

Optotune components for laser processing

Enabling compact 2.5D / 3D scan heads and the inline inspection

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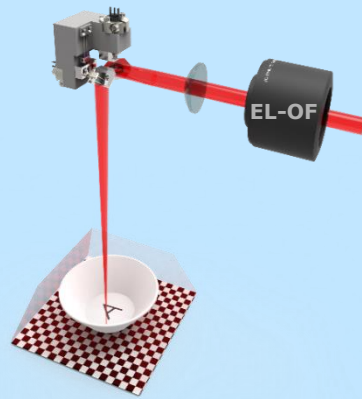
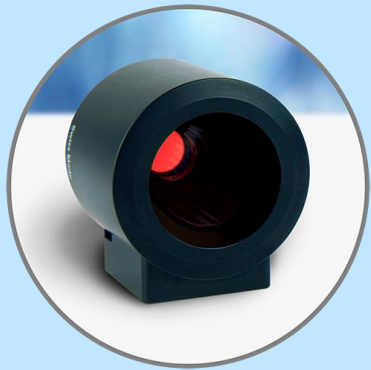
January 2022

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Optotune products for Laser processing



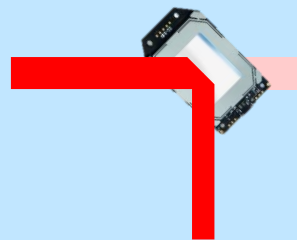
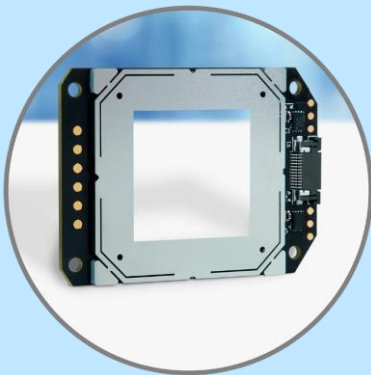
2.5 & 3D laser marking



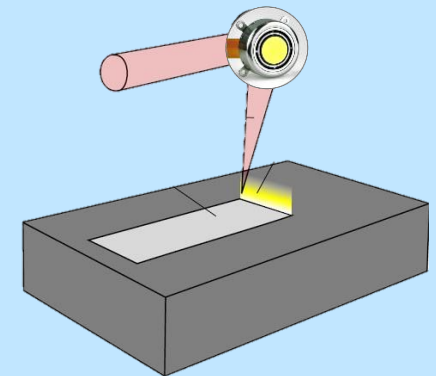
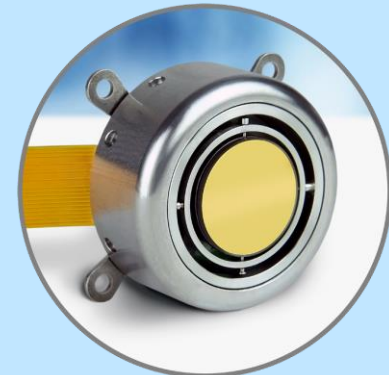
Inline inspection and AF



