November 2014

LSM 880 and LSM 880 NLO

Notes on device safety and installation requirements

Knowledge of this manual is required for the operation of the instrument. Would you therefore please make yourself familiar with the contents of this manual and pay special attention to hints concerning the safe operation of the instrument.

The specifications are subject to change; the manual is not covered by an update service.

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CHAPTER 1 NOTES ON DEVICE SAFETY

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1 General

The LSM 880 and LSM 880 NLO laser scanning microscopes, including their original accessories and compatible accessories from other manufacturers, may only be used for the purpose of microscopic and spectroscopic techniques.

Laser Scanning Microscopes (LSM) are intended for high resolution imaging of biological or material samples, whereby in contrast to wide field microscopy the specimen is illuminated raster-fashion with a focused laser beam and the optical arrangement prevents light from out-of-focus regions of the specimen contributing to image formation.

☞ Installation and commissioning of the LSM 880 system must be performed by authorized ZEISS service staff. The system should not be used prior to instruction by a ZEISS representative.

The manufacturer will not assume liability for any malfunction or damage caused by anything other than the intended use of the LSM 880 system or individual modules or parts of it, nor by any repair or other service operation performed or attempted by persons other than duly authorized service staff. Any such action will invalidate any claim under warranty, including parts not directly affected by such action. This also includes the modification of the system computer with new cards, etc. by the user. The use of a camera at the base port of Axio Observer.Z1 SP stands with motorized beam path switching is not allowed for reasons of laser safety. Any manipulation will result in the loss of warranty of laser safety.

Please read also the notes on device safety and manuals of the microscope, the HBO, the HAL, the HXP, and additional optional devices, if ordered, as the UV Laser, the piezo focusing device, the heating inserts, the Ti:Sa laser and the OPO (optical parametric oscillator).

As the system is largely operated via menus on a computer, you should be familiar with the principles of the WINDOWS operating system and its graphical user interface. The respective manuals are supplied together with the programs.

The LSM 880 system is a device that belongs to laser hazard class 3B. The system is equipped with safety interlocks that comply with laser hazard class 3B and 4. If equipped with a Ti:Sa laser (see list in section 8), the LSM 880 system is a device that belongs to laser hazard class 4. WHO recommendations concerning health and industrial protection when handling laser devices must be observed. The operator of the unit must also observe all and any relevant statutory accident prevention regulations. The user is referred to the safety data sheet provided together with the manual.

The LSM 880 system meets the EMC requirements for EN 55011 Class A (intended use in industrial environment). If the LSM is operated in a residential area or in a small trade area other devices may be influenced by conducted or radiated disturbance. In this case special EMC measures are required.

2 Regulations

Extensive knowledge of the hardware / the system is indispensable for safe operation of the LSM 880 system.

☞ Read these operating instructions and all device publications belonging to the system conscientiously **before** operating the LSM 880 system! You can obtain additional information on the hardware configuration delivered and on optional system extensions from the manufacturer or via the service hotline.

The LSM 880 system has been designed, built and tested in conformity with the following regulations and guidelines:

- DIN EN 61010-1 (IEC 61010-1) "Safety requirements for electrical equipment for measurement, control and laboratory use", taking relevant CSA and UL specifications into account,
- DIN EN 60825-1 (IEC publication 60825-1) "Safety of laser equipment",
- 21 CFR §1040.10: "Performance Standards for light emitting products – laser products",
- DIN EN 61326-1 "Electrical equipment for measurement, control and laboratory use – EMC requirements",
- Low voltage directive: 2006/95/EC,
- EMC directive: 2004/108/EC, KN 61000-6-2, KN 11.
- EMC User notice for Korean only:

사용자안내문

기 종 별	사 용 자 안 내 문
A급 기기 (업무용 방송통신기자재)	이 기기는 업무용(A급) 전자파적합기기로서 판매자 또는 사용자는이 점을 주의하시기 바라며, 가정외의 지역에서 사용하는 것을 목적으로 합니다.

The company works according to a certified Environment Management System according to ISO 14001.

The Product was developed, tested and produced in accordance with the valid regulations and guidelines for environmental law of the European Union.

The product and its accessories have been classified as instrument category 9 (laboratory equipment or comparable standard). The product and its accessories agree with the EU-regulations 2011/65/EC (RoHS) and 2012/19/EC (WEEE), if applicable for the product.

ZEISS has installed a process for taking back and recycling the instruments within the member states of the European Union, which takes care of the appropriate utilization according to the said EU guidelines.

For details on the disposal and recycling please refer to your relevant ZEISS sales or service organization.

The product must not be disposed in the household waste or through the municipal disposal organizations. In case of resale the seller is obliged to inform the buyer that the product has to be disposed according to the said regulations.

3 Power Requirements

☞ The LSM 880 system comes with a mains power supply cord and plug, either CEE red (3/N/PE 400/230 V/16A), or NEMA L 14-30P (2/N/Ground 120/240 V/30 A), and with the matching mains socket outlet.
The mains socket outlet must be equipped with a fuse having minimum tripping characteristic C according to IEC/EN 60898.

Line voltage	3/N/PE 400/230 V AC (±10 %)	2/N/Ground 240/120 V AC (±10 %)
Line frequency	50...60 Hz	50...60 Hz
LSM incl. VIS laser:		
Max. current	3 phases at 16 A	2 phases at 25 A
Power	Phase 1 = 600 VA max. Phase 2 = 500 VA max. Phase 3 = 1500 VA max.	Phase 1 = 800 VA max. Phase 2 = 1600 VA max.
Power consumption	2100 VA max.	2100 VA max.
Power consumption		
Ti:Sa Laser 1	800 VA max.	800 VA max.
Ti:Sa Laser 2	800 VA max.	800 VA max.
OPO	600 VA max.	600 VA max.
Class of protection	I	I
Type of protection	IP 20	IP 20
Overvoltage category	II	II
Pollution degree	2	2
Heat emission (without Ti:Sa or OPO laser)	2000 W max.	2000 W max.

☞ EMC test according to DIN EN 61326-1 (05/2010)
1. Noise emission according to CISPR 11 / DIN EN 55011 (04/2011)
2. Noise immunity according to table 2 (industrial sector)

☞ The LSM contains sensitive electronics. A few seconds of faulty power can damage parts of the electronics. The system is therefore equipped with a surge guard, a device that protects the electronics of the LSM from strong electrical power fluctuations like overvoltage, lightning or other external influences.
The surge guard is located within the electrical connection box. It works once to protect the system, then it has to be exchanged. Within warranty, service contracts or any other service visit ZEISS service will check the functionality of the surge guard and provide a new device if necessary. Nevertheless, in the rare case of a voltage surge on the power supply line (e.g. from indirect lightning stroke), a momentary interruption of the acquisition system's functionality is possible. This is no defect. Acquisition can be continued after starting the ZEN software again. Sample position is maintained and no damage occurs to the system. A possible protective means to minimize the probability of a temporary disruption is a transient voltage protector in your facility's power system.

☞ The Ti:Sa laser(s) and OPO need to have a separate electrical connection according to the instructions of the manufacturer.
When operating the main switch of the LSM 880 NLO the Ti:Sa lasers and the OPO are not switched on or off.

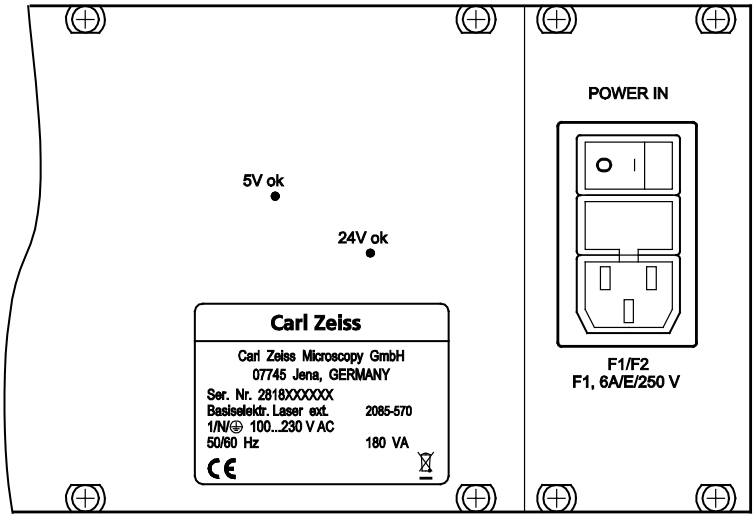


Fig. 1 Fuses F1/F2 of the external laser module

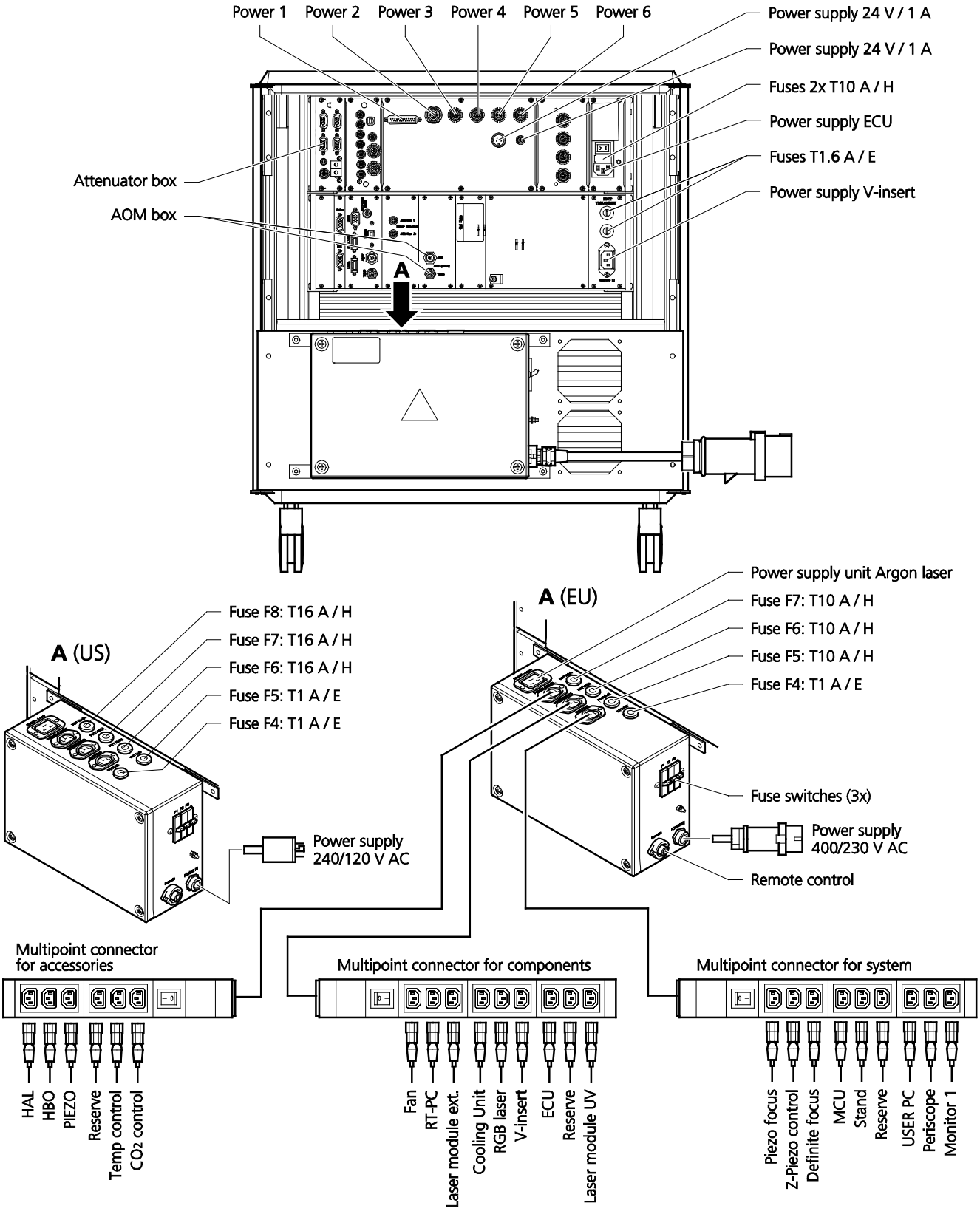


Fig. 2 **Power connector for the LSM 880 system including NLO system and set ups with laser module UV and components. Free/reserve outlets may be used to supply power to additional equipment. No more than 1 A can be provided by each outlet.**

The door interlock interface (Fig. 3/**1**) is covered with a green plug to bypass a door interlock.

- To use the interface remove the top of the green plug and the bypass wire.
- Then connect the wires of the door interlock at the same position.

Two door interlocks can be connected.

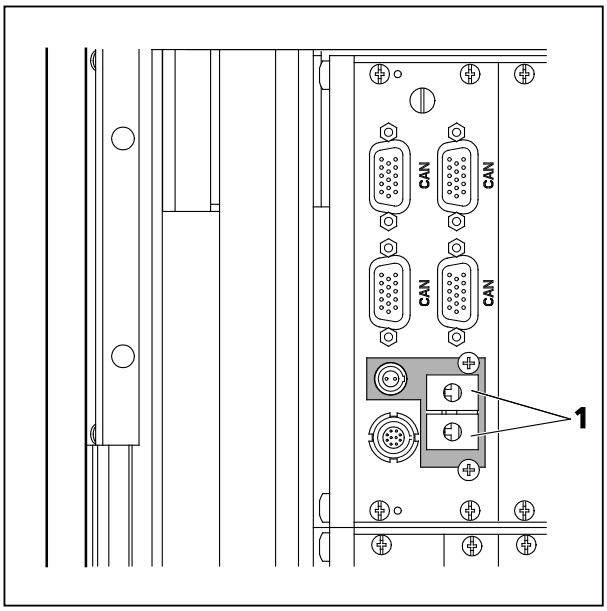
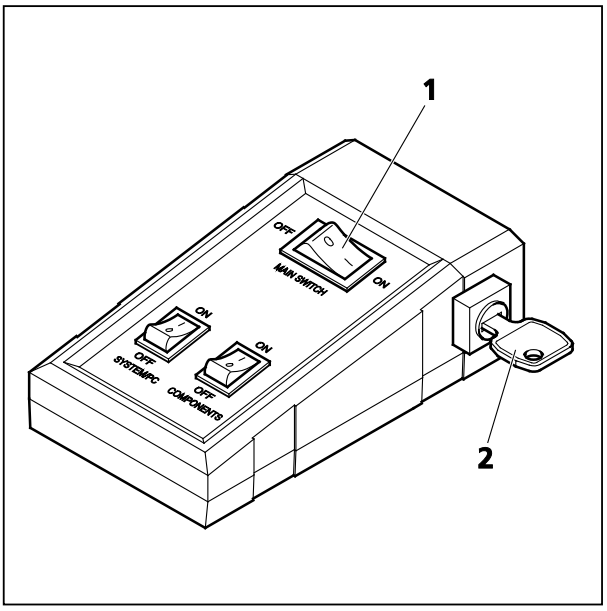


Fig. 3 **Door interlock interface (1) on the back of the electronic rack (see Fig. 2 top)**

The LSM 880 system is controlled by a remote control. This remote control contains the main switch for the system and the key switch for the laser.

