



## 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  $\pm 12.5^\circ$  (often  $\pm 10^\circ$  is a safer limit) either side of the non-deflected incidence angle of  $45^\circ$ .

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

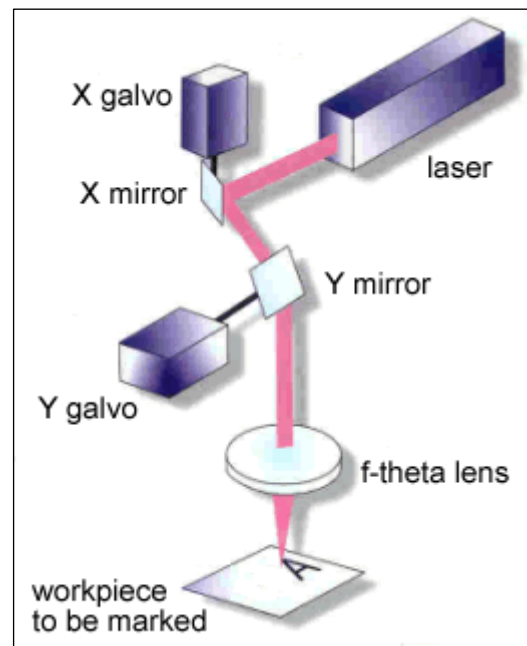
The laser beam will be scanned over an angle  $\theta$ , equal to twice the mirror deflection angle. So, the typical scanned field might be  $\theta = \pm 20^\circ$  in both X and Y directions. ( $\theta = \pm 25^\circ$  would be the usual maximum scanned field). The field size is then approximately  $2F \tan \theta$  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  $\theta$ , 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:



$$d = 13.5QF/D \text{ } \mu\text{m}$$

Example: A TEM<sub>00</sub> beam (Q=1) of 13.5mm (1/e<sup>2</sup>) 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<sub>00</sub> 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<sup>2</sup>) 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<sub>F</sub>, where the definition of full diameter is, to some extent, arbitrary.

For example, a system designer might define D<sub>F</sub> as the measured diameter of a beam print in perspex [plexiglass]. Alternatively, D<sub>F</sub> 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<sub>F</sub>, sufficient to allow for minor misalignment. The length of mirror (1) is determined by the maximum angle of incidence i<sub>max</sub> on the mirror. Let α = (90° - i<sub>max</sub>). Then the mirror length is L1, where L1 = W1/sinα. 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<sup>2</sup> beam diameter (D).

## F-theta characteristic

Lenses described as being 'F-theta', or 'F $\theta$ ', 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  $F \tan \theta$ ). 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. F $\theta$  errors <0.36% are typical for this range, with only the 75mm FL type having a slightly greater value.

## Lens design

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

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

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

## Marking software

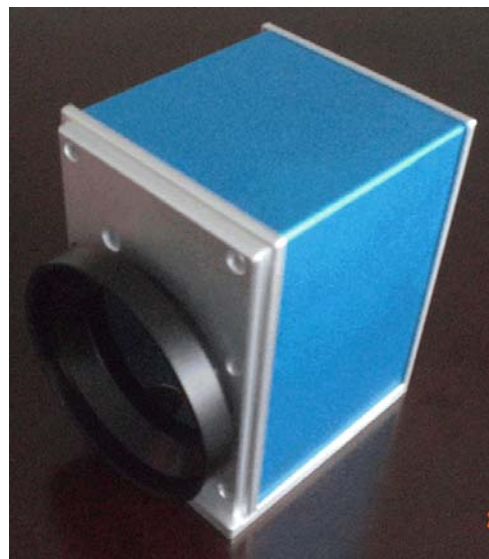
The Window-based marking software supports various fonts, pictures (PLT, DXF, BMP), automated series numbers, barcodes & DataMatrix. The users can easily use AutoCAD or CorelDraw to design their patterns. They also can scan photos or logos and then use marking software to mark.

## Options

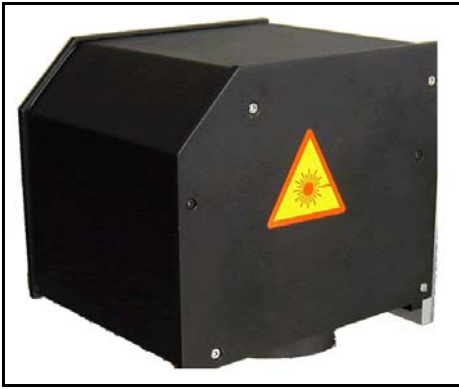
Beam expander



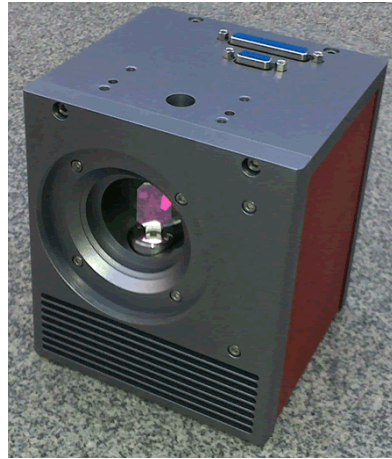
LSST series marking heads (F1 outline)  
dimension A: 128X98X92mm



LSST series marking heads (F2 outline),  
dimension A: 128X98X92mm  
dimension B: 155X118X128mm or  
dimension C: 205X162X178mm



LSST series marking heads (F3 outline)  
dimension A: 155X118X128mm or  
dimension B: 180X145X148mm



LSCT series marking heads

**Description of Part Number:** LSCT-xxxx-yy-zzz-AAAA-BB

LSCT, LSST: LSCT or LSST series marking heads.

xxxx: laser wavelength.

yy: maximum input laser beam diameter.

zzz: marking field, which depends on the used f-theta lens.

AAAA: galvo model number

BB: outlines and dimensions

**CO2 laser marking heads at 10.6um**

Part number	Wave-length um	Max input beam dia. mm	Mark area mm	Focused beam dia. um	Model of galvo	Out line	Dimension LxWxH,mm
LSST-10.6-08-105-8161-1A	10.6	8	105x105	171	OSST8161	F1	128X98X92
LSST-10.6-08-105-8161-2A	10.6	8	105x105	171	OSST8161	F2	128X98X92
LSST-10.6-10-105-8161-1A	10.6	10	105x105	171	OSST8161	F1	128X98X92
LSST-10.6-10-105-8161-2A	10.6	10	105x105	171	OSST8161	F2	128X98X92
LSST-10.6-12-105-8062-2B	10.6	12	105x105	171	OSST8062	F2	155X118X128
LSST-10.6-12-105-8062-3A	10.6	12	105x105	171	OSST8062	F3	155X118X128
LSST-10.6-15-105-8061-3B	10.6	15	105x105	171	OSST8061	F3	180X145X148
LSST-10.6-20-105-8061-3B	10.6	20	105x105	171	OSST8061	F3	180X145X148
LSST-10.6-25-105-3808-2C	10.6	25	105x105	171	OSST3808	F2	205X162X178
LSST-10.6-32-105-3808-2C	10.6	32	105x105	171	OSST3808	F2	205X162X178
LSCT-10.6-12-110-6230	10.6	12	105x105	171	6230		143x123x113
LSCT-10.6-12-110-6231	10.6	12	105x105	171	6231		143x123x113

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

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

Part number	Wave-length um	Max input beam dia. mm	Mark area mm	Focused beam dia. um	Model of galvo	Out line	Dimension (LxWxH, mm)
LSST-1064-08-110-8161-1A	1064	8	110x110	18	OSST8161	F1	128X98X92
LSST-1064-08-110-8161-2A	1064	8	110x110	18	OSST8161	F2	128X98X92
LSST-1064-10-110-8161-1A	1064	10	110x110	18	OSST8161	F1	128X98X92
LSST-1064-10-110-8161-2A	1064	10	110x110	18	OSST8161	F2	128X98X92
LSST-1064-12-110-8062-2B	1064	12	110x110	18	OSST8062	F2	155X118X128
LSST-1064-12-110-8062-3A	1064	12	110x110	18	OSST8062	F3	155X118X128
LSST-1064-15-110-8061-3B	1064	15	110x110	18	OSST8061	F3	180X145X148
LSST-1064-20-110-8061-3B	1064	20	110x110	18	OSST8061	F3	180X145X148
LSST-1064-25-110-3808-2C	1064	25	110x110	18	OSST3808	F2	205X162X178

LSST-1064-32-110-3808-2C	1064	32	110x110	18	OSST3808	F2	205X162X178
LSCT-1064-12-110-6230	1064	12	110x110	18	6230		143x123x113
LSCT-1064-12-110-6231	1064	12	110x110	18	6231		143x123x113

Remark: 1) F-theta lens STY-1064-110-160 is used in above specifications.

2) The above marking heads also can be used in fiber laser marking systems at 1060-1080nm.

