High-Precision Linear Stage

High Travel Accuracy, Long Travel Ranges, Many Motor Variants

M-511 • M-521 • M-531

- Travel ranges: 102, 204 und 306 mm (4", 8", 12")
- Max. velocity to 100 mm/s
- Encoder resolution 50 nm
- Load capacity to 100 kg
- Zero-play ball screw
- XY and XYZ combinations

Reference-class linear stage
High travel accuracy and load capacity due to precision linear guides with preloaded recirculating ball bearings. Backlash-compensated ball screw with 2 mm pitch. Stress-relieved aluminum base for high stability.
XY and XYZ combinations with M-501 precision Z stages possible.

Drive types and position measurement
- M-5x1.DDx: DC motor with integrated ActiveDrive amplifiers for high velocity combined with direct-measuring linear encoder for high resolution and repeatability. M-5x1.DD2 also with integrated holding brake.
- M-5x1.DG1: DC gear motor with direct control and rotary encoder.
- M-5x1.PG1: DC gear motor with integrated ActiveDrive amplifier and rotary encoder.
- M-5x1.PD1: DC motor with integrated amplifier and rotary encoder.
- M-5x1.EC: Brushless DC motor with integrated block commutation and rotary encoder.

Noncontact limit switches. Noncontact reference switch in the middle of the travel range.

Application fields
Industry and research. Laser materials processing, surface inspection.

Motion	Unit	Toleran-ce	M-511.DD1	M-511.DD2	M-511.DG1	M-511.EC	M-511.PD1	M-511.PG1	M-521.DD1	M-521.DD2
Active axes			X	X	X	X	X	X	X	X
Travel range in X	mm		102	102	102	102	102	102	204	204
Maximum velocity in X, unloaded	mm/s		50	50	6	100	100	6	50	50
Straightness (Linear cross-stalk in Y with motion in X)	µm	Typ.	± 1	± 1	± 1	± 1	± 1	± 1	± 1	± 1
Flatness (Linear crosstalk in Z with motion in X)	µm	Typ.	± 1	± 1	± 1	± 1	± 1	± 1	± 1	± 1
Pitch (Rotational crosstalk in θY with motion in X)	µrad	Typ.	± 35	± 35	± 35	± 35	± 35	± 35	± 35	± 35
Yaw (Rotational crosstalk in θZ with motion in X)	µrad	Typ.	± 35	± 35	± 35	± 35	± 35	± 35	± 35	± 35

Positioning	Unit	Tolerance	M-511.DD1	M-511.DD2	M-511.DG1	M-511.EC	M-511.PD1	M-511.PG1	M-521.DD1	M-521.DD2
Integrated sensor			Incremental linear encoder	Incremental linear encoder	Incremental rotary encoder	Incremental rotary encoder	Incremental rotary encoder	Incremental rotary encoder	Incremental linear encoder	Incremental linear encoder
Unidirectional repeatability in X	µm	Typ.	0.1	0.1	0.4	0.5	0.5	0.4	0.1	0.1
Bidirectional repeatability in X	µm	Typ.	± 0.2	± 0.2	± 1	± 1	± 1	± 1	± 0.2	± 0.2
Minimum incremental motion in X	µm	Typ.	0.1	0.1	0.4	0.5	0.5	0.4	0.1	0.1
Backlash in X	µm	Typ.			1	1	1	1		
Sensor signal			A/B quadrature, RS-422	A/B quadrature, RS-422	A/B quadrature, RS-422	A/B quadrature, RS-422	A/B quadrature, RS-422	A/B quadrature, RS-422	A/B quadrature, RS-422	A/B quadrature, RS-422
Sensor resolution	nm		50	50					50	50
Sensor resolution	Cts./rev.				2048	4096	4096	2048		
Reference switch			Hall effect	Hall effect	Hall effect	Hall effect	Hall effect	Hall effect	Hall effect	Hall effect
Limit switches			Hall effect	Hall effect	Hall effect	Hall effect	Hall effect	Hall effect	Hall effect	Hall effect

