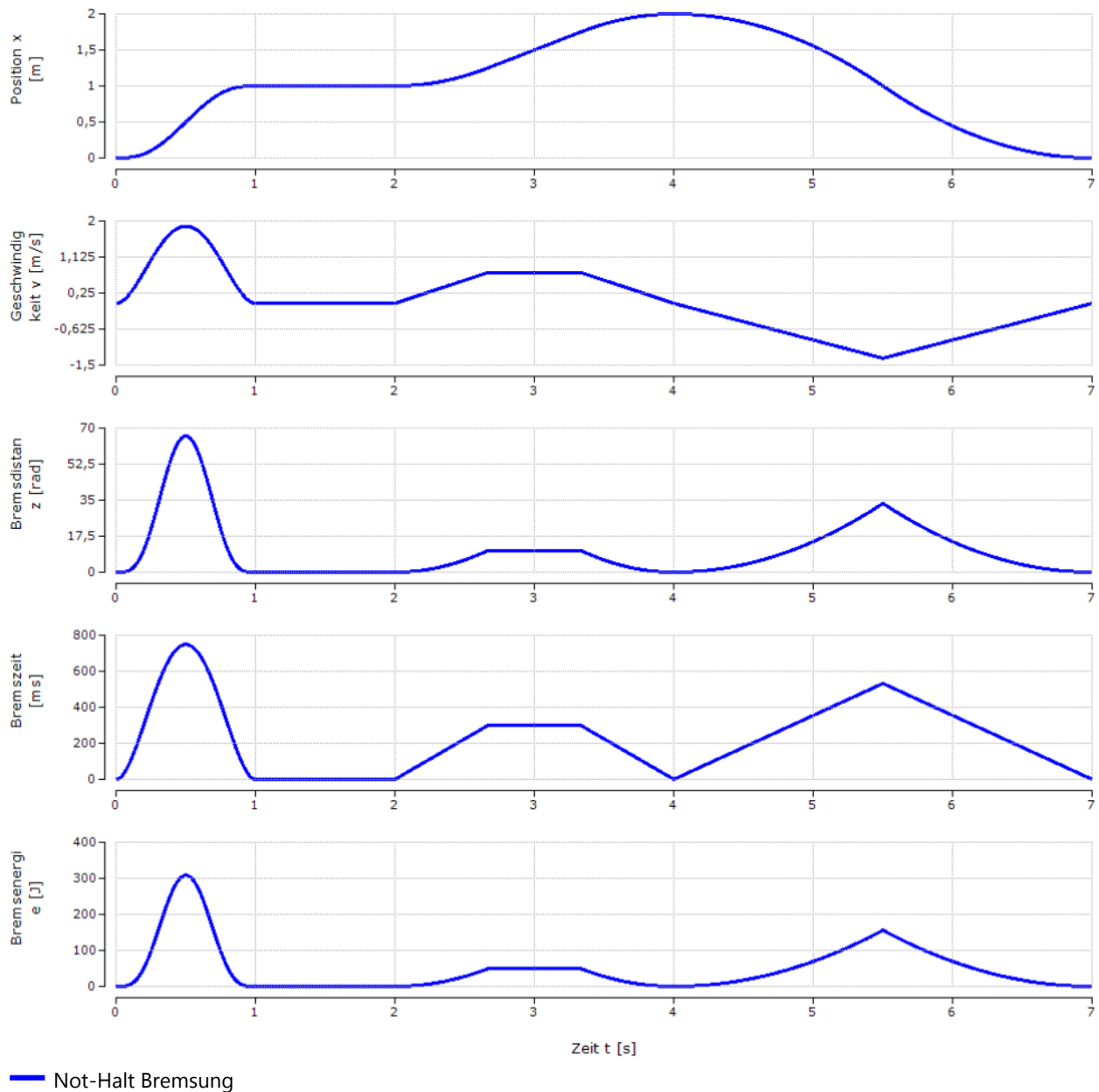
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2.1. Axis: X-Axis



2.1. Axis: X-Axis

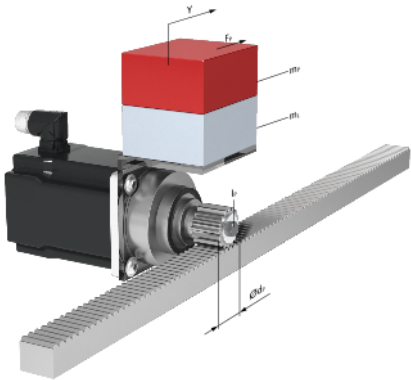
Emergency Brake Investigation



Application Data		
Emergency Braking Torque	$[T_b]$	2 Nm
Maximale Braking Distance Load Shaft	$[\theta_{bShaft}]$	66,15 rad
Braking Time	$[t_b]$	0,75 s

Application Data		
Maximal Braking Distance Load	$[x_b]$	2105,50 mm
Maximal Braking Distance Motor	$[\theta_{bMot}]$	463,02 rad
Maximal Braking Energy	$[E_b]$	308,68 J

