THORLABS GSL Series Gain Switched Lasers User Guide

Contents

THORLABS GSL Series Gain Switched Lasers

Product Information

Specifications

- **Model Options:** GSL45A, GSL49A, GSL52A, GSL63A, GSL85A, GSL106A, GSL131A, GSL155A
- **Typical Center Wavelength:** Varies based on model
- **Picosecond Pulse Width:** 37 mW (for example)
- **Typical Peak Power (ns Operation):** Varies based on model
- **Repetition Rates:** 1, 10, 100, and 200MHz

Product Usage Instructions

Chapter 3: Installation

Follow the guidelines provided in the installation section of the manual to set up the GSL Series Gain-Switched Laser correctly.

Chapter 4: Operation

1. Connect the laser to a power source using the power jack on the back panel.
2. Use the controls on the back panel to adjust pulse width and repetition rate according to your requirements.
3. Ensure proper connections using shielded cables for inputs and outputs.

Chapter 5: Specifications

Refer to the specifications section above for model options, wavelength, pulse width, peak power, and repetition rates available for the GSL Series Gain-Switched Lasers.

FAQ

- **Is the GSL Series Gain-Switched Laser water-resistant?**

  No, the GSL Series Gain-Switched Laser is not water-resistant. Avoid exposing it to liquid spills or moisture to

prevent damage.

- **How can I adjust the pulse width and repetition rate of the laser?**

  The back panel of each laser provides controls for adjusting the pulse width and repetition rate. Refer to the user manual for detailed instructions on using these controls.

Introduction

The GSL series of lasers provide picosecond, nanosecond, and continuous wave operation in a compact, fiber-coupled, turnkey source. Gain-switched pulse generation with repetition rate control up to 200 MHz and adjustable pulse widths allow for applications including high-speed imaging and fluorescence lifetime measurements. They also make these lasers ideal seed sources for additional amplification. Single-mode fiber output through an FC/APC connector allows for integration with a range of fiber-terminated devices.

Series Overview
Model options are summarized in the table below.

Item #	Typical Center Wavelength	Picosecond Pulse Width	Nanosecond Pulse Width	Typ. Max Peak Power (ps Operation)	Typ. Peak Power (ns Operation)
GSL45A	450 nm ± 10 nm	<90 ps	1 to 65 ns	>32 mW	12 mW
GSL49A	488 nm ± 10 nm	<120 ps	1 to 65 ns	>29 mW	12 mW
GSL52A	520 nm ± 10 nm	<120 ps	1 to 65 ns	>40 mW	15 mW
GSL63A	633 nm ± 10 nm	<130 ps	1 to 65 ns	>75 mW	35 mW
GSL85A	850 nm ± 10 nm	<70 ps	1 to 65 ns	>86 mW	37.5 mW
GSL106A	1064 nm ± 10 nm	<100 ps	1 to 65 ns	>35 mW	25 mW
GSL131A	1310 nm ± 20 nm	<80 ps	2 to 65 ns	>43 mW	37.5 mW
GSL155A	1550 nm ± 20 nm	<80 ps	2 to 65 ns	>37 mW	30 mW

Inputs and Controls
The back panel of each laser provides controls for the pulse width and repetition rate, as well as an SMA connector for trigger input and output signals. Available internally generated repetition rates are 1, 10, 100, and 200 MHz.

