KENDRION

KENDRION SOLUTIONS

Permanent magnet brakes

High torque for a strong performance

PRECISION. SAFETY. MOTION.

Kendrion -
The brake experts

Kendrion stands for high-precision electromagnetic actuator systems and components for passenger cars, commercial vehicles and industrial applications. We are the trusted partner of some of the world's market leaders in the automotive and industrial segments when it comes to designing and producing complex components and customised solutions. Rooted in Germany, headquartered in the Netherlands and listed on the Amsterdam stock exchange, our expertise extends across Europe to the Americas and Asia.

Tradition and progress
More than one hundred years after the company was founded by Wilhelm Binder, Kendrion is ideally equipped for the challenges and tasks of the future. The company has always held a strong position in the market and is expanding its activities all over the world. In the field of electromagnetism, Kendrion stands for highest quality, innovation and precision.

Areas of application for brakes and clutches
The Kendrion business unit Industrial Drive Systems develops and produces electromagnetic brakes and clutches for industrial drive technology. They are used to accelerate, brake, position, hold and secure moving drive components and loads. Areas of applications for the brakes and clutches can be found mainly in robotics and automation, conveyor technology, tooling machines and production engineering, medical technology and elevator technology.

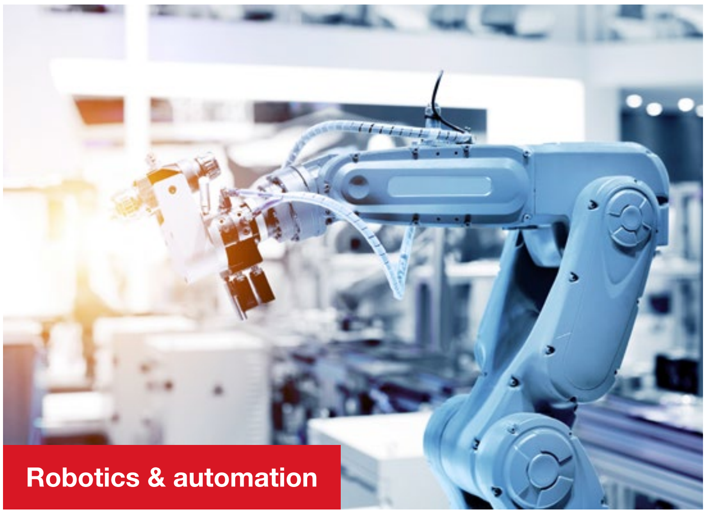
Worldwide availability
The main location is in Villingen-Schwenningen in southern Germany. However, Industrial Drive Systems has further development and production sites as well as a worldwide sales network at its disposal.

We will find the right brake for your application!

Safety with trusted brakes

Branches and applications

The world of Kendrion Industrial Drive Systems



Robotics & automation

Medical technology

Packaging & materials handling

Safety & comfort

Wind turbines

Customised applications

Classic permanent magnet brakes

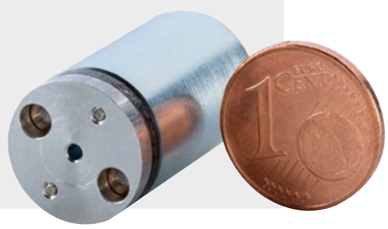
PM Line

Permanent magnet brakes excel in particular by their compact dimensions and their comparatively low weight. Due to the high power density of the permanent magnets the torque that can be achieved at a given installation space is twice as high as with common spring-applied brakes.

Furthermore, due to their design principle permanent magnet brakes are free of backlash and wear. Permanent magnet brakes are thus ideally suited for applications in medical engineering and servomotor applications, e.g. in handling technology and robotics.

The smallest permanent magnet brake of the world

... is smaller in diameter (14 mm) than a one-cent coin, thus finding place in smallest electric motors.



About the PM Line

The PM Line includes permanent magnet single-disc brakes for direct current in which the braking effect is generated by a permanent magnetic field (system opened by electro-magnetic force).

The brake thus acts in currentless state when switched off. In order to neutralize the braking effect the permanent magnetic field is displaced by an opposing electromagnetic field. The PM Line excels by safe, residual torque-free lifting in any mounting position and by backlash-free transmission of the braking torque. These brakes are particularly suitable for applications in the field of servomotors as holding brakes with or without emergency stop function.