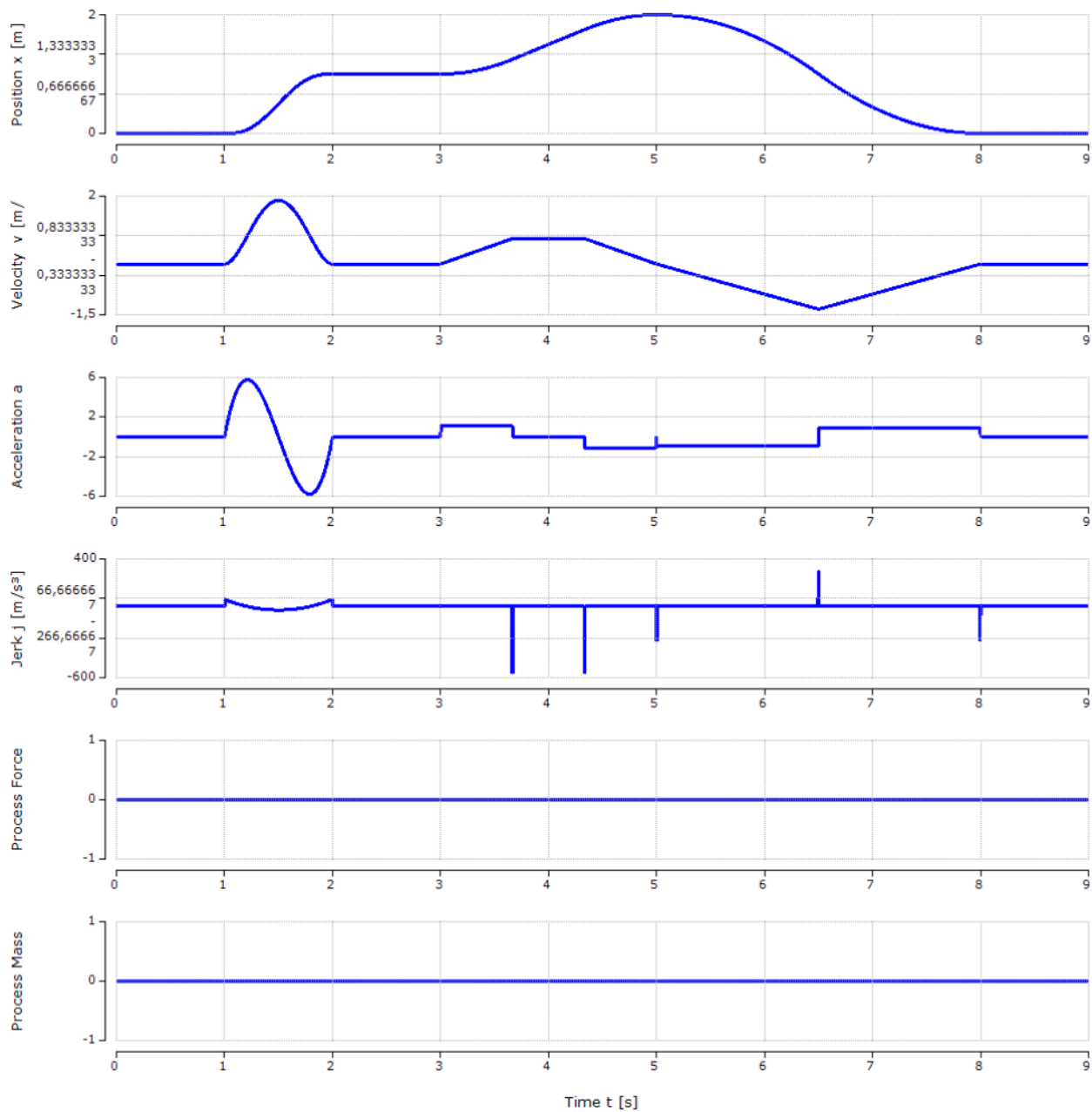
2.2. Axis: Y-Axis



Mechanical Data		
Pitch Circle Diameter	$[\varnothing d_p]$	63,66 mm
Load Mass	$[m_l]$	100 kg
Efficiency	$[\eta]$	0,90

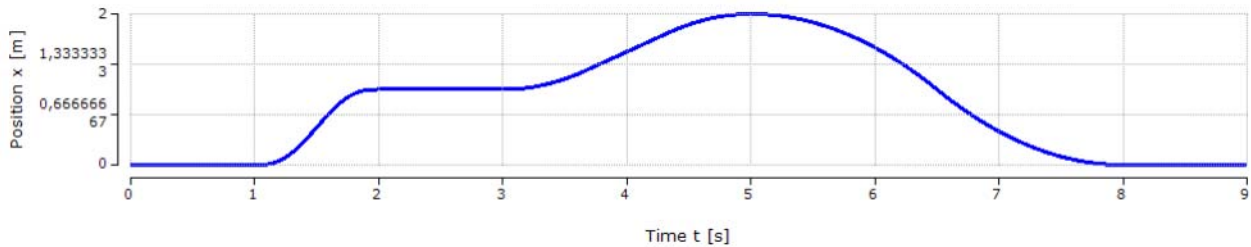
Mechanical Data		
Pinion Inertia	$[I_p]$	10 kgcm ²
Friction Coefficient	$[\mu]$	0,10

2.2. Axis: Y-Axis



2.2. Axis: Y-Axis

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1. Section: TrajectorySection (Rest)

Input Parameter	
Duration	1 s

Resulting Values	
Max speed	0 m/s
Max jerk	0 m/s ³

Resulting Values	
Max acceleration	0 m/s ²

2. Section: TrajectorySection (VDI Section)

Input Parameter	
Positioning Mode	Relative
Position	1000 mm

Resulting Values	
Max speed	1,88 m/s
Max jerk	60 m/s ³

Input Parameter	
Type	m of 5th degree
Duration	1 s

Resulting Values	
Max acceleration	5,77 m/s ²

3. Section: TrajectorySection (Rest)

Input Parameter	
Duration	1 s

Resulting Values	
Max speed	0 m/s
Max jerk	0 m/s ³

Resulting Values	
Max acceleration	0 m/s ²

4. Section: TrajectorySection (Third Rule)

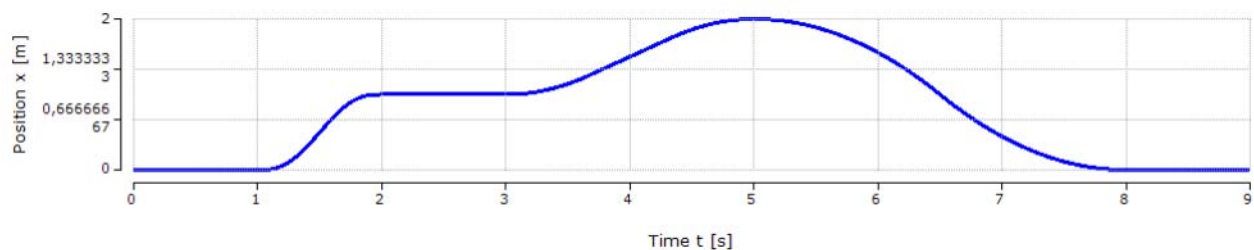
Input Parameter	
Positioning Mode	Relative
Duration	2 s

Resulting Values	
Max speed	0,75 m/s
Max jerk	+unendlich m/s ³

Input Parameter	
Position	1000 mm

Resulting Values	
Max acceleration	1,13 m/s ²

2.2. Axis: Y-Axis



5. Section: TrajectorySection (Half Rule)

Input Parameter	
Positioning Mode	Absolute
Duration	3 s

Resulting Values	
Max speed	1,33 m/s
Max jerk	+unendlich m/s ³

Input Parameter	
Position	0 mm

Resulting Values	
Max acceleration	0,89 m/s ²

6. Section: TrajectorySection (Rest)

Input Parameter	
Duration	1 s

Resulting Values	
Max speed	0 m/s
Max jerk	0 m/s ³

Resulting Values	
Max acceleration	0 m/s ²

2.2. Axis: Y-Axis

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AG2210-+LP090S-MF1-7-1G1-AM804x

Planetary Shaft Gearbox, $M_n = 50,00 \text{ Nm}$, $M_b = 100,00 \text{ Nm}$, Backlash $\leq 8,00 \text{ arcmin}$, $i = 7$, Feather Key

Nominal Data		
Gear Ratio	$[i]$	7
Efficiency	$[\eta]$	0,97
Maximal Output Torque	$[T_{2\max}]$	100 Nm
Nominal Motor Side Speed	$[\omega_{1\text{nom}}]$	3400 rpm
Motor Side Inertia	$[I_1]$	1,47 kgcm ²

Application Data		
Effective torque	$[T_{\text{eff}}]$	0,91 Nm
Mean speed	$[\omega_{\text{avg}}]$	933,33 rpm
Mean power	$[P_{\text{avg}}]$	83,43 W

Nominal Data		
Number of Stages	$[Z]$	1
Nominal Output Torque	$[T_{2n}]$	50 Nm
Emergency Output Torque	$[T_{2\text{emerg}}]$	190 Nm
Maximal Motor Side Speed	$[\omega_{1\max}]$	6000,00 rpm

