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PIMars™ XYZ Piezo Scanning- and Nanopositioning Stages with Parallel Metrology

>> Click http://www.pi.ws/fwd/Piezo-Stage for the Latest Specs on these Products

P-562.3CD PIMars™ Nanopositioning stage: 200 µm x 200 µm x 200 µm travel.

- **To 300 x 300 x 300 µm Travel Range**
- **Parallel-Kinematics/Metrology for Enhanced Responsiveness / Multi-Axis Precision**
- **Direct Metrology with Capacitive Sensors for Highest Precision**
- **66 x 66 mm Clear Aperture**
- **Versions to 6-DOF**
- **Ultra-Fast XY and XYZ Versions Available**
- **Ultra-High-Vacuum Versions up to 10^{-9} hPa Available**
- **Invar, Super-Invar and Titanium Versions Available**
- **PICMA® High-Performance Piezo Drives**

Large Variety of Models and Options

PIMars™ open-frame piezo stages are fast and highly accurate multi-axis scanning and nanopositioning systems offered in a large variety of configurations. Standard models include long-travel systems (to 300 x 300 x 300 µm), high-speed and vacuum versions. Custom six-axis designs with rotation to 6 mrad are available on request. All PIMars™ piezo stages are equipped with ultra-precise guiding systems for multi-axis motion with flatness and straightness in the nanometer range.

Higher Precision Through Parallel Kinematics/Metrology

P-560 series piezo stages feature a parallel-kinematics design with direct-measuring, non-contact capacitive position sensors (parallel, direct metrology). PI capacitive sensors are absolute-measuring devices that boast very high bandwidth and exhibit no periodic errors.

Unlike conventional sensors, capacitive sensors measure the actual distance between the fixed frame and the moving part of the stage. They detect errors contributed by all components in the drive train—from the actuator through the flexures to the platform. This results in higher motion linearity, long-term stability, phase fidelity, and—because external disturbances are seen by the sensor immediately—a stiffer, faster-responding servo-loop. See p. 2-4 *ff.* and p. 5-2 *ff.* for more information.

Parallel kinematics means that all actuators act directly on the same moving platform leading to reduced size, inertia and the elimination of microfriction caused by moving cables. The advantages are enhanced dynamics, higher scanning rates, and better reproducibility.

With parallel metrology, all sensors measure the position of the same moving platform against the same stationary reference (the fixed frame). This means that—in contrast to serial metrology—all motion is inside the servo-loop, no matter which actuator may have caused it, resulting in superior multi-axis precision (Active Trajectory Control).

Dynamic Digital Control for Best Scanning Linearity

Use our new digital control electronics with DDL (Dynamic Digital Linearization) to increase linearity and effective bandwidth by up to 1000-fold (see p. 6-16).

Direct Drive for Ultra-Fast Scanning and Positioning

The P-561.2DD and P-561.3DD versions have resonant frequencies of 1.0 to 1.2 kHz, enabling millisecond scanning rates with sub-nanometer resolution over a range of 45 µm x 45 µm (x 15 µm).

Working Principle / Reliability

P-560 nanopositioning stages are equipped with the award winning PICMA® piezo drives, integrated into a sophisticated, single-module, parallel-kinematics, flexure guiding system. The flexures are FEA modeled for zero stiction, zero friction and exceptional guiding precision. The ceramic-encapsulated PICMA® drives are more robust than conventional piezo actuators, featuring superior lifetime and performance in

Application Examples

- Scanning microscopy
- Mask & wafer alignment
- Scanning interferometry
- Surface metrology
- Biotechnology
- Micromanipulation

Ordering Information

P-561.3CD
PIMars™ XYZ Nanopositioning Stage, 100 x 100 x 100 µm, Parallel Metrology

P-562.3CD
PIMars™ XYZ Nanopositioning Stage, 200 x 200 x 200 µm, Parallel Metrology

P-563.3CD
PIMars™ XYZ Nanopositioning Stage, 300 x 300 x 300 µm, Parallel Metrology

P-561.2DD
PIMars™ XY Nanopositioning Stage, 45 x 45 µm, Parallel Metrology, Direct-Drive

P-561.3DD
PIMars™ XYZ Nanopositioning Stage, 45 x 45 x 15 µm, Parallel Metrology

Vacuum Versions:

P-561.3VD
PIMars™ XYZ Nanopositioning Stage, 100 x 100 x 100 µm, Parallel Metrology, 10^{-6} hPa

P-562.3VD
PIMars™ XYZ Nanopositioning Stage, 200 x 200 x 200 µm, Parallel Metrology, 10^{-6} hPa

P-563.3VD
PIMars™ XYZ Nanopositioning Stage, 300 x 300 x 300 µm, Parallel Metrology, 10^{-6} hPa

P-561.3UD
PIMars™ XYZ Nanopositioning Stage, 100 x 100 x 100 µm, Parallel Metrology, 10^{-9} hPa

P-562.3UD
PIMars™ XYZ Nanopositioning Stage, 200 x 200 x 200 µm, Parallel Metrology, 10^{-9} hPa

P-563.3UD
PIMars™ XYZ Nanopositioning Stage, 300 x 300 x 300 µm, Parallel Metrology, 10^{-9} hPa

Further Vacuum Versions Available
Invar, Super-Invar & Titanium Versions Available
6-DOF Versions Available

