

# High-Speed Tip/Tilt Platform

## Short Settling Time and High Dynamic Linearity



### S-331

- Tip/tilt angle up to 5 mrad, optical deflection angle up to 10 mrad (0.57°)
- High resonant frequencies to 10 kHz (0.5" mirror) for dynamic motion and fast step-and-settle
- Parallel-kinematic design for identically high performance characteristics for both tip/tilt axes
- Position sensors for high linearity
- For mirrors up to Ø 12.7 mm (0.5")

#### Application fields

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

#### Outstanding lifetime due to PICMA® piezo actuators

The PICMA® piezo actuators are all-ceramic insulated. This protects them against humidity and failure resulting from an increase in leakage current. PICMA® actuators offer an up to ten times longer lifetime than conventional polymer-insulated actuators. 100 billion cycles without a single failure are proven.

#### High guiding accuracy due to zero-play flexure guides

Flexure guides are free of maintenance, friction, and wear, and do not require lubrication. Their stiffness allows high load capacity and they are insensitive to shock and vibration. They work in a wide temperature range.

#### High dynamics multi-axis operation due to parallel kinematics

In a parallel-kinematic multi-axis system, all actuators act on a common platform. The minimum mass inertia and the identical design of all axes allow fast, dynamic, and nevertheless precision motion.

Motion	Unit	Tolerance	S-331.2SH	S-331.2SL	S-331.5SH	S-331.5SL
Active axes			ØX, ØY	ØX, ØY	ØX, ØY	ØX, ØY
Rotation range in ØX	mrad		3	3	5	5
Rotation range in ØY	mrad		3	3	5	5
Rotation range in ØX, open loop	mrad	±20%	4.2	4.2	7	7
Rotation range in ØY, open loop	mrad	±20%	4.2	4.2	7	7
Linearity error in ØX	%	Typ.	0.1	0.3	0.1	0.3
Linearity error in ØY	%	Typ.	0.1	0.3	0.1	0.3

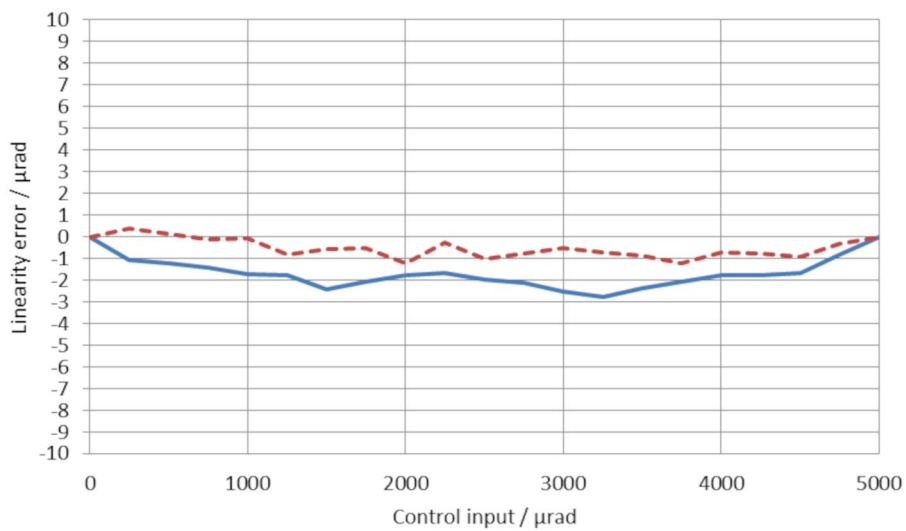
Positioning	Unit	Tolerance	S-331.2SH	S-331.2SL	S-331.5SH	S-331.5SL
Bidirectional repeatability in $\theta_X$	$\mu\text{rad}$	Typ.	1.5	1.5	2.5	2.5
Bidirectional repeatability in $\theta_Y$	$\mu\text{rad}$	Typ.	1.5	1.5	2.5	2.5
Resolution in $\theta_X$ , open loop	$\mu\text{rad}$	Typ.	0.05	0.05	0.1	0.1
Resolution in $\theta_Y$ , open loop	$\mu\text{rad}$	Typ.	0.05	0.05	0.1	0.1
Integrated sensor			SGS, indirect position measuring	SGS, indirect position measuring	SGS, indirect position measuring	SGS, indirect position measuring
Sensor resolution, rotational	$\mu\text{rad}$		0.1	0.1	0.25	0.25