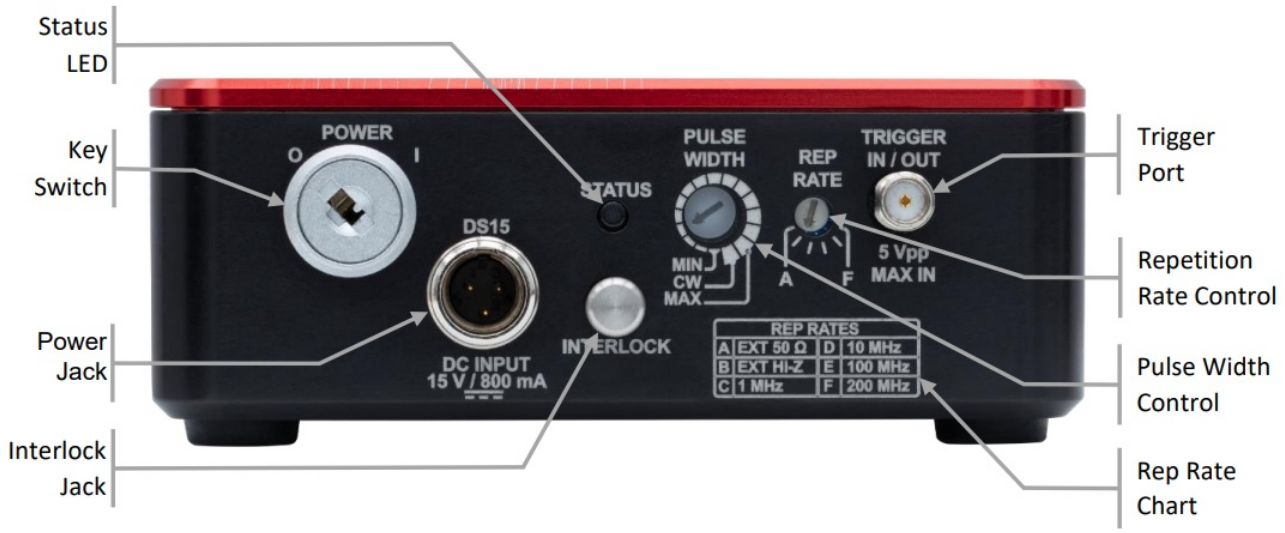


Figure 1 GSL Series Laser Back Panel

Safety Information

All statements regarding safety of operation and technical data in this instruction manual will only apply when the unit is operated correctly. If equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired. Only with written consent from Thorlabs may changes to single components be carried out or components not supplied by Thorlabs be used.

Warnings and Cautions

- **Warning: Laser Radiation**
  - **Avoid Exposure –** Radiation emitted from apertures. Do not look into the laser aperture while the laser is on. Injury to the eye may result. Laser should not be turned on unless there is an optical fiber connected to the laser output port.
  - **Caution** – Use of controls or adjustments or performance of procedures other than those specified herein may result in hazardous radiation exposure.

GSL45A, GSL49A, GSL52A, & GSL63A Laser

GSL85A & GSL106A Laser

GSL131A & GSL155A Lasers

- **Caution: ESD Sensitive Component**

  The components inside this instrument are ESD sensitive. Take all appropriate precautions to discharge

personnel and equipment before making any connections to the unit.

- **Caution: Components not Water Resistant**

  This instrument should be kept clear of environments where liquid spills or condensing moisture are likely. It is not water resistant. To avoid damage to the instrument, do not expose it to spray, liquids, or solvents.

- **Caution: Follow Intended Usage Guidelines**
  - Inputs and outputs must only be connected with shielded connection cables.
  - The safety of any system incorporating the equipment is the responsibility of the assembler of the system. If equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired. Only with written consent from Thorlabs may changes to single components be carried out or components not supplied by Thorlabs be used. There are no user serviceable components inside this device.

Precautions
The following statement applies to the products covered in this manual, unless otherwise specified herein. The statement for other products will appear in the accompanying documentation.
Note: This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules, and meets all requirements of the Canadian Interference Causing Equipment Standard ICES-003 for digital apparatus. These limits are designed to provide reasonable protection against harmful interference in an industrial installation. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. Thorlabs is not responsible for any radio television interference caused by modifications of this equipment or the substitution or attachment of connecting cables and equipment other than those specified by Thorlabs. The correction of interference caused by such unauthorized modification, substitution or attachment will be the responsibility of the user. The use of shielded I/O cables is required when connecting this equipment to all optional peripherals or host devices. Failure to do so may violate FCC and ICES rules.