- To start the system switch the main switch (Fig. 4/**1**) to ON.
- To activate the laser turn the key switch (Fig. 4/**2**) to ON position.



1 Main switch ON/OFF
2 Laser key switch

Fig. 4 **Remote control of the LSM 880 system**

4 Physical Dimensions

	Length (cm)	Width (cm)	Height (cm)	Weight (kg)
Small passively damped system table	90	75	77	80
Small actively damped system table	90	75	77	90
Large actively damped system table	120	90	77	120
Active anti-vibration table (NLO) for Mai Tai Laser or Chameleon	180	150	75	200
Active anti-vibration table (NLO) for two-microscope configuration	250	150	75	400
Periscope for two NLO lasers or NLO laser with OPO	40	37	70	40
Active anti-vibration table (NLO) for Laser Chameleon with OPO	180	180	75	410
Scanning Module LSM 880	50	45	22	27
Microscope	50	35	50	20
Electronic Rack with laser units	80	60	65	80
Plug-in unit external laser	70	55	25	10
Laser Module UV	80	60	45	40
Airyscan	40	20	24	12
Fiber optic cable, UV	200			
Fiber optic cable, VIS(ible)	250			
Cables	250			

5 Environmental Requirements

For operation the system has to be placed in a closed room.

1. Operation, specified performance	T = 22 °C ± 3 °C without interruption (24 h a day independently whether system is operated or switched-off) It has to be ensured that the air-flow of the air-conditioning is not directed at the system.
2. Operation, reduced performance	T = 15 °C to 35 °C, any conditions different from item 1. and 5.
3. Storage, less than 16 h	T = -20 °C to 55 °C
4. Storage, less than 6 h	T = -20 °C to 55 °C
5. Temperature gradient	± 0.5 °C/h
6. Warm up time	1 h, for high-precision and/or long-term measurements ≥ 3 h
7. Relative humidity	< 65 % at 30 °C
8. Operation altitude	max. 2000 m
9. Loss of heat (without Ti:Sa or OPO laser)	2 kW
10. Vibrations under operation conditions (with system table)	5 µm pp at 5 Hz 10 µm pp at 10 Hz 10 µm pp at 20 Hz
11. Shipping shock (LSM 880 box)	10 g

☞ These requirements do not include the requirements for high precision measurements. Please refer to the Operator's Manual of the microscope for these requirements.

6 Notes on Setting up the Microscope System

☞ Installation and commissioning of the LSM 880 system must be performed by authorized ZEISS service staff. The system should not be used prior to instruction by a ZEISS representative.

The LSM 880 and LSM 880 NLO laser scanning microscopes are delivered in several crates.

The LSM 880 system must be set up so as to ensure that the minimum clearance between the wall and the rear of the system is no less than 0.5 m. This clearance is needed for adjustment and maintenance operations.

Do not set up the unit in the proximity of heat sources such as radiators or direct sunlight. To avoid heat build-ups, the ventilation slots on the microscope system and the liquid cooling system must not be covered up.

The system must not be set up in areas with potential danger by explosives.

The unit must be connected to a properly installed socket outlet with earthing contact by means of the mains cables supplied. Continuity of PE connection must not be affected by the use of extension leads.

The system contains components with dangerous voltage. The system must not be opened by anybody else than authorized ZEISS service staff. Before opening the main plug has to be disconnected.

Before connecting the mains cables, please check whether your mains voltage corresponds to the voltage specified on the rating plate of the electrical connection box.

For reasons of laser safety, all ports must either be equipped with the corresponding device (scan head, camera, HBO lamp etc.) or covered with the counterpart of the laser safety kit provided.

Maintenance, repair, modification, removal or exchange of components, or other interference with the equipment beyond the operations described in this manual may only be carried out by the manufacturer ZEISS or by persons expressly authorized by ZEISS to do so.
This applies especially to the microscope system, the laser scanning module, lasers, the PC system, the power supply units, cable connections and other system components.

Please note that the LSM 880 system is a high-precision opto-electronic instrument. Inexpert handling may easily impair its function or even damage it.

The openings for ventilation must not be covered.

There are hot surfaces on the HBO and HAL lamp.

The HBO 50 and HBO 100 W, XBO 75 W, X-Cite 120 and HXP 120 lamps used on the light microscopes incident light path emit UV light which is harmful to the human eye and skin when observed without appropriate filters. Never remove the lamp and look direct into the emitted light of the lamp.

After installation or conversion of the LSM system, authorized specialized staff must carefully check that it is in a proper condition and, particularly, that covers protecting against laser radiation are provided.

Tube openings or other unused mounts should always be protected against dust and moisture with the corresponding device components or with termination covers/blind plugs.

By establishing a corresponding workplace environment, please ensure that the formation of electrostatic charges is avoided.

To avoid vibrations during operation, the LSM 880 system should only be operated in conjunction with the system table (vibration damping).

7 Warning and Information Labels

The warning and information labels attached on the LSM 880 system must be observed. Check whether all of the labels shown below are provided on your instrument, and contact ZEISS Germany or one of the service agencies if you should discover that any of the labels should be missing. You will receive a free replacement.

Description of labels

Caution:
Faults and hazards that might arise during operation which might cause damage to the unit or injury to the user.

Caution:
Laser radiation hazards possible when operating the system.

Caution:
Optical radiation hazards possible when operating the system.

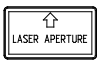
Caution:
High voltage.

Caution:
Pull the mains plug before opening the device housing.

Caution:
Hot surface.

Caution:
UV radiation.

Caution:
Fingers can be caught.



The arrow points to the opening where laser light comes out during operation of the system.

☞ Other labels on the system include one of the above depicted symbols and a detailed description of the handling instructions. See also the following drawings of the system parts.

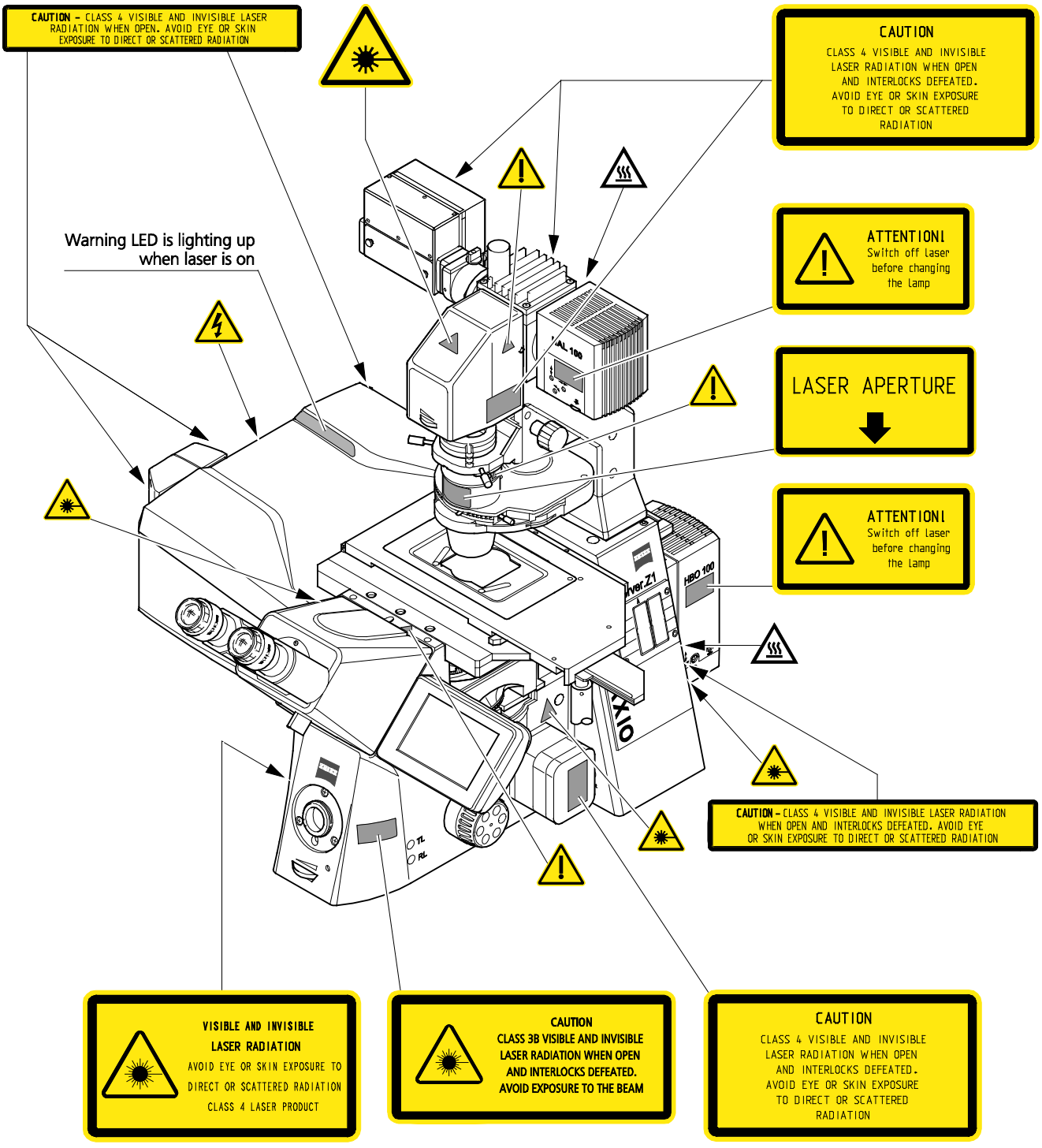


Fig. 5 **Warning and information labels on the Axio Observer.Z1 microscope with the LSM 880 scanning module**

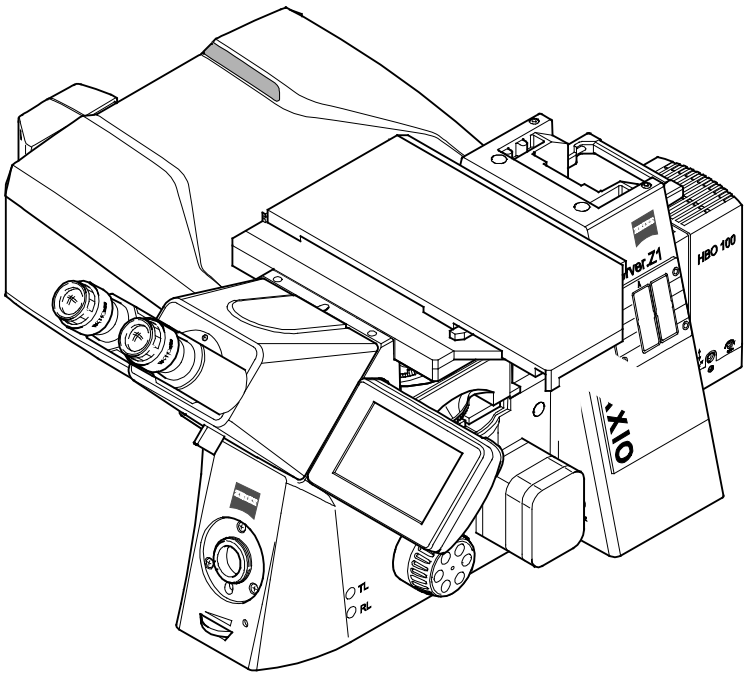


Fig. 6 **Warning and information labels on the Axio Observer.Z1 microscope with the LSM 880 scanning module (US version only)**

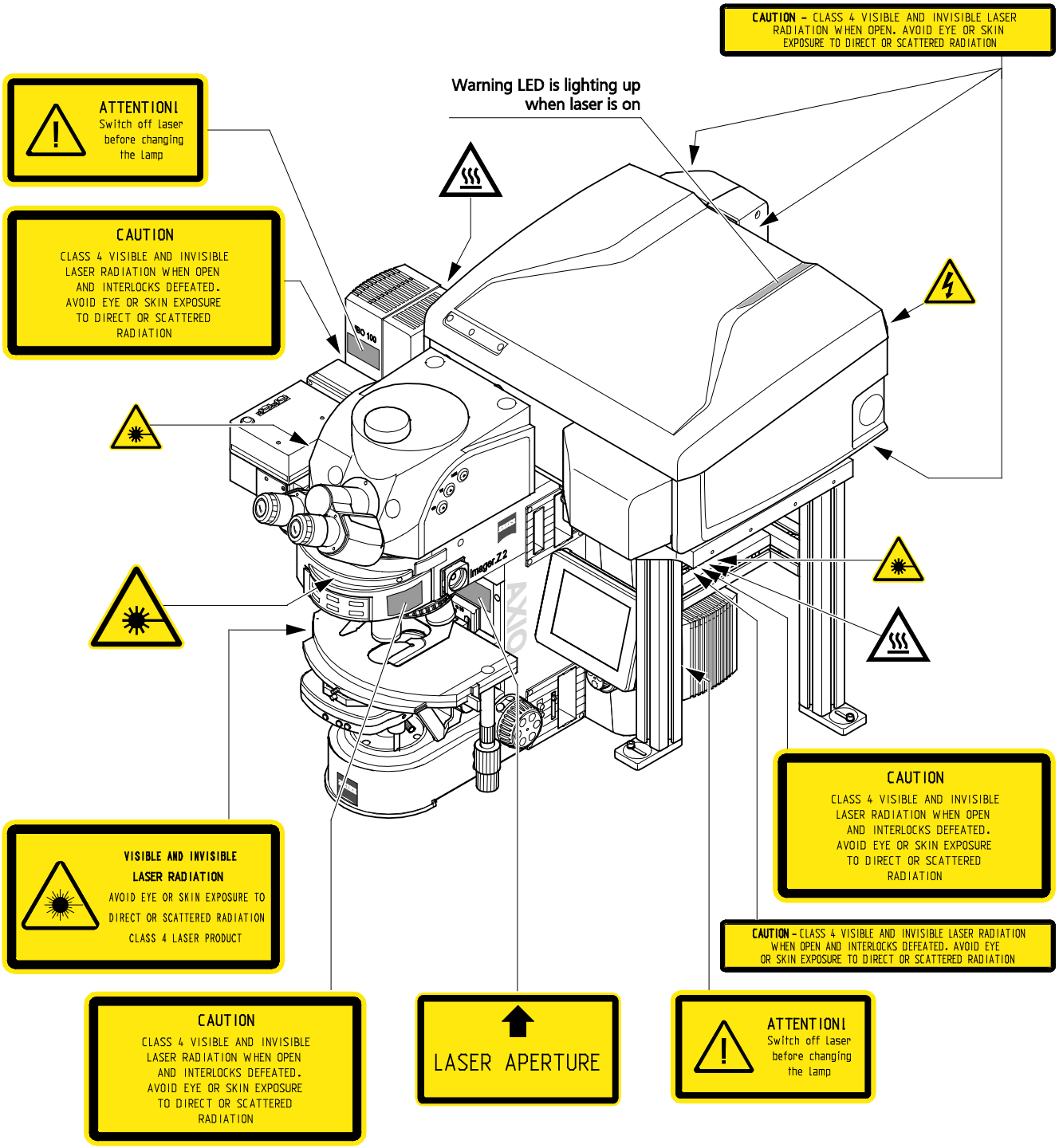


Fig. 9 **Warning and information labels on the Axio Imager.Z2 microscope with the LSM 880 scanning module**

