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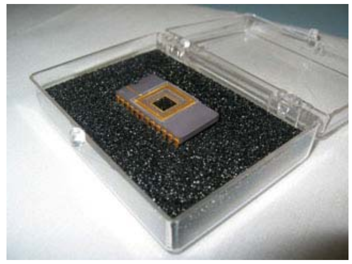
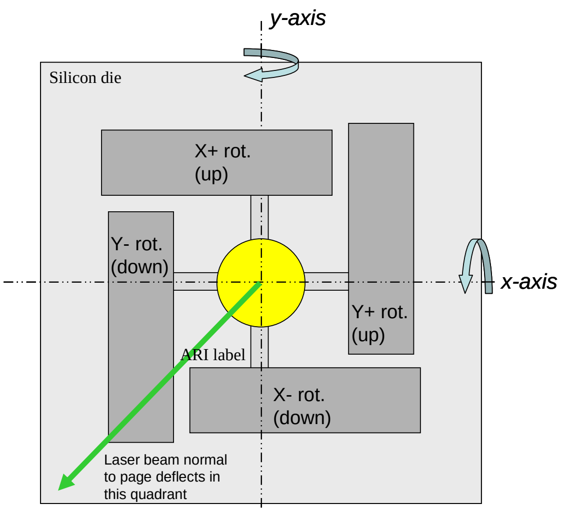


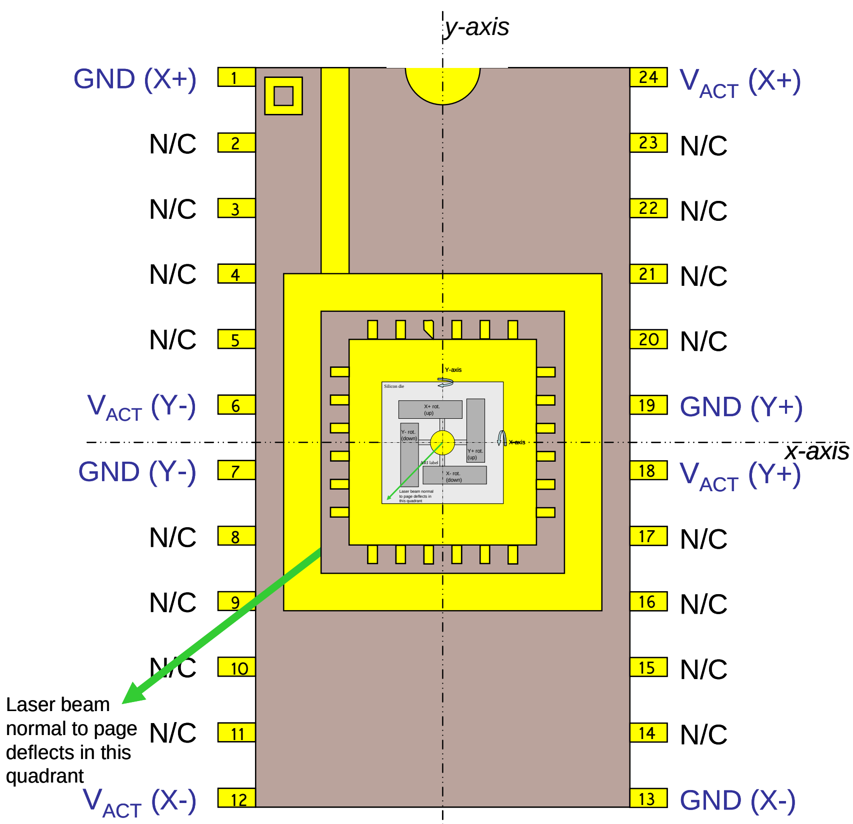
Gimbal-Less Two-Axis Scanning Micromirrors – *B Series*

PIN ASSIGNMENTS

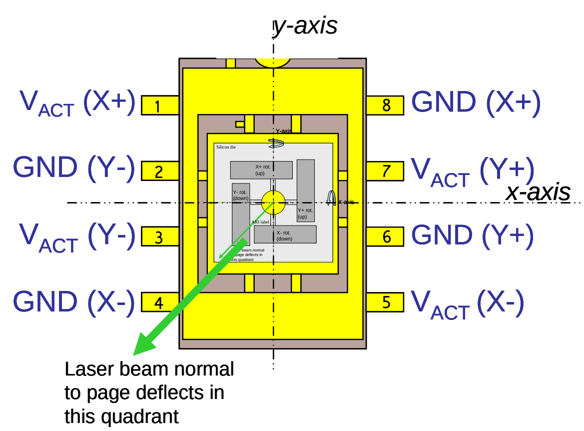


ELECTROSTATIC DISCHARGE SENSITIVITY

This microelectromechanical device can be damaged by ESD. Mirrorcle Technologies, Inc. recommends that all micromirror devices be handled with appropriate precautions. Failure to observe proper handling and installation procedures can cause damage. ESD damage can range from subtle performance degradation to complete device failure.



