Sintec Optronics

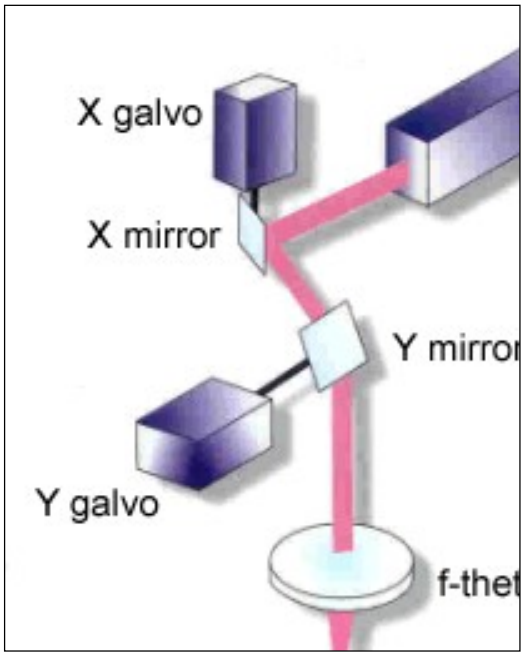
Laser Marking Heads (Laser Scanners, Scan Heads)

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), an interface card (or called 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 $\theta=\pm20°$ in both X and Y directions. ($\theta=\pm25°$ would be the usual maximum scanned field). The field size is then approximately $2F\tan\theta$ 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-8-8162	8	15	90.5x69.5x86	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- 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.

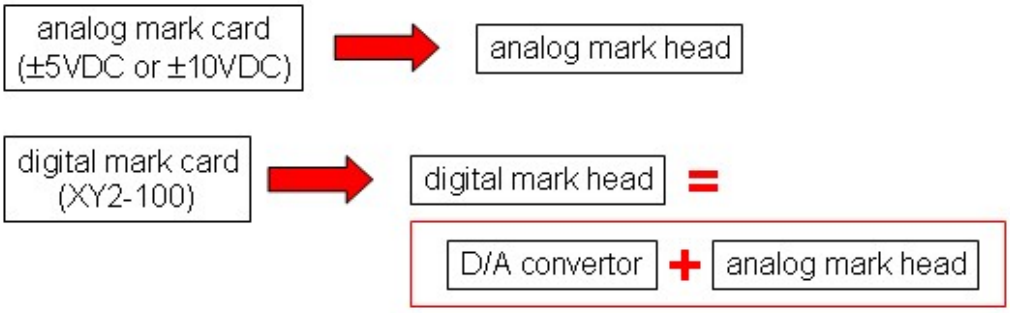
3D Marking Heads

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.



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-8-8162	8	15	XY-100	90.5x69.5x86	0.8	8162
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-8-8162**	**LSST-xxxx-10-8161**
Optical apertures supported, two-axis	≤5mm	≤8mm	≤10mm
Positioning speed	10m/sec	10m/sec	10m/sec
Marking speed			
Good quality (1mm height)	1000cps	800cps	600cps
High quality (1mm height)	600cps	550cps	450cps
Response time	0.3ms at 5mm beam	0.2ms at 5mm beam	0.45ms at 10mm beam

Max mechanical rotation angle	±20°	±20-30°	±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	±15V, 60W	±15V, 60W
Weight	0.6kg	0.8kg	1.6Kg
Dimension	70x55x50mm	90.5x69.5x86mm	116x96x96mm

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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- 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°	±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	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**
Input Aperture	10mm	10mm	10mm
Linearity	99.9%	99.9%	99.9%
Small step response time	0.288ms	0.5ms	0.3ms
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	M79x1
Dimension(L×W×H)	118.5x96.5x94.3	118.5x96.5x93.6	114x96.5x93.7

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:

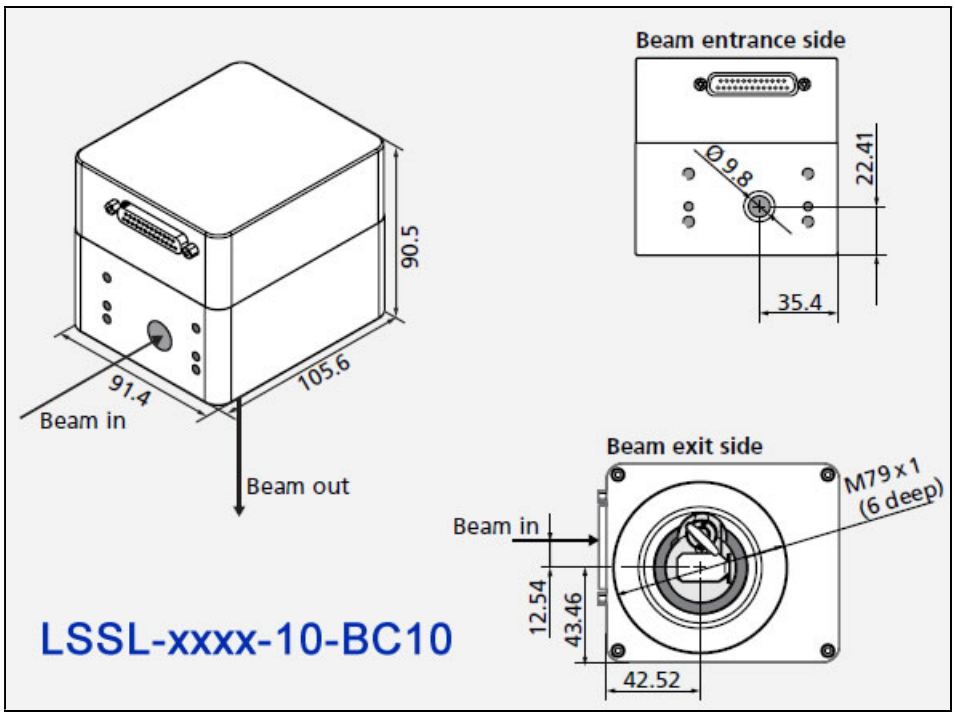
- Compact & light-weight design
- Very fast writing speed
- Excellent price/performance ratio

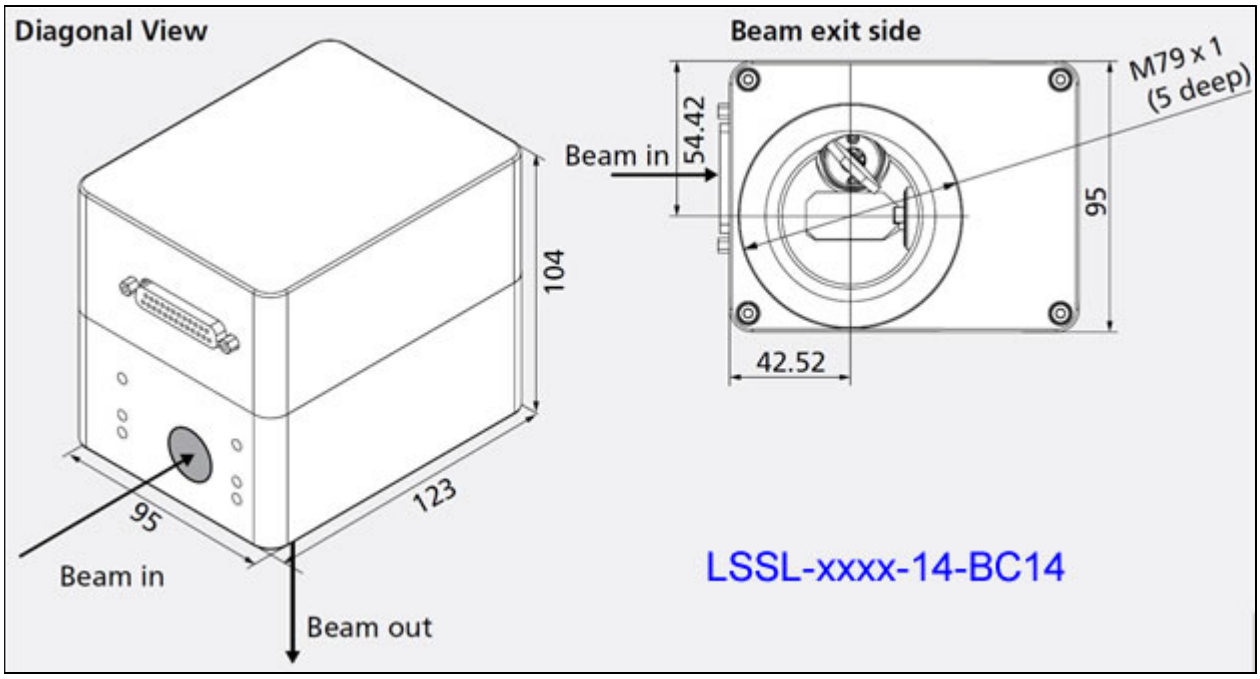
Specifications:

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.

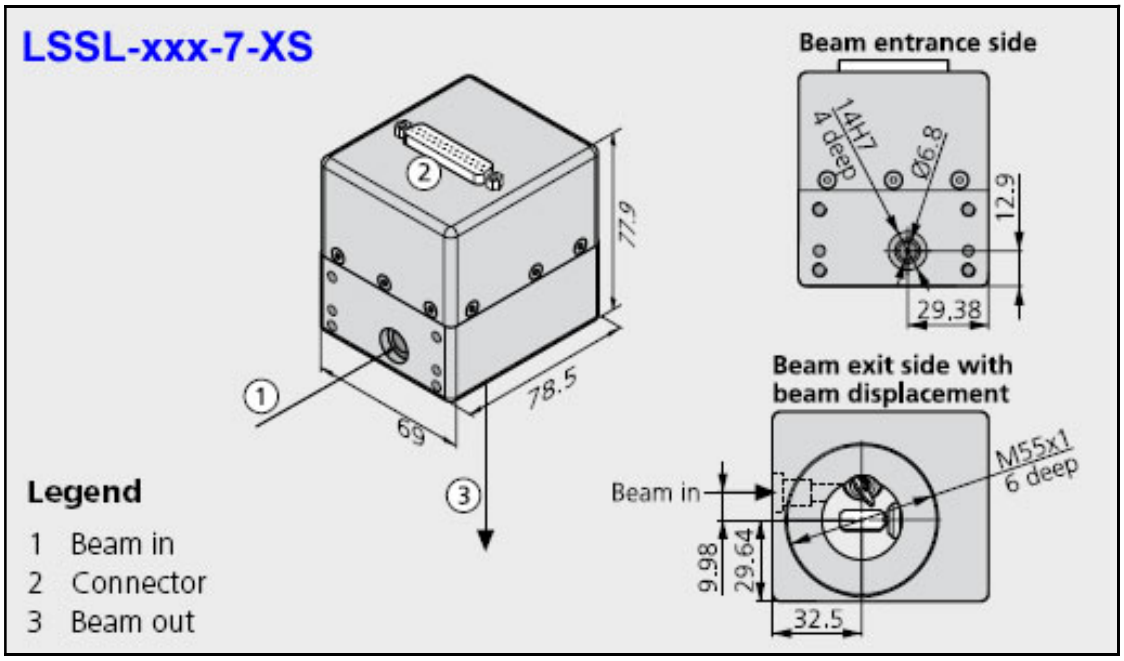
Quality
The high quality is the result of years of experience in the development and manufacture of galvanometer optical scanners and scan systems. In addition, every scan system must first pass the quality check burn-in test before it is released for shipment to the customer.

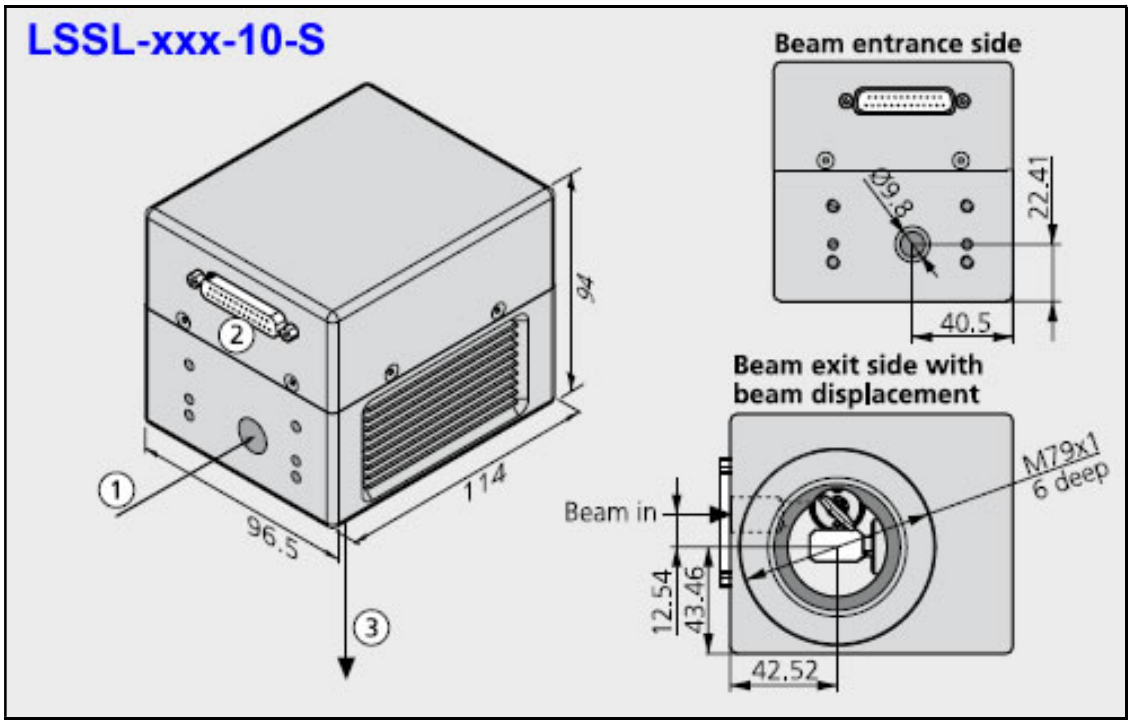
Common Specifications (all angles are in optical degrees)

