

## P-631 Compact Piezo Nanopositioning System

### Cost-Effective, Scalable Design for High-Volume Applications

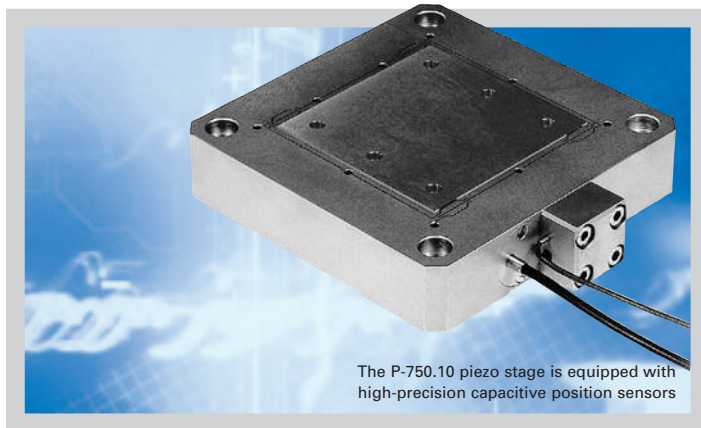


- Cost-Effective, Compact Design for High-Volume Applications
- Travel Range 100 µm, Longer Ranges on Request
- Direct Metrology with Capacitive Sensors
- Resolution to 0,2 nm
- Outstanding Lifetime Due to PICMA® Piezo Actuators
- Mechanically Compatible to P-621 PIHera® Nanopositioning Stages

Model	Closed-loop / open-loop travel @ -20 to +120 V	Closed-loop / open-loop resolution	Linearity	Pitch / yaw	Load capacity
P-631.1CD	120 / 100 µm	0.2 / 0.4 nm	0.02%	25 µrad	10 N

## P-750 Piezo Nanopositioning System

### Dynamic High-Load Nanopositioning Stages with Direct Metrology



- 1 nm Lateral Guiding Accuracy
- Frictionless, High-Precision Flexure Guiding System
- Load Capacity 10 kg
- Resolution <1 nm
- Superior Accuracy With Direct-Metrology Capacitive Sensors
- Direct Drive for Faster Response
- 75 µm Travel Range
- Outstanding Lifetime Due to PICMA® Piezo Actuators

Model	Closed-loop / open-loop travel	Closed-loop / open-loop resolution	Load capacity	Rotation around $\theta_x, \theta_y$	Unloaded resonant frequency
P-750.00	- / 75 µm	- / 0.4 nm	100 N	±10 µrad	600 Hz
P-750.20 with capacitive sensor	75 / 75 µm	1 / 0.4 nm	100 N	±10 µrad	600 Hz

## P-772 Miniature Nanopositioning System

### High Dynamics and Direct Position Measurement



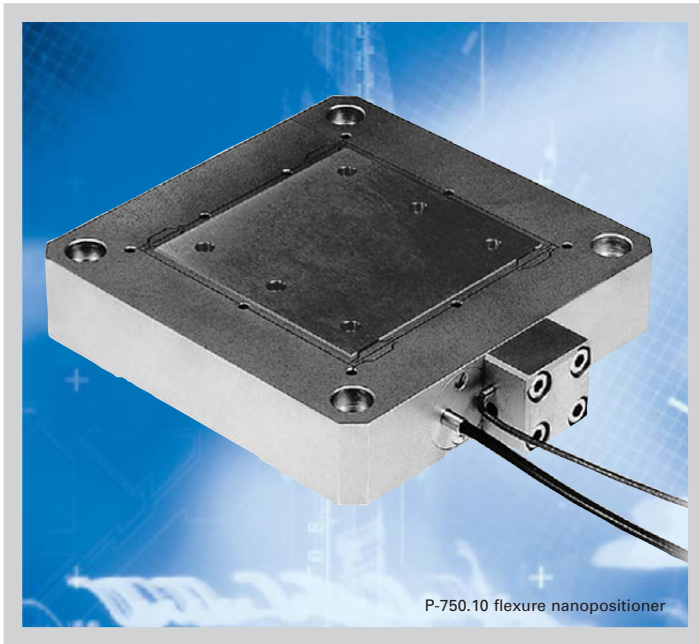
- Smallest Stage with Direct Metrology
- Frictionless, High-Precision Flexure Guiding System
- Resolution <0.1 nm
- Travel Range to 12 µm
- Closed-Loop and Open-Loop Versions
- Rapid Response and Settling
- Outstanding Lifetime Due to PICMA® Piezo Actuators

