

## S-325 Piezo Z/Tip/Tilt Platform High-Speed Tripod System for Mirrors and Optics



S-325.30L piezoelectric fast steering mirror platform / scanner

- Optical Beam Deflection to 10 mrad, Resolution to 50 nrad
- Piston Movement up to 30 μm (for Path Length Adjustment)
- Compact Tripod Design with Coplanar Axes Eliminates Polarization Rotation
- Sub-Millisecond Responsiveness
- Closed-Loop Versions for Higher Precision
- For Mirrors up to 25 mm (1") Diameter
- Frictionless, High-Precision Flexure Guiding System
- Parallel Kinematics for Enhanced Dynamics and Better Multi-Axis Accuracy

The S-325 Z/tip/tilt platforms and actuators provide high speed and precise movement of the platform in two tilt axes as well as sub-nanometer linear resolution with sub-millisecond response. The design is based

on a parallel-kinematics direct-drive piezo tripod (see p. 2-83), and they are especially optimized for industrial applications where 1.000.000.000 motion cycles have to be performed without failure or per-

formance degradation. The systems are designed for mirrors and optics up to 25 mm in diameter and can be mounted in any orientation.

The tripod drive offers optimum 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 size, identical dynamic performance in all axes, faster response and better linearity. It also prevents polarization rotation.

All three piezo linear actuators can be driven individually (for tip/tilt movement) or in parallel (for vertical movement) by a three-channel amplifier.

### High Resolution, Stability and Dynamics

The S-325 offers piston movement of up to 30 μm (ideal for path length adjustment) and mechanical tilt up to 5 mrad (equivalent to 10 mrad optical beam deflection). The zero-friction piezo drives and flexure guidance allow sub-nanometer linear resolution and sub-microradian angular resolution.

### Ordering Information

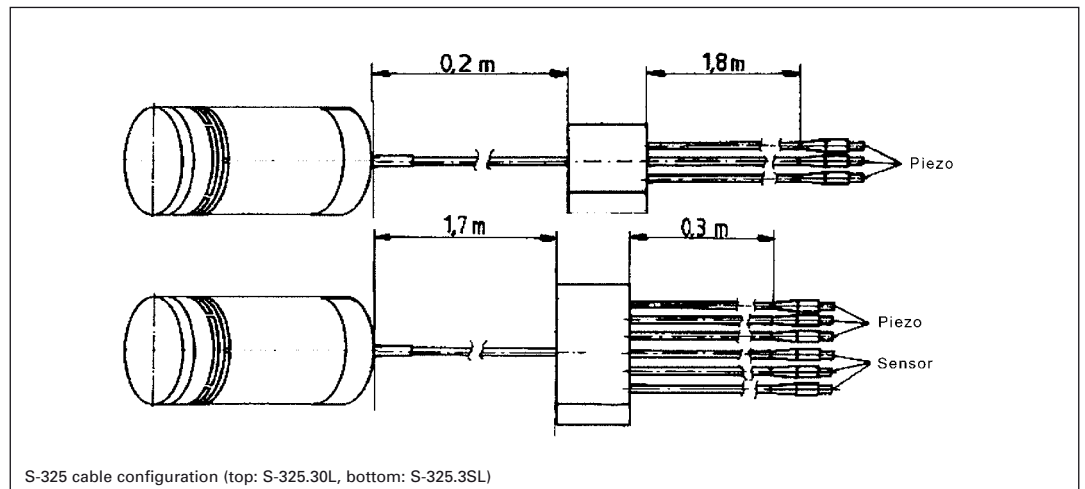
- S-325.3SD**  
High-Dynamics Piezo Z/Tip/Tilt Platform, 5 mrad, 30 μm, SGS, Sub-D Connector
- S-325.3SL**  
High-Dynamics Piezo Z/Tip/Tilt Platform, 5 mrad, 30 μm, SGS, LEMO Connector
- S-325.30L**  
High-Dynamics Piezo Z/Tip/Tilt Platform, 5 mrad, 30 μm, Open-Loop, LEMO Connector

### Open-Loop and Closed-Loop Operation

In open-loop mode, the platform linear motion is roughly proportional to the applied voltage. The S-325.30L open-loop model is ideal for high-bandwidth, high-resolution applications where the absolute angular position is of secondary importance (e.g. for tracking) or where feedback is provided by an external sensor (e.g. CCD, PSD). The S-325.3SL model is equipped with high-resolution strain gauge sensors and provides absolute position control, high linearity and high repeatability. The new E-616 controller/driver module (see p. 2-132) is ideally suited for tip/tilt OEM applications.

