

PowerLine E Air (ITX)

Repair Manual

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General information

Introductory information

1 General information

1.1 Introductory information

1.1.1 Explanation of symbols

The safety instructions in this repair manual are intended to avoid personal injury and property damage.



DANGER

Possible hazards following non-observance of safety instructions!

If safety instructions in these operating instructions are not observed, hazardous situations for persons may arise.

- This text must be read, understood and observed in all respects by all persons working on the system or on parts of the system.
 - The documentation must always be kept close to the system and must be available at all times.
-

1.1.1.1 Layout of the safety instructions

The following layout applies for safety instructions of the classes "Danger", "Warning" and "Caution":

- Symbol
- Hazard level
- Type and source of the hazard
- Potential consequences
- Measures for avoiding the hazard

1.1.1.2 Classification of the safety instructions

Symbol	Hazard level	Explanation
	DANGER	Warning against an immediate hazard resulting in death or serious physical injury, if the relevant hazard notice is not observed or not adequately observed.
	WARNING	Warning against a potentially hazardous situation that could result in death or serious injuries.
	CAUTION	Warning against potentially hazardous situation that could result in minor physical injuries or property damage.
	CAUTION	Indicates supplementary information and tips.

1.1.2 Scope of the repair manual



CAUTION

This repair manual is intended solely for repair personnel trained and authorized by ROFIN-SINAR for PowerLine E Air (ITX) series lasers.

This repair manual is valid for lasers in the ROFIN-SINAR PowerLine E Air (ITX) range.

This repair manual must be read, understood and observed by competent repair 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.



CAUTION

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

This document is the original, German language manual.

All non-German language versions of this document are translations of the original manual.

1.2 Additionally applicable documents on the repair manual



CAUTION

In addition to this repair manual, the following documents must also be observed when carrying out repair work.

Manuals
Repair instructions for Coherent-Rofin marking lasers
Documentation CD/DVD for the laser system
User manual for "Laser console" program
Supplementary manual on the "External power measurement" laser system
"PowerLine E Air (ITX)" assembly and operating instructions
Assembly instructions on external power measurement
VLM manual

Circuit diagrams
19" plug-in unit circuit diagram
Pump modules circuit diagram



CAUTION

The valid circuit diagram is based on the equipment number (serial number sticker on the device). The valid circuit diagram number can be obtained from the service hotline in the case of doubt.

1.3 Contact address

In case of any questions regarding the content of this repair manual or the laser system itself, please contact:

ROFIN-SINAR Laser GmbH
Dieselstr. 15
85232 Bergkirchen/Günding

Germany

Phone: +49-(0) 8131/704-0
Fax: +49-(0) 8131/704-100
Email: info-marking@rofin.de

General information

Notes

Notes

2 Safety



WARNING

Possible hazards when using inadequately qualified personnel!

Improper operation and/or maintenance on the machine/system can result in danger to persons, property and/or the environment.

- 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.



WARNING

Possible hazards due to non-observance of the manufacturer's documentation!

Hazardous situations may arise due to non-observance of the manufacturer's documentation.

- The safety instructions in the other laser system documents (operating instructions and maintenance manual included on the documentation CD/DVD for the system) and the peripheral component documents must also be observed!
 - These documents remain valid without limitations!
-

2.1 Maintenance personnel qualifications



WARNING

Possible hazards when using inadequately qualified personnel!

Improper operation and/or maintenance on the machine/system can result in danger to persons, property and/or the environment.

- *The tasks described in this repair manual may only be performed by persons who have been trained and authorized by ROFIN-SINAR for the PowerLine E Air (ITX) laser.*
-



WARNING

Hazards on electrical equipment!

Electric shock on touching live parts!

- *Work on the electrical systems may only be performed by qualified electricians, in compliance with applicable safety regulations.*
-

The maintenance personnel must continue to meet the following requirements:

- Safe handling of all listed measuring equipment (e.g. voltage, current and resistance measuring devices; oscilloscopes).
 - Safe use of the listed PC technology.
 - Knowledge of hazards which could originate from laser systems.
-



WARNING

Hazards for persons and/or property!

Non-observance of these instructions could result in malfunctions of the laser system, resulting in hazards to persons and property.

- *All safety instructions must be observed!*
-

Safety

Intended use and operation

2.2 Intended use and operation

The laser system has been designed for marking workpieces. Use of the laser for applications other than those intended is considered misuse, and the laser manufacturer is thus not liable for any ensuing damage. In this case, the user assumes full responsibility.

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



WARNING

Possible hazards due to non-observance of the manufacturer's documentation!

Observe the operating instructions for the laser system!

- Additional safety instructions regarding intended use and operation can be found in the laser system Operating Instructions.
-

2.3 Operating the laser



WARNING

Possible hazards due to non-observance of the manufacturer's documentation!

Observe the operating instructions for the laser system!

- Safety instructions regarding operation of the laser system can be found in the laser system Operating Instructions.
-

2.4

General safety instructions

- The proprietor must ensure that no unauthorized personnel perform any work on the laser system or in its vicinity.
- The laser system may only be operated and repaired by qualified personnel. The plant owner is responsible for selecting and training the personnel. The personnel must have annual training on laser-specific risks. This training must be documented.
- The laser system may be operated only in a malfunction-free condition. Safety equipment may be neither dismantled nor deactivated, not even if instructed to do so. The machine's own safety technology should be checked at regular intervals for proper function and effectiveness.
- In the event of modifications to the laser system that impair safety, the laser system must be shut down. The faults must be corrected before turning the laser system back on.
- 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. For example, safety goggles of the appropriate protection class and suitability for the wavelength of the laser. The most current version of the respective national regulations must be observed in this regard.
- Any working methods that impair 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 using any working methods that impair safety.
- The plant owner is obliged to check the system for visible damage and faults at least once a shift. Any changes occurring that impair safety must be eliminated immediately.
- During operation, it is strictly prohibited to reach into the working range of the laser system with your hand or tools; safety equipment must not be circumvented. There is a risk of injury!
- The laser system may only be operated using the provided operating elements. In this case, the use of tools (screwdrivers, etc.) is prohibited.
- Adjustment tasks may only be carried out during setup mode. Personnel must take special care. These setup tasks are only permitted to be performed by qualified personnel using the provided operating elements.
- 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 in particular to 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 commissioning the laser system, all tools and aids must be removed from the working area to exclude the risk of dangers to persons and property.
- When the laser system is shut down, the main switch should be shut off and secured.
- In case of unexpected danger 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.

Safety

General safety instructions

- Wet and compressed-air cleaning of the laser system is prohibited and only permitted under the following conditions:
 - Wet exterior cleaning with mild soapy solution or mild cleaning agent.
 - Compressed air from a can (water-free and oil-free, nitrogen (1 - 2 bar).



DANGER

Hazards due to nitrogen!

There is a possible risk of suffocation if the nitrogen concentration in the ambient air is too high!

- *Never exceed the permissible limit values!*

- Supply lines for the laser system should be laid with cable covers so that no-one can trip over them.
- When working on bought-in functional parts, the technical documents from the relevant 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 replaced immediately.

2.5 Safety instructions on the laser system



DANGER

Laser radiation!

Laser radiation can lead to permanent eye damage and skin burns! Diffuse, secondary (reflected) radiation is also dangerous. Laser radiation can cause a fire risk or risk of explosion.

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



WARNING

Laser radiation!

A laser without any special protective equipment corresponds to protection class 4. The laser beam is invisible at a wavelength of 1064 nm (IR). If the positioning laser is activated (wavelength 675 nm, red laser beam, protection class 2), the laser beam is visible.

- Take measures to protect against laser radiation!
-



Laser class 1

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

The accessible laser radiation is classified as safe.



Laser class 2

Lasers that emit a visible radiation in a wavelength range of 400 nm to 700 nm; eye protection is usually provided here via defensive reactions, including the eyelid closure reflex (up to 0.25 s).

It is to be expected that this reaction offers appropriate protection under reasonably predictable operating conditions.



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 should be labeled with the corresponding warning symbol and the additional text "INVISIBLE LASER RADIATION – avoid irradiation of eyes and skin by direct or scattered radiation – LASER CLASS 4."

Safety

Safety instructions on the laser system



DANGER

Hazards due to beam emissions!

The beam is emitted, depending on the layout of the laser marker, at the optics of the marking head, whereby the optics of these beam guide systems can point in any direction (360°).

- If no galvo head is attached, the laser beam is emitted out of the front of the laser head.
 - Take measures to protect against laser radiation!
-



DANGER

Missing safety devices!

If the safety devices are removed, there is a serious risk of injury!

- Safety devices may neither be bridged nor otherwise circumvented and/or disabled!
 - If the laser system has to be switched on for testing/measuring purposes with the safety devices removed, 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 safety 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, as well as national regulations (e.g. ANSI Z136.1 "Safe Use of Lasers").
-

- The relevant applicable national regulations on operating a laser system must be observed.



CAUTION

Measures for protection from laser radiation must be agreed with the operator's laser safety officer in each case!

- With fully fitted protective housing (e.g. a workstation), the machine has laser protection class 1. This means that no dangerous radiation can escape from the protective paneling, meaning that there is no risk to the machine operator or other persons in the vicinity.



DANGER

Hazards with safety devices removed!

If the machine is being serviced and the protective paneling is removed, the machine has laser protection class 4.

- In this condition, all corresponding laser protection measures can be observed.
-



DANGER

Laser radiation!

The laser radiation can lead to permanent eye damage! Diffuse, secondary (reflected) radiation is also dangerous.

- Wear laser safety goggles!
 - The safety goggles used must correspond 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.

Beam path**CAUTION**

The beam path of the corresponding laser system is explained in the relevant operating instructions.

2.6 Safety instructions on maintenance and setup tasks

**WARNING*****Risk of accidents!***

Hazards when switching the laser system on while carrying out maintenance, repair, set-up and checking activities.

- Shut down the laser system and secure it against reactivation.
 - Prevent the laser system being switched on!
 - The warning sign "System shut down - activation prohibited!" must be attached to the laser system.
-

**DANGER*****Missing safety devices!***

If the safety devices are removed, there is a serious risk of injury!

- It is prohibited to operate the system with partly or completely dismantled safety devices!
 - To comply with laser protection class 1, operating the system with partially or completely dismantled safety devices is fundamentally prohibited.
-
- After installing electrical systems or servicing, the functionality of the existing protective devices must be verified and the protective measures tested by a qualified electrician.
 - Electrically unsecured doors or covers that can be opened or removed only with tools may only be opened or removed 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.

**DANGER*****Laser radiation!***

Hazards due to laser radiation when working on beam-guiding units!

- If parts of the protective housing are removed for work on beam-guiding units, the operation of adjacent systems must be shut down.

Safety

Safety instructions on maintenance and setup tasks

- Authorized personnel located in the vicinity of the laser system during this work must wear safety goggles according to DIN 207.
 - The working area must be labeled (laser class 4) (see point 2.5, page 2-6).
 - In addition, measures must be taken to protect the skin (radiation in the UV-A range).
-



CAUTION

Risk of contamination and damage!

Possible malfunctions due to contaminated/damaged components.

- The mechanical processing (grinding, drilling, cutting, etc.) of parts of the laser system must only take place outside of the working area!
 - The processing of supporting assemblies is strictly prohibited!
-

When the system is being tested and protective devices have to be removed for technical reasons (e.g. to perform setting work), substitute measures must be provided to protect maintenance personnel.

- Define and document alternative protective measures.
- Monitor these protective measures.
- Assign only experienced and trained personnel to these activities.
- Identify hazard areas appropriately.
- Prevent unauthorized personnel from entering the hazard areas. Only personnel who are absolutely critical to completing the work may remain in the hazard area.
- Provide special escape routes for dangerous situations.
- The required safety, warning and measurement equipment must be ready for operation and fully functional.
- As far as possible, carry out system functions and any machine movements only at greatly reduced speed.
- Shut down the system via the emergency stop in the event of danger!
- If necessary, ensure that fire-fighting equipment is provided.

2.7 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 accidental reactivation.
- When working on the electrical systems, turn off and secure the main switch.



DANGER

Dangerous electric voltage!

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

Electric shock on touching live parts!

- The switch cabinet may only be opened by qualified electricians for repair purposes.
- Disconnect electrical equipment before repair and maintenance work and secure against reactivation.



WARNING

Danger due to external voltage!

Additional devices connected to the laser system may have their own mains supply line and could still be live when the main switch of the system is turned off.

- Additional devices should also be switched off and secured against reactivation.

- The control and main power lines are to be laid separately from each other.
Non-observance can result in the following:
 - Failure of the machine function
 - Dangerous malfunctions
 - Destruction of electrical and mechanical components
- Electrical equipment must be checked regularly. Loose connections must be retightened. Damaged lines or cables should be replaced 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 grounding terminal of the measuring device is always connected with the ground point of the control system (measuring cable). Depending on requirements, isolation amplifiers should be used for perfect measurements.



DANGER

Dangerous electric voltage!

Electrical shock hazard!

- Never clean electrical equipment with water or other liquids.

2.8 Electrostatically sensitive devices (ESD)



CAUTION

Electrostatically sensitive devices (ESD)!

The diode modules are components sensitive to electrostatic (ESD)! Electrostatically sensitive devices can be damaged in the event of incorrect handling.

- In case of work on and with the diodes, you must take protective measures!

Protective measures to be taken:

- Make sure the equipotential bonding is continuous!
- Make sure personnel are grounded using wrist and shoe grounding!
- Make sure clothing is conductive and sealed!
- Avoid electrostatically chargeable materials such as normal PE, PVC, polystyrene, etc.!
- Avoid electrostatic fields > 100 V/cm!
- Only use marked and defined packaging and transport materials!



CAUTION

Performing equipotential bonding!

The required disconnection of the power supply prior to opening system components will also disconnect the grounded conductor! This also applies to the disconnection of the plug on the laser head (e.g. only required when removing the laser head for space reasons; do not damage pins in the connection plug)!

- The laser head must be earthed with suitable measures before working on diodes!
- The external grounding must be performed at a marked PE terminal on the laser head and a marked PE terminal in the area around the system!
- The correct equipotential bonding must be checked using measuring technology!
- The ESD wrist band must then be connected to a PE terminal on the laser head!
- Before that, the diode modules may not be disconnected!
- All persons working on diode modules must comply with the measures for the protection of electrostatic sensitive devices (ESD)!
- The work area must be secured!



CAUTION

Risk of damage due to lack of equipotential bonding!

When the connecting lines are removed, touching the connecting terminals can lead to the destruction of the diode! This also applies to disconnecting the connecting lines on the power supply unit!

- Immediately after disconnection, diodes must be short-circuited by a person equipped in accordance with the relevant ESD regulations!

2.9 Emergency stop mechanisms and safety equipment

2.9.1 Emergency stop devices

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 is used to prevent injury to persons, or damage to the machine or workpiece.

Depending on the system layout, the emergency stop pushbutton is on the control panel or on the plug-in supply unit, or available as an external emergency stop push button.

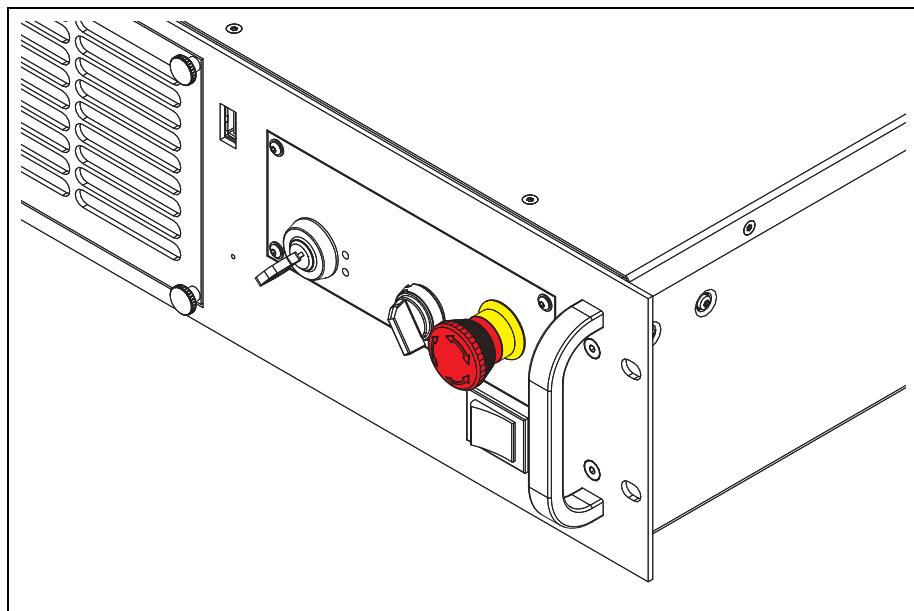


Figure 2.1 Emergency stop pushbutton on control panel



CAUTION

The emergency stop should not be used to end a normal working cycle.

2.9.2 Safety equipment



CAUTION

The safety devices installed in the laser system in question are explained in the corresponding operating manuals.

2.10 Other hazards

2.10.1 Ultraviolet radiation (secondary)



WARNING

Possible hazard due to UV radiation!

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!

- *Check for adequate protection against UV radiation!*
 - *If laser safety goggles are used, then it is necessary to check in each case that adequate protection against UV radiation is provided.*
 - *Furthermore, the necessary protective measures (e.g. face mask, use of sunscreen agents) must be arranged by the owner's occupational safety specialist.*
-

2.10.2 Hazardous materials



WARNING

Hazards due to hazardous materials!

Hazardous fumes and dust may be emitted during the marking process or when carrying out servicing 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 should be used.*
-

2.11 Personal protective measures



DANGER

Laser radiation!

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 servicing of the laser.*
 - *Never look into the laser beam directly or with optical devices.*
 - *The organizational and personal protective measures must be observed!*
-
- Avoid any exposure to direct or secondary laser radiation at all times during installation, operation, maintenance or servicing of the laser. Never look into the laser beam directly or with optical devices. Organizational and personal protective measures must be observed!
 - In the laser operating area, laser protective goggles must be worn to protect against laser radiation of the wavelength 1064 (532) nm and 806 nm. The most current version of the respective national regulations must be observed in this regard.
 - The interlock circuits which act as safety devices must not be removed or bypassed during the operation of the laser system; if they are bypassed they will not operate in accordance with regulations. No liability whatsoever is assumed by the manufacturer if the safety devices are removed or circumvented.

Safety

Organizational protective measures

2.12 Organizational protective measures

The following regulations must be observed. The detailed organizational protective measures and guidelines of DIN EN 60825, Classification VDE 0837 (IEC 825), and national regulations must be complied with.

- The operators must be regularly instructed on safety aspects.
- 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 could occur should be obtained, e.g. from occupational safety authorities.
- Objects that can endanger people due to uncontrolled reflection of the laser radiation must be removed from the laser area.
- Have authorized and specifically appointed persons check the effectiveness of integrated safety equipment (e.g. emergency stop switches) in accordance with defined test cycles. All relevant national safety regulations and guidelines must be observed ([see "Intended use and operation" on page 2-3](#)).

Existing safety devices must be activated during operation. Any hazardous functions must immediately be stopped or interrupted. Before recommissioning the laser system, the corresponding displays or error messages must be acknowledged. Make sure that the laser system can be restarted. If this has been ensured, the safety equipment is in proper working order.

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

2.13 Waste disposal information

Comply with all national and regional regulations regarding waste disposal.

2.14 Labeling

All locations that under certain circumstances (such as when protective covers are opened) present a potential risk, are identified by the required warning labels. The locations of the individual signs are given in the safety chapter of the user manual.



CAUTION

Explanations on the individual warning signs and information signs can be found in the laser system Operating Instructions. The location of individual signs may vary depending on the delivery scope and content.



WARNING

Hazards due to missing safety signs!

In the event of missing safety signs, hazards may not be detected or not detected in good time.

- These labels are not permitted to be removed.*
-

Safety

Notes

3 Disassembly and assembly of components



WARNING

Hazards due to non-observance of safety instructions!

Hazards for persons and/or property can arise due to non-observance of safety instructions.

- All safety instructions in the [Chapter 2, Safety](#) should be observed during all work on the laser system.



CAUTION

Bags with dust protection caps are located at the following locations on the laser system.

Pump module: Power supply to the diodes or HF cables (safety caps for diode outlet and fiber inlet).

Laser head: Cable of the temperature sensor for the Q-Switch (safety caps for resonator inlet and fiber outlet).

The bags with dust protection caps should be fastened back again at those points once work has been completed.

**CAUTION**

It is critical that the tightening torques given here are observed when fitting components. Otherwise the components could be damaged.

Component	Tightening torque
Laser head covers	Handtight
Galvo head	Handtight
External modulator	150 Ncm
Deflecting unit	150 Ncm
Shutter	150 Ncm
Resonator module	150 Ncm
Beam expander	Handtight
Collimating lens	Handtight
Positioning laser	150 Ncm
Positioning laser housing coupling mirror	120 Ncm
Beam absorber / power measuring head	120 Ncm
Beam absorber for external modulator	150 Ncm
Laser head fan	120 Ncm
Plug-in supply unit covers	Handtight
Diodes	55 Ncm
HF generator	120 Ncm
Power supplies	Handtight
Fan supply plug-in unit	Handtight
Temperature sensor -R1	80 Ncm
Electronic components	Handtight

Disassembly and assembly of components

Laser head

3.1 Laser head

3.1.1 Components of the laser head

Designation	Component
Electrical components	
X28 (optional assembly)	X28-option
A13	Jumper board
A6	Q-switch
A6a	External AOM-module (PL-E25air-EM)
A7/X25	Shutter
A39/X39	Power measuring head (option)
M5/M6	Fan
V1/X38	Positioning laser

3.1.2 General covers

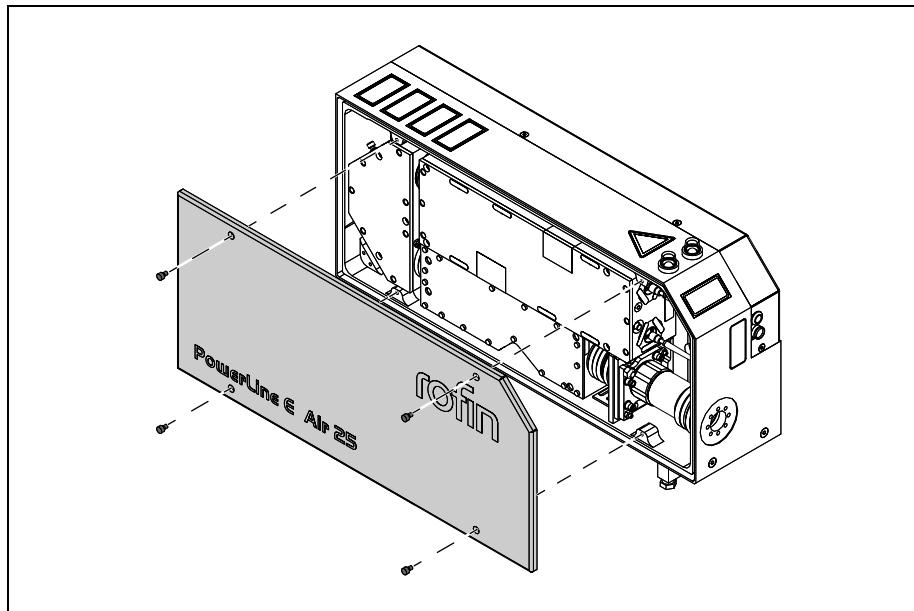


Figure 3.1 Laser head Resonator side

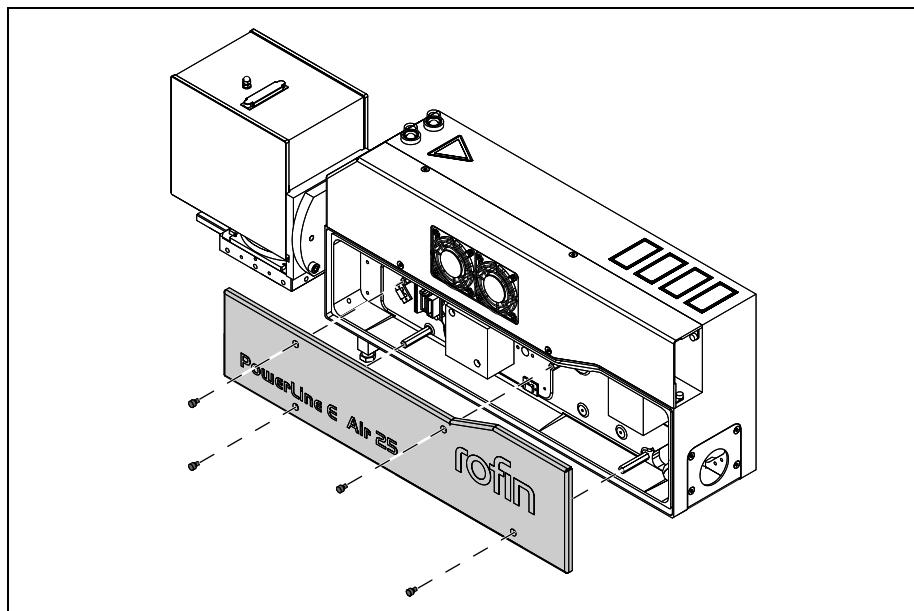


Figure 3.2 Laser head Rear side

Disassembly and assembly of components

Laser head

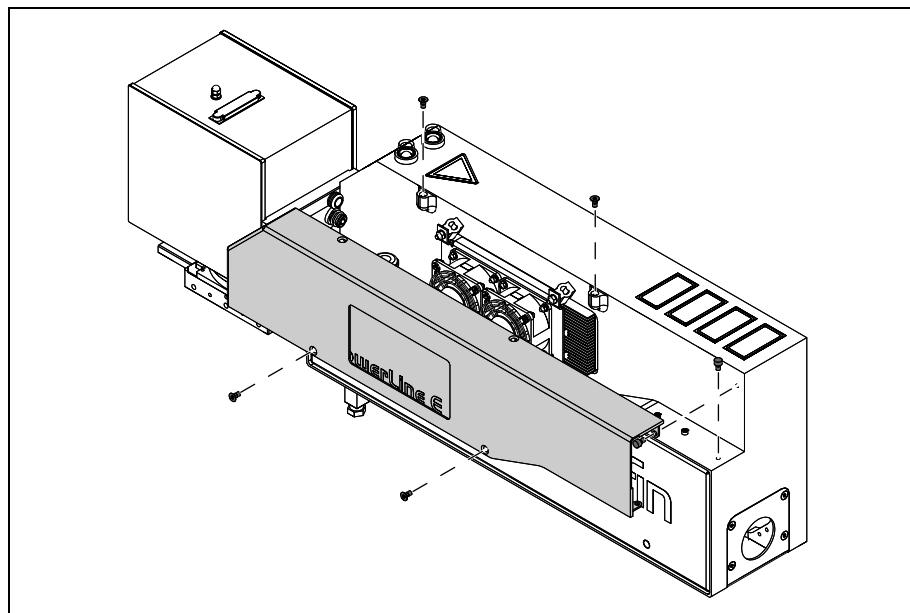


Figure 3.3 Laser head Fan cover

3.1.3 Galvo head

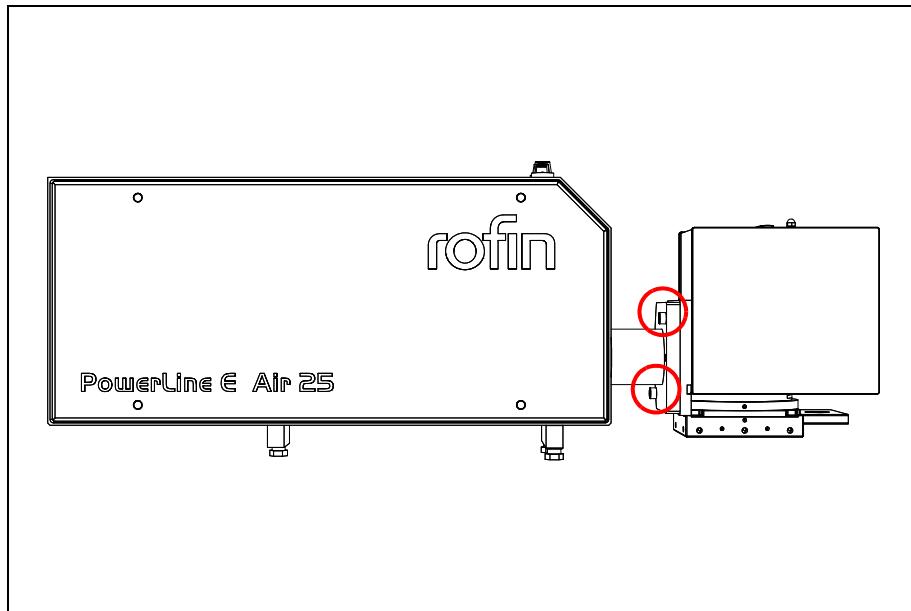


Figure 3.4 Galvo head – 1



CAUTION

Risk of damage!

The galvo head is damaged if connecting or disconnecting under voltage!

- Only remove or insert the connecting cable of the galvo head when no voltage is present!

1. Loosen and remove the connecting plug of the galvo head.
2. Unfasten the fixing screws on the galvo head ([see figure 3.4](#)).
3. Remove the galvo head.

Disassembly and assembly of components

Laser head

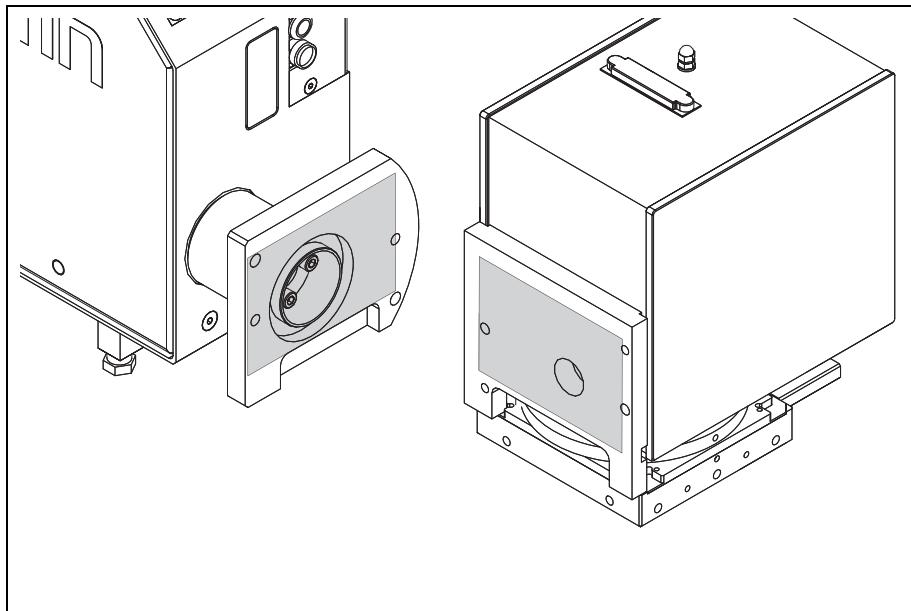


Figure 3.5 Galvo head – 2



CAUTION

Risk of contamination!

If unsuitable adhesive tape is used, there is a risk of contamination due to adhesive residue!

- Only adhesive tape that can be completely removed without residue may be used!
- 4. Cover the entry opening on the galvo head with adhesive tape to prevent contamination inside the galvo head.
- 5. Cover the outlet opening of the laser beam on the laser head with adhesive tape to prevent contamination inside the laser head.
- 6. Mount the galvo head in the reverse order.



WARNING

Fire hazards!

Severe damage to the laser may occur due to adhesive tape or adhesive residue!

- Before installation, check that all adhesive tape has been removed.

3.1.4 External modulator

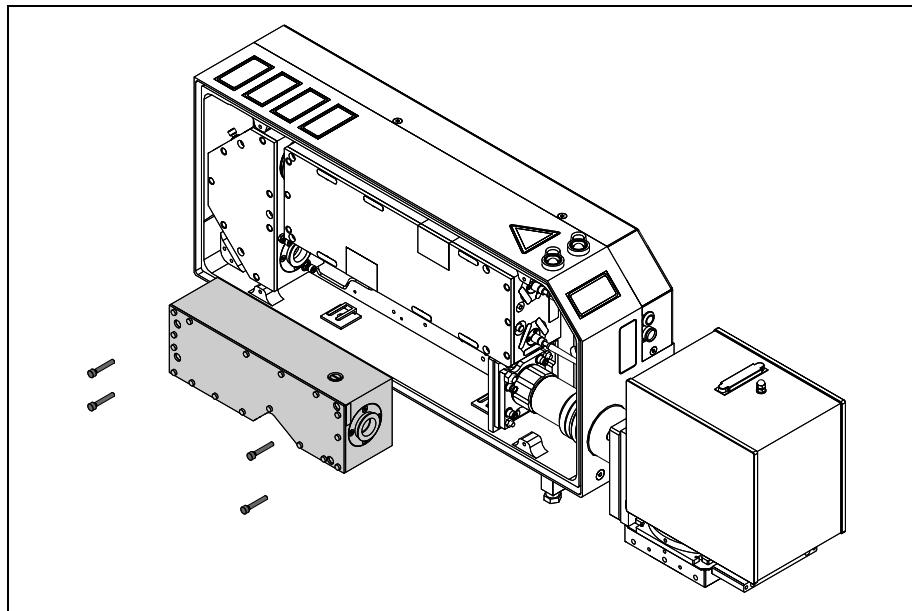


Figure 3.6 External modulator – 1

1. Mount the cover on the resonator side of the laser head.
2. Remove bellows on the input and output of the external modulator.
3. Unfasten the fastening screws on the external modulator.



CAUTION

Hold the external modulator securely to prevent it from tipping out. Do not lose the fastening screws.



CAUTION

Carefully remove the external modulator as the connection line is still fastened to the external modulator.

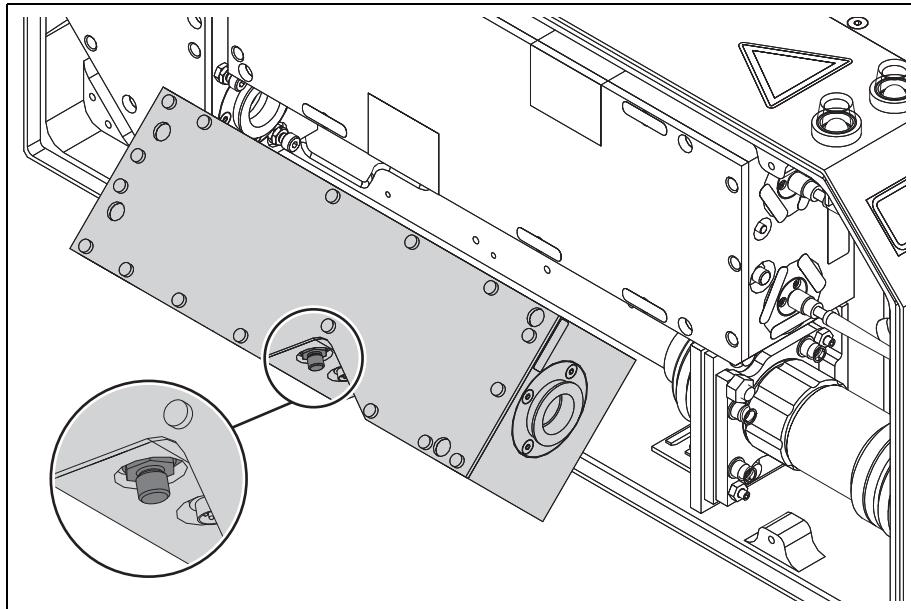


Figure 3.7 External modulator – 2

4. Remove the external modulator from the dowel pin. In the process, secure the fastening screws against falling out.
5. Hold the external modulator securely and disconnect the connecting line.
6. Remove the external modulator and place it on a clean foundation.

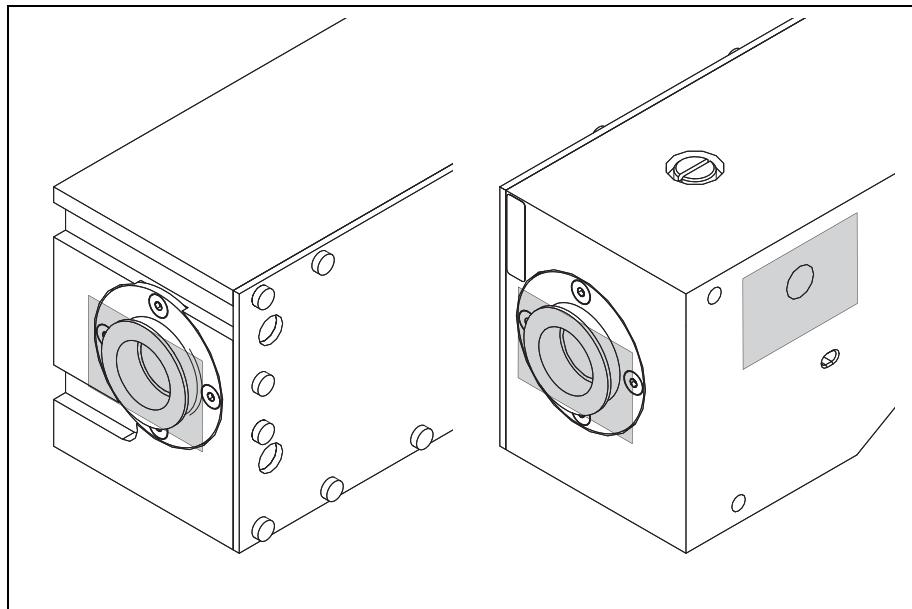


Figure 3.8 External modulator – 3



CAUTION

Risk of contamination!

If unsuitable adhesive tape is used, there is a risk of contamination due to adhesive residue!

- Only adhesive tape that can be completely removed without residue may be used!
- 7. Cover the beam inlet and beam outlet as well as the diffuser lens of the external modulator (see figure 3.8) with adhesive tape to prevent contamination.
- 8. Fit the external modulator in the reverse order.



WARNING

Fire hazards!

Severe damage to the laser may occur due to adhesive tape or adhesive residue!

- Before installation, check that all adhesive tape has been removed.



CAUTION

Risk of damage!

Damaged cables and leads result in functional faults.

- Do not crush or jam the cables and lines inside the laser head during installation!

3.1.5 Deflecting unit

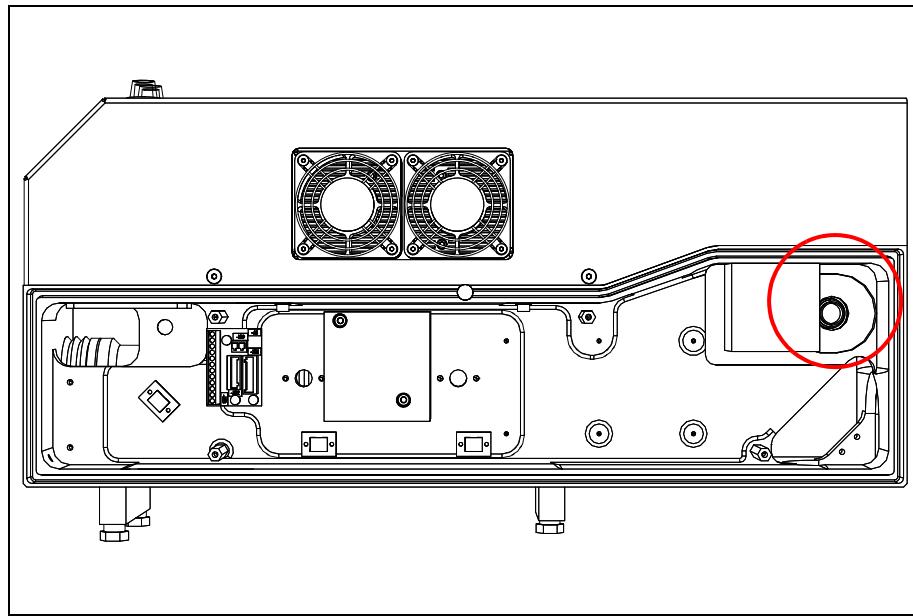


Figure 3.9 Deflecting unit – 1

1. Open both lateral covers of the laser head.
2. Remove the connecting plug (-X25) of the shutter module ([see figure 3.9](#)) on the fan side of the laser head.



CAUTION

Risk of damage!

The connecting plug may be damaged due to the improper use of tools.

- If the use of tools is necessary, do not apply force!
- Do not damage the connecting plug!

-
3. Depending on the laser model, remove the external modulator or beam guide on the resonator side of the laser head.

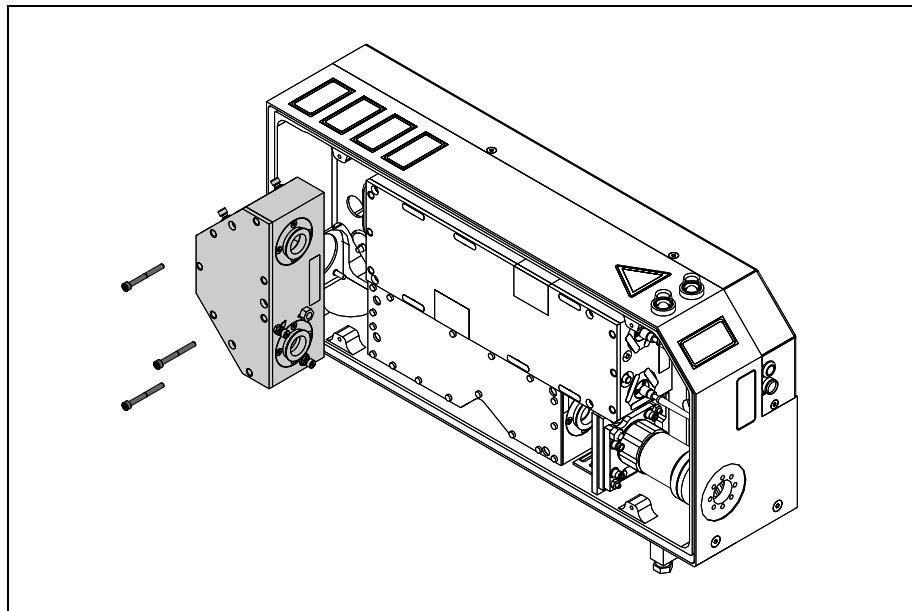


Figure 3.10 Deflecting unit – 2

4. Loosen the three fastening screws of the deflecting unit.
5. Pull the deflecting unit forward off the alignment pins and remove it.
6. Remove the bellows from the resonator module.



CAUTION

Risk of contamination!

If unsuitable adhesive tape is used, there is a risk of contamination due to adhesive residue!

– Only adhesive tape that can be completely removed without residue may be used!

Disassembly and assembly of components

Laser head

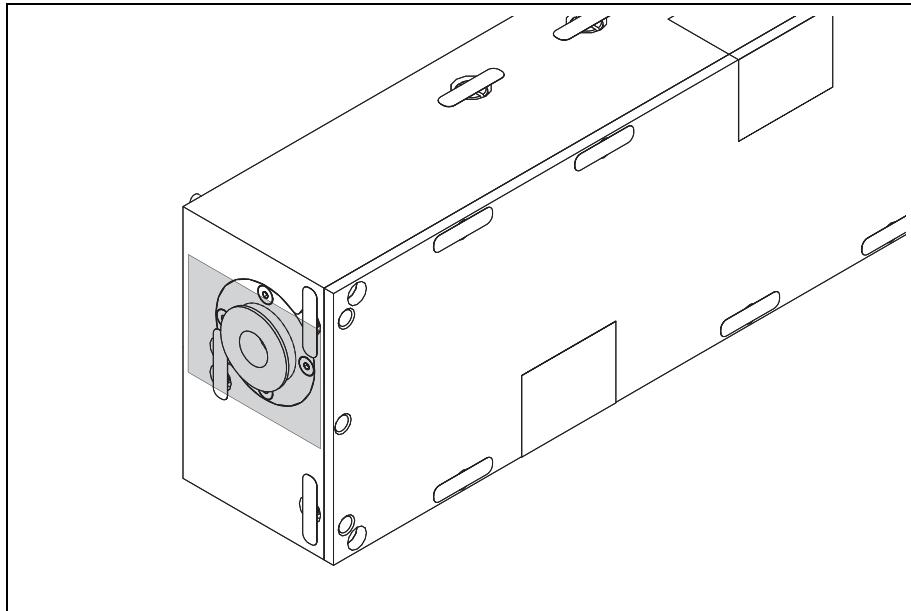


Figure 3.11 Deflecting unit – 3

7. Cover the beam aperture of the resonator module with adhesive tape to prevent the antireflection-coated outlet window of the resonator module from getting dirty.

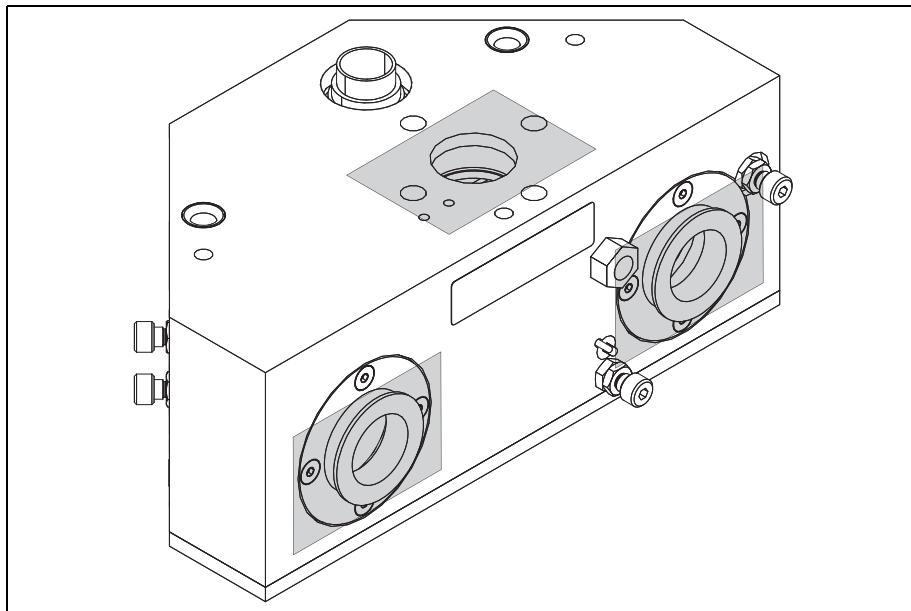


Figure 3.12 Deflecting unit – 4

8. Cover the beam inlet and beam outlet as well as the diffuser lens of the deflecting unit with adhesive tape to prevent contamination.
9. Carry out work inside the deflecting unit.



WARNING

Fire hazards!

Severe damage to the laser may occur due to adhesive tape or adhesive residue!

– Before installation, check that all adhesive tape has been removed.



CAUTION

Risk of damage!

Damaged cables and leads result in functional faults.

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

10. Insert the bellows between the deflecting unit and the resonator module, place the deflecting unit onto the alignment pins, and make sure the bellows are in the correct position.
11. Screw the deflecting unit into place.
12. Then insert the connecting plug (-X25) of the shutter module on the fan side of the laser head and screw it into place.



CAUTION

Risk of damage!

The connecting plug may be damaged due to the improper use of tools.

- Tighten the connecting plug only by hand to prevent any damage to the thread due to the use of tools!*
-

13. Check the adjustment of the laser beam.
14. Install the external modulator and adjust, or fit the beam guide to the resonator side of the laser head. Always pay attention to the correct position of the bellows.
15. Mount both lateral covers of the laser head.
16. Commission the laser system.

3.1.6 Shutter

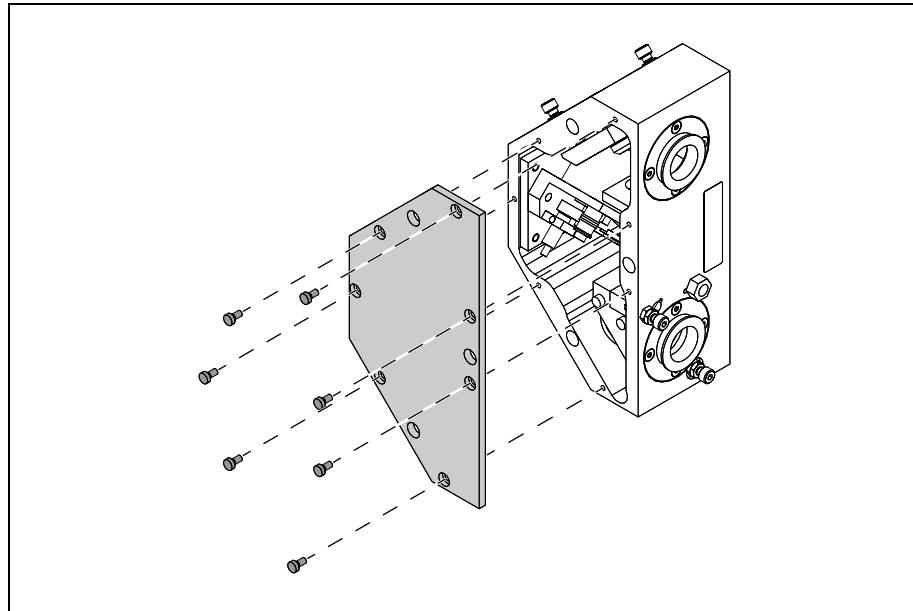


Figure 3.13 Shutter – 1

1. Lay the deflecting unit on a clean foundation.



CAUTION

Risk of damage!

Incorrect handling can damage the deflecting unit.

- *Do not apply any pressure to the deflecting unit, to avoid damaging the connector on the underside.*

2. Loosen the seven fastening screws on the cover of the deflecting unit.
3. Remove the cover.

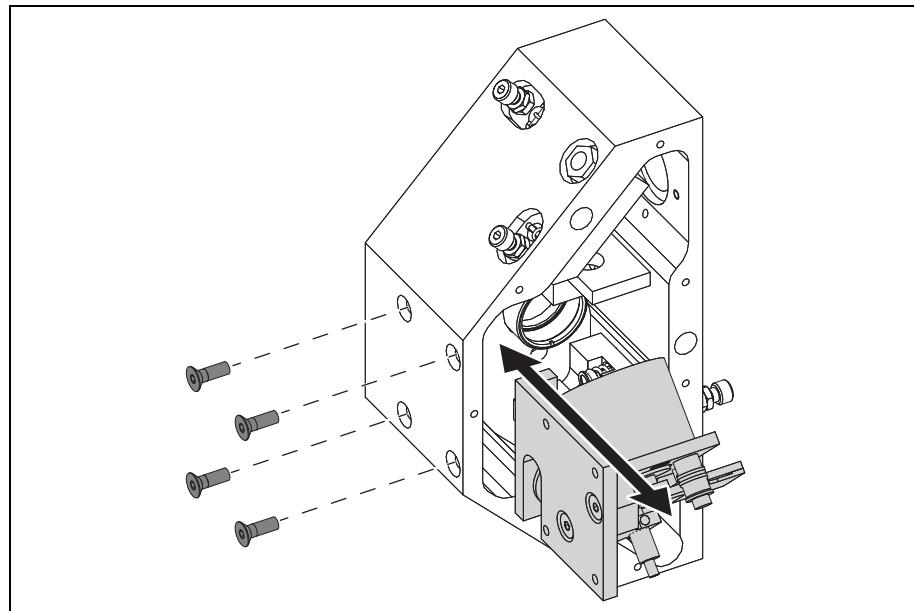


Figure 3.14 Shutter – 2

4. Loosen the four fastening screws of the shutter module.
5. Remove the shutter module.

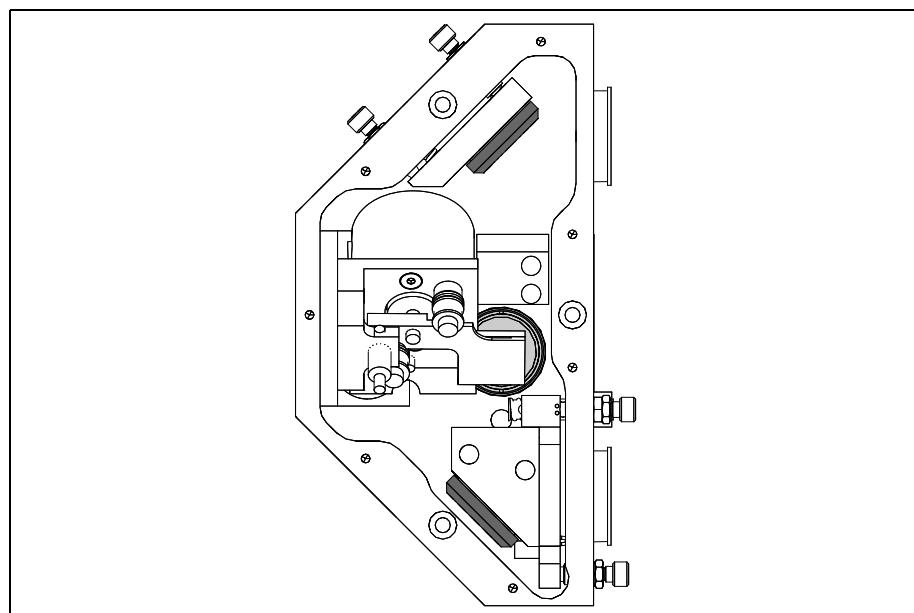


Figure 3.15 Shutter – 3

6. Check the cleanliness condition of the deflecting mirror and lens in front of the internal power measurement or absorber in the deflecting unit. Perform cleaning work if necessary and replace the components.



CAUTION

To dismantle the deflecting mirror it will first be necessary to remove its mount after loosening the two fixing screws.



CAUTION

Risk of damage!

The deflecting mirror will be destroyed if it is installed incorrectly!

- Note the direction of installation of the deflecting mirror!
 - The arrow marking and the golden ring of the deflecting mirror must point in the direction in which the laser beam is aimed (in the direction of the resonator module)!
-



CAUTION

Before installation, check how clean the shutter mirror is; clean if necessary and replace the component.

7. Insert a shutter module into the deflecting unit and screw it into place.
8. Mount the cover of the deflecting unit.



WARNING

Fire hazards!

Severe damage to the laser may occur due to adhesive tape or adhesive residue!

- Before installation, check that all adhesive tape has been removed.
-



CAUTION

Risk of damage!

Damaged cables and leads result in functional faults.

- Do not crush or jam the cables and lines inside the laser head during installation!

9. Insert the bellows between the deflecting unit and the resonator module, place the deflecting unit onto the alignment pins, and make sure the bellows are in the correct position.
10. Mount the deflecting unit.
11. Then insert the connecting plug (-X25) of the shutter module on the fan side of the laser head and screw it into place.



CAUTION

Risk of damage!

The connecting plug may be damaged due to the improper use of tools.

- Tighten the connecting plug only by hand to prevent any damage to the thread due to the use of tools!

12. Check the shutter function multiple times. To do this, open and close the shutter on the laser and over the external control.
13. After replacing the shutter assembly: Perform a safety and function check of the shutter assembly (see page 3-18).
14. Perform a power measurement to determine that the laser beam exits unhindered with the shutter open and with the shutter closed is fully deflected (see point 4.6.7, page 4-30).
15. Check the adjustment of the laser beam (see point 6.5, page 6-16).

16. If present, install the external modulator and adjust, or fit the beam guide to the resonator side of the laser head. Always pay attention to the correct position of the bellows.
17. Mount both lateral covers of the laser head.
18. Commission the laser system.

Safety and function check of the shutter assembly

The check of the shutter assembly is used for the general function check and to guarantee the safety equipment. Potentially faulty assemblies, misalignments and cross-fades with laser radiation are detected in this process.



CAUTION

The visual inspection and measurement are carried out without integrated beam expander. The prerequisite is checking the correct beam adjustment of the laser (see point 6.5, page 6-16).

Measuring equipment:

- Sensor card for low power levels
- Option: Measurement head for power levels < 10 mW

Measurement parameters:

- Maximum laser power (100 % / 80 kHz)

Measurement point:

- Visual inspection with sensor card directly after the shutter assembly (with the deflecting unit cover open)

and/or

- Measurement with power measurement device after galvo flange (measuring point 1)

Preparing the measurement:

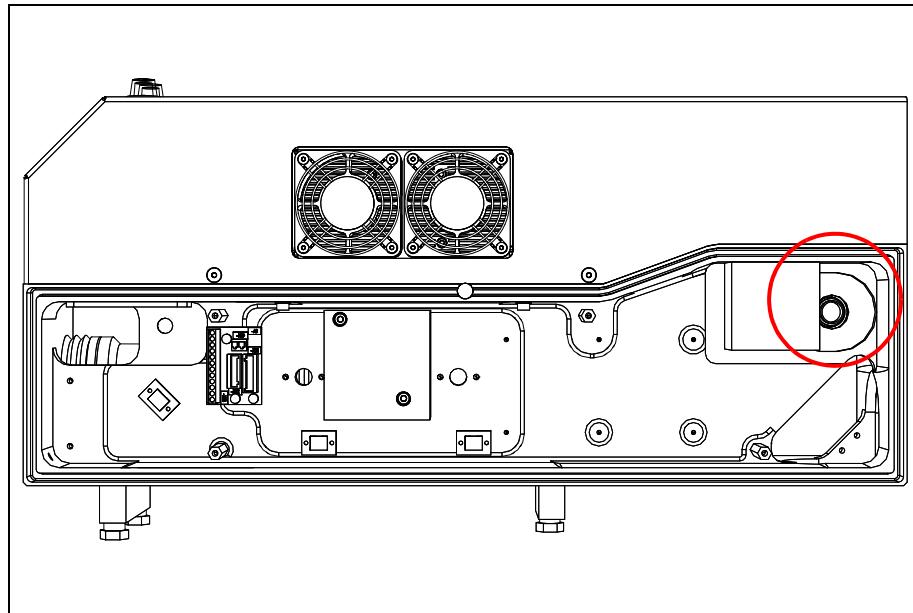


Figure 3.16 Connecting plug - X25

- **Connect a second shutter assembly** for enabling the laser beam externally to -X25 (see figure 3.16).



CAUTION

The **internal shutter of the laser system** must be installed. Its electrical connection should be disconnected.

- Set the laser power to maximum (100 %/80 kHz)
- Enable the laser beam (connect a second shutter and laser beam)

Performing the measurement:

- a) Measurement with power measurement device
 - Approx. 100 mm after the flange plate.
 - During measurement with a measuring device, the measurement head should be aligned on the laser beam (cross-fade). This laser beam is normally located outside the actual beam position.
 - The permissible upper limit is 1.96 mW.

b) Visual inspection with sensor card

- Check the area after the shutter assembly for possible cross-fade using the sensor card.
- A crossfade with directed laser beam should always be visible on the sensor card as an intensive point or circle area.
- The scattered radiation illuminates the sensor area homogeneously.
- See outline diagrams in [Figure 3.17](#) for more details.

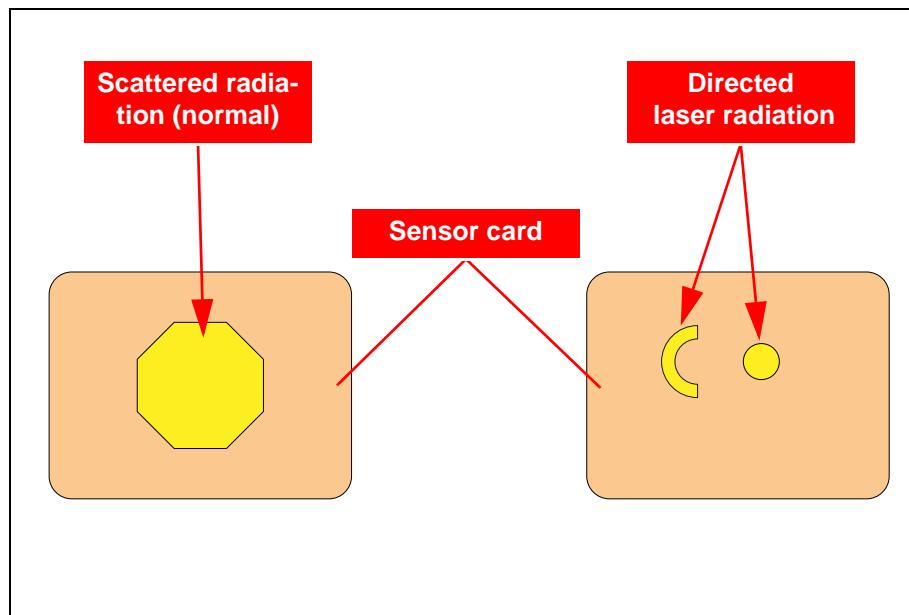


Figure 3.17 Visual inspection with sensor card



CAUTION

Visible, directed laser radiation normally exceeds the permissible maximum value of 1.96 mW and must be shut off.

1. Check the new shutter assembly, where necessary change the shutter assembly and check again.
2. Check that the beam path is OK ([see point 6.5, page 6-16 ff.](#)).
3. Replace the resonator module, perform another beam path adjustment and perform the check again.
4. If these steps are not successful, contact ROFIN-Sinar.

3.1.7 Resonator module

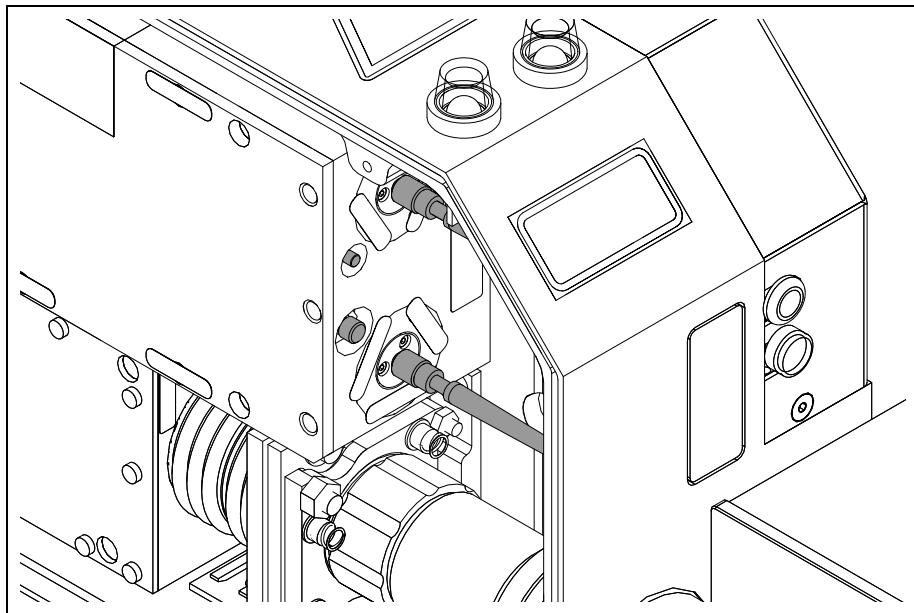


Figure 3.18 Resonator module – 1

1. Mount the cover on the resonator side of the laser head.
2. Slowly loosen the washer and then remove the glass fiber line.



