ROFIN SINAR LASER

## Operating Manual

# • ROFIN DC •

# Industrial $CO_2$ Slab Laser

## Features

- No gas flow / Radio frequency excited
- Extremely low gas consumption
- Integrated gas supply
- Excellent power stability
- Optimal mode structure
- Linear polarized beam angled at 45°
- Automatic power calibration
- Microprocessor-controlled
- Easy to operate

Laser Serial No.:

# Contents ROFIN DC 020:



00-05-25 122 -En

00-06-15 122 -En

## General / Manufacturer / Copyright:



This operating manual must be read, understood and its instructions observed by all personnel responsible for operating the laser. You are asked to note that ROFIN-SINAR can accept no responsibility for damage or malfunctions caused by failure to observe the instructions given in the operating manual.

**Keep this manual for future reference!**

This publication is copyright and all rights are reserved by ROFIN-SINAR. The operating manual is entrusted to the owner of the laser for his personal use only.
It contains technical instructions and drawings, no part of which may be reproduced, transmitted or used without permission for the purpose of entering into competition with the copyright owner, or passed to third parties.

**Note:**

The diagrams and information given in this operating manual are subject to such technical modifications as may be deemed necessary for the improvement of the laser.

Any inquiries regarding the contents of this operating manual or the laser itself should be directed to:

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D - 22113 Hamburg D - 22093 Hamburg
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Fax: 49 - (0) - 40 - 733 63 - 160 Internet: http://www.rofin.com

— ROFIN-SINAR, INC.
45701 Mast Street
Plymouth, MI 48170 USA

Tel.: (313) 455 - 5400
Fax: (313) 455 - 5587

— or your OEM supplier

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**How to use this operating manual:**

— Page numbering:

**1 – 3**
**1** = Section
**3** = Page within section

— Figure numbering:

**Fig. 4.3/2**
**Fig.** = Figure, illustration
**4.3** = Section number
**/2** = Figure number within section

**All sections of this operating manual which deal with safety are framed and printed in bold face.**
**The warning plate illustrated here to the right indicates that you should take extra care when working with or on the laser.**

## Safety instructions and precautions: 2.

**Important:**
**It is strongly recommended that any person who is to participate in the installation, operation or maintenance of the laser equipment shall read and fully understand the contents of this manual and particularly the safety sections 2 - 2.8.**
**Should there be any questions or doubt about the safety aspects of the equipment, please do not hesitate to contact any of the ROFIN-SINAR offices before proceeding.**

**The installation, operation, maintenance and repair of this laser must be performed only by ROFIN-SINAR service staff or specially trained personnel who have received instruction concerning the hazards involved in its operation. "Instruction" also means reading this manual, particularly sections 2 - 2.8.**

**All sections of this operating manual which deal with safety are framed and printed in bold face.**
**The warning plate illustrated here to the right indicates that you should take extra care when working with or on the laser.**

**For Europe:**
**In accordance to EN 60825 — Safety of Laser Products — the ROFIN DC 0XX $CO_2$ - slab - laser is registered as a Class 4 laser product.**

**For USA:**
**The manufacture and subsequent sale of laser equipment is under guidelines governed by the Center for Devices and Radiological Health (CDRH). In accordance to those guidelines, specifically subchapter J of the Radiation Standards, 21 CFR, the ROFIN DC 0XX $CO_2$ - slab - laser is registered as a Class 4 laser product.**

**The $CO_2$ - slab - laser has a typical continuous laser power output of up to 3500 watts at a wavelength of 10.6 µm. Additionally, the $CO_2$ - slab - laser can be pulsed at frequencies up to 5000 Hz with maximum peak powers approaching 5000 watts.**

**Use of the laser for its intended purpose:**
**The $CO_2$ - slab - laser is designed to be used for processing materials in an industrial environment. The laser is a source of radiation and as such forms part of a laser (processing) system. The intended purpose of the laser is therefore determined by the type of the laser system in which it is incorporated (e.g. cutting, welding, surface-working) as well as by the manufacturer´s instructions.**

**The use of the laser for applications other than the intended one constitutes misuse and the laser manufacturer carries no liability for any damage thereby caused. In this case the user carries the entire responsibility.**
**The laser manufacturer accepts no liability for damage caused by modifications made to the machine without permission of the manufacturer.**

**Do not use the laser beam to heat or do any work on foodstuffs. This can effect injuries and can produce poisonous (cancerous) substances, fumes or vapours.**
**Also work on organic material, for example plastics or wood may be dangerous. Before working on these materials with a laser beam, make sure you are familiar with the applicable safety precautions.**

**Attention:**
**If others as the intended operator´s controls are used or other than the intended operation routines are done, this may cause dangerous release of laser radiation (= laser beam)!**

**ROFIN-SINAR lasers are manufactured in accordance with the following safety regulations:**

- **21 CFR (Center for Devices and Radiological Health - CDRH), Class 4**
- **DIN EN 60204 (VDE 0113 / IEC 204)**
- **DIN EN 60825 (VDE 0837 / IEC 825)**
- **VDE 0100**
- **UVV VBG 93 (German Safety rules for accident prevention)**

**Training courses are offered by:**

- **ROFIN-SINAR (maintenance, application, operation of laser)**
- **OEM suppliers (operation of laser system)**
- **Technical supervisory organizations**

**Operation of the laser:**

- **Observe the national accident prevention regulations to prevent injuries by laser beam radiation.**
- **Installation, operation and maintenance on the laser is allowed for trained and authorized personnel only!**

**The potential hazards associated with laser of the Class 4 fall into this basic categories. They will be discussed in detail in the following sections:**

**2.1 Laser radiation hazards**

**2.2 Fire hazards**

**2.3 Hazardous fumes and vapors**

**2.4 Hazardous electrical voltage**

**2.5 Hazardous high voltage**

**2.6 Hazardous high frequency**

**2.7 Other hazards**

**2.8 Warning labels and rating plate**

**While safeguards have been incorporated in the design of the equipment to limit the dangers that these hazards pose, only the user can insure that safe operating conditions are met. Therefore, it is the responsibility of the user to be familiar with the areas of potential hazard and then to apply procedures to avoid the dangers posed by these hazards.**

**For further information over and above the contents of this section of the manual regarding laser safety, consult various user standards such as those published by the American National Standards Institute (ANSI), the Occupational Safety and Health Agency (OSHA), and the Laser Institute of America (LIA).**

**Warning:**
**Use of controls and adjustments or performance of procedures other than those specified herein may result in hazardous laser radiation exposure.**

**Administrative precautions:**

— **See that operators are given regular safety instruction (min. one time per year) and have read and understood this operator´s manual.**

— **Give a copy of this safety instructions and precautions to the operators.**

— **Observe the accident prevention regulations relating to your work.**

— **Affix warning plates and labels to laser equipment.**

— **Bar access to the laser to anybody not working with it.**

— **Designate the laser area adequately.**

— **Remember that combustible or easily inflammable gases, liquids or solids can ignite when irradiated.**
**Remove any such substances from the laser area. Materials such as metals and plastics can give off toxic decomposition products when processed. Find out what hazards are associated with the materials you are processing.**
**Professional organizations can provide the necessary information.**

— **Remove from the laser area any objects which might accidentally reflect laser radiation and injure you or somebody else.**

— **Check the safety of the laser system before starting any work. Especially shutter and laser beam guide and nozzle system.**

## Laser radiation hazards:

2.1

**A. Potential hazards:**

**This is a Class 4 $CO_2$ laser. The laser emits invisible radiation (wavelength: 10.6 µm)!**
**The laser radiation can severely damage your eyes. It can also cause severe skin burns.**
**Even diffuse reflected radiation can be dangerous. Remember that laser radiation may constitute a fire or explosion hazard.**
**The laser´s typical maximum output when operating in CW mode is given in the technical specifications and on the rating label.**
**In accordance with the safety regulations the laser must be operated with laser beam guides. If no laser beam guides are fitted, the laser beam emerges at the front end of the laser head.**

**The laser produces optical radiation (light) that is highly directional and is of a single wavelength (monochromatic).**
**The light from a laser differs from that of a conventional light source, whose energy is widely dispersed to provide general illumination of a sizeable area. The laser maintains nearly all of its energy in a narrow beam of light, even when it is projected over long distances. The small cross-section of the laser beam at any point over its travel can deliver a considerable amount of energy per unit area. The laser, therefore, is considered a device that produces light of a great intensity.**

**The primary laser beam ($CO_2$ radiation / 10.6 µm) produced by ROFIN-SINAR DC (diffusion cooled) lasers occurs at a wavelength which is in the infrared region of the light spectrum. Such optical radiation is not visible to the human eye; rather it is equated to heat energy, such as that which is emitted by the glowing embers of a fire.**

**As with any source of intense light or heat, there is the threat of damage to the eyes and severe burns of the skin from exposure to the direct path of the laser´s beam. Furthermore, since light reflects well off any shiny surface, it is possible that secondary reflections or scattered radiation can pose a safety threat.**

**Warning:**
**At all times during installation, operation, maintenance or service on your laser, avoid all exposure to direct or secondary laser radiation.**

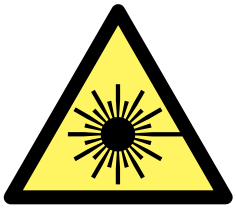

**Fig. 2.1/1**
**Warning label**
**Laser beam warning**

**B. Safety Guidelines:**

**The following are some of the many techniques used to avoid exposure to laser radiation.**

— **The laser beam is invisible! Never stare head-on into the path of a laser beam.**
**Check the safety of the laser system before starting any work. Especially shutter and laser beam guide and nozzle system.**

— **Avoid all unnecessary exposure to direct or secondary laser radiation (reflections).**

— **Wear suitable safety glasses (laser goggles) with side shields whenever in the proximity of an uncontained laser beam. The type to use is EN 207 / 208 (DIN 58215) - eye protection device against laser radiation - wavelength 10.6 µm.**

— **Do not operate the laser without laser beam guides. The complete laser beam must be contained from the laser to its point of exit at the workpiece within a protective enclosure.**

— **If you work on workpieces with reflecting surfaces, e.g. bright or highly reflective sheets of steel, aluminum or other nonferrous and noble metals, you must provide suitable means for protecting the operator from reflected radiation.**
**For further details refer to the safety chapter of the laser systems operating manual.**

## Fire hazards: 2.2

**A. Potential Hazards:**

**These things can occur when a laser beam is directed at a material:**

— **First, the laser beam can continue to pass through the material. The air around you and a select number of special crystals (such as those used for laser optics) fall into this group of materials known as transmitters.**

— **A second group of materials is of a nature that nearly all of the laser beam will be reflected off of its surface. Such materials are known as reflectors. Their specially polished and prepared surfaces are usually used as mirrors to bend or redirect the path of the laser beam.**
**Note: Windows made of glass also reflect laser radiation!**

— **Laser energy which is neither transmitted through nor reflected off of the surface of a material is absorbed. Most materials are considered good absorbers of the radiation from a $CO_2$ laser. Recall from an earlier discussion that radiation which is absorbed is heat.**

— **However, there are some absorbers, such as combustible solvents and materials, which will easily ignite when exposed to the heat of even scattered or unfocused laser beams.**
**Materials such as paper, and oily rags will easily burst into flames.**

**B. Safety Guidelines:**

**The following are some of the many techniques used to avoid fire hazards from laser processing of materials.**

— **Provide quick and easy access to a multiple rating fire extinguisher and other safety equipment.**

— **Learn how to use the fire extinguisher and the other safety equipment.**

— **Bar the laser area. Do not use combustible materials for screening the laser area.**

— **Do not keep paper, oily rags, or other combustible materials anywhere near an open laser beam.**

— **Gas cutting is made with oxygen. Oxygen must not come together with oily or greasy parts, even clothing.**
**Do not use oxygen for cleaning, cooling or venting of clothes!**

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— **Turn off the laser beam or direct it into a suitable beam dump when not processing materials.**

— **Provide some containment of the work area, especially a method to trap heated material expelled from the sides and bottom of a laser cutting application.**

— **Defective parts of a laser system such as nozzle assemblies, processing units, valves, manometers and so on must only changed by specially trained personnel who have received instructions concerning the hazards involved in its operation.**

## Hazardous fumes and vapors: 2.3

**Do not use the laser beam to heat or do any work on foodstuffs. This can effect injuries and can produce poisonous (cancerous) substances, fumes or vapours.**
**Also work on organic material, for example plastics or wood may be dangerous.**
**Before working on these materials with a laser beam, make sure you are familiar with the applicable safety precautions.**

**A. Potential Hazards:**

**Since the absorbed energy produced by the laser beam is heat, laser processing (cutting, welding, melting) can be thought of as a controlled method of heating or burning. The process is similar to but its results are much finer than that of using a flame torch.**
**There are some materials that break down chemically and emit hazardous vapor in the form of gases or particulate matter when they are heated or burned. Examples of such materials include PVC (polyvinyl chloride), polycarbonate, and various types of fiberglass composites. Standard handbooks should be consulted or the manufacturer of the material should be contacted before attempting to process such materials with a laser.**
**Use filters to filter this processing fumes and vapors at your working place. Clean the filters according to the rules and regulations against environmental pollution.**

**B. Safety Guidelines:**

**The following are some of the many techniques used to avoid the threat of exposure to dangerous or toxic fumes and vapors.**

— **Do not attempt to process a material with a laser beam without knowing the characteristics of the material relating to heat. Inform yourself before laser processing of unknown materials.**

— **Provide a method of safely shielding and venting of the fumes produced as a by-product of laser processing.**

— **If you are cutting plastics, filter the cutting vapors downwards.**

— **Do not cut PVC by laser beam! The chemical heat reaction together with the air humidity brings hydrochloric acid. Hydrochloric acid is aggressive and may hazard the operator or the laser system.**

## Hazardous electrical voltage: 2.4

**Service-, repair and adjusting work:**
**Any work on the electro-technics of the laser must only be done by trained staff from ROFIN-SINAR Service Dept. or by skilled electrical engineers after consultation with the ROFIN-SINAR Service Dept.**

**Europe:**
**The ROFIN-SINAR Laser is supplied by a voltage of 3 x 400 / 480 V AC and PE.**

**Non-European countries:**
**The local supply voltage is transformed to 3 x 400 / 480 V AC and PE by a series transformer.**

**Danger signs, warning of dangerous electrical voltage, are fixed to the covers and doors of control cabinet and laser head.**

**Fig. 2.4/1**
**Danger label**
**Warning electrical voltage**

**Maintenance work:**
**The Mains switch (Q1) of the control cabinet has to be switched OFF during any type of maintenance work on the laser!**

**Warning:**
**Before beginning work: check that there is no voltage!**

## Hazardous high voltage: 2.5

**Service-, repair and adjusting work:**
**Any work on the electro-technics of the laser must only be done by trained staff from ROFIN-SINAR Service Dept. or by skilled electrical engineers after consultation with the ROFIN-SINAR Service Dept.**

**Maintenance work and settings which cannot be performed without temporarily defeating the interlock circuits must be carried out by trained staff from ROFIN-SINAR Service Dept. or by skilled electrical engineers.**

**The laser beam is produced by a gas discharge which is ignited by electrical energy and high frequency. The high voltage required to do this can reach levels of up to 11 000 Volts.**

**Warning - Danger:**

**Whenever access to the interior of the laser head or control cabinet is necessary, exercise extreme caution to avoid contact with high voltages.**
**High voltage is absolutely lethal!**
**Only authorized, electrically trained personnel should access these high voltage areas. Use the grounding probe as specified in its manual (grounding probe and its manual are located in the control cabinet).**

**Warning:**
**High voltage is absolutely lethal!**

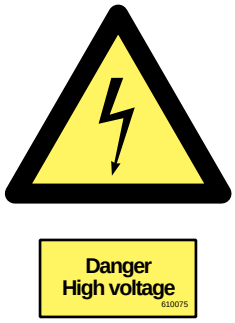


**Fig. 2.5/1**
**Warning label**
**High voltage hazard warning**

**During normal operation, all high voltage units are sealed in the laser and the doors and covers are electrically interlocked.**

**Removing or bypassing any of these safety devices (interlocks) can be lethal!**

**The following are some of the many techniques used to avoid the dangers posed by the presence of high voltage within the laser.**

- **Minimize access only to authorized and trained personnel who are familiar with the electronics and electrical subsystem of the laser. The access doors to HV hazardous area in the laser are key lockable.**
  **Ensure that these doors are securely locked and that the keys are used by trained, authorized personnel only.**
- **Make sure that all electrical power to the laser is OFF before working on the laser.**
- **Never attempt to service the laser alone. Use the "buddy system".**
- **Never attempt to service the laser when tired or under the influence of drugs or alcohol.**
- **Avoid wearing metal objects such as rings, bracelets, watches, and large belt buckles when servicing the laser.**
- **When it comes to accessing the interior of the laser, it is best to be overly cautious.**
- **Be trained on how to treat someone in the event they receive an electrical shock.**

## Hazardous high frequency: 2.6

**Do not open the housing of the high frequency (HF) generator when the laser is ON!**
**The high frequency excites a laser gas discharge in the vacuum vessel of the laser head. Then laser radiation is emitted which is formed to a laser beam. The high frequency (HF) generator works with an anode voltage of approx. 10 000 volts.**

## Other hazards: 2.7

— **Optics: The beam-folding mirrors, the rear mirror and the output coupler consist of materials such as copper, zinc selenide and gallium arsenide and a variety of optical coating materials. As long as the laser is operating normally, these are not a source of danger.**
**If these materials are broken, overheated or otherwise damaged, however, harmful particles such as arsenides and selenides may form.**

— **Damaged optics: Latex gloves should always be worn when handling damaged optics, and the optics should be properly packed and returned either to their manufacturer or to ROFIN-SINAR.**

— **Positioning laser (optional): Some ROFIN-SINAR $CO_2$ - slab - lasers are equipped with the optional positioning laser for workpiece alignment.**
**This device produces a beam of red light which is emitted coaxially but not simultaneously to the output of the $CO_2$ laser beam. With a relatively low energy output qualifying it for rating as a Class 2 laser product, the positioning laser is considered to pose no threat to human skin, making it a relatively safe alignment tool.**
**However, because its output is in the visible light region and is focusable by the human eye, there is a serious threat of severe eye damage if the laser beam of the positioning laser is stared into head-on.**

**Any alignments should only be carried out by persons who have received special instructions by the laser supplier.**

**The positioning laser assembly is equipped with a mechanical shutter and can be activated from the controller terminal or via interface.**

— **Compressed gases / inert gases: Observe the safety recommendations issued by the relevant professional organization that relate to work on devices with compressed gases (Germany: pressure vessel regulation and the technical regulations for gases, e.g. TRG 280, accident prevention regulations, e.g. VBG 61 "Gases"). In confined spaces with insufficient ventilation the inert gases in use can pose a danger of asphyxiation.**

— **High-pressure cutting: For high-pressure cutting, cutting gas is used under great pressure (up to 20 bars). A hazard is posed, amongst other things, by:**
**• splattering from melted metals**
**• rupturing focussing lens**
**• exploding gas supply lines.**
**Always wear laser goggles!**

— **UV-radiation: Metals being laser welded produce metal vapour plasma emitting intensive invisible ultraviolet (UV-) radiation, which can cause serious damage to the eyes and skin.**
**Wear a welding eyeshield and protective clothing in addition to your laser goggles and keep a safe distance from the laser beam source!**

— **General: Wear suitable safety glasses (laser goggles) with side shields whenever in the proximity of an uncontained laser beam. The type to use is DIN EN 207 / 208 (DIN 58215) - eye protection device against laser radiation - wavelength 10.6 µm.**

— **Disposal of used materials: Please note that disposal of all materials (including oils, treated coolant, etc.) used in this product must be conducted according to all local, State and Federal Rules and Regulations.**

— **CO gas: For the operation of $CO_2$ slab lasers by ROFIN-SINAR a Premix laser gas is used. The Premix laser gas contains, among other gases, a 6 percent volume of CO - gas (Carbon monoxide). The laser gas bottle contains 1500 Nl (Nl = standard liters) Premix laser gas on delivery. 6 percent of this is CO, that is 90 Nl.**
**CO gas in high concentrations represents a potential hazard.**
**The other components of the Premix laser gas (94 %) are helium (He), nitrogen (N), carbon dioxide ($CO_2$) and xenon (Xe). These gases do not represent a potential hazard.**
**To fill the vacuum vessel of the laser, 7 Nl of Premix laser gas are required. CO represents < 0.5 Nl of this. Before a refill is done, the laser gas is blown out of the vacuum vessel into the ambient air of the workroom.**
**Refer to the rules and regulations of your country regarding physical and biological limit values of CO in the ambient air.**
**Operators of a $CO_2$ slab laser are obliged to acquaint themselves with potential hazards by considering the conditions on site and taking necessary precautions.**
**Have a good ventilation in your work space and do not vent or open the laser gas bottle!**

## Warning Labels (CDRH-Labels - only USA) and rating plate: 2.8

**Compliance to Certification Standards:**
**This laser product complies with Title 21 of the United States Code of Federal Regulations, Chapter 1, Subchapter J, Parts 1040.10 and 1040.11, as applicable.**
**Location of labels: see radiation control drawings 620396 / 3 laser head and 620409 / 3 power supply in the maintenance section of this manual.**

**Labels required under this regulation are as follows:**

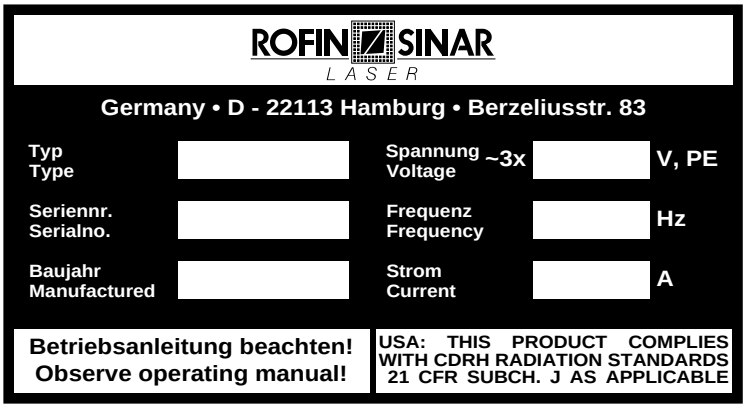


**Fig. 2.8/1:**
**Rating plate - this label is located at the rear side of the control cabinet and at the rear side of the laser head.**

**Laser beam warning label:**

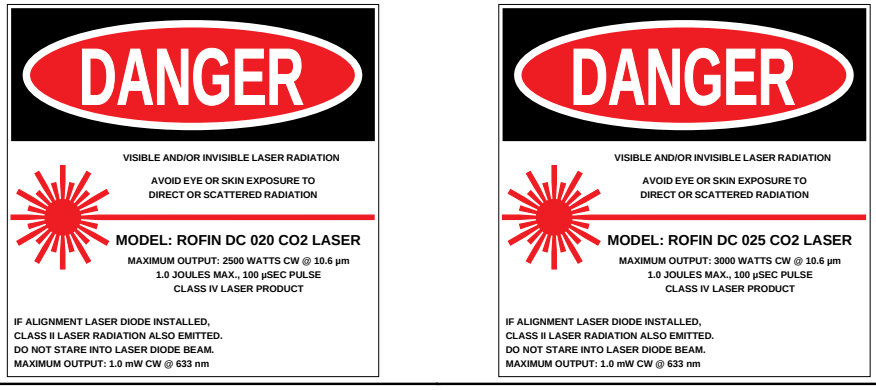


**Fig. 2.8/4 a / b:**
**Warning label (USA): ROFIN DC 020 or ROFIN DC 025 Three such labels are affixed to the laser head, one on each side and on the front side of the laser head.**

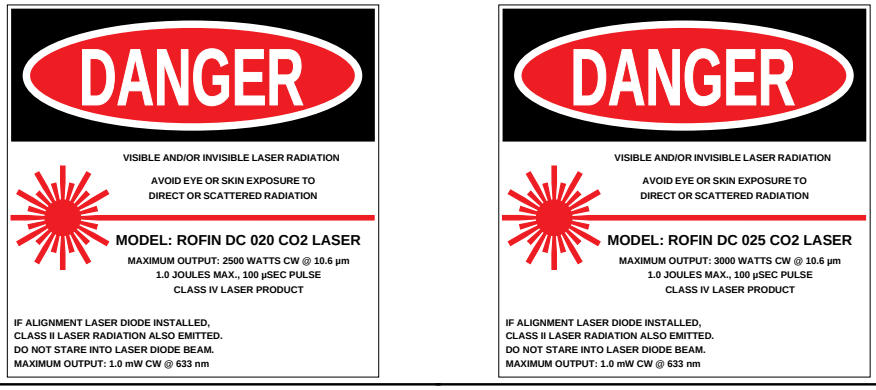


**Fig. 2.8/4 a / b:**
**Warning label (USA): ROFIN DC 020 or ROFIN DC 025 Three such labels are affixed to the laser head, one on each side and on the front side of the laser head.**

**Laser beam warning label:**



**Fig. 2.8/4 c / d:**
**Warning label (USA): ROFIN DC 030 or ROFIN DC 033 Three such labels are affixed to the laser head, one on each side and on the front side of the laser head.**


**Fig. 2.8/4 e:**
**Warning label (USA): ROFIN DC 035 Three such labels are affixed to the laser head, one on each side and on the front side of the laser head.**

**ROFIN-SINAR industrial lasers are designed in strict accordance with the respective safety regulations.**
**We certify that each laser manufactured by our company complies with FDA Radiation Performance Standards, 21 CFR Subchapter J and with DIN EN 60825 (VDE 0837 / IEC 825).**

**Laser beam warning label:**

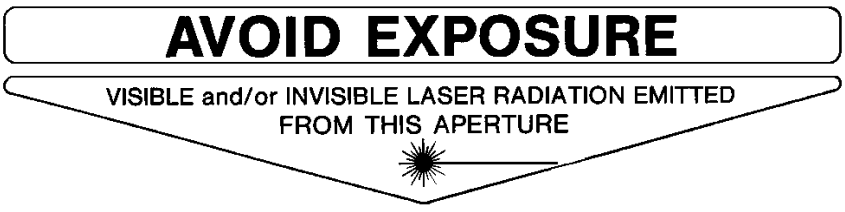


**Fig. 2.8/5:**
**Warning label (USA): Aperture label - this label is located just above the laser beam output port at the forward end of the laser head.**

**Laser beam warning label:**


**Fig. 2.8/6:**
**Warning label (USA): Interlocked housing - this label is affixed wherever access to laser radiation is provided by opening of an interlocked panel.**

**Laser beam warning label:**


**Fig. 2.8/7:**
**Warning label (USA): Non-Interlocked housing - this label is affixed wherever access to laser radiation is provided by opening of an non-interlocked panel.**

**Laser beam data:**

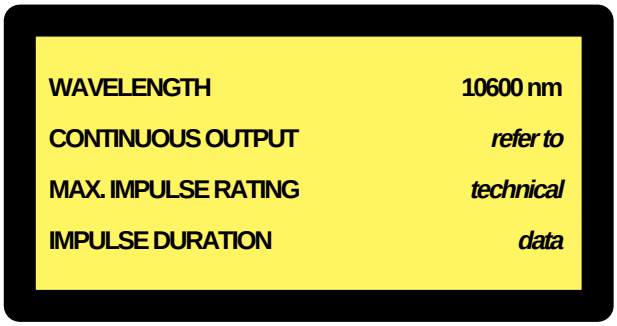


**Fig. 2.8/8:**
**Warning label (Europe): Technical data of wavelength of laser beam and laser power**

**Laser beam warning label:**

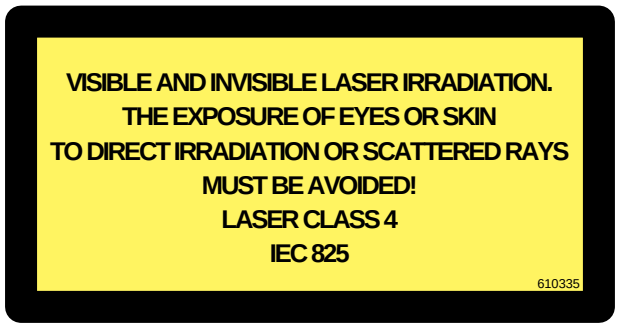


**Fig. 2.8/9:**
**Warning label (Europe)**

**Laser beam warning label:**

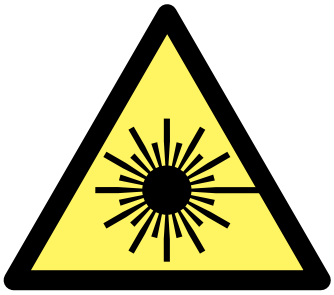

**Fig. 2.8/10:**
**Warning label**

**Laser beam warning label:**

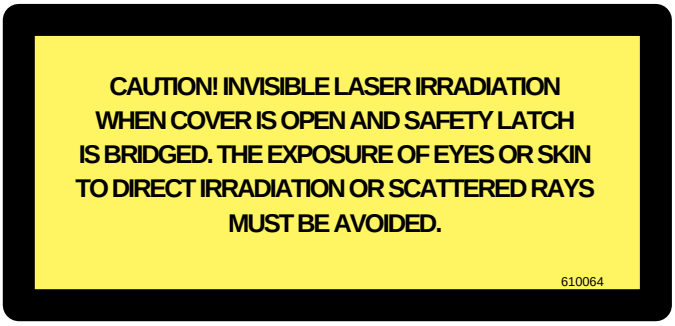


**Fig. 2.8/11:**
**Warning label (Europe)**

**Laser beam warning label:**

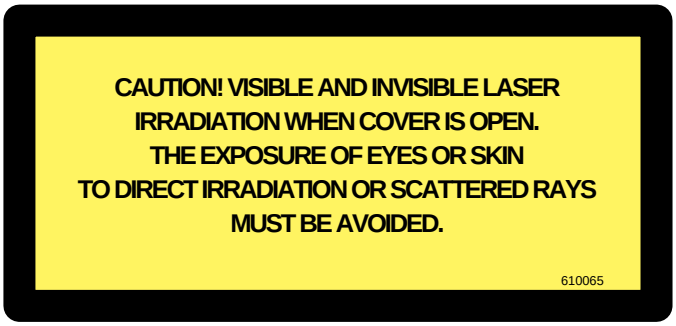


**Fig. 2.8/12:**
**Warning label (Europe)**

**Electrical hazard warning:**

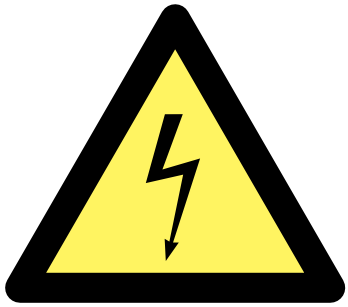

**Fig. 2.8/13:**
**Warning label: Danger from electrical voltage - this label is affixed wherever access to electrical voltage is possible.**

