
LASERVALL
Sources and Laser Systems

# Violino1, Violino2, Violino3

# **General** Manual

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# Violino™

# General Manual
# Use and Installation


**Updates**

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|---|---|---|
| | | |
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# Foreword

This manual describes the operation of the Laservall VIOLINO™ laser system from Laservall S.p.A. The special feature of this solid state laser is the optical pumping system of the resonator. Unlike traditional ones, pumping is effected by a diode laser instead of a flash bulb. This pumping system is used to obtain a highly effective modal and low heat emission, features which make it possible to greatly reduce the dimensions of the resonator and all other laser parts.
The intensity of the laser beam output by the resonator can be modulated and can be used for engraving various materials, for example, plastic and steel. Management of the engraving process is done by software programs installed on a P.C. combined with the operating machine.
The model described is an OEM (Original Equipment Manufacturer) system, i.e. it has been designed and developed as a single component to be integrated in more complex systems. Development technicians are advised to carefully read the chapter on laser system safety instructions found in this manual.
The manual has been prepared in conformance with the requirements of directive ***EEC 89/392*** and subsequent modifications and integrations and is composed of:

Safety regulations for use and maintenance
General machine specifications
Machine installation
Operating modes
Repairs and adjustments
Electrical diagrams

Personnel assigned to operating the machine, in addition to being professionally trained for their specific job must read the manuals, pay careful attention to safety regulations and the sections pertinent to their job.
Individuals assigned to operating the machine are broken down as follows:

**OPERATOR:**
assigned to loading the elements to process, visual inspection of the work cycle, unloading of finished product and cleaning of the machine.

**MECHANICAL MAINTENANCE PERSONNEL:**
assigned to mechanical maintenance of the machine.

**ELECTRICAL MAINTENANCE PERSONNEL:**
assigned to electrical maintenance of the machine.

**N.B.:**
**Laservall S.p.A.** shall not be held responsible for any non conforming use of equipment of its manufacture.

# Introduction to the VIOLINO ™ engraving system

The quality and technological advantages offered by laser engraving in industrial processes have been known for some time. New solutions are constantly tested in applications which were traditionally relegated to other technologies. In the Violino™ engraving system the bulb has been replaced with a laser diode. This innovation has led to an optical efficiency which is between 30 and 50% (compared to the 2-3% of traditional bulb lasers). This is the reason the Violino ™ laser source only consumes a few hundred watts and does not require water cooling devices. The laser source is extremely compact and the life span of a laser diode is currently 10/15,000 hours, with a tendency of becoming longer with new technological developments.
The available power and complete process management via specific software which can be installed on a Personal Computer and combined with the engraving system, provide excellent results on all types of material. The laser beam quality, which reaches the theoretical diffraction level, provides a high decree of precision, with a 100/10000 point per millimeter resolution.

Three models are currently manufactured:

Violino™ 1
Violino™ 2
Violino™ 3

The technical specifications of the three models is described in the following chapters.

## Intended Use

The Violino™ MARKER laser equipment is primarily intended for engraving small dimension products in metal or plastic.

**N.B.:**
**The intended use that the system was designed and produced for cannot be changed.**
**Laservall S.p.A.** shall not be held liable for any non conforming use of equipment of its manufacture.

# Symbols

The symbols used in this manual along with their meaning are shown below. The symbols are repeated within the chapters and/or sections and have the following meaning:

**Generic warning:**
This symbol indicates the need to read the manual carefully or the necessity of an important maneuver or maintenance operation.

**Electricity warning:**
This symbol indicates dangerous voltage associated with the laser, or powerful enough to constitute an electrical risk. This symbol may also appear on the machine at the risk area.

**Laser warning:**
This symbol indicates the danger of exposure to visible or invisible laser radiation. This symbol may also appear on the machine at the risk area.

**Fire warning:**
This symbol indicates the danger of a fire when processing flammable materials. Because there is a danger of fire, it is indispensable to follow the instructions provided by the manufacturer when commissioning the machine.

**N.B.:**
For information on installing and using SMARTIST hardware and software, see the related manual

# Safety

This chapter covers topics related to personnel safety.
The tests performed demonstrate the safety and reliability of the laser when used correctly. It is necessary that the operator be informed of precautionary regulations aimed at avoiding injury or damage to the equipment.

## Laser radiation

As described above, the Violino™ laser is an OEM (Original Equipment Manufacturer) system, which means that it has been designed and developed as a single component to integrate in more complex systems. As an OEM component, it is not equipped with all the safety systems like a finished laser system, therefore the professionally trained personnel must integrate the interlocking devices, guards and safety warnings required by law in the final product. Machine drive signals are described in the related chapter.
Laser radiation is an electromagnetic emission with a micrometric wave length which ranges from the long infrared (CO2 Laser), close infrared (Nd Laser: Yag, Nd: YVO4), visible (He Laser: Ne or Argon) and ultraviolet (excimer laser)
It should be considered non-Ionizing Radiation. In Violino™ Lasers, the emission of a crystal bar is stimulated by "optical pumping" generated by a Diode Laser. The continuous reflection of Photons, between a front mirror and rear mirror, creates a positive reaction so that their number continues to increase, until reaching the concentration necessary to produce a beam which projects from the semi-reflecting front mirror. The radiation (which we can imagine as a "Beam of invisible light") is then Collimated and Focalized with Lenses at a point where the intensity becomes high enough to be able to react with various materials producing an alteration in them due to thermal effect.
The radiation of Violino Lasers is invisible, but since it is near the threshold of visibility, the Eye receives it almost in its entirety without using the natural defense provided by pupil reflex! Added to this is the fact that it is generally very intense, with the result that it can be very harmful to the eye and present vision problems.

**N.B.:**
Directly viewing a Laser beam **can cause irreversible damage** to vision

To prevent permanent damage to vision, a few precautions must be taken.
All individuals who may be exposed to dangerous levels of laser radiation, must know that the laser is active and wear protective goggles if necessary.

Due to its high power, the laser integrated in the Laservall system provokes reflected laser light from flat surfaces. Reflected light is potentially dangerous for the eyes and skin. Electromagnetic emission with a micrometric wave length is placed in long infrared, and is therefore invisible, thus it is not clear where reflected beams are aimed.

**N.B.:**
**It is indispensable to protect yourself from reflected light beams**, because they can be sufficiently intense to create permanent injury to the eyes or skin.

In addition to possible injury to the eyes or skin, direct laser emission can cause flammable materials to burn like organic solvents (alcohol, acetone) or gasoline and cause fabric and clothing to burn.

**N.B.:**
this laser is classified as **class IV**. Class IV includes lasers which can produce risks, not only from **direct** or **reflected** radiation, but also from **scattered** radiation! The laser sources may be a significant risk for the skin and risk of burning flammable materials.

## Absorption of Laser radiation

Human skin absorbs electromagnetic radiation in different ways depending on the wave length of the radiation. Both the eye and skin have a “predisposition” for accepting certain wave lengths, and are more unresponsive to absorbing others. In the specific case of the Eye, the Cornea and Crystalline lens let all the wave lengths from 400 to 1400nm pass and reach the Retina, even with various attenuations. They include the range from visible light to IRA infrared. Thus Nd: YVO4 laser radiation (1064nm wavelength) is included in this range and **leads to direct Retina exposure!**
In terms of the Skin, the “biological window” has different absorption percentages but is not dissimilar in terms of wave length. The maximum exposure values for Skin are much different compared to those tolerated by the Eye.

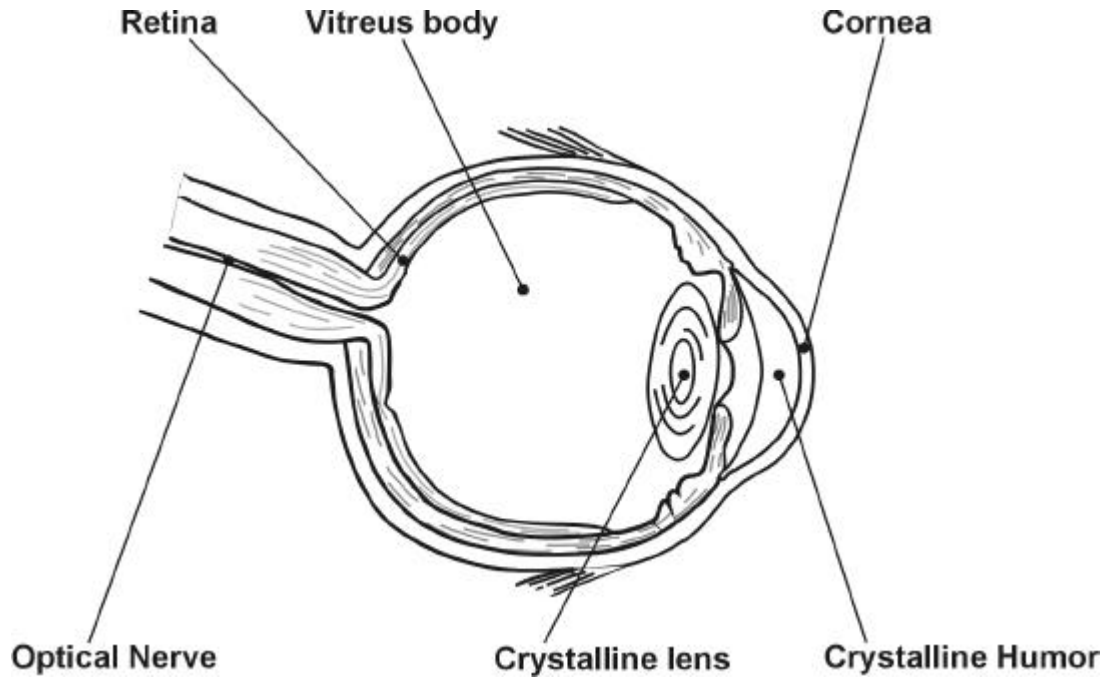



***Figure 1. Eyeball section***

In terms of the damage mechanism that absorbed radiation can cause, it also depends on the wave length. Short lengths (ultraviolet: UV-C 180-280nm; UV-B 280-315 nm, UV-A 315-400 nm) generally cause photo-chemical effects:
cataract, or opacification of the crystalline lens
melanic coloring, or reddening of the skin

Greater wavelengths (infrared: IR-A 780-1400 nm; IR-B 1400 3000nm; IR-C 3000-10 E6 nm) generally cause thermal effects:
detachment or photocoagulation of the retina
burning of the skin

The degree of injury obviously depends on the **amount of absorbed radiation** and the **instantaneous power** of the radiation source.

## Classification and danger level

Regulations have established different classes of Laser danger based on the ability to injure people, from Laser class 1 (basically safe in all conditions) to Laser class IV dangerous in various conditions!

Visible Lasers with the label "**WARNING!**" belong to class IIIA and they should not injure the eye if looked at momentarily (thanks to the self-defensive blinking reflex to intense visible radiation), but they could represent a hazard if observed under a microscope or magnifying glass. Other Lasers belonging to the same class, but with the "**DANGER!**" label are capable of exceeding the maximum allowed exposure level after 0.25 seconds of observation.

Lasers which can produce risks, not only for direct or reflected radiation, but also for scattered radiation belong to dass IV. These Laser sources can also have a significant risk for the Skin and fire risk for flammable material. For these reasons, the User must put into effect all measures aimed at containing the radiation to make sure that it is terminated at the end of its useful path. The operator must also be informed of the risks from exposure to Laser radiation and must wear specific I.P.D. (individual protection devices) including goggles that protect against radiation and are certified as suitable for this use.

**N.B.:**
The Violino™ marker laser device contains a **class IIIA** visible source and a **class IV** invisible source.

## Radiation Viewing Conditions

The Laser output by the resonator is to be considered as a highly collimated and intense monochromatic light source. Due to these characteristics it can be seen as a “punctiform source” of high luminosity. This means that its image is then focalized on the Retina in a very small spot with a dangerously high power density! If the beam becomes divergent and scatters to a non-reflecting screen, then there is an “extended vision” of the image, with a decisively less dangerous power density. So there are different types of radiation viewing based on the access to the radiation and consequently different degrees of dangerousness.

**Direct viewing of the Laser beam:**

This type of viewing is the most dangerous and can occur at the outlet of the laser aperture after having removed the lens. It is to be avoided at all costs! No protective goggles represent a valid means against direct viewing of the beam.

**Direct viewing of the beam after mirror reflection:**

This may occur by directing the beam on a reflecting surface.
Viewing of a mirror reflected beam from a flat surface is very dangerous and equal to direct viewing.

**Direct viewing of the beam output by an Optical Fiber:**

This happens if an Optical Fiber disconnects from the resonator. Viewing of the beam is dangerous up to a significant distance. Filters and Goggles do not ensure safety.

**Direct viewing of the beam after focusing:**
This occurs if the Laser beam is not extinguished with an opportune absorber at the end of its useful path. Looking at the beam is dangerous up to a considerable distance. Filters and goggles can ensure safety for brief exposure, as long as they are the right size and certified.

**Scattered viewing of the beam after focusing:**
This is the most frequent viewing, but opportune Filters and Goggles can ensure safety, even for prolonged exposure.

**The Optical Risk Nominal Distance O.R.N.D. for Violino™ laser is over 15m, for direct or mirror reflected radiation and over 0.5 m for scattered radiation !**
**Only goggles with an Optical Density (O.D.) over 4 can momentarily protect the eyes against accidental viewing of damaging laser radiation!**

**N.B.:**
Always use goggles with conformity certificate.
Remember that **no goggles can provide prolonged protection from direct radiation!**

## Eye and skin risks

If exposed to intense Laser radiation, even of a short duration, or a less intense but longer lasting duration, both the Cornea and the Retina can burn and be damaged irreparably forever. This consequence is completely realistic in the event of direct viewing of a class IV Laser beam.
If subject to direct focalized radiation, even the skin can burn. In addition, it is necessary to bear in mind that a collateral ultraviolet radiation may exist with the main radiation: long exposure may cause skin cancer.

## General Safety Regulations

The User must comply with the regulations and work in the best possible safety conditions to prevent decreasing the degree of machine safety. Therefore it is necessary to develop a Standard Operating Procedure (S.O.P.) related to maneuvers to effect for turning on and off the equipment. This procedure, which shall be prepared around the time of installation, shall serve as a reference for the Operator and shall be written in his/her language.
Training is essential and must include:

Familiarization with system operating procedures.
Knowledge of the biological effects of radiation on the Eyes and Skin
Understanding of the necessity for Individual Protection Devices (I.P.D.)

## Collateral risks

If the intended use of the source is changed, for example for material processing applications, collateral risks may arise represented by the production of fumes and vapors which may be irritating or toxic, if not removed and adequately filtered before being released into the air again.

**N.B.:**
It is advisable **not to change the intended use** without previously contacting the Manufacturer.

An additional risk may be represented by fire caused by processing materials other than those the equipment is designed for.

**N.B.:**
When processing **flammable material**, since there is a **fire danger**, it is indispensable to follow the instructions provided by the manufacturer when the machine is commissioned.

**N.B.:**
Do not subject **materials other** than those the equipment was designed for to radiation.

The most serious collateral risk associated with laser equipment, which may be fatal, is electricity.
This may occur when the manufacturer's warning and procedures are not followed. Unauthorized and untrained personnel must never do any work on the electrical part. The safety devices must never be removed and their operation must be periodically checked.

**N.B.:**
Do not work on the electrical part if you are not trained to do so. **Do not remove protection devices.**

## Collateral risks

**N.B.:**
When processing **flammable material**, since there is a **fire danger**, it is indispensable to follow the instructions provided by the manufacturer when the machine is commissioned.

For example, during the intended use of the Laser source, if a material being processed undergoes alterations and produces irritating and/or toxic fumes, it may be necessary to remove the fumes from processing before releasing them into the air.

An additional risk may be represented by fire caused by processing materials other than those the equipment was designed for.

**N.B.:**
Do not subject **materials other** than those the equipment was designed for to radiation.

**N.B.:**
When processing **flammable material**, such as plastic, since there is a **fire danger**, it is indispensable to follow the instructions provided by the manufacturer when the machine is commissioned and follow the instructions in the **SAFETY** Chapter, in the **Collateral Risks** section.

## Seals

The engraving system has seals in some areas. The seals must not be broken or removed for any reason. The sealed parts may be opened only and exclusively by Laservall S.p.A. Breakage of these seals by a customer shall result in immediate cancellation of the warranty on the entire engraving system.

**N.B.:**
If a customer **breaks or removes the seals placed** by the manufacturer on the laser system **the warranty** on the entire laser system will immediately become **null and void.**

**WARNING!**
**The manufacturer shall not be held liable** for any **non conforming use** of equipment of its manufacture.
It is **forbidden** to operate the equipment before the machine it is intended for has been **declared in conformance** with statutory Directives.

**N.B.:**

Access to the internal parts of the electrical equipment is only permitted for **authorized personnel**, who have been trained and instructed on the electrical risks.
Laservall S.p.A. shall not be held liable for work on electrically charged parts by inadequately trained personnel!

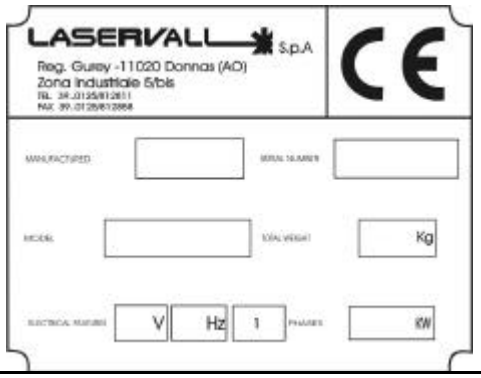
**N.B.:**
Access to the internal parts of the resonator is only permitted for **authorized personnel**, who have been trained and instructed on the optical risks.
Laservall S.p.A. shall not be held liable for work on parts by inadequately trained personnel!

## Safety labels

Labels and plates have been applied to the equipment in conformance with European safety regulations, They must not be removed or damaged. To replace them contact Laservall S.p.A.

## Laser warning labels

| Label | Form and type | Dimensions [mm] |
|---|---|---|
| Laser Nr.1 | Laser Warning  | Side 22<br>Side 50<br>(Vs. art. 91640B) |
| Laser Nr.2 | Information on laser class   | 104 x 52<br>52 x 26 |
| Laser Nr.3 | Information on Laser aperture   | 104 x 52<br>52 x 26 |
| Laser Nr.4 | Radiation information   | 104 x 52<br>52 x 26 |
| Laser Nr.5 | Radiation information   | 104 x 52<br>52 x 26 |

| | | |
|---|---|---|
| Laser Nr.6 | Information on the coexistence of two types of radiation<br>  | 104 x 52<br>52 x 26 |
| Laser Nr.7 |  | |
| Laser Nr.8 |  | 104 x 52 |
| Laser Nr.9 |  | 104 x 52 |
| Laser Nr.10 |  | 104 x 52 |

| | | |
|---|---|---|
| Laser Nr.11 |  | 56 x 40 |
| Laser Nr.12 |  | 56 x 40 |
| Laser Nr.13 |  | 56 x 40 |
| Laser Nr.15 |  | 56 x 40 |
| Laser Nr.20 |  | 20 x 10 |
| Laser Nr.21 |  | 20 x 10 |

## ELECTRICITY WARNING LABELS

| Label | Form and type | Dimensions [mm] |
|---|---|---|
| Electricity Nr.1 | Electricity Warning  | Side 22<br>(Vs. art. 91630A)<br>Side 50<br>(Vs. art. 91630B) |
| Electricity Nr.2 | Information on panels   | 104 x 52 |

**N.B.:**
The plate on the machine must not be damaged or removed. For replacements contact the manufacturer.

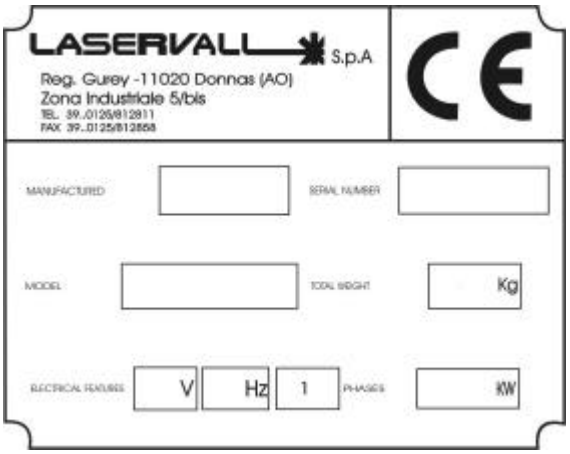



***Figure 2. Example of Informative Plate***

## Figure 1: Front panel

Labels:
Laser 1
Laser 2
LASER EMISSION

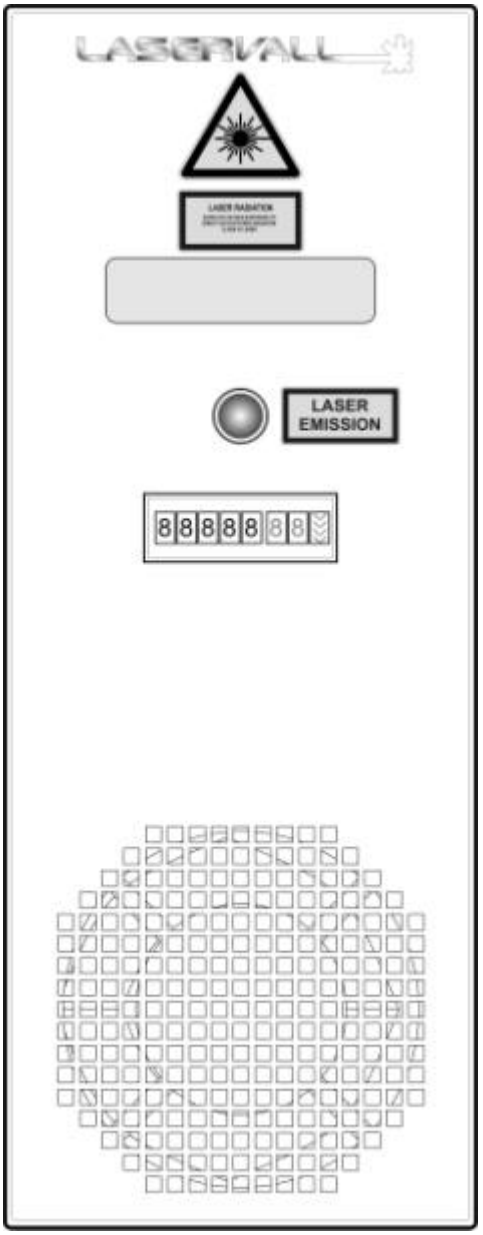



***Figure 3. Front panel***

## Figure 2: Rear panel

Labels:
Laser 3
Laser 6 (only if there is a red diode in the coupler)
Electricity 1 (with indication of power supply voltage)

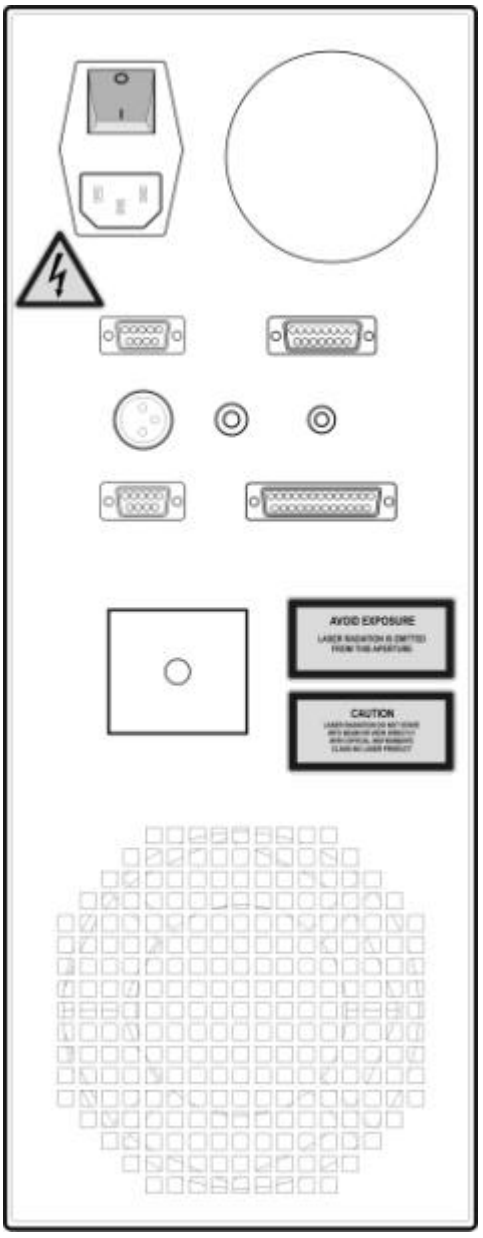



***Figure 4. Rear panel***

## Figure 3: Rack

Labels:
Laser 4
Laser 7
Laser 8 / 9 / 10 (respectively for V1 / V2 / V3)
Electricity 6

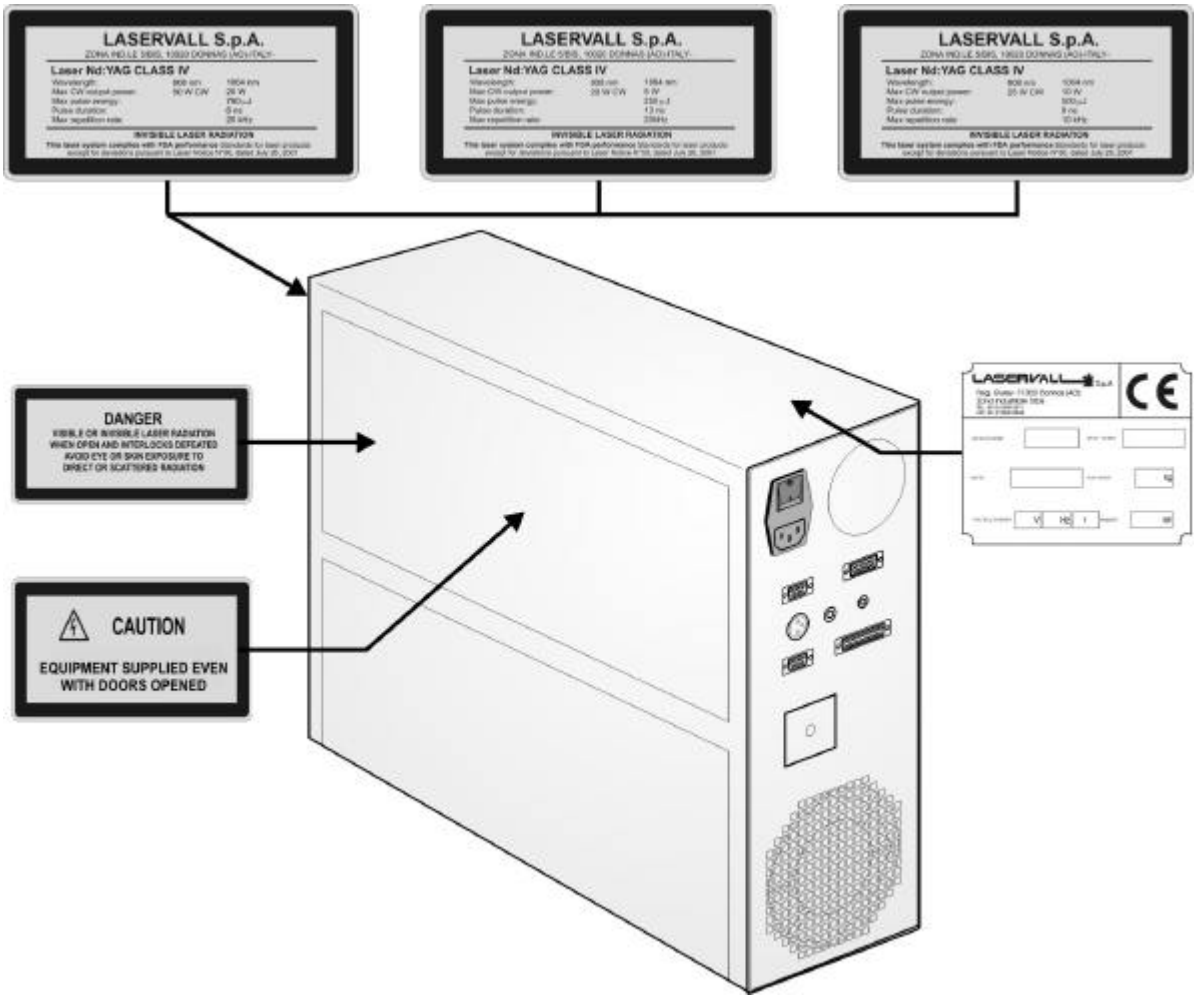




***Figure 5. Positioning of labels on rack***

**N.B.:**
Label to be added near the metal plate for non-EU markets

**Figure 4: Scanner head**

Labels:
Laser 1
Laser 3
Laser 6

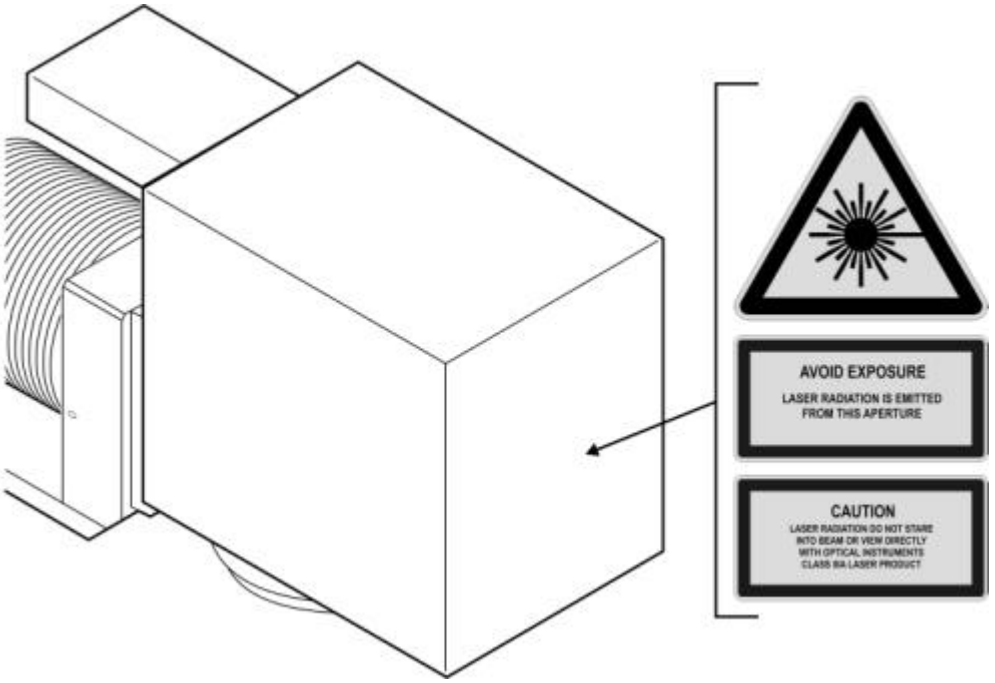




***Figure 6. Positioning of Scanner Head labels***

**N.B.:**
Label which replaces Laser 6 in non-EU markets

## Figure 5: Coupler LD-25 or LD-50

Labels:
Laser 1
Laser 3
Laser 4
Laser 6 (only if there is a red diode in the coupler)

