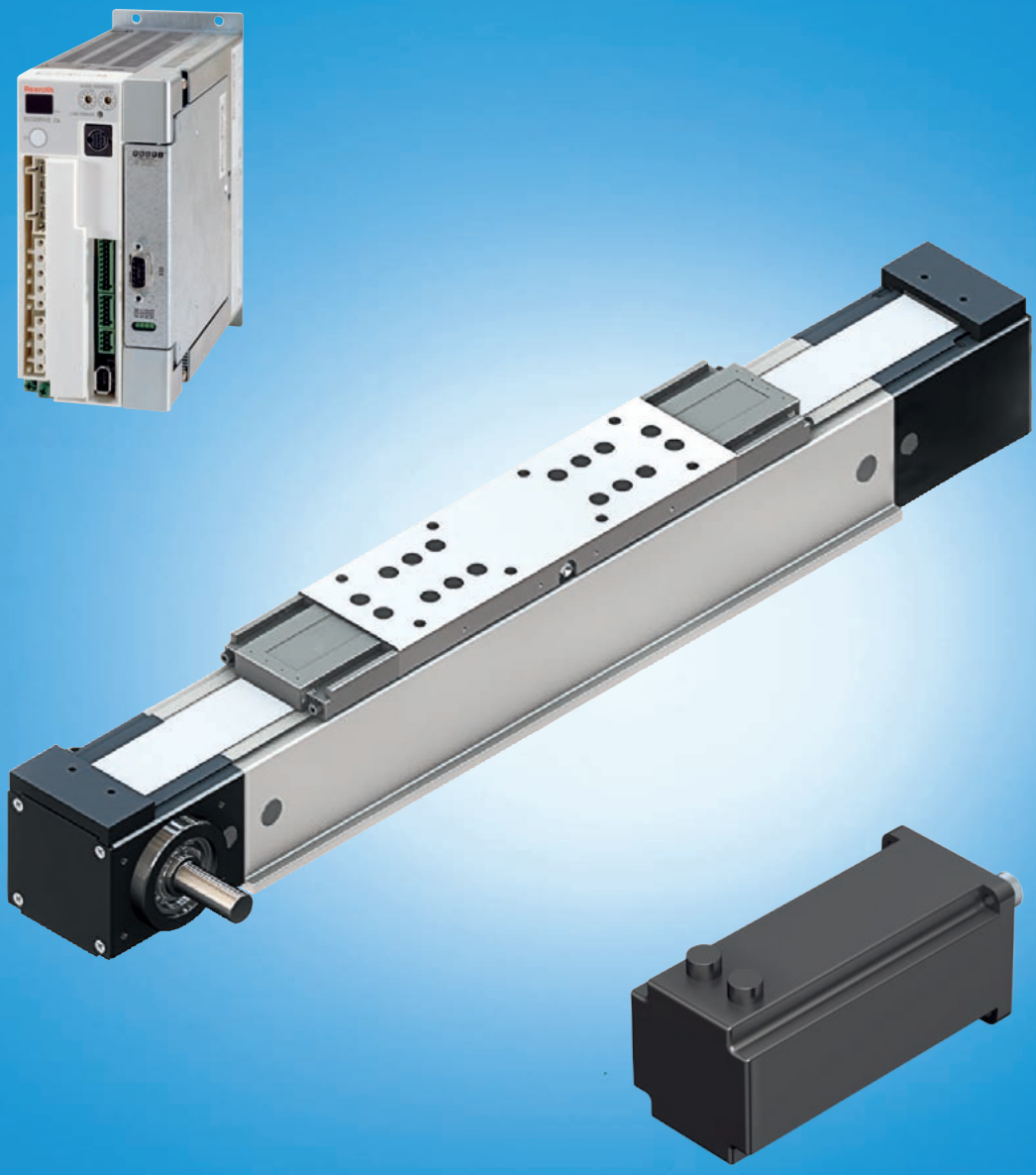
Rexroth
Bosch Group

Linear Modules for Food & Packaging (MKR 20-80)

R310EN 2406 (2009.02)

The Drive & Control Company

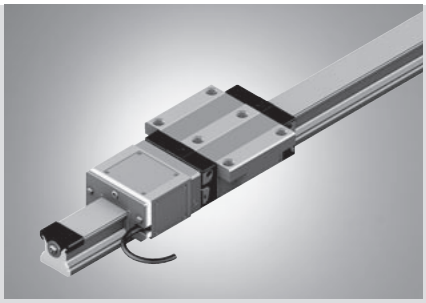
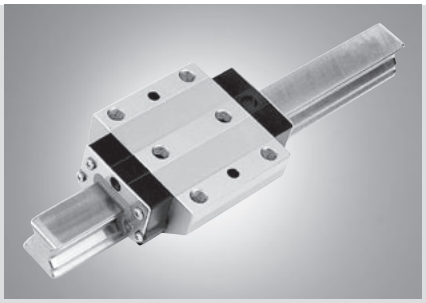


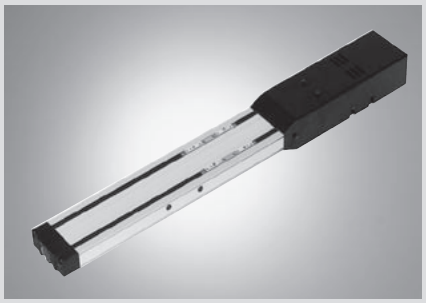
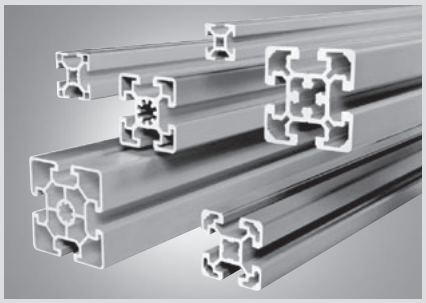
Linear Motion and Assembly Technologies