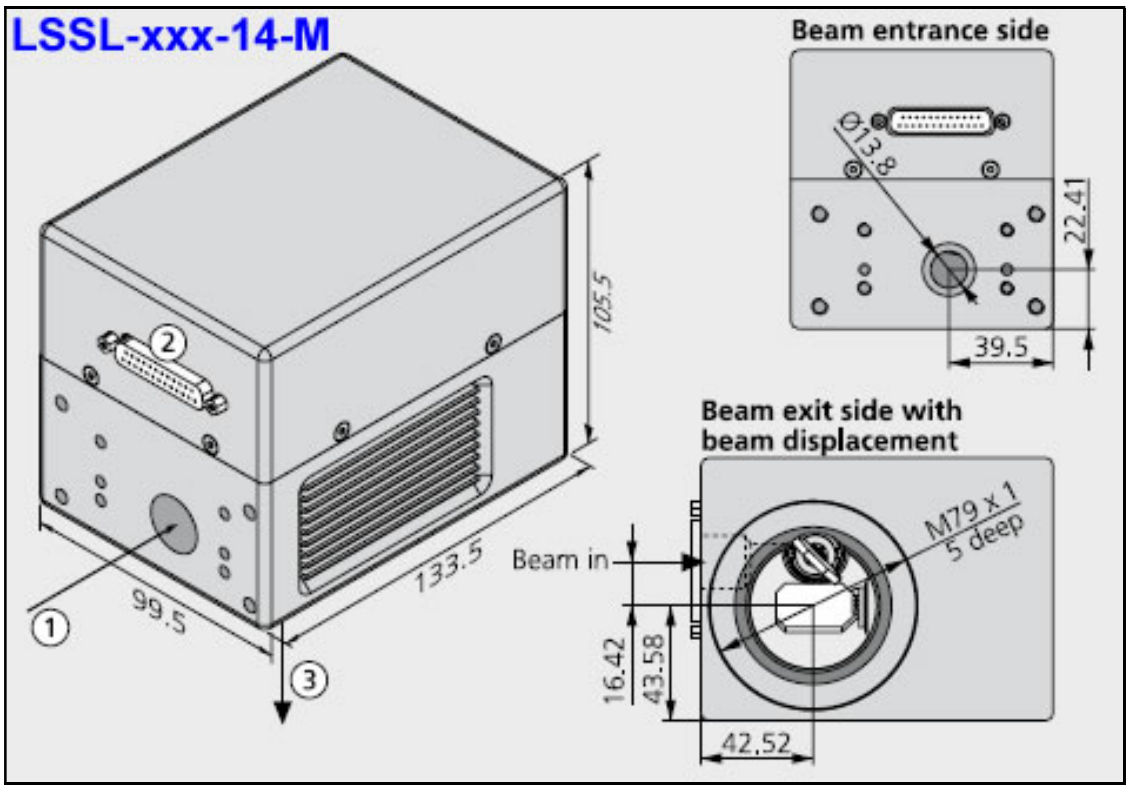
Dynamic Performance	Repeatability	< 22µrad
	Offset drift	30µrad/K
	Gain drift	80ppm/K
	Long-term drift over 8 hours	< 0.3mrad, plus temperature induced gain and offset drift
Optical Performance	Typical scan angle	±0.35rad
	Gain error	< 5mrad
	Zero offset	< 5mrad
	Nonlinearity	< 3.5mrad
Interface	Analog 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)

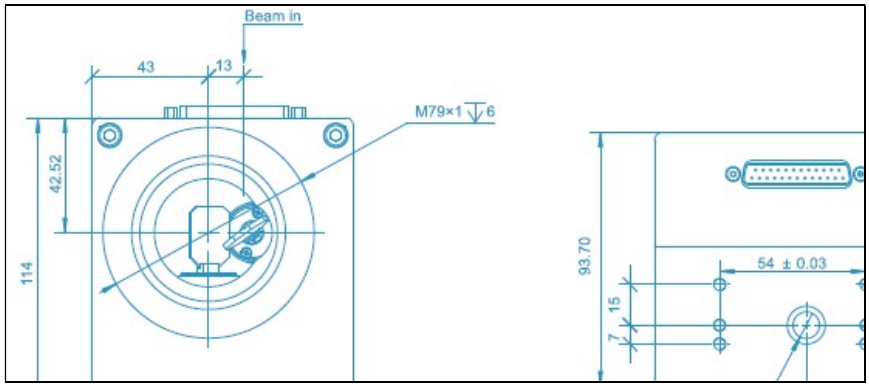
(1) settling to 1/1000 of full scale
(2) with F-Theta objective, f = 160 mm respectively f = 163 mm (LSSL-HS20-30)
(3) at constant ambient temperature and load, without water cooling; achievable even under varying load when equipped with temperature-controlled water cooling
(4) limited by vignetting 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	75urad/K
Gain drift	200ppm/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 Enhanced
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) XY2-100 Enhanced with status feedback
(4) The mirror of 1064nm can stand max laser power

2. LSRM-Q Series 2D Scanning Systems

LSRM-QUANTUM 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.

	LSRM-10-Q10	LSRM-12-Q12	LSRM-14-Q14
Aperture	10mm	12mm	14mm
Beam displacement	13mm	14.5mm	18.1mm
Tracking error time	130us	160us	160us
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	660cps
High quality	500cps	410cps	410cps
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 Enhanced	XY2-100 Enhanced	XY2-100 Enhanced
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)	100W	100W	100W
Dimension	114x87x94mm	114x87x94mm	134x109x107mm

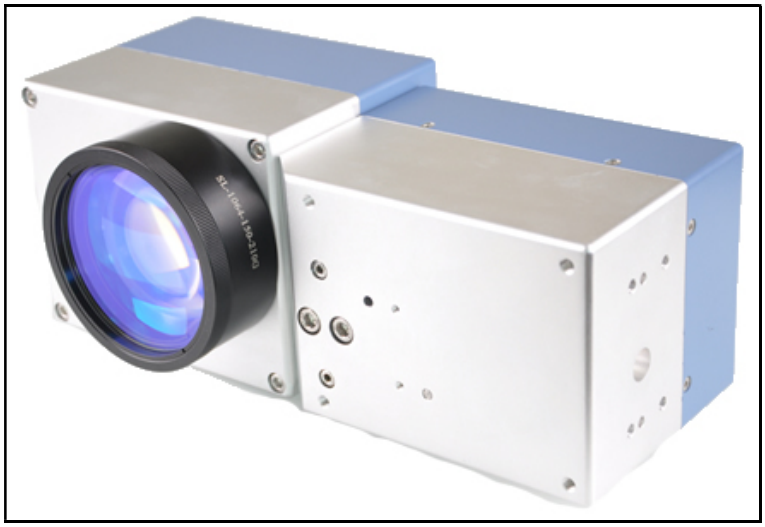
(1) with F-Theta objective, f=160mm
(2) single-stroke characters of 1mm height
(3) XY2-100 Enhanced with status feedback
(4) The mirror of 1064nm can stand max laser power

Water cooling is added to LSRM-Q20/Q30 scanning systems to increase the stability of the systems .

	LSRM-Q20	LSRM-Q30
Aperture	20mm	30mm
Beam displacement	26.5mm	36.5mm
Tracking error time	360us	550us
Offset drift	30urad/K	30urad/K
Gain drift	50ppm/K	50ppm/K
Marking speed	1m/s	0.7m/s
Positioning speed	6m/s	3m/s
Writing speed		
Good quality (1)	320cps	220cps
High quality (2)	210cps	150cps
Repeatability	<15urad	< 15urad
Drift over 8 hours (After 30min warm-up)	< 0.1mrad	< 0.1mrad
Typical scan angle	40 degrees	40 degrees
Interface	XY2-100 Enhanced	XY2-100 Enhanced
Operating temperature	25°±10°	25°±10°
Power requirements	±15V DC, 150W	±15V DC, 150W
Driver mode	Digital	Digital
Resolution	16Bit	16Bit
Max laser power (3)	1000W	5000W
Dimension	170x140x130mm	195x150x165mm

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

3. LSRM-QPT Series Post-Scanning Systems

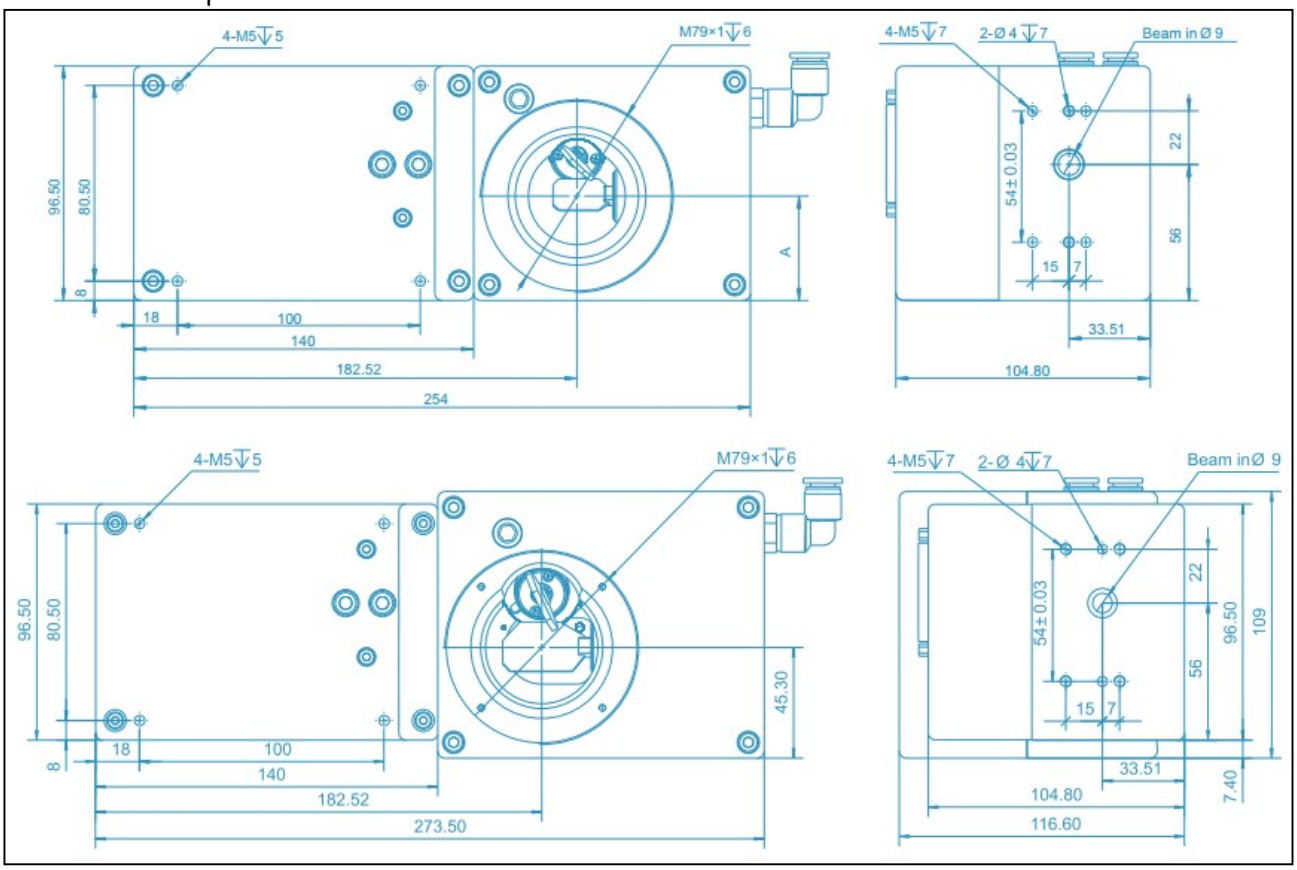


This solution includes a 2D galvo scanner system LSRM-Q series, a dynamic focusing unit Proton series, F-theta lens and a controller LSRM-UMC4. It uses the post-objective scanning technology, the working volume is about 150*150*45mm (with the 210mm F-theta lens). Their advantages are fast marking speed,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

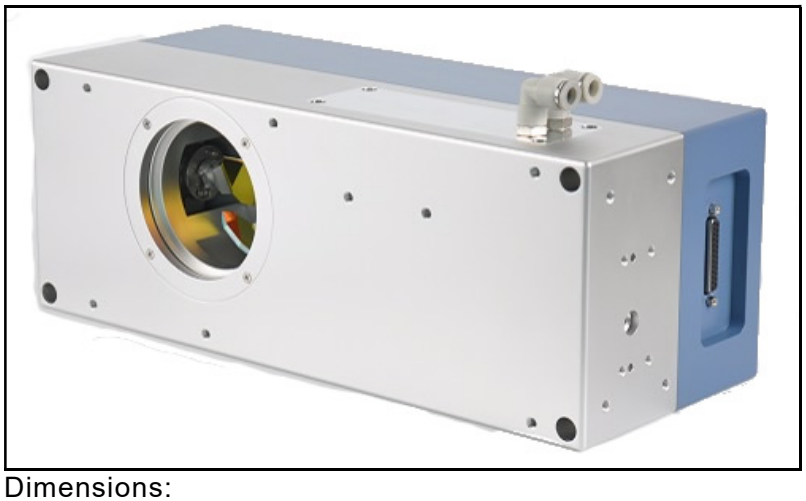
Remarks: (1) Focal length of the f-theta lens is 210mm. (2) Focal length of the f-theta lens is 100mm.

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.

