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## Scan Lenses (f- $\theta$ Lenses) for Nd:YAG Lasers

A family of lenses commonly used in scan systems for reading or printing documents or laser marking systems for focusing laser beam to a smaller spot. The lens must be designed such that the image height is proportional to the scan angle (Theta), not the tangent of that angle, as is usually the case.

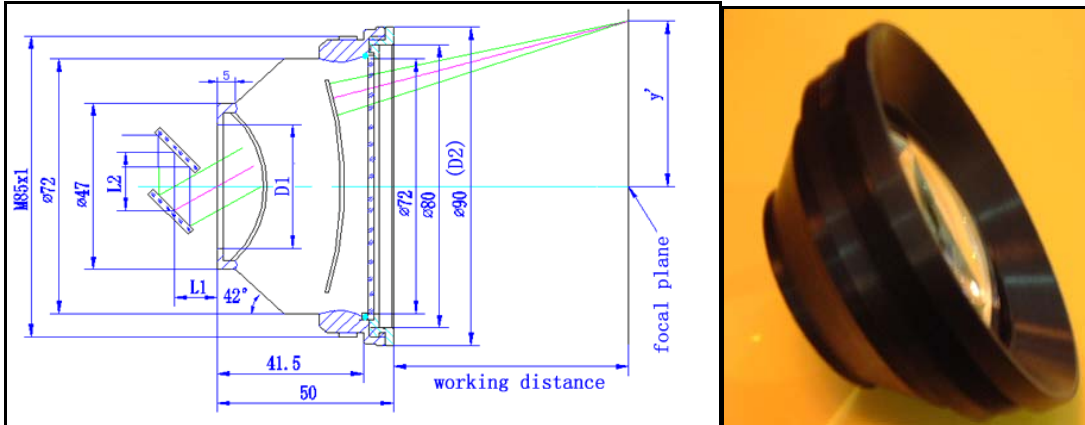


Fig. 1

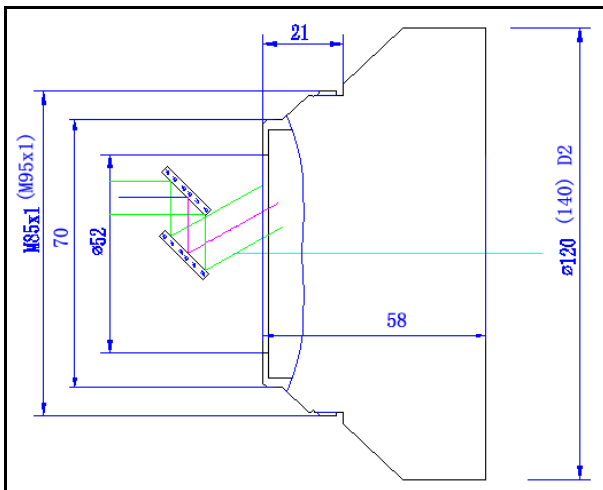


Fig. 2

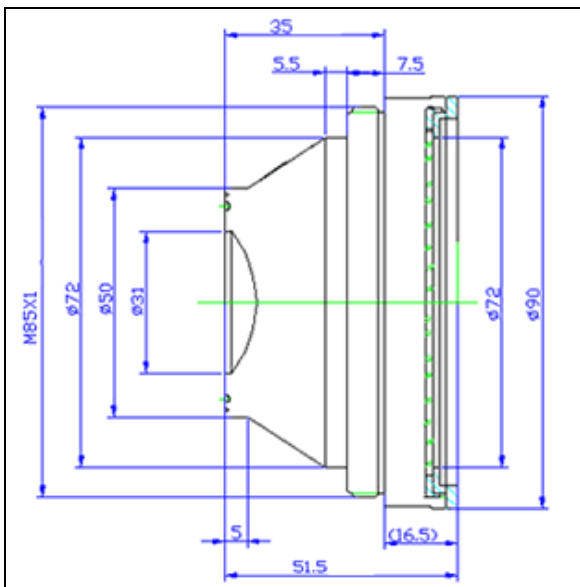


Fig. 3

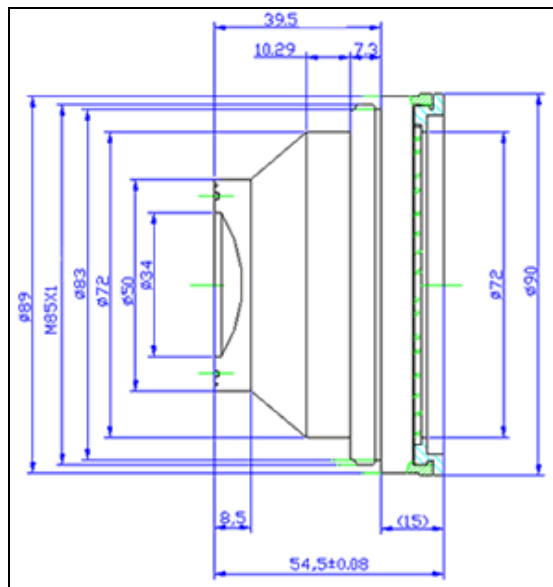


Fig. 4

**Description of part Number: STY-xxxx-yyy-zzz-A**

STY--- STY series YAG laser f-theta lenses

xxxx-- laser wavelength, 1064 means 1064nm, 10.6 means 10.6um.

yyy---- mark field, yyy x yyy mm

zzz---- effective focal length in mm

A----- others

Remark: The f-theta lens consists of 3 lenses and one AR coated protective glass.

**Wavelength 1064nm**

Model	F.L. mm	WD mm	Scan area mm	Scan Angle $\theta_{max}$	E.P. mm	Spot $\mu m$	D1 mm	D2 mm	Screw	Outline
STY-1064-35-63	63	58	$\Phi 50/35 \times 35$	$\pm 22^\circ$	12	10	31	90	M85x1	Fig. 1
STY-1064-50-80	80	91.6	$\Phi 70/50 \times 50$	$\pm 22^\circ$	12	12	31	90	M85x1	Fig. 1
STY-1064-55-80	80	83	$\Phi 78/55 \times 55$	$\pm 25^\circ$	20	15	42	90	M85x1	Fig. 1
STY-1064-62-100	100	107	$\Phi 87/62 \times 62$	$\pm 25^\circ$	12	14	33	90	M85x1	Fig. 1
STY-1064-70-100	100	107	$\Phi 100/70 \times 70$	$\pm 25^\circ$	16	10	40	90	M85x1	Fig. 1
STY-1064-85-130	130	145	$\Phi 120/85 \times 85$	$\pm 25^\circ$	12	14	35	90	M85x1	Fig. 1
STY-1064-102-150	150	165	$\Phi 144/102 \times 102$	$\pm 28^\circ$	12	18	36	90	M85x1	Fig. 1
