Precision Linear Stage

Compact Design, for Loads to 10 kg

L-509

- Travel ranges from 26 to 102 mm (1" to 4")
- Repeatability to 0.1 µm
- Optional with linear encoder for direct position measuring
- ActiveDrive DC, BLDC, DC gearhead, DC motor, stepper motor
- Direction-sensing reference switch
- Variants suitable for vacuum available

Product overview
High travel accuracy and load capacity due to crossed roller guides with anti-creep system. Precision ball screw with 1 mm pitch. Compact design. Stress-relieved aluminum base for high stability. Noncontact optical limit switches. Noncontact optical reference switch with direction sensing in the middle of the travel range.

Motor types available
- DC motor
- ActiveDrive DC motor for high velocity: Control via pulse-width-modulated (PWM) signals, the operating voltage is achieved via an amplifier integrated in the motor housing
- DC servo motor with gearhead for high torques and resolution at low motor power
- 2-phase stepper motor for low velocity and high resolution
- Brushless DC motor: For applications with a high duty cycle. Use a controller with sine commutation for an exceptionally smooth synchronous motion and low vibrations even at a very low velocity.

Types of position measuring
- Without encoder (open loop)
- Integrated rotary encoder on the motor shaft
- Incremental linear encoder

Highly accurate position measuring with incremental linear encoder
Noncontact optical linear encoders measure the position directly at the platform with the greatest accuracy. Nonlinearity, mechanical play or elastic deformation have no influence on the measurement.

Application fields
Autofocus. Laser cutting. Research. Biotechnology. Automation. Optical alignment.

Motion	Unit	Tolerance	L-509.023111	L-509.033111	L-509.053111	L-509.023132	L-509.033132	L-509.053132	L-509.025132	L-509.035132
Active axes			X	X	X	X	X	X	X	X
Travel range in X	mm		26	52	102	26	52	102	26	52
Maximum velocity in X, unloaded	mm/s		50	50	50	50	50	50	50	50
Straightness error E_YX (straightness)	µm	Typ.	±1	±2	±4	±1	±2	±4	±1	±2
Straightness error E_ZX (flatness)	µm	Typ.	±1	±2	±4	±1	±2	±4	±1	±2
Angular error E_BX (pitch)	µrad	Typ.	±60	±90	±120	±60	±90	±120	±60	±90
Angular error E_CX (yaw)	µrad	Typ.	±60	±90	±120	±60	±90	±120	±60	±90

Positioning	Unit	Tolerance	L-509.023111	L-509.033111	L-509.053111	L-509.023132	L-509.033132	L-509.053132	L-509.025132	L-509.035132
Minimum incremental motion in X	µm	Typ.	0.1	0.1	0.1	0.5	0.5	0.5	0.5	0.5
Unidirectional repeatability in X	µm	Typ.	±0.05	±0.05	±0.05	±0.1	±0.1	±0.1	±0.1	±0.1
Bidirectional repeatability in X	µm	Typ.	0.4	0.4	0.4	1	1	1	1	1
Reference switch			Optical	Optical	Optical	Optical	Optical	Optical	Optical	Optical
Limit switches			Optical	Optical	Optical	Optical	Optical	Optical	Optical	Optical
Integrated sensor			Incremental linear encoder	Incremental linear encoder	Incremental linear encoder	Incremental rotary encoder	Incremental rotary encoder	Incremental rotary encoder	Incremental rotary encoder	Incremental rotary encoder
Sensor signal			Sin/cos, 1 V peak-peak	Sin/cos, 1 V peak-peak	Sin/cos, 1 V peak-peak	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 signal period	µm		20	20	20	—	—	—	—	—