24-pin DIP



8-pin DIP

TERMINAL FUNCTIONS

Terminal Type	Rotator	Pin No. 24-pin DIP	Pin No. 8-pin DIP	Terminal Function
GND	(X+)	1	8	Ground connection for the X+ rotator.
V_{ACT}	(Y-)	6	3	Actuation voltage for *y*-axis rotation of the micromirror. Voltage difference between V_{ACT} and GND is converted to torque and rotation of the micromirror about the *y*-axis in the negative θy direction.
GND	(Y-)	7	2	
V_{ACT}	(X-)	6	3	Actuation voltage for *x*-axis rotation of the micromirror. Voltage difference between V_{ACT} and GND is converted to torque and rotation of the micromirror about the *x*-axis in the positive θy direction.
GND	(X-)	13	4	
V_{ACT}	(Y+)	6	3	Actuation voltage for *y*-axis rotation of the micromirror. Voltage difference between V_{ACT} and GND is converted to torque and rotation of the micromirror about the *y*-axis in the negative θy direction.
GND	(Y+)	19	6	
V_{ACT}	(X+)	6	3	Actuation voltage for *x*-axis rotation of the micromirror. Voltage difference between V_{ACT} and GND is converted to torque and rotation of the micromirror about the *x*-axis in the positive θy direction.

RECOMMENDED CONNECTIONS

- All GND leads should be tied together
- Rotators X- and X+ apply torque to the micromirror in the same direction. Activating both rotators in common mode by tying together V_{ACT} (X-) and V_{ACT} (X+) will achieve optimal and maximum micromirror rotation, and will prevent lateral and vertical displacements displacements.
- Rotators Y- and Y+ apply torque to the micromirror in the same direction. Activating both rotators in common mode by tying together V_{ACT} (Y-) and V_{ACT} (Y+) will achieve optimal and maximum micromirror rotation, and will prevent lateral and vertical displacements displacements.
- In open-loop point-to-point mode of operation, drive/control signals should be low-pass filtered to below ½ frequency of first resonant mode to prevent oscillation and ringing and significantly decrease device settling times. Low pass analog Bessel filters or digital approximations of Bessel filters are recommended for this application.

Note: If the device is suddenly disconnected from the HV amplifier while in operation, the capacitors driving the micromirror can remain charged for long periods of time and mirror may remain deflected to large angles. We recommend that the device is brought to rest position with 0V applied to both axes before disconnecting any connections.

TECHNICAL SPECIFICATIONS – STANDARD MIRROR SIZE

Absolute maximum ratings

Either axis static voltage to ground	-130V to 130V
Either axis dynamic* voltage to ground	-50V to 50V

*dyamic refers to signals that excite device resonance and therefore very large amplitude motion

Input impedance characteristics

Parameter	MIN	TYP	MAX	**Unit**
Input resistance	1M	∞	∞	Ω
Input capacitance	15	20	22	pF

Mechanical deflection angle

Mode of operation	**Axis**	**Maximum positive deflection**			**Maximum negative deflection**			**Unit**
		MIN	TYP	MAX	MIN	TYP	MAX	
Point-to-point	X	8	10	12	0	0	0	*deg*
Point-to-point	Y	8	10	12	0	0	0	*deg*
Resonant driving	X	12	16	20	-12	-16	-20	*deg*
Resonant driving	Y	12	16	20	-12	-16	-20	*deg*

Actuation voltage requirements*

Mode of operation	**Axis**	**Vx,y for max. positive deflection**			**Vx,y for max. negative deflection**			**Unit**
		MIN	TYP	MAX	MIN	TYP	MAX	
Point-to-point	X	106	110	119	0	0	0	*V*
Point-to-point	Y	106	110	119	0	0	0	*V*
Resonant drive	X	40	46	49				*V*
Resonant drive	Y	40	46	49				*V*

*Voltages required to achieve maximum deflection angles listed in "Mechanical deflection angle"

