

# S-303

## High-Speed Piezo Phase Shifters with Direct Metrology Option



- 25 kHz Resonant Frequency for Sub-Millisecond Dynamics
- <0.1 Nanometer Resolution
- Capacitive Sensor Option for Highest Linearity and Stability
- Invar Option for Highest Thermal Stability
- Aperture with Open-Loop Versions
- 3 μm Travel Range
- Compact Size: 30 mm Diameter x 10 mm

S-303 phase shifters are extremely fast and compact systems based on a piezo tripod drive. They offer angstrom level resolution, piston movement up to 3 μm with sub-msec response and settling dynamics. The S-303 is designed for mirrors and optics up to 25 mm diameter and can be mounted in any orientation. Open- and closed-loop versions are available.

### S-303.0L: Open-Loop Z-Positioner

The S-303.0L open-loop model is ideal for applications where the position is controlled by an external loop and an external

#### Application Examples

- Interferometry
- Optical path tuning
- Beam stabilization
- Laser physics
- Cavity tuning

sensor. The platform position corresponds roughly to the drive voltage of the piezo actuators. The clear aperture was integrated for transmitted-light applications.

### S-303.CD: Superior Accuracy Through Direct-Motion-Metrology Capacitive Feedback Sensors

The S-303.CD closed-loop models are equipped with non-contact, zero-friction, direct-measuring two-plate capacitive position sensors and were designed for applications requiring nanometer positioning accuracy and stability. Capacitive sensors are absolute-measuring high-bandwidth devices and exhibit no periodic errors. Unlike conventional sensors, direct metrology measures the position of the platform directly rather than the strain in the actuator or guiding system. It improves phase fidelity and permits motion linearity of better than 0.03 % and effective resolution of better

than 0.1 nanometers. This technique, combined with the inherent precision of the PI two-plate capacitive sensor and the temperature-compensated design, results in higher linearity scans, and provides superior responsiveness, resolution, repeatability and stability.

### Working Principle / Lifetime

S-303 systems were developed for industrial applications where 10<sup>9</sup> motion cycles or more must be performed without failure or performance loss. The S-303 drive units incorporate PICMA<sup>®</sup> low-voltage multi-layer piezo actuators. These highly optimized and ceramic-encapsulated drives are more robust than conventional piezo actuators, and feature superior lifetime in static and dynamic applications. Since drives and sensors in the S-303 are frictionless and not subject to wear and tear, these units offer an exceptionally high level of reliability.

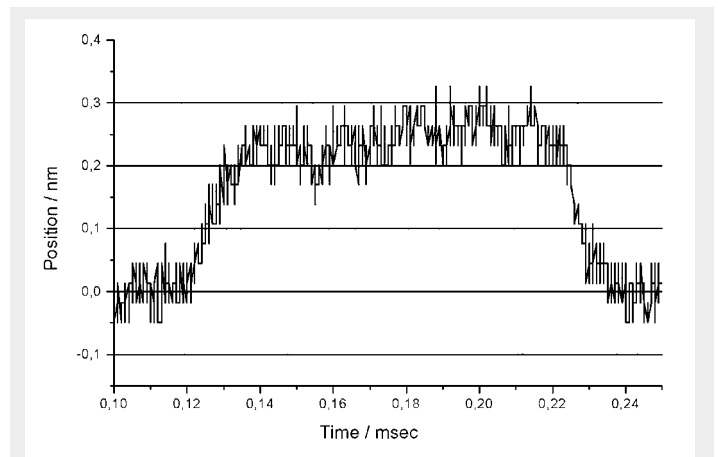
### Ordering Information

- S-303.0L**  
Piezo Phase Shifter, 3 μm, Open-Loop
- S-303.CD**  
Piezo Phase Shifter, 2 μm, Capacitive Sensor
- S-303.0Li**  
Piezo Phase Shifter, 3 μm, Open-Loop, Invar
- S-303.CDi**  
Piezo Phase Shifter, 2 μm, Capacitive Sensor, Invar

