Service Manual

COMPex*Pro*® (RoHS)

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1 INTRODUCTION

This Service Manual is a part of the instructions for use that accompany COMPex*Pro*® excimer laser devices. These instructions promote the intended safe and efficient use of the laser device and contain the information that needs to be known before starting work. Following these instructions should reduce the risk of injury to persons as well reduce the risk of damage, malfunction or inefficient operation of the laser device.

The instructions for use consist of more the one document. Each document has been prepared for a specific target group and will be made available to this group of persons by Coherent, their authorized representative or the laser unit manufacturer (system integrator).

The COMPex*Pro* instructions for use consists of the following separate documents:

– User Manual

– Site Preparation Manual.

– Interfacing Manual

– Service Manual

Installation, de-installation, servicing and detailed troubleshooting shall only be performed by correspondingly trained and instructed service personnel. Consequently, the target group for the Service Manual is strictly limited to skilled personnel that have successfully completed a dedicated Coherent advanced training course for COMPex*Pro* excimer laser devices.

The COMPex*Pro* excimer laser device is intended for use as a subsystem within a laser product (laser assembly or laser unit as defined in ISO 11145). Consequently, the laser device's instructions for use are to be used in conjunction with other instruction manuals that describe the complete system or further system elements. In addition, it is to be supplemented by the respective national rules and regulations for accident prevention and environmental protection.

1.1 The Service Manual

WARNING
Risk of serious injury or equipment damage!
Incorrect maintenance can cause exposure to or contact with hazards such as laser radiation, lethal voltages and toxic or corrosive substances.
Only authorized and correspondingly trained personnel shall maintain or service the laser device. Strictly follow the instructions contained in this manual.

This manual describes the necessary service procedures for the COMPex*Pro* excimer laser device. This includes performance testing, adjustments and the replacement of expendable parts, replacement parts and spare parts as well as installation / de-installation of the laser device and troubleshooting. In addition, this manual gives a more detailed overview about the laser control software to familiarize the service personnel with the necessary background required to perform these activities.

For detailed safety information, please refer to the Safety Chapter of the User Manual.

The screenshots in this manual are only examples and may show configurations or parameter settings which do not necessarily apply to your laser device. Changing the parameter settings to correspond with the screenshots may reduce laser performance or even damage the laser device.

1.1.1 Described Laser Devices

This manual describes the laser device versions COMPex*Pro* 50, COMPex*Pro* 102, COMPex*Pro* 110, COMPex*Pro* 201, COMPex*Pro* 205, BraggStar M and LPX 105NT with running serial numbers of 20000 and above[1].

1.1.2 Intended Audience

The Service Manual is intended for all authorized and correspondingly trained persons that are to maintain, service, install or de-install the COMPex*Pro* laser device.

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1. All laser device serial numbers consist of a device type identifier (e.g. GEP.1120129) and a running number (e.g. 20010)

1.1.3 Availability and Use

The Service Manual must made be available to all service personnel that have successfully completed a corresponding training course and are authorized to carry out the maintenance, service, installation and de-installation of the COMPex*Pro* laser device.

1.1.4 Numbering of Chapters, Pages and Instructions

The pages of this manual are numbered continuously. The page number appears in the lower outside corner of every page.

The chapters are numbered continuously. The name of the chapter appears in the upper outside corner of every even page. Each chapter ends with an even page number. Consequently, certain even pages at the ends of chapters will be intentionally left blank.

Each step within a procedure is sequentially numbered. Each procedure starts with the step number one.

1.1.5 Typographic Conventions

Menu commands, enquiries and prompts are written in uppercase letters enclosed by quotation marks.

– Example: “ARE YOU SURE (YES/NO)?”

Single keys on the keyboard and terminal buttons to be pressed or touched are written in angled brackets.

– Example: Touch <YES> to confirm and to continue.

A plus sign between keys means that the keys are to be pressed simultaneously.

– Example: Press <ALT> + <F10> to open the help window.

The button description <ENTER> is used to describe the keyboard button marked or referred to as ENTER, ↵, RETURN, CR or CARRIAGE RETURN.

Commands to be entered through a keyboard are written in non-proportional lower-case letters.

– Example: Type cd lambda.

Programming commands for remote communication to be used literally are written in upper-case letters.

– Example: OPMODE=

Placeholders in commands or messages are written in italic letters.

– Example: OPMODE=*operating mode*
  Use apermitted command instead of the words operating mode.

Examples are written in non-proportional, upper-case letters to simulate the appearance of monitor displays or printer output.

1.1.6 Trademarks

The trademarks used in this manual are the properties of their respective owners and are used for identification purposes only:

- Coherent and the Coherent Logo are registered trademarks of Coherent Inc., USA
- COMPex*Pro*, LAMBDA PHYSIK and NovaTube are registered trademarks of Coherent LaserSystems GmbH & Co. KG.
- Gyrolok is a registered trademark of Hoke Inc., NJ (USA).
- VCR is a registered trademark of Cajon Company, USA
- SNOOP is a registered trademark of the Swagelok Company, USA
- Shockwatch is a registered trademark of Media Recovery Inc., USA

In the following sections of this manual, no mention is made of patents, trademark rights or other proprietary rights which may attach to certain words. The absence of such mention, however, in no way implies that the words in question are exempt from such rights.

1.1.7 Cited Standards

Unless otherwise stated, all technical standards cited in this manual relate to the latest version of the standard that is applicable at the date of the publication of this manual.

In many cases, the international standards (ISO and IEC standards) have been adopted wholly or in part by national or regional standards authorities and are known locally under the designation assigned by this authority. For instance, the IEC 60825-1 has been adopted by the European Committee for Standardization as the standard EN 60825-1 and, in turn, by various national standards authorities as standards such as DIN EN 60825 (Germany) and BS EN 60825 (United Kingdom). The exact content, number and revision date of the national standard may, however, vary from that of the corresponding international standard. For further information, please contact the publisher of the respective national standard.

1.1.8 Software Versions

The information in this manual relates to the laser control software LCS version 2.81 and the handheld keypad software CTERM 4.62.

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1.2 Safety

1.2.1 Laser Safety Classification

IIEC-60825-1, FDA 21 CFR 1040.10 and 1040.11 and ANSI Z-136.1 indicate the requirements and procedures that are to be followed to ensure the safe use of laser products. These standards and regulations classify each laser product according to the potential hazards arising in its use. In each case, the laser class indicates the accessible emission limit (AEL), i.e. the maximum emission level that humans can access.

The lowest laser class is Class 1 and the highest is Class 4:

– Class 1 laser products are laser products that are safe under reasonably foreseeable conditions of operation.

– Class 4 laser products are laser products that permit human access to emission levels that represent an acute hazard to the eyes and skin from direct and scattered radiation.

Within this classification, the COMPex*Pro*, as a stand-alone laser device, is a Class 4 laser product. It must, consequently, be regarded as a potential hazard to the human operator. The laser beam must also be regarded as a potential fire hazard.

When a Class 4 laser device is integrated in a laser product that has been designed and engineered to prevent human access to laser emission exceeding Class 1 levels during normal operation, the laser product can be classified as a Class 1 laser product. Such a Class 1 laser product must have a protective housing and safety interlocks on all removable housing access panels. Laser operation shall only be possible when all access panels are in place and human access to hazardous levels of laser radiation (including scattered laser radiation) is prevented.

Wherever technically feasible, the product or system into which the laser device is integrated should be designed and engineered as a Class 1 laser product. Nevertheless, the high power laser device incorporated in such a laser product remains a Class 4 laser product. If access panels are removed and safety interlocks defeated (e.g. to perform servicing, adjustment or alignment work), there is the risk of exposure to Class 4 laser radiation.

The laser safety classification of the laser product into which the COMPex*Pro* is integrated is to be indicated by the laser product manufacturer (system integrator). For further information, please refer to the system integrator’s documentation.

To assist with the alignment of the beam path, a laser product may be equipped with a Class 2 or Class 3R (IEC 60825-1) pilot or alignment laser. Such lasers are low power products (max. 5 mW for Class 3R) that emit laser radiation in the visible wavelength range from 400 nm to 700 nm, where the risk of eye injury remains low due to the blink reflex.

1.2.2 Safety Information

The Safety Chapter of the separate User Manual describes the physical hazards related to the excimer laser device, the means of protection against these hazards and the safety features incorporated in the design of the laser device.

This Safety Chapter must be read by all persons entrusted with any sort of work on the laser device. Never start to work on or with the laser device unless you have read and fully understood the safety information in the User Manual!

1.2.3 Signal Words and Symbols in this Manual

The COMPex*Pro* documentation may contain sections in which particular hazards are defined or special attention is drawn to particular conditions. These sections are indicated with signal words in accordance with ANSI Z-535.6 and safety symbols (pictorial hazard alerts) in accordance with ANSI Z-535.3 and ISO 7010.

1.2.3.1 Signal Words

Four signal words are used in the COMPex*Pro* documentation: DANGER, WARNING, CAUTION and NOTICE.

The signal words DANGER**,** WARNING and CAUTION designate the degree or level of hazard when there is the risk of injury:

DANGER
Indicates a hazardous situation which, if not avoided, will result in death or serious injury.

WARNING
Indicates a hazardous situation which, if not avoided, could result in death or serious injury.

CAUTION
Indicates a hazardous situation which, if not avoided, could result in minor or moderate injury.

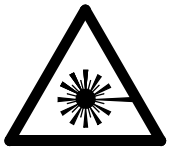
The signal word “NOTICE” is used when there is the risk of property damage:

NOTICE
Addresses practices not related to personal injury.

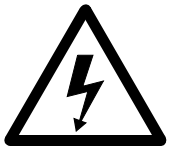
Messages relating to hazards that could result in both personal injury and property damage are considered safety messages and not property damage messages.

1.2.3.2 Symbols

The signal words **DANGER**, **WARNING**, and **CAUTION** are always emphasized with a safety symbol that indicates a special hazard, regardless of the hazard level:



This symbol is combined with one of the signal words **DANGER**, **WARNING** or **CAUTION** to indicate a hazardous situation caused by laser radiation.



This symbol is combined with one of the signal words **DANGER**, **WARNING** or **CAUTION** to indicate a hazardous situation caused by electricity.

This symbol is combined with one of the signal words **DANGER**, **WARNING** or **CAUTION** to indicate a hazardous situation caused by harmful substances.

This symbol is combined with one of the signal words **DANGER**, **WARNING** or **CAUTION** to indicate a hazardous situation caused by circumstances other than those described above.

1.3 Laser Terminology

The ISO 11145 (“Optics and Optical Instruments - Lasers and Laser Related Equipment - Vocabulary and Symbols”) contains a list of laser terminology (for more information, see the Functions Manual):

– Laser
  Consists of an amplifying medium capable of emitting coherent radiation with wavelengths up to 1 mm by means of stimulated emission.

– Laser Device
  A laser, where the radiation is generated, together with essential additional facilities that are necessary to operate the laser, e.g. cooling, power and gas supply.

To prevent misunderstandings, the COMPex*Pro* documentation strictly differentiates between “laser” and “laser device”. Thus “start laser device” means that the power is off and shall be turned on. To “start the laser” means to switch on the laser beam and start laser operation.

In addition to the terminology used by ISO 11145, IEC 60825-1 uses the term “laser product”. This term relates to any product or assembly of components which constitutes or is intended to incorporate a laser. In other words, the term “laser product” can be used in conjunction with any of the definitions contained in ISO 11145.

1.4 Units of Measurements

In this manual, units of measurement are used according to the metric system and the international system of units (SI), e.g. meter, millimeter, square meter, cubic meter, liter, kilogram, bar, pascal.

Temperatures are primarily indicated in degrees celsius (°C).

The water hardness is indicated in parts per million (ppm; American Hardness).

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1.5 Feedback Regarding Documentation

If you have any comments regarding the documentation provided to you, please contact us.

When you contact us, please provide us with:

– the document code or the part number and revision,

– the date of issue,

– the page number, section number and, where applicable, the procedure step number,

– a description of any errors,

– a proposal for improvements.

Feedback Address

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2 SAFETY

This chapter addresses specific safety considerations that are to be taken into account when performing service actions such as the installation, de-installation, servicing and repair of the laser device. It emphasizes the additional unique hazards that occur during such operational phases due to the incomplete state of the laser device and describes the corresponding precautionary measures.

The information in this chapter is intended to complement the information contained in the Safety chapter of the COMPex*Pro* User Manual. Consequently, always use this chapter in conjunction with the safety information provided in the User manual to obtain an overview of safe working practices during all operational phases of the laser device.

2.1 Organizational Requirements

This Service Manual must be made available to all persons that are authorized to perform installation, de-installation, service and repair work on the COMPex*Pro* excimer laser device. These persons shall also be familiar with the safety information contained in the relevant laser device User Manual. This Service Manual shall not be made available either completely or in part to any unauthorized persons without obtaining the prior consent of Coherent factory support.

The specific hazards that are present during product lifetime phases such as installation, servicing, repair and de-installation of the laser device should be addressed by a locally applicable risk management plan. This plan shall clearly indicate the respective personal responsibilities, such as the names of persons supervising operations or details of contact persons that can provide assistance in case of emergencies.

Ensure that the working area is adequately secured before starting to perform installation, servicing, repair or de-installation work. All persons within the working area should be aware of the specific and unique hazards of the work in hand and be instructed to observe the required precautionary measures. Always strictly follow the applicable lock out and/or tag out procedures.

Do not allow unauthorized persons to gain access to interlock defeat keys. Never disclose passwords for the laser control software to persons that do not posses the required rights of access.

2.2 Personnel Requirements

Only authorized service personnel that have been specifically trained by Coherent during a dedicated level C training course for the specific laser devices indicated in Section 1.1.1 on page 2 shall perform the procedures described in this Service Manual.

Installation and de-installation of the laser device shall always be carried out by Coherent service personnel that have been specifically trained to perform such work. All persons that are assigned to assist Coherent service personnel during installation and de-installation shall be made aware of the specific hazards and safe working procedures. The personal responsibility for this instruction should be addressed by the locally applicable risk management plan.

Any work on electrical components or the electrical system shall only be carried out by a qualified electrician working in accordance with electrical engineering rules and regulations.

Only specially trained and instructed personnel shall work with system modules or other equipment containing harmful, asphyxiant or pressurized gases.

Service personnel shall also observe all generally applicable legal and other mandatory regulations relevant to accident prevention and environmental protection. This also applies to all persons that are assigned to assist Coherent service personnel with work such as the installation, de-installation, service and repair of the laser device.

2.3 Material Requirements

Service personnel are obligated to use personal protective equipment (PPE) according to Coherent instructions and regulations as well as wherever required by the circumstances or by law. In addition, they should ensure that all persons that are assigned to assist them during their work also correctly use the appropriate personal protective equipment (PPE). If necessary, contact the responsible supervisor for assistance.

Always use tools and equipment that are suitable for the specific task and are in good working condition. Strictly observe the instructions for use that are provided with the tool or contained in this manual or any other official service document. This includes all instructions relating to mandatory or prohibited actions that are indicated on product warning labels.

Never make any modifications, additions or conversions to tools or other equipment which might affect safety.

Only use approved Coherent spare parts that are specified in the official field replaceable units list or spare parts catalog. Ensure that the shelf lifetime of the part used has not expired.

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2.4 Specific Hazards

This section outlines the unique hazards that exist when the laser device is in an incomplete state, e.g. when being serviced or repaired or during installation and de-installation. These hazards include:

- The laser device or parts of the laser device may tip or drop during installation or de-installation and thereby create a crushing hazard.
- The weight of certain system modules may cause back strain or other related injuries if incorrectly lifted or moved. In some cases, the heavy weight of the module is not immediately apparent.
- System modules with a high center of gravity, such as the laser tube may tip or overturn during transport and thereby create a crushing or cutting hazard.
- Injuries to the head or limbs, e.g. through impact or pinching, when working in confined spaces.
- Unexpected energization of the open laser device with the risk of an electric shock.
- Injury due to the malfunctioning of devices that are subject to electromagnetic interference when operating the laser with an open housing.
- Sudden escape of pressurized gases with the risk of exposure to harmful or asphyxiant gases or injury through objects that have been displaced by the gas pressure.
- Release of water and the risk of injury through slipping on a wet floor.
- Exposure to excessive noise levels when the laser device is operated with an open housing.
- Persons tripping on unsecured cables, hoses, pipes or other objects.

For further information about the hazards inherent to excimer laser devices, please refer to the User Manual.

2.5 Specific Safety Requirements

The risk of injury during or following operational phases such as the installation, servicing, repair and de-installation of the laser device can be minimized by observing the following safety precautions:

- Strictly observe the safety instructions in the laser device User Manual as well as the organizational, personnel and material requirements provided in Sections 2.1 to 2.3 of this manual.
- Prevent unauthorized persons from entering the working area.
- Never work alone. This is particularly important when there is an increased risk of serious injury, e.g. through impact or crushing, or when working on the electrical or gas system.
- All persons within the working area shall use the specified and approved personal protective equipment, e.g. safety shoes, gloves and protective eyewear. Strictly observe all facility safety signs. For further information, contact the site supervisor and consult the relevant section of the laser device User Manual.
- Take into account the weight and potential instability of certain system modules. Note the corresponding warning and weight indication labels on modules and safety messages in this manual. Always use safe working practices for lifting and handling heavy objects.
- Always use appropriate transport and lifting equipment such as cranes, hoists and fork-lift trucks. This equipment shall only be operated by specifically qualified persons.
- Do not move or remain below suspended loads.
- Strictly follow the instructions provided by warning labels on system modules, e.g. always disconnect and lock out the mains power before opening a module. Never open modules that are not field serviceable. In case of doubt, always contact your supervisor.
- Take into account the time required for capacitors to discharge before opening or disconnecting an internal electrical module.
- Ensure that all grounding lines are correctly connected after initial installation, servicing or repair.
- Ensure that all housing covers and other protective equipment are correctly refitted after initial installation, servicing or repair.
- Shut off and lock out the gas supply before connecting or disconnecting any gas lines.
- Before disconnecting the halogen line, always thoroughly purge the line and fill it with inert gas.
- Immediately clean-up any water that may have been spilled during the connection or disconnection of the water lines.
- Prevent tripping hazards, in particular on the main walkways.

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3 FUNDAMENTAL AND PREPARATORY PROCEDURES

This section describes in detail procedures required to prepare the laser device for servicing work or re-enable laser operation after completing servicing work.

This chapter is not to be worked through sequentially. The appropriate procedures are to be performed as instructed in the corresponding sections of this manual.

- Section 3.1 on page 16 describes the lockout / tagout procedure that is to be performed prior to servicing the laser device.
- Section 3.2 on page 19 describes the handling of the housing covers that are to be removed or opened to gain access to the maintenance areas inside the laser device.
- Section 3.3 on page 26 describes the handling and safe use of interlock defeat keys.
- Section 3.4 on page 28 describes the handling of non-interlocked covers that have to be removed during servicing to gain access to specific components and modules inside the laser device.
- Section 3.5 on page 34 describes fundamental gas line maintenance routines which are to be performed periodically or in the course of maintenance and service procedures.

3.1 Lockout / Tagout Procedure

Purpose

This procedure establishes the minimum requirements for the lockout of energy isolating devices whenever maintenance or servicing is performed on the COMPex*Pro* laser device. It shall be used to ensure that the laser device is stopped, isolated from all potentially hazardous energy sources and locked out before employees perform any servicing or maintenance where the unexpected energization or start-up of the laser device or release of stored energy could cause injury.

WARNING
Risk of serious injury!
All employees are required to comply with the restrictions and limitations imposed upon them during the use of lockout.
Authorized employees are required to perform the lockout in accordance with the procedures described in this section.
No employee shall attempt to start, energize or use the laser device when it has been locked out.

The potentially hazardous energy sources of the COMPex*Pro* are:

– High voltage / electric energy

– Laser light

– Compressed gases

To perform maintenance or servicing within the laser device, these hazardous energy sources are isolated by setting the laser device's main switch to the OFF position. When working with an open gas system, e.g. when disconnecting the laser device from the gas supply or working on the gas supply lines (up to and including the solenoid valves), the external gas supply also has to be shut off and locked out / tagged out.

Tools and Materials

- Assigned individual lockout and/or tagout devices suitable for use with the respective energy isolating device.

  The assigned lockout / tagout device shall correspond with OSHA 29 CFR 1910.147(c)(5), i.e. it is to be durable, of a standardized type within the facility, substantial enough to prevent removal without the use of excessive force or unusual techniques and shall indicate the identity of the person applying the device.

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Securing the Main Switch

1. Notify all responsible persons that the laser device requires servicing or maintenance and that it must be shut down and locked out to perform the servicing or maintenance.
2. If the laser device is operating, shut it down by following the usual shut down sequence (see separate User Manual).
3. Ensure that the main switch is set to “OFF” (see Figure 1) so that the laser device is isolated from the potentially hazardous energy sources.

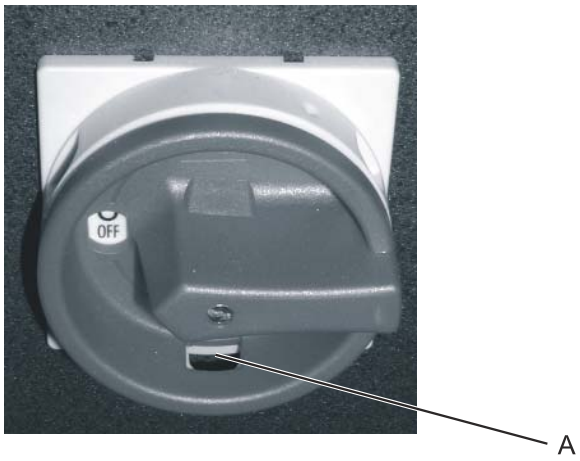

Figure 1: *Main switch lockout*

4. Lockout the main switch by inserting the assigned lockout device into the opening in the bottom of the main switch (see Figure 1, A).

   The lockout device can only be inserted when the main switch is in the “OFF” position.
5. Dissipate any stored or residual energy by following the specific instructions in the respective service or maintenance procedure; e.g. when working on the HV system, always allow the capacitors sufficient time to discharge before starting work.
6. Physically disconnect the laser device from the mains power supply whenever specifically instructed.
7. Ensure that the laser device is disconnected from the energy source and isolated by turning the key switch and making certain that the laser device will not operate.
8. Depending on local regulations, attach appropriate tags to warn that maintenance or servicing is being performed and indicate the identity of the person who applied the lockout device.

   The main switch of the laser device is now locked out. Necessary maintenance or servicing can now be performed. If, however, work is to be carried out on an open gas system, always perform steps 9 to 12 prior to starting the maintenance or servicing work.

Securing the Gas Supply Lines

Steps 9 to 12 are generally applicable when the external gas supply lines are to be isolated to perform work on the COMPex*Pro* excimer laser device. The exact procedure to de-energize and secure the gas supply lines depends on the configuration of the facility's gas supply system and design of the shut off valves. Always first contact the person authorized to perform the gas system lockout/tagout procedure when work on an open gas system is necessary.

9. Notify the responsible persons that servicing or maintenance is required on the COMPex*Pro* laser device and that the gas supply lines leading to the laser device must be shut down and locked out to perform the servicing or maintenance.
10. Turn off the shut off valve (e.g. ball or gate valve) and secure the valve by installing the appropriate valve cover, lock and/or tag.

    Halogen gas lines require double valve isolation for maintenance on the gas system.
11. Evacuate the gas lines between the shut off valve and gas manifold in the laser device.
12. Ensure that the appropriate gas pressure gauges indicate a reading of zero before starting the maintenance or servicing.

Restoring the Laser Device to Service

When the servicing or maintenance action is completed and the COMPex*Pro* excimer laser device is ready to return to the normal operating condition, follow steps 13 to 16.

13. Check the laser device and the immediate area around the laser device to ensure that nonessential items have been removed and that the laser device is operationally intact.
14. Check the work area to ensure that all employees have been safely positioned or removed from the area.
15. Remove the lockout device.

    The lockout device shall be removed from the energy isolating device by the person who applied the device. If the authorized person who applied the device is not available, contact the supervisor of the person who applied the device.
16. Notify the responsible persons that the servicing or maintenance is completed and that the laser device can be switched on and restored to service.

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3.2 Handling Interlocked Housing Covers

This section describes the handling of the interlocked covers that have to be removed from the laser device enclosure to enable maintenance and servicing actions to be carried out inside the laser device.

The interlocked housing covers are the:

– service panel (see Section 3.2.1)

– front mirror access panel (see Section 3.2.2) and

– rear mirror access panel (see Section 3.2.3).

The respective cover interlock switch will disable the high voltage circuit, thereby inhibiting laser emission, and close the halogen valve when the cover is removed. Software-controlled routines that do not require the activation of the high voltage circuit or halogen valve can, however, still be performed. If emission of laser radiation or other normally inhibited actions are absolutely necessary during servicing with an open laser device, the respective housing cover interlock has to be defeated (see Section 3.3).

Securing the Working Area

WARNING
Risk of exposure to harmful halogen gas mixture!
When any housing cover panel is removed, the exhaust no longer extracts air from inside the laser housing. In case of an excimer laser gas leak, harmful gas will be released into the area of the laser device.
Before removing any housing cover, always secure the working area against the potential hazards of a gas leak incident.

To secure the working area before removing a housing cover:

- Turn off the halogen gas supply at the source.
- Ensure that there is no indication of a halogen gas leak inside the laser device. A possible sign of a leak is an interlock or warning indicating that the tube pressure is outside of the permitted range (see Section 7.1 on page 198).

  Whenever a leak is suspected, always purge the gas lines and laser tube before removing the housing cover.

When the housing cover is removed, make sure that no unauthorized persons can access the working area.

3.2.1 Service Panel

CAUTION
Risk of injury through dropping panel!
Depending on version, the service panel is up to approx. 1.7 m (67 in) long and weighs up to approx. 16 kg (35 lb).
Always use the handles to remove and fit the service panel.
The service panel of the COMPex*Pro* 200 should be lifted by two persons.

Purpose

Remove the service panel from the laser device (see Figure 2).

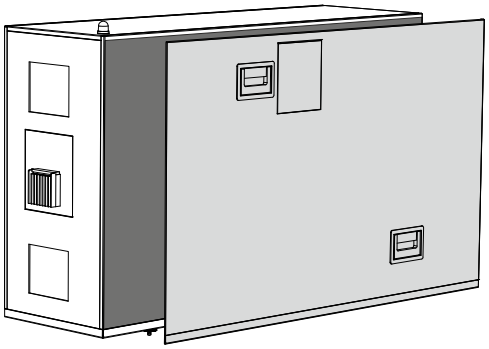

Figure 2: *Service panel*

Tools and Materials

- 3 mm allen key
- 7 mm wrench

Preconditions

- Laser switched off (no laser radiation being emitted)
- Working area secured (see Section 3.2).

Preparation

1. Make sure that the laser tube is filled with inert gas.
2. Turn off the halogen gas supply at the source.

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Removing the Service Panel

3. Use the 3 mm allen key to loosen and remove the screws, on all four sides, that secure the service panel, except for two screws on opposite sides (see Figure 3).

Figure 3: *Unscrewing the service panel*

4. While holding the service panel to prevent it from falling away from the laser device, use the 3 mm allen key to remove the last two screws.
5. Using the two collapsible handles (see Figure 4, B), tilt the service panel away from the top of the laser device. Take into account that a grounding cable (A) is attached to the inside of the service panel.

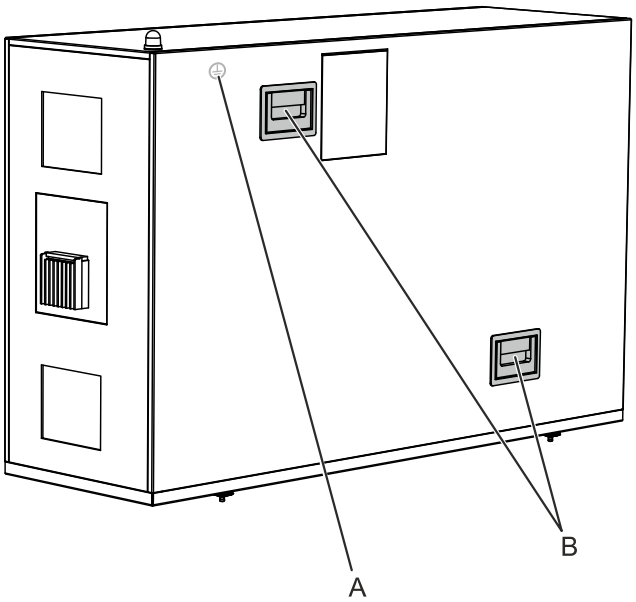


Figure 4: *Service panel grounding cable connection and handles*

6. If necessary, use the 7 mm wrench to unscrew the service panel grounding cable. The approximate location of the grounding cable connection is indicated in Figure 4, A.
7. Lift the service panel away from the laser device (see Figure 5).

Figure 5: *Removing the service panel*

Fitting the Service Panel

8. Use the 7 mm wrench to connect and tighten the service panel grounding cable.
9. Using the two collapsible handles to hold the service panel at an angle, carefully guide the panel into the recess at the bottom of the laser device housing.
10. Press the service panel at the top so that it is correctly located onto the laser device.
11. While holding the panel in position, use the 3 mm allen key to insert and tighten the securing screws.

3.2.2 Front Mirror Access Panel

Purpose

Remove the front mirror access panel (see Figure 6) to gain access to the laser device's output coupler and energy monitor. The internal beam delivery tube is attached to the inside of the front mirror access panel and will be removed together with the front mirror access panel.

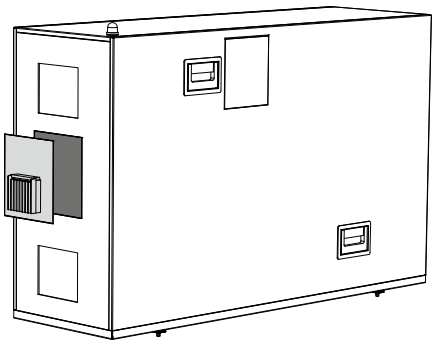


Figure 6: *Front mirror access panels*

Tools and Materials

- 3 mm allen key

Preconditions

- Laser switched off (no laser radiation being emitted)
- Working area secured (see Section 3.2).
- No protective tubes or other fittings attached to the mirror access panel.

Removing the Front Mirror Access Panel

1. Use the 3 mm allen key to loosen and remove the screws securing the front mirror access panel.
2. Lift and pull the front mirror access panel away from the laser device (see Figure 7).

   Take into account that the access panel is held in position by the interlock switch. The internal beam delivery tube is attached to the access panel and will be removed together with the access panel.

Figure 7: *Removing the front mirror access panel*

Fitting the Front Mirror Access Panel

3. Making sure that the internal beam delivery tube fits into the energy monitor and actuator tongue enters the interlock switch, fit the front mirror access panel onto the laser device.
4. Use the 3 mm allen key to insert and tighten the securing screws.

3.2.3 Rear Mirror Access Panel

Purpose

Remove the rear mirror access panel (see Figure 8) to gain access to the laser device's rear mirror.

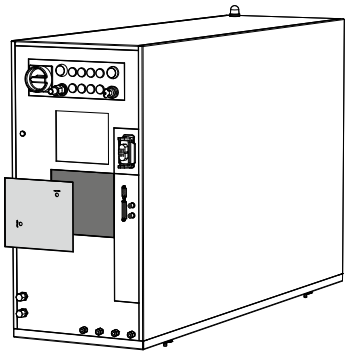


Figure 8: *Rear mirror access panels*

Tools and Materials

- 3 mm allen key

Preconditions

- Laser switched off (no laser radiation being emitted)
- Working area secured (see Section 3.2).

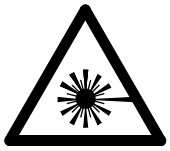
Removing the Rear Mirror Access Panel

1. Use the 3 mm allen key to loosen and remove the securing screws.
2. Lift and pull the mirror access panel away from the laser device.
   Take into account that the access panel is held in position by the interlock switch.

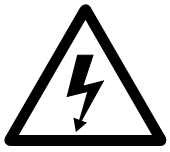
Fitting the Rear Mirror Access Panel

3. Making sure that the actuator tongue enters the interlock switch, fit the mirror access panel onto the laser device.
4. Use the 3 mm allen key to insert and tighten the securing screws.

3.3 Using Cover Interlock Defeat Keys



DANGER
Risk of exposure to class 4 laser radiation!
Whenever the cover interlock is defeated, emission of laser radiation can be started at any time.



WARNING
Risk of electric shock!
Whenever the cover interlock is defeated, the high voltage discharge circuit can be activated at any time.

WARNING
harmful gas hazard
Whenever the cover interlock is defeated, there is the risk of exposure to a harmful gas mixture. The halogen gas solenoid valve can be opened at any time.

Specific Safety Regulations

- Only authorized persons shall defeat safety interlocks.
- Only use dedicated interlock defeat keys. Never attempt to tamper with or disable an interlock switch.
- When safety interlocks are defeated:
  – adequately secure the working area,
  – prohibit unauthorized persons from entering the working area.
- All persons working on or in the area of the laser device must:
  – be aware of the respective hazards,
  – wear personal protective equipment (PPE) as instructed,
  – follow the safe working practices required to minimize the hazards.

  Please refer to the Safety chapter in the separate User Manual for further information.
- Lock away all interlock defeat keys in a safe place whenever they are not in use.
- Strictly follow all applicable local regulations regarding the distribution and use of devices to defeat safety interlocks.

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Purpose

Insert a dedicated interlock defeat key into the corresponding switch to defeat the cover interlock. This allows laser radiation to be emitted and gas actions to be performed when the corresponding housing cover has been removed.

Removal of a housing cover opens the two channel safety control circuit and activates an interlock. This interlock (safety control module off) inhibits operation of the high voltage discharge circuit and halogen valve, thereby preventing emission of laser radiation and gas actions.

After installing the housing cover or inserting the interlock key, the “safety control module off” interlock has to be actively reset to enable operation of the high voltage discharge circuit and halogen valve.

Tools and Materials

- Corresponding cover interlock defeat key

  The reverse side of the interlock defeat key tag should be personalized according to local and company internal tagout regulations.

- Appropriate PPE (e.g. protective eyewear and skin protection) for all persons that are to remain within the working area

Preconditions

- Corresponding housing access panel removed (see Section 3.2)

Defeating a Cover Interlock

1. Ensure that the working area around the laser device is adequately secured to prevent unauthorized persons from entering it.
2. Ensure that all persons that remain in the working area are issued with appropriate PPE and have been instructed in the use of the equipment.
3. Insert the corresponding interlock defeat key into the override switch (see Figure 9, A).

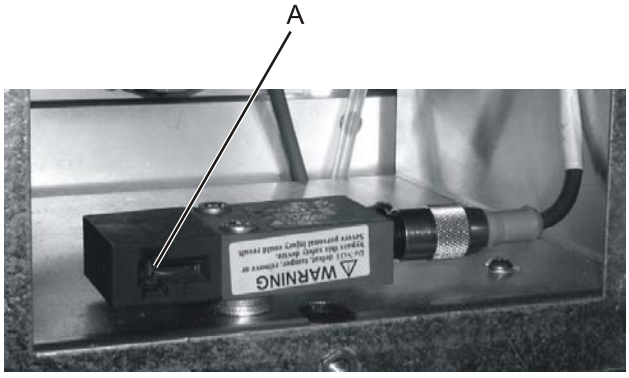

Figure 9: *Rear mirror access panel interlock override switch*

4. Ensure that the warning tag attached to the interlock defeat key remains legible.
5. If the laser device is switched on, press <BREAK> on the handheld keypad to reset the “safety control module off” interlock.

Removing the Cover Interlock Defeat

6. Ensure that no laser radiation is being emitted.
7. Remove the interlock defeat key from the cover interlock switch.
8. Re-install the housing access panel.
9. Return the interlock defeat key to the safe place from which it was taken and ensure that it is locked away.
10. Collect and store away the PPE that was issued in step 2.
11. Re-enable access to the working area around the laser device.
12. Press <BREAK> on the handheld keypad to reset the “safety control module off” interlock.

3.4 Handling Non-Interlocked Covers

DANGER
Risk of serious injury!
When non-interlocked covers are removed, high voltage or moving parts can be directly accessed.
Only authorized and specifically trained service personnel shall remove a non-interlocked cover. Before removing the cover, always shut-down and lockout the laser device. Make sure that the cover is correctly re-installed before restarting the laser device.

This section describes the handling of non-interlocked covers that have to be removed during servicing to gain access to specific components and modules. Before removing a non-interlocked cover inside the laser device, an interlocked housing cover has to be removed (see Section 3.2 on page 19).

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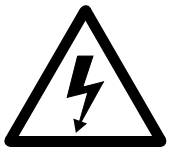
3.4.1 EMI Shielding

Purpose



DANGER
Risk of exposure to lethal voltages
Lethal voltages can be directly accessed when the EMI shielding is removed. Always disconnect the mains power supply and lock out the laser device before starting to remove the EMI shielding.

Remove the front panel of the EMI (electro-magnetic interference) shielding to gain access to the primary components in the discharge circuit such as the thyratron and capacitors. This is, for example, necessary when servicing the discharge circuit or exchanging the laser tube.

To access the screws at the bottom of the EMI shielding, the LCB (laser control board) module has to be removed from the working area.

Tools and Materials

- 3 mm allen key
- 4 mm allen key

Preconditions

- Laser device shut down, electrically disconnected and locked out (see Section 3.1 on page 16)
- Service panel removed (see Section 3.2.1 on page 20).

Removing the LCB Module from the Working Area

1. Disconnect the BNC plug connection to the LCB module (see Figure 10, A).

Figure 10: *Disconnecting the LCB module*

2. When the laser device is fitted with the temperature regulation option, disconnect the BNC connection from the LCB module.
3. Use the 4 mm allen key to unscrew the two screws securing the LCB module (see Figure 11) and lay the module aside.

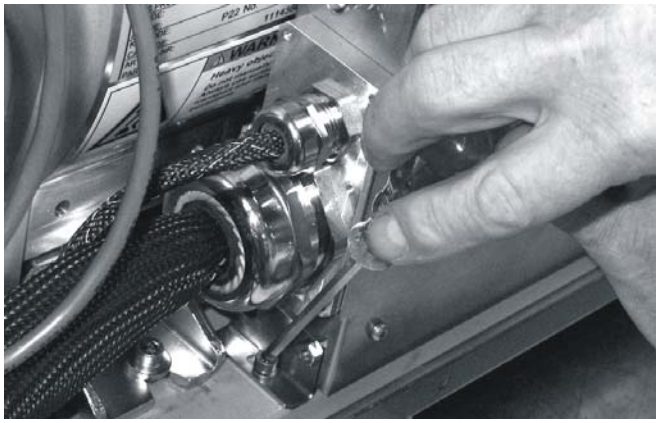


Figure 11: *Unscrewing the LCB module*

Removing the EMI Shielding

4. Use the 3 mm allen key to remove the screws on the front (face) of the EMI shielding (see Figure 12).

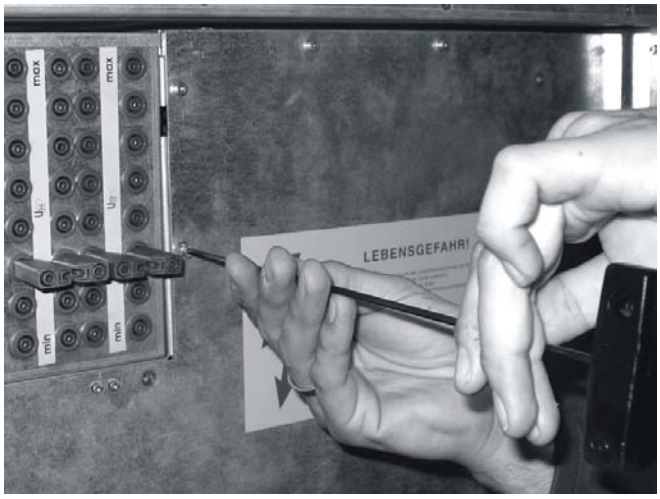


Figure 12: *Removing screws from face of EMI shielding*

5. Use the 4 mm allen key to loosen (but not remove) the screws at the bottom of the EMI shielding (see Figure 13).

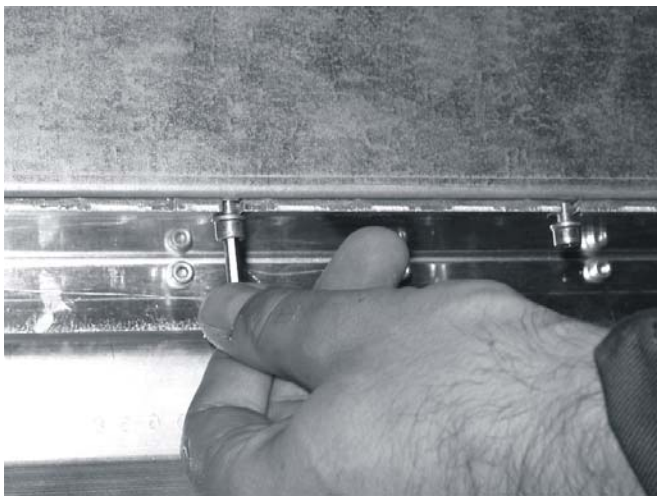


Figure 13: *Loosening screws at bottom of EMI shielding*

6. Pull the front panel of the EMI shielding away from the laser discharge unit (laser tube and discharge circuit assembly).

   Any remaining charge in the capacitors will be automatically discharged by a short-cut plate to ground.

Re-Fitting the EMI Shielding

7. Fit the EMI shielding onto the laser discharge unit and make sure that it is correctly located.

   When the cover is closed, the short-cut plate that grounds the capacitors during service actions will automatically be moved back into its working position.
8. Use the 3 mm allen key to insert and tighten the screws on the front (face) of the EMI shielding (see Figure 12 on page 30).
9. Use the 4 mm allen key to tighten the screws at the bottom of the EMI shielding (see Figure 13).

Re-Fitting the LCB Module

10. Use the 4 mm allen key to tighten the LCB module onto the baseplate of the laser device (see Figure 11)
11. Re-connect the BNC plug to the LCB module (see Figure 10).
12. When the laser device is fitted with the temperature regulation option, re-connect the BNC connection to the LCB module.

3.4.2 Gas Circulation Fan Cover

Purpose

CAUTION
Pinching hazard!
When the gas circulation fan cover is removed, there is the risk of a finger being caught in the rotating fan.

Remove the cover protecting the gas circulation fan. This enables access to the components and connections on the beam exit side of the laser tube.

Tools and Materials

- 3 mm allen key
- 4 mm allen key

Preconditions

- Laser device shut down, electrically disconnected and locked out (see Section 3.1 on page 16)
- Service panel removed (see Section 3.2.1 on page 20).

Removing the Gas Circulation Fan Cover

1. Disconnect the power supply line (plug X8: see Figure 14, B) from the front of gas purifier power supply.

Figure 14: *Connections on gas purifier power supply*

2. Disconnect the signal line (plug X29: see Figure 14, A) from the gas purifier power supply.

3. Use the 3 mm allen key to unscrew the gas circulation fan cover grounding cable (see Figure 15, C).

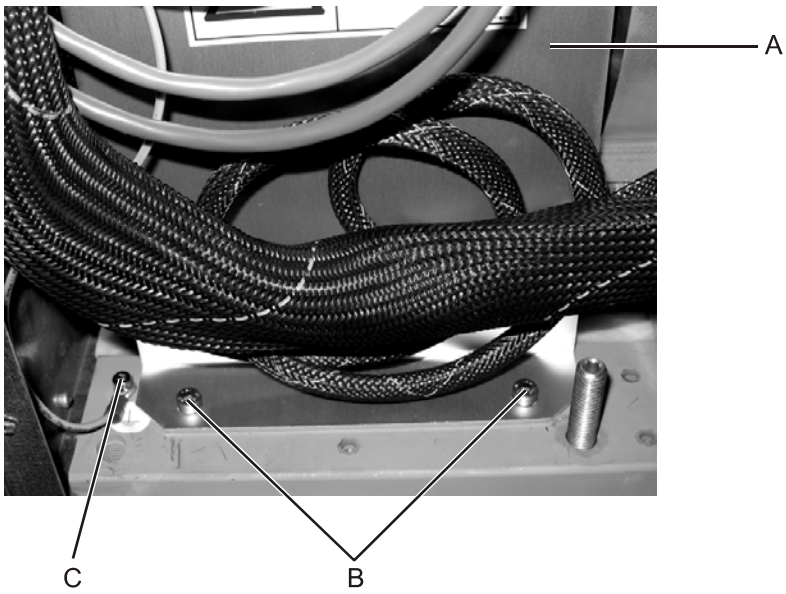


Figure 15: *Removing the gas circulation fan cover sheet*

4. Use the 4 mm allen key to unscrew the two securing screws (see Figure 15, B) and remove the gas circulation fan cover sheet (A).

Re-Fitting the Gas Circulation Fan Cover

5. Use the 4 mm allen key to re-attach the gas circulation fan cover sheet.
6. Use the 3 mm allen key to re-connect the gas circulation fan cover grounding cable.
7. Connect the power supply line (plug X8) that was disconnected in step 1 to the front of the gas purifier power supply.
8. Connect the signal line (plug X29) that was disconnected in step 2 to the front of the gas purifier power supply.

3.5 Gas Lines Maintenance

This section describes procedures to evacuate and refill the gas lines in the external gas system. The condition of the external gas system has a direct influence on the operating performance of the excimer laser.

The gas lines can be evacuated and refilled through either purging or flushing routines:

– Purging means to evacuate a line and fill with inert gas (see Section 3.5.2).

The instructions in this section apply for a straight-forward gas system with one gas source for one laser device. In industrial environments, the COMPex*Pro* may be connected to an external gas handling system that serves a number of consumers. Therefore, always consult the gas handling system supplier's instructions before performing any of the actions described in this section.

3.5.1 Flush Gas Line

NOTICE
If the remaining gas cylinder pressure drops below a critical value, the humidity in the gas may significantly increase. Only use gas cylinders with a remaining pressure of more than 20% of the initial value.

Purpose

Evacuate a gas line and fill the line with fresh gas. This is, for example, necessary to remove helium from the gas line after a leak test or to remove impurities from the gas line after a period of non-operation or exchanging a gas cylinder.

Tools and Materials

- Gases as specified (see Section 8.3 on page 224).

Preconditions

- Laser device switched on and laser ready to operate (no radiation being emitted).
- Gas cylinder valves open and pressure regulators correspondingly set

Evacuating the Gas Line

1. Close the corresponding gas cylinder valve.
2. Ensure that the pressure regulator in the gas line is open.

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3. Press <FLUSH LINE> on the handheld keypad.
   “FLUSH: *current selection* (INERT, BUFFER, RARE, HAL.)” appears in the bottom line of the display
4. Press <Cursor Right> and/or <Cursor Left> to select the desired gas line.
5. Press <ENTER> to confirm the selection.
6. Press <EXE> to evacuate the selected gas line between the laser head valve and the gas cylinder valve.
   The message ”FLUSH: *current selection...*“ appears in the bottom line of the display.

   The vacuum pump runs for two seconds to evacuate the gas line.

   Depending on the length of the gas line, this procedure has to be repeated until the gas line is completely evacuated.

Filling the Gas Line with Fresh Gas

7. Open the gas cylinder valve that was closed in step 1.
8. Repeat the procedure at least once with the gas supply open (i.e. from step 2) to completely fill the line.

3.5.2 Purge Gas Line

NOTICE
If the remaining gas cylinder pressure drops below a critical value, the humidity in the gas may significantly increase. Only use gas cylinders with a remaining pressure of more than 20% of the initial value.

Purpose

Evacuate the gas line for five seconds and then fill the line with the gas connected to the INERT connection (helium). This is, for example, necessary to perform a leak test with a helium leak tester or to remove impurities from the system when the laser is not used for a number of days.

Tools and Materials

- Gases as specified (see Section 8.3 on page 224).

Preconditions

- Laser device switched on and laser ready to operate (no radiation being emitted).
- Gas cylinder valves open and pressure regulators correspondingly set

Purging the Gas Line

1. Close the pressure regulator in the gas line that is to be purged.
2. Ensure that the inert gas cylinder valve is open and the pressure regulator is correspondingly set (see Section 4.6.2.2 on page 97).
3. Press <PURGE LINE> on the handheld keypad.
   “PURGE: current selection (*available gas lines*)”. appears in the bottom line of the display.
4. Press <Cursor Right> and/or <Cursor Left> to select the desired gas line.
5. Press <ENTER> to confirm the selection.
6. Press <EXE> to start the purging procedure.
   The message “PURGE: *current selection...*“ appears in the bottom line of the display. “OFF” appears in the display when the line purging has been completed.

   Depending on the length of the gas line, steps 3 to 6 have to be repeated until the gas line is completely purged.

   Before restarting laser operation, the gas line has to be completely filled with the appropriate gas for the line (see Section 3.5.1 on page 34).

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4 SCHEDULED MAINTENANCE

This chapter contains the routine (periodic) maintenance schedule for the COMPex*Pro* laser device.

The lifetimes are indicated in column 1 of the respective table. A lifetime can be indicated in pulses or actions (dynamic lifetime), as a time interval (static lifetime) or be determined by other factors or a combination of factors.

Maintenance Interval	Action	Time Required
- Every 5 to 25 million pulses[a] - Every 1 to 2 weeks[b]	New gas fill	0.5 h
- Before a new gas fill - After a week of non-operation	Flush gas lines	0.1 h
- Every 10 to 30 million pulses - Every 3 to 5 new gas fills	Clean resonator optics	1.5 h
- After cleaning the tube optics five times	Renew resonator optics	2.0 h
- Whenever the tube optics have been cleaned / exchanged	Align laser beam	1.0 h
	Calibrate energy monitor	0.75 h[c]
- With every energy monitor calibration	Clean beam splitter	0.5 h
- Every 4 weeks - Before a new gas fill	Check halogen filter level	0.05 h
- When indicated by the laser control software - When lifetime of five years has expired	Replace halogen filter	0.5 h
- Every 300 million pulses	Check / adjust thyratron voltages	0.25 h
- When remaining pressure is equal to or less than 20% of initial value	Change halogen gas cylinder	0.75 h
- When gas cylinder has passed the expiry date	Change rare, inert or buffer gas cylinder	0.5 h
- Before transportation - Before storage	Perform transportation fill	0.25 h

a. Typical values for dynamic gas lifetime. XeCl lifetime tends to be greater than the other gases
b. Typical values for static gas lifetime. XeCl lifetime tends to be greater than the other gases
c. Including new gas fill

The laser device has been specifically designed to enable correspondingly trained users to perform routine maintenance. Consequently, all routine maintenance procedures are described in the Maintenance chapter of the separate User Manual. Please refer to corresponding sections of the User Manual for further information about scheduled maintenance.

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5 UNSCHEDULED SERVICE ACTIONS

This chapter describes procedures that are to be performed to restore normal laser operation in case of an unscheduled event; i.e. actions for the upkeep of the COMPex*Pro* laser device that are not classified as routine maintenance (see Section 4). **Always consult Coherent Service before performing any of the procedures described in this chapter.**

In certain cases, the necessary unscheduled maintenance action will require performing procedures that are normally performed in the course of routine maintenance. For descriptions of these procedures, please refer to the Maintenance chapter in the separate User Manual.