**Electrical hazard warning:**

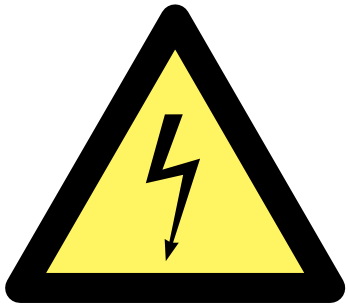


**Fig. 2.8/14:**
**Warning label: High Voltage - these labels are affixed wherever access to high voltage is provided.**

**Electrical hazard warning:**

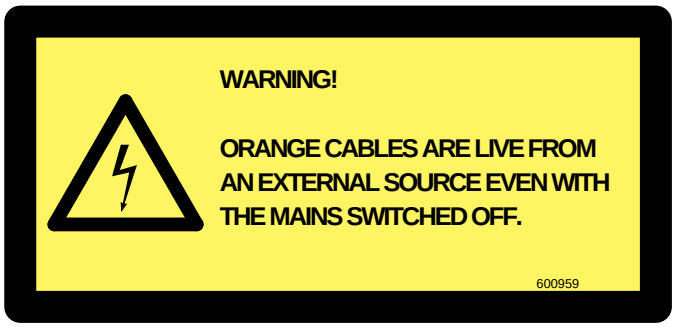


**Fig. 2.8/15:**
**Warning label: Dangerous Voltage - these labels are affixed in the control cabinet.**

**Electrical hazard warning:**


**Fig. 2.8/16:**
**Warning label: Dangerous Voltage - this label is affixed in the control cabinet.**

**Injury warning:**

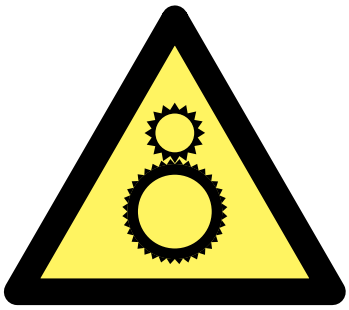

**Fig. 2.8/17:**
**Warning label: Warning for injuries - these label is affixed in the control cabinet.**

**In addition to the above methods of product identification, compliance to the certification standards is likewise provided by incorporation of the following features:**

**Key switch control with ROFIN-SINAR control panel with display and keyboard or with ROFIN-SINAR wiring proposal:**
**Laser operation is controlled by two locking key switches. The high voltage and shutter circuits are disabled when the key switches are in the "disabled" positions.**

**Remote Connector Interlocks:**
**There are remote (accessory interlocks) interlock connections available. These interlocks when activated will disable the high voltage or shutter circuits depending which ones are selected.**

**Laser Emission Warning Indicator:**
**There is a laser emission warning indicator located on top of the laser head at the laser beam output end. This laser emission warning indicator is on whenever the laser high voltage circuits are activated (Laser Emissions). When the "laser beam ON" button is depressed and all interlocks are satisfied, the laser emission warning indicator is ON.**
**Connections are available for an external laser emission warning indicator.**

**Shutter:**
**The $CO_2$ laser beam is stopped by a shutter blade. Upon request the shutter is opened by an electrical solenoid. The position of the shutter is sensed by two inductive sensors. The signals are sent to the computer.**

**If the shutter does not open or close within a given period of time the laser high voltage circuits are disabled.**

**Additionally the shutter unit is provided with a position switch which is actuated by the shutter blade. To switch high voltage on, the shutter blade must be closed.**

# Description of ROFIN DC 020:



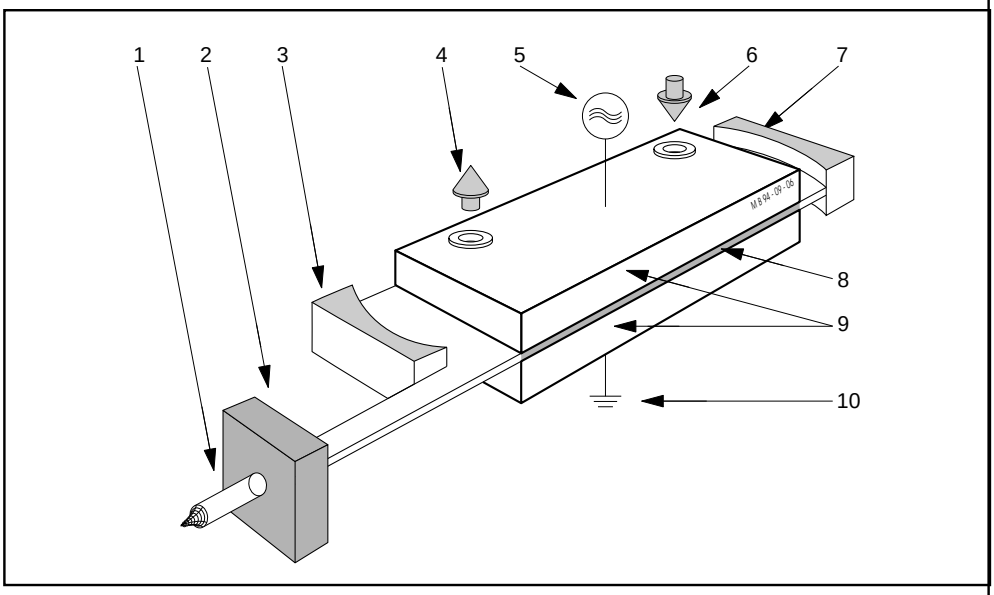


**Fig. 3/1:**
1 Laser beam
2 Laser beam telescope
3 Output mirror
4 Cooling water connection
5 High frequency excitation
6 Cooling water connection
7 Rear mirror
8 Active zone (slab)
9 Waveguiding electrodes
10 Grounding (earthing)

The ROFIN DC 020 laser is a high-frequency excited, diffusion-cooled $CO_2$ Slab Laser, designed for industrial use as a cutting or welding tool.

**Fig. 3/1** shows the laser function principle. Between the waveguiding electrodes (9) a laser gas discharge (active zone) (8) is produced by high-frequency voltage (5, 10).
The rear mirror (7) and output mirror (3) form the optical resonator. In the resonator the laser beam (1) is produced and is emitted from behind the laser beam telescope (2).

The laser consists of laser head and control cabinet.

**Laser head:**

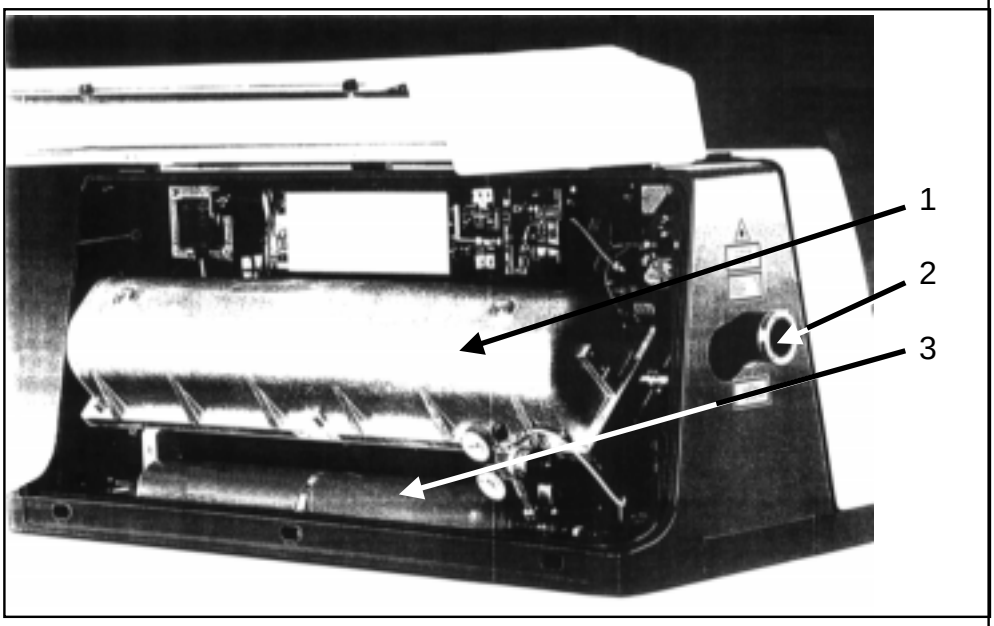


**Fig. 3/2:**
1 Vacuum vessel
2 Laser beam output
3 Laser gas supply (bottle)

The main elements of the laser head are:

- Supporting frame (chassis)
- Laser gas supply
- Plastic panelling
- Vacuum vessel (recipient)
- High-frequency generator
- Laser beam telescope
- Laser beam shutter

When it is closed, the water-cooled mechanic shutter in the laser beam path in front of the laser beam telescope prevents the laser beam from reaching the processing station. The shutter is closed during "stand-by" operation or when a fault arises. The bending mirror of the shutter then directs the laser beam into the absorber where its output power is discharged into the cooling water.
A sensor in the laser beam telescope constantly measures the laser power, which is then displayed on the control panel.

**Control cabinet:**

The main elements of the control cabinet are:

- Power supply with main switch, all fuses, relays, safeguards and protective motor switch for the electrical components of the laser.
- High voltage production for high-frequency generator with HV Softstart unit.
- Computer rack with CPU-card, digital input cards, relay output card, pulse / ramping generator (optional) und comprehensive interface to an external control system.
  The computer rack controls and monitors all important laser functions.
- Keyboard and display (controller terminal).
  The controller terminal can also be installed into other cabinets of the laser system.

The operation of the laser is supported by display texts on the display. The automatic start-up is activated by pressing only one key on the keyboard. Within just one minute the laser is ready to operate.
The laser output power is selected by a continuous potentiometer or numerical by keyboard. All laser functions are controlled from the keyboard, for example, the pulse / ramping generator programs or request for diagnostic and service routines.

# Transport of laser head and control cabinet:



For the transport of ROFIN-SINAR lasers the following instructions should be observed:

— By road: only on trucks with pneumatic suspension

— By rail, sea, air: The laser will be packed and prepared by ROFIN-SINAR accordingly

**Attention!**
**Laser from ROFIN-SINAR are precision units. The laser head is only allowed to be transported in its original packing!**

**Notes:**
**Every warranty is lost when the laser head is transported without its ROFIN-SINAR special packing.**
**In the maintenance section of this operating manual is the ROFIN-SINAR special packing for the laser head is shown.**

**If later transportation is necessary:**

- **Keep the ROFIN-SINAR special packing for later use.**
- **Use the ROFIN-SINAR special packing for later transportation to prevent the laser head from transport damages.**
- **If you have any questions: call ROFIN-SINAR.**

**Note the packing hints on the following pages.**

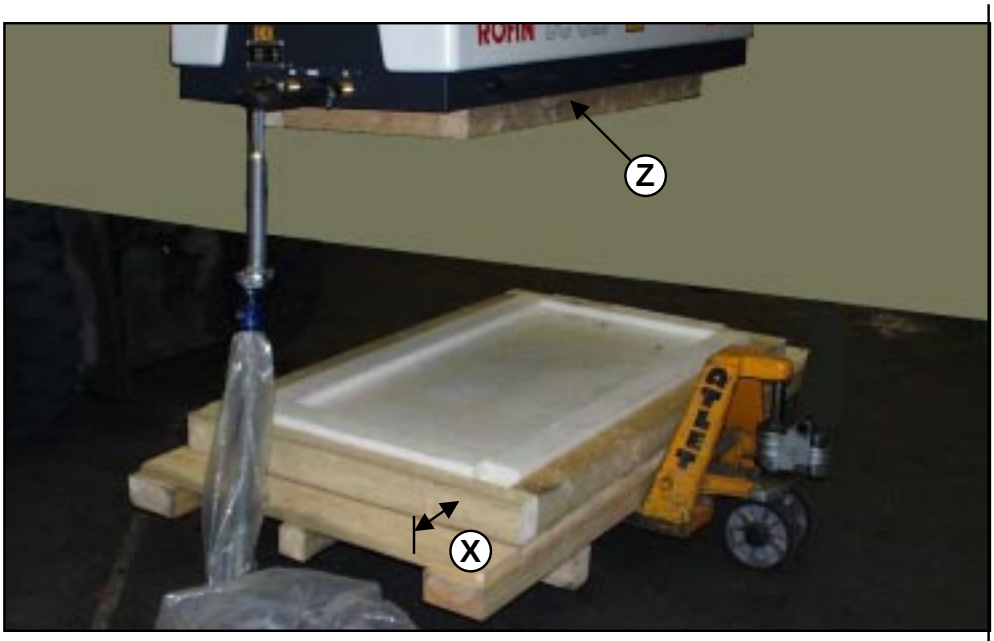


**Fig. 4/1 a:**

- The laser head is threadad onto a wooden supporting frame (Z). **Attention! Only one position is correct!!**.
- Laser head and supporting frame will be placed into the special packing by a crane.
- **Note:**
  **The laser head has to be placed so that the connection cables are on the side (X = app. 17 cm) of the special packing.**


**Fig. 4/1 b:**

1. Remove the 2 eyebolts on the top side of the laser head.
2. Screw the 2 threaded rod (M12) into the bores.
3. Lock the threaded rods with the range spacers made of alloy.
4. Place the wooden frame with its bores over the threaded rods. **Attention! Only one position is correct!!**.
5. Screw the 2 eyenuts onto the threaded rods.
6. Lay the connection cables onto the top side of the laser head.


**Fig. 4/1 c - packing with carton:**

1. Slip the packing made of carton over the laser head and screw it with the pallet.
2. Place the 6 range spacers made of foam (X) as shown.
3. Put on the cover made of carton and lace it **TIGHT** with packing cords.


**Fig. 4/1 d - packing with wooden material:**

1. Screw the 4 side walls made of wood with the pallet.
2. Place the 6 range spacers made of foam (X) as shown in **Fig. 4/1 c**.
3. Lay the 4 balks onto the 6 range spacers made of foam and screw them with the side walls.
4. Put on the cover made of wood and screw it with the side walls and the 4 balks.

**Laser head - Transport by crane:**

Preparation:

- Remove both plastic caps from the top of the laser head panelling
- Screw in the eyebolts (M 12, DIN 580)
- Transport the laser head with crane lifting gear (**Fig. 4/1**)
- Remove the eyebolts and replace the plastic caps

Right:

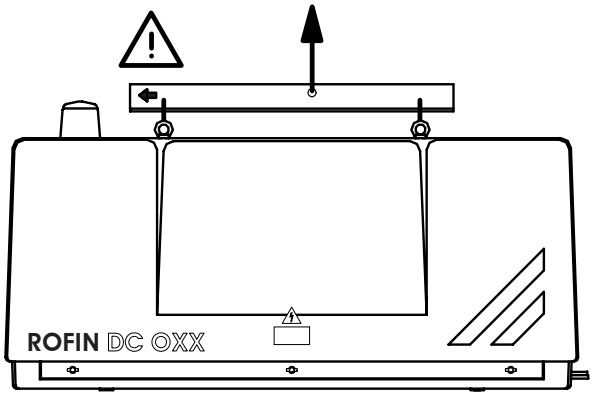


**Fig. 4/1:**
Right

**Wrong:**

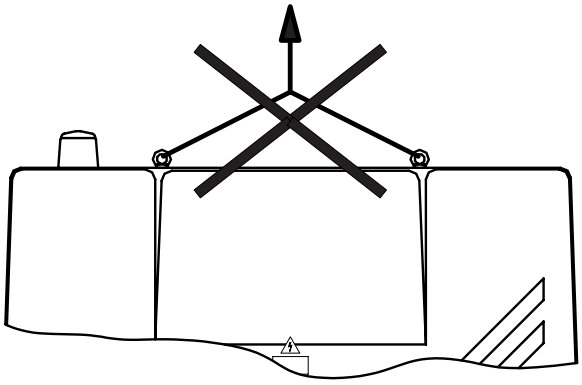

**Fig. 4/2:**
**Wrong**

**Laser head - transport by fork-lift truck:**

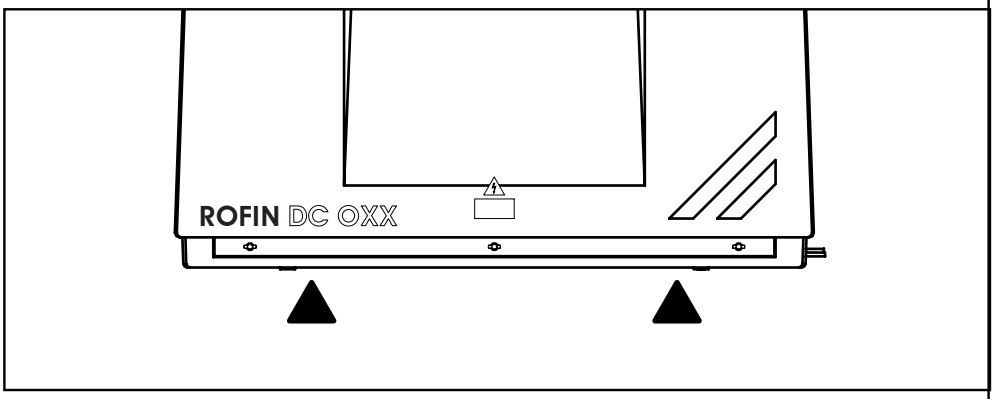


**Fig. 4/3:**
▲ Position fork-lift truck here!

The forks of the fork-lift truck must only be placed under the surfaces marked ▲ (**Fig. 4/3**), otherwise the laser panelling is subject to damage!

**Control cabinet - Transport by crane or fork-lift truck:**

By crane: Eyebolts are attached to the top of the control cabinet for transport purposes.

Fork-lift truck: Pay attention to the position of the gravity centre during transport!

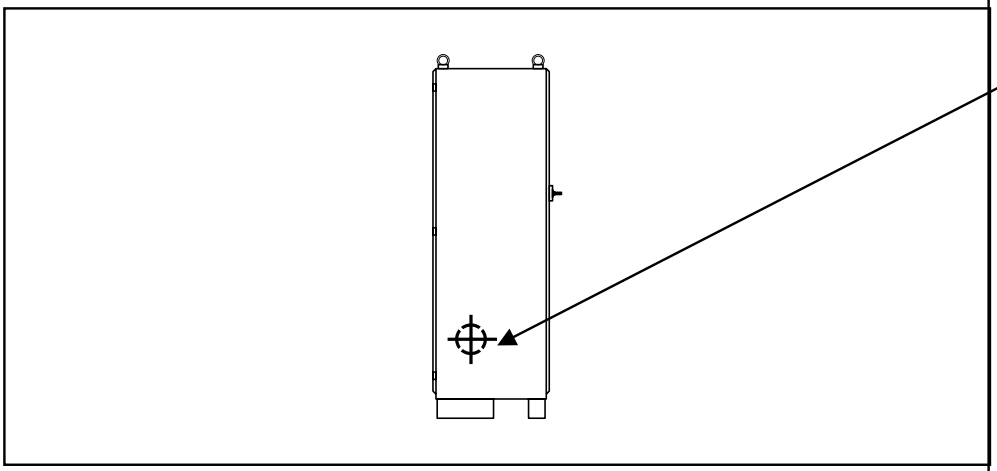

**Fig. 4/4:**
Gravity centre

**ROFIN DC 0XX compact (optional) - Transport by crane or fork-lift truck:**

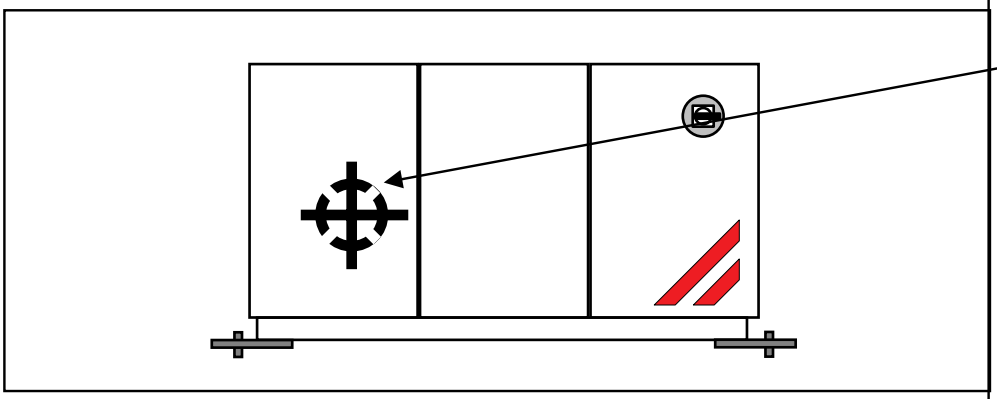

**Fig. 4/5:**
Gravity centre

**ROFIN DC 0XX compact (optional) - Transport by fork-lift truck:**

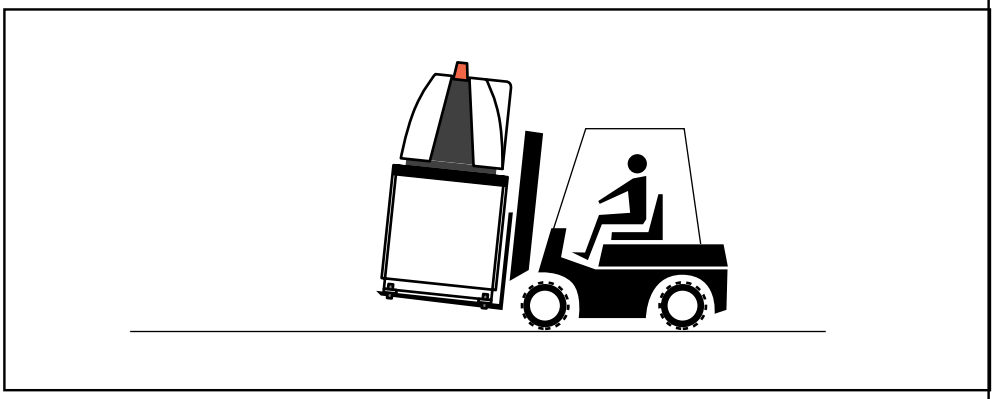

**Fig. 4/6:**
Transport of the DC 0XX compact control cabinet

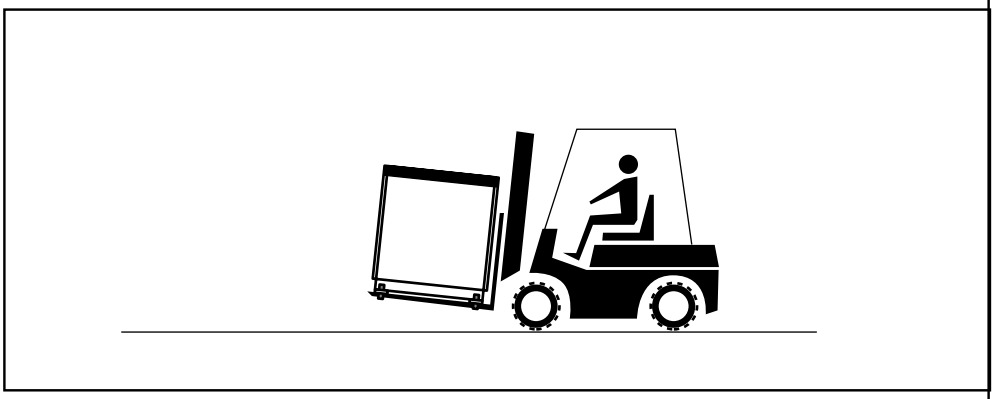

**Fig. 4/7:**
Transport of the DC 0XX compact control cabinet

**ROFIN DC 0XX compact (optional) - Transport by crane:**

**Attention - Danger!**
**The ROFIN DC 0XX compact laser or the compact control cabinet is only allowed to be transported by a special lifting device!**
**The special lifting device you will get by ROFIN-SINAR.**
**Do not lift the unit of laser head and compact control cabinet by lifting at the laser head!**

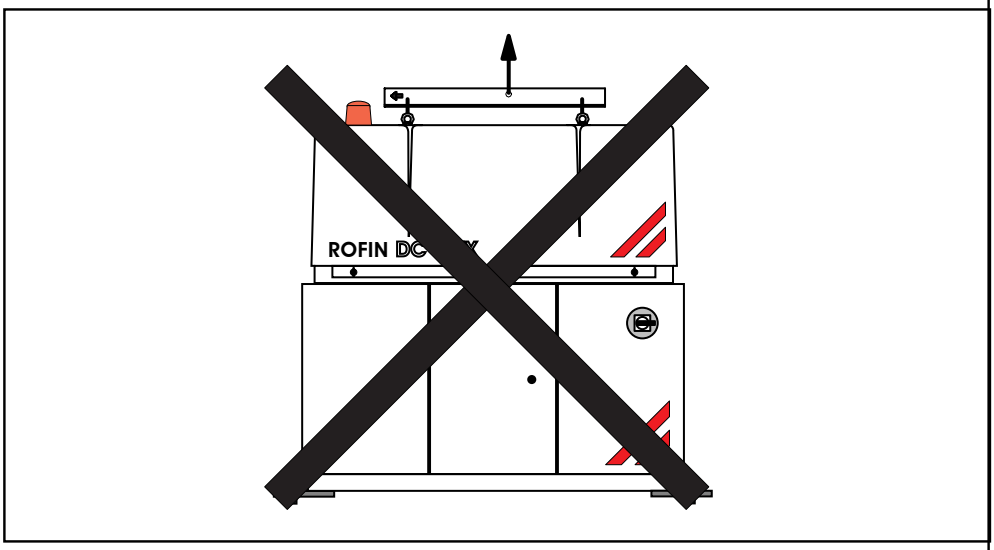

**Fig. 4/8:**
**Wrong!**

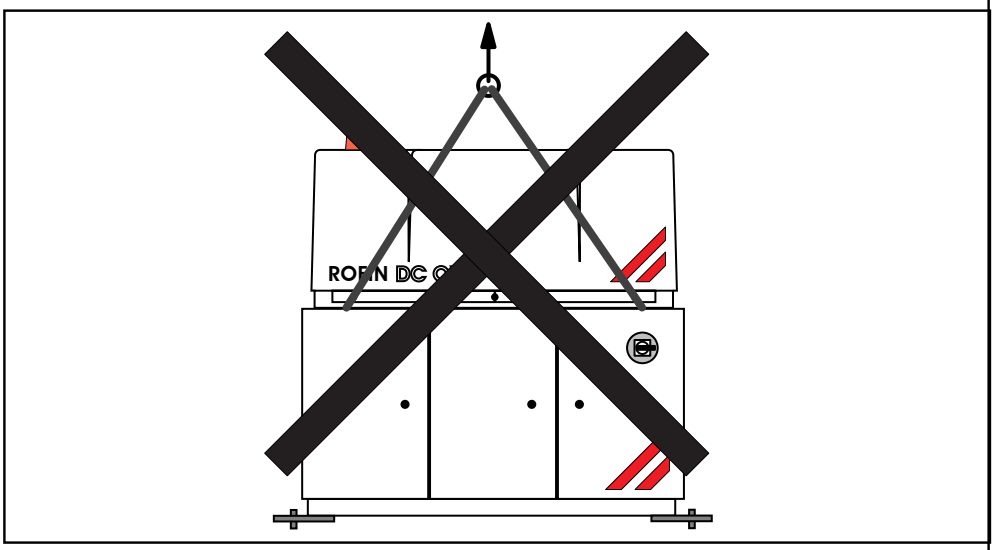

**Fig. 4/9:**
**Wrong!**

## Transport safety devices / Storage / Unpacking / Installation / Assembly:



**Transport safety devices:**

There are no transport safety devices installed in the laser. Check whether your laser system has any transport safety devices and remove them.

**Storage of ROFIN-SINAR lasers:**

- Store in a dry place
- Prevent laser system against corrosion
- In case of frost hazards:
  Laser head:
  Internal cooling water circulation: **Do not rinse lines with an anti-freezing compound**!
  External cooling water circulation: drain off cooling water and rinse lines with an anti-freezing compound; blow out anti-freezing compound with compressed air
  Control cabinet: drain off cooling water from the heat-exchanger, rinse with an anti-freezing compound; blow out the anti-freezing compound with compressed air
  **!!Before starting the laser: Wash out all anti-freezing compound!!**

**Unpacking:**

ROFIN-SINAR lasers are normally supplied sealed in plastic sheeting. Remove this and any wooden cladding completely.

**Installation, alignment:**

The laser head must be installed so that it is properly aligned with the laser beam guide system with which it is going to be used. In other words, the level and direction of the laser beam exit must be accurately aligned with the axial center of the laser beam guides and mirrors.
The correct height can be obtained with a support base specially designed to fit the laser head.
The height and direction of the laser beam can be fine-adjusted using an alignment unit. The support base and the alignment unit are optional items and can be supplied on request.

**Assembly:**

**Danger!**
**Always check that the power supply is off when connecting electrical items. This job should only be performed by trained staff who have been instructed by the manufacturer on how to operate the laser.**
**Never connect the laser to the mains power supply until all lines have been connected to the control cabinet.**

For transport purposes, the lines (approx. 10 m long) linking the laser head and control cabinet are disconnected. These must be re-connected before you can start the laser. The terminal strips and plugs for the electrical connections are located at the laser head terminal box and in the control cabinet.
The connectors have identification codes to allow them to be matched up to their respective mating connections.

Laser gas bottle installed in the laser:
— see **section 7.4.2** — Mounting the pressure reducer.
Laser gas bottle **not** installed in the laser:
— see **section 7.4.2**.

**Dismantling and packing the laser for transport:**

Follow the manufacturer´s forwarding instructions.
If you have any doubts concerning the laser please consult ROFIN-SINAR.

**Recommended space requirements for laser operation and maintenance:**

Observe the regulations for electrical installations (Germany: VDE 0100) when performing space requirements for laser operation and maintenance.

— Laser head:
Front and back: > 0.2 m; sides: > 1.2 m or > 3 m; top: > 1 m

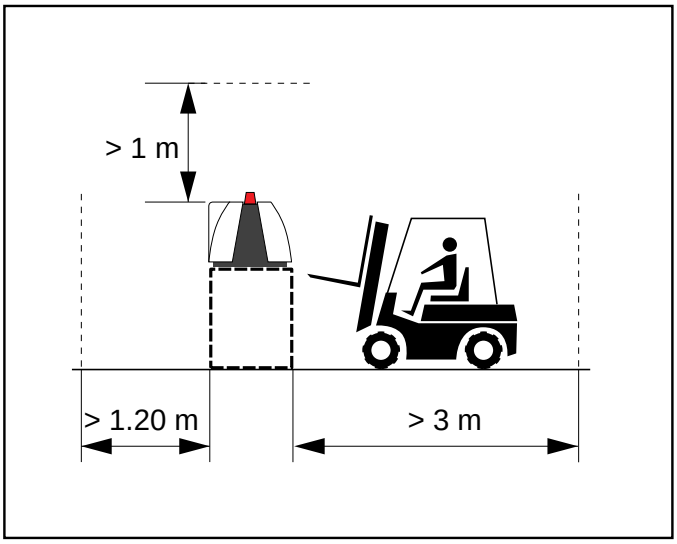


**Fig. 4.1/1**

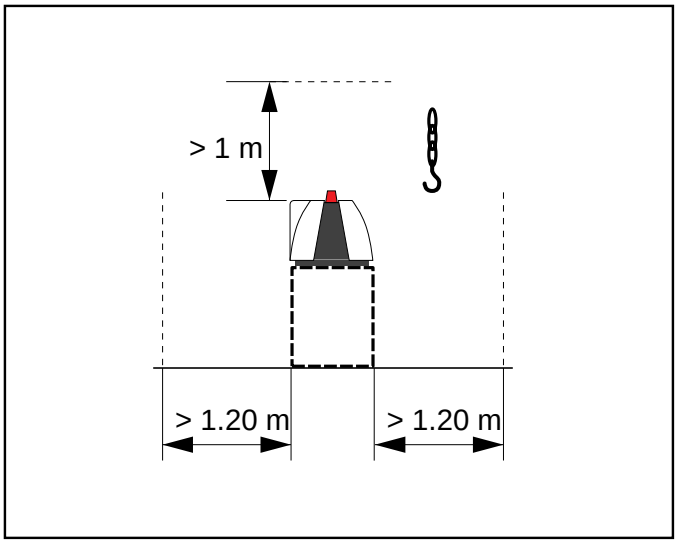


**Fig. 4.1/2**

— Control cabinet: Minimum clearance on door side 0.8 m

**Acceptable ambience conditions:**

— Temperature: + 5 °C to + 40 °C, rise in temperature must be even

— Relative air humidity: 10 % - 90 % (non-condensation forming)

**Floor structure, foundations:**

Minimum requirements:

— Safe floor load: Floor must be capable of supporting at least 1000 kg (2200 lbs).

