PROTOTYPE

optotune
shaping the future of optics

One-axis-resonant dual axis mirror
MR-10-30

Optotune's dual axis resonant mirror series MR-10-30 is the ideal choice for applications requiring fast scanning and large deflection angles in a compact form factor. With a mirror size of 10 mm the MR-10-30 achieves up to ± 25° mechanical tilt in the linear axis and up to ±12.5° mechanical tilt in the resonant axis, resulting in a 100° x 50° field of view. The mirror includes a position feedback system which allows accurate position read-out and control.

The actuator is based on proven technologies. In contrast to galvo mirror systems, the virtual rotation point is very close to the mirror surface. The mirror can be fabricated with various coatings such as gold or protected silver.

Advantages

- Large Scan Angle
- Compact
- Precise

Applications

- LiDAR
- Medical (OCT, confocal microscopy)
- Scientific

The following table outlines the specifications of our standard MR-10-30. Custom mirror coatings and resonant frequencies are possible.

Specifications

Mechanical specifications

Actuator Type	4-Quadrant (2 axis, bi-directional)		
Mechanical tilt angle DC	± 25 X axis; N/A Y axis	°	
Mechanical tilt angle dynamic	± 25 X axis; ± 12.5 Y axis	°	
Mirror diameter	10	mm	
Center of rotation to mirror surface	0.4	mm	
External diameter	35.4	mm	
Height	14.5	mm	
Weight	29.3	g	
Scale drift	T.B.D	ppm/°C	Max
Zero drift (typical)	25	µrad/°C	Max
Full scale bandwidth Sine wave	20 static axis approx. 250 resonant axis	Hz	
Mechanical clamping	screws		
Magnetic shielding	yes		

Optical specifications

Surface finish	Gold and protected silver, other coatings available as custom		
Reflectivity	Gold (45° AOI): - Avg >95% (800 nm < λ < 6 um) Protected Silver (45° AOI): - Avg >96% (450 nm < λ < 2 um)		
Surface quality	60-40	Scratch-Dig	
Mirror flatness	λ/2	@549nm (ISO Norm 10110)	

Optotune AG | Bernstrasse 388 | CH-8953 Dietikon | Switzerland
Phone +41 58 856 3000 | www.optotune.com | info@optotune.com

optotune
shaping the future of optics

Electrical specifications

Control interface	Analog interface for driver coils and for feedback readout		
Actuation current slow (quasi-static) axis	< 0.2 DC, 1 peak	A	
Actuation current fast (resonant) axis	< 0.5 AC	A	
Max continuous current (RMS)	0.3	A	For quasi-static axis
Coil resistance	11	Ohm	Typical
Coil inductivity	6	mH	Typical
Position feedback supply current (@1.5V)	30	mA	
Typical feedback current	0.1	mA	
Temperature sensor	LM75B		I2C-Address: 0x48 (+R/W bit)
EEPROM	M24C08		I2C-Addresses: 0x50 to 0x53 (+R/W bit)

Environmental specifications

Operating temperature	-20 to +85	°C	for higher temp. ranges contact Optotune
Storage temperature	-40 to +85	°C	for higher temp. ranges contact Optotune
Rel. humidity	85	%	
Cycle life	> 10^9	cycles	resonant axis, ongoing

Overview of configurations

Configuration	Coating
MR-10-30-G-2 axis resonant	gold
MR-10-30-PS-2 axis resonant	Protected silver

Static Response

Current vs Angle (quasi-static axis)

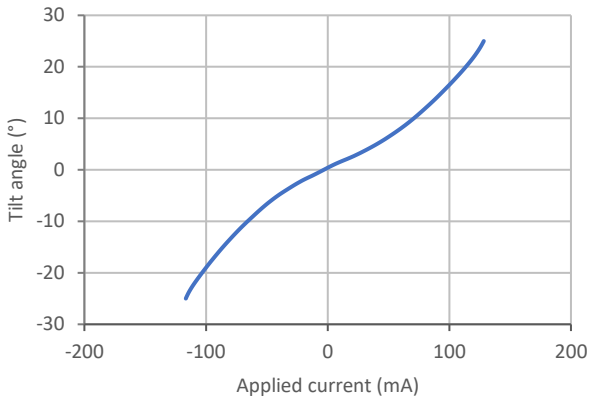

Figure 1: Typical mechanical tilt angle versus applied current for quasi-static axis.

