

# **OLYMPUS<sup>®</sup>**

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## **INSTRUCTIONS**

**LAS/405, LAS/445**  
**LAS/473, LAS/488**  
**LAS/491, LAS/514**  
**LAS/532, LAS/561**  
**LAS/594, LAS/640**  
**LASER SYSTEMS**

This instruction manual describes the fiber-coupled Olympus cell\* diode and diode-pumped solid-state laser systems of different wavelengths and power. To ensure safety, obtain optimum performance and familiarize yourself fully with the use of these products, we recommend that you study this manual thoroughly before operation. Together with this manual, please also read the TIRFM illumination combiner manual, the imaging system manuals and the instruction manuals of the microscope in order to understand overall operation methods. Retain this manual in an easily accessible place near a system for future reference.

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# Imaging Excellence

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# Contents

<b>1</b>	<b>Introduction.....</b>	<b>1</b>
<b>2</b>	<b>Safety Precautions and Handling Instructions.....</b>	<b>3</b>
2.1	Safety Symbols.....	4
2.2	Laser Safety Precautions.....	5
2.3	General Safety Precautions.....	6
2.4	Handling Instructions and Recommendations.....	7
<b>3</b>	<b>Operating the Laser System.....</b>	<b>9</b>
3.1	Starting the Laser System.....	10
3.2	Operation.....	10
3.3	Switching Off the Laser System.....	11
3.4	Using the Interlock to Close the Safety Shutter.....	11
<b>4</b>	<b>Installation and Alignment.....</b>	<b>13</b>
4.1	Components.....	14
4.2	Front View.....	14
4.3	Rear View.....	15
4.4	Installation.....	15
4.5	Alignment of the Fiber Manipulator.....	16
4.6	Connecting and Aligning the Laser Fiber.....	19
<b>5</b>	<b>Software Integration.....</b>	<b>21</b>
5.1	Lasers in cell^M / cell^R.....	22
5.1.1	Configuration of the Lasers.....	22
5.1.2	Image Types.....	23
5.1.3	Controlling the Laser.....	23
5.1.4	Lasers in an Experiment Plan.....	24
5.2	Lasers in the cell^TIRF Control Software.....	25
<b>6</b>	<b>Specifications and Technical Data.....</b>	<b>27</b>
6.1	Model Specific Technical Data.....	28
6.2	General Technical Data.....	28



# 1 Introduction

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Thank you very much for purchasing an Olympus Soft Imaging Solutions' state of the art **cell\*** laser system, which is especially designed for the use as TIRF illumination source in an Olympus **cell<sup>tirf</sup>** Imaging Station, and for your confidence in our products and service. It is Olympus Soft Imaging Solutions' main objective to provide you with solutions able to meet your experimental demands and thus pave the way to your scientific success.

# Introduction



Stack of two Olympus laser systems



This laser system is a Class 3B laser product according to EN 60825-1. It can cause irreversible damage to your eyes. Wear adequate eye protection! **Trained personnel only may perform assembly, alignment or operation. The person in charge of the laser system must be aware of the specific laser safety precautions.** He/she is responsible for the safety of every person present in the room while operating the laser.

This manual is the complete documentation necessary for using the Olympus **cell\*** laser systems correctly and efficiently.

Special care has been taken to guarantee correct and accurate information, although this is subject to changes due to further development of the laser systems. Thus, the manufacturer cannot assume liability for any possible errors. We would appreciate reports of any mistakes as well as suggestions or criticism.

If you find any information missing in this manual or you need additional support, please contact your local Olympus dealer.



## 2 Safety Precautions and Handling Instructions





The Olympus Soft Imaging Solutions cell\* laser system is a product belonging to the laser safety class 3B. Class 3B lasers are medium power lasers with an output power of up to 500 mW within 400 – 700 nm wavelength. Viewing these lasers under direct beam and specular reflection conditions is hazardous. The diffuse reflection is usually not a hazard except for higher power Class 3B and Class 4 lasers. Normally the class 3B laser is not a fire hazard. It is only permitted to use a class 3B laser product under the control of a laser safety officer. Before using this product, be sure to be familiar with the demanded safety measures according to EN 60825-1 and your national laws.

To avoid hazardous situations, strictly follow the laser safety instructions below.




2.1	Safety Symbols .....	4
2.2	Laser Safety Precautions .....	5
2.3	General Safety Precautions .....	6
2.4	Handling Instructions and Recommendations .....	7


## 2.1 Safety Symbols

The following symbols are placed on the laser system. Study the meaning of the symbols and always use the equipment in the safest possible manner.


General symbols	
Symbol	Explanation
	Carefully read the instructions on the label and the manual before use. Improper use could result in personal injury to the user and/or damage the equipment.
	The main switch is turned OFF.
	The main switch is turned ON.
	This symbol indicates separate collection of waste electrical and electronic equipment in the EU countries. Do not throw the equipment into the domestic refuse Please use the return and collection systems available in your country for the disposal of this product

For all parts labeled with the following labels, special laser precautions must be considered.


Laser safety symbols		
Symbol	Explanation	Location
	Indicates the use of a laser beam. Take special care in handling the part.	Front panel
	Laser radiation can cause irreversible damage to your eyes. Wear adequate protection before opening this aperture.	Front panel, Laser radiation is emitted from the center of the black circle. If a fiber coupling is mounted, the laser radiation is emitted from the center of the coupling.
	These apertures should all be closed while operating the system. Only trained personal may dismount connected parts and best when the laser is turned off.	On top of the fiber coupling. Laser radiation is emitted from the center of the coupling if the fiber is disconnected.

$\lambda$ 532 / 50mW	Specifying the wavelength (e.g., 532 nm) and maximum power output (e.g., 50 mW) of the respective laser: values according to type of laser.	Front panel, in the black circle above fiber coupling.
	Classification of the laser	Front panel


## 2.2 Laser Safety Precautions

 Caution: Control or adjustments using procedures other than those described in this manual will lead to hazardous laser beam exposure.

- a A class 3B laser **can cause irreversible damage to your eyes and skin**. Thus do not stare into the laser beam or illuminated fiber. Make sure to wear adequate eye protection during laser operation.
- b The laser system is key controlled. Make sure that access to the key is restricted to authorized personnel only.
- c The person in charge of the laser alignment or operating the laser system must be aware of the safety precautions. He/she is responsible for the safety of any person present in the room while operating the laser system.
- d The usage of a class 3B laser is only permitted under the control of a **laser safety officer** and with respect to national safety regulations.
- e The laser system is equipped with two **laser safety shutters** connected to the interlock.
- f The laser system is usually equipped with a fiber coupling and a light fiber for the respective wavelength. Do not bend, step on or pull excessively on the light fiber. This could damage the fiber and cause hazardous beam leakage. In case of a damaged fiber switch off the laser system immediately and contact Olympus.
- g The laser system is designed as a component for microscopy systems. Please read the respective manuals carefully and assemble the system as described.