Model types

86 611..H00; 14.120.xx.2xx

- Torque range from 0.01 to 120 Nm
- DC direct current
- Face mounting
- Single-disc brake

86 621..H00; 14.120.xx.1xx

- Torque range from 0.01 to 120 Nm
- DC direct current
- Flange mounting
- Single-disc brake

Applications

- Servomotors
- Packaging machines
- Conveyor technology
- Handling technology
- Optics and medical engineering
- Wheelchairs

We are happy to discuss your individual requirements and develop your specific version. Features as **hub diameter, optional felt ring against lubricants, individual hub design, strand protection** or **mass inertia-optimized system** can be adapted.

General information

When planning the machine (e.g. motor) or plant as well as during setup, operation and maintenance of the component the operating instructions have to be observed. The components are manufactured, tested and designed according to the state of the art, in particular in accordance with the regulations for electromagnetic devices and components (DIN VDE 0580). In addition to the technical data in the data sheets you find comments in the operating instructions.

Model type face mounting

PM Line – Technical data

Model types	86 611..H00 – face mounting 14.120.xx.2xx
Standard rated voltage	24 VDC, 205 VDC
Protection class	IP 00
Thermal class	F (B for 14.120.xx.2xx)
Nominal torques	0.01 to 120 Nm
Options	Organic friction pad
Note	Please observe the general information on data sheets and the respective operating manuals. Design subject to change.

Size		Transmis-sible torque	Max. rotational speed	Max. switch. capacity	Max. switching energy (Z = 1)	Rated power	Times		Inertia moment armature and flange hub	Weight
86 611..H00	14.120.xx.2xx	M_4 [Nm]	n_{max} [min^{-1}]	P_{max} [kJ/h]	W_{max} [kJ]	P_N [W]	Coupling time (with parallel varistor t_1 [ms]	Separation time t_2 [ms]	J [$kgcm^2$]	m [kg]
	01[1)]	0.01	20000	–	–	1.8	–	–	0.0006	0.02
02		0.1	49000	0.006	0.0003	2.5	12	16	0.0018	0.029
	02[1)]	0.08	16000	–	–	3.3	–	–	0.0056	0.09
03		0.4	16000	0.2	0.01	6.2	13	27	0.010	0.07
	03	0.6	12000	–	–	10	–	–	0.018	0.1
04		2.2	12000	4	0.2	8	14	28	0.12	0.19
06		3.2	10000	7	0.35	12	19	29	0.38	0.3
07		11	10000	8	0.4	16	20	29	1.06	0.6
09		22	10000	11	0.55	18	25	50	3.6	1.1
11		40	10000	17	0.85	24	25	73	9.5	1.4
14		80	8000	29	1.45	35	53	97	31.8	4.1
16		120	8000	31	1.55	37	80	150	57.5	6

[1)] Pure holding brake

Model type flange mounting

PM Line – Technical data

Model types	86 621..H00 – flange mounting 14.120.xx.1xx
Standard rated voltage	24 VDC, 205 VDC
Protection class	IP 00
Thermal class	F (B for 14.120.xx.1xx)
Nominal torques	0.01 to 120 Nm
Options	Organic friction pad
Note	Please observe the general information on data sheets and the respective operating manuals. Design subject to change.

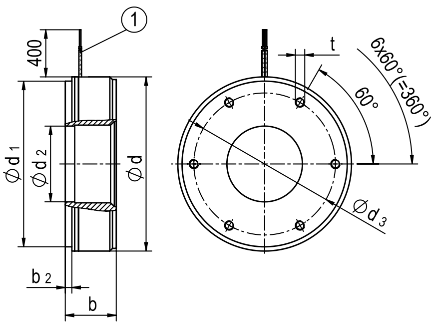
Size		Transferable torque	Max. rotational speed	Max. switch. capacity	Max. switching energy (Z = 1)	Rated power	Times		Inertia moment armature and flange hub	Weight
86 621..H00	14.120.xx.1xx	M_4 [Nm]	n_{max} [min⁻¹]	P_{max} [kJ/h]	W_{max} [kJ]	P_N [W]	Coupling time (with parallel varistor) t_1 [ms]	Separation time t_2 [ms]	J [kgcm²]	m [kg]
	01[1]	0.01	20000	–	–	1.8	–	–	0.0006	0.02
03		0.4	16000	0.2	0.01	6.2	13	27	0.010	0.07
	03	0.6	12000	–	–	10	–	–	0.018	0.12
04		2.2	12000	4	0.2	8	14	28	0.12	0.19
	05	4	10000	–	–	12	–	–	0.22	0.45
06		3.2	10000	7	0.35	12	19	29	0.38	0.3
07		11	10000	8	0.4	16	20	29	1.06	0.6
09		22	10000	11	0.55	18	25	50	3.6	1.1
11		40	10000	17	0.85	24	25	73	9.5	1.4
14		80	8000	29	1.45	35	53	97	31.8	4.1
16		120	8000	31	1.55	37	80	150	57.5	6