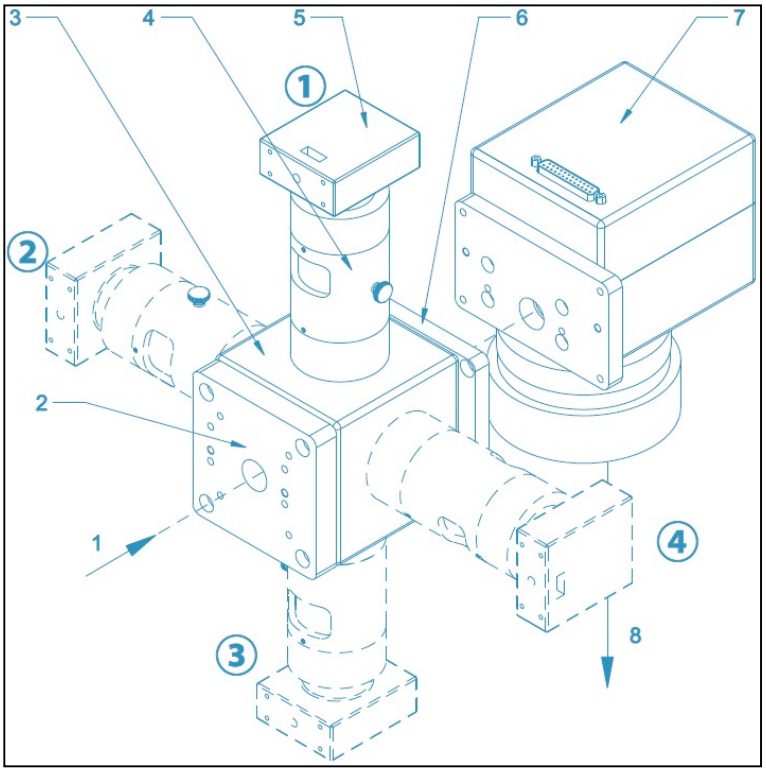
Working Principle:
Illumination light reflected from the surface of the workpiece passes through achromatic F-theta, galvo scanner, beam splitter, CCD lens to reach the CCD sensor. Adjust beam splitter position to compensate the error of machining and assembly to ensure the optical path of the laser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

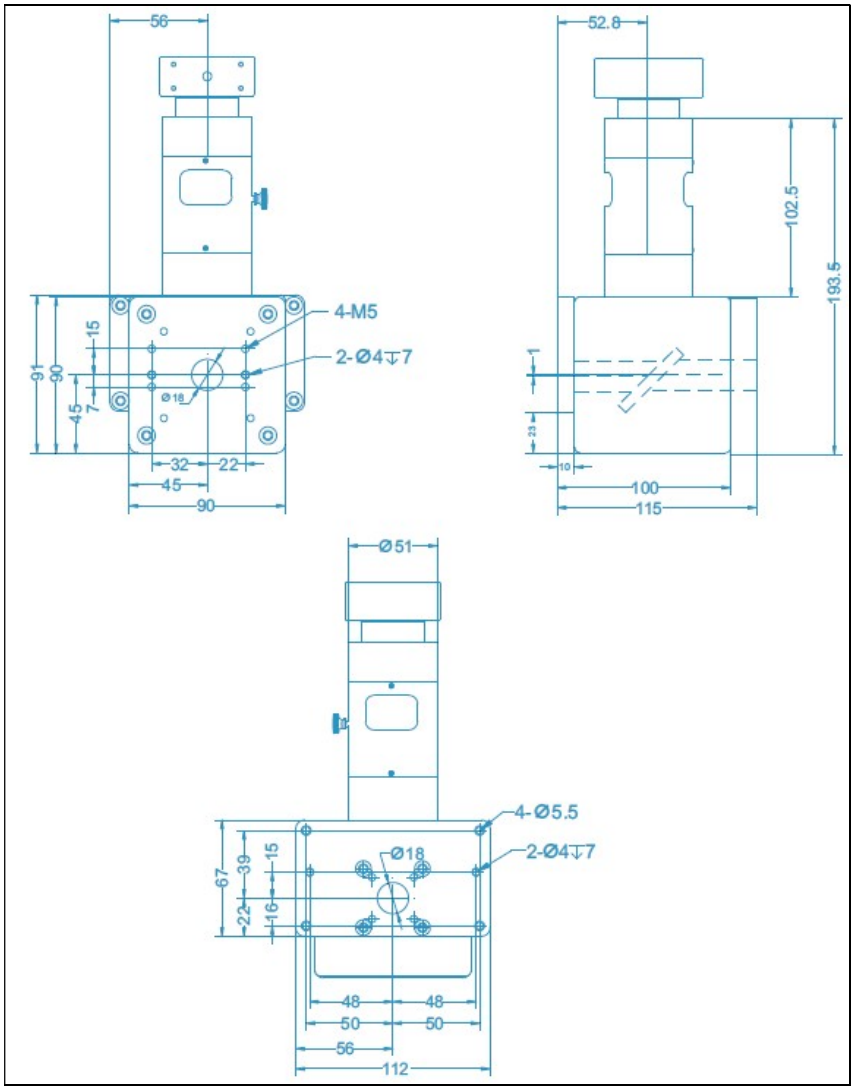
Other Parameters:

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



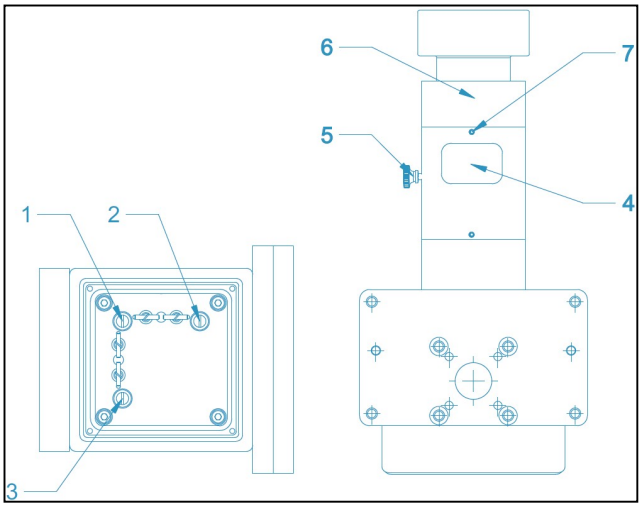
1. Entering beam
2. Beam-entrance side camera adapter
3. Camera adapter
4. CCD objective
5. CCD camera
6. Beam-exit side camera adapter
7. Scan head
8. Exit beam

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.



LSCT-MV Series Laser Marking Heads

Our next generation of 2-axis scan heads feature a compact, industrial design with improved throughput and uptime. Designed for easy system integration due to its compact size and industry-standard interfaces,

LSCT-MV series laser marking heads are well-suited for a variety of marking and coding processes. Specifically those that require high throughput and consistent, reliable quality when repeating marks. They are ideal for non-contact marking of logos, alpha-numeric codes, barcodes, graphics, expiration dates, and many other applications. It has passed numerous extreme condition tests to ensure reliability and safety and is IP50 rated.

Next generation 2-axis scan heads with improved performance:
• Easily integrated into existing systems due to its small size and support of industry standard interface and connectors
• High quality character marking resulting from improved electronics and tuning design
• Tested to perform under extreme conditions to ensure high quality and reliability

Fast Character Marking Performance
Use LSCT-MV when coding applications which require high throughput; the short step response and tune design are optimized for short vectors like in character marking.

Uniform Line Spacing
Achieving uniform line spacing through bi-directional hatching increases throughput by up to 50%, compared to uni-directional hatching. The precise line spacing ensures uniform laser power density on the surface and evenly “fill” shapes like logos or graphics.

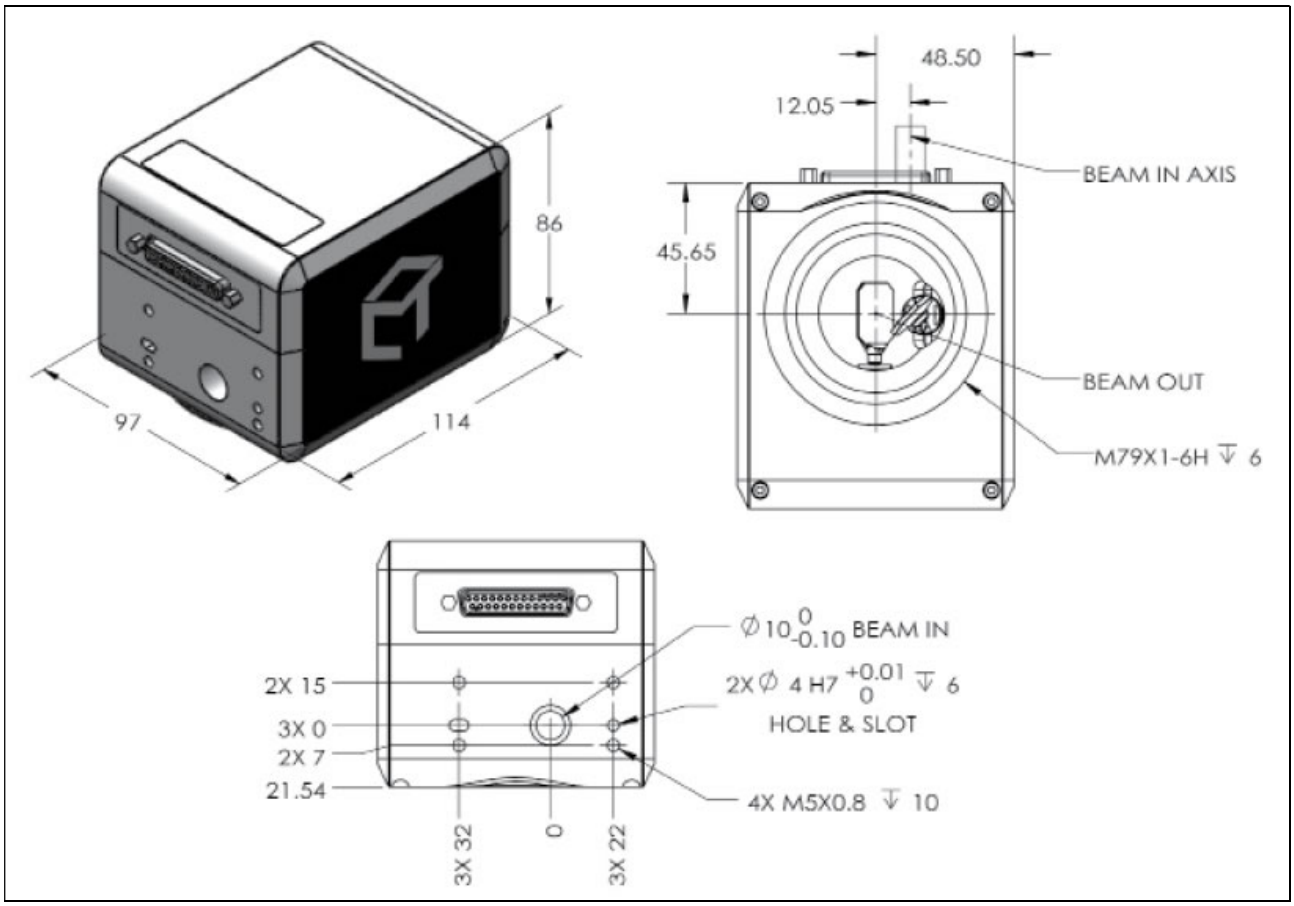
Easy System Integration
Our small system design enables a reduced system footprint for easy integration. Its industry standard interface and input options enable easy replacement option as well as a flexible system integration.

Improved Marking Throughput with our Controller
Users can achieve improved marking throughput with variable poly delay enabled through our Controller, resulting in significant impact in jobs which have corners, arcs and circles. The typical CPS performance is about 50% higher.

Specifications

Highlights	Compatible with a majority of lasers for processing a wide variety of materials and products.
Wavelength Options[1]	CO_2: 9.2 - 10.6 µm Fiber: 1040 - 1090 nm Green: 532 nm Check with factory UV: 353 - 357 nm Check with factory
Mirror Aperture	10mm
Scan Angle	± 20°

Step Response[2] (µsec)	<210
Typical Marking Speed[3] (m/s)	3
Repeatability (µrad)	<3.5
Command Resolution	16-bit
Long Term Drift[4]	Offset: <100 µrad; Scale: <150 ppm
Thermal Drift	Offset: <20 µrad/°C; Scale: <20 ppm/°C
Modular or Enclosed	Enclosed
Dimension	114x97x86mm
Notes:	All angles are in optical degrees, unless otherwise noted. 1. Supports HeNe laser band. 2. Settling to within 1% of position. 3. With 160mm F-Theta lens. 4. During 24 hours of operation after 30 minutes of warm up, per axis.



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

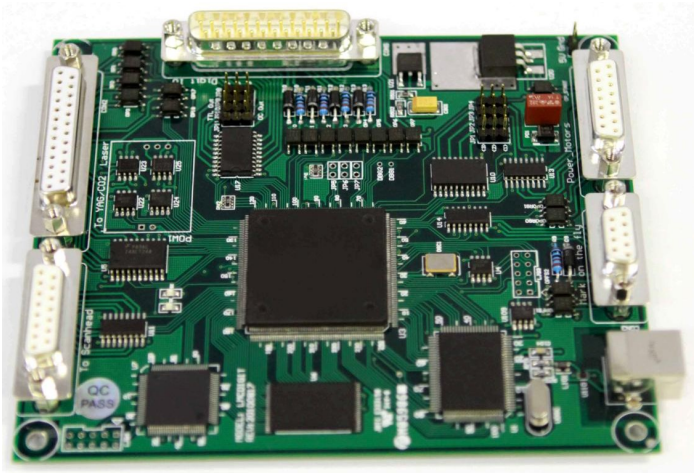
Our marking software has been designed to meet the needs of all types of users of laser marking systems. The software was developed to be a retrofit package for existing systems, or as original software on new systems. The package provides significant advancements over previous laser marking control 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.

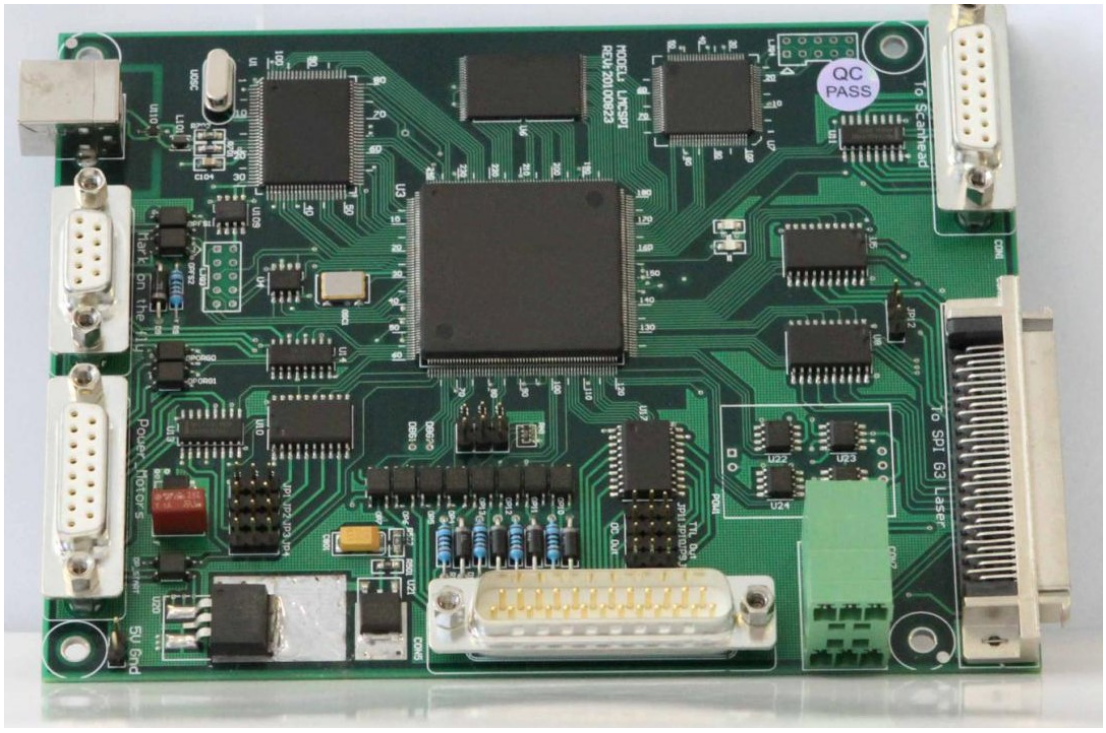
The software can create various objects such as barcode, DataMatrix, text, simple geometrical objects (such as line, rectangle, round-corner rectangle, polygon, circle, ellipse etc), complex graphic objects (such as PLT & BMP files), automatic date coding and alphanumeric serialization.

