Magnetic Fine Steering MEMS Mirror

MM160110-2-15

Revision 1.1

January, 2025

Description

This manual describes the optical, electrical and mechanical specifications of the Magnetic Fine Steering MEMS Mirror.

The sercalo magnetic fine steering MEMS mirrors are used for optical beam steering and scanning. The mirrors provide a large reflective surface up to 16.0x11.0 mm. Using magnetic actuation, the deflection angle is set linearly with the driving current. The mirror is designed for DC operation as well as scanning.

1 Product version

The MM162110-2-15 deflection unit is available in several versions to offer different coatings (gold or aluminum) and different surface error grades.

2 Specifications

2.1 Mechanical dimensions

Figure 1 depict the device layout. All dimensions are in millimeters. The four holes are intended to mount the deflection unit on a reference surface using M4 screws.

	Unit	Min	Typ	Max
Mass	g			50
Dimensions (without connector)	mm^3		51x42x10	

Table 2-1: Mechanical specifications

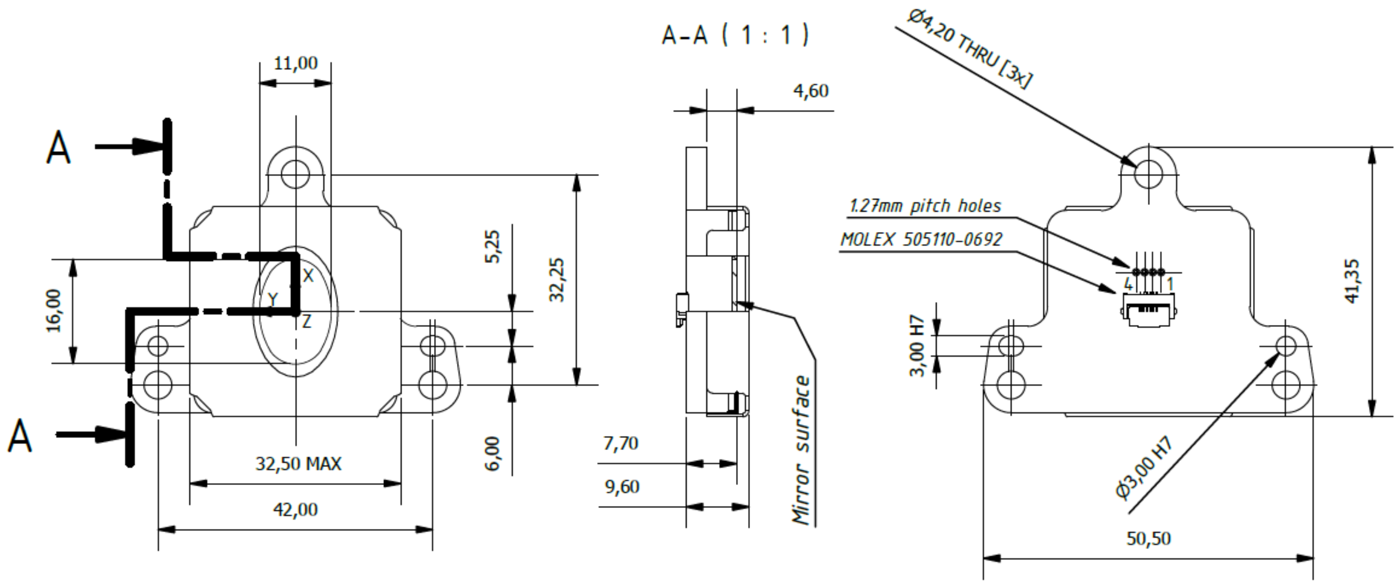

Figure 1: Device dimensions for MM160110-2-15

RECOMMENDATIONS	
I.	Since the device is actuated by a constant magnetic field (i.e. magnets), the user should be careful when using ferromagnetic tools like screwdrivers near the device. Indeed, the tool could be attracted by the device.
II.	For the same reason it is recommended to use nonmagnetic material near the device, or the magnetic flux could deviate, and performance degradation could occur. We suggest fastening the device using screws made from nonmagnetic material.

2.2 Pin assignments

The actuator coils can be controlled using the dedicated 4-pin holes or a 6-pin FPC connector (type *MOLEX 505110-0692*). The pin assignments are detailed in Table 2-2.

Pin number	Name	Description
1	X+	X axis coil positive terminal
2	X-	X axis coil negative terminal
3	Y+	Y axis coil positive terminal
4	Y-	Y axis coil negative terminal
5	GND	Ground for EEPROM memory
6	DATA	1-Wire Data output for EEPROM memory

Table 2-2: Connector pin assignment for MM160110-2-15

2.3 Mirror actuation

The mirror is actuated by two coils moving in a constant magnetic field. The tilt angle increases linearly with the current.