CAUTION

Risk of damage!

Glass fiber lines can be damaged when inserting tools.

- *Do not use any tools!*



CAUTION

Identify the terminal that each was connected to which glass fiber. In this way, the lines are not mixed up, which can lead to malfunctions.

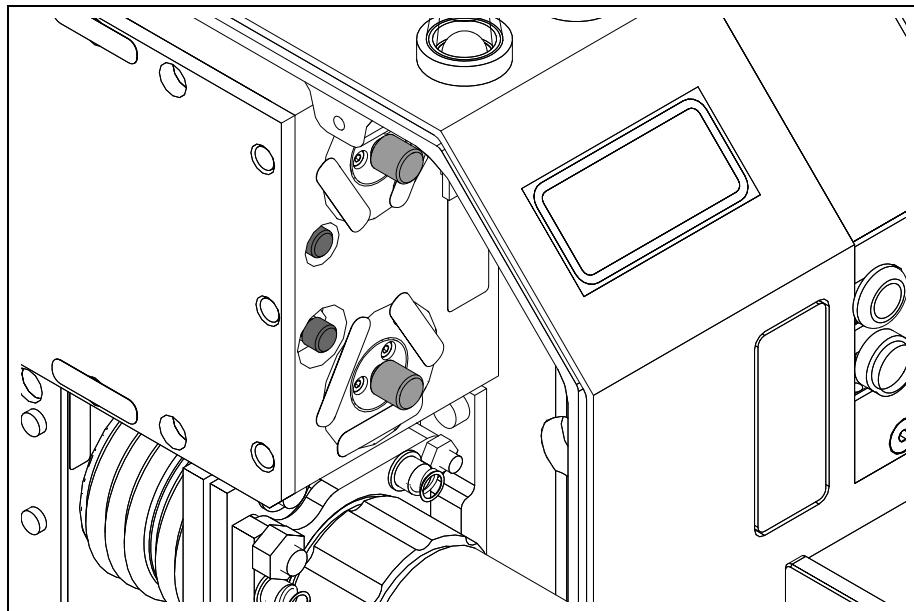


Figure 3.19 Resonator module – 2

3. Attach dust protection caps to the glass fibers and the connections on the resonator module.



CAUTION

Bags with dust protection caps are fastened in the laser system (see page 3-1). The bags with dust protection caps should be fastened back again once work has been completed.

4. Disconnect the SMA plug HF line and SMB plug Q-Switch Interlock line.

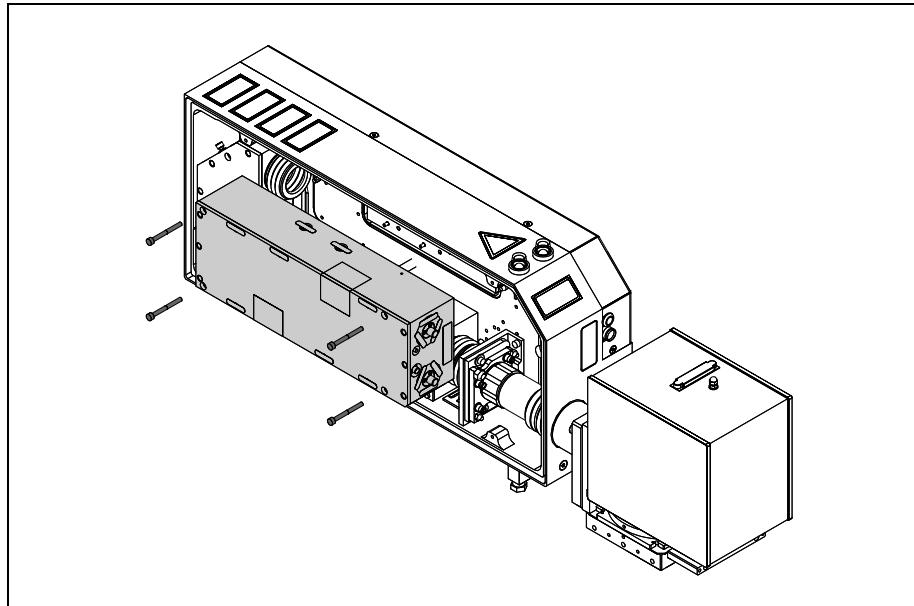


Figure 3.20 Resonator module – 3

5. Loosen the fastening screws of the resonator module.



CAUTION

Hold the resonator module securely to prevent it from tipping out. Do not lose the fastening screws.

6. Remove the resonator module from the alignment pins. In the process, secure the fastening screws against falling out.
7. Unscrew the resonator module and lay it on a clean foundation.



CAUTION

Risk of contamination!

If unsuitable adhesive tape is used, there is a risk of contamination due to adhesive residue!

- *Only adhesive tape that can be completely removed without residue may be used!*

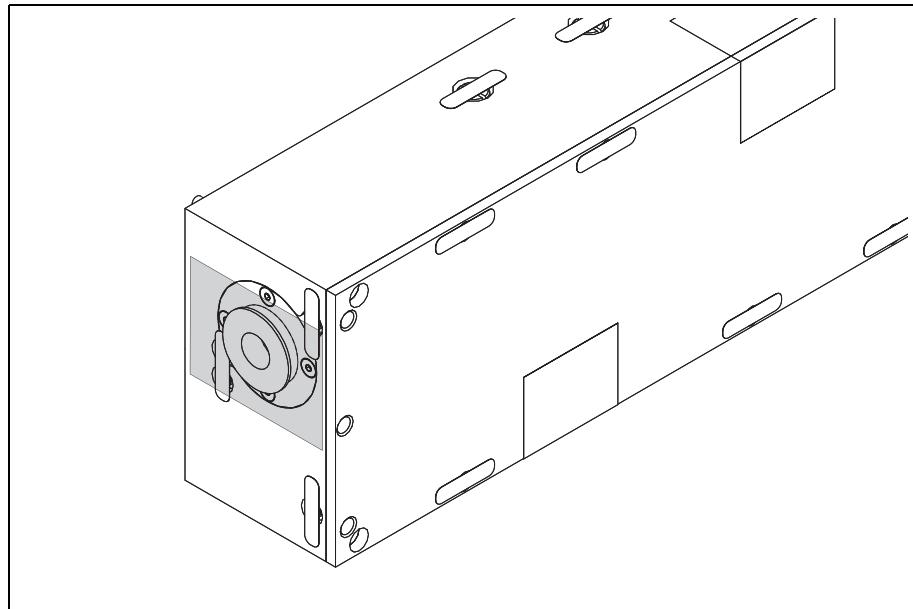


Figure 3.21 Resonator module – 4

8. Cover the beam aperture of the resonator module with adhesive tape to prevent the antireflection-coated outlet window of the resonator module from getting dirty.

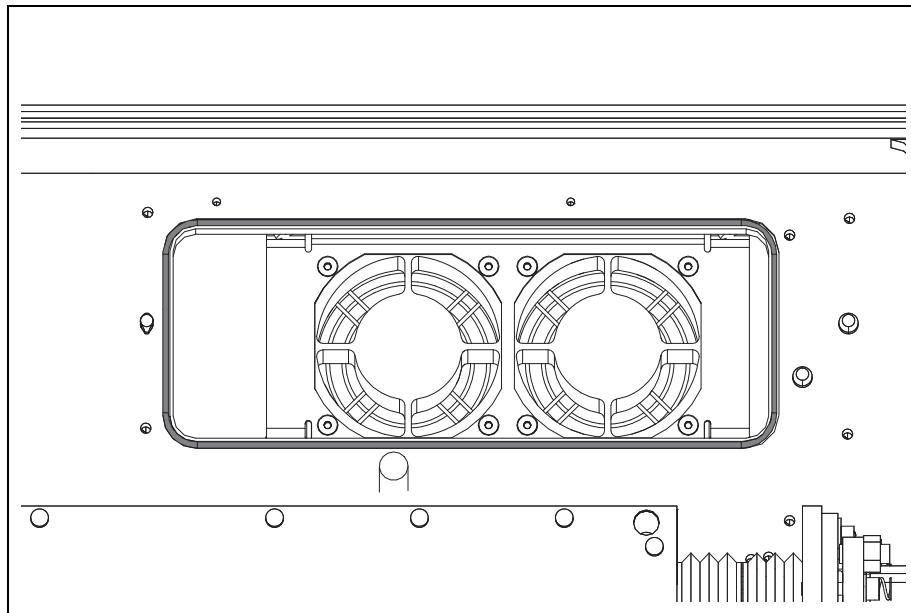


Figure 3.22 Resonator module – 5

- Check the condition and correct fitting of the O-ring (see figure 3.22) on the cooling fans.



CAUTION

The O-ring must be replaced in case of danger, but after replacing the resonator module, at the latest. Each replacement resonator includes a new O-ring.

- Check the condition of the cooling fins and clean if necessary.



WARNING

Fire hazards!

Severe damage to the laser may occur due to adhesive tape or adhesive residue!

- Before installation, check that all adhesive tape has been removed.



CAUTION

Risk of damage!

Damaged cables and leads result in functional faults.

- Do not crush or jam the cables and lines inside the laser head during installation!

- Push the resonator module on to the alignment pins.
- Fit the fastening screws enclosed with the new resonator module.
- Tighten the fastening screws crosswise to a torque of **120 Ncm**.
- Remove the dust protection cap from the resonator module and the glass fiber lines. Connecting the glass fibers.



CAUTION

Risk of damage!

Glass fiber lines can be damaged when inserting tools.

- Do not use tools!

- Connect the SMA plug HF line and SMB plug Q-Switch Interlock line.



WARNING

Laser radiation!

Risk of accident and injury due to laser radiation!

- *Take measures to protect against laser radiation!*
-

16. Insert the mains plug of the laser system and switch on the main switch.
17. Check the adjustment of the laser beam.
18. Perform a safety and function check of the shutter assembly ([see page 3-18](#)).
19. Check the laser power behind the galvo head (on the workpiece) using the power measurement device ([see point 4.6.3, page 4-23](#)).
20. Check the laser leakage power of the HF generator ([see point 4.11, page 4-40](#)).
21. Mount the cover of the laser head.
22. Commission the laser system.
23. Perform the measurement test marking. Enter the measurement values in the logbook.

3.1.8 Beam expander

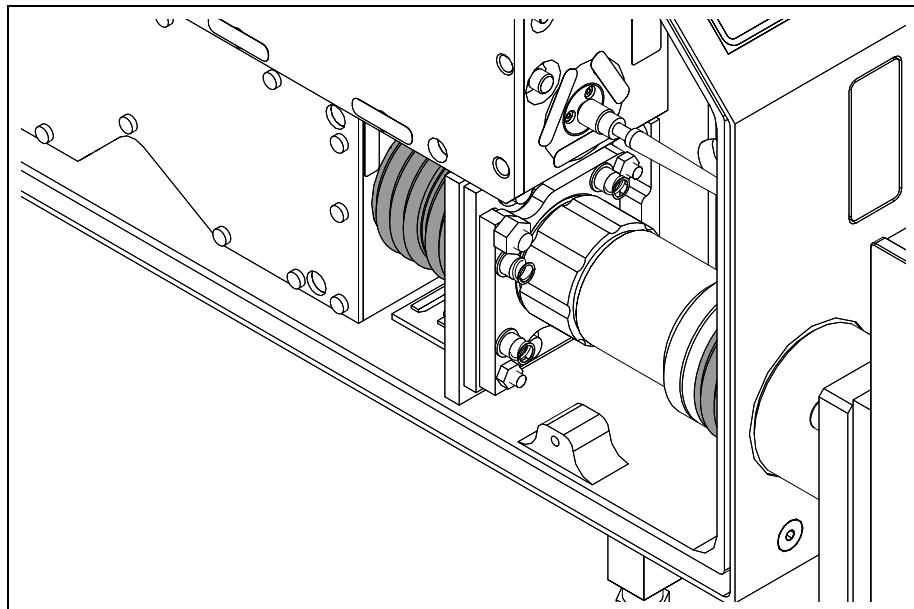


Figure 3.23 Beam expander – 1

1. Open the lateral cover on the resonator side of the laser head.
2. Remove the bellows.

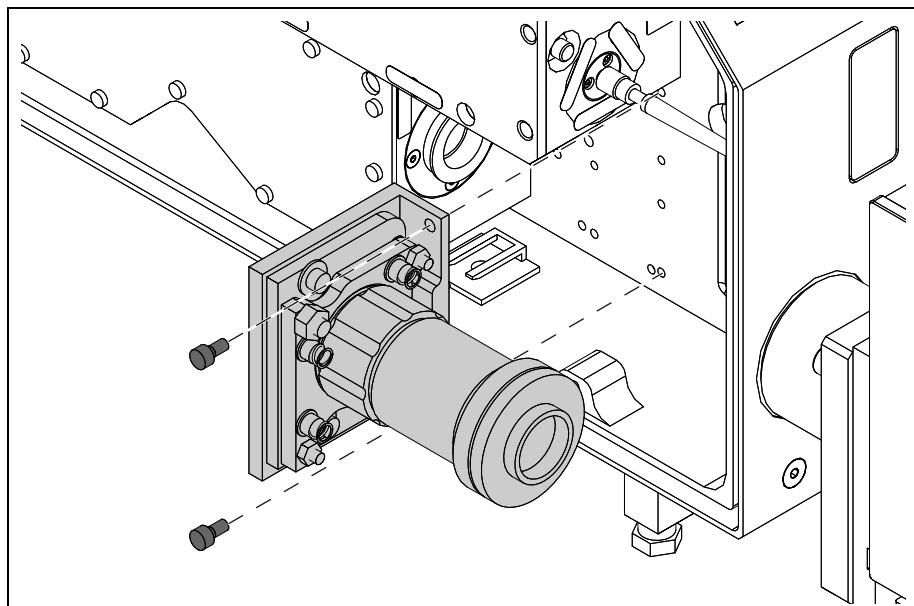


Figure 3.24 Beam expander – 2

3. Dismantle the beam expander including the mount.
4. Note the setting (scale value) on the beam expander.

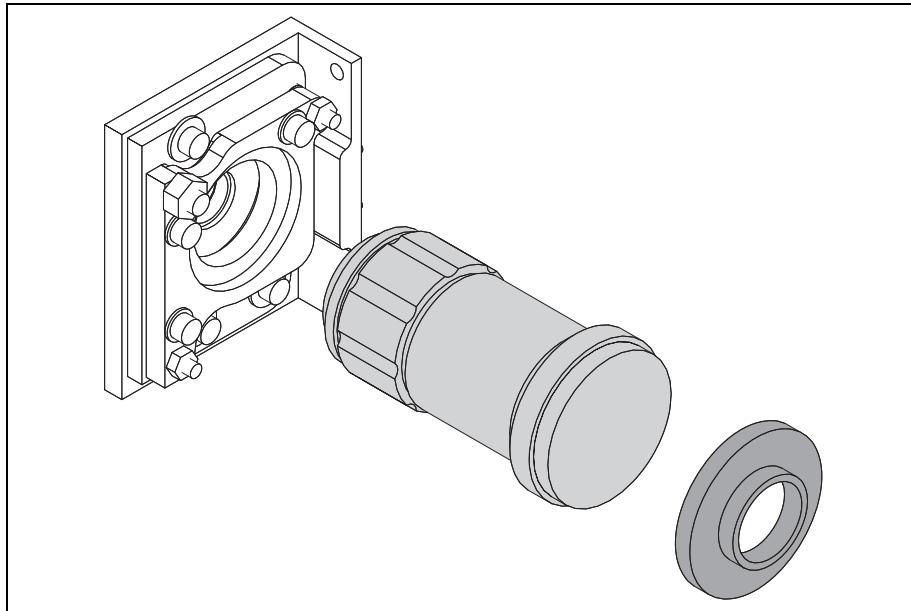


Figure 3.25 Beam expander – 3

5. Unscrew the beam expander from the mount and keep any spacer rings for subsequent use.
6. Perform a visual inspection of the removed beam expander (clean condition, burn marks, etc.).
7. Clean or replace the beam expander as necessary.



CAUTION

If additional work on the laser head is required, seal removed beam expander with dust protection caps.

8. Screw new/cleaned beam expander into the mount.
 - **Install cleaned beam expander using the old spacer rings** so that the scale is legible from outside (front).
 - **Install new beam expander with suitable spacer rings** so that the scale is legible from outside (front).
 - Spacer rings available: 0.25 mm (order number 102146579), 0.5 mm (order number 102119176), 0.8 mm (order number 102119177)
9. Check the adjustment of the laser beam and adjust it if necessary ([see point 6.5, page 6-16](#)).
10. Reinstall the beam expander with the mount. Pay attention to the correct position of the bellows.



CAUTION

Risk of damage!

Damaged cables and leads result in functional faults.

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

11. Set new/cleaned beam expander to the scale value on the removed beam expander.
12. Check the focal point of the laser and adjust it if necessary ([see point 6.4, page 6-12](#)).
13. Perform a test marking.
14. Mount the cover on the resonator side of the laser head.
15. Commission the laser system.

3.1.9 Collimating lens



CAUTION

Present on the beam expander on laser systems in basic version with or without positioning laser.

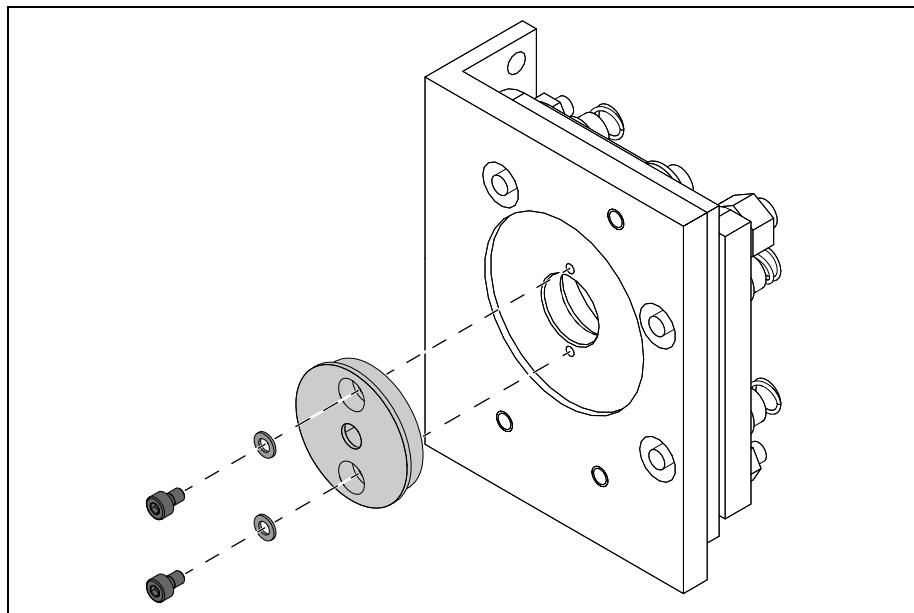


Figure 3.26 Collimating lens

1. Open the lateral cover on the resonator side of the laser head.
2. Dismantle the beam expander including the mount.
3. Unscrew the collimating lens from the beam expander mount.
4. Place the collimating lens on a suitable surface (e.g. lens cleaning paper).
5. Perform a visual inspection of the surfaces with a magnifying glass.



CAUTION

If burns/discoloration are visible, replace the collimating lens including the mount.

6. Re-fit the collimating lens.
7. Fit the beam expander.



CAUTION

Risk of damage!

Damaged cables and leads result in functional faults.

– Do not crush or jam the cables and lines inside the laser head during installation!

8. Check the adjustment of the laser beam and adjust it if necessary (see point 6.5, page 6-16).
9. Fit the bellows.
10. Mount the cover on the resonator side of the laser head.
11. Commission the laser system.

Disassembly and assembly of components

Laser head

3.1.10 Positioning laser¹⁾

1. Open the lateral cover on the resonator side of the laser head.
2. Remove the beam guide of the laser head.

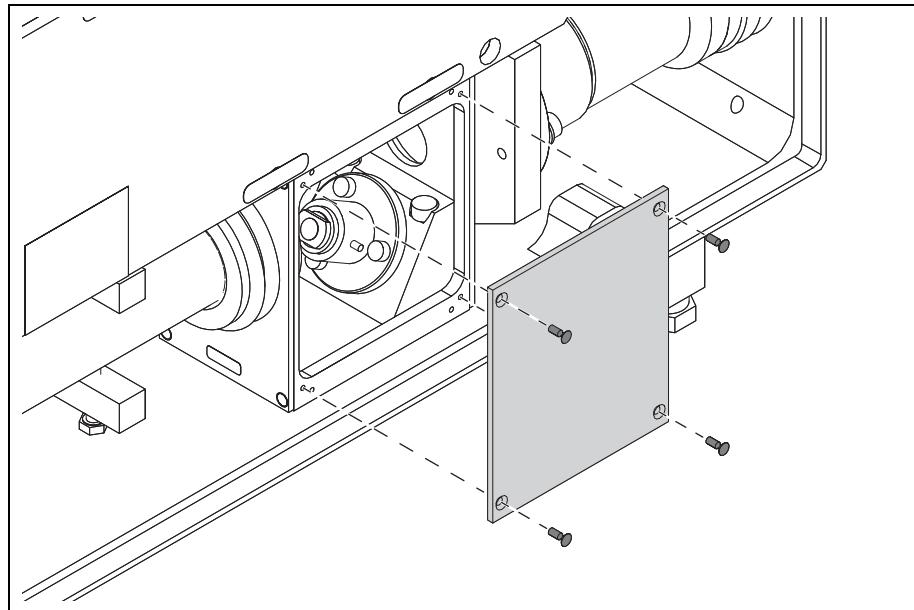


Figure 3.27 Positioning laser – 1

3. Loosen the four fastening screws on the cover of the positioning laser.
4. Remove the cover.

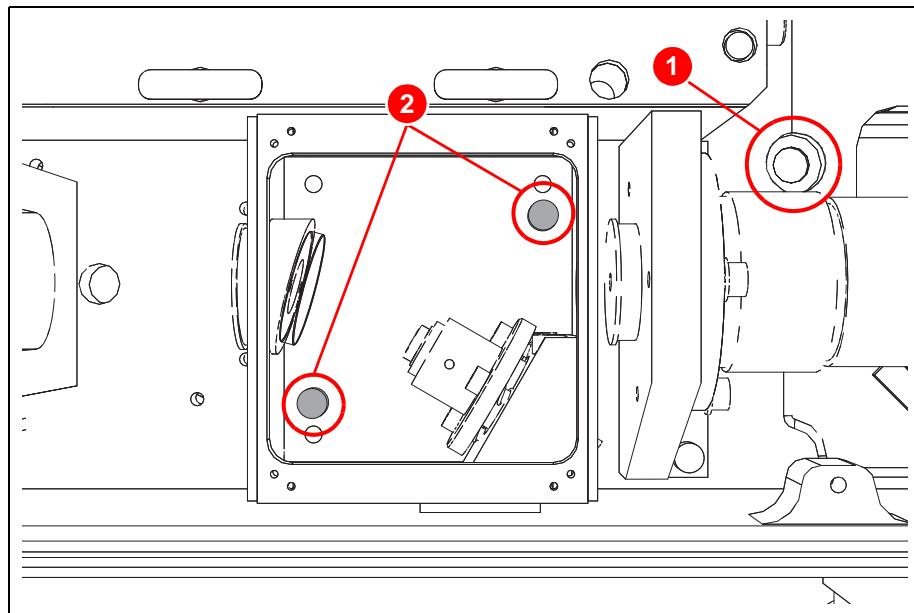


Figure 3.28 Positioning laser – 2

5. Remove the connecting plug on the positioning laser (-X38) (1) ([Figure 3.28](#)).
6. Unfasten the fastening screws (2) on the positioning laser housing; remove the housing from the alignment pins.

¹⁾ Installation depends on the respective laser type

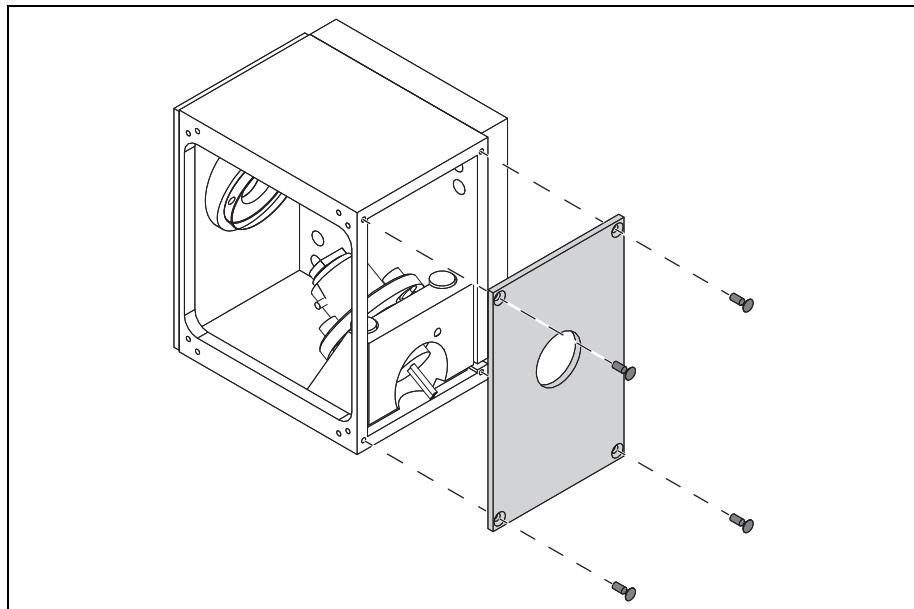


Figure 3.29 Positioning laser – 3

7. Remove the side cover of the alignment laser housing after loosening the four fastening screws.

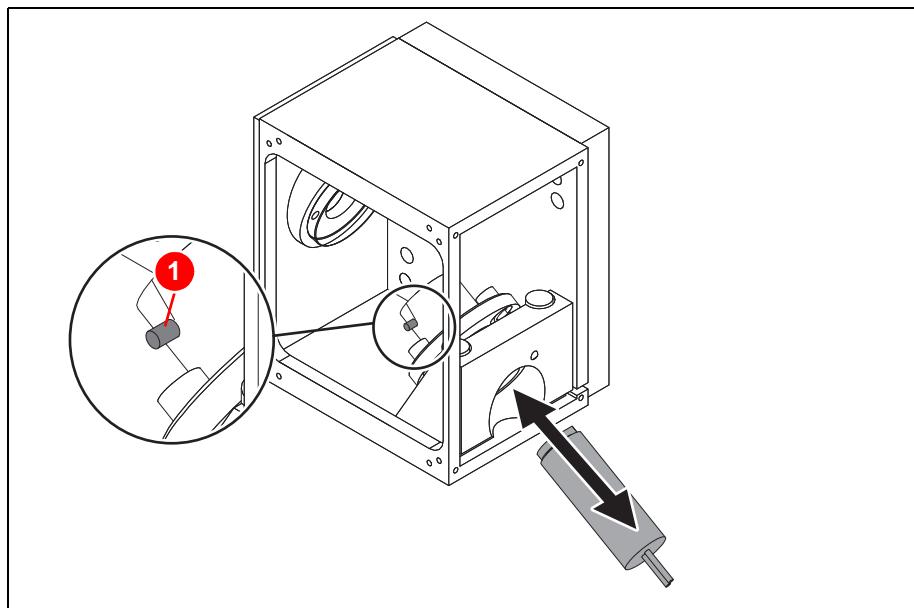


Figure 3.30 Positioning laser – 4



CAUTION

Risk of damage!

The laser beam can be damaged if the positioning laser is inserted too deep on re-installation!

- Before removing the positioning laser, measure its exact installation depth!
- Note down the measurement.

8. Carefully withdraw the alignment laser after loosening the headless screw (1) ([Figure 3.30](#)).
9. Plug the new alignment laser into the connecting plug (-X38).

10. Switch on the system, start up the software (LaserConsole) and switch on the alignment laser.

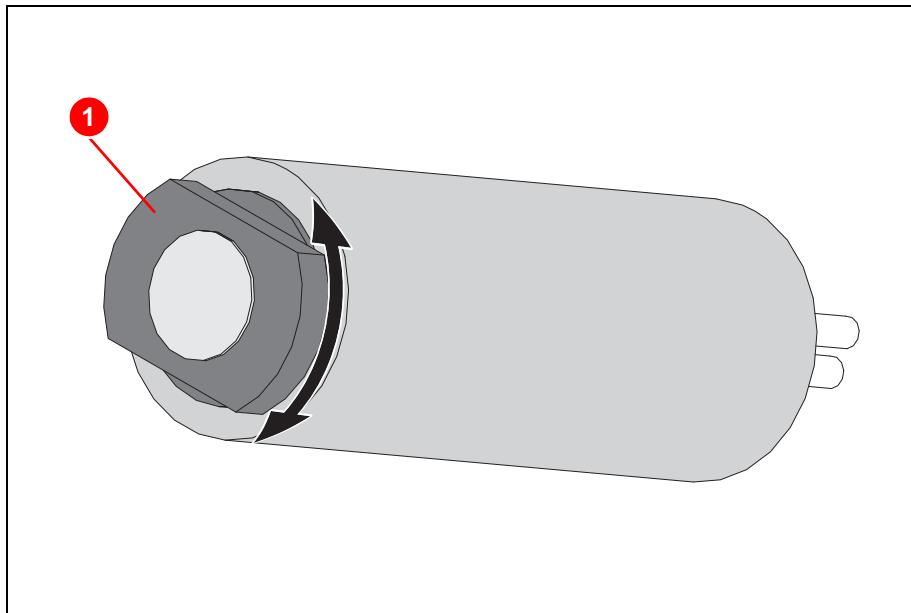


Figure 3.31 Positioning laser – 5

11. Using the brass screw (1) (Figure 3.31), align the red laser beam to a white surface that is about 1.5 m to 2 m away; turn the brass screw until the minimum diameter of the laser beam is attained.
12. Check the cleanliness condition of the coupling mirror in the positioning laser housing. If necessary, carry out cleaning or replacement (see point 3.1.11, page 3-33).
13. Perform the power measurement without installed positioning laser housing.
14. Insert the new alignment laser in the housing and screw it tight.



CAUTION

Risk of damage!

The laser beam can be damaged if the positioning laser is inserted too deep!

– On reinstallation, switch on the installation depth previously measured!

15. Screw the side cover on the positioning laser housing.



CAUTION

Make sure that the cover is fitted on the correct side. The laser beam will be shadowed if it is installed incorrectly!

16. Fit the alignment laser housing in the laser head.



CAUTION

Risk of damage!

Damaged cables and leads result in functional faults.

- *Do not crush, jam, or abrade the connecting lines of the alignment laser during installation!*
 - *Make sure that the connecting lines are fixed so that they cannot be damaged by the laser beam.*
-

17. Perform the power measurement. In the event of power losses, repeat the cleanliness condition again and repeat the cleaning if necessary.
18. Check the adjustment of the alignment laser and adjust it if necessary.
19. Mount the cover of the positioning laser housing.
20. Install the beam guide and pay attention to the correct position of the bellows.
21. Install the beam expander and the mount again; pay attention to the correct position of the bellows.



CAUTION

Risk of damage!

Damaged cables and leads result in functional faults.

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

22. Check the setting of the beam expander.
23. Check the positioning laser in the field.
24. Mount the cover on the resonator side of the laser head.
25. Commission the laser system.

3.1.11 Positioning laser housing coupling mirror

1. Open the lateral cover on the resonator side of the laser head.
2. Remove the beam guide of the laser head.

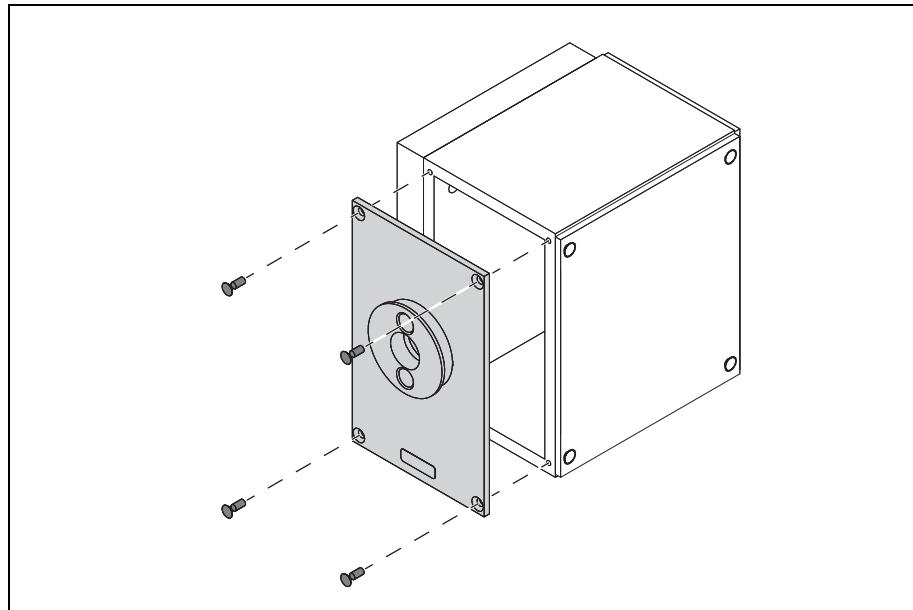


Figure 3.32 Positioning laser housing coupling mirror – 1

3. Remove the side cover of the alignment laser housing after loosening the four fastening screws.

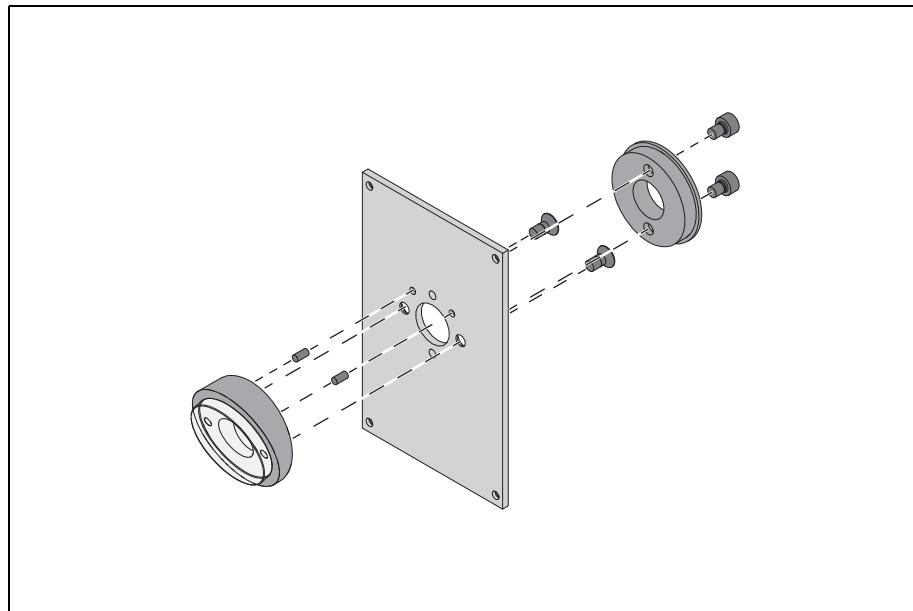


Figure 3.33 Positioning laser housing coupling mirror – 2

4. Perform the power measurement.
5. Removing the coupling mirror.
6. Check the cleanliness condition of the coupling mirror and perform cleaning or replace the coupling mirror if necessary.
7. Fit the coupling mirror.

8. Check the adjustment of the laser beam, adjust if necessary.
9. Install the beam guide and pay attention to the correct position of the bellows.
10. Mount the cover on the resonator side of the laser head.
11. Commission the laser system.

3.1.12 Beam absorber / power measuring head

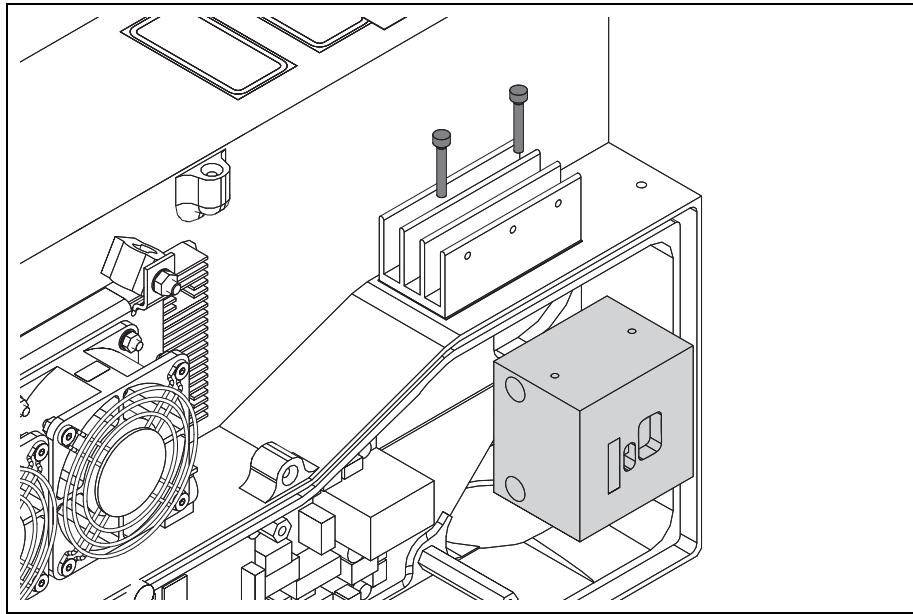


Figure 3.34 Beam absorber / power measuring head



WARNING

Laser radiation!

Risk of accident and injury due to laser radiation! Laser beam is emitted from the diffuser lens when the beam absorber is removed!

- If the laser system needs to remain switched on for further maintenance work with the beam absorber removed, laser safety measures should be taken!

3.1.13 Beam absorber for external modulator

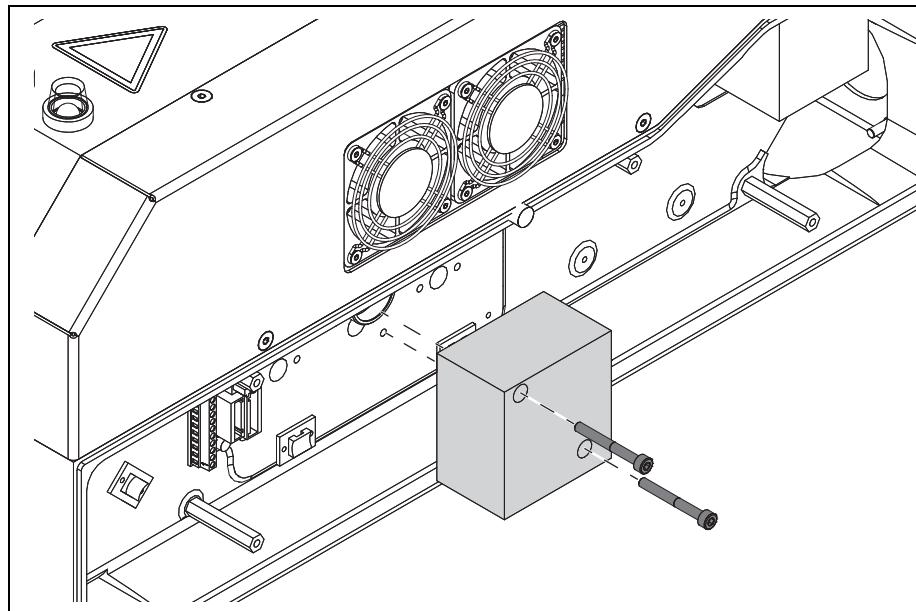


Figure 3.35 Beam absorber for external modulator (passive version)

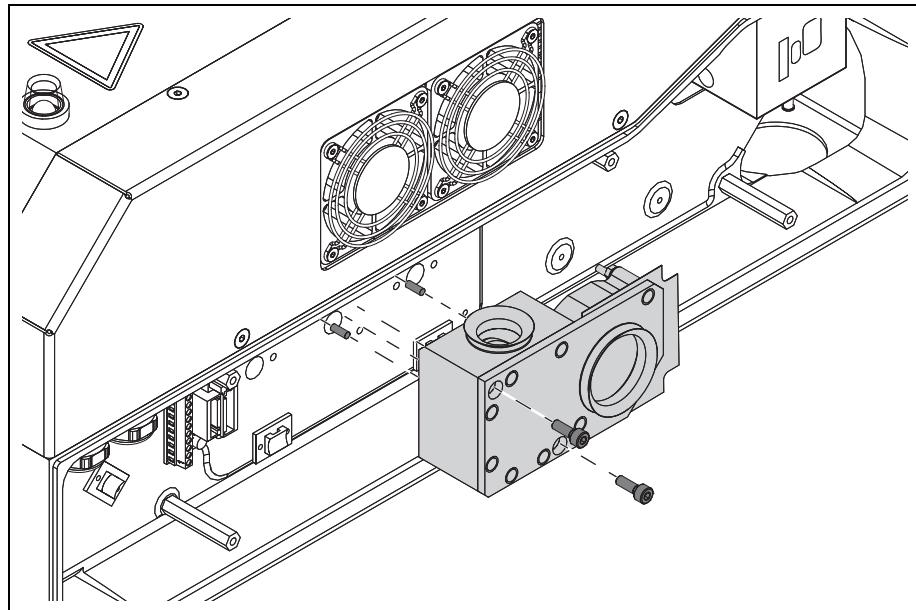


Figure 3.36 Beam absorber for external modulator (active version)



WARNING

Laser radiation!

Risk of accident and injury due to laser radiation! For lasers with external modulator, the primary beam is directed into the absorber with "Beam off"!

- If the laser system needs to remain switched on for further maintenance work with the beam absorber removed, laser safety measures should be taken!

3.1.14 Laser head fan

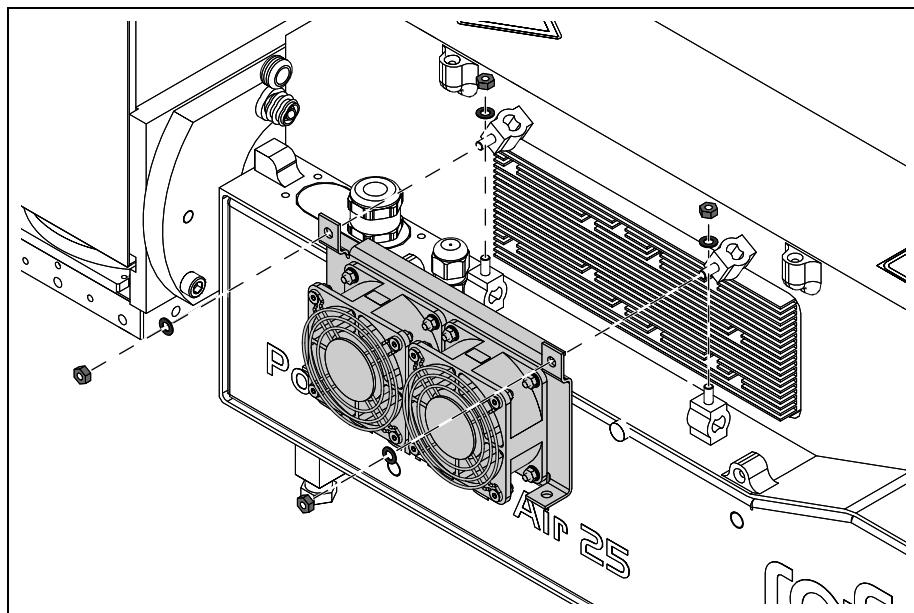


Figure 3.37 Laser head fan

1. Dismantle the fan cover of the laser head.
2. Open the cable screw connection of the fan lines.
3. Disconnect the fan lines and pull them through the cable screw connection one by one.



CAUTION

The lines must be pulled through individually so that the cable markings are not rubbed off the lines.

4. Loosen the screw connections of the fan plate.



CAUTION

Counter with suitable pliers so as not to deform the rubber buffer.

5. Clean or replace the fan unit as required.



CAUTION

Functional faults possible!

Any vibrations can negatively influence the marking result.

- *Use the same fan type (quiet running)!*



CAUTION

Make sure it is in the correct installation position (direction of flow). Also check the degree of soiling of the cooling ribs of the cooling element and clean it with a soft brush as required.

6. Mount the fan plate and screw it into place.



CAUTION

Counter with suitable pliers so as not to deform the rubber buffer.



CAUTION

Functional faults possible!

Any vibrations can negatively influence the marking result.

- Never replace the rubber buffer with rigid materials!
-

7. Pull the fan lines through the cable screw connection one by one and connect them.
8. Tighten the cable screw connection.
9. Make sure the rotors are free of the risk of collision. For a function check, insert the mains plug and turn on the main switch of the plug-in supply unit.
10. Switch off the main switch again.
11. Mount the fan cover and tighten all fastening screws.



CAUTION

Pay attention to the correct position of the rubber sleeve of the connecting line of the galvo head.

3.2 Plug-in supply unit

3.2.1 Components of the plug-in supply unit

Designation	Component
General components	
M1	Fan
M1a	Fan speed control
K9	Emergency stop relay
Power supplies	
G1	24 V / 500 W (TEC 1+2)
G2	24 V / 500 W (diodes + HF driver)
G3	Galvo / +15 V
G4	Galvo / -15 V
A2	Diodes / 6 V / 80 A (power source)
PCBs	
A1	LSC XXX with SSC
A3	Mini-ITX (CPU)
A3.11	SO-DIMM RAM
A3.2	SSD 60 GB mSATA
A3.3	SSD 60GB; 1.8", SATA
A4	ALI-USB
A4.1	ALI-USB-Opto 100
A8	Distributed rear panel
A12	DC/DC converter (24V->19V)
A17	Galvo 2 distributor
Pump module components	
A5	Laser diode(s) with integrated NTC
A7	HF driver HG 29-40
A7a	HF driver HG 29-80 (PL-E Air ITX-EM)
A9	Laser diode protection
A11	Peltier controller
A18	Distributor
M2 / 3	Fan

Disassembly and assembly of components

Plug-in supply unit

3.2.2 General covers

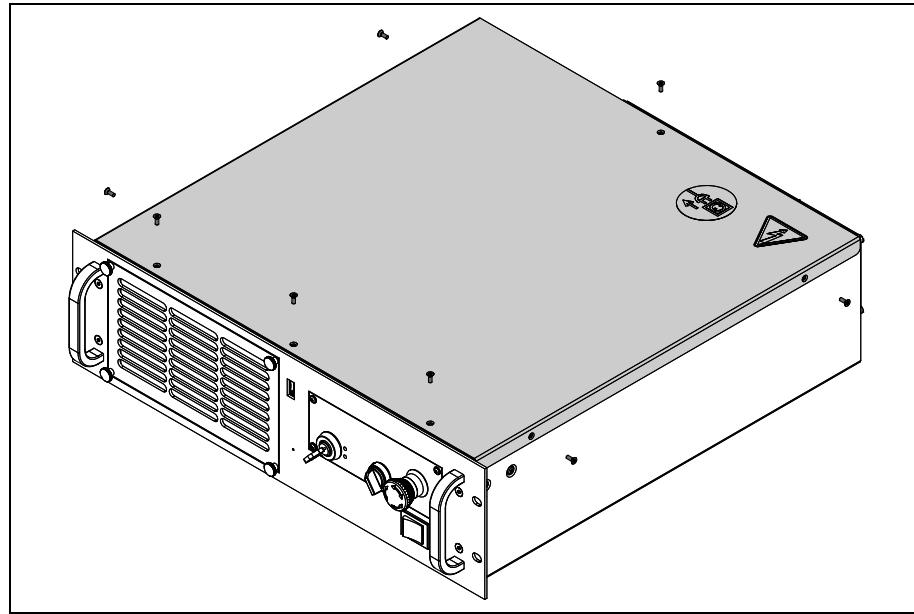


Figure 3.38 Plug-in unit cover

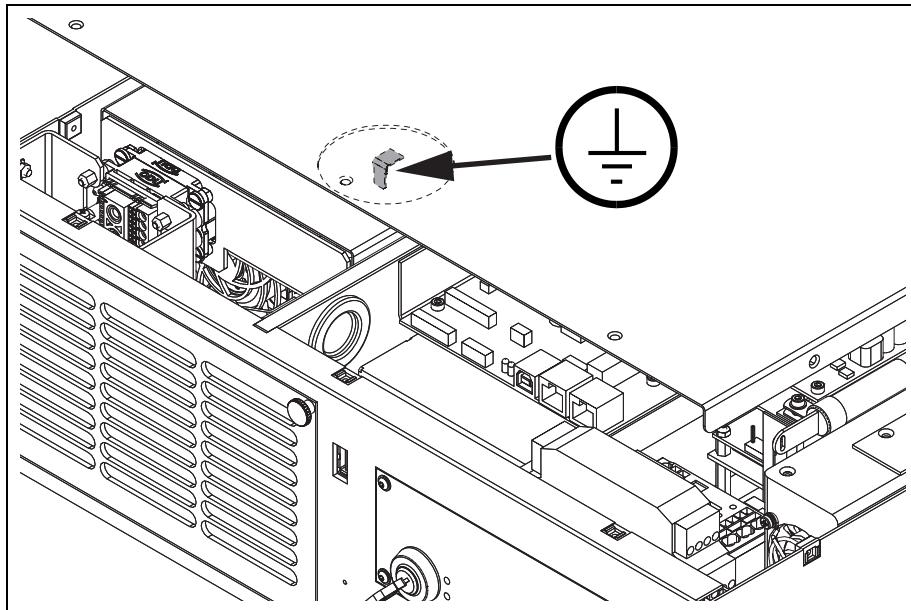


Figure 3.39 Protective conductor connection cover for plug-in unit

3.2.3 Pump module



CAUTION

Electrostatically sensitive devices (ESD)!

Electrostatically sensitive devices can be damaged in the event of incorrect handling. When the mains connection is disconnected as required before the plug-in supply unit is opened, the protective conductor connection is also disconnected.

- Work is only permitted to be performed following prior equipotential bonding!
- The pump module must be earthed with suitable measures before working on diodes!
- The external grounding must be performed at a marked PE terminal of the pump module and a marked PE terminal in the system area!
- The correct equipotential bonding must be checked using measuring technology!
- The ESD wrist band must then be connected to a PE clamp of the pump module!
- Anyone who works on the diode modules must observe the measures for the protection of electrostatically sensitive devices (ESD)!
- The work area must be made safe!

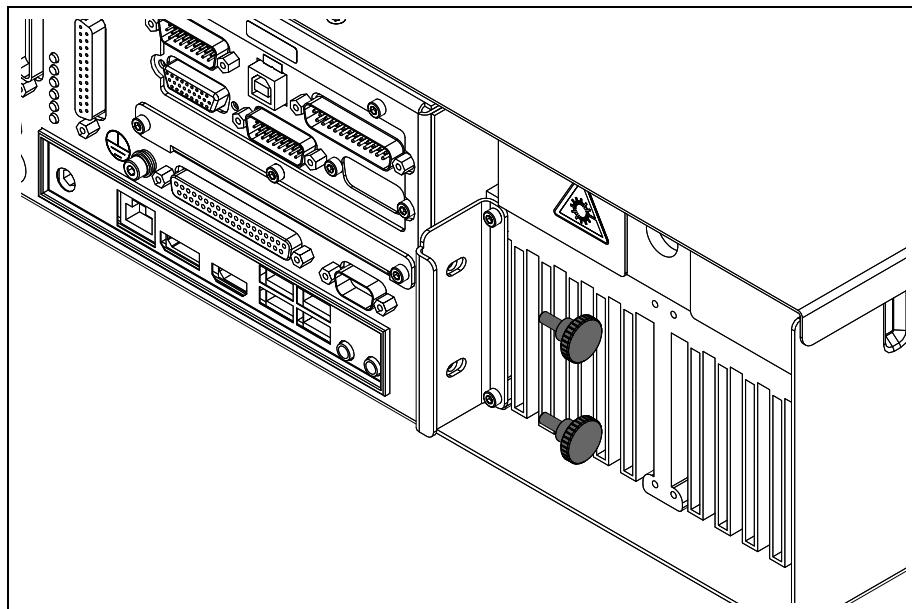


Figure 3.40 Pump module – 1

Disassembly and assembly of components

Plug-in supply unit

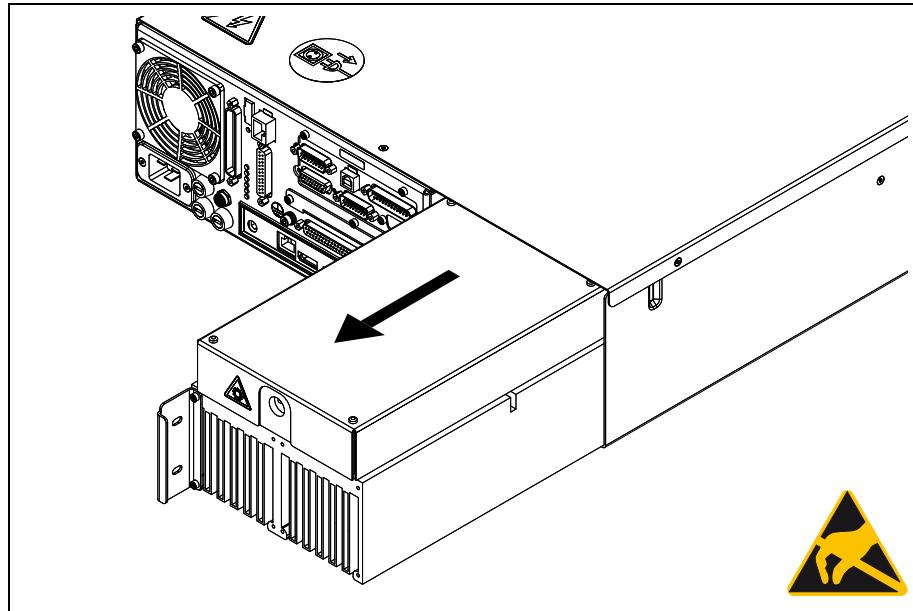


Figure 3.41 Pump module – 2

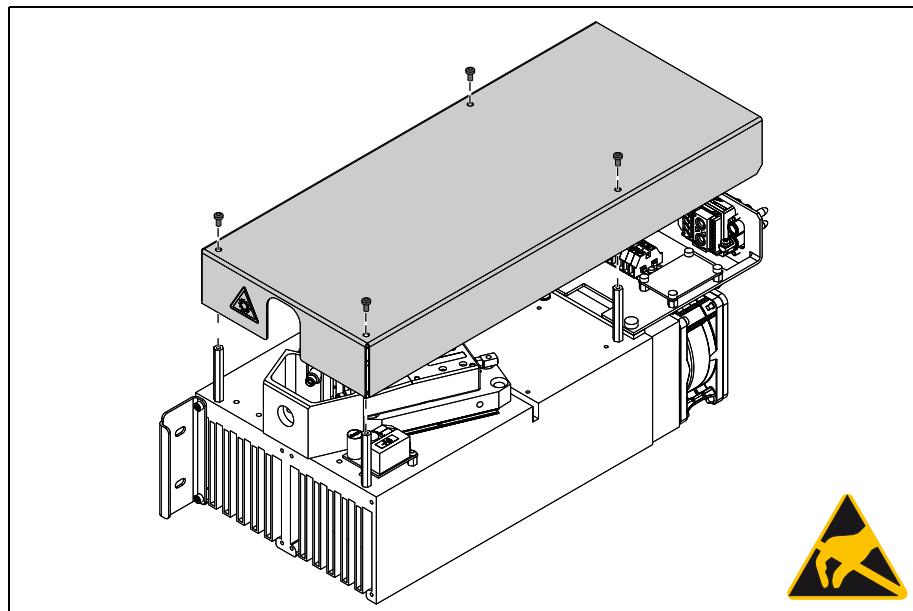


Figure 3.42 Pump module cover

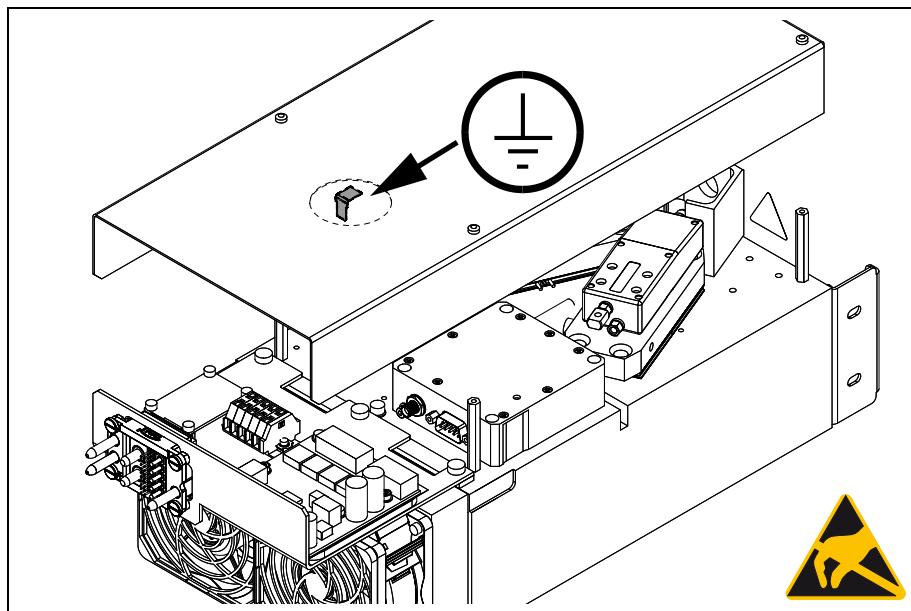


Figure 3.43 Protective conductor connection cover for pump module

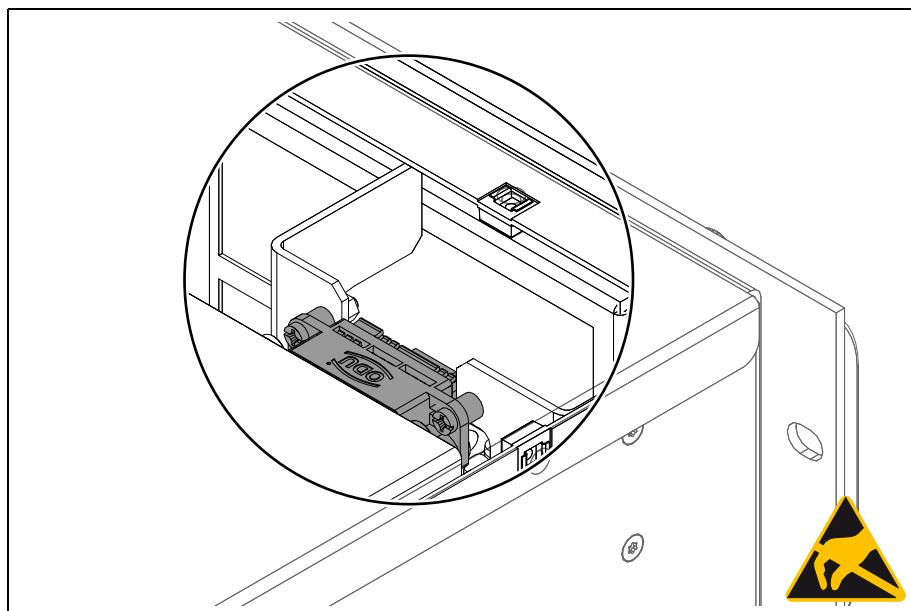


Figure 3.44 Fit pump module



CAUTION

Insert the pump module as far as it will go, so that the plug (see figure 3.44) engages. Fix the pump module using locking screws.

3.2.4 Diodes



CAUTION

Electrostatically sensitive devices (ESD)!

Electrostatically sensitive devices can be damaged in the event of incorrect handling. When the mains connection is disconnected as required before the plug-in supply unit is opened, the protective conductor connection is also disconnected.

- *The diode modules may only be replaced after equipotential bonding has been performed!*
 - *The plug-in supply unit must be earthed with suitable measures before working on diodes!*
 - *The external grounding must be performed at a marked PE terminal of the plug-in supply unit and a marked PE terminal in the system area!*
 - *The correct equipotential bonding must be checked using measuring technology!*
 - *The ESD wrist band must then be connected to a PE clamp of the plug-in supply unit!*
 - *The diode modules must not be disconnected beforehand!*
 - *Anyone who works on the diode modules must observe the measures for the protection of electrostatically sensitive devices (ESD)!*
 - *The work area must be made safe!*
 - *Also applies to work on the ESD relay -A9 (see point 3.2.21, page 3-81).*
-



CAUTION

Risk of damage!

When the connecting lines are removed, touching the connecting terminals can lead to the destruction of the diode!

- *Immediately after disconnection, the diode must be short-circuited by a person equipped in accordance with the relevant ESD regulations!*
-
1. Open the cover on the plug-in supply unit.
 2. Remove the cover on the pump module.
 3. Earth the plug-in supply unit.
 4. Put on the grounding strap and securely fasten the terminal of the ground cable to a port in the plug-in supply unit marked with \oplus .

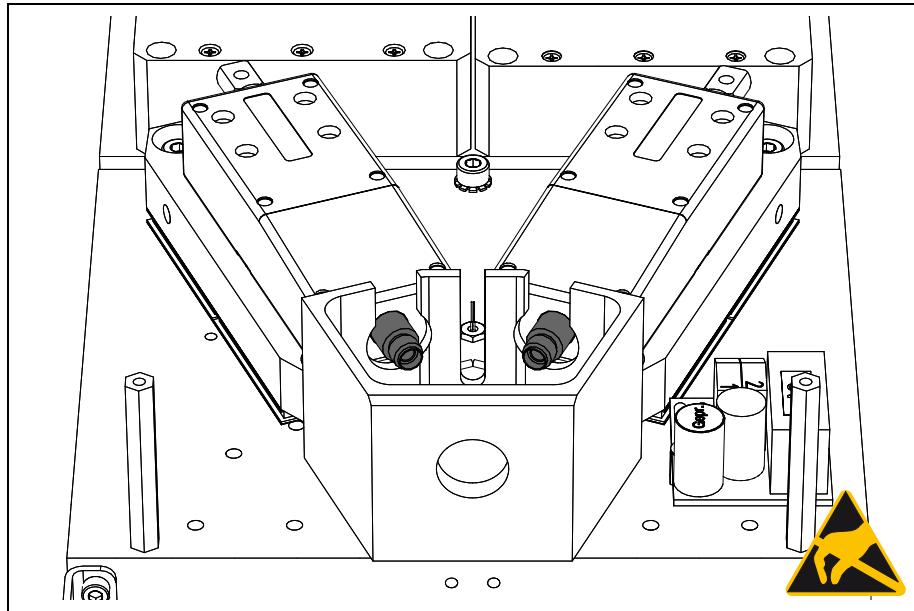


Figure 3.45 Disconnect the glass fiber lines

5. Disconnect the glass fiber line(s) after previously unfastening the crown nuts from the diode.



CAUTION

Risk of damage!