STY-1064-110-160	160	180	$\Phi 155/110 \times 110$	$\pm 28^\circ$	12	18	36	90	M85x1	Fig. 1
STY-1064-110-160-B	160	180	$\Phi 155/110 \times 110$	$\pm 28^\circ$	16	18	40	90	M85x1	Fig. 1
STY-1064-110-160-C	160	180	$\Phi 155/110 \times 110$	$\pm 28^\circ$	20	18	52	120	M85x1	Fig. 2
STY-1064-117-170	170	191	$\Phi 165/117 \times 117$	$\pm 28^\circ$	16	18	38	90	M85x1	Fig. 1
STY-1064-130-188	188	212	$\Phi 185/130 \times 130$	$\pm 28^\circ$	14	18	36	90	M85x1	Fig. 1
STY-1064-145-210	210	236	$\Phi 205/145 \times 145$	$\pm 28^\circ$	16	18	36	90	M85x1	Fig. 1
STY-1064-155-210	210	236	155x155	$\pm 30^\circ$	16	18	36	90	M85x1	Fig. 1
STY-1064-175-254	254	288	$\Phi 245/175 \times 175$	$\pm 28^\circ$	16	20	36	90	M85x1	Fig. 1
STY-1064-175-254-B	254	274	$\Phi 245/175 \times 175$	$\pm 28^\circ$	20	20	52	120	M85x1	Fig. 2
STY-1064-205-290	290	327	$\Phi 290/205 \times 205$	$\pm 28^\circ$	16	20	38	90	M85x1	Fig. 2
STY-1064-230-330	330	363	$\Phi 330/230 \times 230$	$\pm 28^\circ$	16	20	38	90	M85x1	Fig. 2
STY-1064-255-370	370	430	$\Phi 360/255 \times 255$	$\pm 28^\circ$	20	20	52	120	M85x1	Fig. 2
STY-1064-255-380	380	420	$\Phi 360/255 \times 255$	$\pm 28^\circ$	16	20	38	90	M85x1	Fig. 1
STY-1064-286-420	420	456	$\Phi 405/286 \times 286$	$\pm 28^\circ$	20	20	52	120	M85x1	Fig. 2
STY-1064-300-430	430	477	$\Phi 425/300 \times 300$	$\pm 28^\circ$	20	20	52	120	M85x1	Fig. 2
STY-1064-360-525	525	606	$\Phi 510/360 \times 360$	$\pm 28^\circ$	20	30	52	120	M85x1	Fig. 2
STY-1064-420-590	590	650	$\Phi 595/420 \times 420$	$\pm 28^\circ$	20	25	52	140	M95x1	Fig. 2
STY-1064-430-610	610	670	$\Phi 610/430 \times 430$	$\pm 28^\circ$	20	25	52	140	M95x1	Fig. 2
STY-1064-450-650	650	736	$\Phi 636/450 \times 450$	$\pm 28^\circ$	20	30	52	120	M85x1	Fig. 2

