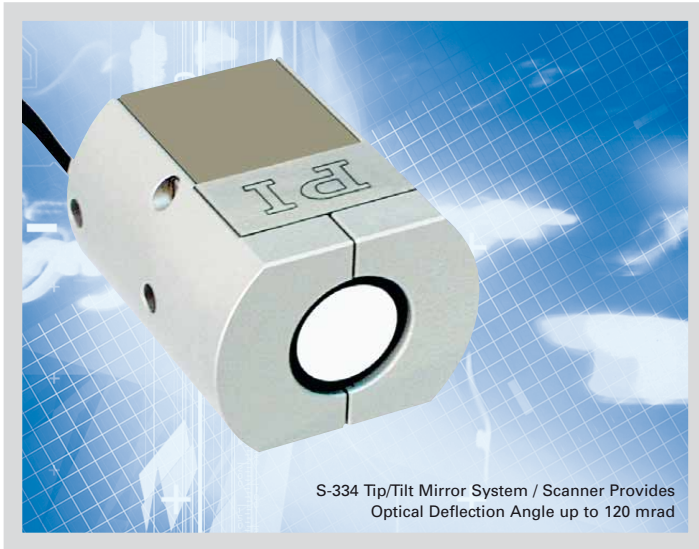


S-334 Miniature Piezo Tip/Tilt-Mirror

Fast Steering Mirror with up to 120 mrad Deflection



- **Miniature Design**
- **Optical Beam Deflection to 120 mrad (~ 6.8°)**
- **Coplanar Axes & Fixed Pivot Point; Eliminate Polarization Rotation**
- **Factory Installed Mirror**
- **Millisecond Response, Resolution to 0.2 μrad**
- **Closed-loop Position Servo-Control for High Accuracy**
- **For Mirrors up to 12.5 mm (0.5") Diameter**
- **Frictionless, High-Precision Flexure Guiding System**
- **Parallel Kinematics for Enhanced Dynamics and Better Multi-Axis Accuracy**

S-334 piezo tip/tilt mirrors / scanners provide extremely large deflection angles in a miniaturized package. These fast steering mirror systems are based on a sophisticated parallel-kinematics design with

two coplanar, orthogonal axes and a fixed pivot point.

Large Tip/Tilt Ranges with Excellent Motion Characteristics

The novel flexure/lever design with minimized inertia allows

for the exceptionally large tip/tilt range of 60 mrad (50 mrad in closed-loop operation, which is equivalent to 100 mrad optical beam deflection) and very fast response in the millisecond range. These parameters make the system unique in the market of piezo driven tip/tilt mirror systems.

Sub-Microradian Resolution

In addition to the large angles and the high dynamics the S-334 provides sub-microradian resolution. The integrated high-resolution, full-bridge strain gauge sensors (SGS) provide absolute position control, excellent repeatability and high linearity, typically better than 0.05% over the entire travel range.

Differential Drive for Improved Stability and Dynamics

The S-334 is based on a parallel-kinematics design with coplanar axes and a single moving platform. Two pairs of differentially-driven piezo actuators are employed to provide the highest dynamics and position 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

Ordering Information

- S-334.1SD**
High-Dynamics Piezo Tip/Tilt Platform, 25 mrad, SGS, Sub-D Connector, incl. Mirror
- S-334.1SL**
High-Dynamics Piezo Tip/Tilt Platform, 25 mrad, SGS, LEMO Connector, incl. Mirror
- S-334.2SD**
High-Dynamics Piezo Tip/Tilt Platform, 50 mrad, SGS, Sub-D Connector, incl. Mirror
- S-334.2SL**
High-Dynamics Piezo Tip/Tilt Platform, 50 mrad, SGS, LEMO Connector, incl. Mirror

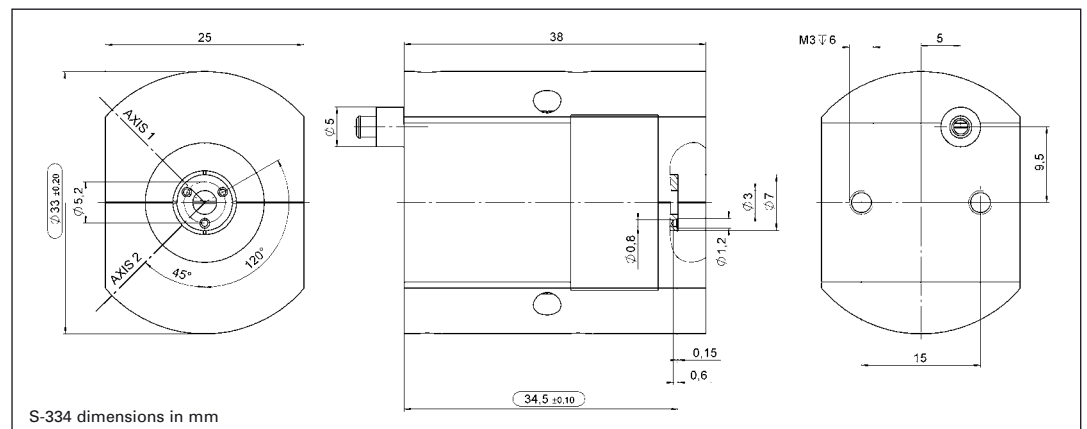
dynamic performance in both axes, faster response and better linearity. It also prevents polarization rotation.

