Robotic Erector System for Linear Modules/Linear Modules

General Product Description

In the past, machine manufacturers themselves have had to devise, design and fabricate systems to install or mount and connect linear modules with precision ball screw assemblies or toothed belt drives.

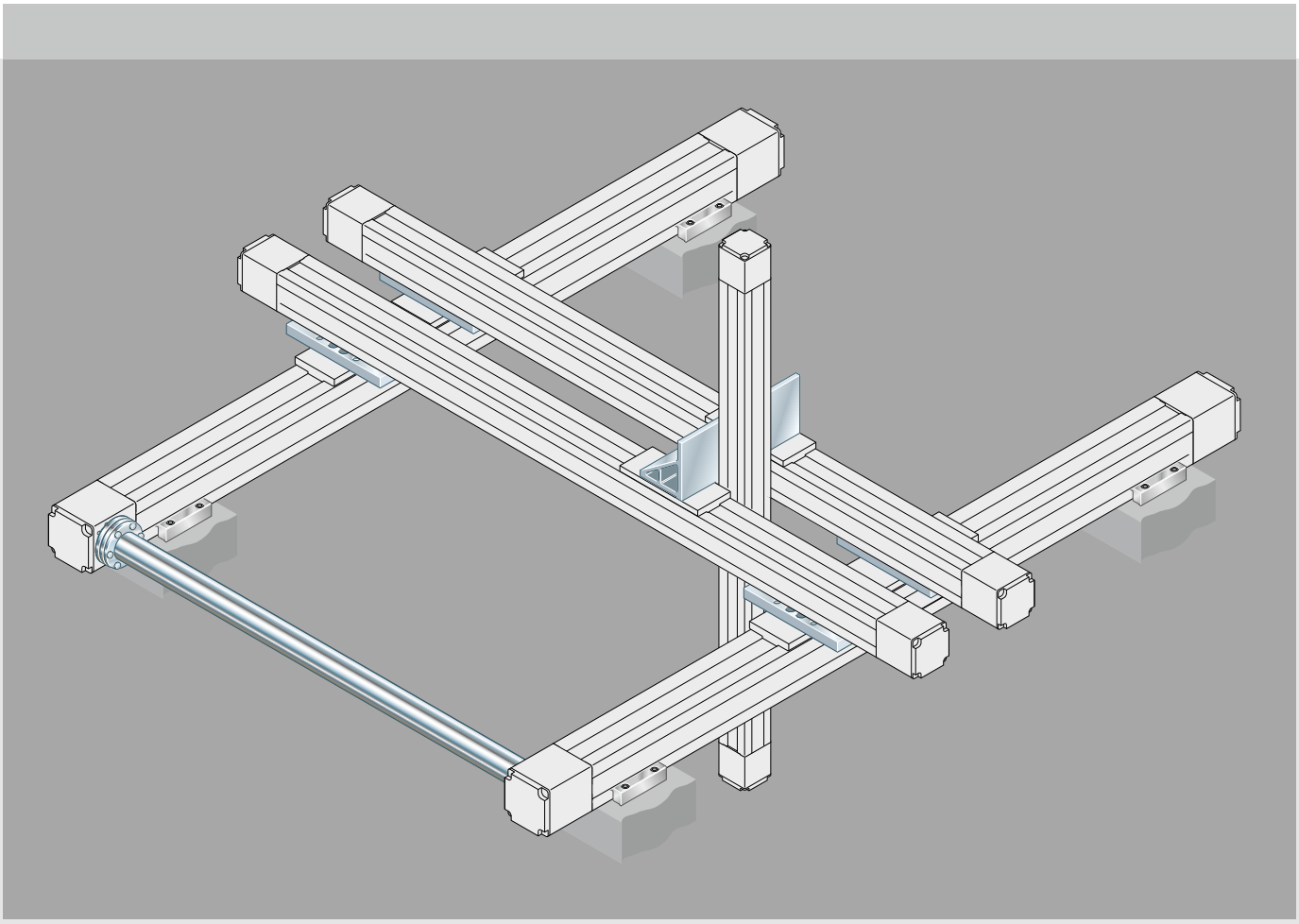
The Robotic Erector System for linear modules facilitates these tasks and brings savings for the user, since the system comprises mass-produced standardized components.

As a result, users can respond flexibly to the varied requirements and uses of linear motion technology.

The system offers various possibilities to construct two or three axes from Linear Modules and connectors.

The basic elements (plates and brackets) have been designed to allow modules to be connected to other modules of the same size or one size larger or smaller. Connecting shafts meet the high requirements for parallel operation of two linear modules with toothed belt drive.

The range also includes purpose-designed mounting accessories. The linear modules and the connecting elements combine to form the Robotic Erector System.

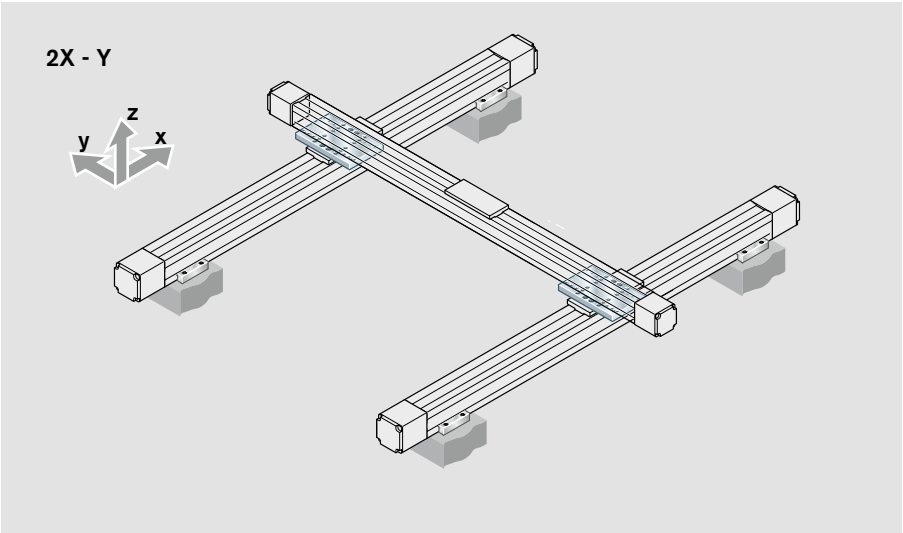


Robotic Erector System for Linear Modules/Linear Modules

Configuration Options

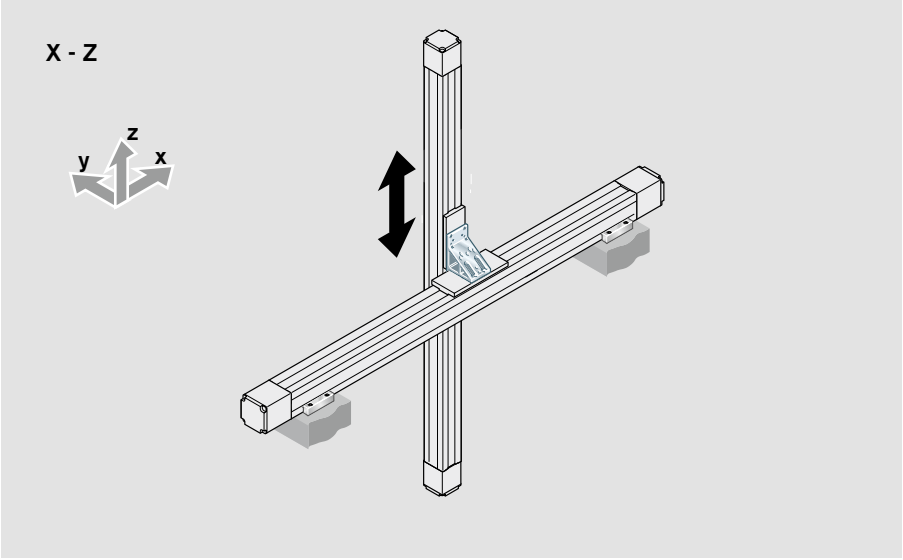
2 axes

Connectors:
2 connection plates



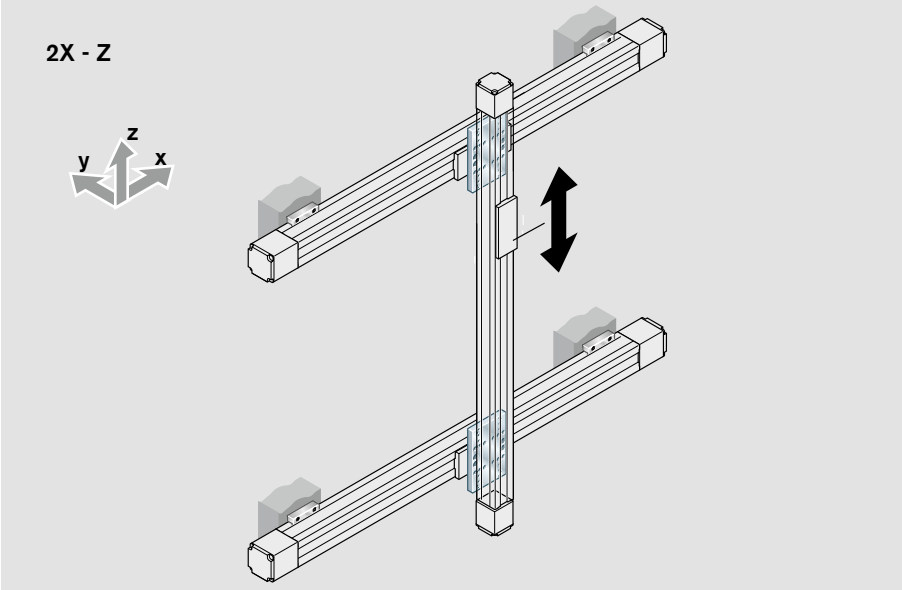
Linear module traverses in the Z-axis.

Connectors:
1 connection bracket



Carriage traverses in the Z-axis.