Drive Properties	Unit	Tolerance	M-511.DD1	M-511.DD2	M-511.DG1	M-511.EC	M-511.PD1	M-511.PG1	M-521.DD1	M-521.DD2
Drive type			DC motor with ActiveDrive	DC motor with ActiveDrive	DC gear motor	Brushless DC motor	DC motor with ActiveDrive	DC gear motor with ActiveDrive	DC motor with ActiveDrive	DC motor with ActiveDrive
Nominal voltage	V		24	24		24	24	24	24	24
Peak voltage	V				12					
Drive force in negative direction of motion in X	N	Typ.	80	80	80	80	80	80	80	80
Drive force in positive direction of motion in X	N	Typ.	80	80	80	80	80	80	80	80

Mechanical Properties	Unit	Tolerance	M-511.DD1	M-511.DD2	M-511.DG1	M-511.EC	M-511.PD1	M-511.PG1	M-521.DD1	M-521.DD2
Guide			Recirculating ball bearing guide	Recirculating ball bearing guide	Recirculating ball bearing guide	Recirculating ball bearing guide	Recirculating ball bearing guide	Recirculating ball bearing guide	Recirculating ball bearing guide	Recirculating ball bearing guide
Drive screw type			Ball screw	Ball screw	Ball screw	Ball screw	Ball screw	Ball screw	Ball screw	Ball screw
Drive screw pitch	mm		2	2	2	2	2	2	2	2
Gear ratio i					29,6 : 1			29,6 : 1		
Holding brake				Electromagnetic safety brake						Electromagnetic safety brake
Moved mass in X, unloaded	g		530	530	530	530	530	530	530	530
Permissible push force in Y	N	Max.	200	200	200	200	200	200	200	200
Permissible push force in Z	N	Max.	1000	1000	1000	1000	1000	1000	1000	1000
Permissible torque in θx	N·m	Max.	40	40	40	40	40	40	40	40
Permissible torque in θY	N·m	Max.	20	20	20	20	20	20	20	20
Permissible torque in θZ	N·m	Max.	20	20	20	20	20	20	20	20
Overall mass	g		5000	5000	5000	5000	5000	5000	6100	6100
Material			Black anodized aluminum	Black anodized aluminum	Black anodized aluminum	Black anodized aluminum	Black anodized aluminum	Black anodized aluminum	Black anodized aluminum	Black anodized aluminum

Miscellaneous	Unit		M-511.DD1	M-511.DD2	M-511.DG1	M-511.EC	M-511.PD1	M-511.PG1	M-521.DD1	M-521.DD2
Connector			D-sub 15-pin (m)	D-sub 15-pin (m)	D-sub 15-pin (m)	D-sub 15-pin (m)	D-sub 15-pin (m)	D-sub 15-pin (m)	D-sub 15-pin (m)	D-sub 15-pin (m)
Connector for supply voltage			M8 4-pin (m)	M8 4-pin (m)			M8 4-pin (m)	M8 4-pin (m)	M8 4-pin (m)	M8 4-pin (m)
Recommended controllers / drivers			C-863 C-884	C-863 C-884	C-863 C-884	C-863 C-884	C-863 C-884	C-863 C-884	C-863 C-884	C-863 C-884
Operating temperature range	°C		10 to 50	10 to 50	-20 to +65	-20 to +65	-20 to +65	-20 to +65	10 to 50	10 to 50

Motion	Unit	Tolerance	M-521.DG1	M-521.EC	M-521.PD1	M-521.PG1	M-531.DD1	M-531.DD2	M-531.DG1	M-531.EC
Active axes			X	X	X	X	X	X	X	X
Travel range in X	mm		204	204	204	204	306	306	306	306
Maximum velocity in X, unloaded	mm/s		6	100	100	6	50	50	6	100
Straightness (Linear crosstalk in Y with motion in X)	µm	Typ.	± 1	± 1	± 1	± 1	± 1	± 1	± 1	± 1
Flatness (Linear crosstalk in Z with motion in X)	µm	Typ.	± 1	± 1	± 1	± 1	± 1	± 1	± 1	± 1
Pitch (Rotational crosstalk in θY with motion in X)	µrad	Typ.	± 35	± 35	± 35	± 35	± 35	± 35	± 35	± 35
Yaw (Rotational crosstalk in θZ with motion in X)	µrad	Typ.	± 35	± 35	± 35	± 35	± 35	± 35	± 35	± 35