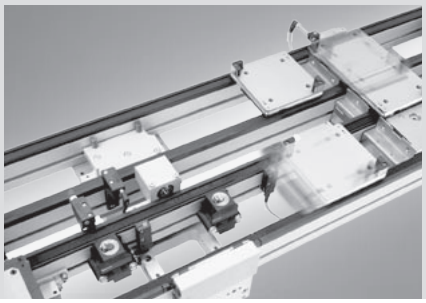
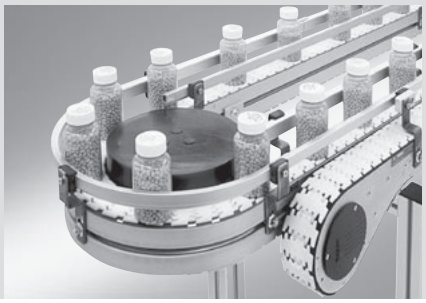
Ball Rail Systems
Roller Rail Systems
Linear Bushings and Shafts

Ball Screw Drives
Linear Motion Systems

Basic Mechanical Elements
Manual Production Systems
Transfer Systems

www.boschrexroth.com/brl

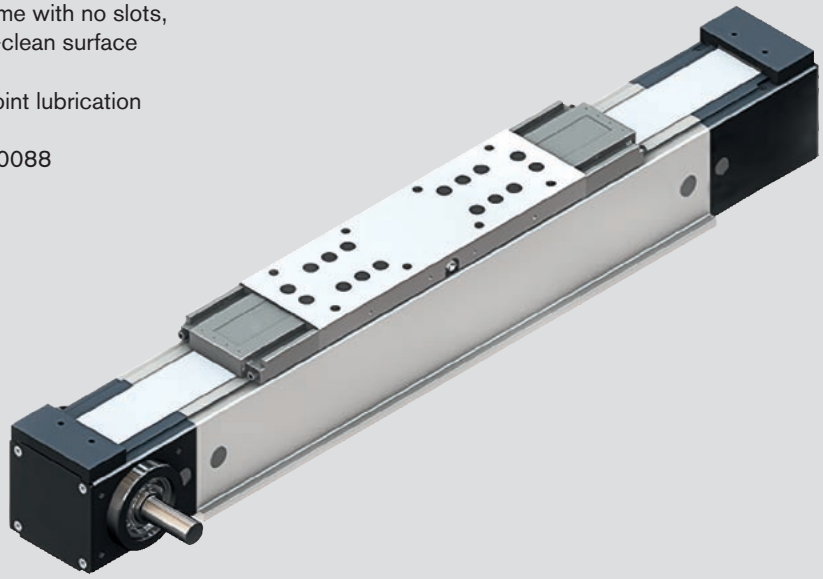
Linear Modules for Food & Packaging

Product Description

Outstanding features

Linear Modules for Food & Packaging have been designed for use in environments requiring a high level of hygiene and ease of cleaning. They are equipped with a Ball Rail System and toothed belt drive and offer an outstanding combination of high performance and compact dimensions.

Linear Modules for Food & Packaging consist of:
- a compact, anodized aluminum profile frame with no slots, resulting in an especially smooth, easy-to-clean surface
- integrated Rexroth Ball Rail System
- carriage with sealable threads and one-point lubrication
- pre-tensioned toothed belt
- stainless steel sealing strip per DIN EN 10088
- AC servomotor
- gear reducer for motor attachment
- control units



Technical Data

General technical data

Linear module	Carriage length L_{ca}	Dynamic load capacity	Dynamic load moments		Moved mass of system m_{ca}	Length		Planar moment of inertia	
						minimum	maximum		
		C	M_t	M_L		L_{min} [1]	L_{max}	I_x	I_y
	(mm)	(N)	(Nm)	(Nm)	(kg)	(mm)	(mm)	(cm^4)	(cm^4)
MKR 20-80	190	17420	221	121	1.4	370	6000	180	211
	260	28300	359	1840	2.2	430			

1) For a theoretical stroke of 100 mm and excess travel of 30 mm at each end

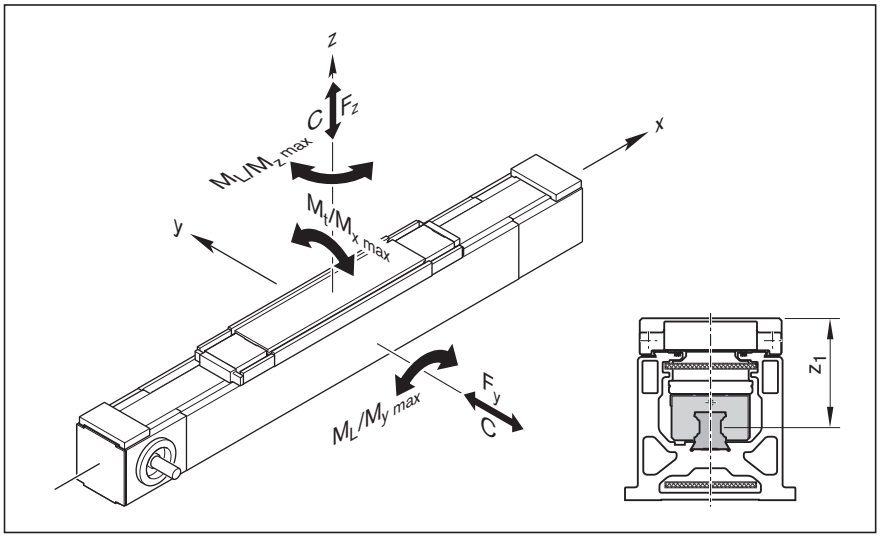
Linear module	Carriage length L_{ca}	Maximum permissible forces		Maximum permissible moments		
		$F_{z\,max}$	$F_{y\,max}$	$M_{x\,max}$	$M_{y\,max}$	$M_{z\,max}$
	(mm)	(N)	(N)	(Nm)	(Nm)	(Nm)
MKR 20-80	190	8700	8700	111	60	60
	260	14150	14150	180	919	919

Modulus of elasticity E $E = 70,000\ N/mm^2$

Technical Data

Note on dynamic load capacities and moments

Determination of the dynamic load capacities and moments is based on a travel life of 100,000 m.
Often only 50,000 m are actually stipulated.
For comparison: Multiply values C, M_t and M_L from the table by 1.26.



