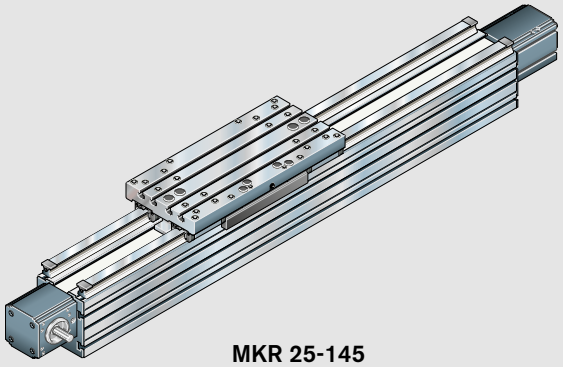
Linear Modules MKR 25-145

Product Description

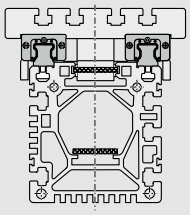
Characteristic features

MKR 25-145: Linear Module with two Ball Rail Systems for high load moment capacity and Toothed Belt Drive for high speeds

The Linear Module MKR 25-145 comprises:
- an anodized aluminum profile frame of high inherent rigidity
- two Rexroth Ball Rail Systems with sealing strips
- a profiled aluminum carriage with four long runner blocks
- a planetary gear integrated in the drive pulley
- with or without gear reducer for attachment of the motor
- an AC servo motor (other motor types on request)
- mountable switches
- control units



MKR 25-145



For mounting, maintenance and start-up, see the relevant Instructions.

Technical Data

General technical data

	Carriage length	Dynamic load capacity	Dynamic load moment		Moved mass	Minimum length	Maximum length	Planar moment of inertia	
		C	M_L	M_t		L_{min}	L_{max}	I_x	I_y
	(mm)	(N)	(Nm)	(Nm)	(kg)	(mm)	(mm)	(cm^4)	(cm^4)
MKR 25-145	400	98 700	5 700	14 600	10,6	760 *	6 000	2 790	1 955

	Maximum permissible loads			
	Forces		Moments	
	$F_{x\,max}$ (N)	$F_{y\,max}$ (N)	$M_{t\,max}$ (Nm)	$M_{l\,max}$ (Nm)
MKR 25-145	49 350	49 350	2 850	7 300

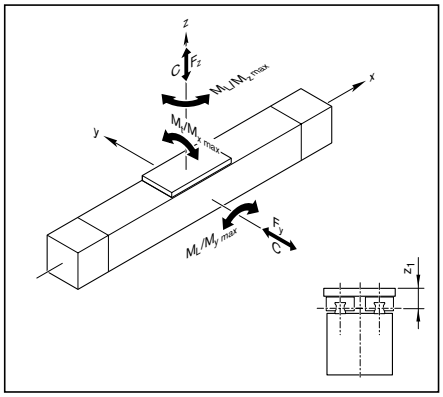
Modulus of elasticity E

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

*) for a theoretical stroke of 100 mm

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.



Z_1 = 50.5 mm
(application point of the effective force)

Drive data

	Gear reducer ratio i	Maximum drive torque M_a	Lead constant	Pulley drive diameter	Belt data					
					Belt type	Width	Tooth pitch	Max. belt drive transmis-sion force	Belt elasticity limit	Specific spring rate
		(Nm)	(mm/rev)	(mm)		(mm)	(mm)	(N)	(N)	(N)
MKR 25-145	1	80.0	290.00	92.2	AT 10	50	10	1740	7500	$2.12 \cdot 10^6$
	1*)	27.0	290.00							
	3	26.6	96.66							
	5	16.0	58.00							
	10	8.0	29.00							

*) With keyway

Combined equivalent load on bearing of the linear guide

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

Service life

Nominal life of the guideway in meters:

$$L = \left(\frac{C}{F_{comb}}\right)^3 \cdot 10^5$$

Nominal life of the guideway in hours:

$$L_h = \frac{L}{3600 \cdot v_m}$$

C	=	dynamic load capacity	(N)
L	=	nominal life in meters	(m)
L_h	=	nominal life in hours	(h)
F_{comb}	=	combined equivalent load on bearing	(N)
v	=	travel speed	(m/min)

Mass of the linear system

Weight calculation does not include motor or switch attachments.
Formula:
Weight factor (kg/mm) · length L (mm) + weight of all parts of fixed length (carriage, end blocks, etc.) (kg)

