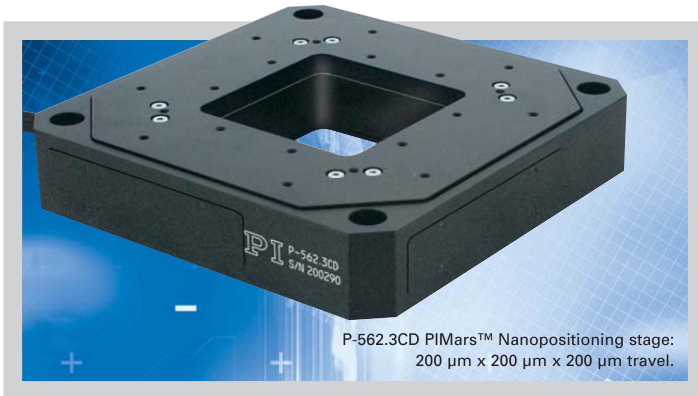
P-561 · P-562 · P-563

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



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.

Application Examples

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

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

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

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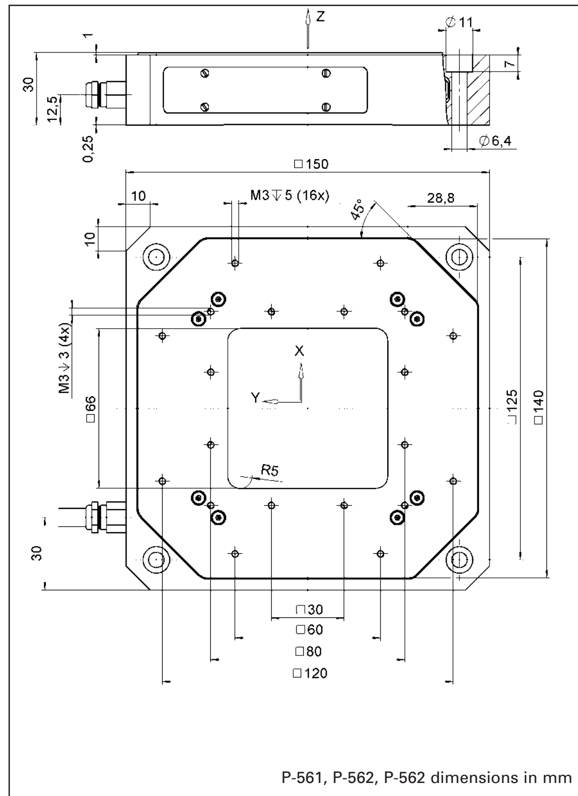
both dynamic and static applications.
Because guidance, actuators and sensors are all frictionless and maintenance-free, these nanopositioning systems achieve outstanding levels of reliability.

Ultra-High-Vacuum Option

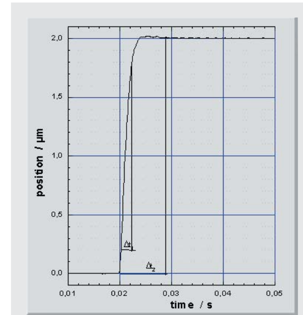
PI offers versions specially designed for applications in ultra-high vacuum (see ordering information). These versions contain vacuum-qualified components only. The integrated ceramic-encapsulated PICMA® actuators allow high bakeout temperatures and assure minimal outgassing rates. A non-magnetizable 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: Piezo-electrics in Positioning
Capacitive Position Sensors
Piezo Drivers & Nano-positioning Controllers
Hexapods / Micropositioning
Photonics Alignment Solutions
Motion Controllers
Ceramic Linear Motors & Stages
Index

