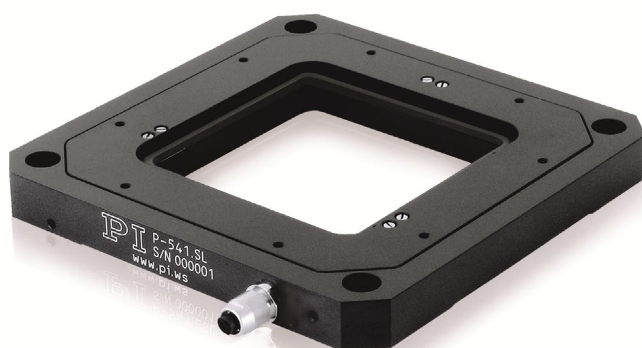
XY Piezo Stage

Low-Profile XY Nanopositioning System with Large Aperture



P-541.2 • P-542.2

- Low profile for easy integration: 16.5 mm
- Aperture 80 mm × 80 mm
- Travel range to 200 µm × 200 µm
- Parallel kinematics for faster response times and higher multi-axis accuracy
- High dynamics direct-drive version
- Sensor technology: Inexpensive strain gauge sensors or capacitive sensors for higher performance
- Outstanding lifetime due to PICMA® piezo actuators
- Combination possible with microscope stages for longer travel ranges

Fields of application

- Scanning microscopy
- High-throughput microscopy
- Super-resolution microscopy
- Mask/wafer positioning
- Interferometry
- Measuring technology
- Biotechnology
- Micromanipulation

Outstanding lifetime thanks to PICMA® piezo actuators

The patented PICMA® piezo actuators are all-ceramic insulated. This protects them against humidity and failure resulting from an increase in leakage current. PICMA® actuators offer an up to ten times longer lifetime than conventional polymer-insulated actuators. 100 billion cycles without a single failure are proven.

Subnanometer resolution with capacitive sensors

Capacitive sensors measure with subnanometer resolution without contacting. They guarantee excellent linearity of motion, long-term stability, and a bandwidth in the kHz range.

High guiding accuracy due to zero-play flexure guides

Flexure guides are free of maintenance, friction, and wear, and do not require lubrication. Their stiffness allows high load capacity and they are insensitive to shock and vibration. They are 100 % vacuum compatible and work in a wide temperature range.

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Automatic configuration and fast component exchange

Mechanics and controllers can be combined as required and exchanged quickly. All servo and linearization parameters are stored in the ID chip of the D-sub connector of the mechanics. The autocalibration function of the digital controllers uses this data each time the controller is switched on.

Maximum accuracy due to direct position measuring

Motion is measured directly at the motion platform without any influence from the drive or guide elements. This allows optimum repeatability, outstanding stability, and stiff, fast-responding control.