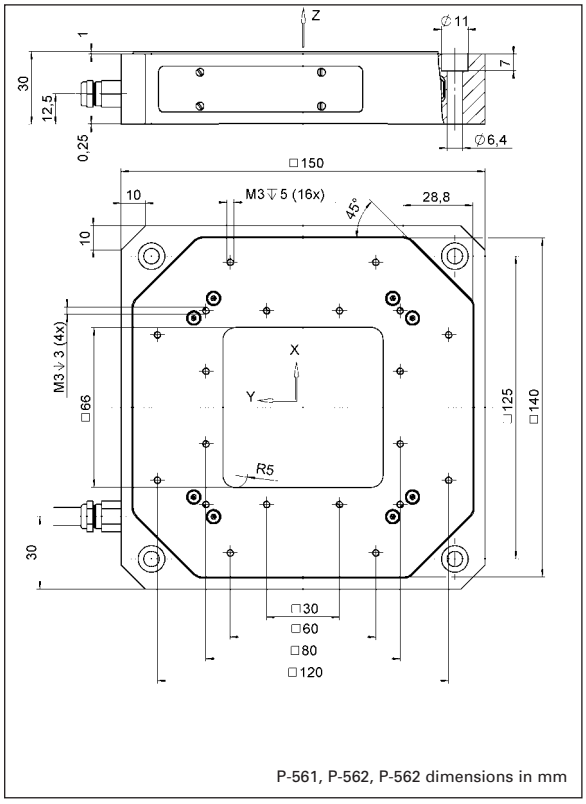
both dynamic and static applications.
Because guidance, actuators and sensors are all frictionless and maintenance-free, these nanopositioning systems achieve outstanding levels of reliability.

Ultra-High-Vacuum Option

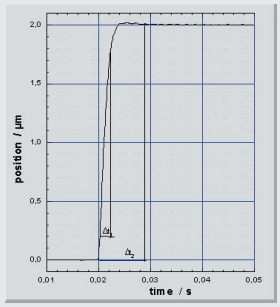
PI offers versions specially designed for applications in ultra-high vacuum (see ordering information). These versions contain vacuum-qualified components only. The integrated ceramic-encapsulated PICMA® actuators allow high bakeout temperatures and assure minimal outgassing rates. A non-magnetizable version is available on request.

Notes

See the "Selection Guide" on p. 2-14 *ff.* for comparison with other nanopositioning systems.



P-561, P-562, P-562 dimensions in mm



P-562.3CD (unloaded) step and settle is faster than 15 ms in X, Y and Z.

Piezo Actuators
Nanopositioning & Scanning Systems
Active Optics / Steering Mirrors
Tutorial: Piezoelectrics in Positioning
Capacitive Position Sensors
Piezo Drivers & Nanopositioning Controllers
Hexapods / Micropositioning
Photonics Alignment Solutions
Motion Controllers
Ceramic Linear Motors & Stages
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Technical Data

Models	P-561.3CD	P-562.3CD	P-563.3CD	P-561.3DD**	Units	Notes see p. 2-84
Active axes	XYZ	XYZ	XYZ	XYZ		
Min. open-loop travel -20 to 120 V	150 x150 x 150	220 x 220 x 220	350 x 350 x 350	55 x 55 x 18	µm	A2
Closed-loop travel	100 x 100 x 100	200 x 200 x 200	300 x 300 x 300	45 x 45 x 15	µm	A5
Integrated feedback sensor	capacitive	capacitive	capacitive	capacitive		B
* Closed-loop / open-loop resolution	0.8 / 0.2	1 / 0.4	1 / 0.7	0.2 / 0.1	nm	C1
Closed-loop linearity (typ.)	0.03	0.03	0.03	0.01	%	
Push force capacity (in X, Y, Z)	200, 200, 50	120, 120, 50	100, 100, 50	200, 200, 50	N	D3
Pull force capacity (in X, Y, Z)	30, 30, 30	30, 30, 30	30, 30, 30	30, 30, 30	N	D3
Max. load	50	50	50	50	N	D4
Electrical capacitance (X, Y, Z)	5.2, 5.2, 10.4	7.2, 7.2, 14.4	7.2, 7.2, 14.4	37.2, 37.2, 6.0	µF ±20%	F1
Dynamic Operating Current Coefficient (X, Y, Z)	5.2, 5.2, 10.4	4.9, 4.9, 9.8	3.1, 3.1, 6.2	103, 103, 50	µA/(Hz x µm)	F2
Resonant frequency unloaded (X, Y, Z)	190, 190, 380	170, 170, 315	120, 120, 240	920, 920, 1050 **	Hz ±20%	G2
Resonant frequency @ 66 g load (X, Y, Z)				800, 800, 1000 **	Hz ±20%	G3
Resonant frequency @ 330 g load (X, Y, Z)	140, 140, 300	140, 140, 195	90, 90, 170	500, 500, 500 **	Hz ±20%	G3
Operating temperature	-20 to 80	-20 to 80	-20 to 80	-20 to 80	°C	H2
Voltage & sensor connection	D	D	D	D		J1 / J2
Body material	Al	Al	Al	Al		L
Recommended amplifier/controller (codes explained p. 2-17)	K, H	K, H	K, H	K, H		

* For calibration information see p. 2-8. Resolution of PI piezo nanopositioners is not limited by friction or stiction. The value given is noise equivalent motion with E-710 digital piezo controller.
** Also available as XY-version (P-561.2DD) with 20% higher resonant frequency.