Glass fiber lines can be damaged when inserting tools.

- Do not use tools!



CAUTION

For lasers with two diodes, mark the socket to which the respective glass fiber was connected. In this way, the lines are not mixed up, which can lead to malfunctions. **For lasers with two diodes, the diode modules must always be replaced in pairs.**

6. Attach dust protection caps to the glass fibers and the connections on the diode modules.
7. Provide short-circuit bridges.



CAUTION

Bags with dust protection caps and short-circuit bridges are fastened in the laser system (see page 3-1). Reattach the bags with dust protection caps and short-circuit bridges there when work is completed.

Disassembly and assembly of components

Plug-in supply unit

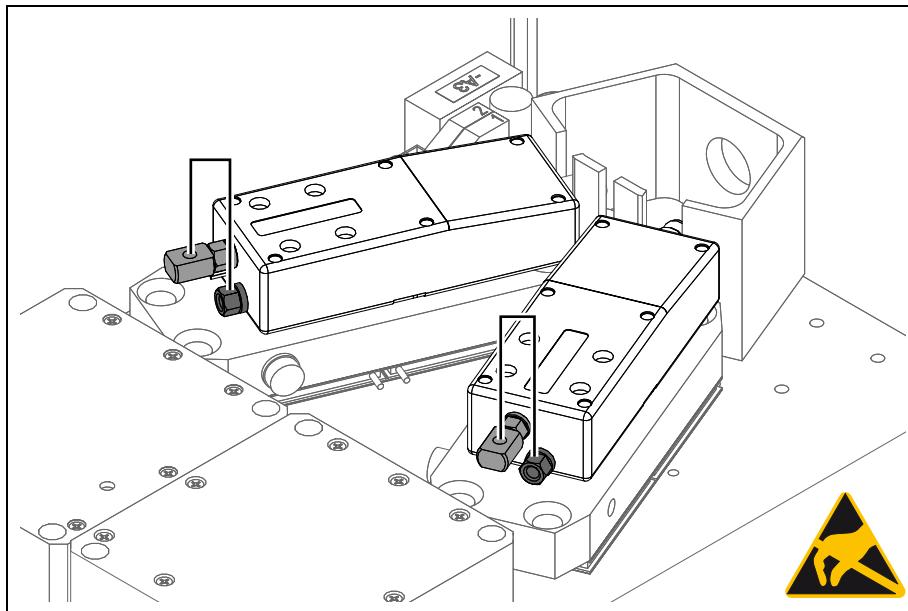


Figure 3.46 Short-circuit diode modules

8. Screw the short-circuit bridges to the housings of the diode modules (maximum tightening torque: **10 Ncm**).
9. Disconnect the diode module and screw the shorting cable to the connecting terminal (maximum torque: **10 Ncm**).

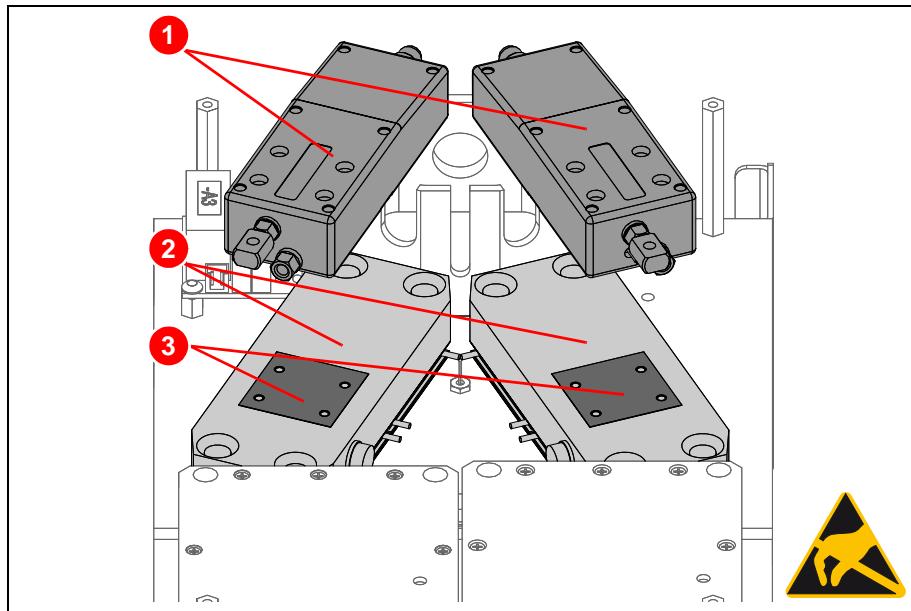


CAUTION

Risk of damage!

For lasers with two diodes, touching the connecting terminals of the second diode without applied equipotential bonding can lead to the destruction of the diode!

- Anyone who works on the diode modules must observe the measures for the protection of electrostatically sensitive devices (ESD)!
- Immediately after disconnection, the diode must be short-circuited by a person equipped in accordance with the relevant ESD regulations!

**Figure 3.47** Removing diode modules

10. Unfasten the fastening bolts on the diode module.
11. Remove diode module(s) (1) ([Figure 3.47](#)).

12. Provide the "Diode module" replacement set.

Contents:

- Diode module
- Threaded inserts (replacement parts)
- Cable binders
- Quick guide



CAUTION

The replacement set will be provided by ROFIN-SINAR depending on your system. Compare the article number of the dismantled module with the new one. Contact ROFIN-SINAR in case of any questions.

Laser type	Replacement kit article number
PL-E AIR 10/25/30	101119309
PL-E AIR 25EM	101130232

13. Clean the cooling surface(s) (2) using lens cleaning paper and isopropyl alcohol.



CAUTION

The electrically insulated heat convectors (3) ([Figure 3.47, page 3-46](#)) are permanently connected to the copper block!



CAUTION

Danger of short circuits!

If the electrically insulated heat convectors are damaged, there is a risk of short circuits!

- Do not damage or remove the heat convectors!

Disassembly and assembly of components

Plug-in supply unit

- The copper block and electrical contact points/surfaces of the diode modules may not be connected.
-
14. Check the condition of the threaded inserts in the copper block!
 15. Clean the cooling surface in the new diode module using lens cleaning paper and isopropyl alcohol.
 16. Before installing the diode module, make sure that it bears the correct part number.
 17. Insert diode module(s) observing the manufacturer's operating instructions.
 18. Gently tighten the fastening screws of the diode screws.



CAUTION

Risk of damage!

Longer screws can damage the cooling surface!

- Always use the fastening screws included in the replacement set!
-

19. Tighten the fastening screws in opposite pairs using a maximum tightening torque of **25 Ncm**.



CAUTION

Risk of damage!

A higher tightening torque leads to a destruction of the threaded inserts in the copper block!

- Observe the maximum tightening torque.
-

20. Remove the short-circuit bridge from the diode connection and connect the diode module (insert minus bridge, maximum tightening torques: **75 Ncm**). Use a lock washer to secure against loosening.



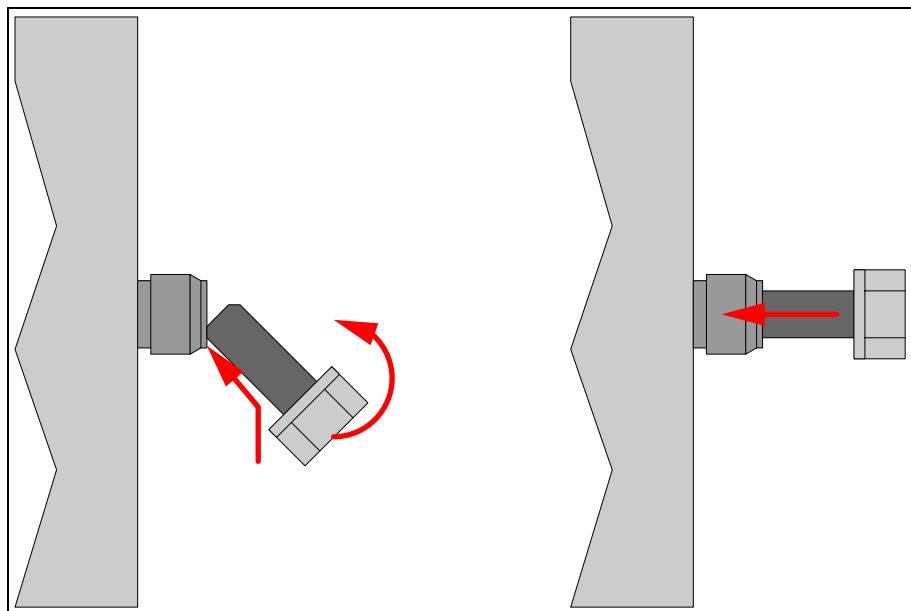
CAUTION

Danger due to transition resistors!

Loose connections result in high contact resistance and can cause damage.

- Due to contact resistance, do not use washers or other materials between the cable lug and the cooling plate/connection.
-

21. Unscrew the short-circuit bridges from the housings of the diode modules.
22. Check both diode modules to make sure the connections are short-circuit-free and not connected to the copper block.

**Figure 3.48** Connecting the glass fiber lines

23. Remove the dust protection caps from the diode modules and glass fiber lines and connect the glass fibers (observe the manufacturer's operating instructions).
 - Carefully remove the protective caps from the end of the fiber and from the fiber socket.
 - Carefully insert the fiber into the fiber socket.
 - Place the fiber plug vertically on the fiber socket and then plug it into the socket ([see figure 3.48](#)).
 - Turn the crown nut of the fiber plug onto the fiber socket.
 - Carefully tighten the crown nut with a fork wrench (maximum tightening torque: **90 Ncm**).



CAUTION

Risk of damage!

If the fiber plug is tightened too much, there is a risk of the diode laser module being damaged!

- The use of a torque tool is explicitly recommended.



CAUTION

For lasers with two diodes, pay attention to the correct connection of the respective glass fibers. Reattach the bag with dust protection caps and short-circuit bridges back in the pump module when work is completed.

24. Secure the shutter against activation.
25. Insert the mains plug of the laser system and switch on the main switch.
26. Commission the laser system for about ten minutes at maximum current.
27. Check the temperature at the coupling points between the diode modules and glass fibers (max. 60 °C).



CAUTION

If the maximum temperature is exceeded, the connection of the glass fibers should be checked. Where necessary, replace the diode module or the glass fibers again.

Disassembly and assembly of components

Plug-in supply unit

28. Check for the correct diode current. Compare it with the programmed current (max. deviation of **±0.5 A**).
29. Fit the covers on the pump module and the plug-in supply unit.
30. Push back the plug-in supply unit and attach it.
31. Check/measure the laser power on the workpiece (see point 4.6.3, page 4-23). Perform trouble-shooting if necessary.
32. Enter the operating hours of the laser system and the time of the diode change in the log-book.
33. Set the laser power using the current limiter (LaserConsole).
34. Commission the laser system.

3.2.5 Glass fiber lines

⚠ CAUTION

Risk of contamination!

Functional faults possible due to contaminated fiber ends.

- When working with open fiber ends, ensure utmost cleanliness.

i CAUTION

An inspection device for the fiber end surfaces is available from ROFIN-SINAR.

i CAUTION

Before replacing glass fiber lines, measure/check the laser power behind the protective glass of the galvo head using the power meter (see point 4.6, page 4-16). Enter the measured value in the logbook.

1. Open the cover on the plug-in supply unit.
2. Remove the cover on the pump module.

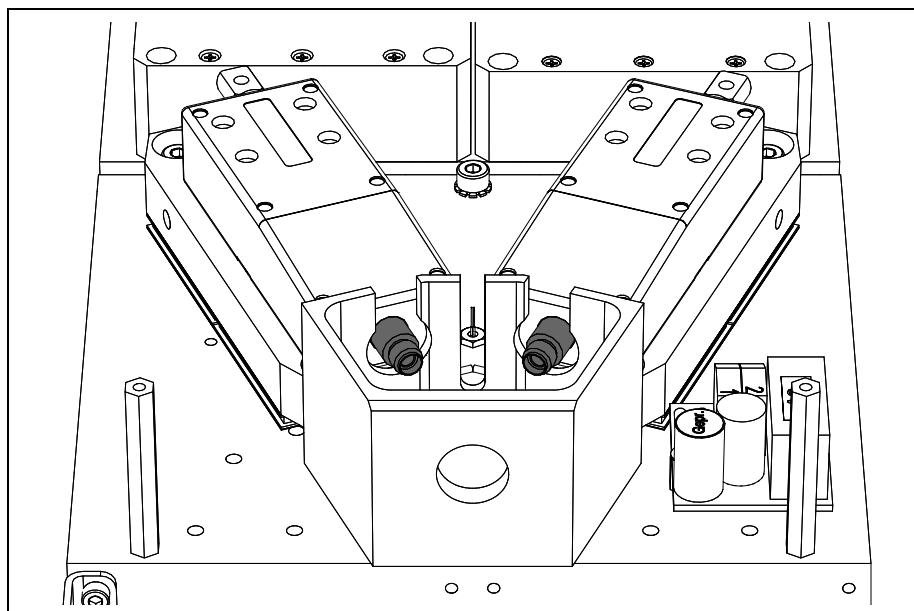


Figure 3.49 Disconnect the glass fiber lines from the diode modules

3. Disconnect the glass fiber line(s) after previously unfastening the crown nuts from the diode.

⚠ CAUTION

Risk of damage!

Glass fiber lines can be damaged when inserting tools.

- Do not use tools!

4. Attach dust protection caps to the glass fibers and the connections on the diode modules.



CAUTION

Bags with dust protection caps are fastened in the laser system (see page 3-1). The bags with dust protection caps should be fastened back again once work has been completed.



CAUTION

Identify the terminal that each was connected to which glass fiber. In this way, the lines are not mixed up, which can lead to malfunctions.

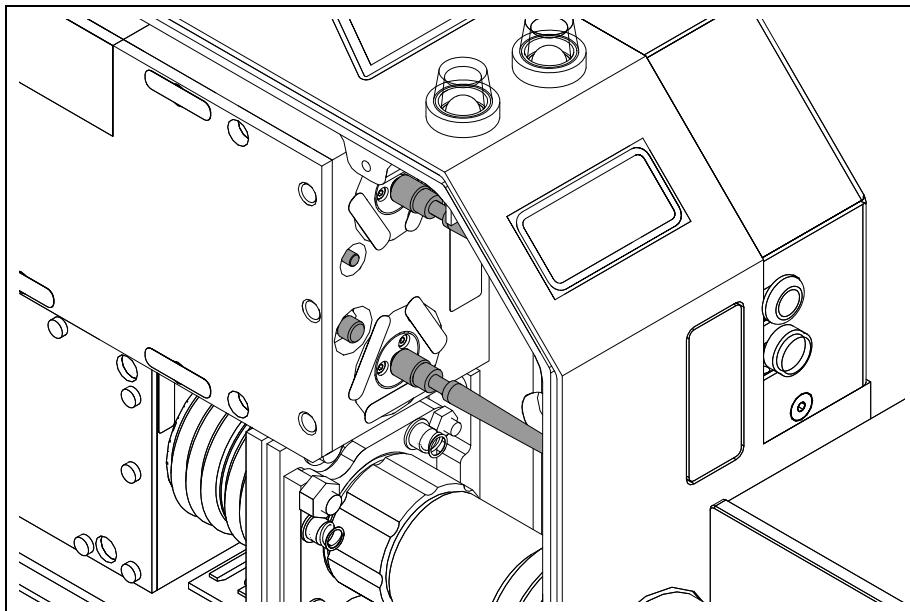


Figure 3.50 Glass fiber lines on the resonator module

5. Open both side covers on the laser head.
6. Slowly loosen the washer and then remove the glass fiber line.



CAUTION

Risk of damage!

Glass fiber lines can be damaged when inserting tools.

- *Do not use tools!*



CAUTION

Identify the terminal that each was connected to which glass fiber. In this way, the lines are not mixed up, which can lead to malfunctions.

Both glass fiber lines should be removed if necessary since the lines are laid in common holding clamps.

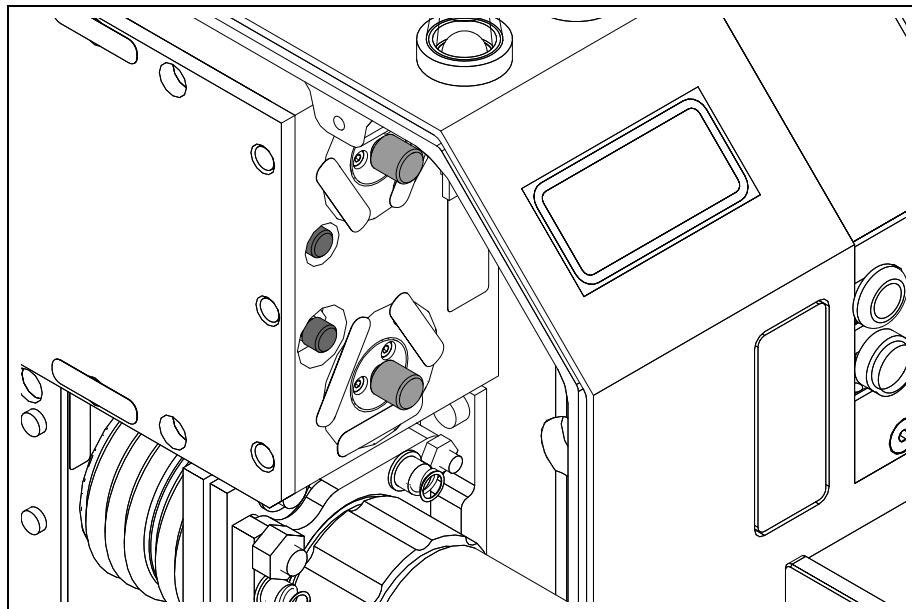


Figure 3.51 Dust protection caps on the resonator module

7. Attach dust protection caps to the glass fibers and the connections on the resonator module.



CAUTION

Bags with dust protection caps are fastened in the laser system (see page 3-1). The bags with dust protection caps should be fastened back again once work has been completed.



CAUTION

Pay particular attention to the correct fitting of the dust protection caps of the glass fibers on the resonator side so that it is not removed when the threading wire is pulled.

8. If fitted, pull the fiber anchor from the mounts above the resonator module, open it and take out the fibers.
9. Pull back the glass fiber lines from the fan side of the laser head to the resonator side.
10. Remove the glass fiber lines from the holding clamps and roll them up.



CAUTION

Risk of damage to the glass fiber lines!

Glass fiber lines may be damaged in the event of improper handling.

- Do not bend glass fiber lines, roll them up without twisting and do not subject the fibers to shocks or tensile stresses.
- Do not get glass fibers dirty (prevent contact with dust and do not let them get on the floor)!

11. Bind the threading wire to the dust protection cap on the resonator side.



CAUTION

For glass fiber lines with separate type plates, they should be fixed using adhesive tape to prevent slippage.

Disassembly and assembly of components

Plug-in supply unit

12. Lay the corrugated tube between the laser head and plug-in supply unit straight.
13. Carefully pull the glass fiber toward the plug-in unit and roll up the glass fiber.



CAUTION

Do not use force! Pull the threading wire through fully!

14. Remove the new glass fiber from the sealed transport bag.
15. Remove the threading wire from the removed glass fiber line.



CAUTION

The threading wire absolutely must be left in the metal tube!

16. Bind the threading wire to the new glass fiber line.
17. Carefully pull the glass fiber toward the laser head using the threading wire and roll up the glass fiber.



CAUTION

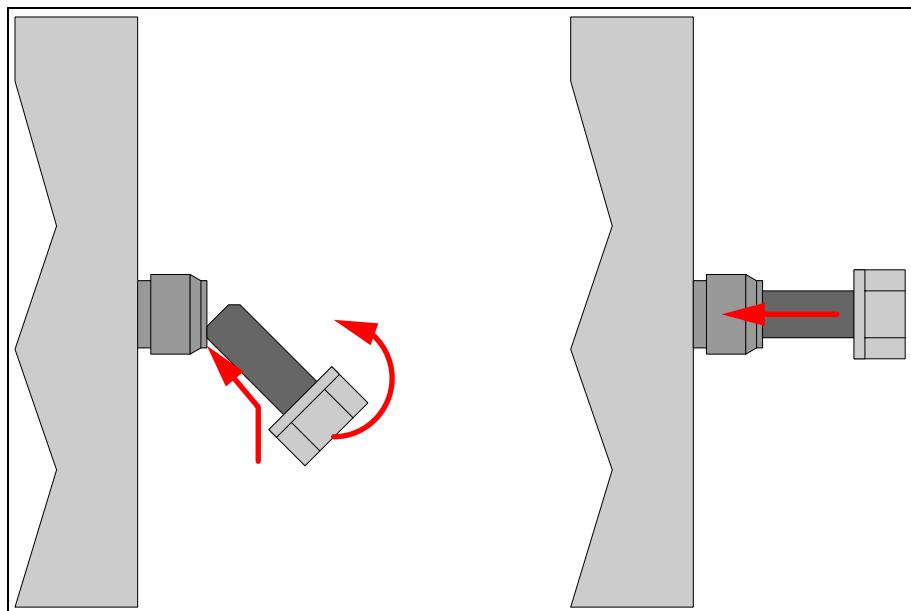
Do not use force! Pull the glass fiber line through fully!

18. Remove the dust protection cap from the diode connection of the glass fiber.
 - Keep the fiber end pointing downward.
 - Remove the cap by turning it downward slowly to prevent underpressure (particles can deposit on the glass fiber).



CAUTION

Prevent soiling of the dust protection caps.

**Figure 3.52** Connecting the glass fiber lines

19. Remove the dust protection caps from the diode modules and glass fiber lines and connect the glass fibers (observe the manufacturer's operating instructions).
 - Carefully remove the protective caps from the end of the fiber and from the fiber socket.
 - Carefully insert the fiber into the fiber socket.
 - Place the fiber plug vertically on the fiber socket and then plug it into the socket ([see figure 3.52](#)).
 - Turn the crown nut of the fiber plug onto the fiber socket.
 - Carefully tighten the crown nut with a fork wrench (maximum tightening torque: **90 Ncm**).



CAUTION

Risk of damage!

If the fiber plug is tightened too much, there is a risk of the diode laser module being damaged!

- The use of a torque tool is explicitly recommended.

20. Where necessary, replace and connect the second glass fiber using a threading wire.
21. Insert glass fibers into the holding clamp of the laser head.



CAUTION

Risk of damage!

Glass fiber lines may be damaged in the event of improper handling.

- Do not bend the glass fiber when inserting it and do not lay radii that are too small (**minimum bending radius 80 mm**).



CAUTION

The line length of the glass fiber determined by technical reasons. A corresponding number of coils should be laid within the laser head.



CAUTION

Lay the glass fiber line flatly in the holding clamps. At tight places, open the holding clamps using a suitable screw driver.



CAUTION

Risk of damage!

Glass fiber lines may be damaged in the event of improper handling.

- *Do not damage the glass fiber line with the screwdriver!*
-

22. Insert second glass fiber if necessary.



CAUTION

Risk of damage!

Glass fiber lines may be damaged in the event of improper handling.

- *Do not damage the fibers when inserting them into the anchor!*
 - *Do not subject the fibers to any kind of tensile force or twisting!*
-

23. If installed, insert the fibers into the fiber anchor, close the anchor and plug it into the mounts above the resonator module.
24. Remove the dust caps from the end of the fiber and the resonator module and insert the fiber into the socket on the resonator module.



CAUTION

Take care that the guide on the fiber is inserted cleanly into the slot in the socket.

25. Tighten the swivel nut by hand.



CAUTION

Risk of damage!

Glass fiber lines can be damaged when inserting tools.

- *Do not use tools!*
-



CAUTION

For lasers with two diodes, pay attention to the correct connection of the respective glass fibers. Reattach the bag with dust protection caps and short-circuit bridges back in the laser system when work is completed (see page 3-1).

26. Secure the shutter against activation.
27. Insert the mains plug of the laser system and switch on the main switch.
28. Commission the laser system for about ten minutes at maximum current.
29. Check the temperature at the coupling points between the diode modules and glass fibers (**max. 60 °C**).



CAUTION

If the maximum temperature is exceeded, the connection of the glass fibers should be checked. Where necessary, replace the diode module or the glass fibers again.

30. Check for the correct diode current. Compare it with the programmed current (max. deviation of **±0.5 A**).
31. Fit the covers on the pump module and the plug-in supply unit.
32. Push back the plug-in supply unit and attach it.
33. Check/measure the laser power on the workpiece ([see point 4.6.3, page 4-23](#)). Perform trouble-shooting if necessary.
34. Enter the operating hours of the laser system and the time of the diode change in the logbook.
35. Set the laser power using the current limiter (LaserConsole).
36. Commission the laser system.
37. Send the removed glass fiber to ROFIN-SINAR for repair.



CAUTION

After having changed the glass fiber lines, perform a comparative measurement of the laser power with the same laser parameters as before the change at the same measuring point. A power increase should be detectable.

With a new diode module, functioning glass fibers, a functioning resonator module, and perfect optical components, the following power values should be reached according to the "Laser type - Power" table on [Page 4-21](#). Enter the measured values in the logbook.



CAUTION

If no power increase is determined, the power of the laser diodes should be measured at the end of the fiber ([see point 4.6.9, page 4-33](#)).

Disassembly and assembly of components

Plug-in supply unit

3.2.6 HF generators

1. Open the cover on the plug-in supply unit.
2. Remove the cover on the pump module.

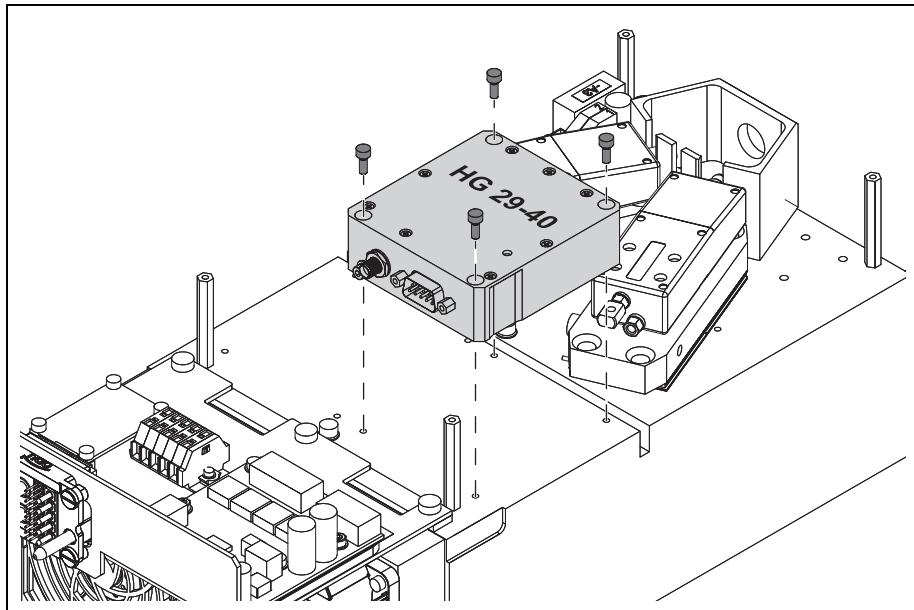


Figure 3.53 HF generator PL-E Air 10/25

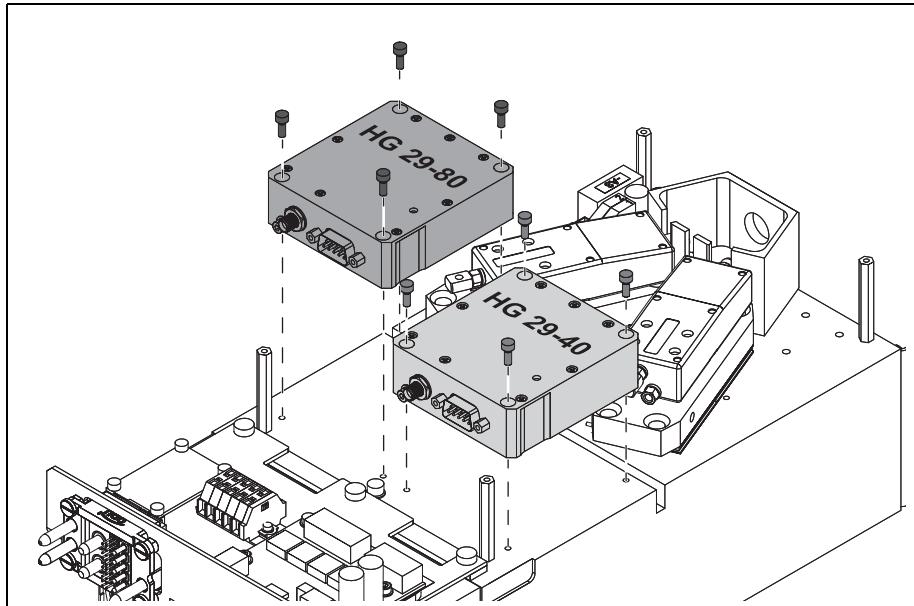


Figure 3.54 HF generators PL-E Air EM

3. Disconnect connecting plug -X12 and HF line -X13.
4. Remove the four fastening screws and remove the HF generator.
5. Clean the cooling surface and bottom of the new HF generator with isopropanol.



CAUTION

Functional faults possible!

For laser systems with an external modulator, two different HF generators are installed.

- Do not confuse the HF generators under any circumstances.
-

6. Secure the HF generator using four fastening screws.
7. Connect the HF line -X13.
8. Insert the measuring adapter into -X12 of the HF generator.
9. Plug connecting plug -X12 into the measuring adapter.
10. Connect the voltmeter to Pin 1 (-) and Pin 5 (+) of the measuring adapter.
11. Set the operating voltage (24 V DC, ±1.0 V).



CAUTION

Functional faults possible!

A voltage lower than 24 V results in reduced power of the HF generator(s).

- Set voltage as necessary on power supply unit -G2.
-

12. Stop the system:
 - Shut down the RCU/PC.
 - Set the key switch to "Off",
 - Turn off the main switch.
13. Remove the measuring unit.
14. Remove the measuring adapter.
15. Insert the connecting plug -X12.
16. Start the system:
 - Turn on the main switch.
 - Start up the PC/RCU,
 - Set the key switch to "On",
17. Set the HF power (see point 4.11, page 4-40).
18. Stop the system:
 - Shut down the RCU/PC.
 - Set the key switch to "Off",
 - Turn off the main switch.
19. Fit the covers on the pump module and the plug-in supply unit.
20. Enter the operating hours of the laser system and the time of the change in the logbook.
21. Commission the laser system.
22. Perform a function check of the laser system (test marking, test processing).

Disassembly and assembly of components

Plug-in supply unit

3.2.7 ALI-USB

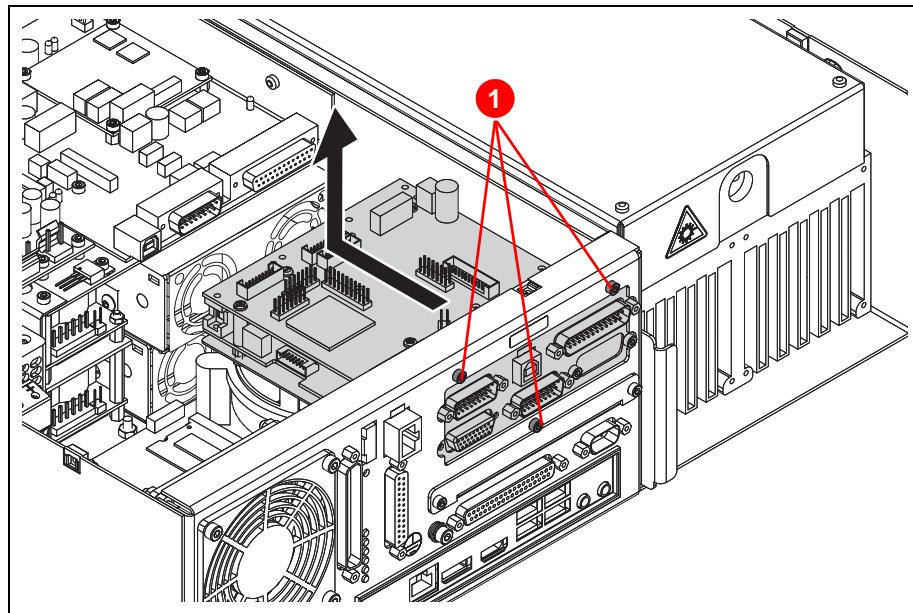


Figure 3.55 ALI-USB

1. Open the cover on the plug-in supply unit.
2. Unscrew the three fastening screws (1) (Figure 3.55) on the ALI-USB.
3. Remove the ALI-USB from the plug-in supply unit.
4. Disconnect the plug-in connectors.
5. Replace ALI-USB.
6. Plug in the plug connections according to the valid circuit diagram.
7. Perform the mounting procedure in the reverse order.
8. Flash and set ALI-USB (see point 4.16, page 4-51).
9. Perform the functional tests.
10. Close the cover of the plug-in supply unit.

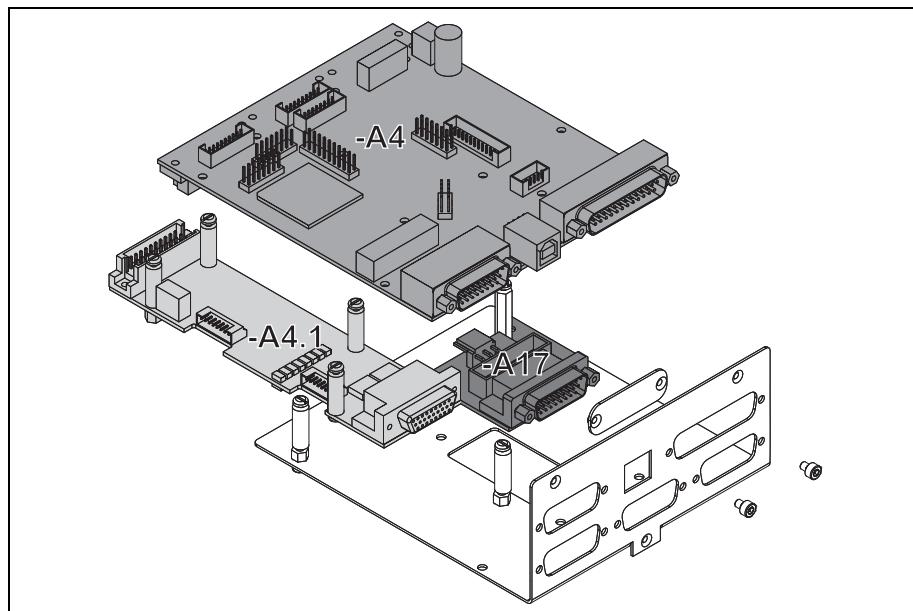


Figure 3.56 ALI-USB

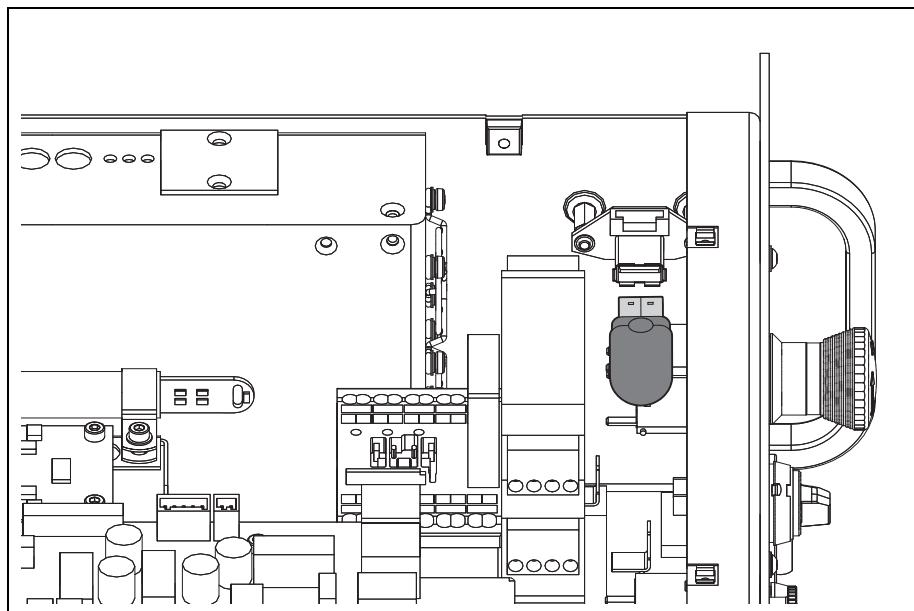


Figure 3.57 USB dongle for VLM software



CAUTION

A USB dongle for the VLM software is located on the right side of the plug-in PC unit (see figure 3.57). This does not have to be removed to replace the ALI-USB! The USB dongle must not be confused with a USB memory stick!

Disassembly and assembly of components

Plug-in supply unit

3.2.8 SSC

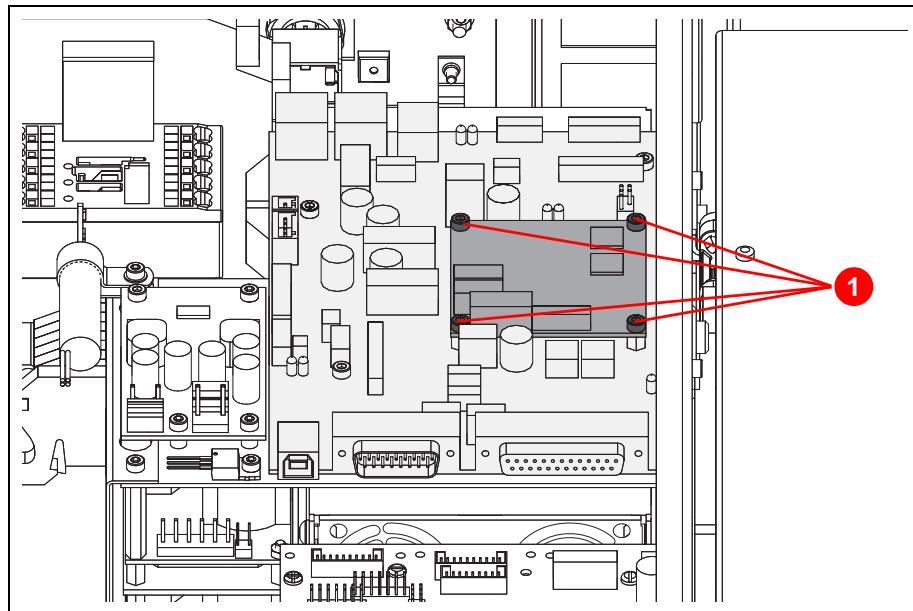


Figure 3.58 SSC

1. Open the cover on the plug-in supply unit.
2. Unscrew the fastening screws of the SSC module (1) ([Figure 3.58](#)).
3. Disconnect the SSC module from the LSC.



CAUTION

Take particular care when disconnecting and connecting the SSC module to avoid bending the connections.

4. Replace the SSC module.
5. Plug the SSC module onto the LSC and screw fasten.
6. Perform the functional tests.
7. Close the cover of the plug-in supply unit.

3.2.9 LSC

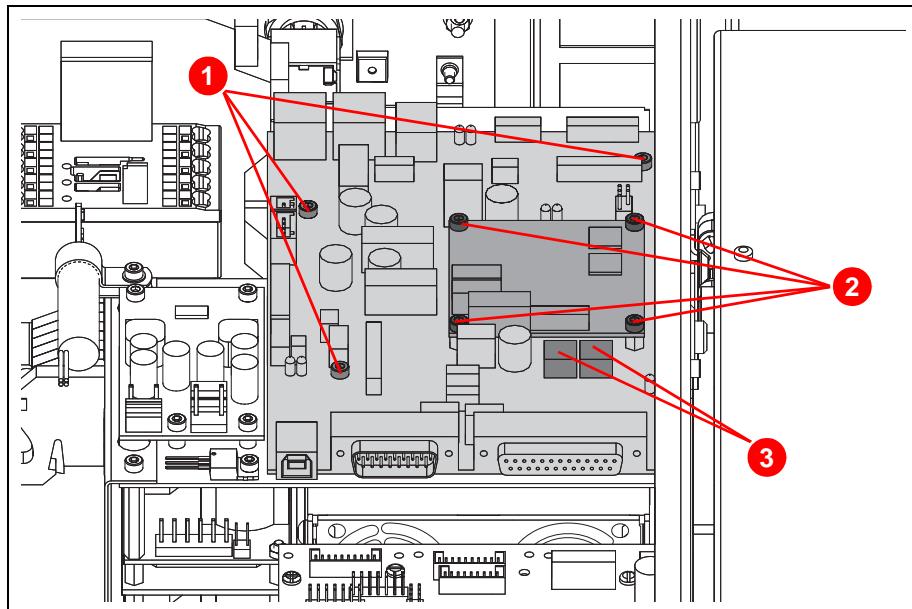


Figure 3.59 LSC



CAUTION

If the PC (ITX-Board) still starts, export the software version of the currently installed boards.

1. Open the cover on the plug-in supply unit.
2. Unscrew the fastening screws (1) ([Figure 3.59](#)) of the LSC.
3. Open the cable ties.
4. Remove the LSC from the plug-in supply unit.
5. Disconnect the plug-in connectors.
6. Unscrew the fastening screws of the SSC module (2).
7. Disconnect the SSC module from the LSC.



CAUTION

Take particular care when disconnecting and connecting the SSC module to avoid bending the connections.

8. Replace the LSC and/or SSC module.
9. Plug the SSC module onto the LSC and screw fasten.
10. Unscrew the fastening screws of the LSC module.
11. Plug in the plug connections according to the valid circuit diagram.
12. Check and set switch positions SW800 and SW801 (3) (see valid circuit diagram for the relevant laser type).
13. Perform the mounting procedure in the reverse order.



CAUTION

The new LSC is supplied ready-flashed. After installation, use the LaserConsole, "Laser Display" module, to check that the hardware and software version of the new LSC is the same or higher than the removed LSC.

If the new card has a lower version, contact ROFIN.

14. Perform the functional tests.
15. Close the cover of the plug-in supply unit.

3.2.10 ITX board

1. Open the cover on the plug-in supply unit.

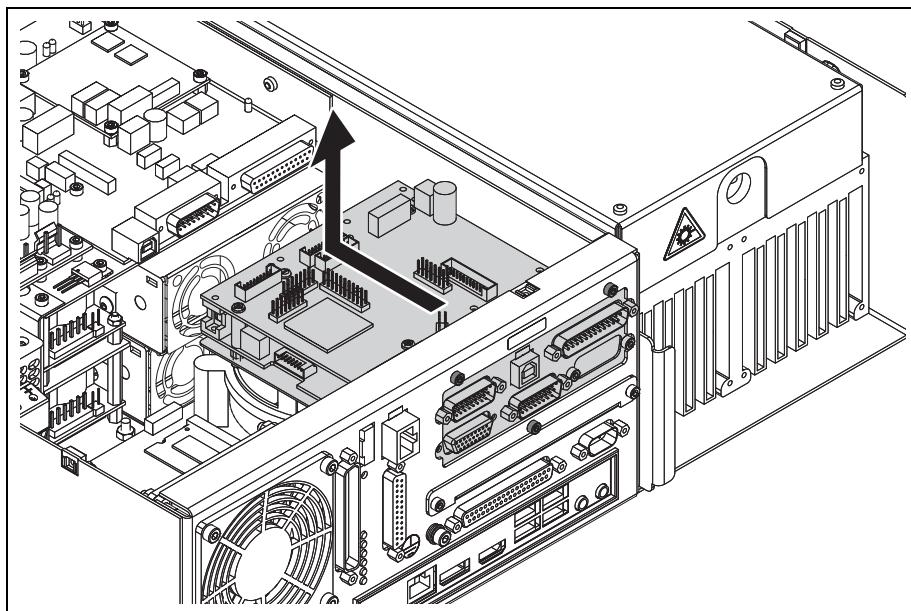


Figure 3.60 Remove ALI-USB

2. Remove ALI-USB ([see point 3.2.7, page 3-59](#)),

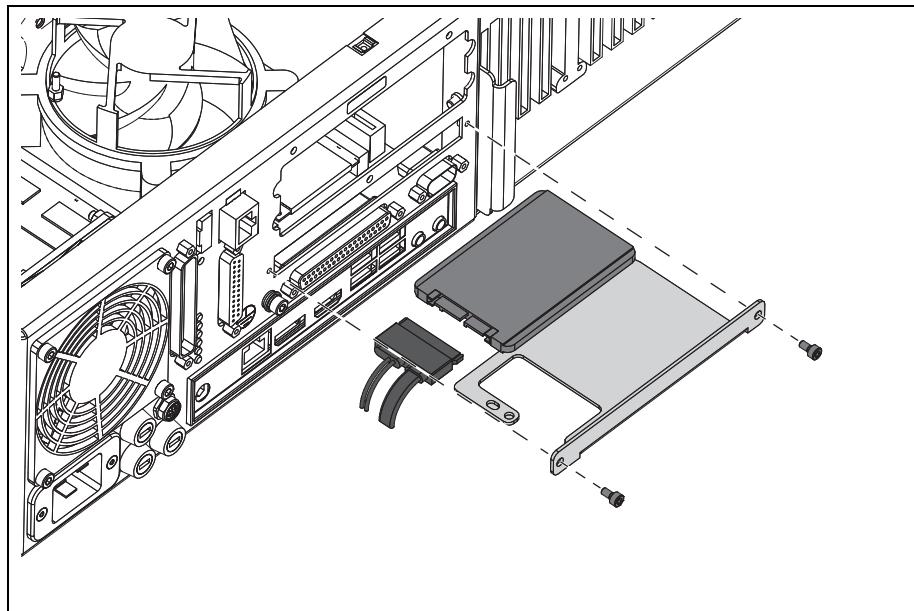


Figure 3.61 Remove the hard disk

3. Remove the hard disk and disconnect.

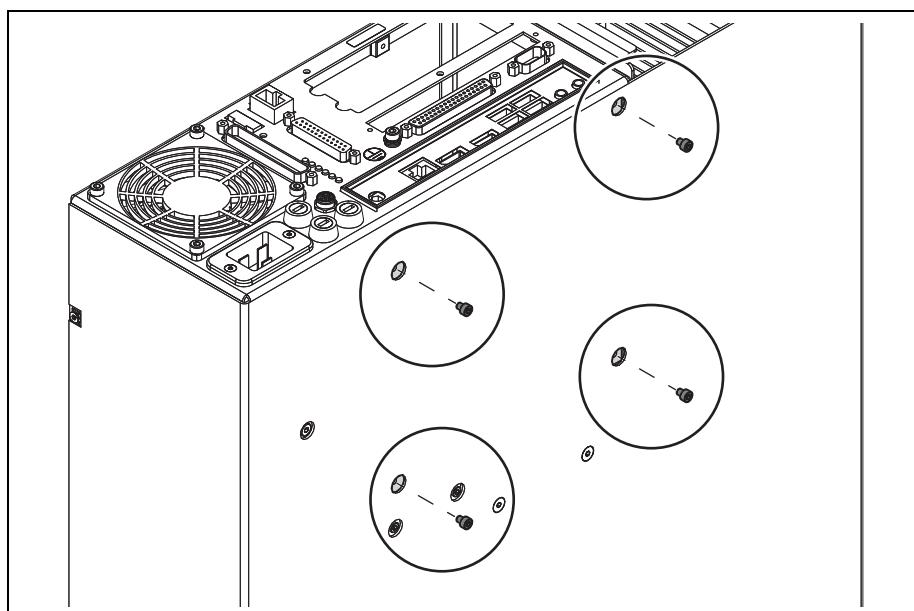


Figure 3.62 Unscrew the ITX board

4. Disconnect the ITX board.
5. Unfasten the fastening screws on the ITX board on the underside of the plug-in supply unit.



CAUTION

Risk of damage!

Any components falling out could become damaged.

- When unfastening the fastening screws, ensure that the component does not fall out of the plug-in supply unit.

Disassembly and assembly of components

Plug-in supply unit

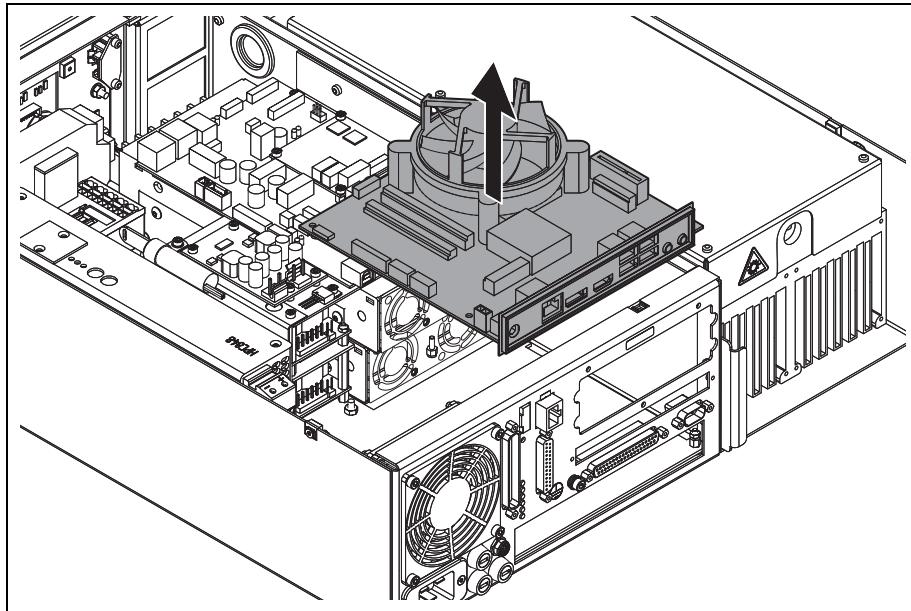


Figure 3.63 Remove the ITX board

6. Remove the ITX board from the plug-in supply unit.



CAUTION

Risk of damage!

Components of the ITX board could become damaged due to incorrect handling.

- Remove and install the components in accordance with the instructions included with the ITX board.

7. Remove the storage module and mSATA hard disk from the ITX board and fit onto the new ITX board.



CAUTION

ITX boards are supplied by Rofin without these components.

8. Fit the ITX board in the plug-in supply unit and connect in accordance with the valid system circuit diagram.
9. Install and disconnect the hard disk.
10. Install the ALI-USB.
11. Close the plug-in supply unit and install.
12. Make the BIOS settings in accordance with the valid ROFIN procedural instructions for installing a Windows image.

3.2.11 HPC 848/845 power supply unit

1. Open the cover on the plug-in supply unit.

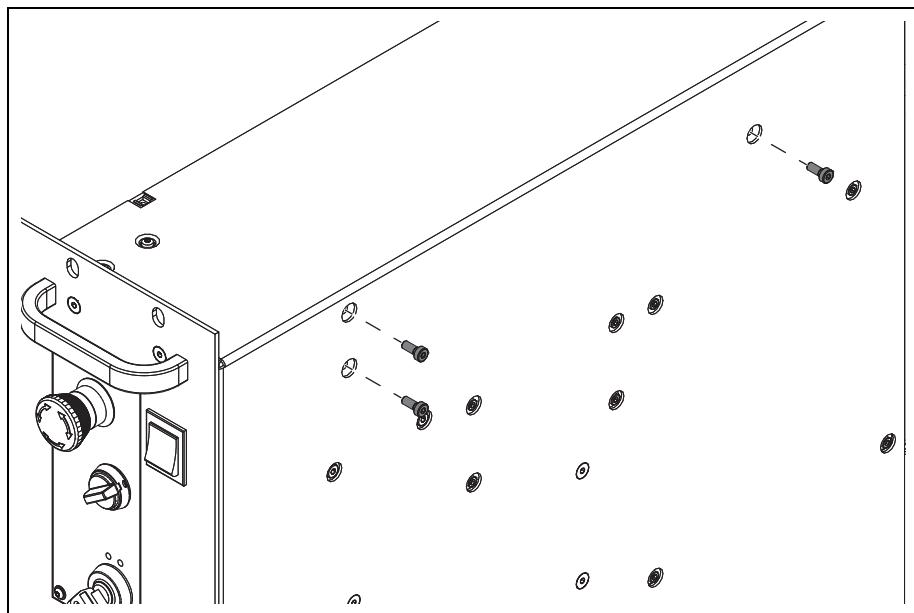


Figure 3.64 HPC 848/845 – 1 power supply unit

2. Disconnect the power supply unit.
3. Unfasten the fastening screws on the power supply unit on the underside of the plug-in supply unit.



CAUTION

Risk of damage!

Any components falling out could become damaged.

- *When unfastening the fastening screws, ensure that the component does not fall out of the plug-in supply unit.*

Disassembly and assembly of components

Plug-in supply unit

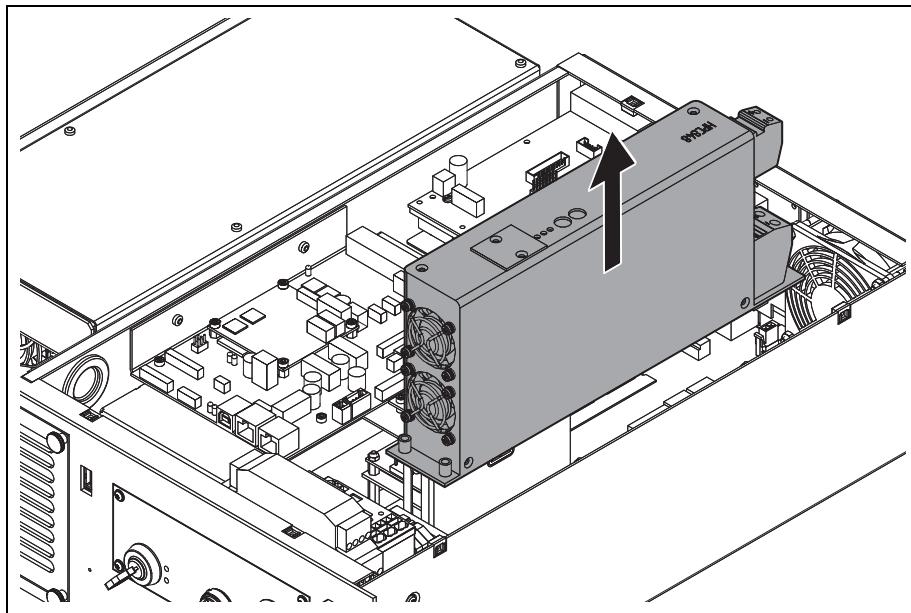


Figure 3.65 HPC 848/845 – 2 power supply unit

4. Remove the power supply unit from the plug-in supply unit.

3.2.12 Power supply units -G1 and -G2

1. Open the cover on the plug-in supply unit.
2. Remove the pump module.

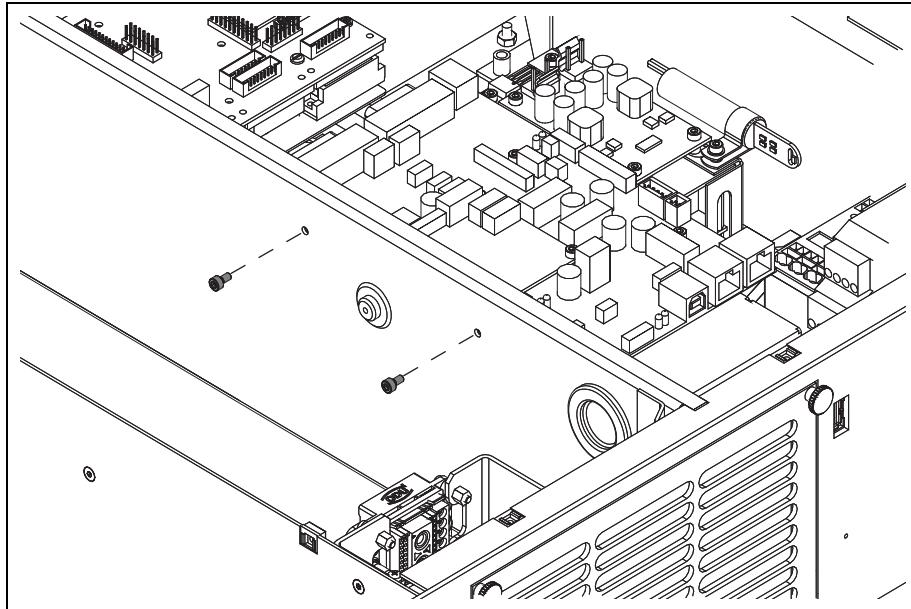


Figure 3.66 Power supply units -G1 and -G2 – 1

3. Disconnect the LSC.
4. Unscrew the fastening screws from the LSC ([see figure 3.66](#)).

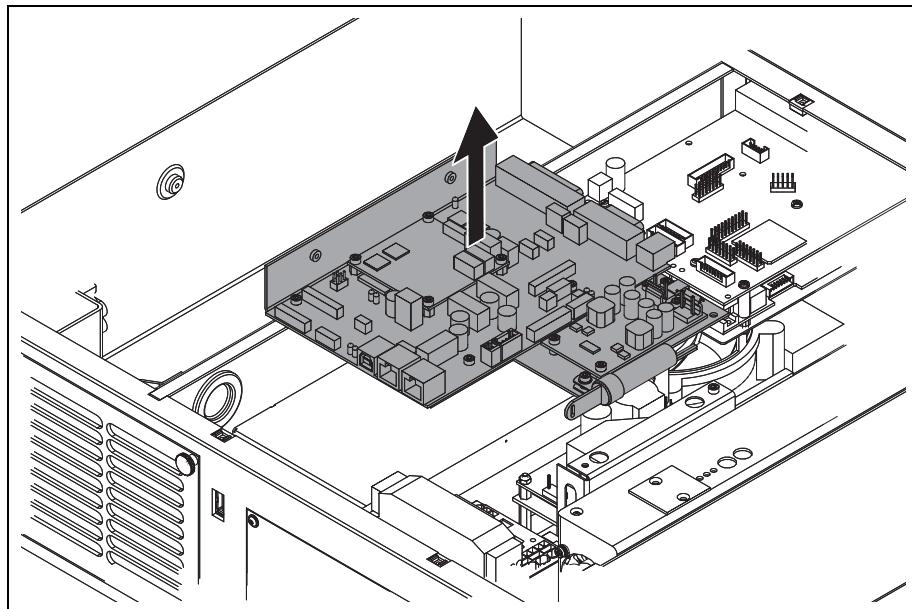


Figure 3.67 Power supply units -G1 and -G2 – 2

5. Remove the LSC from the plug-in supply unit.

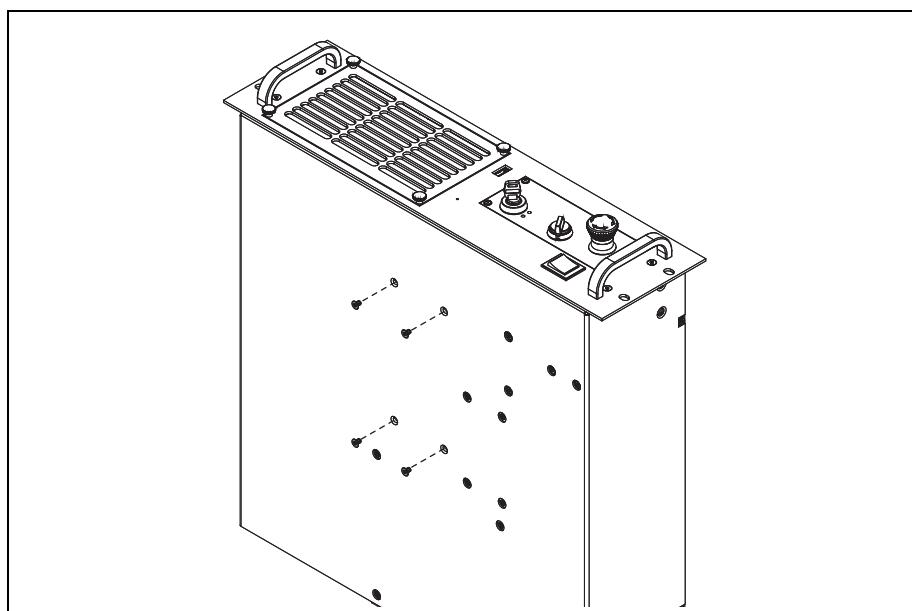


Figure 3.68 Power supply units -G1 and -G2 – 3

6. Unfasten the fastening screws on the power supply units on the underside of the plug-in supply unit.



CAUTION

Risk of damage!

Any components falling out could become damaged.

- When unfastening the fastening screws, ensure that the component does not fall out of the plug-in supply unit.

