Laser Station 2

Quick Start Guide

Disclaimer

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The information contained in this document is subject to change without notice.

The Laser Station 2 must be used according to the Laser Station 2 user guide. Any operation related to maintenance, repair or calibration must be carried out by qualified personnel. Consequently, in case of failure, contact Riscure to find out about the procedure to follow.

Manufactured by

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What is in the box

The box contains the Laser Station 2, and all accessories to connect it to a computer. Some of the components in the package list are optional. They are purchased separately

Package list

Quantity	Description with image	
1	Laser station 2 body • Body • Zoom with color camera • Revolver for 5 objectives • LED illumination with power supply and power cable (region specific) • closed-loop motorized Z-axis • aperture for beam splitter (photo shows optional beam splitter installed)	
1	Laser Station 2 stand • TMC base plate • vertical column with coarse height adjustment	
0 - 3	Microscope objectives (optional): • magnification 5x (red line) • magnification 20x (green line) • magnification 50x (blue line) • magnification 100x (white line)	

Quantity	Description with image	
1	Tango 3 mini control unit (for XY-stage and motorized Z-axis) with: • TANGO 3 mini control unit • TANGO XYZ-joystick • Power cable (region specific) • Power adaptor 24V • USB communication cable • 3-axis driver cable • Z-axis sensor cable • Operating Manual TANGO 3 mini •	
1	Spot-size reducer with: • Spot size reducer • 3 filters (10%, 1%, 0.1%) • camera cable	
1	XY-stage with: • XY-stage • mounting screws and rings	
1	Base plate with: • Base plate • Screw for fixture to XY-stage	

Quantity	Description with image	
1	Clamps for base plate	
1	IR ring light (optional) with: • IR ring light • 3 magnetic objective rings • power supply • power cable (region specific) • NIR camera	
0 - 2	Beam splitters (optional). At least one beam splitter is required for operation of the Laser Station 2. • 370 – 532 nm • 700 – 1100 nm	
0 - 2	Diode lasers (optional) • Diode Laser, wavelength 1064 nm, 20 W, CLASS 4 • Diode Laser, wavelength 808 nm, 14 W, CLASS 4 • Diode Laser, wavelength 445 nm, 3 W, CLASS 4 • Power supply unit, 12 VDC • Power cable (region specific) • Signal cables SMB-to-SMB	

Quantity	Description with image	
0 – 1 	Safety Box (optional) • Safety box can be purchased separately • For safety reasons, it is required to have a safety box as part of the Laser Station 2. • Safety box prevents direct laser beam to exit the box. Box has interlock system to shut down the laser when door is opened. Safety box has key lock on door to provide only access to qualified personnel in possession of the door key. Safety box has emergency switch	
1	Set of 4 hex wrenches: M1.5 + M2 + M2.5 + M4 + M5	
1	Laser test paper	
1	Type 8 training card decapped	
1	This “Laser Station 2 - Quick Start Guide”	

Note: optional components can be purchased additionally

Safety instructions

Laser safety

The Laser Station 2 contains laser sources which are power compatible with a Class 4 laser product as defined in international Standard IEC 60825-1.

The operator of the Laser Station 2 should observe the general precautions:

DO NOT attempt to use the laser sources outside the Safety Box.

DO NOT disassemble the laser source or the Safety Box, while the Safety Box is connected to a power supply

DO NOT attempt to disable the door interlocks of the Safety Box.

ONLY operate the laser
- when the diode laser source is mounted on the microscope together with the camera, light guide and objectives
- or when the laser fiber is attached to the micromanipulator of the DLS/Multi Area Unit.

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

Recommendations for safe use of lasers

The standard reference for laser safety is the American Standard for the Safe Use of Lasers, Z136.1-2000, developed by the American National Standards Institute (ANSI). This reference is the basis for many of the federal regulations for laser and

laser system manufacturers, and for the Occupational Safety and Health Administration (OSHA) laser safety guidelines. It contains detailed information concerning proper installation and use of laser systems.

While the ANSI standard itself does not have the force of law, its recommendations, including warning signage, training, and the designation of a laser safety officer, may be compulsory under local workplace regulations when operating laser systems above Class I. It is the operator's responsibility to ensure that the installation and operation of the laser source with safety box is performed in accordance with all applicable laws.

> Copies of ANSI Standard Z136.1-2000 are available from:
>
> Laser Institute of America
> 12424 Research Parkway, Suite 125
> Orlando, FL 32826
> (407) 380-1553

The safety features of the Riscure Safety Box are described in section Safety Features and Regulatory Compliance.

Electrical safety

The safety box is powered by a 12V power supply unit. The AC input to the 12V power supply unit is potentially lethal and is fully contained with the power supply unit.

DO NOT open the 12 V power supply unit while the unit is plugged in. Opening the power supply unit may expose the operator to the unit's AC input power.

DO NOT open the laser source while the laser source is plugged in. Opening the laser source may expose the operator to the internal voltage to drive the laser diode.