WARNING
Risk of serious injury or equipment damage!
During servicing, there is the risk of exposure to or contact with hazards such as laser radiation, lethal voltages and toxic or corrosive substances.
Only authorized and correspondingly trained service personnel shall perform servicing work on the excimer laser device.
Strictly follow the instructions contained in this manual.

For detailed safety information, please refer to the Safety chapter in the separate User Manual.

Applicable Software

- Laser control software LCS V2.81 and higher
- Handheld terminal software CTERM V4.62 and higher

Related Information

- Fundamental and preparatory procedures (see chapter 3 on page 15)
- Routine operating sequences (see Operation chapter in the separate User Manual)
- Laser control through handheld keypad (see Operating/Display Elements chapter in the separate User Manual)

  The commands found on the hand-held keypad are used in the description of the procedures in this chapter. If the laser device is controlled from a remote PC, the corresponding commands can be found in the Options menu.

5.1 Overview of Procedures

This section provides an overview of the unscheduled service actions that are described in this chaper.

In general, unscheduled service actions consist of either set-up procedures, alignment procedures or module exchange procedures as indicated in the tables below.

Exchange Procedures

Action:	Reference:
24 V power supply	Section 5.20 on page 112
Capacitors (storage and peaking)	Section 5.16 on page 97
Energy monitor	Section 5.25 on page 127
Exhaust fan	Section 5.22 on page 116
Gas circulation fan motor	Section 5.7 on page 70
Gas purifier power supply	Section 5.19 on page 108
HV circuit resistor (470 Ω)	Section 5.12 on page 85
HV discharge coil	Section 5.14 on page 92
HV power supply	Section 5.15 on page 93
HV trigger board	Section 5.11 on page 83
Interface board	Section 5.18 on page 106
Laser control board (LCB)	Section 5.17 on page 103
Laser tube	Section 5.2 on page 41
Laser tube overtemperature switch	Section 5.4 on page 60
Pressure sensor	Section 5.5 on page 62
Temperature sensor	Section 5.6 on page 66
Solenoid gas valve (repair valve)	Section 5.24 on page 125
Solenoid gas valve block	Section 5.23 on page 118
Thyratron	Section 5.9 on page 72
Thyratron supply unit	Section 5.10 on page 80
Vacuum pump	Section 5.21 on page 114
Varistors	Section 5.13 on page 90
Water flow regulating valve	Section 5.26 on page 129

The tools and materials list at the beginning of each exchange procedure assumes that the respective spare parts have been brought to the installation site.

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Set-Up and Optimization Procedures

Action:	Reference:
Passivate laser tube[a]	Section 5.3 on page 59
Re-condition thyratron	Section 5.8 on page 71
Update laser control software	Section 5.27 on page 134
Update handheld keypad software	Section 5.28 on page 144

a. Laser tube passivation is only possible for systems with single gas supply

5.2 Exchange Laser Tube

WARNING
Risk of back injury and crushing!
The laser tube with attached auxiliary components weighs over 100 kg (220 lbs) and has a high center of gravity. Never attempt to lift the laser tube without assistance.
Whenever possible, use suitable mechanical handling devices. All persons handling the laser tube shall wear suitable PPE (e.g. safety shoes) and be fully conversant with the chosen handling devices as well as ergonomically correct and team lifting techniques. Strictly follow all applicable local regulations.

To simplify the removal of the laser tube, use a transport cart and suitable mechanical lifting equipment. In this case, the assistance of at least one additional person is required to safely handle the laser tube.

If mechanical assistance is not available, obtain the assistance of a sufficient number of persons to ensure that the laser tube can be safely handled. Where necessary, reduce the weight to be handled by removing auxiliary components (e.g. thyratron assembly and peaking capacitor bank) prior to removing the laser tube assembly from the laser device.

Purpose

Exchange the laser device's laser tube.

The replacement laser tube is shipped without auxiliary components such as thyratron, peaking and storage capacitors, HV power supply and gas circulation fan. These components have to be swapped-over from the removed laser tube onto the replacement laser tube. In this section the swapping-over of the auxiliary components is described in the order that allows both ease of access and minimum weight handling. Depending on the conditions at the installation site (availability of lifting equipment, available working area etc.) this order may, however, have to be changed.

Tools and Materials

- 7 mm wrench
- 11 mm wrench
- 9/16” wrench
- 17 mm wrench
- 2.5 mm allen key
- 3 mm allen key
- 4 mm allen key
- 5 mm allen key
- Slotted screwdriver
- Dedicated tube Pressure Display Unit (part no. 1261050)
- Suitable wipes or cloth for cleaning spilled water
- Helium leak tester or liquid leak tester (e.g. SNOOP®)

  Make sure that the chosen leak tester is suitable for use in the environment in which the laser is installed. Liquid leak testers are, for instance, not permitted in cleanrooms.
- Where available, mechanical lifting equipment and a transport cart
- Assistance of additional persons (for lifting and positioning).
- Safety shoes with non-slip soles
- Rubber gloves
- Appropriate blanking plugs
- Assigned individual lockout and/or tagout devices suitable for use with the respective energy isolating device.
- Inert gas with remaining pressure of at least 20% of initial value.
- Where available, buffer gas with remaining pressure of at least 20% of initial value.
- Test report for laser tube (provided with replacement laser tube)

Preconditions

- Laser device switched on and laser ready to operate (no radiation being emitted)

  The laser device has initially to remain switched on to enable the laser tube to be evacuated and filled with buffer gas.

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Flush the Laser Tube and Fill with Inert or Buffer Gas

NOTICE
If pressure is applied to a pressure regulator with low secondary pressure, the pressure regulator membrane may become damaged. Always ensure that the pressure regulator is closed, before opening the gas cylinder valve.

1. Open the valve on the inert or buffer gas cylinder and set the pressure regulator in the inert gas line to the specified value
2. Press <PURGE RESERVOIR> on the handheld keypad and select "WIN. EXCHANGE" to flush the laser tube with inert gas.
3. Confirm with <ENTER> and press <EXE> to proceed.

   The tube flushing cycle is now started. For exact details of this cycle, please refer to the corresponding description in the “Resonator Optics Exchange” section of the User Manual.

   At the end of the flushing cycle, the message “EXCHANGE WINDOWS THEN PRESS <ENTER>” appears. This indicates that the tube is filled with inert gas and ready for a window exchange.
4. Press <BREAK> to abort the procedure.
5. Press <NEW FILL> and select <TRANSP.> using the cursor keys.
6. Confirm with <ENTER> and press <EXE> to start the transport fill.

   The laser tube is now evacuated and filled with inert or buffer gas (depending on the external gas supply configuration). At the end of the transport fill, the inert / buffer valve automatically closes.
7. Close all gas cylinder valves.

Turn Off and Drain Cooling Water

8. If the laser device is water cooled, turn off the external water supply at the source.
9. Where available and permitted, connect a compressed air (or similar gas) hose to the cooling water inlet and blow out the residual water.

Gain Access to the Laser Tube

10. Switch off and lockout the laser device (see Section 3.1 on page 16).
11. Use the 3 mm allen key and 7 mm wrench to remove the service panel (see Section 3.2.1 on page 20).
12. Use the 3 mm allen key and 4 mm allen key to lay aside the LCB module and remove the front panel from the EMI shielding (see Section 3.4.1 on page 29).
13. Use the 4 mm allen key to remove the gas circulation fan cover sheet (see Section 3.4.2 on page 32)

Remove the Energy Monitor

14. Use the 3 mm allen key to remove the front mirror access panel (see Section 3.2.2 on page 23).

    The front mirror access panel has to be removed to enable the energy monitor to be taken off of the laser tube.

15. Use the 4 mm allen key to remove the screw that secures the energy monitor (see Figure 16, A) and carefully pull the energy monitor away from the locating pins.

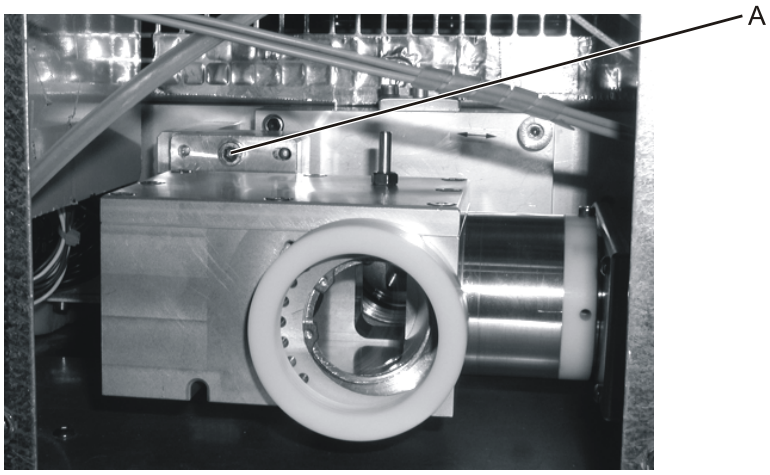

Figure 16: *Unscrewing the energy monitor*

Disconnecting the Electrical and Signal Lines

16. Use the 7 mm wrench to remove the grounding cable from the EMI housing ventilator (see Figure 17, B).

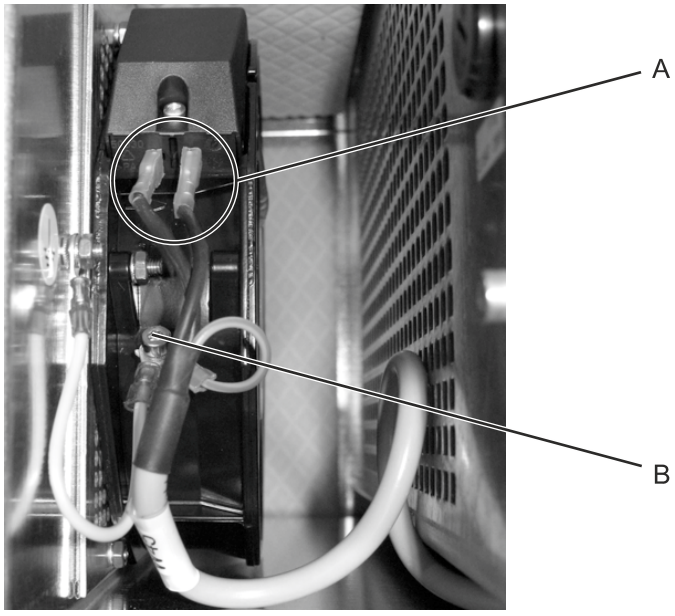

Figure 17: *Disconnecting the EMI housing ventilator*

17. Disconnect the power supply cables from the EMI housing ventilator (A).
18. Disconnect the tube overtemperature switch cable connection X12 (see Figure 18).

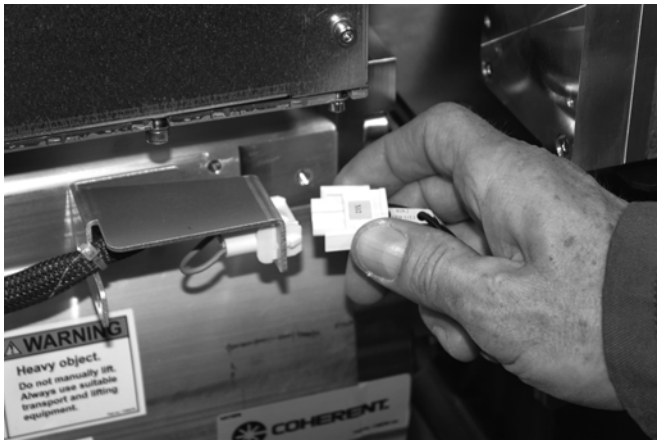

Figure 18: *Disconnecting the tube overtemperature switch*

19. Disconnect the trigger FOL (see Figure 19, C), mains power (D) and grounding cable (B) from the thyratron supply unit.

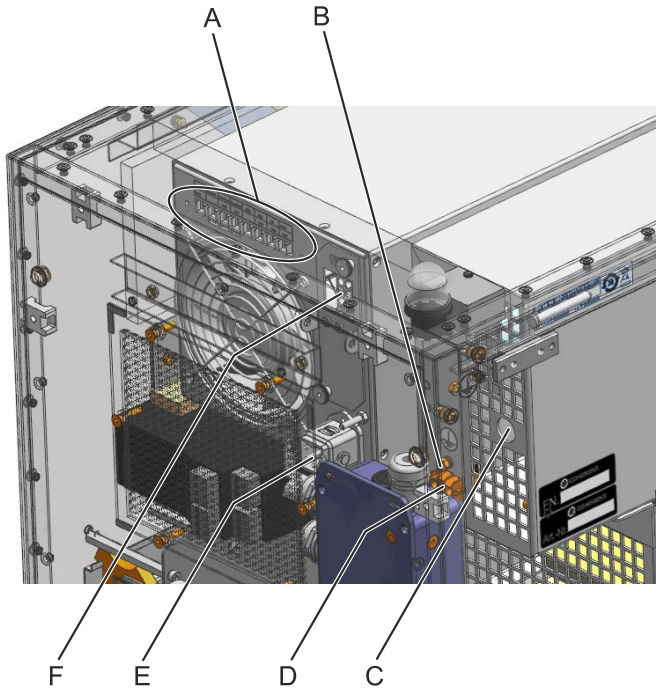

Figure 19: *Connections on thyratron supply unit and HV power supply*

20. Disconnect the mains power (see Figure 19, E), interlock circuit (F) FOLs (A) from the HV power supply.

21. Disconnect the gas circulation fan power supply (see Figure 20).

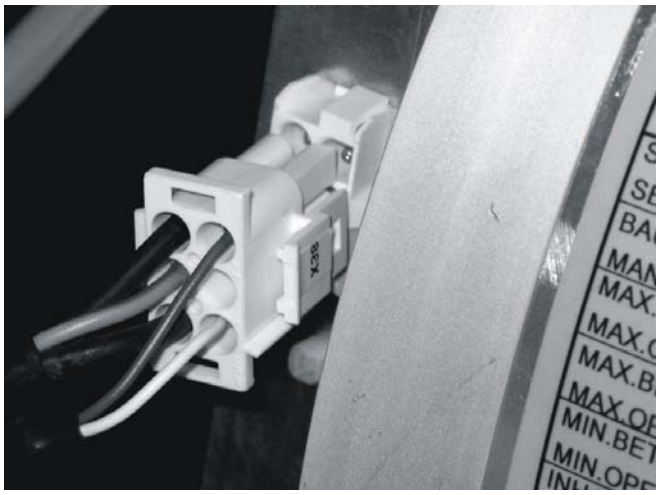

Figure 20: *Disconnecting gas circulation fan power supply*

22. Disconnect the pressure sensor signal line (see Figure 21).

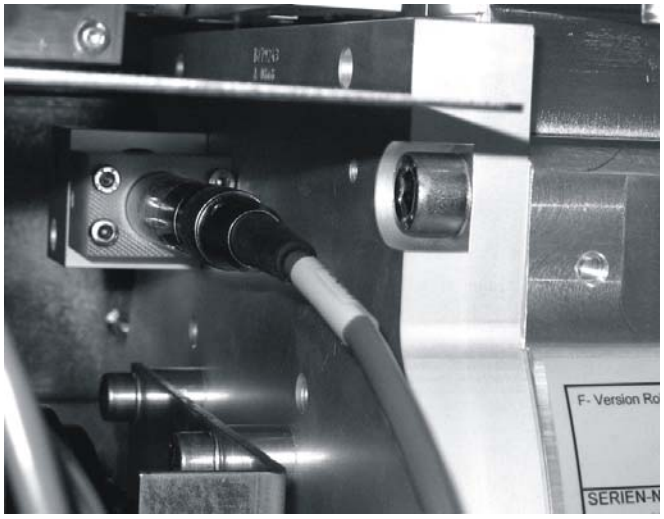

Figure 21: *Pressure sensor signal line*

23. Disconnect the gas purifier power supply (red plug) located behind the gas circulation fan motor (see Figure 22).

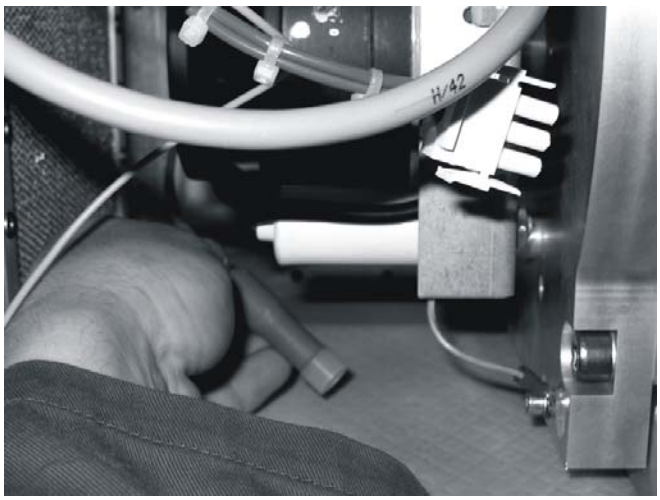

Figure 22: *Disconnecting the gas purifier power supply*

24. Use the 3 mm allen key to disconnect the laser tube grounding cable (see Figure 23, A).

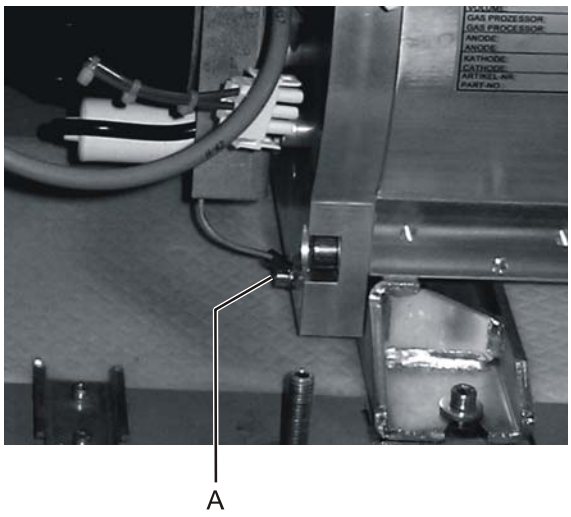

Figure 23: *Laser tube grounding cable*

Disconnecting the Water Lines

25. Lay a suitable cloth or wipes in the laser device housing below the bulkhead water connections to soak any water spillage.
26. Use the 3 mm allen key to loosen the four screws securing the water line connection pieces (see Figure 24).

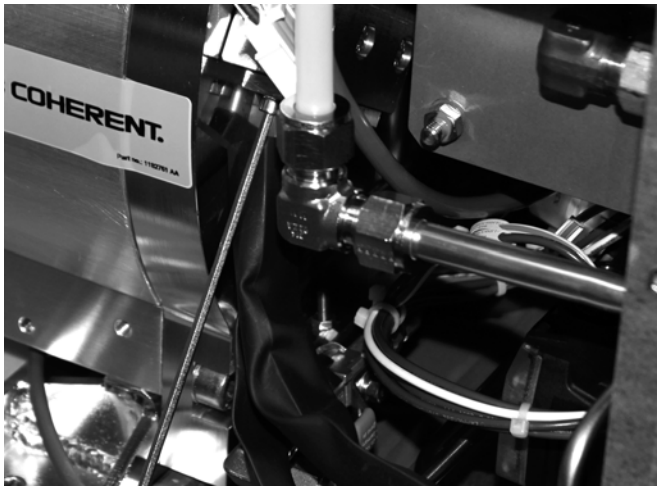

Figure 24: *Loosening the water line connection pieces*

27. Pull the water lines out of the connection pieces (see Figure 25).

Figure 25: *Removing the water lines from the laser tube*

Disconnecting the Gas Lines

28. Close the shut-off valve in the gas supply line (see Figure 26).

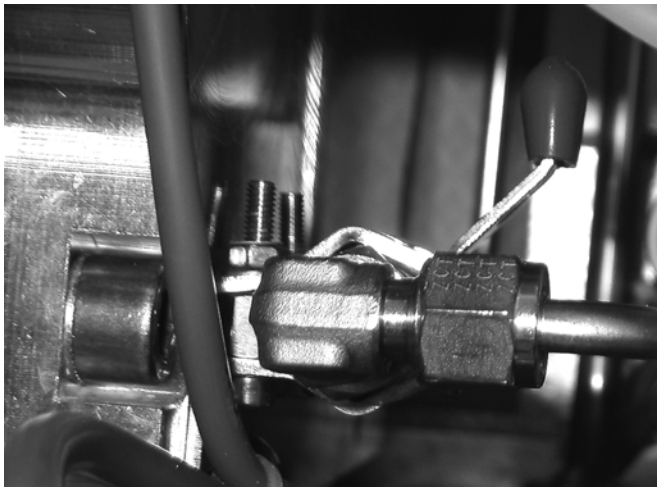

Figure 26: *Gas supply line shut-off valve in closed position*

29. Use the 9/16” wrench to disconnect the laser tube gas line (see Figure 26).

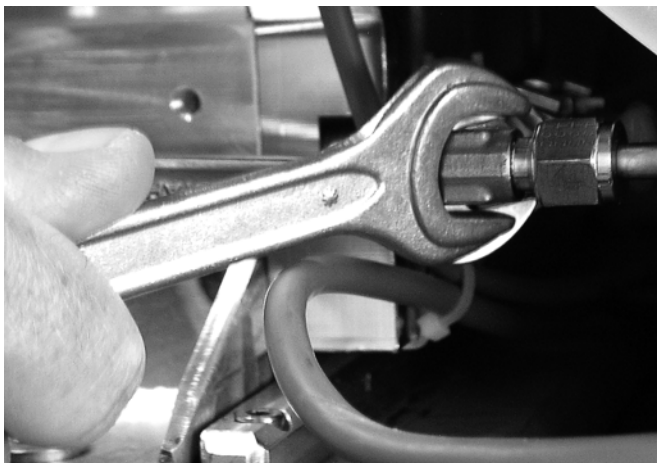

Figure 27: *Unscrewing the laser tube gas connection*

30. Use blanking plugs to close all open gas connections.

Removing the Thyratron Supply Unit and HV Power Supply

31. Unscrew and remove the thyratron supply unit (see Section 5.10 on page 80).
32. Completely disconnect, unscrew and remove the HV power supply (see Section 5.15 on page 93).

Removing the Laser Tube

WARNING
Risk of foot and leg injury!
Always wear safety shoes with non slip soles when lifting heavy loads and when moving or operating a transportation cart.
Stricly follow the transportation cart manufacturer's instructions.

The description in this section of the procedure assumes that a transport cart is available to assist with the exchange of the laser tube.

33. Use the 5 mm allen key to unscrew and remove the screws at the two tube securing brackets (see Figure 28).

Figure 28: *Unscrewing the laser tube*

34. Move an empty transport cart (where available) into position in front of the laser tube.

WARNING
Risk of crushing or pinching!
When removing the laser tube, prevent persons from entering or reaching into the path of movement.
Ensure that no components (e.g. cables, FOL links, screws etc.) are in the path of movement.

35. Carefully pull the laser tube past the two feet and out of the laser housing onto the transport cart (see Figure 29).

    Where necessary, the laser tube may have to be moved to-and-fro at a slight angle until it can be pulled clear of the feet.

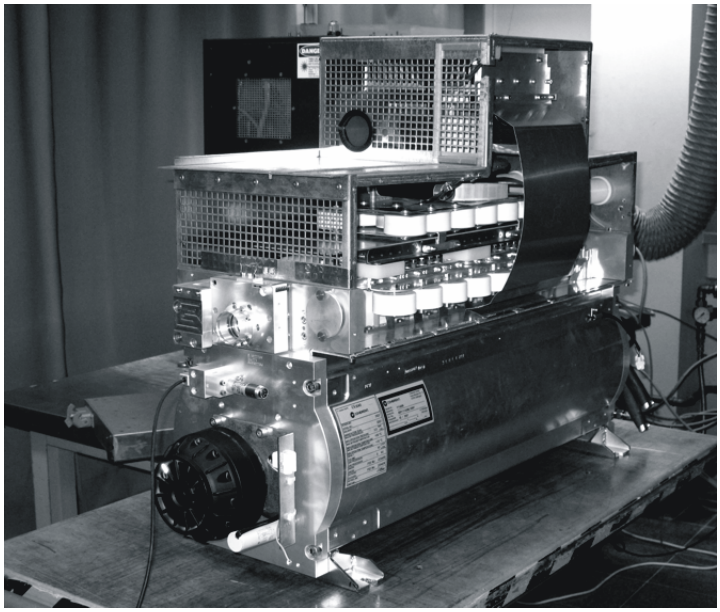

Figure 29: *Laser tube with auxiliary components on transport cart*

36. Carefully move the transport cart with the laser tube into the area where the auxiliary components are to be removed and attached to the replacement laser tube.

Initially Preparing the Replacement Laser Tube

NOTICE
Risk of loss of performance
The performance of the laser may be impaired if the laser tube is damaged or the shelf life has been exceeded. Always carefully check the laser tube prior to installation. Do not install the laser tube if it appears to be damaged or the shelf life has been exceeded.

37. Check the packaging of the replacement laser tube to ensure that there are no visible signs of damage.
38. Use a knife or scissors to remove the outer cover from the replacement laser tube.

39. Check to ensure that the shelf lifetime of the replacement laser tube has not been exceeded.
40. Directly connect the Tube Pressure Display Unit to the pressure sensor connection on the replacement laser tube and check the tube pressure.
41. Compare the tube pressure measured in step 40 with the pressure noted on the test report for the laser tube. If there has been an excessive change in pressure, contact the responsible service support center.
42. Remove the transport locks from the replacement laser tube.
43. Compare the removed laser tube with the replacement laser tube to locate the positions of the components that are to be swapped over (see Figure 30).

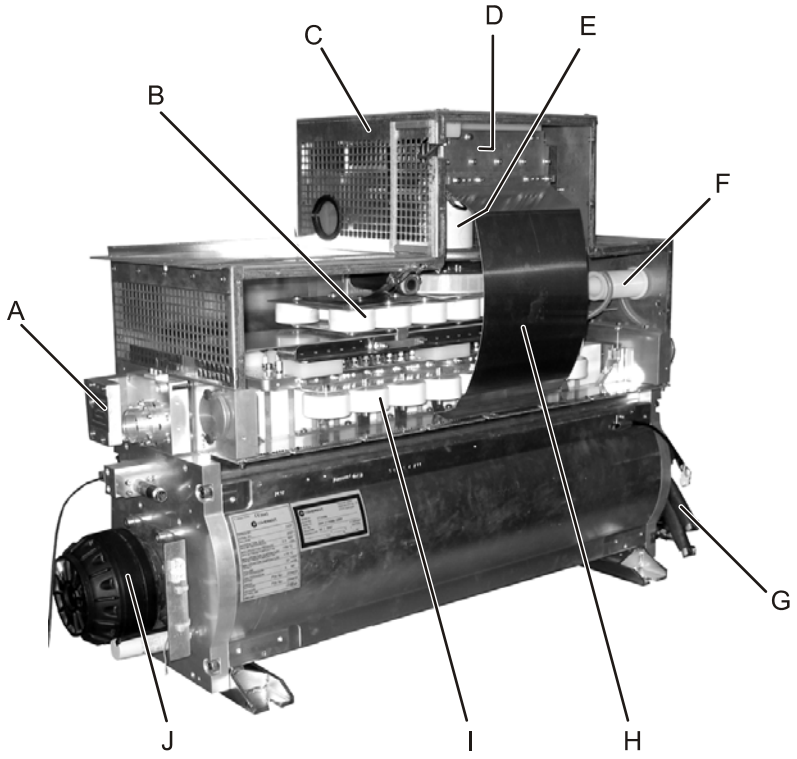

Figure 30: *Overview of auxiliary components to be swapped-over*

Key to Figure 30

A Energy monitor bracket
B Peaking capacitors
C EMI housing
D Thyratron heat sink
E Thyratron
F HV coil
G Water lines
H Thyratron grounding plate
I Storage capacitors
J Gas circulation fan motor

Removing the Thyratron Assembly

NOTICE
Risk of damaging thyratron!
Fingerprints can burn into the ceramic casing of the thyratron and cause premature failure. Always wear protective rubber gloves when handling the thyratron.

44. Use the 3 mm allen key to remove the front thyratron grounding plate (see Figure 30, H) together with the plastic insulation sheet.
45. Remove the thyratron and heat sink assembly (see Section 5.9. on page 72, steps 3 to 10).

Removing the EMI Housing

46. Use the long 3 mm allen key to unscrew the screws securing the EMI housing from above (see Figure 31).

Figure 31: *Unscrewing EMI housing from above*

47. Use the 3 mm allen key to unscrew the two screws securing the EMI housing at the rear (see Figure 32, A).

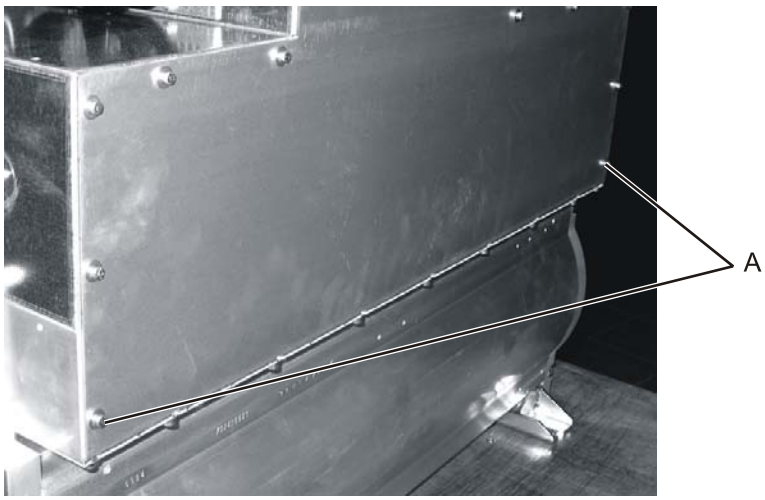

Figure 32: *EMI housing rear securing screws*

48. Lift the EMI housing off of the laser tube assembly.
49. Use the 3 mm allen key to remove the rear thyratron grounding plate together with the plastic insulation sheet.

Swapping-Over the Capacitors

NOTICE
If the storage capacitor array is not mounted in the correct position on the new laser tube, it will be impossible to correctly tighten the thyratron. Always note the exact position of the storage capacitor array before removing it from the old laser tube.

50. Remove the HV coils, storage capacitor array and peaking capacitor bank (see Section 5.16 on page 97).
51. Attach the peaking capacitor bank, storage capacitor array and HV coils to the replacement laser tube (see Section 5.16).

Fitting the EMI Housing and Thyratron Assembly

52. Place the EMI housing onto the replacement laser tube assembly.
53. Use the long 3 mm allen key to insert and tighten the screws securing the EMI housing from above (see Figure 31 on page 53). Make sure that the screws are tightened so that the EMI housing is correctly located.
54. Attach the thyratron and heat sink assembly onto the replacement laser tube (see Section 5.9 on page 72).
55. Use the 3 mm allen key to insert and tighten the two screws securing the EMI housing at the rear (see Figure 32).
56. Use the 3 mm allen key to attach (but not tighten) the front and rear thyrtaron grounding plates and plastic insulation sheets.

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57. Connect the thyratron to the thyratron terminal strip.

Swapping-Over the Fan Motor and Energy Monitor Bracket

58. Use the 6 mm allen key to unscrew the four screws securing the gas circulation fan motor (see Figure 33).

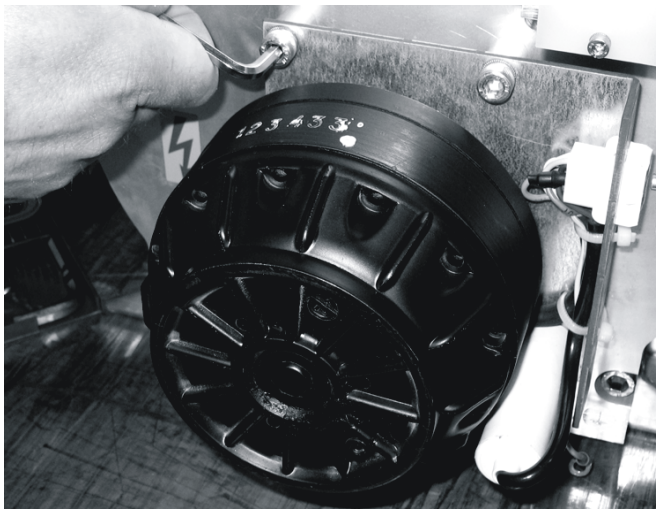

Figure 33: *Unscrewing the gas circulation fan motor*

59. Pull the gas circulation fan away from the laser tube. Take into account that the gas circulation fan has a magnetic coupling.
60. Use the 6 mm allen key to attach the gas circulation fan to the replacement laser tube.
61. Use the 4 mm allen key to unscrew the two countersunk screws (see Figure 34) and remove the energy monitor holding bracket from the removed laser tube.

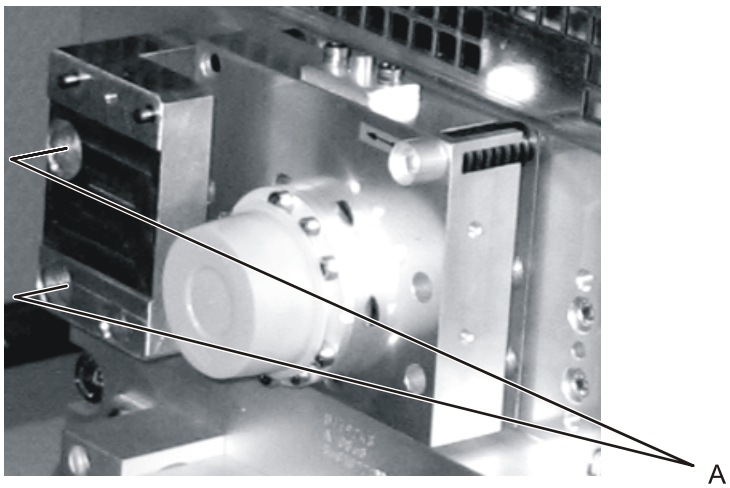

Figure 34: *Removing the energy monitor holding bracket*

62. Use the 4 mm allen key to attach the energy monitor holding bracket in the appropriate position on the replacement laser tube.

Installing the Replacement Laser Tube

63. Carefully move the transport cart with the replacement laser tube into the maintenance area and place it in front of the laser housing to allow the installation of the replacement tube.

WARNING
Risk of crushing or pinching!
When inserting the replacement tube, prevent persons from entering or reaching into the path of movement.
Ensure that no components (e.g. cables, FOL links, screws etc.) are in the path of movement.

64. Carefully push the replacement laser tube from the transport cart into its final position in the laser housing.

    Where necessary, the laser tube may have to be moved to-and-fro at a slightly angle until it is clear of the feet.
65. Use the 5 mm allen key to insert and tighten the screws at the two tube securing brackets (see Figure 28 on page 50).
66. Use the 3 mm allen key to connect the laser tube grounding cable (see Figure 23 on page 47).

Fitting the Thyratron Supply Unit and HV Power Supply

67. Re-install and re-connect the HV power supply (see Section 5.15 on page 93). The location of the connections on the beam exit side are shown in Figure 19 on page 45.
68. Re-install and re-connect the thyratron supply unit (see Section 5.10 on page 80). The location of the connections on the beam exit side are shown in Figure 19 on page 45.
69. Use the 3 mm allen key to tighten the front and rear thyratron grounding plates (see Figure 43 on page 73). Make sure that the plastic insulation is in the correct position.

Re-Connect the Water and Gas Lines

70. Push the water inlet and water outlet lines into the respective water line connection pieces on the laser tube.
71. Use the 3 mm allen key to tighten the water line connection pieces.

CAUTION
Risk of gas leaks!
Overtightening the compression nut can unintentionally deform the ferrules so that they no longer correctly seal the joint.
Strictly follow instructions to tighten the compression nut.

72. Attach the gas line to the connection on the laser tube.
73. Finger tighten the compression nut and then use the 9/16” wrench to turn it 1¼ turns (see Figure 27 on page 49).

Re-Connect the Electrical Connections

74. Connect the gas purifier power supply (sse Figure 22 on page 47).
75. Connect the gas circulation fan power supply (see Figure 20).
76. Connect the pressure sensor signal line (see Figure 21)
77. Connect the overtemperature switch cable connection X12 (see Figure 18).
78. Connect the EMI housing ventilator power supply and grounding cables (see Figure 17).

Re-Install the Energy Monitor

79. Carefully mount the energy monitor onto the locating pins.
80. Use the 4 mm allen key to insert and tighten the screw that secures the energy monitor (see Figure 16).
81. Use the 3 mm allen key to re-insert the front mirror access panel (see Section 3.2.2 on page 23).

Re-Fitting the Non-Interlocked Covers and LCB Module

82. Use the 4 mm allen key to re-install the gas circulation fan cover sheet (see Section 3.4.2 on page 32)
83. Use the 3 mm allen key and 4 mm allen key to re-install the front panel from the EMI shielding (see Section 3.4.1 on page 29).
84. Use the 4 mm allen key to tighten the LCB module onto the baseplate of the laser device (see Figure 11 on page 30).
85. Re-connect the LCB module plug (see Figure 10 on page 29).

    When the laser device is fitted with the temperature regulation option, do not reconnect the BNC plug at this stage. Temperature regulation has to remain disabled while checking the water flow.

Checking the Water and Gas Lines

86. Turn on the external water supply.
87. Unlock and untag the laser device.
88. Switch on the laser device.
89. Check that the tube pressure displayed on the handheld keypad corresponds with the value measured in step 40.
90. Check the cooling water lines for leaks.,
91. When the laser device is fitted with the temperature regulation option, re-connect the BNC connection to the LCB module.
92. Press <PURGE RESERVOIR> and select “PURGE TUBE” to evacuate the gas line between the laser tube shut-off valve and the gas manifold. Abort the process by pressing <BREAK> after approx. 10 seconds.
93. Press <NEW FILL> and select <MAN. INERT>.
94. Press <EXE> to fill the gas manifold with helium.
95. Perform a helium leak test to ensure that the gas connection to the laser tube is leak tight.

96. Turn the manual gas shut off valve in the laser tube inlet line to the open position (see Figure 26 on page 49).
97. Press <NEW FILL> and select <MAN. INERT>.
98. Repeatedly press <EXE> to start the manual inert fill routine until a tube pressure of 3 bar is reached.
99. Wait 15 minutes and check to see if there is a drop in the tube pressure.
100. If the tube pressure drops more than 3 mbar, use a helium leak tester to test the leak tightness of the connections to the laser tube.

Finalization and Restart

101. Check and, where necessary, adjust the thyratron supply voltage (see Maintenance chapter in the User Manual).
102. Re-install the service panel (see Section 3.2.1 on page 20).
103. Flush the laser gas line and the laser tube by pressing <PURGE RESERVOIR> and selecting "WIN. EXCHANGE". Abort the procedure by pressing <BREAK> when the message “EXCHANGE WINDOWS THEN PRESS <ENTER>” appears.
104. Check the gas mixture parameters in the laser control software against the values indicated on the test sheet for the replacement laser tube.

    If parameter changes or a software update are necessary, contact the appropriate continental support center. They will provide the appropriate files for the specific type of laser device and the corresponding installation instructions.
105. Perform a new fill (see Maintenance chapter in the User Manual for further information).
106. Adjust the laser resonator (see Maintenance chapter in the User Manual).
107. Check that the energy monitor is correctly calibrated (see Maintenance chapter in the User Manual).
108. Check the laser performance.
109. Restart laser operation.
110. Prepare the removed laser tube for dispatch.

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5.3 Passivate Laser Tube

WARNING
Risk of exposure to halogen gas!
The passivation fill in the laser tube contains ten times the usual concentration of halogen gas.
Never open the laser device housing when the laser tube contains the passivation fill. Strictly follow the safe working practices for halogen gases listed in the Safety chapter of the User Manual. Ensure that the working area around the laser device is adequately secured.

Purpose

Re-passivate the laser tube after a long period without laser operation or when the passivation of the tube has become damaged through contact with the ambient air.

Halogen gases are aggressive. To protect the laser tube and other components, these are designed so that a protective passivation layer is formed when the material comes into contact with a halogen gas.

This function cannot be performed when the laser device is supplied from a premix gas cylinder.

Tools and Materials

- Gases as specified (see Section 8.3 on page 224).

  If the remaining pressure drops below a critical value, the humidity in the gas cylinders may significantly increase. Only use gas cylinders with a remaining pressure of more than 20 % of the initial value.

Preconditions

- Laser device switched on and laser ready to operate (no radiation being emitted).
- Gas cylinder valves in the halogen and inert lines open and pressure regulators closed

Passivating the Laser Tube

1. Open the valve on the halogen gas cylinder.
2. Set the pressure regulator in the halogen gas line to the required pressure.
3. Open the valve on the helium gas cylinder.
4. Set the pressure regulator in the inert gas line to the required pressure.
5. Press <F6> and enter the appropriate password.

6. Press <EXE> to confirm the choice and start the re-passivation procedure.

   The tube is evacuated to 30 mbar and filled with 200 mbar halogen gas and 900 mbar helium.
7. Leave the laser with the passivation fill for at least 8 hours (e.g. overnight) to allow the halogen to displace the oxygen compounds from the surfaces with which it comes into contact.

Finalization

8. Carry out a new fill (see Maintenance chapter in the User Manual).

5.4 Exchange Tube Overtemperature Switch

Purpose

Exchange the overtemperature switch (see Figure 35, A) and connector (B) on the laser tube.

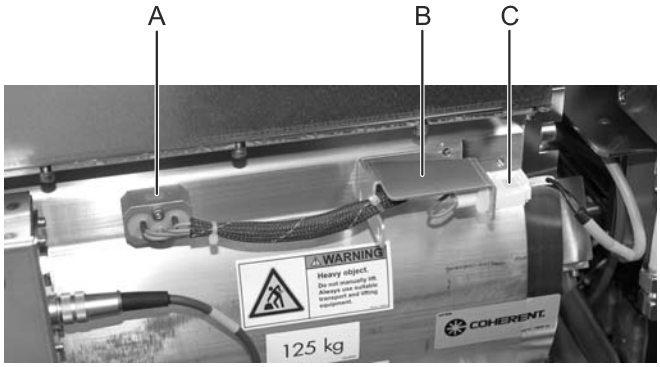

Figure 35: *Tube overtemperature switch and connection*

Preconditions

- Working area secured to enable removal of a housing cover (see Section 3.2 on page 19)
- Laser in OFF mode

Tools and Materials

- 3 mm allen key
- Long 3 mm allen key
- 4 mm allen key

Preparation

1. Remove the service panel (see Section 3.2.1 on page 20).

Exchanging the Tube Overtemperature switch

2. Disconnect the tube overtemperature switch cable connection (see Figure 35, C).
3. Use the 3 mm allen key to unscrew and remove the connector holding bracket (see Figure 36).

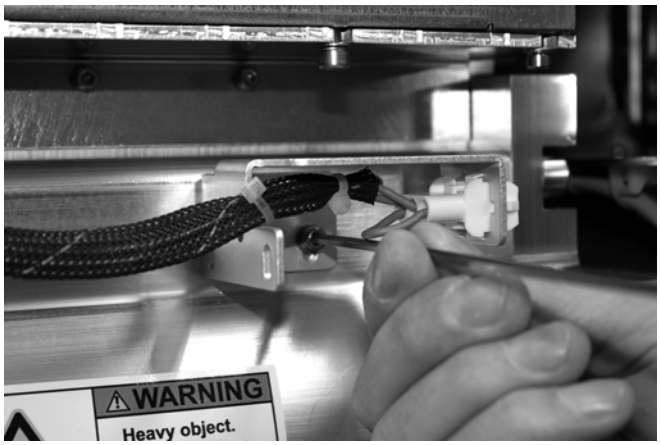

Figure 36: *Removing the overtemperature switch connector bracket*

4. Use the 3 mm allen key to unscrew and remove the overtemperature switch (see Figure 35, A).
5. Use the 3 mm allen key to mount the new overpemperature switch and connector holding bracket
6. Connect the overtemperature switch cable connection.

Finalization

7. Re-install the service panel (see Section 3.2.1 on page 20).

5.5 Exchange Tube Pressure Sensor

WARNING
Risk of exposure to harmful gas mixture!
Always thoroughly flush the laser tube and gas supply lines before starting to exchange the pressure sensor.

CAUTION
The laser device is to remain powered up during this procedure! Ensure that the maintenance area is at all times adequately secured and that no unauthorized persons can access the laser device. All persons in the maintenance area shall be fully familiar with the applicable safety regulations and requirements

Purpose

Exchange the laser tube pressure sensor.

The exact procedure depends on whether the pressure sensor to be removed is operational or not. In both cases, the required actions are described in this section. Certain instructions will, consequently, not apply in all situations (note the additional information in italics).

Tools and Materials

- 2.5 mm allen key
- 3 mm allen key
- *When laser tube pressure sensor is not operational:*
  External computer (PC, laptop or notebook) with LCS Monitor software (CMPX_Mon.exe)

Preconditions

- Laser device switched on and laser ready to operate (no radiation being emitted)
- Replacement pressure sensor ready for installation in the working area.

  To prevent ambient air from entering, the laser tube should not be open for longer than a minute. If this period of time is exceeded a warning message appears.
- *When pressure sensor is not operational:*
  External computer connected to the laser device's COM1 port (see Section 8.1 on page 209).

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Flush the Laser Tube and Fill with Inert Gas

NOTICE
Risk of damaging pressure regulator!
If pressure is applied to a pressure regulator with low secondary pressure, the pressure regulator membrane may become damaged. Always ensure that the pressure regulator is closed, before opening the gas cylinder valve.

1. Open the inert gas valve.
2. Set the pressure regulator in the inert gas line to the value specified in the User Manual (approx. 4 bar [abs.]).
3. *When the pressure sensor is operational:*
   Press <PURGE RESERVOIR> on the handheld keypad and select "WIN. EXCHANGE" using the cursor keys to start the tube flushing cycle.

   If the pressure sensor is not operational, continue the tube flushing procedure at step 6.
4. Confirm with <ENTER> and press <EXE> to proceed.

   The tube flushing cycle is now started. For exact details of this cycle, please refer to the corresponding description in the “Resonator Optics Exchange” section of the User Manual.

   At the end of the flushing cycle, the message “REPLACE WINDOWS (enter)” appears. This indicates that the tube is filled with inert gas. The pressure sensor can now be safely exchanged.
5. Press <BREAK> to abort reservoir purging and continue the pressure sensor exchange procedure at step 13.
6. *When the pressure sensor is not operational:*
   Start the LCS Monitor software and select the Laser Control screen.
7. Activate “Direct Control” by checking the appropriate box.
8. Select “Vacuum” to open the vacuum valve and start the vacuum pump and select Laser Head to open the laser head valve.
9. Allow the vacuum pump to run for approx. 10 minutes to pump the laser gas out of the laser tube and then deselect Vacuum and Laser Head to close the valves and switch off the vacuum pump.

   Take into account that the vacuum pump will continue to run-on for approx. two minutes after deselecting Vacuum.
10. Select Inert to open the inert valve and allow the tube to be filled with inert gas for approx 10 seconds.
11. Repeat steps 8 and 9 and allow the vacuum pump to run for approx. eight minutes to pump the inert gas out of the laser tube.
12. Repeat steps 10 and 11 twice. During the 2nd cycle keep the Inert valve open for 20 to 25 seconds to ensure that there is a slight overpressure in the tube.

Exchanging the Pressure Sensor

NOTICE
Risk of damaging laser tube!
Never allow ambient air to enters the laser tube.
Always ensure that there is an overpressure of inert gas in the laser tube before opening it.

13. Remove the service panel (see Section 3.2.1 on page 20).
14. Remove the gas circulation fan cover (see Section 3.4.2 on page 32).
15. Use the 2.5 mm allen key to unscrew and remove the lower air intake grille (see Figure 37).

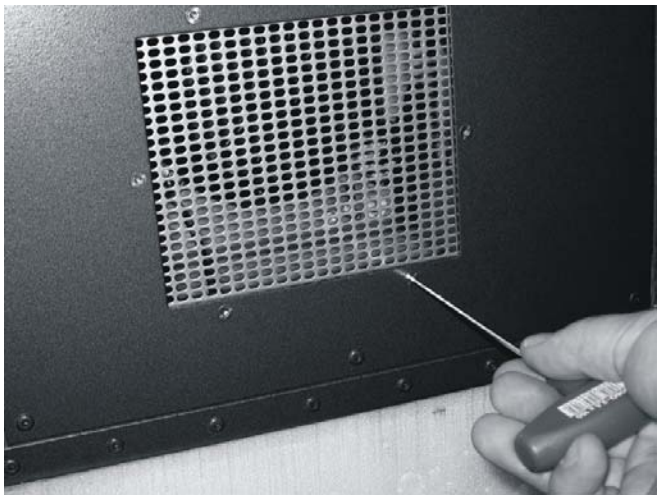

Figure 37: *Removing the lower air intake grille*

16. Disconnect the pressure sensor signal line (see Figure 38, A).

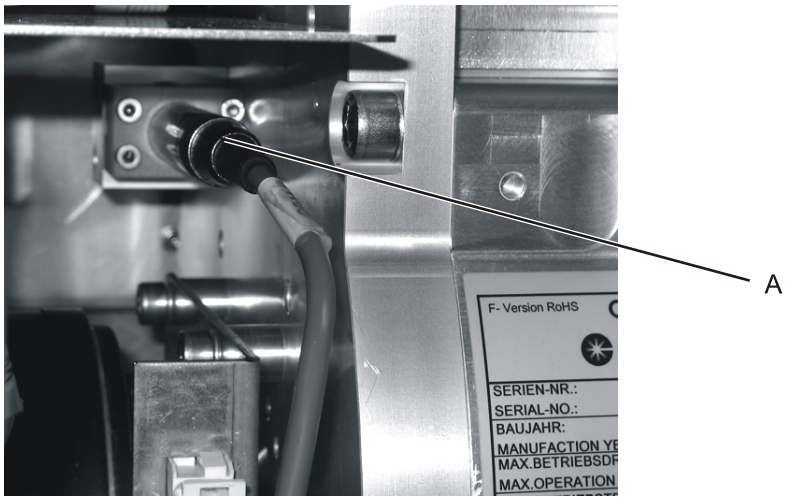

Figure 38: *Disconnecting the pressure sensor signal line*

17. Check that the signal line is fitted with a 5-pin plug.

    If the signal line has an 8-pin plug, the laser device was factory fitted with an 8 bar pressure sensor. As all replacement pressure sensors are 4 bar devices, a pressure sensor upgrade will need to be installed. This procedure is described in the instructions provided with the upgrade kit.
18. Gaining access through the lower air intake opening, use the 3 mm allen key to slowly loosen one of the two screws securing the pressure sensor (see Figure 39, A). If a release of gas is not felt, immediately tighten the screw and increase the inert gas pressure in the laser tube (either press <NEW FILL> and select MAN. INERT or open the internal inert gas valve as described in step 10).

