

P-363

PicoCube® High-Speed, XY(Z) Piezo Stages for Nanotechnology, SPM, AFM

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- Ultra-High-Performance Closed-Loop Scanner for AFM/SPM
- Compact Manipulation Tool for Nanotechnology
- Resonant Frequency 9.8 kHz
- Ultra-High-Precision Capacitive Feedback
- Parallel-Motion Metrology for Highest Linearity and Stability
- 50 Picometers Resolution
- 5 x 5 x 5 µm Travel Range
- Very Small Package
- Rugged Design

Ultra-High-Performance Scanner/Manipulator for Nanotechnology

The P-363 PicoCube® XY/XYZ is an ultra-high-performance closed-loop piezo scanning system. Designed for AFM, SPM and nanomanipulation applications, it combines an ultra-low inertia, high-speed XY/XYZ piezo scanner with non-contact, direct-measuring, parallel-metrology capacitive

feedback capable of 50 picometers resolution. On top of being extremely precise, the PicoCube® system is also very small and rugged. Measuring only 30 x 30 x 40 mm (30 x 30 x 26 mm for XY version), it is easy to integrate in any scanning apparatus.

AFM, STM, SPM, Nanolithography, Nanoimprinting, Nanometrology

The PicoCube® was specifically developed to overcome the limitations of the open-loop scanners currently available for STM, AFM and SPM. In addition to these applications, the PicoCube® is also the ideal scanning and manipulation tool for nanoimprinting, nanolithography, ultra-high-resolution, near-field, scanning optical microscopy and nano-surface-metrology applications.

Higher Precision Through Parallel-Motion Metrology

The PicoCube® is based on a proprietary, ultra-fast, piezo-driven scanner design equipped with direct-measuring, capacitive position sensors (parallel metrology). Unlike conventional sensors, they measure the actual distance between the fixed frame and the moving part of the stage. 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.

PI capacitive sensor electronics use the proprietary ILS (Integrated Linearization System) for enhanced linearity and are less sensitive to EMI than other high-resolution sensor systems.

With parallel metrology, all sensors measure the position of the same moving platform against the same stationary reference. This means that all motion is inside the servo-loop, resulting in superior multi-axis precision (Active Trajectory Control).

Nanometer Accuracy in 1 Millisecond with 50-Picometer Resolution

PicoCube® systems provide resolution of 50 picometers and below. The ultra-fast XY/XYZ piezo drives offer resonant frequencies of 9.8 kHz in Z and >3 kHz in X and Y! The high resonant frequency and high-bandwidth capacitive feedback allow step and settle to 1% accuracy in as little as one millisecond.

Rugged Design

In spite of its ability to move and position on an atomic scale, the PicoCube® boasts a

Ordering Information

P-363.3CD
PicoCube® XYZ Positioning- and Scanning System, 5 x 5 x 5 µm, Parallel-Motion Metrology, Capacitive Sensors, Sub-D Connectors

P-363.3UD
Vacuum Version of P-363.3CD to 10⁻⁹ hPa

P-363.2CD
PicoCube® XY Positioning- and Scanning System, 5 x 5 µm, Parallel-Motion Metrology, Capacitive Sensors, Sub-D Connectors

P-363.2UD
Vacuum Version of P-363.2CD to 10⁻⁹ hPa

P-363.3CL
PicoCube® XYZ Positioning- and Scanning System, 5 x 5 x 5 µm, Parallel-Motion Metrology, Capacitive Sensors, Lemo Connectors

P-363.2CL
PicoCube® XY Positioning- and Scanning System, 5 x 5 µm, Parallel-Motion Metrology, Capacitive Sensors, Lemo Connectors

Different travel ranges or dimensions on request.