Drive Properties	Unit	Tolerance	L-509.023111	L-509.033111	L-509.053111	L-509.023132	L-509.033132	L-509.053132	L-509.025132	L-509.035132
Drive type			DC motor	DC motor	DC motor	DC motor	DC motor	DC motor	Brushless DC motor	Brushless DC motor
Nominal voltage	V		24	24	24	24	24	24	24	24
Peak voltage	V		48	48	48	48	48	48	48	48
Maximum power consumption	W		—	—	—	—	—	—	—	—
Motor resolution	Full steps/rev.		—	—	—	—	—	—	—	—
Drive force in positive direction of motion in X	N	Typ.	60	60	60	60	60	60	60	60
Drive force in negative direction of motion in X	N	Typ.	60	60	60	60	60	60	60	60
Resistance phase-phase	Ω	Typ.	—	—	—	—	—	—	0.81	0.81
Inductance phase-phase	mH		—	—	—	—	—	—	0.64	0.64
Back EMF, phase-phase, rotational	V/kRPM	Max.	—	—	—	—	—	—	3.3	3.3
Number of pole pairs			—	—	—	—	—	—	7	7

Mechanical Properties	Unit	Tolerance	L-509.023111	L-509.033111	L-509.053111	L-509.023132	L-509.033132	L-509.053132	L-509.025132	L-509.035132
Permissible push force in Y	N	Max.	50	50	50	50	50	50	50	50
Permissible push force in Z	N	Max.	100	100	100	100	100	100	100	100
Permissible torque in θX	N·m	Max.	30	30	30	30	30	30	30	30
Permissible torque in θY	N·m	Max.	25	25	25	25	25	25	25	25
Permissible torque in θZ	N·m	Max.	20	20	20	20	20	20	20	20
Holding force in X, passive	N		—	—	—	—	—	—	—	—
Moved mass in X, unloaded	g		240	240	250	220	220	220	220	220
Drive screw type			Ball screw	Ball screw	Ball screw	Ball screw	Ball screw	Ball screw	Ball screw	Ball screw
Drive screw pitch	mm		1	1	1	1	1	1	1	1
Gear ratio i			—	—	—	—	—	—	—	—
Guide			Crossed roller guide	Crossed roller guide	Crossed roller guide	Crossed roller guide	Crossed roller guide	Crossed roller guide	Crossed roller guide	Crossed roller guide
Overall mass	g		1200	1300	1500	1200	1300	1500	1400	1500
Material			Aluminum, steel	Aluminum, steel	Aluminum, steel	Aluminum, steel	Aluminum, steel	Aluminum, steel	Aluminum, steel	Aluminum, steel

Miscellaneous	Unit		L-509.023111	L-509.033111	L-509.053111	L-509.023132	L-509.033132	L-509.053132	L-509.025132	L-509.035132
Operating temperature range	°C		5 to 40	5 to 40	5 to 40	5 to 40	5 to 40	5 to 40	5 to 40	5 to 40
Connector			HD D-sub 26 (m)	HD D-sub 26 (m)	HD D-sub 26 (m)	HD D-sub 26 (m)	HD D-sub 26 (m)	HD D-sub 26 (m)	HD D-sub 26 (m)	HD D-sub 26 (m)
Sensor connector			D-sub 9 (m)	D-sub 9 (m)	D-sub 9 (m)	—	—	—	—	—
Recommended controllers / drivers			C-863 C-885 with C-863.20C885 C-884 G-901 G-910	C-863 C-885 with C-863.20C885 C-884 G-901 G-910	C-863 C-885 with C-863.20C885 C-884 G-901 G-910	C-863 C-885 with C-863.20C885 C-884 G-901 G-910	C-863 C-885 with C-863.20C885 C-884 G-901 G-910	C-863 C-885 with C-863.20C885 C-884 G-901 G-910	C-891 C-885 with C-891.11C885 G-901 G-910	C-891 C-885 with C-891.11C885 G-901 G-910

Motion	Unit	Tolerance	L-509.055132	L-509.10DG10	L-509.20DG10	L-509.40DG10	L-509.10SD00	L-509.20SD00	L-509.40SD00	L-509.1ASD00
Active axes			X	X	X	X	X	X	X	X
Travel range in X	mm		102	26	52	102	26	52	102	26
Maximum velocity in X, unloaded	mm/s		50	3	3	3	20	20	20	20
Straightness error E_YX (straightness)	µm	Typ.	±4	±1	±2	±4	±1	±2	±4	±1
Straightness error E_ZX (flatness)	µm	Typ.	±4	±1	±2	±4	±1	±2	±4	±1
Angular error E_BX (pitch)	µrad	Typ.	±120	±60	±90	±120	±60	±90	±120	±60
Angular error E_CX (yaw)	µrad	Typ.	±120	±60	±90	±120	±60	±90	±120	±60