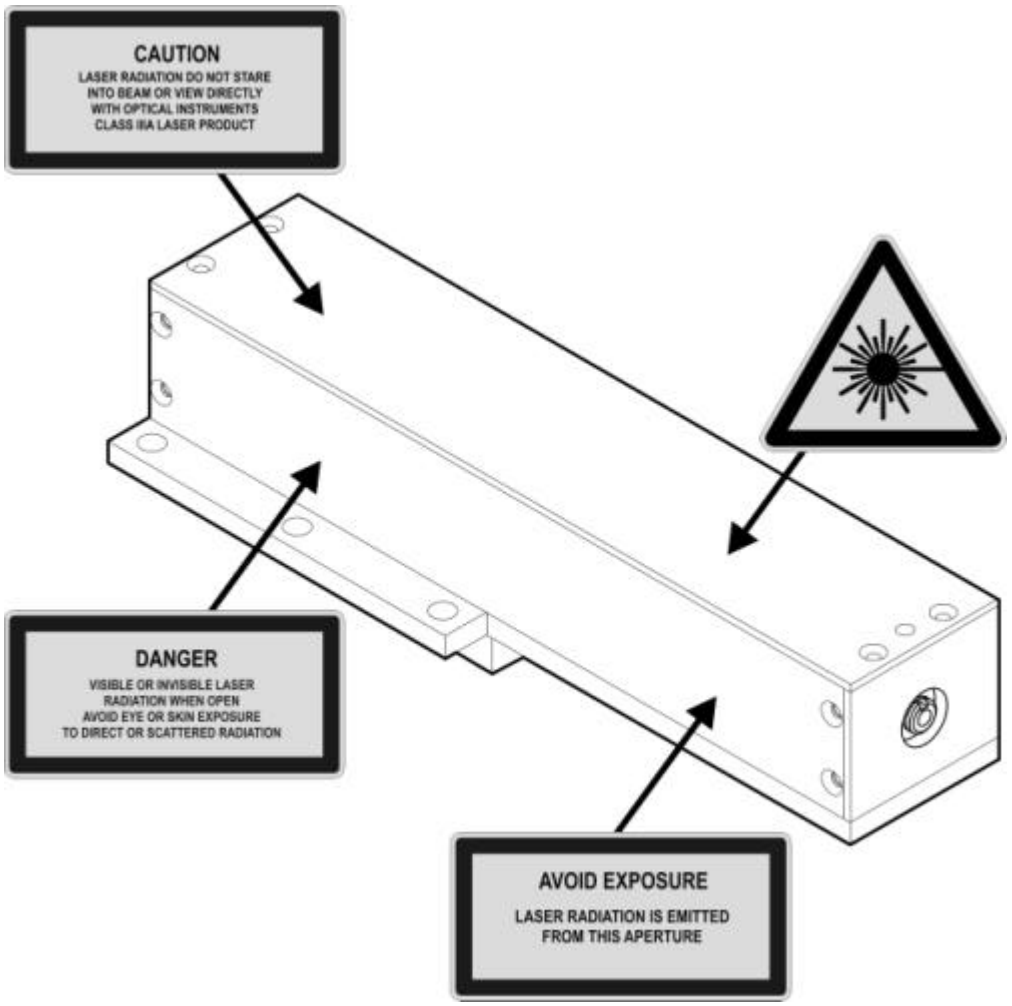



***Figure 7. Positioning of diode labels***

## Figure 6: Safety box

Labels:
Laser 4
Laser 5

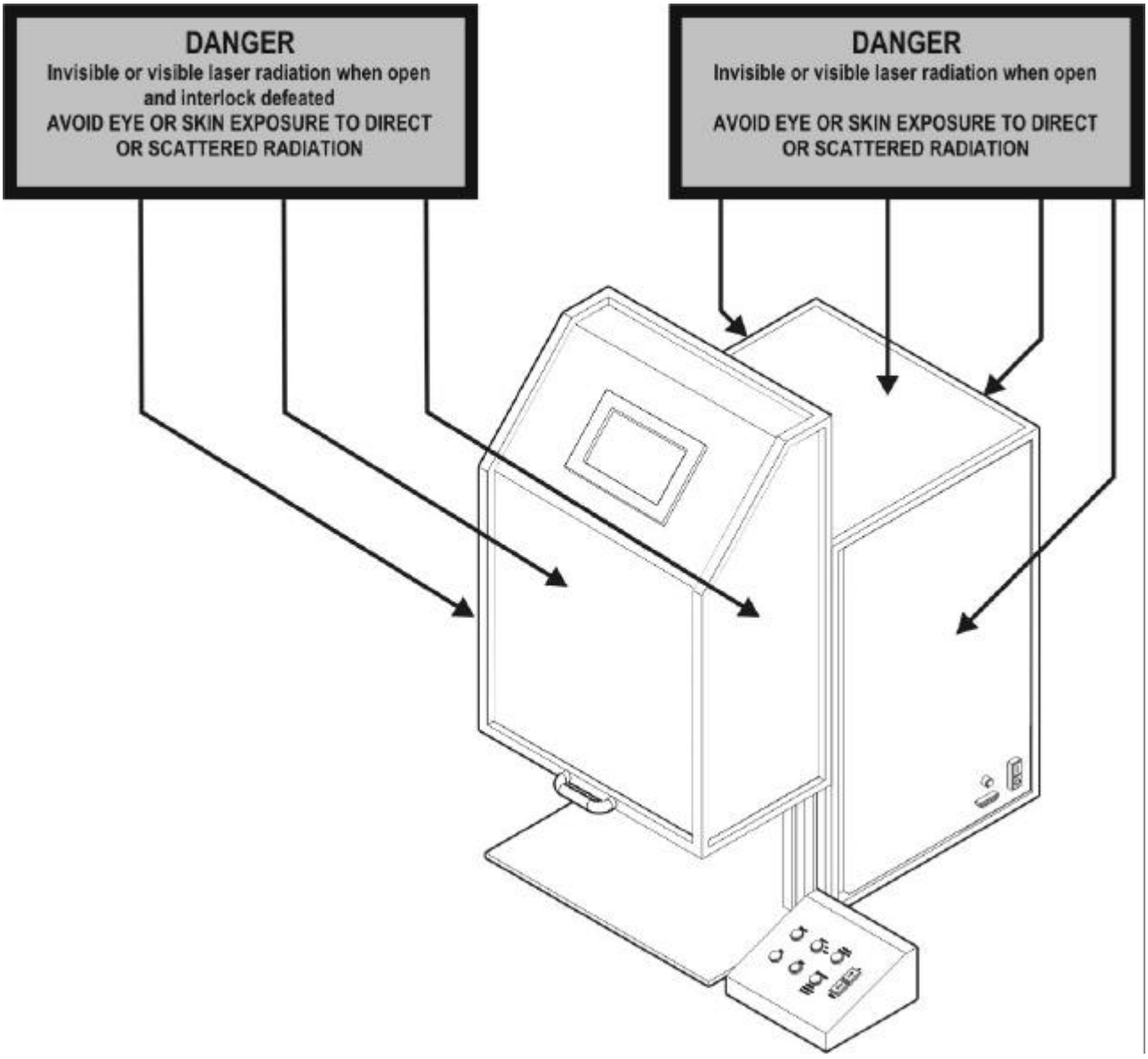



***Figure 8. Positioning of safety box labels***

# Lay out and machine description

The Violino™ engraving system is basically composed of three distinct parts:
Electrical – Rack
Optical – resonator and scanner head
Control – Personal Computer

The Electrical Part is primarily incorporated in a Rack, it provides power for the entire Machine and centralizes the functions needed for its operation.
The Optical Part is composed of a Laser diode installed in the coupler (located in the Rack), a connecting Optical Fiber, a Resonator (laser power supply) and is completed with the Scanner Head, which is opportunely driven to aim the Laser beam in the desired Work Field.
The Control Part supervises engraving operations controlling all their phases, The management software, installed in a PC, is used to set all the parameters for the engraving process.

The main operating units are described and represented in the following chapters and the figure on the following page.

# Main operating units

The description and related technical specifications of the operating units which compose the Violino™ laser system are provided below.

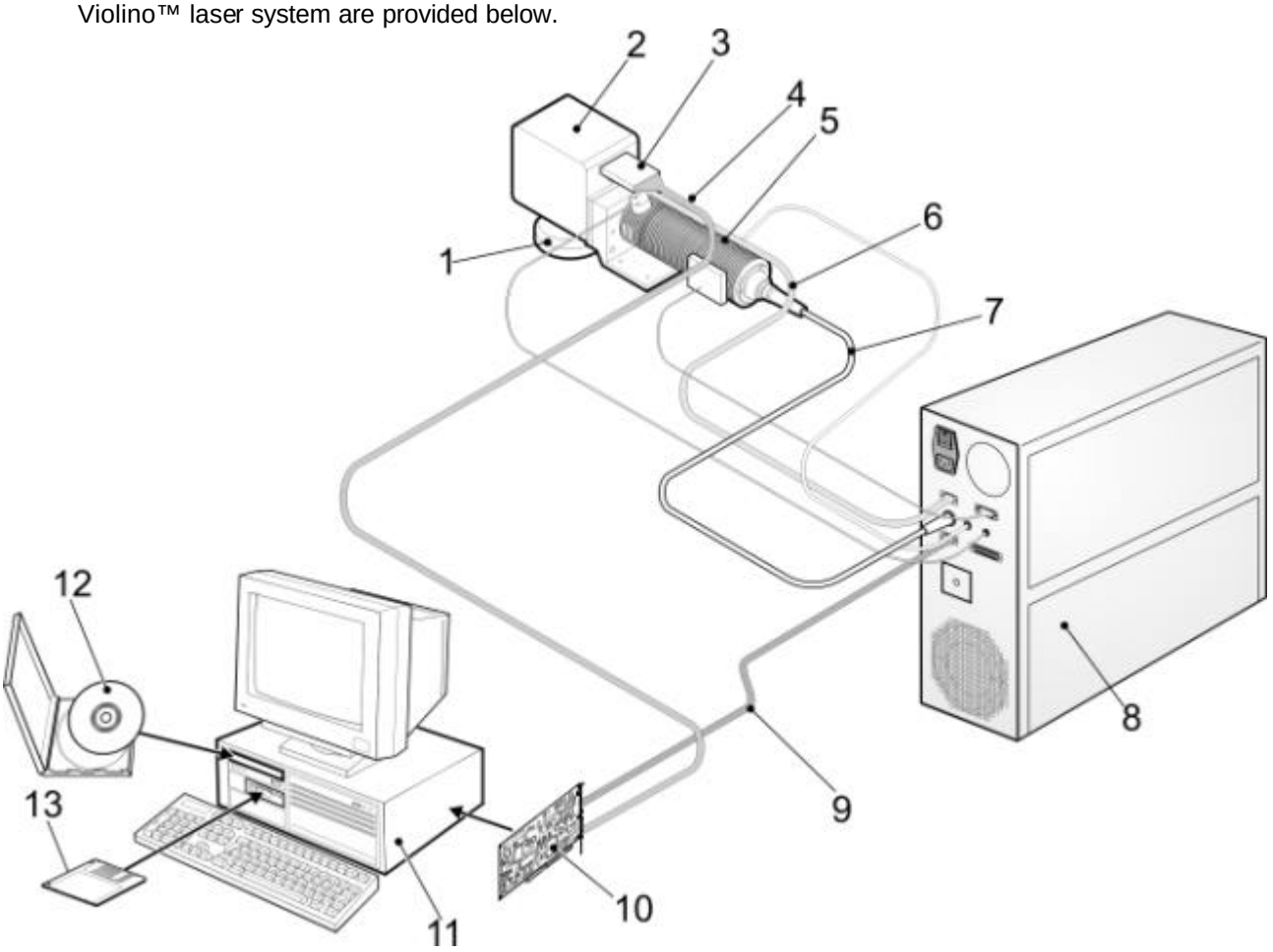



***Figure 9. Complete VIOLINO™ system***

1) Optical lens. Can have different focuses (100mm, 160mm, 254mm)
2) Scanner head. Two mirrors controlled by galvo motors are mounted inside, which provide the engraving coordinates (x, y) to the laser..
3) D/A adapter
4) Signal cables for Galvo motors (from DSP board)
5) Resonator. It contains the optical parts, it is mounted and sealed in a white chamber.
6) Galvo motor power supply cable (from RACK)
7) Optical fiber
8) RACK. Contains the laser electric power part. The laser diode is inside it
9) DSP/RACK signal cable
10) PnP board (DSP processor) to control all the signals and engraving parameters.
11) Personal Computer. Standard personal computer with an integrated PnP board (with DSP processor)
12) Software Smartist PRO, Contains the DSP board drivers and the program for engraving.
13) Floppy containing the configuration file (lasermon.ini)

**N.B.:**
For more information on violino laser system connections, see the related chapter.

## Electrical System Structure

The Electrical System of Violino™ Laser basically consists of various AC-DC generators which provide all the power for the laser system.
The rack also contains the coupler for the 908nm laser diode, the current driver to run the laser diode, the RF driver for the Q-Switch, the display, the I/O board and, completely separated from the electrical part the radiators for dissipating the heat with the fans.

### Block Diagram of the Electrical System

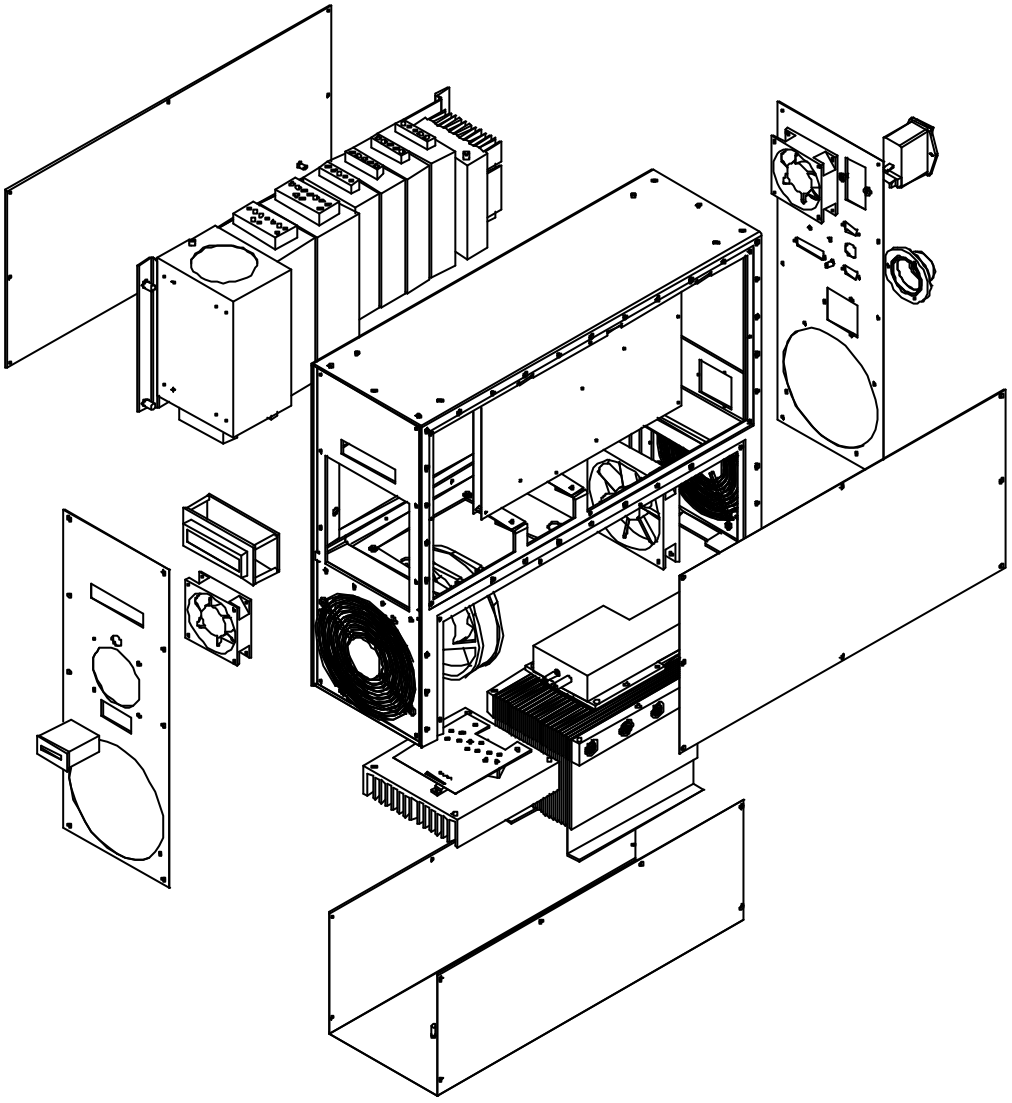


***Figure 10. Block diagram of the electrical system***

**WARNING:**
**The Rack must have at least 10 centimeters of free space in front and behind it to allow proper air flow.**

## Front System Panel SP

The System Panel SP closes the front part of the Rack and is aimed at the operator of Violino™ MARKER Laser. The System Panel SP includes the following elements:

1) Bicolor LED indicating Equipment status
   ***Green*** = Power on
   ***Orange*** = Ready / Stand-By
   ***Red*** = Enable / Laser On
2) Hour meter HM
3) Fan
4) Display

**HOUR METER HM (hour meter)**

The Hour Meter HM is located on the System Panel SP (front) and is powered by 24 Vdc voltage. It records the actual total operation time of the Laser Diode and is used to establish an exact schedule for maintenance work.

**LED**

The Led is located on the System Panel SP (front and is powered by 5Vdc voltage from Microprocessor MIPR-I/O. It visually indicates the conditions “Power On” (green) and “Laser On” (red)

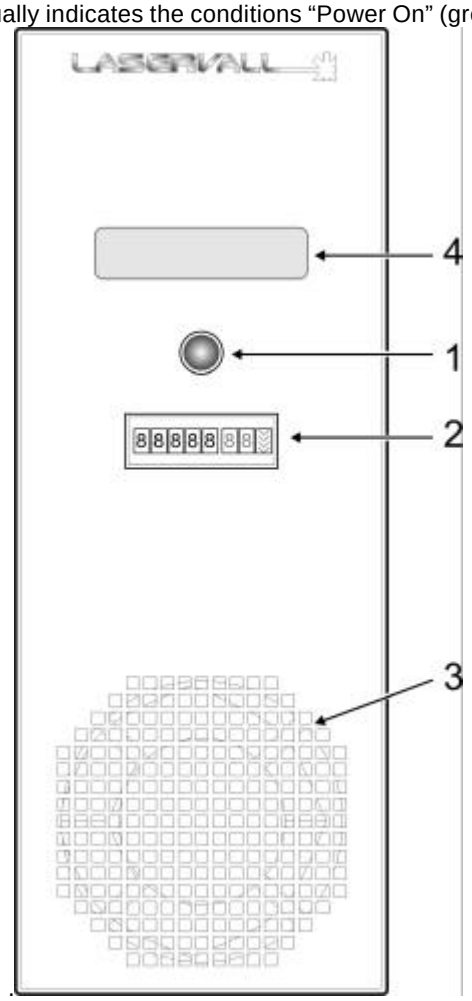



***Figure 11. External controls and indicators***

**N.B.:**
The description of the **Management Panel MP** and its components is provided on page 41, in the **ELECTRICAL INSTALLATION** chapter

## Rear Management Panel MP

The figure below indicates the position of the connections on the rear RACK panel

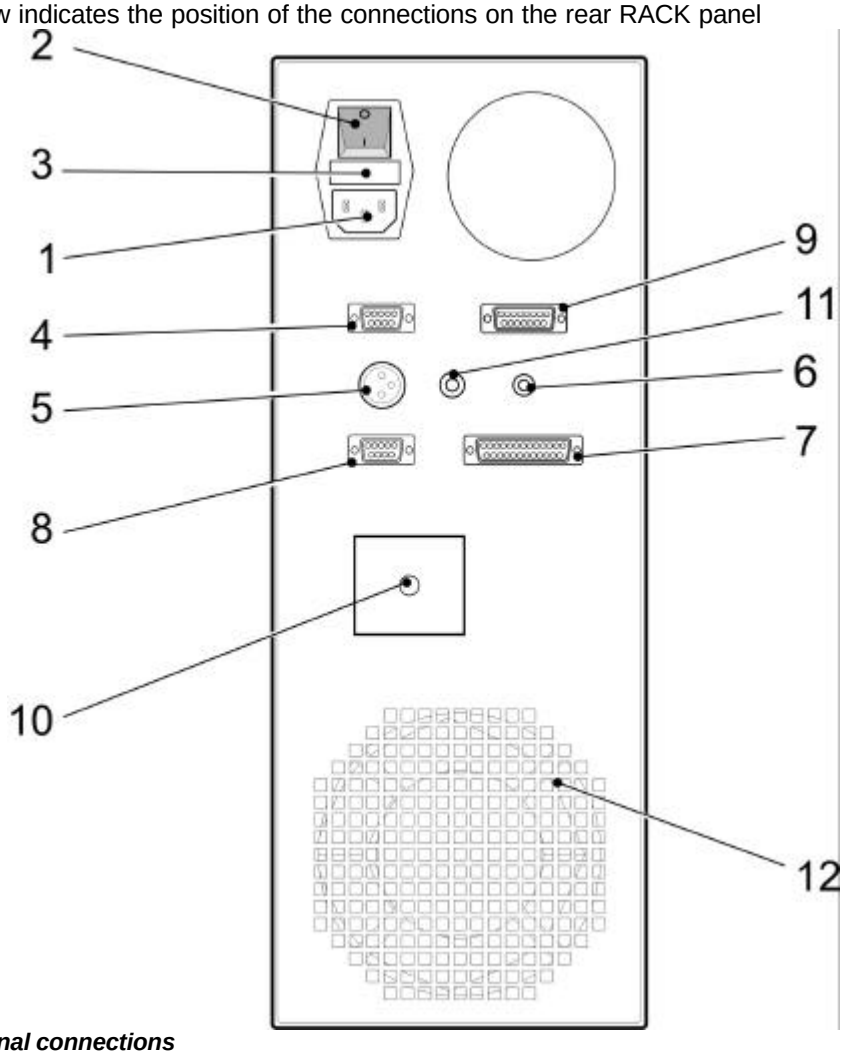



***Figure 12. External connections***

### Description of Management Panel MP

1) Socket for external power supply
2) Main Power Switch MS . INPUT 230/110 Vac – 3/6A – 50/60Hz
3) Protection fuses (5x20 6.3AT)
4) **GALVO SUPPLY**
   Galvo motor power supply SUD D 9PM
5) **EXTERNAL INTERLOCK**
6) **AIMING BEAM**
   Aiming diode SMB F
7) **COMMAND BOX**
   Command Box Connector SUD D 25PF
8) **PC**
   DSP Board Connector (PC) SUD D 9PF
9) **SLAVE OUT**
   Slave Out Connector SUD D 15PF
10) **OPTICAL FIBER**
    Optical Fiber
11) **R.F.**
    Q-Switch Connector SMA F
12) Fan F

## Description of some electrical system components

### MAIN SWITCH

The Main Switch consists of a Filter with IEC Socket and bipolar Switch for 230/110Vac line with a double fuse holder. It is located in the Management Panel MP (rear) and performs the following operations at the same time:
Power disconnection device;
Protection device against overloading and short circuits (2 delayed fuses 5x20 6.3A T);
Category “0” emergency device.
The Main Switch MS is normally used in turn on and turn off operations.

### INPUT/OUTPUT BOARD IOB

The Input/Output Board IOB communicates with the various elements of the Electrical System, centralizing and sorting operational and management functions.
The Board IOB receives voltage directly from Main Switch MS and interfaces with:
Generators
Radio Frequency Driver Board, supplying its 15Vdc low voltage and control signals for driving the Q-Switch QS (located inside the Resonator);
the current driver board
display, front led and hour meter
front panel;
fans;
Peltier cells

In addition, the IOB Board communicates with the Laser Management DSP1 Board and ensures the entire utility interface.

### RADIO FREQUENCY DRIVER BOARD RFD

The Radio Frequency Driver Board RFD drives the electro-optical Q-Switch QS, modulating a output to 40 Mhz (80 Mhz for V2) between 10 Khz and 300 Khz, directly based in the command signals received from IOB.

### CURRENT DRIVER BOARD

The current driver board manages and controls the current which supplies the laser diode in a closed circuit.

### LASER DIODE LD

The Laser diode LD is installed in the Coupler Unit. It is supplied with 2-4 Vdc low voltage and current up to 50 A, it works at a monitored and regulated temperature between 20° and 30°C and supplies electro magnetic energy, the so-called “optical pumping”, needed to supply the resonator.

### PELTIER CELL PC

The Peltier Cell PC is in direct contact with the base of the Coupler Unit, and is located exactly under the Laser diode LD. It is supplied with 24 Vdc low voltage and discharges all of the thermal energy generated by the Laser diode LD on the Dissipater.

**AIMING LASER DIODE ALD**

The Aiming Laser Diode, supplied with approximately 3.5-4 Vdc low voltage, is installed on the Resonator Unit.

**DISPLAY DY**

Display DY provides information on the status of the laser and is the first diagnostic tool in the event of a fault

**Q-SWITCH QS**

Q-Switch QS is an electro-optical component located inside the Resonator Unit. It is an active component on Violino™ 2 and 3, is directly driven by the Radio Frequency Driver Board DRF with wave values between 10,000 and 300,000 Hz.

**N.B.:**

On Violino™ 1 the QSWITCH is passive and oscillates at a fixed frequency placeable in a range between 15,000-30,000 Hz

## Structure of the optical part

The principle of physics that the generation of LASER light is based on, is the phenomenon of light stimulated emission. LASER is the abbreviation for Light Amplification by Stimulated Emission of Radiation. This means that laser is a light amplified by a chain reaction light emission, starting from an initial photon (light particle) which by interacting with the energized atomic system, stimulates the emission of two photons and they in turn interact with other atoms giving rise to a landslide effect.
Energizing the atomic system requires an external energy source, in a suitable form able to start the laser effect. “Optical pumping” is obtained when the light emitted from a luminous sources hits the active material (material able to emit LASER light) so that the atoms energize by absorbing luminous energy.
Amplification of the laser effect is obtained by making the activated material cross the same light it emits various times. This is done by placing the material between two mirrors, or rather creating and “aligning” what is called a “Resonator”. When the resonator is perfectly “aligned”, the crystal and the mirrors are centered on the optical axis. The faces of the crystal, the front mirror and the flat face of the rear mirror are parallel. In this optical configuration the extraction of laser energy from the resonator is at the maximum, the beam is circular and the intensity is approximately uniform.
The Q-Switch is a supplementary optical/acoustic-optical device placed between the crystal and front mirror, it oscillates at a fixed frequency on Violino™ 1 or is driven in radio frequency on Violino™ 2-3. It acts as an “optical switch” preventing the regular and constant flow of photons: when “closed” it is used to increase the energetic level of crystal atomic energizing; when “reopened” the useful energy available output by the resonator is higher than the average value.
Once produced, LASER radiation can be transferred to any point by optical fiber to a refocalization telescope, using it for a specific application.

In the specific case of Violino™ Laser, the following information is also of interest.
The optical part is composed 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 the work field (previously determined by the selected Lens), which is then used to engrave any two dimensional geometric figure.
The special feature of the solid state Violino™ laser source lies in the optical pumping method of the Resonator. Unlike the traditional method, in this case “optical pumping” is effected by a Laser diode instead of a flashbulb. This method is used to obtain an extremely efficient modal (only the TEM00 mode resonates) and it produces very little heat to be dissipated. These two features make it very easy to significantly reduce the dimensions of the Resonator and Rack (Electrical Part) which in this case includes the “pumping” laser diode Coupler and its cooling system.

