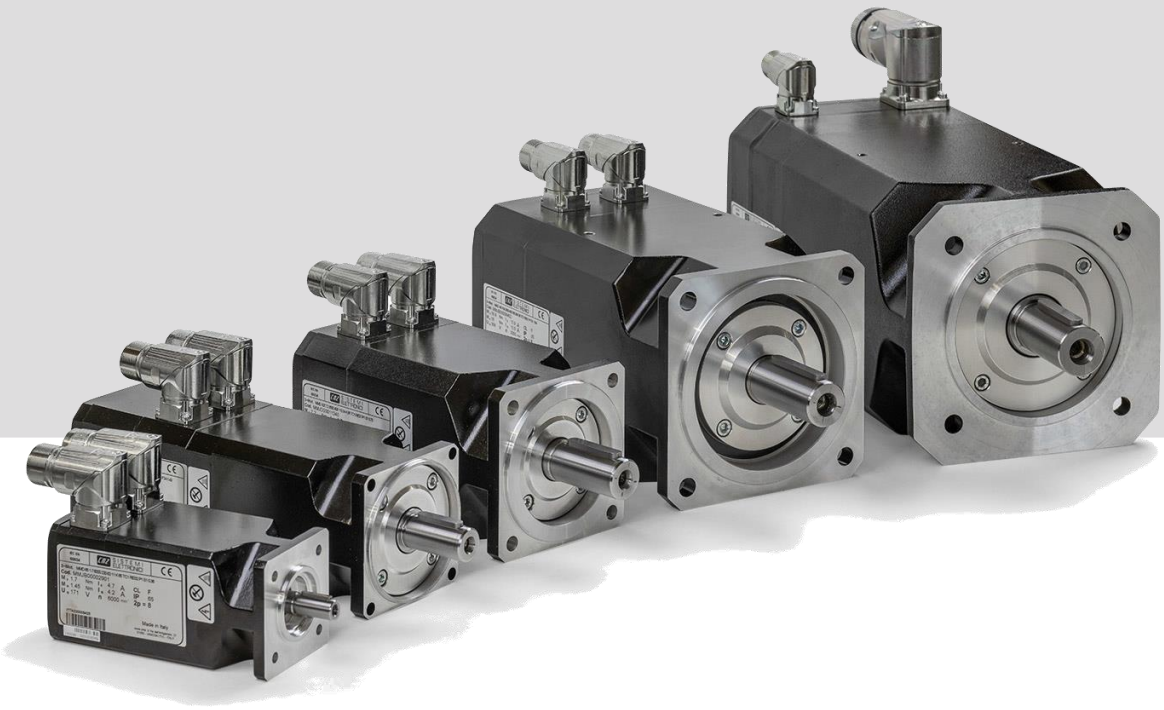
MMD series

Brushless motors



CMZ

Ed. 1.3 - English

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Focus on our synchronous servomotors

These permanent magnet AC synchronous servomotors are ideal for any type of automatic machinery in particular applications with high dynamic requirements. They are particularly suited to typical applications in plastic and metal machining, packaging, food and beverage processing, winding and textile industries.

The dimensions of the motor are drastically reduced, with considerable advantages in terms of torque density, overall dimensions and dynamic performance.
Thanks to the high quality of the neodymium iron boron rare-earth magnets, performance are maximized in terms of very high accelerations and withstand high overloads without risk of demagnetization of the magnets.

The motors are available in six frames covering a stall torque range between 0.85 ÷ 45 Nm with natural cooling and up to 60 Nm with forced ventilation.

These brushless sinusoidal motors are designed as standard for a three phase power supply, 230Vac and 400Vac.

MMD motor series are manufactured using class F insulation materials. The standard cooling method is free ventilation IC410. As option, the forced ventilation IC416 is available only for the size MMD 145 and MMD 170.

Since each servomotor has a protective temperature sensor (PT100) embedded in the motor windings, operating temperature is constantly acquired and monitored by the drive to prevent all risks of damage to the motor irrespective of operating conditions.
An optional electromechanical holding brake is available for all models. Brake operation is controlled entirely by the frequency inverter.

MMD motors are optionally available with an external additional flywheel mass to face the machine inertia.

MMD series are available with degree of protection IP65 (standard) and IP67 (optional).

The following feedback devices are available:
- Resolver with excitation frequency 8 and 10 kHz
- Single turn and Multi-turn: Hiperface protocol supported

MMD Series servomotors are controlled in speed and/or torque by a suitable electronic servo drive. The servo drive therefore constitutes a fundamental part of the actuator and requires perfect synchronization with it in order to achieve optimum performance.

The combination of MMD servomotors with frequency inverters from CMZ inverters ensures the perfect control of the motor in order to optimse the performance according to the machine requirements.

MMD Brushless motor photos used inside this catalogue do not represent the real product colour.
The actual colour is black (RAL 9005). Silver dressing has to be intended for marketing and promotional purposes only.

Standards and directives

MMD motors are manufactured in accordance with applicable standards and Directive listed in the following.

STANDARD

IEC 60034-1, EN 60034-1
Rotating electrical machines
Part 1: Rating and performance

IEC 60034-2-3
Rotating electrical machines
Part 2-3: Specific test methods for determining losses and efficiency of converter-fed AC motor

IEC 60034-5, EN 60034-5
Rotating electrical machines
Part 5: Degrees of protection provided by the integral design of rotating electrical machines (IP code) - Classification

IEC 60034-6, EN 60034-6
Rotating electrical machines
Part 6: Methods of cooling (IC Code)

IEC 60034-8, EN 60034-8
Rotating electrical machines
Part 8: Terminal markings and direction of rotation

IEC 60034-14, IEC 60034-14
Rotating electrical machines
Part 14: Mechanical vibration - Measurement, evaluation and limits of vibration severity

IEC TS 60034-25
Rotating electrical machines
Part 25: Guidance for the design and performance of a.c. motors specifically designed for converter supply

IEC 60072-1
Dimensions and output series for rotating electrical machines - Part 1

DIRECTIVES

Low Voltage Directive: 2014/35/EU

Symbols and units of measure

SYMBOL	U.M.	DESCRIPTION
2p	[-]	Number of poles
dT	[K]	Winding temperature rise
f_H	[-]	Altitude adjustment factor
f_n	[Hz]	Rated frequency
f_T	[-]	Temperature adjustment factor
I_0	[A]	Stall RMS current
I_b	[A]	Brake DC current
I_{max}	[A]	Max RMS current
I_n	[A]	Rated RMS current
J_b	[$Kgm^2 \cdot 10^{-4}$]	Brake moment of inertia
J_M	[$Kgm^2 \cdot 10^{-4}$]	Motor moment of inertia
K_e	[$mV\ min^{-1}$]	Back EMF constant phase-phase
K_T	[Nm/A]	Torque constant
L_{pp}	[mH]	Stator phase-phase inductance
M_0	[Nm]	Stall torque
M_b	[Nm]	Brake torque
m_b	[kg]	Brake mass
M_{EQU}	[Nm]	Equivalent torque
M_{max}	[Nm]	Max torque
m_M	[kg]	Motor mass without bake/ flywheel
M_n	[Nm]	Rated torque
n_n	[min^{-1}]	Rated speed
P_b	[W]	Brake electrical power at 20°C
P_n	[kW]	Rated power
R_{pp}	[Ω]	Stator phase-phase resistance at 20°C
t_1	[ms]	Brake engaging time
t_2	[ms]	Brake relase time
V_b	[V]	Brake DC voltage
V_n	[V]	Rated voltage
ΔJ	[$Kgm^2 \cdot 10^{-4}$]	Inertia increase with brake/flywheel
Δm_M	[kg]	Mass increase with brake/flywheel
τ_{el}	[ms]	Electric time constant
τ_{therm}	[min]	Thermal time constant

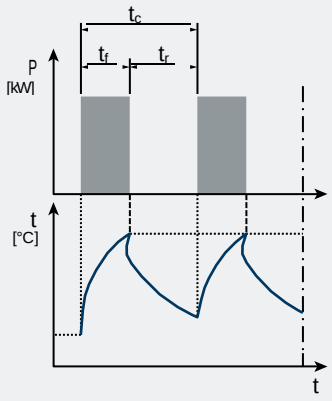
Unless otherwise specified, all dimensions are expressed in millimeters.

Terms and definitions

Back EMF constant [K_e]: is the relationship between the phase-to-phase RMS motor back EMF terminal voltage (V_{AC}) and the corresponding shaft rotational speed. It is typically computed as the RMS value of line voltage at speed of 1 min^{-1} with a winding temperature of 20°C.

Duty type S1: Operation at constant load maintained for sufficient time to allow the machine to reach thermal equilibrium

Duty type S3: sequence of identical duty cycles, each including a time of operation at constant load and a time de-energized and at rest. If not specified the cycle time is fixed equal to 10 minutes.



Intermittence:

$$I = \frac{t_f}{t_f + t_r} \cdot 100\%$$

t_f Work time under constant load
t_r Rest time

Electric time constant [τ_{el}]: is the time taken for the current to reach 63.2% of its steady state value when a step input voltage is applied while the rotor is stationary. Calculated by dividing the winding phase-to-phase inductance (L_{pp}) by the winding phase-to-phase resistance (R_{pp}) at 20°C.

$$\tau_{el} = L_{pp} / R_{pp}$$

Max current [I_{max}]: is the current used to produce the max torque (M_{max}). It is the current limit of the machine, and if exceeded, even for a short period, it may happen an irreversible damage of the machine.

Max torque [M_{max}]: is the absolute maximum torque that can be produced by a servomotor for a short time.

Rated current [I_n]: is the RMS current to produce the rated torque (M_n).

Rated frequency [f_n]: is the frequency of the fundamental component of the output voltage corresponding at the rated speed (n_n) according to the following equation where p is the pole pairs.

$$f_n = p \cdot n_n / 60$$

Terms and definitions

Rated power [P_n]: is the mechanical power available at shaft at rated speed n_n.

$$P_n = 2\pi \cdot M_n \cdot n_n / 60$$

Rated speed [n_n]: is the speed at which the motor has been designed to operate with a reasonable level of control, in terms of overload and overspeed.

Rated torque [M_n]: is the thermally permissible continuous torque for S1 duty at the rated motor speed (n_n). It is normally less than the standstill torque (M_0) due to rotational losses (iron losses, friction losses…).

Standstill current [I_0]: is the RMS current to produce the standstill torque (M_0).

Standstill torque [M_0]: is the thermal limit torque for S1 duty produced when the motor runs at zero speed.

Thermal equilibrium: is the state reached when the temperature rise of the several parts of the machine do not vary by more than a gradient of 2 K per hour.

Thermal time constant [τ_{therm}]: is the time for the temperature to reach 63.2% of this final value between the motor housing and the ambient after a step-wise current change.

Torque constant [K_T]: is the phase RMS current to torque transfer ratio at standstill condition. It is quoted at rated motor winding temperature in steady state condition (thermal equilibrium – S1 duty cycle).

Winding temperature rise [dT]: is the temperature rise, in specified service conditions, of the motor windings above the maximum ambient reference temperature.

Rating plates

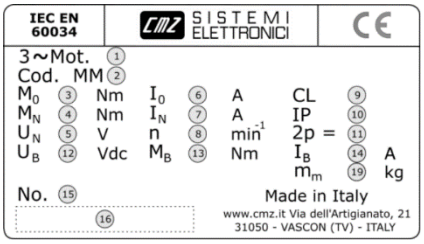
In accordance with IEC 60034-1, the motor rating plate summarizes the motor rating including the approximate total weight. Example of rating plate and fields description are reported hereafter.

Fields:

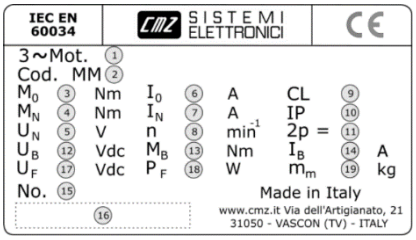
1) Product designation
2) Product code
3) Stall torque
4) Nominal torque
5) Nominal voltage
6) Stall current
7) Nominal current
8) Nominal speed
9) Insulation class
10) Degree of protection
11) Number of poles
12) Brake voltage
13) Brake torque
14) Brake current
15) Numeric serial number
16) Bar code serial number
17) Fan voltage *(*)*
18) Fan power *(*)*
19) Total weight

(*) Only on the plate for motors with forced ventilation.

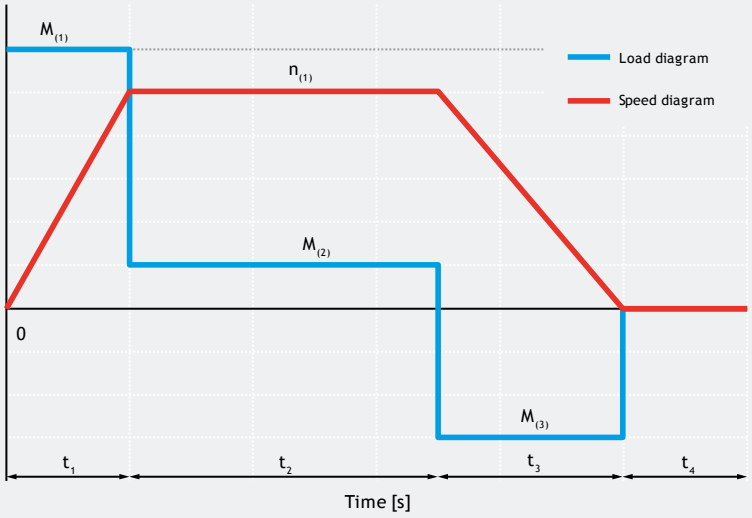
Example of motor unit rating plate:

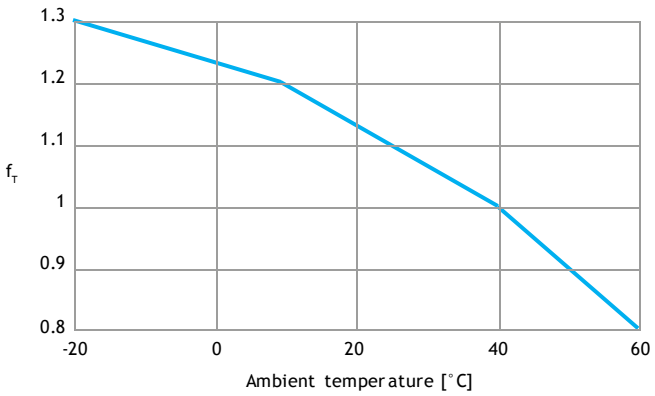
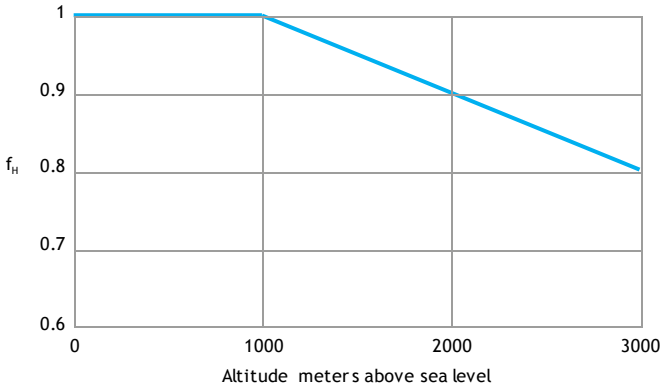


Example of motor rating plate with forced ventilation:

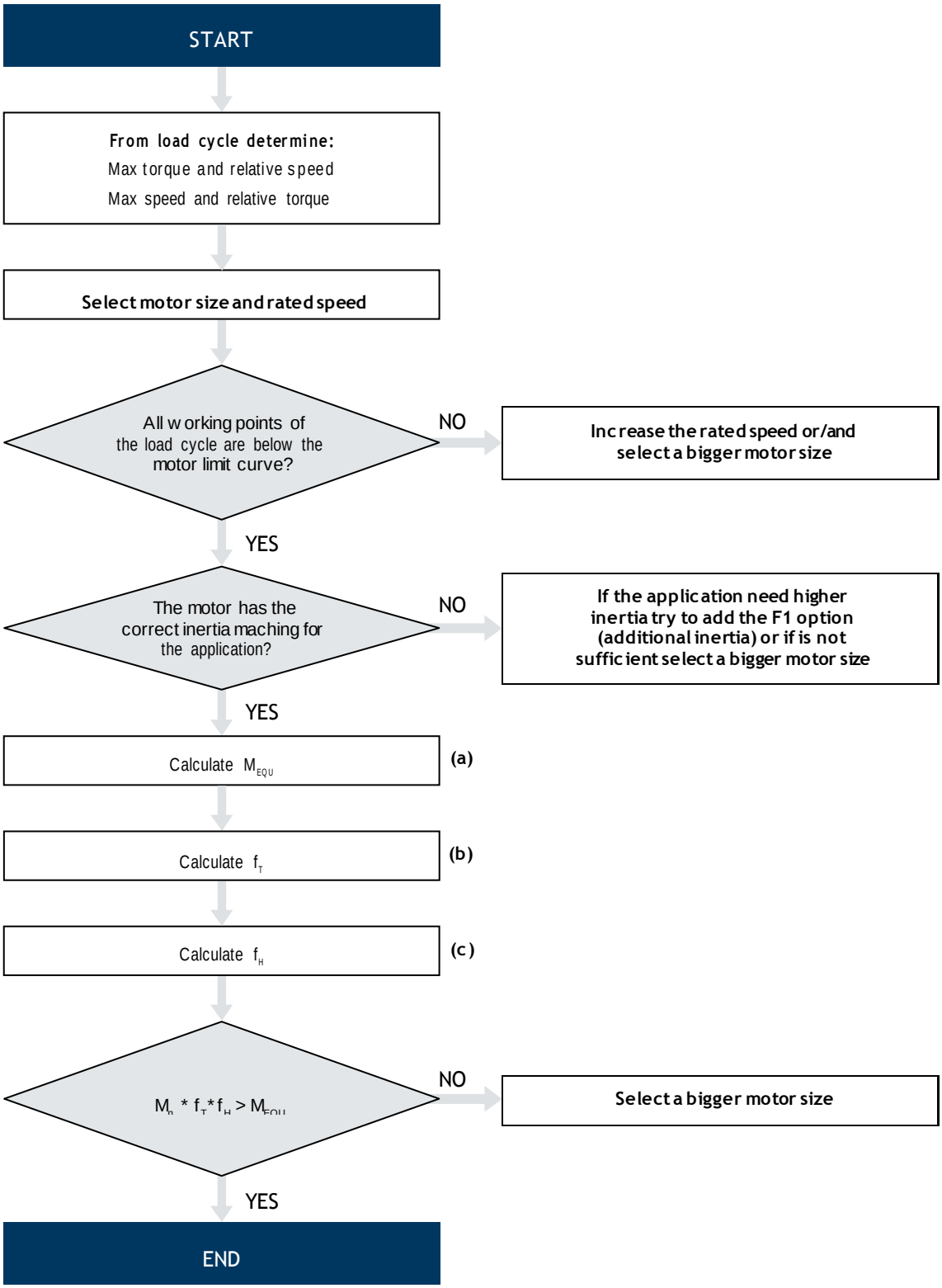


Selecting the servomotor



(a)	Equivalent torque	M_{EQU}	[Nm]	$M_{EQU} = \sqrt{\frac{M^2_{(1)} \cdot t_1 + M^2_{(2)} \cdot t_2 + \ldots + M^2_{(n)} \cdot t_n}{t_1 + t_2 + \ldots + t_n}}$
(b)	Temperature adjusting factor	f_T	-	
(c)	Altitude adjustment factor	f_H	-	

Selecting the servomotor



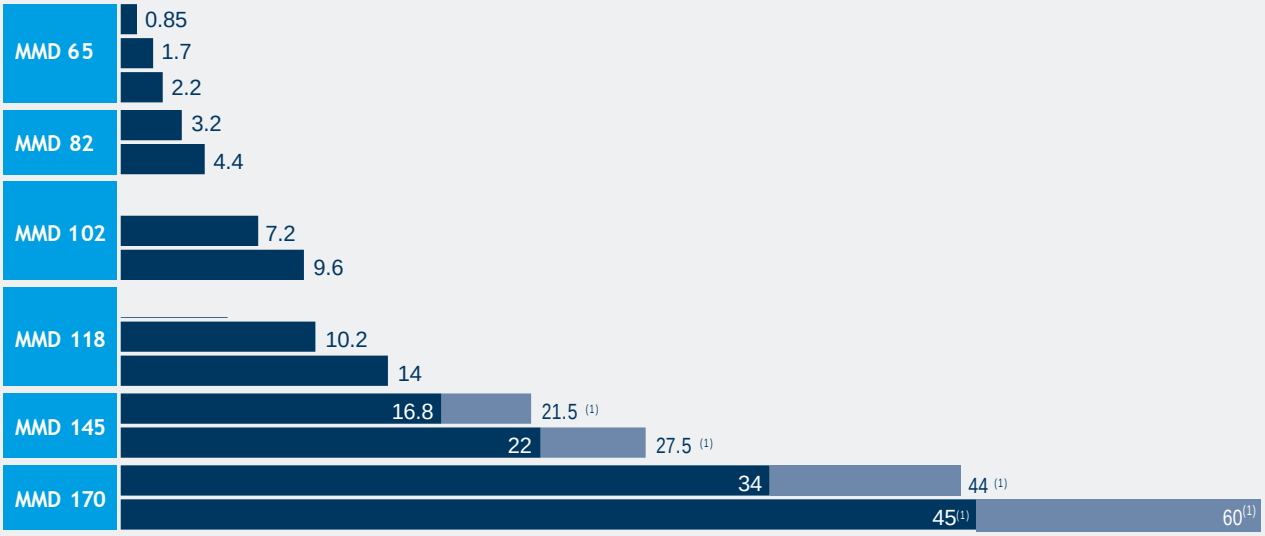
CMZ permanent magnet synchronous servomotors range

The CMZ permanent magnet synchronous motors are available in six sizes with stall torque comprises between 0.85 ÷ 60 Nm.

Product Line Up
- Competitive technology
- Low inertia
- Highest dynamics
- High torque density
- Precision
- Compact design

MMD series

Stall Torque distribution



A brief overview of the available combinations of the basic variants such as motor size, motor stall torque, nominal voltage and nominal speed is reported in the following table.

		MMD 65			MMD 82		MMD 102		MMD 118		MMD 145				MMD 170			
		0.85	1.7	2.2	3.2	4.4	7.2	9.6	10.2	14	16.8	21.5(1)	22	27.5(1)	34	44(1)	45	60(1)
400 V	1600 rpm		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	3000 rpm	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	4500 rpm	X	X	X	X	X	X	X	X	X	X	X	X	X				
	5500 rpm	X	X	X	X	X	X	X	X	X	X	X	X					
	6000 rpm	X	X	X	X	X	X	X	X	X	X							
230 V	1600 rpm	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		
	3000 rpm	X	X	X	X	X	X	X	X	X	X	X	X		X	X		
	4500 rpm	X	X	X	X	X	X	X	X									
	5500 rpm	X	X	X	X	X	X	X	X									
	6000 rpm	X	X	X	X	X	X	X										

(1) Motor with forced ventilation option

Product designation of CMZ servomotors

BASIC VARIANTS

MMD	145	22	3000	400	165	24	K	65

Degree of protection

65	IP65(*)
67	IP67(*)

(*) IP54 if additional fan uniti is moutned

Shaft keyway

K	with key
NK	without key

Shaft diameter

9	(mm)	size 65
11	(mm)	size 65, 82
14	(mm)	size 82
19	(mm)	size 82, 102, 118, 145
24	(mm)	size 102, 118, 145, 170
28	(mm)	size 118, 145, 170
32	(mm)	size 170

Flange (1)

63	(mm)	size 65
75	(mm)	size 65
100	(mm)	size 82, 102
115	(mm)	size 82, 102
130	(mm)	size 118
130S	(mm)	size 118
165	(mm)	size 118, 145, 170

Motor AC voltage (2)

230	(V)
400	(V)

Motor rated speed (2)

1600	(min^{-1})
3000	(min^{-1})
4500	(min^{-1})
5500	(min^{-1})
6000	(min^{-1})

Motor stall torque

0.85	(Nm)	size 65	**10.2**	(Nm)	size 118
1.7	(Nm)	size 65	**14**	(Nm)	size 118
2.2	(Nm)	size 65	**16.8**	(Nm)	size 145
3.2	(Nm)	size 82	**22**	(Nm)	size 145
4.4	(Nm)	size 82	**34**	(Nm)	size 170
7.2	(Nm)	size 102	**45**	(Nm)	size 170
9.6	(Nm)	size 102			

Motor size

65, 82, 102, 118, 145, 170

Series

MMD

OPTIONAL VARIANTS

PTC | RES1 | P1 | S1 | F24 | - | V1R | 1,26

Kt (value of the motor)

Forced ventilation (4)

(blank) no forced ventilation (default)
V1R 24V DC IP 54 angled rotatable receptacle
V1S 24V DC IP 54 straight receptacle
V2R 230V AC IP 54 angled rotatable receptacle
V2S 230V AC IP 54 straight receptacle

Certified execution

(blank) CE

Brake/Flywheel

F24 brake 24 Vdc
F1 additional flywheel / inertia

Signal connector

(blank) Sensorless version, no feedback device
S1 Angled rotatable receptacle, with plug
S1N Angled rotatable receptacle, without plug

Power connector

P1 Angled rotatable receptacle, with plug
P1N Angled rotatable receptacle, without plug

Feedback device

RES1 (3) 2 poles resolver 8 kHz
RES2 (5) 2 poles resolver 10 kHz
A0 Optical absolute encoder Hiperface interface Multi Turn

Thermal protection

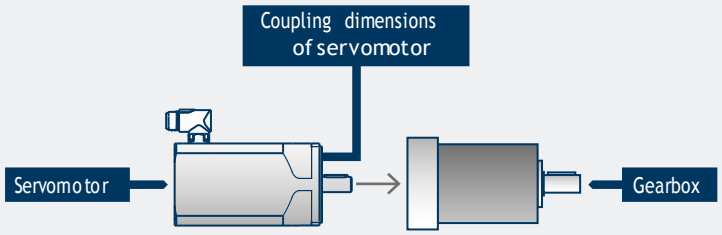
TC1 Platinium sensor PT1000

Notes:
(1) M flange dimension, see page 12
(2) For available motor AC voltage and speed combinations refer to general overview of page 11
(3) Not available for motor size MMD 65
(4) For available motor AC voltage and speed combinations refer to page 45.
(5) Available only for motor size MMD 65

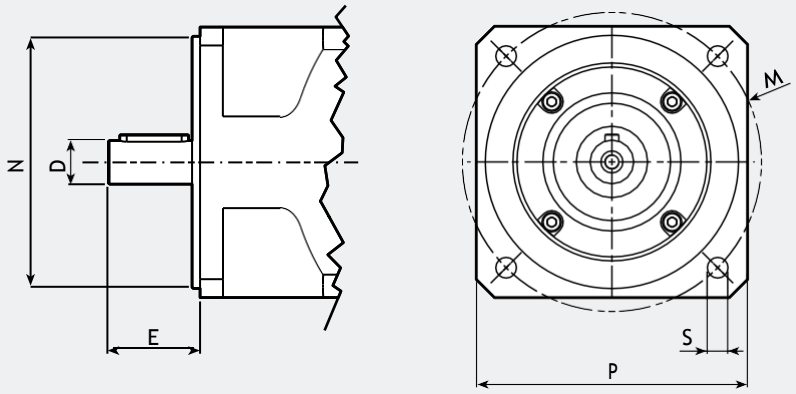
Please check the compatibility with our Motion Control with our Technical team or by consulting the Motion Control catalogue.

Coupling dimensions

The coupling dimensions include both, flange and shaft that are univocally defined by catalogue variants. The flanges and the shafts of MMD are described by fixed geometrics according to standard IEC 60072-1.



According to IEC 60072-1, the interface geometry is defined by quantities D, E, P, M, N, S showed in the following drawing whose numerical values (mm) depend on motor size.



SERVOMOTORS												
		MMD65		MMD82				MMD11			MMD145	MMD170
Shaft diameter x shaft length	DxE	9x20 11x23		11x23 14x30 19x40		19x40 24x50		19x40 24x50 28x60			19x40 24x50 28x60	24x50 28x60 32x60
Flange square	P	65	65	82	100	102	102	118	118	145	145	170
Flange pitch holes diameter	M	63	75	100	115	100	115	130 (1)	130	165	165	165
Diameter of the spigot	N	40	60	80	95	80	95	95	110	130	130	130
Fixing holes diameters	S	5.8	5.8	6.5	9	7	9	9	9	12	12	12

Notes:
(1) Flange variant 130S

Mechanical tolerances

Dimensions and tolerances of shaft extension, key and flange are in accordance with IEC 60072-1.
Shaft extension features an axial threaded hole in accordance with UNI 3221, DIN 332.
Tolerances of the different parts are reported in the table.

COMPONENT		DIMENSIONS	TOLERANCE
Shaft end	D	Ø 9 - 28	j6
		Ø 32	k6
Key	F		h9
Flange	N	Ø < 250	j6

Bearings

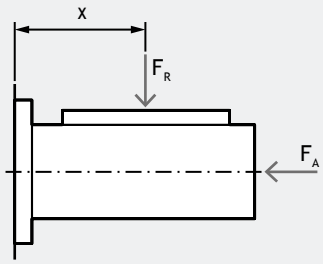
MMD motors use radial ball bearings, lubricated for life with grease and axially pre-loaded. The types of bearings in use are listed in the following table.

SIZE	DRIVE END	NON DRIVE END
MMD 65	6201 2RS	6001 2RS
MMD 82	6205 2RS	6203 2RS
MMD 102	6205 2RS	6204 2RS
MMD 118	6206 2RS	6205 2RS
MMD 145	6206 2RS	6305 2RS
MMD 170	6208 2RS	6305 2RS

Shaft loads

The maxium radial load (F_R) and maximum axial load (F_A) are computed using ISO 281 calculation L_{10h} assuming a bearing life of 20.000h. The load and the speed are assumed to be constant throughout the bearing life.

The maximum radial load is reported as a function of the distance (X) between flange plane and the point of force applicaton. The fatigue limit for the radial load is computed for each size assuming the smallest shaft diameter catalogue (e.g. 11mm for MMD 82). The maximum radial loads F_R are valid only for the horizontal installation of the motor without additional axial load.