[1] Pure holding brake

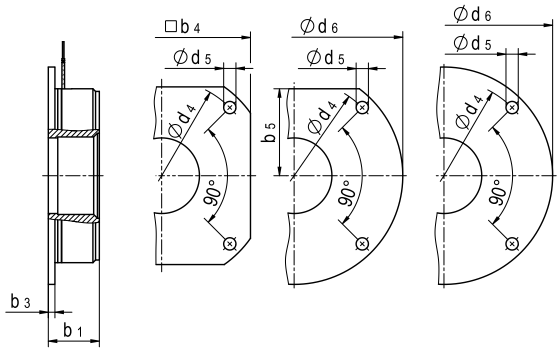
Device dimensions

PM Line – Technical data

Type 86 611[02-16]H00 for face mounting



Type 86 621[02-16]H00 for flange mounting



① Strand diameter x [mm²]

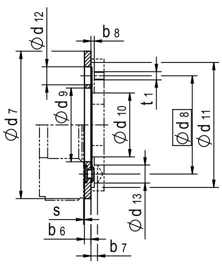
Size	d	$d_{1\ h8}$	d_2	d_3	d_4	d_5	d_6	b	b_1	b_2	b_3	b_4	b_5	t	x [mm²]
01 [1]	14	14	4	8.5	–	–	–	14	–	2	–	–	–	M1.6	0.15
02	19.3	19	5	16.4	–	–	–	20.9	–	4	–	–	–	M2	0.09
02 [1]	23.5	23.5	9	16	–	–	–	17.5	–	–	–	–	–	M3	0.25
03	28	28	9	22	33.5	2.6	–	16	16	3.3	1.5	30	–	M2	0.25
03 [1]	31	31	13	24	36	2.9	42 h10	23.7	23.7	3	3	–	–	M3	0.25
04	39.5	40	13	32.5	54	3.5	–	21	23	4.9	2	45	–	M2	0.25
05 [1]	54.5	–	26	–	58	3.4	65 h9	–	40.2	2	2	–	–	–	0.25
06	56	53	24	48	65	4.5	75 h8	20.8	20.8	3	3.1	–	28	M3	0.25
07	70	66.5	30	61	79.5	5.5	90 h8	25.3	25.3	3.5	3.5	–	35	M3	0.25
09	90	85.5	40	75	102	6.5	115 h8	26.7	26.7	3.5	3.5	–	45	M3	0.25
11	110	104	50	90	121	6.5	132 h8	30.7	30.7	5	5	–	–	M4	0.62
14	140	134	70	120	151	6.5	162 h8	37.2	37.2	6.5	6.5	–	–	M5	0.96
16	160	160	80	120	175	9	190 h8	43.2	43.2	12	7	–	–	M5	0.62

[1] Device dimensions for type 14.120.xx.2 xx and xx 14.120.xx.1 (without illustrations - drawings on demand)

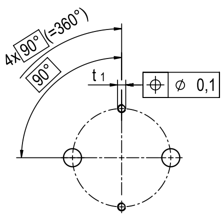
Dimensions in mm

Armature dimensions

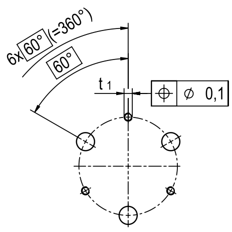
Type 200



Hole pattern for armature reception type 200

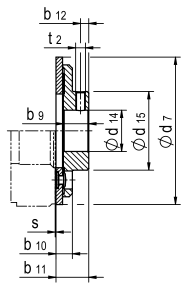


Size 04

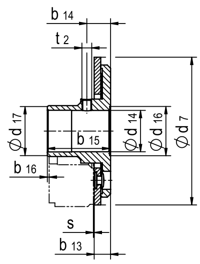


Size 06...16

Type 300



Type 400



Connecting part out of non-magnetizable material
Cut out for spring segments $Ød_{10}$ to $Ød_{11}$; depth = $b_8^{+0,05}$.