**Wavelength 532nm**

Model	F.L. mm	WD mm	Scan area mm	Scan Angle $\theta_{max}$	E.P. mm	Spot $\mu m$	D1 mm	D2 mm	Screw	Out- line
STY-532-35-63	63	58	$\Phi 50/35 \times 35$	$\pm 22^\circ$	12	10	31	90	M85x1	Fig.1
STY-532-50-80	80	91.6	$\Phi 70/50 \times 50$	$\pm 22^\circ$	12	12	31	90	M85x1	Fig.1
STY-532-62-100	100	107	$\Phi 87/62 \times 62$	$\pm 25^\circ$	12	14	33	90	M85x1	Fig.1
StY-532-74-120	120	132	$\Phi 105/74 \times 74$	$\pm 25^\circ$	12	14	35	90	M85x1	Fig.1
STY-532-110-160	160	180	$\Phi 155/110 \times 110$	$\pm 28^\circ$	16	15	36	90	M85x1	Fig.1

Part No.	EFL (mm)	Scan Angle ( $\pm^\circ$ )	Scan Length (mm)	Scan Field (mm)	Ent. pupil (mm)	Avge. spot size ( $\mu m$ )	Length (mm)	WD (mm)	Screw Thread
SL-532-70-100	100	$25^\circ$	87.0	70x70	14.0	12.0	50.0	100.0	M85x1
SL-532-90-120	120	$25^\circ$	102.0	90x90	8.0	10.8	38.85	134.0	M85x1
SL-532-100-162	162	$23^\circ$	132.9	100x100	7.0	-	25.2	183.4	M39/M55
SL-532-115-165	165	$20^\circ$	163.0	115x115	10.0	18.5	48.0	186.0	M85x1
SL-532-148-233	234	$26^\circ$	211.0	148x148	10.0	-	55.3	282.0	M85x1
SL-532-150-254	254	$25^\circ$	220.0	150x150	10.0	21.5	51.0	280.0	M85x1
SL-532-225-410	410	$25^\circ$	366.0	225x225	15.0	15.0	48.94	443.7	M85x1
SL-532-350-508	508	$25^\circ$	500.0	350x350	16.0	15.0	57.0	581.0	M85x1

SL-532-510-740	740	20°	721.0	510x510	16.0	18.5	65.0	896.5	M85x1
SL-532-550-768	768	28°	710.0	550x550	16.0	24.0	58.0	839.0	M102x1

**Wavelength 355nm**

Model	F.L. mm	WD mm	Scan area mm (round/square)	Scan Angle maxi	E.P. mm	Spot $\mu$ m	D1 mm	D2 mm	Screw	Out-line
STY-355-70-100	100	122	$\Phi$ 100/70x70	$\pm$ 25°	8	12	33	90	M85x1	Fig.3
STY-355-110-160	160	185	$\Phi$ 155/110x110	$\pm$ 25°	8	15	33	90	M85x1	Fig.1
STY-355-110-160-B	160	187	$\Phi$ 155/110x110	$\pm$ 25°	8	15	33	90	M85x1	Fig.4

