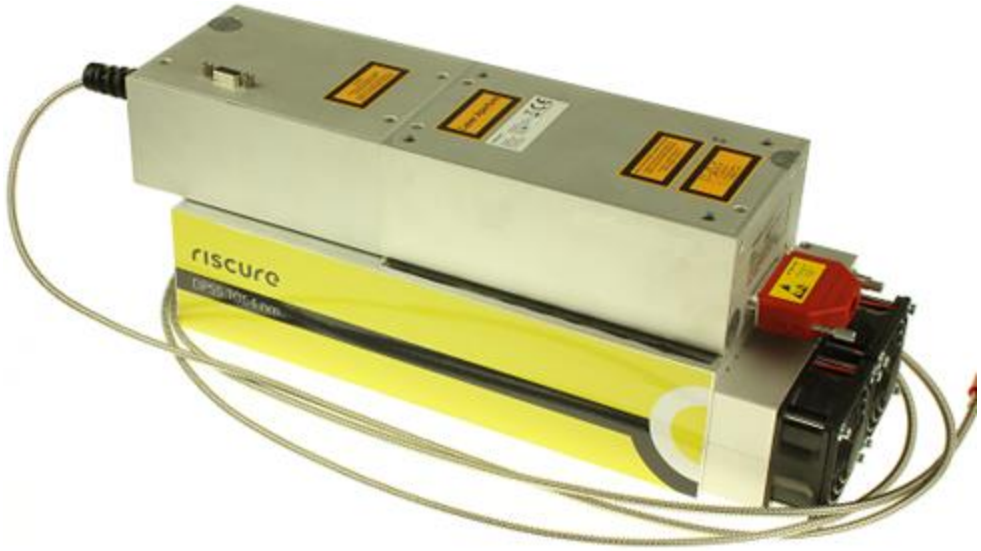
DPSS Laser

Quick Start Guide



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

This tool must be used according to its 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.

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Manufactured by

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What is in the box

The box contains a DPSS Laser source, an optional power supply unit and cables to connect it to a Laser Station 2.

Box content checklist

Quantity	Description		Identifier [1]
1	DPSS Laser Head, class-4		LSRHD
1	Electro Static Discharge (ESD) Protection connector		ESDCAP
1	Cooling Cable		CLCBL
1	Laser Head Cable		LHCBL
1	Attenuator cable		ATTCBL

Quantity	Description		Identifier [1]
1	Laser manual		LSRMAN
1	Laser Head final Test Report		LSRTST
1	USB stick with installation files		USBKEY
1	DPSS Power Supply Unit (PSU)		LSRPSU
1	Power Supply Unit key set		PSUKEY
1	Power Supply Unit Interlock Dummy		LOCKDUM
1	Power Supply Unit User Interface Dummy		UIDUM
1	Power Supply Unit USB cable		USBCBL

Quantity	Description		Identifier [1]
1	Power Supply Unit 24V DC power adapter		DCPSU
1	Power adapter cable (EU/US/UK)		-
1	Fiber Coupler (Optional)		FIBERCUP
1	Interlock cable		LCKCBL
1	BNC-SMB cable, coax, 50 Ω, 6 ft.		TRGCBL
1	Quick Start Guide (this guide)		-

[1] Identifier used in this document to refer to the item.

Depending on your order, the DPSS laser wavelength can be either:

532 nm Green laser, OR 1064 nm Near Infrared laser.

Safety instructions

DPSS laser is power compatible with a Class 4 laser product as defined in International Standard IEC 60825-1.

The DPSS laser system needs to be used in combination with the Riscure Safety Box.

Refer to following manuals for safety and conformity information:

- **Riscure Laser Station 2 manual**
- **Innolas laser manual**
- **Newport Conex-AGP manual (Discontinued)**

What does it do?

The Diode Pumped Solid State (DPSS) Laser is a source of light produced by a solid state laser which is charged by a pumping light emitting diode. After charging (~ 1 ms) the DPSS can generate short light pulses (< 4 ns) with high intensity (> 20 µJ).

The DPSS Laser is attached to the Diode Laser Station or Laser Station 2 and operated for optical Fault Injection (FI) attacks on semiconductors.

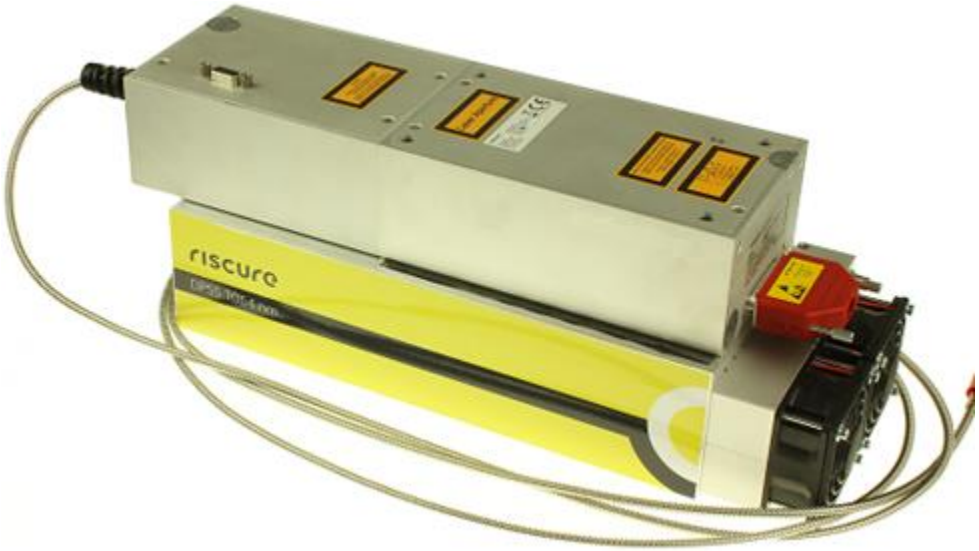


Figure 1 DPSS Laser head

Build the hardware setup

Follow the next steps to install the DPSS Laser on the Diode Laser Station or Laser Station 2.

Verify Power Supply Unit and Laser Head serial numbers

WARNING:

DO NOT CONNECT DPSS Power Supply Unit to any Laser Head with a mismatching serial number

- Read serial number labeled on the Power Supply Unit, see **Error! Reference ource not found.**.

Figure 2 Power Supply Unit label indicating compatible Laser Head serial number

- Read the serial number written on the Laser Head label, see Figure 3.

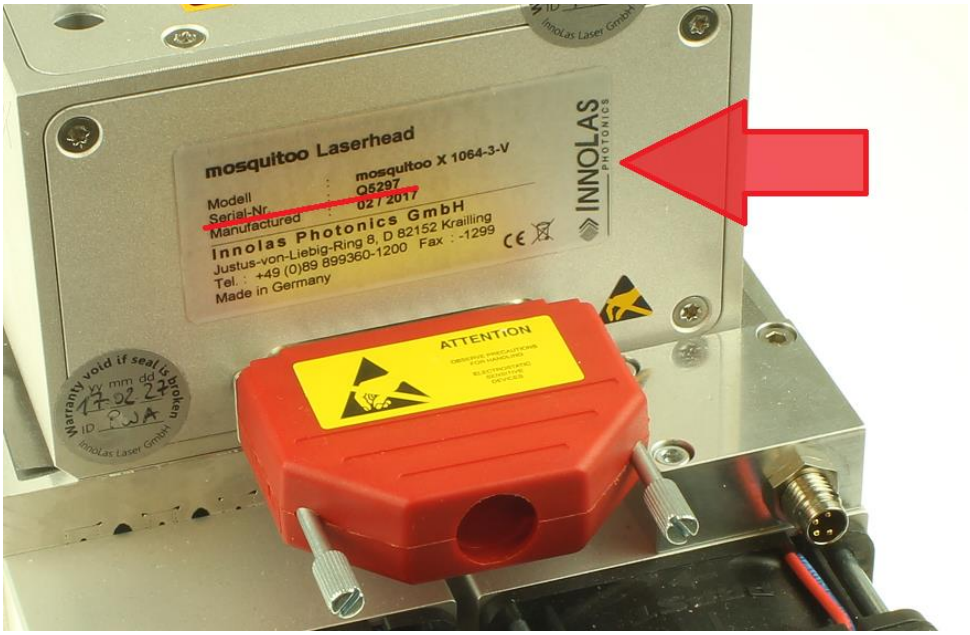


Figure 3 Label on the back of the Laser Head indicating its serial number

- The 2 serial number should be identical, indicating a matching PSU and Laser Head.

Connecting the Power Supply Unit and Laser Head

WARNING:

The Laser Head is very sensitive to Electro Static Discharge (ESD).

To prevent ESD damage to the Laser Head:

- Keep the ESD protection plug connected to the Laser Head whenever the Laser Head is not connected to the power supply, see Figure 4

- Prevent ESD by proper grounding of equipment and your body during connection or disconnection of cables or plugs to Laser Head or power supply

Figure 4 The Laser Head with ESD protection plug (highlighted by red rectangle)

- Warning: Never touch the pins inside the laser head connector. The laser head will die.