Installation

Quick Start Guide

1. Connect the power supply cable to the laser head and then plug the power supply into mains power.
2. Make sure the interlock pin is in place at this time. An external interlock circuit can be added later for more convenient integration of the interlock safety feature.
3. Connect the patch cable with FC/APC connector to the laser output mating sleeve.
4. Put laser safety goggles on if your situation requires them.
5. Turn the power switch on using the key switch.
6. The multicolored status LED indicator (red/green/amber) will blink until the laser temperature has stabilized. Initial warm up can take 30 – 60 seconds. The multicolored laser emission LED (red/blue) will then glow continuously when the laser output is enabled. Note that there is a four second delay between the time the emission indicator glows solid and laser output is enabled.

   Note: For repetition rate setting “A” and “B” there will be no optical output unless the laser is triggered.

Figure 2 GSL Series Laser with Fiber Patch Cable Connected to Output

Packaging List

- GSL Series Laser Head
- Precision Patch Cable, 1 m Long with Ø2 mm Jacket (Item #s GSL45A, GSL49A, GSL52A, GSL63A, GSL85A, GSL106A)
- DS15 +15 V Power Supply
- 2.5 mm Flathead Screwdriver

Operation

Block Diagram

- The block diagram in Figure 3 depicts the internal architecture of the laser head, which contains all of the pulsing drive electronics, safety interlocks, trigger circuits, and the temperature stabilization system. The multicolored LED indicators are designed to be visible through most laser safety glasses. The Status LED blinks during the 30 – 60 s warm up and then turns off once temperature stability is achieved. Additional Status LED indications are summarized in Section 4.6. The Emission LED is active four seconds before laser emission and stays active in any state where laser emission is possible.
- In addition to external triggering with both high impedance (Hi-Z) and 50 Ω termination there are also four different internally generated repetition rates: 1, 10, 100, and 200 MHz.

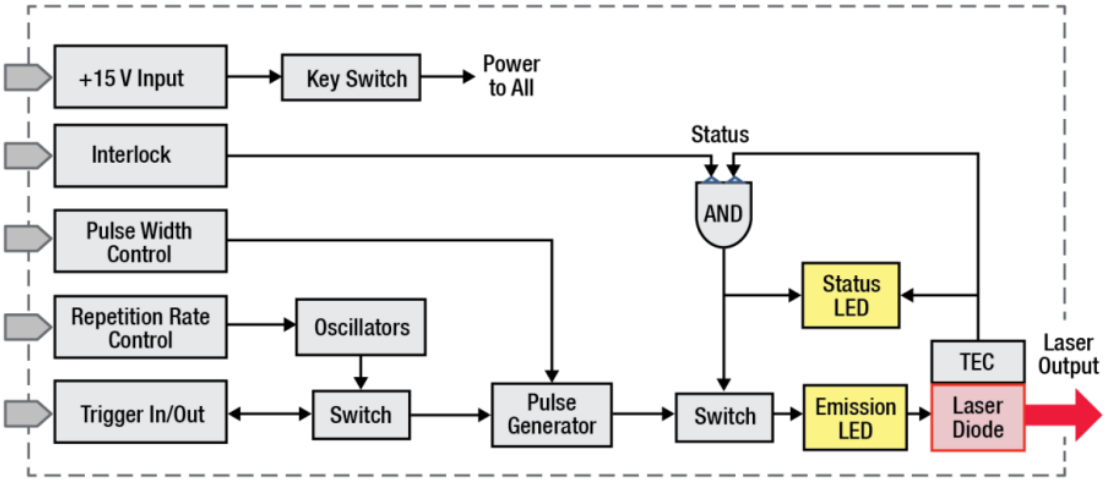


Figure 3 Block Diagram of the GSL Series Laser Head

Power

- Power is supplied by the external, +15 V, wall-mounted DS15 Power Supply included with the unit and shown in the left image of Figure 4. The power supply includes a region-specific plug. The mini-XLR type connector, which uses a latching mechanism to prevent accidental pull-out, plugs into the laser head as shown in the right image of Figure 4.

Figure 4 The DS15 Power Supply (left) connects to the back panel of the laser head (right).

- The key switch controls power to all internal components. When the key switch is turned on, the temperature stabilization system is activated. There is a 30 – 60 second warm up, during which time the LED indicator light blinks. When the LED stops blinking, there is an additional four second delay and then laser is enabled. Note there will not be any optical output until the interlock is satisfied, a trigger signal is supplied, and the pulse width and repetition rate combination are in an allowed state as show in the table in Section 4.5.