Disassembly and assembly of components

Plug-in supply unit

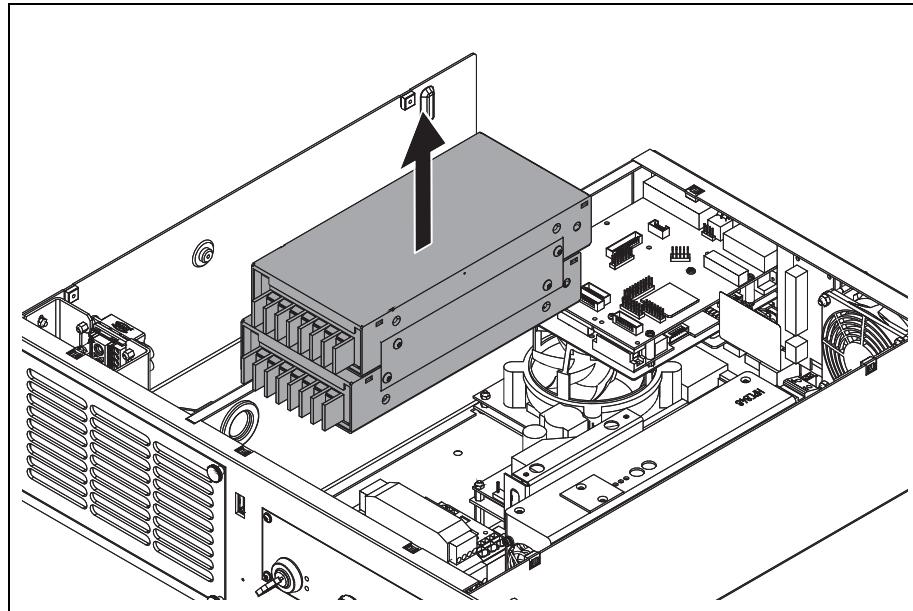


Figure 3.69 Power supply units -G1 and -G2 – 4

7. Remove the power supply units from the plug-in supply unit.

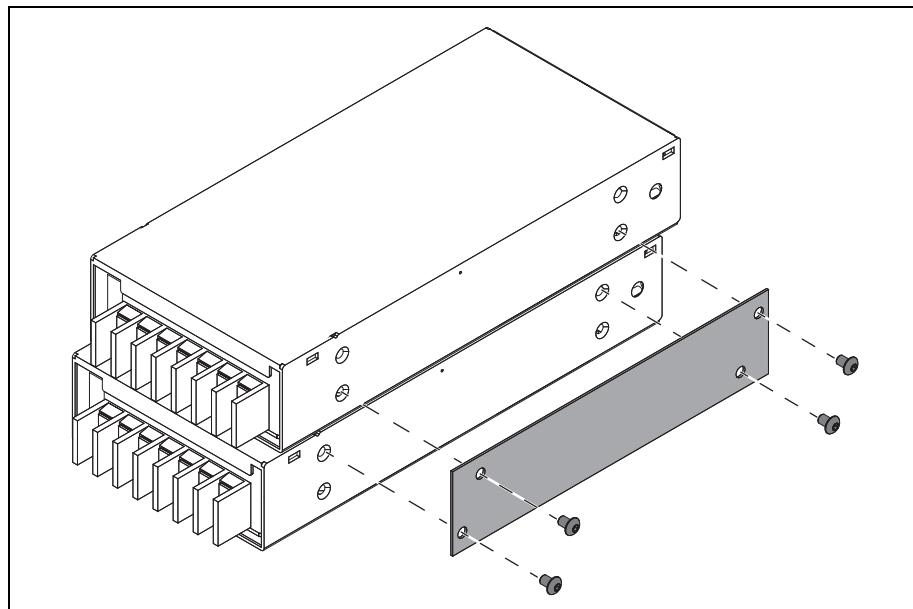


Figure 3.70 Power supply units -G1 and -G2 – 5

8. Dismantle the connecting plate on the power supply units.

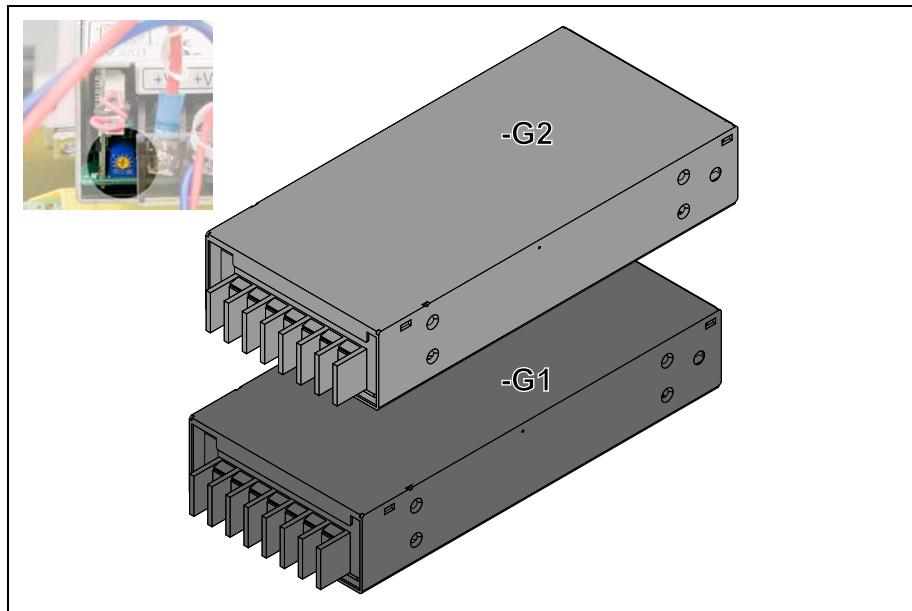


Figure 3.71 Power supply units -G1 and -G2 – 6

9. Replace the power supply units.
10. Connect new power supply units and set 24 Volts (± 0.1 V) on the potentiometer.



CAUTION

For good access to the potentiometer for setting work, open the filter mat cover on the plug-in unit.

Disassembly and assembly of components

Plug-in supply unit

3.2.13 Power supplies -G3 and -G4

1. Open the cover on the plug-in supply unit.
2. Remove the pump module.

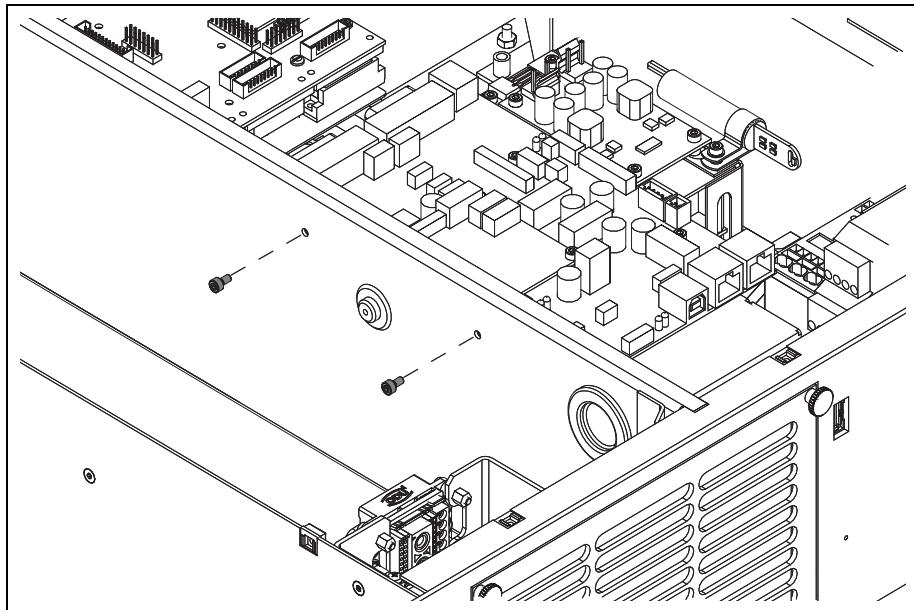


Figure 3.72 Power supplies -G3 and -G4 – 1

3. Disconnect the LSC.
4. Unscrew the fastening screws from the LSC (see figure 3.72).

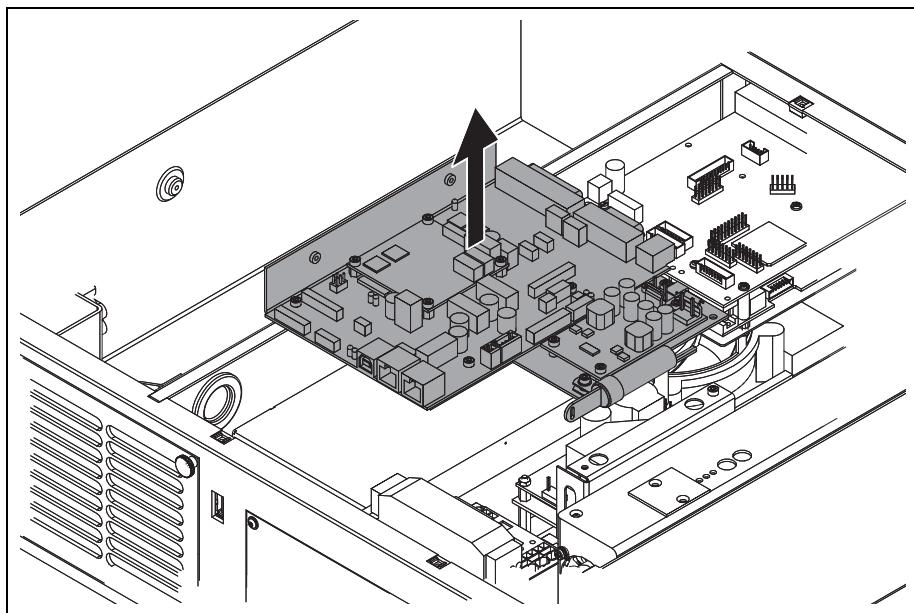


Figure 3.73 Power supplies -G3 and -G4 – 2

5. Remove the LSC from the plug-in supply unit.

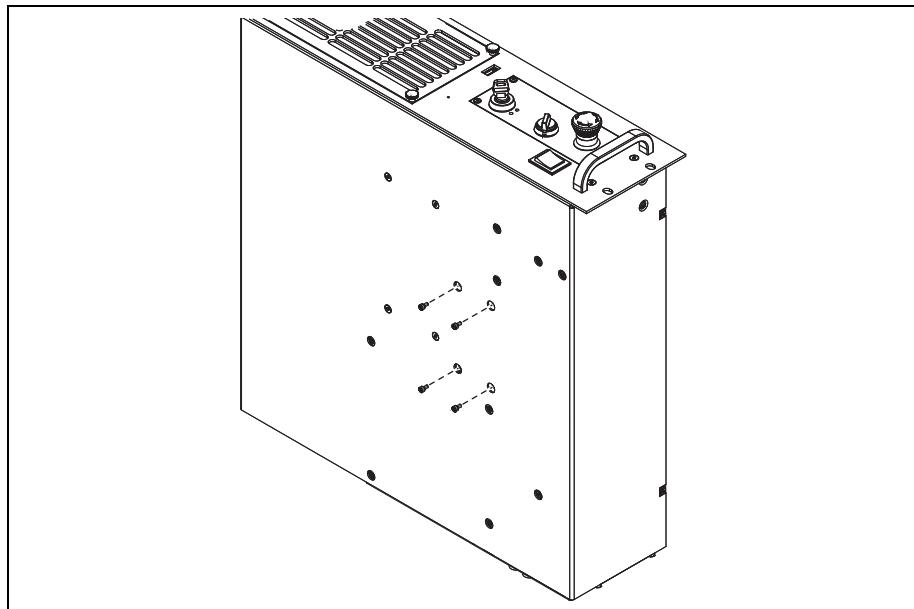


Figure 3.74 Power supplies -G3 and -G4 – 3

6. Unfasten the fastening screws on the power supply units on the underside of the plug-in supply unit.



CAUTION

Risk of damage!

Any components falling out could become damaged.

- *When unfastening the fastening screws, ensure that the component does not fall out of the plug-in supply unit.*

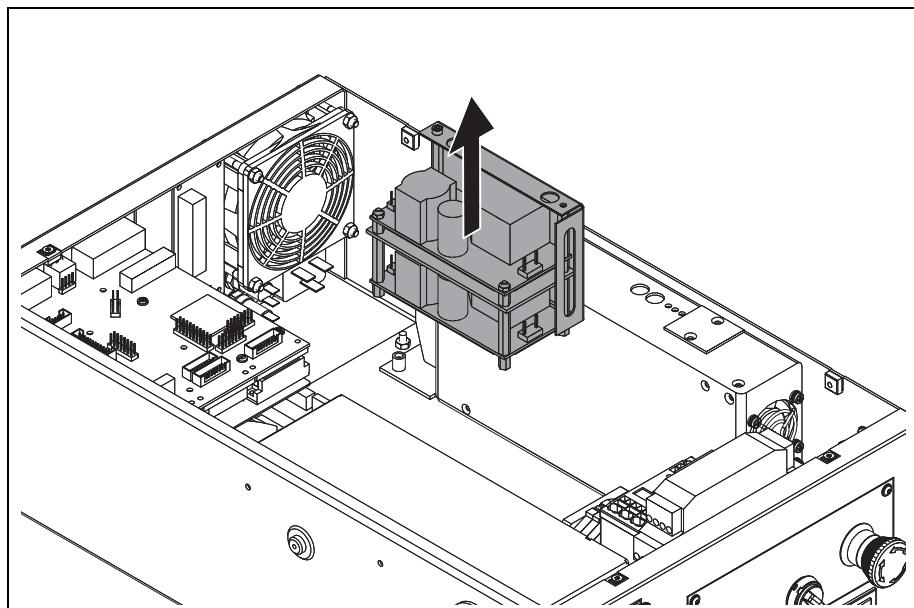


Figure 3.75 Power supplies -G3 and -G4 – 4

7. Remove the power supply units from the plug-in supply unit.

Disassembly and assembly of components

Plug-in supply unit

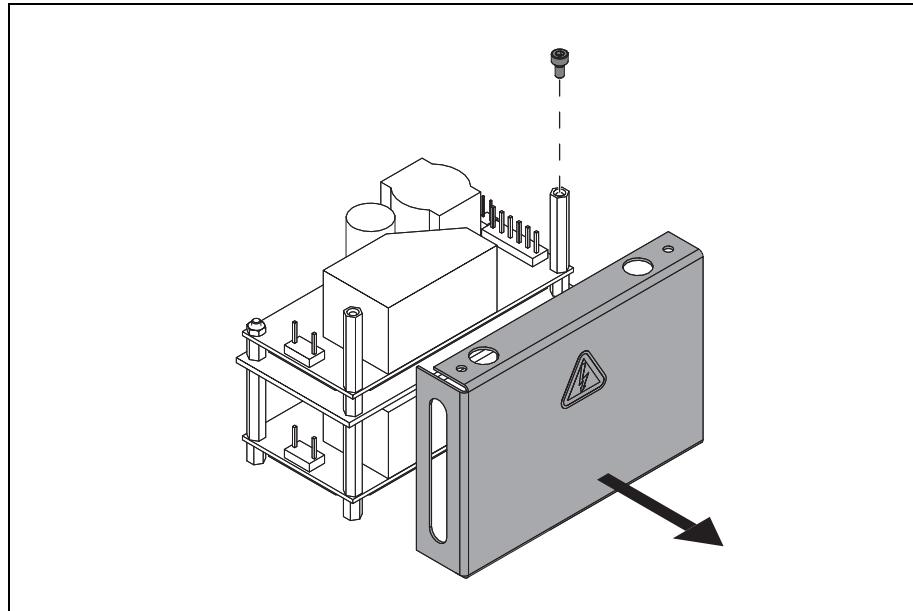


Figure 3.76 Power supplies -G3 and -G4 – 5

8. Remove the protective cover.

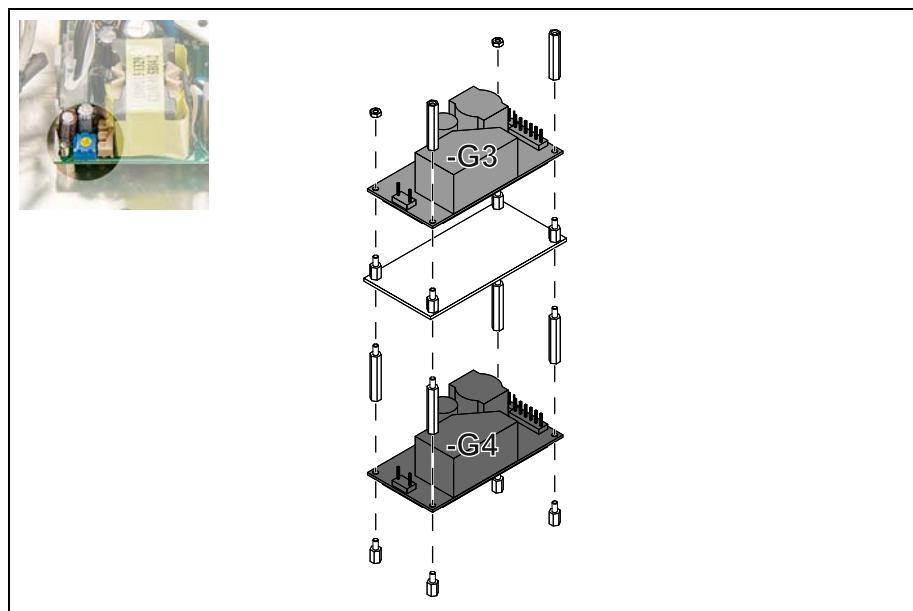


Figure 3.77 Power supplies -G3 and -G4 – 6

9. Replace the power supply units.
10. Connect new power supply units and set 15.5 Volts (+0.2 V/-0 V) on the potentiometer.
11. Check the voltage on the galvo head. 15.5 Volt (± 0.2 V)

3.2.14 Fan supply plug-in unit

1. Open the cover on the plug-in supply unit.
2. Disconnect the fan.

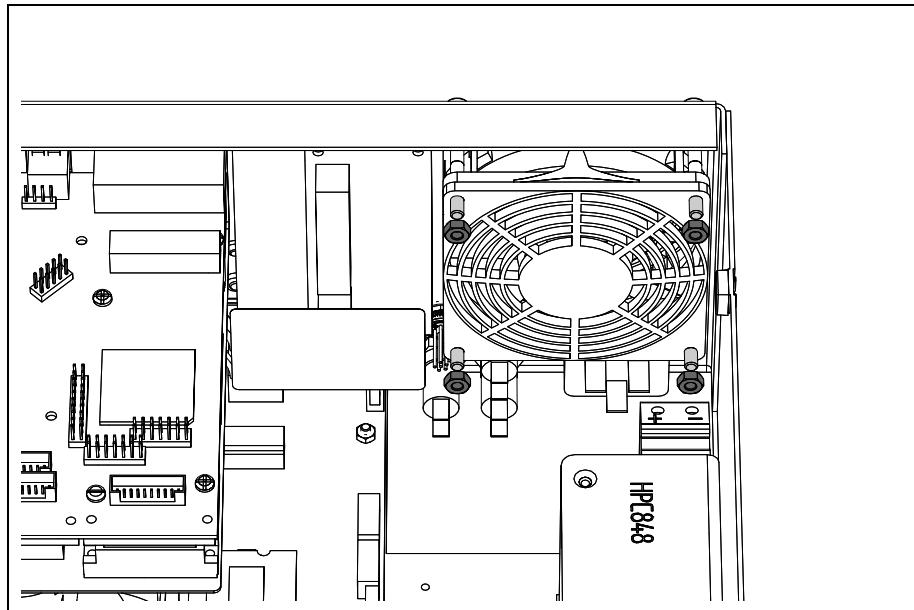


Figure 3.78 Fan plug-in supply unit – 1

3. Unfasten the fastening nuts.

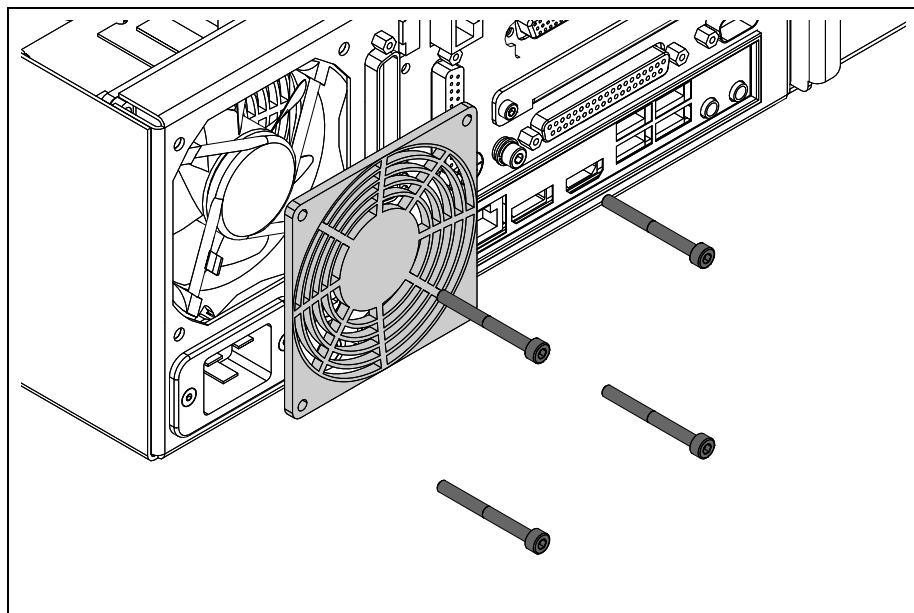


Figure 3.79 Fan plug-in supply unit – 2

4. Remove the external cover and fastening screws.

Disassembly and assembly of components

Plug-in supply unit

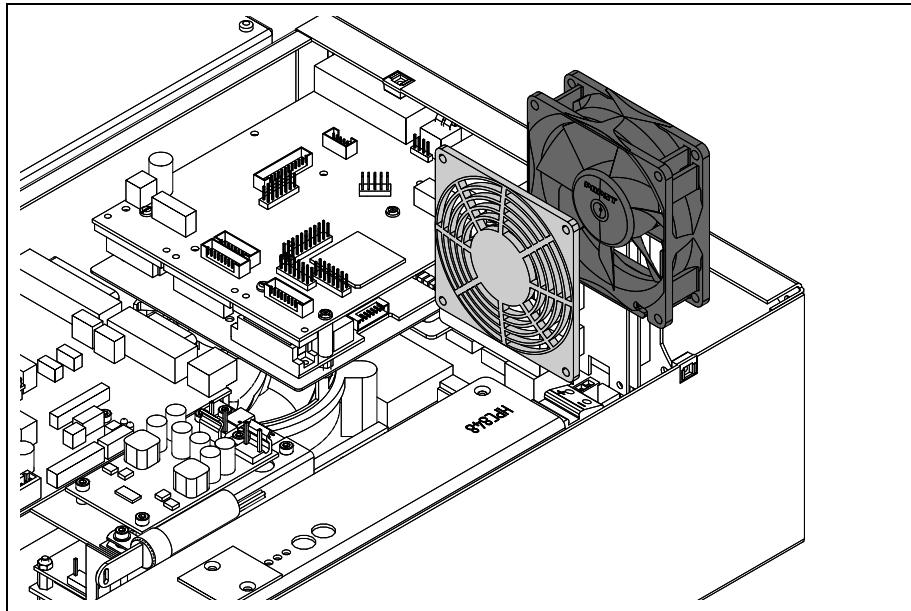


Figure 3.80 Fan plug-in supply unit – 3

5. Remove the fan and internal cover from the plug-in supply unit.



CAUTION

Functional faults possible!

There is insufficient cooling if the fan is incorrectly installed.

- *Ensure the correct installation position on reassembly of the fan (flow direction)!*
- *Use the same fan type (quiet running)!*

3.2.15 Speed controller for fan plug-in supply unit

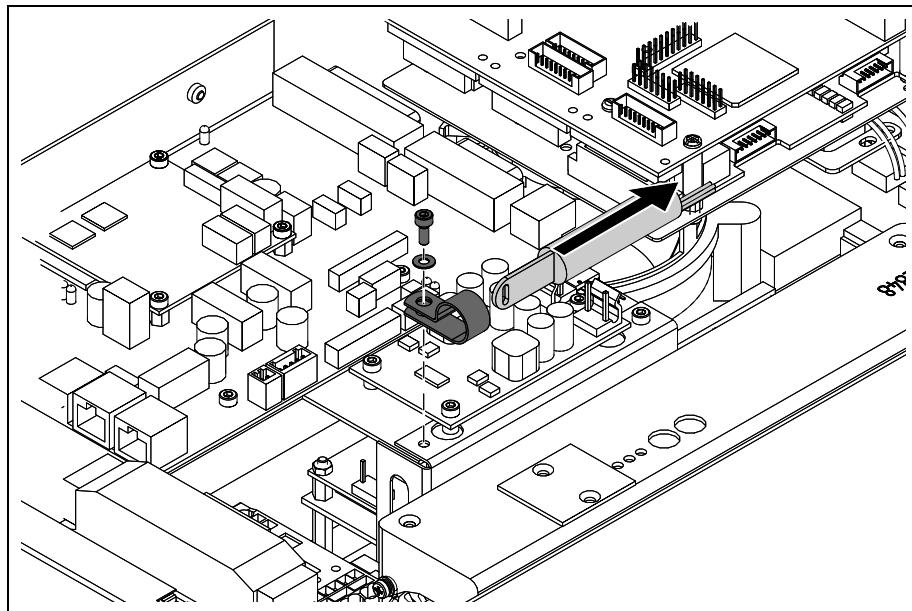


Figure 3.81 Speed controller for fan plug-in supply unit



CAUTION

With an operating voltage of 24 V, the fan motor rotates between 50 % (<23 °C) and 100 % (>34 °C) at room temperature.

At 50 % there is approx. 13 V, and at 100 % 24 V on the motor.

3.2.16 Pump module fan

1. Remove the pump module.
2. Open the cover on the pump module.
3. Disconnect the fan.
4. Unfasten the fastening bolts on the fan.
5. Remove the fan.

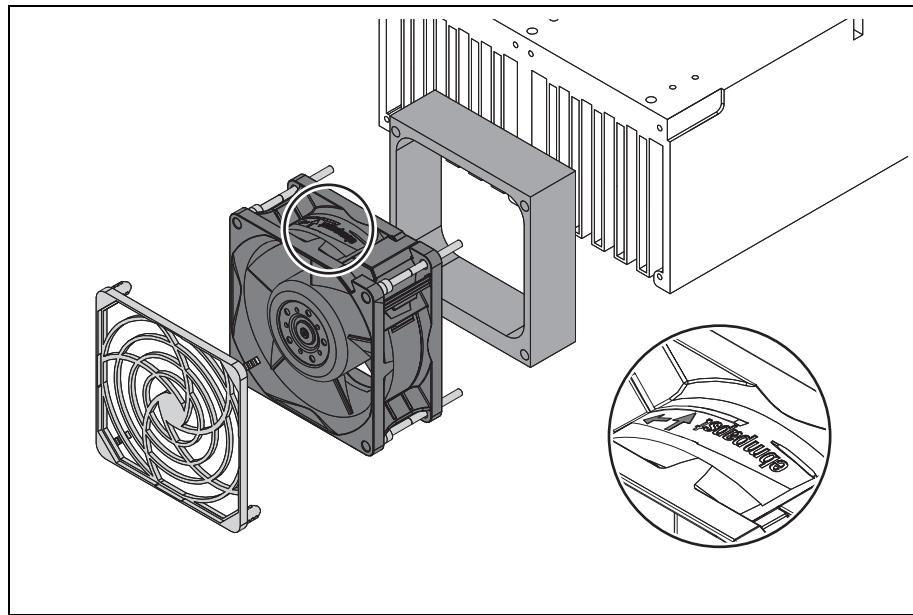


Figure 3.82 Pump module fan

6. Check the fan, clean, and replace if necessary.
7. Install the fan from the side.



CAUTION

Functional faults possible!

There is insufficient cooling if the fan is incorrectly installed.

– Ensure the correct installation position on reassembly of the fan (flow direction)!

3.2.17 Temperature sensor -R1

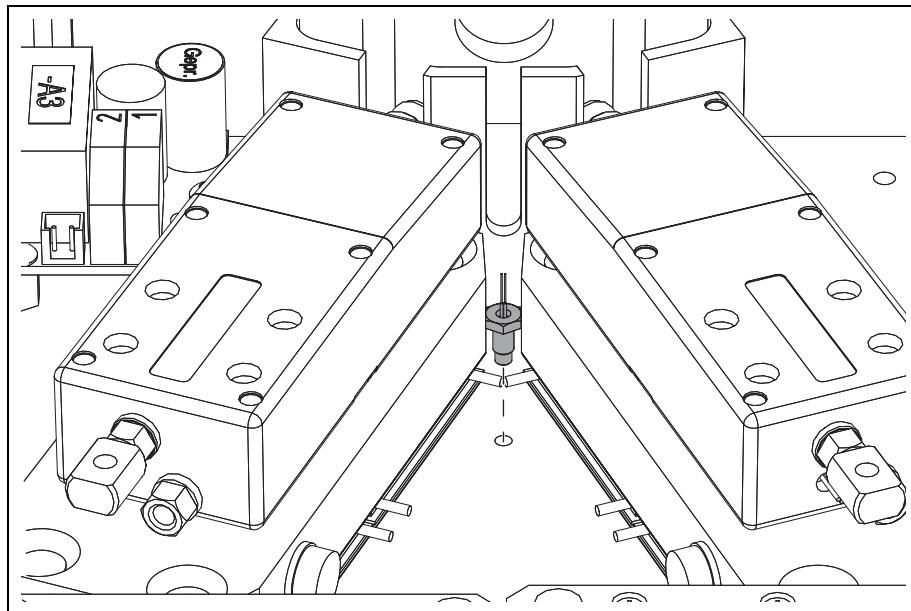


Figure 3.83 Temperature sensor -R1

1. Open the plug connection on the temperature sensor.
2. Unscrew and remove the temperature sensor.
3. Cut the threaded hole on the temperature sensor with a suitable tapping screw (M3) to remove any brass chips.
4. Clean the threaded hole using clean compressed air.
5. Carefully screw in the temperature sensor by hand.



CAUTION

If there is any resistance detected when screwing in the temperature sensor, repeat steps 3 and 4.

6. Plug the plug connection back together.
7. Perform a comparative measurement.
 - Use a thermometer to measure close to R1 and check the display on the generic view/ LaserDisplay.
 - Tolerance ± 0.2 °C.

Disassembly and assembly of components

Plug-in supply unit

3.2.18 Plug-in supply unit control panel

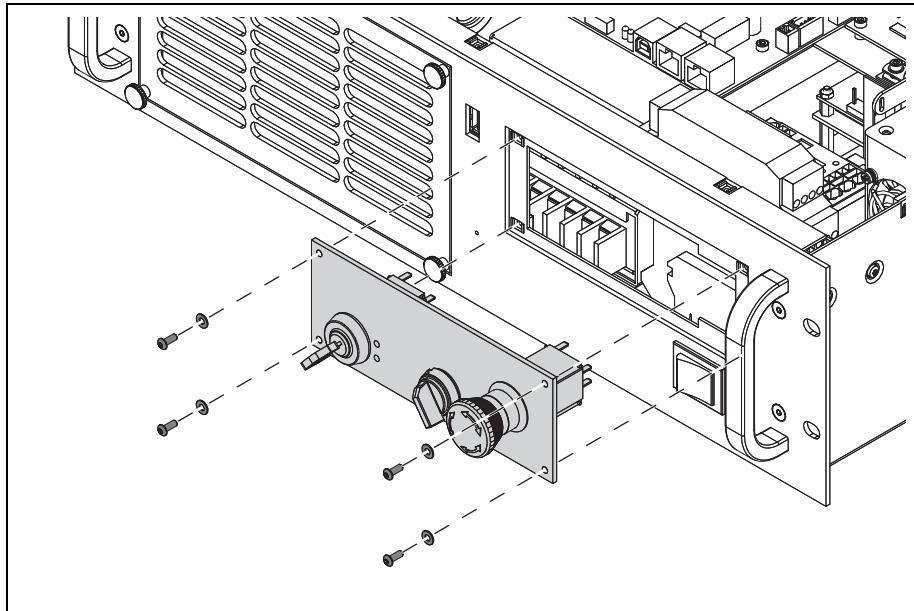


Figure 3.84 Plug-in supply unit control panel

3.2.19 DC/DC converter for ITX

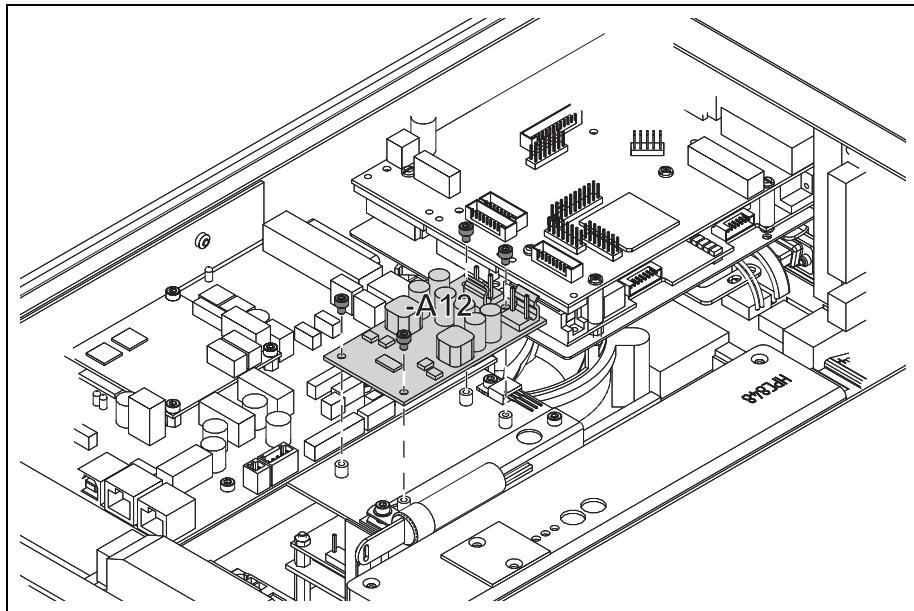


Figure 3.85 DC/DC converter for ITX



CAUTION

*Check the function following installation.
Input 24 V, output 19 V (± 0.1 V).
Do not confuse the connections!*

3.2.20 Peltier controller / distributor of external AOM

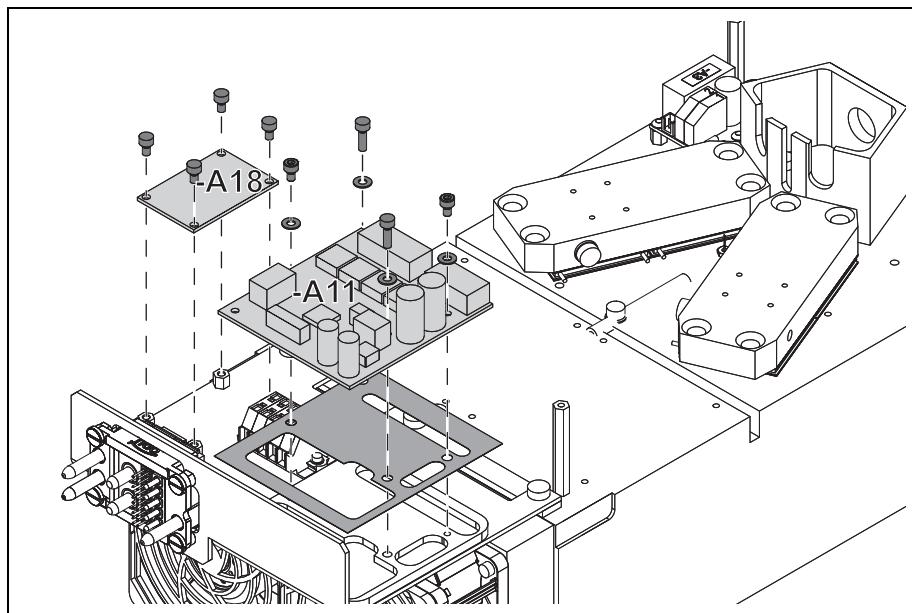


Figure 3.86 Peltier controller / distributor of external AOM



CAUTION

Danger of functional faults!

Damaged film can result in short-circuits.

- Check that there is no damage/perforation of the film at all due to metal chips, etc.



CAUTION

After installation, check the temperature control of the diode(s).

Check the surface temperature of the diodes (37-39 °C) using a thermometer (diode is regulated internally to 40 °C).

3.2.21 ESD relay -A9

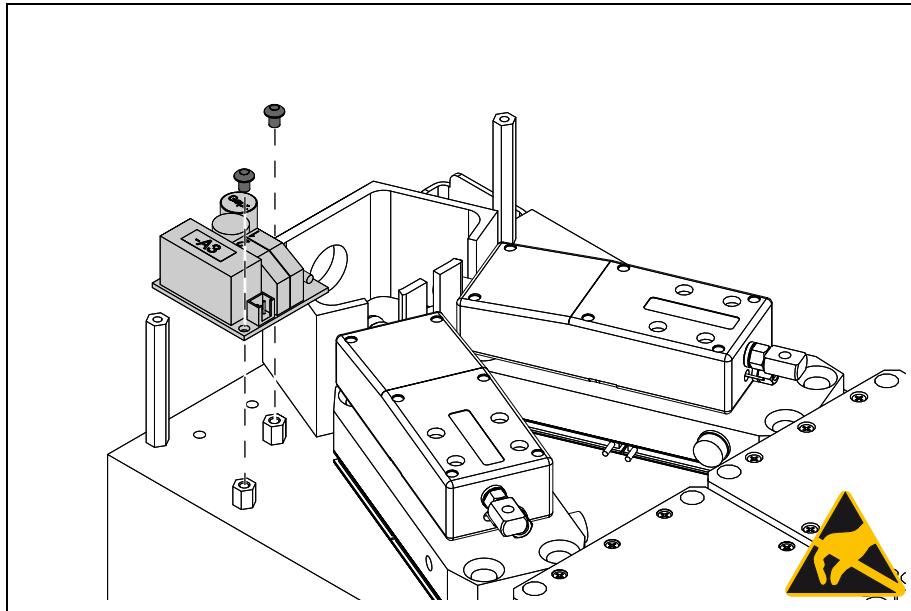


Figure 3.87 ESD relay -A9



CAUTION

Risk of damage to the diodes!

When the connecting lines are removed, touching the connecting terminals can lead to the destruction of the diode!

- When disconnecting the ESD relay, the EGB safety instructions must be followed and the diodes must be short-circuited ([see point 3.2.4, page 3-43](#))!

Notes

Troubleshooting

Basic troubleshooting sequence for the PL-E AIR ITX

4 Troubleshooting



WARNING

Hazards due to non-observance of safety instructions!

Hazards for persons and/or property can arise due to non-observance of safety instructions.

- All safety instructions in the [Chapter 2, Safety](#) should be observed during all work on the laser system.

4.1 Basic troubleshooting sequence for the PL-E AIR ITX

4.1.1 Laser systems in basic version (with and without positioning laser)

1. Check the power supply (230 V AC, fuse F1, F2),
2. Mains switch S1 to "ON".
3. ITX board starts.
 - WINDOWS starts.
 - RCU starts.
 - Start LaserConsole.
 - Start laser display.
4. Monitor what is shown on the laser display.
5. Check power supplies G1, G3, G4.
 - Control voltage 24 V and Peltier controller supply
 - Galvo voltage 2x 15.5 V DC
6. Initialize LSC and ALI-USB.
7. Key switch to pos. 1.
8. If there are no hardware problems (no emergency stop, etc.), relay K1 is triggered after approx. 5 s.
9. Check power supply G2 after triggering K1.
 - 24 V DC power controller A2 (diode current)
 - 24 V DC supply HF generator(s) A7 and A7a
10. Wait until the diodes reach operating temperature.
11. Measure the current flow via diodes with current clamp.
12. Measure the voltage on the diode.
13. Measure the laser power after glass fiber(s) (min. 27 W at 46 A).



CAUTION

This measures the output of the diodes indirectly. A measurement directly after the diode is not possible.

14. Set the current value and frequency so that 25 W is reached at CW.
 - Refer to the logbook for the values.



CAUTION

Take the aging of the diodes into account for the current values.

15. Perform a measurement in the field.
16. Disassemble the galvo head and measure the power after the galvo flange.
17. Dismantle the beam expander and measure the power.
18. Measure the power without collimating lens (minimum power rise ≤ 0.1 W).



CAUTION

To do this, remove the beam expander mount.

19. If the positioning laser is fitted: Measure the power after and before the positioning laser housing.
20. Measure the power after the deflecting block (min. 25 W).
21. Check that the HG 29-40 HF output is being produced and that this is "blanking".
22. If the output power is not reached, dismantle the deflecting unit, place it on the laser head (connect the shutter!) and perform the measurement directly on the resonator output.
23. Replace the resonator if necessary.
24. Check the beam position with the cross wires/adjustment tube.
25. Readjust the beam position if necessary.
26. Check that the Q-Switch in the resonator is blocking the laser beam at nominal power.
27. Readjust the HG 29-40 as required, replace if necessary.
28. If the temperature is not reached, check the Peltier controller.
29. If the shutter malfunctions
 - Check the shutter.
 - Check the SSC on the LSC.

Troubleshooting

Basic troubleshooting sequence for the PL-E AIR ITX

4.1.2 Laser systems with external modulator

1. Check the power supply (230 V AC, fuse F1, F2),
2. Mains switch S1 to "ON".
3. ITX board starts.
 - WINDOWS starts.
 - RCU starts.
 - Start LaserConsole.
 - Start laser display.
4. Monitor what is shown on the laser display.
5. Check power supplies G1, G3, G4.
 - Control voltage 24 V and Peltier controller supply
 - Galvo voltage 2x 15.5 V DC
6. Initialize LSC and ALI-USB.
7. Key switch to pos. 1.
8. If there are no hardware problems (no emergency stop, etc.), relay K1 is triggered after approx. 5 s.
9. Check power supply G2 after triggering K1.
 - 24 V DC power controller A2 (diode current)
 - 24 V DC supply HF generator(s) A7 and A7a
10. Wait until the diodes reach operating temperature.
11. Measure the current flow via diodes with current clamp.
12. Measure the voltage on the diode.
13. Measure the laser power after glass fiber(s) (min. 27 W at 46 A).



CAUTION

This measures the output of the diodes indirectly. A measurement directly after the diode is not possible.

14. Set the current value and frequency so that 25 W is reached at CW.
 - Refer to the logbook for the values.



CAUTION

Take the aging of the diodes into account for the current values.

15. Perform a measurement in the field.
16. Disassemble the galvo head and measure the power after the galvo flange.
17. Dismantle the beam expander and measure the power.
18. Measure the beam at 0 % and 100 %.
 - Check the function of HG 29-80. Is the laser beam being correctly deflected? Is the power being correctly regulated?
 - At 100 %: residual level goes from 0 V to 5 V, maximum laser power after external modulator, HF output HG 29-80 power must increase to the maximum value ([see point 4.11, page 4-40](#)).
 - At 0 % power, no HF, no laser power, residual level approx. 0 V.
 - At 50 % the residual level is at approx. 2.5 V and the HF output is around half of 100 %. The laser power after the external modulator is at around half of 100 %.
19. Stop the RCU.
20. Modify the "config-win32.xml" for operation **without external modulator**.

21. Start RCU.
22. Dismantle EM, place to one side.
23. Measure the power after the deflecting block and collimating lens (min. 25 W).
24. Measure the power without collimating lens (minimum power rise \leq 0.1 W).
25. Check that the HG 29-40 HF output is being produced and that this is "blanking".
26. If the output power is not reached, dismantle the deflecting unit, place it on the laser head (connect the shutter!) and perform the measurement directly on the resonator output.
27. Replace the resonator if necessary.
28. Check that the Q-Switch in the resonator is blocking the laser beam at nominal power.
29. Readjust the HG 29-40 as required, replace if necessary.
30. Check the beam position with the cross wires/adjustment tube.
31. Readjust the beam position if necessary.
32. Check the beam position with cross wires/adjustment tube and WIN-Cam.
33. Readjust the beam position if necessary.
34. Stop the RCU.
35. Modify the "config-win32.xml" for operation **with external modulator**.
36. Install the external modulator.
37. Maximize the power by tipping/rotating the external modulator.
38. Maximize to power with HG 29-80.
39. Linearize the power curve.
40. Check the linearization.
41. If the temperature is not reached, check the Peltier controller.
42. If the shutter malfunctions
 - Check the shutter.
 - Check the SSC on the LSC.

4.2 Image errors



CAUTION

For the precise assessment of the image errors, a measuring magnifier or microscope is required. The marking must be performed on acrylic plates.

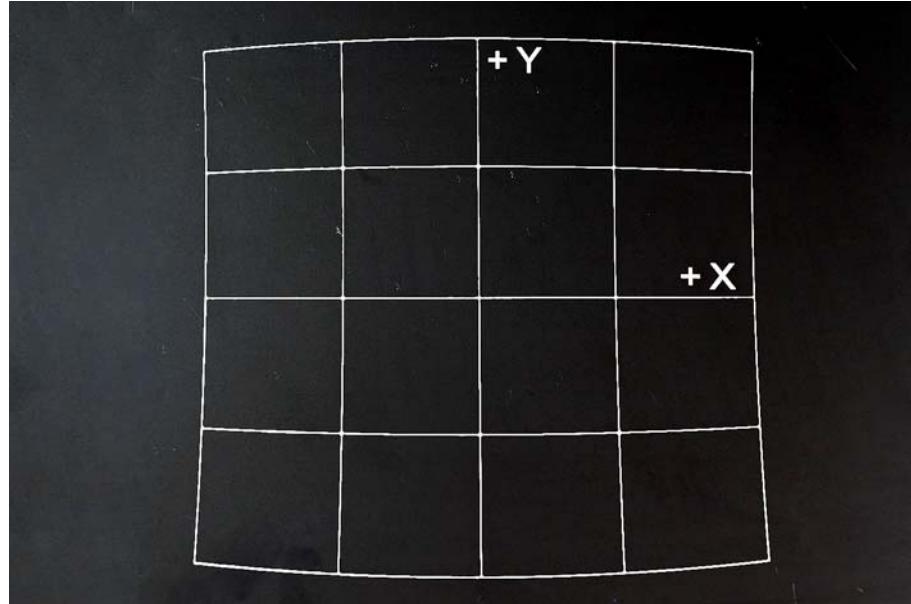


Figure 4.1 Barrel and pincushion distortion

Fault	Remedy
Barrel and/or pincushion distortions in the X and Y directions	Load the compensation file belonging to the optics.

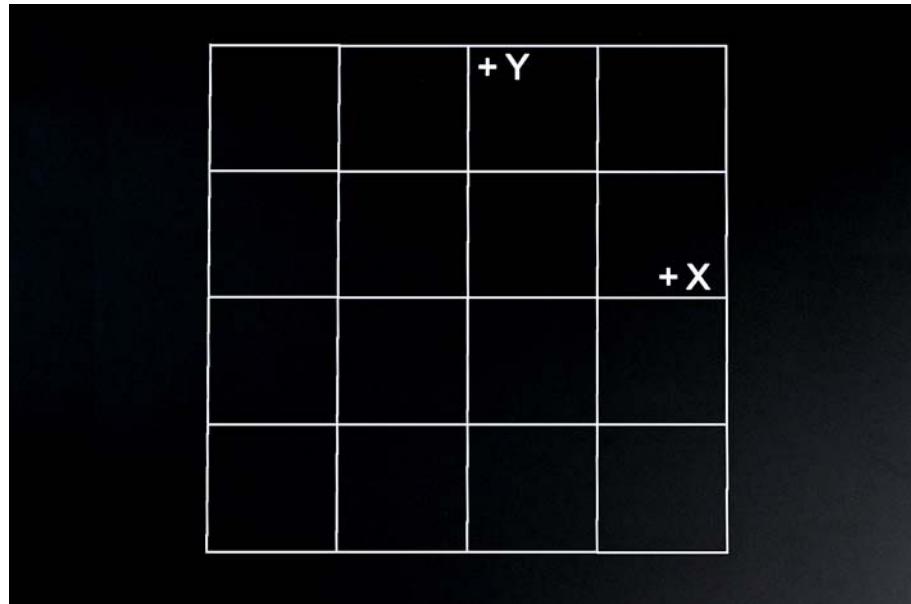


Figure 4.2 Compensation file loaded

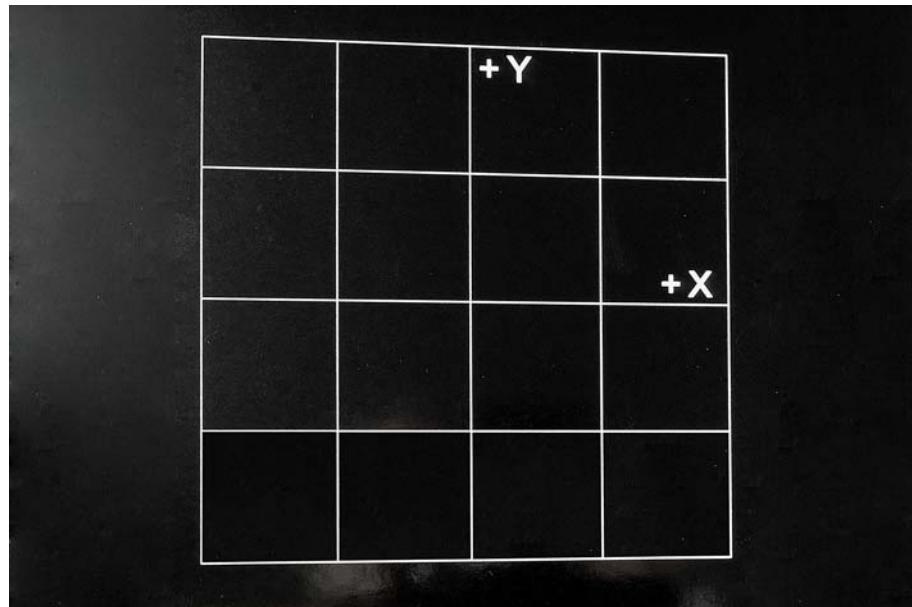


Figure 4.3 Trapezoidal distortion

Fault	Remedy
Trapezoidal distortions in the X and Y directions	Check the adjustment of the workpiece support plate and the galvo head (see point 6.3, page 6-11).

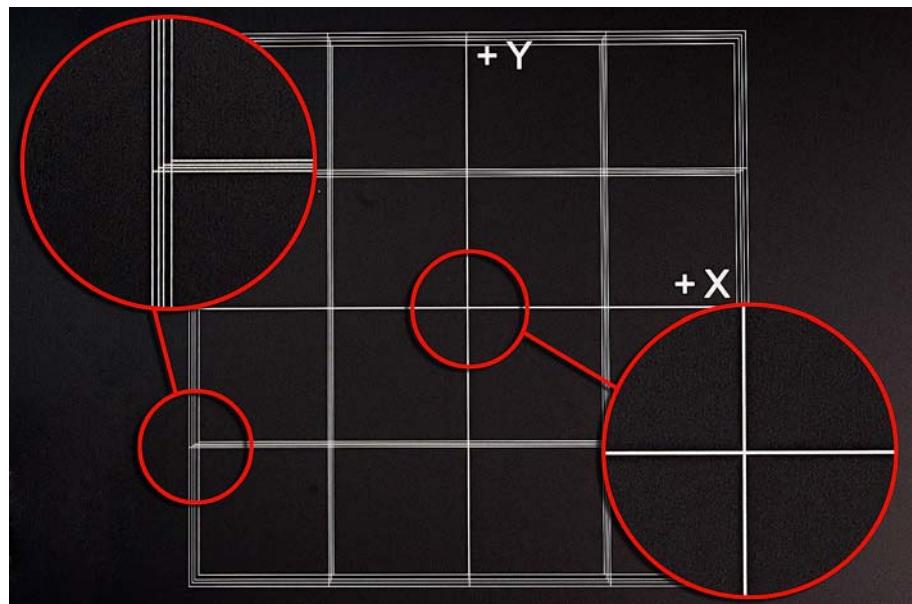


Figure 4.4 Focusing errors

Fault	Remedy
Focusing error (center point okay, deviation at edge)	Check the focal distance of the galvo head (see point 6.3, page 6-11).

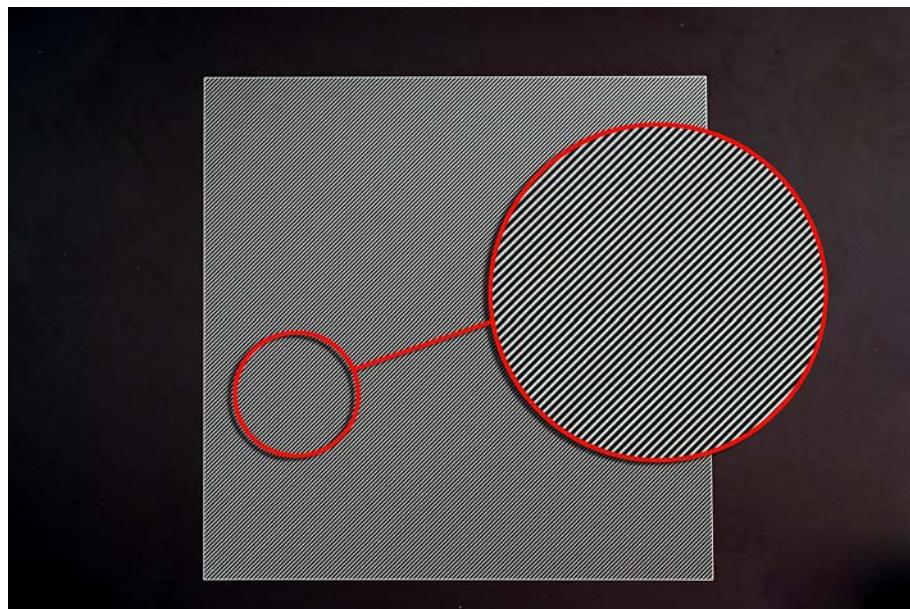


Figure 4.5 Correct image

i CAUTION

All settings and checks, etc. of the hardware or software must be performed according to the valid 5M+e list. Values and settings that differ are not permissible for adjustment or verification.

i CAUTION

To test the image, the test programs "UNI V40.VLM" and "DT-94a.VLM2", included in delivery scope, must be used or a test program must be created (see VLM user manual).

Sample settings of a self-created test program:

- Create a square, the size of which corresponds to the maximum possible marking field of the laser (the maximum size can be found in the "config-win32.xml" file)
- hatching-angle 45°
- Hatching distance approx. 0.5 mm to 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.

i CAUTION

The laser system and the workpiece support plate must be absolutely vibration-free and aligned with each other!

The suction system must be switched on, as vapors obstruct/weaken the laser radiation!

i CAUTION

To prevent errors due to the material being marked, let the test program run through several test samples.



CAUTION

For the precise assessment of the image errors, a measuring magnifier or microscope is required.

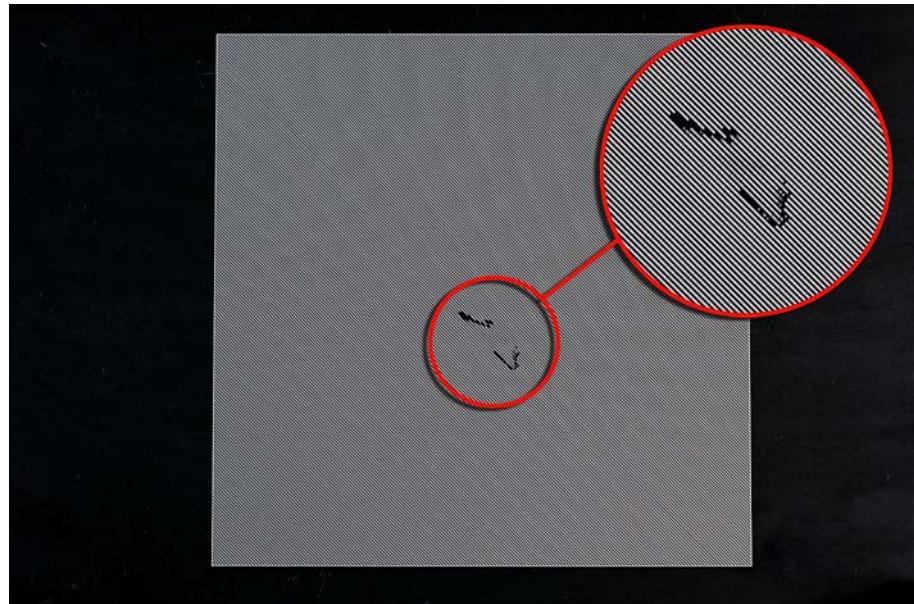


Figure 4.6 Irregular power fluctuations

Fault	Remedy
Irregular power fluctuations	Check the optics for soiling and burning (see chapter 5).

Troubleshooting

Image errors

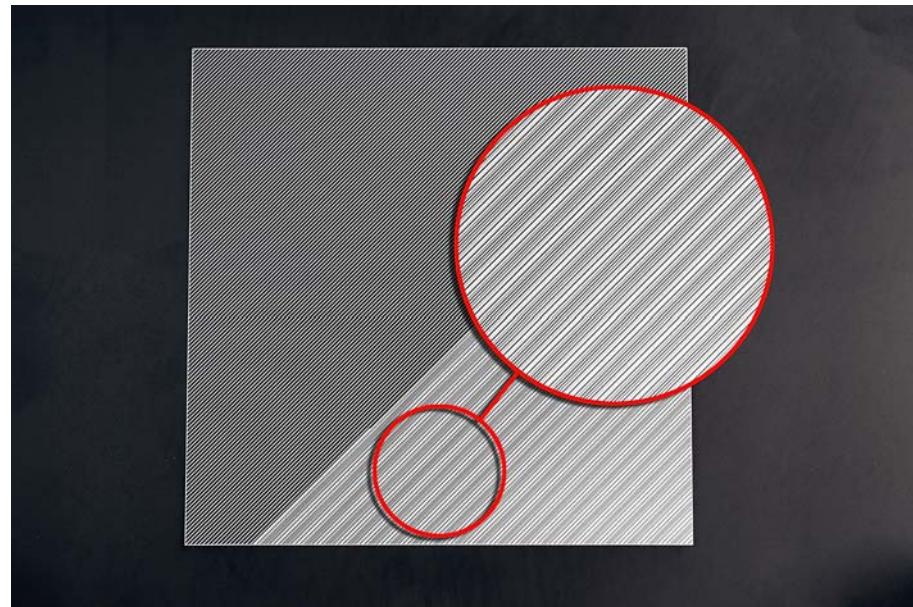


Figure 4.7 Regular power fluctuations

Fault	Remedy
Regular power fluctuations due to internal or external influences	Check the system for vibrations. Check and/or replace the power supply unit, resonator and Q-switch.

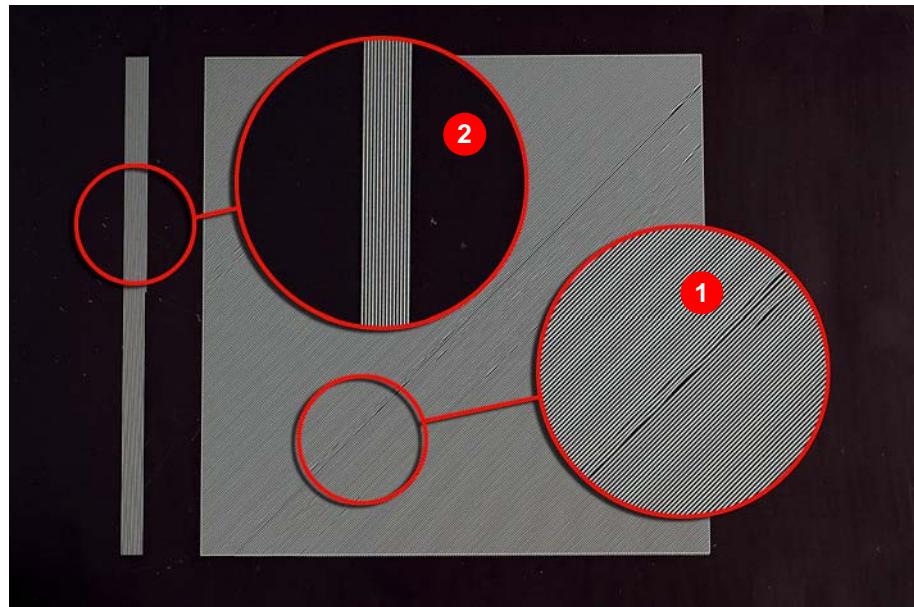


Figure 4.8 Positioning error of galvo head

Fault	Remedy
Positioning error of galvo head (1) (X or Y direction)	Check the system for vibrations. Check/replace galvo head or ALI-USB.



CAUTION

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

4.3 Marking errors



CAUTION

It is generally recommended to compare the marking with a reference sample.

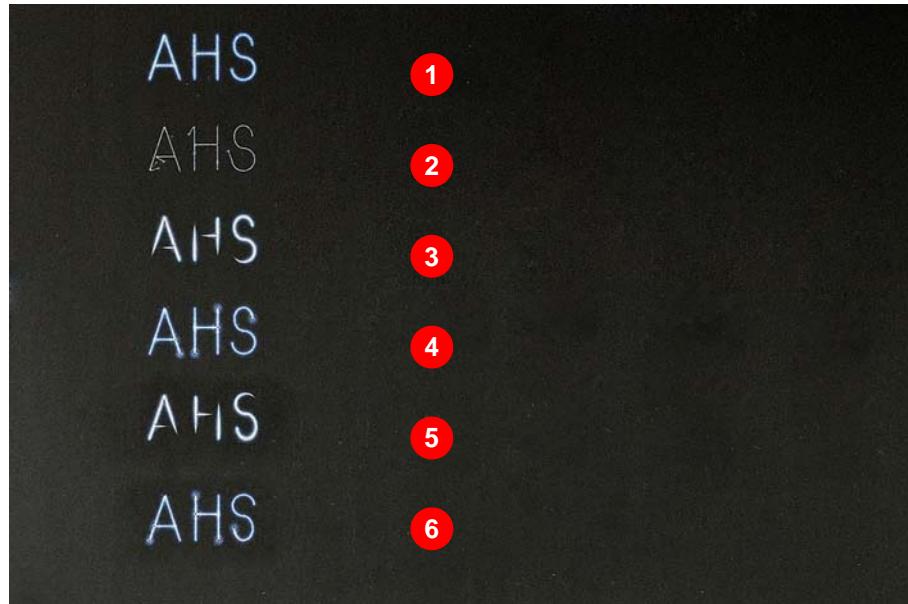


Figure 4.9 Marking errors

No.	Fault	Remedy
1	No error	–
2	"Galvo waiting time" too short.	<ul style="list-style-type: none"> • Check the parameters and hardware.
3	The first pulse is too strongly attenuated.	<ul style="list-style-type: none"> • Check the parameters and hardware.
4	The first pulse is too strongly attenuated or the "Beam waiting time on" is too negative.	<ul style="list-style-type: none"> • Check the parameters and hardware.
5	"Beam waiting time on" too short.	<ul style="list-style-type: none"> • Check the parameters and hardware.
6	First pulse too little attenuated or "Galvo waiting time" too long or "Beam waiting time on" is too positive.	<ul style="list-style-type: none"> • Check the parameters and hardware.