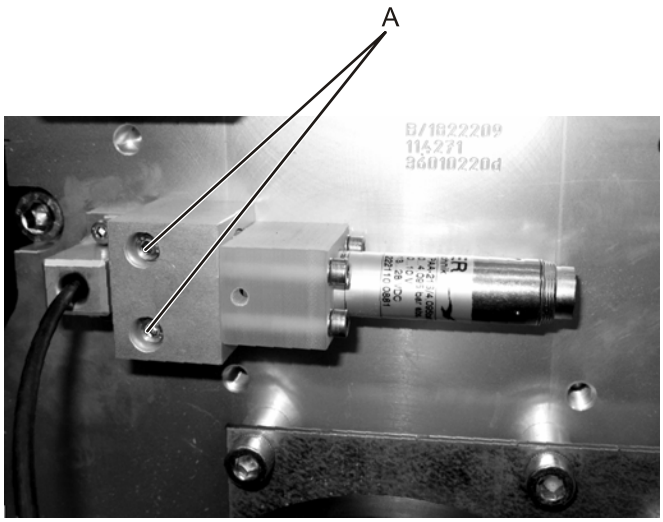

Figure 39: *Pressure sensor securing screws*

19. Use the 3 mm allen key to remove the pressure sensor and immedietely install the new pressure sensor.
20. Plug the pressure sensor cable into the pressure sensor.
21. Check that the pressure reading displayed by the handheld keypad or LCS Monitor software is a realistic value.

Leak Test

22. Press <NEW FILL> on the handheld keypad, select “MAN. INERT” and press <ENTER> to select the manual inert fill routine.
23. Press <EXE> to fill the laser tube with the gas connected to the inert connection for approx. 10 seconds.
24. Repeat step 23 three to four times.
25. Use a helium leak tester to check that there are no leaks at the pressure sensor connection.

26. Press <PURGE RESERVOIR> on the handheld keypad and select "WIN. EXCHANGE" using the cursor keys to start the tube flushing cycle. Immediately continue the cycle by pressing <ENTER> the message “REPLACE WINDOWS (enter)” appears.

    This procedure tests that the new pressure sensor is correctly operating and confirms that there are no leaks.

Finalization

27. Use the 2.5 mm allen key to insert and tighten the lower air intake grille.
28. Re-install the gas circulation fan cover (see Section 3.4.2 on page 32)
29. Re-install the service panel (see Section 3.2.1 on page 20).

5.6 Exchange Tube Temperature Sensor

WARNING
Risk of exposure to harmful gas mixture!
Always thoroughly flush the laser tube and gas supply lines before starting to exchange the temperature sensor.

CAUTION
The laser device is to remain powered up during this procedure! Ensure that the maintenance area is at all times adequately secured and that no unauthorized persons can access the laser device. All persons in the maintenance area shall be fully familiar with the applicable safety regulations and requirements

Purpose

Exchange the laser tube temperature sensor that is fitted to laser devices with the optional automatic temperature regulation feature.

Prior to removing the temperature sensor, the gas mixture has to be pumped out of the laser tube and the tube refilled with the gas connected to the inert valve. Following replacement of the temperature sensor, a leak test has to be performed. These procedures are controlled through a dedicated software routine.

For safety reasons, the laser device cannot be opened until the laser tube is filled with inert gas ready for the temperature sensor exchange procedure. This condition is indicated by a corresponding message on the hand-held keypad. If the laser device is opened prematurely, the dedicated software routine will be aborted and a safety fill will be started.

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Tools and Materials

- 3 mm allen key
- 4 mm allen key
- Inert gas with remaining pressure of at least 20 % of initial value.

Preconditions

- Laser device switched on and laser ready to operate (no radiation being emitted).
- Replacement temperature sensor ready for installation in the working area.

  To prevent ambient air from entering, the laser tube should not be open for longer than a minute. If this period of time is exceeded a warning message appears.

Flush the Laser Tube and Fill with Inert Gas

NOTICE
Risk of damaging pressure regulator!
If pressure is applied to a pressure regulator with low secondary pressure, the pressure regulator membrane may become damaged. Always ensure that the pressure regulator is closed, before opening the gas cylinder valve.

1. Open the inert gas valve .
2. Set the pressure regulator in the inert gas line to the value specified in the User Manual (approx. 5 bar [abs.]).
3. To flush the laser tube with inert gas press <PURGE RESERVOIR> on the handheld keypad and select "WIN. EXCHANGE" using the cursor keys.
4. Confirm with <ENTER> and press <EXE> to proceed.

   The tube flushing cycle is now started. For exact details of this cycle, please refer to the corresponding description in the “Resonator Optics Exchange” section of the User Manual.

   At the end of the flushing cycle, the message “REPLACE WINDOWS (enter)” appears. This indicates that the tube is filled with inert gas. The temperature sensor can now be safely exchanged.

Gaining Access to the Working Area

5. Remove the service panel (see Section 3.2.1 on page 20).
6. Use the 3 mm allen key to unscrew and remove the lower air intake grille (see Figure 37 on page 64).
7. Use the 4 mm allen key to remove the gas circulation fan cover sheet (see Figure 89 on page 110).

Exchanging the Temperature Sensor

8. Disconnect the BNC cable from the LCB box (see Figure 40).

Figure 40: *Disconnecting the temperature sensor cable*

9. Gaining access through the lower air intake opening, use the 3 mm allen key to loosen and remove the temperature sensor (see Figure 41, A) from the laser tube. The temperature sensor is located next to the pressure sensor (see Figure 39 on page 65).

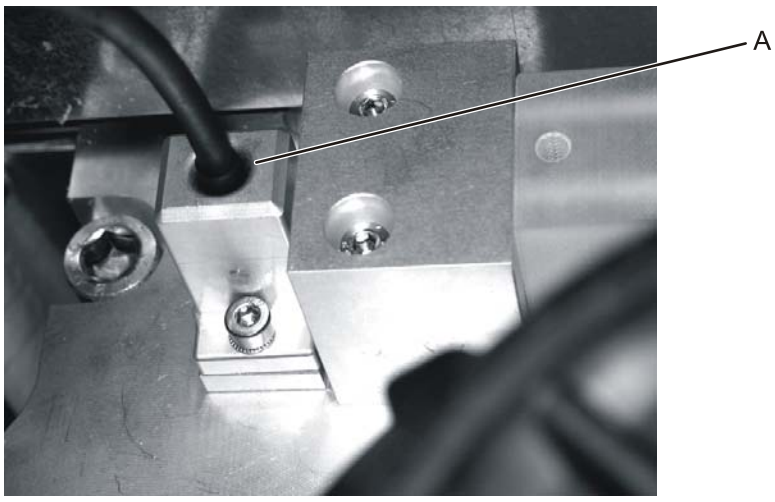

Figure 41: *Location of temperature sensor*

NOTICE
Never press <ENTER> when the temperature sensor is removed. This will automatically continue the software routine which may cause damage to the laser tube.

10. Remove the temperature sensor from the connecting flange and locating piece.

11. Following the order as indicated in Figure 42, assemble the connecting flange (B), locating piece (D), temperature sensor (F), O-rings (A and C) and screws (E).

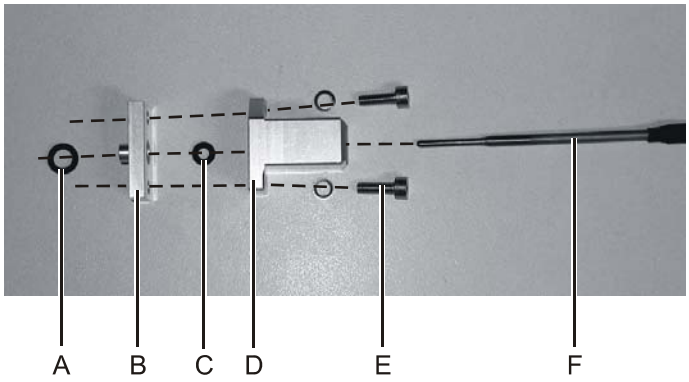

Figure 42: *Temperature sensor assembly*

12. Insert the temperature sensor into the opening in the laser tube.
13. Use the 3 mm allen key to tighten the temperature sensor onto the laser tube.
14. Connect the temperature sensor cable to the appropriate socket on the LCB box.

Leak Test

15. Press <ENTER> to confirm that the temperature sensor has been exchanged.

    An automatic leak test is started. The laser is filled to 3000 mbar with inert gas and the tube pressure is monitored over a 15 minute period. During this period, the message “LEAK TEST“ is displayed.

    Should a leak be detected, the laser tube is evacuated and the warning message “Leak! - Check Windows“ appears. In this case, repeat the leak test at least once before taking further action. If, after repeating the leak test, the warning message appears again, locate the exact source of the leak and rectify.
16. When no leak is detected, press <ENTER> to proceed.

    The laser tube is then evacuated to 80 mbar and filled to 500 mbar twice before being evacuated and finally filled to 1050 mbar.

Finalization

17. Use the 3 mm allen key to insert and tighten the lower air intake grille.
18. Re-install the service panel (see Section 3.2.1 on page 20).
19. Check that the handheld keypad displays a realistic tube temperature value (20°C to 30°C).
20. Perform a new fill (see Maintenance chapter in the User Manual for further information).

5.7 Exchange Gas Circulation Fan Motor

Purpose

Exchange the motor of the laser tube gas circulation fan.

Tools and Materials

- 2.5 mm allen key
- 3 mm allen key
- 4 mm allen key
- 8 mm wrench

Preconditions

- Working area secured to enable removal of a housing cover (see Section 3.2 on page 19)
- Laser device switched off / locked out (see Section 3.1 on page 16)

Preparation

1. Remove the service panel (see Section 3.2.1 on page 20).
2. Remove the gas circulation fan cover (see Section 3.4.2 on page 32).
3. Use the 2.5 allen key to remove the lower air intake grille (see Figure 37 on page 64).

Exchanging the Gas Circulation fan

4. Gaining access through the front air intake opening, use the 6 mm allen key to unscrew the four screws securing the gas circulation fan motor (see Figure 33 on page 55).
5. Pull the gas circulation fan away from the laser tube. Take into account that the gas circulation fan has a magnetic coupling.
6. Remove the gas circulation fan from the service side of the laser device.
7. Insert the replacement gas circulation fan and press it into position against the laser tube.
8. Use the 6 mm allen key to attach the gas circulation fan to the laser tube.

Finalization

9. Use the 2.5 mm allen key to insert and tighten the lower air intake grille.
10. Re-install the gas circulation fan cover (see Section 3.4.2 on page 32).
11. Re-install the service panel (see Section 3.2.1 on page 20).

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5.8 Re-Condition Thyratron

Purpose

Re-condition the thyratron after extended quiescent periods to significantly improve performance.

This is, for example, necessary when:

– a laser device is initially installed after shipment,

– a laser device has been out of operation for more than eight weeks,

– a new thyratron has been installed.

Tools and Materials

- TRMS (True Root Mean Square) voltmeter

Preconditions

- Thyratron to be re-conditioned installed in the laser device.
- Laser device switched on and ready to operate (no laser radiation being emitted).
- Thyratron access panel removed.

Re-Conditioning the Thyratron

1. Apply supply and reservoir heating voltages at a level of 7.0 V to 7.2 V to the thyratron for 15 minutes.

   This has the following effect:

   - Thermal dissociation of barium oxide will replenish the free barium at the cathode surface which supports emission.
   - Titanium in the reservoir assembly will "pump" the atmospheric gases that might have penetrated the thin wall metals during the quiescent period.
2. Set the supply and reservoir heating voltages to 6.3 V. If a special voltage is printed on the thyratron, set the reservoir voltage to this level.
3. Wait for a minute and then use the TRMS voltmeter to measure the voltage at the appropriate test points on the thyratron adjustment panel.
4. Set the laser to the HV constant mode at a repetition rate to 10 Hz.
5. Operate the laser for 15 minutes at the lowest capacitor charging voltage that allows the laser discharge to fire normally.
   This voltage depends on the laser model and laser gas mixture (typical values are 20 kV for the 110 and 205 with ArF and KrF and 22 kV for the 110 and 205 with XeCl and XeF).
6. Increase the repetition rate by 50% and continue to operate the laser for 5 minutes.

7. Repeat step 6 until the desired or maximum repetition rate is achieved.
8. Increase the HV charging voltage by 2 kV and continue to operate the laser for 5 minutes.
9. Repeat step 8 until the desired or maximum HV charging voltage is reached.
10. Continue to operate the laser at the desired HV setting for a further 15 to 30 minutes.

Actions to Rectify Abnormal Firing

Make sure that the laser fires normally throughout the thyratron reconditioning procedure. In case of abnormal firing, proceed as follows:

- If the laser device has just been installed or has not operated for a longer time period, the gas may quickly deteriorate. Consequently, a new gas fill may be required after a short operating period.
- If the thyratron starts to self-fire during the procedure, go back two steps in the conditioning process and continue the procedure from there.
- If the thyratron continues to self-fire despite going back two steps, change to external triggering without supplying external trigger pulses. Apply the capacitor charging voltage. Change the reservoir voltage according to the thyratron performance:
  - Thyratron does not self-fire:
    increase reservoir voltage by 0.2 to 0.3 V
  - Thyratron is self-firing:
    decrease reservoir voltage by 0.2 to 0.3 V

When the laser is correctly firing, continue the re-conditioning process from the step at which the procedure had to be interrupted.

5.9 Exchange Thyratron

NOTICE
Risk of damaging thyratron!
Fingerprints can burn into the ceramic casing of the thyratron and cause premature failure. Always wear protective rubber gloves when handling the thyratron.

Purpose

Exchange the thyratron in the high voltage discharge circuit.

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Tools and Materials

- 3 mm allen key
- Long 3 mm allen key
- 4 mm allen key
- 3/16” allen key
- 7 mm socket wrench
- 10 mm socket wrench
- Protective rubber gloves

Preconditions

- Working area secured to enable removal of a housing cover (see Section 3.2 on page 19)
- Laser device switched off / locked out (see Section 3.1 on page 16)

Preparation

1. Remove the service panel (see Section 3.2.1 on page 20).
2. Use the 3 mm allen key and 4 mm allen key to lay aside the LCB module and remove the front panel from the EMI shielding (see Section 3.4.1 on page 29).
3. Use the 3 mm allen key to loosen the screws (see Figure 43) and slide the front thyratron grounding plate and plastic insulation sheet down from their mounting.

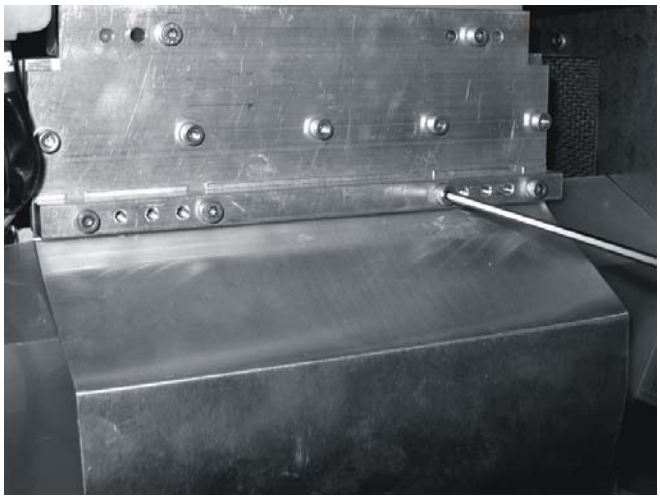

Figure 43: *Removing the front thyratron grounding plate*

4. Use the long 3 mm allen key to loosen the four screws (two shown in Figure 44, A) and slide the rear thyratron grounding plate (B) down from its mounting.

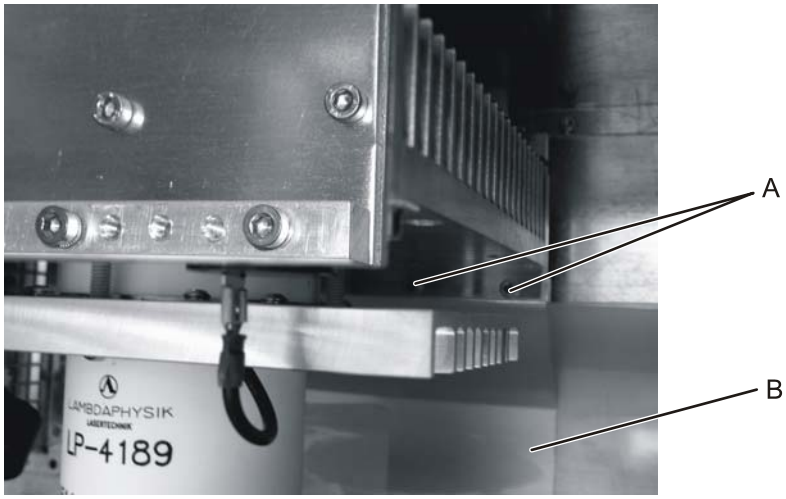

Figure 44: *Rear thyratron grounding plate securing screws*

Removing the Thyratron and Heat Sink Assembly

5. Disconnect the thyratron connection leads from the thyratron terminal strip (see Figure 45, A, B and C).

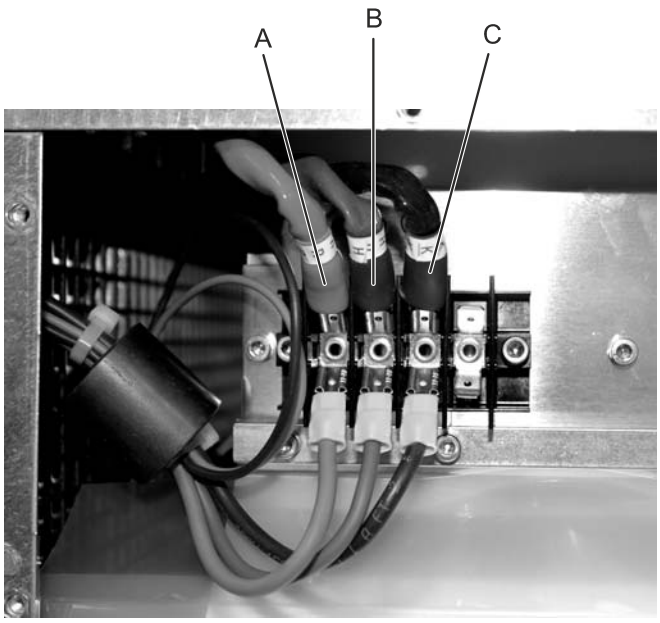

Figure 45: *Thyratron connections at terminal strip*

6. Disconnect the ground cable (see Figure 46, A) and HV trigger cable (B).

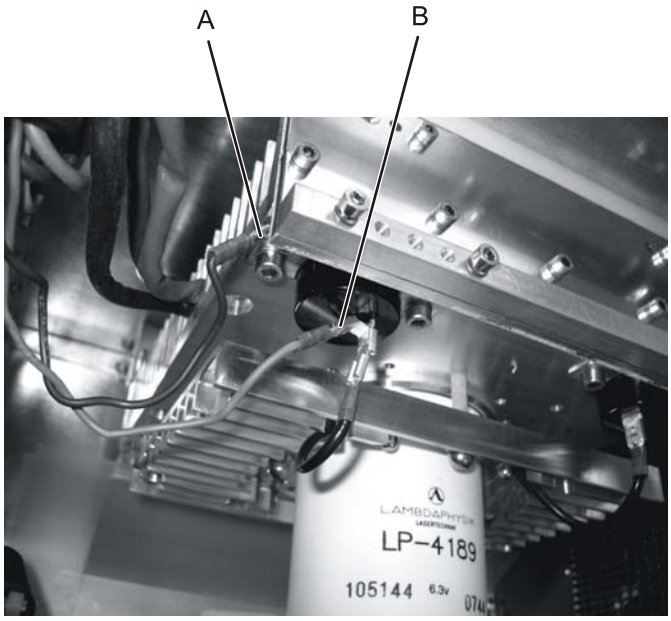

Figure 46: *Thyratron ground and HV trigger cable connections*

7. Use the 3 mm allen key to unscrew the six raised screws securing the thyratron and heat sink assembly (see Figure 47, A).

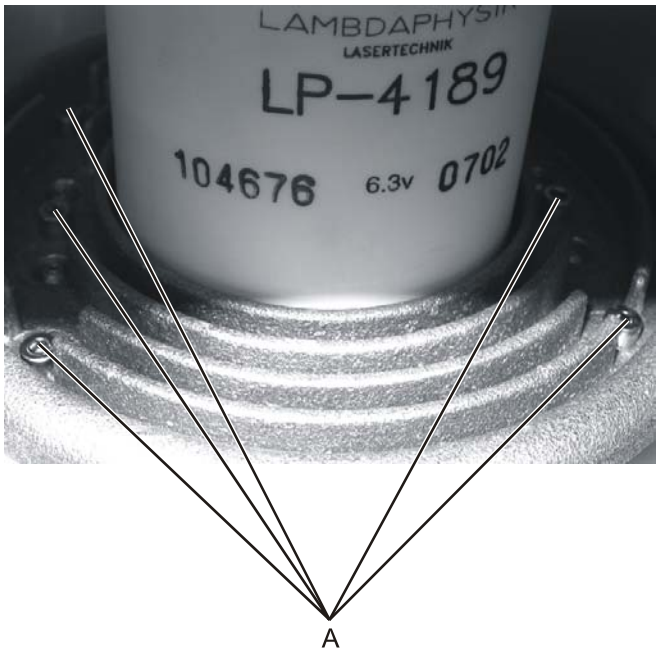

Figure 47: *Thyratron base plate securing screws*

8. Use the long 3 mm allen key to unscrew the two rear thyratron securing screws (see Figure 48).

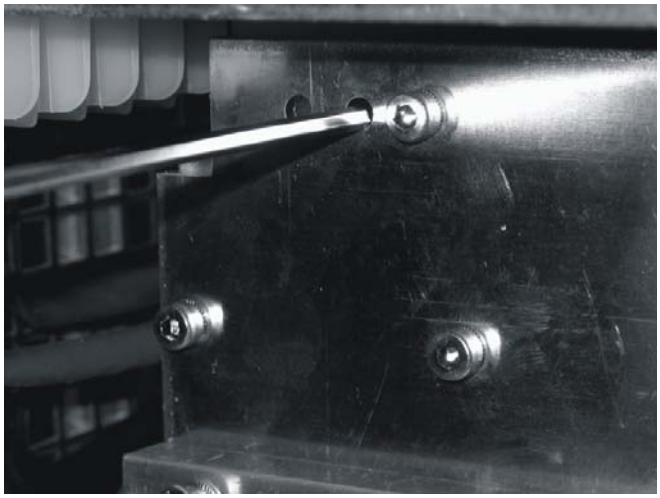

Figure 48: *Unscrewing rear thyratron securing screws*

9. Use the 3 mm allen key to unscrew the two front thyratron securing screws (see Figure 49).

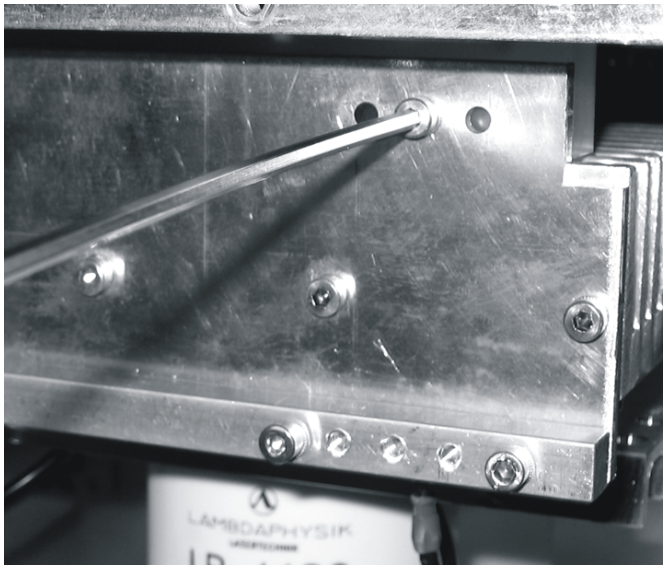

Figure 49: *Unscrewing front thyratron securing screws*

10. Remove the thyratron and heat sink assembly from the laser device.

Removing the Thyratron from the Heat Sinks

11. Turn the thyratron and heat sink assembly upside down and place it onto a work bench (see Figure 50).

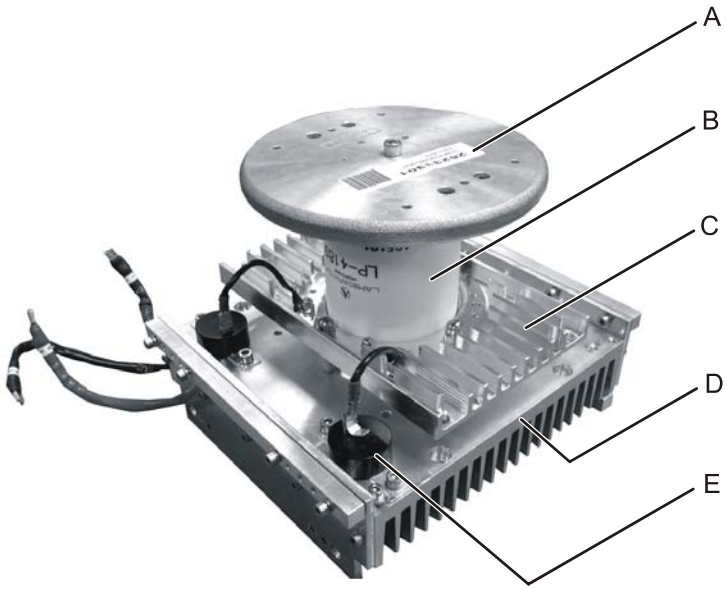

Figure 50: *Thyratron and heat sink assembly*

Key to Figure 50

A Anode heat sink
B Thyratron
C Grid heat sink
D Cathode heat sink
E Varistor

12. Taking care not to lose the contact washer situated between the thyratron and heat sink, use the 3/16” allen key to remove the anode heat sink (see Figure 51).

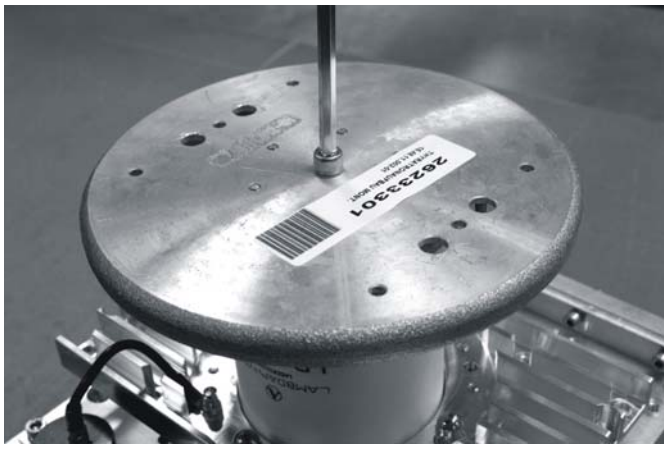

Figure 51: *Removing the anode heat sink*

13. Use the 10 mm socket wrench to remove the four GRP (glass reinforced plastic) screws that secure the thyratron onto the cathode heat sink (see Figure 52, A).

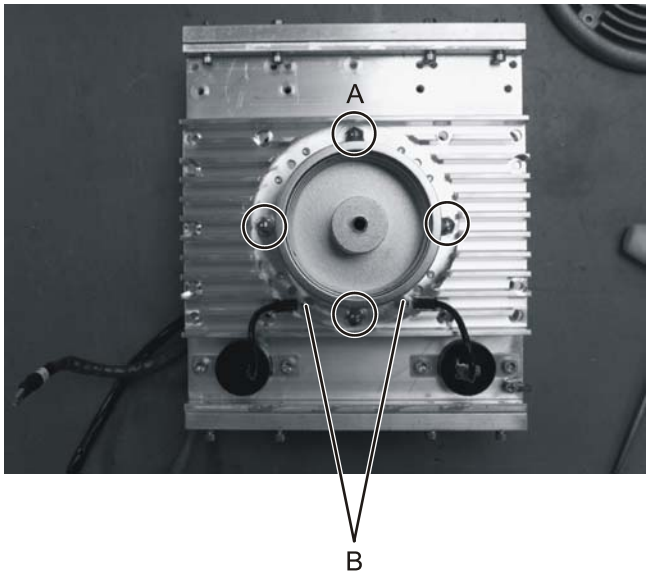

Figure 52: *Cathode heat sink and varistor cable securing screws*

14. Use the 7 mm socket wrench to remove the two hexagon cap nuts securing the varistor cables (see Figure 52, B).
15. Taking care not to trap the heater supply cables, pull the thyratron together with the grid heat sink off of the cathode heat sink.
16. Use the 3 mm allen key to remove the eight screws securing the thyratron to the grid heat sink.

Re-Assembling the Thyratron and Heat Sinks

17. Position the replacement thyratron on the grid heat sink so that the connecting cables are correctly positioned for straightforward connection.

    Figure 53 on page 79 shows the correct cable positions after reassembly.
18. Use the 3 mm allen key to secure the thyratron to the grid heat sink.
19. Making sure that the cables do not get trapped, place the grid heat sink and thyratron onto the cathode heat sink.

NOTICE
Risk of damaging the thyratron assembly!
Do not overtighten the GRP screws. Make sure that the screws are evenly tightenend.

20. Use the 10 mm socket to carefully and evenly tighten the thyratron and grid heat sink onto the cathode heat sink.
21. Use the 7 mm socket wrench to attach the varistor cables.

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22. Place the contact washer on the anode heat sink locating surface of the thyratron.
23. Align the anode heat sink on the thyratron according to the hole pattern of the securing screws.
24. Use the 3/16” allen key to tighten the anode heat sink onto the thyratron assembly.

Re-Installing the Thyratron and Heat Sink Assembly

25. Place the thyratron connections cables between the fins of the cathode heat sink to prevent them from getting trapped during installation into the laser device (see Figure 53).

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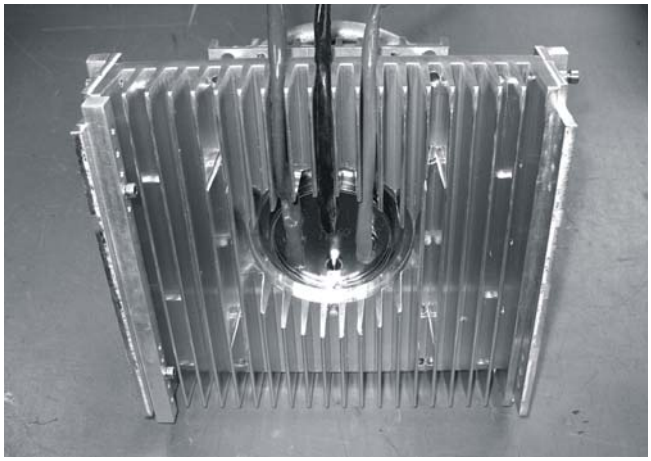

Figure 53: *Top view of thyratron and heat sink assembly*

26. Place the thyratron and heat sink assembly onto the thyratron locating surface in the laser device.
27. Use the long 3 mm allen key to insert and tighten the two rear thyratron securing screws (see Figure 48).
28. Use the 3 mm allen key to insert and tighten the two front thyratron securing screws (see Figure 49).
29. Use the 3 mm allen key to insert and tighten the six thyratron securing screws at the base (see Figure 56).
30. Re-connect the ground and HV trigger cables (see Figure 46).
31. Re-connect the thyratron connection that leads to the thyratron terminal strip (see Figure 45).
32. Use the long 3 mm allen key to re-attach the rear thyratron grounding plate. Make sure that the plastic insulation is in the correct position (see Figure 44).
33. Use the 3 mm allen key to attach the front thyratron grounding plate together with the plastic insulation (see Figure 43).

Finalization

34. Re-install the front EMI shielding and LCB module (see Section 3.4.1 on page 29).
35. Re-condition the thyratron (see Section 5.8).
36. Re-install the service panel (see Section 3.2.1 on page 20).

5.10 Exchange Thyratron Supply Unit

Purpose

Exchange the thyratron supply unit.

Tools and Materials

- 3 mm allen key
- 4 mm allen key
- Multimeter

Preconditions

- Working area secured to enable removal of a housing cover (see Section 3.2 on page 19)

Preparation

1. Remove the service panel (see Section 3.2.1 on page 20).
2. Use the multimeter to measure the heater, reservoir and bias voltages and note the settings.
3. Switch off / lock out the laser device (see Section 3.1 on page 16).
4. Use the 3 mm allen key and 4 mm allen key to lay aside the LCB module and remove the front panel from the EMI shielding (see Section 3.4.1 on page 29).

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Disconnecting the Thyratron Supply Unit

5. Disconnect the trigger FOL (fiber optic light waveguide) from the thyratron supply unit (see Figure 54, A).

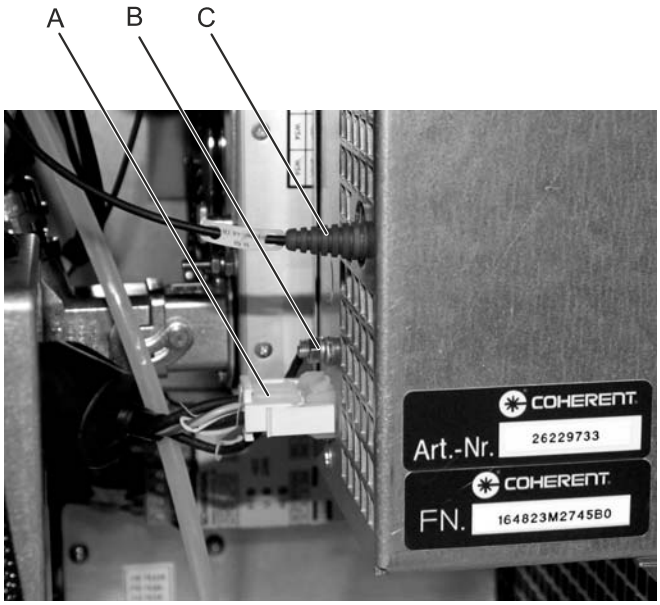

Figure 54: *Disconnecting the thyratron supply unit*

6. Disconnect the power cable (B) from the thyratron supply unit.
7. Disconnect the grounding cable (C) from the thyratron supply unit.
8. Disconnect the thyratron supply unit from the thyratron terminal strip (see Figure 55, A, B and C).

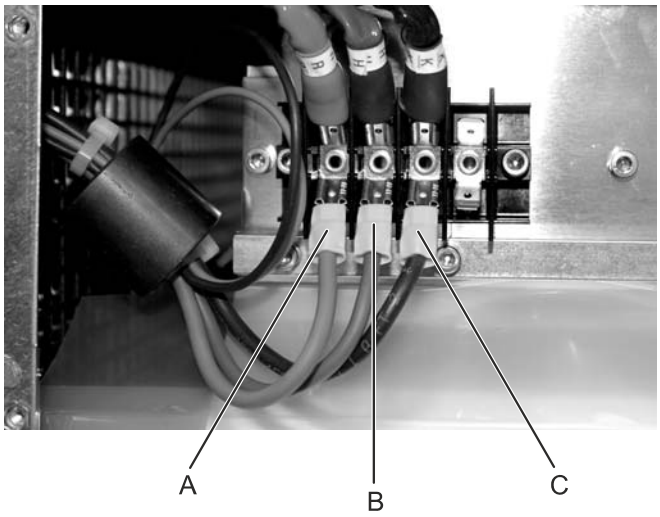

Figure 55: *Disconnecting the thyratron supply unit*

9. Disconnect the ground cable and HV trigger cable from the cathode heat sink and varistor (see Figure 46 on page 74).

Removing the Thyratron Supply Unit

10. Use the 3 mm allen key to unscrew the two screws securing the thyratron supply unit.

    One screw is situated on the locating flange underneath the thyratron supply unit (see Figure 56, A) and the other screw on the side of the unit pointing towards the thyratron (B).

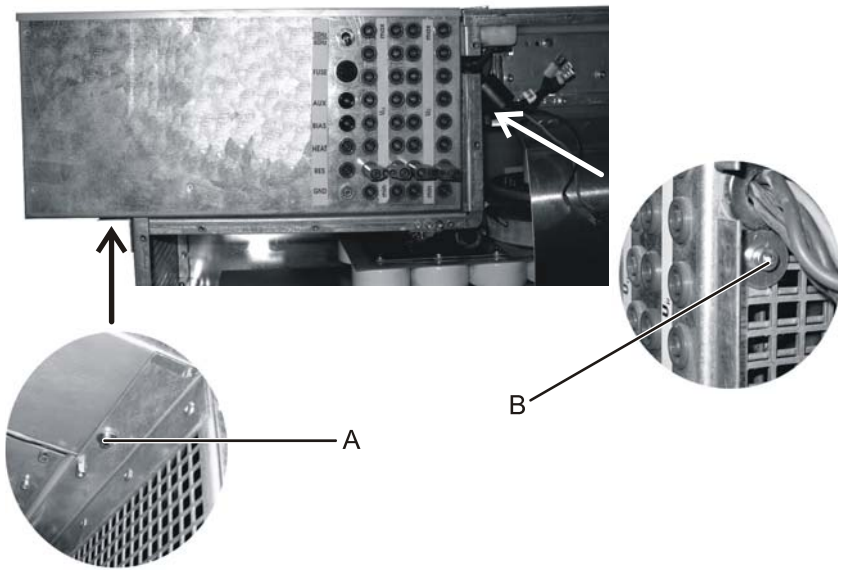

Figure 56: *Screws securing thyratron supply unit*

11. Remove the thyratron supply unit.

Installing the thyratron Supply Unit

12. Locate the replacement thyratron supply unit in position.
13. Use the 3 mm allen key to insert and tighten the two screws securing the thyratron supply unit (see Figure 56).
14. Connect the ground cable and HV trigger cable to the cathode heat sink and varistor (see Figure 46 on page 74).
15. Connect the thyratron supply unit to the thyratron terminal strip (see Figure 55).

Finalization

16. Re-install the front EMI shielding and LCB module (see Section 3.4.1 on page 29).
17. Check that the line frequency toggle switch on the thyratron adjustment panel is set to the correct value.
18. Switch on the laser device.
19. Use the multimeter to measure the heater, reservoir and bias voltages and, where necessary, change the jumper settings according to the values noted in step 2.
20. Re-install the service panel (see Section 3.2.1 on page 20).

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5.11 Exchange HV Trigger Board

Purpose

Exchange the HV trigger board (PCB) in the thyratron supply unit.

Tools and Materials

- 3 mm allen key

Preconditions

- Thyratron supply unit removed from the laser device (see Section 5.10 on page 80)

Exchanging the HV Trigger Board

1. Use the 3 mm allen key to remove the cover from the thyratron supply unit (see Figure 57).

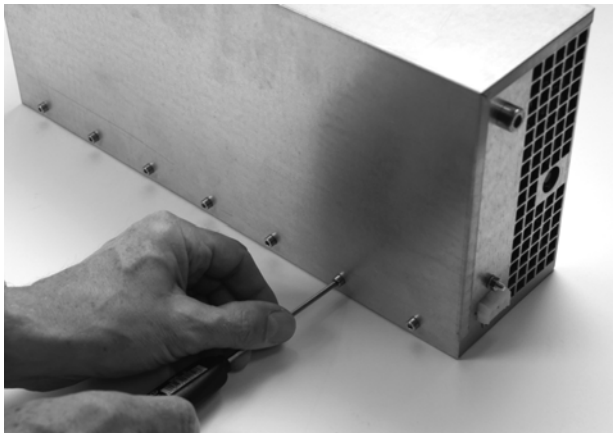

Figure 57: *Removing the thyratron supply unit cover*

2. Disconnect the two electrical connections to the HV trigger board (see Figure 58, A and B).

Figure 58: *HV trigger board electrical connections*

3. Use the 3 mm allen keys to unscrew and remove the four PCB securing screws (see Figure 59).

Figure 59: *Unscrewing the HV trigger board securing screws*

4. Carefully lift the HV trigger board out of the thyratron supply unit (see Figure 60).

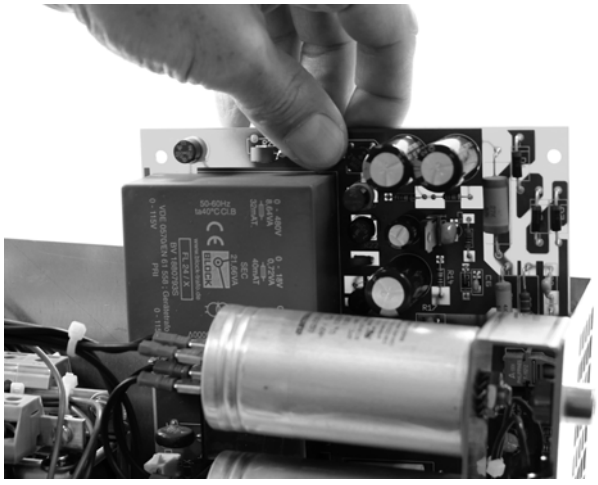

Figure 60: *Removing the HV trigger board*

5. Carefully insert the replacement HV trigger board into the thyratron supply unit.
6. While holding the HV trigger board, use the 3 mm allen keys to tighten the four PCB securing screws.
7. Reconnect the two electrical connections.
8. Re-attach the cover to the thyratron supply unit.

Finalization

9. Re-install the thyratron supply unit into the laser device (see Section 5.10 on page 80).

5.12 Exchange HV Circuit Resistor

Purpose

Exchange the 470 Ω resistor in the high voltage discharge circuit. Always install the heat shrink tube provided with the replacement resistor to prevent sparking in the HV discharge circuit.

Tools and Materials

- 3 mm allen key
- 4 mm allen key
- 7 mm socket wrench
- Heat-shrink tube (38 mm diameter, length of at least 20 cm)
- Sharp scissors or cutting knife
- Ruler or flexible rule
- Heat gun >100° C

Preconditions

- Working area secured to enable removal of a housing cover (see Section 3.2 on page 19)
- Laser device switched off / locked out (see Section 3.1 on page 16)

Preparation

1. Remove the service panel (see Section 3.2.1 on page 20).
2. Use the 3 mm allen key and 4 mm allen key to lay aside the LCB module and remove the front panel from the EMI shielding (see Section 3.4.1 on page 29).

Removing the HV Circuit Resistor

3. Use the cutting knife to remove the insulation from the HV circuit resistor.

4. Use the 7 mm socket wrench to disconnect the HV power supply cable (see Figure 61, A).

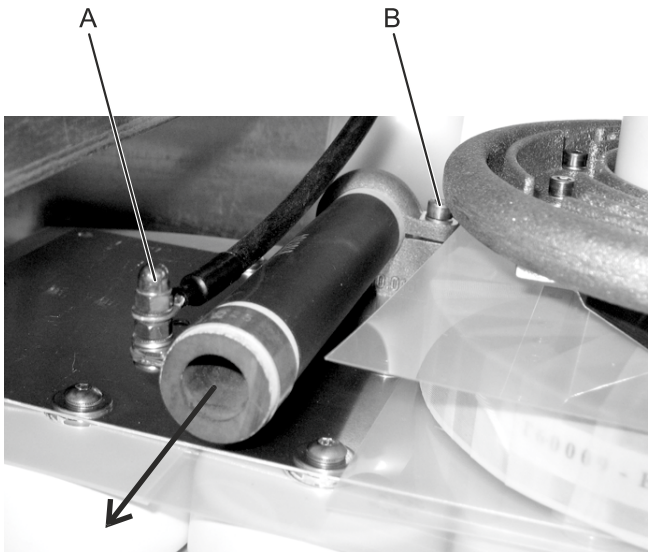

Figure 61: *Removing the HV circuit resistor*

5. Use the 3 mm allen key to loosen the securing clamp (B).
6. Pull the resistor out of the clamp as indicated in Figure 61. Between the clamp and resistor is a copper contact ring.

Insulating the HV Circuit Resistor

7. Use the scissors or knife to cut an 11 cm section of heat shrink tube (see Figure 62).

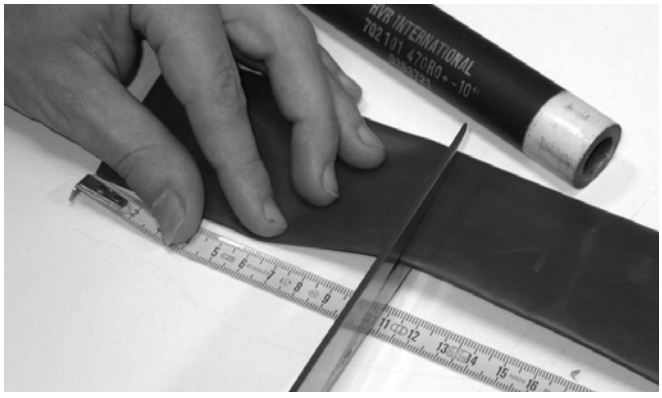

Figure 62: *Cutting the heat shrink tube*

8. Slide the heat shrink tube over the ceramic section of the HV circuit resistor.
9. Place the resistor vertically on a clean and clear working surface.

10. Use the heat gun to shrink the heat shrink tube (see Figure 63).

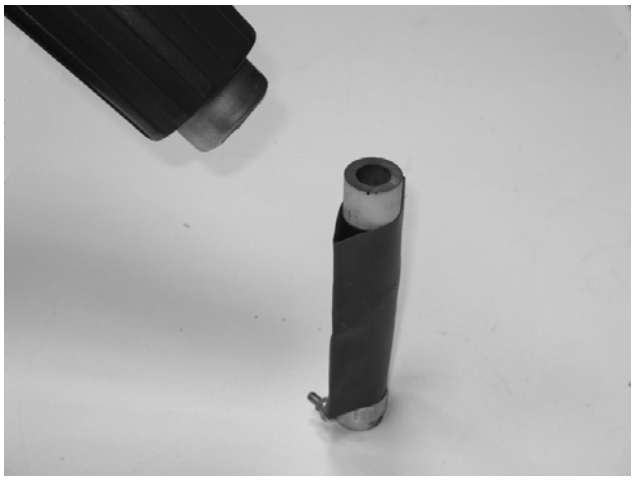

Figure 63: *Insulating the ceramic section of the 470 Ω resistor*

Installing the HV Circuit Resistor

CAUTION
Burn hazard!
Heat shrinking will heat the exposed areas of the resistor.
Always wait for the HV circuit resistor to cool down before installing it in the laser device.

11. Carefully push the new resistor into the copper contact ring and then into position below the securing clamp. The contact ring should be fitted so that it is flush with the clamp on both sides.
12. Use the 3 mm allen key to tighten the securing clamp.
13. Use the 3 mm allen key and 7 mm socket wrench to connect the HV power supply cable (see Figure 64).

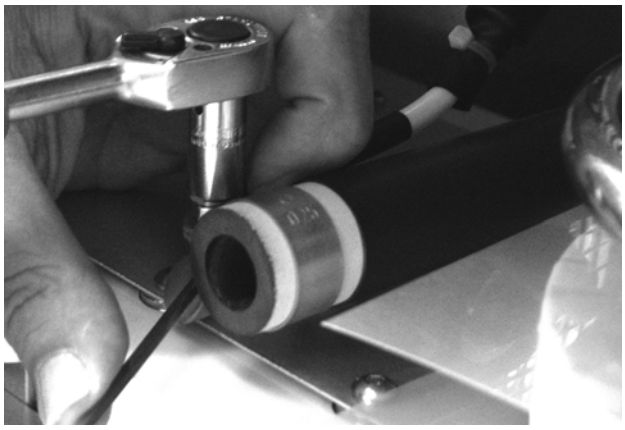

Figure 64: *Connecting the HV power supply cable*

Double Insulating the HV Power Supply Cable Connection

14. Use the scissors or knife to cut a 4 cm section and a 5 cm section of heat shrink tube (see Figure 65).

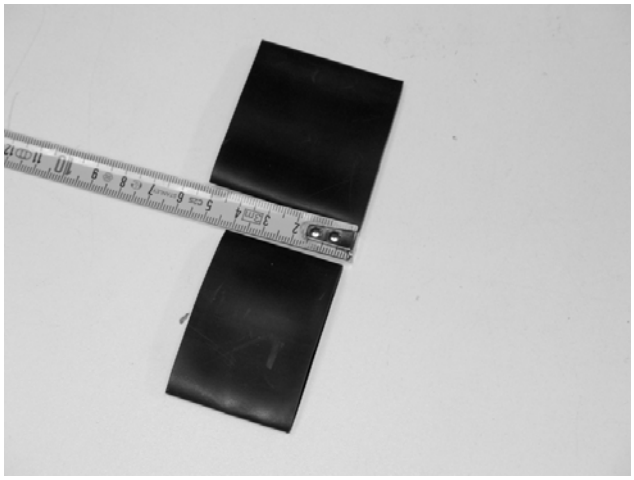

Figure 65: *Preparing the cable connection heat shrink*

15. Slide the 4 cm heat shrink tube over the HV power supply connection (see Figure 66).

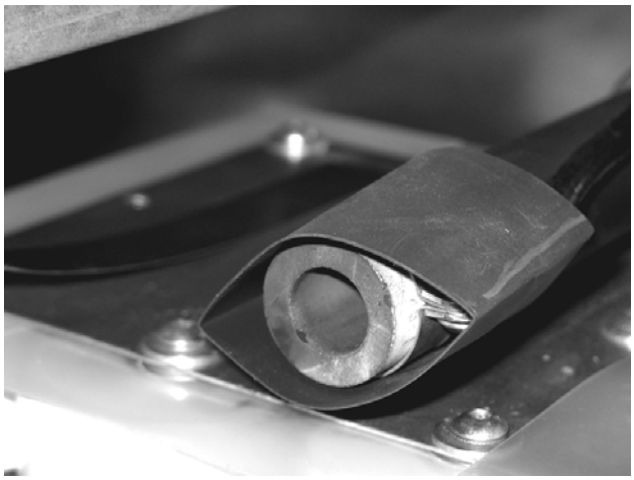

Figure 66: *Fitting the 4 cm heat shrink tube*

NOTICE
Risk of thermally damaging adjacent components!
Exclusively direct the heat energy towards the heat shrink tube on the HV resistor. Ensure that no adjacent components are affected by the heat energy.

16. Use the heat gun to shrink the heat shrink tube (see Figure 67).

Figure 67: *Insulating the HV power supply connection*

17. Slide the 5 cm heat shrink tube over the freshly insulated connection (see Figure 68).

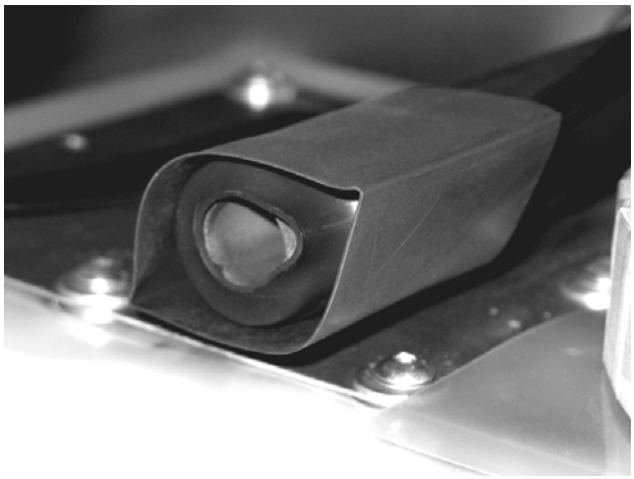

Figure 68: *Fitting the 5 cm heat shrink tube*

18. Use the heat gun to shrink the heat shrink tube.
    The HV circuit resistor and HV power supply cable connection after completion of the insulation procedure is shown in Figure 69.

