

Technical data for the Smart Servo Package

Selection & planning

- Quick reference guide
- Speed-torque diagrams CMP and PSKC
- Outer dimensions
- Formula collection



Smart Servo Package = Smart Selection – fast, reliable and result oriented

The Smart Servo Package makes it extremely easy to select and combine the components to form a customer-specific package. This was made possible by consistently implementing the following optimization potential:

- Reducing dimensioning calculations to the absolutely required minimum
- Simplifying the basic conditions of an application according to the Pareto principle

- Creating verified, fixed combinations between motors and servo gear units
- Using a combination of motor speed/torque curves to being able to directly verify both operating points

The result is an easy and clear selection process. The output of this process is the perfect solution package with all the necessary product components.

Information required for selecting check list

- Travel diagram of the application (travel cycle) that must show the following values per travel section ($s_1, s_2 \dots s_n$) (see examples below):

a) Load values

Either: Acceleration and/or braking torques (M_{DYN}) within the travel cycle per travel section

Or: load mass moment of inertia on the output shaft (J load) within the travel cycle per travel section

b) Duration ($t_1, t_2, \dots t_n$) of the individual travel sections in the travel cycle

c) Total duration ($t_{TOT} = \sum t_1, t_2, \dots t_n$) of the travel cycle

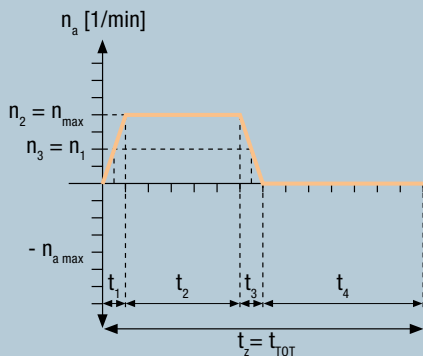
d) Travel velocities (n_{max}, n_{const}) of the travel sections with constant velocity

e) If applicable, static torques (M_{STAT} , friction, counter torques, etc.) per travel section during constant travel

- Overhung loads on the output shaft

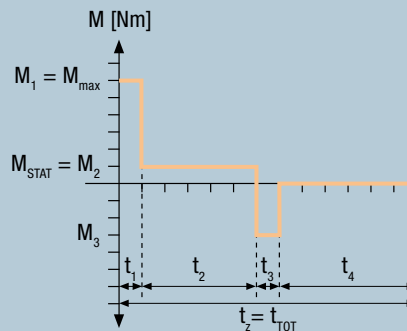
Sample travel diagrams of a positioning movement/travel cycle

Speed – time characteristics



example of a duty cycle with 4 travel sections with a total cycle time t_z .

Torque – time characteristics



Quick reference guide

Quick reference guide with the part numbers of all products within the Smart Servo Package and cross reference among the products / **pages 4-9**

Speed-torque diagrams

Speed-torque diagrams of all servomotors / **pages 10-17**

Outer dimensions

Detailed drawing with outer dimensions (details in the individual documentation or in the system manual) / **pages 18-21**

Formula collection

A collection of the most important formula required for sizing and calculating drive systems / **pages 22-23**

Detailed data of CMP/PSC for drive selection as well as reference tables of Smart Servo Package products with part numbers

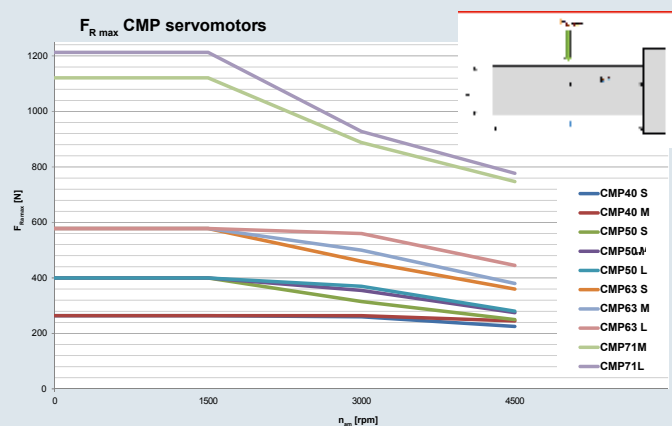
Permitted emergency stop torque

		PSKC														
		221ECH02			321ECH03			521ECH05			521EPH05			621EPH05		
Reduction ratio	i	5	7	5	7	10	10	5	7	10	5	7	10	5	7	10
Max. permitted emergency stop torque	$M_{aEM.STOP}$	63	59	334	313	243	110	334	313	243	330	310	295	640	595	570

Drive and braking torque of CMP servomotors

Motor	J_{mot} [x 10 ⁻⁴ kgm ²]	J_{bmot} [x 10 ⁻⁴ kgm ²]	M_{B1} [Nm]
CMP40M	0.15	0.18	0.95
CMP50S	0.42	0.48	3.1
CMP50M	0.67	0.73	4.3
CMP50L	0.92	0.98	4.3
CMP63S	1.15	1.49	7
CMP63M	1.92	2.26	9.3
CMP63L	2.69	3.03	9.3
CMP71M	4.08	4.50	14
CMP71L	6.18	6.60	14

CMP radial force



Note

LTX		Braking resistor AC 230V					
Output current I_n [A]	Size	Horizontal travel distance			Vertical travel distance		
		Type	Part no.	Design	Type	Part no.	Design
3.2	2	BW LT 100 002	1820 8770	Flat design*	BW LT 100 002	1820 8770	Flat design*
5.5	2	BW072-003	0826 0583	Flat design	BW047-005	0826 2683	Flat design
6.9	2	BW047-005	0826 2683	Flat design	BW027-006	0822 4226	Wire resistor
9.5	3	BW047-005	0826 2683	Flat design	BW147-T	1820 1342	Flat design
12.6	3	BW147-T	1820 1342	Wire resistor	BW147-T	1820 1342	Wire resistor
16.5	3	BW147-T	1820 1342	Wire resistor	BW247-T	1820 0842	Wire resistor

* can be integrated in the inverter

Braking resistor for AC 230 V

- The braking resistor is selected depending on the horizontal or vertical travel distance
- **Info 1:** in horizontal operation, 1/7 of the nominal power is assumed as braking power
- **Info 2:** in vertical operation, 1/3 of the nominal power is assumed as braking power

LTX		Braking resistor AC 460V					
Output current I_n [A]	Size	Horizontal travel distance			Vertical travel distance		
		Type	Part no.	Design	Type	Part no.	Design
1.6	2	BW LT 100 002	1820 8770	Flat design*	BW LT 100 002	1820 8770	Flat design*
3.1	2	BW100-005	0826 2691	Flat design	BW100-005	0826 2691	Flat design
4.2	2	BW100-005	0826 2691	Flat design	BW100-005	0826 2691	Wire resistor
6.4	2	BW100-006	0821 7017	Flat design	BW100-006	0821 7017	Flat design
9.5	3	BW147 -T	1820 1342	Wire resistor	BW247-T	1820 0842	Wire resistor
12.6	3	BW147-T	1820 1342	Wire resistor	BW247-T	1820 0842	Wire resistor
16.5	3	BW247-T	1820 0842	Wire resistor	BW347-T	1820 1350	Wire resistor

* can be integrated in the inverter

Braking resistor for AC 460 V

- The braking resistor is selected depending on the horizontal or vertical travel distance
- **Info 1:** in horizontal operation, 1/7 of the nominal power is assumed as braking power
- **Info 2:** in vertical operation, 1/3 of the nominal power is assumed as braking power

Note

LTX					
Output current I_n [A]	Size	Power [kW]	Output choke	Phase	Part no.
3.2 / 1 ph 3.2 / 3 ph	2	750 W	ND LT 010 290 31 ND LT 010 290 53	3	1820 1644 1820 1679
5.5 / 1 ph 5.5 / 3 ph	2	1.5	ND LT 010 290 21 ND LT 010 290 53	3	1820 1644 1820 1679
6.9 / 1 ph 6.9 / 3 ph	2	2.2	ND LT 010 290 21 ND LT 010 290 53	3	1820 1644 1820 1679
9.5	3	3	ND LT 036 081 53	3	1820 1679
12.6	3	4	ND LT 036 081 53	3	1820 1687
16.5	3	5.5	ND LT 036 081 53	3	1820 1687

Choke for AC 230 V

- Optional: Select an input choke for weak grids

LTX					
Output current I_n [A]	Size	Power [kW]	Output choke	Phase	Part no.
1.6	2	750 W	ND LT 006 480 53	3	1820 1660
3.1	2	1.5	ND LT 006 480 53	3	1820 1660
4.2	2	2.2	ND LT 006 480 53	3	1820 1660
6.4	2	2.2	ND LT 006 480 53	3	1820 1679
9.5	3	4	ND LT 010 290 53	3	1820 1679
12.6	3	5.5 7.5	ND LT 036 081 53	3	1820 1687
16.5	3	11.0	ND LT 036 081 53	3	1820 1687