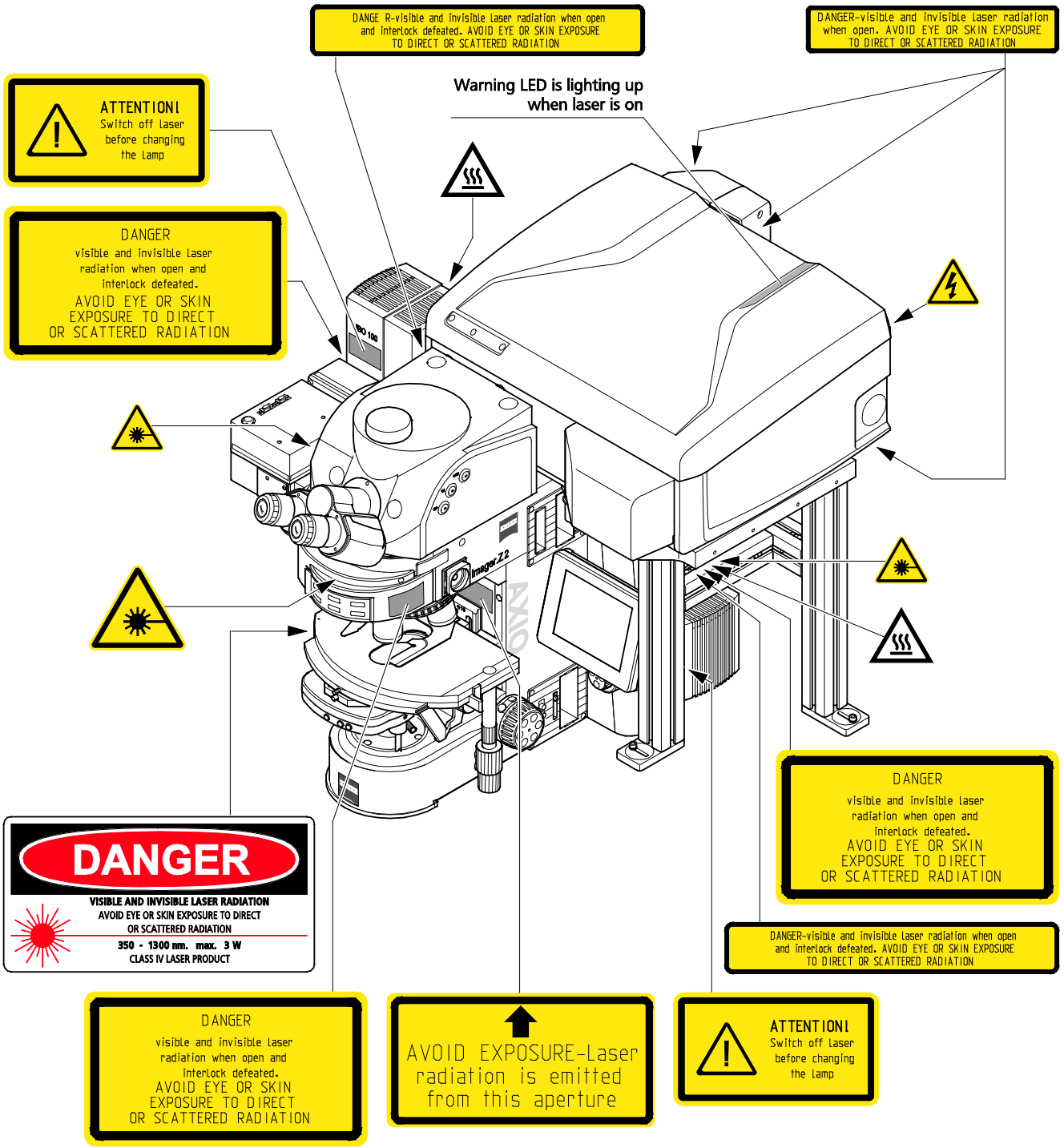


Fig. 10 **Warning and information labels on the Axio Imager.Z2 microscope with the LSM 880 scanning module (US version only)**

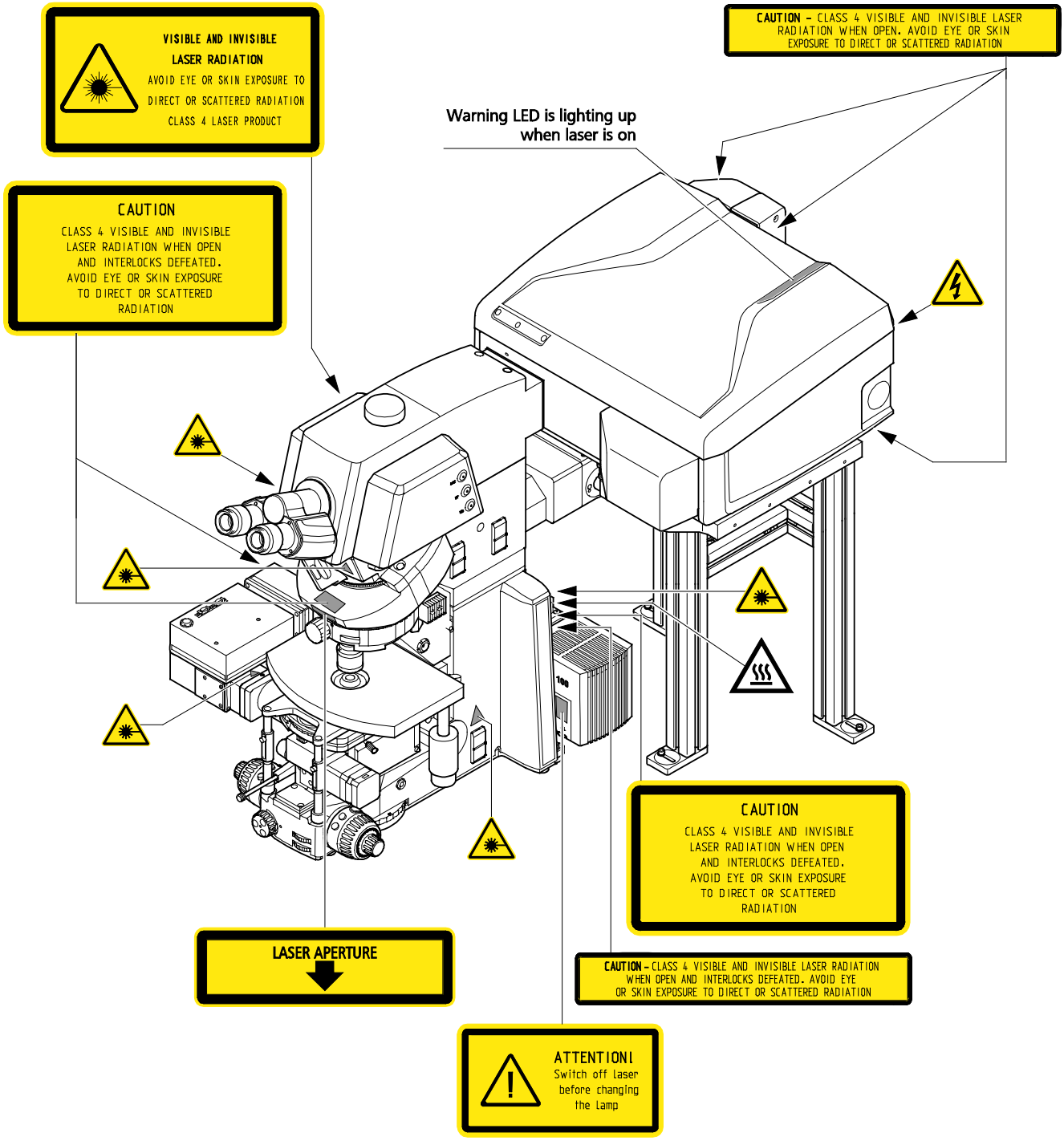


Fig. 11 **Warning and information labels on the Axio Examiner microscope with the LSM 880 scanning module**

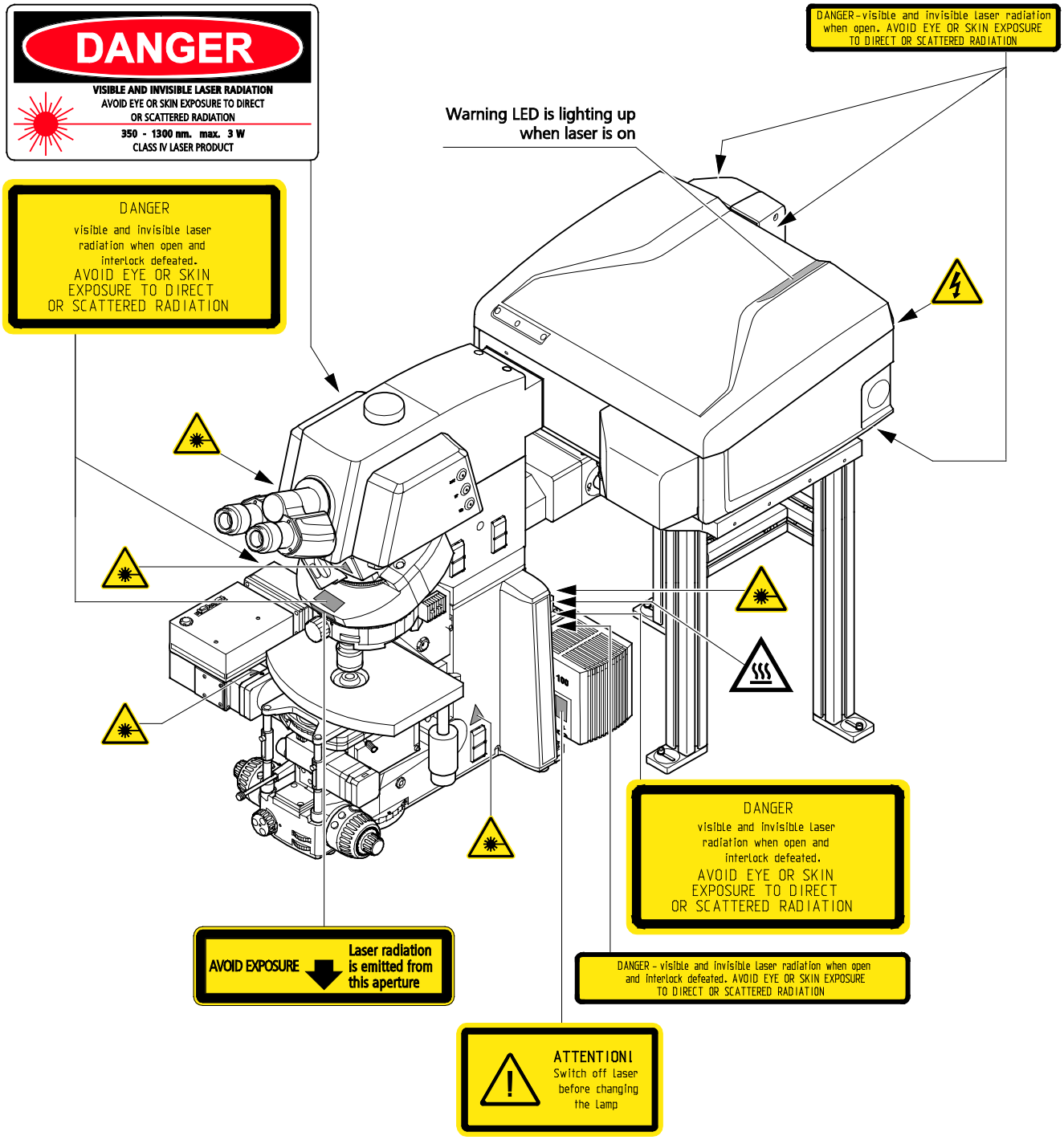


Fig. 12 **Warning and information labels on the Axio Examiner microscope with the LSM 880 scanning module (US version only)**