- Connect the power adaptor cable to a grounded socket

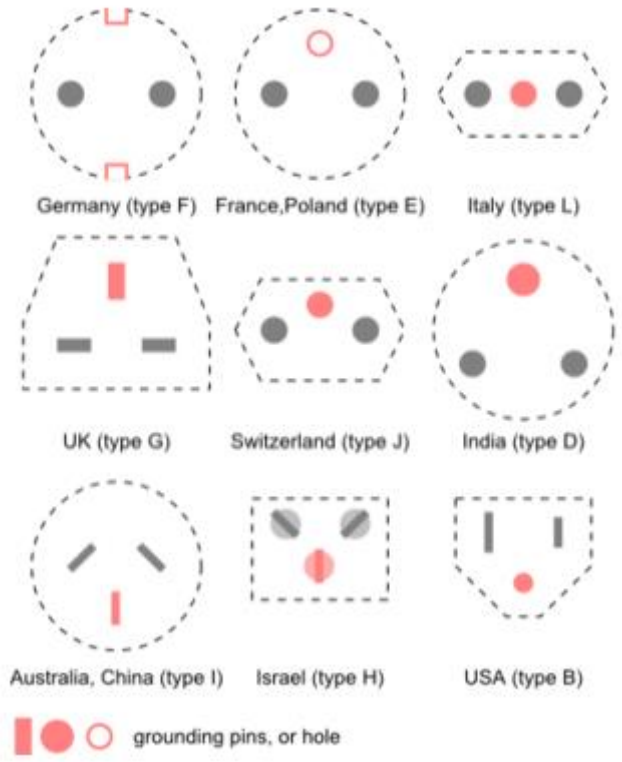


Figure 5 Grounded sockets to connect the power supply unit 24V DC via the power adaptor cable

- Insert the power plug in to the DPSS Power Supply Unit

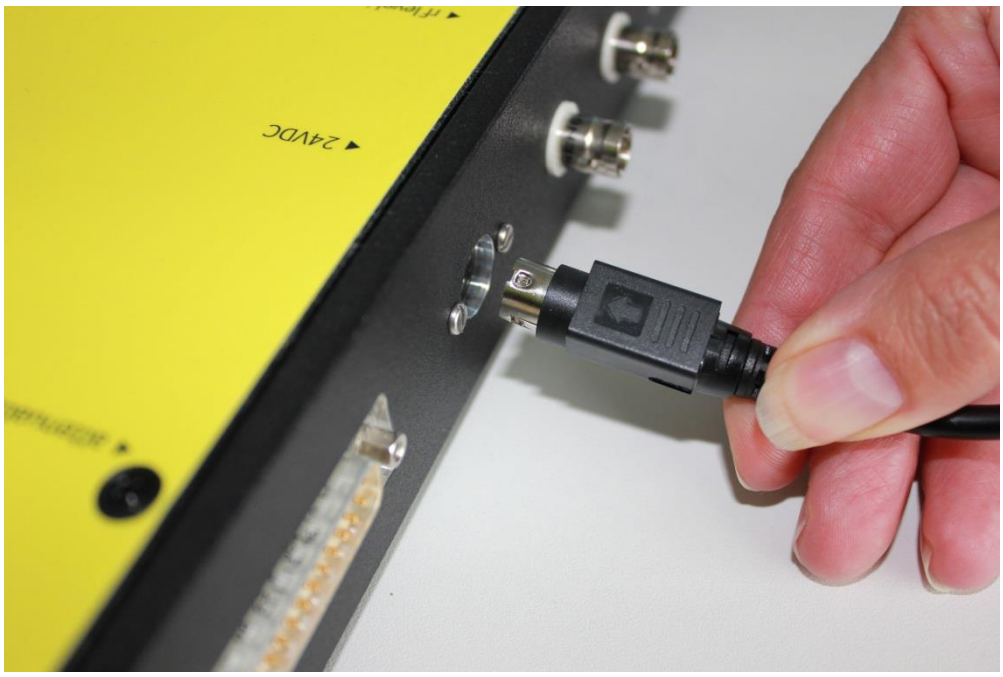


Figure 6 24VDC power plug in to the DPSS supply unit

- Touch the interlock connector to be discharged of possible ESD.

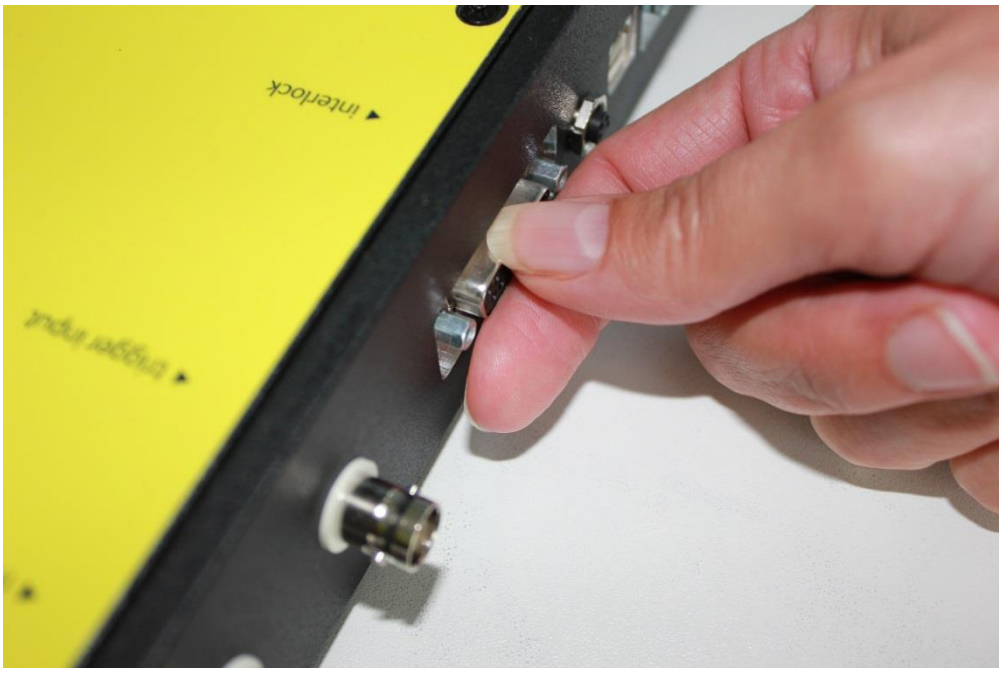


Figure 7 Touch the interlock connector

- While still holding the interlock connector, attach the laser head connector to the DPSS power supply

Figure 8 Be sure to connect the GND shield of the connector first

- On the laser head remove the ESD protection connector

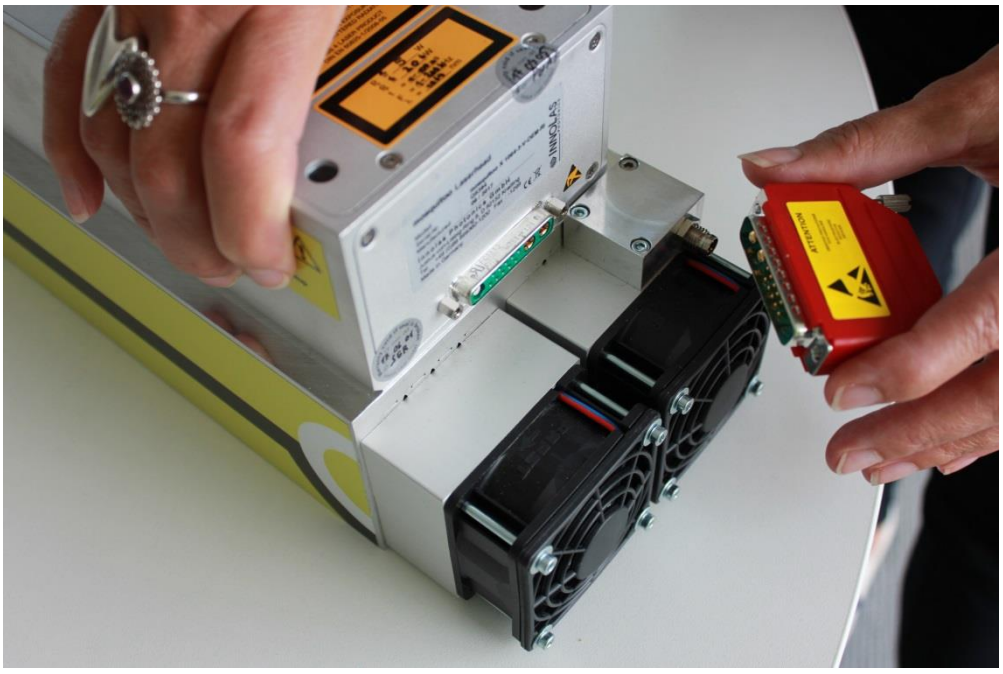


Figure 9 Remove the ESD protection connector while touching the laser head

- While still touching the laser head, connect the laser head cable to the laser head

Figure 10 Be sure to connect the GND shield of the connector first

- It’s now save to connect the other cables to the laser head
- Make the connections with the Cooling cable.

Figure 11 Cooling cable connected to the DPSS PSU

Figure 12 Connect the cooling cable to the Laser Head

- Make the connections with the Attenuator cable.

Figure 13 Connect the attenuator cable to the PSU

Figure 14 Connect the attenuator cable to the Laser Head

- After finishing the previous step, the wiring between the DPSS Laser Head and the Power Supply Unit is complete.

Finalize Power Supply Unit connections

- Connect the User Interface Dummy plug to the PSU, see Figure 15.

Figure 15 Connect the User Interface Dummy to the PSU

- Connect the Interlock cable to the PSU, see Figure 16.

Figure 16 (with Riscure Safety box) Connect interlock cable to the PSU

- Connect the other end of the interlock cable to the Interlock cable from Riscure Safety box. The Safety box interlock connector is shown in Figure 17.

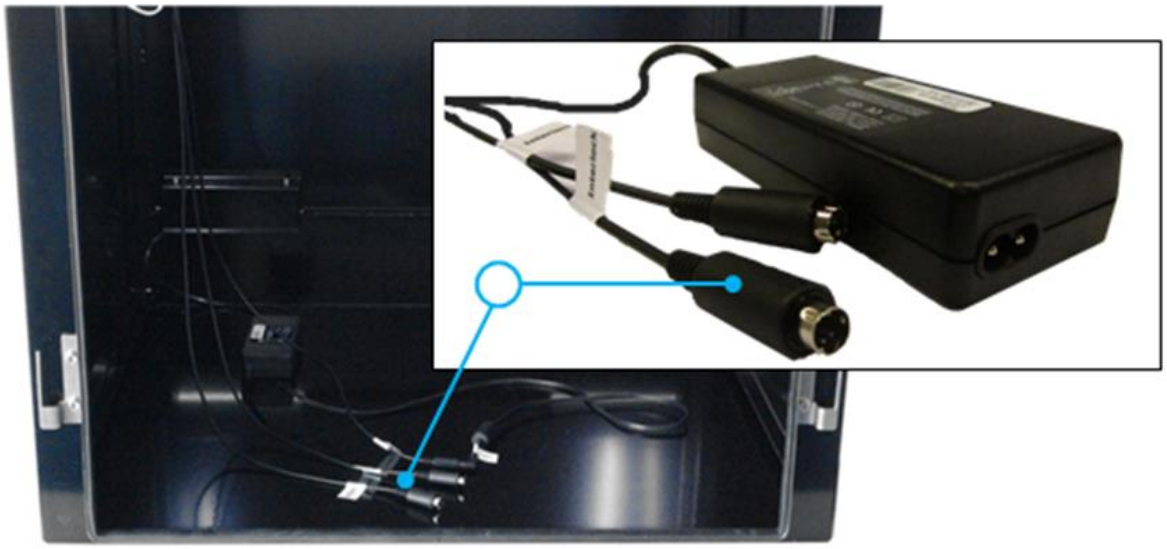


Figure 17 Interlock connector of Riscure Safety box

If your Safty box interlock connector looks like the one shown in Figure 18, then it cannot be directly connected to the interlock cable of DPSS laser. **Please then take contact with Riscure support for help.**

Figure 18 Incompatible Safety box interlock connector

- First connect the USB cable to the PSU, as shown in Figure 19 and then connect the other end of the cable to the PC.