**Resonator**

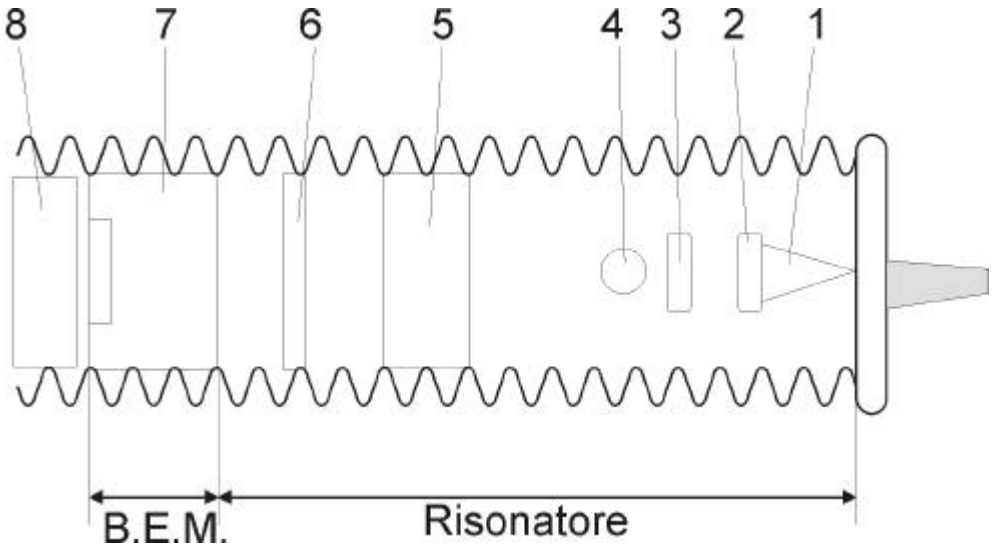



***Figure 13. Resonator diagram***

1) Light output by the optical fiber
2) Refocus lens
3) Rear mirror
4) Crystal
5) Q-switch
   Passive, for Violino 1, with fixed frequency (pen up, pen down system)
   Active, for Violino 2 and 3, variable frequency
6) Front mirror
7) Beam expander module, collimates and increases the laser beam diameter
8) Aiming red diode, displays the limits if the graphic area to engrave

## Diagram of laser beam deviation galvanometric head

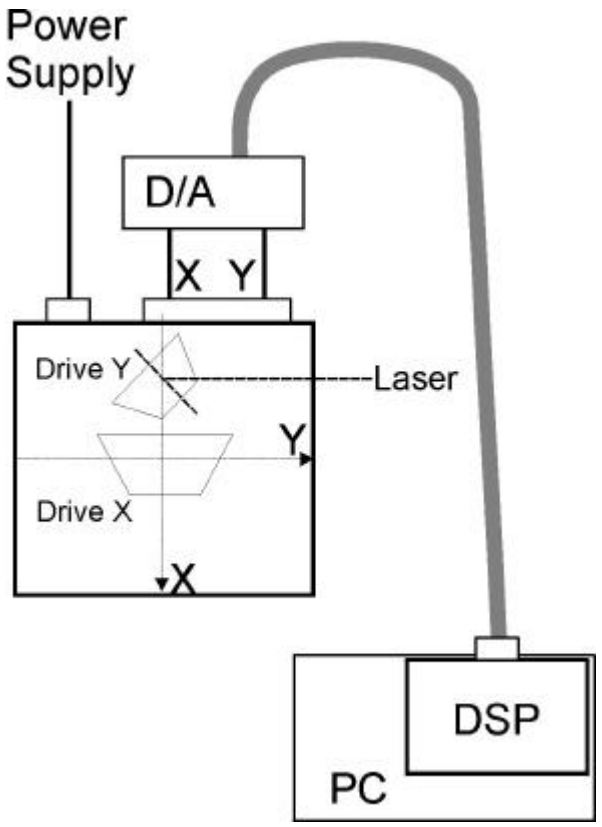



***Figure 14. Laser beam deviation galvanometric head***

Two rotating mirrors are assembled on the laser head, driven by galvo-motors, and controlled by the DSP board mounted inside the PC which in turn interfaces with the D/A digital analog adapter board mounted above the laser beam deviation galvanometric head. (see: ***Figure Complete VIOLINO™ system diagram)***
There are two connections, one for power supply (connector DB9), the other for controlling the two galvo motors which control the X, Y axes, in input from the DSP board (connector DB25).

## Objective lens

The objective lens can have different focuses. The focus sets the dimension of the engraving area.

| Focus Length | 100mm | 160mm | 254mm |
|---|---|---|---|
| Work area | 60x60mm | 110x110mm | 170x170mm |
| Work distance | 97mm | 175mm | 296mm |
| Resolution (16bit) | 0.8?m | 1.7?m | 2.8?m |
| Spot diameter | 20÷40microns | 30÷50 microns | 40÷70 microns |
| Engraving speed * | 250 characters/sec | 250 characters/sec | 250 characters/sec |

* the engraving speed was measured using text strings with a 1.2 mm height Roman-S (single line) font.

# Installation

## Personal Computer preparation

The complete laser engraving system is composed of:
1) DSP board, to be connected to a standard or industrial PC PCI slot.
2) DSP board driver for Windows 95 / 98 / ME / NT4 / 2000.
3) DSP Control program for tuning engraving parameters
4) Graphic editor for drawing models to be sent to the engraver.

The complete system component hierarchy is illustrated in the following chart:

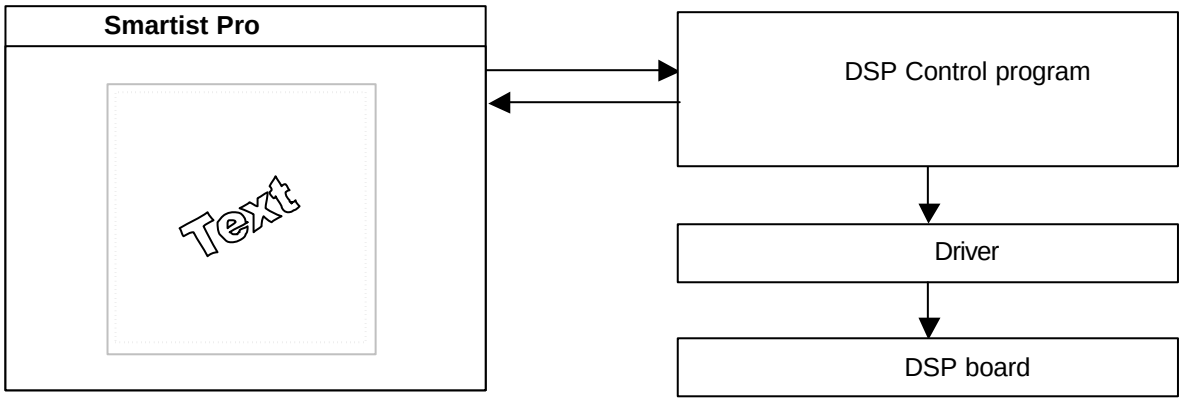



***Figure 15. Software management diagram***

The engraving file is graphically created by **Smartist**, a program for creating bitmap models, photographic marking and vectorial models.

**N.B.:**
For information on installing and using SMARTIST hardware and software, see the related manual

## DSP board installation

The DSP board consists of two separate parts. The main part is inserted in a standard or industrial PC PCI slot and meets Plug and Play version 1.1a specifications.
Generic procedure (See the related manual for the complete procedure):

Turn off the PC
Install DSP2 board (2 in the figure) inside the PC
Turn on the PC
Insert CD Smartist (3 in the figure) and install the software
Copy in the ***..\laservall\bin*** directory the ***lasermon.ini*** in the floppy disk (4 in the figure) supplied with Violino™; writing over the preinstalled file. This operation must be done with the monitor DSP program (triangular yellow icon in the tray area) closed
Restart the computer PC

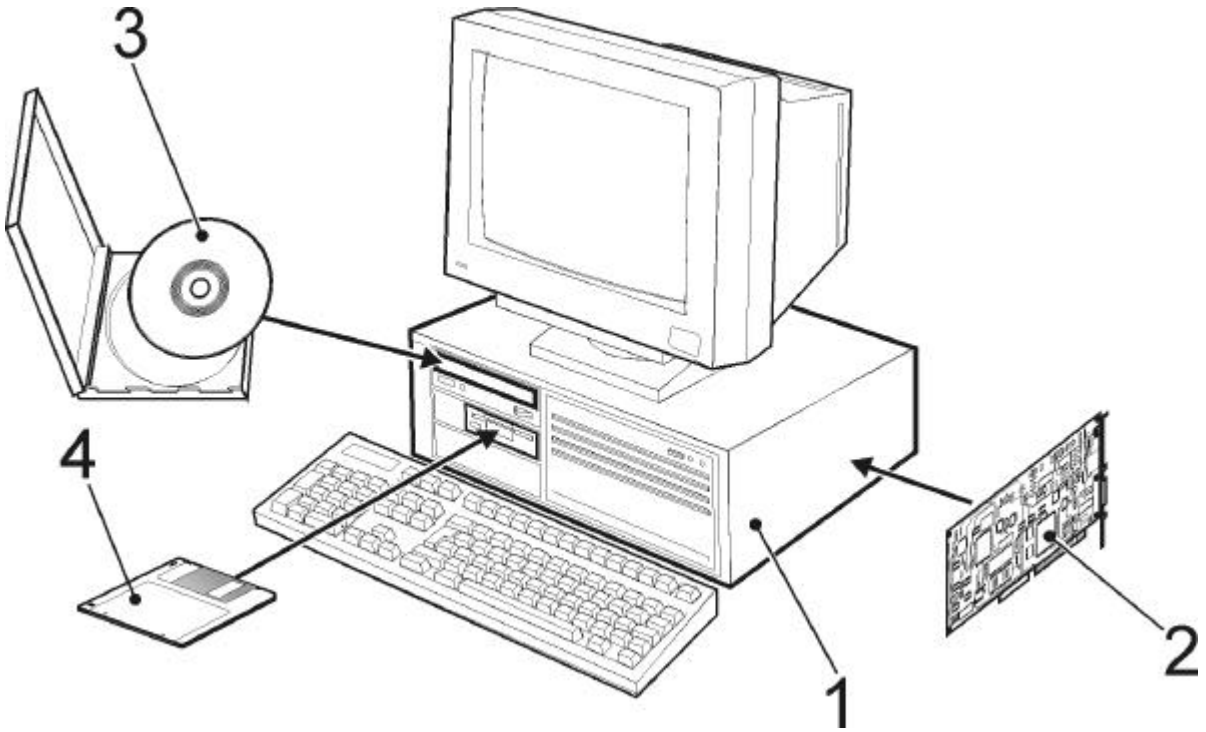
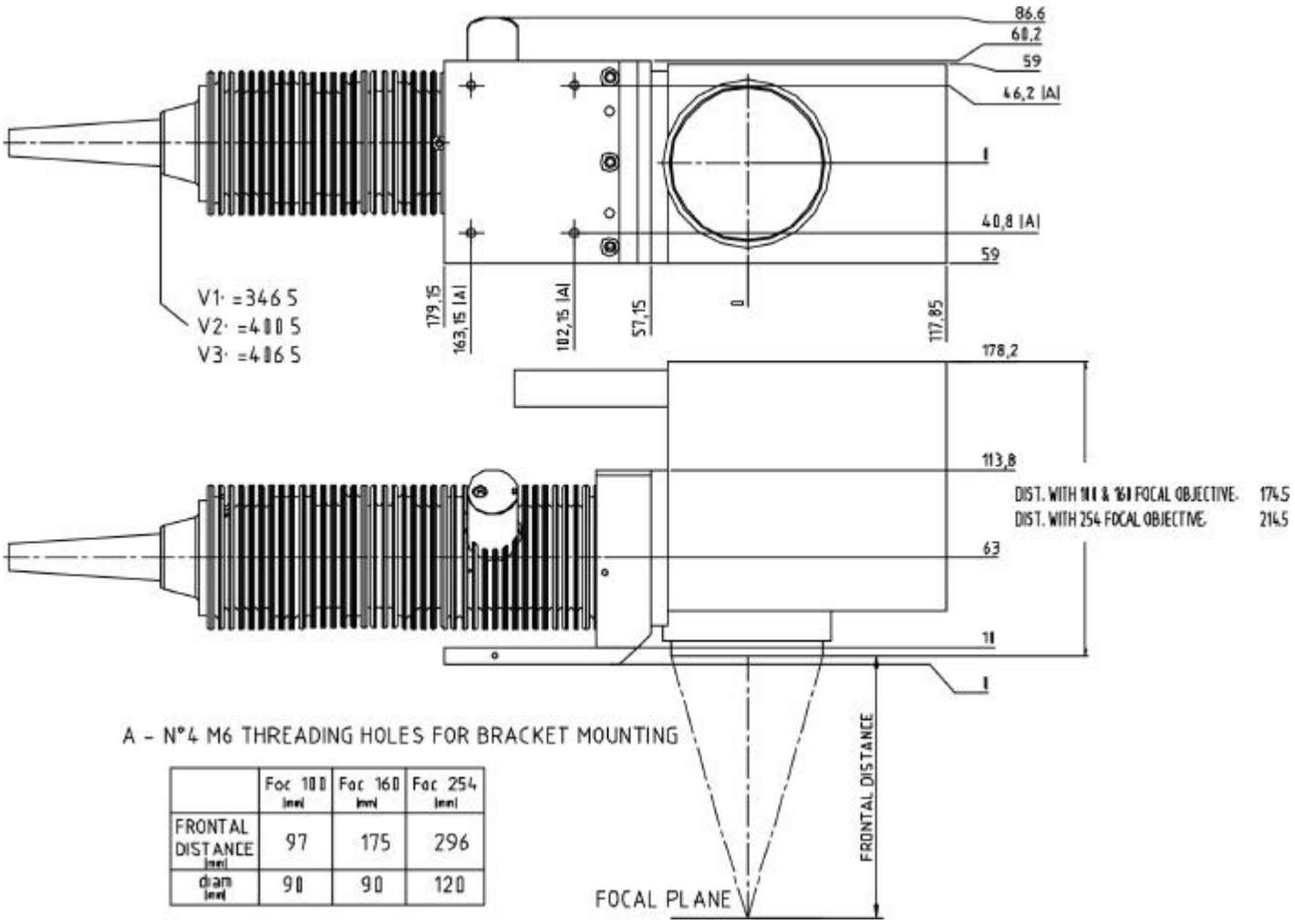



***Figure 16. Personal Computer***

**N.B.:**
For information on installing and using SMARTIST hardware and software, see the related manual

## Resonator fixing points

The figure below indicates the resonator fixing points and the related lens distances.




| | Foc 100 [mm] | Foc 160 [mm] | Foc 254 [mm] |
|---|---|---|---|
| FRONTAL DISTANCE [mm] | 97 | 175 | 296 |
| diam [mm] | 90 | 90 | 120 |

***Figure 17. Resonator fixing points and dimensions***

## Rack dimensions

The figure below shows the rack dimensions

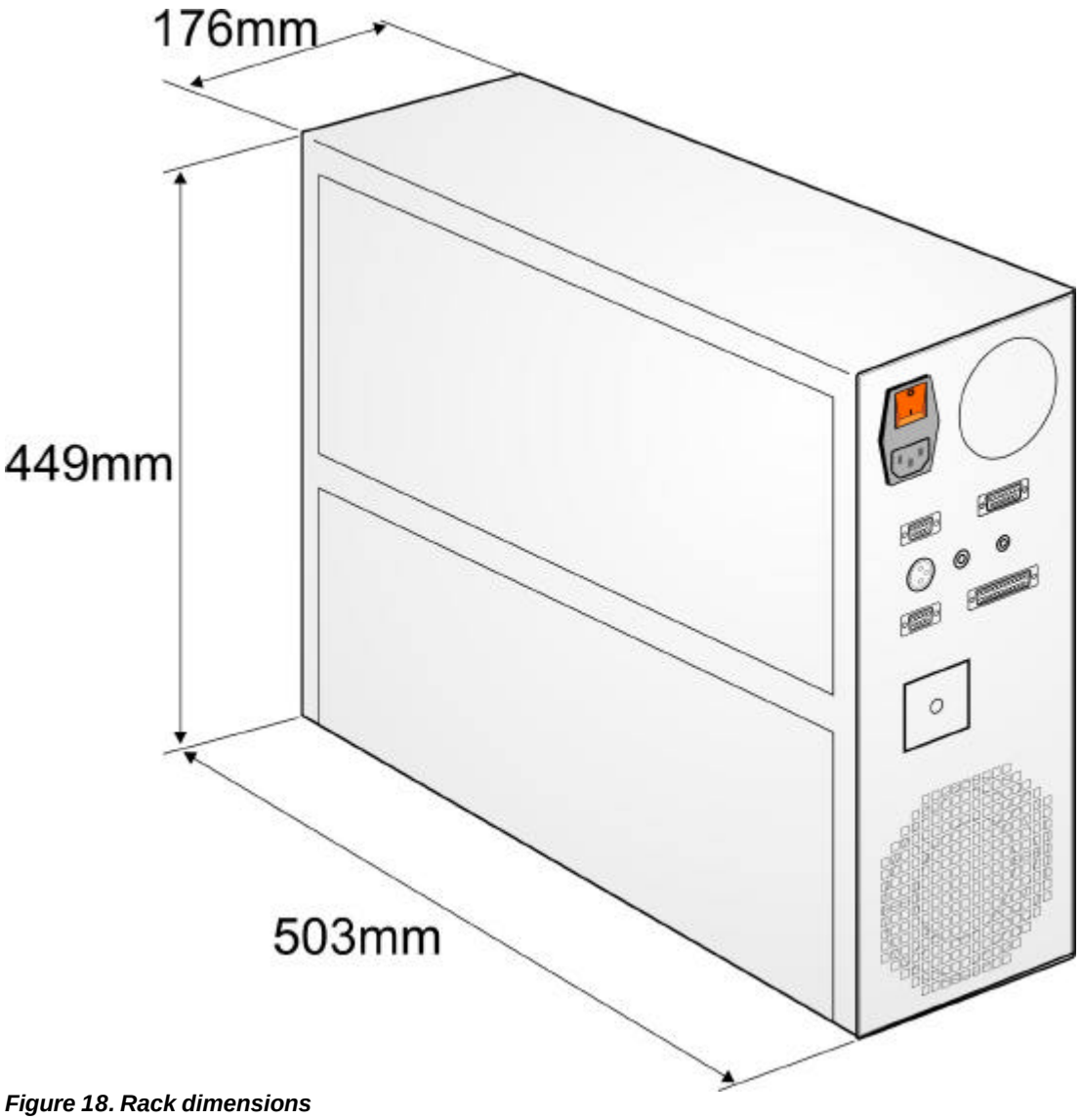



***Figure 18. Rack dimensions***

**WARNING:**
**The Rack must have a free space in the front and back of at least 10 centimeters to guarantee a flow of cooling air.**

## Electrical installation

The Violino™ Laser must be connected to a single phase line with neutral conductor. To ensure selectivity in the event of a short circuit a backup protection is needed with **am 16A fuses**. For industrial installations with $I_{cc}$ greater than 6 kA, to limit the D.C. current to this value an opportune limit switch is necessary. All work inside the equipment must be effected by trained personnel and authorized by Laservall S.p.A.

**N.B.:**

**All work inside** the equipment **must be effected by trained personnel** and **authorized by Laservall S.p.A.**.

A high sensitivity differential cannot be installed upstream from the protection line, only install a medium or low sensitivity one (300 mA – 500 mA).

## Electrical system connections

The Electrical System us completed with the Cables and Wires described below

**LD** Wire plug-SMB plug (3 m length)
between the AIMING BEAM connector 9 on the Management Panel MP and the SMB socket located on the resonator;;
**RF** Wire plug-SMA plug (3 m length)
connecting the Radio Frequency RF connector 15 on the Management Panel MP and the SMA plug located on the Resonator;
**TS** Wire plug-SUB 9 plug pin F (3 m length)
connecting 6 GALVO SUPPLY connector 6 on the Management Panel MP and SUB D connector 9 pin M located on the Scanner Head;
**STS** Wire plug-SUB D 25 plug pin M (3 m length)
connecting SCSI 50 POLI F connector on DSP2 board and SUB D 25 connector pin F located on the Scanner Head;
**PC** Wire plug-SUB D 9 plug pin M (3 m length)
connecting 12 PC connector on Management Panel MP and DB 9 F connector on DSP2 Board.
**SO** Wire plug SUB D pin M (3 m length)
connecting SUB D 15 F Slave Out connector on the Management Panel MP and the can on the resonator

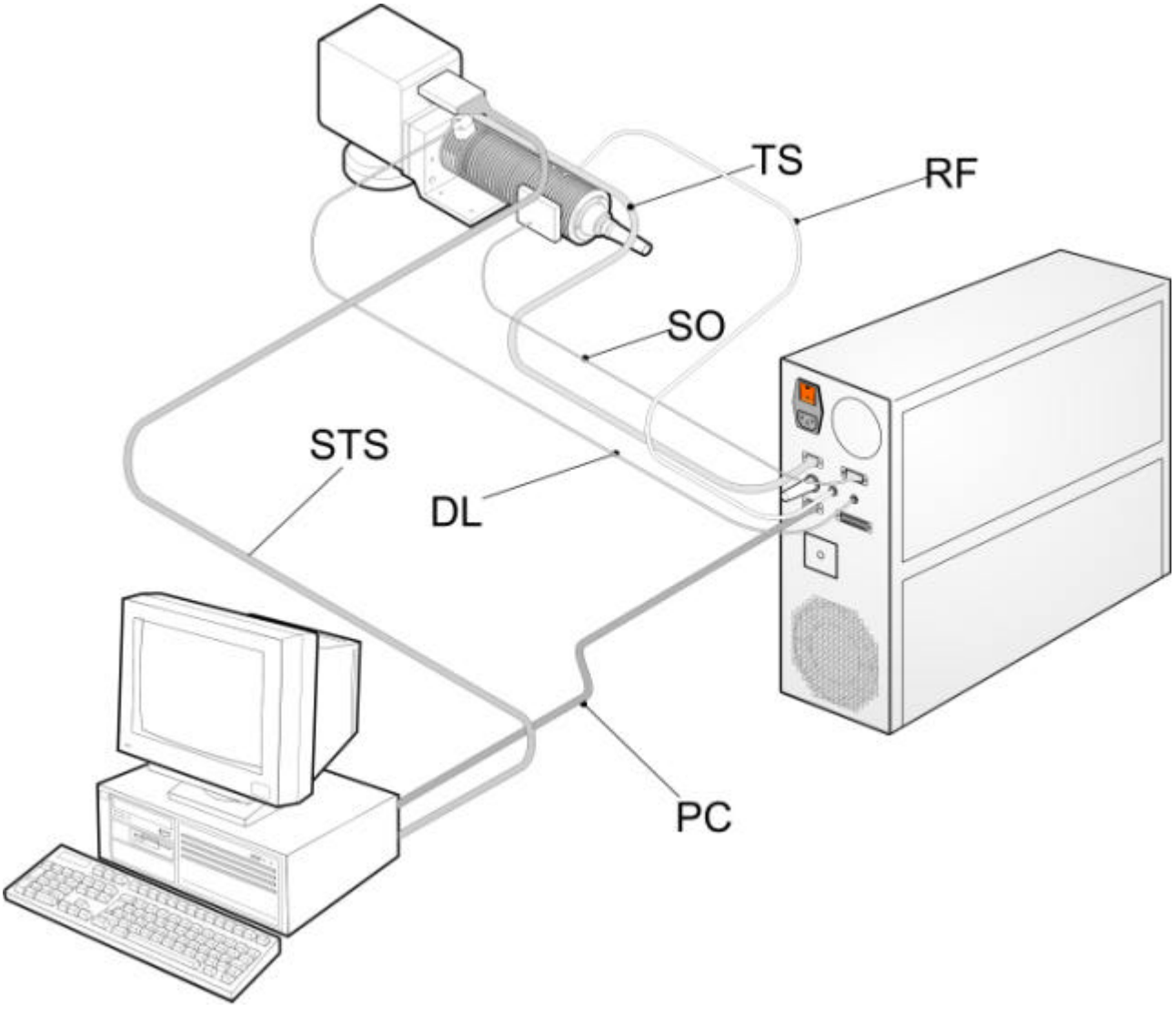



***Figure 19. Connection wires***

## Rear Management Panel MP

The figure below shows the position of the connections on the RACK rear panel.

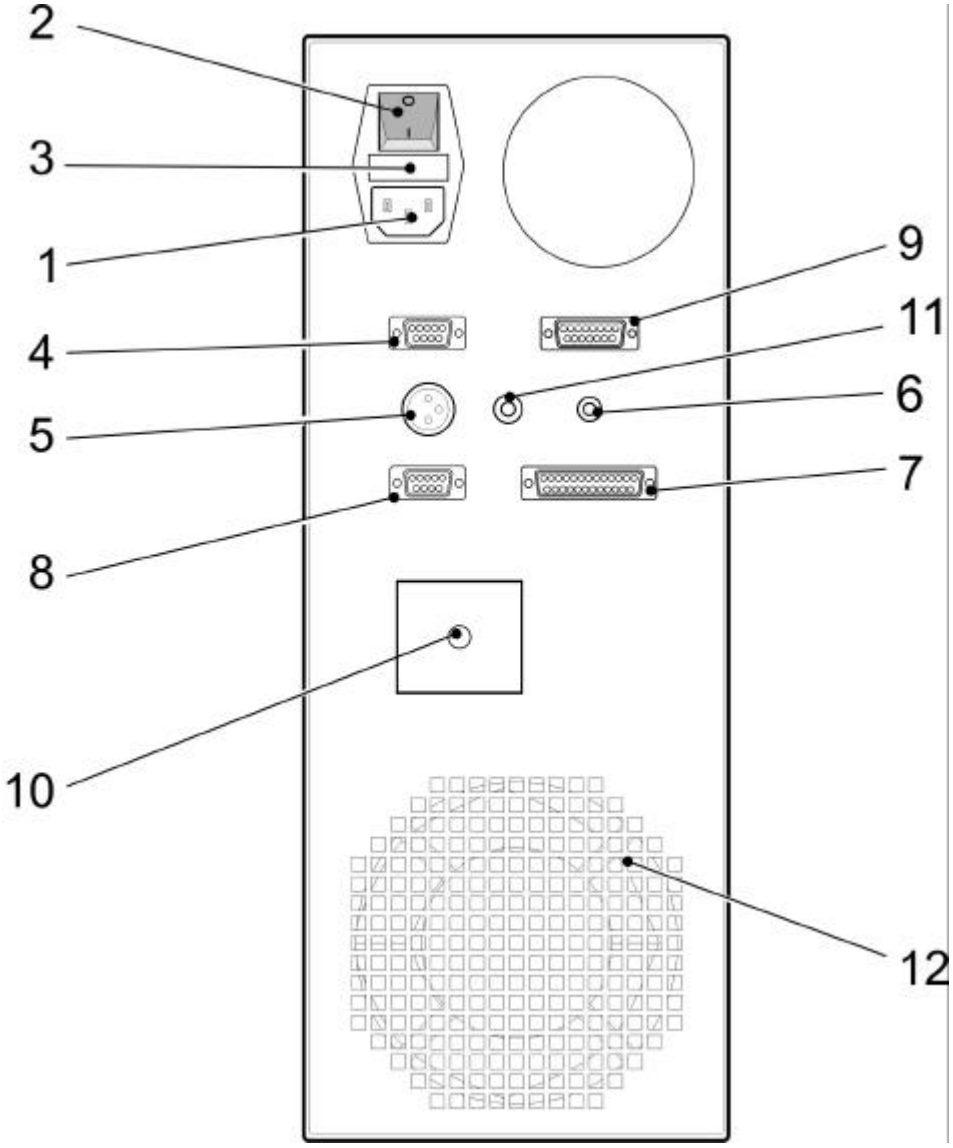



***Figure 20. External connections***

**Description of Management Panel MP**

1) Socket for external power
2) Main Switch. INPUT 230/110 Vac – 3/6 A – 50/60Hz
3) Protection fuses (5x20 6.3AT)
4) Informative plate
5) **GALVO SUPPLY**
   Galvo motor supply SUB D 9PM
6) **EXTERNAL INTERLOCK**
7) **AIMING BEAM**
   Aiming diode SMB F
8) **COMMAND BOX**
   Command Box connector SUB D 25PF
9) **PC**
   DSP Board (PC) connector SUB D 9PF
10) **SLAVE OUT**
    Slave Out connector SUB D 15PF
11) **OPTICAL FIBER**
    Optical Fiber
12) **R.F**.
    Q-Switch connector SMA F
13) Fan F

## External Interlock (EI)

It is possible to connect all the emergency devices aimed at making the laser source safe, in series with this connector.

**Connection:**

Pin 1 / Pin 2 Clear Contact(no voltage):
Interlock Contact off **closed**

The figure below represents the female interlock connector on the rear panel.

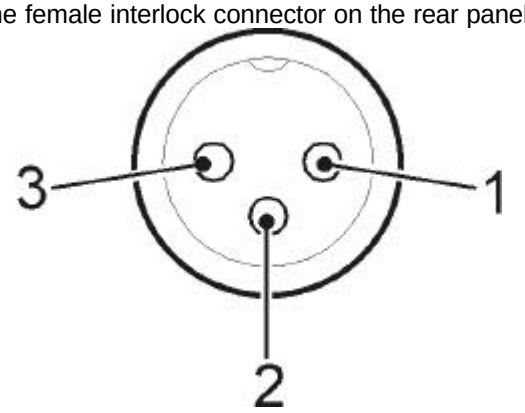



***Figure 21. Interlock connector***

**N.B.**
If an external interlock alarm is generated, disconnect the power and repeat the start-up procedure

## Command Box (CB)

This connector provides the indispensable inputs/outputs for controlling and interfacing of the engraving system. The figure below shows the contact sequence of female connector 25 pin located on the rear panel.

