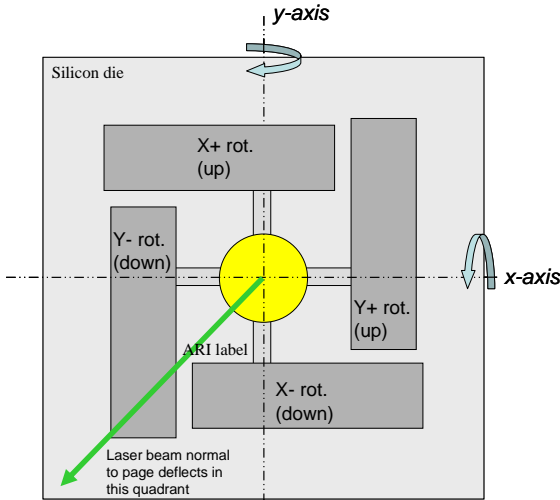


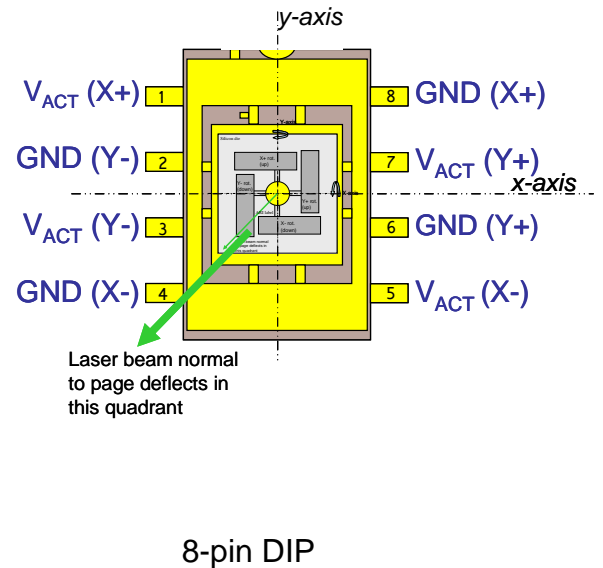
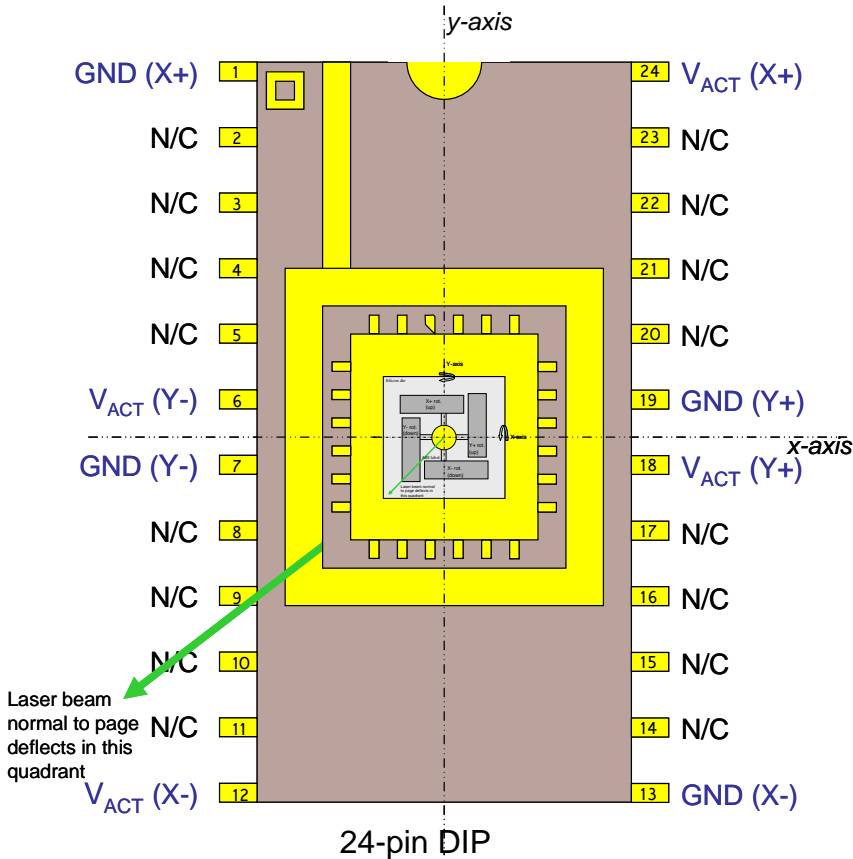
Gimbal-Less Two-Axis Scanning Micromirrors – *L Series*

PIN ASSIGNMENTS



ELECTROSTATIC DISCHARGE SENSITIVITY

This microelectromechanicals 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.



