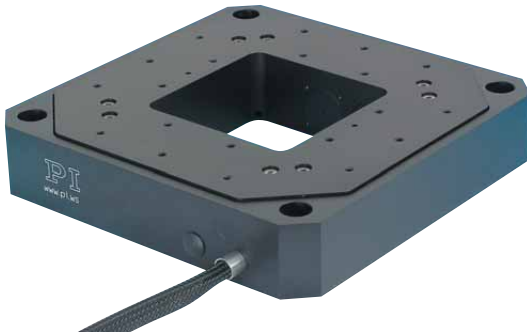


P-518, P-528, P-558 Piezo Z/Tip/Tilt Stage

High-Dynamics with Large Clear Aperture



P-528 Z/Tip/Tilt piezo nanopositioning system

- 1- and 3-Axis Versions
- Closed-Loop Vertical / Tilt Range to 200 μm / 2 mrad (Open-Loop to 240 / 2.4)
- Parallel Kinematics / Metrology for Enhanced Responsiveness & Multi-Axis Precision
- Frictionless, High-Precision Flexure Guiding System
- Outstanding Lifetime Due to PICMA® Piezo Actuators
- Clear Aperture 66 x 66 mm
- Capacitive Sensors for Highest Linearity

P-5x8 series, Z/Tip/Tilt nanopositioners / scanners are open-frame, high-resolution, piezo-driven stages providing motion to 240 μm and 2.4 mrad with resolutions of up to 0.5 nm and 50 nrad. The 66 x 66 mm clear aperture is ideal for transmitted-light applications.

XY and XYZ multi-axis versions in the same form factor

Application Examples

- Metrology
- Interferometry
- Optics
- Lithography
- Scanning microscopy
- Mass storage device testing
- Laser technology
- Micromachining

are also offered as P-517, P-527 (see p. 2-70) models with six degrees of freedom are available upon request.

Capacitive Position Sensors for Higher Accuracy

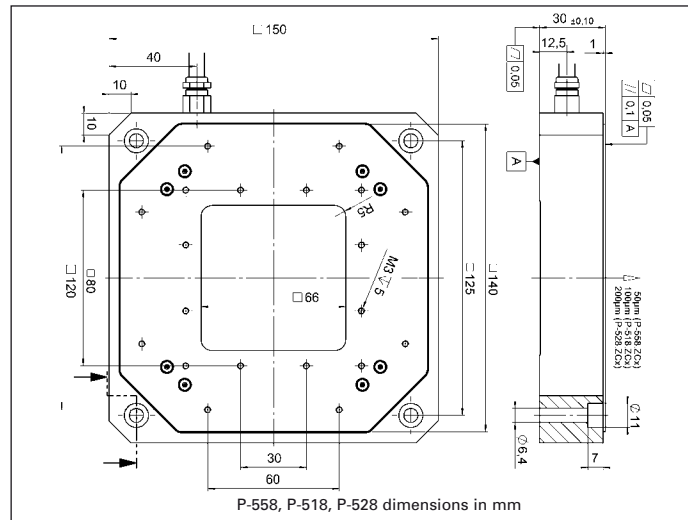
PI's proprietary capacitive sensors measure position directly and without physical contact.

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.

Excellent Guiding Accuracy

Flexures optimized with Finite Element Analysis (FEA) are used to guide the stage. FEA techniques are used to give the design the highest possible stiffness in, and perpendicular to, the direction of motion, and to minimize linear and angular runout. Flexures allow extremely high-precision motion, no matter how minute, as they are completely free of play and friction.

Flatness and Straightness is further enhanced by active trajectory control: 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



Ordering Information

P-558.ZCD
Precision Nanopositioning Z-Stage, 50 μm , Direct Metrology, Capacitive Sensors, Sub-D Connector

P-558.ZCL
Precision Nanopositioning Z-Stage, 50 μm , Direct Metrology, Capacitive Sensors, LEMO Connector

P-518.ZCD
Precision Nanopositioning Z-Stage, 100 μm , Direct Metrology, Capacitive Sensors, Sub-D Connector

P-518.ZCL
Precision Nanopositioning Z-Stage, 100 μm , Direct Metrology, Capacitive Sensors, LEMO Connector

P-528.ZCD
Precision Nanopositioning Z-Stage, 200 μm , Direct Metrology, Capacitive Sensors, Sub-D Connector

P-528.ZCL
Precision Nanopositioning Z-Stage, 200 μm , Direct Metrology, Capacitive Sensors, LEMO Connector

P-558.TCD
Precision Nanopositioning Z/Tip/Tilt Stage, 50 μm , 0.6 mrad, Parallel Metrology, Capacitive Sensors, Sub-D Connector

P-518.TCD
Precision Nanopositioning Z/Tip/Tilt Stage, 100 μm , 1.4 mrad, Parallel Metrology, Capacitive Sensors, Sub-D Connector

P-528.TCD
Precision Nanopositioning Z/Tip/Tilt Stage, 200 μm , 2.4 mrad, Parallel Metrology, Capacitive Sensors, Sub-D Connector

systems, undesirable motion from one actuator in the direction of another (cross-talk) is detected immediately and actively compensated by the servo-loops. This Active Trajectory Control Concept can keep deviation from a trajectory to under a few nanometers, even in dynamic operation.