Positioning	Unit	Tolerance	M-521.DG1	M-521.EC	M-521.PD1	M-521.PG1	M-531.DD1	M-531.DD2	M-531.DG1	M-531.EC
Integrated sensor			Incremental rotary encoder	Incremental rotary encoder	Incremental rotary encoder	Incremental rotary encoder	Incremental linear encoder	Incremental linear encoder	Incremental rotary encoder	Incremental rotary encoder
Unidirectional repeatability in X	µm	Typ.	0.4	0.5	0.5	0.4	0.1	0.1	0.4	0.5
Bidirectional repeatability in X	µm	Typ.	± 1	± 1	± 1	± 1	± 0.2	± 0.2	± 1	± 1
Minimum incremental motion in X	µm	Typ.	0.4	0.5	0.5	0.4	0.1	0.1	0.4	0.5
Backlash in X	µm	Typ.	1	1	1	1			1	1
Sensor signal			A/B quadrature, RS-422	A/B quadrature, RS-422	A/B quadrature, RS-422	A/B quadrature, RS-422	A/B quadrature, RS-422	A/B quadrature, RS-422	A/B quadrature, RS-422	A/B quadrature, RS-422
Sensor resolution	nm						50	50		
Sensor resolution	Cts./rev.		2048	4096	4096	2048			2048	4096
Reference switch			Hall effect	Hall effect	Hall effect	Hall effect	Hall effect	Hall effect	Hall effect	Hall effect
Limit switches			Hall effect	Hall effect	Hall effect	Hall effect	Hall effect	Hall effect	Hall effect	Hall effect

Drive Properties	Unit	Tolerance	M-521.DG1	M-521.EC	M-521.PD1	M-521.PG1	M-531.DD1	M-531.DD2	M-531.DG1	M-531.EC
Drive type			DC gear motor	Brushless DC motor	DC motor with ActiveDrive	DC gear motor with ActiveDrive	DC motor with ActiveDrive	DC motor with ActiveDrive	DC gear motor	Brushless DC motor
Nominal voltage	V			24	24	24	24	24		24
Peak voltage	V		12						12	
Drive force in negative direction of motion in X	N	Typ.	80	80	80	80	80	80	80	80
Drive force in positive direction of motion in X	N	Typ.	80	80	80	80	80	80	80	80

Mechanical Properties	Unit	Toleran-ce	M-521.DG1	M-521.EC	M-521.PD1	M-521.PG1	M-531.DD1	M-531.DD2	M-531.DG1	M-531.EC
Guide			Recircula-ting ball bearing gui-de	Recircula-ting ball bearing gui-de	Recircula-ting ball bearing gui-de	Recircula-ting ball bearing gui-de	Recircula-ting ball bearing gui-de	Recircula-ting ball bearing gui-de	Recircula-ting ball bearing gui-de	Recircula-ting ball bearing gui-de
Drive screw type			Ball screw	Ball screw	Ball screw	Ball screw	Ball screw	Ball screw	Ball screw	Ball screw
Drive screw pitch	mm		2	2	2	2	2	2	2	2
Gear ratio i			29,6 : 1			29,6 : 1			29,6 : 1	
Holding brake								Electroma-gnetic safe-ty brake		
Moved mass in X, unloa-ded	g		530	530	530	530	530	530	530	530
Permissible push force in Y	N	Max.	200	200	200	200	200	200	200	200
Permissible push force in Z	N	Max.	1000	1000	1000	1000	1000	1000	1000	1000
Permissible torque in θx	N·m	Max.	40	40	40	40	40	40	40	40
Permissible torque in θY	N·m	Max.	20	20	20	20	20	20	20	20
Permissible torque in θZ	N·m	Max.	20	20	20	20	20	20	20	20
Overall mass	g		6100	6100	6100	6100	7200	7200	7200	7200
Material			Black an-odized alu-minum	Black an-odized alu-minum	Black an-odized alu-minum	Black an-odized alu-minum	Black an-odized alu-minum	Black an-odized alu-minum	Black an-odized alu-minum	Black an-odized alu-minum