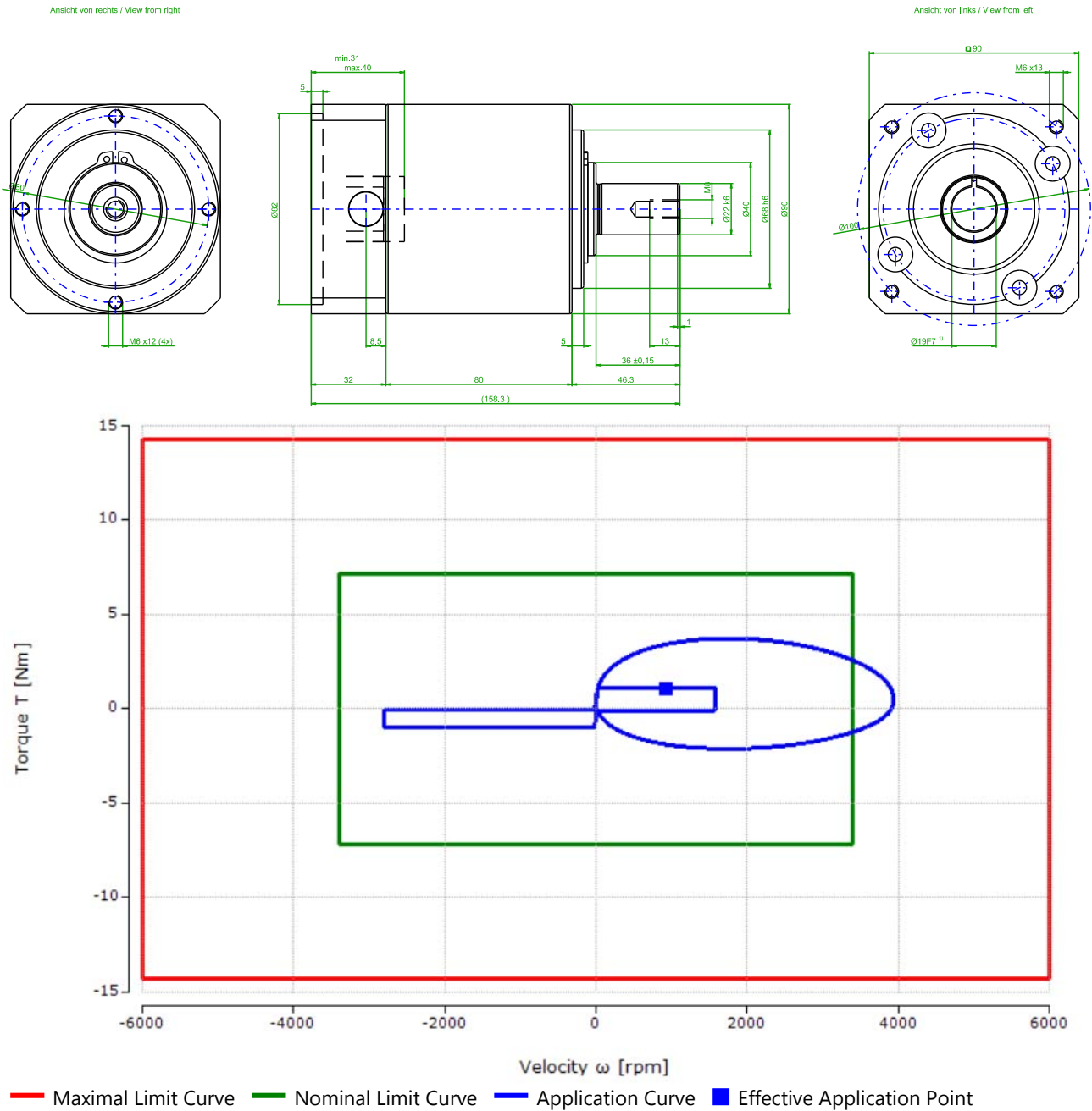
Application Data		
Max torque	$[T_{\max}]$	3,73 Nm
Max speed	$[\omega_{\max}]$	3937,50 rpm
Max power	$[P_{\max}]$	979,42 W

Documentation

http://download.beckhoff.com/download/document/motion/ag2210_ag2300_ba_de.pdf

2.2. Axis: Y-Axis

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2.2. Axis: Y-Axis

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AM8541-0E20-0000

Servomotor, 400 V AC (max. 480 V AC), $M_0 = 2,45 \text{ Nm}$, $I_0 = 3,00 \text{ A}$, $n_n = 6000 \text{ min}^{-1}$, Smooth Shaft, OCT 18 Bit Multiturn, No Brake

Nennwerte		
Standstill Torque	$[T_0]$	2,45 Nm
Rated Torque @ 115 V AC	$[T_{n115}]$	2,43 Nm
Rated Torque @ 230 V AC	$[T_{n230}]$	2,39 Nm
Rated Torque @ 400 V AC	$[T_{n400}]$	2,31 Nm
Rated Torque @ 480 V AC	$[T_{n480}]$	2,27 Nm
Standstill Current	$[I_0]$	3 A
Torque Constant	$[K_e]$	0,82 Nm/A
Number of Pole Pairs	$[n_p]$	4
Motor Length	$[Y]$	209,50 mm

Applikationskennwerte		
Effective torque	$[T_{eff}]$	1,07 Nm
Mean speed	$[\omega_{avg}]$	933,33 rpm
Mean power	$[P_{avg}]$	110,59 W
Mean inertia ratio	$[\lambda_{avg}]$	4,24

Nennwerte		
Max torque	$[T_{max}]$	9,14 Nm
Rated Speed @ 115 V AC	$[\omega_{n115}]$	1300 rpm
Rated Speed @ 230 V AC	$[\omega_{n230}]$	3000,00 rpm
Rated Speed @ 400 V AC	$[\omega_{n400}]$	6000,00 rpm
Rated Speed @ 480 V AC	$[\omega_{n480}]$	6800 rpm
Peak Current	$[I_{max}]$	13,60 A
Voltage Constant	$[K_v]$	56 mV/rpm
Rotor Moment of Inertia	$[J]$	5,27 kgcm ²

Applikationskennwerte		
Max torque	$[T_{max}]$	4,40 Nm
Max speed	$[\omega_{max}]$	3937,50 rpm
Max power	$[P_{max}]$	1323,90 W
Max inertia ratio	$[\lambda_{max}]$	4,24

