

## S-310 – S-316 Piezo Z/Tip/Tilt Scanner High-Speed System with Clear Aperture



- 10 mm Clear Aperture
- Piezo Tripod Design
- Optical Beam Deflection to 2,4 mrad
- Piston Movement up to 12 µm (phase shifter)
- Sub-Millisecond Response, Sub-Microradian Resolution
- Closed-Loop Versions for Higher Precision
- For Optics, Mirrors or Other Components
- Frictionless, High-Precision Flexure Guiding System
- Parallel Kinematics for Enhanced Dynamics and Better Multi-Axis Accuracy

S-310 to S-316 multi-axis tip/tilt platforms and Z-positioners are fast, compact units based on a piezo tripod design. They offer piston movement up to 12 µm and tilt movement up to 1.2 mrad (2.4 mrad optical beam deflection) with sub-millisecond response and settling. The tri-

pod design features optimum angular stability over a wide temperature range.

The systems are designed for mirrors and optics up to 25 mm in diameter and can be mounted in any orientation; the clear aperture is ideal for transmitted-light applications (e.g. for optical filters).

### Open-Loop and Closed-Loop Operation

In open-loop mode, the tip/tilt angle is roughly proportional to the applied voltage. The S-310 to S-315 open-loop models are ideal for high-speed, 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-316.10 model is equipped with high-resolution strain gauge sensors and provides absolute position control, high linearity and high repeatability.

### Available Versions

#### ■ S-310.10, S-314.10

Open-loop Z-platforms; all three piezo linear actuators are electrically connected in parallel, providing vertical positioning (piston movement) of the top ring. Only one drive channel is required.

#### ■ S-311.10, S-315.10

Open-loop Z/tip/tilt positioners; all three piezo linear actuators can be driven individually (or in parallel) by a three-channel amplifier. Vertical (piston movement) positioning and tip/tilt positioning are possible.

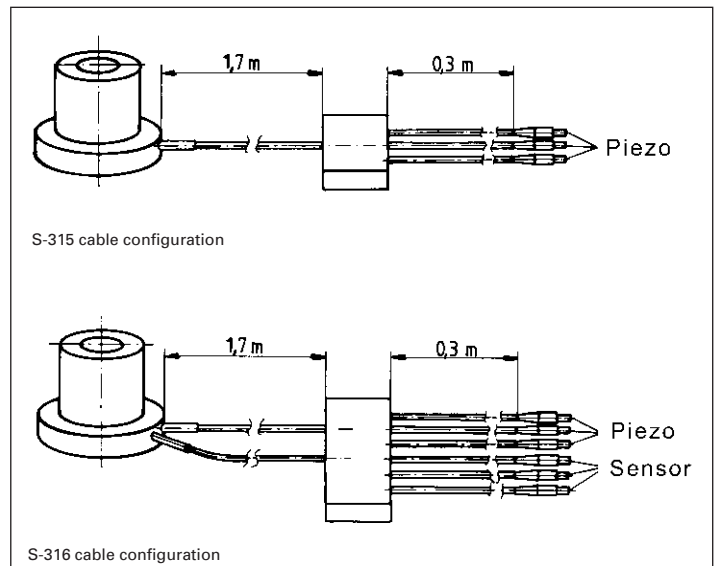
#### ■ S-316.10

Closed-loop Z/tip/tilt positioner. All three piezo linear actuators are equipped with strain gauge position feedback sensors and can be driven individually (or in parallel) by a three-channel am-

### Ordering Information

- S-310.10**  
Piezo Actuator, Clear Aperture, 6 µm, LEMO Connector
- S-311.10**  
Piezo Z/Tip/Tilt Platform, Clear Aperture, 600 µrad, 6 µm, LEMO Connector
- S-314.10**  
Piezo Actuator, Clear Aperture, 12 µm, LEMO Connector
- S-315.10**  
Piezo Z/Tip/Tilt Platform, Clear Aperture, 1.2 mrad, 12 µm, LEMO Connector
- S-316.10**  
Piezo Z/Tip/Tilt Platform, Clear Aperture, 1.2 mrad, 12 µm, SGS, LEMO Connector
- S-316.10D**  
Piezo Z/Tip/Tilt Platform, Clear Aperture, 1.2 mrad, 12 µm, SGS, Sub-D Connector

plifier with a position servo-controller. Vertical positioning (piston movement) and tip/tilt positioning are possible. The integrated position feedback sensors provide sub-microradian resolution and high repeatability.

