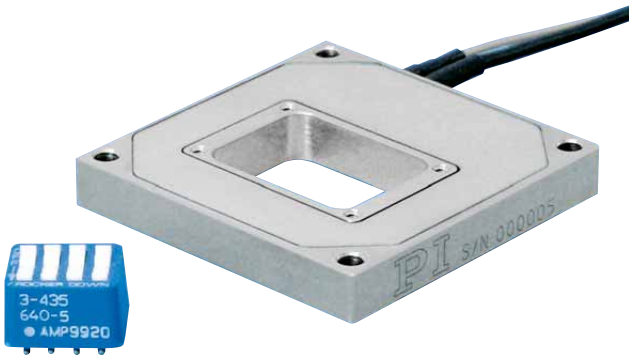


P-712 Low-Profile Piezo Scanner

Compact OEM System



P-712 piezo scanner with up to 40 µm travel range

- High Dynamic, to 5 ms Settling Time
- Travel Range up to 40 µm
- Resolution to 0.2 nm
- Compact Design with Low Profile, 40 x 40 x 6 mm
- Clear Aperture 25 x 15 mm
- PICMA® High-Power Actuators

P-712 piezo scanners are ideal for applications where limited space requires small-sized equipment. The high resonant frequency allows for fast linear scanning with 30 µm travel in one axis and provides settling times of about 5 ms. The P-712 linear scanner is offered in two versions, one with SGS position sensors for closed-loop operation, and one without sensors for open-loop.

Application Examples

- Optical path tuning
- Biotechnology
- Medical technology
- Image processing / stabilization
- CCD / CMOS camera technology

A similar XY version is available with product number P-713 / P-714 (see p. 2-56).

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.

Electric discharge machining (EDM) with fine cutting wires is used to obtain the required precision for the flexures which make up the guidance system and determine the stiffness.

Optional Position Control

High-resolution, broadband, strain gauge sensors (SGS) are applied to appropriate locations on the drive train and measure the displacement of the moving part of the stage relative to the base indirectly. The SGS sensors assure optimum position stability in the nanometer range and fast response.

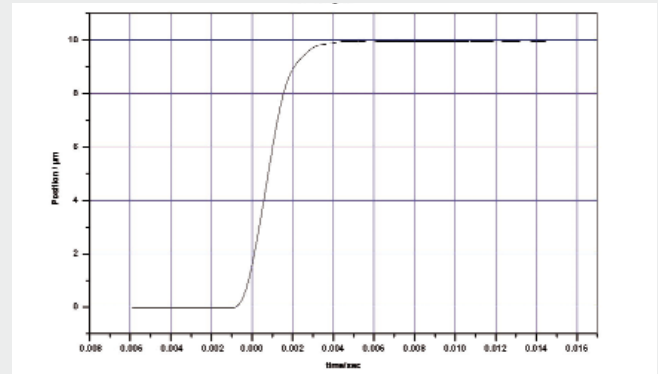
Ceramic Insulated Piezo Actuators Provide Long Lifetime

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

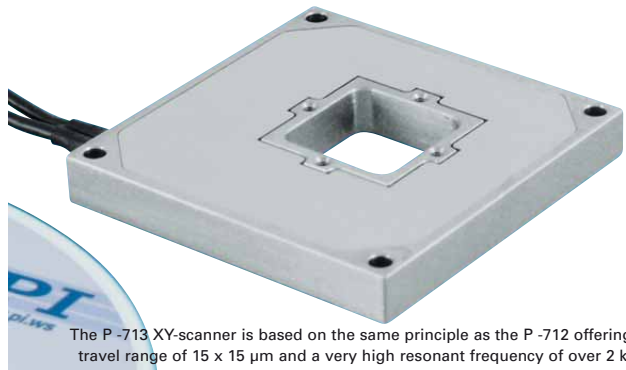
Ordering Information

- P-712.10L**
Low-Profile OEM Nanoscanner,
40 µm, Open-Loop
- P-712.1SL**
Low-Profile OEM Nanoscanner,
30 µm, SGS-Sensor