High dynamics multi-axis operation due to parallel kinematics

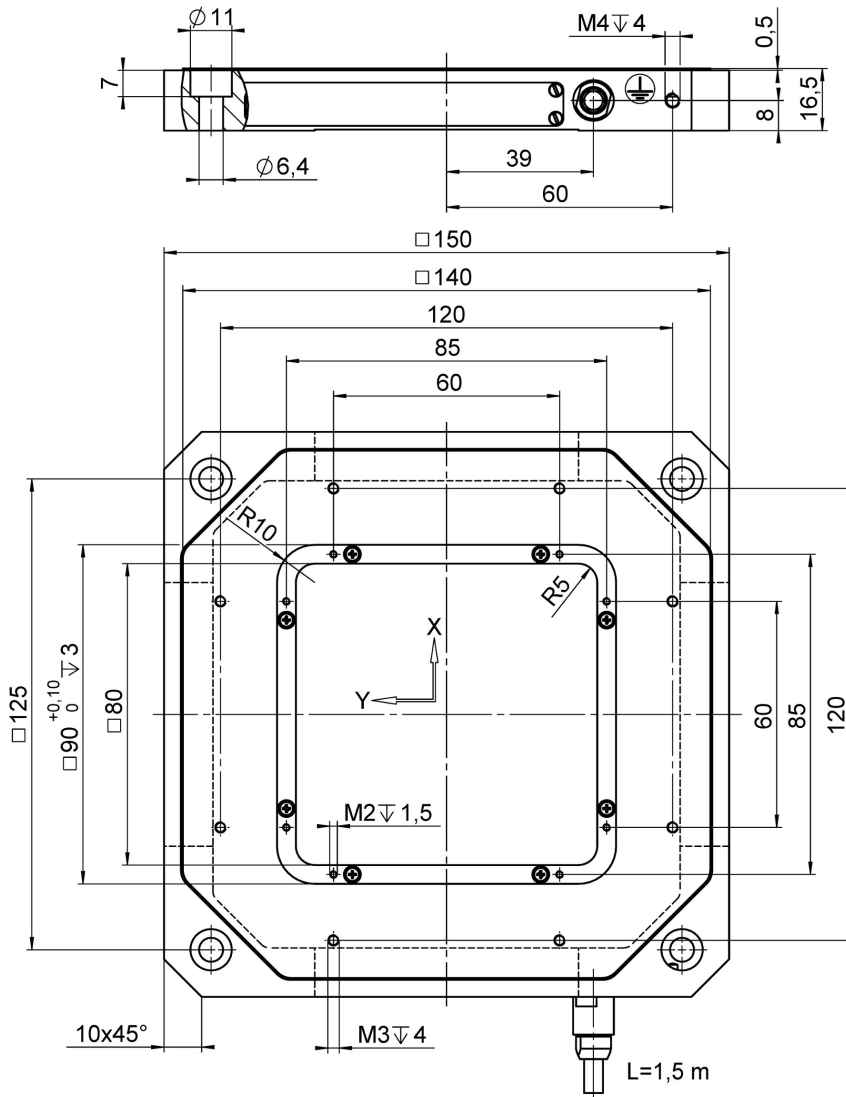
In a parallel-kinematic multi-axis system, all actuators act on a common platform. The minimum mass inertia and the identical design of all axes allow fast, dynamic, and nevertheless precision motion.

Specifications

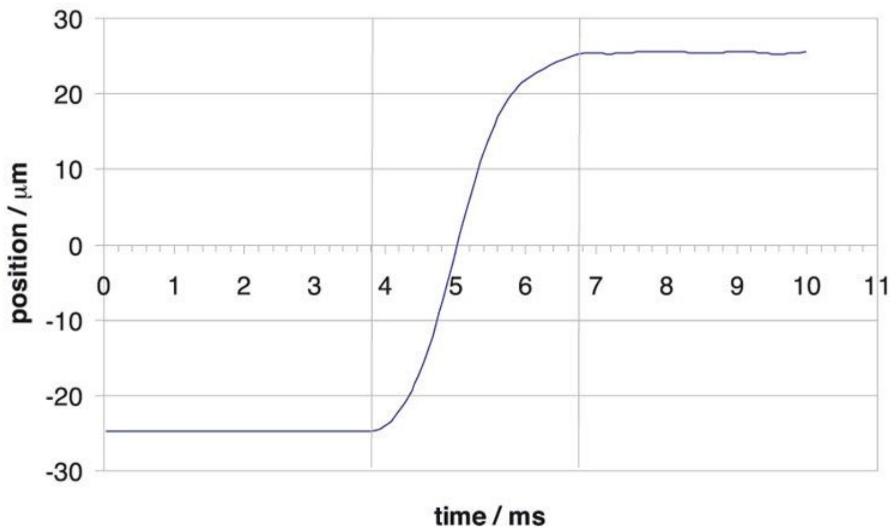
	P-541.2CD / P-541.2CL	P-542.2CD / P-542.2CL	P-541.2DD	P-541.2SL	P-542.2SL	P-541.20L / P-542.20L	Unit	Tolerance
Active axes	X, Y	X, Y	X, Y	X, Y	X, Y	X, Y		
Motion and positioning								
Integrated sensor	Capacitive	Capacitive	Capacitive	SGS	SGS	–		
Travel range at -20 to +120 V, open loop	150 µm × 150 µm	250 µm × 250 µm	60 µm × 60 µm	150 µm × 150 µm	250 µm × 250 µm	see P-541.2CD / P-542.2CD		+20 % / -0 %
Travel range, closed loop	100 µm × 100 µm	200 µm × 200 µm	45 µm × 45 µm	100 µm × 100 µm	200 µm × 200 µm	–		
Resolution, open loop / closed loop	0.2 / 0.3	0.4 / 0.7	0.1 / 0.3	0.2 / 2.5	0.4 / 4	open-loop 0.2 / 0.4	nm	typ.
Linearity error	0.03	0.03	0.03*	0.2	0.2	–	%	typ.
Repeatability	<5	<5	<5	<10	<10	–	nm	typ.
Pitch	<5	<5	<3	<5	<5	<5	µrad	typ.
Yaw	<10	<10	<3	<10	<10	<10	µrad	typ.
Mechanical properties								
Stiffness in motion direction	0.47	0.4	10	0.47	0.4	0.47 / 0.4	N/µm	±20 %
Resonant frequency, no load	255	230	1550	255	230	255 / 230	Hz	±20 %
Resonant frequency, under load, 100 g	200	190	–	200	190	200 / 190	Hz	±20 %
Resonant frequency, under load, 200 g	180	–	1230	180	–	180 / –	Hz	±20 %
Resonant frequency, under load, 300 g	150	145	–	150	145	150 / 145	Hz	±20 %
Push/pull force capacity in motion direction	100 / 30	100 / 30	100 / 30	100 / 30	100 / 30	100 / 30	N	max.
Load capacity	20	20	20	20	20	20	N	max.
Drive properties								
Piezo ceramic	PICMA® P-885	PICMA® P-885	PICMA® P-885	PICMA® P-885	PICMA® P-885	PICMA® P-885		
Electrical capacitance per axis	4.2	7.5	9	4.2	7.5	4.2 / 7.5	µF	±20 %
Miscellaneous								
ID chip functionality	P-541.2CD	P-542.2CD	Yes	–	–	–		
Operating temperature range	-20 to 80	-20 to 80	-20 to 80	-20 to 80	-20 to 80	-20 to 80	°C	
Material	Aluminum	Aluminum	Aluminum	Aluminum	Aluminum	Aluminum		
Mass	0.75	0.75	0.75	0.73	0.73	0.7	kg	±5 %
Cable length	1.5	1.5	1.5	1.5	1.5	1.5	m	±10 mm
Sensor / voltage connection	CD versions: D-sub 25W3 (m) CL versions: LEMO	CD versions: D-sub 25W3 (m) CL versions: LEMO	D-sub 25W3 (m)	LEMO	LEMO	LEMO (no sensor)		
Recommended electronics	E-503, E-505, E-621, E-712, E-727	E-503, E-505, E-621, E-712, E-727	E-503, E-505, E-621, E-712, E-727	E-503, E-505, E-621, E-712, E-727	E-503, E-505, E-621, E-712, E-727	E-503, E-505, E-621, E-712, E-727		