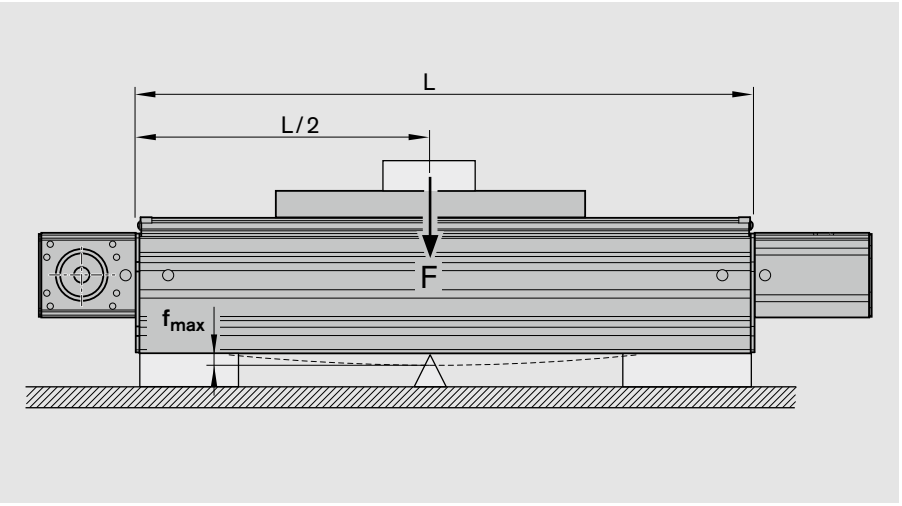
	Carriage length (mm)	Drive unit	Weight (kg)
MKR 25-145	400	Without drive unit	0.0306 · L + 17.4
		Drive i =1	0.0306 · L + 17.7
		With gear reducer	0.0306 · L + 24.6

Linear Modules MKR 25-145

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.



Maximum permissible deflection f_{max}

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

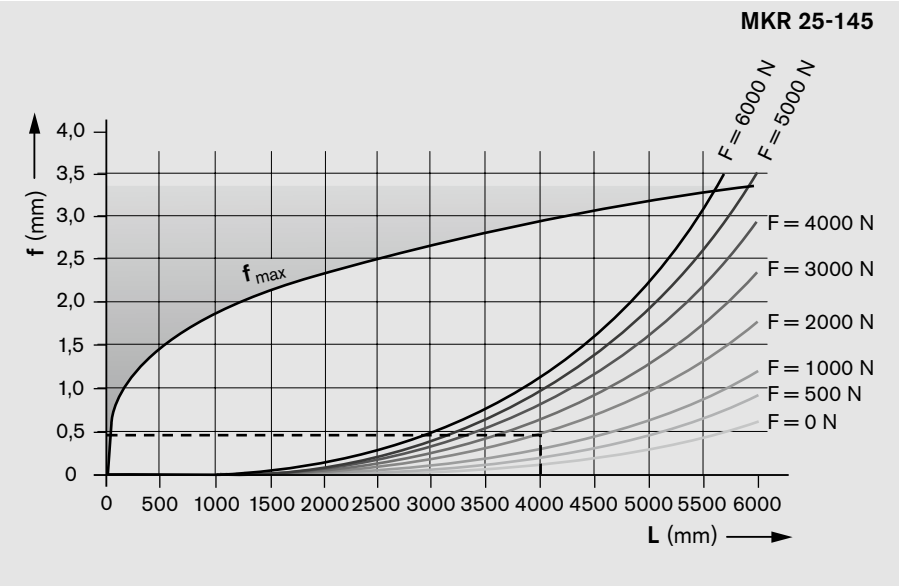
⚠ **f_{max} must not be exceeded!**

Example

Linear Module MKR 25-145:
L = 4000 mm
F = 2000 N
From chart:
f = 0.47 mm
f_{max} = 2.9 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 (approx. 350 mm per end)
- 6 to 8 screws per side
- Solid mounting base



Performance Data

The tables contain performance data examples for gear-motor-controller combinations. They are intended as a rough guide for selection. The precise performance data must be calculated for each application case.
For more information on motors, controllers and control systems, please refer to the catalogs “IndraDrive Cs” and “IndraDrive C for Linear Motion Systems.” These figures do not include any assessment of the effective torque of the motor-controller combination.