Optotune AG | Bernstrasse 388 | CH-8953 Dietikon | Switzerland
Phone +41 58 856 3000 | www.optotune.com | info@optotune.com

Dynamic response

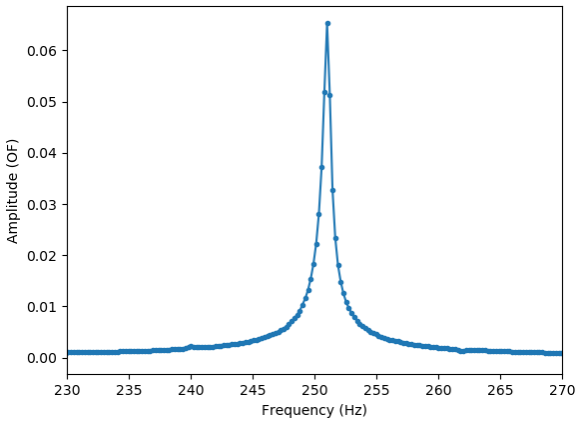

Figure 2: Ringdown spectrum of the resonant axis.

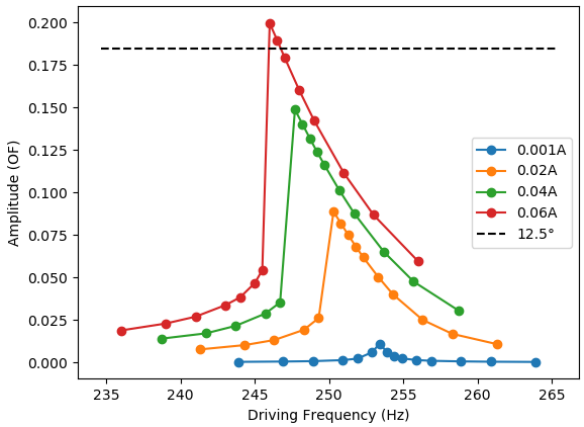

Figure 3: Typical response of resonant axis with sinusoidal excitation and different driving currents. The dashed black line corresponds to the specified maximum range of ±12.5°.

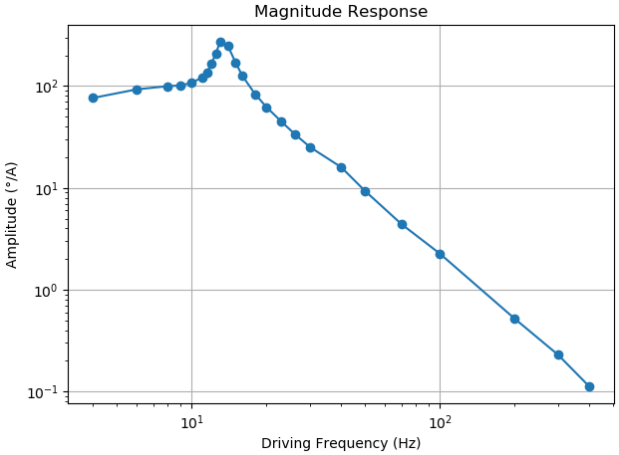

Figure 4: Typical magnitude response of slow axis with sinusoidal excitation and 15 mA excitation amplitude.