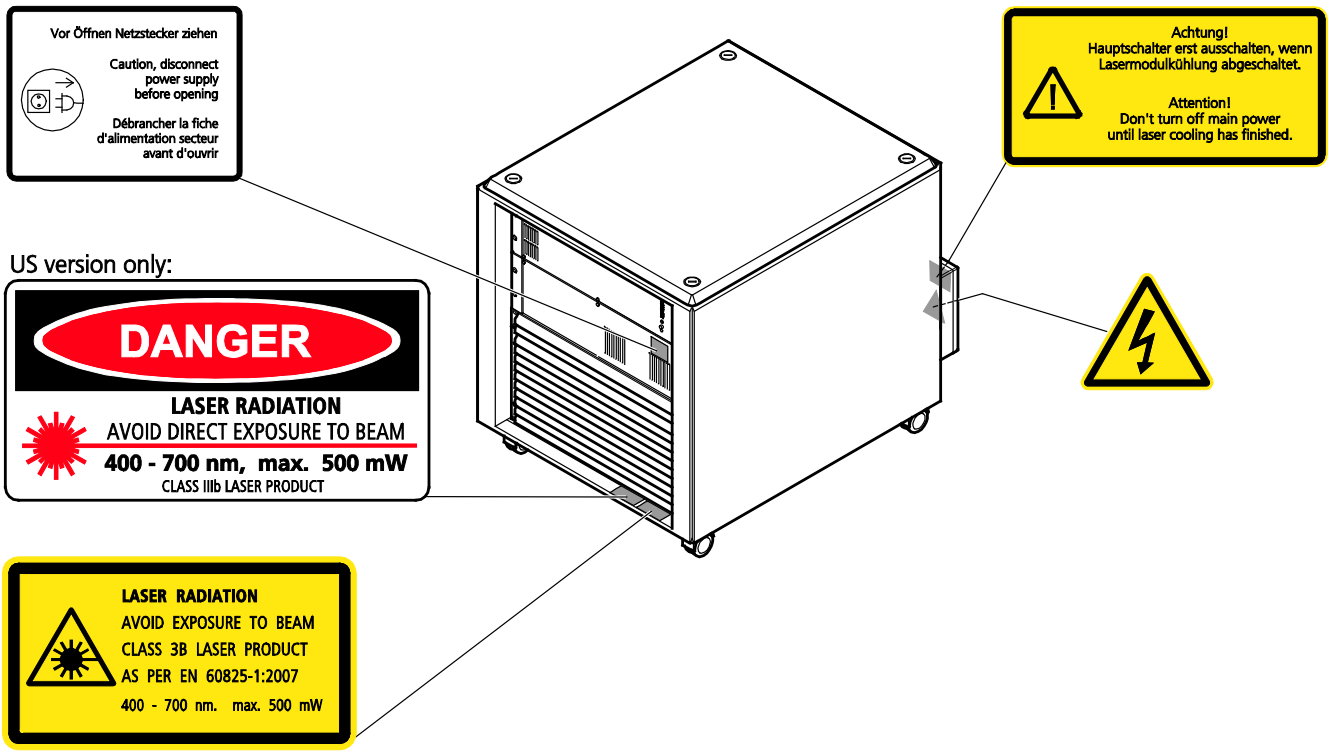


Fig. 13 Warning and information labels on the laser and electronic rack

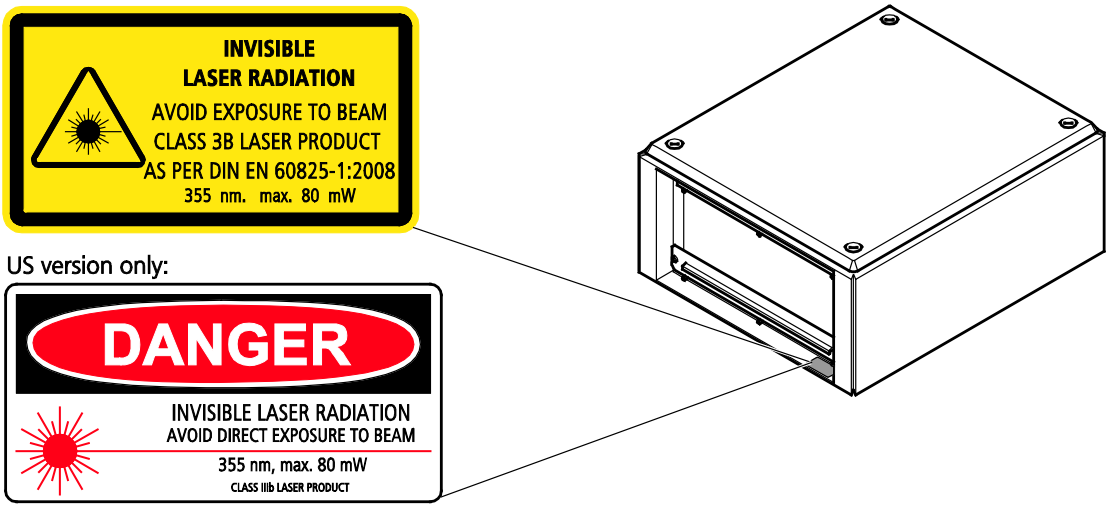


Fig. 14 Explanatory labels on the laser module UV

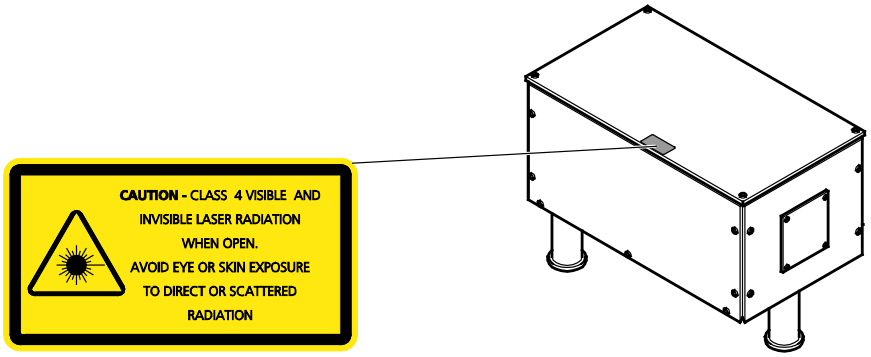


Fig. 15 Warning label on the AOM or attenuator box(es)

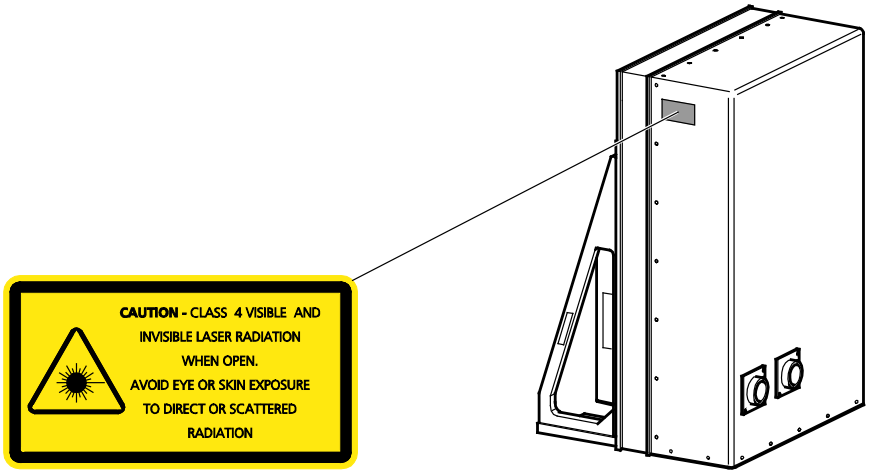


Fig. 16 Warning label on the motorized periscope

8 Notes on Handling the Laser Components and Illumination Systems

The LSM 880 system is a laser hazard class 3B instrument. If equipped with a Ti:Sa laser, the LSM 880 system is a device that belongs to laser hazard class 4.
These moderate and high-risk classes embrace medium-power and high power lasers. You must take care not to expose yourself to the radiation of such lasers. In particular, never look into the laser beam! Only personnel which has been instructed on laser safety is allowed to operate the system.

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

The following laser types are currently intended for use in the LSM 880 system. The use of any other lasers as the ones listed below is not authorized. The values represent the laser power ex fiber into the scan head for all fiber coupled lasers. Power values of direct coupled multiphoton lasers (Ti:Sa / OPO) represent their nominal output power.

Laser	Class	Min. Power
1 Diode laser 405 nm	3B	15 mW
2 Diode laser ps/cw 405 nm	3B	15 mW
3 Diode laser ps/cw 440 nm	3B	15 mW
4 Ar/ML 458/488/514 nm	3B	11.5 / 19.5 mW
5 HeNe 543 nm	3B	0.7 mW
6 DPSS 561 nm	3B	13 mW
7 HeNe 594 nm	3B	1.3 mW
8 HeNe 633 nm	3B	3 mW
9 Ti:Sa Laser Mai Tai (Spectra Physics) 690-1040 nm (depending on the model)	4	min. 3 W
10 Ti:Sa Laser Chameleon (Coherent) 690-1080 nm (depending on the model)	4	min. 3 W
11 OPO (otpical parametric oscillator; Coherent) 1050 – 1300 nm	4	min. 550 mW
12 DPSS UV laser 355 nm	3B	26 mW

☞ Please contact ZEISS if you intend to use a different laser other than the ones above.

The following table shows the expected laser life times:

Laser wavelength (nm)	Type	Min. power specification for end of life time	Expected life time (in hours)
458/488/514	Laser module LGK 7812 ML5	9.1 mW 1)	> 5000
458/488/514	Laser module LGK 7872 ML8	15.4 mW 1)	> 3000
543	LGK 7786 P with fibre coupling	0.5 mW	> 7000
594	LGK 7512 PF with fibre coupling	1.0 mW	> 10000
633	LGK 7628-1F with fibre coupling	2.3 mW	> 10000
561	FKL module YLK 6120 T	10.2 mW	> 5000
405	Laser cassette 405 cw	11.6 mW	> 5000
405	Laser cassette 405 cw/ps	11.6 mW 2)	> 5000
445	Laser cassette 445 cw/ps	11.6 mW 2)	> 5000
355	UV laser module 355 cw	14.6 mW	> 5000

1) Life time specified for total power

2) Average power for cw operation

If used properly, the LSM 880 system will not pose any laser radiation risks for operating staff. Nevertheless, you should observe the following warnings:

- If necessary - insofar as specified by law - inform the laser safety officer before commissioning the laser.
- The LSM system and the Ar laser are equipped with a key-interlock.
- Always store keys for laser key switches and, if applicable, keys for further laser power supply units, where they are inaccessible to persons not authorized to operate the laser.
- A laser ON LED on the scan head lights up when laser radiation is emitted.
- Do not place any reflecting objects into the beam path.
- Never open any covers or panels.
- Never look into the laser beam, not even to simply view the specimen, whether with the aid of optical instruments or without. Otherwise you risk going blind!
- Do not leave any empty objective positions of the nosepiece uncovered.
- If a class 4 laser is attached to the system, already stray light can impose danger to the operator.
- With class 4 lasers take special care of fire protection requirements. Do not use or store flammable or explosive solids, fluids or gases in the vicinity of the system.
- Class 4 lasers can inflame also flammable materials like cloth or paper. Do not put such materials into the beam path.
- Do not reach into the process beam inside the sample area whenever the Class 4 laser is active!

☞ Suitable protective measures must be taken if gases, dust or vapors hazardous to health, secondary radiation or explosive objects should arise on the specimen as a result of laser radiation.

When using a high power broadband illumination (HBO, X-Cite, HXP) in combination with a neutral density reflector module, or in combination with a reflectorized object slide and reflector modules without excitation filter and emission filter in the incident light path, there are operating conditions which lead to strong reflections of excitation light and strong optical radiation into the eyepiece. According to regulations for radiation load the maximal values are below the permissible threshold, and do not lead in all probability to any permanent irritation of the eyes, also because the natural averting reaction limits the exposure to the bright light. Nevertheless we recommend not looking through the eyepiece when using the described setup and when rotating the reflector turret. Especially, we do not recommend the use of the reflector turret controls located on the microscope stand, since this leads to an observation position close to the eyepiece. Instead, use the TFT-Touch screen or the LSM software to switch the reflector turret. In case the reflector turret has to be rotated by hand avoid looking into the eyepiece while doing so.

For the NLO system equipped with a specific push and click filter for NDD imaging be aware that the NDD reflector cube in the reflector turret leads to a strong back reflection of HBO light into the specimen plane and the eyepiece. When observing the specimen through the ocular lens the use of the NDD reflector cube should be avoided. The light flash is not harmful but unpleasant. The reflex of closing the eyelid is sufficiently protective.

Notes on the fiber used with the laser module UV (355 nm)

This component is a wear part and needs special handling to protect it from damage, e.g. don't use the maximum power level of the laser together with max. AOM transmission for dye excitation. For ROI photo manipulation, elevated power levels should only be used for short time. Such laser powers are not useful from an applicative point of view too, since photo damage might occur to biological tissue.

A replacement fiber can be ordered at your local ZEISS sales or service representative using order # 000000-1870-253 (UV-Fiber, packed). The replacement fiber must be installed by a ZEISS service representative. We recommend to replace the fiber when the power is decreasing by more than 25 %.

9 Notes on Care, Maintenance and Service

The manufacturer of the unit cannot be held liable for damage resulting from operating errors, negligence or unauthorized tampering with the device system, particularly as the result of removal or replacement of parts of the unit or as the result of the use of unsuitable accessories from other manufacturers. Any such action will render all warranty claims null and void and also laser safety is no longer warranted.

You are well advised to arrange a service agreement with your nearest ZEISS representative to guarantee perfect functioning of the microscope system in the long term.

Use only original spare parts.

Modifications and conversion work on the components of the system must only be carried out by the manufacturer, by the service agency or by persons authorized and trained for this purpose by the manufacturer.

Do not install any other software without talking to your ZEISS representative.

The LSM computer is a system computer controlling a high end microscope system. The computer must not be used as a general workstation with frequent updates of windows patches or security patches. The LSM software is released with a specific windows version and patch and this must not be changed unless otherwise released by Carl Zeiss Microscopy.

Damaged units or parts may only be repaired or exchanged by the responsible service agency.

During maintenance or repair carried out by the service personnel the customer is requested to stand aside and wear a pair of laser safety goggles if needed.

We strongly recommend to purchase the calibration objective as the calibration and test tasks which are provided with the system maintenance tool (see operating manual) require this tool.

Especially the scanner calibration is recommended every 1-2 years, when the high speeds (13 and above) are used frequently.

9.1 Exchanging Fuses

The customer has the possibility to change defective fuses. The positions of the fuses are shown in Fig. 1 and Fig. 2. The fuses are inserted into fuse holders (normally used for power supply units), bayonet type fuses carriers, slot fuse carriers or screw type fuse carriers. The fuse type is given on the hardware itself and also in Fig. 2.

For exchanging fuses proceed as follows:

- Open the fuse carrier by turning 90° clockwise.
- Pull out the fuse carrier and replace the fuse by a new one of the same type.
- Insert the fuse carrier, push it in and lock it by turning 90° anti-clockwise.

9.2 Cleaning

Care operations that may be carried out by operating staff are limited to cleaning painted and glass surfaces.