Drive data without motor (i = 1)

Belt pulley drive diameter	92.2 mm
Max. linear speed	Up to 5 m/s
Belt type	AT 10, 50 mm wide, steel reinforced
Mass moment of inertia	(250 + L (mm) · 0.0123) · 10^{-4} kgm²

Horizontal operation

MSK 060C, HCS02.1E-W0054, 3 x 400 V

i		5						10				
m_{ex}	(kg)	4	12	20	28	36	46	15	55	95	135	175
t_a	(ms)	120	155	190	215	250	300	175	260	350	435	520
s_a	(mm)	275	350	420	480	555	665	210	310	420	520	626
a	(m/s^2)	37	29	24	21	18	15	13.5	9.2	6.9	5.5	4.6
v_{dc}	(m/s)	4.5						2.4				
*	(mm)	± 0.1										

MSK 076 C, HCS02.1E-W0054, 3 x 400 V

i		3					5						10					
m_{ex}	(kg)	4	8	12	16	20	6	16	36	56	76	96	15	55	95	135	175	195
t_a	(ms)	170	185	210	230	240	275	310	380	340	390	440	476	555	615	690	770	800
s_a	(mm)	430	465	520	570	600	550	615	760	505	585	660	476	555	615	690	770	800
a	(m/s^2)	29	27	24	22	21	14.5	13	10.5	8.9	7.7	6.8	4.2	3.6	3.25	2.9	2.6	2.5
v_{dc}	(m/s)						4			3			2					
*	(mm)	± 0.1																

Vertical operation (frame stationary, carriage travels)

MSK 060C, HCS02.1E-W0054, 3 x 400 V

i		5					10						
m_{ex}	(kg)	6	12	20	30	36	15	25	35	45	55	75	95
t_a	(ms)	140	190	423	205	250	210	260	320	410	520	370	835
s_a	(mm)	315	420	545	310	375	250	310	385	490	625	185	420
a	(m/s^2)	32	24	18.5	14.5	12	11.5	9.3	7.5	5.9	4.6	2.7	1.2
v_{dc}	(m/s)				3		2.4					1	
*	(mm)	± 0.1											

MSK 076 C, HCS02.1E-W0054, 3 x 400 V

i		3				5					10				
m_{ex}	(kg)	4	8	12	16	6	12	22	30	36	15	35	55	75	95
t_a	(ms)	180	210	240	265	220	265	310	366	417	280	375	540	870	1800
s_a	(mm)	445	520	595	655	330	395	465	550	625	140	190	270	435	910
a	(m/s^2)	28	24	21	19	13.6	11.4	9.7	8.2	7.2	3.56	2.66	1.85	1.15	0.55
v_{dc}	(m/s)						3				1				
*	(mm)	± 0.1													

a = acceleration (m/s^2)
i = gear reduction (-)
m_{ex} = mass (kg)
s_a = acceleration travel (mm)
t_a = acceleration time (ms)
v_{dc} = travel speed (m/s)
* = reproducibility (mm)

MSK = servo motor
HCS = digital controller

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Linear Modules MKR 25-145 Components and Ordering Data

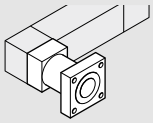
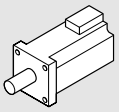
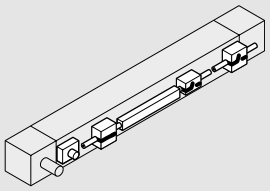
Part number, length R1146 200 10, ... mm			Guideway	Drive unit					Carriage	
Version	Slots for cable duct, left (L)	Slots for cable duct, right (R)		Drive journal	Reduction i = 1 [1]	Reduction i = 1 [2]	Reduction i = 3	Reduction i = 5	Reduction i = 10	L_{ca} = 400 mm	
W/o drive unit (OA)	OA01		01	Without 50	–					10	
With drive unit (MA), without gear reducer i = 1	MA01	MA11	01	Right	01	03	–			05	
	MA02	MA12	01	Left	01	03	–				
	MA03	MA13	01	On both sides	02	04	–				
With external gear reducer (MG)	MG01	MG03	01	Gear unit	–	–	10			05	
	MG02	MG04		With 2nd journal	–	–	11			05	
With integrated LPB gear reducer (MG)	MG05	MG07	01	Integrated gear unit	–	–	20			05	
	MG06	MG08									

Ordering example: see “Inquiry/Order”

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

L_{ca} = carriage length

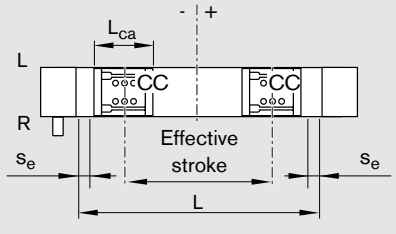
1) Without keyway
2) With keyway
3) Attachment kit also available without motor (when ordering: enter “00” for motor)