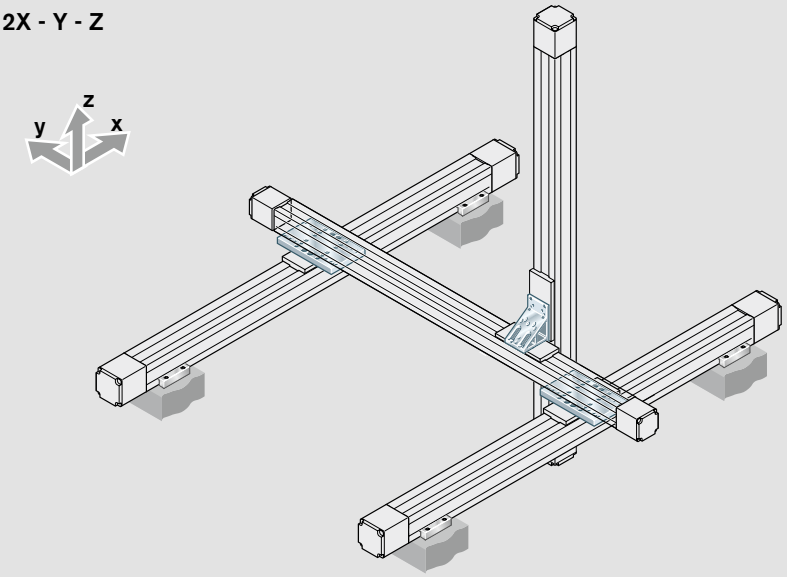
Connectors:
2 connection plates



3 axes

Connectors:
– 2 connection plates
– 1 connection bracket

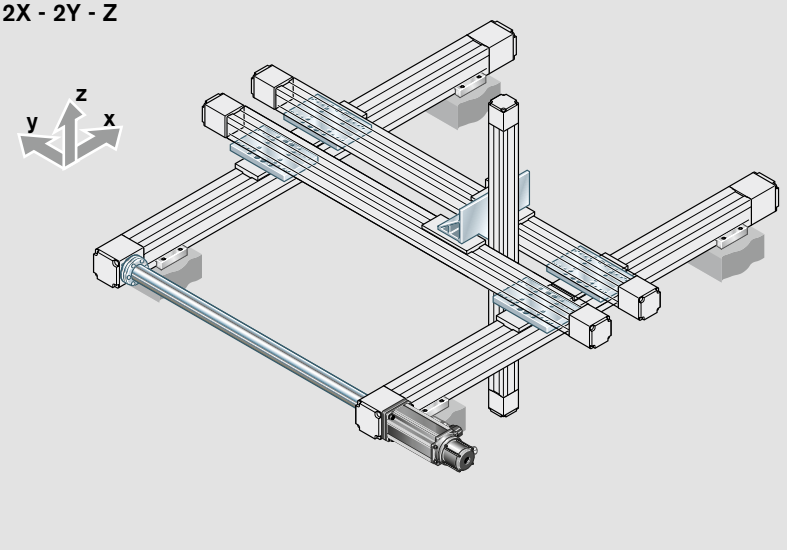
2X - Y - Z



– Torque support for the Y-axis
– Parallel drive, external motor

Connectors:
4 connection plates
1 angle bracket for 3 linear modules
1 connecting shaft

2X - 2Y - Z

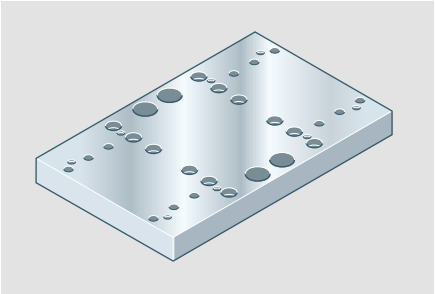


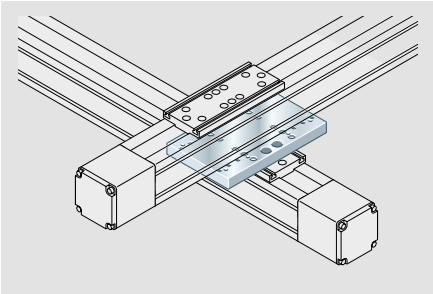
Robotic Erector System for Linear Modules/Linear Modules

Connection Elements

The connectors are mass-produced from a high-strength but lightweight aluminum alloy material that minimizes additional weight and the cost of a system. The connecting shafts are made of steel.

Carriages with T-slots are required to mount the plates and connection brackets.



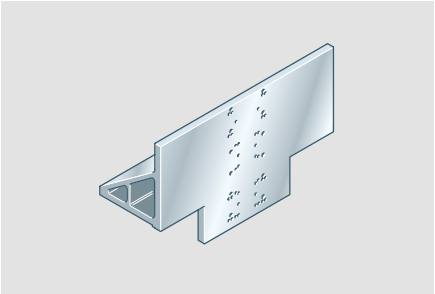


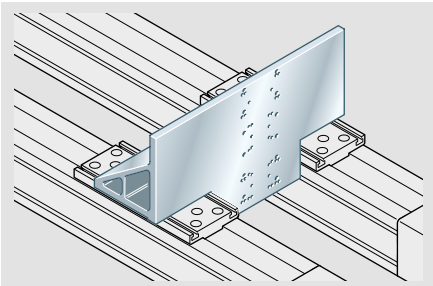
Plates

Connection plate
- right-angled joint between two linear modules
- frame to carriage mounting
- aluminum alloy

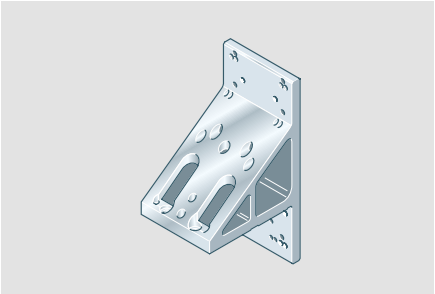
Connection brackets

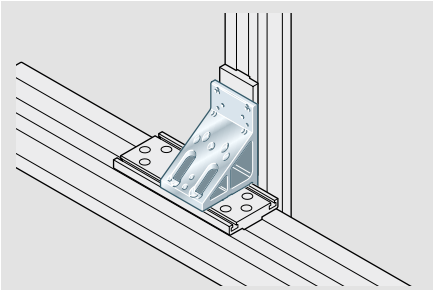
Angle bracket to connect 3 linear modules
- parallel connection between two linear modules
- mounting to carriages
- mounting of Z axes possible
- strengthened by additional ribs





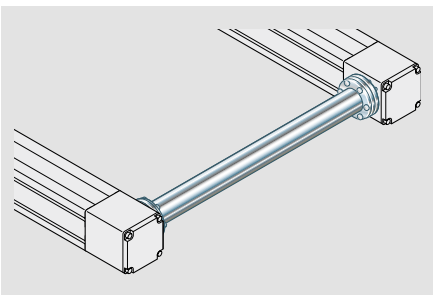
Angle bracket to connect 2 linear modules
- right-angled joint between two linear modules
- carriage to carriage mounting
- carriage to frame mounting
- mounts directly to carriages





Connecting Shafts

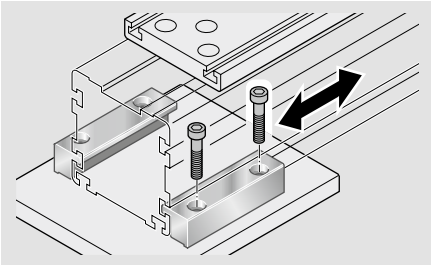
- parallel drive for linear modules
- connecting shafts
  - high rigidity
  - high precision

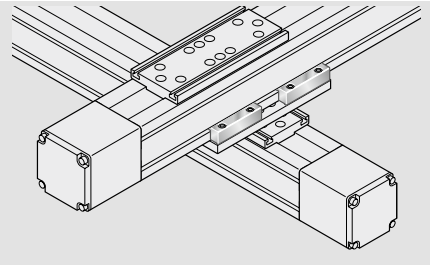


For dimension drawings of the individual connectors, see “Dimensions...”.

Easy mounting to adjacent structures or connection plate by means of clamping fixtures

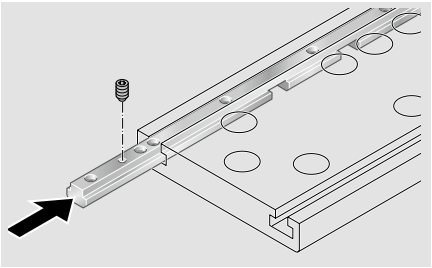
- Simply screw down linear modules.
- Clamping fixtures engage in the T-slots of the frame.
- Equalizes tolerances in longitudinal and transverse direction.

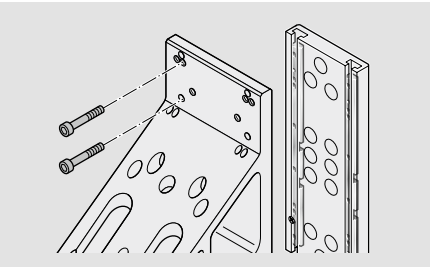




Anchor strips permit rapid and easy assembly using T-slots

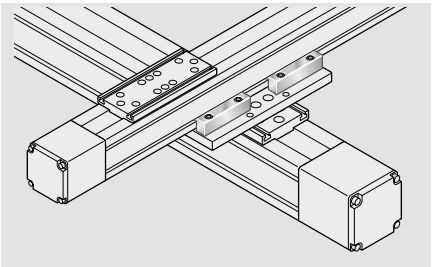
- Insert and adjust the anchor strip.
- Fix in place with set screws, if necessary (i.e., if in vertical position).
- Assemble structure.