Combined equivalent load on bearing of the linear guide

	z_1 (mm)
MKR 20-80	59.6

$$F_{comb} = |F_y| + |F_z| + C \cdot \frac{|M_x|}{M_t} + C \cdot \frac{|M_y|}{M_L} + C \cdot \frac{|M_z|}{M_L}$$

C	=	dynamic load capacity	(N)	M_x	=	torsional moment about the x-axis	(Nm)
F_{comb}	=	combined equivalent load on bearing	(N)	M_y	=	torsional moment about the y-axis	(Nm)
F_y	=	force in y-direction	(N)	M_z	=	torsional moment about the z-axis	(Nm)
F_z	=	force in z-direction	(N)	z_1	=	application point of the effective force	(mm)
M_L	=	dynamic longitudinal moment load capacity	(Nm)				
M_t	=	dynamic torsional moment load capacity	(Nm)				

Drive data

Toothed belt stretch $\Delta_L = (F \cdot L)/c_{spec}$

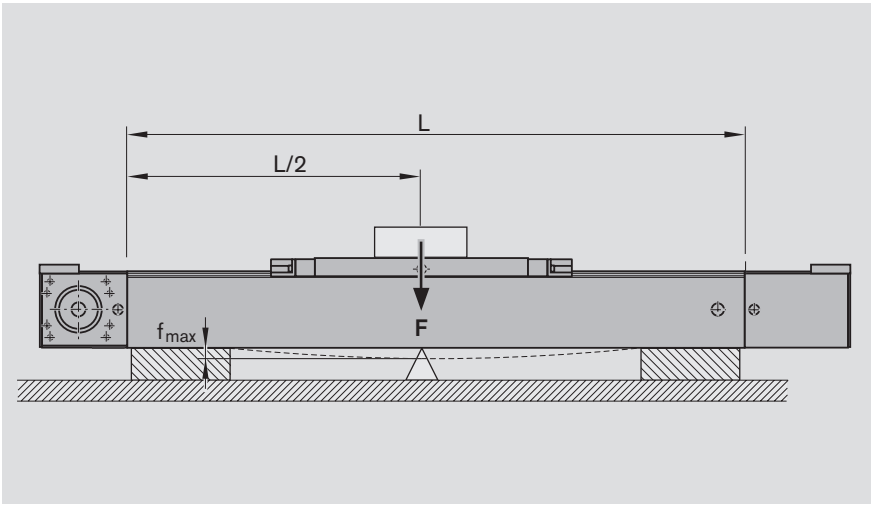
Linear module	Gear reducer ratio i	Maximum drive torque M_a (Nm)	Lead constant (mm/rev)	Belt data: Belt type	Width (mm)	Tooth pitch (mm)	Max. belt drive transmission force (N)	Belt elasticity limit (N)	Specific spring rate c_{spec} (N)
MKR 20-80	1	32.0	205	AT 5	50	5	980	3500	$0.875 \cdot 10^6$
	1 with keyway	27.0	205						
	3	10.7	68.35						
	5	6.4	41.01						
	10	3.2	20.51						

Technical Data

Deflection

A particular feature of Linear Modules is that they can be installed as cantilevered axes.
Deflection must, however, be taken into consideration, because it limits the possible load.
If the maximum permissible deflection is exceeded, additional supports must be provided.

⚠ **Do not mount or support the Linear Module by the end blocks or end enclosures!**



Maximum permissible deflection f_{max}

The maximum permissible deflection f_{max} depends on the length L and the load F.

⚠ **f_{max} must not be exceeded!**
If high system dynamics are required, supports must be provided every 300 to 600 mm.

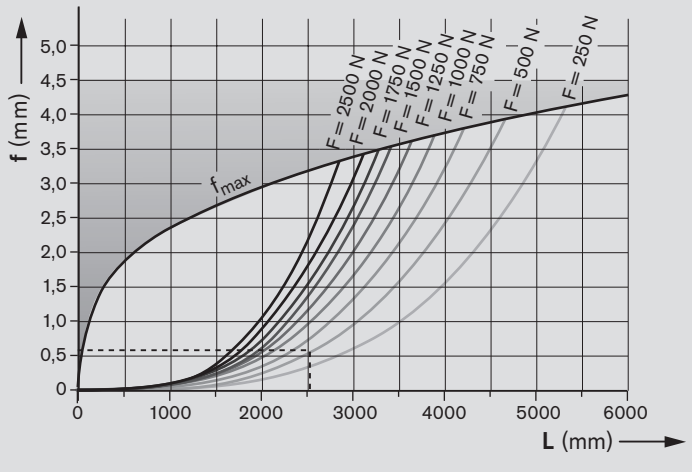
Example

Linear Module MKR 20-80:
L = 2500 mm
F = 500 N
From chart 20-80:
f = 0.6 mm
f_{max} = 3.2 mm

The deflection f lies well below the maximum permissible deflection f_{max}, so no additional supports are required.