— Evenness: Floor must be even and must have been levelled

— If possible, laser and processing unit (laser system) should both be set up on the same foundation plate

ROFIN-SINAR lasers are precision units and should not be operated:

— near machines running at high oscillation amplitudes

— in light-design factory buildings with a foundation load rating of less than 1500 kg

— on vibrating floors, such as the upper level of a machine shop floor

— in rooms where the temperature fluctuates

— in areas where there is a high concentration of vapors from oil, solvents or cleaning agents

## Connecting the cooling water supply: 4.2

**Pay attention to the intended flow directions!!**

**Laser head:**

The cooling water connection fittings are located on the connecting plate of the laser head. These fittings are dimensioned to fit 1" plastic tubing. The plastic tubes are mounted and secured with clamps.

**Control cabinet:**

The cooling water connection fittings with 1/4" inside thread and nozzles for plastic tubes with an inside diameter of 10 - 11 mm are located on the heat exchanger of the control cabinet. The supply is effected at the control cabinet through the floor panel and the laterally mounted cable duct..

**General:**

Laser head and control cabinet: connected in parallel; individual supply possible.
The inlet and outlet of the cooling water supply are marked and must not be confused.
**Only use tubes which are impervious to light to prevent germ formation in the cooling water.**
The laser is set by ROFIN-SINAR at a cooling water inlet temperature of 20 °C. The cooling water inlet temperature is only allowed to deviate by max. ≤ 1 K (K = Kelvin) in order to ensure the laser output stability of ± 2 %.
If you wish to operate the laser at a different cooling water inlet temperature, you must have it readjusted to the specified temperature by ROFIN-SINAR service staff!
To avoid condensation forming on the resonator optics, the temperature of the cooling water must be above dew point.

Further cooling water specifications: **section 8** — Technical data.

# Cooling water specifications: 4.2.1

**Internal cooling water circulation (Cooling water circulation for RF - tube in the laser head):**

**Quality of cooling water:**

— Use demineralized water only with a conductivity of < 30 µS / cm without additives (DIN 57510 / VDE 0510 / part 1, section 4.6).

**External cooling water circulation (laser head and control cabinet):**

To ensure trouble-free operation of the laser and to prevent corrosion in the cooling circuit, the following requirements have to be complied with:

**Quality of cooling water:**

— Use demineralized water.

— If you do not use demineralized water, the following specifications must be observed:
If water is used with a hardness > 0.1 mol / $m^3$ ($Ca^{++}$, $Mg^{++}$), hardness stabilizers have to be added to prevent boiler scale deposit. However, the overall hardness must not exceed 2 mol / $m^3$ ($Ca^{++}$, $Mg^{++}$)

| | |
|---|---|
| Conductivity of the water with additives: | < 1000 µS / cm |
| Chloride content of the water: | < 50 mg / l |
| pH value of the water: | 7 - 8 |

**Suspended particles (external cooling water circulation only):**

To remove particulate contamination, use a filter with a pore size of ≤ 100 µm.
The filter must be located as close as possible in front of the cooling water inlet of the laser head.

**Additives (external cooling water circulation only):**

To prevent corrosion of the cooling water circuit, add an appropriate corrosion inhibitor. Use a multi-metal corrosion inhibitor, which will ensure effective protection against corrosion in stainless steel, copper, copper alloys and aluminium.
**Pay attention to the instructions of the additive manufacturer.**

To prevent corrosion of the cooling water circuit, ROFIN-SINAR recommends the use of the organic corrosion inhibitor VARIDOS LASERCOOL GLS manufactured by Messrs. Schilling-Chemie (ROFIN-SINAR material No. 830 50 35).
VARIDOS LASERCOOL GLS works simultaneously as a bacteriostatic and hardness stabilizer. No additional substances are necessary.

**The amount of VARIDOS LASERCOOL GLS to be used depends upon the water quality:**

1 % (10.0 kg / $m^3$): demineralized water, with reverse osmosis water, water with a max. hardness of 2 mol / $m^3$ ($Ca^{++}$, $Mg^{++}$)

Check both the concentration of VARIDOS LASERCOOL GLS with the Schilling-Chemie test kit (ROFIN-SINAR material No. 830 50 36) and the pH value:
- during initial installation
- after about 4 weeks from initial installation
- regularly every 6 months

**Pay attention to the instructions of the VARIDOS LASERCOOL GLS manufacturer.**

**Germ formation in the cooling water (external cooling water circulation only):**

The addition of VARICID T removes germs (algae and slime) from the cooling water and the cooling water circulation (ROFIN-SINAR material No. 830 50 34).
The concentration of VARICID T to be used is:
0.02 % - 0.05 % (0.2 - 0.5 kg / $m^3$).

Please note:
- Make sure that the two additives (VARIDOS and VARICID) are mixed well with the cooling water and avoid over dosing!
- The cooling water must be changed after about 2 to 8 days.
- Do not operate the laser continually with VARICID T in the cooling water.

**Pay attention to the instructions of the VARICID T manufacturer.**

If VARIDOS LASERCOOL GLS is not available (e.g. in the USA), the inhibited anti-freeze Dowtherm SR-1 produced by Dow Chemical can be used in a concentration of 20 % - 35 % by volume. Do not use less than 20 % by volume, as the corrosion protection would not be effective. Concentrations of less than 10 % by volume can lead to the formation of highly corrosive glycol acids. If Dowtherm SR-1 is used, then there is no need to add biocides and hardness stabilizers.

If none of the above additives are available, a comparable product from another supplier can be used. Ensure a sufficient protection against corrosion, boiler scale deposit and algae growth.
In this case, please consult ROFIN-SINAR.

**Frost protection (external cooling water circulation only):**

If you wish to add anti-freeze to the cooling water, please note that the addition of additives changes the cooling characteristics of the water and makes cooling action less effective. (Pay attention to the instructions of the anti-freeze manufacturer). In this case, please consult ROFIN-SINAR.
A combination of anti-freeze and corrosion inhibitors may result in undesired chemical reactions. Therefore either use VARIDOS LASERCOOL GLS mixed with pure ethylene glycol or use an inhibited anti-freeze based on glycol. Please consult ROFIN-SINAR.

## Connecting the mains power supply: 4.3

**Warning!**
**This job should only be performed by trained staff who have been instructed by the manufacturer on how to operate the laser. Always check that the power supply is OFF when connecting electrical items.**
**Never connect the control cabinet to the mains power supply until all lines have been connected to the laser head and control panel.**

The provision of a mains power supply is the responsibility of the customer. To operate the laser a threephase current of 400 V / 480 V with 50 Hz / 60 Hz and protective conductors (L1, L2, L3, PE) are required (± 20 V is possible after changing connections).
Fuses should be used for line side protection.

**Always observe the VDE regulations or the equivalent regulations that apply in your country.**

**Electrical ratings:**

See technical specifications given in **section 8** - technical data.

**Connecting the mains cable:**
**Connect the laser in correct phase sequence. Use a phasemeter.**

The power supply reaches the control cabinet through the floor panel.
The mains supply cable passes through the cable channel mounted on the side to the cable clamp bar where it is connected to the main switch **Q1** and the grounding connection.

If the local mains supply varies a series transformer can be added.
Line side fuse protection will have to be designed according to the supply voltage available.

## Taking out of operation: 4.4

Taking the laser out of operation (e.g. before dispatch):

— To pump down the vacuum vessel:
- Press function key "VACUUM TEST" in the Service - menu.
- After approx. 5 minutes, when approx. 2 hPa is reached:
  Stop the vacuum test by pressing the function key "VACUUM TEST" again.

— To switch the laser **OFF**:
- see **section 5.2.3** — Switching the laser **OFF**

— To drain the cooling water:
- see **section 7.6** — Before transport, storage … (internal cooling water circuit)
- see **section 7.7** — Draining the cooling water (external cooling water circuit)

**Danger!**
**Any work on the electro-technics of the laser must only be done by trained staff from ROFIN-SINAR Service Dept. or by skilled electrical engineers after consultation with the ROFIN-SINAR Service Dept.**

— **Electrical connections:**
- **Disconnect the electrical connections between the control cabinet and the mains power supply.**
- **To earth the high voltage:**
  **Use the grounding rod as specified in its manual (grounding rod and its manual are located in the control cabinet).**
- **Disconnect the electrical connections between the control cabinet and the laser head. The connectors and screwed connections are in the control cabinet.**

— Laser gas bottle:
- Close the valve of the laser gas bottle.
- Unscrew the pressure reducing valve of the laser gas bottle and pack it for safe transport.
- Protect the laser gas bottle with its protection cap.
  **For certain means of transport (e.g. by airplane) and for transport of the laser to certain countries the laser gas bottle must be removed.**
  If removal of the laser gas bottle is not necessary, it can be left in the laser.

— Optics:
Protect the optics against contamination.

— Transport:
- see **section 4.** — Transport of laser head and control cabinet

# Operator´s controls (+A10): 5.

**Important:**
**It is strongly recommended that any person who is to participate in the installation, operation or maintenance of the laser equipment shall read and fully understand the contents of this manual and particularly the safety sections 2 - 2.8.**
**Should there be any questions or doubt about the safety aspects of the equipment, please do not hesitate to contact any of the ROFIN-SINAR offices before proceeding.**

Depending on your laser equipment you will find descriptions of the operator´s controls of your laser in the following sections.

— **Emergency OFF control panel (section 5.1):**

The Emergency OFF control panel **(230 V AC and 24 V DC)** must be installed in the control cabinet of the laser if the control panel with keyboard and display **or** the ON/OFF control panel **are not installed** in the control cabinet of the laser.

— **ON/OFF control panel (section 5.1.1):**

The ON/OFF control panel **(230 V AC and 24 V DC)**l may be installed either in the control cabinet of the laser or in other units of the laser system.

— **Control panel with display and keyboard (section 5.1.2):**

The control panel with display and keyboard **(230 V AC and 24 V DC)** may be installed either in the control cabinet of the laser or in other units of the laser system.

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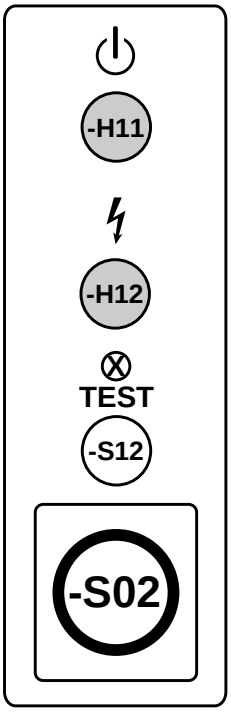
## Emergency OFF control panel: 5.1

The Emergency OFF control panel **(230 V AC and 24 V DC)** must be installed in the control cabinet of the laser if the control panel with keyboard and display **or** the ON/OFF control panel **are not installed** in the control cabinet of the laser.

Number, designation, and function of the buttons and signal lamps of the Emergency OFF control panel:

| No.: | Designation: | Function: |
|---|---|---|
| **-H11** | Mains **ON** | Signal lamp; lights to indicate that the mains power supply is ON. |
| **-H12** | High voltage (HV) **ON** | Signal lamp; lights to indicate that the high voltage (HV) is ON. |
| **-S12** | ⊗ **TEST** | Button to test function of signal lamps **-H11** and **-H12** |
| **-S02** | **Emergency OFF** | Mechanical mushroom - type impact switch which opens the mains contactor. All following loads will be switched OFF.<br>The units described under **Q1** remain ON. |




## ON/OFF control panel: 5.1.1

Documents for the ON/OFF control panel for this laser have not yet been completed. In case of doubt please contact ROFIN-SINAR for details regarding this option.

# Control panel with display and keyboard: (Controller terminal)

5.1.2

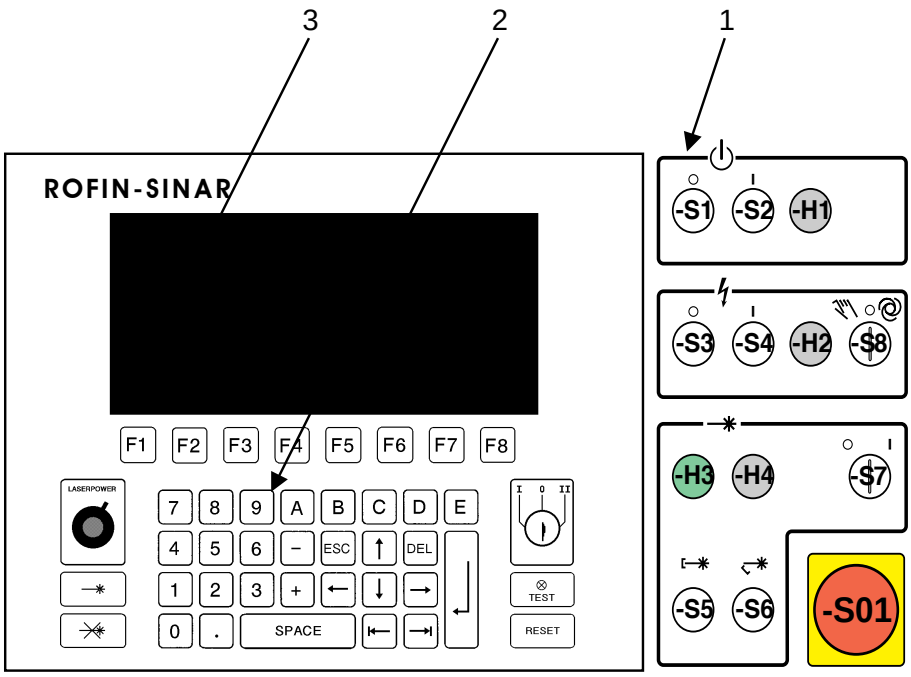



**Fig. 5.1.2/1:**
1 Control panel
2 Keyboard
3 Display

The functions of the switches, buttons and signal lamps, the keyboard and the meaning of the messages shown on the display are described on the following pages.

Number, designation, function and symbol (if there) of switches, buttons and signal lamps of control panel and control cabinet:

| No.: | Designation: | Function: | Symbol: |
|---|---|---|---|
| **Q1** | Main switch | Mechanical switch connected to main supply line; not located on the control panel but at the front of the control cabinet.<br>Can be locked at the "**0**" position with up to three padlocks.<br>Supplies the following units at the "**1**" position:<br>• Power supply unit for 24 V DC supply<br>• 230 V control voltage<br>• Service socket<br>• Lasergas pressure and power metering<br>• Computer rack<br>• Display / keyboard<br>• Positioning laser (optional)<br><br>After self tripping main switch is in its "Tripped" - position (between "**0**" and "**1**") | |
| **-H1** | Mains is **ON** | Signal lamp; lights to indicate that the mains power supply is **ON**. | |
| **-H2** | HV is **ON** | Signal lamp; lights to indicate that the high voltage (HV) is **ON**. | |
| **-H3** | Shutter is **CLOSED** | Signal lamp; lights to indicate that the shutter is **CLOSED**. | |
| **-H4** | Shutter is **OPEN** | Signal lamp; lights to indicate that the shutter is **OPEN**. | |
| **-S01** | **Emergency OFF** | Mechanical mushroom - type impact switch which opens the mains contactor. All following loads will be switched **OFF**.<br>The units described under **Q1** remain **ON**. | |

Number, designation, function and symbol (if there) of switches, buttons and signal lamps of control panel and control cabinet:

| No.: | Designation: | Function: | Symbol: |
|---|---|---|---|
| **-S1** | Mains **OFF** | Button which opens the mains contactor, cancelling the action of **-S2**.<br>All following loads will be switched **OFF**.<br>The units described under **Q1** remain **ON**. | O |
| **-S2** | Mains **ON** | Button which supplies the following units:<br>• Fan of heat exchanger of control cabinet<br>• Fan of high frequency generator<br>• Filament voltage of high frequency tube | I |
| **-S3** | (High voltage) HV **OFF** | Button used to switch high voltage **OFF**. | O |
| **-S4** | (High voltage) HV **ON** | Button used to switch high voltage **ON**;<br>Premise: Shutter must be **CLOSED**. | I |
| **-S5** | Shutter **CLOSE** | Button used to close the shutter. |  |
| **-S6** | Shutter **OPEN** | Button used to open the shutter. |  |
| **-S7** | Key switch Shutter **LOCKED** | Key switch:<br>Shutter **can not** be opened with **-S6** or by CNC. | O |
| **-S7** | Key switch Shutter **ENABLE** | Key switch:<br>Shutter **can** be opened with **-S6** or by CNC (in relation to position of key switch **-S8** Mode Select). | I |

Number, designation, function and symbol (if there) of switches, buttons and signal lamps of control panel and control cabinet:

| No.: | Designation: | Function: | Symbol: |
|---|---|---|---|
| **-S8** | Key switch Mode Select | Key switch:<br>In position "**0**" high voltage (HV), shutter and laser beam **ON**-key are locked. | O |
| **-S8** | Key switch Mode Select | Key switch:<br>Position **Manual** control:<br>• High voltage can be switched ON by pressing button **-S4** High voltage **ON**<br>- after min. 3 seconds:<br>• Shutter **OPEN** or **CLOSE** is possible<br>• Laser beam **ON** or **OFF** by pressing 1 **-key** or 9 **-key** is possible<br>• High voltage can be switched OFF by pressing button **-S3** High voltage **OFF**. |  |
| **-S8** | Key switch Mode Select | Key switch:<br>Position **Automatic** control:<br>Control of the following functions is possible via external contacts:<br>• High voltage **ON** or **OFF**<br>• Shutter **OPEN** or **CLOSE**<br>• Laser beam **ON** or **OFF** |  |

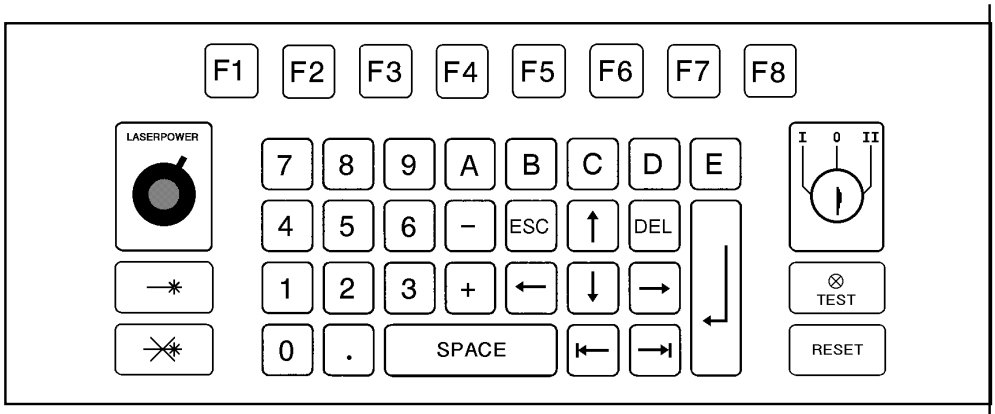



**Fig. 5.1.2/2:**
Keyboard

Using the elements on the keyboard the operating modes of the laser are selected or adjusted.
In the following text the designation of the keys is printed in **bold** characters.

The keyboard is divided up into four areas:

— **LASERPOWER with laser beam ON / OFF keys and potentiometer**
Using the potentiometer you may adjust laser power and other parameters)

| | |
|---|---|
| 1 | Laser beam **ON** (green)<br>**Attention:**<br>**Accidental use of the 1 -key (laser beam ON) is protected by a safety circuit.**<br>**The 1 -key (laser beam ON) must be pressed twice in half a second ("double-click") to turn the laser beam ON.** |
| 9 | Laser beam **OFF** (red) |

— **Function keys F1 - F8**

| | |
|---|---|
| **F1 - F8** | Function keys 1 - 8 |

## — Alphanumeric and symbol keys

| | |
|---|---|
| **0 - 9** | Numeric keys |
| **.** | Decimal point |
| **+** | Plus sign |
| **-** | Minus sign |
| **A - E** | Letter keys |
| **ESC** | Escape |
| **DEL** | Delete |
| ↑ | Cursor up |
| ↓ | Cursor down |
| → | Cursor right |
| ← | Cursor left |
| →\| | Tab |
| \|← | Tab |
| ↵ | Return |
| **SPACE** | Space |

## — Key switch and ⊗ TEST (= lamp test) and RESET - keys

| | |
|---|---|
| **0 , I , II** | Key switch positions |
| ⊗ **TEST** | Lamp test |
| **RESET** | Quit key and fault reset |

## Starting the laser: 5.2

**Initial starting up:**

**The initial starting up of the laser MUST be performed by ROFIN-SINAR service engineers or by OEM engineers instructed by ROFIN-SINAR!**
**It is also a requirement that ROFIN-SINAR service engineers or OEM engineers instructed by ROFIN-SINAR perform the second switching on of the laser, too, in order to guarantee that the operating parameters, the interlock circuits and the safety equipment be properly re-checked after transport.**
**You are asked to note that damage to ROFIN-SINAR lasers caused by an incorrect starting procedure is not covered by the manufacturer´s parts warranty.**

After connecting the mains power supply the laser can be started.

**Day-to-day starting procedure:**

The ordinary day-to-day starting procedure is as follows:

— Open the cooling water inflow line (If you are using a chiller, switch it ON).

— Switch the Main switch **Q1** ON.

— Press the **Mains ON** button:
  • the signal lamp **Mains is ON** lights up
  • the fan in the laser head is switched on
  • MAINS ON appears on the display

— Messages on the display:
  • "WATER TEST" and approx. 10 seconds later:
  • "FILAMENT ON" and approx. 30 seconds later:
  • "HV READY"

If a fault message appears on the display, remove the cause and confirm with **RETURN**.

Now switch the high voltage ON:

— Press the **High voltage ON** - Button:
  • the signal lamp **High voltage is ON** lights up
  • the laser emission warning indicator lights up

The laser is now operational. You can select a program via the keyboard.

**Attention:**
**Before turning the laser beam ON with the 1 -key you must read and observe the safety instructions given in sections 2 - 2.8 of this operating manual.**

**Safety instructions for workpiece alignment:**
**After setting the laser parameters required, remove the key of the key switch MODE SELECT from the control panel in position "0" and pull it out. The workpiece can then be aligned.**
**Lock and seal off the laser system accordingly until the alignment has be completed. Clearly mark the alignment work, for example, by setting up warning plates.**

**Attention:**
**Accidental use of the 1 -key (laser beam ON) is protected by a safety circuit.**
**The 1 -key (laser beam ON) must be pressed twice in half a second ("double-click") to turn the laser beam ON.**

Switch the laser beam ON by pressing the 1 **-key** (**laser beam ON**).

The required laser power is adjusted by the potentiometer on the keyboard or by CNC.

## Switching the laser ON: 5.2.1

Before you switch ON the laser, proceed as follows:

**Make certain that all the safety instructions relating to laser operation have been observed and that all the necessary precautions have been taken.**
**Read and observe the safety instructions given in the relevant section of this operating manual!**

— Open the cooling water inflow line (If you are using a chiller, switch it ON).

— Turn the Main switch **Q1** ON.

## Operating the laser: 5.2.2

To operate the laser, proceed according to the following sequence:

— Press the **Mains ON** button:
- the signal lamp **Mains is ON** lights up
- the fan in the laser head is switched on
- the fans in the control cabinet are switched on
- "MAINS ON" appears on the display

— Messages on the display:
- "WATER TEST" and approx. 10 seconds later:
- "FILAMENT ON" and approx. 30 seconds later:
- "HV READY"

If a fault message appears on the display, remove the cause and confirm with **RETURN**.

Now switch the high voltage ON:

— Press the **High voltage ON** - Button:
- the signal lamp **High voltage is ON** lights up
- the laser emission warning indicator lights up

The laser is now operational. You can now select a program via the key-board.

**Attention:**
**Before turning the laser beam ON with the 1 -key you must read and observe the safety instructions given in sections 2 - 2.8 of this operating manual.**

**Safety instructions for workpiece alignment:**
**After setting the laser parameters required, remove the key of the key switch MODE SELECT from the control panel in position "0" and pull it out. The workpiece can then be aligned.**
**Lock and seal off the laser system accordingly until the alignment has be completed. Clearly mark the alignment work, for example, by setting up warning plates.**

**Attention:**
**Accidental use of the 1 -key (laser beam ON) is protected by a safety circuit.**
**The 1 -key (laser beam ON) must be pressed twice in half a second ("double-click") to turn the laser beam ON.**

Switch the laser beam ON by pressing the 1 **-key** (**laser beam ON**).

The required laser power is adjusted by the potentiometer on the keyboard or by CNC.

## Switching the laser OFF : 5.2.3

— Press the 9 **-key** to switch the laser beam OFF.

— Press button **High voltage (HV) OFF** to switch the high voltage OFF.

— Press button **Mains OFF** to switch the main power supply OFF.

— Switch OFF the cooling water supply.

— Turn the Main switch **Q1** OFF.

## Status messages / Warnings / Fault alarms: 5.3

Status messages, warnings and fault alarms are shown on the lasers display. They are listed here in alphabetical order of their alarm text.
The fault menu can be activated by a function key in addition.
Fault alarms marked by a "*" have to be reset by the **RESET** key.

**Mains supply fault:**

| Inputs | Description | Result | Text |
|---|---|---|---|
| **--** | **Mains supply > ± 10 % or counter-clockwise (CCW) phase sequence.** | **Mains, computer, HV OFF** | **Display is OFF (no text display possible!)** |

**Status messages:**

| Inputs | Description | Result | Status text |
|---|---|---|---|
| -- | **The vacuum vessel will be evacuated** (at vacuum test or lasergas exchange) | HV locked | EVACUATION |
| -- | **Lasergas exchange is running** The function can be activated in the Service menu with the corresponding function key. | HV locked | GAS EXCHANGE |
| -- | **The vacuum vessel will be filled with lasergas** (at lasergas exchange) | HV locked | GASFILLING |
| -- | Mains is OFF and ready to be switched ON. | HV locked | MAINS OFF |
| -- | **Vacuum test is activated** The function can be switched ON or OFF in the Service menu. | HV locked | VACUUM TEST |
| E10.4 E11.2 | After switching ON mains power supply the computer will wait for maximal 3 minutes for correct cooling water flow before the filament for the RF tube will be switched ON. | HV locked | WATER TEST |

**Warning signals:**

| Inputs | Description | Result | Warning text |
|---|---|---|---|
| -- | **Warning signal:**<br>The lasergas pressure in the vacuum vessel is above limit. This signal shows you that lasergas exchange will be necessary soon. | none | CAVITY PRESSURE |
| -- | **Warning signal:**<br>The pressure sensor B3 of the integrated lasergas bottle has tripped. | none | * GAS BOTTLE PRESSURE |
| E11.5 | **Warning signal:**<br>The motor circuit - breaker Q4 for the vacuum pump has tripped. | Operation possible - gas exchange locked | * I > VACUUM PUMP (Q4) |
| E11.13 | **Warning signal:**<br>The current monitor relay of the laser emission warning indicator gives no feedback (laser emission warning indicator defective). | none | LASER WARNING LAMP |
| E10.5 | **Warning signal:**<br>The lasergas pressure of the integrated lasergas bottle is too low or the lasergas bottle is not opened yet. | Operation possible - gas exchange locked | * PRESSURE LASERGAS |
| -- | **Warning signal:**<br>One or more components of the laser have reached the service interval (for maintenance). | none | SERVICE INTERVAL |

**Fault alarms:**

| Inputs | Description | Result | Fault alarm text |
|---|---|---|---|
| all E... | The 24 V supply is OFF<br>(When 24V is not there, this fault alarm is not on the display because the display is supplied by 24 V, too.) | Mains locked | * 24 V SUPPLY |
| X34.5/6 | The connector X34 at the Pulse- / Ramping generator (RPG) is not connected. | HV locked | * ANALOG CONNECTION |
| -- | The maximal allowed evacuating time to evacuate the vacuum vessel is overranged. | HV locked, STOP gas exchange | * EVACUATION TIME |
| E10.3 | The dynamic pressure gauge S25 of the RF generator fan measures too low dynamic pressure or counter-clockwise (CCW) phase sequence. | HV and vacuum pump locked | * FAN RF GENERATOR |

**Fault alarms:**

| Inputs | Description | Result | Fault alarm text |
|---|---|---|---|
| -- | The maximal allowed lasergas fill time to fill the vacuum vessel is overranged. | HV locked, STOP gas exchange | * GAS FILL TIMEOUT |
| E10.5<br>E11.5 | A fault has been occured at the lasergas exchange, or lasergas exchange was not possible. | HV locked, STOP gas exchange | * GASCHANGE FAULT |
| -- | Lasergas exchange is necessary. | HV locked | * GASCHANGE REQUIRED |
| E10.7 | The grid control for the RF tube measures a too high average grid current. | HV locked | * GRID CURRENT |
| E11.7 | An overcurrent or a short circuit of the HV supply has been detected. | HV locked | * HV OVER-CURRENT |
| E11.14 | The HV Softstart unit gives no feedback signal. | HV locked | * HV SOFT-START FAULT |
| E11.7 | The HV overcurrent metering gives no feedback signal. | Mains and HV locked | * HV MONITORING |
| E11.6 | The motor circuit breakers Q5 and / or Q6 for the fans (laser head / control cabinet) have tripped. | HV locked | * I > FANS (Q5 / Q6) |
| E11.4 | The motor circuit breaker Q3 for the RF tube filament has tripped. | HV locked | * I > FILAMENT (Q3) |
| -- | An average overcurrent of the HV supply has been detected. | HV locked | * Ia OVER-CURRENT |
| E10.6 | A door of the laser head or an external Interlock is open. | HV locked | * INTERLOCK / DOORS |
| E11.12 | The HV contactor K1 does not switch OFF, when the high voltage is locked. | Mains and HV locked | * K1 FAULT |

**Fault alarms:**

| Inputs | Description | Result | Fault alarm text |
|---|---|---|---|
| E11.8 | The mains contactor K3 does not switch OFF, when the mains power is locked. | Mains and HV locked | * K3 FAULT |
| E11.13 | The current monitor relay of the laser emission warning indicator gives no feedback (laser emission warning indicator defective). | HV locked | * LASER WARNING LAMP |
| -- | The maximal allowed laser power is overranged. | HV locked | * LASERPOWER LIMIT |
| X14.1/2 | The loop current of the laser power metering is under 3,5 mA (Nominal 4 - 20 mA). | HV locked | * POWER MEASURE |
| X14.3/4 | The loop current of the cavity pressure metering is under 3,5 mA (Nominal 4 - 20 mA). | Mains and HV locked | * PRESSURE MEASURE |
| -- | The pressure in the vacuum vessel is not in operating range. | HV locked | * PRESSURE RANGE |
| E11.9<br>E11.10<br>E11.11 | The shutter gives no or too slow feedback signals. | Mains or HV locked | * SHUTTER FAULT |
| E11.0 | The thermostat S16 for monitoring the HV transformer has tripped. | HV locked | * TEMP. HV TRANSF. |
| E11.1 | The thermostats S14 and / or S15 for monitoring the HV in the control cabinet have tripped. | HV locked | * TEMP. HV CABINET |
| E10.0 | The thermostat S20 for monitoring the temperature of the cooling water of the RF tube has tripped. | HV locked | * TEMP. RF TUBE |
| E11.3 | The thermostat S22 for monitoring the cooling water has tripped. | HV locked | * TEMP. WATER |
| E10.1 | The thermostats S33, S34 and / or S35 for monitoring the shutter have tripped. | HV locked | * TEMP. SHUTTER |

**Fault alarms:**

| Inputs | Description | Result | Fault alarm text |
|---|---|---|---|
| E10.2 | S24 (pressure switch or thermostat) for the laser beam telescope has tripped. | HV locked | * TEMP./PR. TELESCOPE |
| E10.8 | Not installed | HV locked | * WATER CONDUCTIVITY |
| E11.2 | The flow meter S23 for monitoring the waterflow of the cooling water has tripped. | HV locked | * WATERFLOW |
| E10.4 | The flow meter S21 for monitoring the waterflow of the cooling water for the RF tube has tripped. | HV locked | * WATERFLOW RF TUBE |

# Computer rack: 6.

**General:**

The computer controls and checks the functions of the laser. The cards 5 - 8 (digital inputs and relay outputs) control the laser.
The integrated analog interface 10 measures resonator pressure and laser power.
The interface between computer and display / keyboard is on card 13.