Choke for AC 460 V

- Optional: Select an input choke for weak grids

Cable length	Encoder cable, 6 x 2 x 0.25 mm ²	
	Fixed installation	Cable carrier installation
5	13324535-05	13324551-05
10	13324535-10	13324551-10
15	13324535-15	13324551-15

Cable length	Motor cable without brake, 4 x 1.5 mm ²		Motor cable without brake ¹⁾ , 4 x 2.5 mm ²	
	Fixed installation	Cable carrier installation	Fixed installation	Cable carrier installation
5	5904544-05	5906245-05	05904552-05	05906253-05
10	5904544-10	5906245-10	05904552-10	05906253-10
15	5904544-15	5906245-15	05904552-15	05906253-15

Cable length	Motor cable with brake, 4 x 1.5 mm ² + 2 x 1 mm ²		Motor cable with brake ¹⁾ , 4 x 2.5 mm ² + 3 x 1 mm ²	
	Fixed installation	Cable carrier installation	Fixed installation	Cable carrier installation
5	13354345-05	13354388-05	13354353-05	13354396-05
10	13354345-10	13354388-10	13354353-10	13354396-10
15	13354345-15	13354388-15	13354353-15	13354396-15

Motor and encoder cables

- Selection of the motor cable according to the motor with or without brake, for cable carrier or fixed installation
- Encoder cable is always needed! (Cable carrier or fixed installation)

1) When using a CMP71L with a MC LTP-B0110-5A3-4-00 applying full nominal current.

Note

CMP_... PSKC_21

	Type ¹⁾	Part no. for logistics and stockkeeping	J_{BMOT} $\times 10^{-4} \text{ kgm}^2$	M_B Nm
with brake	CMP40M / BP / KY / AKOH / SB1	1477 0490	0.18	0.95
	CMP50S / BP / KY / AKOH / SB1	1477 0504	0.48	3.1
	CMP50M / BP / KY / AKOH / SB1	1477 0512	0.73	4.3
	CMP50L / BP / KY / AKOH / SB1	1477 0520	0.98	4.3
	CMP63S / BP / KY / AKOH / SB1	1477 0539	1.49	7
	CMP63M / BP / KY / AKOH / SB1	1477 0547	2.26	9.3
	CMP63L / BP / KY / AKOH / SB1	1477 0555	3.03	9.3

	Type ¹⁾	Part no. for logistics and stockkeeping	J_{BMOT} $\times 10^{-4} \text{ kgm}^2$
without brake	CMP40M / BP / KY / AKOH / SM1	1477 0415	0.15
	CMP50S / BP / KY / AKOH / SM1	1477 0423	0.42
	CMP50M / BP / KY / AKOH / SM1	1477 0431	0.67
	CMP50L / BP / KY / AKOH / SM1	1477 0458	0.92
	CMP63S / BP / KY / AKOH / SM1	1477 0466	1.15
	CMP63M / BP / KY / AKOH / SM1	1477 0474	1.92
	CMP63L / BP / KY / AKOH / SM1	1477 0482	2.69

¹⁾ The motors are equipped with keys and conform with European (CE), USA (UR) and Canadian (CSA) standards.

Servomotors AC 230 V

- Determine the servomotor by means of the part number
- Decide whether a brakemotor is needed or not

	Type ¹⁾	Part no. for logistics and stockkeeping	J_{BMOT} $\times 10^{-4} \text{ kgm}^2$	M_B Nm
with brake	CMP40M / BP / KY / AKOH / SB1	1477 0881	0.18	0.95
	CMP50S / BP / KY / AKOH / SB1	1477 0903	0.48	3.1
	CMP50M / BP / KY / AKOH / SB1	1477 0911	0.73	4.3
	CMP50L / BP / KY / AKOH / SB1	1477 0938	0.98	4.3
	CMP63S / BP / KY / AKOH / SB1	1477 0946	1.49	7
	CMP63M / BP / KY / AKOH / SB1	1477 0954	2.26	9.3
	CMP63L / BP / KY / AKOH / SB1	1477 0962	3.03	9.3
	CMP71M / BP / KY / AKOH / SB1	1477 0989	4.5	14
	CMP71L / BP / KY / AKOH / SB1	1477 0997	6.6	14

	Type ¹⁾	Part no. for logistics and stockkeeping	J_{BMOT} $\times 10^{-4} \text{ kgm}^2$
without brake	CMP40M / KY / AKOH / SM1	14770784	0.15
	CMP50S / KY / AKOH / SM1	14770792	0.42
	CMP50M / KY / AKOH / SM1	14770806	0.67
	CMP50L / KY / AKOH / SM1	14770814	0.92
	CMP63S / KY / AKOH / SM1	14770822	1.15
	CMP63M / KY / AKOH / SM1	14770830	1.92
	CMP63L / KY / AKOH / SM1	14770849	2.69
	CMP71M / KY / AKOH / SM1	14770865	4.08
	CMP71L / KY / AKOH / SM1	14770873	6.18

¹⁾ The motors are equipped with keys and conform with European (CE), USA (UR) and Canadian (CSA) standards.

Servomotors AC 400 V

- Determine the servomotor by means of the part number
- Decide whether a brakemotor is needed or not

Note

Type	Part no. for logistics and stockkeeping	Motor		$J_{\text{GEAR UNIT}} \times 10^{-4} \text{ kgm}^2$
PSKC221 with motor adapter	1477 0563	CMP40	i = 5	0.26
ECH02/01/02	1477 0571		i = 7	0.23
	1477 0598		i = 10	0.22
PSKC221 with motor adapter	1477 0601	CMP50	i = 5	0.26
ECH02/08/04	1477 0628		i = 7	0.23
	1477 0636		i = 10	0.22
PSKC321 with motor adapter	1477 0644	CMP50	i = 5	0.92
ECH03/08/04	1477 0652		i = 7	0.85
	1477 0660		i = 10	0.81
PSKC321 with motor adapter	1477 0679	CMP63	i = 5	0.92
ECH03/13/06	1477 0687		i = 7	0.85
	1477 0695		i = 10	0.81
PSKC521 with motor adapter	1477 0709	CMP63	i = 5	3
ECH05/13/6	1477 0717		i = 7	2.7
	1477 0725		i = 10	2.5
PSKC521 with motor adapter EPH	1477 1004	CMP71	i = 5	3.2
05/26/13	1477 1012		i = 7	2.9
	1477 1020		i = 10	2.6
PSKC621 with motor adapter EPH	1477 1039	CMP71	i = 5	4.4
05/26/13	1477 1047		i = 7	3.6
	1477 1055		i = 10	3.1

PSC servo gear units

- Select the projected servo gear unit by means of the part number
- Make sure the adapter matches the motor size

Type MC LTP-B. ...	Size	Part no.	I_N 100 %	Up to 60 s 200%	Up to 2 s 250%	Power
0008-2B1-4-00	2	1825 1382	3.2 A	6.3 A	7.9 A	750 W
0015-2B1-4-00		1825 1528	5.5 A	10.9 A	13.7 A	1500 W
0022-2B1-4-00		1825 1641	6.9 A	13.7 A	17.2 A	2200 W

Type MC LTP-B. ...	Size	Part no.	I_N 100 %	Up to 60 s 200%	Up to 2 s 250%	Power
0008-2A3-4-00	2	1825 1358	3.2 A	6.3 A	7.9 A	750 W
0015-2A3-4-00		1825 1471	5.5 A	10.9 A	13.7 A	1500 W
0022-2A3-4-00		1825 1617	6.9 A	13.7 A	17.2 A	2200 W
0030-2A3-4-00	3	1825 1722	9.5 A	18.9 A	23.6 A	3000 W
0040-2A3-4-00		1825 1765	12.6 A	25.2 A	31.5 A	4000 W
0055-2A3-4-00		1825 1846	16.5 A	24.7 A	33.0 A	5500 W

Drive/inverter LTX AC 230 V

- The inverter is determined by the projected motor
- The corresponding inverter is selected according to the supply voltage 1x or 3x AC 230 V
- **LTX-H1A is always needed!**

Type MC LTP-B. ...	Size	Part no.	I_N 100 %	Up to 60 s 200%	Up to 2 s 250%	Power
0008-5A3-4-00	2	1825 1412	1.6 A	3.2 A	4.0 A	750 W
0015-5A3-4-00		1825 1552	3.1 A	6.2 A	7.7 A	1500 W
0022-5A3-4-00		1825 1684	4.2 A	8.4 A	10.5 A	2200 W
0040-5A3-4-00	3	1825 1803	6.4 A	12.8 A	16.0 A	4000 W
0055-5A3-4-00		1825 1870	9.5 A	19 A	23.7 A	5500 W
0075-5A3-4-00		1825 1927	12.6 A	25.2 A	31.5 A	7500 W
0110-5A3-4-00		1825 1986	16.5 A	33 A	41.3 A	11000 W