Documentation

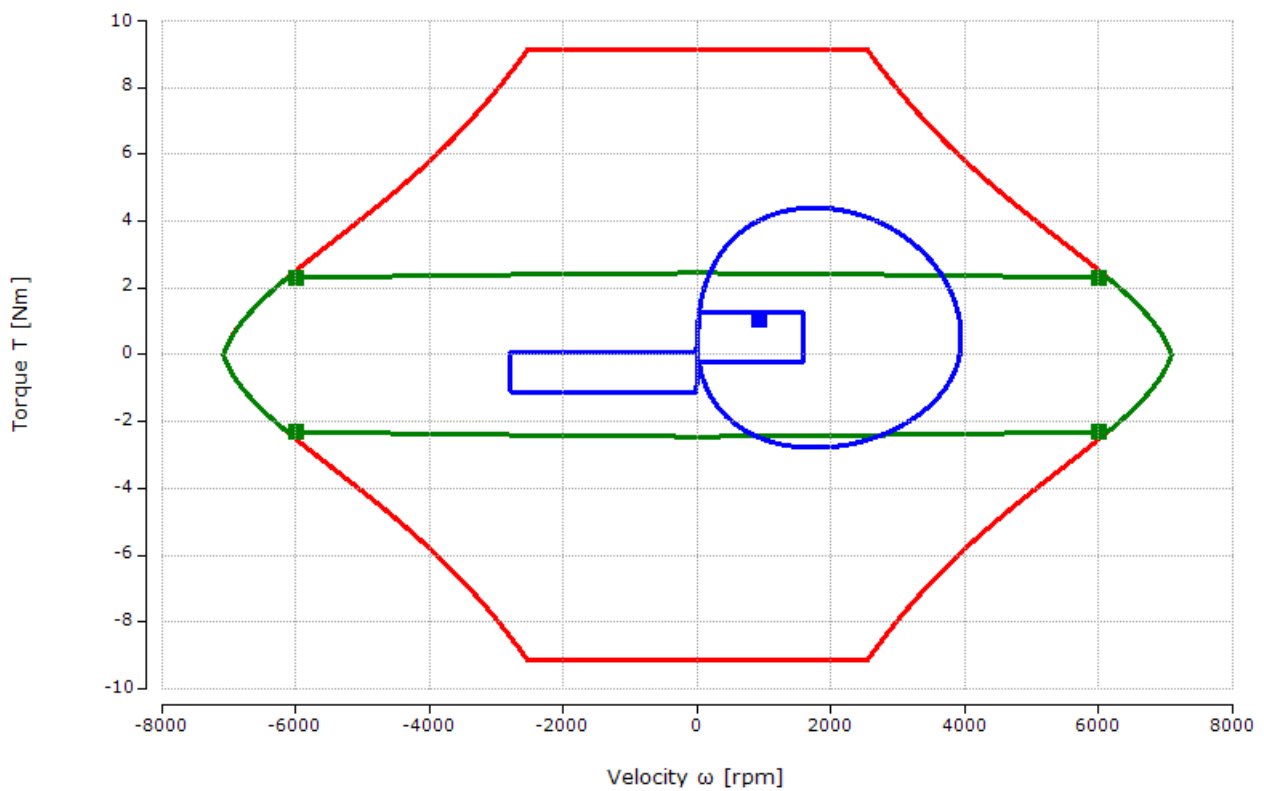
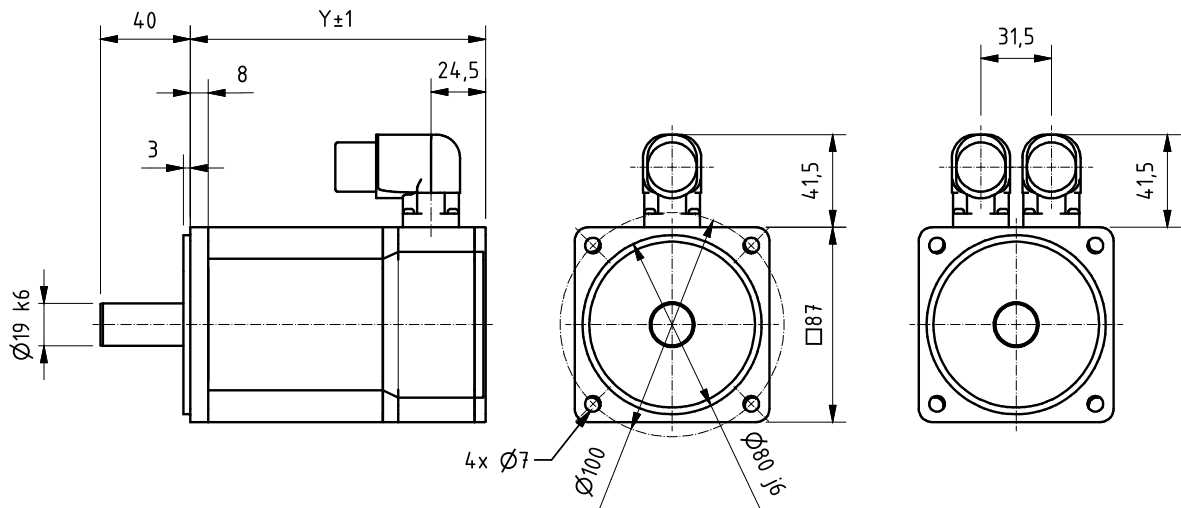
http://download.beckhoff.com/download/Document/Drives/AM8000_AM8500_BA_de.pdf

Step Model

http://download.beckhoff.com/download/Technical_Drawings/Drive_Technology/step/AM85xx/AM8541-xx11_STP.zip

2.2. Axis: Y-Axis

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2.2. Axis: Y-Axis



AX8108-0100-0000

One Axis Module 8A, OCT, TwinSAFE (STO, SS1)

Nominal Data	
Number of Channels	1
Maximal Output Current	20 A

Nominal Data	
Rated Output Current	8 A

Documentation

http://download.beckhoff.com/download/document/motion/ax8000_startup_de.pdf

Step Model

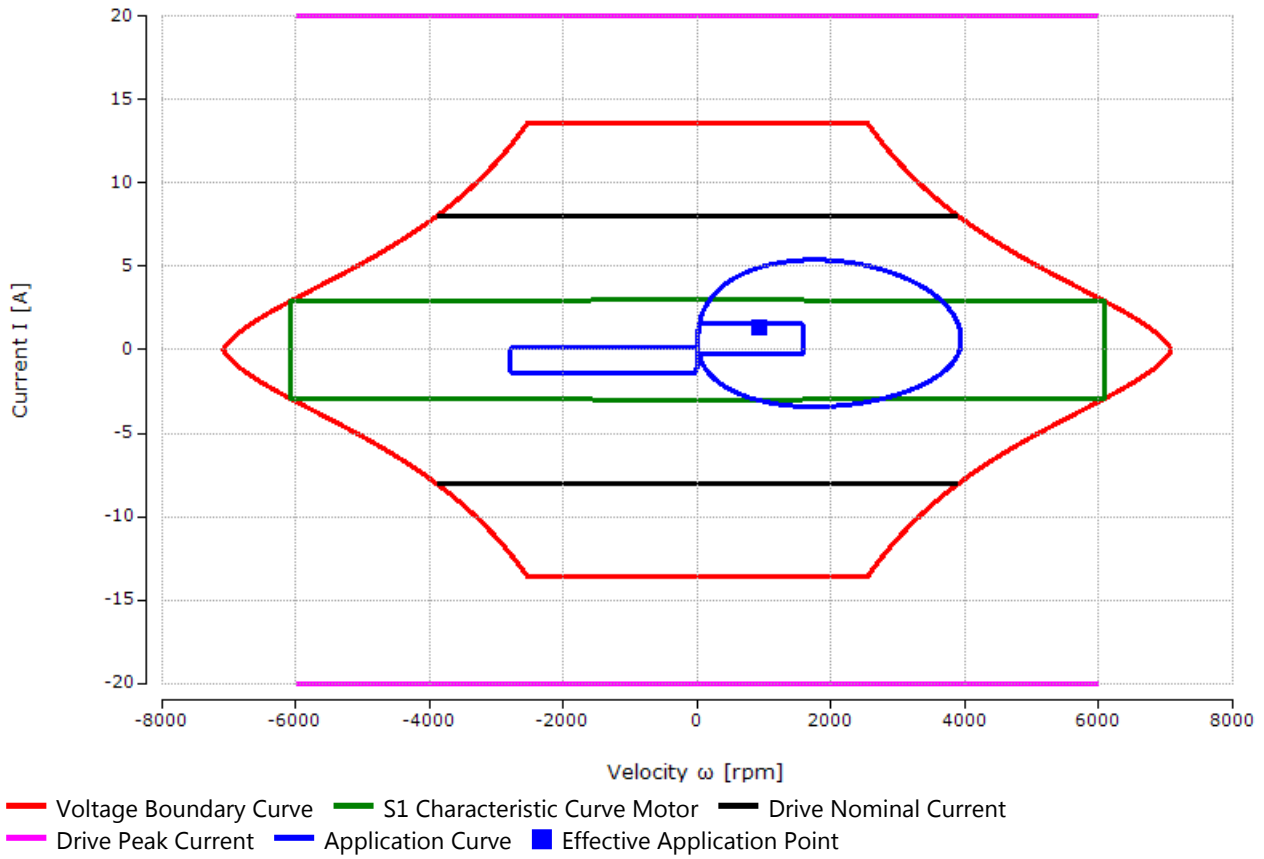
http://download.beckhoff.com/download/Technical_Drawings/Drive_Technology/step/AX8000/ax8108_ax8118_ax8206_str

