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Nano mechanisms

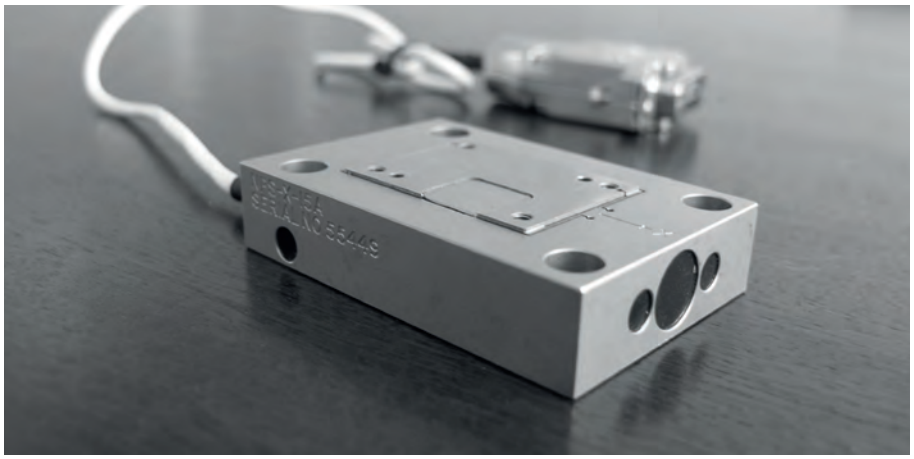
NPS-X-15A and NPS-X-15D

NPS-X-15A

The NPS-X-15A was originally designed for high speed, ultra precision MR head and disk drive testing.

It's small size and millisecond response time is ideal for applications where high reliability and throughput are essential. A low moving mass and high stiffness combine to offer extremely high bandwidth.

The capacitive sensor design provides the sub-nanometer displacement measurement and closed-loop feedback over a range in excess of 16 microns. Flexure guidance offers high purity of motion, with parasitic motion reduced to less than 5 microradians. Combined with Queensgate's digital closed-loop controllers, the NPS-X-15A can achieve millisecond response and settle times.



NPS-X-15A

NPS-X-15D

The same mechanical footprint as the NPS-X-15A, on which it is based, but with an increased height of 15.5mm. Its advantages are increased stiffness, higher resonant frequency and faster settle times.

Applications

- MR head and disk drive testing
- Interferometry
- Metrology

Suggested controllers

NPC-A-1110DS or NPC-D-5110DS series closed loop controllers. The NPC-D-5110DS 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-24 bit resolution, providing 0.006nm steps in a 100μm range. The virtual front panel software facilitates user control of all operating parameters, including PID loop set up.

Key features

- >15μm travel with sub-nanometer resolution
- First resonant frequency >3KHz
- Millisecond response time with a load of 50g
- In-situ scanning and stepping response optimization
- Robust and reliable for production test
- Plug and play facilities for low down-time

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Queensgate Instruments
info@queensgate.com
www.nanopositioning.com

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Nano mechanisms NPS-X-15A (NPS-X-15D)

Specification Values for NPS-X-15D in parenthesis

Parameter	Symbol	Value			Units	Comments
Static physical						
		Minimum	Typical	Maximum		
Material		Stainless steel 316				
Size		60 long x 40 wide x 13.5 high (60x40x15.5)			mm	
*Range	$d_{xp\cdot max}$	± 7.5	± 8		μm	
Scale factor	b_{x1}		1		μm	Note 1
*Scale factor error (1σ)	δb_{x1}		0.1		%	
Resonant frequency: 0g load	$f_{0\cdot 0}$	3000 (3500)			Hz	
50g load	$f_{0\cdot 50}$		2500 (2900)		Hz	
200g load	$f_{0\cdot 200}$		1500 (1750)		Hz	
Maximum load				5	Kg	Note 2
Dynamic physical (typical values)						
		Fast	Medium	Slow		Note 3
3dB Bandwidth	$B_{x\cdot p}$	250 (300)	170 (200)	35 (35)	Hz	
*Small signal settle time	$t_{xs\cdot s}$	1.7 (1.5)	4.3 (3.5)	25 (25)	ms	Note 4
*Position noise (1σ)	$\delta x_{p\cdot n}$	0.2	0.1	0.05	nm_{rms}	Note 5
Slew rate	$u_{xp\cdot max}$	2	1	0.2	μm/ms	Note 6
Error terms						
		Minimum	Typical	Maximum		
*Hysteresis (peak to peak)	$\delta_{xp\cdot hyst}$		0.005	0.01	%	Note 7
*Linearity error (peak)	$\delta_{xp\cdot lin}$		0.01	0.02	%	Note 8
*Rotational error	$\delta\phi_x$		1	5	μradians	Note 9
*Rotational error	$\delta\theta_x$		1	5	μradians	Note 9
*Rotational error	$\delta\gamma_x$		1	5	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. This is the maximum load for gravity acting in the Z-direction to avoid damage to the stage 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 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 loads up to 500 grams – 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; the absolute maximum value (in open loop operation) is ~3.5 $\mu m \bullet ms^{-1}$.
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 Z, Y and X axes respectively.

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www.nanopositioning.com