Miscellaneous	Unit		M-521.DG1	M-521.EC	M-521.PD1	M-521.PG1	M-531.DD1	M-531.DD2	M-531.DG1	M-531.EC
Connector			D-sub 15-pin (m)	D-sub 15-pin (m)	D-sub 15-pin (m)	D-sub 15-pin (m)	D-sub 15-pin (m)	D-sub 15-pin (m)	D-sub 15-pin (m)	D-sub 15-pin (m)
Connector for supply vol-tage					M8 4-pin (m)	M8 4-pin (m)	M8 4-pin (m)	M8 4-pin (m)		
Recommended controllers / drivers			C-863 C-884	C-863 C-884	C-863 C-884	C-863 C-884	C-863 C-884	C-863 C-884	C-863 C-884	C-863 C-884
Operating temperature range	°C		-20 to +65	-20 to +65	-20 to +65	-20 to +65	10 to 50	10 to 50	-20 to +65	-20 to +65

Motion	Unit	Toleran-ce	M-531.PD1	M-531.PG1
Active axes			X	X
Travel range in X	mm		306	306
Maximum velocity in X, unloaded	mm/s		100	6
Straightness (Linear cros-stalk in Y with motion in X)	µm	Typ.	± 1	± 1
Flatness (Linear crosstalk in Z with motion in X)	µm	Typ.	± 1	± 1
Pitch (Rotational crosstalk in θY with motion in X)	µrad	Typ.	± 35	± 35
Yaw (Rotational crosstalk in θZ with motion in X)	µrad	Typ.	± 35	± 35

Positioning	Unit	Toleran-ce	M-531.PD1	M-531.PG1
Integrated sensor			Incremental rotary encoder	Incremental rotary encoder
Unidirectional repeatabili-ty in X	µm	Typ.	0.5	0.4
Bidirectional repeatability in X	µm	Typ.	± 1	± 1
Minimum incremental motion in X	µm	Typ.	0.5	0.4
Backlash in X	µm	Typ.	1	1
Sensor signal			A/B quadrature, RS-422	A/B quadrature, RS-422
Sensor resolution	nm			
Sensor resolution	Cts./rev.		4096	2048
Reference switch			Hall effect	Hall effect
Limit switches			Hall effect	Hall effect