DO NOT open the laser source while the laser source is connected via the interlock plug to the safety box. Opening the laser source may expose the operator to the internal voltage to drive the laser diode.

DO NOT make or break any electrical connections to the system while the unit is switched on.

Fire safety

High power laser systems represent a fire hazard in combination with light absorbing surfaces and flammable or ignitable materials.

DO NOT use any flammable or combustible materials, explosives or volatile solvents such as acetone, alcohol or gasoline inside the safety box

ALWAYS keep a properly maintained and inspected fire extinguisher at hand.

Safety Features and Regulatory Compliance

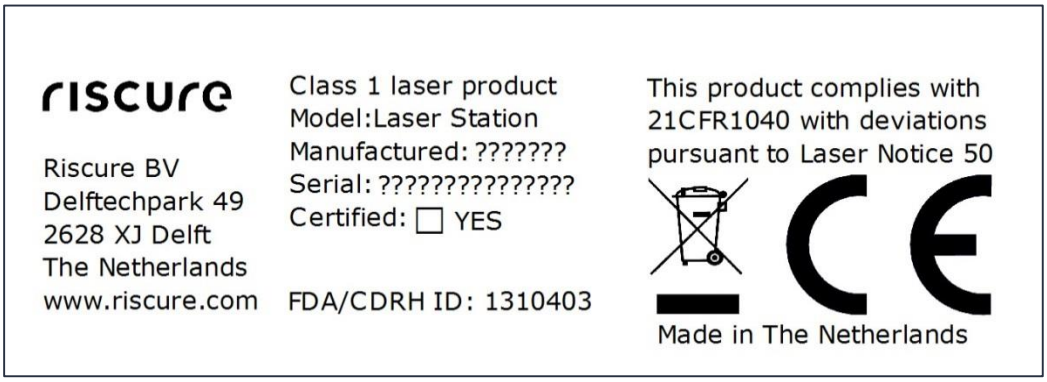
Riscure has incorporated specific safety features into the Laser Station 2 to meet the requirements of 21 CFR 1040 and the International Standard IEC 60825-1.

These safety features included in 21 CFR 1040 and IEC 60825-1 require that certification, identification, and warning labels be placed on laser products.

Reproductions of labels on the Riscure laser sources and Riscure safety box follow, with their locations specified:

1. **Certification/Identification Label**:

   This label is located on the back side of the safety box.

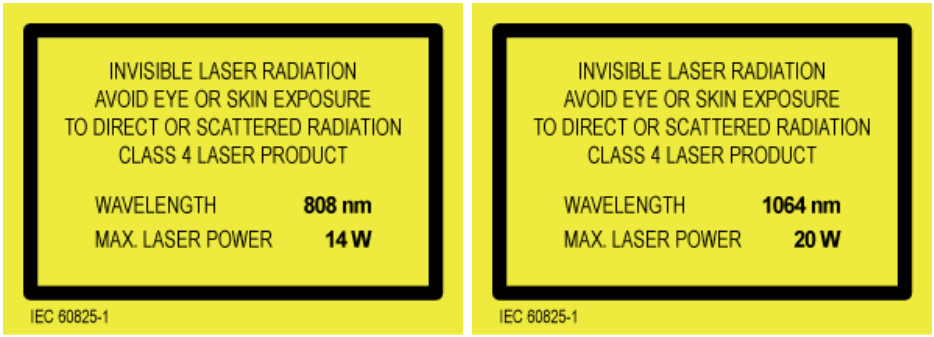


2. **Warning label**:

   This label is located on the front of the laser source.

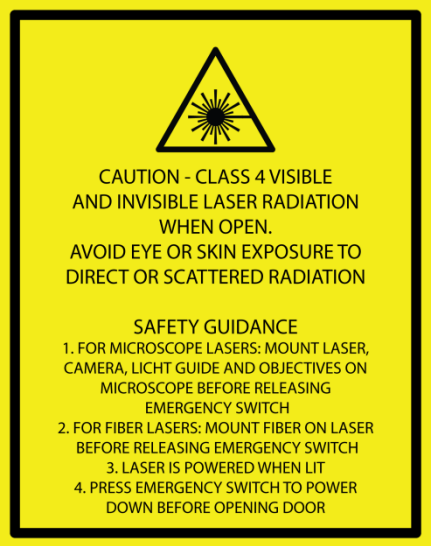
3. **Explanatory labels**:

   These labels identify the classification of the laser sources in accordance with IEC 60825-1. The labels are located on the side of the laser source:



   Interlocked protective housing safety label. This label is located on the door

of the safety box.



4. **Aperture safety label**:

   This label is located at the bottom of the laser source, next to the laser beam exit.

What does it do

The Laser Station 2 is a workbench for optical Fault Injection (FI) attacks on semiconductors using a laser. The workbench consists of a microscope on a stand with an XY-stage.

