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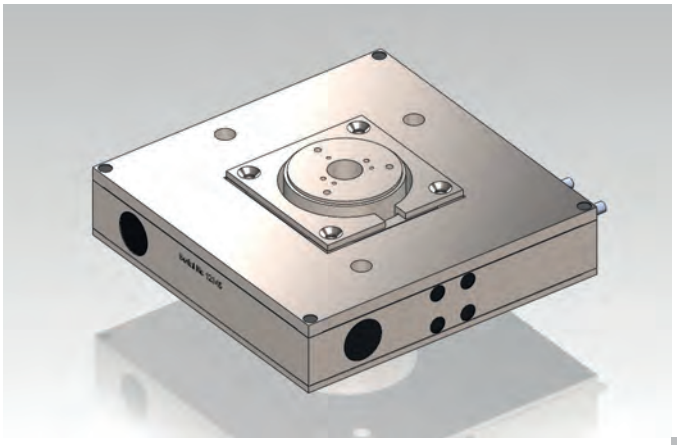
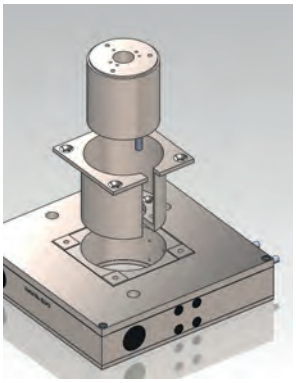
Nano mechanisms

NPS-XYZ-100/Z15H



The NPS-XYZ-100A/15H stage integrates the NPS-XY-100A with the hollow NPS-Z-15H to provide an optical taper right into the focal plane of the sample under test. This arrangement offers over 100μm of travel in X & Y axes and over 15μm travel in the Z axis.

Coupled with a range of interfacing options to our closed loop digital controller, this system provides a sophisticated and easy to implement solution for new and existing NSOM users.



Key features

- Sub-nanometer accuracy positioning and stability in X, Y and Z axes
- Hysteresis / linearity errors <0.005%
- Simple implementation, easy image calibration
- In-situ optimization of stage scanning response
- Exceptional short- and long- term stability

Options

- Digital, analogue and serial control options
- Optical fiber chucks and adapter plates for custom configurations
- Ultra low noise and drift electronics

Suggested controller

NPS3330 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-XYZ-100/Z15H

Specification

Axis	Parameter	Symbol	Value			Units	Comments
XY	**Static physical**						
			Minimum	Typical	Maximum		
	Material		Super Invar (Bright nickel plated)				
	Size		100 x 100 x 38.5			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_x		1		N·μm^{-1}	
	Resonant frequency: 0g load	$f_{0\cdot0}$		350		Hz	
	50g load	$f_{0\cdot50}$		260		Hz	
	1000g load	$f_{0\cdot1000}$		120		Hz	
	Maximum load				1	Kg	Note 3
XY	**Dynamic physical (Typical values)**						
	Loop settings		Fast	Medium	Slow		Note 4
	Bandwidth	$B_{x\cdot p}$	53	20	4	Hz	
	*Small signal settle time	$t_{xs\cdot s}$	15	30 1	30	ms	Note 5
	*Position noise (1σ)	$\delta x_{p\cdot n}$	0.7	0.5	0.25	nm	Note 6
	Slew rate	$u_{xp\cdot max}$	3	2	0.5	μm·ms^{-1}	Note 7
XY	**Error terms**						
	*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	μrad	Note 10
	*Rotational error	$\delta\theta_x$		5	10	μrad	Note 10
	*Rotational error	$\delta\gamma_x$		5	10	μrad	Note 10
	Orthogonality	$d\,f_{\,orth}$		8		mrad	
Z	**Static physical**						
			Minimum	Typical	Maximum		
	Material		Super Invar				
	*Range	$d_{xp\cdot max}$	± 7.5 ±	8.0		μm	
	*Scale factor	b_{x1}		1		μm	Note 2
	Scale factor uncertainty (1s)	δb_{z1}			0.1	%	
	Static stiffness	k_z		20		N·μm^{-1}	
	Resonant frequency: 0g load	$f_{0\cdot0}$		900		Hz	
	Maximum load				0.5	kg	Note 3

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Nano mechanisms NPS-XYZ-100/Z15H

Specification (continued)

Axis	Parameter	Symbol	Value			Units	Comments
Z	**Dynamic physical (Typical values)**						
	Loop settings		Fast	Medium	Slow		Note 4
	3dB Bandwidth	$B_{z\cdot p}$	80	40	10	Hz	
	*Small signal settle time	$t_{zs\cdot s}$	5	10	30	ms	Note 5
	*Position noise (1s)	$\delta z_{p\cdot n}$	0.5	0.2	0.1	nm	Note 6
	Slew rate	$u_{zp\cdot max}$	2	1	0.5	$\mu m \cdot ms^{-1}$	Note 7
Z	**Error terms**						
	*Hysteresis (peak to peak)	$\delta_{zp\cdot hyst}$		0.005	0.02	%	Note 11
	*Linearity error (peak)	$\delta_{zp\cdot lin}$		0.01	0.02	%	Note 9
	*Rotational error	$\delta\theta_z$			10	μrad	Note 10
	*Rotational error	$\delta\gamma_z$			10	μrad	Note 10

Notes

*These parameters are measured and supplied with each mechanism

1. With 10 mm diameter central aperture. Includes Z Stage.
2. All position commands are given in micrometers with seven digit resolution.
3. Depends on orientation. 1kg is the maximum load for gravity acting in the Z direction. 0.5kg is the maximum load for gravity acting in the X or Y axes. Loads greater than 5kg 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 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 - equivalently 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 500 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; the absolute maximum value (in open loop operation) is ~3.5 $\mu m \bullet ms^{-1}$.
8. Percentage 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.
11. Percentage of the displacement. The hysteresis specification for a displacement of less than 1μm amplitude is 0.2nm.

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