Size	d_7	d_8	d_9	d_{10}	d_{11}	d_{12}	d_{13}	d_{14}	d_{15}	d_{16}	d_{17}	b_6
01 [3]	14	–	–	–	–	–	–	1.5 / 3	–	–	4.6	1.5
02	18.6	–	–	–	–	–	–	3 [1] / 4 [2]	10.5	–	–	1
02 [3]	23	14.5	8	–	–	4.5	–	4 / 5	9.8	–	–	2
03	28.5	–	–	–	–	–	–	4 [1] / 8 [2]	14	upon request	upon request	2
03 [3]	31	19.5	12.5	–	–	5	–	5 / 8	13			2.3
04	39.5	29	17	16	37	7	7	6 [1] / 8 [2]	16			4.9
05 [3]	54	38	29	–	–	6.5	–	10 / 15	24			2.8
06	56	46	28	35	54	7	7	6 [1] / 15 [2]	24			3
07	70	60	37	46	68	8.5	8.5	10 [1] / 22 [2]	30			3.5
09	90	76	46	60	88	10.5	10.5	10 [1] / 30 [2]	40			4
11	110	95	59	78	108	12	12	15 [1] / 35 [2]	50			5
14	140	120	75	98	136	16	16	20 [1] / 48 [2]	70			6.5
16	160	135	83	113	156	16	16	20 [1] / 62 [2]	79			7

Size	b_7	b_8	b_9	b_{10}	b_{11}	b_{12}	b_{13}	b_{14}	b_{15}	b_{16}	s	t_1	t_2
01 [3]	–	–	–	–	7	–	3.7	–	7	–	$0.09^{\pm 0.01}$	–	–
02	–	–	6.1	3.9	7.1	1.6	–	–	–	–	$0.1^{\pm 0.02}$	–	2x M2.5
02 [3]	–	–	7	4.1	9.1	2.5	–	–	–	–	$0.12^{+0.05}_{-0.03}$	–	1x M3
03	–	–	8.5	5	10.5	3.5	–	–	–	upon request	$0.15^{+0.06}$	–	2x M3
03 [3]	–	–	8	4.3	10.3	3.5	–	–	–		$0.15^{+0.1}_{-0.05}$	–	1x M3
04	2.2	$1.5^{+0.05}$	15	8.4	17.5	6	–	–	–		$0.2^{+0.1}$	M3	2x M3
05 [3]	–	–	12	6	15	5	–	–	–		$0.2^{+0.1}_{-0.05}$	–	1x M4
06	2.8	$1^{+0.05}$	17	8	20	6	8.5	15	29		$0.2^{+0.1}$	M3	2x M3
07	3	$1.2^{+0.05}$	20	9.5	23.5	7	10	13	35		$0.3^{+0.1}$	M4	2x M4
09	4	$1.3^{+0.05}$	25	12	29	7	10.6	20	37		$0.3^{+0.1}$	M5	2x M5
11	5	$1.6^{+0.05}$	30	14	35	11	13	22.5	43.5		$0.3^{+0.1}$	M6	2x M6
14	6	$2.3^{+0.05}$	40	16	46.5	15	16.5	29.5	53.5		$0.3^{+0.1}$	M8	2x M8
16	6	$2.8^{+0.05}$	40	16.5	47	15	–	–	–		$0.3^{+0.1}$	M8	2x M8

[1] Min. bore
[2] Max. bore
[3] Anchor dimensions for type 14.120.xx.2 xx and xx 14.120.xx.1 (without illustrations - drawings on demand)

Dimensions in mm

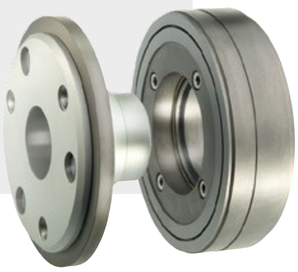
Permanent magnet brakes with high torque

High Torque Line

Due to their high power density, wear- and residual torque-free operation and short switching cycles permanent magnet brakes are in most cases the optimum solution in robotics and machine building. With respect to voltage tolerances and operating temperatures, however, the conventional design of the permanent magnet brake may reach its limit. Taking advantage of a completely new setup of the magnetic circuit these limits can be overcome by the High Torque Line. This patented setup optimizes the magnetic flow while the coil is energized, i.e. when the brake is opened, thus allowing an operation at up to -40°C. Especially in case of highly demanding applications, e.g. in the safety area or with outdoor applications such as wind turbines, the brakes of the High Torque Line are the perfect choice.