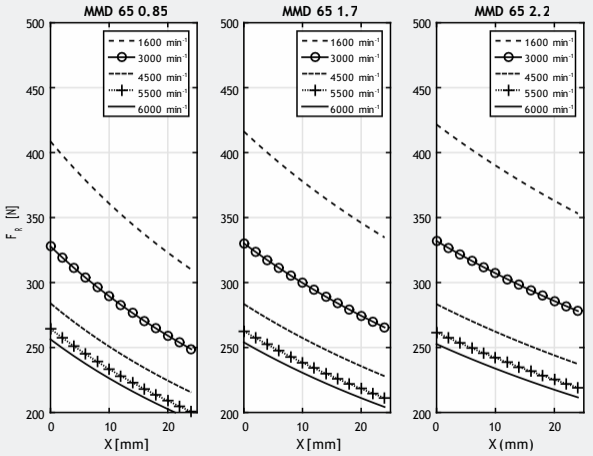
Maximum axial load (F_R=0)

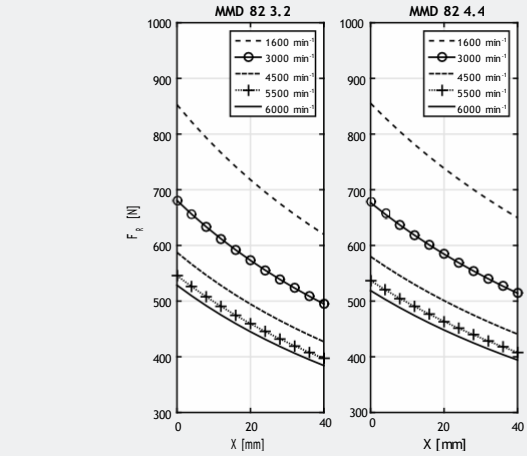
SIZE		SPEED [min^{-1}]				
	[Nm]	1600	3000	4500	5500	6000
MMD 65	0.85	59	48	42	39	38
	1.7	65	53	46	43	42
	2.2	69	56	49	46	44
MMD 82	3.2	115	94	82	77	75
	4.4	120	100	85	81	79
MMD 102	7.2	150	120	105	100	95
	9.6	160	130	110	105	100
MMD 118	10.2	170	139	121	115	110
	14	180	145	130	120	115
MMD 145	16.8	280	230	200	185	180
	22	295	240	210	195	
MMD 170	34	300	270			
	45	320	290			

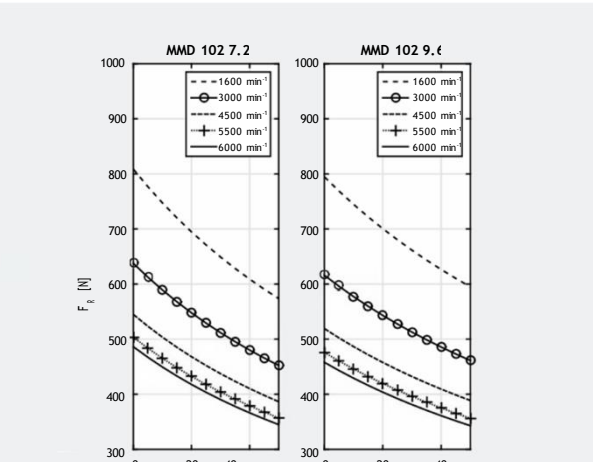
Shaft loads

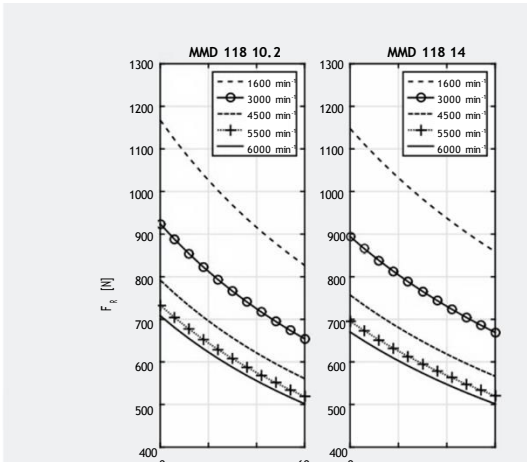
Maximum radial load (F_A=0)

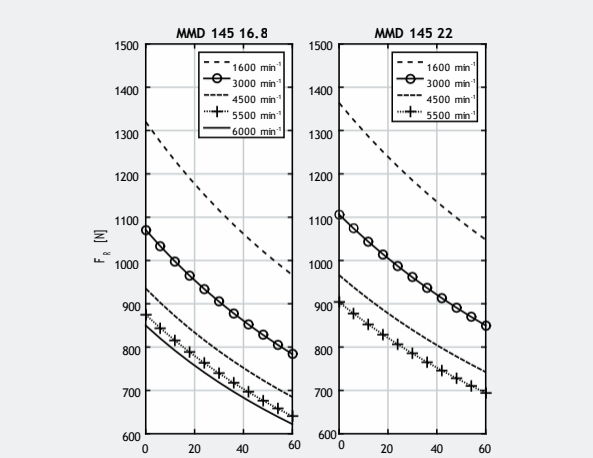
Curves paramtrized according to motor nominal speed.

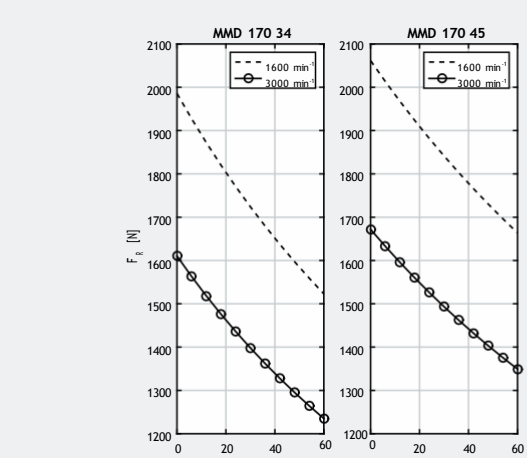










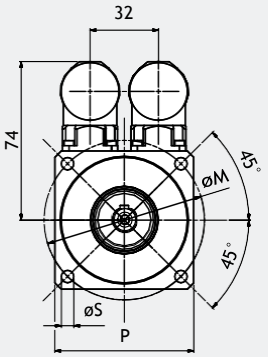


MMD 65 • Ratings

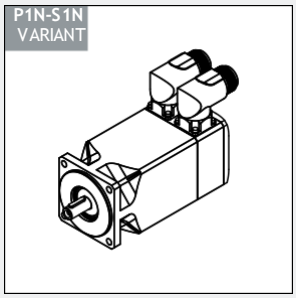
			MMD 65 0.85 Nm					MMD 65 1.7 Nm					MMD 65 2.2 Nm				
	M_0	[Nm]	0.85					1.70					2.20				
	M_n	[Nm]	0.83	0.80	0.76	0.74	0.73	1.65	1.60	1.52	1.48	1.45	2.12	2.05	1.95	1.85	1.80
	n	[min^{-1}]	1600	3000	4500	5500	6000	1600	3000	4500	5500	6000	1600	3000	4500	5500	6000
	f_n	[Hz]	107	200	300	367	400	107	200	300	367	400	107	200	300	367	400
	P_n	[kW]	0.14	0.25	0.36	0.43	0.46	0.28	0.50	0.72	0.85	0.91	0.36	0.64	0.92	1.07	1.13
	M_{max}	[Nm]	2.55					4.90					6.20				
	2p	[-]	8					8					8				
	J	[Kgm^2 · 10^{-4}]	0.2					0.4					0.6				
	τ_{el}	[ms]	3					3					3				
	τ_{therm}	[min]	14					20					26				
	m_M	[kg]	1.3					1.9					2.6				
230 Vac	V_n	[V_{AC}]	168	181	172	179	177	193	180	180	174	171	179	180	191	192	190
230 Vac	I_0	[A]	0.77	1.23	1.93	2.18	2.39	1.26	2.34	3.40	4.20	4.70	1.70	2.96	4.10	4.90	5.40
230 Vac	I_n	[A]	0.74	1.16	1.74	1.92	2.09	1.25	2.30	3.20	3.90	4.20	1.65	2.78	3.60	4.10	4.40
230 Vac	I_{max}	[A]	2.50	3.90	6.20	7.00	7.70	4.30	8.00	11.5	14.5	15.9	5.40	9.40	12.9	15.6	17.1
230 Vac	K_e	[mV/min^{-1}]	75	47	30	27	24	89	48	33	26	24	90	52	38	31	28
230 Vac	K_T	[Nm/A]	1.10	0.69	0.44	0.39	0.36	1.35	0.73	0.50	0.40	0.36	1.29	0.74	0.54	0.45	0.41
230 Vac	R_{pp}	[Ω]	48.4	19.2	7.75	6.10	5.04	30.4	8.79	4.19	2.66	2.20	18.8	6.21	3.27	2.26	1.86
230 Vac	L_{pp}	[mH]	145	57.5	23.2	18.3	15.1	91.9	26.6	12.6	8.00	6.60	56.9	18.8	9.90	6.80	5.60
400 Vac	V_n	[V_{AC}]	-	295	331	318	306	336	311	308	316	300	285	314	314	328	313
400 Vac	I_0	[A]	-	0.76	0.98	1.23	1.38	0.72	1.35	1.98	2.34	2.68	1.07	1.70	2.48	2.88	3.27
400 Vac	I_n	[A]	-	0.72	0.88	1.08	1.21	0.72	1.33	1.85	2.14	2.43	1.04	1.60	2.20	2.41	2.68
400 Vac	I_{max}	[A]	-	2.43	3.10	3.90	4.40	2.46	4.60	6.70	8.00	9.10	3.40	5.40	7.90	9.10	10.4
400 Vac	K_e	[mV/min^{-1}]	-	76	59	47	42	155	83	57	48	42	143	90	62	53	47
400 Vac	K_T	[Nm/A]	-	1.12	0.87	0.69	0.62	2.36	1.26	0.86	0.73	0.63	2.06	1.29	0.89	0.76	0.67
400 Vac	R_{pp}	[Ω]	-	50.0	30.3	19.2	15.1	92.3	26.3	12.2	8.79	6.65	47.6	18.8	8.82	6.56	5.08
400 Vac	L_{pp}	[mH]	-	150	90.7	57.5	45.2	279	79.5	37.0	26.6	20.1	144	56.9	26.7	19.8	15.4
F24	Mb	[Nm]	2					2					2				
F24	Δm_M	[kg]	0.2					0.2					0.2				
F24	ΔJ	[Kgm^2 · 10^{-4}]	0.1					0.1					0.1				
F1	Δm_M	[kg]	0.4					0.4					0.4				
F1	ΔJ	[Kgm^2 · 10^{-4}]	0.5					0.5					0.5				

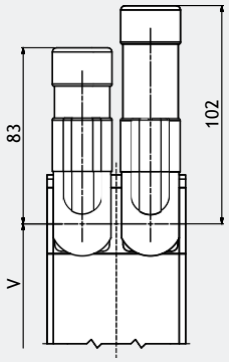
MMD 65 • Dimensions

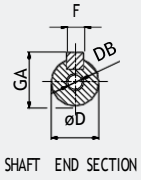
P1-S1 VARIANT



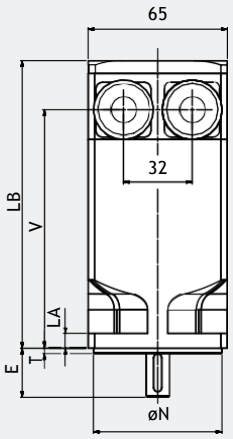
P1N-S1N VARIANT







SHAFT END SECTION



B5 FLANGE VARIANT						
Flange variant	P	M	N	S	T	LA
63	65	63	40	5.8	2.5	7
75	65	75	60	5.8	2.5	7

SHAFT DIAMETER VARIANT					
Shaft diameter	D	E	DB	GA (1)	F (1)
9	9	20	M3	10.2	3
11	11	23	M4	12.5	4

MOTOR LENGTH DEPENDING ON THE OPTION

DIMENSION V

Torque	Without Brake or Flyweel			With Brake or Flyweel **F24/F1** options		
	Feedback Variants			Feedback Variants		
M_0	**RES2**		**A0**	**RES2**		**A0**
0,85	89		89	89		138
1,7	112		112	112		161
2,2	138		138	138		187

DIMENSION LB

Torque	Without Brake or Flyweel			With Brake or Flyweel **F24/F1** options		
	Feedback Variants			Feedback Variants		
M_0	**RES2**		**A0**	**RES2**		**A0**
0,85	112		130	143		179
1,7	135		153	166		202
2,2	161		179	192		228

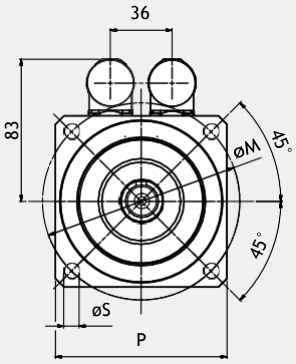
Notes:
(1) Motor shaft extension without key available.

MMD 82 • Ratings

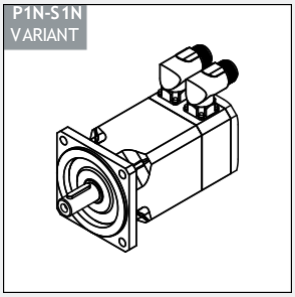
			MMD 82 3.2 Nm					MMD 82 4.4 Nm				
	M_0	[Nm]	3.20					4.40				
	M_n	[Nm]	3.15	3.00	2.80	2.60	2.50	4.20	3.80	3.55	3.30	3.15
	n	[min^{-1}]	1600	3000	4500	5500	6000	1600	3000	4500	5500	6000
	f_n	[Hz]	107	200	300	367	400	107	200	300	367	400
	P_n	[kW]	0.53	0.94	1.32	1.50	1.57	0.70	1.19	1.67	1.90	2.00
	M_{max}	[Nm]	8.50					11.5				
	2p	[-]	8					8				
	J	[$Kgm^2 \cdot 10^{-4}$]	1.4					1.7				
	τ_{el}	[ms]	5.7					5.7				
	τ_{therm}	[min]	26					33				
	m_M	[kg]	3.5					4.6				
230 Vac	V_n	[V_{AC}]	191	207	200	176	176	181	208	188	196	197
	I_0	[A]	2.51	3.90	6.00	8.30	9.00	3.30	5.30	8.40	9.70	10.6
	I_n	[A]	2.37	3.80	5.30	7.00	7.60	3.10	4.60	6.80	7.30	7.60
	I_{max}	[A]	8.30	13.4	20.6	15.5	8.30	9.80	15.9	25.1	29.2	32.0
	K_e	[mV/min^{-1}]	92	57	37	27	24	93	57	36	31	29
	K_T	[Nm/A]	1.33	0.82	0.53	0.39	0.35	1.35	0.83	0.53	0.45	0.42
	R_{pp}	[Ω]	11.3	4.33	1.81	0.96	0.81	6.89	2.63	1.05	0.78	0.66
	L_{pp}	[mH]	64.2	24.5	10.3	5.40	4.60	39.0	14.9	6.00	4.40	3.70
400 Vac	V_n	[V_{AC}]	332	358	312	323	308	315	356	328	335	335
	I_0	[A]	1.39	2.25	3.90	4.50	5.20	1.88	3.10	4.80	5.70	6.20
	I_n	[A]	1.36	2.16	3.40	3.80	4.30	1.76	2.70	3.90	4.30	4.50
	I_{max}	[A]	4.70	7.69	13.2	15.5	17.7	5.60	9.20	14.4	17.1	18.6
	K_e	[mV/min^{-1}]	159	98	57	49	43	161	99	63	53	49
	K_T	[Nm/A]	2.31	1.42	0.83	0.71	0.62	2.34	1.43	0.92	0.77	0.71
	R_{pp}	[Ω]	34.3	13.05	4.42	3.23	2.47	20.8	6.8	3.21	2.26	1.92
	L_{pp}	[mH]	194	73.9	25.0	18.3	14.0	118	44.1	18.1	12.8	10.8
F24	Mb	[Nm]	4.5					4.5				
	Δm_M	[kg]	0.6					0.6				
	ΔJ	[$Kgm^2 \cdot 10^{-4}$]	0.2					0.2				
F1	Δm_M	[kg]	1					1				
	ΔJ	[$Kgm^2 \cdot 10^{-4}$]	3					3				

