

**RSM PowerLine F**

*Repair Manual*

**

RSM PowerLine F - Repair Manual

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**General Information**

**1 General Information**

**1.1 Identification data**

| **Identification data**  **Machine type:**  **Model designation:**  **Serial number:**  **Order number:**  **Parts list number:**  **Manufactured on:** |
| --- |

**1.2 Customer data**

| **Customer data**  **Inventory number:**  **Location:** |
| --- |

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**General Information**

**1.3 Introductory information**

**1.3.1 Explanation of symbols**

1 ***Attention:*** *This symbol appears in all safety instructions in the repair manual. Possible risks are thus specially marked.*

*Non-observance of these safety instructions can lead to severe injury (including death) and/or to considerable property damage!*

3 ***Note:*** *This symbol indicates information and advice regarding operation and maintenance in the repair manual.*

**1.3.2 Scope of the repair manual**

1 ***Attention:*** *This repair manual is intended solely for maintenance personnel trained and authorized by ROFIN-SINAR for PowerLine E series lasers.*

*This repair manual is valid for lasers of the ROFIN-SINAR PowerLine E series.*

This repair manual must be read, comprehended and observed by the competent maintenance personnel. ROFIN-SINAR Laser GmbH shall not be liable for damage and operating failure resulting from the non-observance of the repair manual. The copyright on this repair manual is exclusively reserved to ROFIN-SINAR. This manual is only entrusted to the owner of the laser for his/her personal use.

No part of this repair manual nor technical regulations nor drawings may be reproduced, stored in a retrieval system or transmitted, in any form or by any means, electronic, mechanical, photocopying, recording, or otherwise without the prior consent of Rofin-Sinar.

3 ***Note:*** *We reserve the right to make technical changes in the information in this repair manual in order to improve the laser system.*

2 RSM PowerLine F - Repair Manual

**General Information**

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**General Information**

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**Safety**

**2 Safety**

This laser system may only be installed, operated, serviced and repaired by specially trained personnel who have received instruction concerning the hazards involved in its operation. This includes reading this repair manual and especially this chapter.

Please contact ROFIN-SINAR Laser or the system manufacturer if you have questions regarding this chapter or the safety of the laser system in general.

1 ***Attention:*** *The safety instructions in the other laser system documents (operating instructions, maintenance manual) and the peripheral component documents must also be observed! These documents remain valid without limitations!*

**2.1 Operation according to regulations**

The laser system has been designed to mark workpieces. The use of the laser for applications other than the intended ones are considered misuse and the laser manufacturer is not liable for any damage thereby caused. In this case, the user assumes the entire responsibility.

The laser manufacturer is not liable for damage caused by modifications made to the machine without consulting the manufacturer.

ROFIN-SINAR lasers have been manufactured in accordance with the following safety regulations:

– EN ISO 12100

– EN 60204

– EN 60825

– VDE 0837 (IEC 825)

– UVV BGV B2

– BGI 832

– VDE 0100

– VDE 0105

– 21 CFR - National Center for Devices and Radiological Health - CDRH No. 0121857-004 ; ROFIN-SINAR lasers correspond to the valid EU guidelines:

– 73/23/EEC (Low-Voltage Directive)

– 89/336/EEC (EMC Directive)

– 98/37/EC, Appendix IIA (Machinery Directive [if there is machine status])

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**Safety**

**2.2 Operation of the laser**

The rules for the prevention of accidents by laser radiation (UVV) BGV B2 (formerly VBG 93) must be observed when operating the laser in the area within which these rules and relating instructions are valid. The implementation of the accident prevention regulation UVV BGV B2 "Laser Irradiation" can be found in BGI 832 - Operation of Laser Equipment. Under UVV BGV B2, a person must be appointed to take charge of laser safety, and the professional association and the appropriate work safety authorities for lasers from class 3B or 4 must also be informed.

Outside the area within which the BGV B2 is valid, the national regulations of the user’s country must be observed with regard to the rules for prevention of accidents by laser radiation.

The laser system may only be operated by trained and authorized personnel. Training courses are offered by:

– ROFIN-SINAR Laser GmbH (maintenance, repair application, operation)

– OEM suppliers (operation)

– Professional Association of Precision Mechanics and Electronic Textile Technique (UVV) – PTB Physical and Technical Federal Institute Braunschweig (UVV)

– Technical Supervisory Associations (UVV)

**2.3 General safety instructions**

• The plant owner must make sure that no unauthorized personnel work on the laser system or in its vicinity.

• The laser system may be operated only by qualified personnel. The plant owner is responsible for the selection and training of the personnel. The personnel must have annual training on laser-specific risks. This training must be documented. The personnel must be taught to handle the laser system at set intervals, for which a written record must be kept.

• The laser system may be operated only in a malfunction-free state. Safety equipment may be neither dismantled nor deactivated, not even upon instruction.

The machine's own safety technology should be checked at regular intervals for proper function and effectiveness.

• In case of changes to the laser system that impair safety, the laser system must be shut down. Before turning the laser system on again, the faults have to be remedied.

• Due to a possible risk of injury, the laser system should be clearly surveyable and clean. • The personnel is obliged to wear the required personal protective equipment (PSA). E. g. protective goggles with the corresponding protective class adapted to the wavelength of the laser (see BGI 5092 "Selection and use of protective goggles and adjustment goggles"). • Every manner of working that impairs the safety of the laser system or people is prohibited. Improper use of the laser system must be ruled out.

• Operating the system under the influence of drugs, alcohol or medications that influence perception and reactions is prohibited!

• When switched on, the laser system must be monitored by operating personnel. Personnel must refrain from any manner of working that impairs safety.

• The plant owner is obliged to check the system for visible damage and faults at least once a shift. Changes that appear that impair safety must be eliminated immediately.

• During operation, you absolutely may not reach into the working range of the laser system with your hand or tools; safety equipment may not be evaded. A risk of injury exists! • The laser system may only be operated using the provided controls. In this case, the use of tools (screwdrivers, or similar) is prohibited.

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**Safety**

• Adjustment tasks may only take place during the setup mode. Personnel must take special care. These adjustment tasks may be performed only by qualified personnel using the provided controls.

• If unexpected risks arise during the operation of the laser system, operation must stop until the risks have been eliminated.

• The responsibilities for the various tasks within the scope of the operation of the system must be clearly defined. This applies particularly for work on electrical equipment and on beam guiding components.

• Electrically unsecured doors or covers that can be opened or removed only with tools may be opened or removed only when the main switch is turned off.

• Before powering up the laser system, all tools and aids must be removed from the working area to exclude an endangerment of people and property.

• When the laser system is shut down, the main switch should be shut off and secured. • In case of unexpected risk situations, the laser system must be shut down immediately using the emergency stop button.

• Emergency stop mechanisms may not be used as off switches in normal situations. • After the emergency stop is pressed or after a serious fault, a safety check is required. • Work in the electrical switch cabinet or on the control panel or electrical system may only be

performed by qualified personnel. Control and switch cabinets must always be kept closed. • Wet and compressed-air cleaning of the laser system is prohibited and only permitted under the following conditions:

– Wet-clean the outside with mild soapy solution or mild cleaning agents.

– Compressed air from a can (water-free and oil-free, nitrogen (1 - 2 bar).

1 ***Attention:*** *There is a risk of suffocation in case the nitrogen concentration in the ambient air is too high! Never exceed the permissible limit values!*

• Supply lines for the laser system (electrical power, cooling water) are to be laid in cable seats so that no one can trip over them.

• During work performed on additionally purchased function parts, the technical documents of the manufacturers must be observed.

• All safety notices and warnings attached to the laser system may not be removed and must always be legible. Damaged or illegible safety symbols must be exchanged immediately.