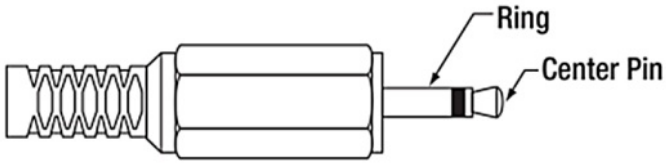
Interlock Circuit

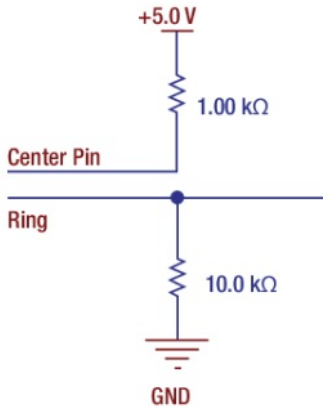
- The laser is equipped with a phono-type interlock jack located on the back panel. To enable the laser source, a short circuit must be applied across the terminals of the interlock connector. The shorting device (interlock pin) installed in all units shipped from Thorlabs performs this function. Leave the shorting device installed unless using an external safety circuit or other type of remotely controlled switch to enable laser output.
- Making use of the Interlock feature requires the appropriate 2.5 mm phono-type plug, which is shown in the left

diagram of Figure 5 and is readily available through most electronics retailers. The plug should be wired to the external safety circuit or switch and then plugged into the back panel's interlock jack in place of the shorting device. The electrical specifications of the interlock jack are listed in the following table, and the circuit schematic describing how the interlock jack is connected inside the laser head is shown in the right diagram of Figure 5.

Parameter	**Specification**
Interlock Switch Requirements	Must be Normally Open Dry Contacts, Apply no External Voltag es to the Interlock Input
Type of Mating Connector	2.5 mm Mono Phono Jack
Open Circuit Voltage	5 VDC (Center Pin is at 5 VDC, Ring is Ground)

- The user's safety circuit must be attached to the phono plug and wired such that the ring and center pin are shorted when it is safe to enable the laser. The laser will be enabled when connection is closed. If it changes to an open state, the laser source will turn off.





Repetition Rates and Pulse Widths

- The GSL series of lasers has four internally triggered repetition rates and two externally triggered settings accommodating both Hi-Z and 50 Ω impedance. The internally available rates include: 1, 10, 100 and 200 MHz. Use the included 2.5 mm flathead screwdriver to operate these controls.
- All of the GSL series offers controls for varying the pulse width. Use the included 2.5 mm flathead screwdriver to operate this control also, as shown in Figure 6. The range of pulse widths for each model are listed in the specifications table in Section 5.1. The pulse width control directly programs the pulse generator and has 16 positions, which allows the pulse width to be adjusted to the settings shown in the table in Section 4.5. Plots of typical pulses and of typical pulse width as a function of control setting are available in the web presentation.

Figure 6 Pulse width and repetition rate controls are adjusted with the included 2.5 mm flathead screwdriver.

Trigger Port

The Trigger In/Out port has dual function. If the internal oscillators are used, then the Trigger port provides an output signal that is synchronized with the pulse generation. Both a Hi-Z and 50 Ω user-trigger mode are available for low-frequency and high-frequency operation respectively. In the user-triggered mode, the SMA port allows external trigger signals to drive the pulse generator. See the Specifications table in Section 5.2 for the correct signal levels and impedances. Allowable repetition rate ranges for each pulse duration are given in the table below.