Highest requirements to the holding moment

... are met by the High Torque Line even under extreme environmental conditions with widly varying ambient temperatures from -40°C to +120°C.



About the High Torque Line

The current High Torque Line is a complete re-design of the previous setup.

The new setup of the magnetic circuit excels by enormous benefits:

- Higher torque with appr. same size and power consumption
- Significantly extended voltage and temperature range (-40°C to +120°C)
- High consistency of torque during the complete life cycle

Optimized geometry
By a new and patented arrangement of the poles and of the permanent magnet the magnetic flow is ideally controlled, resulting in the advantages mentioned.

Higher torque
While developing the High Torque Line we did not only succeed in increasing the braking torque (with roughly identical construction volume and identical electrical power input) but also in significantly improving the consistency of the torque over the whole life cycle.

Model types

86 611..K00
- Torque range from 0.4 to 300 Nm
- DC direct current
- Face mounting
- Single-disc brake (holding brake)
- Manual air gap adjustment

86 611..P00
- Torque range from 0.4 to 300 Nm
- DC direct current
- Face mounting
- Single-disc brake (holding brake)
- Automatic air gap adjustment

Applications

- Servomotors
- Robotics and automation
- Wind energy
- Safety engineering
- Optics and medical engineering

We are happy to discuss your individual requirements and develop your specific version. Features as **hub diameter, optional felt ring against lubricants, individual hub design** or **strand protection** can be adapted.

General information

When planning the machine (e.g. motor) or plant as well as during setup, operation and maintenance of the component the operating instructions have to be observed. The components are manufactured, tested and designed according to the state of the art, in particular in accordance with the regulations for electromagnetic devices and components (DIN VDE 0580). In addition to the technical data in the data sheets you find comments in the operating instructions.

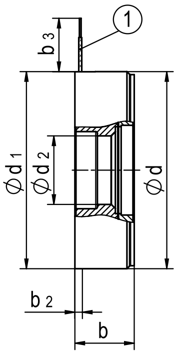
Permanent magnet single-disc brake

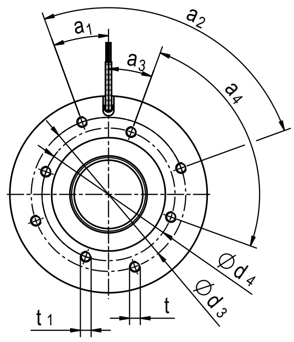
High Torque Line – Technical data

Model types	86 611..K00; 86 611..P00
Standard rated voltage	24 VDC
Protection class	IP 00
Thermal class	F
Nominal torques	0.4 to 300 Nm
Note	Please observe the general information on data sheets and the respective operating manuals. Design subject to change.

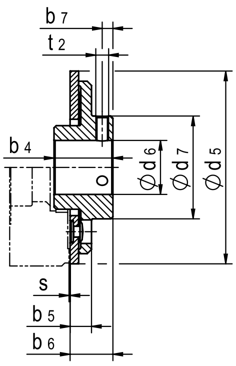
Size	Transmis-sible torque M_4 [Nm]	Max. rotational speed n_{max} [min^{-1}]	Max. switch. capacity P_{max} [kJ/h]	Max. switching energy (Z = 1) W_{max} [kJ]	Rated power P_N [W]	Times: Coupling time (with parallel varistor) t_1 [ms]	Times: Separation time t_2 [ms]	Inertia moment armature and flange hub J [kgcm^2]	Weight m [kg]
03	0.4	10000	0.2	0.01	6	13	24	0.019	0.1
04	2.5	10000	0.6	0.03	9	20	35	0.09	0.25
05	5	10000	0.6	0.03	12	25	50	0.39	0.4
06	9	10000	6	0.3	15	25	60	0.55	0.65
07	10	10000	6	0.3	14	25	90	0.8	0.6
08	15	10000	18	0.9	18	29	130	1.35	1.15
09	22	10000	18	0.9	19	40	100	2.73	1.2
10	32	10000	28	1.4	22.5	60	200	4.1	1.86
11	60	10000	40	2	25	50	220	14.7	3.1
14	80	10000	106	5.3	36.5	65	280	27	4.4
16	140	6000	106	5.3	43	60	450	48.6	5.9
21	300	6000	200	10	41.8	300	350	200	13