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**Safety**

**2.4 Safety notices for the laser system**

1 ***Attention:*** *Laser radiation is very hazardous for the eyes. Radiation of the skin can cause severe burns. Diffuse, secondary (reflected) radiation is also dangerous. Laser radiation can cause fire risk or risk of explosion. Avoid any exposure to direct or secondary laser radiation at all times during installation, operation, maintenance or service of the laser. Never look into the laser beam directly or with optical devices. The organizational and personal protective measures must be observed!*

1 ***Attention:*** *Laser radiation can lead to permanent eye damage and skin burns!*

1 ***Attention:*** *After the cover of the laser head has been opened, the laser beam can be accessed freely! Laser operation with removed cover is prohibited! After completing service and repair work for which the laser head must be opened, the labels ("Do not open") must be pasted over the two top fastening screws of the laser head cover again!*

1 ***Attention: Warning against laser radiation!***

*A laser without any special protective unit corresponds to hazard class 4. A laser beam is invisible at a wave length of 1064 nm. If the positioning laser is activated (wavelength 660 nm, red laser beam, hazard class 3R), the laser beam is visible.*

**Laser class 1**

Lasers that are safe under reasonably predictable conditions; this includes the use of optical instruments for the direct observation of the beam.

The accessible laser radiation is classified as safe.

**Laser class 3R**

Lasers emitting in the waverange of 302.5 nm to 1,000,000 nm (1,000 µm) and

where directly looking into the beam may be hazardous. The limit of accessible

emission is within five times of the limit value (GZS) of class 2 in the wavelength

range of 400 nm to 700 nm and within five times of the limit value (GZS) of class 1 for other wavelengths.

"Visible laser radiation" is present if the emitted radiation lies within of the visible

radiation (wavelength range between 400 nm and 700 nm).

**Laser class 4**

Lasers that can also generate dangerous, diffuse reflections. They can lead to skin injuries and the risk of fire. Their use requires extreme caution.

"Invisible laser radiation" is present if the emitted radiation lies outside of the visible radiation (wavelength range between 400 nm and 700 nm).

These areas are to be labeled with the corresponding warning symbols and the

additional text "INVISIBLE LASER RADIATION – avoid irradiation of eyes and skin through direct or scattered radiation – LASER CLASS 4."

1 ***Attention:*** *Depending on the layout of the laser marker, the beam is emitted from the optics of the marking head. The optics in these beam guide systems can point in any direction (360°).*

1 ***Attention:*** *If no galvo head is attached, the laser beam is emitted out of the front of the laser head.*

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**Safety**

• The owner of a laser system of laser classes 3B or 4 is obliged to name a laser protection officer for the operation of the plant.

• When the protective housing is installed completely, the machine has laser protection class 1. This means that no dangerous radiation can escape from the protective paneling and thus no risk exists for the machine operator or other people in the vicinity.

1 ***Attention:*** *If the machine is serviced and the protective paneling is removed, the machine has laser protection class 4. In this state, all applicable laser protection measures must be complied with.*

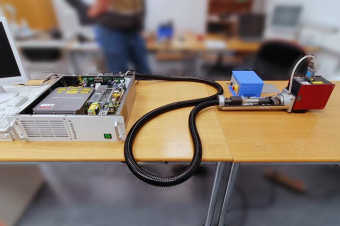
1 ***Attention:*** *The protective goggles used must be adapted to the wavelength of the laser and have the corresponding protection class.*

• To counteract potential malfunctions arising from inadvertent laser radiation, we remind you to comply with the proper use of the safety shutter (hereafter "Shutter").

1 ***Attention:*** *If the laser system has to be switched on for testing/measuring purposes, measures for protection against laser radiation must be taken (use of protective goggles, setup and positioning of partition walls, attachment of warning signs and barriers, etc.). These measures must be coordinated with the laser protection officer.*

*The DIN EN 207 Filter und Augenschutzgeräte gegen Laserstrahlung (BS EN 207 Filters and Eye Protectors Against Laser Radiation (Laser Eye-Protectors)), DIN EN 60825-1 Sicherheit von Lasereinrichtungen (BS EN 60825-1 Safety of Laser Products), and DIN EN 60825-4 Sicherheit von Laserschutzwänden (BS EN 60825- 4 Safety of Laser Products: Laser Guards) standards must be observed.*

**2.4.1 Beam path**

****

***Figure 2.1*** *Beam path*

The dashed line designates the beam path of the laser. The same applies to to the alignment laser (if applicable).

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**Safety**

**2.4.2 Alignment laser1**

The alignment laser is a laser diode of protection class 3R. The accessible laser emission is within the wavelength range from 302.5 nm to 106 nm and is hazardous for eyes. The power or energy equals a maximum of five times of the limit value of the accessible radiation of class 2 in the wavelength range of 400 nm to 700 nm and within five times of the limit value of class 1 for other wavelengths.

Remark:

Class 3R laser devices are potentially hazardous to eyes as are Class 3B laser devices. The risk of eye injury is lower because the limit value of accessible radiation (GZS) in the visible wavelength range is limited to five times of the limit value of the accessible radiation (GZS) of class 2, and in the other wavelength ranges to five times of the limit value for accessible radiation (GZS) of class 1.

For continuously radiating lasers of class 3R, the limit value of accessible radiation (GZS) P limit = 5 mW (with small sources C6 = 1) in the wavelength range 400 nm to 700 nm.

1 ***Attention:*** *Never look into the beam of the alignment laser directly or with optical devices.*

**2.5 Safety instructions for maintenance and setting tasks**

1 ***Attention:*** *During the performance of maintenance, repair, setting, and monitoring tasks, the system must be shut down and secured against restarting. The warning sign "System shut down - activation prohibited!" must be attached to the laser system.*

1 ***Attention:*** *For the observance of laser protection class 1, the operation of the system with partially or completely dismantled protective housing is fundamentally prohibited.*

• After the mounting of the electrical systems or servicing, the function of the existing protective devices should be checked and the protective measures tested.

• Electrically unsecured doors or covers that can be opened or removed only with tools may be opened or removed only when the main switch is turned off.

• Work in the electrical switch cabinet or on the control panel or electrical system of the machine may only be performed by qualified personnel. Control and switch cabinets must always be kept closed.

• If safety devices are removed during repair work, the machine may not be restarted until all safety devices have been attached and checked for proper function.

• During maintenance work, make sure that electrical and media lines are not damaged or crushed.

During this work, the main switch should be shut off and secured.

1 ***Attention: Laser radiation danger:*** *If parts of the protective housing are removed for work on beam-guiding units, operation of neighboring systems must be shut down. Authorized personnel located in the vicinity of the laser system during this work must wear protective goggles according to DIN 207. The working area must be labeled (laser class 4) (see Section 2.4, page 10).*

1. Installation depends on the respective laser type

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**Safety**

1 ***Attention:*** *After the cover of the laser head has been opened, the laser beam can be accessed freely! Laser operation with removed cover is prohibited! After completing service and repair work for which the laser head must be opened, the labels ("Do not open") must be pasted over the two top fastening screws of the laser head cover again!*

1 ***Attention:*** *The mechanical processing of parts of the laser system (grinding, drilling, separating, etc.) must fundamentally take place outside of the working area!* ***The processing of support subassemblies is fundamentally prohibited!***

**2.6 Electrotechnical safety instructions**

• Wiring, electrical connection, commissioning, maintenance, and repair may only be performed by qualified electricians.

• Work may not be performed on live parts under any circumstances. The system or parts of it must be electrically disabled and secured against unintentional reactivation.

• When working on the electrical systems, turn off and secure the main switch.

1 ***Attention: High voltage! Extreme danger!***

*The devices marked with lighting bolts signs in the switch cabinet (main switch, repair socket, mains connection terminals) remain live after the main switch is turned off.*

*The switch cabinet may only be opened by electricians for repair purposes.*

1 ***Attention:*** *Additional devices connected to the laser system may have their own mains supply line and thus be live when the main switch of the system is turned off.*

• The control and main power lines are to be laid separately from each other.