Figure 19 Connect the USB cable to the PSU

- Connect the BNC-SMB cable *to the PSU, it will be used to receive trigger signal from either Riscure devices (i.e. VC Glitcher and Spider) or from other trigger sources*, see Figure 20.

Figure 20 Connect the BNC-SMB cable to the PSU

At the moment, all necessary wiring to the DPSS PSU is complete.

Connecting the Fiber Coupler

The Fiber Coupler serves as the bridge connecting the DPSS laser fiber to the optical input of the Diode Laser Station or the Laser Station 2.

- Mount and secure the Fiber Coupler adapter to the Diode Laser Station or Laser Station 2, see Figure 21.

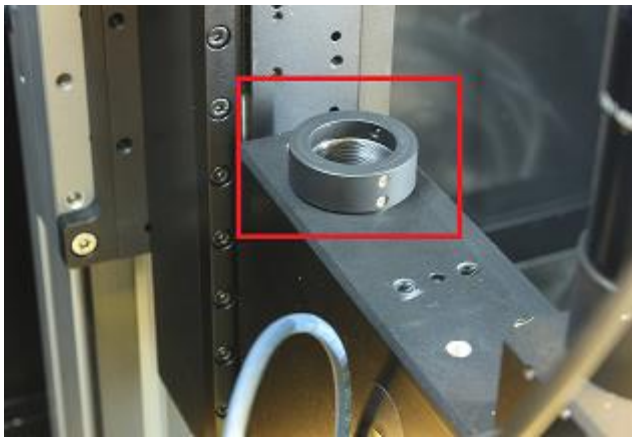


Figure 21 Fiber Coupler adapter

- Mount the Fiber Coupler, and secure it to the adapter, see

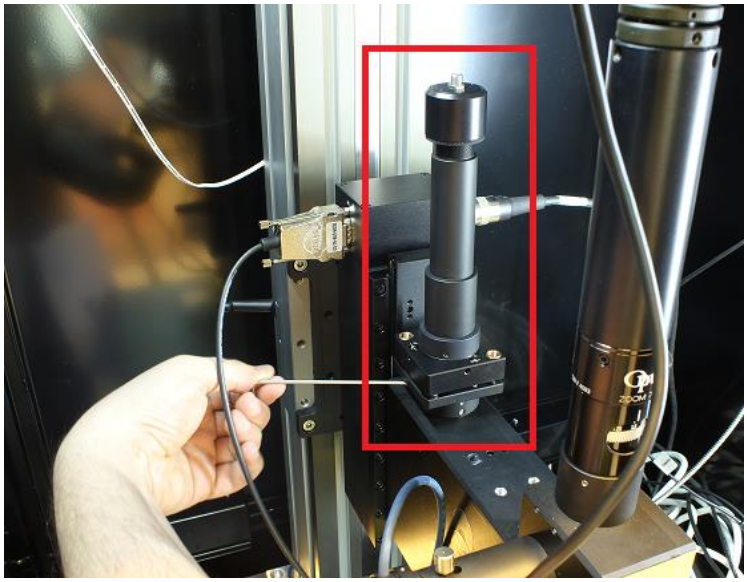


Figure 22 Securing the Fiber Coupler

- Remove the protection cap from the Laser Head fiber end, see Figure 23.

Figure 23 Fiber end with protection cap (left), and without protection cap (right)

- Insert the Fiber end to the top of the Fiber Coupler, see

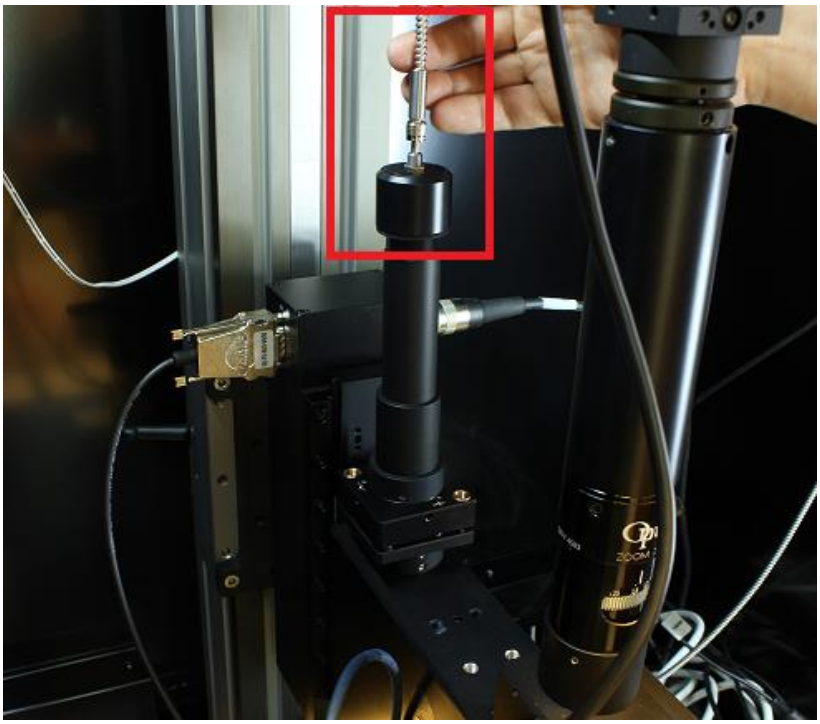


Figure 24 Inserting the Fiber end to the Fiber Coupler

Attention:

Fiber Cable with a smooth curve improves power distribution within the laser spot.

- Secure the Fiber end into the SMA connector at the top of the Fiber Coupler, and fix the fiber so that it has a smooth bending curve, see Figure 25 and Figure 26.

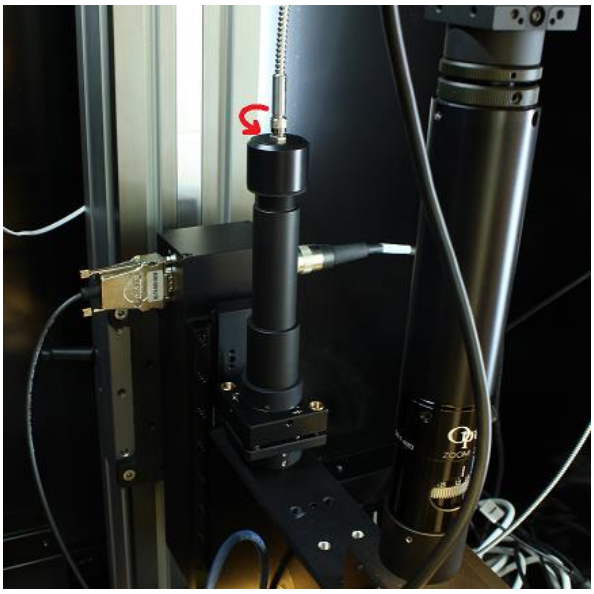


Figure 25 Connections with the Fiber Coupler

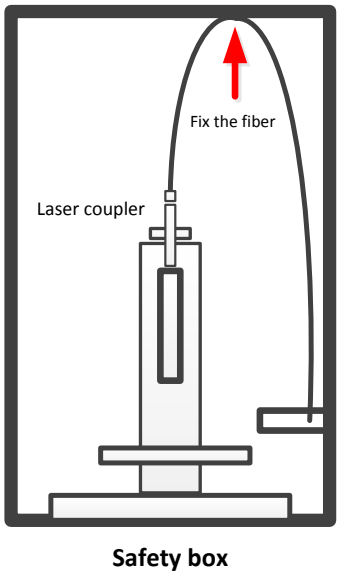


Figure 26 Secure the optical fiber to the top plate of the safety box

Key lock operation of the Power Supply Unit

As shown in Figure 27, a key switch is used to change the state of the PSU. With the key inserted, the PSU can be switched between the following states:

OFF— The PSU is completely shut down.

STANDBY – 24 V DC is applied to the PSU, and it will be ready to warm the Laser Head.

ON – The PSU will begin to warm up the Laser Head, and subsequently become ready for firing laser pulses.

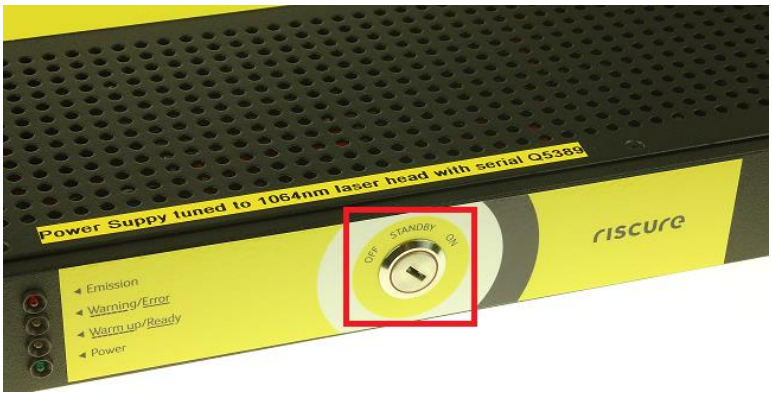


Figure 27 The key switch and available PSU states

Warm up the Laser Head

- Insert the key to the PSU, see Figure 28.

Figure 28 The key inserted into the Power Supply Unit

- Turn the key to the "STANDBY" position, and wait until the "Power" LED lights up. All the other LEDs should be OFF, see Figure 29.

Figure 29 Key turned to "STANDBY" position, "Power" LED lighting up

- Turn the key further to the "ON" position, the PSU will start to warm up the laser head. During warming up, the "Warm up/Ready" LED will blink, see Figure 30.

Figure 30 Key turned to "ON" position and the "Warm up/Ready" LED blinking

- Warming up the Laser Head requires a couple of minutes. Once the laser has been warmed up the "Warm up/Ready" LED stops blinking and lits continuously, see Figure 31.

Figure 31 PSU LEDs when DPSS Laser Head is ready to fire

- NOTE that the "Emission" LED goes OFF as soon as the Interlock circuits of the Safety box is Open, signaling that the current supply to the DPSS laser diode is cut off, see Figure 32.

Figure 32 PSU LED state when Interlock circuits of the Riscure Safety box is Open

Connect DPSS Power Supply Unit to a VC Glitcher or a Spider

The DPSS laser can be triggered using Riscure VC Glitcher or Spider.

- When triggering the laser using a VC Glitcher, the SMB end of the BNC-SMB cable of the PSU (see Figure 33) should be connected to the "digital glitch" port of the VC Glitcher device.