Pulse Width Position	Pulse Width	Max Rep. Rate	Min Rep. Rate
1 – MIN	<130 ps[a]	200 MHz	200 kHz
2	1 – 2 ns	200 MHz	200 kHz
3	3 – 4 ns	100 MHz	200 kHz
4	6 ns	30 MHz	Single Shot
5	8 ns	30 MHz	Single Shot
6	10 ns	30 MHz	Single Shot
7	12 ns	30 MHz	Single Shot
8	14 ns	30 MHz	Single Shot
9	16 ns	30 MHz	Single Shot
10	18 ns	25 MHz	Single Shot
11	20 ns	20 MHz	Single Shot
12	25 ns	16 MHz	Single Shot
13	30 ns	13 MHz	Single Shot
14	40 ns	10 MHz	Single Shot
15 – MAX	65 ns	5 MHz	Single Shot
16 – CW	CW	N/A	N/A

Status LED

The operational state of the GSL series of lasers is indicated through the multicolor (Red/Green/Amber) “STATUS” LED on the back panel of the laser. Following typical thermal stabilization and laser emission delay, this LED should be OFF (-). A full list of the states is summarized in the following table.

Laser State	Status LED State		
	Red	Green	Amber
Laser Emission	–	–	–
Error	Blinking [a]	–	–
Interlock OPEN	On	–	–
Rep. Rate Out of Range	–	–	Slow Blinking
Laser Powering On	–	Slow Blinking	–

Specifications

Optical Specifications

Item #	GSL45A	GSL49A	GSL52A	GSL63A
Center Wavelength	450 ± 10 nm	488 ± 10 nm	520 ± 10 nm	633 ± 10 nm
Fiber Type[a]	460HP	460HP	460HP	SM600
Fiber Mode-Field Diameter	3.5 ± 0.5 µm @ 515 nm			3.6 – 5.3 µm @ 633 nm[b]
Laser Class	3B	3B	3B	3B
Picosecond Pulse Operation				
Average Power[c]	>0.6 mW	>0.7 mW	>1.0 mW	>2.0 mW
Pulse Duration[d]	<90 ps	<120 ps	<120 ps	<130 ps
Spectral Linewidth	<3 nm	<4 nm	<6 nm	<3 nm
Repetition Rates	200 kHz to 200 MHz			
Peak Power (Typ. Max)	>32 mW	>29 mW	>40 mW	>75 mW
Power Stability[e]	<2%			
Nanosecond Pulse Operation				
Pulse Durations[d]	1 – 65 ns			
Repetition Rates[f]	See Section 4.5			
Peak Power (Typical)	12 mW	12 mW	15 mW	35 mW
CW Operation				
Average Power	3 mW	5 mW	5 mW	15 mW

Item #	GSL85A	GSL106A	GSL131A	GSL155A
Center Wavelength	850 ± 10 nm	1064 ± 10 nm	1310 ± 20 nm	1550 ± 20 nm
Fiber Type[a]	780HP	HI1060	SMF-28 Ultra	SMF-28 Ultra
Fiber Mode-Field Diameter	5.0 ± 0.5 µm @ 850 nm	6.2 ± 0.3 µm @ 1060 nm	9.2 ± 0.4 µm @ 1310 nm	10.4 ± 0.5 µm @ 1 550 nm
Laser Class	3B	3B	1M	1M
Picosecond Pulse Operation				
Average Power[b]	>1.2 mW	>0.7 mW	>0.7 mW	>0.6 mW
Pulse Duration[c]	<70 ps	<100 ps	<80 ps	<80 ps
Spectral Linewidth	<5 nm	<15 nm	<12 nm	<20 nm
Repetition Rates	200 kHz to 200 MHz			
Peak Power (Typ. Max)	>86 mW	>35 mW	>43 mW	>37 mW
Power Stability[d]	<2%			
Nanosecond Pulse Operation				
Pulse Durations[c]	1 – 65 ns		2 – 65 ns	
Repetition Rates[e]	See Section 4.5			
Peak Power (Typical)	37.5 mW	25 mW	37.5 mW	30 mW
CW Operation				
Average Power	20 mW			

Trigger Specifications

Parameter		Specification	
Max Input Frequency[a]		200 MHz	
Input Voltage[b]	50 Ω (AC Coupled)[c]	0.2 – 5.0 Vpp	
	Hi-Z, 5 kΩ (DC Coupled)	VIL	0 – 0.8 V
		VIH	2.2 – 5 V
Output Voltage	50 Ω	400 mV	
	Hi-Z	800 mV	
Max Timing Jitter[d]		12 ps RMS	
Delay from External Trigger Input to Optical Output[e]		44 ± 4 ns	
Delay from Internal Trigger to Optical Output[e]		3.4 ± 1.5 ns	