EPLAN-Macros

http://www.beckhoff.de/default.asp?forms/eplan_macros/default.aspx?lg=de

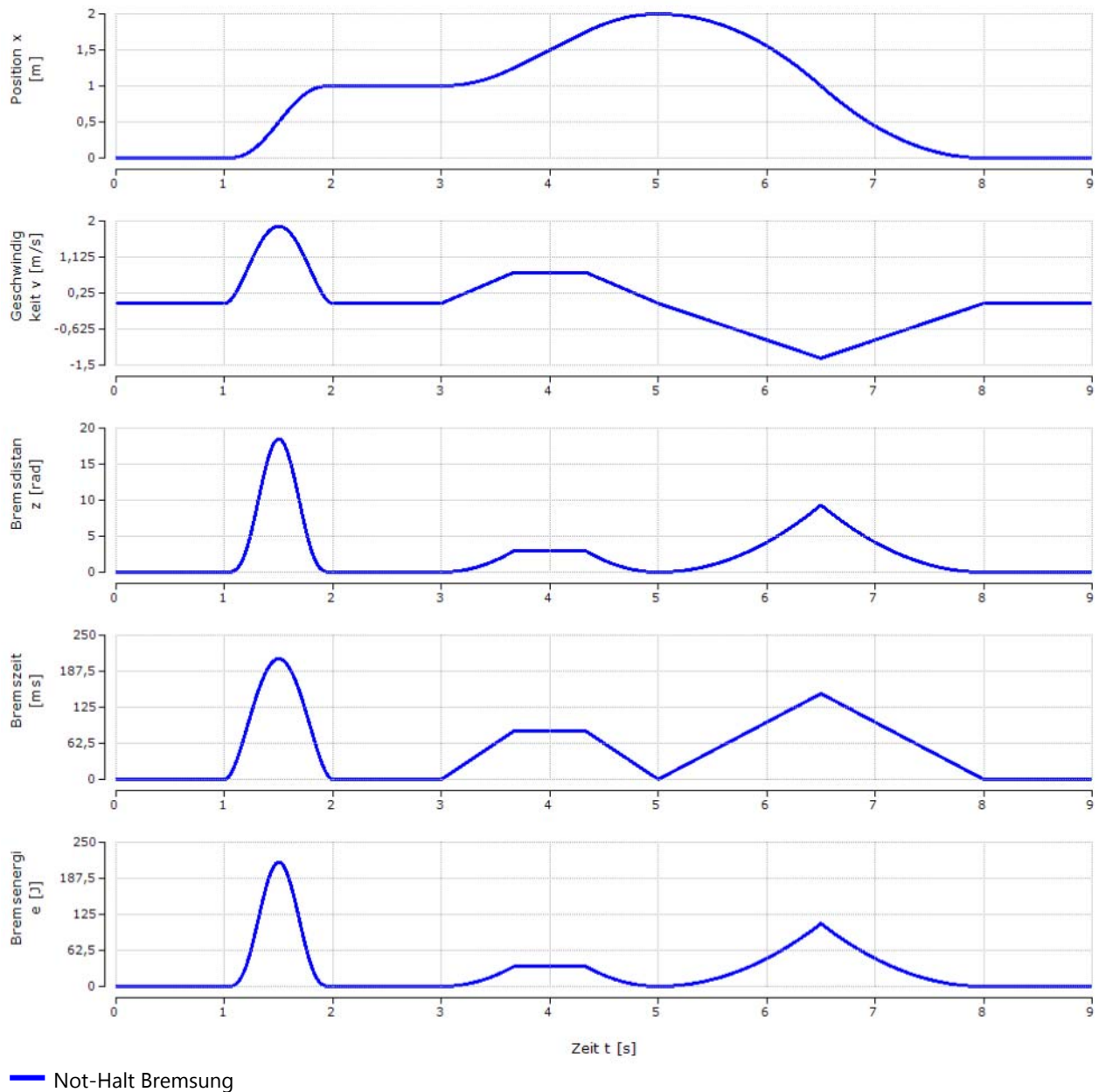
2.2. Axis: Y-Axis

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2.2. Axis: Y-Axis

Emergency Brake Investigation

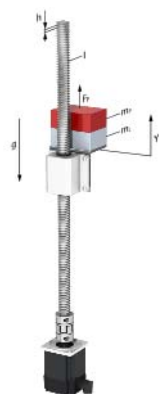


— Not-Halt Bremsung

Application Data		
Emergency Braking Torque	$[T_b]$	5 Nm
Maximale Braking Distance Load Shaft	$[\theta_{bShaft}]$	18,48 rad
Braking Time	$[t_b]$	0,21 s

Application Data		
Maximal Braking Distance Load	$[x_b]$	588,18 mm
Maximal Braking Distance Motor	$[\theta_{bMot}]$	129,35 rad
Maximal Braking Energy	$[E_b]$	215,58 J