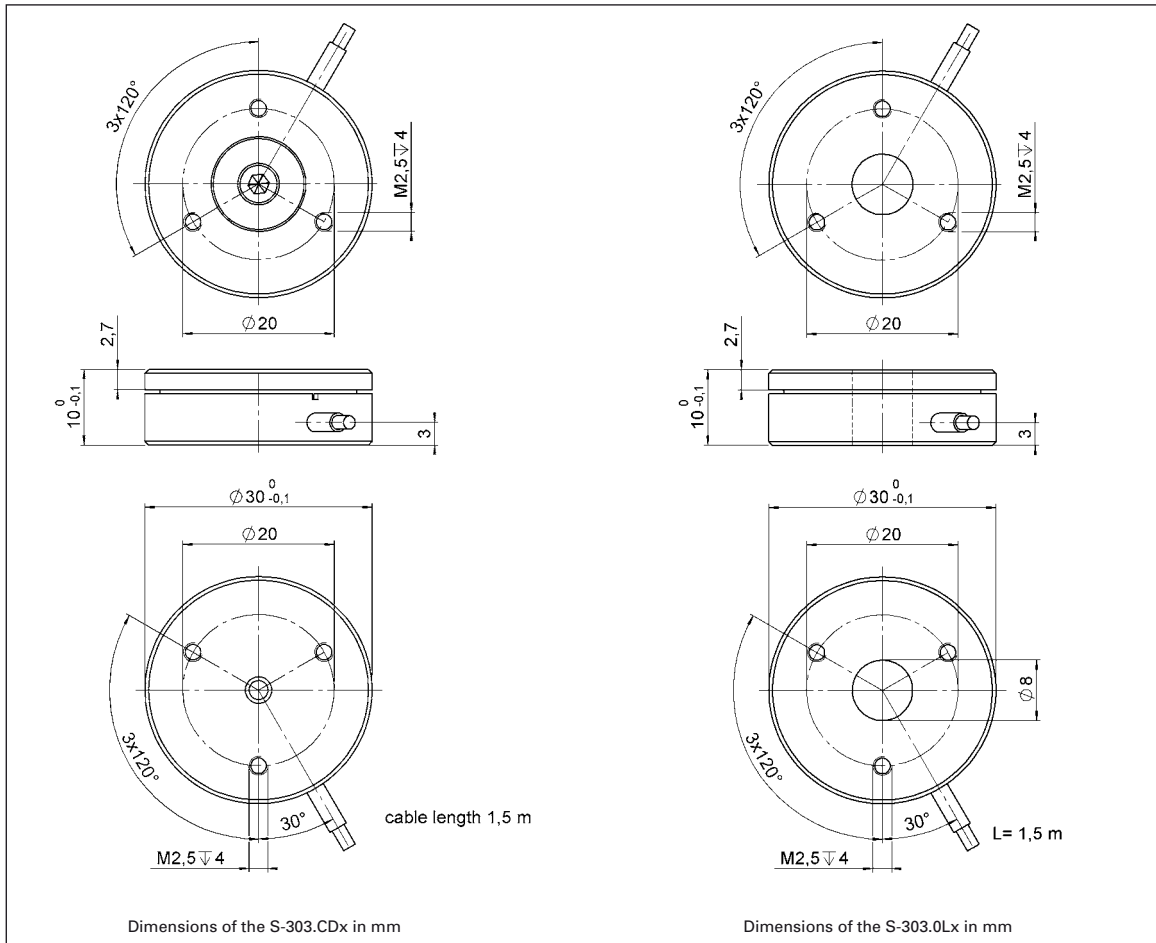
Ask about custom designs!

### Notes

See the "Selection Guide" on p. 3-8 for comparison with other steering mirrors.



A 250 picometer step (0.25 nm) of the S-303 platform, controlled by an E-503 amplifier module and an E-509.C1A servocontroller module. Measured with special ultra-high-resolution capacitive gauge, ±0.02 nm resolution.



### Technical Data

Models	S-303.CDx	S-303.0Lx	Units	Notes see page 3-26
Active axes	Z	Z		
Min. Open-loop travel @ -20 to +120 V	3	3	$\mu\text{m} \pm 20\%$	A2
Closed-loop travel	2	-	$\mu\text{m}$	A5
Integrated feedback sensor	capacitive	-		B
* Closed-loop / open-loop resolution	0.03 / 0.03	- / 0.03	nm	C1
** Closed-loop linearity (typ.)	1.0	-	%	
Full-range repeatability (typ.)	0.7	-	nm	C
Stiffness			$\text{N}/\mu\text{m} \pm 20\%$	D1
Max. ( $\pm$ ) normal load	0.5	0.5	N	D4
Electrical capacitance	0.9	0.9	$\mu\text{F} \pm 20\%$	F1
*** Dynamic operating current coefficient (DOCC)	50	50	$\mu\text{A}/(\text{Hz} \times \mu\text{m})$	F2
Unloaded resonant frequency	25	25	$\text{kHz} \pm 20\%$	G2
Operating temperature range	-20 to 80	-20 to 80	$^{\circ}\text{C}$	H2
Voltage connection	D	VL		J1
Sensor connection	D	-		J2
Mass	100	30	$\text{g} \pm 5\%$	
Body material	Al, Invar optional	Al, Invar optional		L
Recommended Amplifier/Controller (codes explained page 3-9)	F, M	G, C		

\* For calibration information see p. 3-7. Resolution of PZT Nanopositioners is not limited by friction or stiction. Noise equivalent motion with E-503, E-710.