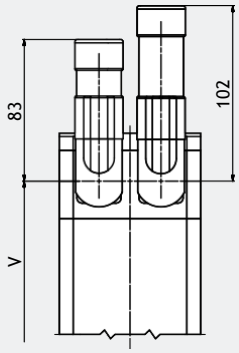
MMD 82 • Dimensions

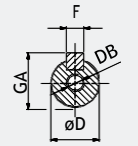
P1-S1 VARIANT



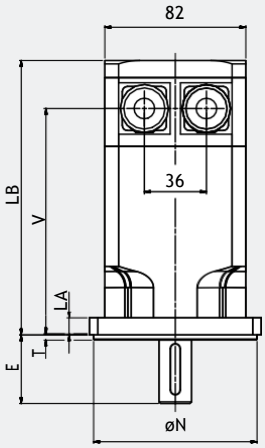
P1N-S1N VARIANT







SHAFT END SECTION



B5 FLANGE VARIANT						
Flange variant	P	M	N	S	T	LA
100	82	100	80	6.5	3	10
115	100	115	95	9	3	10

SHAFT DIAMETER VARIANT					
Shaft diameter	D	E	DB	GA (1)	F (1)
11	11	23	M4	12.5	4
14	14	30	M5	16	5
19	19	40	M6	21.5	6

MOTOR LENGTH DEPENDING ON THE OPTION

DIMENSION V

Torque	Without Brake or Flyweel			With Brake or Flyweel **F24/F1** options		
	Feedback Variants			Feedback Variants		
M_0	**RES1**		**A0**	**RES1**		**A0**
3.2	132		132	132		218
4.4	152		152	152		238

DIMENSION LB

Torque	Without Brake or Flyweel			With Brake or Flyweel **F24/F1** options		
	Feedback Variants			Feedback Variants		
M_0	**RES1**		**A0**	**RES1**		**A0**
3.2	160		183	200		246
4.4	180		203	220		266

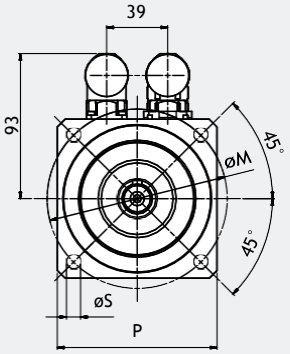
Notes:
(1) Motor shaft extension without key available.

MMD 102 • Ratings

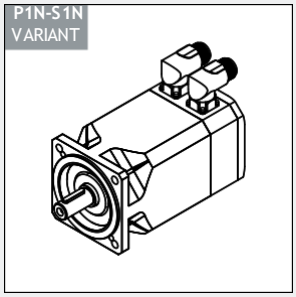
			MMD 102 7.2 Nm					MMD 102 9.6 Nm				
	M_0	[Nm]	7.20					9.60				
	M_n	[Nm]	7.00	6.70	6.00	5.80	5.60	9.20	8.50	7.70	6.90	6.50
	n	[min^{-1}]	1600	3000	4500	5500	6000	1600	3000	4500	5500	6000
	f_n	[Hz]	107	200	300	367	400	107	200	300	367	400
	P_n	[kW]	1.17	2.10	2.83	3.30	3.50	1.54	2.70	3.60	4.00	4.10
	M_{max}	[Nm]	21.0					28.0				
	2p	[-]	8					8				
	J	[Kgm^2 · 10^{-4}]	3.4					4.7				
	τ_{el}	[ms]	8.4					8.4				
	τ_{therm}	[min]	31					38				
	m_M	[kg]	5.8					7.4				
230 Vac	V_n	[V_{AC}]	187	208	182	183	185	183	184	187	192	190
	I_0	[A]	5.00	8.20	13.9	16.9	18.2	6.30	11.5	16.8	19.8	21.8
	I_n	[A]	4.90	8.00	12.6	14.4	15.4	6.00	10.2	13.5	14.3	14.8
	I_{max}	[A]	18.3	29.7	51.0	61.0	66.0	20.4	37.0	54.0	64.0	70.0
	K_e	[mV/min^{-1}]	94	58	34	28	26	102	56	38	33	30
	K_T	[Nm/A]	1.43	0.88	0.52	0.43	0.40	1.52	0.84	0.57	0.48	0.44
	R_{pp}	[Ω]	3.02	1.15	0.40	0.27	0.23	2.24	0.68	0.32	0.23	0.19
	L_{pp}	[mH]	25.4	9.70	3.30	2.30	1.90	18.8	5.70	2.70	1.90	1.60
400 Vac	V_n	[V_{AC}]	320	355	305	320	305	318	324	323	332	333
	I_0	[A]	2.94	4.80	8.30	9.70	11.0	3.60	6.50	9.70	11.5	12.4
	I_n	[A]	2.92	4.70	7.50	8.20	9.30	3.40	5.80	7.80	8.30	8.40
	I_{max}	[A]	10.7	17.4	30.0	35.0	40.0	11.7	21.0	31.0	37.0	40.0
	K_e	[mV/min^{-1}]	161	99	57	49	43	177	99	66	56	52
	K_T	[Nm/A]	2.45	1.51	0.87	0.75	0.65	2.65	1.48	0.99	0.84	0.77
	R_{pp}	[Ω]	8.87	3.35	1.11	0.82	0.63	6.77	2.11	0.95	0.68	0.58
	L_{pp}	[mH]	74.7	28.2	9.40	6.90	5.30	56.8	17.7	8.00	5.70	4.80
F24	Mb	[Nm]	9					9				
	Δm_M	[kg]	1.1					1.1				
	ΔJ	[Kgm^2 · 10^{-4}]	0.5					0.5				
F1	Δm_M	[kg]	1.7					1.7				
	ΔJ	[Kgm^2 · 10^{-4}]	7.5					7.5				

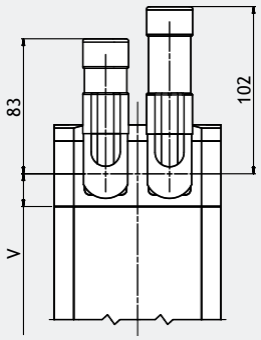
MMD 102 • Dimensions

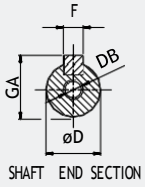
P1-S1 VARIANT



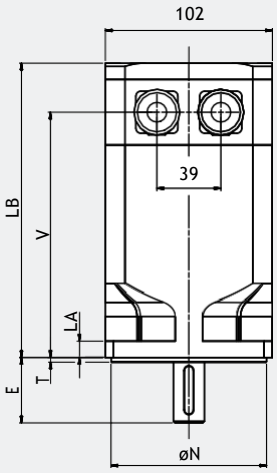
P1N-S1N VARIANT







SHAFT END SECTION



B5 FLANGE VARIANT						
Flange variant	P	M	N	S	T	LA
100	102	100	80	7	3	10
115	102	115	95	9	3	10

SHAFT DIAMETER VARIANT					
Shaft diameter	D	E	DB	GA (1)	F (1)
19	19	40	M6	21.5	6
24	24	50	M8	27	8

MOTOR LENGTH DEPENDING ON THE OPTION

DIMENSION V

Torque	Without Brake or Flyweel			With Brake or Flyweel **F24/F1** options		
	Feedback Variants			Feedback Variants		
M_0	**RES1**		**A0**	**RES1**		**A0**
16	150		150	150		190
9.6	177		177	177		217

DIMENSION LB

Torque	Without Brake or Flyweel			With Brake or Flyweel **F24/F1** options		
	Feedback Variants			Feedback Variants		
M_0	**RES1**		**A0**	**RES1**		**A0**
7.2	180		203	220		266
9.6	207		230	247		293

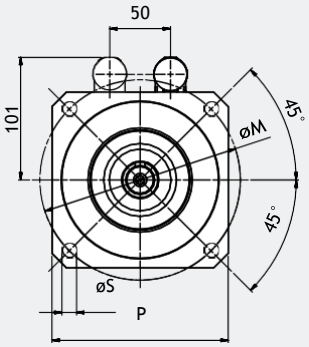
Notes:
(1) Motor shaft extension without key available.

MMD 118 • Ratings

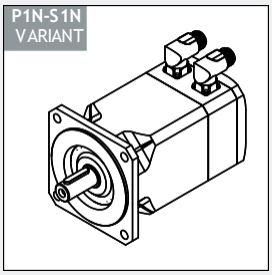
			MMD 118 10.2 Nm					MMD 118 14 Nm				
	M_0	[Nm]	10.2					14.0				
	M_n	[Nm]	10.0	9.50	8.50	8.00	7.50	13.3	12.2	10.9	9.70	9.00
	n	[min^{-1}]	1600	3000	4500	5500	6000	1600	3000	4500	5500	6000
	f_n	[Hz]	107	200	300	367	400	107	200	300	367	400
	P_n	[kW]	1.68	3.00	4.00	4.60	4.70	2.20	3.80	5.00	5.30	5.30
	M_{max}	[Nm]	30.0					39.0				
	2p	[-]	8					8				
	J	[$Kgm^2 \cdot 10^{-4}$]	7.8					9.9				
	τ_{el}	[ms]	13					13				
	τ_{therm}	[min]	34					42				
	m_M	[kg]	9.7					11.7				
230 Vac	V_n	[V_{AC}]	184	178	174	196	-	184	192	-	-	-
	I_0	[A]	7.20	13.7	20.8	22.6	-	9.20	16.3	-	-	-
	I_n	[A]	7.20	13.5	18.3	17.4	-	8.60	14.0	-	-	-
	I_{max}	[A]	25.3	48.0	73.0	79.0	-	30.0	53.0	-	-	-
	K_e	[mV/min^{-1}]	95	50	33.1	30.4	-	104	59	-	-	-
	K_T	[Nm/A]	1.41	0.75	0.49	0.45	-	1.51	0.86	-	-	-
	R_{pp}	[Ω]	1.56	0.43	0.19	0.16	-	1.17	0.37	-	-	-
	L_{pp}	[mH]	20.5	5.70	2.50	2.10	-	15.4	4.90	-	-	-
400 Vac	V_n	[V_{AC}]	312	342	314	323	306	323	320	325	335	329
	I_0	[A]	4.30	6.80	11.6	13.7	15.8	5.30	9.80	14.4	16.9	18.9
	I_n	[A]	4.20	6.70	10.2	10.5	11.4	4.90	8.40	10.9	11.4	11.8
	I_{max}	[A]	14.9	23.6	40.0	48.0	55.0	17.2	32.0	47.0	55.0	62.0
	K_e	[mV/min^{-1}]	161	102	60	50	44	182	98	67	57	51
	K_T	[Nm/A]	2.39	1.51	0.88	0.75	0.65	2.66	1.43	0.97	0.83	0.74
	R_{pp}	[Ω]	4.47	1.78	0.61	0.43	0.33	3.60	1.04	0.48	0.35	0.28
	L_{pp}	[mH]	58.8	23.4	8.00	5.70	4.30	47.4	13.7	6.30	4.60	3.70
F24	Mb	[Nm]	18					18				
	Δm_M	[kg]	2.2					2.2				
	ΔJ	[$Kgm^2 \cdot 10^{-4}$]	1.7					1.7				
F1	Δm_M	[kg]	3.5					3.5				
	ΔJ	[$Kgm^2 \cdot 10^{-4}$]	16					16				

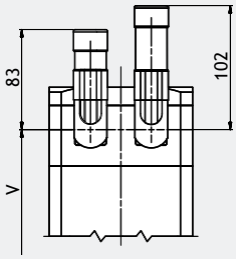
MMD 118 • Dimensions

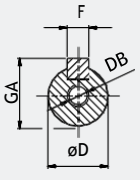
P1-S1 VARIANT



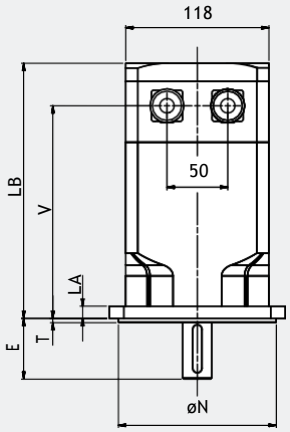
P1N-S1N VARIANT







SHAFT END SECTION



B5 FLANGE VARIANT						
Flange variant	P	M	N	S	T	LA
130S	118	130	95	9	3.5	10
130	118	130	110	9	3.5	10
165	145	165	130	11.5	3.5	10

SHAFT DIAMETER VARIANT					
Shaft diameter	D	E	DB	GA (1)	F (1)
19	19	40	M6	21.5	6
24	24	50	M8	27	8
28	28	60	M10	31	8

MOTOR LENGTH DEPENDING ON THE OPTION

DIMENSION V

Torque	Without Brake or Flyweel			With Brake or Flyweel **F24/F1** options		
	Feedback Variants			Feedback Variants		
M_0	**RES1**		**A0**	**RES1**		**A0**
10.2	175		175	225		225
14	208		208	258		258

DIMENSION LB

Torque	Without Brake or Flyweel			With Brake or Flyweel **F24/F1** options		
	Feedback Variants			Feedback Variants		
M_0	**RES1**		**A0**	**RES1**		**A0**
10.2	210		210	260		260
14	243		243	293		293

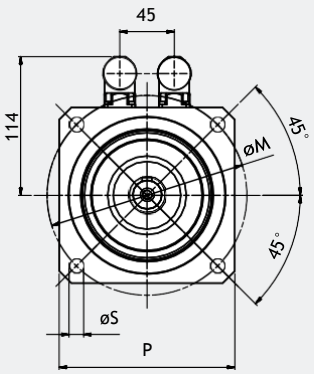
Notes:
(1) Motor shaft extension without key available.