#### Nd:YAG laser marking heads at 532nm

Part number	Wave-length um	Max input beam dia. mm	Mark area mm	Focused beam dia. um	Model of galvo	Out line	Dimension (LxWxH,mm )
LSST-532-08-110-8161-1A	532	8	110x110	15	OSST8161	F1	128X98X92
LSST-532-08-110-8161-2A	532	8	110x110	15	OSST8161	F2	128X98X92
LSST-532-10-110-8161-1A	532	10	110x110	15	OSST8161	F1	128X98X92
LSST-532-10-110-8161-2A	532	10	110x110	15	OSST8161	F2	128X98X92
LSST-532-12-110-8062-2B	532	12	110x110	15	OSST8062	F2	155X118X128
LSST-532-12-110-8062-3A	532	12	110x110	15	OSST8062	F3	155X118X128
LSST-532-15-110-8061-3B	532	15	110x110	15	OSST8061	F3	180X145X148
LSST-532-20-110-8061-3B	532	20	110x110	15	OSST8061	F3	180X145X148
LSST-532-25-110-3808-2C	532	25	110x110	15	OSST3808	F2	205X162X178
LSST-532-32-110-3808-2C	532	32	110x110	15	OSST3808	F2	205X162X178
LSCT-532-12-110-6230	532	12	110x110	15	6230		143x123x113
LSCT-532-12-110-6231	532	12	110x110	15	6231		143x123x113

F-theta lens STY-532-110-160 is used in above specifications.

#### Remark:

- The marking field of our standard marking head is 105x105mm (CO2 laser) or 110x110mm (Nd:YAG laser). Other mark fields are available upon request. In fact, the marking field depends on the f-theta lens. Thus you may prepare a few f-theta lenses with different marking fields for your various applications.
- The focused beam diameter is theoretical calculation for reference only and actual focused beam diameter depends on beam expander, f-theta lens and laser.
- The DC power supply for the above marking heads is DCBJ-80-25-2 (+/-25VDC).

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

- Whole marking head, including (1) integrated marking head (galvanometer & its driver, scan mirror, f-theta lens and all mechanical parts. Aligned for use. (2) D/A card LMX-1 & marking software and (3) DC power supply.
- BASIC marking head, including integrated marking head (galvanometer & its driver, scan mirror), DC power supply & all mechanical parts. Aligned for use.

## LSD Series Digital Laser Marking Heads

Beside the above Nd:YAG laser and fiber laser analog marking heads, we bring you a new family of performance economy digital scan heads for fiber laser marking. We offer digital servo technology along with high performance galvanometers in a compact scan head design. These core components are offered with industry standard mechanical bolt patterns, industry standard power and communication pinouts as well as a range of popular apertures, mirror coatings and lenses.

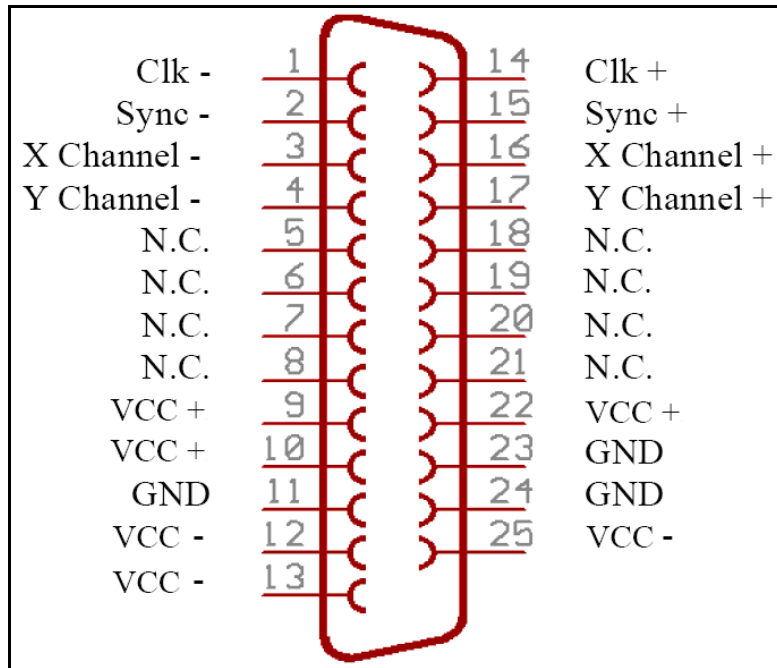
These scan heads are ideal for easy OEM design integration and are also well suited as drop in replacements to reduce total system costs in applications such as marking, processing-on-the-fly, ablating, surface texturing, structuring and more. Our scan heads make performance beam steering more economical than ever for your system design.



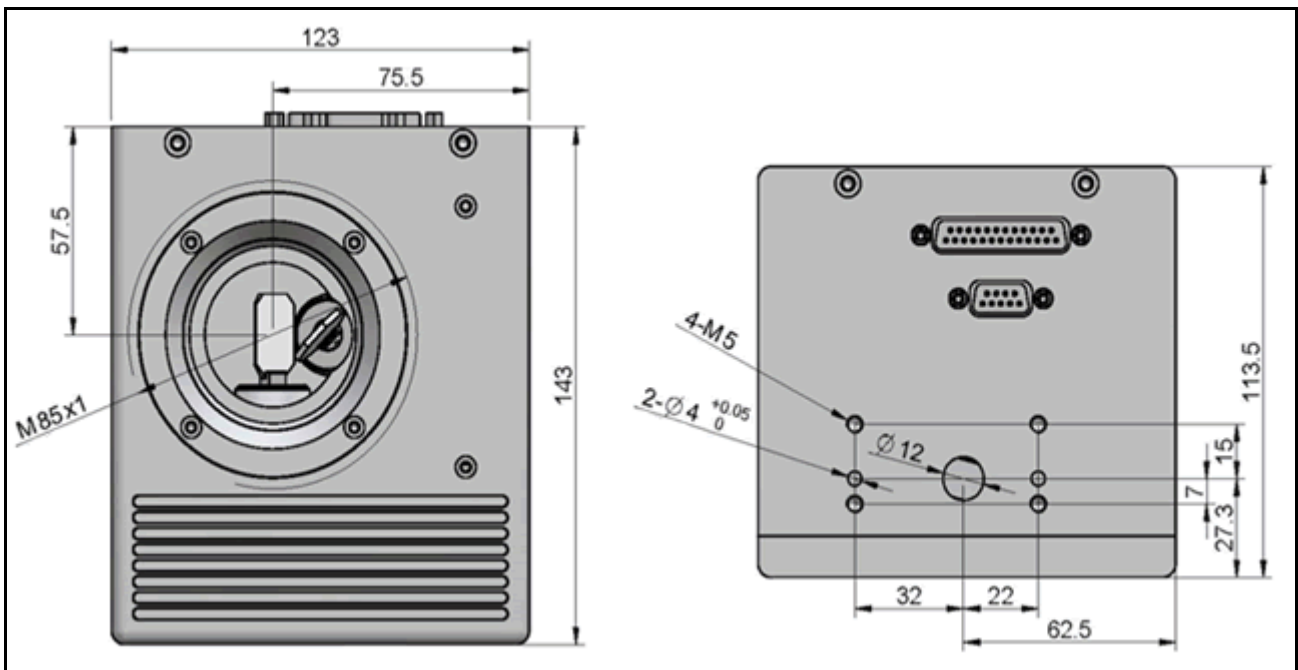
Part number	LSD-F-10-110
Suitable laser wavelength	1060 – 1080 nm
Maximum input beam	10 mm
Step response time	260us
Non-linearity	<0.4% ptp
Optical scan angle	±24°
Repeatability	12 urad
Mark area	110 x 110 mm
Focused beam diameter	18 um
Digital Communication	XY2-100
Input electricity	±15VDC -5A
Dimension (LxWxH)	143x123x113mm

Remark:

- 1) The mark area depends on the f-theta lens used in the head. Here f-theta lens STY-1064-110-160 is used in above specifications.
- 2) The focused beam diameter is theoretical calculation for reference only and actual focused beam diameter depends on beam expander, f-theta lens and laser.
- 3) Our LMC series mark card and software can be used to control the mark head and fiber lasers.



Interface PINs



Mechanical Dimensions

## LSDC Series Digital Scan Heads

We bring you features never before available in a scan head family. Named the LSDC Digital Scan Heads, its performance was defined as “Best in Class” by our customers. It also offers you incredible design flexibility with modular design architecture and tune optimization software. The software allows real time application domain tuning to meet your specific applications needs with the desired balance of speed and accuracy. LSDC digital scan heads combine 16-bit digital servo technology with high performance galvanometers in a compact modular scan head design for multiple configuration options and easy plug and play integration into your laser system. These scan heads are ideal for high speed marking, serialization, bar code marking, data matrix coding, processing-on-the-fly and more.



LSDC digital scan heads deliver high speed beam steering with all the advantages and throughput of digital servo technology for high performance and increased throughput for your system.