Part No.	EFL (mm)	Scan Angle ( $\pm$ °)	Scan Length (mm)	Scan Field (mm)	Ent. pupil (mm)	Average spot Size ( $\mu$ m)	Length (mm)	Working Distance (mm)
SL-355-60-100	100.0	25°	85.0	60x60	6.0	15.5	56.0	130.5
SL-355-76-108	108.3	28.4°	107.7	76x76	6.0	-	49.0	146.0
SL-355-109-174	173.9	25°	153.2	109x109	6.0	-	36.8	218.4
SL-355-112-160	160.0	20°	158.0	112x112	7.0	13.5	50.0	177.79
SL-355-112-160Q	160.0	29°	160.0	112x112	6.0	18	50.36	206.6
SL-355-155-250	250.3	25.4°	219.2	155x155	10.0	-	61.0	309.6
SL-355-160-254	254.0	25°	220.0	160x160	12.0	22.0	55.0	311.0
SL-355-130-269	269.3	19.0°	183.0	130x130	4.0	-	47.0	276.1
SL-355-180-290	290.0	25.5°	255.0	180x180	20.0	40.0	65.0	332.5
SL-355-320-580	580.0	22°	455.0	320x320	10.0	27.0	38.0	668.0
SL-355-350-580	580.0	25°	495.0	350x350	15.0	24.0	46.0	689.0
SL-355-500-810	810.0	28°	850.0	500x500	24.0	55.0	57.0	880.0
SL-355-440-831	831.1	21.4°	624.5	440x440	14.0	-	62.5	983.2
SL-355-470-912	919.2	20.8°	678.0	470x470	14.0	-	40.0	1032.0

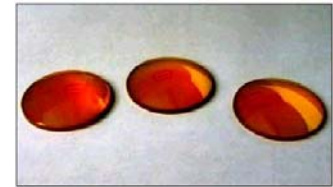
**wavelength 266nm**

Part No.	EFL (mm)	Scan Angle ( $\pm$ °)	Scan Length (mm)	Scan Field (mm)	Ent. pupil (mm)	Average spot Size ( $\mu$ m)	Length (mm)	Working Distance (mm)
SL-266-70-100	100.0	28°	95.0	70x70	5.0	8.0	49.0	137.0
SL-266-73-101	101.5	29.2°	100.7	73x73	5.0	-	49.0	136.5
SL-266-110-160	160.0	28°	160.0	110x110	5.0	10.0	36.7	200.0
SL-266-105-162	162.3	25°	142.7	105x105	5.0	-	36.8	204.5
SL-266-112-250	249.5	18°	159.0	112x112	4.0	-	47.0	253.6
SL-266-90-254	254.0	18°	156.0	90x90	4.0	16.0	47.0	25.0

