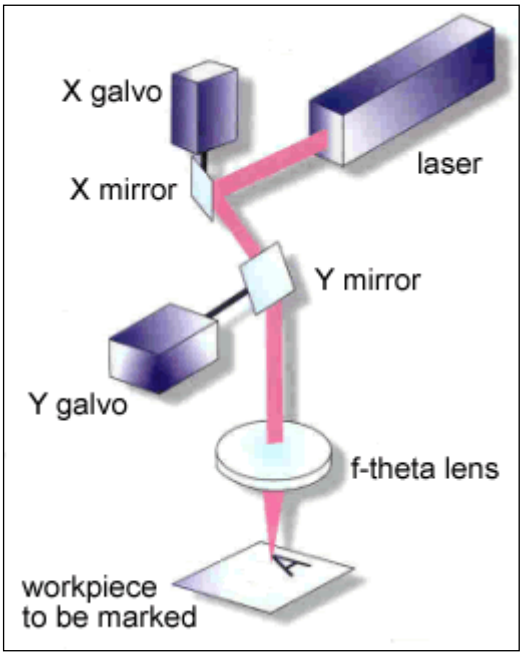
Sintec Optronics

Laser Marking Heads (Laser Scanners, Scan Heads)

A whole laser marking head (or called laser scanner) consists of two scan mirrors, two galvanometers (or called galvo-scanner motor) & drive cards (or called driver), a XY mount, a scanning lens (f-theta lens), a control card (or called marking card), optional D/A card, a set of marking software and a DC power supply.

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 $\tan\theta$.
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:

$d = 13.5QF/D\ \mu m$

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.

How to Properly Select Marking Head, Beam Expander, Scan Mirror, F-theta Lens and Laser

Here laser beam diameter is D1, beam diameter after beam expander is D2, beam expansion ratio is T, maximum allowed input beam diameter of scan mirrors is D3, maximum allowed input beam diameter of marking head is D4, Entrance pupil of f-theta lens is EP.

$D3 \geq D1 * T$ or $D4 \geq D1 * T$ or $EP \geq D1 * T$

Marking field is proportional to focal length (or working distance) and focused beam diameter is also proportional to focal length (or working distance).

Part Number Description of Marking Heads

Part Number: LSxx-xxxx-yy-AAAA
LSxx: laser scanner. xx means series marking heads such as SL, JC & RM.
xxxx: laser wavelength.

yy: maximum input laser beam diameter.
AAAA: notes or remarks

2D Marking Heads

Part number	Max entrance dia. mm	DC power supply, V	Dimension LxWxH,mm	Weight
LSSL-xxxx-7-XS	7	15	79x69x78	0.65
LSSL-xxxx-10-S	10	15	115x97x94	1.9
LSSL-xxxx-14-M	14	15	134x100x106	2.3
LSSL-xxxx-10-BC10	10	15	106x91x91	1.5
LSSL-xxxx-14-BC14	14	24/30	134x100x105	2.15
LSSL-xxxx-10-HS-10	10	15	165x118x147	3.0
LSSL-xxxx-20-HS-20	20	15	207x240x280	5.8
LSSL-xxxx-25-HS-25	25	15	207x240x280	5.8
LSSL-xxxx-30-HS-30	30	15	207x240x280	5.8
LSSL-xxxx-7-HSII-7	7	15	165x118x147	3.0
LSSL-xxxx-10-HSII-10	10	15	165x118x147	3.0
LSSL-xxxx-14-HSII-14	14	15	165x118x147	3.0
LSSL-xxxx-10-HSIII-10	10	15	165x118x147	3.0
LSSL-xxxx-14-HSIII-14	14	15	165x118x147	3.0
LSRM-xxxx-10-A10	10	15	114x97x94	
LSRM-xxxx-10-Q10	10	15	114x97x94	
LSRM-xxxx-12-Q12	12	15	114x97x94	
LSRM-xxxx-14-Q14	14	15	134x109x107	
LSRM-xxxx-20-Q20	20	15	170x150x140	
LSRM-xxxx-30-Q30	30	15	195x150x165	
LSRM-xxxx-50-Q50	50	15	246x202x168	
LSST-xxxx-5-8166	5	15	70x55x50	0.6
LSST-xxxx-10-8161	10	15	116x96x96	1.6
LSST- xxxx -12-8063	12	15	120x106x100	2.3
LSST- xxxx -20-8061	20	24	180x146x148	3.2
LSST- xxxx -25-3808	25	24	210x161x172	5.1
LSST- xxxx -32-3808	32	24	210x161x172	5.1
LSJC-xxxx-7-1105	7	15	80x69x80	
LSJC-xxxx-9- 1403	9	15	100x77x77.5	
LSJC-xxxx-10- 2206	10	15	118.5x96.5x94.1	
LSJC-xxxx-10- 7110	10	15	118.5x96.5x93.6	
LSJC-xxxx-10-7106	10	15	118.5x96.5x94.3	
LSJC-xxxx-10- 7210	10	15	100x77x77.5	
LSJC-xxxx-10- 7220	10	15	118.5×96.5×97.7	
LSJC-xxxx-10- 7310	10	15	118.5x96.5x93.6	
LSJC-xxxx-12- 2207	12	15	121x98x106	
LSJC-xxxx-14- 2208	14	15	126x98x105	
LSJC-xxxx-16-2807	16	24	186x145x156	
LSJC-xxxx-20-2808	20	24	186x145x156	
LSJC-xxxx-20-8220	20	24	186x145x156	
LSJC-xxxx-25-3808	25	24	215x158x183	
LSJC-xxxx-30-3808	30	24	215x158x183	
LSJC-xxxx-30-8330	30	24	215x158x183	
LSJC-xxxx-32-3808	32	24	215x158x183	
LSJC-xxxx-50-8250	50	24		

Remarks: All above marking heads can be controlled via analog or XY2-100 and the default is XY2-100.

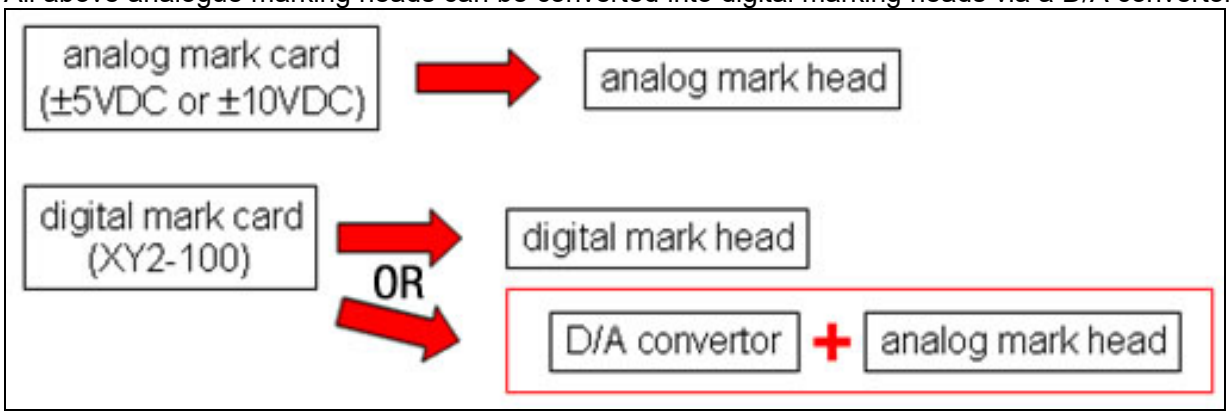
3D Marking Heads

Part number	Max entrance dia. mm	Control	DC power supply, V	Dimension LxWxH,mm	Weight kg
LSRM-1064-6-QPT	6	XY2-100	15	254x97x105	
LSRM-1064-7.2-QPT	7.2	XY2-100	15	254x97x105	
LSRM-1064-8.4-QPT	8.4	XY2-100	15	254x97x105	
LSRM-532-3.3-QPT	3.3	XY2-100	15	274x109x116	
LSRM-532-4-QPT	4	XY2-100	15	274x109x116	
LSRM-532-4.6-QPT	4.6	XY2-100	15	274x109x116	
LSRM-xxxx-QP20		XY2-100	15	350x140x188	
LSRM-xxxx-QP30		XY2-100	15	400x155x194	
LSJC-1064-3D7210-300	10	XY2-100	24		
LSJC-355-3D7210-200	10	XY2-100	24		
LSJC-1064-3D8220-500	20	XY2-100	24		
LSJC-10.6-3D8230-300	30	XY2-100	24		
LSJC-10.6-3D8330-1200	30	XY2-100	24	557x158x188	
LSSL-xxxx-14-excelliSHIFT	14	XY2-100	15	115x160x142	3.7

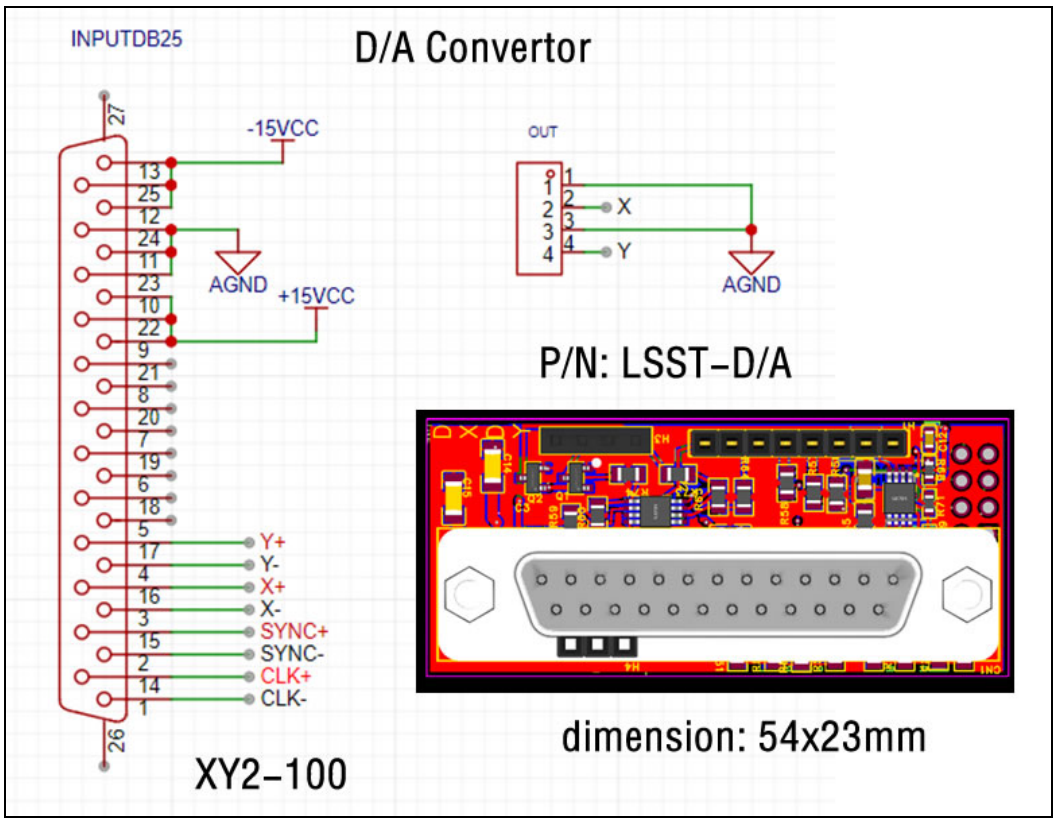
All above marking heads can operate at 1064nm, 532nm, 355nm, 266nm or 10.6um wavelength. Other wavelengths and entrance diameters available upon request. Please contact us for more information.

Remark:

- The marking field of marking head depends on the f-theta lens. In general, it is 105x105mm (CO2 laser) or 110x110mm (Nd:YAG or fiber laser). Other mark fields are available upon request. In order to have best marking result, you may prepare a few f-theta lenses with different mark fields for your various applications.
- The focused beam diameter depends on the optical system such as beam expander and f-theta lens, laser beam parameter such as beam diameter and beam divergence angle, and marking parameters such as marking speed and material.
- All above analogue marking heads can be converted into digital marking heads via a D/A convertor.