Device and armature dimensions

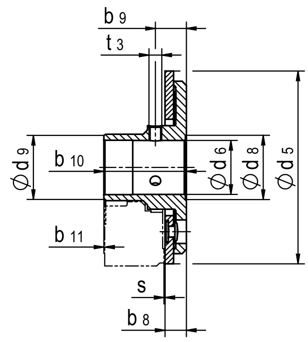




Type ...K00



Type ...P00



① Strand diameter x [mm²]

Exemplary illustration

Size	d	$d_{1\ f9}$	d_2	d_3	d_4	b	b_2	b_3	t	t_1	a_1	a_2	a_3	a_4	x [mm²]
03	32	32	9.6	27	–	19	5	400	3x M3	–	20°	120°	–	–	0.25
04	44	44	14.9	35	31	18.6	5	400	3x M3	3x M3	20°	120°	20°	120°	0.25
05	55	56	23	42	35	23.8	5	400	4x M4	4x M4	20°	90°	20°	90°	0.25
06	65	65	23	48	42	23.8	5	400	4x M4	4x M4	70°	90°	45°	90°	0.25
07	72	72	27	54	42	23.5	5	400	4x M4	4x M4	20°	90°	70°	90°	0.25
08	82	82	27	54	42	28.6	5	400	4x M4	4x M4	20°	90°	70°	90°	0.25
09	92	92	32	72	62	27.7	5	550	4x M5	4x M5	20°	90°	0°	90°	0.25
10	102	100	44	83	72	36.5	5	800	4x M6	4x M6	20°	90°	0°	90°	0.25
11	122	120	48.5	83	72	38	5	800	4x M6	4x M6	0°	90°	70°	90°	0.25
14	140	134	56.5	97	83	40.8	5	750	4x M8	4x M8	20°	90°	0°	90°	0.25
16	160	160	63	120	97	44.8	5	1000	6x M5	4x M8	30°	60°	0°	90°	0.50
21	205	200	91	167	140	56.1	10	1000	6x M8	6x M8	30°	60°	60°	60°	0.50

Size	d_5	d_6	d_7	d_8	d_9	b_4	b_5	b_6	b_7	b_8	b_9	b_{10}	b_{11}	s	t_2	t_3
03	32	4 [1] / 8 [2]	14	–	–	8.5	5	10.5	3.5	–	–	–	–	$0.1^{+0.1}$	2x M3	–
04	42.8	6 [1] / 10 [2]	37	upon request	upon request	12	–	8.1	2.5	8.1	–	26.7	upon request	$0.15^{+0.1}$	3x M3	–
05	56	12 [1] / 17.2 [2]	56			16	–	10.7	3.6	10.7	–	34.5		$0.2^{+0.1}$	3x M4	–
06	63	12 [1] / 18 [2]	51.5			18	4.8	10.5	3.5	10.5	–	34.2		$0.2^{+0.1}$	3x M4	–
07	69.5	12 [1] / 20.2 [2]	38			17	7.3	15.3	4	7.3	10.6	30.8		$0.2^{+0.1}$	3x M5	3x M5
08	80	16 [1] / 20.2 [2]	40			17.5	7.4	15.5	4.1	7.4	10.4	35.8		$0.3^{+0.1}$	3x M5	3x M5
09	90	18 [1] / 26.2 [2]	48			27.5	10	20	5	10	14.5	37.9		$0.27^{+0.1}$	3x M6	3x M6
10	100	25.2 [1] / 36 [2]	85			30	–	15.2	5	15.2	–	51.9		$0.3^{+0.1}$	3x M6	–
11	121	28 [1] / 36 [2]	94			40	–	22	7	14	20	52.2		$0.4^{+0.1}$	3x M8	3x M10
14	138	35 [1] / 40.2 [2]	78			41.3	15.5	28.8	7.3	15.5	22	56.5		$0.3^{+0.1}$	3x M10	3x M10
16	160	30 [1] / 45.5 [2]	90			39	15.5	29.5	8	29.5	–	74.5		$0.3^{+0.1}$	3x M10	–
21	202	36 [1] / 65.2 [2]	195			59	–	24.3	–	24.3	31	79.5		$0.4^{+0.1}$	–	3x M12

