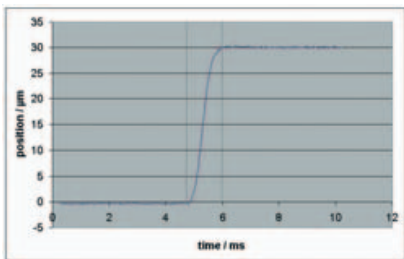


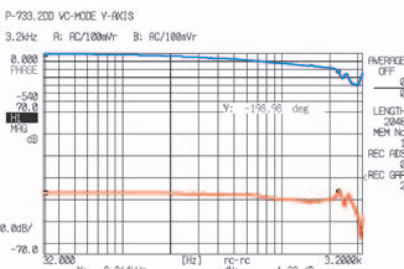
P-733.2DD High Speed AZK DeRXVd Wc P-733.3DD PRæZIV EoRTV_Z_XLDCI> ZIc dT aj



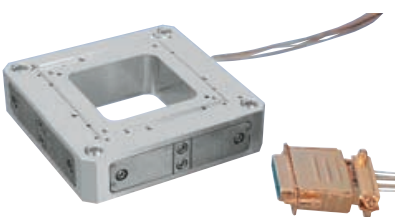
P-733.3DD (left side) and P-733.2DD, high-speed, direct drive XY(Z) scanning stages are the fastest scanning stages with large aperture currently available (2.2 kHz resonant frequency!). Both units feature a footprint of only 100 x 100 mm. Compact disc for size comparison.



0 to 100% travel in 1.36 msec, without overshoot. The P-733.2DD is the fastest, highest precision closed-loop XY scanning stage with large aperture currently available.



The P-733.2DD provides more than 2.2 kHz resonant frequency for highest scanning dynamics.



P-733.2UD nonmagnetic XY nanopositioner for ultra-high vacuum up to 10⁻⁸ hPa.

- **4 x Faster, Through Direct Drive**
- **To 2.2 kHz Resonant Frequency in X and Y**
- **100 Picometers Resolution**
- **Parallel-Metrology with Capacitive Sensors for Highest Multi-Axis Precision**
- **Parallel-Kinematics Design for Enhanced Responsiveness**
- **Active Runout Compensation**
- **30 x 30 or 30 x 30 x 10 µm Travel Range**
- **50 x 50 mm Clear Aperture**

Fastest Multi-Axis Systems w/Large Aperture

P-733.2DD and .3DD direct-drive stages are the fastest and most accurate multi-axis piezo scanning systems with a large aperture currently available. They provide a positioning and scanning range of 30 x 30 (x10) µm and are equipped with parallel-metrology capacitive position feedback for superior multi-axis linearity and repeatability.

The novel, high-stiffness direct drive system leads to a resonant frequency of more than 2 kHz, (4 x more than similar systems) enabling millisecond scanning rates and >500 Hz scanning frequency with sub-nanometer resolution.

Low-Profile and Clear Aperture—Ideal for Microscopy

Only 20mm high, the P-733.2DD provides one of the lowest profiles available for parallel-metrology NanoPositioning systems. The 50 x 50 mm clear aperture is ideal for transmitted-light applications such as near-field scanning microscopy, confocal microscopy and mask alignment. P-733 stages are designed for applications with loads up to 2 kg.

Higher Precision through Parallel Kinematics/Metrology

P-733 piezo scanning stages feature a parallel-kinematics design with direct-measuring, multi-axis non-contact capacitive position sensors (parallel metrology). The capacitive sensors measure the position of the moving platform (rather than strain in the actuator, as common with lower-precision strain gauge sensors). Parallel metrology can “see” all controlled degrees of freedom simultaneously and compensate for runout and crosstalk of orthogonal axes (active trajectory control).

A major advantage of the single-module, parallel-kinematics design is the identical dynamic performance of the X and Y axes, important for high scanning rates. In addition, there are no moving cables and no cable management issues to be resolved when integrating the unit. This design increases reliability, enhances responsiveness and also increases repeatability and accuracy at the nanometer level, because the force and friction exerted by a moving cable are eliminated (see the “Tutorial” section for further details).