MMD 145 • Ratings

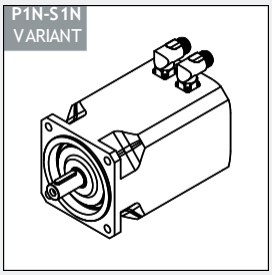
			MMD 145 16.8 Nm					MMD145 22 Nm				
	M_0	[Nm]	16.8					22.0				
	M_n	[Nm]	16.5	16.0	14.0	13.0	12.5	20.7	19.2	17.0	15.0	-
	n	[min^{-1}]	1600	3000	4500	5500	6000	1600	3000	4500	5500	-
	f_n	[Hz]	107	200	300	367	400	107	200	300	367	-
	P_n	[kW]	2.76	5.00	6.60	7.50	7.90	3.50	6.00	8.00	8.60	-
	M_{max}	[Nm]	46.0					59.0				
	2p	[-]	8					8				
	J	[$Kgm^2 \cdot 10^{-4}$]	12.8					17.6				
	τ_{el}	[ms]	16					16				
	τ_{therm}	[min]	36					47				
	m_M	[kg]	15.2					18.2				
230 Vac	V_n	[V_{AC}]	180	176	-	-	-	185	202	-	-	-
	I_0	[A]	12.1	22.8	-	-	-	15.4	26.5	-	-	-
	I_n	[A]	11.9	21.9	-	-	-	14.5	22.9	-	-	-
	I_{max}	[A]	46.0	88.0	-	-	-	51.0	87.0	-	-	-
	K_e	[mV/min^{-1}]	89	47	-	-	-	102	60	-	-	-
	K_T	[Nm/A]	1.39	0.74	-	-	-	1.42	0.83	-	-	-
	R_{pp}	[Ω]	0.84	0.24	-	-	-	0.67	0.23	-	-	-
	L_{pp}	[mH]	13.3	3.80	-	-	-	10.6	3.60	-	-	-
400 Vac	V_n	[V_{AC}]	314	358	314	319	305	319	321	323	357	-
	I_0	[A]	6.90	10.9	19.0	22.8	26.0	9.00	16.4	24.3	26.5	-
	I_n	[A]	6.80	10.5	16.4	17.5	19.0	8.40	14.2	18.3	17.6	-
	I_{max}	[A]	26.7	42.0	73.0	88.0	100	29.5	54.0	80.0	87.0	-
	K_e	[mV/min^{-1}]	156	99	57	47	42	176	96	65	59	-
	K_T	[Nm/A]	2.42	1.54	0.88	0.74	0.65	2.45	1.34	0.90	0.83	-
	R_{pp}	[Ω]	2.53	1.02	0.34	0.24	0.18	1.97	0.59	0.27	0.23	-
	L_{pp}	[mH]	40.4	16.3	5.40	3.80	2.90	31.5	9.40	4.30	3.60	-
F24	Mb	[Nm]	18					18				
	Δm_M	[kg]	2.6					2.6				
	ΔJ	[$Kgm^2 \cdot 10^{-4}$]	1.7					1.7				
F1	Δm_M	[kg]	5.0					5.0				
	ΔJ	[$Kgm^2 \cdot 10^{-4}$]	36					36				

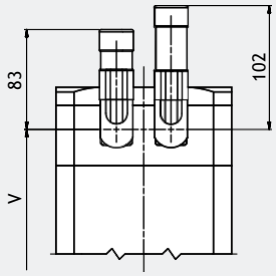
MMD 145 • Dimensions

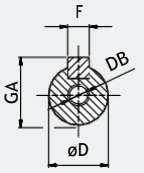
P1-S1 VARIANT



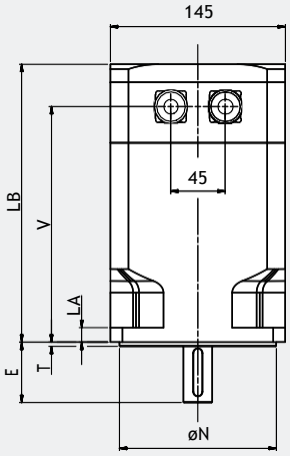
P1N-S1N VARIANT







SHAFT END SECTION



B5 FLANGE VARIANT						
Flange variant	P	M	N	S	T	LA
165	145	165	130	12	3.5	12

SHAFT DIAMETER VARIANT					
Shaft diameter	D	E	DB	GA (1)	F (1)
19	19	40	M6	21.5	6
24	24	50	M8	27	8
28	28	60	M10	31	8

MOTOR LENGTH DEPENDING ON THE OPTION

DIMENSION V

Torque	Without Brake or Flyweel			With Brake or Flyweel **F24/F1** options		
	Feedback Variants			Feedback Variants		
M_0	**RES1**		**A0**	**RES1**		**A0**
16.8	195		195	245		245
22	230		230	280		280

DIMENSION LB

Torque	Without Brake or Flyweel			With Brake or Flyweel **F24/F1** options		
	Feedback Variants			Feedback Variants		
M_0	**RES1**		**A0**	**RES1**		**A0**
16.8	230		230	280		280
22	265		265	315		315

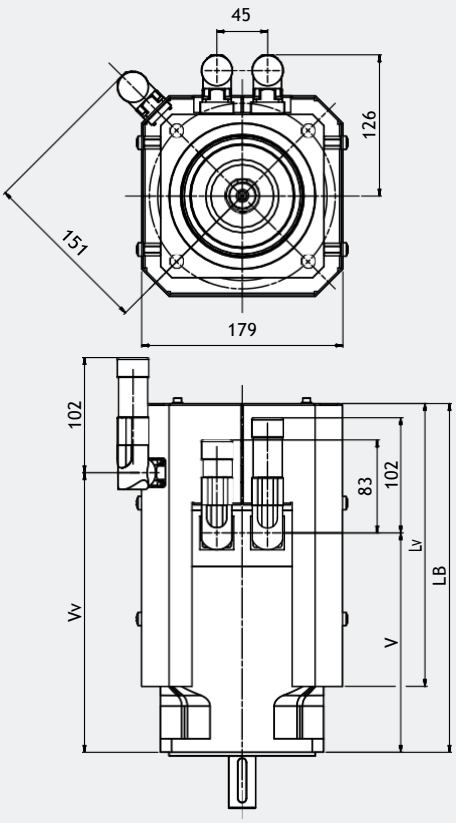
Notes:
(1) Motor shaft extension without key available.

MMD 145 with Forced Ventilation option • Ratings

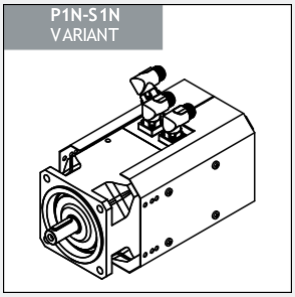
			MMD 145 16.8 Nm with Forced Ventilation					MMD145 22 Nm with Forced Ventilation				
	M_0	[Nm]	21.5					27.5				
	M_n	[Nm]	20.5	19.2	17.2	15.7	-	27.4	26.1	24.3	-	-
	n	[min^{-1}]	1600	3000	4500	5500	-	1600	3000	4500	-	-
	f_n	[Hz]	107	200	300	367	-	107	200	300	-	-
	P_n	[kW]	3.43	6.00	8.10	9.00	-	4.60	8.20	11.5	-	-
	M_{max}	[Nm]	46.0					59.0				
	2p	[-]	8					8				
	J	[Kgm^2 · 10^{-4}]	12.8					17.6				
	τ_{el}	[ms]	16					16				
	τ_{therm}	[min]	17					22				
	m_M	[kg]	18.7					21.7				
230 Vac	V_n	[V_{AC}]	203	195	-	-	-	214	-	-	-	-
	I_0	[A]	16.3	30.0	-	-	-	19.8	-	-	-	-
	I_n	[A]	15.5	26.6	-	-	-	19.6	-	-	-	-
	I_{max}	[A]	46.0	88.0	-	-	-	51.0	-	-	-	-
	K_e	[mV/min^{-1}]	89	47	-	-	-	102	-	-	-	-
	K_T	[Nm/A]	1.32	0.72	-	-	-	1.39	-	-	-	-
	R_{pp}	[Ω]	0.84	0.24	-	-	-	0.67	-	-	-	-
	L_{pp}	[mH]	13.3	3.80	-	-	-	10.6	-	-	-	-
400 Vac	V_n	[V_{AC}]	345	331	322	323	-	363	352	348	-	-
	I_0	[A]	9.45	17.6	25.8	30.0	-	11.5	21.1	30.0	-	-
	I_n	[A]	8.90	15.2	20.0	21.6	-	11.4	19.8	27.1	-	-
	I_{max}	[A]	26.7	50.0	73.0	88.0	-	29.5	54.0	80.0	-	-
	K_e	[mV/min^{-1}]	156	83	57	47	-	176	96	65	-	-
	K_T	[Nm/A]	2.28	1.23	0.83	0.72	-	2.39	1.31	0.92	-	-
	R_{pp}	[Ω]	2.53	0.72	0.34	0.24	-	1.97	0.59	0.27	-	-
	L_{pp}	[mH]	40.4	11.5	5.40	3.80	-	31.5	9.40	4.30	-	-
F24	Mb	[Nm]	18					18				
	Δm_M	[kg]	2.6					2.6				
	ΔJ	[Kgm^2 · 10^{-4}]	1.7					1.7				
F1	Δm_M	[kg]	5.0					5.0				
	ΔJ	[Kgm^2 · 10^{-4}]	36					36				

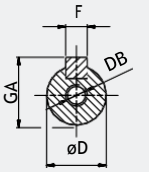
MMD 145 with Forced Ventilation option • Dimensions

P1-S1 VARIANT



P1N-S1N VARIANT





SHAFT END SECTION

B5 FLANGE VARIANT						
Flange variant	P	M	N	S	T	LA
165	145	165	130	12	3.5	12

SHAFT DIAMETER VARIANT					
Shaft diameter	D	E	DB	GA (1)	F (1)
19	19	40	M6	21.5	6
24	24	50	M8	27	8
28	28	60	M10	31	8

MOTOR LENGTH DEPENDING ON THE OPTION

DIMENSION V - (Vv)						
Torque	Without Brake or Flyweel			With Brake or Flyweel **F24/F1** options		
	Feedback Variants			Feedback Variants		
M_0	**RES1**		**A0**	**RES1**		**A0**
16.8	195 - (249)		195 - (249)	245 - (299)		245 - (299)
22	230 - (284)		230 - (284)	280 - (334)		280 - (334)

DIMENSION LB - (Lv)						
Torque	Without Brake or Flyweel			With Brake or Flyweel **F24/F1** options		
	Feedback Variants			Feedback Variants		
M_0	**RES1**		**A0**	**RES1**		**A0**
16.8	310- (252)		310 - (252)	360 - (252)		360 - (252)
22	345 - (252)		345 - (252)	395 - (312)		395 - (312)

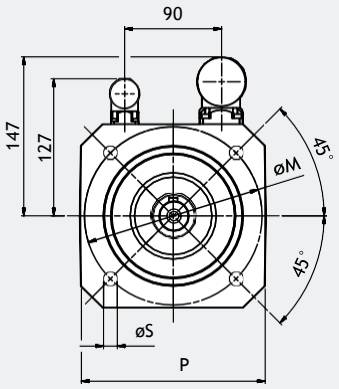
Notes:
(1) Motor shaft extension without key available.

MMD 170 • Ratings

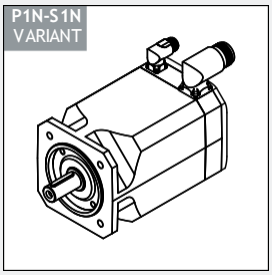
			MMD 170 34 Nm					MMD170 45 Nm				
	M_0	[Nm]	34.0					45.0				
	M_n	[Nm]	31.0	27.5	-	-	-	42.0	36.0	-	-	-
	n	[min^{-1}]	1600	3000	-	-	-	1600	3000	-	-	-
	f_n	[Hz]	107	200	-	-	-	107	200	-	-	-
	P_n	[kW]	5.20	8.60	-	-	-	7.00	11.3	-	-	-
	M_{max}	[Nm]	90.0					125				
	2p	[-]	8					8				
	J	[$Kgm^2 \cdot 10^{-4}$]	33.8					47.5				
	τ_{el}	[ms]	20					19				
	τ_{therm}	[min]	50					65				
	m_M	[kg]	25					30				
230 Vac	V_n	[V_{AC}]	181	182	-	-	-	-	-	-	-	-
	I_0	[A]	21.8	40.4	-	-	-	-	-	-	-	-
	I_n	[A]	19.7	32.2	-	-	-	-	-	-	-	-
	I_{max}	[A]	66.0	121	-	-	-	-	-	-	-	-
	K_e	[mV/min^{-1}]	99	54	-	-	-	-	-	-	-	-
	K_T	[Nm/A]	1.56	0.84	-	-	-	-	-	-	-	-
	R_{pp}	[Ω]	0.30	0.09	-	-	-	-	-	-	-	-
	L_{pp}	[mH]	5.80	1.70	-	-	-	-	-	-	-	-
400 Vac	V_n	[V_{AC}]	319	315	-	-	-	310	314	-	-	-
	I_0	[A]	12.4	23.3	-	-	-	17.1	31.0	-	-	-
	I_n	[A]	11.2	18.6	-	-	-	15.9	24.9	-	-	-
	I_{max}	[A]	37.0	70.0	-	-	-	52.0	96.0	-	-	-
	K_e	[mV/min^{-1}]	174	93	-	-	-	185	101	-	-	-
	K_T	[Nm/A]	2.74	1.46	-	-	-	2.64	1.50	-	-	-
	R_{pp}	[Ω]	0.91	0.26	-	-	-	0.57	0.17	-	-	-
	L_{pp}	[mH]	17.9	5.10	-	-	-	11.1	3.30	-	-	-
F24	Mb	[Nm]	36					36				
	Δm_M	[kg]	4.5					4.5				
	ΔJ	[$Kgm^2 \cdot 10^{-4}$]	5.6					5.6				
F1	Δm_M	[kg]	8.2					8.2				
	ΔJ	[$Kgm^2 \cdot 10^{-4}$]	70					70				

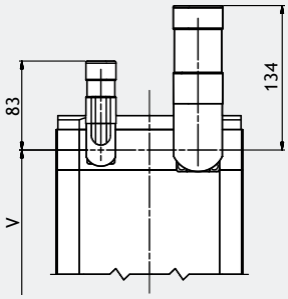
MMD 170 • Dimensions

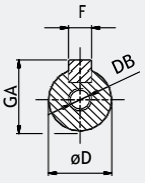
P1-S1 VARIANT



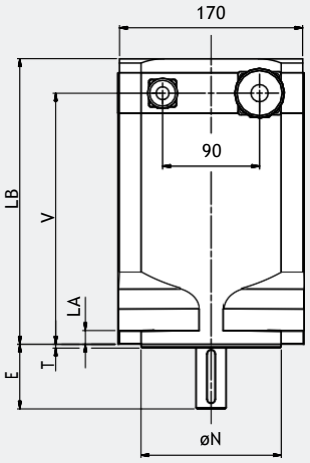
P1N-S1N VARIANT







SHAFT END SECTION



B5 FLANGE VARIANT						
Flange variant	P	M	N	S	T	LA
165	170	165	130	12	3.5	12

SHAFT DIAMETER VARIANT					
Shaft diameter	D	E	DB	GA (1)	F (1)
24	24	50	M8	27	8
28	28	60	M10	31	8
32	32	60	M12	35	10

MOTOR LENGTH DEPENDING ON THE OPTION

DIMENSION V

Torque	Without Brake or Flyweel			With Brake or Flyweel **F24/F1** options		
	Feedback Variants			Feedback Variants		
M_0	**RES1**		**A0**	**RES1**		**A0**
34	233		233	308		308
45	287		287	362		362

DIMENSION LB

Torque	Without Brake or Flyweel			With Brake or Flyweel **F24/F1** options		
	Feedback Variants			Feedback Variants		
M_0	**RES1**		**A0**	**RES1**		**A0**
34	265		303	340		378
45	319		357	394		432

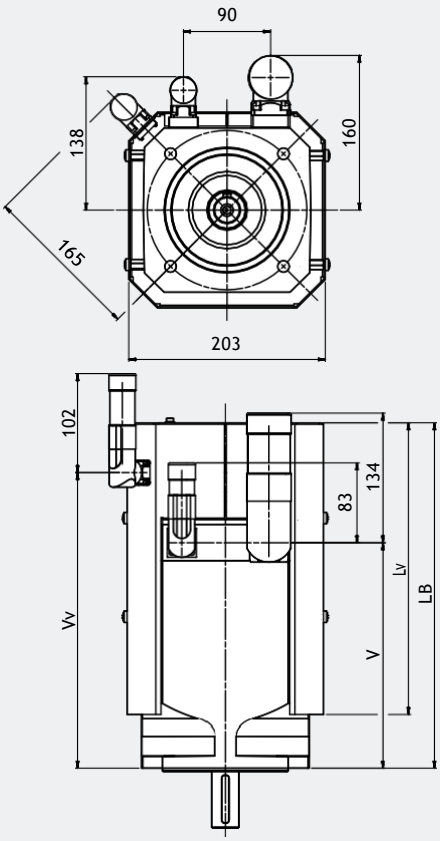
Notes:
(1) Motor shaft extension without key available.