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)



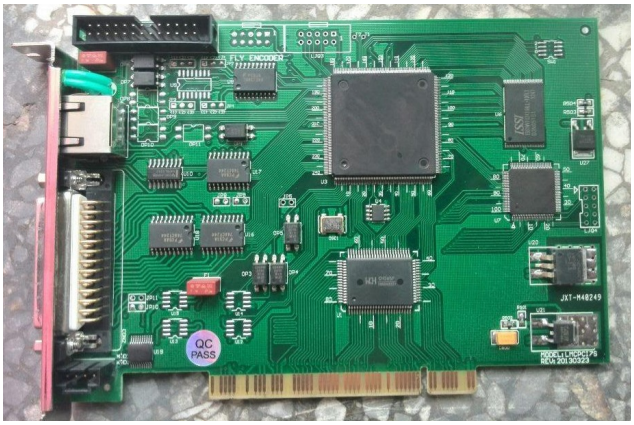
- Use 68-pins SCSI 3 socket, connect fiber laser module via 68-pin cable directly
- Adjustable digital/analog output used for scan head
- Mark-on-fly function with an encoder connected
- Extend axes output: Two Direction/pulse signals, used to control stepping motor or servomotor
- 25 routes general 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:

Software	Type (I/O)	Model	Remarks
EzCAD2 (version 2) XP/WIN7/WiN8/WIN10 32/64Bit	USB	LMC-V4-USBFIBER	For fiber lasers. 12 inputs, 8 outputs, 2 extensions, digital galvo
		LMC-V4-USBDIGI	For CO2/YAG/UV lasers. 16 inputs, 14 outputs, 2 extensions, digital galvo
		LMC-V4-SPI	For SPI lasers, 68-PIN SCSI3. 13 inputs, 8 outputs, 2 extensions, digital galvo
	PCIE	LMC-PEIC-FB	For fiber lasers. DB25, 6 inputs, 2 TTL outputs, 2 extensions, digital galvo
		LMC-PEIC-SZ	For CO2/YAG/UV lasers, ON/OFF, PWM, power/frequency, 10 inputs, 8 TTL output, 2 extensions, digital galvo
	Economic & simple	LMC-LMCV4-FIBER-M	For fiber lasers. 2 inputs, 2 TTL outputs, 1 extension, digital galvo
		LMC-LMCV4-DIGIT-M	For CO2/YAG/UV lasers, ON/OFF, PWM, power/frequency, 2 inputs, 2 TTL outputs, 1 extension, digital galvo
		LMC-FBLI-B-LV1	DB25, 2 inputs, 2 TTL outputs, digital galvo
		LMC-FBLI-B-LV4	DB25, 2 inputs, 2 TTL outputs, digital galvo
	Extensions	LMC-RangeFinding	For measuring distance or fixed distance marking. USB port, 2 inputs + 2 series input, 1 OC output + 2 TTL outputs

		LMC-DynamicFocusing	USB port, 8 inputs, 4 TTL/OC outputs, 2 extensions, digital galvo
		LMC-DAboard	XY2-100, 3 analog outputs
		LMC-Rotation	Digital galvo, RS232, 2D/ratary/scan marking
		LMC-Auto-focusing	USB or RS232
		LMC-Synchronization	4 inputs, 4 outputs
EzCAD3 (Version 3) WIN7/WIN8/WIN10, 64BIT	USB	LMC-DLC2	For all lasers. USB2.0, DB25, XY2-100 (16/18BIT), 4-axis, 10 inputs, 8 outputs
		LMC-DLC2-M4	For all lasers. USB2.0, DB25, XY2-100 (16/18BIT), 4-axis, 10 inputs, 8 outputs
		LMC-DLC2-M6	For all lasers. XY2-100 (16/18BIT), 6-axis, 26 inputs, 24 TTL/OC outputs
		LMC-DLC2-MC	For all lasers. XY2-100 (16/18BIT), SL2-100 (20BIT), 10 inputs, 8 TTL/OC outputs
		LMC-DLC-3D-PRINT	For all lasers. USB2.0, DB25, XY2-100 (16/18BIT), 4-axis, 10 inputs, 8 outputs
	PCIE	LMC-DLC2-PCIE	For fiber laser. USB2.0, DB25, 10 inputs, 8 TTL/OC outputs, XP/WIN7/WIN8/WIN10, 32/64BIT
		LMC-DLC2-PCIE-MP4	DC-3-20PIN, DC3-10PINN-2.54, 4-axis (X,Y,Z,A)
		LMC-DLC2-PCIE-MP6	6-axis (XYZABC), 11 inputs, 8 outputs, 2 PWMs, 4 analog inputs, 4 analog outputs
	DLC extensions	LMC-SPI	Converted to SPI laser
		LMC-IPG	Converted to IPG-E laser
		LMC-STD	Converted to Co2/YAG laser
		LMC-QCW5V	Converted to QCW IPG-YLM laser
		LMC-QCW24V	Converted to QCW IPG-YLM laser

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.

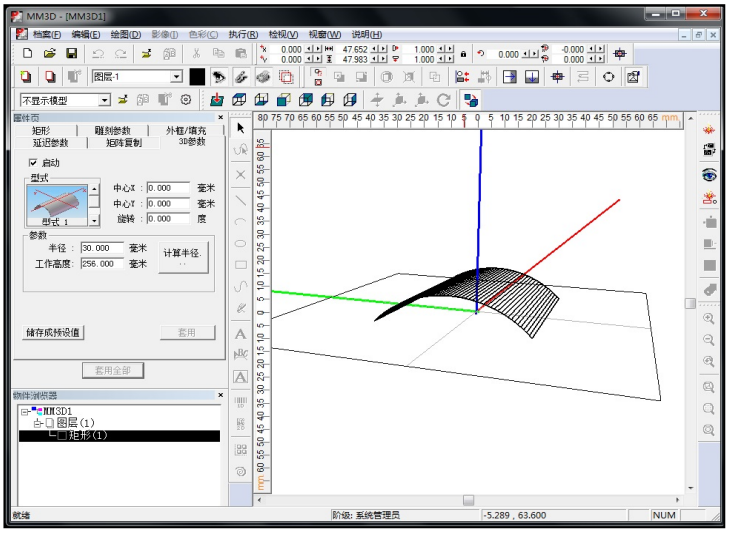
2) STEL-UMC4 card

- 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.

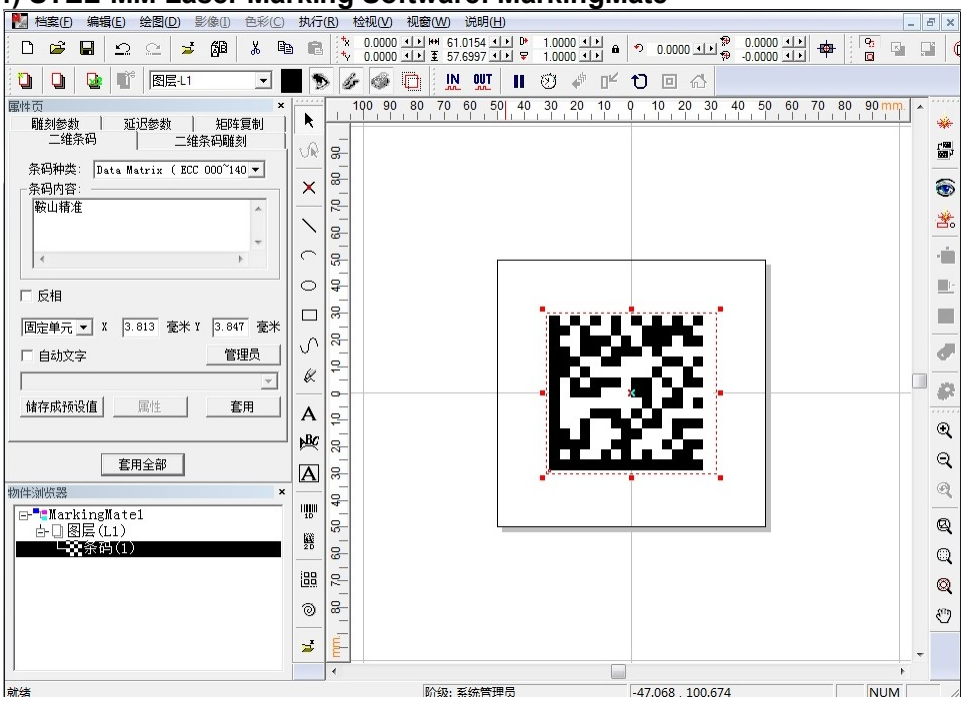
3) STEL-MM3D Laser Marking Software

- 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

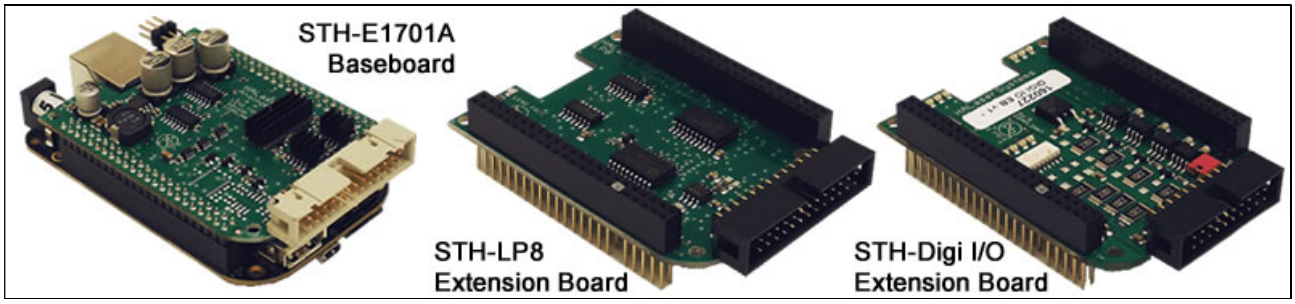
STEL-MM MarkingMate is window-based laser marking software developed which is easy and friendly to use powerful tool. Support variety vector and bitmap graphic, and provide library and OCX omponent for marking solution provider. Easily to mark on plane or non-plane surface, also support variety PCI or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

3. STH Series Mark Control Boards and Software

3.1 STH-E1701A Modular Analogue Scanner Controller

Beside different other, common scanner cards STH-BeamConstruct also supports the only modular scanner controller card worldwide: the STH-E1701A analog scanner card. This is a low-cost scanner card with the smallest ground-size out there* and it is the only one which can be extended by additional boards* providing different signals and outputs. So it is not necessary to buy one fully featured card and to pay for functions that are not needed. Via its extension boards only these functions and I/Os can be added, that are really required.

These extension boards are plugged onto baseboard. Several of them can be combined freely according to required functionality.



STH-E1701A Baseboard is an analogue scanner card which can be extended by options described by below and provides following features:

- 16 bit analogue interface to scanhead with X and Y channel, ±5V and ±10V output
- 3x 12 bit additional analogue outputs, 0..5V output
- ILDA-capable interface
- USB 2.0 and 100 Mbit Ethernet connection
- Online XY grid correction with support for several correction table file formats (like STH-BeamConstruct HD .bco correction files, SCAPS™ .ucf, Scanlab™ .ctb and .ct5, Raylase™ .gcd, GSI/CTI™ .xml, Sunny™ .txt)
- Switching between up to 16 grid correction tables during marking process
- 10 microseconds vector cycle time and resolution (microstep period)
- Command execution time down to 0,5 microseconds
- Realtime processing of laser and scanner signals
- 26 bit internal resolution (for better quality also with 16 bit hardware output)
- Can control nearly every laser type (this may require extension boards as described below)
- 512 MByte DDR3 RAM
- 1 GHz CPU clock
- Support for Micro-SD and Micro-SDHC cards with up to 32 GByte disk space for stand-alone operations
- Internal command and vector data list with more than 17 million entries
- Continuous list concept, no need to swap between buffers
- STH-BeamConstruct PRO license included
- Open source compatibility library that emulates existing programming interface for
- fast and easy usage with existing software (contains e.g. Scanlab™ RTC4™, SCAPS™ USC™/SCI and other compatible interfaces)
- Very small size of about 87 mm x 55 mm
- Shipped with easy to use connection kit
- Hardware/firmware is quality made in EU/Germany

STH-LP8 Extension Board requires STH-E1701A baseboard as described above and provides additional signals for controlling lasers and external equipment. It offers following features and functions:

- STH-LP8 8 bit CMOS level parallel digital output e.g. for controlling laser power
- STH-LP8 latch CMOS level digital output for usage with IPG™ and compatible laser types
- Master Oscillator CMOS level digital output for usage with IPG™ and compatible laser types
- 8 bit 0..5V analogue output e.g. for controlling laser power
- Two laser CMOS level digital outputs for usage with YAG, CO2, IPG™ and compatible laser types (outputs can provide PWM frequency, Q-Switch, FPK-pulse, continuously running frequency, stand-by frequency), running with frequencies up to 20 MHz
- Hardware is quality made in EU

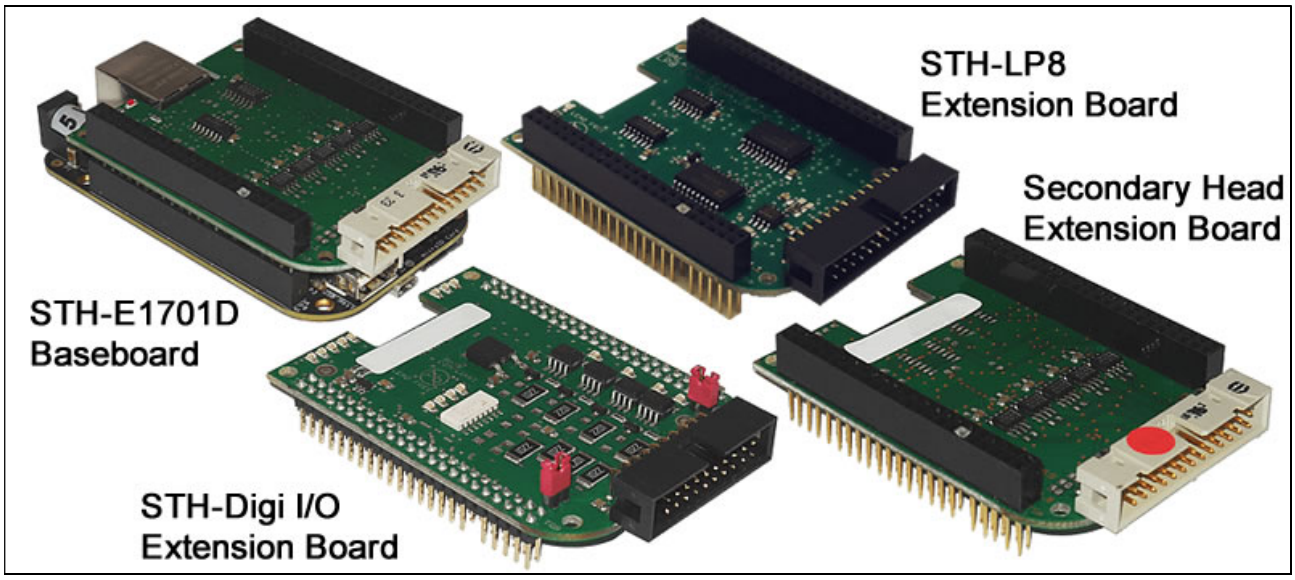
STH-Digi I/O Extension Board requires a baseboard as described above and provides additional I/Os for controlling external equipment. It offers following features and functions:

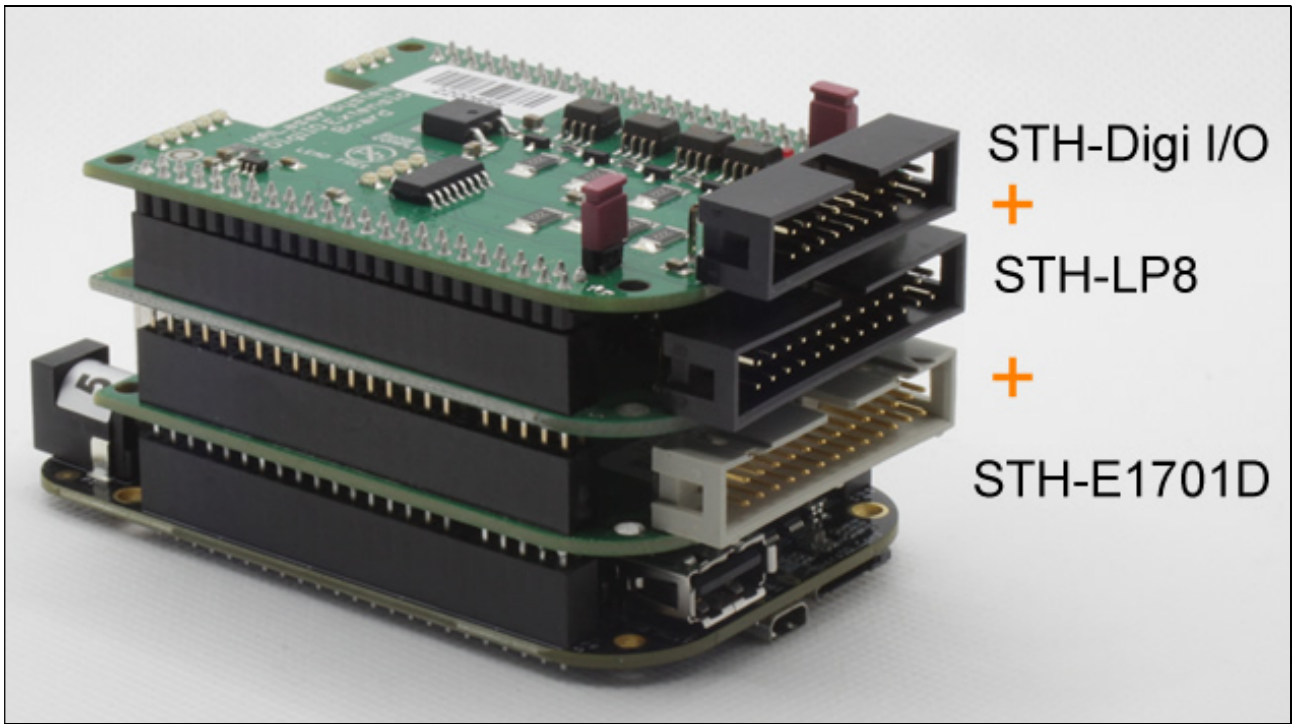
- 8 digital inputs and 8 digital outputs can be switched to opto-insulated mode with external power supply of up to 24 V
- 2 inputs can be used for 90 degree phase-shifted encoder signal for marking on-the-fly applications
- Inputs can be used to select one of up to 256 stand-alone marking jobs stored on microSD card of baseboard
- Hardware is quality made in EU

3.2 STH-E1701D Modular XY2/100 Scanner Controller

Beside different other, common scanner cards STH-BeamConstruct also supports the only modular scanner controller card worldwide: the STH-E1701D digital XY2/100 scanner card. This is a low-cost scanner card with the smallest ground-size out there and it is the only one which can be extended by additional boards providing different signals and outputs. So it is not necessary to buy one fully featured card and to pay for functions that are not needed. Via its extension boards only these functions and I/Os can be added, that are really required.

These extension boards are plugged onto baseboard. Several of them can be combined freely according to required functionality.





STH-E1701D Baseboard is an XY2/100 scanner card which can be extended by options described below and provides following features:

- 16 bit XY2-100 interface to scanhead with X, Y and Z channel
- 18 bit XY2-100-E interface to scanhead with X and Y channel
- 20 bit XY3-100 (LIA202002 standard)interface with X and Y channel
- 100 Mbit Ethernet connection
- USB 2.0 connection
- Online XYZ grid correction with support for several correction table file formats (like SCAPS™ .ucf, Scanlab™ .ctb and .ct5, Raylase™ .gcd, GSI/CTI™ .xml, Sunny™ .txt
- High-definition online XYZ grid correction with STH-BeamConstruct HD correction files (.bco)

- Switching between up to 16 grid correction tables during marking process
- 10 microseconds vector cycle time and resolution (microstep period)
- Command execution time down to 0,5 microseconds
- Realtime processing of laser and scanner signals
- 26 bit internal resolution (for better quality also with 16 or 18 bit hardware output)
- Can control nearly every laser type (this may require extension boards as described below)
- Two laser CMOS level digital outputs for usage with YAG, CO2, IPG™ and compatible laser types (outputs can provide PWM frequency, Q-Switch, FPK-pulse, continuously running frequency, stand-by frequency), running with frequencies up to 20 MHz
- 512 MByte DDR3 RAM
- 1 GHz CPU clock
- Support for Micro-SD and Micro-SDHC cards with up to 32 GByte disk space for stand-alone operations
- Extremely low power consumption of about 1,8 W (Baseboard without any Extension Boards)
- Internal command and vector data list with more than 17 million entries
- Continuous list concept, no need to swap between lists
- STH-BeamConstruct PRO license included
- Open source compatibility library that emulates existing programming interface for fast and easy usage with existing software (contains e.g. Scanlab™ RTC4™, SCAPS™ USC™/SCI and other compatible interfaces)
- Very small size of about 87 mm x 55 mm
- Hardware/firmware is quality made in EU/Germany

STH-LP8 Extension Board requires STH-E1701D baseboard as described above and provides additional signals for controlling lasers and external equipment. It offers following features and functions:

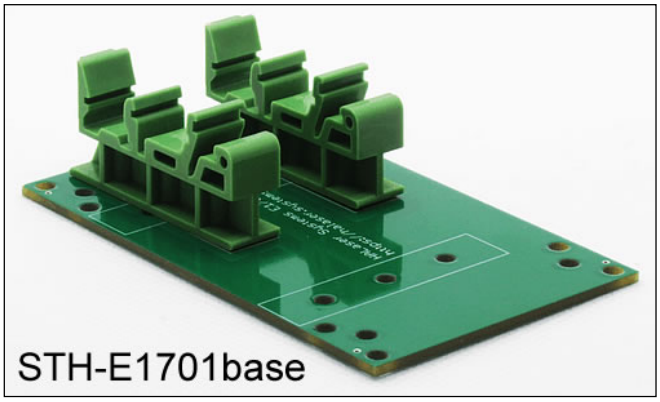
- STH-LP8 8 bit CMOS level parallel digital output e.g. for controlling laser power
- STH-LP8 latch CMOS level digital output for usage with IPG™ and compatible laser types
- Master Oscillator CMOS level digital output for usage with IPG™ and compatible laser types
- 8 bit 0..5V analogue output e.g. for controlling laser power
- Two laser CMOS level digital outputs for usage with YAG, CO2, IPG™ and compatible laser types (outputs can provide PWM frequency, Q-Switch, FPK-pulse, continuously running frequency, stand-by frequency), running with frequencies up to 20 MHz
- Hardware is quality made in EU

STH-Digi I/O Extension Board requires a baseboard as described above and provides additional I/Os for controlling external equipment. It offers following features and functions:

- 8 digital inputs and 8 digital outputs can be switched to opto-insulated mode with external power supply of up to 24 V
- 2 inputs can be used for 90 degree phase-shifted encoder signal for marking on-the-fly applications
- Inputs can be used to select one of up to 256 stand-alone marking jobs stored on microSD card of baseboard
- Hardware is quality made in EU

Secondary Head Extension Board gives possibility to connect an additional scanhead which then works fully parallel to the primary one connected to the baseboard and makes use of the same laser:

- XY2/100 interface for an additional scanhead marking parallel to head of baseboard
- Up to three of these extensions can be used with one STH-E1701D baseboard to connect up to four scanheads
- Hardware is quality made in EU



The optional **STH-E1701base Mounting Kit** allows faster and easier mechanical installation of all types of STH-E1701 controller boards:

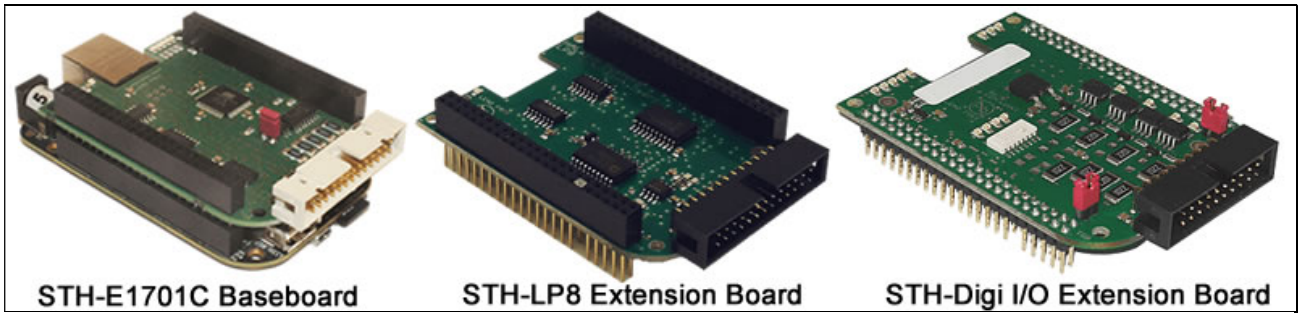
- Comes with DIN rail clamps which can be installed in 2 different positions combined with 2 different orientations resulting in 4 different mounting variants
- STH-E1701 can be mounted on top of STH-E1701base with distance bolts or hex-stands using premanufactured mounting holes
- Can be used also without DIN rail clamps for custom mounting in machines and as top-cover for STH-E1701

3.3 STH-E1701C Modular 5-Axis CNC Controller

Beside common laser scanner controller cards STH-BeamConstruct also supports the only modular, 5-axis CNC controller card worldwide: the STH-E1701C. This is a low-cost CNC controller card with the smallest ground-size out there and it is the only one which can be extended by additional boards providing different signals and outputs. So it is not necessary to buy one fully featured card and to pay for functions that are not needed. Via its extension boards only these functions and I/Os can be added, that are really required.

Due to its future-proof design and its extensive interfaces and software options, it is not limited to laser applications, but it is also able to control mechanical tools such as mills. Our STH-BeamConstruct control application fully supports such machinery, beside the common laser parameters it is also able to handle the STH-E1701C and the specialities of such mechanical tools.

These extension boards are plugged onto baseboard. Several of them can be combined freely according to required functionality.



STH-E1701C Baseboard is a 5-axis CNC controller card which can control lasers as well as other tools with suitable hardware interfaces. It can be extended by options described below and provides following features:

- Support for up to 5 stepper motor axes which can be controlled via step/direction signals
- Can be used with any XY-table/-gantry, XYZ-stage or similar 2..5-axis, motor-driven CNC devices
- Fully synchronous movements of all axes for real 2D/3D/... operations
- 100 Mbit Ethernet connection
- USB 2.0 connection
- Command execution time down to 0,5 microseconds
- Realtime processing of laser and motion signals
- CMOS level on/off output to toggle laser or tool
- Can control nearly every laser type (this may require extension boards as described below)
- Power ramping output to modulate laser power or tool speed during movements
- CMOS level inputs to start or stop operations by hardware signal
- 5 optionally opto-insulated reference-switch inputs which can be operated with up to 24 V external power
- 512 MByte DDR3 RAM
- 4-core system with 1 GHz clock on main CPU core
- Extremely low power consumption of about 1,8 W (Baseboard without any Extension Boards)
- Internal command and vector data list with more than 17 million entries
- Continuous list concept, no need to swap between lists
- STH-BeamConstruct PRO license included
- Very small size of about 87 mm x 55 mm
- Hardware/firmware is quality made in Germany

STH-LP8 Extension Board requires the STH-E1701C baseboard as described above and provides additional signals for controlling lasers and external equipment. It offers the following features and functions:

- STH-LP8 8 bit CMOS level parallel digital output e.g. for controlling laser power
- STH-LP8 latch CMOS level digital output for usage with IPG™ and compatible laser types
- Master Oscillator CMOS level digital output for usage with IPG™ and compatible laser types
- 8 bit 0..5V analogue output e.g. for controlling laser power

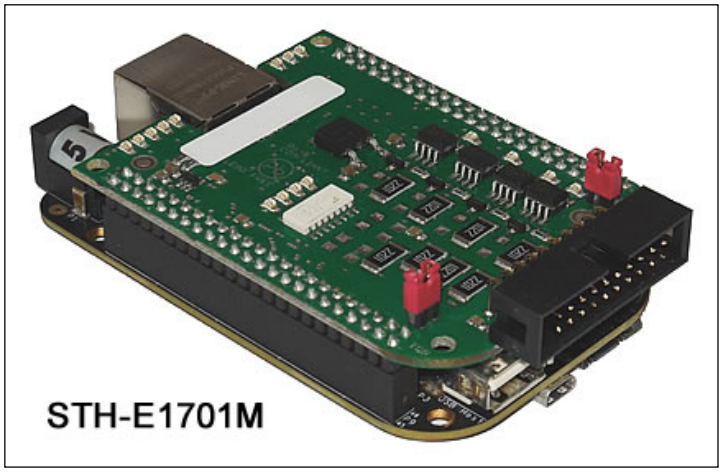
- Two laser CMOS level digital outputs for usage with YAG, CO2, IPG™ and compatible laser types (outputs can provide PWM frequency, Q-Switch, FPK-pulse, continuously running frequency, stand-by frequency), running with frequencies up to 20 MHz
- Hardware is quality made in EU

