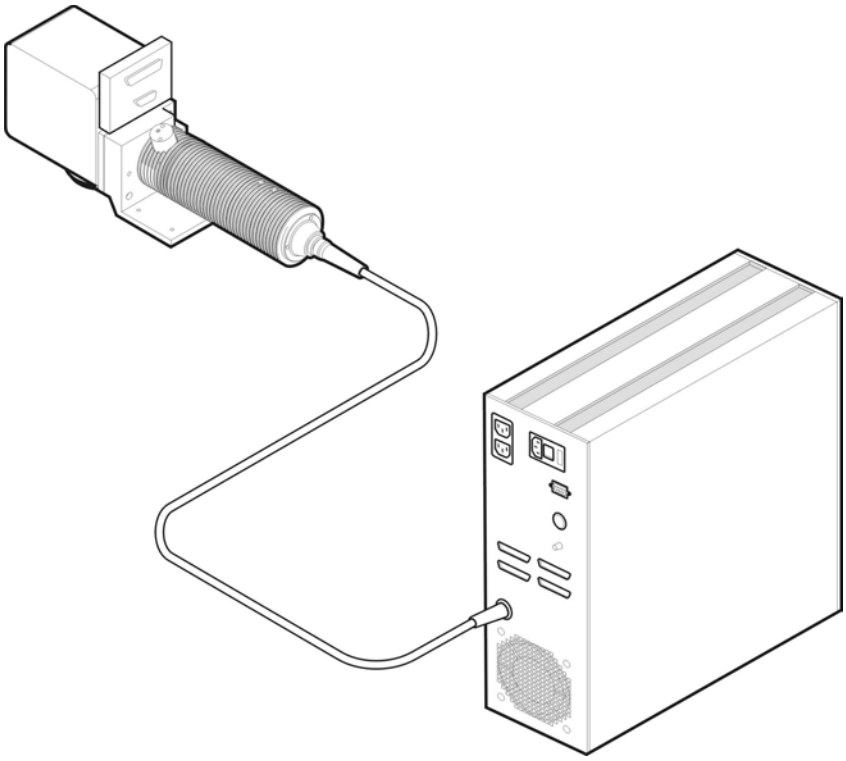
Manual

Systeme für Produktmarkierungen



Ö S T L I N G

Technologies

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Printed: November 27, 2002

Lasonall

General Manual

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Edition: 11 June 2002

Table of revisions

Previous Edition	Subject areas covered in the new edition	No. of pages added or modified

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Foreword

This is the user's manual for the Östling LASONALL™ laser system by Östling The special feature of this laser in the solid state lies in the optical pumping system of the resonator. Unlike conventional systems, pumping takes place by means of a laser diode instead of a flash light. This pumping system allows higher modal efficiency and lower heat emission to be achieved, features that reduce considerably the size of the resonator and all the other parts that go to make up the laser.
The intensity of the laser beam leaving the resonator can be modulated and allows different materials to be marked, such as for example, plastic and steel. The marking process is carried out by software programs installed on a PC, connected to the marking machine.
The model described is an OEM system (Original Equipment Manufacturer), which means that it has been designed and developed as an individual component to be integrated into more complex systems. Development technicians should read carefully the chapter on safety precautions for laser systems, detailed later in this manual.
The manual has been drawn up according to the requirements set out in directive ***CEE 89/392*** and its subsequent amendments and additions. It comprises:

- Safety precautions for use and maintenance
- General machine characteristics
- Machine installation
- Operating modes
- Repair and adjustment
- Electrical diagrams

Staff responsible for operating the machine, in addition to being professionally trained in their duties, must also read the manuals, paying particular attention to the safety rules and to the sections that deal with their own specific responsibilities.
Machine staff are defined as follows:

- **OPERATOR:**
  responsible for loading the materials to be processed, visual supervision of the work cycle, unloading finished products and cleaning the machine.

- **MAINTENANCE MECHANIC:**
  responsible for mechanical maintenance on the machine.

- **MAINTENANCE ELECTRICIAN:**
  responsible for electrical maintenance on the machine

NOTE:
Östling declines all responsibility for any use of its machine other than the intended one

Introduction to the LASONALL ™ marking system

The qualitative and technological advantages offered by laser marking in industrial production have been acknowledged for some time now. New ideas and methods are continually experimented with in applications that traditionally belong to other technologies. In the Lasonall™ marking system the light has been replaced by a laser diode. This innovation has brought the optical efficiency to between 30 and 50% (compared to the 2-3% of a conventional light laser). This is the reason why the Lasonall ™ laser source only absorbs a few hundred watts and does not require water cooling devices.
The size of the laser source is extremely small and the life of a laser diode is currently 10/15000 hours, with a tendency to increasing this as technology develops.
The power available allows excellent marking on all types of material. The quality of the laser beam reaches the theoretical limit of diffraction, giving a high level of accuracy, with a resolution of 100/10000 points per millimetre.

There are currently three production models available:

- Lasonall™ 1
- Lasonall™ 2
- Lasonall™ 3

The technical characteristics of the three different models will be described in the chapters that follow.

Intended use

The Lasonall™ MARKER Laser equipment is intended mainly for marking small sized manufactured products in metal or plastic.

Symbols used

There follows a list of the symbols used in this manual along with their descriptions. These will be found in chapters and/or paragraphs with the following meanings:

General Warning:
This symbol warns of the need to read the manual carefully or the need for an important maintenance operation or manoeuvre

Electrical Warning:
This symbol warns of dangerous voltages associated with the laser, or in any case of such entity as to create the risk of electric shock. The symbol may also be found on the machine itself next to the area of risk.

Laser Warning:
This symbol warns of the danger of exposure to visible or invisible laser radiation. The symbol may also be found on the machine itself next to the area of risk.

Fire Warning
This symbol warns of a fire hazard when flammable materials are being processed. As there is a risk of fire, it is essential to observe the manufacturer's directions when starting up the machine.

Safety

This chapter deals with matters pertaining to personal safety.
Tests carried out have proved the safety and reliability of the laser when used properly. The operator should nevertheless be aware of all the necessary safety rules in order to avoid any risk of damage to persons or the equipment itself.

Laser radiation

As already stated in the previous chapter, the Lasonall™ laser is an OEM system (Original Equipment Manufacturer), which means that it has been designed and developed as an individual component to be integrated into more complex systems. As an OEM component, it has not been fitted with all the safety systems that complete a laser system. Specialised technicians will need to connect up the machine with all the interlocks, safety indicators and protection devices. The pilot signals for the machine are described in the relative chapter.
Laser radiation is an electromagnetic emission with a micrometric wavelength found in far infrared (CO_2 Laser), near infrared (Nd:Yag, Nd:YVO4 Laser), visible (He:Ne or Argon Laser), and ultraviolet (ecchymer lasers).
It should be considered non Ionogenic Radiation. In Lasonall™ Lasers, the emission of a crystal bar is excited by “optical pumping” generated by a powerful Laser Diode. The continuous bouncing of Photons between a front and a rear mirror sets up a positive reaction and so their numbers increase by the instant, until the required concentration is achieved to produce a collimated beam emitted from the semi-reflective front mirror. The radiation (which we can imagine to be a "Beam of invisible light") is then Focused by means of Lenses on a point where the intensity becomes so great that it can react with different materials to cause an alteration by thermal effect.
Even though the radiation of Violin Lasers may be invisible, because it is near the threshold of vision, the Eye receives it virtually integrally without even any pupillary reflex! If we also take into account that this is generally very intense, it follows that it can be extremely damaging or lethal to the eyesight.

NOTE:
Looking directly at a Laser beam **can cause irreversible damage** to the eyesight

To avoid permanent personal injury, certain precautions must be followed.
All persons who may be exposed to dangerous levels of laser radiation, must know when the laser is active, in which case they must wear protective glasses.

The laser integrated in the Östling system, because of its high power, causes laser light to be reflected from flat surfaces. This reflected light is potentially dangerous to the eyes and skin. Electromagnetic emission with micrometric wavelength comes within the far infrared range and is therefore invisible, it is therefore not obvious where these reflected beams are directed.

NOTE:
Protection from reflected light beams is essential, because these can be of sufficient intensity to cause permanent damage to the eyes and to the skin.

In addition to the potential damage to eyes and skin, invisible laser emission can burn clothes and other flammable materials such as organic solvents (alcohol, acetone) or benzines.

NOTE:
The laser in question is in **class IV**. Class IV covers all lasers which are hazardous, not just because of **direct** or **reflected** radiation, but also because of **diffused** radiation! These laser sources can be particularly dangerous to the skin and represent a fire hazard for flammable materials.

Absorbing Laser radiation

Human tissue absorbs electromagnetic radiation in different ways depending on the wavelength of the actual radiation. Both the eye and the skin have their own "predisposition" for accepting certain wavelengths, and they are more refractory to absorbing others. In the specific case of the Eye, the Cornea and the Crystalline Lens allow to pass and reach the Retina, even though with different attenuation, all the wavelengths ranging from 400 to 1400 nm, i.e. the range of light between visible to IRA infrared. It should therefore immediately be seen that the radiation of Nd:YVO4 Lasers (wavelength 1064 nm), falling within this range, **means the Retina is directly exposed!**
As far as the Skin is concerned, the "biological window" has a different percentage of absorption but not dissimilar in terms of wavelengths. As can easily be imagined however, the maximum exposure values for the Skin compared to those tolerated by the Eye are very different.

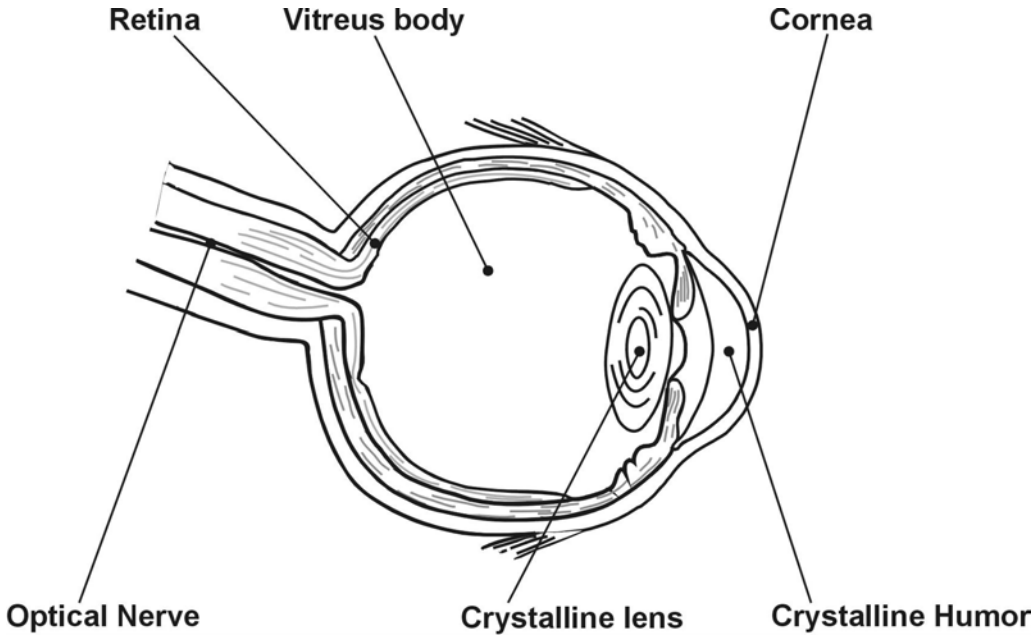

Figure 1. Section of the eyeball

As regards the damage mechanism that absorbed radiation can cause, this too depends on the wavelength. Short wavelengths (ultraviolet: UV-C 180-280nm; UV-B 180-280 nm, UV-A 315-400 nm) generally cause photochemical effects:

- cataracts, or rather a clouding of the lens in the eye
- melanic coloration, or rather reddening, of the skin

Longer wavelengths (infrared: IR-A 780-1400 nm; IR-B 1400 3000nm; IR-C 3000-10 E6 nm) generally cause heat effects:

- detachment and photo-coagulation of the retina in the eye
- burning of the skin

The level of damage caused obviously depends on the **quantity of radiation absorbed** and on the **instantaneous power** of the radiation source.

Classification and danger

The Regulating Standard has set out different class of danger for Lasers on the basis of their capacity to cause damage to persons, from Lasers in class I (intrinsically safe in all respects) to class IV Lasers, dangerous under various conditions!

NOTE:
The Lasonall™ laser marker contains a **visible source in class IIIa** and an **invisible source in class IV.**

Class IIIA includes visible Lasers that carry a label marked "**CAUTION!**" and that should not damage the eye if glanced at momentarily (because of the eyelid's self-protecting reflex to intense visible radiation), but which can cause serious damage if observed through a microscope or a magnifying lens. Other Lasers belonging to the same class, but marked with the label "**DANGER!**" are able to exceed the maximum permitted exposure level already after only 0.25 seconds.

Class IV includes all those Lasers that can present dangers, not only due to direct or reflected radiation, but also because of diffused radiation! These Laser sources can be very dangerous to the skin and represent a risk to flammable materials. For these reasons, the User must take all the necessary steps to contain the radiation to ensure it is directed towards its end goal. Furthermore the Operator must be aware of the risks deriving from exposure to Laser radiation and must be equipped with the necessary P.P.D. (personal protection devices) consisting of certificated glasses for protection from radiation.

Radiation vision conditions

The Laser emitted from the resonator must be considered a source of highly collimated and intense monochromatic light. Because of these characteristics it can be seen as a highly luminous "punctiform source". This means that its "image" is then focused on the Retina in a very small spot with a dangerously high concentration of strength! If the beam instead becomes divergent and is diffused on a non reflective screen, then we have an "extended vision" of the image, with a much less dangerous concentration of strength. Different types of radiation vision can therefore be distinguished depending on the way the actual radiation is accessed and consequently the different levels of danger involved.

Direct vision of Laser beam:

This type of vision is the most dangerous and can happen at the laser aperture output, after the optics have been removed. It must be avoided at all costs! No protective glasses can offer enough protection against direct vision of the beam.

Direct vision of the beam after mirror reflection:

This can happen when the beam is directed on a reflective surface.
Vision of a beam mirror-reflected off a flat surface is just as dangerous as direct vision.

Direct vision of a beam coming out of a Fiber optic:

This takes place if the Fiber optic is disconnected from the resonator. Vision of the beam is dangerous up to a considerable distance. Filters and Glasses cannot guarantee safety.

Direct vision of a beam after focusing optics:

This takes place if the Laser beam is not made to “die” on a suitable absorber at the end of its path. Vision of the beam is very dangerous up to a considerable distance. Filters and glasses can guarantee safety for brief exposure, as long as they are of the right size and properly certificated.

Diffused vision of a Laser beam, after focusing optics:

This is the most frequent vision for equipment in an operational set up. Vision of the beam is not dangerous unless close up, but suitable Filters and Glasses can guarantee safety, even for long exposure.

General safety precautions

In order not to diminish the level of safety provided for by the equipment, the User must adopt the correct procedure and work under the safest possible conditions. A Standard Operating Procedure (S.O.P.) does however need to be set out regarding the maneuvers to be made for starting up the equipment and shutting it down. This procedure, displayed near the installation, must serve as a reference for the Operator and should be written in his language.
It will be indispensable to train staff in the following areas:

- Familiarization with the system operating procedures.
- Knowledge of the biological effects of radiation on the Eyes and Skin.
- An appreciation of the need for personal protection devices (P.P.D.)

NOTE:
Always use properly certificated protective glasses.
Remember that **no glasses can offer protection from direct radiation!**

Risks to the eyes and the skin

If subjected to intense Laser radiation, even for just a short time, or at a lower intensity but for a longer time, both the Cornea and the Retina can be burnt and irreversibly damaged forever. This outcome is a virtual certainty in the case of direct vision of a class IV Laser beam.
If subjected to focused direct radiation, the skin can also be burned. In addition it must also be remembered that, along with the main radiation, a collateral ultraviolet radiation may also exist: long exposure to this can cause cancer of the skin.