**Non-observance may result in the following:**

– Failure of the machine function

– Endangering malfunctions

– Destruction of electrical and mechanical components

• Electrical equipment must be checked regularly. Loose connections must be retightened. Damaged lines or cables should be exchanged immediately.

• The switch cabinet and all electrical supply units must always be kept locked. Access is permitted only to authorized personnel with a key or special tool.

• PCBs or plug connection may be removed only when the system is shut down. Do not mix up PCBs or plug connections. The label or coding must be observed.

• In case of measurements on live subassemblies or lines, a second person must always be present who can turn off the main switch in case of an emergency.

• When working with grounded measuring devices (oscilloscope), make sure that the ground bushing of the measuring device is always connected with the ground point of the control system (measuring cable). According to requirements, isolation amplifiers should be used for perfect measurements.

1 ***Attention:*** *Never clean electrical equipment with water or other liquids.*

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**Safety**

**2.7 Electrostatic sensitive devices (ESD)**

1 ***Attention:*** *The electronic components of the PC plug-in are electrostatic sensitive devices (ESD)! Protective measures must be observed when working on these components!*

**Protective measures to be performed:**

• Ensure constant equipotential bonding!

• Make sure that personnel is grounded with wristbands and shoes!

• Make sure that clothing is closed and has discharge capacity!

• Materials that can charge electrostatic energy such as normal PE, PVC, styrofoam, etc. must be avoided!

• Avoid electrostatic fields >100 V/cm!

• Use only marked and defined packaging and transport materials!

1 ***Attention: When the power connection is disconnected as required prior to opening the PC plug-in, the PE connection will also be disconnected!***

***The PC plug-in must be properly grounded before work is performed on electronic components! The external connection to ground must be established at a marked PE terminal of the plug-in and a marked PE terminal in the system area! A measurement must be performed to ensure correct equipotential bonding). The ESD wrist band must then be connected to a PE terminal of the plug-in!***

***No work may be performed on electronic components prior to that!***

1 ***Attention:*** *All personnel working on electronic components must comply with the required measures to protect electrostatic sensitive devices! The work area must be secured!*

**

***Figure 2.2*** *PC plug-in*

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**Safety**

**2.8 Emergency stop mechanisms and safety equipment**

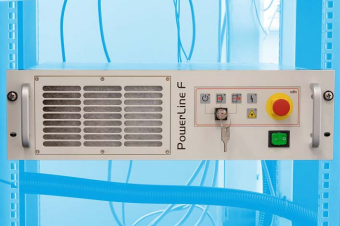
**2.8.1 Emergency stop mechanisms**

The emergency stop is caused by operating the red emergency stop push button. The emergency stop switches off the laser as quickly as possible and stops all movements of the operation process and used to prevent injury to persons, or damage to the machine or workpiece.

Depending on the system layout, the Emergency stop pushbutton is located on the external control panel or the supply plug-in.



***Figure 2.3*** *Emergency stop push button external control panel*

**

***Figure 2.4*** *Emergency stop push button supply plug-in*

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**Safety**

3 ***Note:*** *The emergency stop should not be used to end a normal working cycle.*

**2.8.2 Safety equipment**

****

***Figure 2.5*** *Warning lamp laser head*

There are two warning lamps opposite each other in the laser head.

These warning lamps will illuminate when the laser system is switched on with the main switch and the key switch is set to position I (system closed in operating mode/shutter) or position II (Open activation system in operating mode/shutter, i. e. when the laser radiation is generated.

The warning lamps flash when an error occurs.

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**Safety**

**2.9 Other dangers**

**2.9.1 Ultraviolet radiation**

1 ***Attention:*** *The metal vapor plasma which emerges when welding and marking certain metals with a laser beam emits intense invisible ultraviolet radiation which can cause severe damage to the eyes and the skin!*

1 ***Attention:*** *The laser protective goggles for 1064 nm or 532 nm specified by DIN EN 207 or EN 208 do not offer protection from this ultraviolet radiation.*

3 ***Note:*** *Special goggles which protect the eyes against ultraviolet radiation are commercially available.*

**2.9.2 Hazardous materials**

1 ***Attention:*** *Hazardous fumes and dust may be given off during the marking process or when carrying out service tasks (e. g. replacing contaminated filters). The regulations of the supplier in regard to safety must be observed. When handling hazardous materials, a suitable breathing mask and protective gloves shall be used.*

**2.10 Personal protective measures**

1 ***Attention:*** *Laser radiation is very hazardous for the eyes. Radiation of the skin can cause severe burns. Diffuse, secondary (reflected) radiation is also dangerous. Laser radiation can cause fire risk or risk of explosion.*

1 ***Attention:*** *After the cover of the laser head has been opened, the laser beam can be accessed freely! Laser operation with removed cover is prohibited! After completing service and repair work for which the laser head must be opened, the labels ("Do not open") must be pasted over the two top fastening screws of the laser head cover again!*

• Avoid any exposure to direct or secondary laser radiation at all times during installation, operation, maintenance or service of the laser. Never look into the laser beam directly or with optical devices. The organizational and personal protective measures must be observed!

• Wear suitable protective goggles in the laser area according to DIN EN 207 and EN 208 – eye protection against laser radiation at a wavelength of 1064 (660) nm.

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**Safety**

**2.11 Administrative precautions**

The following regulations must be observed. The detailed organizational protective measures and guidelines of DIN EN 60825, Classification VDE 0837 (IEC 825), must be observed. • The operators must be instructed in safety regularly.

• Attach warning signs to warn against laser radiation.

• Deny access to the laser system to anybody not working on it.

• The laser area must be sufficiently labeled.

• Due to a possible risk of fire and explosion, no flammable or easily flammable gases, liquids, or solids may be brought into the laser area.

• Toxic decomposition products may develop when certain materials (e. g. metals or plastics) are processed. Information on possible risks that can appear should be obtained, e. g. from professional organizations.

• Objects that can endanger people through the uncontrolled reflection of the laser radiation must be removed from the laser area.

• Have authorized and purposely appointed persons check the effectiveness of integrated safety equipment (e. g. emergency stop) according to defined test cycles. All relevant national safety regulations and guidelines must be observed (see "Operation according to regulations" on page 7).

Existing safety equipment must be actuated during operation. Any endangering functions must immediately be stopped or interrupted. Before renewed powering up the laser system, the corresponding displays or error messages must be acknowledged. Make sure that the laser system can be restarted. If this is confirmed the safety equipment is in proper working order.

• Make sure that the warning lamps regarding laser radiation function properly. A defective lamp must be replaced immediately. The laser radiation warning lamps are located on top of the laser head.

**2.12 Waste disposal information**

Comply with all national and regional regulations regarding waste disposal.

**2.13 Labeling**

All locations which, under certain circumstances (e. g. when protective covers are opened), represent a potential risk, are labeled with the required warning labels. The location of the individual signs are marked in the Safety chapter in the user manual.