Positioning	Unit	Tolerance	L-509.055132	L-509.10DG10	L-509.20DG10	L-509.40DG10	L-509.10SD00	L-509.20SD00	L-509.40SD00	L-509.1ASD00
Minimum incremental motion in X	µm	Typ.	0.5	0.1	0.1	0.1	0.1	0.1	0.1	0.02
Unidirectional repeatability in X	µm	Typ.	±0.1	±0.2	±0.2	±0.2	±0.15	±0.15	±0.15	±0.05
Bidirectional repeatability in X	µm	Typ.	1	6	6	6	2	2	2	0.4
Reference switch			Optical	Optical	Optical	Optical	Optical	Optical	Optical	Optical
Limit switches			Optical	Optical	Optical	Optical	Optical	Optical	Optical	Optical
Integrated sensor			Incremental rotary encoder	Incremental rotary encoder	Incremental rotary encoder	Incremental rotary encoder	—	—	—	Incremental linear encoder
Sensor signal			A/B quadrature, RS-422	A/B quadrature, RS-422	A/B quadrature, RS-422	A/B quadrature, RS-422	—	—	—	Sin/cos, 1 V peak-peak
Sensor signal period	µm		—	—	—	—	—	—	—	20

Drive Properties	Unit	Tolerance	L-509.055132	L-509.10DG10	L-509.20DG10	L-509.40DG10	L-509.10SD00	L-509.20SD00	L-509.40SD00	L-509.1ASD00
Drive type			Brushless DC motor	DC gear motor	DC gear motor	DC gear motor	2-phase stepper motor	2-phase stepper motor	2-phase stepper motor	2-phase stepper motor
Nominal voltage	V		24	24	24	24	24	24	24	24
Peak voltage	V		48	48	48	48	48	48	48	48
Maximum power consumption	W		—	8.5	8.5	8.5	10	10	10	10
Motor resolution	Full steps/rev.		—	—	—	—	200	200	200	200
Drive force in positive direction of motion in X	N	Typ.	60	60	60	60	60	60	60	60
Drive force in negative direction of motion in X	N	Typ.	60	60	60	60	60	60	60	60
Resistance phase-phase	Ω	Typ.	0.81	4.09	4.09	4.09	3.3	3.3	3.3	3.3
Inductance phase-phase	mH		0.64	0.18	0.18	0.18	2.8	2.8	2.8	2.8
Back EMF, phase-phase, rotational	V/kRPM	Max.	3.3	1.68	1.68	1.68	—	—	—	—
Number of pole pairs			7	—	—	—	—	—	—	—

Mechanical Properties	Unit	Tolerance	L-509.055132	L-509.10DG10	L-509.20DG10	L-509.40DG10	L-509.10SD00	L-509.20SD00	L-509.40SD00	L-509.1ASD00
Permissible push force in Y	N	Max.	50	50	50	50	50	50	50	50
Permissible push force in Z	N	Max.	100	100	100	100	100	100	100	100
Permissible torque in θX	N·m	Max.	30	30	30	30	30	30	30	30
Permissible torque in θY	N·m	Max.	25	25	25	25	25	25	25	25
Permissible torque in θZ	N·m	Max.	20	20	20	20	20	20	20	20
Holding force in X, passive	N		—	50	50	50	50	50	50	50
Moved mass in X, unloaded	g		220	220	220	220	220	220	220	240
Drive screw type			Ball screw	Ball screw	Ball screw	Ball screw	Ball screw	Ball screw	Ball screw	Ball screw
Drive screw pitch	mm		1	1	1	1	1	1	1	1
Gear ratio i			—	2401 : 81	2401 : 81	2401 : 81	—	—	—	—
Guide			Crossed roller guide	Crossed roller guide	Crossed roller guide	Crossed roller guide	Crossed roller guide	Crossed roller guide	Crossed roller guide	Crossed roller guide
Overall mass	g		1700	1400	1600	1900	1400	1500	1700	1400
Material			Aluminum, steel	Aluminum, steel	Aluminum, steel	Aluminum, steel	Aluminum, steel	Aluminum, steel	Aluminum, steel	Aluminum, steel