- When triggering the laser using a Spider, the SMB end of the BNC-SMB cable of the PSU (see Figure 33) should be connected to the "glitch out 1" port of the Spider device.

Figure 33 BNC-SMB cable that connects to either a VC Glitcher or a Spider

Windows driver installation

- Connect the USB cable of DPSS PSU to your PC.
- Connect the USB stick as shown in "Box content checklist" to your PC.
- Open the root directory of the stick. It will be later referred as "[usb_key_folder]".
- Open Windows Device Manage, the DPSS PSU is now an unrecognized device "USB Laser Interface" under "Other devices" category, see Figure 34.

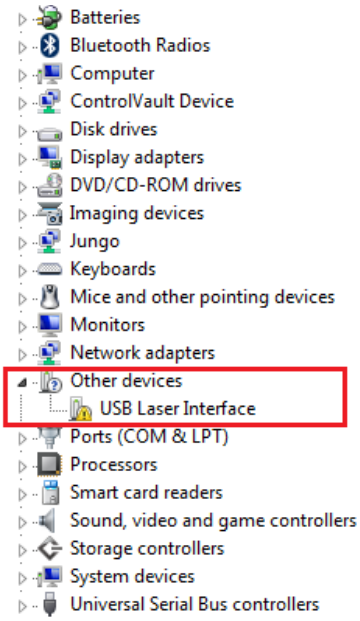


Figure 34 Unrecognized USB Laser Interface

- To install the driver for the "USB Laser Interface":
    - Right mouse click on "USB Laser Interface" and select Update Driver Software.
    - Select "Browse my computer for driver software".
    - Check "Include subfolders" option, then click "Browse" button.
    - Navigate in the file browser window and select the folder: "[usb_key_folder]\USB Interface Driver\Windows7".
    - Click "Ok" button to close the browser, and click "Next".
    - Select "Install this driver software anyway" if Windows Security warning pops up, see Figure 35.

- The USB Laser Interface now becomes an unrecognized device with name "USB Serial Port". See Figure 36.

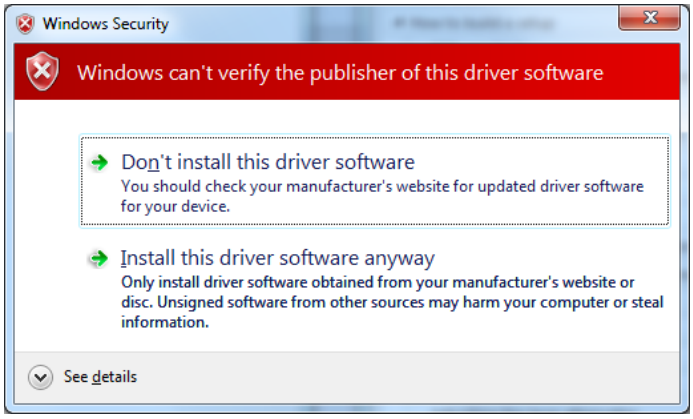


Figure 35 Windows warning of installing an unsigned driver

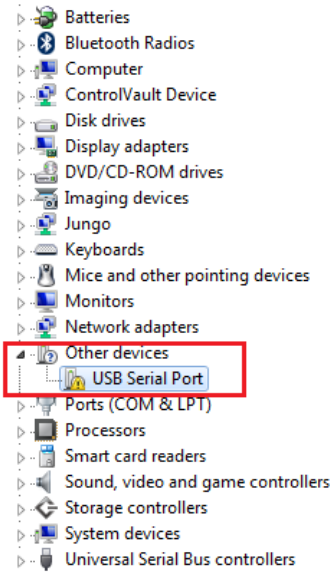


Figure 36 Unrecognized USB Serial Port

- To install the driver to the "USB Serial Port" device:
  - Right mouse click and select Update Driver Software.
  - Select "Browse my computer for driver software".
  - Check "Include subfolders" option, then click "Browse" button.
  - Navigate in the file browser window and select the folder: "[usb_key_folder]\USB Interface Driver\Windows7".
  - Click "Ok" button to close the browser, and click "Next".

- Select "Install this driver software anyway" if Windows Security warning pops up, see Figure 35.

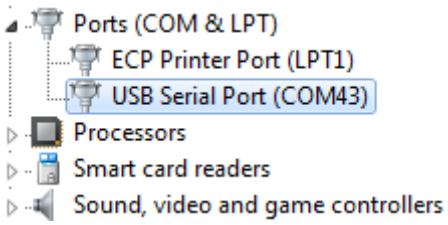


Figure 37 DPSS PSU shows up as "COMXX" with successfully installed driver

- As shown in Figure 37, the USB device will then be detected and identified with name of “USB Serial Port (COM*XX*)”.
- After this step, the Windows driver for DPSS laser has been successfully installed.

Prepare the DPSS laser for Inspector operation

Inspector Perturbation module can operate the DPSS laser for Fault Injection (FI) operation, after a "DPSS laser" device has been created in Inspector.

To create a "DPSS laser" device:

- Launch Inspector 4.12 or a later version.
- In the software menu, select "Tools" > "Hardware Manager…"

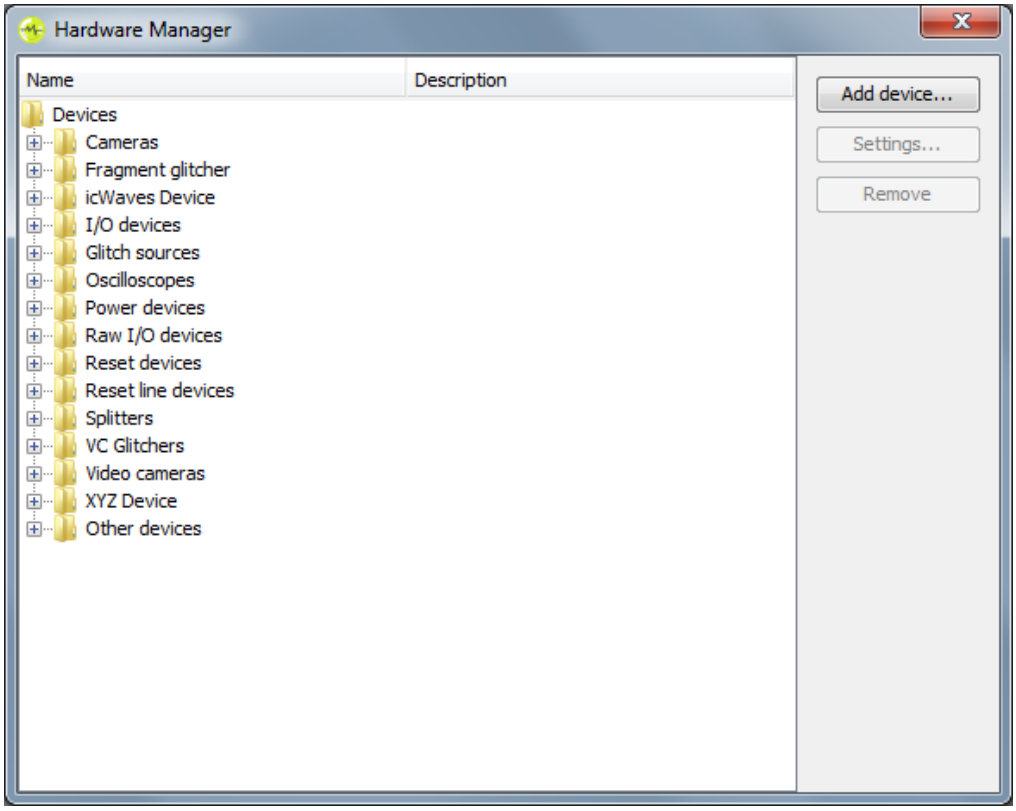


Figure 38 Inspector Hardware Manager

- Right click "Add device…" and select "DPSS laser".
- A configuration dialog shows up to specify DPSS laser properties, see

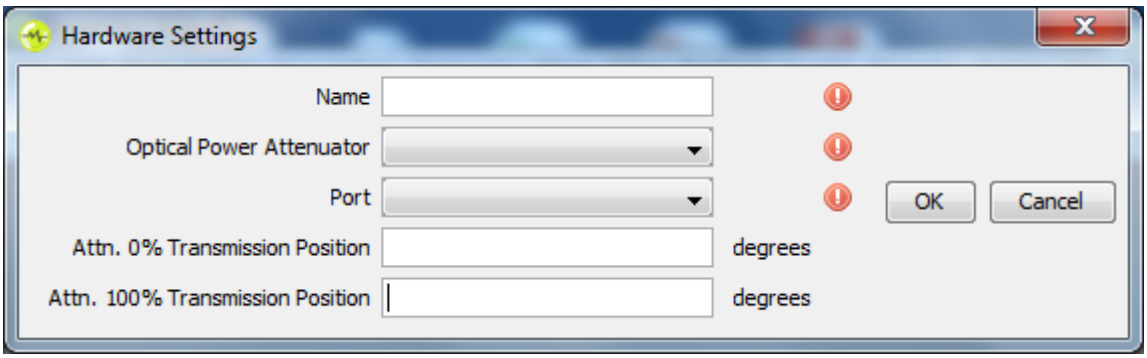


Figure 39 Empty DPSS laser device configuration dialog

- Assign a name to this DPSS laser device (for example, "DPSS @ COMXX")
- Select "DPSS integrated" for "Optical Power Attenuator" property. "Newport" attenuator has been discontinued and is shown as legacy support, see Figure 40.

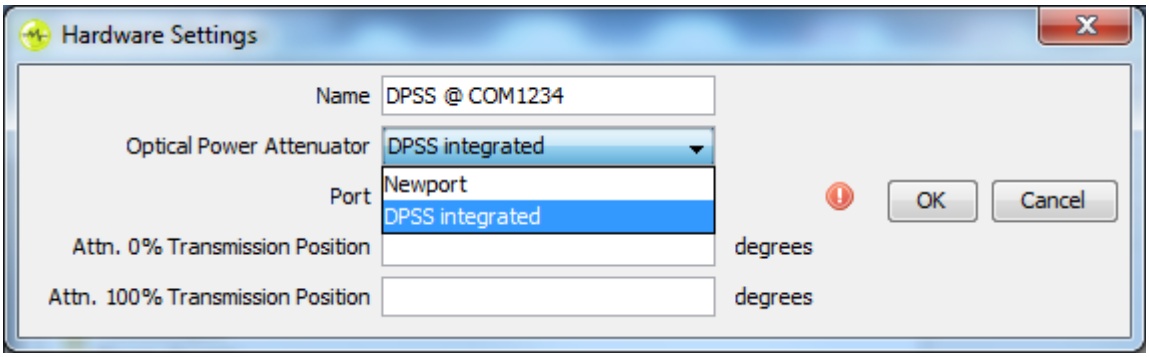


Figure 40 Selecting the "DPSS integrated" as Optical Power Attenuator

- Select correct COM port index of DPSS PSU based on the port enumeration assigned by Windows Device Manager.