## Scan Lenses for 10.6um CO<sub>2</sub> Lasers

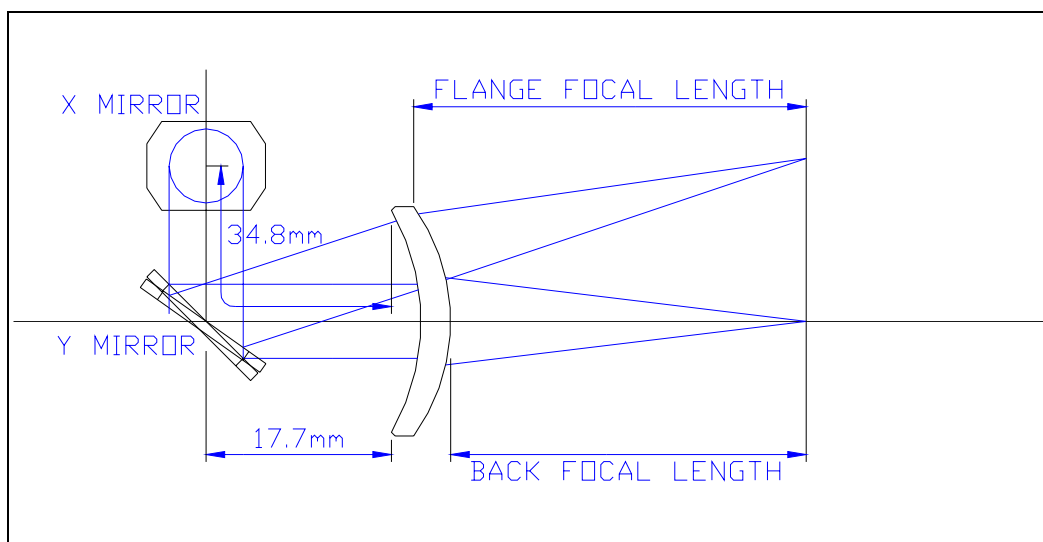
### 1. Single-element Scan Lenses

#### 1) Un-mounted Single-element STSL Series Lenses



STSL scanner lenses specially designed and optimized for use in CO<sub>2</sub> laser 2-axis galvo-scanner systems with full beam diameters of up to 15.0mm. Mirror sets appropriate for use with beam diameters up to 15mm require an increase in mirror separation in comparison with smaller mirrors. These changed optical conditions are catered for by the STSL series. These single-element lenses are designed to represent the best achievable compromise for on-axis and off-axis aberrations, field flatness and F-theta characteristics, obtainable using single-element spherical-surface designs of (standard) 48mm diameter. The lens materials is ZnSe.

Part no.	Focal length (mm)	Field size (mm)	Back focal length (mm)	Flange focal length (mm)	Average spot diameter (μm)
STSL-10.6-50-75	75.2	50 x 50	74.2	78.4	171
STSL-10.6-60-90	90.1	60 x 60	90.0	94.8	174
STSL-10.6-70-101	101.3	70 x 70	101.4	106.1	181
STSL-10.6-105-149	149.1	105 x 105	150.6	155.6	219
STSL-10.6-120-175	175.0	120 x 120	177.4	178.4	243
STSL-10.6-125-179	179.2	125 x 125	181.9	187.3	247
STSL-10.6-140-201	200.6	140 x 140	203.5	208.8	269
STSL-10.6-155-226	225.5	155 x 155	228.0	232.8	296
STSL-10.6-175-249	249.4	175 x 175	253.3	258.5	320
STSL-10.6-210-298	298.0	210 x 210	302.6	307.7	373
STSL-10.6-250-363	362.6	250 x 250	368.2	373.2	445
STSL-10.6-280-394	394.4	280 x 280	401.4	406.7	481
STSL-10.6-300-433	432.7	300 x 300	441.0	446.2	525
STSL-10.6-340-482	481.8	340 x 340	490.2	495.3	581
STSL-10.6-370-529	528.8	370 x 370	538.5	543.5	634
STSL-10.6-415-592	591.7	415 x 415	586.5	589.9	717
STSL-10.6-500-717	716.5	500 x 500	730.0	734.7	850
STSL-10.6-550-782	781.6	550 x 550	797.7	802.2	925
STSL-10.6-600-848	848.4	600 x 600	859.6	863.7	1000
STSL-10.6-680-978	977.6	680 x 680	993.7	997.9	1150
STSL-10.6-840-1183	1183	840 x 840	1205	1208	1390
STSL-10.6-850-1201	1201	850 x 850	1216	1220	1410
STSL-10.6-920-1285	1285	920 x 920	1317	1321	1520
STSL-10.6-1000-1409	1409	1000 x 1000	1421	1425	1650
STSL-10.6-1120-1577	1577	1120 x 1120	1593	1596	1840
STSL-10.6-1256-1746	1746	1256 x 1256	1783	1787	2040
STSL-10.6-1500-2122	2122	1500 x 1500	2173	2177	2420

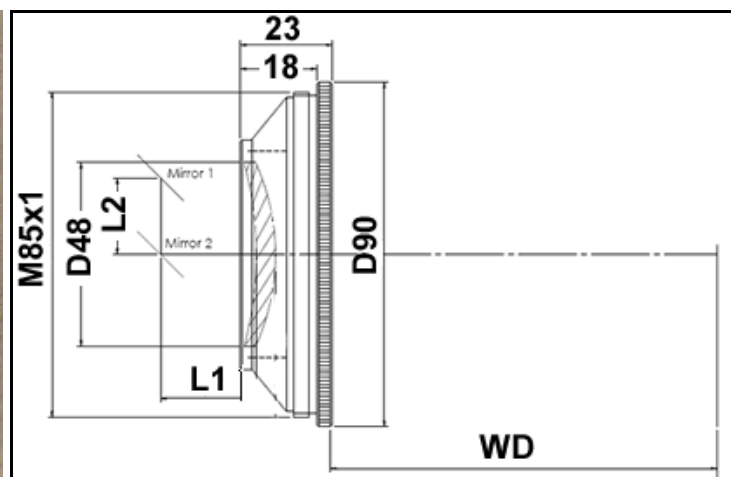


Remark:

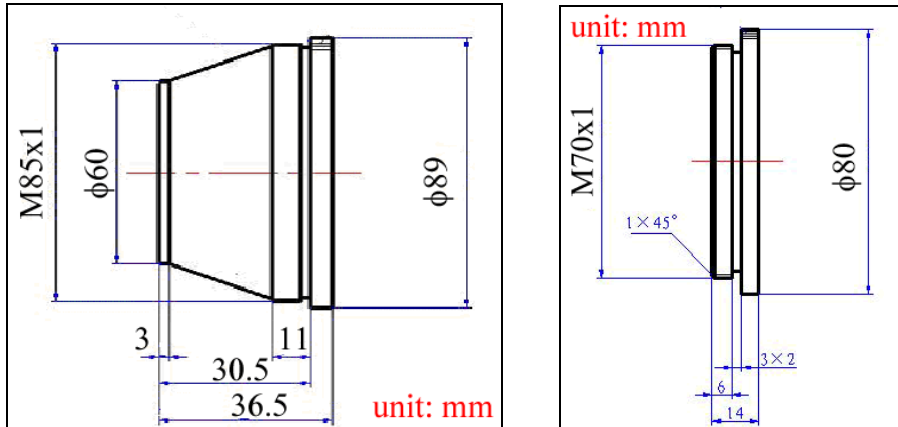
- (1) The lenses are meniscus form; one concave and one convex surface. The concave always faces the incident beam.
- (2) The mirror locations are the same for every STSL lens, so any lens can replace any other in the cell and be correctly positioned. The field sizes given, assume an optical field angle of +/-20deg.
- (3) Focused spot diameters assume a 15mm diameter full beam (approximately 12mm  $1/e^2$ ) and TEM<sub>00</sub> mode ( $M^2 = 1$ ). The 'average' is the mean of 25 field positions in a quadrant.
- (4) For all STSL lenses, the diameter is 48.0 +/-0.1 mm, and the edge thickness is 3.0 +/-0.1 mm.

## 2) Mounted Single-element STSL Series Lenses

Part no.	Focal length (mm)	Field size (mm)	WD (mm)	Average spot diameter ( $\mu\text{m}$ )
STSL-10.6-50-75	75.2	50 x 50	59.8	171
STSL-10.6-60-90	90.1	60 x 60	75.6	174
STSL-10.6-70-100	101.3	70 x 70	87.0	181
STSL-10.6-105-150	149.1	105 x 105	136.2	219
STSL-10.6-120-175	175.0	120 x 120	163.0	243
STSL-10.6-125-180	179.2	125 x 125	167.5	247
STSL-10.6-140-200	200.6	140 x 140	189.1	269
STSL-10.6-155-225	225.5	155 x 155	213.6	296
STSL-10.6-175-250	249.4	175 x 175	238.9	320
STSL-10.6-210-300	298.0	210 x 210	288.2	373
STSL-10.6-250-360	362.6	250 x 250	353.8	445
STSL-10.6-280-400	394.4	280 x 280	387.0	481
STSL-10.6-300-435	432.7	300 x 300	426.6	525
STSL-10.6-340-482	481.8	340 x 340	475.8	581
STSL-10.6-370-529	528.8	370 x 370	524.1	634
STSL-10.6-415-600	591.7	415 x 415	572.1	717
STSL-10.6-500-720	716.5	500 x 500	715.6	850
STSL-10.6-550-782	781.6	550 x 550	783.3	925
STSL-10.6-600-848	848.4	600 x 600	845.2	1000
STSL-10.6-680-977	977.6	680 x 680	979.3	1150
STSL-10.6-840-1150	1183	840 x 840	1190.6	1390
STSL-10.6-850-1200	1201	850 x 850	1201.6	1410
STSL-10.6-920-1285	1285	920 x 920	1302.6	1520
STSL-10.6-1000-1409	1409	1000 x 1000	1406.6	1650
STSL-10.6-1120-1577	1577	1120 x 1120	1578.6	1840
STSL-10.6-1256-1746	1746	1256 x 1256	1768.6	2040
STSL-10.6-1500-2122	2122	1500 x 1500	2158.6	2420



