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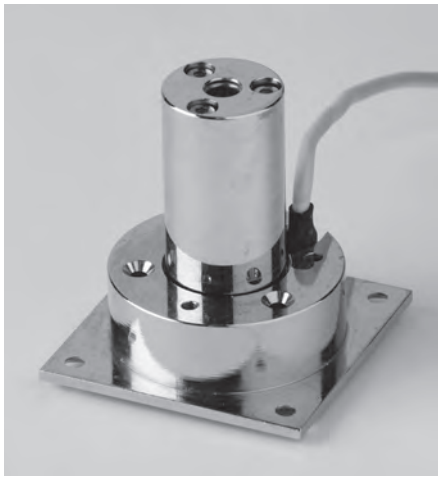
Nano mechanisms

NPS-Z-15A

The NPS-Z-15A is a piezo-scanned flexure guided stage with integrated capacitance position sensors.

It features a front reference surface to allow integration with the NPS-XY-100(x) providing three axis positioning control*. It is capable of sub-nanometer resolution and reproducibility. This stage has been designed to have extremely low angular deviation from the axis of travel; it is ideal for use in scanning probe microscope tips and othe applications where sideways motion is not tolerable.

* Requires ADP-XY100/Z15A



NPS-Z-15A

Key features

- >15μm travel with sub-nanometer resolution
- Typically <0.005% hysteresis and <0.01% linearity error
- First resonant frequency >3.5KHz typical
- High bandwidths (>300Hz)and fast response times
- In-situ scanning and stepping response optimization
- Robust and reliable
- Super Invar construction

Applications

- Scanning Probe Microscopy
- NSOM
- Atomic Force Microscopy
- Precision Engineering
- Interferometry
- Metrology

Suggested controller

NPS3110 series closed loop controller. The NPS3000 controller is designed specifically to control Queensgate's Nanometer Precision Mechanisms. They use modern DSP techniques and combine piezo drive amplifiers, capacitance position sensing circuitry and servo control capability.

Use of PID (proportional integral differential) feedback terms greatly improves settle times and minimizes the effect of mechanical resonances. Advanced control techniques developed by Queensgate allow-21 bit resolution, providing 0.05nm steps in a 100μm range. The virtual front panel software facilitates user control of all operating parameters, including PID loop set up.

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Nano mechanisms NPS-Z-15A

Specification

Parameter	Symbol	Value			Units	Comments
Static physical						
		Minimum	Typical	Maximum		
Material		Super Invar (Bright nickel plated)				
Size		51 long x 37 diameter			mm	
*Range	$d_{zp\cdot max}$	± 7.5	± 8.0		μm	
Scale factor	B_{z1}		1		μm	Note 1
*Scale factor error (1σ)	δb_{z1}		0.05	0.1	%	
Static stiffness	k_z		20		N·μm $^{-1}$	
Resonant frequency: 0g load	$f_{0\cdot 0}$		3500		Hz	
20g load	$f_{0\cdot 20}$		2800		Hz	
100g load	$f_{0\cdot 100}$		1650		Hz	
Maximum Load				0.5	Kg	Note 2
Dynamic physical (Typical values)						
		Fast	Medium	Slow		Note 3
3dB Bandwidth	$B_{z\cdot p}$	340	240	36	Hz	
*Small signal settle time	$t_{zs\cdot s}$	1.5	2.5	21	ms	Note 4
*Position noise (1σ)	$\delta z_{p\cdot n}$	0.2	0.15	0.05	nmrms	Note 5
Slew rate	$u_{zp\cdot max}$	2	1	0.5	μm/ms	Note 6
Error terms						
		Minimum	Typical	Maximum		
*Hysteresis (peak to peak)	$\delta_{zp\cdot hyst}$		0.005	0.01	%	Note 7
*Linearity error (peak)	$\delta_{zp\cdot lin}$		0.01	0.02	%	Note 8
*Rotational error	$\delta\phi_z$		2	10	μradians	Note 9
*Rotational error	$\delta\gamma_z$		2	10	μradians	Note 9

Notes

*These parameters are measured and supplied with each mechanism

1. All position commands are given in micrometers with seven digit resolution.
2. Depends on orientation. 0.5 Kg is the maximum load for gravity acting in the Z-direction. 0.5 Kg is the maximum load for gravity acting in the X or Y axes. Loads greater than 0.2 Kg can cause damage to the flexure mechanism.
3. For dynamic operation the servo-loop parameters are preset for different performances; the parameters are user settable via software control. Fast means the fastest the stage can stably move with less than 20 grams load. Medium means the maximum stable speed for loads up to 100 grams. Slow means the speed at which the servo loop is stable for all masses up to the maximum allowed mass – equivalent to low noise setting.
4. This is the 2% settle time. It is a function of the servo loop parameters which are user controllable. The test step size is 500 nm.
5. The actual position noise of the stage.
6. The highest rate of change of true position with time that can be achieved. It is limited by the closed loop parameters.
7. Percent of the displacement. The hysteresis specification for a displacement of less than 1μm amplitude is 0.1 nm.
8. Percent error over the full range of motion.
9. Angular motion over the full range of the stage. These rotational errors are rotational errors around the X and Y axes respectively.

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