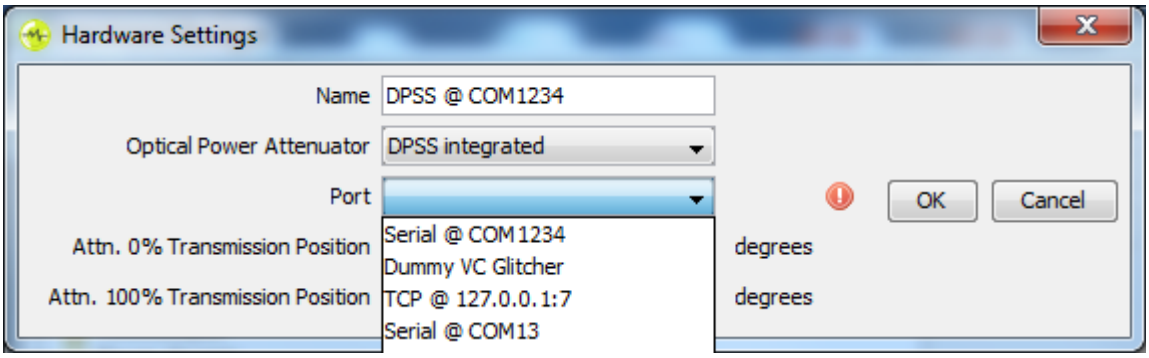


Figure 41 Selecting DPSS PSU COM port index for "Port" property

- Read from the DPSS laser final Test Report the 0% Transmission position, and the 100% Transmission position, see Figure 42

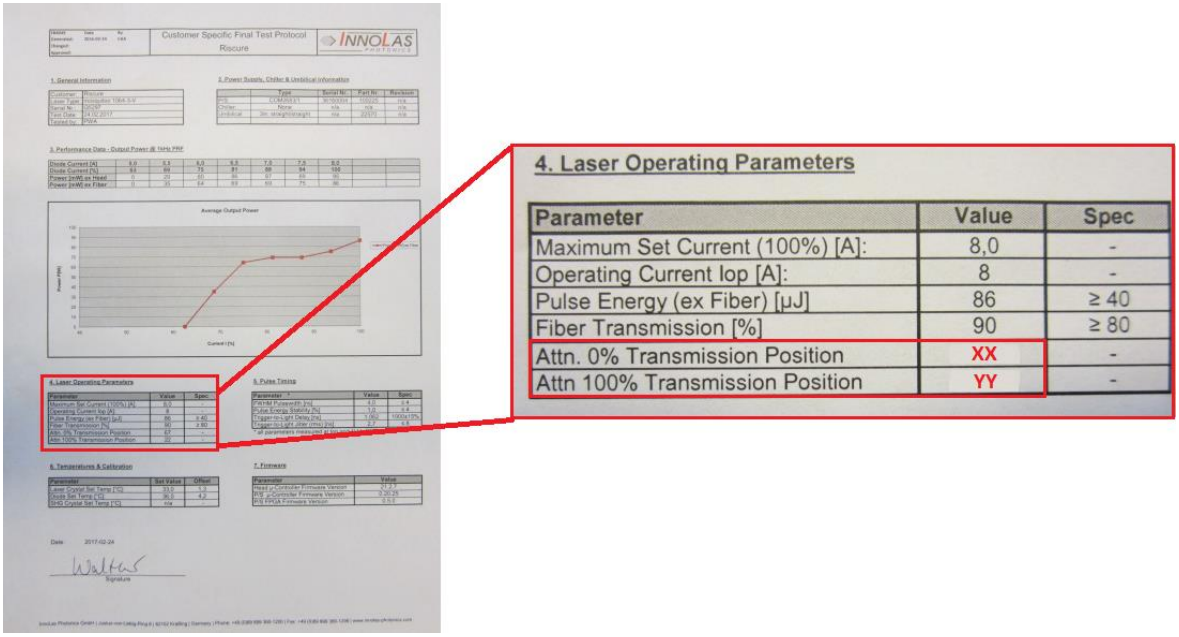


Figure 42 The Laser Head final test report (left), and attenuator 0%, 100% transmission position (right)

- Enter these 2 values into the corresponding fields of the dialog, so the dialog should look similar to Figure 43.

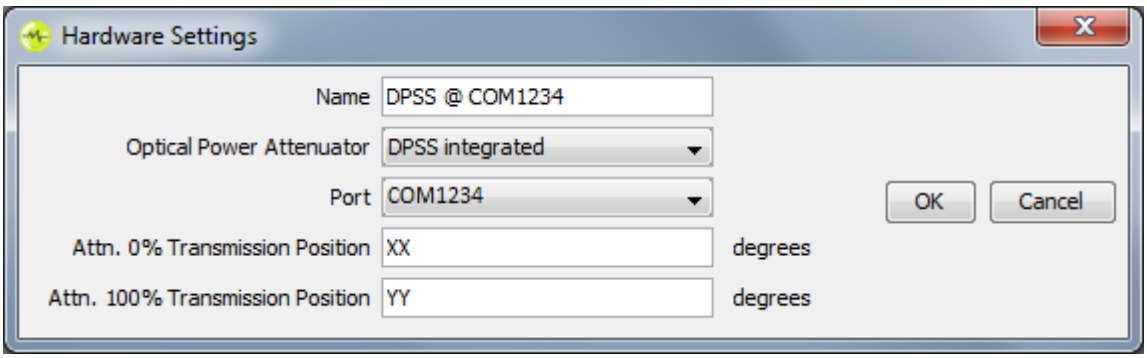


Figure 43 DPSS laser device configured with dummy properties

- Click "OK" to create the "DPSS laser" device with the specified properties.

- In Inspector "Hardware manger", expand "Raw IO Device" category by clicking on the "+", see Figure 44.

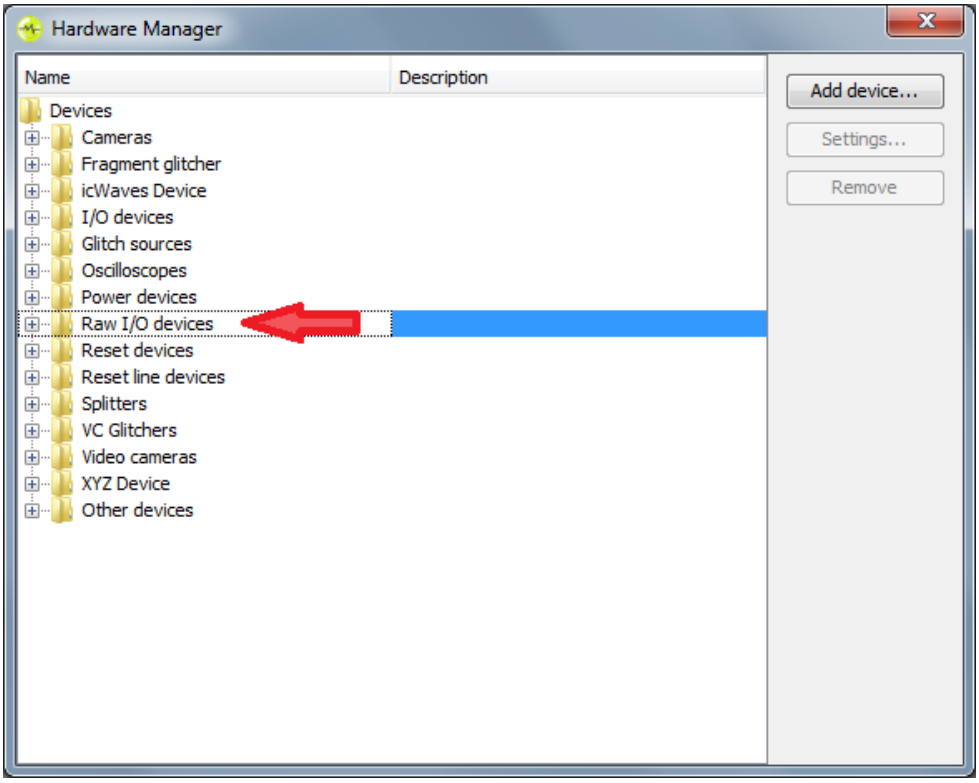


Figure 44 Raw I/O devices category of Inspector Hardware Manager

- Click the COM port index corresponding to the DPSS PSU, and then click "Settings…" button, see Figure 45.

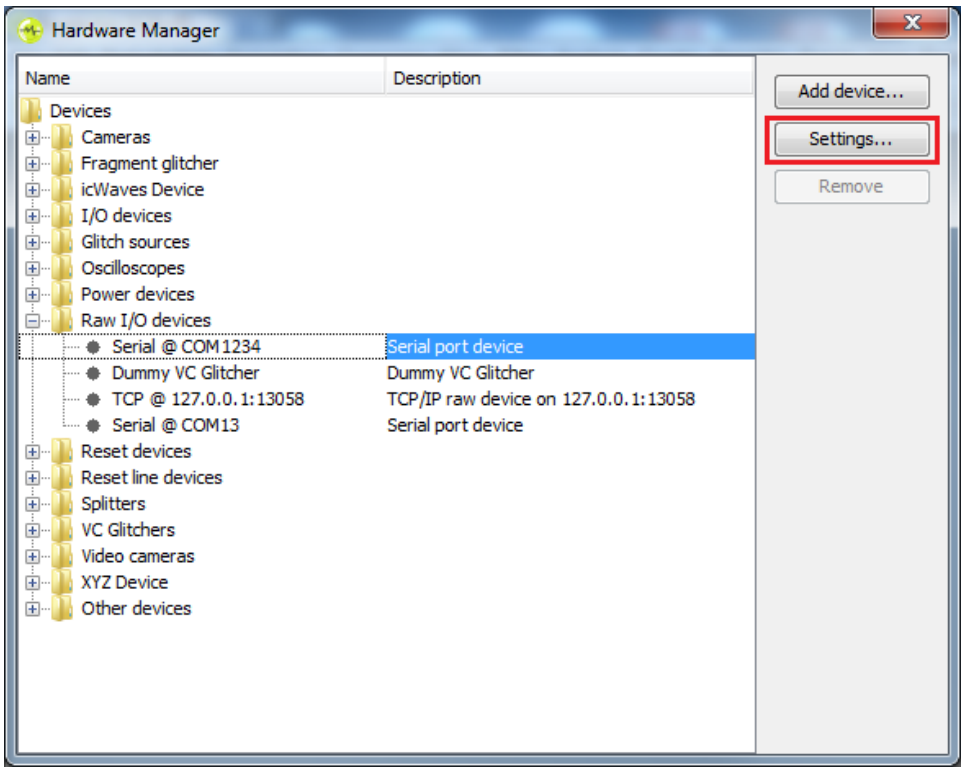


Figure 45 Select the COM port index used by "DPSS laser" device setting

- In the settings dialog, change baud rate settings to 19200, see Figure 46.