The laser unit is mounted next to the microscope and laser light is inserted into the optical path of the microscope. Laser light is aimed and guided through a spot size reducer and an optical revolver to a spot area on the target. The optical revolver has space for five switchable objectives. Objectives for 5x, 20x, and 50x magnification can be purchased separately.

The microscope has a top camera for visual confirmation of the laser spot on the target. An external light source provides additional illumination for the top camera view.

The XY-stage is controlled by a Tango controller unit, operated by an XYZ-joystick. A wheel at the side of the XYZ-joy stick controls the Z-axis or camera focus

Figure 1 Laser Station 2 components.

How to build the setup

Follow the next steps to assemble the Laser Station 2.

DO NOT allow dust and dirt to enter the microscope and damage the objectives.

Create a clean environment before assembling the Laser Station 2.

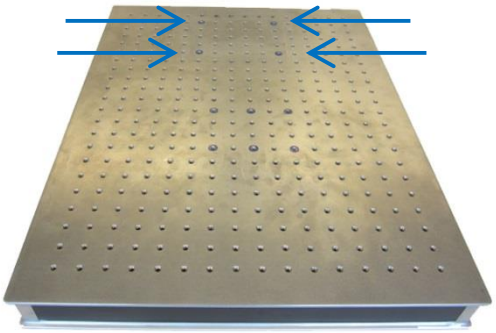
The Laser Station 2 set-up is **HEAVY** and cannot be moved inside the safety box by a single person. Please consider to build up the stand and mount the laser body inside the safety box directly. The photos in this guide are taken outside the safety box to improve photo quality.

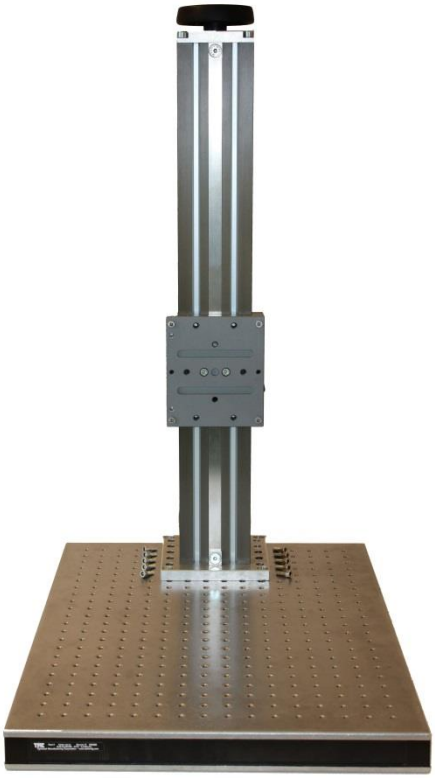
Tools required:

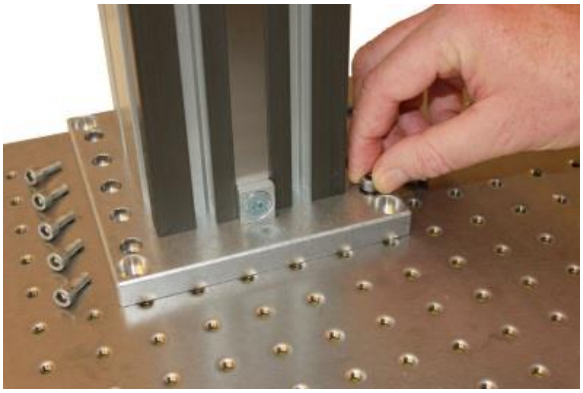
- hex wrench M1.5, M2, M2.5, M4 and M5

Build Laser Station 2 stand

1. Place TMC base plate on a solid foundation.
2. Place vertical stand on base plate along short side of the base plate according to photo below.
3. The stand should be rotated so that the laser body mount is towards the center of the base plate.
4. Vertical stand contains 5 holes on each side of its foot. Align 2 x 5 holes with holes in the base plate. Four holes in the base plate are colored blue to mark the position of the corners of the 2 x 5 holes in the foot.
5. Take 10 hex-screws and washers out of plastic bag and put into holes
6. Fix 10 hex-screws with hex-key.







Changing laser height

1. If not already loose, loosen the handles of the microscope support. The handles are positioned at the back side of the microscope body mounting plate.
2. Rotate top wheel to desired microscope body height. A typical distance between microscope body mounting plate and top of stand is 25 cm.
3. Tighten handles.