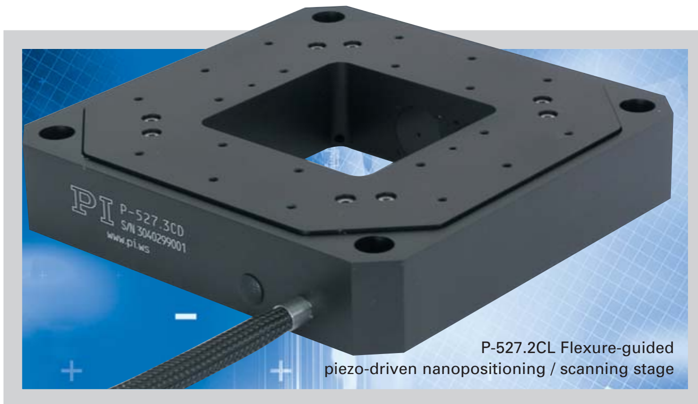
Technical Data

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.

P-517 · P-527

Multi-Axis, Piezo Nanopositioning / Scanning Stages with Parallel Metrology



P-527.2CL Flexure-guided piezo-driven nanopositioning / scanning stage

- **XYθ_Z, XYZ and XY Versions**
- **Precision Trajectory Control**
- **Parallel-Kinematics/Metrology for Enhanced Responsiveness / Multi-Axis Precision**
- **Travel Ranges to 200 µm**
- **Clear Aperture to 66 x 66 mm**
- **PICMA® High-Performance Piezo Drives**

Ordering Information

P-517.2CL
XY Piezo Nanopositioning Stage, 100 x 100 µm, Parallel Metrology, LEMO Connectors

P-527.2CL
XY Piezo Nanopositioning Stage, 200 x 200 µm, Parallel Metrology, LEMO Connectors

P-517.3CL / P-517.3CD *
XYZ Piezo Nanopositioning Stage, 100 x 100 x 20 µm, Parallel Metrology

P-527.3CL / P-527.3CD *
XYZ Piezo Nanopositioning Stage, 200 x 200 x 20 µm, Parallel Metrology

P-517.RCD
X,Y, θ_Z Piezo Nanopositioning Stage, 100 x 100 µm, 2 mrad, Parallel Metrology, Sub-D

P-527.RCD
X,Y, θ_Z Piezo Nanopositioning Stage, 200 x 200 µm, 4 mrad, Parallel Metrology, Sub-D

* .3CL with LEMO Connectors
.3CD with Sub-D Connectors

P-517 and P-527 single-module, multi-axis piezo-nanopositioning stages are available in XY θ_Z, XY and XYZ configurations featuring linear travel ranges to 200 x 200 x 20 µm and rotation ranges to 4 mrad. The 66 x 66 mm clear aperture is ideal for transmitted-light applications. Z/tip/tilt versions in the same form factor are also offered (see the P-528, p. 2-52).

Higher Precision Through Parallel Kinematics/Metrology

P-500 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).

Application Examples

- Biotechnology
- Metrology
- Lithography
- Nanopositioning
- Scanning microscopy
- Disk-drive testing
- Optical trapping
- Laser technology

Dynamic Digital Control for Best Scanning Linearity

Use our new digital control electronics with DDL (Dynamic Digital Linearization) to increase linearity and effective

Technical Data

Models	P-517.2CL	P-527.2CL
Active axes	X, Y	X, Y
Open-loop travel @ 0 to 100 V	100 x 100	200 x 200
Closed-loop travel	100 x 100	200 x 200
Integrated feedback sensor	2 x capacitive	2 x capacitive
* Closed- / open-loop resolution	1 / 0.3	2 / 0.5
Closed-loop linearity (typ.)	0.03	0.03
Full-range repeatability (typ.)	±5	±10
Stiffness	2	1
Push / pull force capacity (in operating direction)	200 / 30	200 / 30
Max. (±) normal load	50	50
Electrical capacitance	9 / axis	9 / axis
** Dynamic operating current coefficient (DOCC)	11.5 / axis	5.5 / axis
Unloaded resonant frequency	450	350
Resonant frequency @ 500 g load	250	190
Resonant frequency @ 2500 g load	140	110
Operating temperature range	-20 to 80	-20 to 80
*** Voltage connection	2 x VL	2 x VL
*** Sensor connection	4 x C	4 x C
Weight (with cables)	1400	1400
Body material	Al	Al
Recommended amplifier/controller (codes explained p. 2-17)	H, F, L, K	H, F, L, K

