

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

R310EN 2406 (2009.02)

The Drive & Control Company

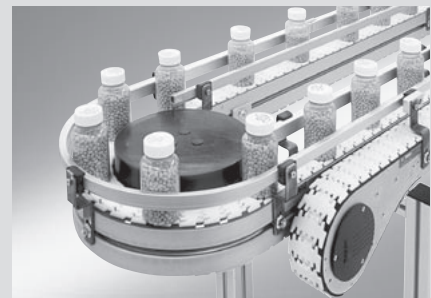
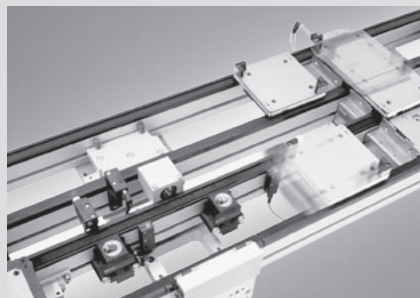
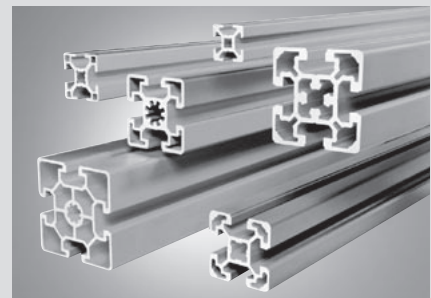
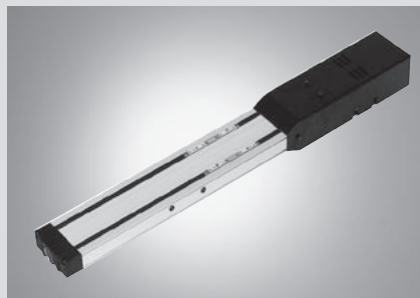
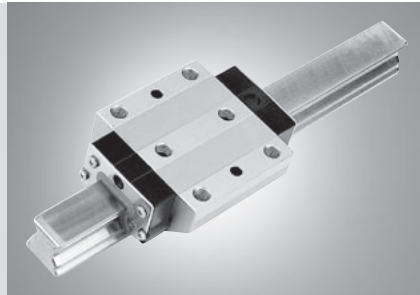
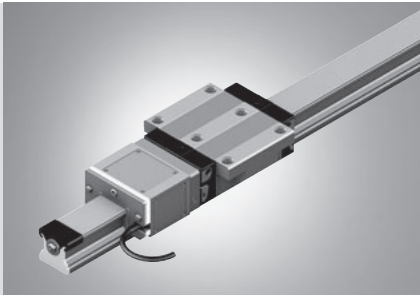


Linear Motion and Assembly Technologies

Ball Rail Systems
Roller Rail Systems
Linear Bushings and Shafts

Ball Screw Drives
Linear Motion Systems

Basic Mechanical Elements
Manual Production Systems
Transfer Systems



Linear Modules for Food & Packaging

Product Description	4
Technical Data	4
Performance Data	7
Components and Ordering Data	8
Dimensions	10
Mounting	12
Motors	13
Lubrication	14
Documentation	14