Power, Environmental, and Physical Specifications

Parameter	Specification
AC Input Frequency Range to DS15 Power Supply	50 – 60 Hz
AC Input Voltage to DS15 Power Supply	100 – 240 V
DC Input Voltage Range to Laser	14.5 – 15.5 V
DC Input Current to Laser	1100 mA Max
Operating Temperature Range	10 to 45 °C
Storage Temperature Range	0 to 60 °C
Humidity Range (RH)	5% to 85%
Mass	0.80 kg
Dimensions (L x W x H)	185.6 mm x 100.0 mm x 39.4 mm (7.31″ x 3.94″ x 1.55″)

Mechanical Drawings

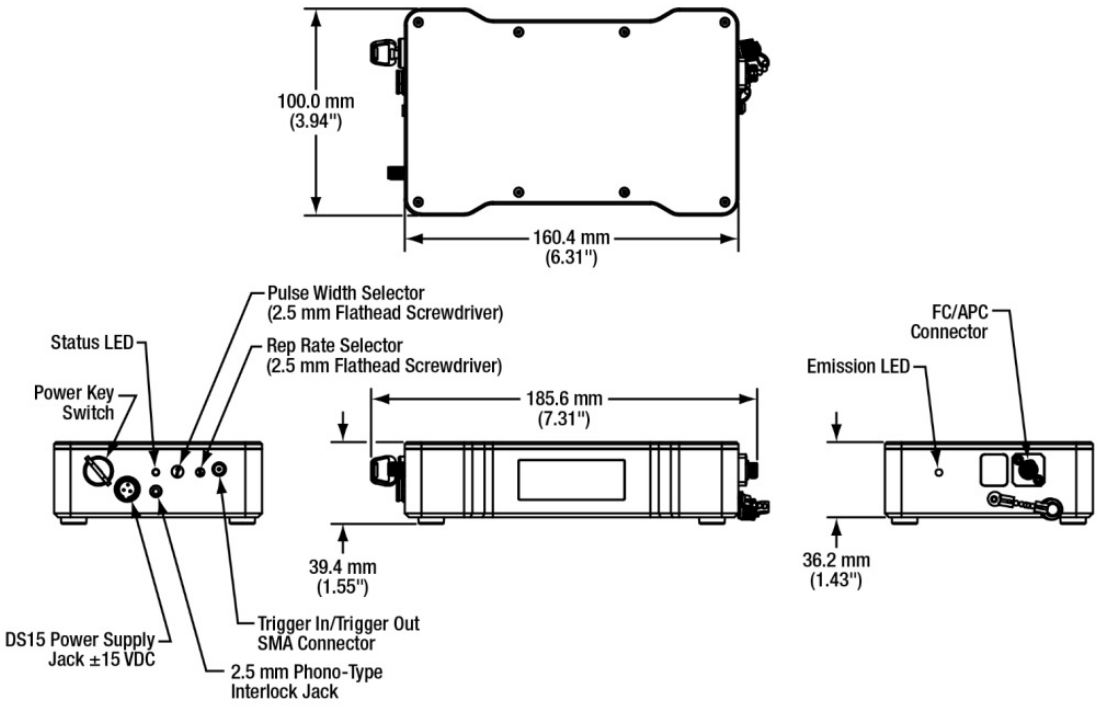


Figure 7 Mechanical Drawing of GSL Series Laser

Maintenance and Troubleshooting

Maintenance

- The GSL laser should not require regular maintenance. If necessary, the housing can be cleaned using a soft cloth moistened with a mild glass cleaner. Do not use acetone, chemical solvents, or harsh cleaning solutions, and do not spray cleaning solutions directly onto the unit. See Section 7.3 for advice on fiber cleaning.
- Aside from the procedure outlined in Section 7.3, there are no user serviceable components in GSL series

lasers. If malfunctions occur, please contact Thorlabs' technical support (techsupport@thorlabs.com). Do not disassemble the unit.

- See the troubleshooting guide below for basic help.