4.4

Focusing errors

Fault	Possible reasons	Remedy
The mark that is shown is too wide (>50 µm vs. the setting)	Laser parameters faulty	<ul style="list-style-type: none"> • Recheck and adjust.
	The material to be marked is flawed.	<ul style="list-style-type: none"> • Check the material batch. • Use proper material.
	Focusing errors	<ul style="list-style-type: none"> • Adjust focus. • Inspect protective glasses (dust, spots, burn marks, discoloration) • Inspect beam expander (correct divergence setting; dust, spots, burn marks, discoloration) • Inspect IR focusing lens (correct setting; dust, spots, burn marks, discoloration) • Check the optics (optical inspection, cleaning, replacement with appropriate field correction). • Inspect the resonator module (replace if defective).
	Laser beam out-of-round (ellipticity)	<p> CAUTION</p> <p><i>Check test marking against process parameters for focus and roundness. To do this, generate a cross with lines at 0° and 90°, as well as a cross with 45° offset.</i></p> <ul style="list-style-type: none"> • If faulty, check the roundness (e.g. ellipticity) of the beam as to the focusing optics, THG module and IR resonator module using WinCam. • Replace faulty components.

Troubleshooting

Emergency stop circuit

4.5 Emergency stop circuit

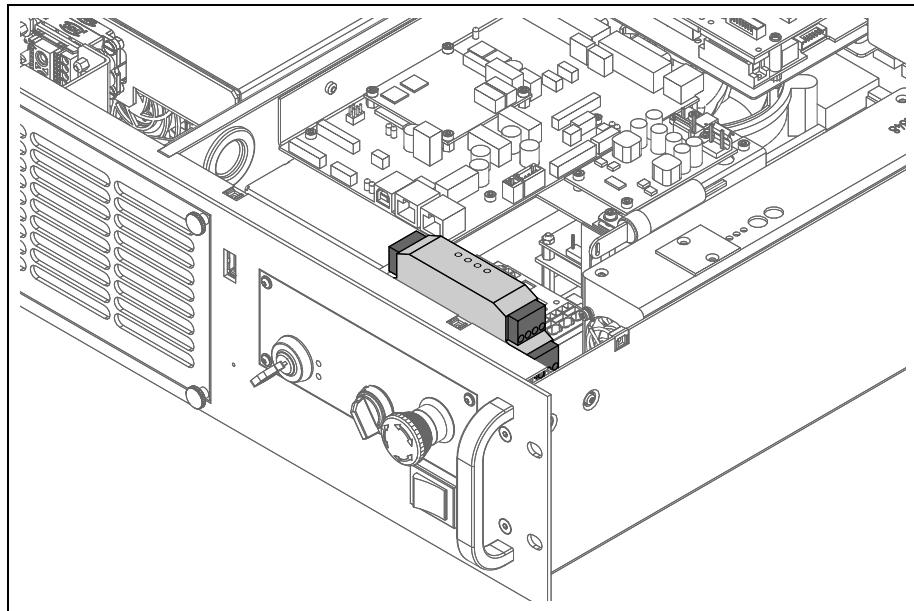
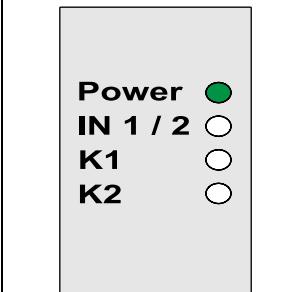
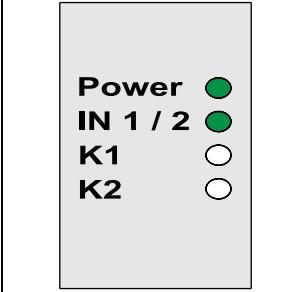
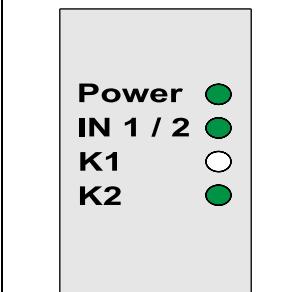
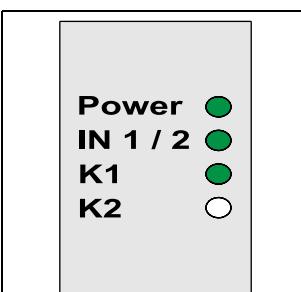
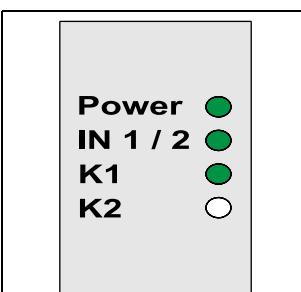


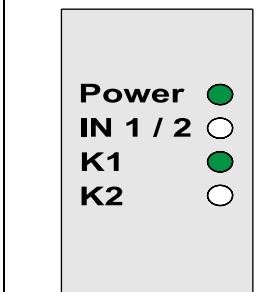
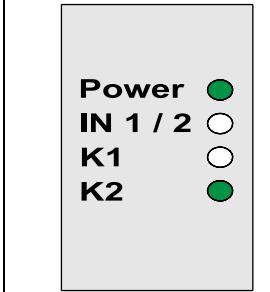
Figure 4.10 Position of the emergency stop relay in the plug-in supply unit

Fault	Possible reasons	Remedy
	<ul style="list-style-type: none">Emergency stop circuit OK.	-
	<ul style="list-style-type: none">Power supply not present.Cross-circuit between locking circuit S11 / S12 and S21 / S22.Short circuit: Between contact points A1 and A2.	<ul style="list-style-type: none">Connect the power supply.Remove the cross-circuit.Remove the short circuit.

Fault	Possible reasons	Remedy
	<ul style="list-style-type: none"> The safety function has been triggered. 	<ul style="list-style-type: none"> Unlock the pressed emergency stop switch. See "Emergency stop function" in the circuit diagram.
	<ul style="list-style-type: none"> The activation or locking circuits are incorrect or are not connected at all. 	<ul style="list-style-type: none"> Check the connections on the circuits .
	<ul style="list-style-type: none"> Error in reset circuit: Enabling contact(s) on K1 and K2 faulty 	<ul style="list-style-type: none"> Check start circuits S33 / S34 (i.e. contacts K1** relay). Replace safety relay.
	<ul style="list-style-type: none"> Error in reset circuit. Enabling contact(s) on K1 faulty. 	<ul style="list-style-type: none"> Replace safety relay.
	<ul style="list-style-type: none"> Interruption between S11 and S12. 	<ul style="list-style-type: none"> Check circuits S11 and S12 (switch off and restart).
	<ul style="list-style-type: none"> Short circuit between S21 and S22. Fault detection on next prompt. 	<ul style="list-style-type: none"> Remove the short circuit.
	<ul style="list-style-type: none"> Supply voltage too low. 	<ul style="list-style-type: none"> Adjust supply voltage.
	<ul style="list-style-type: none"> Error in reset circuit. Enabling contact(s) on K2 faulty. 	<ul style="list-style-type: none"> Replace safety relay.
	<ul style="list-style-type: none"> Interruption between S21 and S22. 	<ul style="list-style-type: none"> Check circuits S21 and S22 (switch off and restart).
	<ul style="list-style-type: none"> Short circuit between S11 and S12. 	<ul style="list-style-type: none"> Remove the short circuit.

Troubleshooting

Emergency stop circuit

Fault	Possible reasons	Remedy
	<ul style="list-style-type: none">• Interruption between S21 and S22.	<ul style="list-style-type: none">• Check circuits S21 and S22.
	<ul style="list-style-type: none">• Interruption between S11 and S12.	<ul style="list-style-type: none">• Check circuits S11 and S12.

4.6 Measurement of the laser power



DANGER

Laser system opened, safety devices missing!

With the laser system opened and/or safety devices removed, there is a serious risk of accident!

- Take measures for protection against laser radiation (wear laser safety goggles, wear PPE, setup and position partition walls, attach warning signs and barriers, etc.).
 - All persons present must be protected.
 - These measures must be coordinated with the laser safety officer.
 - Ensure a shutdown in the event of danger (e.g. press emergency stop switch/main switch on the laser system by a second person)!
-



CAUTION

For the measurement of laser power, a power measurement device with a measuring adapter for the particular laser type is required. It is essential to observe the operating instructions for the measuring device!



CAUTION

To achieve reproducible measurement results and to prevent overheating of the measurement head, we recommend using the "Measurement Head Cooling Adapter", if a correspondingly cooled measurement head is used. 30 seconds' settling time for the measuring equipment must be observed!



CAUTION

Wait until the laser system warm-up time has elapsed before starting the measurements. 15 min. lead time + 30 min. warm-up time.



CAUTION

Note measured power values to have them to hand as comparison values for subsequent measurements.



CAUTION

It is only permitted to use calibrated measuring instruments with measuring heads with appropriate resolution (min. 0.01 W).

Measuring equipment to be calibrated yearly

Troubleshooting

Measurement of the laser power

For laser power measurements, the following precautions must be taken prior to measuring:

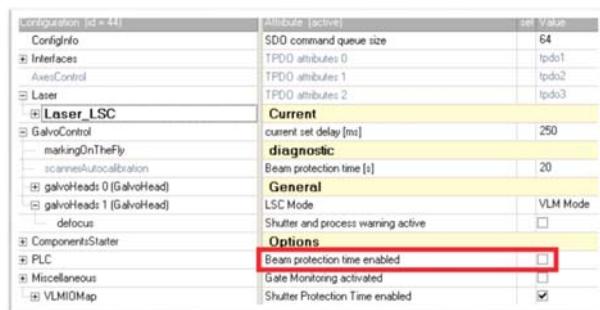


Figure 4.11 LaserConsole

1. Start the PC and load WIN-DOWS®.
2. Start "LaserConsole > LaserDisplay".
3. In the tree view, select "Laser >Laser_LSC".
4. Under "Options", check the activation of the beam protection time and deactivate the "Beam time protection enabled" value if necessary (see figure 4.11).



CAUTION

Reactivate the setting after completion of the adjustment work (if previously active).

4.6.1 Measurement points

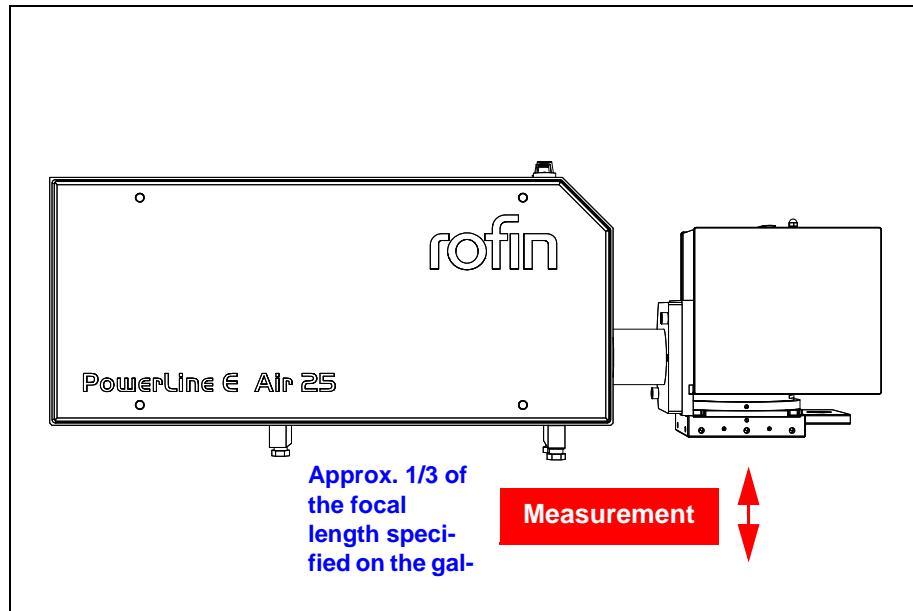


Figure 4.12 Laser power after the galvo head



CAUTION

Risk of damage!

With the incorrectly set measurement distance, there is a risk of damage to the measurement head!

- The laser power after the galvo head must always be measured outside the focus to prevent burning or other damage to the measurement head!

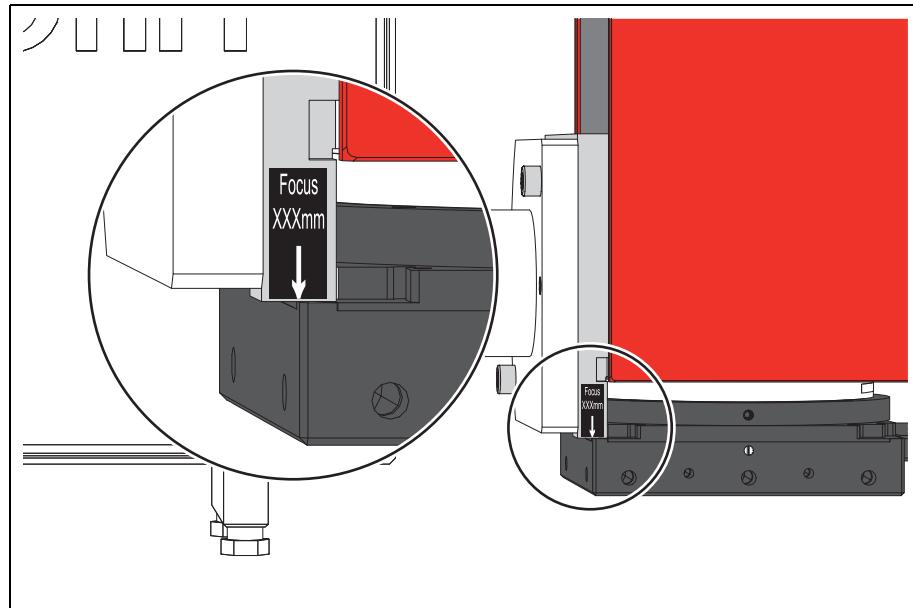


Figure 4.13 Measure the focal distance

Troubleshooting

Measurement of the laser power



CAUTION

At a focal length of 343 mm, for example, measure at a maximum of 110 to 120 mm beneath the protective glass!

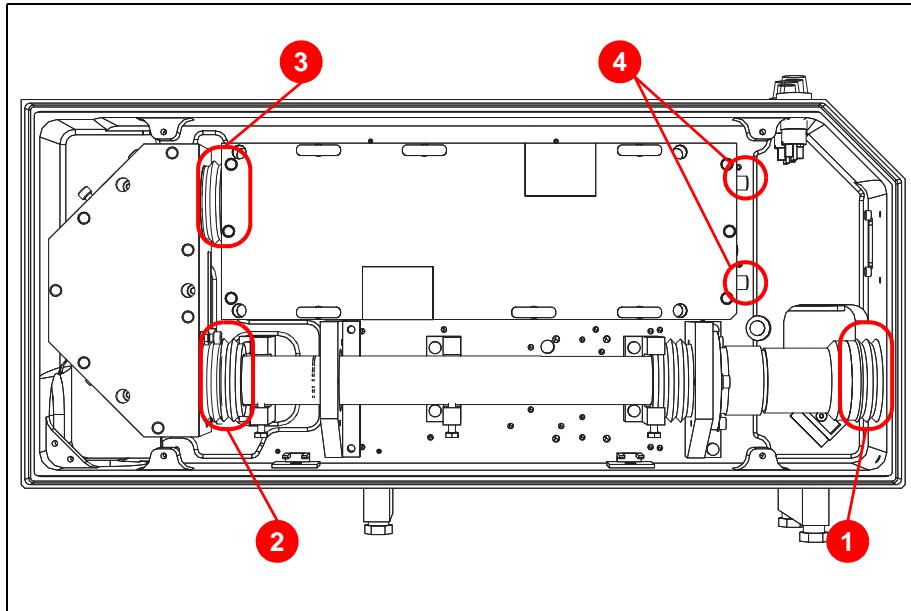


Figure 4.14 Laser systems in basic version

No.	Measurement point
1	Galvo flange ¹⁾
2	Output of the deflecting unit
3	Output of the resonator module
4	Diode power of the fiber end

¹⁾ Perform the measurement with and without the installed beam expander.

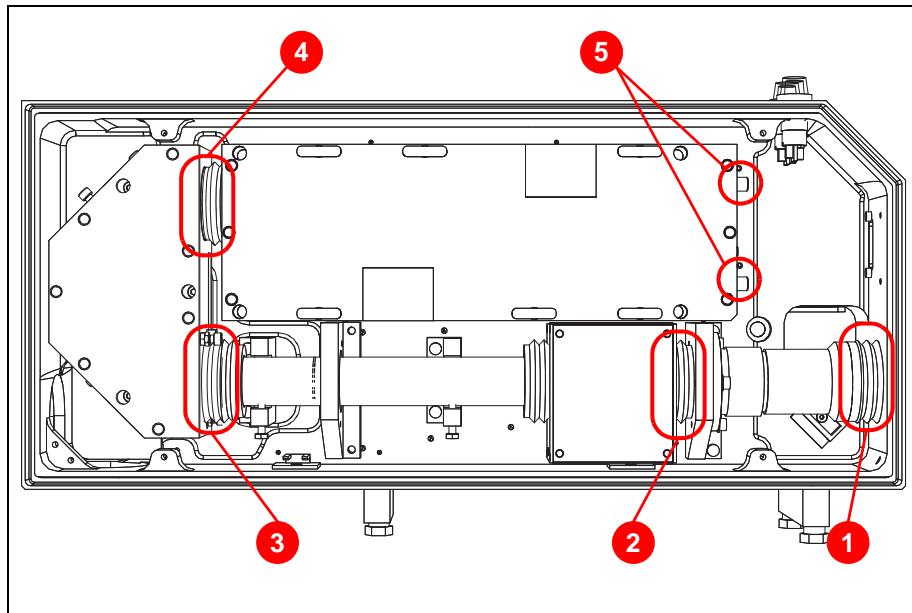


Figure 4.15 Laser system with positioning laser

No.	Measurement point
1	Galvo flange ¹⁾
2	Positioning laser output
3	Output of the deflecting unit
4	Output of the resonator module
5	Diode power of the fiber end

¹⁾ Perform the measurement with and without the installed beam expander.

Troubleshooting

Measurement of the laser power

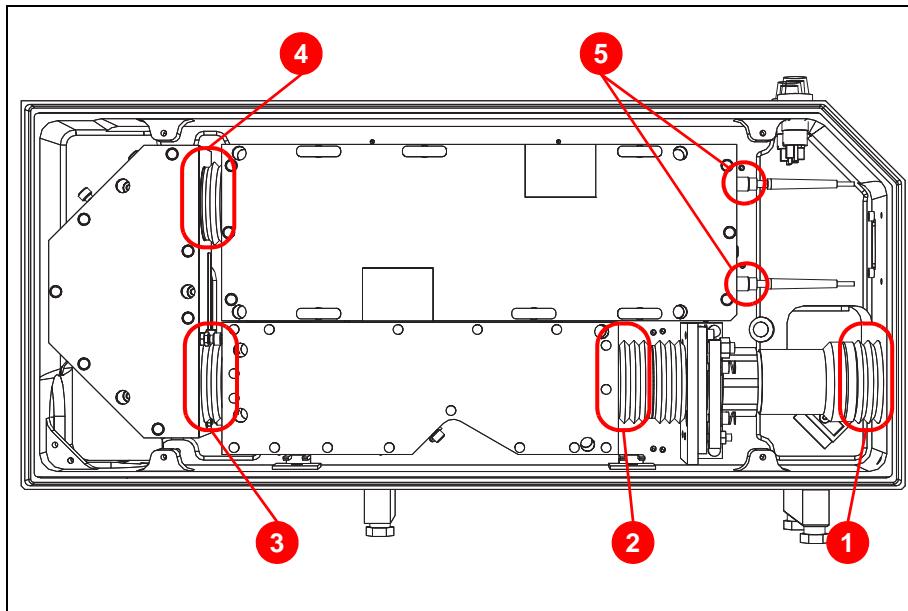


Figure 4.16 Laser system with external modulator

No.	Measurement point
1	Galvo flange ¹⁾
2	External modulator output
3	Output of the deflecting unit
4	Output of the resonator module
5	Diode power of the fiber end

¹⁾ Perform the measurement with and without the installed beam expander.

Laser type	Power
HP/HQ - 1064 nm with RSM PowerLine E Air-10	<ul style="list-style-type: none"> CW HP: 10.5 - 11 W CW HQ: 8.5 - 9 W
1064 nm with PowerLine E Air (ITX)-25	<ul style="list-style-type: none"> CW HQ: min. 24 W, max. 25 W
1064 nm with PowerLine E Air (ITX)-30	<ul style="list-style-type: none"> CW HP: min. 25 W, max. 27 W
1064 nm with PowerLine E Air (ITX)-25 EM	On measurement point 1 with 100 % EM and default current <ul style="list-style-type: none"> CW: min. 25 W, max. 26 W @ 70 kHz: min. 24 W, max. 25 W



CAUTION

The values are based on the maximum diode current at 30 W (RSM PowerLine E Air-10) bzw. 30 W (RSM PowerLine E Air-25/30-) output power of the diode module. These values are the minimum values, measured at the galvo flange with beam expander 1.5 - 2.0.

4.6.2 Basic power measurement procedure



CAUTION

Before performing a power measurement, the general conditions (e.g. water temperature, flow rate, room temperature) must always be checked.

1. Secure the shutter against activation.



WARNING

Laser radiation!

Risk of accident and injury due to laser radiation!

- Take measures to protect against laser radiation!

2. Position the measurement head.



CAUTION

Risk of damage!

With incorrect settings, the measuring device can be damaged.

- Set the measuring device to the wavelength of the laser!
- Observe the operating instructions for the measuring device!

3. Activate the main switch of the laser system.



DANGER

Laser system opened, safety devices missing!

With the laser system opened and/or safety devices removed, there is a serious risk of accident!

- Take measures for protection against laser radiation (wear laser safety goggles, wear PPE, setup and position partition walls, attach warning signs and barriers, etc.).
- All persons present must be protected.
- These measures must be coordinated with the laser safety officer.
- Ensure a shutdown in the event of danger (e.g. press emergency stop switch/main switch on the laser system by a second person)!

4. Open the shutter.
5. Perform the measurement.
6. Close the shutter.
7. Remove the measuring head.
8. Turn off the main switch to reset the emergency stop relay for a restart.
9. Completely mount the components.
10. Mount the cover of the laser head.
11. Commission the laser system.

Troubleshooting

Measurement of the laser power

4.6.3 Power measurement in the operating area

4.6.3.1 Performing the measurement

1. Set the power measuring instrument to the wavelength to be measured.
2. Set the galvo position to "Field center".
3. Position the measurement head under the galvo head using suitable tools (at approx. 1/3 of the focal length specified on the galvo head).



CAUTION

Risk of damage!

With the incorrectly set measurement distance, there is a risk of damage to the measurement head!

- *The laser power after the galvo head must always be measured outside the focus to prevent burning or other damage to the measurement head!*
-



CAUTION

At a focal length of 343 mm, for example, laser power is measured at a maximum of 110 to 120 mm beneath the protective glass!

4. Activate the main switch of the laser system.



DANGER

Laser system opened, safety devices missing!

With the laser system opened and/or safety devices removed, there is a serious risk of accident!

- *Take measures for protection against laser radiation (wear laser safety goggles, wear PPE, setup and position partition walls, attach warning signs and barriers, etc.).*
 - *All persons present must be protected.*
 - *These measures must be coordinated with the laser safety officer.*
 - *Ensure a shutdown in the event of danger (e.g. press emergency stop switch/main switch on the laser system by a second person)!*
-

5. Open the shutter.
6. Perform the measurement ([see point 4.6, page 4-16](#)).



CAUTION

Observe the 30 second settling time for the measuring equipment!

7. Compare the measured power with the logbook entry to detect any power losses.



CAUTION

Risk of damage!

Without sufficient cooling, the measurement head can be damaged!

- *If a water-cooled measurement head is used, the optionally available cooling adapter must be used!*
-

8. Close the shutter.

9. Perform stability test.

Perform stability test with regard to power fluctuations

1. Switch on beam.
 - After 2 minutes, 95 % of 25 W at 70 kHz must be reached.
 - Wait 20 minutes and log with measuring device.
 - Save measured curve.
 - In this process, the fluctuations must be less than $\pm 10\%$. (min. 22.5 W, max. 27.5 W)
2. If the stability is not attained, then the EM module, resonator, diodes, fibers, HF generator, HPC power supply unit and LCS must be replaced in the listed sequence.



CAUTION

After each component change, repeat the test until stability is achieved.

3. If the component replacement does not result in improved stability, then the protective glass, lens, galvo and beam expander must be checked, including their mechanical fasteners, and replaced as necessary.

4.6.3.2 Evaluating the measurement

Fault	Possible reasons	Remedy
Power loss compared to the logbook entry.	Contamination and/or damage to the protective glass	<ul style="list-style-type: none">• Clean, replace.
	Contamination and/or damage to the focusing optics, beam expander or galvo mirror	<ul style="list-style-type: none">• Perform further power measurements (see point 4.6.4, page 4-25).

Troubleshooting

Measurement of the laser power

4.6.4 Power measurement on the galvo flange

4.6.4.1 Performing the measurement

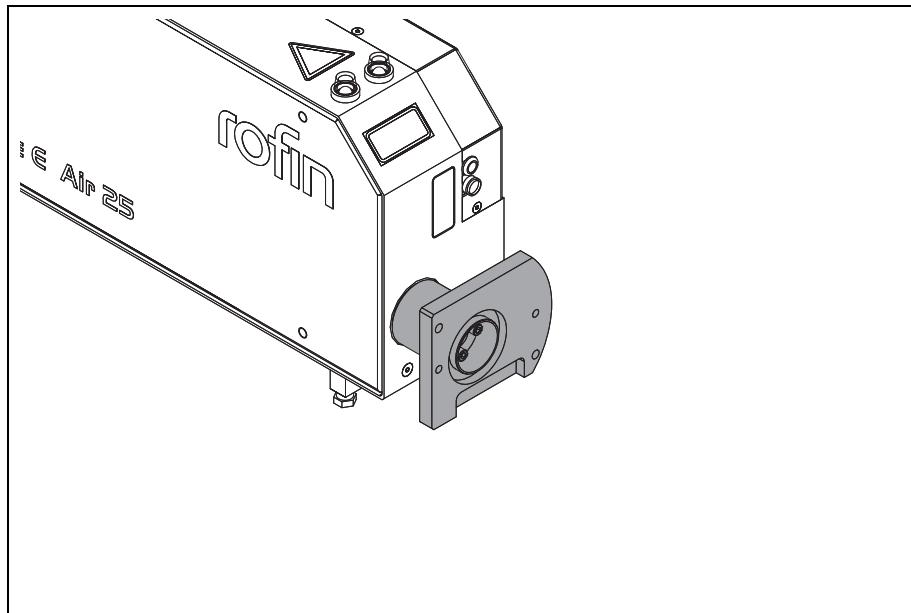


Figure 4.17 Power measurement on the galvo flange

1. Dismantle the galvo head.
2. Set the power measuring instrument to the wavelength to be measured.
3. Position the measurement head in front of the galvo head using suitable tools.
4. Perform the measurement ([see point 4.6, page 4-16](#)).



CAUTION

Observe the 30 second settling time for the measuring equipment!

5. Compare the measured power with the power after the galvo head to detect any power losses.

4.6.4.2 Evaluating the measurement

Fault	Possible reasons	Remedy
Increase in power in relation to the measurement in the operating area.	Soiling, damage to the protective glass, focusing optics, beam expander, galvo mirror	<ul style="list-style-type: none">• Clean, replace. <p>i CAUTION</p> <p><i>In case of damage to the galvo head, the complete head must be replaced.</i></p>
	Galvo head voltage supply fault	<ul style="list-style-type: none">• Measure the voltage and adjust it if necessary• Check power supply unit HPC 848/845.
	Defective galvo head	<ul style="list-style-type: none">• Check its function.• If necessary, replace the galvo head or ALI-USB, focusing optics.
No power increase	Preceding components faulty	<ul style="list-style-type: none">• Perform further power measurements (see point 4.6.5, page 4-27).

Troubleshooting

Measurement of the laser power

4.6.5 Power measurement after the external modulator

4.6.5.1 Performing the measurement

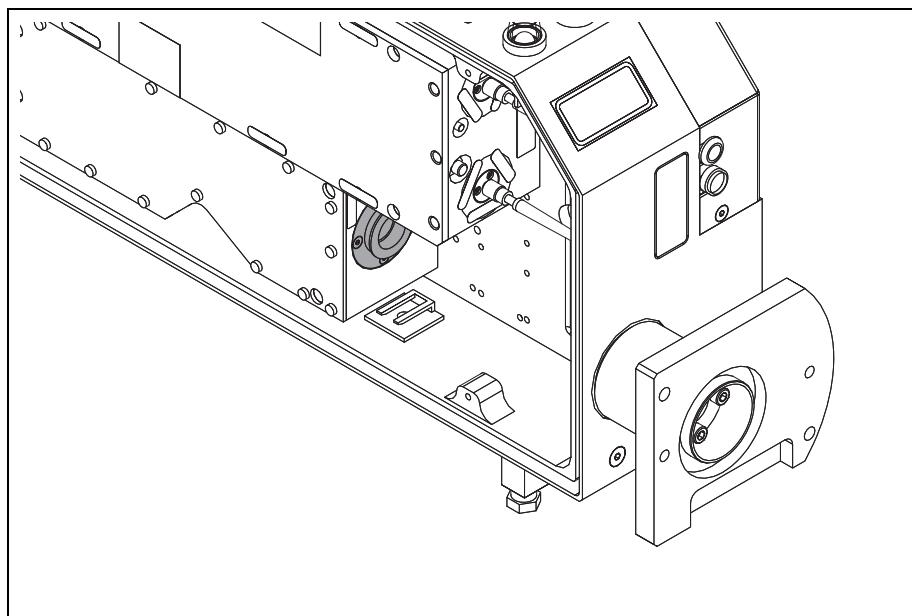


Figure 4.18 Power measurement after the external modulator

1. Set the power measuring instrument to the wavelength to be measured.
2. Removing the beam expander.
3. Position the measurement head after the external modulator using suitable tools.
4. Perform the measurement ([see point 4.6, page 4-16](#)).



CAUTION

Observe the 30 second settling time for the measuring equipment!



CAUTION

Compare the measured power with the beam expander to detect any power losses.

4.6.5.2 Evaluating the measurement

Fault	Possible reasons	Remedy
Increase in power in relation to the measurement at the galvo flange.	Contamination and/or damage to the beam expander	<ul style="list-style-type: none">• Clean, replace.
No power increase	Preceding components faulty	<ul style="list-style-type: none">• Perform further power measurements (see point 4.6.6, page 4-28).

4.6.6 Power measurement after the positioning laser module

4.6.6.1 Performing the measurement

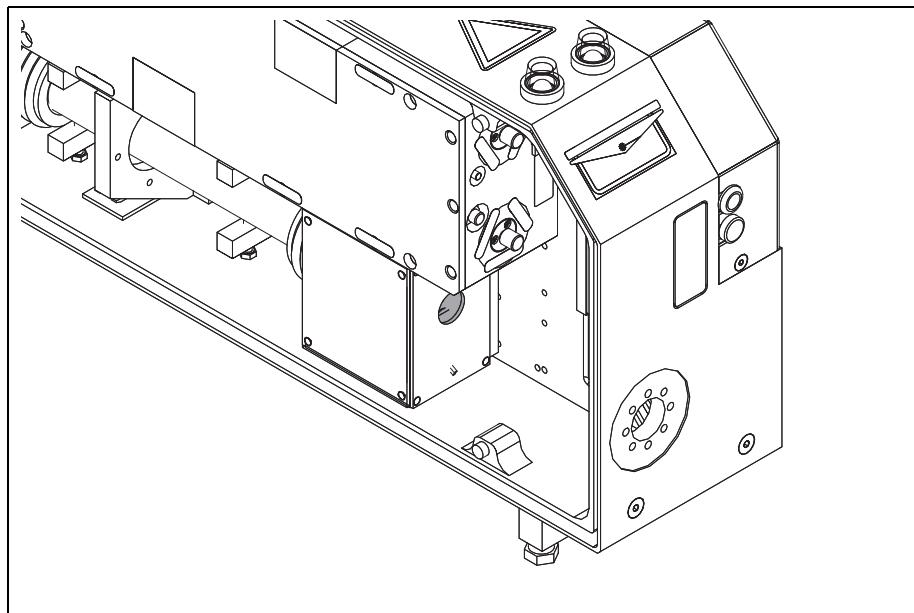


Figure 4.19 Power measurement after the positioning laser module

1. Set the power measuring instrument to the wavelength to be measured.
2. Removing the beam expander.
3. Position the measurement head after the positioning laser module using suitable tools.
4. Perform the measurement (see point 4.6, page 4-16).



CAUTION

Observe the 30 second settling time for the measuring equipment!



CAUTION

Compare the measured power with the beam expansion to detect any power losses.

Troubleshooting

Measurement of the laser power



CAUTION

For laser systems with collimating lens:

Perform the measurement with/without the installed collimating lens.

4.6.6.2 Evaluating the measurement

Fault	Possible reasons	Remedy
Increase in power in relation to the measurement at the galvo flange.	Contamination and/or damage to the beam expander	<ul style="list-style-type: none">• Clean, replace.
Power increase in relation to the measurement after the positioning laser module.	Contamination and/or damage to the positioning laser module	<ul style="list-style-type: none">• Clean, replace.
No power increase	Upstream components (e.g. deflecting mirror, shutter, collimating lens) faulty	<ul style="list-style-type: none">• Perform further power measurements (see point 4.6.7, page 4-30).

4.6.7 Power measurement at the output of the deflecting unit

4.6.7.1 Performing the measurement

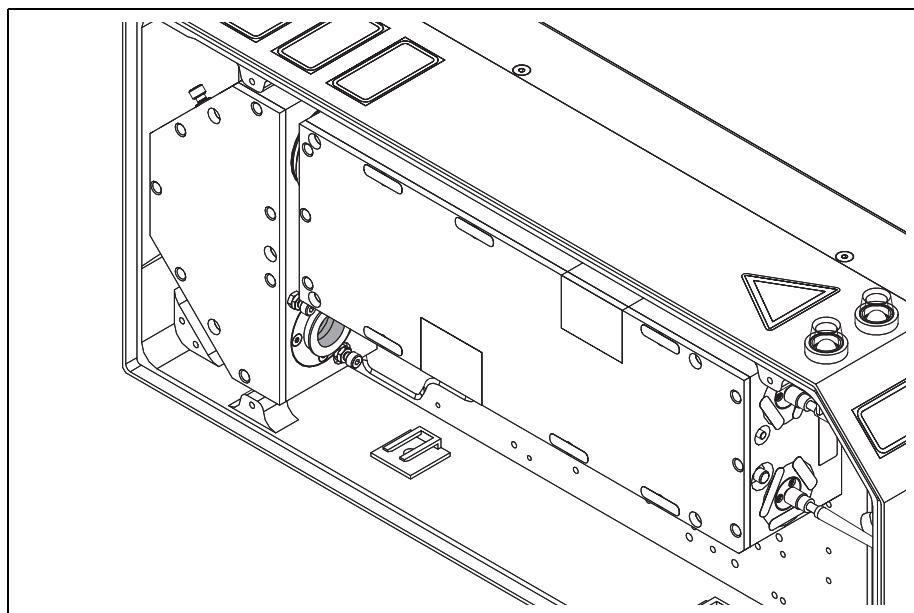


Figure 4.20 Power measurement at the output of the deflecting unit

1. Set the power measuring instrument to the wavelength to be measured.
2. Position the measurement head after the deflecting unit using suitable tools.
3. Perform the measurement (see point 4.6, page 4-16).



CAUTION

Observe the 30 second settling time for the measuring equipment!



CAUTION

Compare the measured power with the power at the galvo flange to detect any power losses due to the IR focusing lens.

4.6.7.2 Evaluating the measurement

Fault	Possible reasons	Remedy
Increase in power in relation to the measurement with the IR focusing lens.	Soiling/damage to the IR focusing lens	<ul style="list-style-type: none">• Clean it / replace the component
No power increase	Preceding components faulty	<ul style="list-style-type: none">• Perform further power measurements (see point 4.6.8, page 4-31).

Troubleshooting

Measurement of the laser power

4.6.8 Power measurement at the output of the resonator module

4.6.8.1 Performing the measurement

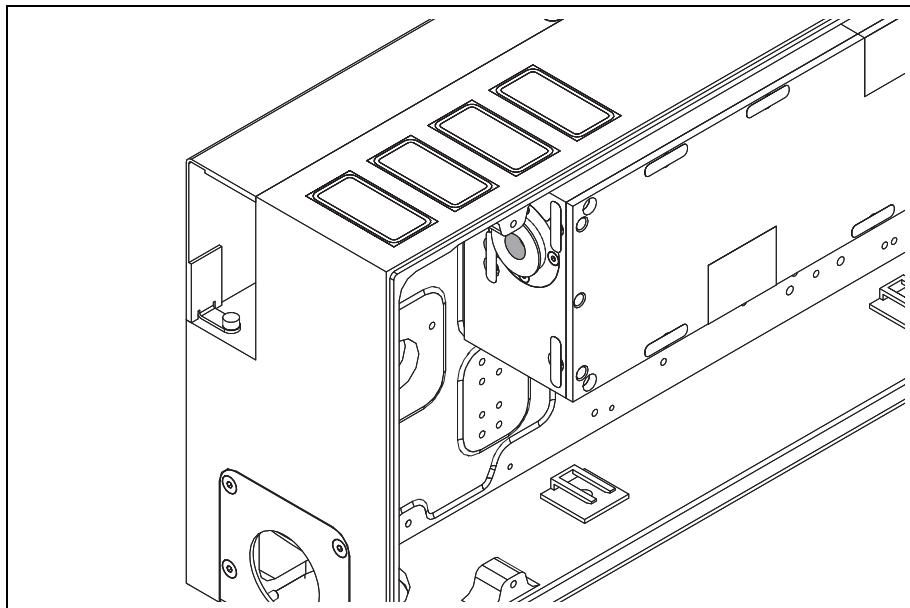


Figure 4.21 Power measurement at the output of the resonator module

1. Dismantling the deflecting unit ([see point 3.1.5, page 3-11](#)).
2. Place the deflecting unit on the laser head and reinser the connecting plug (X25).
3. Set the power measurement device to the wavelength to be measured (**1064 nm**).
4. Position the measurement head at the output of the resonator module.



DANGER

Laser radiation! Shutter has no safety function!

The laser beam cannot be deflected by the shutter.

- Shut down the laser system via the emergency stop in case of emergency!



CAUTION

Risk of damage!

Components may be damaged in the event of improper handling.

- Be careful not to damage the fibers in the interior of the laser head with the laser beam!
- Use beam protection plates if necessary!
- Set the current as low as possible so that the power density is not sufficient to damage the stationary measurement head!
- Under no circumstances may the measurement head be removed while the laser beam is switched on!

5. Perform the measurement ([see point 4.6, page 4-16](#)).



CAUTION

Observe the 30 second settling time for the measuring equipment! To avoid incorrect results, do not move the measurement head during measurements.



CAUTION

Compare the measured power with the power at the output of the deflecting unit to detect any power losses due to the deflecting unit.

4.6.8.2 Evaluating the measurement

Fault	Possible reasons	Remedy
Power increase in relation to the measurement after the deflecting unit.	Soiling of the deflecting mirror	<ul style="list-style-type: none">• Clean it.
	Defective coating of the deflecting mirror	<ul style="list-style-type: none">• Replace the deflecting mirror.
	Defective shutter module	<ul style="list-style-type: none">• Replace the shutter module.
	Defective resonator module (if the diode power, HF/QS, and fiber are OK)	<ul style="list-style-type: none">• Replace the resonator module.
	Fault in the residual level of the hardware/software	<ul style="list-style-type: none">• Check the resonator module.• Check the setting of the HF generator (residual level, settings, cable).• Check the software settings.
Power increase within the tolerance range	Upstream components faulty	<ul style="list-style-type: none">• Perform further power measurements (see point 4.6.9, page 4-33).

Troubleshooting

Measurement of the laser power

4.6.9 Measurement of the diode power



CAUTION

When working with open fiber ends, ensure utmost cleanliness.

4.6.9.1 Performing the measurement

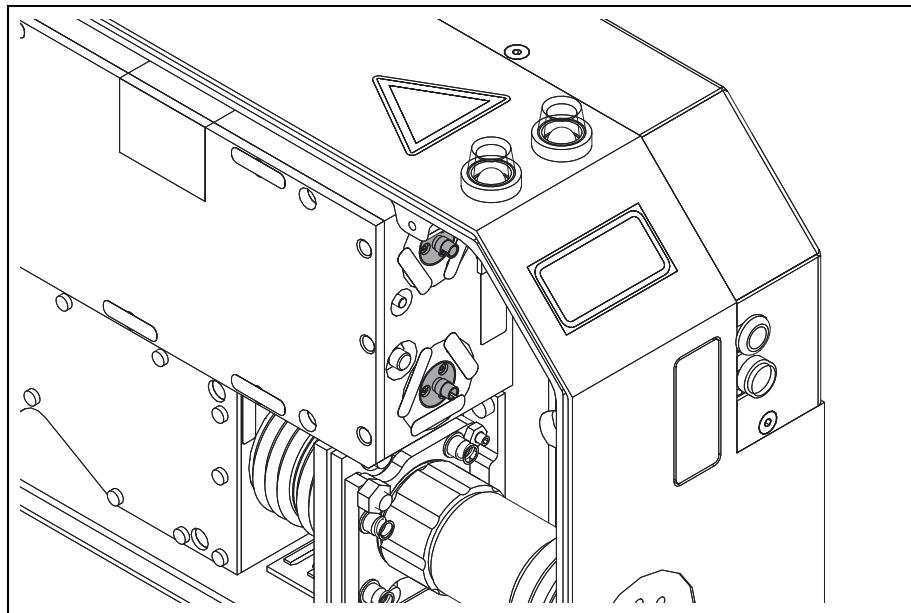


Figure 4.22 Measurement of the diode power

1. Mount the measurement head of the power measuring device at the measuring adapter for the diode power.
2. Disconnect the glass fiber line from the resonator module.
3. Connect the glass fiber line to the measuring adapter.
4. Mount the absorber in front of the respective connection of the removed glass fiber on the resonator module to shield any transmitted residual laser radiation.



CAUTION

Risk of damage to the resonator module!

Reflections may damage the resonator module.

- Position the absorber at a slight angle when doing this to prevent damage to the resonator module!
- Never close the connection on the resonator module using dust protection caps!



CAUTION

Short circuit!

There is a risk of a short circuit in the area of the warning lamps when installing the absorber!

- Do not allow the warning lamp contacts to short-circuit with the metallic absorber!

5. Perform the measurement (see point 4.6, page 4-16).

6. Perform the measurement at the second fiber.



WARNING

Laser radiation!

Risk of accident and injury due to laser radiation!

- *Switch off the laser system before checking for contamination and secure against reactivation!*

7. Using a fiber microscope, check the fiber end for contamination after the measurement and clean or replace if needed. Attach the fiber immediately.

4.6.9.2 Evaluating the measurement

Fault	Possible reasons	Remedy
Power loss at the end of a fiber	Declining diode power	<ul style="list-style-type: none"> • Readjust the laser power using the current limiter (e.g. LaserConsole/MCT).
i CAUTION <i>The maximum power loss is 10%.</i>	Diode module or glass fiber defective	<p>Replace the fiber and repeat the measurement:</p> <ul style="list-style-type: none"> a) Fault occurs in the other diode module > glass fiber defective. b) Fault occurs in the same diode module > diode module defective.
Power loss at both fiber ends	Declining diode power	<ul style="list-style-type: none"> • Readjust the laser power using the current limiter (e.g. LaserConsole/MCT).
	Power supply fault	<ul style="list-style-type: none"> • Check the diode voltage. • Check power supply unit HPC 848/845.
	Diode current fault	<ul style="list-style-type: none"> • Measure the diode current. • Check power supply unit HPC 848/845. • Replace LCS card.
	Service life of the diodes reached	<ul style="list-style-type: none"> • Check logbook entry. • >20,000-40,000 h, then replace/change diodes.

Troubleshooting

Measuring the diode voltage

Fault	Possible reasons	Remedy
No power	Power supply fault	<ul style="list-style-type: none">Check the diode voltage.Check power supply unit HPC 848/845.
	Diode current fault	<ul style="list-style-type: none">Measure the diode current.Check power supply unit HPC 848/845.Replace LCS card.
	Diode module defective	<ul style="list-style-type: none">Replace the diode module.

4.7 Measuring the diode voltage

4.7.1 Performing the measurement

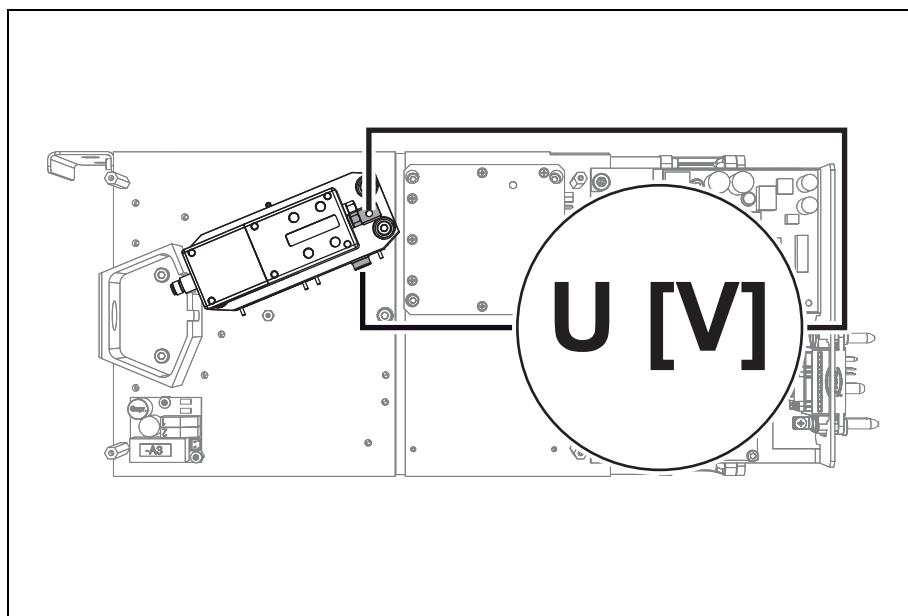


Figure 4.23 One diode voltage measurement

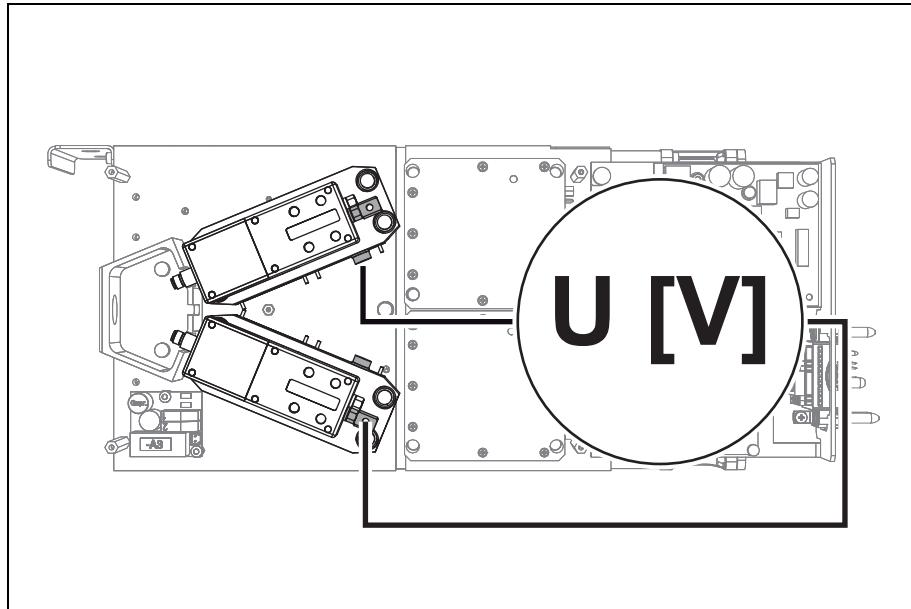


Figure 4.24 Two diode voltage measurement

1. Check voltage on -X6 of the HPC 848/845.
2. **RSM PowerLine E Air-10:** Measure the voltage on the diode.
RSM PowerLine E Air-25/30-: Measure the voltage across both diodes.

Measured values (at maximum current):

- With one diode ~1.7 V to ~2.0 V
- With two diodes ~3.4 V to ~4.0 V

4.7.2 Evaluating the measurement

Fault	Possible reasons	Remedy
Voltage fault	Cable defective	<ul style="list-style-type: none"> • Check the cable.
	Contact point faulty	<ul style="list-style-type: none"> • Check the contact points.
	Power supply fault	<ul style="list-style-type: none"> • Check the HPC 848/845.
	One/both diodes defective (short circuit)	<ul style="list-style-type: none"> • Replace the diode module(s).
No voltage	Power supply fault	<ul style="list-style-type: none"> • Check the HPC 848/845. • Short-circuit bridge (-X6a) connected for the diode module(s)

Troubleshooting

Measuring the diode current

4.8 Measuring the diode current

4.8.1 Performing the measurement

1. Measure the diode current using the clamp-on ammeter.
2. Compare the current value with the programmed current value. The deviation may amount to a maximum of ± 0.5 A.



CAUTION

The clamp-on ammeter used for this measurement must have the appropriate accuracy, i.e. the measurement error of the measuring device may not be greater than the tolerance.

4.8.2 Evaluating the measurement

Fault	Possible reasons	Remedy
Reduced current flow	Power supply fault	<ul style="list-style-type: none">• Measure nominal voltage from the LCS to the HPC 848/845 (10 V corresponds to 70 A).• Check HPC840 power supply unit.• Replace LCS card.
	Contact point faulty	<ul style="list-style-type: none">• Check the contact points (measure the voltage on the diodes and on the HPC 848/845).
No current flow	Power supply fault	<ul style="list-style-type: none">• Check power supply unit HPC 848/845.
	Cable defective	<ul style="list-style-type: none">• Check the cable.
	Contact point faulty	<ul style="list-style-type: none">• Check the contact points and repair them.

4.9 Temperature measurement of the diodes

4.9.1 Performing the measurement

1. Commission the laser system for about ten minutes at maximum current.
2. Check the temperature at the coupling between the diode module/resonator module and the glass fiber (**max. 60 °C**).

4.9.2 Evaluating the measurement

Fault	Possible reasons	Remedy
Temperature too high (max. 60 °C)	Diode module or glass fiber defective	<p>Check the condition of the fiber ends:</p> <ul style="list-style-type: none">• In the event of contamination/damage > replace fibers.• Fibers visually OK > check/replace diode module. <p>Replace the fiber and repeat the measurement:</p> <ul style="list-style-type: none">a) Fault occurs in the other diode module > glass fiber defective.b) Fault occurs in the same diode module > diode module defective.

Troubleshooting

Measuring the temperature of the cooling block

4.10 Measuring the temperature of the cooling block

4.10.1 Performing the measurement

1. Commission the laser system for about ten minutes at maximum current.
2. **Laser systems with one diode:** Check the temperature of the copper block (**max. 25 °C**).
Laser systems with two diodes: Temperature measurement on the copper block between both diodes (**max. 30 °C**).
3. Compare measured values with display in the laser console (Generic View > Laser LS > Temperature of base plate 1). If there are differences, perform troubleshooting.

4.10.2 Evaluating the measurement

Fault	Possible reasons	Remedy
Temperature too high	Cooling block contaminated.	<ul style="list-style-type: none">• Clean the cooling block.
	Malfunction/contamination of the fans.	<ul style="list-style-type: none">• Function check/cleaning of the fans.
	Filter mats contaminated.	<ul style="list-style-type: none">• Clean/replace filter mats.
	Diode insulation damaged.	<ul style="list-style-type: none">• Replace the insulation.
	Peltier elements faulty.	<ul style="list-style-type: none">• Replace the entire cooling element.
	Regulation of the Peltier controller faulty.	<ul style="list-style-type: none">• Replace the Peltier controller.
	Fault in sensor R5.	<ul style="list-style-type: none">• Replace the sensor.
	Ambient temperature too high.	<ul style="list-style-type: none">• Provide appropriate ambient temperatures.
	Plug-in unit incorrectly installed. <ul style="list-style-type: none">• Supply air cannot be correctly suctioned.• Exhaust air blocked.• Exhaust air circulated and is re-suctioned.	<ul style="list-style-type: none">• Provide corresponding air circulation.
Temperature deviation between the measured value and the display in LaserConsole	Correct offset in LaserConsole	<ul style="list-style-type: none">• Set the offset (see point 4.15, page 4-47)

4.11 Measuring the HF power



CAUTION

The HF generators HG 29-40 and HG 29-80 are used. HG 29-80 only for laser systems with external modulator.

4.11.1 Performing the measurement

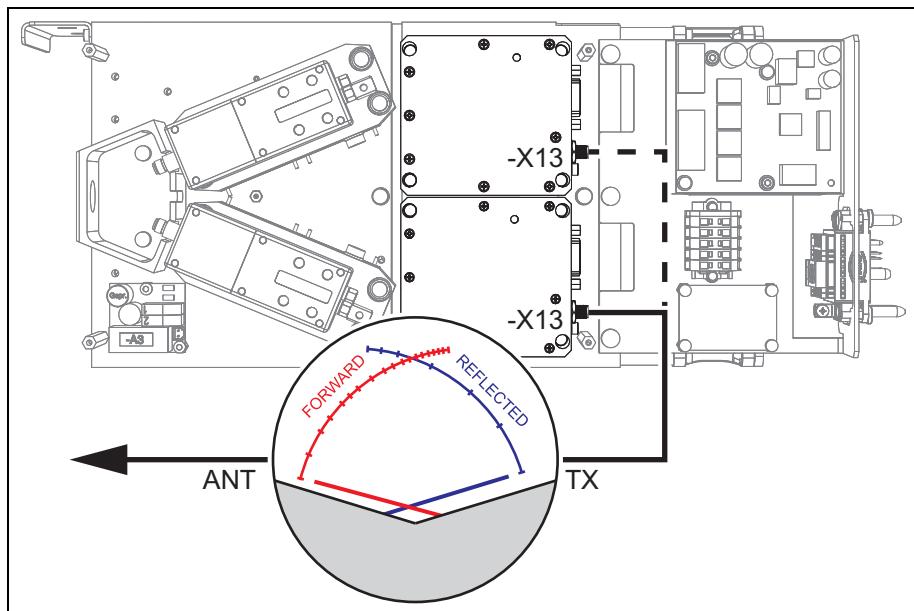


Figure 4.25 Connecting the HF power and standing wave measuring device.

1. Check the power supply (24 V, ± 0.1 V).
2. Compare the measurement with the logbook entry.



CAUTION

Do not bend the HF lines, as this will alter the impedance of the line!

3. Disconnect the HF line -X13 from the HF generator and connect it to the "ANT" connection on the HF power and standing wave measuring device.
4. Connect the "TX" connection on the HF power and standing wave measuring device and the HF connection -X13 of the HF generator with a measuring line.
5. Activate the main switch of the laser system.
6. Set the key switch to the "1" position; leave the shutter closed.
7. Perform the measurement.



CAUTION

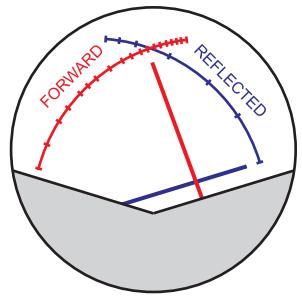
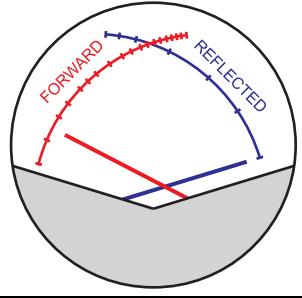
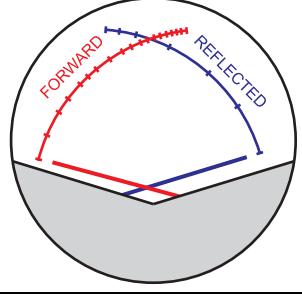
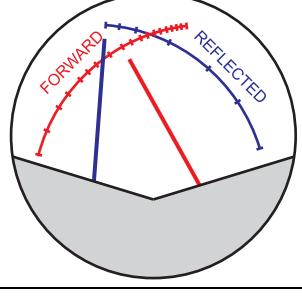
No marking program may be run during the measurement.

8. Switch off the laser equipment.
9. Reassemble the system.

Troubleshooting

Measuring the HF power

4.11.2 Evaluating the measurement

Fault	Possible reasons	Remedy
	<p>Measurement OK</p> <ul style="list-style-type: none"> The measured value lies between 12 and 15 W. 	-
	<p>HF power too low</p> <ul style="list-style-type: none"> Measured value < 10 W 	<ul style="list-style-type: none"> Check voltage 24 V DC on -X5 of the HPC 848/845 (-A2). Check the setting of the HF generator.
	HF fault, no power	<ul style="list-style-type: none"> Check voltage 24 V DC on -X5 of the HPC 848/845 (-A2). Check voltage 24 V DC on the HG -A7 -X12 with adapter. Check LSC. Check ALI-USB. Check cabling.
	HF power okay, reflection of Q-switch	<ul style="list-style-type: none"> Check that the HF line is free of bends or kinks (replace damaged lines). Check the HF cables between the HF generator and resonator module. Replace the resonator module (Q-switch defective).

4.12 Measuring the residual level

4.12.1 Performing the measurement

1. Plug the measuring adapter into -X12 of the HG-24-40/80.
2. Plug connecting plug -X12 into the measuring adapter.
3. Connect the voltmeter to Pin 1 (-) and Pin 8 (+) of the measuring adapter.
4. Switch on the laser system.
5. Set the key switch to the "1" position.
6. Leave the shutter closed.
7. Turn on the laser beam.



CAUTION

The laser beam will be deflected on to the internal measuring head or the absorber.

8. Measure the residual level.
9. Switch off the laser beam.
10. Switch off the laser equipment.
11. Reassemble the system.

4.12.2 Evaluating the measurement

Fault	Possible reasons	Remedy
No voltage	Measurement OK	–
Voltage display (0.05 V)	Residual level circuit, output driver or control defective	<ul style="list-style-type: none">• Check ALI-USB.• Check the HF generator.• Check the cabling.

Troubleshooting

Measuring the Beam On signal

4.13 Measuring the Beam On signal

4.13.1 Performing the measurement

1. Plug the measuring adapter into -X12 of the HG-24-40/80.
2. Plug connecting plug -X12 into the measuring adapter.
3. Connect the voltmeter to Pin 1 (-) and Pin 3 (+) of the measuring adapter.
4. Switch on the laser system.
5. Turn on the laser beam.
6. Open the shutter.
7. Measure the beam on signal.
8. Close the shutter.
9. Switch off the laser beam.
10. Perform fine measurement with an oscilloscope and a fast photo-diode.
11. Switch off the laser equipment.
12. Reassemble the system.



CAUTION

The blanking signal can only then be measured if the system is in "Operation" condition and the "Beam on" command is being issued via LaserConsole or by starting a marking program with the corresponding laser parameters.

4.13.2 Evaluating the measurement

Fault	Possible reasons	Remedy
No voltage with "Beam off" (>0 V to <0.4 V)	Residual level OK	–
Voltage indicated with "Beam off" (>0.4 V)	HF generator control from LSC or ALI-USB defective	<ul style="list-style-type: none">• Check ALI-USB.• Check LSC.• Check the HF generator.• Check the cabling.
No voltage with "Beam on" (<4.4 V)	Fault in actuation of HF generator, LSC or ALI-USB	<ul style="list-style-type: none">• Check ALI-USB.• Check LSC.• Check the HF generator.• Check the cabling.
Voltage indicated with "Beam on" (≥4.4 V to ≤5 V)	Signal OK	–

4.14 Testing the control current of the Peltier elements

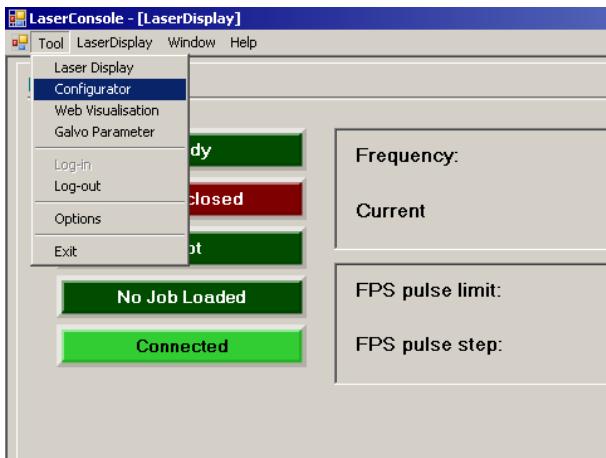


Figure 4.26 Calling Configurator

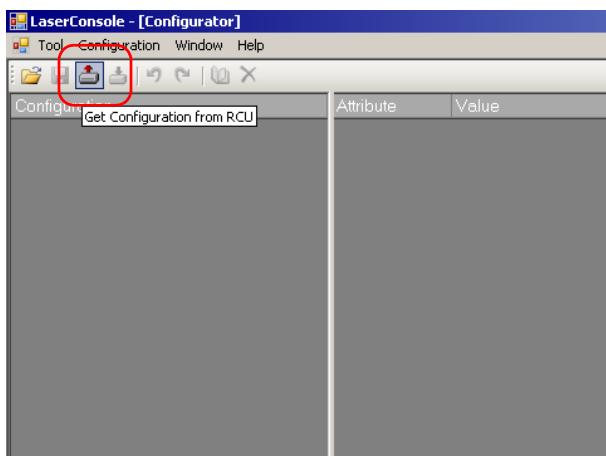


Figure 4.27 Loading the configuration of the RCU

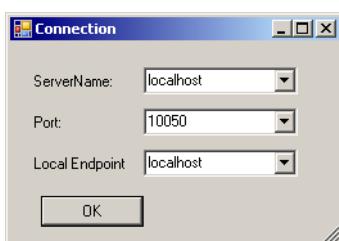


Figure 4.28 Selecting/confirming the connection

1. Call Configurator in LaserConsole (Tool > Configurator).

2. Click the "Get Configuration from RCU" button.

3. Select and confirm the connection in the popup window.

Troubleshooting

Testing the control current of the Peltier elements

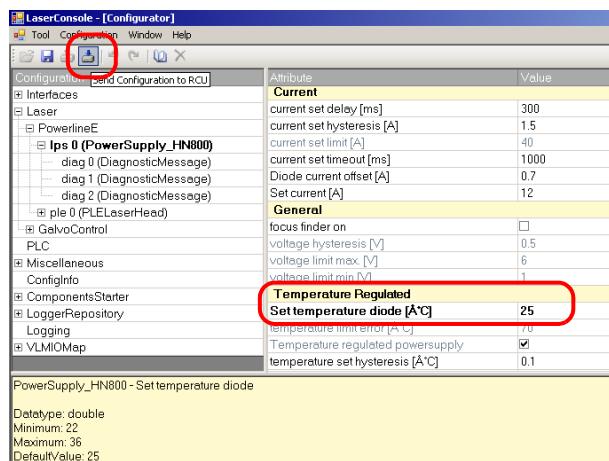


Figure 4.29 Checking/setting the temperature value



CAUTION

Note the currently set temperature value and re-enter it after testing.