High precision beam control

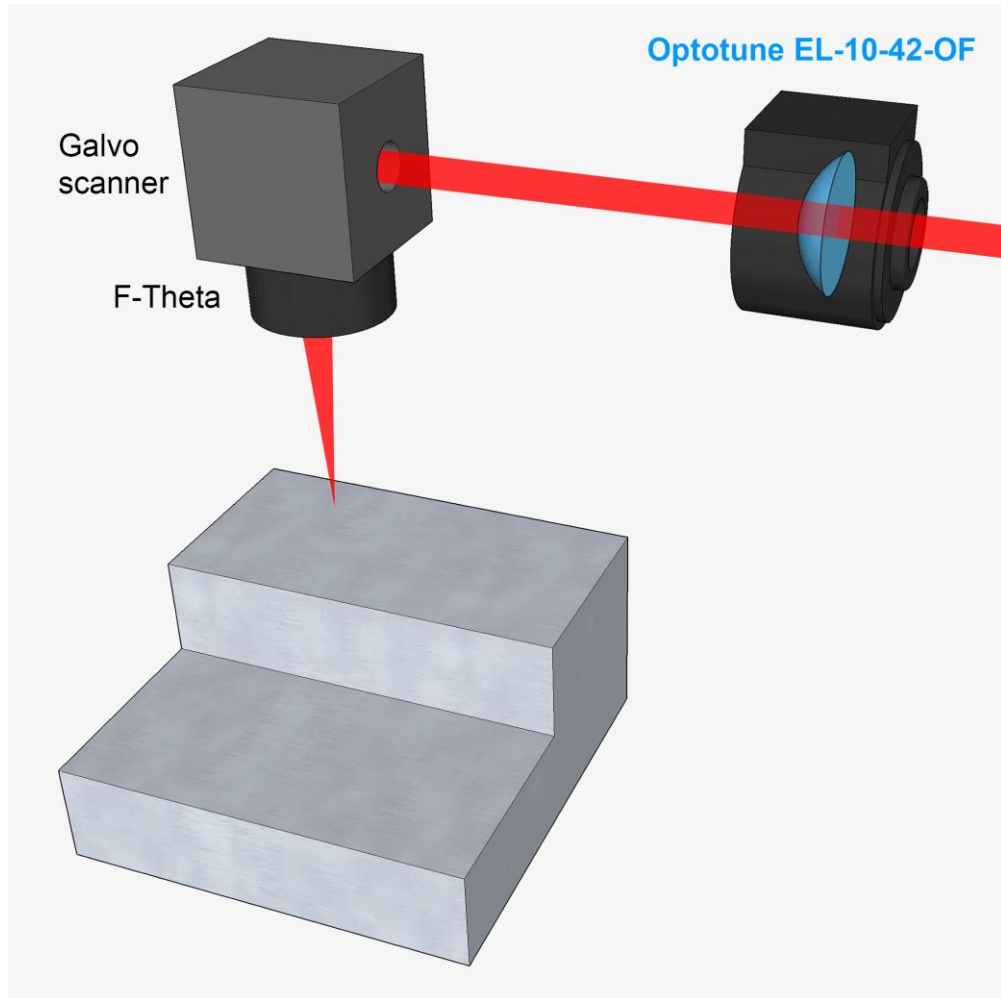


2D mirrors

