Sintec Optronics Pte Ltd
50 Bukit Batok Street 23 #07-15 Singapore 659578
Tel: +65 67781866 Fax: +65 65152908

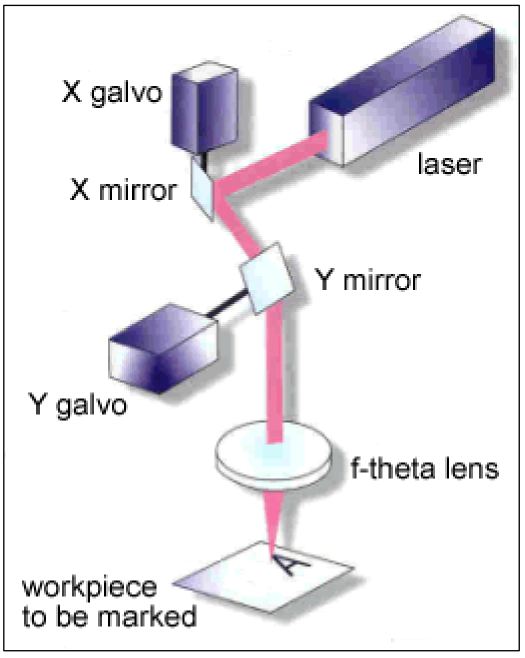
Laser Marking Head (Laser Scanner)

A whole laser marking head (or called laser scanner) consists of two scan mirrors, two galvanometers (or called galvo-scanner motor) & drive cards, a XY mount, a scanning lens (f-theta lens), an interface card (or called D/A card), a set of marking software and a DC power supply. Two types of scanning optics for CO2 and Nd:YAG lasers are available.

Basics of 2-axis laser scanners

A laser beam is reflected from two scan mirrors in turn, and directed through a focusing lens. The mirrors are capable of high speed deflection about a rotation axis, being driven by a galvo-scanner motor. In most cases the maximum deflection angle of the mirror is ±12.5° (often ±10° is a safer limit) either side of the non-deflected incidence angle of 45°.

Note that, for best performance, the lens will appear to be 'the wrong way round' when compared with a standard meniscus lens used in conventional focusing of a laser beam.



Some of the design objectives in specification of 2-axis laser scanners are:

- Achievement of desired scanned field size
- Maximization of scan speeds
- Minimizing focused spot sizes
- Lowest cost solutions

Some of the limitations to be considered are:

- Quality factor **Q** (Q = M^2) of the laser beam
- Scan angle limitations
- Loss of power due to beam-clipping
- Physical aperture of the scanner head

Field of scan

The laser beam will be scanned over an angle θ, equal to twice the mirror deflection angle. So, the typical scanned field might be θ=±20° in both X and Y directions. (θ=±25° would be the usual maximum scanned field). The field size is then approximately 2Ftanθ in both X and Y.

The approximation arises because:

1) it is usually desirable to have a deliberate *distortion characteristic* in the scanner lens design so that the field position is proportional to θ, not tanθ.
2) scanning in two axes produces a geometrical distortion which is unrelated to the lens properties.

Focused spot size

The lower limit on spot size 'd' ($1/e^2$ intensity diameter) for a laser beam of diameter 'D' ($1/e^2$) is:

d = 13.5QF/D μm

Example: A TEM_{00} beam (Q=1) of 13.5mm ($1/e^2$) diameter, focused by a perfect lens of 100mm focal length, will form a focused spot of 100μm diameter. (Taking a more realistic value of Q=1.5, the spot size would be 150μm).

Beam clipping and optical aberrations can lead to focused spot sizes which are larger than the minimum *diffraction limited* value found from the equation above.

Large field sizes demand the use of lenses of long focal length. In turn, this leads to increased focused spot size unless the beam diameter, mirror sizes, and lens diameter are all increased.

