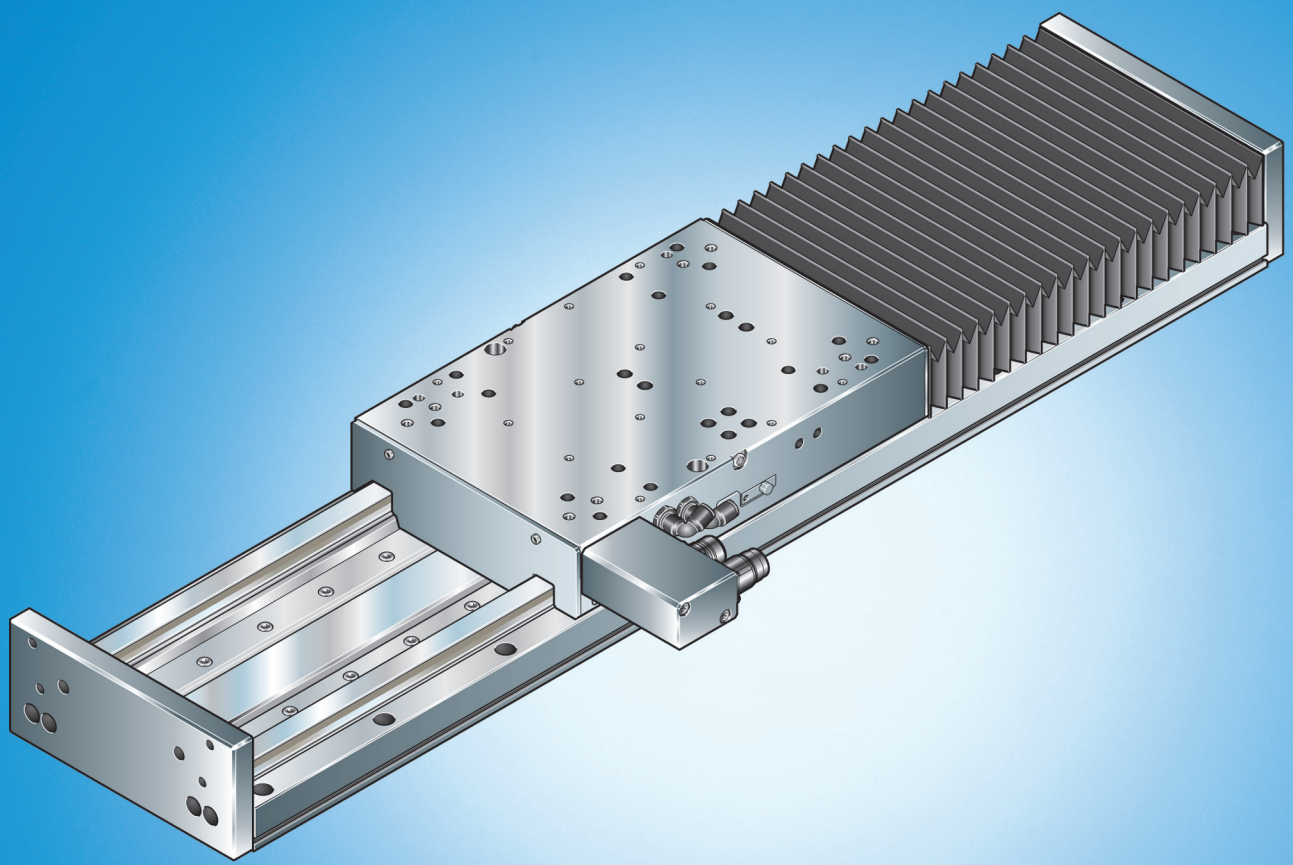
Rexroth
Bosch Group

Ball Rail Tables TKL

with Ball Rail Systems and Linear Motor

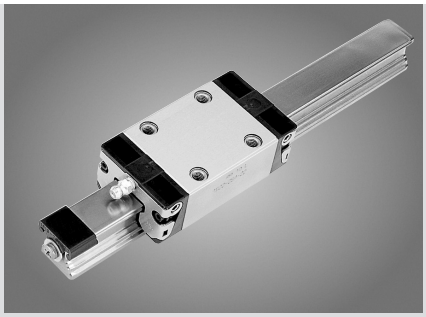
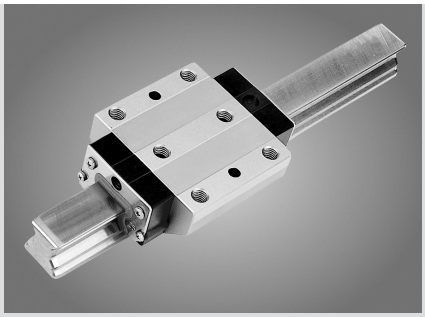
R310EN 2531 (2006.01)

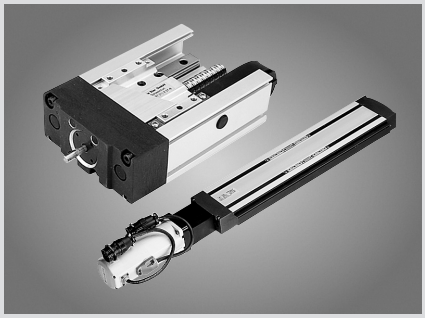
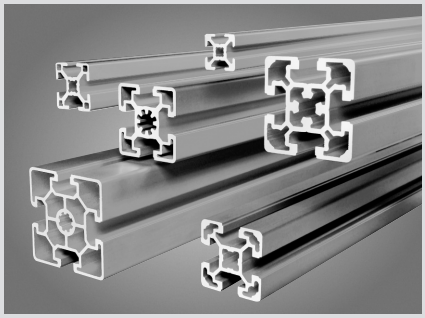
The Drive & Control Company

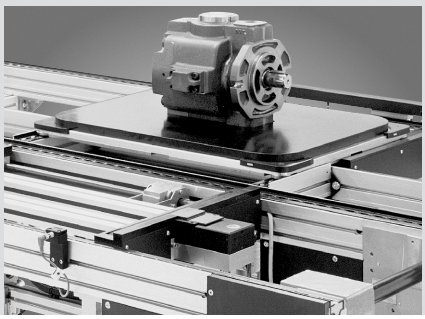
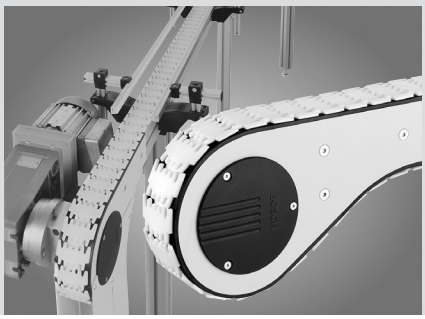


Linear Motion and Assembly Technologies

Ball Rail Systems
Roller Rail Systems
Linear Bushings and Shafts
Ball Screw Drives
Linear Motion Systems
Basic Mechanical Elements
Manual Production Systems
Transfer Technology

www.boschrexroth.com/brl

Ball Rail Tables TKL

Product Overview

Outstanding features

Ball Rail Tables TKL will help you solve your linear motion problems rapidly and cost-effectively for a wide variety of different applications – from simple single-axis systems to multi-axis configurations.

The well-matched combination of synchronous linear motor, ball rail system, position measuring system and carriage substantially reduces the design complexity of the mechanical structures usually needed for linear motion.

Since they require no rotary to linear motion conversion mechanisms, Ball Rail Tables TKL offer you all the advantages of backlash-free drives.

Ball Rail Tables TKL are particularly suitable for applications that simultaneously call for
- high speed,
- high acceleration, and
- extremely good positioning.

They can easily master positioning tasks at high approach speeds or involving a rapid succession of short-stroke movements with high acceleration, while coping with even the most demanding positioning accuracy requirements.

Controllers and servo amplifiers with SERCOS interface, field bus, analog or positioning interface are available for optimal control of the Ball Rail Tables TKL.

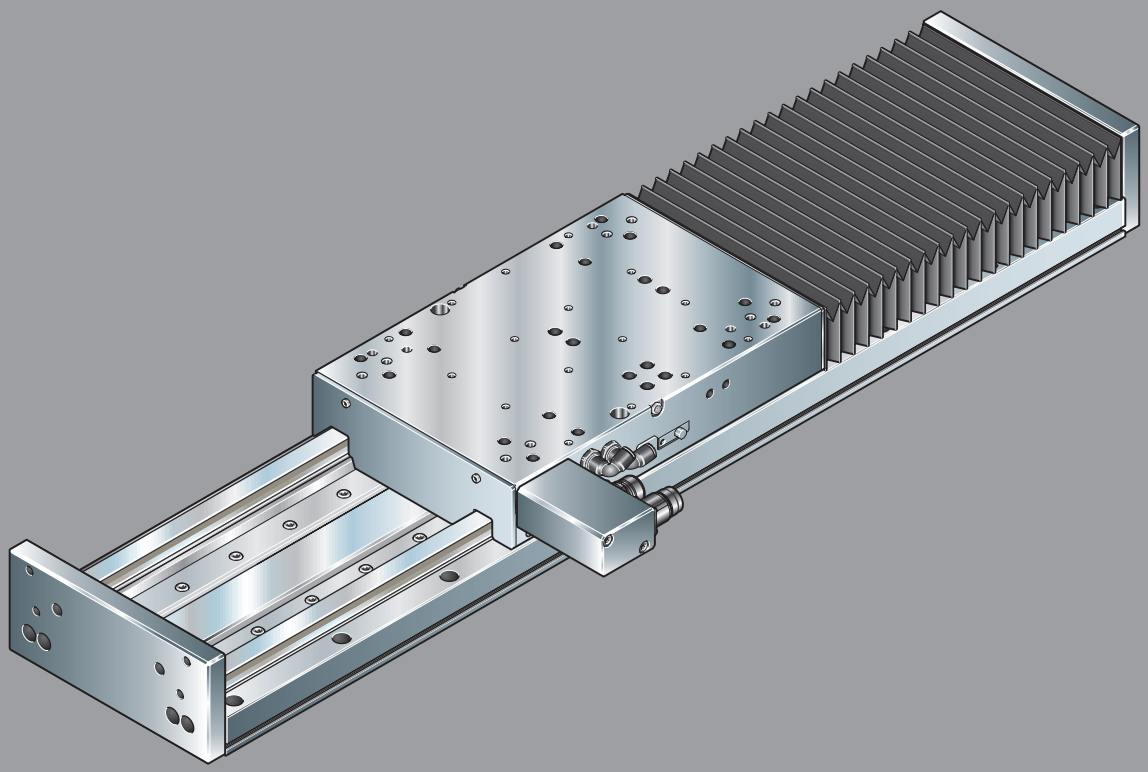
Further highlights

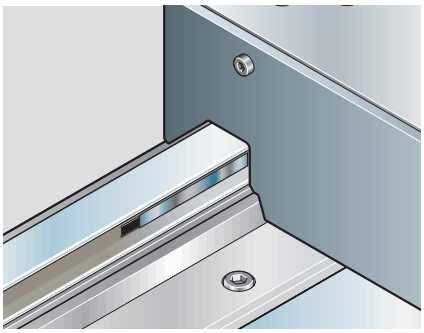
- Internals protected by high-quality, welded, oil- and moisture-resistant high-speed bellows
- High travel speeds and high acceleration rates thanks to excellent dynamics of the linear motor
- High load capacity assured by the use of long runner blocks
- High positioning accuracy thanks to integrated measuring system or glass scale
- Easy maintenance of ball rail system via one central lubrication point
- Lube ports provided on both carriage sides
- Zero maintenance linear motor
- Clamping unit as an option

Application areas:

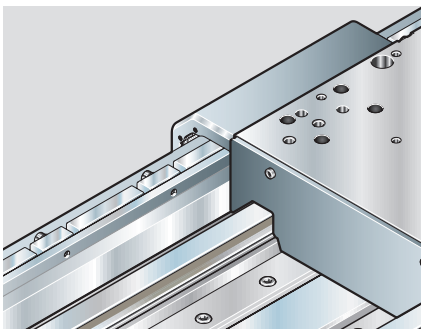
- Transfer lines
- Machining centers
- Handling systems
- Textile machines
- Packaging machines
- Testing

Ball Rail Tables TKL





Integrated Position Measuring System (IMS)
– No additional space requirement for measuring system



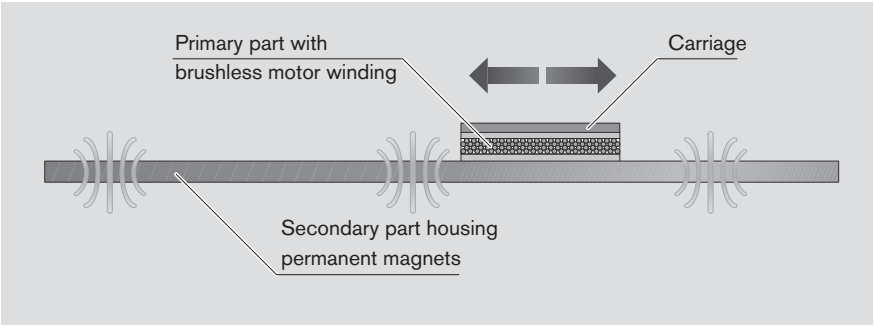
Glass scale
– Freely accessible from the outside

Product Overview

The Drive Unit

Basic principle

The key drive components of Ball Rail Tables TKL are the thrust block (primary part) and the permanently magnetized thrust rod (secondary part).
Two Ball Rail Systems support and guide the primary part and its load.
The thrust block and the thrust rod do not come into contact with each other.
The weight of the payload is transmitted to the Ball Rail System only.
Unlike rotary drive systems, the linear motor comprises no moving parts and is consequently wear and maintenance free.
It is therefore ideal for 24-hour operation.
It also eliminates the need for additional rotary to linear conversion mechanisms.
Because there is no backlash, positional repeatability is outstanding and is maintained for life.