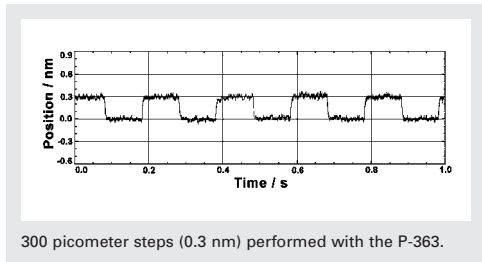
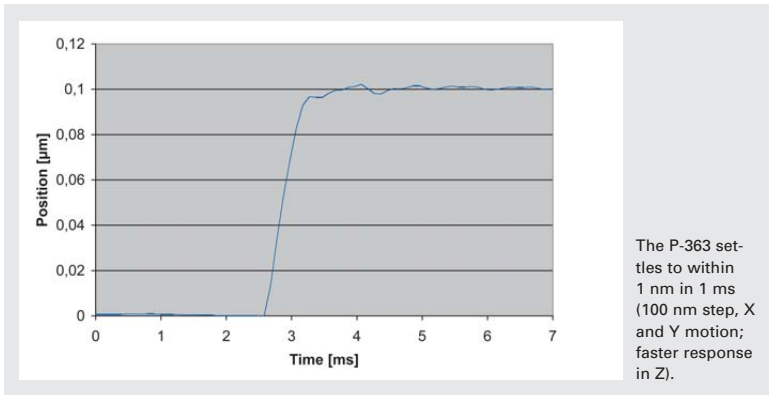
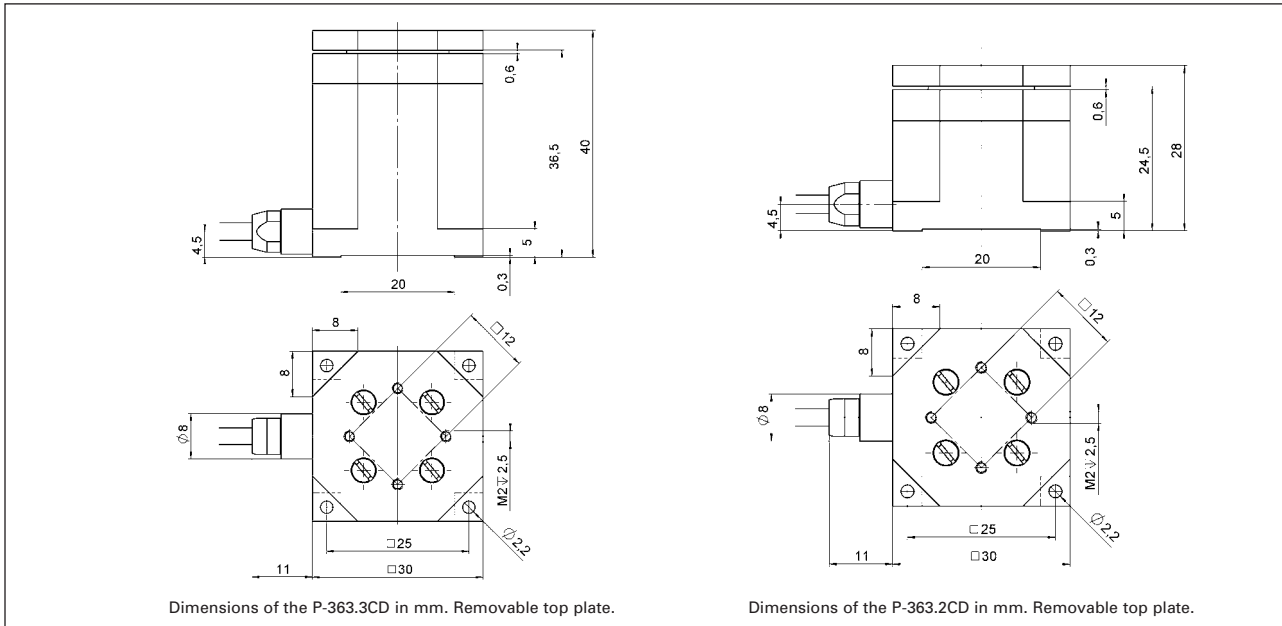
rugged design for real-world applications. For extra-high stability and reduced mass, the body is precision machined from heat-treated and stress-relieved titanium. The sophisticated frictionless design also ensures that the (moving) top plate protects the internal actuator/sensor unit from contamination.

Control

The PicoCube® controller is based on the E-500, 19" rack-mount chassis with one E-509.CA3 servo-controller and three E-507.36 power amplifier modules. This controller is equipped with high-speed analog interfaces (0 to 10 V). An optional E-516 20-bit interface module (see page 6-26) is also available.

Application Examples

- Atomic Force Microscopy
- Micromanipulation
- Biotechnology
- Nanomanipulation
- Nanoimprinting
- Nanometrology
- Nanolithography



Technical Data

Models	P-363.3CD	P-363.2CD	Units	Notes see p. 2-84
Active axes	X, Y, Z	X, Y		
Open-loop travel @ -250 to +250V	6, 6, 5.5	6, 6	µm	A5
Closed-loop travel	5, 5, 5	5, 5	µm	A2
Integrated feedback sensor	capacitive	capacitive		B
* Closed- / Open-loop resolution	0.1 / 0.05	0.1 / 0.05	nm	C1
Closed-loop linearity (X, Y, typ.)	1	1	nm	
Max. load	10	10	N	D4
Tilt, off-axis (typ.)	0.5	0.5	µrad	
Electrical capacitance	60 (X, Y); 110 (Z)	60	nF ±20%	F1
Unloaded resonant frequency (X, Y)	3.1	4.2	kHz ±20%	G2
Unloaded resonant frequency (Z)	9.8	-	kHz ±20%	G2
Resonant frequency @ 20 g load (X, Y)	1.5	2.1	kHz ±20%	G3
Operating temperature range	-40 to 120	-40 to 120	°C	H2
** Voltage and sensor connection	Sub-D special	Sub-D special		J1
Weight (with cables)	225	190	g ±5%	
Body material	Titanium	Titanium		L
Recommended amplifier/controller	E-500 rack, E-509, E-507.36 amplifier	E-500 rack, E-509, E-507.36 amplifier		

* For calibration information see p. 2-8.
 Resolution of PI piezo nano-positioners is not limited by friction or stiction. The value given is noise equivalent motion with E-509.C3A controller and E-507.36 amplifier.
 ** P-363.xCL versions with Lemo connectors

- 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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