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 θ_y 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 θ_x 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 θ_y 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 θ_x 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.
- 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.
- 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 -135V to 135V

Either axis dynamic* voltage to ground -60V to 60V

*dynamic 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	7.5	9	10.6	0	0	0	deg
Point-to-point	Y	7.5	9	10.6	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	V _{x,y} for max. positive deflection			V _{x,y} for max. negative deflection			Unit
		MIN	TYP	MAX	MIN	TYP	MAX	
Point-to-point	X	120	126	132	0	0	0	V
Point-to-point	Y	120	126	132	0	0	0	V
Resonant drive	X	45	50	54				V
Resonant drive	Y	45	50	54				V

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

Achievable dynamic response

Mode of operation	Axis	MIN	TYP	MAX	Unit
		<125	<200	<400	
Point-to-point 99% settling*	Y	<125	<200	<400	μs
Dominant resonant mode	X	>2.6	3.3	>3.5	kHz
Dominant resonant mode	Y	>2.6	3.3	>3.5	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 -135V to 135V

Either axis dynamic* voltage to ground -60V to 60V

*dynamic 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	7.5	9	10.6	0	0	0	deg
Point-to-point	Y	7.5	9	10.6	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	V _{x,y} for max. positive deflection			V _{x,y} for max. negative deflection			Unit
		MIN	TYP	MAX	MIN	TYP	MAX	
Point-to-point	X	120	126	132	0	0	0	V
Point-to-point	Y	120	126	132	0	0	0	V
Resonant drive	X	45	50	54				V
Resonant drive	Y	45	50	54				V

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

Achievable dynamic response

Mode of operation	Axis	0.8 MM diameter			1.2 MM diameter			Unit
		MIN	TYP	MAX	MIN	TYP	MAX	
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	>3.0	3.65	>3.8	>1.6	1.81	>2.0	kHz
Dominant resonant mode	Y	>3.0	3.65	>3.8	>1.6	1.81	>2.0	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 ≤ 2.4 mm 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			

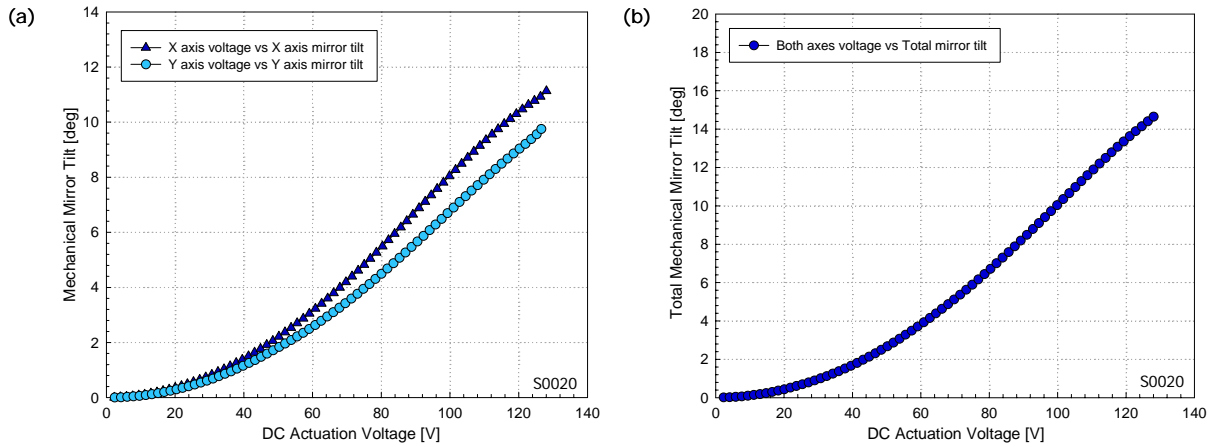


Figure 1. Measured “ramp response,” or voltage vs. static mechanical micromirror tilt angle for a typical B-series device: (a) comparison of mechanical tilt when each axis is activated separately, and (b) total mechanical tilt of the micromirror when both axes are tied together and activated with common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