Miscellaneous	Unit		L-509.055132	L-509.10DG10	L-509.20DG10	L-509.40DG10	L-509.10SD00	L-509.20SD00	L-509.40SD00	L-509.1ASD00
Operating temperature range	°C		5 to 40	5 to 40	5 to 40	5 to 40	5 to 40	5 to 40	5 to 40	5 to 40
Connector			HD D-sub 26 (m)	HD D-sub 26 (m)	HD D-sub 26 (m)	HD D-sub 26 (m)	HD D-sub 26 (m)	HD D-sub 26 (m)	HD D-sub 26 (m)	HD D-sub 26 (m)
Sensor connector			—	—	—	—	—	—	—	D-sub 9 (m)
Recommended controllers / drivers			C-891 C-885 with C-891.11C885 G-901 G-910	C-863 C-885 with C-863.20C885 C-884 G-901 G-910	C-863 C-885 with C-863.20C885 C-884 G-901 G-910	C-863 C-885 with C-863.20C885 C-884 G-901 G-910	C-663.12 C-885 with C-663.12C885 G-901 G-910	C-663.12 C-885 with C-663.12C885 G-901 G-910	C-663.12 C-885 with C-663.12C885 G-901 G-910	C-663.12 C-885 with C-663.12C885 G-901 G-910

Motion	Unit	Tolerance	L-509.2ASD00	L-509.4ASD00
Active axes			X	X
Travel range in X	mm		52	102
Maximum velocity in X, unloaded	mm/s		20	20
Straightness error E_YX (straightness)	µm	Typ.	±2	±4
Straightness error E_ZX (flatness)	µm	Typ.	±2	±4
Angular error E_BX (pitch)	µrad	Typ.	±90	±120
Angular error E_CX (yaw)	µrad	Typ.	±90	±120

Positioning	Unit	Tolerance	L-509.2ASD00	L-509.4ASD00
Minimum incremental motion in X	µm	Typ.	0.02	0.02
Unidirectional repeatability in X	µm	Typ.	±0.05	±0.05
Bidirectional repeatability in X	µm	Typ.	0.4	0.4
Reference switch			Optical	Optical
Limit switches			Optical	Optical
Integrated sensor			Incremental linear encoder	Incremental linear encoder
Sensor signal			Sin/cos, 1 V peak-peak	Sin/cos, 1 V peak-peak
Sensor signal period	µm		20	20

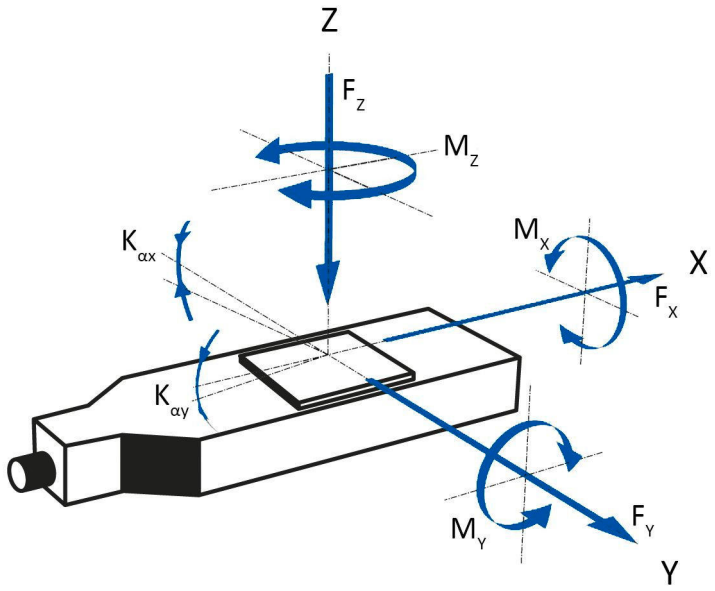
Drive Properties	Unit	Tolerance	L-509.2ASD00	L-509.4ASD00
Drive type			2-phase stepper motor	2-phase stepper motor
Nominal voltage	V		24	24
Peak voltage	V		48	48
Maximum power consumption	W		10	10
Motor resolution	Full steps/rev.		200	200
Drive force in positive direction of motion in X	N	Typ.	60	60
Drive force in negative direction of motion in X	N	Typ.	60	60
Resistance phase-phase	Ω	Typ.	3.3	3.3
Inductance phase-phase	mH		2.8	2.8
Back EMF, phase-phase, rotational	V/kRPM	Max.	—	—
Number of pole pairs			—	—