Higher Precision in Periodic Motion

The highest dynamic accuracy in scanning applications is

made possible by the DDL algorithm, which is available in PI's modern digital controllers. DDL eliminates tracking errors, improving dynamic linearity and usable bandwidth by up to three orders of magnitude!

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.

Technical Data

Model	P-558.ZCD/ P-558.ZCL	P-558.TCD	P-518.ZCD/ P-518.ZCL	P-518.TCD	P-528.ZCD/ P-528.ZCL	P-528.TCD	Units	Tolerance
Active axes	Z	Z, θ_x , θ_y	Z	Z, θ_x , θ_y	Z	Z, θ_x , θ_y		
Motion and positioning								
Integrated sensor	Capacitive	Capacitive	Capacitive	Capacitive	Capacitive	Capacitive		
Open-loop travel, -20 to +120 V	60	60	140	140	240	240	μm	min. (+20%/-0%)
Open-loop tip/tilt angle, -20 to +120 V	–	± 0.3 mrad	–	± 0.7 mrad	–	± 1.2 mrad	mrad	min. (+20%/-0%)
Closed-loop travel	50	50	100	100	200	200	μm	
Closed-loop tip/tilt angle	–	± 0.25 mrad	–	± 0.5 mrad	–	± 1 mrad	mrad	
Open-loop resolution	0.2	0.2	0.2	0.4	0.6	0.6	nm	typ.
Open-loop tip/tilt angle resolution	–	0.02	–	0.04	–	0.06	μrad	typ.
Closed-loop resolution	0.5	0.5	0.8	0.8	1	1	nm	typ.
Closed-loop tip/tilt resolution	–	0.05	–	0.05	–	0.1	μrad	typ.
Linearity θ_x , θ_y	–	0.03	–	0.03	–	0.03	%	typ.
Repeatability	± 5	± 5	± 5	± 5	± 10	± 10	nm	typ.
Repeatability θ_x , θ_y	–	± 0.03	–	± 0.05	–	± 0.1	μrad	typ.
Runout θ_z (Z motion)	<10	<10	<10	<10	<20	<20	μrad	typ.
Runout θ_x , θ_y (Z motion)	<50	<50	<50	<50	<100	<100	μrad	typ.
Mechanical properties								
Stiffness	4	4	2.7	2.7	1.5	1.5	N/ μm	$\pm 20\%$
Unloaded resonant frequency (Z)	570	570	500	500	350	350	Hz	$\pm 20\%$
Unloaded resonant frequency (θ_x , θ_y)	–	610	–	530	–	390	Hz	$\pm 20\%$
Resonant frequency @ 30 g in Z	410	410	350	350	210	210	Hz	$\pm 20\%$
Resonant frequency @ 500 g in X, Y	–	430	–	370	–	250	Hz	$\pm 20\%$
Resonant frequency @ 2500 g in Z	245	245	200	200	130	130	Hz	$\pm 20\%$
Resonant frequency @ 2500 g θ_x , θ_y	–	240	–	190	–	115	Hz	$\pm 20\%$
Push/pull force capacity	100 / 50	100 / 50	100 / 50	100 / 50	100 / 50	100 / 50	N	Max.
Drive properties								
Ceramic type	PICMA® P-885	PICMA® P-885	PICMA® P-885	PICMA® P-885	PICMA® P-885	PICMA® P-885		
Electrical capacitance	6	6	8.4	8.4	14.8	14.8	μF	$\pm 20\%$
Dynamic operating current coefficient	15	15	10.5	10.5	9.2	9.2	$\mu\text{A}/(\text{Hz}\cdot\mu\text{m})$	$\pm 20\%$
Miscellaneous								
Operating temperature range	-20 to 80	-20 to 80	-20 to 80	-20 to 80	-20 to 80	-20 to 80	$^{\circ}\text{C}$	
Material	Aluminum	Aluminum	Aluminum	Aluminum	Aluminum	Aluminum		
Dimensions	150 x 150 x 30	150 x 150 x 30	150 x 150 x 30	150 x 150 x 30	150 x 150 x 30	150 x 150 x 30	mm	
Mass	1380	1380	1400	1400	1420	1420	g	$\pm 5\%$
Cable length	1.5	1.5	1.5	1.5	1.5	1.5	m	± 10 mm
Sensor / voltage connection	CD-version: Sub-D special CL-version: LEMO	Sub-D Special	CD-version: Sub-D special CL-version: LEMO	Sub-D Special	CD-version: Sub-D special CL-version: LEMO	Sub-D Special		

Resolution of PI Piezo Nanopositioners is not limited by friction or stiction. Value given is noise equivalent motion with E-503 (p. 2-146) or E-710 controller (p. 2-128) Recommended controller

CD-Versions:

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

Single-channel digital controller: E-753 (bench-top) (p. 2-108)

CL-Versions:

Single-channel: E-500 modular piezo controller system (p. 2-142) with E-505 (p. 2-147) high-power amplifier module and E-509 servo-controller (p. 2-152)

Multi-channel versions:

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)

Linear Actuators & Motors

Nanopositioning / Piezoelectrics

Piezo Flexure Stages / High-Speed Scanning Systems

Linear

Vertical & Tip/Tilt

2- and 3-Axis

6-Axis

Fast Steering Mirrors / Active Optics

Piezo Drivers / Servo Controllers

Single-Channel

Multi-Channel

Modular

Accessories

Piezoelectrics in Positioning

Nanometrology

Micropositioning

Index