### Key Specifications

#### Digital Technology

- USA Galvo Motors
- 16-bit Digital Servo Driver
- Servo Optimization Software

#### Plug & Play

- Analog or Digital XY2-100 Communication Protocol
- Standard Power and Communication Pinouts
- Standard Mechanical Interface
- Standard and Custom Lens Grid Correction Files

#### Complete Family of Sizes

- Clear Aperture Sizes of 7mm,10mm,14mm
- Broad Range of Supported Lenses

#### Modular Design Architecture

- Open Scan Heads
- Enclosed Scan Heads

Part Number	LSDC-7	LSDC-10	LSDC-14
Aperture Size	7 mm	10 mm	14 mm
Beam Displacement	9.79 mm	12.27 mm	18.71 mm
Step Response (1% Full Scale) <sup>1</sup>	200 $\mu$ s	230 $\mu$ s	350 $\mu$ s
Typical Mark Speed <sup>2</sup>	5 m/s	4 m/s	3 m/s
Typical Jump Speed <sup>2</sup>	15 m/s	10 m/s	8 m/s
Typical Writing Speed <sup>2</sup>	1200 cps	850 cps	500 cps
Tracking Error	150 $\mu$ s	150 $\mu$ s	200 $\mu$ s
Long Term Drift (8 hours)	< 0.5 mrad	< 0.5 mrad	< 0.5 mrad
Nonlinearity (Max. % over $\pm 20^\circ$ optical)	0.2	0.2	0.2
Repeatability <sup>3</sup>	28 $\mu$ rad	28 $\mu$ rad	23 $\mu$ rad
Typical Scan Angle	$\pm 22^\circ$	$\pm 22^\circ$	$\pm 22^\circ$
Gain Error	< 5 mrad	< 5 mrad	< 5 mrad
Zero Offset	< 5 mrad	< 5 mrad	< 5 mrad
Skew	< 1.5 mrad	< 1.5 mrad	< 1.5 mrad
Power Requirements	$\pm 15$ VDC max. 3 A	$\pm 15$ VDC max. 3 A	$\pm 15$ VDC max. 3 A
Digital Communication	XY2-100	XY2-100	XY2-100
Analog Communication	+/- 10 V +/- 10 mA	+/- 10 V +/- 10 mA	+/- 10 V +/- 10 mA
Lightning Tuning Port	15 pin (female)	15 pin (female)	15 pin (female)
Weight	~3kg	~3kg	~3kg
Operating Temp	$25^\circ \pm 10^\circ$ C	$25^\circ \pm 10^\circ$ C	$25^\circ \pm 10^\circ$ C
Mirror Coatings	YAG, CO2, Silver	YAG, CO2, Silver	YAG, CO2, Silver

<sup>1</sup> Settling to within 1% of position

<sup>2</sup> Single stroke 1 mm characters with f-160 lens

<sup>3</sup> Root mean square



## LSDC-XP Digital Scan Heads

We bring you the latest technology in high performance scan heads available. LSDC-XP Digital Scan Heads offer the latest state space digital servo technology matched with high performance galvanometers in a compact rugged scan head design. State space servo technology (SSST) has user feed forward commands with trajectory planning using a real time simulator. SSST delivers higher speeds and greater accuracy than traditional PID servo designs. Also, LSDC-XP is self-tuning which means your system is always running with the highest performance and with the greatest efficiency. These core components are offered with industry standard mechanical bolt patterns, industry standard power and communication pinouts as well as a range of popular apertures, mirror coatings and lenses making them ideal for easy OEM design integration. These scan heads are suited for the highest performance applications such as high speed marking, data matrix marking, coding, texturing and more. LSDC-XP Digital Scan Heads give improved beam steering with the superior material processing speed of state space digital servo technology with the greatest efficiency, superior performance and increased throughput for your system.

Part Number	LSDC-20	LSDC-25
Aperture Size	20mm	25 mm
Beam Displacement	25.52 mm	29.82 mm
Step Response (1% Full Scale) <sup>1</sup>	600 $\mu$ s	650 $\mu$ s
Typical Mark Speed <sup>2</sup>	1.4 ms	1.4 ms
Typical Jump Speed <sup>2</sup>	1.5 m/s	1.5 m/s
Typical Writing Speed <sup>2</sup>	7.0 m/s	7.0 m/s
Tracking Error	500 cps	500 cps
Long Term Drift (8 hours)	500 $\mu$ s	500 $\mu$ s
Typical Scan Angle	$\pm 20^\circ$	$\pm 15^\circ$
Gain Error	< 5 mrad	< 5 mrad
Zero Offset	< 5 mrad	< 5 mrad
Power Requirements	$\pm 15$ V DC max. 3 A each	$\pm 15$ V DC max. 3 A each
Digital Communication	XY2-100	XY2-100
Analog Communication	$\pm 5$ V or $\pm 10$ V $\pm 5$ mA or $\pm 10$ mA	$\pm 5$ V or $\pm 10$ V $\pm 5$ mA or $\pm 10$ mA
Lightning Tuning Port	15 pin (female)	15 pin (female)
Weight	~5.0kg	~5.0kg
Operating Temp	$25^\circ \pm 10^\circ$ C	$25^\circ \pm 10^\circ$ C
Mirrors	Be	Be
F-theta Lenses	YAG - 163, 254, 330, 420	YAG - 163, 254, 330, 420

<sup>1</sup> Settling to within 1% of position; <sup>2</sup> Single stroke 1 mm characters with f-160 lens; <sup>3</sup> Root mean square

### Comparison of LSDC and LSDC-XP Digital Scan Heads

#### LSDC-XP Digital Scan Heads

- Key Features
- CTI Galvo Motors
- Highest Speed
- State Space Digital Servo
- Self-Tuning

#### LSDC Digital Scan Heads

- Key Features
- CTI Galvo Motors
- High Speed
- Digital Servo
- TuneMaster

		LSDC-XP Digital Scan Heads			LSDC Digital Scan Heads		
ENTRANCE APERTURE		7	10	14	7	10	14
MAX LASER POWER [W]	YAG	100	150	250	100	150	250
	CO2	50	100	200	50	100	200
WRITING SPEED (cps*)		1300	900	600	1200	850	500
MARKING SPEED (m/s)		5.5	4.5	3.5	5.0	4.0	3.0
KEY ATTRIBUTE		Highest Speed			High Speed		
ACCURACY		BETTER			BETTER		
SERVO TYPE		Digital State Space			16 bit Digital		
TUNING		Self-Tuning			TuneMaster		
COMMUNICATION		XY2-100			XY2-100 or Analog +/-		
POWER INPUT		+/-15 - 28V			+/-15V		

## LSDC-PS Series Scan Heads

### For 7, 10 & 14mm Clear Apertures

Performance-Economy Scan Heads and Unmatched Configuration Flexibility, with ASD Servo Drivers.

#### Key Specifications

ProSeries Analog Technology

- High Quality Galvo Motors
- ASD Analog Servo Drivers
- Factory Tuned

Plug & Play

- Analog or Digital XY2-100 Communication Protocol
- Standard Power and Communication Pinouts
- Standard Mechanical Interfaces
- Standard and Custom Lens Grid Correction Files

Family of Sizes

- Clear Aperture Sizes of 7mm,10mm,14mm
- Broad Range of Supported Lenses

Modular Design Architecture

- Open Scan Heads
- Enclosed Scan Heads

We bring you a new family of performance economy scan heads. Named the LSDC-PS Scan Heads, they offer analog servo technology along with high performance galvanometers in a compact modular scan head design. The modular architecture means these scan heads are available as both open frame or enclosed scan heads with the same components to meet your product development and product improvement needs. These core components are offered with industry standard mechanical bolt patterns, industry standard power and communication pinouts as well as a range of popular apertures, mirror coatings and lenses. These scan heads are ideal for easy OEM design integration and are also well suited as drop in replacements to reduce total system costs in applications such as marking, processing-on-the-fly, ablating, surface texturing, structuring and more. LSDC-PS Scan Heads make performance beam steering more economical than ever for your system design.