MMD 170 with Forced Ventilation option • Ratings

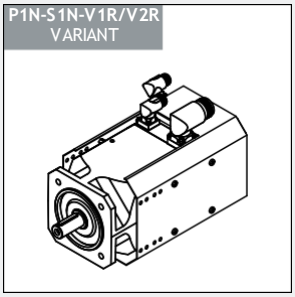
			MMD 170 34 Nm with Forced Ventilation					MMD170 45 Nm with Forced Ventilation				
	M_0	[Nm]	44.0					60.0				
	M_n	[Nm]	42.0	39.0	-	-	-	57.0	53.0	-	-	-
	n	[min^{-1}]	1600	3000	-	-	-	1600	3000	-	-	-
	f_n	[Hz]	107	200	-	-	-	107	200	-	-	-
	P_n	[kW]	7.00	12.2	-	-	-	9.50	16.6	-	-	-
	M_{max}	[Nm]	90.0					125				
	2p	[-]	8					8				
	J	[$Kgm^2 \cdot 10^{-4}$]	33.8					47.5				
	τ_{el}	[ms]	20					19				
	τ_{therm}	[min]	23					29				
	m_M	[kg]	29					34				
230 Vac	V_n	[V_{AC}]	207	205	-	-	-	-	-	-	-	-
	I_0	[A]	29.8	55.1	-	-	-	-	-	-	-	-
	I_n	[A]	28.7	48.9	-	-	-	-	-	-	-	-
	I_{max}	[A]	66.0	121	-	-	-	-	-	-	-	-
	K_e	[mV/min^{-1}]	99	54	-	-	-	-	-	-	-	-
	K_T	[Nm/A]	1.48	0.80	-	-	-	-	-	-	-	-
	R_{pp}	[Ω]	0.3	0.09	-	-	-	-	-	-	-	-
	L_{pp}	[mH]	5.8	1.7	-	-	-	-	-	-	-	-
400 Vac	V_n	[V_{AC}]	350	342	-	-	-	361	351	-	-	-
	I_0	[A]	17.0	31.8	-	-	-	23.0	42.0	-	-	-
	I_n	[A]	16.3	28.2	-	-	-	21.5	36.3	-	-	-
	I_{max}	[A]	37.0	70.0	-	-	-	52.0	96.0	-	-	-
	K_e	[mV/min^{-1}]	174	93	-	-	-	185	101	-	-	-
	K_T	[Nm/A]	2.59	1.39	-	-	-	2.62	1.43	-	-	-
	R_{pp}	[Ω]	0.91	0.26	-	-	-	0.57	0.17	-	-	-
	L_{pp}	[mH]	17.9	5.10	-	-	-	11.1	3.30	-	-	-
F24	Mb	[Nm]	36					36				
	Δm_M	[kg]	4.5					4.5				
	ΔJ	[$Kgm^2 \cdot 10^{-4}$]	5.6					5.6				
F1	Δm_M	[kg]	8.2					8.2				
	ΔJ	[$Kgm^2 \cdot 10^{-4}$]	70					70				

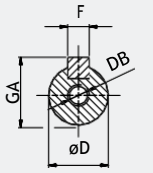
MMD 170 with Forced Ventilation option • Dimensions

P1-S1-V1R/V2R VARIANT



P1N-S1N-V1R/V2R VARIANT





SHAFT END SECTION

B5 FLANGE VARIANT						
Flange variant	P	M	N	S	T	LA
165	170	165	130	12	3.5	12

SHAFT DIAMETER VARIANT					
Shaft diameter	D	E	DB	GA (1)	F (1)
24	24	50	M8	27	8
28	28	60	M10	31	8
32	32	60	M12	35	10

MOTOR LENGTH DEPENDING ON THE OPTION

DIMENSION V - (Vv)

Torque	Without Brake or Flyweel			With Brake or Flyweel **F24/F1** options		
	Feedback Variants			Feedback Variants		
M_0	**RES1**		**A0**	**RES1**		**A0**
34	233 - (306)		233 - (306)	308 - (381)		308 - (381)
45	287 - (360)		287 - (360)	362 - (435)		362 - (435)

DIMENSION LB - (Lv)

Torque	Without Brake or Flyweel			With Brake or Flyweel **F24/F1** options		
	Feedback Variants			Feedback Variants		
M_0	**RES1**		**A0**	**RES1**		**A0**
34	395 - (340)		395 - (340)	478 - (348)		478 - (348)
45	449 - (340)		449 - (340)	524 - (415)		524 - (415)

Notes:
(1) Motor shaft extension without key available.

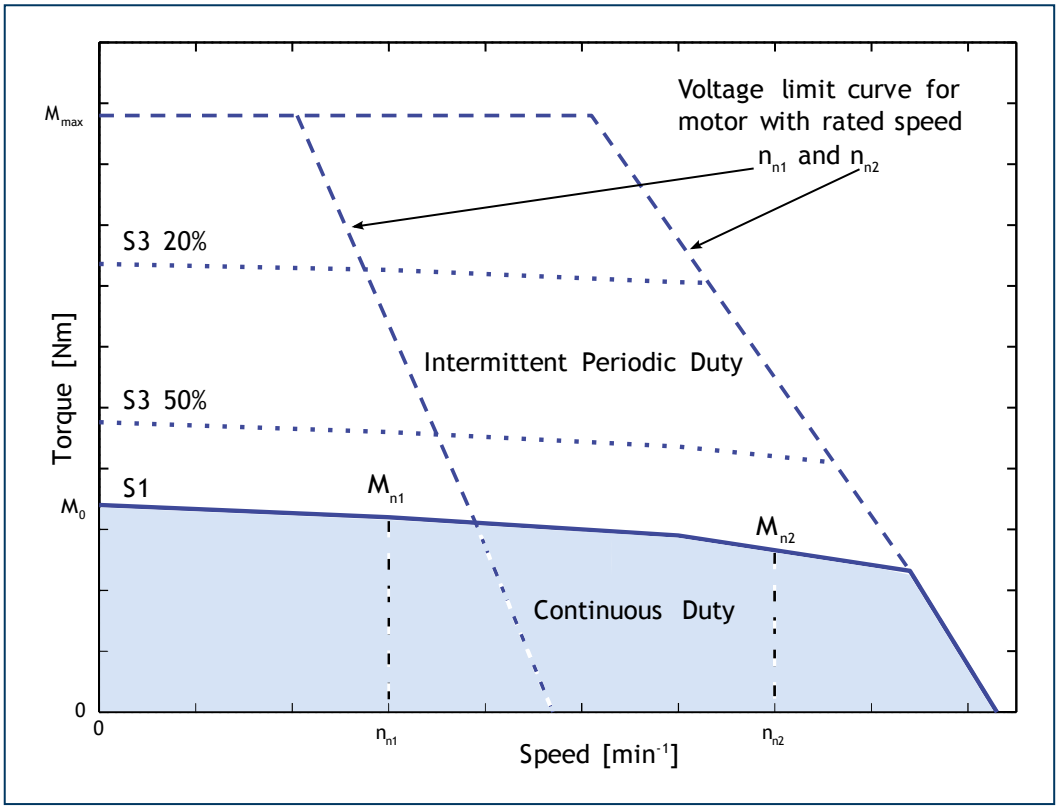
Torque-speed characteristic

The permissible operating range of a brushless servomotor is limited by thermal, mechanical, and electromagnetic limits.

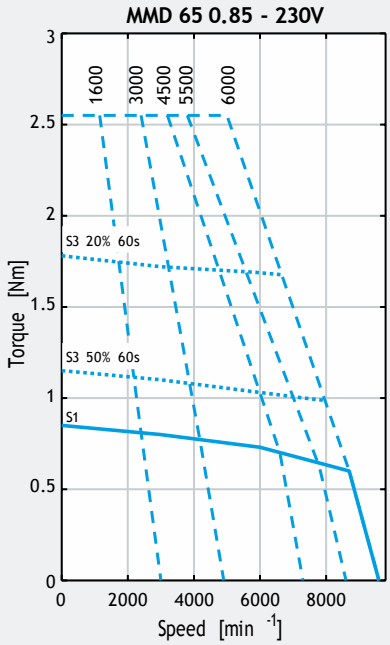
The thermal limit is dependent on the thermal class of the insulation system (F). To adhere to the temperature limits, the torque must be reduced as the speed increases, starting from stall torque M_0. The maximum permissible torque is then dependent on the operation mode. The characteristic curves are assigned for continuous duty S1 and intermittent periodic duty S3 with a cycle time of 10 minutes, except for small motors, for which a cycle time of 1 minute is specified and noted in the characteristic curves. A transient, high overload capacity up to M_{max} is provided.

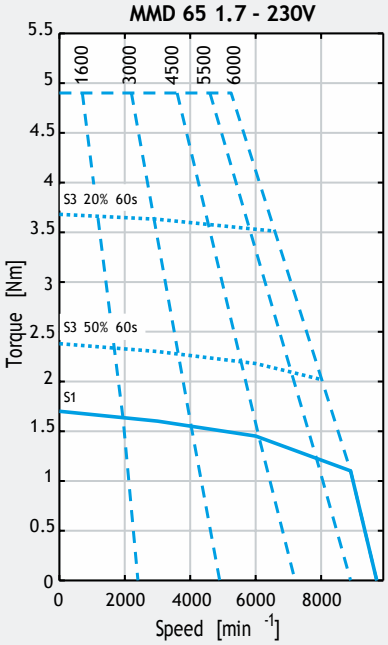
The speed range is limited by the maximum mechanical speed and the voltage limit. The voltage limit is usually lower than the mechanical limit. The voltage limiting characteristic curve is determined by the motor nominal speed. The characteristic curves for each nominal speed are reported in the same diagram. For drive sizing convenience, it is preferable to select the motor whose voltage limit curve does not lie too far above the maximum speed required for the application.

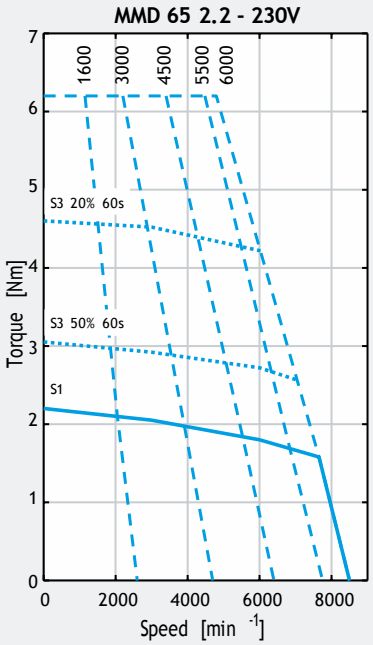
Therefore, the performance characteristics of a brushless motor are described by a torque and speed operating area. The continuous duty zone is bordered by the maximum continuous torque curve up to the intersection with the voltage limit curve. Continuous duty in the area above the S1 characteristic curve is not thermally permitted for the motor. The intermittent periodic duty zone is bordered by the peak torque line and the voltage limit curve.