	Motor attachment			Motor		Switches / Cable duct / Socket-plug	Documentation	
								
	Reduction i =	Attachment kit[3] with gear reducer	for motor	without Brake	with Brake		Standard report	Measurement report
	–	00	–	00		**Without switch and cable duct** 00	01	02 Friction moment 05 Positioning accuracy
	–	00	–	00		**Switches:** – PNP NC 11- . ± ... mm – PNP NO 13- . ± ... mm – Mechanical 15- . ± ... mm **Ordering data:** Switch type Mounting side (R/L) Direction of travel Switching distance		
	–	00	–					
	–	00	–					
	i = 3	06	MSK 060C	90	91	**Cable duct (loose)** – Length 20, ... mm		
	i = 5	16						
	i = 10	26						
	i = 3	02	MSK 076C	92	93	**External socket/plug (loose)** 17		
	i = 5	11						
	i = 10	21						
	i = 3	05	MSK 060C	90	91	**External switching cam** 16		
	i = 5	15						
	i = 10	25						
	i = 3	04	MSK 076C	92	93			
	i = 5	14						
	i = 10	24						

Length L

$$L = (\text{effective stroke} + 2 \cdot \text{excess travel } s_e) + 40 \text{ mm} + L_{ca}$$

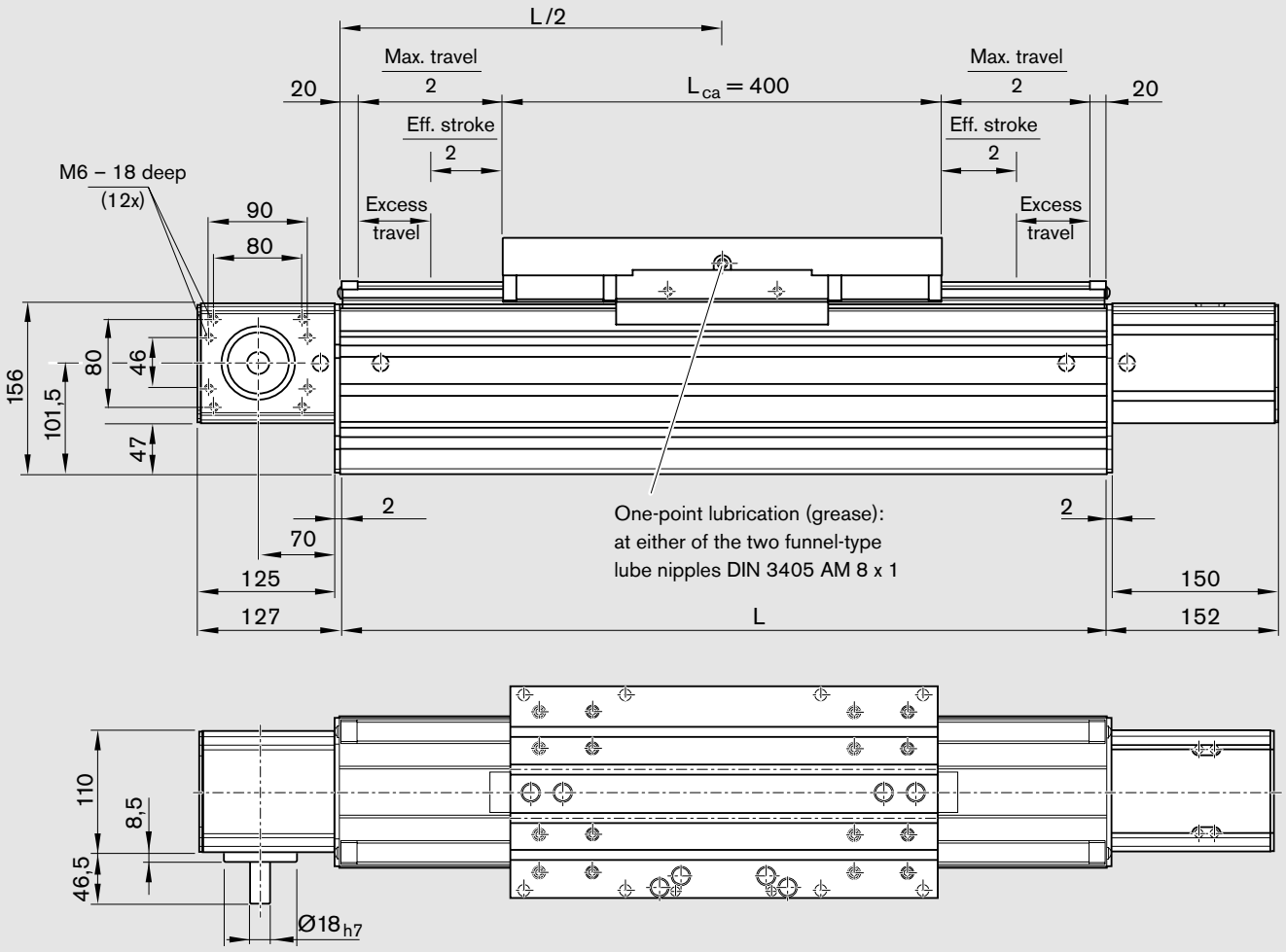
Effective stroke = maximum travel of carriage center (CC) between the outermost switch activation points.
The excess travel s_e must be longer than the braking distance. The acceleration travel can be taken as a guideline value for the braking distance.