Dynamic Digital Control for Best Scanning Linearity

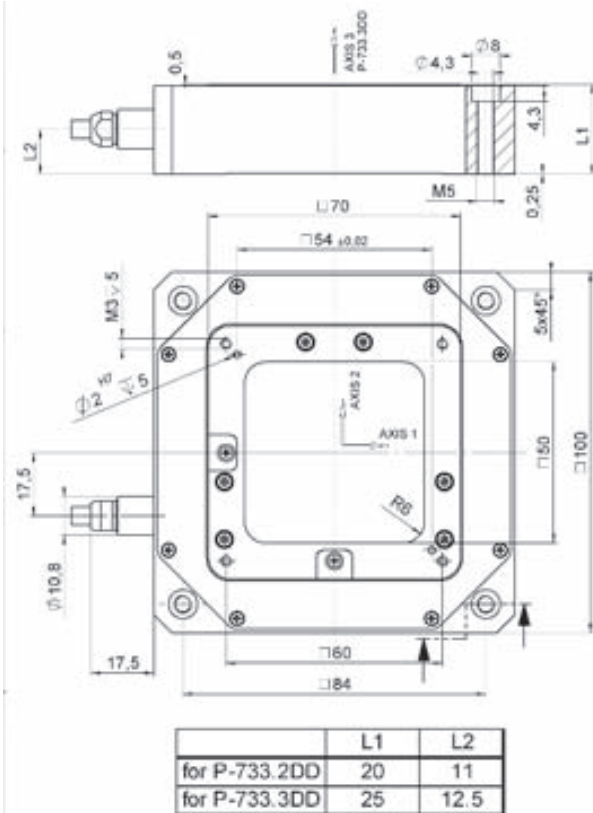
Use our new digital control electronics with the DDL (Dynamic Digital Linearization) control option for the highest linearity in scanning applications. These systems virtually eliminate tracking errors and permit use of the entire travel range with high dynamic accuracy in the nanometer range.

Working Principle/Reliability

P-733 NanoPositioners units are equipped with ultra-high-performance PICMA[®] monolithic multilayer piezo actuators integrated into a sophisticated single-module, parallel-kinematics flexure guiding system. The newly designed and highly optimized piezo drives (first with 100% ceramic insulation) are more robust than conventional piezo actuators, and feature superior lifetime in dynamic and static applications. The wire-EDM-cut flexures are FEA modeled for zero-stiction/zero-friction, ultra-high resolution and exceptional guiding precision. Integrated capacitive position feedback sensors in a parallel-metrology configuration provide sub-nanometer resolution and stability in closed-loop operation (with PI electronics). Because guidance, actuators and sensors are all frictionless and maintenance-free, P-733 systems achieve exceptional levels of reliability.

Non-Magnetic Vacuum Versions

For applications in ultrahigh vacuum, the P-733.2UD (see page 2-60) is available. It is both nonmagnetic and non-magnetizable, important for SEM applications. To guarantee minimal outgassing rates and optimal UHV suitability, P-733.2UD units contain vacuum qualified components only.



Dimensions of P-733.2DD and .3DD in mm.

Application Examples

- Imaging (resolution enhancement)
- Scanning microscopy
- Surface structure analysis
- Biotechnology
- Atomic force microscopy
- Semiconductor test equipment
- Precision mask and wafer alignment
- Scanning interferometry
- Nanomanipulation and other applications where high-precision, single-plane multi-axis motion is required

Ordering Information

P-733.2DD

XY High-Speed Direct Drive Piezo Scanning Stage, 30 x 30 μm , Capacitive Sensors, Sub-D Connector

P-733.3DD

XYZ High-Speed Direct Drive Piezo Scanning Stage, 30 x 30 x 10 μm , Capacitive Sensors, Sub-D Connector