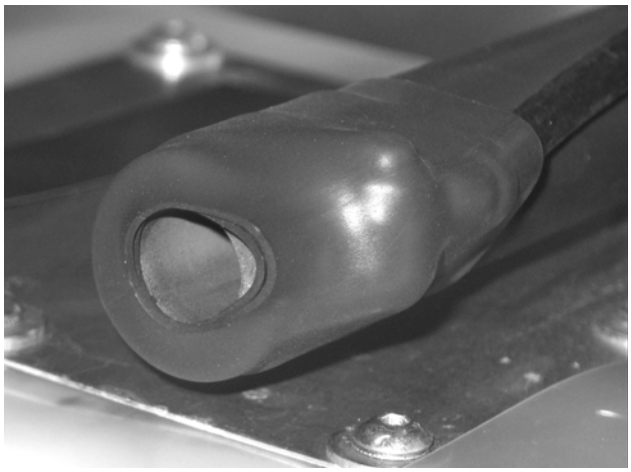

Figure 69: *Insulated HV circuit resistor and connection*

Finalization

19. Use the 3 mm allen key to attach the front thyratron grounding plate. Make sure that the plastic insulation is in the correct position.
20. Re-install the front EMI shielding and LCB module (see Section 3.4.1 on page 29).
21. Re-install the service panel (see Section 3.2.1 on page 20).

5.13 Exchange Varistors

Purpose

Exchange the varistors in the high voltage discharge circuit.

Tools and Materials

- 3 mm allen key
- 4 mm allen key
- Heat conductive paste

Preconditions

- Working area secured to enable removal of a housing cover (see Section 3.2 on page 19)
- Laser device switched off / locked out (see Section 3.1 on page 16)

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Preparation

1. Remove the service panel (see Section 3.2.1 on page 20).
2. Use the 3 mm allen key and 4 mm allen key to lay aside the LCB module and remove the front panel from the EMI shielding (see Section 3.4.1 on page 29).
3. Use the 3 mm allen key to loosen the screws and remove the front thyratron grounding plate (see Figure 43 on page 73).

Exchanging the Varistors

4. Disconnect the HV trigger (see Figure 70, C) and thyratron (B) connection cables from the varistors.

Figure 70: *Exchanging the varistors*

5. Use the 3 mm allen key to unscrew and remove the varistors (see Figure 70, A).
6. Thinly spread heat conductive paste across the rear of the new varistors.
7. Insert the varistors and use the 3 mm allen key to tighten them in position.
8. Connect the HV trigger and thyratron connection cables to the varistors.

Finalization

9. Use the 3 mm allen key to attach the front thyratron grounding plate. Make sure that the plastic insulation is in the correct position.
10. Re-install the front EMI shielding and LCB module (see Section 3.4.1 on page 29).
11. Re-condition the thyratron (see Section 5.8).
12. Re-install the service panel (see Section 3.2.1 on page 20).

5.14 Exchange HV Discharge Coil

Purpose

Exchange the charge/discharge coil in the high voltage discharge circuit.

Tools and Materials

- Housing key
- 3 mm allen key
- 4 mm allen key

Preconditions

- Working area secured to enable removal of a housing cover (see Section 3.2 on page 19)
- Laser device switched off / locked out (see Section 3.1 on page 16)

Preparation

1. Remove the service panel (see Section 3.2.1 on page 20).
2. Use the 3 mm allen key and 4 mm allen key to lay aside the LCB module and remove the front panel from the EMI shielding (see Section 3.4.1 on page 29).

Exchanging the HV Discharge Coil

3. Use the 3 mm allen key to disconnect the HV discharge coil from the capacitor bank (see Figure 71).

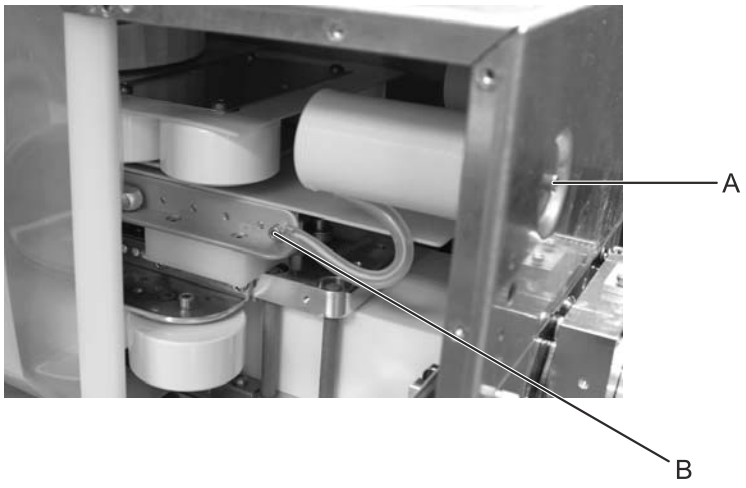

Figure 71: *Disconnecting and removing the HV discharge coil*

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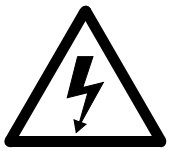
4. Use the 3 mm allen key to unscrew the discharge coil from the EMI housing.
5. Use the 3 mm allen key to install and reconnect the replacement discharge coil.

Finalization

6. Re-install the front EMI shielding and LCB module (see Section 3.4.1 on page 29).
7. Re-install the service panel (see Section 3.2.1 on page 20).

5.15 Exchange HV Power Supply



WARNING
Risk of electric shock!
The capacitors in the HV power supply may remain energized for at least ten minutes after disconnecting the mains power. Always disconnect the laser device from the mains power and wait for the capacitors to discharge before starting to remove the HV power supply.

Purpose

Exchange the high voltage power supply in the laser discharge circuit.

Tools and Materials

- 3 mm allen key
- 4 mm allen key
- 7 mm wrench
- 11 mm wrench

Preconditions

- Working area secured to enable removal of a housing cover (see Section 3.2 on page 19)
- Laser device switched off / locked out (see Section 3.1 on page 16)

Preparation

1. Remove the service panel (see Section 3.2.1 on page 20).
2. Use the 3 mm allen key and 4 mm allen key to lay aside the LCB module and remove the front panel from the EMI shielding (see Section 3.4.1 on page 29).
3. Remove the thyratron supply unit (see Section 5.10)

Disconnecting the HV Power Supply

4. Disconnect the Harting mains power plug from the HV power supply (see Figure 72; B).

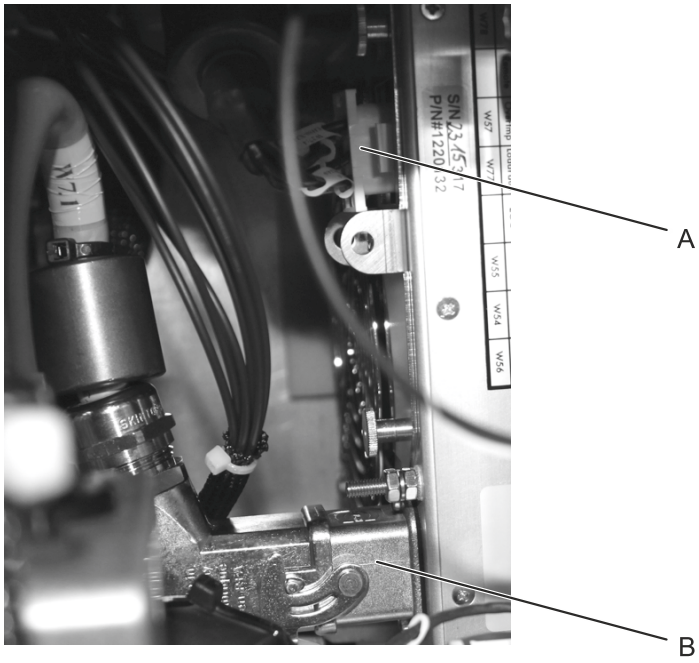


Figure 72: *Disconnecting the HV power supply*

5. Disconnect the interlock circuit AMP plug (A) and FOLs from the HV power supply.

Removing the HV Power Supply

6. Use the 11 mm wrench to unscrew the HV power supply grounding screw (see Figure 73, B).

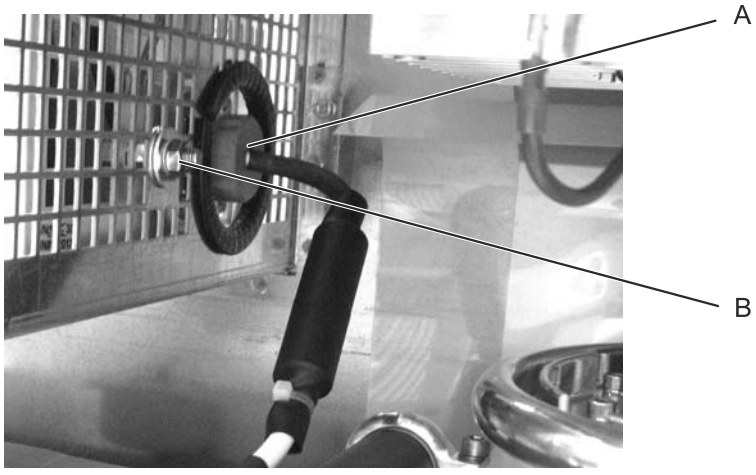


Figure 73: *HV Power supply cable connection and grounding screw*

7. Unscrew the grounding screw and disconnect the HV power supply cable from the HV power supply (see Figure 73, A).
8. Use the 3 mm allen key to unscrew the two screws securing the HV power supply (see Figure 74, A).

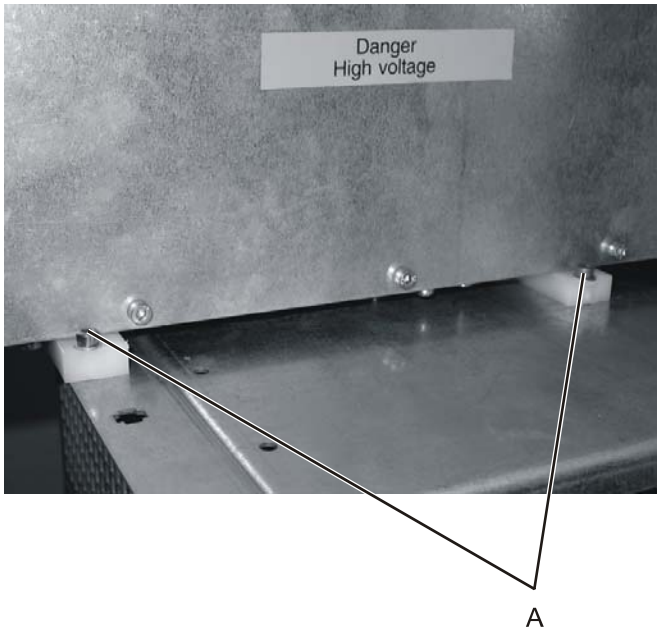


Figure 74: *Screws securing HV power supply*

9. Remove the HV power supply.

Installing the HV Power Supply

10. Remove the appropriate FOL connection caps and connect the FOLs to the HV power supply (see Figure 75, A).

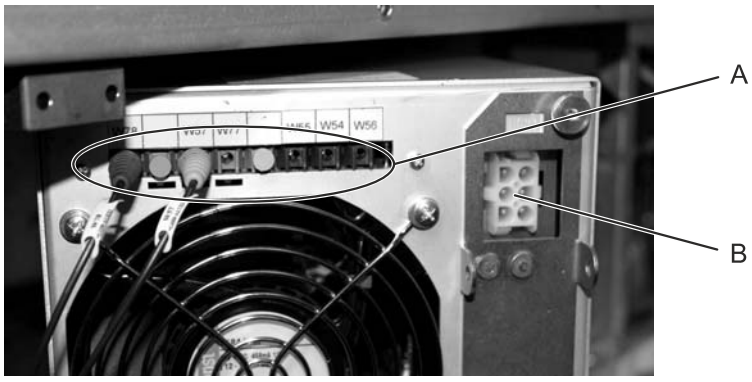


Figure 75: *Connecting FOLs and interlock circuit to EPU1.5 HVPS*

11. Connect the interlock circuit AMP plug to the appropriate socket on the HV power supply (see Figure 75, B).

12. Place the HV power supply into position and tighten the securing screws (see Figure 76, A).

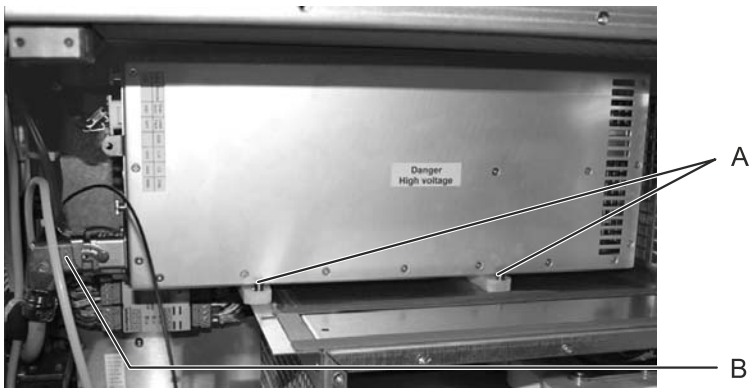


Figure 76: *HV power supply after installation*

13. Connect the Harting mains power plug to the HV power supply (see Figure 76, B).
14. Tighten the HV power supply grounding screw on the thyratron side of the HV power supply (see Figure 77, A).

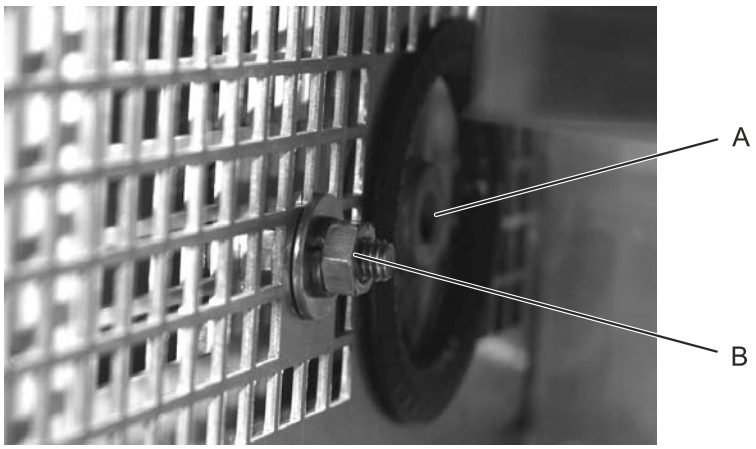


Figure 77: *Grounding screw and HV power supply cable connection*

15. Connect the HV power supply cable to the socket on the thyratron side of the HV power supply (see Figure 77, B).

Finalization

16. Insert and connect the thyratron supply unit (see Section 5.10).
17. Re-install the front EMI shielding and LCB module (see Section 3.4.1 on page 29).
18. Re-install the service panel (see Section 3.2.1 on page 20).

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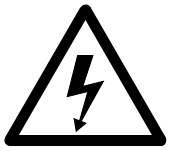
5.16 Exchange Capacitors



WARNING
Risk of electric shock!
Capacitors may remain energized for at least ten minutes after disconnecting the mains power.
Removed capacitors and capacitor arrays may automatically regain their charge when not correctly grounded
Always disconnect the laser device from the mains power and wait for the capacitors to discharge before starting to remove the capacitor arrays. Permanently ground the capacitors during transport and storage.

NOTICE
Risk of damaging capacitors!
Fingerprints can burn into the ceramic casing of the capacitors and cause premature failure. Always wear protective rubber gloves when handling capacitors.

Purpose

Exchange the storage and/or peaking capacitors in the laser discharge circuit.

The storage capacitors are arranged in a storage capacitor array and the peaking capacitors in a peaking capacitor bank. Either individual capacitors or the complete capacitor array or bank can be exchanged.

To enable individual capacitors to be exchanged, the respective capacitor array or bank has to be removed from the laser device. To gain access to the peaking capacitor bank, the storage capacitor array has to be removed. When exchanging the complete storage capacitor array, the magnetic assist and HV circuit resistor have to be swapped over from the old array to the new.

This section describes:

– the removal of the storage capacitor array in steps 6 to 9,

– the additional procedures that are required when exchanging the complete storage capacitor array in steps 10 to 16,

– the removal of the peaking capacitor bank in steps 17 to 21,

– the exchange of individual capacitors in either the storage capacitor array or peaking capacitor bank in steps 22 to 24,

– the installation of the peaking capacitor bank in steps 25 and 26,

– the installation of the storage capacitor array in steps 27 and 28.

Tools and Materials

- 3 mm allen key
- 4 mm allen key
- 7 mm wrench
- Protective rubber gloves

Preconditions

- Working area secured to enable removal of a housing cover (see Section 3.2 on page 19)
- Laser device switched off / locked out (see Section 3.1 on page 16)

Preparation

1. Remove the service panel (see Section 3.2.1 on page 20).
2. Use the 3 mm allen key and 4 mm allen key to lay aside the LCB module and remove the front panel from the EMI shielding (see Section 3.4.1 on page 29).
3. Remove the thyratron and heat sink assembly (see Section 5.9. on page 72, steps 3 to 10).

Removing the Storage Capacitor Array

4. Use the cutting knife to remove the insulation from the HV circuit resistor.
5. Use the 7 mm wrench to disconnect the HV power supply cable from the HV resistor (see Figure 61 on page 86).

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NOTICE
If the storage capacitor array is not mounted in the correct position, it is impossible to correctly tighten the thyratron. Always note the exact position of the storage capacitor array before removing it from the laser tube.

6. Note the distance between the edge of each of the copper strips on the capacitor bank and the edge of the respective attachment clamp (see Figure 78, distance z).

   The COMPex*Pro* 100 Series has a total of four clamps at the front and the COMPex*Pro* 200 Series has a total of six front clamps.

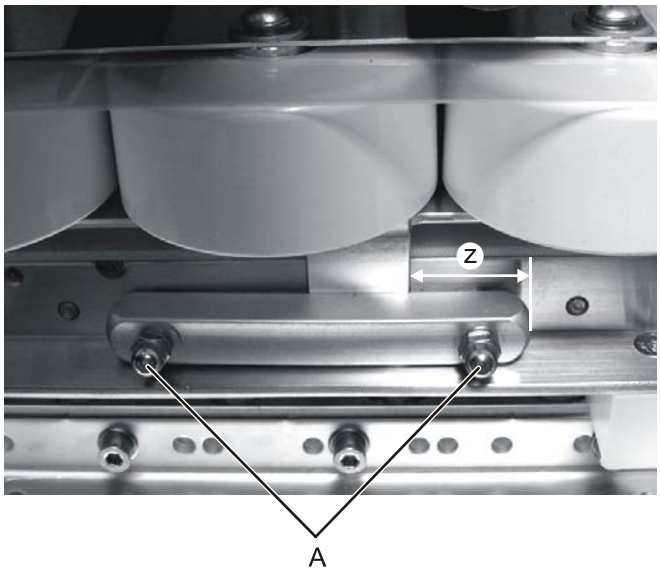

Figure 78: *Storage capacitor array attachment clamp with screws*

7. Use the 7 mm wrench to loosen (but not remove) the screws (see Figure 78, A) that secure each of the storage capacitor array attachment clamps.
8. Repeat step 7 to loosen the clamps at the rear of the storage capacitor array.

   These clamps are located in the corresponding positions to those at the front. They can be reached through the opening in the position of the removed thyratron assembly.
9. Lift the storage capacitor array off of the peaking capacitor bank.
   - To exchange the storage capacitor array, continue with step 10.
   - To exchange the peaking capacitor bank or individual peaking capacitors, continue with step 17.
   - To exchange individual storage capacitors, continue with step 22.

Exchanging the Storage Capacitor Array

10. Use the 3 mm allen key to loosen the HV resistor securing clamp (see Figure 79, B).

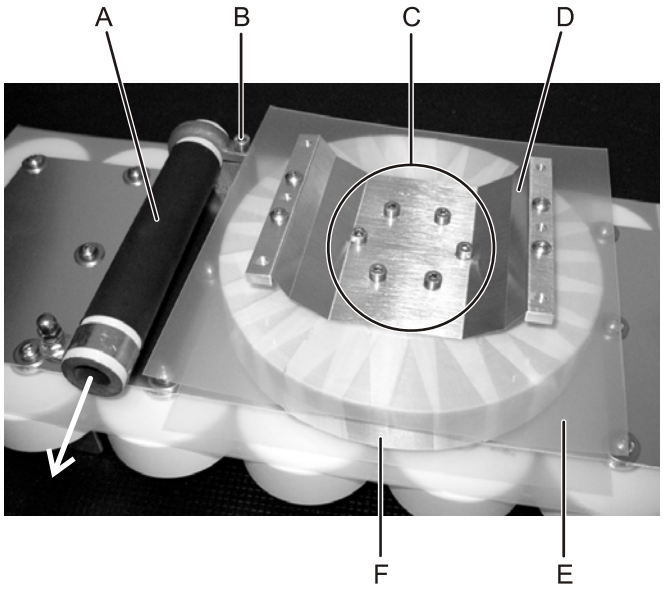

Figure 79: *Exchanging the storage capacitor array*

11. Pull the HV resistor (A) together with the copper contact ring out of the securing clamp in the direction shown in Figure 79.
12. Use the 3 mm allen key to unscrew the six attachment screws (C).
13. Remove the thyratron contact plate (D), plastic insulation sheet (E) and magnetic assist (F) from the old array and place them in the correct fitting position on the new storage capacitor array.
14. Use the 3 mm allen key to insert and tighten the six attachment screws crosswise and in stages.
15. Carefully push the HV resistor into the copper contact ring and then into position below the securing clamp. The contact ring should be fitted so that it is flush with the clamp on both sides.
16. Use the 3 mm allen key to tighten the HV resistor securing clamp.
    - To re-install the storage capacitor array, continue with step 27.

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Removing the Peaking Capacitor Bank

17. Use the 3 mm allen key to unscrew the securing screws at the top front of the peaking capacitor bank (see Figure 80).

Figure 80: *Unscrewing the peaking capacitor bank at the top*

18. Repeat step 17 to unscrew the screws at the top rear of the peaking capacitor bank.
19. Use the 3 mm allen key to unscrew the row of securing screws at the bottom front of the peaking capacitor bank (see Figure 81).

Figure 81: *Peaking capacitor bank securing screws at bottom*

20. Repeat step 19 to unscrew the screws at the bottom rear of the peaking capacitor bank.
21. Lift the peaking capacitor bank off of the laser tube.
    - To exchange individual capacitors, continue with step 17.
    - To install a new peaking capacitor bank continue with step 25.

Exchanging Individual Capacitors

NOTICE
Risk of unnecessary additional downtime!
The capacitors in the immediate vicinity of the defective capacitor are subject to premature failure. Always also exchange the adjacent capacitors in addition to the defective capacitor.

22. Use the 3 mm allen key to remove the screws securing the capacitor at the top and bottom.
23. Slide the capacitor out of the bank or array.
24. Slide the new capacitor into the appropriate position in the array or bank and use the 3 mm allen key to secure it at the top and bottom.
    - To re-install the peaking capacitor bank continue with step 25
    - To re-install the storage capacitor array, continue with step 27.

Installing the Peaking Capacitor Bank

25. Locate the storage capacitor array onto laser tube.
26. Use the 3 mm allen key to attach the peaking capacitor bank to the laser tube (securing screws at front and rear, top and bottom).

Installing the Storage Capacitor Array

27. Taking into account the positions noted in step 6, use the 7 mm wrench to insert the storage capacitor array.
28. Use the 7 mm wrench to connect the HV power supply cable to the HV resistor

Finalization

29. Re-install the thyratron and heat sink assembly (see Section 5.9. on page 79, steps 26 to 33)
30. Re-install the front EMI shielding and LCB module (see Section 3.4.1 on page 29).
31. Re-install the service panel (see Section 3.2.1 on page 20).
32. Switch on the laser device and wait for the warm-up period to elapse.
33. Perform a new fill (see Maintenance chapter in the User Manual for further information).
34. Adjust the laser resonator (see Maintenance chapter in the User Manual).
35. Check that the energy monitor is correctly calibrated (see Maintenance chapter in the User Manual).
36. Check the laser performance.
37. Restart laser operation.

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5.17 Exchange LCB

Purpose

Exchange the laser control board (LCB).

Tools and Materials

- 2.5 mm allen key
- 3 mm allen key
- Slotted screwdriver
- External computer (PC, laptop or notebook) with LCS Monitor software (CMPX_Mon.exe)
- RS 232, 9 pole D-sub null-modem cable

Preconditions

- Laser device switched on and laser ready to operate (no radiation being emitted)

  The laser device has initially to remain switched on to enable the laser parameters to be downloaded.
- Working area secured to enable removal of a housing cover (see Section 3.2 on page 19)

Preparation

1. Use the null-modem cable to connect the external computer to the COM1 port of the laser device (see Section 8.1 on page 209).
2. Use the LCS Monitor software to download the current parameter settings from the LCB (see Section 8.1.2.2 on page 218).
3. Save the current laser paramater settings as a text file (see Section 8.1.2.3 on page 219).
4. Where possible, print out the parameter settings text file.
5. Terminate the LCS Monitor software.
6. Switch off / lock out the laser device (see Section 3.1 on page 16).
7. Remove the service panel (see Section 3.2.1 on page 20).

Removing the Laser Control Board

8. Use the 3 mm allen key to remove the cover from the LCB module (see Figure 82).

Figure 82: *Removing the LCB module cover*

9. Disconnect the FOLs (fiber optic light waveguides) from the connections on the LCB (see Figure 83, D).

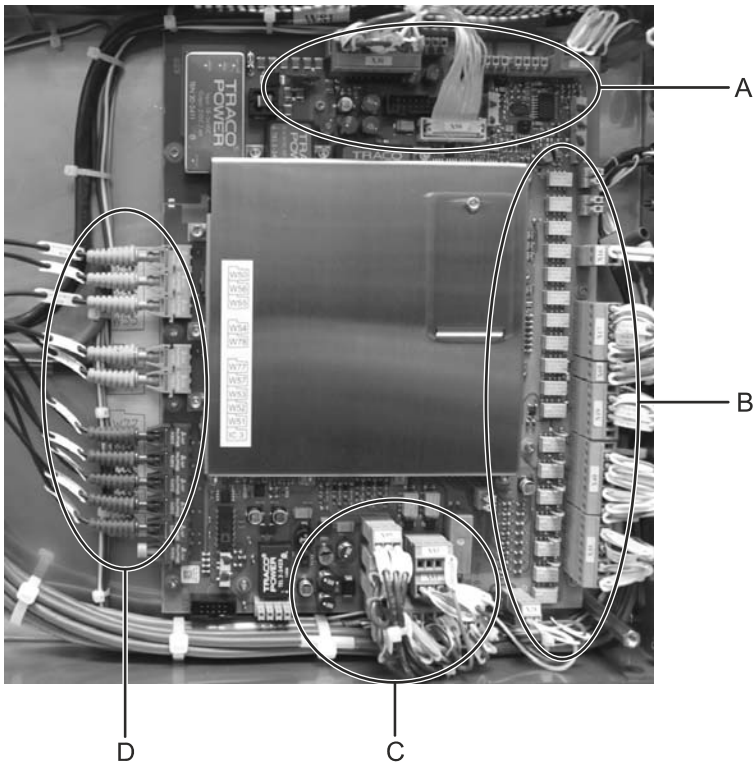


Figure 83: *Location of LCB connections*

10. Disconnect the electrical connections (connections with prefix X) from the LCB (see Figure 83, A-C).
11. Use the 2.5 mm allen key to unscrew the securing screws and remove the LCB. The locations of the securing screws are shown (circled) in Figure 84.

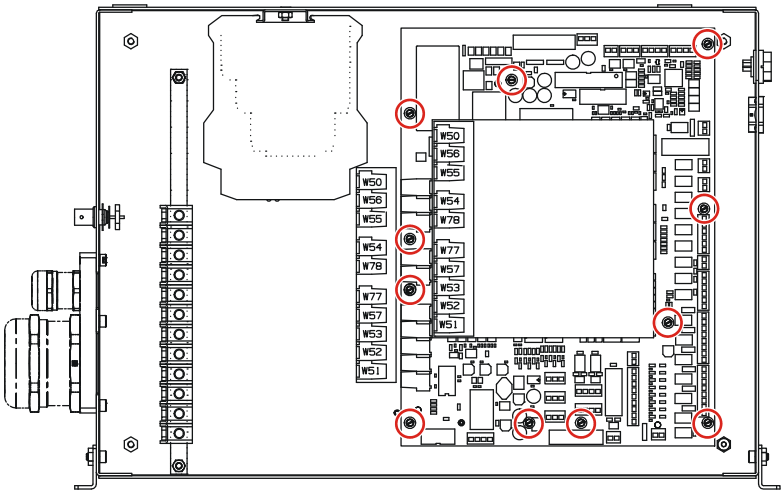


Figure 84: *Location of LCB securing screws*

Installing the Laser Control Board

12. Use the 2.5 mm allen key to install and tighten the LCB.
13. Noting the identification markings on the LCB, reconnect the electrical connections and FOLs.
14. Use the 3 mm allen key to attach and tighten the LCB module cover.

Finalization

15. Re-install the service panel (see Section 3.2.1 on page 20).
16. Restore the laser device to service (see Section 3.1 on page 16).
17. Use the LCS Monitor software to upload the settings that were downloaded in step 2 (see Section 8.1 on page 209).
18. Make sure that the settings noted in step 3 (particularly the serial number, total counter and calibration menu settings) have been correctly restored.
19. Make sure that logically correct values are displayed on the hand-held keypad.
20. Carry out a few standard operating routines and check that the laser behaves normally (listen for valves opening and triggering sounds, check the settings on the hand-held keypad).
21. Disconnect the external computer and restart laser operation.

5.18 Exchange Interface Board

Purpose

Exchange the interface board

Tools and Materials

- 2.5 mm allen key
- 9/16” wrench (for laser devices with purge gas connection)
- Slotted screwdriver
- External computer (PC, laptop or notebook) with LCS Monitor software (CMPX_Mon.exe)
- RS 232, 9 pole D-sub null-modem cable

Preconditions

- Laser device switched off.

Preparation

1. Disconnect the handheld keypad (see Figure 85, B) and any other devices (A) connected to the interface board connection plate.

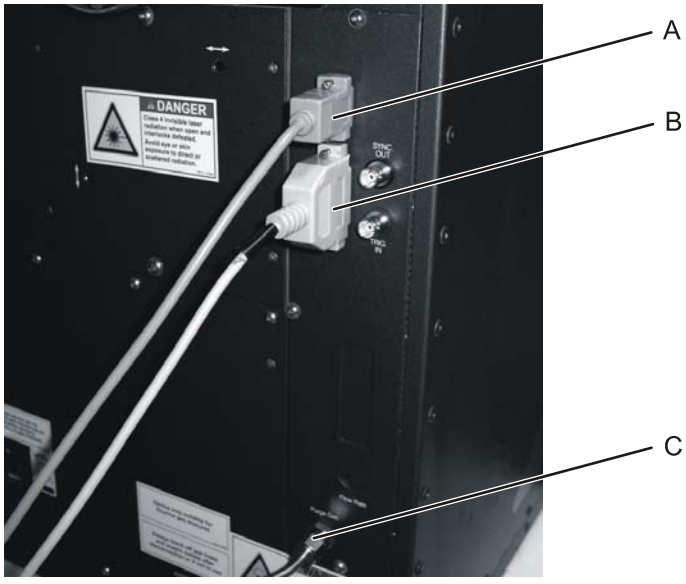


Figure 85: *Interface board external connections*

2. Where necessary, use the 9/16” wrench to disconnect the purge gas supply (C) from the laser device.

Exchanging the Interface Board

3. Use the 2.5 allen key to unscrew the three screws securing the interface board (see Figure 86).

Figure 86: *Removing the interface board*

4. Pull the interface board sufficiently out of the laser device to enable disconnection (see Figure 87).

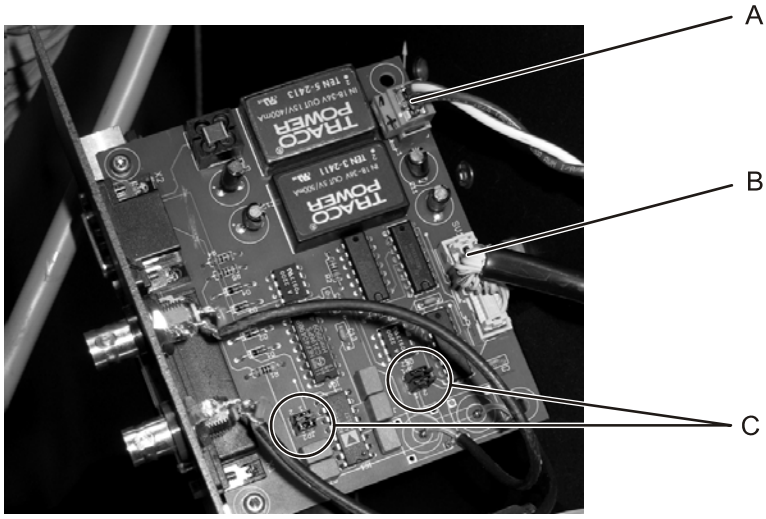


Figure 87: *Interface board internal connections*

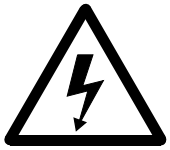
5. Disconnect the 24 V power supply line (see Figure 87, A) and communications line (B) and, if necessary, de-solder the Sync Out and Trigger In lines from the PCB.
6. Remove the interface board from the laser device.
7. Compare the settings of the jumpers (C) on the new board with the settings on the old board and, where necessary, adjust.

8. Connect the connections removed in step 5 to the new interface board and push it into the laser device housing.
9. Use the 2.5 mm allen key to insert and tighten the screws removed in step 3.

Finalization

10. Connect the hand-held keypad to COM2.
11. Use the null-modem cable to connect the external computer to COM1 (see Section 8.1 on page 209).
12. Where necessary, use the 9/16” wrench to connect the purge gas supply disconnected in step 2.
13. Restart the laser device and make sure that logically correct values are displayed on the hand-held keypad.
14. Use the hand-held keypad to carry out a few standard operating routines and check that the laser behaves normally (listen for valves opening and triggering sounds etc., check the settings on the hand-held keypad).
15. Start the LCS Monitor software and select the Laser Control screen (see Section 8.1.1.6 on page 216).
16. Use the LCS Monitor software to carry out a few standard operating routines and check that the laser behaves normally (e.g. check that the settings displayed by the Monitor software and hand-held keypad correspond).
17. Connect the approriate external device to the Sync. Out port and and check that the signal is correctly output.
18. Connect the approriate external device to the Ext. Trigger port and check that the trigger signal is correctly interpreted.
19. Disconnect the external computer and restart laser operation.

5.19 Exchange Gas Purifier Power Supply



WARNING
Hazardous voltage!
The gas purifier power supply has an output voltage of 5 kV DC. Always disconnect the laser device from the mains voltage before disconnecting the gas purifier power supply.

Purpose

Exchange the power supply for the gas purifier in the laser tube.

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Tools and Materials

- 3 mm allen key
- 4 mm allen key
- 7 mm wrench

Preconditions

- Working area secured to enable removal of a housing cover (see Section 3.2 on page 19)
- Laser device switched off / locked out (see Section 3.1 on page 16)

Preparation

1. Remove the service panel (see Section 3.2.1 on page 20).

Removing the Gas Purifier Power Supply

2. Disconnect the power supply line (plug X8: see Figure 88, B) from the front of gas purifier power supply.

Figure 88: *Connections on gas purifier power supply*

3. Disconnect the signal line (plug X29: see Figure 88, A) from the gas purifier power supply.

4. Use the 4 mm allen key to unscrew the two securing screws (see Figure 89, B) and remove the gas circulation fan cover sheet (A).

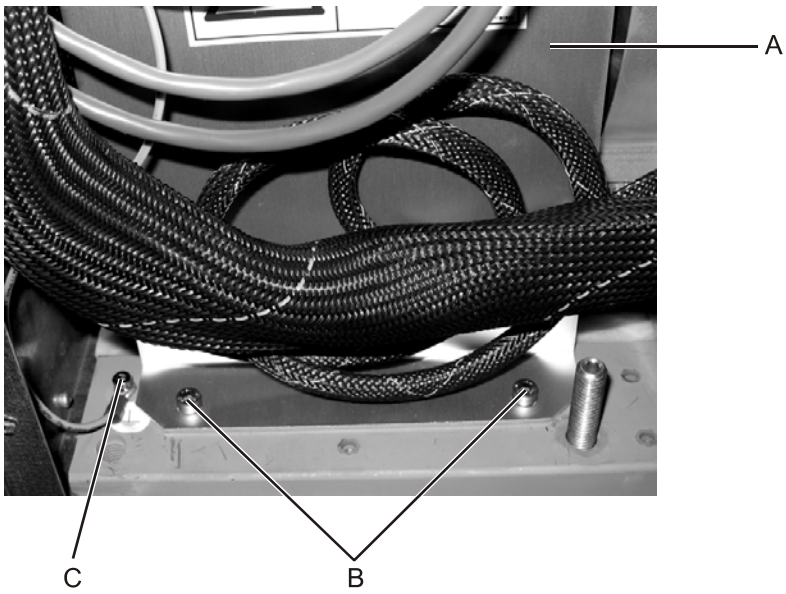

Figure 89: *Removing the gas circulation fan cover sheet*

5. Use the 7 mm wrench to unscrew the gas purifier power supply (see Figure 90, A).

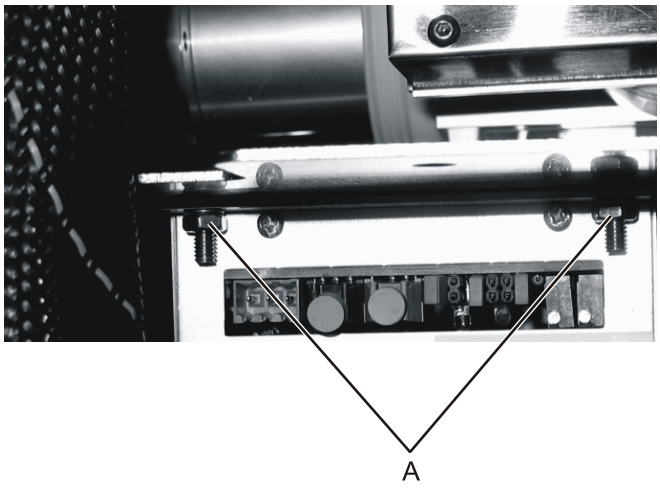

Figure 90: *Unscrewing the gas purifier power supply*

Certain versions of gas purifier are also secured with two screws at the rear. To access these screws, remove the lower air intake grille (3 mm allen key required, see Figure 37 on page 64).

Other versions of gas purifier power supply are secured from above by four M4 screws. To access and remove all of these screws (3 mm allen key required), the energy monitor first has to be removed (see Maintenance chapter in the User Manual for further information).

6. Carefully pull the gas purifier power supply forward (see Figure 91) until the HV cable BNC connection at the rear becomes visible.

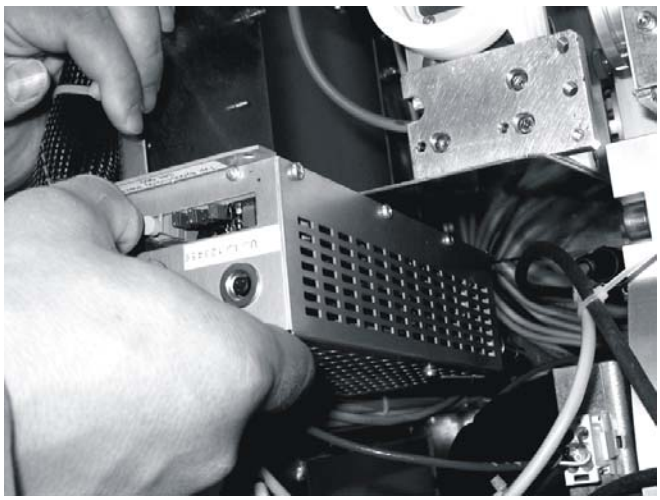

Figure 91: *Removing the gas purifier power supply*

7. Disconnect the HV cable and remove the gas purifier power supply.

Installing the Gas Purifier Power Supply

8. Compare the settings of the jumpers at the front of the new gas purifier power supply with the settings on the old unit and, where necessary, adjust.
9. Connect the HV cable to the BNC connection on the rear of the gas purifier power supply.
10. Insert and tighten the gas purifier power supply.

    Do not re-attach the gas circulation fan cover sheet at this stage, as the LEDs at the front of the gas purifier power supply have to remain visible for testing purposes.
11. Connect the power supply line (plug X8) that was disconnected in step 2 to the front of the gas purifier power supply.
12. Connect the signal line (plug X29) to the front of the gas purifier power supply.

Checking Operation of the Gas Purifier Power Supply

13. Switch on the laser device.

DANGER
Risk of serious injury!
When cover interlocks are defeated, there is the risk of injury through class 4 laser radiation, high voltage and halogen gas.
When safety interlocks are defeated, always adequately secure working area to prevent unauthorized entry.
All persons remaining in the working are shall follow the safe working practices required to minimize the hazards.

14. Insert the service panel interlock defeat key (see Section 3.3 on page 26).
15. Set the laser to external triggering without connecting the external trigger generator. This prevents the emission of laser radiation when the laser ON mode is selected.
16. Skip the laser warm-up phase.
17. Select the laser ON mode and check that the gas circulation fan turns and the two LEDs on the front of the gas purifier power supply light.
18. Set the laser to the OFF mode and switch off the laser device.
19. Remove the service panel interlock defeat key (see Section 3.3 on page 26).

Finalization

20. Use the 4 mm allen key to re-attach the gas circulation fan cover sheet (see Section 3.4.2 on page 32).
21. Re-install the service panel (see Section 3.2.1 on page 20).

5.20 Exchange 24 V Power Supply

Purpose

Exchange the 24 V power supply.

Tools and Materials

- 2.5 mm allen key
- 3 mm allen key
- 4 mm allen key
- 7 mm socket wrench
- Small slotted screwdriver

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Preconditions

- Working area secured to enable removal of a housing cover (see Section 3.2 on page 19)
- Laser device switched off / locked out (see Section 3.1 on page 16)

Preparation

1. Remove the service panel (see Section 3.2.1 on page 20).

Exchanging the 24V Power Supply

2. Remove the gas circulation fan motor (see Section 5.7 on page 70).
3. Use the 7 mm socket wrench to unscrew the 24 V power supply mounting screw (see Figure 92, A).

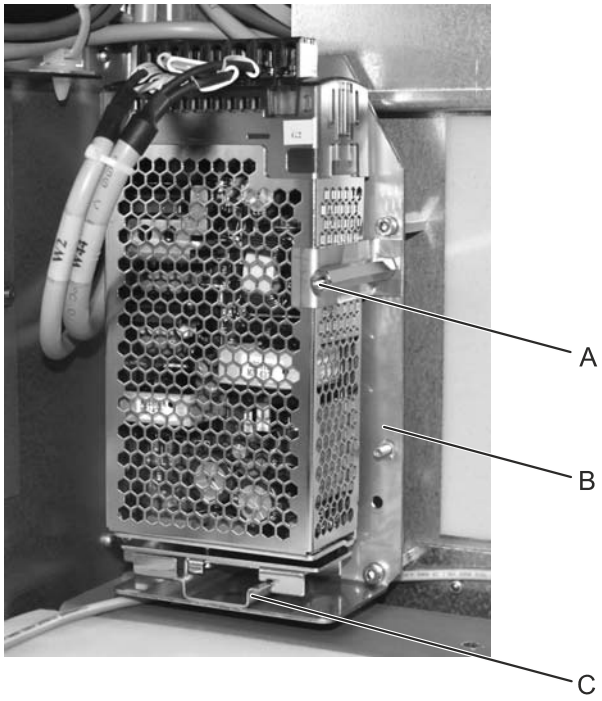

Figure 92: *Removing the 24 V power supply*

4. Carefully slide the 24 V power supply along the C-rail (see Figure 92, C) and off of the mounting bracket (B).
5. Note the configuration of the electrical connections.
6. Use a screwdriver to disconnect the 24 V power supply and remove it from the laser device.
7. Use a screwdriver to reconnect the 24 V power supply.
8. Slide the 24 V power supply on the C-rail until it engages in position on the mounting bracket.
9. Use the 7 mm socket wrench to tighten the attachment screw.

Finalization

10. Re-insert the gas circulation fan together with the fan cover lower air intake grille (see Section 5.7 on page 70).
11. Re-install the service panel (see Section 3.2.1 on page 20).

5.21 Exchange Vacuum Pump

CAUTION
Risk of skin irritation and burns!
Skin contact with gas mixtures containing halogen gas may cause skin exposure or even acid-like burns, depending on the level of exposure. Always wear suitable chemical resistant gloves when working on the vacuum pump. Refer to the excimer laser gas supplier‘s MSDS for further information.

Purpose

Exchange the vacuum pump in the gas exhaust system.

Tools and Materials

- 2.5 mm allen key
- 19 mm wrench
- Suitable gloves

Preconditions

- Working area secured to enable removal of a housing cover (see Section 3.2 on page 19)
- Laser device switched off / locked out (see Section 3.1 on page 16)

Preparation

1. Remove the service panel (see Section 3.2.1 on page 20).

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Removing the Vacuum Pump

2. Disconnect the electrical supply line from the connection on the vacuum pump (see Figure 93, A).

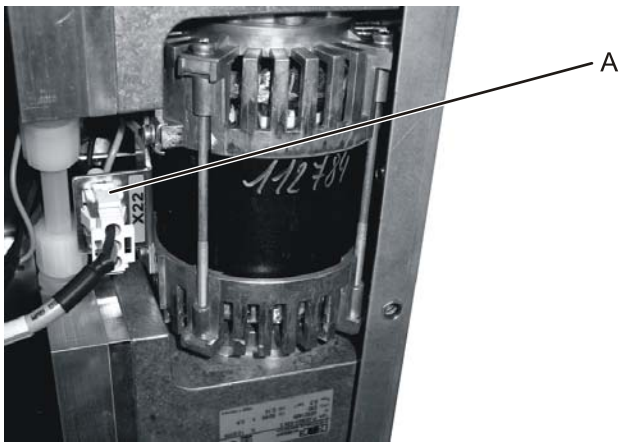

Figure 93: *Vacuum pump electrical supply line*

3. Use the 19 mm wrench to loosen and disconnect the exhaust inlet line from the vacuum pump (see Figure 94, A).

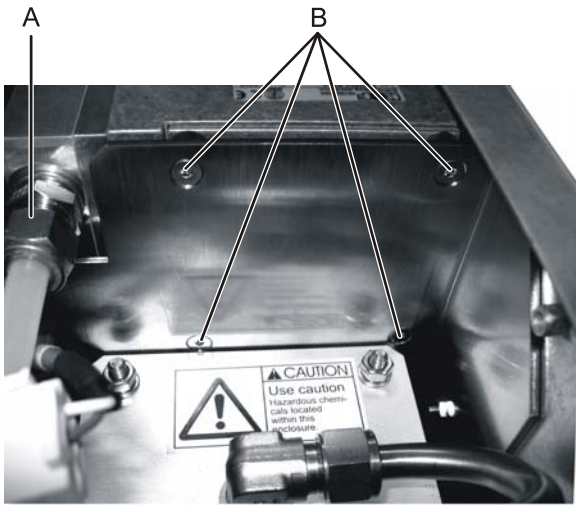

Figure 94: *Removing the vacuum pump*

4. Use the 2.5 mm allen key to loosen and remove the four screws (B) securing the vacuum pump in position.
5. Carefully lift the vacuum pump out of the laser device.

Installing the Vacuum Pump

6. Noting the positions of the screw holes in the supporting surface, carefully locate the vacuum pump in position in the laser device.
7. Use the 2.5 mm allen key to insert and tighten the four screws securing the vacuum pump in position.

8. Use the 19 mm wrench to connect and tighten the exhaust inlet line to the vacuum pump.
9. Connect the electrical supply line to the vacuum pump.
10. Switch on the laser device.

Finalization

11. Press <PURGE RESERVOIR>, use the cursor keys to select “PURGE TUBE” and then press <ENTER> and <EXE> .

    During the reservoir purging cycle, check that the laser tube is correctly evacuated.
    - If the laser tube is not evacuated to 60 mbar, this indicates a leak in the gas system that will need to be detected and rectified. In this case, check all connections to the vacuum pump.
    - If the laser tube is successfully evacuated to 60 mbar, abort the reservoir purging cycle and proceed with step 12.
12. After ensuring that there are no gas leaks, re-attach the service panel (see Section 3.2.1 on page 20).
13. Press <NEW FILL> , <ENTER> and <EXE> to start the new fill procedure.

5.22 Exchange Exhaust Fan

Purpose

Exchange the axial fan in the gas exhaust system.

Tools and Materials

- 2.5 mm allen key
- 3 mm allen key
- 4 mm allen key
- 7 mm wrench

Preconditions

- Working area secured to enable removal of a housing cover (see Section 3.2 on page 19)
- Laser device switched off / locked out (see Section 3.1 on page 16)

Preparation

1. Remove the service panel (see Section 3.2.1 on page 20).

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2. Use the 4 mm allen key to remove the exhaust flange together with the external exhaust line from the laser device (see Figure 95).

Figure 95: *Removing the exhaust flange with exhaust line*

Exchanging the Exhaust Fan

3. Disconnect the electrical connections (see Figure 96, A) from the exhaust fan.

Figure 96: *Exhaust fan electrical connections and securing nut*

4. Use the 3 mm allen key to loosen the ground connection from the exhaust fan (see Figure 96, B).

5. While holding each of the two securing nuts (see Figure 96, B) with the 7 mm wrench, use the 2.5 mm allen key to unscrew the screws on each side of the exhaust grille (see Figure 97).

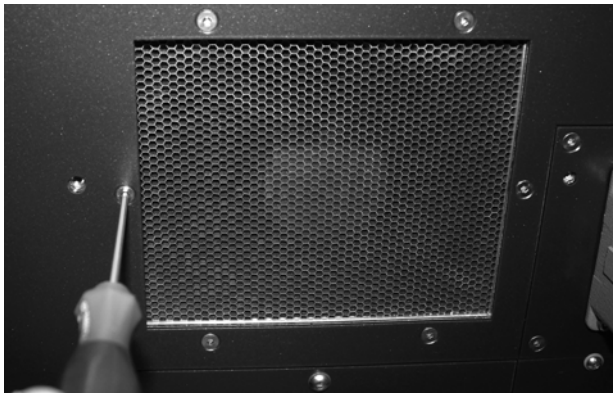

Figure 97: *Unscrewing the exhaust fan*

6. Remove the exhaust fan from the laser device.
7. Insert the replacement exhaust fan and secure it using the 7 mm wrench and 2.5 mm allen key.
8. Connect the electrical connections
9. Use the 3 mm allen key to connect the ground connection.