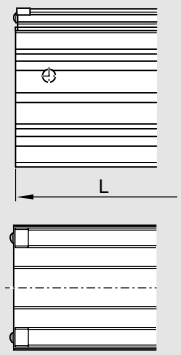
Linear Modules MKR 25-145

Linear Modules MKR 25-145 Dimensions

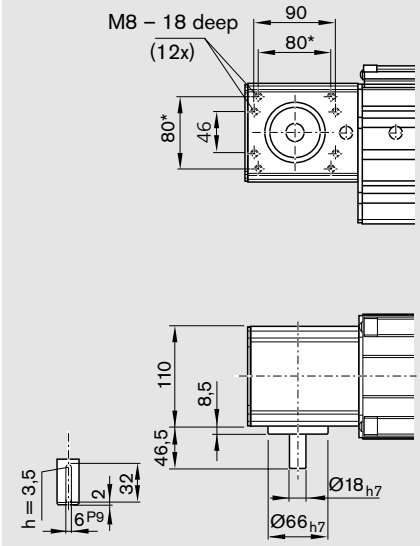
All dimensions in mm
Drawings not to scale



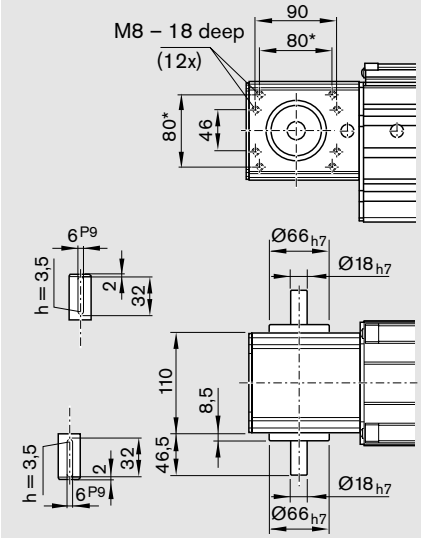
OA01

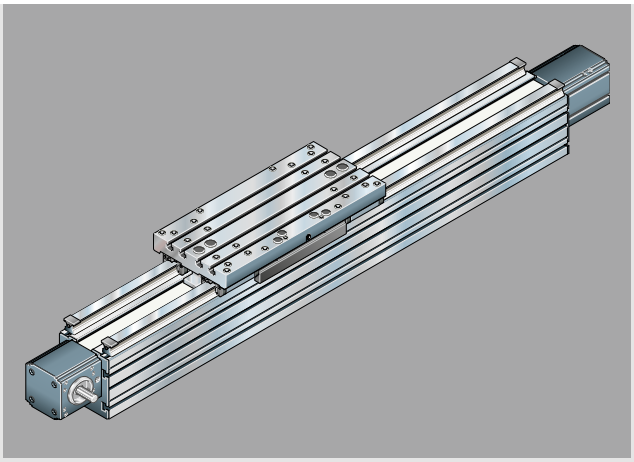


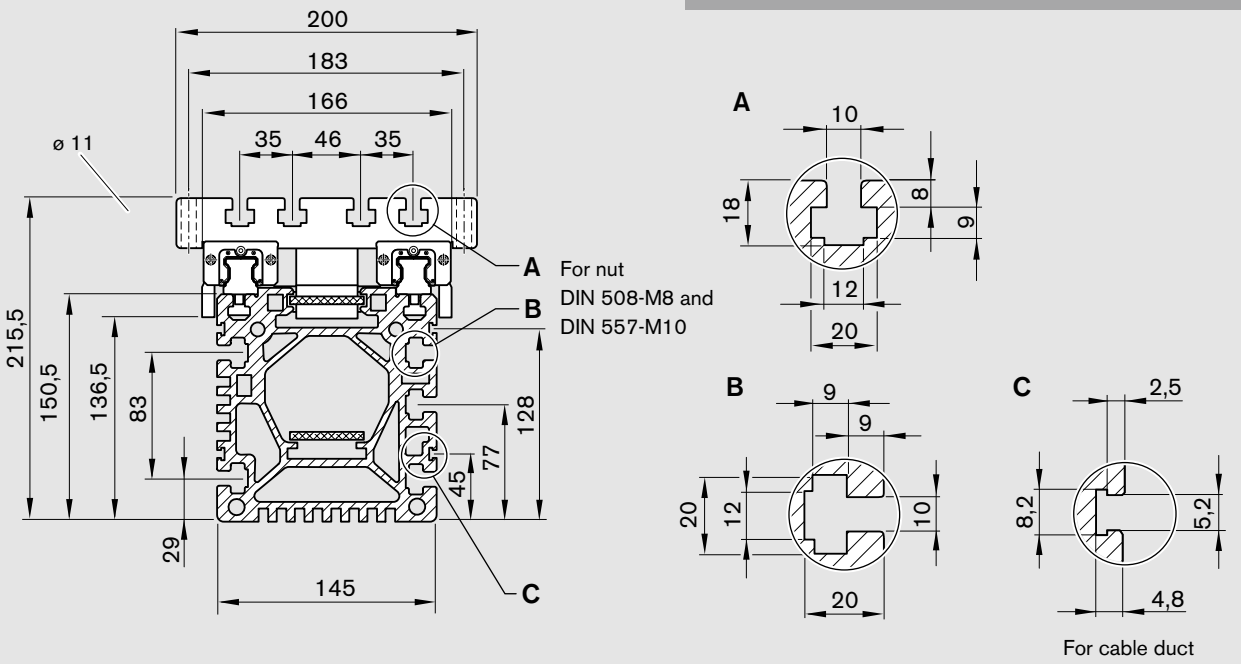
MA01, MA02, MA11, MA12



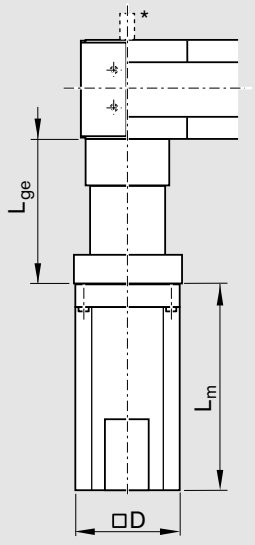