The Advantages

Easy to install and use

Fully integrated load bearing system, providing a ready-to-install solution for the design engineer. No need to source individual components.

High speeds and high acceleration

Synchronous direct linear drive.
High K_V factor and high dynamics.

⚠ Caution
For vertical configurations, please consult us!

Precise motion and high dynamic response for life

Thrust generated directly at the payload. No need for rotary to linear conversion mechanisms, no gears and thus no backlash. Linear high-resolution position sensing system.

Permits very high load cycle rates

Excellent heat dissipation thanks to liquid cooling of primary part.

Easy maintenance

No internal moving parts, no wear and no motor maintenance.
Central lube ports for maintenance of runner blocks (on both sides of carriage).

Safety Notes

⚠ Warning
Danger for people with pacemakers!
The drive unit generates strong magnetic fields (even when switched off!) which can under certain circumstances affect the functioning of pacemakers.
This could cause health problems. We therefore advise people with pacemakers to keep clear of the drive unit.
We also recommend to mark hazard zones with a warning sign to DIN 40023.

⚠ Caution
Risk of injury or damage to the drive unit through improper handling or non-specialist installation!
- Mounting or dismounting only by specialists and using appropriate tools. Please note that the use of ferromagnetic materials can give rise to extremely high forces of attraction. Wrong handling could result in crushed hands or limbs.
- Provide additional external hydraulic shock absorbers in the end positions.
- Encapsulate the drive unit to prevent injuries.

⚠ Caution
On powering up, the system will respond with an initial uncontrolled movement of up to 37.5 mm before performing its reference cycle of 80 mm max.

⚠ Caution
Interference with on-board electronic systems in transportation (e.g., aircraft) due to strong magnetic fields! It is therefore vital to observe the relevant rules and regulations when transporting drive units.

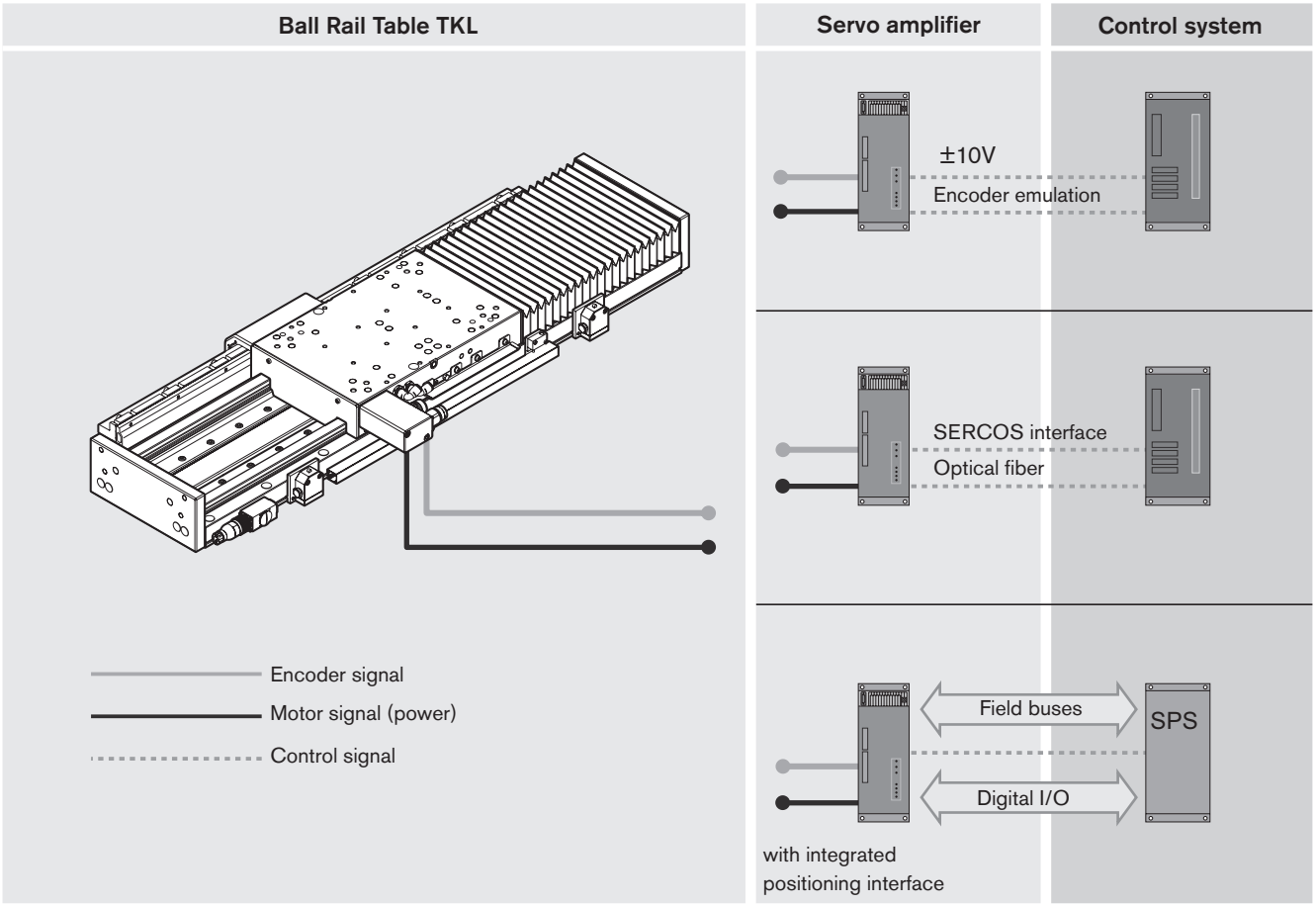
The Control System

Basic principle

Rexroth offers matching servo amplifiers for the Ball Rail Table TKL (see “Controllers, Motors, Electrical Accessories” catalog).

They power the linear motor as well as constituting the interface to a master control system.

A position measuring system integrated in the mechanical structure signals the carriage’s actual position to the control system position loop.



The Advantages

Various command signal interfaces offered

- Control via analog +/−10 V signal (velocity command signal)
- Control via SERCOS interface
- Control via positioning interface (integrated in the servo amplifier)
- Control via field buses

Complete with integrated position measuring system

Ready for connection to the linear measuring inputs in your servo amplifier or control unit.

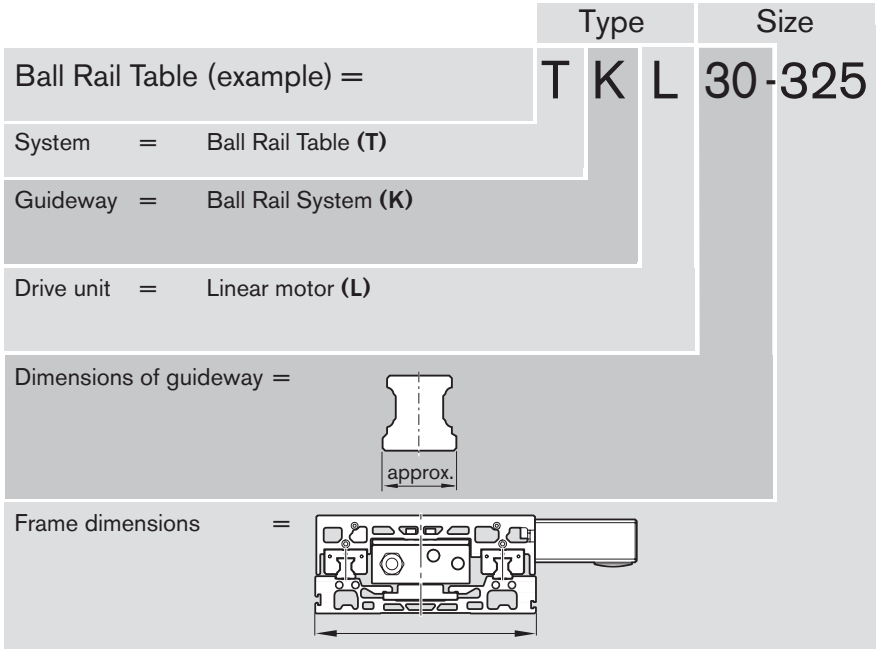
Matching servo amplifier

Designed for easy connection and installation. Diagnostic interface as standard. Motor-controller combination from the same source.

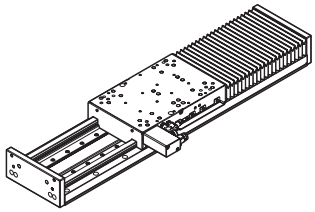
Product Overview

Type Designation (size)

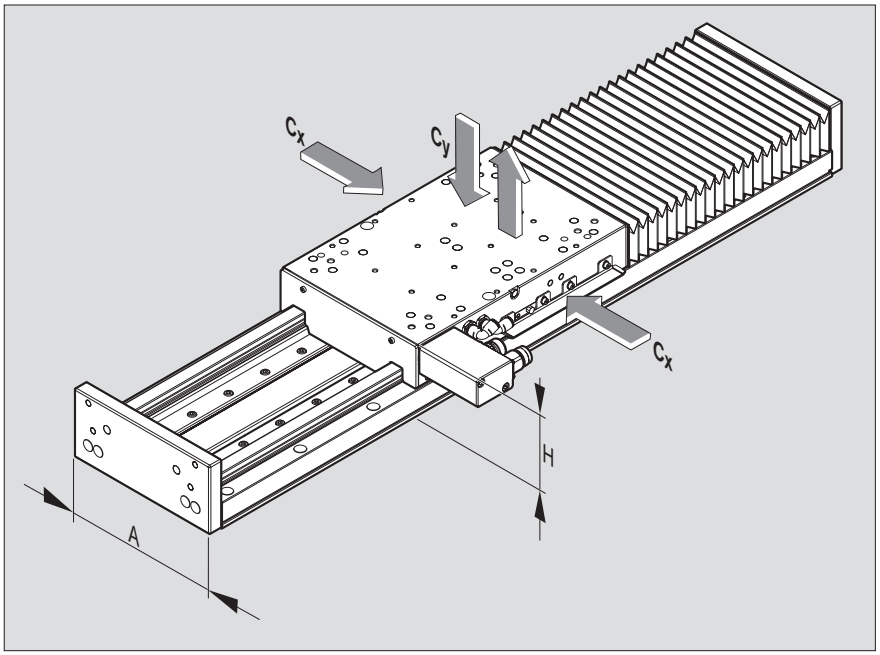
The Ball Rail Tables are designated according to type and size.



Type Designation, Sizes

	Type	Guideway	Drive unit	Ball Rail Table	
Ball Rail Tables	TKL	Ball Rail Systems	Linear motor		

Overview of Ball Rail Tables with permissible loads



Suitable loads
(recommended values)

As far as the desired service life is concerned, loads of up to approximately 20% of the dynamic load and moment values (**C, M_t, M_L**) have proved acceptable.
With a side load above 8% **C**, it should be taken into account when considering the service life that only one rail is secured laterally. Higher side loads are only taken up by the runner blocks on the fixed rail.

In addition, the following must not be exceeded:
– the maximum permissible loads
– the maximum permissible speeds
– the maximum permissible motor data
(for precise details, see “Technical Data”).

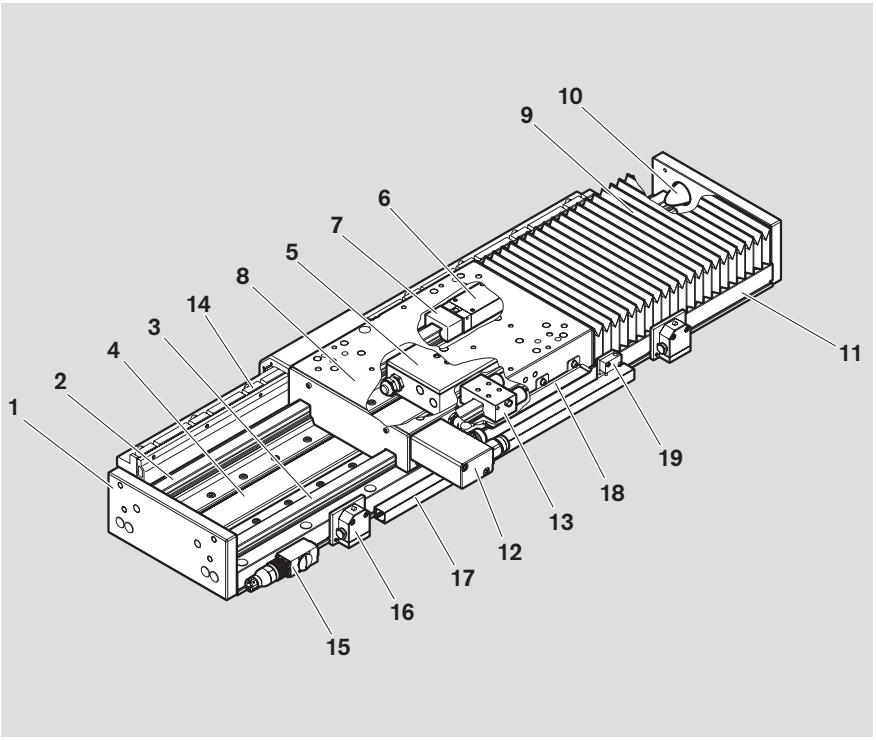
Ball Rail Table	Dimensions A x H [mm]	Dyn. load capacity C_X, C_Y [N][1) 2)]
TKL 20 - 225	225 x 100	75000
TKL 25 - 275	275 x 110	89300
TKL 30 - 325	325 x 120	123000 (163000)[3)]

1) Take maximum loads into account.
2) Values for standard version (for high-speed runner blocks the values will be reduced).
3) Only for version with primary part C or table length 775 mm.

