

S-330 Piezo Tip/Tilt-Platform

High-Dynamics, Large-Angle Piezo Tip/Tilt Platforms for Fast Steering Mirrors



S-330 tip/tilt platforms with optical beam deflection angles of 4, 10 and 20 mrad

- Resolution to 20 nrad, Excellent Position Stability
- Optical Beam Deflection to 20 mrad ($>1^\circ$)
- Higher Dynamics, Stability & Linearity Through Parallel-Kinematics Design
- Sub-Millisecond Response
- For Mirrors up to 50 mm Diameter
- Closed-Loop Versions for Better Linearity
- Excellent Temperature Stability

S-330 piezo tip/tilt platforms are fast and compact tip/tilt units, providing precise angular motion of the top platform around two orthogonal axes.

Application Examples

- Image processing / stabilization
- Interlacing, dithering
- Laser scanning / beam steering
- Optics
- Optical filters / switches
- Beam stabilization

These flexure-guided, piezo-electric platforms can provide higher accelerations than other implementations, enabling step response times in the sub-millisecond range. Closed-loop and open-loop versions with 3 different tilt ranges up to 10 mrad (20 mrad optical deflection) are available.

Parallel-kinematics design for improved stability, linearity and dynamics

PI piezo tip/tilt mirror systems are based on a parallel-kinematics design with coplanar axes and a single moving platform. Two pairs of differential-

ly-driven piezo actuators are employed to provide the highest possible angular stability over a wide temperature range. Compared to stacked, (two-stage) piezo or galvo scanners, the single-platform design provides several advantages: smaller package size, identical dynamic performance in both axes, faster response and better linearity. It also prevents polarization rotation.

Fast Piezo Ceramic Drives

Frictionless, flexure-guided piezo ceramic drives provide higher accelerations than other actuators, such as voice-coils, and enable response in the millisecond range and below. Piezo actuators do not require energy to hold a position. The resulting low heat signature is a great advantage in infrared imaging systems like those used in astronomy.

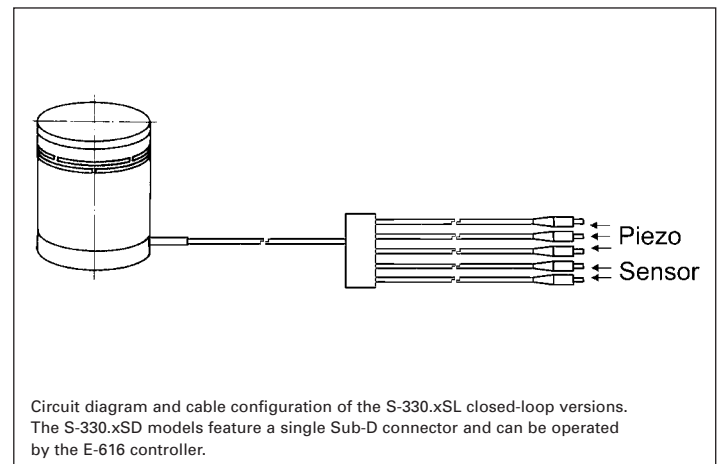
Closed Loop Operation

For high stability and repeatability, absolute-measuring strain gauge sensors (SGS) are applied to appropriate locations on the drive train. They provide a high-bandwidth, position feedback signal to the controller. The sensors are connected in a bridge configuration to eliminate thermal drift,

Ordering Information

- S-330.2SL**
High-Dynamics Piezo Tip/Tilt Platform, 2 mrad, SGS, LEMO Connector
- S-330.2SD**
High-Dynamics Piezo Tip/Tilt Platform, 2 mrad, SGS, Sub-D Connector
- S-330.20L**
High-Dynamics Piezo Tip/Tilt Platform, 2 mrad, Open-Loop, LEMO Connector
- S-330.4SL**
High-Dynamics Piezo Tip/Tilt Platform, 5 mrad, SGS, LEMO Connector
- S-330.4SD**
High-Dynamics Piezo Tip/Tilt Platform, 5 mrad, SGS, Sub-D Connector
- S-330.40L**
High-Dynamics Piezo Tip/Tilt Platform, 5 mrad, Open-Loop, LEMO Connector
- S-330.8SL**
High-Dynamics Piezo Tip/Tilt Platform, 10 mrad, SGS, LEMO Connector
- S-330.8SD**
High-Dynamics Piezo Tip/Tilt Platform, 10 mrad, SGS, Sub-D Connector
- S-330.80L**
High-Dynamics Piezo Tip/Tilt Platform, 10 mrad, Open-Loop, LEMO Connector