Modell	Closed-loop / open-loop travel @ 0 to +100 V	Closed-loop / open-loop resolution	Linearity	Unloaded resonant frequency	Load capacity
P-772.1CD / P-772.1CL	10 / 12 µm	0.05 / 0.05 nm	0.03%	1.7 kHz	5 N
P-772.0L	- / >10 µm	- / 0.05 nm	-	1.7 kHz	5 N

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# P-750

## High-Load Piezo-Driven Nanopositioning Stages with Direct Metrology



P-750.10 flexure nanopositioner

- 10 kg Load Capacity
- 1 nm Lateral Guiding Precision
- Resolution <1 nm
- PICMA® High-Performance Piezo Drives
- Fast Response
- 75 µm Travel Range
- Direct Metrology with Capacitive Sensors for Highest Precision
- Frictionless Precision Flexure Guiding System

P-750 high-load, piezo-driven flexure-guided, nanopositioning stages are designed to provide motion in one axis with extremely low off-axis error. They feature a positioning and scanning range up to 75 µm with fast settling, on the order of a few milliseconds. Closed-loop versions with integrated

capacitive and LVDT (linear variable differential transformer) feedback sensors are offered for enhanced accuracy and repeatability.

### Superior Accuracy Through Direct-Motion Metrology

The capacitive-sensor equipped versions (P-750.10) permit motion linearity to 0.03% with effective resolution in the sub-nanometer range. PI capacitive sensors are absolute-measuring, direct-metrology devices that boast very high bandwidth and exhibit no periodic errors.

Unlike conventional indirect sensors, capacitive sensors

measure the actual distance between the fixed frame and the moving part of the stage. They detect errors contributed by all components in the drive train—from the actuator through the flexures to the platform. This results in higher motion linearity, long-term stability, phase fidelity, and—because external disturbances are seen by the sensor immediately—a stiffer, faster-responding servo-loop. See p. 2-4 *ff.* and p. 5-2 *ff.* for more information.

P-750.10 models are equipped with lower-cost, direct-metrology LVDT sensors providing 10 nm resolution.

### Dynamic Digital Control for Best Scanning Linearity

Use our new digital control electronics with DDL (Dynamic Digital Linearization) to increase linearity and effective bandwidth in scanning applications by up to 1000-fold (see p. 6-16). By virtually eliminating tracking errors, DDL also increases the usable travel range.

### Working Principle / Reliability

P-750 nanopositioning stages are equipped with the award winning PICMA® piezo drives, integrated into a sophisticated single-module, flexure guiding system. The wire-EDM-cut flexures are FEA modeled for zero stiction, zero friction and exceptional guiding precision. The ceramic-encapsulated PICMA® drives are more robust than conventional piezo actuators, featuring superior lifetime and performance in both dynamic and static applications. Because guidance, actuators and sensors are all frictionless and maintenance-free, these nanopositioning systems achieve outstanding levels of reliability.

