



Fine Steering & Fast Steering Mirrors



Make optical innovation happen



Established in Switzerland in 2008
and privately owned



28 sales partners and distributors
in 30 countries



250 employees in Switzerland,
Slovakia, Taiwan and Korea



More than 1 million products sold
worldwide



R&D spend exceeding 25% of
revenue



Industrial, medical, AR/VR and
automotive markets



5000 m² production & cleanroom
capacities exceeding 300 Ku/year



Innovative award winning products

Core competences



Patented optical technology: Optotune combines optics with smart actuation techniques to enable compact and reliable solutions for dynamic light control. Thanks to our highly innovative and patented technology, our customers are able to deliver cutting-edge products across several markets.



In-depth research capabilities: Optotune is continuously investing in material characterization and testing to deliver state-of-the-art products that solve the most challenging applications such as high-frequency vibration environments or ultra-portable systems.



Scalable manufacturing: having different manufacturing sites at various levels of automation enables our customers to access our products with a top-class delivery performance from sampling through to mass production in class 1000 cleanrooms.



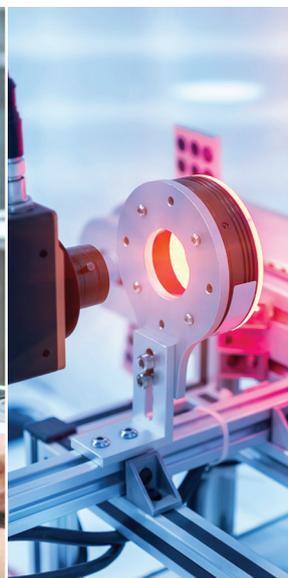
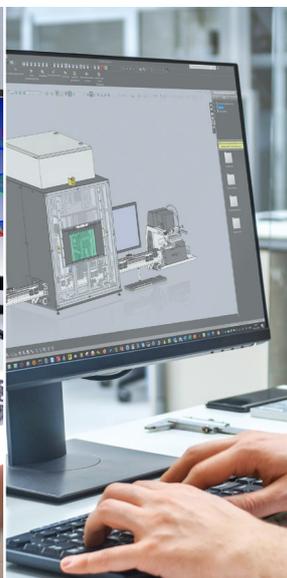
360° design skills: from optics simulation in Zemax to mechanical and electrical design to software, our R&D team enables our customers to access a one-stop-shop for our liquid lenses and optical actuators.



Application & customer support team: application diversity in fast changing markets has increased the challenge to identify the appropriate solution; our application engineering team will carry out extensive feasibility studies to select the right Optotune products to solve your challenge.



Custom design: demanding applications have often specific requirements (coatings, optical power ranges, dimensional constraints, certificates), which call for customization. Optotune's know-how in design, manufacturing and quality assurance enables the delivery of future-proof custom products.



Fine Steering and Fast Steering Mirrors



Fine Steering Mirrors

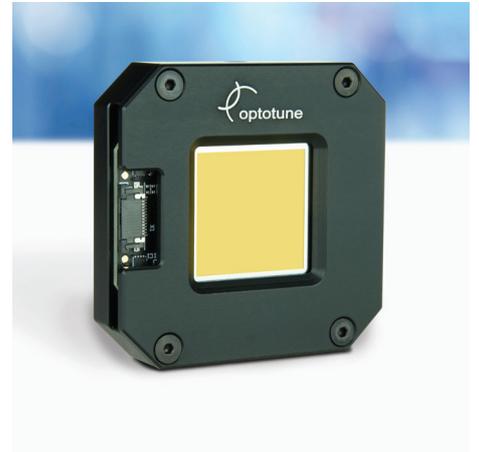
Optotune's FMR devices have been designed with fine-tilt, high-angular resolution applications in mind. With a large clear aperture of 20 x 20 mm they can scan various beam patterns at 250 Hz bandwidth, with ± 2.3 mrad tilt range. With the Optotune ICC-4C-2000 controller they are a plug and play fine steering solution.

Main features:

- One large optical surface for 2 DOF motion
- 2D wobbling of low- to high-power laser beams
- Mrad angular range with μ rad resolution
- Long lifetime thanks to bearingless design
- Customizable in a small footprint

Applications:

- Laser soldering and welding
- Fine 2D beam alignment (e.g. in laser cavities)
- Lissajous scanning



FMR-20-PG



FMR-20-DNIR



Fast Steering Mirrors

Whether in R&D or in product development, Optotune's disruptive 2D fast steering mirror solutions offer completely new design and integration possibilities.