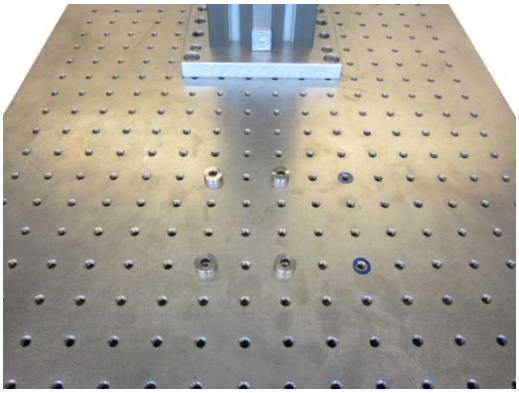
Un-locking XY-stage

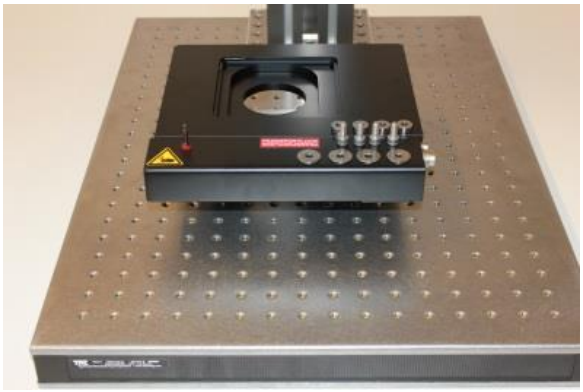
1. Place the XY-stage bottom side up.
2. Remove the red transport lock of the XY-stage.

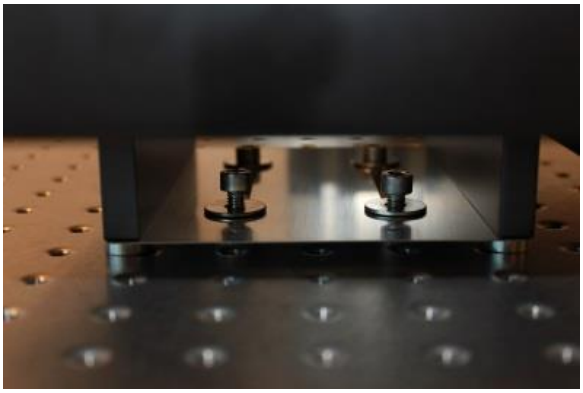
DO NOT use the XY-stage with the transport lock fitted: it WILL break the XY-stage!

Installing the XY-stage

1. Place distance rings on TMC base plate to mark the position for the XY stage. Distance rings have a height of 4 mm and an outside diameter of 14 mm
2. Six holes in the base plate are colored blue to mark positions for the XY stage:
    - Place the distance rings over left-hand six marked holes to position the XY stage centered to the base place. This position is convenient for small targets.
    - Place the distance rings over right-hand six marked holes to position the XY stage at the right-hand side of the base place. This position is convenient for printed circuit boards with the target chip out of center or for the VC Glitcher with extension board.
3. The center of the distance rings should be visible through apertures in the bottom plate of the XY stage.
4. Fix XY-stage to TMC plates with rings and screws.

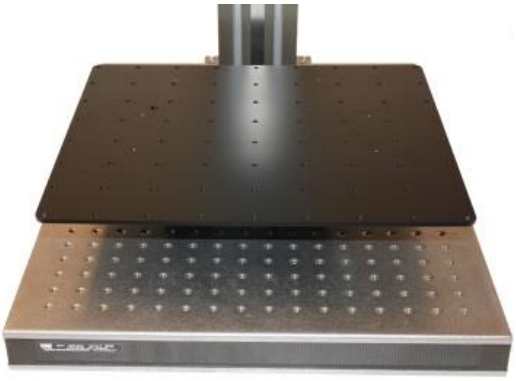






Mounting the black base plate the XY-stage

1. Remove any objects from the top of the XY-stage
2. Place black base plate over XY-stage. If positioned correctly, the larger hole in the base plate aligns with a threaded hole in the XY-stage.
3. Fix black base plate to XY-stage with screw through base plate to threaded hole in XY-stage



Mounting the Laser station body

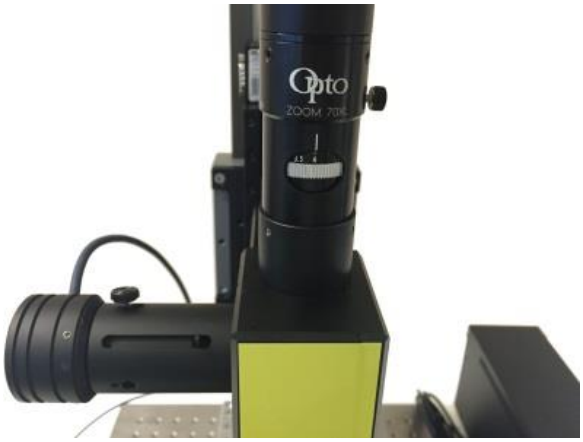
1. Because of the weight of the Laser Station 2 body, this is a two person activity
2. Remove screws from height adjustable flange
3. Hold Laser Station 2 body in front of flange with four holes aligned
4. Insert and tighten 4 hex screws to fix Laser Station 2 body to flange