4. Check the current temperature value (**25 °C**) and set as necessary.
5. Send the configuration to the RCU using the "Send Configuration to RCU" button.
6. Confirm the sending of the confirmation.
7. End the RCU software and restart it to assume the changes.
8. Set the key-operated switch on the control panel to "0" and then to "1" (system on, shutter off) again.



Figure 4.30 Confirming sending

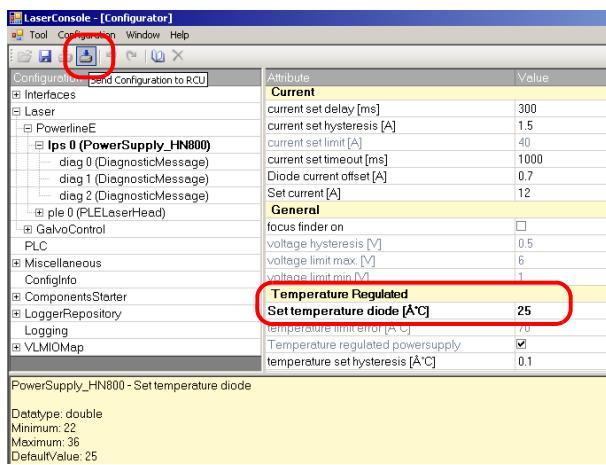


Figure 4.31 Setting the temperature values for measurement

9. Measure the current flow to the Peltier elements using a clamp-on ammeter:

- Heating: set the highest value for the temperature (**28°C**) and send it to the RCU (see **5.** through **8.**). The current flow runs toward zero.
- Cooling: set the value for the temperature (**22°C**) and send it to the RCU (see **5.** through **8.**). Short-term current flow up to **approx. 20 A**.
- Control operation after cooling: current flow up to **approx. 4 A to 7 A** (depending on the ambient temperature and other factors).



CAUTION

A strongly reduced current flow indicates that the Peltier elements are defective. In this case, the cooling element in the plug-in supply unit should be replaced.

10. Call Configurator again.
11. Reset the previously noted highest temperature value.
12. Send the configuration to the RCU.
13. Restart the RCU software.

Troubleshooting

Setting the temperature offset in LaserConsole

4.15 Setting the temperature offset in LaserConsole



CAUTION

In this process, observe the notes on pages 4-49 and 4-50.

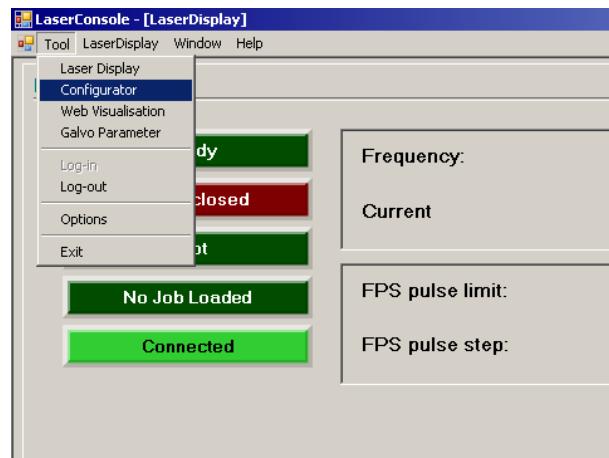


Figure 4.32 Calling Configurator

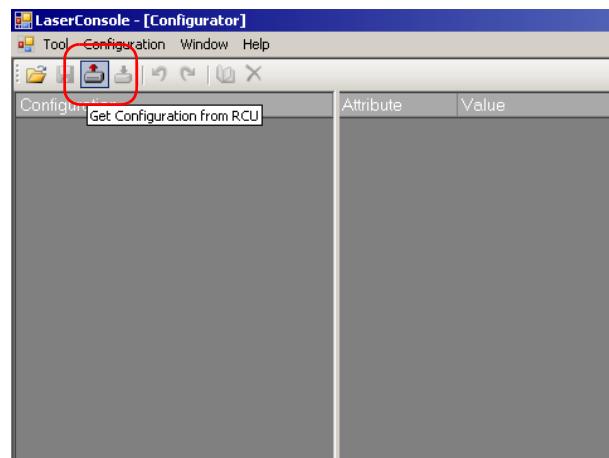


Figure 4.33 Loading the configuration of the RCU

1. Call Configurator in LaserConsole (Tool > Configurator).

2. Click the "Get Configuration from RCU" button.

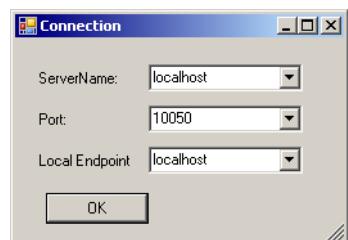


Figure 4.34 Selecting/confirming the connection

3. Select and confirm the connection in the popup window.

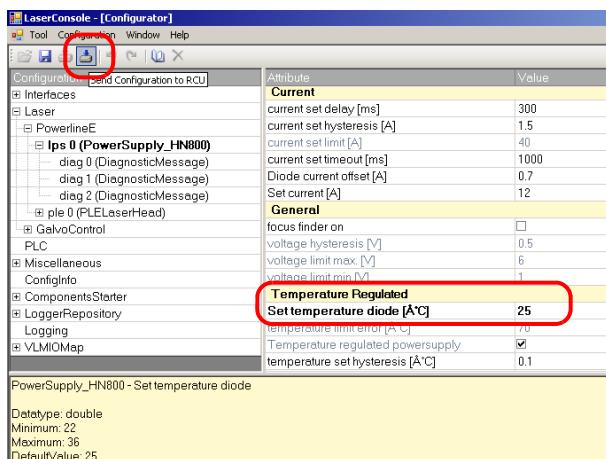


Figure 4.35 Setting the standard temperature

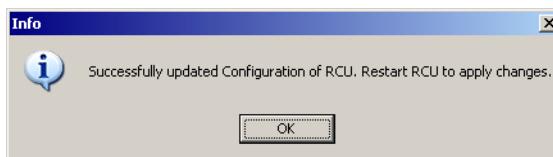


Figure 4.36 Confirming sending

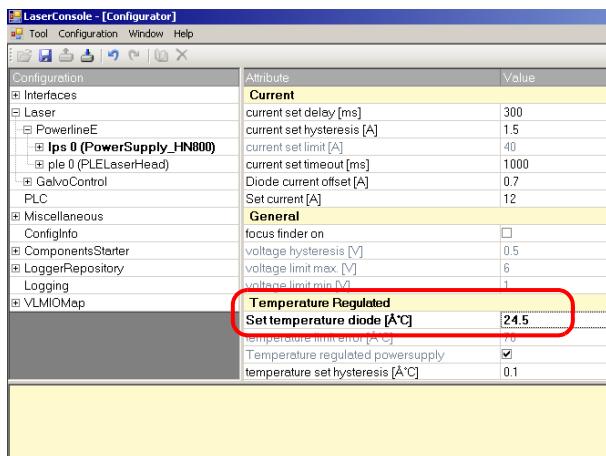


Figure 4.37 Setting the temperature offset

- Set the standard value for the temperature.

RSM PowerLine E Air-10: 25 °C.

RSM PowerLine E Air-25/30:
30 °C.

- Send the configuration to the RCU using the "Send Configuration to RCU" button.

- Confirm the sending of the confirmation.

- End the RCU software and restart it to assume the changes.

- Set the key switch on the control panel to "0" and then to "1" (system on, shutter off) again.

- Perform the temperature measurement on the cooling block (see point 4.10, page 4-39).

- Call Configurator again.

- Set the temperature offset.

For example:

Software display: 25 °C

measured value: 25.5 °C

entry in configurator: 24.5 °C

- Send the configuration to the RCU.

- Restart the RCU software.

- Check the assumption of the calibration by performing the measurement again.

Troubleshooting

Setting the temperature offset in LaserConsole

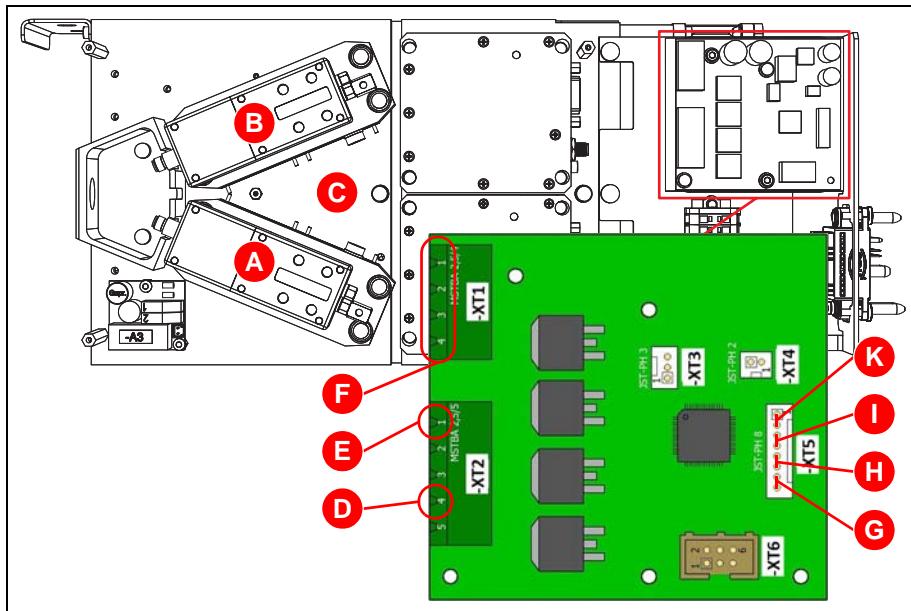


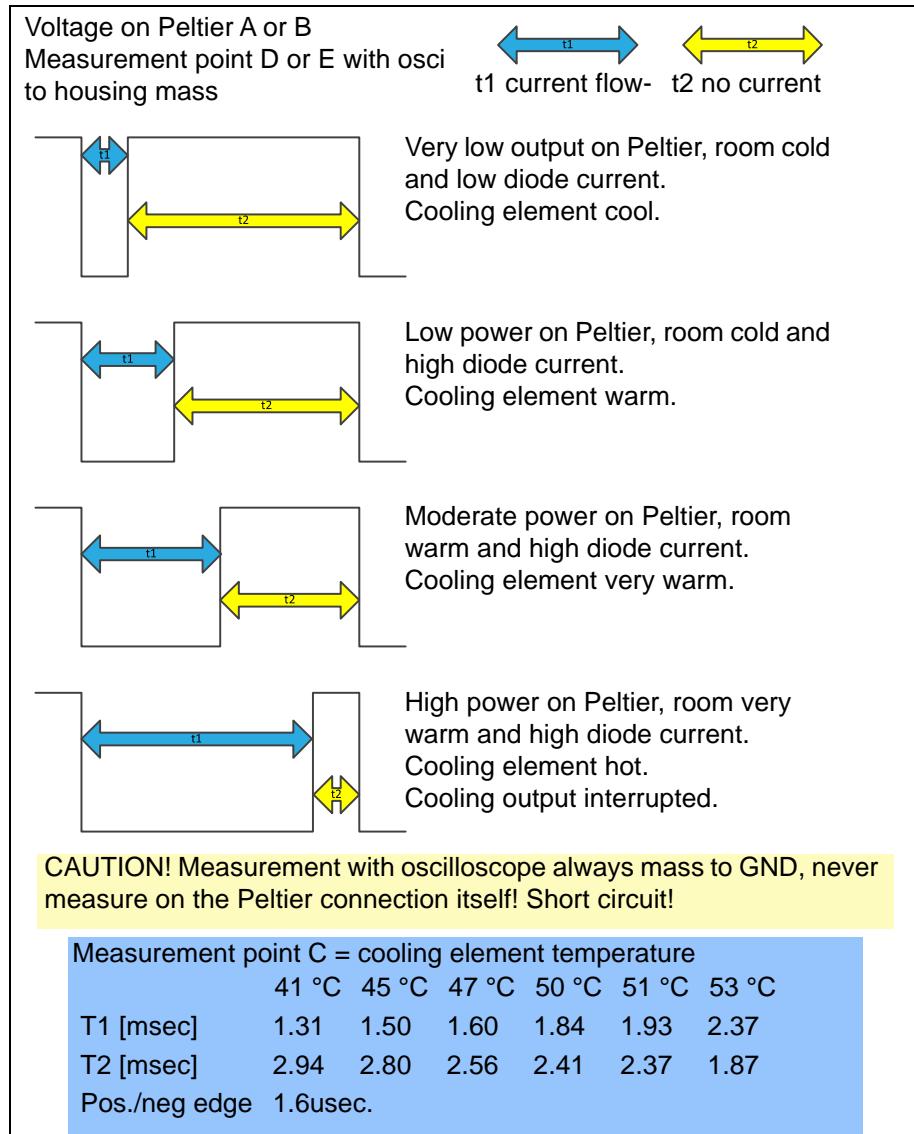
Figure 4.38 Measuring points on the cooling module

Loc- cat ion	Name	Room temperature 23 °C	Room temperature 35 °C
A	Diode cover	38.3 °C ¹⁾	38.3 °C
B	Diode cover	37.7 °C	37.3 °C
C	Cooling element	41.1 °C	51.3 °C
D	Peltier A Voltage A	2.60 A ²⁾ 8.31 V ³⁾	3.70 A 12.97 V
E	Peltier B Voltage B	2.67 A 8.31 V	3.6 A 12.83 V
F	I total U supply	5.3 A 24 V DC	7.30 A 24 V DC
G	U NTC A	1.759 V	1.762 V
H	U NTC B	1.758 V	1.762 V
I	U NTC Reso	-	-
K	U NTC C	3.13 V	2.634 V

1) Temperature measurements with thermometer with contact sensor.

2) Current measurements with DC current clamp.

3) Voltage measurements with multimeter DC.

**Figure 4.39** Voltage measurement with osci

4.16 Loading a new ALI-USB configuration

4.16.1 Initial starting of the RCU (SW)



CAUTION

All lasers with LSC and ALI-USB can already be started WITHOUT RCU (SW)! Set key switch from "0" to "1". This means that lasers with a longer warm-up phase can warm up while the PC is still starting.

When RCU.exe is first started, the ALI-USB is flashed automatically. This is indicated by the RCU in the taskbar flashing yellow for approx. 30 s.

The folder "C:\Rofin\rcu\bin" contains the two files "ALI_USB.ldr" and "Ali_usb_topsheet_v3.bit".

During the flash process, these are renamed to "ALI_USB.ldr.flashed" and "Ali_usb_top-sheet_v3.bit.flashed".



CAUTION

Each time the RCU is started, a check is carried out that ".flashed" has been added to both files as the file extension.

".flashed" present: RCU is started immediately.

".flashed" not present: ALI-USB is only flashed, then the RCU is started.

If it becomes necessary to flash the ALI-USB (e.g. following replacement or a fault), delete the file extension ".flashed" on both files and start RCU.

4.16.2 Installing drivers for ALI-USB and LSC



CAUTION

The LSC card is designated in the Device Manager as "RCU-USB-Interface". "ALI-USB" occurs twice.

1. Open the Control Panel/Device Manager.
2. Right-click the first of the three standard entries.
3. Select "update driver software".
4. Click "Browse my computer for driver SW".
5. In the next window, click "browse" and select the folder "C:\Rofin\Support\FTD2xx".
6. Click "OK" and then "NEXT".
7. Confirm the "install this driver software anyway" confirmation prompt.
8. Repeat the process for the other two entries.

4.17 Checking ALI-USB system settings



Figure 4.40 Open the computer control panel

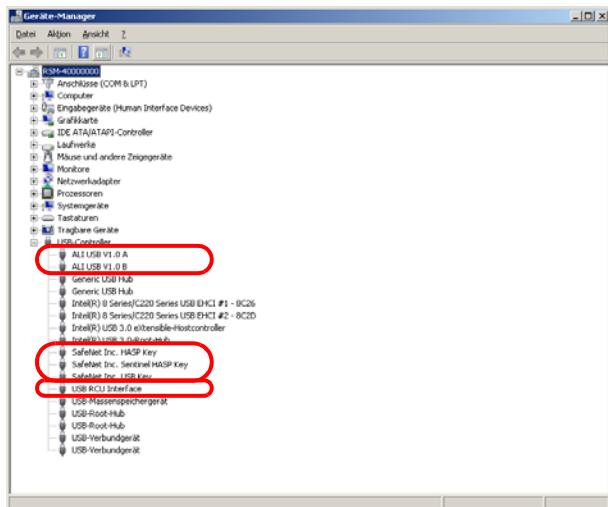


Figure 4.41 Device Manager

1. Open the computer control panel (right click on "My computer > Manage").

2. Open the Device Manager.
3. Under "USB-Controller", check for the presence of the ALI-USB and USB RCU interface. Check for the presence of the USB-VLM dongle as well.

CAUTION

The LSC card is designated in the Device Manager as RCU-USB-Interface, ALI-USB occurs twice there.

4. Open device properties by right-clicking the entry in each case.

Troubleshooting

Checking ALI-USB system settings

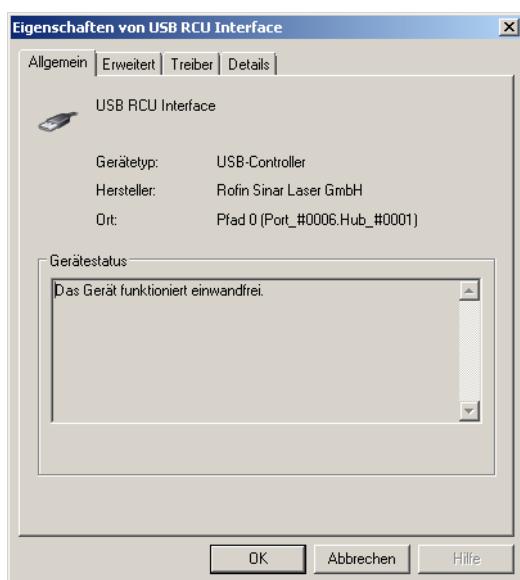


Figure 4.42 Device properties
LSC

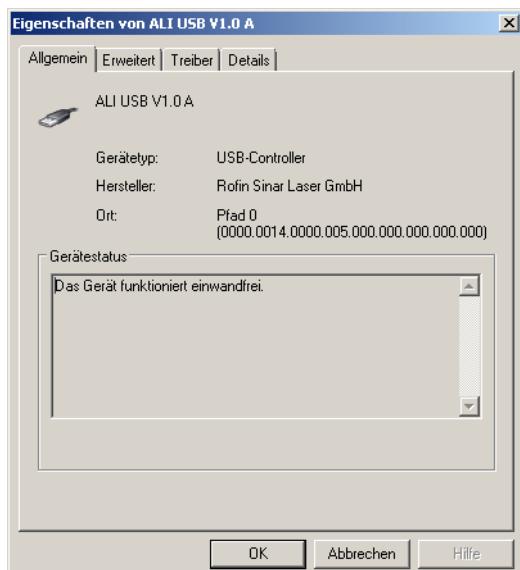


Figure 4.43 Device properties
ALI USB A

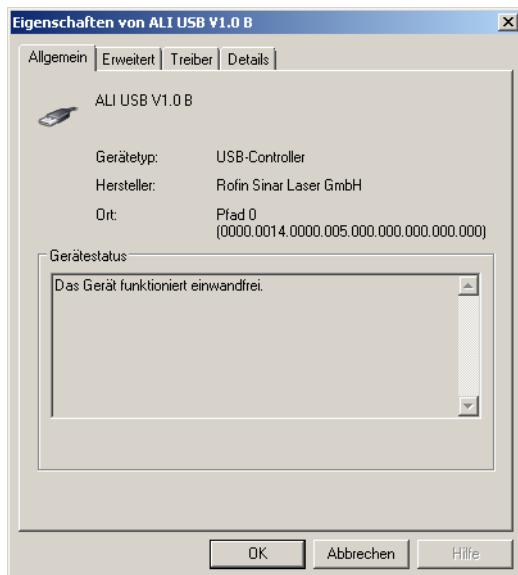


Figure 4.44 Device properties
ALI USB B

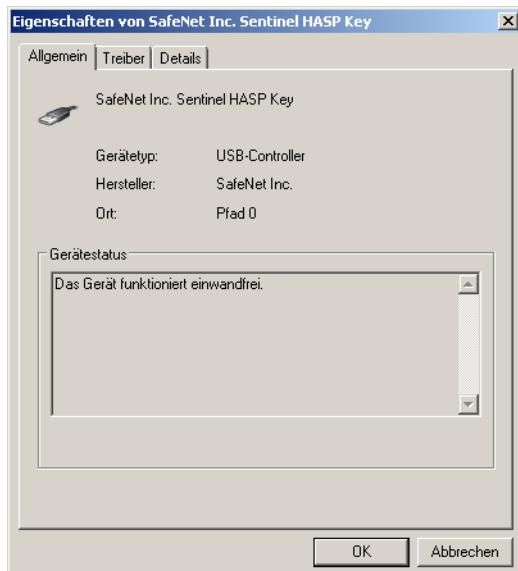


Figure 4.45 Device properties
USB-Dongle 1

Troubleshooting

Checking ALI-USB system settings

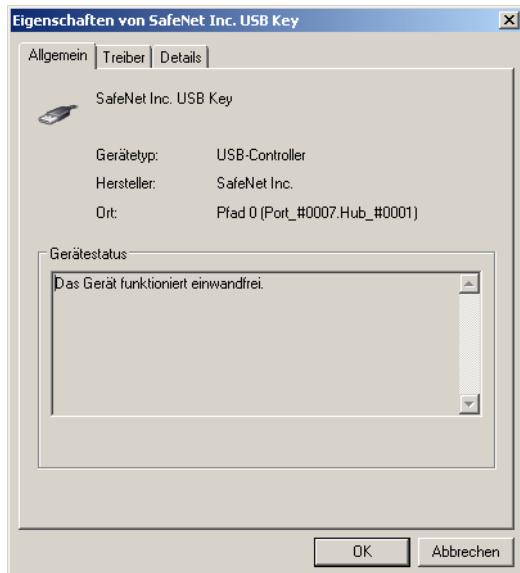


Figure 4.46 Device properties
USB-Dongle 2

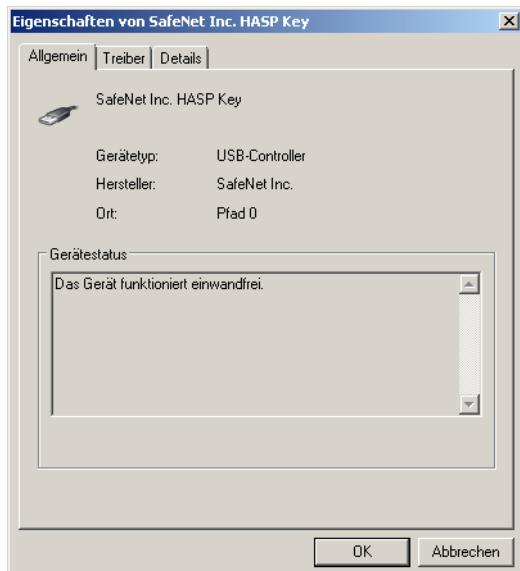


Figure 4.47 Device properties
USB-Dongle 3

Notes

5 Checking and cleaning optical components



WARNING

Hazards due to non-observance of safety instructions!

Hazards for persons and/or property can arise due to non-observance of safety instructions.

- All safety instructions in the [Chapter 2, Safety](#) should be observed during all work on the laser system.
-



CAUTION

The surfaces of the optical components are to be cleaned according to the maintenance schedule.



CAUTION

Risk of contamination!

When touching optical components with your bare hands, there is a risk of contamination.

- Wear nitrile gloves to prevent contamination of the optics!
 - When using nitrile rubber gloves, the work instructions supplied with the gloves must be observed!
-



CAUTION

For cleaning, lens cleaning paper and water-free isopropyl alcohol or purified compressed air should be used! Water in the isopropanol causes surface streaks.



WARNING

Isopropyl alcohol!

Isopropyl alcohol basically has special dangers. The substance is highly flammable. It irritates the eyes. Fumes can cause sleepiness and a dazed state.

- It may basically only be used by accordingly trained personnel with the necessary care.
- The safety data sheet must always be observed!



CAUTION

Under no circumstances should cleaning fluid be permitted to get inside the laser system! Operational malfunctions could otherwise result!



CAUTION

Sensitive optical components!

Risk of damage to optical components!

- *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!*
 - *Cleaning tasks must be carried out in a dust-free and climatically controlled environment!*
-



CAUTION

Use isopropanol (2-propanol for analysis ACS, ISO; purity 99.8%) for cleaning optical components. Use and store containers properly; keep the original containers closed and never retain or use the contents any longer than two years.

5.1

Basic procedure for cleaning

1. Dismantle optical components as described in [Chapter 3](#).
2. Blow the dust off of the surface to be cleaned using clean, dry and oil-free air or nitrogen.



WARNING

Nitrogen!

There is risk of health hazards when handling nitrogen!

- *If nitrogen is used, appropriate protective measures must be initiated!*
-

3. Cut the lens cleaning paper with scissors to produce a strip that is a little narrower than the surface to be cleaned. This will ensure that the lens cleaning paper lies completely on the surface to be cleaned.
4. Clean optical components using lens cleaning paper and isopropyl alcohol.

5.2 Cleaning lenses and mirrors

The following components must be cleaned when fitted because it is not possible to completely dismantle them:



Deflecting mirror power measurement (option).



CAUTION

The retaining block can remain in the protective glass holder for cleaning purposes.

Figure 5.1 Deflecting mirror power measurement



Galvo head focusing optics

Figure 5.2 Galvo head focusing optics



Galvo head deflecting mirror

Figure 5.3 Galvo head deflecting mirror



Figure 5.4 Beam expander

Beam expander



CAUTION

Both of the outside lenses must be cleaned.



CAUTION

The cleanliness must be checked with the aid of a magnifying glass (with at least 10x magnification) or microscope.



Figure 5.5 Positioning laser emergence lens

Positioning laser emergence lens

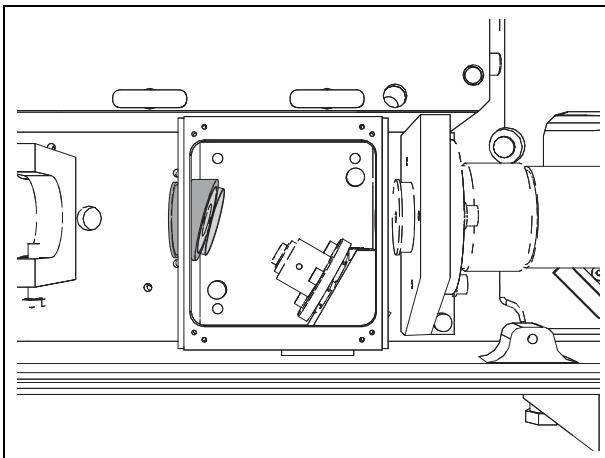


Figure 5.6 Positioning laser coupling mirror

Positioning laser coupling mirror



CAUTION

It is only possible to clean the inside of the coupling mirror with fluid. The outside can only be cleaned with compressed air.

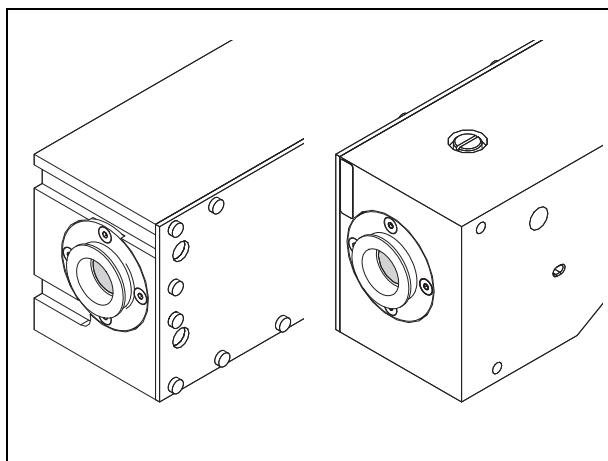


CAUTION

The cleanliness must be checked with the aid of a magnifying glass (with at least 10x magnification) or microscope.

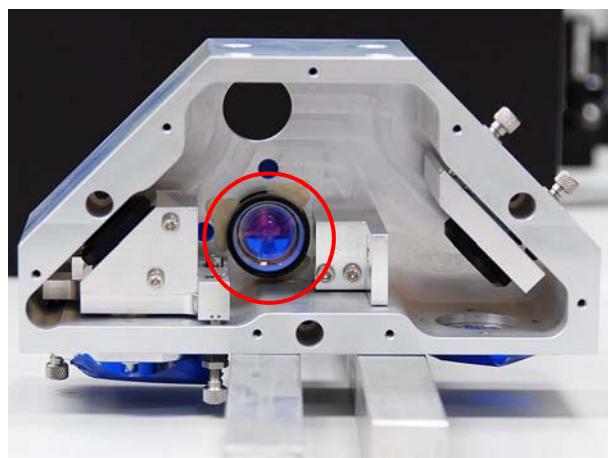
Checking and cleaning optical components

Cleaning lenses and mirrors



Inlet and outlet lens of external modulator

Figure 5.7 Inlet and outlet lens of external modulator



Deflecting unit/shutter mirror absorbing lens

Figure 5.8 Deflecting unit absorbing lens



Shutter module

Figure 5.9 Shutter module

Performing the cleaning



Figure 5.10 Clean lenses and mirrors

- Fold the lens cleaning paper and grasp with tweezers.
- Place the lens cleaning paper on the surface to be cleaned and, with a dropper bottle, apply 1-2 drops of isopropyl on the lens cleaning paper.
- Carefully pull off the paper moistened with isopropanol.
- Turn the component to be cleaned by 90° and draw the isopropanol-soaked lens cleaning paper over the surface once again. This will minimize streaking.
- Inspect the cleaning results with the aid of a flashlight.
- Repeat the cleaning procedure until the surface of the optics is clean.
- If possible, 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.

5.3 Cleaning protective glasses



Figure 5.11 Cleaning protective glass (1)

- Hold the component to be cleaned at the sides.



Figure 5.12 Cleaning protective glass (2)

- Place the lens cleaning paper on the surface to be cleaned and, with a dropper bottle, apply 1-2 drops of isopropyl on the lens cleaning paper.

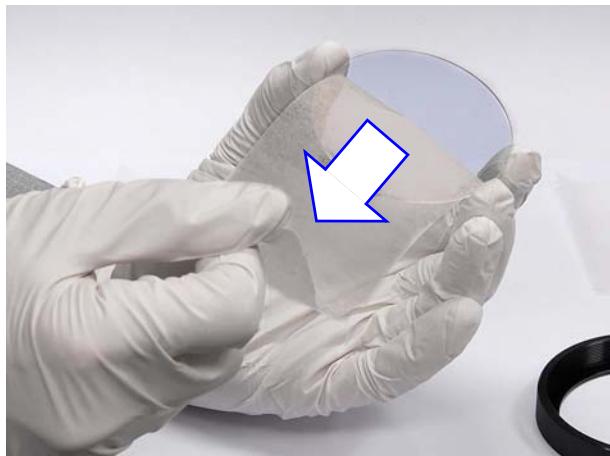


Figure 5.13 Cleaning protective glass (3)

- Carefully pull off the paper moistened with isopropanol.
- Turn the component to be cleaned by 90° and draw the isopropanol-soaked lens cleaning paper over the surface once again. This will minimize streaking.
- Check the cleaning result using a suitable light source.



CAUTION

For each cleaning process, always use a new lens cleaning paper cloth to prevent recontamination.

- Repeat the cleaning procedure until the surface of the optics is clean.
- Always clean both sides of lenses or partially two-way mirrors. In the process, make sure that both previously cleaned surfaces are not recontaminated.



CAUTION

To prevent recontamination, do not moisten cleaned surfaces (e.g. by breathing on them).

5.4 Cleaning glass fiber lines



Figure 5.14 Connecting the glass fiber lines to the fiber microscope

- Using a fiber microscope, inspect the ends of the glass fiber lines for contamination and burn marks.

i CAUTION

Different adapters are required to evaluate both fiber ends.

i CAUTION

The focal length differs on both fiber ends.

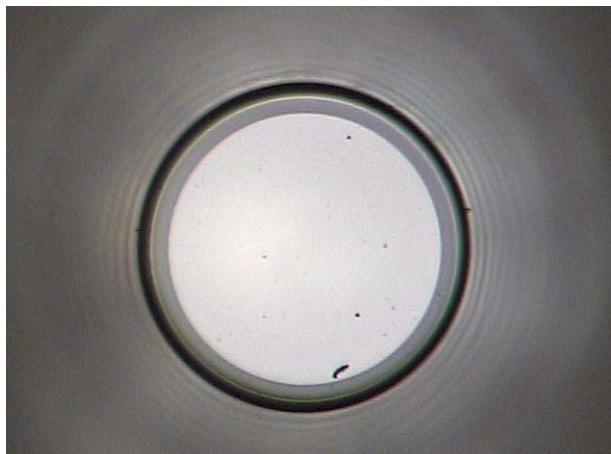


Figure 5.15 Contaminated fibers

- Figure 5.15 shows an example of a contaminated fiber.

i CAUTION

Glass fiber lines that cannot be cleaned according to the manner described here must be replaced.

If the power loss in the fiber is less than 10% it is unnecessary to replace the fiber.

5.5 Resonator module

i CAUTION

No cleaning should be performed on or in the resonator module. If necessary, the resonator module should be replaced as a complete unit. Repair and cleaning inside the resonator module may be performed only by ROFIN-SINAR. In case of non-observance, the warranty is no longer valid.

Notes

6 Adjustment tasks



WARNING

Hazards due to non-observance of safety instructions!

Hazards for persons and/or property can arise due to non-observance of safety instructions.

- All safety instructions in the [Chapter 2, Safety](#) should be observed during all work on the laser system.
-



CAUTION

Risk of damage to the adjusting aids!

Damaged adjusting aids lead to imprecise adjusting results!

- Careful handling of the adjusting aids must be guaranteed!
-



CAUTION

All settings and checks, etc. of the hardware or software must be performed according to the operating instructions for the relevant laser type. Values and settings that differ are not permissible for adjustment or verification.



CAUTION

If power differences are ascertained between both measurements, check the beam position again and adjust if necessary. If required, the optical components (deflecting mirror) must be checked again; clean and replace as necessary.

6.1 Adjusting steps to be carried out

6.1.1 Laser systems in basic version

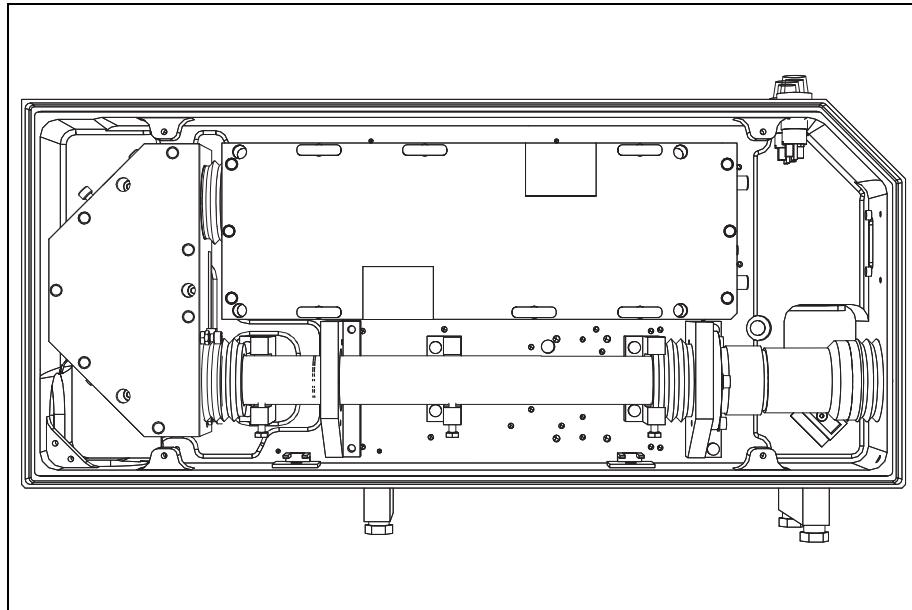


Figure 6.1 Laser systems in basic version

1. Dismantle the galvo head (see point 3.1.3, page 3-6).
2. Remove the beam expander (see point 3.1.8, page 3-26).
3. Perform the basic adjustment of the laser beam (see point 6.5.2.1, page 6-20).
4. Install beam expander.
5. Check beam position.
6. Adjust beam expander if necessary.
7. Mount the galvo head.
8. Measure laser power.
9. Perform field correction and check.

Adjustment tasks

Adjusting steps to be carried out

6.1.2 Laser systems with positioning laser

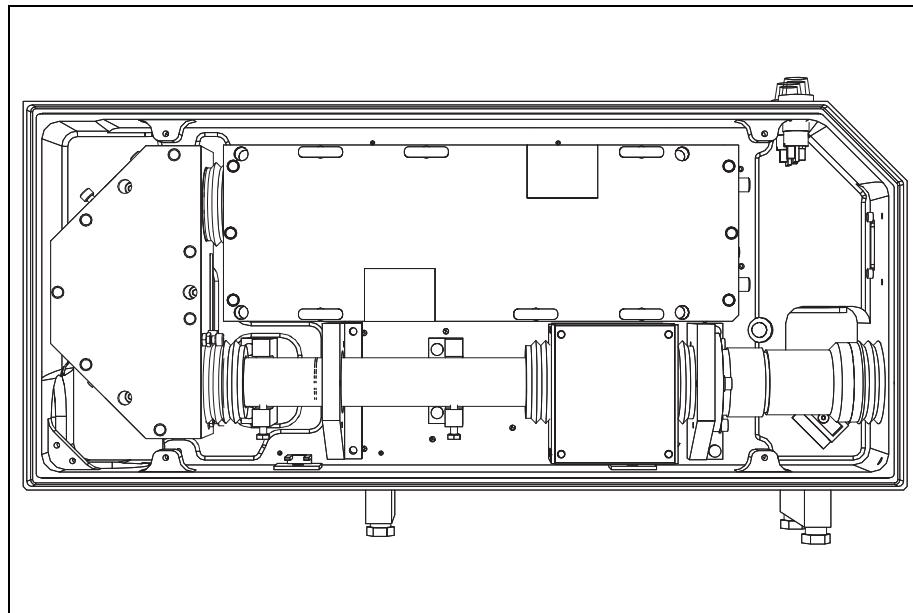


Figure 6.2 Laser systems with positioning laser

1. Dismantle the galvo head ([see point 3.1.3, page 3-6](#)).
2. Remove the beam expander ([see point 3.1.8, page 3-26](#)).
3. Perform the basic adjustment of the laser beam ([see point 6.5.2.1, page 6-20](#)).
4. Install beam expander.
5. Check beam position.
6. Adjust beam expander if necessary.
7. Mount the galvo head.
8. Measure laser power.
9. Adjust positioning laser.
10. Perform field correction and check.

6.1.3 Laser systems with external modulator

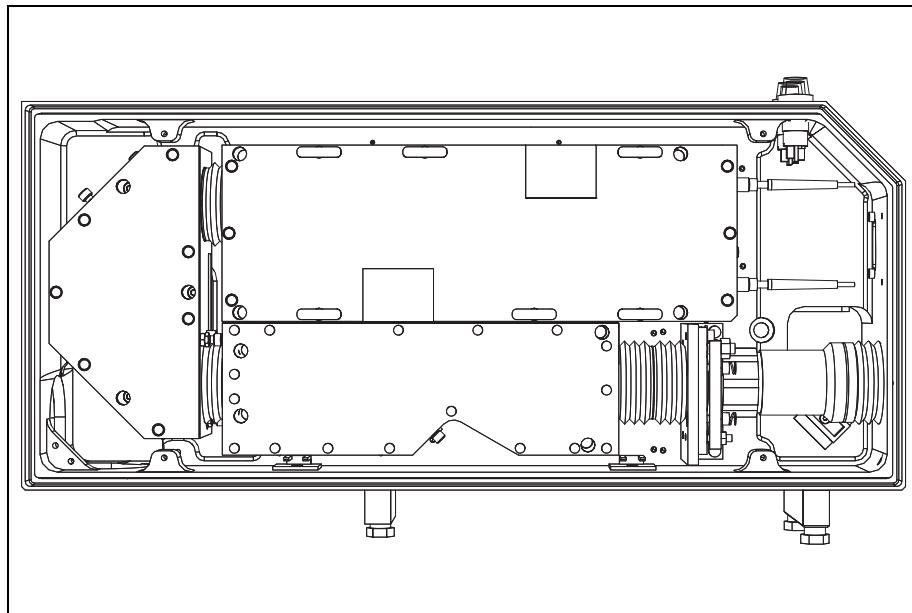


Figure 6.3 Laser systems with external modulator

1. Dismantle the galvo head ([see point 3.1.3, page 3-6](#)).
2. Remove the beam expander ([see point 3.1.8, page 3-26](#)).
3. Remove external modulator ([see point 3.1.4, page 3-8](#)).
4. Perform the basic adjustment of the laser beam ([see point 6.5.2.1, page 6-20](#)).
5. Perform the fine adjustment of the laser beam with the WinCam ([see point 6.5.2.2, page 6-32](#)).
6. Install external modulator and check beam position using the WinCam.
7. Maximize output of the external modulator.
8. Install beam expander.
9. Check the beam position again using the WinCam.
10. Adjust beam expander if necessary.
11. Mount the galvo head.
12. Measure laser power.
13. Perform field correction and check.

6.2 Preparatory tasks

i CAUTION

All settings and checks, etc. of the hardware or software must be performed according to the operating instructions for the relevant laser type. Values and settings that differ are not permissible for adjustment or verification.

6.2.1 LaserConsole



Figure 6.4 LaserConsole

1. Start the PC and load WIN-DOWS®.
2. Start "LaserConsole > LaserDisplay".
3. In the tree view, select "Laser >Laser_LSC".
4. Under "Options", check the activation of the beam protection time and deactivate the "Beam time protection enabled" value if necessary (see figure 6.4).

i CAUTION

Reactivate the setting after completion of the adjustment work (if previously active).

6.2.2 PC configuration

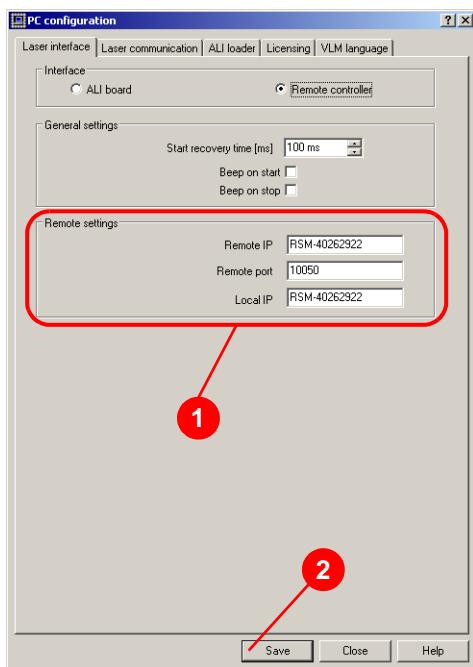


Figure 6.5 PC configuration

6.2.3 WinCam software

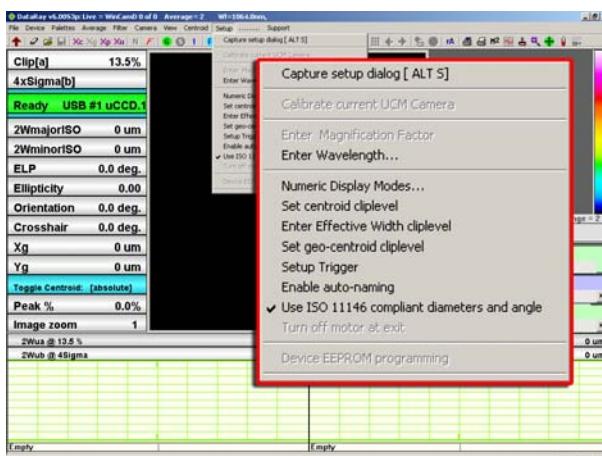


Figure 6.6 WinCam settings (1)

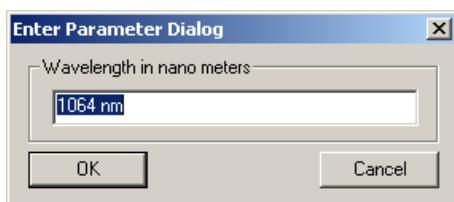


Figure 6.7 WinCam settings (2)

1. Start the PC and load WIN-DOWS®.
2. Start PC configuration.
3. Under "Remote settings" (1) (Figure 6.5), check the values (name of the laser, e.g.: RSM-XXXXXXX) and adjust if necessary.

i CAUTION

If the name is incorrect, it is not possible to establish a connection via RCU.

4. Activate changed values by clicking the "Save" button (2).

1. Start the PC and load WIN-DOWS®.
2. Open the "DataRay" program on the PC.
3. Make or check basic settings to the software:
 - Select Setup > "Use ISO 11146 compliant diameters and angle".

4. Select Setup > "Enter Wavelength ..." and enter the wavelength of the laser in nm (e.g. 1064 nm).

Adjustment tasks

Preparatory tasks

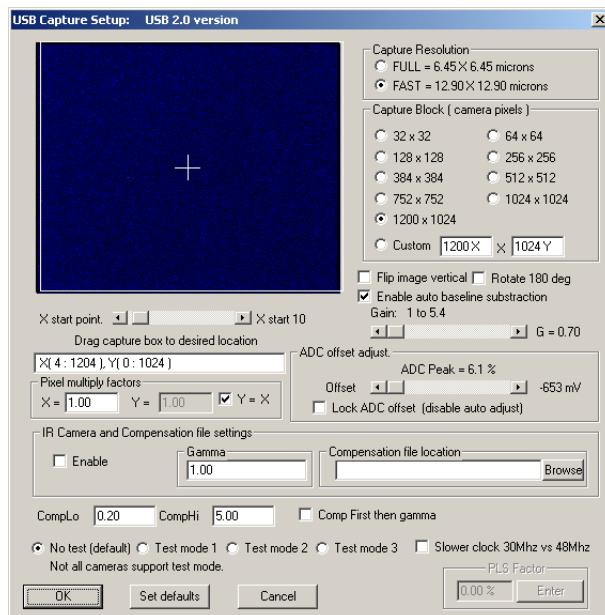


Figure 6.8 WinCam settings (3)

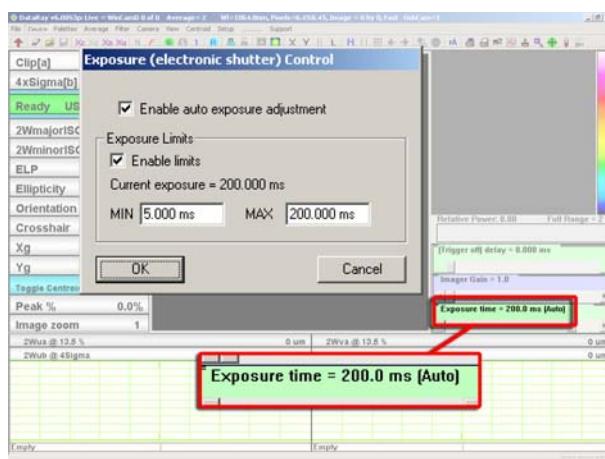


Figure 6.9 WinCam settings (4)

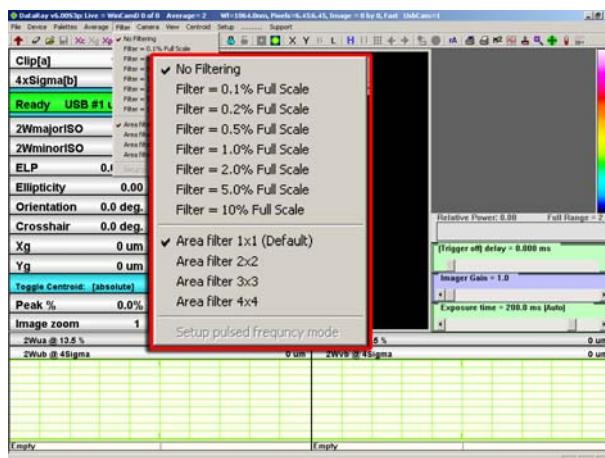


Figure 6.10 WinCam settings (5)

- Call up Setup > "Capture Setup Dialog" and make the settings according to [Figure 6.8](#).

- Using the right-hand mouse button, click on "Exposure time" and, in the pop-up that opens, set the limits for the exposure time according to [Figure 6.9](#).

- In the "Filter" menu, select the "No filtering" and "Area filter 1x1 (Default)" options.

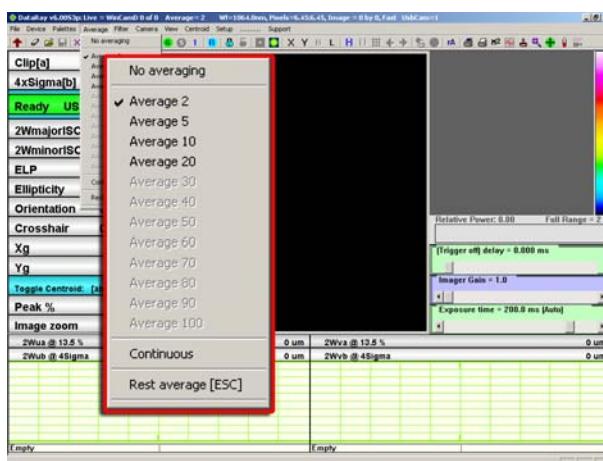


Figure 6.11 WinCam settings (6)

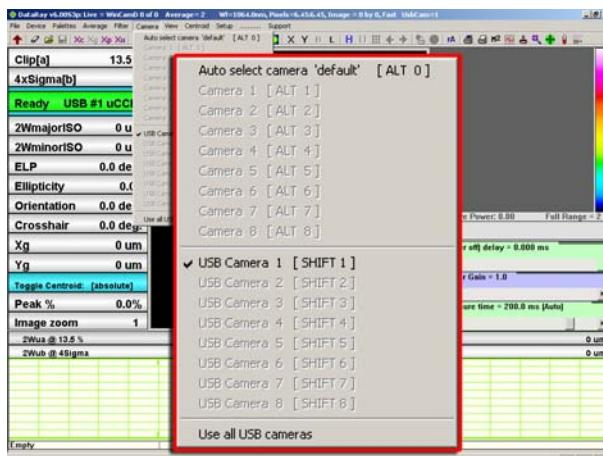


Figure 6.12 WinCam settings (7)

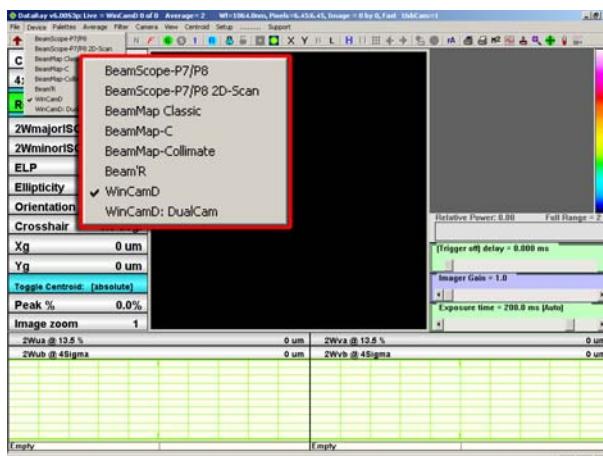


Figure 6.13 WinCam settings (8)

8. In the "Average" menu, select the "Average 2" option.

9. In the "Camera" menu, select the "USB Camera 1" option.

10. In the "Device" menu, select the "WinCamD" option.

Adjustment tasks

Preparatory tasks

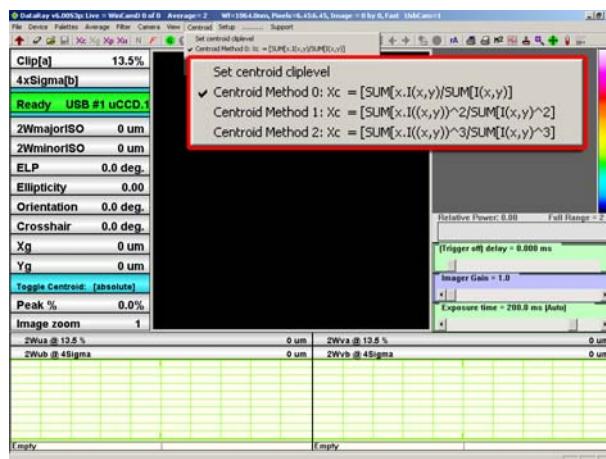


Figure 6.14 WinCam settings (9)

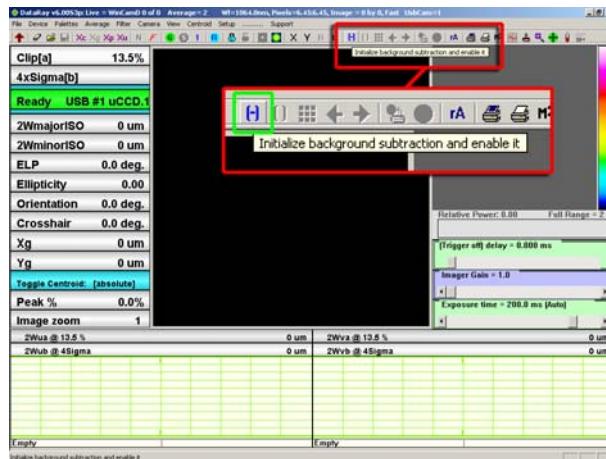


Figure 6.15 WinCam settings (10)



Figure 6.16 WinCam settings (11)

- In the "Centroid" menu, select the "Centroid Method 0: Xc = [SUM[I(x,y)]/SUM[I(x,y)]]" option.

- Click on the "Initialize background subtraction and enable it" button to adjust the offset for the ambient noise due to the incidence of external light.

CAUTION

Risk of damage!

No laser beam is permitted to impinge on the camera during this process.

– Shutter must be closed.

- Confirm the input prompt (Figure 6.16).

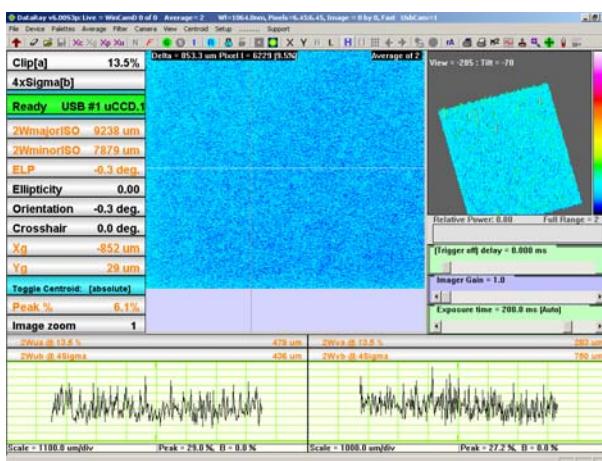


Figure 6.17 Noise suppression deactivated

Figure 6.17 shows the WinCam with noise suppression deactivated.

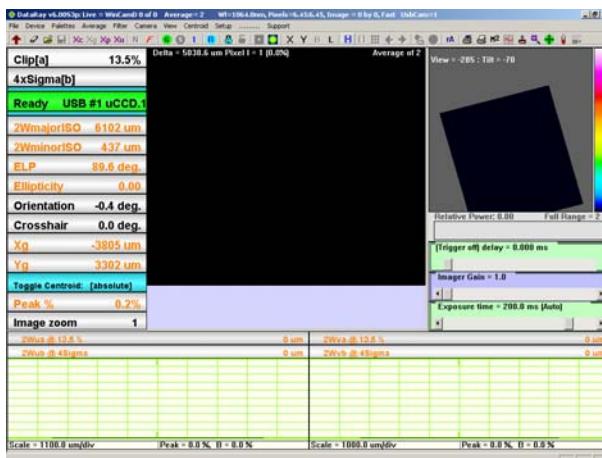


Figure 6.18 Noise suppression activated

Figure 6.18 shows the WinCam with noise suppression activated.



CAUTION

If the ambient light changes, the noise suppression must be initialized again.

6.3 Adjusting the laser head

1. Check the X and Y directions of the position of the workpiece support plate using a machine level gauge.
2. Perform an adjustment if necessary.
3. Check the X and Y directions of the position of the galvo head by placing a machine level gauge on the protective glass slide.
4. Adjust the position of the galvo head using the three-point support plate of the laser head if necessary.



CAUTION

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, adjust if necessary ([see point 6.4, page 6-12](#)).

6.4 Adjusting the focus distance

6.4.1 Mechanical basic settings

1. Place the test material on the workpiece support plate.

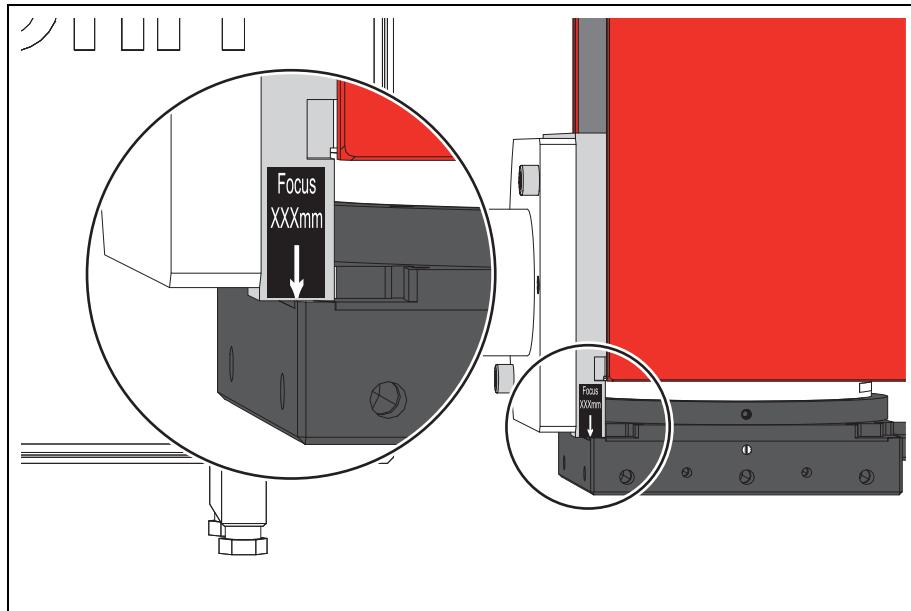


Figure 6.19 Measure the focal distance

2. Read off focus distance on the reference point (see figure 6.19).
3. Mechanically readjust the focal distance as needed.
4. Check the field value and readjust.
5. Set the focus by means of the beam expander (see point 6.4.2, page 6-13).

Adjustment tasks

Adjusting the focus distance

6.4.2 Manual focus setting



CAUTION

The field value must be within the tolerance.

1. Switch off the laser system and secure it against reactivation.
2. Mount the cover on the resonator side of the laser head.
3. Secure the laser system against being switched on (remove the key from the key switch).



WARNING

Laser radiation!

Risk of accident and injury due to laser radiation!

- *Take measures to protect against laser radiation!*
-

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



DANGER

Laser system opened, safety devices missing!

With the laser system opened and/or safety devices removed, there is a serious risk of accident!

- *Take measures for protection against laser radiation (wear laser safety goggles, wear PPE, setup and position partition walls, attach warning signs and barriers, etc.).*
 - *All persons present must be protected.*
 - *These measures must be coordinated with the laser safety officer.*
 - *Ensure a shutdown in the event of danger (e.g. press emergency stop switch/main switch on the laser system by a second person)!*
-

5. Lay marking material (anodized metal sheet, coated paper) under the galvo head.



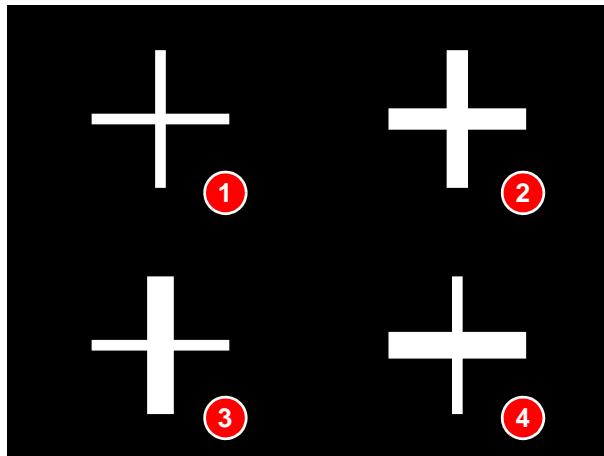
WARNING

Fire hazards!

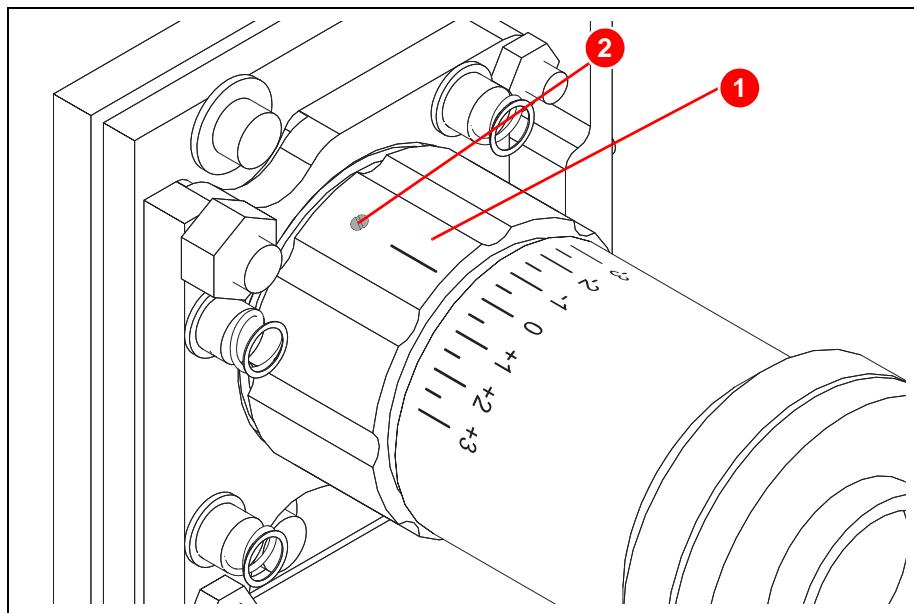
When using unsuitable marking material there is a risk of fire!