Drive Properties	Unit	Tolerance	S-331.2SH	S-331.2SL	S-331.5SH	S-331.5SL
Drive type			Piezo actuator/PICMA®	Piezo actuator/PICMA®	Piezo actuator/PICMA®	Piezo actuator/PICMA®
Nominal voltage	V		120	120	120	120
Maximum power consumption	W					
Electrical capacitance in $\theta_X$	$\mu\text{F}$	$\pm 20\%$	0.96	0.96	6.2	6.2
Electrical capacitance in $\theta_Y$	$\mu\text{F}$	$\pm 20\%$	0.96	0.96	6.2	6.2

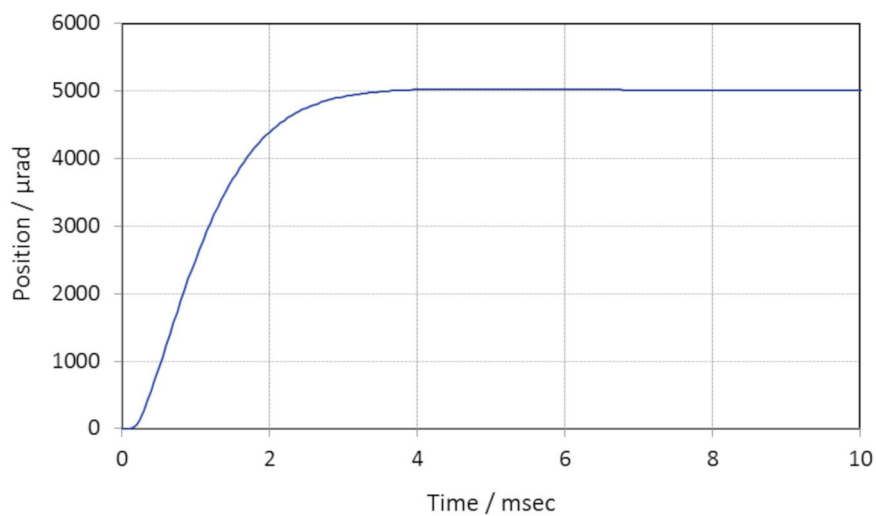
Mechanical Properties	Unit	Tolerance	S-331.2SH	S-331.2SL	S-331.5SH	S-331.5SL
Resonant frequency in $\theta_X$ , unloaded	Hz	$\pm 20\%$	10050	10050	2990	2990
Resonant frequency in $\theta_X$ , under load with glass mirror ( $\varnothing$ 12.7 mm; thickness 3 mm)	Hz	$\pm 20\%$	9020	9020	2980	2980
Resonant frequency in $\theta_Y$ , unloaded	Hz	$\pm 20\%$	10050	10050	2990	2990
Resonant frequency in $\theta_Y$ , under load with glass mirror ( $\varnothing$ 12.7 mm; thickness 3 mm)	Hz	$\pm 20\%$	9020	9020	2980	2980
Moment of inertia in $\theta_X$ , unloaded	$\text{g}\cdot\text{mm}^2$	$\pm 20\%$	30	30	30	30
Moment of inertia in $\theta_Y$ , unloaded	$\text{g}\cdot\text{mm}^2$	$\pm 20\%$	30	30	30	30
Distance of pivot point to platform surface	mm	$\pm 0.1$ mm	4	4	4	4
Guide			Flexure guide/Flexure guide with lever amplification	Flexure guide/Flexure guide with lever amplification	Flexure guide/Flexure guide with lever amplification	Flexure guide/Flexure guide with lever amplification
Overall mass	g		130	130	280	280
Material			Steel, platform titanium	Steel, platform titanium	Steel, platform titanium	Steel, platform titanium