Optotune AG | Bernstrasse 388 | CH-8953 Dietikon | Switzerland
Phone +41 58 856 3000 | www.optotune.com | info@optotune.com

Maximum oscillation frequency

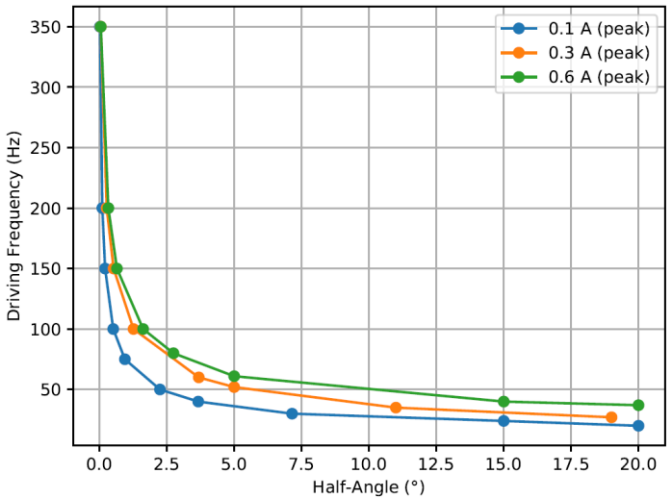

Figure 5: Max. oscillation speed (sinus) of quasi-static axis as a function of mechanical half-angle and driving current. The total optical FOV is 4 times the mechanical half-angle.

Reflectivity

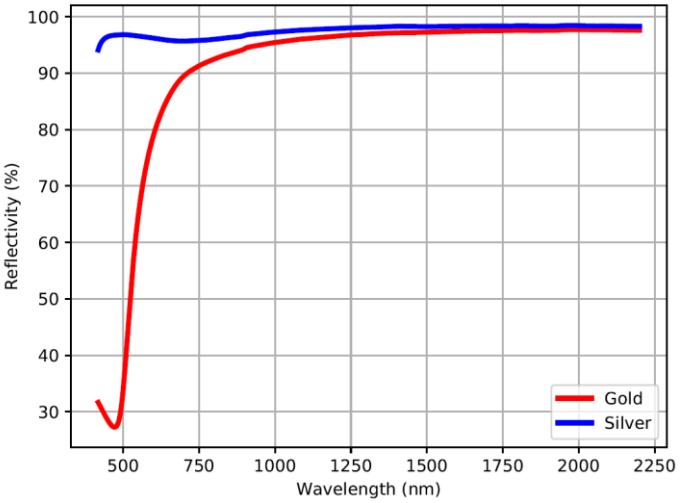

Figure 6: Reflectivity for different wavelengths at 0° angle of incidence (AOI).

Optotune AG | Bernstrasse 388 | CH-8953 Dietikon | Switzerland
Phone +41 58 856 3000 | www.optotune.com | info@optotune.com

optotune
shaping the future of optics

Mounting

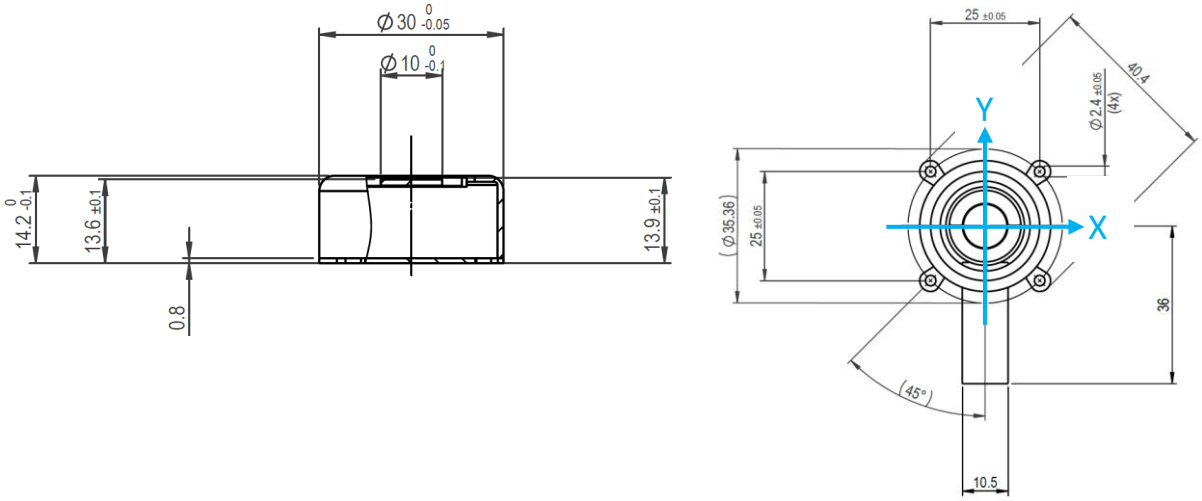

Figure 7: Mechanical drawing of MR-10-30 (unit: mm). The X-Axis corresponds to the quasi-static axis and the Y-Axis to the resonant axis.

