



Laser Scanning Lenses

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Scan Lens Theory

Scan Field Diameter

The scan field diameter determines many of the overall lens specifications. Once a scan field diameter is determined, it is along with the focal length defines the deflection angle required, since the focus position is portional to the product of $F \times \theta$.

Back Working Distance

The distance from the work surface to the output side of the lens housing is the Back Working Distance (BWD). Depending on lens complexity and the degree of telecentricity, the back working distance can usually be specified and controlled during lens design.

Output Scan Angle

The angle between the normal to the image plane, or work surface, and the paraxial ray of the output beam is the output scan angle (ϕ). This angle is always zero for telecentric lenses. In general ϕ varies with the position of the focused spot across the work surface.

Spot Size

The spot size will be most affected by the input laser beam diameter, divergence of the laser source, and the effective focal length of the lens system. For a diffraction limited lens coupled with a Gaussian source, the $1/e^2$ spot size can be expressed as:

$$S = 1.27\lambda \times EFL/A$$

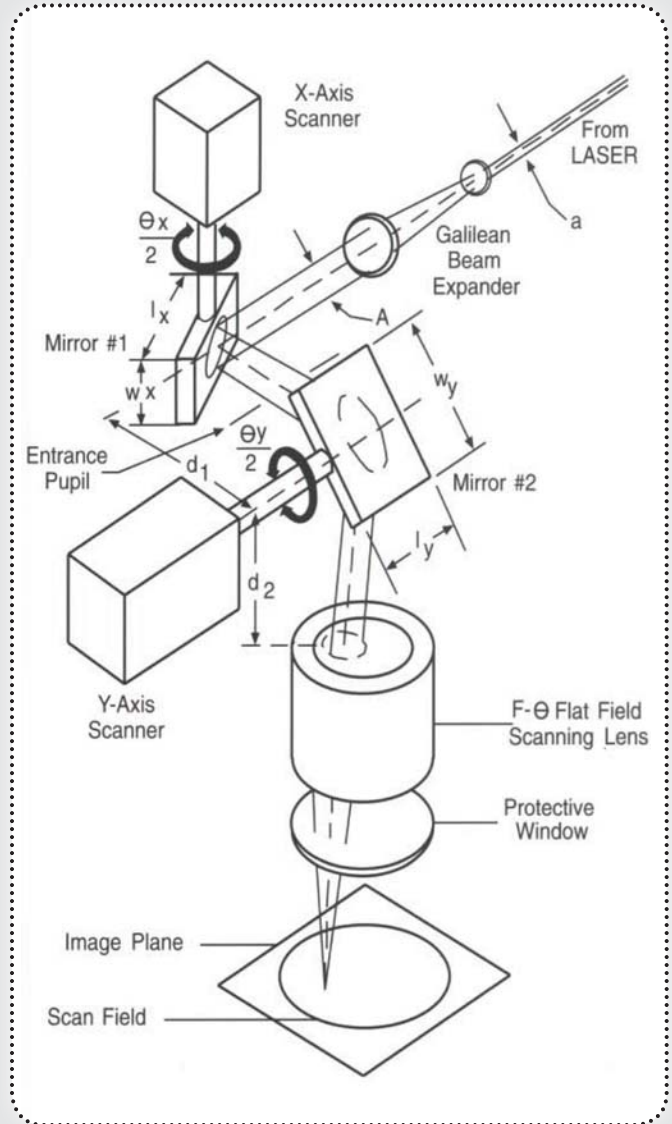
This equation is true for lens apertures which are 1.8 times larger than the $1/e^2$ beam diameter. In such instances less than 0.1% of the beam intensity is truncated by the lens aperture. For a "tophat" intensity beam incident over the entire lens aperture the spot size will be approximated by the following:

$$S = 2.44 \lambda \times EFL/A$$

The previous equations predict the spot size on the axis of the scanning lens system. For non-telecentric designs, the spot size off axis will be elongated proportionally to the output scan angle (ϕ) and is given by:

$$S_e = S / \cos \phi$$

For lens systems where ϕ is less than 10 degrees, the elongation is generally less than 2%.