Miscellaneous	Unit		S-331.2SH	S-331.2SL	S-331.5SH	S-331.5SL
Operating temperature range	$^{\circ}\text{C}$		-20 to 80	-20 to 80	-20 to 80	-20 to 80
Connector			D-sub 37-pin (m)	LEMO LVPZT	D-sub 37-pin (m)	LEMO LVPZT
Sensor connector				LEMO for strain gauge sensors		LEMO for strain gauge sensors
Cable length	m		2	2	2	2
Recommended controllers / drivers			E-727	E-509.S3 + E-505.00 (2x) + E-505.00S + E-500.00	E-727	E-509.S3 + E-505.00 (2x) + E-505.00S + E-500.00

## Drawings / Images

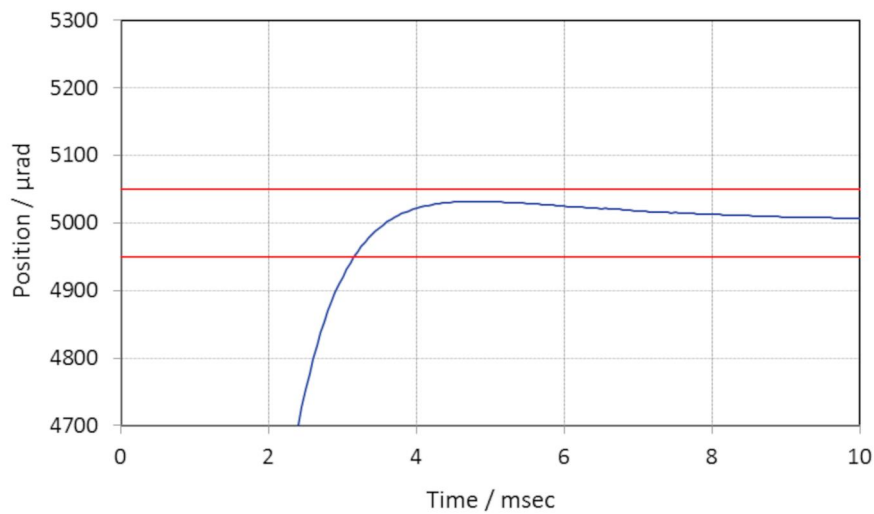


Unidirectional linearity error for both axes: The solid blue line represents axis 1, the dotted brown line represents axis 2. The linearity error at full displacement of the S-331.5SH with the E-727.3SD digital piezo controller is less than 0.05 %.

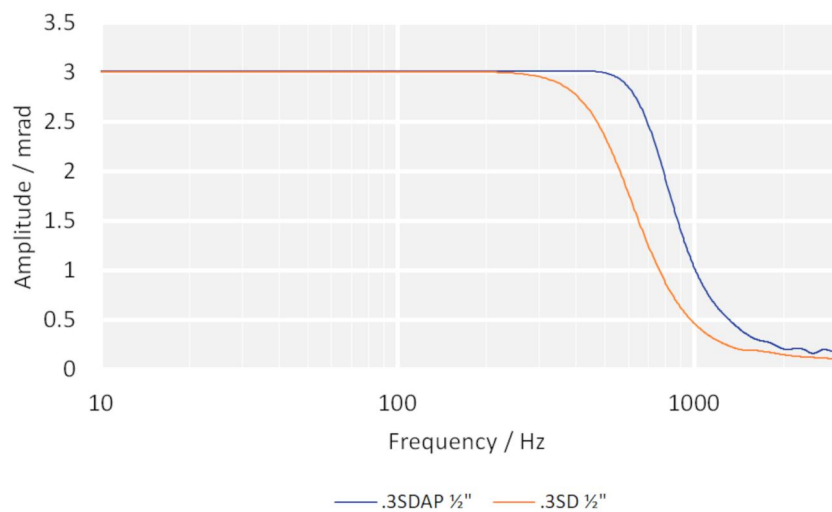


Full displacement of an unloaded S-331.5SL with E-505 piezo amplifier module and E-509 servo controller module

## Drawings / Images



Settling time of an unloaded S-331.5SL at full displacement with E-505 piezo amplifier module and E-509 servo controller module: The settling time is 3 ms with an accuracy of  $\pm 1\%$  for a step of 5 mrad (full displacement).