1 ***Attention:*** *These labels must not be removed.*

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**Safety**

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**Safety**

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**Required tools, measuring devices, and aids**

**3 Required tools, measuring devices, and aids**

In addition to a standard tool set, the tools, measuring devices, and aids listed in the following are required for performing repair work on lasers of the RSM PowerLine F series:

• Protective goggles\* 

1 ***Attention:*** *The protective*

*goggles must be adapted to the*

*wavelength of the laser that is used.*

3 ***Note:*** *The protective goggles*

*shown in Figure 3.1 are suitable for all*

*wavelengths that may occur with the RSM*

*PowerLine F. If protective goggles are*

*used that do not cover the entire*

*wavelength range, multiple protective*

*goggles must be used accordingly.*

***Figure 3.1*** *Protective goggles*

• Power measurement device including 

sensor and fitting for power

measurement head LM 200\*

1 ***Attention:*** *When the power*

*measurement device is used, protective*

*goggles adapted to the wavelength of the*

*laser must be used!*

***Figure 3.2*** *Power measurement device*

• Adjustment tube of galvo head with 

base plate\*

***Figure 3.3*** *Adjustment tube of galvo head with*

*base plate*

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**Required tools, measuring devices, and aids**

**** ***Figure 3.4*** *Cross wires with seat*

** ***Figure 3.5*** *Transducer disk*

** ***Figure 3.6*** *Multimeter*

• Cross wires with seat D=16 mm, cross wires D=25 mm\*

• Transducer disk "Beam catcher"\* 1 ***Attention:*** *When the transducer disk is used, protective goggles adapted to the wavelength of the laser must be used!*

• Multimeter

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**Required tools, measuring devices, and aids**

**** ***Figure 3.7*** *Fine measuring tips*

** ***Figure 3.8*** *Measuring adapter for galvo voltage*

** ***Figure 3.9*** *Scotch tape no. 6877 50x66*

• Fine measuring tips

3 ***Note:*** *Various measuring points cannot be reached with standard measuring tips.*

• Measuring adapter for galvo voltage\*

• Scotch tape no. 6877 50x66\* 1 ***Attention:*** *Only tape that can be completely removed without residue may be used!*

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**Required tools, measuring devices, and aids**

**** ***Figure 3.10*** *Precision level gauge*

** ***Figure 3.11*** *Lens cleaning paper pack*

** ***Figure 3.12*** *Isopropyl alcohol*

• Precision level gauge

• Lens cleaning paper pack\*

• Isopropyl alcohol for the cleaning of optical components\*

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**Required tools, measuring devices, and aids**

**** ***Figure 3.13*** *Compressed air can*

** ***Figure 3.14*** *Rubber gloves and dust protection mask*

** ***Figure 3.15*** *ESD wrist band with spiral cord*

• Compressed air can\*

• Rubber gloves and dust protection mask for cleaning tasks\*

• ESD wrist band with spiral cord\*

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**Required tools, measuring devices, and aids**

**** ***Figure 3.16*** *M-Function PL-CF test box*

• M-Function PL-CF test box\* The test box can be used to externally activate the functions of the laser. The connection is established at plugs -X42a and -X42b of the supply plug-in.

\*. For the order number, see the ROFIN-SINAR measuring and adjusting device catalog

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**Commissioning the laser for testing and measuring purposes**

**4 Commissioning the laser for testing and measuring purposes**

**4.1 Settings in the VLM software**

3 ***Note:*** *The main or alignment laser will only start while a VLM program is running.*

**1.** Starting the PC. 

**2.** Starting the VLM software.

**3.** Create the ellipse and assign a

height and width of 2 mm in the

properties.

***Figure 4.1*** *Ellipse properties - dimensions*

**4.** Calling "Drawing settings" under 

"Options".

***Figure 4.2*** *Calling drawing settings*

**5.** Check the "Multiple marking" box. 

**6.** Click the [Apply] and [OK] buttons to

activate changes.

***Figure 4.3*** *Drawing settings*

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**Commissioning the laser for testing and measuring purposes**

**** ***Figure 4.4*** *Ellipse properties - LP type*

****1 2*****Figure 4.5*** *Start laser*

**7.** Call "Ellipse properties" again and select the "LP type" tab.

**8.** Enter the values for current and frequency.

3 ***Note:*** *Do not enter an absolute value under "Cur.(A)" but a percentage of the maximum current.*

**9.** Copy the entry with the "Add" button until a total of about 50 to 60 repeats are performed and set the speed [V] to 10 mm/s.

3 ***Note:*** *The laser is only in operation during marking.*

**10.** Start the program and thereby the main laser using Button (1)

(Figure 4.5) or the alignment laser using Button (2).

3 ***Note:*** *The main or alignment laser can only be started individually. The two lasers cannot be operated*

*simultaneously.*

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**Commissioning the laser for testing and measuring purposes**

**4.2 Settings in the machine configuration**

3 ***Note:*** *In order to be able to start the laser with disassembled galvo head, enter the following settings in the machine configuration. These settings must be reset after testing and measuring has been completed.*

**1.** Starting the PC. 

**2.** Starting the machine configuration.

***Figure 4.6*** *Starting the machine configuration*

**3.** Select the "Galvo 1" (1) tab and click 

on the "Expanded" (2) button.

**1**

**2**

***Figure 4.7*** *Machine configuration*

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**Commissioning the laser for testing and measuring purposes**

**** ***Figure 4.8*** *Advanced galvo head settings*

****1 2** ***Figure 4.9*** *Activating the machine configuration*

**4.** Uncheck the "Activate galvo check" box.

**5.** Click the "OK" button.

**6.** Click on the "Save" (1) and "Convert to active machine configuration file" (2) buttons.

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**Commissioning the laser for testing and measuring purposes**

**** ***Figure 4.10*** *Enable galvo check*

**7.** Reactivate the galvo check after completing tests and

measurements.

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**Commissioning the laser for testing and measuring purposes**

**4.3 Starting the main laser from the VLM software**

**1**

***Figure 4.11*** *Start the main laser*

The laser must be started according to the instructions in the user manual.

The main laser is started in the VLM software using the corresponding button (1) (Figure 4.11).

3 ***Note:*** *The main laser can only be started when the alignment laser is out of commission. A VLM program must be running (see Section 4.1, page 27).*

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**Commissioning the laser for testing and measuring purposes**

**4.4 Starting the alignment laser1 from the VLM software 1**

***Figure 4.12*** *Starting the alignment laser*

The laser must be started according to the instructions in the user manual.

The main laser is started in the VLM software using the corresponding button (1) (Figure 4.11).

3 ***Note:*** *The main laser can only be started when the alignment laser is out of commission. A VLM program must be running (see Section 4.1, page 27).*

1. Installation depends on the respective laser type

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**Commissioning the laser for testing and measuring purposes**

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**Troubleshooting**

**5 Troubleshooting**

**5.1 Image errors**

3 ***Note:*** *For the precise assessment of the image faults, a measuring magnifier or microscope is required.*

**

***Figure 5.1*** *Barrel or pillow shaped distortion*

| **Error**  Barrel and/or pillow shaped distortions in the X and Y directions | **Remedy**  Load the compensation file belonging to the optics. |
| --- | --- |



***Figure 5.2*** *Compensation file loaded*

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**Troubleshooting**

****

***Figure 5.3*** *Trapezoidal distortion*

| **Error**  Trapezoidal distortions in the X and Y directions | **Remedy**  Check the adjustment of the workpiece support plate and the galvo head (see Section 7.1, page 61). |
| --- | --- |



***Figure 5.4*** *Focusing errors*

| **Error**  Focusing error (center point okay, deviation at edge) | **Remedy**  Checking the focal distance of the galvo head (see Section 7.1, page 61). |
| --- | --- |

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**Troubleshooting**

****

***Figure 5.5*** *Correct image*

3 ***Note:*** *A test program should be created to test the image (see the VLM user manual).*

**Sample settings for the test program:**

• Square 120 mm x 120 mm (congruent with the maximum marking field of the laser) • Hatching 45°

• Hatching distance approximately 0.5 mm ... 2.0 mm

• The speed, current and frequency must be adapted to the material being marked. The image of the lines must be clean and have a high acutance.