Structure, Mounting

1 End plate
2 Guide rail with integrated measuring system
3 Guide rail
4 Linear motor secondary part
5 Linear motor primary part
6 Runner block (4 or 6 in total)
7 Probe of integrated measuring system
8 Carriage (aluminum)
9 Polyurethane protective bellows
10 Rubber buffer
11 Base plate (aluminum)
12 Plug mount for motor and linear measuring system

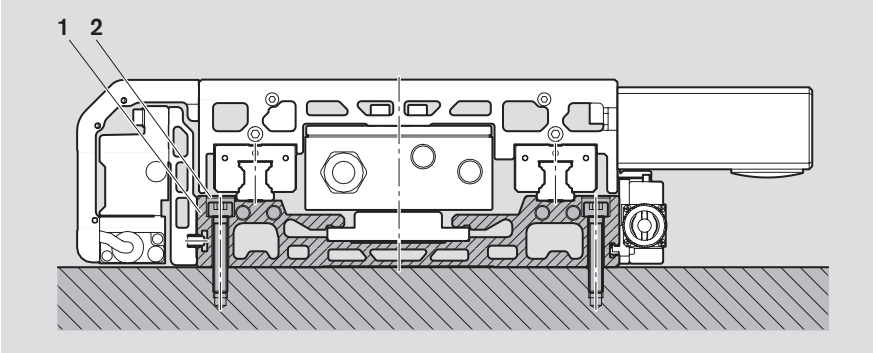
Attachments:
13 Clamping unit
14 Glass scale
15 Socket/plug
16 Mechanical switch (with mounting accessories)
17 Cable duct (aluminum alloy)
18 Switching cam
19 Proximity switch (with mounting accessories)



General notes on mounting

Ball Rail Tables TKL are mounted from above.
Mounting hole plugs are included with the unit.
For connection dimensions, see the relevant dimension drawings.

1 Base plate
2 Mounting hold plug

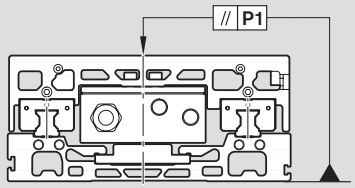


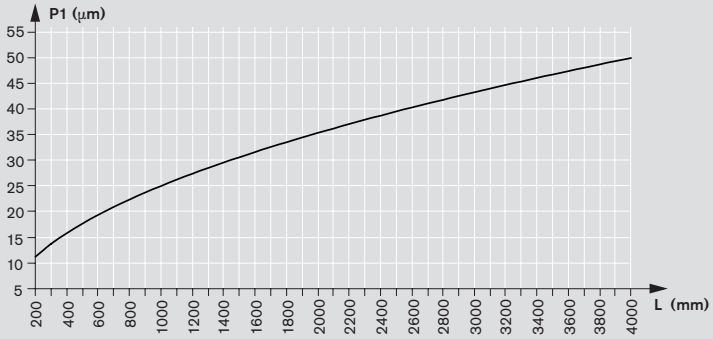
Accuracy

All accuracy data apply to the unit when screwed down and assume an ideal flat mounting base surface. Irregularities in the mounting base surface are not taken into account in the values given below.

Accuracy P1

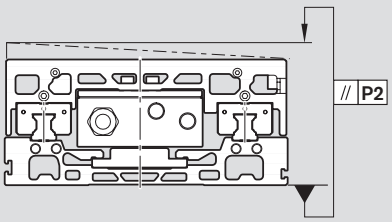
Measured in the center of the carriage

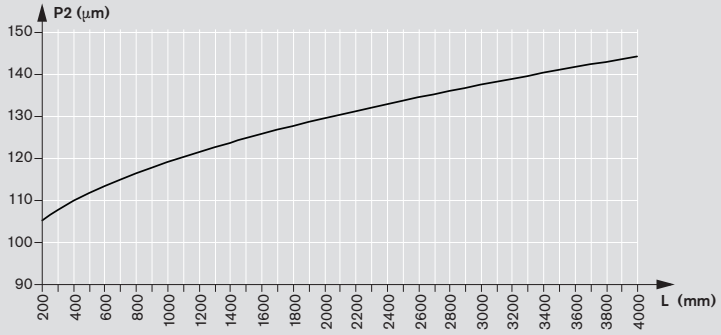




Accuracy P2

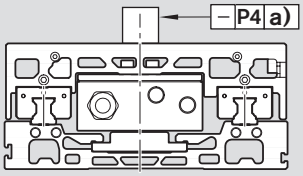
Measured in the center of the carriage

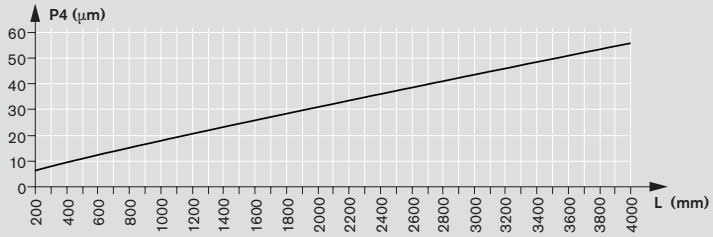




Accuracy P4

Measured in the center of the carriage





a) lengthwise

Technical Data

Motor data[1)]

Size	Motor	Primary part	Motor winding	Peak thrust[2)] F_{max} (N)	Continuous thrust F_{dN} (N)	Rated velocity[3)] at F_{dN} v_N (m/s)	Maximum velocity at F_{max}[3)] v_{Fmax} (m/s)	Attractive force[4)] F_{ATT} (N)
TKL20-225	MLP040	A	300	600	190	6.6	4.1	1200
		B	250	900	280	5.0	3.3	1700
TKL25-275	MLP070	A	300	2000	500	6.6	4.1	2900
		B	250	2600	770	5.0	3.3	3750
TKL30-325	MLP100	A	190	3750	1180	4.3	2.8	5400
		B	250	5600	1600	5.0	3.6	8000
		C	190	7150	2310	4.8	3.1	10400

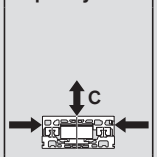
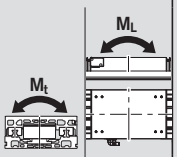
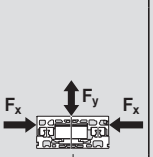
All of the data given above refer to the following conditions:
- Motor winding temperature 135 °C
- Cooling medium: water, inlet temperature 30 °C

1) The values determined are effective values according to IEC 60034-1, unless stated otherwise. Reference value 540 V DC
2) The achievable peak thrust depends on the drive controller used.
3) The achievable velocities depend on the supply voltage.
   At velocities above 300 m/min (≙ 5 m/s) high-speed runner blocks are required.
4) Between the primary and secondary part at rated air gap, primary part de-energized.

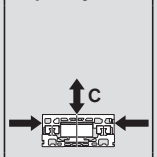
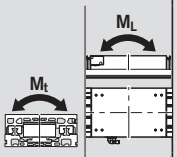
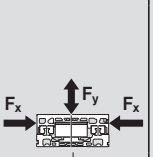
⚠ **The attractive force of the motor must be taken into account when calculating the service life!**

General Technical Data

Standard runner blocks

Size	Motor	Primary part	Motor winding	Carriage length	Dynamic load capacity	Dynamic moment			Maximum loads		Moved mass	Maximum length	Planar moment of inertia	
														
				L_T (mm)	C (N)	M_t (Nm)	M_L (Nm)		F_y (N)	F_x (N)	m_b (kg)	L_{max} (mm)	I_x (cm^4)	I_y (cm^4)
TKL20-225	MLP040	A	300	340	75000	6000	8000		32100	19800	15.5	3940	121	3132
		B	250	400			10000				17.9			
TKL25-275	MLP070	A	300	395	89300	8900	10000		46800	23400	24.2	3940	170	6204
		B	250	465			13000				27.5			
TKL30-325	MLP100	A	190	475	123000	14000	18000		89000	30800	35.4	3980	223	10492
		B	250	625			26000				44.6			
		C	190	775	163000	19000	35000				56.1			

High-speed runner blocks

Size	Motor	Primary part	Motor winding	Carriage length	Dynamic load capacity	Dynamic moment			Maximum loads		Moved mass	Maximum length	Planar moment of inertia	
														
				L_T (mm)	C (N)	M_t (Nm)	M_L (Nm)		F_y (N)	F_x (N)	m_b (kg)	L_{max} (mm)	I_x (cm^4)	I_y (cm^4)
TKL20-225	MLP040	A	300	340	53900	4300	5870		21828	13464	15.5	3940	121	3132
		B	250	400			7270				17.9			
TKL25-275	MLP070	A	300	395	67100	6710	8120		31824	15912	24.2	3940	170	6204
		B	250	465			10140				27.5			
TKL30-325	MLP100	B	250	625	88370	10600	19260		60520	20940	44.6	3980	223	10492

Weight calculation

TKL 20-225:
$M = 0.027 \cdot L + 4.3 + m_b$

TKL 25-275:
$M = 0.038 \cdot L + 6.3 + m_b$

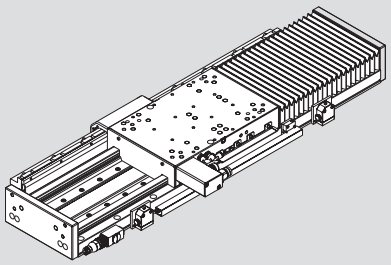
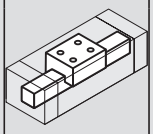
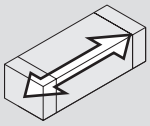
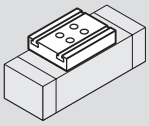
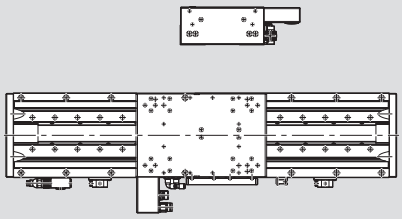
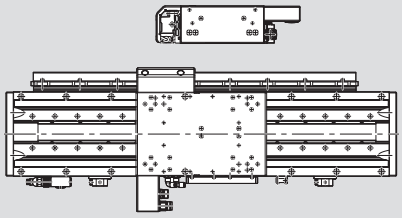
TKL 30-325:
$M = 0.048 \cdot L + 8.8 + m_b$

M	=	total mass of Ball Rail Table	(kg)
L	=	length	(mm)
m_b	=	moved mass	(kg)

Note on dynamic load capacities and moments

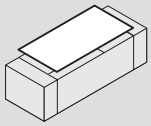
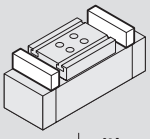
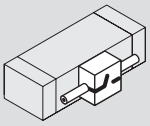
The dynamic load capacities and moments are based on 100,000 m travel.
However, a travel of just 50,000 m is often taken as a basis.
If this is the case, for comparison purposes:
Multiply values **C**, $\mathbf{M}_t$ and $\mathbf{M}_L$ from the table by 1.26.

TKL 20-225 Components and Ordering Data

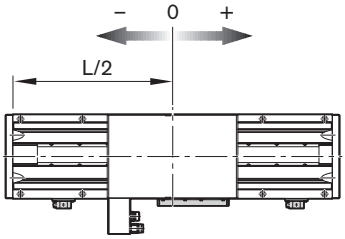
Part number, length R1450 305 10, ... mm	Version	Type	Guideway	Drive unit		Carriage	
							
				Motor winding		Runner block type	
						Standard	High-speed
						$V_{max} \leq 5$ m/s[1]	$V_{max} > 5$ m/s[1]
						Preload	Preload
				0250	0300	8% C	8% C
with integrated measuring system							
	MM01	Primary part A $L_T = 340$	01		08	02	04
		Primary part B $L_T = 400$	01	17		12	14
with glass scale							
	MM02	Primary part A $L_T = 340$	05		08	07	
		Primary part B $L_T = 400$	05	17		17	

L_T = carriage length

1) The velocity depends on the motor and the supply voltage.