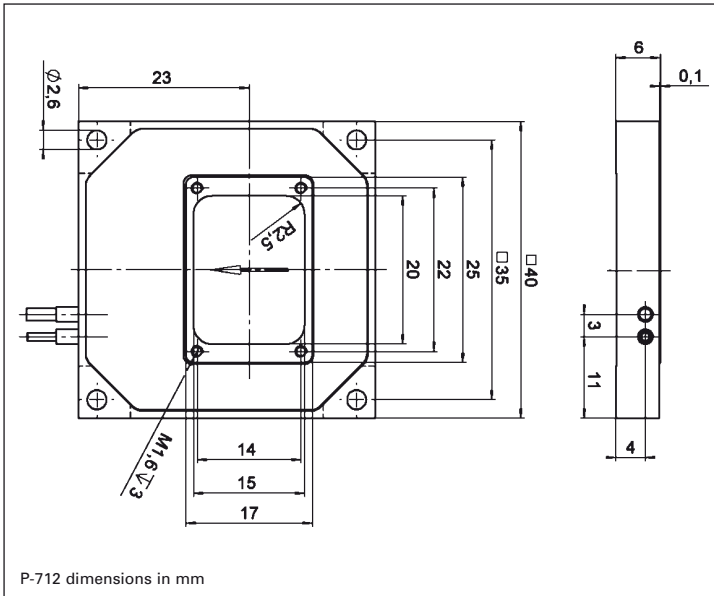
resistant to ambient humidity and leakage-current failures. They are thus far superior to conventional actuators in reliability and lifetime.



Settling time for the P-712 at 30 µm is in the 5 ms range



The P-713 XY-scanner is based on the same principle as the P-712 offering a travel range of 15 x 15 µm and a very high resonant frequency of over 2 kHz



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

Technical Data

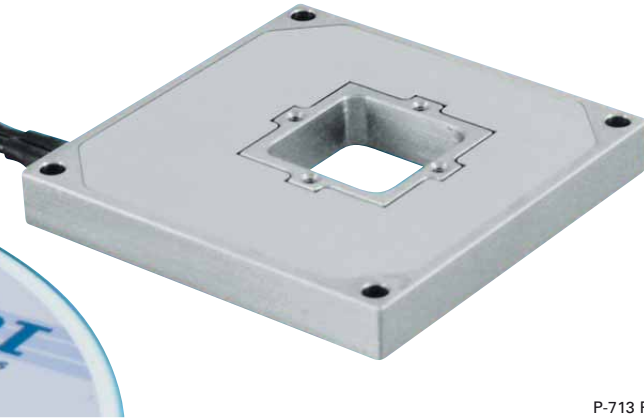
Model	P-712.1SL	P-712.10L	Units	Tolerance
Active axes	X	X		
Motion and positioning				
Integrated sensor	SGS	–		
Open-loop travel, -20 to +120 V	40	40	µm	min. (+20%/0%)
Closed-loop travel	30	–	µm	calibrated
Closed-loop resolution	2	–	nm	typ.
Open-loop resolution	0.2	0.2	nm	typ.
Linearity, closed-loop	0.3	–	%	typ.
Repeatability	±5	–	nm	typ.
Pitch	±5	±5	µrad	typ.
Yaw	±20	±20	µrad	typ.
Mechanical properties				
Stiffness in motion direction	0.6	0.6	N/µm	±20%
Unloaded resonant frequency	1550	1550	Hz	±20%
Resonant frequency under load	1090 (20 g)	1090 (20 g)	Hz	±20%
Push/pull force capacity in motion direction	6	6	N	Max.
Load capacity	5	5	N	Max.
Lateral Force	6	6	N	Max.
Drive properties				
Ceramic type	PICMA® P-882	PICMA® P-882		
Electrical capacitance	0.3	0.3	µF	±20%
Dynamic operating current coefficient	1.3	1.3	µA/(Hz • µm)	±20%
Miscellaneous				
Operating temperature range	-20 to 80	-20 to 80		
Material	Stainless steel	Stainless steel		
Dimensions	40 x 40 x 6	40 x 40 x 6	mm	
Mass	0.095	0.095	kg	±5%
Cable length	1.5	1.5	m	±10 mm
Voltage connection	LEMO	LEMO		
Sensor connector	LEMO	–		