1 ***Attention:*** *The laser system and the workpiece support plate must be absolutely vibration-free! The suction system must be switched on since vapors obstruct/weaken the laser radiation!*

3 ***Note:*** *To prevent errors due to the material being marked, let the test program run through several test patterns.*

3 ***Note:*** *For the precise assessment of the image faults, a measuring magnifier or microscope is required.*

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**Troubleshooting**

****

***Figure 5.6*** *Irregular power fluctuations*

| **Error**  Irregular power fluctuations | **Remedy**  Check the optics for soiling and burning (see Chapter 6). |
| --- | --- |



***Figure 5.7*** *Regular power fluctuations*

| **Error**  Regular power fluctuations due to internal or external influences | **Remedy**  Check or change the laser unit. Check system for vibrations. |
| --- | --- |

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**Troubleshooting**

**2**

**1**

***Figure 5.8*** *Positioning error of galvo head*

| **Error**  Positioning error of galvo head (1) (X or Y direction) | **Remedy**  Check/exchange the galvo head or ALI board.  Check the system for vibrations. |
| --- | --- |

3 ***Note:*** *If the test matrix is not hatched in a 45° angle, errors will possibly not be recognized (2).*

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**5.2 Marking errors**

****

***Figure 5.9*** *Marking errors*

**Troubleshooting**

**1**

**2**

**3**

**4**

**5**

**6**

| **No.**  **1**  **2**  **3**  **4**  **5**  **6** | **Error**  No error  Distortions  The first pulse is too strongly attenuated.LASER-OFF-DELAY too long  LASER-OFF-DELAY too short  The first pulse is not attenuated enough. | **Remedy**  –  • Check the parameters and hardware. • Check the parameters and hardware. • Check the parameters and hardware. • Check the parameters and hardware. • Check the parameters and hardware. |
| --- | --- | --- |

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**Troubleshooting**

**5.3 Emergency stop circuit**

1 ***Attention:*** *The peripheral components of the laser system should be shut down and secured against reactivation.*

**• Emergency stop circuit OK ***Figure 5.10*** *Emergency stop relay – OK*

**• Emergency stop circuit triggered ***Figure 5.11*** *Emergency stop relay – Triggered*

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**Troubleshooting**

**5.4 Measurement of the laser power**

1 ***Attention:*** *For the measurement of the laser power, a power measurement device with a measuring adapter for the respective laser type is required (see Chapter 3). The operating instructions of the measuring device absolutely must be observed!*

1 ***Attention:*** *If the laser system has to be switched on for testing/measuring purposes, measures for protection against laser radiation must be taken (use of protective goggles, setup and positioning of partition walls, attachment of warning signs and barriers, etc.). These measures must be coordinated with the laser protection officer.*

*The DIN EN 207 Filter und Augenschutzgeräte gegen Laserstrahlung (BS EN 207 Filters and Eye Protectors Against Laser Radiation (Laser Eye-Protectors)), DIN EN 60825-1 Sicherheit von Lasereinrichtungen (BS EN 60825-1 Safety of Laser Products), and DIN EN 60825-4 Sicherheit von Laserschutzwänden (BS EN 60825- 4 Safety of Laser Products: Laser Guards) standards must be observed.*

1 ***Attention:*** *During the measurement of the laser power, a second person must always be present to press the emergency stop button/main switch of the laser system in case of an emergency.*

1 ***Attention:*** *The peripheral components of the laser system should be shut down and secured against reactivation.*

**5.4.1 Measuring points**

**m**

**m**

**0**

**0**

**6**

**7**

**.**

**x**

**o**

**t**

**am**

| **Measuring** |
| --- |

**p**

**u**

***Figure 5.12*** *Laser power after the galvo head*

1 ***Attention:*** *The laser power after the galvo head must fundamentally be measured outside of the focus to prevent burning or other damage to the measurement head! At a burning width of e. g. 160 mm, measures a maximum of 60 to 70 mm underneath the protective glass!*

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**Troubleshooting**

**1**  ***Figure 5.13*** *Laser power measuring point on the galvo flange*

| **No.**  **1** | **Measuring point**  Galvo flange\* |
| --- | --- |

\*. Perform the measurement with and without the installed beam expansion and with and without built-in shutter.

| **Laser type**  PWL 10 F  PWL 20 F | **Power**  • 60 kHz, 100 % Current: > 9.00 W • 60 kHz, 100 % Current: > 18.00 W |
| --- | --- |

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**Troubleshooting**

**5.4.2 Performing the measurement**

1 ***Attention:*** *Before powering up the laser for measuring purposes, the measurement head should be positioned at the measuring point!*

1 ***Attention:*** *Do no move the measurement head through the activated laser beam! There is a risk of an uncontrolled deflection of the laser beam!*

**1.** Secure the shutter against 

activation.

**2.** Disassemble galvo head and enter

settings in the machine configuration

(see Section 4.2, page 29).

1 ***Attention:*** *Take measures for*

*protection against laser radiation*

*(see page 42)!*

**3.** Position the measurement head.

1 ***Attention:*** *Set the measuring*

*device to the wavelength of the laser!*

*Observe the operating instructions of the*

***Figure 5.14*** *Measuring the laser power*

*measuring device!*

**4.** Activate the main switch of the laser system.

1 ***Attention:*** *If the emergency stop button/main switch of the laser system is out of reach, a second person must always be present who can press the emergency stop button/main switch in case of an emergency.*

**5.** Starting the VLM program (see Section 4.1, page 27).

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**Troubleshooting**

**** ***Figure 5.15*** *Key switch / shutter*

**6.** Open the shutter.

**7.** Perform the measurement. 3 ***Note:*** *Compare the measured power with the power after the galvo head to detect any power losses. The measurement should be performed with and without an installed beam expansion and with and without a built-in shutter to detect any power losses due to these components.*

1 ***Attention:*** *Perform the measurement only for a short time to prevent damage to the measuring head! Follow the instructions in the operating instructions of the measuring device!*

**8.** Close the shutter.

**9.** Remove the measurement head. **10.** Switch off the laser equipment. **11.** Completely mount the components. **12.** Commission the laser system.

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**Troubleshooting**

**5.4.3 Assessment of the measurement**

| **Error**  Power okay, marking result faulty | **Possible Reasons**  Focal distance incorrectly adjusted | **Remedy**  • Adjusting |
| --- | --- | --- |
| Focal point incorrectly  adjusted | • Adjusting |
| Optical components have changed their properties | • Perform further power measurements |
| Handling system faulty | • Check it.  • Adjusting |
| Power too low | Voltage and current supply | • Checking the power  supply |
| Laser beam | • Check the beam  adjustment.  • Check the optical  components. |
| Power fluctuations | Voltage and current supply | • Checking the power  supply |
| Vibrations | • Check it. |
| Power loss | Soiling, protective glass damage, focusing lens, beam expansion, galvo mirror | • Clean, exchange  3 ***Note:*** *In case of damage to the galvo head, the complete head must be exchanged.* |
| Galvo head voltage supply fault | • Measure the voltage and adjust it if necessary.  • Checking the power  supply |
| Defective galvo head | • Check its function.  • Exchange the galvo head or the ALI card for the  optics if necessary. |
| Contamination of beam  expander: | • Clean it. |
| Defective shutter module | • Exchange the shutter module |

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**Troubleshooting**

**5.5 Loading a new ALI configuration  *Figure 5.16*** *VLM PC configuration*

** ***Figure 5.17*** *Selecting the ALI loader file*

3 ***Note:*** *The "New Hardware Found" dialog is called if the version difference between the old and new ALI card is too great (e. g. Version 1 to Version 3).*

**1.** After the change of the ALI card on the laser PC, call the VLM PC

configuration (VisualLaserMarker > Configuration > PC Configuration). **2.** Call the ALI loader.