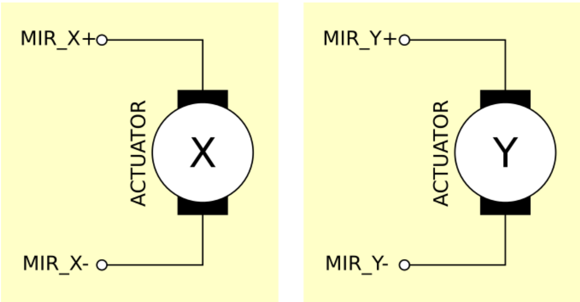

Figure 2: Mirror driving actuators electrical scheme

	Unit	Min	Typ	Max
Actuating current (X axis)	mA/°	22.0	27	32.0
Actuating current (Y axis)	mA/°	18.5	22	25.5
Power consumption (DC max angle)	W			0.6
Coil resistance (X axis)	Ω	92.0	96.0	100.0
Coil resistance (Y axis)	Ω	167.0	175.0	183.0
Resonance frequency (X axis)	Hz	290.0	315.0	340.0
Resonance frequency (Y axis)	Hz	150.0	165.0	180.0
Tilt angle (both axes)	°	-1.5		1.5

Table 2-3: Electrical specifications of the actuators

The required current with an alternative source depends on the driving frequency. Closer the frequency is to the resonance, lower should be the current. A measured set of gain values is provided within the product report sheet attached with each device. For reference, a typical step response is shown below for a voltage driver for both axes. This is a direct step response without a control loop. A dedicated controller, knowing some device parameters, could handle the ringing efficiently.

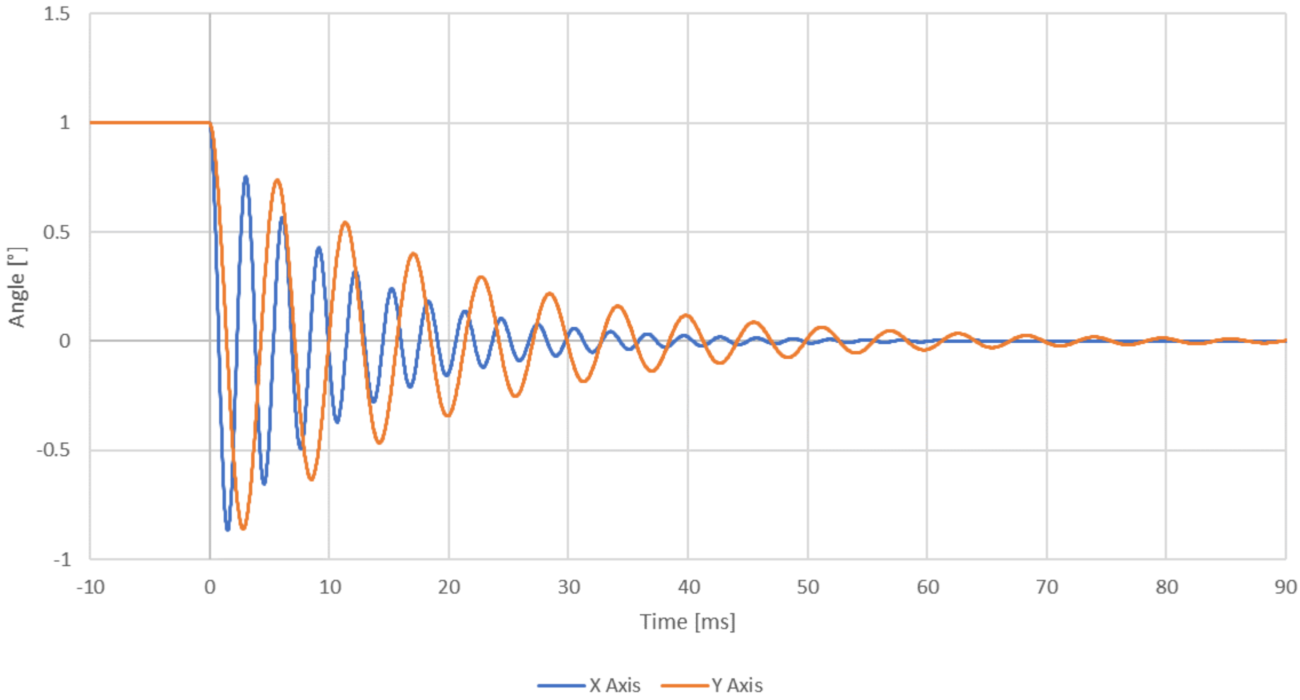

Figure 3: Voltage step response for a typical device

RECOMMENDATIONS	
III.	If used in DC mode large current steps could damage the device, because of the overshoot of the mechanical response. For this reason, we strongly recommend to: - limit the maximum current to to G_{DC}×1.5 (i.e., X_{max}=50mA, Y_{max}=40mA) - limit current ramps to 2 A/s. - use a voltage driver
IV.	A quick way to check the mirror integrity is to measure the resistance of both coils. If one or both resistances are high (>100kΩ) or infinite values, the MEMS torsion bars are probably broken.