Recommended controller / amplifier

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

P-713 XY Piezo Scanner

Cost-Effective OEM System with Low Profile



P-713 Piezo Scanner

- **Ideal for Pixel Sub-Stepping in Image Enhancement**
- **Small Footprint and Low Profile: 45 x 45 x 6 mm with Clear Aperture**
- **Very Cost-Effective Design**
- **Travel Ranges to 20 x 20 μm**
- **Parallel Kinematics for Better Multi-Axis Accuracy and Dynamics**

P-713 family piezo scanners and positioners with travel ranges of 15 x 15 μm feature especially compact designs. Ideal applications for the P-713 are high-dynamic scanning or tracking moves, all with closed-loop methods for enhancing image resolution. Such tasks involve moving to specific positions in a small area (e.g. marked cells or CCD photosites) and from there following or performing motion

with an amplitude of a few microns. The resonant frequency of up to over 2 kHz makes for settling times of a few milliseconds, even after a full-range move, all with closed-loop repeatability of under 5 nm. A single-axis version with similar footprint is available as P-712 (see p. 2-14) and XY versions with longer travel ranges are available on request.

Flexibility

The basic version of the P-713 nanopositioner offers a guiding accuracy in the motion plane of 50 μrad . This value is generally sufficient for dithering and interlacing tasks in scanning patterns of a few microns. For more demanding applications, the P-714 offers higher accuracy of typically < 25 μrad .

Nanometer Position Servo-Control

If servo-control is required and no external position sensor is

available, the P-713.2SL version, equipped with high-resolution strain gauge sensors (SGS) can provide nanometer-range resolution.

High-resolution, broadband, strain gauge sensors (SGS) are applied to appropriate locations on the drive train and measure the displacement of the moving part of the stage relative to the base indirectly. The SGS sensors assure optimum position stability in the nanometer range and fast response.

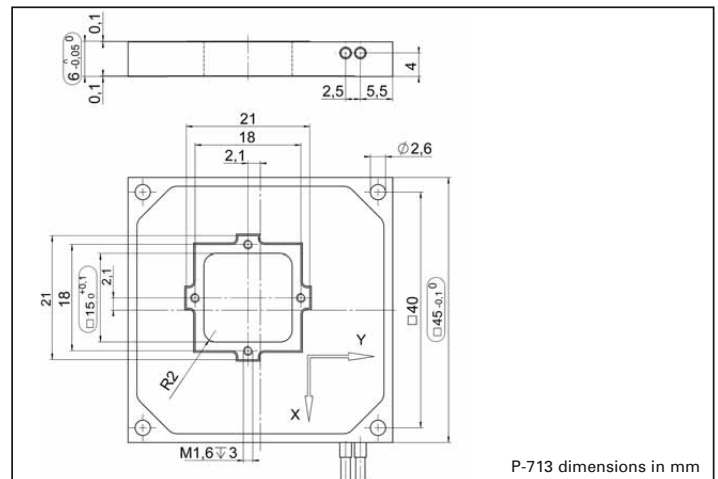
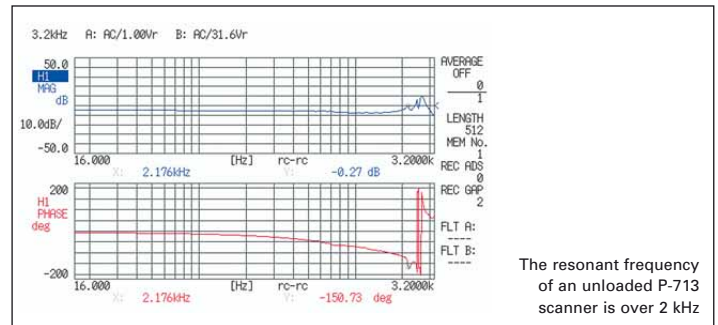
Ceramic Insulated Piezo Actuators Provide Long Lifetime