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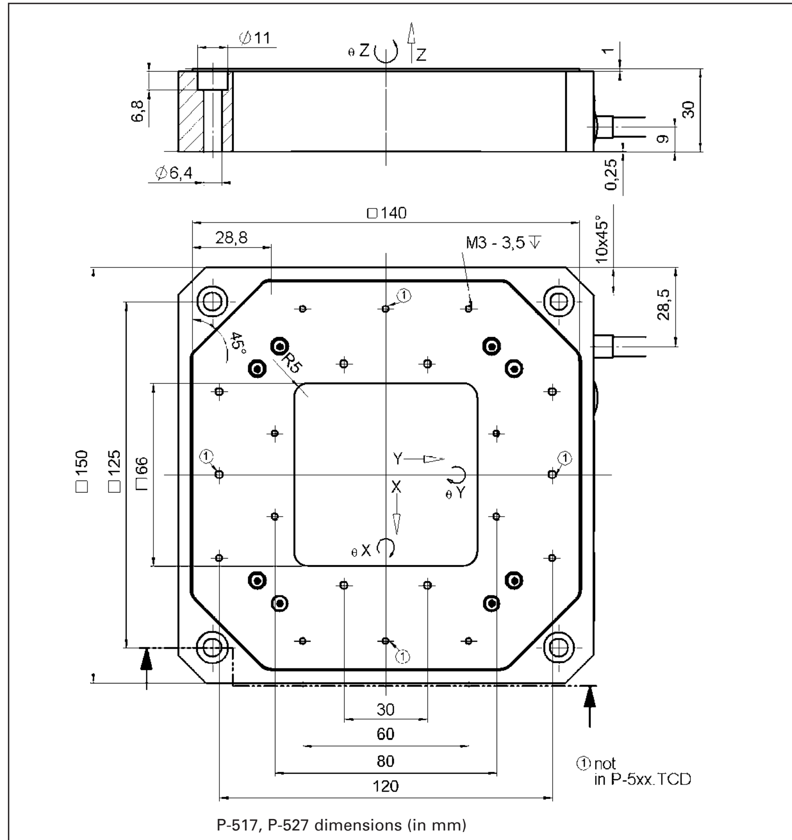
bandwidth by up to 1000-fold (see p. 6-16).

Working Principle / Reliability

P-500 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 both dynamic and static applications.

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



P-517, P-527 dimensions (in mm)

P-517.3CL/ P-517.3CD ****	P-527.3CL/ P-527.3CD ****	P-517.RCD	P-527.RCD	Units	Notes see p. 2-84
X, Y, Z	X, Y, Z	X, Y, θ_z	X, Y, θ_z		
100 x 100 x 20	200 x 200 x 20	100 ±1 mrad	200 ±2 mrad	µm ±20%	A2
100 x 100 x 20	200 x 200 x 20	100 ±1 mrad	200 ±2 mrad	µm	A5
3 x capacitive	3 x capacitive	3 x capacitive	3 x capacitive		B
X, Y: 1/0.3; Z: 0.1/0.1	X, Y: 2/0.5; Z: 0.1/0.1	X,Y: 1/0.3; θ_z: 0.3 /0.1 µrad	X, Y: 2/0.5; θ_z 0.3/0.1 µrad	nm	C1
0.03	0.03	0.03	0.03	%	
X, Y: ±5; Z: ±1	X, Y:±10; Z: ±1	X, Y: ±5; θ_z: ±0.5 µrad	X, Y: ±10; θ_z: ±1.0µrad	nm	C3
X, Y: 2; Z: 15	X, Y: 1; Z: 15	2	1	N/µm ±20%	D1
200 / 30; Z: 50 / 30	200 / 30; Z: 50 / 30	200 / 30	200 / 30	N	D3
50	50	50	50	N	D4
X, Y: 9; Z: 6	X, Y: 9; Z: 6	X, Y: 9	X, Y: 9	µF ±20%	F1
X, Y: 11.5; :Z: 62	X, Y: 5.5; :Z: 62	X, Y: 11.5	X, Y: 5.5	µA/(Hz x µm)	F2
450; Z: 1100	350; Z: 1100	X, Y: 450; θ_z: 400	X, Y: 350; θ_z: 300	Hz ±20%	G2
X, Y: 250	X, Y: 190	X, Y 250	X, Y: 190	Hz ±20%	G3
X, Y: 140	X, Y: 110	X, Y 140	X, Y: 110	Hz ±20%	G3
-20 to 80	-20 to 80	-20 to 80	-20 to 80	°C	H2
3 x VL ****	3 x VL ****	D	D		J1
6 x C ****	6 x C ****	D	D		J2
1450	1450	1400	1400	g ±5%	
Al	Al	Al	Al		L
H, F, L	H, F, L	K	K		