 Direct exposure to laser radiation is possible at the following positions of the laser system:

- At the fiber port of the laser system’s housing, if the fiber is removed
- At the exit of the laser fiber

 Olympus Soft Imaging Solutions GmbH accepts no liability for any health damage caused by improper use of the laser system and laser related setup!

## 2.3 General Safety Precautions

- a Always use power cords and power supplies provided or approved by Olympus Soft Imaging Solutions.
- b Provide unimpaired access to the main power switch at the rear panel.
- c No electrical cord should be connected or disconnected while the power switch is set on ("I"). Make sure that the unit's main power switch is set off ("O") before plugging or unplugging the power cord to the power outlet.
- d Always make sure that the grounding terminal of the laser system and the wall outlet are connected properly. If the system is not grounded, Olympus Soft Imaging Solutions cannot warrant the electrical safety and proper performance of the system.
- e When installing the laser system, leave at least 100 mm free air space to the rear panel and at least 100 mm to the sides and on top to allow air circulation. The air outlet is located at the rear of the housing while the inlet grid is at the bottom.  
Two or even three laser units may be stacked on top of each other. To do so, the supports at the bottom of the second and third unit must be flipped upside down so that they sit tightly on the housing of the unit underneath, in order to keep them from sliding off sideways (see Chapter 4.4, *Installation*).
- f The laser system must be placed on an even, stable and flat surface while standing on its supports. Make sure that no cloth or paper can clog the air slits at the bottom of the housing.
- g Never open the housing of the laser system or attempt to disassemble it. The internal power supply units and electrical circuits can cause severe electrical shock and thus are not serviceable by the user. Warranty will be lost if the housing is opened.
- h Do not operate the laser system under environmental conditions other than specified in this manual.
- i If the equipment is not used as specified in this manual, the safety and performance may be impaired. In addition, the equipment may be damaged and warranty may be lost. Use the equipment only as outlined in this instruction manual.
- j Please refer to the user manuals of your cell<sup>^</sup>R / cell<sup>^</sup>M Imaging Station.



Olympus Soft Imaging Solutions GmbH accepts no liability for any damages caused by the use of lasers or parts not belonging to the related setup

## 2.4 Handling Instructions and Recommendations

- a** The laser system is a precision instrument. Handle it with great care and avoid subjecting it to sudden or severe impact. Also connect each cable gently while power is turned off.
- b** The ventilating fans of the laser system as well as the mechanical attenuator and shutter of the DPSS lasers may generate vibrations and sound. Therefore it is recommended not to place the laser system on the same table as the microscope.
- c** The laser system may only be opened and disassembled by authorized service personnel at Olympus Soft Imaging Solutions. High voltage and very hot surfaces inside the housing may bare a high risk of injury. Warranty will be lost if the laser is opened.
- d** Before using the laser system for the first time, check that all cords (power line, interlock, shutter trigger) are connected correctly.
- e** Do not operate the laser system inside a climate chamber.
- f** Do not bend the laser fiber to a diameter of less than 15 cm. The fiber is fragile and may break if bent too strongly or if torsional stress is applied. A broken fiber may cause hazardous laser output!
- g** Cover the ends of the laser fiber with the protection cover when they are not attached to the system or to the microscope.
- h** Always operate the laser system in an upright position. Never lay it on the side during operation. This could cause damage and affect the laser safety.
- i** Before transporting the system, make sure it is turned off and cooled down for at least 10 minutes.
- j** Turning the laser on and off repeatedly will shorten its life span.
- k** To clean the surface of the laser system, use a lint-free, dry and soft cloth. Never attempt to use organic solvents or strong detergents.
- l** The fiber ends are highly sensitive and should never be touched. If contaminated, gently clean them with optical cleansing tissue slightly moistened with lens cleansing fluid or ask your Olympus specialist for advice. Since these fluids are highly inflammable, be careful to keep them away from open fire, heat or hot surfaces and potential sources of electrical sparks, such as main switches.



## 3 Operating the Laser System

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The following chapter describes the intended use of the cell\* laser system and the functioning of the control indicators. Special focus is given to the use as part of a (multi-line) cell<sup>lrf</sup> setup.

3.1	Starting the Laser System.....	10
3.2	Operation .....	10
3.3	Switching Off the Laser System.....	11
3.4	Using the Interlock to Close the Safety Shutter .....	11

## 3.1 Starting the Laser System

Before switching the laser system on, be sure all devices are setup and connected properly as described in this manual. If the laser system is integrated in an Olympus **cell<sup>tirf</sup>** system according to the **cell<sup>tirf</sup>** illumination combiner manual and if this system is operated in **User mode**, the **cell<sup>tirf</sup>** system in its entirety can be operated as a Class 1 laser product. Otherwise activate or attach warning signs signaling the operation of a Class 3B laser in the room and make sure to prevent access of unauthorized persons to the room.

1. For safety reasons we recommend to always turn the attenuator control to the minimum position (counter clockwise) before starting the laser system.

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2. Switch on the laser with the main switch located on the rear panel.

---
3. Turn the **Starting Key** to the **ON** position.  
The laser head is still off and the laser safety shutters are closed. Make sure that the high-speed laser shutter is closed (**SHUTTER LED** off) before starting the laser.

---
4. Press the **START** button.  
The laser head is being started and the **LASER EMISSION LED** and **SAFETY SHUTTER LED** light up. The laser safety shutters are opened. Depending on the type of laser, it takes up to one minute until laser radiation is emitted from the laser head. If the high-speed laser shutter is open, laser light is being emitted from the system.



Laser light may be emitted immediately.

## 3.2 Operation

The high-speed laser shutter can be triggered via the BNC connector at the front panel. A TTL low voltage opens the shutter while a TTL high voltage opens it. The **SHUTTER LED** lights up when the shutter is opened.

The intensity of the laser can be adjusted manually using the **ATTENUATION** knob.

The high-speed laser shutter, as a component of an Olympus **cell<sup>tirf</sup>** system, can be controlled either manually, using the switch of the TIRFM control box (**OPEN, CLOSE**) or via the **cell<sup>tirf</sup> Control** software (if the switch is set to **REMOTE**). See the **cell<sup>tirf</sup>** illumination combiner manuals for details.