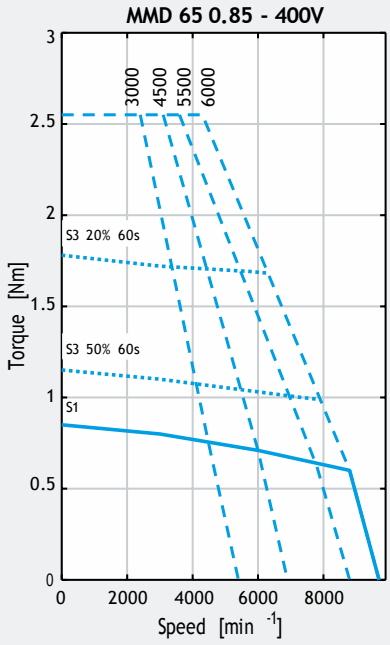


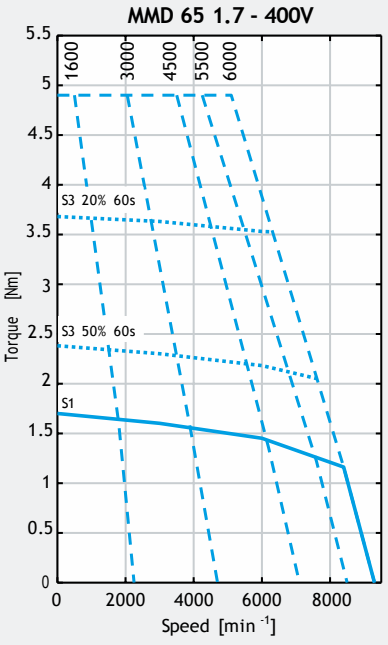
MMD 65 • Torque-speed curves

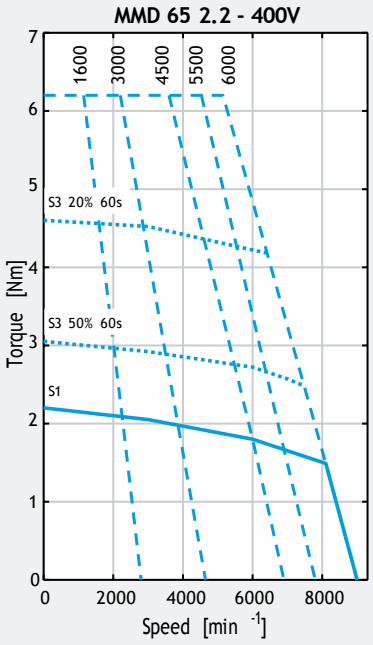






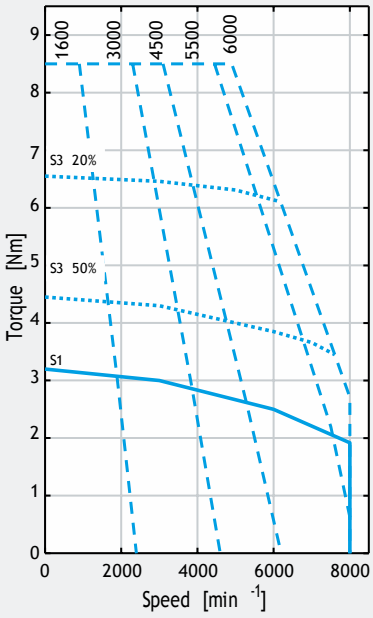




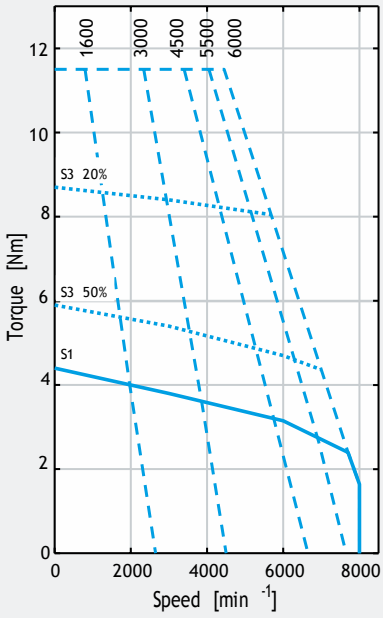


MMD 82 • Torque-speed curves

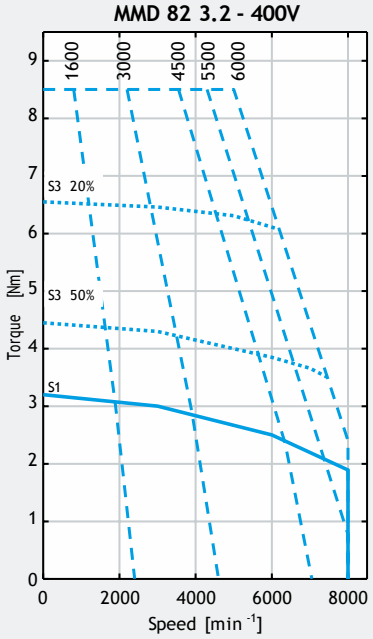
MMD 82 3.2 - 230V



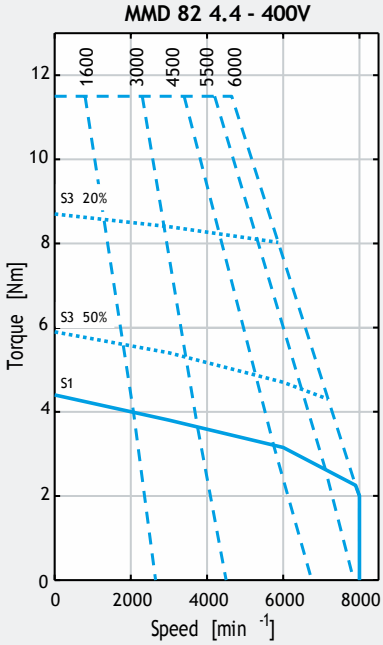
MMD 82 4.4 - 230V



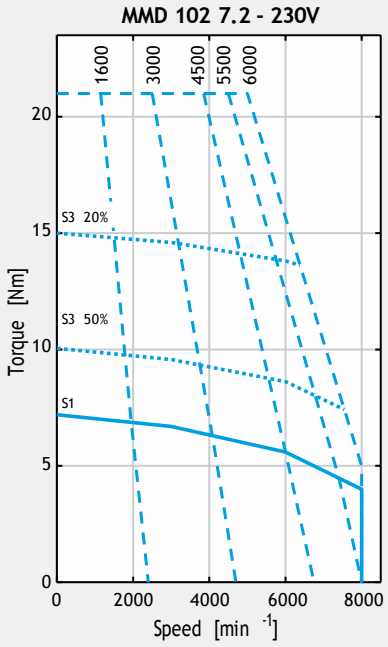
MMD 82 3.2 - 400V

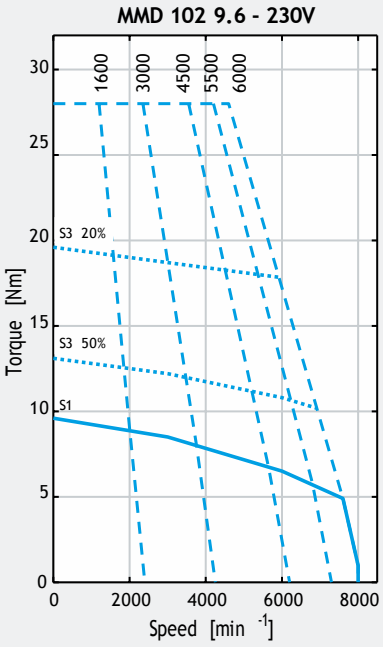


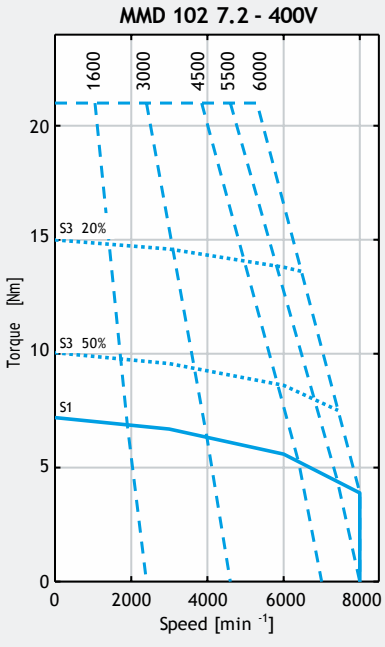
MMD 82 4.4 - 400V

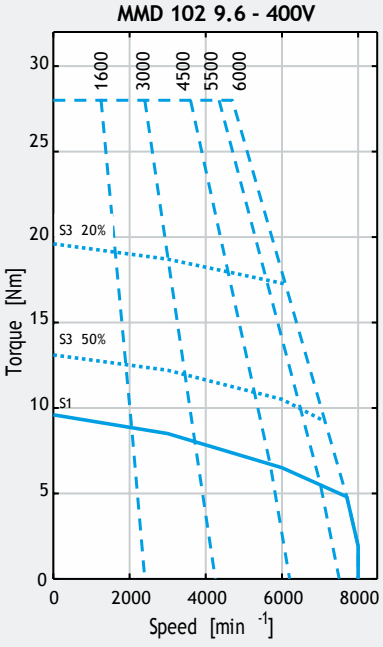


MMD 102 • Torque-speed curves



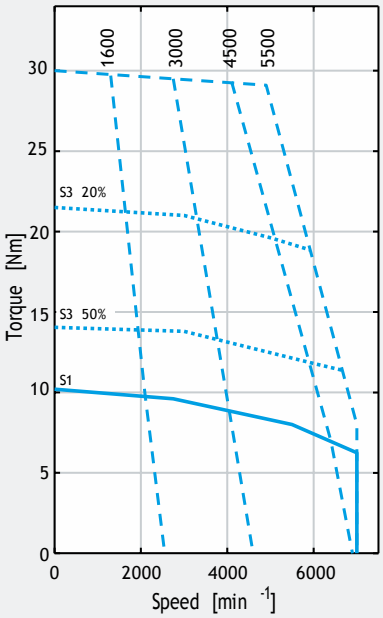




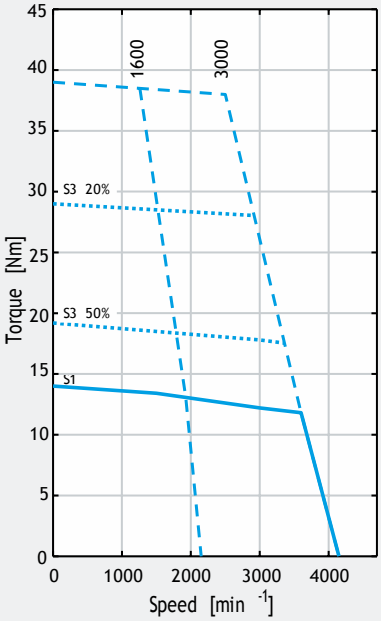


MMD 118 • Torque-speed curves

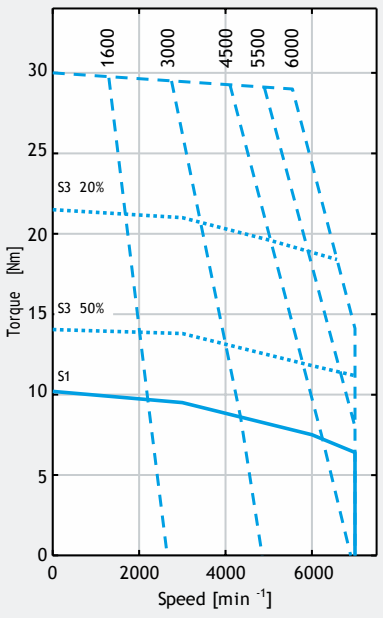
MMD 118 10.2 - 230V



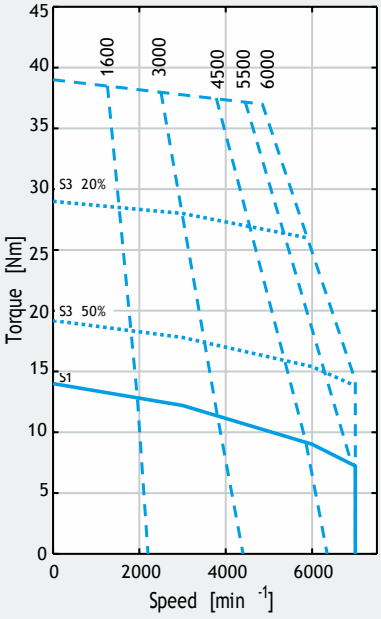
MMD 118 14 - 230V



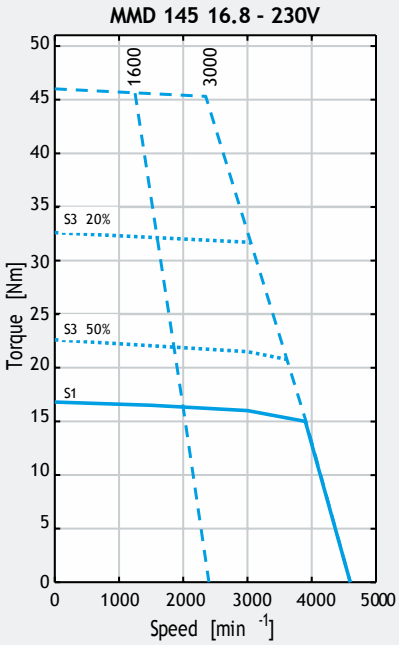
MMD 118 10.2 - 400V

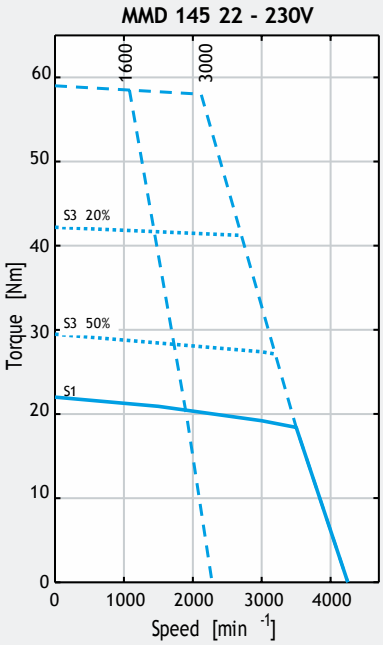


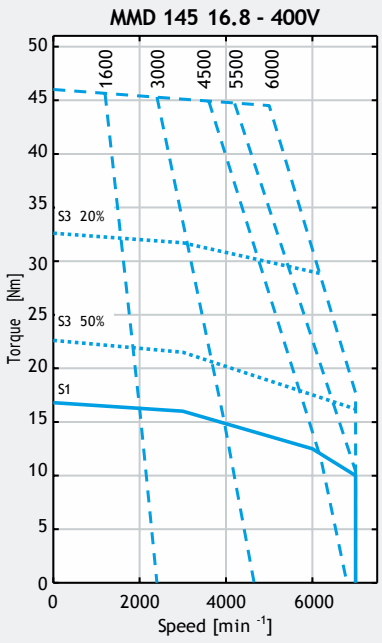
MMD 118 14 - 400V

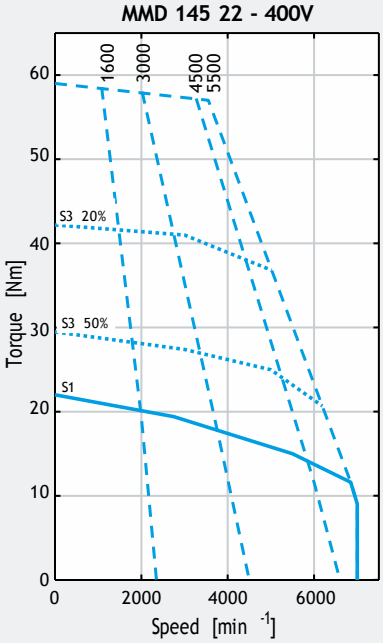


MMD 145 • Torque-speed curves





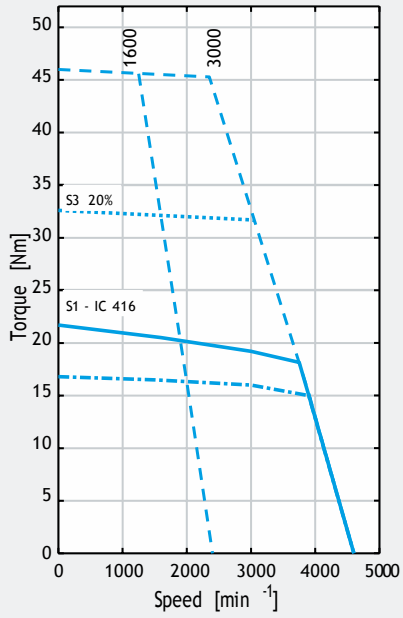




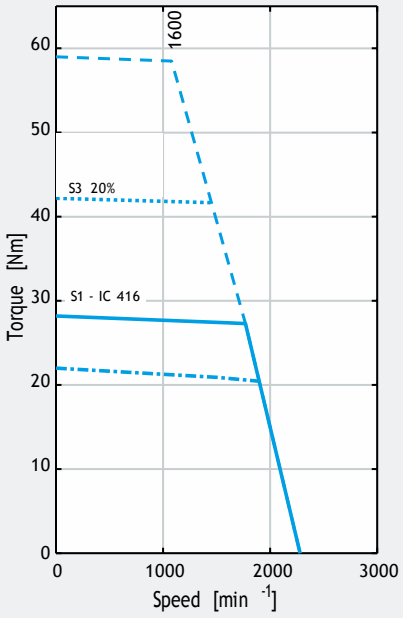
MMD 145 with Forced Ventilation option

Torque-speed curves

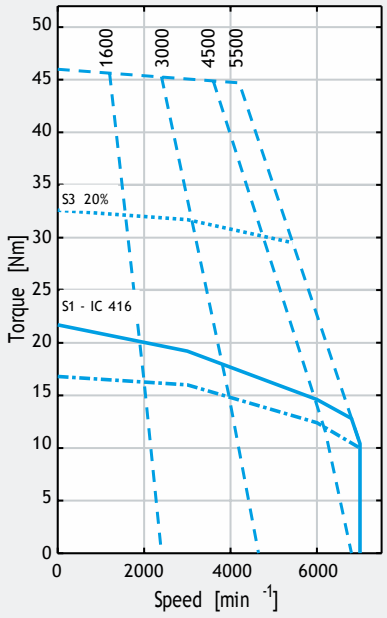
MMD 145 16.8 - 230V with fan unit



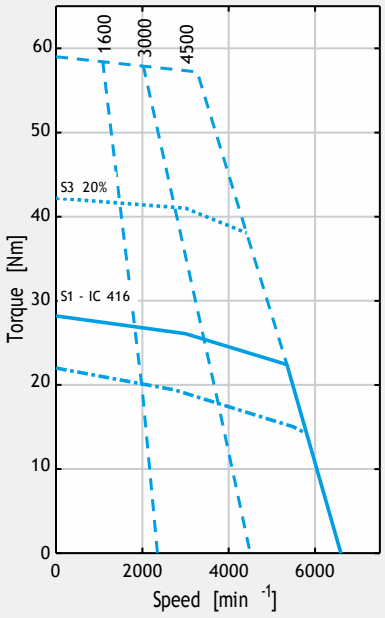
MMD 145 22 - 230V with fan unit



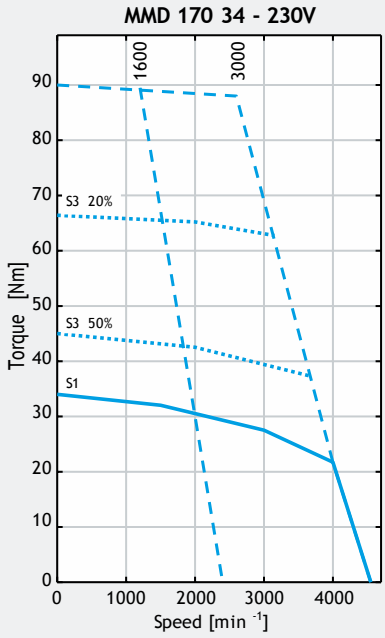
MMD 145 16.8 - 400V with fan unit

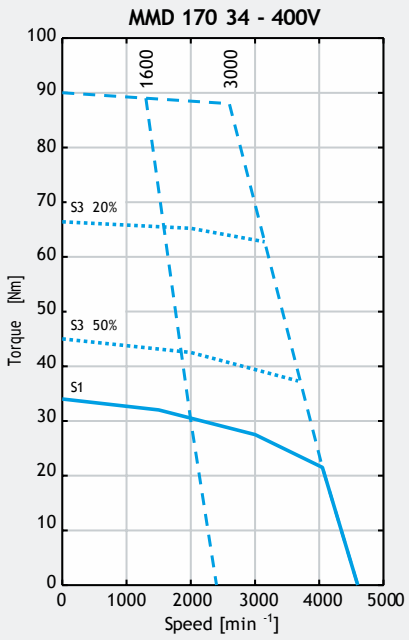


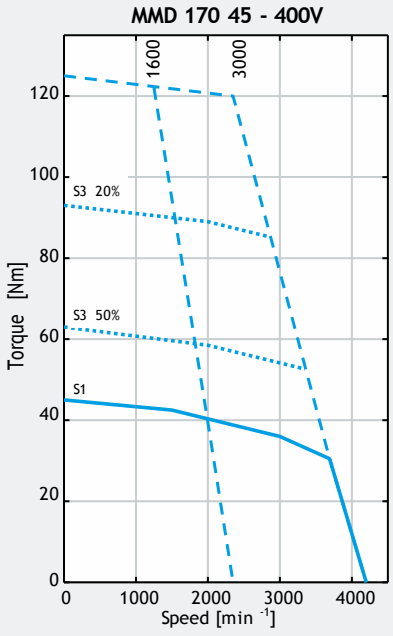
MMD 145 22 - 400V with fan unit



MMD 170 • Torque-speed curves

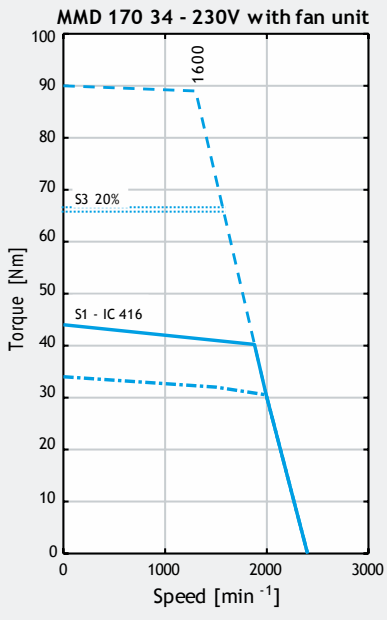


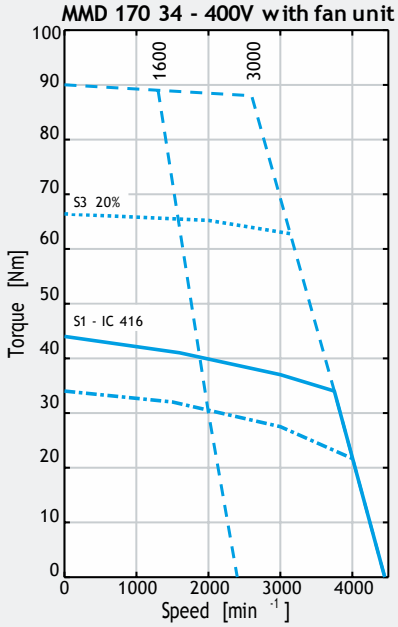


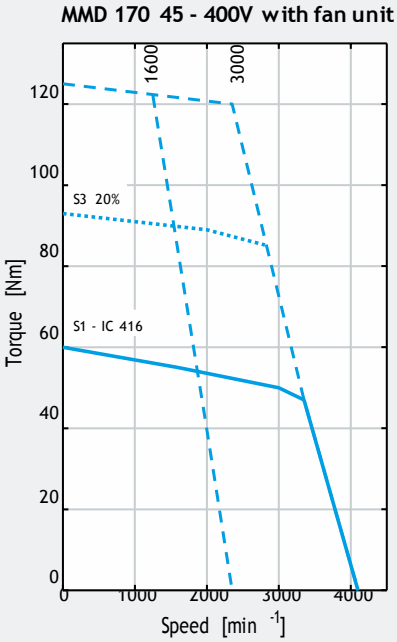


MMD 170 with Forced Ventilation option

Torque-speed curves

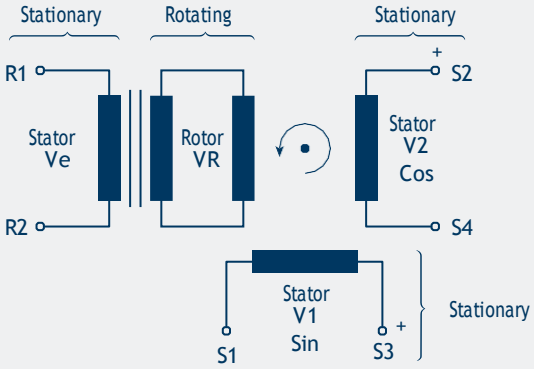






Feedback devices

RESOLVER: [RES1,RES2]
The resolver is an electromagnetic transformer consisting of a stator and a rotor elements excited from an external source. It produces two output signals that correspond to the sine and cosine angle of the motor shaft. This is a robust device of good accuracy, capable of withstanding high temperature and high levels of vibration. Position information is absolute within one turn.



ITEM	MMD 65 RES2	MMD82 - MMD170 RES1
Poles number	2	2
Transformation ratio	0.5 ±5%	0.5 +15% -5%
Input voltage [Vac_{rms}]	7	11
Input current [mA]	65	57
Input frequency [kHz]	10	8
Phase shift	0°	-11°
Input impedance Zro	70 + j100	75 + j185
Output impedance Zss (Ω)	175 +j275	135 + j265
Electrical error	±10'	±10'
Accuracy ripple	1' max	1' max
Operating temperature	-55°C ... + 155°C	-55°C ... + 155°C
Max Speed [min^{-1}]	10000	20000
Mass [kg]	0.065	0.28
Rotor Inertia [$kgm^2 \times 10^{-6}$]	3.0	5.0

Please check the compatibility with our Motion Control with our Technical team.

Optical encoders

The optical absolute encoder use a high precision optical disc to measure the angular position. Single turn absolute encoder has an absolute positional information only within one turn. Multi turn absolute encoder is provided of extra gear wheels that account of several shaft revolution. Therefore the output is unique for each shaft position and revolution up to available revolutions.

SICK ENCODERS

ITEM	MMD65 MMD82 - MMD170
	A0
Manufacturer	SICK AG
Data interface	Hiperface
Model	SKM36
Type	Multi turn
Measuring principle	Optical
Power supply	7VDC ... 12VDC
Current consumption	60mA
Periods per revolution	128
Position per revolution	4096 (12 bits)
Revolutions	4096 (12 bits)
Operating temperature	-20°C ... +110°C
Max Speed [min^{-1}]	10000
Resistance to shocks	100 g / 6 ms
Resistance to vibrations	50 g / 10 ... 2000 Hz
Mass [kg]	0.07
Rotor Inertia [$kgm^2 \times 10^{-6}$]	0.45

Please check the compatibility with our Motion Control with our Technical team.

Thermal protection

As standard, the MMD motors are equipped with an integrated PT1000 thermistor to protect the windings against overtemperatures exceeding the limit of the motor class F insulation.

OPTIONS	THERMAL PROTECTOR	NOTE
TC1	PT1000	A platinum resistance temperature sensor is place in contact with the motor winding. The PT1000 characteristic is in accordance with IEC 60751 : 2008, tolerance class B. The working temperature is from -40°C to 250°C.

Electromechanical holding brake - F24 option

An electromagnetic holding brake is available. The brake variant can be ordered by selecting the F24 value in the brake option field.

The electromechanical brake is for use as an holding brake with motor shaft stationary. Do not use it as a dynamic brake, except for emergencies such as main supply faliure.