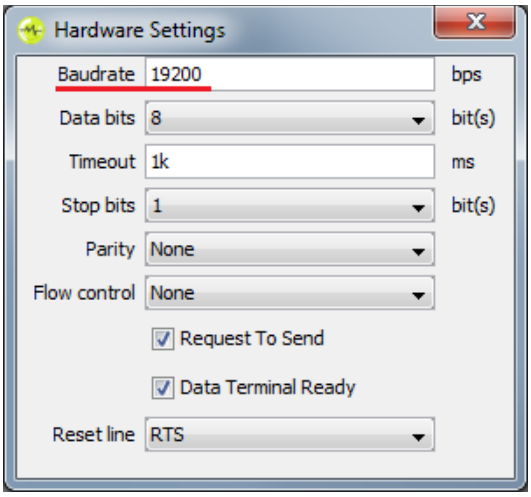


Figure 46 Modify the Baudrate setting of the select Serial port

- Close the settings dialog.
- Close Inspector Hardware Manager.

- At this point, the created "DPSS Laser" device can be selected and operated by Inspector software.

ATTENTION:

DPSS Laser has to be initialized by Inspector before usage. Please read the following chapters for initialization procedure using a VC Glitcher or a Spider separately.

Initialize DPSS laser using VC Glitcher

- Connect a VC Glitcher to the PC via USB. The DPSS PSU should also be connected to this PC.
- Connect 15V DC adapter to the VC Glitcher.
- Connect "trigger input" port of DPSS PSU to the "digital glitch" port of the VC Glitcher.
- Launch Inspector 4.12 or a later version.
- In Inspector software menu, select "Perturbation" > "Single XYZ" > "Embedded" > "Protocol"
- Go to "Single XYZ Embedded Glitch Setup" tab:
    - Select a VC Glitcher at the "Glitcher" drop down list.
    - Select a "DPSS Laser" device as "Glitch source".
    - Select "Glitch after trigger" as "Reset and Trigger source" setting.
    - Other settings can use their default values.
- In the bottom of the "Single XYZ Embedded Glitch Setup" tab, set "Test glitch source cycles" to 1, and "Test glitch source power" to 0%.

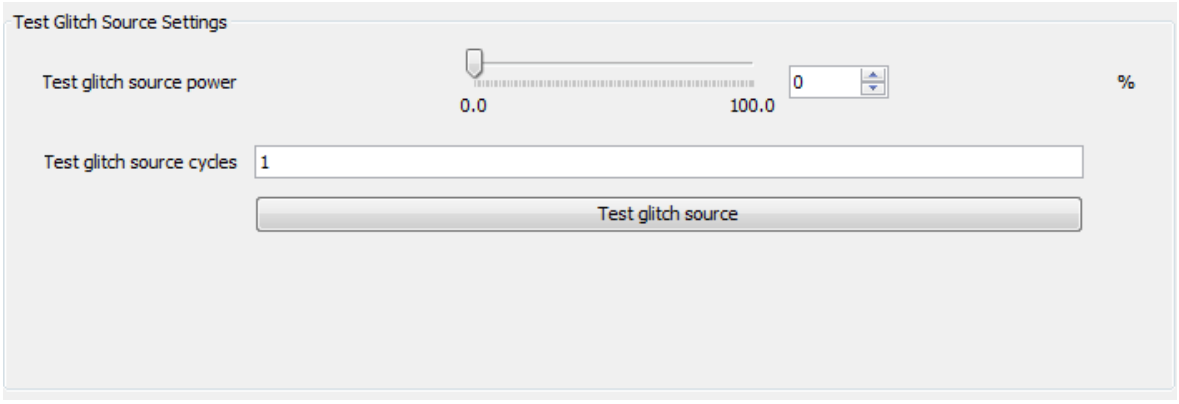


Figure 47 The Test Glitch Source Settings

- Press "Test glitch source" button once to kick start the initialization process of DPSS laser attenuator

ATTENTION:

The initialization takes up to 100 seconds and Inspector software will stop responding to user input during the process.

- After maximum 100 seconds, Inspector software can operate the DPSS laser device similarly to any other Riscure diode laser modules.
- Use "Test glitch source power" setting in combination with "Test glitch source" button to experiment and search the desired laser power level.

Initialize DPSS laser using Spider

- Connect a Spider to the PC via USB. The DPSS PSU should also be connected to this PC.
- Connect 15V DC adapter to the Spider, and flip the power switch of Spider upward to switch on Spider.
- Connect the "trigger input" port of DPSS PSU to "glitch out 1" port of the Spider.
- Install Spider SDK 1.3 or a later version.
- Launch Inspector 4.12 or a later version.
- In Inspector software menu, select "File" > "Open User Module…".
- In the file browser, select Spider Sequence module "SpiderLaserTwinScan.java", and click "Open".
- Click "Compile and load module" button to compile the opened Spider Sequence module.

Figure 48 Compile module button

- In Inspector software menu, select "Perturbation" > "Single XYZ" > "Embedded" > "Spider"
- Go to "Target" tab, and in the "Sequence" drop down list, select "SpiderLaserTwinScan".
- Select the COM port index of Spider device for "Spider COM port" option.
- In "Laser 1" settings as shown in Figure 49:
    - Select a created "DPSS Laser" device as the "Glitch source".
    - Set "Test Laser Power" to 0%.

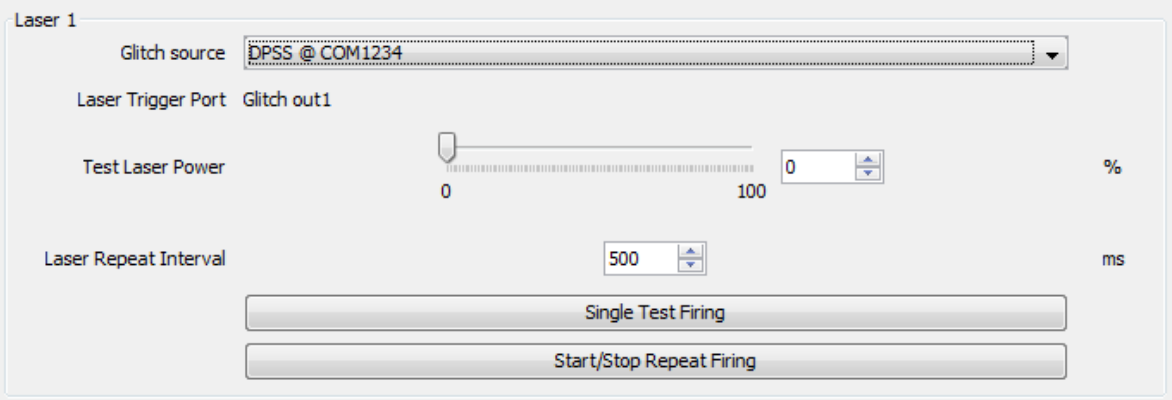


Figure 49 Spider laser testing interface

- Click "Single Test Firing" button once to kick start the initialization process of DPSS laser attenuator.

ATTENTION:

The initialization takes up to 100 seconds and Inspector software will stop responding to user input during the process.

- After maximum 100 seconds, Inspector software can operate the DPSS laser device similarly to any other Riscure diode laser modules.
- Use "Test Laser Power" setting in combination with "Single Test Firing" button to experiment and search the desired laser power level.

Adjusting the laser spot

Once the camera image is focused, the Fiber Coupler can be adjusted to

- fine-tune the laser spot on the die (Figure 50b)
- position the laser spot within the camera field of view (Figure 50c)

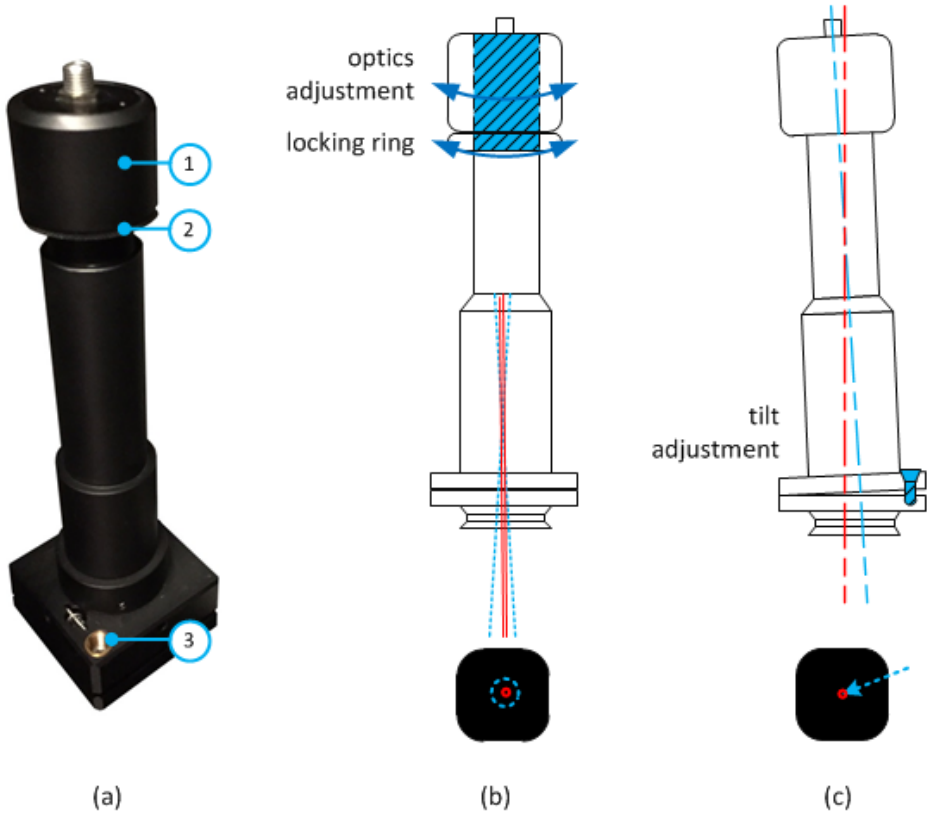


Figure 50 Fiber Coupler adjustment controls

Focusing the laser spot size *without* Spot Size Reducer

Please follow the next steps to adjust the Fiber Coupler (Figure 50b):

- Unlock the locking ring (2)
- Unlock the fiber-end form the SMA connector on top of the Fiber Coupler but keep the fiber end inside.