MA03, MA13



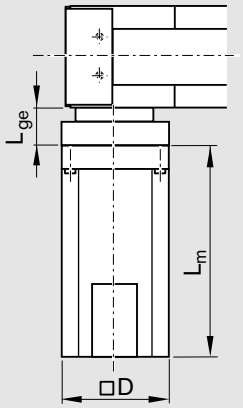




MG01* - MG04*



MG05 - MG08



Motor	Dimensions (mm)				
	Gear unit		Motor		
		L_{ge}	D		L_m
	MG01 - MG04	MG05 - MG08		without brake	with brake
MSK 060C	162	50	116	226.0	259.0
MSK 076C	172	60	140	292.5	292.5

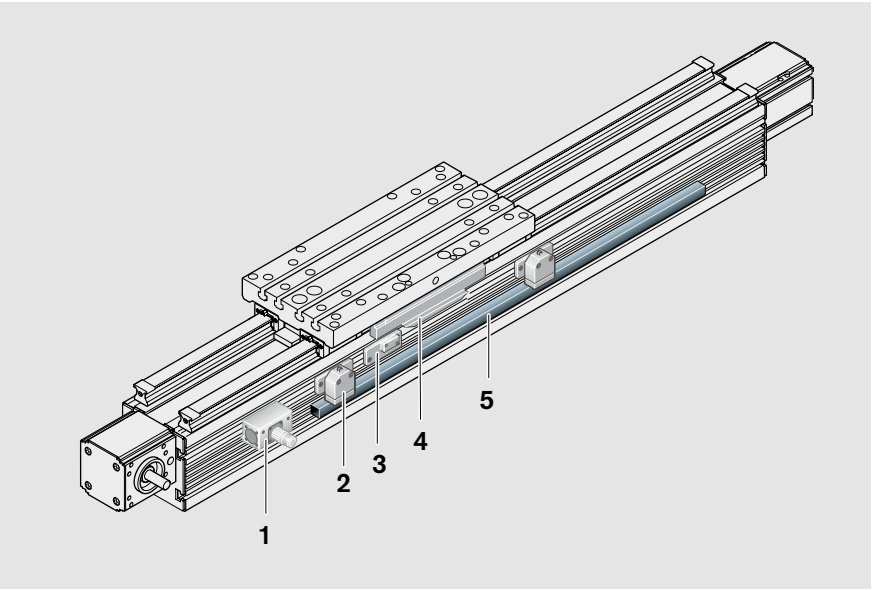
* For drive unit Option 11: second journal Ø18 x 43