Cover		Position measuring system		End cushioning		Switches	Documentation	
								
PU bellows		Integrated measuring system	Glass scale	with cushioning	with cushioning and clamping[2]		Standard report	Special report
with	without							
	05	21		11	21			02 Frictional drag
01		21		12	22			04 Running accuracy
	05		31	11	21		01	05 Positioning accuracy
01			31	12	22			

Direction

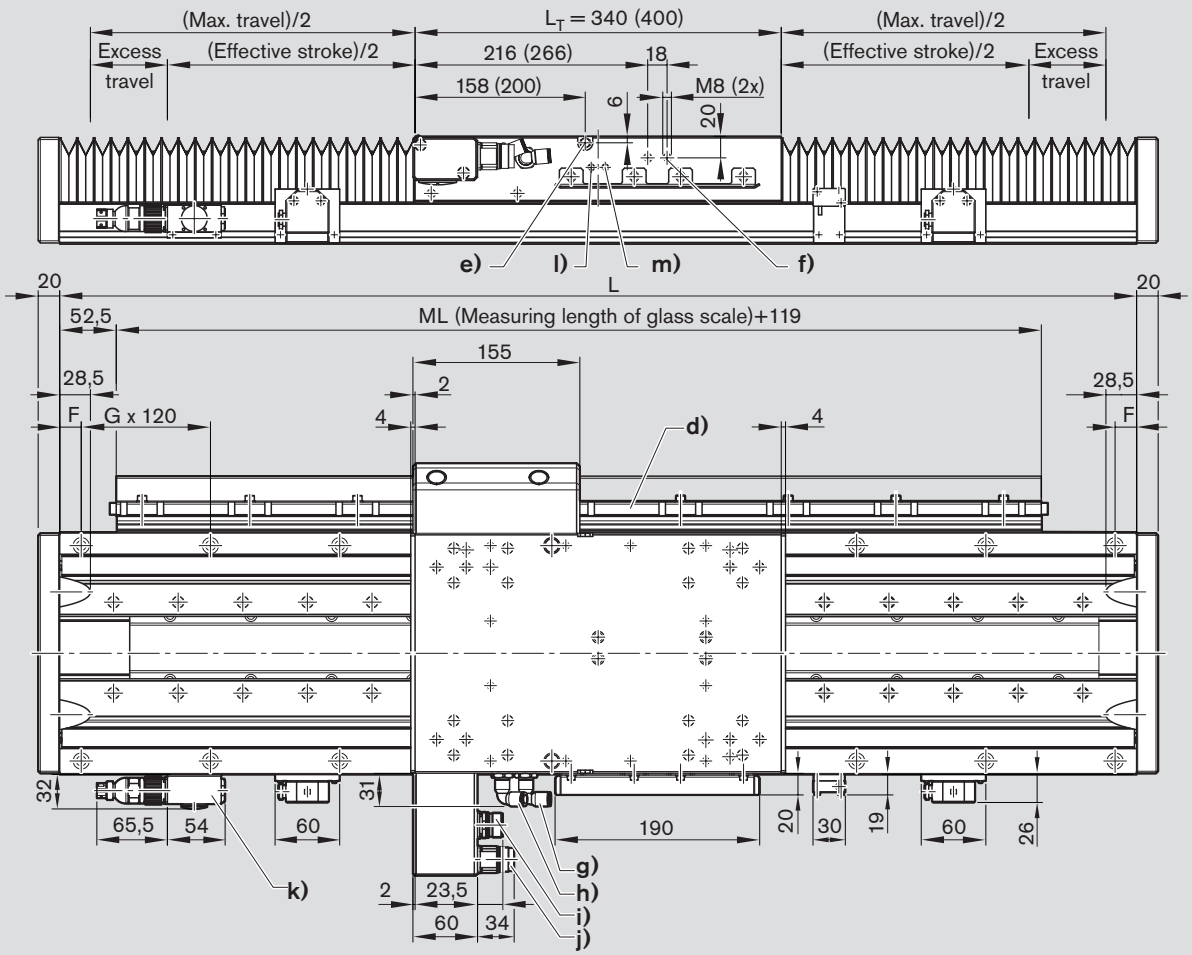


Switches

Without switch and cable duct	00
PNP NC	11-A +/–... mm
PNP NO	13-A +/–... mm
Mechanical	15-A +/–... mm
Switching cam, external	16
Socket/plug external, supplied loose	17
Cable duct, supplied loose	20- x +/–... mm

2) To be selected for non-horizontal installation

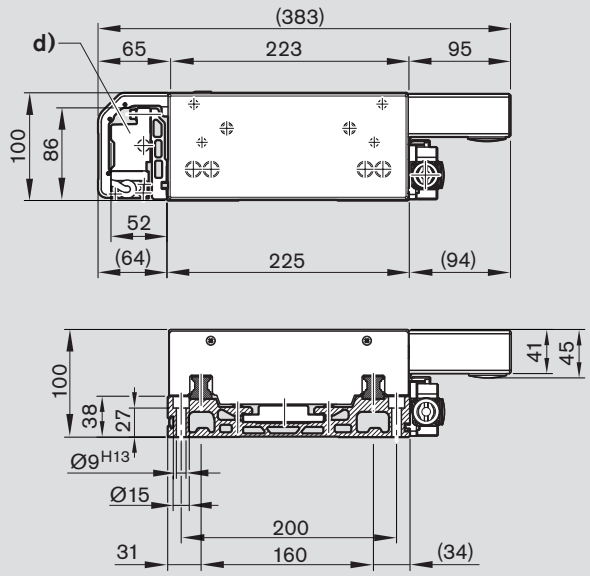
TKL 20-225 Dimension Drawing



Length L (mm)	Counterbored mounting hole spacing F	G x 120	F	Max. travel (mm) for version with bellows and carr. length L_T 340	400	without bellows and carr. length L_T 340	400
460	50	3 x 120	50	70	-	-	-
520	20	4 x 120	20	122	70	105	-
580	50	4 x 120	50	174	122	165	105
640	20	5 x 120	20	226	174	225	165
700	50	5 x 120	50	278	226	285	225
760	20	6 x 120	20	330	278	345	285
820	50	6 x 120	50	382	330	405	345
880	20	7 x 120	20	434	382	465	405
940	50	7 x 120	50	486	434	525	465
1000	20	8 x 120	20	538	486	585	525
1060	50	8 x 120	50	590	538	645	585
1120	20	9 x 120	20	642	590	705	645
1180	50	9 x 120	50	694	642	765	705
1240	20	10 x 120	20	746	694	825	765
1300	50	10 x 120	50	798	746	885	825
1360	20	11 x 120	20	850	798	945	885
1420	50	11 x 120	50	902	850	1005	945
1480	20	12 x 120	20	954	902	1065	1005
1540	50	12 x 120	50	1006	954	1125	1065
1600	20	13 x 120	20	1058	1006	1185	1125
1660	50	13 x 120	50	1110	1058	1245	1185

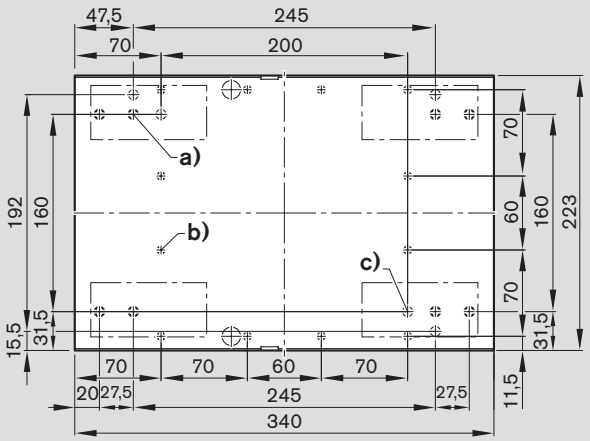
Length L (mm)	Counterbored mounting hole spacing F	G x 120	F	Max. travel (mm) for version with bellows and carr. length L_T 340	400	without bellows and carr. length L_T 340	400
1720	20	14 x 120	20	1162	1110	1305	1245
1780	50	14 x 120	50	1214	1162	1365	1305
1840	20	15 x 120	20	1266	1214	1425	1365
1900	50	15 x 120	50	1318	1266	1485	1425
1960	20	16 x 120	20	1370	1318	1545	1485
2020	50	16 x 120	50	1422	1370	1605	1545
2080	20	17 x 120	20	1474	1422	1665	1605
2140	50	17 x 120	50	1526	1474	1725	1665
2200	20	18 x 120	20	1578	1526	1785	1725
2260	50	18 x 120	50	1630	1578	1845	1785
2320	20	19 x 120	20	1682	1630	1905	1845
2380	50	19 x 120	50	1734	1682	1965	1905
2440	20	20 x 120	20	1786	1734	2025	1965
2500	50	20 x 120	50	1838	1786	2085	2025
2560	20	21 x 120	20	1890	1838	2145	2085
2620	50	21 x 120	50	1942	1890	2205	2145
2680	20	22 x 120	20	1994	1942	2265	2205
2740	50	22 x 120	50	2046	1994	2325	2265
2800	20	23 x 120	20	2098	2046	2385	2325
2860	50	23 x 120	50	2150	2098	2445	2385
2920	20	24 x 120	20	2202	2150	2505	2445

View of end face

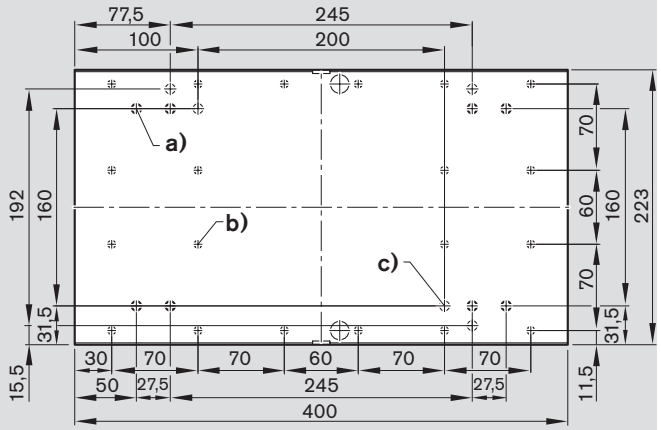


a) M8 - min. 12 deep (8x)
b) M6 - min. 9 deep (12x)
c) 8^{H7} - 18 deep (5x)
d) Glass scale
e) One-point lubrication via funnel-type lube nipple DIN3405 AM8x1 on both sides
f) Mounting hole pattern for power cable chain
g) Return cooling connection for hose Ø8 mm
h) Supply cooling connection for hose Ø8 mm
i) Measuring system socket
j) Motor socket
k) Socket plug
l) Air connection M5 for clamping unit
m) Air filter for clamping unit

Mounting hole pattern for carriage length L_T = 340



Mounting hole pattern for carriage length L_T = 400



Length L (mm)	Counterbored mounting hole spacing F G x 120 F	Max. travel (mm) for version with bellows and carr. length L_T 340	400	without bellows and carr. length L_T 340	400
2980	50 24 x 120 50	2254	2202	2565	2505
3040	20 25 x 120 20	2306	2254	2625	2565
3100	50 25 x 120 50	2358	2306	2685	2625
3160	20 26 x 120 20	2410	2358	2745	2685
3220	50 26 x 120 50	2462	2410	2805	2745
3280	20 27 x 120 20	2513	2462	2865	2805
3340	50 27 x 120 50	2565	2513	2925	2865
3400	20 28 x 120 20	2617	2565	2985	2925
3460	50 28 x 120 50	2669	2617	3045	2985
3520	20 29 x 120 20	2721	2669	3105	3045
3580	50 29 x 120 50	2773	2721	3165	3105
3640	20 30 x 120 20	2825	2773	3225	3165
3700	50 30 x 120 50	2877	2825	3285	3225
3760	20 31 x 120 20	2929	2877	3345	3285
3820	50 31 x 120 50	2981	2929	3405	3345
3880	20 32 x 120 20	3033	2981	3465	3405
3940	50 32 x 120 50	3085	3033	3525	3465

Effective stroke

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.
Recommended standard configuration:
– 2 mechanical switches
– 1 proximity switch

Effective stroke = max. travel − 2 · excess travel

Distance between switch activation points of two switches		
Switch position	**For switch combination**	**Min. spacing [mm]**
external	mechanical – mechanical	60
	mechanical – proximity	45
	proximity – proximity	12.5

Maximum switch activation point

The switch activation point characterizes the position of the center of the carriage after travel.
The zero point is at L/2.

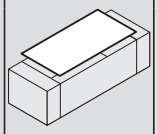
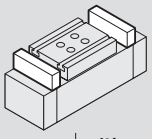
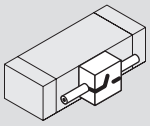
Max. switch activation point = 0.5 · max. travel − excess travel

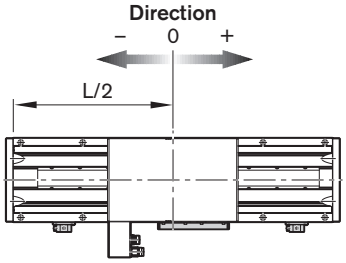
TKL 25-275 Components and Ordering Data

Part number, length R1450 705 10, ... mm	Version	Type	Guideway	Drive unit		Carriage	
				Motor winding		With runner blocks	
				0250	0300	Standard $V_{max} \leq 5$ m/s[1] Preload 8% C	High-speed $V_{max} > 5$ m/s[1] Preload 8% C
with integrated measuring system	MM01	Primary part A $L_T = 395$	01		08	02	04
		Primary part B $L_T = 465$	01	17		12	14
with glass scale	MM02	Primary part A $L_T = 395$	05		08	07	
		Primary part B $L_T = 465$	05	17		17	

L_T = carriage length

1) The velocity depends on the motor and the supply voltage.