Achievable dyamic response

Mode of operation	**Axis**	MIN	TYP	MAX	**Unit**
Point-to-point 99% settling*	X	<190	<320	<500	*μs*
Point-to-point 99% settling*	Y	<190	<320	<500	*μs*
Dominant resonant mode	X	>2.45	2.7	>2.9	*kHz*
Dominant resonant mode	Y	>2.45	2.7	>2.9	*kHz*

*Best case large-angle settling times achieved with properly filtered/conditioned step signals

Optical properties

Mirror diameter	0.7	*mm*
Custom mirror sizes and shapes	any <2.4mm available for larger orders	

	MIN	TYP	MAX	
Mirror radius of curvature	>4	>5	>10	*m*
Mirror surface rms roughness	<1	1	<5	*nm*
Mirror coating		Si		
Custom mirror coatings		available for larger orders		

TECHNICAL SPECIFICATIONS – SPECIAL MIRRORS SIZES

Absolute maximum ratings

Either axis static voltage to ground	-130V to 130V
Either axis dynamic* voltage to ground	-50V to 50V

*dyamic refers to signals that excite device resonance and therefore very large amplitude motion

Input impedance characteristics

Parameter	MIN	TYP	MAX	**Unit**
Input resistance	1M	∞	∞	Ω
Input capacitance	15	20	22	pF

Mechanical deflection angle

Mode of operation	**Axis**	**Maximum positive deflection**			**Maximum negative deflection**			**Unit**
		MIN	TYP	MAX	MIN	TYP	MAX	
Point-to-point	X	8	10	12	0	0	0	*deg*
Point-to-point	Y	8	10	12	0	0	0	*deg*
Resonant driving	X	12	16	20	-12	-16	-20	*deg*
Resonant driving	Y	12	16	20	-12	-16	-20	*deg*

Actuation voltage requirements*

Mode of operation	**Axis**	**Vx,y for max. positive deflection**			**Vx,y for max. negative deflection**			**Unit**
		MIN	TYP	MAX	MIN	TYP	MAX	
Point-to-point	X	106	110	119	0	0	0	*V*
Point-to-point	Y	106	110	119	0	0	0	*V*
Resonant drive	X	40	46	49				*V*
Resonant drive	Y	40	46	49				*V*

*Voltages required to achieve maximum deflection angles listed in "Mechanical deflection angle"

Achievable dyamic response

Mode of operation		**0.8 MM diameter**			**1.2 MM diameter**			
	Axis	MIN	TYP	MAX	MIN	TYP	MAX	**Unit**
Point-to-point 99% settling*	X	<125	<200	<400	<125	<200	<400	*µs*
Point-to-point 99% settling*	Y	<125	<200	<400	<125	<200	<400	*µs*
Dominant resonant mode	X	>2.7	3.2	>3.35	>1.35	1.55	>1.7	*kHz*
Dominant resonant mode	Y	>2.7	3.2	>3.35	>1.35	1.55	>1.7	*kHz*

*Best case large-angle settling times achieved with properly filtered/conditioned step signals

Optical properties

Mirror diameter	0.8 or 1.2	*mm*
Custom mirror sizes and shapes	any <=2.4mm diameter available for larger orders	

	MIN	TYP	MAX	
Mirror radius of curvature	>1	>1	>5	*m*
Mirror surface rms roughness	<2	<5	<15	*nm*
Mirror coating		100nm thick Al		
Custom mirror coatings		available for larger orders		

