P-615

NanoCube® XYZ Piezo NanoAlignment Systems with Parallel Metrology

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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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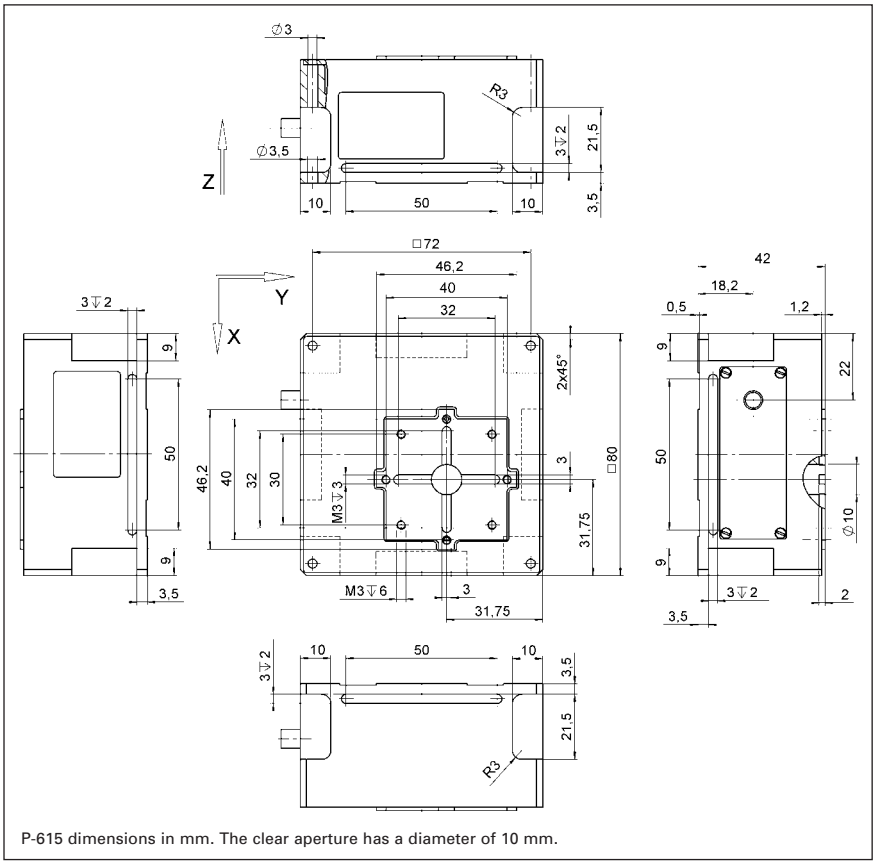
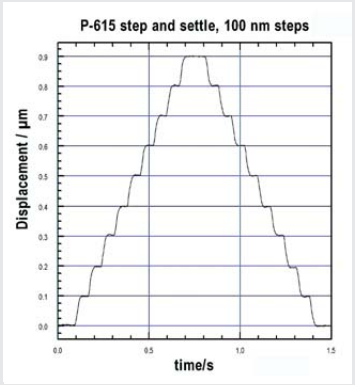


P-615 dimensions in mm. The clear aperture has a diameter of 10 mm.



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.

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.