Additionally, the laser is fully integrated in the **cell<sup>AR</sup> / cell<sup>AM</sup>** system. Thus the laser illumination can be operated with the user interface of the software or via the Experiment Manager as described in Chapter 5, *Experiment Integration*.



### 3.3 Switching Off the Laser System

1. Switch off the laser head by turning the **Starting Key** to **OFF**. The laser emission indicators will be turned off.

---

2. Switch off the main power switch at the rear panel.

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3. Remove the key and make sure it is accessible to authorized personnel only.

### 3.4 Using the Interlock to Close the Safety Shutter

The laser system is equipped with an interlock that interrupts, when disconnected, the laser beam output by closing the laser safety shutters (**SAFETY SHUTTER** LEDs off). It does not switch off the laser head.

The **INTERLOCK** plug at the laser controller front panel has to be connected to an interlock system according to electrical requirements (see technical data); otherwise the laser cannot be started.

As part of a cell<sup>lrf</sup> system, the interlock must be connected to the LAS-BOB breakout box for safety reasons. All connected laser systems can be switched off simultaneously with the emergency interrupter on the LAS-MC laser shutter manual control that is connected to the interlock via the LAS-BOB breakout box.

During installation and adjustment it may be helpful to use the interlock (by pressing the emergency interrupter of the TIRFM system or by opening interlock circuit by pulling the **INTERLOCK** plug at the laser front panel) to close the safety shutter.



If other laser types such as gas lasers are connected to the **Emergency Stop**, they may be switched off completely. Frequent switching on and off of such devices will shorten their life span.

To restart laser radiation, close the interlock circuit and press the **START** button.



Laser light will be emitted immediately if the high-speed shutter was open before pressing the **Emergency Stop**.



## 4 Installation and Alignment

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The following chapter gives you a short overview of the basic cell\* laser system components and the setup as part of an Olympus cell<sup>trf</sup> system.

4.1	Components .....	14
4.2	Front View .....	14
4.3	Rear View .....	15
4.4	Installation .....	15
4.5	Alignment of the Fiber Manipulator .....	16
4.6	Connecting and Aligning the Laser Fiber .....	19

## 4.1 Components

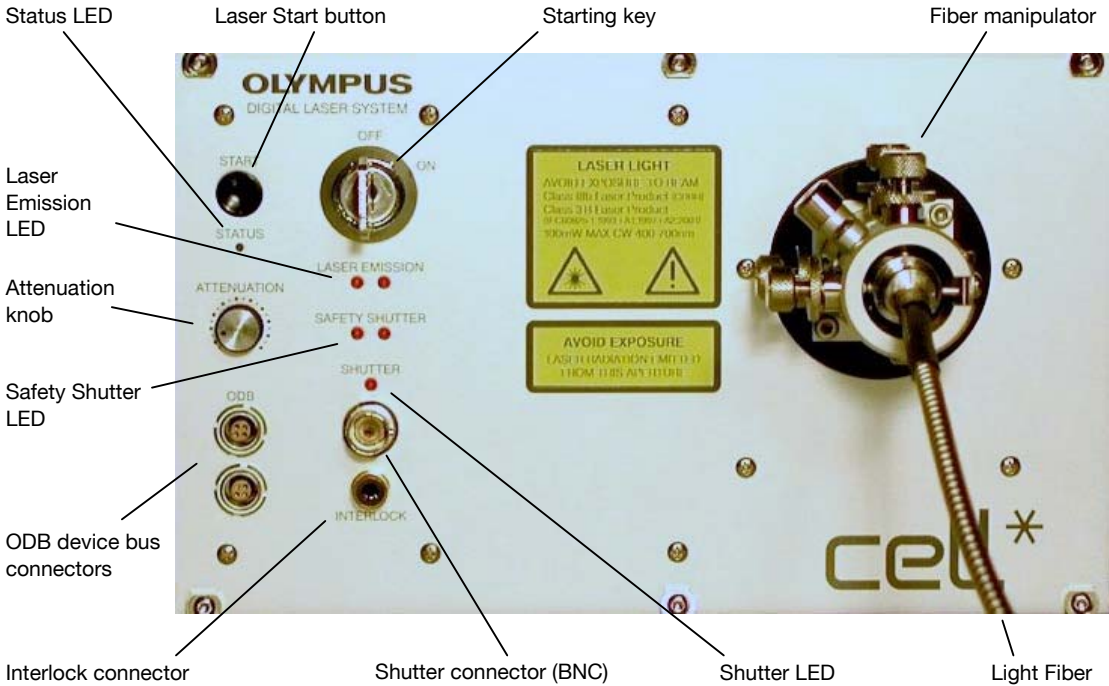
### Standard Components

- Solid state laser system
- Power cord
- Two starter keys.

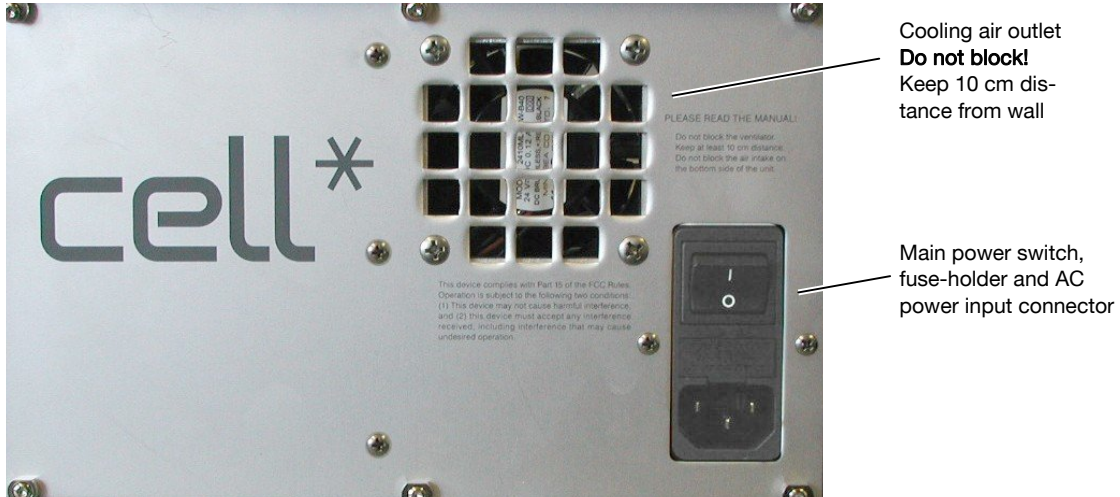
### Additional Components

- Fiber manipulator (usually mounted and aligned to the laser)
- Laser fiber (adapted to the respective laser wavelength, not to be exchanged with other fibers)
- Alignment tool.