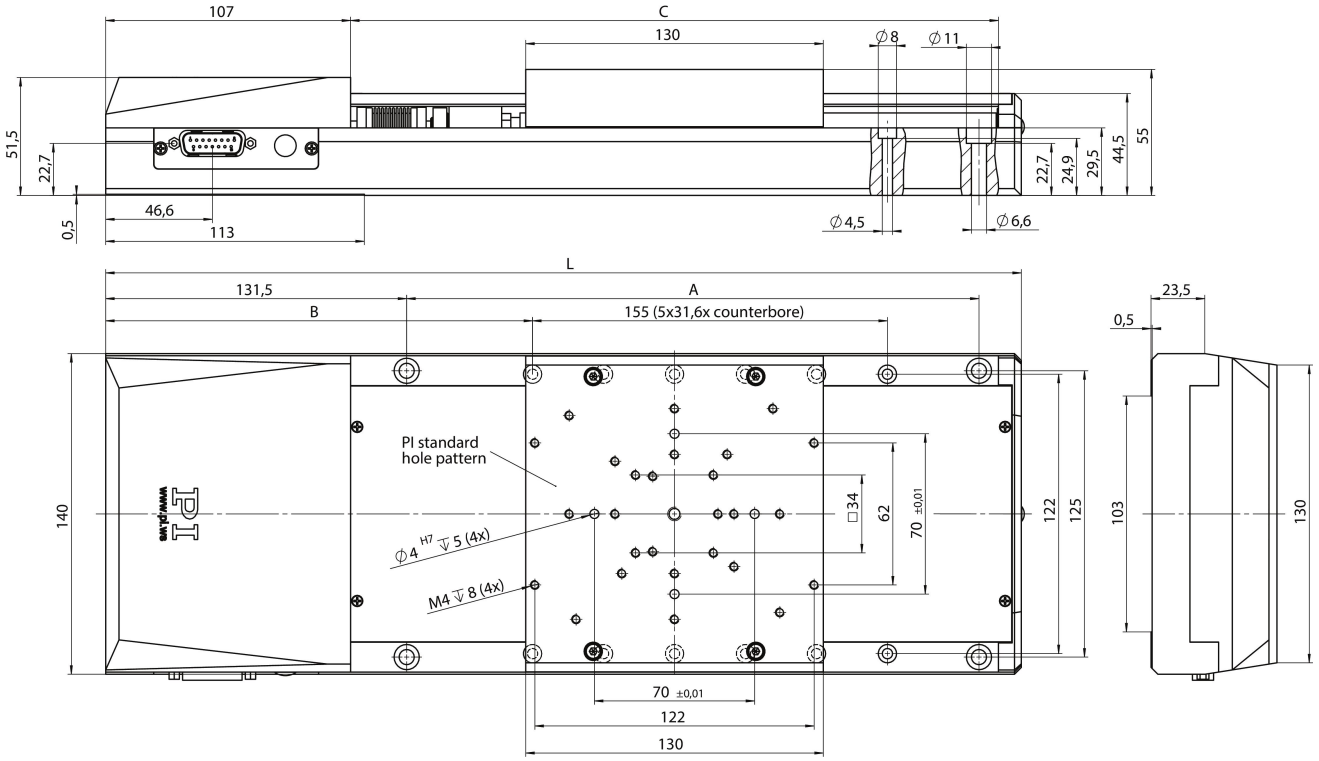
Drive Properties	Unit	Toleran-ce	M-531.PD1	M-531.PG1
Drive type			DC motor with ActiveDrive	DC gear motor with ActiveDrive
Nominal voltage	V		24	24
Peak voltage	V			
Drive force in negative di-rection of motion in X	N	Typ.	80	80
Drive force in positive di-rection of motion in X	N	Typ.	80	80

Mechanical Properties	Unit	Toleran-ce	M-531.PD1	M-531.PG1
Guide			Recirculating ball bearing guide	Recirculating ball bearing guide
Drive screw type			Ball screw	Ball screw
Drive screw pitch	mm		2	2
Gear ratio i				29,6 : 1
Holding brake				
Moved mass in X, unloa-ded	g		530	530
Permissible push force in Y	N	Max.	200	200
Permissible push force in Z	N	Max.	1000	1000
Permissible torque in θx	N·m	Max.	40	40
Permissible torque in θY	N·m	Max.	20	20
Permissible torque in θZ	N·m	Max.	20	20
Overall mass	g		7200	7200
Material			Black anodized aluminum	Black anodized aluminum

Miscellaneous	Unit		M-531.PD1	M-531.PG1
Connector			D-sub 15-pin (m)	D-sub 15-pin (m)
Connector for supply vol-tage			M8 4-pin (m)	M8 4-pin (m)
Recommended controllers / drivers			C-863 C-884	C-863 C-884
Operating temperature range	°C		-20 to +65	-20 to +65

Note on pitch, yaw, straightness, flatness: Specified value applies per 100 mm
Note on gear ratio: $(28/12)^4 \sim 29.6 : 1$

Drawings / Images



	L	A	B	C
M-511	400	250	186,5	283
M-521	500	350	236,5	383
M-531	600	450	286,5	483

M-511, M-521, M-531, dimensions in mm. Note that a comma is used in the drawings instead of a decimal point.

Order Information

M-511.DD1
High-precision linear stage; DC motor with ActiveDrive; 102 mm travel range; 1000 N load capacity; 50 mm/s maximum velocity; ball screw; incremental linear encoder, 50 nm sensor resolution, A/B quadrature, RS-422

M-511.DD2
High-precision linear stage; DC motor with ActiveDrive; 102 mm travel range; 1000 N load capacity; 50 mm/s maximum velocity; ball screw; incremental linear encoder, 50 nm sensor resolution, A/B quadrature, RS-422; electromagnetic safety brake