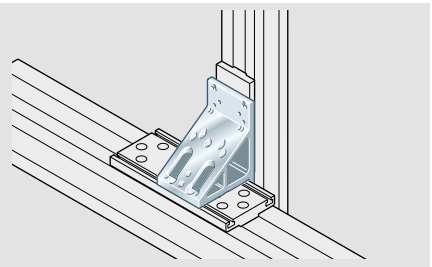


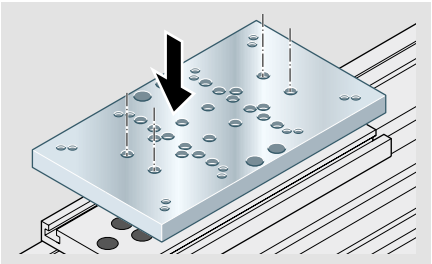


Connection of identical/different module sizes

– MK. 35-165	MK.	35-165
	MK.	25-110
	MLR	10 110
	MK.	25-145
– MK. 25-110 – MLR 10 110	MK.	25-110
	MLR	10 110
	MK.	20 80
	MLR	10 80
	MK.	25-145
–MK. 15-65	MK.	15-65
	MK.	20 80
	MLR	10 80



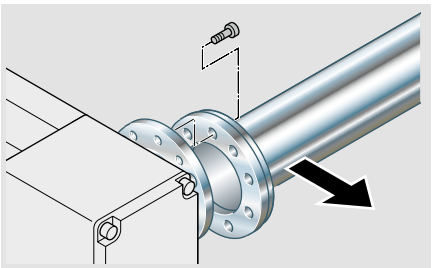




With types MKR and MLR, allows removal of the toothed belt without dismantling the plates or angle brackets.

Mounting/removal of connecting shafts to/from installed linear modules

- Easy adjustment for synchronous parallel operation, as connecting shafts can be turned steplessly into any position.



Robotic Erector System for Linear Modules/Linear Modules

Erecting Robotic Structures

Mounting of Linear Modules with Rexroth mounting components

Identification system for part numbers
Example:

Connection plate
R0391 210 03

Part number of individual component

Complete assembly kit: R0391 200 00

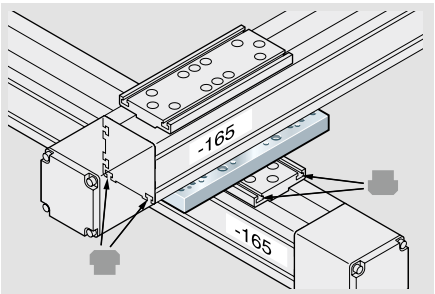
Connection of Linear Module		to Linear Module
MKK 35-165	>	MKK 35-165
MKR 35-165		MKR 35-165

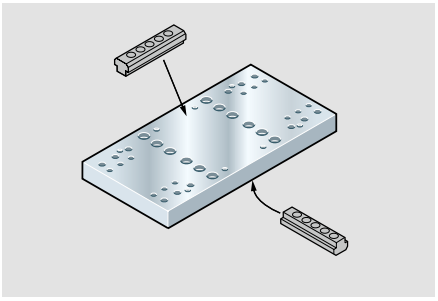
Part number of the complete assembly kit including mounting accessories (in this case: including anchor strips and screws as per DIN)

Connection plate R0391 210 03

Complete assembly kit: R0391 200 00

Mounting using threaded anchor strips.

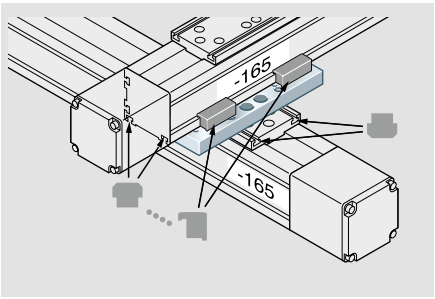


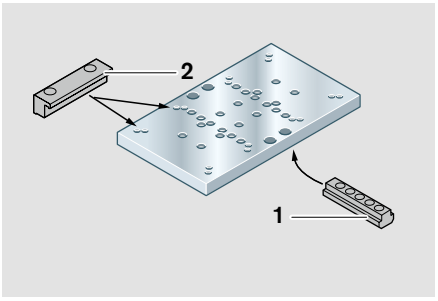


Connection plate R0391 210 62

Complete assembly kit: R0391 200 50

Anchor strips (1) fixable with set screws.
Mounting using clamping fixtures (2).



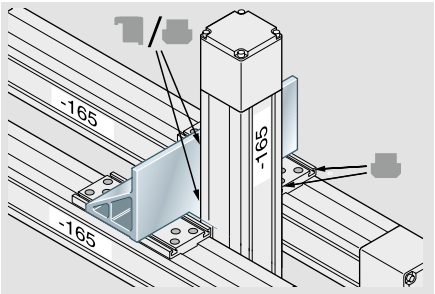


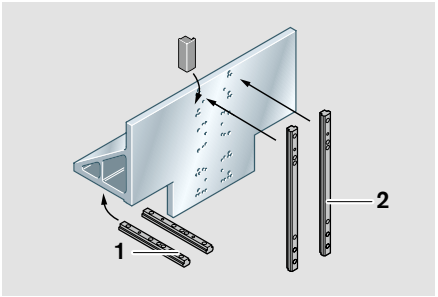
Angle bracket R0391 150 02

– on carriage with anchor strips
Complete assembly kit: R0391 100 65

Anchor strips (1) + (2) fixable with set screws.

– on frame with clamping fixtures
Complete assembly kit: R0391 100 66

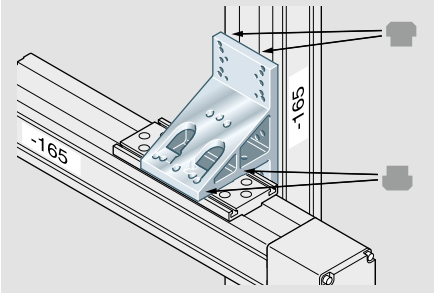


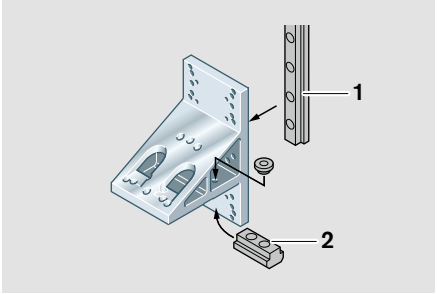


Angle bracket R0391 150 01

Complete assembly kit: R0391 100 50

Anchor strips (1) + T-nuts (2) fixable with set screws.





Symbols used

Anchor strip or T-nut

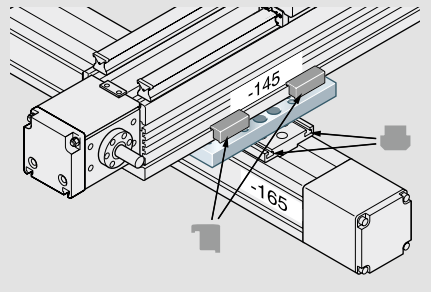
Clamping fixture

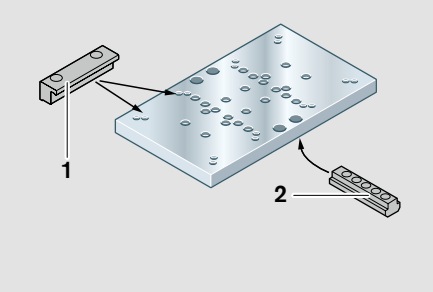
Connection of Linear Module		to Linear Module
MKK 35-165	>	MKK 25-145
MKR 35-165		MKR 25-145

Connection plate R0391 210 62

Complete assembly kit: R0391 200 51

- Mounting using clamping fixtures (1).
- Mounting using threaded anchor strips (2).



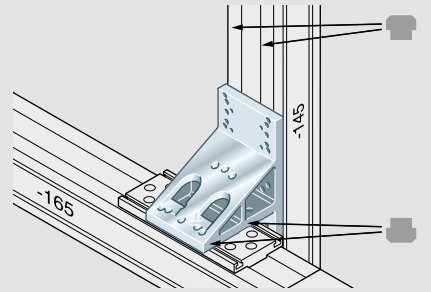


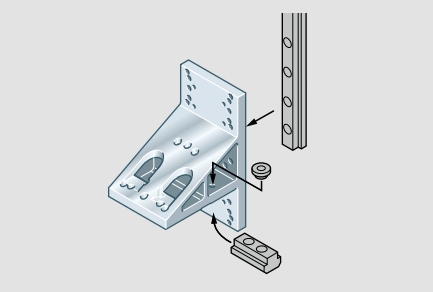
Angle bracket R0391 150 01

Complete assembly kit: R0391 100 51

- Anchor strips (1) + T-nuts (2) fixable with set screws.

Note
For precise details of the Rexroth mounting accessories, see “Mounting Accessories” and “Mounting”.





Robotic Erector System for Linear Modules/Linear Modules

Erecting Robotic Structures

Mounting of Linear Modules with Rexroth mounting components

Connection of Linear Module		to Linear Module
MKK 35-165 MKR 35-165	>	MKK 25-110 MKR 25-110 MLR 10 110

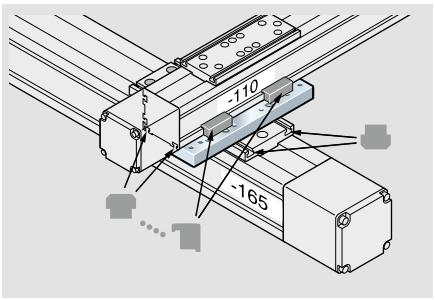
Connection plate R0391 210 03

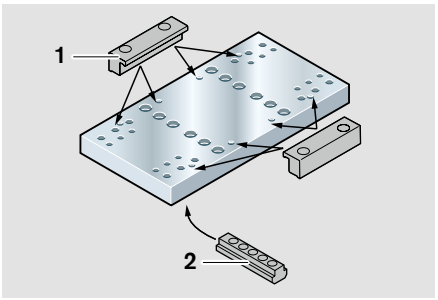
Complete assembly kit: R0391 200 01

Mounting using clamping fixtures (1).

Complete assembly kit: R0391 200 02

Mounting using threaded anchor strips (2).



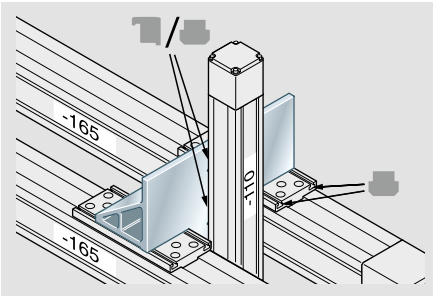


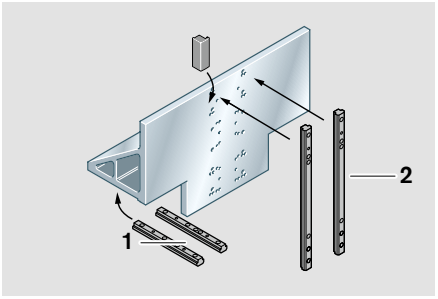
Angle bracket R0391 150 02

– on carriage with anchor strips
Complete assembly kit: R0391 100 67

Anchor strips (1) + (2) fixable.