## 4.2 Front View

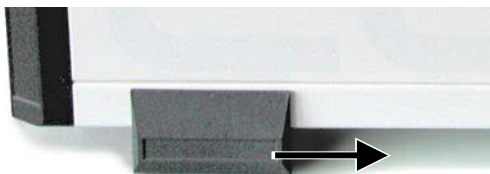


### 4.3 Rear View

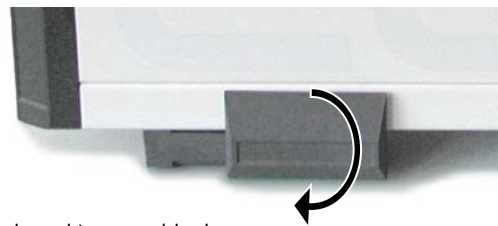


### 4.4 Installation

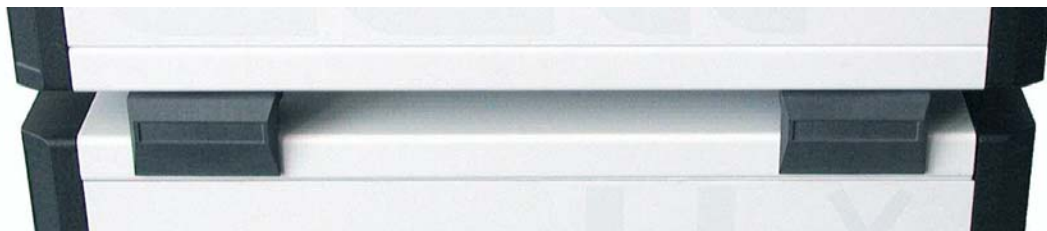
1. The Olympus cell\* laser systems may be set up as a stack. The four supporting stands can be modified for safely stacking the units. Slide the gray parts of the supporting stands of the upper unit backwards, turn them up side down and slide them back on.



Housing supports, regular position



slide backwards and turn up side down



Stack of two units

2. Check if the Main power switch at the rear panel is set to off (O).

---

3. Connect the **INTERLOCK** connector at the front panel of the **cell**<sup>trif</sup> laser with one of the four **INTERLOCK 4 – 3 – 2 – 1** plugs of the **cell**<sup>trif</sup> LAS-BOB break-out box using a cinch cable.

---

4. Connect the **SHUTTER** connector on the **cell**<sup>trif</sup> laser front panel with corresponding **SHUTTER 4 – 3 – 2 – 1** BNC plug at the **cell**<sup>trif</sup> LAS-BOB front panel using a BNC cable.



The Olympus **cell**<sup>trif</sup> illumination combiners are available for up to four lasers. The numbering of each plug corresponds to the number of the shutter switch of the **cell**<sup>trif</sup> LAS-MC laser shutter manual control. (See the **cell**<sup>trif</sup> illumination combiner manual.) Make sure that the cables are connected to the designated plugs.

5. The laser fiber has been carefully aligned at Olympus Soft Imaging Solutions. Connect the fiber as described below and check the results. Due to transportation, a certain misalignment may occur. For alignment and optimizing procedure, strictly follow the instructions below.

---

6. Connect the laser with the ODB device bus using the two 4-pin female Lemo plugs on the electronics housing at the front panel using the communication cable. For example, connect one plug with the **cell**<sup>trif</sup> real-time controller board at the imaging computer back panel, respectively with the AD-USB-ODB adaptor. Connect the second plug with one of the other ODB bus devices of the imaging system; see the note below.

---

7. Connect the power cord to the AC power input connector at the rear panel.






The laser is a device that communicates with the **cell**<sup>trif</sup> System Coordinator board, the **cell**<sup>trif</sup> Real-time Controller board or the AD-USB-ODB adaptor, respectively, through the so-called ODB device bus. Other such devices are the fast filter wheels U-FFWO and U-FFWR as well as the fast shutter U-FSHA, the fast mirror unit turret IX2-FRFACA, the **cell**<sup>trif</sup> illumination combiners and the **cell**<sup>trif</sup> MT10 illumination system. These devices are connected in series, i.e., one device is connected directly to the controller; the second one is connected to the first and so on. The order of devices is not of importance.

## 4.5 Alignment of the Fiber Manipulator

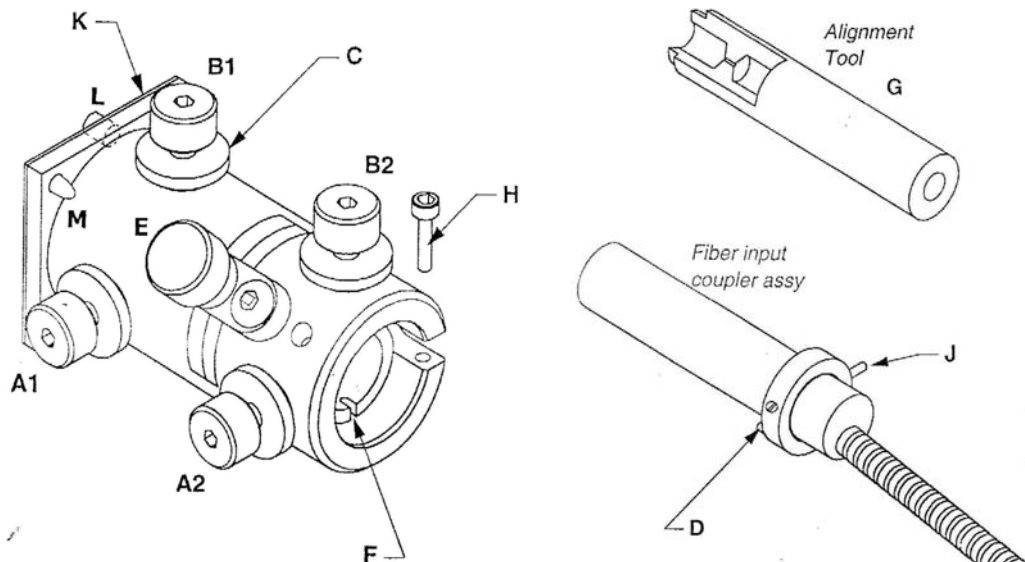
The fiber manipulator is always carefully aligned at Olympus Soft Imaging Solutions. However, during transport or system setup, the proper alignment might be lost and the light output not optimal. Also, even in a properly setup system the correct alignment might eventually be lost if the adjustment screws are inadvertently tuned. Readjustment by trained personnel is needed in that case.

