P-587

6-Axis, Long-Travel Piezo Nanopositioning / Scanning Stage with Parallel Metrology

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P-587 piezo-driven nanopositioning / scanning stage with 6-axis digital controller

- **For Scanning and Positioning in all Six Degrees of Freedom**
- **800 x 800 x 200 µm Linear Range**
- **Up to 10 mrad Rotational Range**
- **Precision Trajectory Control**
- **Parallel-Kinematics/Metrology for Enhanced Responsiveness / Multi-Axis Precision**
- **Direct Metrology with Capacitive Sensors for Highest Precision**
- **ID-Chip for AutoCalibration Function**
- **PICMA® High-Performance Piezo Drives**

The P-587.6CD is a unique, highly accurate 6-axis scanning and positioning system, providing a linear travel range of 800 x 800 x 200 µm and rotation ranges of 10 mrad.

Application Examples

- Nanoimprinting
- Nanomanufacturing
- Metrology
- Nanopositioning
- Semiconductor test equipment
- Precision mask and wafer alignment
- Scanning interferometry
- Surface structure analysis

AutoCalibration

For optimized operation and interchangeability of nanomechanisms and controllers, the P-587.6CD is equipped with an ID-chip which holds all calibration data and sends it to the digital controller.

Higher Precision Through Parallel Kinematics/Metrology

P-587 piezo scanning 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. They permit motion linearity to 0.004 %.

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 E-710.6CD digital control electronics with the DDL (Dynamic Digital Linearization) as a standard feature to increase linearity and effective bandwidth in scanning applications by up to 1000-fold (see p. 6-16).

Ordering Information

P-587.6CD
6-Axis, Long-Travel Piezo Flexure Stage, 800 x 800 x 200 µm x 3 x 3 x 10 mrad

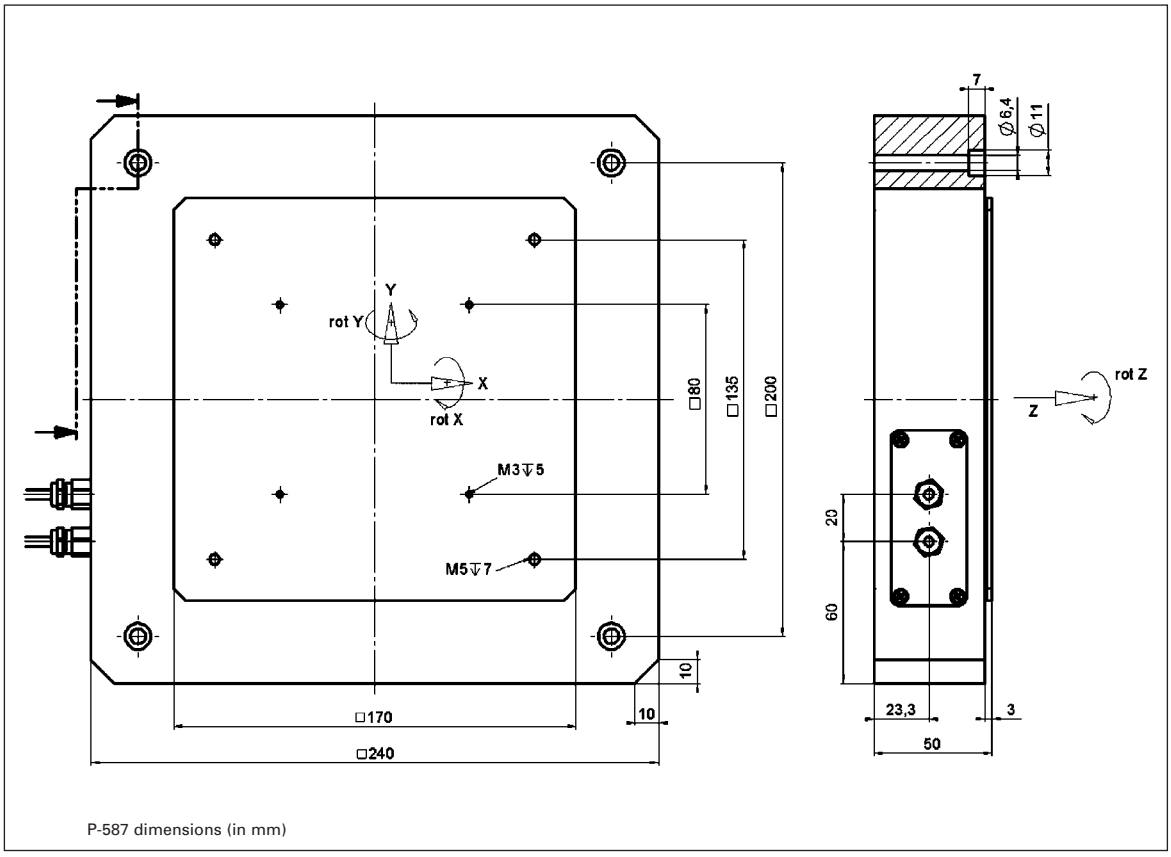
Ask about custom designs!

Working Principle / Reliability

P-587 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.

Notes

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



P-587 dimensions (in mm)

Technical Data

Models	P-587.6CD	Units	Notes see p. 2-84
Active axes	X Y Z θ_X, θ_Y, θ_Z		
Closed-loop travel in XYZ	800 x 800 x 200	µm	A5
Closed-loop travel in θ_X, θ_Y, θ_Z	3 x 3 x 10	mrad	
Integrated feedback sensors	capacitive		B
* Closed-loop resolution	10^{-5} x travel range		
Closed-loop linearity (typ.)	XY: 0.004% (30 nm) Z: 0.01% (20 nm) rotations: 0.2% (2 µrad)		
Max. (±) normal load	50	N	D4
Electrical capacitance (XY)	2 x 42 / axis	µF ±20%	F1
Electrical capacitance (Z)	4 x 4.5 µF	µF ±20%	
** Resonant frequency XY	103	Hz ±20%	G2
** Resonant frequency Z	220	Hz ±20%	G2
** Resonant frequency θ_X, θ_Y	308	Hz ±20%	G2
** Resonant frequency θ_Z	140	Hz ±20%	G2
Crosstalk, all axes at full range	1	µrad	
Operating temperature range	-20 to 80	°C	H2
Voltage / sensor connection	ID		J1/J2
Weight (without cables)	7.2	kg ±5%	
Body material	Al/Invar		L
Recommended amplifier/controller	E-710.6CD		

* 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.
** at 600 g load