### Application Examples

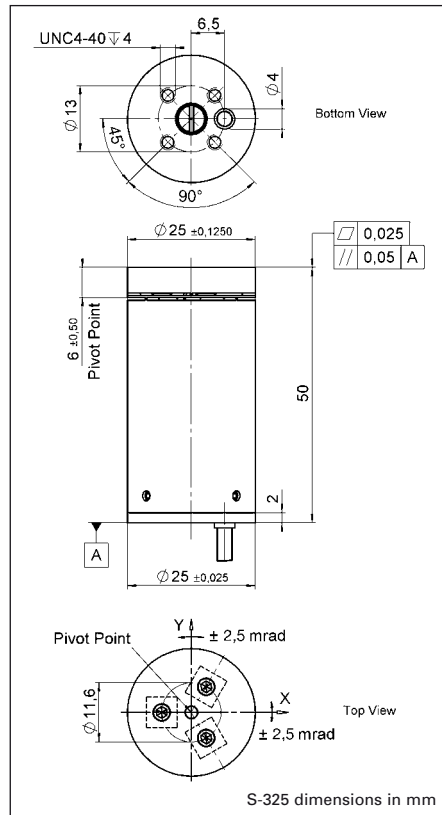
- Image processing / stabilization
- Optical trapping
- Laser scanning / beam steering
- Laser tuning
- Optical filters / switches
- Optics
- Beam stabilization



S-325 cable configuration (top: S-325.30L, bottom: S-325.3SL)

### High Reliability and Long Lifetime

The compact S-325 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.



### Technical Data

Model	S-325.30L	S-325.3SL	S-325.3SD	Units	Tolerance
Active axes	Z, $\theta_X$ , $\theta_Y$	Z, $\theta_X$ , $\theta_Y$	Z, $\theta_X$ , $\theta_Y$		
<b>Motion and positioning</b>					
Integrated sensor	–	SGS	SGS		
Open-loop travel, 0 to +100 V	30	30	30	$\mu\text{m}$	min. (+20%/-0%)
Open-loop tip/tilt angle, 0 to +100 V	5	5	5	mrad	min. (+20%/-0%)
Closed-loop travel	–	30	30	$\mu\text{m}$	
Closed-loop tip/tilt angle	–	4	4	mrad	
Open-loop resolution	0.5	0.5	0.5	nm	typ.
Open-loop tip/tilt angle resolution	0.05	0.05	0.05	$\mu\text{rad}$	typ.
Closed-loop linear resolution	–	0,6	0,6	nm	typ.
Closed-loop tip/tilt resolution	–	0.1	0.1	$\mu\text{rad}$	typ.
<b>Mechanical properties</b>					
Unloaded resonant frequency	2	2	2	kHz	$\pm 20\%$
Resonant frequency (with 25 x 8 mm glass mirror)	1	1	1	kHz	$\pm 20\%$
Distance of pivot point to platform surface	6	6	6	mm	$\pm 0.5$ mm
Platform moment of inertia	515	515	515	$\text{g} \cdot \text{mm}^2$	$\pm 20\%$
<b>Drive properties</b>					
Ceramic type	PICMA® P-885	PICMA® P-885	PICMA® P-885		
Electrical capacitance	9.3	9.3	9.3	$\mu\text{F}$	$\pm 20\%$
Dynamic operating current coefficient	39	39	39	$\mu\text{A} / (\text{Hz} \cdot \text{mrad})$	$\pm 20\%$
<b>Miscellaneous</b>					
Operating temperature range	-20 to 80	-20 to 80	-20 to 80	$^{\circ}\text{C}$	
Material casing	Aluminum	Aluminum	Aluminum		
Mass	0.065	0.065	0.065	kg	$\pm 5\%$
Cable length	2	2	1.5	m	$\pm 10$ mm
Sensor / voltage connection	LEMO	LEMO	Sub-D		

For maximum tilt range, all three piezo actuators must be biased at 50 V. Due to the parallel-kinematics design linear travel and tilt angle are inter-dependent. The values quoted here refer to pure linear / pure angular motion. See equations (p. 2-84).  
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)  
Single-channel (1 per axis): E-610 OEM servo controller / amplifier (p. 2-110), E-625 servo controller bench-top (p. 2-114)  
Versions with Sub-D connectors: E-616 servo controller for tip/tilt mirror systems (p. 2-132)

### 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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