Safety

If the intended use of the source is changed, for example for material processing applications, collateral risks may arise from the production of irritating and toxic fumes and vapours. In these applications the processing fumes may need to be extracted and filtered before releasing them into the environment once more.

NOTE:
The intended use must not be changed without having previously contacted the Manufacturer.

The most serious collateral risk, a potentially lethal one, associated with any laser equipment is without doubt the risk of electric shock.
This can arise when the equipment Manufacturer's prescribed warnings and procedures are not observed. Unauthorised and untrained staff must never attempt any type of intervention on electrical components. The safety devices must on no account be removed and their efficiency should be periodically checked.

NOTE:
Do not work any electrical parts unless properly trained. **Do not remove the protective devices.**

Collateral risks

NOTE:
When **flammable materials** are being processed, as there is a **fire hazard**, it is essential to observe the recommendations given by the Manufacturer when putting the machine into service.

If, for example, in the intended use of the Laser source, the material undergoes alterations and irritating and/or toxic fumes or vapours are produced during the working process, it may be necessary to extract the fumes and filter them before releasing them into the environment once again.

A further risk may be that of fire caused by the processing of materials other than those for which the equipment was intended.

NOTE:
Do not use the laser radiation on **materials other than** those for which the equipment was intended

Seals

At certain points around the marking system there are seals. These seals must under no circumstances at all ever be broken or removed. The sealed parts are in fact to be opened solely and exclusively by Östling. The violation of these seals by the customer immediately invalidates the warranty on the whole marking system.

NOTE:
Breakage or removal of the Manufacturer's seals by the customer, **immediately invalidates the warranty** on the whole marking system.

WARNING!
The Manufacturer declines all responsibility for any **use** of the machine **which does not conform with what it was intended for**.
It is **prohibited** to start operating the equipment until a **declaration** has been obtained that the machine it is destined to be used with **conforms to** the regulating Directives.

Note :
Access to the inner components of the electrical equipment is granted **to authorised staff only**, who are qualified and have been made aware of the risk of electric shock!
Östling declines all responsibility for intervention on live parts by unqualified persons!

Note:
Access to the inner parts of the Laser resonator is granted **to authorised staff only**, who are qualified and have been made aware of the risks to the eyesight!
Östling declines all responsibility for intervention by persons unaware of such risks!

Note :
When **flammable** materials are processed, such as for example plastic, as there is the risk of fire, it is essential to observe the Manufacturer's recommendations when putting the machine into service; in addition read the Paragraph **Collateral risks** in the Chapter on **SAFETY.**

Safety labels

Labels and plates are affixed to the equipment in conformity with European safety regulations. These must on no account be removed or damaged. For any replacements needed, contact Östling

Optical safety label

Figure 2. Example of optical safety information label

Located on the resonator or on the scanner head

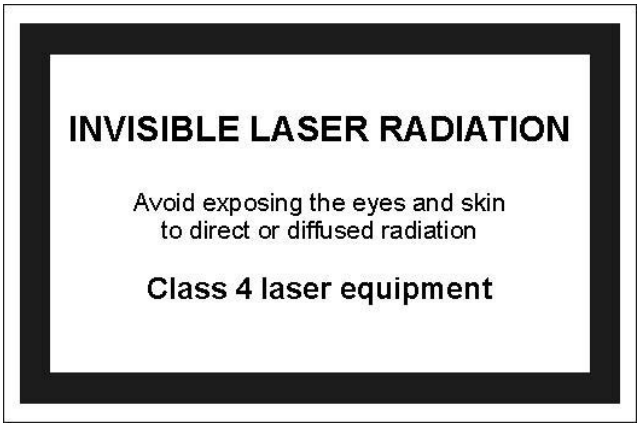

Figure 3. Example of optical safety warning label 1

Located on the resonator or on the scanner head

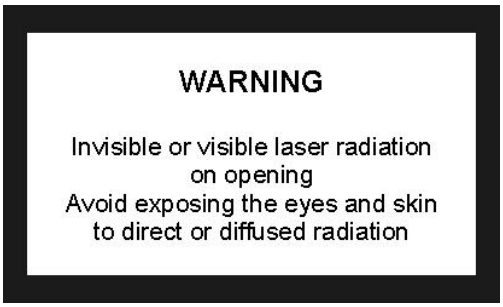

Figure 4. Example of optical safety warning label 2

Located over each cover or casing whose removal will allow direct or indirect access to the laser light.

Figure 5. Example of optical safety warning label 3

Located at each opening where laser radiation is emitted directly.

Laser labels

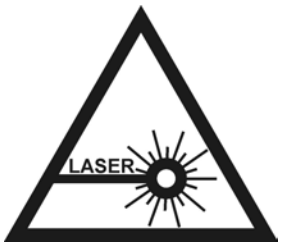

Figure 6. Example of laser label 1

Located at the fiber optic connector.

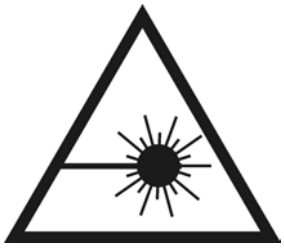

Figure 7. Example of laser label 2

Located next to structures or objects that can emit Laser radiation.

Labels concerning the Electrical Part

Figure 8. Example of electric shock label 1

Located next to structures or objects subject to high and/or dangerous voltage levels. On the part where power supply connections for the laser are found (rear of the equipment).

Figure 9. Example of label warning of dangerous structures

Located next to structures or objects subject to high and/or dangerous voltage levels. On the part where power supply connections for the laser are found (rear of the equipment).

Lay out and machine description

The Lasonall™ marking system basically comprises three very separate sections:

- Electrics - Rack
- Optics - resonator and scanner head
- Control - Personal Computer

The electrical part is mostly contained in a Rack, supplies power to the whole Machine and centralises all the functions needed to operate it.
The Optical Part consists of a Laser Diode installed in the coupler (located in the Rack), a connecting Fiber optic, a Resonator (a laser light generator), and is completed with the Scanner Head which, when suitably piloted, directs the Laser beam to the required point of the Working Field.
The Control Part looks after the marking operations, controlling each phase involved. The software used, installed in the server PC, allows all working parameters for the marking process to be set.

The chapters that follow and the figures on the next page represent and describe the main operating units.

Main operating units

This section provides descriptions and the relative technical specifications of the operating units that make up the Lasonall™ laser system.

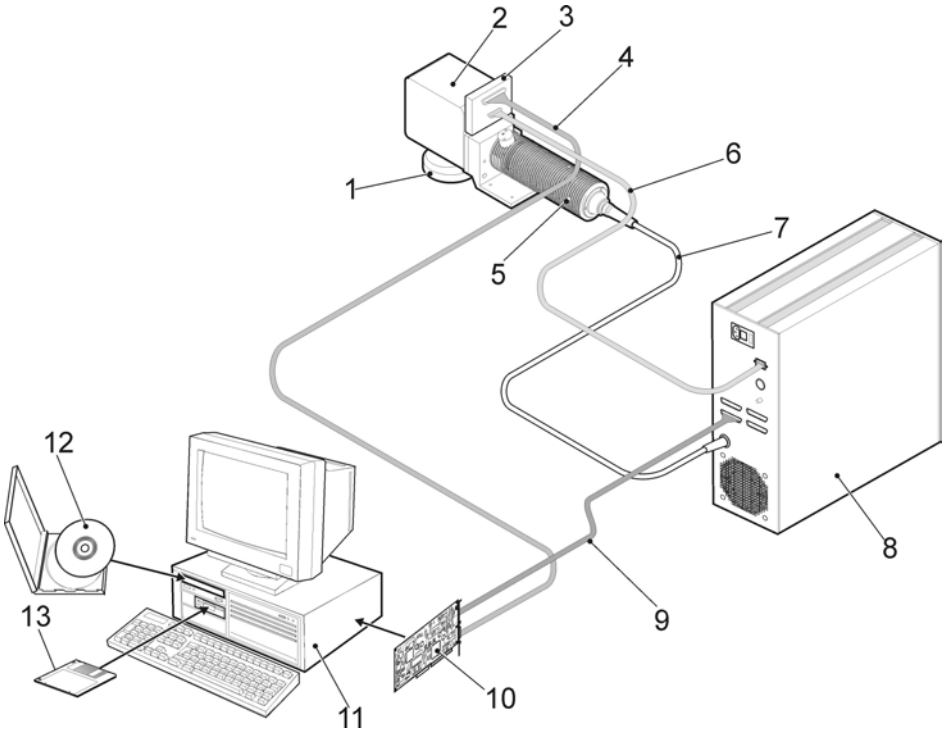

Figure 10. LASONALL™ complete system

1) Optical lens. Can be of different focal lengths (100mm, 160mm, 254mm)
2) Scanner Head. There are two mirrors inside controlled by galvo motors, which give the laser the marking co-ordinates (x, y).
3) A/D Converter.
4) Signal cable for Galvo motors (from DSP board)
5) Resonator. Contains the optical parts and is assembled and contained in a sealed chamber.
6) Power supply cable for Galvo motors (from RACK)
7) Fiber optic
8) RACK. Contains the electrical laser power. Inside there is the laser diode
9) DSP/RACK signal cable
10) PnP card (with DSP processor) to control all marking signals and parameters.
11) Personal Computer. Standard PC, integrated with a PnP card (with DSP processor)
12) Creator Pro Software, Contains the drivers for the DSP card and the marking program. 13) Floppy disk containing the configuration files (lasermon.ini)

NOTE:
For more information on connections in the Lasonall laser system, refer to the relative chapter

Structure of the Electrical system

The Lasonall™ laser electrical system basically consists of an AC-DC Converter able to supply a Laser Diode with a constant current up to a maximum value of 50/70A.
Almost all the electrical and electronic components are contained inside or installed on the front and back panels of a Rack: this unit is therefore the “heart” of all the equipment's operating functions. By looking at the block diagram below, the following functional components can be identified:

Block Diagram representing the Electrical System

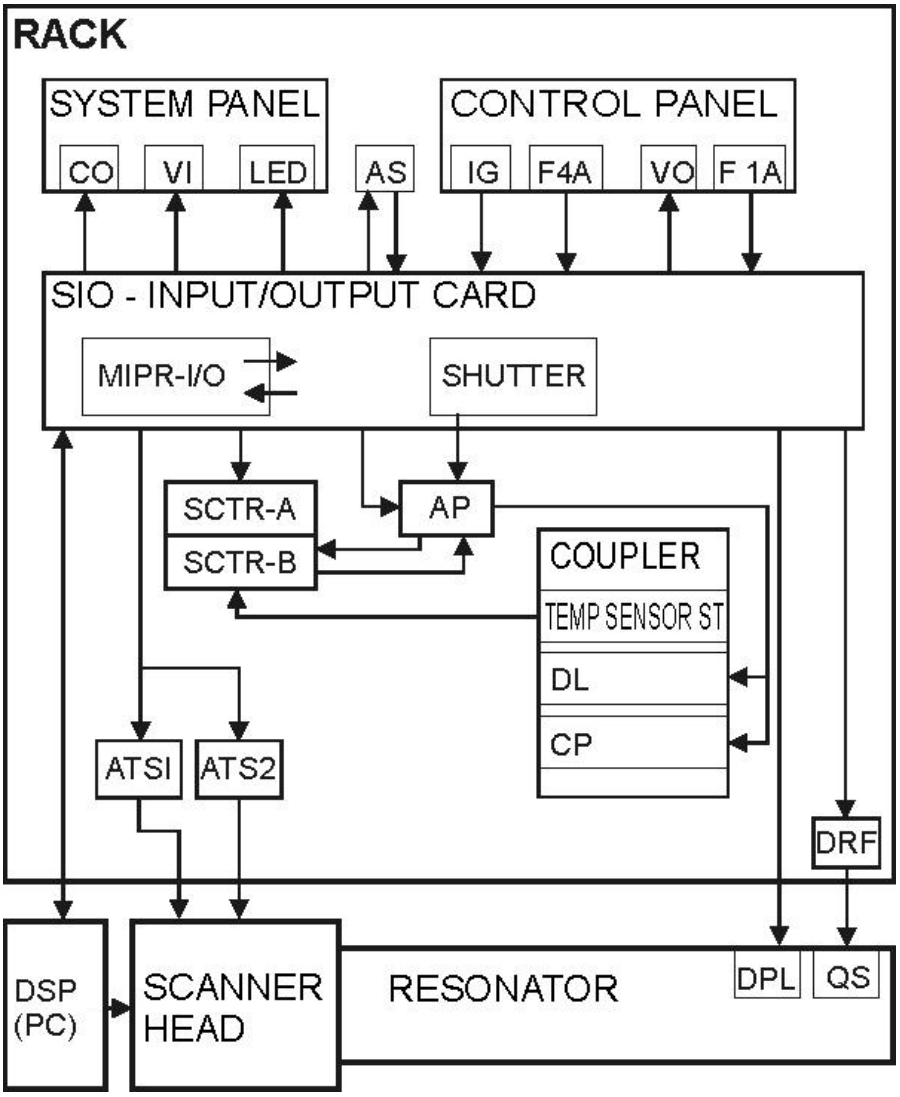

Figure 11. Block diagram of electrical system

MAIN SWITCH MS

The Main Switch MS consists of a Filter with an IEC Connector and a Bipolar switch for the 220V AC supply line complete with double fuse holder. This is located on the Control Panel CP (rear) and simultaneously provides the following functions:

- Power supply cut out device;
- Trigger device for overload and short circuits (2 Rapid 5x20 4A F Fuses);
- Category “0” Emergency device.

The Main Switch MS is used normally for turning the equipment on and off.

SIO INPUT/OUTPUT CARD

The SIO Input/Output Card communicates with different component parts of the Electrical System, centralising and processing operational and control functions.
The SIO Card receives power directly from the Main Switch MS and feeds:

- the Service Feeder SF, which generates a low voltage of 15 V DC;
- the two feeders ATS1 and ATS2 assigned to the Scanner Head SH electronics, that generate the 15 V DC low voltages needed to activate them;
- the Power Feeder PF, supplying 220 V AC voltage;
- the Radio-Frequency Driver Card RFD, supplying it with a 15 V DC low voltage and the command signals for piloting the Q-Switch QS (located inside the Resonator);
- part “A” of the Control Card CTRC, supplying it with a 15 V DC low voltage and the command signals;
- the Input/Output Microprocessor MIPR-I/O, supplying it with a 15 V DC low voltage;
- the Pointer Laser Diode, supplying it with a 3.5 V DC low voltage;
- the Safety relay that acts as an Electronic Shutter SH;
- the air outlet Fan FO for taking air out of the Rack, supplying it with 220 V AC voltage;
- the air intake Fan FI for bringing air into the Rack, supplying it with 220 V AC voltage;
- the Hour Counter CO, supplying it with 220 V AC voltage.

In addition, the SIO Card communicates with the DSP2 Card for controlling the Laser.

SERVICE FEEDER SF

The Service Feeder SF converts 220 V AC voltage into 15 V DC and supports, by means of the I/O card, all the service requirements of the Electronic System.

FEEDERS ATS1 AND ATS2 FOR SCANNER HEAD SH

The Feeders ATS1 and ATS2 convert 220 V AC voltage into 15 V DC and, by means of the SIO Input/Output Card, feed the Galvo-Mirrors (for directional control of the laser beam) housed in the Scanner Head SH.

POWER FEEDER PF

The Power Feeder PF has basically three functions:

- it feeds the Laser Diode LD, supplying a voltage of approx. 2 V DC and current up to 50A;
- it feeds the Peltier Cell (Pcell), supplying it with a 12 V AC voltage;
- it feeds part “B” of the CTRC Control Card, supplying it with a 15 V DC voltage.

RADIO-FREQUENCY DRIVER CARD RFD

The Radio-Frequency Driver Card RFD pilots the electro-optical Q-Switch QS, generating radio waves of between 10,000 and 300,000 Hz, in direct response to the command signals received from the SIO.