Finalization

10. Re-attach the exhaust flange and external exhaust line.
11. Re-install the service panel (see Section 3.2.1 on page 20).

5.23 Exchange Solenoid Gas Valve Block

WARNING
Harmful gas hazard!
The gas system of the excimer laser device contains a harmful halogen gas mixture. Avoid inhalation and skin contact.
Always fill the gas lines, valve block and laser tube with inert gas before starting to exchange the gas valve block.
Always wear gloves and safety goggles when working on gas lines that have carried a halogen gas mixtures.

Purpose

Exchange the complete solenoid gas valve block.

To replace an individual solenoid gas valve after removing the gas valve block, please refer to Section 5.24 on page 118.

Tools and Materials

- 2.5 mm allen key
- 3 mm allen key
- 4 mm allen key
- 9/16” wrench
- 19 mm wrench
- Adjustable wrench
- Helium leak tester or liquid leak tester (e.g. SNOOP)

  Make sure that the chosen leak tester is suitable for use in the environment in which the laser is installed. Liquid leak testers are, for instance, not permitted in cleanrooms.
- Gas line blanking plugs
- Inert gas with remaining pressure of at least 20 % of initial value.
- Suitable wipes or cloth for cleaning spilled water
- Gloves
- Safety goggles

Preconditions

- Laser device switched on and laser ready to operate (no radiation being emitted)

  The laser device has initially to remain switched on to enable the gas system to be evacuated and filled with inert gas.

Flush the Laser Tube and Fill with Inert Gas

NOTICE
If pressure is applied to a pressure regulator with low secondary pressure, the pressure regulator membrane may become damaged. Always ensure that the pressure regulator is closed, before opening the gas cylinder valve.

1. Open the inert gas valve.
2. Set the pressure regulator in the inert gas line line to the value specified in the User Manual (approx. 5 bar [abs.]).
3. Press <PURGE RESERVOIR> on the handheld keypad and select “WIN. EXCHANGE” with the cursor keys.
4. Confirm with <ENTER> and press <EXE> to proceed.

   The tube flushing cycle is now started. For exact details of this cycle, please refer to the corresponding description in the “Resonator Optics Exchange” section of the User Manual.

   At the end of the flushing cycle, the message “EXCHANGE WINDOWS THEN PRESS <ENTER>” appears. This indicates that the tube is filled with inert gas.

5. Press <BREAK> to abort the procedure.

Purge the Halogen Gas Line

6. Close the pressure regulator in the halogen gas line.
7. Press <PURGE LINE> on the handheld keypad and select “HALOGEN” with the cursor keys.
8. Confirm with <ENTER> and press <EXE> to proceed.

   The halogen gas line is evacuated for 10 seconds and then filled with inert gas.

   “OFF” appears in the display when the line purging has been completed.
9. Repeat steps 7 and 8 at least three times until the halogen gas line is completely filled with inert gas.
10. Close the cylinders valves in all of the external gas lines.

Gaining Access to the Working Area

11. Shut down / lockout the laser device (see Section 3.1 on page 16).
12. Remove the service panel (see Section 3.2.1 on page 20).
13. Turn off the external water supply at the source.
14. Place wipes or cloth below the internal water line connections.
15. Pull back the cladding (see Figure 98, B) and use the 17 mm allen key to disconnect the water lines (A) from the bulkhead connection.

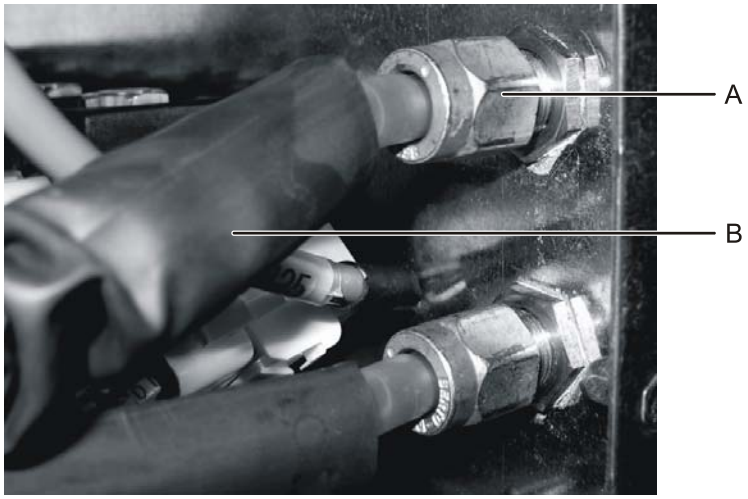

Figure 98: *Disconnecting the water lines*

Disconnecting the Gas Valve Block

16. Use the 2.5 mm and 3 mm allen keys to unscrew the halogen protection cover (see Figure 144 on page 165).
17. Use the 9/16” wrench to disconnect all external gas lines and remove any blanking plugs from the connections on the bulkhead.

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18. Close the shut-off valve in the gas supply line (see Figure 99).

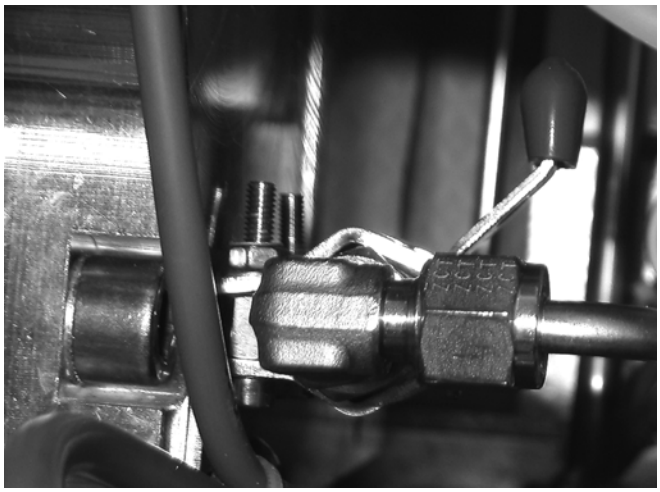

Figure 99: *Gas supply line shut-off valve in closed position*

19. Use the 9/16” wrench and adjustable wrench to disconnect the gas filling line at the connection to the laser tube (see Figure 100).

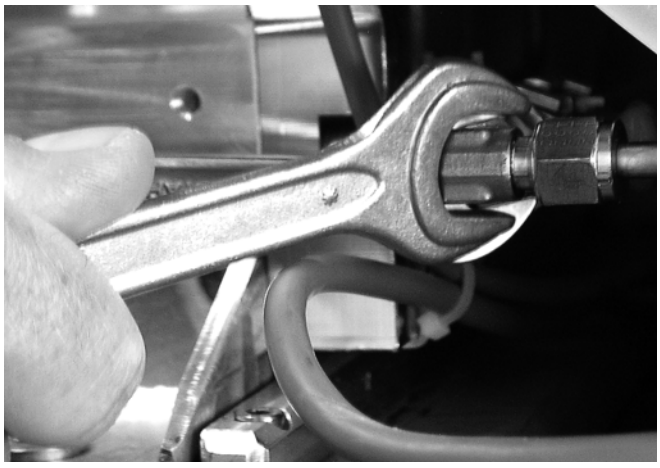

Figure 100: *Disconnecting the laser tube gas filling line*

20. Screw blanking plugs onto the open gas lines.

21. Use the 19 mm wrench to disconnect the vacuum line from the valve block (see Figure 101, A).

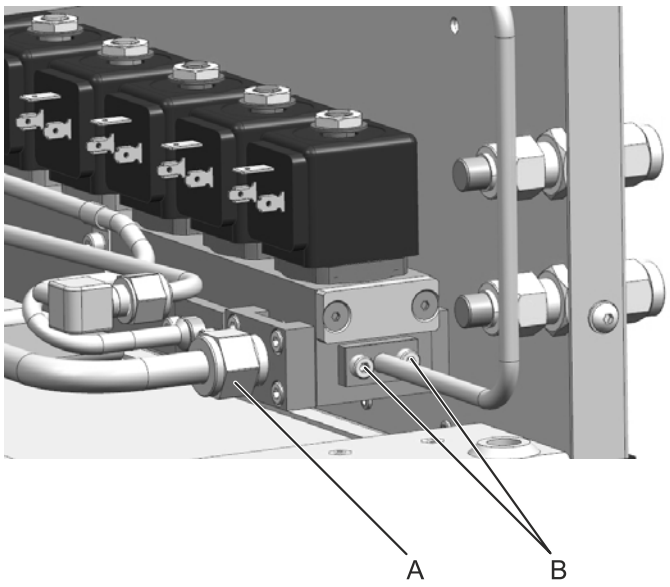

Figure 101: *Disconnecting vacuum line from valve block*

22. Screw blanking plugs onto the open gas lines (except onto the valve block).
23. Use the 3 mm Allen key to disconnect the overpressure relief line (see Figure 101, B).
24. Disconnect the electrical connections from the gas valve block (see Figure 102, A).

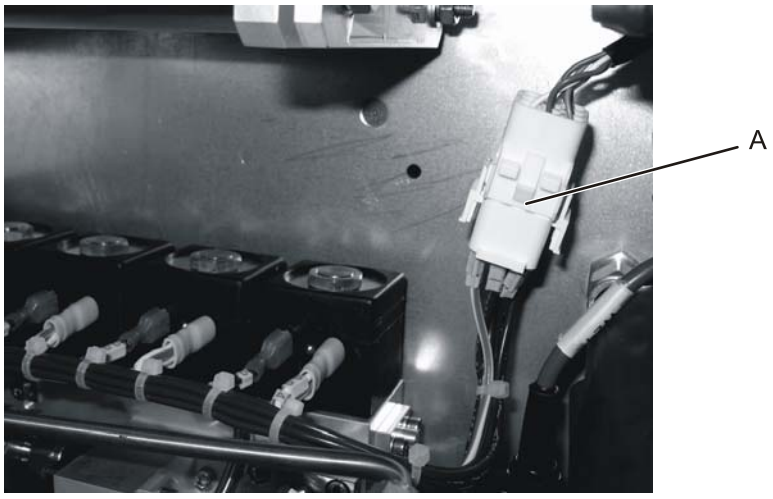

Figure 102: *Gas valve block electrical connections*

Removing the Gas Valve Block

25. Use the 2.5 mm allen key to remove the two screws that secure the valve block to the bulkhead (see Figure 103, A).

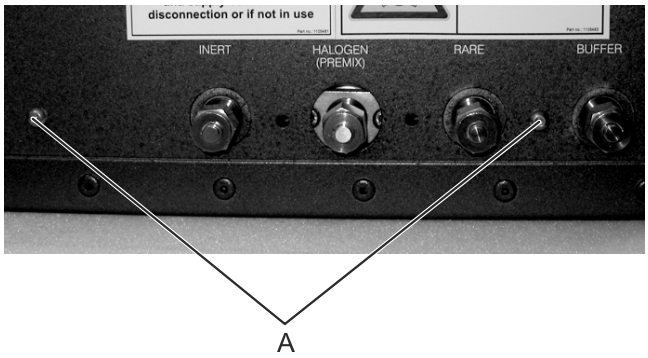

Figure 103: *Screws securing gas valve block to bulkhead*

26. Push the valve block away from the bulkhead and lift it out of the laser head.
27. Use the 3 mm allen key to remove the laser tube gas filling line from the removed gas valve block and screw it onto the new valve block.
28. Disconnect all cables from the removed valve block and connect them in the corresponding positions on the new gas valve block.

Installing the Gas Valve Block

29. Unscrew the blanking plugs from the replacement valve block and screw them onto the old valve block.

    The blanking plugs have to be removed to allow the valve block to be correctly fitted in the laser head.
30. Taking care not to damage any lines or FOLs, carefully insert the valve block into the laser head and locate against the bulkhead.
31. Use the 2.5 mm allen key to tighten the valve block in position.

Reconnecting the Gas Valve Block

32. Reconnect the valve block electrical connections (see Figure 102).
33. Use the 3 mm Allen key to reconnect the overpressure relief line (see Figure 101).
34. Use the 19 mm wrench to reconnect the vacuum line.
35. Use the 9/16” wrench and expandable wrench to reconnect and tighten the laser tube gas filling line (see Figure 100).
36. Use the 9/16” wrench to reconnect the appropriate external gas lines and fit the blanking plugs.

    Before fitting the halogen line, fit the halogen protection cover.
37. Use the 2.5 mm and 3 mm allen keys to tighten the halogen protection cover.

Restarting the Laser Device

38. Use the 17 mm wrench to reconnect the internal water lines to the bulkhead connections.
39. Unlock / switch on the laser device (see Section 3.1 on page 16).
40. Use the <FLUSH LINE> function to evacuate each gas line in turn (see Section 3.5.1 on page 34).

    In each case, clicking noises should be heard after pressing <EXE> as the respective gas valve opens. If a valve does not open, one of the electrical lines is most likely not correctly connected to the valve block.

Leak Testing the Gas Valve Block Connections

41. Set the manually operated laser tube valve to the “open” position by turning the handle until it is parallel to the gas line.
42. Except for the halogen gas line, open the gas cylinders valves and correspondingly set the pressure regulators in the external gas lines.

    All of the non-toxic gas lines are now pressurized up to the gas valve block.
43. Press <NEW FILL> on the handheld keypad and select “MAN. INERT” with the cursor keys.
44. Confirm with <ENTER> and press <EXE> to proceed.

    The laser tube is filled to a pressure of approx. 3000 mbar with inert gas.
45. Use a helium or liquid leak tester to check that there are no leaks at the gas line connections to the valve block.
46. Repeat steps 7 and 9 to purge the halogen gas line and completely fill it with inert gas.
47. Use a helium or liquid leak tester to check that there are no leaks at the halogen gas line connections.
48. After ensuring that there are no gas leaks, re-attach the service panel (see Section 3.2.1 on page 20).

Finalization

49. Open the external halogen gas valve and correspondingly set the pressure regulator.
50. Press <FLUSH LINE> on the handheld keypad and select “HALOGEN” with the cursor keys.
51. Confirm with <ENTER> and press <EXE> to proceed.

    The halogen gas line is evacuated and filled with fresh halogen gas Depending on the configuration of the gas system, this procedure has to be repeated until the gas line is completely filled.
52. Repeat steps 49 to 51 to flush each of the other gas lines in turn .
53. Press <NEW FILL>, <ENTER> and <EXE> to start the new fill procedure.

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5.24 Repair Solenoid Gas Valve

NOTICE
Risk of malfunction through incorrect gas valve installation!
When replacing a valve, take into account that two different valve units are used. These units cannot be visibly differentiated from each other. They are indicated by the corresponding part number on the valve unit packaging. Consequently, do not open the valve unit packaging before determining the valve to be replaced.

Purpose

Use the gas valve replacement kit (p/n 1180712) to repair a defective solenoid gas valve in the solenoid gas valve block.

The gas valve replacement kit consists of the following components:

– 1 x valve unit for 0.8 mm to 1.0 mm nozzle for halogen or rare valve (part no. 1146317)

– 1 x valve unit for 2.25 mm to 3.0 mm nozzle for buffer, inert, laser head and vacuum valve (part no. 1146319)

– 8 x M5 Allen screws

– 8 x washers

– 2 x O-rings

Tools and Materials

- 4 mm Allen key
- 14 mm wrench
- Isopropyl alcohol

Preconditions

- Defective valve identified through functional tests
- Gas valve block removed from laser device (see Section 5.23 on page 118).

Solenoid Gas Valve Repair Procedure

1. Identify the position of the valve which is to be replaced (see Figure 104) and open the bag containing the corresponding replacement valve.
   - Use part no. 1146317 to replace a rare (B) or halogen (C) valve.
   - Use part no. 1146319 to replace a buffer (A), inert (D), laser head (E) or vacuum (F) valve.

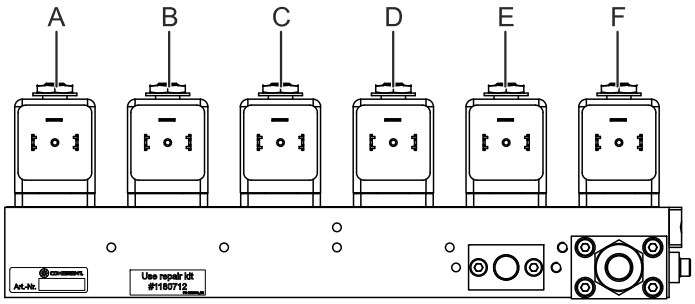

Figure 104: *Configuration of the solenoid gas valve block*

2. Use the 14 mm wrench to remove the solenoid (see Figure 105, A) from the valve that is to be repaired.

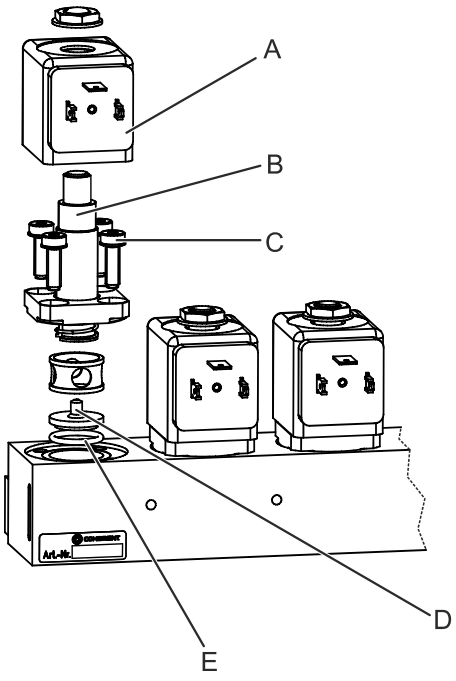

Figure 105: *Repairing a buffer valve*

3. Use the 4 mm allen key to remove the defective valve (B) together with the valve spring and O-ring.
4. Check that the nozzle (D) is not clogged. If necessary, carefully clean the nozzle with isopropyl alcohol.

5. Insert the O-ring (E) from the repair kit.
6. Insert the replacement valve.
7. Use the 4 mm allen key to tighten the four screws (C) crosswise and in stages.
8. Use the 14 mm wrench to re-install the solenoid (A).

Finalization

9. Re-insert the gas valve block into the laser device and perform the required leak tests (see Section 5.23 on page 118).

5.25 Exchange Energy Monitor

Purpose

Exchange the internal energy monitor

Tools and Materials

- 4 mm allen key
- 3 mm allen key

Preconditions

- Laser device switched off.

Removing the Energy Monitor

1. Use the 3 mm allen key to remove the front mirror access panel and internal beam delivery tube (see Section 3.2.2 on page 23).

   Removal of the front mirror access panel (shutter panel) provides sufficient access to enable exchange of the energy monitor. If access is nevertheless restricted, also remove the service panel.
2. Disconnect the purge gas line from the energy monitor.

3. Use the 4 mm allen key to remove the screw that secures the energy monitor (see Figure 106).

Figure 106: *Unscrewing the energy monitor*

4. Carefully pull the energy monitor away from the locating pins.
5. Turn the energy monitor and remove it from the laser device sufficiently to allow disconnection of the remaining supply and signal lines (see Figure 107).

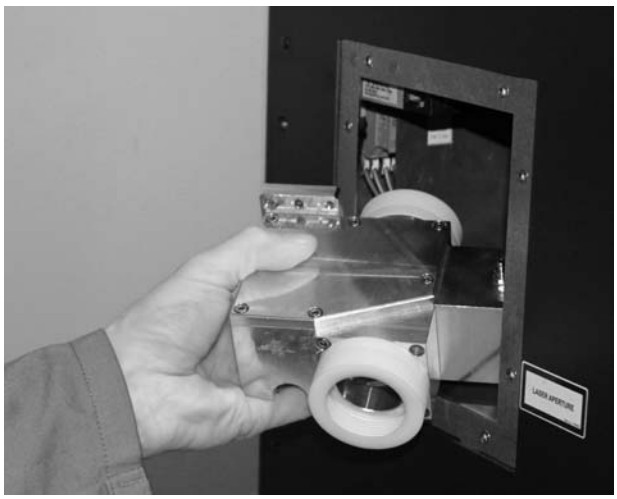

Figure 107: *Removing the energy monitor*

6. Disconnect the electrical connection from the energy monitor.
7. Disconnect the FOLs from the energy monitor.
8. Place aside the removed energy monitor.

Inserting the Energy Monitor

9. Connect the FOLs to the replacement energy monitor.
10. Connect the electrical connection to the energy monitor.

11. Insert the energy monitor into the laser device and carefully attach it onto the two locating pins (see Figure 108, A).

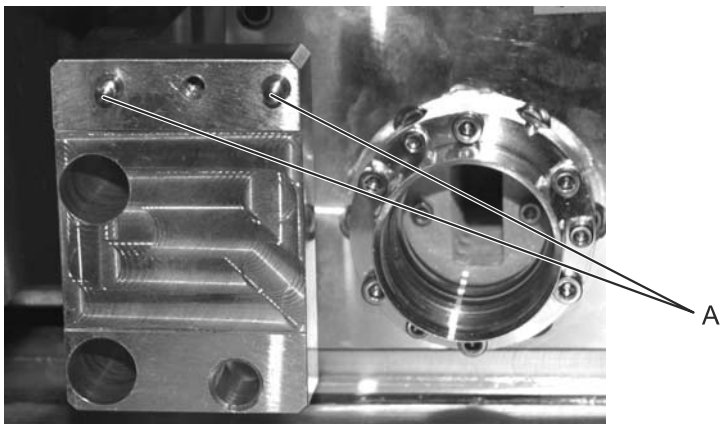

Figure 108: *Attaching the energy monitor*

12. Use the 4 mm allen key to reinsert and tighten the securing screw.
13. Connect the purge gas line to the energy monitor.

Finalization

14. Reinsert the front mirror access panel and internal beam delivery tube (see Section 3.2.2 on page 23).
15. Switch on the laser device.
16. Calibrate the energy monitor (see User Manual).

5.26 Exchange Water Flow Regulating Valve

Purpose

Exchange the water flow regulating valve that is fitted to laser devices equipped with the optional automatic temperature regulation feature.

The water flow regulating valve is integrated into the water inlet line. Consequently, the water inlet line has to be replaced to exchange a defective flow regulating valve.

Tools and Materials

- 17 mm wrench
- 22 mm wrench
- 3 mm allen key
- Suitable wipes or cloth for cleaning spilled water

Preconditions

- Working area secured to enable removal of a housing cover (see Section 3.2 on page 19)
- Laser device switched off / locked out (see Section 3.1 on page 16)

Preparation

1. Turn off the external water supply at the source.
2. Where available and permitted, connect a compressed air (or similar gas) hose to the cooling water inlet and blow out the residual water.
3. Remove the service panel (see Section 3.2.1 on page 20).

Removing the Water Inlet Line and Regulating Valve

4. Loosen the knurled nut (see Figure 109, A) and remove the electronic box (B) from the pressure regulating valve.

   The electronic box only has to be exchanged if it is assumed to be defective. In this case refer to steps 15 to 21 under the heading “Connecting the Electronic Box to the LCB”.

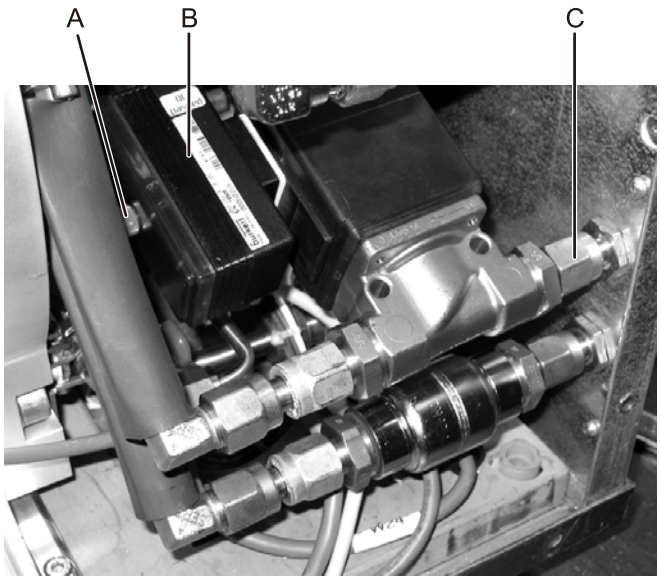

Figure 109: *Regulating valve electronic box and inlet line connection*

5. Place wipes or cloth below the internal water line connections.
6. Use the 17 mm allen key to disconnect the water inlet line (see Figure 109, B) from the bulkhead connection.

7. Use the 3 mm allen key to loosen the two screws and disconnect the water inlet line from the connecting piece on the laser tube (see Figure 110, A).

Figure 110: *Disconnecting internal water lines at laser tube*

8. Remove the cladding from the water line.

Installing the Water Inlet Line and Flow Regulating Valve

9. Insert the brass ferrule into the compression nut and screw by hand onto the bulkhead end of the water inlet line (see Figure 111).

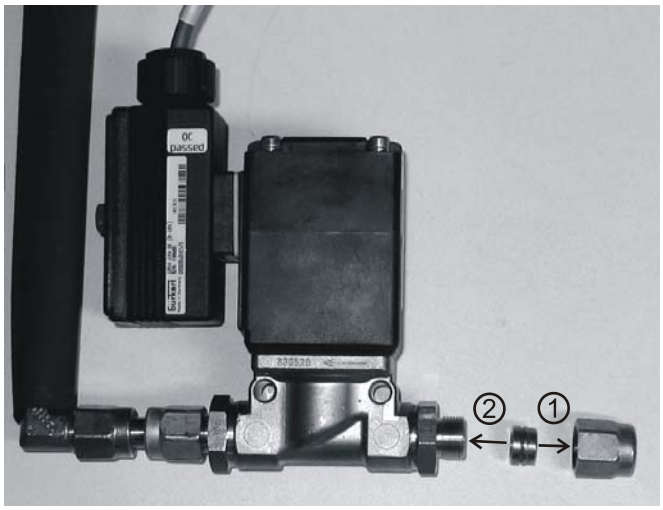

Figure 111: *Attaching the ferrule and compression nut*

10. Fit a hose ferrule into the hose end of the water inlet line (see Figure 112).

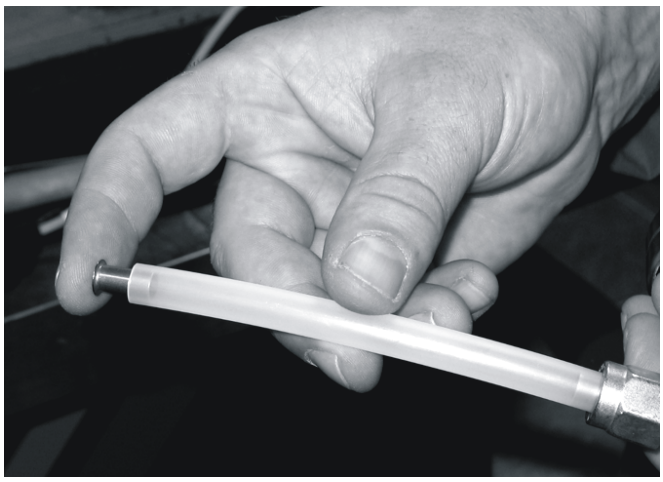

Figure 112: *Inserting the hose ferrule*

11. Slide the cladding removed in step 8 onto the water line.
12. Attach the hose end of the water inlet line to the connecting piece on the laser tube.
13. Making sure that the flow regulating valve fits below the halogen filter, use the 17 mm and 22 mm wrenches to attach the water inlet line to the top water connection piece (see Figure 113).

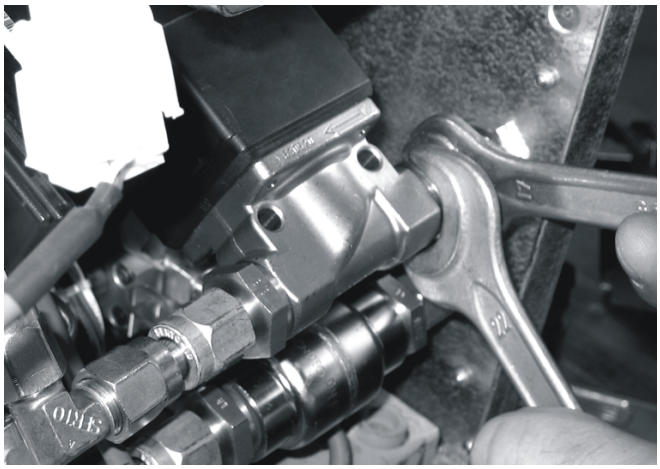

Figure 113: *Attaching water inlet line at bulkhead connection*

14. If the old electronic box is to be re-used, attach it to the flow regulating valve.

    If the new electronic box is to be used, it has to be connected to the LCB box instead of the old electronic box. In this case, follow steps 15 to 21.

Connecting the Electronic Box to the LCB

The means of connection depends on the design of the LCB box:

– If the LCB box is fitted with a DIN connector, the cable and connecting plug that is factory-fitted to the electronic box will be used.

– If the LCB box is fitted with a Harting connector, the flow regulating valve has to be hardwired to cable W32 in the laser device instead of being connected through the factory-fitted cable (see steps 15 to 21 below).

15. Unscrew and remove the electronic box from the water regulating valve.
16. Take the top off of the electronic box.
17. Note the positions of the three wires at the terminals in the electronic box (see Figure 114).

Figure 114: *Connections in flow regulating valve electronic box*

Key to Figure 114:

A Green
B Brown
C White

18. Use a small screwdriver to disconnect the wires from the terminals in each electronic box.
19. Connect the wires in cable W32 to the terminals in the new electronic box as noted in step 17.
20. Put the top back onto the new electronic box.
21. Screw the new electronic box back onto the flow regulating valve.

Finalization

22. Unlock / switch on the laser device (see Section 3.1 on page 16).
23. Turn on the external cooling water supply and set the flow rate to maximum. The water flow through the laser device cooling circuit can be heard.

24. Visibly check all connections of the cooling water lines for leaks.
25. Listen to make sure that the flow regulating valve has closed. No cooling water should be flowing as the laser tube is still cold and, consequently, requires no further cooling.
26. Re-install the service panel (see Section 3.2.1 on page 20).

5.27 Download / Install Software Update

Purpose

Download new software versions and / or parameter settings onto the laser device's laser control board (LCB). This section describes the procedure for the LCB02.

Tools and Materials

- RS 232, 9 pole D-sub null-modem cable
- External computer (PC, laptop or notebook) with the following software:
  - HyperTerminal
  - LCS Monitor (CMPX_Mon.exe)
- Latest control software and parameter settings files on internal drive or data medium:
  - compex.RTB.
  - Appropriate menu parameter "*.nvs" file (depends on model and gas supply mode)

  These files should be obtained in advance from your local service support center.
- FPGA (PLD) software and configuration files on internal drive or data medium:
  - FPGAV*xxx*.RBF (with *xxx* as software version, V4.14 and higher)
  - FPGA programming software FLASH.BAT and FLASHPRG.EXE (files already exist on SD-Card.)

Preconditions

- Laser device switched on (no laser radiation being emitted)

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Preparation

1. Connect the null-modem cable between COM1 on the laser device and the serial port on the external computer (e.g. COM1).
2. Download the current laser operating parameters (see Section 8.1.2.2 on page 218).
3. Save the current laser operating parameters as a text file (see Section 8.1.2.3 on page 219).

Install and Set-Up the HyperTerminal

4. Start the external computer and select “HyperTerminal” as shown in Figure 115 or alternatively start “hyperterm.exe”.

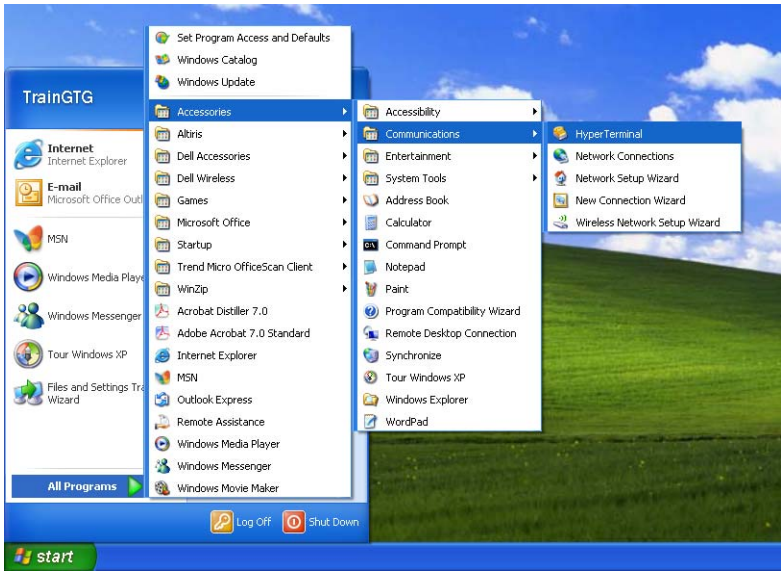

Figure 115: *Selecting the HyperTerminal function*

If the HyperTerminal has not yet been set up, the system requests information about your location, area code (e.g. “United States” and “535”) and connection type (“phone” has to be selected).

The screen form shown in Figure 116 appears.

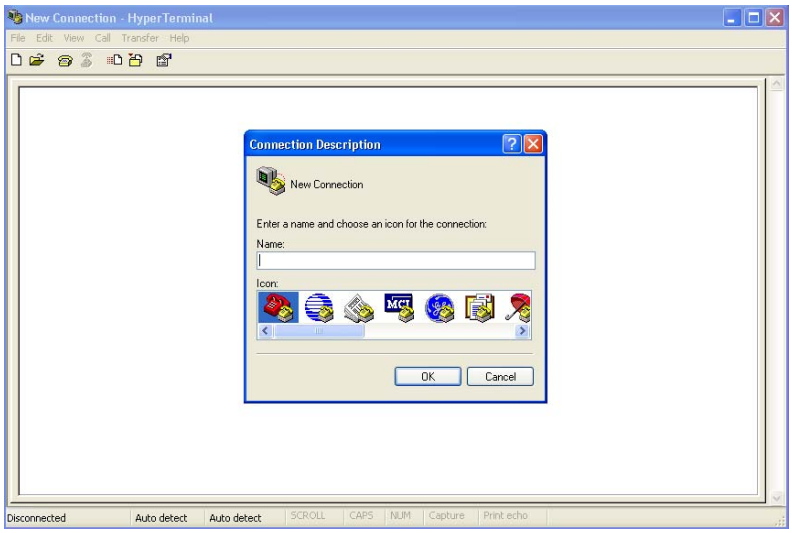

Figure 116: *HyperTerminal setup screen*

5. Specify the desired name for the HyperTerminal connection (e.g. COMPexPro), choose a symbol and click OK.
6. Indicate the null-modem cable connection port on the external computer (usually COM1) as indicated in Figure 117.

   This setting can be saved on the desktop for further use.

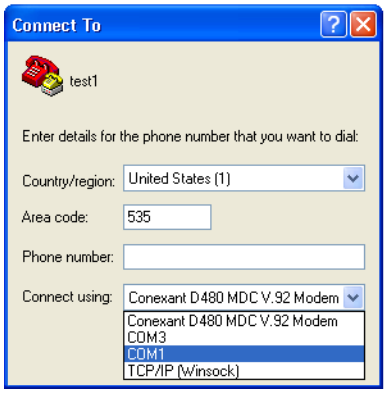

Figure 117: *Specifying null-modem connection port*

7. Set the properties of the null-modem port to the values shown in Figure 118:
   - Bits per second: 115200
   - Data bits: 8
   - Parity: None
   - Stop bits: 1
   - Flow control: None

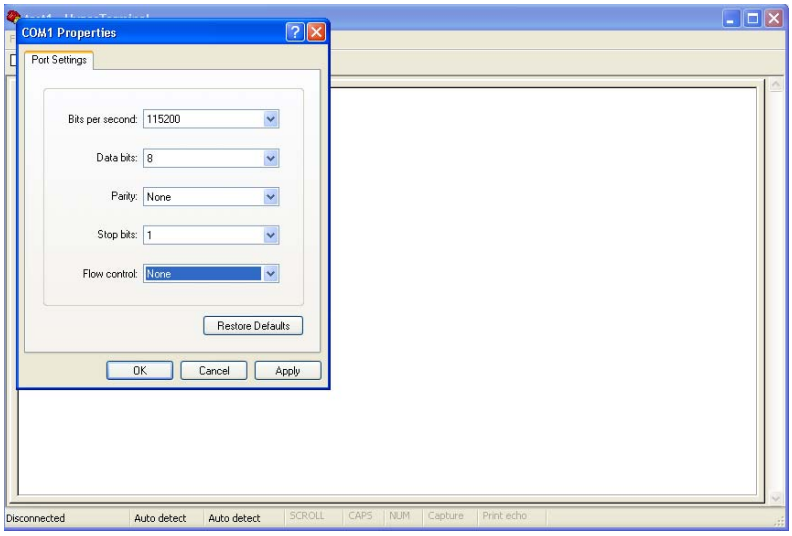

Figure 118: *Specifying the null-modem port properties*

8. Click OK to establish a connection.

Access the Laser Device Controller's Internal Drive

9. Switch the laser device OFF and then ON again at the key switch to reboot the laser control software.

10. When “Skip?[N, Y]?” appears, immediately press <Y> to skip the booting of the laser control software. The external computer now has access to the laser device controller’s internal drive.

    If <Y> is pressed too late or <N> is pressed, the laser control software will start. In this case, repeat the procedure from step 9.

    If the command was successful, the screen shown in Figure 119 appears.

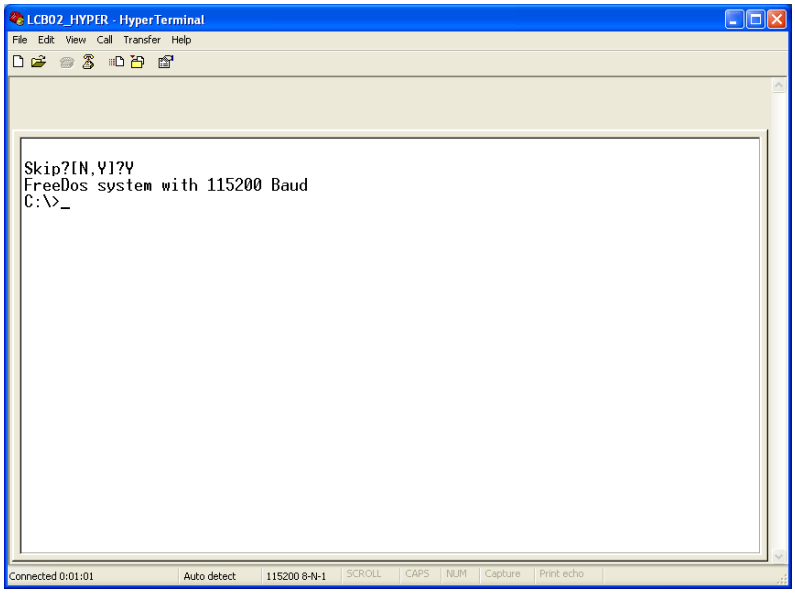

Figure 119: *Preparing connection with laser device controller’s internal drive*

Download the Laser Control Software

11. Type download and press <ENTER>.
12. Select “Transfer” and then “Send File”.

13. Select “Z modem” or “Z modem with crash recovery” in the “Protocol” line (see Figure 120)

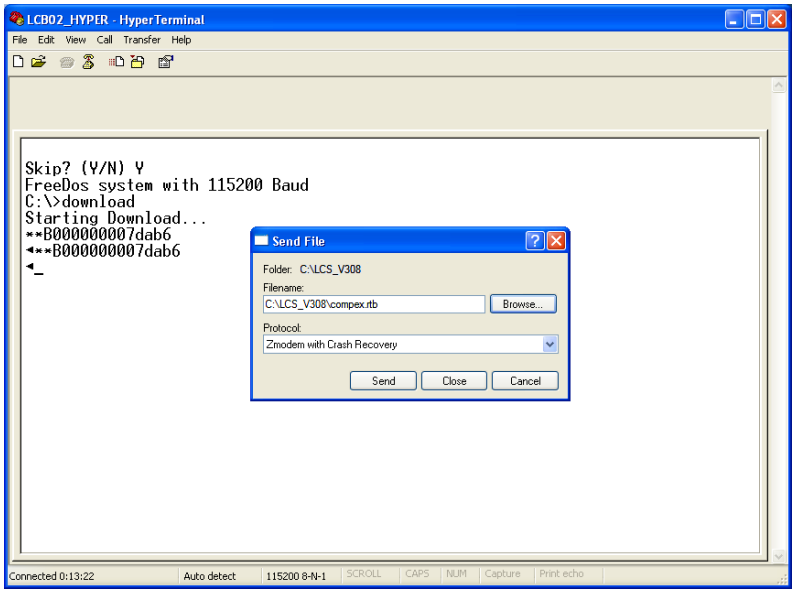

Figure 120: *Downloading the laser control software*

14. Click the “Browse..” button and search for “compex.RTB” on the appropriate drive of the external computer or disk.
15. Click “Open”.

    The external computer path appears in the input line.
16. Click “Send”.

    The download is completed when “Download finished” appears (see Figure 121).

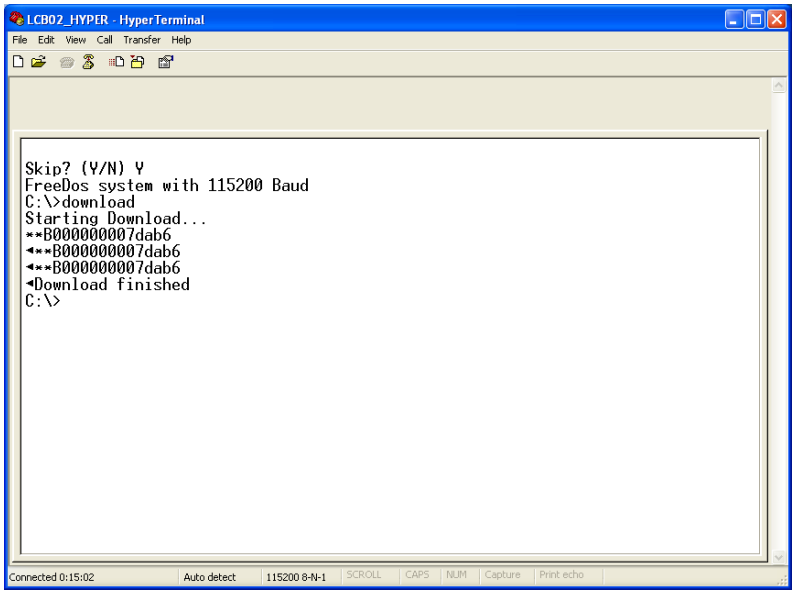

Figure 121: *Transmission end screen*

17. Repeat steps 12 to 16 download the file FPGAV*xxx*.RBF (with *xxx* as the FPGA software version).

Program the PLD

18. When the download is finished, type flash fpgav*xxx*.rbf (with *xxx* as the FPGA software version) and press <ENTER>.

    The PLD program module of the LCB board is configured. The messages shown in Figure 122 appear. The programming is finished when “C:\>” appears at the HyperTerminal (see Figure 122).

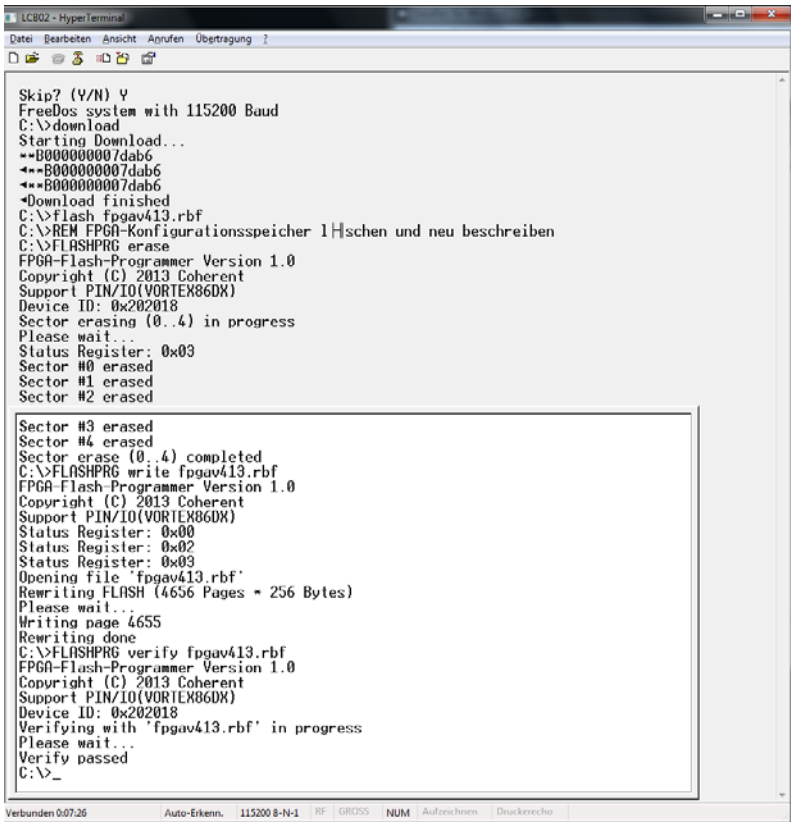

Figure 122: *PLD programming*

Load Parameter Settings

19. Click the appropriate button to terminate the HyperTerminal.
20. Switch the laser device OFF and then ON again at the key switch to reboot the laser control software.
21. Check that the newly installed software version is indicated on the handheld keypad display.

22. Start the LCS Monitor (CMPX_Mon.exe) and select the “Parameter Settings” tab (see Figure 123).

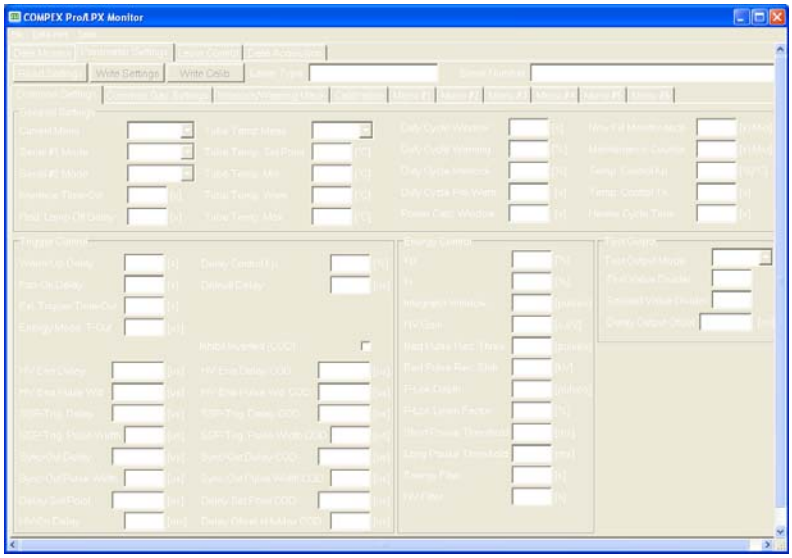

Figure 123: *LCS Monitor parameter settings screen*

23. Click the “Read Settings” button to display the currently active parameter settings (see Figure 124).

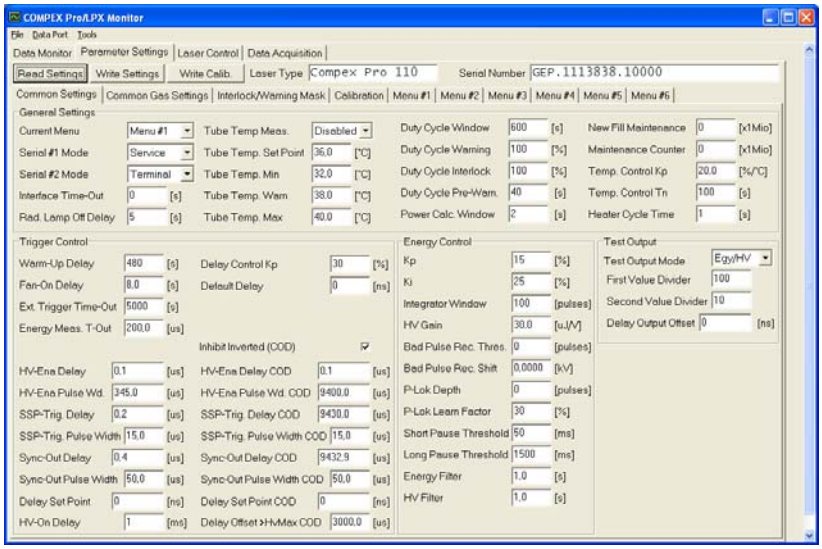

Figure 124: *Parameter settings display*

24. Make sure that the laser software version indicated in the bottom line of the screen is correct (see Figure 125).

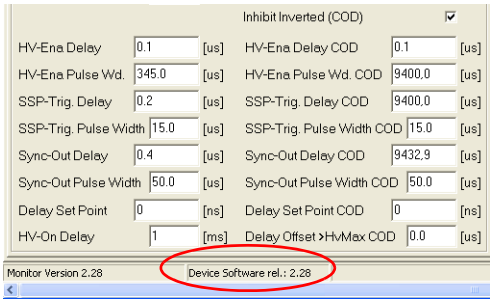

Figure 125: *Laser software version display*

NOTICE
Risk of data loss!
The laser-specific calibration data will be overwritten when the new parameter settings are loaded. Once the new parameter settings have been loaded, there is no possibility of automatically restoring the old settings.

25. Select the “Calibration” tab and note the “Serial Number” as well as the “Tube Pressure Calibration”, “Energy Calibration” and “Delay Calibration” settings (see Figure 126).

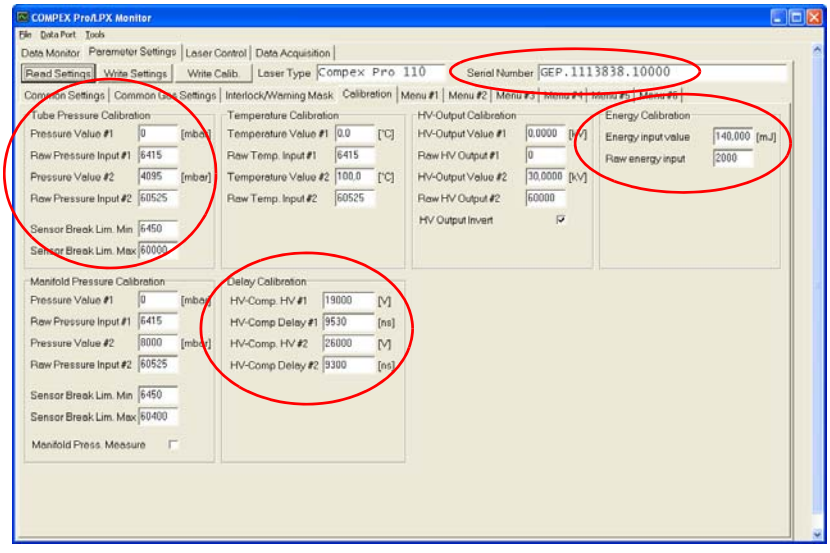

Figure 126: *Loading new settings*

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26. Select “File” and “Load Settings” to load the new parameter settings (see Figure 127).

