

P-733 XY Stage and XYZ Stage with Piezo Flexure Drive

High-Precision XY(Z) Scanner Family with Aperture



P -733.3 DD (left) and P -733.2 DD, 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. CD for size comparison.

- Travel Ranges to 100 x 100 μm in X,Y & to 10 μm in Z
- Resolution to 0.1 nm with Capacitive Sensors
- High-Speed Versions with Direct Drive
- Vacuum and Non-Magnetic Versions
- Parallel Kinematics for Better Multi-Axis Accuracy and Dynamics
- Parallel Metrology for Active Trajectory Control
- Frictionless, High-Precision Flexure Guiding System
- Clear Aperture 50 x 50 mm for Transmitted-Light Applications

P-733 XY and XYZ piezo driven stages are fast and highly accurate nanopositioning and scanning systems. They provide a positioning and scanning range of 100 x 100 (x10) μm together with sub-nanometer resolution and are equipped with parallel-metrology capaci-

tive position feedback for superior multi-axis linearity and repeatability. The guiding accuracy minimizes runout to under 10 nm over the whole travel range. In addition, 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
- Surface inspection
- Metrology / interferometry
- Biotechnology
- Semiconductor testing
- Mask / wafer positioning
- Micromanipulation
- Nanopositioning with high flatness & straightness

Fastest Multi-Axis Systems / Direct Drive, Low Profile and Large Apertures

P-733.2DD / .3DD multi-axis piezo nanopositioning systems are the fastest ultra-high-precision, open-frame stages for scanning microscopy. They provide a positioning and scanning range of 30 x 30 (x10) μm . P-733 nanopositioning and scanning stages feature very low profiles, as low as 20 mm (0.8 inch). The novel, high-stiffness direct drive gives the systems resonant frequencies as high as 2.2 kHz (4 x that of

other comparable systems), enabling millisecond scanning rates with sub-nanometer resolution.

Parallel-Kinematics / Metrology for Enhanced Responsiveness

In a parallel kinematics multi-axis system, all actuators act directly on one moving platform. This means that all axes move the same minimized mass and can be designed with identical dynamic properties. Multi-axis nanopositioning systems equipped with both parallel kinematics and parallel, direct metrology are able to measure platform position in all degrees of freedom against one common fixed reference. 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.

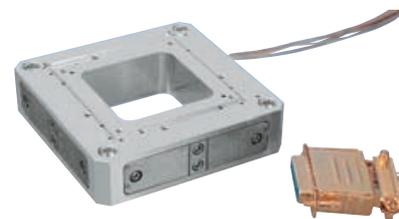
Capacitive Sensors for Subnanometer Resolution

PI's proprietary capacitive sensors measure position directly and without physical contact. They are 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. The direct drive versions are rated to 0.1 nm resolution for every axis.

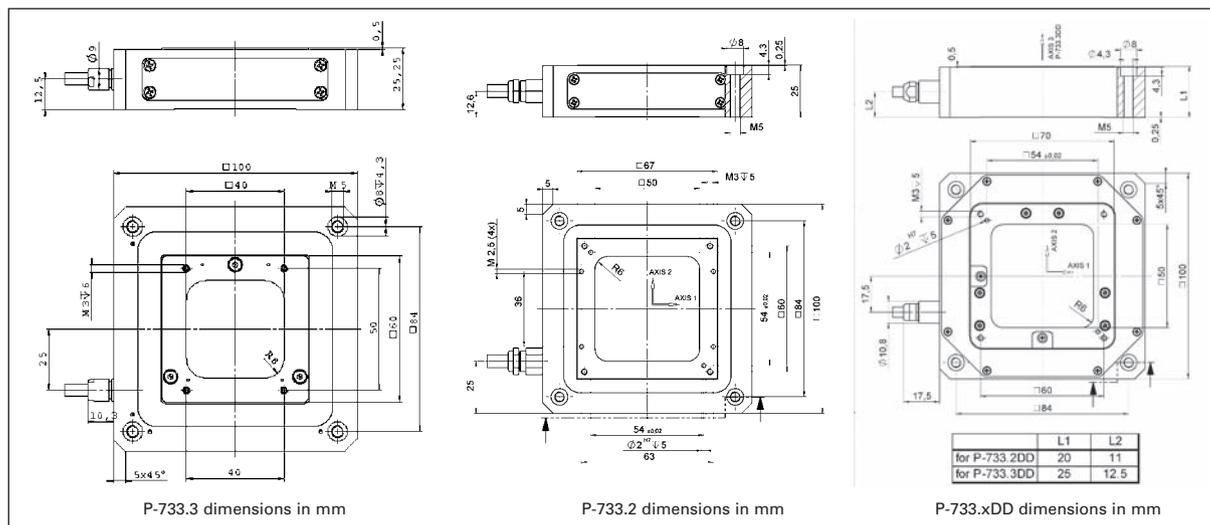
Large Variety of Models for a Broad Range of Applications