CONTROL CARD CTRC

The Control Card CTRC, because it is a unique element, is divided virtually into two distinct parts.
Part “A” (CTRC-A) receives and isolates the signals coming from the SIO;
Part “B” (CTRC-B) controls the operation of the power Laser Diode LD through

- piloting the current that powers it;
- controlling the maximum current it can take, thus guaranteeing its safe operation.

In addition, it processes the signals from the Temperature Sensor TS that works on the Laser Diode LD and

- maintains its working temperature within the ideal range of 20° to 30° C;
- prevents it from working at temperatures of over 35° C.

INPUT/OUTPUT MICROPROCESSOR MIPR-I/O

The Microprocessor MIPR-I/O controls all the functioning logic of the equipment, control of the alarms, the monitoring of internal signals and external consensus. The Microprocessor is incorporated in the SIO Card.

POWER LASER DIODE LD

The power Laser Diode LD is installed on the Coupler Unit. It is supplied with a low voltage of 2 V DC and current up to 50/70 A, works at a monitored and regulated temperature of between 20° and 30° C and supplies electromagnetic energy, the so called “optical pumping”, needed to supply the resonator.

PELTIER CELL (Pcell)

The Peltier Cell (Pcell) is in direct contact with the base of the Coupler Unit, and is located exactly underneath the power Laser Diode LD. It is supplied with a low voltage of 12 V DC and discharges to the Heat Sink all the thermal energy generated by the power Laser Diode LD, merely serving as a heat exchanger.

ELECTRONIC SHUTTER SH

The Electronic Shutter SH acts as a barrier to the Laser beam generated by the Resonator Unit. In actual fact, this is a safety relay installed on the SIO Input/Output Card that intervenes on the power Laser Diode LD command signals, directly allowing or preventing its supply and subsequent activation.

TEMPERATURE SENSOR TS

The Temperature Sensor TS is fixed to the power Laser Diode LD and its detection is controlled by the Control Card CTRC.

POINTER LASER DIODE PLD

The Pointer Laser Diode, supplied with a low voltage of approx. 3,5 – 4 V DC, is installed on the Resonator Unit. This is superimposed over the power Laser beam and allows its optical path to be indirectly visualised, as well as the operational field output from the Scanner Head SH.

Q-SWITCH QS

The Q-Switch QS is an electrical-optical component located inside the Resonator Unit. It is an active component on Lasonall™ 2 and 3, and is piloted directly by the Radio-Frequency Driver Card RFD with wave values of between 10,000 and 300,000 Hz.

NOTE:

On Lasonall™ 1 the Q-SWITCH is passive and oscillates at a fixed frequency in a range of between 15,000-30,000 Hz

FAN FO

The Fan FO for extracting the air circulating in the Rack is located on the Control Panel CP (rear) and is supplied with a voltage of 220 V AC. It expels hot air from inside the Rack by heat exchange with the Heat Sink where suitably installed.

FUSE 1A

The Rapid Fuse (5x20 1A F) is located in the fuse holder installed on the Control Panel CP (rear) and protects the 15V DC low voltage supply circuit.

The System Panel SP

The System Panel SP encloses the front of the Rack and is intended for the Operator of the Lasonall™ MARKER laser equipment. The System Panel SP includes the following component parts:

1) Two-colour Leds for signalling the Equipment status
   Green = Green Power On
   Red = Red Laser On
2) Hour Counter CO
3) Fan FI

FAN FI

The Fan FI for drawing circulating air into the Rack is located on the System Panel SP (front) and is supplied with 220 V AC voltage. It draws in sufficient air for heat exchange, in this way cooling the inside of the Rack.

HOUR COUNTER

The Hour Counter CO is located on the System Panel SP (front) and is supplied with 220 V AC voltage. It records the total effective time the Laser Diode has been activated, in this way allowing maintenance operations to be scheduled.

LED

The Led is located on the System Panel SP (front) and is supplied with a voltage of 5V DC by the Microprocessor MIPR-I/O. It gives a visual display of the status “Power On” (green) and “Laser On”(red).

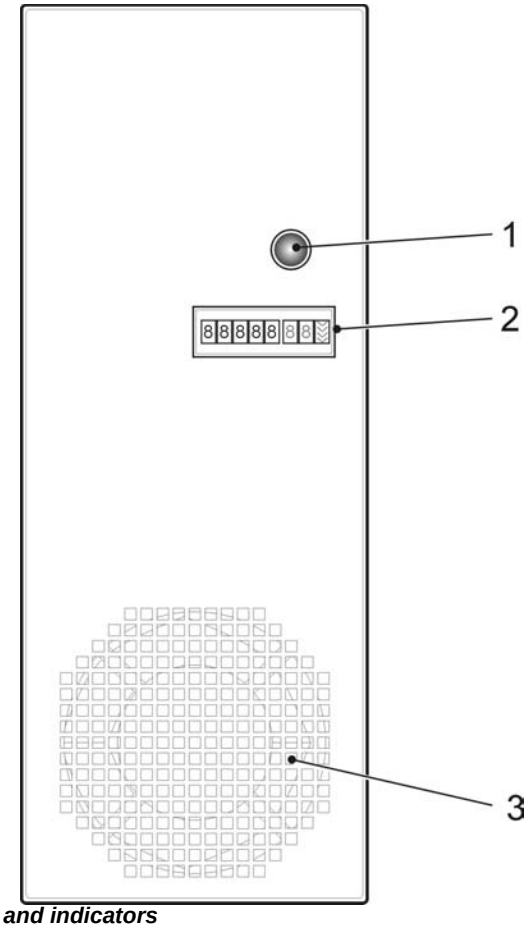

Figure 12. External controls and indicators

NOTE:
A description of the **Control Panel CP** and its components is given on page 41, in the chapter **ELECTRICAL INSTALLATION**

RACK

Contains the optical pumping diode and the relative cooling system.

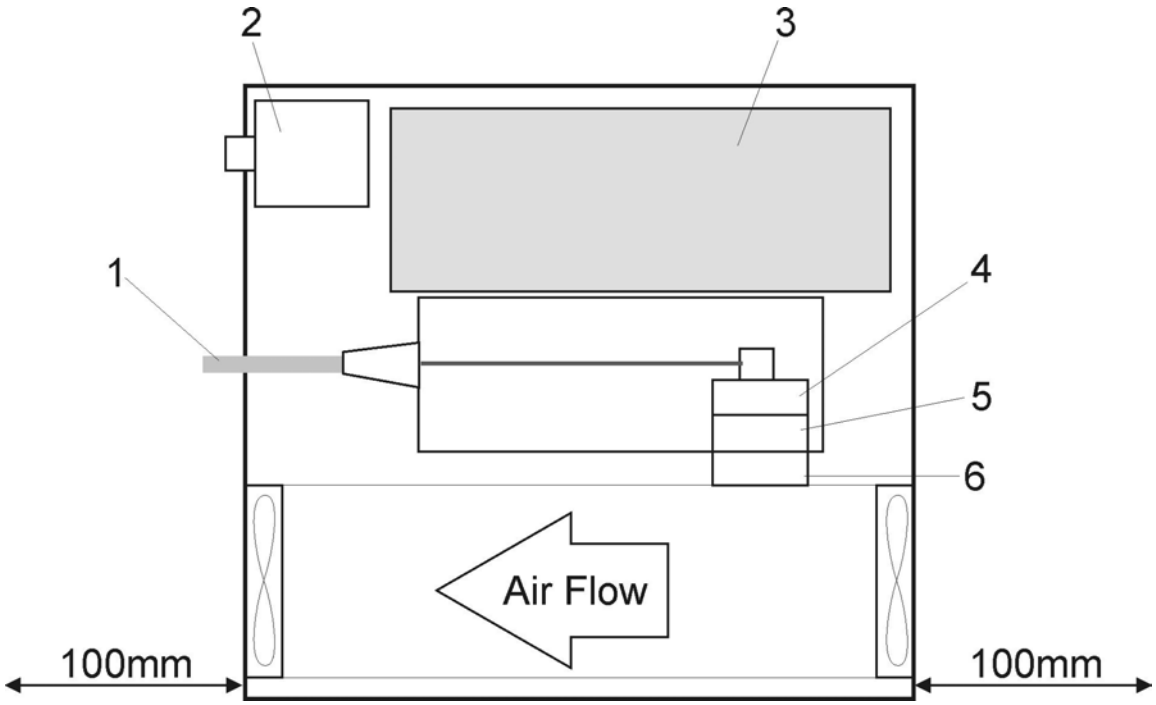

Figure 13. Rack Diagram

1) Fiber optic carrying the laser beam 600um
2) Radio frequency control for Q-switch
3) Governing Card: generates the supply voltages :
   - laser diode power supply
   - ±15 V AC for the scanner head
   - continuous voltage for RF to pilot Q-switch (on Lasonall™ 2-3)
4) Laser diode
5) Thermal cooler
6) Heat sink

WARNING:
A space of at least 10 centimetres must be left in front of and behind the Rack, to guarantee an adequate flow of cooling air.

Structure of the optical part

The physical principle on which the generation of LASER light is based is the phenomenon of the stimulated emission of light. LASER, is in fact an acronym for Light Amplification by Stimulated Emission of Radiation. This means that the laser is light amplified by a chained photonic emission, originating from an initial photon (light particle) which when interacting with the excited atomic system, stimulates the emission of two photons and these, in turn by interacting with other atoms give rise to a knock-on effect.
To excite the atomic system an external source of energy is needed, in a suitable form to induce the laser effect. "Optical pumping", the principle used by Östling, is achieved when the light emitted from a luminous source, on investing an active material (material able to emit LASER light) excites the atoms by the absorption of luminous energy.
Amplification of the laser effect is achieved by making the light emitted pass several times through the same active material. This is done by putting the active material between two opposing mirrors, or rather constructing and "aligning" what is termed the "Resonator". When the resonator is perfectly "aligned", the crystal and the mirrors are centred on the optical axis. The surfaces of the crystal, the front mirror and the flat surface of the rear mirror are parallel. In this optical configuration maximum extraction of laser energy from the resonator is achieved, the beam is circular and of approximately uniform intensity.
The Q-Switch is an additional optical/acoustic device set between the crystal and the front mirror, and oscillates at a fixed frequency on Lasonall™ 1 or is piloted by radio frequency on Lasonall™ 2-3. It acts as an “optical switch” to impair the regular and constant flow of photons: when “closed”, it allows the level of crystal atomic excitation energy to be increased; “re-opening it”, the working energy available coming out of the resonator is therefore higher than the average value.
Once produced, LASER light can be transferred to any point required by fiber optic up to a refocus lens, finally exploiting it for the required application.

In the specific case of the Laser Lasonall™ equipment, we can add a little more information.
The optical part is made up of two modules with different functions. The first is the Resonator (described above) where, the laser light is generated. The second is the Scanner Head, a module able to deviate the light beam to any point in a working field (preset by the chosen Focusing Lens), that allows any two-dimensional geometrical figure to be marked.
The special feature of the Lasonall™ laser source in the solid state lies in the method of optical pumping of the Resonator. In fact, unlike traditional methods, in this case the “optical pumping” is achieved by means of a Laser Diode instead of a Flash Light. This method gives a very high modal efficiency (only the TEM00 mode resounds) and produces little heat to be dissipated. These two characteristics mean that the size of the Resonator and the Rack (Electrical Part) can be reduced, which, in this case, includes the Coupler of the “pumping” Laser Diode and the cooling system.

Resonator

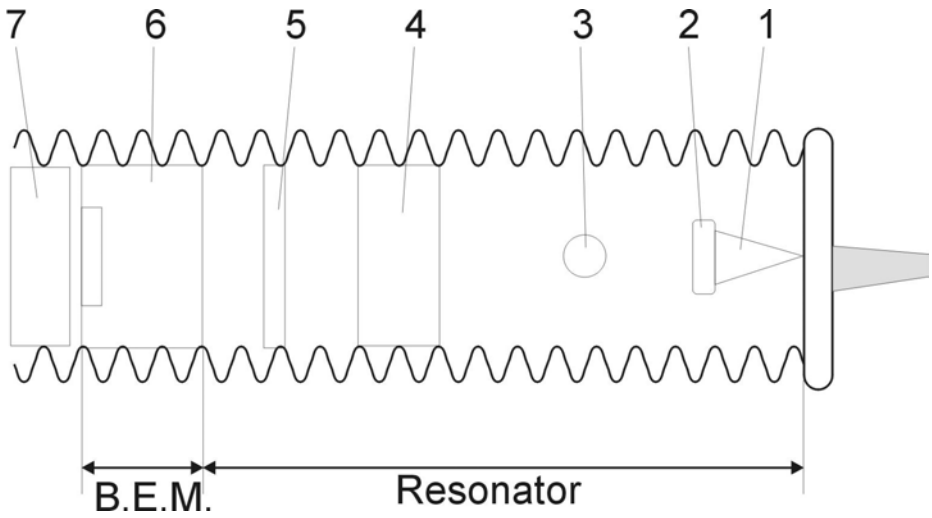

Figure 14. Resonator diagram

1) Light emitted from the fiber optic
2) Refocus lens
3) Rear mirror
4) Crystal
5) Q-switch
   Passive on Lasonall 1, or rather fixed frequency (pen up, pen down system) Active on Lasonall 2 and 3, variable frequency
6) Front mirror
7) Beam expander module, increases the diameter of the laser beam
8) Red Pointer Diode, visualises the limits of the graphic area to be marked

Diagram of laser beam deviation galvanometric head

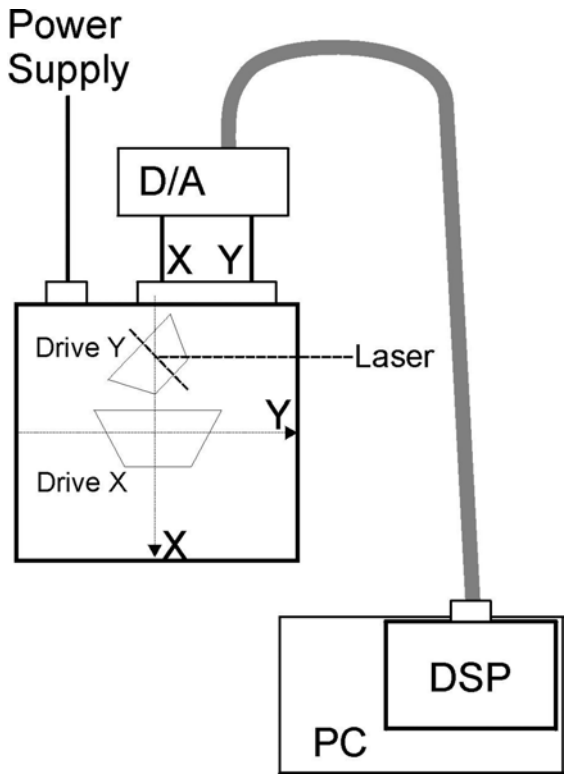

Figure 15. Laser beam deviation galvanometric head

There are two tiltable mirrors fitted to the laser head, moved by galvo-motors, and controlled by the DSP board fitted inside the PC that in turn interfaces with the D/A (digital analogue) conversion board, fitted above the laser beam deviation galvanometric head (see: ***LASONALL™ complete system figure***) There are two connections, one for the power supply (connector DB9), the other to control the two galvo motors that control the X Y axes, input from the DSP board (connector DB25).

Lens

The lens can have different focal lengths. The focal length of the optic determines the size of the marking area.

Focal length	**100mm**	**160mm**	**254mm**
Working area	50x50mm	110x110mm	180x180mm
Working distance	118mm	190mm	299mm
Resolution (16bit)	0.8. m	1.7. m	2.8. m
Spot diameter	20÷40. m	30÷50. m	40÷70. m
Marking speed *	250 characters/sec	250 characters/sec	250 characters/sec

* the marking speed has been measured using strings of text with a Roman-S font (single line) 1.2 mm high.