Our D/A convertor is shown as follows:


INPUTDB25
D/A Convertor
-15VCC
AGND
+15VCC
OUT
X
Y
AGND
P/N: LSST-D/A
Y+
Y-
X+
X-
SYNC+
SYNC-
CLK+
CLK-
XY2-100
dimension: 54x23mm

LSST Series Laser Marking Heads

Fast speed, High accuracy & Low pricing!

Description of Part Number: LSST-xxxx-yy-zzz-AAAA
LSST:LSST series laser scanners.
xxxx: laser wavelength such as 10.6um, 1064nm, 532nm, 355nm etc.
yy: maximum input laser beam diameter.
AAAA: galvo model number

Part number	Max input beam dia. mm	DC power supply ±V	Control	Dimension LxWxH mm	Weight kg	Galvo
LSST-xxxx-5-8166	5	15	XY-100	70x55x50	0.6	8166
LSST-xxxx-10-8161	10	15	XY-100	116x96x96	1.6	8161
LSST- xxxx -12-8063	12	15	XY-100	120x106x100	2.3	8063
LSST- xxxx -20-8061	20	24	XY-100	180x146x148	3.2	8061
LSST- xxxx -25-3808	25	24	XY-100	210x161x172	5.1	3808
LSST- xxxx -32-3808	32	24	XY-100	210x161x172	5.2	3808

Part number	**LSST-xxxx-5-8166**	**LSST-xxxx-10-8161**
Optical apertures supported, two-axis	≤5mm	≤10mm
Positioning speed	10m/sec	10m/sec
Marking speed		
Good quality (1mm height)	1000cps	600cps
High quality (1mm height)	600cps	450cps
Response time	0.3ms at 5mm beam	0.45ms at 10mm beam
Max mechanical rotation angle	±20°	±20°

Linearity	99.9% over ±20°	99.9%, over ±20°
Operation temp	0-40 ℃	0-40 ℃
DC power input	±15V, 60W	±15V, 60W
Weight	0.6kg	1.6Kg
Dimension	70x55x50mm	116x96x96mm

.

Part number	**LSST-xxxx-12-8063**	**LSST-xxxx-20-8061**	**LSST-xxxx-25-3808**
Optical apertures supported, two-axis	≤12mm	≤20mm	≤25mm
Positioning speed	10m/sec	10m/sec	10m/sec
Marking speed			
Good quality (1mm height)	800cps	600cps	500cps
High quality (1mm height)	450cps	350cps	450cps
Response time	0.6ms at 12mm beam	0.7ms at 20mm beam	1ms at 25mm beam
Max mechanical rotation angle	±20°	±20°	±20°
Linearity	99.9%, over ±20°	99.9% over ±20°	99.9% over ±20°
Operation temp	0-40 ℃	0-40 ℃	0-40 ℃
DC power input	±15V, 60W	±24V, 200W	±24V, 200W
Weight	2.3kg	3.2kg	5.1kg
Dimension	120x106x100mm	180x146x148mm	210x161x172mm

Part number	**LSST-xxxx-30-3808**	**LSST-xxxx-32-3808**	
Optical apertures supported, two-axis	≤30mm	≤32mm	
Positioning speed	7m/sec	7m/sec	
Marking speed			
Good quality (1mm height)	400cps	400cps	
High quality (1mm height)	350cps	350cps	
Response time	1ms at 30mm beam	1ms at 32mm beam	
Max mechanical rotation angle	±20°	±20°	
Linearity	99.9% over ±20°	99.9% over ±20°	
Operation temp	0-40 ℃	0-40 ℃	
DC power input	±24V, 200W	±24V, 200W	
Weight	5.2kg	5.2g	
Dimension	210x161x172mm	210x161x172mm	

Remark:

- Positioning and marking speeds are with f-theta lens f=160mm and for single-stroke character of 1mm height
- Default control is digital XY-100 and the analog control is available upon request.
- The DC power supply is provided with match of the marking head needed.
- The f-theta and beam expander are available upon request.

LSJC Series Laser Marking Heads

Fast speed, High accuracy & Low pricing!

Our optical galvanometers are designed by adopting the magnet-moving structure, combining the most advanced international photoelectric sensor technology and the PDM control mode, and using the high-grade processes and technologies.

Our marking heads have the good running stability, high positioning accuracy, fast marking speed, and strong anti-interference ability. Their overall performance has reached the international leading level in this field. The advantages are as follows:

- Adopted the photoelectric sensors imported from America, and owned the proprietary intellectual property rights.
- Differential photoelectric sensor for accurate detection of motor rotor position, good linearity, low drift, high resolution and repeated positioning.
- Accurate load design for various mirrors with high accuracy of motor assembly, reasonable structure, very small static friction coefficient and zero offset, which ensures the best dynamic characteristics for the whole system.
- Drivers with advanced detection ability of position and speed, greatly improving the dynamic response performance and scanning speed of the whole system.
- Design of overload, over-current and reverse connect protection, makes the system running more reliable.
- Design with electromagnetic compatibility, high signal-to-noise ratio and strong anti-interference ability.

List of 2D Marking Heads

Part number	Max entrance dia. mm	DC power supply, V	Dimension LxWxH,mm
LSJC-xxxx-7-1105	7	15	80x69x80
LSJC-xxxx-9- 1403	9	15	100x77x77.5
LSJC-xxxx-10- 2206	10	15	118.5x96.5x94.1
LSJC-xxxx-10- 7110	10	15	118.5x96.5x93.6
LSJC-xxxx-10-7106	10	15	118.5x96.5x94.3
LSJC-xxxx-10- 7210	10	15	100x77x77.5
LSJC-xxxx-10- 7220	10	15	118.5×96.5×97.7
LSJC-xxxx-10- 7310	10	15	118.5x96.5x93.6
LSJC-xxxx-12- 2207	12	15	121x98x106
LSJC-xxxx-14- 2208	14	15	126x98x105
LSJC-xxxx-16-2807	16	24	186x145x156
LSJC-xxxx-20-2808	20	24	186x145x156
LSJC-xxxx-20-8220	20	24	186x145x156
LSJC-xxxx-25-3808	25	24	215x158x183

LSJC-xxxx-30-3808	30	24	215x158x183
LSJC-xxxx-30-8330	30	24	215x158x183
LSJC-xxxx-32-3808	32	24	215x158x183
LSJC-xxxx-50-8250	50	24	

List of 3D Marking Heads

Part number	Max entrance dia. mm	DC power supply, V	Dimension LxWxH,mm
LSJC-xxxx-3D7210	10	24	
LSJC-xxxx-3D2207	12	24	262x110x110
LSJC-xxxx-3D8220	20	24	
LSJC-xxxx-3D8230	30	24	556.3x176x158
LSJC-xxxx-3D8330	30	24	

Detailed Specifications

Part Number	**LSJC-xxxx-7-1105**	**LSJC-xxxx-9-1403**	**LSJC-xxxx-10-2206**
Input Aperture	7mm	9mm	10mm
Linearity	99.9%	99.9%	99.9%
Small step response time	0.3ms	0.3ms	0.35ms
Maximum Scan Angle	±15°	±15°	±11°
Resolution	12μrad	12μrad	12μrad
Repeatability	8μrad	8μrad	8μrad
Working Temperature	0-45℃	0-45℃	0-45℃
Storage Temperature	-10 to +60℃	-10 to +60℃	-10 to +60℃
Input Voltage	±15VDC	±15VDC	±15VDC
Interface Signal Digital	XY2-100	XY2-100	XY2-100
Mount Thread	M55x1	M55x1	M79x1
Dimension(L×W×H)	80x69x80	100x77x77.5	118.5x96.5x94.1

Part Number	**LSJC-xxxx-10-7106**	**LSJC-xxxx-10-7110**	**LSJC-xxxx-10-7210**	**LSJC-xxxx-10-7220**
Input Aperture	10mm	10mm	10mm	10mm
Linearity	99.9%	99.9%	99.9%	99.9%
Small step response time	0.288ms	0.5ms	0.3ms	0.26ms
Maximum Scan Angle	±15°	±15°	±15°	±15°
Resolution	12μrad	12μrad	12μrad	12μrad
Repeatability	8μrad	8μrad	8μrad	8μrad
Working Temperature	0-45℃	0-45℃	0-45℃	0-45℃
Storage Temperature	-10 to +60℃	-10 to +60℃	-10 to +60℃	-10 to +60℃
Input Voltage	±15VDC	±15VDC	±15VDC	±15VDC
Interface Signal Digital	XY2-100	XY2-100	XY2-100	XY2-100
Mount Thread	M79x1	M79x1	M79x1	M79x1
Dimension(L×W×H)	118.5x96.5x94.3	118.5x96.5x93.6	114x96.5x93.7	118.5x96.5x97.7

Part Number	**LSJC-xxxx-10-7310**	**LSJC-xxxx-12-2207**	**LSJC-xxxx-14-2208**
Input Aperture	10mm	12mm	14mm
Linearity	99.9%	99.9%	99.9%
Small step response time	0.5ms	0.45ms	0.6ms
Maximum Scan Angle	±15°	±15°	±15°
Resolution	12μrad	12μrad	12μrad
Repeatability	8μrad	8μrad	8μrad
Working Temperature	0-45℃	0-45℃	0-45℃
Storage Temperature	-10 to +60℃	-10 to +60℃	-10 to +60℃
Input Voltage	±15VDC	±15VDC	±15VDC
Interface Signal Digital	XY2-100	XY2-100	XY2-100
Mount Thread	M79x1	M79x1	M85x1
Dimension(L×W×H)	118.5x96.5x93.6	121x98x106	126x98x105

Part Number	LSJC-xxxx-16-2807	LSJC-xxxx-20-2808	LSJC-xxxx-20- 8220
Input Aperture	16mm	20mm	20mm
Linearity	99.9%	99.9%	99.9%
Small step response time	1ms	1.2ms	0.8ms
Maximum Scan Angle	±15°	±15°	±15°
Resolution	12μrad	12μrad	12μrad
Repeatability	8μrad	8μrad	8μrad
Working Temperature	0-45℃	0-45℃	0-45℃
Storage Temperature	-10 to +60℃	-10 to +60℃	-10 to +60℃
Input Voltage	±24VDC	±24VDC	±24VDC
Interface Signal Digital	XY2-100	XY2-100	XY2-100
Mount Thread	M79x1	M85x1	M85x1
Dimension(L×W×H)	186x145x156	121x98x106	186x145x156

Part Number	LSJC-xxxx-30-3808	LSJC-xxxx-30-8330	LSJC-xxxx-50-8250
Input Aperture	30mm	30mm	50mm
Linearity	99.9%	99.9%	99.9%
Small step response time	1.6ms	1.2ms	2.5ms
Maximum Scan Angle	±15°	±15°	±15°
Resolution	12μrad	12μrad	12μrad
Repeatability	8μrad	8μrad	8μrad
Working Temperature	0-45℃	0-45℃	0-45℃
Storage Temperature	-10 to +60℃	-10 to +60℃	-10 to +60℃
Input Voltage	±24VDC	±24VDC	±24VDC
Interface Signal Digital	XY2-100	XY2-100	XY2-100
Mount Thread	M95x1	M95x1	
Dimension(L×W×H)	215x158x183	215x158x183	

3D Marking Heads

Part Number	LSJC-1064-10-3D7210-300	LSJC-355-10-3D7210-200	LSJC-xxxx-12-3D2207
Input Aperture	10mm	10mm	12mm
Mark field	300x300mm	200x200mm	
Linearity	99.9%	99.9%	99.9%
Small step response time	0.3ms	0.3ms	0.45ms
Maximum Scan Angle	±15°	±15°	±15°
Resolution	12μrad	12μrad	12μrad
Repeatability	8μrad	8μrad	8μrad
Working Temperature	0-45℃	0-45℃	0-45℃
Storage Temperature	-10 to +60℃	-10 to +60℃	-10 to +60℃
Input Voltage	±24VDC	±24VDC	±24VDC
Interface Signal Digital	XY2-100	XY2-100	XY2-100
Dimension(L×W×H)			262x110x110

Part Number	LSJC-1064-20-3D8220-500	LSJC-10.6-30-3D8230-300	LSJC-10.6-30-3D8330-1200
Input Aperture	20mm	30mm	30mm
Mark field	500x500mm	300x300mm	1200x1200mm
Linearity	99.9%	99.9%	99.9%
Small step response time	0.8ms	1.2ms	1.2ms
Maximum Scan Angle	±15°	±15°	±15°
Resolution	12μrad	12μrad	12μrad
Repeatability	8μrad	8μrad	8μrad
Working Temperature	0-45℃	0-45℃	0-45℃
Storage Temperature	-10 to +60℃	-10 to +60℃	-10 to +60℃
Input Voltage	±24VDC	±15VDC	±15VDC
Interface Signal Digital	XY2-100	XY2-100	XY2-100
Dimension(L×W×H)		556.3x176x158	

LSSL Series Laser Marking Heads

Portable size, Fast speed, High accuracy

1. LSSL-BC Series Marking Heads

Our LSSL-BC series scan heads are the ideal entry-level 2D scan systems for deflecting and positioning laser beams in the working plane. The scan heads offers superior cost effectiveness and is optimized for coding and marking.