[1] Min. bore [2] Max. bore

Dimensions in mm

Classic permanent magnet brake vs. High Torque

Features	PM Line	High Torque Line
Residual torque-free	+ +	+ +
Higher torque	+	+ +
High power density	+	+ +
Optimized magnet system	+	+ +
Wear-free operation in all mounting positions	+ +	+ +
Torque consistency at low and high temperatures	+ (-5 to +120°C)	+ + (-40 to +120°C)
High stability in operating voltage range	+	+
Easy, stress-free mounting	+ +	+ +
Application is easy to service	+ +	+ +

General technical information

List of abbreviations

M_4	[Nm]	Transmissible torque: highest torque that can be applied to the closed brake before slippage occurs. If only static load is applied to brakes M_4 is referred to as nominal torque.
n_{max}	[min^{-1}]	Maximum rotational speed of motor shaft resp. armature system.
P_{max}	[kJ/h]	Highest switching performance: Permissible switching work converted to heat per time unit.
W_{max}	[kJ]	Highest switching work: maximum switching work permitted to load the brake.
Z	[h^{-1}]	Switching frequency: number of switching operations evenly distributed over one hour.
U_N	[VDC]	Nominal voltage: designation or identification of allocated supply voltage with voltage coils.
P_N	[W]	Nominal voltage: rounded value of coil capacity at nominal voltage referred to 20°C.
t_1	[ms]	Coupling time: Sum of response delay t_{11} and rise time t_{12}.
t_{11}	[ms]	Response delay: time from switching off current to start of torque increase.
t_{12}	[ms]	Rise time: time from start of torque rise until 90% of torque is reached.
t_2	[ms]	Separation time: sum of response delay t_{21} and release time t_{22}.
t_{21}	[ms]	Response delay: time from switching on current to start of torque decrease.
t_{22}	[ms]	Decrease time: time from start of torque decrease until 10% of nominal torque is reached.
J	[$kgcm^2$]	Moment of inertia of armature system and flange hub.
s	[mm]	New air gap in new condition.
s_{Bmax}	[mm]	Maximum permitted operating air gap until maintenance of brake.

Operation

All given performance data always refer to the operating mode S1, in particular to the specified maximum temperature of the operating range of the brake. This corresponds to a permanent current feed of the brake until the steady-state temperature has been reached. In short-term operation S2 and intermittent operation S3 the performance data increases significantly.

Notes on the technical data

W_{max} (maximum switching work) is the switching work which must not be exceeded with braking processes from max. 3000min^{-1}. Braking processes from rotational speeds > 3000min^{-1} significantly reduce the maximum permitted switching work per switching. In this case it is required to consult the manufacturer. The maximum switching performance Pmax is the switching work W which can be implemented in the brake per hour. The permitted number of switchings (emergency stops) Z per hour with holding brakes and the resulting max. permitted switching work Wmax is to be taken from the technical data and the respective operating instructions. In case of deviating applications, e.g. as a working brake, the manufacturer needs to be consulted. The values P_{max} and W_{max} are standard values. They are valid for installation without additional cooling. The coupling time t_1 is achieved with operation at 110% of the rated voltage, maximum air gap s_{Bmax}, operational temperature (120°C) and operation with a suitable varistor. The separation time t_2 is achieved with operation at 90% of the rated voltage, smallest new air gap s and at operational temperature (120°C). The values given for the times are maximum values. The coupling time t_1 and the separation time t_2 are valid for DC-switching of the brake. In case of AC-switching of the brake the coupling time t_1 rises significantly. The specified transmissible torques M_4 signify the components in their minimum transmissible torque (statistical evaluation). Depending on the application the actually acting transmissible torque M_4 deviates from the values indicated for the transmissible torque M_4. In case of oily, greasy or badly contaminated friction surfaces the transmissible torque M_4 may be reduced. All technical data are valid with due observance of the run-in conditions (see respective operating instructions) of the brake determined by the manufacturer.