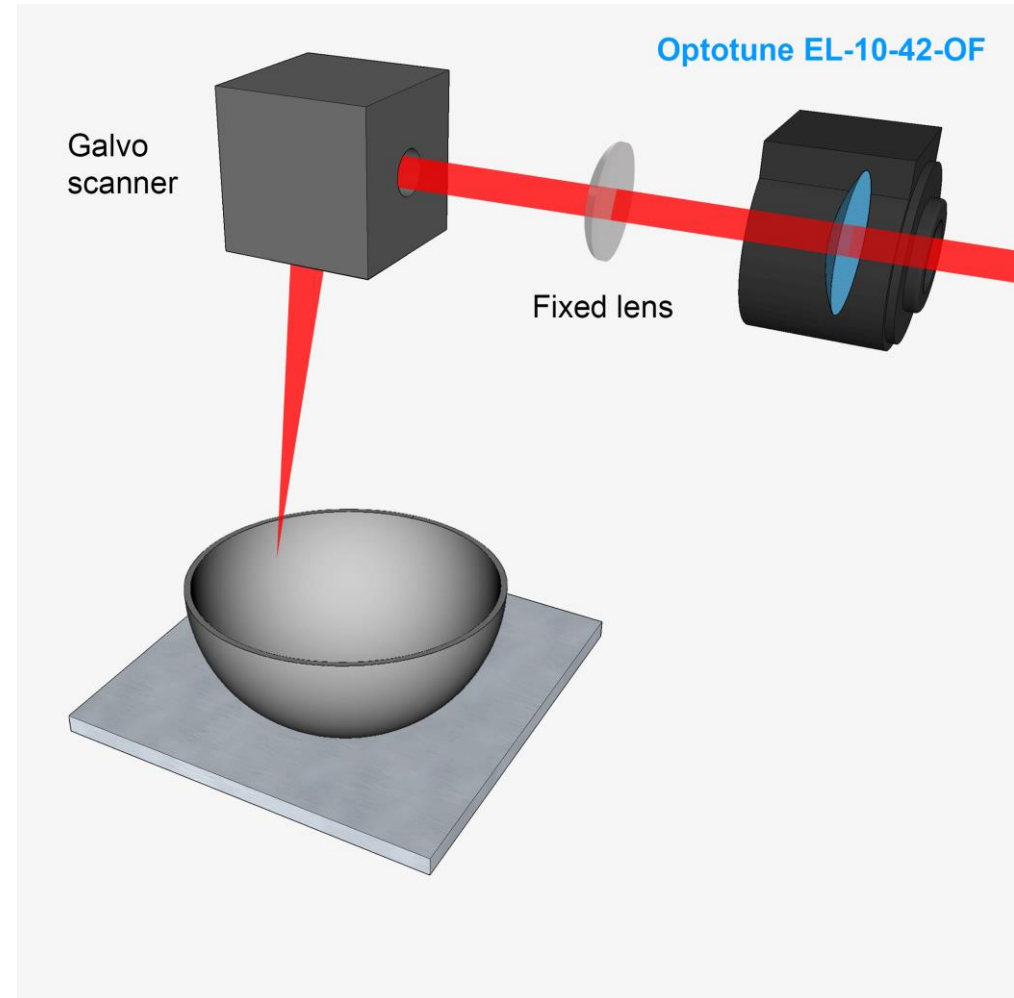




2.5D: Z-stepping



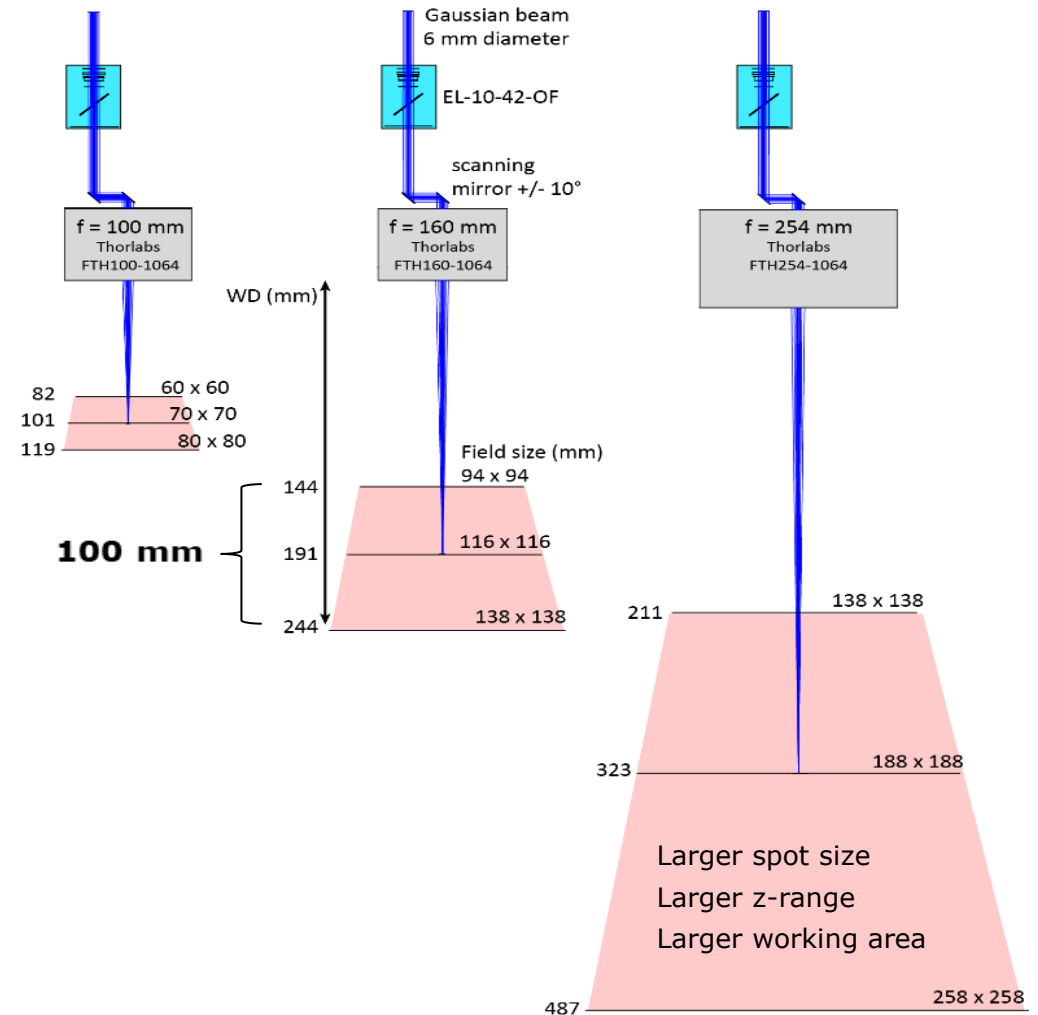
