P-612 XY Piezo Nanopositioning System

Compact, Clear Aperture

The P-612.2SL is a piezo-based nanopositioning system featuring a compact footprint of only 60 x 60 mm and a height of 18 mm. Due to the 20 x 20 mm open aperture, the system is excellently suited for sample positioning in microscopy or scanning applications. Equipped with piezo drives and zero-stiction, zero-friction flexure guiding system, the series provides nanometer-range resolution and millisecond response time. A Z stage with the same form factor is available for vertical positioning applications (see P-612.2SL p. 2-38).

Cost-Effective Design

Flexures optimized with Finite Element Analysis (FEA) are used to guide the compact, low-cost stage. Flexures allow extremely high-precision motion, no matter how minute, as they are completely free of play and friction. They also optimize stiffness in and perpendicular to the direction of motion.

Position Servo-Control with Nanometer Resolution

High-resolution, broadband, strain gauge sensors (SGS) are applied to appropriate locations on the drive train and measure the displacement of the moving part of the stage relative to the base directly. The SGS sensors assure optimum position stability in the nanometer range and fast response.

The open-loop models are ideal for applications where fast response and very high resolution are essential, but absolute positioning is not important. They can also be used in applications where the position is controlled by an external linear position sensor such as an interferometer, a PSD (position sensitive diode), CCD chip / image processing system, or the eyes and hands of an operator.

Ceramic Insulated Piezo Actuators Provide Long Lifetime

Highest possible reliability is assured by the use of award-winning PICMA® multilayer piezo actuators. PICMA® actuators are the only actuators on the market with ceramic-only insulation, which makes them resistant to ambient humidity and leakage-current failures. They are thus far superior to conventional actuators in reliability and lifetime.

Ordering Information

<table>
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<tr>
<th>Model</th>
<th>Description</th>
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<tbody>
<tr>
<td>P-612.25L</td>
<td>XY Nanopositioning System with 20 x 20 mm Aperture, 100 x 100 µm, Strain Gauge Sensors</td>
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<tr>
<td>P-612.20L</td>
<td>XY Nanopositioning System with Aperture 20 x 20 mm, 100 x 100 µm, Open-Loop</td>
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System properties

<table>
<thead>
<tr>
<th>Property</th>
<th>Specification</th>
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<tbody>
<tr>
<td>System configuration</td>
<td>P-612.2 SL and E-500 modular system with E-503 amplifier and E-509 sensor module, 100 load</td>
</tr>
<tr>
<td>Amplifier bandwidth, small signal</td>
<td>45 Hz</td>
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<tr>
<td>Settling time (10% step width)</td>
<td>15 ms</td>
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Piezo Flexure Stages / High-Speed Scanning Systems

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Piezo Nano Positioning

Technical Data

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<th>Tolerance</th>
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<tr>
<td>Active axes</td>
<td>X, Y</td>
<td>X, Y</td>
<td></td>
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Motion and positioning

- Integrated sensor: SGS
- Open-loop travel: -20 to +120 V
  - Travel: 130 µm
  - Resolution: 0.8 nm typ.
- Closed-loop travel: 100 µm
- Linearity: 0.4 % typ.
- Repeatability: <10 nm typ.
- Pitch: ±10 / ±50 µrad typ.
- Yaw in X/Y: ±10 / ±50 µrad typ.

Mechanical properties

- Stiffness: 0.15 N/µm
- Unloaded resonant frequency: 400 Hz
- Resonant frequency @ 100 g: 200 Hz
- Push/pull force capacity in motion direction: 15 / 5 N
- Load capacity: 15 / 5 N

Drive properties

- Ceramic type: PICMA® P-885
- Electrical capacitance: 1.5 µF
- Dynamic operating current coefficient: 1.9 µA/(Hz • µm)

Miscellaneous

- Operating temperature range: -20 to 80 °C
- Material: Aluminum, steel
- Mass: 105 g
- Cable length: 1.5 m
- Sensor connector: LEMO connector
- Voltage connection: LEMO connector

Resolution of PI Piezo Nanopositioners is not limited by friction or stiction. Noise equivalent motion with E-503 amplifier (p. 2-146)

Recommended controller

Single-channel (1 per axis): E-610 servo-controller / amplifier (p. 2-110), E-625 servo-controller, bench-top (p. 2-114), E-621 controller module (p. 2-160)

Multi-channel: modular piezo controller system E-500 (p. 2-142) with amplifier module E-503 (three channels) (p. 2-146) or E-505 (1 per axis, high-power) (p. 2-147) and E-509 controller (p. 2-152)
**P-612.Z Piezo Z Stage**

**Compact Nanopositioning Stage with Aperture**

These elevation stages are cost-effective, compact, piezo-based positioning systems with travel ranges of 100 µm. The space-saving design features a footprint of only 60 x 60 mm. The 20 x 20 mm clear aperture makes them ideally suited for sample positioning in microscopy. Equipped with PICMA® piezo drives and zero-stiction, zero-friction flexure guiding system, the series provides nanometer-range resolution and millisecond response time.

**Position Servo-Control with Nanometer Resolution**

High-resolution, broadband, strain gauge sensors (SGS) are applied to appropriate locations on the drive train and measure the displacement of the moving part of the stage relative to the base. The SGS sensors assure optimum position stability in the nanometer range and fast response.

The open-loop models are ideal for applications where fast response and very high resolution are essential, but absolute positioning is not important. They can also be used when the position is controlled by an external sensor such as an interferometer, a PSD (position sensitive detector), CCD chip/image processing system, or the eyes and hands of an operator.

**High Reliability and Long Lifetime**

The compact P-612 systems are equipped with preloaded PICMA® high-performance piezo actuators which are integrated into a sophisticated, FEA-modeled, flexure guiding system. The PICMA® actuators feature cofired ceramic encapsulation and thus provide better performance and reliability than conventional piezo actuators. Actuators, guiding system and sensors are maintenance-free, not subject to wear and offer an extraordinary reliability.

**Application Examples**

- Interferometry
- Scanning microscopy
- Nanopositioning
- Biotechnology
- Quality assurance testing
- Semiconductor fabrication

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<th>Model</th>
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<tr>
<td>P-612.ZSL</td>
<td>Vertical Nanopositioning Stage, 100 µm, 20 x 20 mm Aperture, SGS-Sensor</td>
</tr>
<tr>
<td>P-612.Z0L</td>
<td>Vertical Nanopositioning Stage, 100 µm, 20 x 20 mm Aperture, No Sensor</td>
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</table>

Settling takes less than 10 ms over the entire travel range in closed-loop operation.

*P-612s are available as XY-scanners (P-612.2SL, on the left) and vertical stages (P-612.ZSL, on the right) providing a travel range of 100 µm per axis.*
Resolution of PI Piezo Nanopositioners is not limited by friction or stiction. Value given is noise equivalent motion with E-503 amplifier. (p. 2-146) Recommended controller/amplifier E-610 servo controller/amplifier card (p. 2-110), E-625 servo-controller, bench-top (p. 2-114), E-665 high-power servo-controller with display, bench-top (p. 2-116), E-660 bench-top for open-loop systems (p. 2-119)