– on frame with clamping fixtures
Complete assembly kit: R0391 100 68

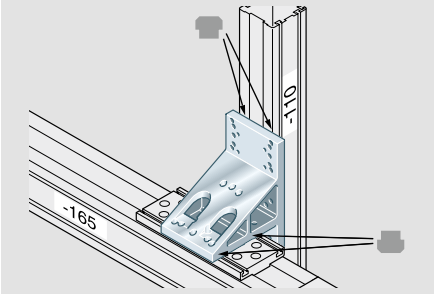


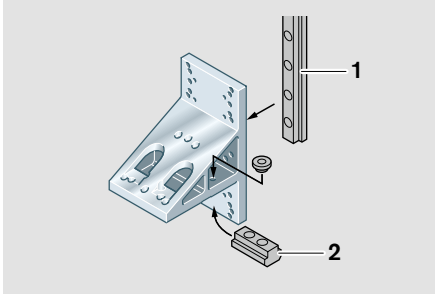


Angle bracket R0391 150 01

Complete assembly kit: R0391 100 52

Anchor strips (1) + T-nuts (2) fixable with set screws.





Symbols used

Anchor strip or T-nut

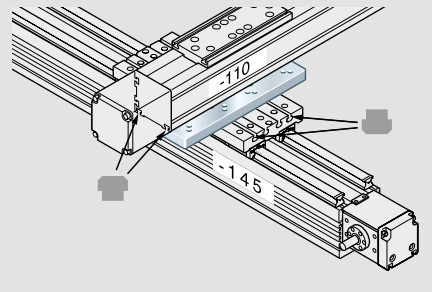
Clamping fixture

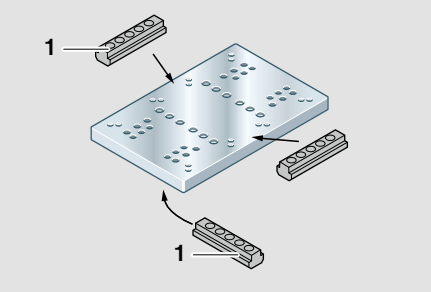
Connection of Linear Module		to Linear Module
MKR 25-145 MKZ 25-145	>	MKK 25-110 MKR 25-110 MLR 10 110

Connection plate R0391 210 61

Complete assembly kit: R0391 200 55

- Mounting using threaded anchor strips (1).



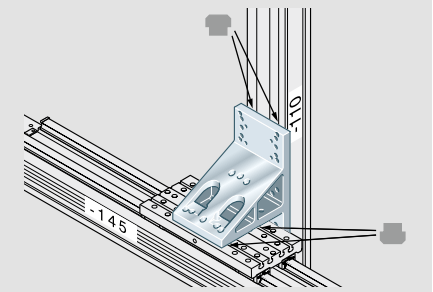


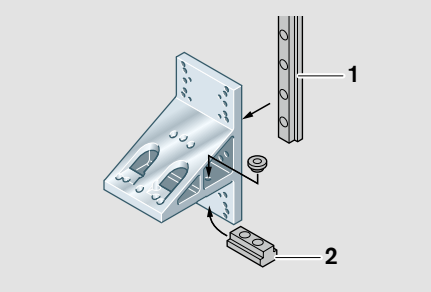
Angle bracket R0391 150 01

– **on carriage with anchor strips**

Complete assembly kit: R0391 100 52

- Anchor strips (1) + T-nuts (2) fixable with set screws.





Note
For precise details of the Rexroth mounting accessories, see “Mounting Accessories” and “Mounting”.

Robotic Erector System for Linear Modules/Linear Modules

Erecting Robotic Structures

Mounting of Linear Modules with Rexroth mounting components

Identification system for part numbers (example):

Connection plate
R0391 210 03

Part number of individual component

Complete assembly kit: R0391 200 00

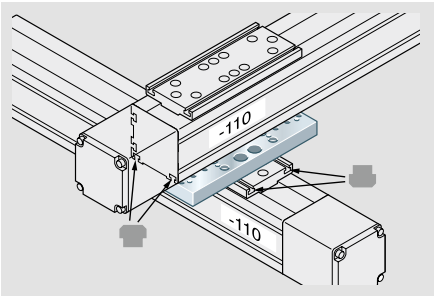
Connection of Linear Module		to Linear Module
MKK 25-110	>	MKK 25-110
MKR 25-110		MKR 25-110
MLR 10-110		MLR 10-110

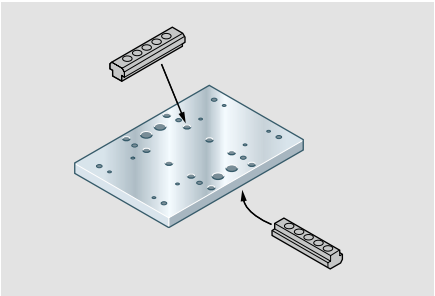
Part number of the complete assembly kit including mounting accessories (in this case: including anchor strips and screws as per DIN)

Connection plate R0391 210 02

Complete assembly kit: R0391 200 03

Mounting using threaded anchor strips.





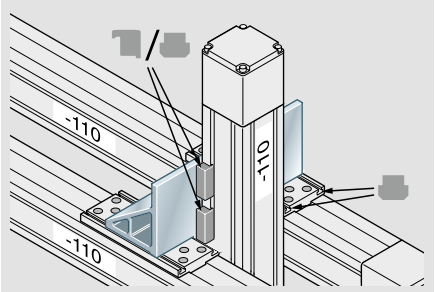
Angle bracket R0391 140 11

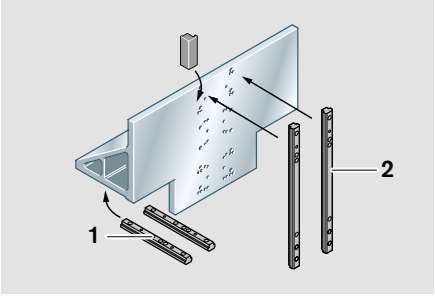
– on carriage with anchor strips
Complete assembly kit: R0391 100 69

Anchor strips (1) + (2) fixable.

– on frame with clamping fixtures
Complete assembly kit: R0391 100 70

Anchor strips (1) fixable.

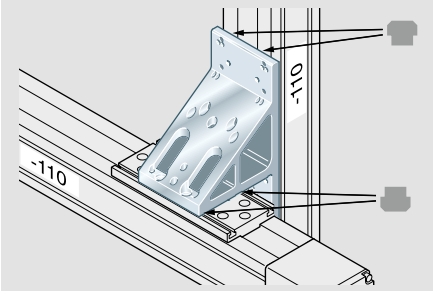


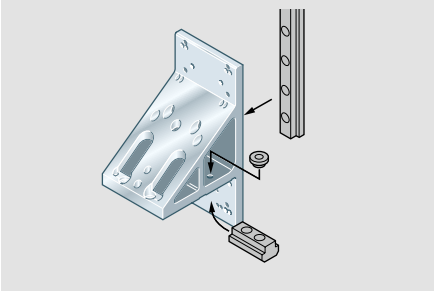


Angle bracket R0391 140 08

– on carriage with anchor strips
Complete assembly kit: R0391 100 53

Anchor strips (1) + T-nuts (2) fixable with set screws.





Symbols used

Anchor strip or T-nut

Clamping fixture

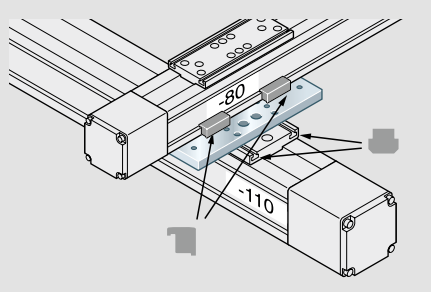
Connection of Linear Module		to Linear Module
MKK 25-110	>	MKK 20 80
MKR 25-110		MKR 25-80
MLR 10-110		MLR 10-80

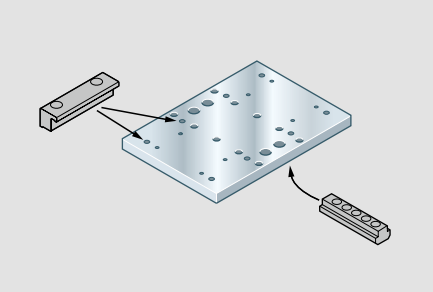
Connection plate R0391 210 02

Complete assembly kit: R0391 200 04

Mounting using clamping fixtures (1).

Mounting using threaded anchor strips (2).





Angle bracket R0391 140 11

Mounting for frame size -80:
– on carriage with anchor strips

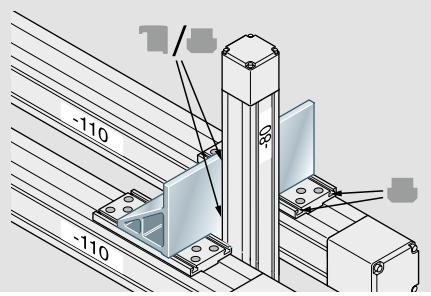
Complete assembly kit: R0391 100 71

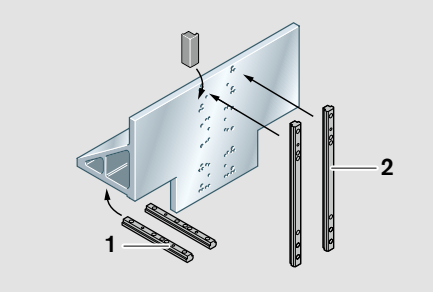
Anchor strips (1) + (2) fixable.

– on frame with clamping fixtures

Complete assembly kit: R0391 100 72

Anchor strips (2) fixable.