Mechanical Properties	Unit	Tolerance	L-509.2ASD00	L-509.4ASD00
Permissible push force in Y	N	Max.	50	50
Permissible push force in Z	N	Max.	100	100
Permissible torque in θX	N·m	Max.	30	30
Permissible torque in θY	N·m	Max.	25	25
Permissible torque in θZ	N·m	Max.	20	20
Holding force in X, passive	N		50	50
Moved mass in X, unloaded	g		240	250
Drive screw type			Ball screw	Ball screw
Drive screw pitch	mm		1	1
Gear ratio i			—	—
Guide			Crossed roller guide	Crossed roller guide
Overall mass	g		1600	1800
Material			Aluminum, steel	Aluminum, steel

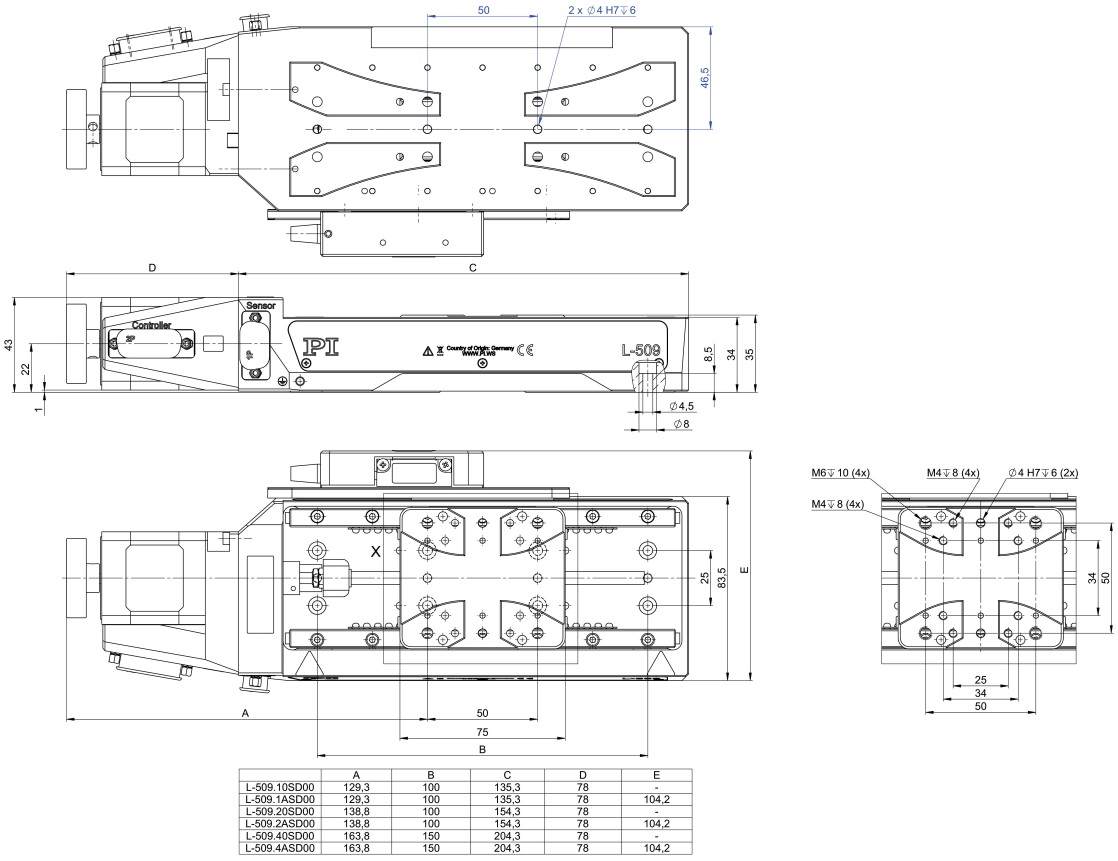
Miscellaneous	Unit		L-509.2ASD00	L-509.4ASD00
Operating temperature range	°C		5 to 40	5 to 40
Connector			HD D-sub 26 (m)	HD D-sub 26 (m)
Sensor connector			D-sub 9 (m)	D-sub 9 (m)
Recommended controllers / drivers			C-663.12 C-885 with C-663.12C885 G-901 G-910	C-663.12 C-885 with C-663.12C885 G-901 G-910