- *Under no circumstances may the absorbing surface be made of flammable materials!*
-

6. Switch on the laser system using the key switch.
7. Open shutter; the emission of the laser beam is blocked by the Q-switch.
8. Allow the program for the cross in the middle of the field with the material to run according to the laser parameters.
9. Close the shutter.

**Figure 6.20** Check focus setting

10. Check the cross depicted. 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) ([Figure 6.20](#)) (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)

**Figure 6.21** Beam expander

11. If necessary, change the focal point by adjusting the adjusting ring (1) ([Figure 6.21](#)).
12. Move material under the galvo head, open the shutter, and let the program run.
13. Check the image of the cross.

**CAUTION**

Repeat Steps 7 through 13 until the focal point is correctly set.

14. Fix the position of the beam expander using the locking screw (2).

Adjustment tasks

Adjusting the focus distance

If a correct setting is not possible (beam expander in minus or plus on the end stop):



CAUTION

This can occur in situations where the optical components or the resonator module have been replaced.

1. Reset the beam expander to "0".
2. Adjust the distance of the laser to the marking object up or down long enough for the lines of the X/Y cross are roughly the same.
3. Then mark a square with the dimensions of the marking field, e.g. 120 x 120, 180 x 180, etc. on suitable material.
4. Measure field size in X and Y.
5. Create a backup copy of the current field correction file in the field correction wizard.
6. In the field correction wizard, adjust the active field correction X and Y until the field in X and Y is of the right size again.
7. Open shutter; the emission of the laser beam is blocked by the Q-switch.
8. Allow the program for the cross in the middle of the field with the material to run according to the laser parameters.
9. Close the shutter.
10. Check the cross depicted. The focal point is correctly set when both lasered lines in the X and Y direction have the same dimensions at the smallest possible width.
 - Adjustment OK (1) ([Figure 6.20, page 6-14](#)) (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)
11. If necessary, change the focal point by adjusting the adjusting ring (1) ([Figure 6.21, page 6-14](#)).
12. Move material under the galvo head, open the shutter, and let the program run.
13. Check the image of the cross.



CAUTION

Repeat Steps 7 through 13 until the focal point is correctly set.

14. Fix the position of the beam expander using the locking screw (2).

6.5 Adjusting the laser beam



CAUTION

All settings and checks, etc. of the hardware or software must be performed according to the valid operating instructions for the relevant laser type. Values and settings that differ are not permissible for adjustment or verification.

6.5.1 Adjustment points

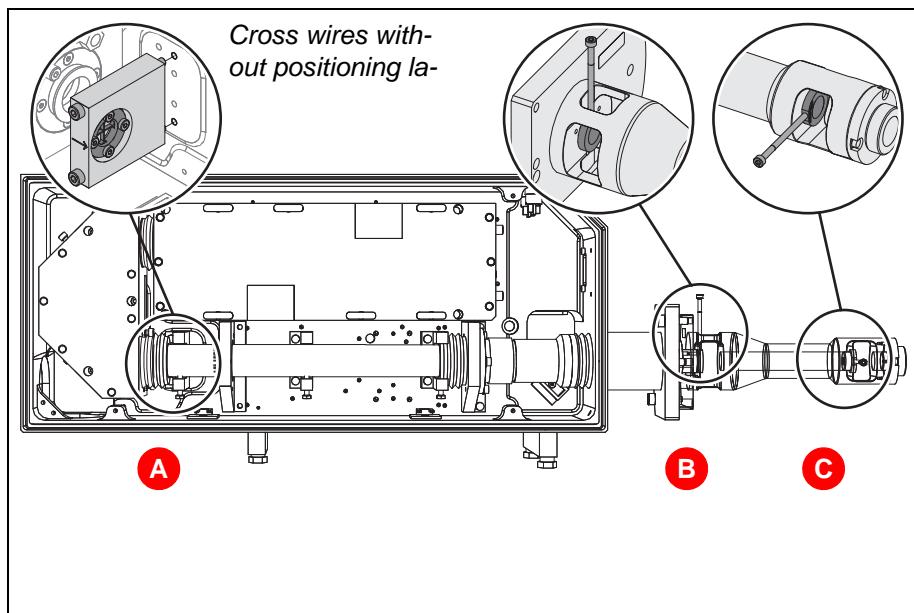


Figure 6.22 Adjustment points Laser systems in basic version

No.	Adjustment point
A	Output of the deflecting unit
B	Galvo flange
C	Adjustment tube

Adjustment tasks

Adjusting the laser beam

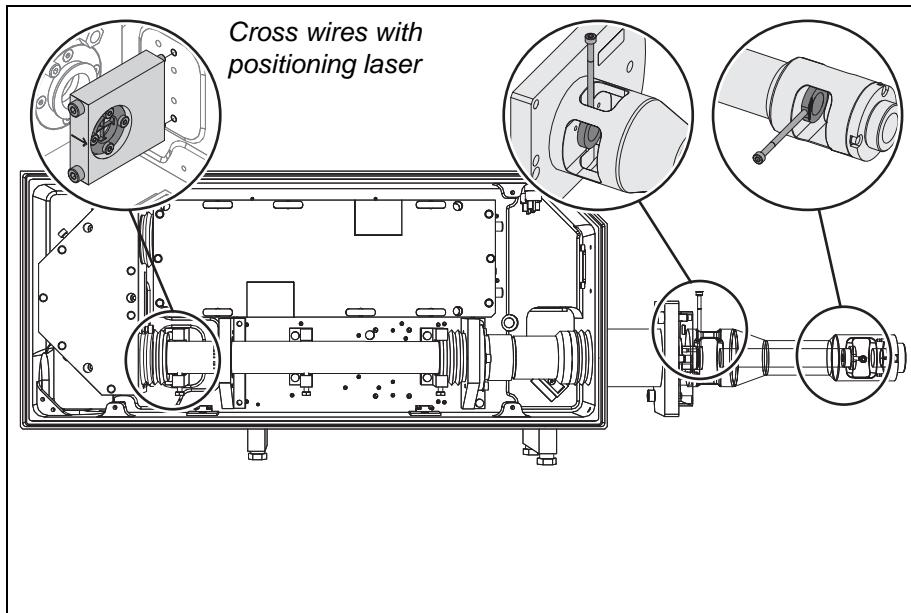


Figure 6.23 Adjustment points Laser systems with positioning laser

No.	Adjustment point
A	Output of the deflecting unit
B	Galvo flange
C	Adjustment tube

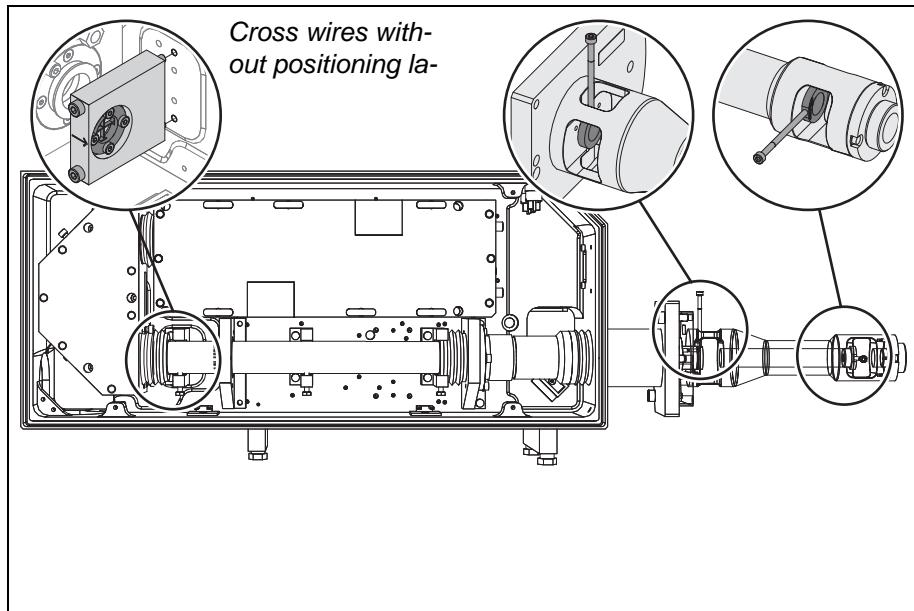


Figure 6.24 Adjustment points Laser systems with external modulator

No.	Adjustment point
A	Output of the deflecting unit
B	Galvo flange
C	Adjustment tube

Adjustment tasks

Adjusting the laser beam

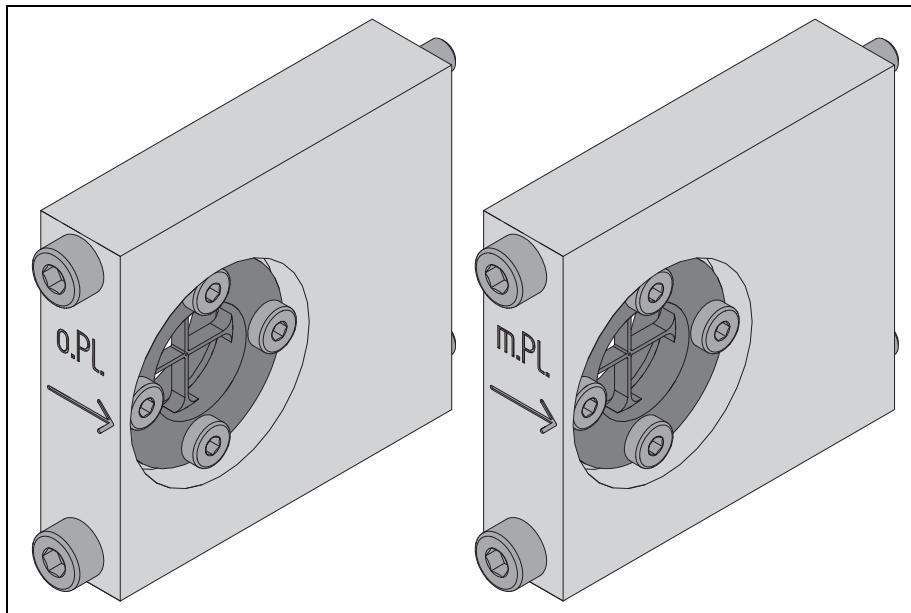


Figure 6.25 Cross wires

i CAUTION

Use the appropriate adjusting aperture for the laser system (with or without positioning laser)! Note the direction of installation! The adjustment cannot be performed correctly if this is not observed.

6.5.2 Main laser



CAUTION

All settings and checks, etc. of the hardware or software must be performed according to the valid operating instructions for the relevant laser type. Values and settings that differ are not permissible for adjustment or verification.

6.5.2.1 Basic adjustment¹⁾



CAUTION

For laser systems **with external modulator**, the following parameters must be set in the laser console for startup operation without EM:

Path	Parameter	Value
Interfaces\Interpolation\iff-Driver	Bitmap execution mode	100 kHz Mode
Interfaces\Interpolation\iff-Driver	Marking with external modulator	inactive
Laser\Laser_LSC	Power Mode	Normal: Power in A
Laser\Laser_LSC	Beam protection time enabled	inactive

1. Switch off the laser system and secure it against reactivation.



CAUTION

Risk of damage!

The galvo head is damaged if connecting or disconnecting under voltage!

- Only remove or insert the connecting cable of the galvo head when no voltage is present!

2. Dismantle the galvo head, set it aside, and cover the entry openings with the corresponding cover cap or tape to prevent the inside of the galvo head becoming contaminated.



CAUTION

Risk of contamination!

If unsuitable adhesive tape is used, there is a risk of contamination due to adhesive residue!

- Only adhesive tape that can be completely removed without residue may be used!

¹⁾ To be performed for all laser systems.

Adjustment tasks

Adjusting the laser beam

3. Open the cover on the resonator side of the laser head (chamfered corner located on the right).
4. Dismantling the beam guide.
5. If present, disassemble the external modulator.



CAUTION

For laser systems with positioning laser, check the cleaning status of the positioning laser and clean as necessary.

6. Dismantle the beam expander including the mount.



CAUTION

The current adjustment of the beam expander should be noted so that the correct focal distance can be reset after a possible misalignment of the beam expander.

7. Unscrew the beam expander from the mount.
8. Dismantle the collimating lens (if present).
9. Secure the shutter against activation.



WARNING

Laser radiation!

Risk of accident and injury due to laser radiation!

- Take measures to protect against laser radiation!
-

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



DANGER

Laser system opened, safety devices missing!

With the laser system opened and/or safety devices removed, there is a serious risk of accident!

- Take measures for protection against laser radiation (wear laser safety goggles, wear PPE, setup and position partition walls, attach warning signs and barriers, etc.).
 - All persons present must be protected.
 - These measures must be coordinated with the laser safety officer.
 - Ensure a shutdown in the event of danger (e.g. press emergency stop switch/main switch on the laser system by a second person)!
-

11. Using suitable means, mount a transducer disk opposite the galvo flange and in front of a surface that absorbs laser beams.
12. Fit the adjusting aperture after the deflecting unit on **adjustment point A**.



CAUTION

Use the appropriate adjusting aperture for the laser system (with or without positioning laser)! Note the direction of installation! The adjustment cannot be performed correctly if this is not observed.

i CAUTION

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

⚠ CAUTION

Risk of damage to the adjusting aids!

Damaged adjusting aids lead to imprecise adjusting results!

- Careful handling of the adjusting aids must be guaranteed!

13. Switch on the laser system, set a low output (approx. 5 ... 7 W).

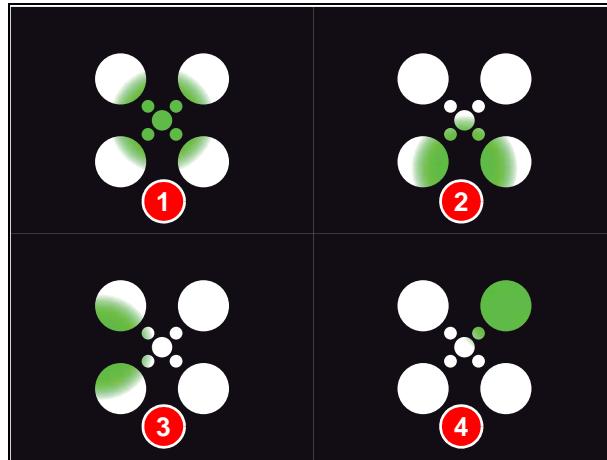


Figure 6.26 Checking the beam adjustment

14. Open the shutter and check the projection of the main laser on the transducer disk.

[Figure 6.26](#) shows examples of possible projections:

- Adjustment OK (1)
 - Emission too low (2)
 - Emission too far to the left (3)
 - Emission too far to the top right (4)
15. Close the shutter.

Adjustment tasks

Adjusting the laser beam

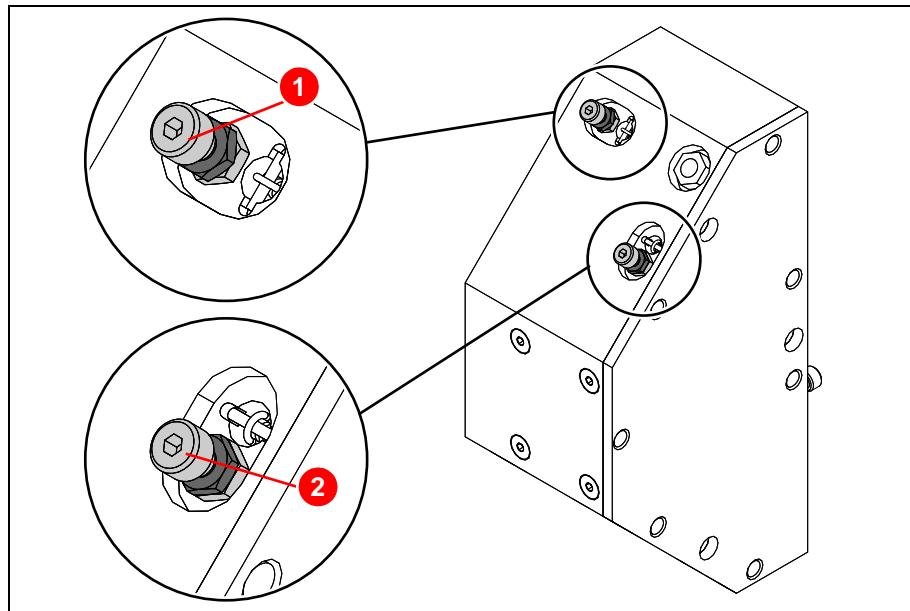


Figure 6.27 Beam adjustment of the upper deflecting mirror

16. Adjust the beam by adjusting the upper deflecting mirror of the deflecting unit.
 - Horizontal adjustment (1) ([Figure 6.27](#))
 - Vertical adjustment (2) ()
17. Close the shutter after adjustment.
18. Disassemble the adjusting aperture from **adjustment point A**.
19. Screw the adjustment tube onto the galvo flange.
20. Insert the cross wires with mount into **adjustment point B**.
21. Open the shutter and check the projection of the laser on the transducer disk ([see figure 6.26](#)).

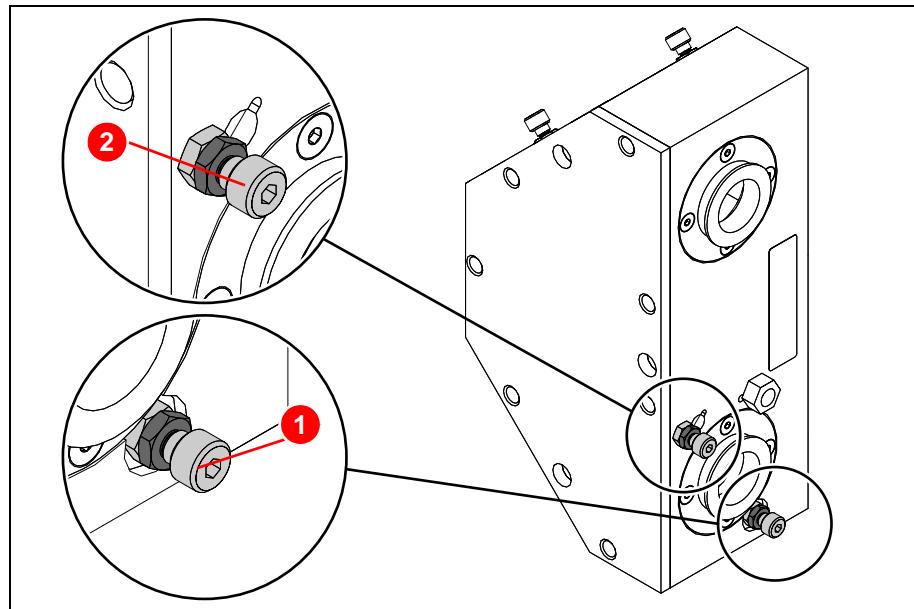


Figure 6.28 Beam adjustment of the lower deflecting mirror



WARNING

Risk of injury!

There is a risk of injury due to reaching into the laser beam!

- *Do not reach into the laser beam during the adjustment!*

22. Adjust the beam by adjusting the lower deflecting mirror of the deflecting unit.
 - Horizontal adjustment (1) ([Figure 6.28](#))
 - Vertical adjustment (2) ()
23. Close the shutter after adjustment.
24. Remove the cross wires and insert the adjusting aperture again.

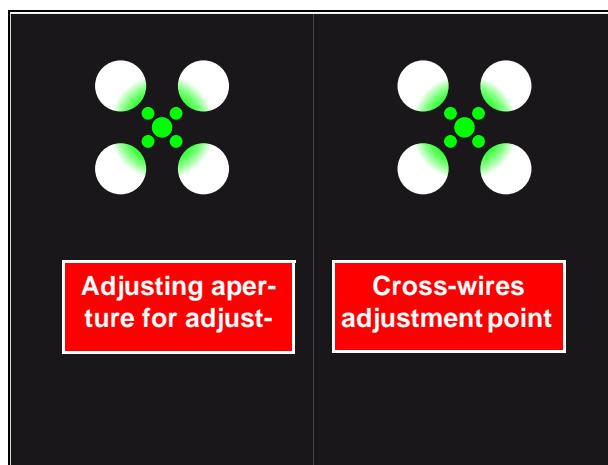


Figure 6.29 Beam adjustment OK



CAUTION

Repeat steps 12 through 24 until no more deviations can be determined in the projections for the two cross wires.

Adjustment tasks

Adjusting the laser beam

25. If no more deviations in the image can be determined between A and B, the adjustment is okay (see figure 6.29, page 6-24).
26. Insert the cross wires with mount into **adjustment point B**.
27. Carefully tighten the adjusting screws on the deflecting unit.
28. Check the beam position again. If the beam position is misaligned, adjust it again.
29. Using suitable means, mount a transducer disk opposite the galvo flange and in front of a surface that absorbs laser beams.



WARNING

Fire hazards!

If unsuitable materials are used, there is a risk of fire due to laser beam!

– Under no circumstances may the absorbing surface be made of flammable materials!

30. Align the transducer disk parallel to the galvo flange.
31. Set the distance from the transducer disk to the galvo flange to at least 200 to 300 mm.
32. Open the shutter. Align the marking or the cross wires on the transducer disk with the laser beam.
33. Fix the transducer disk in this position.



CAUTION

For the remaining work, the transducer disk and the laser head must remain in the same positions!

34. Close the shutter.

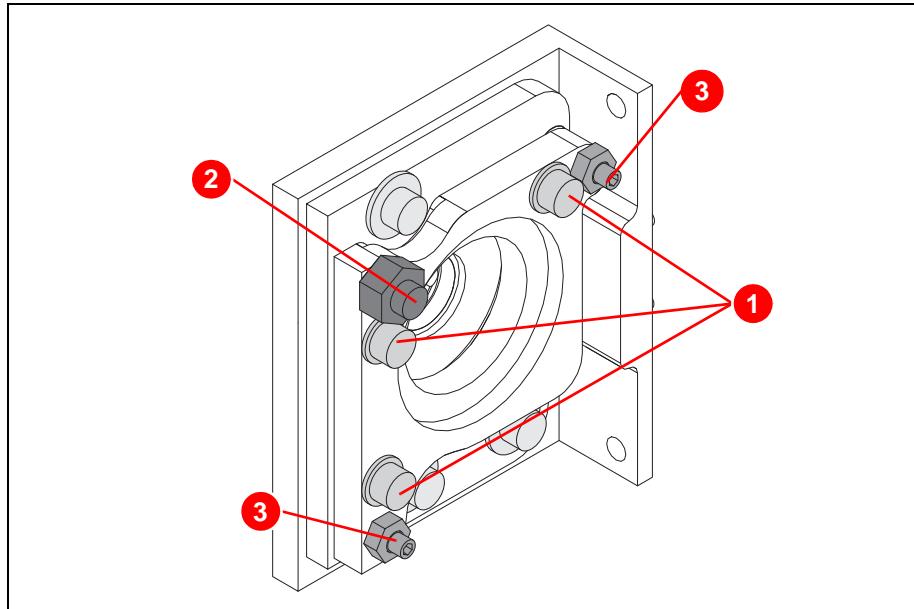


Figure 6.30 Basic setting of the beam expander mount

i CAUTION

The basic setting of the beam expander mount should only be checked and adjusted as necessary if it has been misaligned or if a new mount has been fitted.

35. Check the basic setting of the beam expander mount and readjust if necessary.
 - The distance between the two silver-colored plates must be 1 to 1.5 mm. The plates must be aligned parallel to each other.
 - To adjust, loosen screws (1) ([Figure 6.30](#)) and set the distance using the support screws (2 and 3).
 - Tighten the screws (1) hand-tight again.
36. Perform a power measurement without beam expander mount.
37. Fit the beam expander mount.
38. Check whether or not the installation has resulted in a power loss. If it has, check the adjustment again.

i CAUTION

The beam expander mount has a hole with a certain diameter. This diameter should be dimensioned such that no power loss is determined only at 100% adjustment.

Adjustment tasks

Adjusting the laser beam



CAUTION

Perform an adjustment between adjustment points B and C.

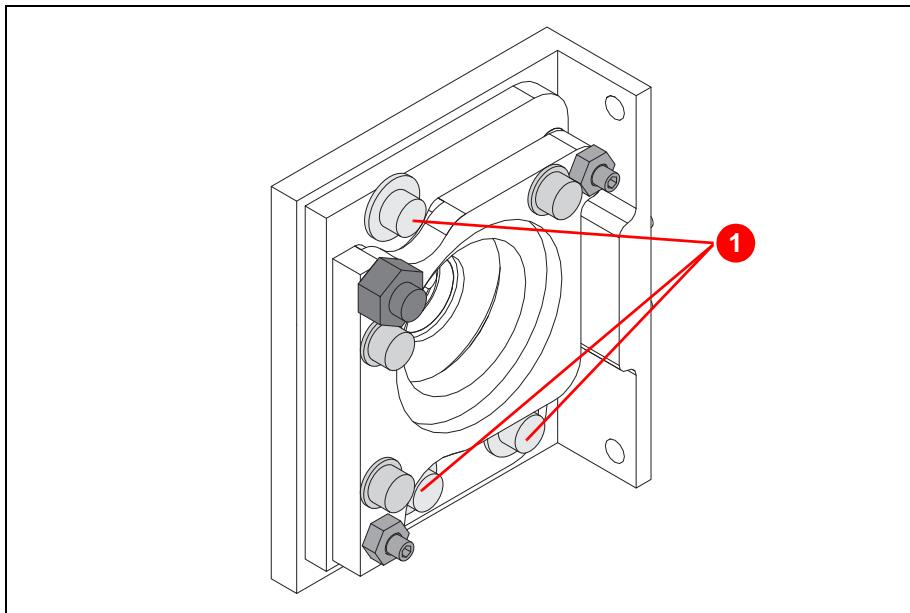


Figure 6.31 Fit the beam expander mount

39. Loosen the screws (1) ([Figure 6.31](#)).



CAUTION

If there is a lens in the mount for reducing the beam divergence (collimating lens), this must be removed before the basic settings are carried out.



CAUTION

Risk of damage!

Damaged cables and leads result in functional faults.

- Do not crush or jam the cables and lines inside the laser head during installation!

40. Screw the beam expander into the mount.

41. Insert the cross wires into **adjustment point B**.

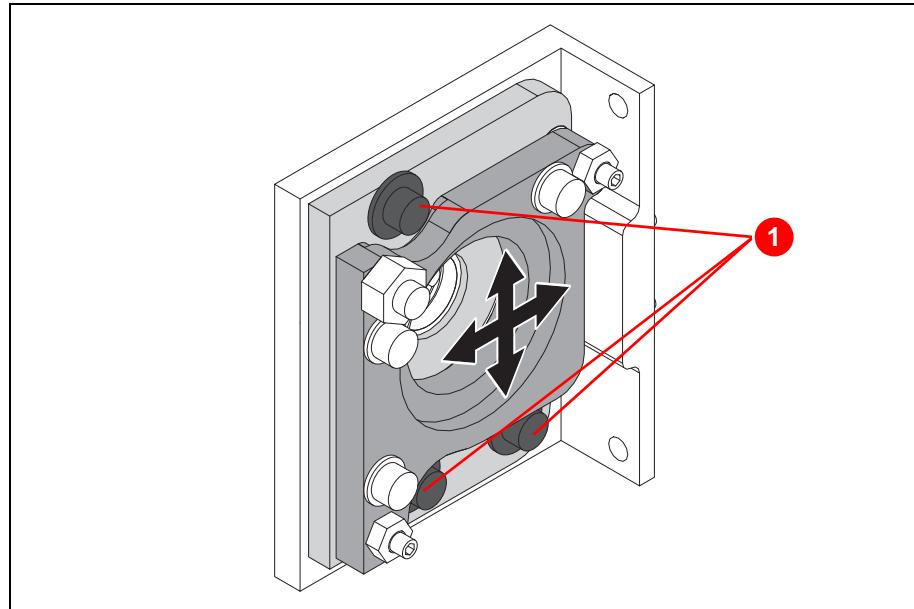


Figure 6.32 X/Y adjustment

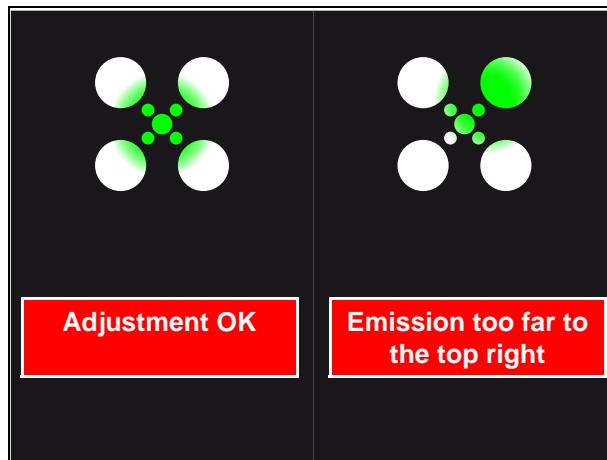


Figure 6.33 Beam adjustment of beam expander in X/Y direction

42. Open the shutter and check the position of the beam (beam centered through the cross wires and mount) ([see figure 6.33](#)). If the beam is centered, continue with point 43. If the beam is off-center, loosen screws (1) and move the beam expander in the X and Y directions until the beam passes centrally through the cross wires. Carefully tighten the screws (1) afterwards.



CAUTION

Take care not to alter the position of the beam expander when tightening the screws.

43. Close the shutter.
44. Remove the cross-wires from **adjustment point B**.
45. Insert the cross wires into **adjustment point C**.
46. Open the shutter and check the position of the beam.

Adjustment tasks

Adjusting the laser beam

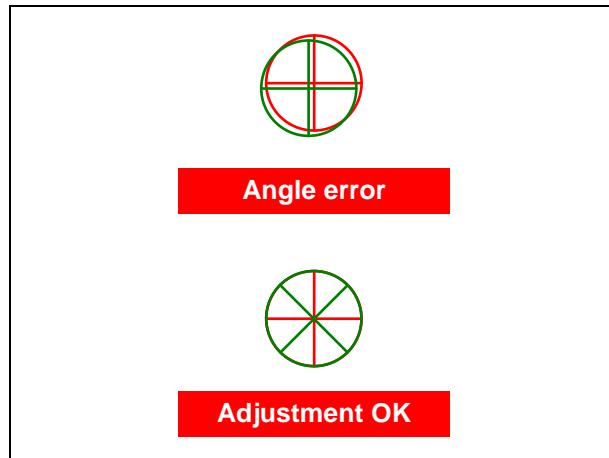


Figure 6.34 Checking the beam position at the galvo flange (1)

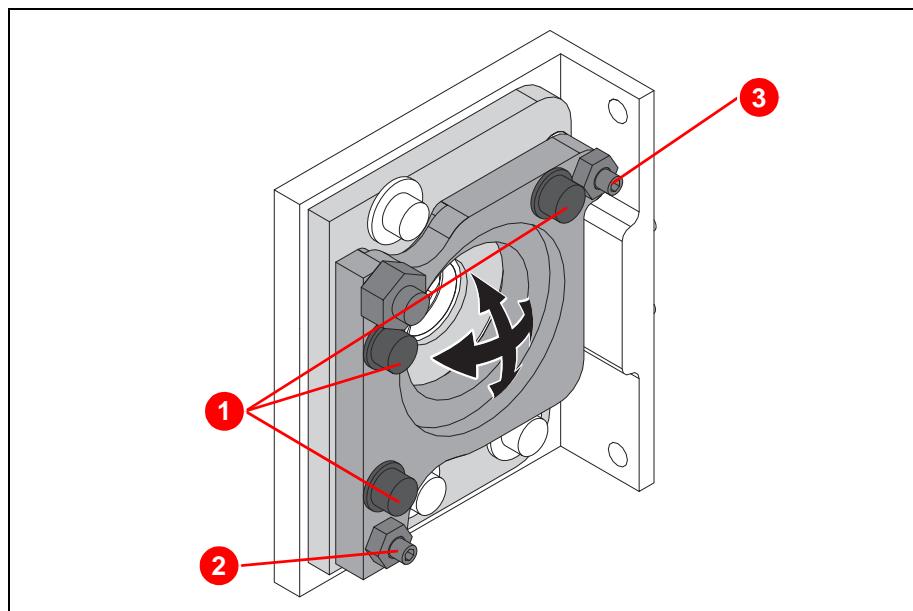


Figure 6.35 Angular setting of the beam expander

47. Loosen screws (1) ([Figure 6.35](#)) and adjust the angle of the beam expander using screws (2) in the horizontal direction and (3) in the vertical direction.
48. After the adjustment, tighten screws (1) by hand and carefully tighten screws (2) and (3).

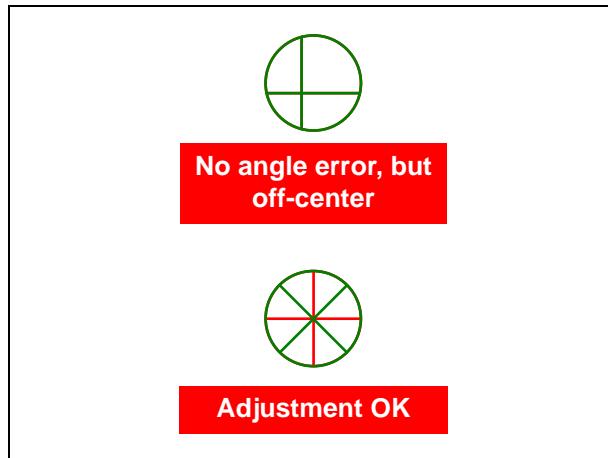


Figure 6.36 Checking the beam position at the galvo flange (2)

49. Open the shutter and check the position of the beam (beam centered through the cross wires and mount) ([see figure 6.33](#)). If the beam is off-center, loosen screws (1) ([Figure 6.32, page 6-28](#)) and move the beam expander in the X and Y directions until the beam passes centrally through the cross wires. Carefully tighten the screws (1) afterwards.
50. Close the shutter.
51. Repeat points 47 through 50 until the centering of the laser beam through the adjusting aperture on the beam expander (X/Y setting) and the angle setting are correct.

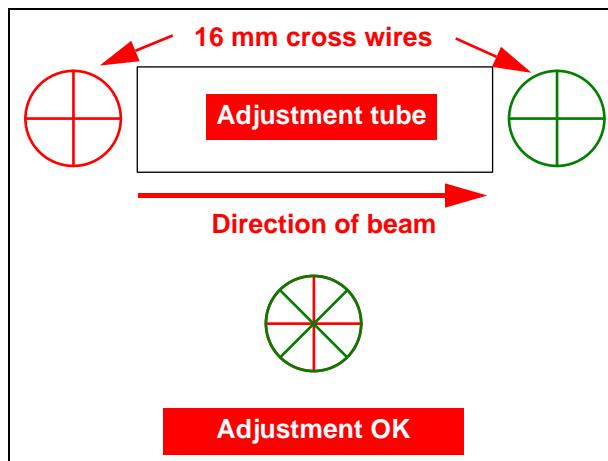


Figure 6.37 Checking the beam position at the galvo flange (2)

52. Open the shutter and check the position of the beam. To do this, rotate the cross wires in the adjustment tube by 45°. If the displayed crosses are congruent, the adjustment is OK (then continue with point 56).
53. If present, fit the collimating lens.
 - Before installing the collimating lens, perform the power measurement.
 - Perform visual inspection and lens cleaning as necessary.
 - Perform the power measurement with installed collimating lens (max. power difference from the previous measurement: 0.3 W).
 - In the case of a greater power difference, clean the lens again or replace it.



CAUTION

The collimating lens is fitted and must not be adjusted.

The collimating lens changes the power density, however (beam diameter reduces). The laser power must be reduced as necessary.

54. Check the beam position.
55. If necessary, correct the beam position by adjusting the beam expander mount (repeat steps [47](#) to [50](#)).
56. Remove the adjustment tube.
57. Switch off the system.
58. Fit the galvo head.
59. Switch on the main switch, start the system and set the current so that **a laser power of approx. 6 to 7 W** is produced.
60. Start the VLM software and move the galvo mirror to a defined starting position using the "Initialize hardware" button.
61. Check the middle and centered image of the laser beam at approx. 1/3 of the focal length specified on the galvo head.



CAUTION

If the image after the galvo head is not correct (e.g. eccentric, laser beam not round), the galvo head and the ALI board must be checked.

62. Check the adjustment of the beam expander; if necessary, set to the value read before the adjustment procedure and check the focal point ([see point 6.4, page 6-12](#)).
63. Measure the power in front of the beam expander or alignment laser housing (optional) and on the galvo flange.



CAUTION

If a power difference >0.3 W can be determined, the adjustment should be performed again.

64. Switch off the laser system.
65. Perform the further/final activities in accordance with the existing laser system:
 - Laser systems **with external modulator**: Perform advanced adjustment of the laser beam ([see point 6.5.2.2, page 6-32](#)).
 - Laser systems in **basic version and with positioning laser**: Re-fit the beam guide, bellows and galvo head.
 - Laser systems **with positioning laser**: Perform adjustment of the positioning laser ([see point 6.5.3, page 6-43](#)).
66. Switch off the laser system.
67. Mount the cover on the resonator side of the laser head.
68. Commission the laser system.
69. Check the laser power behind the galvo head (on the workpiece) using the power measurement device and perform a test marking procedure (max. power loss 1 W). Enter the measurement values in the logbook.

6.5.2.2 Advanced adjustment with WinCam¹⁾

1. Perform the basic adjustment of the laser beam (see point 6.5.2.1, page 6-20).

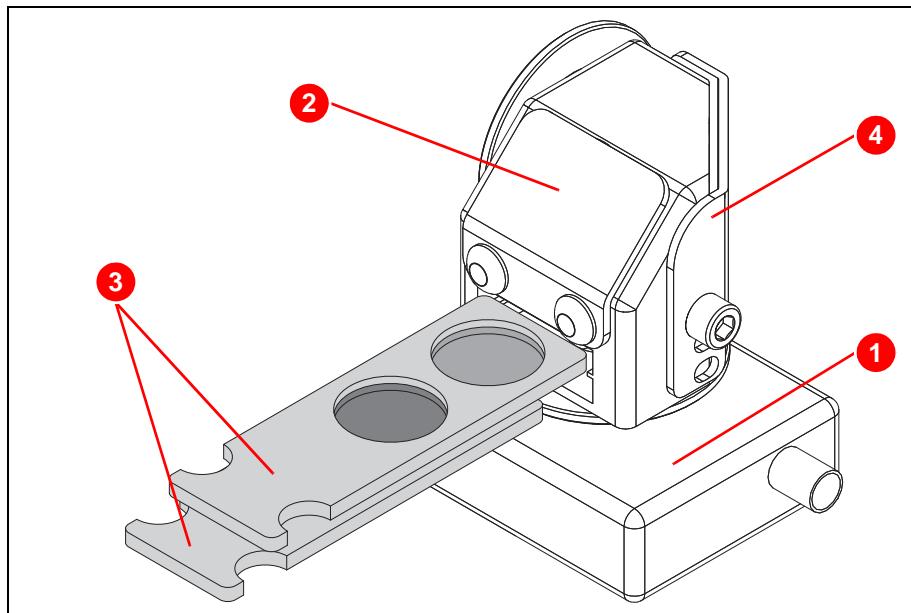


Figure 6.38 Fitting the WinCam

2. Fit the WinCam components (see figure 6.38):
 - CCD camera (1),
 - Attenuator block (2),
 - ND filter set (3),
 - Beam protection plate (4).



CAUTION

Risk of damage!

The CCD camera is destroyed without an ND filter or with the wrong ND filter!

- The use of ND filters is mandatory!
- The camera itself must be fastened with an ND-4 screw-on filter, located on the attenuator block.
- Ensure that the filters used are suitable for the wavelength of the laser (1064 nm).



WARNING

Fire hazards!

Without a beam protection plate fitted, the laser beam goes out!

- Always fit the beam protection plate!



WARNING

Burn hazard!

The beam protection plate can heat up after prolonged measurements!

- Allow the beam protection plate to cool down before touching it.

3. Insert the highest filter combination into the attenuator block (e.g. ND4 and ND2).

¹⁾ Only carry out for laser systems with external modulator.

Adjustment tasks

Adjusting the laser beam

- Set the laser power to approx. 13 to 14 W.



CAUTION

Risk of damage!

If the power is too high, there is a risk of destroying the attenuator block!

- Do not exceed the maximum laser power specified in the attenuator block manual!

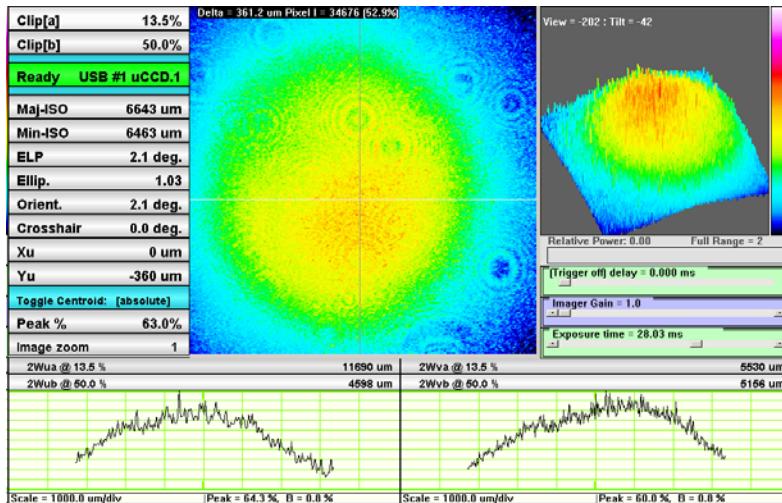


Figure 6.39 Checking the laser beam

- Open the "DataRay" program on the PC.
- Check or make the basic settings to the WinCam (see point 6.2.3, page 6-6).
- Set the WinCam software to a wavelength of **1064 nm**.
- Connect the CCD camera to the USB port on the PC.
- Open the shutter and check that the laser beam is present.

If no laser radiation is visible:

- Close the shutter.
- Reduce the density of the ND filter combination in stages (e.g. ND4 and ND1).



CAUTION

Risk of damage!

There is a risk of damaging the filter holder!

- Never insert or remove filters when the laser beam is switched on!

- Open the shutter and check for the presence of the laser beam once more.
- Repeat steps a to c until the laser beam is visible in the software.
- Remove a filter if necessary.



CAUTION

Risk of damage!

The CCD camera is destroyed without an ND filter or with the wrong ND filter!

- The use of ND filters is mandatory!

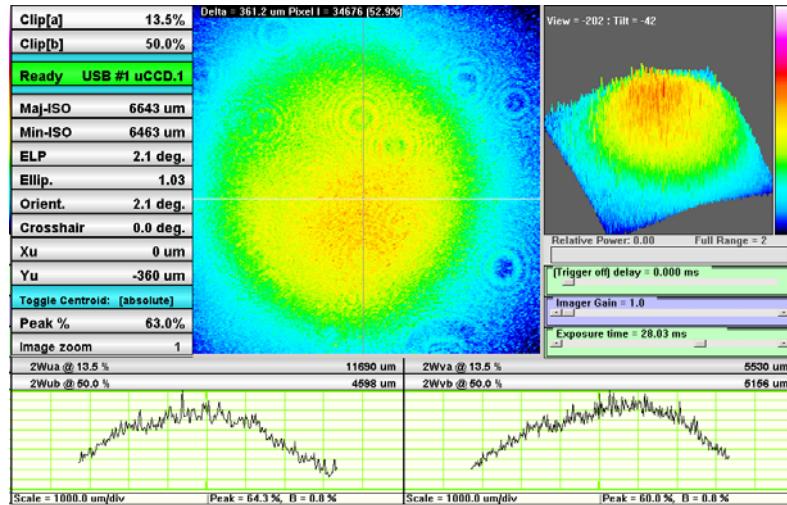


Figure 6.40 Checking the camera position

10. Open the shutter and check the camera position.
11. Close the shutter and adjust the camera position as required. To do this, loosen the clamping ring on the camera and rotate the camera in 90° increments or in the software options of WIN-CAM. Use the tabs „Setup“ -> Capture setup dialog -> "Flip image vertical" or "Rotate 180°".

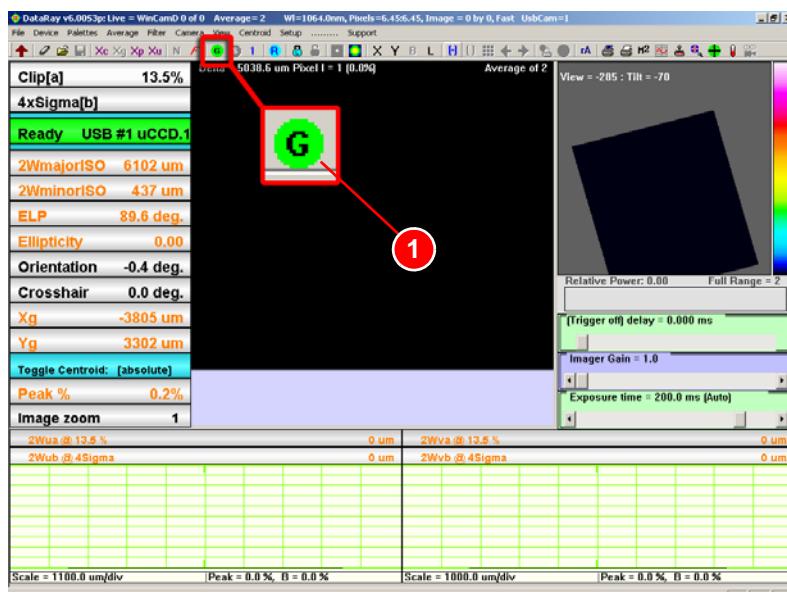


Figure 6.41 Setting up the laser beam (1)

12. Open the shutter and start the WinCam measurement with the button (1) ([Figure 6.41](#)).

Adjustment tasks

Adjusting the laser beam

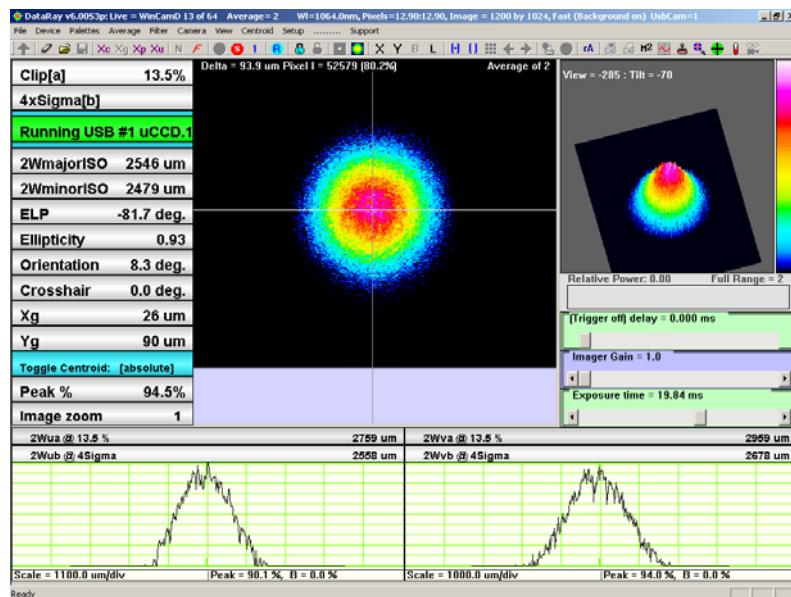


Figure 6.42 Setting up the laser beam (2)

13. The projection of the laser beam should be in the center of the monitor screen (see figure 6.42).

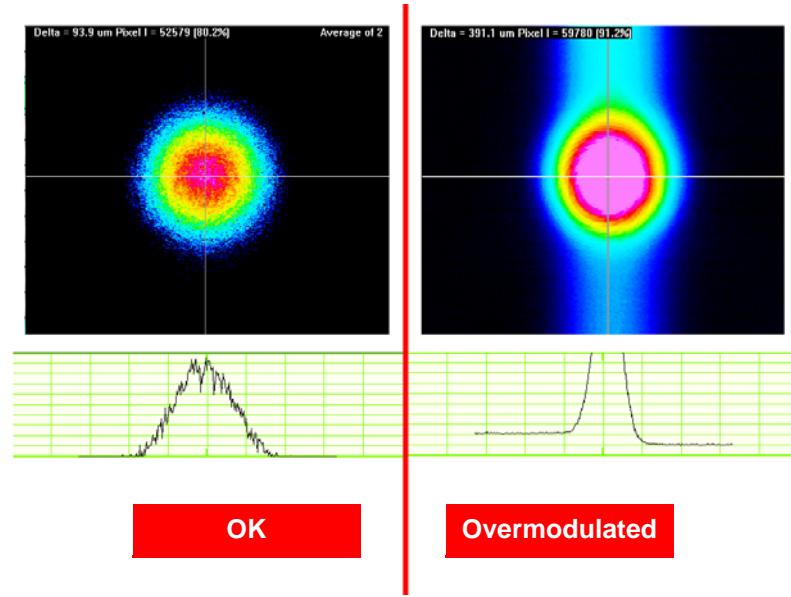


Figure 6.43 Camera overmodulation



DANGER

Eye damage due to laser beam!

When checking the image without laser safety goggles, there is an acute risk of damage to the eyes due to the laser beam!

- To check the projection without safety goggles, the laser beam must be switched off!



CAUTION

When using the prescribed safety goggles, it may not be possible to detect the blue display of the overmodulation in the laser beam image!



CAUTION

To check the overmodulation, click on the Stop button (see figure 6.44). A snapshot will be displayed. Switch off the laser beam and check the screen display without safety goggles.

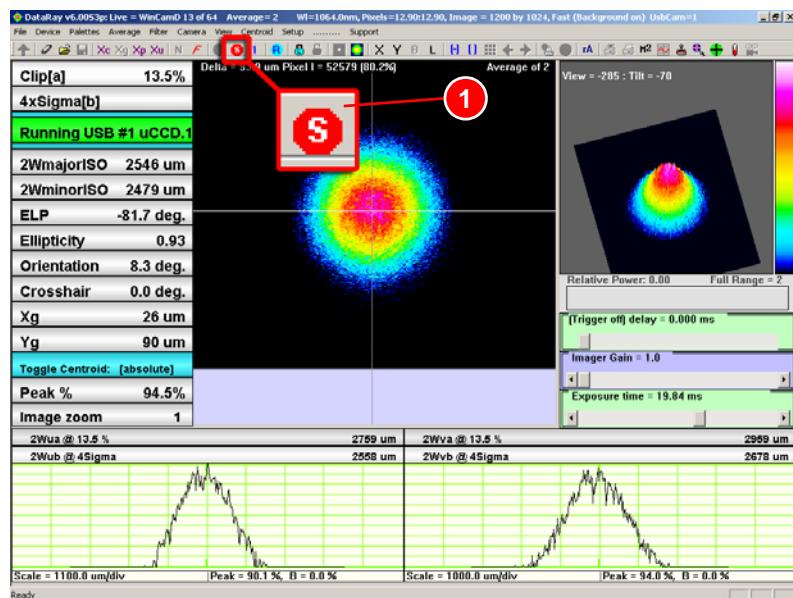


Figure 6.44 Stopping the measurement

14. Stop the WinCam measurement using the button (1) (Figure 6.44) and close the shutter.
15. Fit the cross wires after the deflecting unit (**adjustment point A**).



CAUTION

Note the direction of installation of the cross wires. The adjustment cannot be performed correctly if this is not observed.

Adjustment tasks

Adjusting the laser beam

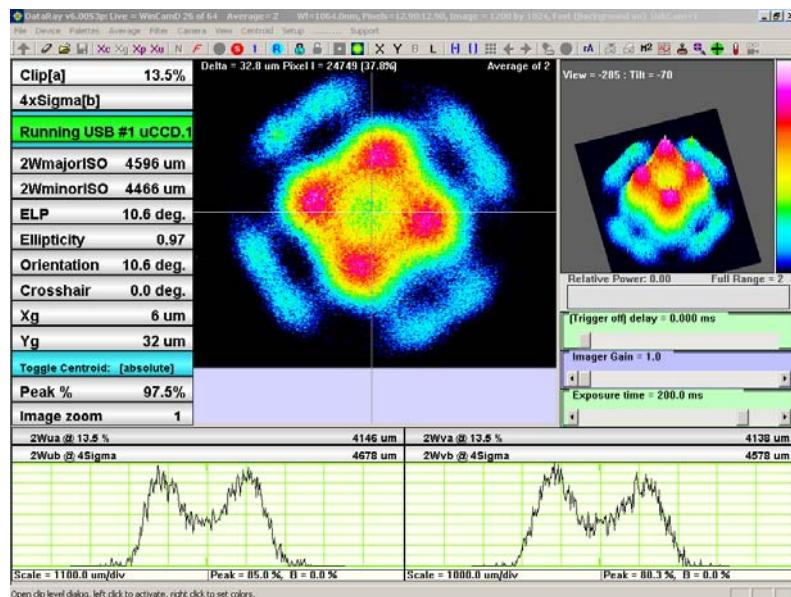


Figure 6.45 Measurement "A" before adjustment

16. Open the shutter and start the WinCam measurement.

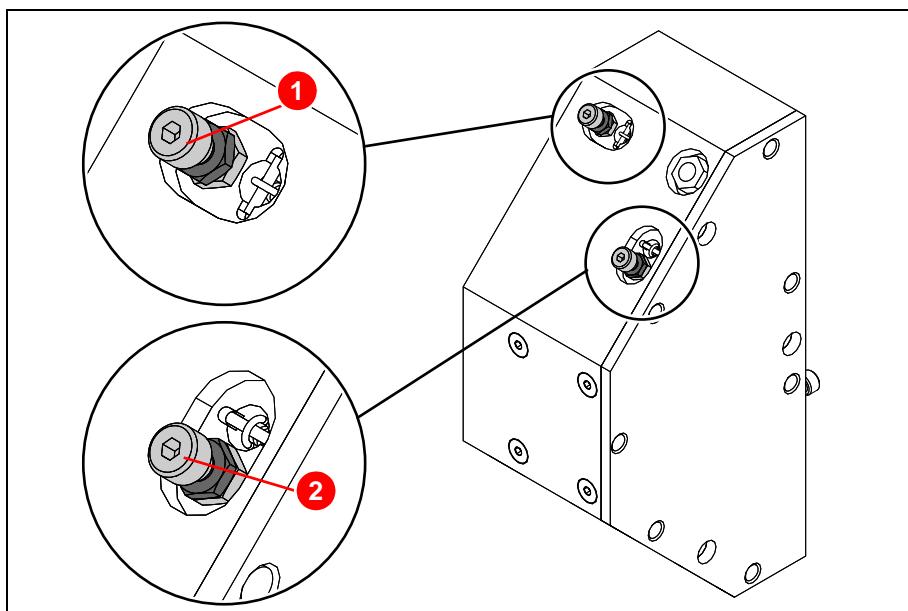


Figure 6.46 Beam adjustment of the upper deflecting mirror

17. Release the lock nuts on the adjusting screws.



CAUTION

Under no circumstances release the lower nut. This is the retainer for the adjusting screw!

18. Carry out the beam adjustment by adjusting the upper deflecting mirror in the deflecting unit to the center of the cross wires.
 - Horizontal adjustment (1) (Figure 6.46)
 - Vertical adjustment (2) ()

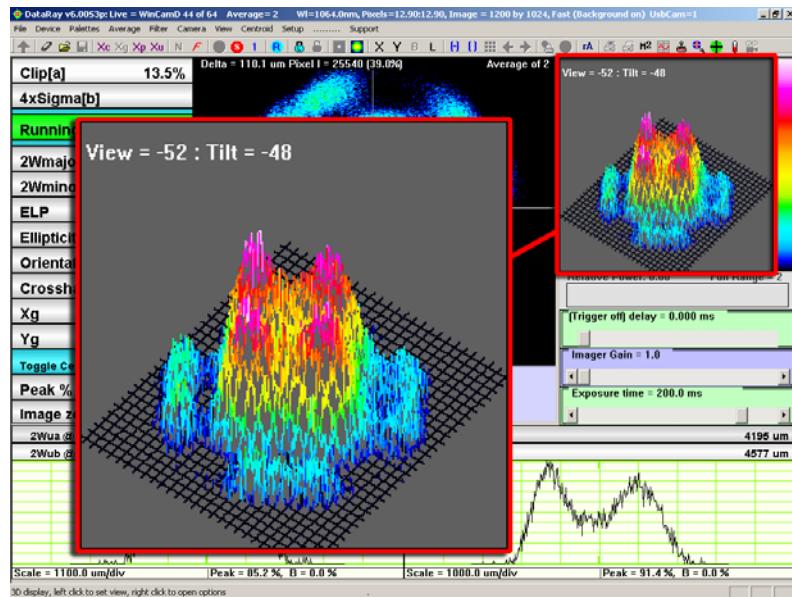


Figure 6.47 3D representation of the laser beam



CAUTION

For more precise checking of the adjustment, the 3D representation can be rotated by keeping the mouse button pressed.

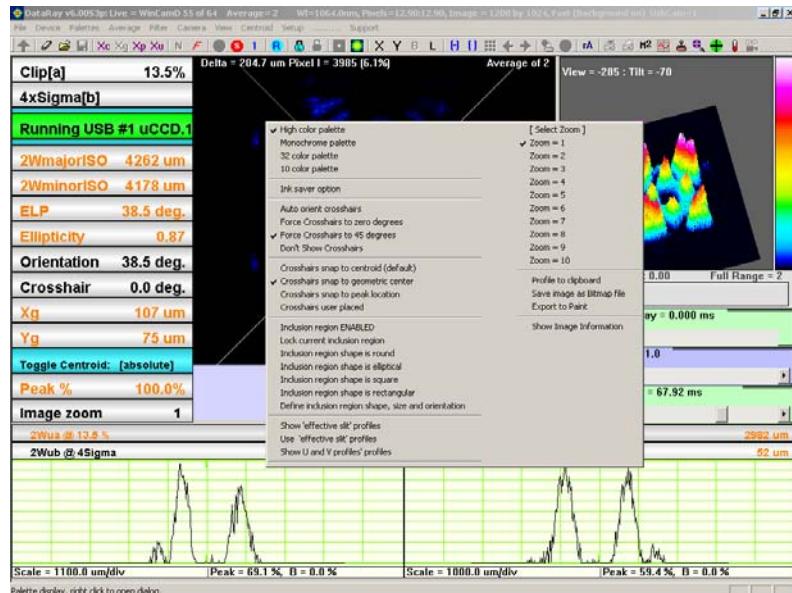


Figure 6.48 WinCam software cross wires settings



CAUTION

The orientation of the cross wires in the WinCam software can be altered by right-clicking on the image of the laser beam, in order to make more precise adjustments.

Adjustment tasks

Adjusting the laser beam

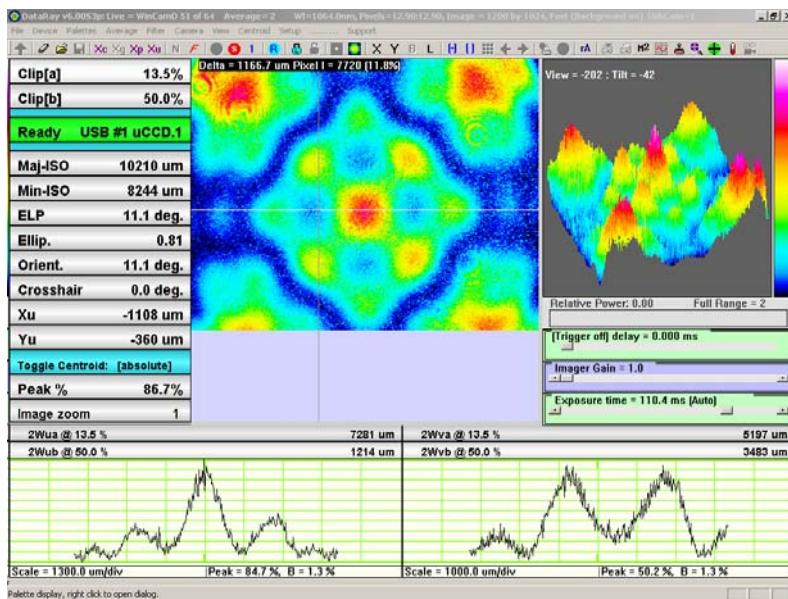


Figure 6.49 Measurement "A" after adjustment

19. Close the shutter after adjustment.
20. Dismantle the cross wires after the deflecting unit (**adjustment point A**).
21. Fit the cross wires after the deflecting unit (**adjustment point B**).



CAUTION

Ensure the presence of the absorber surface relative to the beam aperture.

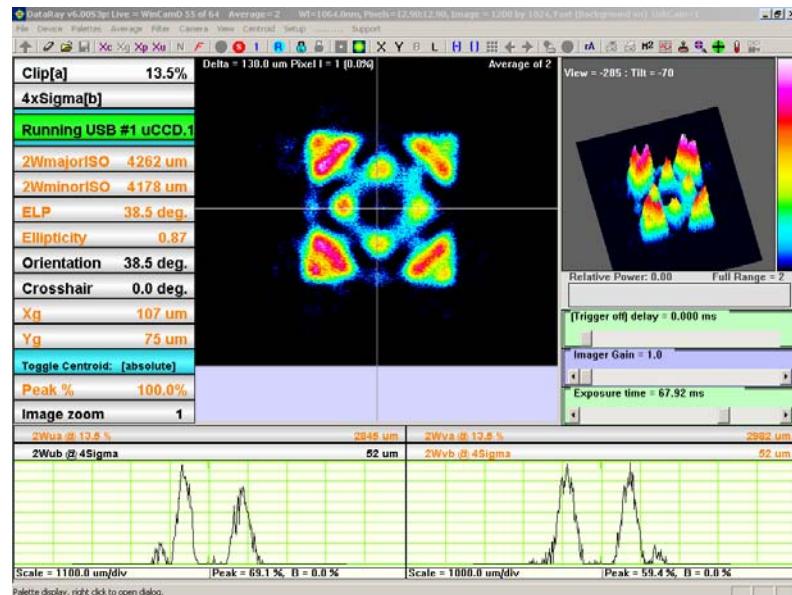


Figure 6.50 Measurement "B" before adjustment

22. Open the shutter and check the projection of the laser in the WinCam (see figure 6.50).
23. Unfasten the counternuts on the adjusting bolts on the lower deflecting mirror.



CAUTION

Under no circumstances release the lower nut. This is the retainer for the adjusting screw!