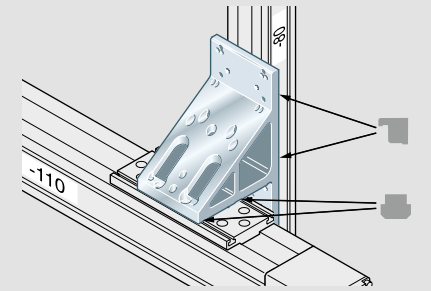
Angle bracket R0391 140 08

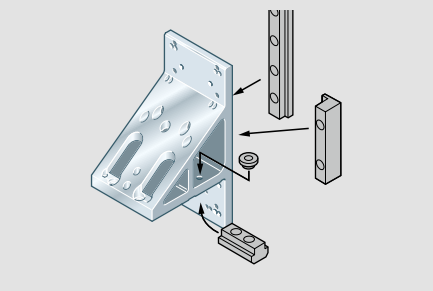
Mounting for frame size -80:
– on carriage with anchor strips
Complete assembly kit: R0391 100 54

Anchor strips (1) fixable.

– on frame with clamping fixtures
Complete assembly kit: R0391 100 55

Note
For precise details of the Rexroth mounting accessories, see “Mounting Accessories” and “Mounting”.





Robotic Erector System for Linear Modules/Linear Modules

Identification System for Part Numbers

Identification system for part numbers (example):

Connection plate R0391 210 03

Part number of individual component

Complete assembly kit: R0391 200 00

Part number of the complete assembly kit including mounting accessories (in this case: including anchor strips and screws as per DIN)

Connection plate R0391 210 58

Complete assembly kit: R0391 200 56

- Mounting using clamping fixtures (1).
- Mounting using threaded anchor strips (2).

Angle bracket R0391 140 08

– **Z axis (size -65) with anchor strips on carriage**

Complete assembly kit: R0391 100 58

- Anchor strips (1) + T-nuts (2) fixable with set screws.

– **Z axis (size -80) with anchor strips on carriage**

Complete assembly kit: R0391 100 59

- Anchor strips (1) + T-nuts (2) fixable with set screws.

– **Z axis on frame with clamping fixtures (size -65 and -80)**

Complete assembly kit: R0391 100 60

- Z axis mounted using anchor strips (1) and fixable with set screws.

Connection plate R0391 210 57

Complete assembly kit: R0391 200 57

- Mounting using clamping fixtures (1).
- Mounting using threaded anchor strips (2).

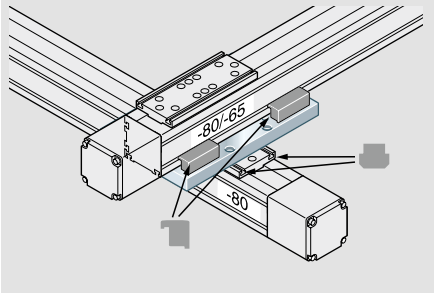
Symbols used

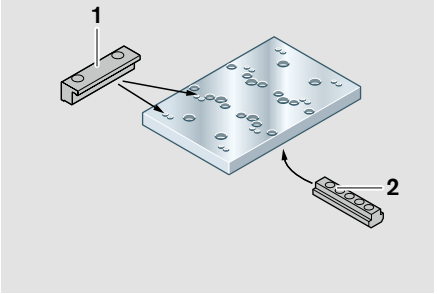
- Anchor strip or T-nut
- Clamping fixture

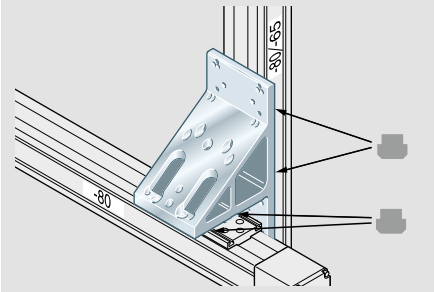
Note

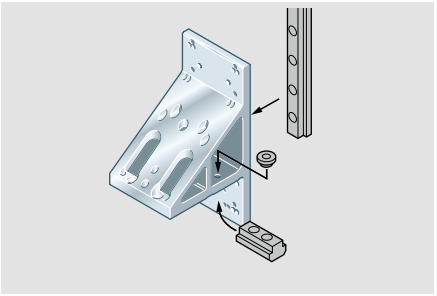
For precise details of the Rexroth mounting accessories, see “Mounting Accessories” and “Mounting”.

Connection of Linear Module		to Linear Module
MKK 20-80 MKR 20-80 MLR 10-80	>	MKK 20-80 MKR 20-80 MLR 10-80 MKK 15-65 MKR 15-65 MKP 15-65

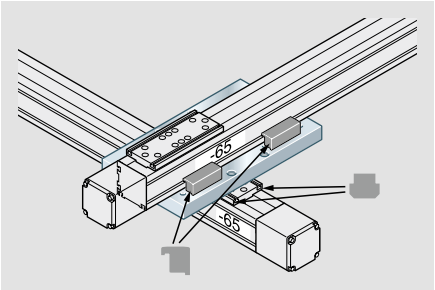


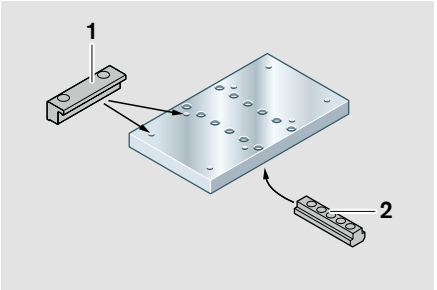






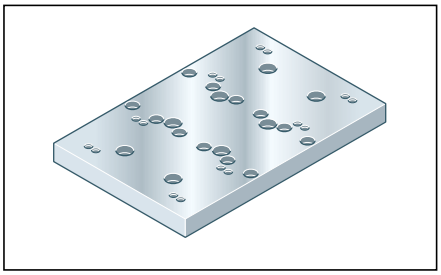
Connection of Linear Module		to Linear Module
MKK 15-65 MKR 15-65 MKP 15-65	>	MKK 15-65 MKR 15-65 MKP 15-65

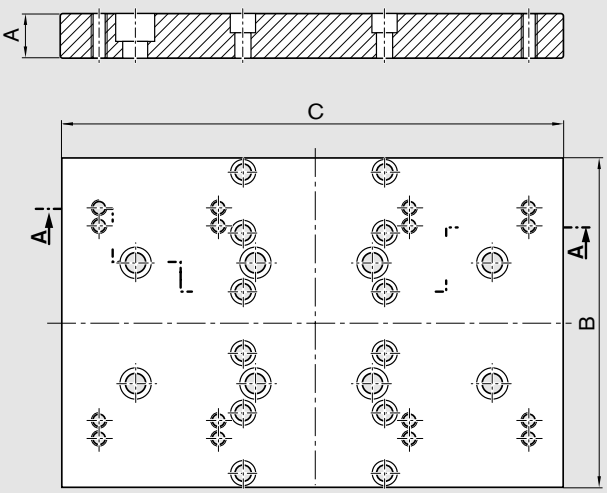




Connection plates

for connection of linear modules
Aluminum alloy, anodized





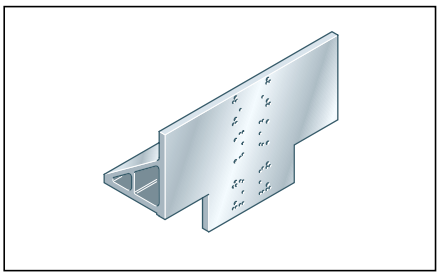
Section A – A

Frame size	Part number	Dimensions			Weight
		A (mm)	B (mm)	C (mm)	(kg)
-65 / -65	R0391 210 57	18	115	196	1.20
-80 / -65	R0391 210 58	18	138	210	1.45
-110/ -80	R0391 210 02	18	138	220	1.50
-110/ -165	R0391 210 03	25	163	320	3.50
-145/ -110	R0391 210 61	25	230	360	5.60
-145/ -165	R0391 210 62	25	240	410	6.70