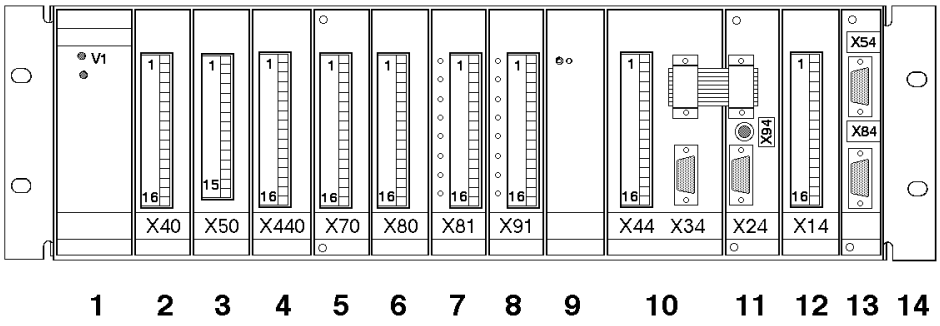



**Fig. 6/1:**
Computer rack

1 Power supply 5 V / 5 A, ± 15 V / 0.5 A (Power supply for computer)
2 X40-Digital inputs (24 V)
CNC-interface: pulse selection, level selection
3 X50-Digital outputs (24 V) (Ramping generator option only)
4 X440-Digital inputs (24 V) (optional)
5 X70-Digital inputs (24 V)
6 X80-Digital inputs (24 V)
7 X81-Relay outputs
8 X91-Relay outputs
9 CPU - Central processing unit
10 X34-Pulse generator, control for PWM
X44-Pulse- / Ramping Generator (RPG), external control for Pulse interface / analog signals
11 PWM; PWM-Output (BNC-connector) (PWM = Pulse width modulator)
12 X14-Analog interface laserhead
13 Serial interfaces:
X54-Serial CNC-interface
X84-Connection keyboard and display
14 19" Computer rack (3 HE = 3 height units)

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## Digital inputs 24 V DC at computer rack: 6.0.1

A list of the digital inputs with their immediate status can be obtained on the display of the digital input / output (I / O) menu.
The list will help you to check the values displayed.

| Contacts | Correct status | Input / Function | Description |
|---|---|---|---|
| X70.1 | 1, if the thermostat S20 for the cooling water of the RF tube has not tripped. | E10.0 | TEMP. RF TUBE |
| X70.2 | 1, if none of the thermostats S33, S34 and / or S35 of the laser beam shutter or S36 has tripped. | E10.1 | TEMP. SHUTTER |
| X70.3 | 1, if S24 (pressure switch or thermostat) for the telescope gives no fault alarm. | E10.2 | TEMP./PR. TELESCOPE |
| X70.4 | 1, if the dynamic pressure gauge S25 of the RF generator fan measures dynamic pressure O.K. | E10.3 | FAN RF GENERATOR |
| X70.5 | 1, if the flow meter S21 measures enough cooling water flow through the RF tube. | E10.4 | WATERFLOW RF TUBE |
| X70.6 | 1, if the pressure switch S26 measures enough laser gas pressure behind the pressure reducing valve at the laser gas bottle. | E10.5 | PRESSURE LASERGAS |
| X70.7 | A door of the lasser head or an external Interlock is open. | E10.6 | INTERLOCK / DOORS |
| X70.8 | 1, if the grid control of the RF tube measures no grid overcurrent. | E10.7 | GRID CURRENT |
| X70.9 | Reserve - not used. | E10.8 | -- |
| X70.10 | 1, if the cooling water conductivity monitoring gives no fault alarm. | E10.9 | WATER CONDUCTIVITY |
| X70.11 | For optional ON / OFF operators panel only! | E10.10 | GASCHANGE |
| X70.12 | For optional ON / OFF operators panel only! | E10.11 | LAMPTEST |
| X70.13 | For optional ON / OFF operators panel only! | E10.12 | RESET |
| X70.14 | 1, if the key switch **Mode select** is in position "**Automatic**". | E10.13 | MAN/AUTO ENABLE |
| X70.15 | External selection of positioning laser. | E10.14 | ALIGNMENT LASER |

| Contacts | Correct status | Input / Function | Description |
|---|---|---|---|
| X80.1 | 1, if the thermostat S16 for the HV transformer has not tripped. | E11.0 | TEMP. HV TRANSF. |
| X80.2 | 1, if none of the thermostats S14 or S15 for the HV in the control cabinet has tripped. | E11.1 | TEMP. HV CABINET |
| X80.3 | 1, if the flow meter S23 measures enough cooling water flow. | E11.2 | WATERFLOW |
| X80.4 | 1, if the thermostat S22 for the cooling water has not tripped. | E11.3 | TEMP. WATER |
| X80.5 | 0, if the motor circuit breaker Q3 for the filament of the RF tube is switched ON. | E11.4 | I > FILAMENT (Q3) |
| X80.6 | 0, if the motor circuit breaker Q4 for the vacuum pump is switched ON. | E11.5 | I > VACUUM PUMP (Q4) |
| X80.7 | 0, if the motor circuit breakers Q5 and Q6 for the fans are switched ON. | E11.6 | I > FANS (Q5 / Q6) |
| X80.8 | 1, if the HV overcurrent metering measures no overcurrent. | E11.7 | HV OVER-CURRENT |
| X80.9 | 1, if mains contactor K3 is switched OFF. | E11.8 | MAINS IS OFF (K3) |
| X80.10 | 1, if contactor K9 measures that the shutter is CLOSED. | E11.9 | SHUTTER IS CLOSED |
| X80.11 | 1, if contactor K8 indicates that the shutter will be opened. | E11.10 | SHUTTER K8 |
| X80.12 | 1, if contactor K10 measures that the shutter is OPEN. | E11.11 | SHUTTER IS OPEN |
| X80.13 | 1, if the HV contactor K1 is switched OFF. | E11.12 | HV IS OFF (K1) |
| X80.14 | 1, if the laser emission warning indicator is ON (warning lamp on top of the laser head). | E11.13 | LASER WARNING LAMP |
| X80.15 | 1, if Softstart for the HV transformer is O.K. | E11.14 | HV SOFTSTART O.K. |

## Relay outputs 24 V DC at computer rack: 6.0.2

A list of relay outputs with their immediate status can be displayed on the digital input / output (I / O) menu.

| Contacts | Correct status | Output | Description |
|---|---|---|---|
| X81.2/3 | Closed if shutter is enabled | K32.0 | SHUTTER ENABLE |
| X81.4/5 | Closed to switch ON the vacuum pump | K32.1 | VACUUM PUMP ON |
| X81.6/7 | Closed to switch ON the filament of the RF tube | K32.2 | FILAMENT ON |
| X81.8/9 | Closed to switch ON the grid voltage for the RF tube | K32.3 | GRID VOLTAGE ON |
| X81.10/11 | Closed to switch ON the valve Y1 for laser gas filling of the vacuum vessel | K32.4 | GAS FILL VALVE |
| X81.12/13 | Closed to switch ON valve Y2 for vacuum vessel evacuation | K32.5 | EVACUATION VALVE |
| X81.14/15 | Closed for 200 ms if the shutter shall be opened via a ramping program (with optional Ramping generator only!) | K32.6 | SHUTTER OPEN |
| X91.2/3 | Closed if mains is enabled | K33.0 | MAINS ENABLE |
| X91.4/5 | Closed if HV is enabled | K33.1 | HV ENABLE |
| X91.6/7 | Closed if a general fault occurs | K33.2 | FAULT INDICATION |
| X91.8/9 | Control signal for the positioning laser | K33.3 | ALIGNMENT LASER |
| X91.10/11 | Closed permanently at a general fault.<br>Closed periodically at laser gas exchange or vacuum test. | K33.4 | FAULT LAMP |
| X91.12/13 | Closed if lamp test is activated | K33.5 | LAMPTEST |
| X91.14/15 | Closed if HV Softstart is activated | K33.6 | HV SOFTSTART |

## Interfaces to external control system: 6.1

The laser has various interfaces to an external control system. The interfaces are lead to connectors in the control cabinet.
External commands and messages to laser via potential-free contacts of CNC:

**Switching voltage is 230 V AC!**

| Function / description: | Contacts: |
|---|---|
| **Emergency OFF**<br>When these contacts open the laser main supply is switched OFF. | X71.1/13 |
| **Mains OFF**<br>When these contacts open the laser main supply is switched OFF, or is disabled if already OFF. | X71.2/14 |
| **--**<br>--- | X71.3/15 |
| **Ext. interlock**<br>If these contacts are open the high voltage for the laser cannot be switched on. | X71.4/16 |
| **High voltage OFF**<br>When these contacts open the high voltage is switched OFF or is disabled if already OFF. | X71.5/17 |
| **High voltage ON**<br>When these contacts have been closed for approx. 500 msec the high voltage will switched ON.<br>High voltage will remain ON as long as contacts X71.5/17 are closed and no fault alarms occur. | X71.6/18 |
| **Shutter CLOSE**<br>When these contacts open the shutter will CLOSE, or opening of the shutter is disabled if shutter is already CLOSE. | X71.7/19 |
| **Shutter OPEN**<br>When these contacts have been closed for approx. 200 msec the shutter will OPEN.<br>Premises:<br>• High voltage is ON<br>• Keyswitch **Mode select** must be at the **Automatic** position<br>• Keyswitch Shutter must be enabled | X71.8/20 |

| Function / description: | Contacts: |
|---|---|
| **Positioning laser**<br>When these contacts have been closed, the positioning laser is switched ON.<br>**Note: Positioning laser is ready after approximately 1.5 seconds.** | X71.12/24 |
| **Shutter open (Computer)**<br>Connection to switch shutter by computer.<br>Available with optional Ramping Generator only!<br><br>**Attention - Note that the shutter then will be controlled only via the computer-software!** | see drawing<br>122.700 ASP 01/3 |

## Status signals from laser to an ext. control system: 6.1.1

The interfaces are wired to terminal strip X83 in the control cabinet.
These signals are also passed via potential-free contacts of the laser.

| Function / description: | Contacts: |
|---|---|
| **Emergency OFF**<br>Contact opens when one of the Emergency OFF buttons on the laser is pressed. | X83.1/13 |
| **Mains ON**<br>This contact will close when the main supply is switched ON at the laser. | X83.2/14 |
| **Chiller ON**<br>This contact closes when the main power supply is switched ON at the laser. This enables an external chiller to be switched on at the same time than the laser. | X83.3/15 |
| **High voltage ON**<br>This contact will close when the high voltage is switched ON at the laser.<br>**Note: Laser is ready after approximately 5 seconds.** | X83.4/16 |
| **Shutter OPEN**<br>This contact will close when the shutter has opened. | X83.5/17 |
| **Shutter CLOSED**<br>This contact will close when the shutter has closed. | X83.6/18 |
| **General fault**<br>This contact will close if the computer measures a fault alarm. | X83.7/19 |
| **Shutter CLOSED**<br>This status signal is given by a positively driven contact. It is directly placed at the shutter. | X83.8/20 |
| **Positioning laser**<br>This status signal is given by a positively driven contact. It is directly controlled by the positioning laser. | X83.12/24 |

## Pulse- and analog-interface X44: 6.1.2

X44 is a 16 - pole terminal strip and is located on the Pulse generator at the computer rack.

| Function / description: | Contacts: |
|---|---|
| **EXT. GATE 24 V** **= Laser ON**<br>**EXT. GATE 15 / 5 V**<br>Use jumper "Gate" on PCB 422 to switch between 5 V and 15 V.<br>**EXT. GATE GND**<br>Maximum delay for this input is 300 µs (microseconds). | X44.1<br>X44.2<br><br>X44.3 |
| **EXT. PULSE 15 / 5 V**<br><br>Use jumper "Pulse" on PCB 422 to switch between 5 V and 15 V. If "Ext. Pulse" is activated in the selected pulse program, this input is used for pulsing the laser directly.<br>**EXT. PULSE GND** | X44.4<br><br><br><br>X44.5 |
| **INCR + 5 V** Power supply voltage of incremental encoder<br>**INCR +** Positive signal from incremental encoder<br>**INCR -** Negative signal from incremental encoder<br>**INCR. GND** GND of incremental encoder | X44.6<br>X44.7<br>X44.8<br>X44.9 |
| **+ 10 V** Power supply voltage for external potentiometer | X44.10 |
| **ANALOG 1 +** 0 - 10 V<br>**ANALOG 1 –**<br>**ANALOG 1 GND** | X44.11<br>X44.12<br>X44.13 |
| **ANALOG 2 +** 0 - 10 V<br>**ANALOG 2 –**<br>**ANALOG 2 GND** | X44.14<br>X44.15<br>X44.16 |

## Serial interface TTY (20 mA); connector X54 (optional): 6.1.3

X54 is a 9-pole D-sub connector and is located at the computer rack. The interface will be used for optional serial CNC-interface.

## Digital input, terminal strip X440 (optional): 6.1.4

The digital input can be used for digital control of power levels.

## CNC interface, terminal strip X40: 6.1.5

## Pulse Programs - Selection by CNC

Terminal strip X40 is located at the computer rack. The signals to X40 are processed by the software, and as a result delays of up to 1.5 msec can occur.
These signals have opto-couplers and are rated for 24 V DC (U = 20 to 27 V, I < 12 mA).

| Function / description: | Contacts: |
|---|---|
| **Selection of Pulse- and Ramping Programs**<br>These signals are used for external program selection. If several select lines are activated simultaneously, their weightings are added, so that programs can be selected in binary coded form. Pulse- or ramping program: see X40.10.<br>Note: **Selection of Pulse- or Ramping programs via CNC-interface** on the following pages. | X40.1 bis X40.9 |
| **Selection between Pulse- and Ramping Programs**<br>(Available with optional Ramping Generator only!)<br>If this contact is 24 V, a ramping program is selected with X40.1 to X40.9.<br>If this contact is 0 V, a pulse program is selected with X40.1 to X40.9. | X40.10 |
| **Fault RESET**<br>This contact provides RESET of laser fault alarms from external. | X40.14 |
| **Lamp test**<br>This contact provides a lamp test (lamps on the control panel of the laser) from external. | X40.15 |
| **EXT. GND**<br>This contact provides a common reference potential for signals X40.1 to X40.15. | X40.16 |

**Selection of Pulse- or Ramping programs via CNC-interface:**

The contacts X40.1 - X40.9 are used for the external selection of programs at the CNC interface connector.

Pulse- or ramping program selection is made with signal X40.10.

Programs 0 - 8 may be selected by activating individual signal lines:

| Activated signal line: | X40.9 | X40.8 | X40.7 | X40.6 | X40.5 | X40.4 | X40.3 | X40.2 | X40.1 |
|---|---|---|---|---|---|---|---|---|---|
| Value: | | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 |
| Program no.: | | | | | | | | | |
| 0 | | | | | | | | | |
| 1 | | | | | | | | | **x** |
| 2 | | | | | | | | **x** | |
| 3 | | | | | | | **x** | | |
| 4 | | | | | | **x** | | | |
| 5 | | | | | **x** | | | | |
| 6 | | | | **x** | | | | | |
| 7 | | | **x** | | | | | | |
| 8 | | **x** | | | | | | | |

You may select 1 - 15 programs by activating several signal lines simultaneously. In this case, merely the contacts X40.1, X40.2, X40.4, and X40.8 are used; contact X40.9 is set to "0".

The sum of the values of signal lines selected indicates the number of the selected program number:

| Activated signal line: | X40.9 | X40.8 | X40.7 | X40.6 | X40.5 | X40.4 | X40.3 | X40.2 | X40.1 |
|---|---|---|---|---|---|---|---|---|---|
| Value: | | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 |
| Program no.: | | | | | | | | | |
| 0 | | | | | | | | | |
| 1 | | | | | | | | | x |
| 2 | | | | | | | | x | |
| 3 | | | | | | | | x | x |
| 4 | | | | | | x | | | |
| 5 | | | | | | x | | | x |
| 6 | | | | | | x | | x | |
| 7 | | | | | | x | | x | x |
| 8 | | x | | | | | | | |
| 9 | | x | | | | | | | x |
| 10 | | x | | | | | | x | |
| 11 | | x | | | | | | x | x |
| 12 | | x | | | | x | | | |
| 13 | | x | | | | x | | | x |
| 14 | | x | | | | x | | x | |
| 15 | | x | | | | x | | x | x |

**Selection of 64 programs (binary):**

Max. 64 programs are available to be selected. External selection is explained next:

— Apply a voltage of 24 V DC to contact X40.9.

— Apply **NO** (0 V) voltage to contact X40.7 and X40.8

— Use contacts X40.1 to X40.6 to select program.

— The sum of the values of lines selected indicates the selected program number:

| Activated signal line: | X40.9 | X40.8 | X40.7 | X40.6 | X40.5 | X40.4 | X40.3 | X40.2 | X40.1 |
|---|---|---|---|---|---|---|---|---|---|
| Value: | - | - | - | 32 | 16 | 8 | 4 | 2 | 1 |
| Program no.: | | | | | | | | | |
| 0 | X | | | | | | | | |
| 1 | X | | | | | | | | X |
| 2 | X | | | | | | | X | |
| 3 | X | | | | | | | X | X |
| 4 | X | | | | | | X | | |
| 5 | X | | | | | | X | | X |
| 6 | X | | | | | | X | X | |
| 7 | X | | | | | | X | X | X |
| 8 | X | | | | | X | | | |
| 9 | X | | | | | X | | | X |
| 10 | X | | | | | X | | X | |
| 11 | X | | | | | X | | X | X |
| 12 | X | | | | | X | X | | |
| 13 | X | | | | | X | X | | X |
| 14 | X | | | | | X | X | X | |
| 15 | X | | | | | X | X | X | X |
| 16 | X | | | | X | | | | |
| 17 | X | | | | X | | | | X |
| 18 | X | | | | X | | | X | |
| 19 | X | | | | X | | | X | X |
| 20 | X | | | | X | | X | | |
| 21 | X | | | | X | | X | | X |
| 22 | X | | | | X | | X | X | |
| 23 | X | | | | X | | X | X | X |
| 24 | X | | | | X | X | | | |
| 25 | X | | | | X | X | | | X |

| Activated signal line: | X40.9 | X40.8 | X40.7 | X40.6 | X40.5 | X40.4 | X40.3 | X40.2 | X40.1 |
|---|---|---|---|---|---|---|---|---|---|
| Value: | - | - | - | 32 | 16 | 8 | 4 | 2 | 1 |
| Program no.: | | | | | | | | | |
| 26 | X | | | | X | X | | X | |
| 27 | X | | | | X | X | | X | X |
| 28 | X | | | | X | X | X | | |
| 29 | X | | | | X | X | X | | X |
| 30 | X | | | | X | X | X | X | |
| 31 | X | | | | X | X | X | X | X |
| 32 | X | | | X | | | | | |
| 33 | X | | | X | | | | | X |
| 34 | X | | | X | | | | X | |
| 35 | X | | | X | | | | X | X |
| 36 | X | | | X | | | X | | |
| 37 | X | | | X | | | X | | X |
| 38 | X | | | X | | | X | X | |
| 39 | X | | | X | | | X | X | X |
| 40 | X | | | X | | X | | | |
| 41 | X | | | X | | X | | | X |
| 42 | X | | | X | | X | | X | |
| 43 | X | | | X | | X | | X | X |
| 44 | X | | | X | | X | X | | |
| 45 | X | | | X | | X | X | | X |
| 46 | X | | | X | | X | X | X | |
| 47 | X | | | X | | X | X | X | X |
| 48 | X | | | X | X | | | | |
| 49 | X | | | X | X | | | | X |
| 50 | X | | | X | X | | | X | |
| 51 | X | | | X | X | | | X | X |
| 52 | X | | | X | X | | X | | |
| 53 | X | | | X | X | | X | | X |
| 54 | X | | | X | X | | X | X | |
| 55 | X | | | X | X | | X | X | X |
| 56 | X | | | X | X | X | | | |
| 57 | X | | | X | X | X | | | X |
| 58 | X | | | X | X | X | | X | |
| 59 | X | | | X | X | X | | X | X |
| 60 | X | | | X | X | X | X | | |
| 61 | X | | | X | X | X | X | | X |
| 62 | X | | | X | X | X | X | X | |
| 63 | X | | | X | X | X | X | X | X |

**Selection of 64 programs BCD (= Binary Coded Decimal code):**

Max. 64 programs are available to be selected. External selection is explained next:

— Apply a voltage of 24 V DC to contact X40.8 and X40.9.

— Use contacts X40.1 to X40.7 to select program.

— The sum of the values of lines selected indicates the selected program number:

| Activated signal line: | X40.9 | X40.8 | X40.7 | X40.6 | X40.5 | X40.4 | X40.3 | X40.2 | X40.1 |
|---|---|---|---|---|---|---|---|---|---|
| Value: | - | - | 40 | 20 | 10 | 8 | 4 | 2 | 1 |
| Program no.: | | | | | | | | | |
| 0 | | | | | | | | | |
| 1 | X | X | | | | | | | X |
| 2 | X | X | | | | | | X | |
| 3 | X | X | | | | | | X | X |
| 4 | X | X | | | | | X | | |
| 5 | X | X | | | | | X | | X |
| 6 | X | X | | | | | X | X | |
| 7 | X | X | | | | | X | X | X |
| 8 | X | X | | | | X | | | |
| 9 | X | X | | | | X | | | X |
| 10 | X | X | | | X | | | | |
| 11 | X | X | | | X | | | | X |
| 12 | X | X | | | X | | | X | |
| 13 | X | X | | | X | | | X | X |
| 14 | X | X | | | X | | X | | |
| 15 | X | X | | | X | | X | | X |
| 16 | X | X | | | X | | X | X | |
| 17 | X | X | | | X | | X | X | X |
| 18 | X | X | | | X | X | | | |
| 19 | X | X | | | X | X | | | X |
| 20 | X | X | | X | | | | | |
| 21 | X | X | | X | | | | | X |
| 22 | X | X | | X | | | | X | |
| 23 | X | X | | X | | | | X | X |
| 24 | X | X | | X | | | X | | |
| 25 | X | X | | X | | | X | | X |

| Activated signal line: | X40.9 | X40.8 | X40.7 | X40.6 | X40.5 | X40.4 | X40.3 | X40.2 | X40.1 |
|---|---|---|---|---|---|---|---|---|---|
| Value: | - | - | 40 | 20 | 10 | 8 | 4 | 2 | 1 |
| Program no.: | | | | | | | | | |
| 26 | X | X | | X | | | X | X | |
| 27 | X | X | | X | | | X | X | X |
| 28 | X | X | | X | | X | | | |
| 29 | X | X | | X | | X | | | X |
| 30 | X | X | | X | X | | | | |
| 31 | X | X | | X | X | | | | X |
| 32 | X | X | | X | X | | | X | |
| 33 | X | X | | X | X | | | X | X |
| 34 | X | X | | X | X | | X | | |
| 35 | X | X | | X | X | | X | | X |
| 36 | X | X | | X | X | | X | X | |
| 37 | X | X | | X | X | | X | X | X |
| 38 | X | X | | X | X | X | | | |
| 39 | X | X | | X | X | X | | | X |
| 40 | X | X | X | | | | | | |
| 41 | X | X | X | | | | | | X |
| 42 | X | X | X | | | | | X | |
| 43 | X | X | X | | | | | X | X |
| 44 | X | X | X | | | | X | | |
| 45 | X | X | X | | | | X | | X |
| 46 | X | X | X | | | | X | X | |
| 47 | X | X | X | | | | X | X | X |
| 48 | X | X | X | | | X | | | |
| 49 | X | X | X | | | X | | | X |
| 50 | X | X | X | | X | | | | |
| 51 | X | X | X | | X | | | | X |
| 52 | X | X | X | | X | | | X | |
| 53 | X | X | X | | X | | | X | X |
| 54 | X | X | X | | X | | X | | |
| 55 | X | X | X | | X | | X | | X |
| 56 | X | X | X | | X | | X | X | |
| 57 | X | X | X | | X | | X | X | X |
| 58 | X | X | X | | X | X | | | |
| 59 | X | X | X | | X | X | | | X |
| 60 | X | X | X | X | | | | | |
| 61 | X | X | X | X | | | | | X |
| 62 | X | X | X | X | | | | X | |
| 63 | X | X | X | X | | | | X | X |

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## Programming with Pulse- / Ramping Generator (optional):



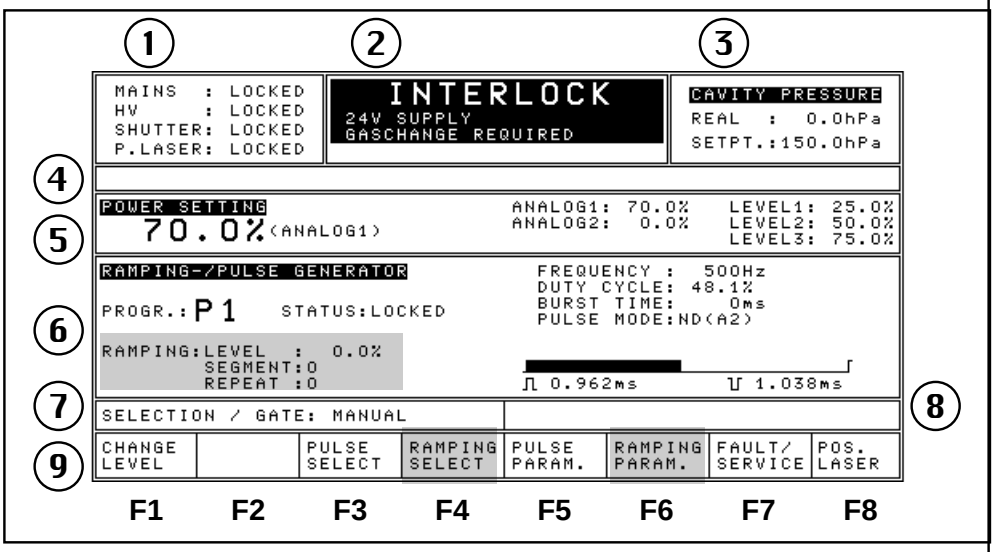



**Fig. 6.2/1:**
Laser Menu (example)
**Grey marked parts of Laser Menu only available with optional Pulse- / Ramping-Generator (RPG).**

On the display the current conditions of the laser are shown. Several menus can be selected.

(1)

Shows current condition of mains, high voltage, laser beam shutter and positioning laser.

(2)

Gives information about current working conditions and fault alarms and messages. If High Voltage is turned on, actual laserpower is shown.

(3)

Shows actual cavity gas pressure and nominal value.

(4)

Shows warnings.

**5**

Power setting: Nominal values for laser power.
Levels analog 1 and 2 are external analog inputs.
Digital is a digital input (optional). Select level via pulse or ramping programs.
Level 1 - 3 are programmable values. They will be changed by pressing function key **F1** CHANGE LEVEL.
The preset value selected is displayed in bigger size. Text beside shows the source of nominal value.

**6**

Pulse- / Ramping Generator (RPG): Shows status of Pulse Generator and parameters of the selected pulse program.
If Ramping Generator (option) is installed, ramping parameters are displayed.

**7**

SELECTION / GATE: Shows settings of selection and start of pulse and ramping programs. The display shows the position of the key switch **Mode Select** (operation via **Manual- (MANUAL)** or **Automatic (AUTO)**).

Setting MANUAL: Selection of programs, levels and release of discharge (= laser beam **ON**) only possible by keyboard. Selection via CNC - Interface is locked.

Setting AUTO: Selection of programs via CNC - interface. Release of discharge (= laser beam **ON**) with signal "Ext. Gate" on Pulse Generator (X44).

**8**

Changing parameters: Information about change of parameters (INTERNAL or EXTERNAL) if optional serial CNC - interface is installed. Changing is only possible in the Service / Report Menu.

Setting INTERNAL: Changing of parameters only possible by keyboard. Selection via serial CNC - Interface is locked.

Setting EXTERNAL: Changing of parameters only via serial CNC - interface.

**9**

Short commands: Using the corresponding function keys the listed commands are available.

**Key switch on keyboard:**

Depending on the position of the key switch (on keyboard) different function keys are available.
Positions are 0, I and II. The key may be pulled out in any position. This makes it possible for the programmer or service personnel to lock the laser in the chosen position.

Position 0:
Parameters can not be changed exceptional level 1. The discharge (= laser beam **ON**) can not be turned on with the 1 -key.