Features:

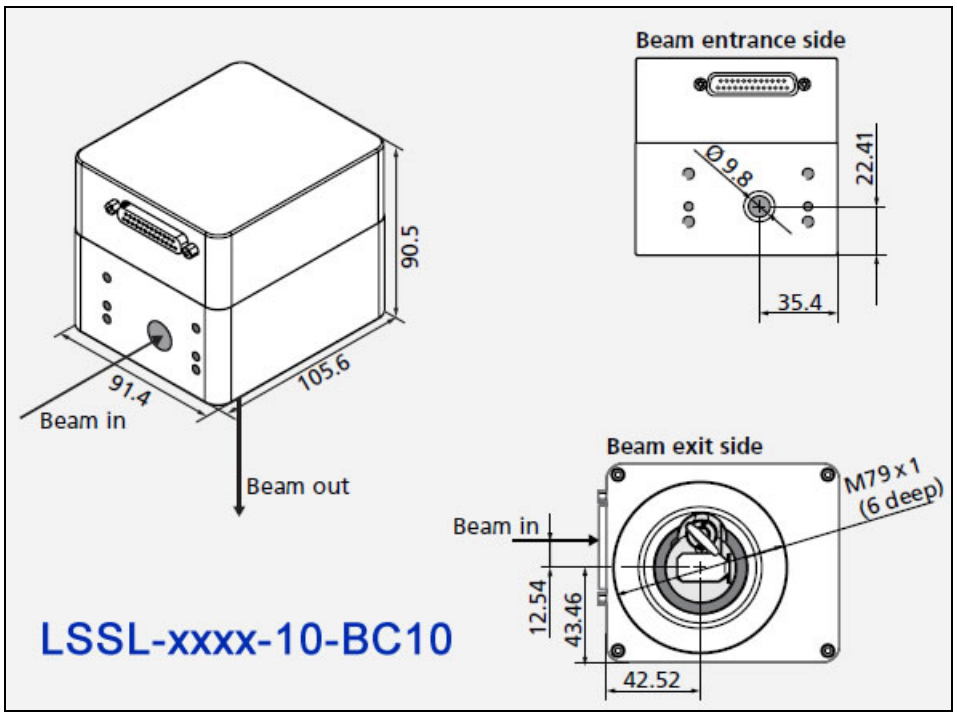
- Compact & light-weight design
- Very fast writing speed
- Excellent price/performance ratio

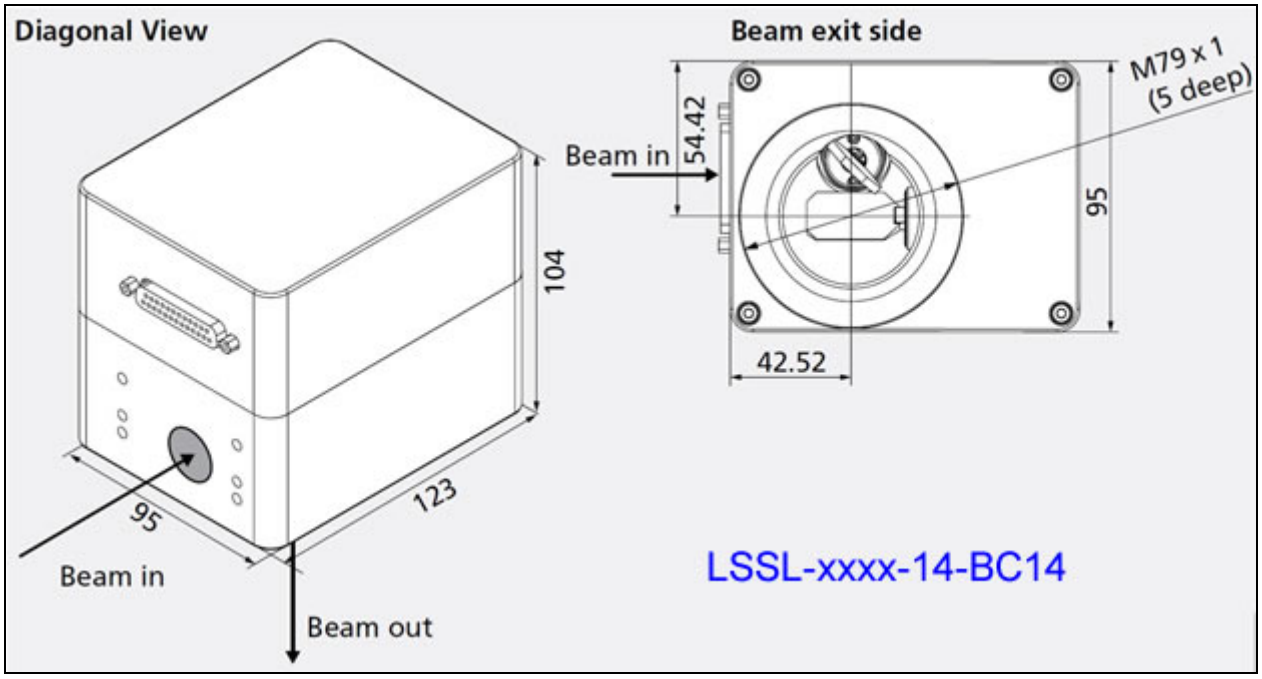
Specifications:

Model	LSSL-xxxx-10-BC10	LSSL-xxxx-14-BC14
Aperture (mm)	10	14
Tracking error (ms)	0.14	0.18
Marking speed(1) (m/s)	2.5	2.0
Positioning speed (m/s)	12.0	12.8
Step response time(2) - 1% of full scale (ms)	0.35	0.45
Step response time - 10% of full scale (ms)	1.0	1.4
Typical scan angle (rad)	±0.35	
Gain error (mrad)	<5	
Zero offset (mrad)	<5	
Power supply	±15 V DC, max. 3 A each	24 V / 30 V DC, max. 3 A each
Interface (digital)	SL2-100, XY2-100	
IP protection class	IP 50	
Operating temperature(°C)	25 ± 10	
Repeatability – RMS (µrad)	<2.0	
Positioning resolution(3) (bit)	16	
Nonlinerity	< 3.5 mrad / 44°	
Temperature drift – offset (µrad/K)	<30	
Temperature drift – gain (ppm/K)	<160	
8h drift – offset (µrad)	<100	
8h drift – gain (ppm)	<250	
Beam displacement (mm)	12.54	16.42
Dimension (mm)	106x91x91	123x95x104
Weight (kg)	1.5	2.15

(1) With F-theta lens, f = 160mm;
(2) Setting to 1/1000 of full scale;
(3) Based on the full angle range (e.g. positioning resolution 11 µrad for angle range ±0.36 rad)

Dimensions (mm):





Options:

- Coatings for the following wavelengths: LSSL-BC10: 355nm, 532nm, 1064nm and 10600nm; LSSL-BC14: 1064nm and 10600nm.
- Suitable f-theta lenses available for various scan fields and focal lengths.
- Extension into a 3-axis scan system.

2. LSSL-SC Series Marking Heads

Typical Fields of Application:
-> Marking in the packaging sector
-> Semiconductor industry
-> Electronics industry

LSSL SC series laser marking head is an ultra-compact one which delivers excellent dynamics and superior product quality in a minimum-size package. The solid performance of the marking heads is made possible by the new, miniaturized servo amplifiers and industry-proven OSSL series galvanometer optical scanners. Aperture of 7, 10 and 14mm are available.

Sealed against water and dust, the LSSL robust and exceptionally compact housing facilitates straightforward integration into production environments-even confined, difficult to-access locations. A wide variety of objectives can be used with these scan heads.

Versions with analog or digital interfaces are available. The digital version can be simply controlled via a PCI interface board or PC-independent standalone board. LSSL scan heads are ideally suited for solutions requiring very high marking speeds and integration in confined spaces. Applications include coding in the packaging industry or the marking of electronic components – areas traditionally served by inkjet systems.

Optics
We precisely optimize and tune all optical components to one another to ensure maximum focus quality and stable process parameters. Optical components offered by us include exceptionally compact objectives, as well as objective adapters for standard objectives. Optics for various wavelengths, power densities, focal lengths and image fields are available.

Control
LSSL marking heads are equipped with either an analog or a digital standard interface accessible via a 25-pin D-SUB connector. They are easily controlled via PC interface board or the PC-independent standalone board from us.

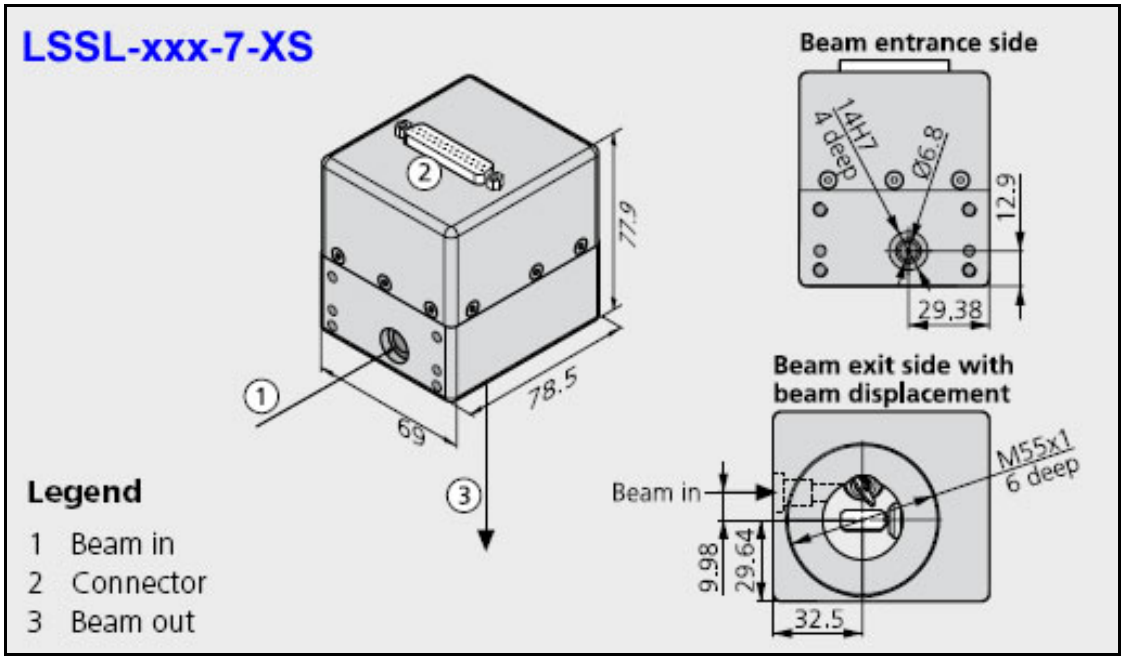
Quality
The high quality is the result of years of experience in the development and manufacture of galvanometer optical scanners and scan systems. In addition, every scan system must first pass the quality check burn-in test before it is released for shipment to the customer.