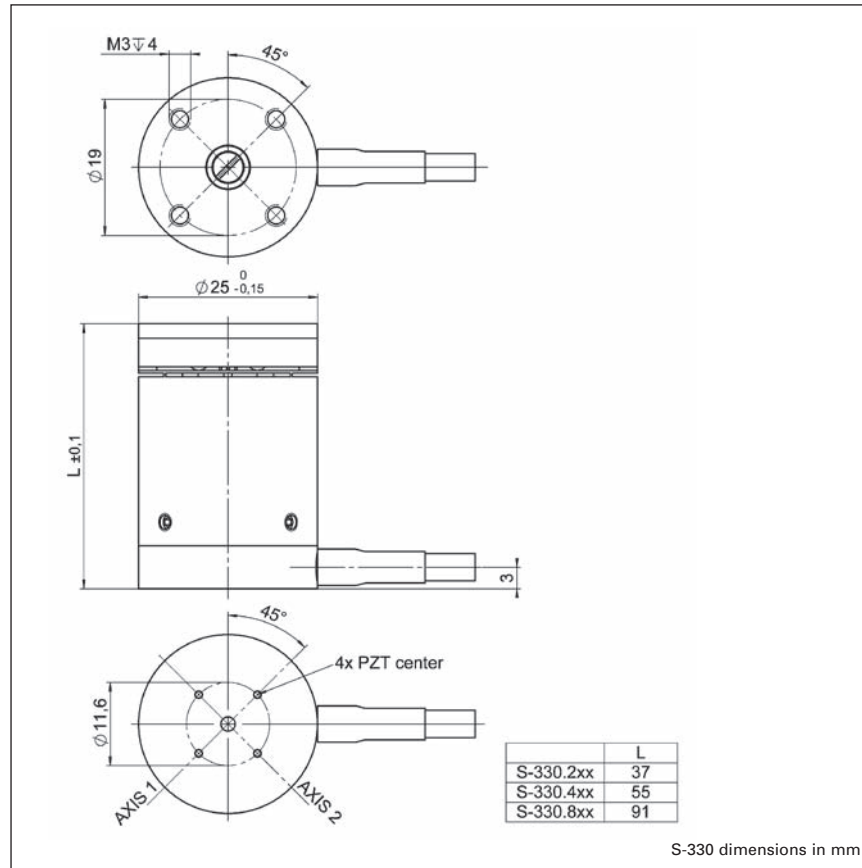
and assure optimal position stability. Open-loop systems are also available.



Circuit diagram and cable configuration of the S-330.xSL closed-loop versions. The S-330.xSD models feature a single Sub-D connector and can be operated by the E-616 controller.

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.



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

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Technical Data

Model	S-330.2SL	S-330.4SL	S-330.8SL	S-330.2SD S-330.4SD S-330.8SD	S-330.20L S-330.40L S-330.80L	Units	Tolerance
Active axes	Θ_x, Θ_y	Θ_x, Θ_y	Θ_x, Θ_y	Θ_x, Θ_y	Θ_x, Θ_y		
Motion and positioning							
Integrated sensor	SGS	SGS	SGS	SGS	–		
Open-loop tip/tilt angle, -20 to +120 V	3.5	7	15	as SL version	as SL version	mrad	min.
Closed-loop tip/tilt angle	2	5	10	as SL version	–	mrad	
Open-loop tip/tilt angle resolution	0.02	0.1	0.2	as SL version	as SL version	μ rad	typ.
Closed-loop tip/tilt resolution	0.05	0.25	0.5	as SL version	–	μ rad	typ.
Linearity in Θ_x, Θ_y	0.1	0.2	0.25	as SL version	–	%	typ.
Repeatability Θ_x, Θ_y	0.15	0.5	1	as SL version	–	μ rad	typ.
Mechanical properties							
Unloaded resonant frequency (Θ_x, Θ_y)	3.7	3.3	3.1	as SL version	as SL version	kHz	$\pm 20\%$
Resonant frequency loaded in Θ_x, Θ_y (with 25 x 8 mm glass mirror)	2.6	1.6	1.0	as SL version	as SL version	kHz	$\pm 20\%$
Distance of pivot point to platform surface	6	6	6	6	6	mm	± 1 mm
Platform moment of inertia	1530	1530	1530	1530	1530	g x mm ²	$\pm 20\%$
Drive properties							
Ceramic type	PICMA®	PICMA®	PICMA®	PICMA®	PICMA®		
Electrical capacitance	3/axis	6/axis	12.5/axis	as SL	as SL	μ F	$\pm 20\%$
Dynamic operating current coefficient	0.22/axis	0.4/axis	0.8/axis	as SL	as SL	μ A/Hz • mrad	$\pm 20\%$
Miscellaneous							
Operating temperature range	-20 to 80	-20 to 80	-20 to 80	-20 to 80	-20 to 80	°C	
Material case	Stainless steel	Stainless steel	Stainless steel	Stainless steel	Stainless steel		
Material platform	Invar	Invar	Invar	Invar	Invar		
Mass	0.2	0.38	0.7	as SL version	as SL version	kg	$\pm 5\%$
Cable length	1.5	1.5	1.5	1.5	1.5	m	± 10 mm
Sensor / voltage connection	LEMO	LEMO	LEMO	Sub-D connector	LEMO		

Recommended controller / amplifier

Versions with LEMO connector: modular piezo controller system E-500 (p. 2-142) with amplifier module E-503.00S (three channels) (p. 2-146) or 1 x E-505.00S and 2 x E-505 (high speed applications) (p. 2-147) and E-509 controller (p. 2-152) (optional)

Open-loop: E-663 three channel amplifier (p. 2-136)

Versions with Sub-D connectors: E-616 servo controller for tip/tilt mirror systems (p. 2-132)