The chart is valid for:
- both ends firmly fixed (200 to 250 mm per end)
- 6 to 8 screws per side
- solid mounting base

MKR 20-80



Performance Data

Performance values for horizontal operation

With servo motor MSK 050C and ECODRIVE Cs controller Connection voltage: 3 x 400 V

⚠ **The tables contain performance data examples for different gearbox-motor-controller combinations. They are intended to serve as a guide for selection; exact values must be calculated based on individual cases.**

Gear reducer ratio		i = 3					i = 5					i = 10				
Mass m_{ex}	(kg)	4	6	8	10	12	10	15	20	25	35	30	40	50	60	80
Acceleration time t	(ms)	100	116	135	152	167	125	150	176	200	250	200	227	254	276	333
Acceleration distance s	(mm)	250	291	338	379	417	188	225	265	300	402	150	171	191	209	250
Acceleration a	(m/s^2)	50	43	37	33	30	24	20	17	15	9.8	7.5	6.6	5.9	5.4	4.5
Travel speed v	(m/s)					5.0					2.8					1.5
Repeatability ±	(mm)					0.1					0.1					0.1

With servo motor MSK 040C and DKC controller[1] Connection voltage: 3 x 400 V

Gear reducer ratio		i = 3				i = 5					i = 10				
Mass m_{ex}	(kg)	1	2	3	4	4	6	8	10	14	10	20	40	60	80
Acceleration time t	(ms)	78	91	100	111	72	85	106	136	155	111	154	222	286	364
Acceleration distance s	(mm)	195	228	250	278	123	145	181	231	263	111	154	222	286	364
Acceleration a	(m/s^2)	54	55	50	45	47	40	32	25	22	18	13	9	7	5.5
Travel speed v	(m/s)				5.0					3.4					2.0
Repeatability ±	(mm)				0.1					0.1					0.1

With servo motor MSM 040B and DKC controller[1] Connection voltage: 1 x 230 V

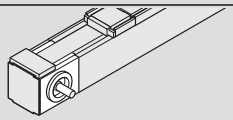
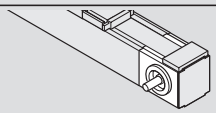
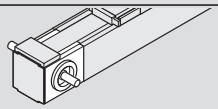
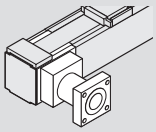
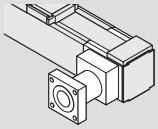
Gear reducer ratio		i = 5					i = 10						
Mass m_{ex}	(kg)	2	4	6	8	10	10	15	20	25	30	35	40
Acceleration time t	(ms)	29	35	43	49	55	42	49	58	67	75	85	93
Acceleration distance s	(mm)	30	36	43	49	55	21	25	30	34	38	43	47
Acceleration a	(m/s^2)	68	57	47	40.8	36.2	24	20.4	17.2	14.9	13.3	11.8	10.8
Travel speed v	(m/s)					2							1
Repeatability ±	(mm)					0.1							0.1

1) For more information on motors, controllers and control systems, please refer to the catalogs “ECODRIVE Cs” and “IndraDrive for Linear Motion Systems”. These figures do not take the effective torque of the motor-controller combination into account.

Drive data without motor (i = 1)

Drive unit diameter	65.27 mm
Travel speed with sealing strip	to 5 m/s
Mass moment of inertia (short carriage)	$(21.1 + L\ (mm) \cdot 0.00379) \cdot 10^{-4}\ kgm^2$
Mass moment of inertia (long carriage)	$(29.7 + L\ (mm) \cdot 0.00379) \cdot 10^{-4}\ kgm^2$

Linear Modules for Food & Packaging Components and Ordering Data

Part number, length R1140 160 20, ... mm Version		Guideway	Drive unit Drive journal	i = 1 [1]	i = 1 [2]	i = 3	i = 5	i = 10	Carriage L_{ca} = 190 mm without slots	L_{ca} = 260 mm without slots	
With drive unit (MA), without gear reducer (i = 1)	MA01 	01	Journal at right	01	03	–			02	12	
	MA02 	01	Journal at left	01	03	–					
	MA03 	01	Journal on both sides	02	04	–					
With drive unit, with gear reducer (MG)	MG01  MG02 	01	Gear reducer at right/ Gear reducer at left	–	–	10 11 Gear reducer with second shaft end					

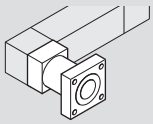
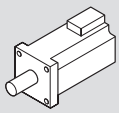
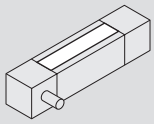
Ordering example:

L_{ca} = carriage length

⚠ **Please check whether the selected combination is a permissible one (load capacities, moments, maximum speeds, motor data, etc.)!**

1) Without keyway
2) With keyway

Ordering data Option	Option code	Description
Linear Module and size	MKR 20-80	Linear Module MKR, size 20-80, length 1400 mm
Part number, length	R1140 160 20, 1400 mm	
Version	MG01	With gear reducer at right
Guideway	01	Ball rail system
Drive unit	02	i = 1; Journal on both sides
Carriage	12	Carriage, length L_{ca} = 260 mm without slots, with mounting threads only
Motor attachment	04	Attachment kit with gear reducer for motor MSK 050C, i = 3
Motor	89	Motor MSK 050C with brake
Cover	10	With sealing strip, without longitudinal seals
Documentation	01	Measurement report: standard report

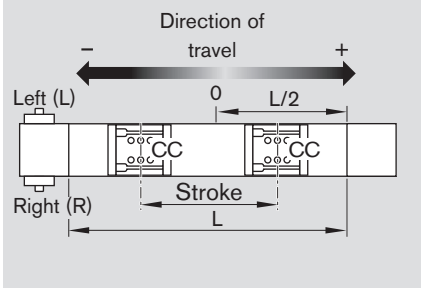
Motor attachment			Motor[4]		Cover[5]		Documentation	
								