M-511.DG1
High-precision linear stage; DC gear motor; 102 mm travel range; 1000 N load capacity; 6 mm/s maximum velocity; ball screw; incremental rotary encoder, 2048 counts/rev sensor resolution, A/B quadrature, RS-422

Order Information

M-511.EC
High-precision linear stage; brushless DC motor; 102 mm travel range; 1000 N load capacity; 100 mm/s maximum velocity; ball screw; incremental rotary encoder, 4096 counts/rev sensor resolution, A/B quadrature, RS-422

M-511.PD1
High-precision linear stage; DC motor with ActiveDrive; 102 mm travel range; 1000 N load capacity; 100 mm/s maximum velocity; ball screw; incremental rotary encoder, 4096 counts/rev sensor resolution, A/B quadrature, RS-422

M-511.PG1
High-precision linear stage; DC gear motor with ActiveDrive; 102 mm travel range; 1000 N load capacity; 6 mm/s maximum velocity; ball screw; incremental rotary encoder, 2048 counts/rev sensor resolution, A/B quadrature, RS-422

M-521.DD1
High-precision linear stage; DC motor with ActiveDrive; 204 mm travel range; 1000 N load capacity; 50 mm/s maximum velocity; ball screw; incremental linear encoder, 50 nm sensor resolution, A/B quadrature, RS-422

M-521.DD2
High-precision linear stage; DC motor with ActiveDrive; 204 mm travel range; 1000 N load capacity; 50 mm/s maximum velocity; ball screw; incremental linear encoder, 50 nm sensor resolution, A/B quadrature, RS-422; electromagnetic safety brake

M-521.DG1
High-precision linear stage; DC gear motor; 204 mm travel range; 1000 N load capacity; 6 mm/s maximum velocity; ball screw; incremental rotary encoder, 2048 counts/rev sensor resolution, A/B quadrature, RS-422

M-521.EC
High-precision linear stage; brushless DC motor; 204 mm travel range; 1000 N load capacity; 100 mm/s maximum velocity; ball screw; incremental rotary encoder, 4096 counts/rev sensor resolution, A/B quadrature, RS-422

M-521.PD1
High-precision linear stage; DC motor with ActiveDrive; 204 mm travel range; 1000 N load capacity; 100 mm/s maximum velocity; ball screw; incremental rotary encoder, 4096 counts/rev sensor resolution, A/B quadrature, RS-422

M-521.PG1
High-precision linear stage; DC gear motor with ActiveDrive; 204 mm travel range; 1000 N load capacity; 6 mm/s maximum velocity; ball screw; incremental rotary encoder, 2048 counts/rev sensor resolution, A/B quadrature, RS-422

M-531.DD1
High-precision linear stage; DC motor with ActiveDrive; 306 mm travel range; 1000 N load capacity; 50 mm/s maximum velocity; ball screw; incremental linear encoder, 50 nm sensor resolution, A/B quadrature, RS-422

M-531.DD2
High-precision linear stage; DC motor with ActiveDrive; 306 mm travel range; 1000 N load capacity; 50 mm/s maximum velocity; ball screw; incremental linear encoder, 50 nm sensor resolution, A/B quadrature, RS-422; electromagnetic safety brake

M-531.DG1
High-precision linear stage; DC gear motor; 306 mm travel range; 1000 N load capacity; 6 mm/s maximum velocity; ball screw; incremental rotary encoder, 2048 counts/rev sensor resolution, A/B quadrature, RS-422

Order Information

M-531.EC
High-precision linear stage; brushless DC motor; 306 mm travel range; 1000 N load capacity; 100 mm/s maximum velocity; ball screw; incremental rotary encoder, 4096 counts/rev sensor resolution, A/B quadrature, RS-422

M-531.PD1
High-precision linear stage; DC motor with ActiveDrive; 306 mm travel range; 1000 N load capacity; 100 mm/s maximum velocity; ball screw; incremental rotary encoder, 4096 counts/rev sensor resolution, A/B quadrature, RS-422

M-531.PG1
High-precision linear stage; DC gear motor with ActiveDrive; 306 mm travel range; 1000 N load capacity; 6 mm/s maximum velocity; ball screw; incremental rotary encoder, 2048 counts/rev sensor resolution, A/B quadrature, RS-422