Cover		Position measuring system		End cushioning		Switches	Documentation	
								
PU bellows with	PU bellows without	Integrated measuring system	Glass scale	with cushioning	with cushioning and clamping[2]		Standard report	Special report
	05	21		11	21			02 Frictional drag
01		21		12	22			04 Running accuracy
	05		31	11	21		01	05 Positioning accuracy
01			31	12	22			

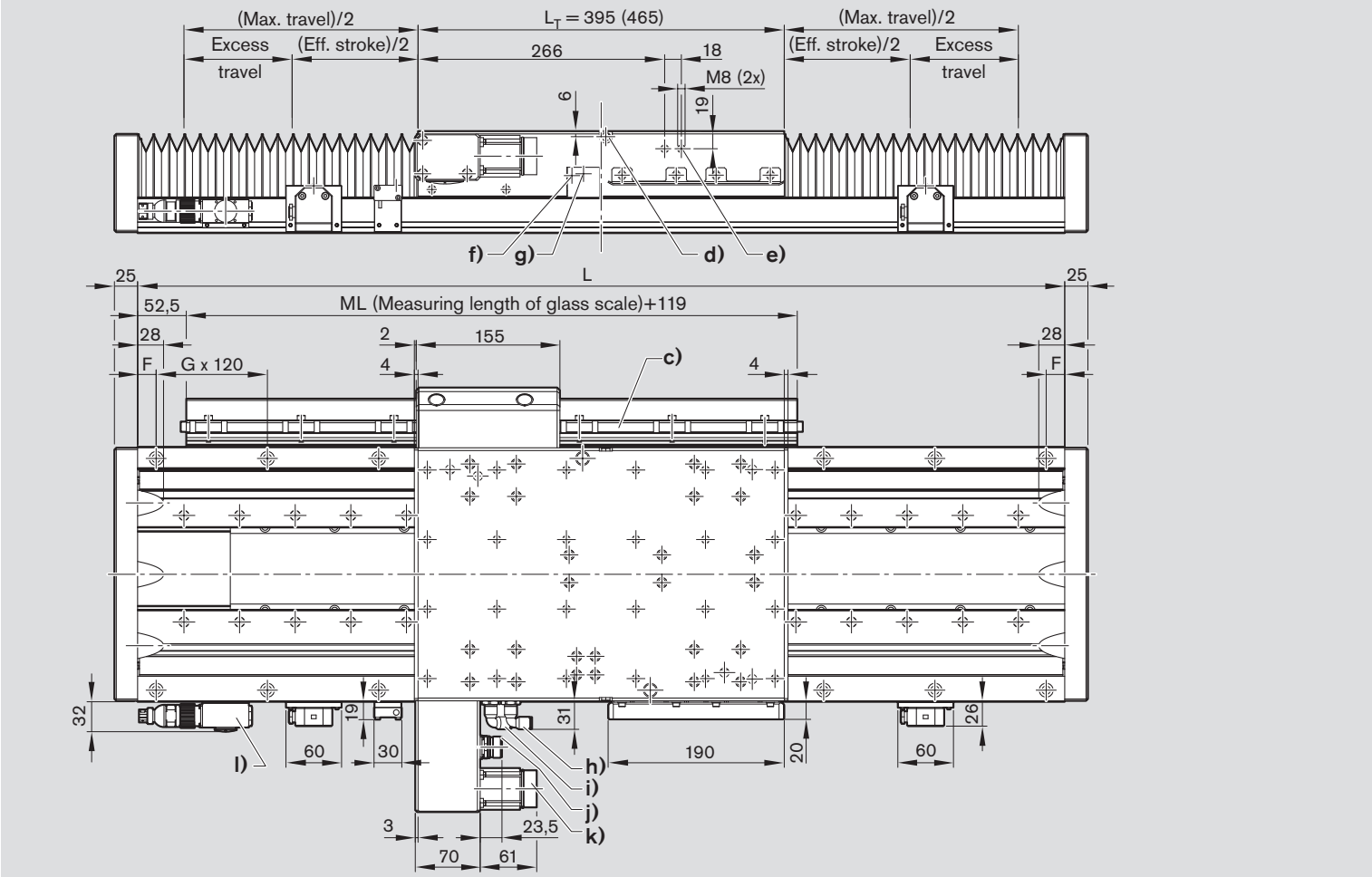


Switches

Without switch and cable duct	00
PNP NC	11-A +/–... mm
PNP NO	13-A +/–... mm
Mechanical	15-A +/–... mm
Switching cam, external	16
Socket/plug external, supplied loose	17
Cable duct, supplied loose	20- x +/–... mm

2) To be selected for non-horizontal installation

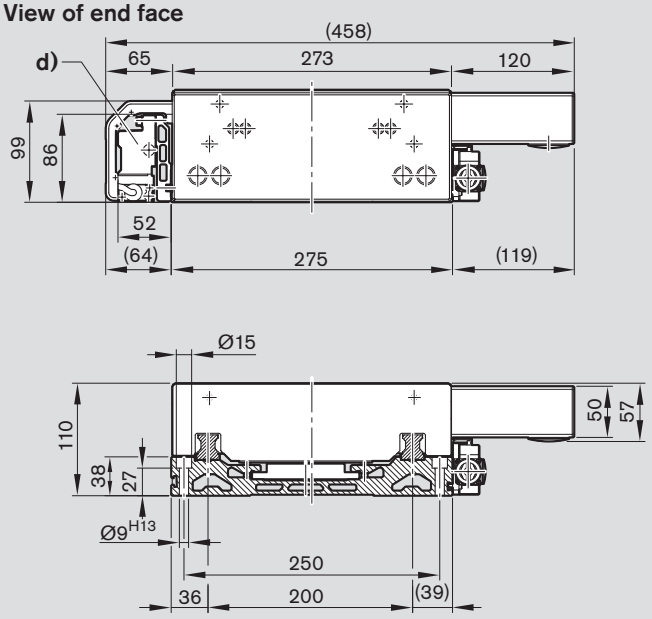
TKL 25-275 Dimension Drawing



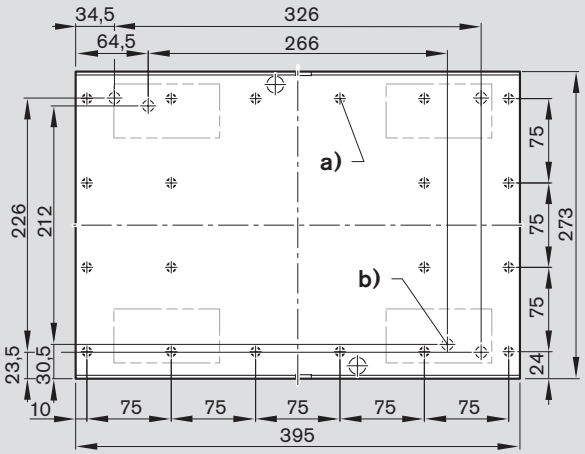
Length L (mm)	Counterbored mounting hole spacing			Max. travel (mm) for version with bellows and carr. length L_T		without bellows and carr. length L_T	
	F	G x 120	F	395	465	395	465
580	50	4 x 120	50	122	-	111	-
640	20	5 x 120	20	175	113	171	101
700	50	5 x 120	50	228	166	231	161
760	20	6 x 120	20	282	219	291	221
820	50	6 x 120	50	335	273	351	281
880	20	7 x 120	20	388	326	411	341
940	50	7 x 120	50	441	379	471	401
1000	20	8 x 120	20	494	432	531	461
1060	50	8 x 120	50	547	485	591	521
1120	20	9 x 120	20	601	539	651	581
1180	50	9 x 120	50	654	592	711	641
1240	20	10 x 120	20	707	645	771	701
1300	50	10 x 120	50	760	698	831	761
1360	20	11 x 120	20	813	751	891	821
1420	50	11 x 120	50	867	805	951	881
1480	20	12 x 120	20	920	858	1011	941
1540	50	12 x 120	50	973	911	1071	1001
1600	20	13 x 120	20	1026	964	1131	1061
1660	50	13 x 120	50	1079	1017	1191	1121
1720	20	14 x 120	20	1133	1071	1251	1181
1780	50	14 x 120	50	1186	1124	1311	1241

Length L (mm)	Counterbored mounting hole spacing			Max. travel (mm) for version with bellows and carr. length L_T		without bellows and carr. length L_T	
	F	G x 120	F	395	465	395	465
1840	20	15 x 120	20	1239	1177	1371	1301
1900	50	15 x 120	50	1292	1230	1431	1361
1960	20	16 x 120	20	1345	1283	1491	1421
2020	50	16 x 120	50	1399	1336	1551	1481
2080	20	17 x 120	20	1452	1390	1611	1541
2140	50	17 x 120	50	1505	1443	1671	1601
2200	20	18 x 120	20	1558	1496	1731	1661
2260	50	18 x 120	50	1611	1549	1791	1721
2320	20	19 x 120	20	1665	1602	1851	1781
2380	50	19 x 120	50	1718	1656	1911	1841
2440	20	20 x 120	20	1771	1709	1971	1901
2500	50	20 x 120	50	1824	1762	2031	1961
2560	20	21 x 120	20	1877	1815	2091	2021
2620	50	21 x 120	50	1930	1868	2151	2081
2680	20	22 x 120	20	1984	1922	2211	2141
2740	50	22 x 120	50	2037	1975	2271	2201
2800	20	23 x 120	20	2090	2028	2331	2261
2860	50	23 x 120	50	2143	2081	2391	2321
2920	20	24 x 120	20	2196	2134	2451	2381
2980	50	24 x 120	50	2250	2188	2511	2441
3040	20	25 x 120	20	2303	2241	2571	2501

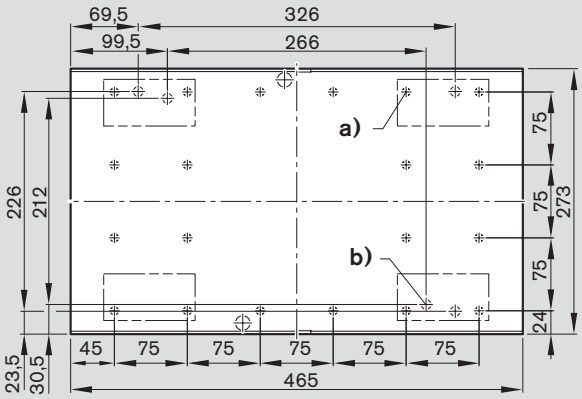
View of end face



Mounting hole pattern for carriage length L_T = 395



Mounting hole pattern for carriage length L_T = 465



a) M8 - min. 12 deep (24x)
b) 10^{H7} - 20 deep (5x)
c) Glass scale
d) One-point lubrication via funnel-type lube nipple DIN3405 AM8x1 on both sides
e) Mounting hole pattern for power cable chain
f) Air connection M5 for clamping unit
g) Air filter for clamping unit
h) Return cooling connection for hose Ø8 mm
i) Supply cooling connection for hose Ø8 mm
j) Measuring system socket
k) Motor socket
l) Socket plug

Length L (mm)	Counterbored mounting hole spacing F G x 120 F	Max. travel (mm) for version with bellows and carr. length L_T 395	465	without bellows and carr. length L_T 395	465
3100	50 25 x 120 50	2356	2294	2631	2561
3160	20 26 x 120 20	2409	2347	2691	2621
3220	50 26 x 120 50	2462	2400	2751	2681
3280	20 27 x 120 20	2516	2454	2811	2741
3340	50 27 x 120 50	2569	2507	2871	2801
3400	20 28 x 120 20	2622	2560	2931	2861
3460	50 28 x 120 50	2675	2613	2991	2921
3520	20 29 x 120 20	2728	2666	3051	2981
3580	50 29 x 120 50	2782	2719	3111	3041
3640	20 30 x 120 20	2835	2773	3171	3101
3700	50 30 x 120 50	2888	2826	3231	3161
3760	20 31 x 120 20	2941	2879	3291	3221
3820	50 31 x 120 50	2994	2932	3351	3281
3880	20 32 x 120 20	3047	2985	3411	3341
3940	50 32 x 120 50	3101	3039	3471	3401

Effective stroke

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.
Recommended standard configuration:
– 2 mechanical switches
– 1 proximity switch

Effective stroke = max. travel − 2 · excess travel

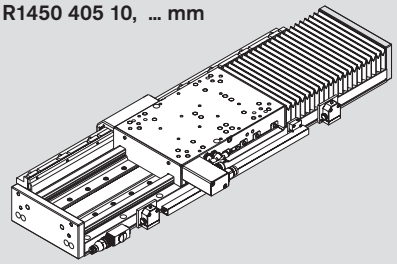
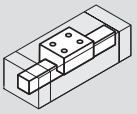
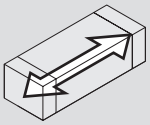
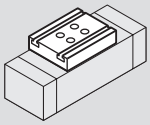
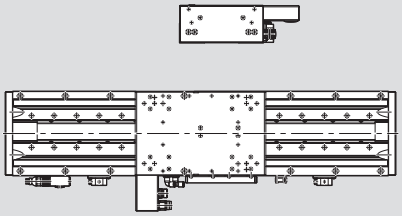
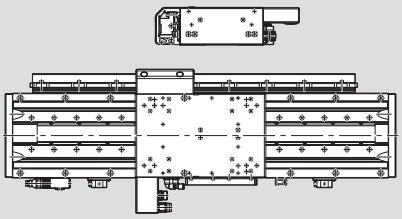
Distance between switch activation points of two switches		
Switch position	**For switch combination**	**Min. spacing [mm]**
external	mechanical – mechanical	60
	mechanical – proximity	45
	proximity – proximity	12.5

Maximum switch activation point

The switch activation point characterizes the position of the center of the carriage after travel.
The zero point is at L/2.