Drive/inverter LTX AC 460 V

- The inverter is determined by the projected motor
- **LTX-H1A is always needed!**

Note

Selection control/gateway				
Applications/operating modes	Device type	Bus system	Controller designation	Part no.
– Speed command – 3 process data words (not synchronized)	Gateway	PROFIBUS DP-V1	DFP21B/UOH11B	1840 4073
		DeviceNet	DFD11B/UOH11B	1840 5010
		PROFINET	DFE32B/UOH11B	1840 5029
		EtherNet/IP, Modbus/TCP	DFE33B/UOH11B	1840 5037
		EtherCAT®	DFE24B/UOH11B	1840 5045
– Speed command – Touch probe positioning – Bus positioning with 6 process data words – Universal module single-axis – Reference travel – Speed command – Touch probe positioning – Bus positioning with 6 process data words – Universal module with synchronous operation – Reference travel	Application controller CCU (Configurable Control Unit)	PROFIBUS DP-V1, DeviceNet	DHF21B/OMC41B-T0/UOH21B	1840 8621
		PROFINET, EtherNet/IP, Modbus/TCP	DHR21B/OMC41B-T0/UOH21B	1840 8648
		PROFIBUS DP-V1, DeviceNet	DHF41B/OMC41B-T1/UOH21B	1840 8656
		PROFINET, EtherNet/IP, Modbus/TCP	DHR41B/OMC41B-T1/UOH21B	1840 8664
Freely programmable (MultiMotion light) – Speed – Positioning – Reference travel	Controller MOVI-PLC®	EtherNet TCP/IP, UDP (no higher-level PLC)	DHE21B/OMH41B-T0/UOH11B	1840 8672
		PROFIBUS DP-V1, DeviceNet	DHF21B/OMH41B-T0/UOH21B	1840 8400
		PROFINET, EtherNet/IP, Modbus/TCP	DHR21B/OMH41B-T0/UOH21B	1840 8680
		EtherNet TCP/IP, UDP (no higher-level PLC)	DHE41B/OMH41B-T2/UOH11B	1840 8699
Freely programmable (MultiMotion) – Speed – Positioning – Reference travel – Synchronous operation – Electronic cam		PROFIBUS DP-V1, DeviceNet	DHF41B/OMH41B-T2/UOH21B	1840 8702
		PROFINET, EtherNet/IP, Modbus/TCP	DHR41B/OMH41B-T2/UOH21B	1840 8613

Controller

- Optional: Selection of CCU / MultiMotion controllers
- Optional: Selection of fieldbus gateways

DFx-Gateway /
MOVI-PLC®/CCU



Cable set A (basic set)	Cable length to axis		Quantity	Description
	0.5 m			
			1	RJ45 open end
Part number	2820 2554		1	Cable terminator + splitter
Designation	(OP LT 005 A2)		1	Drive connector cable 0.5 m, RJ45-RJ45

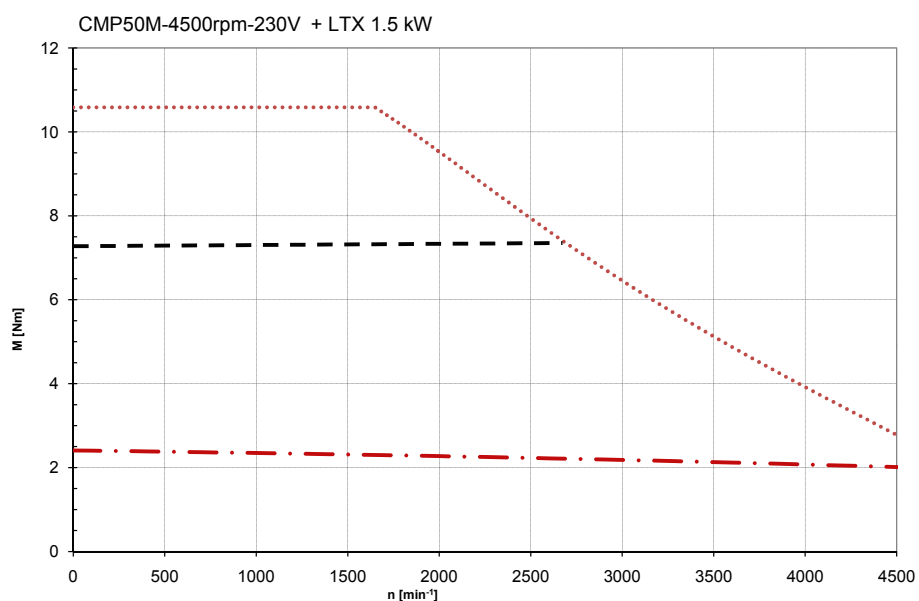
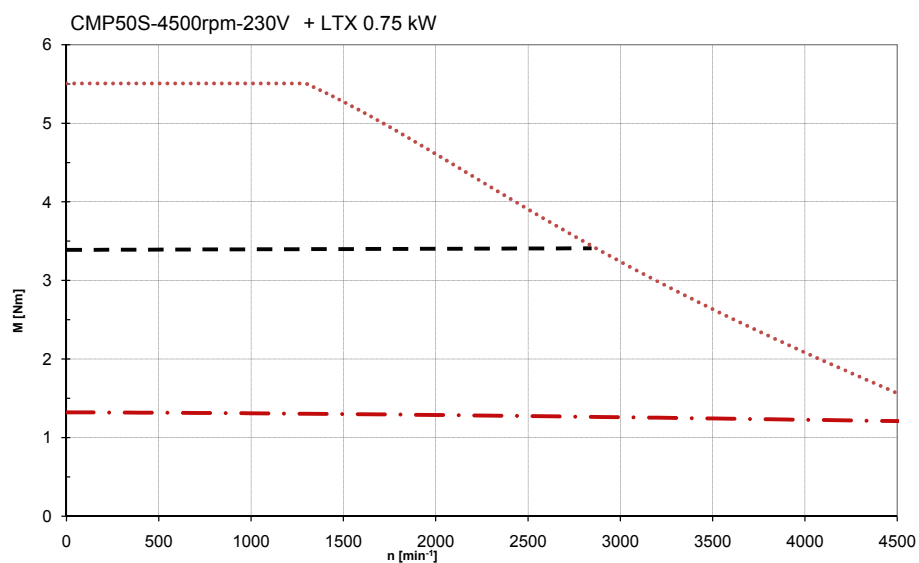
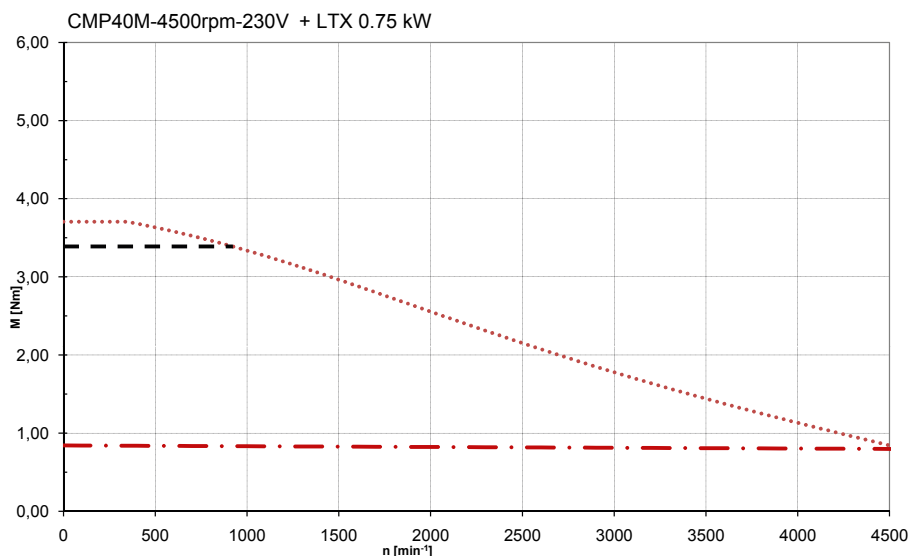
Cable set B (extension set)	Cable length between the axes		Quantity	Description
	0.5 m	1 m		
			1	Cable splitter
Part number	2820 2546	2820 2562	1	Drive connector cable 0.5 m, RJ45-RJ45
Designation	(OP LT 005 B2)	(OP LT 010 B2)	1	Cable between drives, with variable length

Cable set

- Select the cable sets for connecting the axes with one another and for connection with controllers or gateways from SEW-EURODRIVE
- **Cable set “A”** is always required for one axis or for the first axis
- **Cable set “B”** is required for every additional axis

Example: Minimum required cables for an axis system with 5 axes:

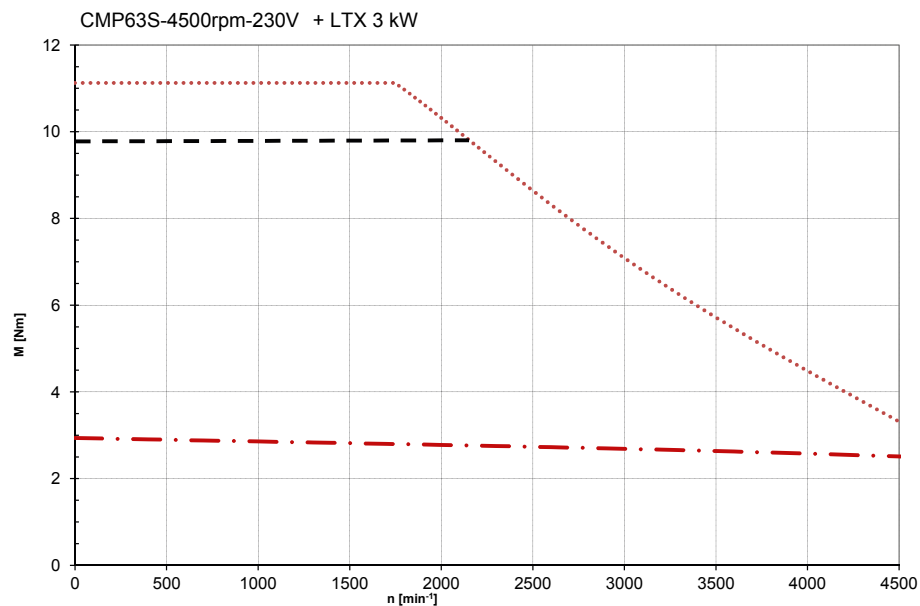
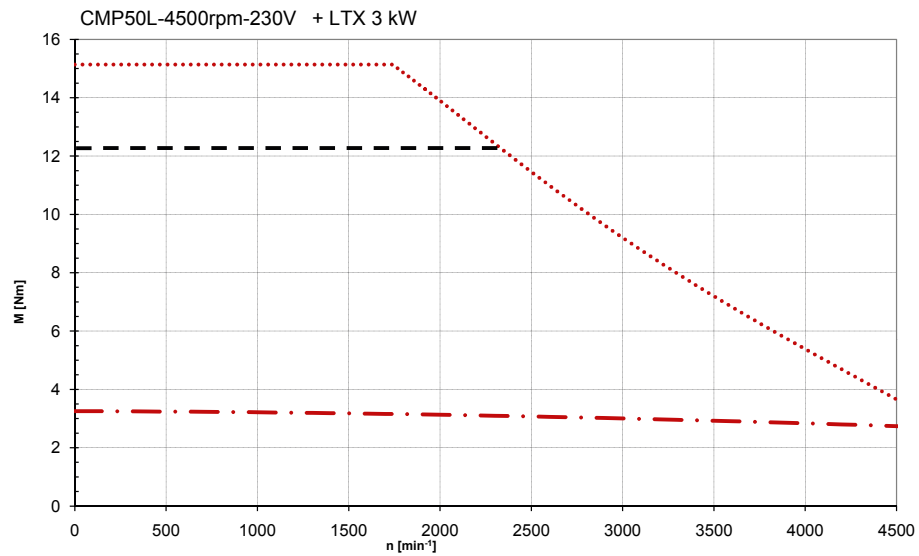
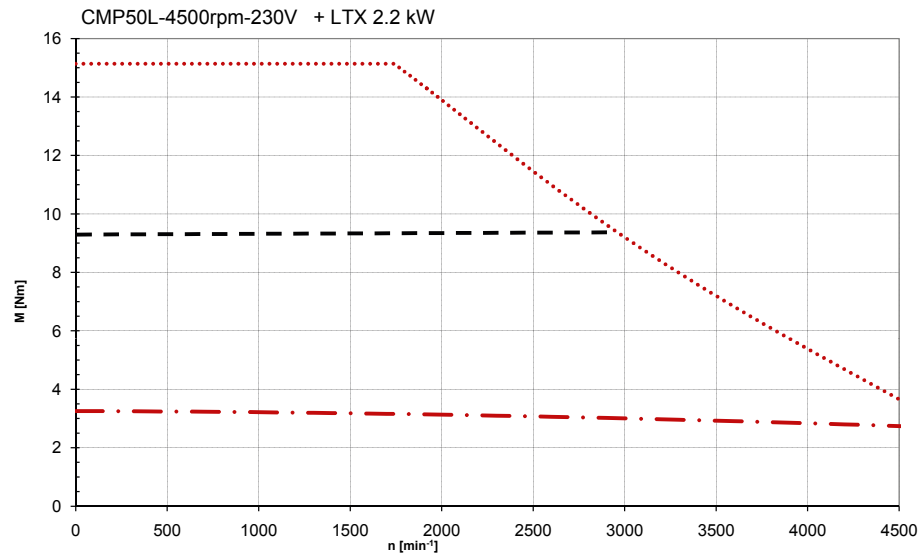
- 1x cable set “A”
- $(5 - 1) = 4x$ cable set “B”



--- M_{max_output} of the CMP
motor LTX combination

..... M_{pk} CMP 4500 rpm
- . - . M S1 CMP

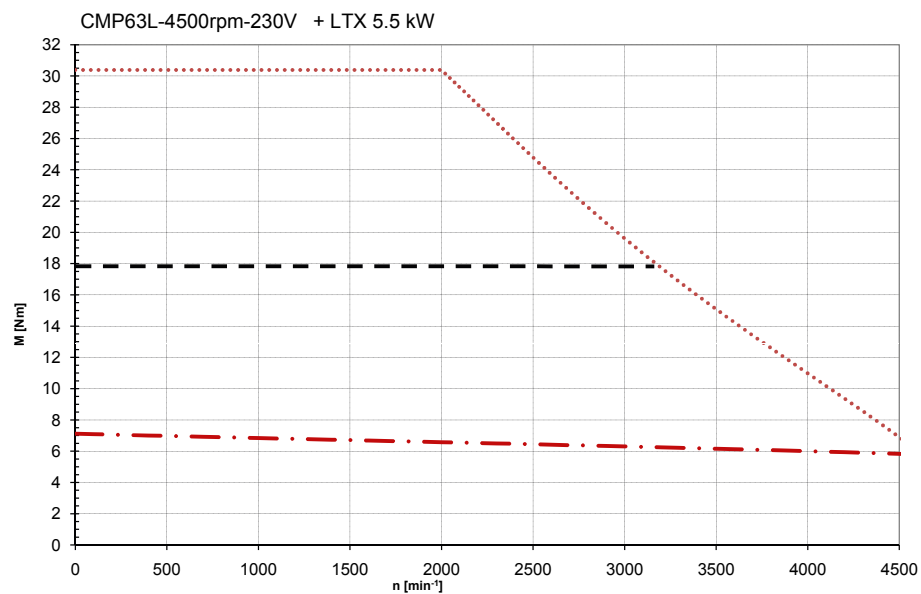
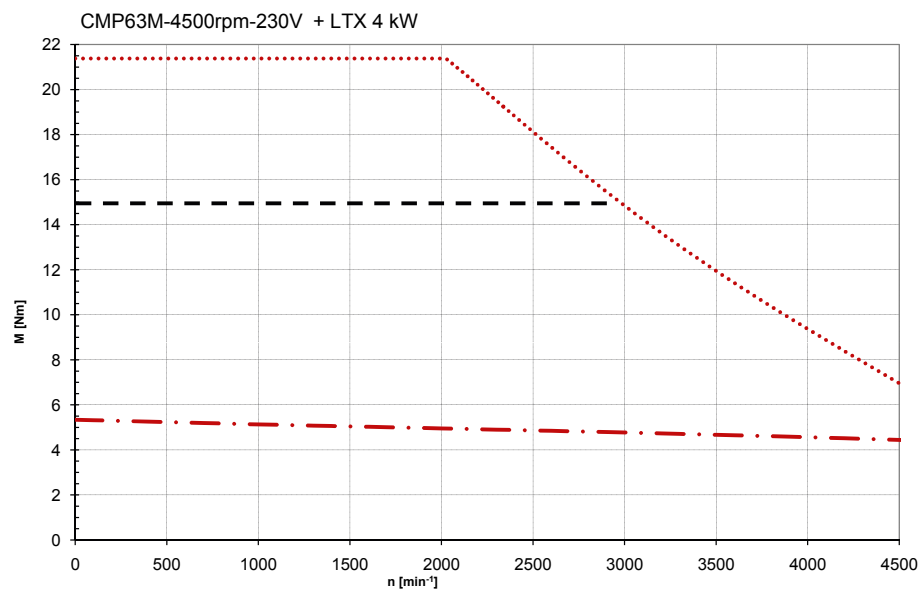
(to enhance ease of reading, individual characteristic curves might not be visible as a result of scaling)