Part Number	LSDC-PS07	LSDC-PS10	LSDC-PS14
Aperture Size	6.8mm	10mm	14mm
Beam Displacement	9.79 mm	12.27 mm	18.71 mm
Step Response (1% Full Scale) (1)	200 $\mu$ s	240 $\mu$ s	400 $\mu$ s
Typical Mark Speed (2)	4.0 ms	3.0 ms	2.0 ms
Typical Jump Speed (2)	11 m/s	8.0 m/s	6.5 m/s
Typical Writing Speed (2)	900 cps	650 cps	400 cps
Tracking Error	100 us	120 us	200 us
Long Term Drift (8 hours)	0.5 mrad	0.5 mrad	0.5 mrad
Nonlinearity (Max. % over $\pm 20^\circ$ optical)	0.2	0.2	0.2
Repeatability (3)	17 urad	14 urad	10 urad
Typical Scan Angle	$\pm 22^\circ$	$\pm 22^\circ$	$\pm 22^\circ$
Gain Error	< 5 mrad	< 5 mrad	< 5 mrad
Zero Offset	< 5 mrad	< 5 mrad	< 5 mrad
Skew	< 1.5 mrad	< 1.5 mrad	< 1.5 mrad
Power Requirements	$\pm 15$ VDC 3A each	$\pm 15$ VDC 3A each	$\pm 15$ VDC 3A each
Digital Communication	XY2-100	XY2-100	XY2-100
Analog Communication	+/-10V +/-10mA	+/-10V +/-10mA	+/-10V +/-10mA
Weight	~2.5kg	~2.5kg	~2.5kg
Operating Temp	$25^\circ \pm 10^\circ$ C	$25^\circ \pm 10^\circ$ C	$25^\circ \pm 10^\circ$ C
Mirror Coatings	YAG, CO2, Silver	YAG, CO2, Silver	YAG, CO2, Silver

(1) Settling to within 1% of position

(2) Single stroke 1 mm characters with f-160 lens

(3) Sigma from mean position

(4) All angles are in optical degrees

## LSDC-PSII Scan Heads

We also brings you a new family of high performance, low noise scan heads for highest accuracy and low drift. Named the LSDC-PSII Scan Heads, they offer high performance galvanometers and the latest analog servo technology with up to 3x lower noise than other systems for the highest accuracy performance in a compact rugged scan head design. These core components are offered with industry standard mechanical bolt patterns, industry standard power and communication pinouts as well as a range of popular apertures, mirror coatings and lenses. These scan heads are ideal for easy OEM design integration or as drop in replacements to improve total system performance. These scan heads are suited for applications such as high accuracy marking, scribing, photovoltaic, micro-machining, rapid manufacturing, trimming, engraving, perforating and more. LSDC-PSII Scan Heads give highest accuracy, lowest dither and highest stability beam steering for superior performance and quality for your most demanding precision driven material processing applications.



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### Comparison of LSDC-PS and LSDC-PSII Scan Heads

#### LSDC-PSII Scan Heads

- CTI Galvo Motors
- Highest Accuracy
- Low Dither
- Low Drift

#### LSDC-PS Scan Heads

- CTI Galvo Motors
- Economy
- Flexible Modular Design
- Most Compact Design

		LSDC-PSII Scan Heads			LSDC-PS Scan Heads		
ENTRANCE APERTURE		7	10	14	7	10	14
MAX LASER POWER [W]	YAG	100	150	250	100	150	250
	CO2	50	100	200	50	100	200
WRITING SPEED (cps)		800	600	350	900	650	400
MARKING SPEED (m/s)		2.0	1.5	0.75	2.5	2.0	1.0
KEY ATTRIBUTE		Highest Accuracy			Economy		
ACCURACY		BEST			GOOD		
SERVO TYPE		High Performance Analog			Analog		
TUNING		Pre-Tuned			Pre-Tuned		
COMMUNICATION		XY2-100 or Analog +/-			XY2-100 or Analog +/-		
POWER INPUT		+/-15V			+/-15V		

## Flying Laser Marking Heads

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

The flying marker is widely used in production line to mark brand, date, batch numbers, series number, warranty period, producer name etc. It is similar to ink jet printer to mark the flying products. The products are moving/flying when the laser marks the patterns on the products. The marks are permanent and there is no consumable such as ink.

The maximum flying speed is 100m/min. It suits the applications in medicine, cosmetics, foods, wine, cloth, semiconductor, chemical industries.

In most cases the flying marking is done with a CO2 laser and thus the suitable materials to be marked are paper, leather, acrylic, plastic, wood, painted metal, PCB board etc.

### Description of part number: LSF-xxxx-yy-zzz-AAAA-BB

LSF: LSF series flying mark heads

xxxx: laser wavelength

yy: maximum input laser beam diameter

zzz: marking area zzz x zzz in mm.

AAAA: model of galvos

BB: outline and dimension



### CO2 laser flying marking heads

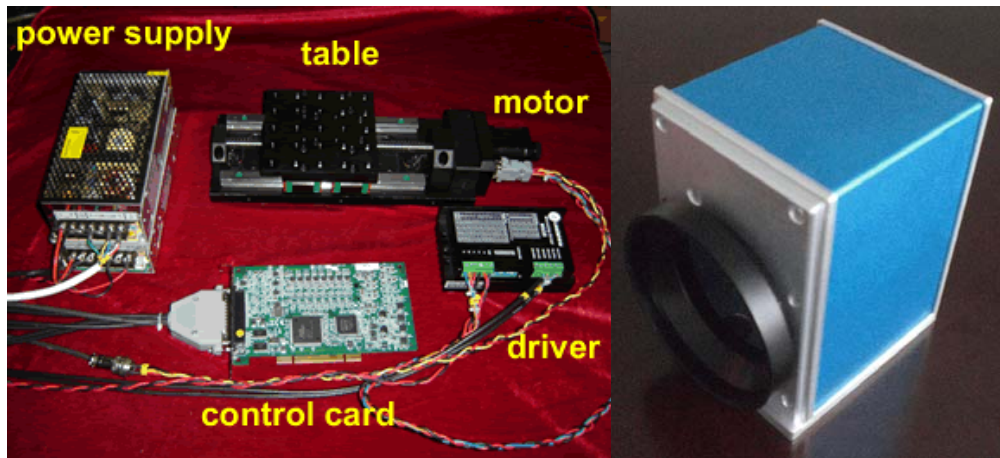
Part number	Wave-length um	Max input beam dia. mm	Mark area mm	Focused beam dia. um	Model of galvo	Out line	Dimension (LxWxH,mm )
LSF-10.6-08-105-8161-1A	10.6	8	105x105	171	OSST8161	F1	128X98X92
LSF-10.6-08-105-8161-2A	10.6	8	105x105	171	OSST8161	F2	128X98X92
LSF-10.6-10-105-8161-1A	10.6	10	105x105	171	OSST8161	F1	128X98X92
LSF-10.6-10-105-8161-2A	10.6	10	105x105	171	OSST8161	F2	128X98X92
LSF-10.6-12-105-8062-2B	10.6	12	105x105	171	OSST8062	F2	155X118X128
LSF-10.6-12-105-8062-3A	10.6	12	105x105	171	OSST8062	F3	155X118X128
LSF-10.6-15-105-8061-3B	10.6	15	105x105	171	OSST8061	F3	180X145X148
LSF-10.6-20-105-8061-3B	10.6	20	105x105	171	OSST8061	F3	180X145X148
LSF-10.6-25-105-3808-2C	10.6	25	105x105	171	OSST3808	F2	205X162X178
LSF-10.6-32-105-3808-2C	10.6	32	105x105	171	OSST3808	F2	205X162X178
LSF-10.6-12-110-6231	10.6	12	105x105	171	6231		184x176x124

#### Remark:

- F-theta lens STSL-10.6-105-150 is used in above specifications. Other mark areas available upon request.
- The focused beam diameter is theoretical calculation for reference only and actual focused beam diameter depends on beam expander, f-theta lens and laser.
- The marking software is LMC-1F.
- Other laser wavelengths available upon request.

## 3D Laser Engraving Head

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



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

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

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

Here laser beam diameter is  $D_1$ , beam diameter after beam expander is  $D_2$ , beam expansion ratio is  $T$ , maximum allowed input beam diameter of scan mirrors is  $D_3$ , maximum allowed input beam diameter of marking head is  $D_4$ , Entrance pupil of f-theta lens is  $EP$ .

$$D_3 \geq D_1 * T \text{ or } D_4 \geq D_1 * T \text{ or } EP \geq D_1 * T$$

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

## 3-Axis Laser Scanning Systems (Dynamic-Focusing Scanning Heads)

**Leading edge performance for large field size and large aperture applications**

3-axis laser scanning system is designed to meet with the requirement of laser scanning with extreme small beam size and large scanning field as well as high scanning flexibility. The applicable lasers are YAG, CO<sub>2</sub> and fiber. It consists of a scan head, linear translator modules, a group of dynamic focusing mirrors, XY scanners, deflection mirrors and a protection window. It takes digital signal and supports XY<sub>2</sub>-100 standard protocol.

Different from the pre-objective scanning system, in a 3-Axis dynamic scanning system, the scanning mirrors are placed after the objective lens. This lens system is made of a movable expanding lens and focusing lens unit. The laser beam first enters an expander lens; the expanded beam will enter the focusing lens unit, then go through the scanning mirrors and reach the focal plane finally. Moving the expander lens with a motorized translator induces the change of the distance between the expander lens and the focusing lens, which makes the focused laser spot move within a two or three-dimensional space, so called "3-Axis scanning".

LSCT series 3-Axis Subsystems provide system designers with a cost effective solution for large field scanning requirements or applications that requires a large scan aperture to achieve a small focused spot size. As field size or scan aperture increases, the size and cost of a flat-field lens rises exponentially. Through the use of a unique high-speed dynamic focus module, LSCT subsystems eliminate the need for this expensive optic.

By placing the focusing lenses before the scan head, the size of the optical elements become independent of field size. This flexible design allows the systems to be readily configured for a wide range of field sizes with a single, economical lens set. To maintain high accuracy over large field sizes, LSCT systems combine advanced thermally regulated moving-magnet scanners with the precision servo controller. LSCT subsystems are available with control software.