Personal Computer

The DSP2 card is fitted with a DSP Microprocessor that supervises all the marking operations and, by means of the software provided, is able to control the graphics for the whole process. It controls the Laser beam emission and governs the X and Y axis co-ordinates by acting directly on the voltages of the galvo motors inside the laser beam deviation galvanometric head. It is divided into two separate parts. The Main card (175 x 110 mm) is inserted into the PCI slot of a Standard or industrial PC and conforms to version 1.1a Plug And Play requisites, also offering the opportunity of being used in "Legacy" systems (not PnP). To this card is connected an expansion card (86 x 77 mm) whose sole aim is to isolate the PC / Laser signals. The diagram below illustrates the structure of the card:

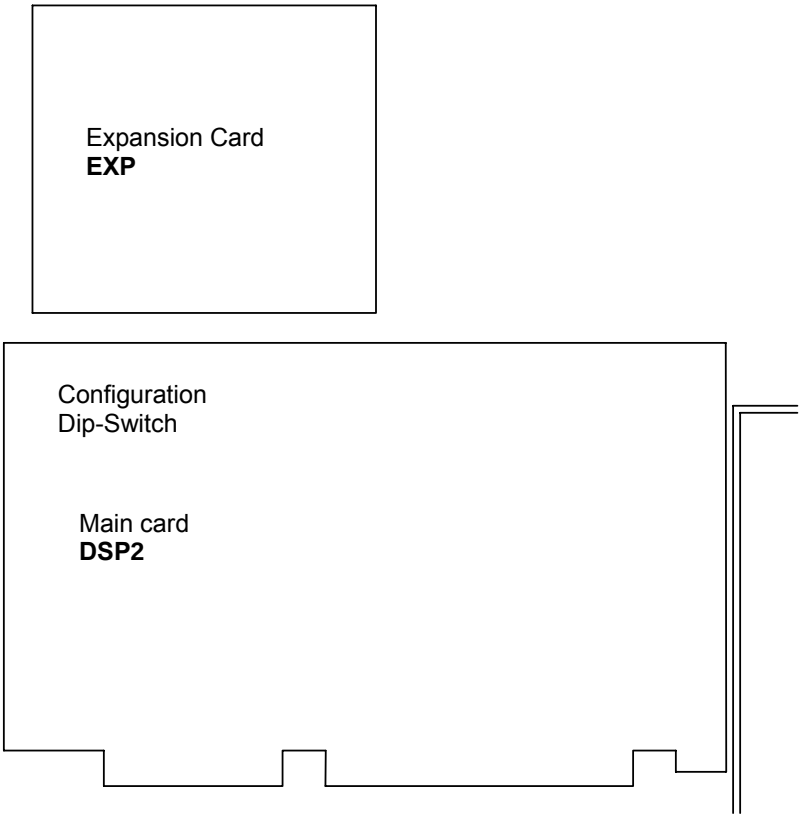

Figure 16. DSP Board

NOTE:
In order for the drivers of the DSP card and the CREATOR PRO software to work properly, the energy saving settings must be removed from the PC. The most common options are:

- stand by
- turn off monitor
- disable hard disks

The value "**NEVER**" must be set for all the above options.

NOTE:
For information on how to use the (CREATOR) laser control program refer to the relevant manual.

Technical characteristics

	Lasonall	Lasonall	Lasonall
	1	**2**	**3**
Wavelength	1064 nm	1064 nm	1064 nm
Power	5W	10W	20W
Q-switch frequency	10-20 kHz	10-200 kHz	5-300 kHz
Laser quality	$M^2 < 1.1$	$M^2 < 1.1$	$M^2 < 2$
Pointer	635 nm - Class I	635 nm - Class I	635 nm - Class I
Power supply	90-240 VAC 3A	90-240 VAC 4A	90-240 VAC 6A
Dimensions			
Laser source	Ø85 mm x 213mm	Ø85 mm x 255mm	Ø85 mm x 255mm
Laser + scanner head	550x120x175mm	610x120x175mm	615x120x175mm
Power supply	500x180X450mm	500x180X450mm	500x180X450mm

The above technical characteristics are also found on the plate affixed to the equipment, conforming to all European safety regulations.

NOTE:
The ID plate affixed to the machine must on no account be removed or damaged. For any eventual replacements needed contact the manufacturer.

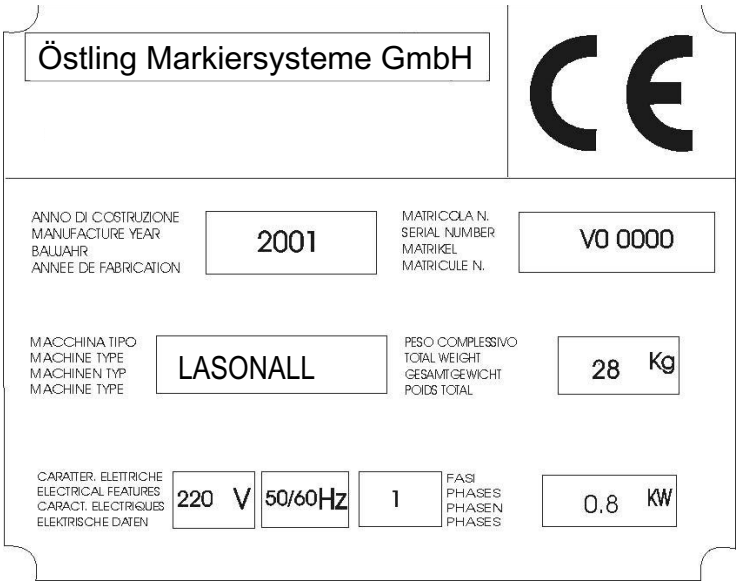

Figure 17. Example of ID plate

Installation

Preparation of the Personal Computer

The complete laser marking system is made up of:
1) DSP2 Card, to be connected to an PCI type slot on a Standard or industrial PC.
2) DSP card control Driver available for Windows 95 / 98 / ME / NT4 / 2000.
3) DSP card control program (DSP Control), for setting up the marking parameters.
4) Graphics Editor for creating models to send to the marker.

The diagram below shows the hierarchy of the various components in the complete system:

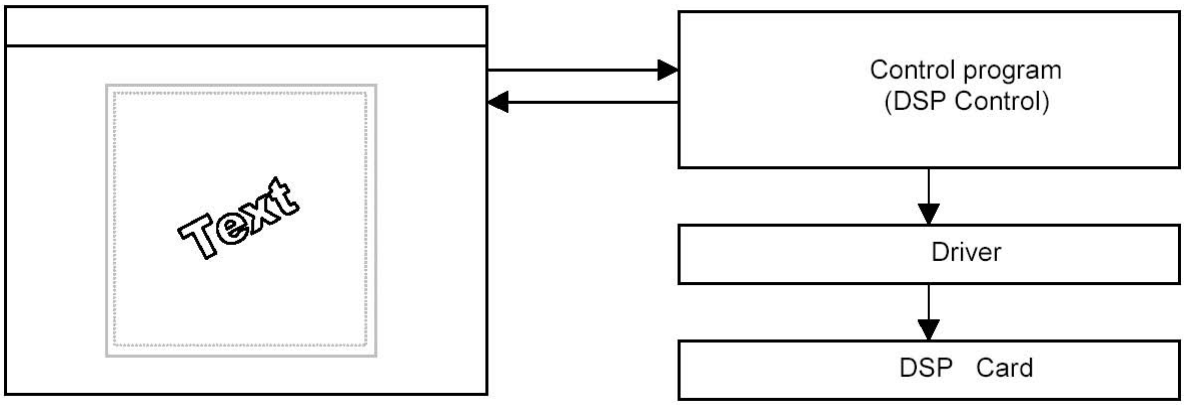

Figure 18. Software control diagram

The graphics of the marking file are created by the **Creator Pro 3.0** (or higher) program, designed for creating bitmap models, for photographic marking, and for vectorial models.

NOTE:
For instructions on the use of CREATOR software, refer to the relative manual.

Installing the DSP2 Card

The DSP2 Card is made up of two separate parts. The Main card (175 x 110 mm) is inserted into the PCI slot of a Standard or industrial PC and conforms to version 1.1a Plug And Play requisites, also offering the opportunity of being used in "Legacy" systems (not PnP). To this card is connected an expansion card (86 x 77 mm) whose sole aim is to isolate the PC / Laser signals..

Procedure:

- Turn off the PC 1
- Install the DSP2 Card (2 in figure) inside the PC 1
- Turn on the PC
- Insert the Creator CD (3 in figure) and install the software
- Take the file ***lasermon.ini*** contained in the floppy disk (4 in figure) supplied with Lasonall™ and copy it to the folder ***..\Lasonall Creator Pro IV\bin***\; writing over the file already installed. The operation must be carried out with the DSP program monitor (triangular yellow icon in the tray area) closed
- Restart the PC

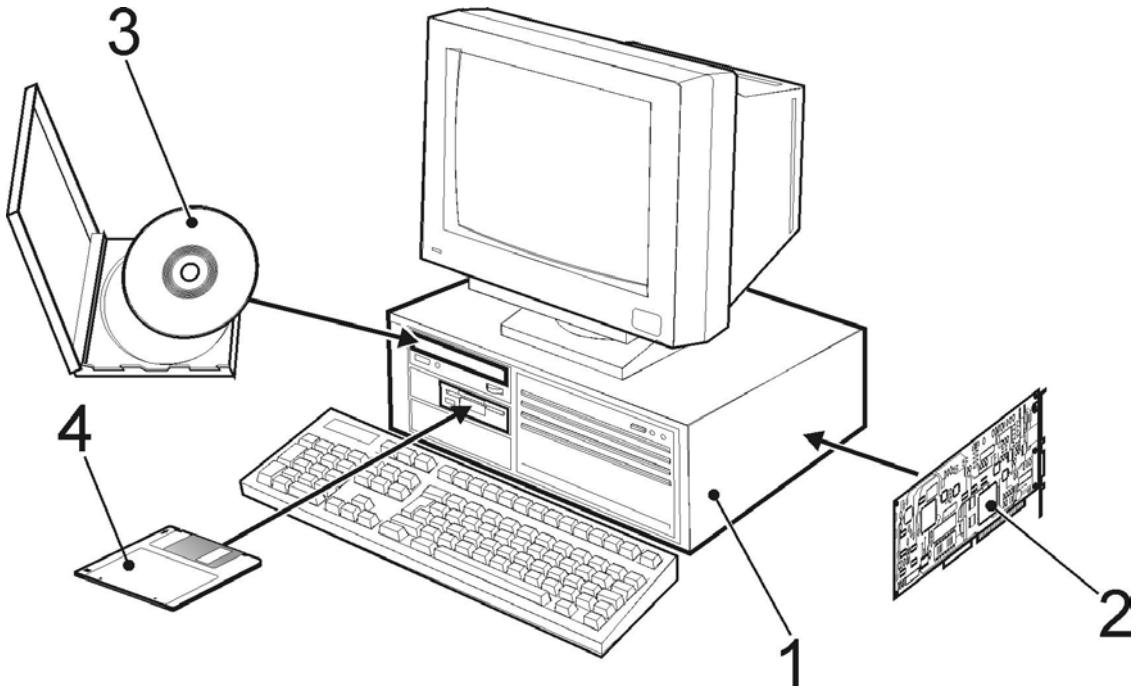

Figure 19. Personal Computer

Installing the Driver

Windows 9x/Me

The Lasonall DSP2 boards do not work under Windows 9x/Me.

Windows NT4/2K

To install the card in a Windows NT/2K system, follow the steps for physically installing the cards into the PC. Then, start up the computer. Windows will ask you to insert the CD containing the drivers. Insert your Lasonall software package CD. Installation will proceed automatically.

Place the file "laser.ini" contained on the floppy disk (4 in figure) supplied with your Lasonall laser and copy it to the folder "C:\Program Files\Lasonall Creator IV\bin", overwriting the file already existing there. This operation must be carried out with the DSP program monitor (triangular yellow icon in the system tray) closed.

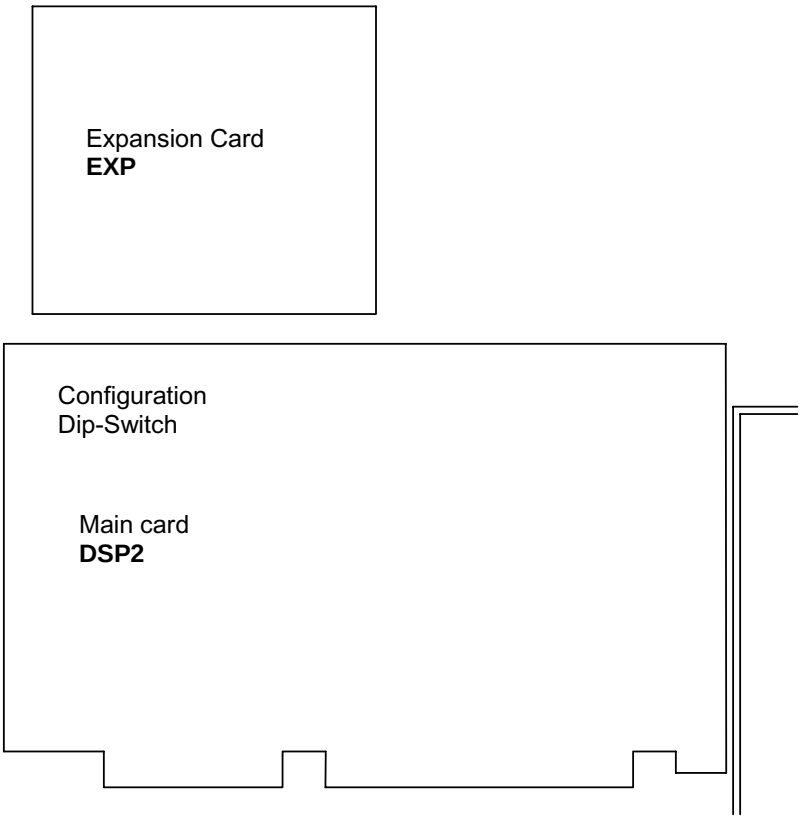

Figure 20. DSP2 Card

NOTE:
For further details on the DSP2 Card and use of the CREATOR software, refer to the relative manual.

Resonator fixing points

The diagrams below show the fixing points for the resonator and the relative focal distances.