Key features:

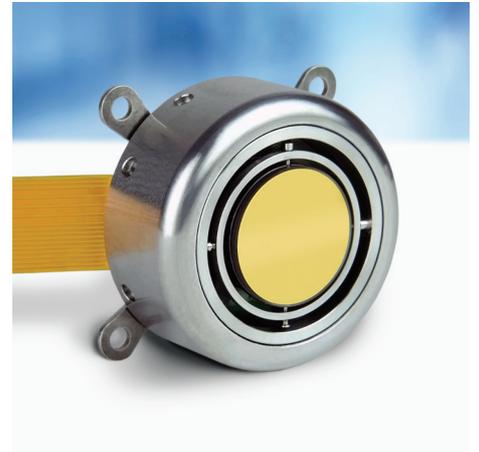
- Large clear apertures and beam angles
- 2D beam deflection with a single optical element
- Robust voice-coil actuation
- Optical real-time position feedback
- Compact & lightweight
- Customized coatings available

Dual axis fast steering mirror with position feedback

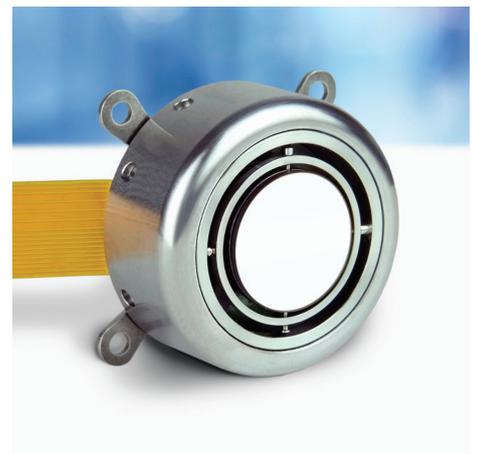
Optotune's dual axis fast steering mirror (FSM) offers the benefit of large deflections and large mirror size in a compact package. The actuator is based on proven voice-coil technology. A built-in position feedback allows it to be accurately controlled with a standard PID controller. The virtual rotation point of our 2D mirrors is close to the mirror surface which makes 2D scanning straight forward. The mirror is ideal for vector scanning and point & shoot applications.

Applications:

- Automotive (LiDAR, dynamic headlights, ADAS)
- Machine vision (field-of-view expansion)
- Free-space communication
- Biometric (eye-tracking)
- Diagnostics (e.g. OCT, Fundus camera)
- Metrology