**3.** Press the "FlashFile" button

**4.** Select and open the corresponding ALI loader file.

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**Troubleshooting**

**** ***Figure 5.18*** *Installation ended*

** ***Figure 5.19*** *Laser interface*

**5.** Wait until the installation of the FlashFile is complete.

3 ***Note:*** *In this way, any test program on the ALI card is overwritten.*

**6.** Adapt the settings in the laser interface.

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**Troubleshooting**

**** ***Figure 5.20*** *Laser communication*

**7.** Adapt the settings in the laser communication.

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**Troubleshooting**

**5.6 Checking the ALI system settings  *Figure 5.21*** *Call the computer administration*

** ***Figure 5.22*** *Device Manager*

**

***Figure 5.23*** *Device properties*

**1.** Call the computer administration (right click on My Computer > Administer).

**2.** Open the Device Manager. **3.** Under "Multifunction Adapters", check whether the ALI controller exists.

**4.** Check the device properties.

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**Troubleshooting**

**5.7 Settings in the RCU and VLM software**

For more information about the installation of the software and required settings, refer to the applicable software manuals.

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**Troubleshooting**

Notes

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**Cleaning optical components**

**6 Cleaning optical components**

3 ***Note:*** *The surfaces of the optical components are to be cleaned according to the maintenance schedule.*

3 ***Note:*** *The ambient conditions must be as dust-free as possible while cleaning optical components to prevent repeated contamination.*

1 ***Attention:*** *For cleaning, lens cleaning paper and isopropyl alcohol or purified compressed air should be used!*

**Cleaning of the optical components:**

**1.** Dismantle optical components as described below.

**2.** Blow fine dust particles off the surfaces using purified compressed air.

**3.** Clean optical components using lens cleaning paper and isopropyl alcohol.

– With a pipette, apply 1-2 drops of isopropyl to the surface to be cleaned.

– Apply lens cleaning paper and carefully remove or wipe off the isopropyl alcohol.

1 ***Attention:*** *Always work with clean, non-greasy hands so as not to soil the optical components! Use gloves if necessary!*

– Repeat the cleaning procedure until the surface of the optics is clean.

1 ***Attention:*** *Do not damage optical components during cleaning! Do not apply pressure! Remove the lens cleaning paper only in one direction. Use a new piece of lens cleaning paper each time you clean!*

– Always clean both sides of lenses or partially two-way mirrors. In the process, make sure that both previously cleaned surfaces are not soiled further.

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**Cleaning optical components**

**6.1 Galvo head**

**6.1.1 Protective glass**

**1.** Depending on the galvo type, pull the protective glass mount from the protective glass slide or unscrew the retaining ring of the protective glass.

**2.** Loosen the respective fastening of the protective glass and remove it.

**3.** Clean it.

**4.** Put the protective glass back in place and fasten it.

**5.** Push the protective glass mount into the protective glass slide or screw the retaining ring of the protective glass in.

3 ***Note:*** *Make sure that the protective glass and protective glass mount are installed on the right side.*

****1**

***Figure 6.1*** *Protective glass*

3 ***Note:*** *The gold colored ring (1) (Figure 6.1) on the protective glass must always be positioned toward the laser beam (inside of the galvo head). Incorrect installation may lead to marking errors.*

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**Cleaning optical components**

**6.1.2 Focusing lens**

1 ***Attention:*** *Switch off the laser system and secure it against reactivation. Pull the mains plug. The peripheral components of the laser system should also be shut down and secured against reactivation.*

**1.** Loosen and remove the connecting

**1** ***Figure 6.2*** *Galvo head connecting plug*

****1** ***Figure 6.3*** *Dismantling the galvo head*

** ***Figure 6.4*** *Covering the entry openings*

plug of the galvo head (1)

(Figure 6.2).

**2.** Loosen the fastening screws (1) (Figure 6.3).

**3.** Remove the galvo head.

**4.** Cover the entry openings with tape (tape to be used: see Chapter 3) to prevent the inside of the galvo head from getting dirty.

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**Cleaning optical components**

**1**  ***Figure 6.5*** *Removing the protective glass (protective glass slide)*

****1** ***Figure 6.6*** *Remove the protective glass (screwed protective glass)*

** ***Figure 6.7*** *Dismantling the guide plate (protective glass slide)*

**5. Protective glass slide:**Remove the protective glass (1) (Figure 6.5). **Remove screwed protective**

**glass:** Unscrew retaining ring (1) (Figure 6.6) and remove protective glass.

3 ***Note:*** *If the protective glass is damaged, it must be exchanged (see Section 8.1.2, page 81).*

3 ***Note:*** *All parts must be marked for reinstallation with suitable tools.*

**6.** Clean the protective glass (see page 53).

**7. Protective glass slide:** Loosen the screws (Figure 6.7) of the guide plate for the protective glass.

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**Cleaning optical components**

**1**  ***Figure 6.8*** *Removing the focusing optics*

****1** ***Figure 6.9*** *Removing the distance ring*

** ***Figure 6.10*** *Checking the cleaning state*

**8.** Unscrew the focusing optics (1) (Figure 6.8).

**9.** Clean it (see page 53).

**10.** Removing the distance ring (1) (Figure 6.9).

**11.** Clean the deflecting mirror (Figure 6.10) (see page 53).

**12.** Clean (see Section 6.1, page 54) if necessary.

**13.** Mount the galvo head in the reverse order.

3 ***Note:*** *When mounting the galvo head, pay attention to the correct position of the distance ring (see Figure 6.9) and*

*the position of the protective glass (see Section 6.1.1, page 54).*

**14.** Remount the galvo head to the laser and connect it.

**15.** Commission the laser system.

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**Cleaning optical components**

**6.2 Beam expander1**

1 ***Attention:*** *Switch off the laser system and secure it against reactivation. Pull the mains plug. The peripheral components of the laser system should also be shut down and secured against reactivation.*

**1.** Remove the shutter (see

Section 8.2, page 83).

**1**  ***Figure 6.11*** *Loosening the beam expander*

*mount*

****1 2** ***Figure 6.12*** *Remove the beam expander*

1. Installation depends on the respective laser type

**2.** Loosen the three attachment screws (1) (Figure 6.11) on the beam

expander mount.

**3.** Carefully remove the beam expander (1) (Figure 6.12) and the mount (2).

3 ***Note:*** *The current setting of the beam expander should be noted so that the correct focal distance can be reset after any false adjustment of the beam expander.*

**4.** Unscrew the beam expander from the mount.

**5.** Clean it (see page 53).

**6.** Screw the beam expander into the mount and reinstall the mount.

1 ***Attention:*** *Do not crush or jam the cables and lines inside the laser head during installation!*

**7.** Check the adjustment of the laser beam and adjust it if necessary (see Section 7.2.1, page 63).

**8.** Check the adjustment of the beam expander; set the value read before the cleaning procedure if necessary.

**9.** Mount the cover of the laser head. **10.** Commission the laser system. **11.** Check the laser power behind the

galvo head (on the workpiece) using the power measurement device and perform a test marking procedure. Enter the measurement values in the logbook.

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**Cleaning optical components**

**6.3 Laser source**

1 ***Attention:*** *No cleaning tasks are required on and in the laser source. If necessary, the laser source should be exchanged as a complete unit. Repair and cleaning inside the laser source may be performed only by ROFIN-SINAR. In case of non-observance, the warranty is no longer valid.*

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**Cleaning optical components**

Notes

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**Adjustment tasks**

**7 Adjustment tasks**

**7.1 Adjusting the laser head**

1 ***Attention:*** *Switch off the laser system and secure it against reactivation. Pull the mains plug. The peripheral components of the laser system should also be shut down and secured against reactivation.*

1 ***Attention:*** *If the laser system has to be switched on for testing/measuring purposes, measures for protection against laser radiation must be taken (use of protective goggles, setup and positioning of partition walls, attachment of warning signs and barriers, etc.). These measures must be coordinated with the laser protection officer.*

*The DIN EN 207 Filter und Augenschutzgeräte gegen Laserstrahlung (BS EN 207 Filters and Eye Protectors Against Laser Radiation (Laser Eye-Protectors)), DIN EN 60825-1 Sicherheit von Lasereinrichtungen (BS EN 60825-1 Safety of Laser Products), and DIN EN 60825-4 Sicherheit von Laserschutzwänden (BS EN 60825- 4 Safety of Laser Products: Laser Guards) standards must be observed.*

**1.** Check the X and Y directions of the 

position of the workpiece support

plate using a level gauge.