Upon installation of the laser system the alignment of the fiber manipulator has to be checked and corrected if necessary. This is described in the following. In a first step the alignment tool, a cylinder with

pinhole, is used for a crude adjustment. It is then replaced by the light fiber (see Chapter 4.6, *Connecting and Aligning the Laser Fiber*) for a final optimization of the light output.

-  This laser system is a Class 3B laser product according to EN 60825-1. It can cause irreversible damage to your eyes. Wear adequate eye protection! **Trained personnel only may perform assembly, alignment or operation. The person in charge of the laser system must be aware of the specific laser safety precautions.** He/she is responsible for the safety of every person present in the room while operating the laser.
-  The alignment of the fiber manipulator is considered a service action. Trained personnel may perform it only.
-  Always point the laser towards a safe area (like a wall or a sheet of black paper) because bright laser light might be emitted suddenly by only small adjustments to the fiber manipulator. Keep the laser off and the shutters closed whenever practical. Always wear adequate eye protection when operating the laser.

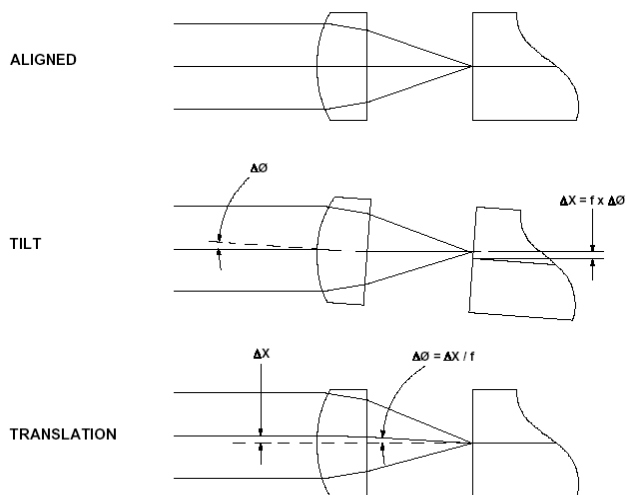
1. Be sure to have the high-speed laser shutter closed (set the switch of the **cell<sup>lrf</sup>** LAS-MC laser shutter manual control to (O), closed) to prevent unwanted beam output. Set the **ATTENUATION** at the laser front panel to minimum. You may increase the intensity in small steps later.
- 
2. Point the laser's emitting aperture to a dark and rough surface in order to absorb as much light as possible and reduce reflections once emission starts. Be sure to have no reflecting element (e.g. tools, watch, jewelry etc.) in the path of the laser beam.



Fiber manipulator, alignment tool and fiber input (drawings by Point Source)

- A1/A2:** Horizontal adjustment screws
- B1/B2:** Vertical adjustment screws
- C:** Locking nuts
- D:** Polarising key
- E:** Locking mechanism – Push release
- F:** Polarising keyway

- G:** Alignment tool with pinhole
- H:** Retaining screw
- J:** Retaining key
- K:** Transit Plate
- L:** Dowels
- M:** Fixing clip




Principle of Operation (drawing by Point Source)

3. Press the locking mechanism (E) to put the alignment tool (G) into the fiber manipulator with the pinhole pointing towards the laser.


---

4. Switch on the **cell**<sup>\*</sup> laser as described in Chapter 3.1 (main switch **ON**, starting key **ON**, **START** button).

---

-  5. Hold a piece of paper in front of the fiber manipulator to check for laser light emission, open the high-speed laser shutter with the TIRFM shutter controller. (Set the switch of the **cell**<sup>tirf</sup> LAS-MC laser shutter manual control to (I), open.)


---

-  6. Loosen the locking nuts (C) of the four adjustment screws A and B. Turn the two adjustment screws that are closer to the laser housing (A1 and B1) in either direction until the light output is at maximum.  
An indication for good alignment of the pinhole is a symmetrical diffraction pattern of the light spot on the wall (or wherever the laser is pointing to).


---

7. Close the high-speed laser shutter. (Set the switch of the **cell**<sup>tirf</sup> LAS-MC laser shutter manual control to (O), closed.)

---

-  8. Press the locking mechanism (E) and take out the alignment tool. Turn it 180° so that the pinhole is pointing away from the laser and reinsert into the fiber manipulator. Open the high-speed laser shutter. (Set the switch of the **cell**<sup>tirf</sup> LAS-MC laser shutter manual control to (I), open.)

---

-  9. Turn the pair of adjustment screws A2 and B2 that are closer to the exit in either direction until the light output is at maximum and the diffraction pattern of the light spot appears symmetrical. Close the high-speed laser shutter. (Set the switch of the **cell**<sup>tirf</sup> LAS-MC laser shutter manual control to (O), closed.)

---

10. Repeat steps 3 – 9 to further optimize the alignment.



11. Remove the adjustment tool and continue with the alignment of the laser fiber as described in the next chapter.

## 4.6 Connecting and Aligning the Laser Fiber



This laser system is a Laser Safety Class 3B laser product according to EN 60825-1. It can cause irreversible damage to your eyes. Wear adequate eye protection!

The alignment of the laser fiber inside the **cell<sup>lrf</sup>** illumination combiner is considered a service action. Trained personnel may perform it only. Please refer to the **cell<sup>lrf</sup>** Service Manual or ask Olympus for advice.



Handle the fiber with care because the fiber ports are fragile and the fiber itself might break when stepped on, pulled or bent excessively. Do not use a damaged fiber.



Always point the unprotected end of the laser fiber towards a safe area (like a wall or a sheet of black paper) because bright laser light might be emitted suddenly by only small adjustments to the fiber manipulator.



During the alignment laser radiation will occur. Whenever laser radiation is not needed use the high-speed laser shutter via the corresponding switch on the **cell<sup>lrf</sup>** LAS-MC laser shutter manual control, or, whenever practical, the safety shutter via the interlock to stop laser radiation. See Chapter 3.4, *Using the Interlock for Closing the Safety Shutter*, for details.

1. To prevent laser radiation output when inserting the fiber, be sure to have the laser switched off, the laser safety shutter closed and the high-speed laser shutter closed. (Set the switch of the **cell<sup>lrf</sup>** LAS-MC laser shutter manual control to ( **O** ), closed.). Set the **ATTENUATION** to minimum intensity.

---

2. Remove the protective cap from the laser input end of the laser fiber (silver). While pushing the lock mechanism (**E**), insert the fiber input coupler assay with the polarization key (**D**) fitting into the polarization keyway (**F**) of the fiber manipulator. Make sure that the retaining key (**J**) is moved completely into the socket.