At PI, technical data is specified at 22 ±3 °C. Unless otherwise stated, the values are for unloaded conditions. Some properties are interdependent. The designation "typ." indicates a statistical average for a property; it does not indicate a guaranteed value for every product supplied. During the final inspection of a product, only selected properties are analyzed, not all. Please note that some product characteristics may deteriorate with increasing operating time.

Drawings / Images



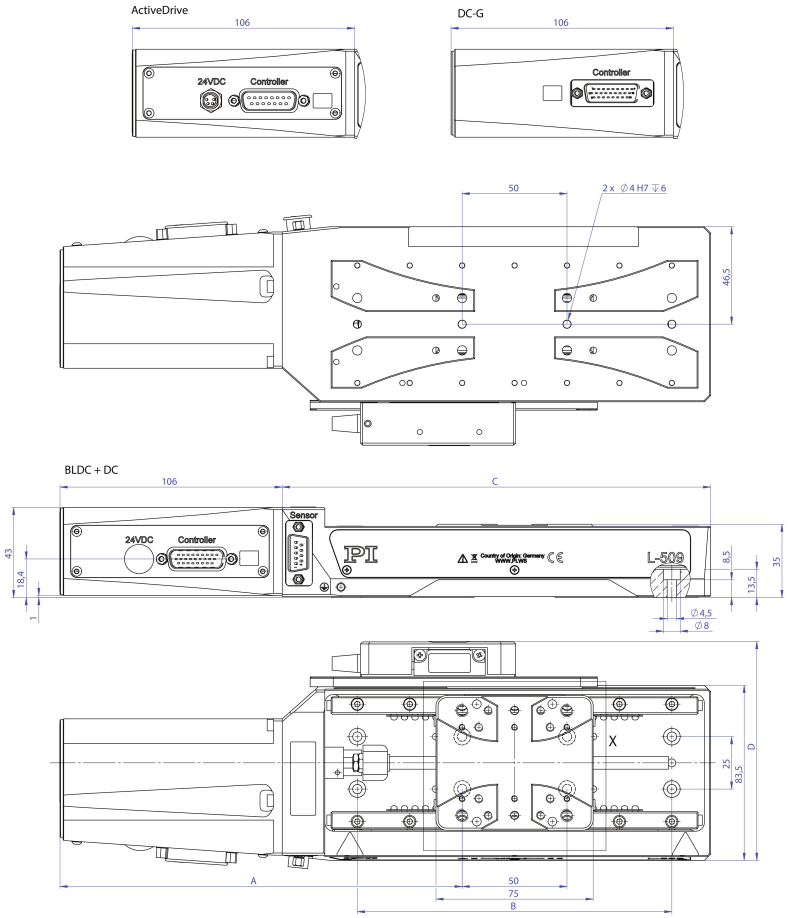
Direction of the axes and torques for linear stages