- Before cleaning the instrument make sure the main power supply is disconnected.
- Cleaning painted surfaces:
  To do this, use a clean cloth that has been moistened in a mixture of water and some detergent; do not use any solvent, however. Dry with a lint-free cloth.
- Cleaning glass surfaces:
  Glass surfaces that have become soiled or which are marked with fingerprints may be rubbed with a clean optical cleaning cloth.
  If soiling is persistent, dip the optical cleaning cloth into a mixture of distilled water and a small quantity of detergent.
  To complete cleaning, lightly breathe on the glass surface and rub it dry with a clean cloth. Lint or dust is best removed with a clean brush.
- Make sure that no cleaning liquid penetrates into the system.

9.3 Maintenance of the Liquid Cooling System

The scan module of your LSM 880 is connected to a liquid cooling system. Please consider that the pH value of the cooling liquid changes over time.

To prevent corrosion in the cooler of the detection module, the pH value of the cooling liquid must be checked at least once a year and the liquid replaced as necessary. Please observe the directions of the cooling system manufacturer in the supplied operating manual.

If you have signed a service agreement with ZEISS, our service staff will perform the check as part of the maintenance procedure.

The safety data sheet for the cooling liquid should also be observed.

9.4 Count on Service in the True Sense of the Word

Because the ZEISS microscope system is one of your most important tools, we make sure it is always ready to perform. What's more, we'll see to it that you are employing all the options that get the best from your microscope. You can choose from a range of service products, each delivered by highly qualified ZEISS specialists who will support you long beyond the purchase of your system. Our aim is to enable you to experience those special moments that inspire your work.

Repair. Maintain. Optimize.

Attain maximum uptime with your microscope. A ZEISS Protect Service Agreement lets you budget for operating costs, all the while reducing costly downtime and achieving the best results through the improved performance of your system. Choose from service agreements designed to give you a range of options and control levels. We'll work with you to select the service program that addresses your system needs and usage requirements, in line with your organization's standard practices.

Our service on-demand also brings you distinct advantages. ZEISS service staff will analyze issues at hand and resolve it – whether using remote maintenance software or working on site.

Enhance Your Microscope System.

Your ZEISS microscope system is designed for a variety of updates: open interfaces allow you to maintain a high technological level at all times. As a result you'll work more efficiently now, while extending the productive lifetime of your microscope as new update possibilities come on stream.

Please note that our service products are always being adjusted to meet market needs and maybe be subject to change.

10 User Interface

All user interface ports, except the nosepiece module GaAsP NDD 2 channels, are equipped with a safety interlock system which warrants laser safety. These interlock devices must not be manipulated. Other interfaces not described here are service interfaces and are only to be operated by authorized ZEISS service personnel. The following devices can be mounted and dismounted by the user or are accessible by the user:

- Halogen lamp
- Transmission PMT
- Switching Mirror
- NDD's (see corresponding system manual for details)
- BiG.2
- GaAsP NDD 2 channels

10.1 Mounting and Dismounting Lamps, T-PMT and Switching Mirror

The ports of the lamps, the switching mirror and the transmission T-PMT are equipped with hardware interlock devices which have to be operated in the following way:

Interlock with sensor ring and contact ring:

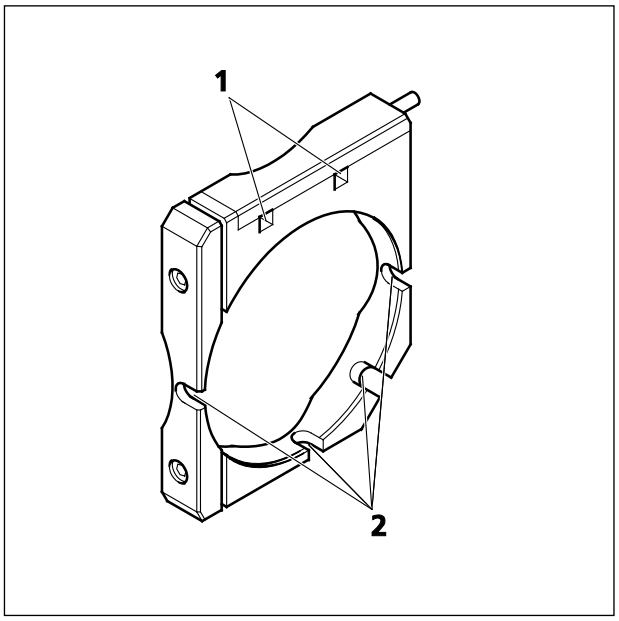


Fig. 17 Sensor ring mounted to the interface ports on the microscope side

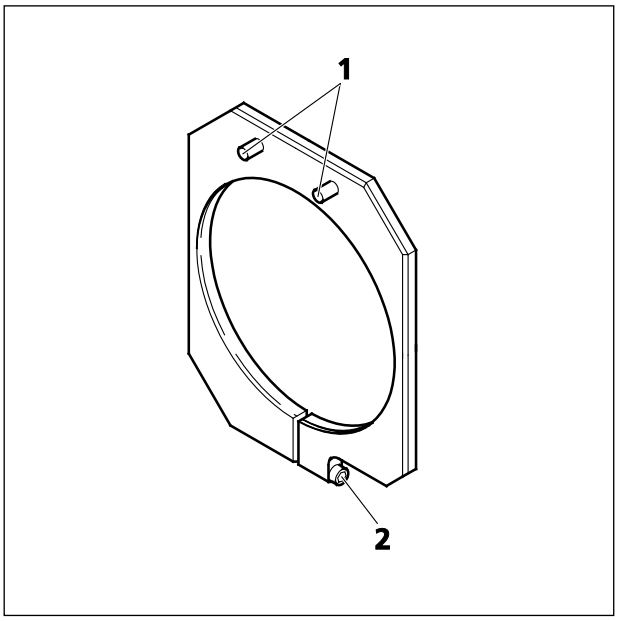


Fig. 18 Contact ring mounted to the lamp, T-PMT or switching mirror

The interlock is working when the sensors of the sensor ring (Fig. 17/**1**) are depressed by the pins on the contact ring (Fig. 18/**1**). Whenever this is not the case, for example if the distance between the two devices is too large, the laser will be blocked and the system cannot be used.

☞ In case the system is not operating following the removal or attachment of any device on a port with safety interlock check again the connection of the Contact ring to the Sensor ring.

For dismounting the lamps, T-PMT or switching mirror slightly unscrew the contact ring first (Fig. 18/**2**) so it can be moved away from the sensor ring (Fig. 17). Then unscrew the lamp, T-PMT or switching mirror turning the main screw which is in one of the recesses of the sensor ring (Fig. 17). Hold the device to be dismounted with one hand while unscrewing to keep it from dropping. The now empty port has to be closed with the blind cap (Fig. 19) to restore the functionality of the system. Use the main screw of the port to fix the cap. Make sure the pins of the cap depress the sensors of the sensor ring.

☞ Do not remove the sensor ring from the microscope. This might result in failure of laser safety and a non operating system.

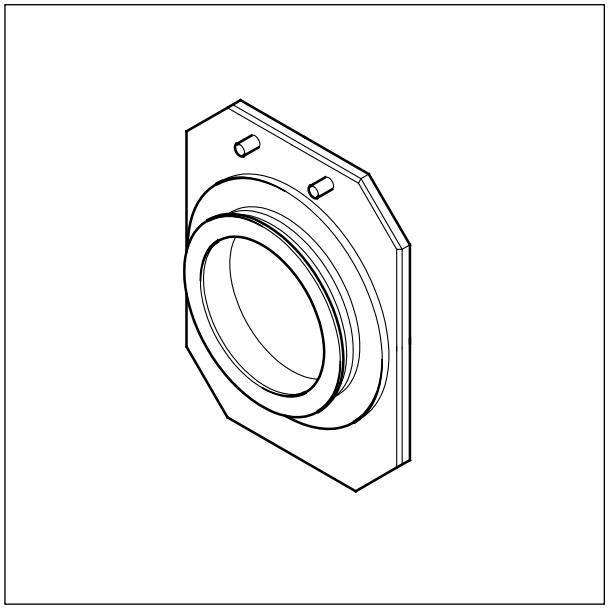


Fig. 19 Blind cap for closing any port equipped with an interlock device

For mounting any lamp, T-PMT or the switching mirror back onto the microscope reverse the steps for dismounting the device. Be careful not to bend the pins on the contact ring when screwing the device onto the microscope port.

For the Axio Observer.Z1 transmission port and the two ports available on the motorized switching mirror no sensor ring is present. Instead the sensors are directly installed at the Axio Observer.Z1 transmission port or the two ports of the motorized switching mirror.

10.2 Mounting and Dismounting the BiG.2

☞ Do not remove the laser safety cable (Fig. 20/**1**) from the LSM 880 system. This might result in failure of laser safety and a non-operating system.

☞ Always shut down the system completely before mounting or dismounting the BiG.2.

- Loosen the two fastening screws (Fig. 20/**3**) of the BiG.2 port (Fig. 20/**2**).
- Slowly pull the BiG.2 (Fig. 20/**4**) away from the port.
- For mounting the BiG.2 onto any port, make sure the pins and the electronic connections of the safety interface match closely.
- Push the BiG.2 to the port and fasten the two fastening screws.
- The BiG.2 has to be connected to the RT-PC directly via the connector LVDS. Depending on the use of BiG.2 the following connectors have to be used on the RT-PC:
  - LVDS-D for BiG.2 attached to the direct coupling (DC-out) port on the scan head or as NDD in transmission (NDD-T)
  - LVDS-C for BiG.2 attached to the NDD port in reflection (NDD-R).
- When the BiG.2 is relocated on the system, please make sure to select the new port in the Config Tool (see ZEN folder on your harddrive).
- For changing between the DC-out port and NDD-T no change of the cabling is necessary.
- When the BiG.2 is moved from the NDD-R to the DC-out port the following steps have to be performed to change the cabling:
  a) the cable connected to the Sub-LVDS connector on the BiG.2 (if available) has to be disconnected and plugged into the LVDS-C connector on the RT-PC
  b) the cable connected to the LVDS port of the BiG.2 needs to be plugged into the LVDS-D connector on the RT-PC
  c) the cable connected to the LVDS-D connector on the RT-PC is then plugged into the Sub-LVDS connector on the BiG.2
- When the BiG.2 is moved from the DC position to the NDD port in reflection the following steps have to be performed to change the cabling:
  a) the cable connected to the Sub-LVDS connector on the BiG.2 (if available) has to be disconnected and plugged into the LVDS-D connector on the RT-PC
  b) the cable connected to the LVDS port of the BiG.2 needs to be plugged into the LVDS-C connector on the RT-PC
  c) the cable connected to the LVDS-C connector on the RT-PC is then plugged into the Sub-LVDS connector on the BiG.2

Steps a and c for both processes have to be performed only if additional NDD.2 modules are attached to the system. Additional modules are connected to the system in a row starting from the Sub-LVDS connector of the BiG.2.

If the BiG.2 is not attached, the laser safety cover must be mounted on the BiG.2 port to close the laser safety loop:

- Push the laser safety cover (Fig. 21/**3**) to the port (Fig. 21/**1**) and fasten the two fastening screws (Fig. 21/**2**).

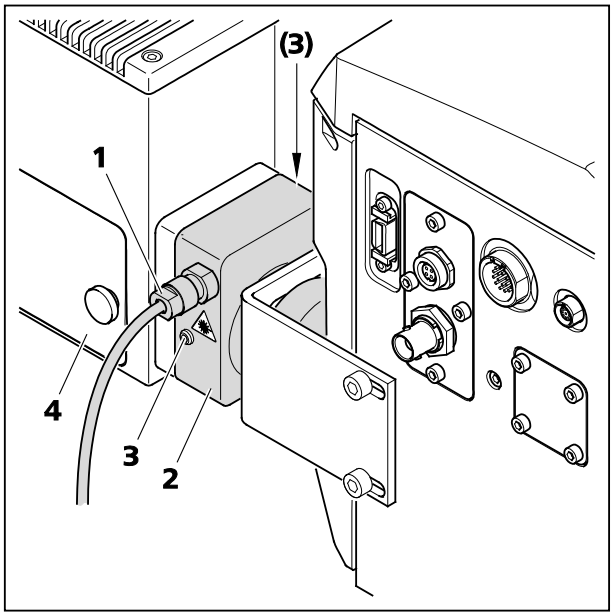


Fig. 20 Port connection between LSM 880 and BiG.2

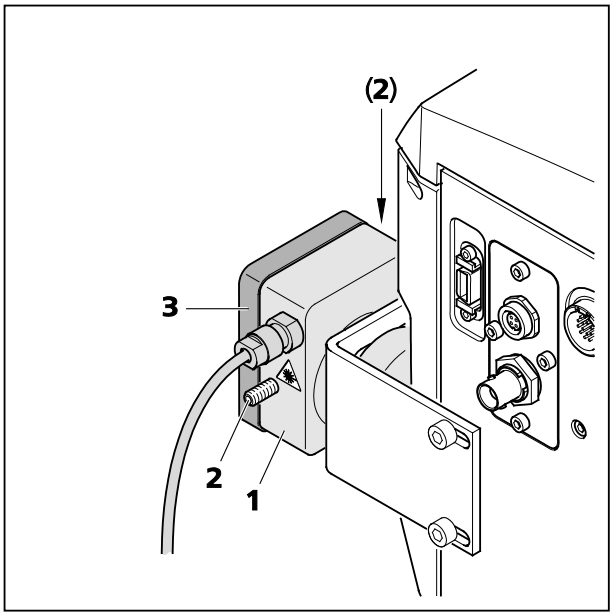


Fig. 21 Laser safety cover for BiG.2 port

10.3 Changing the Filter Modules in the BiG.2

You can remove and replace filter modules by push and click.

☞ When opening the filter insert, the safety control will switch off the laser light.

☞ Using a P&C filter module with a long pass dichroic projects the longer wavelength range of the emission spectrum to channel 2 and the shorter range of the emission spectrum to channel 1. Alterations of filters can be indicated to the software as described in the operating manual.

To exchange the filter module of the BiG.2 proceed as follows:

- Loosen the two knurled screws (Fig. 22/**2**).
- Remove the filter insert (Fig. 22/**3**) of the BiG.2 (Fig. 22/**1**) and put it down.

How to uninstall a module:

- Disengage the filter module (Fig. 23/**4**) from the left spring clips (Fig. 23/**2**) of the filter insert (Fig. 23/**1**) by tilting it forward, then lift it off the right spring clips (Fig. 23/**3**) and remove the module.

How to install a module:

- Insert the filter module with the aid of its mounting elements on its lower and upper sight (Fig. 23/**4**) into the right spring clips (Fig. 23/**3**) on the filter insert.
- Press the filter module against the left spring clips (Fig. 23/**2**) until it engages firmly.