* 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, E-503.

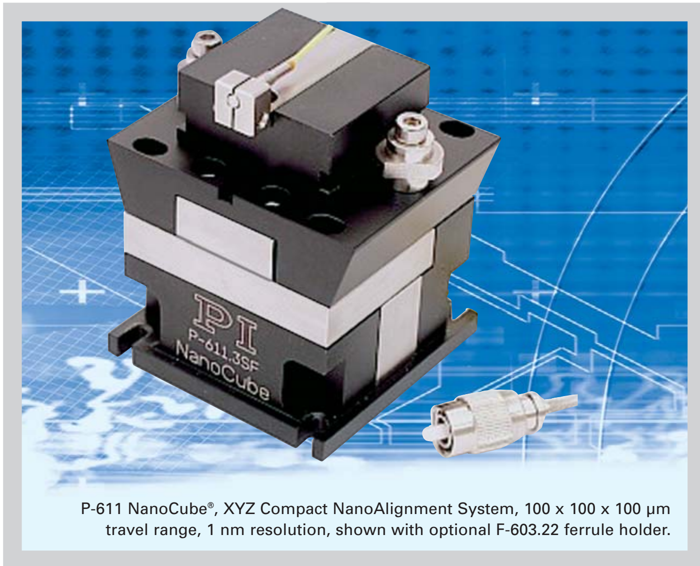
** Dynamic Operating Current Coefficient of linear axes is in µA per Hz and µm. Example P-527.2xx: Sinusoidal scan of 30 µm at 10 Hz requires approximately 1.8 mA drive current.

*** Cable length: 1.5 m.
P-5x7.xCD with one sub-D special connector for sensor and operating voltage.
P-5x7.xCL with LEMO connectors.

**** P-5x7.3CD with one sub-D special connector for sensor and operating voltage.

P-611.3OF · P-611.3SF

NanoCube® XYZ Rapid Photonics NanoAlignment Add-on System



P-611 NanoCube®, XYZ Compact NanoAlignment System, 100 x 100 x 100 µm travel range, 1 nm resolution, shown with optional F-603.22 ferrule holder.

- **Ideal for Fiber Alignment and Photonics Packaging Applications**
- **100 x 100 x 100 µm Travel Range, Ultra-Compact Package!**
- **1 nm Resolution**
- **Closed- and Open-Loop Versions**
- **Precision Trajectory Control w/ Frictionless Flexures**
- **Fast Scanning and Settling**
- **Large Variety of Controllers**

The P-611.3OF and P-611.3SF NanoCube® NanoAlignment systems are based on PI's vast experience with ultra-high-precision piezo scanning systems (see the "Nanopositioning & Scanning Systems" section) and photonics packaging applications. They combine a 100 x 100 x 100 µm XYZ positioning and scanning range with a zero stiction/friction wire-EDM-cut guiding system in an extremely compact package. NanoCube® systems provide motion with nanometer-scale resolution and settling times of only a few milliseconds.