Position I:
The discharge (= laser beam **ON**) can be turned on with the 1 -key. The operator can select pulse and ramping programs, change pulse and ramping parameters and levels.

Position II:
Same as position I, additionally the Service / Report Menu can be chosen. Only personnel knowing the Service-Codes can change laser parameters.
Please consult ROFIN-SINAR, if you want to use this option.

**Care for the observation and take notice of all safety instructions and precautions which are prescribed for laser operation.**

**Caution:**
**Read and observe safety section 2 - 2.8 of the owners manual before turning on the laser beam with the 1 -key!**

**Attention:**
**Accidental use of the 1 -key (laser beam ON) is protected by a safety circuit.**
**The 1 -key (laser beam ON) must be pressed twice in half a second ("double-click") to turn the laser beam ON.**

**Description of short commands available in position 0, I or II of the key switch on the keyboard:**

**CHANGE LEVEL**

Function key **F1** to change levels 1 - 3 (Power-level).
Premise:
With option serial CNC - interface the setting of "Parameter change" must be "INTERNAL".
In position "0" of key switch only level 1 can be changed.

- Select a level using the cursor keys.
- Adjust level to desired value using potentiometer or change the selected level by keyboard and quit with RETURN, e. g.:

**27.8** ↵

After pressing RETURN-key cursor goes to next level.
If only this level shall be changed, press function key **F1** again to finish input.

**PULSE SELECT**

Function key **F3** to select pulse programs.
Premise:
Key switch on keyboard in position I or II and "SELECTION / GATE" on "MANUAL".

Input window for PULSE SELECTION:


Type in pulse program-number by keyboard and quit with RETURN, e. g.:

**12** ↵

Now pulse program 12 is selected.

**RAMPING SELECT**

Function key **F4** to select ramping programs.
Only available with optional Pulse- / Ramping Generator (RPG).

Premise:
Key switch on keyboard in position I or II and "SELECTION / GATE" on "MANUAL".

Input window for RAMPING SELECTION:


Type in ramping program-number by keyboard and quit with RETURN, e. g.:

**7** ↵

Now ramping program 7 is selected.

**PULSE PARAM.**

Function key **F5** to select the Pulse Parameter Menu.

**RAMPING PARAM.**

Function key **F6** to select the Ramp Parameter Menu.
Only available with optional Pulse- / Ramping Generator (RPG).

**FAULT/ SERVICE**

Function key **F7** to select the Fault Alarm Menu.

**POS. LASER**

Function key **F8** to activate the positioning laser. If the positioning laser is active, the text of the function key is displayed inverse.

Premise:
SELECTION / GATE: MANUAL

**Note:**
It takes approx. 1.5 seconds until the positioning laser is ready.

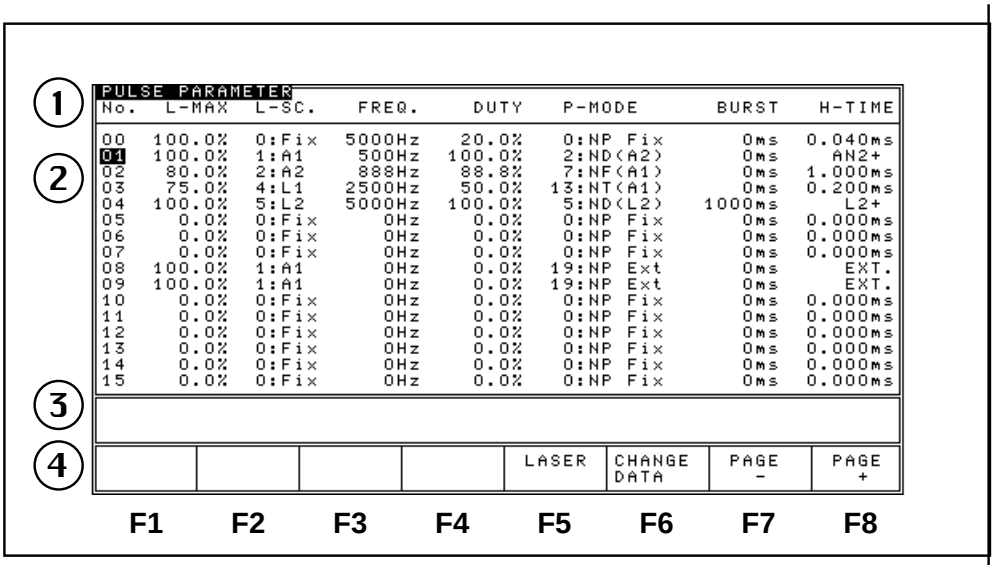



**Fig. 6.2/2:**
Pulse Parameter Menu (example)

The laser has a programmable Pulse Generator which stores 64 Pulse Programs (pulse program-numbers: 0 - 63).
Changing of pulse parameters possible by keyboard or serial CNC - interface (optional).
Selection of pulse programs by keyboard or CNC - interface (X40).

The Pulse Parameter Menu is divided up into 4 areas:

(1)

Names of columns of pulse parameters:

| | |
|---|---|
| No. | number of pulse program |
| L-MAX | maximum pulse level |
| L-SC. | displays source for scaling the pulse level |
| FREQ. | pulse frequency |
| DUTY | duty cycle |
| P-MODE | pulse mode |
| BURST | display of burst time in milliseconds;<br>BURST 0 = continuous mode |
| H-TIME | displays the computed pulse duration or the source which controls the pulse duration |

(2)

Simultaneous display of 16 from 64 pulse programs. The number of the selected pulse program is displayed inverse.

③

Shows warning if changing of pulse parameters is locked.

④

Short commands: Using the corresponding function keys the listed commands are available.

**Description of short commands of Pulse Parameter Menu:**

| LASER |
|---|

Function key to select Laser Menu.

| CHANGE DATA |
|---|

Function key to change selected pulse programs:
First you have to select the number of the pulse program with the cursor keys.
After pressing function key **F6** the selected pulse program will be framed and the function keys switch to other short commands (**Fig. 6.2/3**).

| PAGE - |
|---|

Function key to display the previous 8 pulse programs of the listing.

| PAGE + |
|---|

Function key to display the next 8 pulse programs of the listing.

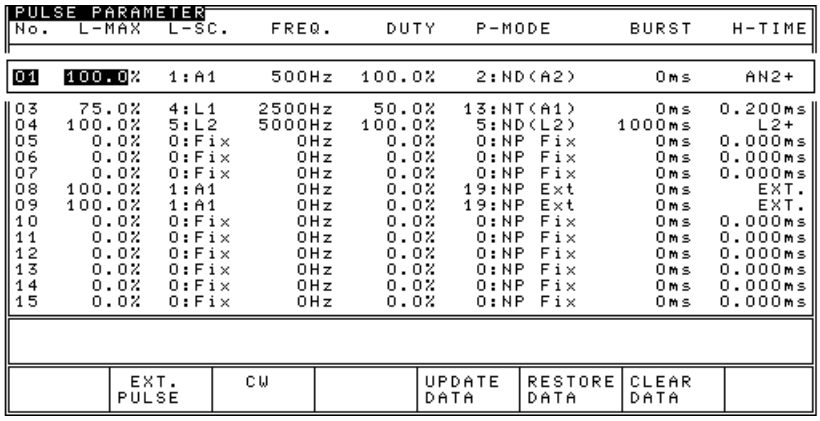



**Fig. 6.2/3:**
Pulse Parameter Change Menu (example)

Pulse Parameter Change Menu after pressing function key **F6** CHANGE DATA in the Pulse Parameter Menu (**Fig. 6.2/2**).

**EXT. PULSE**

Function key to activate external pulse input (X44) in the selected pulse program.
The same function can be released by putting value "19" into column "P-MODE".

**CW**

Function key to activate CW-Mode. Duty cycle setting is fixed to 100 %.

**UPDATE DATA**

Function key to save the edited data.
**Copy function**: If you change the pulse program-number, the data will be written into the pulse program with the new number.

**RESTORE DATA**

Function key to cancel changes. Changes you made but not saved yet will not be saved.

**CLEAR DATA**

Function key to clear the selected data in columns Frequency, Duty cycle and Burst time. All values in these columns become zero. You can return this function by pressing function key **F6** RESTORE DATA.

**Hints for changing pulse programs:**

After pressing function key **F6** CHANGE DATA in the Pulse Parameter Menu (**Fig. 6.2/2**) the Pulse Parameter Change Menu will appear. The cursor is in column "L-MAX" of the Pulse Parameter Change Menu (**Fig. 6.2/3**).

With cursor keys →| and |← you can change from column to column. Cursor keys → and ← move cursor in one column.

You may change values of the following columns:

**Safety instructions for workpiece alignment:**
**After setting the laser parameters required, remove the key of the key switch MODE SELECT from the control panel in position "0" and pull it out. The workpiece can then be aligned.**
**Lock and seal off the system accordingly until the alignment has be completed. Clearly mark the alignment work, for example, by setting up warning plates.**

**No.**

Column for pulse program-number.
**Copy function:** If you change the pulse program-number, the data will be written into the pulse program with the new number.

**L-MAX:**

Pulse level within the borders: 0.0 - 100.0 %.
If you program a value > 0 into column "L-SC.", then in column "L-MAX" the maximum possible pulse level is displayed. The maximum possible pulse level will only be reached, when the source for scaling (L-SC.) is at 100 %.

**L-SC.:**

Pulse level (PL) source for scaling the pulse level.

| Coding of column "L-SC.": | Resulting pulse level: (L = L-MAX) |
|---|---|
| 0 : Fix | I = L |
| 1 : A1 | I = L * A1 |
| 2 : A2 | I = L * A2 |
| 3 : Di | I = L * Di |
| 4 : L1 | I = L * L1 |
| 5 : L2 | I = L * L2 |
| 6 : L3 | I = L * L3 |
| 7 : A1d | I = A1 |
| 8 : A2d | I = A2 |

**Note:**
A1d and A2d are connected directly analog. L-MAX is 100 % therefore.

**FREQ.:**

Pulse frequency within the borders: 8 - 5000 Hz.

**Special value: 0**

Input of value "0" means "No Pulses". Duty cycle will be set to 0 % automatically.
You can use this feature to move a X / Y-table without laser power (with activated Gate).

**DUTY:**

Duty cycle = programming the ON duration of pulses in %.

**Attention:**
**There is no special function for CW-Mode! You will get CW-Mode by input duty cycle 100 % or pressing function key F3 "CW".**

The laser power will than be programmed with the **pulse level.**

**Borders:**

- Minimal duty cycle is the smallest allowed pulse duration (Th) of 0.026 msec. (26 µs).
  E. g.: If pulse frequency is 1000 Hz, minimal duty cycle is 2.6 %.
- Maximum duty cycle is 100 %.

**P-MODE:**

Pulse mode. Coding of column "P-MODE":

| Code: | resulting pulse function: | |
|---|---|---|
| 0 : NP Fix | f = F; | d = D |
| 1 : ND(A1) | f = F; | d = D * A1 |
| 2 : ND(A2) | f = F; | d = D * A2 |
| 3 : ND(Di) | f = F; | d = D * Di |
| 4 : ND(L1) | f = F; | d = D * L1 |
| 5 : ND(L2) | f = F; | d = D * L2 |
| 6 : ND(L3) | f = F; | d = D * L3 |
| 7 : NF(A1) | Th = D / F; | f = F * A1 |
| 8 : NF(A2) | Th = D / F; | f = F * A2 |
| 9 : NF(Di) | Th = D / F; | f = F * Di |
| 10 : NF(L1) | Th = D / F; | f = F * L1 |
| 11 : NF(L2) | Th = D / F; | f = F * L2 |
| 12 : NF(L3) | Th = D / F; | f = F * L3 |
| 13 : NT(A1) | Th = D / F; | Tl = (10 - 9 * A1 - D) / F |
| 14 : NT(A2) | Th = D / F; | Tl = (10 - 9 * A2 - D) / F |
| 15 : NT(Di) | Th = D / F; | Tl = (10 - 9 * Di - D) / F |
| 16 : NT(L1) | Th = D / F; | Tl = (10 - 9 * L1 - D) / F |
| 17 : NT(L2) | Th = D / F; | Tl = (10 - 9 * L2 - D) / F |
| 18 : NT(L3) | Th = D / F; | Tl = (10 - 9 * L3 - D) / F |
| 19 : NP EXT | f = EXT | d = EXT |

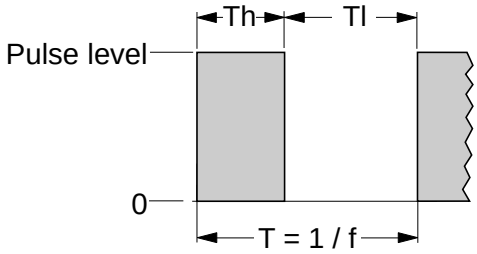
**Pulse mode 0:** FIX (fixed value)
At pulse mode 0 pulse frequency and duty cycle will be set directly by the programmed values in the columns "FREQ." AND "DUTY".

**Pulse mode 19:** EXT (pulse external)
At pulse mode 19 the external pulse input (X44 Pin 4 and 5) will be released.

**Explanation of abbreviations:**

Terms:

F : programmed pulse frequency
D : programmed duty cycle
L : programmed pulse level
f : resulting pulse frequency
d : resulting duty cycle
l : resulting pulse level
Th : pulse duration
Tl : pulse pause
T : Th + Tl = 1 / f
L1…L3 : level 1…3
A1 / A2 : analog input 1 / 2
Di : digital input



## P-MODE 1 - 6: Feature "Duty cycle external":

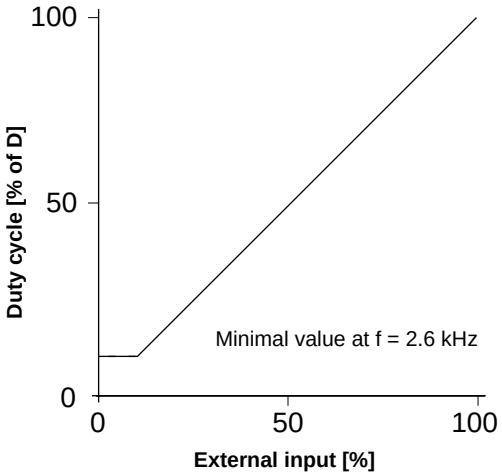



**Fig. 6.2/4:**

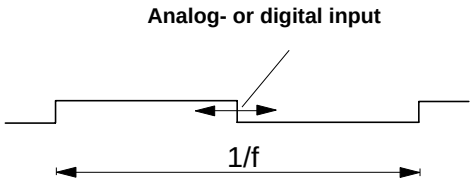



**Fig. 6.2/5:**

At a fixed pulse frequency (F) the duty cycle is determined by an external analog or digital input or a level.
Duty cycle is changing linear from minimal allowed value for programmed pulse frequency up to the programmed value in column "DUTY".

**P-MODE 7 - 12:**
**Feature "Constant pulse duration, frequency external":**

At a fixed pulse duration (Th) the pulse frequency is changing linear to a external analog or digital input or a level.
Effect: You can use the laser for cutting with constant pulse energy per path length if a CNC with a proportional velocity output is installed.
The values in columns "FREQ." and "DUTY" determine the pulse duration.

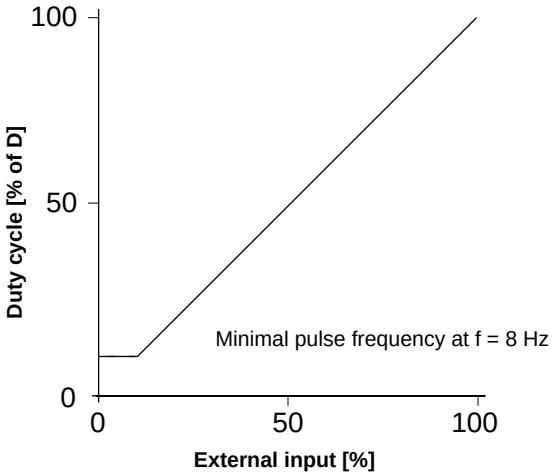



**Fig. 6.2/6:**

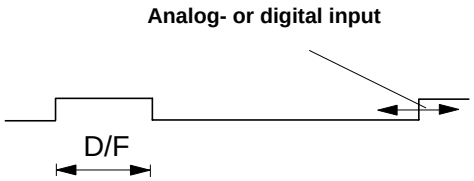



**Fig. 6.2/7:**

Th = D / F
allowed value for F are: 8 - 5000 Hz

The pulse duration (Th) can be determined from 0.026 msec. to 125 msec.

Pulse frequency and duty cycle are linear from the minimal pulse frequency to the programmed values in columns "FREQ." and "DUTY".

**P-MODE 13 - 18:**
**Feature "Constant pulse duration, OFF - time external":**

At fixed pulse duration (Th) the pulse pause (TI) will be changed linear to an external analog or digital input or a level.
The values in columns "FREQ." and "DUTY" determine the pulse duration.

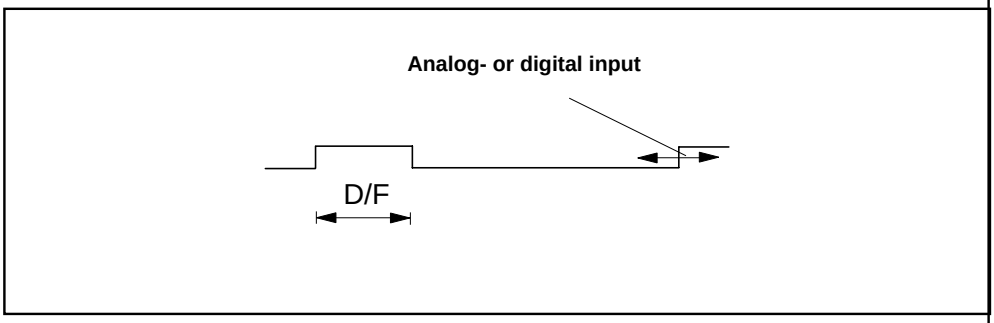



**Fig. 6.2/8:**

Th = D / F
allowed values for F: 8 - 5000 Hz

The pulse duration (Th) can be determined from 0.026 msec. to 125 msec.

Input 0 %: TI = (10 - D) / F
Input 100 %: TI = (1 - D) / F

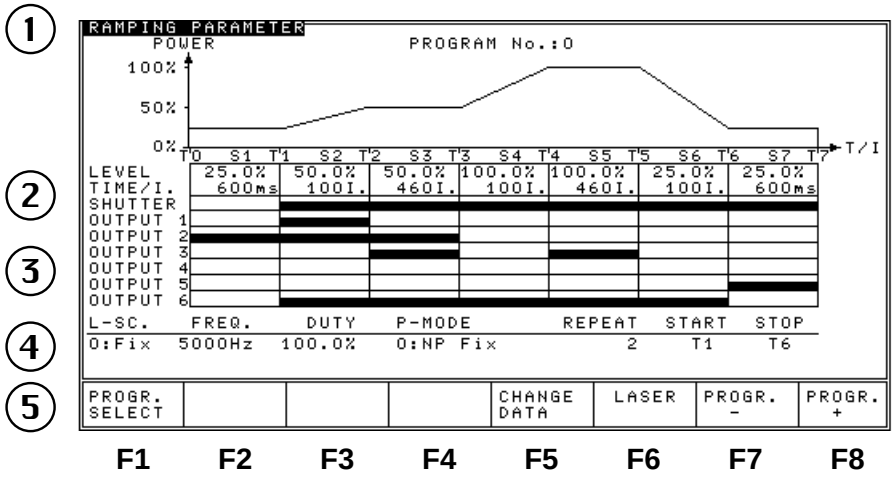



**Fig. 6.2/13:**
Ramping Parameter-Menu (example)

**Ramping Generator:**

Key features:
- Graphic diagram of ramping curve
- Repeat function (Loop) for segment welding

The Laser is equipped with a programmable Ramping Generator, which can store up to 64 pulse programs (program numbers: 0 - 63). The ramping parameters are entered using the keyboard.
Selecting ramping programs is possible using the keyboard or an external CNC control connected to the corresponding interface.
The ramping programs contain max. 7 segments. They are displayed on the display. Additionally you can program a number of repetitions (Loop) between two segments.

The Ramping Generator also has:
- a programmable laser beam shutter and
- 6 programmable digital outputs for commands to the processing machine.

**Fig. 6.2/13** shows an example of the Ramping Parameter Menu.

The Ramping Parameter Menu is divided up into 5 areas:

(1)

Power diagram (Level * duty cycle) and program number.

(2)

Table of values:

| | |
|---|---|
| Level | 0.0 - 100.0 % |
| Time / Increment | 0 - 65535 ms / Incr. |

You can change these values by using keyboard and cursor keys.

(3)

Display programming of laser beam shutter and digital outputs 1 - 6.

Programming:
With cursor keys → and ← you can change from segment to segment.
Cursor keys ↑ and ↓ move cursor in one segment up and down.
0 (zero) = laser beam shutter **CLOSE**, output **OFF**
1 = laser beam shutter **OPEN**, output **ON**
SPACE = toggle between 0 and 1

■■■■■ = laser beam shutter **OPEN** or
■■■■■ = digital output 1 - 6 **ON**

(4)

Premises for the whole ramp:

| | |
|---|---|
| L-SC.: | Code for the source of scaling of the ramp curve:<br>0 = Fix<br>1 = Analog 1<br>2 = Analog 2<br>3 = Digital input<br>4 = Level 1<br>5 = Level 2<br>6 = Level 3 |
| FREQ.: | Pulse frequency ( 0 or 8 - 5000 Hz) |
| DUTY: | Duty cycle (0.0 - 100.0 %) |
| P-MODE: | Coding of pulse mode, see pulse programs |
| REPEAT: | Repetition counter (0 - 65535) |
| START: | Start for repetitions |
| STOP: | End for repetitions |

(5)

Short commands: Using the corresponding function keys the listed commands are available.
The short commands of **Fig. 6.2/13** are displayed in key switch position "0". Editing is disabled. To edit values, the key switch has to be in position "I" or "II". Lock the key switch in position "0" to prevent your programs from changing or misuse.

**Description of short commands:**

**PROGR. SELECT**

Function key to select a ramping program.

**CHANGE DATA**

Function key to change the selected ramping program.

**LASER**

Function key to select the Laser Menu.

**PROGRAM –**

Function key to select the previous ramping program of the listing.

**PROGRAM +**

Function key to select the next ramping program of the listing.

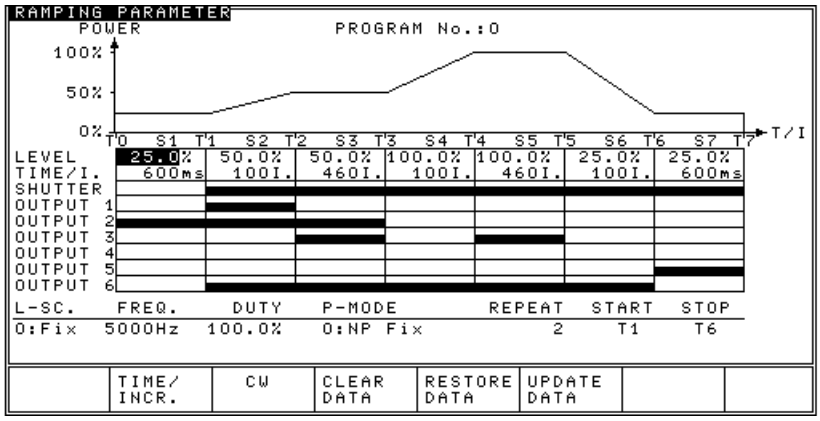



**Fig. 6.2/14:**
Ramping Parameter Change Menu (example)

After pressing function key CHANGE DATA in the Ramping Parameter Menu (**Fig. 6.2/13**) you will find the following short commands:

**TIME/ INCR.**

Function key to change between time-input in msec (milliseconds) or in increments for the segment the cursor is.

**CW**

Function key to select CW-mode. The duty cycle will be determined to 100 %.

**CLEAR DATA**

Function key to reset all values to "0". This function may be cancelled with function key RESTORE DATA.

**RESTORE DATA**

Function key to cancel changes. Changes you made but not saved yet will not be saved.

**UPDATE DATA**

Function key to store the edited values.
**Copy function:** If you change a program-number, the data will be written into the program with the new number.

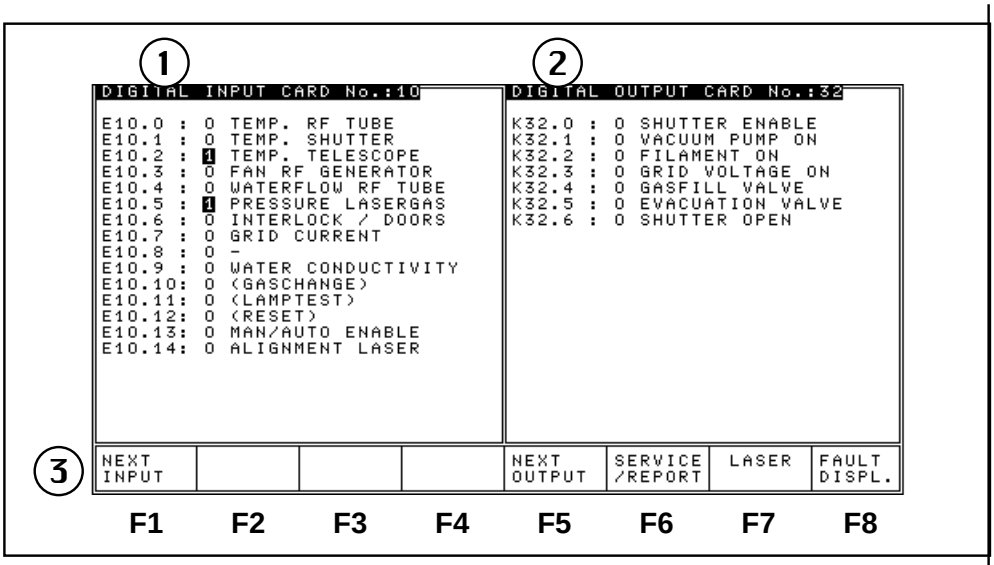



**Fig. 6.2/15:**
Digital Input / Output Menu (example)

The Digital Input / Output (I/O) Menu is divided up into 3 areas:

(1)

Display of the inputs of a digital input card.

(2)

Display of the outputs of a digital output card.

(3)

Short commands: using the corresponding function keys the listed commands are available.

**Explanation of short commands of the Digital Input / Output Menu:**

**NEXT INPUT**

Function key to select the next digital input card.

**NEXT OUTPUT**

Function key to select the next digital output card.

**SERVICE /REPORT**

(Key switch in position II)
Function key to select the Service / Report Menu.

**LASER**

Function key to select the Laser Menu.

**FAULT DISP.**

Function key to select the Fault Alarm Menu.

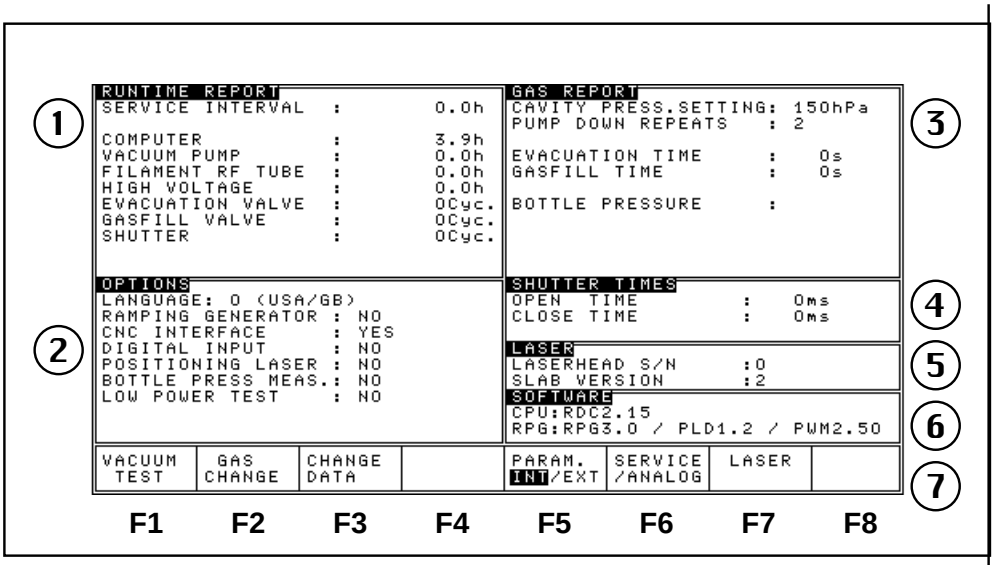



**Fig. 6.2/16 a:**
Service / Report Menu (example)

Service / Report Menu. For safety reasons only ROFIN-SINAR service-personal or specially trained persons may change the preset laser parameters. To be able to change these parameters you have to know specific Service-Codes.

(1)

Display of the operating time and the cycles of the listed components.

(2)

Display all available options.

(3)

Displays nominal value of gas pressure and evacuation and gas fill times of the vacuum vessel (cavity, resonator). The gas pressure is fixed by ROFIN-SINAR.
This gasflow rate guarantees the laser-specifications which are listed in **section 8** — technical data — of this operating manual.

(4)

Display Shutter Report; shows the open- and close time of the laser beam shutter.

(5)

Laser data.

(6)

Displays software-revisions of both microprocessors in the computer.

⑦

Short commands: Using the corresponding function keys the listed commands are available.

**Explanation of the short commands of the Service / Report Menu:**

**VACUUM TEST**

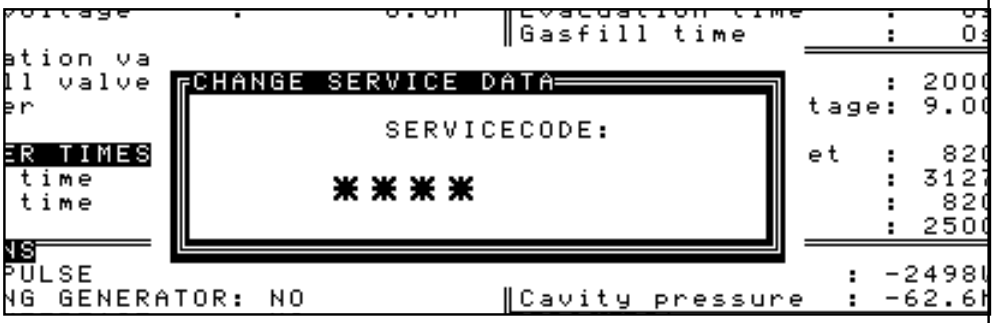
Function key to switch Vacuum Test-Function ON or OFF.

**GAS CHANGE**

Function key to start the laser gas exchange mode. The laser gas in the vacuum vessel should be replaced every 24 hours. To do so, press the function key GAS CHANGE of the Service / Report Menu (**fig. 6.2/16 a**).

**CHANGE DATA**

Function key to change parameters. After pressing, the menu for the Service-Code is displayed.




For safety reasons only ROFIN-SINAR service-personal or specially trained persons may change the preset laser parameters. To be able to change these parameters you must know specific Service-Codes.