---


3. The retaining screw (**H**) must be closed for safety reasons to prevent the fiber from being released inadvertently.


---


4. Point the fiber exit to a dark and rough surface and carefully remove the protective cap to check the proper alignment of the fiber.


---


5. Switch on the laser system as described in Chapter 3.1, *Starting the Laser System* (main switch **ON**, starting key **ON**, **START** button). Do not stare onto the fiber end. After a cold start it may take up to one minute until laser radiation is emitted.

-  6. Open the high-speed laser shutter by switching the corresponding switch on the **cell**<sup>tirf</sup> LAS-MC laser shutter manual control to ( I ), open, and carefully increase the output by turning the **ATTENUATION** knob clockwise to maximum.

 If no light is emitted while all shutters are open (all LEDs on), the attenuator is set to maximum transmission and the laser has been on for more than one minute, it is possible that the fiber manipulator is severely misaligned. In this case the fiber manipulator alignment has to be performed as described in the previous chapter.

-  7. Loosen the locking nuts (C) of the four adjustment screws A and B. Turn the two adjustment screws that are closer to the laser housing (A1 and B1) in either direction until the light output is at maximum.

 The four adjustment screws of the fiber manipulator allow reducing tilt and translation misalignments between the focused laser beam and the fiber core. (See the scheme in the previous chapter.) The fiber core is only a few microns in diameter. While the adjustment screws have a very fine pitch to facilitate adjustments, still, a small turn may lead to a pronounced change in light intensity.

-  8. Turn the pair of adjustment screws A2 and B2 that are closer to the fiber in either direction until the light output is at maximum.

---


9. Repeat steps 7 and 8 to further optimize the alignment.

---

10. Close the high-speed laser shutter (set the switch of the **cell**<sup>tirf</sup> LAS-MC laser shutter manual control to ( O ), closed).

---

11. Tighten the locking nuts of all four adjustment screws to fix the position of the fiber inside the fiber manipulator.

 Do not over-tighten the locking nuts. Gently tightening the locking nuts after adjustment is sufficient for the corrugated spring washers to securely fix the position of the adjustment screws.

12. Proceed with coupling the fiber into the **cell**<sup>tirf</sup> illumination combiner as described in the **cell**<sup>tirf</sup> Service Manual.

## 5 Software Integration

Both the high-speed laser shutter and the attenuator of the cell\* lasers can be controlled via the cell^M / cell^R imaging software. During an experiment the high-speed laser shutter opens automatically and closes again afterwards when a laser-illuminated image is to be acquired.

5.1	Lasers in cell^M / cell^R.....	22
5.1.1	Configuration of the Lasers.....	22
5.1.2	Image Types.....	23
5.1.3	Controlling the Laser.....	23
5.1.4	Lasers in an Experiment Plan .....	24
5.2	Lasers in the cell^TIRF Control Software .....	25

## 5.1 Lasers in cell<sup>M</sup> / cell<sup>R</sup>

### 5.1.1 Configuration of the Lasers

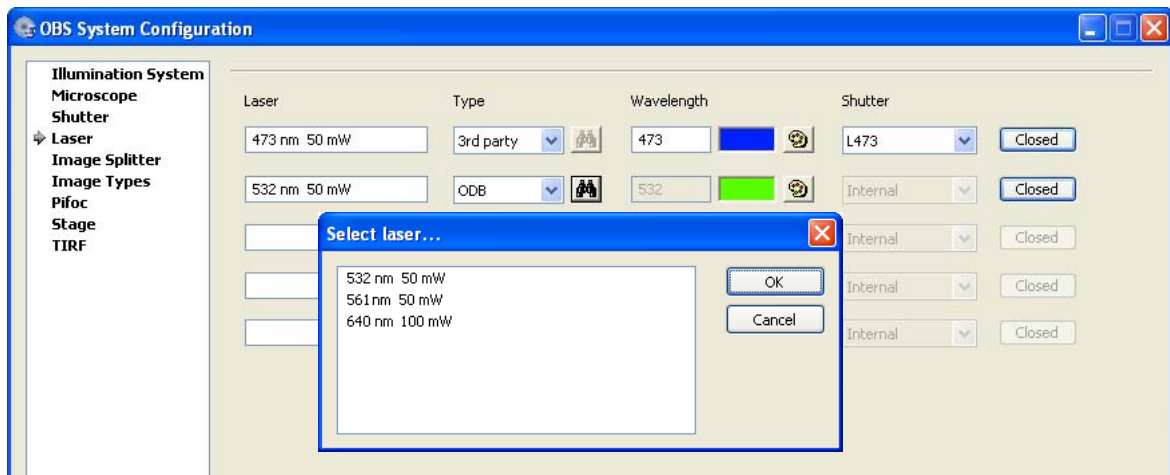


ObsConfig.exe

Open the ObsConfig software and choose the **Laser** configuration page. Select **Type ODB**.

Click on the **Binocular** button in the next free row to open the **Select laser...** window. It lists all lasers connected to the cell<sup>M</sup> System Coordinator / cell<sup>R</sup> Real-Time Controller via the ODB Device Bus.

Select a laser from the list. It will be entered automatically into the **Laser** text box; likewise **Wavelength**, with color and **Internal/Shutter**.



Make sure that the TIRFM objective is correctly configured in the ObsConfig software, see the cell<sup>M</sup> / cell<sup>R</sup> Software Manual, Chapter 15.2.3, *Configuration of the Objectives*.

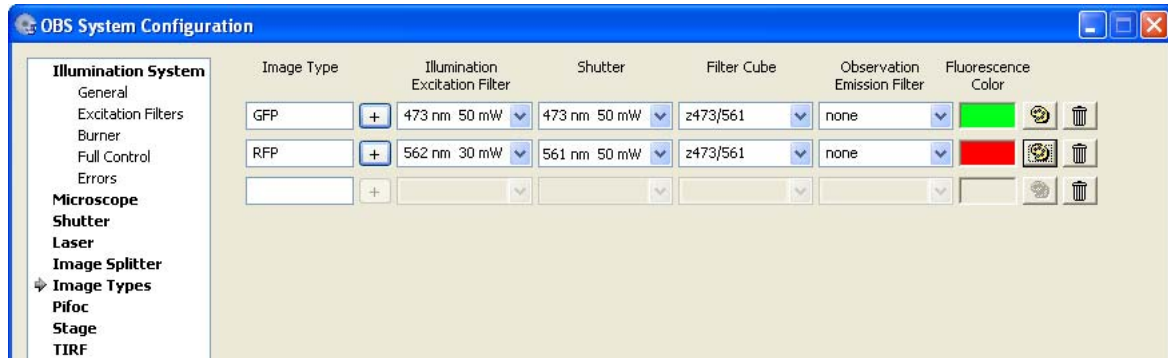


**Caution:** Use the laser only with the fitting cube! Be sure to have an adequate filter cube in the light path before opening the high-speed laser shutter! Do not change the cube while the high-speed laser shutter is open!