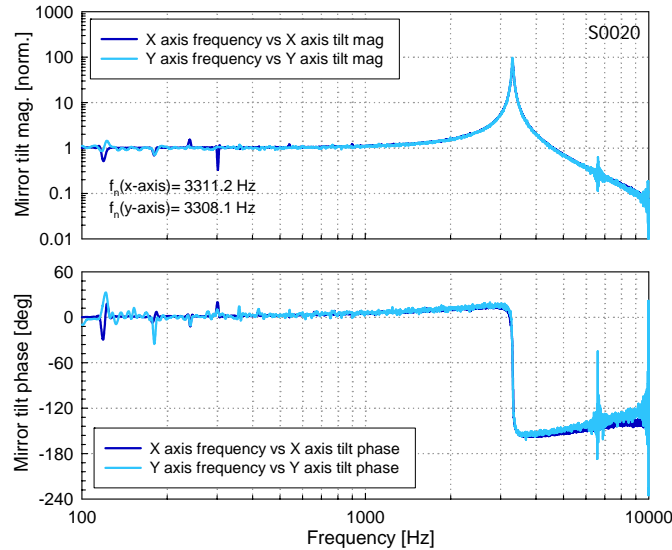


Figure 2. Measured small-signal magnitude and phase response for a typical B-series device with a standard 700 μm diameter micromirror. Magnitude of tilt normalized to 100 Hz value. $V_{ACT} = \text{bias of } 48\text{V} + 1\text{V}_{rms} \text{ excitation}$. Each axis measured separately.

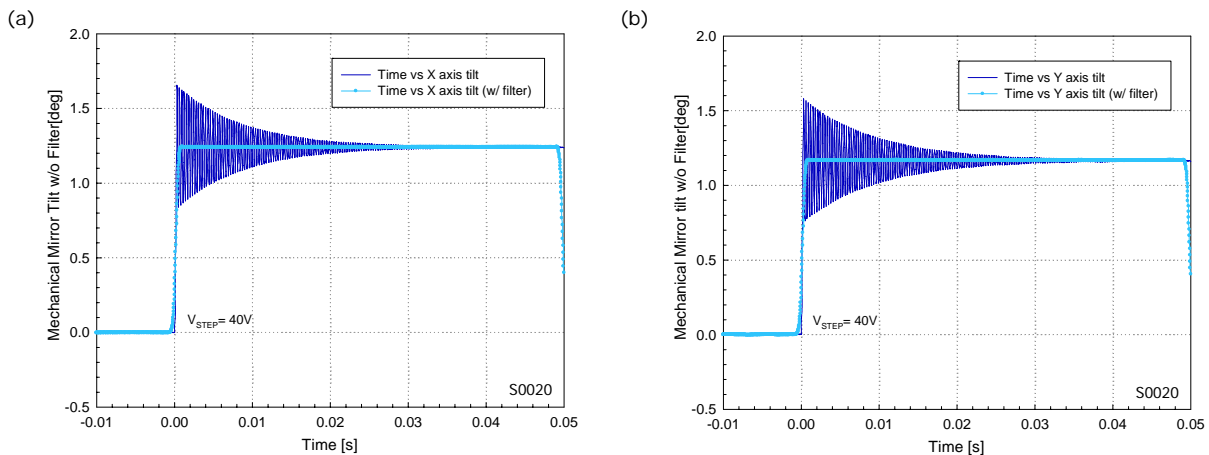


Figure 3. Measured step responses for a typical B-series device: (a) response to an unfiltered step excitation vs. 800Hz 6th order Bessel filtered step excitation from 0V to 40V on the x-axis, and (b) step response on the y-axis to same conditions.