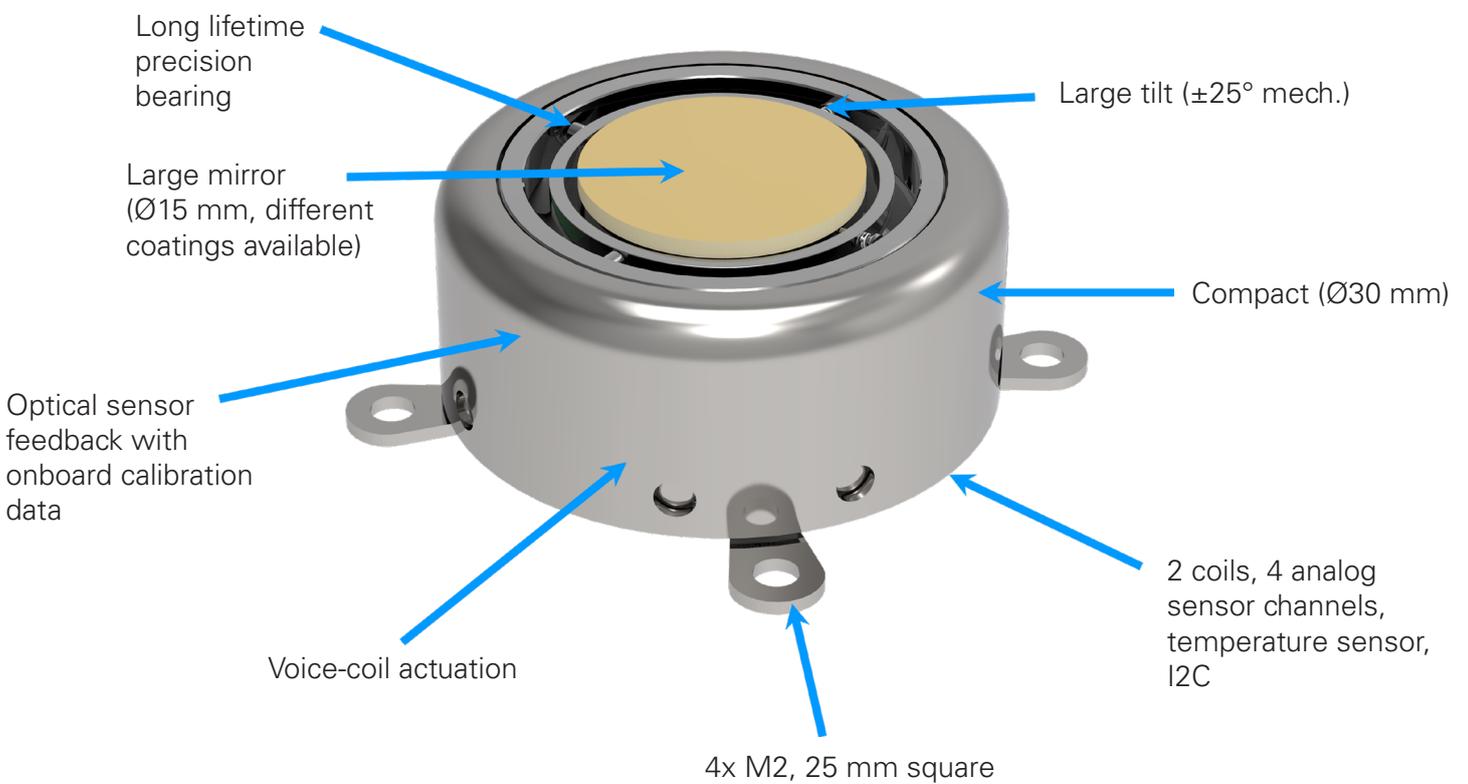
MR-15-30-G 25x25D



MR-15-30-PS-25x25D
Also available: MR-15-30-DVIS-25x25D



Technology



- 2D mirror
- Voice-coil actuation
- Actuator behind mirror
- Proven long-lifetime precision bearing
- Closed-loop actuation with integrated feedback
- Analog actuator and feedback interface
- On-board angular calibration data
- On-board temperature sensor

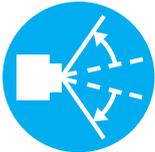
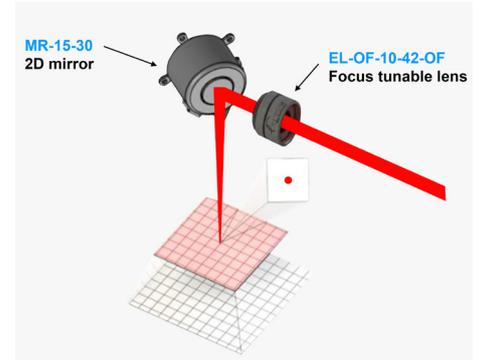


3D laser beam-steering

Combining a 2D mirror for x/y with an electrically focus tunable lens allows you to direct your laser beam spot precisely and fast at any point within the addressable volume.

Applications:

- Diagnostic/ophthalmic devices
- Spectroscopic devices
- 3D printing



FOV expansion and AOI selection

The FOV expansion kit featuring a MR-15-30 dual-axis fast steering mirror enables field of view expansion and area of interest (AOI) selection. The standalone camera on the left is equipped with a wide-angle objective to capture the overall scene. The camera on the right, equipped with a narrow-angle tele lens, looks onto the mirror, and allows you to “zoom-in” and select a small AOI out of a 100° optical FOV.

Applications:

- Security applications
- Surveillance and face-tracking in airports and other public spaces
- Inspection
- Gigapixel imaging