Troubleshooting

Problem	Suggested Checks
No Output	Check that power is supplied and connected properly. Check that key switch is turned on. Confirm that laser is warmed up (30 – 60 s). Confirm the interlock circuit is complete. Check that the indicator LED is glowing continuously. Check that a trigger signal is being provided for REP RATE position "A" and "B".
Power is Low	Check to see if the fiber end face is dirty. If so, see the cleaning instructions in section 7.3.
Status LED Blinking Amber	Internal or externally provided repetition rate is out of range for pulse width. Check that the repetition rate falls into the allowable range provided in section 4.5.
Status LED Blinking Red	Temperature control or communications error. Check that the unit is being operated within the ambient temperature range. Contact Te ch Support to assist with this error.

Fiber Inspection and Cleaning
Should an issue arise with low output power or a distorted beam out of the laser, please follow these instructions to inspect and clean the end face of the fiber.

1. Turn off the power to the unit and disconnect the power supply.
2. Using a 1.3 mm hex wrench, remove the mating sleeve at the laser output (Figure 8).
3. Pull out the mating sleeve to give access to the fiber connector. Take care not to pull out more than 10cm of fiber to allow for inspection and cleaning with fiber cleaner.
4. Once the endface has been inspected and/or cleaned, replace the mating sleeve and test for performance.

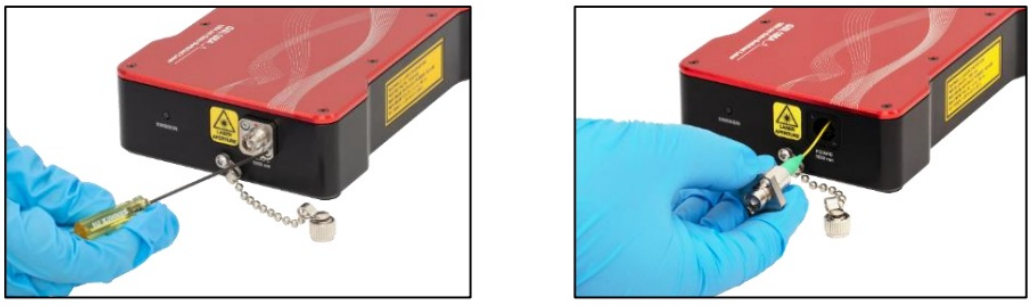
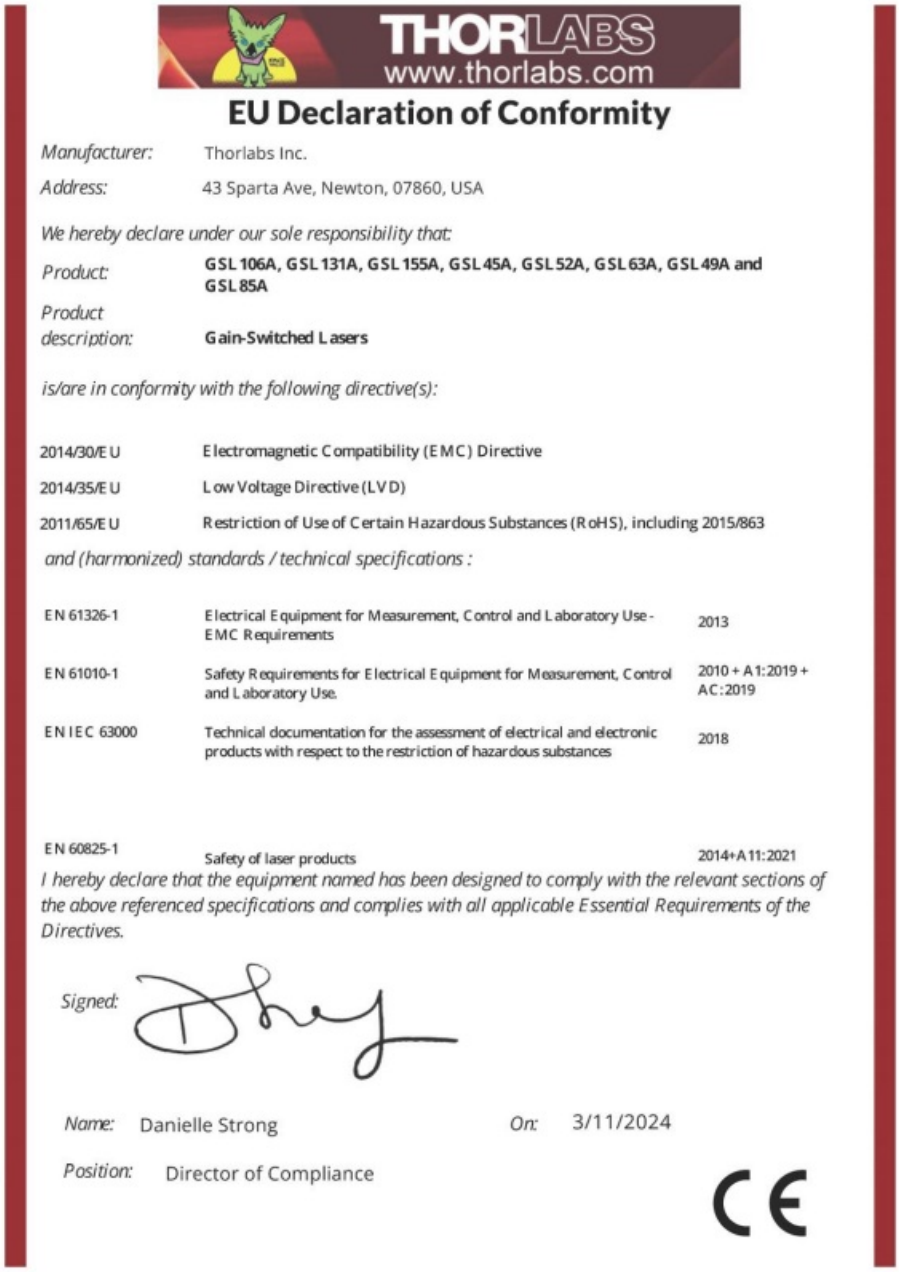


