P-733

High-Dynamics XY and XYZ Nanopositioning / Scanning Stages with Parallel Metrology

P-733.3CD XY scanning stage with active Z-axis
P-733 stages are ideal for single-molecule microscopy

- **Travel Ranges of 100 x 100 µm in X, Y and 10 µm in Z**
- **Direct Metrology with Capacitive Sensors**
- **Resolution to 0.1 nm**
- **Parallel Kinematics for Better Multi-Axis Accuracy and Dynamics**
- **Parallel Metrology for Active Trajectory Control**
- **50 x 50 mm Clear Aperture for Transmitted-Light Applications**

P-733 XY piezo driven stages are fast and highly accurate nanopositioning and scanning systems. They provide a positioning and scanning range of 100 x 100 (x 10) µm together with sub-nanometer resolution. The 50 x 50 mm clear aperture is ideal for transmitted-light applications such as near-field scanning microscopy. The high-speed Z-axis of the P-733.3CD can actively compensate any out-of-plane, Z-axis deviation during XY motion.

Application Examples

- Image processing / stabilization
- Scanning microscopy
- Metrology / Interferometry
- Biotechnology
- Semiconductor testing
- Mask / wafer positioning
- Micromanipulation
- Nanopositioning

Capacitive Sensors for Higher Linearity

Capacitive sensors measure position directly and without physical contact. This makes them free of friction and hysteresis, a fact which, in combination with the positioning resolution of well under 1 nm, makes it possible to achieve very high levels of linearity. A further advantage of direct metrology with capacitive sensors is the high phase fidelity and the high bandwidth of up to 10 kHz. The closed-loop resolution is 0.3 nm for the X and Y axes and 0.2 nm for the optional Z-axis.

Parallel Kinematics and Metrology for High Trajectory Fidelity

In a parallel kinematics multi-axis system, all actuators act directly on the same moving platform. This means that all axes see the same moved mass and can be designed with identical dynamic properties. Parallel kinematics systems have additional advantages over serially stacked systems, including more-compact construction, no cumulative error from the different axes and no moving cables to cause friction that degrades resolution and linearity. Parallel kinematics systems can be operated with up to six degrees of freedom with low inertia and excellent dynamic performance.

Multiaxis nanopositioning systems equipped with both parallel kinematics and Direct Metrology are able to measure platform position in all degrees of freedom against a common, fixed reference: i.e. parallel metrology. In such systems, undesirable motion from one actuator in the direction of another (cross-talk) is detected immediately and actively compensated by the servo-loops. Known as Active Trajectory Control Concept, the parallel kinematics/parallel metrology combination can keep deviation from a trajectory to under a few nanometers, even in dynamic operation.

Superior 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.

Wide Variety for Flexibility in Many Applications

For the highest dynamics applications, the P-733.2DD and P-733.3DD models with direct drive are available.

For Z-axis scanning applications, the P-733.ZCD version is available with a travel range of 100 µm.

For ultra-high-vacuum applications down to 10^{-9} hPa, nanopositioning systems as well as comprehensive accessories, such as suitable feedthroughs, are available.

Ordering Information

P-733.2CD
XY Piezo Nanopositioning / Scanning Stage, 100 x 100 µm, Capacitive Sensors, Parallel Metrology, Sub-D Connector

P-733.2CL
XY Piezo Nanopositioning / Scanning Stage, 100 x 100 µm, Capacitive Sensors, Parallel Metrology, LEMO Connector

P-733.3CD
XYZ Piezo Nanopositioning / Scanning Stage, 100 x 100 x 10 µm, Capacitive Sensors, Parallel Metrology, Sub-D Connector

P-733.3CL
XYZ Piezo Nanopositioning / Scanning Stage, 100 x 100 x 10 µm, Capacitive Sensors, Parallel Metrology, LEMO Connector

P-733.2VL
XY Piezo Nanopositioning / Scanning Stage, 100 x 100 µm, Capacitive Sensors, Parallel Metrology, LEMO Connector, Vacuum Compatible down to 10^{-6} hPa

P-733.2VD
XY Piezo Nanopositioning / Scanning Stage, 100 x 100 µm, Capacitive Sensors, Parallel Metrology, Sub-D Connector, Vacuum Compatible down to 10^{-6} hPa

P-733.2UD
XY Piezo Nanopositioning / Scanning Stage, 100 x 100 µm, Capacitive Sensors, Parallel Metrology, Sub-D Connector, Vacuum Compatible down to 10^{-9} hPa

Ask about custom designs.