Switching System MKR 25-145

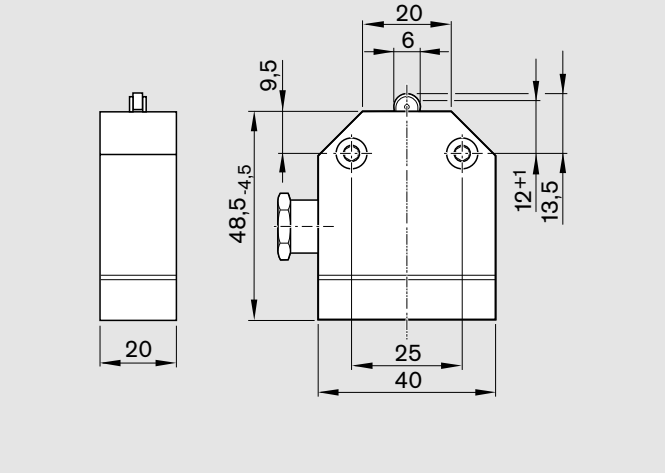
Switching System MKR 25-145

Overview of the switching system MKR 25-145

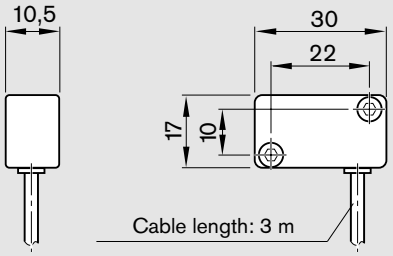
1 Socket with plug
2 Mechanical switch (with mounting accessories)
3 Proximity switch (with mounting accessories)
4 Switching cam
5 Cable duct (aluminum alloy)



Mechanical switch (technical data)	
Repeatability	± 0.05 mm
Permissible ambient temperature	–5 °C to +80 °C
Protection class	DIN 40050 IP 67
Bounce time	< 2 ms
Insulation class	Group C as per VDE 0110
Rated voltage	250 V AC
Continuous current	5 A
Switching capacity at 220 V, 40–60 Hz	cosφ = 0.8 at 2 A
Contact resistance when new	< 240 mΩ
Connection type	Screw connector
Contact system	Single-pole changeover
Switching system	Snap-action
B_{10d} as per EN ISO 13849-1	1 000 000 switching cycles



Proximity switch (technical data) Miniature circuit-breaker with potted cable (3 x 0.14 mm² Unitronic)	
Housing form	NO
Minisensor	Form A DIN 41635
Operating voltage	10 ... 30 V DC
Residual ripple	≤ 10%
Load	200 mA
No-load current	≤ 20 mA
Switching frequency	max. 1500 Hz
Temperature-related shift in make point	≤ 4 µm/K
Output signal steepness	≥ 1 V/µs
Repeatability of make point per EN 50008	≤ 0.1 mm
$MTTF_d$ as per EN ISO 13849-1	30 – 100 years

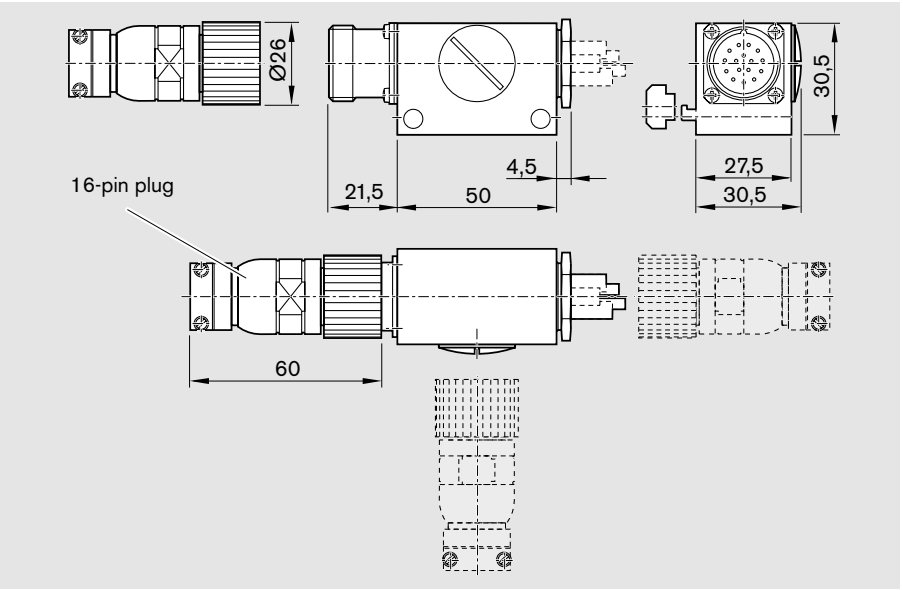


Socket and plug

- Attach the socket at the end with the most switches.