- After exchanging the filter module, replace the filter insert (Fig. 22/**3**) into the BiG.2 (Fig. 22/**1**).
- Fasten the two knurled screws (Fig. 22/**2**).

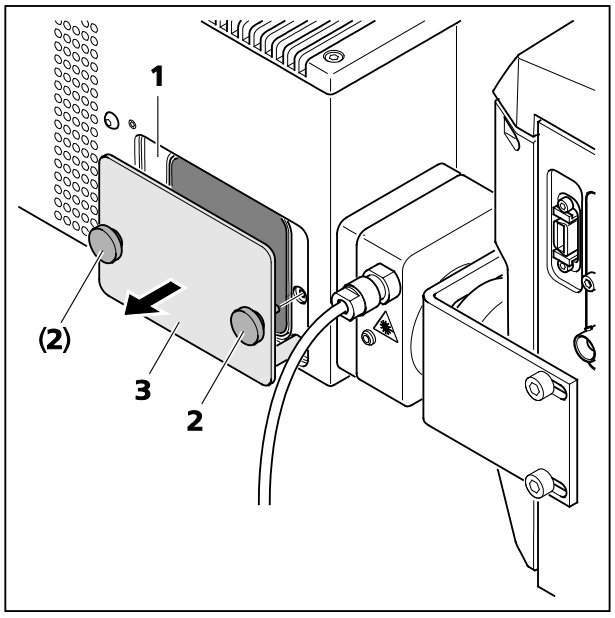


Fig. 22 Filter insert of the BiG.2

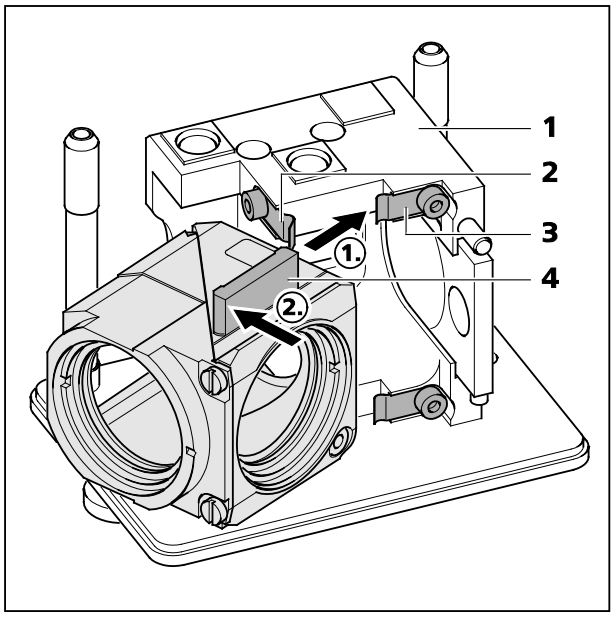


Fig. 23 Changing the filter module

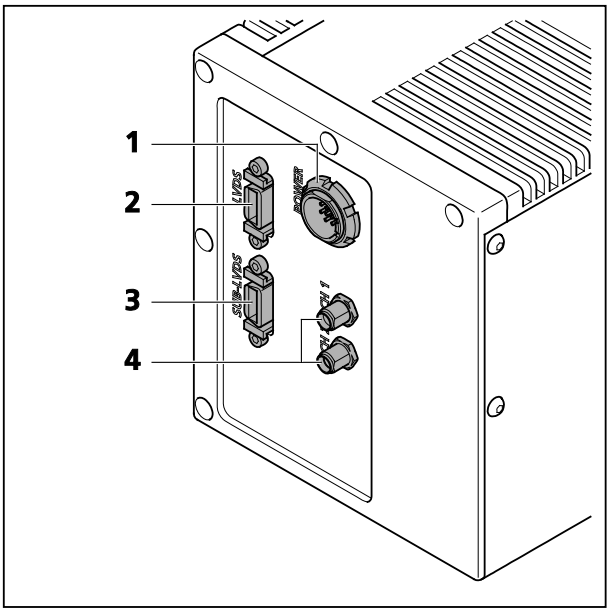


Fig. 24 Rear view BiG.2 module

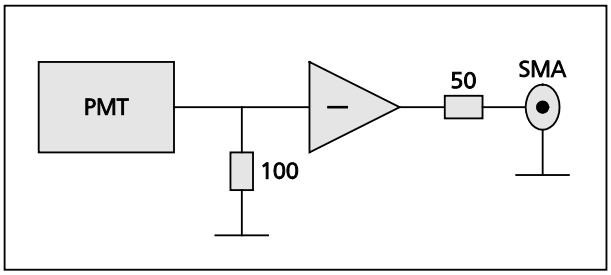


Fig. 25 Signal transfer scheme from PMT to SMA connector

10.4 External Connectors on BiG.2

In the rear of the BiG.2 module, two SMA connectors are available which deliver the signals of both GaAsP PMT detector channels (see Fig. 24/**4**).

The signals are always provided both to be registered by the LSM system and by an external device (i.e. electronics for FLIM) which is linked to these connectors.

Using a P&C filter cube with a long pass dichroic projects the longer wavelength range of the emission spectrum to channel 2 and the shorter range of the emission spectrum to channel 1.

The assignment of the connectors is as follows:

Name	BiG.2	Meaning
Power (Fig. 24/**1**)	12-pin LEMO ECJ-2B	Power supply through main electronics unit
LVDS (Fig. 24/**2**)	14-pin MDR	Main communication link
Sub-LVDS (Fig. 24/**3**)	14-pin MDR	Communication to optional module
Ch1/Ch2 (Fig. 24/**4**)	SMA	Amplified PMT signal (inverted) R_i = 50 Ω BW ~ 200 MHz V_{out} (max) = +5V Gain/Amplification = 42,3 (32,5dB)

10.5 Using the GaAsP NDD 2 Channels on Axio Examiner Stand for Multiphoton Imaging

The GaAsP NDD 2 channels is used instead of a regular objective holder on the Axio Examiner stand. It is equipped with two high sensitive GaAsP detectors.

The detectors are used to detect emission signals generated with multiphoton excitation.

It is equipped with a dichroic filter which separates the excitation light from the emission light and which directs the emission light towards the two detectors.

It is also equipped with a special filter cube which holds two emission filters and one dichroic filter. This filter cube separates and filters the emission signals right before the detectors. Both filter units are set and controlled manually.

The module can be exchanged for other objective holders. The system needs to be shut down when doing so.

Mounting the GaAsP NDD 2 channels to the microscope stand

- Move the rear side of the unit (Fig. 26/**2**) sideways towards the guide rail for the objective holders (Fig. 26/**1**).
- Once clicked into the guide rail move the unit upwards until it's stopped by the upper pin (Fig. 26/**3**).
- Fix the unit to the stand with the wing screw (Fig. 27/**1**) on the left hand side.
- Connect the detector unit to the electronics of the microscope via the cable on the left hand side (Fig. 27/**2**).
- Make sure the power supply and LVDS cables are connected to the system accordingly.

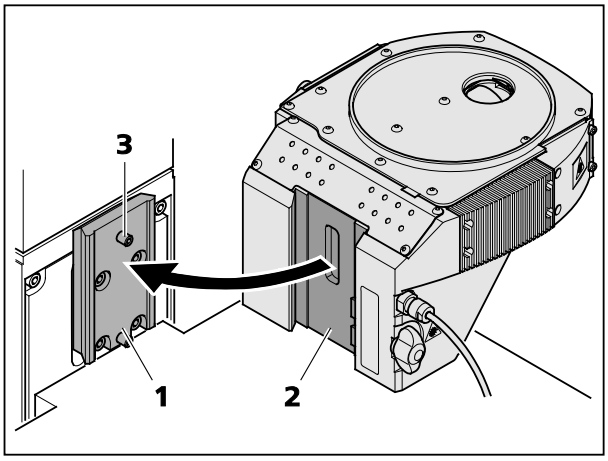


Fig. 26 Mounting the GaAsP NDD 2 channels to the microscope

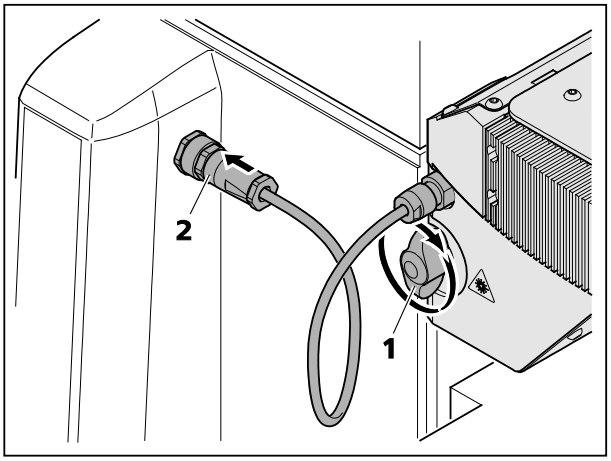


Fig. 27 Connecting the GaAsP NDD 2 channels to the microscope

Do not leave any opening for filters uncovered when working with the system.

Do not grab into these openings or insert any other device when the system is in use, as you may damage the unit or risk getting your fingers in the way of the laser beam.

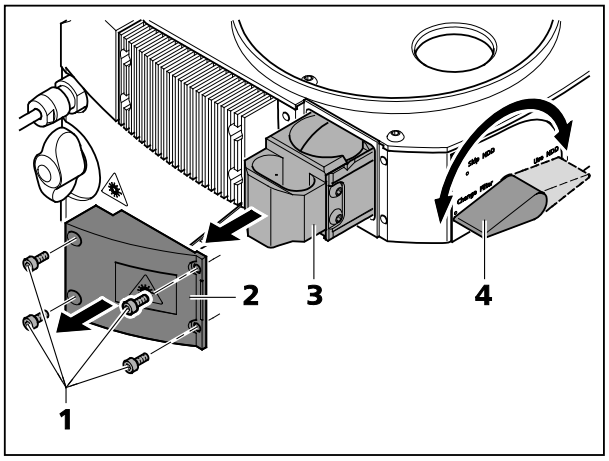


Fig. 28 Changing the dichroic filters of the GaAsP NDD 2 channels

Using and changing the dichroic filter of the GaAsP NDD 2 channels

Imaging with the GaAsP NDD 2 channels:

- Move the dichroic filter by turning the knob on the front of the unit (Fig. 28/**4**) so its tip points to the right position indicated as "NDD".

Observing the sample with the ocular or skipping the detector for imaging:

- Move the knob to the "Skip NDD" position.

Changing the dichroic filter:

- Move the knob to the "Change" position.
- Unfasten the four screws on the left hand side of the unit (Fig. 28/**1**) and remove the cap (Fig. 28/**2**).
- Grab the filter holder (Fig. 28/**3**) and slide it out/in.
- Reposition the cap and fasten it again with the four screws.

Do not leave the opening uncovered when working with the system.

Do not grab into the opening or insert any other device as you may damage the unit.

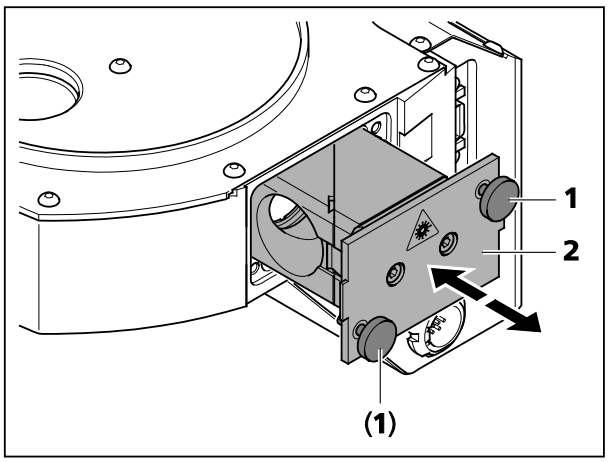


Fig. 29 Changing the Emission filters of the GaAsP NDD 2 channels

Changing the emission filters of the GaAsP NDD 2 channels

- Unlock the special filter cube with the two knurled screws on the right hand side of the unit (Fig. 29/**1**).
- Slide the filter cube (Fig. 29/**2**) in or out of the opening.
- Fasten the knurled screws to fix the filter holder in its working position.

Do not leave the opening uncovered when working with the system.

Do not grab into the opening or insert any other device as you may damage the unit.

CHAPTER 2 SETUP REQUIREMENTS

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1 Space Requirements

1.1 LSM 880 on Small System Table

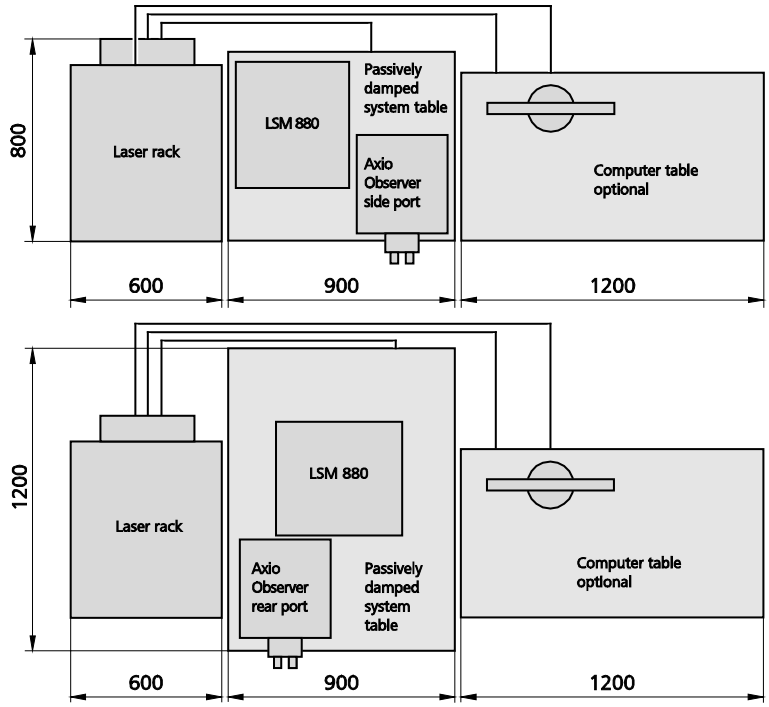


Fig. 1 Space requirements for LSM on small system table (measurements in mm)

☞ The realtime PC and the liquid cooling system are located beneath the system table. The Argon laser power supply is placed on top of the laser rack. The user PC is located under the computer table. If present, the laser module UV is located on top of the Laser Rack of the LSM 880. The total height of this rack is then 1 m.