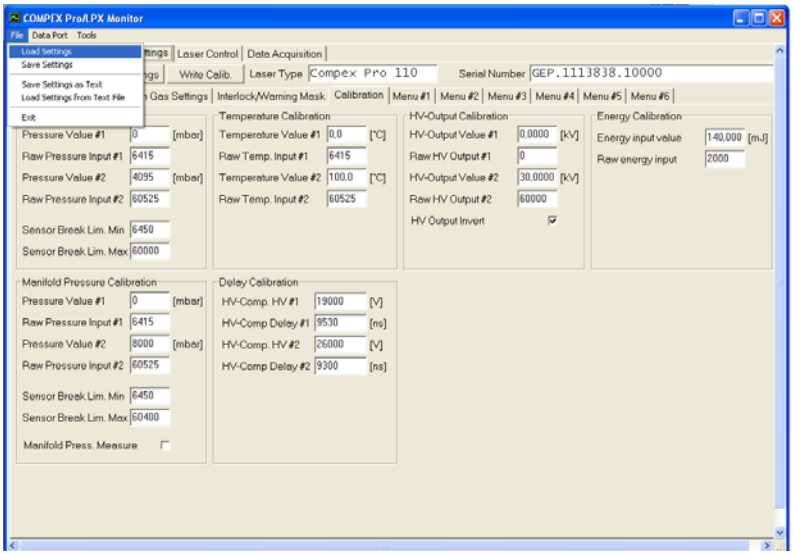

Figure 127: *Loading new settings*

27. Click the “Search” button and search for the menu parameter (*.nvs) file on the external computer disk that contains the appropriate parameter settings for the specific version of the laser device.
28. Click “Open”.
29. Select the “Calibrate” tab and change the “Serial Number” as well as “Tube Pressure Calibration”, “Energy Calibration” and “Delay Calibration” settings to the values noted in step 25.

    If the tube pressure sensor has just been upgraded from 8 bar to 4 bar, the “Tube Pressure Calibration” settings are not to be changed
30. Click “Write Settings” to send the parameter settings to the F-RAM on the laser controller.
31. Click “Write Calibration” to send the calibration settings to the F-RAM on the laser controller.

Finalization

32. Click “Read Settings” to display the currently active parameter settings.
33. Check the parameter settings.
34. Disconnect the null-modem cable from the laser device.

5.28 Upgrade CTERM Software

Purpose

Upgrade the CTERM software in the handheld keypad. This software is stored on an EPROM. Consequently, this EPROM will have to be exchanged to upgrade the software.

Tools and Materials

- Flat screwdriver
- Phillips-head screwdriver
- IC pliers (see Figure 128)

Figure 128: *IC pliers for EPROM removal*

Preconditions

- Laser device switched off

Preparation

1. Use the flat screwdriver to disconnect the handheld keypad and interconnecting cable from the laser device.
2. Use the Phillips-head screwdriver to remove the four screws that secure the rear cover of the handheld keypad.
3. Remove the rear cover from the handheld keypad. This may require a little effort as the cover has a very tight fit.

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4. Use the IC pliers to pull the EPROM with the old software out of the IC holder (see Figure 129).

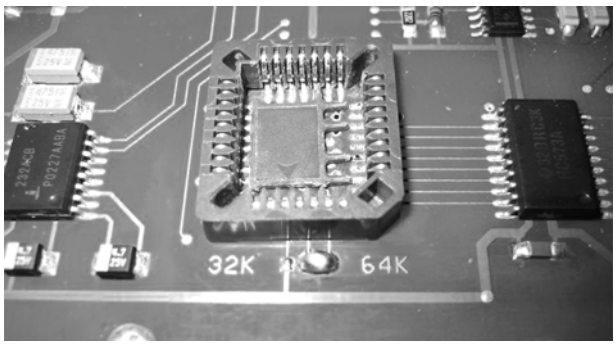

Figure 129: *IC holder after removal of the EPROM*

5. Insert the EPROM with the upgraded software into the IC holder.

   Ensure that the flat and angled edge of the EPROM is in line with the IC holder on the circuit board. Ensure that the seating is good when pressing the EPROm into position.
6. Ensuring that the insulation strip at the bottom is opposite the signal cable connection (see Figure 130), press the rear cover back onto the front part of the handheld keypad and tighten the four screws.

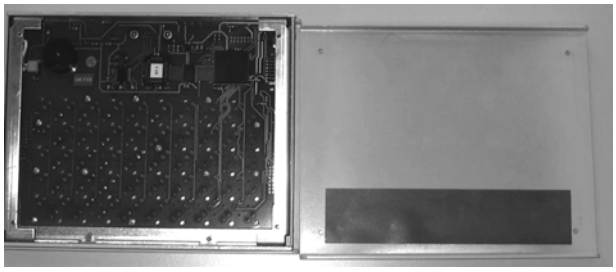

Figure 130: *Fitting the handheld terminal back cover*

7. Replace the label indicating the EPROM software version with the new label that was provided with the EPROM.

Finalization

8. Reconnect and tighten the interconnecting cable to the handheld keypad.
9. Restart the laser device.
10. During the terminal boot sequence, check the CTERM version number of the handheld keypad.

    As soon as power is applied to the handheld keypad, the version number will be displayed in the 2nd line of the display for a few seconds. After that the message “waiting for connection” appears.
11. When the laser control software is fully booted up verify the terminal functionality.

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6 INSTALLATION AND DEINSTALLATION

This chapter contains the procedures to unpack and install as well as de-install the COMPex*Pro* laser device.

WARNING
Risk of serious injury or equipment damage!
The laser device is a heavy object. Incorrect handling may result in crushing or back injury. There is also the risk of exposure to hazards such as laser radiation, lethal voltages and toxic or corrosive substances during installation and de-installation. Only authorized and correspondingly trained personnel shall transport, install or de-install the excimer laser device. Strictly follow the instructions contained in this manual.

For detailed safety information, please refer to the Safety chapter in the separate User Manual.

Applicable Software

- Laser control software LCS V2.81 and higher
- Handheld terminal software CTERM V4.62 and higher

Related Information

- Fundamental and preparatory procedures (see Chapter 3 on page 15)
- Routine operating sequences (see Operation chapter in the separate User Manual)
- Laser control through handheld keypad (see Operating/Display Elements chapter in the separate User Manual)

6.1 Moving and Unpacking

This section describes the internal transport and unpacking of the COMPex*Pro* excimer laser device. After following all procedures detailed in this chapter, the laser device is ready for connection at the installation location.

To ensure that the laser device is moved and unpacked safely and that no damage occurs, strictly adhere to the requirements in this chapter.

6.1.1 Safety Guidelines

WARNING
Risk of crushing!
The heaviest version of the COMPex*Pro* laser device weighs approx. 395 kg (870.8 lb) together with its rigid transport packaging and approx. 325 kg (715 lbs) without packaging. Prevent tipping or dropping during lifting and transportation.

When externally or internally moving the laser device and its components, always follow all standard safety precautions and practices for the transportation and handling of heavy equipment. Always use appropriate lifting equipment.

NOTICE
Risk of damage through shocks and excess vibration!
Shocks and excess vibration can damage sensitive and precision components of the laser device, including the laser device's feet. Avoid sudden shocks, especially when the laser device is attached to the base plate of the rigid transport packaging.

Ensure that the COMPex*Pro* laser device is transported carefully, regardless of the packaging stage.

NOTICE
Risk of damage through excess tilting!
Keep the laser device as horizontal as possible during transportation and installation. If tilting is necessary, ensure that the maximum permissible tilting gradients are not exceeded. Only tilt for short periods.

The maximum permissible tilting gradients are 5° around the beam axis and 20° longitudinally (see Figure 131).

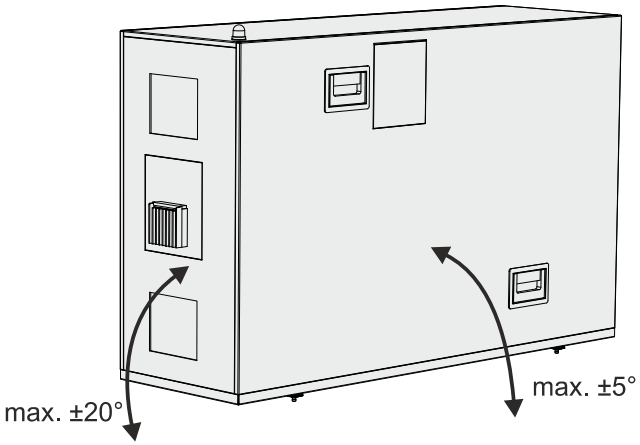

Figure 131: *Permitted tilting gradients*

Avoid vibrations when the laser device is tilted.

6.1.2 Transport and Storage Conditions

NOTICE
Always store the packaging containing the laser device under the conditions specified in this section. The laser device must never be stored in the open air nor in any structure that does not fully shield it from the elements.

The following climatic conditions must be maintained while transporting and during temporary storage of the laser device:

Air temperature	-20 °C to +50 °C (4 °F to 122 °F)
Humidity	< 70% RH

It is important that the laser device is not subjected to rapid changes in temperature or relative humidity.

6.1.3 Packaging

All COMPex*Pro* laser devices are delivered in a single rigid transport package, except for the COMPex*Pro* 200 series which is delivered with an additional package containing accessories.

6.1.4 Internal Transport

WARNING
Risk of crushing!
The heaviest laser device version together with its rigid transport packaging weighs approx. 395 kg (870.8 lb).
Prevent tipping or dropping during lifting and transportation.

When lifting and transporting the laser device and its components always follow all standard safety precautions and practices for the transportation and handling of heavy equipment. A suitable fork-lift truck or similar device is required to lift and transport the laser device. Ensure that the fork length and lifting capacity is sufficient to safely lift and transport the laser device in the respective packaging stage.

All passageways, corridors and access points along the transport route have to have sufficient clearances to enable the safe transportation of the laser device in the respective packaging stage. This is particularly important after the removal of the rigid transport packaging.

6.1.5 Transport Packaging

This section describes the means of packaging of the COMPex*Pro* to ensure safe shipment and delivery in the required condition.

NOTICE
Always retain the transport packaging to ensure optimum protection of the laser device during subsequent shipment.

The size, weight and configuration of the transport packaging is indicated in Section 6.1.3 on page 150.

Each COMPex*Pro* laser device has two-stage transport packaging:

– rigid transport packaging and

– anti-static (polyethylene) inner cover.

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The rigid transport packaging (see Figure 132) fully encapsulates the laser devices and inner cover. It consists of a plywood base pallet (B) and plywood upper panels (A) at the sides, front rear and top.

Figure 132: *Rigid transport packaging*

The base pallet has two shock absorbing buffers (see Figure 133). The laser device feet are placed in the locating holes (A) so that the laser device is secured in position when the rigid packaging is closed.

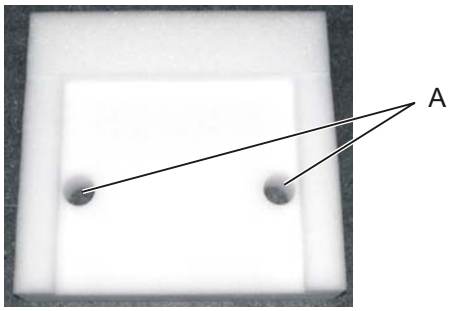

Figure 133: *Shock absorbing buffers*

The laser device is to be stored in the rigid transport packaging. Remove the anti-static inner cover immediately prior to installing the laser device.

6.1.6 Transport / Lifting With Rigid Packaging

WARNING
Risk of crushing!
The heaviest version of the COMPex*Pro* laser device in its rigid transport packaging weighs approx. 395 kg (870.8 lb).
Prevent tipping or dropping during lifting and transportation.

A suitable fork lift truck or similar device is required to lift the laser device. Ensure that the fork length and loading capacity is sufficient to safely lift the laser device in its packaging. The dimensions and weight of the packed laser device are indicated in Section 6.1.3 on page 150.

The laser device can be lifted longitudinally from the side. Set the forks as far apart as possible to safely lift the laser device.

6.1.7 Initial Inspection of Delivery

Purpose

Check that no damage has occurred to the laser device during transportation and that the shipment is complete.

To monitor the handling of the laser device during transportation, Shockwatch indicators are fixed to the rigid transport packaging. These turn to red when subject to excess shocks.

Tools and Materials

- None

Preparation

- None

Initially Checking the Laser Device Packaging

1. Ensure that none of the Shockwatch indicators on the rigid transport packaging have turned to red.
2. Inspect for visible signs of damage to the rigid transport packaging.

Checking the Contents of Shipment

3. Check the contents of the shipment against the packing list provided.
4. Sign the delivery note.

If any parts are missing, immediately contact Coherent. The contact address is indicated on the reverse side of the cover sheet of this manual.

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Damaged Deliveries

If the initial inspection of the delivery indicates mishandling or tipping of the laser device during transport, proceed as follows:

- Do not refuse the shipment.
- Make a corresponding notation on the delivery receipt document.
- If there are visible signs of damage, leave the laser device in the original transport packaging and request immediate inspection from the carrier within three days of delivery. Take photographs of the damage.
- If there are no visible signs of damage to the packaging, remove the packaging and check for visible signs of damage to the laser device.
- If there are signs of damage to the laser device, immediately contact Coherent for further inspection and rectification. Take photographs of the damage.

6.1.8 Remove Rigid Packaging

Purpose

Remove the top and side panels from the rigid transport packaging.

At the end of this procedure the laser device remains attached to the base pallet and is protected by the inner cover.

Tools and Materials

- Suitable fork-lift truck
- Clip removal tool (provided)
- Screwdriver for removal of clip removal tool

Preparation

1. Using the fork-lift truck or appropriate device, move the laser device to the location where it is to be unpacked.
2. Set down the laser device in the unpacking location.

Removing the Rigid Packaging

NOTICE
The original packaging is needed to re-ship the laser device. Remove and store the removed packaging in such a way that no parts are lost or damaged.

3. Unscrew and remove the clip removal tool (see Figure 134, A) from the rigid transport packaging.

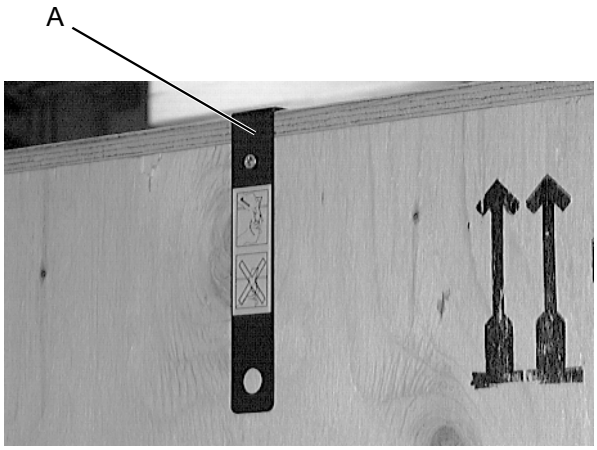

Figure 134: *Location of clip removal tool*

CAUTION
Risk of injury through incorrect use of the clip removal tool!
The transport packaging clips are under tension.
Do not use excess force to remove.
While levering off, use the other hand to restrain movement.

4. Working from the top downwards, remove the clips from the rigid transport packaging. Push the clip removal tool into the recess on the clip, press against the clip to control movement and lever off (see Figure 135).

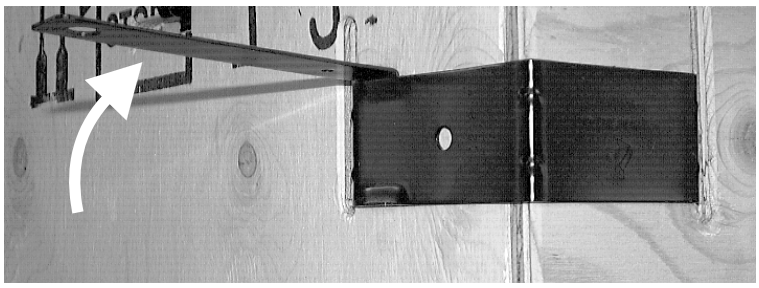

Figure 135: *Removing the clips*

5. When the corresponding clips have been removed, remove the top, front, rear and side panels of the packaging.

Storing the Transport Packaging

6. Stack the disassembled panels of the rigid transport packaging and accessory packaging onto the base pallet.

   When stacking, ensure that the outer cover does not become contaminated or damaged and that the inside surfaces of the panels cannot become contaminated.

6.1.9 Transport / Lifting Without Rigid Packaging

WARNING
Risk of crushing!
The heaviest version of the COMPex*Pro* laser device weighs appprox. 325 kg (715 lbs) without packaging.
Prevent tipping or dropping during lifting and transportation.

NOTICE
Risk of contaminating or damaging the laser optics!
To avoid the formation of condensed water, ensure that the max. permissible temperature gradient (5 °C/h) is maintained while moving the laser device from the storage area.

Ensure that all passageways, corridors and access points have sufficient clearances. Pay particular attention to the clearences required to turn the laser device. The dimensions of the laser device are indicated in Section 6.1.3 on page 150.

A suitable lifting device is required to lift and transport the laser device.

NOTICE
Incorrect lifting can cause serious damage to the laser device!
Use lifting points as far apart as possible to safely lift the laser device.

When using a fork lift truck, always transport or lift the laser device together with the base pallet. Ensure that the fork length and/or the loading capacity are sufficient to safely lift the laser device.

When using a crane, position the lifting harness or belt as near to the laser device's feet as possible.

6.1.10 Remove Anti-Static Inner Cover

Purpose

Remove the anti-static inner cover from the laser device and unpack the accessories.

Tools and Materials

- Safety knife for cutting sealing tape

Preparation

1. Move the laser device and accessories to the installation area.

Removing the Inner Covers

NOTICE
The original packaging is needed to re-ship the laser device. Store the removed packaging in such a way that no parts are lost or damaged.

2. Remove the tape that seals the anti-static inner cover onto the laser device and lift the anti-static inner cover off the laser device.
3. Take the accessories out of the packaging and carefully clean them as required.

6.2 Connection

This section describes the initial inspection and mechanical alignment of the laser device as well as the connection of the utilities. The exact connection procedure depends on the version and wavelength of the laser device as well as the selected gas supply mode.

After following all procedures detailed in this chapter, the laser device can be switched on.

To prevent unnecessary downtime and ensure optimum performance of the laser device, the installation site and external facilities have to be prepared in accordance with the requirements detailed in the separate Site Preparation Manual before starting the installation procedure.

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6.2.1 Initial Laser Device Inspection

Purpose

Ensure that the laser device and separate parts have reached the installation location.

Tools and Materials

- Packing list

Preconditions

- Laser device situated at the final installation location

Initially Checking the Laser Device

1. Check the laser device housing for visible signs of damage.
2. Check that the beam shutter is closed and the transport locking screw is inserted.
3. Check that all components listed in the packing list are at the installation location.
4. Check that the gas connectors are covered with blanking plugs.
5. Check that all safety labels are attached according to the label plan in the Safety Chapter of the User Manual.

6.2.2 Position and Level Laser Device

Purpose

Set down the laser device at the final installation location and adjust the laser device feet until the beam exit is at the required height.

Tools and Materials

- 15 mm wrench
- Flexible rule
- Spirit level

Preconditions

- Laser device situated at the final installation location

Positioning the Laser Device

1. Set down the laser device at the exact installation position (e.g. within the laser system).
2. Use the 15 mm wrench and flexible rule to adjust the feet on the beam exit side until the beam exit aperture is at the desired height.
3. Use the 15 mm wrench to adjust the feet on the connection side until the laser device is visibly levelled.

Levelling the Laser Device

4. Lay the spirit level on top of the laser device housing parallel to one of the long sides and adjust the feet on the connection side until the laser device is level.
5. Lay the spirit level on top of the laser device at the beam exit parallel to the short side and adjust the feet until the laser device is levelled.
6. Repeat step 5 on the connection side.
7. Repeat step 4 parallel to the other long side.
8. Use the flexible rule to check that the beam exit aperture is at the correct height.
9. Remove the service panel (see Section 3.2.1 on page 20).
10. Lay the spirit level on base plate below the laser tube to double check that the laser device is level.
11. Re-attach the service panel (see Section 3.2.1 on page 20).

6.2.3 Remove Transport Lock

Purpose

Remove the vacuum pump transport lock from the laser device.

Tools and Materials

- 2.5 mm allen key

Preconditions

- Laser device positioned at final installation location

Removing the Transport Locks

1. Use the 2.5 mm allen to remove the transport locking screw and plastic washer from the marked position on the connection side of the laser device (see Figure 136, A).

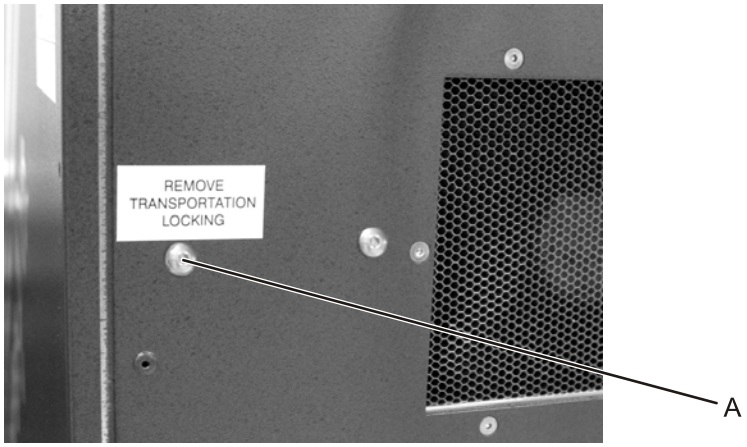


Figure 136: *Vacuum pump transport locking screw*

2. Place the transport screw and washer in the service case for future use.

6.2.4 Connect Water Lines

Purpose

Where required, connect the cooling water lines to the laser device.

Under normal operating conditions:

– the COMPex*Pro* 50 and COMPex*Pro* 110 require water cooling at repetition rates of 20 Hz and above.

– the COMPex*Pro* 205 requires water cooling at repetition rates of 10 Hz and above.

– the COMPex*Pro* 102 and COMPex*Pro* 201 are fully air-cooled.

As particles in the cooling water can clog the coolant circuit, the final user is to provide and maintain a fine line filter in the external cooling water supply line immediately in front of the shut-off valve for the laser device.

The cooling water has to comply with the specifications indicated in Section 8.3.1.4 on page 229. Do not use deionized water.

Tools and Materials

- Hose cutter
- 17 mm wrench
- 2 water hoses (supplied with laser device)
- 2 sets of water connection fittings (supplied with laser device, see Figure 137)

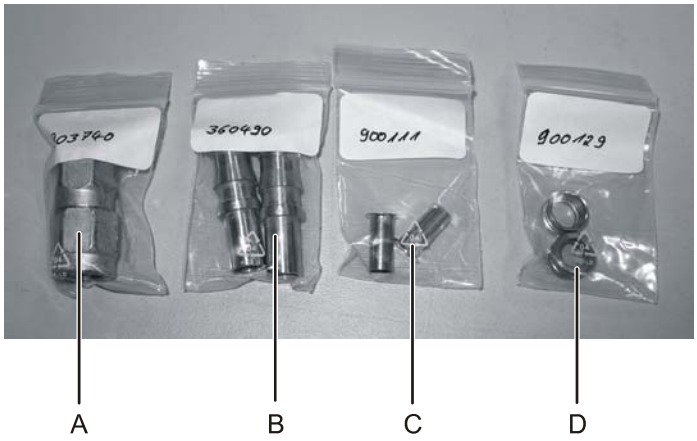


Figure 137: *Supplied water connections*

Key to Figure 137:

A Union nuts
B Hose nipples
C Stiffener sleeves (can be used instead of hose nipples)
D Compression ferrules

- When hose nipples are used, 2 hose clamps and appropriate screwdriver
- 2 sets of connectors for connection to water source and drain and, if applicable, appropriate tool to tighten the connectors
- Water supply as specified (see Section 8.3.1.4 on page 229)

Preconditions

- Laser device positioned at final installation location

Preparing the Water Hoses

1. Cut the water hose to the lengths required for the individual water inlet and water outlet lines (hoses).
2. Insert a hose nipple into the first water hose in the direction indicated in Figure 138.

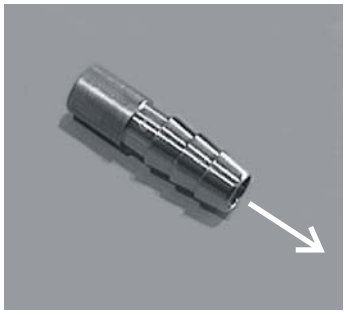


Figure 138: *Insertion of nipple into water hose*

   Alternatively, insert a stiffener sleeve into the hose end instead of the hose ferrule and then proceed to step 4.
3. Use a hose clamp to tighten the water hose onto the hose nipple.
4. Repeat steps 2 and 3 to prepare the other water hose.

Connecting the Water Lines

After tightening the nut on the hose onto the fitting on the laser device, the compression ferrule is formed in such a way that the nut, nipple and ferrule can no longer be disassembled. To check the connection unscrew the nut completely. A distinct deformation (annular bulb) must be visible inside of the nipple.

5. Slide the union nut (see Figure 139, C) over the hose nipple (D).

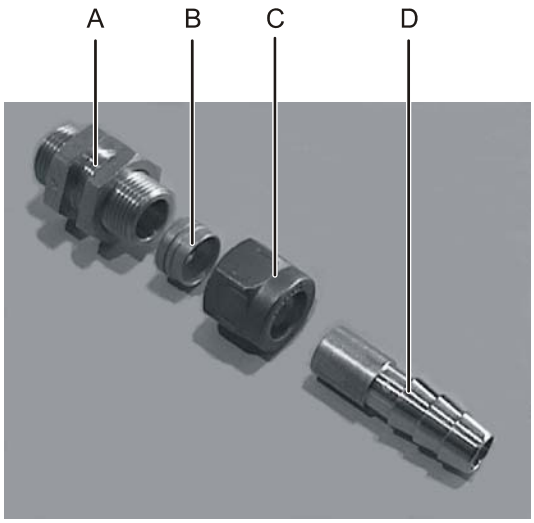


Figure 139: *Cooling water connection*

6. Slide the compression ferrule (B) over the hose nipple until it reaches its stop.
7. While pressing the hose nozzle (see Figure 139, D) against the water inlet connection fitting on the laser device (A), tighten the union nut (B) until finger tight.
8. Use the 17 mm wrench to tighten the union nut onto the fitting on the laser device by turning 1 ½ rotations.
9. Unscrew the nut to allow the hose nozzle to release the tension.
10. Tighten the nut once again until finger tight and use the 17 mm wrench to tighten the nut by turning ¼ rotation for the final fit.
11. Connect the other end of the water inlet hose to the water source. The means of connection is dependent upon the configuration of the selected source.
12. Repeat steps 5 to 10 to attach and secure the other water hose to the water outlet connector.

    The completed water connection using hose nozzles is shown in Figure 140.

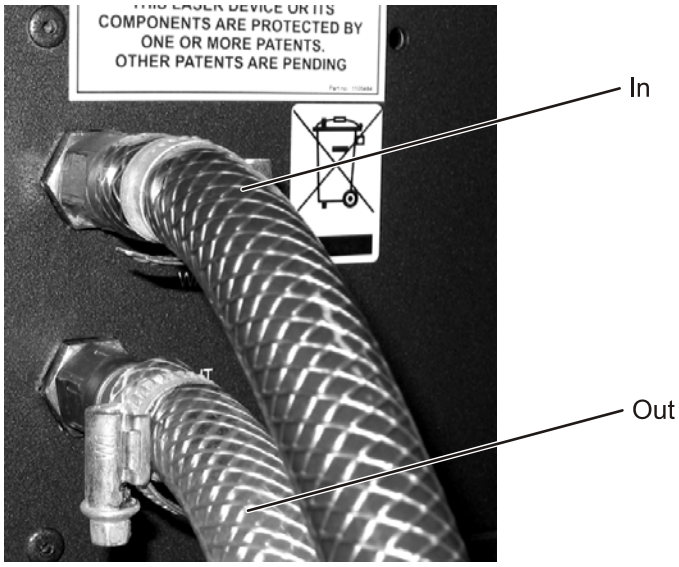


Figure 140: *Completed water connection*

13. Connect the other end of the water outlet hose to the water drain. The means of connection varies according to the type of drain.

Finalization

14. Turn on the water supply at the source and adjust to the flow rate indicated in Section 8.3.1.4 on page 229.
15. Check that there are no water leaks or blockages.

6.2.5 Connect Gas Lines

WARNING
Risk of gas leaks!
Excessive overtightening will damage the sealing beads and may cause leakage from the system.
Tighten all gas connections in accordance with the gas fitting manufacturer's instructions.

NOTICE
If the remaining gas cylinder pressure drops below a critical value, the humidity in the gas may significantly increase. Only use gas cylinders with a remaining pressure of more than 20% of the initial value.

Purpose

Connect the gas supply lines to the laser device.

Four copper lines with the appropriate Gyrolok fittings are provided with the laser device. These gas lines are only intended for temporary use. For permanent connection, Coherent recommends stainless steel gas lines. Exact material specifications as well as information about assembly, welding requirements, cleanliness and re-passivation is contained in the separate Site Preparation manual.

The exact configuration of the external gas supply depends on the wavelength of the laser and the selected gas supply mode. A premix gas line always has to be connected to the Halogen connection on the laser device (in contrast to earlier COMPex and COMPex*Pro* laser devices).

Tools and Materials

- Halogen protection cover and securing screws (in service case, see Figure 143)
- 2.5 mm allen key
- 3 mm allen key
- 9/16" wrench

Preconditions

- All necessary gas supply lines installed and prepared according to the separate Site Preparation manual and the gas supply system manufacturer's instructions. Each required gas supply line has to be fitted with a female nut for connection to the 6 mm Gyrolok connector on the laser device.
- Laser device positioned at final installation location

Preparation

1. Identify the external gas supply connections.
2. Visually check that all gas supply valves and pressure regulators are closed.
3. Locate the appropriate gas connectors on the laser device.

Connecting the Halogen or Premix Line

4. Unscrew and remove the blanking plug from the halogen connection on the laser device (see Figure 141). Where necessary, use the 9/16” wrench.

   Store the blanking plug in the service case for future use.

Figure 141: *Removing the halogen line blanking plug*

5. Use the 2.5 mm allen key to remove the two screws on each side of the halogen connection (see Figure 142, A). This is necessary to enable the halogen protection cover to be fitted.

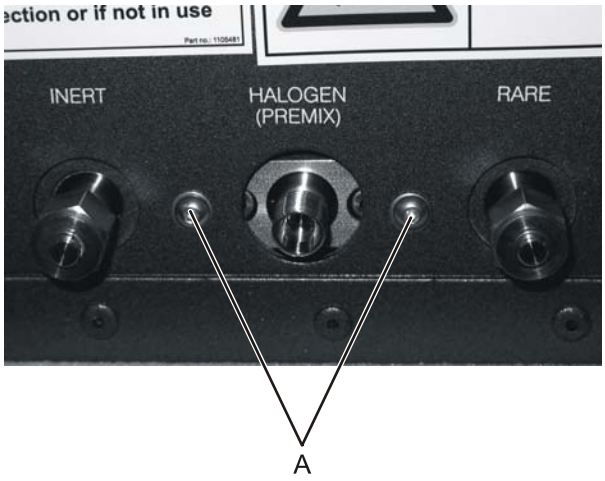


Figure 142: *Preparing to fit halogen protection cover*

6. Use the 2.5 mm allen key to loosen the screw (see Figure 143, A) fastening the halogen protection cover's sealing pieces (B).

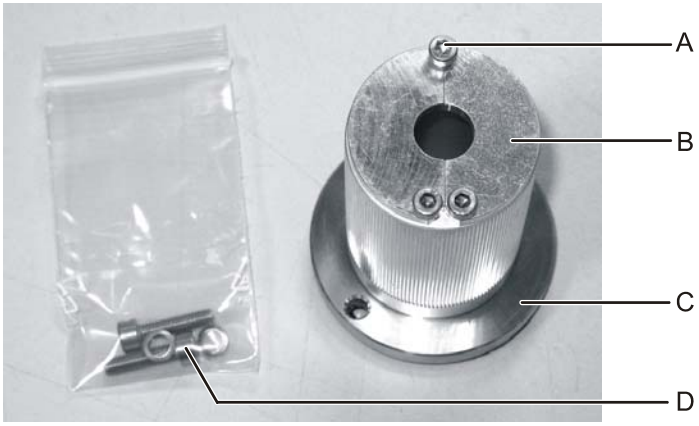


Figure 143: *Halogen protection cover assembly*

Key to Figure 143:

A	Sealing piece fastening screw	C	Locating flange
B	Sealing piece	D	Securing screws

7. Open the sealing pieces (see Figure 143, B) and slide the halogen protection cover onto the halogen gas supply line.

   The locating flange on the halogen protection cover has to point in the same direction as the nut on the halogen line (see Figure 144).

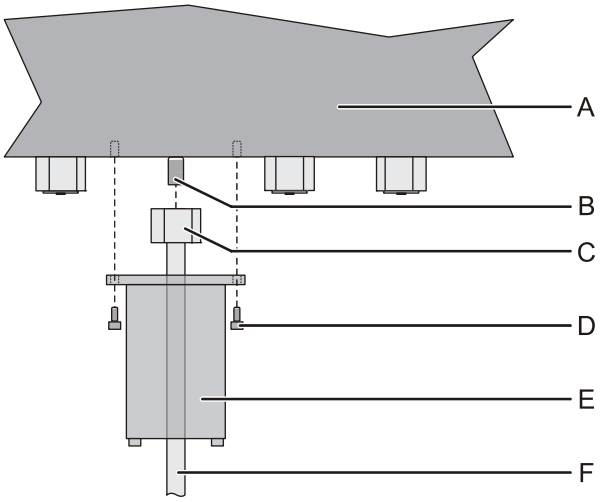


Figure 144: *Attaching the halogen protection cover*

Key to Figure 144:

A	Laser device housing	D	Securing screws
B	Halogen connection fitting	E	Halogen protection cover
C	Nut on halogen line	F	Halogen gas supply line

NOTICE
Risk of damaging the gas fittings through over-tightening.

8. Fit the nut on the halogen gas line (see Figure 144, C) onto the appropriate Gyrolok fitting (B) on the laser device and tighten until finger-tight.
9. Use the 9/16” wrench to tighten the nut onto the Gyrolok fitting (turn ¼ turn).
10. Carefully slide the halogen protection cover (see Figure 144, E) along the halogen gas supply line (F) until the locating flange is located against the laser device housing (A).
11. Use the 3 mm allen key and the securing screws provided (see Figure 143, D and Figure 144, D) to tighten the halogen protection cover onto the laser device housing (see Figure 145).

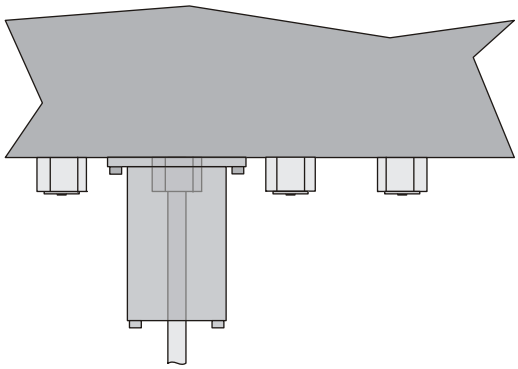


Figure 145: *Halogen protection cover on laser housing*

12. Close the halogen protection cover’s sealing pieces around the halogen gas supply line and use the 2.5 mm allen key to retighten the screw loosened in step 6.

Connecting the Rare, Buffer, Inert and Purge Lines

13. Fit the nut on the appropriate gas line onto the corresponding Gyrolok fitting on the laser device and tighten until finger-tight.
14. Taking care not to damage the fitting, use the 9/16” wrench to tighten the nut onto the Gyrolok fitting (turn ¼ turn).
15. Repeat steps 13 and 14 to connect the other gas lines.

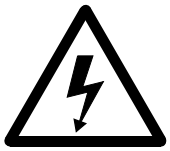
Finalization

16. Double check that the gas supply lines are connected to the correct fittings on the laser device and are correctly tightened.

CAUTION
Risk of gas leaks and laser tube contamination!
Do not apply gas to the gas lines until they have been flushed and tested for leaks.

17. Check that blanking plugs are correctly fitted to all gas connections that are not used.
18. Perform a helium leak test to ensure that all external connections in the gas supply lines as well as the connections to the laser device are gas tight (see Section 6.3.3 on page 179).

6.2.6 Connect Mains Power Line



WARNING
Risk of electric shock!
The laser device shall only be connected to the mains power by a skilled electrician working in accordance with the applicable electrical engineering rules.
Before connection, ensure that the laser device is set for the mains voltage and frequency at the installation location.

NOTICE
A) To prevent serious mains supply line damage, the mains supply line must be installed with strain-relief in a cable channel.
B) In certain areas, local regulations require a breaking capacity larger than 1.5 kA for 208 V or 230 V operation. In this case, a 16 A, characteristic C circuit breaker with a minimum breaking capacity of 10 kA has to be inserted in the mains power supply for the laser device.
C) If operation with an external transformer is necessary, make sure that the transformer is correctly connected to the mains power source. Otherwise, there is the risk of serious damage to the laser device.

Purpose

Connect the laser device's power supply line to the mains wall socket.

Tools and Materials

- 3 mm allen key
- Wire cutter and stripper
- Appropriate plug for the local mains wall socket
  This plug is to be approved in accordance with valid international and local electrical standards!
- Appropriate screwdriver for the plug used

Preconditions

- Laser device positioned at final installation location

Checking the Electrical Connection Settings

1. Check that the electrical connection data on the laser device type plate (located on connection side of the laser device) is correct for the mains power supply that the laser device is to be connected to.
2. Remove the service panel (see Section 3.2.1 on page 20).
3. Check the label (see Figure 146, B) to ensure that the mains input transformer is correctly set .

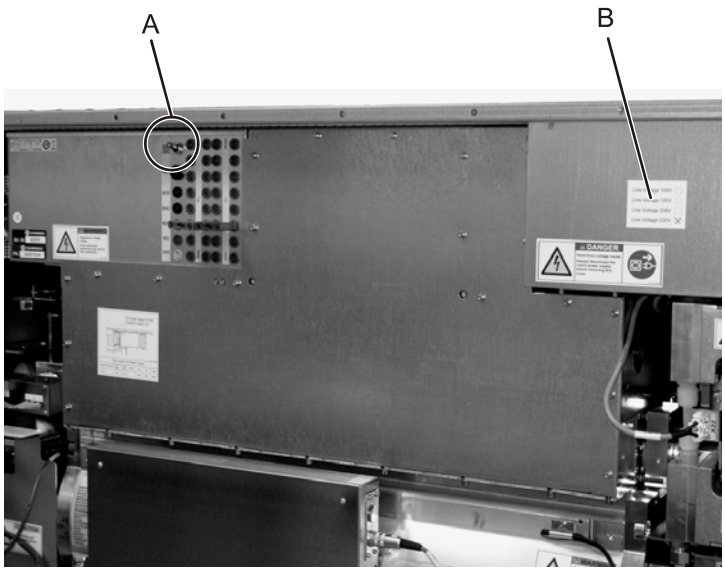


Figure 146: *Frequency and transformer settings*

4. Ensure that the frequency toggle switch (A) on the thyratron power supply is correctly set.
5. Close the service panel (see Section 3.2.1 on page 20).

Connecting the Mains Power Supply

6. Ensure that the laser device's key switch is set to OFF.
7. Ensure the laser device's main switch is set to OFF.
8. Blank the ends of the power supply cable (hard-wired to the laser device).
9. Connect the blanked ends to the mains plug (the colors of the wires depend on the power supply version):
   - Black or brown: phase
   - White or blue: neutral
   - Green or yellow/green: ground
10. Insert the prepared plug into the mains socket.
11. Lay the power supply cable with strain-relief in a cable channel.

Finalization

12. Switch on the main switch and check that the POWER ON lamp on the laser device's operating panel lights.
13. Switch off the main switch to continue with the connection procedure.

6.2.7 Install Exhaust Line

WARNING
Harmful gas hazard!
Permanently connect the laser device exhaust to an appropriate ventilation system. Make sure that the exhaust is not connected to the ducting of systems that are used to process breathing air (e.g. air conditioning systems). Never operate the laser unless it is correctly connected to the air extraction system.

Purpose

Install the exhaust line between the laser device and the building's industrial ventilation system.

After connection of the exhaust line, any contamination within the laser device housing will be directed into the industrial ventilation system.

Under normal operating conditions, the exhaust air does not contain harmful gases or by-products. With certain failure scenarios, however, the exhaust air may contain small concentrations of halogen gas or ozone and, consequently, shall be treated accordingly.

The external exhaust system has to be configured by the customer according to local requirements and the applicable regulations. To ensure that the specified exhaust flow rate is present at all times, a suitable monitoring system is required for the external exhaust system. The final user is responsible for the provision and installation of a suitable external exhaust monitoring system as well as providing the specified ventilation. In addition, the external exhaust system should also contain a smoke detector. We also recommend the inclusion of a halogen sensor.

Even when the laser device is switched off, preventative measures are necessary to ensure that no halogen gas escapes from the area of the laser device into the surrounding environment in a worst-case situation.

Tools and Materials

- 4 mm allen key
- Exhaust line assembly (3 m supplied with laser device)
- Connections to fume extraction or industrial ventilation system

Preconditions

- Laser device positioned at final installation location

Installing the Exhaust Line

1. Use the 4 mm allen key to remove the two screws at the exhaust fan outlet on the rear side of the laser device (see Figure 147).

Figure 147: *Loosening exhaust fan outlet*

2. Connect the exhaust flange to the exhaust fan outlet using the (just removed) two 4 mm allen screws.
3. Use the clamp provided to attach the exhaust hose to the exhaust flange.
4. Connect the other end to the exhaust tube to a suitable ventilation output.

Finalization

5. Check that the air input filters on the front of the laser are fitted properly and are not obstructed.
6. Switch on the laser device's main switch.
7. Check that the exhaust fan, mounted at the top on the connection side of the laser device, is working and sucking air out of the laser device.
8. Check that there are no leaks at the exhaust connection.
9. Switch off the main switch to continue with the connection procedure.

6.2.8 Connect Control Devices

Purpose

Connect the required control devices to the laser device.

The devices indicated in Figure 148 can be simultaneously connected:

– Hand-held keypad, supplied with the laser device (D)

– External computer control system (A)

– Synchronization device (B)

– External trigger generator (C)

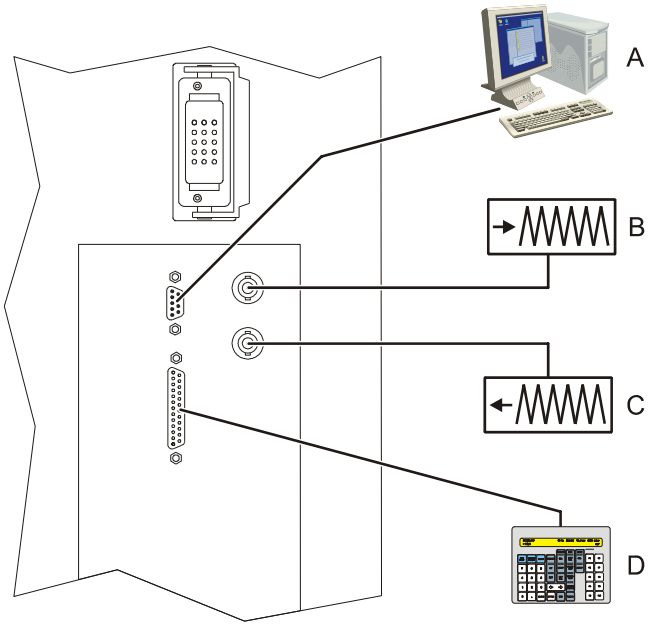


Figure 148: *Standard control device connection configuration*

The external computer can also be connected to COM2 when no hand-held keypad is required and the latest set of remote control commands are to be used (see separate Interfacing Manual for further information). In this case, COM1 is available for the connection of a diagnostics computer.

Tools and Materials

- Required control devices and appropriate interconnecting cables (see separate Interfacing Manual for exact specifications)
- Appropriate screwdriver for the RS232 plugs used

Preconditions

- Laser device switched off
- External control devices and interconnecting cables correctly set-up and configured (see separate Interfacing Manual and system integrator's documentation)
- External control devices switched off

Connecting the Hand-Held Keypad

1. Connect the 25 pin plug of the hand-held keypad interconnect to COM2 on the laser device and tighten the connections.
2. Connect the other end of the interconnect to the hand-held keypad and tighten the connections.

Connecting the External Computer Control System

3. Connect the 9 pin plug of a standard RS232 interconnect to COM1 on the laser device and tighten the connections.

   When the external computer system is to be connected to COM2 (instead of the hand-held keypad), there is no backward compatibility with programs written for earlier COMPex or LPX laser devices.
4. Connect the other end of the interconnect to the appropriate port on the external computer system and tighten the connections.

Connecting the Trigger Generator and Synchronization Device

5. Connect the BNC cable for the trigger generator to the port marked TRIG IN on the laser device.
6. Connect the BNC cable for the synchronization device to the port marked SYNC. OUT on the laser device.
7. Make sure that the trigger generator and synchronization device are correctly connected.

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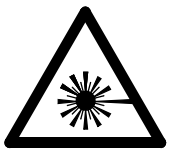
6.2.9 Connect Remote Connector



DANGER
Risk of exposure to Class 4 excimer laser radiation!
Never put the laser into operation unless it is properly connected to a fail-safe external interlock switch and external laser radiation warning lamp.

Purpose

Connect the laser device to a category 3 external safety circuit (according to EN954-1), external laser radiation indicator lamp and, where required, to an external detector for gas system errors (e.g. leaks).

A schematic of the Remote connection on the laser device is provided in Figure 149.

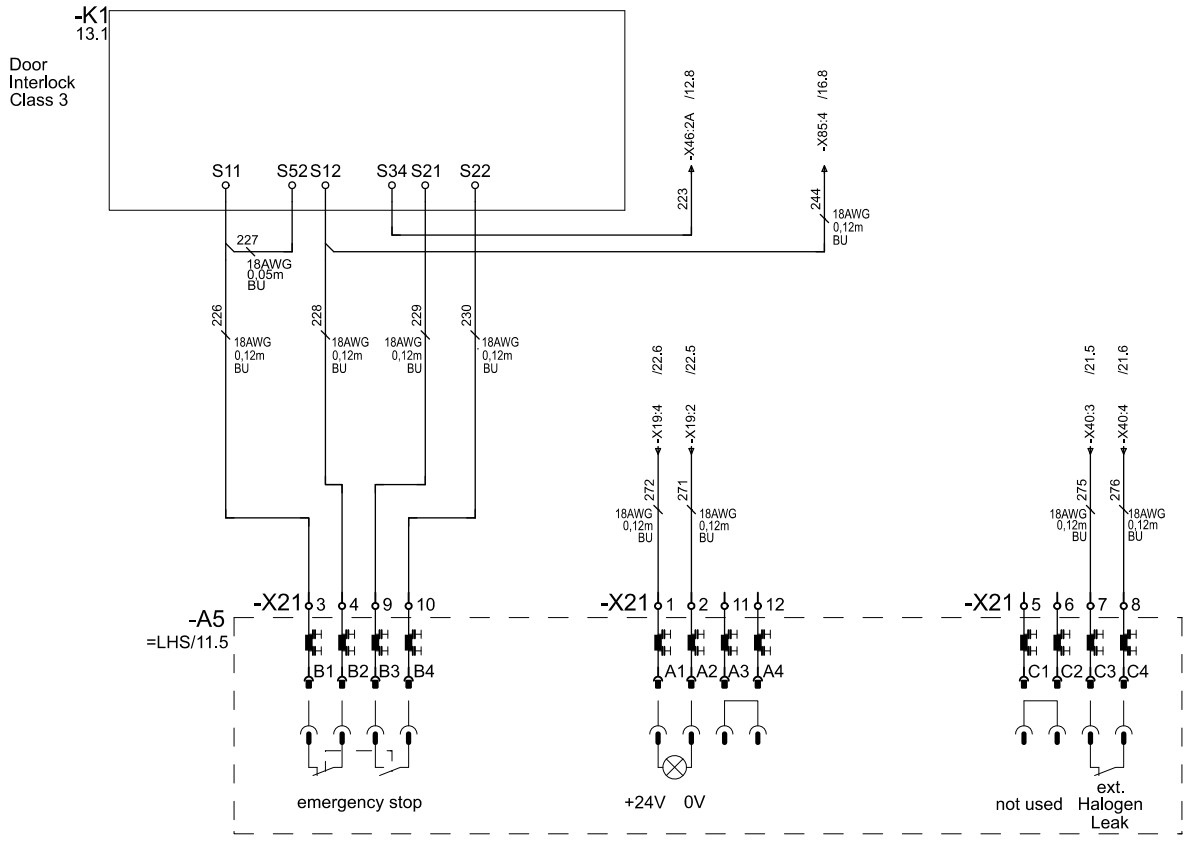


Figure 149: *Schematic of Remote connection*

Tools and Materials

- Harting HAN 15D male connector
- Crimping pliers

Preconditions

- Laser device switched off
- All external circuits ready to operate

Connecting the External Safety Circuit

1. Use the crimping pliers to connect two lines of the external safety circuit to pins B1 and B2 of the Harting 15D male plug so that the contact closes to enable laser radiation.
2. Use the crimping pliers to connect two lines of the external safety circuit to pins B3 and B4 of the Harting 15D male plug so that the contact opens to enable laser radiation.

   The laser can only be operated when contact B1 and B2 closes and B3 and B4 opens simultaneously.

Connecting the Laser Radiation Warning Lamp

3. Use the crimping pliers to connect the external laser radiation warning lamp to pins A1 (+ 24 V DC) and A2 (- 0 V) of the Harting 15D male plug .

Connecting the External Gas Error Detector

4. When required, use the crimping pliers to connect the gas error detector to pins C3 and C4 of the Harting 15D male plug so that the contact closes if there is no external gas error. If the external gas error message is not required, the contacts C3 and C4 have to be jumpered.

   The signal through C3 and C4 will generate a message indicating that there is a problem with the external gas supply. This signal will not switch off the laser.

Finalization

5. Remove the dummy Remote plug from the laser device.
6. Connect the plug prepared in steps 1 to 4 to the Remote socket on the laser device.
7. Switch on the laser device and ensure that there is no Remote interlock, no external gas warning and no safety module interlock.

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6.3 Initial Start-Up and Checks

6.3.1 Check Electrical System

Purpose

Initially turn on the laser device and ensure that the thyratron supply voltage is correctly set.