Robotic Erector System for Linear Modules/Linear Modules

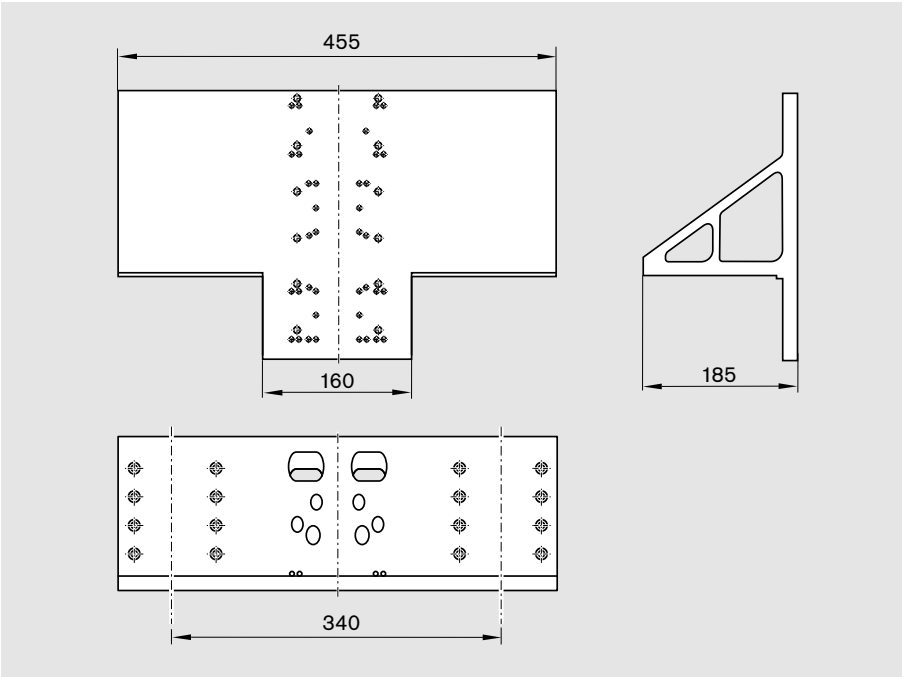
Angle Brackets

Dimensions



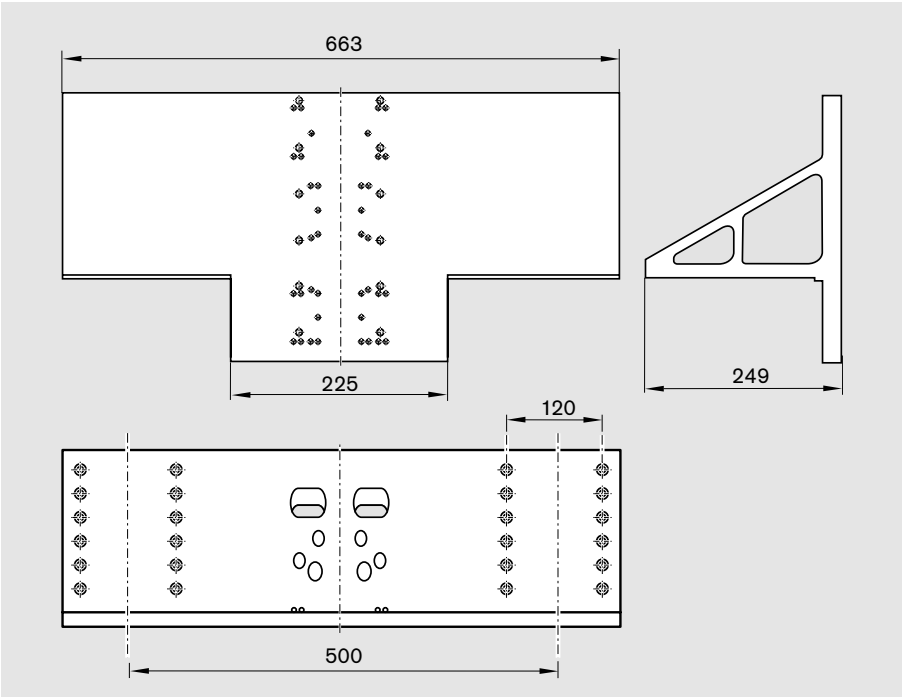
Angle bracket
R0391 140 11

for connecting 3 linear modules with frame sizes -110 and -80
Fabricated aluminum alloy



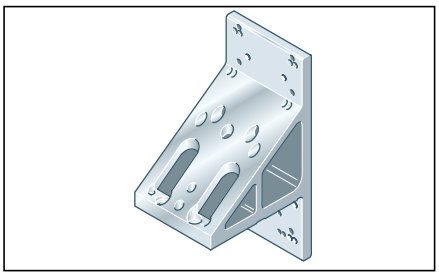
Angle bracket
R0391 150 02

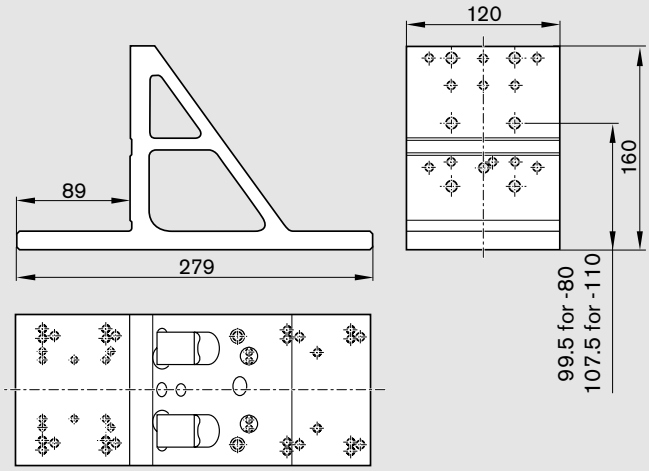
for connecting 3 linear modules with frame sizes 2x -165 and 1x -110 or 2x -165 and 1x -165
Fabricated aluminum alloy



Angle bracket
R0391 140 08

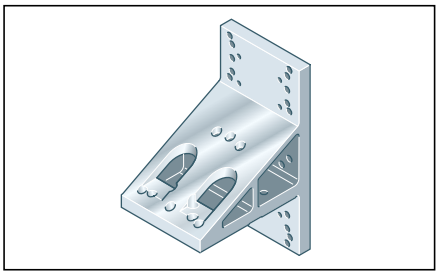
for all linear modules with frame sizes
-110, -80 and -65
Fabricated aluminum alloy, anodized
Weight approx. 2.5 kg

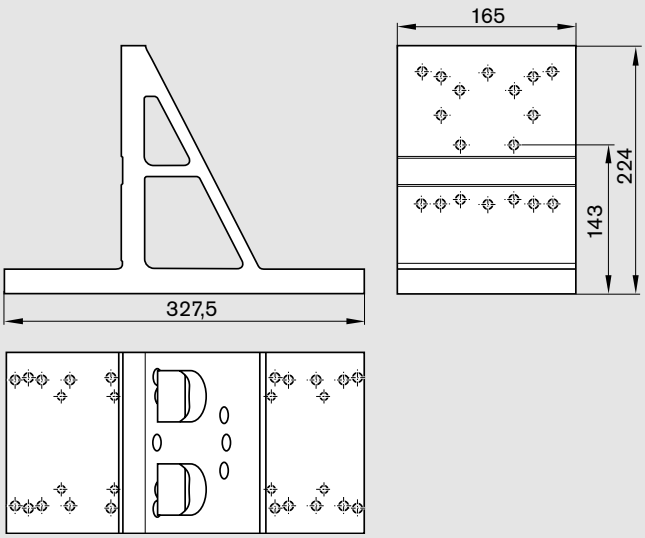




Angle bracket
R0391 150 01

for all linear modules with frame sizes
-165, -145 and -110
Fabricated aluminum alloy, anodized
Weight approx. 5.8 kg





Robotic Erector System for Linear Modules/Linear Modules

Connecting Shafts

Steel connecting shafts with disk-pack coupling
(shaft 1, 2)
- Compensation of misalignments
- Backlash-free and torsionally stiff
- Bridge large distances between axes
- Dynamically balanced as per VDI 2060

Connecting shafts with flexible membrane coupling
(shaft 3 - 6)
- Compensation of misalignments
- Backlash-free and torsionally stiff
- Bridge large distances between axes
- Clamping hub (mounting and dismounting without shifting aligned axes)
- Dynamically balanced as per VDI 2060

Ordering
Please state the part number and length L_{cs} when ordering.
Alternative design subject to same technical data.

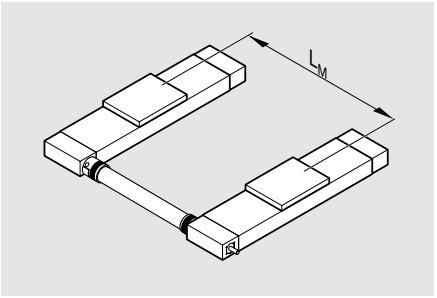
Notes on horizontal mounting orientation (version for vertical mounting orientation on request)
Alternative design subject to same technical data.

⚠ **Install guards to protect against contact with rotating parts during operation!**
Comply with the equipment safety rules and machine safety regulations at all times!

Calculation of length L_{cs} for i = 1:

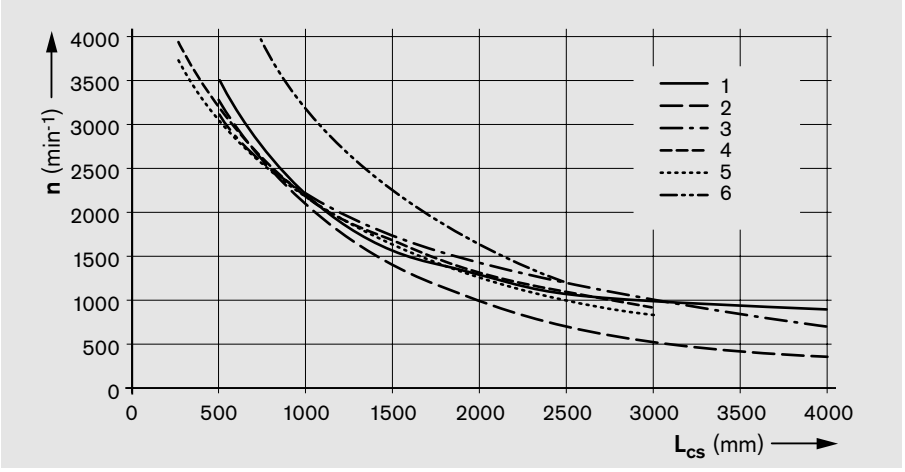
Shaft	Frame size	Length L_{cs} (mm)
1	-165	L_M – 220 mm
2	-110	L_M – 140 mm
	-80	L_M – 120 mm
3	-110	L_M – 155 mm
4	-80	L_M – 144 mm
5	-65	L_M – 105 mm
6	-40	L_M – 55 mm

L_{cs} = overall length of the connecting shaft (mm)
L_M = center-to-center distance between linear modules (mm)



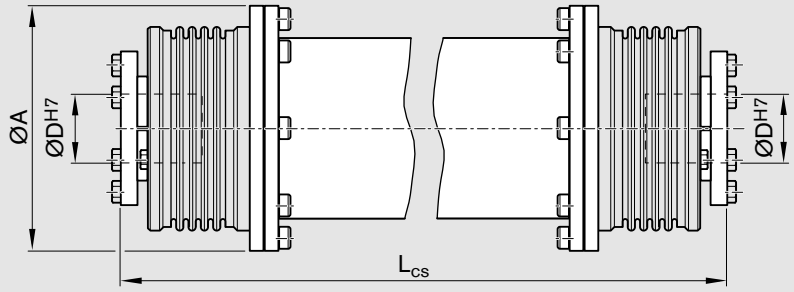
Critical speed as a function of overall length

n = rotary speed (min^{-1})
L_{cs} = overall length of the connecting shaft (mm)



Dimensions

Steel connecting shafts (disk-pack coupling)