Technical Data

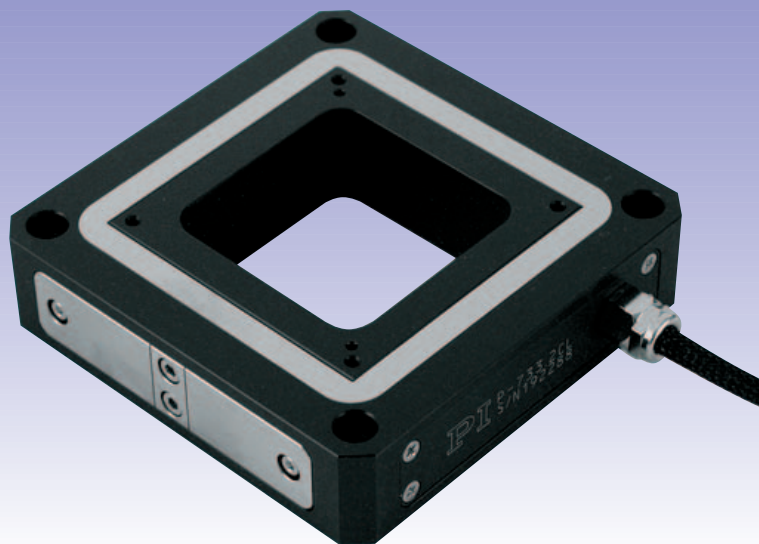
Models	P-733.2DD	P-733.3DD	Units	Notes see page 2-44
Active axes	X,Y	X,Y,Z		
Min. open-loop travel @ -20 to 120 V	33 x 33	33 x 30 x 14	$\mu\text{m} \pm 20\%$	A2
Closed-loop travel	30 x 30	30 x 30 x 10	μm	A5
Integrated feedback sensor	capacitive	capacitive	B	
Closed-loop / open-loop ** resolution	0.1 / 0.1	0.1 / 0.1	nm	C1
Closed-loop linearity (typ.)	0.03	0.03	%	
Full-range repeatability (typ.)	± 1.0	± 1.0	nm	C3
Stiffness (X,Y,Z)	20, 20, -	4, 4, 10	N/ $\mu\text{m} \pm 20\%$	D1
Push/pull force capacity (in operating direction)	300 / 100	300 / 100	N	D3
Max. (\pm) normal load	2	2	kg	D4
Tilt ($\theta\text{X}/\theta\text{Y}$) (typ.)	3	3	μrad	E1
Electrical capacitance (X,Y,Z)	6.0, 6.0, -	6.0, 6.0, 4.4	$\mu\text{F} \pm 20\%$	F1
*Dynamic operating current coefficient (DOCC) (X,Y,Z)	25, 25, -	25, 25, 50	$\mu\text{A}/(\text{Hz} \times \mu\text{m})$	F2
Unloaded resonant frequency (X,Y,Z)	2230, 2230, -	1200, 1200, 1200	Hz $\pm 20\%$	G2
Resonant frequency @ 50 g load (X, Y, Z)	1800, 1800, -		Hz $\pm 20\%$	G3
Resonant frequency @ 200 g load (X, Y, Z)		530, 530, 635	Hz $\pm 20\%$	G3
Operating temperature range	- 20 to 80	- 20 to 80	$^{\circ}\text{C}$	H2
Voltage connection	sub-D, special	sub-D, special		J1
Sensor connection	sub-D, special	sub-D, special		J2
Weight (with cables)	525	635	g $\pm 5\%$	
Body material	Al	Al		L
Recommended Amplifier/ Controller (codes explained see page 6-46)	H, F, L	H, F, L		

* Dynamic Operating Current Coefficient in μA per hertz and μm . Example: Sinusoidal scan of 10 μm at 100 Hz requires approximately 25 mA drive current.

** Resolution of PI Piezo NanoPositioners is not limited by friction or stiction. Noise equivalent motion with E-503 amplifier.

P-733

Single-Module, XY Piezo Flexure NanoPositioner and Scanner



P-733 Flexure NanoPositioner is ideal for single molecule microscopy.

Application Examples

- Scanning microscopy
- Semiconductor test equipment
- Precision mask and wafer alignment
- Scanning interferometry
- Imaging (resolution enhancement)
- Surface structure analysis
- Biotechnology
- Micromanipulation and other applications where single-plane high-precision XY motion is required

Notes

See the "PZT Control Electronics" section for our comprehensive line of low-noise modular and OEM control electronics for computer and manual control.