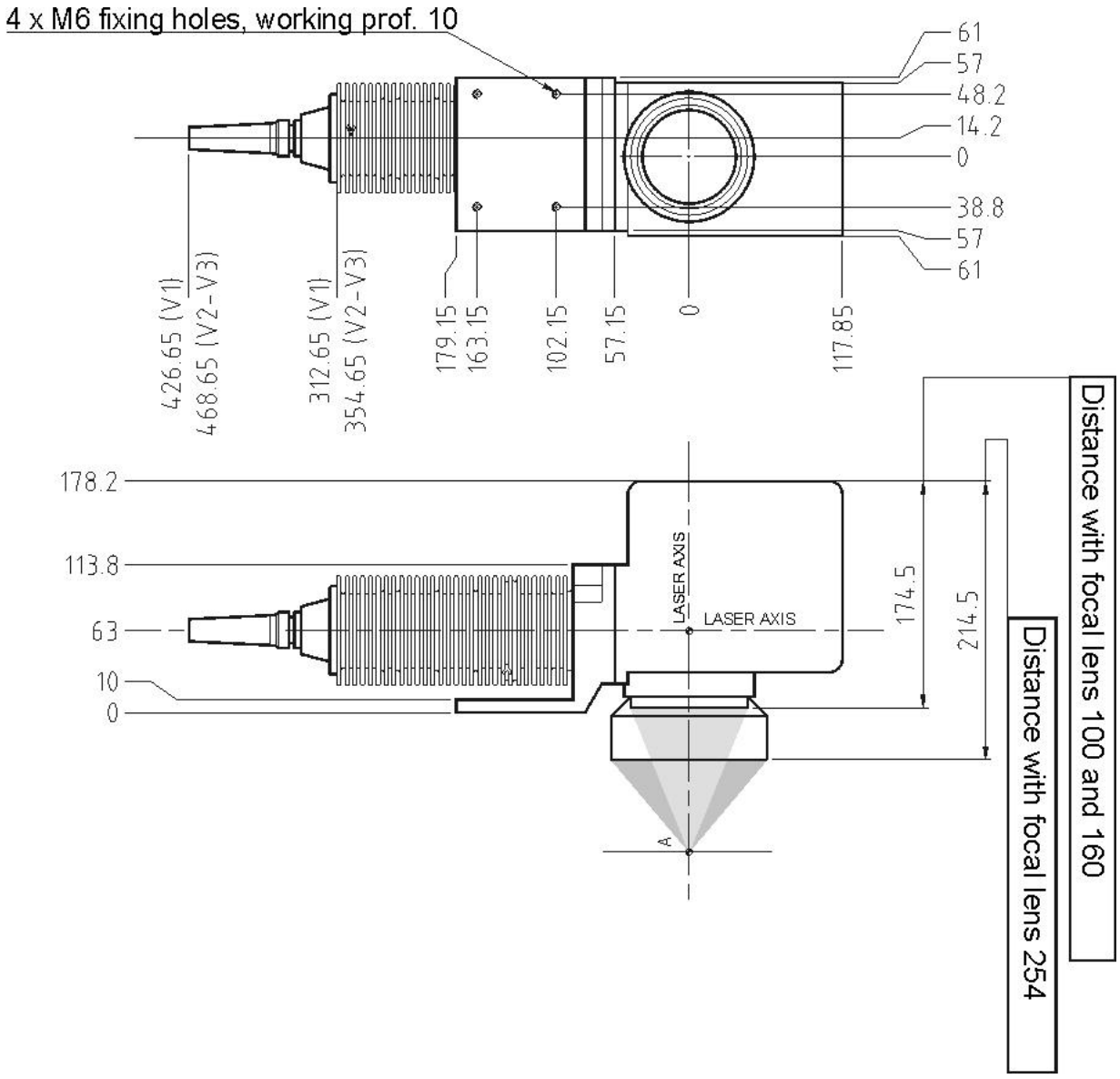

Figure 21. Dimensions and resonator fixing points

ELECTRICAL INSTALLATION

The Lasonall™ laser equipment must be connected to a single phase line with an earth and a protection conductor. To ensure selectivity in the case of short circuit a back up protection must be provided with **16 A am type fuses**. In the case of installation in factories with I_{cc} greater than 6 kA, to limit the D.C. current to this value, a cable with a minimum length of 5 metres is needed. Any intervention on the internal equipment must be carried out by qualified personnel and authorised by Östling

NOTE:

Any intervention on the internal equipment must be carried out by qualified personnel and **authorised by Östling**.

Upstream of the protection line a highly sensitive differential cannot be installed, only one of medium or low sensitivity (300 mA - 0.5 mA).

Electrical system connections

The electrical system is completed with the following Cables and Connectors:

Characteristics of connecting Cables

LD SMB plug-to-plug cable (length 3 m)
between connector 9 AIMING BEAM on the Control Panel CP and the SMB plug on the resonator;

RF SMA plug-to-plug cable (length 3 m)
between connector 15 Radio Frequency RF on the Control Panel CP and the SMA plug on the resonator;

SH 9 pin F Canon socket-to-socket Cable (length 3 m)
between connector 6 GALVO SUPPLY on the Control Panel CP and the 9 pin M Canon connector on the Scanner Head;

STS 25 pin M Canon plug-to-plug cable (length 3 m)
between connector DB 25 F on the DSP2 Card and the 25 pin F Canon connector on the Scanner Head;

PC Canon 9 pin M plug-to-plug cable (length 3 m)
between connector 12 PC on the Control Panel CP and DB 9 F connector on the DSP2 Card.

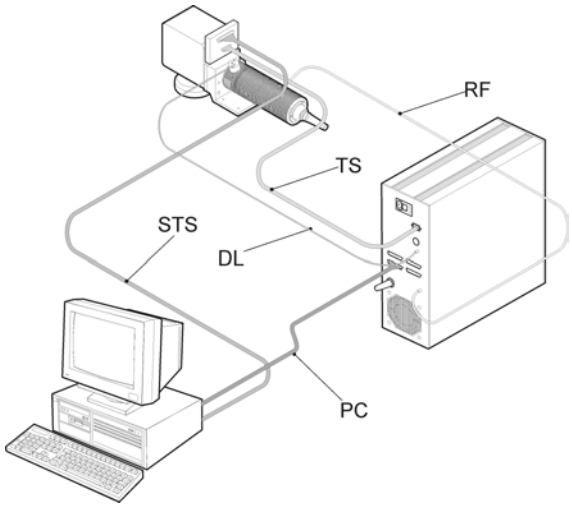

Figure 22. Connecting cables

Control Panel CP

The diagram below shows the layout of the connections located at the rear of the RACK.

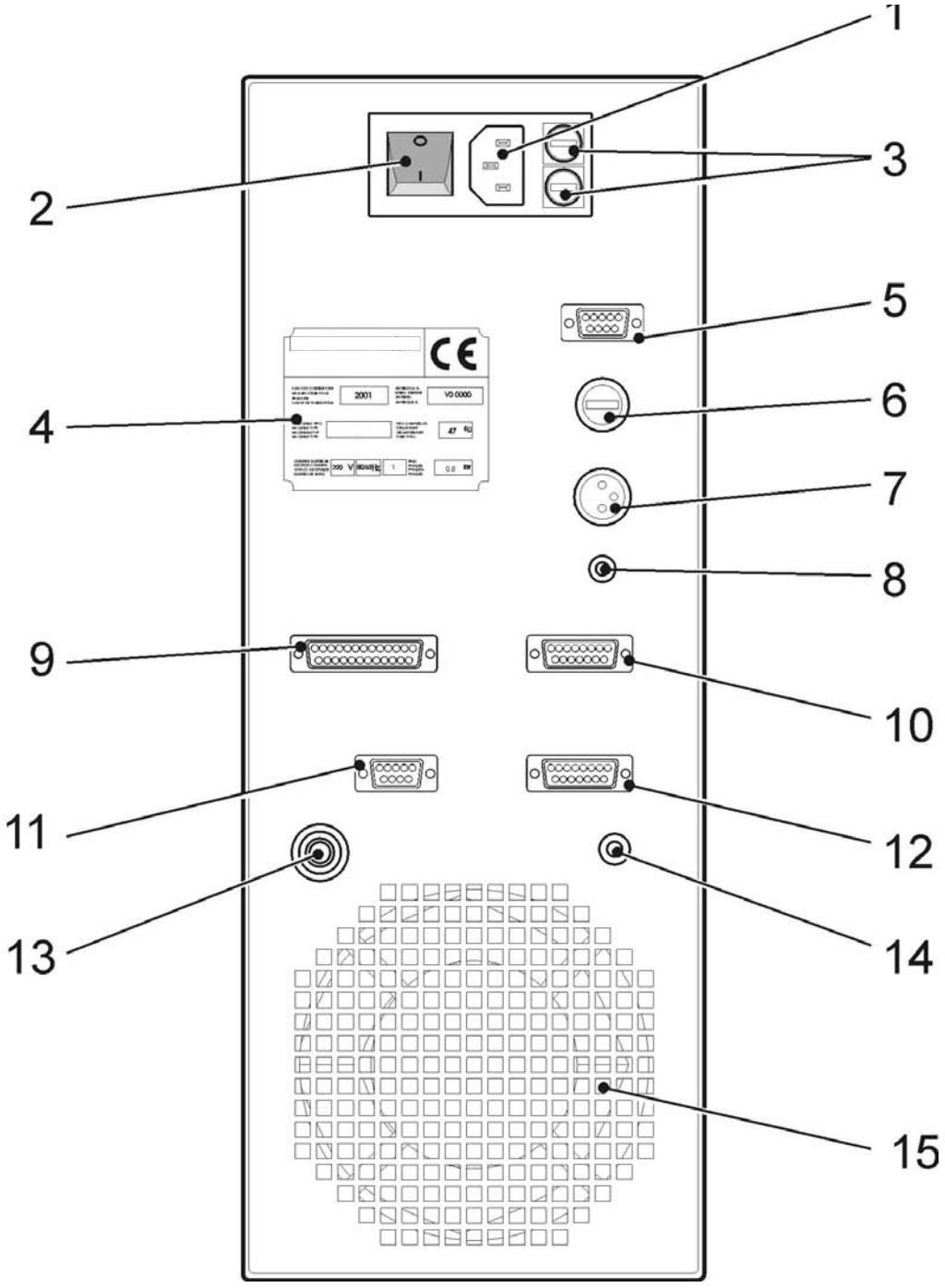

Figure 23. External connections

Description of the Control Panel CP

1) Socket for external power supply
2) Main Switch for MS Power supply. INPUT 220V AC - 3A - 50/60Hz
3) Fuses (Jx20 4AF)
4) ID plate
5) **GALVO SUPPLY**
   Power supply to galvo motors SUBMINI CANON 9PM
6) **FUSE 1A**
   Rapid fuse (5x20 1Amp F)
7) **EXTERNAL INTERLOCK**
8) **AIMING BEAM**
   Pointer diode SMB F
9) **COMMAND BOX**
   Command Box Connector SUBMINI CANON 25PF
10) **SLAVE IN**
   Slave In Connector SUBMINI CANON 15PM
11) **PC**
   DSP card (PC) Connector SUBMINI CANON 9PF
12) **SLAVE OUT**
   Connector Slave Out SUBMINI CANON 15PF
13) **FIBER OPTIC**
   Fiber Optic
14) **R.F**.
   Q-Switch Connector SMA F
15) Cooling fan FO

External Interlock (EI)

All the emergency devices for putting the laser source into a safe status can be connected in series with this connector.

Connection:

Pin 1 / Pin 2 Clean contact:
Interlock off contact **closed**

The diagram below shows the female interlock connector on the rear of the panel

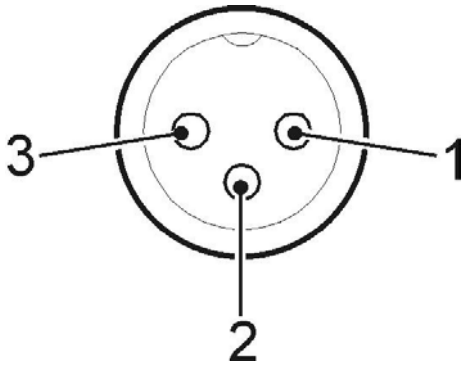

Figure 24. Interlock Connector

Command Box (CB)

This connector supplies the inputs/outputs which are indispensable for control and interfacing with the marking system. The diagram below shows the pin layout of the 25 pin female connector located on the rear of the panel.

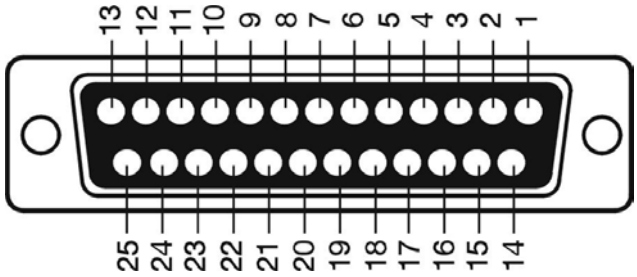

Figure 25. Command Box

Input Signals

Emergency and stop
Pin 1 / Pin 2 Clean contact

The emergency is disabled with the contact **closed**

Start key
Pin 4 / Pin 12 Clean contact

The laser is turned on with the contact **closed**. This contact must be enabled by a spring loaded key. The contact must normally be open.

NOTE:
The laser **will not turn on** if:
- The clean contact between pin **4** and **12** is normally **closed**
- The clean contact between pin **7** and **8** is **closed**

Electronic shutter
Pin 7 / Pin 8 Clean contact

The shutter is open with the contact **closed**

NOTE:
It is not possible to open the shutter when the software is operating (marking taking place). External Safety Guards (Barriers, gates, doors, etc.) are usually connected in series with these Pins.

Output Signals

Laser Diode current monitoring
Pin 16 Analogue output
Pin 17 Reference GND for pin 16

The reading factor for the current is 0.1 Volts/Amps

Power ON
Pin 18 Analogue output LOW = 0 Volts when the laser is off
HIGH = 13 Volts when the laser is on
Pin 19 Reference GND for pin 18

Laser Ready
Pin 20 Analogue output LOW = 0 Volts, when the laser is on (Temp OK)
HIGH = 13 Volts, when the laser is off (Wait temp OK)
PIN 21 Reference GND for pin 20

Shutter
Pin 22 Analogue output LOW = 0 Volts, when the shutter is closed
HIGH = 13 Volts, when the shutter is open
Pin 21 Reference GND for pin 22

NOTE:
The pins not mentioned are not used.

Summary table of COMMAND BOX connector

Pin N°	Type	Signal	Description
1	Input	Clean C.	**Emergency and stop**
2	Input	Clean C.	The emergency is disabled with the contact **closed**
3			
4	Input	Clean C.	Laser start up. Achieved with the contact **closed**
5			
6			
7	Input	Clean C.	**Electronic shutter**
8	Input	Clean C.	The shutter is open with the contact **closed**
9			
10			
11			
12	Input	Clean C.	Laser start up. Achieved with the contact **closed**
13			
14			
15			
16	Output	Analogue	**Current control**
17	GND		Reference GND for pin 16
18	Output	Analogue	**Power ON.** 0 Volts when the laser is off. 13 Volts when the laser is on
19	GND		Reference GND for pin 18
20	Output	Analogue	**Laser Ready.** 0 Volts with the laser on. 13 Volts with the laser off
21	GND		Reference GND for pin 20 and 22
22	Output	Analogue	**Electronic shutter.** 0 Volts, shutter closed. 13 Volts, shutter open
23			
24			
25			

General Power Supply

The equipment must be connected to a single phase 220V AC (L+N+E) line, 3 or 6 Amps 50/60 HZ depending on the model.

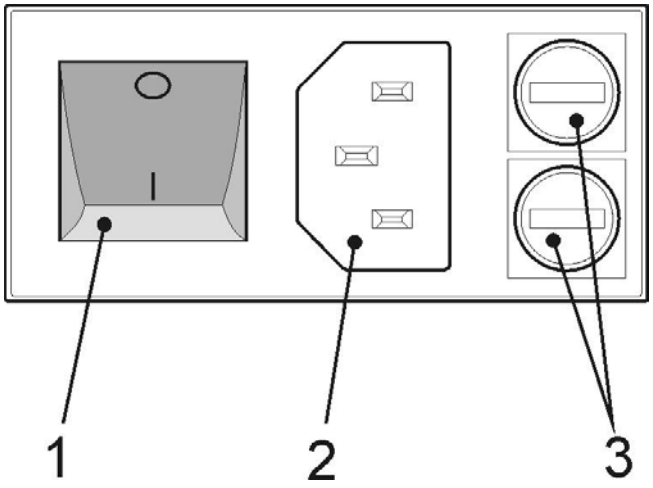

Figure 26. Power supply socket

1) Main Switch MS
2) 220 Volt Power supply socket
3) Pair of fuses

NOTE:
The power supply must be sectioned and protected with 16 A AM back up fuses.

Characteristics of connecting plugs

BY Canon 15 pin M Connector SLAVE OUT 12

WARNING:
1. pins 02 and 03 must always be connected (bridge),
2. pins 07 and 08 must always be connected (bridge).