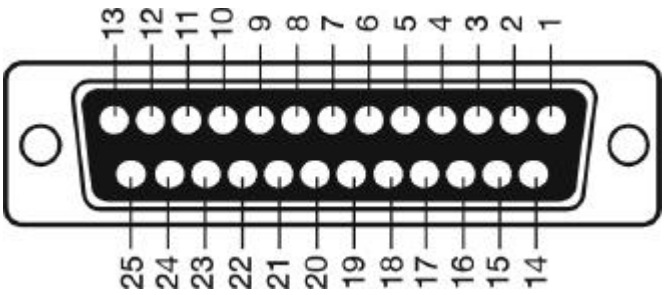



***Figure 22. Command Box***

### Input signals

**Emergency and stop**
Pin 1 / Pin 2 Clear Contact (no voltage):

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

**Start key**
Pin 4 / Pin 12 Clear Contact (no voltage):

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

**N.B.:**
The laser **will not go on** if:
The clear contact between pin 4 and 12 is normally closed
The clear contact between pin 7 and 8 is closed
Less than a second has elapsed since the emergency was reset

**Electronic shutter**
Pin 7 / Pin 8 Clear Contact (no voltage):

The shutter is opened with a **closed** contact.

**N.B.:**
To maintain the integrity and reliability of the diode, when the shutter is opened, the diode current has a 700ms ramp. The laser reaches maximum efficiency one second after the shutter is opened.

**Output signals**

**Power ON**

| | | | |
|---|---|---|---|
| Pin 18 | Analog output | LOW | = 0 Volt when the laser is off |
| | | HIGH | = 12 Volt when the laser is on |
| Pin 19 | GND reference for pin 18 | | |

**Laser Ready**

| | | | |
|---|---|---|---|
| Pin 20 | Analog output | LOW | = 0 Volt, when the laser is ready (Temp OK) |
| | | HIGH | =12 Volt, when the laser is not ready( Wait temp OK) |
| PIN 21 | GND reference for pin 20 | | |

**Shutter**

| | | | |
|---|---|---|---|
| Pin 22 | Analog output | LOW | = 0 Volt, when the shutter is closed |
| | | HIGH | = 12 Volt, when the shutter is open |
| Pin 21-24 | GND reference for pin 22 | | |

**N.B.:**
the pins not indicated are not used

**COMMAND BOX connector table**

| Pin N° | Type | Signal | Description |
|---|---|---|---|
| **1** | Input | Clear C. | **Emergency and stop** |
| **2** | Input | Clear C. | The emergency is disabled with a **closed** contact |
| **3** | | | Internal connection do not use |
| **4** | Input | Clear C. | Laser on. Obtained with **closed** contact |
| **5** | | | Internal connection do not use |
| **6** | | | Internal connection do not use |
| **7** | Input | Clear C. | **Electronic shutter** |
| **8** | Input | Clear C. | The shutter is open with a **closed** contact |
| **9** | | | Internal connection do not use |
| **10** | | | Internal connection do not use |
| **11** | | | Internal connection do not use |
| **12** | Input | Clear C. | Laser on. Obtained with **closed** contact |
| **13** | | | Internal connection do not use |
| **14** | | | Internal connection do not use |
| **15** | | | Internal connection do not use |
| **16** | | | Internal connection do not use |
| **17** | | | Internal connection do not use |
| **18** | Output | Analog | **Power ON.** 0 Volt when the laser is off. 12 Volt when the laser is on |
| **19** | GND | | GND reference for pin 18 |
| **20** | Output | Analog | **Laser Ready.** 0 Volt, with laser ready. 12 Volt, with laser not ready |
| **21** | GND | | GND reference for pin 20 and 22 |
| **22** | Output | Analog | **Electronic shutter.** 0 Volt, shutter closed. 12 Volt, shutter open |
| **23** | | | Internal connection do not use |
| **24** | GND | | GND reference for pin 20 and 22 |
| **25** | | | Internal connection do not use |

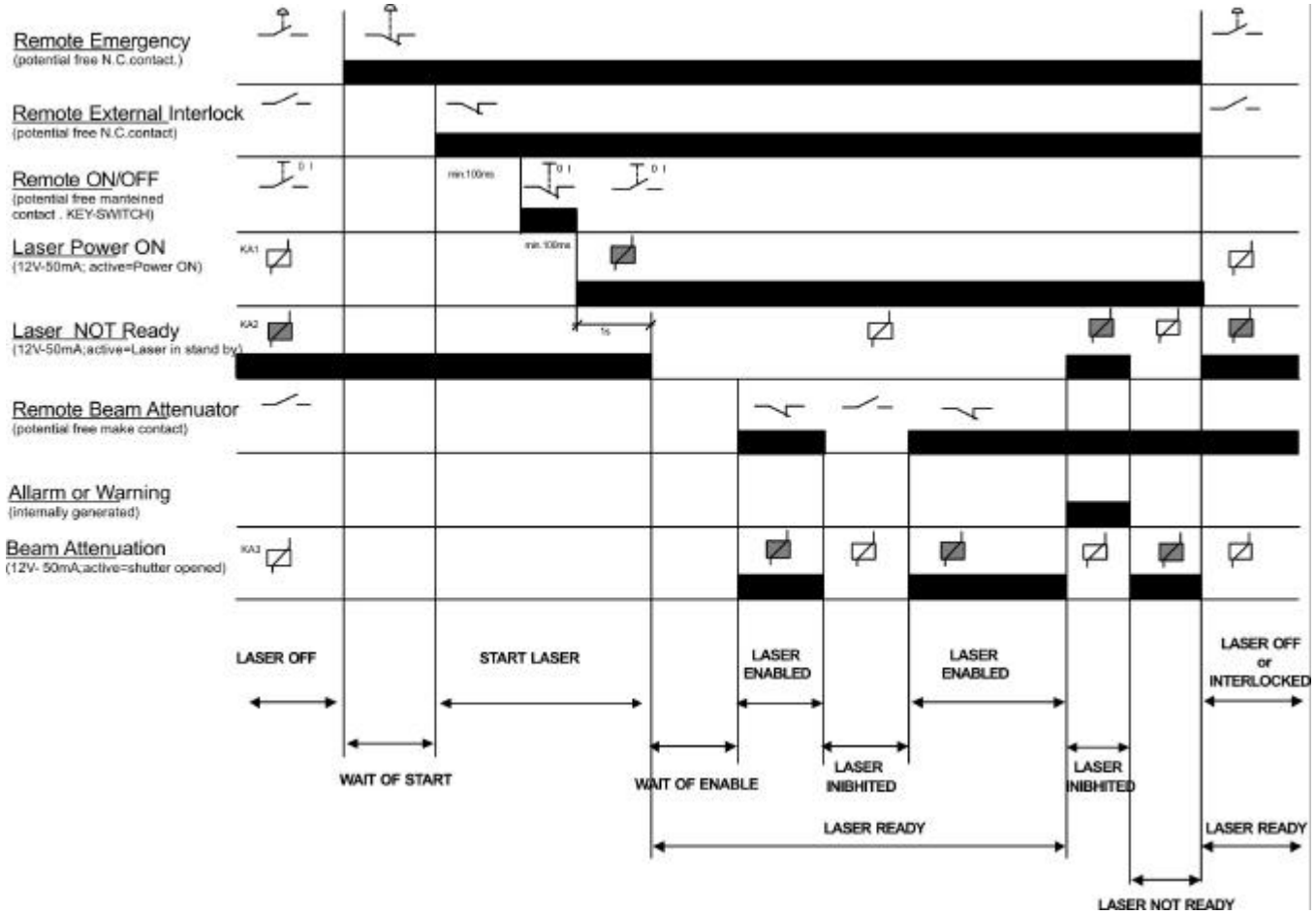
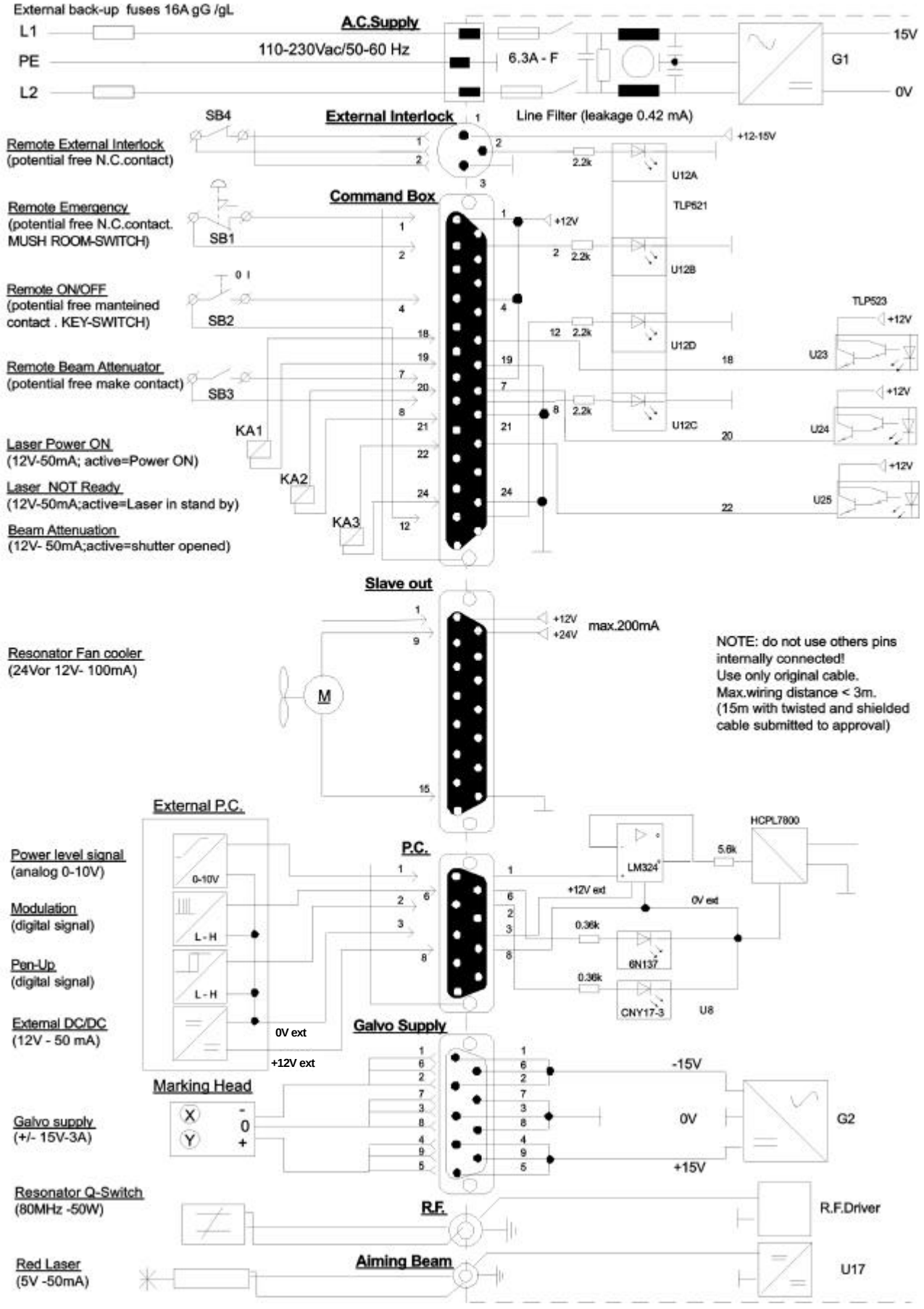



***Figure 23. Command Box graphic signals***

## Extrnal Connection Diagram



**General Power Supply**

The laser must be connected to a single phase 220/110Vac line (L+N+Pe), 3 or 6 Amperes 50/60 HZ depending on the model.

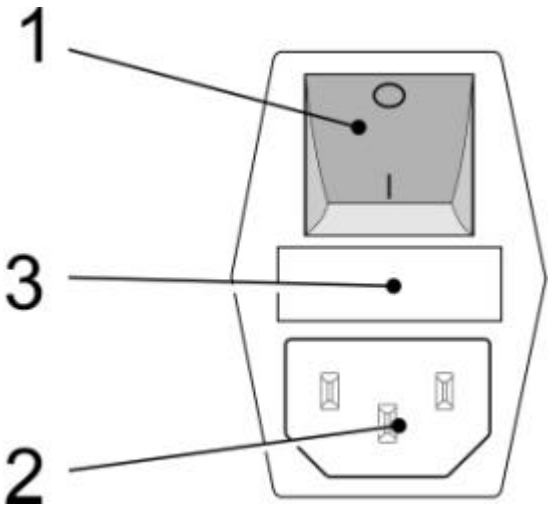



***Figure 24. Power supply***

1) Main Switch MS
2) 220 Volt Socket
3) Pair of fuses

**N.B.:**
The power supply line must always be divided and protected with 16 A AM backup fuses

## Optical Fiber Connection

The RACK laser aperture is connected to the Resonator by an OPTICAL FIBER. The end of the fiber in the RACK is supplied already connected. The end of the fiber in the resonator must be connected when the system is installed.

**Procedure:**

1) Make sure the main switch is in the OFF position
2) Remove the back cover of the resonator by unscrewing the three screws (5). Slide the optical fiber into the spring mounted grommet in the back cover.

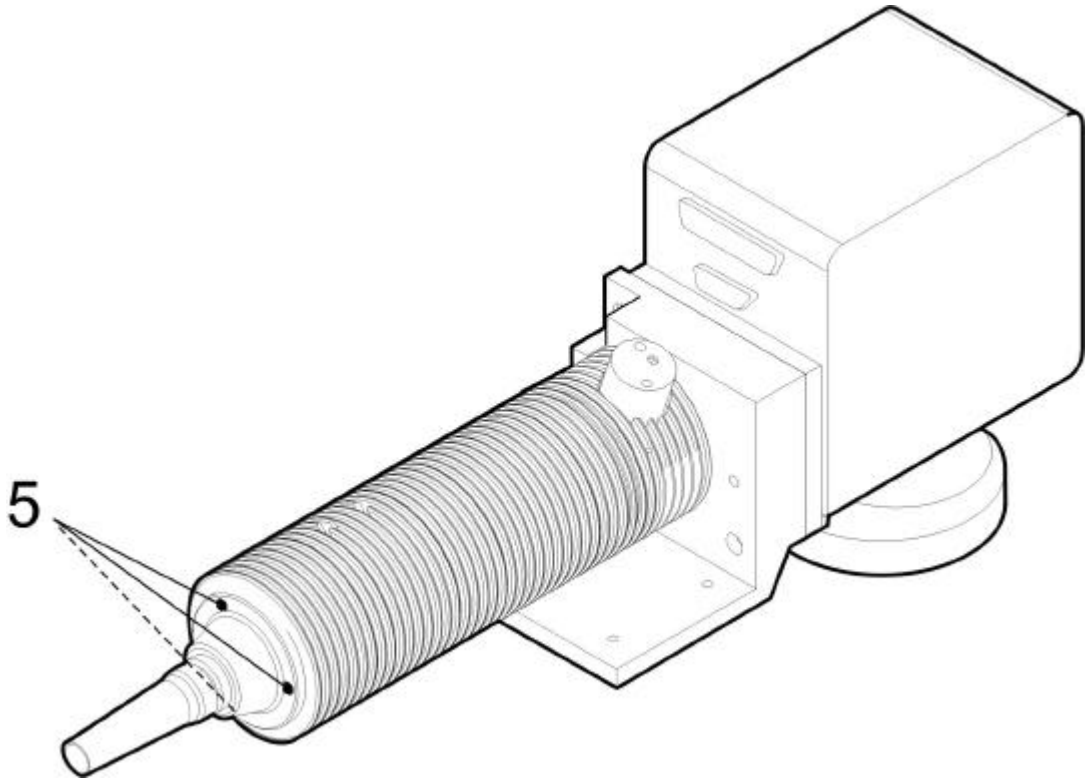



***Figure 25. Resonator back cover***

3) Remove cap 1 from the optical fiber connector. Unscrew nut 4

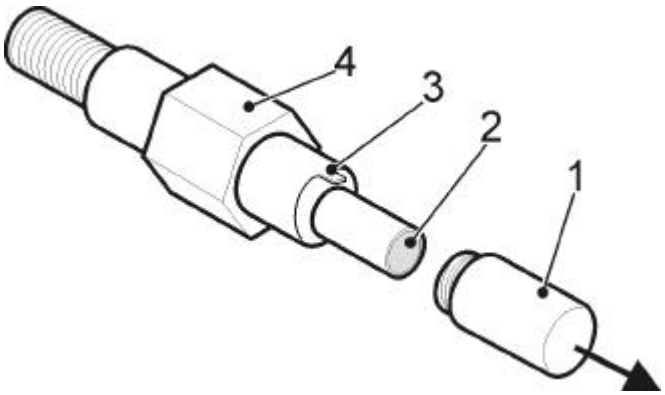



***Figure 26. End of the optical fiber***

4) After having removed the protection cap on the resonator, insert the fiber connector; first gently lay it on the fiber opening 6 on the resonator, then carefully slide it into the holder – do not let the optical face (central part 2) come into contact with any other surfaces.

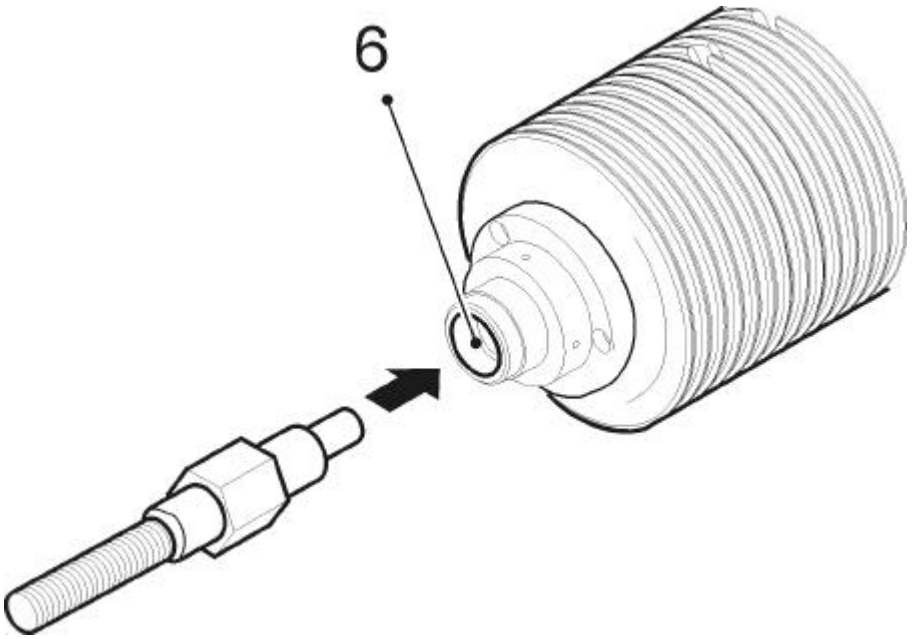



***Figure 27. Inserting the optical fiber in the resonator***

5) Make sure the three mechanical supports on the male/female connectors are in the correct position, then screw the connector against the Resonator Tube with nut 4.

**N.B.:**
The operation to insert the optical fiber must be done very carefully. Do not let the optical face (central part 2) come into contact with any other surfaces.

**WARNING:**
The protection caps for the optical fiber and fiber opening **must be kept. Returns of the** optical fibers or resonators **will not be accepted without their caps**.

**WARNING:**
Repeat the procedure also to connect the fiber to the rack by removing the coupler protection label and seal

**WARNING:**
To avoid damaging or breaking the optical fiber, never subject it to rays with a curve under 15 Cm

**WARNING!**
**Direct viewing** of a **Laser** beam may cause irreversible damage to vision!
The optical fiber is an integral part of the optical path of the violino laser system.
Do not work with the optical fiber disconnected or damaged for any reason.
Using an optical fiber which is bent, damaged or poorly connected may cause serious vision risks.

## Preliminary testing

Before installing the Violino™ laser equipment make sure that it was not damaged during shipping!
Make sure that the resonator, Scanner Head and focus lens are intact and undamaged
Make sure that the electricity source is available and in conformance with what is specified in this manual.
Measure the voltage.
Make sure that there is adequate distance from the walls for correct circulation of cooling air
Make sure that the Main Switch MS is in the “0” position before inserting the plug.
If not, put it in the “0” position.
Make sure that the equipment is correctly connected according to the diagrams attached to this manual.

**WARNING!**
Carefully read, apply and observe ALL the conditions established in the Chapter on installation.

**WARNING!**
Carefully read and refer to the wiring diagrams at the end of this manual for the installation.

make sure that all the Connection Wires and Connectors are correctly inserted
Make sure the Optical Fiber connectors are correctly inserted in the Rack and Scanner Head
Make sure the Laser Beam is intercepted, at the output of the Lens, inside an adequate, opportunely isolated area, which offers protection against direct and/or scattered radiation.

**WARNING!**
**directly viewing** a **Laser** beam may cause **irreparable** damage to your vision!

**WARNING:**
**The Rack must have a free space in the front and back of at least 10 centimeters to guarantee a flow of cooling air.**

# Installation procedure and First Laser start-up

**1° PHASE**

a) Make sure the plug is correctly inserted.
b) Make sure that all the equipment connection wires are correctly connected;
c) Close the Main Switch MS (Management Panel MP) and make sure that the following occur at the same time:
   1. the display goes on
   2. the fans start
d) Start (START).
   This is effected by closing the contact between pin 04 and 12 on the COMMAND BOX connector (Management Panel MP) with a pulse command. At start-up:
   1. the POWER ON condition starts: the green Led goes on.
e) After approximately 1 second and if the temperature of the laser diode system is correct, the equipment is ready for operation, the led becomes orange, the red light beam of the aiming laser diode ALD appears; READY / STAND BY condition
f) Enable ("Open") the ELECTRONIC SHUTTER by closing the contact between pins 07 and 08 on the COMMAND BOX connector (Management Panel MP), make sure that:
   1. the "ENABLE" condition starts: the Led changes status - Red.
   2. the red luminous point of red light of the Aiming Laser Diode ADL disappears from the Work field.
g) Disable ("Close") the ELECTRONIC SHUTTER by reopening the contact between pins 07 and 08 on the COMMAND BOX connector (Management Panel MP): return to the "READY / STAND BY" condition.

Once PHASE 1° of the Installation Procedure is finished, the laser source is in READY / STAND BY, ready to operate.

**N.B.:**
From this point the Laser source is ready to emit radiation

**2° PHASE**

h) Start the PC
i) Install the *SMARTIST* engraving software.*(See the specific manual)* .
j) If open, close the DSP management program (by clicking on the yellow icon in the tray area) and copy the file **Laser.ini** from the attached floppy disc in the folder **\laservall\bin.**
l) Deploy the engraving program.
l) Enable the SHUTTER again.
m) Run an Engraving test.
n) Disable the Electronic Shutter

**N.B.:**
For information on installing and using SMARTIST hardware and software, see the related manual

## Engraving

**N.B.:**
From this point the Laser source is ready to emit radiation

The engraving procedure is based on the type of Violino™ integration on the system and the type of required application. However, it is possible to summarize the following elementary sequences:

Enter in the software engraving mask
Insert a piece to be engraved in the engraving area.
Press the START button to start engraving
Wait for the end of engraving and remove the processed object

Engraving in the above conditions requires that the laser head (See objective lens) is at the correct focus distance from the piece to be engraved.
To bring the head to the correct position you need to enter the correct software window (See Software Manual) and use the Z axis (automatic or manual) to position and ensure that the laser is focused on the surface to engrave.
Normally the correct position is the point where the maximum amount of noise and luminosity is generated by the laser during engraving.

## Turn-off Procedure

Once the Installation and First Start-up Procedure has been terminated, and the operation of all Violino™ Laser equipment functionality has been checked, the equipment can be turned off as follows:

a) Open Command Box contact 7-8, and Command box contact 4-12
b) Press the STOP button on the machine used to open the contact between pins 01 and 02 on the COMMAND BOX Connector (Management Panel MP);
b) Exit the engraving program:
c) Open Main Switch MS (Management Panel MP).

**N.B.:**
For information on installing and using SMARTIST hardware and software, see the related manual

# Protection and Safety Circuits

### Safety stops and resetting

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

In the event that situations or faults are generated that may have hazardous consequences for the operator or the machine, safety circuits must be installed which completely block laser operation.

These circuits must be connected to Pins 1 and 2 on the Command Box or External Interlock.

# Daily Operations

## Preliminary Checks

Once the Installation, First Start-up and Turning off procedures described in the previous Chapters have been correctly effected, the Violino™ Laser equipment is operational.
However, the following preliminary checks must be effected daily before each start-up:

a) Make sure the operating area is clear;
b) Make sure that the plug is correctly inserted.
b) Make sure that the fan area is clear

## Switching on

To put the Laser Violino™ equipment into operation, follow the Standard Operating Procedure S.P.O., proceeding as described below:

a) Put the Main Switch MS on the CLOSED position;
b) Start the PC;
c) c) Start the equipment by pressing the START button and check
   1. for the presence of the red luminous point (Aiming Laser Diode) in the focus surface of the Work Field,
   2. the READY/STAND BY condition, i.e. that the led (System Panel SP) is on and Orange;
d) Select the desired Engraving Program:

**N.B.:**
For information on installing and using SMARTIST hardware and software, see the related manual

e) Enable the shutter and check that
   1. the luminous red point (Aiming Laser Diode) disappears on the focus point of the Work Field,
   2. the ENABLE condition, i.e. that the led (System Panel SP) is on and Red;

**N.B.:**
From this instant the Laser is ready to emit radiation

## Focusing the objective lens (Smartist 4)

Engraving in the conditions described in the previous chapters requires that the laser head be at the correct focus distance from the piece to engrave.
Axis Z control window is used to effect “engraving tests” useful for finding the focus. The program makes it possible to start a test where the laser effects a continuous engraving of a geometric figure with preset parameters, used to position the axis at the same time. The greatest laser interaction with the specific material indicates the best focus has been reached.

**N.B.:**
Normally the correct position is the point where the maximum amount of noise and luminosity is generated by the laser during engraving..

To start the test select the desired geometric figure (line, square, circle), set the dimensions in mm. Set the laser parameters and enable the “Start Test” tag.

The program can be used for integrated management of the Z axis, the mechanical axis used to focus on different planes, The axis control window is accessible by selecting the menu item “Laser” ✍ “Axis Z” or by pressing “Axis Z” on the tool-bar.

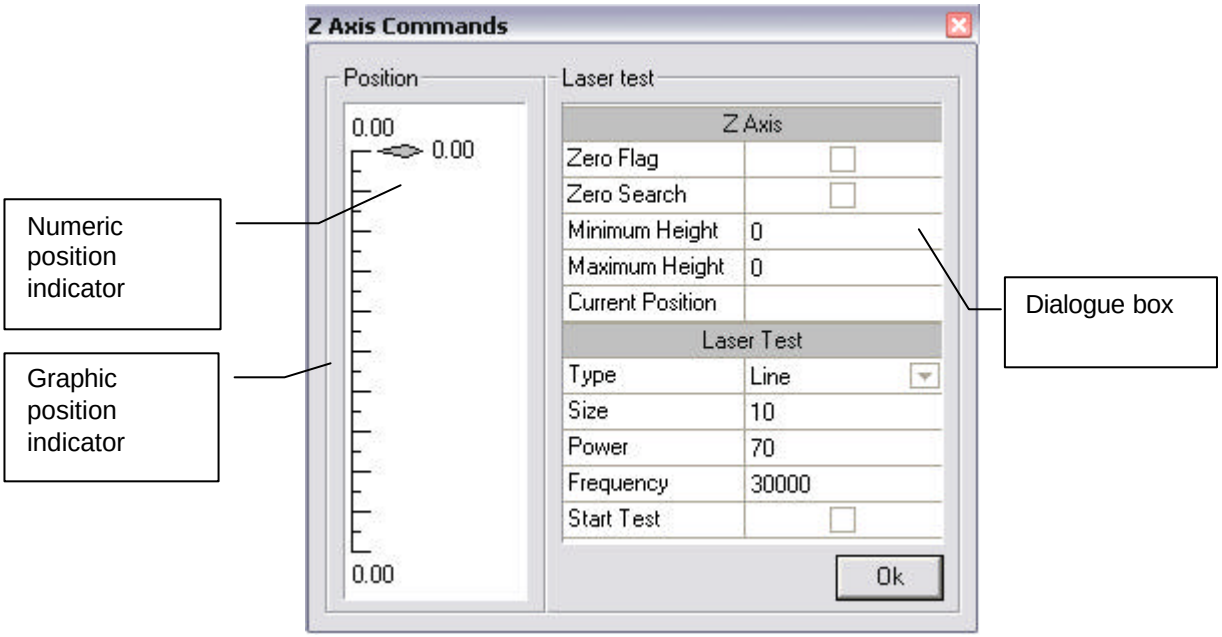



***Figure 28. Z axis control window***

| | |
|---|---|
| Zero flag | Detects the position of the mechanical axis (shows the axis on the sensor) |
| Zero search | Enables a search for zero along axis Z, the zero position is related to a proximity switch |
| Minimum height | Set the minimum height axis Z can reach |
| Maximum height | Set the maximum height axis Z can reach |
| Current Position | Represents the current position indicator reached by axis Z, a measurement can be entered by the operator |

**Laser Test**

These parameters are normally used during the focusing phase before engraving.

The axis control window is used to display the current position with a numeric positioner which shows the current position in millimeters and a bar which graphically represents the axis position total offset. The axis can be positioned from the window by entering the new position in the specific box or using the “Arrow down” and “Arrow up” buttons on the keyboard. In the latter case, press the button to start the movement and hold it pressed. The movement will stop when the button is released.
Furthermore, the axis control function can be used to reset, i.e. to automatically seek the mechanical reference position. Select “Zero search”, the axis will start searching and stop when the mechanical zero sensor is reached.

**N.B.:**
Press the “ESC” button on the keyboard to stop any movement or reset.

**N.B.:**
For information on installing and using SMARTIST hardware and software, see the related manual

## Parameter Setting

The Parameters to administrate in an Engraving Process in terms of Laser Sources are basically as follows:

a) Number of passes
b) a) Distributed power;
c) b) Laser beam movement speed;
d) c) Pulse frequency.