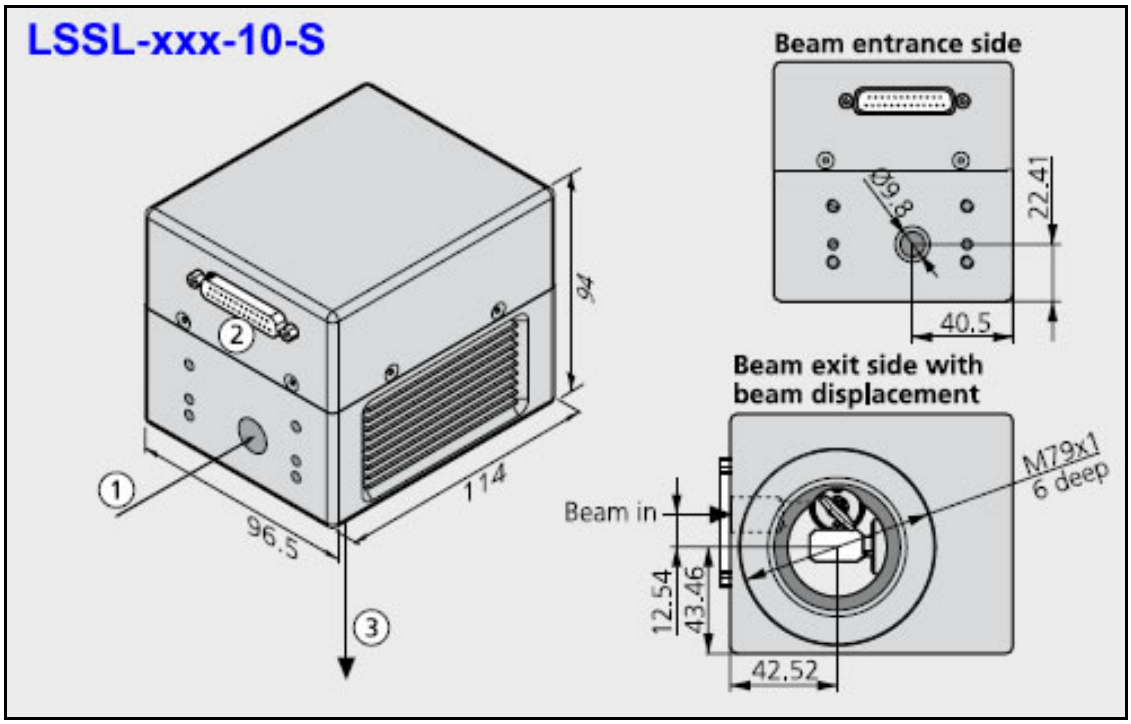
Common Specifications (all angles are in optical degrees)

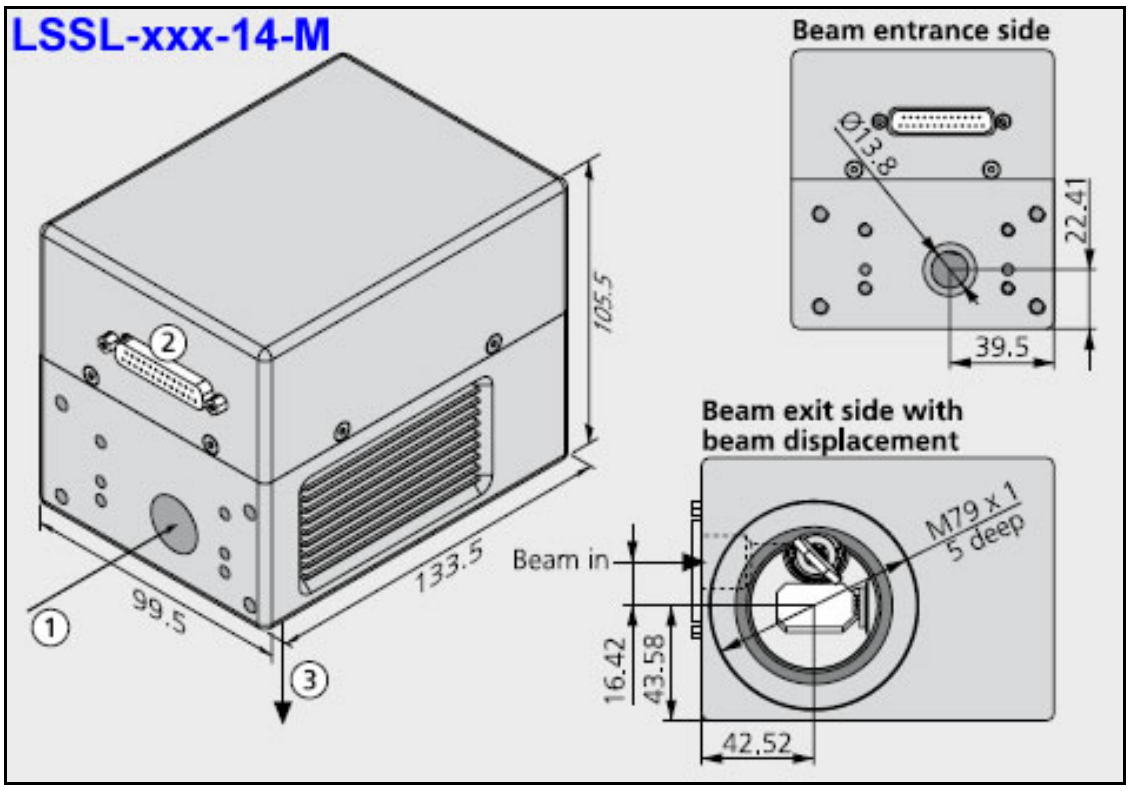
Dynamic Performance	Repeatability	< 22µrad
	Offset drift	30µrad/K
	Gain drift	80ppm/K
	Long-term drift over 8 hours	< 0.3mrad, plus temperature induced gain and offset drift
Optical Performance	Typical scan angle	±0.35rad
	Gain error	< 5mrad
	Zero offset	< 5mrad
	Nonlinearity	< 3.5mrad
Interface	Analog version	±4.8 V
	Digital version	XY2-100 standard
Operating Temperature		25 °C ± 10 °C

Product-Dependent Specifications (all angles are in optical degrees)

Part number	LSSL-xxx-7-XS	LSSL-xxx-10-S	LSSL-xxx-14-M
Aperture	7mm	10mm	14mm
Beam displacement	9.98mm	12.54mm	16.42mm
Dynamic Performance Tracking error	 0.14ms	 0.18ms	 0.30ms
Step Response Time (settling to 1/1000 of full scale) 1% of full scale 10% of full scale	 0.30ms 0.70ms	 0.40ms 1.2ms	 0.65ms 1.6ms
Typical speeds Marking speed Positioning speed Writing speed with good writing quality Writing speed with high writing quality	 2.5m/s 12.0m/s 900cps 600cps	 2.0m/s 7.0m/s 640cps 400cps	 1.0m/s 7.0m/s 410cps 280cps
Power Requirements	±15VDC max. 2A each	±15VDC max. 3A each	±15VDC max. 3A each
Dimension	79x69x78mm	114x97x94mm	134x100x106
Weight (without objective)	650g	1.9kg	2.3kg







3. LSSL-HS Series Marking Heads

These compact scan heads provide optimal solutions for nearly all challenges found in industrial laser materials processing. The mechanically and electrically inter-compatible scan heads have apertures ranging from 7 to 30 mm and various levels of dynamics. High long-term stability and low drift values are ensured via integrated temperature stabilization.

We have products for practically every customer needs. Small aperture systems optimally combine top speed and exceptional precision. Marking speeds exceeding 1000 characters per second can be achieved.

Also available are large-aperture scan heads offering small spot size, high speed and laser-power handling up to the multi-kilowatt range.

The housing concept as well as tight manufacturing and assembly tolerances bring high flexibility and certainty to the design and operation of laser materials processing systems. This also facilitates speedy adaptation to individual customer requirements. In conjunction with new electronics, these scanners deliver highest dynamic performance, lowest drift and best linearity.

Typical Applications:
• Materials processing
• Marking
• Micro-structuring
• Rapid manufacturing
• 3D applications
• Processing-on-the-fly

Optics
Scan mirrors and objectives with optimized mounts are available for all typical laser types and working fields. To optimally utilize standard objectives, LSSL-HS-25's two scan axes have differing maximum scan angles. This results in an elliptical image field with the larger semi-axis perpendicular to the entrance beam axis.

Control
All scan heads of these series are equipped with either analog or digital standard interfaces and are easily controlled via our control boards. All scan heads are optionally available with an optical fiber data interface.

Attachment Provisions
Threaded and non-threaded holes at the housing's beam entrance side of LSSL-HS-20, -25 and -30 facilitate mounting of the scan head and installation of fiber optic outputs. On the beam exit side, threaded holes are available for attaching add-on components such as cross jets, illumination, distance sensors or thermal shields.

Cooling
The LSSL-HS-20, -25 and -30 scan heads provide water-cooling connections for the entrance aperture, electronics and galvanometer scanners, along with air-cooling of the deflection mirrors. This ensures constant working conditions and excellent long-term stability, thus guaranteeing reliable operation even in high-laser-power applications.

Options
• Upgrade to a 3-axis scan system
• High-performance variants with lightweight mirrors (14 mm apertures and higher)
• Available as a scan module without housing (except LSSL-HS-30)
• Water and air cooling (10 mm apertures and higher; standard for LSSL-HS-20, -25 and -30)
• Camera adapter for optical process monitoring

Common Specifications

Repeatability (RMS)	< 2 µrad

Positioning resolution	18 bit (8)
Optical performance Gain error Zero offset Skew	 < 5 mrad < 5 mrad < 1,5 mrad
Power requirements	±(15+1.5) V DC, max. 3 A (max. 6 A for LSSL-HS-20-30)
Input signals Digital version Analog version	 SL2-100, XY2-100 Standard or optical data transfer alternatively: ±4.8 V; ±9.6 V; ±4.8 mA; ±9.6 mA
Output signals Digital version Analog version	3 status signals per axis S L2-100, XY2-100 Standard or optical data transfer TTL level
Operating temperature	25 °C ± 10 °C
Typical air requirements (9)	clean, filtered air 20 l/min at Δp < 2 bar
Typical water requirements	5 l/min at Δp < 0.1 bar, p < 4 bar
(all angles are in optical degrees) (8) based on the full angle range (e.g. positioning resolution 2.8 µrad for angle range ±0.36 rad), resolutions better than 16 bit (11 µrad) only together with SL2-100 interface (9) air and water cooling optional for LSSL-HSIII-10 & 14, LSSL-HSII-7-14 and LSSL-HS10	

LSSL-HS Series

Part number	LSSL-HS10	LSSL-HS20	LSSL-HS25	LSSL-HS30
Aperture	10 mm	20 mm	25 mm	30 mm
Tracking error	0.18 ms	0.35 ms	0.50 ms	0.55 ms
Step response time(1) 1% of full scale 10% of full scale	 0.35 ms 0.90 ms	 0.80 ms 2.50 ms	 0.90 ms 3 .20 ms	 1.20 ms 4.50 ms
Typical speeds(2) Marking speed Positioning speed Writing speed Good writing quality High writing quality	 2.0 m/s 7.0 m/s 640 cps 400 cps	 1.0 m/s 6.0 m/s 320 cps 210 cps	 0.8 m/s 5.0 m/s 260 cps 170 cps	 0.7 m/s 3.0 m/s 220 cps 150 cps
Long-term drift	< 0.6 mrad(7)	< 0.6 mrad(7)	< 0.6 mrad(7)	< 0.6 mrad(7)
Optical performance Typical scan angle of scanner 1 Typical scan angle of scanner 2 Typical field size – ellipse (2), (4) Typical field size – square (2), (4) Nonlinearity	 ±0.35 rad ±0.35 rad - 110 x 110 mm2 < 3.5 mrad / 44°	 ±0.35 rad ±0.35 rad - 90 x 90 mm2 <3.5mrad/44°	 ±0.26 rad ±0.40 rad 80 x 130mm2 75 x 75 mm2 <3.5mrad/44°	 ±0.35 rad ±0.35 rad - 50 x 50 mm2 <3.5mrad/44°
Dimension	165x118x147mm	207x140x180	207x140x180	207x140x180
Weight (without objective)	approx. 3 kg (5)	approx. 5.8 kg	approx. 5.8 kg	approx. 5.8 kg