- Rotate the head (1) of the Fiber Coupler while observing the effect in the camera view to focus the laser spot. To visualize the laser spot, the laser needs to fire. To fire the laser, you need to provide the laser with trigger pulses. This can be done via Inspector in combination with a VC Glitcher or a Spider. See Section "Initialize DPSS laser using VC Glitcher" or "Initialize DPSS laser using Spider" for details on generating test firing pulses.
- After focusing, fix fiber end and apply locking ring again

Focusing the laser spot size *with* Spot Size Reducer

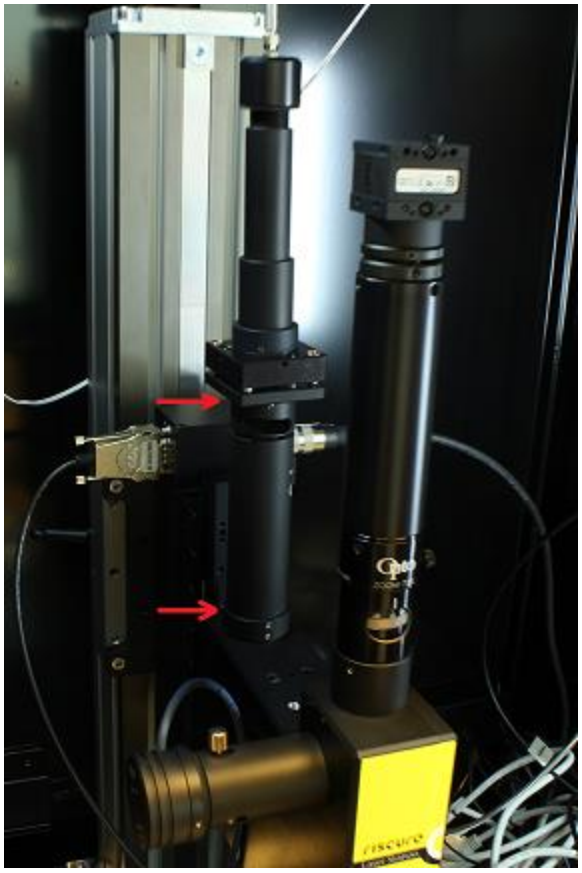


Figure 51 Spot Size Reducer inserted between Fiber Coupler and the

When a Spot Size Reducer tube (shown in Figure 51) is inserted in-between Fiber Coupler and microscope, you may need to perform the focusing procedure again but this time for the Spot Size Reducer instead of the Fiber Coupler. The head of the spot size reducer can be rotated relative to the body of the Spot Size reducer.

This will influence the focus of the laser spot. Please refer to the Quick Start Guide of the Laser Station 2 for further details.

Aligning the laser spot position

Two diagonal corners of the Fiber Coupler base are fitted with adjustment screws (3).

- Adjust the screws while observing the effect in the camera view.

The screw can be adjusted with a hexagonal wrench which is supplied with the Diode Laser Station of Laser Station 2.

Protect you Device under Test

The DPSS laser generates pulses of high intensity which can easily damage the device under test. It is strongly advised to start the perturbation analysis at a very low power level e.g. several percent. After shooting laser pulses at various locations over the area of interest and at various moments within the time interval of interest without any changes in the device's response, the analyst can tune up the power level to run a succeeding scan over area and time interval at a higher power level.

Keep the fiber end clean

The fiber end can become easily contaminated by dust or dirt if the fiber end touches another object e.g. your finger. The contamination will reduce the laser power. The contamination should be removed as soon as possible to avoid permanent contamination. The contamination can often be removed by 99% pure alcohol or acetone.

Fix fiber position and avoid mechanical stress

Bending the fiber influences the set of optical modes inside the fiber and will have an influence on the optical output power coming out of the fiber up to +/- 10%. It is advised the fix the fiber to a certain position to avoid changing the bending radius and power level.

The first part of the fiber directly at the exit of the Laser Head should be free of mechanical stress. Stress at the start of the fiber may influence the output power to a much greater extend.

Change DPSS laser device parameters (Advanced)

The operational settings for the Innolas driver have been set by the manufacturer. There is no need to change these settings. If for any reason, the user would like to change these settings, the user need to install the Innolas laser driver first.

Please be aware that changing the laser settings may negatively influence the laser performance.

Attention:

We do not recommend changing default manufacturer settings unless it is absolutely necessary.

Installation of Innolas laser control software and USB driver

The laser control software installation file can be found at the USB memory key that is part of the shipment.

To install the laser control software:

- Locate the installer file at: "[usb_key_folder]\InnolasLaserControl\Software\ILCInstallV1041.exe "
- Right click on the installer and choose **"Run as administrator"** to avoid error shown in Figure 52**.**

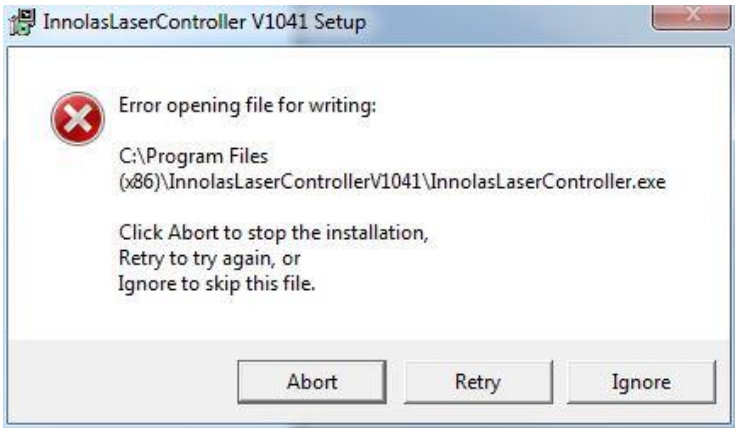
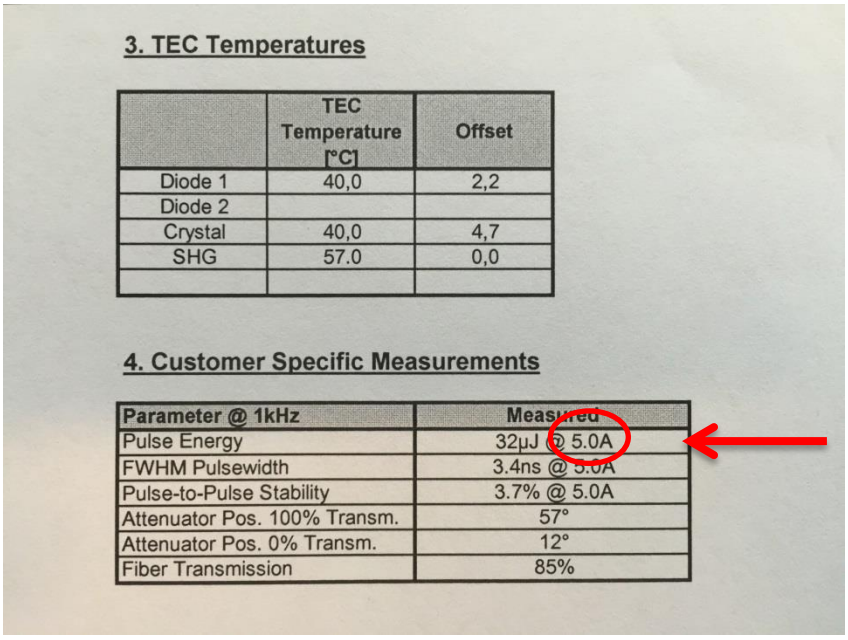


Figure 52 Error thrown by the installer if not started as Administrator

- ✓ During the first run, you need to select the configuration file. You can select between "basic", "advanced" and "full" profiles. We recommend "basic" to limit the amount of displayed parameters.

The manufacturer delivers together with the laser a Final Test Report showing the optimum Diode Operating Current [A], see figure below.



3. TEC Temperatures

	TEC Temperature [°C]	Offset
Diode 1	40,0	2,2
Diode 2		
Crystal	40,0	4,7
SHG	57.0	0,0

4. Customer Specific Measurements

Parameter @ 1kHz	Measured
Pulse Energy	32µJ @ 5.0A
FWHM Pulsewidth	3.4ns @ 5.0A
Pulse-to-Pulse Stability	3.7% @ 5.0A
Attenuator Pos. 100% Transm.	57°
Attenuator Pos. 0% Transm.	12°
Fiber Transmission	85%

Figure 53 Final test report shows optimum Diode Operating Current [A]

The following laser setting defaults are applied before shipment. The settings are kept during power down.