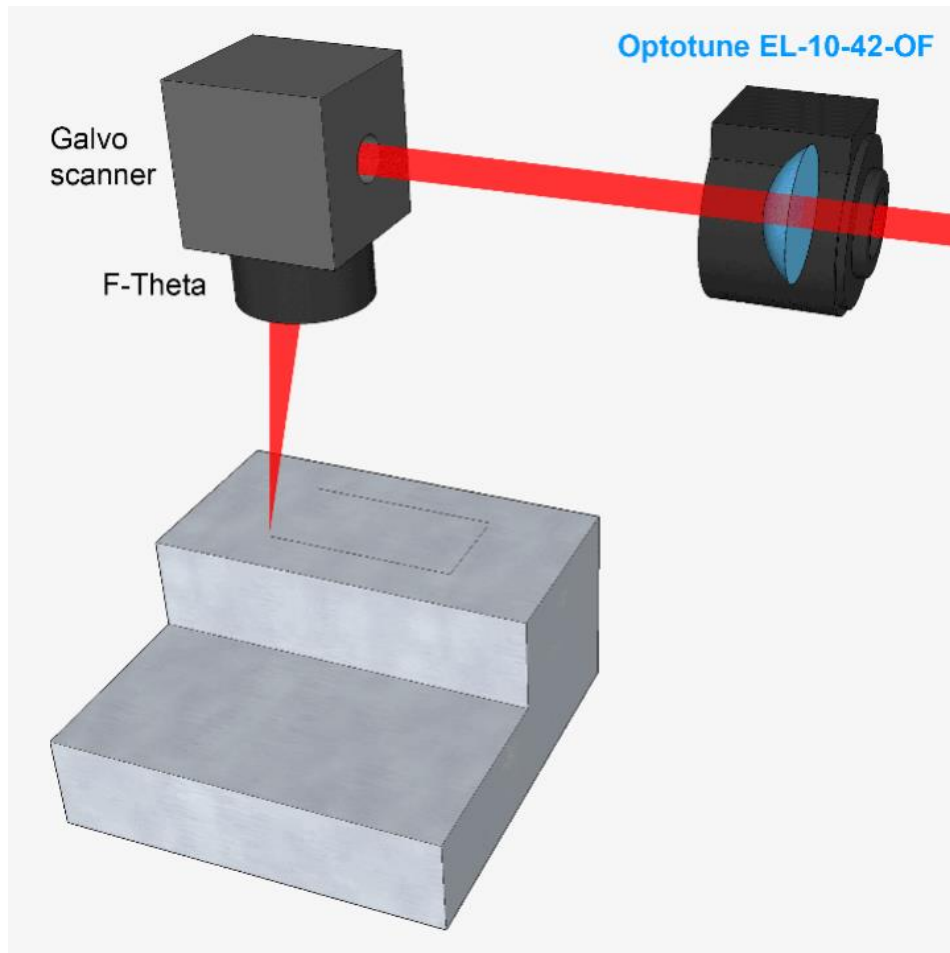
3D: Curved surface marking