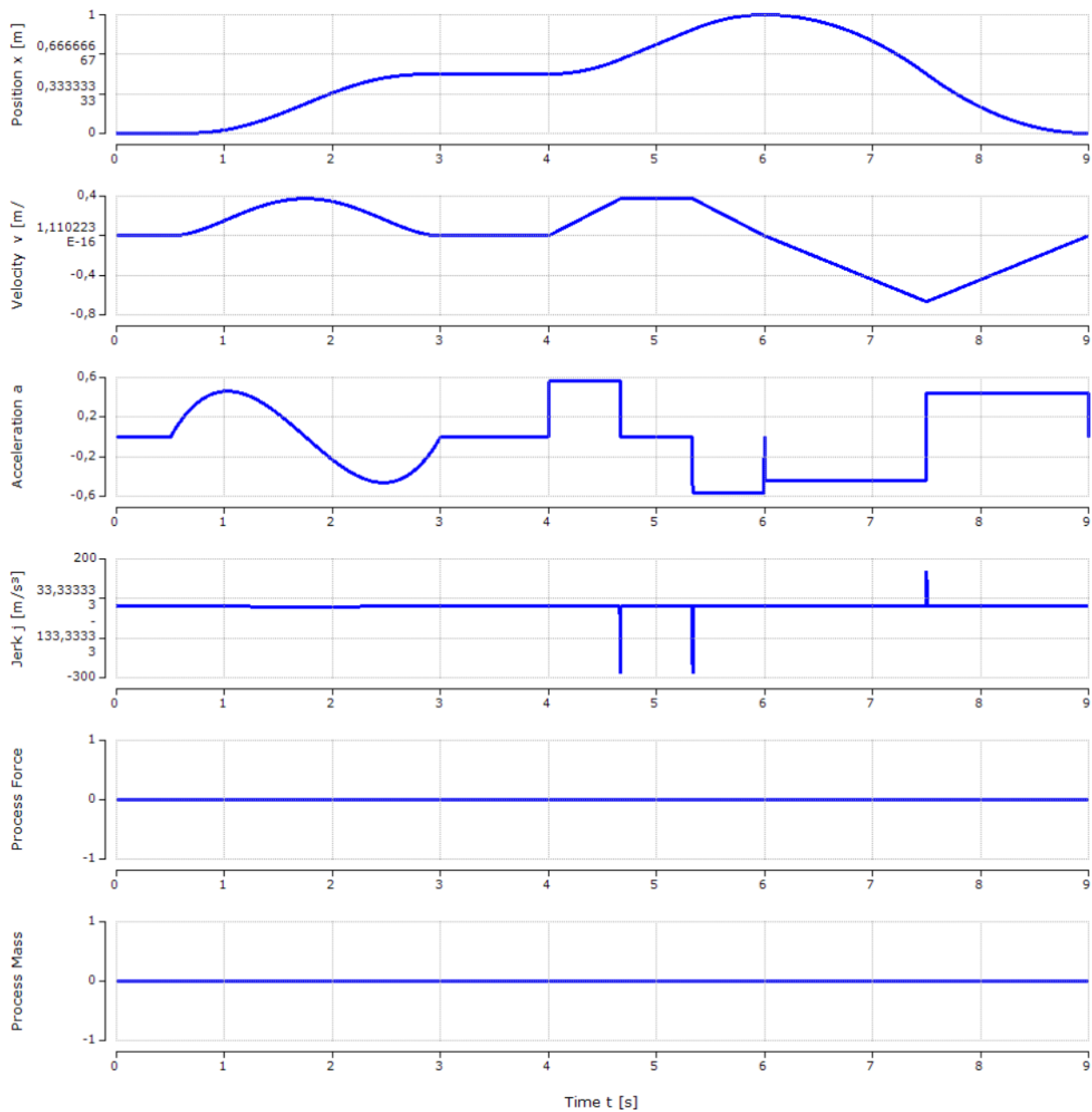
2.3. Axis: Z-Axis



Mechanical Data		
Thread Lead	[h]	5 mm
Load Mass	[m _L]	10 kg
Efficiency	[η]	0,90

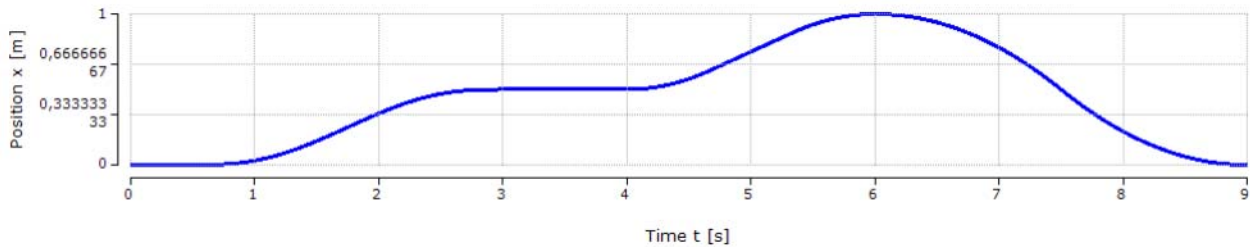
Mechanical Data		
Inertia Spindle	[I]	1 kgcm ²
Friction Coefficient	[μ]	0,10
Gravitation	[g]	9,81 m/s ²

2.3. Axis: Z-Axis



2.3. Axis: Z-Axis

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1. Section: TrajectorySection (Rest)

Input Parameter	
Duration	0,50 s

Resulting Values	
Max speed	0 m/s
Max jerk	0 m/s ³

Resulting Values	
Max acceleration	0 m/s ²

2. Section: TrajectorySection (VDI Section)

Input Parameter	
Positioning Mode	Relative
Position	500 mm

Resulting Values	
Max speed	0,38 m/s
Max jerk	1,92 m/s ³

Input Parameter	
Type	m of 5th degree
Duration	2,50 s

Resulting Values	
Max acceleration	0,46 m/s ²

3. Section: TrajectorySection (Rest)

Input Parameter	
Duration	1 s

Resulting Values	
Max speed	0 m/s
Max jerk	0 m/s ³

Resulting Values	
Max acceleration	0 m/s ²

4. Section: TrajectorySection (Third Rule)

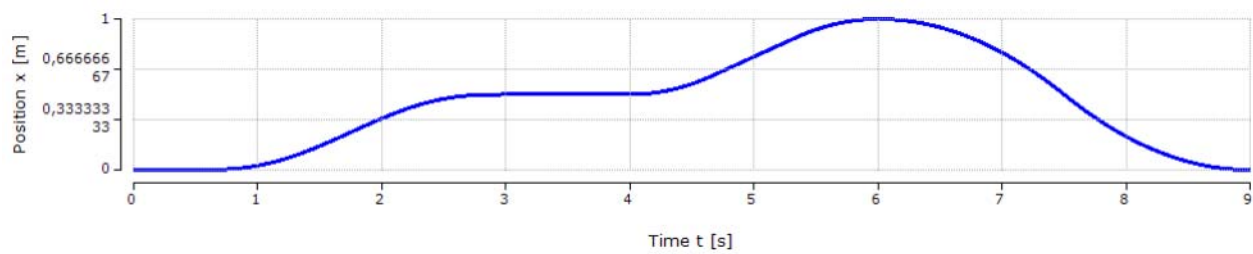
Input Parameter	
Positioning Mode	Relative
Duration	2 s

Resulting Values	
Max speed	0,38 m/s
Max jerk	+unendlich m/s ³

Input Parameter	
Position	500 mm

Resulting Values	
Max acceleration	0,56 m/s ²

2.3. Axis: Z-Axis



5. Section: TrajectorySection (Half Rule)

Input Parameter	
Positioning Mode	Absolute
Duration	3 s

Resulting Values	
Max speed	0,67 m/s
Max jerk	+unendlich m/s ³

Input Parameter	
Position	0 mm

Resulting Values	
Max acceleration	0,44 m/s ²

2.3. Axis: Z-Axis

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AM8033-1J21-0000

Servomotor, 400 V AC (max. 480 V AC), $M_0 = 3,22 \text{ Nm}$, $I_0 = 6,80 \text{ A}$, $n_n = 9000 \text{ min}^{-1}$, Feather Key, OCT 18 Bit Multiturn, Holding Brake

Nennwerte		
Standstill Torque	$[T_0]$	3,22 Nm
Rated Torque @ 115 V AC	$[T_{n115}]$	3,05 Nm
Rated Torque @ 230 V AC	$[T_{n230}]$	2,70 Nm
Rated Torque @ 400 V AC	$[T_{n400}]$	2,30 Nm
Rated Torque @ 480 V AC	$[T_{n480}]$	2,30 Nm
Standstill Current	$[I_0]$	6,80 A
Torque Constant	$[K_e]$	0,47 Nm/A
Number of Pole Pairs	$[n_p]$	4
Motor Length	$[Y]$	180 mm

Applikationskennwerte		
Effective torque	$[T_{eff}]$	0,15 Nm
Mean speed	$[\omega_{avg}]$	2666,66 rpm
Mean power	$[P_{avg}]$	37,25 W
Mean inertia ratio	$[\lambda_{avg}]$	0,73

Nennwerte		
Max torque	$[T_{max}]$	17,20 Nm
Rated Speed @ 115 V AC	$[\omega_{n115}]$	2700 rpm
Rated Speed @ 230 V AC	$[\omega_{n230}]$	5900,00 rpm
Rated Speed @ 400 V AC	$[\omega_{n400}]$	9000 rpm
Rated Speed @ 480 V AC	$[\omega_{n480}]$	9000 rpm
Peak Current	$[I_{max}]$	39,80 A
Voltage Constant	$[K_v]$	34 mV/rpm
Rotor Moment of Inertia	$[J]$	1,46 kgcm ²

Applikationskennwerte		
Max torque	$[T_{max}]$	0,27 Nm
Max speed	$[\omega_{max}]$	8000 rpm
Max power	$[P_{max}]$	175,93 W
Max inertia ratio	$[\lambda_{max}]$	0,73