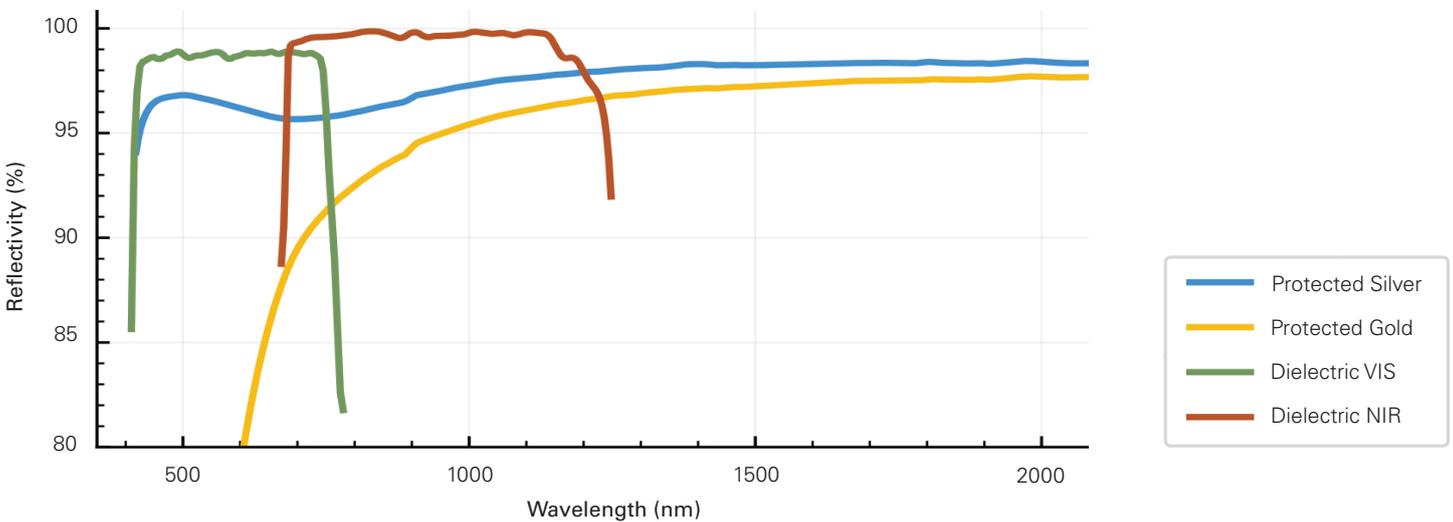
FOV Expansion Development Kit



Overview of Mirrors

	MR-15-30	FMR-20
		
Scan direction	2D	2D
Control	Closed loop on both axes	Open loop on both axes
Mech. tilt angle	$\pm 25^\circ$ both axes	$\pm 0.2^\circ$ both axes
Mirror size	$\varnothing 15$ mm	20x20 mm ²
Resolution (closed loop)	22 μ rad (with MR-E-3)	4 μ rad (with ICC-4C-2000)
Repeatability RMS (typical)	40 μ rad	–
Full scale bandwidth	20 Hz both axes	250 Hz both axes
Settling time	3 ms (0.1° mech. step) 13 ms (20° mech. step)	4 ms (0.2° mech. step)
Mirror coatings	Protected gold Protected silver Dielectric VIS Other coatings upon request	Protected gold Dielectric NIR Other coatings upon request
Mirror flatness P-V @549nm	$\lambda/2$	2λ
Connectivity	2 coils, 4 analog sensor channels, I2C (temperature sensor, EEPROM)	2 coils, I2C (temperature sensor, EEPROM)
Compatible controller	MR-E-3	ICC-4C-2000 with Extension kit

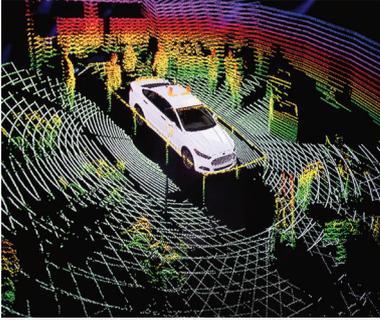
Mirror Reflectivity [comparison for different coatings]