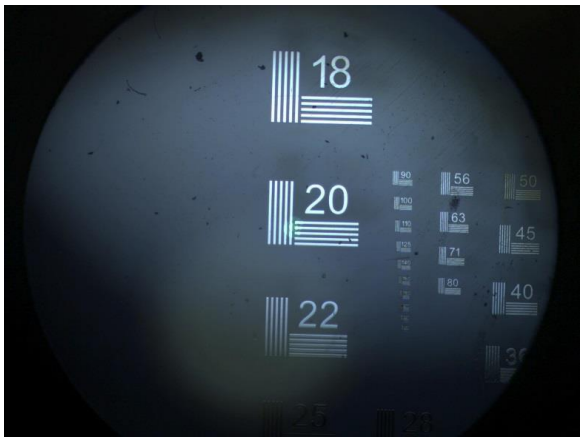
Check camera zoom tube

1. The zoom camera tube is mounted to Laser Station 2 body by manufacturer.
2. Due to vibrations during transport camera tube may get lose any may not be in vertical position. This has a negative impact on the camera image
3. Make sure the tube is in vertical position and the screws are tightened, see photo below

Setting zoom

1. The camera tube is equipped with zoom functionality
2. A zoom level below value 2 is intended to get a wide overview over the chip surface which is required for an additional (optional) Twin Scan module
3. A zoom level below value 2 may result in inhomogeneous illumination of the camera image
4. Changing from zoom level below value 2 to zoom level above level 2 may require focus adjustment





Mounting the camera

1. Mount camera and rotate camera to show camera type sticker on front.

2. The camera is connected to the zoom tube via two height and focus adjustment wheels. These wheels can be used to focus the camera image

once the laser spot is in focus. The adjustment should be done such that the laser spot and camera image are in focus simultaneously. After this adjustment, further focus adjustments for laser spot and camera image can be performed simultaneously by rotating the focus wheel at the side of the Tango 3D joystick. Note: an alternative way to match laser spot focus plane to camera image focus plane is to adjust the spot size reducer, see section on the spot size reducer.

Changing beam splitter

1. The Laser Station 2 needs at least one beam splitter for operation of the laser. However, the beam splitters and must be purchased separately.
2. The wavelength range of the beam splitter must match the wavelength of the laser. During purchase of the laser station, the appropriate beam splitter or beam splitters need to be selected to match the laser or lasers which will be used. The wavelength range is printed at the front of the beam splitter

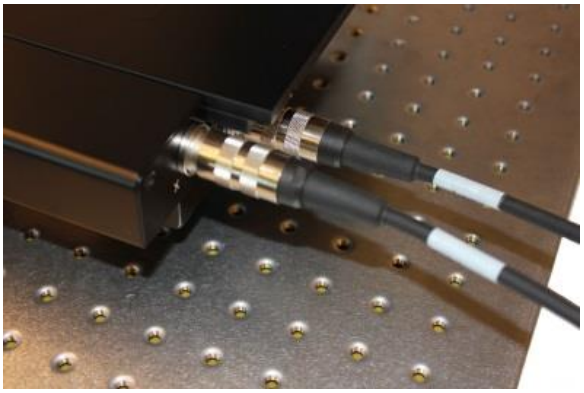
Laser wavelength	Wavelength range of beam splitter
1064 nm, 808 nm	700 – 1100 nm
532 nm, 445 nm	370 – 532 nm

3. The beam splitter has two screws to fix the beam splitter to the Laser Station 2 body
4. Loosen screws (screws cannot be taken out) and remove beam splitter
5. Insert beam splitter of your choice and fix screws

For maximum light transmission to the camera the beam splitter can be taken out. Maximum light transmission to the camera may be required for optical emission analysis or to get a clearer image when using the IR ring light.

Connecting cables from Tango 3 controller

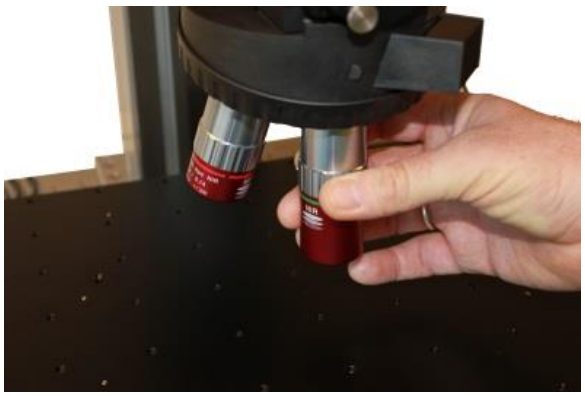
1. Connect XYZ-joystick to Tango 3 mini controller
2. Connect 3-axis drive cable to Tango 3 mini controller
3. Connect Z-axis sensor cable to Encoder 3 of the Tango 3 mini controller
4. The Tango 3 mini controller is mounted at the back of the LS 2 stand with 2 hex screws.
5. Pass power & USB cables through apertures at the back side of the safety box and connect
6. Connect 3-axis drive cable to XY-stage (connectors X and Y) and Z-axis motor (connector Z)
7. Connect Z-axis sensor cable to the Z-axis encoder output