High Reliability and Long Lifetime

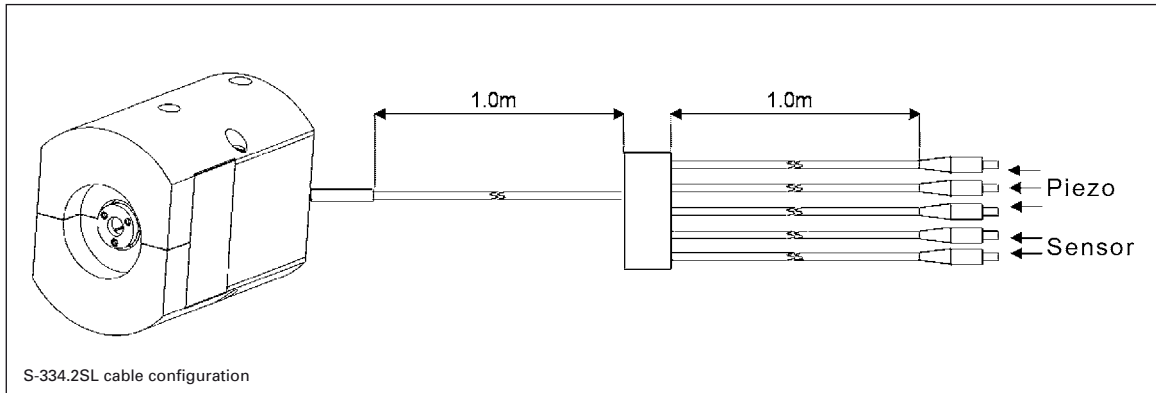
The compact S-334 systems are equipped with preloaded PICMA® high-performance piezo actuators which are integrated into a sophisticated, FEA-modeled, flexure guiding system. The PICMA® actuators feature cofired ceramic encapsulation and provide better performance and reliability than conventional piezo actuators. Actuators, guidance and sensors are maintenance-free, not subject to wear and offer extraordinary reliability.

Application Examples

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



Factory Installed Mirror in diameter and 2 mm thick
 The S-334 is equipped with a (flatness $\lambda/5$, reflectivity >98 %
 factory-installed mirror 10 mm from 500 nm to 2 μm).



Technical Data

Model	S-334.1SL S-334.1SD	S-334.2SL S-334.2SD	Units	Tolerance
Active Axes	θ_x, θ_y	θ_x, θ_y		
Motion and positioning				
Integrated sensor	SGS	SGS		
*Open-loop tilt angle at -20 to +120 V	30	60	mrad	min. (+20 %/-0 %)
*Closed-loop tilt angle	25	50	mrad	
Open-loop resolution	0.2	0.5	μrad	typ.
Closed-loop resolution	1	5	μrad	typ.
Linearity	0.05	0.05	%	typ.
Repeatability	2	5	μrad	typ.
Mechanical properties				
Resonant frequency underload (with standard mirrors)	3.0	1.0	kHz	$\pm 20\%$
Load capacity	0.2	0.2	N	Max.
Distance of pivot point to platform surface	6	6	mm	± 1 mm
Platform moment of inertia	1530	1530	$\text{g} \cdot \text{mm}^2$	$\pm 20\%$
Standard mirror (mounted)	diameter: 10 mm, thickness: 2 mm; BK7, $\lambda/5$, R > 98 % ($\lambda = 500$ nm to 2 μm)	diameter: 10 mm, thickness: 2 mm; BK7, $\lambda/5$, R > 98 % ($\lambda = 500$ nm to 2 μm)		
Drive properties				
Ceramic type	PICMA® P-885	PICMA® P-885		
Electrical capacitance per axis	3	3	μF	$\pm 20\%$
Miscellaneous				
Operating temperature range	-20 to 80	-20 to 80	$^{\circ}\text{C}$	
Material casing	Titanium	Titanium		
Mass	0.065	0.065	kg	$\pm 5\%$
Cable length	2	2	m	± 10 mm
Sensor / voltage connection	LEMO connector / 25-pin sub-D connector	LEMO connector / 25-pin sub-D connector		

Recommended controller / amplifier

Closed-loop versions with D-sub connector: E-616 controller for tip/tilt mirror systems (p. 2-132);

Open-loop 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 servo controller (p. 2-152 / 3-16)

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

Resolution of PI piezo tip/tilt platforms is not limited by friction or stiction. Noise equivalent motion with E-503 amplifier, (p. 2-146).

*Mechanical tilt, optical beam deflection is 120 mrad (open loop) and 100 mrad (closed-loop), respectively.

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Active Optics

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Servo Controllers

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