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

Ordering Information

- P-713.20L**
Low-Profile OEM XY Nanoscanner, 20 x 20 μm , No Sensor, LEMO Connector
- P-713.2SL**
Low-Profile OEM XY Nanoscanner, 15 x 15 μm , SGS-Sensor, LEMO Connector

and leakage-current failures. They are thus far superior to conventional actuators in reliability and lifetime. See the "Selection Guide" for comparison with other nanopositioning systems (see p. 2-4 ff).



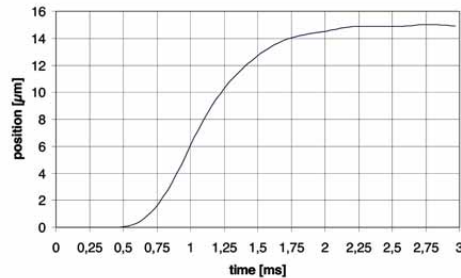
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Application Examples

- Pixel dithering / sub-stepping image resolution enhancement
- Quality assurance testing
- Optical Metrology
- Microscopy
- Imaging
- CCD / CMOS camera technology

System properties

System controller	P-713.2SL with modular system E-500 (E-503 amplifier and E-509 sensor module); 20 g load
Bandwidth, small signal	300 Hz
Bandwidth, large signal	220 Hz
Settling time (10% step width)	3.1 ms
Settling time (full travel)	4.5 ms



Settling time for the P-713 at 15 µm is in the 2 ms range

Technical Data

Model	P-713.20L	P-713.2SL	Units	Tolerance
Active axes	X, Y	X, Y		
Motion and positioning				
Integrated sensor	-	SGS		
Open-loop travel, -20 to +120 V	20	20	µm	min. (+20%/0%)
Closed-loop travel	-	15	µm	
Open-loop resolution	0.1	0.1	nm	typ.
Closed-loop resolution	-	1	nm	typ.
Linearity	-	0.3	%	typ.
Repeatability	-	<4	nm	typ.
Pitch	typ. ±1 max. ±5	typ. ±1 max. ±5	µrad	typ.
Yaw	typ. ±40 max. ±50	typ. ±40 max. ±50	µrad	µrad
Mechanical properties				
Stiffness	0.8	0.8	N/µm	±20%
Unloaded resonant frequency	2250	2250	Hz	±20%
Resonant frequency under load	1310 (20 g) 1020 (50 g) 460 (100 g)	1310 (20 g) 1020 (50 g) 460 (100 g)	Hz	±20%
Push/pull force capacity in motion direction	5 / 5	5 / 5	N	Max.
Load capacity	2	2	N	Max.
Drive properties				
Ceramic type	PICMA® P-882	PICMA® P-882		
Electrical capacitance in X, Y	0.31	0.31	µF	±20%
Dynamic operating current coefficient (DOCC) in X, Y	2.5	2.5	µA/(Hz • µm)	±20%
Miscellaneous				
Operating temperature range	-20 to 80	-20 to 80	°C	
Material	Stainless steel, ferromagnetic	Stainless steel, ferromagnetic		
Dimensions	45 x 45 x 6	45 x 45 x 6		
Mass	0.1	0.1	kg	±5%
Cable length	1.5	1.5	m	±10 mm
Sensor connection	-	LEMO		
Voltage connection	LEMO	LEMO		

Resolution of PI piezo nanopositioners is not limited by friction or stiction. Value given is noise equivalent motion with E-503 amplifier (p. 2-146)
 Dynamic Operating Current Coefficient in µA per Hz and µm. Example: Sinusoidal scan of 10 µm at 100 Hz requires approximately 2.5 mA drive current.
 Recommended controller / amplifier
 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)

Linear Actuators & Motors

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Linear
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