**2.** Perform an adjustment if necessary.

***Figure 7.1*** *Checking the position of the*

*workpiece support plate*

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**Adjustment tasks**

**** ***Figure 7.2*** *Checking the position of the galvo head*

** ***Figure 7.3*** *Adjusting the laser head*

** ***Figure 7.4*** *Adjusting the focal distance*

**3.** Check the X and Y directions of the position of the galvo head using a level gauge.

**4.** Adjust the position of the galvo head using the three-point support plate of the laser head parallel to the

workpiece support if necessary.

3 ***Note:*** *If the workpiece support plate cannot be aligned to be absolutely straight, the galvo head must be adjusted in parallel at the value measured under 1.*

**5.** Check the focal distance using the stickers on the galvo head and the logbook entries and adjust it if

necessary.

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**Adjustment tasks**

**7.2 Adjusting the laser beam**

**7.2.1 Main laser**

1 ***Attention:*** *Switch off the laser system and secure it against reactivation. Pull the mains plug. The peripheral components of the laser system should also be shut down and secured against reactivation.*

1 ***Attention:*** *If the laser system has to be switched on for testing/measuring purposes, measures for protection against laser radiation must be taken (use of protective goggles, setup and positioning of partition walls, attachment of warning signs and barriers, etc.). These measures must be coordinated with the laser protection officer.*

*The DIN EN 207 Filter und Augenschutzgeräte gegen Laserstrahlung (BS EN 207 Filters and Eye Protectors Against Laser Radiation (Laser Eye-Protectors)), DIN EN 60825-1 Sicherheit von Lasereinrichtungen (BS EN 60825-1 Safety of Laser Products), and DIN EN 60825-4 Sicherheit von Laserschutzwänden (BS EN 60825- 4 Safety of Laser Products: Laser Guards) standards must be observed.*

**1.** Dismantle the galvo head, set it 

aside, and cover the entry openings

with tape (tape to be used:

(see Chapter 3) to prevent the inside

of the galvo head from getting dirty.

**2.** Open the cover of the laser head.

***Figure 7.5*** *Dismantling the galvo head*

**3.** Unscrew the shutter and lay it down 

next to the laser head.

3 ***Note:*** *Do not disconnect the plug*

*in connection (-X25) because the laser will*

*not be activated.*

1 ***Attention:*** *Position the shutter so*

*that damage (e. g. when opening the*

*shutter) cannot occur! The shutter*

*remains in operation!*

1 ***Attention:*** *The shutter will no*

*longer block the laser beam!*

**4.** Secure the laser against activation.

***Figure 7.6*** *Dismantle the shutter*

1 ***Attention:*** *Take measures for protection against laser radiation (see page 63)!*

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**Adjustment tasks**

**2**

**1**

**5.** If applicable, remove the beam expander (1) (Figure 7.7) including the mount (2).

3 ***Note:*** *The current setting of the beam expander should be noted so that the correct focal distance can be reset after any false adjustment of the beam expander.*

***Figure 7.7*** *Remove the beam expander * ***Figure 7.8*** *Mounting the transducer disk*

**6.** Insert the mains plug of the laser system and switch on the main switch.

1 ***Attention:*** *If the emergency stop button/main switch of the laser system is out of reach, a second person must always be present who can press the emergency stop button/main switch in case of an emergency.*

**7.** Record the laser power curve. 3 ***Note:*** *The power curve serves to set the corresponding power and as a reference value to determine whether the shutter, beam expander and galvo head are causing a loss of power (cutting the beam, defective optical components, etc.)*

**8.** Across from the galvo flange, mount a transducer disk (see Chapter 3) on a surface that absorbs laser beams using suitable equipment.

**9.** Activate the laser system and set the power in the VLM program

(approx. 7 ... 10 W).

3 ***Note:*** *Maximum output power PWL 10 F: 10 W, PWL 20 F: 20 W.*

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**Adjustment tasks**

****45° ***Figure 7.9*** *Mounting the cross wires*

**1** 

**2**

**10.** Enter the settings in the machine configuration (see Section 4.2,

page 29), open the shutter, start the VLM program (see Section 4.1, page 27) and check the emission of the main and alignment lasers on the transducer disk.

**11.** Switch of the laser.

**12.** Insert the cross wires and their seat as shown in Figure 7.9 into the

adjustment tube. This will ensure that a vertical cross is displayed during the adjustment.

3 ***Note:*** *In the following steps, make sure that the cross wires are always in the same installation position.*

1 ***Attention:*** *Careful handling of the adjusting aids must be guaranteed (no deformation of the cross-wires, no excessive laser power)! Damaged adjusting aids lead to imprecise adjusting results!*

3 ***Note:*** *Adjusting aids to be used: see Chapter 3.*

**13.** Screw the adjustment tube (1) (Figure 7.10) onto the base plate (2).

***Figure 7.10*** *Adjustment tube and base plate*

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**Adjustment tasks**

**** ***Figure 7.11*** *Installation on the galvo flange*

****1 2 3 4**

***Figure 7.12*** *Checking the beam adjustment* **2**

**1**

**2**

***Figure 7.13*** *Beam adjustment*

**14.** Screw on the base plate of the adjustment tube to the galvo flange.

**15.** Switch on the laser, start the VLM program and check the image of the laser on the transducer disk.

Figure 7.12 shows examples for possible image:

– Adjustment OK (1)

– Emission too low (2)

– Emission too far to the left (3) – Emission too far to the right (4)

**16.** Adjust the beam by adjusting the support block.

– Loosen the fastening screws (1) (Figure 7.13).

– Adjust using the support screws (2).

– Retighten the fastening screws after the adjustment.

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**Adjustment tasks**

**3**

**4**

**5**

The following settings are possible: 

(1) Moving lengthwise,

(2) Moving across,

(3) Twisting,

(4) Tilt,

(5) Height adjustment.

**2**

**1**

***Figure 7.14*** *Setting options*

** ***Figure 7.15*** *Moving the support block*

** ***Figure 7.16*** *Mount the second set of cross wires*

1 ***Attention:*** *If tools are used to move the support block (see Figure 7.15), make sure that cables in the laser head are not crushed or damaged!*

**17.** Shut the laser off after the adjustment.

**18.** Mount the second set of cross-wires on the adjustment tube.

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**Adjustment tasks**

**1 2 **

**3 4**

***Figure 7.17*** *Checking the beam adjustment* **2** 

**1**

***Figure 7.18*** *Mount the beam expander ***1** ***Figure 7.19*** *Setting the beam expander*

**19.** Switch on the laser, start the VLM program and check the image of the laser on the transducer disk.

Figure 7.17 shows examples for possible image:

– Adjustment OK (1)

– Emission too low (2)

– Emission too far to the left (3) – Emission too far to the right (4) 3 ***Note:*** *The front cross-wires must be turned by 45° for more exact control of the laser beam.*

1 ***Attention:*** *Do not reach into the laser beam when turning the cross wires!*

**20.** Shut the laser off after the adjustment.

**21.** If applicable, mount the beam expander (1) (Figure 7.18) including the mount (2).

**22.** Switch on the laser, Start the VLM program and check the image of the laser on the transducer disk (see Figure 7.12 and Figure 7.17).

**23.** Move the beam expander after loosening the three fastening screws (1) (Figure 7.19) and use them to set it (roundness of the laser beam, center beam emission). Figure 7.20 shows examples for possible image.