LSSL-HSII Series

Part number	LSSL-HSII-7	LSSL-HSII-10	LSSL-HSII-14
Aperture	7 mm	10 mm	14 mm
Tracking error	0.11 ms	0.12 ms	0.24 ms
Step response time(1) 1% of full scale 10% of full scale	 0.23 ms	 0.35 ms 1.70 ms	 0.40 ms 1.60 ms
Typical speeds(2) Marking speed Positioning speed Writing speed Good writing quality High writing quality	 3.5 m/s 15.0 m/s 1100 cps 800 cps	 3.0 m/s 12.0 m/s 1000 cps 700 cps	 1.5 m/s 7.0 m/s 500 cps 340 cps
Long-term drift	< 0.3 mrad(6)	< 0.6 mrad (7)	< 0.6 mrad (7)
Optical performance Typical scan angle of scanner 1 Typical scan angle of scanner 2 Typical field size – ellipse (2), (4)	 ±0.35 rad ±0.35 rad -	 ±0.35 rad ±0.35 rad -	 ±0.35 rad ±0.35 rad -

Typical field size – square (2), (4) Nonlinearity	110 x 110 mm2 <3.5mrad/44°	110 x 110 mm2 <3.5 mrad / 44°	90 x 90 mm2 < 3.5 mrad / 44°
Dimension	165x118x147mm	165x118x147mm	165x118x147mm
Weight (without objective)	approx. 3 kg (5)	approx. 3 kg (5)	approx. 3 kg (5)

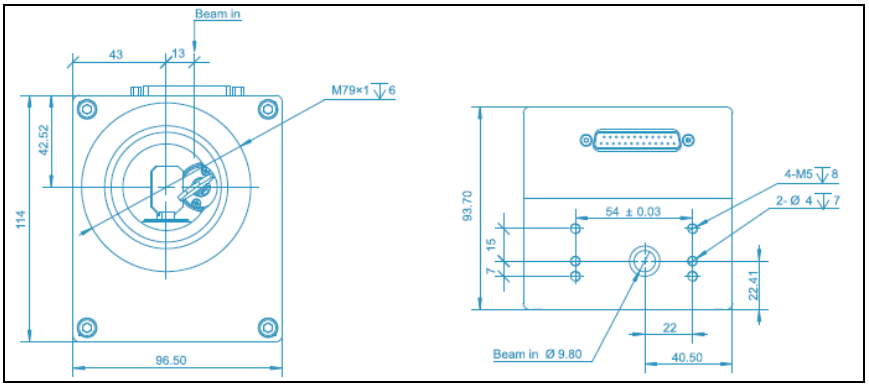
(1) settling to 1/1000 of full scale
(2) with F-Theta objective, f = 160 mm respectively f = 163 mm (LSSL-HS20-30)
(3) at constant ambient temperature and load, without water cooling; achievable even under varying load when equipped with temperature-controlled water cooling
(4) limited by vignetting at objective
(5) with optional water cooling up to 4.7 kg
(6) at constant ambient conditions, plus offset drift < 30 µrad/K and gain drift < 100 ppm/K
(7) after warm-up

LSSL-HSIII Series

Part number	LSSL-HSIII-10	LSSL-HSIII-14
Aperture	10 mm	14 mm
Tracking error	0.12 ms	0.18 ms
Step response time(1) 1% of full scale 10% of full scale	 0.35 ms 1.7 ms	 0.35 ms 1.2 ms
Typical speeds(2) Marking speed Positioning speed Writing speed Good writing quality High writing quality	 3.0 m/s 12 m/s 1000 cps 700 cps	 2.0 m/s 12 m/s 660 cps 410 cps
Long-term drift 8-h-drift (after 30 min warm-up) (3) Offset Gain 24-h-drift (after 3 h warm-up) (3) Offset Gain	 < 100 µrad < 100 ppm < 100 µrad < 100 ppm	 < 100 µrad < 100 ppm < 100 µrad < 100 ppm
Temperature drift Offset Gain	 < 15 µrad/K < 25 ppm/K	 < 15 µrad/K < 25 ppm/K
Optical performance Typical scan angle of scanner 1 Typical scan angle of scanner 2 Typical field size – square (2), (4) Nonlinearity	 ±0.35 rad ±0.35 rad 110 x 110 mm2 < 0.9 mrad / 44°	 ±0.35 rad ±0.35 rad 90 x 90 mm2 < 0.9 mrad / 44°
Dimension	165x118x147mm	165x118x147mm
Weight (without objective)	approx. 3 kg (5)	approx. 3 kg (5)

LSRM Series Precision Optical Scanning Systems

1. LSRM-A Series 2D Scanning Systems



LSRM-A series is a totally digital 2D galvanometer system. Embedded control system guarantees the servo loop operation. It is compact, stable and cost-efficient. It is the basic version of LSRM series scan heads. Mirrors of general wavelengths are available such like 1064nm, 532nm 355nm, 10.6um, suitable for laser marking, microscope, drilling, trimming and cutting etc.

Aperture	10mm
Beam displacement	13mm
Tracking error time	220us
Offset drift	50urad/K
Gain drift	75ppm/K
Step response time	
1% of full scale	0.3ms
10% of full scale	0.8ms
Marking speed (1)	2m/s
Positioning speed	12m/s
Writting speed (2)	
Good quality	500cps
High quality	450cps
Repeatability	< 22urad
Drift over 8 hours (After 30min warm-up)	< 0.3mrad
Typical scan angle	40 degrees
Interface (3)	XY2-100
Operating temperature	25°C±10°
Power requirements	±15V DC, 150W
Driver mode	Digital
Resolution	16Bit
Max laser power (4)	100W
Dimension (LxWxH)	114x97x94mm

(1) with F-Theta objective, f=160mm
(2) single-stroke characters of 1mm height
(3) The mirror of 1064nm can stand max laser power

2. LSRM-Q Series 2D Scanning Systems

LSRM-Q series is totally digital 2D galvanometer system. The system operates based on the embedded platform. It is compact, stable and high quality. More fast and accuracy. The offset drift and gain drift are very low. Mirrors of typical laser wavelengths are available and optimized for inertial and stiffness. Suitable for high end application like ITO scratching, laser micro processing etc. Added water and air cooling function to improve the stability of the system.

	LSRM-xxxx-10-Q10	LSRM-xxxx-12-Q12	LSRM-xxxx-14-Q14
Aperture	10mm	12mm	14mm
Beam displacement	13mm	14.5mm	18.1mm
Tracking error time	120us	135us	160us
Weight	2.05kg	2.05kg	2.85kg
Offset drift	30urad/K	30urad/K	30urad/K
Gain drift	50ppm/K	50ppm/K	50ppm/K
Step response time			
1% of full scale	0.3ms	0.3ms	0.5ms
10% of full scale	0.8ms	0.8ms	1ms
Marking speed (1)	2.5m/s	2m/s	2m/s
Positioning speed	15m/s	11m/s	8m/s
Writting speed (2)			
Good quality	800cps	660cps	550cps
High quality	500cps	410cps	350cps
Repeatability	< 15urad	< 15urad	< 15urad
Drift over 8 hours (After 30min warm-up)	< 0.1mrad	< 0.1mrad	< 0.1mrad
Typical scan angle	40 degrees	40 degrees	40 degrees
Interface (3)	XY2-100/ SL2-100	XY2-100/ SL2-100	XY2-100/ SL2-100
Operating temperature	25°C±10°	25°C±10°	25°C±10°
Power requirements	±15V DC, 150W	±15V DC, 150W	±15V DC, 150W
Driver mode	Digital	Digital	Digital
Resolution	16Bit	16Bit	16Bit
Max laser power (4)	200W	300W	400W
Dimension	114x97x94mm	114x97x94mm	134x109x106mm

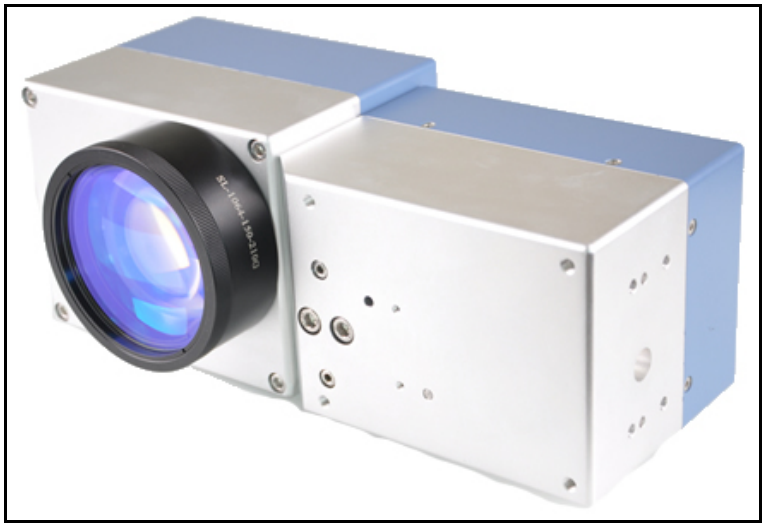
(1) with F-Theta objective, f=160mm
(2) single-stroke characters of 1mm height
(3) XY2-100-EH with status feedback to change without notice
(4) The mirror of 1064nm can stand max laser power,with air cooling.

	LSRM-xxxx-20-Q20	LSRM-xxxx-30-Q30	LSRM-xxxx-50-Q50
Aperture	20mm	30mm	50mm
Beam displacement	26.5mm	36mm	55mm

Tracking error time	360us	550us	1.8ms
Weight	4.9kg	6.5kg	7.5kg
Offset drift	30urad/K	30urad/K	30urad/K
Gain drift	50ppm/K	50ppm/K	50ppm/K
Step response time			
1% of full scale	0.83ms	3.04ms	-
10% of full scale	1.34ms	6.29ms	-
Marking speed	1m/s	0.7m/s	0.3m/s
Positioning speed	6m/s	3m/s	1.2m/s
Writing speed			
Good quality (1)	320cps	220cps	-
High quality (2)	210cps	150cps	-
Repeatability	<15urad	< 15urad	< 15urad
Drift over 8 hours (After 30min warm-up)	< 0.1mrad	< 0.1mrad	< 0.1mrad
Typical scan angle	40 degrees	40 degrees	40degrees
Interface	XY2-100/SL2-100	XY2-100/SL2-100	XY2-100/SL2-100
Operating temperature	25°±10°	25°±10°	25°±10°
Power requirements	±15V DC, 150W	±15V DC, 150W	±15V DC, 150W
Driver mode	Digital	Digital	Digital
Resolution	16Bit	16Bit	16Bit
Max laser power (3)	1500W	3500W	6000w
Dimension	170x140x130mm	195x153x150mm	260x220x170mm

(1) with F-Theta objective, f=160mm
(2) single-stroke characters of 1mm height
(3) XY2-100-EH with status feedback to change without notice
(4) The mirror of 1064nm can stand max laser power in air cooling