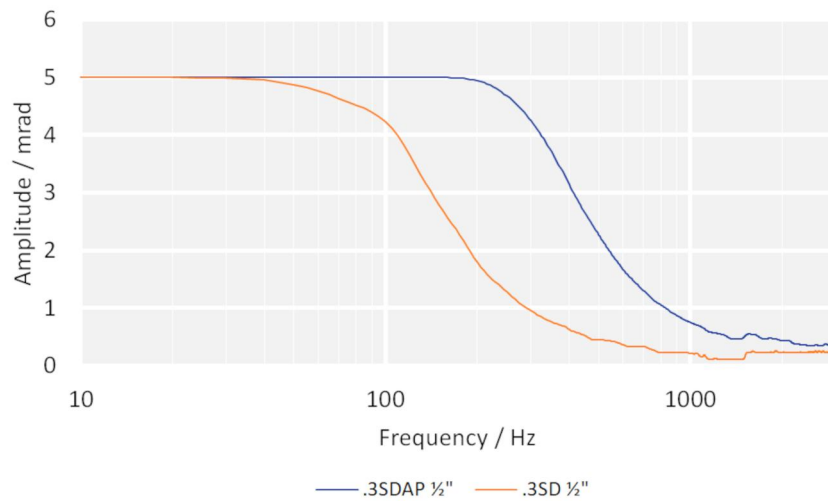
System frequency response with different E-727 controllers: S-331.2SH

The different performance level of the E-727 controller variants influences the dynamic properties of the system significantly.

E-727.3SD: 3 mrad, tuning optimized for 480 Hz

E-727.3SDAP: 3 mrad, tuning optimized for 800 Hz

## Drawings / Images



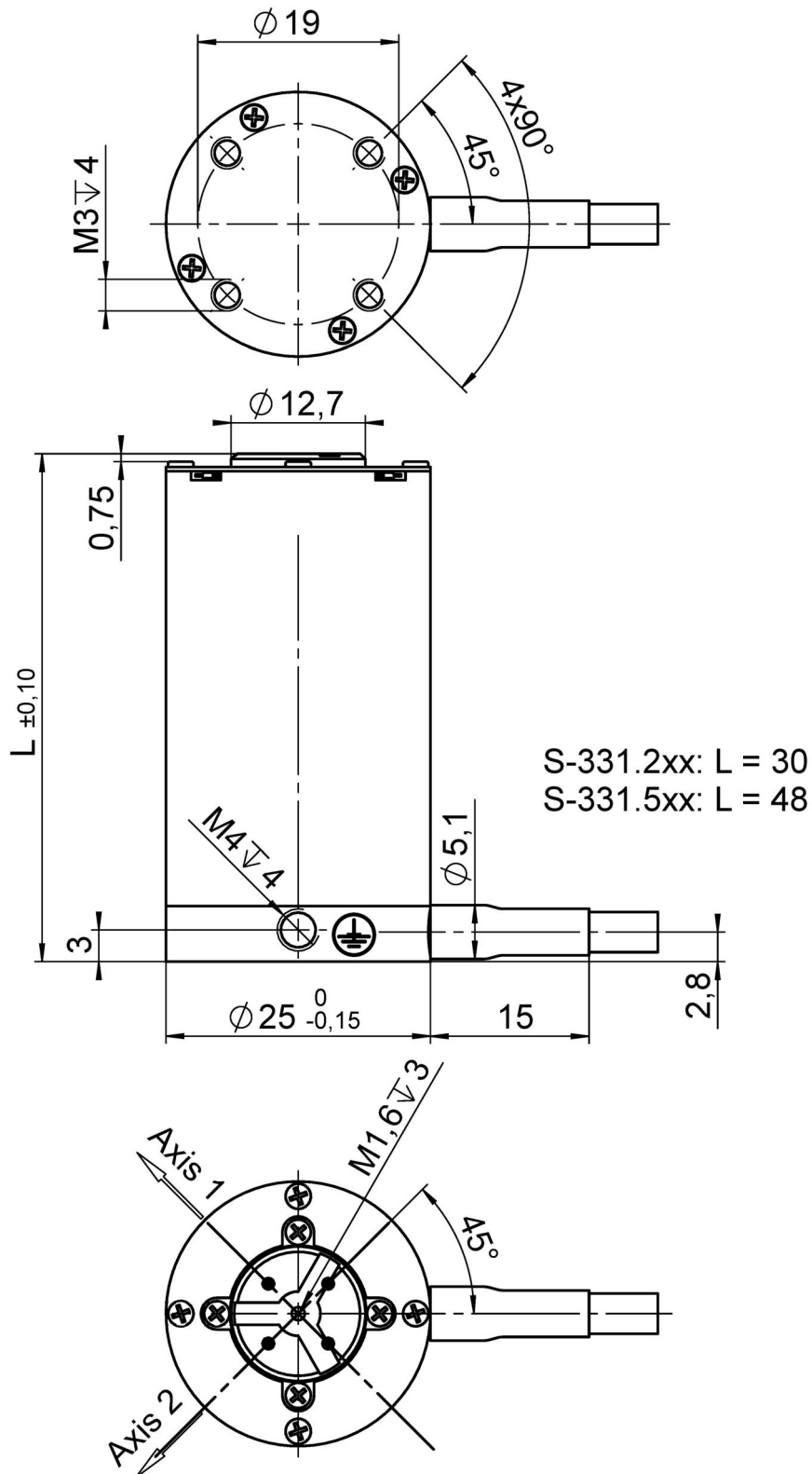
System frequency response with different E-727 controllers: S-331.5SH