2.5D laser processing with EL-10-42-OF



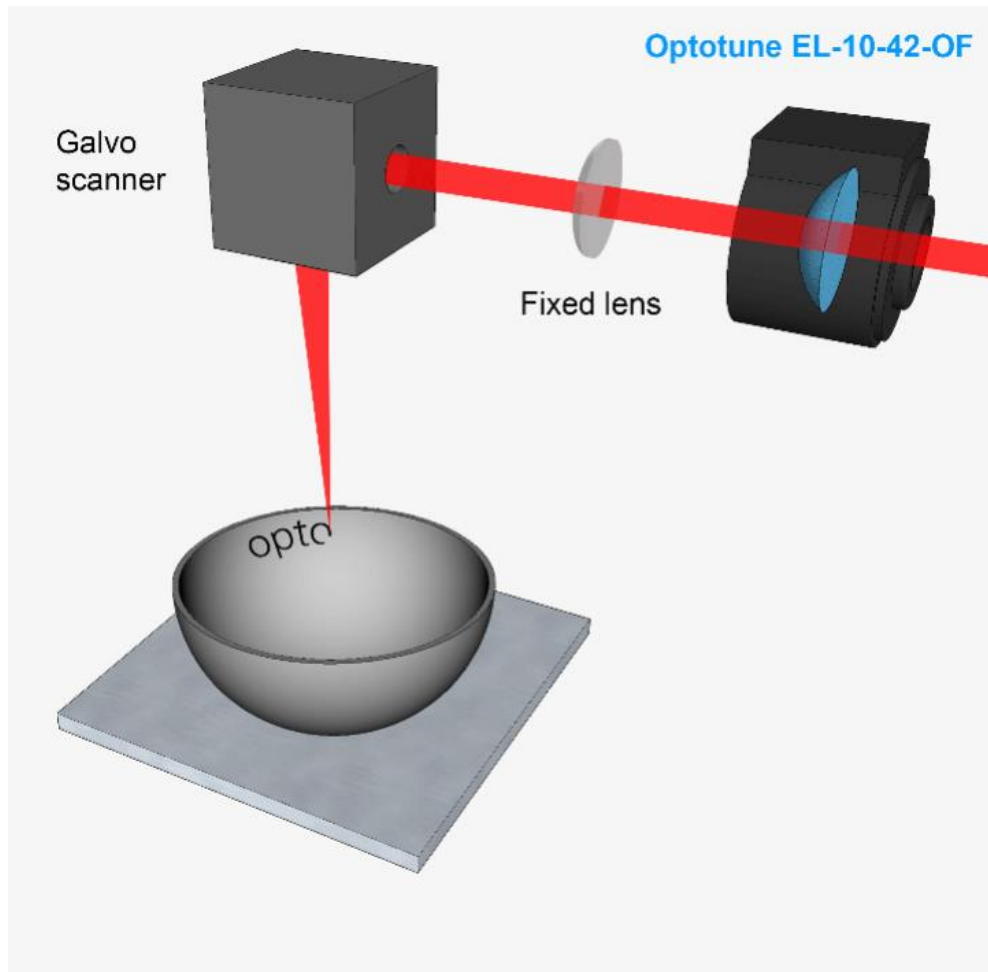
EL-10-42-OF allows to jump between large z-axis variations ($\Delta z = 100\text{mm}$ with $f = 160\text{mm}$ for f-theta)



3D laser processing with EL-10-42-OF



Both z-scanning and field flattening performed by EL-10-42-OF
No need for f-theta, just EL-10-42-OF and a simple focusing lens



- Compact
- Cost efficient
- Easy to install
- High z-speed (6m/s)
- Constant spot sizes in the entire scan volume
- Large area marking (LAM)
- Autofocus

EL-10-42-OF specs in the NIR and at 532nm



Product	EL-10-42-OF-NIR EL-10-42-OF-532	unit
Clear aperture	10	mm
Maximum operating average laser power @ NIR (950-1100 nm) @ 532 nm	50 20	W
Optical power: tuning range	-2.0 to +2.0	dpt
Optical power: repeatability	typical: < 0.02 max: < 0.04	dpt
Optical power: long term stability 8h		
Wavelength range (NIR)	950 – 1100	nm
Wavefront error @ 1064 nm @ 532 nm	< 0.15 < 0.3	λ RMS
Transmission NIR (950-1100 nm) @ 532 nm	> 94 % > 95 %	
Long term radiation damage @ 1064 nm: 40 mJ /cm ² at 20 kHz	No effect after 2000 h	
Damage threshold @ 1064 nm: 125 ns-pulsed at 50 kHz 10 ps-pulsed at 50 kHz	2.6 2.05	J/cm ²
Response time with EL-E-OF-A analog board	80% step: 12 20% step: 6	ms
Response time with Scaps digital board	80% step: 8 20% step: 4.5	ms
Focal length resolution	Continuous (depends on control electronics)	
Lifecycles (10%-90% sinusoidal)	> 100'000'000	

Typical parameters in a marking system with f = 160 mm f-theta lens

Max z-tuning range	100	mm
Repeatability (10%-90% step)*	typical: < 500 max: < 1000	μ m
Long term drift over 8h*		



All EL-10-42-OF lenses undergo extensive OQC tests including laser testing

Analog and digital drivers for EL-10-42-OF



EL-E-OF-A (2.5D)