### 3) Mounted Single-element Scan Lenses, STDC Series



Model	Scan area (mm)		WD (mm)	EP (mm)	Scan angle(°)	FD (mm)
	Rectangular	Round				
STDC-10.6-36	36×36	φ51	72	11	15	25
STDC-10.6-60	60×60	φ86	97	11	20	25
STDC-10.6-80	80×80	φ113	102	11	25	25
STDC-10.6-90	90×90	φ128	119	11	25	25
STDC-10.6-110	110×110	φ156	151	11	25	25
STDC-10.6-110-14	110×110	φ156	146	14	30	23
STDC-10.6-125	125×125	φ177	175	11	25	25
STDC-10.6-175	175×175	φ247	252	11	25	25
STDC-10.6-200	200×200	φ283	294	11	25	25
STDC-10.6-250	250×250	φ352	398	11	25	25
STDC-10.6-300	300×300	φ424	447	11	25	25
STDC-10.6-350A	350×350	φ497	531	11	25	25
STDC-10.6-350B	350×350	φ497	427	11	30	25
STDC-10.6-400A	400×400	φ566	608	11	25	25
STDC-10.6-400B	400×400	φ566	506	11	30	25
STDC-10.6-500A	507×507	φ718	772	11	25	25
STDC-10.6-500B	500×500	φ708	616	11	30	25

Model	EP (mm)	Scan angle(°)	Scan area (mm×mm)	Spacing# (mm)	WD (mm)	Focused beam dia. (μm)	
						Center	edge
STDC-10.6-60-20	20	20	60×60	30	122.5	278	300
STDC-10.6-80-20	20	19	59×59	33	128.5	247	264
STDC-10.6-90-20	20	17	60×60	33	145.5	237	252
STDC-10.6-100-20	20	23	100×100	30	176	135	143

# the distance between the two scan mirrors. The lens material is GaAs.

## 2. Mounted 2-element Scan Lenses

### 1) STC Series Lenses

Model	WD mm	Scan area (mm)		Spot size (centre) μm	Spot size (off axis) μm	EP (mm)	Scan angle (°)	FD mm
		Rectangular	Round					
STC-10.6-40	95	36×36	51	115	135	11	20	27
STC-10.6-80	118	80×80	113	120	140	11	27	16
STC-10.6-110	145	110×110	156	210	225	16	30	17
STC-10.6-125	188	125×125	177	235	285	16	30	17
STC-10.6-175	257	175×175	247	245	300	16	30	18
STC-10.6-200	294	200×200	283	320	365	16	30	19
STC-10.6-250	360	250×250	354	330	375	16	30	20
STC-10.6-300	433	300×300	424	385	430	16	30	20
STC-10.6-350	502	350×350	495	400	450	16	30	20

STC-10.6-400	569	400×400	566	420	485	16	30	20
STC-10.6-500	803	500×500	718	460	520	16	30	21
STC-10.6-700	960	700×700	990	530	680	16	30	21

The lens material is GaAs.

## 2) SL2 Series Lenses

F-Theta scan lens rugged double elements are designed for CO<sub>2</sub> laser system that employ X - Y galvo scanning mirrors. The lens are widely used in fields such as engraving and marking applications.

Part No.	EFL (mm)	Scan Field (mm)	Average Spot Size (um)	Beam Dia. (mm)	Mir. Sep. (mm)	2nd Mir. to Lens Mount (mm)	Max. Input Angle (deg.)	90% CA (mm)	Working Distance (mm)
SL2-10.6-35-60G	60	35X35	100	14	13	25	20	45	55
SL2-10.6-50-80G	80	50X50	118	14	13	25	20	45	76
SL2-10.6-70-122G	122	70X70	158	14	13	25	20	46	130
SL2-10.6-110-170G	170	110X110	170	14	13	25	20	54	185
SL2-10.6-140-220G	220	140X140	224	14	13	20	20	53	239
SL2-10.6-175-275G	250	175X175	239	14	13	25	20	51	305
SL2-10.6-210-300G	300	210X210	387	14	20	20	20	86	330
SL2-10.6-250-360G	360	250X250	465	14	20	20	20	86	393
SL2-10.6-300-420G	420	300X300	570	14	20	20	20	86	465
SL2-10.6-350-485G	485	350X350	822	14	20	30	20	87	528
SL2-10.6-F420G-20	420	300X300	505	20	30	30	20	78	470
SL2-10.6-110-150Z	150	110X110	170	14	13	27	20	64	159
SL2-10.6-140-200Z	200	140X140	224	14	13	27	20	69	215
SL2-10.6-175-250Z	250	175X175	239	14	13	27	20	78	270
SL2-10.6-F300Z-20	300	210X210	387	14	20	20	20	86	327
SL2-10.6-250-360Z	360	250X250	489	14	20	20	20	98	393
SL2-10.6-300-420Z	420	300X300	502	16	20	26	20	101	460
SL2-10.6-400-560Z	560	400X400	905	14	20	26	20	93	590