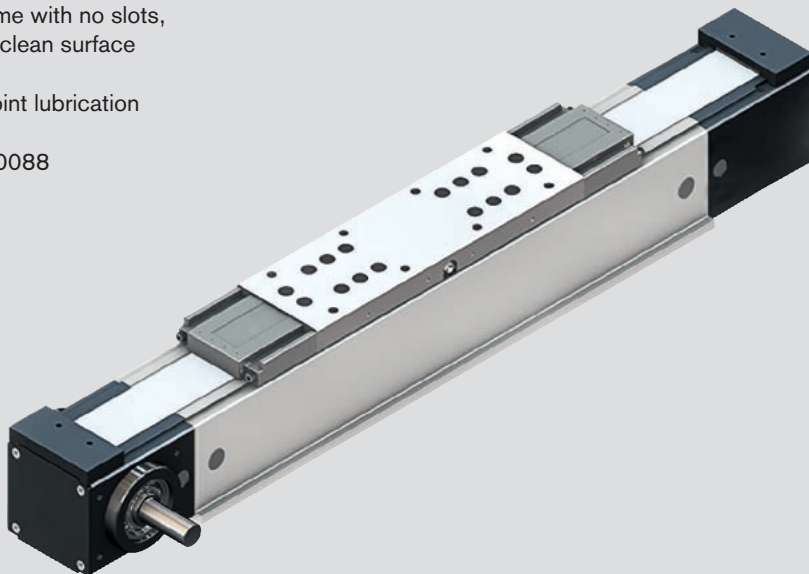
Product Description

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} (mm)	Dynamic load capacity C (N)	Dynamic load moments		Moved mass of system m_{ca} (kg)	Length		Planar moment of inertia	
			M_t (Nm)	M_L (Nm)		minimum $L_{min}^{1)}$ (mm)	maximum L_{max} (mm)	I_x (cm ⁴)	I_y (cm ⁴)
MKR 20-80	190	17 420	221	121	1.4	370	6 000	180	211
	260	28 300	359	1 840	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} (mm)	Maximum permissible forces		Maximum permissible moments		
		$F_{z max}$ (N)	$F_{y max}$ (N)	$M_{x max}$ (Nm)	$M_{y max}$ (Nm)	$M_{z max}$ (Nm)
MKR 20-80	190	8 700	8 700	111	60	60
	260	14 150	14 150	180	919	919

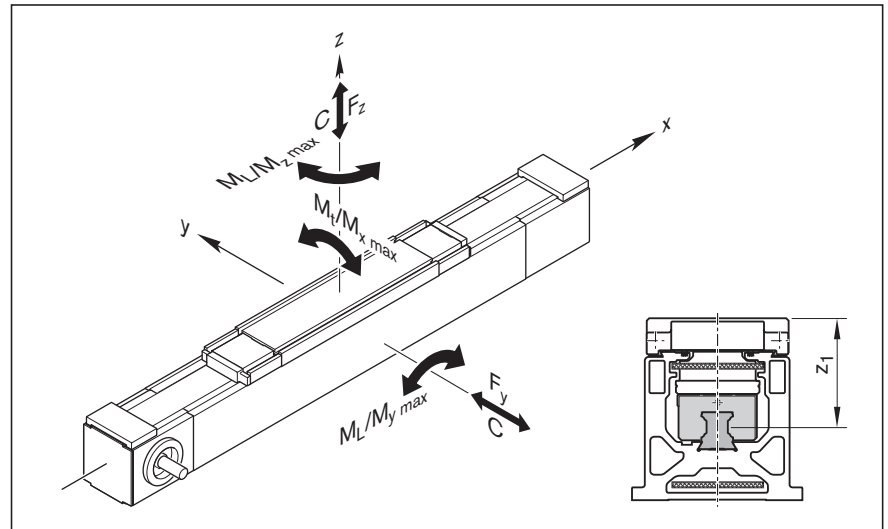
Modulus of elasticity E

$$E = 70,000 \text{ N/mm}^2$$

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

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

- C = dynamic load capacity (N)
- F_{comb} = combined equivalent load on bearing (N)
- F_y = force in y-direction (N)
- F_z = force in z-direction (N)
- M_L = dynamic longitudinal moment load capacity (Nm)
- M_t = dynamic torsional moment load capacity (Nm)
- M_x = torsional moment about the x-axis (Nm)
- M_y = torsional moment about the y-axis (Nm)
- M_z = torsional moment about the z-axis (Nm)
- z₁ = application point of the effective force (mm)

Drive data

Toothed belt stretch

$$\Delta_L = (F \cdot L) / c_{\text{spec}}$$

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 · 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