### 5.1.2 Image Types

The laser shutter can be used like any other microscope **Shutter** and can also be configured as part of an **Image Type** in the corresponding ObsConfig software page.

Image types, when called in course of the execution of an Experiment Plan, cause the system to select certain hardware settings as explained in detail in the cell^M / cell^R Software Manual, Chapter 5.3.2.1, *Image Acquisition* and Chapter 15.3, *Definition of Image Types*.



A properly configured **Image Type** using laser illumination causes the following when called in an **Image Acquisition** command:

1. The specified filter cube will be moved into the light path (if the filter turret is motorized).

---

2. The high-speed laser shutter will be opened 1 ms before the camera starts the image exposure, respectively the diode will be switched on less than 1 ms before.

---

3. The high-speed laser shutter will be closed again after the camera finishes the image exposure, respectively the diode will be switched off less than 1 ms after this.

---

4. The image will be stored with the selected **Fluorescence Color** (false-color palette) in the database.

### 5.1.3 Controlling the Laser



**Laser**

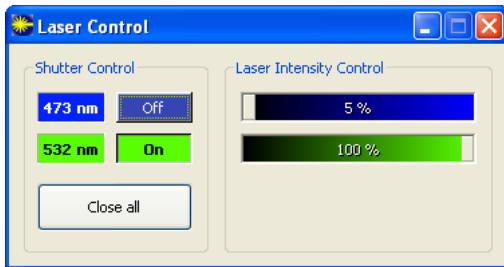
Click the **Laser** button in the Acquisition toolbar of the cell^M / cell^R graphical interface to open the **Laser Control** window. It can be moved freely across the screen to your convenience.

#### Shutter Control

**Off/On.** These buttons show the shutter status of each laser. Click here to open or close the shutter of a laser.



Laser light may be emitted immediately.



**Close all.** Click here to close all shutters.

### Laser Intensity Control

Use the sliders to adjust the laser intensities. The adjustment can be set in discrete steps in case of DPSS lasers while diode lasers can be adjusted continuously from 0 % to 100%.

## 5.1.4 Lasers in an Experiment Plan



Only use the laser with an adequate filter cube.

Do not execute experiments while in maintenance mode.

### 5.1.4.1 Image acquisition

This is analogous to any other image acquisition as long as the laser and the **Image Types** are properly configured in **ObsConfig**; see Chapter 5.2.1, *Configuration*, as well as the cell<sup>M</sup> / cell<sup>R</sup> Manual, Chapter 5, *Experiment Manager*.

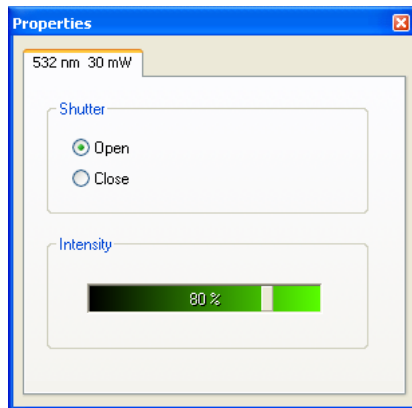
### 5.1.4.2 Laser commands



Use the command icon to change laser intensities during an experiment or to open or close a laser shutter without image acquisition.

The Experiment Plan of a dual-line TIRF time-lapse series may look like the following example:

## Properties



### Shutter

**Open.** Check this radio button to open the shutter during the experiment.

**Close.** Check this radio button to close the shutter during the experiment.

### Intensity

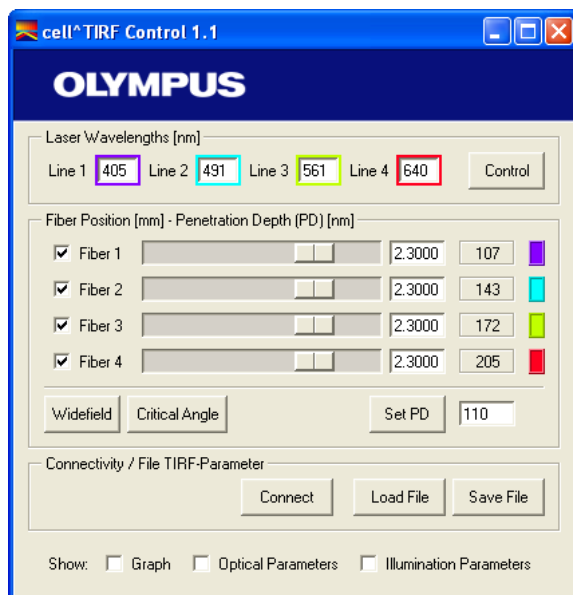
Use the slider to adjust the laser intensity.

## 5.2 Lasers in the cell^TIRF Control Software



---

Execute the **cell^TIRF.exe** file to start the software.



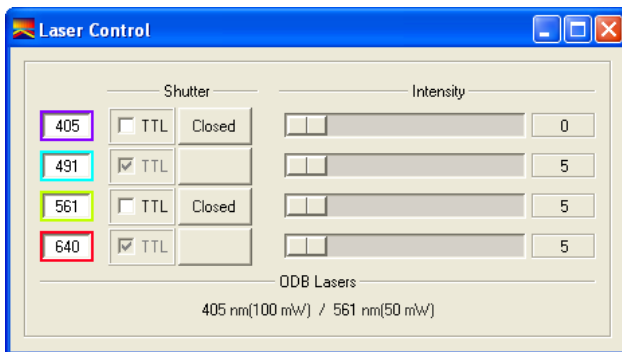
**Connect.** Click here to establish the communication between PC and the **cell<sup>tirf</sup>** MITICO illumination combiner and the lasers connected to it through the ODB Device Bus and the AD-USB-ODB adaptor box. See also the **cell<sup>tirf</sup>** User Manual.

#### Laser Wavelengths [nm].

**Line 1.** Set the wavelength of the first laser. This is the one connected to the upmost fiber port of the **cell<sup>tirf</sup>** MITICO illumination combiner and is the one with the shortest wavelength.

**Line 2, Line 3, Line 4.** Set the wavelengths of the other lasers in the order of increasing wavelength.

**Control.** Click this button to open the **Laser Control** window.



**Shutter: TTL.** Do NOT check this box in case Olympus Soft Imaging Solutions lasers are connected via the ODB device bus.