1.2 LSM 880 with Airyscan on Large System Table

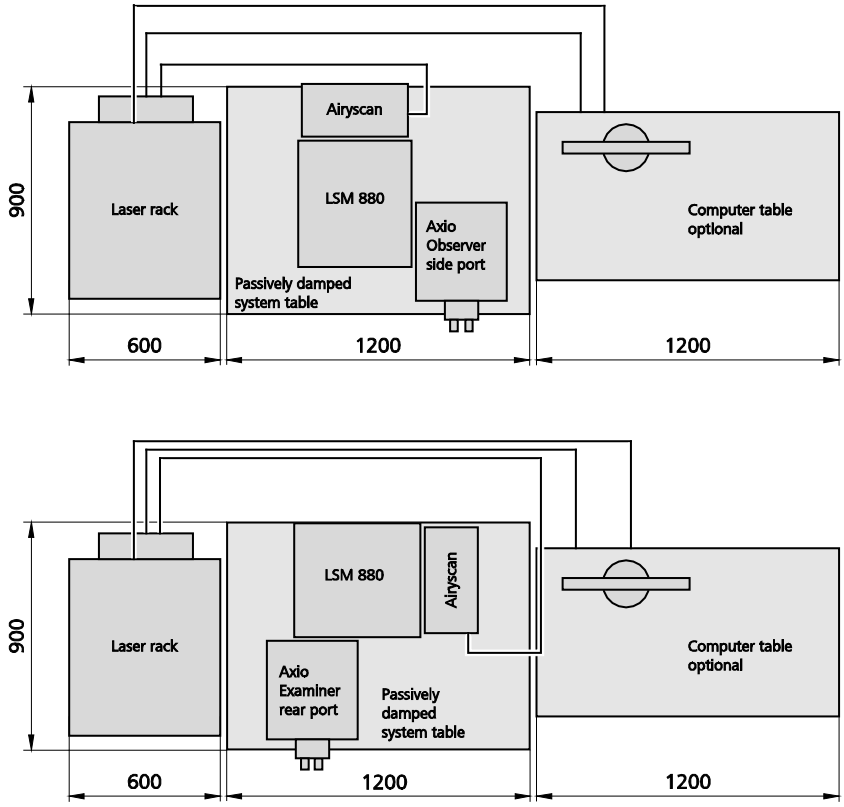


Fig. 2 Space requirements for LSM with Airyscan on large system table (measurements in mm)

☞ The realtime PC and the liquid cooling system are located beneath the system table. The Argon laser power supply is placed on top of the laser rack. The user PC is located under the computer table. If present, the laser module UV is located on top of the Laser Rack of the LSM 880. The total height of these racks is then 1 m. For systems with Axio Observer rear port the size of the system table is 900 mm wide and 1200 mm deep. For systems with Axio Imager the size of the system table is 900 mm wide and 750 mm deep.

1.3 LSM 880 Equipped with Two Photon Laser (NLO) for Single Stand

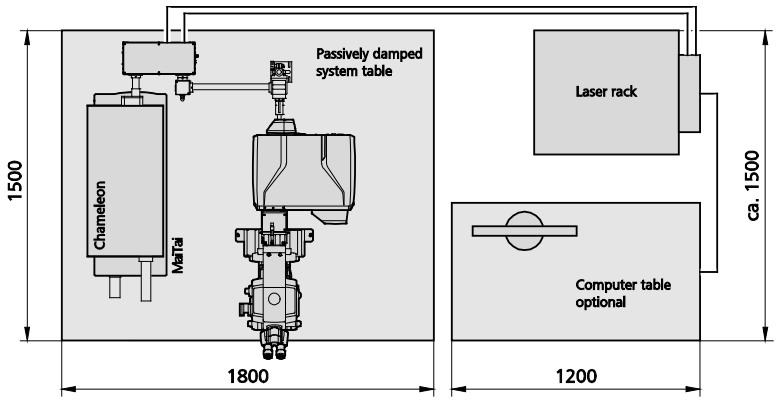


Fig. 3 Space requirements for Two Photon Laser (NLO) single stand (measurements in mm)

☞ The user PC and the real time electronics are located beneath the computer table. The power supply of the Argon laser is placed on top of the laser rack. The liquid cooling system and the chiller of the NLO laser are located beneath the system table.

1.4 LSM 880 Equipped with Two Photon Laser (NLO) for Dual Stand

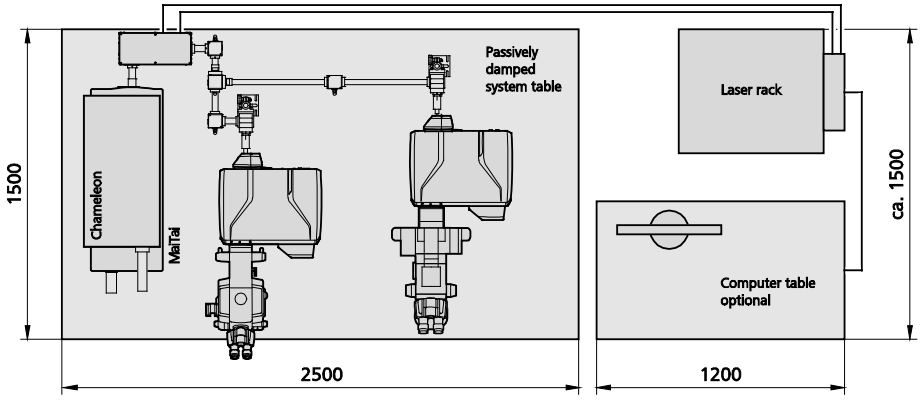


Fig. 4 Space requirements for Two Photon Laser (NLO) dual stand (measurements in mm)

☞ The user PC and the real time electronics are located beneath the computer table. The power supply of the Argon laser is placed on top of the laser rack. The liquid cooling system and the chiller of the NLO laser are located beneath the system table.

1.5 LSM 880 NLO on Axio Examiner Equipped with NLO Laser and OPO

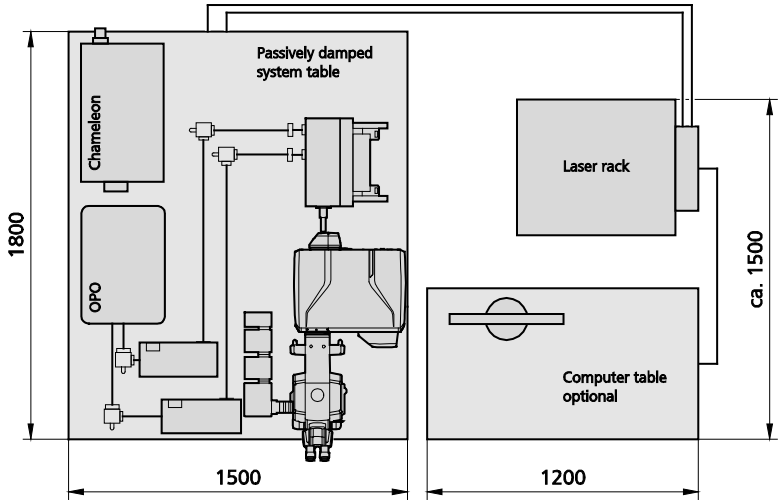


Fig. 5 Space requirements for LSM 880 NLO with NLO laser and OPO
(Measurements in mm. With Airyscan module the system table size is 1800 x 1800.)

☞ The user PC and the real time electronics are located beneath the computer table. The power supply of the Argon laser is placed on top of the laser rack. The liquid cooling system and the chiller of the NLO laser are located beneath the system table.

1.6 LSM 880 NLO on Axio Examiner Equipped with Two NLO Lasers

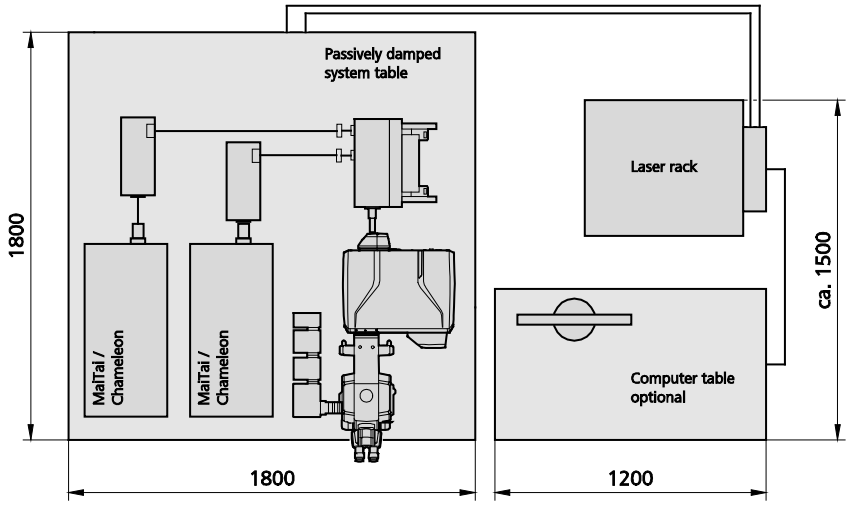


Fig. 6 Space requirements for LSM 880 NLO with two NLO lasers
(Measurements in mm. With Airyscan module the system table size is 1500 x 2500.)

☞ The user PC and the real time electronics are located beneath the computer table. The power supply of the Argon laser is placed on top of the laser rack. The liquid cooling system and the chiller of the NLO laser are located beneath the system table.

1.7 LSM 880 NLO on Axio Observer Equipped with NLO Laser and OPO

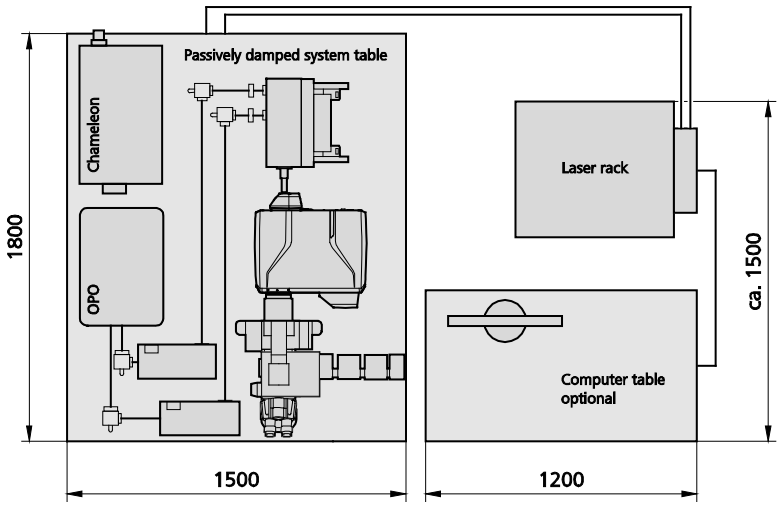


Fig. 7 Space requirements for LSM 880 NLO with NLO laser and OPO
(Measurements in mm. With Airyscan module the system table size is 1800 x 1800.)

☞ The user PC and the real time electronics are located beneath the computer table. The power supply of the Argon laser is placed on top of the laser rack. The liquid cooling system and the chiller of the NLO laser are located beneath the system table.

1.8 LSM 880 NLO on Axio Observer Equipped with two NLO Lasers

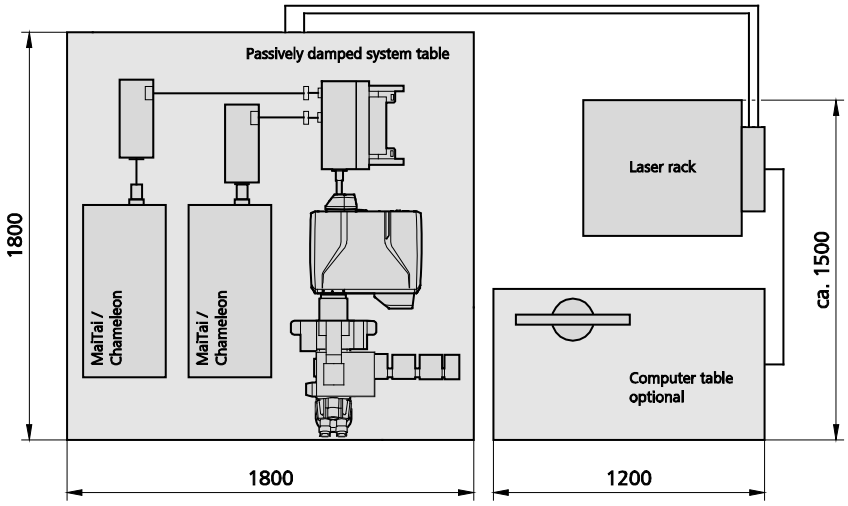


Fig. 8 Space requirements for LSM 880 NLO with two NLO lasers
(Measurements in mm. With Airyscan module the system table size is the same.)

☞ The user PC and the real time electronics are located beneath the computer table. The power supply of the Argon laser is placed on top of the laser rack. The liquid cooling system and the chiller of the NLO laser are located beneath the system table.

2 Power Requirements

☞ The LSM 880 system comes with a mains power supply cord and plug, either CEE red (3/N/PE 400/230V/16A), or NEMA L 14-30P (2/N/Ground 120/240V/30A), and with the matching mains socket outlet.
The mains socket outlet must be equipped with a fuse having minimum tripping characteristic C according to IEC/EN 60898.

Line voltage	3/N/PE 400/230 V AC (±10 %)	2/N/Ground 240/120 V AC (±10 %)
Line frequency	50...60 Hz	50...60 Hz
LSM incl. VIS laser:		
Max. current	3 phases at 16 A	2 phases at 25 A
Power	Phase 1 = 600 VA max. Phase 2 = 500 VA max. Phase 3 = 1500 VA max.	Phase 1 = 800 VA max. Phase 2 = 1600VA max.
Power consumption	2100 VA max.	2100 VA max.
Power consumption		
Ti:Sa Laser 1	800 VA max.	800 VA max.
Ti:Sa Laser 2	800 VA max.	800 VA max.
OPO	600 VA max.	600 VA max.
Class of protection	I	I
Type of protection	IP 20	IP 20
Overvoltage category	II	II
Pollution degree	2	2
Heat emission (without Ti:Sa or OPO laser)	2000 W max.	2000 W max.