Gear ratio i =	Attachment kit[3] with gear reducer	for motor	without	with Brake	without	with Sealing strip	Standard report	Measurement report
–	00	–	00		00	10 Without longitudinal seals	01	02 Frictional torque 05 Positioning accuracy
–	00	–	00					
–	00	–	00					
–	00	–	00					
i = 3	01	MSK 040C	86	87		15 With longitudinal seals		
i = 5	10							
i = 10	20							
i = 3	02	MSM 040B	74	75				
i = 5	11							
i = 10	21							
i = 3	04	MSK 050C	88	89				
i = 5	14							
i = 10	24							

3) Attachment kit also available without motor (when ordering: enter “00” for motor).
4) Stepping motors on request
5) Cover permissible up to
L = 3500 mm
v = 2.5 m/s

Linear module length:

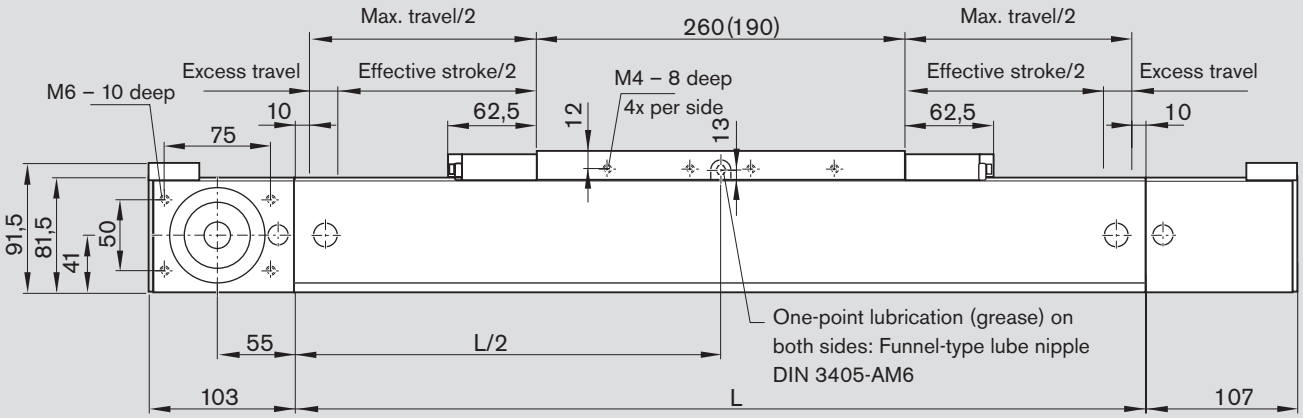
$$L = \text{stroke} + 2 \cdot \text{excess travel} + 20\ \text{mm} + L_{ca}$$

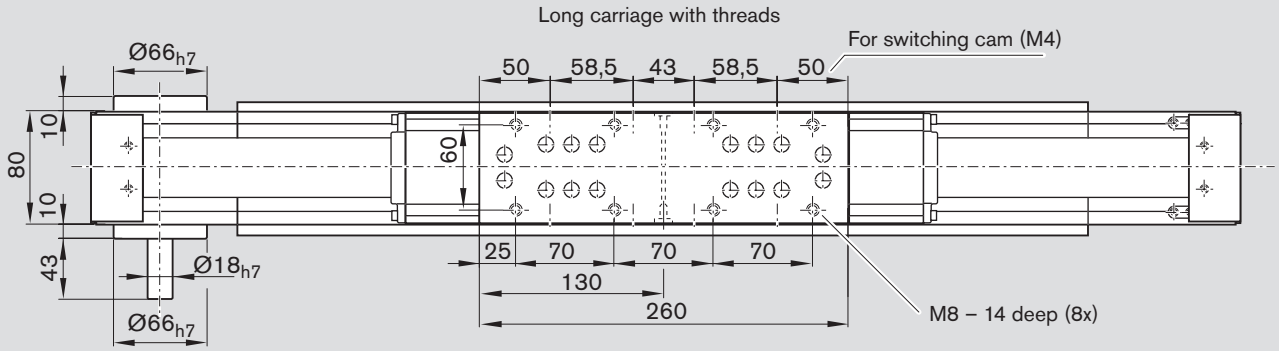
Stroke = maximum travel of carriage center (CC) between the outermost switch activation points.
For safe operation, the excess travel must be longer than the braking distance.
The acceleration travel can be taken as a guideline value for the braking distance.



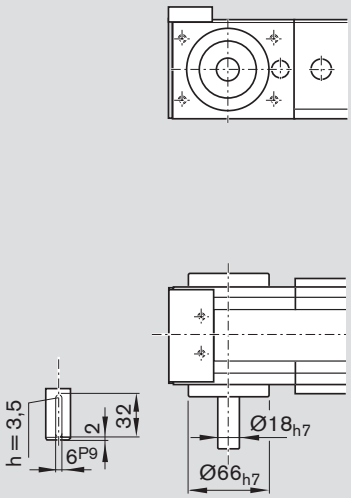
Linear Module for Food & Packaging (MKR 20-80) Dimensions

All dimensions in mm.
Drawings not to scale.