Tools and Materials

- Key to key switch
- 3 mm allen key
- TRMS Voltmeter (TRMS=True Root Mean Square)
- Excimer Laser Test Sheet

Preconditions

- Laser device correctly connected to the mains power supply line (see Section 6.2.6 on page 167) and configured for the local mains supply
- Hand-held keypad connected to COM2

Turning-On the Laser Device

1. Double check that the mains cable is correctly connected to the mains wall socket and appropriately secured (with strain relief in a cable channel).
2. Turn the main switch (see Figure 150, A) clockwise to the ON setting. The POWER ON lamp (B) lights and various consumers in the laser device will start.

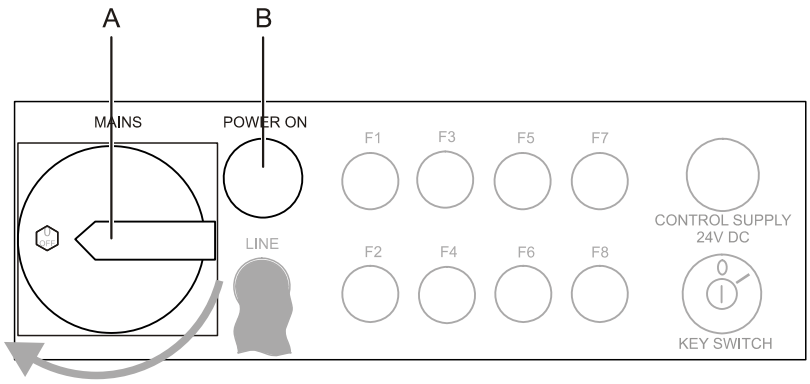

Figure 150: *Switching on the laser device*

3. Insert the key into the key switch (see Figure 151, A) and turn clockwise to the I setting to activate the laser controller.

   The CONTROL SUPPLY lamp (B) lights and the controller software boots. During this period the laser device performs a self test which is indicated by the flashing “self test” message on the hand-held keypad display.

   After a successful self-test, the laser device will start to warm up the thyratron.

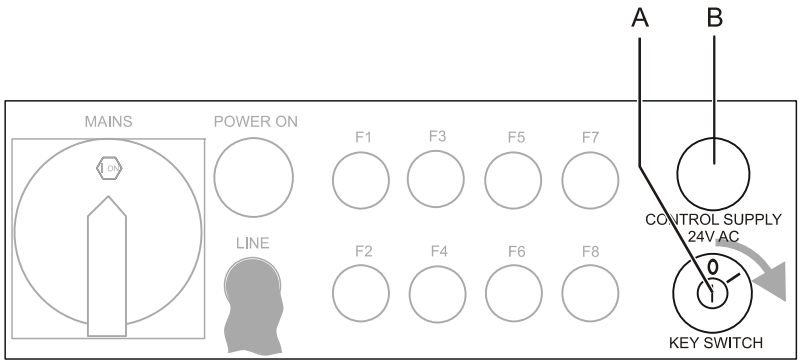

Figure 151: *Activating the control voltage*

4. When the laser control software has booted, check that the correct type of laser is indicated on the hand-held keypad display.

Checking the Thyratron Supply Voltages

5. Use the 3 mm allen key to remove the thyratron adjustment panel cover.
6. Use the TRMS voltmeter to measure the heating voltage of the thyratron (U_H) between the jacks GND and HEAT (see Figure 152) and note the value.

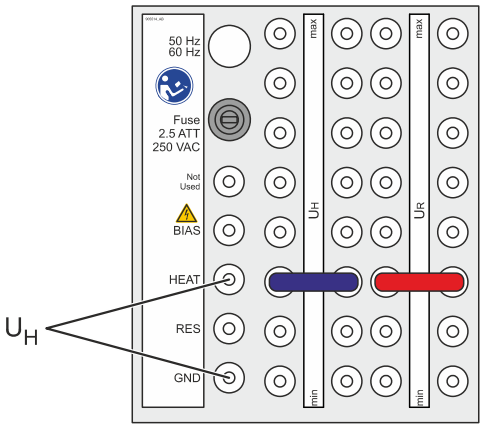

Figure 152: *Measuring thyratron heating voltage*

7. Measure the heating voltage of the hydrogen reservoir (U_R) between the jacks GND and RES (see Figure 153) and note the value.

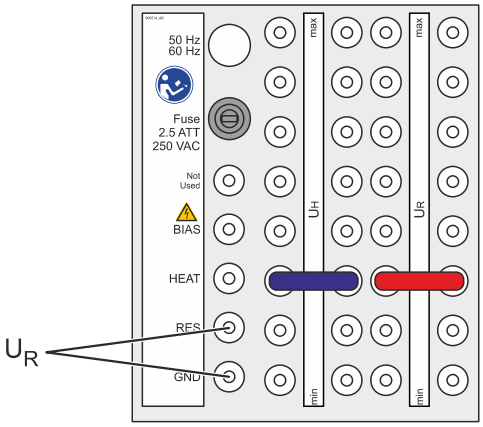

Figure 153: *Measuring reservoir heating voltage*

8. Measure U_{BIAS} between the jacks GND and BIAS and note the value.
9. Check that the values measured in steps 6 to 8 correspond with the respective values on the Excimer Laser Test Sheet.

   Where necessary, adjust the heater and reservoir voltages (see User Manual for further information).

   Substantial differences indicate a defective thyratron, thyratron supply module, trigger board or varistor. In this case, contact the local Coherent service support center for further instructions.

6.3.2 Check Gas System

Purpose

Check the pressure of the transport fill in the laser tube to ensure that there is no internal gas leak. Ensure that the laser tube will be filled with the correct laser gas mixture when the New Fill procedure is started.

Tools and Materials

- Excimer Laser Test Sheet

Preconditions

- Laser device connected to the gas supply lines (see Section 6.2.5 on page 163)
- Hand-held keypad connected to COM2
- Laser Device switched on

Check Gas Pressure in Laser Tube

1. Check that the tube pressure displayed on the hand-held keypad is approximately 1500 mbar.

   A pressure drop of more than 400 mbar may indicate a leak. In this case contact the local Coherent service support center for further instructions before continuing.

Check Gas Menu Settings

WARNING
Risk of exposure to halogen gas!
Incorrect gas menu selection can cause excessive halogen concentrations in the laser tube. If this mixture is pumped out undiluted, the halogen filter and exhaust can overheat. This significantly increases the risk of gas leaks.
Never disclose the menu password to unauthorized persons. In case of an incorrect gas fill, immediately contact Coherent service support before taking any further action!

1. Press the <MENU SEL> key.

   “Password= (read Manual)” appears in the bottom line of the handheld keypad display.
2. Type the password 778 and press <ENTER>.

   The gas mixture and supply mode appears in the bottom line of the handheld keypad display.
3. Make sure that the currently active gas mixture matches the resonator optics indicated on the Excimer Laser Test Sheet.
4. Make sure that the currently active gas supply mode (single or premix) corresponds with the configuration of the external gas supply lines.
5. Press <ENTER> to confirm that the correct gas menu has been selected.
6. Check that the currently active partial pressures correspond with the values indicated on the test sheet (press <ENTER> to scroll through the list).

6.3.3 Leak Test and Passivate Laser Gas Lines

NOTICE
If the remaining pressure drops below a critical value, the humidity in the gas cylinders may significantly increase. Only use gas cylinders with a remaining pressure of more than 20 % of the initial value.

Purpose

Test the gas lines for leaks. After a successful leak test, clean the gas system and passivate the halogen gas line. The sequence in which this procedure has to be executed is:

– evacuate the gas lines and test for underpressure leaks

– fill the gas supply system with inert gas (helium)

– clean the excimer laser gas lines

– passivate the halogen gas line and internal gas system.

Tools and Materials

- 4 mm allen key
- Helium leak tester or liquid leak tester (e.g. SNOOP®)

  Make sure that the chosen leak tester is suitable for use in the environment in which the laser is installed. Liquid leak testers are, for instance, not permitted in cleanrooms.
- Ethanol and cleaning paper (when SNOOP was used)
- Gases as specified in Section 8.3 (page 224)
- Laptop PC with LASCONTROL software

Preconditions

- Laser device fully installed
- Pressure regulators and cylinder valves in all gas lines closed

Checking for Vacuum Leak Tightness

NOTICE
Incorrect operation can damage the pressure regulator!
If pressure is applied to a pressure regulator with low secondary pressure, the pressure regulator membrane may become damaged. Always ensure that the pressure regulator is closed, before opening the gas cylinder valve.

1. Ensure that the pressure regulators and cylinder valves are closed on all gas lines.
2. Open the gas cylinder valve of the first gas line to be checked.

3. Set the corresponding pressure regulator to at least 4 bar (abs.).

   The pressure regulator has to be set to at least 4 bar to completely evacuate the line between the gas cylinder valve and the laser head. With lower pressure settings, residues may remain in the line between the pressure regulator and the gas cylinder valve.
4. Close the corresponding gas cylinder valve.
5. Press <FLUSH LINE> on the handheld keypad and use the cursor keys to select the line to be checked.
6. Press <ENTER> to confirm the selection.
7. Press <EXE> to evacuate the selected gas line.
   The message ”FLUSH: *gas line name*“ appears in the bottom line of the display.

   The gas line is evacuated for 10 seconds.
8. Repeat step 7 until the pressure regulator gauge indicates a relatively constant vacuum.

   If a vacuum is not reached there is a relatively large leak in the gas line. Check all connections in the line. If necessary, tighten the connections and repeat the evacuation of the gas line.
9. After appoximately 10 minutes, check the pressure regualator gauge again. A significant increase in pressure indicates a leak.

   If there is a leak; check and, where necessary, tighten the line connections. Following this, repeat the vacuum leak test.
10. Close the pressure regulator in the gas line that has been checked.
11. Repeat steps 2 to 10 for all other gas lines.

Checking for Overpressure Leak Tightness

12. Ensure that the pressure regulators and cylinder valves are closed on all gas lines.
13. Open the inert gas cylinder valve.
14. Set the pressure regulator in the inert gas line to the specified value.
15. Close the inert gas cylinder valve and observe the reading on the pressure gauge for 10 minutes.
16. If necessary, rectify any gas leak indicated by a drop in pressure.
17. When there is no indication of a leak, re-open the inert gas cylinder valve.
18. With the buffer gas cylinder valve closed and the pressure regulator open, press <PURGE LINE> on the handheld keypad and use the cursor keys to select the BUFFER line.
19. Press <ENTER> to confirm the selection.
20. Press <EXE> to purge the BUFFER line.
    A corresponding message appears in the bottom line of the display. The inert gas line and the internal gas system are evacuated and filled with inert gas (He).

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21. Use the LASCONTROL software Service menu (see Figure 154) to fill the BUFFER line to approx. 4 bar (abs.).

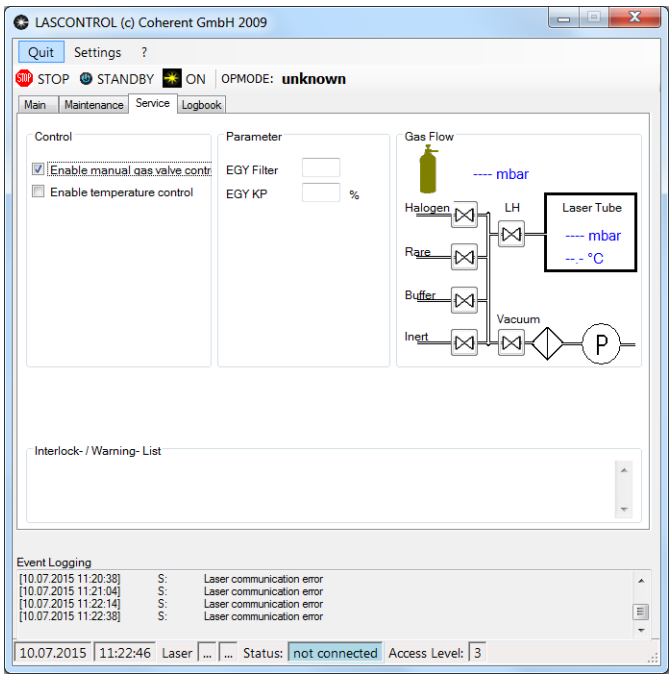


Figure 154: *LASCONTROL Service menu*

22. Wait approx. 10 minutes to see if the pressure drops and use a helium leak detector to check for leaks in the gas line.
23. If necessary, rectify any gas leaks.
24. When there is no indication of a leak, repeat steps 5 to 7 to flush the buffer gas line.
25. Open the buffer gas cylinder valve.
26. Repeat steps 18 to 25 for the other gas lines that are to be used (e.g. halogen and rare if the laser device is to be supplied by separate gas cylinders).

Cleaning and Filling the Gas Lines

27. Ensure that the cylinder valves of all gas lines are open and that the pressure regulators are set to the required values.
28. Press <FLUSH LINE> on the handheld keypad and use the cursor keys to select the INERT line.
29. Press <ENTER> to confirm the selection.
30. Press <EXE> a number of times to clean the inert line.
    The line is evacuated and at the same time refilled with fresh gas.
31. Repeat steps 28 bis 30 for all other gas lines, except the HALOGEN gas line.

Leak Checking the Internal Gas System

32. Check that the laser tube pressure indicated on the Handheld keypad is approx. 1500 mbar.
33. Remove the service cover from the laser device.
34. Open the laser tube manual shut-off valve (see Figure 155).

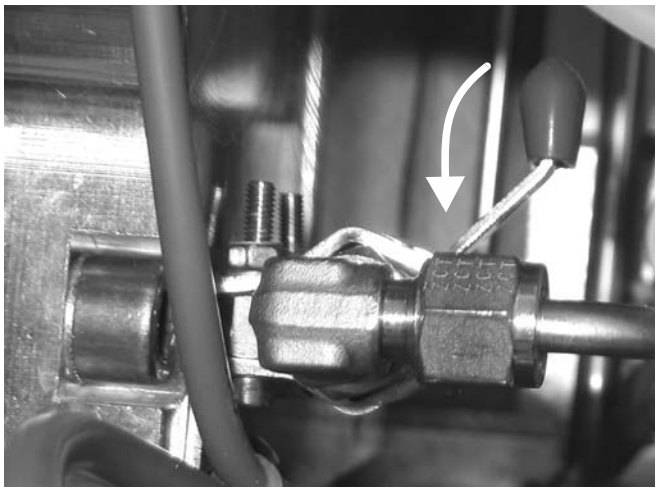


Figure 155: *Opening the laser tube shut-off valve*

35. Press <NEW FILL> on the handheld keypad and use the cursor keys to select MAN. INERT.
36. Press <ENTER> and <EXE> to confirm and start the procedure that manually fills the laser tube with inert gas.
37. When the indicated tube pressure has reached 3000 mbar, press <BREAK> to abort the manual inert procedure.
38. Wait for five minutes and note the tube pressure (P1) and tube temperature (T1) at the beginning of the measurement period.
39. Wait for 60 minutes and note the tube pressure (P2) and tube temperature (T2) at the end of the measurement period.
40. Calculate the leak rate using the following equation:

$$P1 - P2\frac{T1[K]}{T2[K]}$$

The leak rate is acceptable if it is less than 2 mbar / h at a constant ambient temperature.

Re-Passivating the Halogen Gas Line

41. Repeat steps 28 to 30 for the halogen gas line.
42. Leave the halogen gas in the gas line for approx. 8 h.
43. After waiting approx. 8 h, press <EXE> to flush the halogen line again. This fills the halogen line with fresh gas.

Finalization

44. When SNOOP was used, clean the gas line connections with ethanol and wipe dry with cleaning paper.

6.3.4 Fill Laser Gas

NOTICE
If the remaining gas cylinder pressure drops below a critical value, the humidity in the gas may significantly increase. Only use gas cylinders with a remaining pressure of more than 20% of the initial value.

Purpose

Evacuate spent excimer laser gases from the laser tube and fill the laser tube with the appropriate fresh excimer laser gases. The laser tube is automatically evacuated and filled to the required pressure through the dedicated software routine “NEW FILL”. The exact gas mixture is determined through the currently active gas menu. The “NEW FILL” is to be carried out twice to ensure that all traces of the transport fill are removed from the laser tube.

Tools and Materials

- Gases as specified (see Section 8.3 on page 224).

Preconditions

- Laser device switched on and laser ready to operate.
- Laser device housing closed
- Gas cylinder valves open and pressure regulators correspondingly set
- Laser gas lines leak tested, flushed and passivated (see Section 6.3.3 on page 179)

Evacuating and Filling the Laser Tube

1. Turn on the excimer laser gases and set the pressure regulator in each line to the required pressure (see User Manual).
2. Press <NEW FILL> on the handheld keypad.
   “> NEW FILL” appears in the bottom line of the display.
3. Press <ENTER> to confirm that a new fill is to be started.

4. Press <EXE> to start the NEW FILL procedure.

NOTICE
Only interrupt the procedure with <BREAK> in case of an emergency. As the procedure is immediately interrupted and the fill is incomplete, there may be insufficient pressure in the laser tube. In this case, manually fill the laser tube to 1050 mbar with inert gas (see User Manual) or restart the new fill procedure.

At the start of each new fill, the halogen filter ratio is checked. If it exceeds 100%, the message “RENEW HALOGEN FILTER” is displayed and an interlock occurs after the next halogen gas action. Replace the halogen filter at the latest before the next new fill procedure.

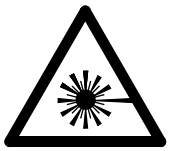
The vacuum pump starts to evacuate the tube, the current pressure is displayed. After reaching 60 mbar the individual gases are then filled into the laser tube at the partial pressures indicated in the gas menu. When the new fill has been successfully completed, “OFF” appears in the display.

NOTICE
If evacuation fails (vacuum setpoint value not reached), warning status code 32 appears and a safety fill is performed. This automatically fills the laser tube to 1050 mbar with inert or buffer gas (depending on external gas supply configuration). Always determine the reason for the evacuation failure before continuing the new fill procedure (for further information, please refer to the troubleshooting information on page 205).

5. Repeat steps 2 to 4.

This repeat of the new fill procedure is only necessary after initially installing the laser device. Subsequent new fills only have to be performed once.

6.3.5 Check Laser Performance



DANGER
Risk of exposure to Class 4 radiation!
During this procedure, work on an open laser may be required. This work shall only to be performed by authorized and correspondingly trained personnel.
Always wear suitable eye and skin protection when there is the risk of exposure to Class 4 excimer laser radiation.

CAUTION
The laser device is to remain powered up during this procedure! Ensure that the maintenance area is at all times adequately secured and that no unauthorized persons can access the laser device. All persons in the maintenance area shall be fully familiar with the applicable safety regulations and requirements.

Purpose

Check that the laser is performing within specifications.

Tools and Materials

- 3 mm Allen key
- 4 mm Allen key
- Protective eyewear suitable for the currently active laser wavelength
- Suitable energy meter or power meter

Preconditions

- Laser device switched on and laser ready to operate (no radiation being emitted).

Preparation

1. Use the 3 mm allen key to remove the locking screw from the shutter plate and open the shutter.
2. Place the external energy measuring device in the beam path and set-up the display unit (for further information, please refer to the energy measuring device's operating instructions).

Checking the Output Power and Energy

3. Press <MODE> on the hand-held keypad and use the cursor keys to select HV NGR.
4. Press <REPRATE> and set the repetition rate to 5 Hz.
5. Press <HV> and set the HV to 24 kV.

6. Press <RUN STOP> and slowly ramp up the high voltage in 1 kV steps until the value on the test sheet is reached.
7. Read off and note the indicated laser pulse energy.

   If a power meter is being used, use the following equation to calculate the pulse energy.

$$E(mJ) = \frac{P_{ext}(W)}{1000 \cdot 5(Hz)}$$

8. Press <REPRATE> and increase the repetition rate in 10 Hz steps until the maximum indicated on the test sheet is reached.
9. Read off and note the indicated laser output power.
10. Compare the values determined in steps 7 and 9 with the “Pulse energy“ and “Average power” specifications and test values indicated on the Excimer Laser Test Sheet.

    The indicated value must be above specifications and correspond as closely as possible with the test values.

    Possible reasons for deviations are:

    - the laser tube needs re-passivation (see Section 5.3 on page 59),
    - the laser resonator needs re-alignment (refer to the Maintenance chapter in the User Manual for further information).

Checking the Energy Monitor Calibration

11. Press <REPRATE> and set the repetition rate to 5 Hz.
12. Compare the pulse energy determined in step 7 with the pulse energy indicated on the hand-held keypad display.

    If the deviation is more than 2% to 3%, the energy monitor requires re-calibration (refer to the Maintenance chapter in the User Manual for further information).

Finalization

13. Switch off the laser.
14. Close the shutter and re-insert the locking screw.

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6.4 Disconnection

6.4.1 Prepare Laser Tube for Transportation / Storage

WARNING
Risk of exposure to harmful gas mixture!
Always thoroughly flush the laser tube and gas supply lines before starting to disconnect the laser device.
WARNING

NOTICE
If the remaining gas cylinder pressure drops below a critical value, the humidity in the gas may significantly increase. Only use gas cylinders with a remaining pressure of more than 20% of the initial value.

Purpose

Flush the laser tube and fill with a special transportation gas fill prior to disconnection of the laser device for transport or storage.

Transportation regulations strictly prohibit the transport of the laser device if it contains halogen gases. Consequently, the laser tube has to be flushed and filled with a transportation filling.

During storage, the transportation fill prevents gases from entering the laser tube that can cause damage to the passivation layer and corrosion to the supply lines.

Tools and Materials

- Inert gas with remaining pressure of at least 20% of initial value
- Buffer gas with remaining pressure of at least 20% of initial value

Preconditions

- Laser device switched on

  The laser device has initially to remain switched on to enable the laser tube to be evacuated and filled with buffer gas
- Inert gas (Helium) and buffer gas (Neon) cylinders connected to the corresponding connections on the laser device
- All housing covers correctly closed (“safety control module off” interlock not active)

Flushing the Laser Tube

NOTICE
If pressure is applied to a pressure regulator with low secondary pressure, the pressure regulator membrane may become damaged. Always ensure that the pressure regulator is closed, before opening the gas cylinder valve.

1. Open the external inert gas valve and the buffer gas valve.
2. Set the pressure regulators in the inert and buffer gas lines to the values specified in the User Manual (approx. 4 bar [abs.]).
3. To flush the laser tube with inert gas press <PURGE RESERVOIR> on the handheld keypad and select <WIN. EXCHANGE> using the cursor keys.
4. Confirm with <ENTER> and press <EXE> to proceed.

   The tube flushing cycle is now started. For exact details of this cycle, please refer to the corresponding description in the “Resonator Optics Exchange” section of the User Manual.

   At the end of the flushing cycle, the message “EXCHANGE WINDOWS THEN PRESS <ENTER>” appears. This indicates that the tube is filled with inert gas and ready for a window exchange.
5. Press <BREAK> to abort the procedure.

Filling the Laser Tube with Buffer Gas

6. Press <NEW FILL> and select <TRANSP> using the cursor keys.
7. Confirm with <ENTER> and press <EXE> to start the transportation fill.

   The laser tube is now evacuated to 60 mbar and filled to 1500 mbar with buffer gas (Neon). The buffer gas valve closes. If premix gas is being used and no buffer gas is connected, the software will automatically fill the laser tube with inert gas (Helium).
8. Close the gas valve and pressure regulator in the external buffer gas line.

Closing the Laser Tube Shut-Off Valve

9. Remove the service panel (see Section 3.2.1 on page 20).
10. Close the manual shut-off valve (see Figure 155 on page 182).
11. Re-attach the service panel (see Section 3.2.1 on page 20).

6.4.2 Prepare Gas Lines for Disconnection

NOTICE
If pressure is applied to a pressure regulator with low secondary pressure, the pressure regulator membrane may become damaged. Always ensure that the pressure regulator is closed, before opening the gas cylinder valve.

Purpose

Prepare the internal gas lines for transportation and storage of the laser device. The halogen gas line has to be evacuated and filled with inert gas to prevent corrosion during transportation and storage. The other gas lines have to be manually evacuated.

Tools and Materials

- Gases as specified (see Section 8.3 on page 224)

  If the remaining gas cylinder pressure drops below a critical value, the humidity in the gas may significantly increase. Only use gas cylinders with a remaining pressure of more than 20% of the initial value.

Preconditions

- Laser device switched on (no radiation being emitted)
- All housing covers correctly closed (“safety control module off” interlock not active).
- Laser tube prepared for transportation / storage

Filling the Halogen Line with Inert Gas

1. Ensure that the halogen gas cylinder valve is closed.
2. Open the pressure regulator in the halogen gas line.
3. Open the inert gas cylinder valve and set the pressure regulator to the required value in the range of 4.4 bar (abs) to 5.2 bar (abs).
4. Press <PURGE LINE> on the handheld keypad.
5. Press <Cursor Right> and/or <Cursor Left> to select HALOGEN.
6. Press <ENTER> to confirm the selection.
7. Press <EXE> to start the purging procedure.
   “OFF” appears in the display when the line purging has been completed.
8. Repeat step 7 at least five times to ensure that there are no halogen residues remaining in the gas line.

Finalization

9. Close the pressure regulators and gas cylinder valves in the external gas supply lines.

6.4.3 Drain Water Lines

Purpose

Turn off the external cooling water supply and drain the water lines.

Tools and Materials

- Compressed air (or similar gas) supply

Preconditions

- Laser device switched on (no radiation being emitted)

Turn Off the External Water Supply

1. Turn off the external water supply at the source.

Draining the Cooling Water

2. Where available and permitted, connect the compressed air hose to the cooling water inlet.
3. If the laser device is fitted with the automatic tube temperature regulation option, deselect the temeperature control mode:
   – Press <F5>,
   – Enter the appropriate password and press <ENTER>,
   – User the cursor keys to select TEMP CONTROL=OFF and press <ENTER>.
4. If connected, use compressed air to blow out the residual water.
5. If deselected in step 3, reselect TEMP CONTROL=ON.

6.4.4 Disconnect Water Lines

Purpose

Disconnect the water lines from the laser device.

Preconditions

- Laser device switched off (see Section 6.4.5)

Tools and Materials

- 17 mm wrench
- Suitable wipes or cloth for cleaning spilled water

Disconnecting the Water Lines

1. Place wipes or cloth below the external water line connections.
2. Use the 17 mm wrench key to disconnect the external water lines at the corresponding connections.

6.4.5 Shut Down Laser Device

Purpose

Shut down the laser device immediately prior to disconnection.

Tools and Materials

- None

Preconditions

- Laser tube filled with transportation fill (see Section 6.4.1)
- Halogen gas line purged and filled with inert gas (see Section 6.4.2)
- Inert, buffer and rare gas cylinders and pressure regulators closed (see Section 6.4.2)
- Water lines drained (see Section 6.4.3)

Shutting Down the Software

1. Press <F10> and press <Cursor Right> or <Cursor Left> until “SHUTDOWN” appears on the left of the display.
2. Press <ENTER> to confirm the selection.
3. Press <EXE> (B).
   “> SHUTDOWN ....” appears on the display while the laser device and laser control software are being shutdown.

Switching Off the Laser Device

4. When “SWITCH MAINS OFF” appears on the handheld keypad display, turn the key in the key switch counter-clockwise to the “O” setting.

WARNING
Prevent accidents through unauthorized operation!
To prevent unauthorized operation of the laser device, always remove the key from the key switch after shutting down the laser device. Keep the key in a safe place.

5. Remove the key from the key switch and keep in a safe place.
6. Turn the main switch counter-clockwise to the “OFF” setting.
   The LINE ON lamp goes out.

6.4.6 Disconnect Gas Lines

WARNING
Risk of exposure to harmful gas mixture!
Before disconnecting the halogen gas line, ensure that it has been thoroughly purged.

Purpose

Disconnect the gas lines from the laser device.

Tools and Materials

- 2.5 mm allen key
- 3 mm allen key
- 9/16” wrench
- Blanking plug for each gas line (removed during installation)

Preconditions

- Gas cylinder valves and pressure regulators in all external gas supply lines closed
- Laser tube filled with transportation fill (see Section 6.4.1)
- Halogen gas line purged and filled with inert gas (see Section 6.4.2)
- Inert, buffer and rare gas cylinders and pressure regulators closed (see Section 6.4.2)
- Laser device switched off (see Section 6.4.5)

Disconnecting the Gas Valve Block

1. Use the 2.5 mm and 3 mm allen keys to unscrew and slide back the halogen protection cover.
2. Taking into account that non-toxic overpressure will be released, use the 9/16” wrench to disconnect all external gas lines.
3. Use the 9/16” wrench to screw the blanking plugs onto the gas connections on the bulkhead.
4. Use the 2.5 mm allen key to re-attach the halogen protection cover.

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6.4.7 Disconnect Exhaust Line

Purpose

Disconnect the exhaust line from the laser device.

Tools and Materials

- 4 mm allen key
- Exhaust line assembly (3 m supplied with laser device)
- Connections to fume extraction or industrial ventilation system

Preconditions

- Laser device switched off (see Section 6.4.5)

Disconnecting the Exhaust Line

1. Disconnect the exhaust hose from the building ventilation output.
2. Remove the clamp and disconnect the exhaust tube from the exhaust flange.
3. Use the 4 mm allen key to remove the exhaust flange.
4. Use the 4 mm allen to re-insert the two 4 mm allen screws removed in step 3.

6.4.8 Disconnect Electrical and Signal Lines

Purpose

Disconnect the electrical and signal lines from the laser device.

Tools and Materials

- Appropriate screwdriver for the RS232 plugs used

Preconditions

- Laser device switched off (see Section 6.4.5)

Disconnecting the Mains Electrical Line

1. Disconnect the mains power supply plug into the mains socket.
2. Remove the mains power supply cable from the cable channel.

Disconnecting the Remote (Safety) Circuit

3. Disconnect the external safety circuit plug from the Remote socket.
4. Insert the dummy Remote plug into the Remote socket.

Disconnecting the Signal Lines

5. Use the appropriate screwdriver to loosen and disconnect the hand-held keypad interconnect from COM2.
6. Use the appropriate screwdriver to loosen and disconnect the other end of the interconnect from the hand-held keypad.
7. Use the appropriate screwdriver to loosen and disconnect the external computer system interconnect from COM1
8. Disconnect the other end of the interconnect from the external computer system.
9. Disconnect the trigger generator interconnect from TRIG IN.
10. Disconnect the synchronization interconnect from SYNC. OUT.

6.4.9 Install Transport Locks

Purpose

Secure the shutter and vacuum pump with the appropriate transport locking screws.

Tools and Materials

- 2.5 mm allen key
- 3 mm allen key

Preconditions

- Laser device switched off (see Section 6.4.5)

Installing the Transport Locks

1. Use the 2.5 mm allen to insert the transport locking screw and plastic washer into the marked position on the connection side of the laser device (see Figure 136 on page 159).
2. Use the 3 mm allen key to insert the transport locking screw into the shutter plate.

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6.4.10 Repackage Laser Device

WARNING
Risk of crushing!
The heaviest version of the COMPex*Pro* laser device weighs approx. 395 kg (870.8 lb) together with its rigid transport packaging and approx. 325 kg (715 lbs) without packaging. Prevent tipping or dropping during lifting and transportation.

When externally or internally moving the laser device and its components, always follow all standard safety precautions and practices for the transportation and handling of heavy equipment. Always use appropriate lifting equipment.

Purpose

Repackage the laser device in the two-stage transport packaging.

Tools and Materials

- Suitable fork-lift truck
- Rigid transport packaging for laser device and accessories
- Sheets of bolstering material
- Continuous steel strips
- Four new (unused) Shockwatch indicators
- Two new (unused) 3D-Tilt indicators
- Anti-static plastic cover for laser device
- Anti-static plastic bags for accessories
- Self-adhesive sealing tape

Preconditions

- Laser device secured for transport and ready for movement

Preparation

1. Ensure that all parts of the transport packaging are clean and undamaged.
2. Move the laser device's anti-static plastic transport cover and the anti-static plastic bags for the accessories to the laser device.

Fitting the Anti-Static Plastic Covers

3. Fit the anti-static plastic cover over the laser device.
4. Tape the bottom of the plastic cover to the bottom of the laser device.
5. Pack the accessories into suitable anti-static plastic bags.

Fitting the Rigid Transport Packaging

6. Move the laser device and packaged accessories into the packing area (see Section 6.1.9 on page 155).

WARNING
Risk of crushing!
The laser device without packaging weighs approx. 325 kg (715 lbs).
Never stay or work below the suspended laser device.
Ensure that no other persons enter the area below the suspended laser device.

NOTICE
When lifting the laser device onto the pallet, ensure that the feet are clear. Always slowly lower the laser device down onto its feet.

7. Use the fork-lift truck to lift the laser device onto the base pallet.
8. Attach the sheets of bolstering material to the laser device.
9. Working from the bottom upwards, attach the front, rear, side and top panels of the packaging and close the locks.
10. Attach the continuous steel strips to the rigid transport packaging.
11. Affix 3D-Tilt indicators (see Figure 156, A) to a long and a short side of the transport packaging.

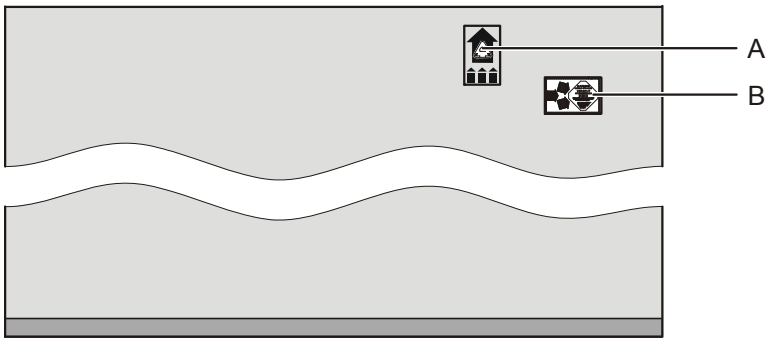

Figure 156: *Long side of packed laser device*

12. Affix Shockwatch indicators (see Figure 156, B) to each side of the rigid transport packaging.
13. Transport the laser device to the goods out area for dispatch (see Section 6.1.6 on page 152).

7 TROUBLESHOOTING

WARNING
Risk of serious injury or equipment damage!
Incorrectly performed troubleshooting can cause exposure to or contact with hazards such as laser radiation, lethal voltages and toxic or corrosive substances.
Only authorized and correspondingly trained personnel shall perform troubleshooting on the laser device. Strictly follow the instructions contained in this manual.

The following sections provide an overview of the interlock messages and warnings and briefly indicate fundamental solutions. If an issue cannot be resolved with the proposals made, call authorized service:

EUROPE
Coherent LaserSystems GmbH & Co. KG
Hans-Böckler-Straße 12
D - 37079 Göttingen, Germany

Tel.: +49 (551) 6938-345 / 306
Fax: +49 (551) 6869-358
eMail: ServiceGTG@coherent.com

U.S.A.
Coherent Inc.
5100 Patrick Henry Drive
Santa Clara, CA 95054, USA

Tel.: 1 (8 00) EXCIMER
+1 (408) 764-4090
Fax: +1 (503) 914-1490
eMail: cscfl@coherent.com

JAPAN
Coherent Japan Office:
Tokyo MK Building
7-2-14 Toyo
Koto-Ku, Tokyo
135-0016, Japan

Tel.: +81 (3) 5635-8770
Fax: +81 (3) 5635-8701
Internet: http://www.coherent.co.jp

KOREA
Coherent Asia Korea
Eagle Town 1F, 5F, 278-20, Seongsu 2ga-3 dong Seongdong-Gu
Seoul, 133-832, Korea

Tel.: +82 (2) 460-7911
Fax: +82 (2) 460-7901

Applicable Software

The procedures in this section assume that the Laser control software LCS V2.81 and higher is being used.

Related Information

The procedures in this section assume familiarity with frequently repeated actions. For further information about these actions please refer to the corresponding descriptions in the User Manual.

For troubleshooting, detailed wiring diagrams are available. If necessary, contact your local Coherent office to order a current version.

Status Code Display

Interlocks and warnings are indicated by a status code that appears after the currently active operating mode in the bottom line of the hand-held keypad display. If more than one interlock or warning is active, the corresponding status codes are separated by a comma.

When a status code other than “0” (laser OK) appears, press <F1> to display a help text. This text indicates the error status (warning or interlock) and provides a plain-language description of the malfunction. If more than one status code is active, press the appropriate cursor key to page through the help texts. To terminate the help text display, press <ENTER> or <BREAK>.

7.1 Interlocks

An interlock indicates a malfunction or critical interference in the functioning of the laser. The interlock can be triggered by a hardware device such as a switch or sensor (hardware interlock) or be triggered by a software monitoring function (software interlock).

When an interlock occurs, the operating mode is automatically switched to OPMODE=OFF. The extent to which the laser device is shut down and laser operation is inhibited as a response to an interlock varies depending on the circumstances and potential hazard. This case-related differentiation allows the laser to be safely restarted as quickly as possible after rectifying the malfunction. Communication with the laser device’s controller remains possible at all times.

The following table provides an overview of the interlock status codes and provides fundamental information regarding error rectification.

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No.	Interlock	Reason	Solution	Comment
0	Laser ok	- No interlock or warning active	- No action required	
2	Preset energy too high, check energy setpoint	- Energy set-point value too high - High voltage reaches HV_{max} or remains in HV Warning range for eight minutes (i.e. insufficient laser gas quality)	- Set energy to a valid value - Perform a new gas fill - Check optics lifetime and clean or exchange if necessary - Check that the gas mixture and gas quality is as specified - Check the energy monitor calibration - Check the alignment of the laser resonator - With triggering set to internal, low light off and COD off, check that the HV at the storage capacitors corresponds with the currently set value. If not, exchange the HV power supply - If the above measures provide no improvement, exchange the laser tube	This software interlock will be triggered after the “Preset energy too high” warning (status code 89).
6	Tube pressure out of range	- The laser tube pressure is either too high or too low - New gas fill required - Gas leak - Defective pressure sensor or poor signal - Tube temperature out of range	**WARNING** **Harmful gas hazard!** **Removing a housing cover will interrupt the exhaust flow and allow leaking gases to escape. Always purge the gas lines and laser tube before opening the housing.** - Check the sum of the gas partial pressures (gas menu) - Check pressure sensor signal line connections - Check for gas leaks - Perform a new gas fill - Exchange pressure sensor	Software interlock. If the laser device is not fitted with automatic temperature regulation, the pressure is to be between 0.8 p_N and 1.2 p_N (“p_N” is the total pressure given in the menu). For devices with automatic pressure regulation, the pressure is to be between 0.97 p_N and 1.05 p_N (“p_N” is the total pressure given in the menu with temp. compensation).

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No.	Interlock	Reason	Solution	Comment
10	Tube temperature too high	- No or insufficient flow of cooling water through the laser tube heat exchanger	- Check the cooling water supply (source, valves, flow, inlet pressure) - Check the tube temperature sensor and exchange if necessary - After fault rectification, press <BREAK> to clear the interlock and then reboot the laser device	Hardware interlock triggered by a thermal switch located on the laser tube. When the temperature returns to within the permitted range, the switch automatically closes itself The interlocks “safety control module off” (status code 122) and “reboot required” (status code 31) will also be triggered.
11	Ventilation motor failed	- Gas circulation fan motor damaged - Internal motor temperature switch has triggered as the motor has become too hot - Gas circulation fan does not turn properly or has seized up	- Try to reboot the laser device. If unsuccessful, exchange the gas circulation fan.	Hardware interlock.
16	Remote interlock switch is open	- The remote safety circuit has been interrupted (e.g. an external interlock switch has been activated)	- Use the short circuit plug at the Remote socket to determine if the internal or external circuit has triggered the interlock - If the short circuit plug, clears the interlock, the customer’s external safety circuit has to be checked (e.g. activated or defective switch or loose connection etc.) - If the short circuit plug, does not clear the interlock, use the appropriate circuit diagrams to check the interlock circuit in the laser device	Hardware interlock A “safety control module off” interlock (status code 122) will also be triggered.

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No.	Interlock	Reason	Solution	Comment
18	HV power supply ERROR	- Power supply HV charging circuit does not reach set HV level - Short circuit in HV charging circuit	- With triggering set to external, low light off and COD off, check that the HV at the storage capacitors corresponds with the currently set value. If not, exchange the HV power supply - Check the thyratron and, if necessary, exchange - Check the storage capacitors and, if necessary, exchange	This hardware interlock indicates an output overload, over-voltage or short circuit condition.
26	Low Light. > 30% of light pulses missing in 10 s	- At least 30% of all pulses in an interval of 10 seconds are below the energy detection threshold and more than 20 pulses have been triggered within this interval - High Voltage setting is too low	- Check gas fill (correct gas mixture, lifetime) - Check laser tube lifetime - Check optics - Check energy monitor connections - Increase the HV or energy set point - Check the thyratron triggering and exchange the thyratron supply unit or thyratron if necessary - Check the energy monitor and exchange if necessary	Software interlock The low light detection function can be by-passed to perform further tests by pressing F2 and entering the appropriate password.
27	No gas flow. Check gas bottle pressure	- “No gas flow. Check gas bottle pressure” warning (status code 23) ignored - Gas cylinder is empty - Gas cylinder valve is closed - Pressure regulator closed or setting incorrect - Defective solenoid valve	- Ensure that the gas cylinders are not empty - Ensure that the gas cylinder valves are open - Ensure that the pressure regulators are correctly set - Check the operation of the valves in the gas manifold and exchange the gas manifold if necessary	Software interlock. A “No gas flow. Check gas bottle pressure” warning (status code 23) always occurs before this interlock is triggered.
30	Configuration error detected	- No valid set of parameters can be loaded from the FRAM	- Update the laser control software - Exchange the LCB	Software interlock
31	Reboot required	- The tube temperature interlock (status code 10) has been activated. The laser control software has to be rebooted to reset the safety control relay	- Follow the instructions to rectify the fault that caused the interlock. Following this, switch the laser device off and then on again to reboot the laser control software	Software interlock

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No.	Interlock	Reason	Solution	Comment
42	Cover 1 open. Service panel open	- Cover interlock triggered as the service panel (cover 1) is open	- Close the service panel and press <BREAK> before restarting laser operation - Check the interlock switch and exchange if necessary	Hardware interlock that inhibits laser operation and gas actions. A “safety control module off” interlock (status code 122) will also be triggered.
46	Liquid leak detected	- The liquid sensor detects liquid at the bottom of the laser device housing	- Check cooling water temperature (if cooling water is too cold, condensation my occur) - Check cooling water connections inside the laser device housing - Check the liquid sensor and exchange if necessary	Hardware interlock
49	HV power supply temperature too high	- The HV power supply is running too hot - HV power supply fuse (F6) has blown. This also disables the thyratron supply voltage	- Check for excessive ambient temperature - Check fuse and, if necessary, replace - Check operation of the fans in the laser device housing and EMI cover and exchange if necessary - Exchange HV power supply	Hardware interlock
62	Halogen filter exchange required	- The halogen filter filling capacity has been exceeded - The corresponding maintenance counter and warning code 103 have been ignored	- Exchange the halogen filter and reset the halogen filter filling capacity indicator	Software interlock. No further gas actions are permitted
63	HI/PGR request time out	- The predefined period to perform the requested gas action (3600 sec) has elapsed	- Restart the laser and send the necessary command to start the required gas action (see status code 104). - Manually perform the required gas action	Software interlock
95	Max. power	- Calculated power exceeds the max. power parameter - The energy monitor calibration is completely incorrect	- Reduce the energy setting, HV setting or repetition rate - Check the energy monitor calibration	Software interlock

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No.	Interlock	Reason	Solution	Comment
120	Cover 2 open. Front mirror access panel open	- Cover interlock triggered as front mirror access panel (cover 2) is open	- Close the respective access panel and press <BREAK> before restarting laser operation - Check the respective interlock switch and exchange if necessary	Hardware interlock that inhibits laser operation and gas actions. A “safety control module off” interlock (status code 122) will also be triggered.
121	Cover 3 open. Rear mirror access panel open	- Cover interlock triggered as rear mirror access panel (cover 3) is open		
122	Safety control module off	- Either or both channels of the interlock circuit has been interrupted by activation of a cover interlock (status codes 42, 120 or 121), an external interlock switch (status code 16), or an over-temperature switch (status code 10)	- Follow the instructions relating to the other hardware interlock status code that is displayed - Press <BREAK> to clear the interlock after physical rectification - If the interlock is not cleared by pressing <BREAK>, interrupt both channels of the interlock circuit (e.g. open a cover or disconnect the remote safety circuit) while the laser device is running and then close both channels and press <BREAK> - Check for a fault in the safety circuit (e.g. defective switch). After repair, check the correct operation of the safety circuit before restarting the laser.	Hardware interlock Never reboot the laser device in an attempt to clear a cover or remote interlock. The laser control software remembers that the interlock has been triggered and not correctly cleared and will issue a warning (status code 69) after each restart of the laser device. Always reboot the laser device after an over-temperature interlock
125	Tube temperature too high	- Indicated temperature exceeds the max. tube temperature parameter	- Check the cooling water supply (source, valves, flow, inlet pressure) - Check the water flow regulating valve (where fitted) and exchange if necessary	Software interlock
127	Communication time out	- No communication through the serial interface within set time period or communication corrupted	- Check that the handheld keypad or control computer is correctly connected to the serial interface - Check the COM port settings in the laser control software - Check the 24 V power supply connections to the interface board - Exchange the interface board	Software interlock

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No.	Interlock	Reason	Solution	Comment
128	Tube pressure sensor failed	- The tube pressure sensor reading is outside of the parameter range	- Check the connections to the tube pressure sensor - Exchange the tube pressure sensor	Software interlock
130	Tube temperature sensor failed	- The tube temperature sensor reading is outside of the parameter range	- Check the connections to the tube temperature sensor - Measure resistance of the BNC connection - Exchange the tube temperature sensor	Software interlock
157	Gas action timeout	- A gas action could not be completed within the max. permitted time	- Check the external gas supply (cylinder pressure and valves, settings of pressure regulator) - Check for leaks - Check that the manual shut off valve is open - Check the operation of the vacuum pump and exchange if necessary - Check the operation of the valves in the gas manifold and exchange the gas manifold if necessary	Software interlock
182	Gas mismatch. Gas mixture in tube <> selected gas menu	- Gas mixture does not correspond with the currently active gas menu - Tube flushing, transport fill, passivation fill or safety fill has been carried out (no excimer laser gas in laser tube)	- Check the currently active gas menu - Perform a new gas fill	Software interlock The interlock is reset by a new fill
220	Watchdog error. Fatal error, call service	- Fatal internal software error. Watchdog will no longer be automatically reset	- Exchange LCB	Software interlock
221	External gas failure	- A failure has been detected in the external gas circuit - The corresponding contacts in the Remote connector are open	- Check the external gas supply circuit - Check the Remote connector - Test with the dummy remote plug	Software interlock
224	Tube pressure too high	- The gas pressure in the laser tube has reached the predetermined upper limit. Any further increase will cause the rupture disk to burst. Do not try to fill additional gas into the tube!	- Perform a new gas fill - Feel the laser tube, if excessively hot, exchange the tube overtemperature switch (reed switch)	Software interlock

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7.2 Warnings and Messages

Warnings will automatically be cleared if the corresponding parameter becomes within it's limits, if the corresponding missing signal is detected or if the corresponding error state has been rectified. In some cases, an interlock may be triggered after a pre-defined warning period.

The following table provides an overview of the status codes and warnings and contains basic information regarding error rectification.

No.	Warning	Reason	Solution	Comment
0	Laser ok	- No interlock or warning active	- No action required	
21	Warm-up	- Laser device has just been switched on. The thyratron is warming up	- Wait until the thyratron has warmed up before starting laser operation	The default value for the warm-up period is 8 minutes
23	No gas flow. Check gas bottle pressure	Gas flow too low during a gas action - Gas cylinder is empty - Gas cylinder valve is closed - Pressure regulator closed or setting incorrect - Defective solenoid valve	- Ensure that the gas cylinders are not empty - Ensure that the gas cylinder valves are open - Ensure that the pressure regulators are correctly set	If the warning is ignored, a "No gas flow. Check gas bottle pressure" interlock will occur (status code 27)
25	Preset energy too low, check energy setpoint	- High voltage has reached HV_{min} but the energy output is still higher than preset value (entered value is out of range)	- Enter a new value within the permitted range - Check gas partial pressures - Calibrate the energy monitor	
32	No vacuum. Vacuum detection time-out	Set time period to evacuate the laser tube to the set point pressure has been exceeded - Halogen filter leak or gas leak - Vacuum pump failure	- Check halogen filter for leak - Audibly check if the vacuum pump starts correctly - Check vacuum pump fuse - Check vacuum pump and vacuum pump connections - Check that the manual shut-off valve is open	A safety fill will automatically be carried out *NOTICE* Risk of seriously damaging laser tube! Each attempt to evacuate a leaking laser tube allows atmospheric oxygen to penetrate the laser tube.

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No.	Warning	Reason	Solution	Comment
51	Internal gas purifier error	- Short circuit at internal gas purifier	- Disconnect the gas purifier power supply and restart the laser device. If the warning remains, exchange the gas purifier power supply. If the warning disappears, there may be a short circuit in the gas purifier (in this case call service support).	If operation is continued in this state, optic lifetime may be reduced
64	Tube temperature too high	- No or insufficient flow of cooling water through the laser tube heat exchanger	- Check water supply (flow, pressure, temperature) - Check environmental conditions - Check that the cooling fan is correctly operating	If no action is taken, the “Tube temperature too high” interlock will be triggered (status code 125)
69	Check safety relay	- Only one channel of the remote interlock circuit was opened - The laser device was switched off with a remote interlock active (status code 16)	- Rectify the reason for the activation of the Remote interlock (status code 16) as described in Section 7.1, - After rectifying the interlock, interrupt and then close both channels of the safety circuit, e.g. by physically triggering and rectifying a cover interlock. Press <BREAK> to confirm that the interlock has been cleared	
89	Preset energy too high	- High voltage reaches the HV Warning Range (i.e. insufficient laser gas quality)	- Check energy setpoint - Perform a new gas fill - Check optics lifetime - Check gas mixture and quality of gases	If no action is taken, the “Preset energy too high, check energy setpoint“ interlock will be triggered (status code 2).
103	Halogen filter exchange required soon	- The filling capacity of the halogen filter calculated by the software on the basis of the executed gas actions has been reached	- Exchange the halogen filter and reset the halogen filter filling capacity indicator	No further gas actions can be carried out until the halogen filter has been exchanged. The next attempt to carry out a gas action triggers the “Halogen filter exchange required” interlock (status code 62)

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No.	Warning	Reason	Solution	Comment
104	Laser request: HI/PGR	- The automated gas action algorithm indicates that a PGR or macro PGR is required	- Manually activate the required gas action by pressing <ENTER> on the handheld keypad or sending the command OPMODE=HI/PGR	This warning only occurs in the PGR Request mode If no action is taken, the “HI/PGR request time out“ interlock will be triggered (status code 63)
123	Tube pressure too high	- The gas pressure in the laser tube is too high	- Perform a new gas fill - Check the pressure sensor	
124	Tube temperature too low	- The laser has just been started and the gas has not reached the required operating temperature - Malfunction in the laser cooling circuit	- If the warning occurs when the laser is initially started, allow the laser to run for a few minutes. The warning should disappear when the gas reaches the required operating temperature - If the laser is operating at low duty cycle with a low HV value, reduce the water flow rate	When the laser is operated when this warning is active, the required performance specifications may not be attained.
126	Leak test failed	- Excessive temperature change during the leak test - The pressure drop during the leak test after exchanging the tube optics exceeded the permitted threshold	- Press <ENTER> to repeat the leak test - Check the newly installed tube optics for leaks	
223	Tube pressure high	- The gas pressure in the laser tube has almost reached the predetermined upper limit.	- Perform a new gas fill	If the pressure continues to rise, the “Tube pressure too high“ interlock will be triggered (status code 224)

(Sheet 3 of 3)

D149033 [AA]

8 APPENDIX

This chapter provides an overview of the dedicated service software packages available for the COMPex*Pro* laser device, lists the primary operating specifications and contains a list of abbreviations used in the COMPex*Pro* documentation.