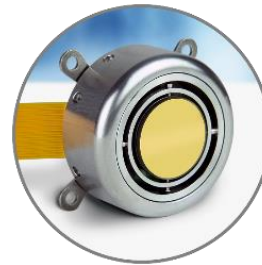
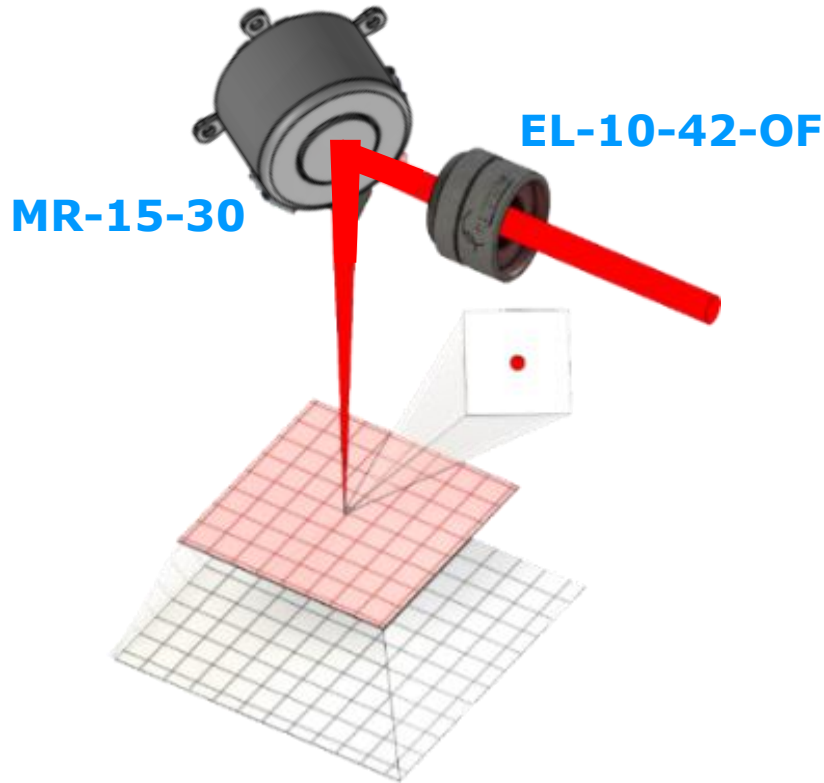
SCAPS Optotune-DSD-2-O (3D)



XY2-100 integration by USB calibration interface
 Only one power supply
 Thermal Control and lens status signal

Interface	Analog 0-5V	Digital XY2-100, X-Y bi-directional Scaps interface
Controller	Microprocessor based	FPGA based
Intelligence	Standard PID control	Model based drive algorithm
80% step response	12ms	8ms
Demonstrated processing speed on 45deg slope (160mm F-Theta)	0.7m/s	6m/s
Suitable operation	Z-Stepping for 2D processing	True 3D processing

Compact laser processing with 2D-mirrors



Applications:

- Laser ablation, cleaning...
- Laser templating
- 3D printing
- Ophthalmology

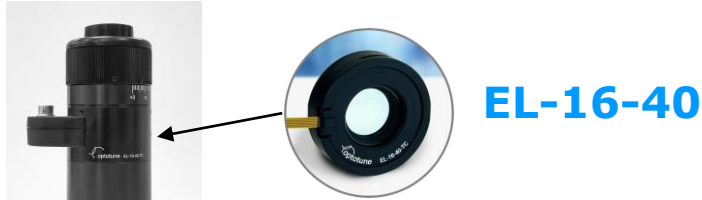
MR-15-30	
Mirror size	15 mm
Mechanical tilt – fast axis (half angle)	25°
Full-scale bandwidth – fast axis	20 Hz
Mechanical tilt – slow axis (half angle)	25°
Full-scale bandwidth – slow axis	20 Hz
Mech. Repeatability RMS typical	30-100 μ rad
Footprint	30x14.5
Position feedback	yes
Laser power	up to 1 W

MR-10-30	
Mirror size	10 mm
Mechanical tilt – fast axis (half angle)	12.5°
Full-scale bandwidth – fast axis	280 Hz
Mechanical tilt – slow axis (half angle)	25°
Full-scale bandwidth – slow axis	20 Hz
Mech. Repeatability RMS typical	30-100 μ rad (slow axis)
Footprint	30x14.5
Position feedback	yes
Laser power	up to 1 W

