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a brand of Elektron Technology

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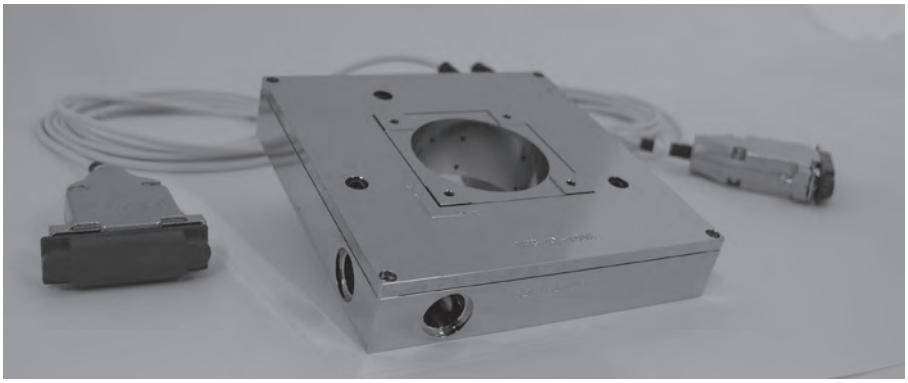
Nano mechanisms

NPS-XY-100A

The NPS-XY-100A NanoMechanism is a piezo scanned flexure guided stage with integrated capacitance position sensors capable of sub-nanometer resolution and reproducibilty.

Finite element analysis of the flexure guidance mechanisms has reduced parasitic angular motions to less than 25 micro-radians over the full 100μm range.

The Super Invar construction (CTE 0.3ppm K^{-1}, compared to Aluminium at 23ppm K^{-1}) minimizes thermal drift, which on a nanometer scale is very important. The unique iso-static mounting system ensures that stresses from the mounting system are properly relieved and establishes the center of the stage as the co-ordinate reference point.



NPS-XY-100A

Key features

- >100µm travel in each axis with sub-nanometer resolution
- Typically <0.005% hysteresis and <0.01% linearity error
- First resonant frequency >350Hz
- In-situ scanning and stepping response optimization
- Robust and reliable
- Super Invar construction

Applications

- High Precision Microscopy
- AFM, SPM, NSOM

Suggested controller

The NPS3000 series closed loop 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-XY-100A

Specification

Parameter	Symbol	Value			Units	Comments
Static physical						
		Minimum	Typical	Maximum		
Material		Super Invar (Bright nickel plated)				
Size		100 x 100 x 23			mm	Note 1
*Range	$d_{xp\cdot max}$	± 50	± 55		μm	
Scale factor	b_{x1}		1		μm	Note 2
*Scale factor error (1σ)	δb_{x1}			0.1	%	
Static stiffness	k_z		1		N·μm^{-1}	
Resonant frequency: 0g load	$f_{0\cdot 0}$		350		Hz	
50g load	$f_{0\cdot 50}$		260		Hz	
1000g load	$f_{0\cdot 1000}$		120		Hz	
Maximum load				1	Kg	Note 3
Dynamic physical (Typical values)						
		Fast	Medium	Slow		Note 4
3dB Bandwidth	$B_{x\cdot p}$	53	20	4	Hz	
*Small signal settle time	$t_{xs\cdot s}$	15	30	130	ms	Note 5
*Position noise (1σ)	$\delta x_{p\cdot n}$	0.7	0.5	0.25	nm$_{rms}$	Note 6
Slew rate	$u_{xp\cdot max}$	3	2	0.5	μm/ms	Note 7
Error terms						
		Minimum	Typical	Maximum		
*Hysteresis (peak to peak)	$\delta_{xp\cdot hyst}$		0.005	0.01	%	Note 8
*Linearity error (peak)	$\delta_{xp\cdot lin}$		0.01	0.02	%	Note 9
*Rotational error	$\delta\phi_x$		10	25	μradians	Note 10
*Rotational error	$\delta\theta_x$		5	10	μradians	Note 10
*Rotational error	$\delta\gamma_x$		5	10	μradians	Note 10
Orthogonality	$\delta\theta_{orth}$		8		mradians	

Notes

*These parameters are measured and supplied with each mechanism

1. With 40mm diameter central aperture.
2. All position commands are given in micrometers with seven digit resolution.
3. Depends on orientation. 1 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 5 kg can cause damage to the flexure mechanism.
4. 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 50 grams load. Medium means the maximum stable speed for loads up to 200 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.
5. This is the 2% settle time. It is a function of the servo loop parameters which are user controllable. The test step size is 2000 nm.
6. The actual position noise of the stage.
7. The highest rate of change of true position with time that can be achieved. It is limited by the closed loop parameters.
8. Percent of the displacement. The hysteresis specification for a displacement of less than 1μm amplitude is 0.1 nm.
9. Percent error over the full range of motion.
10. Angular motion over the full range of the stage. These rotational errors are rotational errors around the Z, Y and X axes respectively.

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