### Ordering Information

**P-750.00**  
Piezo Flexure Stage, 75 µm

**P-750.10**  
Piezo Flexure Stage, 75 µm, LVDT Sensor

**P-750.20**  
Piezo Flexure Stage, 75 µm, Capacitive Sensor

**Ask about custom designs!**

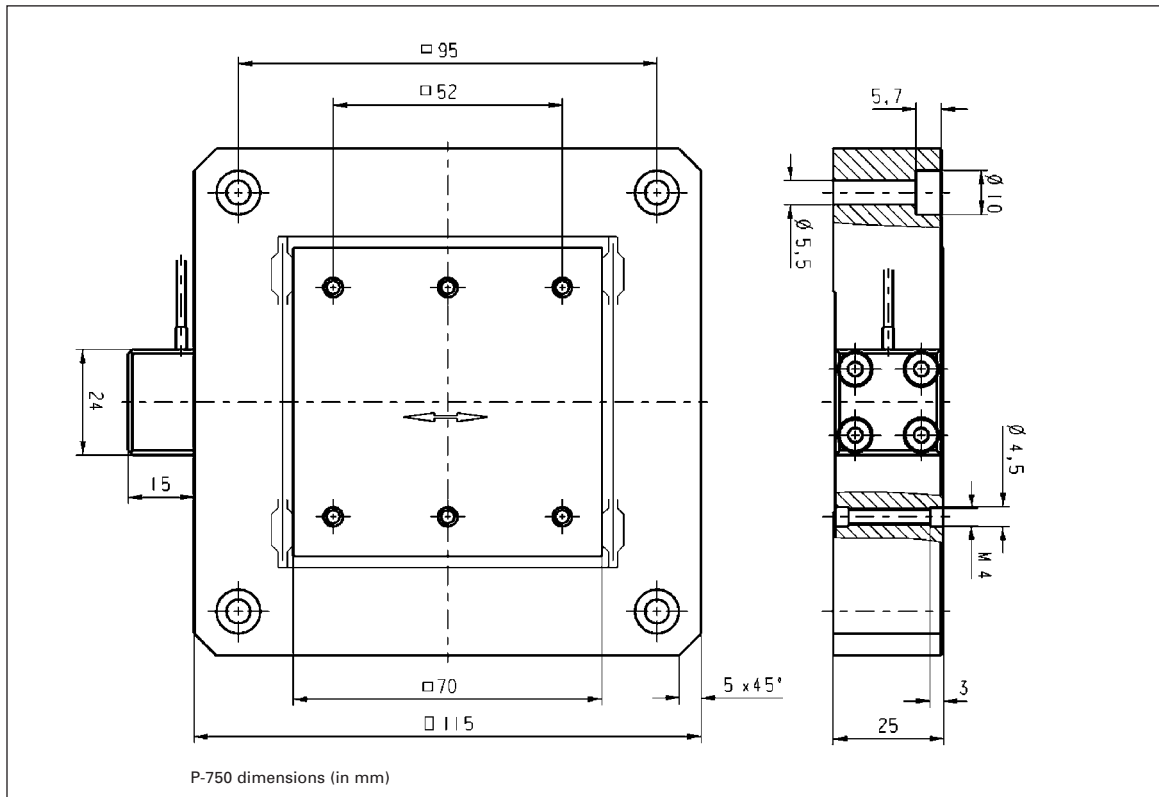
### Notes

See the “Piezo Drivers & Nanopositioning Controllers” section, p. 6-8 *ff.* for our comprehensive line of low-noise control electronics.

See the “Selection Guide” on p. 2-14 *ff.* for comparison with other nanopositioning systems.

### Application Examples

- Metrology
- Disk drive testing
- Wafer steppers
- Semiconductor equipment



### Technical Data

Models	P-750.00	P-750.10	P-750.20	Units	Notes see p. 2-84
Active axes	X	X	X		
Open-loop travel @ 0 to 100 V	75	75	75	$\mu\text{m} \pm 20\%$	A2
Closed-loop travel	-	75	75	$\mu\text{m}$	A5
Integrated feedback sensor	-	LVDT	capacitive		B
* Closed-loop / open-loop resolution	- / 1	10 / 1	1 / 1	nm	C1
Closed-loop linearity (typ.)	-	0.1	0.03	%	
Full-range repeatability (typ.)	-	$\pm 20$	$\pm 3$	nm	C3
Stiffness	12	12	12	$\text{N}/\mu\text{m} \pm 20\%$	D1
Push/pull force capacity (in operating direction)	800 / 100	800 / 100	800 / 100	N	D3
Max. ( $\pm$ ) normal load	100	100	100	N	D4
Lateral force limit	50	50	50	N	D5
Tilt ( $\theta_x, \theta_y$ ) (typ.)	10	10	10	$\mu\text{rad}$	E1
Lateral runout (Y) (typ.)	1	1	1	nm	E2
Electrical capacitance	7.5	7.5	7.5	$\mu\text{F} \pm 20\%$	F1
** Dynamic operating current coefficient (DOCC)	12.5	12.5	12.5	$\mu\text{A}/(\text{Hz} \pm \mu\text{m})$	F2
Unloaded resonant frequency	600	600	600	$\text{Hz} \pm 20\%$	G2
Resonant frequency @ 1900 g load	250	250	250	$\text{Hz} \pm 20\%$	G3
Operating temperature range	-20 to 80	-20 to 80	-20 to 80	$^{\circ}\text{C}$	H2
Voltage connection	VL	VL	VL		J1
Sensor connection	-	L	2 x C		J2
Weight (with cables)	2500	2550	2550	$\text{g} \pm 5\%$	
Body material	N-S	N-S	N-S		L
Recommended amplifier/controller (codes explained p. 2-17)	G, C	H, E	H, F, L		

\* For calibration information see p. 2-8. Resolution of PI piezo nanopositioners is not limited by friction or stiction. The value given is noise equivalent motion with E-503 amplifier.

\*\* Dynamic Operating Current Coefficient in  $\mu\text{A}$  per Hz and  $\mu\text{m}$ . Example: Sinusoidal scan of  $30 \mu\text{m}$  at 10 Hz requires approximately 3.8 mA drive current.

Piezo Actuators

**Nanopositioning & Scanning Systems**

Active Optics / Steering Mirrors

Tutorial: Piezo-electrics in Positioning

Capacitive Position Sensors

Piezo Drivers &amp; Nanopositioning Controllers

Hexapods / Micropositioning

Photonics Alignment Solutions

Motion Controllers

Ceramic Linear Motors &amp; Stages

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