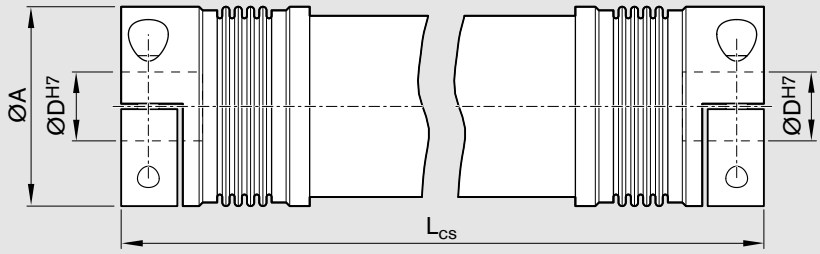


Dimensions and part numbers

Shaft	Frame size	Part number	Dimensions			Torque	Weight	Flexibility		Mass moment of inertia
			A (mm)	D (mm)	$L_{cs\ max}$ (mm)	(Nm)	(kg)	Δk_a (mm)	Δk_w (°)	(10^{-6} kgm²)
1	**-165**	R0391 510 11	147	35	4 000	400	7 + 13.5 kg/m	2.6	1	23300 + 20.6 · L_{cs}
2	**-80, -110**	R0391 510 12	110	18	4 000	100	3 + 4.6 kg/m	1.8	1	3300 + 4.4 · L_{cs}

Δk_a = axial flexibility (mm)
Δk_w = angular flexibility (°)

Connecting shafts (membrane coupling)



Dimensions and part numbers

Shaft	Frame size	Part number	Dimensions			Torque	Weight	Mass moment of inertia
			A (mm)	D (mm)	$L_{cs\ max}$ (mm)	(Nm)	(kg)	(10^{-6} kgm²)
3	**-110**	R0391 510 13	81	18	4 000	150	3.3 + 1.5 kg/m	9700 + 0.14 · L_{cs}
4	**-80**	R0391 510 14	66	18	3 000	60	1.2 + 1.3 kg/m	1130 + 0.13 · L_{cs}
5	**-65**	R0391 510 15	60	16	3 000	25	0.7 + 1.1 kg/m	570 + 0.07 · L_{cs}
6	**-40**	R0391 510 21	32	10	1 500	25	0.12 + 0.3 kg/m	23 + 0.075 · L_{cs}

Robotic Erector System for Linear Modules/Linear Modules

Mounting and Fastening Elements

General Notes

When mounting and securing connection components, do not exceed the maximum tightening torques for screws as indicated in the following table.

Mounting accessories

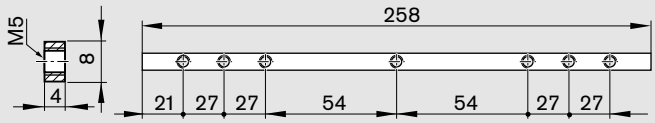
Tightening torques for fastening screws

8.8	M4	M5	M6	M8	M10	M12
(Nm)	2.7	5.5	9.5	23	46	80

Threaded anchor strips

Steel, black finished
All anchor strips can be fixed in place for vertical installation.

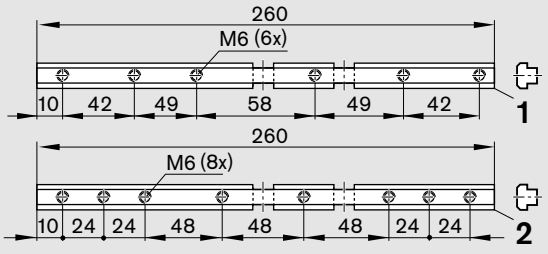
Frame size -80



Part number

R0391 710 03

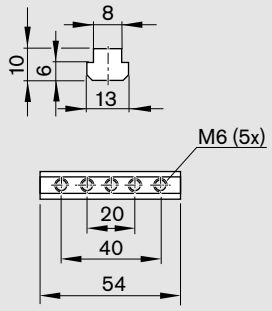
Frame size -110



Part number

(1): R0391 710 01
(2): R0391 710 00
Profiles as per DIN 508

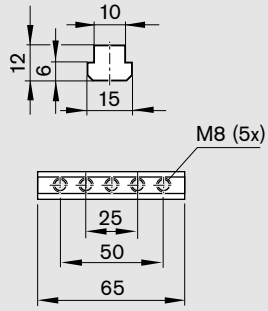
Frame size -110



Part number
R0391 710 06

Profile as per DIN 508

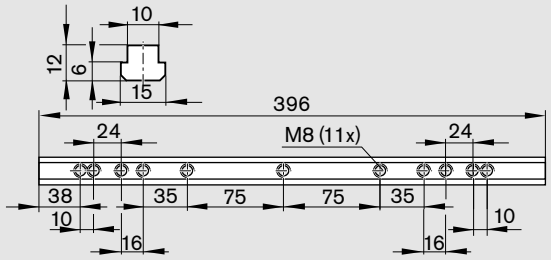
Frame size -145 and -165



Part number
R0391 710 05

Profile as per DIN 508

Frame size -165



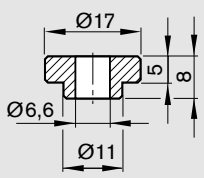
Part number
R0391 710 04

Profile as per DIN 508

Reducers

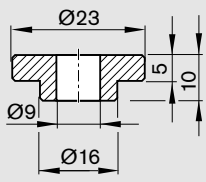
Aluminum alloy, black anodized

Frame size -110



Part number
R0391 750 14

Frame size -165



Part number
R0391 750 15

Linear Modules

Mounting

General Notes

The linear modules are mounted using various mounting components:
- Clamping fixtures
- T-nuts for frame size -110 and up
- Square nuts
- Spring nuts
- Screws for T-slots as per DIN 787 (not shown).

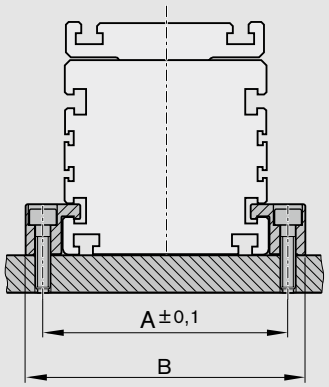
Length dependent on base.

When mounting Linear Modules, please note the maximum tightening torques listed in the table.

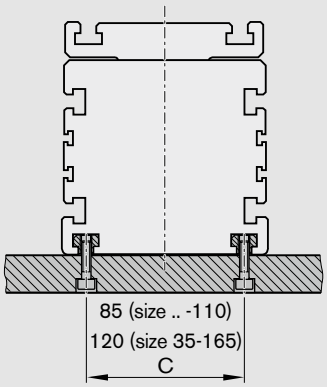
Size	A (mm)	B (mm)
15-65	81	95
20-80/10-80	96	110
25-110/10-110	132	150
35-165	192	218
25-145	172	198

See “Robotic Erector System for Linear Modules” for additional mounting accessories for connecting linear modules.

Fastening with clamping fixtures

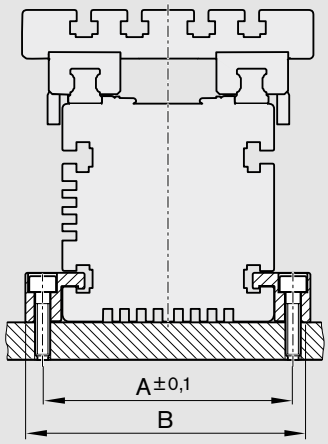


Fastening with T-nuts

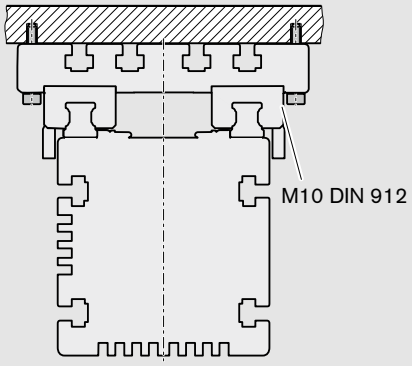


MKR 25-145

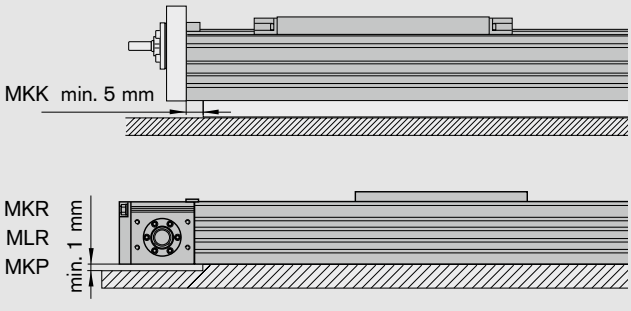
Mounting by the frame for horizontal operation



Mounting by the carriage for vertical operation



⚠ **Do not mount or support the Linear Module by the end block, end enclosure or end plate!**
The frame is the main load-bearing part!



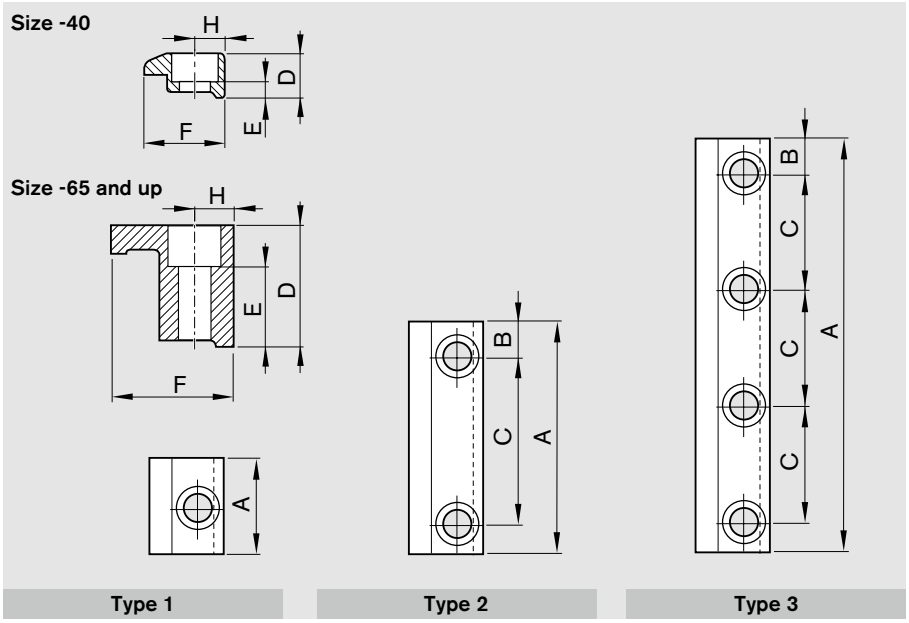
Tightening torques of the fastening screws
at friction factor 0.125
Strength class 8.8