Documentation

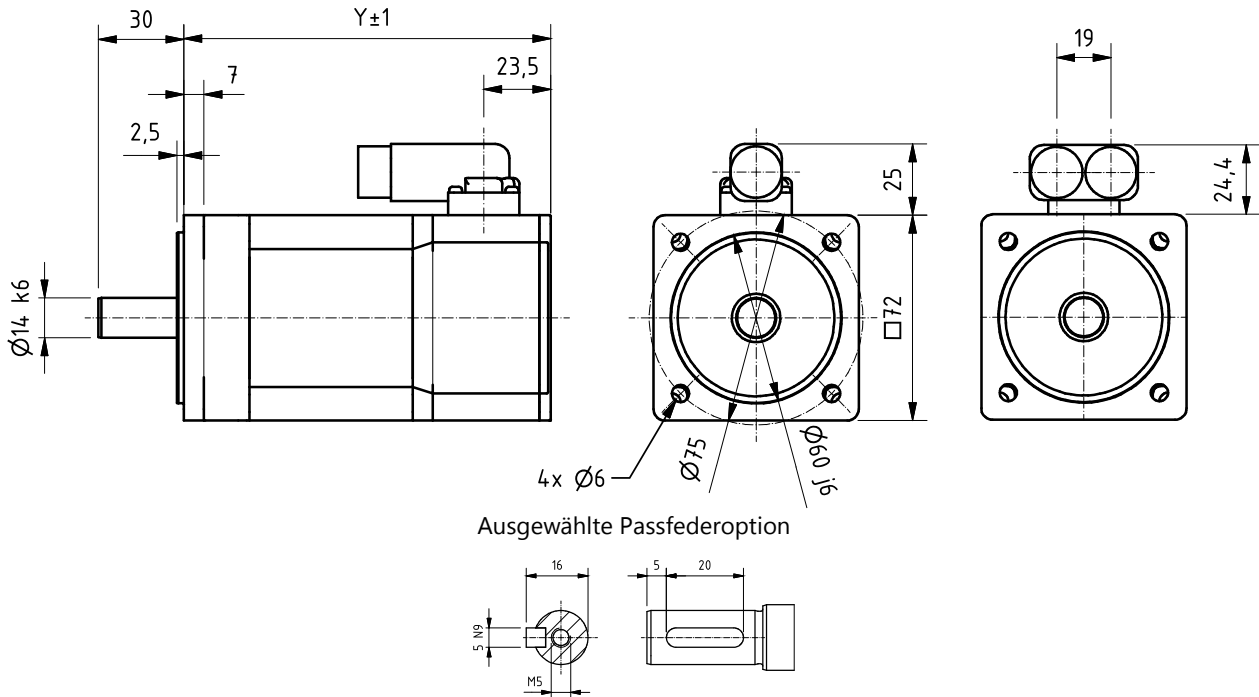
http://download.beckhoff.com/download/Document/Drives/AM8000_AM8500_BA_de.pdf

Step Model

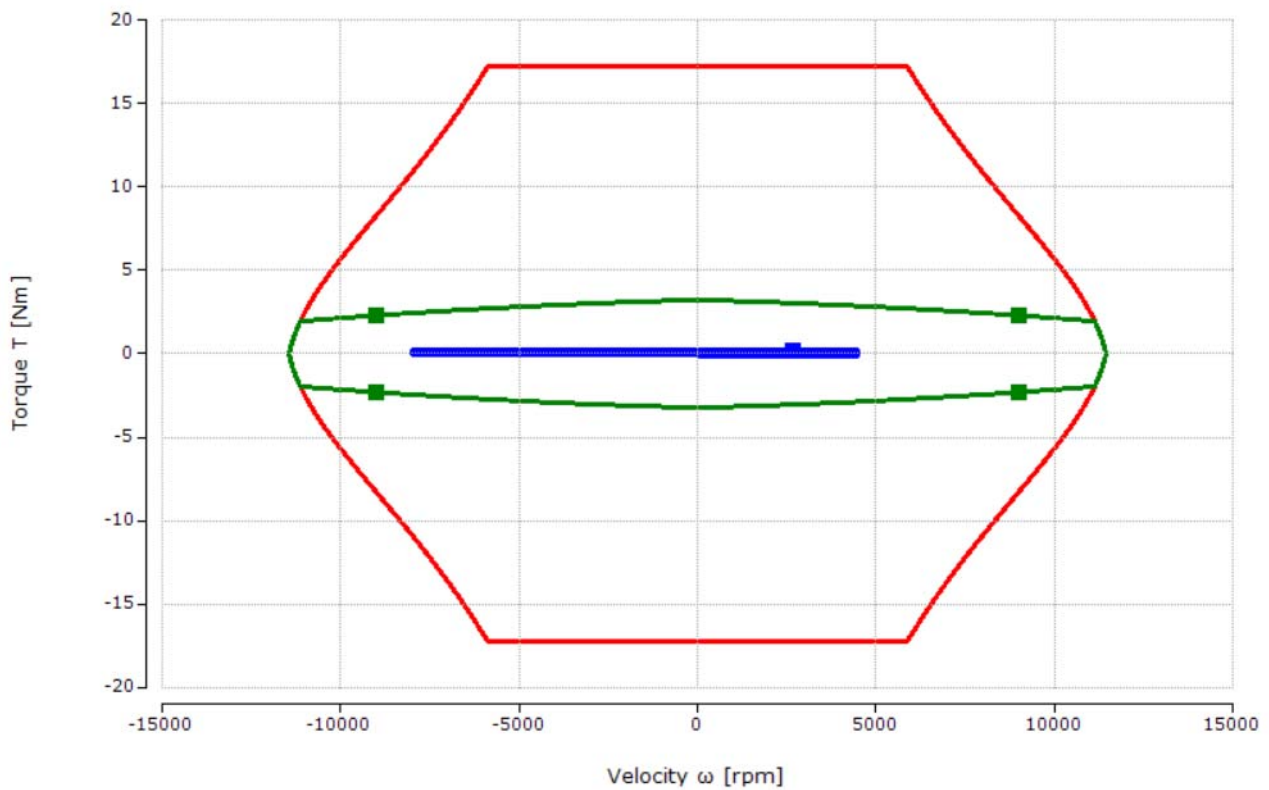
http://download.beckhoff.com/download/Technical_Drawings/Drive_Technology/step/AM80xx/AM8033-xx11_STP.zip

2.3. Axis: Z-Axis

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Ausgewählte Passfederoption



— Voltage Boundary Curve @ 400 V AC — S1 Characteristic Curve ■ Nominal Point @ 400 V AC
— Application Curve ■ Effective Application Point

2.3. Axis: Z-Axis



AX8108-0100-0000

One Axis Module 8A, OCT, TwinSAFE (STO, SS1)