Application Examples

- Photonics packaging
- Optical device testing
- MEMS positioning/alignment
- Fiber alignment
- Micromachining
- Micromanipulation (life sciences)
- Semiconductor test systems

Open- & Closed-Loop Models

Open- and closed-loop versions are offered to suit your application. Several fiber, waveguide and optics adapters are available for mounting on the NanoCube® (e.g. model F-603.60, see "Fiber, Objective and Waveguide Holders" see page 8-26).

NanoCubes® are also available in a slightly different package without the fiber adapter interface, see the P-611 article on page 2-74 in the "Nanopositioning & Scanning Systems" section.

Automatic Alignment

NanoCubes® can be operated with the E-664 bench-top controller. A special controller card (model E-760, see page 6-33) featuring built-in optical metrology can be installed in the F-206 hexapod controller or the C-880 automation controller. A variety of other rackmount and bench-top controllers is also available.

NanoCubes® can be easily combined with a number of automated or manual PI micropositioning systems, from single axis stages to 6-degree-of-freedom micromanipulators.

Working Principle / Lifetime

P-611 nanopositioners are equipped with the award-winning PICMA® long-life piezoelectric drives integrated into a sophisticated flexure guiding system. The force exerted by the piezo drive pushes a multi-flexure parallelogram via an integrated motion amplifier. The wire-EDM-cut flexures are FEA modeled (finite element analysis) for zero stiction and friction, ultra-high resolution and exceptional guiding precision. All components are frictionless and maintenance-free.

Notes

For versions without the fiber adapter interface see p. 2-36, p. 2-38 and p. 2-74 in the "Nanopositioning & Scanning Systems " section.

Ordering Information

P-611.3SF
NanoCube® XYZ NanoAlignment Stage, 100 x 100 x 100 µm, Closed-Loop, Fiber Adapter Interface

P-611.3OF
NanoCube® XYZ NanoAlignment Stage, 100 x 100 x 100 µm, Open-Loop, Fiber Adapter Interface

Recommended Controllers
E-760, E-664 (see pp. 6-32 *ff.*)

Ask about custom designs!