The socket and plug have 16 pins.
The socket and switch are not pre-wired. The switch activation points can thus be optimized during start-up. A plug is provided.

The plug can be mounted in three directions (see diagram).

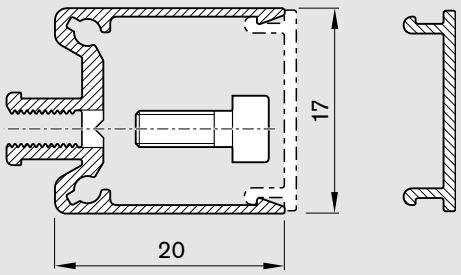


Cable duct

- The cable duct is fastened in the T-slots on the side of the frame. Fastening screws widen the profile and give the cable duct a secure hold.

For the slot position, see “Components and Ordering Data” tables and “Dimensions”.
The cable duct will accommodate up to two cables for mechanical switches and three cables for proximity switches.

Fastening screws and cable grommets are included.



Ordering the switches and accessories

Item		Frame size -145
1	Socket-plug	R1175 001 53
2	Mechanical switch with accessories	R1175 201 51
	Mechanical switch alone	R3453 040 16
3	Proximity switch	
	– Accessories without switch	R1175 201 50
	– PNP NC	R3453 040 01
	– NPN NC	R3453 040 02
	– PNP NO	R3453 040 03
	– NPN NO	R3453 040 04
4	Switching cam	R1175 001 50
5	Cable duct	R0396 620 17

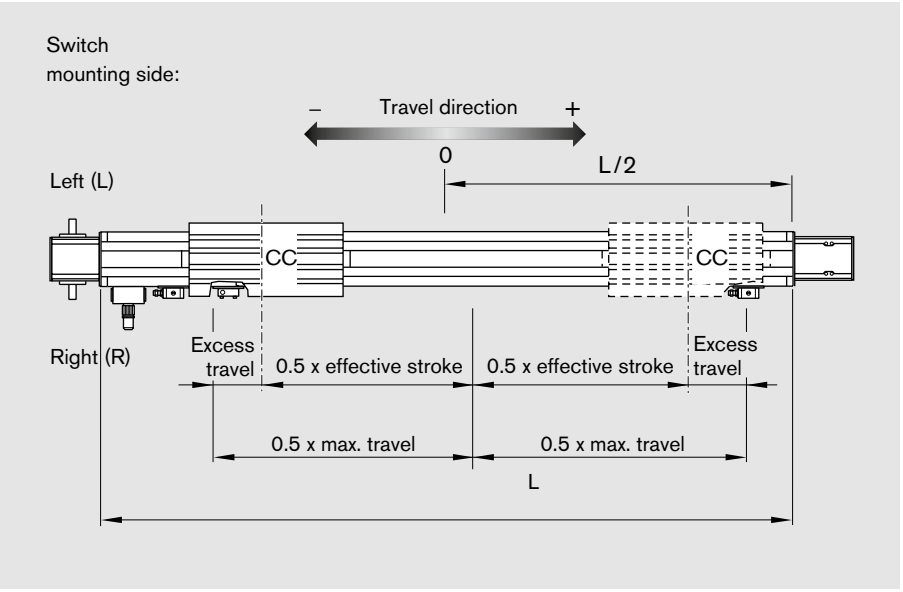
Switching System MKR 25-145

Switch mounting arrangements MKR 25-145

Mechanical and proximity switches
Switching distance: The switching distance is the distance between the carriage center (CC) and the zero point (0) when a switch is activated (given in mm).

Mounting example
Example for a mechanical limit switch (provided the zero point is at L/2):
Maximum switching distance =
= 0.5 x (max. travel) – excess travel
= 0.5 x effective stroke

For safe operation of the Linear Module, the excess travel must be longer than the braking distance.
Recommended standard configuration:
– 2 mechanical switches
– 1 proximity switch
Slide the mounting plates with switches into the slot and fix with two socket head cap screws.



Take note of the minimum switching distance (determined by the mounting plates):

mechanical-mechanical	=	62 mm
mechanical-proximity	=	49 mm
proximity-proximity	=	35 mm

The switches and socket-plug are mounted in the upper T-slots of the frame and activated by a switching cam on the carriage.