queensgate
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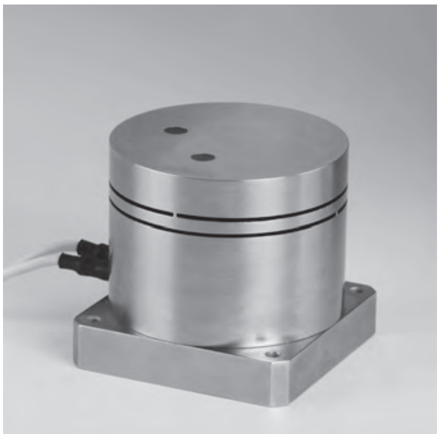
Nano mechanisms

NPS-θγ-2B

The Queensgate NPS-θγ-2B has been developed for applications requiring ultra-high precision positioning of mirrors in optical inspection and imaging systems. The mirror is simply fixed onto the tilting platform of the stage to provide > 2 milliradians of travel with sub micro-radian resolution.

Low moving masses and optimised open-loop control offer exceptional response times for high speed application. Flexible digital open loop electronics allow response optimisation to be performed in-situ.



NPS-θγ-2B

Key features

- >2mrad range in each axis with sub micro-radian resolution
- Enclosed mechanism for high stability and reliability
- Small signal settle times <3ms
- Simple flexure design for low cost/high volume applications
- EEPROM with stage calibration data for ‘plug and play’ ability
- Low noise and low drift electronics

Applications

- Precision beam steering
- Image jitter correction

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-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.

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Specification

Parameter	Symbol	Value			Units	Comments
Static physical						
		Minimum	Typical	Maximum		
Material		Aluminium (Electroless nickel plated)				
Size		56 high x 60 diameter			mm	
*Range	$d_{\theta p \cdot max}$	±1	±1.05		mrad	
*Scale factor	$b_{\theta 1}$		1		mrad	Note 1
Scale factor uncertainty (1σ)	$\delta b_{\theta 1}$			0.1	%	
Resonant frequency: 0g load	$f_{0 \cdot 0}$		1000		Hz	
200g load	$f_{0 \cdot 200}$		380		Hz	
Dynamic physical						
Loop setting		Fast	Medium	Slow		Note 2
3dB Bandwidth	$B_{\theta p}$	200	70	20	Hz	
*Small signal settle time	$t_{\theta s.s}$	3	10	100	ms	Note 3
*Position noise (1σ)	$\delta\theta_{p \cdot n}$	15	6	2	nrads	Note 4
Slew rate	$u_{\theta p \cdot max}$	0.25	0.1	0.01	mrads/ms	Note 5
Error terms						
		Minimum	Typical	Maximum		
*Hysteresis (peak to peak)	$\delta\theta_{p \cdot hyst}$		0.05	0.1	%	Note 6
*Nonlinearity (peak)	$\delta\theta_{p \cdot lin}$		0.03	0.05	%	Note 7
*Crosstalk	$\delta\theta_{x\gamma}$		0.05	0.1	mrads	Note 8

Notes

*These parameters are measured and supplied with each mechanism

1. All position commands are given in mrad with 7 digit resolution.
2. 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 g load. Medium means the maximum speed for loads up to 200 g. Slow means the speed at which the servo loop is stable for all masses up to 500 g – equivalent to low noise setting.
3. This is the 2% settle time. It is a function of the servo loop parameters which are user controllable. The test step size is 100 μrad.
4. The actual position noise of the stage.
5. The highest rate of change of true position with time that can be achieved. It is limited by the closed loop parameters.
6. Percent of the displacement. The hysteresis specification for a displacement of less than 1 mrad is less than 1μrad.
7. Percent error over the full range of motion.
8. Measured over the full range of motion.

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