Spot sizes are given in the form of an average spot size over the whole, maximum, field-of-scan. A second figure, the standard deviation from average spot size, gives a measure of variation of the spot size to be expected over the field.

Beam clipping

The physical aperture of a laser scanner is often limited by a circular aperture of the scanner head, of diameter 'A' mm, say.

Beam clipping can occur at a circular aperture, even for a well-centred beam, when the 'tails' of the beam energy distribution is blocked by the metalwork. The percentage power loss at a circular aperture, for a TEM_{00} beam (Q=1) is shown in the following table:

Table: Power Loss

A/D	0.8	1	1.2	1.4	1.6	1.8	2
Loss %	27.8	13.5	5.6	1.98	0.6	0.15	0.03

The table indicates that, where the physical aperture of the scanner is limited to A mm diameter, the laser beam diameter D ($1/e^2$) must be selected by a compromise between reduced spot size and power loss due to beam clipping. A value of D = A/1.4 would probably be acceptable for most laser scanner systems. Power loss due to beam clipping increases for de-centred beams.

Mirror design

Mirror (1) (or called Scan Mirror X)

The width of mirror (1) is determined by the beam diameter. It is easier to discuss this in terms of a 'full beam diameter' D_F, where the definition of full diameter is, to some extent, arbitrary.

For example, a system designer might define D_F as the measured diameter of a beam print in perspex [plexiglass]. Alternatively, D_F may be the measured 99% power points, or perhaps a value chosen in the range 1.4D to 1.6D.

The mirror width W1 is slightly larger than the selected value of D_F, sufficient to allow for minor misalignment. The length of mirror (1) is determined by the maximum angle of incidence i_{max} on the mirror. Let $\alpha = (90° - i_{max})$. Then the mirror length is L1, where $L1 = W1/\sin\alpha$. The large shape 'chamfers' on scanner mirrors are determined by the separation, S1, between mirrors (1) and (2); the scan angles, and the need that the mirrors should not collide during scanning.

Mirror (2) (or called Scan Mirror Y)

The width of mirror (2), W2, should be identical to the length of mirror (1). The length, L2, of mirror (2) is found from projection of the beam onto the second mirror at a distance of S1, and at maximum scan angle θ. These mirrors are built and coated *specifically for use with CO2 or YAG lasers*. They have a very high laser damage threshold, measured at 1000W/mm of $1/e^2$ beam diameter (D).

F-theta characteristic

Lenses described as being ‘F-theta’, or ‘Fθ’, type are designed so as to produce an off-axis spot at a location proportional to the scan angle. In turn, this may be directly proportional to a voltage applied to the galvo scanner motor. (A lens with zero distortion would form a spot at a field location of Ftanθ). No 2-axis galvo scanner can have a true F-theta characteristic, due to distortion from use of two mirrors. Single-element lenses are designed to be the best compromise between smallest spot size and F-theta characteristic. Errors in F-theta characteristic are usually 2% - 3% for these single element lenses. Multi-element lenses allow design freedom enabling a closer approach to F-theta performance. Fθ errors <0.36% are typical for this range, with only the 75mm FL type having a slightly greater value.

Lens design

All scanning lens designs are based on factors described above. For typical small scanner systems, limited to perhaps 10mm or 15mm full beam diameter, lenses of 48mm diameter have been found to be suitable. For 15mm beams, this lens size is only possible by minimizing the distances S1 and M2L. Each class of lens is designed for use with a specific range of beam diameters, and, more importantly, *for a specific set of values S1 and M2L.*