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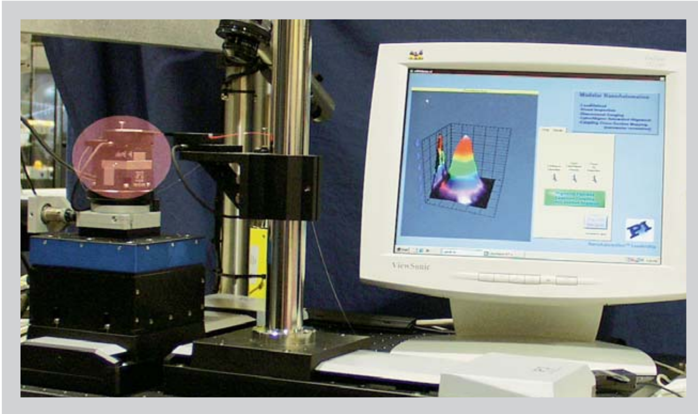
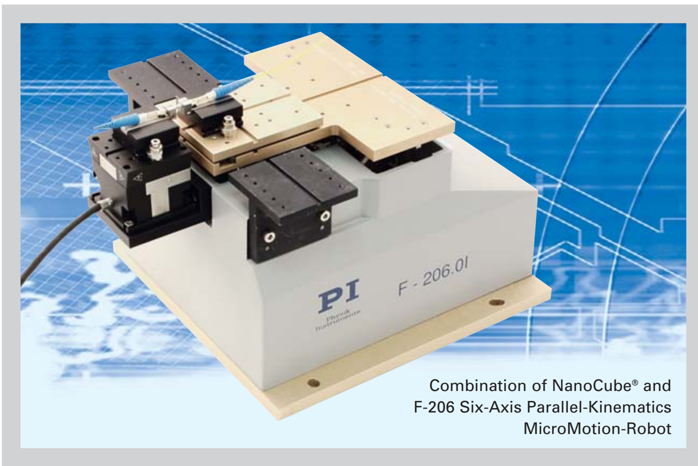
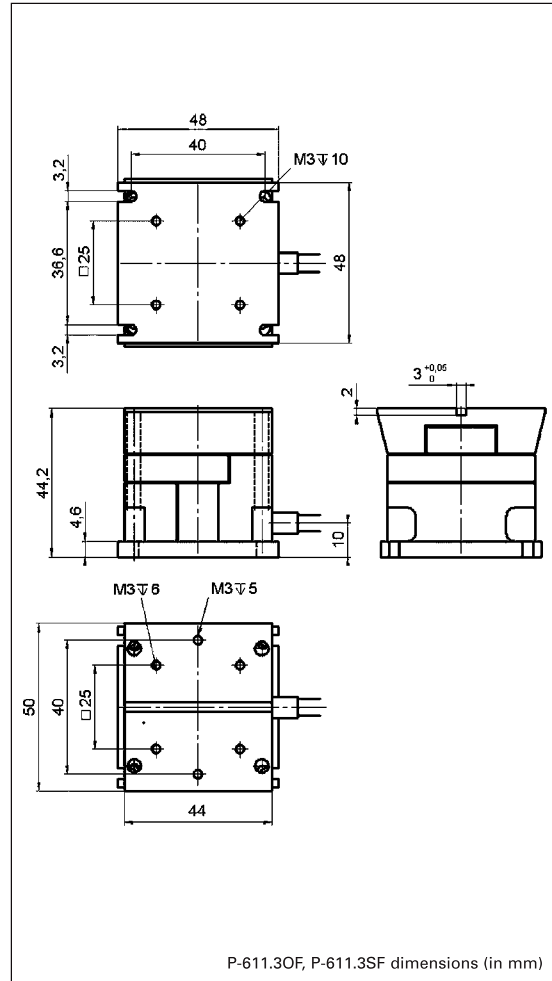


P-611 NanoCube® in a coarse/fine travel alignment application with M-511, M-501 and M-037 stages. CyberAligner™ software takes data of the complete cross-coupling section, aligns the platform and displays the profile on screen (this process only takes a few seconds).



Combination of NanoCube® and F-206 Six-Axis Parallel-Kinematics MicroMotion-Robot



P-611.3OF, P-611.3SF dimensions (in mm)

Technical Data

Models	P-611.3SF	P-611.3OF	Units	Notes see page 2-44
Active axes	X,Y,Z	X,Y,Z		
Open-loop travel @ 0 to 100 V	100 / axis	100 / axis	µm ±20 %	A2
Closed-loop travel	100 / axis	-	µm	A5
Integrated feedback sensor	SGS	-		B
** Closed-loop / open-loop resolution	2 / 1	- / 1	nm	C1
Stiffness	0.3	0.3	N /µm ±20 %	D1
Max. (+/-) normal load	1.5	1.5	kg	D4
Electrical capacitance	1.5 / axis	1.5 / axis	µF ±20 %	F1
* Dynamic operating current coefficient (DOCC)	1.7 / axis	1.7 / axis	µA/(Hz x µm)	F2
Unloaded resonant frequency (X/Y/Z)	350/220/250	350/220/250	Hz ±20 %	G2
Operating temperature range	- 20 to 80	- 20 to 80	°C	H2
*** Voltage connection	Sub-D-Special	Sub-D-Special		J1
*** Sensor connection	Sub-D-Special	-		J2
Weight (w/o cables)	250	250	g ±5 %	
Body material	S/Al	S/Al		L
Recommended Amplifier/Controller (codes explained see page 6-46)	N, C, D ,G , H	N, G, C		

* Dynamic Operating Current Coefficient in µA per hertz and µm. Example: Sinusoidal scan of 50 µm at 10 Hz requires approximately 0.8 mA drive current.
** Resolution of PZT NanoPositioners is not limited by stiction or friction. Noise equivalent motion with E-503 amplifier.
*** Adapter cable with LEMO connectors for sensor and operating voltage available.