**Shutter: Shutter button.** It is active only for Olympus Soft Imaging Solutions lasers if **TTL** is NOT activated. Click here to open/close the laser shutter.

**Intensity sliders.** It is active only for Olympus Soft Imaging Solutions lasers connected via the ODB device bus. Use the slider to adjust the intensity of the laser.

**ODB Lasers.** This field lists all Olympus Soft Imaging Solutions lasers connected via the ODB device bus.



# 6 Specifications and Technical Data

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6.1	Model Specific Technical Data .....	28
6.2	General Technical Data.....	28

## 6.1 Model Specific Technical Data

Model Specific Technical Data								
Model	Wavelength	Laser head power	Type	Shutter, attenuator	Output at fiber	Noise (rms)	Noise (p-p)	Beam diameter
LAS-405-60-D	405 ± 5 nm	60 mW	diode	electronic	> 50%	< 0.2%"		1.1 mm
LAS-405-100-D	405 ± 5 nm	100 mW	diode	electronic	> 50%	< 0.2%"		1.4 mm
LAS-445-50-D	445 ± 5 nm	50 mW	diode	electronic	> 50%	< 0.2%"		1.1 mm
LAS-473-25-D	473 ± 5 nm	25 mW	diode	electronic	> 50%	< 0.2%"		1.1 mm
LAS-473-50	473 nm	50 mW	DPSS	mechanical	> 55%	< 0.3%*	< 3%*	0.7 mm
LAS-488-60-D	488 ± 2 nm	60 mW	diode	electronic	> 50%	< 0.2%"		1.3 mm
LAS-488-150	488 ± 2 nm	150 mW	DPSS	mechanical	> 50%	< 0.25%**	< 1%**	0.7 mm
LAS-491-50	491 nm	50 mW	DPSS	mechanical	> 55%	< 0.3%*	< 3%*	0.7 mm
LAS-491-100	491 nm	100 mW	DPSS	mechanical	> 55%	< 0.3%*	< 3%*	0.7 mm
LAS-514-50	514 nm	50 mW	DPSS	mechanical	> 55%	< 0.25%**	< 1%**	0.7 mm
LAS-532-50	532 ± 2 nm	50 mW	DPSS	mechanical	> 55%	< 0.3%*	< 3%*	0.32 mm
LAS-561-50	561 nm	50 mW	DPSS	mechanical	> 50%	< 0.25%*	< 1%*	0.7 mm
LAS-561-100	561 nm	100 mW	DPSS	mechanical	> 55%	< 0.25%*	< 1%*	0.7 mm
LAS-561-150	561 nm	150 mW	DPSS	mechanical	> 55%	< 0.25%*	< 1%*	0.7 mm
LAS-594-50	594 nm	50 mW	DPSS	mechanical	> 55%	< 0.25%*	< 1%*	0.7 mm
LAS-640-100-D	640 (+7, -2) nm	100 mW	diode	electronic	> 50%	< 0.2%"		1 mm

" : 20 Hz – 10 MHz; \* : 10 Hz – 2 MHz; \*\* : 20 Hz – 2 MHz / 20 Hz – 20 KHz

## 6.2 General Technical Data

**Long-term power stability** (2 hours, ±3°C): <4%

**Warm-up time:** <15 minutes

### Beam Parameters

- Circular
- Spatial mode: TEM<sub>00</sub>, M<sup>2</sup> < 1.1 (LAS-561-50: < 1.2)
- Polarization ratio: 100:1, vertical

**Dimensions and Weight:** H 148 x W 246 x D 315 mm, approx. 6.5 kg

**Power supply rating:** 100 – 120 V and 200 – 240 V AC, 50 – 60 Hz (47 – 63 Hz), 1.0 / 0.5 A

**Fuse:** 250VAC, T2AH (5 x 20mm)

**Operating environmental conditions:** Indoors use only.

- Altitude: up to 2000 m
- Ambient temperature: 10°C to 40°C
- Maximum relative humidity: 80% up to 31°C, 70% at 34°C, 60% at 37°C, 50% at 40°C
- Supply voltage fluctuation:  $\pm 10\%$
- Pollution degree 2 (in accordance with IEC664)
- Over-voltage category II (in accordance with IEC664)

**Mechanical safety shutter:** two shutters, mechanically forced closing action,

**Mechanical high-speed shutter (DPSS lasers):** opening/closing time 1.0 +/- 0.2 ms,

**Mechanical attenuator (DPSS lasers):** transmission between 0.2% and 100%, 20 positions, manual selection, the table shows typical values.

Mechanical Attenuation – Typical Transmission Values [%]										
Position	1	2	3	4	5	6	7	8	9	10
Transmission	0.2	2	5	8	11	16	20	24	29	35
Position	11	12	13	14	15	16	17	18	19	20
Transmission	41	47	54	61	67	75	81	87	93	100

**LED indicators:**

- **STATUS** (laser controller front): lights up once, when main switch is set to on (“I”)
- **LASER EMISSION** (laser controller front): two LEDs, indicating laser head is powered up
- **SHUTTER** (laser controller front): indicating high-speed laser shutter is open.
- **SAFETY SHUTTER** (laser controller front): two LEDs, indicating safety shutter is open.

**Connectors, front:**

- **SHUTTER:** BNC connector, TTL input signal for high-speed shutter  
Permitted input voltage range 0V–5V  
Shutter closed: open connector or voltage between 2.0V and 5V ( $I = -2.3\text{mA} @ 2.4\text{V}$ )  
Shutter open: voltage between 0V and 0.8V ( $I = -4.8\text{mA} @ 0.8\text{V}$ ).
- **INTERLOCK:** Cinch connector, controls the safety shutters.  
Usually this input is connected to the TIRFM control box.  
Do not apply any voltage to this input.  
Shorting this input with a switch or a relay contact will open the safety shutter ( $I = 50\text{mA max.}$ ; resistance of external interlock loop  $< 10 \text{ Ohm}$ ).  
No connection or an open contact will close the safety shutter.
- **ODB (2x):** 4 pin connection for service and future extension,

**Connectors, rear:** 3 pin AC input plug with ground,

**Light output:** Laser light, wavelength and power according to type of laser, (see table),

**Optical fiber:** Minimum bend diameter 25 cm short term, avoid stress.

**Conformity:** The laser system conforms to the following directives and standards:

- Low Voltage Directive 73/23/EEC
- EMC Directive 89/336/EEC
- Directive 93/68/EEC
- EN 61010-1: 2001 (low voltage, laboratory equipment)
- EN 61326:1997 + A1: 1998 + A2: 2001 (EMC)
- IEC60825-1: 1993 +A1: 1997 +A2: 2001

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