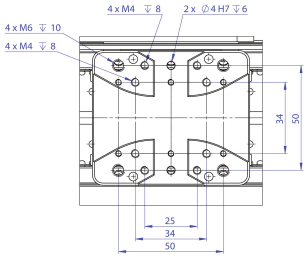
	A	B	C	D	E
L-509.10SD00	129,3	100	135,3	78	-
L-509.1ASD00	129,3	100	135,3	78	104,2
L-509.20SD00	138,8	100	154,3	78	-
L-509.2ASD00	138,8	100	154,3	78	104,2
L-509.40SD00	163,8	150	204,3	78	-
L-509.4ASD00	163,8	150	204,3	78	104,2

L-509 models with stepper motor, dimensions in mm

Drawings / Images

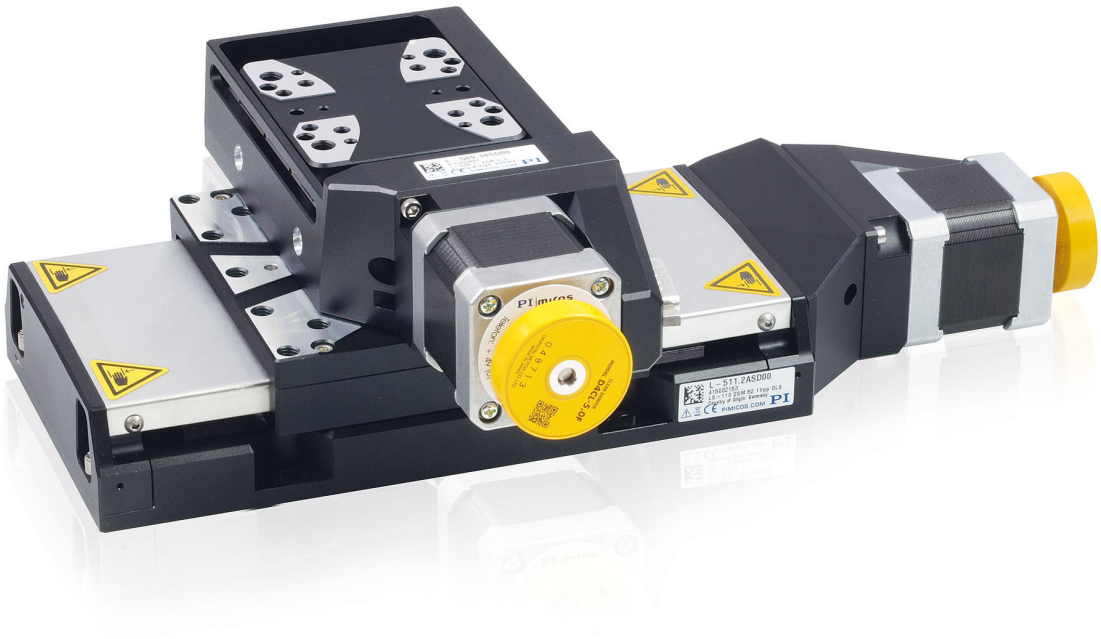


	A	B	C	D
BLDC + DC				
L-509.023111	157,3	100	135,3	104,2
L-509.023132	157,3	100	135,3	-
L-509.025132	157,3	100	135,3	-
L-509.033111	166,8	100	154,3	104,2
L-509.033132	166,8	100	154,3	-
L-509.035132	166,8	100	154,3	-
L-509.053111	191,8	150	204,3	104,2
L-509.053132	191,8	150	204,3	-
L-509.055132	191,8	150	204,3	-
ActiveDrive DC				
L-509.10AD10	157,3	100	135,3	-
L-509.14AD00	157,3	100	135,3	104,2
L-509.20AD10	166,8	100	154,3	-
L-509.24AD00	166,8	100	154,3	104,2
L-509.40AD10	191,8	150	204,3	-
L-509.44AD00	191,8	150	204,3	104,2
DC-G				
L-509.10DG10	157,3	100	135,3	-
L-509.20DG10	166,8	100	154,3	-
L-509.40DG10	191,8	150	204,3	-



L-509 models with BLDC, DC gearhead, and ActiveDrive DC motors, dimensions in mm

Drawings / Images



L-511 and L-509 precision stages can be combined without adapter plate for multi-axis positioning