Confocal Microscopy Laser Scanning Lenses

By using a Special Optics Telecentric F-Theta Laser Scan lens in place of a conventional microscope objective, Confocal Laser Scanning Microscopes can provide an image area more than 100 times that of a standard microscope. Our Telecentric F-Theta laser scan lenses are optimized for Confocal Microscopy and are ideal for focusing the incoming laser beam to a spot on the microscope slide.

Custom designed lens orders are welcomed. We design and construct countless specialty lenses for our customers everyday. Call, email or submit a custom lens request using our online form. We'd be of help to design something to fit your exact specifications.

Applications:

- Genomic and Proteomic Analysis
- Tissue Imaging
- Biotechnology

Features

- Diffraction Limited
- Precision Manufacture and Assembly



Confocal Microscopy Laser Scanning Lenses

Model	Wavelength Range (nm)	Focal Length (mm)	Field Size (mm)	Max. Input* Aperture (mm)	FWD (mm)	BWD (mm)	Scan Angle (degrees)	Lateral Color (microns)	1/e ² Spot Size (microns)
55-S28-3T	530 - 590	28.6	3	28.6	16	2.8	+/- 3	< 1	0.5
55-S30-15T	488 - 600	30.0	13	15.0	14	12.5	+/- 13	< 5	3
55-S80-25T	450 - 650	80.3	25	8.0	16	53.0	+/- 9	< 3	6
55-S172-36T	500 - 1100	172	36	20.0	49	86.0	+/- 6	< 8	10

* Single Axis Scanning
T denotes Telecentric
Model 55-S28-3 transmits 50% @ 365 nm

IR Laser Scanning Lenses

Special Optics IR F-Theta Laser Scanning Lenses are typically used with Nd:YAG lasers in laser marking, laser engraving, and laser cutting systems. All our designs are Diffraction Limited and provide a flat field at the plane of interest. Standard features include Diffraction Limited performance, air-spaced design for high damage threshold, and anti-reflection coatings on all surfaces.

In addition to the lenses listed, Special Optics regularly designs custom laser optical systems for a large variety of OEM applications and performance levels. Call us at (973) 366-7289 or email us at sales@specialoptics.com to speak with one of our leading optical designers.

Features

- Diffraction Limited
- Precision Manufacture and Assembly
- Telecentric Models Available
- Germanium and ZnSe



IR Laser Scanning Lenses

Model (T denotes Telecentric)	Wavelength (microns)	Scan Field (mm)	EFL (mm)	Max Input Beam*	BWD (mm)	Deflection (degrees)	FWD (mm)	1/e ² Spot Size** (microns)
55-S77-54	10.6	54	77.2	9.5	90	20	26	172
55-S102-100	10.6	100	102	16	120	28.5	22	135
55-S275-200	10.6	198	277.8	15	295	20	48	395
55-S100-100	10.6	100	100	21	113	28.5	30	101
55-S150-150	10.6	150	150	21	171	28.5	26.3	151
55-S125-100	10.6	100	125	16	150	23	26.2	166
55-S96-75	10.6	75	96	14	97	22	24	145
55-S117-75	10.6	75	117	17	117	18	42	146
55-S120-108	10.6	108	120	14	122	25	23.4	181
55-S149-129	10.6	129	149	17	153	25	46.3	187
55-S90-42T-λ	9.3 or 10.6	42	90	34	92	14	41	56
55-S101-70T-λ	9.3 or 10.6	70	101	33	92	22	44.2	64
55-S129-82T-λ	9.3 or 10.6	84	129	24	136	19	48.2	115
55-S58-40T-λ	9.3 or 10.6	40	58	39	34	21.2	39	31

Please replace λ in model number with working wavelength when ordering.

* Single Axis Scanning

** Spot Size = 2 λ F#

Telecentric UV Laser Scanning Lenses

Special Optics telecentric F-Theta UV Scan lenses offer greater depth of field and smaller spot sizes when marking objects for laser material processing. Telecentric scan lenses, by the very nature of their design, maintain a near normal incidence angle of the beam to the work piece. This ensures that position errors and image distortions are minimized over the entire scan range. With the shorter wavelength, a smaller spot size is achievable.

Having a greater depth of field and smaller spot size are important for precision laser micro-machining processes where there is a need to produce fine spot sizes so as to control the width of a laser mark, scribe or drilled hole while maintaining precise placement over a relatively large field. The ability to accomplish this is sometimes affected by just minimal warping of a wafer or solar panel.