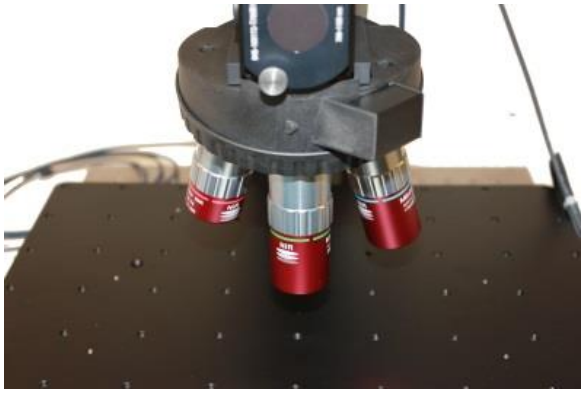


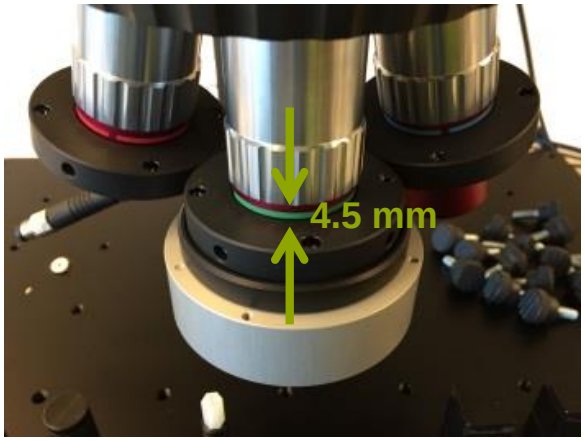
The Z-axis controller has a closed loop control for high accuracy. The close loop control may generate **high pitched noise**

Mounting objectives and IR ring light

1. Mount objectives to the revolver of the laser station 2 body
2. Connect the magnetic rings of the IR ring light to the objectives using a hex-key
3. Apply a distance of 4.5 mm between magnetic ring and thicker ring around objectives
4. Click the IR ring light to one of the three magnetic rings







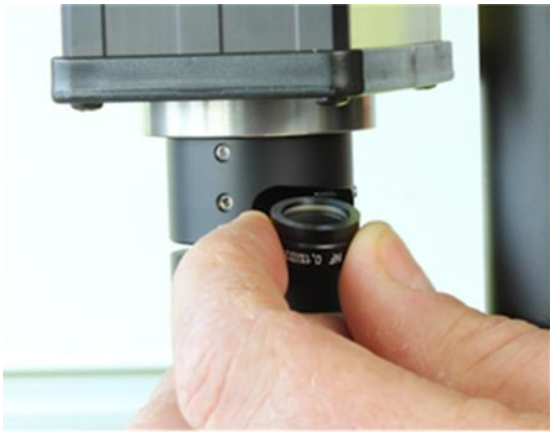
Mounting spot size reducer and diode laser

1. If not already mounted, place and fix ring on top of Laser Station 2 body.
2. Insert spot size reducer in ring on top of Laser Station 2 body. The spot size reducer will reduce the spot size diameter by a factor 10. The total power over the spot area will be reduced by approximately a factor 10. The use of the spot size reduction is optional. The spot size reducer can be taken out to obtain a larger spot size
3. Fix spot size reducer by tightening screws

4. Insert diode laser (optional) in spot size reducer and tighten screws

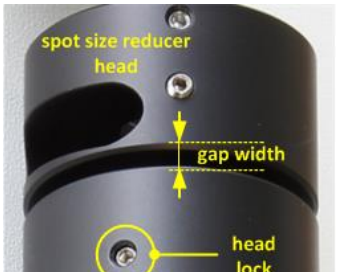
Insert filters to spot size reducer

1. Three filters are available to reduce optical power towards the chip. Each filter is labeled which the percentage of remaining light intensity (0.1 %, 1% or 10%)
2. The use of the filter is not required. To make use of a filter, insert the selected filter inside the provide gap in the spot size reducer head. The position of the filter is tilted by design to avoid reflections back into the laser
3. Filter can be removed by pushing the filter with a hex wrench through an aperture at the other side of the spot size reducer head.



Focusing the laser spot

1. Loosen the head lock screw with hex wrench M1.5. You are now able to rotate the spot size reducer head relative to the spot size reducer body.
2. By rotating the head you will focus the laser spot
3. The table below gives approximate values for the gap with for various laser wave lengths
4. Fasten the head lock to secure the reducer head



Laser wavelength	Gap width
445 nm (blue)	0 mm
532 nm (green)	0 mm
808 nm (red)	0 mm

	**Laser wavelength**	**Gap width**
	1064 nm (near infrared)	2 mm

Connecting light source and camera

1. Connect the power supply of the LED illumination to the controllable power supply
2. Insert the USB cable between camera and PC
3. Mount camera and rotate camera to show camera type sticker on front.

OVER VOLTAGE will damage the color and NIR cameras. Camera receives 5 V power supply over USB. USB hubs which deliver more than 5 V may damage the camera. This may happen if (by accident) the USB hub is powered by a voltage supply which exceeds 5 V.