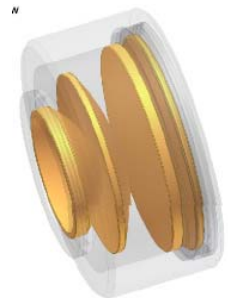
- Material: G-GaAs (transmit 10.6um only)
- Material: Z-ZnSe (transmit both 10.6um and visible)

## 3. F-theta scan lenses for CO<sub>2</sub> laser - Triple element made of ZnSe

Part No.	Wave-length (um)	EFL(mm)	WD (mm)	Mirror Scanning angle	Scanning area(mm <sup>2</sup> )	Entrance beam size (mm)	Mirrors separation (a2-a1) (mm)	Last mirror to first lens(a1) (mm)	Focused spot size (um)	Connection thread	Total length (mm)
SL3-9.4-50-80W	9.4	80	89.4	+/- 25	50X50	14	18	18	84.5	M85X1	39.20
SL3-9.4-60-105Z	9.4	105	60.1	+/- 25	60X60	14	18	21	88.5	M85X1	86
SL3-10.6-50-80W	10.6	80	89.4	+/- 25	50X50	14	18	18	84.5	M85X1	39.20
SL3-10.6-60-105Z	10.6	105	60.1	+/- 25	60X60	14	18	21	88.5	M85X1	86

## ST3 Series Scan Lenses

- focal lengths 75 and 100mm respectively
- the 75mm focal length lens is also nearly telecentric (see below) with the focused beam less than 5° to the normal diffraction limited performance over the entire image plane
- virtually zero F-theta error
- can be fitted with a protective window



Part No.	Wavelength (um)	EFL (mm)	Scan area (mm)	Entrance (mm)	Spot dia. (mm)
ST3-10.6-50-75	10.6	75	50x50	15	89
ST3-10.6-70-100	10.6	100	70x70	15	113

## Scan Lenses for other Wavelengths

### Eye Safe Laser (wavelength 1550nm)

Part No.	EFL(mm)	Scan Angle( $\pm^\circ$ )	Scan Length(mm)	Scan Field(mm)	Ent. pupil(mm)	Average spot size( $\mu$ m)	Length(mm)	Working Distance(mm)	Screw Thread
SL-1550-100-160	160.0	25°	140	100×100	9	43	47	175.63	M85x1

### Short Pulse Laser (wavelength 1060nm)

Part No.	EFL (mm)	Scan Angle( $\pm^\circ$ )	Scan Length (mm)	Scan Field (mm)	Ent. Pupil (mm)	Length (mm)	Working Distance (mm)	Screw Thread
SL-1060-95-163	163.0	25°	138.1	95×95	10.0	44.0	197.1	M85x1

### UV Laser (wavelength 405nm)

Part No.	EFL (mm)	Scan Angle ( $\pm^\circ$ )	Scan Length (mm)	Scan Field (mm)	Ent. pupil (mm)	Length (mm)	Working Distance (mm)
SL-405-110-176	175.9	25°	154.8	110x110	6.0	36.8	220.7
SL-405-300-375	375.3	31°	420.4	300x300	10.0	48.0	447.5
SL-405-326-594	594.1	22°	466.4	326x326	10.0	38.0	686.5

### Scan Lens for mask imaging for Excimer (wavelength 248nm)

Part No.	EFL (mm)	Scan Angle ( $\pm^\circ$ )	Scan Length (mm)	Scan Field (mm)	Ent. pupil (mm)	Length (mm)	Working Distance (mm)
SL-248-200-221	221.1	14°	-	200x200	10.0x10.0	38.6	303.6

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When you select a f-theta lens, you need to consider the following factors:

1. When the marking field increases, the focal length will be longer and the focused beam diameter will be larger.
2. When the diameter is larger, the power density on the workpiece will be lower. Thus you may need higher laser power.
3. When the laser power is higher, the laser beam quality may be worse and then the focused beam diameter will be larger.

Thus you should choose a proper f-theta lens according to a reasonable marking field. In order to meet various application requirements such as large field and small field, you may buy a few lenses with different marking fields to achieve good marking quality.