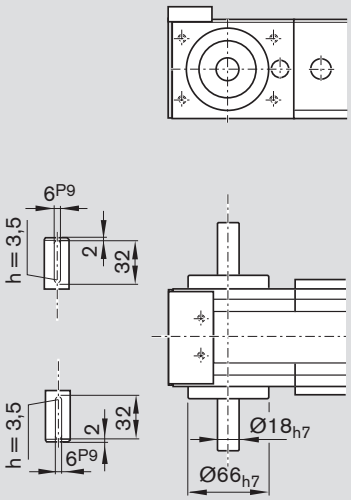


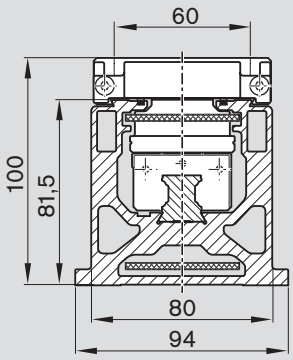


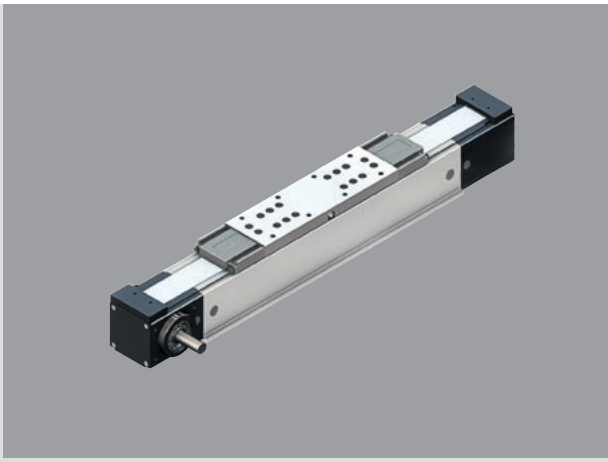
MA01, MA02



MA03

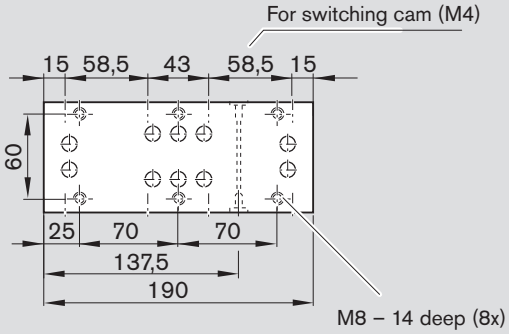




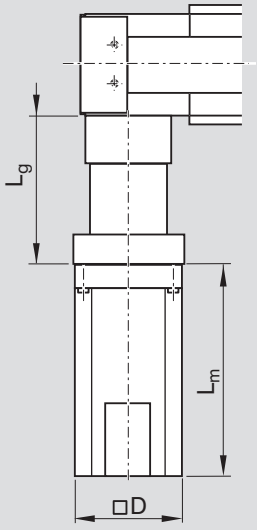


Longitudinal seals in carriage

Short carriage with threads



MG01, MG02



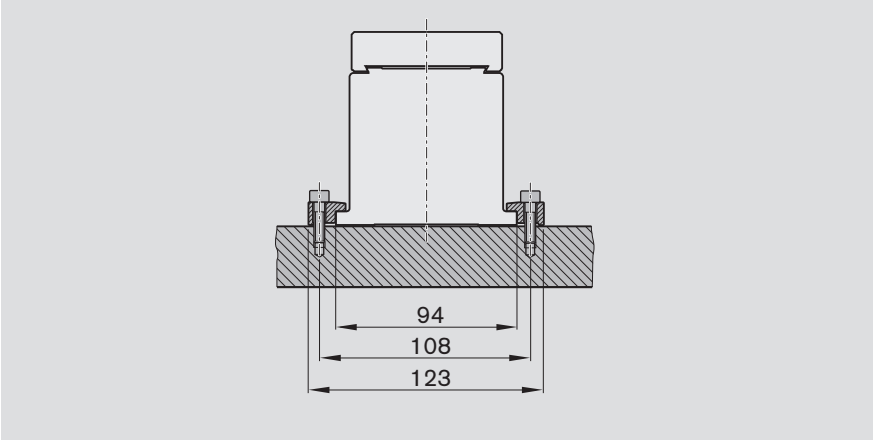
Motor	Dimensions (mm)			
	Gear reducer	Motor		
	L_g MG01 MG02	D	Without brake	L_m With brake
MSK 040C	135	82	185.5	215.5
MSK 050C	145	98	203.0	233.0
MSM 040B	140	80	157.5	191.5

Mounting

General notes

Clamping fixtures
The modules are mounted using clamping fixtures which engage with the flanges on the frame.

⚠ **Do not mount or support the Linear Module by the end blocks or end enclosures!**

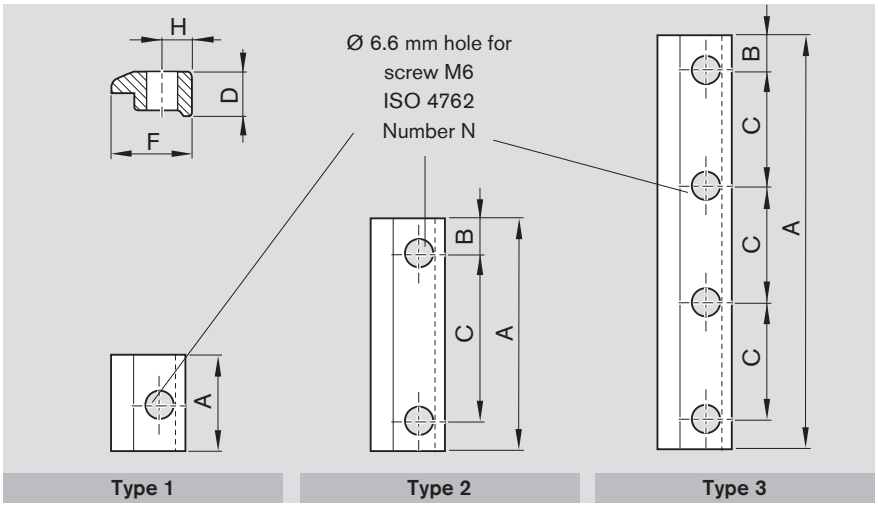


Clamping fixtures

Recommended number of clamping fixtures per meter and side:
- Type 1: 6 pieces
- Type 2: 4 pieces
- Type 3: 3 pieces