The **STH-Digi I/O Extension Board** requires a baseboard as described above and provides additional I/Os for controlling external equipment. It offers following features and functions:

- 8 digital inputs which can be switched to opto-insulated mode with external power supply of up to 24 V
- 8 digital outputs which can be switched to opto-insulated mode with external power supply of up to 24 V
- Hardware is quality made in Germany

3.4 STH-E1701M 4-Axis Motion Controller

Beside some other motors and controller cards STH-BeamConstruct supports the STH-E1701M stepper motor controller board. This is a Ethernet and USB controllable card which provides following features:



- 100 Mbit Ethernet connection
- USB 2.0 connection
- Command execution time down to 1 microsecond
- Support of up to four independent motion axes
- Generates step and direction pulses for usage with stepper motor driver
- 500 kHz maximum step clock
- Linear, exponential and s-shaped acceleration modes
- Freely definable referencing modes with auto-searching for reference switch
- Realtime processing
- Programmable via binary API (via DLL/Windows or .so/Linux) or ASCII command interface (via Telnet/Ethernet or serial interface/USB)
- 512 MByte DDR3 RAM
- 1 GHz CPU clock
- Extremely low power consumption of 1,9 W (non-insulated mode)
- 8 digital outputs providing either CMOS logical levels or electrically insulated outputs via external power supply for controlling 4 motors via step and direction signals
- 8 freely usable digital inputs expecting either CMOS logical levels or electrically insulated inputs via external power supply for usage with limit-/reference switches or encoder inputs
- Two decoders for evaluation of axis position via quadrature encoder signal
- Alternative operation mode: jog-control (manual/stand-alone), signals at inputs start movement of related axes
- Alternative operation mode: I/O controller card with 8 independent digital outputs and 8 digital inputs
- Very small size of about 87 mm x 55 mm
- Hardware/firmware is quality made in EU/Germany

Summary

Part number/combination	Descriptions
STH-E1701D baseboard	XY2-100/XY3-100 controller for CO_2 and YAG, can be optionally extended with 1x LP8, 1x DigiIO and/or 1..3x Secondary Head Extension
STH-E1701D equipped with STH-LP8 and STH-Digi IO Extension	XY2-100/XY3-100 controller for CO_2, YAG, MOPA and others plus 8 digital in- and outputs, can optionally control up to four stepper motor drivers
STH-Digi IO Extension for STH-E1701C or STH-E1701D	Extends STH-E1701D by 8 digital in- and outputs, can optionally control up to four stepper motor drivers
STH-LP8 Extension for STH-E1701C or STH-	Adds STH-LP8, Latch. MO and 5V analogue output for control of MOPA lasers and others

E1701D	
Secondary Head Extension for STH-E1701D	Adds possibility to connect an other, paralle lrunning scanhead to STH-E1701D up to 3 scan heads.
STH-E1701C Baseboard	5-axis CNC controller for CO2 and YAG, can be optionally extended with 1x LP8 and/or 1x DigiIO
STH-E1701base Mounting Kit	Mounting kit for easy mechanical installation of STH-E1701D, STH-E1701C and STH-E1701M controllers in machines and e.g. on standard DIN rail

Combinations

	STH-LP8 Extension	STH-Digi IO Extension	Secondary Head Extension	STH-E1701base
STH-E1701A	X	X		X
STH-E1701C	X	X		X
STH-E1701D	X	X	X (up to three)	X
STH-E1701M				X

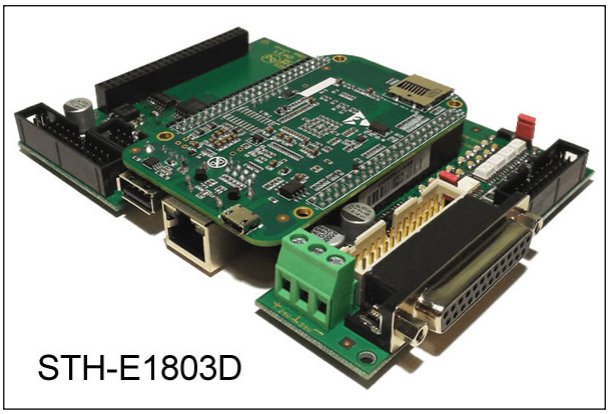
3.5 STH-E1803D Compact XY2/100 and XY3/100 Scanner Controller

The STH-E1803 controller is not a successor or replacement of the STH-E1701D Modular Scanner Controller but an own product with a different area of application.

Technically it is fully compatible with a STH-E1701D controller with STH-LP8 Extension and Digi I/O Extension plus additional:

- Two analogue 0..10 V outputs, plus
- A serial RS232/RS485 interface, plus
- Better performance, plus
- Scanhead power supply provided via controller

Now all incorporated in one compact card. With all these features it is still a low-cost scanner card which can be used with all XY2-100, XY2-200, XY2-100E, XY2-200E and XY3-100 compatible scanheads.


STH-E1803D

The STH-E1803 Controller provides following general features:

- Can be used with any scanhead with XY2-100, XY2-200, XY2-100-E, XY2-200-E or XY3-100 (LIA202002 standard) interface
- 100 Mbit Ethernet connection, USB 2.0 connection
- Online XYZ grid correction with support for several correction table file formats (like BeamConstruct HD .bco correction files, SCAPS™ .ucf, Scanlab™ .ctb and .ct5, Raylase™ .gcd, GSI/CTI™ .xml, Sunny™ .txt)
- Fast online switching between up to 16 grid correction tables
- 10 microseconds vector cycle time and resolution (microstep period), command execution time down to 0,5 microseconds
- Realtime processing of laser and scanner signals
- 26 bit internal resolution (for better quality also with 16 or 18 bit hardware output)
- 512 MByte DDR3 RAM, 1 GHz CPU clock
- Extremely low power consumption of about 2 W (without scanhead power supply)
- Internal command and vector data list with more than 20 million entries
- Continuous list concept, no need to swap between lists
- BeamConstruct PRO license included
- Compact size of about 125 mm x 100 mm
- Quality made in EU/Germany

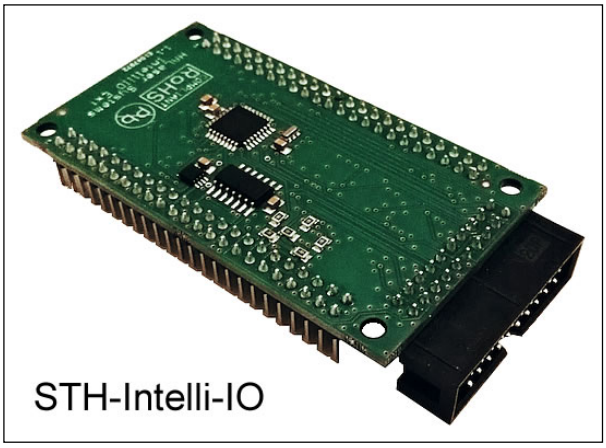
Beside of that it provides following connectivity features and interfaces:

- 16 bit XY2-100 interface to scanhead with X, Y and Z channel
- 18 bit XY2-100-E interface to scanhead with X, Y and Z channel
- 20 bit XY3-100interface to scanhead with X and Y channel

- Two laser CMOS level digital outputs for usage with YAG, CO2, IPG™, SPI™ and other compatible laser types (outputs can provide PWM frequency, Q-Switch, FPK-pulse, continuously running frequency, stand-by frequency), running with frequencies up to 20 MHz
- STH-LP8 8 bit CMOS level parallel digital output e.g. for controlling laser power
- STH-LP8 latch and Master Oscillator CMOS level digital output for usage with IPG™ and compatible laser types
- 2x 12 bit 0..10 V analogue outputs e.g. for controlling power of SPI™ lasers
- 8 digital inputs and 8 digital outputs can be switched to opto-insulated mode with external power supply of up to 24 V
- 2x2 inputs can be used for 90 degree phase-shifted encoder signals for 1D and 2D marking on-the-fly applications
- Digital inputs can be used to select one of up to 256 stand-alone marking jobs stored on microSD card of baseboard
- RS232/RS485 serial interface
- Can be powered with 12..24 V with direct supply to scanhead to save additional wiring
- Support for Micro-SD and Micro-SDHC cards with up to 32 GByte disk space for stand-alone operations

The optional STH-Intelli-IO Extension Board...

- Can be plugged to E1803D expansion connector
- Offers additional 3x 12 bit 0..5V analogue inputs for multi-purpose data acquisition
- Makes use of own microcontroller so that special, customised applications can run fully parallel on the board


STH-Intelli-IO

In digital I/O mode:

- Provides 8 general purpose digital outputs and 6 general purpose digital inputs (0/5 V)

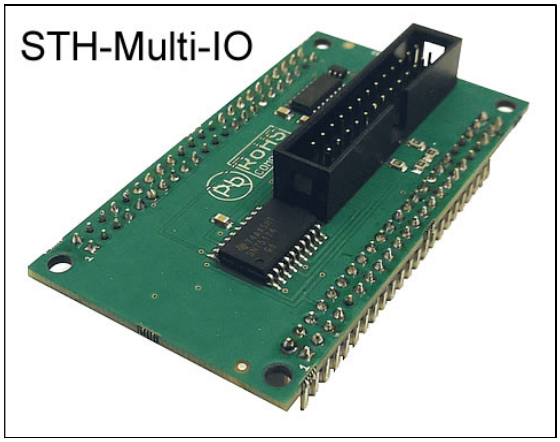
In motion control mode:

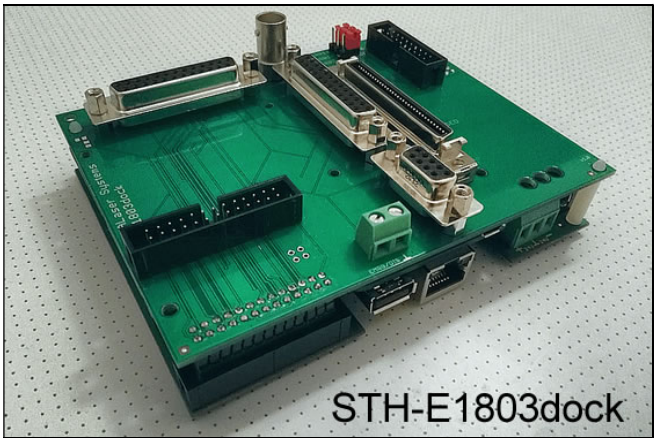
- supports up to four stepper motor axes, controlled via step- and direction signals
- up to 39 kHz jitter-free step frequency (45 kHz maximum step frequency)
- moves all four axes at the same time
- movements possible fully parallel to laser/scanner operation

The optional STH-Multi-IO Extension Board...

- Can be plugged to STH-E1803D expansion connector
- Provides a 2D XY2-100(E)/XY3-100 secondary head interface to connect a second scanhead which works fully parallel to the primary one
- Comes with a second RS232/RS485 serial interface which works fully independent from the first one on the STH-E1803D baseboard
- Offers 3x 12 bit 0..5V analogue inputs for multi-purpose data acquisition

Please note: the STH-Multi-IO expansion can not be used together with the STH-E1803dock!


STH-Multi-IO

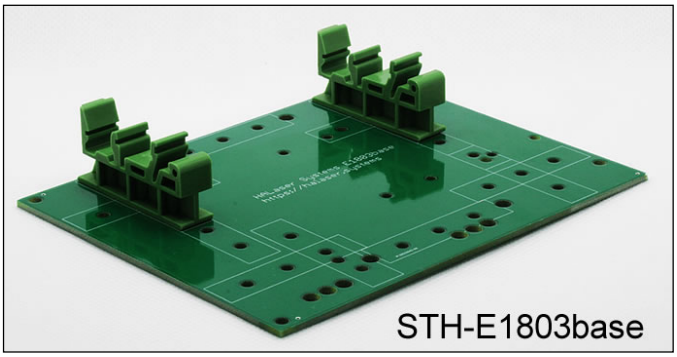

STH-E1803dock

The optional STH-E1803dock Extension Board provides an easy and simple way to connect different laser types with a 1:1 cable connection. The STH-E1803dock is a full-size extension which is plugged on very top of the STH-E1803D controller. Using this breakout-board connection of a laser is done within minutes as only some standard cables need to be plugged. It is available in several variants which can be used for different families of laser types each:

- STH-E1803dock MOPA can be used for digitally controlled master oscillator/power amplifier laser types like IPG™ YLP, MaxPhotonics™ MFP, JPT™ YDFLP, Raycus™ RFL and compatible
- STH-E1803dock YLM can be used for analogue controlled master oscillator/power amplifier laser types like IPG™ YLM and compatible
- STH-E1803dock SPI can be used for SPI™ G3/G4/redENERGY™, TRUMPF™ TruPulse nano™ and compatible fiber lasers
- STH-E1803dock CO2/YAG can be used for PWM/Q-Switch based laser types
- STH-E1803dock Combined (shown in picture) can be used for digitally and analogue controlled master oscillator/power amplifier laser types, SPI G4 lasers, CO2 and YAG lasers (via BNC connector)

The optional **STH-E1803base Mounting Kit** allows faster and easier mechanical installation of an STH-E1803D controller board:

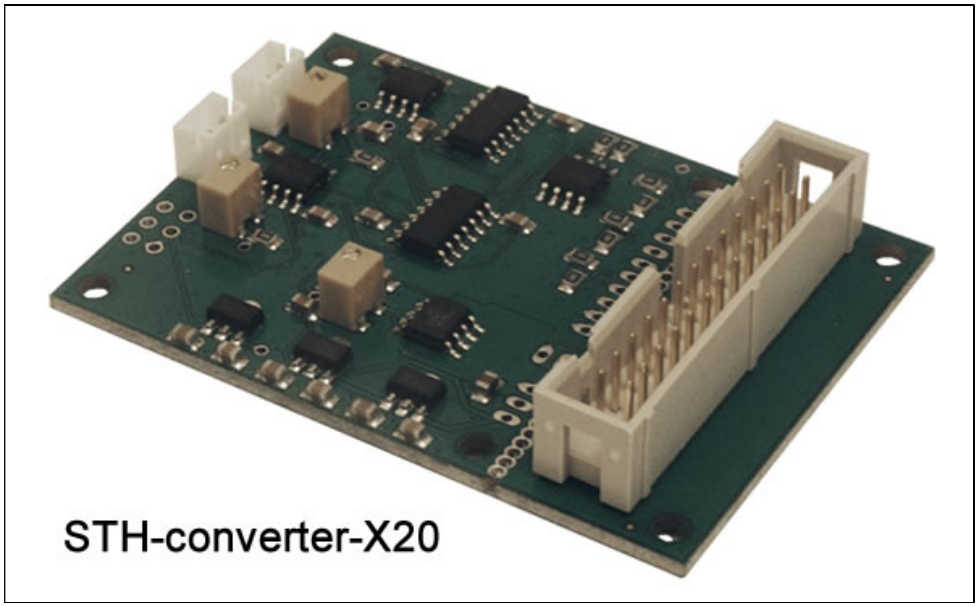
- Comes with DIN rail clamps which can be installed in 6 different positions and 4 different rientations
- STH-E1803D can be mounted on top of STH-E1803base with distance bolts or hex-stands using premanufactured mounting holes
- Can be used also without DIN rail clamps for custom mounting in machines and as top-cover for STH-E1803D