Camera driver installation

1. Camera driver installation files can be found in the Inspector folder > hardware > Camera > driver
2. Run uEye32_44001_WHQL.exe or uEye64_44001_WHQL.exe for 32– or 64–bits.
3. Run uEye-DirectShow_44100.exe and check "Register cameras on connect" and "Use camera names" during installation

The **IDS uEye Cockpit** camera interface software allows detailed setting of NIR camera parameters. After launching uEye Cockpit, select Monochrome > uEye > Properties. Set Pixel Clock and frame refresh rate to the lowest values to improve image clarity.

Verification of the setup

Follow the next checks to verify you have built a working setup.

1. Is the Laser Station 2 powered?
2. Is the Laser Station 2 connected?
3. Is the Laser Station 2 responding to commands?

Please ensure that a check is successful, before proceeding to the next check.

If a check is not successful, refer to section “Common problems”.

Check 1 - Is the Laser Station 2 powered?

If the Tango Desktop unit is powered and the XY-joystick connected, the LED on the XY-joystick will be ON and the XY-stage responds to movement of the joystick.

If the LES is powered the target under the objective is illuminated.

Check 2 - Is the Laser Station 2 connected?

The Laser Station 2 is connected to the computer by:

- The USB camera.
- The USB (or RS232) link with the Tango controller unit

The USB camera is recognized by Windows as a generic video capturing device. Video can be recorded and viewed by any suitable application, and does not depend on Inspector.

The Tango 3 controller unit comes with driver software. After installing the driver software, Windows will identify the unit on USB (or serial port) as “*Serial @ COMxx*” device. The Inspector Hardware Manager will classify the device as category “XYZ Device”.

Check 3 - Is the Laser Station 2 responding to commands?

Inspector FI and Inspector SCA/FI can operate the Tango controller unit to perform scan operations, and thereby override the manual positioning of the XY-stage.

To move the XY-stage with Inspector:

1. Select **Perturbation** >> **Single XYZ** >> any target type.
   A perturbation configuration dialog opens.
2. Select tab **XYZ Device**.
3. Set **Device Selection** to *"<your tango device>"* from the list.
4. In property group **Controller and Settings**, press buttons **N**, **E**, **S**, **W**.
   The XY-stage moves into the four directions.

Inspector can show the live camera view, to help positioning the XY-stage:

5. Select tab **Camera**.
6. Set **Device Selection** to *"<your camera device>"* from the list.
   A number of properties are added, depending on the camera. Keep the settings at their default values.
7. In group Device Control Panel, go to **Live Feed**, press button **Open**.
   A panel opens with live images from the selected camera.

Help and troubleshooting

Common problems

1. The uEye camera (indicated by ‘UI-serial number’) is not shown in the camera device pull down menu of Tools > Open Camera View or of Perturbation > Camera tab. Possible causes:
    - Camera not connected. After connection of the camera to the USB port, at first the led on the camera is illumined red.
    - Driver not installed. After a couple of seconds, the color should change from red to green. If not, try to reinstall the hardware driver following the description in section 8.4.4 uEye Microscope Camera.
    - Driver not installed correctly. Perhaps you forgot to check "Register cameras on connect" and "Use camera names" during the installation of the DirectShow driver since this deviates from the default installation. Please uninstall the driver and re-install while checking "Register cameras on connect" and "Use camera names".

Have questions?

Visit the Riscure Support portal: http://support.riscure.com.

Technical specifications

Operational conditions

- Room temperature 15 – 35 °C (59 – 95 °F), non-condensing
- AC mains 100 – 240 V, 50 – 60 Hz.

Maintain stable environmental conditions (temperature, humidity, airflow etc.) in order to reliably repeat tests and compare test results.

Unplugging the PSU from the product is not required, but recommended when not used for an extended time.

Power supply input

Use of a PSU other than supplied by Riscure is not supported. Power spikes may cause internal damage and loss of accuracy.

XY-stage

- Travel range: max. 75 x 50 mm
- Max. travel speed: 45 mm/s
- Step size: 0.05 µm
- Accuracy: ± 3 µm
- Repeatability: < 1 µm

Motorized Z-axis

- 100 mm travel
- 0.05 µm resolution
- Feed precision < 1 µm
- Closed loop system

Cameras

Visual light

- 1/2” Sony CMOS
- Colour
- 3.1 MP
- USB 2.0

NIR

- 1/1.8” Sony CMOS
- monochrome
- 3.1 MP
- USB 2.0

Optical system

- 3 objectives (optional); magnification 5x, 20x and 50x
- 3 filters; remaining intensity 0.1%, 1% and 10% of laser power produced
- Spot size: 6 x 1.4 µm @ 50x objective for 808 nm and 1064 nm diode lasers including 10x spot size reducer tube
- Optical 7x zoom, enables Field Of View changes from 3.6 mm to 0.5 mm based on 5x objective
- *Optional:* Laser mirrors (Beam splitters):
  - 700 nm – 1100 nm with 80% transmission for lasers within this wavelength range. Remaining reflected light form target goes to camera.
  - 370 nm – 532 nm with 80% transmission for lasers within this wavelength range. Remaining reflected light form target light goes to camera.