- Advanced, high-speed design
- Superior accuracy and stability
- Dynamic z-axis controls focal point for applications in:
  - rapid prototyping
  - converting
  - large-field laser processing
  - precision cutting of flex circuits, adhesive labels packaging, or as a flexible prototyping tool for any die-cut part

Part No.	LSCT1350 (-9, -17)	LSCT1330 (-9, -17)	LSCT2330	LSCT4320	LSCT5320
Wavelength	10.6 $\mu$ m	10.6 $\mu$ m	1064nm	325-355nm	488-532nm
Scan Head Aperture (mm)	50	30	30	20	20
Field Size Range <sup>1</sup> (mm x mm)	100 - 2000	100 - 2000	30 - 3000	100 - 2500	190 - 3000
Input Beam Diameter (mm)	9 or 17	9 or 17	6	1.3 – 3.3	2.4
Max. Power <sup>2</sup> , cw (W)	200, 500+	100,200,500+	150	80	80
Gain Drift (ppm/ °C, typ.)	25	25	25	25	25
Offset Drift ( $\mu$ mR/ °C, typ.)	3	3	3	3	3
Example Field Size <sup>3</sup> (mm x mm)	400	400	400	400	400
Spot Size Diameter <sup>4</sup> ( $\mu$ m)	210	350	40	16	30
Repeatability <sup>5</sup> ( $\mu$ m)	12	12	12	12	12

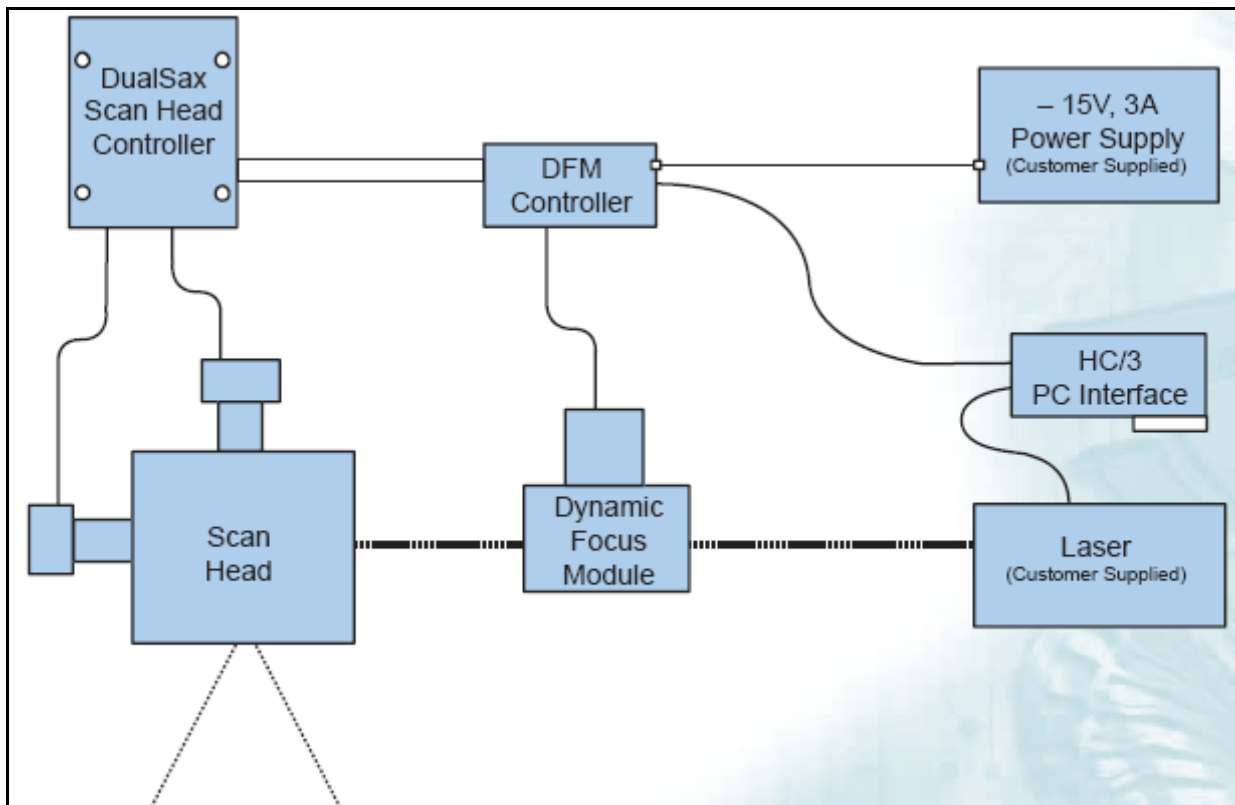
<sup>1</sup>. For Field Size requirements beyond this range contact us.

<sup>2</sup>. Maximum power rating is field size dependent on HPLK13xx-9 and -17 systems. Consult factory for more information.

<sup>3</sup>. Shown to provide examples of achievable spot size and repeatability. Consult factory for specifications at other field sizes.

<sup>4</sup>. Theoretical value based on input beam quality  $M^2 < 1.5$

<sup>5</sup>. Assumes stable environment. Value represents 2-bit resolution in a 16-bit system.



## 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<sub>2</sub> 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.

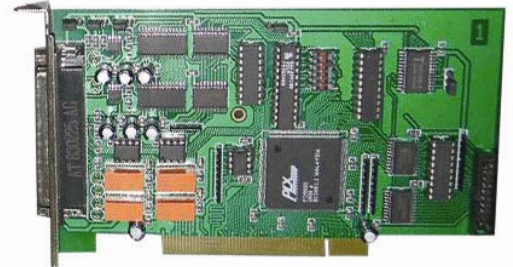
The software can create various objects such as barcode, DataMatrix, text, simple geometrical objects (such as line, rectangle, round-corner rectangle, polygon, circle, ellipse etc), complex graphic objects (such as PLT & BMP files), automatic date coding and alphanumeric serialization.

There are three types of marking cards (interface cards) and relevant software: LMS series, LMX series and LMC series.

### 1. LMS Series Cards and Software

There are following main functions of LMS cards:

- PCI slot card
- DA output resolution: 16 BIT
- D/A output: 2 channels (to control X galvo and Y galvo)
- D/A output voltage: -5V to +5V
- Clock timing: 8MHz
- Digital output: 8 channels, TTL/CMOS compatible
- Digital input: 8 channels, TTL/CMOS compatible
- External input: 4 channels (used for foot switch, detector, replay etc.)
- PWM output: 1 channel (to control laser)
- Relay output: 4 channels



A DB37 connector is used as I/O ports and they are defined as follows:

S/N	Name	Description	Remark
1	+12V	+12VDC of the computer	
2	GND	Ground of the computer	
3	COM1	commonly contact output of the 1st output relay	
4	NC2	normally closed contact output of the 2nd output relay	
5	NO2	normally opened contact output of the 2nd output relay	
6	COM3	commonly contact output of the 3rd output relay	
7	NC4	normally closed contact output of the 4th output relay	
8	NO4	normally opened contact output of the 4th output relay	
9	IN1+	positive pole of the 1stst optical input	
10	IN2+	positive pole of the 2nd optical input	
11	IN3+	positive pole of the 3rd optical input	
12	1N4+	positive pole of the 4th optical input	