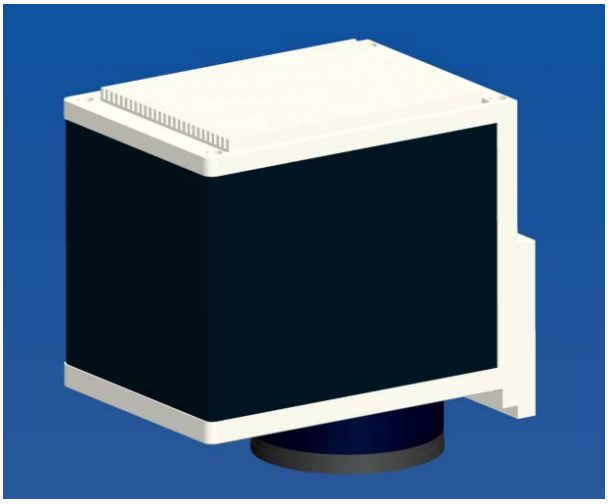
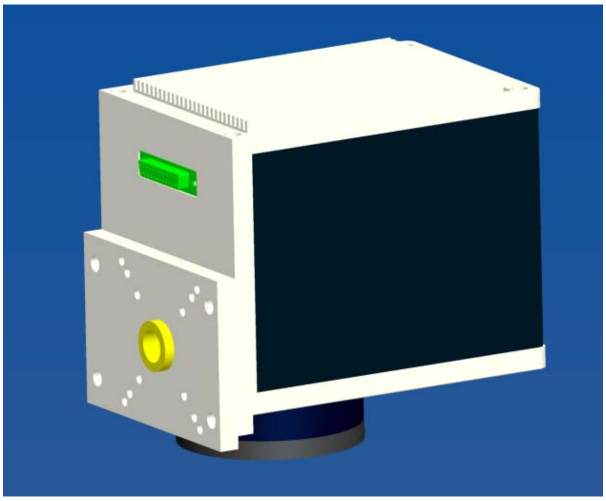
In each case the lens is designed to provide the best compromise performance for flat field, spot size and F-theta characteristic for the specified beam diameter and mirror locations, while avoiding beam-clipping at the lens mount.

For certain (longer focal length, single-element) lenses it is possible to obtain an improvement in performance by increasing the distance M2L. This necessitates the design/use of lenses of larger diameter (to avoid beam clipping).

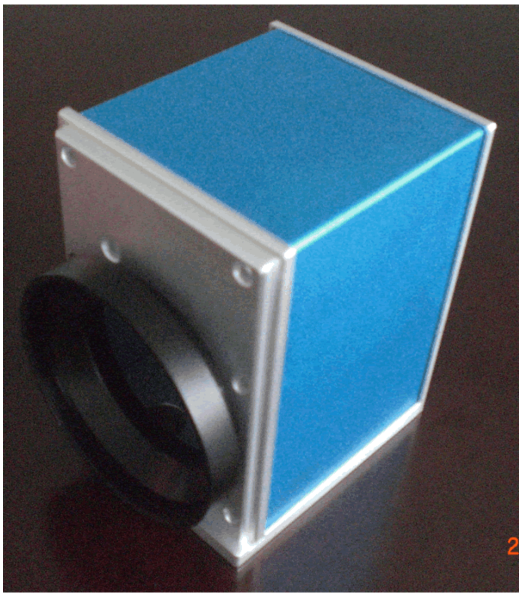
Marking software

The Window-based marking software supports various fonts, pictures (PLT, DXF, BMP), automated series numbers, barcodes & DataMatrix. The users can easily use AutoCAD or CorelDraw to design their patterns. They also can scan photos or logos and then use marking software to mark.