Data of the available brake for each motor size are summarized in the following table.
When the motor is delivered without brake, the brake fitting is not possible.

The brake coil voltage supply must be 24V DC-voltage.
The brake option is responsible of an increment of the motor length.
Brake leads are wired in the power connector togheterwith motor leads.

Please note that the brake option is not available when the "additional inertia" option is selected.

Motor	Rated brake torque 20°C M_b	Rated brake torque 100°C M_b	Brake voltage V_b	Brake current I_b	Brake power 20°C P_b	Inertia increase ΔJ	Mass increase Δm_M	Engaging time t_1	Release time t_2
	Nm	Nm	Vdc	A	W	$Kgm^2 \cdot 10^{-4}$	kg	ms	ms
65	2	1.8	24	0.46	11	0.068	0.2	6	25
82	4.5	4		0.5	12	0.18	0.6	7	35
102	9	8		0.75	18	0.54	1.1	7	40
118	18	15		1.0	24	1.66	2.2	10	50
145	18	15		1.0	24	1.66	2.6	10	50
170	36	32		1.1	26	5.56	4.5	22	90

Notes
t_1 Time from disconnecting the current until the rated torque is attained
t_2 Time from connecting the current until the torque decreases

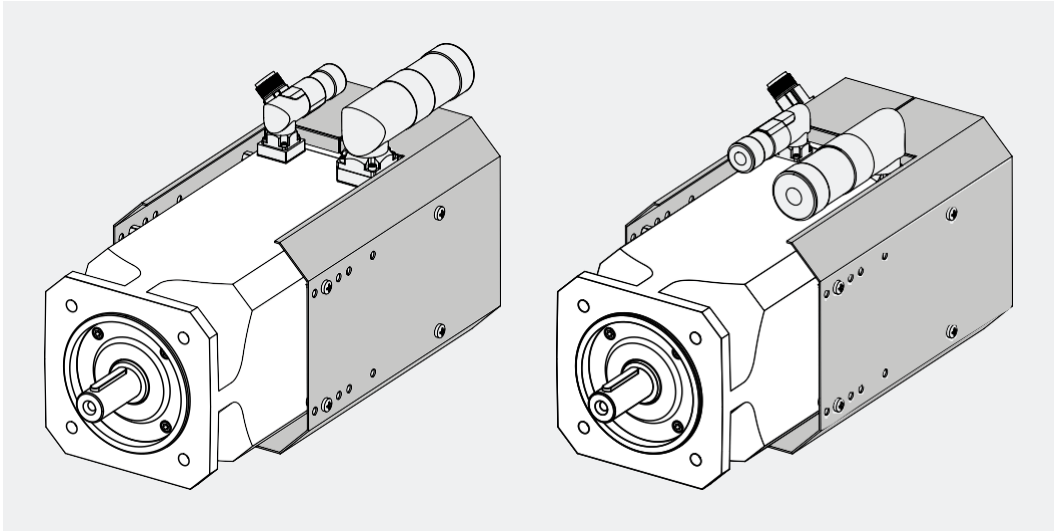
Additional inertia feature - F1 option

MMD Permanent Magnet AC Synchronous Motor series is provided optionally with additional inertia.
The MMD motors with additional inertia have higher rotor moment of inertia in comparison with basic version. Additional inertia is designed to be used in application with high load inertia. The increased rotor moment of inertia provides a comfortable control response due to "higher" inertial matching of the machine.

MOTOR	INERTIA INCREASE ΔJ	MASS INCREASE Δm_M
	$Kgm^2 \cdot 10^{-4}$	kg
65	0.5	0.4
82	3	1
102	7.5	1.7
118	16	3.5
145	36	5
170	70	8.2

Forced ventilation

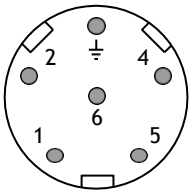
MMD motors size 145 and 170 can be ordered completed with additional fan unit (forced ventilation IC 416) selecting the proper designation variants (V1R, V1S, V2R, V2S). Motors originally provided with a fan unit have the power and signal connectors rotatable as per standard MMD motors (180° x 90°).
The fan cowl is black painted RAL 9005. Fans have metal housing and IP54 degree of protection.



Forced ventilation

FANS ELECTRICAL DATA AND CONNECTION

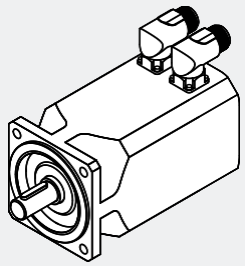
FANS ELECTRICAL DATA				
MMD size	Fan voltage	Voltage range	Power	Frequency
MMD 170	24V DC	12...30V DC	12 W	-
	230V AC	-	45 / 39 W	50/60 Hz
MMD 145	24V DC	12...30V DC	12 W	-
	230V AC	-	30 / 28 W	50/60 Hz

LAYOUT OF SUPPLY CONNECTORS VXS / VXR AND PRE-ASSEMBLED CABLES			
PIN	DESCRIPTION		CABLE LABEL
1	Not connected		-
2	Not connected		-
⏚	Earth		Yellow-Green
4	+VDC / Phase		1
5	- VDC / Neutral		2
6	Not connected		-

PLUG CONNECTOR	
MODEL	DESCRIPTION
TE cod. B ST A 085 FR 54 48 0100 000	Plug connector with pin - Clamping range: 7.5 .. 12mm
TE cod. B ST A 085 FR 03 43 0100 000	Plug connector with pin - Clamping range: 4.2 .. 6.6mm

Connections

The power and feedback device connections can made by angled rotatable receptacles connector (P1N S1N or P1 S1).

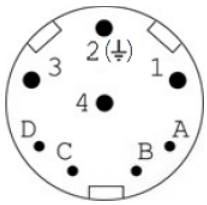


P1N S1N
Angled rotatable receptacles

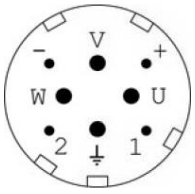
Power connections

The 8-pin power connector of the motor with feedback includes the pins of the motor supply and the ones for the brake supply (if provided).

MMD65 - MMD145	
Power connector layout (P1N/P1 options)	
Connector PIN number	Description
1	Phase U
⏚	Earth - SL
3	Phase V
4	Phase W
A	n.c.
B	n.c.
C	Brake +
D	Brake -



MMD170	
Power connector layout (P1N/P1 options)	
Connector PIN number	Description
U	Phase U
V	Phase V
W	Phase W
⏚	Earth - SL
1	n.c.
2	n.c.
+	Brake +
-	Brake -



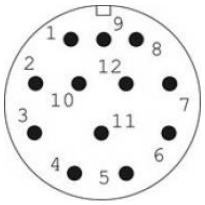
Signal connections

The signal connector gathers the feedback device signals and the thermal protection terminal. Each feedback device has proper signal connector layout. Variants with flying cable have different termination on the inverter feedback module side.

MOTOR WITH RESOLVER (RES1/RES2) / MMD65 - MMD170

Signal connector layout (S1N/S1 options)

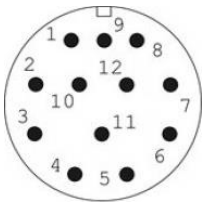
Connector PIN number	Description
1	Sin +
2	Cos +
3	Cos -
4	n.c.
5	n.c.
6	Sin -
7	Exct +
8	Shield cable
9	Thermal protector +
10	Thermal protector -
11	Exct -
12	n.c.



MOTOR WITH HYPERFACE ENCODER (A0) / MMD65 - MMD170

Signal connector layout (S1N/S1 options)

Connector PIN number	Description
1	7-12 V
2	GND (0V)
3	Sin -
4	Cos -
5	RS485 +
6	RS485 -
7	Sin +
8	Cos +
9	Thermal protector +
10	Thermal protector -
11	n.c.
12	n.c.



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