Nominal Data	
Number of Channels	1
Maximal Output Current	20 A

Nominal Data	
Rated Output Current	8 A

Documentation

http://download.beckhoff.com/download/document/motion/ax8000_startup_de.pdf

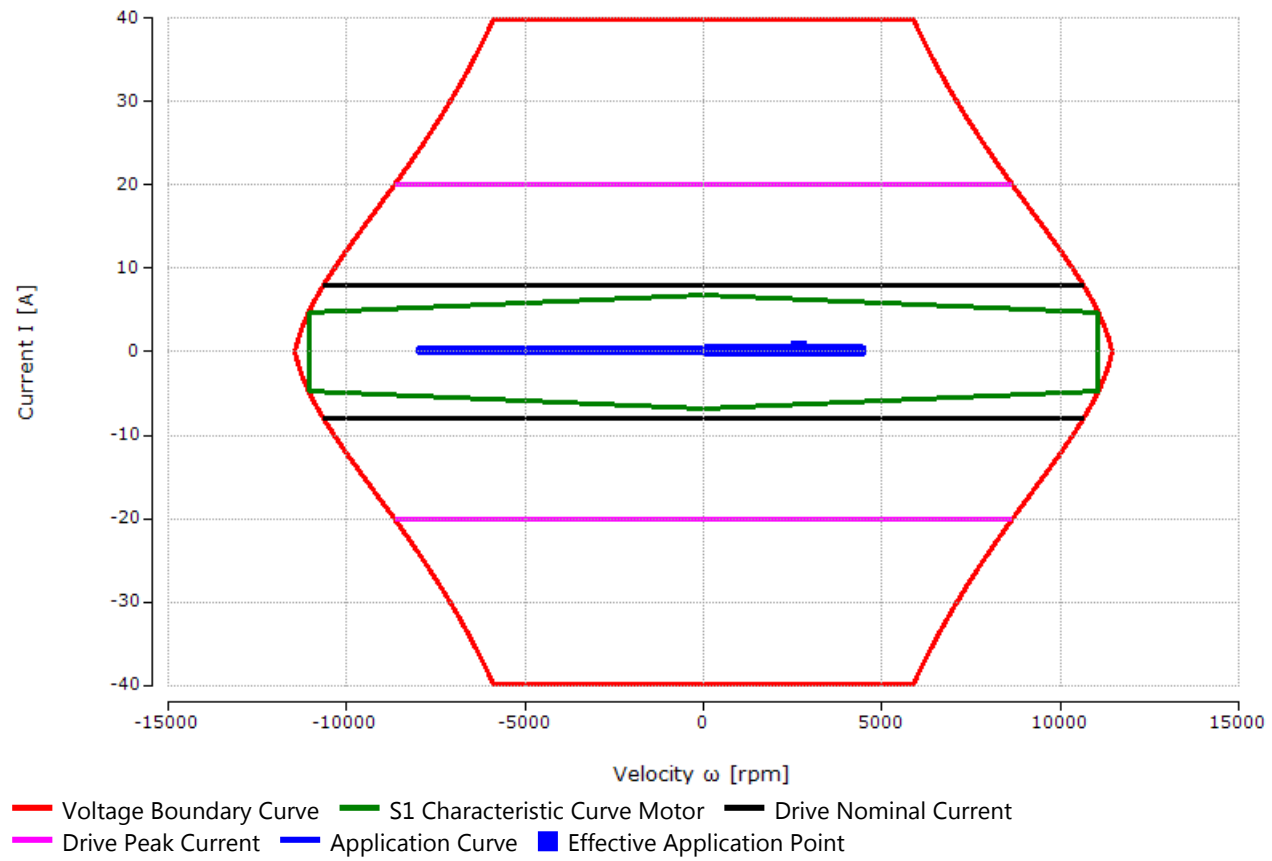
Step Model

http://download.beckhoff.com/download/Technical_Drawings/Drive_Technology/step/AX8000/ax8108_ax8118_ax8206_str

EPLAN-Macros

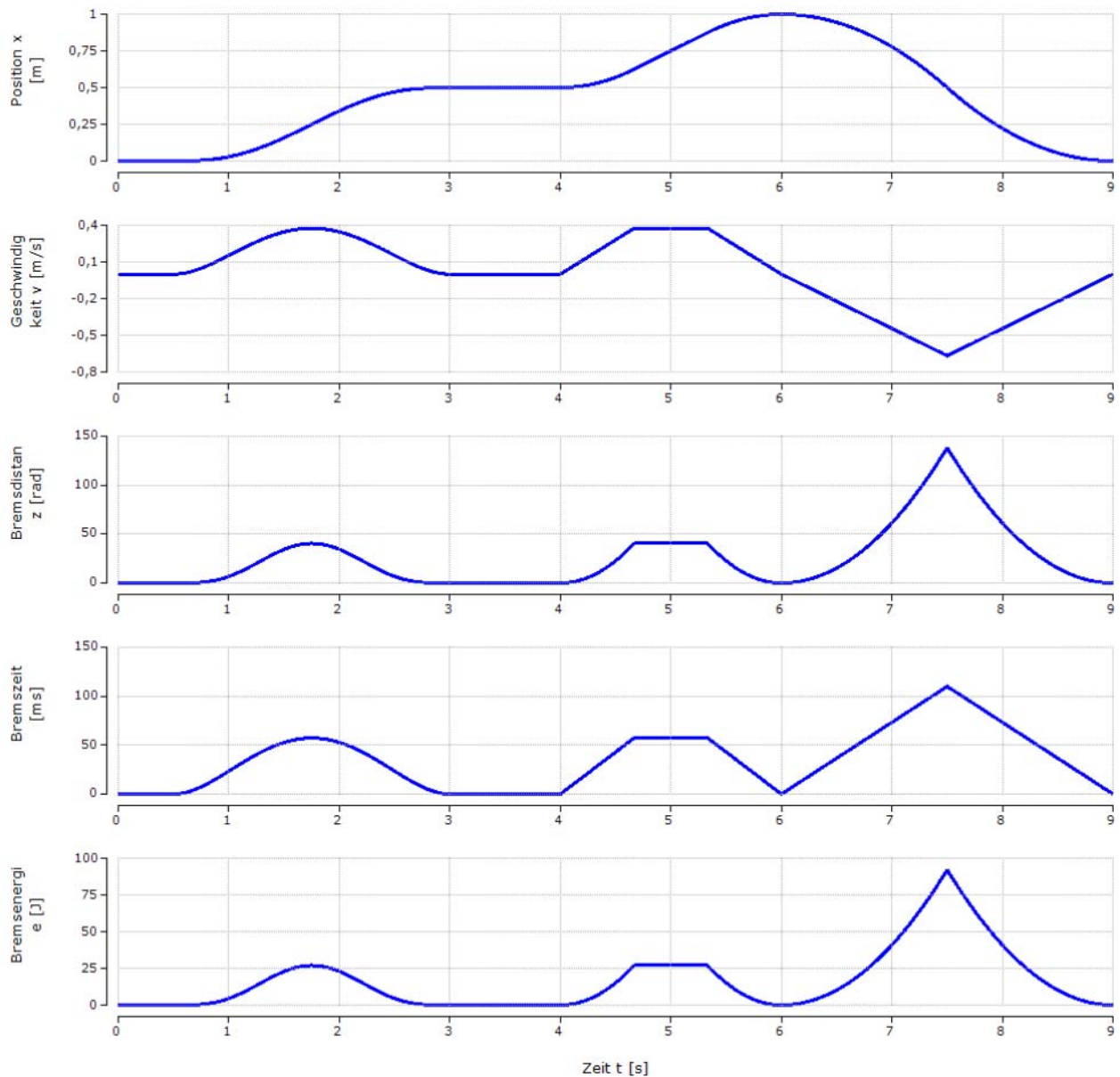
http://www.beckhoff.de/default.asp?forms/eplan_macros/default.aspx?lg=de

2.3. Axis: Z-Axis



2.3. Axis: Z-Axis

Emergency Brake Investigation



— Not-Halt Bremsung

Application Data		
Emergency Braking Torque	$[T_b]$	2 Nm
Maximale Braking Distance Load Shaft	$[\theta_{bShaft}]$	138,22 rad
Braking Time	$[t_b]$	0,11 s

Application Data		
Maximal Braking Distance Load	$[x_b]$	109,99 mm
Maximal Braking Distance Motor	$[\theta_{bMot}]$	138,22 rad
Maximal Braking Energy	$[E_b]$	92,15 J