Overview of Development Kits and Controllers

	MR-E-3 Development Kit	MR-E-3 OEM Kit	FOV Expansion Development Kit
			
Compatible mirror controller	 MR-E-3 Base unit	 MR-E-3 OEM version	 MR-E-2 Base unit
Fast steering mirror version	 MR-E-3 Mirror head (gold, silver, dielectric, custom)	 MR-15-30, MR-C-15-30 (custom)	 MR-E-2 Mirror head dielectric
Tunable lens	–	–	EL-16-40-TC-VIS-5D (-2 dpt to +3 dpt)
Tunable lens controller	–	–	EL-E-4i
Camera	–	–	Daheng 1/1.8" 3MP
Wide angle lens	–	–	4mm (80° HFOV)
Narrow angle lens	–	–	50mm (8° HFOV) or 75mm (5° HFOV)
Image system angular resolution	–	–	4 mdeg/pixel (50mm lens) or 2.5 mdeg/pixel (75mm lens)
Use cases	Evaluation, R&D, plug-and-play	Prototyping, integration into OEM equipment	Gigapixel imaging, AOI selection, face recognition
Advantages	Electronics fully protected in housing	Compactness	All-in-one
Thermal management	Assured by kit	By customer	Assured by kit
Connectivity	USB UART SPI Analog input (0 - 10 V)	USB UART SPI Analog input (0 - 10 V)	USB
What's in the box?	MR-E-3 mirror head MR-E-3 base unit Power supply USB cable	Mirror MR-E-3 OEM version Power supply USB cable	MR-E-2 mirror head MR-E-2 base unit Tunable lens Lens driver Camera (2x) Wide angle lens Narrow angle lens Mechanical holder Power supply USB cable

Overview of Applications for Mirrors and Kits

	 LiDAR	 Free-space Communication	 Surveillance / Face Detection
The Challenge	Galvo scanners are bulky and power hungry. MEMS scanners suffer from limited scan angle/ mirror size.	Turbulences in the atmosphere and movement of communication towers require real-time adjustments. Coarse steering units and fine steering units are bulky and complex.	Need to select small AOI with high enough resolution within a large FOV.
Our Solution	Our 2D fast steering mirrors allow to build compact and reliable LiDAR systems with large FOV.	Our MR-15-30 2D fast steering mirror as coarse steering mirror in combination with our FMR-20 fine steering mirror offer a compact solution to ensure a stable communication link.	Our MR-15-30 2D fast steering mirror in combination with a standard camera, an electric lens, a widefield and a narrow field lens and 2 cameras, allow you to select a face from a large distance.
Key Benefits	<ul style="list-style-type: none"> • Compact • Combination of large mirror size and large FOV • Long lifetime (>1 billion cycles) • Designed for high vibration and shock resistance • Wide choice of coating options (including dielectrics) • Customizations are available on a project basis 	<ul style="list-style-type: none"> • Compact • Increased FOV • Long lifetime (>1 billion cycles) • Reduced reflection loss (single interface) 	<ul style="list-style-type: none"> • Gigapixel resolution through image stitching • Large FOV
Products	<ul style="list-style-type: none"> • MR-15-30 	<ul style="list-style-type: none"> • MR-15-30 • FMR-20 	<ul style="list-style-type: none"> • FOV expansion development kit





Gigapixel Imaging	Adaptive Headlights	OCT	Cosmetic Lasers
<p>Limited camera resolution.</p>	<p>The headlight needs to be bright and directed into the curve. Existing solutions are slow and not compatible with laser-based headlights.</p>	<p>When scanning the retina, normal galvo heads are too bulky to be placed close to the eye and introduce beam-shifts due to the different rotation points of the 2 axes. As a workaround they often require complex optical relay systems.</p>	<p>Bulky handpiece is difficult to hold. Heavy handpiece leads to strain on the doctor's arm. Existing scan mechanisms are power-hungry.</p>
<p>Our MR-15-30 2D fast steering mirror in combination with a standard camera and an electric lens allow you to generate high-resolution images.</p>	<p>Our MR-15-30 2D fast steering mirror combined with a laser light engine could be the next generation headlight.</p>	<p>Our MR-15-30 2D fast steering mirror.</p>	<p>Our MR-15-30 2D fast steering mirror for fast and compact point and shoot laser beam-steering.</p>
<ul style="list-style-type: none"> Gigapixel resolution through image stitching 	<ul style="list-style-type: none"> Compact Fast Large FOV (100°) Robust (>1B cycles) 	<ul style="list-style-type: none"> Compact Single rotation point Reduced reflection losses 	<ul style="list-style-type: none"> Compact and light-weight handpiece for better comfort Up to 15 mm mirror size for small spot size Up to 100° FOV Simpler optics (no beam-shift) Reduced reflection loss (single mirror surface)
<ul style="list-style-type: none"> FOV expansion development kit 	<ul style="list-style-type: none"> MR-15-30 	<ul style="list-style-type: none"> MR-15-30 	<ul style="list-style-type: none"> MR-15-30



THE NEW WAY OF LIGHT CONTROL



OPTOTUNE'S VERSATILE AND COMPACT FAST STEERING MIRRORS

Fast steering mirrors outperform MEMS and galvos when it comes to the combination of mirror size, tilt angle and compactness

www.optotune.com