P-615

NanoCube® XYZ Piezo NanoAlignment Systems with Parallel Metrology

P-615 NanoCube® 350C Nanopositioning System, 350 x 350 x 250 µm travel range.

- **350 x 350 x 250 µm Closed-Loop Travel Range**
- **Parallel-Kinematics Design & Direct Capacitive Metrology for Higher Multi-Axis Accuracy**
- **Compact Design: 80 x 80 x 42 mm (Open & Closed-Loop Versions)**
- **10 mm Clear Aperture**
- **PICMA® High-Performance Piezo Drives**
- **1 nm Resolution**
- **Ideal for Alignment and Photonics Packaging Applications**
- **Vacuum Compatible to 10^{-6} hPa**

The P-615 NanoCube® is a novel, closed-loop, multi-axis piezo nanopositioning and alignment system. Its 350 x 350 x 250 µm, XYZ positioning and scanning range comes in a compact package. Equipped with a zero-stiction, zero-friction guiding system, this NanoCube® provides motion with ultra-high resolution and settling times of only a few milliseconds. Open- and closed-loop versions are offered to suit your application.

Application Examples

- Micromachining
- Micromanipulation
- Life sciences
- Semiconductor test systems
- Photonics packaging

Double Stiffness

The P-615's unique flexure design has double the stiffness in the vertical axis than in X and Y, providing faster response and higher operating frequencies under load. For example, the settling time to reach a commanded position with 1 % accuracy is only 15 ms in the Z-axis with 100 g load (as opposed to 10 ms without load).

Photonics Alignment

The P-615 is equipped with a fiber adapter interface similar to the P-611.3SF NanoCube® (see page 8-16) and accommodates all F-603-series fiber holders and accessories (see page 8-26).

Higher Precision Through Parallel Kinematics/Metrology

P-615s are based on a novel, frictionless, XYZ piezo-driven scanner design, equipped with direct-measuring, non-contact capacitive position sensors (parallel, direct metrology).

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.

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).

Working Principle / Reliability

P-615 nanopositioning stages are equipped with the award winning PICMA® piezo drives, integrated into a sophisticated, single-module, parallel-kinematics, flexure guiding system. The wire-EDM-cut 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 both dynamic and static applications.

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

Ordering Information

P-615.3CD
NanoCube® XYZ Piezo Nanopositioning Stage, 350 x 350 x 250 µm, Parallel Metrology, Sub-D-Connector

P-615.3UD
Vacuum Version of P-615.3CD, to 10^{-9} hPa.

P-615.3CL
NanoCube® XYZ Piezo Nanopositioning Stage, 350 x 350 x 250 µm, Parallel Metrology, Lemo Connectors

P-615.30L
NanoCube® XYZ Piezo Nanopositioning Stage, 460 x 400 x 300 µm, Open-Loop, Lemo Connector

Notes

See the “Piezo Drivers & Nanopositioning Controllers” section, p. 6-8 *ff.* for our comprehensive line of low-noise control electronics.