The different performance level of the E-727 controller variants influences the dynamic properties of the system significantly.

E-727.3SD: 5 mrad, tuning optimized for static operation

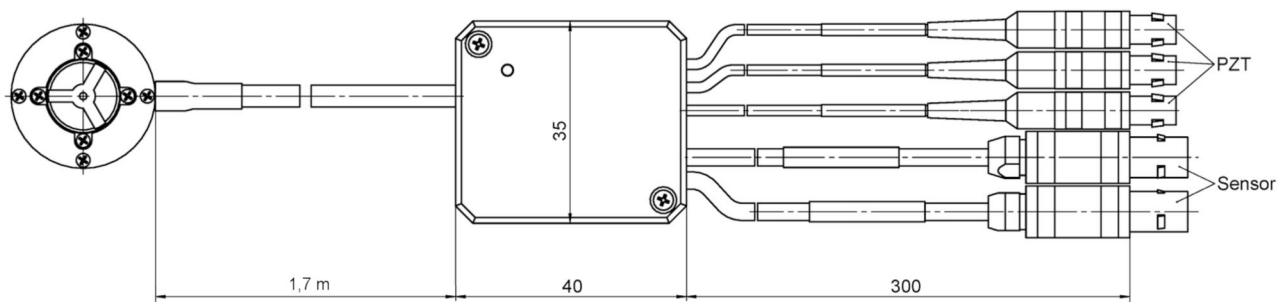
E-727.3SDAP: 5 mrad, tuning optimized for 250 Hz

## Drawings / Images



S-331, dimensions in mm. Note that a comma is used in the drawings instead of a decimal point.

## Drawings / Images



S-331.xSL with cable splitter box; dimensions in mm. Note that a comma is used in the drawings instead of a decimal point.

## Order Information

### S-331.2SH

High dynamic tip-tilt platform with high stiffness, 3 mrad tip/tilt angle, strain gauge sensor, D-sub 37 connector (m)

### S-331.2SL

High dynamic tip-tilt platform with high stiffness, 3 mrad tip/tilt angle, strain gauge sensor, LEMO connectors

### S-331.5SH

High dynamic tip-tilt platform with high stiffness, 5 mrad tip/tilt angle, strain gauge sensor, D-sub 37 connector (m)

### S-331.5SL

High dynamic tip-tilt platform with high stiffness, 5 mrad tip/tilt angle, strain gauge sensor, LEMO connectors