- Type in the Service-Code.
- Press the function key of the parameter you want to change.
- Change the parameter with the keyboard.
- Press function key "CHANGE DATA" or ↵ - key (RETURN) to finish inputs.

**PARAM. INT/EXT**

Available with option Serial CNC - interface only: Function key to select from where parameters can be changed.
INT:
By keyboard only
EXT:
By Serial CNC - interface only

**Safety rules for tooling the machine:**
**Pull off the key of the key switch on the keyboard of the laser in position "0" after setting parameters!**
**Lock the machine during tool setting time and sign the tool setting for example with a danger signal.**

**SERVICE /ANALOG**

Function key to select the Service Analog Menu.

**LASER**

Function key to select the Laser Menu.

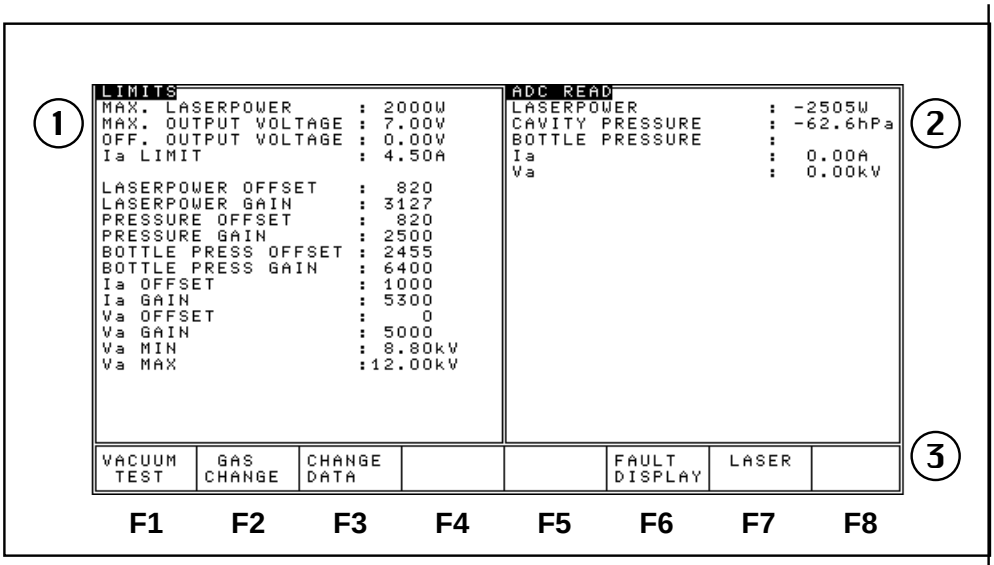



**Fig. 6.2/16 b:**
Service / Analog Menu (example)

Service / Analog Menu.

(1)

Displays limitation of maximum laserpower and balancing values.

(2)

Displays actual measured analog values for balancing purposes (for ROFIN-SINAR Service personnel only).

(3)

Short commands: Using the corresponding function keys the listed commands are available.

**Explanation of the short commands of the Service / Analog Menu:**

**FAULT DISP.**

Function key to select the Fault Alarm Menu.

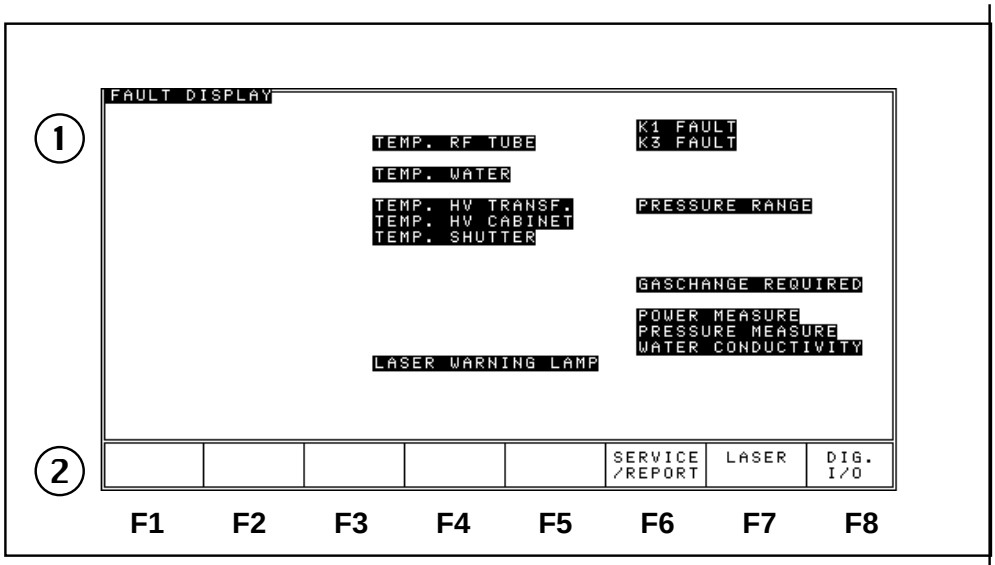



**Fig. 6.2/17:**
Fault Alarm Menu (example)

The Fault Alarm Menu is divided up into 2 areas:

(1)

Display of fault alarms.

(2)

Short commands: Using the corresponding function keys the listed commands are available.

**Description of short commands of Fault Alarm Menu:**

**CNC IF FAULTS**

With option Serial CNC - interface only!
Informations given only to ROFIN-SINAR Service or specially trained personnel.

**SERVICE /REPORT**

Function key to select Service / Report Menu.

**LASER**

Function key to select Laser Menu.

**DIG. I/O**

Function key to select Digital Input / Output Menu.

# Maintenance - generally: 7.

**General safety instructions for maintenance work:**

**Attention!**
**The maintenance and repair of this laser must be performed only by specially trained personnel who have received instruction concerning the hazards involved in its operation. "Instruction" also means reading this manual, particularly sections 2 - 2.8!**

**Attention!**
**The Mains switch (Q1) of the control cabinet has to be switched OFF during any type of maintenance work on the laser! Observe section "Switching the laser OFF".**

**— Always wear laser goggles at maintenance work!**
**The specification of the laser goggles for this laser you will find in section 2.7.**

**— Safe the laser from being switched ON by locking the Mains switch with a padlock while working on it.**

**— Warning:**
**High voltage is absolutely lethal!**
**Always check the capacitors C1 and C2 of the HV power supply before any work in the high voltage (HV) area of the laser head or the control cabinet. They must be discharged totally.**

**Maintenance work:**
**The Mains switch (Q1) of the control cabinet has to be switched OFF during any type of maintenance work on the laser!**

**Warning:**
**Before beginning maintenance or repair work: check that there is no voltage!**

**It is absolutely essential to follow the safety instructions given in section 2 - 2.8 of this manual!**

## Maintenance intervals, maintenances and checks: 7.1

| Maintenance intervals: | Maintenances / checks: | Section: |
|---|---|---|
| — Once a day | 1. Check shutter unit - shutter opens and closes | **7.5** |
| | 2. Exchange of gas | **6.2** |
| — Once a week | 1. Check external cooling water circulation | **4.2** |
| | 2. Check oil level on vacuum pump | **7.3** |
| | 3. Check filling level of internal cooling water circulation | **7.6** |
| | 4. Check pressure in the laser gas cylinder | **7.4.1**<br>**7.4.2** |
| | 5. Note the values displayed in the RUNTIME REPORT field in the Service / Report menu. | **-.-** |
| | 6. Check the laser head and control cabinet for cooling water leakage and contamination. | **-.-** |
| — After 2000 hours or after 6 months | — Inform ROFIN-SINAR Service. ROFIN-SINAR recommends a preventive maintenance to ensure a high availability of the laser. | **-.-** |
| — After 6000 hours or after12 months | — Inform ROFIN-SINAR Service. ROFIN-SINAR recommends you to carry out the necessary maintenance for the laser. | **-.-** |

## Laser resonator: 7.2

The laser resonator is maintenance free. It is fine adjusted and sealed at ROFIN-SINAR. Further adjusting is **not** necessary!

Call for ROFIN-SINAR Service when the laser beam quality or laser output power has changed. This may happen for example after transporting the laser head or long term operation of the laser.

**Attention!**
**The resonator cover is only allowed to be removed by ROFIN-SINAR service personnel. The screws on the resonator cover are not allowed to be changed!**

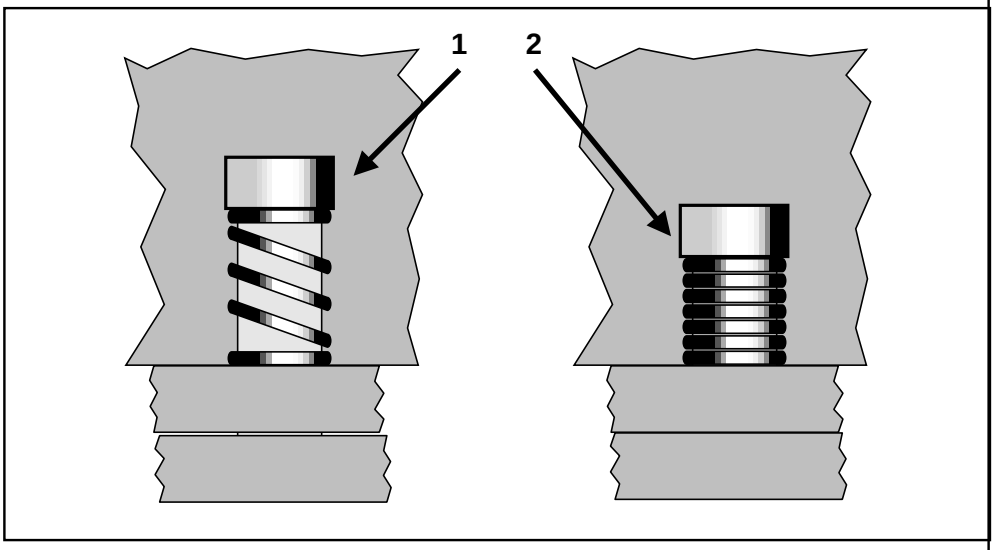



**Fig. 7.2/1:**
**The screw fitting in the resonator cover with screws and springs**
**1 Correct**
**2 Wrong**

**Note:**
**The resonator cover seals the vacuum vessel. It is retained by 6 screws M6 x 50 and springs (1). The screws are not allowed to be replaced with shorter screws (2)!**
**The springs ensure a carefully directed pressure compensation in the event of an overpressure in the vacuum vessel owing to a fault.**

## Vacuum pump: 7.3

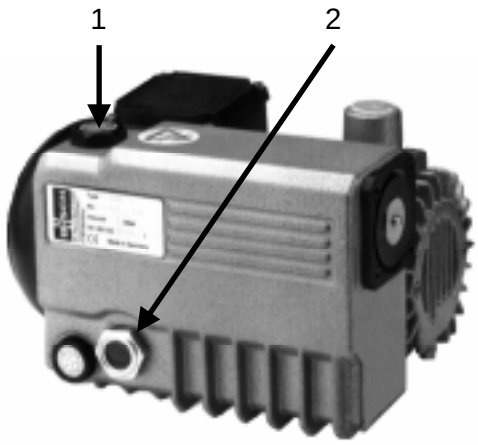



**Fig. 7.3/1:**
**Vacuum pump**
1 Oil fill plug
2 Oil sight glass and oil level label

**Oil quality:**

**Use only specific synthetic oil VE 68 (ROFIN-SINAR material - no.: 830 50 38) for the vacuum pump.**
**The necessary working life of mineral oil in the vacuum pump can not be guaranteed because of the longterm service intervals of the $CO_2$ - Slab - Laser.**

**Oil level check:**

- Check the oil level regularly
- Check when vacuum pump is OFF
- The oil level has to be between 3/4 or max. at the oil level label near the oil sight glass
- Add oil when the vacuum pump is OFF! — **Note the oil quality!**

**Oil change / Change of exhaust filter:**

Oil and vacuum pump exhaust filter will be changed at the normal laser maintenance intervals by ROFIN-SINAR Service personnel.

Note: The vacuum pump of the $CO_2$ - Slab - Laser has no oil filter.

## Laser gas bottle: 7.4

For the operation of $CO_2$ slab lasers by ROFIN-SINAR a Premix laser gas is used. The Premix laser gas contains, among other gases, a 6 percent volume of CO - gas (Carbon monoxide). The laser gas bottle contains 1500 Nl (Nl = standard liters) Premix laser gas on delivery. 6 percent of this is CO, that is 90 Nl.

**CO gas in high concentrations represents a potential hazard.**

The other components of the Premix laser gas (94 %) are helium (He), nitrogen (N), carbon dioxide ($CO_2$) and xenon (Xe). These gases do not represent a potential hazard.

To fill the vacuum vessel of the laser, 7 Nl of Premix laser gas are required. CO represents < 0.5 Nl of this. Before a refill is done, the laser gas is blown out of the vacuum vessel into the ambient air of the work-room.

Refer to the rules and regulations of your country regarding physical and biological limit values of CO in the ambient air.

**Operators of a $CO_2$ slab laser are obliged to acquaint themselves with potential hazards by considering the conditions on site and taking necessary precautions.**

**Have a good ventilation in your work space and do not vent or open the laser gas bottle!**

## Pressure in the laser gas bottle - Check: 7.4.1

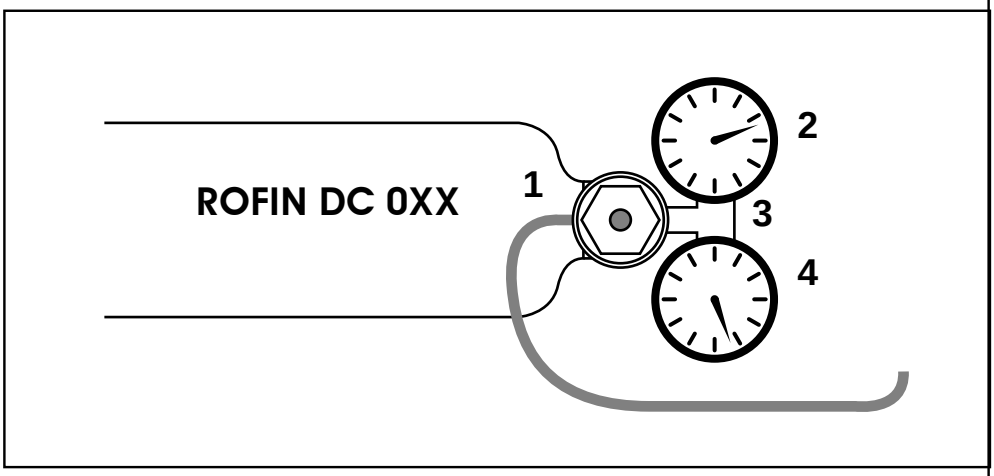



**Fig. 7.4.1/1:**
1 Tube to the vacuum vessel
2 Display for pressure in the laser gas bottle (high pressure)
3 Pressure reducer
4 Display for laser gas pressure to the vacuum vessel (low pressure)

— **Check 1 x per week - Pressure in the laser gas bottle:**

- If the pressure in the laser gas bottle is < 30 bars, a new laser gas bottle should be ordered.
- If the pressure in the laser gas bottle is < 30 bars, a warning signal will be displayed on the display of the Controller Terminal (optional). You should now order a new laser gas bottle.

The exact order description is: **PREMIX ROFIN DC 0XX** (see **section 7.4.3** — laser gas bottle - order)

— **Check (tightness) after the Laser Gas Bottle Change:**

Make **absolutely** certain to check that the screws are tight after exchanging the laser gas bottle according to **section 7.4.2**!

- Switch off the high voltage with push button **S3** (High voltage **OFF**).
- Open the right - hand side (when looking in the direction of the laser beam) of the plastic laser housing.
- Close the laser gas cylinder valve.
- Read the pressure in the laser gas cylinder on the pressure display (2) or in the Service / Report menu (optional). Make a note of the value.
- Close the right - hand side of the plastic laser housing.
  **Note: the laser can continue to be operated.**
- The normal pressure loss ist 0.5 bars / hour.
- Read the pressure in the laser gas cylinder on the display (2) (e.g. after 10 hours = 5 bars). If the pressure loss is > 5 bars there is a leak in the system!
  Retighten all the screws which were loosened during the laser gas bottle change.
  Recheck again for tightness.

## Laser gas bottle - Change: 7.4.2

**Laser gas bottle - Change when the laser gas pressure < 10 bars:**

— Switch the laser off (**Section 5.2.3**).

— Close the valve of the laser gas bottle.

— Unscrew and remove the pressure reducer (3) (**Fig. 7.4.1/1**) from the laser gas bottle.

— Secure the laser gas bottle with the protective cap.

— Untighten the clamp holding the laser gas bottle and lift the laser gas bottle out of the laser housing.

— Place the new laser gas bottle into the laser housing. Refasten the clamp for the laser gas bottle.

**Mounting the pressure reducer:**

— Remount the pressure reducer (3) (**Fig. 7.4.1/1**) onto the laser gas bottle.

— After mounting the pressure reducer:
• Press pushbutton **F2** "GAS CHANGE" in the Service / Report Menu to remove any impurities. Effect this procedure twice.

**Note: If the screw connections between the laser gas bottle and the pressure reducer are not tight laser gas will escape into the surrounding atmosphere!**
• Check for tightness according to **Section 7.4.1**.

## Laser gas bottle - Order: 7.4.3

**Please order here:**

ROFIN-SINAR, INC.
45701 Mast Street
Plymouth, MI 48170 USA

Tel.: (313) 455 - 5400
Fax: (313) 455 - 5587

## Laser beam shutter: 7.5

**Shutter (Fig. 7.5/1 and 7.5/2):**

General points:
When an opening impulse is triggered, the rotary solenoid (2) turns the water cooled shutter blade (5) out of the laser beam path.
Two springs installed in the rotary solenoid and its dead weight holds the shutter blade in the CLOSED position.
In the CLOSED position the laser beam is reflected into the absorber (3) by the shutter blade.
Fault alarms are provided for:

- shutter power supply fault
- temperature of absorber, shutter blade and / or rotary solenoid is too high
- shutter OPEN and / or shutter CLOSE times (monitored by 2 inductive sensors (4, 6) are too long (> 200 msec)

Additionally the shutter unit is provided with a position switch (pos. 10 in **Fig. 7.5/2**) which is actuated by the shutter blade. To switch high voltage on, the shutter blade must be closed.

The functioning of the shutter is constantly monitored. If there is an error, a fault alarm is displayed on the display and the high voltage is automatically switched OFF.

**Warning:**
**Check the function of the shutter regularly each time before you start the laser!**

The shutter will be maintenanced at the normal laser maintenance intervals by ROFIN-SINAR Service personnel.

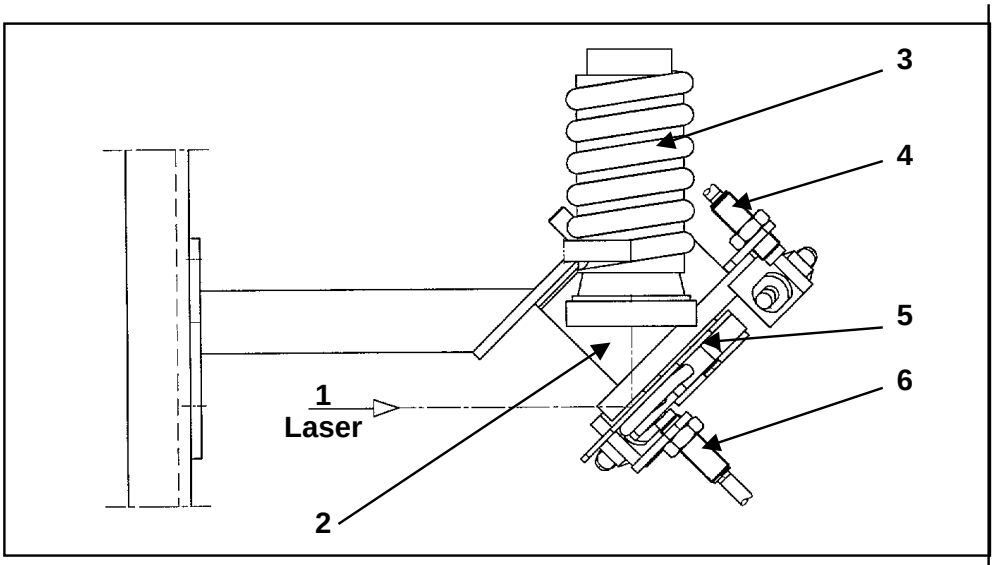



**Fig. 7.5/1:**
**Shutter**
1 Laser beam direction
2 Rotary solenoid
3 Absorber (laser beam dump)
4 Inductive sensor
5 Shutter blade
6 Inductive sensor
7 --

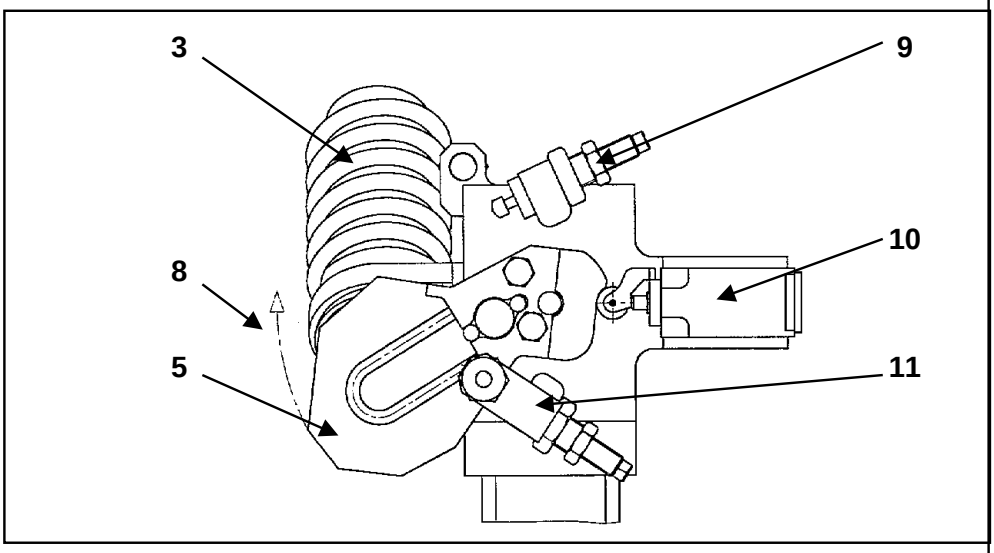



**Fig. 7.5/2:**
**Shutter, other point of view**
3 Absorber (laser beam dump)
5 Shutter blade
8 Rotary direction of shutter blade
9 Shock absorber
10 Position switch
11 Shock absorber

# Internal cooling water circuit: 7.6

**Internal cooling water circuit (cooling water circuit for RF - tube in the laser head):**

— **Check cooling water (internal cooling water circuit):**
**Service interval: 1 time per week**
- Switch the laser OFF.
- Open the plastic panelling of the laser head.
- Check the level of the cooling water of the internal cooling water circuit at the ion exchange cartridge (**Fig. 7.6/1**).
  The cooling water level in the ion exchange cartridge must be between MAX. and MIN. (**Fig. 7.6/1**).

**Replenish cooling water (internal cooling water circuit):**
- Unscrew the locking screw (1) at the filler opening of the ion exchange cartridge and remove it.
- Use only cooling water of ROFIN-SINAR cooling water - specification (**section 4.2.1**) for the **internal cooling water circuit.**
- Tighten the locking screw (1).
- Call ROFIN-SINAR if the cooling water of the internal cooling water circuit must replenished more than one time in 4 weeks.

— **Before transport, storage (danger of frost action) etc.:**
**Drain off the cooling water (internal cooling water circuit):**
- Unscrew the locking screw (1) at the filler opening of the ion exchange cartridge and remove it.
- Take the cooling water draining hose (**No. 55**) and open the vent plug (the end of the hose is under the vacuum pump). Insert the end of the hose in a vessel.
- Untie the hose clip of the thicker hose at the cooling water pump of the laser and pull the hose away from it.
- Blow compressed air into the hose nozzle of the cooling water pump and into the hose. Cooling water volume: approx. 2 liters.
- Before transport, storage etc.: **Do not rinse lines with anti-freezing compound!**
- Put the hose onto the hose nozzle of the cooling water pump again and secure it with the hose clip.
- Seal the vent plug on hose **No. 55**.
- Tighten the locking screw (1).

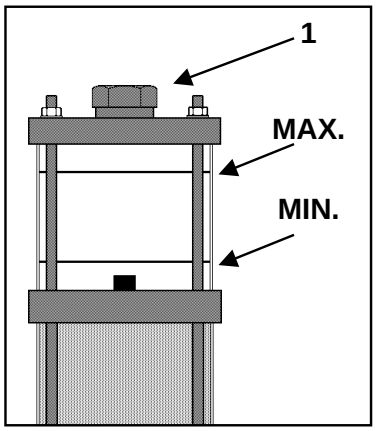



**Fig. 7.6/1:**
**Ion exchange cartridge**
1 Locking screw for cooling water filler opening

**Replenish cooling water (internal cooling water circuit):**

- Unscrew the locking screw (1) at the filler opening of the ion exchange cartridge and remove it.
- Filling capacity: ca. 2 liters.
- Use only cooling water of ROFIN-SINAR cooling water - specification (**section 4.2.1**) for the **internal cooling water circuit.**
- Switch the laser ON to start the cooling water pump for a **short** time.
- Switch the laser OFF.
- Use only cooling water of ROFIN-SINAR cooling water - specification (**section 4.2.1**) for the **internal cooling water circuit.**
- Repeat these points until ca. 2 liters of cooling water is filled into the internal cooling water circuit and no air bubbles are rising in the ion exchange cartridge any more.
  The cooling water level in the ion exchange cartridge must be between MAX. and MIN. (**Fig. 7.6/1**).
- Tighten the locking screw (1).
- Check the level of the cooling water in the ion exchange cartridge again after 4 hours.

## External cooling water circuit: 7.7

**External cooling water circuit (laser head and control cabinet):**

— **Check of cooling water and filter for cooling water (ext. cooling water circuit):**
**Service interval: every 3 months**
- The cooling water must be free of algae and clean.
- The filter for the cooling water must be free of contamination.
- Check the level of the cooling water of the external cooling water circuit at your refrigerator.
- Use only cooling water of ROFIN-SINAR cooling water - specification (**section 4.2.1**) for the **external cooling water circuit.**

— **Change of cooling water (external cooling water circuit):**
**Service interval: 1 time per year**
- Use only cooling water of ROFIN-SINAR cooling water - specification (**section 4.2.1**) for the **external cooling water circuit.**

**Draining the cooling water (external cooling water circuit):**
- Untie the hose clips of the hoses at laser head and heat exchanger of control cabinet and pull the hoses away.
- Before transport, storage etc.: **Rinse lines with an anti-freezing compound! Before starting the laser: Wash out all anti-freezing compound!**
- Blow out all cooling water (or anti-freezing compound) with compressed air from laser head and heat exchanger of control cabinet.
- Disposal of cooling water must be conducted according to all local, State and Federal Rules and Regulations.

**Replenish cooling water (external cooling water circuit):**
- **Before starting the laser: Wash out all anti-freezing compound!**
- Connecting the refrigerator to the laser:
  Put the cooling water hoses to the fittings of laser head and heat exchanger of control cabinet and secure them with hose clips.
- Use only cooling water of ROFIN-SINAR cooling water - specification (**section 4.2.1**) for the **external cooling water circuit.**

## Spare parts and accessories / ROFIN-SINAR Adresses:



You can obtain the desired spare part or accessory from ROFIN-SINAR under specification of the order number

| Designation: | Order number: |
|---|---|
| Oil for vacuum pump (VE 68) | 8 305 038 |
| Lamp for laser warning lamp | 710 790 |
| | |
| Laser safety goggles (wavelength of 10.6 µm) | 8 310 005 |
| Lense paper | 8 309 000 |
| Cotton wool sticks | 8 200 010 |
| | |
| | |
| | |
| | |
| | |

Any inquiries regarding the contents of this operating manual or the laser itself should be directed to:

— ROFIN-SINAR Laser GmbH
Berzeliusstraße 83
D - 22113 Hamburg
Germany

Tel.: 49 - (0) - 40 - 733 63 - 0
Fax: 49 - (0) - 40 - 733 63 - 160

or

ROFIN-SINAR Laser GmbH
P.O. Box 74 03 60
D - 22093 Hamburg
Germany

E - Mail: info@rofin-ham.de
Internet: http://www.rofin.com

— ROFIN-SINAR, INC.
45701 Mast Street
Plymouth, MI 48170 USA

Tel.: (313) 455 - 5400
Fax: (313) 455 - 5587

— or your OEM supplier

# Technical specifications ROFIN DC 010:



**Laser beam data:**

| | |
|---|---|
| Wavelength: | 10.6 µm |
| Excitation: | Radio Frequency (RF) |

**Output power:**

| | |
|---|---|
| Guaranteed: | 1000 W |
| Range (typical): | 100 - 1000 W |
| Stability: | ± 2 % (24 h) (Cooling water $\Delta T \leq \pm 1$ K) |

**Laser beam quality:**

| | |
|---|---|
| Diameter: | < 25 mm |
| Beam quality factor: | K > 0.8 |
| Divergence: | < 0.5 mrad full angle (distances up to 10 m; values for distances over 10 meters are obtainable from ROFIN-SINAR on request) |
| Pointing stability: | ≤ 0.15 mrad (EN ISO 11145) |
| Polarization: | linear, 45° relative to the horizontal plane |

**Pulse generator (optional):**

| | |
|---|---|
| Frequency: | 0 or 8 - 5000 Hz |
| Width: | 26 µs - CW |

**Ramping generator (optional):**

| | |
|---|---|
| Level: | 0.0 - 100.0 % |
| Time / Increment: | 0 - 65535 ms / Incr. |
| Frequency: | 8 - 5000 Hz |
| Duty cycle: | 0.0 - 100.0 % |

**Laser gas:**

| | |
|---|---|
| Laser gas: | ROFIN-SINAR Special - Premix |
| Consumption: | < 0.3 Nl / h (Nl = liter) |
| Laser gas exchange interval: | > 24 h |
| Mode: | semi - automatic |

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**Laserversion:** **ROFIN DC 010**

**Dimensions:**

| | | | |
|---|---|---|---|
| Laser head: | (L) | 1700 | mm |
| | (W) | 800 | mm |
| | (H) | 853 | mm |
| Control cabinet: | (W) | 800 | mm |
| | (D) | 600 | mm |
| | (H) | 1900 | mm |

Compact control cabinet (optional): see **section 8.4**

**Weights:**

| | | | |
|---|---|---|---|
| Laser head: | approx. | 500 | kg |
| Control cabinet: | approx. | 570 | kg |

Compact control cabinet (optional): see **section 8.4**

**External control facilities:**

— Commands from external control system / control panel
— Status signals to external control system
— CNC interface
— External pulse interface
— External analog signals

**Electrical ratings:**

The provision of a main power supply is the responsibility of the customer.

| | |
|---|---|
| Voltage: | 3 x 230 / 400 V ± 10 % or<br>3 x 277 / 480 V ± 10 %;<br>50 or 60 Hz; PE<br>(other operating voltages: optional) |
| Connected load: | approx. 20 kVA |
| Max. current consumption: | < 35 A / < 30 A |
| Fuses: | 63 A NH |

**Cooling water (external circuit):**

| | |
|---|---|
| Water quality: | demineralized water |
| Max. conductivity after addition of corrosion inhibitors: | < 1000 µS / cm |
| Impurities: | ≤ 100 µm |

For more cooling water hints see operating manual

**Laserversion:** **ROFIN DC 010**

**Cooling water circuit (external):**

| | |
|---|---|
| Laser head: | The cooling water connection fittings are located at the connection plate. The fittings are dimensioned to fit 1" plastic tubing. The tubes are placed over the connectors and secured with clamps. |
| Control cabinet: | The cooling water connection fittings with 1/4" inside thread and connectors for plastic tubing with 10 - 11 mm inside diameter are located at the heat exchanger. The plastic tubes are placed over the connectors and secured with clamps. |
| Minimal flow rate: | ≥ 3000 l / h (laser head)<br>≥ 800 l / h (control cabinet) |
| Refrigeration capacity: | ≥ 18 kW |
| Supply pressure: | ≤ 6000 hPa (6 bars) |
| Pressure drop: | ≤ 3000 hPa (3 bars) |
| Backwash pressure: | ≤ 1500 hPa (1.5 bars) |
| Temperature: | 19 °C to 27 °C (must be above dew point!) |
| Recommended temperature: | 20 °C to 22 °C |
| Temperature tolerance: | ≤ ± 1 K |

**Inert gas specifications:**

Inert gas supply fittings are provided on the connection side of the laser head and are dimensioned to fit 4K plastic tubing. The tubes are placed over the fittings and secured with union nuts.

| | |
|---|---|
| Nitrogen: | |
| Purity: | ≥ 4.6 |
| Pressure: | 3800 to 5300 hPa (3.8 to 5.3 bars)<br>(all pressure specifications related to atmosphere) |
| Flow rate: | ≥ 4 l / min (factory adjusted by ROFIN-SINAR) |

or

| | |
|---|---|
| Compressed air: | |
| Oil: | ≤ 0.005 mg / $m^3$ |
| Water: | ≤ 0.05 g / $m^3$ |
| Permissible filter pore size: | ≤ 0.05 µm |
| Pressure: | 3800 to 5300 hPa (3.8 to 5.3 bars)<br>(all pressure specifications related to atmosphere) |
| Flow rate: | ≥ 4 l / min (factory adjusted by ROFIN-SINAR) |

**Laserversion:** **ROFIN DC 010**

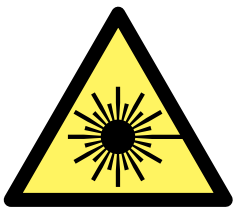
The compressed air which is used to flush the laser beam telescope must correspond to this specification!
Oil and water free compressed air is seldom available from a factory air supply! Factory air supplies are often contaminated by oil and water. This will damage the telescope optics. Ask ROFIN-SINAR for informations to separate the compressed air.