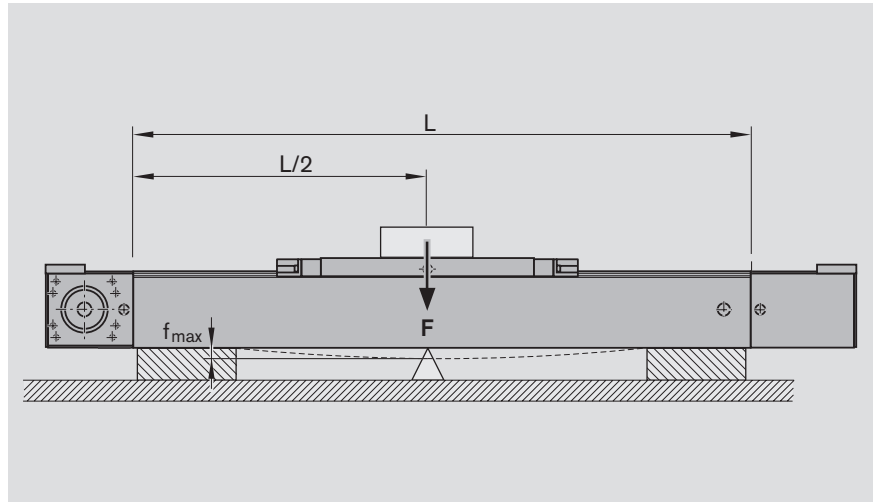
Deflection

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:

$L = 2500 \text{ mm}$

$F = 500 \text{ N}$

From chart 20-80:

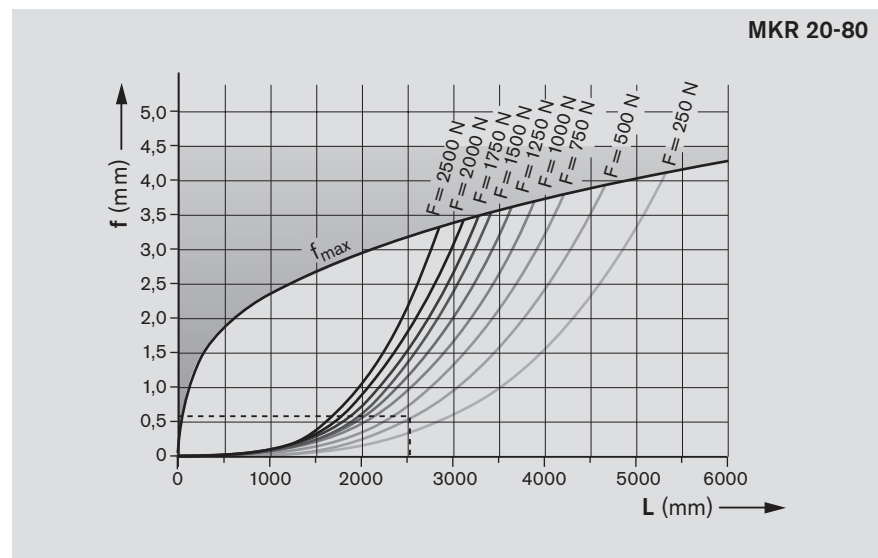
$f = 0.6 \text{ mm}$

$f_{max} = 3.2 \text{ mm}$

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



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 \pm	(mm)	0.1					0.1					0.1				

With servo motor MSK 040C
and DKC controller¹⁾
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 \pm	(mm)	0.1				0.1					0.1				

With servo motor MSM 040B
and DKC controller¹⁾
Connection voltage: 1 x 230 V

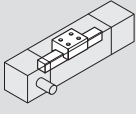
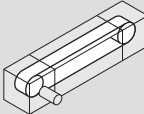
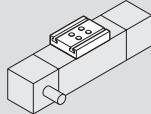
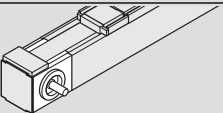
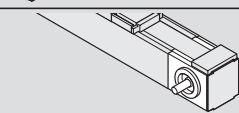
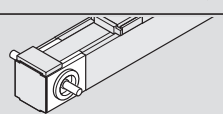
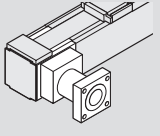
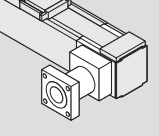
Gear reducer ratio		i = 5					i = 10						
Mass m_{ex}	(kg)	2	4	6	8	10	10	15	20	25	30	35	40
Acceleration time t	(ms)	29	35	43	49	55	42	49	58	67	75	85	93
Acceleration distance s	(mm)	30	36	43	49	55	21	25	30	34	38	43	47
Acceleration a	(m/s ²)	68	57	47	40.8	36.2	24	20.4	17.2	14.9	13.3	11.8	10.8
Travel speed v	(m/s)	2					1						
Repeatability \pm	(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)	$(21.1 + L \text{ (mm)} \cdot 0.00379) \cdot 10^{-4} \text{ kgm}^2$
Mass moment of inertia (long carriage)	$(29.7 + L \text{ (mm)} \cdot 0.00379) \cdot 10^{-4} \text{ kgm}^2$