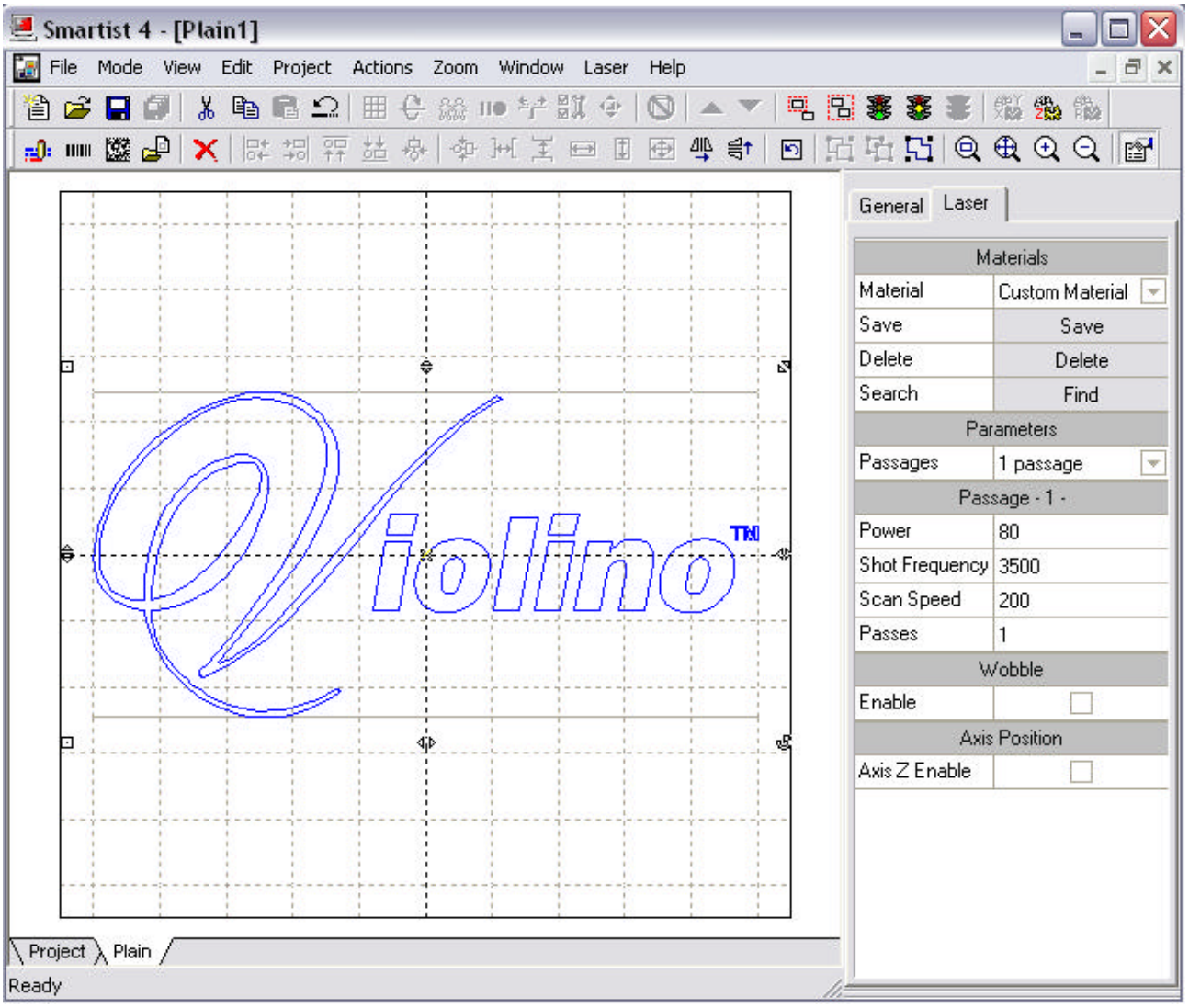



***Figure 29. Engraving Parameter Settings***

Setting of all Job Parameters is effected with the Engraving Program. The Operator should carefully read the related Manual.

**N.B.:**
For information on installing and using SMARTIST hardware and software, see the related manual

## Shutting Down

Once the work phase has ended, to shut down the Violino™ Laser, follow the Standard Operating Procedure, and proceed as follows:

a) Open the shutter (pins 7-8) and the start key (pins 4-12) on the command box connector
b) Press the STOP button (pins 1-2) on the command box connector;
c) Exit the engraving program:
d) Open Main Switch MS (Management Panel MP)

**WARNING:**
Follow the Start-up and Shut Down procedures exactly as described !

# Maintenance

## Ordinary Maintenance

Ordinary maintenance involves weekly maintenance jobs, which only regard cleaning the following part:

Objective lens protective glass, and cleaning around the fans. Rub gently with a cloth dampened with Acetone or Ethyl Ether.

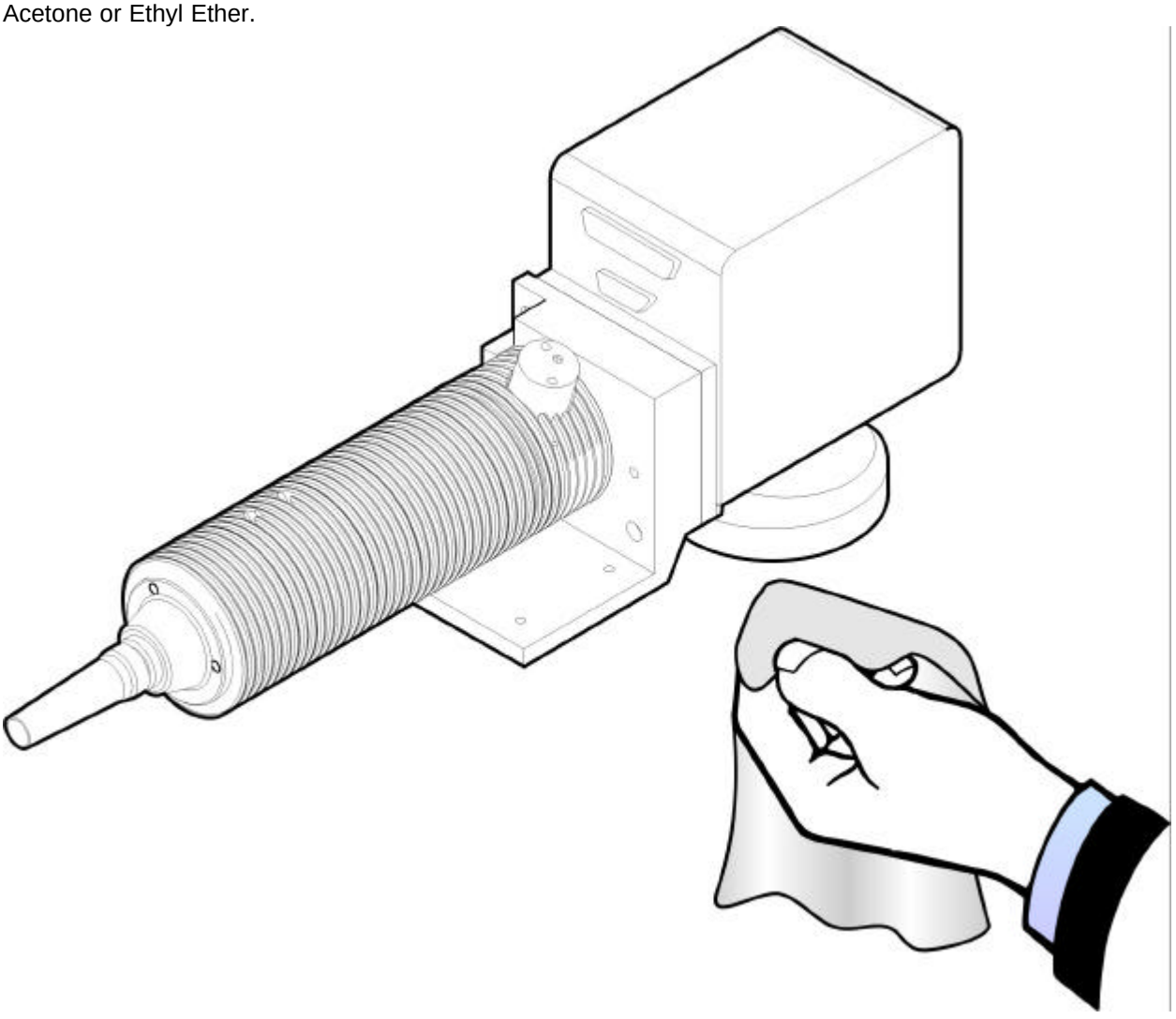


***Figure 30. Cleaning the Objective Lens***

# General specifications and features (overview)

| LASER MODEL | VIOLINO 1 | VIOLINO 2 | VIOLINO 3 |
|---|---|---|---|
| Laser Medium | Nd:YAG | Nd:$YVO_4$ | Nd:$YVO_4$ |
| Wavelength | 1064 nm | 1064 nm | 1064 nm |
| Nominal Power | 5W ±5 % (at Laser aperture) | 10W ±5 % (at Laser aperture) | 20W ±5 % (at Laser aperture) |
| Polarization | Random | Linear ( >100:1 ) | Linear ( >100:1 ) |
| Modulation | Fixed 10 - 20kHz | TTL 10kHz to 100kHz | TTL 20kHz to 200kHz |
| Laser Pumping | Diode Laser | Diode Laser | Diode Laser |
| | | | |
| Aiming Beam | Red Laser Diode | Red Laser Diode | Red Laser Diode |
| Supply | 90Va.c. to 240Va.c. | 90Va.c. to 240Va.c. | 90Va.c. to 240Va.c. |
| Frequency | 50-60 Hz | 50-60 Hz | 50-60 Hz |
| Power | < 400W | < 500W | < 700 W |
| Heat Load | 80W (273 btu/h) | 120W (409 btu/h) | 240W (818 btu/h) |
| Operating Temp. | +15 to + 35°C | +15 to + 35°C | +15 to + 35°C |
| Relative Humidity | 10 to 80%(non condensing ) | 10 to 80 % (non condensing ) | 10 to 80 % (non condensing) |
| Heat Exchanger | Air to Air ( Integrated) | Air to Air ( Integrated) | Air to Air ( Integrated) |
| | Overall Dimension (LxWxH;mm) | Overall Dimension (LxWxH;mm) | Overall Dimension (LxWxH;mm) |
| Rack | 180 , 500 , 450 | 180 , 500 , 450 | 180 , 500 , 450 |
| Resonator | Ø85 , 348 | Ø85 , 402 | Ø85 , 408 |
| Marking Head | 175 , 120 , 180 | 175 , 120 , 180 | 175 , 120 , 180 |
| | Approx.Weight | Approx.Weight | Approx.Weight |
| Rack | 19 kg ( 41.8 lb) | 20 kg ( 44 lb) | 34 kg ( 75 lb ) |
| Resonator | 4 kg ( 8 lb) | 4,3 kg ( 9.4 lb) | 4,9 kg ( 10 lb ) |
| Marking Head | 3,8 kg ( 8.3 lb) | 3,8 kg ( 8.3 lb) | 3,8 kg ( 8.3 lb ) |
| | Protection Class | Protection Class | Protection Class |
| Rack | IP 20 (IP54 optional) | IP 20 (IP54 optional) | IP 20 (IP54 optional) |
| Resonator | IP 54 | IP 54 | IP 54 |
| Marking Head | IP 54 | IP 54 | IP 54 |
| | Environmental | Environmental | Environmental |
| | | | |
| Max.Acceleration | 0,5 G | 0,5 G | 0,5 G |
| Storage temp. | - 5°C to + 55°C < 24 h(non condensing ) | - 5°C to + 55°C < 24 h(non condensing ) | - 5°C to + 55°C < 24 h(non condensing ) |
| Operating Altitude | < 1500m ( 5,000 feet ) | < 1500m ( 5,000 feet ) | < 1500m ( 5,000 feet ) |
| Conformance | Requirements of IEC 825-1:1993 | Requirements of IEC 825-1:1993 | Requirements of IEC 825-1:1993 |
| Laser Class | Working Laser / 1064nm: Class IV<br>Pumping Laser / 808nm: Class IV<br>Aiming Beam Laser/ 635nm: Class IIIA | Working Laser / 1064nm: Class IV<br>Pumping Laser / 808nm: Class IV<br>Aiming Beam Laser/ 635nm: Class IIIA | Working Laser / 1064nm: Class IV<br>Pumping Laser / 808nm: Class IV<br>Aiming Beam Laser/ 635nm: Class IIIA |
| | | | |
| **NOTE:** | **Specifications subject to change without notice** | | |

| Marking Head | Scangin10 / Scanjet (options) | | |
|---|---|---|---|
| Objective F | 100 | 160 | 254 |
| Focal distance | 97±2mm | 175±4 mm | 296±4 mm |
| Marking Area | 60x60$mm^2$ | 110x110$mm^2$ | 170x170$mm^2$ |
| Min Spot Diam. | 20 - 40 micron | 40 - 60 micron | 60 - 100 micron |

**N.B.:**
this laser is classified as **class IV**. Class IV includes lasers which can produce risks, not only from **direct** or **reflected** radiation, but also from **scattered** radiation! The laser sources may be a significant risk for the skin and risk of burning flammable materials.

## Electricity

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

Absorbed power:.....
Violino™ 1.....max 400 W
Violino™ 2.....max 500 W
Violino™ 3.....max 700 W

## Ambient operating conditions

Ambient temperature:..... min 15 C°
..... max. 35C°
Humidity: ..... < 90 % without condensation
Altitude: ..... < 1500 m
Suspensions ..... 3 mg/$m^3$
Vibration: absent

## Cooling

Air cooled.
Air temperature: min1 0° C – max 30° C

## Dimensions and weight

| Component | Height | Width | Depth |
|---|---|---|---|
| **Rack:** | 448 mm | 176 mm | 503 mm |
| **Resonator:** | Ø 85 | | 348/408mm |

Weight of the individual components:

Rack:

| | |
|---|---|
| Violino 1 | Kg 19 |
| Violino 2 | Kg 20 |
| Violino 3 | Kg. 34 |
| Resonator: | Kg 4.5 |
| Scanner Head: | Kg 3.5 |
| Lens: | Kg 0.3 |

### Warning:

Handle Violino rack with care

## Lifting and Transport

Each component can be lifted supporting it from the bottom or with the handles attached to the upper part of the rack. The component must be raised when transported, avoid bumping it into things and collisions.

## Storage

All of the equipment components can be stored at a temperature ranging from –5°C to 55°C for no longer than 24 hours and without condensation.

## Shocks and vibration

The components are not designed to withstand shocks and vibration and may be damaged.

## Acceleration

The maximum acceleration the equipment can withstand without damage is 0.5 G

# General safety regulation for LASER Systems during operation

## National Legislation:

| | |
|---|---|
| D.P.R. 547 of 27/04/55 | titles III and VII "..on the prevention of occupational accidents and hygiene.." |
| D.P.R. 626 of 19/09/94 | articles 21 and 22; IV and V "..on Occupational Health and Safety.." |
| D.P.R. 475 of 04/12/92 | "…enacting directive 89/686 on I.P.D..." |
| D.P.R. 476 of 04/12/92 | "...enacting directive 89/336 on EMC.." |

## European Legislation

| | |
|---|---|
| Directive 89/392 EEC | 1.5.12 " ..Machine Directive; essential safety requirements.." |
| Directive 89/656 EEC | "..use of individual protection equipment.." |
| Directive 89/686 EEC | "..Individual protection devices.." |
| Directive 89/336 EEC | "..Electromagnetic compatibility.." |

## European standards:

### General standards type A, B

| | |
|---|---|
| EN 292 parts 1,2 | "..machine safety, general principles, fundamental concepts.." |
| EN 60204 | "..machine safety, Electrical equipment.." |
| EN 50081-1 | "..electromagnetic compatibility, Industry emissions.." |
| EN 50082-2 | "..electromagnetic compatibility, Industry output.." |
| IEC 110-24 file 2617G | "..guide for applying legislative decree on (EMC).." |

### Type C specific standards

| | |
|---|---|
| EN 60825 | "..LASER equipment, radiation safety.." |
| IEC 76.2 file 1284G | "..Guide for using LASER devices.." |
| EN UNI 13626 | "..Systems with Laser.." |

## Introduction:

When faced with the problem of checking the safety of a System, the first step to take is to identify the dangers connected with operating the System. If a LASER device is installed on the system, in addition to the Dangers for the type and mode of operation, it is necessary to bear in mind the further Danger represented by LASER Radiation (electromagnetic radiation, primarily infrared).
The safety of this type of Device is the subject of specific standards, in terms of electricity and radiation (non-ionized).
Consequently the technical recommendations offered by these specific Standards must be carefully observed. They are aimed at reducing the access Risk to Danger at levels presumably in conformance with the Law.
Observance of these Standards is the responsibility of the Manufacturer of the LASER Source and the Integrator of the Source in the System and the System User.
Thus, there is not only one way for increasing the safety as various protection systems can be identified.

## Protection system:

A general rule to be observed is that "…where there is danger there should not be a Person and where there is a Person there should not be danger…".
This makes it immediately clear that the main path to take involves placing a Guard between the Person and the danger, this reduces the risk of access to the danger to a minimum. Another path to take is to setup a series of protective measures which inform individuals of the existence of danger, preventing them from involuntarily coming into contact with danger. Lastly, there is the necessity of individual protection devices for any risk which may vary according to the operating conditions.
Three types of protective measures have been identified for LASER equipment:

A - Design Devices

B - Procedural and Administrative

C - Individual Protection

## Design Devices:

These are the most opportune for an industrial environment. They involve a series of steps which during the design, construction and integration phase of the System, take into account the existing dangers and devices to minimize risk. When applicable this is effected by equipping the system with specific casing which encloses both the LASER and the work area. preventing dangerous radiation from reaching the outside of the casing. This reduces the acceptable emission level (AEL) to a level so that a LASER classified as dangerous (Class IV) does not emit radiation toward the exterior that is higher than that corresponding to Class I, and not considered dangerous.

**Regulations on guards.**

Guards, barriers or casing must be able to intercept infrared radiation emitted by a LASER and be able to withstand perforation.

This requirement is easy to meet (for a LASER with low power) using sheet metal panels which completely shield the radiation and indefinitely withstand perforation due to radiation not aimed at them. For a high power LASER it is necessary to establish a perforation time between one inspection and the next or use active casing, able to withstand perforation (using hollow spaces and adequate sensors).

For Nd-Yag, NdYVO4 lasers a metal protection with a thickness over 1.5 mm provides sufficient protection to indefinitely withstand laser radiation of the incorporated Laser source which is not directly aimed.

The access panels and the safety locks must be designed so there is no access to dangerous radiation.

Depending on the type of process or process intervention, it may be necessary to remove the casing or panels. In this situation, and if the panels are not attached to the structure by screws which require specific tools, these removable panels must be equipped with removable safety locks which once engaged reduce the radiation to permitted levels.
This is normally created using an electric interlock with the LASER energizing power system. The interlock device, acting as a safety function for individuals, must be in conformance for this type of use and acceptance tested.

The inspection devices must contain specific attenuation devices able to prevent human access to radiation over AEL class I.

There is often a problem of having an Inspection window for observing the interaction between the LASER ray and the material being processed. The windows must be equipped with Optical Density (O.D.) Filters able to decrease the radiation to levels which are not dangerous. The O.D. calculation must take the type of LASER into account, its operation, distance of the focus surface, observation direction, exposure time etc. The filter, acting as a safety device for individuals must also be acceptance tested and certified.

**Special measures for class IV LASER:**

Class IV LASER requires remote control, key control. emission warning and an attenuation device.
For these LASERS the Manufacturer must supply the User with a device used to easily add an external safety device to the LASER. This is created with a remote locking connector, or a contact which if open blocks or reduces laser emission.

The start device must prevent unauthorized personnel from operating the LASER. A key control, which can be removed in the off position, is used for this purpose.

When LASER radiation is active it is necessary to warn personnel of its presence. In this case an emission warning is given (generally a flashing red light).

A device must always be present to temporarily stop the LASER beam. For this, the source Manufacturer creates a beam attenuating or shutter device.

Other construction requirements are described in table D2 of IEC standard 76-2 “Guide for LASER device use”.

**Control and plate positioning:**
According to requirements the controls must be positioned outside of any possibility of radiation access and opportune and standardized warning labels must be positioned so they are clearly visible.

## User Requirements; Administrative procedures and Standard operating procedure (S.O.P.)

Use requirements which must be observed for correct use of Laser equipment are important in order to prevent making the Manufacturer's efforts in terms of safety fruitless. They also force the User to correctly use the protections provided by the Manufacturer with the addition the User is responsible for, and with the obligation of developing an in-house procedure aimed at providing individuals with a standard behavior for the best safety conditions. They are also aimed at preventing unauthorized individuals from accessing areas where LASER processing is effected. A Standard Operating Procedure must be established related to operation for starting and shutting down the Equipment. This procedure must be displayed near the installation as a reference for the Operator and must be written in the Operator's language. Training of personnel is essential and must include:

a – Familiarization with system operating procedures;
b – Appropriate use of danger control procedures, warning signals etc.;
c – Necessity of individual protection;
d – Biological effects of LASER on eyes and skin;

## Individual protections, individual protection devices (I.P.D.):

These devices must be viewed as an additional safety measure along with the protection systems indicated in A and B and not as the main or even only safety measure. They include goggles which must be secure and conformance certified, they are the final barrier between the eye and radiation! The O.D. calculation of the goggles must be conducted pursuant to regulatory recommendations based on worst case viewing conditions.
Remember that no goggles can effectively protect the eyes from direct viewing of the LASER beam!

## Remaining risks that the User must identify and eliminate:

These are risks related to using the LASER and not from the LASER itself. There is collateral radiation, associated to the main radiation. It is visible infrared and ultraviolet which can represent a potential danger due to its intensity.
Due to its high power density (Irradiation) the LASER beam is able to cause the combustion of flammable substances such as volatile substances (Solvents, gases, ethers, alcohols etc.) as well as metacrylic or plastic resins.
The interaction of the LASER beam with organic and inorganic material causes the production of fumes and vapors, which may be harmful and/or toxic in some cases!
A highly flammable solvent which is irritating for the eyes, or if inhaled, is used for cleaning the Lenses.

**Warnings:**

The following warnings minimize the remaining risks:

Do not remove the protective casing on the bulbs and guards.
Use goggles and gloves top handle the bulbs.
Do not aim the LASER at material considered to be flammable.
Use appropriate suction devices to eliminate fumes.
Filter fumes before releasing them into the air.
Do not work with the electrical system on and the guards removed.
Do not adjust the Laser while it is operating.
Only use professionally trained and authorized personnel.

If all the requirements described to this point are meet, it is possible to reasonably state that operating on a system containing a LASER source does not involve greater risks than any other activity!

**N.B.:**
If in doubt contact the source and system manufacturers!

# Conformance to EEC Directives and CE Marking; Additional Instructions for the User

## Terminology

International regulations have standardized the terminology related to Lasers, Laser components, accessories, performance etc. The particularly significant ones and applicable industry regulations have been provided below.

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 on is moving, with appropriate actuators, controls and power circuits combined for a specific application, in particular for processing, treating, moving or packing material..

***1.2 LASER SYSTEM,***
machine in which a Laser source is inserted which possesses sufficient energy to interact with the piece being processed, and such machine has all the operation and safety aspects of a machine ready for use.

***1.3 MANUFACTURER,***
individual or organization which assembles the laser system.

***1.4 COMPLEX COMPONENT,***
element used to create a machine, but which cannot in itself be considered a machine as it does not possess the intrinsic function for final use.

***1.5 INSTALLED SYSTEM,***
system composed of multiple machines and/or system combined to meet a specific objective but not destined to be put on the market as a single saleable unit.

***1.6 ELECTRO MAGNETIC COMPATIBILITY,***
(Electro Magnetic Compatibility):suitableness of a machine or system to satisfactorily operate in its own electro magnetic environment, without introducing electro magnetic disturbance that is unacceptable for everything found in this environment, including emission requirements (disturbance produced by the machine) and immunity (insensitivity of the machine) to the disturbances produced by the environment.

***1.7 SECOND ENVIRONMENT,***
environment which includes all industrial uses other than those directly connected to a low voltage electrical supply for building for domestic use.

***1.8 ON SITE,***
area where the machine is installed for normal use by the final user and where the machine has been tested.

***1.9 LIMITED DISTRIBUTION,***
sales procedure whereby the manufacturer limits the supply of machines to suppliers, customers or users, which separately or jointly, have the technical knowledge of requirements related to E.M.C. for the installation of electric and electronic machinery and which provide, through exchange technical specifications, for on-site measurement of actual surrounding conditions.

## Reference documents and industry standards

***2.1 ELECTROMAGNETIC COMPATIBILITY (EMC);***
Directive 89/336/EEC of 3 May 1989 related to Electromagnetic Compatibility and subsequent modifications.

***2.2 LOW VOLTAGE DIRECTIVE;***
Directive 73/23/EEC of 19 February 1973, concerning electric material destined to be used within certain voltage limits

***2.3 CENELEC EN 60204-1 STANDARD;***
Machine safety. Machine electrical equipment.

***2.4 CENELEC EN 60825-1 STANDARD;***
Laser equipment safety. User requirements and guide

***2.5 CEN EN 12626 STANDARD;***
Laser processing machinery-machine safety.

## Conformance with EEC Directives and CE marking

***3.1*** CONDITIONS FOR CONFORMITY TO EMC DIRECTIVES OF "VIOLINO" LASER SOURCES.
The conformity of Laser sources defined in the title of this paragraph to the Directives related to Electro magnetic Compatibility, are only valid for the conditions listed 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 PART OF A MACHINE OR SYSTEM OR INSTALLED SYSTEM; THEREFORE THE OPERATING CONDITIONS OF THE SOURCE WITHIN A SYSTEM MUST BE AS DESCRIBED IN PARAGRAPH 4 OF THIS PUBLICATION

***3.12*** THE SOURCES DEFINED IN THE TITLE OF THIS PUBLICATION ARE ONLY SOLD BY LIMITED DISTRIBUTION (As defined in point 1.9); THEREFORE THE INSTALLER AND/OR USER ARE AWARE OF THE REQUIREMENTS RELATED TO ELECTRO MAGNETIC COMPATIBILITY.

***3.1.3*** THE SOURCES DEFINED IN THE TITLE OF THIS PARAGRAPH MUST BE INSTALLED ACCORDING TO THE INSTRUCTIONS INDICATED IN THE PREVIOUS PARAGRAPHS OF THIS PUBLICATION. IN ADDITION THE INSTRUCTION PROVIDED HEREIN MUST BE COMPLETELY OBSERVED, INCLUDING ON-SITE TESTING OF FINAL COMPLIANCE WITH THE DIRECTIVES

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

**DECLARATION OF CONFORMITY**

Laservall S.p.A. hereby declares that in the conditions described in this document, in particular in section 3, VIOLINO series sources are in conformance with EEC Directives related to ELECTRO MAGNETIC COMPATIBILITY and EEC Directives related to LOW VOLTAGE according to the regulatory references in section 2.

***3.3*** NOTE FOR THE APPLICATION OF OTHER EEC DIRECTIVES
LASER sources are not subject to other EEC Directives other than those indicated in section 2. However, for application purposes, there are references to other Directives, and the following declaration has been provided in particular to comply with art. 4 of Machine Directive 89/392/EEC.

**MANUFACTURER DECLARATION**

FOR THE PURPOSE OF MACHINE DIRECTIVE REQUIREMENTS Laservall S.p.A. hereby declares that the VIOLINO sources must be installed pursuant to its own instructions and shall not be put into operation until the machines where they are incorporated have been declared in conformance with the above mentioned Directive.

## Electro magnetic compatibility application guide

The requirement to comply with precise EMC regulations is die to the increasing use of powerful electronic devices, which due to the techniques used are the source of disturbances in a very vast field of frequencies (emission) and at they same time they are also affected by disturbances produced by other devices and thus require an adequate level of immunity.

***4.1*** Disturbances are customarily classified as low frequency ( 0< f < 9 kHz) and high frequency ( f > 9 kHz). Low frequency phenomenon which are particularly important are those connected to harmonic frequencies and electricity frequency. There are other widespread phenomenon such as electrostatic discharge in air or by contact.

***4.2*** Disturbances can be transmitted via conductors (conducted disturbances in a field ranging from 0.15 MHz to 30 MHz) and via irradiation (irradiated disturbances ranging from 30 MHz to 1000Mhz).

***4.3*** Case studies in industrial environments point to conducted disturbances as the main cause of failure to comply with electro magnetic compatibility! For this reason installation of a Laser Source must be effected scrupulously following the instructions below.

***4.3.1*** Connections and wiring. Laser equipment connections to other devices and external sources must be made taking into account minimization criteria of electro magnetic influences between them. Power circuit wiring must be physically separated from command and control (signal circuit) circuits, this is effected using metal channels, metals shields or shielded cables, even for power circuits.

***4.3.2*** Filter devices. All equipment, which requires supplementary devices to comply with EMC regulations, must be equipped with such devices, assembled according the Manufacturer instructions. Supplementary devices include RC units to assemble in parallel to AC relay coils, diodes to assemble in parallel to DC relay coils, filters for high frequency conducted disturbance to be assembled on the mains input (ask Laservall for the most suitable type).

***4.3.3*** Wire shielding. Wire shielding must end as close to the incoming terminal boards as possible.

***4.3.4*** Metallic panels. All the panels which make up the system must be interconnected so that they present low impedance to high frequencies. This is obtained by adding numerous screws between the unpainted walls and using EMC metal seals. All the metallic parts are connected with a good ground connection.

## Guide to applying Low Voltage safety

***5.1*** Installation. Only professionally trained individuals can operate in the installation, connection to external energy sources, and in general, for any type of intervention on the electric part. Dangerous voltage is present inside the Laser power supply!

***5.2*** Power cut-off device. Since the laser is designed to be incorporated in a system including other equipment, it is necessary to install a manually controlled power cut-off device common to the entire system. This is the installer's responsibility.