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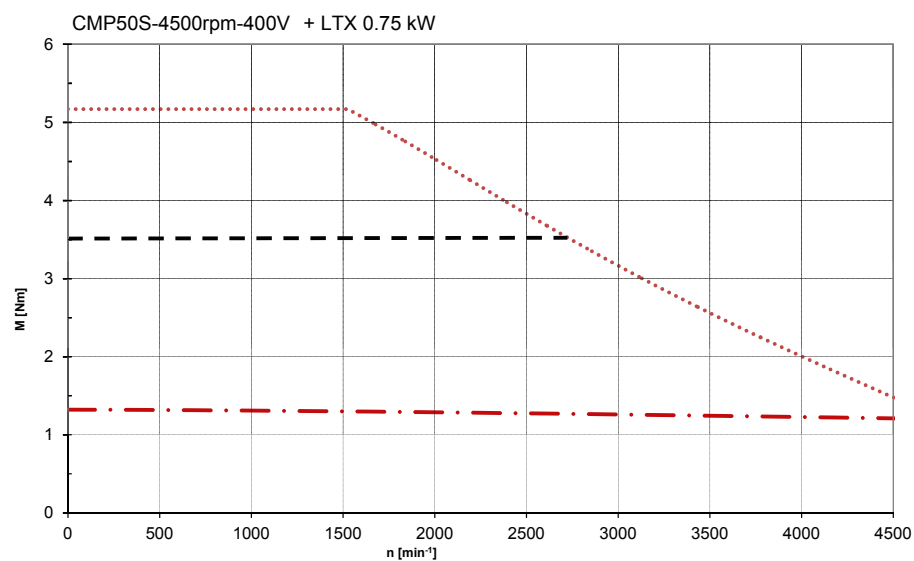
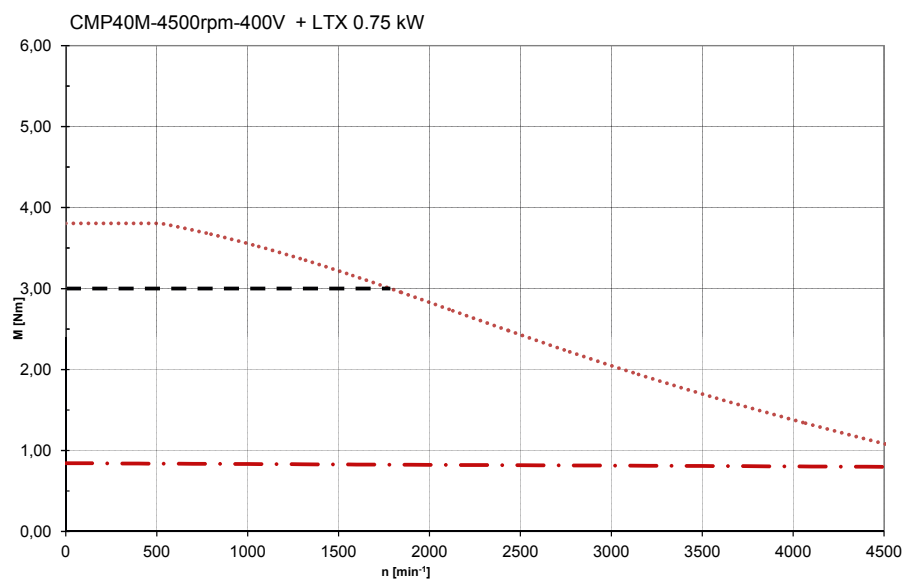
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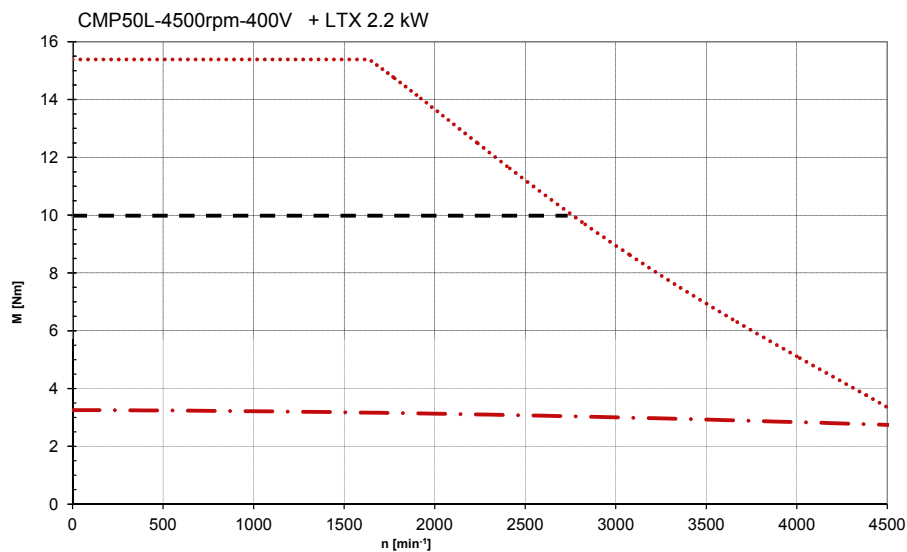
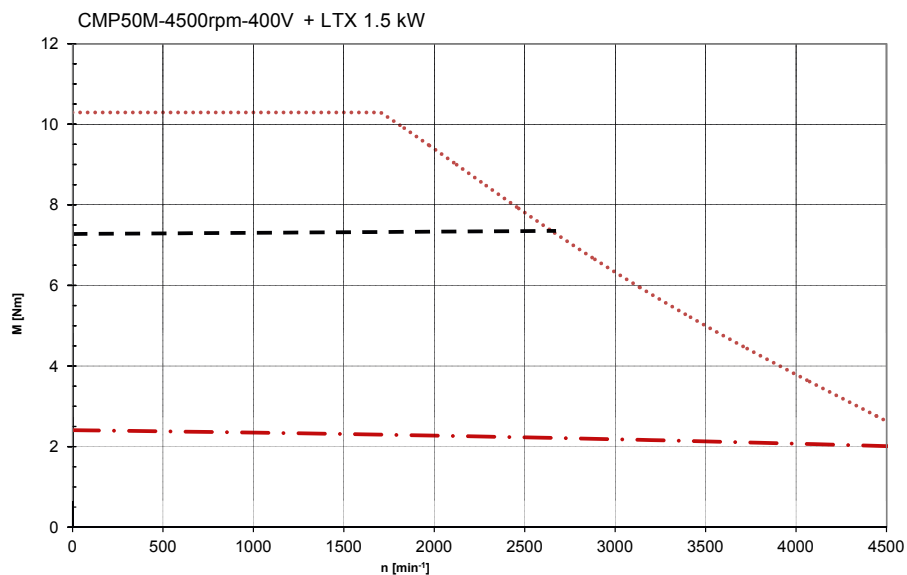
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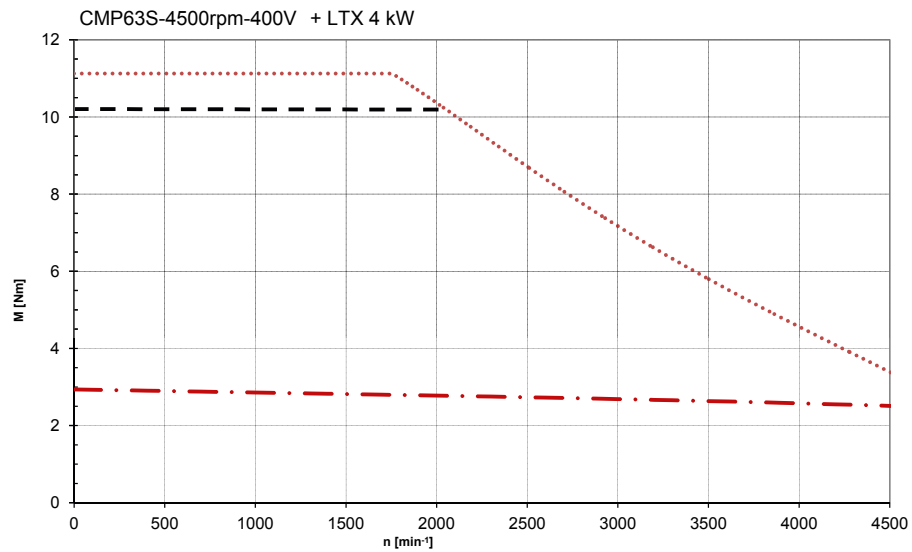
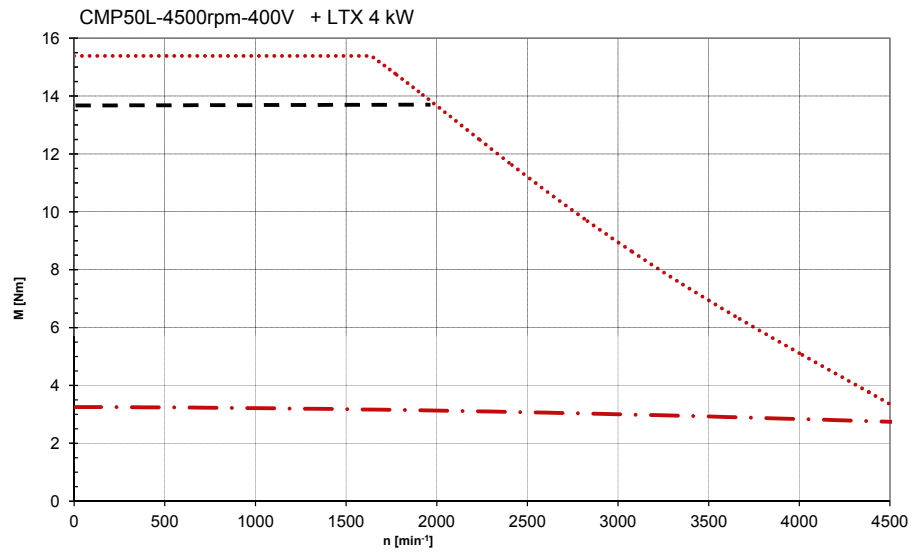
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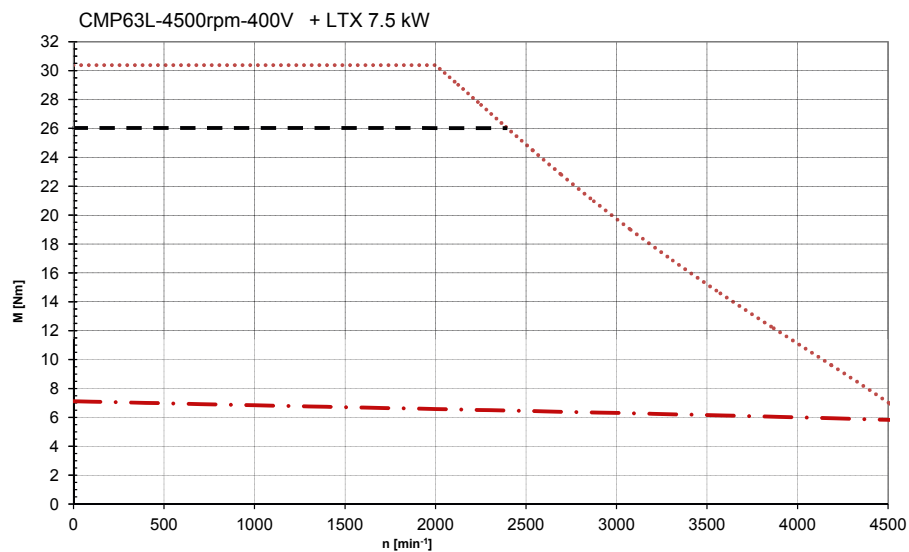
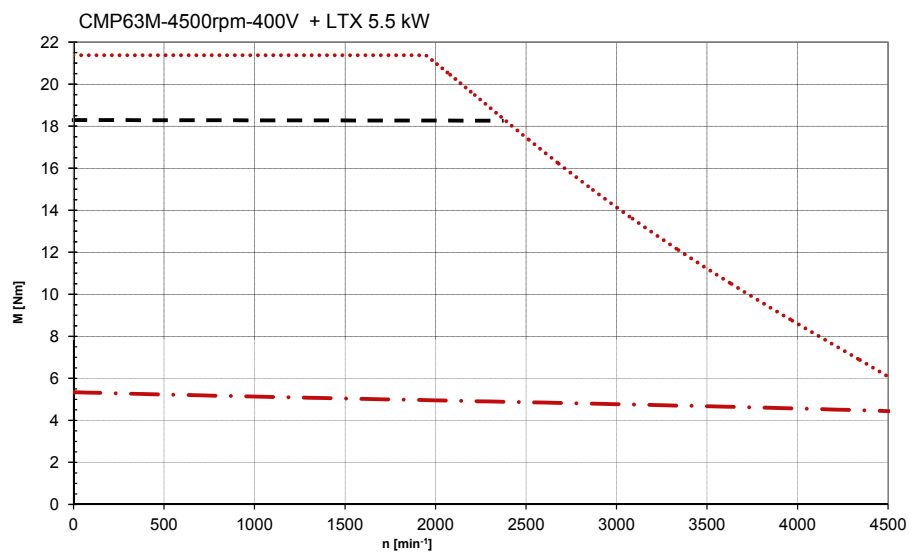
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..... M_{pk} CMP 4500 rpm
- . - . - M_{S1} CMP