**Ambient conditions:**

Operation:
Temperature: + 5 °C … + 40 °C
Relative air humidity: 50 % at 40 °C, 90 % at 20 °C
Storage:
Temperature (with antifreeze compound): - 25 °C … + 55 °C

## Positioning laser (optional): 8.1

**The positioning laser is a Class 2 laser.**
**With Class 2 laser equipment the eyes are adequately protected by the natural eyelid closure reflex, provided visual contact with the beam is brief.**
**Avoid intentionally looking at the beam!**
**It is mandatory to wear protective goggles for the frequency of the positioning laser beam while you are working with it!**



**Important:**
**It is strongly recommended that any person who is to participate in the installation, operation or maintenance of the laser equipment shall read and fully understand the contents of this manual and particularly the safety sections 2 - 2.8.**
**Should there be any questions or doubt about the safety aspects of the equipment, please do not hesitate to contact any of the ROFIN-SINAR offices before proceeding.**

**Any alignments should only be carried out by persons who have received special instructions by the laser supplier in accordance with the occupational safety laws currently in force and the requirements specified by the relevant professional organizations.**

The positioning laser has a compact, low - wattage laser diode. It emits a visible red laser beam.
As the beam path is clearly visible, the positioning laser can be used to align the external laser beam guides and allows the workpiece to be precisely positioned.

The positioning laser is activated by a function key on the controller terminal or via an interface.
It takes approx. 1.5 seconds until the positioning laser is ready.

# Technical specifications ROFIN DC 015: 8.

**Laser beam data:**

| | |
|---|---|
| Wavelength: | 10.6 µm |
| Excitation: | Radio Frequency (RF) |

**Output power:**

| | |
|---|---|
| Guaranteed: | 1500 W |
| Range (typical): | 150 - 1500 W |
| Stability: | ± 2 % (24 h) (Cooling water $\Delta T \leq \pm 1$ K) |

**Laser beam quality:**

| | |
|---|---|
| Diameter: | < 25 mm |
| Beam quality factor: | K > 0.8 |
| Divergence: | < 0.5 mrad full angle (distances up to 10 m; values for distances over 10 meters are obtainable from ROFIN-SINAR on request) |
| Pointing stability: | ≤ 0.15 mrad (EN ISO 11145) |
| Polarization: | linear, 45° relative to the horizontal plane |

**Pulse generator (optional):**

| | |
|---|---|
| Frequency: | 0 or 8 - 5000 Hz |
| Width: | 26 µs - CW |

**Ramping generator (optional):**

| | |
|---|---|
| Level: | 0.0 - 100.0 % |
| Time / Increment: | 0 - 65535 ms / Incr. |
| Frequency: | 8 - 5000 Hz |
| Duty cycle: | 0.0 - 100.0 % |

**Laser gas:**

| | |
|---|---|
| Laser gas: | ROFIN-SINAR Special-Premix |
| Consumption: | < 0.3 Nl / h (Nl = liter) |
| Laser gas exchange interval: | > 24 h |
| Mode: | semi-automatic |

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**Laserversion:** **ROFIN DC 015**

**Dimensions:**

| | | | |
|---|---|---|---|
| Laser head: | (L) | 1700 | mm |
| | (W) | 800 | mm |
| | (H) | 853 | mm |
| Control cabinet: | (W) | 800 | mm |
| | (D) | 600 | mm |
| | (H) | 1900 | mm |

Compact control cabinet (optional): see **section 8.4**

**Weights:**

| | | | |
|---|---|---|---|
| Laser head: | approx. | 500 | kg |
| Control cabinet: | approx. | 570 | kg |

Compact control cabinet (optional): see **section 8.4**

**External control facilities:**

— Commands from external control system / control panel
— Status signals to external control system
— CNC interface
— External pulse interface
— External analog signals

**Electrical ratings:**

The provision of a main power supply is the responsibility of the customer.

| | |
|---|---|
| Voltage: | 3 x 230 / 400 V ± 10 % or<br>3 x 277 / 480 V ± 10 %;<br>50 or 60 Hz; PE<br>(other operating voltages: optional) |
| Connected load: | approx. 29 kVA |
| Max. current consumption: | < 45 A / < 38 A |
| Fuses: | 63 A NH |

**Cooling water (external circuit):**

| | |
|---|---|
| Water quality: | demineralized water |
| Max. conductivity after addition of corrosion inhibitors: | < 1000 µS / cm |
| Impurities: | ≤ 100 µm |

For more cooling water hints see operating manual

**Laserversion:** **ROFIN DC 015**

**Cooling water circuit (external):**

| | |
|---|---|
| Laser head: | The cooling water connection fittings are located at the connection plate. The fittings are dimensioned to fit 1" plastic tubing. The tubes are placed over the connectors and secured with clamps. |
| Control cabinet: | The cooling water connection fittings with 1/4" inside thread and connectors for plastic tubing with 10 - 11 mm inside diameter are located at the heat exchanger. The plastic tubes are placed over the connectors and secured with clamps. |
| Minimal flow rate: | ≥ 4000 l / h (laser head)<br>≥ 800 l / h (control cabinet) |
| Refrigeration capacity: | ≥ 24 kW |
| Supply pressure: | ≤ 6000 hPa (6 bars) |
| Pressure drop: | ≤ 3000 hPa (3 bars) |
| Backwash pressure: | ≤ 1500 hPa (1.5 bars) |
| Temperature: | 19 °C to 27 °C (must be above dew point!) |
| Recommended temperature: | 20 °C to 22 °C |
| Temperature tolerance: | ≤ ± 1 K |

**Inert gas specifications:**

Inert gas supply fittings are provided on the connection side of the laser head and are dimensioned to fit 4K plastic tubing. The tubes are placed over the fittings and secured with union nuts.

| | |
|---|---|
| Nitrogen: | |
| Purity: | ≥ 4.6 |
| Pressure: | 3800 to 5300 hPa (3.8 to 5.3 bars)<br>(all pressure specifications related to atmosphere) |
| Flow rate: | ≥ 4 l / min (factory adjusted by ROFIN-SINAR) |

or

| | |
|---|---|
| Compressed air: | |
| Oil: | ≤ 0.005 mg / $m^3$ |
| Water: | ≤ 0.05 g / $m^3$ |
| Permissible filter pore size: | ≤ 0.05 µm |
| Pressure: | 3800 to 5300 hPa (3.8 to 5.3 bars)<br>(all pressure specifications related to atmosphere) |
| Flow rate: | ≥ 4 l / min (factory adjusted by ROFIN-SINAR) |

**Laserversion:** **ROFIN DC 015**

The compressed air which is used to flush the laser beam telescope must correspond to this specification!
Oil and water free compressed air is seldom available from a factory air supply! Factory air supplies are often contaminated by oil and water. This will damage the telescope optics. Ask ROFIN-SINAR for informations to separate the compressed air.

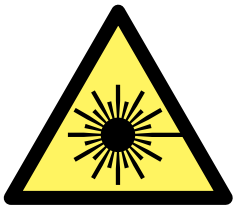
**Ambient conditions:**

Operation:
Temperature: + 5 °C … + 40 °C
Relative air humidity: 50 % at 40 °C, 90 % at 20 °C
Storage:
Temperature (with antifreeze compound): - 25 °C … + 55 °C

## Positioning laser (optional): 8.1

**The positioning laser is a Class 2 laser.**
**With Class 2 laser equipment the eyes are adequately protected by the natural eyelid closure reflex, provided visual contact with the beam is brief.**
**Avoid intentionally looking at the beam!**
**It is mandatory to wear protective goggles for the frequency of the positioning laser beam while you are working with it!**

**Important:**
**It is strongly recommended that any person who is to participate in the installation, operation or maintenance of the laser equipment shall read and fully understand the contents of this manual and particularly the safety sections 2 - 2.8.**
**Should there be any questions or doubt about the safety aspects of the equipment, please do not hesitate to contact any of the ROFIN-SINAR offices before proceeding.**



**Any alignments should only be carried out by persons who have received special instructions by the laser supplier in accordance with the occupational safety laws currently in force and the requirements specified by the relevant professional organizations.**

The positioning laser has a compact, low - wattage laser diode. It emits a visible red laser beam.
As the beam path is clearly visible, the positioning laser can be used to align the external laser beam guides and allows the workpiece to be precisely positioned.

The positioning laser is activated by a function key on the controller terminal or via an interface.
It takes approx. 1.5 seconds until the positioning laser is ready.

# Technical specifications ROFIN DC 020:



**Laser beam data:**

| | |
|---|---|
| Wavelength: | 10.6 µm |
| Excitation: | Radio Frequency (RF) |

**Output power:**

| | |
|---|---|
| Guaranteed: | 2000 W |
| Range (typical): | 200 - 2000 W |
| Stability: | ± 2 % (24 h) (Cooling water $\Delta T \leq \pm 1$ K) |

**Laser beam quality:**

| | |
|---|---|
| Diameter: | < 25 mm |
| Beam quality factor: | K > 0.8 |
| Divergence: | < 0.5 mrad full angle (distances up to 10 m; values for distances over 10 meters are obtainable from ROFIN-SINAR on request) |
| Pointing stability: | ≤ 0.15 mrad (EN ISO 11145) |
| Polarization: | linear, 45° relative to the horizontal plane |

**Pulse generator (optional):**

| | |
|---|---|
| Frequency: | 0 or 8 - 5000 Hz |
| Width: | 26 µs - CW |

**Ramping generator (optional):**

| | |
|---|---|
| Level: | 0.0 - 100.0 % |
| Time / Increment: | 0 - 65535 ms / Incr. |
| Frequency: | 8 - 5000 Hz |
| Duty cycle: | 0.0 - 100.0 % |

**Laser gas:**

| | |
|---|---|
| Laser gas: | ROFIN-SINAR Special - Premix |
| Consumption: | < 0.3 Nl / h (Nl = liter) |
| Laser gas exchange interval: | > 24 h |
| Mode: | semi - automatic |

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**Laserversion:** **ROFIN DC 020**

**Dimensions:**

| | | | |
|---|---|---|---|
| Laser head: | (L) | 1700 | mm |
| | (W) | 800 | mm |
| | (H) | 853 | mm |
| Control cabinet: | (W) | 800 | mm |
| | (D) | 600 | mm |
| | (H) | 1900 | mm |

Compact control cabinet (optional): see **section 8.4**

**Weights:**

| | | | |
|---|---|---|---|
| Laser head: | approx. | 500 | kg |
| Control cabinet: | approx. | 570 | kg |

Compact control cabinet (optional): see **section 8.4**

**External control facilities:**

— Commands from external control system / control panel
— Status signals to external control system
— CNC interface
— External pulse interface
— External analog signals

**Electrical ratings:**

The provision of a main power supply is the responsibility of the customer.

| | |
|---|---|
| Voltage: | 3 x 230 / 400 V ± 10 % or<br>3 x 277 / 480 V ± 10 %;<br>50 or 60 Hz; PE<br>(other operating voltages: optional) |
| Connected load: | approx. 33 kVA |
| Max. current consumption: | < 55 A / < 46 A |
| Fuses: | 80 A NH |

**Cooling water (external circuit):**

| | |
|---|---|
| Water quality: | demineralized water |
| Max. conductivity after addition of corrosion inhibitors: | < 1000 µS / cm |
| Impurities: | ≤ 100 µm |

For more cooling water hints see operating manual

**Laserversion:** **ROFIN DC 020**

**Cooling water circuit (external):**

| | |
|---|---|
| Laser head: | The cooling water connection fittings are located at the connection plate. The fittings are dimensioned to fit 1" plastic tubing. The tubes are placed over the connectors and secured with clamps. |
| Control cabinet: | The cooling water connection fittings with 1/4" inside thread and connectors for plastic tubing with 10 - 11 mm inside diameter are located at the heat exchanger. The plastic tubes are placed over the connectors and secured with clamps. |
| Minimal flow rate: | ≥ 4000 l / h (laser head)<br>≥ 800 l / h (control cabinet) |
| Refrigeration capacity: | ≥ 28 kW |
| Supply pressure: | ≤ 6000 hPa (6 bars) |
| Pressure drop: | ≤ 3000 hPa (3 bars) |
| Backwash pressure: | ≤ 1500 hPa (1.5 bars) |
| Temperature: | 19 °C to 27 °C (must be above dew point!) |
| Recommended temperature: | 20 °C to 22 °C |
| Temperature tolerance: | ≤ ± 1 K |

**Inert gas specifications:**

Inert gas supply fittings are provided on the connection side of the laser head and are dimensioned to fit 4K plastic tubing. The tubes are placed over the fittings and secured with union nuts.

| | |
|---|---|
| Nitrogen: | |
| Purity: | ≥ 4.6 |
| Pressure: | 3800 to 5300 hPa (3.8 to 5.3 bars)<br>(all pressure specifications related to atmosphere) |
| Flow rate: | ≥ 4 l / min (factory adjusted by ROFIN-SINAR) |

or

| | |
|---|---|
| Compressed air: | |
| Oil: | ≤ 0.005 mg / $m^3$ |
| Water: | ≤ 0.05 g / $m^3$ |
| Permissible filter pore size: | ≤ 0.05 µm |
| Pressure: | 3800 to 5300 hPa (3.8 to 5.3 bars)<br>(all pressure specifications related to atmosphere) |
| Flow rate: | ≥ 4 l / min (factory adjusted by ROFIN-SINAR) |

**Laserversion:** **ROFIN DC 020**

The compressed air which is used to flush the laser beam telescope must correspond to this specification!
Oil and water free compressed air is seldom available from a factory air supply! Factory air supplies are often contaminated by oil and water. This will damage the telescope optics. Ask ROFIN-SINAR for informations to separate the compressed air.

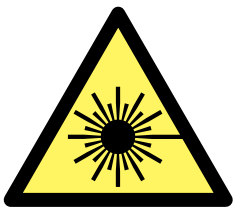
**Ambient conditions:**

Operation:
Temperature: + 5 °C … + 40 °C
Relative air humidity: 50 % at 40 °C, 90 % at 20 °C
Storage:
Temperature (with antifreeze compound): - 25 °C … + 55 °C

## Positioning laser (optional): 8.1

**The positioning laser is a Class 2 laser.**
**With Class 2 laser equipment the eyes are adequately protected by the natural eyelid closure reflex, provided visual contact with the beam is brief.**
**Avoid intentionally looking at the beam!**
**It is mandatory to wear protective goggles for the frequency of the positioning laser beam while you are working with it!**

**Important:**
**It is strongly recommended that any person who is to participate in the installation, operation or maintenance of the laser equipment shall read and fully understand the contents of this manual and particularly the safety sections 2 - 2.8.**
**Should there be any questions or doubt about the safety aspects of the equipment, please do not hesitate to contact any of the ROFIN-SINAR offices before proceeding.**



**Any alignments should only be carried out by persons who have received special instructions by the laser supplier in accordance with the occupational safety laws currently in force and the requirements specified by the relevant professional organizations.**

The positioning laser has a compact, low - wattage laser diode. It emits a visible red laser beam.
As the beam path is clearly visible, the positioning laser can be used to align the external laser beam guides and allows the workpiece to be precisely positioned.

The positioning laser is activated by a function key on the controller terminal or via an interface.
It takes approx. 1.5 seconds until the positioning laser is ready.

# Technical specifications ROFIN DC 025: 8.

**Laser beam data:**

| | |
|---|---|
| Wavelength: | 10.6 µm |
| Excitation: | Radio Frequency (RF) |

**Output power:**

| | |
|---|---|
| Guaranteed: | 2500 W |
| Range (typical): | 250 - 2500 W |
| Stability: | ± 2 % (24 h) (Cooling water $\Delta T \leq \pm 1$ K) |

**Laser beam quality:**

| | |
|---|---|
| Diameter: | < 25 mm |
| Beam quality factor: | K > 0.8 |
| Divergence: | < 0.5 mrad full angle (distances up to 10 m; values for distances over 10 meters are obtainable from ROFIN-SINAR on request) |
| Pointing stability: | ≤ 0.15 mrad (EN ISO 11145) |
| Polarization: | linear, 45° relative to the horizontal plane |

**Pulse generator (optional):**

| | |
|---|---|
| Frequency: | 0 or 8 - 5000 Hz |
| Width: | 26 µs - CW |

**Ramping generator (optional):**

| | |
|---|---|
| Level: | 0.0 - 100.0 % |
| Time / Increment: | 0 - 65535 ms / Incr. |
| Frequency: | 8 - 5000 Hz |
| Duty cycle: | 0.0 - 100.0 % |

**Laser gas:**

| | |
|---|---|
| Laser gas: | ROFIN-SINAR Special - Premix |
| Consumption: | < 0.3 Nl / h (Nl = liter) |
| Laser gas exchange interval: | > 24 h |
| Mode: | semi - automatic |

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**Laserversion:** **ROFIN DC 025**

**Dimensions:**

| | | | |
|---|---|---|---|
| Laser head: | (L) | 1700 | mm |
| | (W) | 800 | mm |
| | (H) | 853 | mm |
| Control cabinet: | (W) | 800 | mm |
| | (D) | 600 | mm |
| | (H) | 1900 | mm |

Compact control cabinet (optional): see **section 8.4**

**Weights:**

| | | | |
|---|---|---|---|
| Laser head: | approx. | 500 | kg |
| Control cabinet: | approx. | 570 | kg |

Compact control cabinet (optional): see **section 8.4**

**External control facilities:**

— Commands from external control system / control panel
— Status signals to external control system
— CNC interface
— External pulse interface
— External analog signals

**Electrical ratings:**

The provision of a main power supply is the responsibility of the customer.

| | |
|---|---|
| Voltage: | 3 x 230 / 400 V ± 10 % or<br>3 x 277 / 480 V ± 10 %;<br>50 or 60 Hz; PE<br>(other operating voltages: optional) |
| Connected load: | approx. 40 kVA |
| Max. current consumption: | < 60 A / < 50 A |
| Fuses: | 80 A NH |

**Cooling water (external circuit):**

| | |
|---|---|
| Water quality: | demineralized water |
| Max. conductivity after addition of corrosion inhibitors: | < 1000 µS / cm |
| Impurities: | ≤ 100 µm |

For more cooling water hints see operating manual

**Laserversion:** **ROFIN DC 025**

**Cooling water circuit (external):**

| | |
|---|---|
| Laser head: | The cooling water connection fittings are located at the connection plate. The fittings are dimensioned to fit 1" plastic tubing. The tubes are placed over the connectors and secured with clamps. |
| Control cabinet: | The cooling water connection fittings with 1/4" inside thread and connectors for plastic tubing with 10 - 11 mm inside diameter are located at the heat exchanger. The plastic tubes are placed over the connectors and secured with clamps. |
| Minimal flow rate: | ≥ 5000 l / h (laser head)<br>≥ 800 l / h (control cabinet) |
| Refrigeration capacity: | ≥ 35 kW |
| Supply pressure: | ≤ 6000 hPa (6 bars) |
| Pressure drop: | ≤ 3000 hPa (3 bars) |
| Backwash pressure: | ≤ 1500 hPa (1.5 bars) |
| Temperature: | 19 °C to 27 °C (must be above dew point!) |
| Recommended temperature: | 20 °C to 22 °C |
| Temperature tolerance: | ≤ ± 1 K |

**Inert gas specifications:**

Inert gas supply fittings are provided on the connection side of the laser head and are dimensioned to fit 4K plastic tubing. The tubes are placed over the fittings and secured with union nuts.

| | |
|---|---|
| Nitrogen: | |
| Purity: | ≥ 4.6 |
| Pressure: | 3800 to 5300 hPa (3.8 to 5.3 bars)<br>(all pressure specifications related to atmosphere) |
| Flow rate: | ≥ 4 l / min (factory adjusted by ROFIN-SINAR) |

or

| | |
|---|---|
| Compressed air: | |
| Oil: | ≤ 0.005 mg / $m^3$ |
| Water: | ≤ 0.05 g / $m^3$ |
| Permissible filter pore size: | ≤ 0.05 µm |
| Pressure: | 3800 to 5300 hPa (3.8 to 5.3 bars)<br>(all pressure specifications related to atmosphere) |
| Flow rate: | ≥ 4 l / min (factory adjusted by ROFIN-SINAR) |

**Laserversion:** **ROFIN DC 025**

The compressed air which is used to flush the laser beam telescope must correspond to this specification!
Oil and water free compressed air is seldom available from a factory air supply! Factory air supplies are often contaminated by oil and water. This will damage the telescope optics. Ask ROFIN-SINAR for informations to separate the compressed air.

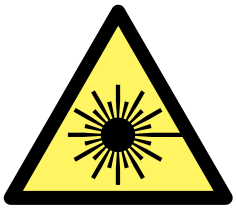
**Ambient conditions:**

Operation:
Temperature: + 5 °C … + 40 °C
Relative air humidity: 50 % at 40 °C, 90 % at 20 °C
Storage:
Temperature (with antifreeze compound): - 25 °C … + 55 °C

## Positioning laser (optional): 8.1

**The positioning laser is a Class 2 laser.**
**With Class 2 laser equipment the eyes are adequately protected by the natural eyelid closure reflex, provided visual contact with the beam is brief.**
**Avoid intentionally looking at the beam!**
**It is mandatory to wear protective goggles for the frequency of the positioning laser beam while you are working with it!**

**Important:**
**It is strongly recommended that any person who is to participate in the installation, operation or maintenance of the laser equipment shall read and fully understand the contents of this manual and particularly the safety sections 2 - 2.8.**
**Should there be any questions or doubt about the safety aspects of the equipment, please do not hesitate to contact any of the ROFIN-SINAR offices before proceeding.**



**Any alignments should only be carried out by persons who have received special instructions by the laser supplier in accordance with the occupational safety laws currently in force and the requirements specified by the relevant professional organizations.**

The positioning laser has a compact, low - wattage laser diode. It emits a visible red laser beam.
As the beam path is clearly visible, the positioning laser can be used to align the external laser beam guides and allows the workpiece to be precisely positioned.

The positioning laser is activated by a function key on the controller terminal or via an interface.
It takes approx. 1.5 seconds until the positioning laser is ready.

# Technical specifications ROFIN DC 030:



**Laser beam data:**

| | |
|---|---|
| Wavelength: | 10.6 µm |
| Excitation: | Radio Frequency (RF) |

**Output power:**

| | |
|---|---|
| Guaranteed: | 3000 W |
| Range (typical): | 300 - 3000 W |
| Stability: | ± 2 % (24 h) (Cooling water $\Delta T \leq \pm 1$ K) |

**Laser beam quality:**

| | |
|---|---|
| Diameter: | ≥ 23 < 30 mm (distances up to 10 m) |
| Beam quality factor: | K > 0.7 |
| Divergence: | < 0.5 mrad full angle (distances up to 10 m; values for distances over 10 meters are obtainable from ROFIN-SINAR on request) |
| Pointing stability: | ≤ 0.15 mrad (EN ISO 11145) |
| Polarization: | linear, 45° relative to the horizontal plane |

**Pulse generator (optional):**

| | |
|---|---|
| Frequency: | 0 or 8 - 5000 Hz |
| Width: | 26 µs - CW |

**Ramping generator (optional):**

| | |
|---|---|
| Level: | 0.0 - 100.0 % |
| Time / Increment: | 0 - 65535 ms / Incr. |
| Frequency: | 8 - 5000 Hz |
| Duty cycle: | 0.0 - 100.0 % |

**Laser gas:**

| | |
|---|---|
| Laser gas: | ROFIN-SINAR Special - Premix |
| Consumption: | < 0.6 Nl / h (Nl = liter) |
| Laser gas exchange interval: | > 24 h |
| Mode: | semi - automatic |

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**Laserversion:** **ROFIN DC 030**

**Dimensions:**

| | | | |
|---|---|---|---|
| Laser head: | (L) | 2100 | mm |
| | (W) | 800 | mm |
| | (H) | 853 | mm |
| Control cabinet: | (W) | 800 | mm |
| | (D) | 600 | mm |
| | (H) | 1900 | mm |

Compact control cabinet (optional): see **section 8.4**

**Weights:**

| | | | |
|---|---|---|---|
| Laser head: | approx. | 550 | kg |
| Control cabinet: | approx. | 570 | kg |

Compact control cabinet (optional): see **section 8.4**

**External control facilities:**

— Commands from external control system / control panel
— Status signals to external control system
— CNC interface
— External pulse interface
— External analog signals

**Electrical ratings:**

The provision of a main power supply is the responsibility of the customer.

| | |
|---|---|
| Voltage: | 3 x 230 / 400 V ± 10 % or<br>3 x 277 / 480 V ± 10 %;<br>50 or 60 Hz; PE<br>(other operating voltages: optional) |
| Connected load: | approx. 46 kVA |
| Max. current consumption: | < 65 A / < 55 A |
| Fuses: | 100 A NH |

**Cooling water (external circuit):**

| | |
|---|---|
| Water quality: | demineralized water |
| Max. conductivity after addition of corrosion inhibitors: | < 1000 µS / cm |
| Impurities: | ≤ 100 µm |

For more cooling water hints see operating manual

**Laserversion:** **ROFIN DC 030**

**Cooling water circuit (external):**

| | |
|---|---|
| Laser head: | The cooling water connection fittings are located at the connection plate. The fittings are dimensioned to fit 1" plastic tubing. The tubes are placed over the connectors and secured with clamps. |
| Control cabinet: | The cooling water connection fittings with 1/4" inside thread and connectors for plastic tubing with 10 - 11 mm inside diameter are located at the heat exchanger. The plastic tubes are placed over the connectors and secured with clamps. |
| Minimal flow rate: | ≥ 5000 l / h (laser head)<br>≥ 800 l / h (control cabinet) |
| Refrigeration capacity: | ≥ 45 kW |
| Supply pressure: | ≤ 6000 hPa (6 bars) |
| Pressure drop: | ≤ 3000 hPa (3 bars) |
| Backwash pressure: | ≤ 1500 hPa (1.5 bars) |
| Temperature: | 19 °C to 24 °C (must be above dew point!) |
| Recommended temperature: | 20 °C to 22 °C |
| Temperature tolerance: | ≤ ± 1 K |

**Inert gas specifications:**

Inert gas supply fittings are provided on the connection side of the laser head and are dimensioned to fit 4K plastic tubing. The tubes are placed over the fittings and secured with union nuts.

| | |
|---|---|
| Nitrogen: | |
| Purity: | ≥ 4.6 |
| Pressure: | 3800 to 5300 hPa (3.8 to 5.3 bars)<br>(all pressure specifications related to atmosphere) |
| Flow rate: | ≥ 4 l / min (factory adjusted by ROFIN-SINAR) |

or

| | |
|---|---|
| Compressed air: | |
| Oil: | ≤ 0.005 mg / $m^3$ |
| Water: | ≤ 0.05 g / $m^3$ |
| Permissible filter pore size: | ≤ 0.05 µm |
| Pressure: | 3800 to 5300 hPa (3.8 to 5.3 bars)<br>(all pressure specifications related to atmosphere) |
| Flow rate: | ≥ 4 l / min (factory adjusted by ROFIN-SINAR) |

**Laserversion:** **ROFIN DC 030**

The compressed air which is used to flush the laser beam telescope must correspond to this specification!
Oil and water free compressed air is seldom available from a factory air supply! Factory air supplies are often contaminated by oil and water. This will damage the telescope optics. Ask ROFIN-SINAR for informations to separate the compressed air.

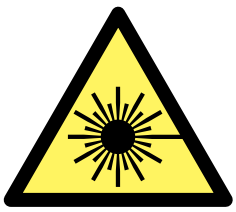
**Ambient conditions:**

Operation:
Temperature: + 5 °C … + 40 °C
Relative air humidity: 50 % at 40 °C, 90 % at 20 °C
Storage:
Temperature (with antifreeze compound): - 25 °C … + 55 °C

## Positioning laser (optional): 8.1

**The positioning laser is a Class 2 laser.**
**With Class 2 laser equipment the eyes are adequately protected by the natural eyelid closure reflex, provided visual contact with the beam is brief.**
**Avoid intentionally looking at the beam!**
**It is mandatory to wear protective goggles for the frequency of the positioning laser beam while you are working with it!**

**Important:**
**It is strongly recommended that any person who is to participate in the installation, operation or maintenance of the laser equipment shall read and fully understand the contents of this manual and particularly the safety sections 2 - 2.8.**
**Should there be any questions or doubt about the safety aspects of the equipment, please do not hesitate to contact any of the ROFIN-SINAR offices before proceeding.**



**Any alignments should only be carried out by persons who have received special instructions by the laser supplier in accordance with the occupational safety laws currently in force and the requirements specified by the relevant professional organizations.**

The positioning laser has a compact, low - wattage laser diode. It emits a visible red laser beam.
As the beam path is clearly visible, the positioning laser can be used to align the external laser beam guides and allows the workpiece to be precisely positioned.