Figure 8 Removal of Fiber Mating Sleeve (Left) and Fiber Connector Pulled Out for Cleaning (Right)

Declaration of Conformity



THORLABS
www.thorlabs.com

EU Declaration of Conformity

Manufacturer: Thorlabs Inc.

Address: 43 Sparta Ave, Newton, 07860, USA

We hereby declare under our sole responsibility that:

Product: **GSL106A, GSL131A, GSL155A, GSL45A, GSL52A, GSL63A, GSL49A and GSL85A**

Product description: **Gain-Switched Lasers**

is/are in conformity with the following directive(s):

2014/30/EU	Electromagnetic Compatibility (EMC) Directive
2014/35/EU	Low Voltage Directive (LVD)
2011/65/EU	Restriction of Use of Certain Hazardous Substances (RoHS), including 2015/863

and (harmonized) standards / technical specifications :

EN 61326-1	Electrical Equipment for Measurement, Control and Laboratory Use - EMC Requirements	2013
EN 61010-1	Safety Requirements for Electrical Equipment for Measurement, Control and Laboratory Use.	2010 + A1:2019 + AC:2019
EN IEC 63000	Technical documentation for the assessment of electrical and electronic products with respect to the restriction of hazardous substances	2018
EN 60825-1	Safety of laser products	2014+A11:2021

I hereby declare that the equipment named has been designed to comply with the relevant sections of the above referenced specifications and complies with all applicable Essential Requirements of the Directives.

Signed:

Name: Danielle Strong *On:* 3/11/2024

Position: Director of Compliance

CE

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Documents / Resources

	THORLABS GSL Series Gain Switched Lasers [pdf] User Guide GSL Series, GSL Series Gain Switched Lasers, Gain Switched Lasers, Switched Lasers, Lasers

References

- Thorlabs, Inc. - Your Source for Fiber Optics, Laser Diodes, Optical Instrumentation and Polarization Measurement & Control
- Thorlabs, Inc. - Your Source for Fiber Optics, Laser Diodes, Optical Instrumentation and Polarization Measurement & Control
- User Manual