1 ***Attention:*** *Do not reach into the laser beam when setting the beam expander!*

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**Adjustment tasks**

****

| **Adjustment OK** |
| --- |



| **Emission too far to the upper right** |
| --- |

**24.** Readjust the support block, if necessary (see steps 15 to 19). **25.** Compare the power to determine whether the beam expander (if applicable) causes a loss of power. Clean the beam expander, if

necessary.

**26.** Shut the laser off after the adjustment.

***Figure 7.20*** *Beam adjustment beam expander* **1**

**2**

***Figure 7.21*** *Mount the shutter*

**27.** Mount the shutter (1) (Figure 7.21) including the strip (2).

1 ***Attention:*** *Do not crush or jam the cables and lines inside the laser head during installation!*

**28.** Switch on the laser, Start the VLM program and check the image of the laser on the transducer disk (see Figure 7.12 and Figure 7.17) and adjust as needed.

**29.** Compare the power to determine whether the shutter causes a loss of power. Realign the shutter as

needed.

**30.** Shut the laser off after the adjustment.

**31.** Remove the cross wires and their seat from the adjustment tube.

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**Adjustment tasks**

****

| **Cross wires in the base plate** |
| --- |



| **Cross wires in the adjustment** |
| --- |

**32.** Switch on the laser, Start the VLM program and check the image of the laser on the transducer disk. Adjust as needed.

**33.** Shut the laser off after the adjustment.

**34.** Remove the cross wires and their seat from the base plate.

**35.** Screw the adjustment tube to the base plate of the galvo flange.

**36.** Switch on the laser, Start the VLM program and check the image of the laser on the transducer disk. Adjust as needed.

***Figure 7.22*** *Beam adjustment OK*

3 ***Note:*** *Repeat adjustments until no more deviations can be determined in the image after the installation position changes.*

3 ***Note:*** *If power losses due to the shutter are still present after multiple adjustments, contact ROFIN-SINAR.*

**37.** If no more deviations in the image can be determined, the adjustment is okay (see Figure 7.22).

**38.** Check the adjustment of the beam expander; set the value read before the adjustment procedure if

necessary.

**39.** Mount the galvo head.

**40.** Mount the cover of the laser head. **41.** Commission the laser system. **42.** Check the laser power behind the

galvo head (on the workpiece) using the power measurement device and perform a test marking procedure. Enter the measurement values in the logbook.

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**Adjustment tasks**

**7.2.2 Focal point**

3 ***Note:*** *The following tasks only apply to laser systems with installed beam expanders.*

1 ***Attention:*** *Switch off the laser system and secure it against reactivation. Pull the mains plug. The peripheral components of the laser system should also be shut down and secured against reactivation.*

1 ***Attention:*** *If the laser system has to be switched on for testing/measuring purposes, measures for protection against laser radiation must be taken (use of protective goggles, setup and positioning of partition walls, attachment of warning signs and barriers, etc.). These measures must be coordinated with the laser protection officer.*

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1 ***Attention:*** *To adjust the focal point, the distance between the galvo head and workpiece may not be changed as the field size otherwise shifts!*

**1.** Unscrew the shutter and lay it down 

next to the laser head.

3 ***Note:*** *Do not disconnect the plug*

*in connection (-X25) because the laser will*

*not be activated.*

1 ***Attention:*** *Position the shutter so*

*that damage (e. g. when opening the*

*shutter) cannot occur! The shutter*

*remains in operation!*

1 ***Attention:*** *The shutter will no*

*longer block the laser beam!*

**2.** Secure the shutter against

***Figure 7.23*** *Dismantle the shutter*

activation.

1 ***Attention:*** *Take measures for protection against laser radiation (see page 71)!*

**3.** Insert the mains plug of the laser system and switch on the main switch.

1 ***Attention:*** *If the emergency stop button/main switch of the laser system is out of reach, a second person must always be present who can press the emergency stop button/main switch in case of an emergency.*

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**Adjustment tasks**

**1 2**

**3 4**

***Figure 7.24*** *Checking the focus setting ***1** ***Figure 7.25*** *Setting the focal point*

**4.** Lay material (an anodized metal sheet, coated paper) under the galvo head.

**5.** Switch on the laser system using the key switch.

**6.** Open the shutter.

**7.** Let the program for the cross in the middle of the field with the material run according to the laser

parameters.

**8.** Switch of the laser.

**9.** Check the image of the cross. The focal point is correctly set when both laser lines in the X and Y direction have the same dimensions at the smallest possible width.

– Adjustment OK (1) (circular

cross-section)

– Too wide (2) (circular cross

section)

– Y dimension too wide (3) (cross section elliptical, X axis > Y-axis) – X dimension too wide (4) (cross section elliptical, X axis < Y-axis) **10.** If necessary, change the focal point

by adjusting the adjusting ring (1) (Figure 7.25) on the beam expander. 1 ***Attention:*** *Do not reach into the laser beam when turning the adjusting ring!*

3 ***Note:*** *If the adjusting ring cannot be adjusted, remove the beam expander and loosen the locking screw (1) (Figure 7.26, page 73).*

**11.** Move material under the galvo head, open the shutter, and let the

program run.

**12.** Check the image of the cross. 3 ***Note:*** *Repeat Steps 6 through 12 until the focal point is correctly set.*

**13.** Shut the laser off after the adjustment.

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**Adjustment tasks**

**1**  ***Figure 7.26*** *Fixing the beam expander*

**1** 

**2**

***Figure 7.27*** *Mount the shutter*

**7.2.3 Alignment laser1**

**14.** Removing the beam expander. **15.** Fix the position of the beam expander using the locking screw (1) (Figure 7.26).

**16.** Mount the beam expander **17.** Setting the beam expander (see page 68).

**18.** Mount the shutter (1) (Figure 7.27) including the strip (2).

1 ***Attention:*** *Do not crush or jam the cables and lines inside the laser head during installation!*

**19.** Check the adjustment of the laser (see page 69).

**20.** Compare the power after the galvo head to determine whether the

beam expander (if applicable),

shutter or galvo head causes a loss of power. Clean, repair or align the beam expander, if necessary.

**21.** Shut the laser off after the adjustment.

**22.** Mount the cover of the laser head. **23.** Commission the laser system.

The alignment laser has the same beam emission as the main laser. No additional adjustment tasks are necessary.

1. Installation depends on the respective laser type

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**Adjustment tasks**

Notes

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**Repair work**

**8 Repair work**

3 ***Note:*** *The "Maintenance Schedule" chapter in the RSM PowerLine F user manual must also be observed. The necessary aids are listed in Chapter 3 of this repair manual and in the "Spare Parts" chapter of the RSM PowerLine F user manual.*

**8.1 Changing the optical components**

1 ***Attention:*** *When changing the optical components, make sure that the surfaces of the new components are always free of grease and dust.*

**8.1.1 Galvo head**

1 ***Attention:*** *Switch off the laser system and secure it against reactivation. Pull the mains plug. The peripheral components of the laser system should also be shut down and secured against reactivation.*

3 ***Note:*** *The necessary spare parts of the galvo head can be ordered individually from ROFIN SINAR. To observe the field geometry/correction after the change of the galvo head and/or focusing optics, we recommend that you order the components with a compensation file created by ROFIN-SINAR.*

**1.** Loosen and remove the connecting

**1*****Figure 8.1*** *Galvo head connecting plug*

plug of the galvo head (1) (Figure 8.1).

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**Repair work**

**1**  ***Figure 8.2*** *Dismantling the galvo head*

****1** ***Figure 8.3*** *Removing the distance ring*

** ***Figure 8.4*** *Covering the entry openings*

**2.** Loosen the fastening screws (1) (Figure 8.2).

**3.** Remove the galvo head.

**4.** Removing the ring seal (1) (Figure 8.3).

**5.** Cover the entry openings with tape (tape to be used: see Chapter 3) to prevent the inside of the galvo head from getting dirty.

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