☞ EMC test according to DIN EN 61326-1 (05/2010)
1. Noise emission according to CISPR 11 / DIN EN 55011 (04/2011)
2. Noise immunity according to table 2 (industrial sector)

☞ The LSM contains sensitive electronics. A few seconds of faulty power can damage parts of the electronics. The system is therefore equipped with a surge guard, a device that protects the electronics of the LSM from strong electrical power fluctuations like overvoltage, lightning or other external influences.
The surge guard is located within the electrical connection box. It works once to protect the system, then it has to be exchanged. Within warranty, service contracts or any other service visit ZEISS service will check the functionality of the surge guard and provide a new device if necessary. Nevertheless, in the rare case of a voltage surge on the power supply line (e.g. from indirect lightning stroke), a momentary interruption of the acquisition system's functionality is possible. This is no defect. Acquisition can be continued after starting the ZEN software again. Sample position is maintained and no damage occurs to the system. A possible protective means to minimize the probability of a temporary disruption is a transient voltage protector in your facility's power system.

☞ The Ti:Sa laser(s) and OPO need to have a separate electrical connection according to the instructions of the manufacturer.
When operating the main switch of the LSM 880 NLO the Ti:Sa lasers are not switched on or off.

3 Physical Dimensions

	Length (cm)	Width (cm)	Height (cm)	Weight (kg)
Small passively damped system table	90	75	77	80
Small actively damped system table	90	75	77	90
Large actively damped system table	120	90	77	120
Active anti-vibration table (NLO) for Mai Tai Laser or Chameleon	180	150	75	200
Active anti-vibration table (NLO) for two-microscope configuration	250	150	75	400
Periscope for two NLO lasers or NLO laser with OPO	40	37	70	40
Active anti-vibration table (NLO) for Laser Chameleon with OPO	180	180	75	410
Scanning Module LSM 880	50	45	22	27
Microscope	50	35	50	20
Electronic Rack with laser units	80	60	65	80
Plug-in unit external laser	70	55	25	10
Laser module UV	80	60	65	40
Airyscan	40	20	24	12
Fiber optic cable, UV	200			
Fiber optic cable, VIS(ible)	250			
Cables	250			

4 Dimension of Shipment Crates

Crate containing	Length (cm)	Width (cm)	Height (cm)	Weight (kg)
Large system table	130	100	92	130
Small system table	100	85	92	100
Active anti-vibration table (NLO) for Mai Tai Laser or Chameleon	190	160	90	350
Active anti-vibration table (NLO) for two-microscope configuration	260	160	90	480
Periscope for two NLO lasers or NLO laser with OPO	70	67	90	60
Active anti-vibration table (NLO) for Laser Chameleon with OPO	200	200	90	510
Laser Rack and LSM 880	104	94	144	130
Accessories (large box)	139	94	114	150
Accessories (small box)	112	94	96	100
Microscope stand (max. size)	96	89	94	50
Laser module UV (without laser)	104	94	72	10
Laser UV	74	60	40	30
Liquid cooling system	64	42	28	8

5 Environmental Requirements

For operation the system has to be placed in a closed room.

1. Operation, specified performance	T = 22 °C ± 3 °C without interruption (24 h a day independently whether system is operated or switched-off) It has to be ensured that the air-flow of the air-conditioning is not directed at the system.
2. Operation, reduced performance	T = 15 °C to 35 °C, any conditions different from item 1. and 5.
3. Storage, less than 16 h	T = -20 °C to 55 °C
4. Storage, less than 6 h	T = -20 °C to 55 °C
5. Temperature gradient	± 0.5 °C/h
6. Warm up time	1 h, for high-precision and/or long-term measurements ≥ 3 h
7. Relative humidity	< 65 % at 30 °C
8. Operation altitude	max. 2000 m
9. Loss of heat (without Ti:Sa or OPO laser)	2 kW
10. Vibrations under operation conditions (with system table)	5 µm pp at 5 Hz 10 µm pp at 10 Hz 10 µm pp at 20 Hz
11. Shipping shock (LSM 880 box)	10 g

6 Available Lasers

6.1 Laser Insert RGB (pigtailed; 458, 488, 514, 543, 561, 594, 633 nm)

Single-mode polarization preserving fiber
Laser beam attenuation for all lasers by VIS-AOTF
Ar laser (458, 488, 514 nm, 11.5 or 19.5 mW)
HeNe laser (543 nm, 0.7 mW)
DPSS laser (561 nm, 13 mW)
HeNe laser (594 nm, 1.3 mW)
HeNe laser (633 nm, 3 mW)

6.2 Laser Insert V (pigtailed; 405, 440 nm)

Single-mode polarization preserving fiber
Laser beam attenuation by direct modulation
Diode laser (405 nm, 15 mW)
Diode laser pulsed/cw (405 nm, 15 mW):

- cw mode
  - max power ca. 15 mW at fiber out
  - range 0.6-15 mW w/o
  - attenuator, attenuation by a factor of 25
- pulsed mode
  - repetition rate 20-50-80 MHz
  - mean power: @20 MHz - ca. 0.2 mW; @50 MHz - ca. 0.5 mW; @80 MHz - ca. 0.8 mW
  - peak power: 50-300 mW
  - pulse width: 50-90 ps
  - jitter < 20 ps

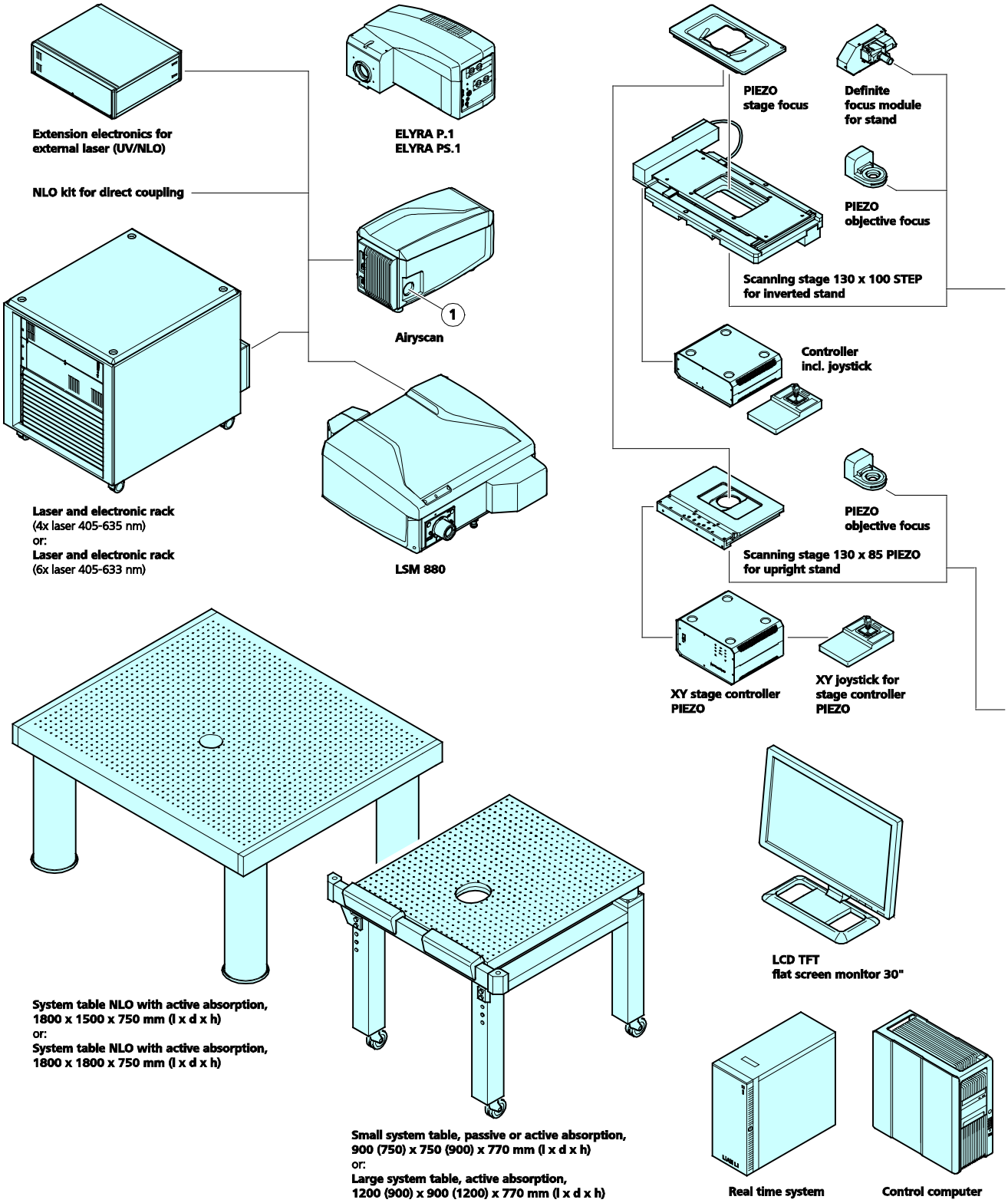
Diode laser pulsed/cw (440 nm, 15 mW):

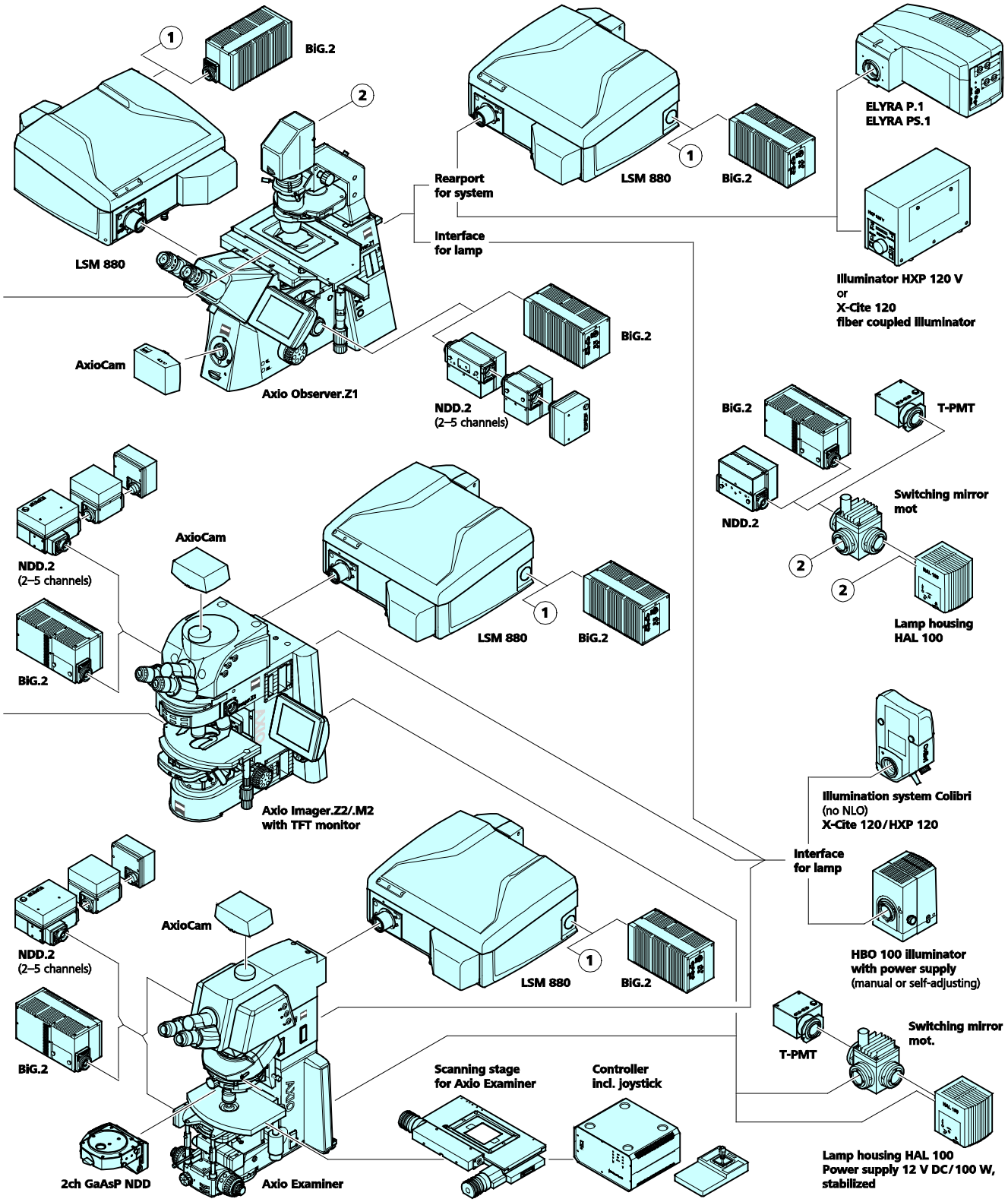
- cw mode
  - max power ca. 15 mW at fiber out
  - range 0.6-15 mW w/o
  - attenuator, attenuation by a factor of 25
- pulsed mode
  - repetition rate 20-50-80 MHz
  - mean power: @20 MHz - ca. 0.1 mW; @50 MHz - ca. 0.25 mW; @80 MHz - ca. 0.4 mW
  - peak power: 50-300 mW
  - pulse width: 50-90 ps
  - jitter < 20 ps

6.3 Laser Module UV (355 nm)

Single-mode polarization preserving fiber
Laser beam attenuation by AOM
DPSS laser (355 nm, 26 mW)

7 System Overview LSM 880




1
BiG.2
2
LSM 880
AxioCam
Axio Observer.Z1
Rearport
for system
Interface
for lamp
LSM 880
1
BiG.2
ELYRA P.1
ELYRA PS.1
Illuminator HXP 120 V
or
X-Cite 120
fiber coupled illuminator
BiG.2
NDD.2
(2–5 channels)
BiG.2
T-PMT
NDD.2
Switching mirror
mot
2
2
Lamp housing
HAL 100
NDD.2
(2–5 channels)
AxioCam
BiG.2
LSM 880
1
BiG.2
Axio Imager.Z2/.M2
with TFT monitor
Illumination system Colibri
(no NLO)
X-Cite 120/HXP 120
Interface
for lamp
HBO 100 illuminator
with power supply
(manual or self-adjusting)
NDD.2
(2–5 channels)
AxioCam
BiG.2
LSM 880
1
BiG.2
T-PMT
Switching mirror
mot.
Scanning stage
for Axio Examiner
Controller
incl. joystick
2ch GaAsP NDD
Axio Examiner
Lamp housing HAL 100
Power supply 12 V DC/100 W,
stabilized