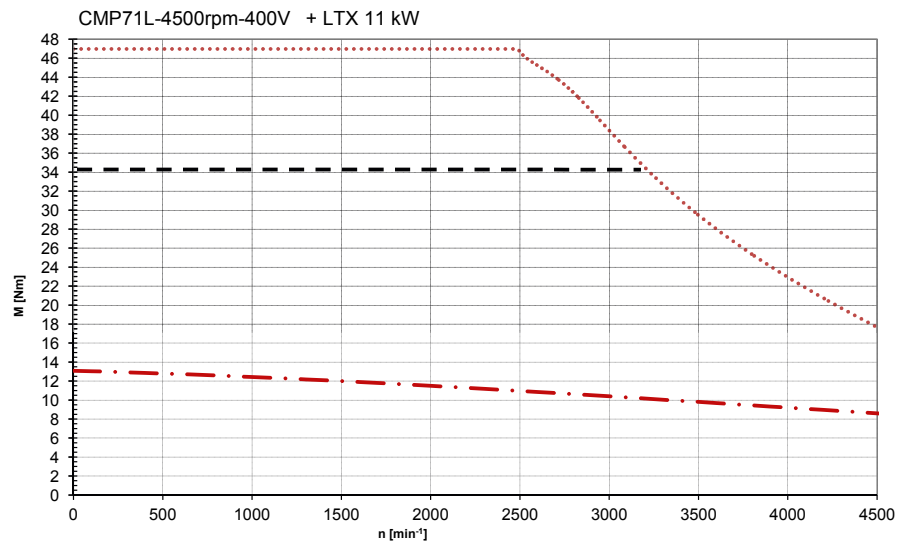
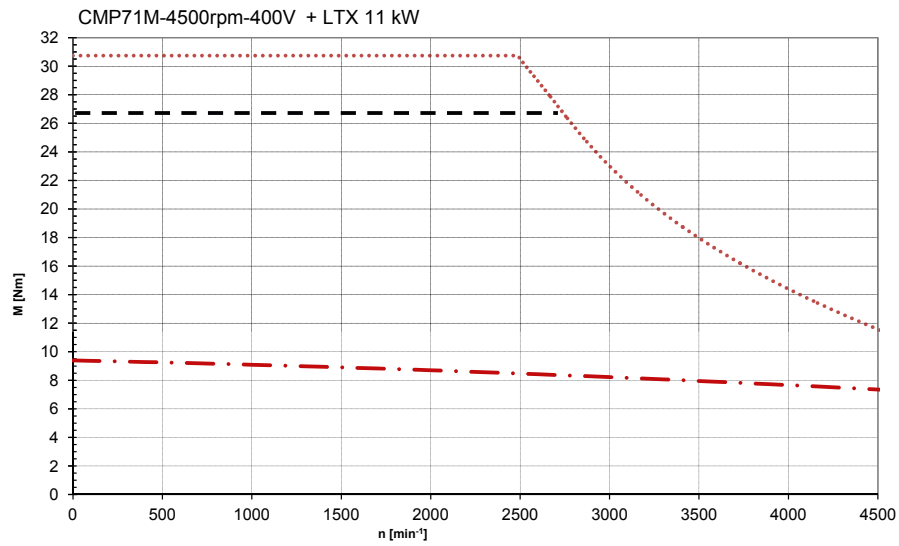
(to enhance ease of reading, individual characteristic curves might not be visible as a result of scaling)



— — — — — $M_{\text{max_output}}$ of the CMP
motor LTX combination

..... M_{pk} CMP 4500 rpm
- . - . - M_{S1} CMP

(to enhance ease of reading, individual characteristic curves might not be visible as a result of scaling)