***5.3*** Stop function. Since the laser is designed to be incorporated in a system including other equipment, it is necessary to create a category O stop common to the entire system. This is the installer's responsibility.

***5.4*** Emergency stop. Since the laser is designed to be incorporated in a system including other equipment, the emergency stop must be installed based on the technical specifications of the system, bearing in mind that it may be necessary to let cooling water circulate for a few seconds before disconnecting the power. The emergency function is the installer's responsibility.

***5.5*** Protection category. The "Violino" laser sources have a minimum protection classification of IP54 while the Laser Power supply has a minimum protection category of IP33. To comply with the Machine Directive and Standard EN 60204, the installer is responsible for placing them in a container according to the protection category required for the final use.

## Guide to applying Laser radiation safety.

***6.1*** Information. As required by standard EN 60825-1-guide 1284G it is necessary to provide opportune information on eye and skin risks to individuals who may come into contact with Laser radiation.

***6.2*** Training. The operator and all individuals who are assigned to using the laser system must receive opportune instructions on safely starting and shutting off the system, by means of a Standard Operating Procedure (SOP) to be followed.

***6.3*** Confining radiation. As required by the Machine Directive, the Laser radiation must be completely confined within opportune guards.

***6.4*** Inspection windows Inspection windows must possess an opportune, clearly identifiable protection filter for Laser radiation. If equipped with the source, do not replace the filter with another non-original one.

***6.5*** Laser safety Technician. As indicated in guide 1284G of standard EN 60825-1 it is necessary to periodically check that the safety conditions for using a Laser source are maintained, that the Optical Risk Nominal Distance (ORND) is observed and that Goggles (IPD) are always available, and if required, that the are regularly used. Therefore a Laser safety Technician (LST) must be appointed.

***6.6*** Protection during maintenance. Since some safety measures are lacking during maintenance operations, it is necessary to establish a class IV Controlled Laser Area, with access only for professionally trained and authorized individuals, equipped with specific goggles.

## Conclusions:

Laservall S.p.A., as manufacturer of “Laser” laser sources, provides a laser device which is not intended for immediate use, but is to be connected, by others, to other devices which have the final aim of creating a laser processing system.
Laservall S.p.A., as manufacturer of a laser source, has built its equipment, considered as a complex component, in compliance with current Directives and in keeping with industry regulations. .

The system Manufacturer must ensure the safety of the laser processing Machine according to other Directives (for example Machine Directive) including, as required by the Directive, the analysis of risks, implementation of safety measures, certifications and testing of safety measures and the production of adequate information for safe use of the machine

Laservall S.p.A. is available for providing the machine Manufacturer with all the information in its possession to help the Manufacturer comply with the Directives.

# Troubleshooting

**N.B.:**
The following chapter is aimed at non-expert users. Its purpose is to provide an initial attempt in the event of a fault and diagnosis of the type of fault. For this reason the pages are divided onto various levels, the first level is for the operator, the second for a maintenance technician and the third is only for professionally trained personnel authorized by Laservall.

**WARNING:**
The procedures which require removal of the panels must only be effected by professionally trained personnel who has been informed of the electrical and laser radiation risks!

**WARNING:**
All procedures which require access to laser radiation and/or a hazard involving the electricity must only be effected in the presence of professionally trained personnel!

**WARNING:**
During all troubleshooting operation make sure that the laser beam is aimed at a safe position, on an absorber or Power Meter!

**WARNING:**
Laservall S.p.A. shall not be held liable for any damage or injury arising from a failure to follow the procedures indicated in this chapter.

**WARNING:**
Laservall S.p.A. shall not be held liable for any injury or damage caused by work done by untrained and unauthorized personnel, and/or for modifications made to the original equipment and/or replacement of defective components with non-original components.

## Start-up problems

**Chart (A1.1): THE LASER DOES NOT GO ON**

**The Display is off, the LED status light is off, the fans do not operate**

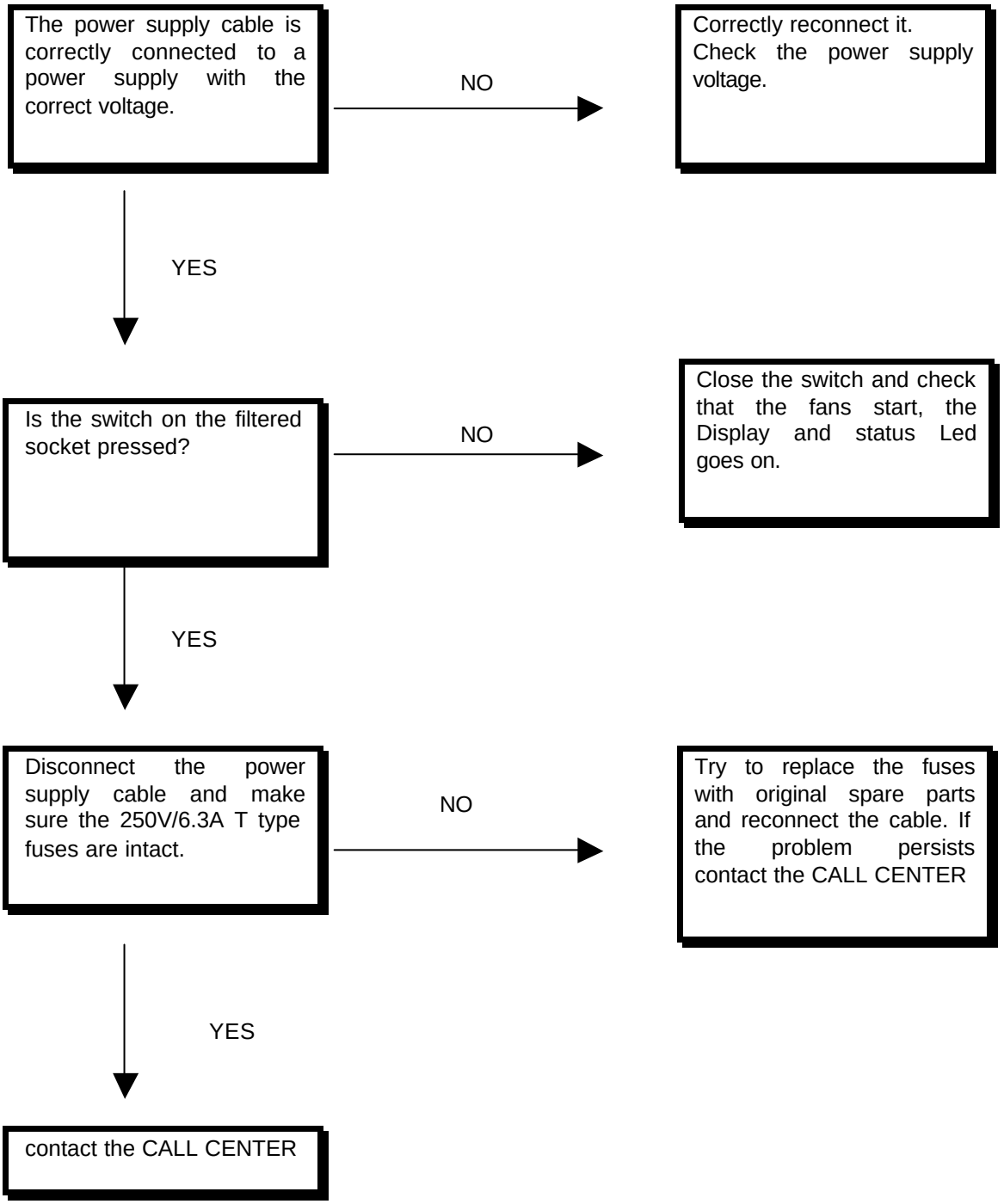


**Chart (A2.1): THE LASER DOES NOT START**

**"INTERLOCK ON" appears on the display, the status LED is off**

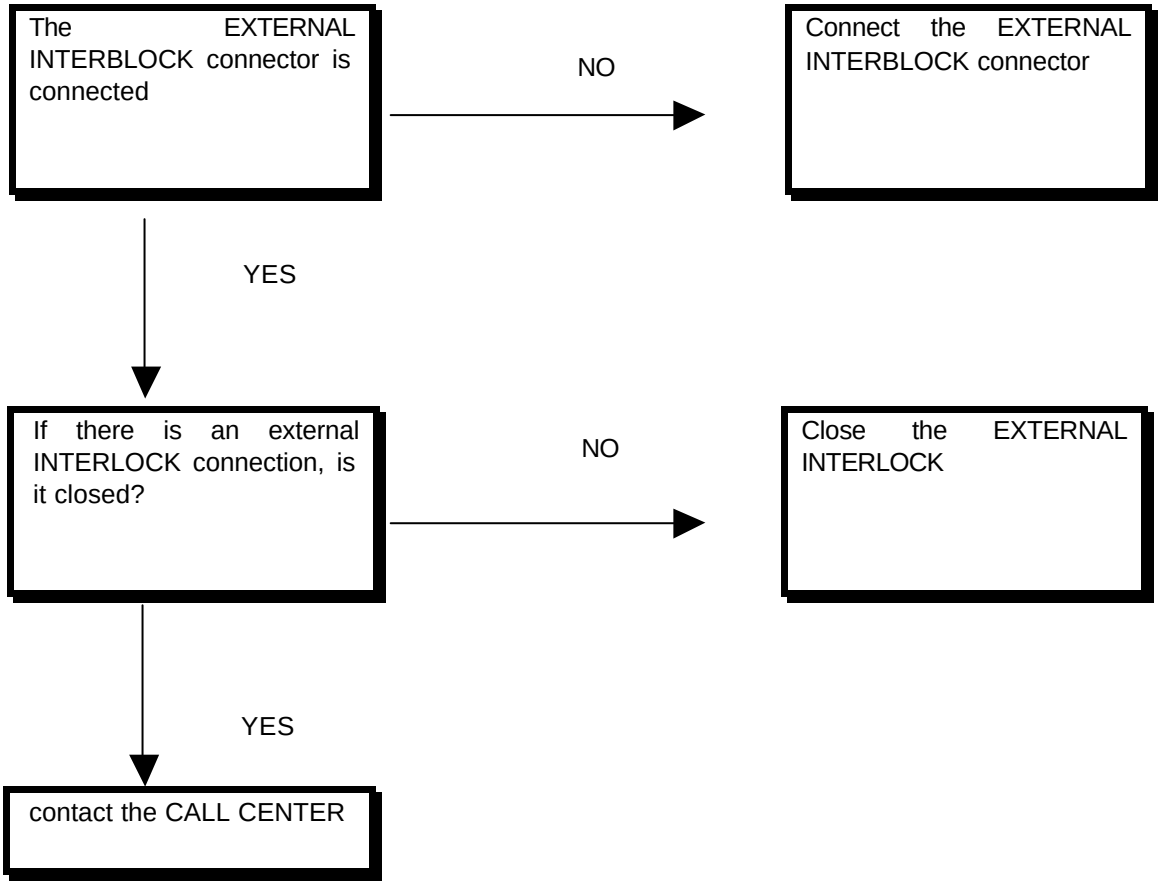


**Chart (A3.1): THE LASER DOES NOT START**

**("EMERGENCY ON" appears on the display, the status LED is off)**

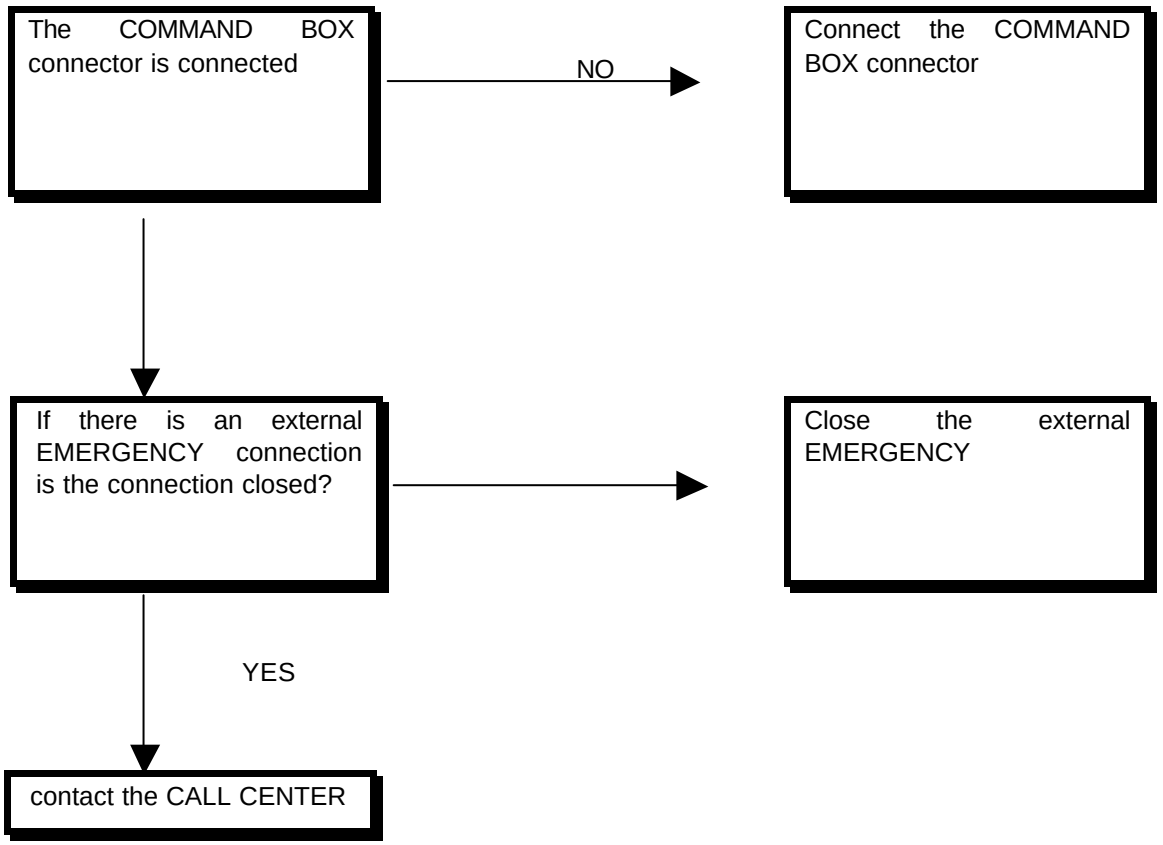


**Chart (A4.1): THE LASER DOES NOT START**

**"KEY NOT OK" appears on the display, the status LED is off**

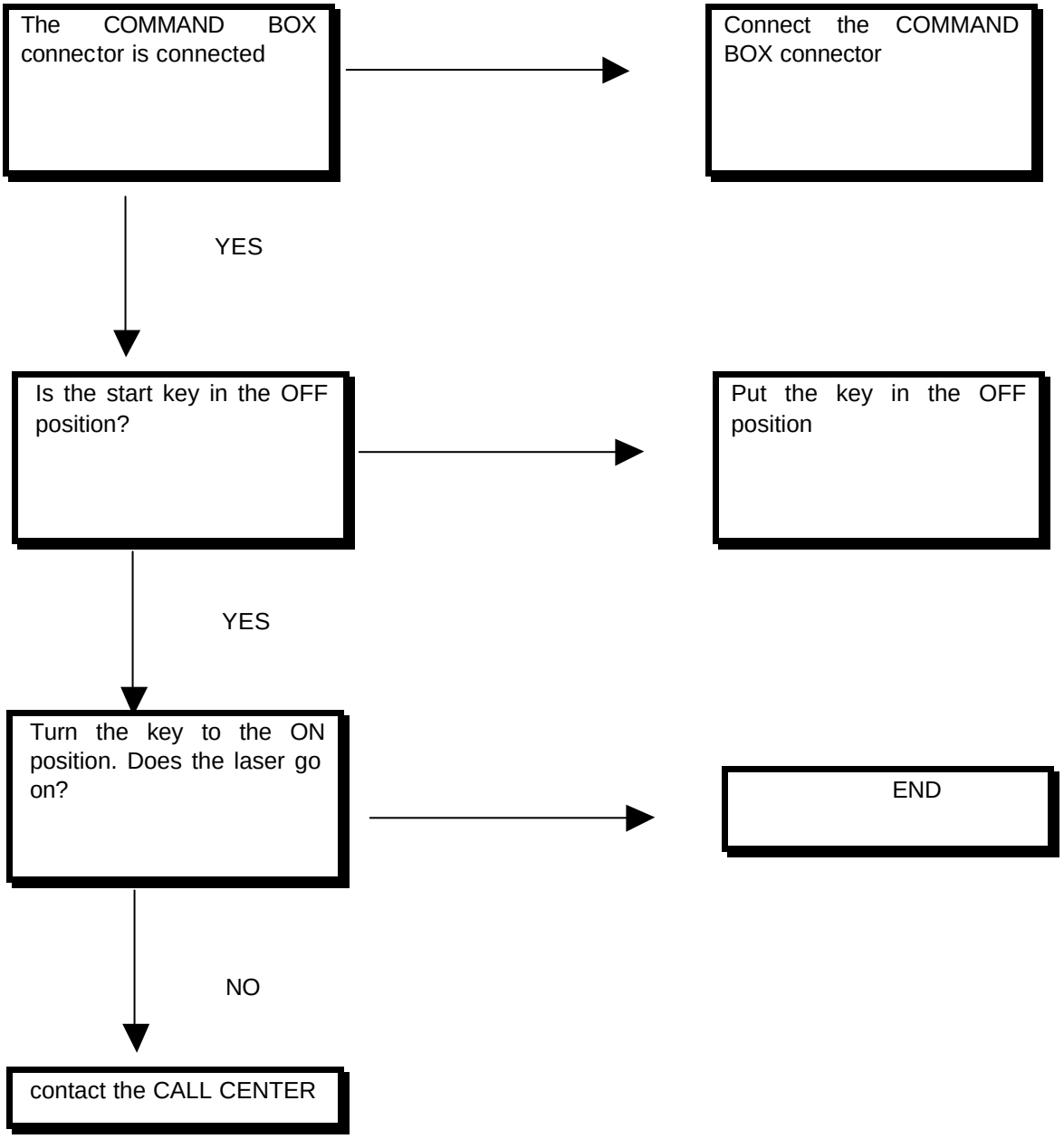


**Chart (A5.1): THE LASER DOES NOT ENABLE**

**“ENABLE NOT OK” appears on the display, the status LED is off**

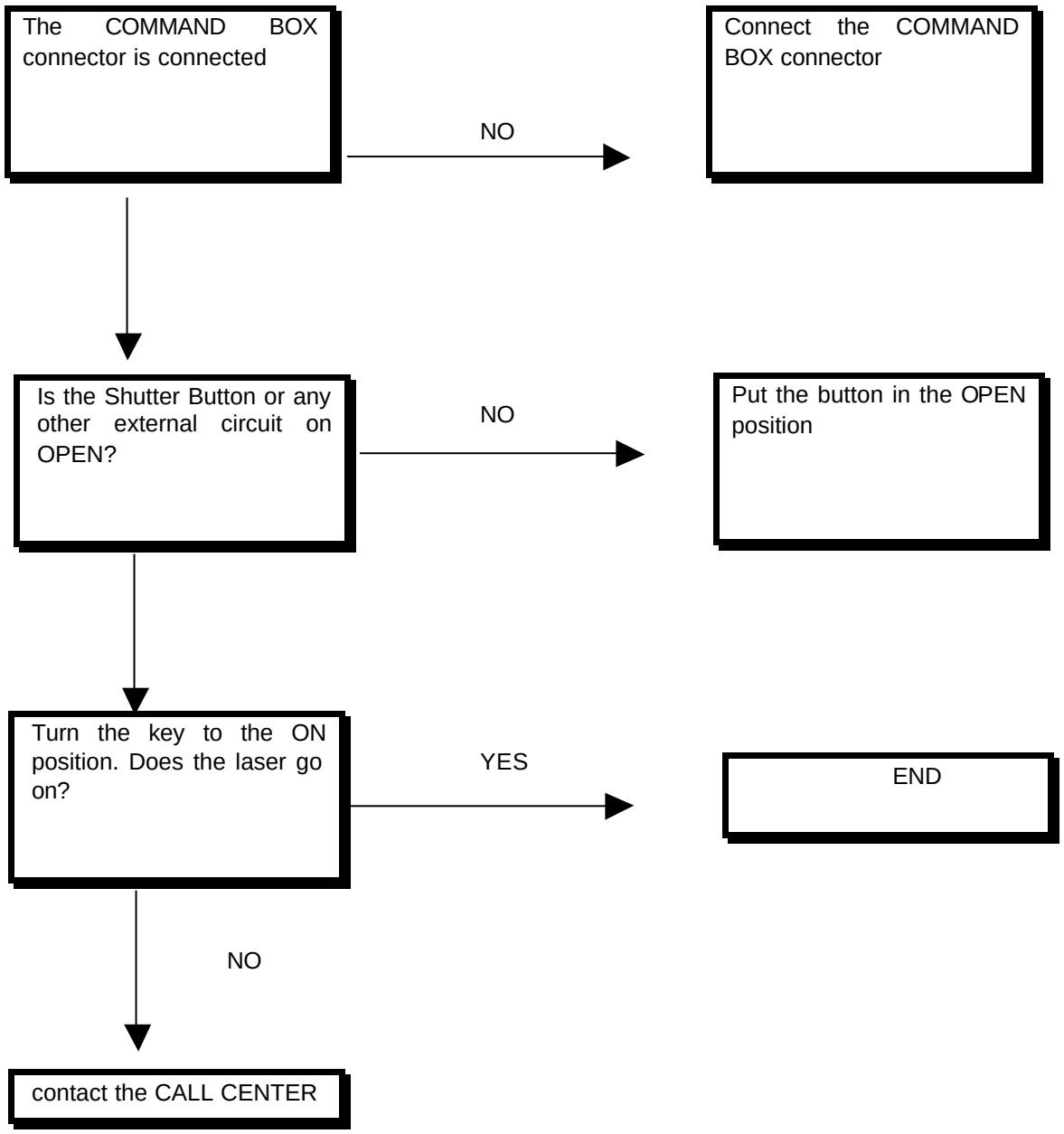
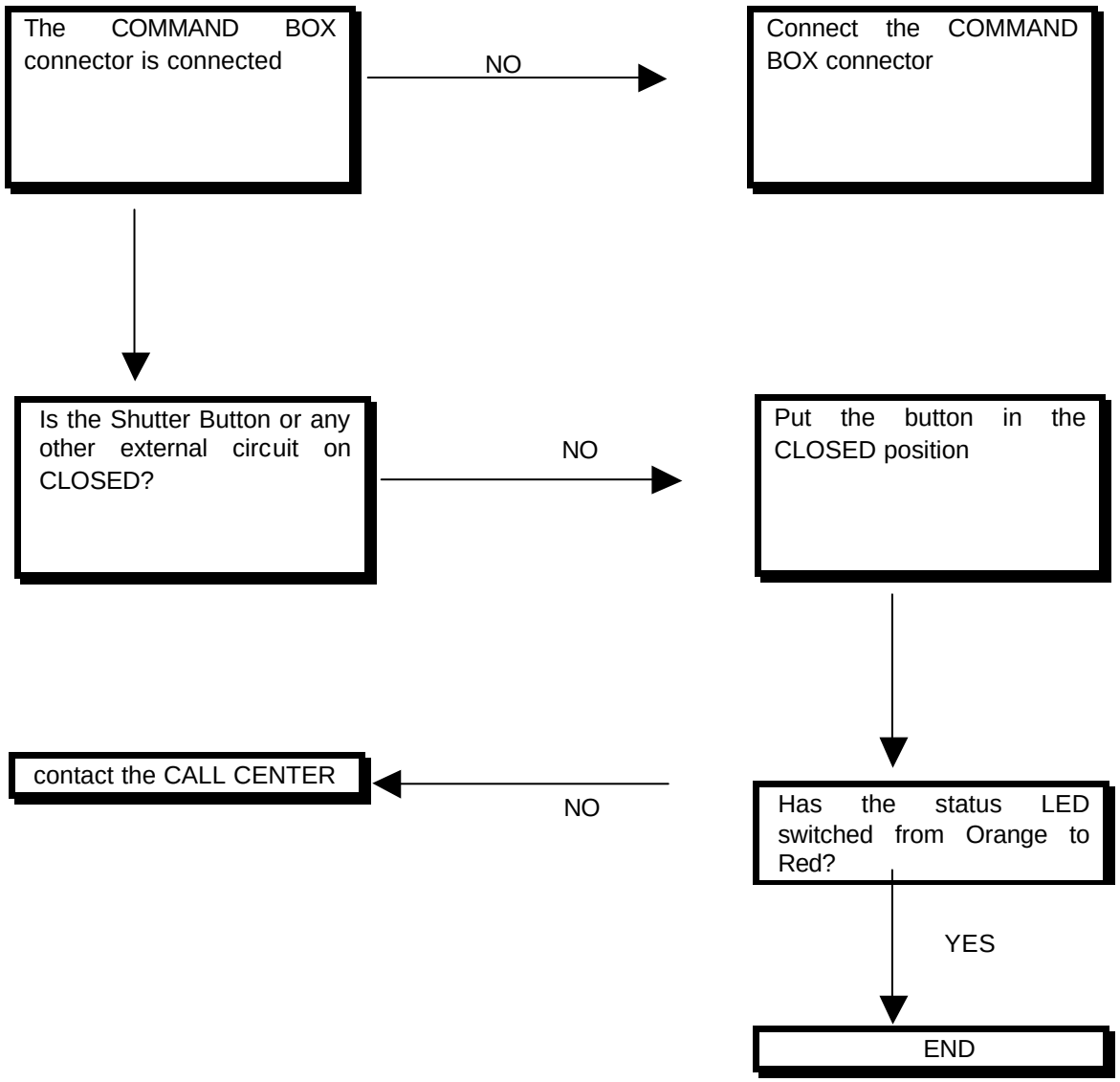


**Chart (A6.1):THE LASER IS READY BUT DOES NOT EMIT**

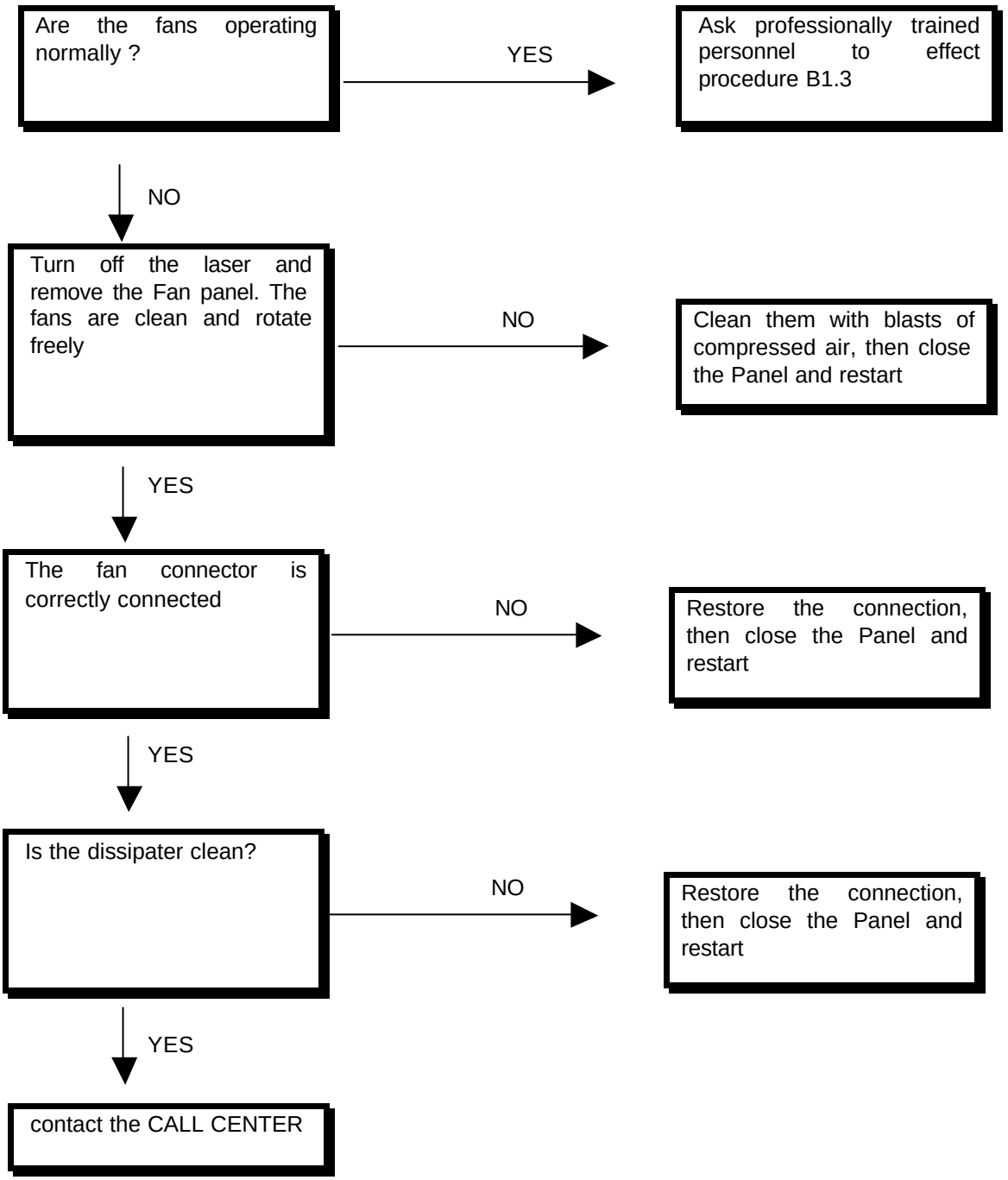
**“READY” appears on the display, the status LED remains orange**