When operating the permanent magnet single-disc brake the nominal operating conditions acc. DIN VDE 0580 must be observed! Please observe data sheet, operating instructions and the technical notes in the technical customer document!

Design subject to change!

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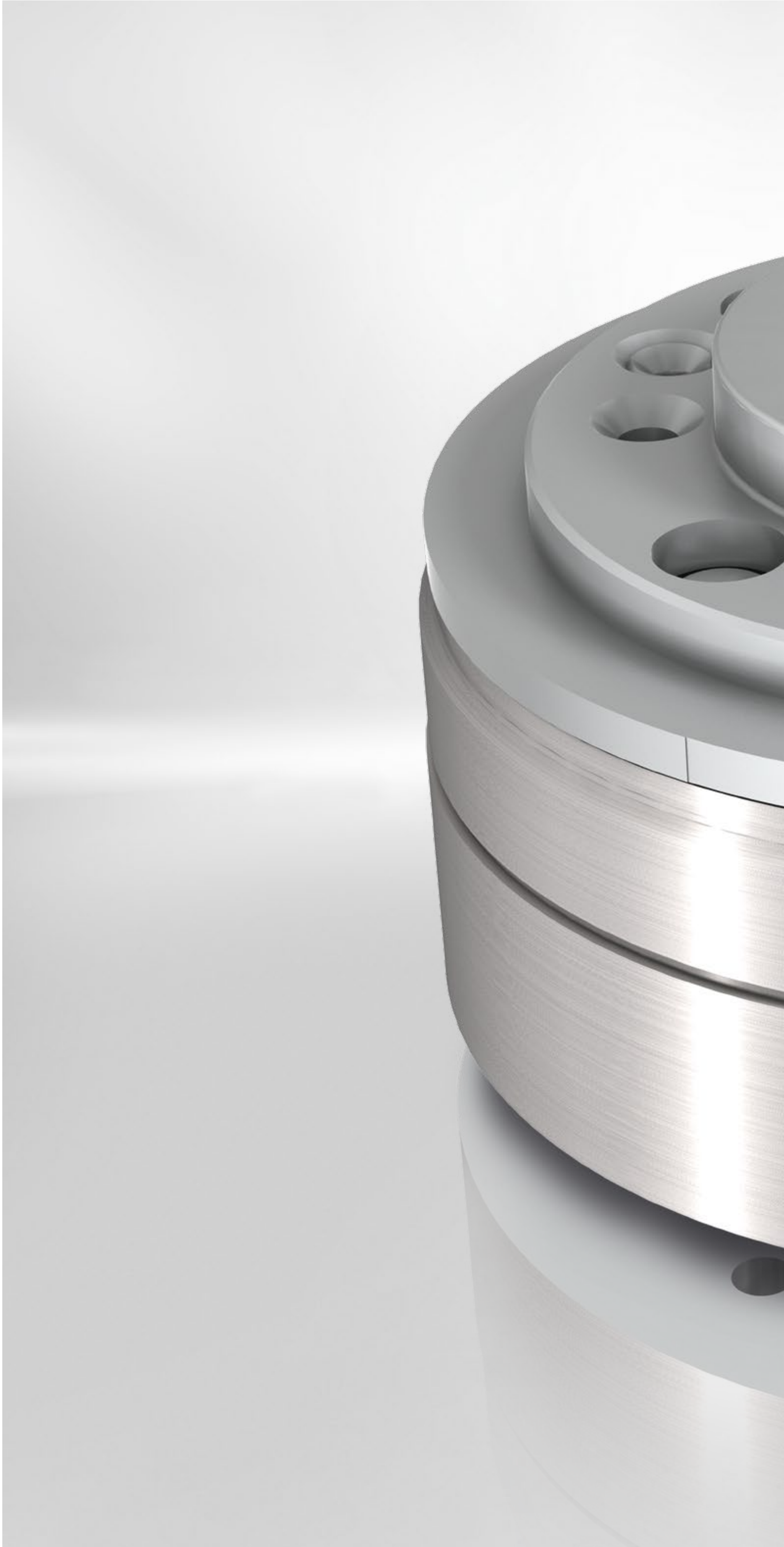

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