3. LSRM-QPT Series Post-Scanning Systems



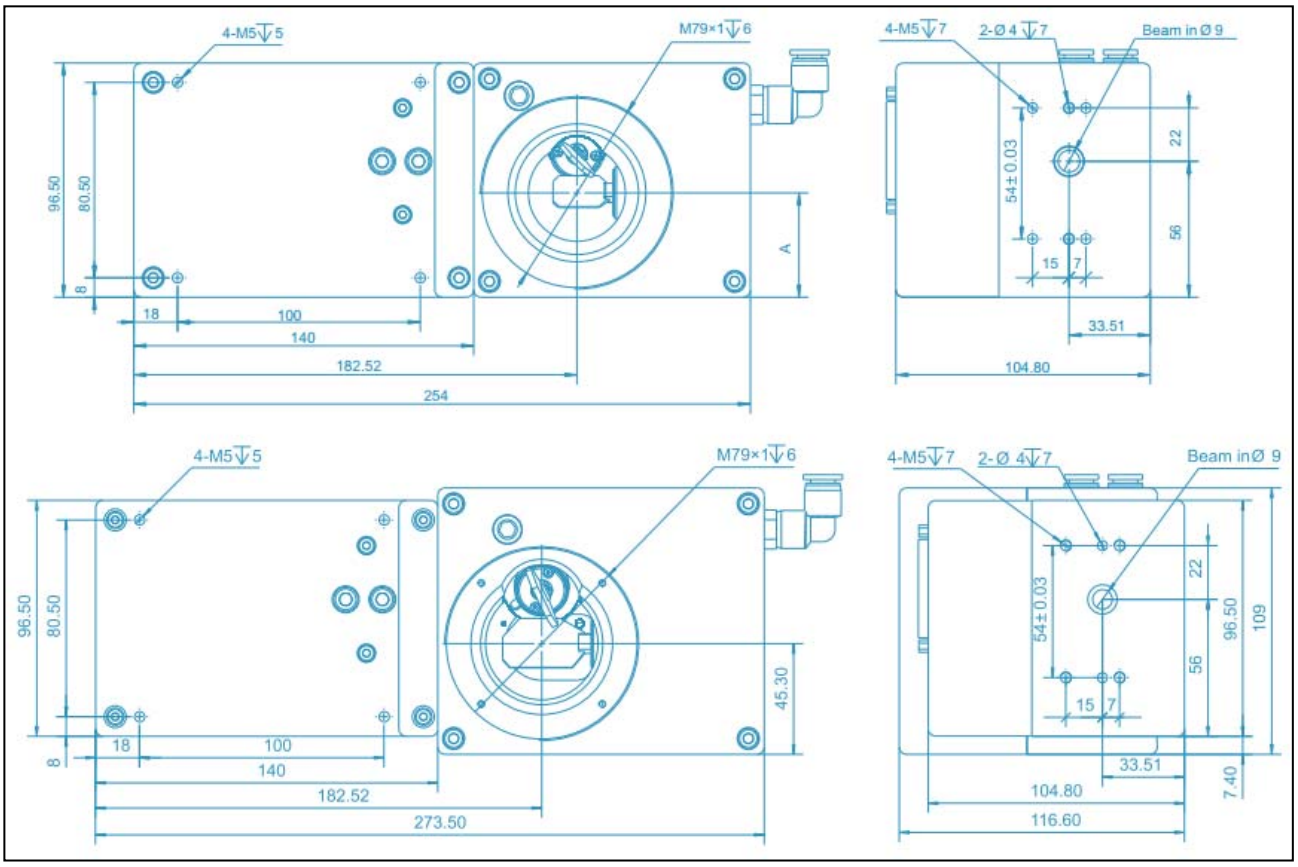
This solution includes a 2D galvo scanner system LSRM-Q series, a dynamic focusing unit Proton series, F-theta lens and a controller LSRM-UMC4. It uses the post-objective scanning technology, the working volume is about 150*150*45mm (with the 210mm F-theta lens). Their advantages are fast marking speed, small focal spot and low power loss.

Part number	LSRM-1064-6-QPT LSRM-1064-7.2-QPT LSRM-1064-8.4-QPT	LSRM-532-3.3-QPT LSRM-532-4-QPT LSRM-532-4.6-QPT
Wavelength	1064nm	532nm
Beam expansion factor	1.67	3
Input aperture	6mm/7.2mm/8.4mm	3.3mm/4mm/4.6mm
Scan head apertures	10/12/14mm	10/12/14mm

Focus range in Z-direction	±22.5mm (1)	±2.5mm (2)
Tracking error time	700us	700us
Dimension	274x109x116mm	254x97x105mm

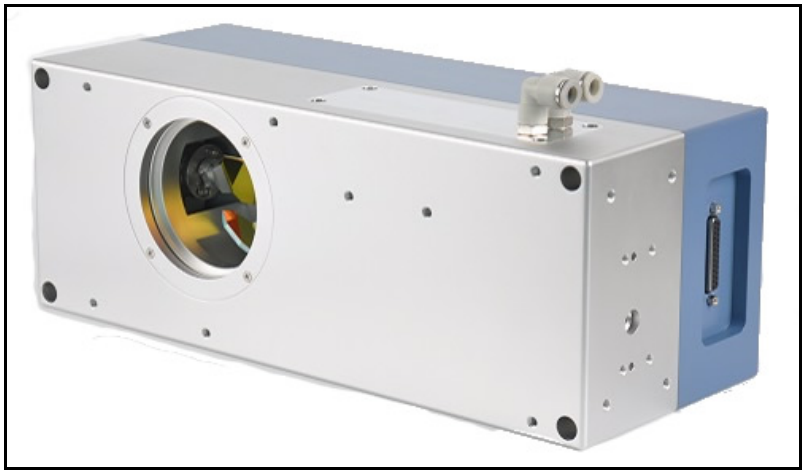
Remarks: (1) Focal length of the f-theta lens is 210mm. (2) Focal length of the f-theta lens is 100mm.

All of the above parameters are theoretical values.



4. LSRM-QP Series Pre-Scanning Systems

LSRM-QP series 3D pre-scanning system includes a 2D galvo scanner system LSRM-Q, a dynamic focusing unit Proton series, and a controller LSRM-UMC4. It uses the pre-objective scanning technology to realize the large field and 3D laser application. Their advantages are fast marking speed, small focal spot and low power loss.



Dimensions:
LSRM-QP20: 350x140x188mm
LSRM-QP30: 400x155x194mm

Typical CO2 laser configuration example: LSRM-QP30

Scanning field	600x600mm	800x800mm
Focal spot diameter	364um	487um
Working distance	502mm	777mm
Resolution	9um	12um

Typical Nd:YAG laser configuration example: (λ=1064nm) LSRM-QP20/ 30

Scanning field	400x400mm	600x600mm	800x800mm
Focal spot diameter			
QP-20	34um	52um	—
QP-30	-	36um	48um
Working distance			
QP-20	502mm	777mm	—
QP-30	-	777mm	1051mm
Resolution	6um	9um	12um

Typical UV laser configuration example: LSRM-Q14 + Proton

Working dimension	400x400mm	600x600mm
Spot diameter	17um	26um
Working distance	520mm	795mm
Resolution	6um	9um

- All of the above parameters are theoretical values.
- Distance between edge of deflection unit and working surface. This distance is dependent on the product model and will vary with laser divergence and objective tolerance.
- Actual spot size and writing speed are dependent on material and application.

5. LSRM-CA: CCD Adapter

Traditional galvo scanner correction method is given priority to the manual measurement and accuracy is difficult to be guaranteed which affects the processing quality. Galvo scanner with a camera adapter vision module can greatly improve the accuracy of the calibration, and monitor the work surfaces at the same time.

Installation:
The camera adapter is mounted between the scan head's beam entrance and the laser flange.

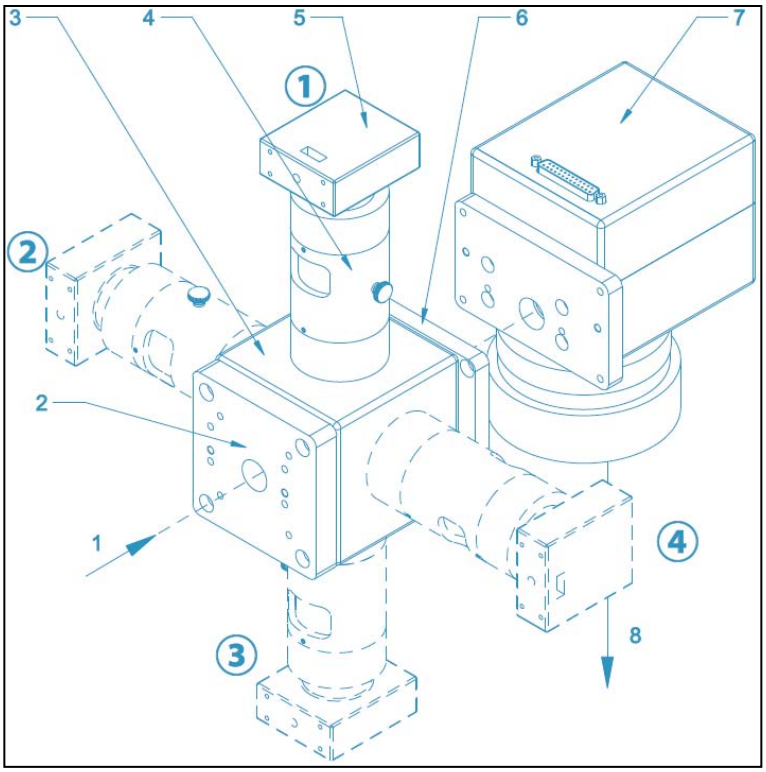
Working Principle:
Illumination light reflected from the surface of the workpiece passes through achromatic F-theta, galvo scanner, beam splitter, CCD lens to reach the CCD sensor. Adjust beam splitter position to compensate the error of machining and assembly to ensure the optical path of the laser and reflected light coaxial. Make the laser coincide with the CCD image detection point.

Field of View (FOV):
Field of view is decided by the lens's focal length, CCD camera, CCD camera photosensitive element size together. For example, 160mm lens, CCD target surface size of ½ ", the field of view is 10.4mm * 8.3mm (see table)

Laser wavelength	1064nm			532nm
Pilot laser wavelength	635nm			635nm
Diameter of entering beam	14mm			10mm
Scan head mirror coating	1064nm + 635nm			532nm + 635nm
Processing field size	100 x 10 0mm			100 x 100mm
Observation wavelength	1064nm / 635nm			532nm / 635nm
Focal length camera objective	102mm			102mm
Flat field objective	160mm	210mm	254mm	163mm
Observation field size	10.4x8.3mm	13.7x10.9mm	16.6x13.3mm	10.6 x 8.5mm

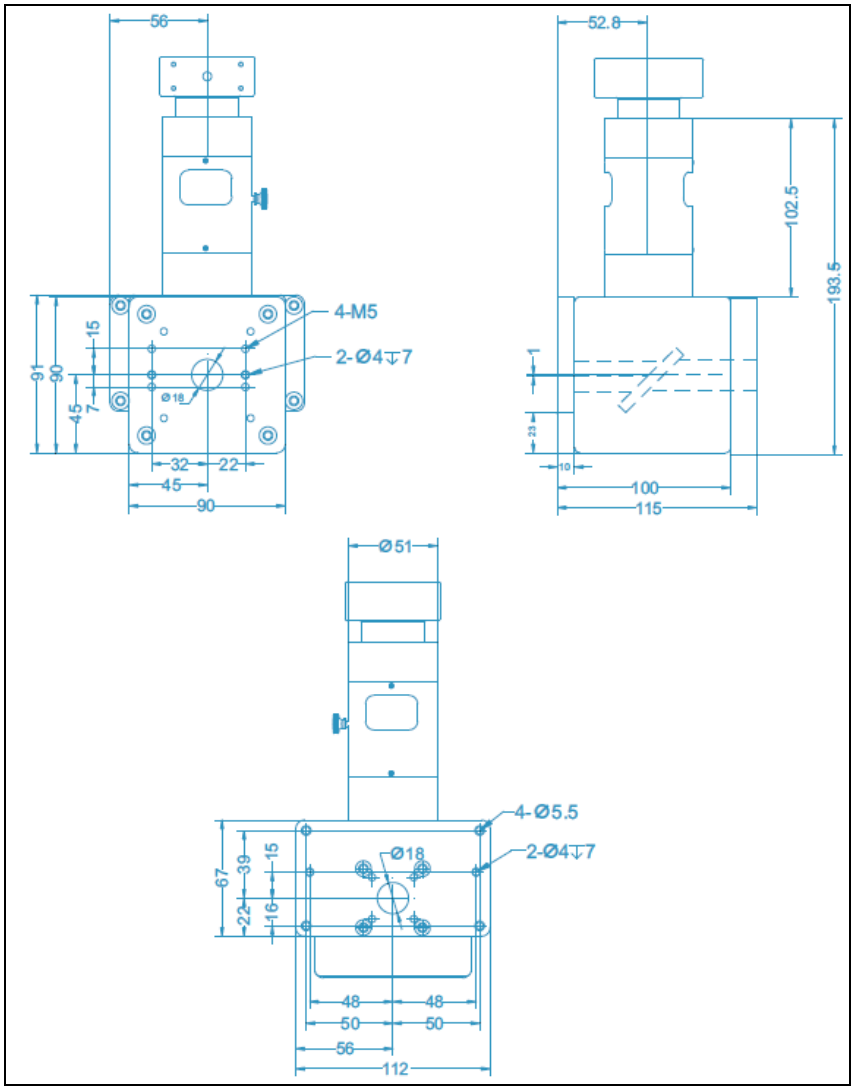
Other Parameters:

Diameter of entering beam	14mm
Operating temperature	25 ±10℃
Max. Chip size	95 %
Camera Connection type	≥1/2″
Weight(without camera)	C-mount
Laser transmissivity	≈2.6 K g



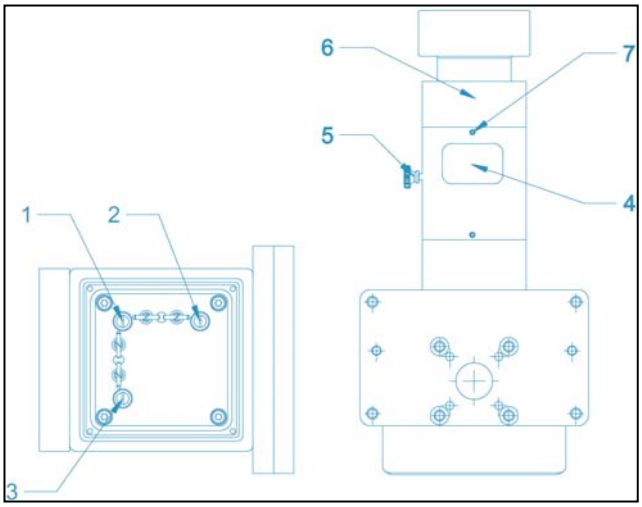
1. Entering beam
2. Beam-entrance side camera adapter
3. Camera adapter
4. CCD objective
5. CCD camera
6. Beam-exit side camera adapter
7. Scan head
8. Exit beam

All dimensions are in mm.



Coaxial CCD adapter tuning method and steps

1. Adjust the galvanometer height, find the galvanometer focus position.
2. Mark the crosshair.
3. Adjust the focus ring 4 (CW or CCW), to the camera showing a clear image.
4. Locking screw 5 to lock the focus ring 4.
5. Loosen screw 7, CW or CCW adjusting ring 6, to make the orientation of the image the same as the crosshairs.
6. Lock screw 7.
7. Observe the CCD image crosshair and the marked crosshair position. If the two crosshair does not coincide with each other need to open the protective cover, tuning the knob 2 and knob 3. Take ② (see Figure 1) as an example, when the knob 2 is adjusted, the centre of the image will move left and right diagonally. When the knob 3 is adjusted, the centre of the image will move up and down diagonally .Tuning knob 2 and 3 to make the image crosshair coincide with the marked crosshair.
8. After tuning restore the cover.



Marking Card and Marking Software

Our marking software has been designed to meet the needs of all types of users of laser marking systems. The software was developed to be a retrofit package for existing systems, or as original software on new systems. The package provides significant advancements over previous laser marking control systems, while remaining extremely user-friendly. It's an object oriented, graphically interactive, PC control system providing a user the ability define and execute laser marking jobs. Multiple hardware interfaces are supported giving the software the ability to control most Nd:YAG and CO_2 laser marking systems.

Unlike some marking software, the operator never has to remember what fonts and logo's need to be loaded for a particular job. The software automatically performs all required graphic loading. The software does not require users to learn any programming languages or special codes, and yet the software provides all of the flexible, graphic control users are accustomed to, including radial marking, aspect control, character spacing, angular rotations, and full justification. Text to be marked can be fixed or variable. Variable text can be retrieved at runtime from a variety of sources including, the keyboard, a bar code reader, and disk files. Automatic date coding and alphanumeric serialization are included as variable text types. Fonts include laser engraving fonts and Window's True Type fonts. True Type fonts can be vector filled using user specified density, angle and kerf. Graphics (sometimes called "logo's" on other systems) can be imported from a large variety of common vector formats. All graphic features are either menu controlled or graphically controlled via the mouse and keyboard.

The software can create various objects such as barcode, DataMatrix, text, simple geometrical objects (such as line, rectangle, round-corner rectangle, polygon, circle, ellipse etc), complex graphic objects (such as PLT & BMP files), automatic date coding and alphanumeric serialization.

There are two series marking cards (interface cards) and relevant software: LMC and STEL. The custom design is available upon request..

1. LMC Series Cards and Software

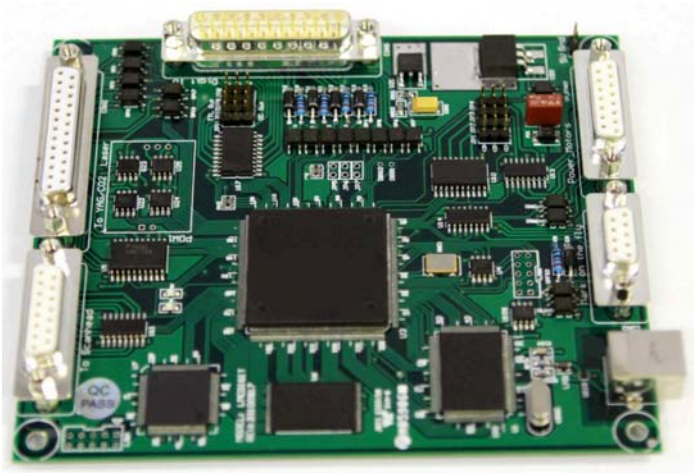
Our marking software has been designed to meet the needs of all types of users of laser marking systems. The software was developed to be a retrofit package for existing systems, or as original software on new systems. The package provides significant advancements over previous laser marking control systems, while remaining extremely user-friendly. It's an object oriented, graphically interactive, PC control system providing a user the ability define and execute laser marking jobs. Multiple hardware interfaces are supported giving the software the ability to control most Nd:YAG, CO_2 and fiber laser marking systems such as adjusting currents, frequency, duty ratio . and red light indication.

Unlike some marking software, the operator never has to remember what fonts and logo's need to be loaded for a particular job. The software automatically performs all required graphic loading. The software does not require users to learn any programming languages or special codes, and yet the software provides all of the flexible, graphic control users are accustomed to, including radial marking, aspect control, character spacing, angular rotations, and full justification. Text to be marked can be fixed or variable. Variable text can be retrieved at runtime from a variety of sources including, the keyboard, a bar code reader, and disk files. Automatic date coding and alphanumeric serialization are included as variable text types. Fonts include laser engraving fonts and Window's True Type fonts. True Type fonts can be vector filled using user specified density, angle and kerf. Graphics (sometimes called "logo's" on other systems) can be imported from a large variety of common vector formats. All graphic features are either menu controlled or graphically controlled via the mouse and keyboard.

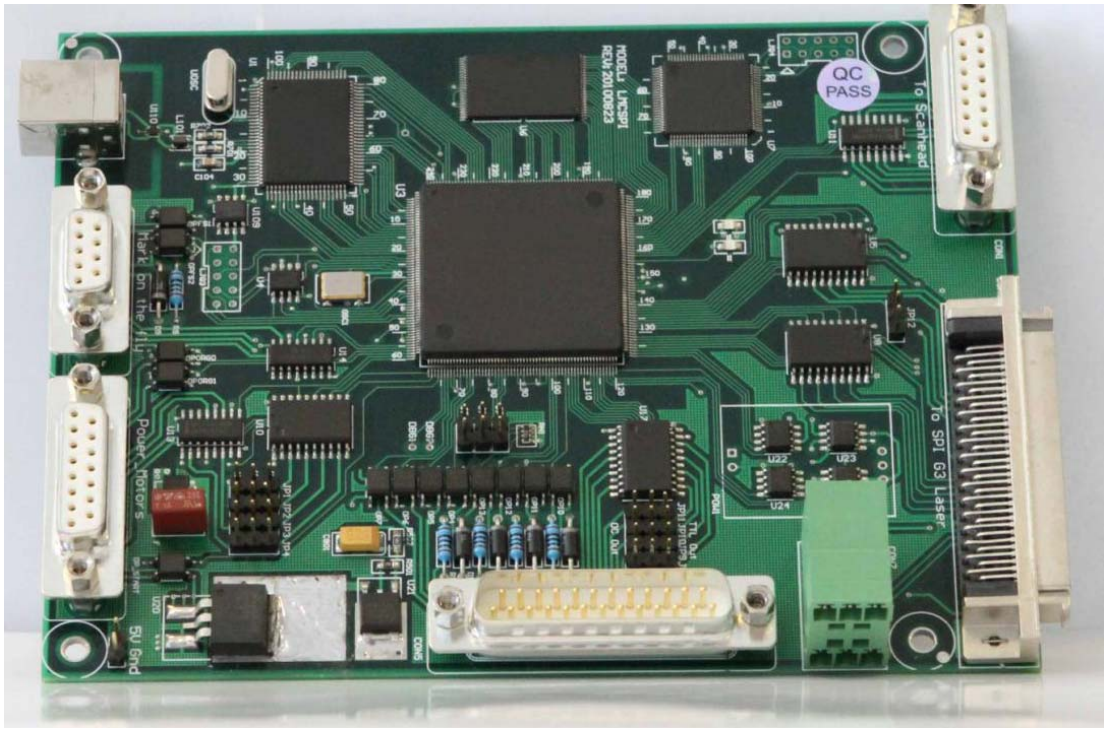
The software can create various objects such as barcode, DataMatrix, text, simple geometrical objects (such as line, rectangle, round-corner rectangle, polygon, circle, ellipse etc), complex graphic objects (such as PLT & BMP files), automatic date coding and alphanumeric serialization.

Digital card (control CO2 laser, YAG laser)

- Data transfer:usb2.0 interface
- Digital output used for scan head
- Support FPK with three ways [optional]
- Support high-speed fly marking with rotary encoder
- Eight digital input and seven digital output used for other controlled equipment
- 25 routes general digital signals(TTL compatible), 4 of the IO ports can be OC IO, can connect with relay.
- LASER Signal: TTL, used for laser On/Laser Off .
- PWM Signal: TTL, used to adjust the frequency and duty ratio.
- Tow Direction/Pulse signals, used to control stepping motor.
- START Signal: used to connect foot switch



Digital fiber card (control fiber lasers)



- Use 68-pins SCSI 3 socket, connect fiber laser module via 68-pin cable directly
- Adjustable digital/analog output used for scan head
- Mark-on-fly function with an encoder connected
- Extend axes output: Two Direction/pulse signals, used to control stepping motor or servomotor
- 25 routes general digital signals(TTL compatible), 4 of the IO ports can be OC IO, can connect with relay
- Original start signal: Used when marking contents are the same and high speed is required
- Compatible with USB2.0

Dynamic focus board

- Dynamic focus .three digital output for scan head
- Support FPK with two ways (optional)
- 6 routes digital input and 6 routes digital output
- LASER signal : TTL, used for laser on/laser off
- PWM signal: TTL ,used to adjust the frequency and duty ratio

- Direction/pulse signals ,used to control stepping motor or servomotor
- DB25 connector used for IPG YLP laser directly (optional)
- Compatible with USB2.0

PCIE card (control CO2 and YAG laser)

PCIE-F card (control fiber laser)

DA converter Board

DA converter is an integrated product for digital to analogue single conversion, to enable higher marking accuracy and long distance signal transmission which is less susceptible to electrical noise.

There are two types:
->2 channel: supports 2 channels output, and the digital protocol has not extended coding, which is labeled as “20071012-V101”;

->3 channel: supports 3 channels output, and the digital protocol has the extended coding, which is labeled as “20080107-V103”.