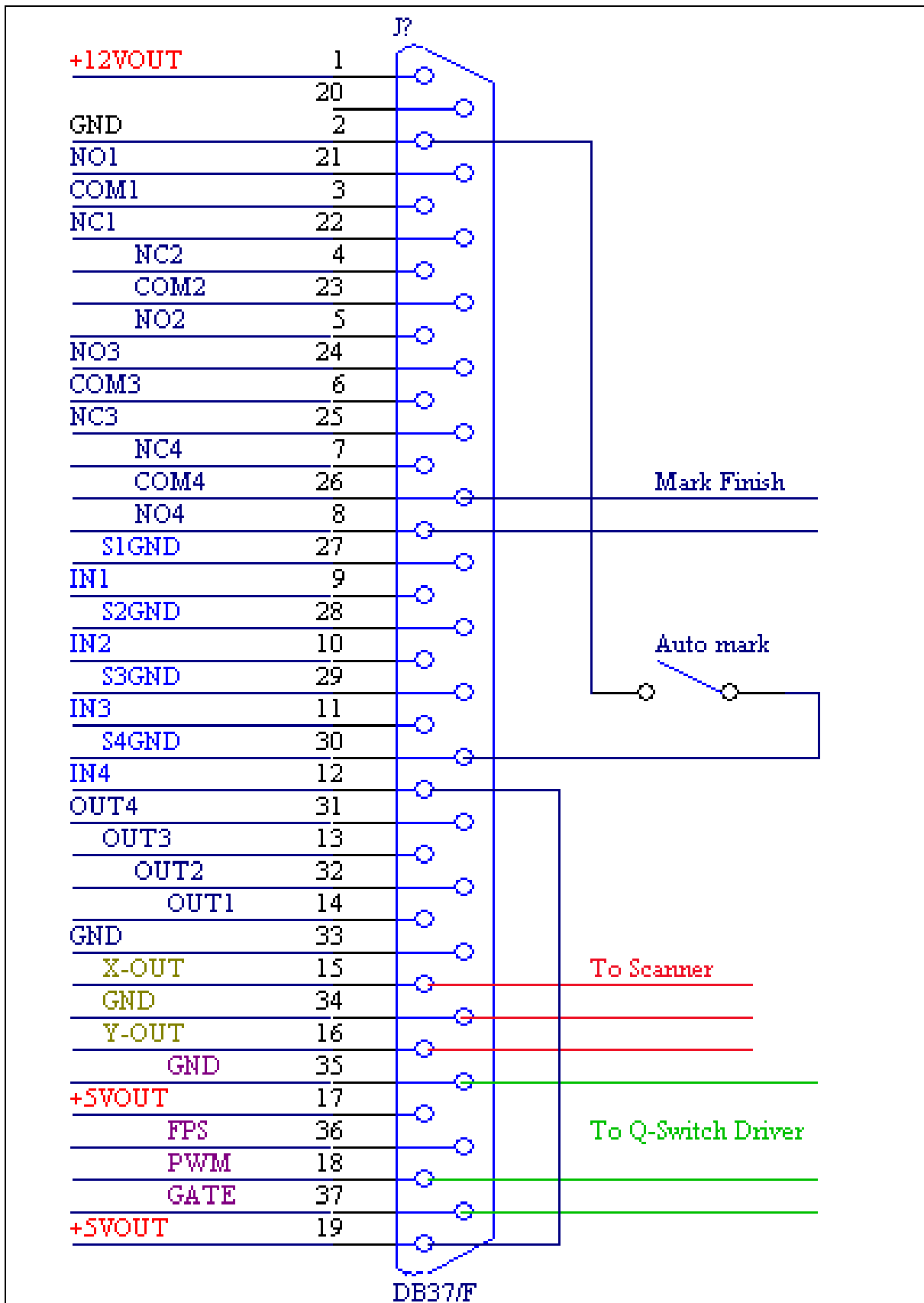
13	OUT3	3rd additional output signal 3	
14	OUT1	1st additional output signal 1	
15	X-OUT	X galvo control output	analog
16	Y-OUT	Y galvo control output	analog
17	VCC	+5VDC of the computer	
18	PWM	PWM output. To control pulse repetition rate of YAG laser or laser power and modulation frequency of CO2 laser	TTL
19	VCC	+5VDC of computer	
20	empty	spare	
21	NO1	normally opened contact output of the 1st output relay	
22	NC1	normally closed contact output of the 1st output relay	
23	COM2	commonly contact output of the 2nd output relay	
24	NO3	normally opened contact output of the 3rd output relay	
25	NC3	normally closed contact output of the 3rd output relay	
26	COM4	commonly contact output of the 4 <sup>th</sup> output relay	
27	IN1-	negative pole of the 1st optical input	
28	IN2-	negative pole of the 2nd optical input	
29	IN3-	negative pole of the 3rd optical input	
30	IN4-	negative pole of the 4th optical input	
31	OUT4	4th additional output signal	
32	OUT2	2nd additional output signal	
33	GND	COM of additional output signals	
34	GND	COM of galvos	
35	GND	COM of laser control signals	
36	FPS	FPS signal	
37	GATE	To control laser beam on/off in YAG lasers	TTL

There are following main functions of LMS marking software:

- Operation under WINXP / 2000
- Acceptable for PLT and BMP
- Support drawing such as circle, rectangle, line etc.
- Support the edit of SHX and TTF fonts
- Barcode, 2D DataMatrix
- Support the layers up to 8
- Save of all system parameters
- Support copy, delete, replace, move etc
- Support mirror, hatch
- Set pulse repetition rate, pulse duty factor
- Control ON/OFF, laser power of CO2 lasers from Synrad, Coherent, Universal Laser s etc

Model and description:

Model	Main function
LMS-1	2D marking to control X galvo and Y galvo
LMS-1A	2D marking to control X galvo and Y galvo plus rotation table
LMS-1AB	2D marking to control X galvo and Y galvo plus XY table



## 2. LMX Series Cards and Software

LMX Marking Control Card is especially developed for scan head and laser control in real time with a PCI bus interface. It is used with corresponding software to control laser marking.

- 2 analog output ports ( for scan head );
- 1 laser switch signal(TTL);
- 1 PWM signal(TTL);
- 9 digit input signals;
- 4 output signals(relay output);
- 2 differential mode axes control for step/servo motor;
- 1 single ended mode axe control for stop/servo motor;

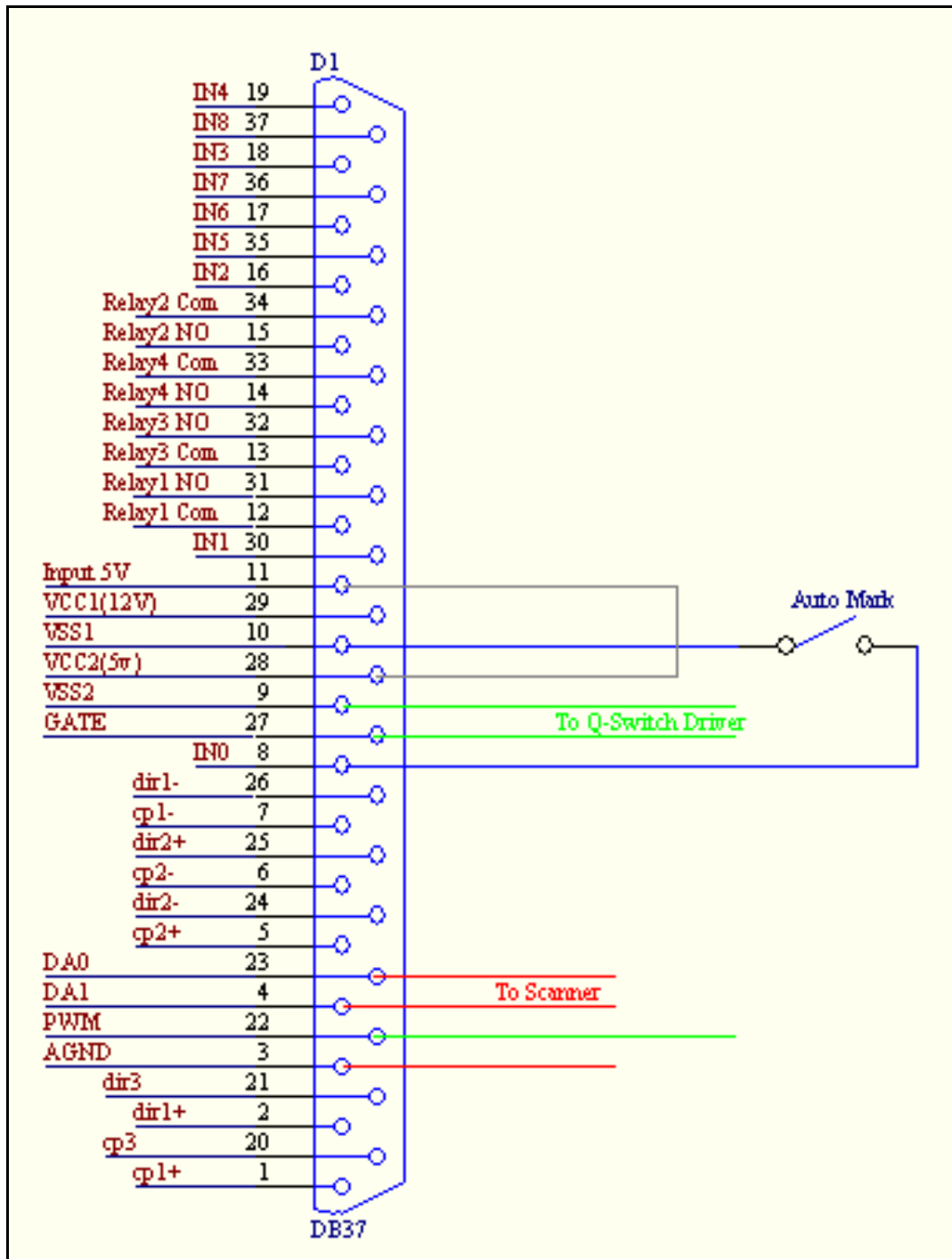


### DB37: Pin Assignments

No.	Name	Description	Characteristics
1	CP1+	1 <sup>st</sup> pulse+ signal	
2	DIR1+	1 <sup>st</sup> direction+ signal	
3	AGND	Analog GND	Analog
4	X-OUT	Scanning mirror X output	Analog
5	CP2+	2 <sup>nd</sup> pulse+ signal	
6	CP2-	2 <sup>nd</sup> pulse- signal	
7	CP1-	1 <sup>st</sup> pulse- signal	
8	IN0	0 input signal	
9	12V GND	Power 12V GND	
10	5V GND	Power 5V GND	
11	Input 5V	Input 5V	
12	COM1	Relay1 COM	
13	COM3	Relay3 COM	
14	NO4	Relay4 normal open port	
15	NO2	Relay 2 normal open port	
16	IN2	2 input signal	
17	IN6	6 input signal	
18	IN3	3 input signal	
19	IN4	4 input signal	
20	CP3	3 <sup>rd</sup> pulse signal	
21	DIR3	3 <sup>rd</sup> pulse signal	
22	PWM	PWM signal	TTL
23	Y-OUT	Scanning mirror Y output	Analog
24	DIR2-	2 <sup>nd</sup> direction- signal	
25	DIR2+	2 <sup>nd</sup> direction+ signal	
26	DIR1-	1 <sup>st</sup> direction- signal	
27	GATE	Laser output signal in YAG laser	TTL
28	5V	Power 5V	
29	12V	Power 12V	
30	IN1	1 input signal	
31	NO1	Relay1 normal open port	
32	NO3	Relay3 normal open port	
33	COM4	Relay4 COM	
34	COM2	Relay2 COM	
35	IN5	5 input signal	
36	IN7	7 input signal	
37	IN8	8 input signal	