* With digital controller. With analog controllers, the typical linearity error for direct drive positioners can be up to 0.1 %.
The resolution of the system is limited only by the noise of the amplifier and the measuring technology because PI piezo nanopositioning systems are free of friction.
All specifications based on room temperature (22 °C ±3 °C).

Drawings / Images



P-541.2 • P-542.2, dimensions in mm



The P-541.2DD has a settling time of only 3 ms for a 50-µm step.

PI

Ordering Information

P-541.2DD
XY nanopositioning system with large aperture, high dynamics direct drive, 45 µm × 45 µm, parallel kinematics, capacitive sensors, D-sub connector

P-541.2CD
XY nanopositioning system with large aperture, 100 µm × 100 µm, parallel kinematics, capacitive sensors, D-sub connector

P-541.2CL
XY nanopositioning system with large aperture, 100 µm × 100 µm, parallel kinematics, capacitive sensors, LEMO connectors

P-542.2CD
XY nanopositioning system with large aperture, 200 µm × 200 µm, parallel kinematics, capacitive sensors, D-sub connector

P-542.2CL
XY nanopositioning system with large aperture, 200 µm × 200 µm, parallel kinematics, capacitive sensors, LEMO connectors

P-541.2SL
XY nanopositioning system with large aperture, 100 µm × 100 µm, strain gauge sensors, LEMO connectors

P-542.2SL
XY nanopositioning system with large aperture, 200 µm × 200 µm, strain gauge sensors, LEMO connectors

P-541.20L
XY nanopositioning system with large aperture, 100 µm × 100 µm, without sensors, LEMO connectors

P-542.20L
XY nanopositioning system with large aperture, 200 µm × 200 µm, without sensors, LEMO connectors

Accessories

P-542.PD1
Petri dish holder for P-54x nanopositioning systems, 35 mm

P-542.SH1
Microscope slide holder for P-54x nanopositioning systems