Linear Modules for Food & Packaging Components and Ordering Data

Part number, length R1140 160 20, mm		Guideway	Drive unit					Carriage		
Version										
			Drive journal	i = 1 ¹⁾	i = 1 ²⁾	i = 3	i = 5	i = 10	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	without with Sealing strip	without with Sealing strip	Standard report	Measurement report						
	-	00	-	00											
	-	00	-	00											
	-	00	-	00											
	-	00	-	00											
	i = 3	01	MSK 040C	86	87	00	10 Without longitudinal seals	01	02 Frictional torque						
	i = 5	10													
	i = 10	20													
	i = 3	02	MSM 040B	74	75					15 With longitudinal seals		05 Positioning accuracy			
	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

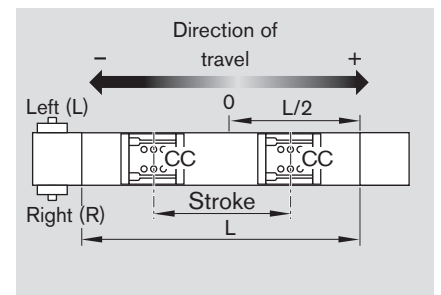
Linear module length:

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

Stroke = maximum travel of carriage center (CC) between the outermost switch activation points.

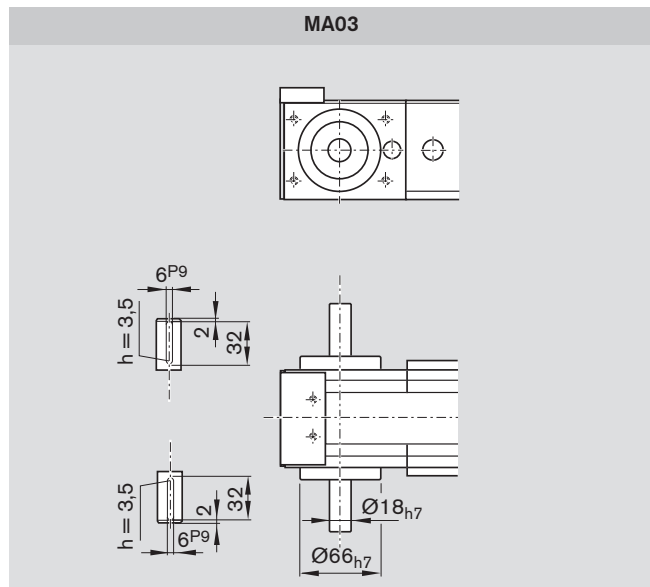
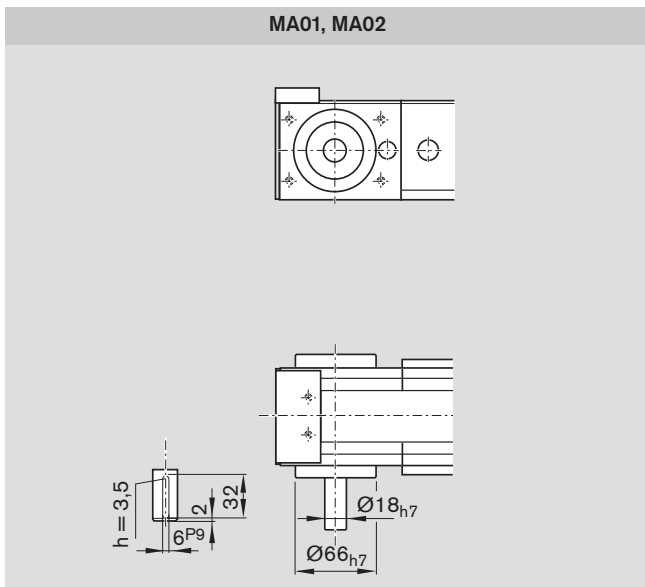
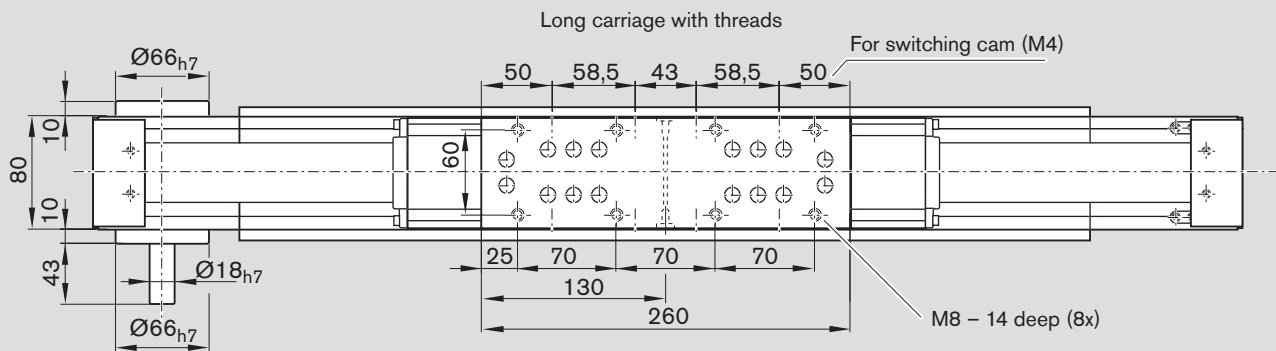
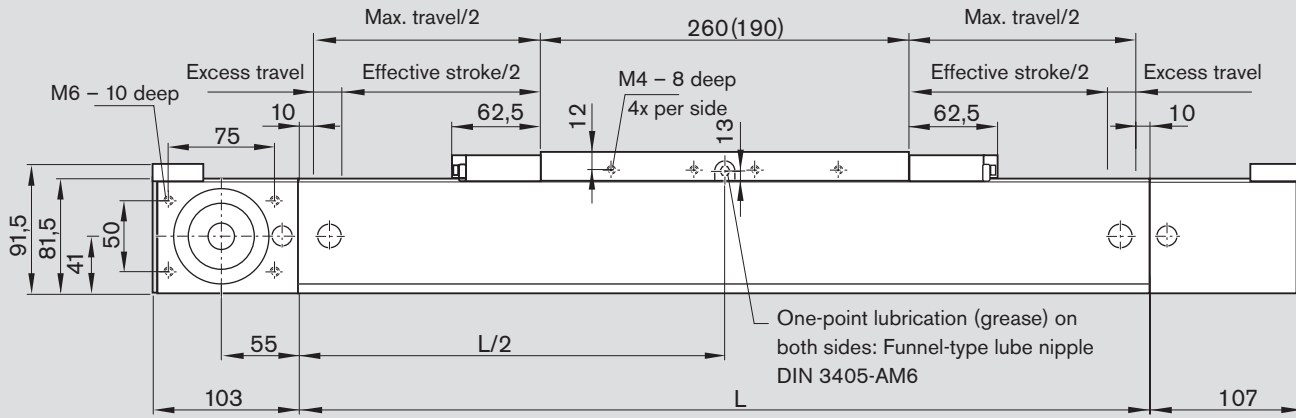
For safe operation, the excess travel must be longer than the braking distance.

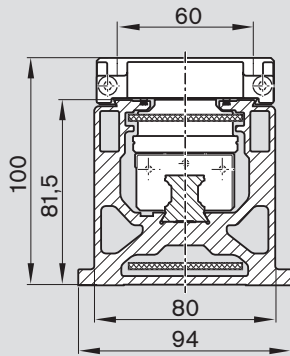
The acceleration travel can be taken as a guideline value for the braking distance.



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

All dimensions in mm.
Drawings not to scale.