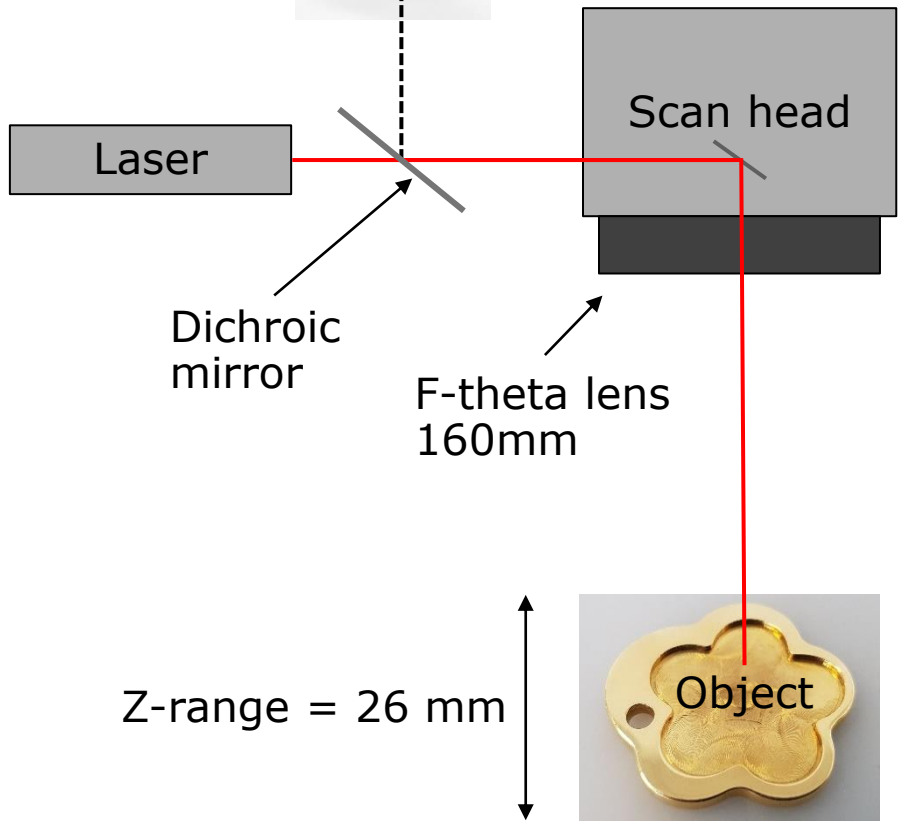
Inline inspection with Distance measurement for Laser processing using EL-16-40



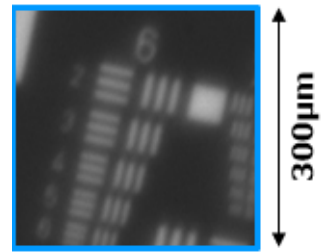
Inline camera



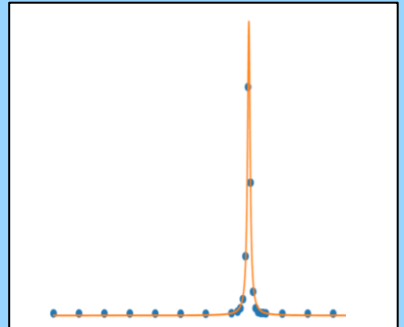
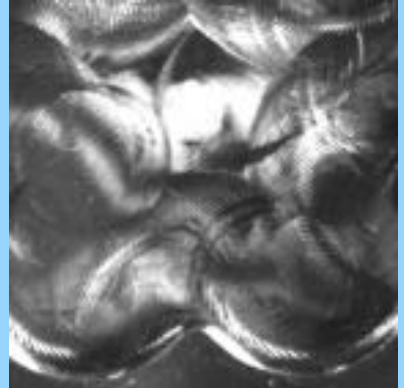
EL-16-40