Model and description:

Model	Main function
LMX-1	2D marking to control X galvo and Y galvo
LMX-1A	2D marking to control X galvo and Y galvo plus rotation table
LMX-1AB	2D marking to control X galvo and Y galvo plus XY table



### 3. LMM Series Cards and Software

LMM Marking Control Card is especially developed for scan head and fiber laser control in real time with a PCI bus interface. It is used with corresponding software to control laser marking. The suitable fiber lasers are IPG, Manlight and SPI lasers via 8-bit laser power adjustment.

- 2 analog output ports ( for scan head );
- 11 digital output signals, TTL/CMOS compatible;
- 7 digital input signals TTL/CMOS compatible;
- 1 PWM signal output (TTL).

There are following main functions of LMM marking software:

- Operation under WINXP / 2000
- Acceptable for PLT and BMP
- Support drawing such as circle, rectangle, line etc.
- Support the edit of SHX and TTF fonts
- Barcode, 2D DataMatrix, series numbers, date, time
- Support the layers up to 8
- Save of all system parameters
- Support copy, delete, replace, move etc
- Support mirror, hatch, group
- Set pulse repetition rate, pulse duty factor
- Control ON/OFF, laser power of CO2 lasers from Synrad, Coherent, Universal Lasers, Manlight and IPG etc.

#### DB37: Pin Assignments

No.	Name	Description	Characteristics
1	CP1+	1 <sup>st</sup> pulse+ signal	
2	DIR1+	1 <sup>st</sup> direction+ signal	
3	AGND	Analog GND	Analog
4	X-OUT	Scanning mirror X output	Analog
5	CP2+	2 <sup>nd</sup> pulse+ signal	
6	CP2-	2 <sup>nd</sup> pulse- signal	
7	CP1-	1 <sup>st</sup> pulse- signal	
8	IN0	0 input signal	
9	COM	Relay Comm	
10	GND	GND	
11	NO	Relay NO	
12	D0		
13	D2		
14	D4		
15	D6		
16	NC	Relay NC	
17	Temp	Alarm Temperature	
18	Alarm MO	Alarm MO	
19	Frequency	Alarm Frequency	
20	CP3	3 <sup>rd</sup> pulse signal	
21	DIR3	3 <sup>rd</sup> pulse signal	
22	Pulse Repet	Pulse Repe	TTL
23	Y-OUT	Scanning mirror Y output	Analog
24	DIR2-	2 <sup>nd</sup> direction- signal	
25	DIR2+	2 <sup>nd</sup> direction+ signal	
26	DIR1-	1 <sup>st</sup> direction- signal	
27	PA	Power Amplifier(PA)	TTL
28	5V	5V	
29	Red Light	Red Light	TTL
30	IN1	1 input signal	
31	D1		
32	D3		
33	D5		
34	D7		
35	Back Ref	Alarm back reflection	
36	MO	Master Oscillator(MO)	TTL
37	ES	Emergency Stop	TTL

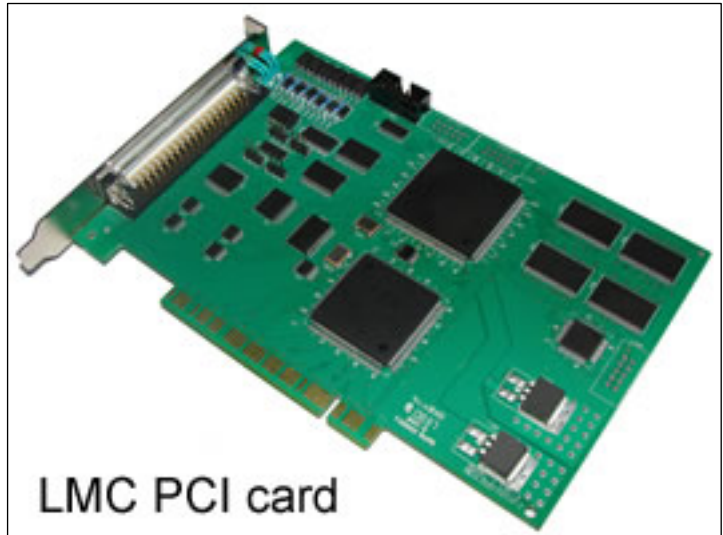
#### Model and description:

Model	Main function
LMM-1	2D marking to control X galvo and Y galvo
LMM-1A	2D marking to control X galvo and Y galvo plus rotation table
LMM-1AB	2D marking to control X galvo and Y galvo plus XY table

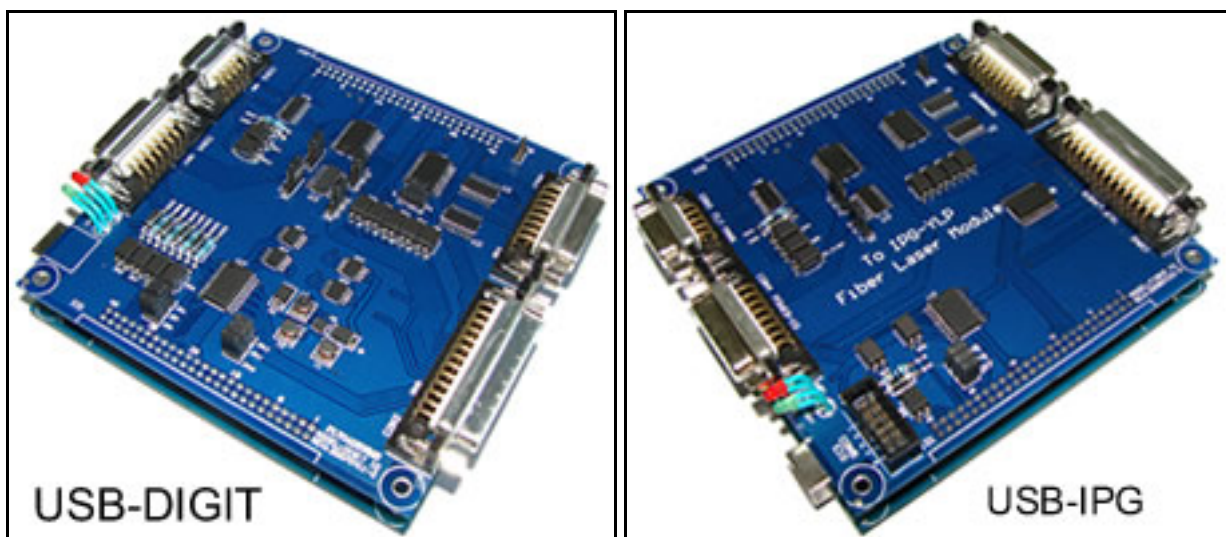
#### 4. LMC Series Cards and Software

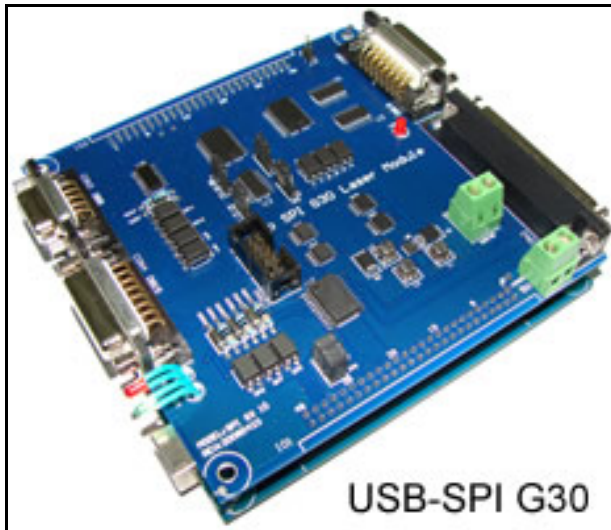
Our marking software has been designed to meet the needs of all types of users of laser marking systems. The software was developed to be a retrofit package for existing systems, or as original software on new systems. The package provides significant advancements over previous laser marking control 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 and CO<sub>2</sub> 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.