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

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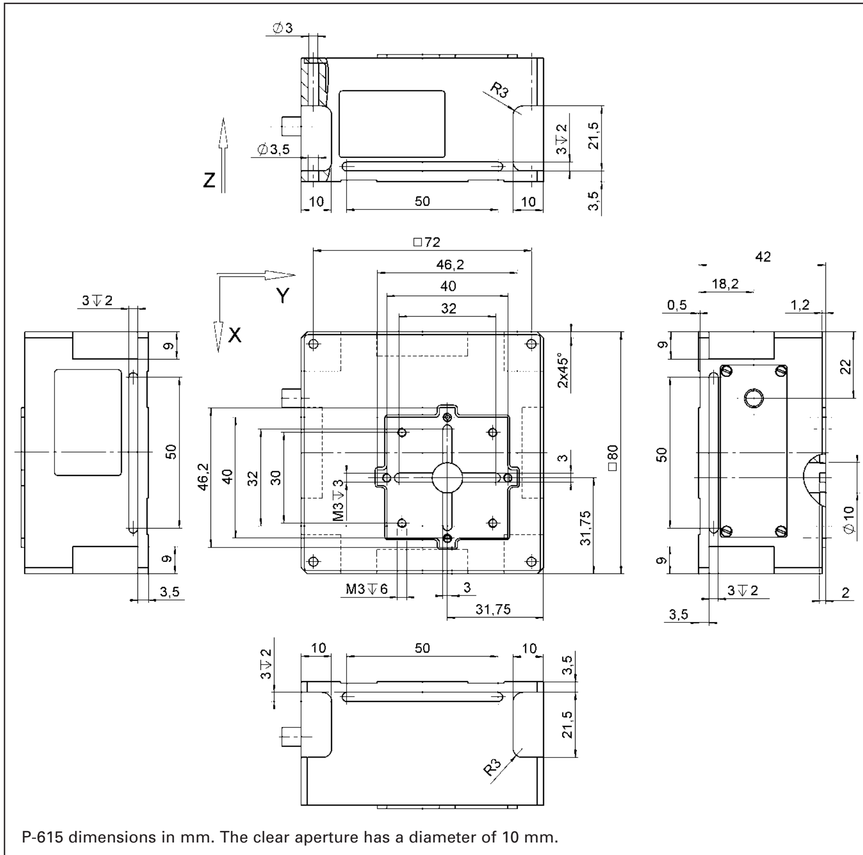
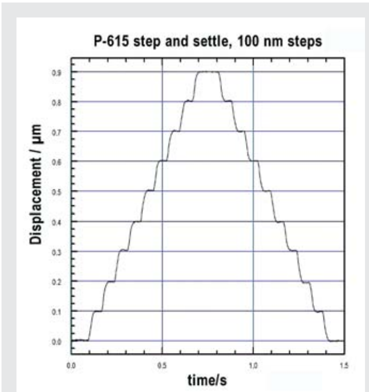


P-615 dimensions in mm. The clear aperture has a diameter of 10 mm.



P-615, X-axis with 100 g load performing 100 nm steps in rapid sequence without overshoot. Settling time for the Z-axis to reach a commanded position with 1 % accuracy is only 15 ms.

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

Models	P-615.3CD / P-615.3CL	P-615.30L	Units	Notes see p. 2-84
Active axes	X, Y, Z	X, Y, Z		
Min. open-loop travel -20 to 120 V	400 in X, Y; 300 in Z	400 in X,Y; 300 in Z	µm	A2
Closed-loop travel	350 in X, Y; 250 in Z	-	µm	A5
Integrated feedback sensor	capacitive	-		B
* Closed- / open-loop resolution	1.0 / 0.5	- / 0.5	nm	C1
Closed loop linearity (typ.)	0.02	-	%	
Stiffness	0.13 in X, Y; 0.35 in Z	0.13 in X, Y; 0.35 in Z	N/µm	D1
Max. load	10 in X, Y; 20 in Z	10 in X, Y; 20 in Z	N	D4
Electrical capacitance	3.0 in X, Y; 6.0 in Z	3.0 in X, Y; 6.0 in Z	µF ±20%	F1
Unloaded resonant frequency	210 in X, Y; 270 in Z	210 in X, Y; 270 in Z	Hz ±20%	G2
Resonant frequency @100 g	140 in X, Y; 200 in Z	140 in X, Y; 200 in Z	Hz ±20%	G2
Operating temperature range	-20 to 80	-20 to 80	°C	H2
Voltage connection	D **	LEMO FFA.00.250		J1
Sensor connection	D **	-		J2
Weight (w/o cables)	580	570	g ±5%	
Body material	Al	Al		L
Recommended amplifier/controller (codes explained p. 2-17)	D, H	G, 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-503 amplifier.

** P-615.3CL with LEMO connectors for sensor and operating voltage.