Model and description for LMC boards:

Part number	Functions	Option
LMC-USB-FIBER	For fiber lasers. 12 inputs, 8 outputs, 2D marking, rotary (or another axis)	Fly, 2D large field, multi-marking heads
LMC-USB-DIGIT	For CO2, YAG lasers. 16 inputs, 8 outputs, 2D marking, rotary (or another axis)	Fly, 2D large field, multi-marking heads
LMC-USB-SPI	For SPI fiber lasers. 12 inputs, 8 outputs, 2D marking, rotary (or another axis)	Fly, 2D large field, multi-marking heads
LMC-PCIE	For CO2, YAG lasers. 12 inputs, 2 outputs, 2D marking, rotary (or another axis)	Fly, 2D large field, multi-marking heads
LMC-PCIE-F	For fiber lasers. 8 inputs, 2 outputs, 2D marking, rotary (or another axis)	Fly, 2D large field, multi-marking heads
LMC-DLC2	For CO2/YAG/fiber lasers.10 inputs, 8 outputs, multi marking heads; 2D large field; off-controller marking; fly-on marking; 2.5D marking; laser welding; cutting; Open TCP/IP communication; rapid 2D data matrix fly-on; marking; 18bit/20bit control	3D marking

Remark:
The boards always come with 2D marking to control 2D galvos plus one axis (rotary or Z-axis). On-fly and XY-axis are available upon request at additional cost.

2. STEL Series Marking Cards and Software

1) STEL-PMC2 card

- Support digital scanners by XY2-1 00 protocol.
- For analog scanners, signals converted by the DA2-1 6 daughter board.
- Built-in DSP, marking computing do not occupy computer CPU time.
- 1 0μs galvo-motor-position updating rate.
- FPK, PPK, R05 first pulse suppression.
- Two 1 2-bits analog control signals.
- Support 3-axis encoder inputs, can be used to detect the object position of fly-marking and XY table.
- PWM maximum output frequency is 1 0MHz, minimum pulse width is 0.1 μs.
- 4-axis pulse/direction digital control signals, the maximum output frequency is 2MHz.
- General purpose 1 6-bits digital outputs, 1 6-bits digital inputs.
- Specific 1 6-bits laser control digital outputs.
- Up to 4 cards installed simultaneously.
- Support for Windows XP/Vista/Windows7/Windows8.

STEL-PMC2 is a PCI bus advanced laser marking card, support digital galvo motor, compatible with XY2-100 protocol, and through DA-1 6 daughter board can control analog galvo motor precisely.

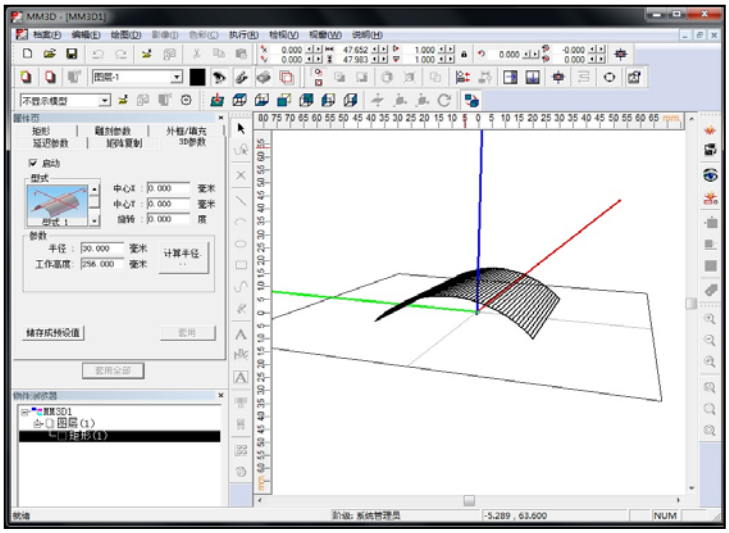
2) STEL-UMC4 card

- Built-in DSP, marking computing do not occupy computer CPU time.
- Support one XY2-100 digital control signal output, 10μs cycle update galvo motor position.
- FPK, PPK, R05 first pulse suppression.
- Two 12-bits analog control signals.
- PWM maximum output frequency is 10MHz, minimum pulse width is 0.1μs.
- Support offline marking, could access 16 files each contains 8 sets auto-text and 8 kinds of fonts.
- One RS232 Communication Port for PLC communication.
- Support one encoder input for mark-on-fly function.
- Support one pulse/direction digital control signal output, the maximum output frequency is 2MHz.

- Contain expansion connectors for connecting with a variety of daughter boards.
- Support for Windows XP/Vista/Windows7/Windows8.

STEL-UMC4 is a USB bus advanced laser marking card, and support digital galvo motor, compatible with XY2-100 protocol. STEL-UMC4 built-in full offline marking functions could access up to 16 files.

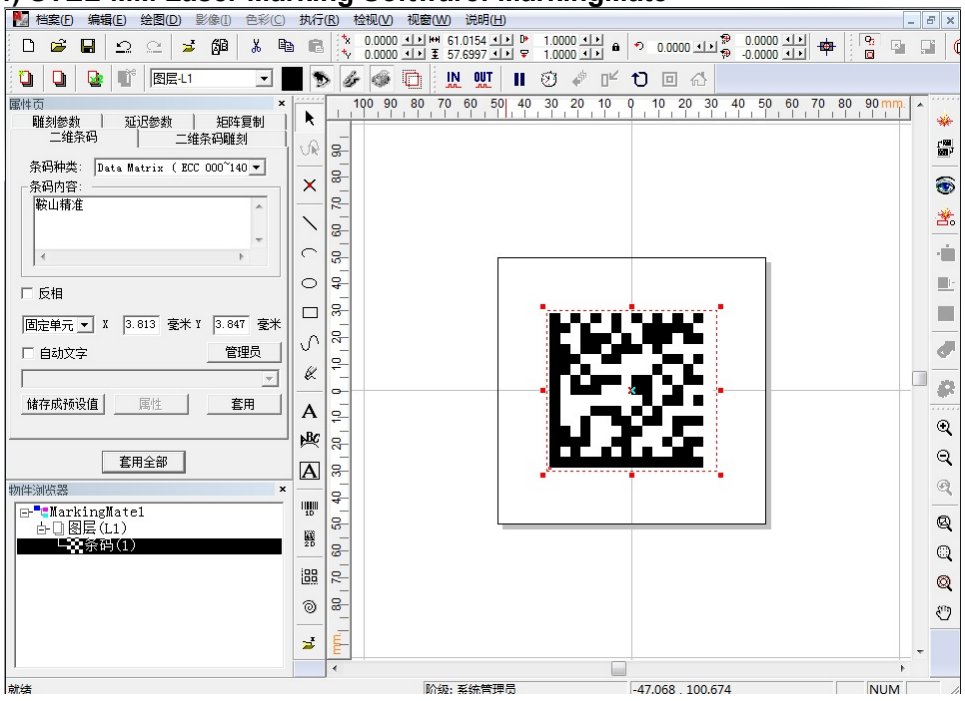
3) STEL-MM3D Laser Marking Software



- Support STL 3D model
- Draw in 2D graphic
- Built in several frequently used models
- Support import 3D DXF as marking path
- Graphic Coated or projection mapping to curved surface
- Real-time preview, what you see is what you get
- Automated process control
- Support X,Y,or Z axis motion

MM3D marking software has combined the third marking axis(focal shifter) control ability, which could help user marking on irregular curve surface. After user imports the 3D model in STL format, MM3D will paste the drew graphic on the model surface. At this time, user could put the working-piece on the proper marking position to complete marking task. Not only MM3D allowed user import 3D model in STL format, but built in several most frequently used curve surface; or user could import 3D DXF file as marking path.

4) STEL-MM Laser Marking Software: MarkingMate



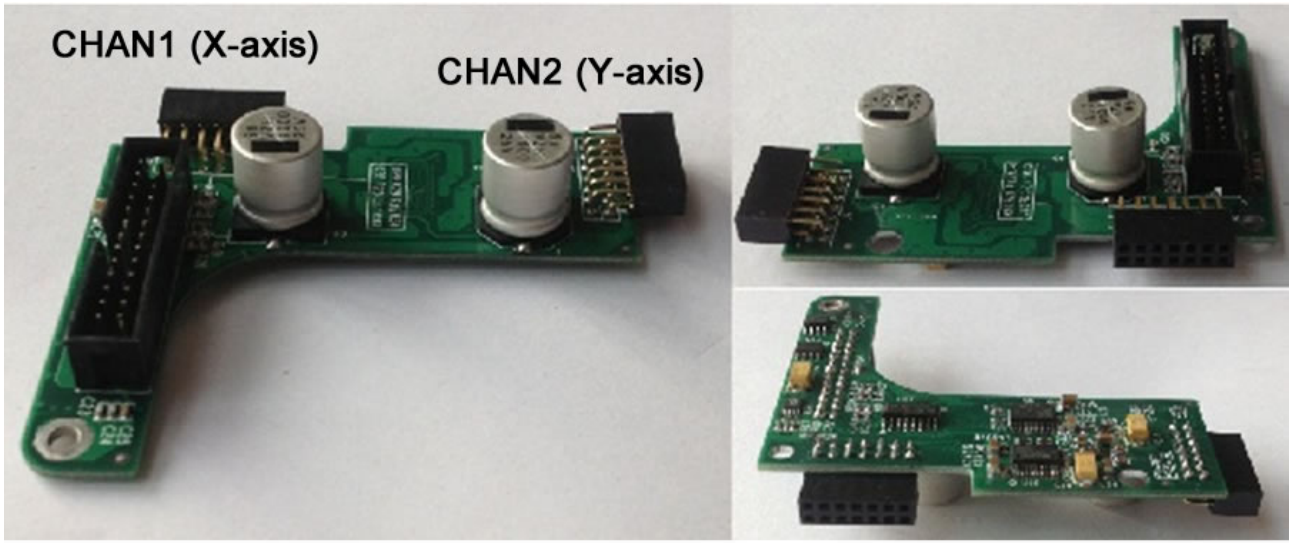
- Support many kinds of language such as Chinese, English, Japanese, Deutsch
- Support Win XP,Vista,Win7,Win8
- Provide Draw Menu: Vertex, Line, Arc, Circle, Text, Barcode
- A multiplicity of Auto Text: Serial No, Date, Keyboard, File
- Best compatibility, can import variety of image formats
- Provide Object-Related Property Table, has being selected, the Property
- Mark Parameter List shows all the marking parameters users set themselves.
- Control Object-Related Property: Digital In, Digital out, Stop, Delay Time, Motion, Reset & Homing.
- Support RS-232,TCP OP Parameters
- Layer-Related Property Table

- Matrix Property
- Compensation for all lens distortion
- Provide 3-user levels
- Users can set the deviation compensation between align light and laser
- Support many types of laser marking cards such as PMC2,MC3,RTC3,4,5
- Support many types of lasers, such as CO2,YAG,fiber,green,UV

STEL-MM MarkingMate is window-based laser marking software developed which is easy and friendly to use powerful tool. Support variety vector and bitmap graphic, and provide library and OCX component for marking solution provider. Easily to mark on plane or non-plane surface, also support variety PCI or USB marking controller, able to control almost all kinds of laser.

ST-DAC-XY2-CD DA Converter

ST-DAC-XY2-CD series DA converter is an integrated product for digital to analogue single conversion, to enable higher marking accuracy and long distance signal transmission which is less susceptible to electrical noise.



Interface: Digital Singal Input

The DIGITAL SIGNAL INPUT connector is used for digital signal input according to the XY2-100 standard. The DIGITAL SIGNAL INPUT connector is also used for connecting the converter board to a power supply with balanced power source of DC+/-15V.

This board draws approximately 50mA from pins 17, 18, 19 and approx. 20mA from pins 23, 24, 25. However, when driver board and scanners are connected and operating, then 1.5A is required for each of X and Y axes.

Interface: Analog Signal Output

DC+/-15V power to the driver board is provided by ANALOG SIGNAL OUTPUT connectors. The X&Y axis output connectors provide analog output signal in the range of -5V to +5V for controlling the scanners via driver board.