EI Connector 7 EXTERNAL INTERLOCK - Control Panel CP

WARNING:
1. pins 02 and 03 must always be connected (bridge),

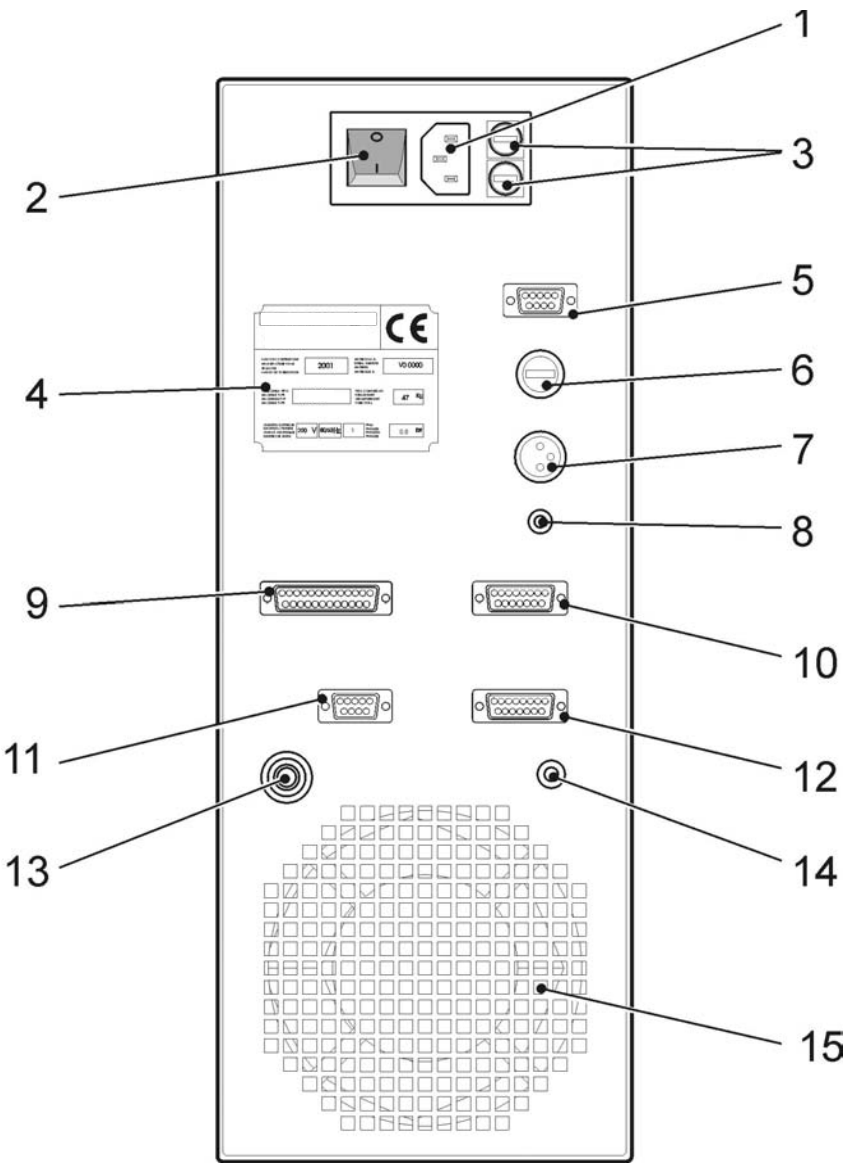

Figure 27. Rear connectors

Fiber optic connection

The laser aperture on the RACK is connected to the Resonator by means of a FIBER OPTIC. The end of the fiber that goes into the RACK is supplied already connected. The end of the fiber that goes into the resonator must be fixed when the system is installed.

Procedure:

1) Make sure the main switch is set to OFF
2) Remove the rear cover from the resonator, undoing the three screws 5. Slip the fiber optic through the sprung cable holder and into the rear cover just removed.

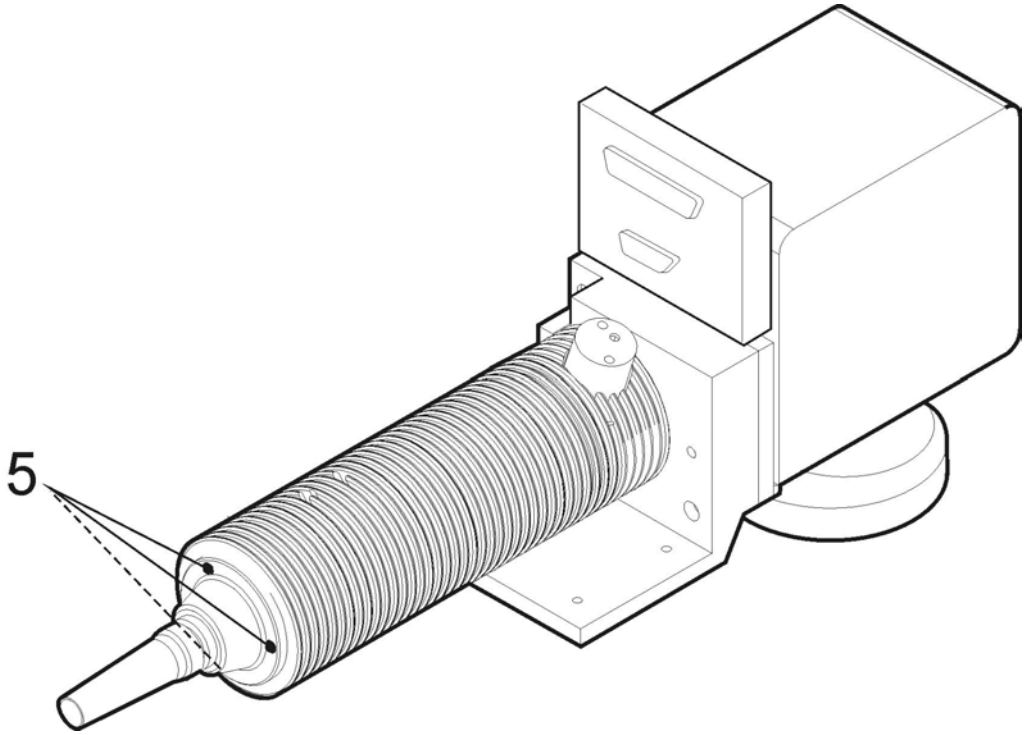

Figure 28. Rear resonator cover

3) Remove the protective hood 1 from the fiber optic connector by undoing nut 4

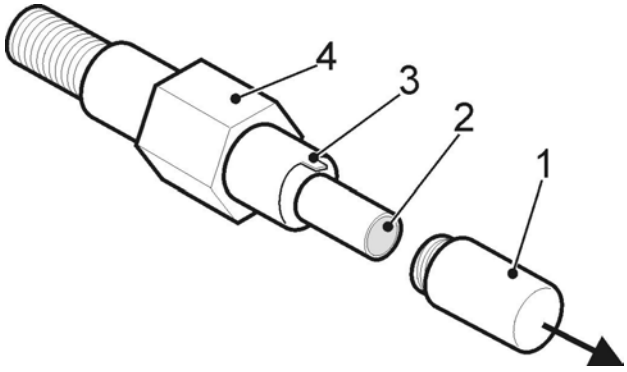

Figure 29. End of fiber optic

4) Insert the fiber connector; first resting it delicately on the fiber entry 6 on the resonator, then slipping it carefully into the housing, making sure that on no account the optical surface (central part 2) it comes in contact with any other surface.

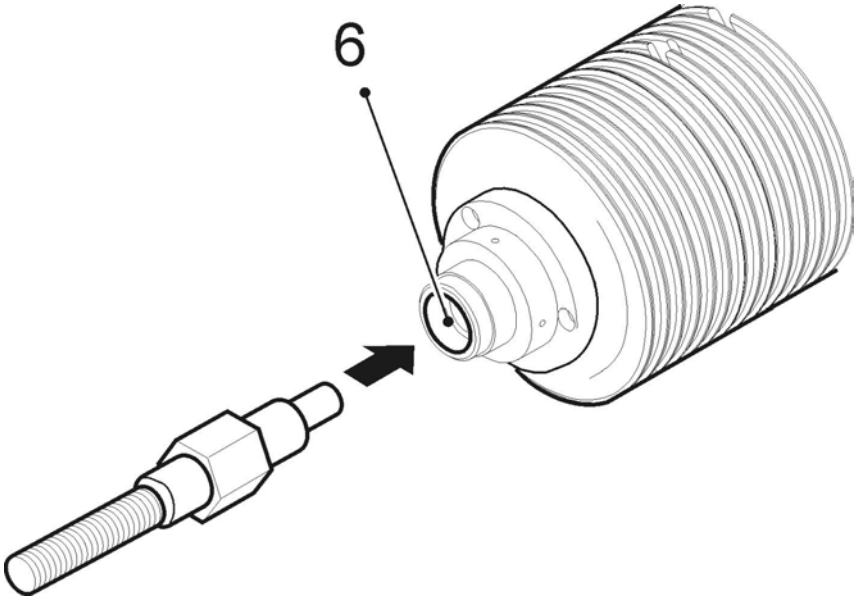

Figure 30. Fiber optic entry into resonator

5) Make sure that the mechanical references 3 located on the male/female connectors are positioned correctly, Then screw the connector into the Resonator Tube, using nut 4.

NOTE:
The operation of inserting the fiber must be carried out with extreme care. Under no circumstances allow the optical surface (central part 2) to come into contact with any other surface.

WARNING:
The protective hoods for the fiber optic and the fiber entry **must be put in a safe place**. **No returned fiber optics or resonators can be accepted without their relative covers**.

Preliminary checks

Before installing the Lasonall™ laser equipment make sure that nothing has been damaged during transportation!

- Check that the resonator, the Scanner Head and the Focusing lens are all in one piece and undamaged.
- Make sure that the power supply is available and conforms to what is specified in this manual.
- Test the voltage.
- Make sure the equipment is at the correct distance from the walls to allow adequate air circulation for cooling.
- Make sure the Main Switch is set to "0" before connecting the power socket.
- If necessary, rest it to “0”.
- Make sure that the equipment is correctly connected according to the diagrams enclosed with this manual.

WARNING!
Read carefully, apply and observe ALL the conditions defined in the Chapter on installation.

- Check that all the Connecting Cables and Connectors are correctly inserted.
- Make sure that the Fiber optic connectors are plugged correctly into the Rack and the Scanner Head.
- Make sure that the Laser beam is intercepted by the Focusing lens on exit, inside a suitable isolated area, that will offer protection against the risk of direct and/or diffused radiation.

WARNING!
Looking directly at a **Laser** beam can cause **irreversible** damage to the eyesight!

WARNING:
A space of at least 10 centimetres must be left in front of and behind the Rack, to guarantee an adequate flow of cooling air.

Procedure for installation and first Laser start up

1st PHASE

a) Check that the power supply cable is properly inserted.
b) Check that all the equipment connecting cables are properly linked up.
c) Turn off the Main Switch MS (Control Panel CP) and at the same time check that:
   1. the Led (System Panel SP) - still off - flashes just once.
   2. the Fan FO (Control Panel CP) works properly.
   3. There is power to the Pointer Laser Diode PLD; its beam of red light is seen on the focal plane at the centre of the Working field.
d) START.
   This is done by closing the contact between pins 04 and 12 of the COMMAND BOX connector (Control Panel CP) with an impulsed command. On start up:
   1. The equipment passes to the POWER ON status: the Led comes on - coloured Green.
   2. the Fan FI starts up (System Panel SP).
e) After about 10 seconds the equipment is ready to be operated:
   Enable ("Open") the SHUTTER by closing the contact between pins 07 and 08 of the COMMAND BOX connector (Control Panel CP) and check that:
   1. the "LASER ON" status appears: the Led changes to Red.
   2. The little red dot of the Pointer Laser Diode PLD disappears from the working field.
f) Disable ("Close") the SHUTTER by reopening the contact between pins 07 and 08 on the COMMAND BOX connector (Control Panel CP): the "POWER ON" status returns.

The 1st PHASE of the Installation procedure is now finished, the laser source is in stand-by, ready to be operated.

2nd PHASE

h) Start the server PC.
i) Install the marking *Creator Pro* software.
j) If active, close the DSP control program (by clicking on the yellow icon in the tray area) and copy the **Lasermon.ini** file from the floppy disk supplied to the folder **\Lasonall Creator Pro IV\bin.**
l) Run the marking program.
l) Reactivate the SHUTTER.
m) Carry out a Marking test.
n) Disable the Shutter.

NOTE:
For information on use of the Creator Pro software, refer to the relative manual.

Marking

The marking procedure depends on how the Lasonall™ is integrated into the system and on the type of application required. The basic sequences can in any case be summarised as follows:

- Enter the marking screen of the software being used.
- Insert the piece to be marked in the marking area.
- Press the START button to run the marking process.
- Wait until the end of marking and remove the finished piece.

Marking under the above conditions implies that the laser head (See lens) is at the correct focal length from the piece to be marked.
To set the head to the correct position it is necessary to enter the appropriate software window (See Software Manual) and position the Z axis (automatic or manual) in such a way that the laser is focused on the surface to be marked.
The correct position can usually be identified as the point where, when marking starts, the noise and light generated by the laser are greatest.

Shutting down Procedure

Once the Installation and First Start up procedures are completed, and all the Lasonall™ laser equipment has been checked, proceed with shut down as follows:

a) Press the STOP button on the machine which opens the contact between pins 01 and 02 of the COMMAND BOX connector (Control Panel CP);
b) Exit the marking Program:
c) Open the Main Switch MS (Control Panel CP).
d) Open the 7-8 Command Box contact.

NOTE:
For information on use of the CREATOR software, refer to the relative manual.

Protection and Safety Circuits

Safety stop and reset

The Lasonall™ model described is an OEM system (Original Equipment Manufacturer), which means that it has been designed and developed as an individual component to be integrated into more complex systems.

In case situations or malfunctions arise which may have dangerous consequences for the operator or the machine itself, safety circuits must be provided which block the laser operation completely.

These circuits must be connected to pins 1 and 2 of the Command BOX or the External Interlock.

Daily operations

Preliminary checks

Once the procedures of Installation, First Start up and Shut down described in the previous Chapters have been carried out, the Lasonall™ laser equipment is operational.
Every day, and in any case before each time the machine is turned on, carry out the following checks:

a) Make sure that the working area is free;
b) Make sure the power cable is properly connected;
c) Check that the cooling fan areas are free.

Putting into Service

For putting the Laser Lasonall™ equipment into service, carry out the Standard Operating Procedure S.O.P. by proceeding as follows.

a) Turn the Main Switch MS to the CLOSED position;
b) Switch on the server PC;
c) Start the equipment by pressing the START button and check for
   1. the presence of the luminous red dot (Laser Diode Pointer) on the focal plane of the Working field;
   2. the POWER ON status, or rather that the led (System Panel SP) is on and coloured Green;
d) Select the Marking Program required.

NOTE:
For information on use of the CREATOR software, refer to the relative manual.

e) Enable the Shutter and check for
   1. The disappearance of the luminous red dot (Laser Diode Pointer) on the focal plane of the Working field;
   2. the LASER ON status, or rather that the led (System Panel SP) is on and coloured Red.

NOTE:
From this moment onwards the laser source is ready to emit radiation.

Setting Parameters

As far as the Laser source is concerned, the Parameters to be set in a Marking Process essentially involve:

a) The number of passes;
b) the Power applied;
c) the Speed at which the Laser beam moves;
d) the Impulse Frequency.