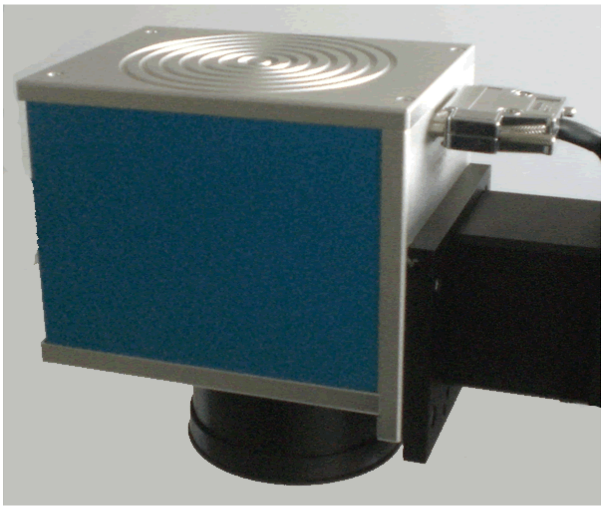
Options
Beam expander

LSCT and LSSH series marking heads

LSST series marking heads



LSST series marking heads

Description of Part Number: LSCT-xxxx-yy-zzz-AAAA
LSCT, LSSH or SST: LSCT, LSSH or LSST series marking heads. The galvos in their marking heads are different.
xxxx: laser wavelength.
yy: maximum input laser beam diameter.
zzz: marking field, which depends on the used f-theta lens.
AAAA: galvo model number or other remarks

CO2 laser marking heads at 10.6um

Part number	Wave-length um	Max input beam dia. mm	Mark area mm	Focused beam dia. um	Model of galvo	Dimension （LxWxH,mm）
LSST-10.6-08-105-8161	10.6	8	105x105	171	OSST8161	128X98X92
LSST-10.6-10-105-8161	10.6	10	105x105	171	OSST8161	128X98X92
LSST-10.6-12-105-8062	10.6	12	105x105	171	OSST8062	155X118X128
LSST-10.6-15-105-8061	10.6	15	105x105	171	OSST8061	180X145X148
LSST-10.6-20-105-8061	10.6	20	105x105	171	OSST8061	180X145X148
LSST-10.6-25-105-3808	10.6	25	105x105	171	OSST3808	205X162X178
LSCT-10.6-12-105-6231	10.6	12	105x105	171	6231	184x176x124
LSSH-10.6-10-105-22	10.6	10	105x105	171	OSSH22	175x166x124
LSSH-10.6-12-105-28	10.6	12	105x105	171	OSSH28	184x176x124
LSSH-10.6-16-105-28	10.6	16	105x105	171	OSSH28	194x140x168

F-theta lens STSL-10.6-150-105 is used in above specifications.

Nd:YAG laser and fiber laser marking heads at 1064nm

Part number	Wave-length um	Max input beam dia. mm	Mark area mm	Focused beam dia. um	Model of galvo	Dimension （LxWxH,mm）
LSST-1064-08-110-8161	1064	8	110x110	18	OSST8161	128X98X92
LSST-1064-10-110-8161	1064	10	110x110	18	OSST8161	128X98X92
LSST-1064-12-110-8062	1064	12	110x110	18	OSST8062	155X118X128
LSST-1064-16-110-8061	1064	16	110x110	18	OSST8061	180X145X148
LSST-1064-20-110-8061	1064	20	110x110	18	OSST8061	180X145X148
LSST-1064-25-110-3808	1064	25	110x110	18	OSST3808	205X162X178
LSST-1064-32-110-3808	1064	32	110x110	18	OSST3808	205X162X178
LSCT-1064-12-110-6231	1064	12	110x110	170	6231	184x176x124
LSSH-1064-10-110-22	1064	10	110x110	170	OSSH22	175x166x124
LSSH-1064-12-110-28	1064	12	110x110	170	OSSH28	184x176x124
LSSH-1064-16-110-28	1064	20	110x110	170	OSSH28	194x140x168

F-theta lens STY110 is used in above specifications.