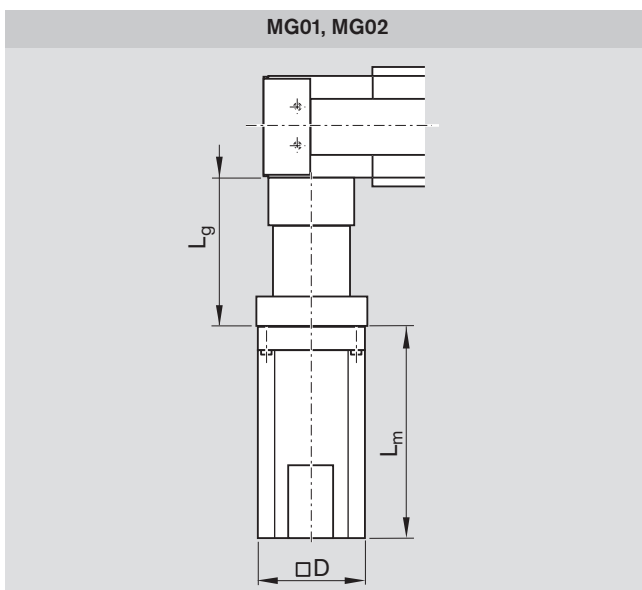
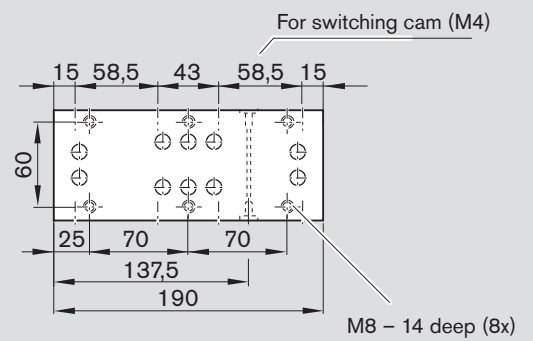




Longitudinal seals in carriage



Short carriage with threads



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

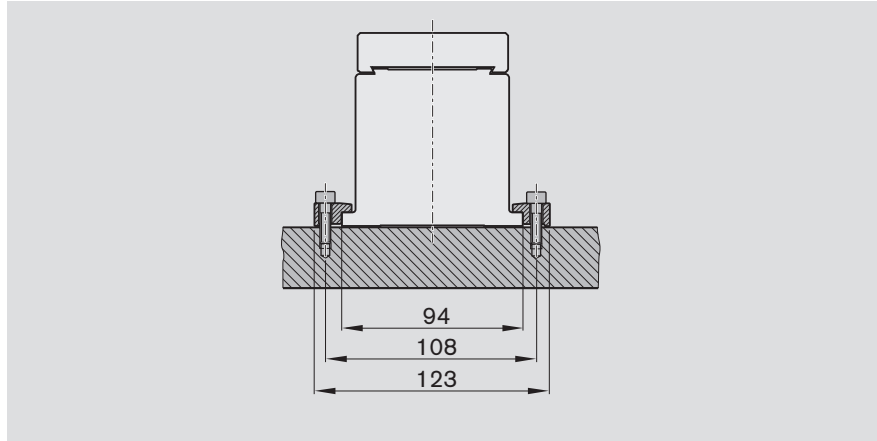
Mounting

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!