## Overheating problems

**Chart (B1.1): THE LASER STOPS IN ALARM**

**"TEMPERATURE FAULT" appears on the display, the status LED is green**



## Chart (B1.2): THE LASER STOPS IN ALARM

**“TEMPERATURE FAULT” appears on the display, the status LED is green**

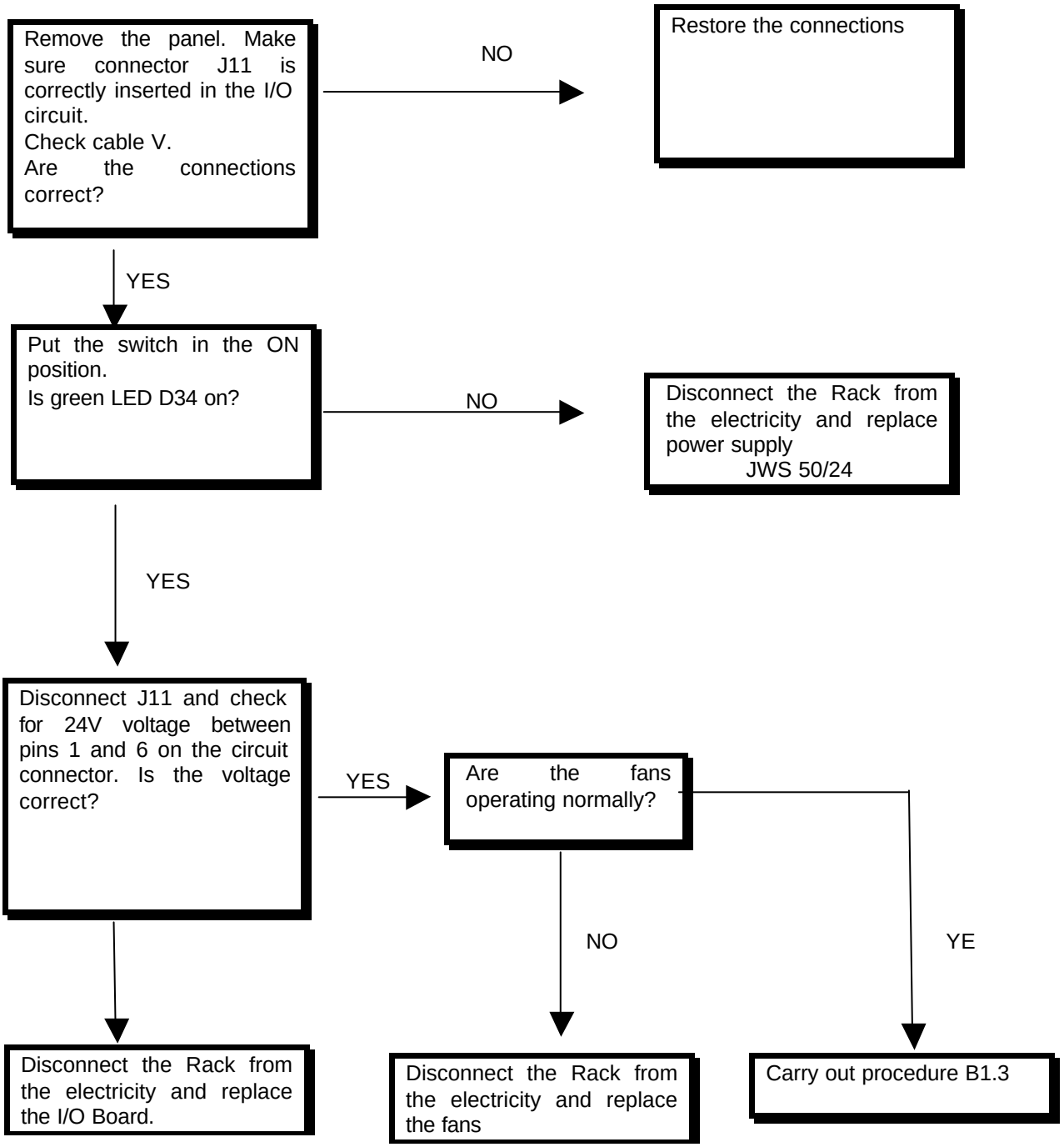
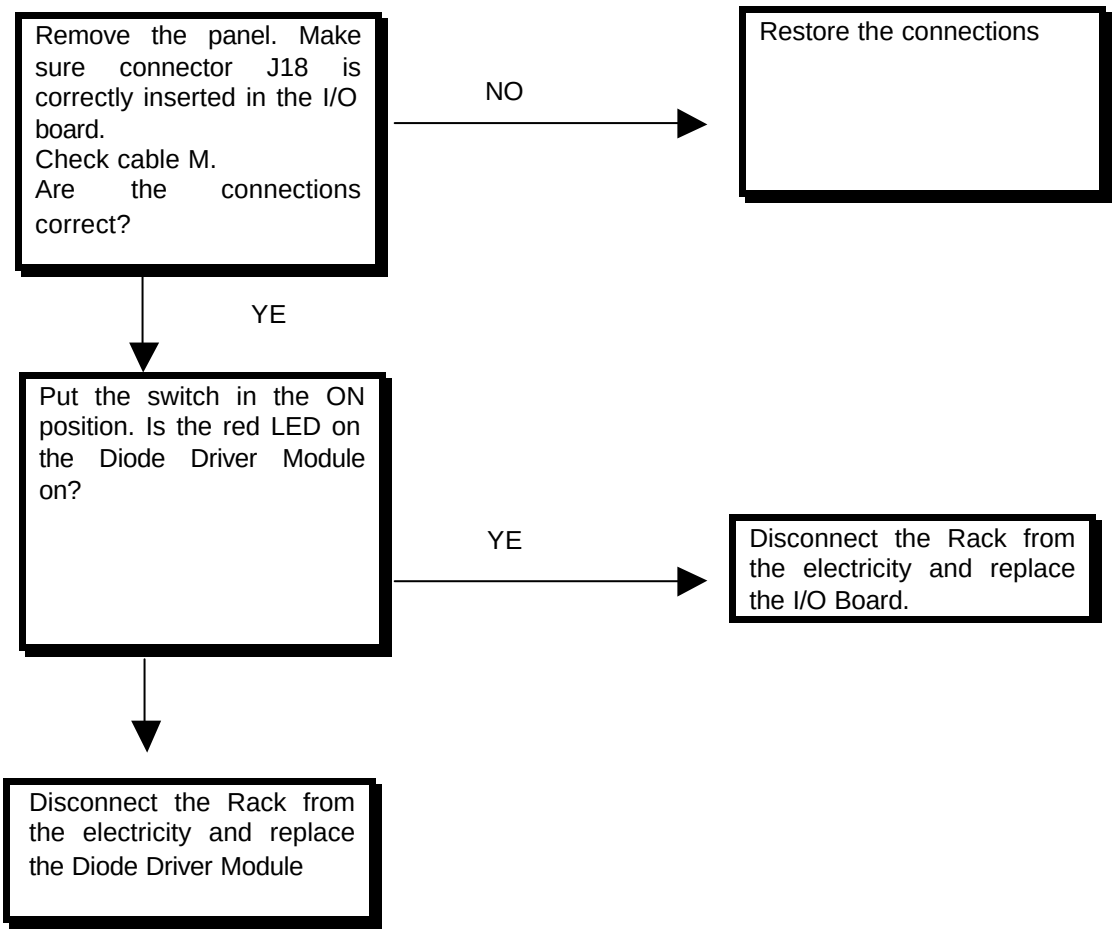


**Chart (B1.3): THE LASER STOPS IN ALARM**

**"TEMPERATURE FAULT" appears on the display, the status LED is green**



## Chart (B1.2): THE LASER STOPS IN ALARM

**“TEMPERATURE FAULT” appears on the display, the status LED is green**

**WARNING:**
Dangerous voltage!

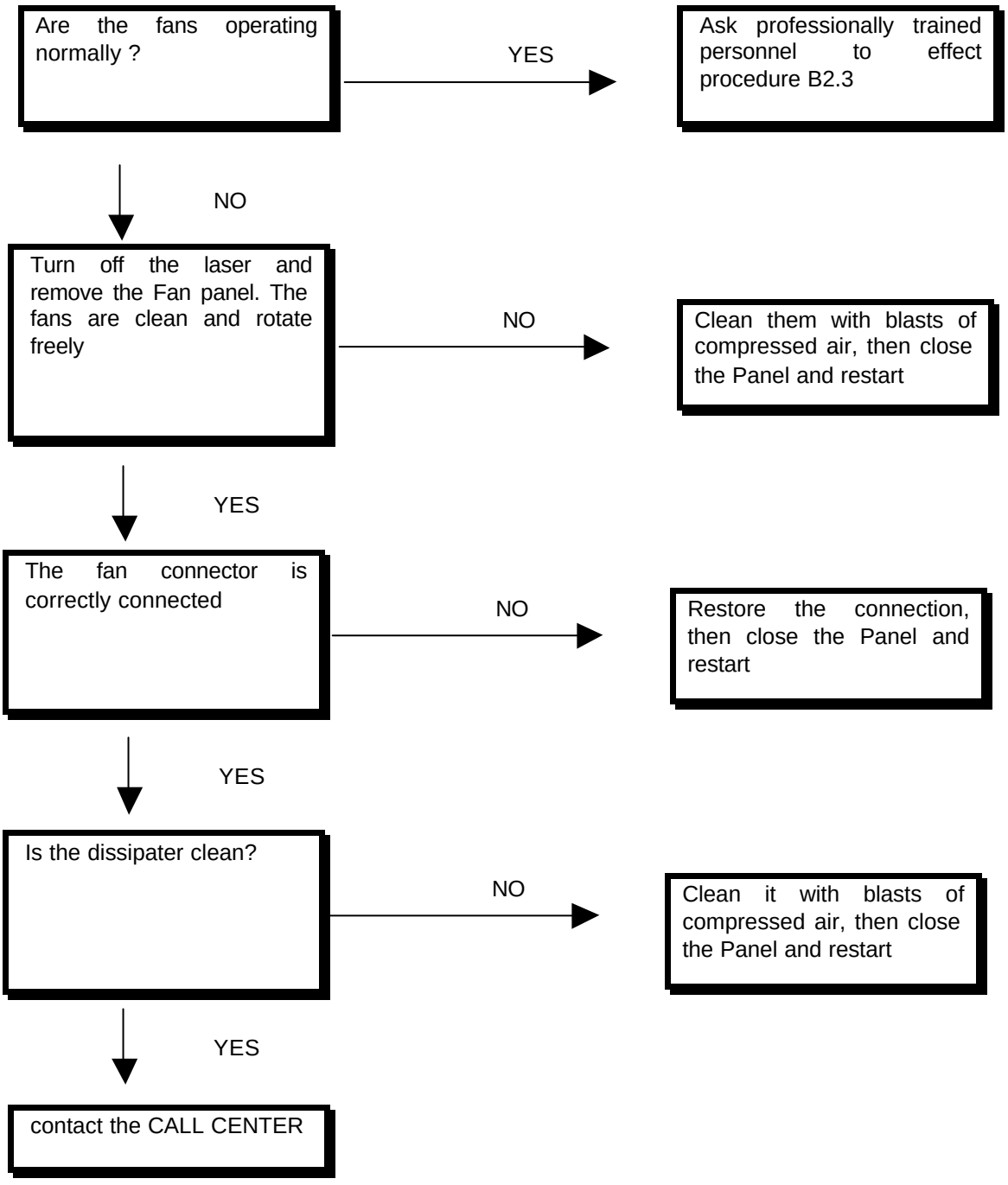
This procedure requires removal of the Rack panel and must only be effected by professionally trained personnel!

The fault may be connected to overheating of the dissipater of the Diode Driver Module due to poor cooling of the dissipater. This may be caused by a decrease in air flow due to blockage of the fans or a dirty dissipater. Another possible cause may be related to a connection fault between the fan power supply connector on the I/O board and the fans.
The fault may also be in the I/O board.

| | |
|---|---|
| The procedure involves making sure that the fans are not blocked and can turn normally. | **With the switch in the off position so that the fans do not start unexpectedly, make sure that nothing is blocking their rotation. Clean the air passage and dissipater.** |
| If the fans are not blocked and turn freely, make sure they are correctly connected to the I/O board on **J11** | **Remove the panel and check connector J11 and wire V powering the fans** |
| If the fans are correctly connected make sure that they are correctly supplied with **24Vd.c.** voltage. | **The presence of electricity can be monitored when green LED D34 goes on. Its value can be measured between pins 1 (gnd) and 6 (+24V) on connector J11.** |
| If the voltage is not correct the problem may be related to the I/O board or the auxiliary **24V** power supply.<br>If the voltage is correct and the fans do not turn the problem involves the fans and they must be replaced. | **Contact the CALL-CENTER to replace the power supply. Disconnect the Rack from the electricity and replace power supply JWS50/24.**<br>**Contact the CALL-CENTER to replace the fans. Disconnect the Rack from the electricity and replace the fans.** |
| The alarm may also be due to a missing connection between the I/O board and the Diode Driver Module or poor operation of the module. | **Check the connection of connector J18 and cable M.**<br>**Make sure that the red LED on the Diode Driver Module circuit is on.**<br>**If the LED is off, disconnect the Rack from the electricity and contact the CALL-CENTER to replace the Module.** |

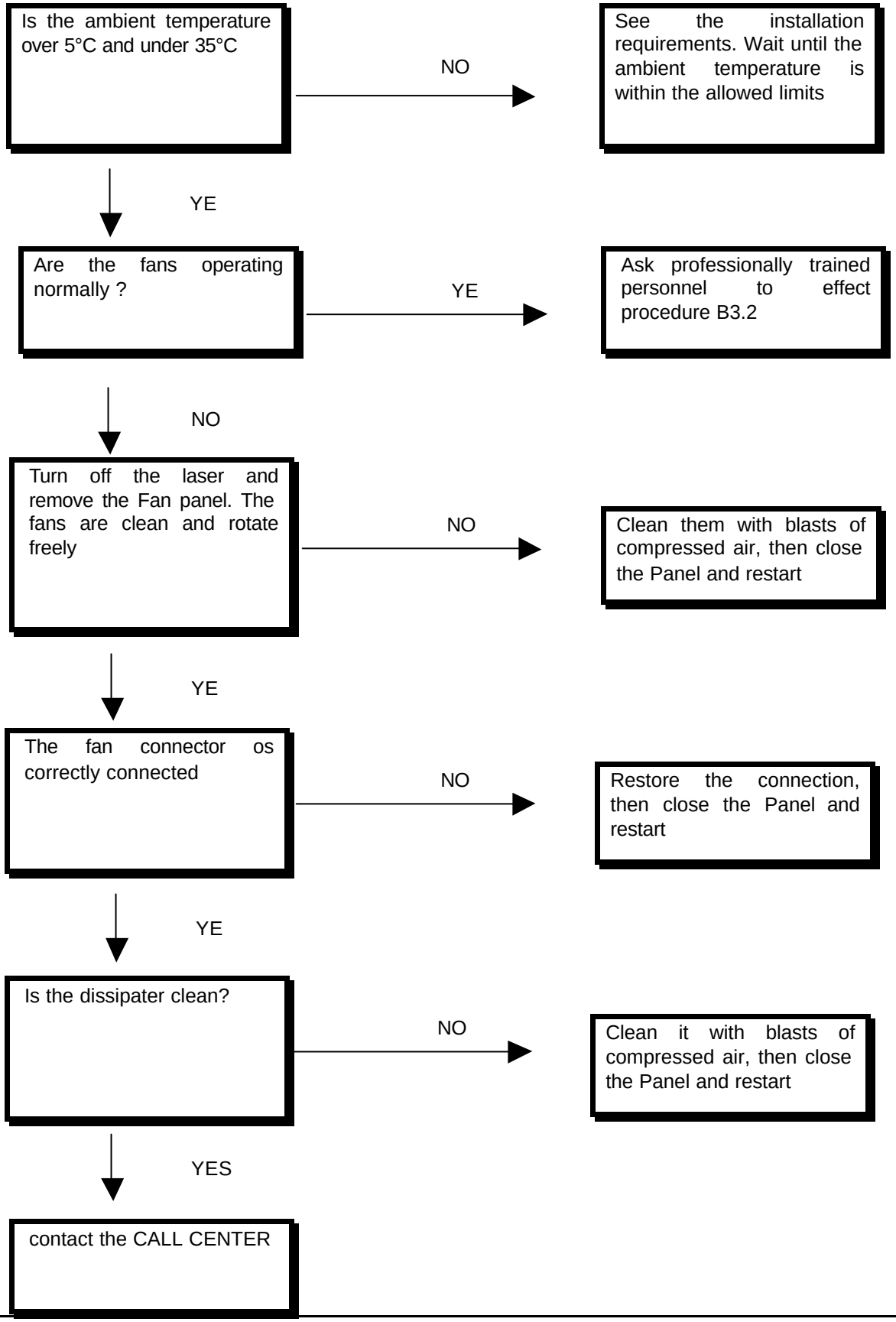
**Chart (B1.2): THE LASER STOPS IN ALARM**

**"TEMP MASTER(SLAVE) H" appears on the display, the status LED is green**



## Chart (B3.1): THE LASER STOPS IN ALARM

**"TEMP MASTER(SLAVE) FAULT" appears on the display, the status LED is green**



## Problems with the diode current driver

**Chart (C1.1): THE LASER DOES NOT START**

**"JWS FAULT" appears on the display, the status LED is off**

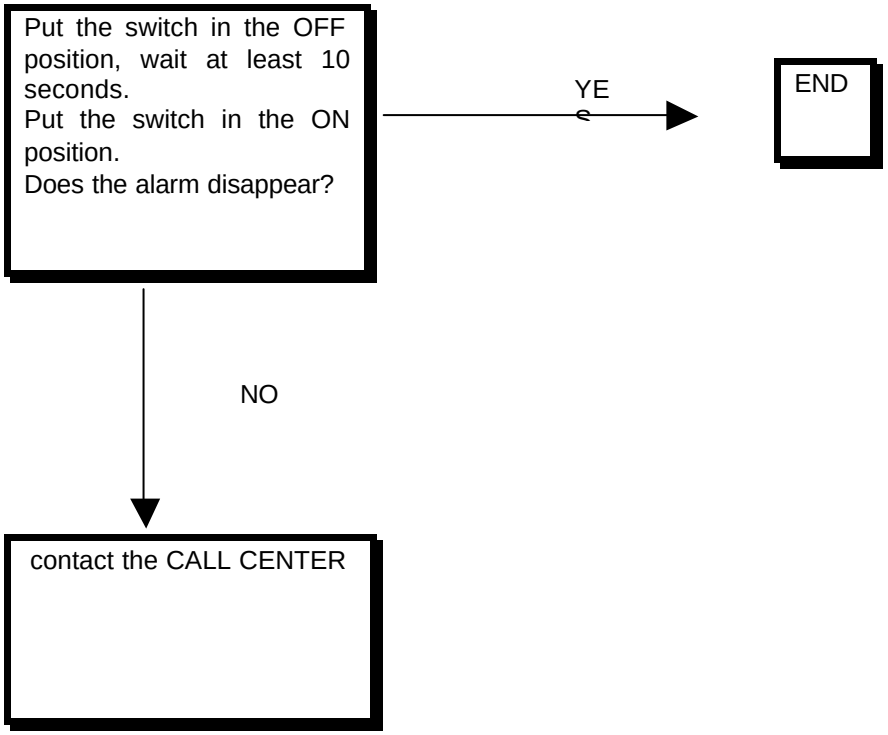
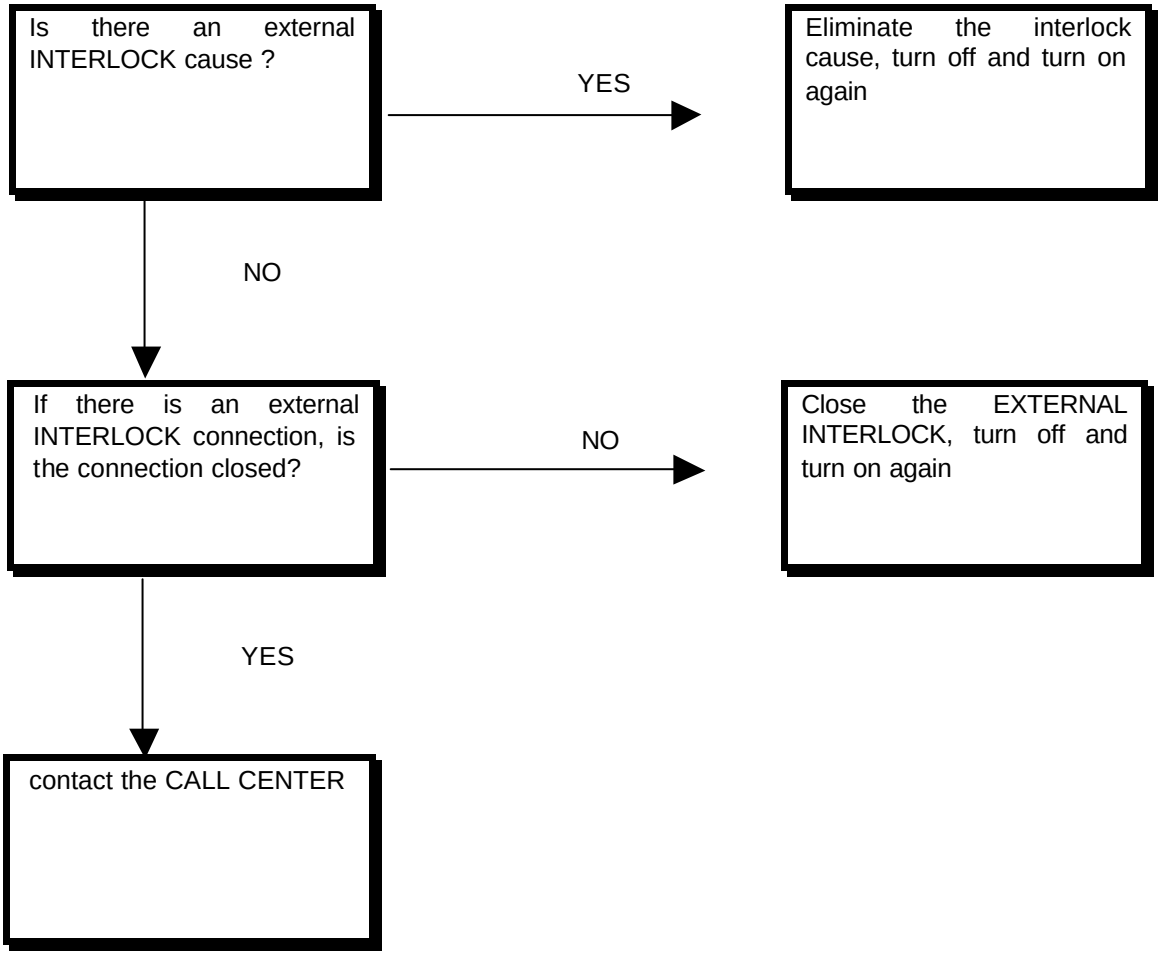


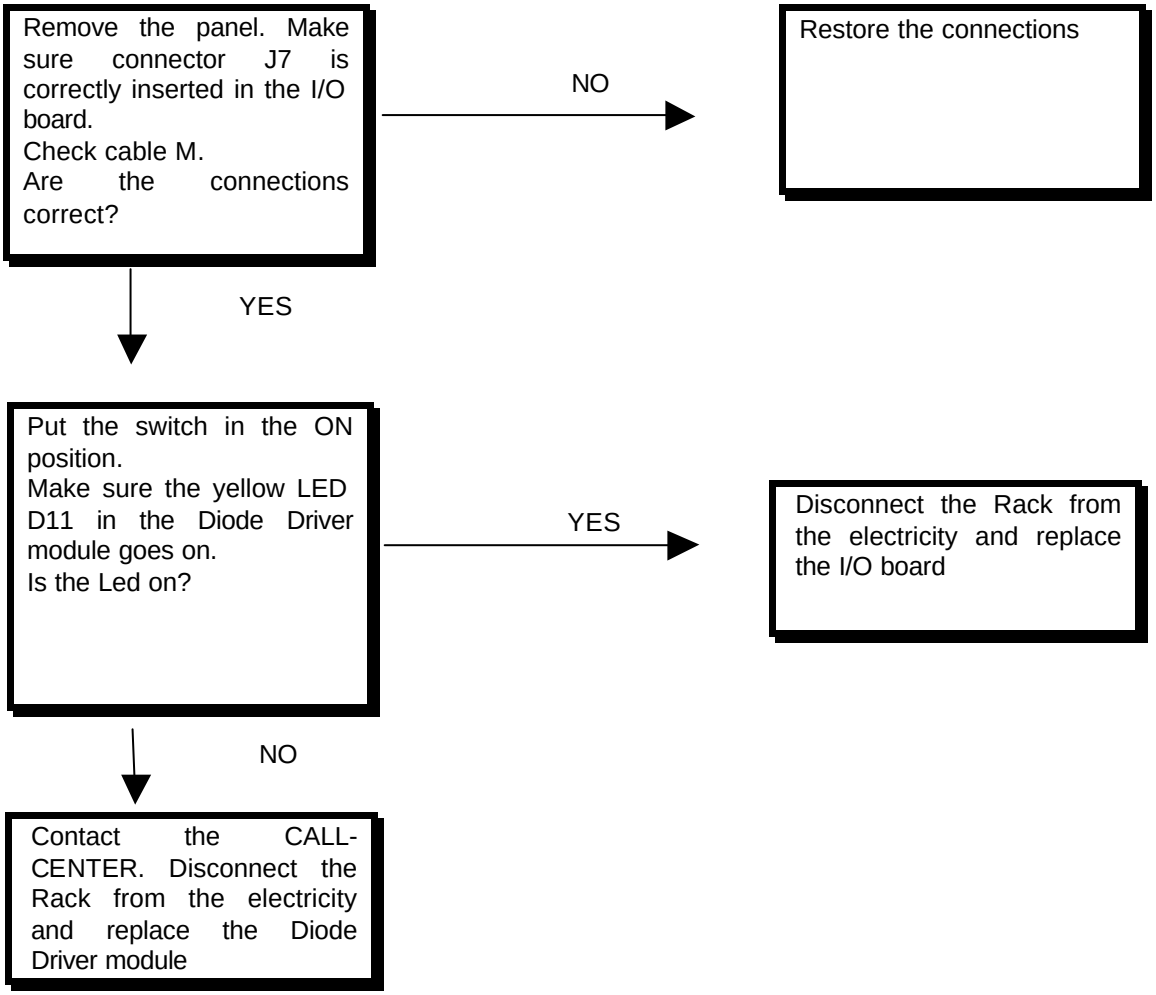
**Chart (C2.1): THE LASER DOES NOT ENABLE**

**“POWER FAULT” appears on the display, the status LED is ON AND GREEN**



## Chart (C2.1): THE LASER DOES NOT ENABLE

**“POWER FAULT” appears on the display, the status LED is ON AND GREEN**



## Chart (C2.1): THE LASER DOES NOT ENABLE

**“POWER FAULT” appears on the display, the status LED is ON AND GREEN**

**WARNING:**
Dangerous voltage!

This procedure requires removal of the Rack panel and must only be effected by professionally trained personnel!