Nd:YAG laser marking heads at 532nm

Part number	Wave-length um	Max input beam dia. mm	Mark area mm	Focused beam dia. um	Model of galvo	Dimension （LxWxH,mm）
LSST-532-08-110-8161	532	8	110x110	15	OSST8161	128X98X92
LSST-532-10-110-8161	532	10	110x110	15	OSST8161	128X98X92
LSST-532-12-110-8062	532	12	110x110	15	OSST8062	155X118X128
LSST-532-16-110-8061	532	16	110x110	15	OSST8061	180X145X148
LSST-532-20-110-8061	532	20	110x110	15	OSST8061	180X145X148
LSCT-532-12-110-6231	532	12	110x110	15	6231	184x176x124
LSSH-532-10-110-22	532	10	110x110	15	OSSH22	175x166x124
LSSH-532-12-110-28	532	12	110x110	15	OSSH28	184x176x124
LSSH-532-16-110-28	532	16	110x110	15	OSSH28	194x140x168

F-theta lens STY-532-110 is used in above specifications.

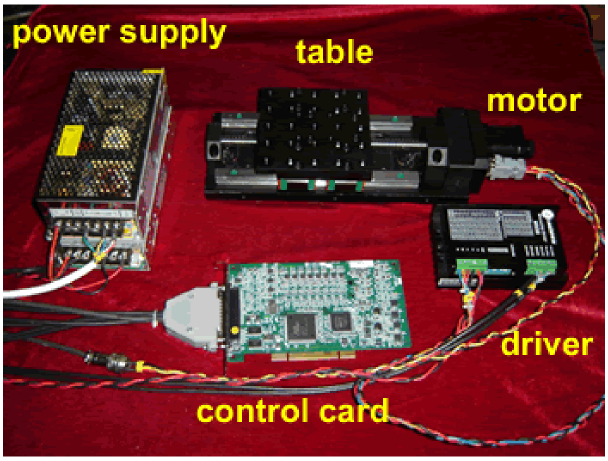
Remark:

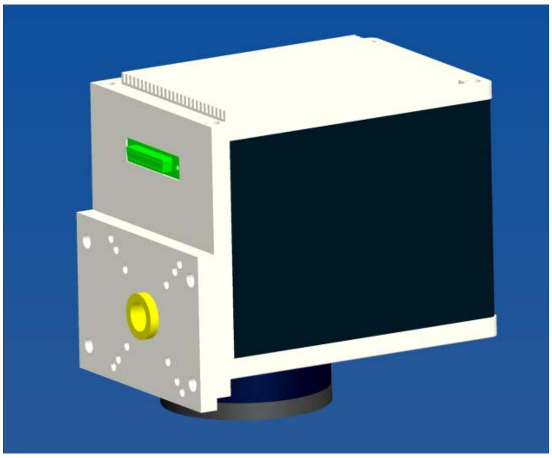
- The marking field of our standard marking head is 105x105mm (CO2 laser) or 110x110mm (Nd:YAG laser). Other mark fields are available upon request. In fact, the marking field depends on the f-theta lens. Thus you may prepare a few f-theta lenses with different marking fields for your various applications.
- The focused beam diameter is theoretical calculation for reference only and actual focused beam diameter depends on beam expander, f-theta lens and laser.
- The DC power supply for the above marking heads is DCSH-150-24-2 (+/-24VDC).

In order to meet the experienced customers' requirement on cost, we also supply BASIC laser marking head which just includes the basic parts such as galvanometers and drivers, scan mirrors, DC power supply and all mechanical parts. BASIC marking heads are integrated and aligned for use. The model numbers will be LSCT-xxxx-yy-AAAA-BASIC or LSST-xxxx-yy-AAAA-BASIC.

3D Laser Engraving Head

We can provide OEMs and system integrators with a range of high performance components and sub-assemblies of 3D laser engraving heads at more attractive prices. The engraving head includes a control card, a table with driver, a 2D marking head and DC power supplies.





The control card is used to control the table (step motor), position limits of the table, marking head and laser beam on/off. It is inserted onto the mother board of a computer. The drive software and laser engraving software comes with the control card.

The dimension of the table is 365x120x55mm. The length of the screw is 230mm and the travel range is 120mm. There is a position limit on both ends. The signals are given via DB9.