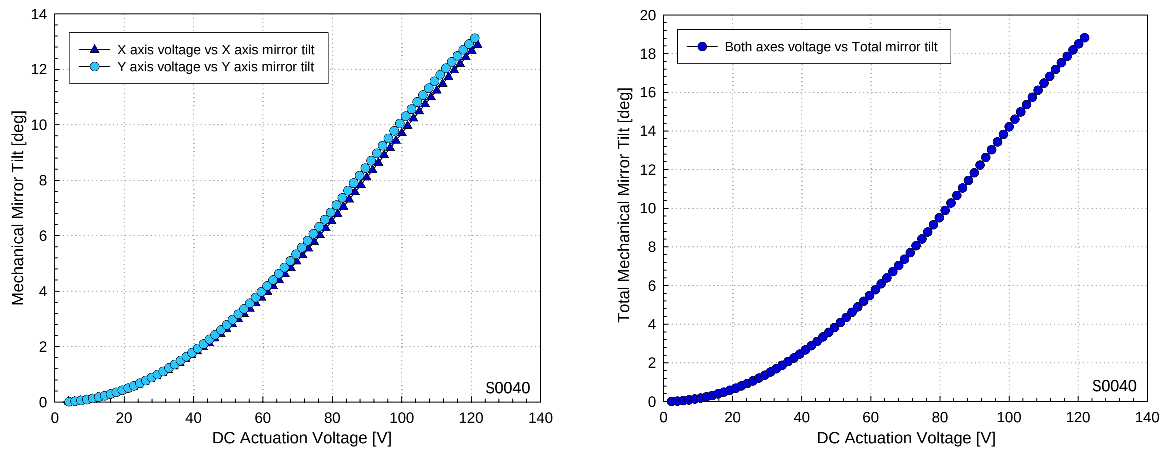


Figure 1. Measured "ramp response," or voltage vs. static mechanical micromirror tilt angle for a typical B-series device: (a) comparison of mechanical tilt when each axis is activated separately, and (b) total mechanical tilt of the micromirror when both axes are tied together and activated with common actuation voltage.

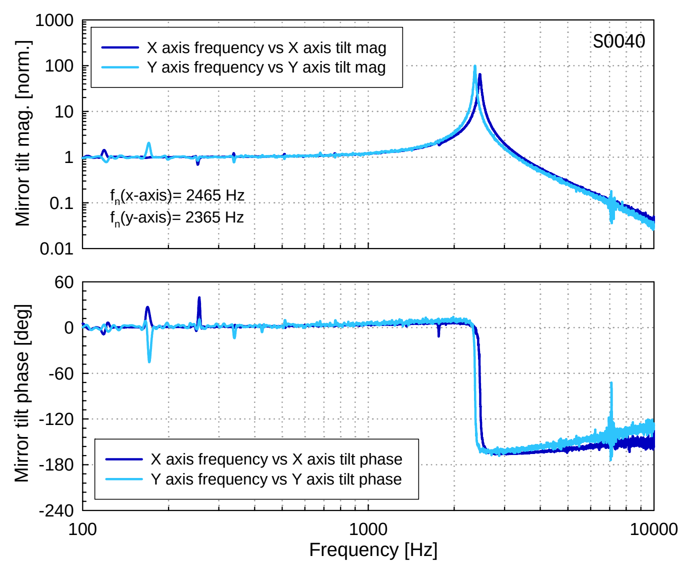


Figure 2. Measured small-signal magnitude and phase response for a typical B-series device with a standard 700µm diameter micromirror. Magnitude of tilt normalized to 100 Hz value. V_{ACT} = bias of 48V + 1Vrms excitation. Each axis measured separately.

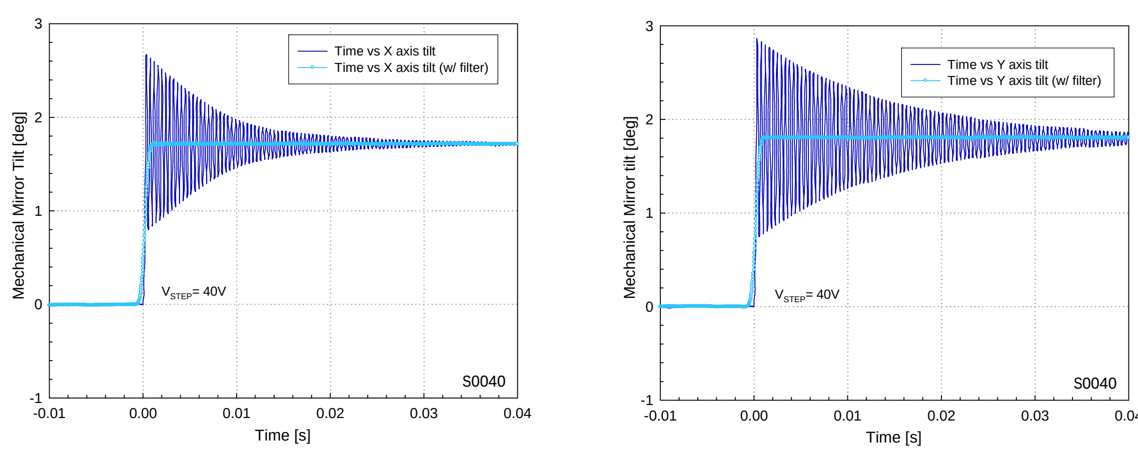


Figure 3. Measured step responses for a typical B-series device: (a) response to an unfiltered step excitation vs. 800Hz 6th order Bessel filtered step excitation from 0V to 40V on the x-axis, and (b) step response on the y-axis to same conditions.