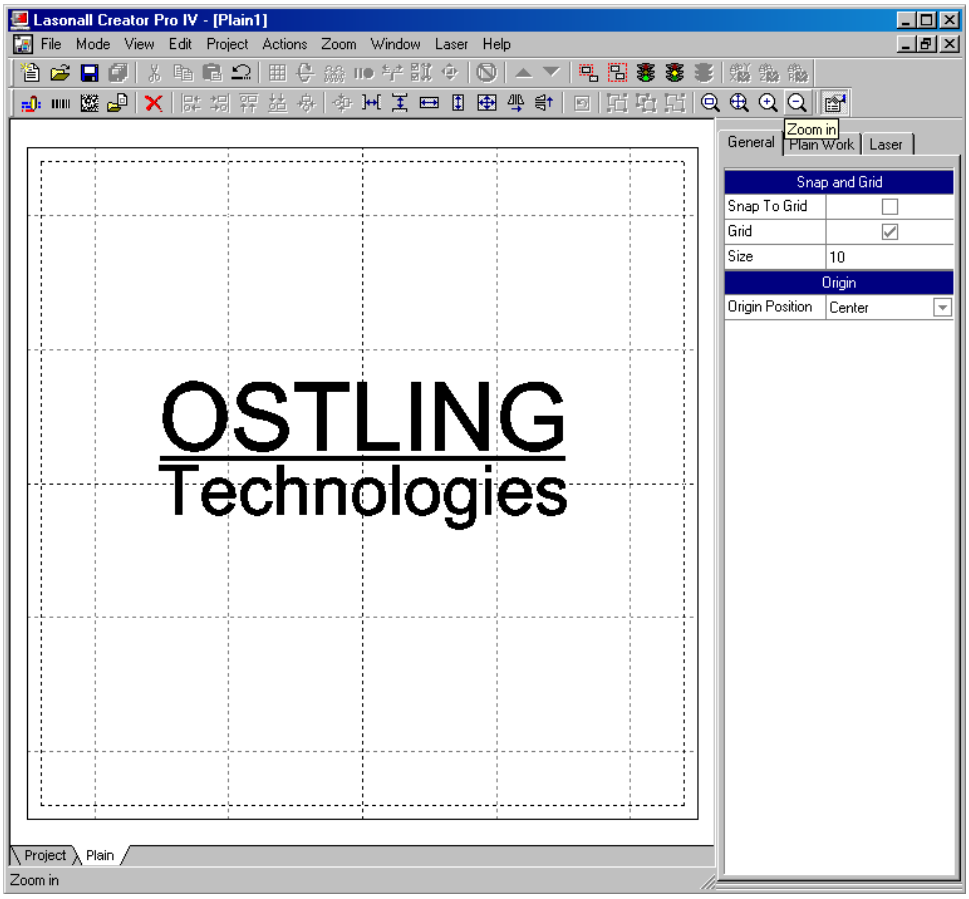

Figure 31. Setting marking Parameters

All the Working Parameters are set using the Marking Program. The Operator is therefore advised to read the Manual carefully.

NOTE:
For information on use of the CREATOR software, refer to the relative manual.

Shutting down the equipment

Once the working phase is over, to shut down the Laser Lasonall™ equipment, carry out the Standard Operating Procedure S.O.P. by proceeding as follows.

a) Press the STOP button on the machine;
b) Exit the Marking Program;
c) Open the Main Switch MS (Control Panel CP);
d) Open the shutter (pin 7-8).

WARNING:
Always follow closely the Putting into Service and Shutting down procedures described above !

Maintenance

Routine maintenance

The routine maintenance program provides for weekly operations, which involves exclusively cleaning the following element:

The protective glass for the Focusing lens, and cleaning the areas around the fans.
Rub delicately with a cloth dampened in Acetone or Diethylether.

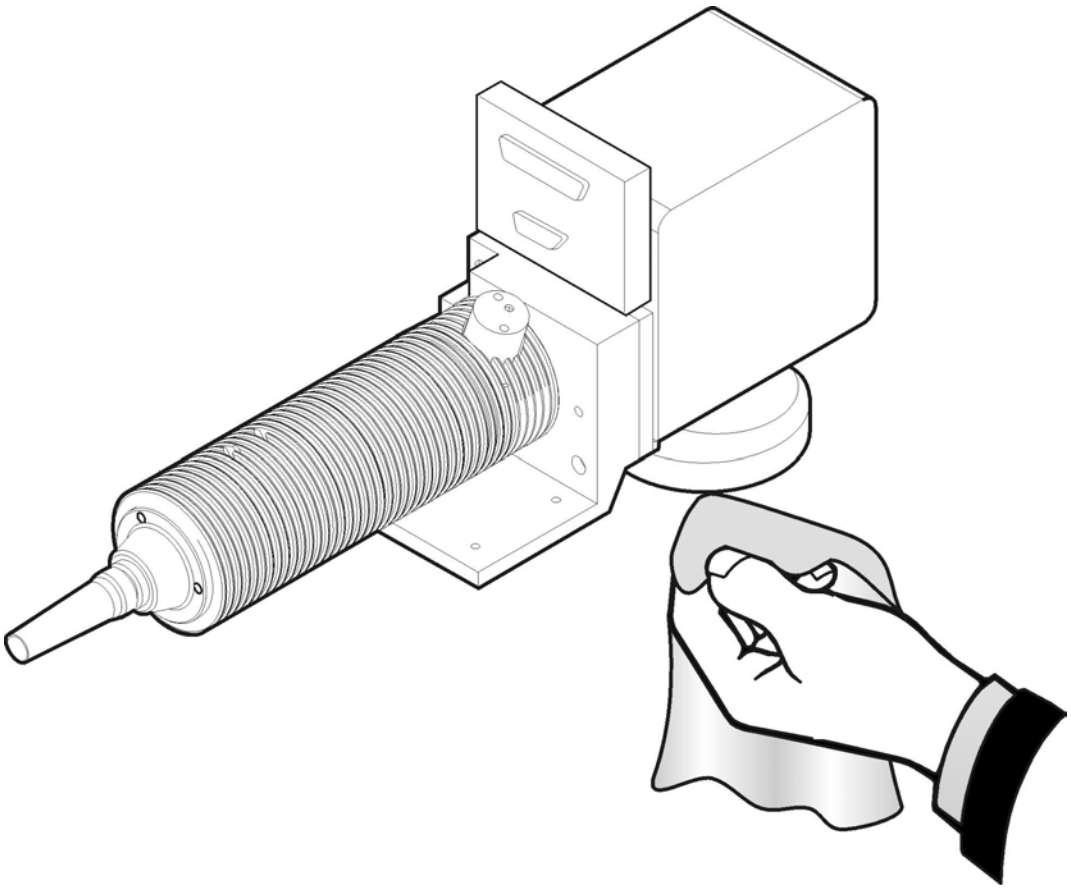

Figure 32. Cleaning the Focusing lens

Problems and Troubleshooting

As already explained, the Lasonall™ laser equipment basically comprises an Electrical part, an Optical part, and a Control part.
Therefore, as far as Maintenance is concerned and, more specifically, should any problems arise, the User **must** treat the equipment as a combination of these three parts, and each of these as a single element which cannot be broken down.

WARNING!:
The USER is under no circumstances authorised to access the internal components which together make up the Electrical, Optical and Control parts!

WARNING:
Do not attempt any repairs on the Electrical part!

This being understood, there follows a list of problems which could occasionally arise (on starting up or while the equipment is being operated), with their possible causes and the action to be taken in each case.

Trouble seeking table

PROBLEM	POSSIBLE CAUSE	ACTION
NO POWER to the equipment.	Power supply cable badly connected; 220 V AC power not turned on at the mains; Fuse(s) 4A F blown; A Safety switch is open (Emergency, Gate, etc.).	Check power cable is properly inserted; Turn on mains 220 V AC power supply; Replace fuse(s); Check suitability of the interface signals; Identify the switch and rest the working condition.
The equipment does NOT START when button is pressed.	Emergency stop button engaged; IE Connector Interlock; Fuse 1A F blown; BY Connector Slave Out; PC off; **Faulty electrical or electronic component.**	Release Emergency stop button; Replace the Fuse; Check suitability of the interface signals; Check the PC connection and whether the switch is closed; Run the Marking Program *Creator Pro*; **Contact Östling**
The Laser source WILL NOT activate.	Obstacles in the optical path, between the Scanner Head and the Working Field; Marking Program *Creator Pro* not activated; **Faulty electrical, electronic or optical component.**	Make sure the optical path is clear of all obstacles; Check the Resonator connections; **Contact Östling**
The Laser beam ONLY marks in one spot.	The Scanner Head has no power; **Faulty electrical, electronic or optical component.**	Check the Scanner Head connections; **Contact Östling**

Repairing faults and Problem Solving

By referring to the table on the previous page, we will now describe, for each type of fault - problem, the operations to be carried out to overcome the inconveniences that may occur when starting the machine or during its operation.

Power Supply Disabled

Even though the main switch on the casing has been turned on, the machine still does not come on. In this case the following scenarios are possible:
The power cable is disconnected:
Connect the cable and repeat the start up operation.

One of the safety switches is open:
Identify the safety switch that is open and close it, then repeat the start up operation.

Warning!
Under no circumstance open the power supply unit. There is still **dangerous** voltage even with the power unit disconnected from the mains.

The Laser will not turn on

Even when the key is turned, or when the relative signals are activated, the power supply for the laser resonator will not come on and therefore the resonator cannot emit laser light:

Emergency button engaged:
Release the button, located on the front panel, and repeat the start up procedure.

Fuse blown:
Replace the fuse only if qualified and authorised by Östling

P.C. switch off:
Turn on the P.C. using its switch and continue with the normal machine start up procedure.

Software program not active:
With the P.C. on, select the Marking Program required and start running it, then repeat the start up procedure for just the laser.

No Laser light

When the start key is turned, or the relative signals are activated, the laser resonator power supply comes on but the laser emits no light:

Shutter engaged:
Press the Shutter button, and check again to see if there is any laser light.

Obstacles along the optical path:
Examine **just** the lens of the Scanner Head and the space between the actual lens and the piece to be marked. Then remove any obstacles found and check that the laser is working properly now by carrying out some test marking.

Scanner Head damaged:
Seek technical assistance.

Resonator damaged:
Seek technical assistance.

The laser marks only in one spot

The machine is on and ready to mark (the resonator is on and is able to emit laser light).
When marking, however, the laser does not move and marks in just one spot. The most probable causes are:

The Scanner Head power cable is disconnected:
Turn off the machine and connect the relative power cable correctly. Try starting the laser once again.

Driver Card for Scanner Head damaged:
Seek technical assistance.

Scanner Head Broken:
Seek technical assistance.

General characteristics and specifications (summary)

Technical characteristics

	Lasonall 1	Lasonall 2	Lasonall 3
Wavelength	1064 nm	1064 nm	1064 nm
Average power (Q-switch)	5W	10W	20W
Q-switch frequency	10-20 kHz	10-200 kHz	5-300 kHz
Laser quality	$M^2 < 1.1$	$M^2 < 1.1$	$M^2 < 2$
Resolution	0.032mm	0.032mm	0.032mm
Pointer	635 nm - Class I	635 nm - Class I	635 nm - Class I
Marking Speed	250 characters/sec.	250 characters/sec.	250 characters/sec.
Source Classification	Class IV	Class IV	Class IV
Power supply	90-240 VAC 3A	90-240 VAC 4A	90-240 VAC 6A
Dimensions			
Laser source	Ø85 mm x 213mm	Ø85 mm x 255mm	Ø85 mm x 255mm
Laser + scanner head	550x120x175mm	610x120x175mm	615x120x175mm
Power supply	500x180x450mm	500x180x450mm	500x180x450mm

NOTE:
The laser in question is in **class IV**. Class IV covers all lasers which are hazardous, not just because of **direct** or **reflected** radiation, but also because of **diffused** radiation! These laser sources can be particularly dangerous to the skin and represent a fire hazard for flammable materials.

Electrical power supply

Single phase voltage + N + E: .. 90-240V (±10%)
Mains frequency:..... 50/60 Hz (± 1%)
Harmonic distortion..... < 10%
Interruptions:..... < 3ms

Current absorption:
Lasonall™ 1..... max 3A
Lasonall™ 2..... max 4A
Lasonall™ 3..... max 6A
Power absorption:.....
Lasonall™ 1..... max 600
Lasonall™ 2..... max 600
Lasonall™ 3..... max 1000

Environmental operating conditions

Room temperature:..... min 5 C°
..... max. 40C°
Humidity level:..... < 90 % without condensation
Altitude: ..... < 3000 m
Suspensions .....= 3 mg/m^3
Vibrations: none

Cooling

Air cooled.
Air temperature: ..... min 5° C - max 30° C

Dimensions and weight

Component	Height	Width	Depth
Rack:	450 mm	180 mm	500 mm
Resonator:	Ø 85		240 mm / 295 mm

Weight of individual equipment components:

- Electrical power supply Rack: Kg 20
  Lasonall 3 Kg.40
- Resonator: Kg.5
- Scanner Head: Kg 2.7
- Focusing lens: Kg 0.3

Warning:

Handle the Lasonall rack with extreme care.

Lifting and Transportation

Each of the equipment components can be lifted by supporting it underneath. During transportation the component must be kept lifted and all knocks or collisions avoided.

General safety rules for LASER systems in the working environment

National reference legislation:

D.P.R. 547 of *27/04/55*	titles III and VII "..on the prevention of accidents and work hygiene.."
D.P.R. 626 of 19/09/94	articles 21 and 22; all. IV and V "..on Health and Safety at Work.."
D.P.R. 475 of 04/12/92	"…the implementation of directive S9/686 on the P.P.D."
D.P.R. 476 of 04/12/92	".. the implementation of directive 89/336 on EMC.."

European reference legislation:

Directive 89/392 EEC	all. 1.5.12 " ..Machine Directive; essential safety requirements.."
Directive 89/656 EEC	"..the use of personal protection equipment.."
Directive S9/686 EEC	"..Personal protection devices.."
Directive 89/336 EEC	"..Equipment electromagnetic compatibility.."

European reference standards:

Type A, B general standards

EN 292 parts 1,2	"..safety of machinery, general principles, fundamental concepts.."
EN 60204	".. safety of machinery, electrical equipment.."
EN 50081-1	".. electromagnetic compatibility, Factory emissions.."
EN 50082-2	".. electromagnetic compatibility Factory immissions.."
CEI 110-24 fasc.2617G	"..guide to the application of the legislative decree on the (EMC).."

Type C specific standards

EN 60825	".. LASER equipment, safety from radiation.."
CEI 76.2 fasc. 1284G	"..Guide for the use of LASER equipment.."
EN UNI 13626	"..Plant with Lasers.."

Foreword:

When the problem of checking the safety of a system is posed, the first step to take is that of identifying what dangers are connected to operating the actual system.
If the plant has LASER equipment installed on board, as well as the usual Dangers deriving from the type and the method of operation, a further Danger must also be taken into account, namely LASER radiation (electromagnetic type radiation, mainly infrared).
The safety of this type of Equipment is covered by specific Standards, from both the electrical and radiation (non ionised) points of view.
It follows that careful observance of the technical advice offered by the specific reference Standards, will reduce the Risk of Danger at levels presumably conforming to the wishes of the Legislator.
Observance of these Standards is expected, in equal part, by the Laser Manufacturer, the Integrator of the Source in the System and the User of the actual System.
It can therefore be appreciated that there is no single way of increasing safety while instead different protection systems can be identified.

Protection systems:

One general rule to follow is "…where there is danger, Man must not be and where there is Man, there must be no danger…".
With this in mind we can immediately see that the principle to follow is that of placing a Barrier between the danger and Man able to reduce to the minimum the risk of access to that danger. Another route to follow is that of instigating a series of protective measures informing people that a danger risk exists, preventing them from accidentally coming into contact with the danger. Finally, there remains the need for means of personal protection for those occasions in which the risk can vary depending on the operating conditions.
For LASER equipment three types of protective measure have been identified:

A - Engineering devices

B - Procedural and administrative

C - Personal protection

Engineering devices:

These prove to be the most suitable measures for an industrial environment and consist of a series of provisions which, already during the plant design, construction and integration phase, take into account the dangers that exist and the devices for minimising the risks. When applicable, this is done by equipping the plant with suitable covers that enclose both the LASER and the working area, preventing dangerous radiation from travelling beyond the outside of the cover itself. In this way the acceptable emission limit (AEL) is reduced to such a level that a LASER in itself classified as dangerous (Class IV) will not send out radiation in excess of that corresponding with Class I, considered not dangerous.

Regulating standards regarding shields.

Shields or barriers or covers must be capable of intercepting the infrared radiation emitted by the LASER and able to withstand perforation.