When screwed in place, make sure the mirror is in firm contact with the heat sink. It is recommended that the heatsink can dissipate about 2-5 W.

In terms of lateral alignment, the outer diameter of the housing can serve as an alignment feature.

Electrical connection

Pin	Function	Value	Pin	Function	Value
1	Position feedback supply Cathode	40 mA 1.5 V	11	VDD	3.3V
2	Position feedback supply Anode		12	SCL	Digital 3.3 V
3	Y Coil +	± 1 A ± 15 V	13	SDA	Digital 3.3 V
4			14	GND	
5	Y Coil -		15	Position feedback Anode	currents (µA range)
6			16	Position feedback Y2 Cathode	
7	X Coil +		17	Position feedback Y1 Cathode	
8			18	Position feedback X2 Cathode	
9	X Coil -		19	Position feedback X1 Cathode	
10			20	Position feedback Anode	

Table 1: Electrical pinout MR-15-30. The X Coil controls the quasi-static axis, the Y Coil the resonant axis.

Optotune AG | Bernstrasse 388 | CH-8953 Dietikon | Switzerland
Phone +41 58 856 3000 | www.optotune.com | info@optotune.com

Environmental testing

The MR-10-30/MR-15-30 is going through environmental and accelerated aging tests as outline in the table below.

Test	MR-10-30/ MR-15-30
Mechanical cycling: > 1 billion cycles of the resonant axis	Passed
Temperature cycling – non-operational 85°C/60h, -40°/60h; 2 cycles, non-operational No significant change in repeatability	Passed
Temperature cycling –operational -20°C ... 90°C operational (steady state jumps over entire FOV every 5sec, 20 cycles 60hours)	Passed
Temperature drift & heating effects Temperature drift: approx. 20urad/K No significant self-heating at low frequency	Passed
Temperature & Humidity 85°C / 85% (duration: 1 week)	Passed

Table 2: Environmental tests performed on the MR-15-30

2D raster scan

The MR-10-30 is specifically designed for raster-scanning applications such as Lidar. By overlaying a linear scan pattern on the quasi-static axis with the resonant oscillation, a dense line-scan can be generated.

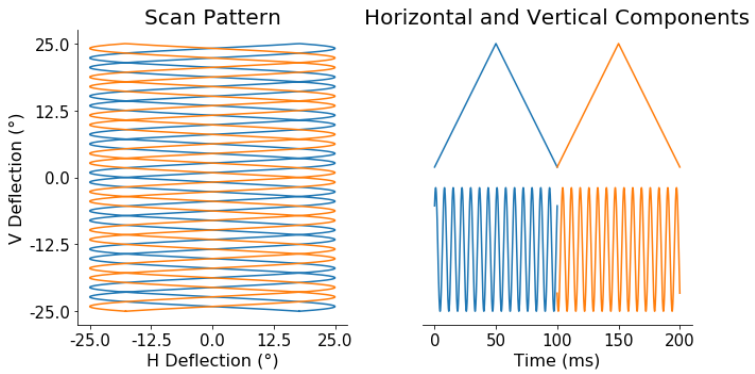

Figure 8: Example for a dense scan pattern. A fast sinusoidal oscillation in the resonant axis at 250 Hz overlays a linear, triangular pattern at 10 Hz in the quasi-static axis.

For more information on optical, mechanical and electrical parameters, please contact sales@optotune.com.

Optotune AG | Bernstrasse 388 | CH-8953 Dietikon | Switzerland
Phone +41 58 856 3000 | www.optotune.com | info@optotune.com