High resolution:
30 lp/mm (image)
9 μm on object
10 mm scan head aperture

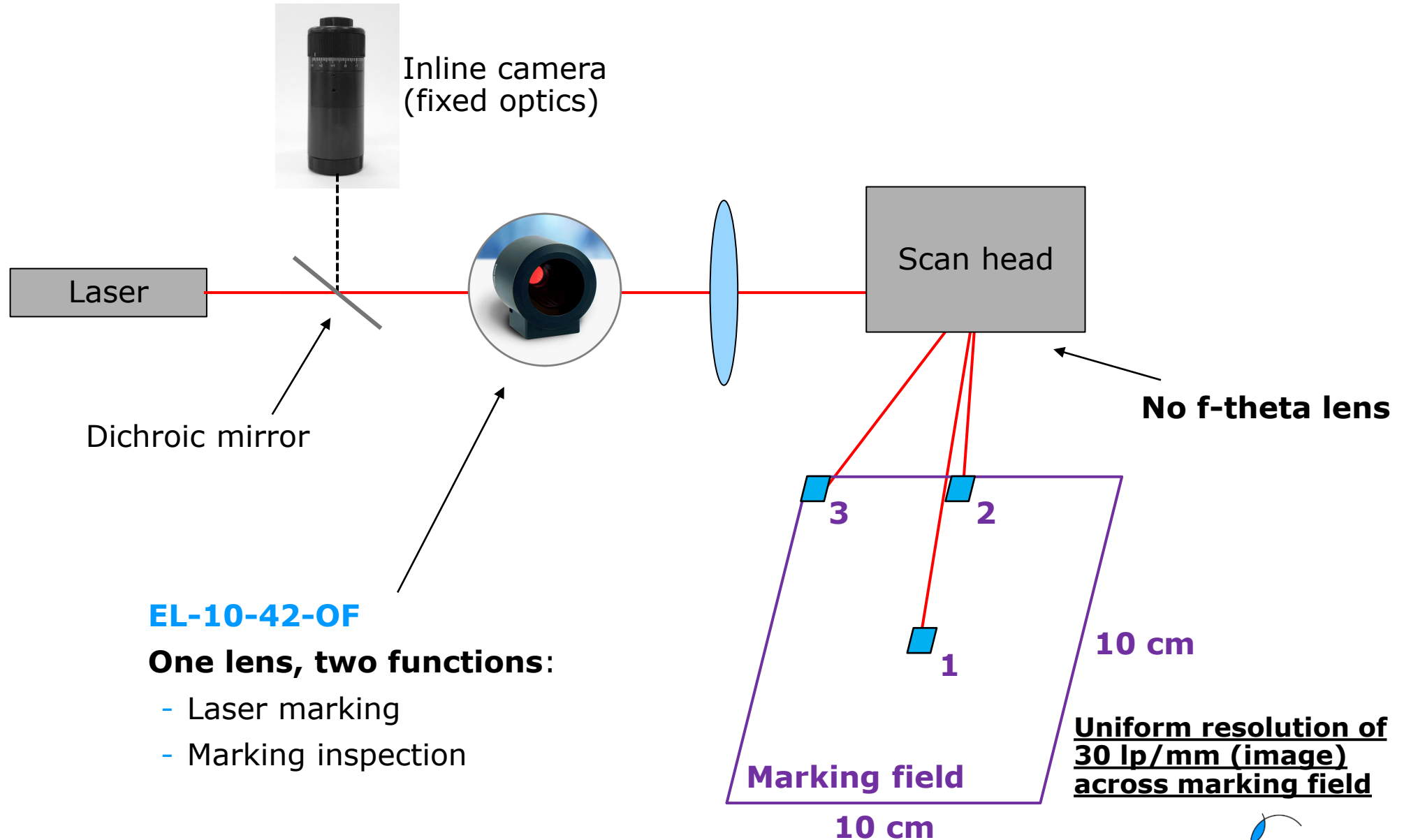


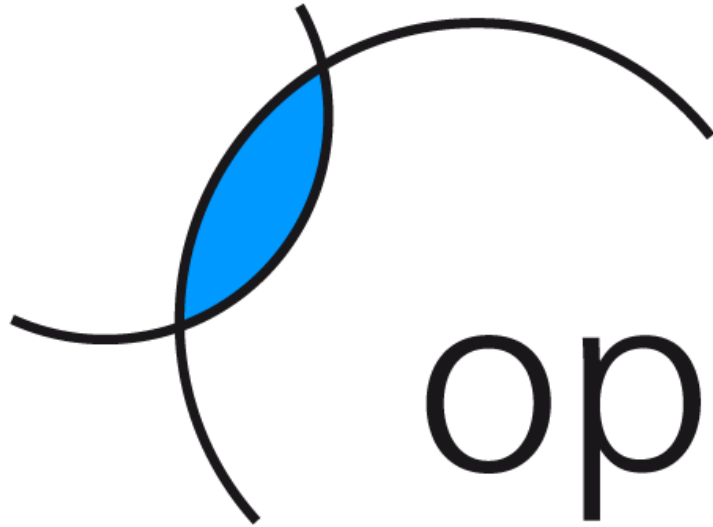
Inspection & DFF depth measurement



Depth from focus: A focus tunable lens in conjunction with an autofocus algorithm can reliably measure distance to an arbitrary object in less than a second

Inline inspection for Laser processing up to 50W using EL-10-42-OF





optotune

shaping the future of optics