Remote connections

- USB 2.0 camera connection to PC.
- USB 2.0 Tango 3 mini control connection to PC.

Technical specifications – Diode Laser

Operational conditions

- Room temperature 20 - 30 °C, (68 – 86 °F), preferred

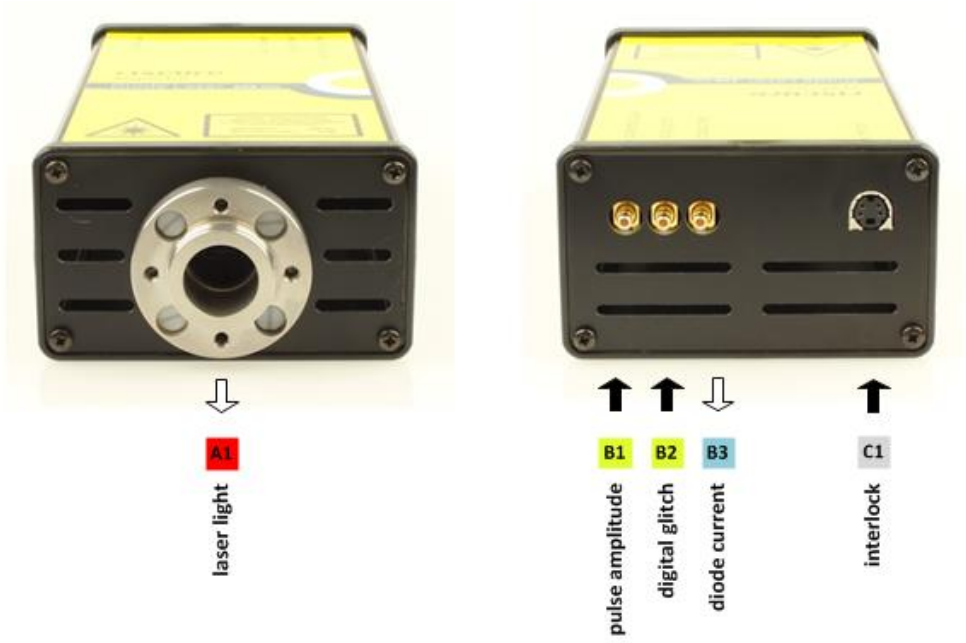
Power supply input

- 12 V DC, max 2.5 A

Laser

- Diode laser Class-4, wavelength 1064 nm (near infrared), 20 W
- Diode laser Class-4, wavelength 808 nm (red), 14 W
- Diode laser Class-4, wavelength 445 nm (blue), 3 W
- Activation frequency, max. 25 MHz
- Activation pulse duration, min. 20 ns, max 100 µs.
- Pulse amplitude full range settling time 1 s.
- Diode current feedback test signal, -20 A/V @ 50 Ω.

Connectors



Port	Label	Description
A1	-	Diode laser light output
B1	**pulse amplitude**	SMB, 1 kΩ. Analog input 0.0 – 3.3 V Laser power level control: 0.0V = 0%, ≥ 3.3V = 100% (max).
B2	**digital glitch**	SMB, 50 Ω. Binary input 0.0 – 3.3 V. Laser light activation: Active high.
B3	**diode current**	SMB, 50 Ω. Analog output -1.5 – 1.5 V. Feedback signal proportional to diode current. Negative on activation.
C1	**interlock**	12 V DC Power supply connection from Safety Box PSU.

Declaration of conformity

EC-DECLARATION OF CONFORMITY

Suppliers Details

Name

Riscure B.V.

Address

Frontier Building, Delftechpark 49, 2628 XJ Delft, The Netherlands

Product Details

Product Name

Inspector

Model Name(s)

Laser Station

Trade Name

Riscure

Applicable Standards Details

Directives:

- MD (2006/42/EC) - LVD (2006/95/EC) - EMC directive (2004/108/EC)

Standards:

- IEC 60825-1; IEC 320 C8; IEC 60950-1; 21 CFR 1040; ANSI/ESD S20.20:2007; BS EN 61340-5-1:2007; EN55022-B; EN61000-4-2, 4-5; EN-ISO 12100:2010; CISPR 11; CISPR22-B; UL 1950

Supplementary Information

The appliance fulfils the relevant requirements of the above mentioned directives according to our technical documentation TCD - Laser Station. Risk assessment according to the EN-ISO 12100:2010.

Declaration

I hereby declare under our sole responsibility that the product(s) mentioned above to which this declaration relates complies with the above mentioned standards and Directives

Name	Issued Date
Dr.ir. F.G. de Beer / Technical Director	02 / 02 / 2016

Signature of representative

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