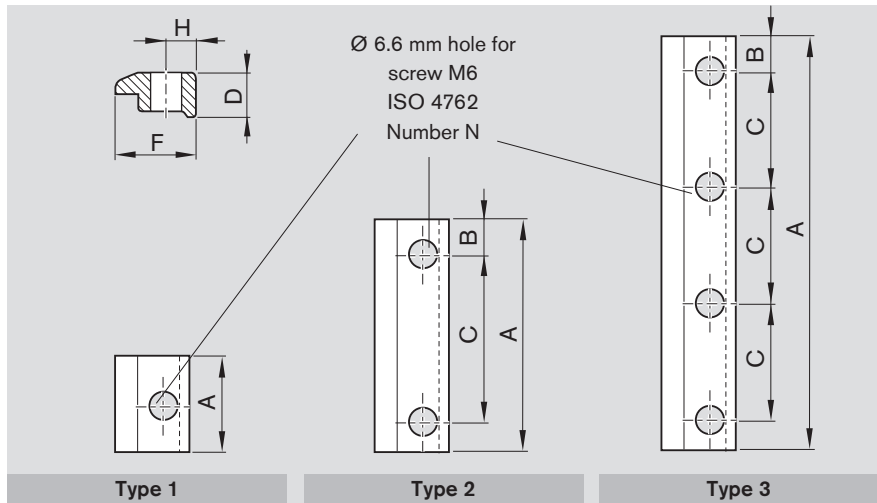
Clamping fixtures

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



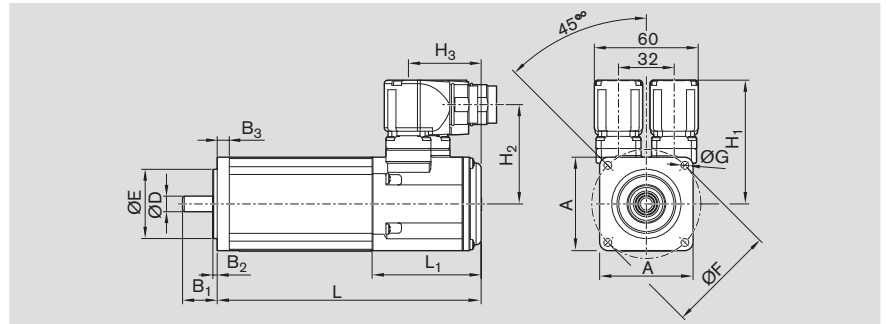
Linear module	for	Type	Number of holes	Dimensions (mm)						Part number
				N	A	B	C	D	F	
MKR 20-80	M6	1	1	25	-	-	11.5	19.3	7.5	R1175 192 00
		2	2	62	11	40				R1175 192 01
		3	4	142	11	40				R1175 192 02

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

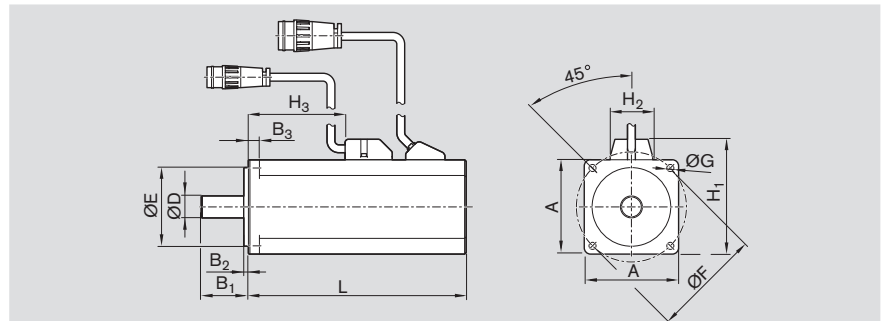
Motor data

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)												L without brake	L with brake
	A	B ₁	B ₂	B ₃	ØD h6	ØE h7	ØF	ØG	H ₁	H ₂	H ₃			
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

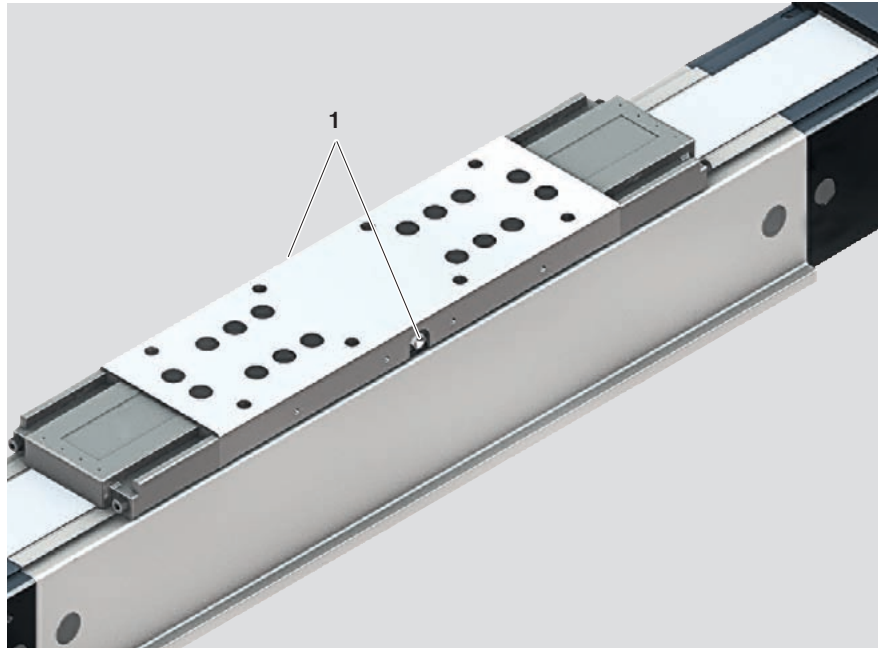
- 1 Funnel-type lube nipple DIN 3405-AM6 for the runner blocks (on both sides, either side can be used).