Special Optics Telecentric UV Scanning lenses include focal lengths of 34mm, 50mm, and 100mm and are available for 266nm or 355nm wavelengths. The scan fields range from 9mm, 20mm, 45mm, and 55mm. Our telecentric UV Scan lenses were developed to accommodate large input beam diameters ranging from 17mm to 10mm. Thanks to the larger input beam design and shorter UV wavelength, the spot sizes achieved are 1.0 microns, 2.5 microns, and 5 microns respectively. All Special Optics lens designs are diffraction limited and deviation of the telecentricity is less than 0.9%.

Features

- Diffraction Limited
- Precision Manufacture & Assembly
- Air-Spaced Design
- Achromatic Designs Available

Telecentric UV Laser Scanning Lenses

Model	Wavelength (microns)	Scan Field (mm)	EFL (mm)	Max Input Beam*(mm)	BWD (mm)	Deflection (degrees)	FWD (mm)	Spot Size (microns)
55-S34-9UV-λ	266 or 355	9	34	17	10	7	17	1
55-S50-20UV-λ	266 or 355	20	50	10	15	12	23	2.5
55-S100-45UV-λ	355	45	100	10	150	16	28	5
55-S100-55UV-λ	266 or 355	55	100	10	135	16	28	5

Please replace λ in model number with working wavelength when ordering.

VIS-NIR Laser Scanning Lenses

Special Optics high precision F-Theta Scan lenses (450nm to 1064nm) achieve ultra-fine resolution laser cutting and etching and are used in the most demanding laser micro-machining applications. The Special Optics F-Theta Scan lenses are ideally used in combination with our large output beam expanders for a variety of laser processing and laser micro-machining tasks such as cutting of solar cells, laser marking, laser drilling, and laser scribing.

In addition to the lenses listed, Special Optics regularly designs custom laser optical systems for a large variety of OEM applications and performance levels. Call us at (973) 366-7289 or email us at sales@specialoptics.com to speak with one of our leading optical designers.



Features:

- Provide a Flat Field at the Image Plane
- Diffraction Limited Performance
- Air Spaced Designs for high damage threshold
- Anti-reflection coatings on all surfaces
- Designs from the visible to infrared regions
- Achromatic Designs Available

VIS-NIR Laser Scanning Lenses

Model (T denotes Telecentric)	Wavelength (microns)	Scan Field (mm)	EFL (mm)	Max Input Beam* (mm)	BWD (mm)	Deflection (degrees)	FWD (mm)	1/e ² Spot
55-S70-30	1.064	30	63.4	8	70.0	13.6	17.0	10.7
55-S160-84T	1.064	84	160.0	28	190.0	15.0	35.0	8.0
55-S112-90T	1.064	90	112.2	13	155.6	23.0	27.6	11.7
55-S117-90	1.064	90	117.3	8	133.5	22.0	21.7	19.8
55-S181-90	1.064	100	181.3	19	229.0	15.8	35.8	12.9
55-S191-125	1.064	125	191.3	13	194.0	22.0	26.0	19.9
55-S236-150	1.064	152	236.8	25	298.0	18.4	55.4	12.8
55-S266-170	1.064/VIS	170	266.0	15	275.0	18.0	370	24.0
55-S266-252	1.064	252	266.5	10	338.0	27.0	48.0	36.0
55-S295-250	1.064	250	295.4	25	355.0	25.0	37.6	16.0
55-S459-432	1.064	432	459.0	26	540.0	27.0	48.0	24.0
55-S700-450	1.064/VIS	450	699.0	34	725.0	18.0	55.0	28.0
55-S700-560	1.064	560	699.0	35	580.0	23.0	35.0	27.0
55-S190-60-VIS	0.45 - 0.65 (apochromatic)	60	190.0	16	129.4	9.0	27.5	9.8
55-S190-100-VIS	0.45 - 0.65 (apochromatic)	100	190.0	16	161.0	15.0	24.0	9.8
55-S87-36T	0.488	36	87.0	27	5.8	12.0	29.0	2.0
55-S223-77T	0.632	77	223.0	22	231.5	10.0	33.0	8.1

* Single Axis Scanning
T denotes Telecentric
** Assumes a diffraction limited beam, spot size = 1.27λ F#