The positioning laser is activated by a function key on the controller terminal or via an interface.
It takes approx. 1.5 seconds until the positioning laser is ready.

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# Technical specifications ROFIN DC 035: 8.

**Laser beam data:**

| | |
|---|---|
| Wavelength: | 10.6 µm |
| Excitation: | Radio Frequency (RF) |

**Output power:**

| | |
|---|---|
| Guaranteed: | 3500 W |
| Range (typical): | 350 - 3500 W |
| Stability: | ± 2 % (24 h) (Cooling water $\Delta T \leq \pm 1$ K) |

**Laser beam quality:**

| | |
|---|---|
| Diameter: | ≥ 23 < 30 mm (distances up to 10 m) |
| Beam quality factor: | K > 0.7 |
| Divergence: | < 0.5 mrad full angle (distances up to 10 m; values for distances over 10 meters are obtainable from ROFIN-SINAR on request) |
| Pointing stability: | ≤ 0.15 mrad (EN ISO 11145) |
| Polarization: | linear, 45° relative to the horizontal plane |

**Pulse generator (optional):**

| | |
|---|---|
| Frequency: | 0 or 8 - 5000 Hz |
| Width: | 26 µs - CW |

**Ramping generator (optional):**

| | |
|---|---|
| Level: | 0.0 - 100.0 % |
| Time / Increment: | 0 - 65535 ms / Incr. |
| Frequency: | 8 - 5000 Hz |
| Duty cycle: | 0.0 - 100.0 % |

**Laser gas:**

| | |
|---|---|
| Laser gas: | ROFIN-SINAR Special - Premix |
| Consumption: | < 0.6 Nl / h (Nl = liter) |
| Laser gas exchange interval: | > 24 h |
| Mode: | semi - automatic |

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**Laserversion:** **ROFIN DC 035**

**Dimensions:**

| | | | |
|---|---|---|---|
| Laser head: | (L) | 2100 | mm |
| | (W) | 800 | mm |
| | (H) | 853 | mm |
| Control cabinet: | (W) | 800 | mm |
| | (D) | 600 | mm |
| | (H) | 1900 | mm |

Compact control cabinet (optional): see **section 8.4**

**Weights:**

| | | | |
|---|---|---|---|
| Laser head: | approx. | 550 | kg |
| Control cabinet: | approx. | 570 | kg |

Compact control cabinet (optional): see **section 8.4**

**External control facilities:**

— Commands from external control system / control panel
— Status signals to external control system
— CNC interface
— External pulse interface
— External analog signals

**Electrical ratings:**

The provision of a main power supply is the responsibility of the customer.

| | |
|---|---|
| Voltage: | 3 x 230 / 400 V ± 10 % or<br>3 x 277 / 480 V ± 10 %;<br>50 or 60 Hz; PE<br>(other operating voltages: optional) |
| Connected load: | approx. 55 kVA |
| Max. current consumption: | < 80 A / < 68 A |
| Fuses: | 100 A NH |

**Cooling water (external circuit):**

| | |
|---|---|
| Water quality: | demineralized water |
| Max. conductivity after addition of corrosion inhibitors: | < 1000 µS / cm |
| Impurities: | ≤ 100 µm |

For more cooling water hints see operating manual

**Laserversion:** **ROFIN DC 035**

**Cooling water circuit (external):**

| | |
|---|---|
| Laser head: | The cooling water connection fittings are located at the connection plate. The fittings are dimensioned to fit 1" plastic tubing. The tubes are placed over the connectors and secured with clamps. |
| Control cabinet: | The cooling water connection fittings with 1/4" inside thread and connectors for plastic tubing with 10 - 11 mm inside diameter are located at the heat exchanger. The plastic tubes are placed over the connectors and secured with clamps. |
| Minimal flow rate: | ≥ 5000 l / h (laser head)<br>≥ 800 l / h (control cabinet) |
| Refrigeration capacity: | ≥ 50 kW |
| Supply pressure: | ≤ 6000 hPa (6 bars) |
| Pressure drop: | ≤ 3000 hPa (3 bars) |
| Backwash pressure: | ≤ 1500 hPa (1.5 bars) |
| Temperature: | 19 °C to 24 °C (must be above dew point!) |
| Recommended temperature: | 20 °C to 22 °C |
| Temperature tolerance: | ≤ ± 1 K |

**Inert gas specifications:**

Inert gas supply fittings are provided on the connection side of the laser head and are dimensioned to fit 4K plastic tubing. The tubes are placed over the fittings and secured with union nuts.

| | |
|---|---|
| Nitrogen: | |
| Purity: | ≥ 4.6 |
| Pressure: | 3800 to 5300 hPa (3.8 to 5.3 bars)<br>(all pressure specifications related to atmosphere) |
| Flow rate: | ≥ 4 l / min (factory adjusted by ROFIN-SINAR) |

or

| | |
|---|---|
| Compressed air: | |
| Oil: | ≤ 0.005 mg / $m^3$ |
| Water: | ≤ 0.05 g / $m^3$ |
| Permissible filter pore size: | ≤ 0.05 µm |
| Pressure: | 3800 to 5300 hPa (3.8 to 5.3 bars)<br>(all pressure specifications related to atmosphere) |
| Flow rate: | ≥ 4 l / min (factory adjusted by ROFIN-SINAR) |

**Laserversion:** **ROFIN DC 035**

The compressed air which is used to flush the laser beam telescope must correspond to this specification!
Oil and water free compressed air is seldom available from a factory air supply! Factory air supplies are often contaminated by oil and water. This will damage the telescope optics. Ask ROFIN-SINAR for informations to separate the compressed air.

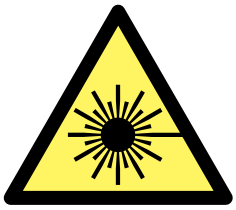
**Ambient conditions:**

Operation:
Temperature: + 5 °C … + 40 °C
Relative air humidity: 50 % at 40 °C, 90 % at 20 °C
Storage:
Temperature (with antifreeze compound): - 25 °C … + 55 °C

## Positioning laser (optional): 8.1

**The positioning laser is a Class 2 laser.**
**With Class 2 laser equipment the eyes are adequately protected by the natural eyelid closure reflex, provided visual contact with the beam is brief.**
**Avoid intentionally looking at the beam!**
**It is mandatory to wear protective goggles for the frequency of the positioning laser beam while you are working with it!**

**Important:**
**It is strongly recommended that any person who is to participate in the installation, operation or maintenance of the laser equipment shall read and fully understand the contents of this manual and particularly the safety sections 2 - 2.8.**
**Should there be any questions or doubt about the safety aspects of the equipment, please do not hesitate to contact any of the ROFIN-SINAR offices before proceeding.**



**Any alignments should only be carried out by persons who have received special instructions by the laser supplier in accordance with the occupational safety laws currently in force and the requirements specified by the relevant professional organizations.**

The positioning laser has a compact, low - wattage laser diode. It emits a visible red laser beam.
As the beam path is clearly visible, the positioning laser can be used to align the external laser beam guides and allows the workpiece to be precisely positioned.

The positioning laser is activated by a function key on the controller terminal or via an interface.
It takes approx. 1.5 seconds until the positioning laser is ready.

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## Control panels (optional): 8.2

— **Emergency OFF control panel (section 5.1):**

The Emergency OFF control panel **(230 V AC and 24 V DC)** must be installed in the control cabinet of the laser if the control panel with keyboard and display **or** the ON/OFF control panel **are not installed** in the control cabinet of the laser.

— **ON/OFF control panel (section 5.1.1):**

The ON/OFF control panel **(230 V AC and 24 V DC)**l may be installed either in the control cabinet of the laser or in other units of the laser system.

— **Control panel with display and keyboard (section 5.1.2):**

The control panel with display and keyboard **(230 V AC and 24 V DC)** may be installed either in the control cabinet of the laser or in other units of the laser system.

## Laser gas pressure display (optional): 8.3

The gas pressure in the laser gas bottle may be displayed on the display of the controller terminal (optional).
The laser software analyses the signal of an electrical pressure transducer which is mounted on the laser gas bottle instead of the pressure display (2) shown at **fig. 7.4.1/1**. In the Service / Report menu the laser software shows the actual gas pressure in the laser gas bottle and displays a warning signal when the gas pressure is < 30 bars.
So you will get a just in time warning to order a new laser gas bottle or to prepare the change of the laser gas bottle.

# ROFIN DC 0XX compact (optional): 8.4

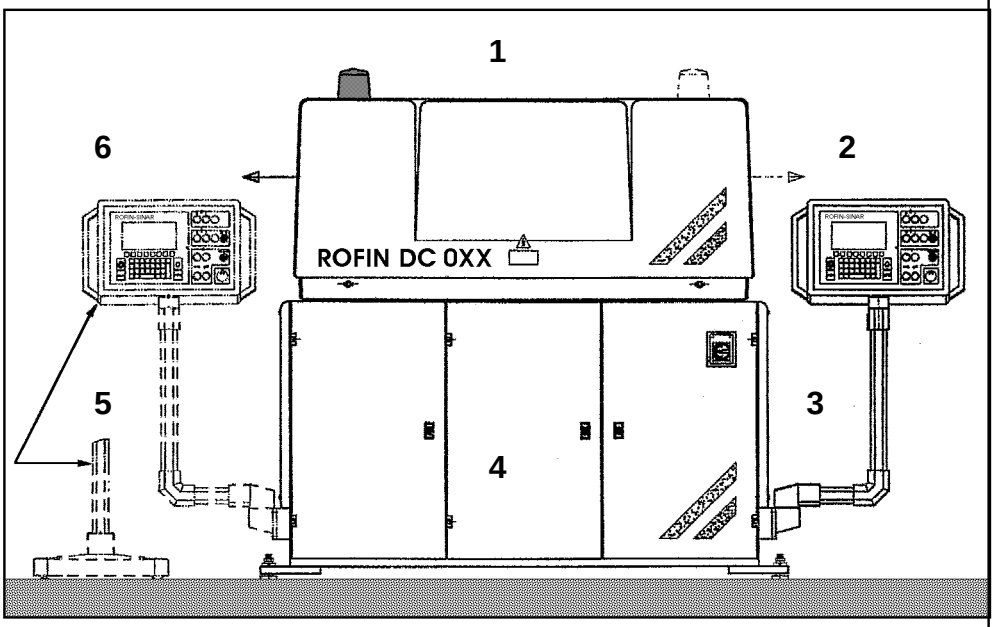


**Fig. 8.4/1:**
ROFIN DC 0XX Laser on compact control cabinet
1 ROFIN DC 0XX Laser
2 Controller Terminal right side
3 Laser gas bottle (optional)
4 Compact control cabinet (optional)
5 Controller Terminal on a roller (optional)
6 Controller Terminal left side

The ROFIN DC 0XX laser can be delivered with a compact control cabinet instead of the normal control cabinet (optional). The compact control cabinet can be used to adjust the laser head when using adjustable floor anchoring bolts (optional).
The laser is operated via the Controller Terminal, which can be mounted selectively on the right or the left side or on a roller (optional).

**Compact control cabinet:**

| | | | | |
|---|---|---|---|---|
| Dimensions: | | | | |
| Length: | ca. | 1800 | mm | (without Controller Terminal and laser gas bottle (optional)) |
| | ca. | 1950 | mm | with adjusting feet |
| Breadth: | ca. | 900 | mm | |
| Height: | ca. | 1013 | mm | (ca. 1040 mm with adjustable floor anchoring bolts) |
| Weight: | ca: | 850 | kg | |

**Laser head:**

Dimensions and weight: see **section 8.**

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## ROFIN-SINAR LasTerm (optional): 8.5

ROFIN-SINAR LasTerm (= Laser Terminal Emulation) is a functional software reproduction of the normal ROFIN DC 0XX laser´s Controller Terminal with display and keyboard. It can be installed on a CNC, a PC or a laptop computer (eventually with touch screen display).

If you use LasTerm you do not need the normal Controller Terminal to operate the software menus and to send commands to the laser controller. LasTerm substitutes the normal Controller Terminal totally.

The operation of LasTerm is on PC or Laptop e.g. by a computer mouse and on a CNC with the keys of the CNC.

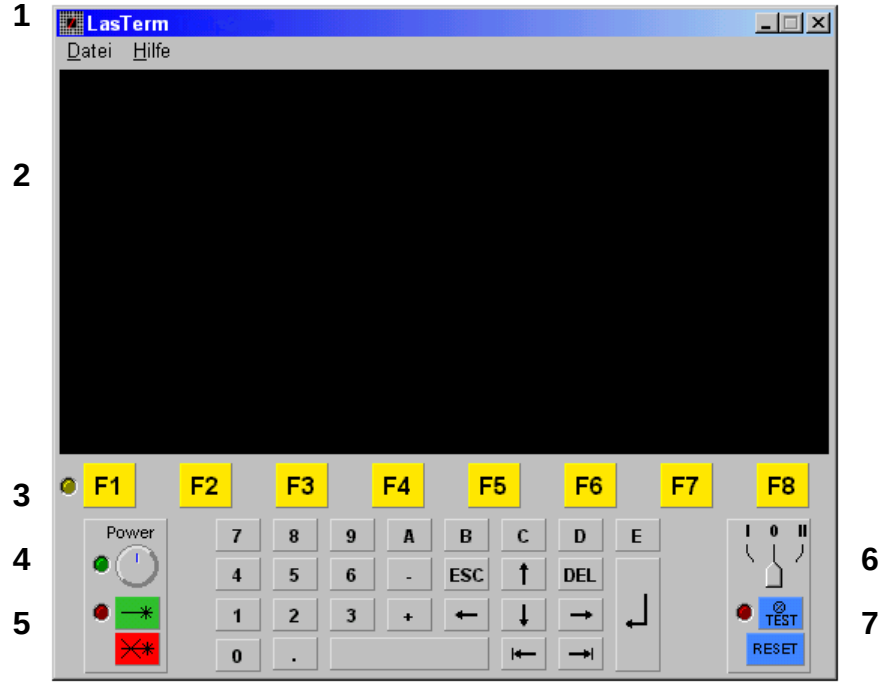


**Fig. 8.5/1:**
ROFIN-SINAR LasTerm
1 Menus
2 Display
3 Function keys
4 Potentiometer
5 Laser beam ON and - OFF - keys
6 Key switch (substitute for the key switch on the normal Controller Terminal)
7 TEST and RESET - keys

**System requirements:**

LasTerm is a 32 bit application which is designed for Windows 9x or Windows NT. **It does not run under Windows 3.x.**
You need a free communication port in your PC to connect LasTerm to the laser controller. The connection is via cable to the normal display interface at the laser controller.

**Installing the Software:**

Run the delivered setup program to install the LasTerm software or copy the following files to your computer:

- Terminal.exe
- Terminal.enu
- Terminal.deu
- Terminal_enu.hlp
- Terminal_deu.hlp
- Terminal_enu.cnt
- Terminal_deu.cnt

Provide security that a communication port (Comm Port) is available. The preset of LasTerm is COM2 but you can assign the communication port in the menu "File / Options".

This dialog will be selected via the menu "File / Options". It has three pages.

- On page "**Communication**" you can select communication port and baud rate. If you select an occupied communication port you will get a fault message. If you select an unqualified baud rate you will get a wrong or unreadable display image because of transmission errors. ROFIN-SINAR recommends you to use a baud rate of 9600 Baud.
- On page "**General**" you can select the language LasTerm uses (only english or german for menus, hints and dialogs). The language used for the software menus is selected by the laser controller further. Also on this page you can select whether to see a hint about shortcuts at every new program start.
- On page "**Codes**" you can set passwords for changes of the key switch positions. For positions I and II you can set different passwords. After setting the passwords LasTerm asks for the password at any attempt to change the position of the key switch. LasTerm also asks for the password if you try to change or delete the password in this dialog.
  For selecting the "0" position no password is necessary.

**Starting the program:**

To start the program make a double click on "Terminal.exe".

**Help:**

Together with the program you will get several help texts and informations for installation, operation and registration of the LasTerm software.

**Registration:**

You may test LasTerm for 60 days. Latest than you must register the program at ROFIN-SINAR.
Necessary therefore is the license number seen when you open the "Info" dialog (menu "Help / Info"). Call ROFIN-SINAR and tell this license number. You than will get a register number.

To input this register number open the "Info" dialog again and press the "Register" key. Type in the register number in the following dialog and than press the OK key.
The program now is licensed.

**These functions will be activated by the related key commands of the CNC:**

| | |
|---|---|
| Laser beam ON (press 2 times) | **Ctrl + L** |
| Laser beam OFF | **Ctrl + O ("O")** |
| Fault reset | **Ctrl + R** |
| Lamp test | **Ctrl + T** |
| Aktivates and deaktivates the laser power potentiometer | **Ctrl + P** |
| | |
| Key switch position 0 | **Ctrl + 0 ("zero")** |
| Key switch position 1 | **Ctrl + 1** |
| Key switch position 2 | **Ctrl + 2** |
| | |
| Cancel LasTerm´s input windows | **Esc or Q** |
| Copies the aczual laser screen to the clipboard | **Ctrl + PrntScrn** |
| Help | **Ctrl + H** |
| About dialog | **Ctrl + A** |
| Options dialog | **Ctrl + S** |
| | |
| **These key commands only work after activating the potentiometer (Ctrl + P):** | |
| Reduce the value by 1 by potentiometer | **Ctrl + Left or Down** |
| Increase the value by 1 by potentiometer | **Ctrl + Right or Up** |
| Reduce the value by 10 by potentiometer | **PageDown or Ctrl + PageDown** |
| Increase the value by 10 by potentiometer | **PageUP or Ctrl + Page-Up** |

If you have further questions call ROFIN-SINAR Laser.

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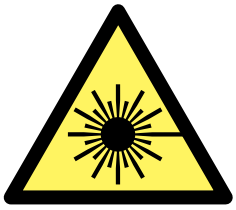
## Laser modules P 200 (optional): 8.6

**Danger — attention:**
**— The installation, operation, maintenance and repair of laser modules P 200 may only be performed by ROFIN-SINAR service staff or specially trained personnel who have received instruction concerning the hazards involved in its operation.**
**"Instruction" also means reading this operating manual, particularly Sections 2 - 2.7 — Safety instructions.**

**Danger — attention — general hints:**
- **The installation of laser modules P 200 may only be performed by specially trained personnel!**
  **The safety regulations of your national professional organizations for work on machines with electrical and high voltage must be adhered to.**
  **The electrical connection must be installed according to the rules and regulations of your national standards.**
- **Implement the wiring and the numbering of the connection lines according to the technical documents from ROFIN-SINAR!**
  **These documents and their observation are the premise for service and maintenance work on the laser system done by ROFIN-SINAR service staff.**
- **The fuses of the laser system and the line cross section of the mains line have to be designed according to the country´s specific mains voltage.**



The laser modules P 200 are designed to be used only as a part of another machine. Rules for Europe: Taking it into operation is forbidden until the final machines conformity with the directives 89/392/EWG and 89/336/EWG has been stated.

The laser modules P 200 are not mounted into a enclosed and shielded control cabinet by ROFIN-SINAR.
You, as the manufacturer of the laser system, are responsible for ensuring the compliance to standards and regulations of the European Union, e.g. the directive for Electromagnetic Compatibility.
In this case, ROFIN-SINAR is not allowed to declare an EU - Declaration of Conformity.

To document the compliance with the Machinery Directive you can obtain an EU Declaration of the manufacturer from ROFIN-SINAR.

**Laser modules P 200 available on order from ROFIN-SINAR:**

1. Mounting plate P 200
2. HV (High Voltage) supply P 200
3. Connection lines between laser head, mounting plate P 200 and HV supply P 200

**1. Mounting plate P 200:**

**Note the general points at the beginning of Section 8.6!**

**The mounting plate P 200 includes:**

- Power supply (24 V DC) with series fuse
- Auxiliary contactors
- Emergency - **OFF** relay (contactor safety combination).
- Mains filter
- Isolating transformer
- 19" computer chassis with computer. The computer is firmly mounted by the computer carrying plate with two fans on the mounting plate P 200.
  The computer is explained in **Section 6** of this operating manual. There you will find designation and position of plug - in boards, interfaces, etc.
- Interfaces for the external connection of the laser.
- Main circuits
- Fuses
- Power supply for the HV supply P 200, vacuum pump, ventilator and fans of the laser head.
- An installed phase detector prevents the starting of the laser ("**Mains ON**"), if the three outer conductors create a counterclockwise field, a phase fails or if the mains supply variation is > 10 %.

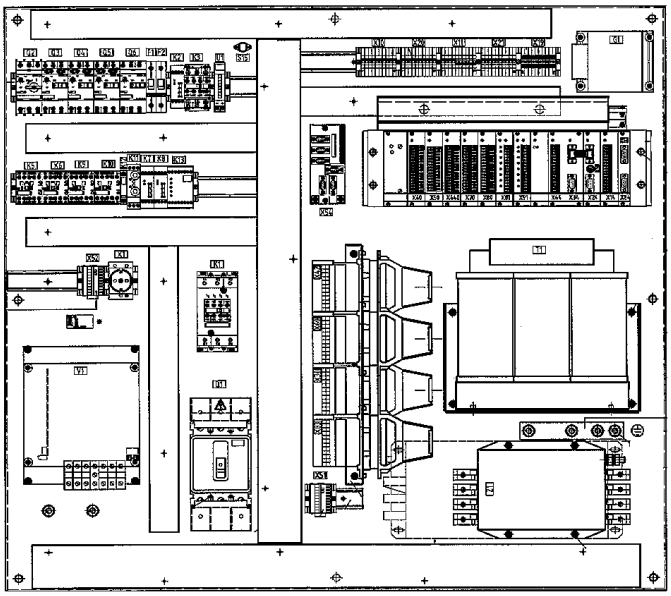


**Fig. 8.6/1:**
Mounting position of mounting plate P 200

**Technical data:**

| | |
|---|---|
| Weight: | approx. 180 kg |
| Internal protection: | IP 20 |
| Dissipation: | $P_V$* = 150 W<br>(sufficient cooling necessary) |

**Installation:**

| | |
|---|---|
| Installation position: | vertical (see **fig. 8.6/1**); the equipment side of the mounting plate P 200 has to be accessible |
| Admissible temperature in the cabinet during operation: | + 5 °C to 40 °C |
| Relative humidity: | 30 - 95 %; no condensation forming<br>No moisture may enter the mounting plate P 200! |
| Storage temperature: | - 25 °C to + 55 °C |
| Maintenance: | The mounting plate P 200 is maintenance - free. |

**Attention:**
**Note that electrical contacts X71 as section 6.1 — interfaces to an external control system — in laser modules P 200 are changed to X30!**
**For the laser modules P 200 the switching voltage at X30 is 24 V AC!**

**2. HV supply P 200:**

**Note the general points at the beginning of Section 8.6!**

**Danger — attention:**
**The laser beam is produced by a gas discharge which is ignited by electrical energy and high frequency. The high voltage required to do this can reach levels of up to 11 000 Volts.**

**Danger — attention:**

**— High voltage is absolutely lethal!**

**— Whenever access to the HV supply P 200 or the interior of the laser head is necessary, exercise extreme caution to avoid contact with high voltages.**

**— Only authorized, electrically trained personnel should access these high voltage areas.**
**Use the grounding probe as specified in its manual. Grounding probe and its manual have been delivered by ROFIN-SINAR with the laser modules P 200.**

**The HV supply P 200 includes:**
- High voltage rectifiers
- Overcurrent control
- Transformer
- Capacitors

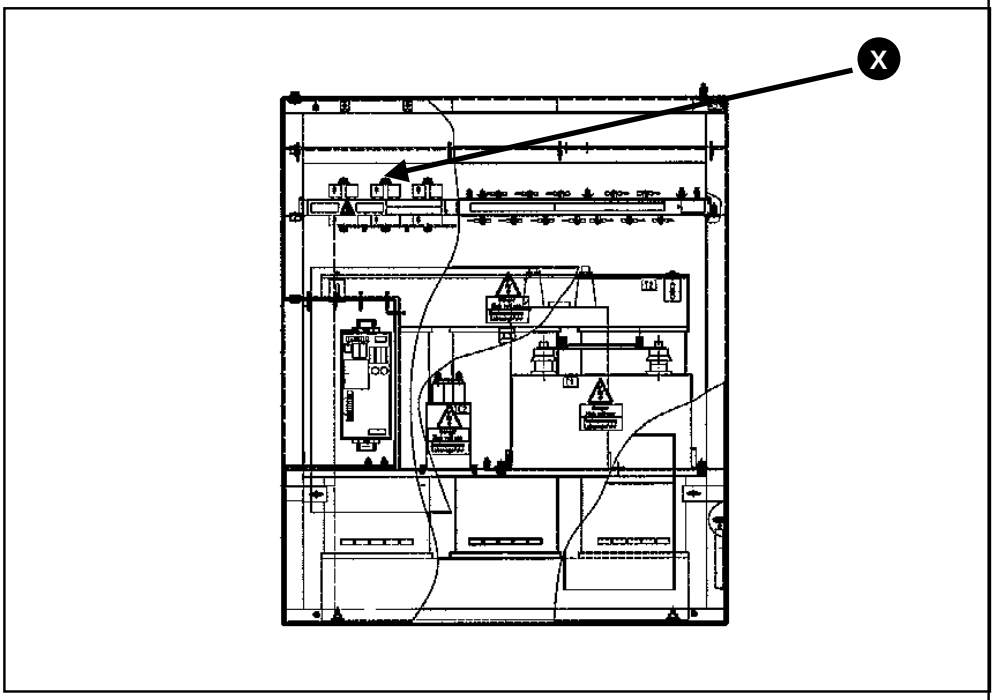



**Fig. 8.6/2:**
Mounting position of HV supply P 200
X: sufficient cooling at this area is necessary - with air circulation of $v \geq 3$ m / s

**Technical data:**

| | |
|---|---|
| Weight: | approx. 340 kg |
| Internal protection: | IP 00 |
| Dissipation: | $P_V$* = 2500 W<br>(sufficient cooling necessary) |

**Installation:**

| | |
|---|---|
| Installation position: | vertical (see **fig. 8.6/2**) |
| Admissible temperature in the cabinet during operation: | + 5 °C to 40 °C<br>(sufficient cooling at area "X" (see **fig. 8.6/2**) with air circulation of v ≥ 3 m / s necessary) |
| Relative humidity: | 30 - 95 %; no condensation forming<br>No moisture may enter the HV supply P 200! |
| Storage temperature: | - 25 °C to + 55 °C |
| Maintenance: | The HV supply P 200 is maintenance - free. |

**3. Connection lines:**

**Note the general points at the beginning of Section 8.6!**

**Connection lines:**

- Impact safe flexible tubing
- Electrical connectors

**Technical data:**

| | |
|---|---|
| Length: | approx. 0.5 m |
| Internal protection: | IP 54 |

**4. Installation of the laser modules P 200 after integration into your laser system:**

If a fault alarm is indicated by the laser´s interface after starting the computer, clear the fault and quit via the corresponding interface.
If the fault alarm further or the message "**SYSTEM FAULT**" is indicated, you have to reset the system ("SYSTEM RESET).
To do this, press the red pushbutton on the CPU - card of the computer.

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# List of abbreviations and explanatory notes: 9.

The list contains abbreviations and explanatory notes of laser technology. It may be that not all them are used in this ROFIN-SINAR manual.

| | |
|---|---|
| A/D converter | Analog-to-Digital converter |
| AS [ASP] | Connection diagram |
| BCD | Binary Coded Decimal code (programmers code) |
| BET | Beam Expanding Telescope |
| Blower | Roots blower |
| Booster | Electrical power supply to bring flashlamps from ignition to simmer mode |
| BS [BSP] | Construction circuit diagram |
| Caustic | Beam contour |
| CCD camera | Charge-coupled device camera |
| CNC | NC-controller system with integrated computer (**C**omputer **N**umerical **C**ontrol) |
| Controller Terminal | Operator panel **with** display and keyboard |
| CPU | **C**entral **P**rocessing **U**nit of a computer |
| CW | Continuous Wave mode |
| DI-cartridge | Ion exchange cartridge |
| DI-Water | Demineralized water |
| Discriminator | Fiber cable shielding unit |
| Divergence | Angle used to measure beam expansion over a distance. Unit of measurement: rad |
| DVM | Digital Voltmeter |
| Flowtube | Water flow tube for Nd:YAG - laser rod |
| HE | Unit used to measure height in 19" rack systems |
| HeNe-Laser | Helium-Neon Laser, emits visible laser radiation for positioning and aligning |
| HF | High Frequency |
| HV | High Voltage |
| Interlock | Safety circuit. Shuts off power (e.g. high voltage) if contacts are opened. |
| Invar(rods) / Invar | Alloy with low thermal expansion coefficient. Spacertubes ("invar rods") are made of this material. |
| kinematic | Related to motion |
| λ/4-Phase shifter | Optical component to alter direction of polarization |
| Laser | Term used to describe all devices that operate on the principle of **L**ight **A**mplification by **S**timulated **E**mission of (electromagnetic) **R**adiation with wavelengths of less than 1 mm |

| | |
|---|---|
| Laser beam | Spatially directed laser radiation |
| Laser diode | Laser diode, emits visible laser radiation for positioning and aligning |
| LD alignment laser | Laser diode alignment laser |
| LED | **L**ight **E**mitting **D**iode |
| LSB | Least significant bit |
| Mode | Density distribution of laser beam |
| Mode order (degree) | Unit used to measure laser beam quality |
| MSB | Most significant bit |
| Nd:YAG-Laser | Neodymium-doped Yttrium-aluminium-garnet laser |
| Nl | Standard litres (german unit of measurement) |
| OEM | **O**riginal **E**quipment **M**anufacturer |
| PCB | Printed Circuit Board |
| PS [PSP] | Schematic diagram |
| PWM | Pulse Width Modulator |
| RF | Radio Frequency |
| RL [RLP] | Piping / tubing diagram |
| RPG | Ramping- / Pulse Generator |
| Shutter | Unit to stop the laser beam |
| Skt. | Graduation of scale |
| SL [SLP] | Circuit diagram (current) |
| SM | Source of laser stimulation (Switched Mode) |
| Softstart (unit) | Unit to switch ON high voltage softly |
| SPS | Stored-program controller |
| STP | Standard Pressure |
| TEM | Transverse Mode (used to describe power distribution across laser beam) |
| µS/cm | Micro-Siemens per centimeter = value for conductivity |