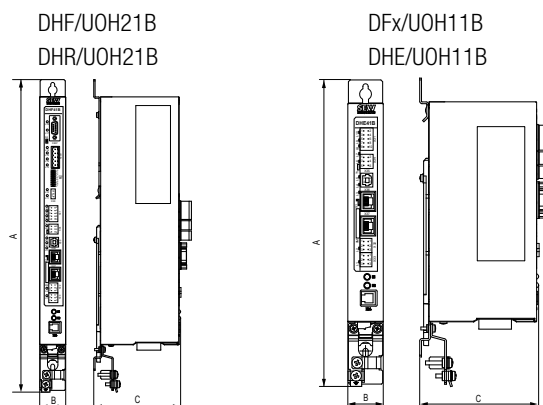
— — — — — $M_{\text{max_output}}$ of the CMP
motor LTX combination

..... M_{pk} CMP 4500 rpm
- . - . - M S1 CMP

(to enhance ease of reading, individual characteristic curves might not be visible as a result of scaling)

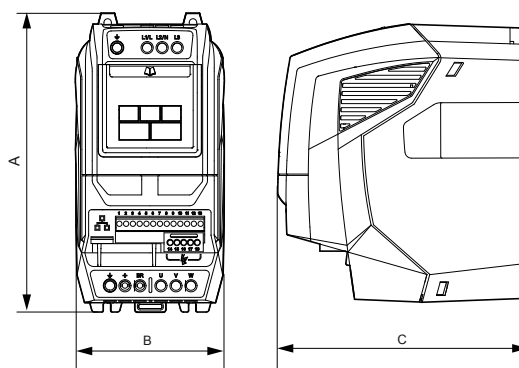
MOVI-PLC® controller

Controller/gateway		A	B	C
DHE21B/UOH11B and DHE41B/UOH11B and DFx/UOH11B	mm	257.5	30	100
	inch	10.14	1.18	3.94
DHF21B/UOH21B and DHF41B/UOH21B and DHR21B/UOH21B and DHR41B/UOH21B	mm	358.5	30	100
	inch	14.11	1.18	3.94



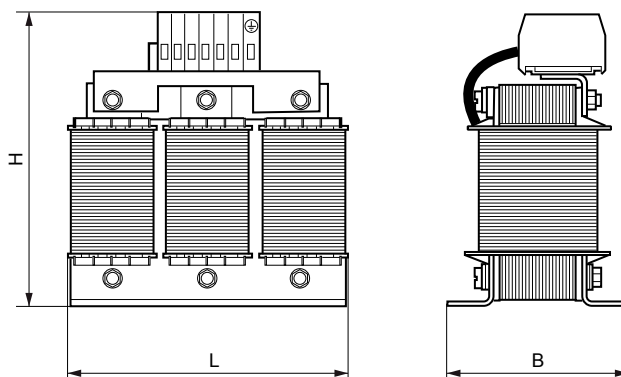
MOVITRAC® LTX universal inverter

Dimensions		Size 2	Size 3
A (height)	mm	221	261
	inch	8.68	10.28
B (width)	mm	110	132
	inch	4.33	5.2
C (depth)	mm	185	205
	inch	7.28	8.07



Line chokes, 3-phase current

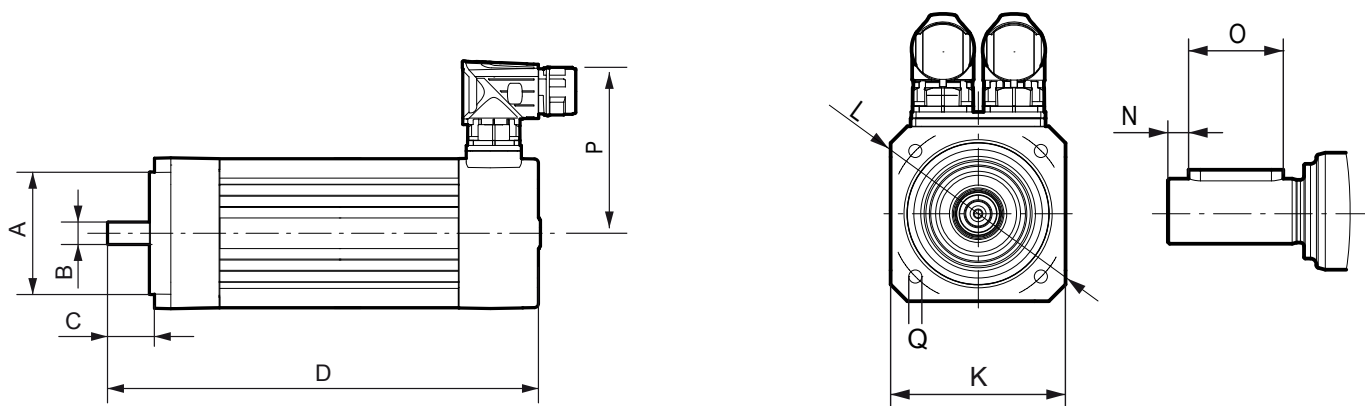
Type		Main dimensions				Weight
		L	B	H		
ND LT 010 290 53	mm	125	71	127	kg	2.5
	inch	4.92	2.8	5.0	lb	5.51
ND LT 036 081 53	mm	155	77	185	kg	7.2
	inch	6.10	3.03	7.28	lb	15.81
ND LT 010 290 21	mm	66	80	70	kg	0.8
	inch	2.60	3.15	2.76	lb	1.76
ND LT 006 480 53	mm	95	56	107	kg	1.3
	inch	3.74	2.20	4.21	lb	2.87



CMP40-63 servomotors

Motor type	A	B	C	D	D (with brake)	K	L	N	O	P	Q
CMP40M	40 _{j6}	9 _{k6}	20	192.5	222	57	63	4	12	77	4.5
CMP50S	60 _{j6}	11 _{k6}	23	211.5	240	73	75	3.5	16	85.5	5.5
CMP50M	60 _{j6}	11 _{k6}	23	250.5	279	73	75	3.5	16		
CMP50L	60 _{j6}	11 _{k6}	23	289.5	318	73	75	3.5	16		
CMP63S	80 _{j6}	14 _{k6}	30	246	274	88	100	4	22	91.5	6.5
CMP63M	80 _{j6}	14 _{k6}	30	296	324	88	100	4	22		
CMP63L	80 _{j6}	14 _{k6}	30	346	374	88	100	4	22		
CMP71M	110 _{j6}	24 _{k6}	50	269	327	116	130	5	40	102	9
CMP71L	110 _{j6}	24 _{k6}	50	319	377	116	130	5	40	102	9

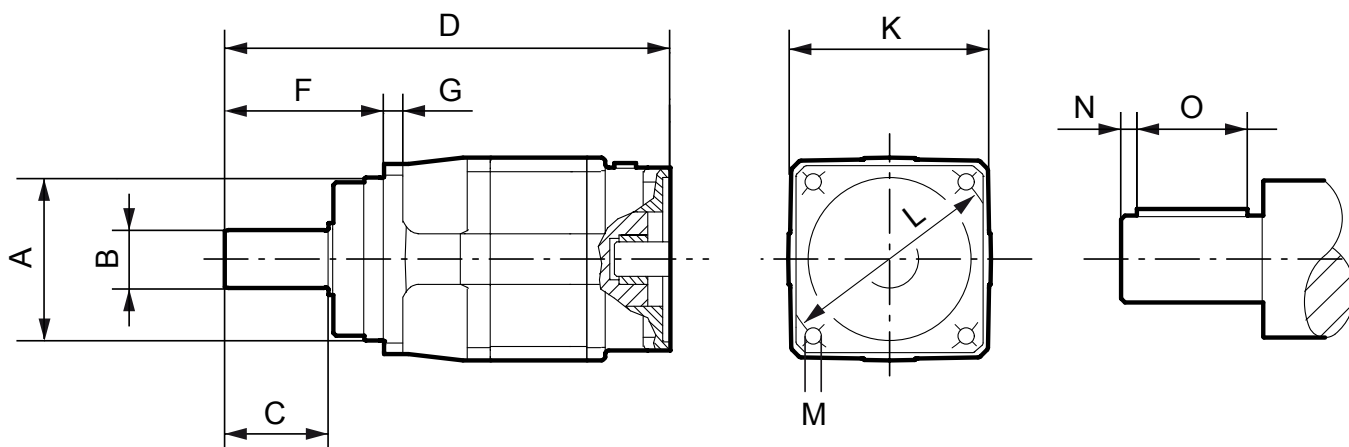
(Dimensions in mm)



PSKC planetary servo gear units

Gear unit	Adapter	Prepared motor mounting	A	B	C	D	F	G	K	L	M	N	O
PSKC 221	ECH02/01/02	CMP40	60 _{g6}	16 _{k6}	28	149	48	8	65	68	5.5	2	25
	ECH02/08/04	CMP50				152							
PSKC 321	ECH03/08/04	CMP50	70 _{g6}	22 _{k6}	36	172	56	10	76	85	6.6	4	28
	ECH03/13/06	CMP63				179							
PSKC 521	ECH05/13/06	CMP63	90 _{g6}	32 _{k6}	58	237	88	13	105	120	9	4	50
PSKC 521	EPH/05/26/13	CMP71 M/L	90 _{g6}	32 _{k6}	58	263	88	13	105	120	9	4	50
PSKC 621	EPH05/26/13	CMP71L	130 _{g6}	40 _{k6}	82	302	112	14	142	165	11	4	70