Drawings / Images

Multi-axis setup with L-511 (horizontal) and L-509 (vertical) precision stages

Order Information

L-509.023111
Precision linear stage; DC motor; 26 mm travel range; 100 N load capacity; 50 mm/s maximum velocity; ball screw; incremental linear encoder, 20 µm sensor signal period, sin/cos, 1 V peak-peak

L-509.033111
Precision linear stage; DC motor; 52 mm travel range; 100 N load capacity; 50 mm/s maximum velocity; ball screw; incremental linear encoder, 20 µm sensor signal period, sin/cos, 1 V peak-peak

L-509.053111
Precision linear stage; DC motor; 102 mm travel range; 100 N load capacity; 50 mm/s maximum velocity; ball screw; incremental linear encoder, 20 µm sensor signal period, sin/cos, 1 V peak-peak

L-509.023132
Precision linear stage; DC motor; 26 mm travel range; 100 N load capacity; 50 mm/s maximum velocity; ball screw; incremental rotary encoder, A/B quadrature, RS-422

L-509.033132
Precision linear stage; DC motor; 52 mm travel range; 100 N load capacity; 50 mm/s maximum velocity; ball screw; incremental rotary encoder, A/B quadrature, RS-422

L-509.053132
Precision linear stage; DC motor; 102 mm travel range; 100 N load capacity; 50 mm/s maximum velocity; ball screw; incremental rotary encoder, A/B quadrature, RS-422

L-509.025132
Precision linear stage; brushless DC motor; 26 mm travel range; 100 N load capacity; 50 mm/s maximum velocity; ball screw; incremental rotary encoder, 20000 counts/rev sensor resolution, A/B quadrature, RS-422

L-509.035132
Precision linear stage; brushless DC motor; 52 mm travel range; 100 N load capacity; 50 mm/s maximum velocity; ball screw; incremental rotary encoder, 20000 counts/rev sensor resolution, A/B quadrature, RS-422

L-509.055132
Precision linear stage; brushless DC motor; 102 mm travel range; 100 N load capacity; 50 mm/s maximum velocity; ball screw; incremental rotary encoder, 20000 counts/rev sensor resolution, A/B quadrature, RS-422

L-509.10DG10
Precision linear stage; DC gear motor; 26 mm travel range; 100 N load capacity; 3 mm/s maximum velocity; ball screw; incremental rotary encoder, 4096 counts/rev sensor resolution, A/B quadrature, RS-422

L-509.20DG10
Precision linear stage; DC gear motor; 52 mm travel range; 100 N load capacity; 3 mm/s maximum velocity; ball screw; incremental rotary encoder, 4096 counts/rev sensor resolution, A/B quadrature, RS-422

L-509.40DG10
Precision linear stage; DC gear motor; 102 mm travel range; 100 N load capacity; 3 mm/s maximum velocity; ball screw; incremental rotary encoder, 4096 counts/rev sensor resolution, A/B quadrature, RS-422

Order Information

L-509.10SD00
Precision linear stage; 2-phase stepper motor; 26 mm travel range; 100 N load capacity; 20 mm/s maximum velocity; ball screw

L-509.20SD00
Precision linear stage; 2-phase stepper motor; 52 mm travel range; 100 N load capacity; 20 mm/s maximum velocity; ball screw

L-509.40SD00
Precision linear stage; 2-phase stepper motor; 102 mm travel range; 100 N load capacity; 20 mm/s maximum velocity; ball screw

L-509.1ASD00
Precision linear stage; 2-phase stepper motor; 26 mm travel range; 100 N load capacity; 20 mm/s maximum velocity; ball screw; incremental linear encoder, 20 µm sensor signal period, sin/cos, 1 V peak-peak

L-509.2ASD00
Precision linear stage; 2-phase stepper motor; 52 mm travel range; 100 N load capacity; 20 mm/s maximum velocity; ball screw; incremental linear encoder, 20 µm sensor signal period, sin/cos, 1 V peak-peak

L-509.4ASD00
Precision linear stage; 2-phase stepper motor; 102 mm travel range; 100 N load capacity; 20 mm/s maximum velocity; ball screw; incremental linear encoder, 20 µm sensor signal period, sin/cos, 1 V peak-peak