Recommended lubricants

For lubricant quantities and intervals, see "Mounting Instructions for Linear Modules".

⚠ Do not use greases containing solid particles (e.g., graphite or MoS₂)

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.

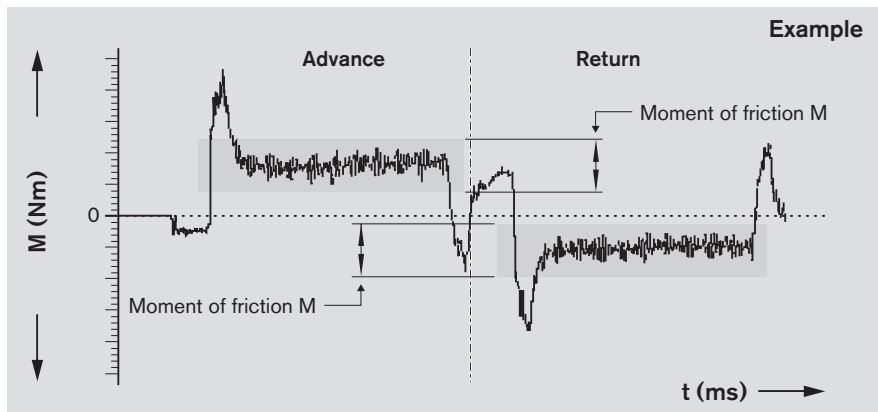
- Checks listed in the standard report:
- functional checks of mechanical components
 - functional checks of electrical components
 - design is in accordance with order confirmation

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)



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.

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.

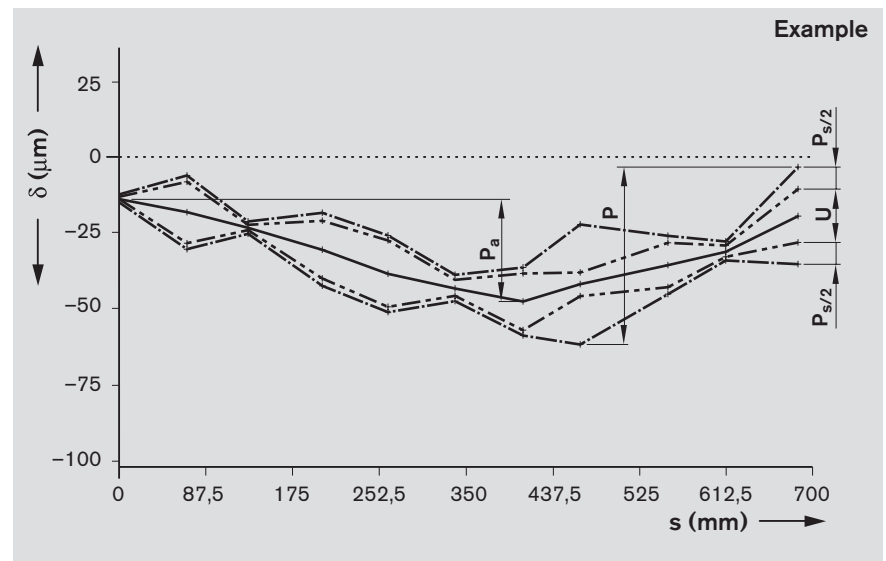
Reversal range U

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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