- **Precision Trajectory Control**
- **Single-Module, Parallel-Kinematics Design Features Enhanced Responsiveness and Automatic Runout Compensation**
- **For XY Scanning & Positioning**
- **100 × 100 μm Travel Range**
- **Integrated Capacitive Sensors for Resolution < 0.3 nm**
- **50 × 50 mm Clear Aperture**
- **Ultrahigh Vacuum Version Available**
- **Ultra-Fast XY and XYZ Versions Available**

P-733 NanoPositioning Stages are fast and highly accurate, low-profile, XY scanning and positioning systems. They provide a positioning and scanning range of 100 × 100 μm and are equipped with capacitive feedback sensors for highest accuracy and repeatability, in the nanometer and sub-nanometer range.

Clear Aperture

The 50 × 50 mm, clear aperture is ideal for transmitted-light applications such as near-field scanning microscopy, confocal microscopy and mask alignment. P-733 stages are designed for applications with loads up to 2 kg.

Higher Precision through Parallel Kinematics/Metrology

P-733 piezo scanning stages are equipped with direct-measuring, multi-axis capacitive position sensors (parallel metrology). The capacitive sensors measure the position of the moving platform rather than strain in the actuator (as common with lower-precision strain gauge sensors). Parallel metrology can "see" all controlled degrees of freedom simultaneously and compensate for runout and crosstalk of orthogonal axes.

A major advantage of the single-module parallel-kinematics design is that there are no moving cables and no cable management issues to be resolved when integrating the unit. This design increases reliability, enhances responsiveness and also increases repeatability and accuracy at the

nanometer level, because the friction and force exerted by a moving cable are eliminated (see the "Tutorial" section, page 4-1 *ff.* for further details).

Working Principle

P-733 NanoPositioners are equipped with low-voltage piezoelectric drives (0 to 100 V) 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 for zero stiction/friction, ultra-high resolution and exceptional guiding precision. Integrated capacitive position feedback sensors provide sub-nanometer resolution and stability in closed-loop operation (with PI electronics).

Operation in UHV

For applications in ultrahigh vacuum down to 10⁻⁹ hPa PI offers a special version of the P-733.2UD.

It is nonmagnetic (as well as non magnetizable) and contains vacuum qualified components only. These guarantee minimal outgassing rates and an optimal UHV suitability.

Ultra-Fast Scanning in XY and XYZ

With the same footprint as the P-733, the P-733.2DD and P-733.3DD Versions offer a resonant frequency of up to 2 kHz in X and Y. This enables millisecond scanning rates with sub-nanometer resolution over a range of 30 μm x 30 μm (x 10 μm).