This is easily done (for low power LASERS) by using sheet steel panels or Polycarbon only for CO_2 lasers! Which completely shield the radiation and resist perforation indefinitely if radiation is not focused on them. On more powerful LASERS a perforation time must be established between one inspection and the next or alternatively active covers must be used, able to detect perforation (by means of gaps and adequate sensors).

On Nd-Yag, NdYVO4 Laser equipment all that is needed is a metal shield of a thickness greater than 1.5 mm to resist indefinitely non focused laser radiation from the laser source incorporated.

The access panels and safety blocks must be designed in such a way as to prevent access to the dangerous radiation.

According to the type of work and/or intervention on the process, it may be necessary to remove covers or panels. In this case and wherever panels are not fixed solidly to the structure by means of screws that require the use of special tools to remove them, these removable Panels must be equipped with safety blocks that, when activated, reduce the radiation to the levels permitted.
This is generally achieved using electrical interlocks with the system power supply for the LASER excitation system. The interlock device, acting as a safety measure for people, must be a type which conforms and is type approved for such use.

The observation optics must contain special attenuators able to prevent human access to radiation above the AEL for class I.

The problem often arises of requiring an inspection window for observing the interaction between the laser beam and the material being marked. In this case the Windows must incorporate optical density (O.D.) filters able to attenuate the radiation to non dangerous levels. Calculation of the necessary O.D. must take into account the type of LASER, its operation, the distance from the focal plane, the direction of observation, the exposure time etc. The filter too, acting as a safety device for persons, must be properly type approved and certificated.

Particular precautions for class IV LASERS:

Provisions for LASERS in class IV include a remote control, key control, an emission warning signal and an attenuator.
For this type of LASER the Manufacturer must provide the User with a provision which makes it easy to add external safety devices to the actual LASER. This is done using a remote control block connector, or rather a contact which if open blocks or reduces the laser emission.

The start up device must prevent unauthorised persons from being able to operate the LASER. For this purpose, a key control which stays in the off position when removed is used.

When the LASER radiation is on, people need to be made aware of its presence. In this case a signal to notify emission is provided (normally a flashing red light).

Finally there must always be a measure to stop the LASER beam temporarily. This is provided by the Manufacturer of the source with a beam attenuator or shutter.

Further construction features are summarised in tab.D2 of standard CEI 76-2 “Guide to the use of LASER equipment”.

Location of controls and Labelling:

According to the regulations, the controls must be located in an area away from the possibility of access to radiation and that suitable and normalised warning labels must be positioned in places clearly visible to all.

Rules for the User; Administrative procedure and Standard Operating Procedure (S.O.P.):

The user directions to be observed for correct use of Laser equipment are important so that the manufacturer's efforts in terms of safety are not in vain. Furthermore, they force the User into employing correctly the protective measures provided by the Manufacturer with the addition of those of his own responsibility with the same obligation to draw up an internal working procedure for putting persons in the safest conditions by means of appropriate conduct. They are also aimed at preventing unauthorised persons from accessing the area dedicated to working with LASER equipment. In particular a Standard Operating Procedure (S.O.P.) should be drawn up for the procedure to be followed for putting the equipment into service and shutting it down. This procedure must be displayed near the installation, as a reference for the Operator, and must be drawn up in the Operator's language. The training of employees is nevertheless a necessity, covering:

a - Familiarisation with the system operating procedure;
b - Appropriate use of the control procedures for danger, warning signals, etc;
c - The need for personal protection;
d - The biological effects of the LASER on the eyes and skin.

Personal protection, personal protection devices (P.P.D):

These devices must be seen as extra safety measures in addition to the protective systems described in A and B and not as the principle or, even worse, the only safety measures! These consist of eye protection which must obviously be very safe and certificated to the required standards, being as this is the final barrier between the eye and the radiation! Calculation of the O.D. of the glasses must be must be carried out according to the regulating standard recommendations allowing for the worst observation conditions.
It should in any case be remembered that no glasses can protect the eye efficiently from direct vision of a LASER beam!

Residual risks that the User must identify and eliminate:

These are risks that arise not from the LASER itself but rather from the way it is used. Associated with the radiation principle, there are in fact collateral radiations, of an infrared visible type, and ultraviolet, which because of their intensity, can represent potential danger.
Because of its high power density (Irradiation), the Laser beam is able to instigate the combustion of flammable volatile substances (Solvents, benzines, ethers, alcohol, etc.) as well as methacrylate or plastic resins.
The interaction of the Laser beam with organic and inorganic materials causes the formation of fumes and vapours which, in certain cases, can prove harmful and/or toxic to health!
A highly flammable solvent which is harmful to the eyes and if inhaled is used to clean the Lenses.

Warnings:

In order to try and minimise the residual risks too, the following warnings should be noted:

- Do not remove protective casings around the lights and the protective barriers.
- Use glasses and gloves when handling the lights.
- Do not the Laser beam materials believed to be flammable.
- Take away fumes using a suitable extractor.
- Do not introduce fumes into the environment unless previously filtered.
- Do not operate with the electrical circuit powered and the protective barriers removed.
- Do not make adjustments with the Laser working.
- Seek the assistance of only qualified and authorised technicians.

In conclusion, if all the precautions mentioned up to now have been satisfied, it can be reasonably believed that operating a system containing a laser source will involve no more risks than any other activity!

NOTE:
If in any doubt at all, contact the manufacturer of the source and the system!

Conformity with CEE Directives and CE Marking; Supplementary Instructions for the User

Terminology

International regulations have standardised the terminology used for Lasers, their components, accessories, performance etc. There follows a series of the most significant meanings and references the standards which apply to the sector.

Definitions according to European standard EN 12626 (ISO 11553) Safety of machinery-Laser processing machines

1.1 MACHINE,
a group of connected parts or components, of which at least one is in movement, with suitable actuators, controls and power circuits joined together for a specific application, in particular for the process, treatment, movement or packaging of materials.

1.2 LASER SYSTEM,
machinery incorporating a laser source that possess sufficient energy to interact with the piece being processed, and whose machine has all the functional and safety aspects of a machine ready for use.

1.3 MANUFACTURER,
the individual or organisation that assembles the laser system.

1.4 COMPLEX COMPONENT,
an element that makes up the equipment, but which cannot in itself be termed the equipment because it has no intrinsic function for the final use.

1.5 INSTALLED SYSTEM,
the assembly consisting of several pieces of equipment and/or combined systems in such a way as to create a specific object but not destined to be released on the market as a single commercial unit.

1.6 ELECTROMAGNETIC COMPATIBILITY
Suitability of a device, a piece of equipment or a system to function in its own electromagnetic surroundings in a satisfactory way, without causing unacceptable electromagnetic disturbance to everything located in the surrounding area, including both emission requirements (disturbance produced by the equipment) and immunity (the insensitivity of the actual equipment) to disturbances produced by the surroundings.

1.7 SECOND ENVIRONMENT,
the environment that includes all the industrial utilities other than those connected directly to a low voltage electrical power supply that supplies buildings for domestic purposes.

1.8 IN SITU,
the environment in which the equipment is installed for normal use by the final User and in which the equipment must be tested.

1.9 RESTRICTED DISTRIBUTION,
a way of commercialisation in which the manufacturer limits the supply of equipment to suppliers, customers or users who, either separately or jointly, possess the technical competence of the requisites relative to the E.M.C. for the installation of electrical and electronic equipment and who provide, by means of exchange of technical specifications to the "in situ" measurement of the actual surrounding conditions.

Reference documents and standards for the sector

2.1 ELECTROMAGNETIC COMPATIBILITY DIRECTIVE (EMC);
Directive 89/336/CEE of 3rd May 1989 relative to Electromagnetic Compatibility and subsequent amendments.

2.2 LOW VOLTAGE DIRECTIVE;
Directive 73/23/CEE of 19th February 1973, concerning electrical material destined for use within such voltage limits.

2.3 CENELEC EN 60204-1 STANDARD;
Safety of machinery. Machine electrical equipment.

2.4 CENELEC EN 60825-1 STANDARD;
Safety of Laser equipment, directions and guide for the User.

2.5 CEN EN 12626 STANDARD;
The safety of laser processing machinery-machines.

Conformity to CEE Directives and CE markings

3.1 CONDITIONS FOR CONFORMITY TO THE EMC DIRECTIVE OF LASER SOURCES

Conformity of the Laser sources defined in the title of this paragraph to the Directives regarding Electromagnetic Compatibility, are only valid under the conditions set out below.

3.1.1 THE SOURCES DEFINED IN THE TITLE OF THIS PARAGRAPH ARE COMPLEX COMPONENTS (As defined in point 1.5) SOLD TO BE INCLUDED AS PARTS OF EQUIPMENT OR A SYSTEM OR AN INSTALLED SYSTEM; THEREFORE THE OPERATING CONDITIONS OF THE SOURCE WITHIN THE SYSTEM MUST BE THOSE PRESCRIBED IN PARAGRAPH 4 OF THIS PUBLICATION.

3.12 THE SOURCES DEFINED IN THE TITLE OF THIS PARAGRAPH ARE SOLD EXCLUSIVELY IN RESTRICTED DISTRIBUTION (As defined in point 1.9); THE INSTALLER AND/OR THE USER ARE THEREFORE AWARE OF THE REQUIREMENTS PERTAINING TO ELECTROMAGNETIC COMPATIBILITY.

3.1.3 THE SOURCES DEFINED IN THE TITLE OF THIS PARAGRAPH MUST BE INSTALLED ACCORDING TO THE INSTRUCTIONS IN PARAGRAPHS 4, 5, 6 OF THIS PUBLICATION AND IN ADDITION THE PRECAUTIONS STATED IN IT MUST BE STRICTLY OBSERVED, INCLUDING THE IN SITU VERIFICATION OF FINAL OBSERVANCE OF THE DIRECTIVE.

3.1.4 THE SOURCES DEFINED IN THE TITLE OF THIS PARAGRAPH ARE SOLELY DESTINED FOR USE IN THE SECOND ENVIRONMENT (As defined in point 1.7).

DECLARATION OF CONFORMITY

Östling declares that, in the conditions specified in this document, in particular in paragraph 3, the sources of the LASONALL ? series: prove to conform to the community Directives regarding ELECTROMAGNETIC COMPATIBILITY and the community Directive regarding LOW VOLTAGE according to the reference standards stated in paragraph 2.

3.3 NOTES ON THE APPLICATION OF OTHER EEC DIRECTIVES

LASER sources are not governed by other EEC Directives, apart from those stated in paragraph 2. There are however, for application purposes, references in other Directives; in particular to comply with the requirements of art.4 of Machine Directive 89/392/CEE, there follows the declaration of incorporation.

MANUFACTURER'S DECLARATION

Östling IN CONFORMITY WITH THE REQUIREMENTS OF THE MACHINE DIRECTIVE, declares that the sources of the LASONALL series must be instelled according to its own instructions and must not be put into service until it has been declared that the machines in which they will be incorporated conform to the above mentioned Directive.

Guide to the application of Electromagnetic Compatibility

The need to observe precise standards as regards EMC is due to the increasing use of powered electronic devices, which, because of the techniques used, are the source of disturbances in a vast field of frequencies (emission) and, in the meantime, they themselves are sensitive to disturbances produced by other equipment, and so must be provided with a sufficient level of immunity.

4.1 The disturbances are conventionally classified as low frequency (0< f < 9 kHz) and high frequency (f > 9 kHz). Among the low frequency phenomena, the particularly important ones are to do with the harmonics of the power supply frequency. There are also large spectrum phenomena, such as static electricity discharges in the air or by contact.

4.2 Disturbances can be transmitted both through conductors (disturbances within the frequency field from 0.15 MHz to 30 MHz) and by irradiation (disturbances irradiated in the frequency field between 30 MHz and 1000Mhz).

4.3 Case histories in the industrial sphere show that in disturbances conducted the main cause is the lack of observation of electromagnetic compatibility!
For this reason installation of the Laser source must take place adhering scrupulously to the instructions shown below.

4.3.1 Connections and cabling. The connection of Laser equipment to other devices and external sources must be carried out taking into account the criteria for reducing the electromagnetic influences between them to the minimum. The power circuits cables must be physically separated from the cables of the command and control circuits (signal circuits); this is achieved by running them through metal channels, metal sheaths or screened cables, power cables as well.

4.3.2 Filter device. All equipment for which supplementary devices are prescribed to make them conform to EMC regulations, must be equipped with such devices, fitted according to the manufacturer's instructions. Supplementary devices are for example RC groups to be fitted in parallel to the AC relay coils, diodes to be fitted in parallel to the AC relay coils, filters to guard against the disturbances conducted in high frequency to be fitted to the mains supply input (ask Östling for the type most suitable).

4.3.3 Cable screening. Cable screening must end as near as possible to the entry terminal block.

4.3.4 Metal panels. All panels that make up the system must be interconnected so that they present low impedance at the high frequencies. This is achieved by adding numerous fixing screws between unpainted surfaces and using EMC metal seals. All the metal pats must have a good earth connection.

Application guide to safety at Low Voltage

5.1 Installation. Only qualified persons must work on the installation, connection to external energy sources and, in general, for any type of intervention on the electrical part. Dangerous voltages are present inside the Laser power supply!

5.2 Power cut out devices. As the equipment is designed to be incorporated into a system that also includes other equipment, the installation of a power cut out device is necessary with a manual control common to the whole system, to be fitted by the installer.

5.3 Stop function. As the equipment is designed to be incorporated into a system that also includes other equipment, a category O stop device common to the whole system in needed, to be fitted by the installer.

5.4 Emergency stop. As the equipment is designed to be incorporated into a system that also includes other equipment, an emergency stop device is required to suit the specific plant characteristics, bearing in mind that it may be necessary to leave the cooling water to circulate for a few seconds before completely cutting off the power supply, the emergency function must be fitted by the installer.

5.5 Level of protection. The laser sources have a minimum IP54 protection level, while the Laser Power Supply has a minimum IP33 protection level. To comply with the Machine Directive and EN 60204 standard it is necessary for the Installer to house these inside a container suitable for the level of protection required for the final use.

Application guide to safety from Laser radiation.

6.1 Information. According to EN 60825-1-guide 1284G standard, persons who may come into contact with Laser radiation must be suitably informed on the dangers of personal injury to the eyes and skin.

6.2 Training. The Operator and all persons authorised to use the laser system must have received adequate instruction regarding the start up and shutting down under safe conditions of the system by means of a Standard Operating Procedure (SOP) to be observed.

6.3 Radiation confinement. As prescribed by the Machine Directive, the Laser radiation must be completely contained inside suitable protective barriers.

6.4 Inspection windows. Any inspection windows must be equipped with a suitable and clearly defined protective filter from the Laser radiation. If supplied with the source, do not replace the filter with any other non original item.

6.5 Laser safety technician. As indicated in the guide 1284G of EN 60825-1 standard, it must be checked periodically that safety conditions are not lacking regarding use of the laser source, that the Optical Risk Nominal Distance (ORND) are observed, and that any eventual Eye protection devices (PPD) are always available and, if required, that they are used regularly. It is therefore necessary for a Laser Safety Technician to be trained (LST).

6.6 Protection during maintenance. During maintenance operations, as certain safety measures are lacking, a class IV Controlled Laser Area must be set up, to which only qualified and authorised persons can gain access, equipped with suitable protective glasses.

Conclusions:

Östling, as manufacturer of the laser sources, supplies laser equipment which is not designed for immediate use but is rather to be solidly combined, under the responsibility of others, to other devices whose final purpose is that of setting up a laser process system.
Östling, as manufacturer of the laser source, is responsible for constructing its own equipment, to be considered a complex Component, in conformity with the relevant Directives and in observation of the regulating standards for the sector.

The system constructor must ensure the safety of the laser process Machine under the terms of the other Directives (e.g. Machine Directive) included in it, as prescribed by the actual Directive, the risk analysis, the implementation of safety measures, the certification and the verification of safety measures, the production of adequate information for safe use of the machine.

Östling puts itself at the disposal of the Machine Constructor to supply all the information in its possession to assist the Constructor in conforming with the wishes of the Directives.