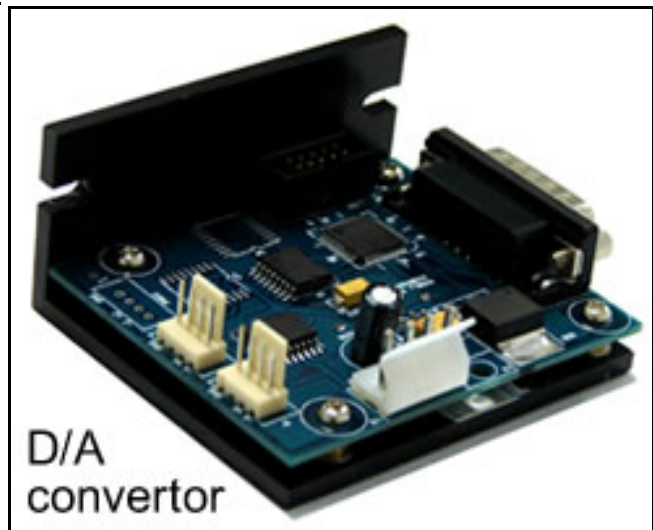


The software can create various objects such as barcode, DataMatrix, text, simple geometrical objects (such as line, rectangle, round-corner rectangle, polygon, circle, ellipse etc), complex graphic objects (such as PLT & BMP files), automatic date coding and alphanumeric serialization.





USB-SPI G30

D/A  
convertor**Model and description:**

Model	Main function
LMC-5	2D marking to control X and Y analog galvos
LMS-5A	2D marking to control X and Y analog galvos plus rotation table
LMC-5F	2D marking to control X and Y analog galvos plus marking on the fly (fly-marking)
LMC-5AB	2D marking and 2D moving to control X and Y analog galvos plus 2 additional motors (for large field marking using XY table and 2D marking head)
LMC-USB-DIGIT	Digital card, to control X and Y digital galvos plus 2 additional motors.
LMC-USB-IPG	Fiber digital card, to IPG fiber lasers and to control X and Y digital galvos plus 1 additional motor.
LMC-USB-SPI	Fiber digital card, to SPI G3.0 fiber lasers and to control X and Y digital galvos plus 2 additional motors.
LMC-USB-D/A	D/A conversion card, to convert 2 input digital signals into 2 output analog signals , which are used to drive analog galvos.
LMC-USB-ANALOG	Analog card, consisting of USB-DIGIT and USB-D/A.
LMC-USB-IPG-ANALOG	Fiber analog card, consisting of USB-IPG and USB-D/A.
LMC-USB-SPI-ANALOG	Fiber analog card, consisting of USB-SPI and USB-D/A.

A DB37 connector is used in LMC PCI card and their pins are defined as follows:

NO.	Name	Definition	Signal Ref.	Character
1	GND	Ground of computer power supply		
2	ANAPORT2	Analog (Frequency) output [0V-5V]	Ref to GND	Analog
3	FPK	FPK output	Ref to GND	TTL
4	LASER	Laser switch output	Ref to GND	TTL
5	XVOL+	Scanhead output X in-phase [ $\pm 5V$ ]	Ref to GND	Analog
6	GND	Ground of computer power		
7	YVOL+	Scanhead output Y in-phase [ $\pm 5V$ ]	Ref to GND	Analog
8	VCC	+5V of computer power supply	Ref to GND	
9	BPUL-	Extended axis B negative pulse signal	Ref to GND	TTL
10	BDIR-	Extended axis B negative direction signal	Ref to GND	TTL
11	APUL-	Extended axis A negative pulse signal	Ref to GND	TTL
12	ADIR-	Extended axis A negative direction signal	Ref to GND	TTL
13	OUT1	Output control signal No. 1	Ref to EXGND	TTL
14	EXGND	Ground of external 5V power supply		
15	IN3	Input signal No. 3		
16	IN2	Input signal No. 2		
17	S01GND	Ground of IN0 and IN1		
18	IN4	Input signal No. 4		
19	START	External start mark signal		
20	ANAPORT1	Analog (Power) output [0V-9.5V]	Ref to GND	Analog
21	GND	Ground of computer power		
22	PWM	Laser PWM output control signal	Ref to GND	TTL
23	GND	Ground of computer power		
24	XVOL-	Scanhead output X reverse phase [ $\pm 5V$ ]	Ref to GND	Analog
25	YVOL-	Scanhead output Y reverse phase [ $\pm 5V$ ]	Ref to GND	Analog
26	VCC	+5V of computer power supply		
27	GND	Ground of computer power		
28	BPUL+	Extended axis B positive pulse signal	Ref to GND	TTL
29	BDIR+	Extended axis B positive direction signal	Ref to GND	TTL
30	APUL+	Extended axis A positive pulse signal	Ref to GND	TTL
31	ADIR+	Extended axis A positive direction signal	Ref to GND	TTL
32	OUT0	Output control signal No. 0	Ref to EXGND	TTL
33	EX5V	External +5V power supply		
34	S23GND	Ground of IN2 and IN3		
35	IN1	Input signal No. 1		
36	IN0	Input signal No. 0		
37	SSGND	Ground of START and IN4		

There are 4 connectors in LMC USB card and their pins are described as follows:

#### CON1 (DB15)

Pin No.	Signal name	Illustrations
1,9	CLK-/CLK+	Clock signal. Difference output
2,10	SYNC-/ SYNC+	Synchronized signal. Difference output
3,11	XChannel-/ XChannel+	Digital signal of X axis galvo. Difference output
4,12	YChannel-/ YChannel+	Digital signal of Y axis galvo. Difference output
5,13	ZChannel-/ ZChannel+	Digital signal of Z axis galvo. Difference output
6,14	Status-/ Status+	The state feedback signal of Galvo. Difference input
8,15	Gnd	The reference ground of control card.



## CON2 (DB25)

Pins	Signal name	Illustrations
1-8	P0-P7	Laser power. TTL output.
9	PLATCH	Power latch signal. TTL output.
10,11,12,13,14,15,24	Gnd	Control card's Ground
16, 21	SGIN0, SGIN1	Laser status input.
17	Vcc	5V power output of control card.
18	MO	Master Oscillator switch. TTL output
19	AP	Power amplifier. TTL output.
20	PRR	Pulse repetition rate. TTL output.
22	Out2	Laser's red light indication signal. TTL output.
23	EMSTOP	Emergency stop signal. TTL output.
25		NC

## CON3 (DB9)

PIN No.	Signals	Illustrations
1	IN8	Common input signal 8. Forms a return circuit with GND 9. To use this signal, connect it and GND respectively to either terminals of power.
2,6	IN 9+/ IN 9-	TTL input signal. Internal 1K current-limited resistor. External current-limited resistor is suggested when voltage is over 12V. Please refer to IN9 Port Illustration.
3, 7	BCODEN/BCODEP	Encoder phase B input signal. Differential input.
4, 5	ACODEN/ACODEP	Encoder phase A input signal. Differential input.
8	Vcc	Control card 5V output.
9	Gnd	Control card Ground. As the return circuit signal of pin 8 & 1.

## CON4 (DB15)

PIN No.	Signals	Illustrations
1	SGIN4	Common input signal 4. Forms a return circuit with ground 12 and 13 of the control board. To use this signal, connect it and the ground respectively to either terminal of the power. This is an input signal.
2	EMSTOP	Emergency-stop signal. Forms a return circuit with ground 12 & 13. To use this signal, connect it and the ground signal respectively to either terminal of the NORM-OPEN switch. When this EMSTOP is pressed, it means there is emergency and operation is immediately stopped. The signal is an input signal.
3	POW_BTN	Power signal of the laser instrument main power source. Forms a return circuit with the Ground 12 & 13 of the control board. To use this signal, connect it and the Ground signal respectively to either terminal of the NORM-OPEN switch. When the power button is pressed downward, pin 10& 11 are connected; when the button is bounced upwards, they are disconnected. For the power connection, see "Power Connection". This is an input signal.
4,5	VCC	5V input power positive terminal. This is an input signal.
8	START	Start signal. Forms a return circuit with Ground 12 & 13. To use this signal, connect it and the Ground signal respectively to either terminal of the power. This is an input signal.
9	OUT0	Common output signal 0. Uses GND 12 & 13 signals as reference signals. This is an output signal.
10,11	POW_CON,P OW_CON1	Connection port of power relay. Connect POW_CON to the anode of power relay's control power. One of the power relay's control ports should be connected with POW_CON1, and the other to the cathode of the cathode of power relay's control power. When the 3-point power is plugged in, POW_CON and POW_CON1 are connected. At that time, power relay's control port is connected to its control power, power relay picks up, and fiber laser main power is on. Please see "Power Connection" for reference.
12,13	Gnd	5V input power cathode (Ground signal), i.e. the control card's Ground

		signal. This is an input signal.
6,14	DIR-/DIR+	Output signal. Direction signal of the extend axis (step motor or servo motor). The output mode could be set up either as differential output, or as level output (TTL output).This is an output signal.
7,15	PUL-/PUL+	Pulse signal of extend axis (step motor or servo motor). The output mode could be set up either as differential output, or as level output (TTL output). This is an output signal.

**The marking software is always being improved and modified from time to time. The actual software characteristics may change a little.**