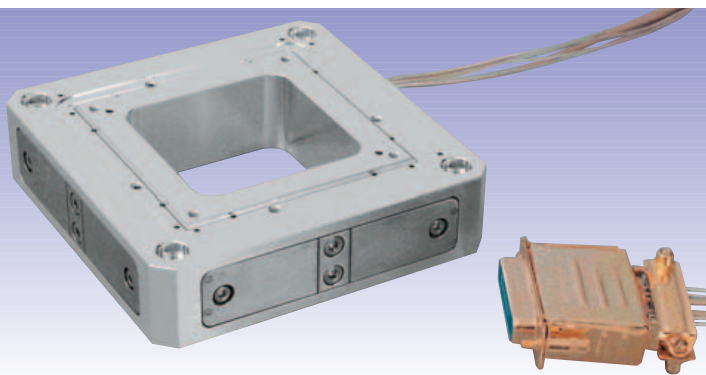
<http://www.pi.ws>
info@pi.ws

Technical Data

Models	P-733.2CL	P-733.2CD	Units	Notes see p. 2-44
Active axes	X,Y	X,Y		
Open-loop travel @ 0 to 100 V	100 × 100	100 × 100	μm ±20%	A2
Closed-loop travel ≥	100 × 100	100 × 100	μm	A5
Integrated feedback sensor	2 x capacitive	2 x capacitive	B	
Closed-loop / open-loop ** resolution ≤	0.3 / 0.2	0.3 / 0.2	nm	C1
Closed-loop linearity (typ.)	0.03	0.03	%	
Full-range repeatability (typ.)	±2.5	±2.5	nm	C3
Stiffness	2	2	N/μm ±20%	D1
Push/pull force capacity (in operating direction)	300 / 100	300 / 100	N	D3
Max. (±) normal load	2	2	kg	D4
Tilt (θ _x /θ _y) (typ.)	1/3	1/3	μrad	E1
Electrical capacitance	7.2 / axis	7.2 / axis	μF ±20%	F1
* Dynamic operating current coefficient (DOCC)	9 / axis	9 / axis	μA / (Hz x μm)	F2
Unloaded resonant frequency	500	500	Hz ±20%	G2
Resonant frequency @ 200 g load	340	340	Hz ±20%	G3
Resonant frequency @ 500 g load	230	230	Hz ±20%	G3
Operating temperature range	- 20 to 80	- 20 to 80	°C	H2
Voltage connection	2 x VL	sub-D, special		J1
Sensor connection	4 x C	sub-D, special		J2
Weight (with cables)	580	580	g ±5%	
Body material	Al	Al		L
Recommended Amplifier/ Controller (codes explained p. 6-46)	H, F, L	H, F, L		

* Dynamic Operating Current Coefficient in μA per hertz and μm. Example: Sinusoidal scan of 30 μm at 10 Hz requires approximately 2.7 mA drive current.

** Resolution of PZT NanoPositioners is not limited by friction or stiction. Noise equivalent motion with E-503 amplifier.



P-733.2UD nonmagnetic XY nanopositioner for ultrahigh vacuum up to 10⁻⁹ hPa.

Ordering Information

P-733.2CL

XY PZT Flexure Stage, 100 × 100 μm, Capacitive Sensors, Lemo Connectors

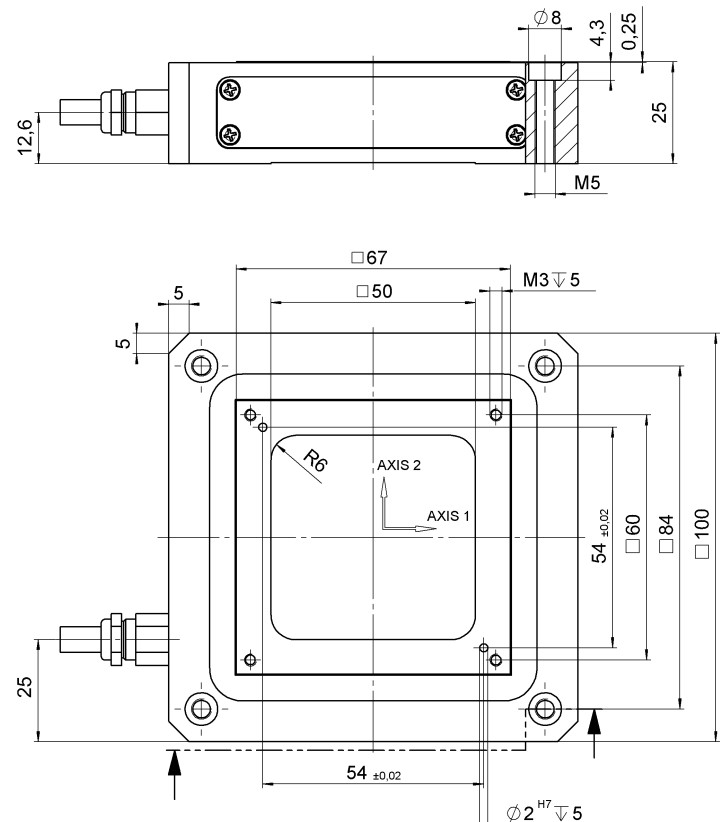
P-733.2CD

XY PZT Flexure Stage, 100 × 100 μm, Capacitive Sensors, Sub-D Connector

P-733.2UD

Ultrahigh Vacuum – XY PZT Flexure Stage, 100 × 100 μm, Capacitive Sensors, Non-Magnetic, Sub-D Connector

Custom Designs for Volume Buyers



P-733 dimensions (in mm)