\*\* With digital controller, analog controllers will provide a linearity of typ. 1 nm.

\*\*\* Dynamic Operating Current Coefficient in  $\mu\text{A}$  per Hz and  $\mu\text{m}$ . Example: Sinusoidal scan of 1  $\mu\text{m}$  at 10 Hz requires approximately 0.5 mA drive current.

Piezo Actuators

Nanopositioning &amp; Scanning Systems

Active Optics / Steering Mirrors

Tutorial: Piezo-electrics in Positioning

Capacitive Position Sensors

Piezo Drivers &amp; Nanopositioning Controllers

Hexapods / Micropositioning

Photonics Alignment Solutions

Motion Controllers

Ceramic Linear Motors &amp; Stages

Index

## S-323 Piezo Z/Tip/Tilt Platform

### High Dynamics & Stability Nanopositioning System with Direct Metrology



- Optical Beam Deflection to 6 mrad
- Sub- $\mu$ rad Resolution for High Positioning Stability
- Position Servo-Control with Capacitive Sensors
- Frictionless, High-Precision Flexure Guiding System
- System Combination with Digital Controllers for Highest Linearity

Model	Active axes	Travel range	Resolution	Unloaded resonant frequency
S-323.3CD	Z, $\theta_x$ , $\theta_y$	30 $\mu$ m, $\pm$ 1.5 mrad	0.1 nm, $\pm$ 0.05 $\mu$ rad	1.7 kHz

## S-303 Piezo Phase Shifter

### Highest Dynamics and Stability with Capacitive Feedback Sensor

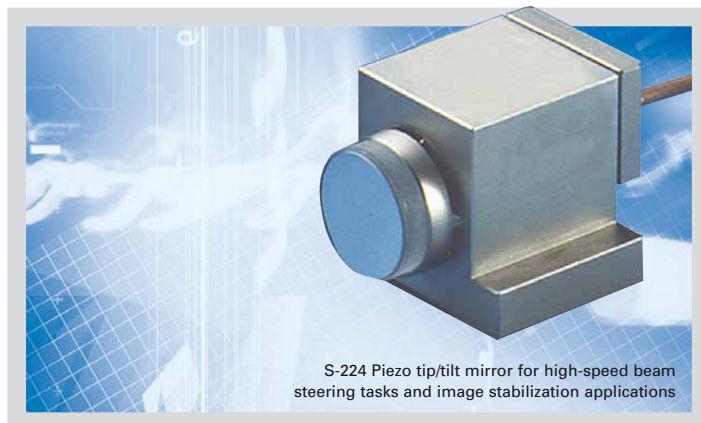


- 25 kHz Resonant Frequency for Sub-Millisecond Dynamics
- Capacitive Sensor Option for Highest Linearity and Stability
- 3  $\mu$ m Travel Range
- Compact Size: 30 mm Diameter x 10 mm
- Aperture with Open-Loop Versions
- Invar Option for Highest Thermal Stability

Model	Active axes	Closed-loop/ open-loop travel @ -20 to +120V	Closed-loop/ open-loop resolution	Unloaded resonant frequency
S-303.CD (closed-loop)/ S-302.0L (open-loop)	Z	2 / 3 $\mu$ m	0.03 nm	25 kHz

## S-224 – S-226 Piezo Tilt-Mirror

### Fast Steering Mirror Combines Highest Dynamics and Compact Design



- Optical Beam Deflection to 4.4 mrad
- Sub- $\mu$ rad Resolution, Sub-Millisecond Response
- Frictionless, High-Precision Flexure Guiding System
- Includes BK7 Mirror
- Optional Position Feedback Sensor
- Outstanding Lifetime Due to PICMA® Piezo Actuators

Model	Active axes	Open-loop tilt angle @ 0 to +100V	Closed-loop/ open-loop resolution	Unloaded resonant frequency
S-224.00 (open-loop)/ S-226.00 (closed-loop)	$\theta_x$	2.0 / 2.2 mrad	0.05 / 0.1 $\mu$ rad	9 kHz