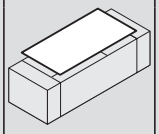
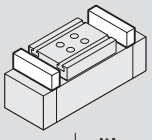
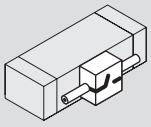
Max. switch activation point = 0.5 · max. travel − excess travel

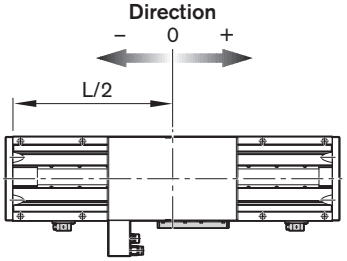
TKL 30-325 Components and Ordering Data

Part number, length R1450 405 10, ... mm 	Version	Type	Guideway 	Drive unit  Motor winding		Carriage  With runner blocks Standard $V_{max} \leq 5$ m/s[1] Preload	
				0190	0250	8% C	
with integrated measuring system 	MM01	Primary part A $L_T = 475$	01	06		02	
		Primary part B $L_T = 625$	01		17	12	
		Primary part C $L_T = 775$	01	26		22	
with glass scale 	MM02	Primary part A $L_T = 475$	05	06		07	
		Primary part B $L_T = 465$	05		17	17	
		Primary part C $L_T = 775$	05	26		27	

L_T = carriage length

1) The velocity depends on the motor and the supply voltage.

Cover		Position measuring system		End cushioning		Switches	Documentation	
								
PU bellows		Integrated measuring system	Glass scale	with cushioning	with cushioning and clamping[2]		Standard report	Special report
with	without							
	05	21		11	21		01	02 Frictional drag
01		21		12	22			04 Running accuracy
	05		31	11	21			05 Positioning accuracy
01			31	12	22			

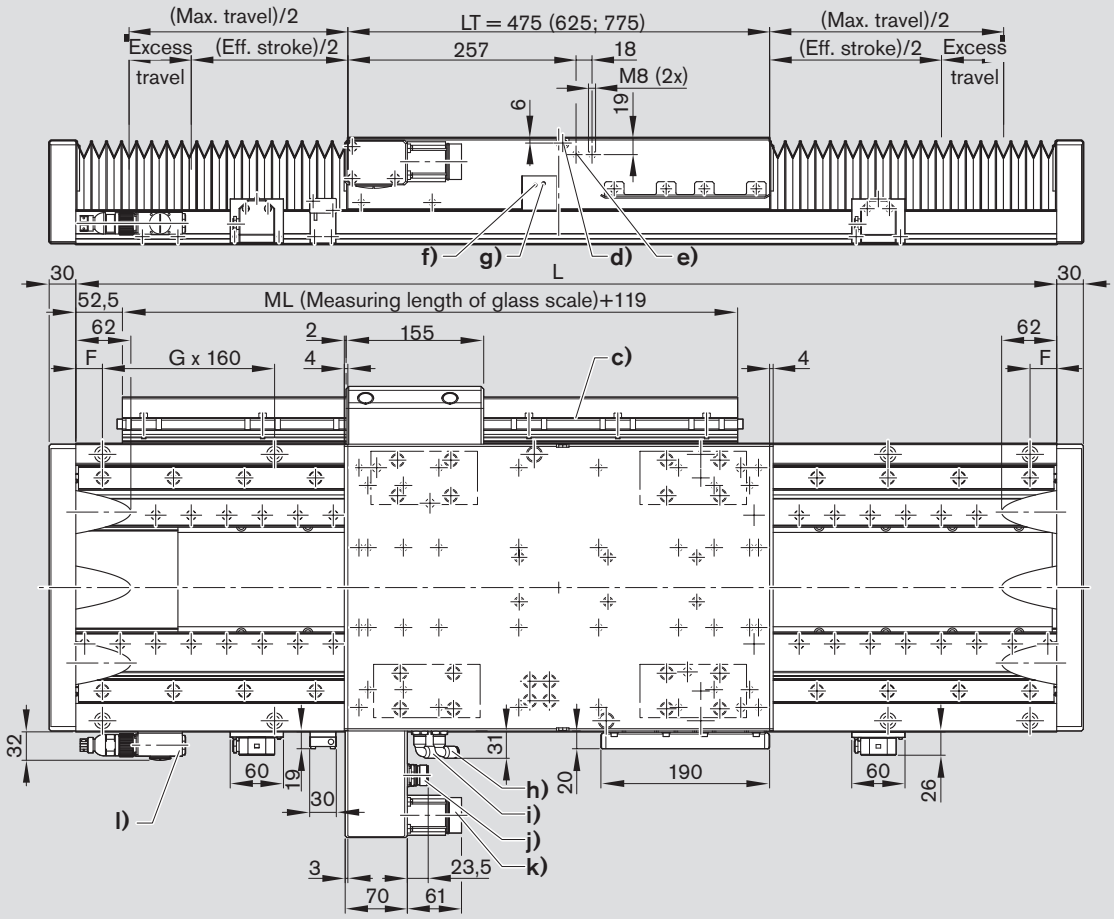


Switches

Without switch and cable duct	00
PNP NC	11-A +/–... mm
PNP NO	13-A +/–... mm
Mechanical	15-A +/–... mm
Switching cam, external	16
Socket/plug external, supplied loose	17
Cable duct, supplied loose	20- x +/–... mm

2) To be selected for non-horizontal installation

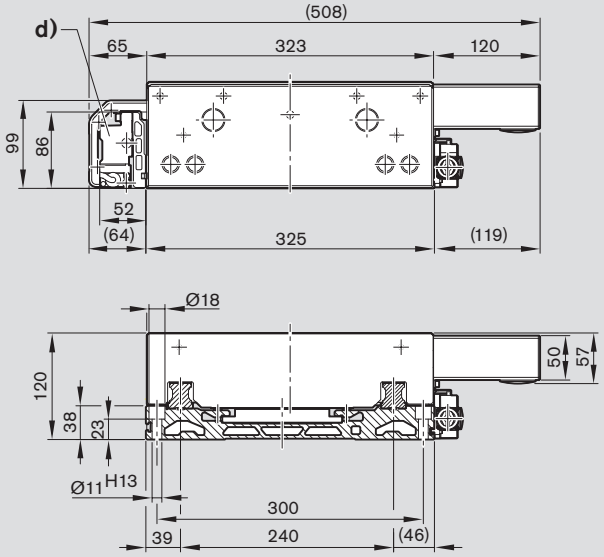
TKL 30-325 Dimension Drawing



Length L (mm)	Counterbored mounting hole spacing				Max. travel (mm) for version with bellows and carr. length L_T			without bellows and carr. length L_T		
	F	G	x 160	F	475	625	775	475	625	775
700	30	4	x 160	30	157	-	-	-	-	-
780	70	4	x 160	70	228	-	-	163	-	-
860	30	5	x 160	30	299	166	-	243	-	-
940	70	5	x 160	70	370	237	-	323	173	-
1020	30	6	x 160	30	441	308	175	403	253	-
1100	70	6	x 160	70	512	379	246	483	333	183
1180	30	7	x 160	30	583	450	317	563	413	263
1260	70	7	x 160	70	654	521	388	643	493	343
1340	30	8	x 160	30	725	592	459	723	573	423
1420	70	8	x 160	70	796	663	530	803	653	503
1500	30	9	x 160	30	867	734	601	883	733	583
1580	70	9	x 160	70	938	805	672	963	813	663
1660	30	10	x 160	30	1008	875	743	1043	893	743
1740	70	10	x 160	70	1079	946	813	1123	973	823
1820	30	11	x 160	30	1150	1017	884	1203	1053	903
1900	70	11	x 160	70	1221	1088	955	1283	1133	983
1980	30	12	x 160	30	1292	1159	1026	1363	1213	1063
2060	70	12	x 160	70	1363	1230	1097	1443	1293	1143
2140	30	13	x 160	30	1434	1301	1168	1523	1373	1223
2220	70	13	x 160	70	1505	1372	1239	1603	1453	1303
2300	30	14	x 160	30	1576	1443	1310	1683	1533	1383

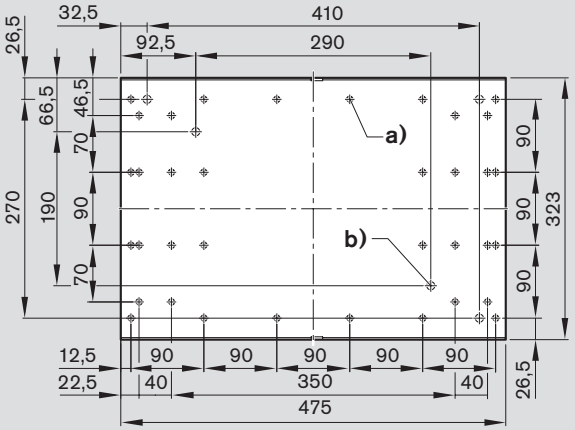
Length L (mm)	Counterbored mounting hole spacing				Max. travel (mm) for version with bellows and carr. length L_T			without bellows and carr. length L_T		
	F	G	x 160	F	475	625	775	475	625	775
2380	70	14	x 160	70	1647	1514	1381	1763	1613	1463
2460	30	15	x 160	30	1718	1585	1452	1843	1693	1543
2540	70	15	x 160	70	1789	1656	1523	1923	1773	1623
2620	30	16	x 160	30	1860	1727	1594	2003	1853	1703
2700	70	16	x 160	70	1930	1797	1665	2083	1933	1783
2780	30	17	x 160	30	2001	1868	1735	2163	2013	1863
2860	70	17	x 160	70	2072	1939	1806	2243	2093	1943
2940	30	18	x 160	30	2143	2010	1877	2323	2173	2023
3020	70	18	x 160	70	2214	2081	1948	2403	2253	2103
3100	30	19	x 160	30	2285	2152	2019	2483	2333	2183
3180	70	19	x 160	70	2356	2223	2090	2563	2413	2263
3260	30	20	x 160	30	2427	2294	2161	2643	2493	2343
3340	70	20	x 160	70	2498	2365	2232	2723	2573	2423
3420	30	21	x 160	30	2569	2436	2303	2803	2653	2503
3500	70	21	x 160	70	2640	2507	2374	2883	2733	2583
3580	30	22	x 160	30	2711	2578	2445	2963	2813	2663
3660	70	22	x 160	70	2782	2649	2516	3043	2893	2743
3740	30	23	x 160	30	2852	2719	2586	3123	2973	2823
3820	70	23	x 160	70	2923	2790	2657	3203	3053	2903
3900	30	24	x 160	30	2994	2861	2728	3283	3133	2983
3980	70	24	x 160	70	3065	2932	2799	3363	3213	3063

View of end face

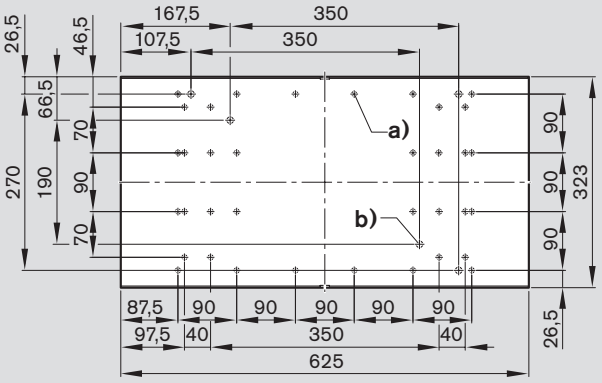


a) M8 - min. 12 deep (24x)
b) 10^{H7} - 20 deep (5x)
c) Glass scale
d) One-point lubrication via funnel-type lube nipple DIN3405 AM8x1 on both sides
e) Mounting hole pattern for power cable chain
f) Air connection M5 for clamping unit
g) Air filter for clamping unit
h) Return cooling connection for hose Ø8 mm
i) Supply cooling connection for hose Ø8 mm
j) Measuring system socket
k) Motor socket
l) Socket plug

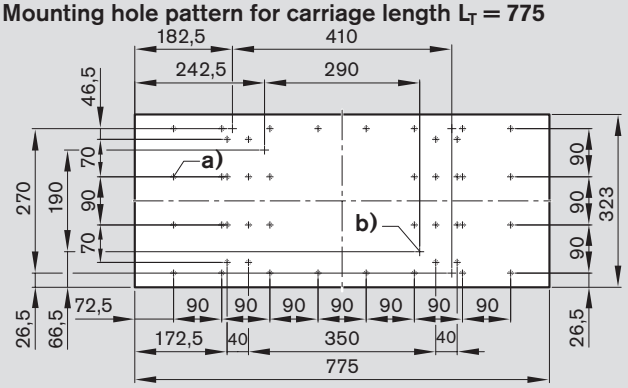
Mounting hole pattern for carriage length $L_T = 475$



Mounting hole pattern for carriage length $L_T = 625$



Mounting hole pattern for carriage length $L_T = 775$



Effective stroke

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.
Recommended standard configuration:
– 2 mechanical switches
– 1 proximity switch

Effective stroke = max. travel − 2 · excess travel

Distance between switch activation points of two switches

Switch position	For switch combination	Min. spacing [mm]
external	mechanical – mechanical	60
	mechanical – proximity	45
	proximity – proximity	12.5

Maximum switch activation point

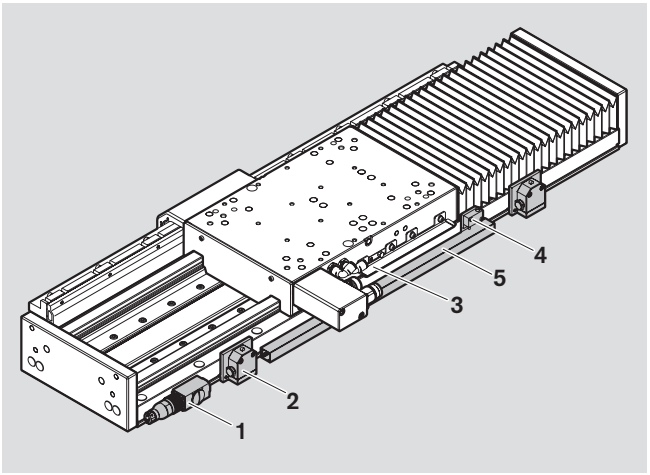
The switch activation point characterizes the position of the center of the carriage after travel.
The zero point is at L/2.

