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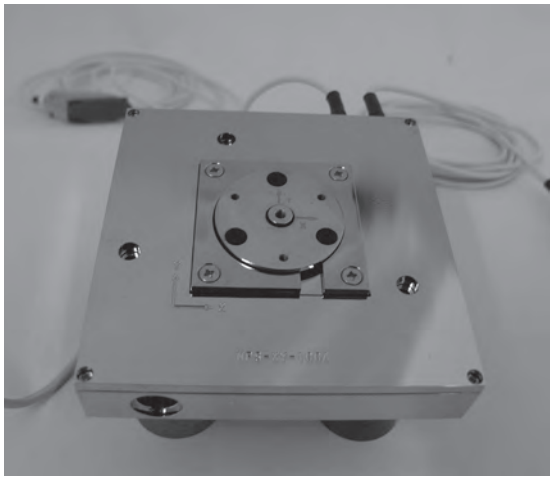
Nano mechanisms

NPS-XYZ-100/Z15A

The NPS-XYZ-100A/15A stage integrates the NPS-XY-100A with an NPS-Z-15A to provide a solid XYZ arrangement with over 120μm of travel in X & Y axes and over 16μm 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 users of high resolution microscopes.



NPS-XYZ-100/Z15A

Key features

- Sub-nanometer positioning accuracy and stability in X, Y and Z axes
- Solid platform
- Ultra-low hysteresis / linearity errors
- Simple implementation, easy image calibration
- In-situ optimisation of stage scanning response
- Exceptional short- and long- term stability
- Super Invar construction

Options

- XY, XYZ (clear aperture) and XYZ (hollow for NSOM or optical microscopy) configurations
- Digital, analogue and serial control options
- Adapter plates allow 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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Specification

Axis	Parameter	Symbol	Value			Units	Comments
XY	**Static physical**						
			Minimum	Typical	Maximum		
	Material		Super Invar				
	Size		100 x 100 x 48			mm	Note 1
	*Range	$d_{xp.max}$	± 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}	
XY	**Dynamic physical (Typical values)**						
	Loop Settings		Fast	Medium	Slow		Note 3
	*Bandwidth	$B_{x\cdot p}$	90	30	20	Hz	
	*Small signal settle time	$t_{xs\cdot s}$	10	20	130	ms	Note 4
	*Position noise (1σ)	$\delta x_{p\cdot n}$	0.4	0.3	0.1	nm	Note 5
	Slew rate	$u_{xp.max}$	3	2	0.5	μm·ms^{-1}	Note 6
XY	**Error terms**						
	*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	$\delta\phi_x$		10	25	μrad	Note 9
	*Rotational error	$\delta\theta_x$		2	10	μrad	Note 9
	*Rotational error	$\delta\gamma_x$		2	10	μrad	Note 9
Z	**Static physical**						
			Minimum	Typical	Maximum		
	Material		Super Invar				
	*Range	$d_{xp\cdot max}$	± 7.5	± 8.5		μm	
	*Scale factor	b_{x1}		1		μm	Note 2
	Scale factor error (1σ)	δb_{x1}			0.1	%	
Z	**Dynamic physical (Typical values)**						
	Loop settings		Fast	Medium	Slow		Note 10
	*Position noise (1σ)	$\delta x_{p\cdot n}$	0.1	-	0.05	nm	Note 5
Z	**Error terms**						
	*Hysteresis (peak to peak)	$\delta_{xp\cdot hyst}$			0.05	%	Note 7
	*Linearity error (peak)	$\delta_{xp\cdot lin}$		0.01	0.02	%	Note 8
	*Rotational error	$\delta\phi_x$		10		μrad	Note 9
	*Rotational error	$\delta\theta_x$		5		μrad	Note 9
	*Rotational error	$\delta\gamma_x$		5		μrad	Note 9

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Notes

*These parameters are measured and supplied with each mechanism

1. No central aperture.
2. All position commands are given in micrometers with seven digit resolution.
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 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.This is the maximum load for gravity acting in the Z-direction to avoid damage to the stage mechanism.
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 2000 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 µm•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.
10. For dynamic operation the servo loop parameters are preset for different performances; the parameters are user settable via software control. Percent error over the full range of motion.

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