For Z-axis scanning applications, the P-733.ZCD (see

p. 2-42) 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.



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



Technical Data

Model	P-733.2CD P-733.2CL	P-733.3CD P-733.3CL	P-733.2DD	P-733.3DD	Units	Tolerance
Active axes	X, Y	X, Y, Z	X, Y	X, Y, Z		
Motion and positioning						
Integrated sensor	Capacitive	Capacitive	Capacitive	Capacitive		
Open-loop travel, -20 to +120 V	115 x 115	115 x 115 x 12	33 x 33	33 x 33 x 14	µm	min. (+20%/-0 %)
Closed-loop travel	100 x 100	100 x 100 x 10	30 x 30	30 x 30 x 10	µm	
Open-loop resolution	0.2	0.2 (0.1 in Z)	0.1	0.1	nm	typ.
Closed-loop resolution	0.3	0.3 (0.2 in Z)	0.1	0.1	nm	typ.
Linearity (X, Y)	0.03	0.03	0.03*	0.03*	%	typ.
Linearity (Z)	-	0.03	-	0.03*	%	typ.
Repeatability (X, Y)	<2	<2	<2	<2	nm	typ.
Repeatability (Z)	-	<1	-	<1	nm	typ.
Pitch (X,Y)	<±3	<±3	<±5	<±5	µrad	typ.
Yaw (X, Y)	<±10	<±10	<±10	<±10	µrad	typ.
Runout θZ (motion in Z)		<±5		<±5	µrad	typ.
Mechanical properties						
Stiffness	1.5	1.4 (9 in Z)	20	4 (10 in Z)	N/µm	±20 %
Unloaded resonant frequency	500	460 (1400 in Z)	2230	1200 (1100 in Z)	Hz	±20 %
Resonant frequency @ 120 g	370	340 (1060 in Z)	-	-	Hz	±20 %
Resonant frequency @ 200 g	340	295 (650 in Z)	1550	530 (635 in Z)	Hz	±20 %
Push/pull force capacity in motion direction	50/20	50/20	50/20	50/20	N	Max.
Drive properties						
Ceramic type	PICMA® P-885	PICMA® P-885	PICMA® P-885	PICMA® P-885		
Electrical capacitance	6	6 (2.4 in Z)	6.2	6.2 (3.3 in Z)	µF	±20 %
Dynamic operating current coefficient	7.5	7.5 (30 in Z)	25	25 (41 in Z)	µA	(Hz • µm) ±20 %
Miscellaneous						
Operating temperature range	-20 to 80	-20 to 80	-20 to 80	-20 to 80	°C	
Material	Aluminum	Aluminum	Aluminum	Aluminum		
Mass	0.58	0.675	0.58	0.675	kg	±5 %
Cable length	1.5	1.5	1.5	1.5	m	±10 mm
Sensor/ voltage connection	Sub-D special (CD-version) LEMO (CL-version)	Sub-D special (CD-version) LEMO (CL-version)	Sub-D special	Sub-D special		

*With digital controller. Non-linearity of direct drive stages measured with analog controllers is up to 0.1 % typ.

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)

Multi-channel digital controllers: E-710 bench-top (p. 2-128), E-712 modular (p. 2-140), E-725 high-power (p. 2-126), E-761 PCI board (p. 2-130)