Summary

Model/combination	Descriptions
STH-E1803D	XY2-100/XY2-200/XY3-100 scanner controller board, can be extended by STH-Intelli-IO- or STH-Multi-IO-Extension
STH-E1803D equipped with optional STH-Intelli-IO extension	XY2-100/XY2-200/XY3-100 scanner controller board, extended by 6 digital in- and outputs or 4 stepper motor axes via STH-Intelli-IO extension board
STH-E1803D equipped with optional E1803dock	XY2-100/XY2-200/XY3-100 scanner controller board, extended by E1803dock which allows easy connection via simple 1:1 cables
STH-Intelli-IO extension board	Can be used to control 4 stepper motor axes or 6 digital in- and outputs, provides 3 analogue inputs for process data measurement
STH-Multi-IO extension board	Can be used to connect a second, parallel scanhead, provides a second, separate serial interface (RS232 and RS485) and 3 analogue inputs for process data measurement
STH-E1803base Mounting Kit	Mounting kit for easy mechanical installation of STH-E1803D controller in machines and e.g. on standard DIN rail, provides several mounting positions and orientations to choose from

3.6 20 Bit XY3-100 Analogue Converter (STH-converter-X20)



The converter is an adapter module to operate analogue scanheads together with a XY3-100 scanner controller card. It is fully adjusted, ready to be used and needs to be electrically connected only for operation. It provides the following features:

- XY3-100input signal
- -5V..+5V analogue output with 20 bit resolution
- wide range power supply: +-10V .. +-24 V
- simple 1:1 connection with E1803D controller card possible
- full operation with any other XY3-100 scanner controller
- instant-on, no bootup time after power-up
- small size of 62x45 mm (can be shrinked to 45x45 mm if necessary)

So it can be used to connect a XY3-100 digital controller board to an analogue scanhead and will guarantee a low-latency, fully synchronous operation.

The XY3-100 protocol itself is a new, open, future-proof and non-proprietary standard for communication between scanner controller card and scanhead. It provides variable position resolutions in range 16..26 bit and an extended backchannel. It is hardware-compatible to its predecessor XY2-100 and therefore can be implemented in existing hardware via a firmware upgrade easily.

3.7 Hardware Comparison

Following tables give a quick overview about all hardware available. This includes an overview about all electronics and control boards.

Model	STH-E1701A	STH-E1701D	STH-E1701C	STH-E1701M	STH-E1803D
Type	Modular Analogue Scanner and Laser Controller	Modular Digital XY2/100(E) Scanner and Laser Controller	Modular 5-Axis CNC Controller	Motor Controller	Compact Digital XY2/100(E) and XY2/200(E) Scanner and Laser Controller
Controllable Devices / Interfaces	* Analog Scanhead * Laser (may require extensions) * Stepper Motors (requires Digi I/O Extension Boardand power driver)	* XY2/100 Scanhead * XY2/100E Scanhead * Laser (may require extensions) * Stepper Motors (requires Digi I/O Extension Boardand power driver)	* XY/XYZ/5-Axis CNC Gantry/Table * Laser (may require extensions) * Additional Stepper Motors (requires Digi I/O Extension Boardand power driver)	* Stepper Motors (requires power driver)	* XY2/100 Scanhead * XY2/100E Scanhead * XY2/200 Scanhead * XY2/200E Scanhead * Laser * Stepper Motors (requires power driver) RS232/RS485
Interface to Scanhead	±2,5..10 V (analogue)	XY2/100 (digital) 26 pin			XY2/100 (digital) D-SUB25 and 26 pin
Secondary Scanhead		Up to 3 via Secondary Head Extension Board			One via Multi-IO Extension Board
Interface to Laser	may require extension boards	may require extension boards	may require extension boards		Yes
Motion Axes	up to four independent axes via Digi I/O Extension Board	up to four independent axes via Digi I/O Extension Board	5 CNC axes via baseboard, up to 4 independent axes via Digi I/O Extension Board	up to four independent axes	up to four independent axes via integrated digital IOs
Expandable by Extension Boards	Yes	Yes	Yes		Yes
Supports stand-alone operation	Yes	Yes		Yes, manual jog-mode	Yes
Supports marking on-the-fly	requires Digi I/O Extension Board	requires Digi I/O Extension Board			Yes
STH-BeamConstruct PRO License included	Yes	Yes	Yes		Yes
Power Supply	±15 V	+5 V or USB	+5 V or USB	+5 V or USB	±12..24 V or USB
SLS/3D Printing (Rapid Prototyping)	Yes. Laser via scanhead	Yes. Laser via scanhead	Yes. Laser via XYZ-table/gantry		Laser via scanhead

3.8 Laser Marking Software STH-BeamConstruct

STH-BeamConstruct is an integrated, stand-alone laser marking software solution for nearly all kinds of laser scanner, laser CNC and mechanical CNC applications. It can be used for laser welding, cutting, engraving, marking, natural branding, milling as well as for rapid prototyping / SLS / 3D printing.

It offers more than only the common features, supports several laser scanner and CNC controllers and provides full support for industrial usage. Laser marking or milling projects created within STH-BeamConstruct can be sent to a scanner system or a mill out of the application directly or they can be used within a custom visualisation and process control application created using the OpenAPC software package.

So material processing projects generated with this application can be integrated seamless into existing machine control, there is no need to run the CAD-interface of this application within a production environment.

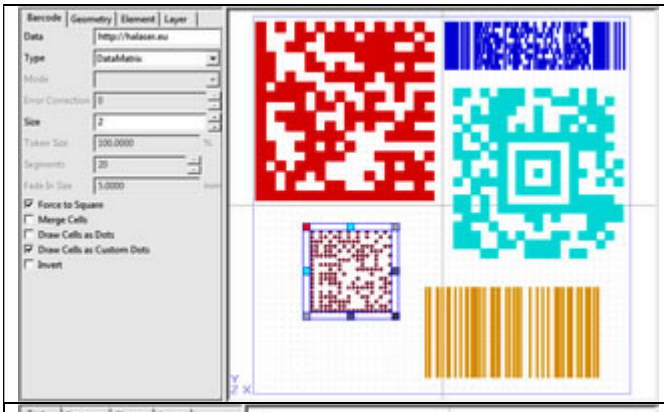
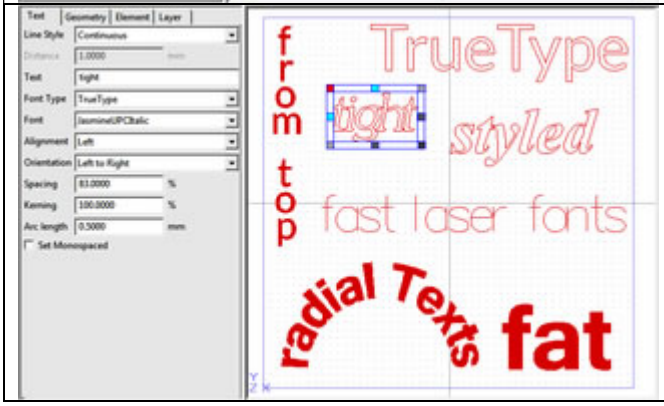
Some of the key features of STH-BeamConstruct:

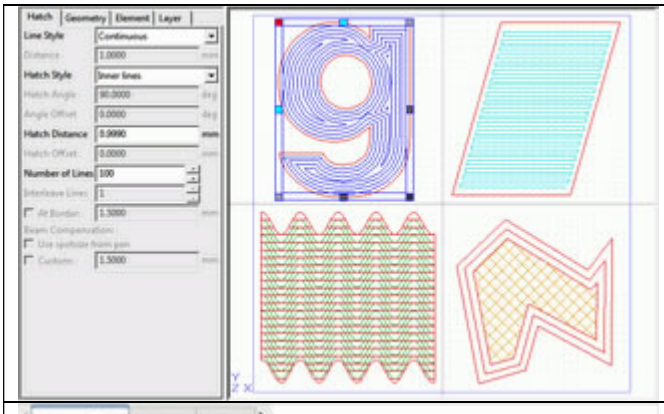
- Several static primitives like lines, circles, spirals, rectangles, triangles, polygons, bezier-curves

- Different additional elements and object-types that can be combined with primitive geometries freely to easily create complex geometries
- Freely definable and combinable filling/hatching of elements using different complex modes and patterns including hatching of three-dimensional elements
- Dynamic elements like serial numbers, date, time, data set externally; they can be combined with (1) Text and barcode elements; (2) Text with support for all TrueType™ fonts and styles as well as speed-optimised laser-fonts; (3) Barcodes with support for DataMatrix, PDF417, EAN, UPC, GTIN, MaxiCode, Aztec, Codabar, USPS, EIHBCC-codes and much more
- Cutting of laser projects into smaller pieces that fit into the workspace and automated processing with integrated control of motion drives
- Smart Interface for Industry 4.0/Smart Factory applications
- Repeated processing of laser vector data with integrated motion controlling (one direction, rotational or X-Y-tables)
- Support for several scanner controller cards like sth-E1701A, STH-E1701C, STH-E1803D, STH-E1701M, Scanlab™ RTC4™ / RTC5™ / RTC6™ / RTCscanalone™, SCAPS™ USC-1™ / USC-2™ / USC-3™ and others more
- Full machine integration and automation possibilities via process control solution that is able to embed fully featured laser marking projects
- Full support for 3D editing and marking, all geometries can be edited and modified in all three dimensions easily without artificial restrictions
- Freely rotateable and movable 3D view to inspect generated laser projects
- Slicing of solid 3D models for 2D layer based rapid prototyping or depth engraving applications
- CAD and WYSIWYG capabilities of laser project editor
- Software available for Windows™ and Linux™
- Can be translated into every language, English, Deutsch, Russian, Chinese and others already available

STH-BeamConstruct - extensive but easy to use features:

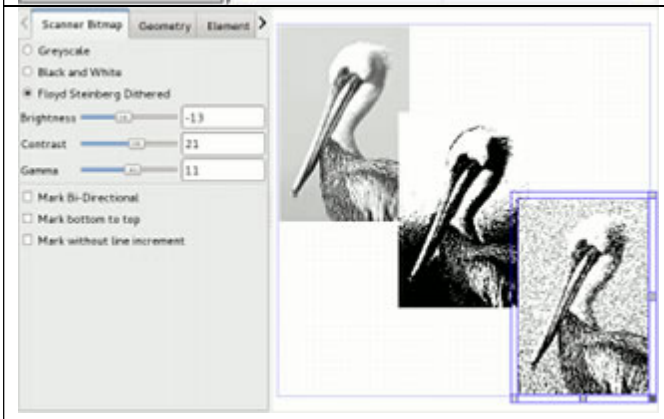
Here shows some of the STH-BeamConstruct key functions but is far away from being a complete feature list. There are several more functions than the ones described here.

	Barcodes ● Support for several 1D and 2D barcodes ● More than 50 international barcode types including DataMatrix, UPC/EAN/GTIN, QR, Aztec, MaxiCode, several EHIBCC-types and others more ● Barcode parameters like size, error correction level, token expansion, inversion, quiet zone and others more can be changed freely (depending on the capabilities of the chosen barcode) ● Barcode segments can be replaced by dots or custom dots for some 2D types
	Texts and Font Styles ● Support for TrueType™ and special high-speed laser style fonts ● Several text effects ● Rotation of texts by using post-processing elements ● Texts can be modified during processing for dynamic content



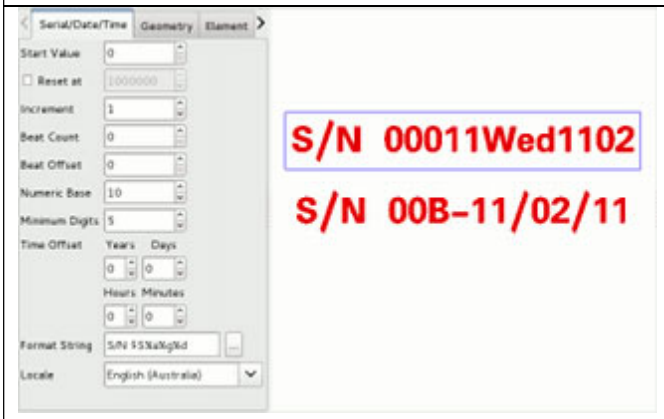
Fill Patterns / Hatching

- Filling of polygon with an unlimited, freely configurable and combineable number of hatch patterns
- Beam compensation according to currently used laser properties
- Post-processing of hatch-lines to create complex effects and patterns
- Several speed- and quality-oriented hatch-styles



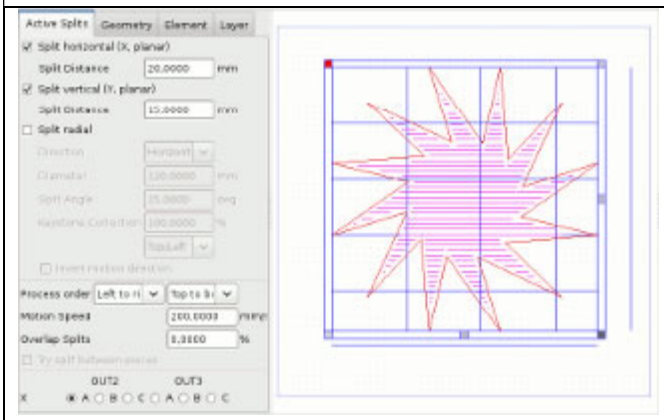
Raster Images / Bitmap Marking

- Import of all common raster image file formats such as GIF, PNG, JPEG, BMP, TIFF
- In-application editing of R/G/B components as well as contrast, brightness and gamma
- Support for real grayscale images, dithered black and white images, hard shadow black and white images
- Imported scanner bitmaps freely scaleable and modifiable
- Import pictures as lighttable background image to use it as template and for drawing vector marking data on top of it