2.4 EEPROM

A 1024-Bit, 1-Wire EEPROM of type DS2431 is mounted on the device. Some information about the device and the actuators parameters are stored within. The address and description of the stored parameters are available on request.

2.5 Mirror coating

The mirror surface can be gold or aluminum coated.

It shall never be cleaned with an air gun or a soaked fabric. The risk of breaking the torsion bars is too high. Preferably, dust particles should be removed with a single bristle paintbrush.

	Unit	Metallic	
		Gold	Aluminum
Operating wavelength		infrared	visible
Reflectivity	%	98% @1550nm	> 85%
LIDT	J/cm^2	0.16 (1030nm, 10ps)	0.08 (515nm, 10ps)
Surface Flatness (RMS)	nm	< 50 (Grade 5) < 100 (Grade 10)	< 100 (Grade 10) < 200 (Grade 20)
Roughness	nm	< 1	< 1.5

Table 2-4: Optical specifications

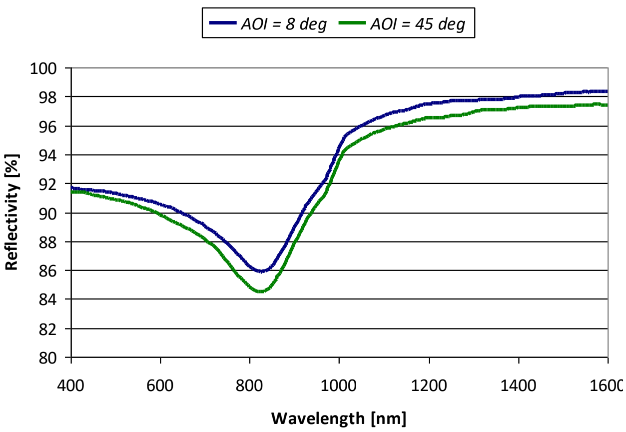

Figure 4: Typical reflectivity for Aluminum coated mirror in function of incidence angle

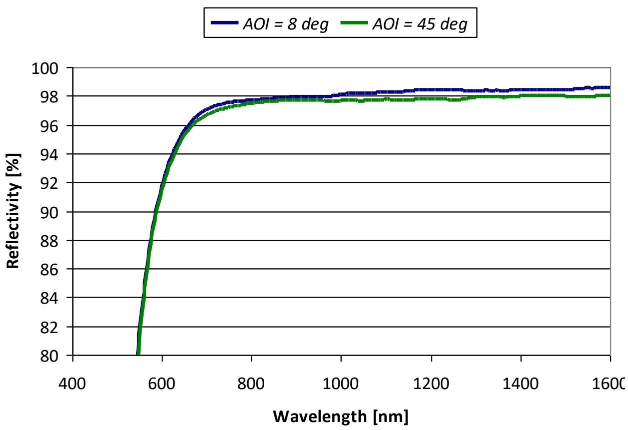

Figure 5: Typical reflectivity for Gold coated mirror in function of incidence angle

2.6 Environmental specifications

2.6.1 Mechanical environment

All mechanical environments are achieved with the actuator coils connected, not free.

		Unit	Min	Typ	Max
Sinus vibration	10 – 80 Hz	g		4 – 30	
	80 – 100 Hz	g		30	
Random vibration	20 – 100 Hz	dB/oct		12	
	100 – 300 Hz	g^2/Hz		1.5	
	300 – 2000 Hz	dB/oct		-8	
Shock	100 Hz	g		30	
	1 kHz	g		500	
	10 kHz	g		500	

Table 2-5: Mechanical Environment

2.6.2 Thermal Environment

	Unit	Min	Typ	Max
Operating Temperature	°C	-5		85
Storage Temperature	°C	-40		85

Table 2-6: Thermal Environment

3 Absolute Maximum Ratings

Applicable absolute maximum ratings for the full operating temperature range without causing irreversible damage to the device are listed in Table 3-7.

Parameter	Unit	Rating Limit
Maximum supply current X axis (DC)	mA	50
Maximum supply current Y axis (DC)	mA	40
Maximum current ramp (DC) (see Recommendation III)	A/s	2

Table 3-7 – Absolute maximum ratings

4 Label Information

MM	160110	2	15	AU	10

Mirror Size:
160110 = 16.0x11.0mm²

Number of Axis:
2

Maximum Angle:
15 = 1.5°

Surface finish:
AU = Gold
AL = Aluminum

Surface Flatness:
5 = < 50nm RMS
10 = <100nm RMS
20 = <200nm RMS

5 Contact Information

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