8.8	M4	M5	M6	M8	M10	M12
(Nm)	2.7	5.5	9.5	23	46	80

Clamping fixtures

Recommended number of clamping fixtures for Miniature Linear Modules -40:
- Type 1: 6 pieces per side/m
- Type 2: 4 pieces per side/m
- Type 3: 3 pieces per side/m

Recommended number of clamping fixtures for Linear Modules -65 and up:
- Type 2: 3 per meter and side

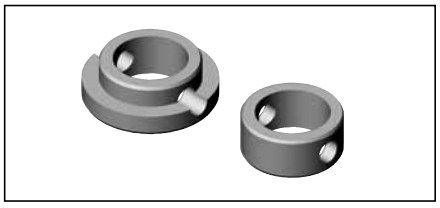


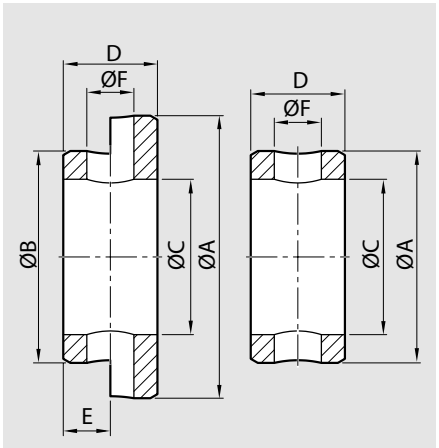
Size	Countersink ISO 4762 for	Type	Number of holes N	Dimensions (mm) A	B	C	D	E	F	H	Part number
12-40	M5	1	1	22	–	–	10.0	4.8	15	6.5	R1419 010 01
		2	2	57	8.5	40					R1419 010 43
		3	4	77	8.5	20					R1419 010 44
15-65	M6	2	2	78	14	50	20.0	11.5	20	7	R1175 190 24
20-80/10-80	M6			78	14	50	20.0	11.5	20	7	R1175 190 24
25-110/10-110	M8			108	19	70	27.5	16.5	29	9	R1175 290 26
35-165	M10			163	29	105	40.5	27.0	41	13	R1175 390 14
25-145	M10			163	29	105	32.0	18.5	41	13	R1175 290 44

Centering rings

The centering ring serves as a positioning aid. It creates a positive-locking connection with good reproducibility.

Material: steel (corrosion-resistant)





Module	Centering ring size	Part number	Dimensions (mm) A k6	B k6	C ±0.1	D -0.2	E +0.2	ØF
MKK 12-40	**7**	R0396 605 43	7	–	5.5	3	–	1.6
MKR 12-40	**7-5**	R0396 605 47	7	5	3.4	3	1.5	1.6
	9-7	R0396 605 49	9	7	5.5	3.5	1.5	1.6
	12-7	R0396 605 77	12	7	5.5	3.5	1.5	1.6

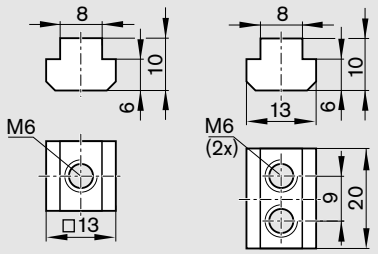
Linear Modules

Mounting

T-nuts

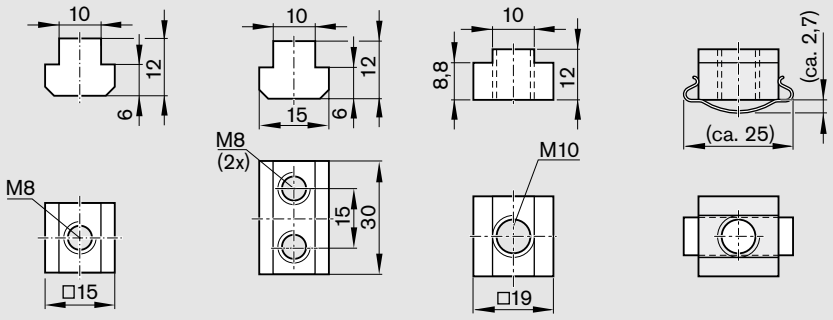
See “Robotic Erector System for Linear Modules”
for additional mounting accessories for connecting linear modules.

Size 25-110
Size 10-110



Part number	Part number
R3447 001 01	R0391 750 03 Profile as per DIN 508

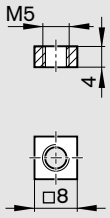
Size 35-165
MKR 25-145



Part number	Part number	Part number	Part number
M6: R3447 003 01 M8: R3447 002 01	R0391 750 04 Profile as per DIN 508	R3447 006 01 T-nut	R3454 030 49 Fixing spring for T-nut R3447 006-01

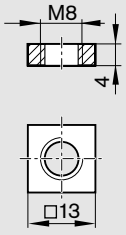
Square nuts

Size 15-65;
20-80; 10-80



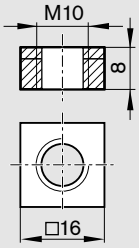
Part number
R3442 001 00 per DIN 557

Size 25-110
Size 10-110



Part number
R3442 003 01 per DIN 562

Size 35-165

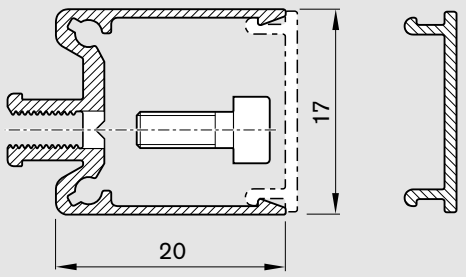


Part number
R3442 002 00 per DIN 557

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.



Linear Modules

Documentation

Standard report

Option 01

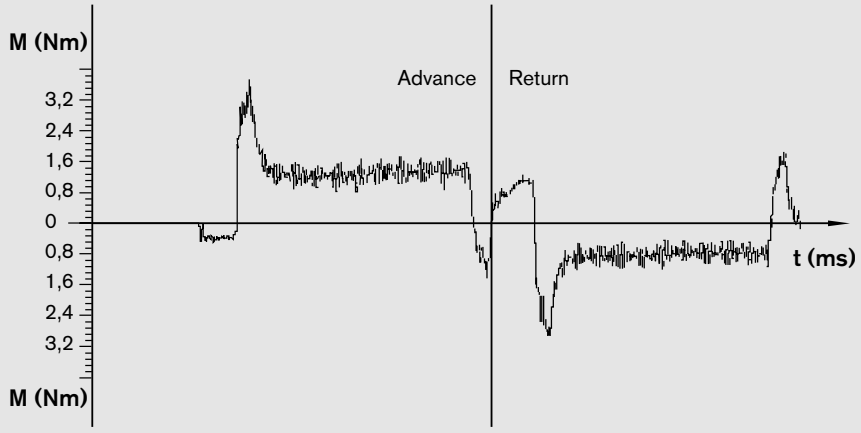
The standard report serves to confirm that the checks listed in the report have been carried out and that the measured values lie within the permissible tolerances.

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

Frictional moment of complete system

Option 02
The moment of friction is measured over the entire travel range.

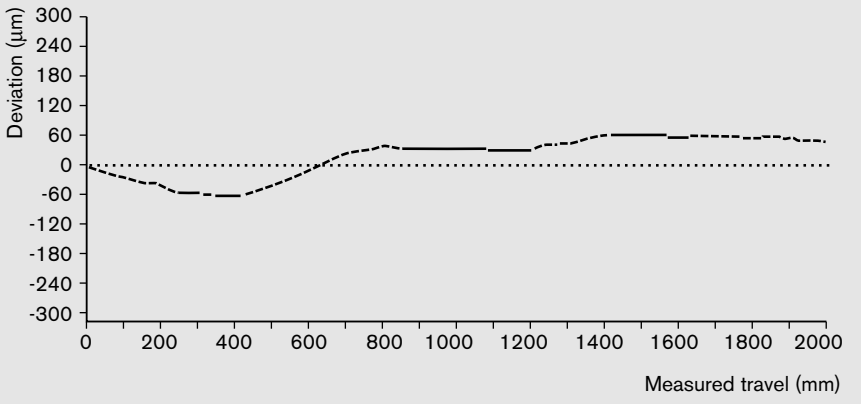
Example



Lead deviation of ball screw for Linear Modules MKK

Option 03
In addition to graphical representation (see illustration), a measurement report is supplied in table form.

Example

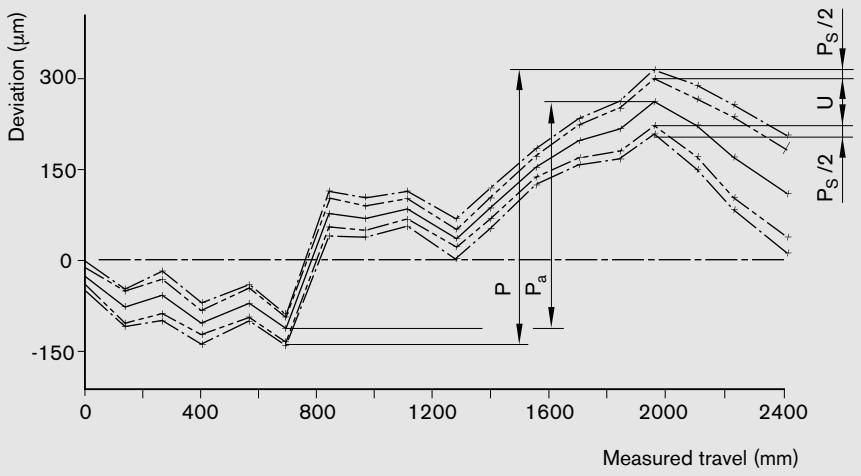


Positioning accuracy

per VDI/DGQ 3441
Option 05

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

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:
- 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.