8.1 LCS Monitor Service Software

NOTICE
Incorrectly defined laser control software parameters can seriously impair laser operation. Always consult the Coherent Continental Service Center before changing the values of any laser control software parameters.

This section provides an overview of the “LCS Monitor” service software program CMPX_MON.exe. This program enables the checking and modification of parameter settings as well as control of the laser through a laptop computer.

CMPX_MON.exe can be obtained from Coherent service. It is a program initially developed for Windows XP that works together with a device-specific settings file in either a binary (*.nvs) or text format (*.txt).

The laptop computer with CMPX_MON.exe and the appropriate *.nvs or *.txt file has to be connected through one of its serial interfaces to the port COM1 on the laser device (see Figure 157).

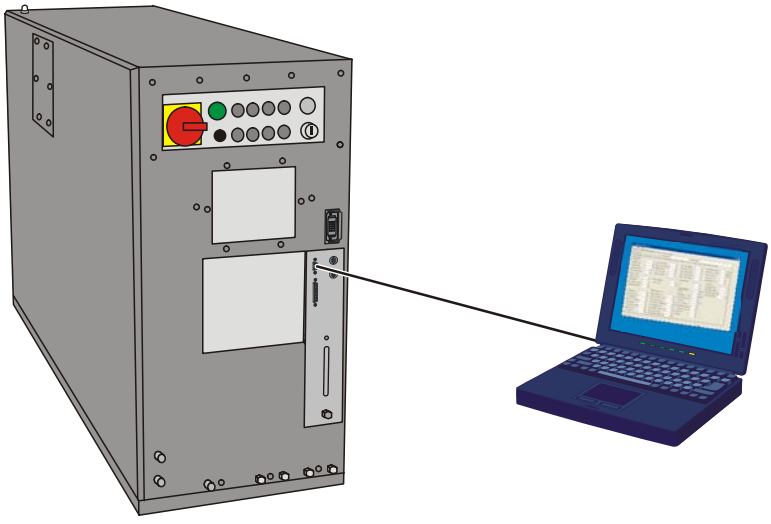

Figure 157: *Connecting CMPX_MON.exe laptop to the laser device*

8.1.1 Overview of User Interface

After starting CMPX_MON.exe, the screen shown in Figure 158 appears.

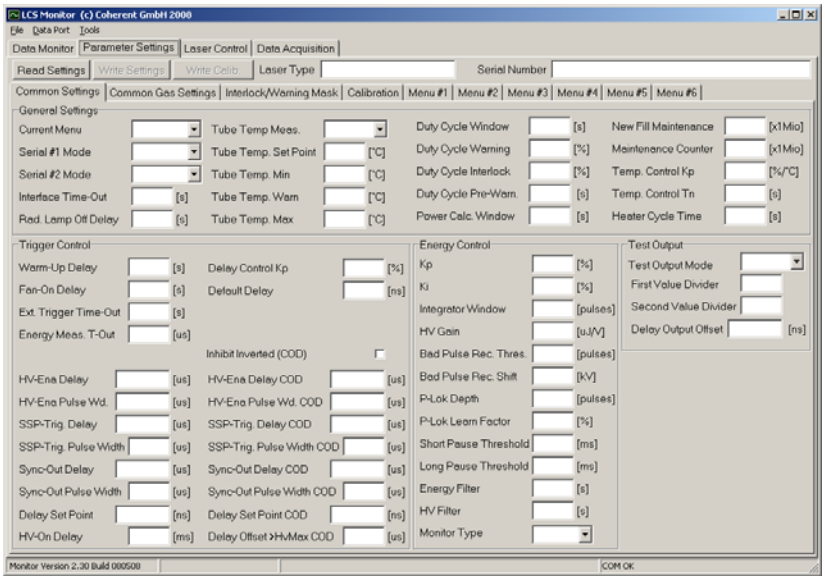

Figure 158: *CMPX_MON.exe start screen*

This fundamentally consists of:

– a menu bar with the pull-down menus:
  – File (see Section 8.1.1.1)
  – Data Port (see Section 8.1.1.2)
  – Tools (see Section 8.1.1.3)
– the tab controls and the corresponding screens:
  – Data Monitor (see Section 8.1.1.4)
  – Parameter (see Section 8.1.1.5)
  – Laser Control (see Section 8.1.1.6)
  – Data Acquisition (see Section 8.1.1.7)

The software version and COM port status is indicated in the bottom line of the screen.

8.1.1.1 File Menu

The *File* pull-down menu is shown in Figure 159.

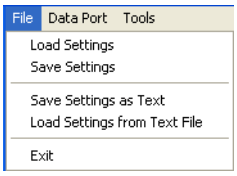

Figure 159: *File menu*

Load Settings enables a binary laser parameter file (*.nvs) to be loaded from the laptop into the “LCS Monitor” service software program. This, for example, allows factory-updated laser parameter settings to be adapted for a specific laser device before being downloaded onto the laser control board.

Save Settings enables the current settings in the “LCS Monitor” service software program to be saved as a binary file (*.nvs), onto the laptop.

Save Settings as Text enables the current settings in the “LCS Monitor” service software program to be saved as a text file (*.txt), onto the laptop. This, for example, allows the current settings to be saved as a plain language file for subsequent analysis.

Load Settings as Text File enables a laser parameter text file (*.txt) to be loaded from the laptop into the “LCS Monitor” service software program. Any inconsistencies in the file will be indicated in a dialog window.

Exit terminates the “LCS Monitor” service software program.

8.1.1.2 Data Port Menu

The *Data Port* menu (see Figure 160) selects the serial port of the laptop computer through which communication with the laser device is to occur.

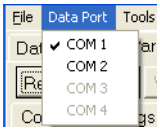

Figure 160: *Data Port menu*

The available ports are written in black. The currently active port (COM1 in Figure 160) is indicated by a check mark.

8.1.1.3 Tools Menu

The *Tools* menu currently only has one item: *Send Time/Date*. This sets the laser device's internal clock so that it corresponds with the time and date of the laptop computer.

8.1.1.4 Data Monitor Screen

The *Data Monitor* screen (see Figure 161) is intended for software debugging. It provides lists of the individual addresses on the laser control board, indicating their current decimal and hexadecimal values.

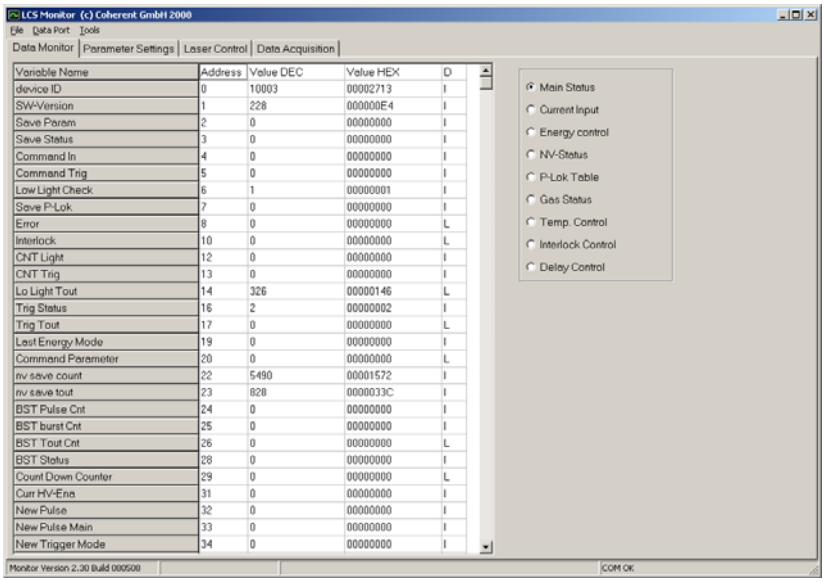

Figure 161: *Data Monitor screen*

Radio buttons on the right of the screen select the individual groups of addresses.

- *Main Status* displays the addresses starting at 0.
- *Current Input* displays the addresses starting at 1000.
- *Energy Control* displays the addresses starting at 1200.
- *NV-Status* displays the non-volatile addresses starting at 14000.
- *P-Lok Table* displays the Powerlok addresses starting at 10000.
- *Gas Status* displays the addresses starting at 11000.
- *Temp. Control* displays the temperature control addresses starting at 12000.
- *Interlock Control* displays the addresses starting at 13000.
- *Delay Control* displays the addresses starting at 15000.

8.1.1.5 Parameter Screen

The *Parameter* screen (see Figure 162) is the default choice after starting the “LCS Monitor” service software program. It has three buttons and ten tab controls.

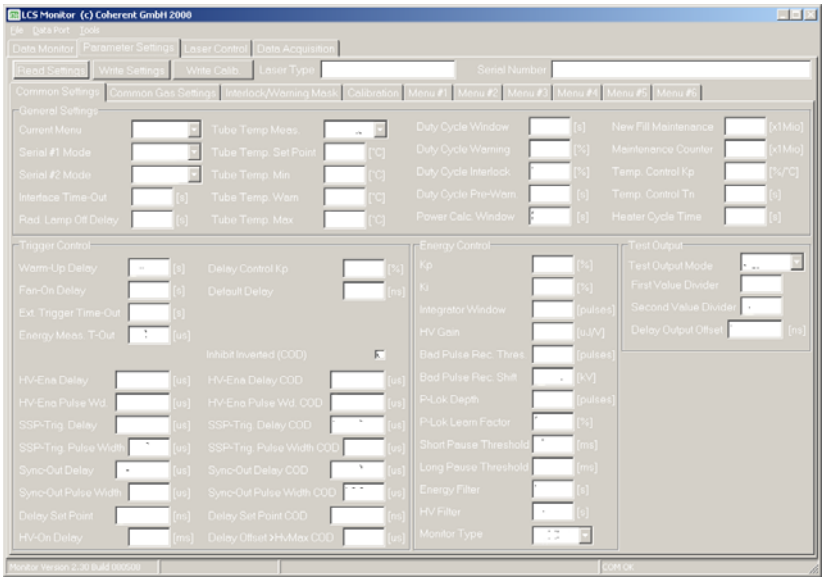

Figure 162: *Parameter screen with Common Settings*

Parameter settings can be loaded into the *Parameters* screen for evaluation and modification through the *Load Settings* items in the *File* menu (see Section 8.1.1.1) or the *Read Settings* button (see below).

Buttons

The *Read Settings* button downloads the current settings from the non-volatile memory (FRAM = ferroelectric random access memory) of the connected laser device to the “LCS Monitor” service software program. The downloaded settings are grouped into various menus. Each menu is displayed by selecting the appropriate tab.

The *Write Settings* button uploads the settings displayed in each of the menus except the *Calibration* menu to the FRAM on the laser control board (LCB) of the connected laser device. All parameter settings on the LCB are overwritten. Once the settings on the LCB have been overwritten there is no possibility of restoring the previous factory settings.

The *Write Calib.* button uploads the settings displayed in the *Calibration* menu to the FRAM on the laser control board (LCB) of the connected laser device. All calibration settings on the LCB are overwritten. Once the settings on the LCB have been overwritten there is no possibility of restoring the previous factory settings.

Menus

The *Common Settings* menu (see Figure 162) contains the general parameter settings (e.g. selected gas menu, serial interface mode and tube temperature setpoint) as well the settings for trigger control, COD and energy control. To upload any changes made in this menu to the laser device, press *Write Settings*.

The *Common Gas Settings* menu (see Figure 163) contains the settings for gas actions and the gas system check. To upload any changes made in this menu to the laser device, press *Write Settings*.

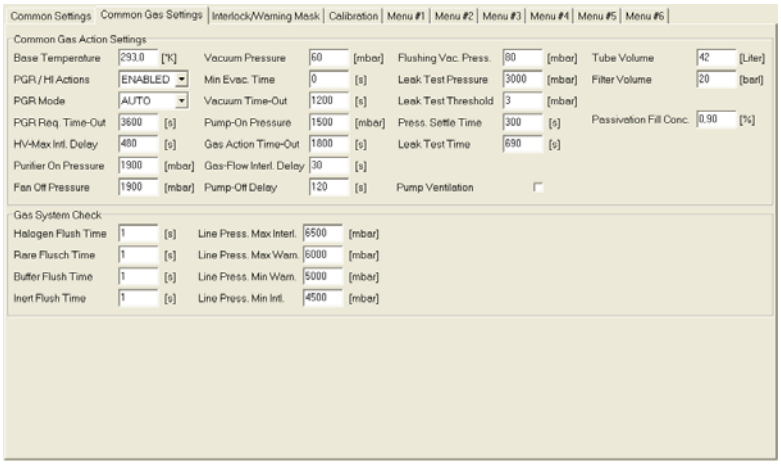

Figure 163: *Common Gas Settings menu*

The *Interlock/Warning Mask* menu (see Figure 164) indicates the active interlock and warning messages. For troubleshooting purposes, the output of individual interlock or warning messages can be suppressed by deactivating the respective check box and pressing *Write Settings*. The deactivated message will no longer be output by the laser control software when the corresponding condition occurs. After restarting the laser device, all messages are automatically active again.

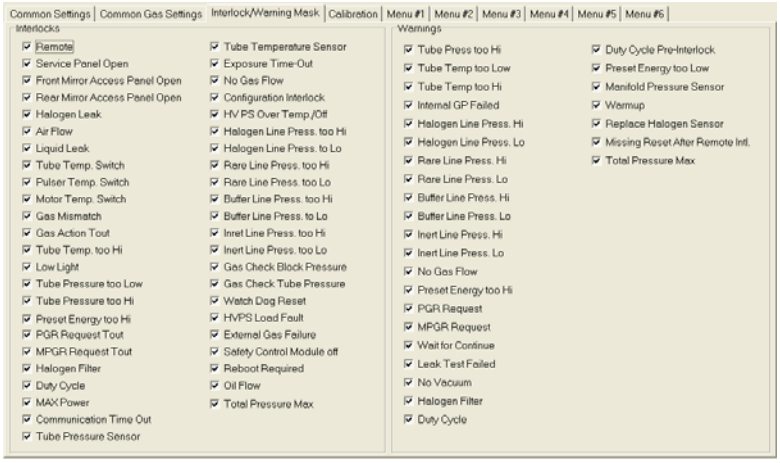

Figure 164: *Interlock / Warning menu*

NOTICE
Incorrectly defined calibration settings can damage the laser device! Always consult the Coherent Continental Service Center before changing any calibration settings.

The *Calibration* menu (see Figure 165) indicates the current settings of various sensors in the laser device such as the tube temperature sensor and tube pressure sensor. To upload any changes made in this menu to the laser device, press the *Write Calib.* button.

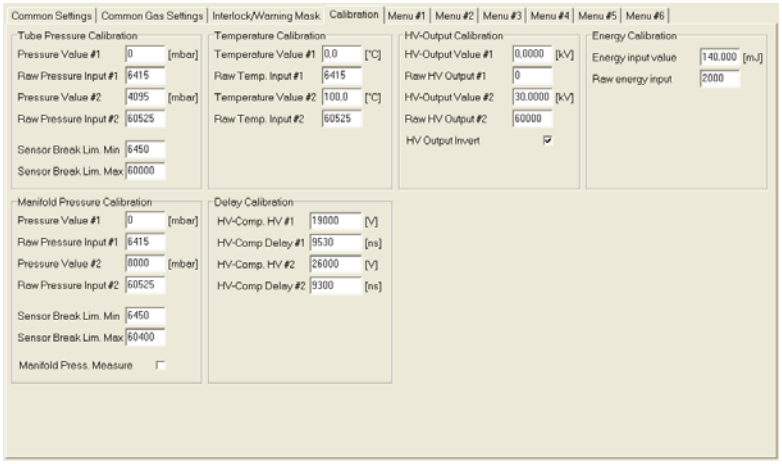

Figure 165: *Calibration menu*

Menu #1 to *Menu #6* (see Figure 166) indicate the current settings in the individual gas menus. The currently active gas menu is indicated in the *Common Settings* menu. To upload any changes made in these menus to the laser device, press *Write Settings*.

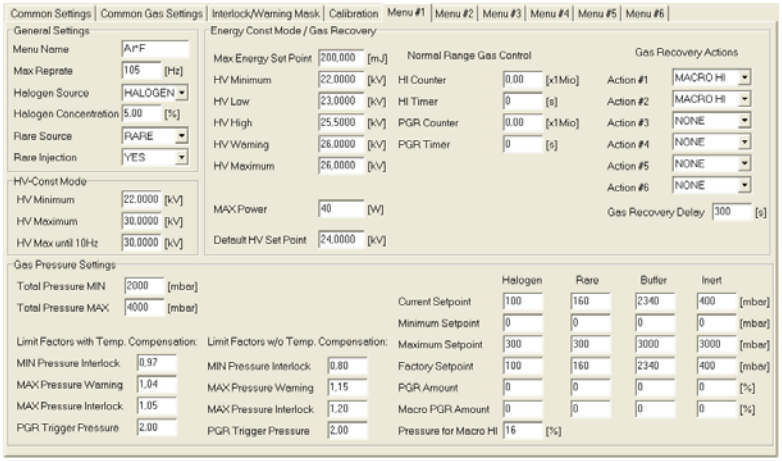

Figure 166: *Gas menu*

8.1.1.6 Laser Control Screen

NOTICE
Risk of system damage or downtime!
All command buttons on the *Laser Control* screen directly start the corresponding laser function without any futher prompts. No commands are password protected. Only specifically trained and authorized service personnel shall operate the laser device through the “LCS Monitor” *Laser Control* screen.

The *Laser Control* screen (see Figure 167) allows direct control of the connected laser device when “Host” (COM1) is selected as the laser device’s control device. All relevant operating paremeters are downloaded from the laser device and displayed in the respective fields of this screen. The values in fields with a white background can be changed by the user.

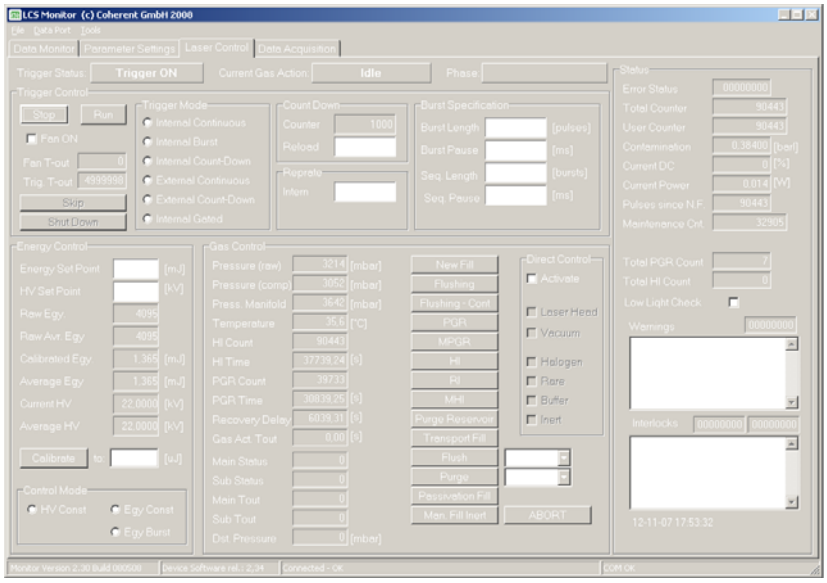

Figure 167: *Laser Control screen*

Pressing the appropriate command button (e.g. RUN, STOP or NEW FILL) will immediately start the corresponding routine in the laser device.

8.1.1.7 Data Acquisition Screen

The *Data Acquisition* screen (see Figure 168) enables the laser device's output energy and HV to be graphically displayed.

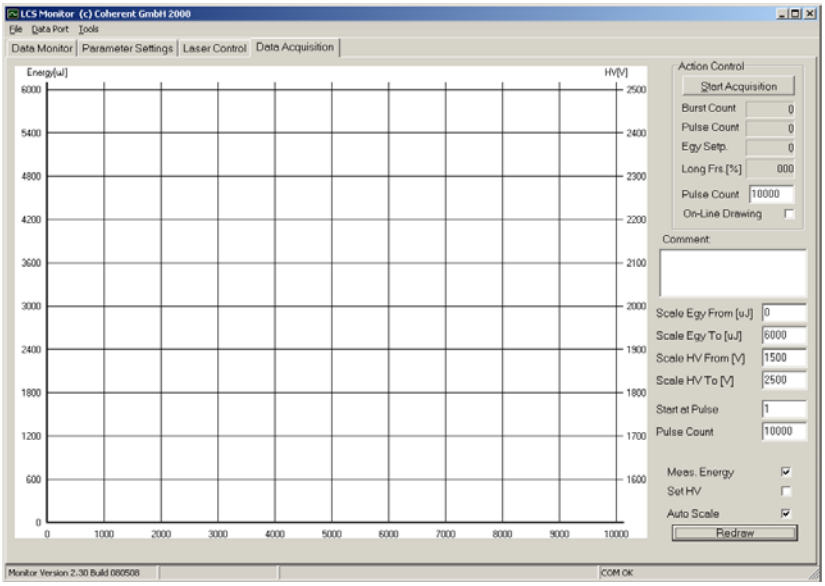

Figure 168: *Data Acquisition screen*

The *Start Acquisition* button starts the acquisition of the data that is to be graphically represented.

The *Pulse Count* field determines the number of laser pulses that are to be emitted during the data acquisition procedure.

The *On-Line Drawing* check box (when activated) updates the display while recording.

The fields *Scale Egy From* and *...To* and *Scale HV From* and *...To* define the upper and lower values of the vertical scales on the chart. To enable the scales to be changed, the *Auto Scale* check box has to be deactivated.

The *Auto Scale* check box (when activated) automatically selects the appropriate scale to provide the clearest display of the acquired data.

The *Redraw* button updates the chart. This button has to be pressed to graphically represent the recently acquired data if the *On-Line Drawing* check box is not active. It also has to be pressed to update a change of scale on the chart.

8.1.2 Operating Routines

This section briefly describes some of the operations that can be carried out using the “LCS Monitor” service software program. For a detailed description of the procedure to perform a laser control software update, please refer to Section 5.27 on page 134.

8.1.2.1 Establish Communication

Purpose

Establish communication between the laser device’s laser control board and the laptop PC.

Preparation

1. Connect the serial port COM1 on the laser device to a serial port on the laptop PC.
2. Start the laser device.

Setting Up the Laser Device

1. Press <F10> on the hand-held keypad and select “COM1MODE”.
2. Use the cursor keys to select “Ser”.
3. Press <EXE> to change the mode of COM1 to Service.

Setting Up the Laptop PC

4. Start the “LCS Monitor” service software program.
5. Select the appropriate port on the laptop PC in the “Data Port” menu.

8.1.2.2 Download Laser Operating Parameters

Purpose

Download the operating parameters from the laser control board’s FRAM to the “LCS Monitor” service software program.

Downloading Operating Parameters

1. Establish communication between the laser control board and laptop PC (see Section 8.1.2.1).
2. Click “Parameter Settings”
3. Click “Read Settings”.

   The settings of the connected laser device appear in the displayed menu.

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8.1.2.3 Save Laser Operating Parameters as Text File

Purpose

Save the downloaded laser operating parameters as a plain language text file.

Saving Parameters as Text File

1. Download the laser operating parameters from the FRAM on the laser control board (see Section 8.1.2.3).
2. Open the “File” pull-down menu.
3. Click “Save Settings as Text”.
4. Select the directory and enter the file name under which the settings are to be saved.
5. Click “SAVE”.

8.1.2.4 Save Laser Operating Parameters as Binary File

Purpose

Save the downloaded laser operating parameters as a binary (*.nvs) file.

Saving Parameters as Binary File

1. Download the laser operating parameters from the FRAM on the laser control board (see Section 8.1.2.3).
2. Open the “File” pull-down menu.
3. Click “Save Settings”.
4. Select the directory and enter the file name under which the settings are to be saved.
5. Click “SAVE”.

8.1.2.5 Graphically Display Laser Output Performance

Purpose

Use the Data Acquisition function to graphically display the output of the laser. Where required, the displayed output can be captured and saved on the laptop PC with a raster graphics editor (e.g. Microsoft Paint .

Preparation

1. Establish communication between the laser control board and laptop PC (see Section 8.1.2.1).
2. Use the Laser Control screen (see Section 8.1.1.6) to make sure that the laser operating parameters are correctly set for the data acquisition procedure.
3. Start the laser.

Starting the Data Acquisition

4. Click the “Data Acquisition” tab to select the “Data Acquisition” screen (see Section 8.1.1.7 on page 217).
5. Set the cursor into the “Pulse Count” field and enter the number of pulses that are to be emitted during the data acquisition procedure.
6. Where required, deactivate the “Auto Scale” check box and define the scale of the chart in the corresponding fields.
7. Where required, activate the “On-Line Drawing” check box.
8. Click the “Start Acquisition” button.

   If “On-Line Drawing” is active, the output of the laser will be immediately displayed (see Figure 169). If “On-Line Drawing” is not active, click “Redraw” to display the laser output.

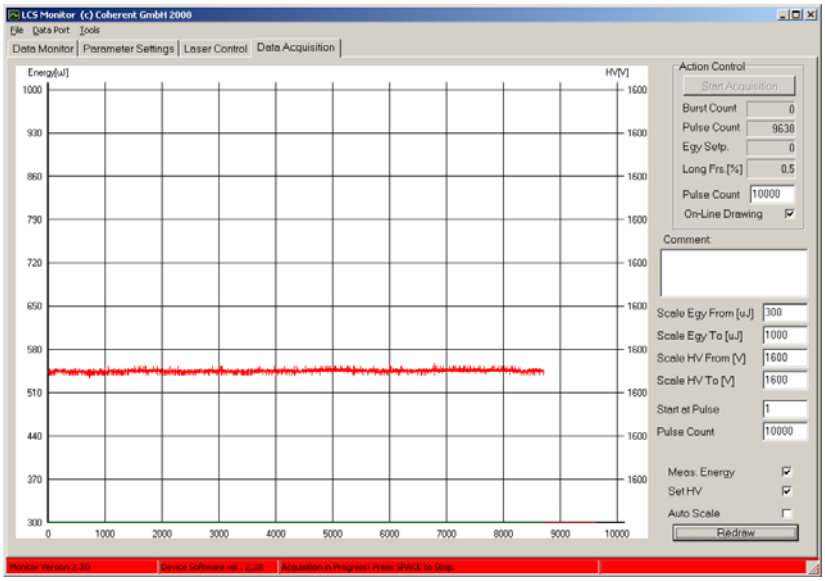

Figure 169: *Data acquisition and display in progress*

Saving the Graphic Display

9. Start the raster graphics editor on the laptop PC.
10. Switch to the “LCS Monitor” service software program and press <ALT>+<PRINT SCREEN> to capture the current screen.
11. Switch to the raster graphics editor and use the appropriate command to insert the captured graphic.

12. Save the displayed graphic as a raster graphics file (e.g. in *.png or *.bmp format). It is advisable to include the date and time of the capture as well as the identification of the laser device in the file name.

8.2 LASCONTROL Service Menu

LASCONTROL is a user interface to the laser control software that is installed on a PC and can be used instead of the handheld keypad to control the laser device. The system requirements, installation and fundamental operation of the LASCONTROL software package are described in the dedicated LASCONTROL Software Manual.

This section provides an overview of the password-protected Service menu (see Figure 170) that is exclusively intended for correspondingly trained service personnel. This menu contains certain commands that are not available through the hand-held keypad.

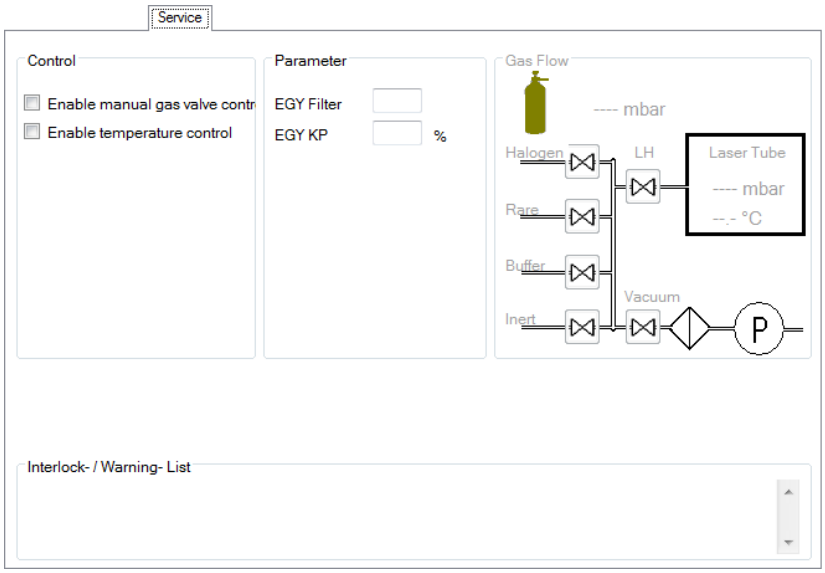

Figure 170: *LASCONTROL Service menu*

The Service menu is divided into the following sections:

– Control (see Section 8.2.1 on page 222)
– Parameter (see Section 8.2.2 on page 222)
– Gas Flow (see Section 8.2.3 on page 223)
– Interlock / Warning List (see Section 8.2.4 on page 224)

The purpose of the individual operating and display elements is described in the following subsections.

8.2.1 Control

The check boxes in the Control section (see Figure 171) enable or disable dedicated switching and control functions.

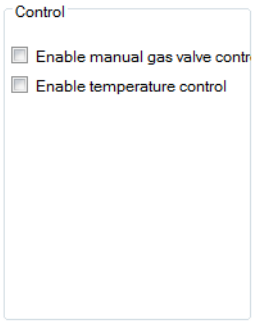

Figure 171: *Control section of LASCONTROL Service menu*

Enable Manual Gas Valve Control

The Enable Manual Gas Valve Control check box activates the Gas Flow section of the Service menu to allow the solenoid gas valves and vacuum pump to be manually operated (see Section 8.2.3).

Enable Temperature Control

The Enable Temperature Control check box is only available if the laser device is equipped with the automatic temperature regulation option. It defines the status of the tube temperature measurement closed loop. When the check box is checked, the tube temperature measurement function is enabled.

8.2.2 Parameter

The input boxes in the Parameter section (see Figure 172) enable operating parameters to be changed. Always consult your local service support center before changing any of the values in this section of the menu.

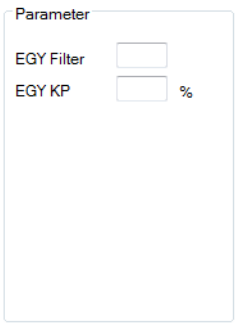

Figure 172: *Parameter section of LASCONTROL Service menu*

EGY Filter

The EGY Filter input box enables the input of the time period during which the average energy that is to be displayed is calculated. This period is indicated in units of 1/10 second. The default value is 10 (i.e. one second).

For instance, the value 50 indicates that the average energy for display is to be calculated over a period of five seconds. If no filter is required, the value 00 has to be set.

EGY KP

The EGY KP input box enables the sensitivity of the energy controller to be set for operations in the energy constant mode. A higher value will increase the sensitivity so that the high voltage will be changed faster to compensate for energy deviations. This value is optimally set when the laser device is shipped and should normally never be amended.

8.2.3 Gas Flow

The gas flow menu (see Figure 173) enables the pneumatically actuated valves as well as the vacuum pump in the gas supply and exhaust circuit to be directly controlled. It contains a gas flow diagram and hotspots that can be clicked to actuate the corresponding valve or pump.

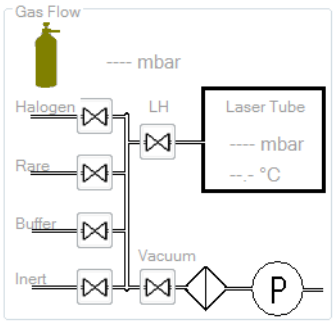

Figure 173: *Gas Flow section of LASCONTROL Service menu*

The laser tube pressure and temperature box displays the readings provided by the respective sensors in the laser tube.

The manifold pressure display has no function as the COMPex*Pro* is not fitted with a pressure sensor in the gas manifold.

8.2.4 Interlock / Warning List

The Interlock / Warning List (see Figure 174) provides the number and plain language description of all interlocks and warnings that currently exist. This information is used in conjunction with the descriptions in Section 7 on page 197 to determine the reason for the interlock or warning as well as the necessary corrective action.

The interlock or warning that has most recently occurred is shown at the top of the list. In the example shown in Figure 174, a warning was ignored sufficiently long for a related interlock to occur.

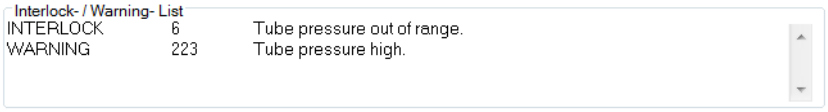

Figure 174: *Interlock / Warning List with active entry*

8.3 Specifications

This section lists the specifications that the respective laser device needs to correspond with to perform its intended function as a light source.

Due to the COHERENT policy of continuous optimization of their laser devices, the data contained in this chapter is subject to variation.

8.3.1 COMPex*Pro*

8.3.1.1 Laser Beam Parameters

COMPex*Pro* 50

Characteristic	ArF	KrF
Nominal wavelength	193 nm	248 nm
Max. repetition rate	50 Hz	50 Hz
Max. pulse energy	100 mJ	150 mJ
Max. average power	4 W	7 W
Energy stability, 1 Sigma	2%	1%

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COMPex*Pro* 102

Characteristic	ArF	KrF	XeCl	XeF
Nominal wavelength	193 nm	248 nm	308 nm	351 nm
Max. repetition rate	20 Hz	20 Hz	20 Hz	20 Hz
Max. pulse energy	200 mJ	400 mJ	250 mJ	200 mJ
Max. average power	4 W	7 W	5 W	4 W
Energy stability, 1 Sigma	2%	1%	2%	2%

COMPex*Pro* 110

Characteristic	ArF	KrF	XeCl	XeF
Nominal wavelength	193 nm	248 nm	308 nm	351 nm
Max. repetition rate	100 Hz	100 Hz	100 Hz	100 Hz
Max. pulse energy	200 mJ	400 mJ	250 mJ	200 mJ
Max. average power	12 W	30 W	16 W	12 W
Energy stability, 1 Sigma	2%	1%	2%	2%

COMPex*Pro* 201

Characteristic	ArF	KrF	XeCl	XeF
Nominal wavelength	193 nm	248 nm	308 nm	351 nm
Max. repetition rate	10 Hz	10 Hz	10 Hz	10 Hz
Max. pulse energy	400 mJ	700 mJ	500 mJ	300 mJ
Max. average power	4 W	5 W	3.5 W	3 W
Energy stability, 1 Sigma	2%	1%	2%	2%

COMPex*Pro* 205

Characteristic	ArF	KrF	XeCl	XeF
Nominal wavelength	193 nm	248 nm	308 nm	351 nm
Max. repetition rate	50 Hz	50 Hz	50 Hz	50 Hz
Max. pulse energy	400 mJ	700 mJ	500 mJ	300 mJ
Max. average power	15 W	30 W	20 W	15 W
Energy stability, 1 Sigma	2%	1%	2%	2%

8.3.1.2 Gases

Premix Gas

Gas mixture	see corresponding table
Purity	Excimer grade
Inlet pressure range	4.4 bar (abs) to 5.2 bar (abs)
Flow rate range	0.05 l/s to 0.5 l/s

COMPex*Pro* 50	
193 nm (ArF)	**248 nm (KrF)**
0.13% F2 4.51% Ar 95.36% Ne	0.13% F2 3.42% Kr 96.45% Ne

COMPex*Pro* 102 / COMPex*Pro* 110			
193 nm (ArF)	**248 nm (KrF)**	**308 nm (XeCl)**	**351 nm (XeF)**
0.17% F2 5.33% Ar 16.50% He 78.00% Ne	0.12% F2 3.03% Kr 96.85% Ne	0.13% HCl 0.03% H2 1.88% Xe 97.96% Ne	0.18% F2 0.46% Xe 99.36% Ne

COMPex*Pro* 201 / COMPex*Pro* 205			
193 nm (ArF)	**248 nm (KrF)**	**308 nm (XeCl)**	**351 nm (XeF)**
0.16% F2 6.25% Ar 93.59% Ne	0.09% F2 3.82% Kr 96.09% Ne	0.08% HCl 0.02% H2 2.78% Xe 97.12% Ne	0.19% F2 12.83% He 0.45% Xe 86.53% Ne

Inert Gas

Type of gas	He
Purity	99.995%
Inlet pressure range	4.4 bar (abs) to 5.2 bar (abs)
Flow rate range	0.8 l/s to 3.0 l/s

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Single Gases (308 nm Only)

Halogen: Hydrogen Chloride (HCl, H_2 in He)

Type of gas	4.5% HCl and 0.9% H2 in He
Purity	99.995%
Inlet pressure range	4.4 bar (abs) to 5.2 bar (abs)
Flow rate range	0.05 l/s to 0.5 l/s

Rare: Xenon (Xe)

Type of gas	Xe
Purity	99.999%
Inlet pressure range	4.4 bar (abs) to 5.2 bar (abs)
Flow rate range	0.05 l/s to 0.5 l/s

Inert: Helium (He)

Type of gas	He
Purity	99.995%
Inlet pressure range	4.4 bar (abs) to 5.2 bar (abs)
Flow rate range	0.8 l/s to 3.0 l/s

Buffer: Neon (Ne)

Type of gas	Ne
Purity	99.995%
Inlet pressure range	4.4 bar (abs) to 5.2 bar (abs)
Flow rate range	0.8 l/s to 3.0 l/s

Purge Gas

Type of gas	N2
Purity	99.999%
Flow rate range	8 l/min to 12 l/min

8.3.1.3 Electricity

Wiring	Single phase
Nominal voltage	104 VAC / 120 VAC / 208 VAC / 230 VAC
Voltage range	Nominal voltage ± 10%
Wires	2 + PE
Frequency	50 Hz / 60 Hz

The other electrical specifications for the respective version and local voltage configuration are indicated in the following table:

Version	Voltage	Phases	Power	Full load amps	Machine OCP rating	Amp rating largest load	Short circuit current rating
50	104 VAC	1	1.5 kVA	15 A	12 A	12.5 A	10 kA
	120 VAC	1	1.5 kVA	13 A	12 A	12.5 A	10 kA
	208 VAC	2	1.5 kVA	7 A	16 A	12.5 A	1.5 kA
	230 VAC	1	1.5 kVA	6 A	16 A	12.5 A	1.5 kA
102	104 VAC	1	1.5 kVA	12 A	12 A	12.5 A	10 kA
	120 VAC	1	1.5 kVA	11 A	12 A	12.5 A	10 kA
	208 VAC	2	1.5 kVA	8 A	16 A	12.5 A	1.5 kA
	230 VAC	1	1.5 kVA	6 A	16 A	12.5 A	1.5 kA
110	104 VAC	1	3 kVA	24 A	12 A	12.5 A	10 kA
	120 VAC	1	3 kVA	22 A	12 A	12.5 A	10 kA
	208 VAC	2	3 kVA	15 A	16 A	12.5 A	1.5 kA
	230 VAC	1	3 kVA	13 A	16 A	12.5 A	1.5 kA
201	104 VAC	1	1.5 kVA	12 A	12 A	12.5 A	10 kA
	120 VAC	1	1.5 kVA	11 A	12 A	12.5 A	10 kA
	208 VAC	2	1.5 kVA	8 A	16 A	12.5 A	1.5 kA
	230 VAC	1	1.5 kVA	6 A	16 A	12.5 A	1.5 kA
205	104 VAC	1	3 kVA	24 A	12 A	12.5 A	10 kA
	120 VAC	1	3 kVA	22 A	12 A	12.5 A	10 kA
	208 VAC	2	3 kVA	15 A	16 A	12.5 A	1.5 kA
	230 VAC	1	3 kVA	13 A	16 A	12.5 A	1.5 kA

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8.3.1.4 Cooling Water

Water flow rate	1 l/min to 5 l/min
Water temperature at inlet	10° C to 20° C[a]
Static water pressure	2 bar to 4 bar
Dynamic water pressure drop (in/out)	2 bar to 4 bar
Heat transfer to water	< 1.5 kW
Electrical resistance	10 kΩ cm to 100 kΩ cm
Suspended particle size	< 200 µm
Hardness	< 100 ppm Ca
pH range	6.5 to 8

a. When setting the cooling water temperature, take into account the dew point. Set the inlet temperature of the cooling water in accordance with the ambient air temperature and relative humidity to prevent dew forming on the water lines in the laser device.

Recommended additive:

- for corrosion protection and anti-freeze protection	Antifrogen N®
- for corrosion protection	10 ppm 1H-Benzotriazol

8.3.1.5 Air Intake / Exhaust

Air flow rate	200 m³/hour to 300 m³/hour
Air intake temperature	15 °C to 25 °C
Heat transfer to air	< 1 kW
Max. exhaust length	4 m (157.5 in)[a]
Exhaust diameter	150 mm (5.9 in)

a. An additional blower is required if the max. length is exceeded

8.3.1.6 Environmental Operating Conditions

Air temperature	15 °C to 25 °C
Temperature change	2 °C / hour
Humidity	30% RH to 70% RH
Pressure change	< 10 mbar / hour
Altitude above sea level	< 2000 m
Pollution	class 9 or better (according to ISO 14644-1)

8.3.1.7 Signal Lines

Trigger In

Signal level	3.3 VDC to 5 VDC, TTL
Pulse duration	10 µs to 100 µs
Trigger edge	positive slope
Delay ext. trigger to light pulse:	
- without COD	2 µs
- 50 with COD	9500 µs
- 102 with COD	12500 µs
- 110 with COD ≤ 26 kV	9500 µs
- 110 with COD > 26.kV	12500 µs
- 201 / 205 with COD	18000 µs
Delay, drift	< 200 µs
Jitter ext. trigger to light pulse	< ± 25 ns (pulse-to-pulse)

Sync. Out

SYNC. OUT is a BNC socket that enables the output of a signal that informs an external device that a trigger signal (either internal or external) has just been given.

Signal level	3.3 VDC to 5 VDC, TTL
Pulse duration	50 µs
Delay sync. out to light pulse	0.5 µs

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8.3.2 BraggStar M

8.3.2.1 Laser Beam Parameters

Nominal wavelength	248 nm
Max. repetition rate	100 Hz
Max. pulse energy	140 mJ
Max. average power	12 W
Energy stability, 1 Sigma	1%
Pulse duration (FWHM)	20 ns

8.3.2.2 Gases

Premix Gas

Gas mixture	0.13% F2 / 3.42% Kr / 96.45% Ne
Purity	Excimer grade
Inlet pressure range	4.4 bar (abs) to 5.2 bar (abs)
Flow rate range	0.05 l/s to 0.5 l/s

Inert Gas

Type of gas	He
Purity	99.995%
Inlet pressure range	4.4 bar (abs) to 5.2 bar (abs)
Flow rate range	0.8 l/s to 3.0 l/s

Purge Gas

Type of gas	N2
Purity	99.999%
Flow rate range	8 l/min to 12 l/min

8.3.2.3 Electricity

Nominal voltage	104 VAC / 120 VAC / 208 VAC / 230 VAC
Voltage range	Nominal voltage ± 10%
Frequency	50 Hz / 60 Hz
Wires	2 + PE

The other electrical specifications for the respective local voltage configuration are indicated in the following table:

Voltage	104 VAC	120 VAC	208 VAC	230 VAC
Phases	1	1	2	1
Power	2 kVA	2 kVA	2 kVA	2 kVA
Full load amps	21 A	19 A	10 A	10 A
Machine OCP rating	12 A	12 A	16 A	16 A
Amp rating largest load	12.5 A	12.5 A	12.5 A	12.5 A
Short circuit current rating	10 kA	10 kA	1.5 kA	1.5 kA

8.3.2.4 Cooling Water

Water flow rate	1 l/min to 5 l/min
Water temperature at inlet	10° C to 20° C[a]
Static water pressure	2 bar to 4 bar
Dynamic water pressure drop (in/out)	2 bar to 4 bar
Heat transfer to water	< 1.5 kW
Electrical resistance	10 kΩ cm to 100 kΩ cm
Suspended particle size	< 200 µm
Hardness	< 100 ppm Ca
pH range	6.5 to 8

a. When setting the cooling water temperature, take into account the dew point. Set the inlet temperature of the cooling water in accordance with the ambient air temperature and relative humidity to prevent dew forming on the water lines in the laser device.

Recommended additive:

- for corrosion protection and anti-freeze protection	Antifrogen N®
- for corrosion protection	10 ppm 1H-Benzotriazol

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8.3.2.5 Air Intake / Exhaust

Air flow rate	200 m³ / hour to 300 m³ / hour
Air intake temperature	15 °C to 25 °C
Heat transfer to air	< 1 kW
Max. exhaust length	4 m (157.5 in)[a]
Exhaust diameter	150 mm (5.9 in)

a. An additional blower is required if the max. length is exceeded

8.3.2.6 Operating Environmental Conditions

Air temperature	15 °C to 25 °C
Temperature change	2 °C / hour
Humidity	30% RH to 70% RH
Pressure change	< 10 mbar / hour
Altitude above sea level	< 2000 m
Pollution	class 9 or better (according to ISO 14644-1)

8.3.2.7 Signal Lines

Trigger In

Signal level	3.3 VDC to 5 VDC, TTL
Pulse duration	10 µs to 100 µs
Trigger edge	positive slope
Delay ext. trigger to light pulse:	
- without COD	2 µs
- with COD	9500 µs
Delay, drift	< 200 µs
Jitter ext. trigger to light pulse	< ± 10 ns (pulse-to-pulse)

Sync. Out

Signal level	3.3 VDC to 5 VDC, TTL
Pulse duration	50 µs
Delay sync. out to light pulse	0.5 µs

8.3.3 LPX 105NT

8.3.3.1 Laser Beam Parameters

Nominal wavelength	193 nm
Max. repetition rate	50 Hz
Max. pulse energy	140 mJ
Max. average power	9 W
Energy stability, 1 Sigma	< 4%
Pulse duration (FWHM)	10 - 25 ns

8.3.3.2 Gases

Two Cylinder Excimer Laser Gas Premix

Type of gas	Halogen premix
Gas mixture	5% F2 in He
Purity	99.995%
Inlet pressure range	4.4 bar (abs) to 5.2 bar (abs)
Flow rate range	0.05 l/s to 0.5 l/s

Type of gas	Buffer premix
Gas mixture	8.77% Ar / 65.79% Ne / 25.44% He
Purity	99.995%
Inlet pressure range	4.4 bar (abs) to 5.2 bar (abs)
Flow rate range	0.8 l/s to 3.0 l/s

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Single Cylinder Excimer Laser Gas Premix

Gas mixture	0.25% F2 28.98% He 8.33% Ar 62.44% Ne
Purity	99.995%
Inlet pressure range	4.4 bar (abs) to 5.2 bar (abs)
Flow rate range	0.05 l/s to 0.5 l/s

Inert Gas

Type of gas	He
Purity	99.995%
Inlet pressure range	4.4 bar (abs) to 5.2 bar (abs)
Flow rate range	0.8 l/s to 3.0 l/s

Purge Gas

Type of gas	N2
Purity	99.999%
Flow rate range	8 l/min to 12 l/min

8.3.3.3 Electricity

Nominal voltage	230 VAC
Voltage range	Nominal voltage ± 10%
Frequency	50 Hz / 60 Hz
Phases	1
Wires	2 + PE
Power	2.5 kVA
Full load amps	11 A
Machine OCP rating	16 A
Amp rating largest load	12.5 A
Short circuit current rating	1.5 kA

8.3.3.4 Air Intake / Exhaust

Air flow rate	200 m³ / hour to 300 m³ / hour
Air intake temperature	5 °C to 25 °C
Heat transfer to air	< 1 kW
Max. exhaust length	4 m (157.5 in)[a]
Exhaust diameter	150 mm (5.9 in)

a. An additional blower is required if the max. length is exceeded

8.3.3.5 Operating Environmental Conditions

Air temperature	15 °C to 25 °C
Temperature change	2 °C / hour
Humidity	30% RH to70% RH
Pressure change	< 10 mbar / hour
Altitude above sea level	< 2000 m
Pollution	class 9 or better (according to ISO 14644-1)

8.3.3.6 Signal Lines

Trigger In

Signal level	3.3 VDC to 5 VDC, TTL
Pulse duration	10 µs to 100 µs
Trigger edge	positive slope
Delay ext. trigger to light pulse	
- without COD	2 µs
- with COD	12100 µs
Delay, drift	< 200 µs
Jitter ext. trigger to light pulse	< ± 10 ns (pulse-to-pulse)

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Sync. Out

Signal level	3.3 VDC to 5 VDC, TTL
Pulse duration	50 µs
Delay sync. out to light pulse	0.5 µs

8.4 Abbreviations

µHI	micro halogen injection
AEL	Accessible emission limit (of laser radiation)
ANSI	American National Standards Institute
CDRH	Center for Devices and Radiological Health
Const	Constant
CPU	Central processing unit
E-Mon	Energy monitor
EGY	Energy
ELT (module)	Electronics (module)
EMC	Electromagnetic compatibility
EMI	Electromagnetic interference
EMO	Emergency-OFF
EXT TRIG	External trigger (input connection)
FOL	Fiber optic light waveguide
H_2	Hydrogen
HCl	Hydrogen Chloride
He	Helium
HI	Halogen injection
HR mirror	High reflective mirror (rear resonator optic)
HV	High voltage
HVPS	HV power supply module
IEC	International Electrotechnical Commission
ISO	International Organization for Standardization
LED	Light emitting diode
MHI	Macro halogen injection
MI	Magnetic isolator
MPGR	Macro partial gas replacement (macro PGR)
N_2	Nitrogen
Ne	Neon

NF	New Fill (total gas replacement)
NGR	No gas replacement (mode)
OC	Output coupler (front resonator optics)
OEM	Original Equipment Manufacturer
OPMODE	Operating Mode
OSHA	Occupational Safety and Health Administration
PE	Protective earth
PGR	Partial gas replacement
Reprate	Repetition rate (laser pulse frequency)
RI	(Micro) rare injection
SYNC OUT	Synchronization out (output connection)
UPS	Uninterruptible power supply
UV	Ultra-violet
Xe	Xenon
XeI	Xenon injection

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