



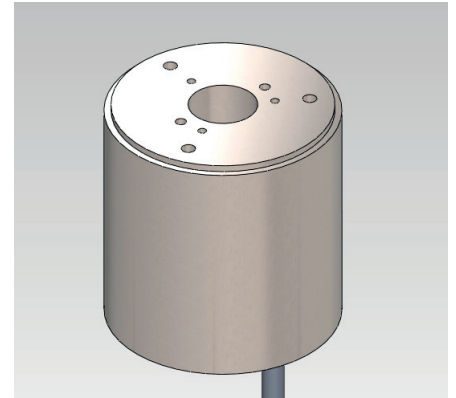
Nano mechanisms

NPS-Z-15H

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

The NPS-Z-15H offers over $15\mu\text{m}$ of closed loop travel with sub-nanometre resolution. Flexure guidance gives stability and pure axial motion to less than 5 micro-radians motion. This stage has been specifically designed with a hollow core, ideal for carrying a sample tip or optical fibre into the heart of any high-resolution microscope system.

A simple adapter (ADP-XY100/Z15A) couples the stage to the Queensgate® XY scanning stage so that complete XYZ control to sub-nanometre level over $120\times 120\times 15$ microns is achieved.



NPS-Z-15H

Key features

- > 15 micrometer travel with sub-nanometer resolution
- Typically < 0.005% hysteresis and < 0.01% linearity error
- First resonant frequency > 900 Hz
- In-situ scanning and stepping response optimization
- Robust and reliable
- Super Invar construction

Applications

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

Suggested controller

NPS3110, or NPS3330 (3-channel version) for XYZ, 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 $100\mu\text{m}$ range. The virtual front panel software facilitates user control of all operating parameters, including PID loop set up.





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Specification

Parameter	Symbol	Value			Units	Comments
Static physical						
		Minimum	Typical	Maximum		
Material		Super Invar (Electroless nickel plated)				
Size		35 long x 34 diameter			mm	10 mm clear central aperture
*Range	d_{zp-max}	± 7.5	± 8		μm	
Scale factor	b_{z1}		1		μm	Note 1
*Scale factor error (1σ)	δb_{z1}			0.1	%	
Static stiffness	k_z		20		$N\cdot\mu m^{-1}$	
Resonant frequency: 0g load	f_{0-0}		900		Hz	
Maximum load				0.5	Kg	Note 2
Dynamic physical (Typical values)						
		Fast	Medium	Slow		Note 3
3dB Bandwidth	$b_{z,p}$	80	40	10	Hz	
*Small signal settle time	t_{zs-s}	5	10	30	ms	Note 4
*Position noise (1σ)	δz_{p-n}	0.50	0.20	0.10	nm_{rms}	Note 5
Slew rate	u_{zp-max}	2	1	0.5	$\mu m/ms$	Note 6
Error terms						
		Minimum	Typical	Maximum		
*Hysteresis (peak to peak)	δz_{p-hyst}		0.005	0.02	%	Note 7
*Linearity error (peak)	δz_{p-lin}		0.01	0.02	%	Note 8
*Rotational error	$\delta \phi_z$			10	$\mu radians$	Note 9
*Rotational error	$\delta \gamma_z$			10	$\mu radians$	Note 9

Notes

*These parameters are measured and supplied with each mechanism

- All position commands are given in micrometers with seven digit resolution.
- Depends on orientation. 0.5 Kg is the maximum load for gravity acting in the Z-direction. 0.1 Kg is the maximum load for gravity acting in the X or Y axes. Loads greater than 2 Kg can cause damage to the flexure mechanism.
- 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.

- 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.
- The actual position noise of the stage.
- The highest rate of change of true position with time that can be achieved. It is limited by the closed loop parameters.
- Percent of the displacement. The hysteresis specification for a displacement of less than $1\mu m$ amplitude is 0.1 nm.
- Percent error over the full range of motion.
- Angular motion over the full range of the stage. These rotational errors are rotational errors around the X and Y axes respectively.