Tightening torque

		M6
8.8	(Nm)	9.5



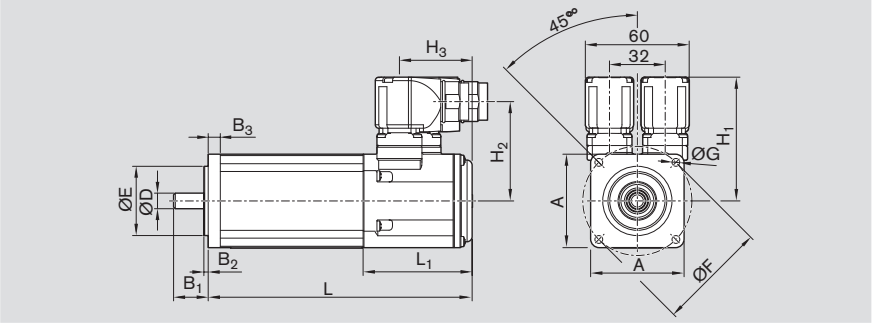
Linear module	for	Type	Number of holes N	Dimensions (mm) A	B	C	D	F	H	Part number
MKR 20-80	M6	1	1	25	–	–	11.5	19.3	7.5	R1175 192 00
		2	2	62	11	40				R1175 192 01
		3	4	142	11	40				R1175 192 02

Motors

AC Servo Motors MSK

Notes

All MSK motors have an absolute multiturn encoder. The motors can be supplied complete with controller and control unit. For more information on motors, controllers and control systems, please refer to the catalog "IndraDrive for Linear Motion Systems".



Dimensions

Motor	Dimensions (mm)														
	A	B_1	B_2	B_3	ØD k6	ØE j6	ØF	ØG	H_1	H_2	H_3	L without brake	L with brake	L_1	R
MSK 040C	82	30	2.5	8	14	50	95	6.6	83.5	69	31	185.5	215.5	42.5	R8
MSK 050C	98	40	3	9	19	95	115	9	85.5	71	43.5	203	233	55.5	R8

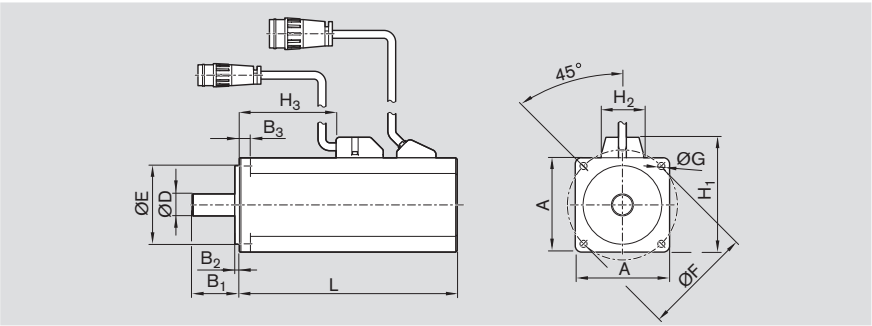
Motor data

Motor		Unit	MSK 040C-0600	MSK 050C-0600
Maximum rotary speed	n_{max}	(min^{-1})	5600	5700
Maximum permissible torque	M_{max}	(Nm)	8.1	15
Rated torque	M_N	(Nm)	2.7	5.0
Motor mass moment of inertia	J_m	(10^{-6} kgm^2)	140	330
Mass without brake	m_m	(kg)	3.6	5.4
Holding brake				
Holding torque	M_{br}	(Nm)	4.0	5.0
Brake mass moment of inertia	J_{br}	(10^{-6} kgm^2)	23	107
Mass of brake	m_{br}	(kg)	0.32	0.7

AC Servo Motors MSM

Notes

All MSM motors have an absolute multiturn encoder. The motors can be supplied complete with controller and control unit. For more information on motors, controllers and control systems, please refer to the catalog "ECODRIVE Cs".



Dimensions

Motor	Dimensions (mm)												
	A	B_1	B_2	B_3	ØD h6	ØE h7	ØF	ØG	H_1	H_2	H_3	L without brake	L with brake
MSM 040B	80	35	3	8	19	70	90	6.0	93	27	76.0	157.5	191.5

Motor data

Motor		Unit	MSM 040B
Maximum rotary speed	n_{max}	(min^{-1})	3000
Maximum permissible torque	M_{max}	(Nm)	7.10
Rated torque	M_N	(Nm)	2.40
Motor mass moment of inertia	J_m	(10^{-6} kgm^2)	67.0
Mass without brake	m_m	(kg)	3.1
Holding brake			
Holding torque	M_{br}	(Nm)	2.45
Brake mass moment of inertia	J_{br}	(10^{-6} kgm^2)	8.0
Mass of brake	m_{br}	(kg)	0.7