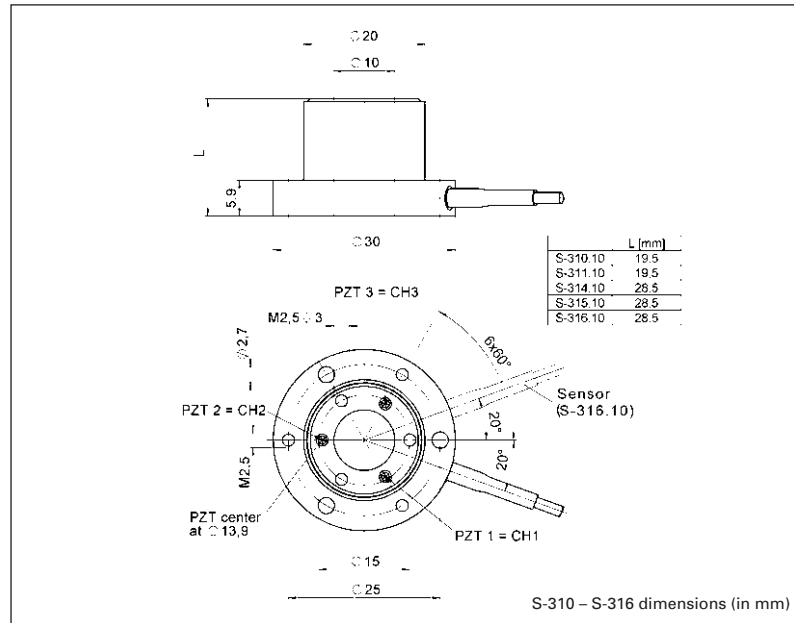


### Application Examples

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

## High Reliability and Long Life-time

The compact S-310 - S-316 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-310.10	S-314.10	S-311.10	S-315.10	S-316.10	Units	Tolerance
Active axes	Z	Z	Z, $\theta_x$ , $\theta_y$	Z, $\theta_x$ , $\theta_y$	Z, $\theta_x$ , $\theta_y$		
<b>Motion and positioning</b>							
Integrated sensor	-	-	-	-	SGS		
Open-loop travel, 0 to +100 V	6 / -	12 / -	6 / -	12 / -	12 / 12	$\mu\text{m}$	min. (+20%/-0%)
*Open-loop tilt angle @ 0 to 100 V	-	-	600	1200	1200	$\mu\text{rad}$	min. (+20%/-0%)
Closed-loop travel	-	-	-	-	12	$\mu\text{m}$	
*Closed-loop tilt angle	-	-	-	-	1200	$\mu\text{rad}$	
Open-loop resolution	0.1	0.2	0.1	0.2	0.2	nm	typ.
Open-loop tip/tilt angle resolution	-	-	0.02	0.05	0.05	$\mu\text{rad}$	typ.
Closed-loop resolution	-	-	-	-	0.4	nm	typ.
Closed-loop tip/tilt resolution	-	-	-	-	0.1	$\mu\text{rad}$	typ.
Linearity	-	-	-	-	0.2	%	typ.
<b>Mechanical properties</b>							
Stiffness	20	10	20	10	10	N/ $\mu\text{m}$	$\pm 20\%$
Unloaded resonant frequency (Z)	9.5	5.5	9.5	5.5	5.5	kHz	$\pm 20\%$
Resonant frequency (with 15 x 4 mm glass mirror)	6.5	4.4	6.5	4.1	4.1	kHz	$\pm 20\%$
Resonant frequency (with 20 x 4 mm glass mirror)	6.1	4.2	6.1	3.4	3.4	kHz	$\pm 20\%$
Distance of pivot point to platform surface	-	-	5	5	5	mm	$\pm 1$ mm
Platform moment of inertia	-	-	150	150	150	$\text{g} \cdot \text{mm}^2$	$\pm 20\%$
<b>Drive properties</b>							
Ceramic type	PICMA® P-882	PICMA® P-882	PICMA® P-882	PICMA® P-882	PICMA® P-882		
Electrical capacitance	0.39	0.93	0.39	0.93	0.93	$\mu\text{F}$	$\pm 20\%$
Dynamic operating current coefficient	8	10	8	10	10	$\mu\text{A} / (\text{Hz} \cdot \text{mrad})$	$\pm 20\%$
<b>Miscellaneous</b>							
Operating temperature range	-20 to 80	-20 to 80	-20 to 80	-20 to 80	-20 to 80	$^{\circ}\text{C}$	
Material	Stainless steel	Stainless steel	Stainless steel	Stainless steel	Stainless steel		
Mass	0.045	0.055	0.045	0.055	0.055	kg	$\pm 5\%$
Cable length	2	2	2	2	2	m	$\pm 10$ mm
Sensor connection	-	-	-	-	LEMO		
Voltage connection	LEMO	LEMO	LEMO	LEMO	LEMO		

## 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

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 twice as large. 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 interdependent. The values quoted here refer to pure linear / pure angular motion (equations p. 2-84).

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)

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) (optional), E-517 interface module (p. 2-156) (optional)