Max. switch activation point = 0.5 · max. travel − excess travel

Switch Mounting Arrangements

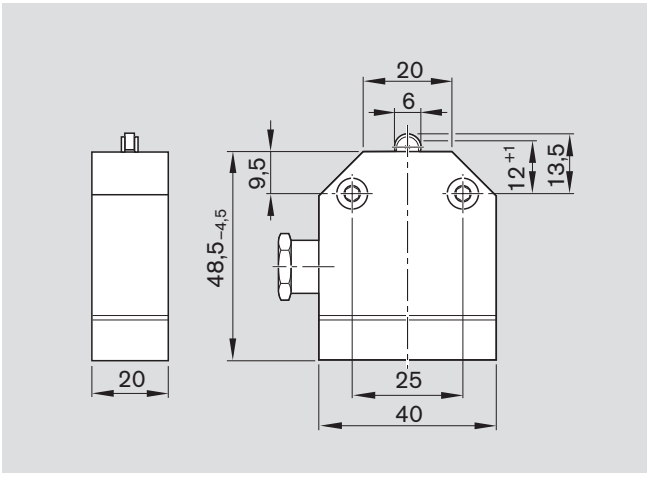
Switching system overview

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



Mechanical switch

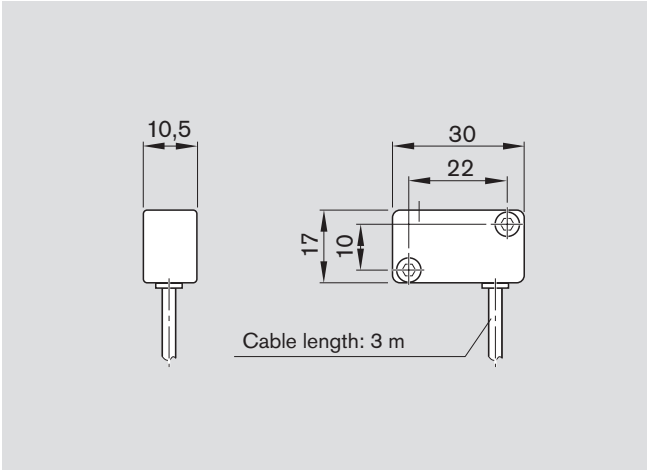
Reproducibility	=	± 0.05 mm
Permissible ambient temperature	=	–5°C to +80°C
Enclosure	=	DIN 40050 IP 67
Contact time	=	< 2 ms
Insulation	=	group C to VDE 0110
Rated voltage	=	250 V AC
Continuous current	=	5 A
Switching capacity at 220 V, 40-60 Hz	=	cosφ = 0.8 at 2 A
Contact resistance when new	=	< 240 µm
Connection	=	screw connection
Contact system	=	single-pole changeover
Switch system	=	snap-action



Proximity switch

Miniature circuit-breakers with potted cable
(3 x 0.14 mm² Unitronic)

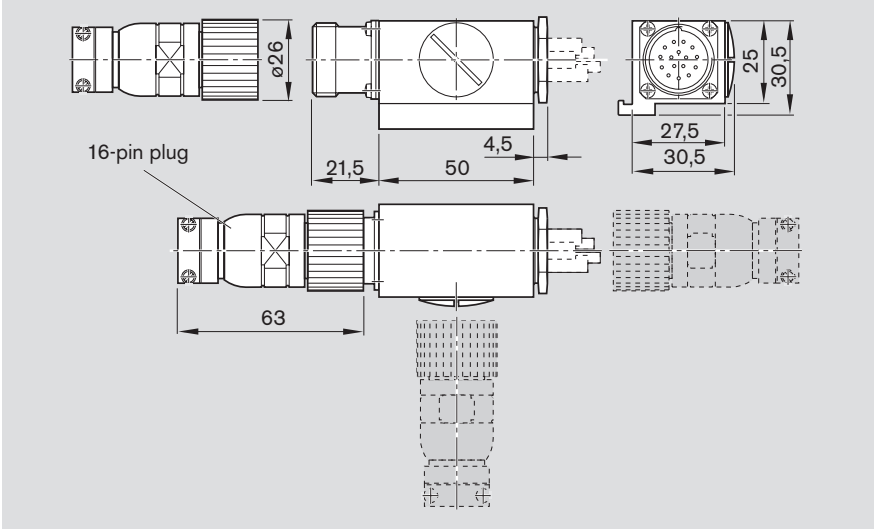
Housing form	=	NO
Minisensor	=	Form A DIN 41635
Voltage	=	10...30 V DC
Residual ripple	=	≤ 10 %
Load	=	200 mA
No-load current	=	≤ 20 mA
Switching frequency	=	max. 1500 Hz
Temperature-related shift in make point	=	≤ 4 µm/°C
Output signal steepness	=	≥ 1 V/µs
Repeatability of make point to EN 50008	=	≤ 0.1 mm



External socket and plug for external switch

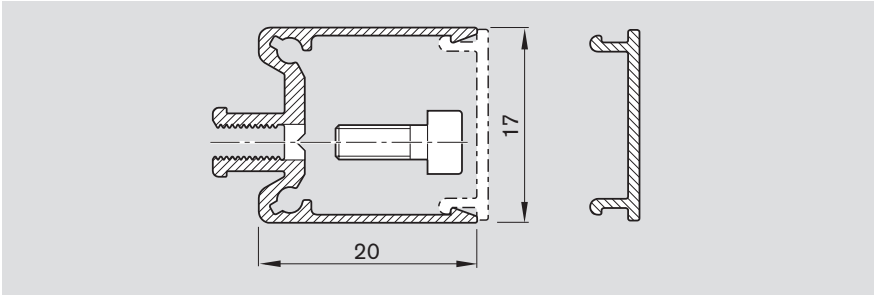
- The socket and plug each have 16 pins
- The socket and plug are not pre-wired. The switch activation points can thus be optimized during start-up.
- A plug is provided.

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



Cable duct

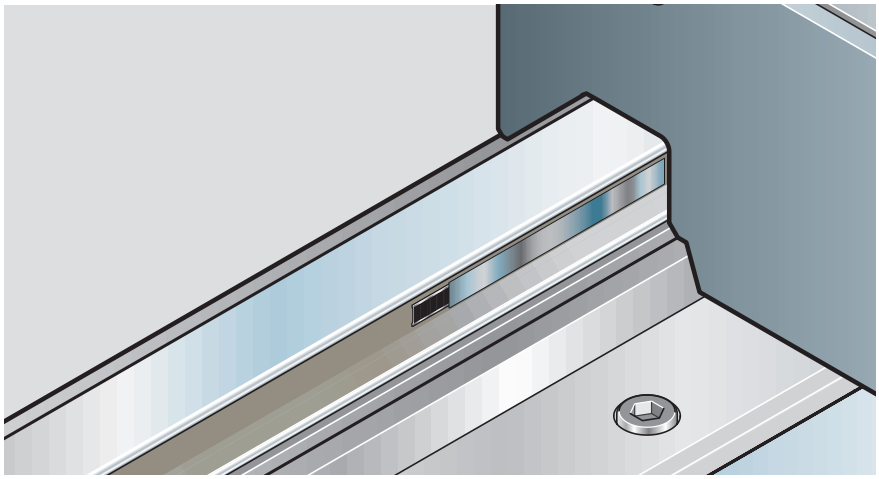
- The cable duct holds a maximum of two cables for mechanical switches and three cables for proximity switches.
- The duct is fixed by clipping it into the T-slot on the table and is secured by tightening the fixing screws.
- The fixing screws and cable grommets are supplied with the duct.



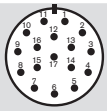
Integrated Position Measuring System (IMS)

Technical Data

For more information, see “Integrated Measuring System” catalog.



17-pin connector M23
Contact side

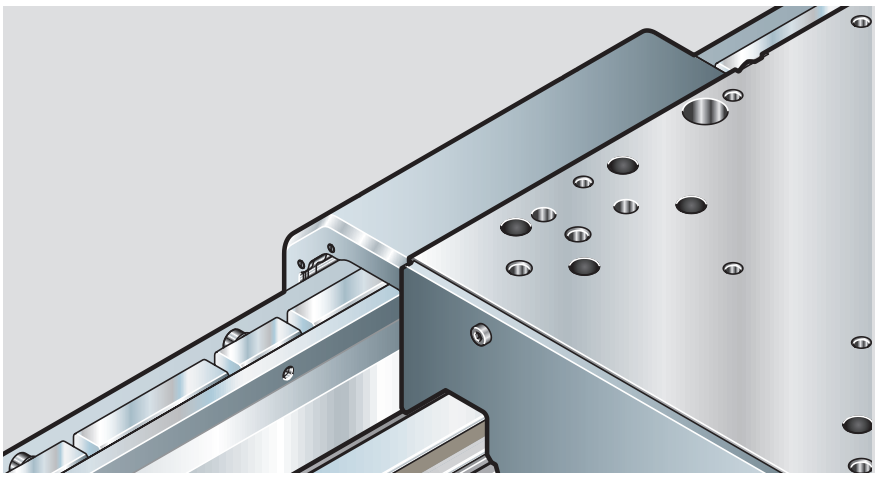


	Voltage supply				Incremental signals				Reference signals	
	7	1	10	4	15	16	12	13	3	2
	U_P	Sensor U_P	0V	Sensor 0V	A+	A–	B+	B–	R+	R–

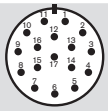
Interpolation accuracy	± 3 µm
Accuracy class	± 5 µm (per 1 m measuring length)
Incremental signals	1 Vpp, pitch = 1000 µm
Reference mark	Distance coded
Voltage supply	5 V ± 5%
Current consumption	250 mA
Vibration (55 – 2000 Hz)	≤ 100 m/s^2
Shock (11 ms)	≤ 500 m/s^2
Operating temperature	0 to 50°C
Enclosure (DIN EN 60529)	IP 67 (motor IP 65)
Storage temperature	–10 to 70°C
Max. rail length	4000 mm (one-piece)
Max. travel speed	8 m/s

Glass Scale

Absolute measuring system



17-pin connector M23
Contact side



	Voltage supply					Incremental signals				Absolute position values			
	7	1	10	4	11	15	16	12	13	14	17	8	9
	U_P	Sensor U_P	0V	Sensor 0V	Inner shield	A+	A–	B+	B–	DATA+	DATA–	CLOCK+	CLOCK–

Scale	Glass scale with code track and incremental track $\alpha_{therm} \approx 8 \cdot 10^{-6}\ K^{-1}$
Accuracy class	± 5 µm (per 1 m measuring length)
Measuring length ML in mm	From 140 to 1840 in 100 mm steps, from 2040 to 4240 in 200 mm steps
Absolute position values	EnDat 2.1
Incremental signals	1 Vpp, pitch = 20 µm, limit frequency –3 dB = ≥ 150 kHz
Voltage supply	5 V ± 5%
Current consumption	300 mA without load
Vibration (55 – 2000 Hz)	≤ 200 m/s²; measuring length 3240 and up: ≤ 150 m/s² (EN 60 068-2-6)
Shock (11 ms)	≤ 300 m/s² (EN 60 068-2-27)
Acceleration	≤ 100 m/s²; in measuring direction
Operating temperature	0 to 50°C
Enclosure (DIN EN 60529)	IP 53 for attachment acc. to mounting instructions IP 64 for compressed air connection via DA 300
Mass	1.1 kg + 5.5 kg/m measuring length
Max. travel speed	3 m/s
Required feed force	≤ 4 N

Pneumatic Clamping Units

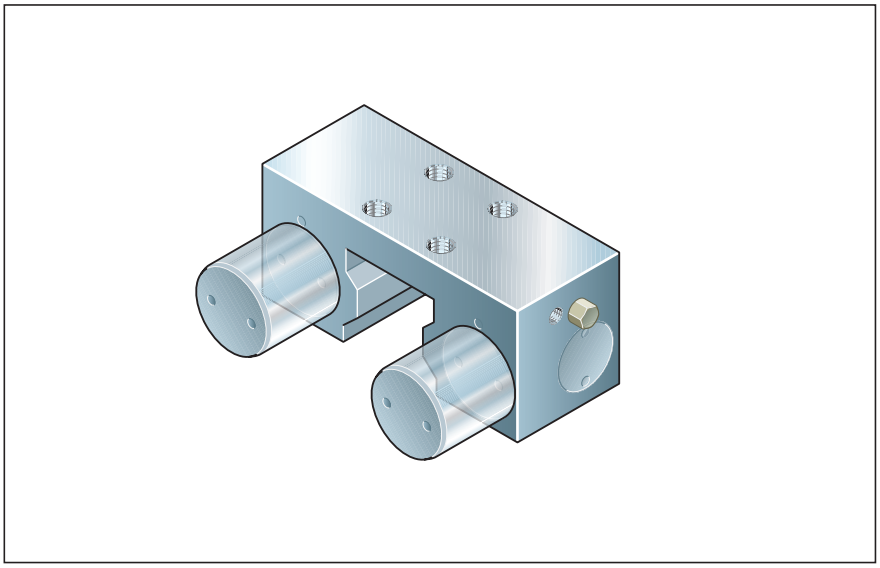
MKS for Ball Rail Systems

Clamps without pressurization (spring energy)
- Opening pressure min. 5.5 bar
- Max. operating pressure pneumatic 8 bar

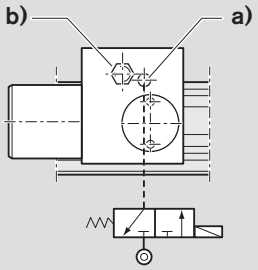
Notes

⚠ The unit may not be used as a braking unit! For use only when the axis is at a standstill.