P-733.2UD non-magnetic XY scanning stage for UHV to 10^{-9} hPa

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Tutorial: Piezo-electrics in Positioning
Capacitive Position Sensors
Piezo Drivers & Nano-positioning Controllers
Hexapods / Micropositioning
Photonics Alignment Solutions
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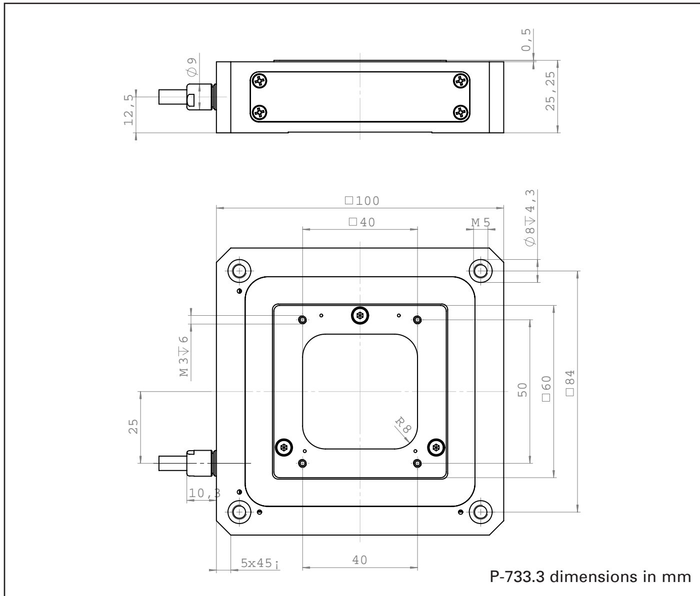
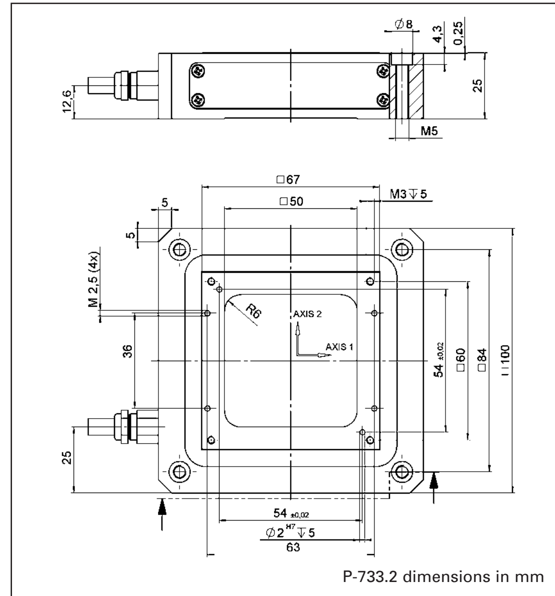


P-733.3 dimensions in mm



P-733.2 dimensions in mm

Technical Data

	P-733.2CD	P-733.3CD	Units	Tolerance
Active axes	X, Y	X, Y, Z		
Motion and positioning				
Integrated sensor	Capacitive	Capacitive		
Open-loop travel, -20 to +120 V	115 x 115	115 x 115 x 12	µm	min.
Closed-loop travel	100 x 100	100 x 100 x 10	µm	
Open-loop resolution	0.2	0.2 in X, Y, 0.1 in Z	nm	typical
Closed-loop resolution	0.3	0.3 in X, Y, 0.2 in Z	nm	typical
Linearization	0.01	0.01 in X, Y, 0.03 in Z	%	typical
Repeatability	<2	<2 in X, Y, 1 in Z	nm	typical
Pitch	2	1	µrad	typical
Yaw	10	10	µrad	typical
Mechanical properties				
Stiffness in motion direction	1.4	1.4 in X, Y, 9.0 in Z	N/µm	±20 %
Unloaded resonant frequency	460	460 in X, Y, 1400 in Z	Hz	±20 %
Resonant frequency @ 120 g	340	340 in X, Y, 1060 in Z	Hz	±20 %
Resonant frequency @ 200 g	295	295 in X, Y, 610 in Z	Hz	
Push/pull force capacity in motion direction	300 / 100	300 / 100	N	Max.
Load	20	20	N	Max.
Drive properties				
Ceramic type	PICMA®	PICMA®		
Electrical capacitance	6.0 per axis	6.0 in X, Y, 3.3 in Z	µF	±20 %
Dynamic operating current coefficient	7.5 per axis	7.5 in X, Y, 40 in Z	µA/(Hz x µm)	±20 %
Miscellaneous				
Operating temperature range	-20 to +80	-20 to +80	°C	
Material	Al	Al		
Mass	580	675	g	±5 %
Cable length	1.5	1.5	m	±10 mm
Sensor connection	Sub-D Mix (CD-version) 4x LEMO (CL-version)	Sub-D Mix (CD-version) 6x LEMO (CL-version)		
Voltage connection	Sub-D Mix (CD-version) 2x LEMO (CL-version)	Sub-D Mix (CD-version) 3x LEMO (CL-version)		
Recommended controller/amplifier	H, F, L	H, F, L		