Lubrication

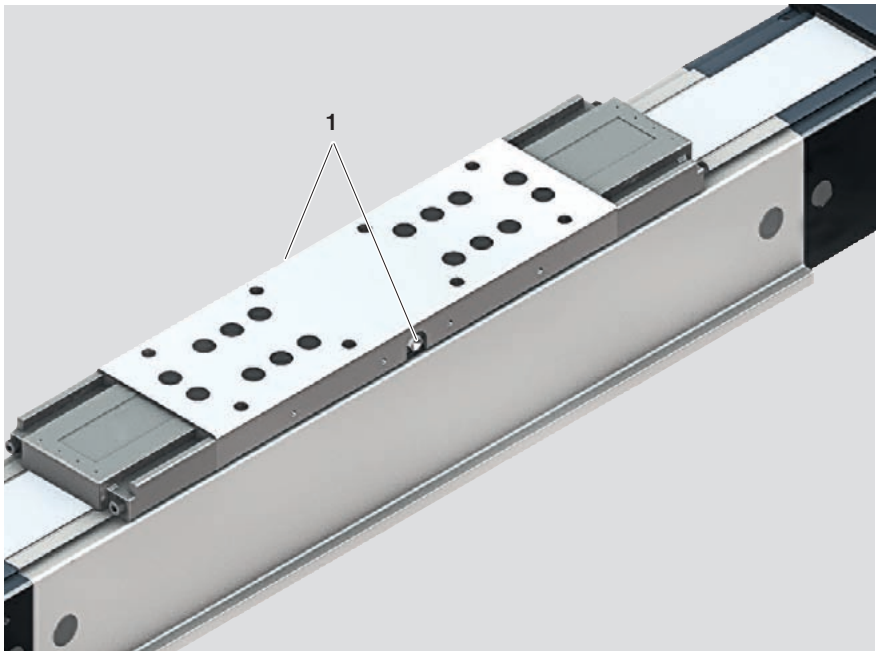
Lubrication notes
Basic lubrication is applied in-factory before shipment.
Linear Modules have been designed for lubrication with grease using a grease gun. The only maintenance required is re-lubrication of the guideway via the funnel-type lube nipples (1).

Lubrication points
1 Funnel-type lube nipple DIN 3405-AM6 for the runner blocks (on both sides, either side can be used).

Recommended lubricants
For lubricant quantities and intervals, see “Mounting Instructions for Linear Modules”.

⚠ **Do not uses greases containing solid particles (e.g., graphite or MoS_2)**

For lubrication in short-stroke applications (< 50 mm), please consult us.



Linear module	Grease DIN 51825	Consistency class DIN 51818	Recommended grease	Part number (400 g cartridge)
MKR 20-80	KP2K	NLGI 2	Dynalub 510	R3416 037 00

Documentation

Standard report

Option no. 01

The standard report serves to confirm that the checks listed in the report have been carried out and that the measured values lie within the permissible tolerances.

Checks listed in the standard report:
– functional checks of mechanical components
– functional checks of electrical components
– design is in accordance with order confirmation

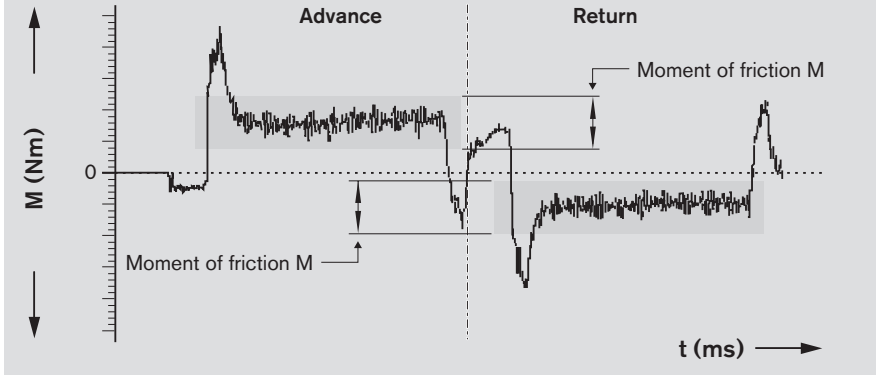
Frictional moment of complete system

Option no. 02

The moment of friction M is measured over the entire travel range.

M = moment of friction (Nm)
t = travel time (ms)

Example

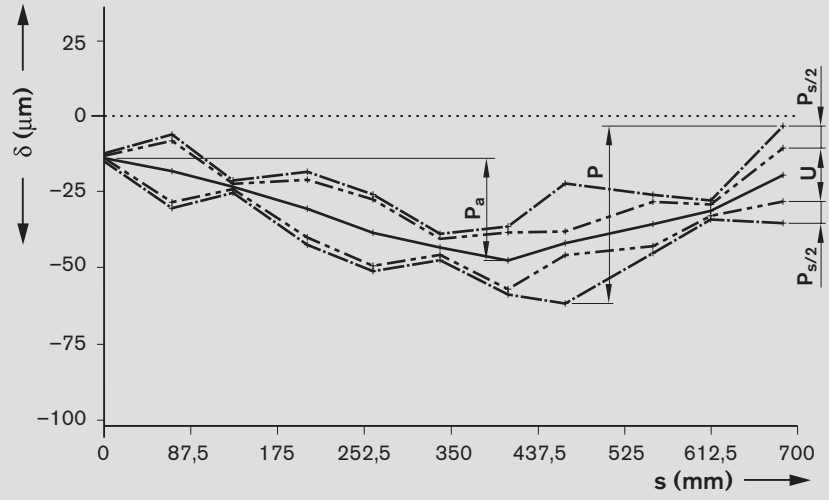


Positioning accuracy per VDI/DGQ 3441

Option no. 05

Measurement points are selected at irregular intervals along the travel range. This allows even periodical deviations δ in µm to be detected during positioning.
Each measurement point is approached several times from both sides.
This gives the following parameters.

Example



δ = deviation (µm)
s = measured travel (mm)

Positioning accuracy P

The positioning accuracy corresponds to the total deviation. It encompasses all the systematic and random deviations during positioning.

The positioning accuracy takes the following characteristic values into consideration:
– position deviation
– reversal range
– position variation range

Position deviation P_a

The position deviation corresponds to the maximum difference arising in the mean values of all the measurement points. It describes systematic deviations.

Reversal range U

The reversal range corresponds to the difference in mean values of the two approach directions.

The reversal range is determined at every measurement point. It describes systematic deviations.

Position variation range P_s

The position variation range describes the effects of random deviations.
It is determined at every measurement point.

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