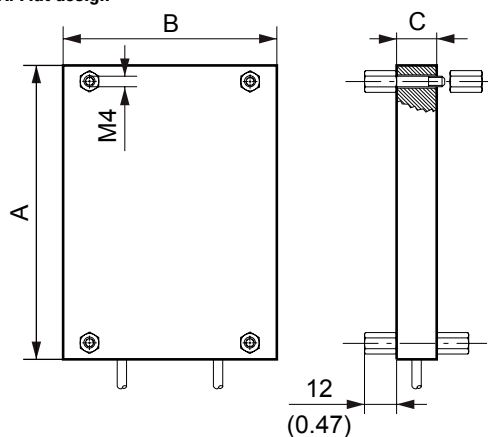
(dimensions in mm)



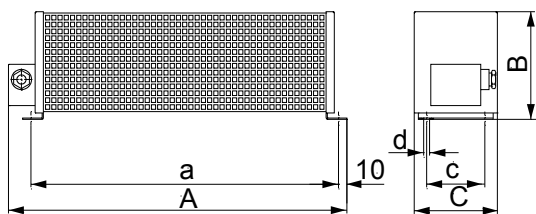
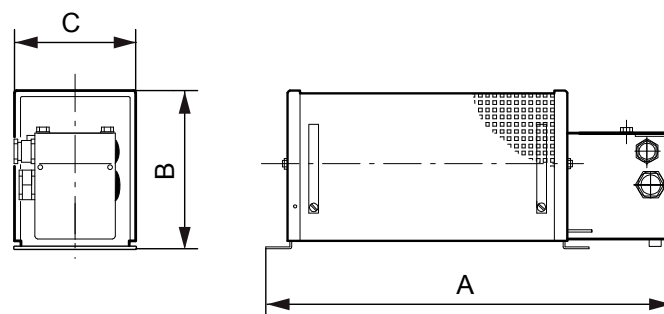
Braking resistors

Type	Design		Main dimensions				Weight
			A	B	C		
BW027-006	A	mm	486	120	92	kg	2.2
		inch	19.1	4.72	3.6	lb	4.9
BW072-003	A	mm	110	80	50	kg	0.3
		inch	4.33	3.1	0.59	lb	0.7
BW047-005	A	mm	216	80	15	kg	0.6
		inch	8.50	3.1	0.59	lb	1
BW147-T	B	mm	549	120	185	kg	4.9
		inch	21.6	4.72	7.28	lb	11
BW247-T	B	mm	749	120	185	kg	9.2
		inch	29.5	4.72	7.28	lb	20
BW347-T	B	mm	749	210	185	kg	12.4
		inch	29.5	8.27	7.28	lb	27.3
BW100-005	A	mm	216	80	15	kg	0.6
		inch	8.5	3.1	0.59	lb	1.0
BW100-006	A	mm	486	120	92	kg	2.2
		inch	19.1	4.72	3.6	lb	4.9

A: Flat design



B: Round wire



Conversion help

Formula tables

Torques

Translational	$M = F \cdot r = (F \cdot D) / 2$ $M \text{ [Nm]} = (F \text{ [N]} \cdot D \text{ [mm]}) / 2000$
Rotational	$M = J \cdot \alpha$ $M \text{ [Nm]} = J \text{ [kgm}^2] \cdot ((n \text{ [min}^{-1}]) / 9.55 \cdot t_A \text{ [S]})$

Object	Position of the rotary axis	Moment of inertia J
Circular ring, thin Hollow cylinder, thin-walled	Perpendicular to the ring plane	$J = m \cdot r^2$
Solid cylinder	Longitudinal axis	$J = 1/2 \cdot m \cdot r^2$
Hollow cylinder, thick-walled	Longitudinal axis	$J = 1/2 \cdot m \cdot (r_1^2 + r_2^2)$
Circular disk	Perpendicular to the plane of the disk	$J = 1/2 \cdot m \cdot r^2$
Circular disk	Axis of symmetry in the plane of the disk	$J = 1/4 \cdot m \cdot r^2$
Rod, thin with length l	Perpendicular to the middle of the rod	$J = 1/12 \cdot m \cdot l^2$

Static resistive forces	Static and dynamic friction
Friction force	$F_R = \mu \cdot F_N$
Weight	$F_N = m \cdot g \cdot \cos \alpha$
Resistance to motion	$F_F = m \cdot g \cdot (2 / D \cdot (\mu_L \cdot d / 2 + f) + c)$
Rolling friction	$F = m \cdot g \cdot (2 \cdot f) / D$
Bearing friction	$F = m \cdot g \cdot \mu_L \cdot d / D$
Track friction	$F = m \cdot g \cdot c$
Vertical hoist	$F = m \cdot g$
Grade resistance	$F = m \cdot g \cdot \sin \alpha$

Dynamic resisting forces

Linear motion	$F = m \cdot a$
Rotation	$M = J \cdot \alpha$

F_R = friction force [N]
 μ = coefficient of friction
 F_N = weight perpendicular to the surface [N]
 m = mass [kg]
 g = gravitational acceleration [m/s²]
 α = gradient angle [°]
 F_F = resistance to motion [N]
 D = carrying wheel diameter [mm]
 μ_L = bearing friction value
 d = lever arm of rolling friction [mm]
 c = wheel flange and side friction coefficient

Value information tables

Power transmission elements	Conditions	Efficiency
Wire rope	per complete loop of the rope roll (with friction or plain bearing)	0.91 – 0.95
Rubber bands	per complete loop / rollers with friction bearings (normal tension of the band)	0.81 – 0.85
Toothed belt	per complete loop / rollers with friction bearings (normal tension of the band)	0.90 – 0.96
Chains	per complete loop / wheels with friction bearing (depending on chain size)	0.90 – 0.96

Material pairing	Type of friction	Coefficient of friction	Lever arm
Steel on steel	Static friction (dry)	$\mu_0 = 0.12 - 0.60$	$f \approx 0.5 \text{ mm}$
	Dynamic friction (dry)	$\mu = 0.08 - 0.50$	
	Static friction (greased)	$\mu_0 = 0.12 - 0.35$	
	Dynamic friction (greased)	$\mu = 0.04 - 0.25$	
Plastic belt on steel	Static friction (dry)	$\mu_0 = 0.25 - 0.45$	
	Dynamic friction (dry)	$\mu = 0.25$	
Steel on plastic	Dynamic friction (dry)	$\mu_0 = 0.20 - 0.45$	
	Dynamic friction (greased)	$\mu = 0.18 - 0.35$	
Plastic on steel			$f \approx 2 \text{ mm}$
Hard rubber on steel			$f \approx 7 \text{ mm}$
Hard rubber on concrete			$f \approx 10 - 20 \text{ mm}$

Conversion tables

Conversion of forces

	N	pound-force / lbf
1 N =	1	$2.24809 \cdot 10^{-1}$
1 lbf =	4.44822	1

Conversion of power

	kW	horsepower hp
1 kW =	1	1.34102
1 hp =	$7.45700 \cdot 10^{-1}$	1

Conversion of moments of inertia

	kg cm ²	kg m ²	lb in ²	lbf in s ²
1 kg cm ² =	1	10^{-4}	$3.41717 \cdot 10^{-1}$	$8.85075 \cdot 10^{-4}$
1 kg m ² =	10^4	1	3417.17	8.85075
1 lb in ² =	2.92640	$2.92640 \cdot 10^{-4}$	1	$2.59008 \cdot 10^{-3}$
1 lbf in s ² =	1129.85	$1.12985 \cdot 10^{-1}$	386.089	1

Conversion of torques

	Nm	lbf in
1 Nm =	1	8.85075
1 lbf in =	$1.12985 \cdot 10^{-1}$	1

Conversion of masses

	kg	pound lb = lbm
1 kg =	1	2.20462
1 lb = 1 lbm =	$4.53592 \cdot 10^{-1}$	1

Conversion of lengths

	mm	cm	m	Inch in	Feet ft
1 mm =	1	10^{-1}	10^{-3}	$3.93701 \cdot 10^{-2}$	$3.28084 \cdot 10^{-3}$
1 cm =	10	1	10^{-2}	$3.93701 \cdot 10^{-1}$	$3.28084 \cdot 10^{-2}$
1 m =	1000	100	1	39.3701	3.28084
1 in =	25.4	2.54	$2.54 \cdot 10^{-2}$	1	$8.33333 \cdot 10^{-2}$
1 ft =	304.8	30.48	$3.048 \cdot 10^{-1}$	12	1

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