Adjustment tasks

Adjusting the laser beam

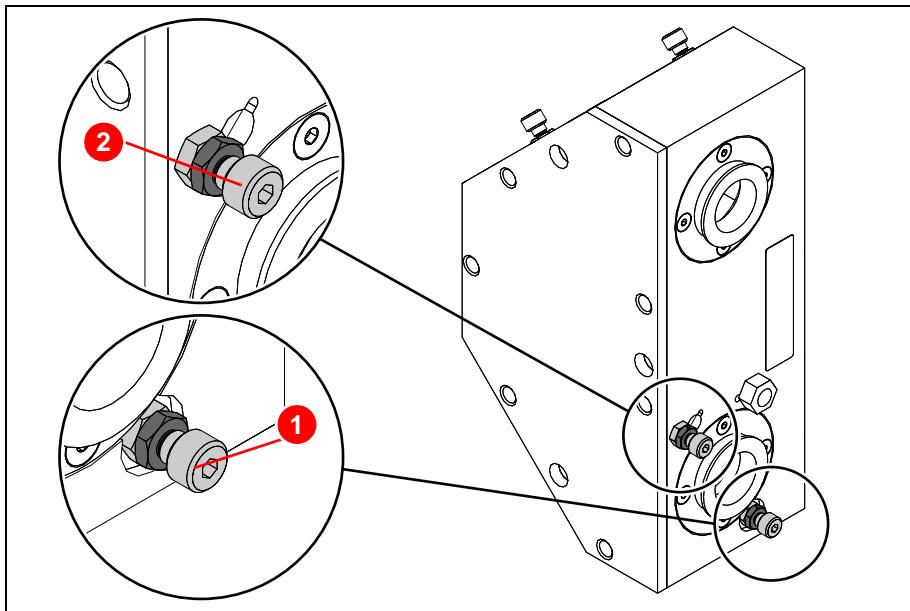


Figure 6.51 Beam adjustment of the lower deflecting mirror



WARNING

Risk of injury!

There is a risk of injury due to reaching into the laser beam!

- Do not reach into the laser beam during the adjustment!

24. Adjust the beam by adjusting the lower deflecting mirror of the deflecting unit.
 - Horizontal adjustment (1) (Figure 6.51)
 - Vertical adjustment (2) ()
25. Close the shutter after adjustment.
26. Insert the cross wire with mount into the base plate on the galvo flange.
27. Carefully tighten the adjusting screws on the deflecting unit.



CAUTION

Ensure that the beam position does not change while the lock nuts are being tightened!

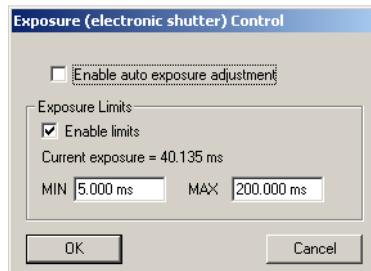


Figure 6.52 Exposure Control settings

28. Using the right-hand mouse button, click on "Exposure time" and in the pop-up which opens, disable the "Enable auto exposure adjustment" option (see figure 6.52).

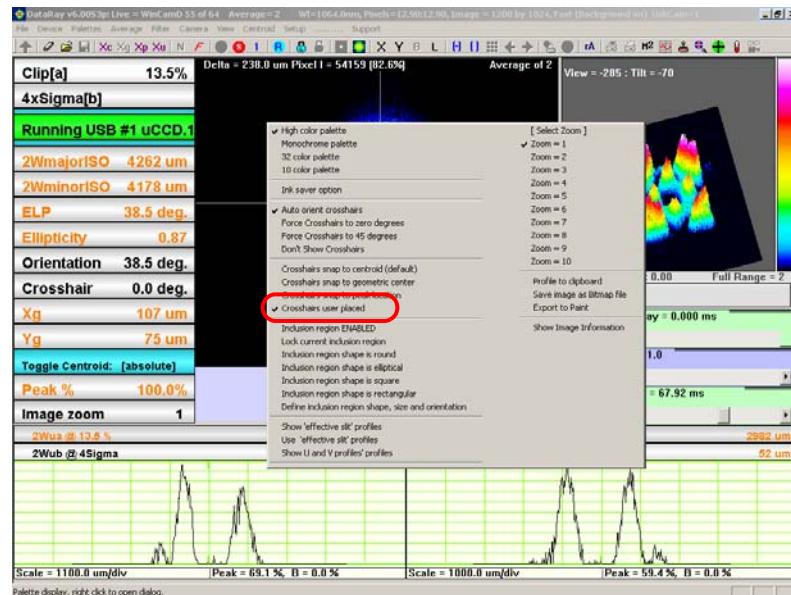


Figure 6.53 User-defined cross wires

29. Define the cross-wires in the WinCam software as user-defined (see figure 6.53). This results in the coordinates of the cross wires being held at a fixed point. To do this, click with the mouse in the center of the projection. The lines of the cross wires follow the mouse and are fixed.
30. Remove the cross wires.
31. Set a suitable zoom factor in the WinCam software.
32. Check the beam geometry of the laser beam using WinCam.
33. Fit and adjust the external modulator (see point 6.5.4, page 6-45).

6.5.3 Positioning laser¹⁾

1. Switch off the laser system and secure it against reactivation.
2. Open the cover on the resonator side of the laser head (chamfered corner located on the right).
3. Secure the shutter against activation.



WARNING

Laser radiation!

Risk of accident and injury due to laser radiation!

- Take measures to protect against laser radiation!

-
4. Insert the mains plug of the laser system and switch on the main switch.



DANGER

Laser system opened, safety devices missing!

With the laser system opened and/or safety devices removed, there is a serious risk of accident!

- Take measures for protection against laser radiation (wear laser safety goggles, wear PPE, setup and position partition walls, attach warning signs and barriers, etc.).
 - All persons present must be protected.
 - These measures must be coordinated with the laser safety officer.
 - Ensure a shutdown in the event of danger (e.g. press emergency stop switch/main switch on the laser system by a second person)!
-
5. Fix marking material (an anodized metal sheet, coated paper) into place in the focus under the galvo head using tape.



WARNING

Fire hazards!

When using unsuitable marking material there is a risk of fire!

- Under no circumstances may the absorbing surface be made of flammable materials!

-
6. Switch on the laser system using the key switch.
 7. Open shutter; the emission of the laser beam is blocked by the Q-switch.
 8. Allow the program for the cross in the middle of the field with the material to run according to the laser parameters.
 9. Close the shutter.
 10. Switch off the laser system; leave the main switch in the "On" position.

¹⁾ Installation depends on the respective laser type.

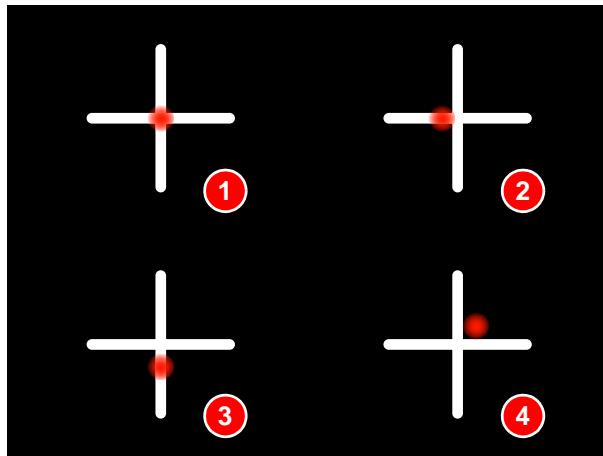


Figure 6.54 Checking the adjustment of the alignment laser

11. Check the position of the alignment laser in relation to the image of the cross wires.

Figure 6.54 shows examples of possible projections:

- Adjustment OK (1)
 - Emission too far to the left (2)
 - Emission too low (3)
 - Emission too far to the top right (4)
12. Open the housing of the alignment laser.

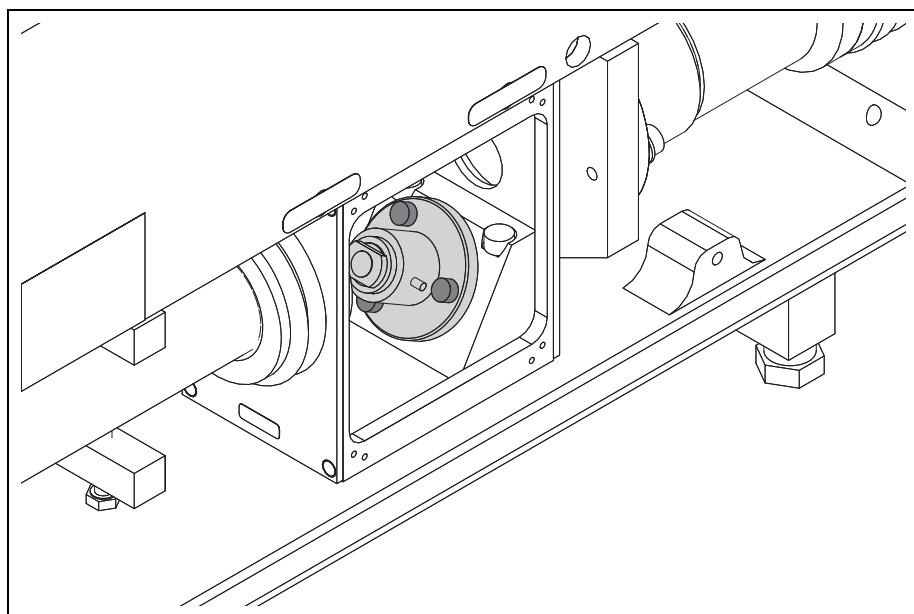


Figure 6.55 Adjustment of the alignment laser

13. Adjust the positioning laser to the center of the marked cross wires using the three adjusting screws (see figure 6.55).
14. Close the housing of the alignment laser.
15. Mount the cover on the resonator side of the laser head.
16. Commission the laser system.

Adjustment tasks

Adjusting the laser beam

6.5.4 External modulator¹⁾

1. Measure the laser power on measurement point 3 (after the deflecting unit) with temporary current I_{OP_temp} at 70 kHz.
2. Check/set the blocking behavior HG 29-80 ([see point 6.6.3, page 6-52](#)).
3. Set the current to 10 A, then skip to I_{OP_temp} .
 - In addition, it is not permitted for any beam to be emitted in the process.
 - If necessary, equalize via minor adjustment of the potentiometer in CW direction.



CAUTION

After installing the external modulator, the following parameters must be set in the laser console for operation with EM:

Path	Parameter	Value
Interfaces\Interpolation\iff-Driver	Marking with external modulator	active
Laser\Laser_LSC	Current for analog power	Operating point current I_{OP_temp}
Laser\Laser_LSC	Power Mode	Analog Power Mode : Power in %
Laser\Laser_LSC	Shutter Protection Time Enabled	inactive



DANGER

Laser radiation!

With activated external modulator, the laser beam is always on after the resonator with nominal output (e.g. 25 W with PL E AIR 25 EM ITX)!

- Take measures to protect against laser radiation!

¹⁾ Installation depends on the respective laser type.

4. Perform a basic (see point 6.5.2.1, page 6-20) and advanced adjustment (see point 6.5.2.2, page 6-32) of the laser beam.

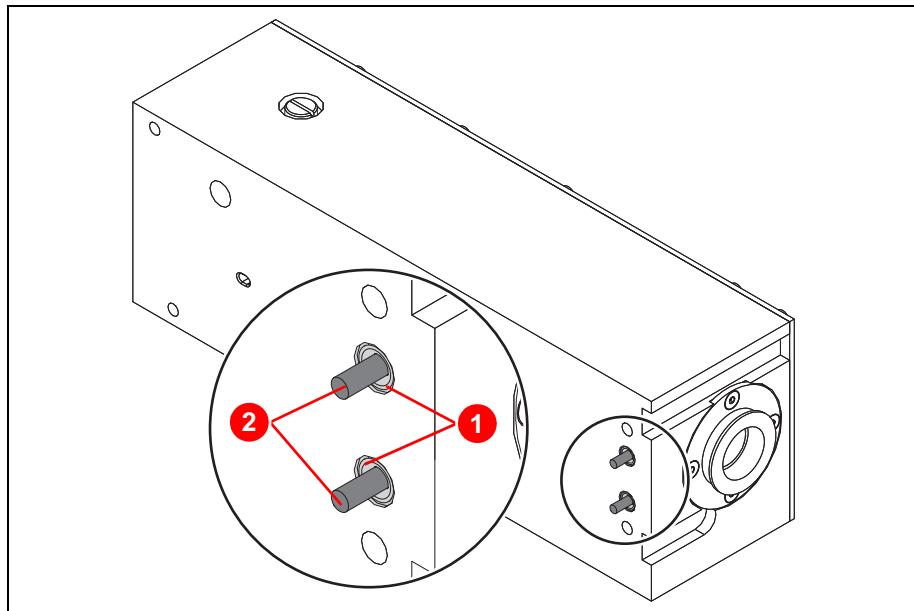


Figure 6.56 External modulator dowel pins

5. Check that the sockets (1) (Figure 6.56) do not project beyond the dowel pins.



CAUTION

Use 3 x dowel pins 3x12 (110101068).

6. Fit two dowel pins (2) into the sockets of the external modulator.

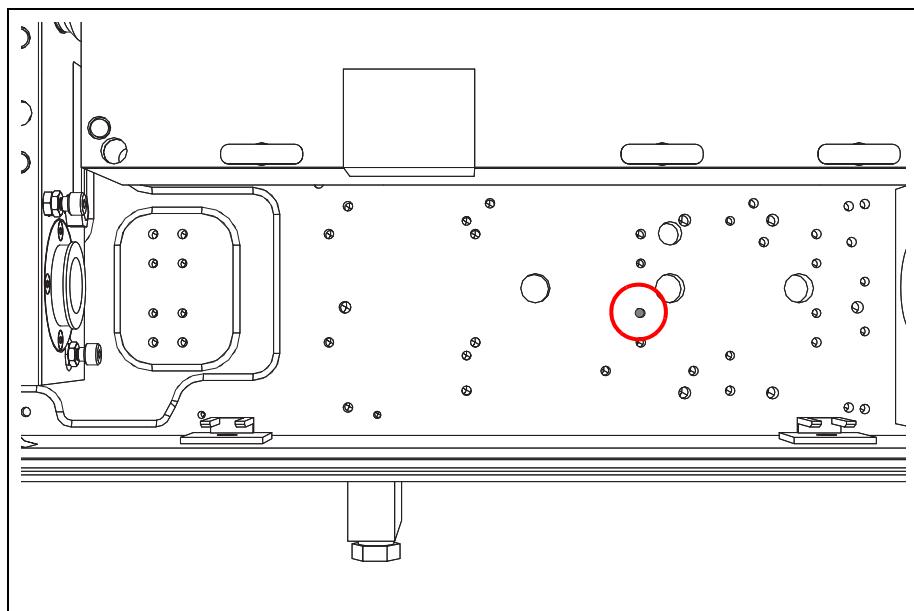


Figure 6.57 Dowel pin in the laser head

7. Insert the third dowel pin into the laser head (there is a slot here in the external modulator).
8. Shut down the PC.
9. Switch off the plug-in unit.

Adjustment tasks

Adjusting the laser beam

10. Fit the bellows to the external modulator.
11. Connect the HF line to the external modulator and secure.
12. Insert the external modulator into the laser head, but do not yet tighten the screws.



CAUTION

Risk of damage!

Components may be damaged in the event of improper handling.

- *Do not pinch the fibers and HF line, and ensure that the bellows are correctly positioned.*

-
13. Position the power measuring head at the beam output and put into operation.



WARNING

Laser radiation!

Risk of accident and injury due to laser radiation!

- *Take measures to protect against laser radiation!*

-
14. Switch on the system.
 15. Start the laser console and log on as "service".
 16. Set current I_{OP_temp} (100 % = nominal output).
 17. Turn on the laser beam.
 18. Reduce the power of the laser beam after the external modulator to 30 to 40 % (7.5-10 W).



CAUTION

Risk of damage!

If the power is high, the WinCam can be damaged during the following check!

- *Reduce the power of the laser beam.*

-
19. Check the beam position in the WinCam.



CAUTION

In the event of a beam offset >500 µm in X and/or Y, contact Rofin.

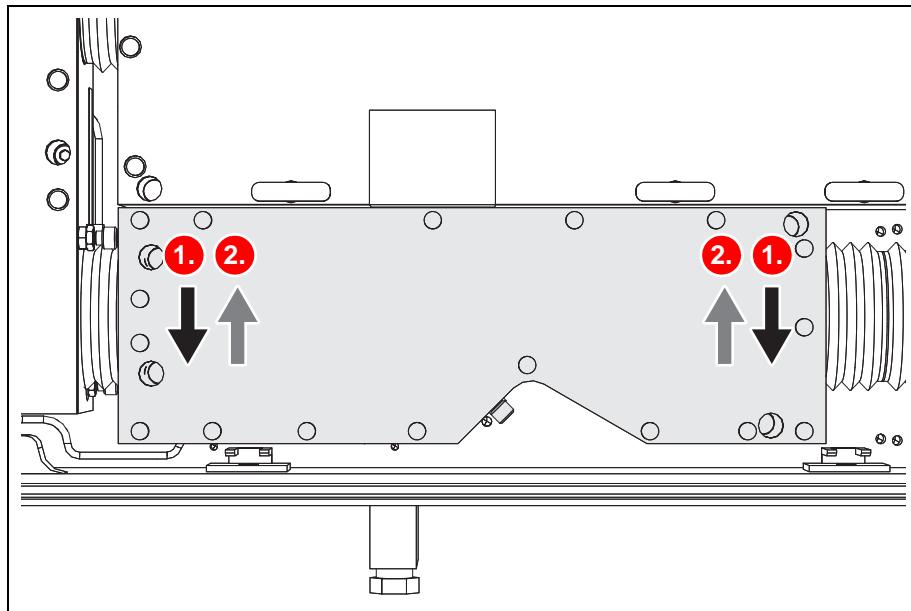


Figure 6.58 Move the external modulator

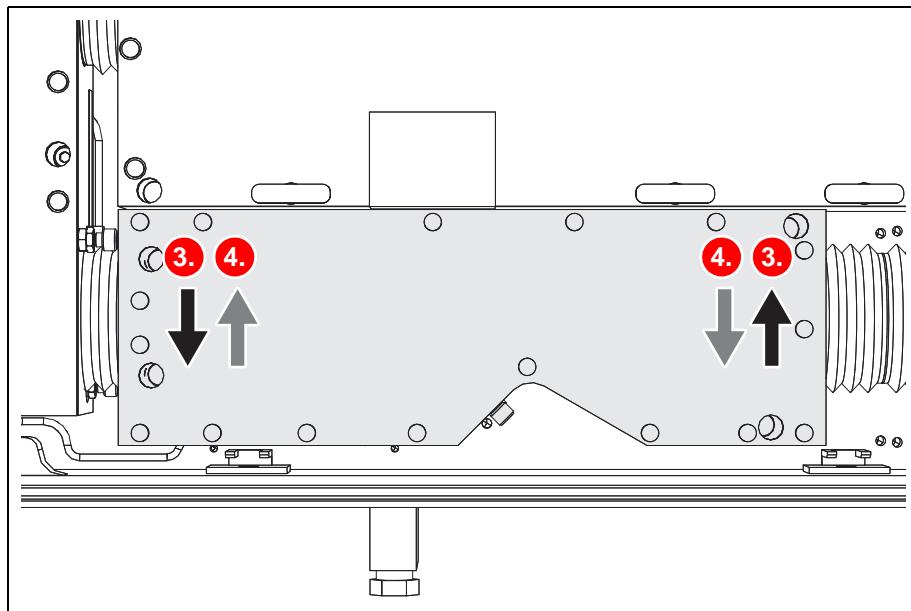


Figure 6.59 "Tip" the external modulator

20. By moving and "tipping" the external modulator, you can determine the position in which the power is greatest.
21. Carefully tighten the fastening screws in this position. In this process, check on the power display that the power does not reduce.
22. Open the cover on the plug-in supply unit.
23. Open the cover on the pump module.

Adjustment tasks

Adjusting the laser beam

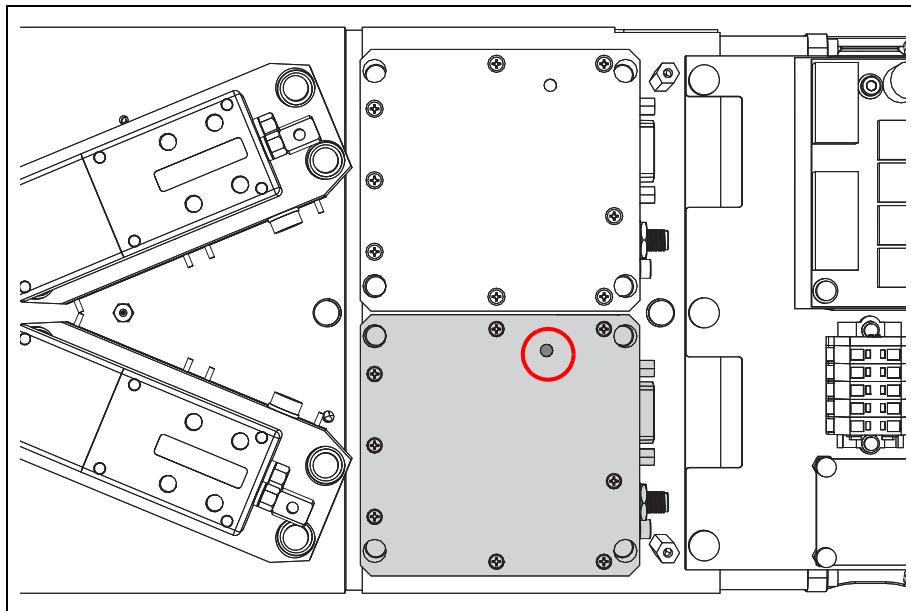


Figure 6.60 HG 29-80

24. Use the potentiometer on the HG 29-80 to maximize the power at I_{OP_temp} and 70 kHz. Note down the value.
25. The measured value must be $\geq 85\%$ of the power value measured before installation of the external modulator (maximum permissible loss 4.4 W). If not, contact Coherent-Rofin.
26. Check the position of the laser beam after the beam expander using the WinCam and if necessary readjust in x, y, phi.
27. Measure the power again on the galvo flange.
28. Switch off the laser system.
29. Re-fit the beam guide, bellows and galvo head.
30. Mount the cover on the resonator side of the laser head.
31. Commission the laser system.
32. Measure the power outside the focus with 70 kHz and I_{OP_temp} and reduce the current in stages until 24-25 W is reached in the field.
33. Enter the current value in "configwin-32.xml" as a new current limit.

6.6 HF generator

6.6.1 HG 29-40 operating voltage

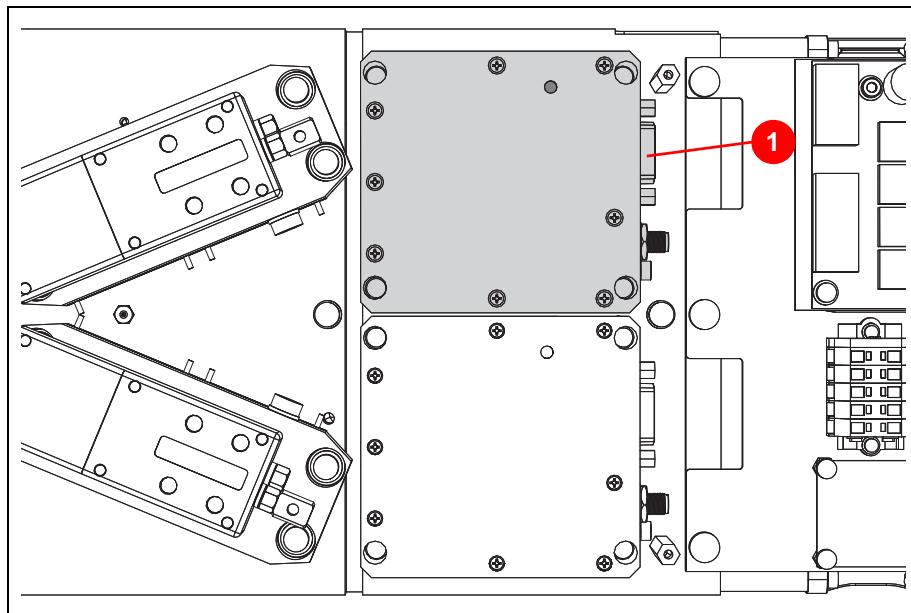


Figure 6.61 Connecting plug -X12 HG 29-40

1. Unscrew the connecting plug -X12 (1) (Figure 6.61) from the HG-29-40 and remove.
2. Plug the measuring adapter into -X12 on the HG 29-40.
3. Plug connecting plug -X12 into the measuring adapter.
4. Connect the voltmeter to Pin 1 (-) and Pin 5 (+) of the measuring adapter.
5. Secure the laser system against being switched on (remove the key from the key switch).



DANGER

Laser system opened, safety devices missing!

With the laser system opened and/or safety devices removed, there is a serious risk of accident!

- Take measures for protection against laser radiation (wear laser safety goggles, wear PPE, setup and position partition walls, attach warning signs and barriers, etc.).
- All persons present must be protected.
- These measures must be coordinated with the laser safety officer.
- Ensure a shutdown in the event of danger (e.g. press emergency stop switch/main switch on the laser system by a second person)!

6. Insert the mains plug of the laser system.
7. Turn on the main switch.
8. Set the key switch to the "1" position.
9. Wait for the system warm-up time of 15 minutes.
10. Measure the operating voltage (**24.0 V -1 V/+2 V**) on HG 29/-X12.



CAUTION

In the event of incorrect operating voltage, the supply unit -G1 should be checked/replaced.

11. Set the key switch to the "0" position and wait for the run-on time.
12. Turn off the main switch.
13. Remove the measuring adapter and measuring equipment.

6.6.2 HG 29-80 operating voltage

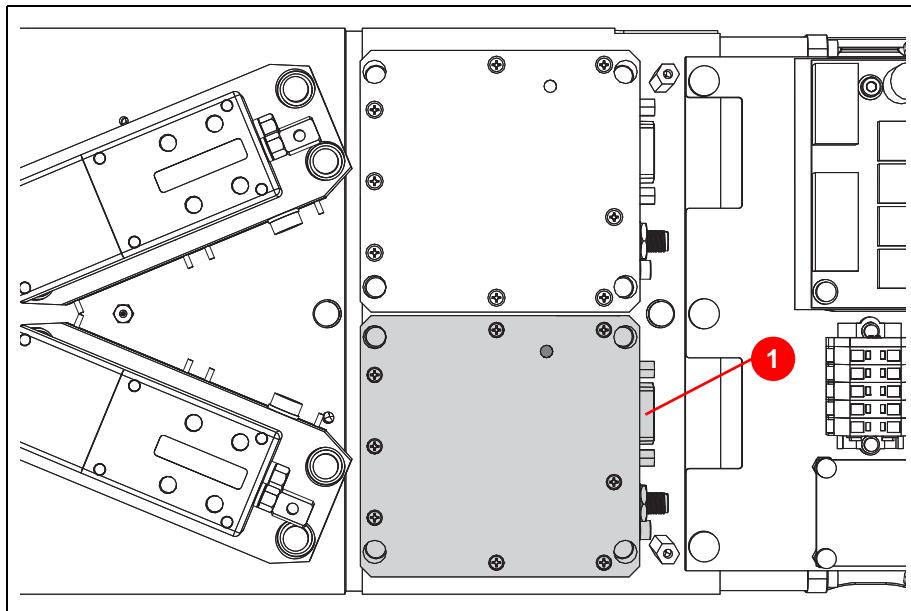


Figure 6.62 Connecting plug -X12 HG 29-80

1. Unscrew the connecting plug -X12 (1) ([Figure 6.62](#)) from the HG-29-80 and remove.
2. Plug the measuring adapter into -X12 on the HG 29-80.
3. Plug connecting plug -X12 into the measuring adapter.
4. Connect the voltmeter to Pin 1 (-) and Pin 5 (+) of the measuring adapter.
5. Secure the laser system against being switched on (remove the key from the key switch).



DANGER

Laser system opened, safety devices missing!

With the laser system opened and/or safety devices removed, there is a serious risk of accident!

- Take measures for protection against laser radiation (wear laser safety goggles, wear PPE, setup and position partition walls, attach warning signs and barriers, etc.).
- All persons present must be protected.
- These measures must be coordinated with the laser safety officer.
- Ensure a shutdown in the event of danger (e.g. press emergency stop switch/main switch on the laser system by a second person)!

6. Insert the mains plug of the laser system.
7. Turn on the main switch.

8. Set the key switch to the "1" position.
9. Wait for the system warm-up time of 15 minutes.
10. Measure the operating voltage (24.0 V -1 V/+2 V) on HG 29/-X12.



CAUTION

In the event of incorrect operating voltage, the supply unit -G1 should be checked/replaced.

11. Set the key switch to the "0" position and wait for the run-on time.
12. Turn off the main switch.
13. Remove the measuring adapter and measuring equipment.

6.6.3 HF output HG 29-40

1. Secure the laser system against being switched on (remove the key from the key switch).



DANGER

Laser system opened, safety devices missing!

With the laser system opened and/or safety devices removed, there is a serious risk of accident!

- Take measures for protection against laser radiation (wear laser safety goggles, wear PPE, setup and position partition walls, attach warning signs and barriers, etc.).
 - All persons present must be protected.
 - These measures must be coordinated with the laser safety officer.
 - Ensure a shutdown in the event of danger (e.g. press emergency stop switch/main switch on the laser system by a second person)!
-

2. Insert the mains plug of the laser system.
3. Determine the temporary current I_{OP_temp} for the operating point:
 - Power 28 to 29 W at 70 kHz.
 - Note down the current value.
 - This value applies to all power curves, and the actual power limit is calculated later on in the field.



CAUTION

The HF generator must be in operation for 15 min. to correctly set the HF output.

If the HF output is set too soon, problems may occur during the blocking behavior or quality may be lost during marking.

4. Check the operating voltage.
5. Open the shutter.
6. Turn on the laser beam.
7. Using the transducer disk, search for laser radiation outside of the focal point.

Laser radiation present

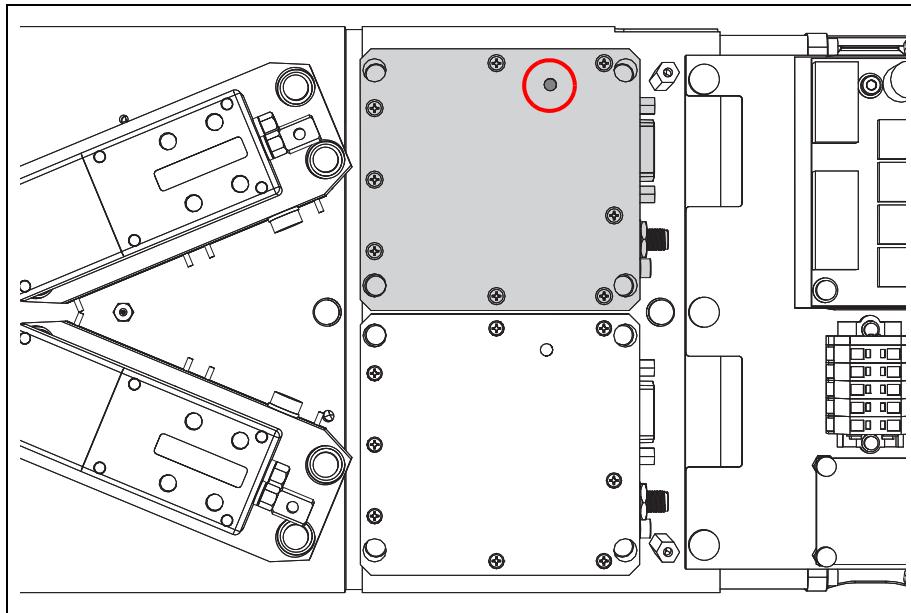


Figure 6.63 Potentiometer HG 29-40



CAUTION

Turn the potentiometer on the HG 29-40 completely to the left and slowly increase the output by turning it clockwise.

- Increase the RF power by slowly turning the potentiometer to the right (clockwise) until the laser radiation disappears.

Approximate adjustment



CAUTION

Use the IR transducer screen from this point!

8. Using the IR transducer screen, search for laser radiation outside of the focal point as follows:
 - When using the IR transducer screen, keep it moving to guarantee a constant display. After about 10 to 15 seconds, "charge" the IR transducer screen at a light source (approx. 1 to 2 seconds).
 - Do not subject areas outside the active surface of the sensor card with laser radiation, as they absorb the radiation. Damage to the card, including the risk of fire, is possible!

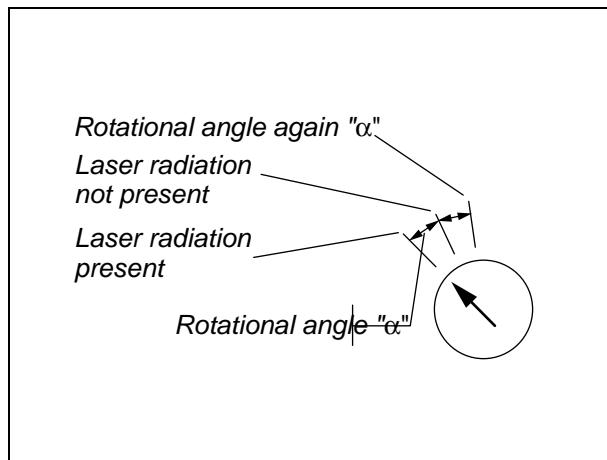


Figure 6.64 HF power setting HG 29-40

Laser radiation present

- a) Increase the RF power by slowly turning the potentiometer to the right (clockwise) until the laser radiation disappears. Proceed with b).

No laser radiation present

- b) Decrease the HF power by slowly turning the potentiometer to the left (counterclockwise) until the laser radiation emerges.
- c) Turn the potentiometer to the right (clockwise) until the laser radiation disappears. The two positions of the potentiometer (laser radiation present/not present) describe the " α " angle of rotation (Figure 6.64).
- d) Turn the potentiometer by this angle of rotation to the right (clockwise) again. This ensures that the RF power remains sufficiently stable in the long term.

Fine adjustment

9. With a jump from 10 A to I_{OP_temp} , the Q-Switch must not permit the laser beam (short pulse) through at all.
10. Where necessary, equalize by adjusting the potentiometer clockwise.
11. Mount the cover of the laser head.
12. Commission the laser system.
13. Check the "Frequency" and "First pulse suppression" parameters for application/markng program and re-set the first pulse parameter if necessary.

6.6.4 HF output HG 29-80

1. Secure the laser system against being switched on (remove the key from the key switch).



DANGER

Laser system opened, safety devices missing!

With the laser system opened and/or safety devices removed, there is a serious risk of accident!

- Take measures for protection against laser radiation (wear laser safety goggles, wear PPE, setup and position partition walls, attach warning signs and barriers, etc.).
- All persons present must be protected.
- These measures must be coordinated with the laser safety officer.
- Ensure a shutdown in the event of danger (e.g. press emergency stop switch/main switch on the laser system by a second person)!

-
2. Insert the mains plug of the laser system.



CAUTION

The HF generator must be in operation for 15 min. to correctly set the HF output.

If the HF output is set too soon, problems may occur during the blocking behavior or quality may be lost during marking.

3. Check the operating voltage.
4. Open the shutter.
5. Turn on the laser beam.



DANGER

Laser radiation!

With activated external modulator, the laser beam after the resonator is always on!

- Take measures for protection against laser radiation (wear laser safety goggles, wear PPE, setup and position partition walls, attach warning signs and barriers, etc.).
- All persons present must be protected.
- These measures must be coordinated with the laser safety officer.
- Ensure a shutdown in the event of danger (e.g. press emergency stop switch/main switch on the laser system by a second person)!



CAUTION

The HG 29-80 should only be used with an external modulator and the settings carried out as specified in the table on [Page 6-45](#).

HF blanking HG 29-80 is always to mass!

6. Set optimum external modulator via tipping/rotating ([see page 6-48](#)).
7. Set up the HG 29-80 and maximize the laser power ([see page 6-49](#)).

8. To check that the power is exiting the HG 29-80, run a marking program (e.g. circle at slow speed, CW, laser power in %).
 - At 100 %: residual level goes from 0 V to 5 V, maximum laser power after external modulator, HF output HG 29-80 power must increase to the maximum value ([see point 4.11, page 4-40](#)).
 - At 0 % power, no HF, no laser power, residual level approx. 0 V.
 - At 50 % the residual level is at approx. 2.5 V and the HF output is around half of 100 %. The laser power after the external modulator is at around half of 100 %.



CAUTION

The laser power is only displayed correctly in percent if a linearization of the power curve has already been carried out in accordance with [Section 7.1, page 7-1](#).

6.7

Performing a field correction

1. Mark a square with the dimensions of the marking field, e.g. 120 x 120, 180 x 180, etc. on suitable material.
2. Measure field size in X and Y.
3. Create a backup copy in the active field correction file using the field correction wizard.
4. In the field correction wizard, adjust the active field correction X and Y until the field in X and Y is of the right size again.

Adjustment tasks

Notes

Notes

7 Setting up the integrated PC



WARNING

Hazards due to non-observance of safety instructions!

Hazards for persons and/or property can arise due to non-observance of safety instructions.

- All safety instructions in the [Chapter 2, Safety](#) should be observed during all work on the laser system.
-

7.1 Linearizing the power output



CAUTION

The function described below is used for recalibration. The system is supplied with a calibration/measurement having been performed.



CAUTION

The "LABMAX" measuring equipment from Coherent and "NOVA" from OPHIR is currently supported. The operating instructions for the measuring equipment should also be observed. USB drivers must be installed.



CAUTION

Leave the laser system switched on for at least an hour, so that the entire laser system (resonator module, HF generator, etc.) stabilize accordingly.

Explanation

With the PL-E Air 25 EM (External Modulator), the laser power is set via an external modulator in % (0 – 100 %) and not via the diode current.

The resonator has a permanently set default current (I_{AP}).

The beam is enabled after switching on, and directed into the shutter radiation sink or into the EM radiation sink. This provides constant, stable output power at all times. The laser power is then switched via the EM located in the beam path after the resonator and regulated in the output.

The EM is an AOM (AcousticOptical Modulator), as well as the Q-Switch installed in the resonator.

The EM is actuated via a further HF driver and a 0-5V signal.

The resultant laser characteristics are linearized via software and converted into a 0-100% power setting.

With this operating mode, no initial pulse response occurs as the resonator is always in operation and the laser beam is switched with the EM. The function of the first pulse suppression can still be used. However, defined switch-on ramps can then be generated via the EM.

The linearization takes place in the field as the PL-E Air 25 EM is specified in the field.

Proceed as follows:

- Set current I_{AP} where the output at 70 kHz in the field is between 24 and 25 W. Ideally this should come as close to the maximum 25 W as possible, but not any higher.



CAUTION

Set value of the I_{AP} in 0.5 ampere steps (40.0, 41.5, 42.0, etc.).

The final I_{AP} can also be lower than the I_{AP_temp} before it !

- Enter the I_{AP} configurator in "configwin-32.xml".

Laser\Laser_LSC	Current for analog power	I_{AP}
-----------------	--------------------------	----------

- Save.

- Restart the RCU.

- Set the current limit (I_{AP}) in LSC.

- Start the laser console (log on as Service)
- LaserDisplay / Online Configuration / Current Max -> I_{AP}
- Press "EXIT".



CAUTION

"Create Power Curves" must be restarted.

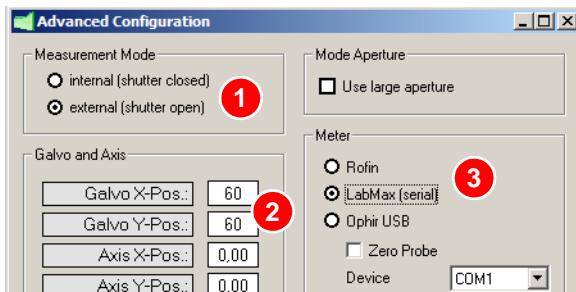


Figure 7.1 Advanced Configuration

- Open shutter (1) (Figure 7.1).
- Position the measurement head underneath the galvo head.
- Position the galvo mirror in the middle of the field (2).
- Select the measuring device (3).
 - OPHIR:** The driver for OPHIR must be installed (installation of the StarLab software)
 - Zero Ophir using StarLab or manually (see description of the measuring device).
 - LabMax:** Select the Com Port and set the parameters (see description of the measuring device).
 - Select ZERO probe ("zero" the measuring device).

- Enter parameter.

- Frequency: 70 kHz

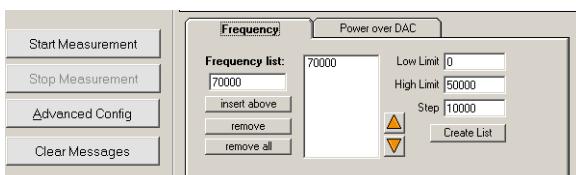


Figure 7.2 Enter parameter – 1

Setting up the integrated PC

Linearizing the power output

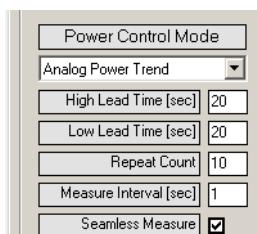


Figure 7.3 Enter parameter – 2

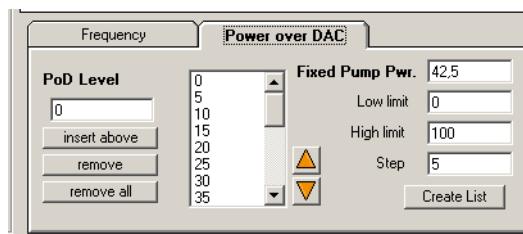


Figure 7.4 "Power over DAC" tab

- Power Control Mode: Analog Power Trend
- Low Lead Time: 20 s
- High Lead Time: 20 s
- Repeat Count: 10

11. Go to the "Power over DAC" tab and enter "Step" and "Fixed Pump Power"

- Fixed Pump Pwr: I_{AP} (example: 42.5 A = 25 W)
- Low Limit: 0
- High Limit: 100
- Step: 5

12. Click "Create List"



CAUTION

After this it is not permitted to record the power curve using "Create Power Curves" as otherwise the linearization is deleted!

13. Press "Start Measurement" to record a curve.

- Do not allow any programs to be running during recording.

14. After a successful measurement, rename the file "powercurves.txt" (directory C:\Rofin\VisualLaser-Marker\System) to "analogpower-trend.txt".

7.2 VLM – Show power curves

With this test function a calculation can be made as to whether a current must be set in order that a certain power can be attained at a specific frequency.

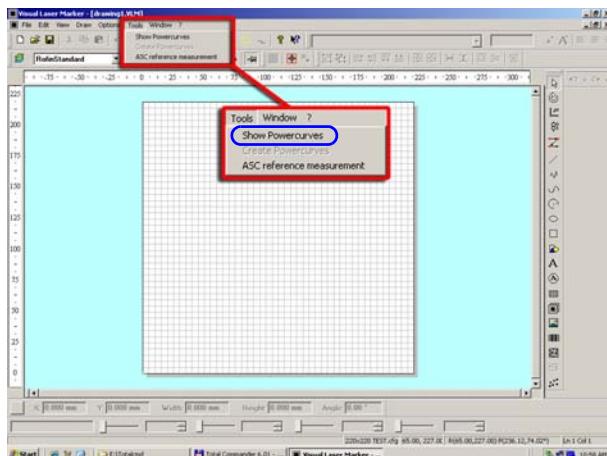


Figure 7.5 Program for field correction



Figure 7.6 Display power curves

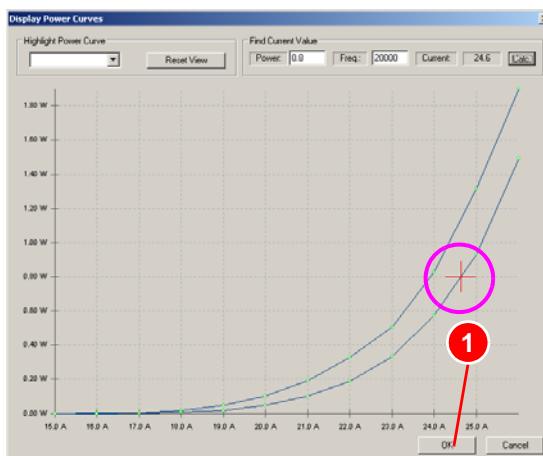


Figure 7.7 Calculate the current value

CAUTION

Risk of damage!

Possible damage to the laser system if operated incorrectly!

- This function may only be performed by authorized personnel!

1. Switch on the laser system and let it warm up for an hour.
2. Start up the laser PC and load WINDOWS®.
3. Starting the VLM software.
4. Call up the power curves by way of "Tools -> Show power curves".
5. Enter the power and frequency to be used under "Find Current Value" (1) (Figure 7.6).
6. Press the "Calc." (2) button. The current value is then calculated.

7. The current to be used (in example 24.6 A) is shown under "Current" (highlighted in gray, as only displayed and not editable) and a red cross is marked on the 20 kHz curve for visual checking of the calculated current value.
8. Press the "OK" (1) (Figure 7.7) button.

Setting up the integrated PC

All in one test

7.3 All in one test

This test comprises a check of all galvo, laser and software parameters.

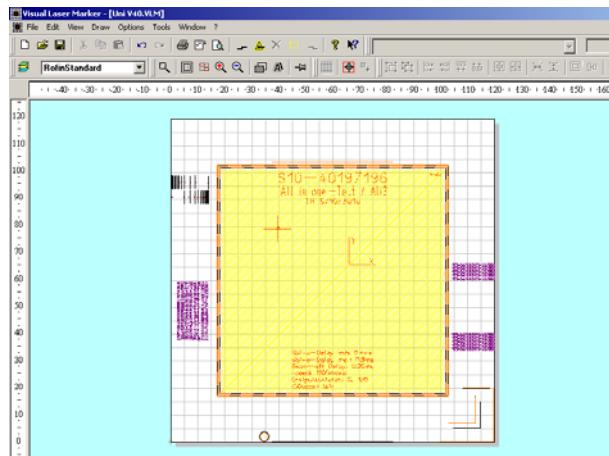


Figure 7.8 Uni V40.VLM

1. Starting the VLM software.
2. Open the "Uni V40.VLM" file.
3. Place the test material (the material to be marked during the process) beneath the galvo head.
4. Run the "Uni V40.VLM" test program.
5. Inspect the test marking for irregularities with the aid of a magnifying glass.

7.4 Drift test

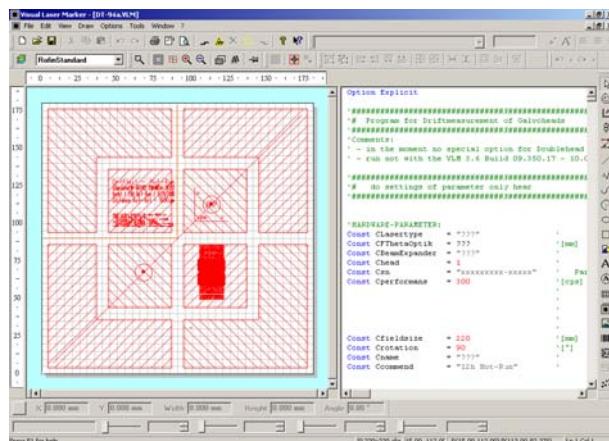


Figure 7.9 DT-94a.VLM

1. Starting the VLM software.
2. Open the "DT-94a.VLM" file.
3. Place the test material (the material to be marked during the process) beneath the galvo head.
4. Run the "DT-94a.VLM" test program.
5. Inspect the test marking for irregularities with the aid of a magnifying glass.



CAUTION

Tolerance of the drifts: $\pm 66 \mu\text{m}$.

7.5 Continuous test

This involves a continuous test of the laser power!

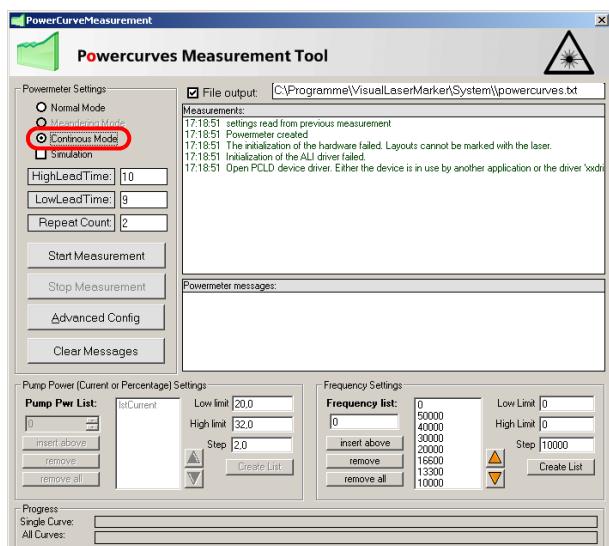


Figure 7.10 Selecting the Continuous mode

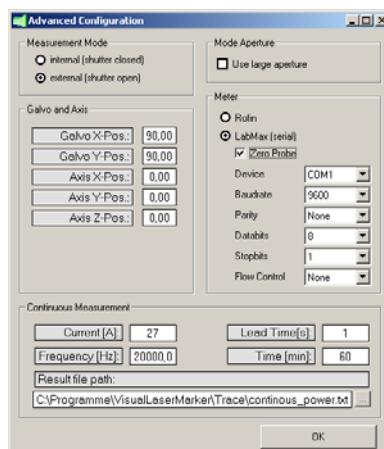


Figure 7.11 Settings for a one hour test

Figure 7.12 Continuous test

1. Switch on the laser system and wait for the system to warm up.
2. Start up the laser PC and load WINDOWS®.
3. Call up "Power curves" (Start -> VisualLaserMarker -> Tools -> CreatePowerCurves).

i CAUTION

The VLM software must be shut down for this.

4. Select "Continuous Mode" (see figure 7.10).

5. For the test, enter the current value with which the 800 mW output power at 20 kHz should be attained (see point 7.2, page 7-4).
6. Specify the path for the file to be saved under "Result File Path".
7. Use the POWERCURVES tool for measuring process-specific reference values.

8. Check the output text file (see figure 7.12) for whether the power fluctuations are within the tolerance range ($\pm 10\%$).

7.6 Field correction

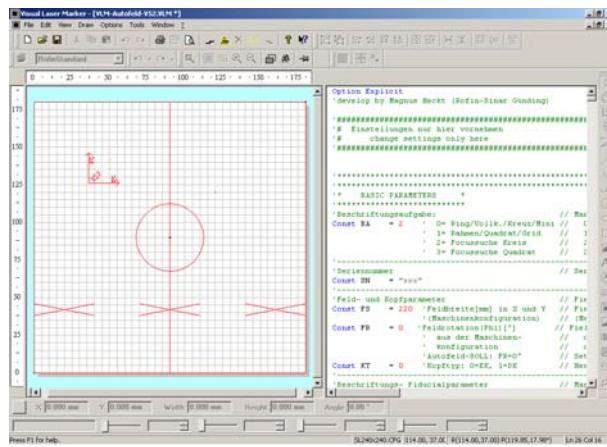


Figure 7.13 Field correction

1. Warm up the laser system.
2. Switch off the drift correction.
3. Set the field correction (compensation file) back to zero.
4. Set the parallelism and focal distance between the laser head and marking level as precisely as possible (see point 6.4, page 6-12).
5. Call up the "VLM-Autofeld-V52.VLM" program.
6. The corresponding parameters for field size, number of measurement points, etc. are entered in the right side of the program (VB script part).
7. Run the program, measure the marking and create the correction file.
8. Close the VLM.
9. Enter the generated correction file in the machine configuration, save the machine configuration and close it.
10. Restart the VLM and execute the "VLM-Autofeld-V52.VLM" program again over a new material.
11. Measure the marking.



CAUTION

Tolerance: $\pm 66 \mu\text{m}$.

12. The test program creates a file named "Equipmentnr¹⁾.acc". The measurement values and deviations are compiled in this text file.
13. Carry out field corrections according to the proprietor's specifications.

¹⁾ The exact equipment number (e.g. 40258406) of the laser system is assigned as the file name.

7.7 Automatic Self Calibration (ASC)¹⁾



CAUTION

Before activating the ASC, a drift test must first be performed (Section 7.4, page 7-5)! No ASC may be activated during the drift test! The laser system must be warmed up for 3 hours prior to the drift test with the "file DT-94a.VLM". Subsequently, a continuous test lasting 12 hours must be performed.



CAUTION

Leave the laser system switched on for at least an hour so that the galvo head warms up and the galvo head electronics stabilize accordingly.

Functionality

After complying with the conditions stated above, first, a reference measurement is performed. This serves as a reference point for all other tests. This "initial measurement" is also indicated as such in the logfile.

```
2012-03-14T16:24:23.750+00:00 DEBUG VLM:LDCPc1d.DriftCorr Ref Position Head1 X1: 7992
2012-03-14T16:24:23.750+00:00 DEBUG VLM:LDCPc1d.DriftCorr Ref Position Head1 X2: 56081
2012-03-14T16:24:23.750+00:00 DEBUG VLM:LDCPc1d.DriftCorr Ref Position Head1 Y1: 8708
2012-03-14T16:24:23.750+00:00 DEBUG VLM:LDCPc1d.DriftCorr Ref Position Head1 Y2: 56597
```

Figure 7.14 Reference measurement



CAUTION

Four positions (x_1, x_2, y_1, y_2) are always measured.

Afterward, a control measurement is carried out. Deviations from the measurement values are used to make corrections to the zero point position and the field size in both axes.

```
2012-04-03T16:16:59.812+01:00 DEBUG VLM:LDCPc1d.DriftCorr 4 measured positions for head: 0
2012-04-03T16:16:59.812+01:00 DEBUG VLM:LDCPc1d.DriftCorr Drift Position X1: 7987
2012-04-03T16:16:59.812+01:00 DEBUG VLM:LDCPc1d.DriftCorr Drift Position X2: 56091
2012-04-03T16:16:59.812+01:00 DEBUG VLM:LDCPc1d.DriftCorr Drift Position Y1: 8706
2012-04-03T16:16:59.812+01:00 DEBUG VLM:LDCPc1d.DriftCorr Drift Position Y2: 56611
```

Figure 7.15 Control measurement

For example, at position X+100 and at Y+100, an error of 20 is measured. This is saved.

If a drift (a deviation from the saved values) becomes apparent, an automatic correction to the saved values is performed.

Prerequisites for this are that the machine configuration ("Galvo" tab) contains correct values, the field correction file is loaded in the machine configuration and the system has been warmed up.

¹⁾ Option.

Setting up the integrated PC

Automatic Self Calibration (ASC)

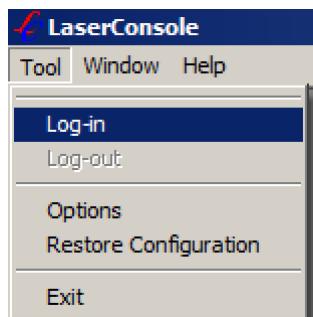


Figure 7.16 Open laser console

1. Open laser console.
2. Open log-in.

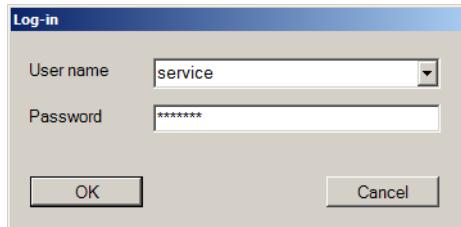


Figure 7.17 Log-in on laser console

3. Log in as "Service".

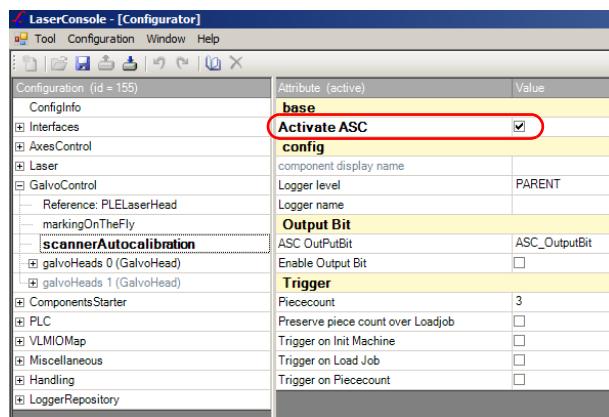
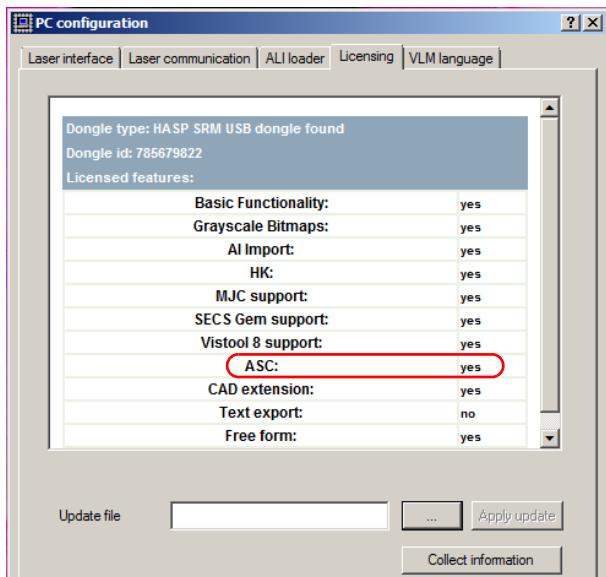


Figure 7.18 Activate "ASC"

4. Open configurator.
5. Activate "ASC".



CAUTION

License must be activated (PC configuration) (see figure 7.19). Galvo with ASC capability must be entered (see figure 7.20) and also be physically disconnected present.

Figure 7.19 License activation

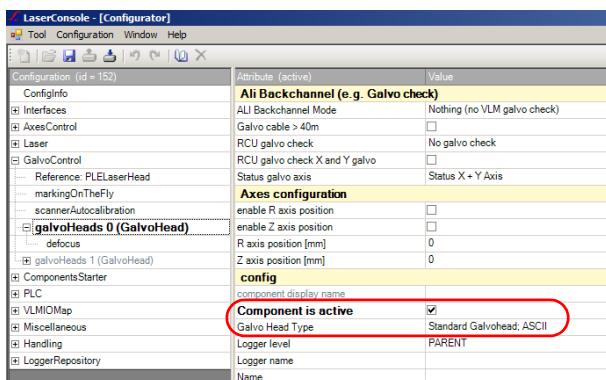


Figure 7.20 Enter galvo with ASC capability

Setting up the integrated PC

Automatic Self Calibration (ASC)

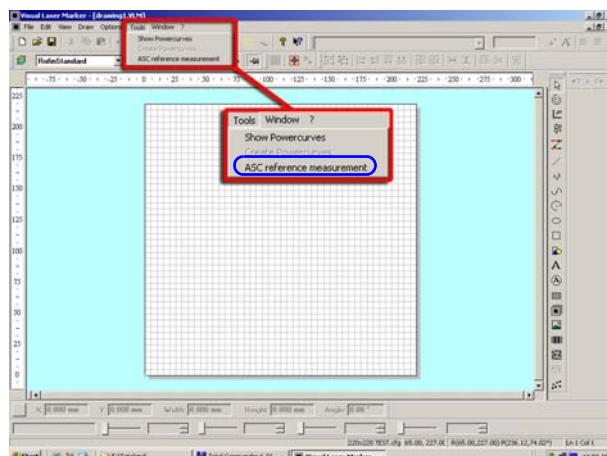


Figure 7.21 Program for field correction

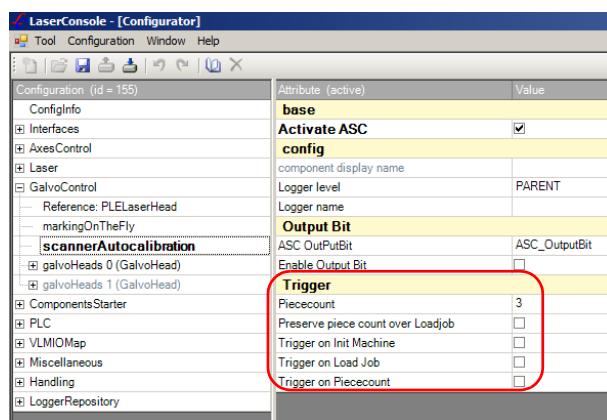


Figure 7.22 Activating the trigger

- Starting the VLM software.

CAUTION

Risk of damage!

Possible damage to the laser system if operated incorrectly!

- This function may only be performed by authorized personnel!
- The reference point for the automatic self-calibration is set by this.

- Start the ASC by way of "Tools -> ASC reference measurement".

CAUTION

This measurement lasts about 5 seconds.

- The system has now been calibrated and the ASC is active.
- Specify when the calibration should be checked by the software (see figure 7.22).
 - "Init Machine": when initializing the hardware.
 - "Load Job": when loading the marking program.
 - "Piececount": when the quantity of markings specified in the input field has been reached (e.g. every 100th marking).

CAUTION

The corresponding chapter in the VLM manual must also be observed.

- Save the settings with "Save" and activate them with "Use as active machine configuration file".
- Perform a log-out in the laser console.
- Commission the laser system.

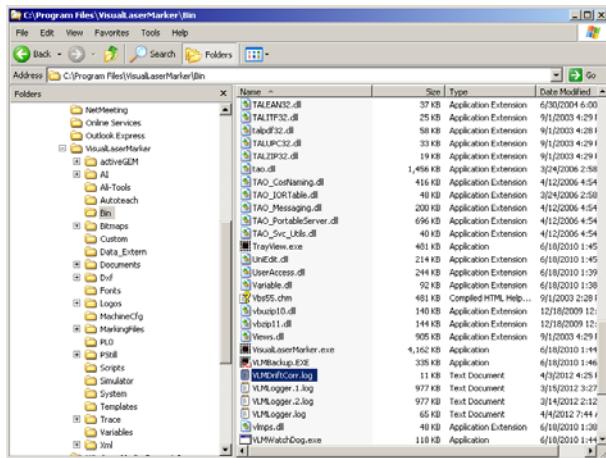


Figure 7.23 Open the logfile



Figure 7.24 Drift correction value check

13. To check the ASC function of the "VLMDriftCorr.log" file in the directory "C:\Program Files\VisualLaserMarker\Bin", open with a text editor.

14. Check the values in the logfile. These must be saved.



CAUTION

There may not be any zero values for the reference values. If zero values are present, the cause must be investigated (e.g. ASC not activated, false galvo head, no connection to the galvo, etc.).

Setting up the integrated PC

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