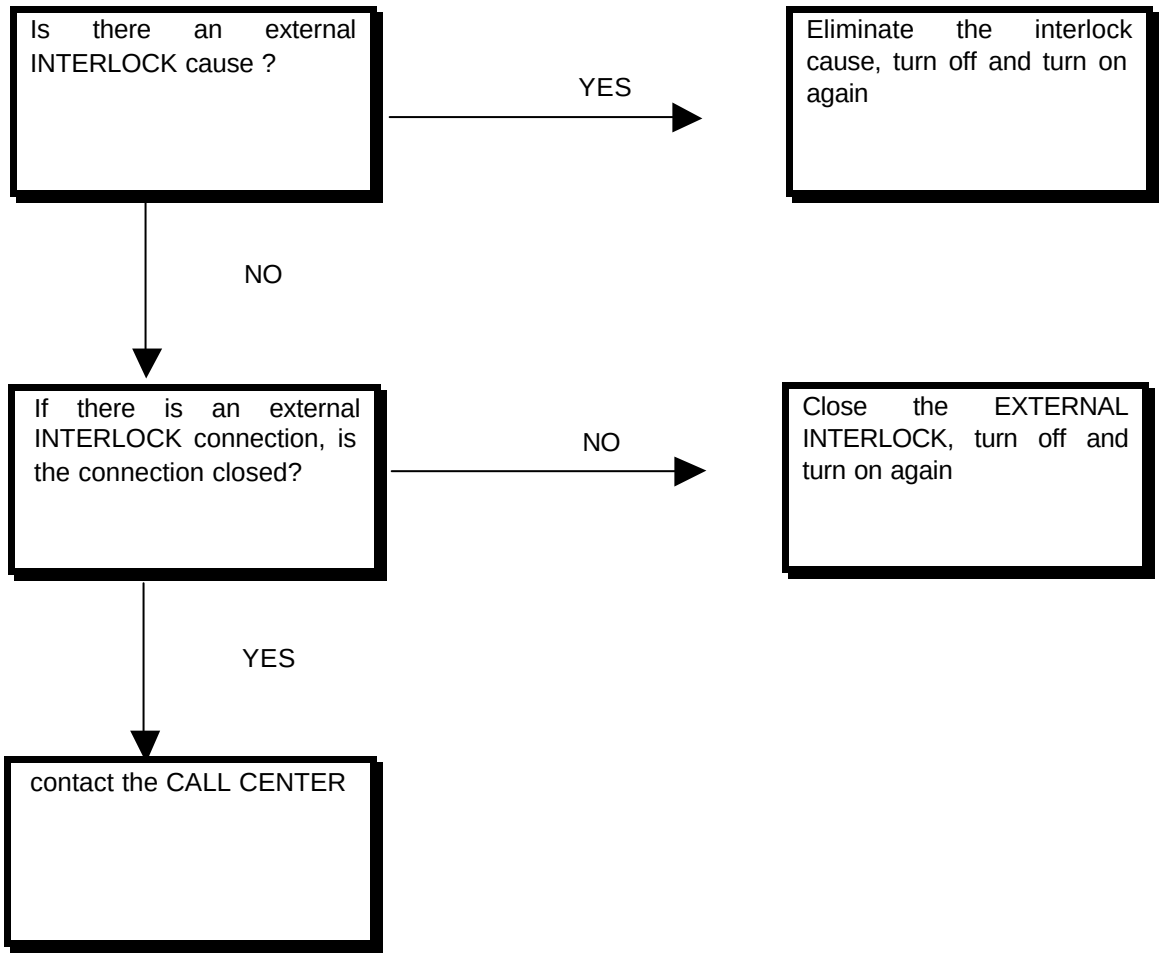
The fault may be due to a poor connection or insertion of connector J18 in the I/O board. If the fault does not involve connections, a POWER MONITOR signal may have been generated by the Diode Driver. It is also possible that the Diode Driver module is faulty.

| | |
|---|---|
| The procedure involves an initial visual inspection of the connections between the Diode Driver module and the I/O board, the and the connection via cable **M** and connector **J18** | **In the event of a connection defect, restore the correct wiring and notify the CALL-CENTER of the fault.** |
| Then power up the Rack and check the status of yellow Led **D11** on the Diode Driver | **When it is turned on make sure the yellow led on the Diode Driver Module goes on and remains on** |
| If the yellow Led is on it means that the Module has not detected any cause for an alarm and the fault is in the **I/O** board | **If the POWER MON signal is present, the fault is in the I/O board which must be replaced** |
| If the yellow Led is off it means that the Module has detected a cause for an alarm and the fault is in the Diode Driver circuit | **Contact the CALL-CENTER to replace the Diode Driver module. Disconnect the Rack from the electricity and replace the module.** |

**WARNING:**
Close the RACK after working!

**Chart (C3.1): THE LASER DOES NOT ENABLE**

**"I MAX FAULT" appears on the display, the status LED is ON AND GREEN**



## Lens problems

**Chart (D1.1): NO AIMING LASER**

**“READY” appears on the display, the status LED is ON AND ORANGE**

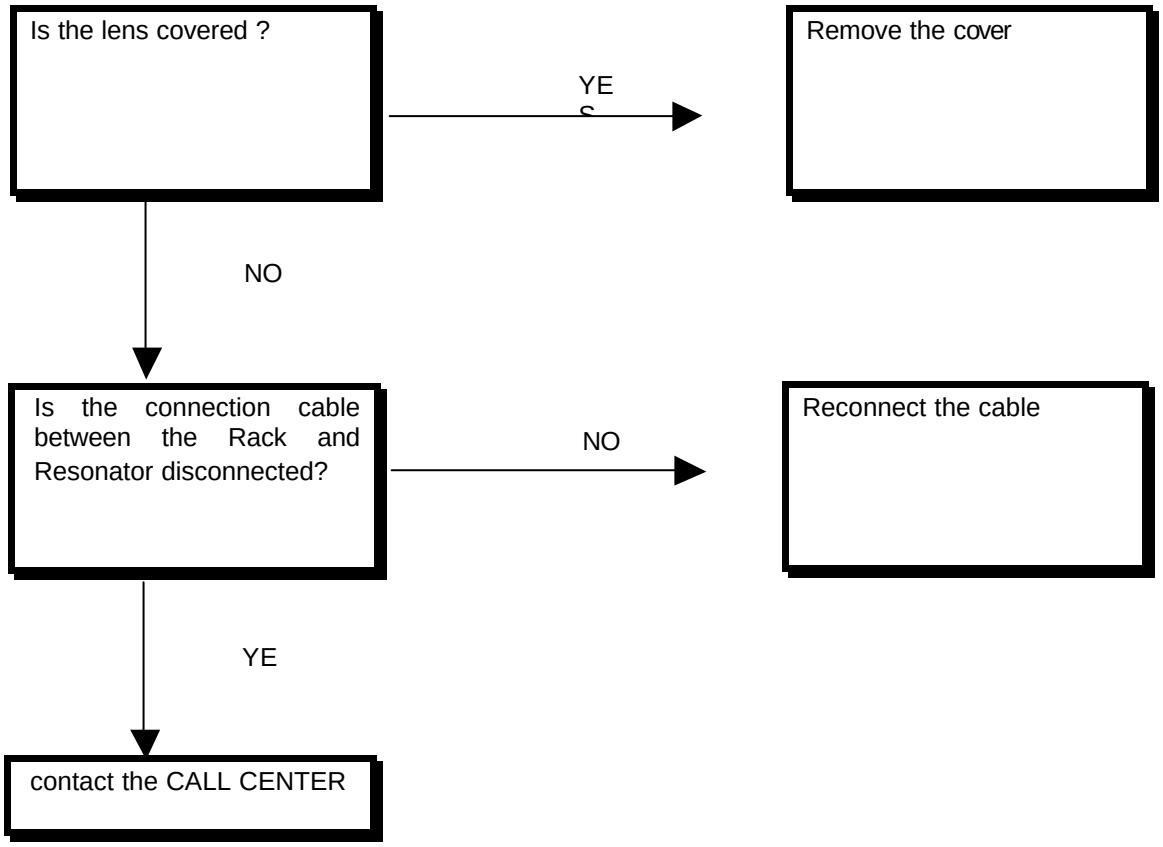


**Chart (D2.1): THE LASER IS READY BUT THERE IS NO EMISSION**

**"ENABLE" appears on the display, the status LED is red**

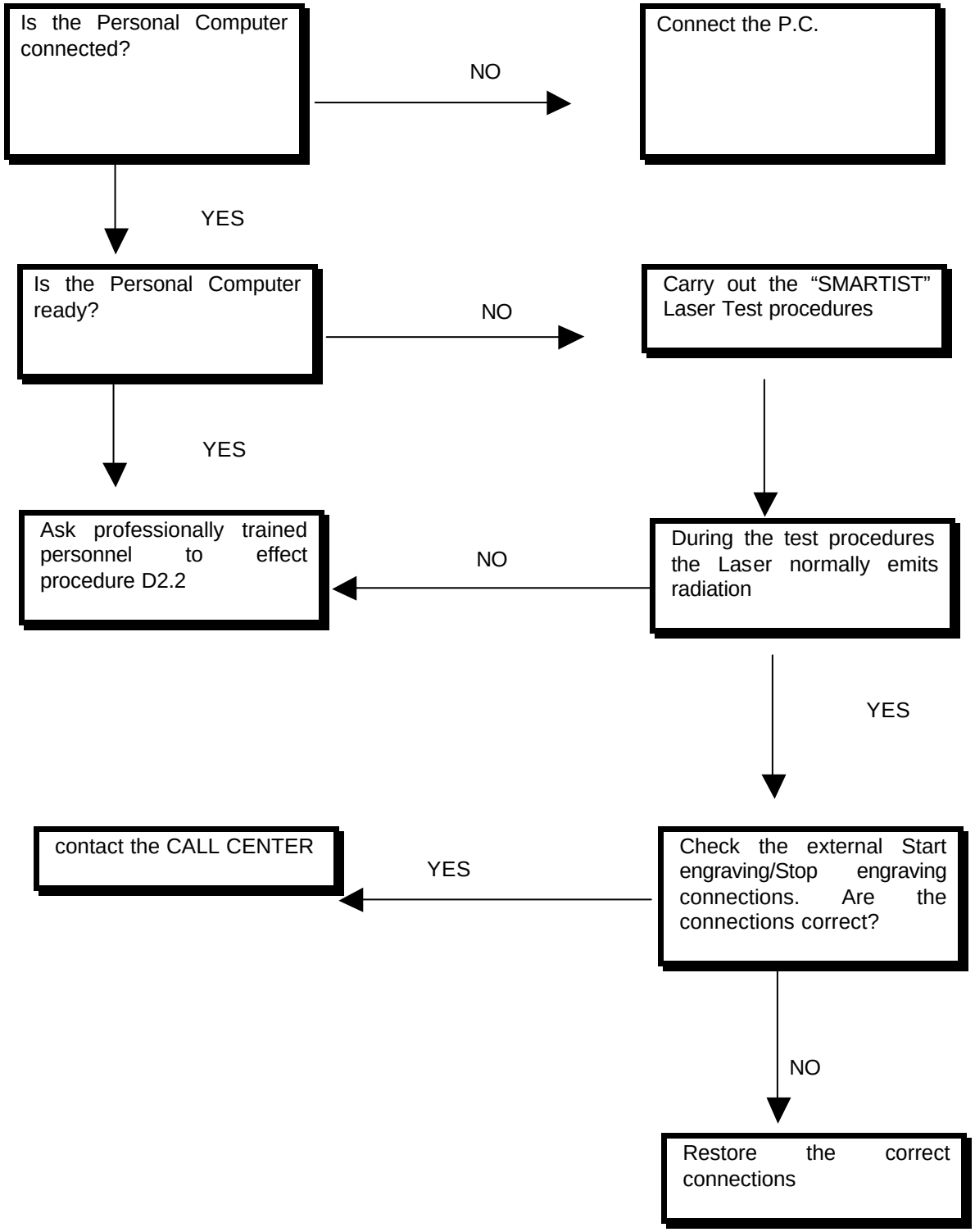


**Chart (D3.1): LASER POWER IS NOT UNIFORM**

**"ENABLE" appears on the display, the status LED is red**

Remove the lens, radio frequency cable and Scanner Head power supply cable.
Put a Power Meter for 50W / I.R Lasers under the Head.
All uninvolved individuals must be beyond the optical risk distance and wear appropriate goggles for 1064 nm laser radiation

**WARNING OPTICAL HAZARD!**

**WARNING DANGEROUS LASER RADIATION!**

Start the Laser and program an engraving with a long duration at minimum speed and maximum power. Measure the optical power and compare it with the c.w. provided by the CALL-CENTER and shown on the Laser acceptance test sheet.
Is the value correct (within 10%)?

YES

contact the CALL CENTER

Interrupt emission and stop the laser. Reconnect the radio frequency cable and disconnect the optical fiber from the resonator side. Put the Power Meter in front of the Optical Fiber opening. Restart engraving. Measure the optical power and compare it with the Fiber output value provided by the CALL-CENTER and shown on the Laser acceptance test sheet.
Is the value correct (within 10%)?

YES

Contact the CALL-CENTER to replace the Resonator

NO

Contact the CALL-CENTER to replace the coupler or the O.F.

## Chart (D3.1): LASER POWER IS NOT UNIFORM

**“ENABLE” appears on the display, the status LED is red**

**WARNING:**
Hazardous laser radiation!

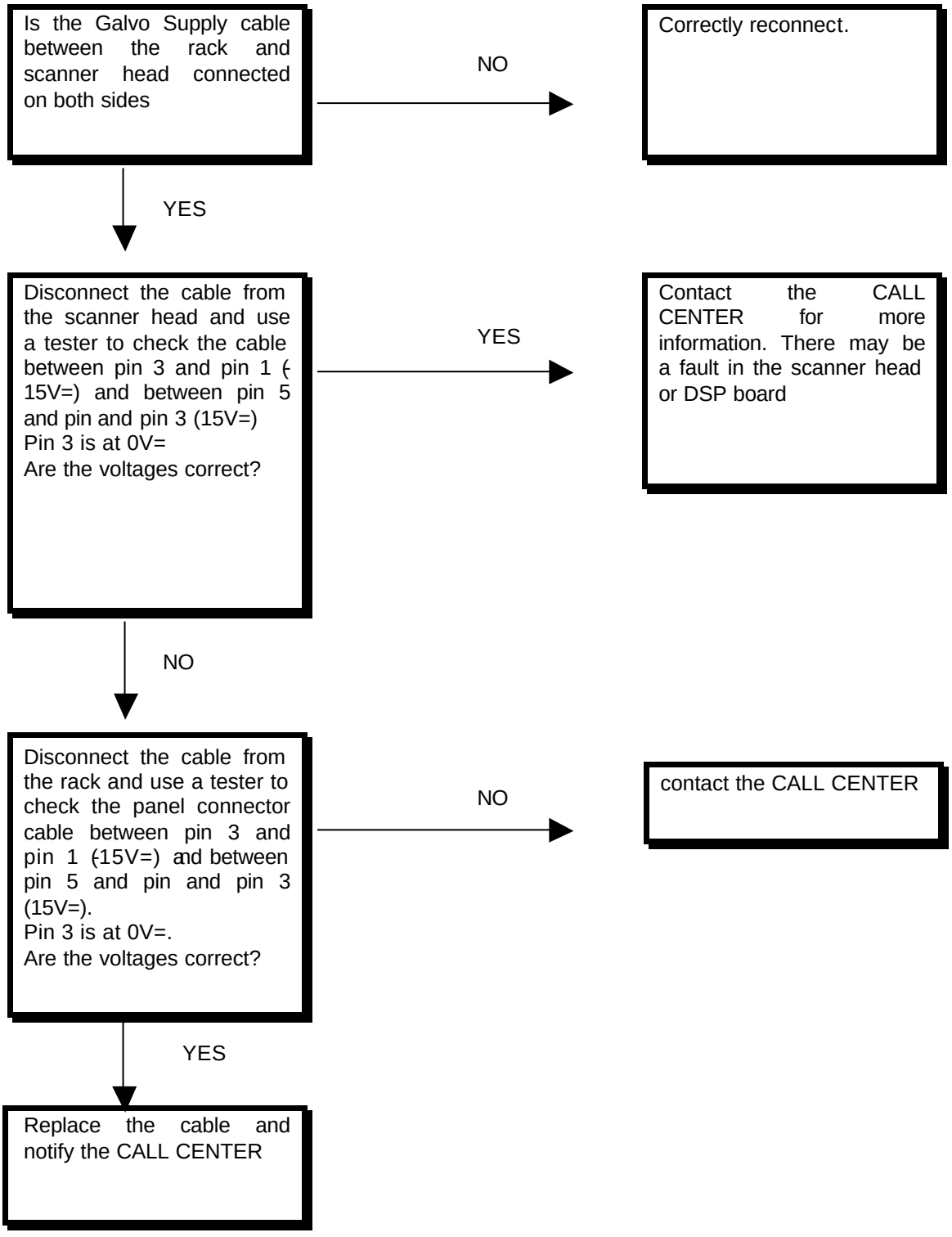
This procedure requires removal of the Laser guards and must be carried out only by professionally trained personnel equipped with appropriate goggles for the specific wave length!

The most frequent causes for this type of fault are due to a fault in the Optical Fiber connecting the couple in the Rack of the coupler itself. Another possible cause is a fault in the acoustic-optical in the Resonator or its operation via the radio frequency Driver and the connection cable.

| | |
|---|---|
| The procedure involves measuring the laser radiation coming from the laser aperture after the scanner head and comparing it with the value detected in the factory and shown on the acceptance test sheet. | **Remove the lens and place a Power Meter for infrared laser radiation with 1064nm wavelength and 50W max. power under the scanner head (not more than 10-15 cm away).** |
| Disconnect the radio frequency cable to turn off the acoustic-optic contained in the resonator. Start the laser programming a long engraving with 100% power parameters to measure the continual laser power value coming from the Resonator. | **Measure the optical power value and compare it with the original value in c.w. shown on the specific laser acceptance test sheet. Make sure the value is within the 10% tolerance range compared to the value indicated in the acceptance test sheet. If it differs by more than 10% the fault may be due to a defect in the radiation transmission system Optical Fiber. In this case carry out procedure D3.4.** |
| If the power value is within the tolerance, interrupt the engraving and reconnect the radio frequency cable to restore the power to the acoustic-optic contained in the Resonator. Restart engraving setting the frequency at 20000Hz. Remeasure the modulated optical power coming from the Resonator. | **Measure the optical power value and compare it with the original value at 20000Hz shown on the specific laser acceptance test sheet. Make sure the value is within the 10% tolerance range compared to the value indicated in the acceptance test sheet. If it differs by more than 10% the fault may be due to a defect in the acoustic-optic drive.** |
| If the value is not within the tolerance, interrupt the engraving, turn off the laser and check the radio frequency cable; replace it if it is defective. | **Visually inspect the radio frequency cable, make sure it is not crushed or peeling, measure its continuity with a Tester (Ohm x 1). Make sure it has not shorted.** |
| If the radio frequency cable is intact, the fault may be in the radio frequency driver in the Rack. | **Contact the CALL-CENTER to replace the radio frequency driver.** |

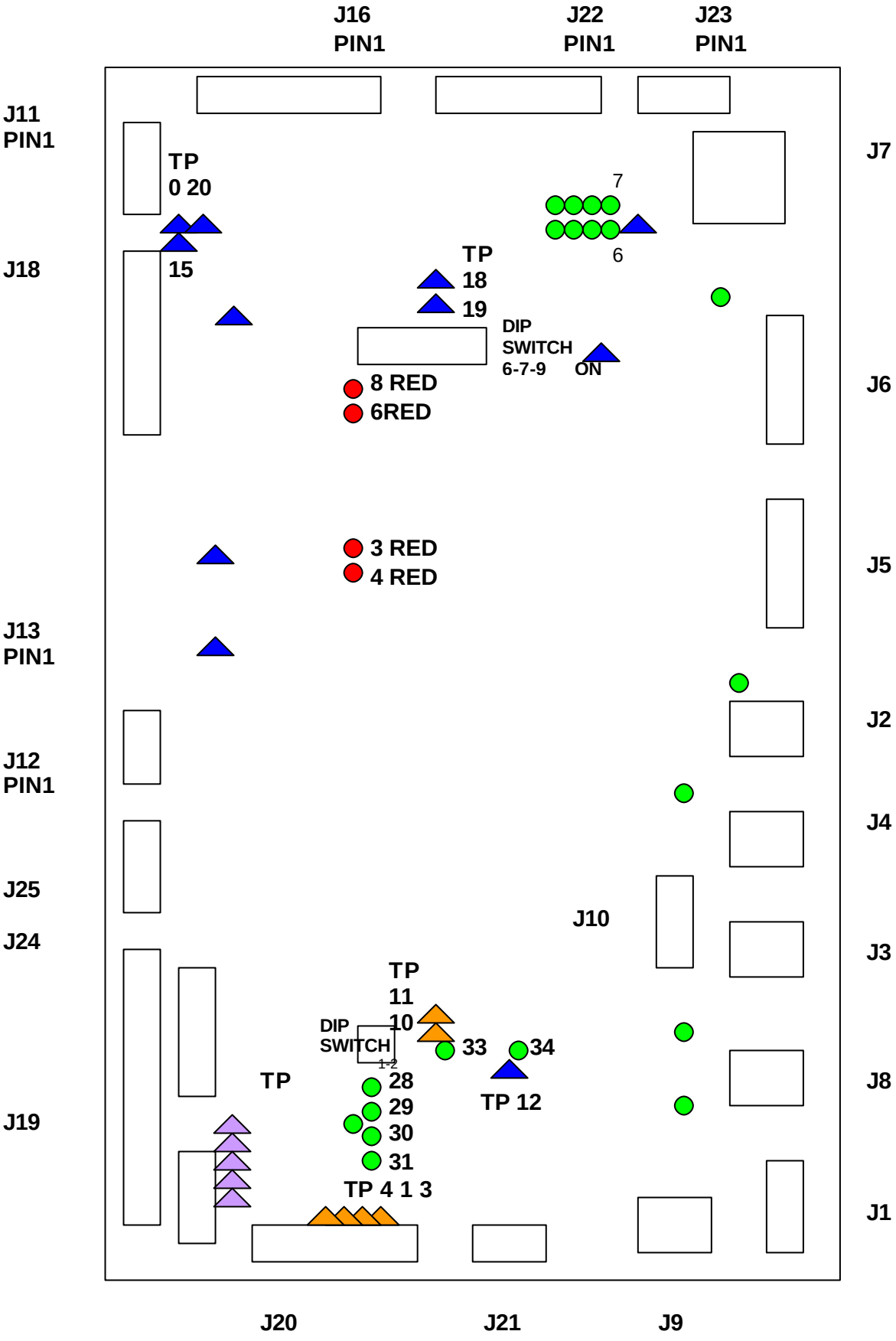
## Chart (D4.1):THE SCANNER HEAD DOES NOT MOVE THE MIRRORS

**READY appears on the Display, the status LED is orange, the red pointer does not move when a laser test is performed**




**WARNING:**
Dangerous voltage!

**I/O Board**


J16
PIN1
J22
PIN1
J23
PIN1
J11
PIN1
J7
TP
0 20
7
6
J18
15
TP
18
19
DIP
SWITCH
6-7-9
ON
8 RED
6RED
J6
3 RED
4 RED
J5
J13
PIN1
J2
J12
PIN1
J4
J25
J10
J24
J3
TP
11
10
DIP
SWITCH
1-2
33
34
TP
28
29
30
31
TP 12
J8
J19
TP 4 1 3
J1
J20
J21
J9

**I/0 Board LED description**

| | |
|---|---|
| D0 | ENABLE JWS 300/5 |
| D1 | DISABLE SIGNAL IN |
| D2 | POWER ON |
| D3 | ENABLE CURRENT DRIVER |
| D4 | NOT READY |
| D5 | ENABLE AIMING BEAM |
| D6 | ENABLE GREEN LED |
| D7 | ENABLE RED LED |
| D3 RED | LOW TEMPERATURE MASTER |
| D4 RED | HIGH TEMPERATURE MASTER |
| D8 RED | LOW TEMPERATURE SLAVE |
| D9 RED | HIGH TEMPERATURE SLAVE |
| D28 | INTERLOCK INPUT |
| D29 | EMERGENCY INPUT |
| D30 | ENABLE INPUT |
| D31 | KEY INPUT |
| D32 | 12 VOLT FROM PC |
| D33 | 12 VOLT INTERNAL |
| D34 | 24 VOLT |
| D35 | PLUS 15 VOLT SCANNING HEAD |
| D36 | MINUS 15 VOLT SCANNING HEAD |
| D37 | 24 VOLT PELTIER MASTER |
| D38 | 24 VOLT PELTIER SLAVE |
| D39 | 15 VOLT RF DRIVER |

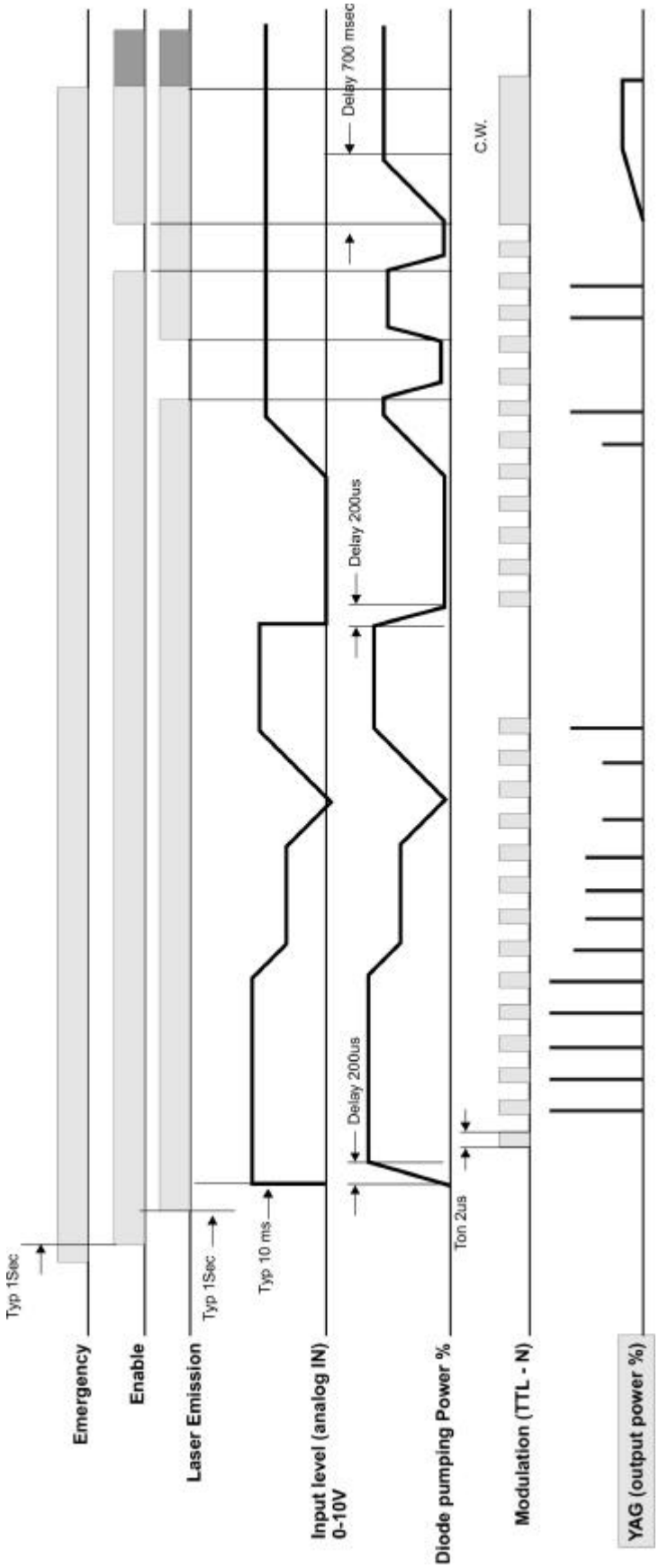
**I/O Board Test Point description**

| | | | |
|---|---|---|---|
| TP0 | CURRENT MONITOR | 0.1 V/A | REF TP 12 |
| TP1 | EXTERNAL INTERLOCK | 0 / 12 VOLT | REF TP 10 |
| TP2 | EMERGENCY | 0 / 12 VOLT | REF TP 10 |
| TP3 | ENABLE | 0 / 12 VOLT | REF TP 10 |
| TP4 | KEY | 0 / 12 VOLT | REF TP 10 |
| TP5 | LEVEL IN | 0 / 12 VOLT | REF TP 8 |
| TP6 | MODULATION IN | TTL | REF TP 8 |
| TP7 | EMISSION IN | TTL | REF TP 8 |
| TP8 | REFERENCE FOR PC | | |
| TP9 | 12 VOLT FROM PC | 12 VOLT | REF TP 8 |
| TP10 | REFERENCE FOR INTERNAL OUTPUT | | |
| TP11 | 12 VOLT INTERNAL OUTPUT | 12 VOLT | REF TP 10 |
| TP12 | GND | | |
| TP13 | TEMPERATURE MASTER | 0 / 10 V | REF TP 12 |
| TP14 | TEMPERATURE SLAVE | 0 / 10 V | REF TP 12 |
| TP15 | ENABLE CURRENT DRIVER | TTL | REF TP 12 |
| TP16 | ENABLE JWS | TTL | REF TP 12 |
| TP17 | DISABLE SIGNAL IN | 0 / 12 V | REF TP 12 |
| TP18 | MODULATION OUT TO DRIVER RF | TTL | REF TP 12 |
| TP19 | EMISSION OUT TO DRIVER CURRENT | TTL | REF TP 12 |
| TP20 | LEVEL OUT TO DRIVER CURRENT | 0 / 10 V | REF TP 12 |
| TP21 | OUT PIC ENABLE | TTL | REF TP 12 |

## Rack Alarms

| | |
|---|---|
| EMERGENCY ON | PIN 1-2 COMMAND BOX OPEN CONTACT |
| WAIT KEY | START STANDBY (PULSE ON PIN 4-12 OF COMMAND BOX) |
| INTERLOCK ON | PIN 1-2 OPEN ON EXTERNAL INTERLOCK |
| ENABLE | LASER READY FOR LASER EMISSION |
| TEMP MASTER L | MASTER DIODE TEMPERATURE UNDER 5°C |
| TEMP SLAVE L | SLAVE DIODE TEMPERATURE UNDER 5°C |
| JWS FAULT | ERROR ON CURRENT DRIVER POWER SUPPLY |
| I MAX FAULT | CURRENT DRIVER ALARM (TURN OFF THE LASER AND RESTART TO RESET) |
| POWER FAULT | CURRENT DRIVER ALARM (TURN OFF THE LASER AND RESTART TO RESET) |
| FINAL FAULT | CURRENT DRIVER ALARM (TURN OFF THE LASER AND RESTART TO RESET) |
| TEMP M FAULT | MASTER DIODE TEMPERATURE UNDER 5°C OR OVER 50°C |
| TEMP S FAULT | SLAVE DIODE TEMPERATURE UNDER 5°C OR OVER 50°C |
| TEMP MASTER H | MASTER DIODE TEMPERATURE OVER 35°C |
| TEMP SLAVE H | SLAVE DIODE TEMPERATURE OVER 35°C |
| READY | LASER STAND-BY FOR SHUTTER ON |
| ENABLE NOT OK | CLOSED CONTACT ON COMMAND BOX PIN 7-8 DURING START-UP PROCEDURE |
| KEY NOT OK | CLOSED CONTACT ON COMMAND BOX PIN 4-12 DURING START-UP PROCEDURE |

## Laser timing diagram



**WARNING:**
Procedures which require opening of the panels must only be effected by personnel which is trained and informed of the electrical and laser radiation risks.
If in doubt contact the manufacturer of the source and system!

**WARNING:**
All the procedures which require access to laser radiation and/or an electricity related hazard must only be effected in the presence of trained personnel.
If in doubt contact the manufacturer of the source and system!

**WARNING:**
**Laservall S.p.A. shall not be held liable for any injury or damage caused by work done by untrained and unauthorized personnel, and/or for modifications made to the original equipment and/or replacement of defective components with non-original components.**
If in doubt contact the manufacturer of the source and system!

**N.B.:**
See the Trouble Shooting manual.
The manufacturer shall provide, based on request from the Call Center, the wiring diagrams, component lists, calibration instructions and other information to appropriately trained personnel for repairing faulty parts which the manufacturer considers repairable!