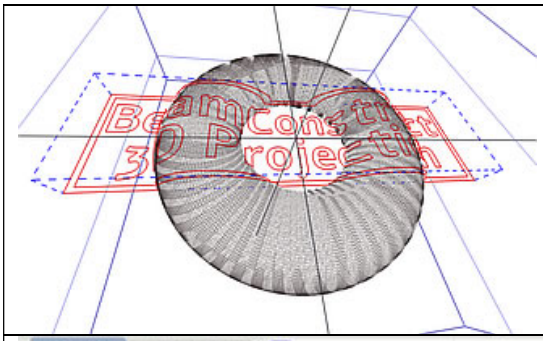
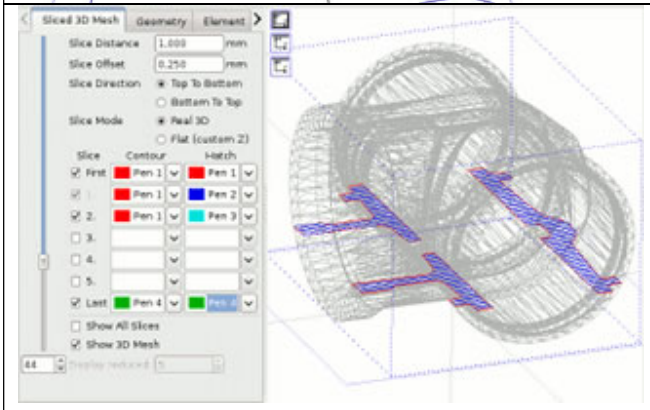
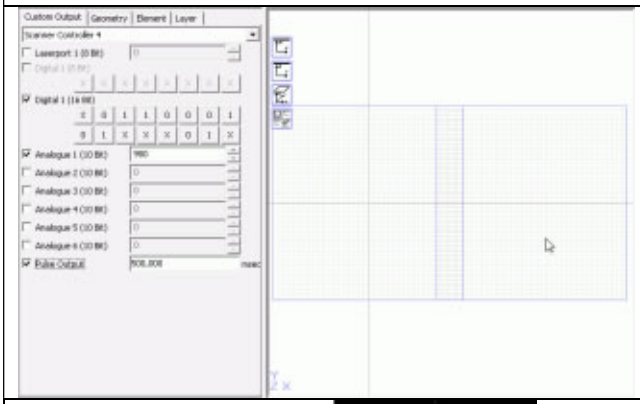
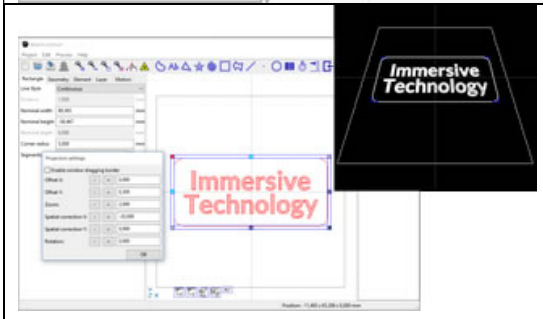
Serial Numbers, Date/Time, Best-Before-Dates

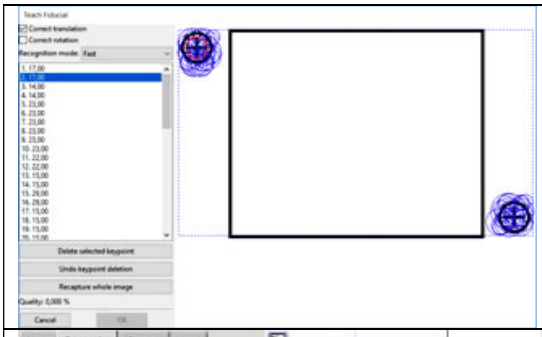
- Support for dynamic content that can be assigned to text and barcode elements to implement serial numbers, date/time information, best-before-dates, tracking information, production information and others more
- Automated and cyclic update before every marking operation
- Format and content freely choosable, text can be combined with counting numbers, date and time information of different styles and formats
- Localised date and time information
- Splitting direction, overlapping, object diameter, keystone correction factor and many other parameters can be defined freely
- Customisable formats of numbers and digits



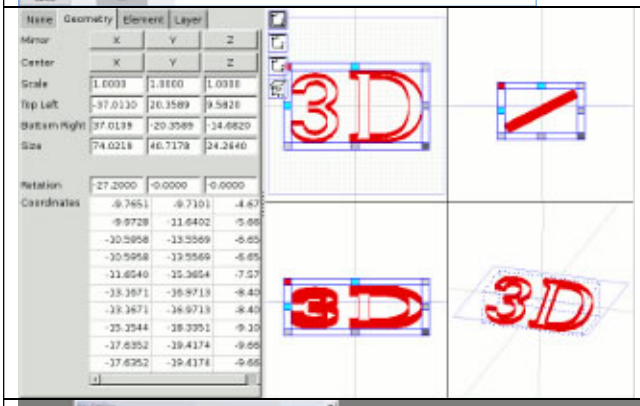
Splitting Geometries into Tiles

- Grouping of elements into a split group to process working pieces larger than the available working area
- Geometries can be splitted one-dimensional (X or Y direction or rotational mode) or two-dimensional (for use with e.g. XY-table)
- Positions where geometries are cut can be edited and modified freely
- Splitted parts are put together during processing by synchronous movements
- Splitting direction, overlapping, object diameter, keystone correction factor and many other parameters can be defined freely
- Split groups support all kind of elements and all combinations of them, vector geometries are cut as well as scanner bitmaps

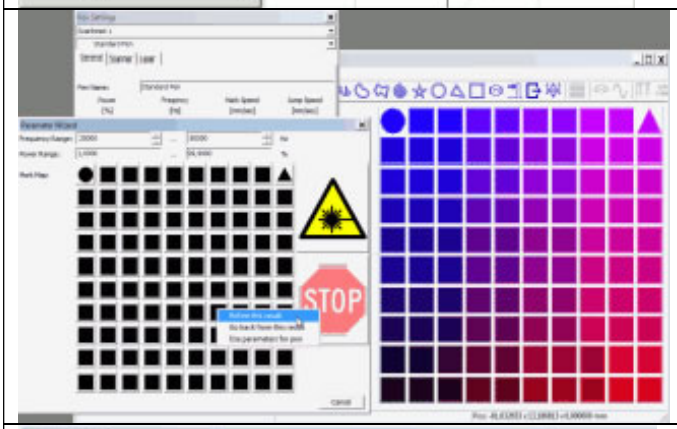
	Projection of geometry to 3D ground shapes ● 3D mesh can be used as ground object ● Geometries then can be projected onto this 3D ground shape ● Can be used with 3D scanheads ● Allows 3D marking on irregular, freely definable surfaces ● Available in version 6.4 or newer
	Slicing of solid 3D models to 2D layers ● Sliced 3D models can be processed layer by layer for depth engraving or rapid prototyping/SLS/SLM/3D-printing applications ● Variable pen definitions for contour and hatch can be defined freely for first and last slice as well as pen-patterns for all other layers ● Support for 2D marking systems, 3rd axis can be done by external device ● Support for 3D marking systems, 3rd dimension is handled by Z axis of scanner ● Rotating hatch patterns, hatch angle can be changed automatically for every slice ● Slice distance and first slice offset freely choosable depending on desired model size and accuracy ● Support for several 3D formats like Surface Tesselation Language™ (STL), RenderWare™ (RWX), WaveFront™ OBJ, Polygon (PLY), Object File Format (OFF), 3D Manufacturing Format (3MF), 3D Studio (3DS), Additive Manufacturing Format (AMF) ● Import and export of already sliced data in Common Layer Interface™ (CLI) format ● Support-structures can be generated automatically or loaded as pre-calculated data (STH-BeamConstruct PRO only)
	Multi-head Support ● Several overlapping or separated working areas supported ● Different scanner controllers can be mixed as well as different laser types and scanheads ● Automatic and speed-optimised distribution of vector data over available heads and working area ● Simultaneous and speed-optimised marking on all available heads ● Support of up to 9 scanheads at the same time (9 in PRO version, up to two in free version
	Immersive Projection View ● Display the current project directly into the working area using a video projector ● Perfect view and adjustment possibilities of the current marking data during machine set-up and production ● Immersive technology to break the current barriers between input data and marking result ● Projectors mounting position and spatial distortion can be adjusted and legalised via software easily



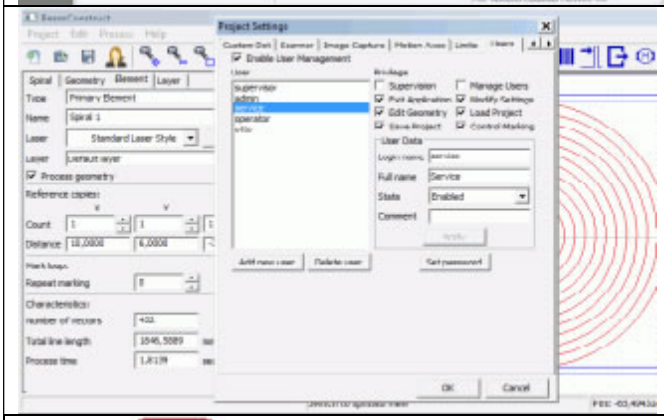
Vision
- Integrated vision system with live background image
- Camera calibration for image distortion
- Fiducial teaching and management
- Automatic fiducial recognition
- Geometry-correction based on fiducials



3D Editing / Split View
- Comfortable editing of 3D data in views from top, front and side
- All editing functions available without limitations in these views
- Additional foreshortened view that can be zoomed, rotated and moved freely to inspect the model from all sides easily
- Split view with all three editing views and the foreshortened view shown at the same time for fast and simple editing also in case of complex models



Pen Parameter Wizard (STH-BeamConstruct PRO only)
- Easy evaluation of suitable pen parameters
- Creates a 2D matrix with varying power and frequency values
- Best marking result can be used for next measurement step or for usage with current pen
- 100 parameter sets can be checked on one go, no more time-consuming experiments are necessary to find best values



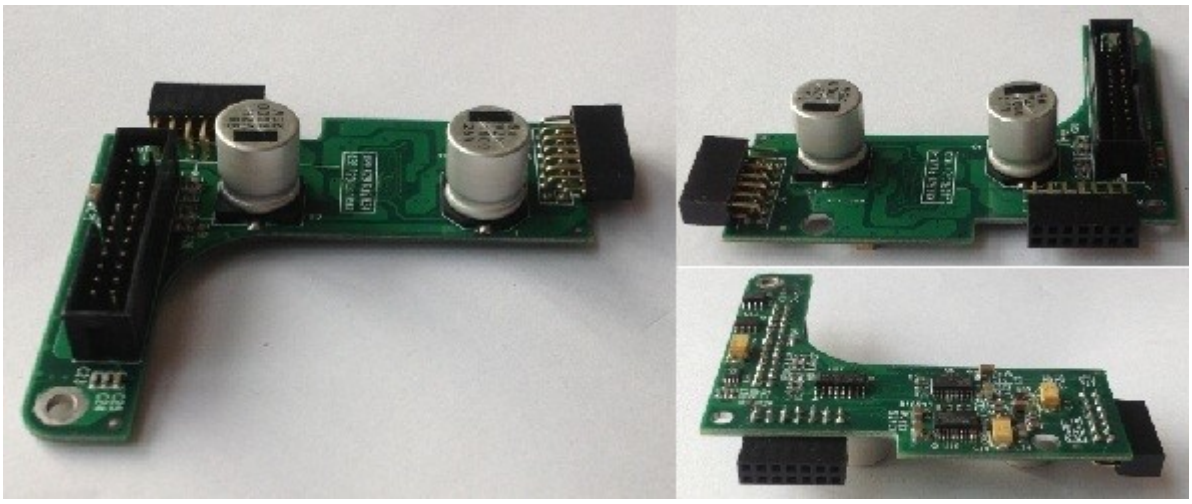
User- and Privilege-Management (STH-BeamConstruct PRO only)
- Create users, apply roles and related privileges to them
- Limit possibilities and functionalities that are accessible for a user
- Avoid users performing operations they are not allowed to do
- Specify password to protect user access
- Access to restricted functions only possible via log-in

Industry 4.0 Smart Interface (STH-BeamConstruct PRO only)
- Easy to use XML interface to get production state and process data from
- Support for MQTT IoT notification protocol
- Can be used to watch the state of STH-BeamConstruct
- Gives one operator the possibility to easily watch several machines or production lines
- Allows easy integration into a smart factory and in automated production environments
- Can be used for traceability purposes
- Free Smartphone-Appavailable to demonstrate the features of the Smart Interface and to watch

	several machines in order to be notified on state changes ● Production line integration and automated operation via Hermesmachine interface (supporting The Hermes Standard protocol version 1.x)

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.

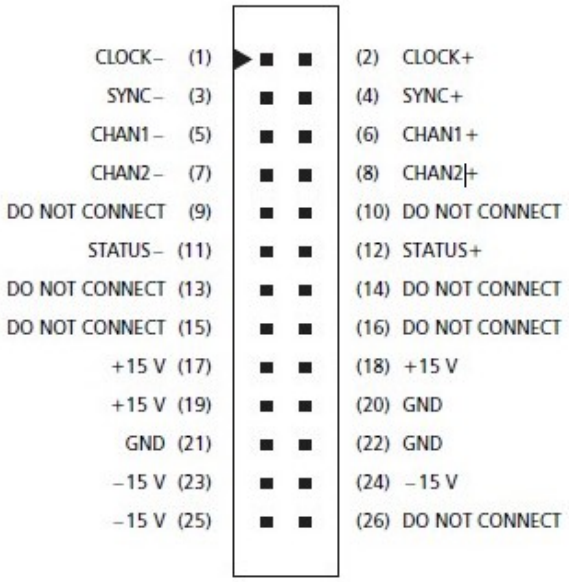


Interface: Digital Singal Input

This series DIGITAL SIGNAL INPUT connector is used for digital signal input according to the XY2-100 standard. The pin-out of this is shown right.

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.

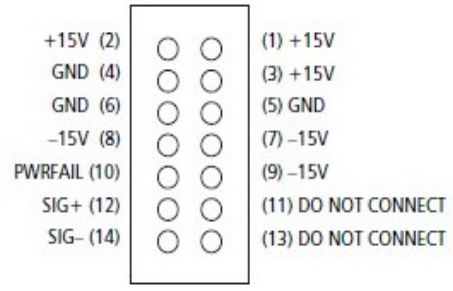


Digital Singal Input

Interface: Power Output

DC+/-15V power to the two driver board is provided by ANALOG POWER output connectors. The pin-out of the connector is shown as right figure.

The ANALOG POWER OF X&Y axis output connectors provide analog output signal in the range of -5V to +5V for controlling the scanners via driver board.



Power Output