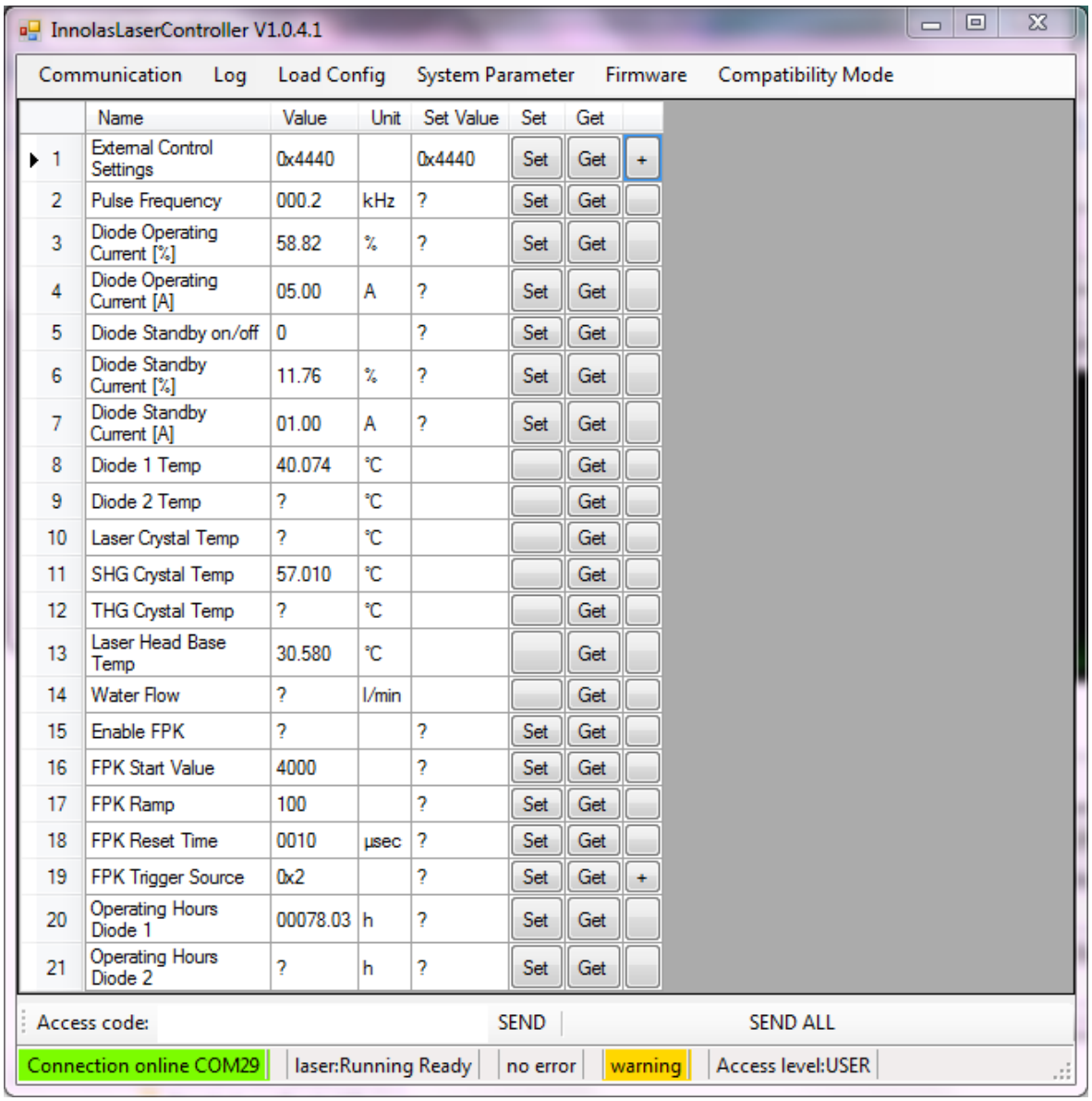
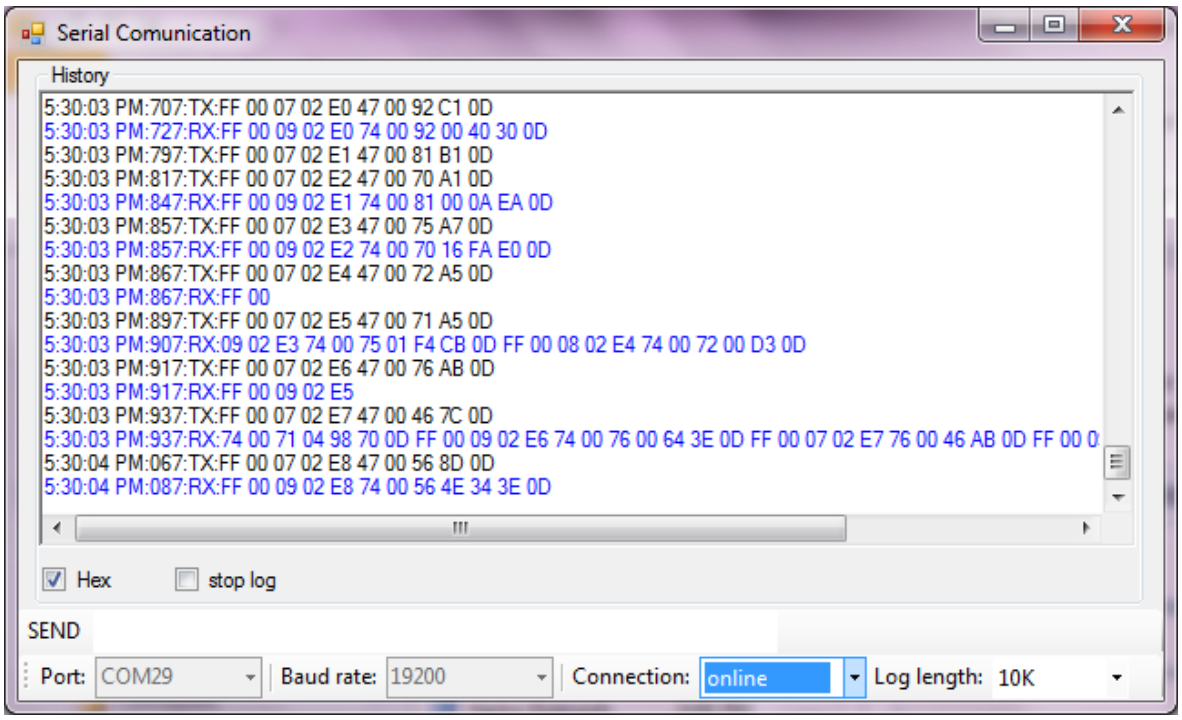


Figure 54 Default settings for laser (Diode Operation Current [A] should be taken from Final test report)

As mentioned earlier, there is no need to change the settings of the laser. It is even preferable to keep the factory settings as these settings correspond to an optimum balance of pulse duration, pulse power and trigger to laser pulse delay.

If for some reason to user wants to change the settings, you need to start the InnolasLaserController software. For communication to the laser, you need to click at Communication in the menu bar. The window below will pop-up. Select com port and select online.



Test firing the laser using InnolasLaserController software

You may want to test run the laser without having a trigger pulse generator available. For this purpose you can set the laser to internal triggering via the InnolasLaserController user interface. The following External Control Settings and Pulse Frequency set the laser to internal pulsing at 0.2 kHz.

Before closing the InnolasLaserController software always set the com port offline to allow other programs as Inspector to communicate to the laser power supply.

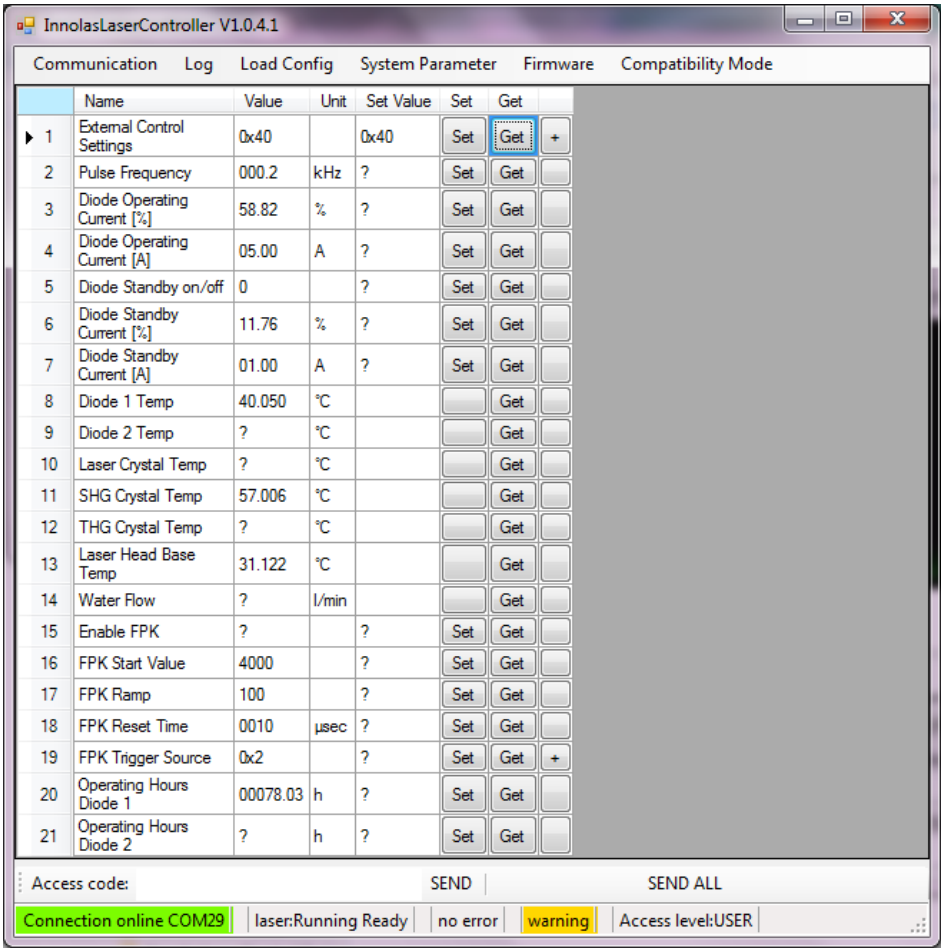


Figure 55 Test run settings for 532 nm laser (Diode Operation Current should be taken from Final Test report)

Trouble shooting

My DPSS laser is unrecognized by Windows Device Manager

The DPSS laser will show up as a COM port device after its driver files have been successfully installed.

My DPSS laser is not available for selection in Inspector

The DPSS laser will not be available for selection in Inspector before a "DPSS laser" device is created in Inspector.

My DPSS laser does not fire

- **Check all cable connections** as described in "Build the hardware setup".
- **Laser Head** – The Laser Head must be warmed up before capable of generating laser pulses. The "Warm up/Ready" LED should not be blinking and remains continuously ON.
- **Inspector baud rate setting** -- the "Raw IO Device" in Inspector Hardware Manager that has matching COM port index to the DPSS laser must have baud rate setting of 19200. Restart Inspector after change the baud rate.
- **Open Interlock –** As a safety measure, the laser head current supply is cut off when the Interlock circuits is Open. When the Interlock circuits is Closed, the "Emission" LED should be lit ON constantly.

Inspector freezes after an attempt to test fire the DPSS laser

When fired for the first time, the attenuator must be initialized to realize accurate laser emission setting. This process lasts for a period of maximum *100 seconds* and Inspector User Interface hangs during the process.

Inspector shows an error message after an attempt to fire the DPSS laser

If the InnolasLaserController software have been used the comport is still on-line

In the InnolasLaserController software.

Restart the InnolasLaserController software, and set the com port off offline

Still have questions?

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

Specifications

	Green	NIR
Wave length	532 nm	1064 nm
Trigger to laser pulse delay	1.1 µs	< 1 µs
Max. trigger input voltage	3.3 volts	
Trigger pulse width (positive edge triggered)	> 250 ns	
Minimum recharge time for next laser pulse	1 ms	
Spot size 5x / 20x / 50x objective, no SSR	∅ 40 µm / ∅ 10 µm / ∅ 4 µm	
Spot size 5x / 20x / 50x objective, with SSR	∅ 4 µm / ∅ 1 µm / ∅ 1 µm	
Laser pulse energy	≥ 30 µJ	≥ 40 µJ
Laser pulse duration	≤ 4 ns	