- Use only cleaned and oil air. The specified filter size is 25 µm.
- Read the mounting instructions before start-up.

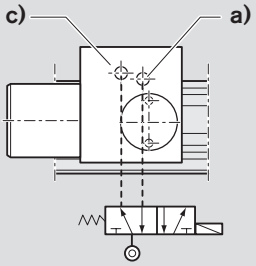


Circuitry[1] for standard air connection



a) Air connection M5
b) Air filter
Nominal diameter min. 6 mm
For TKL 20-225 min. 4 mm

Circuitry[2] for Plus air connection



a) Air connection M5
b) Plus air connection M5
Nominal diameter min. 6 mm
For TKL 20-225 min. 4 mm

Size	Holding force	
	Spring energy[1] (N)	With Plus air connection[2] (N)
TKL 20-225	600	1600
TKL 25-275	750	1950
TKL 30-325[3]	1050	2800

1) Holding force provided by spring energy. Testing is performed in the installed condition with a film of lubricating oil (ISO VG 68).
2) Increased holding force through additional pressurization with 5.5 bar compressed air at the Plus air connection. Switching via 5/2 or 5/3-way directional control valve.
3) For TKL 30-325 C (carriage length L_T = 775 mm), 2 clamping units available on request.

Accessories

Cables

Cable set for Ball Rail Table TKL with linear motor and servo controller IndraDrive, consisting of power supply cable and feedback cable

Carriage	Motor	Part number, ... length	Cable pre-assembly				
			Motor side	Controller side			
				HCS02.* W0028	HCS02.* W0054	HCS03.* W0070	HCS03.* W0150
TKL 20-225	MLP040	R113000118	01	10			
TKL 25-275	MLP070	R113000126	02			11	12
TKL 30-325	MLP100	R113000141	03				12

(Note: The controller side of power cables is pre-assembled with wire end ferrules or cable lug.)

Motor-controller combination

Carriage	Motor	Controller
TKL 20-225	MLP040	HCS02.* W0028
		HCS02.* W0054
TKL 25-275	MLP070	HCS03.* W0070
		HCS03.* W0150
TKL 30-325	MLP100	HCS03.* W0150

Power Cable Chain, Cooling Units, Power Sections

in preparation

Documentation

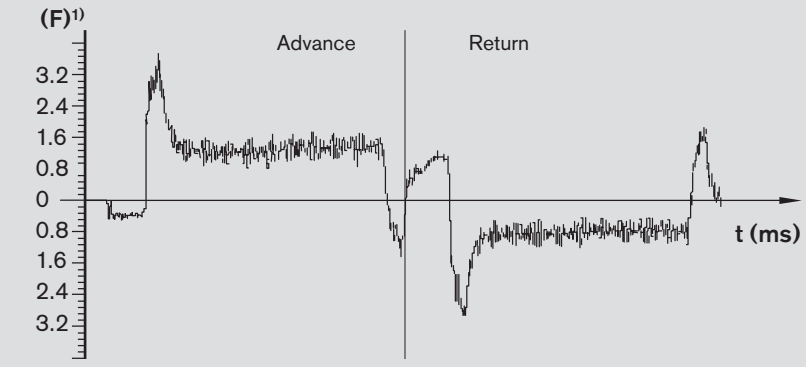
Standard report
Option 01

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

Moment of friction measurement of the complete system (frictional drag)
Option 02
The moment of friction is measured over the entire travel range.

Example



1) in % of F_{dN} = continuous force

Accessories

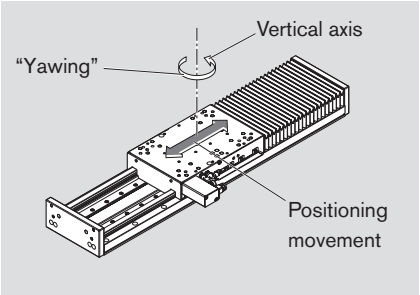
Documentation

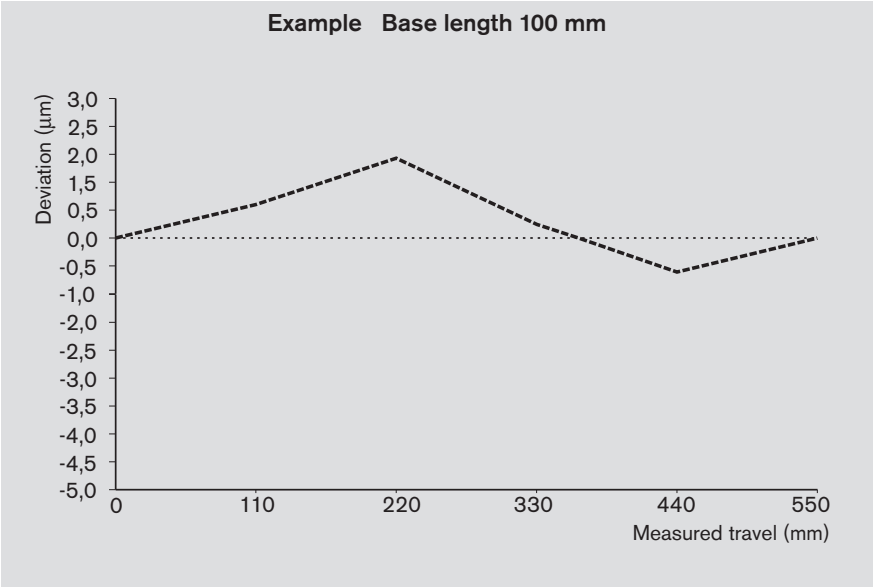
Running accuracy
Option 04

Several measuring points are passed during the total travel.
The following deviations are determined:

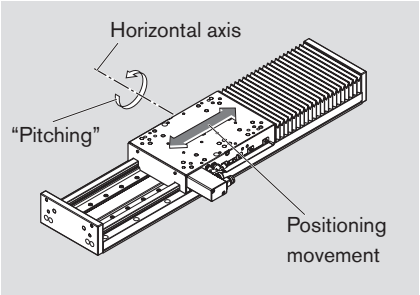
Note: The measurements are taken with the unit screwed down and assuming an ideally flat mounting base surface.

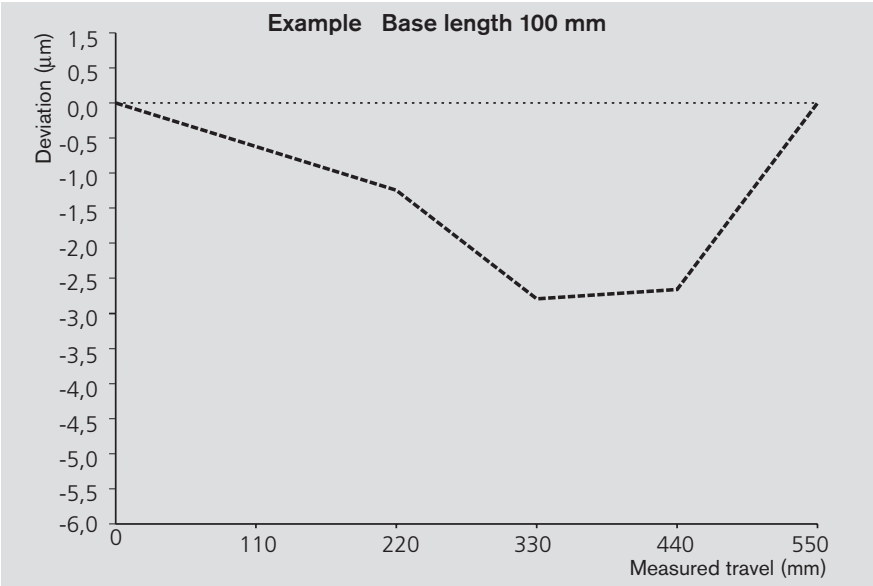
Yawing
Yawing is angular deviation about the vertical axis. This angular deviation is converted to a linear deviation in mm on the basis of a standard length and is plotted on the graph.
The base length is given in the diagram.





Pitching
Pitching means angular deviation about the horizontal axis. This angular deviation is converted to a linear deviation in mm on the basis of a standard length and is plotted on the graph.
The base length is given in the diagram.



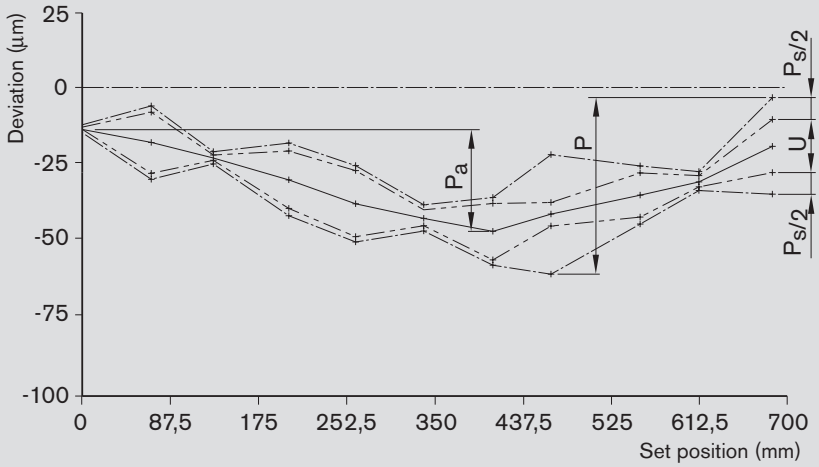


In addition to graphical representation (see illustrations), a measurement report is supplied in table form.

Positioning accuracy to VDI/DGQ 3441 Option 05

Measurement points are selected at irregular intervals along the travel. This enables even periodical deviations to be detected during positioning.
Each measurement point is approached several times from both sides.
This will give the following parameters.
Note: The measurements are taken with the unit screwed down and assuming an ideally flat mounting base surface.

Example



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:
- positioning deviation
- reversal range
- position variation range

Positioning deviation P_a

The positioning 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.

Order Example

Ordering data								Description
Ball Rail Table	**TKL 20-225**							Ball Rail Table
(Part number): R1450 305 10, 1660 mm								TKL 20-225, length 1660 mm
Type	**=**	**MM01**						with integrated position measuring system, as shown in diagram MM01
Guideway	**=**	**01**						Ball Rail Systems
Drive unit	**=**	**17**						with primary part B with motor winding 0250
Carriage	**=**	**12**						one carriage 400 mm long, standard runner blocks, preload 8%
Cover	**=**	**01**						with polyurethane bellows
Position measuring system	**=**	**21**						with integrated position measuring system (IMS)
End position cushioning	**=**	**22**						with buffers and clamping unit
1st switch	**=**	**15**	**-A**	**+**	**400**	**mm**		mechanical switch, external, switch activation point +400 mm
2nd switch	**=**	**11**	**-A**	**–**	**350**	**mm**		PNP NC, external, switch activation point –350 mm
3rd switch	**=**	**15**	**-A**	**–**	**400**	**mm**		mechanical switch, external, switch activation point –400 mm
Cable duct	**=**	**20**			**1500**	**mm**		cable duct 1500 mm long (loose)
Socket/plug	**=**	**17**						socket/plug (loose)
Switching cam	**=**	**16**						with external switching cam (for switch activation)
Documentation	**=**	**01**						with standard report
Cable set (part number) R113000118								
Pre-assembly, motor side	**=**	**01**						
Pre-assembly, controller side	**=**	**10**						

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

Inquiry/Order Form

Bosch Rexroth AG
Linear Motion and Assembly Technologies
D-97419 Schweinfurt, Germany

Telephone +49-9721-937-0

Telefax (direct) +49-9721-937-350

Rexroth Ball Rail Tables TKL

To be completed by customer: Inquiry ☐ / Order ☐
Ball Rail Table TKL _____
(Part number): _____-_____-_____, length _____mm

Type	=	☐☐☐☐
Guideway	=	☐☐
Drive unit	=	☐☐
Carriage	=	☐☐
Cover	=	☐☐
Position measuring system	=	☐☐
End cushioning	=	☐☐
1st switch	=	☐☐ – ☐ ○ ☐☐☐☐ mm
2nd switch	=	☐☐ – ☐ ○ ☐☐☐☐ mm
3rd switch	=	☐☐ – ☐ ○ ☐☐☐☐ mm
Cable duct	=	☐☐ – ☐ ○ ☐☐☐☐ mm
Socket/plug	=	☐☐
Switching cam	=	☐☐
Documentation	=	☐☐

Please check whether the selected combination is technically permissible (load capacities, moments, etc.)!

Cable set

Pre-assembly, motor side	=	☐☐
Pre-assembly, controller side	=	☐☐

Quantity _____ pcs, _____ per month, _____ per year, per order, or _____
Notes:

From

Company: _____ Contact: _____
Address: _____ Department: _____
_____ Telephone: _____
_____ Telefax: _____

Rexroth
Bosch Group

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Subject to technical modifications

Printed in Germany – p 2006/05/2/S

Ball Rail Tables TKL
R310EN 2531 (2006.01)